

TOWN OF MOORESVILLE
TRANSPORTATION IMPACT ANALYSIS
PROCEDURES MANUAL



TOWN OF MOORESVILLE, NORTH CAROLINA

Effective August 1, 2007

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The Town of Mooresville is committed to establishing an interconnected, multimodal transportation system that increases mobility, safety, connectivity, health, and quality-of-life for its citizens and business owners. A transportation impact analysis (TIA) is one important tool for evaluating the incremental impacts that new development may have on the surrounding transportation system, and it helps local decision-makers evaluate whether a development is appropriate for a site or identify mitigation measures that are necessary to maintain the integrity of the transportation system.

A transportation impact analysis (TIA) varies in detail and complexity depending on the type, size, and location of the development. The Town of Mooresville requires that all development applications within the subdivision plan review process complete a statement of need for a TIA to accompany the site specific sketch plan. If warranted, the transportation impact analysis shall be prepared consistent with the minimum rules and requirements set forth herein and any other policies adopted by the Town's Board of Commissioners for fostering a sustainable transportation system. All transportation impact analysis studies are completed by the Town using consultant resources and submitted concurrent with the site specific concept plan. Payment for completing the transportation impact analysis is solely the responsibility of the applicant.

Purpose of the TIA Procedures Manual

The intent of this procedures manual is to provide a consistent basis from which the Town of Mooresville and the North Carolina Department of Transportation (NCDOT) evaluate transportation impacts within the Mooresville community. Included in this manual are requirements for report format, technical aspects and procedures for completing a study, and minimum submittal requirements. A TIA submitted in conformance with this procedures manual shall satisfy the Town's requirements for identifying off-site mitigation; however, the NCDOT reserves the right to request additional information and/or subsequent analyses to satisfy their review requirements independent of the Town of Mooresville.

How to Use the TIA Procedures Manual

This procedures manual moves from the general to the specific for completing a transportation impact analysis in the Town of Mooresville. Following page one, the document is organized into two main sections: 1) general information for the applicant within the subdivision plan review process and 2) minimum content for a transportation impact analysis study for the transportation consultant. All users are expected to be generally familiar with the information presented herein; however, the applicant for the development and the assigned transportation consultant are required to consult in detail those sections of the document most applicable to their roles in preparing the transportation impact analysis.

Section 1: General Information for the Applicant

The following information provides a general framework for requiring transportation impact analysis studies in the Town of Mooresville.

Responsibility for Studies

The Town Engineer, or his designee, shall decide whether to require that the applicant prepare a transportation impact analysis (TIA) as a part of the development review and approval process. When required, the transportation impact analysis must be prepared by a duly qualified and registered professional engineer in the State of North Carolina selected by the applicant from a list of qualified traffic engineering firms. The list was created through solicitation by the Town for professional traffic engineers qualified to perform this service. The list contains the names of at least three traffic engineering firms, along with statements of qualification on each (see Appendix A). The Town of Mooresville will contract with the traffic engineering firm selected by the applicant for the project.

All transportation impact analysis (TIA) studies must be approved by the Town Engineer, or his designee, before the development application can move forward in the land development process.

Minimum Thresholds for TIAs

A transportation impact analysis shall be required for any site specific sketch plan expected to generate traffic volumes that will significantly impact the capacity and/or safety of the transportation system. For the purposes of this document, significant impacts are defined for various levels of development activity – rezoning, preliminary and final plats, conditional use permit, or site plan – using expected gross trip generation. Specifically, a TIA shall be required to accompany a site specific concept plan when expected gross trip generation is 500 vehicles or more (entering/exiting combined) in a 24-hour period or 100 vehicles or more (entering/exiting combined) during either the adjacent road’s peak hour(s) or the development’s peak hour(s). For the purposes of redevelopment, trip generation shall be measured as the net new base trips generated by the proposed use as compared to trips generated by the active use(s) on the site. All trip generation estimates shall be calculated using data published in the most recent edition of the Institute of Transportation Engineers’ (ITE) *Trip Generation Manual*.

Notwithstanding the threshold values above, a transportation impact analysis may be required for a site specific concept plan if the Town Engineer, or his designee, determines that one or more of the following conditions exist:

- Traffic generated from a non-residential development will significantly impact adjacent residential neighborhoods.

- Traffic operation problems for current and/or future years on nearby streets are expected to be substantially aggravated by traffic generated by the proposed new development.
- Affected major thoroughfares identified in the Town of Mooresville Comprehensive Transportation Plan are experiencing noticeable delay.
- Traffic safety issues exist at intersections or streets that would serve the proposed new development.
- The proposed land use differs significantly from that contemplated in the adopted Comprehensive Land Use Plan.
- The internal street or access system is not anticipated to accommodate the expected traffic generation.
- The proposed site plan includes a building with a drive-through window.

A transportation impact analysis shall require updating when either the amount or character of traffic is significantly different from an earlier approved study or more than 24 months have passed since completion of the previous transportation study.

Determination of the need for a transportation impact analysis shall be made during the sketch plan phase of the land development process, and prior to scheduling the mandatory scoping meeting described herein. The applicant shall submit all information required for a *Statement of Need for a Transportation Impact Analysis* prior to the sketch plan meeting with Town staff (see Appendix B). The Town Engineer, or his designee, shall determine whether a transportation impact analysis is required for the development application during the sketch plan meeting, and assign the traffic engineering firm selected by the applicant to the proposed project.

Study Fee

The Town Engineer, or his designee, shall contact the traffic engineering firm assigned to the proposed project, and request an estimate of consultant fees for evaluating transportation impacts associated with the development application. The estimate for consultant fees may be adjusted by the Town Engineer, or his designee, after the mandatory scoping meeting based on the understood scope of services for the project. The Town shall release the work to the consultant for analysis once payment of fees from the applicant in the amount of the projected cost estimate is received.

Mandatory Scoping Meeting

A mandatory scoping meeting with the Town Engineer, or his designee, is required prior to beginning the transportation impact analysis. Transportation consultants

are required to attend the mandatory scoping meeting with the applicant. This meeting should include discussion of requirements and strategies for a transportation impact analysis specific to the site and the proposed development program. The applicant should provide a copy of any previous transportation studies prepared for the site and a sketch plan showing the site location and access point(s) in relation to adjacent properties, proposed internal circulation, and a general distribution of project traffic supported by the proposed development program. The Town of Mooresville shall calculate base trip generation for the proposed development program using information submitted in the *Statement of Need for a Transportation Impact Analysis* prior to the mandatory scoping meeting. Additional items for discussion may include available traffic data, committed development, justification for internal capture or pass-by capture rates, proposed multi-modal split (if appropriate), and project phasing.

A memorandum of understanding (MOU) shall be prepared by the transportation consultant selected by the applicant stating the understood scope of the project (see Appendix C). Failure by the applicant to provide accurate information or failure by the assigned transportation consultant to follow the MOU shall result in disapproval of the transportation impact analysis or a request for additional information. The District Engineer, or his designee, for the North Carolina Department of Transportation, Division 12, District 2 must also review and sign the memorandum of understanding before the assigned consultant begins the transportation impact analysis study.

Section 2: Minimum Contents for a Transportation Impact Analysis

The following outline shall be used for all transportation impact analysis (TIA) reports submitted to the Town of Mooresville. All of the required data and information must be clearly identified in the appropriate sections of the report. Text contained in the required chapters shall be comprehensive and complete. See Appendix D for table and figure formatting requirements.

A detailed summary of the expected content and methodologies to be used in the transportation impact analysis are discussed below.

I. Signature Page

The *Signature Page* summarizes the name of the project, project location, name of the applicant, contact information for the applicant, and date of the study. The name, contact information, registration number, signature, and seal of a duly qualified and registered professional engineer in the State of North Carolina are also required to appear on this page.

II. Table of Contents

The *Table of Contents* shall provide a list of all section headings, figures, and tables included in the TIA report. Page numbers shall denote the location of all information in the TIA report.

III. Executive Summary

The *Executive Summary* of the report represents a clear, concise description of the study findings. It should include a general description of the project scope, study horizon years, existing conditions, probable impacts of the project (i.e., total trips in daily, AM, and PM periods), planned state and/or town capital improvements within the general vicinity of the project, capacity analysis and conclusions, mitigation measures, and recommendations. Technical publications, calculations, documentation, data reporting, and detailed design should not be included in this section.

IV. Introduction

The *Introduction* to the report identifies the applicant's request and provides a brief description of the location of the site within the planning jurisdiction. It also provides a detailed description of the project, including the size of the parcel, anticipated completion dates (including phasing), and the existing and proposed uses for the site. This information should include the square footage of each use or the number and size of dwelling units proposed.

V. Study Area

The limits of the *Study Area* shall be based on the location, size and extent of the proposed project, and an understanding of existing and future land uses and traffic conditions surrounding the site. The limits of the study area for the transportation impact analysis shall be reviewed and approved by the Town Engineer, or his designee, and the North Carolina Department of Transportation (NCDOT) at the mandatory scoping meeting. At a minimum, the study area should include all streets and intersections where site traffic estimated for build-out of the project will constitute 10% or more of any intersection approach during the peak hour. Due to related impacts or current operational problems, the Town Engineer, or his designee, may require other adjacent intersections be included in the study area.

A narrative describing the study area should identify the location of the proposed project within the planning jurisdiction, existing and future land uses in the immediate area, and any unique transportation plans or policies applicable to the area (e.g., CATS commuter rail service). As part of the description, a site location map (*Figure #1 - Vicinity Map*) shall be provided. The map should include natural features, major and minor roadways within the study area, and a boundary of the site under consideration.

VI. Site Description

A brief *Site Description* should summarize the key physical characteristics of the site, including general terrain, development size, existing zoning and use (and proposed use if applicable), internal streets, parking lots, sidewalks and bicycle lanes, proposed driveway locations, and designated loading/unloading areas. Similar information for adjacent properties should be provided to evaluate opportunities for internal connections. A half size (11" x 17") site plan to scale illustrating the project as proposed at full build-out shall be included with the TIA report (*Figure #2 – Site Plan Map*). Information presented in the TIA report shall be identical in every respect to the site plan submitted for development approval.

VII. Existing Conditions

The applicant shall provide a description of *Existing Conditions* for the transportation system within the study area. A narrative and map shall be prepared that presents AM and PM peak hour turning movement volumes for all intersections (signalized and unsignalized) identified for study by the Town Engineer, or his designee (*Figure #3 – Existing Traffic Volumes*). Traffic volumes shall be 16-hour weekday turning movement counts (Monday through Thursday) and no more than twelve months old. Traffic volumes should also represent weeks that have no observed federal, state, or local holidays and periods of the year when local schools are in session. Traffic volumes may not be used when collected during a week with local race activities. The source of existing traffic volume information should be explicitly stated (e.g., Town counts, new counts collected by the applicant, NCDOT counts,

etc.). Summary sheets for existing turning movement counts should be included in the appendix of the TIA report.

A separate narrative and map shall be prepared to describe the characteristics of surrounding major roadways, including functional classification, number of lanes, posted speed limit, existing average daily traffic volumes, typical cross section, intersection control (signalized or unsignalized), and lineal distance between major roadways (*Figure #4 – Existing Geometrics*).

VIII. Future Year Conditions

The applicant shall provide a description of *Future Year Conditions* for the transportation system within the study area. Specific analysis periods to include in the study shall depend greatly upon the development program, proposed project phasing plan, and significant improvements programmed for the transportation system. Future year traffic volumes shall be forecasted using historical growth rate information and/or transportation impact analysis reports for development approved by the Town but not yet built. A narrative and map shall be prepared that presents AM and PM peak hour turning movement volumes for all intersections (signalized and unsignalized) identified for study by the Town Engineer, or his designee (*Figure #5 – Future Year Traffic Volumes*). Turning movement volume development sheets should be included in the appendix of the TIA report. The Town Engineer, or his designee, shall provide both annual growth rate information and a list of approved developments to include in the analysis to the transportation consultant at the mandatory scoping meeting.

