Southern Nevada Traffic Study

Appendix B. TRAFFIC OPERATIONS METHODOLOGY AND ASSUMPTIONS

October 2018

Prepared for

NEVADA DOT SAFE AND CONNECTED

Prepared by HDR

Contents

Appendices

Figures

1. Introduction and Background

There are three main freeways in the Las Vegas Valley: I-15, US 95 (US 95/US 93/I-515), and I-215/ CC 215. Over the last decade, there have been major widening projects on US 95 from the Spaghetti Bowl (the system interchange between I-15, I-515, US 93, and US 95) to the west; I-15 from the Spaghetti Bowl to the north; and on I-15 from Tropicana south to Silverado Ranch. New interchanges have been constructed on I-15 at Silverado Ranch and at Cactus Avenue. Additionally, a new interchange is planned for I-15 at Starr Avenue and the Nevada Department of Transportation (NDOT) recently began construction of Project NEON.

As the Las Vegas area has grown over the last several decades, NDOT and local agencies have developed freeway infrastructure on a corridor-by-corridor basis. In recognition that corridor improvements affect overall traffic patterns on the entire system, NDOT commissioned the Southern Nevada Traffic Study (SNTS) to provide a system-wide traffic analysis study.

To plan and prepare for future capacity needs, the HDR team will conduct a system-wide traffic study with a focus on existing and potential future congestion and other operational deficiencies. HDR may employ a Planning and Environmental Linkage (PEL) study approach to account for environmental, community, and economic factors. The SNTS will compare benefits and costs of alternatives studied, and expedite project-level environmental analysis and coordination as project construction funding is identified.

The intent of this project is to develop travel demand forecasts, perform meso- and microscopic simulation analyses of traffic operations, develop conceptual design of projects, and provide some of the initial documentation required to evaluate potential solutions under the PEL study. This will set the stage for project-level coordination and environmental analysis once funding becomes available for construction.

2. Project Goals and Objectives

The following are the project's goals and objectives:

1. Conduct region-wide traffic forecasting and traffic analyses, and evaluate alternatives and Benefit-Cost Analyses (BCA) of selected urban southern Nevada freeways in coordination with ongoing projects and studies.
2. Provide a model of the freeway network under NDOT's jurisdiction and determine the impacts of freeway projects among the various freeway corridors.
3. Evaluate the needs of the select portions of the region's freeway system and develop improvement strategies to meet the short- and long-term transportation needs; and conduct BCA to prioritize mitigation measures maximizing benefits based on investments.
4. Identify and evaluate performance measures for congestion mitigation on the urban freeway system.
5. Assessment and prioritization of future projects based upon updated analyses; to be evaluated using the NDOT-approved BCA.
6. Prepare traffic data for future projects and NEPA studies.
7. Prepare traffic data for future support of Change in Control of Access Reports (CCAR).

3. Project Study Limits

The study area includes the freeway corridors/segments in the Las Vegas Valley (the Valley) in Clark County, Nevada, identified in Figure 1. The level of analysis, such as meso- or microscopic will vary depending on the corridor. Corridors with recent project development or lesser needs will receive a mesoscopic level of analysis utilizing the Aimsun Next traffic simulation software discussed in Section 5 to document future congestion conditions.

Corridors with greater congestion needs or those slated for alternatives development as part of this project will receive a microscopic level of analysis utilizing the Aimsun Next traffic simulation software to document future congestion conditions and to identify and develop project alternatives.

In addition, the SNTS will evaluate a potential east side link for the Valley. The alignment for this east side link will be determined by the Steering Committee with respect to the north and south connection points. This link will be analyzed using only TransCAD to determine feasibility and will not be included in the meso- or microscopic analysis. The presence of this potential corridor in the future will be modeled only to understand the potential effects on the metropolitan freeway system. The east side link would cause minor diversions on the Aimsun Next network corridors.

The SNTS corridors, tiered by meso- and microscopic level of analysis and are listed below and shown in Figure 2 and Figure 3, respectively:

Mesoscopic Simulation Analysis

1. US 95 from CC 215 to Spaghetti Bowl
2. CC 215 from US 95 to Russell Road
3. I-215 from I-15/I-215 System Interchange to Windmill Lane Lane
4. I-15 from south of Spaghetti Bowl Entrance Ramps to Russell Road

Microscopic Simulation Analysis and Alternative Development

1. I-15 from Russell Road to Sloan
2. I-15/I-215 System Interchange
3. I-515 from Spaghetti Bowl to Eastern Avenue
4. I-515 from Eastern Avenue to I-215/I-515 System Interchange
5. I-215/I-515 System Interchange
6. CC 215 from Russell Road to I-15/I-215 System Interchange
7. I-215 from Windmill Lane Lane to the I-15/I-215 System Interchange
8. Summerlin Parkway from CC 215 to US 95

Figure 1: Project Overview