Transportation improvements assumed in the future conditions analysis may include those with an expected completion date concurrent with that of the development and funded through either the Town of Mooresville Capital Improvements Plan, State of North Carolina Transportation Improvement Program, or indicated as a required condition of approval from another nearby development application. Those improvements committed by other projects must be clearly identified in the report. Prior approval from the Town Engineer, or his designee, must be obtained before including other transportation improvements in the study.

IX. Project Traffic

Project Traffic shall be generated for the proposed development program using the traditional three step process of trip generation, distribution, and assignment. These steps are described in detail below.

Trip Generation

Base trip generation for the proposed land use(s) should be calculated using the latest data published in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual*. Data limitations, data age, choice of peak hour or adjacent street

traffic, choice of independent variable, and choice of average rate versus equation shall be presented and discussed at the pre-application meeting.

Local trip generation rates may be acceptable if appropriate validation is provided by the applicant to support them. Any deviation from ITE trip generation rates shall be documented in the mandatory scoping meeting and subject to final approval by the Town Engineer, or his designee.

Internal Capture

Base generation may be reduced by rate of internal capture when two or more land uses are proposed using methodology recommended in the most current *Trip Generation Handbook* published by the Institute of Transportation Engineers. Reductions greater than 10% require consultation and acceptance by the Town of Mooresville and the North Carolina Department of Transportation. The internal capture reduction should be applied before pass-by trips are calculated.

Pass-by Trips

Pass-by trips are those made as intermediate trips between an origin and primary destination (i.e., home to work, home to shopping, etc.). However, pass-by trips are not diverted from another roadway. Base trip generation may be reduced by rate of pass-by capture using methodology recommended in the most current *Trip Generation Handbook* published by the Institute of Transportation Engineers. Pass-by trips associated with the development program may not exceed 10% of the existing volume reported for the adjacent public street.

A trip generation table (*Table #1 – Trip Generation*) shall summarize all trip generation calculations for the project.

Trip Distribution

External trip distribution shall be determined on a project-by-project basis using one of several sources of information available to transportation professionals. Potential sources for determining project trip distribution may include the regional travel demand model, market analysis, existing traffic patterns, or professional judgment. Regardless of methodology, the procedures followed and logic for estimating trip distribution percentages must be well-documented in the transportation impact analysis. Trip distribution percentages proposed for the surrounding transportation network should be discussed and approved by the Town's Engineer and the North Carolina Department of Transportation (NCDOT) during the mandatory scoping meeting.

Estimates of percentage distribution for trips to and from the development site should be clearly summarized in the report using north, south, east, and west cardinal directions.

A map showing the percentage of site traffic on each street included in the study area should be included in the TIA (*Figure #6 – Trip Distribution*).

Trip Assignment

Project traffic shall be distributed to the surrounding transportation system based on the site's trip generation estimates and trip distribution percentages. Future year traffic forecasts (i.e., future year background traffic plus project traffic) shall be presented in both tabular and graphic formats for AM and PM peak hour conditions at all intersections included in the study area (*Figure #7 – Future Year Traffic Volumes with Project*). If the project will be built in phases, traffic assignments shall be reported for each phase. Pass-by traffic shall be included at the driveways and access points for evaluating driveway volumes.

X. Site Access

A complete description of the ingress/egress of the site should be explained and depicted. It should include number of driveways, their locations, distances between driveways and intersections, types of driveways (two-way, one-way, etc.), traffic controls, etc. The design, number, and location of access points to collector and arterial roadways immediately adjacent to the site must be fully analyzed.

The number of access points should be kept to a minimum and be designed to be consistent with the type of roadway facility.

XI. Capacity Analysis

Capacity analyses shall be conducted for all study area intersections significantly impacted by site traffic estimated at build-out of the development. Capacity calculations should be included for existing, future year no build + 1 year, future year project phases, and future year build-out + 1 year conditions. Although other measurements may be considered, the primary measurement for impacts to the transportation system is level of service (LOS), as defined by the most current edition of the *Highway Capacity Manual*. The Town Engineer, or his designee, may also require safety, traffic simulation, gap and/or other analyses appropriate for evaluating a development application. Additional analyses required for the TIA shall be identified during the mandatory scoping meeting.

AM and PM peak hour levels of service shall be determined for all intersections (signalized and unsignalized) identified for study using methodologies contained in the most current edition of the *Highway Capacity Manual*. In special cases, the Town Engineer, or his designee, may request that additional peak hours or weekend analyses be included in the TIA to determine the significance of traffic impacts generated by the development. Future year no build + 1 year overall intersection level of service measurements for signalized intersections, or level of service measurements for the critical movement of unsignalized intersections, may not

lower as a result of the proposed project without prior approval from the Town Engineer, or his designee. Further, signalized or unsignalized intersections operating at LOS E or F within the study area may not experience increased delay (measured in seconds) as a result of the proposed project without prior approval from the Town Engineer, or his designee.

Levels-of-service for signalized intersections shall be determined using existing signal timing plans provided by either the Town of Mooresville or the North Carolina Department of Transportation. If a traffic signal is part of a coordinated system it must be analyzed as such under all conditions. Other standard practices and default input values for evaluating signalized intersections should be consistent with guidelines published by the North Carolina Department of Transportation, Traffic Engineering and Safety Systems Branch, Congestion Management Unit (“*Capacity Analysis Guidelines*”). Capacity analysis worksheets or computer printouts should be included in the appendix of the TIA report.

All TIA reports submitted to the Town of Mooresville shall use the most current version of Synchro Software for signalized and unsignalized intersections or Sidra Software for roundabouts, consistent with policies released by the North Carolina Department of Transportation. A narrative, table, and map shall be prepared that summarizes the methodology and measured conditions at the intersections reported in level of service (LOS A – F), approach delay for unsignalized intersections or intersection signal delay for signalized intersections, and 95th percentile queue lengths for all intersections (*Table #2 – Summary of Level of Service Measurements, Figure #8 – Existing LOS, Figure #9 – Future LOS (No Build), Figure #10 – Future LOS (Full Build-out)*).

XII. Traffic Signal Warrants

Traffic generated from a proposed development may cause a non-signalized intersection within the study area to fall below the desired level of service. The primary solution for improving these intersections is to install a traffic signal; however, it is not the intent to require signals be automatically installed at all non-signalized intersections that fail (e.g., some intersections may have low volumes or may be located too close to existing signals). The Town Engineer, or his designee, may use additional analysis to determine if a signal is required. Installation of new signals shall only be required when either the intersection meets required warrants for a traffic signal or the new traffic signal does not cause an undesirable delay to the surrounding transportation system.

The need for installing a traffic signal at a new location shall be based on the application of warrants criteria contained in the most current edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) and engineering judgment. In determining the location of a new traffic signal, traffic flow progression is of paramount importance. Spacing of traffic signals within the Town of Mooresville must adhere to guidelines published in the Town’s Comprehensive Transportation

Plan and/or NCDOT requirements. Pedestrian movements must be considered in the evaluation and adequate pedestrian clearance provided in the signal cycle split assumptions.

XIII. Queuing Analysis

For projects that include drive-through facilities or entrance gates, a queuing analysis may be required by the Town Engineer, or his designee, to ensure that vehicle stacking will not adversely impact the public transportation system. The queuing analysis must be performed using accepted transportation engineering procedures approved by the Town Engineer, or his designee.

XIV. Mitigation Measures

This section of the report describes the location, nature, and extent of all transportation improvements proposed by the applicant to improve safety and/or maintain minimum level-of-service through build-out of the project. The expectation for the TIA is to maintain future year no build + 1 year level of service (LOS) conditions, and improvements must be recommended and phased to maintain minimum LOS conditions unless otherwise approved by the Town Engineer, or his designee. For multi-phase developments, the phasing of improvements should be addressed. Capacity analyses may be required to confirm that the phasing of improvements will provide an acceptable level of service with each phase. A narrative and table shall be prepared that summarizes the methodology and measured conditions at the intersections reported in level of service (LOS A – F) and seconds of stop delay (*Table #3 – Level of Service with Mitigation*). A narrative and map shall also be prepared that describes and illustrates recommended improvements, by phase if necessary, for maintaining the integrity of the transportation system (*Figure #11 – Recommended Roadway Laneage*).

The Town Engineer, or his designee, shall approve the TIA if he concludes that the recommendations from the report will maintain the integrity of the transportation system. If mitigation is part of an approved transportation impact analysis, all approved improvements for the entire site must be implemented prior to receipt of any certification of occupancy or final plat approval, whichever is appropriate, unless otherwise provided for in a phasing plan that is included in the approved transportation impact study.

XV. Compliance with Adopted Transportation Plans

All transportation impact analysis reports must include a statement of compliance with plans, programs, and policies adopted by the Town of Mooresville for maintaining a safe and efficient multimodal transportation system. The Town Engineer, or his designee, shall provide the applicant with information to consider for improving bicycle and pedestrian circulation and/or access to the site at the mandatory scoping meeting.

XVI. Recommendations

This section of the report shall provide a clear, concise description of the study's findings regarding impacts of the proposed project on the existing and proposed transportation system, and provide a list of required improvements and a phasing plan (if appropriate) to maintain existing year minimum level of service conditions through build-out of the proposed project. The recommendation should end with a statement by the duly qualified and professional registered engineer responsible for the TIA that indicates whether or not the proposed project will meet minimum standards described herein through build-out of the project.

XVII. Appendix

The *Appendix* of the transportation impact analysis shall contain in following information, in the order provided below:

- Approved Memorandum of Understanding (MOU) from the mandatory scoping meeting
- Summary sheets for traffic data used in the TIA
- Field investigation notes
- Turning movement volume development sheets
- Intersection capacity analysis worksheets

Appendix A

Firms Qualified to Complete a TIA Within the Town of Mooresville

Town of Mooresville, North Carolina | TIA Procedures Manual

The transportation impact analysis (TIA) must be prepared for the applicant by a duly qualified and registered professional engineer in the State of North Carolina chosen from a list of qualified traffic engineering firms maintained by the Town of Mooresville. The list was created through solicitation by the Town for professional engineers qualified to perform this service. The list contains the names of at least three traffic engineering firms, along with statements of qualification on each. The Town of Mooresville will assign the traffic engineering firm to each project at their discretion.

Kimley-Horn and Associates, Inc.
Attn: Jonathan Guy, P.E., A.I.C.P.
4651 Charlotte Park Drive, Suite 300
Charlotte, North Carolina 28217
(704) 333-5131
jonathan.guy@kimley-horn.com

The LPA Group of North Carolina
Attn: Robert Dubnicka, P.E.
5600 Seventy-Seven Center Drive, Suite 200
Charlotte, North Carolina 28217
(704) 665-9935
RDubnicka@lpagroup.com

WSP Sells, Inc.
Attn: Brian D. Dehler, P.E.
15401 Weston Parkway, Suite 100
Cary, North Carolina 27513
(919) 678-0035
brian.dehler@wspsells.com

Appendix B

Statement of Need for a TIA – Standard Form



Transportation Impact Analysis | Statement of Need

A. APPLICANT INFORMATION

Project Name: _____ Applicant Name: _____

Project Location: _____ Applicant Telephone: _____

Project Owner: _____ Applicant Address: _____

Application Request: _____ Preferred Consultant: _____
(eg. rezoning, preliminary or final plat, special use permit, site plan, etc.) (See Appendix A of the Town of Mooresville TIA Procedures Manual for a list of qualified traffic engineering firms available to complete the study.)

B. RESIDENTIAL DEVELOPMENT ^A

Current Development Program			
Current Land Use(s)	No. of Dwelling Units ^B	Peak Hour Period	Peak Hour Trips

Total Peak Hour Trips (Current) _____

Proposed Development Program			
Proposed Land Use(s)	No. of Dwelling Units ^B	Peak Hour Period	Peak Hour Trips

Total Peak Hour Trips (Proposed) _____

Notes:

- A = Use this box for a development application that includes a hotel or motel.
- B = Report the total number of rooms if a hotel or motel is included in the development.

C. NON-RESIDENTIAL DEVELOPMENT

Current Development Program			
Current Land Use(s)	Gross Floor Area	Peak Hour Period	Peak Hour Trips

Total Peak Hour Trips (Current) _____

Proposed Development Program			
Proposed Land Use(s)	Gross Floor Area	Peak Hour Period	Peak Hour Trips

Total Peak Hour Trips (Proposed) _____



Transportation Impact Analysis | Statement of Need

D. COMMENTS

The applicant will submit all information required for a *Statement of Need for a Transportation Impact Analysis* at least five working days prior to scheduling the mandatory scoping meeting. The Town Engineer, or his designee, will determine whether a transportation impact study is required for the site specific sketch plan prior to the mandatory scoping meeting. The specific determination on whether a site specific sketch plan meets the requirements outlined above will be made by the Town Engineer, or his designee, based on the expected gross trip generation for existing and proposed land uses and the relationship to existing and planned thoroughfares or adjacent land uses.

Prepared by: _____ Date: _____

DETERMINATION (Official Use Only)

- A transportation impact analysis (TIA) is required. The applicant should contact the Town of Mooresville Planning Department to schedule the mandatory scoping meeting.
- A transportation impact analysis (TIA) is not required. The proposed site plan and traffic generated by the project do not meet the minimum criteria for requiring a TIA study set forth in the *Town of Mooresville's Transportation Impact Analysis Procedures Manual*.
- More information is required to make a determination. The applicant should contact the Town of Mooresville Planning Department to schedule the mandatory scoping meeting.

Reviewed by: _____ Date: _____

Appendix C

Memorandum of Understanding – Standard Form



Transportation Impact Analysis | Memorandum of Understanding

Applicant Information

Project Name: _____ Case Number: _____

Project Location: _____ Applicant Name: _____

Project Owner: _____ Applicant Telephone: _____

Application Request: _____ Applicant Address _____
(eg. rezoning, preliminary or final plat, special use permit, site plan, etc.)

The Town of Mooresville and the applicant hereby agree that the transportation consultant selected for the transportation impact analysis (TIA) will submit sufficient information, as determined by the Town Engineer, or his designee, in the TIA report for only those sections of the report outline required in the *Town of Mooresville Transportation Impact Analysis Procedures Manual* that are specified as required in the following agreement.

I. Signature Page

Required Not Required

Include the name of the project, location, applicant information, and date of the study. The name, registration number, signature, and seal of a duly qualified and registered professional engineer in the State of North Carolina are also required to appear on this page.

II. Table of Contents

Required Not Required

Include a list of all section headings, figures, and tables included in the TIA report. Pages numbers will denote the location of all information in the TIA report.

III. Executive Summary

Required Not Required

Include a clear, concise description of the study findings. It should include a general description of the project scope, study horizon years, existing conditions, probable impacts of the project, capacity analysis and conclusions, mitigation measures, and recommendations. Technical publications, calculations, documentation, data reporting, and detailed design should not be included in this section. The executive summary should not be longer than five pages, complete in itself, and not dependent on supplementary data included by reference.

IV. Introduction

Required Not Required

Identify the applicant's request and provide a brief description of the location of the site within the planning jurisdiction. Also provide a detailed description of the project, including the size of the parcel, anticipated completion dates (including phasing), and existing and proposed uses for the site. This information should include the square footage of each use or the number and size of dwelling units proposed.



Transportation Impact Analysis | Memorandum of Understanding

Brief description of the applicant's request:

Existing land use(s) occupying the site:

Proposed development program:

Project Location: _____

Anticipated Build-Out: _____

Parcel Size: _____

Project Phases: _____

V. Study Area

Required

Not Required

A narrative describing the study area will identify the location of the proposed project within the planning jurisdiction, existing and future land uses in the immediate area, and any unique transportation plans or policies applicable to the area. As part of the description, a site location map (*Figure #1 - Vicinity Map*) will be provided. The map will include natural features, major and minor roadways within the study area, intersection control, lineal distance between major roadways, and a boundary of the site under consideration.

The following intersections will be included in the analysis:

Unique transportation plans or policies applicable to the study area:

VI. Site Description

Required

Not Required

Include a brief summary for key physical characteristics of the site, including general terrain, development size, existing zoning and use (and proposed use if applicable), internal streets, parking lots, sidewalks and bicycle lanes, proposed driveway locations, and designated loading/unloading areas. Similar information for adjacent properties will be provided to evaluate opportunities for internal connections. A half size (11" x 17") site plan to scale illustrating the project as proposed at full build out will be included with the TIA report (*Figure #2 - Site Plan Map*). Information presented in the TIA report will be identical in every respect to the site plan submitted for approval.



Transportation Impact Analysis | Memorandum of Understanding

A half size (11" x 17") site plan to scale illustrating the project as proposed at full build-out is attached to this Memorandum of Understanding.

VII. Existing Conditions

Required Not Required

Provide a description of the existing transportation system within the study area. A narrative and map will be prepared that presents peak hour turning movement volumes for all intersections (signalized or unsignalized) identified for study by the Town Engineer, or his designee (*Figure #3 – Existing Traffic Volumes*). A separate narrative and map will be prepared to describe the characteristics of surrounding major roadways, including functional classification, number of lanes, posted speed limit, existing average daily traffic volumes, and typical cross section (*Figure #4 – Existing Geometrics*).

Peak Hour(s) Studied for the TIA:

Existing Count Data (including source and data collected):

Are new counts required? If so, identify location and for what time periods?

Special data collection requirements (e.g., weekend counts, vehicle classification counts, etc.):

VIII. Future Conditions

Required Not Required

Provide a description of the future year(s) transportation system within the study area. A narrative and map will be prepared that presents peak hour turning movement volumes for all intersections (signalized and unsignalized) identified for study by the Town Engineer, or his designee (*Figure #5 – Future Year Traffic Volumes*). Future year traffic volumes will be forecasted using historical growth rate information and transportation impact analysis reports for development approved by the Town but not yet built. Turning movement volume development sheets will be included in the appendix of the TIA report. The Town Engineer, or his designee, will provide both annual growth rate information and a list of approved developments to include in the analysis to the transportation consultant at the mandatory scoping meeting.

Transportation improvements assumed in the future conditions analysis will include those with an expected completion date concurrent with that of the development and funded through either the Town of Mooresville Capital Improvements Plan, State of North Carolina Transportation



Transportation Impact Analysis | Memorandum of Understanding

Improvement Program, or indicated as a condition of approval from another nearby application. Prior approval from the Town Engineer, or his designee, must be obtained before including other transportation improvements in the study.

Committed transportation improvements within the study area (type, location, and year for start of construction):

List of approved developments to include as committed project traffic in the TIA:

Method and source of information for growing existing background traffic volumes:

IX. Project Traffic

Required

Not Required

Project traffic will be generated for the proposed development program using the traditional three step process of trip generation, distribution, and assignment.

Trip Generation

A trip generation table (*Table #1 – Trip Generation*) will summarize all trip generation calculations for the project.

Describe the ITE trip generation rates used for the TIA, including choice of peak hour or adjacent street traffic, choice of independent variable, and choice of average rate versus equation. If local trip generation rates are used, provide documentation to the satisfaction of the Town Engineer, or his designee, for supporting such rates.

Will any trip reductions be incorporated into the trip generation calculations (e.g., internal capture, pass-by capture, mode split, etc.)? If so, describe the methodology and supporting documentation for making such trip reductions.



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Trip Distribution

Estimates of percentage distribution for trips to and from the development site will be clearly summarized in the TIA report using north, south, east, and west cardinal directions. Trip distribution percentages proposed for the surrounding transportation network should be discussed and approved by the Town’s Engineer and the North Carolina Department of Transportation (NCDOT) during the mandatory scoping meeting. A map showing the percentage of site traffic on each street included in the study area will be included in the TIA report (*Figure #6 – Trip Distribution*).

Describe the methodology and resulting trip distribution percentages that will be used in the TIA. Supplemental information used to determine reasonable trip patterns is provided (see attached).

Trip Assignment

Project traffic will be distributed to the surrounding transportation system based on the site’s trip generation estimates and trip distribution percentages. Traffic forecasts will be presented in both tabular and graphic formats for all peak hour conditions at all intersections included in the study area. If the project will be built in phases, traffic assignments will be reported for each phase. Pass-by traffic will be included at the driveways and access points for evaluating driveway volumes.

X. Capacity Analysis

Required Not Required

Capacity analyses will be conducted for all study area intersections significantly impacted by site traffic estimated at build-out of the development. Capacity calculations should be included for existing, future year (no build), future year (project phases), and future year (build-out) conditions. Peak hour levels of service will be determined for all intersections (signalized and unsignalized) identified for study using methodologies contained in the most current edition of the *Highway Capacity Manual*. Levels-of-service for signalized intersections will be determined using existing signal timing plans provided by either the Town of Mooresville or the North Carolina Department of Transportation. If a traffic signal is part of a coordinated system it must be analyzed as such under all conditions. Capacity analysis worksheets or computer printouts will be included in the appendix of the TIA report.

The TIA report will use Synchro Software v. _____ for measuring level of service at signalized and unsignalized intersections. A narrative, table, and map will be prepared to summarize the methodology and measured conditions at the intersections reported in level of service (LOS A – F) and seconds of stop delay (*Table #2 – Summary of Level of Service Measurements, Figure #7 – Existing LOS, Figure #8 – Future LOS (No Build), Figure #9 – Future LOS (Full Build-out)*).

Additional analyses required for the TIA (e.g., safety, traffic simulation, etc.):



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Additional peak hour or weekend analyses required? _____

XI. Traffic Signal Warrants

Required Not Required

The need for installing a traffic signal at a new location will be based on the application of warrants criteria contained in the most current edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) and engineering judgment. Spacing of traffic signals within the Town of Mooresville must adhere to guidelines published in the Town's Comprehensive Transportation Plan and/or NCDOT requirements. Pedestrian movements must be considered in the evaluation and adequate pedestrian clearance provided in the signal cycle split assumptions.

Special data collection and/or analysis requirements:

XII. Queuing Analysis

Required Not Required

A queuing analysis will be required by the Town Engineer, or his designee, for projects that include drive-through facilities or entrance gates to ensure that vehicle stacking will not adversely impact the public transportation system.

Proposed methodology for queuing analysis:

Additional data needs: _____

XIII. Site Access

Required Not Required

Inventory and describe the number and type of driveways (i.e., minor, intermediate, or major), their locations, distances between driveways and intersections, types of driveways (two-way, one-way, etc.), and traffic controls serving the driveways. The design, number, and location of access points to collector and arterial roadways immediately adjacent to the site will be fully analyzed. The number of access points will be kept to a minimum and be designed to be consistent with the type of roadway facility.

Special data collection and/or analysis requirements:



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Left and right turn lanes serving the site will be recommended and designed to meet future year capacity needs identified in the TIA report. In addition, left and right turn lanes for unsignalized driveways serving the site will be identified using volume thresholds published in the North Carolina Department of Transportation’s *Policy on Street and Driveway Access to North Carolina Highways* (see Warrant for Left- and Right-Turn Lanes Nomograph, pg. 80). All driveways serving the site will be designed in accordance with the NCDOT’s *Policy on Street and Driveway Access to North Carolina Highways* (see Recommended Treatment for Turn Lanes, pgs. 78-9).

Special data collection and/or analysis requirements:

XIV. Mitigation Measures

Required Not Required

Describe the location, nature, and extent of all transportation improvements proposed by the applicant to improve safety and/or maintain minimum level-of-service through build-out of the project. The expectation for the TIA is to maintain future year (no build + 1 year) overall intersection level of service measurements for signalized intersections or level of service measurements for the critical movement of unsignalized intersections. Improvements must be recommended and phased to maintain minimum LOS conditions unless otherwise noted below. For multi-phase developments, the phasing of improvements should be addressed.

Capacity analyses are required to confirm that the phasing of improvements will provide an acceptable level of service with each phase. A narrative and table will be prepared that summarizes the methodology and measured conditions at the intersections reported in level of service (LOS A – F) and seconds of stop delay (*Table #3 – Level of Service with Mitigation*). A narrative and map will be prepared that describes and illustrates recommended improvements, by phase if necessary, for maintaining the integrity of the transportation system (*Figure #10 – Recommended Roadway Laneage*).

Special data collection and/or analysis requirements:

XV. Compliance with Adopted Transportation Plans

Required Not Required

Include a statement of compliance with plans, programs, and policies adopted by the Town of Mooresville for maintaining a safe and efficient multimodal transportation system. The Town Engineer, or his designee, will provide the applicant and their transportation consultant will relevant studies.



Transportation Impact Analysis | Memorandum of Understanding

Unique transportation plans or policies adopted by the Town of Mooresville applicable to the study area:

XVI. Recommendations

Required Not Required

Provide a clear, concise description of the study’s findings regarding impacts of the proposed project on the existing and proposed transportation system, and provide a list of required improvements and a phasing plan (if appropriate) to maintain minimum future year (no build + 1 year) conditions through build-out of the proposed project. The recommendation will end with a statement by the qualified traffic engineer responsible for the TIA that indicates whether or not the proposed project will meet minimum standards described herein through build-out of the project.

XVII. Appendix

Required Not Required

The appendix of the transportation impact analysis will contain in following information, in the order provided below:

Submittal Requirements

The applicant will submit _____ copies of the transportation impact analysis (TIA) report for concurrent review by the Town Engineer, or his designee, and the North Carolina Department of Transportation. See Appendix C of the *Town of Mooresville Transportation Impact Analysis Procedures Manual* for table and figure formatting requirements.

The transportation impact analysis (TIA) report is anticipated from the transportation consultant for initial review by the Town Engineer, or his designee, on or before _____.

Additional Comments



Transportation Impact Analysis | Memorandum of Understanding

Agreement by All Parties

The undersigned agree to the methodology described in this Memorandum of Understanding (MOU) for completing the required transportation impact analysis (TIA) supportive of the development application identified herein. Any changes to the above methodology contemplated by the applicant, or his transportation consultant, must be submitted to the Town Engineer, or his designee, in writing and a revised MOU executed before such changes will be accepted for the TIA report.

Agreed to this ____ day of _____, 2007.

APPLICANT

(Signature)

(Print Name)

TOWN ENGINEER

(Signature)

(Print Name)

Reviewed and approved by the North Carolina Department of Transportation, Division 12, District 2 on this ____ day of _____, 2007.

DISTRICT ENGINEER

(Signature)

(Print Name)

Appendix D

Standard Format for Tables & Figures

TABLE 1
SAMPLE SITE
TRIP GENERATION

	Intensity	Daily Trips	AM Peak Hour Trips			PM Peak Hour Trips		
			Total	In	Out	Total	In	Out
Land Use								
Single-Family Homes	100 DU	1,040	79	20	59	107	67	40
General Office	25,000 SF	459	62	55	7	107	18	89
Shopping Center	75,000 SF	<u>5,633</u>	<u>132</u>	<u>81</u>	<u>51</u>	<u>518</u>	<u>249</u>	<u>269</u>
	Subtotal	7,132	273	156	117	732	334	398
Internal Capture								
Single-Family Homes		375	0	0	0	43	22	21
General Office		91	0	0	0	12	6	6
Shopping Center		<u>456</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>53</u>	<u>26</u>	<u>27</u>
ITE Methodology		922	0	0	0	108	54	54
Cap at 10% of Adjacent Street Traffic		713	27	16	12	73	33	40
	Subtotal	713	0	0	0	73	33	40
Driveway Volumes			6,419	273	156	117	659	301
Pass-by Capture								
Shopping Center (0% a.m., 42% p.m.)		<u>212</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>212</u>	<u>106</u>	<u>106</u>
ITE Methodology		212	0	0	0	212	106	106
Cap at 10% of Adjacent Street Traffic		808	396	198	198	412	206	206
	Subtotal	212	0	0	0	212	106	106
Net New External Trips			6,207	273	156	117	447	252

Notes:

Adjacent Street Traffic (NC 152 & Church Street) = 1,974 AM Peak Hour / 2,052 PM Peak Hour

Trip generation was calculated using the following data:

Daily Traffic Generation

- Single-Family Homes [ITE 210] = $\text{Ln}(T) = 0.92 \text{Ln}(X) + 2.71$; (50% in, 50% out)
- General Office [ITE 710] = $\text{Ln}(T) = 0.77 \text{Ln}(X) + 3.65$; (50% in, 50% out)
- Shopping Center [ITE 820] = $\text{Ln}(T) = 0.65 \text{Ln}(X) + 5.83$; (50% in, 50% out)

AM Peak-Hour Traffic Generation

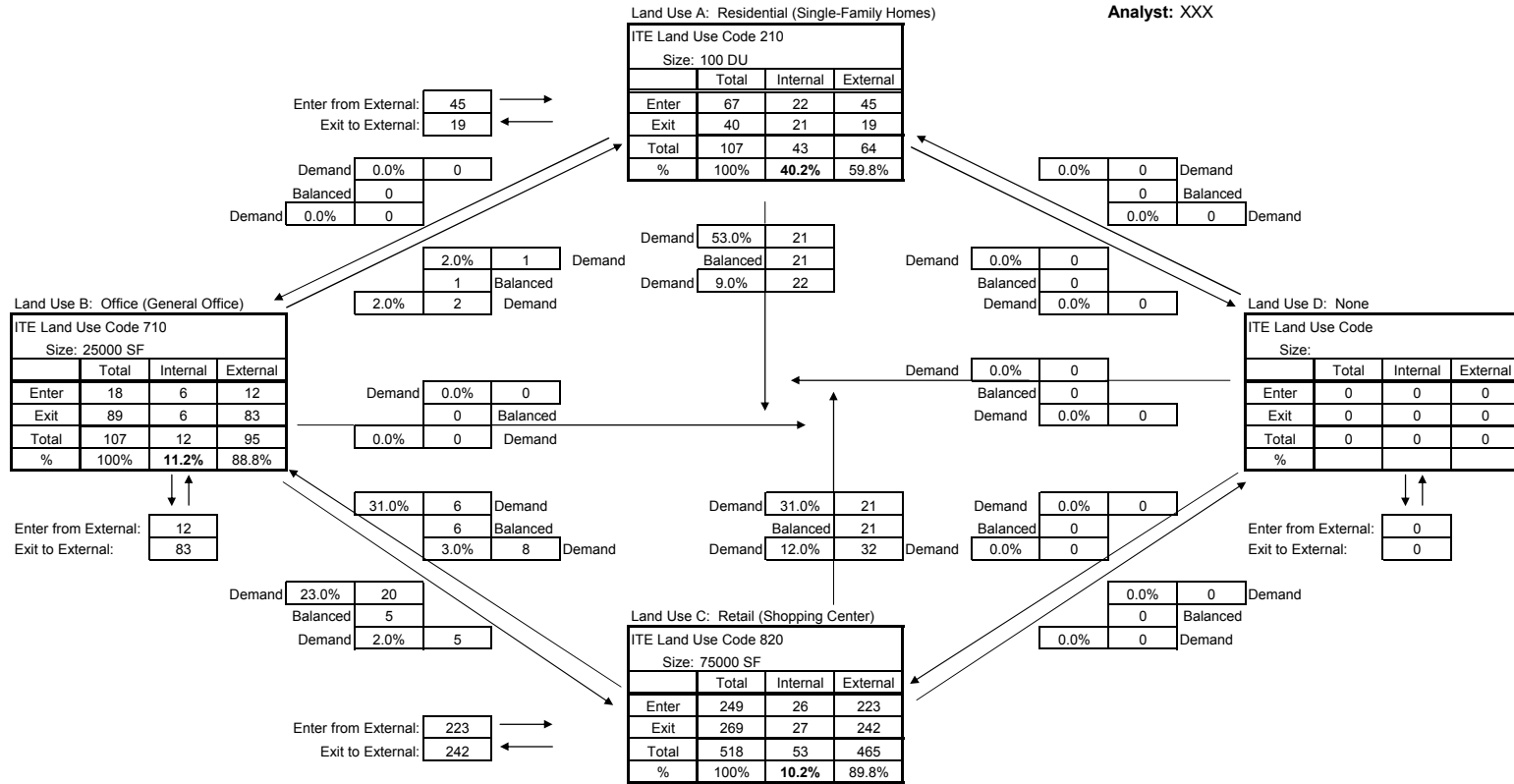
- Single-Family Homes [ITE 210] = $T = 0.70(X) + 9.43$; (25% in, 75% out)
- General Office [ITE 710] = $\text{Ln}(T) = 0.80 \text{Ln}(X) + 1.55$; (88% in, 12% out)
- Shopping Center [ITE 820] = $\text{Ln}(T) = 0.60 \text{Ln}(X) + 2.29$; (61% in, 39% out)

PM Peak-Hour Traffic Generation

- Single-Family Homes [ITE 210] = $\text{Ln}(T) = 0.90 \text{Ln}(X) + 0.53$; (63% in, 37% out)
- General Office [ITE 710] = $T = 1.12(X) + 78.81$; (17% in, 83% out)
- Shopping Center [ITE 820] = $\text{Ln}(T) = 0.66 \text{Ln}(X) + 3.40$; (48% in, 52% out)

ITE MULTI-USE PROJECT INTERNAL CAPTURE WORKSHEET
 (Source: Chapter 7, ITE Trip Generation Handbook, June 2004)

Project Number: 012345678
 Project Name: Sample TIA
 Scenario: Proposed Site
 Analysis Period: PM Peak
 Analyst: XXX



NET EXTERNAL TRIPS FOR MULTI-USE DEVELOPMENT					
Category	Land Use				Total
	A	B	C	D	
Enter	45	12	242	0	299
Exit	19	83	223	0	325
Total	64	95	465	0	624
Single Use Trip Gen Estimate	107	107	518	0	732

Overall Internal Capture = **14.75%**

**TABLE 2
SAMPLE SITE
SUMMARY OF LEVEL OF SERVICE MEASUREMENTS**

Condition	AM Peak Hour (Seconds of Delay)	PM Peak Hour (Seconds of Delay)
NC 152 and Iredell Avenue		
2007 Existing Conditions	B (16.9)	C (28.7)
2010 Background Conditions	C (28.4)	D (48.3)
2010 Build-Out Conditions	C (30.4)	E (58.8)
NC 152 and Institute Avenue		
2007 Existing Conditions	D (25.2)*	F (150.8)*
2010 Background Conditions	D (32.5)*	F (302.1)*
2010 Build-Out Conditions	E (39.2)*	F (463.8)*
Church Street and Iredell Avenue		
2007 Existing Conditions	B (10.4)	B (11.1)
2010 Background Conditions	B (11.3)	B (12.1)
2010 Build-Out Conditions	B (11.5)	B (12.3)
Church Street and Institute Avenue		
2007 Existing Conditions	C (20.0)*	D (29.4)*
2010 Background Conditions	C (23.3)*	E (41.9)*
2010 Build-Out Conditions	D (25.1)*	F (54.1)*
NC 152 and Driveway #1		
2010 Build-Out Condition	E (41.2)*	F (519.7)*
Church Street and Driveway #2		
2010 Build-Out Condition	B (13.1)*	B (14.0)*

* – Unsignalized capacity analysis results provided for the worst minor street movement.

**TABLE 3
SAMPLE TIA
SUMMARY OF LEVEL OF SERVICE WITH MITIGATION**

Condition	AM Peak-Hour LOS (Delay)	PM Peak-Hour LOS (Delay)	Mitigation Improvement
NC 152 and Iredell Avenue			
2010 Build-Out Conditions	C (30.4)	E (58.8)	Addition of a southbound right-turn lane
2010 Build-Out Conditions with Improvements	C (24.5)	D (40.2)	

INTERSECTION VOLUME DEVELOPMENT

**NC 152 and Iredell Avenue
AM PEAK HOUR**

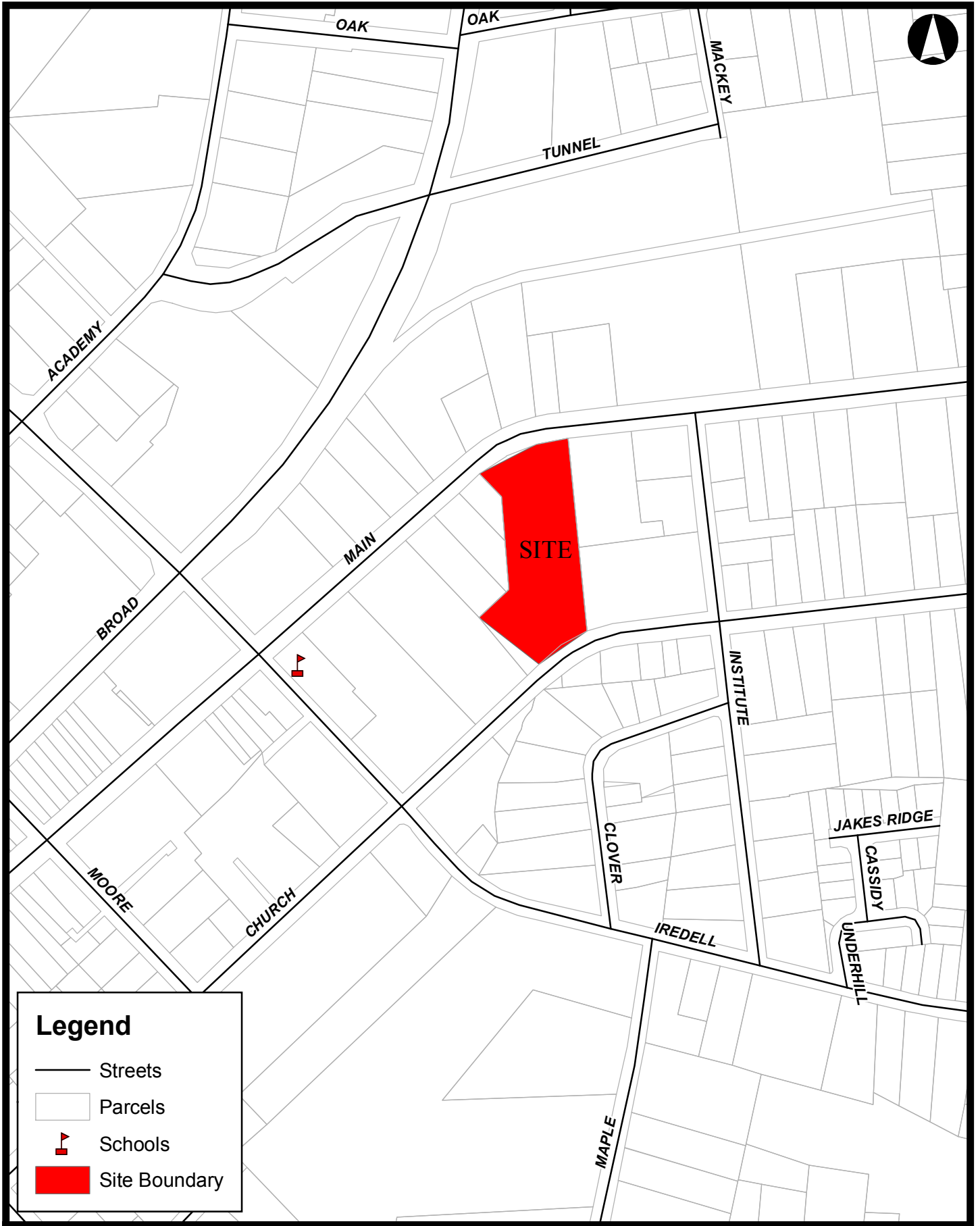
Description	NC 152 <u>Northbound</u>			NC 152 <u>Southbound</u>			Iredell Avenue <u>Eastbound</u>			Iredell Avenue <u>Westbound</u>		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
2007 Observed Traffic	132	477	18	43	520	94	69	311	106	28	427	62
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicle %	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Annual Growth Rate	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
2010 Background Traffic	144	521	20	47	568	103	75	340	116	31	467	68
Percent Assignment	0%	25%	0%	0%	25%	15%	15%	0%	0%	0%	0%	0%
Project Trips (Total)	0	39	0	0	29	18	23	0	0	0	0	0
2010 Buildout Total	144	560	20	47	597	121	98	340	116	31	467	68

PM PEAK HOUR

Description	NC 152 <u>Northbound</u>			NC 152 <u>Southbound</u>			Iredell Avenue <u>Eastbound</u>			Iredell Avenue <u>Westbound</u>		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
2007 Observed Traffic	147	502	17	88	583	97	60	355	132	41	445	89
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1	1	1
Heavy Vehicle %	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Annual Growth Rate	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
2010 Background Traffic	161	549	19	96	637	106	66	388	144	45	486	97
Percent Assignment	0%	25%	0%	0%	25%	15%	15%	0%	0%	0%	0%	0%
Project Trips (Total)	0	49	0	0	63	38	29	0	0	0	0	0
2010 Buildout Total	161	598	19	96	700	144	95	388	144	45	486	97

Note: 2007 Observed Traffic Volumes are hypothetical volumes created for the purposes of this sample table.

3/10/2007 13:51



Legend

- Streets
- ▭ Parcels
- ▴ Schools
- ▭ Site Boundary

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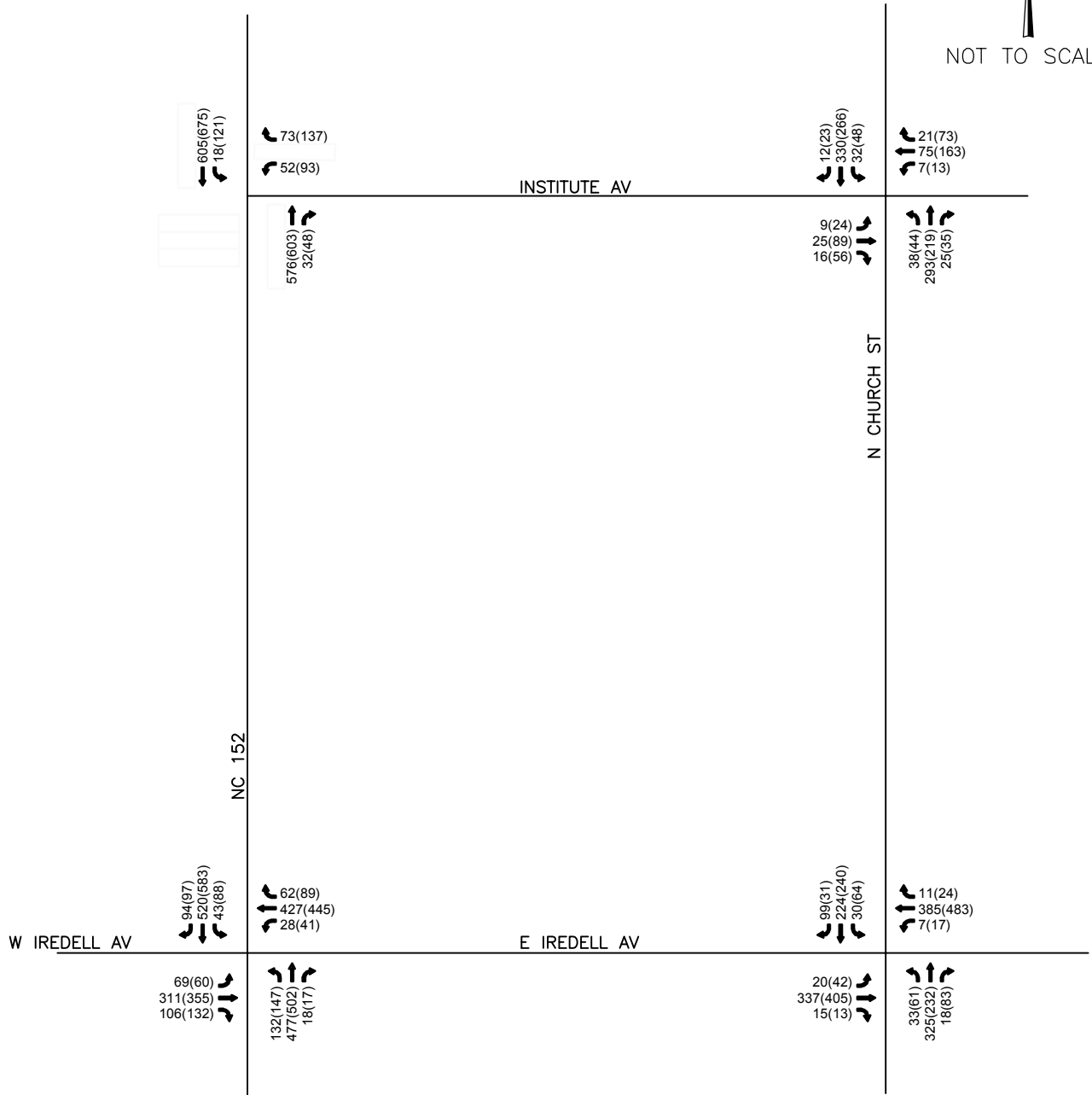
SAMPLE TIA

VICINITY MAP

FIGURE
 1



NOT TO SCALE



LEGEND

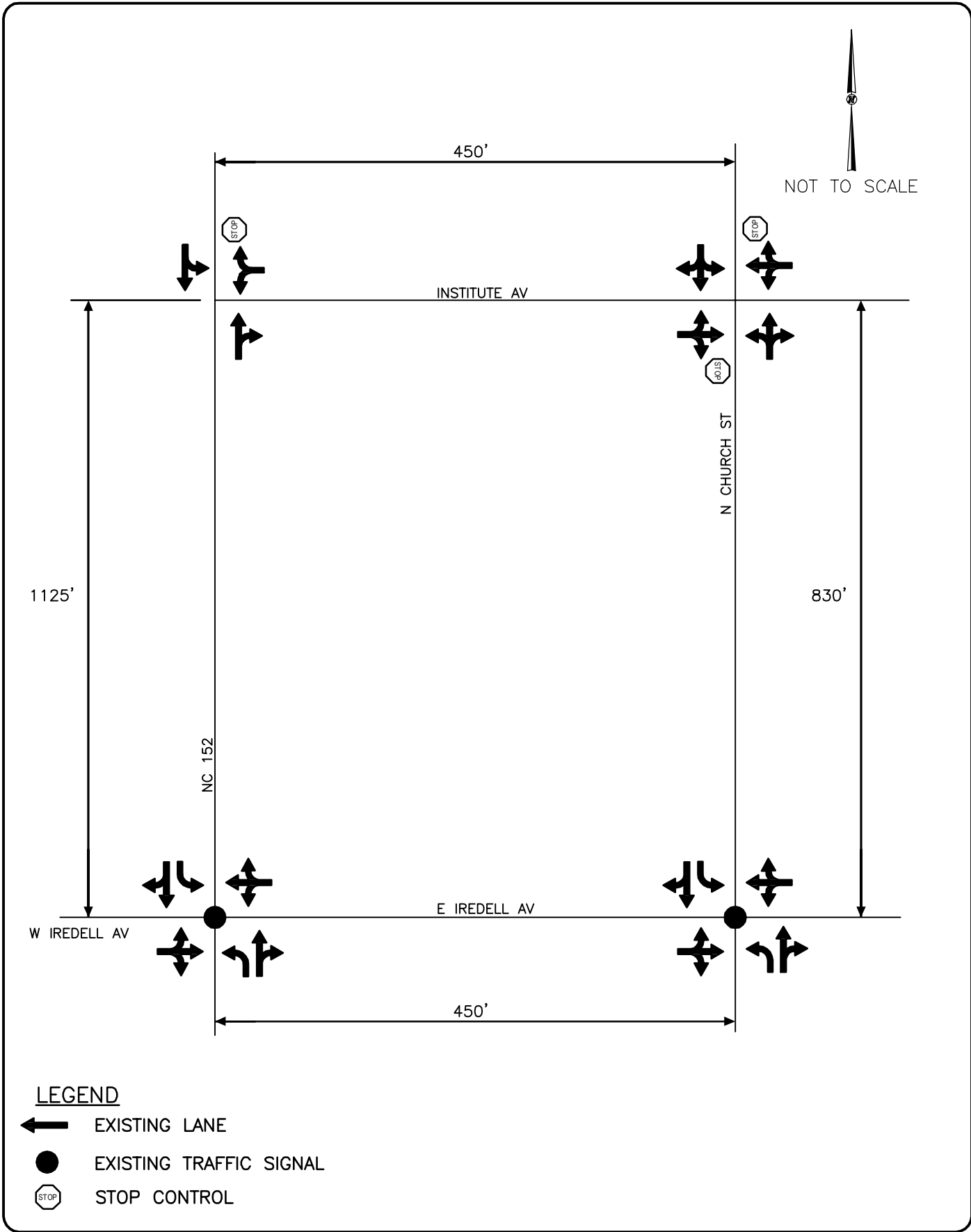
- XX AM PEAK HOUR TRAFFIC VOLUMES
- ((XX)) PM PEAK HOUR TRAFFIC VOLUMES

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SAMPLE SITE

EXISTING TRAFFIC VOLUMES
(2007)

FIGURE
3



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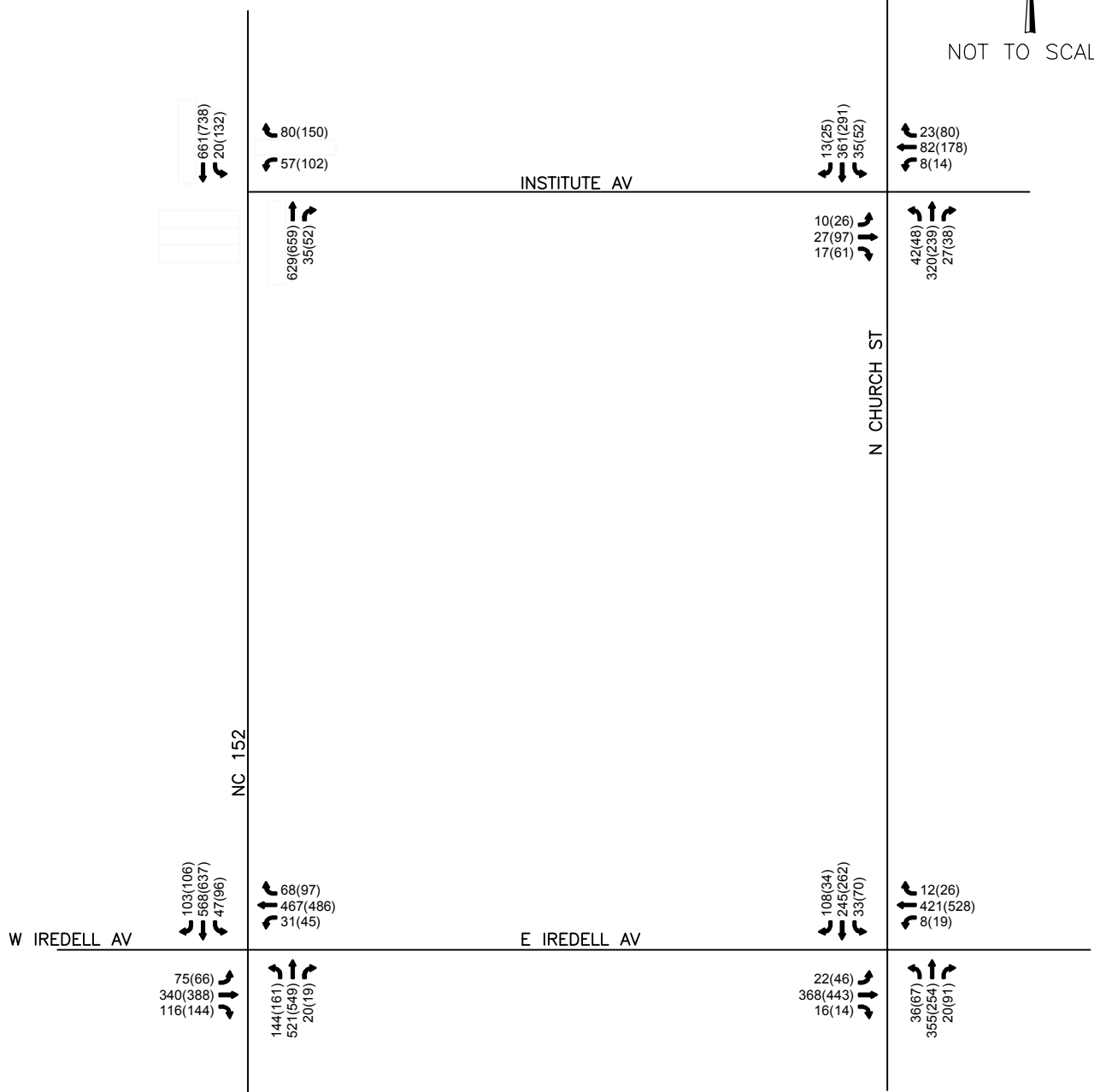
SAMPLE SITE

EXISTING GEOMETRICS

FIGURE 4



NOT TO SCALE



LEGEND

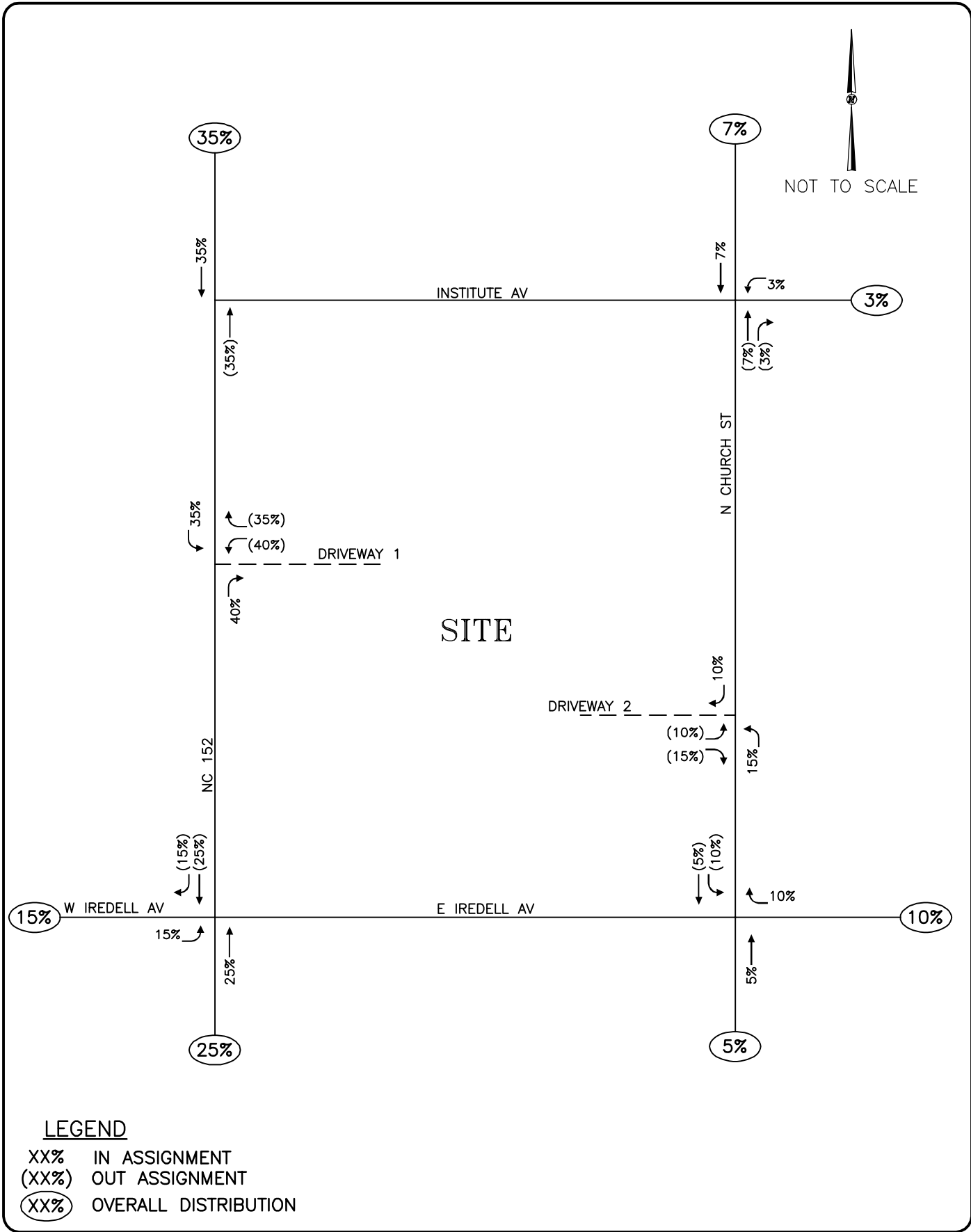
- XX AM PEAK HOUR TRAFFIC VOLUMES
- (XX) PM PEAK HOUR TRAFFIC VOLUMES

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SAMPLE SITE

FUTURE YEAR
TRAFFIC VOLUMES (2010)

FIGURE
5



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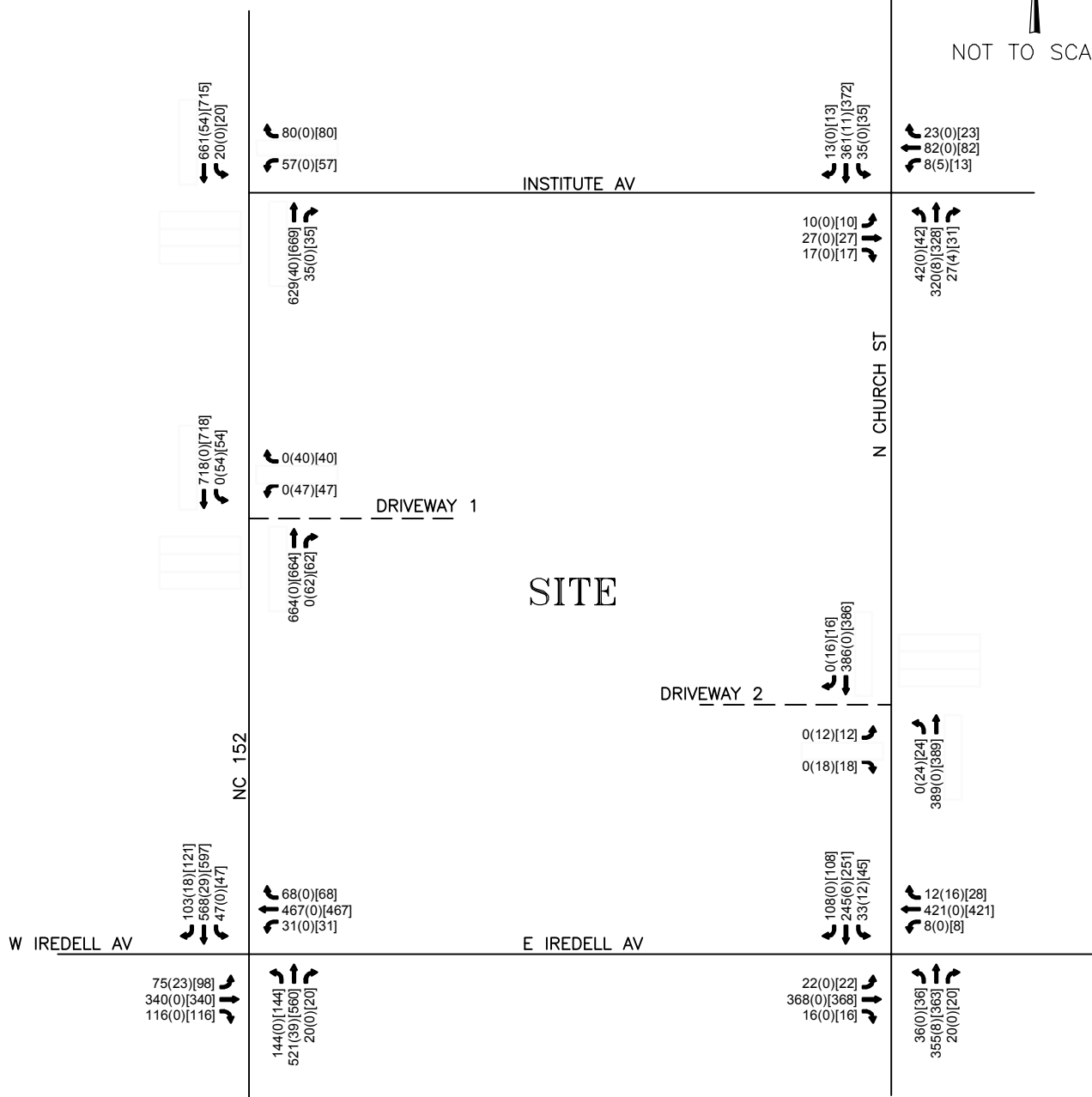
SAMPLE SITE

TRIP DISTRIBUTION

FIGURE
6



NOT TO SCALE



LEGEND

- XX FUTURE BACKGROUND TRAFFIC
- (XX) PROJECT TRAFFIC
- [XX] TOTAL TRAFFIC

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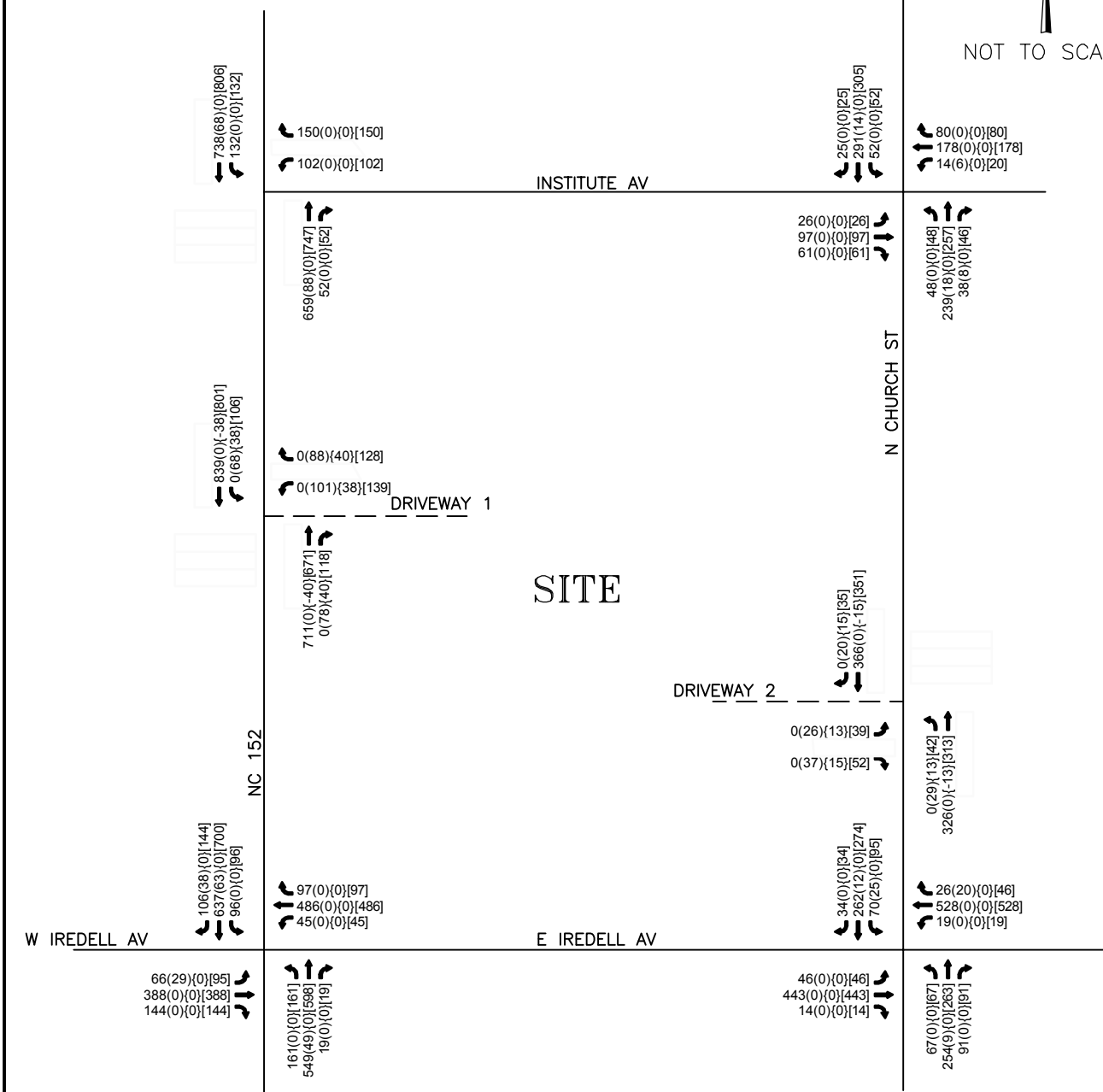
SAMPLE SITE

FUTURE YEAR TRAFFIC VOLUMES WITH PROJECT (2010)

FIGURE 7A



NOT TO SCALE



LEGEND

- XX FUTURE BACKGROUND TRAFFIC
- (XX) PROJECT TRAFFIC
- {XX} PASS-BY TRAFFIC
- [XX] TOTAL TRAFFIC

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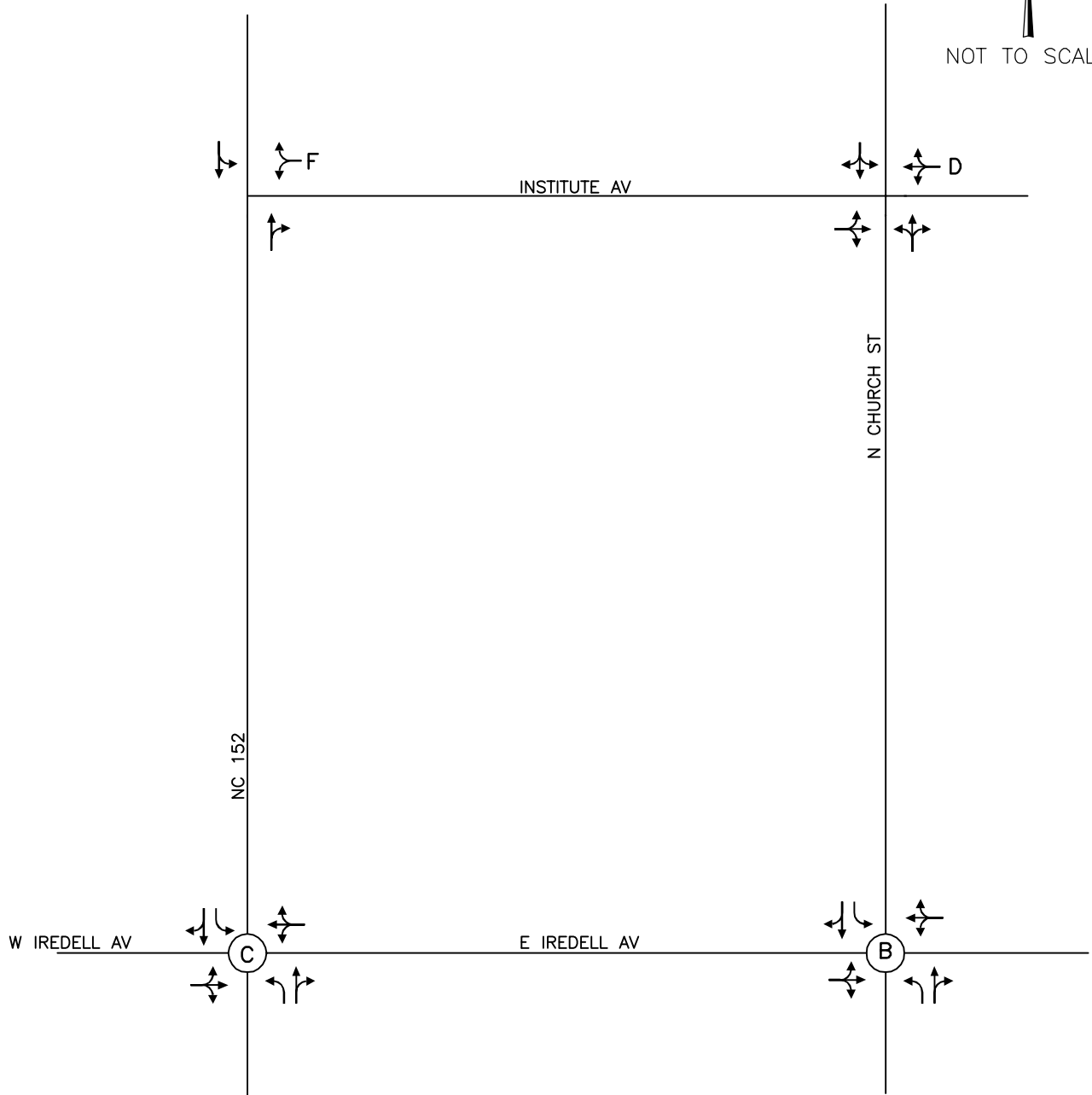
SAMPLE SITE

FUTURE YEAR TRAFFIC VOLUMES WITH PROJECT (2010)

FIGURE 7B



NOT TO SCALE



LEGEND

- (X) OVERALL LOS FOR SIGNALIZED INTERSECTIONS
- X WORST MINOR STREET MOVEMENT FOR UNSIGNALIZED INTERSECTION
- (X) LEVEL OF SERVICE FOR FAILING MOVEMENTS (AT SIGNALIZED INTERSECTIONS)

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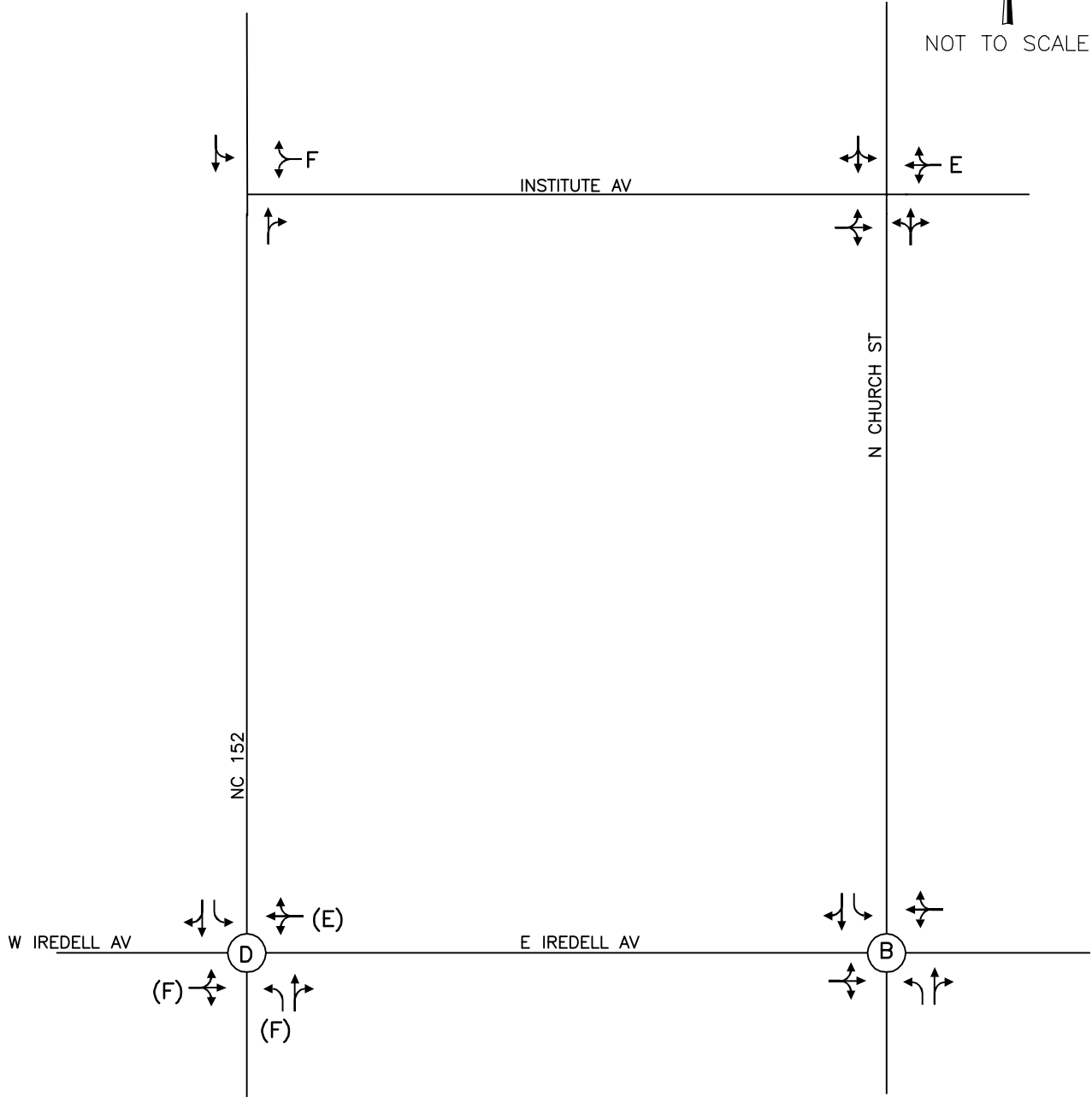
SAMPLE SITE

EXISTING
LEVEL OF SERVICE

FIGURE
8



NOT TO SCALE



LEGEND

- (X) OVERALL LOS FOR SIGNALIZED INTERSECTIONS
- X WORST MINOR STREET MOVEMENT FOR UNSIGNALIZED INTERSECTION
- (X) LEVEL OF SERVICE FOR FAILING MOVEMENTS (AT SIGNALIZED INTERSECTIONS)

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INSERT COMPANY
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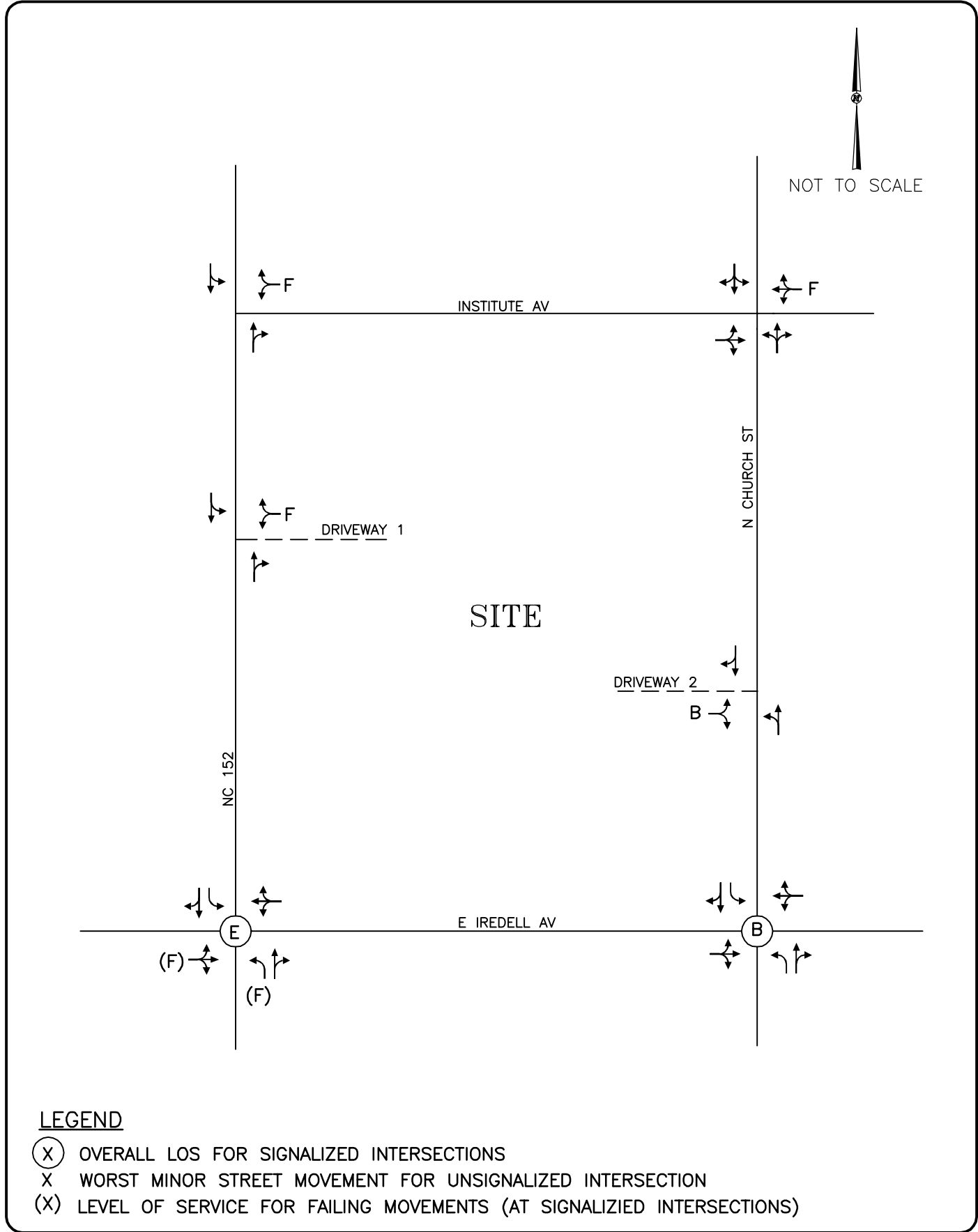
Prepared for the Town of Mooresville

SAMPLE SITE

FUTURE
LEVEL OF SERVICE
(NO BUILD)

FIGURE

9

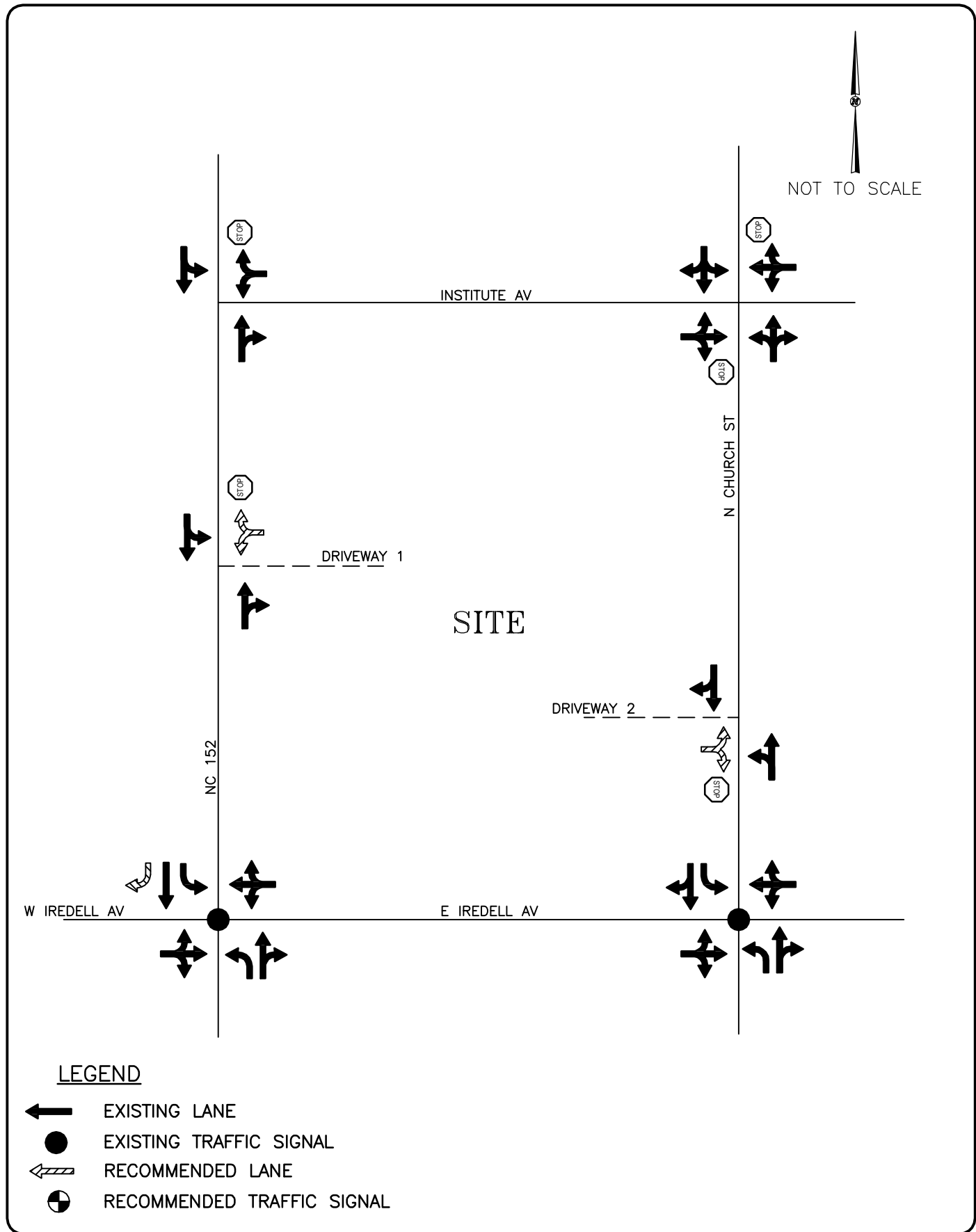


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SAMPLE SITE

FUTURE
 LEVEL OF SERVICE
 (FULL BUILD-OUT)

FIGURE
 10



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SAMPLE SITE

RECOMMENDED
 INTERSECTION LANEAGE

FIGURE
 11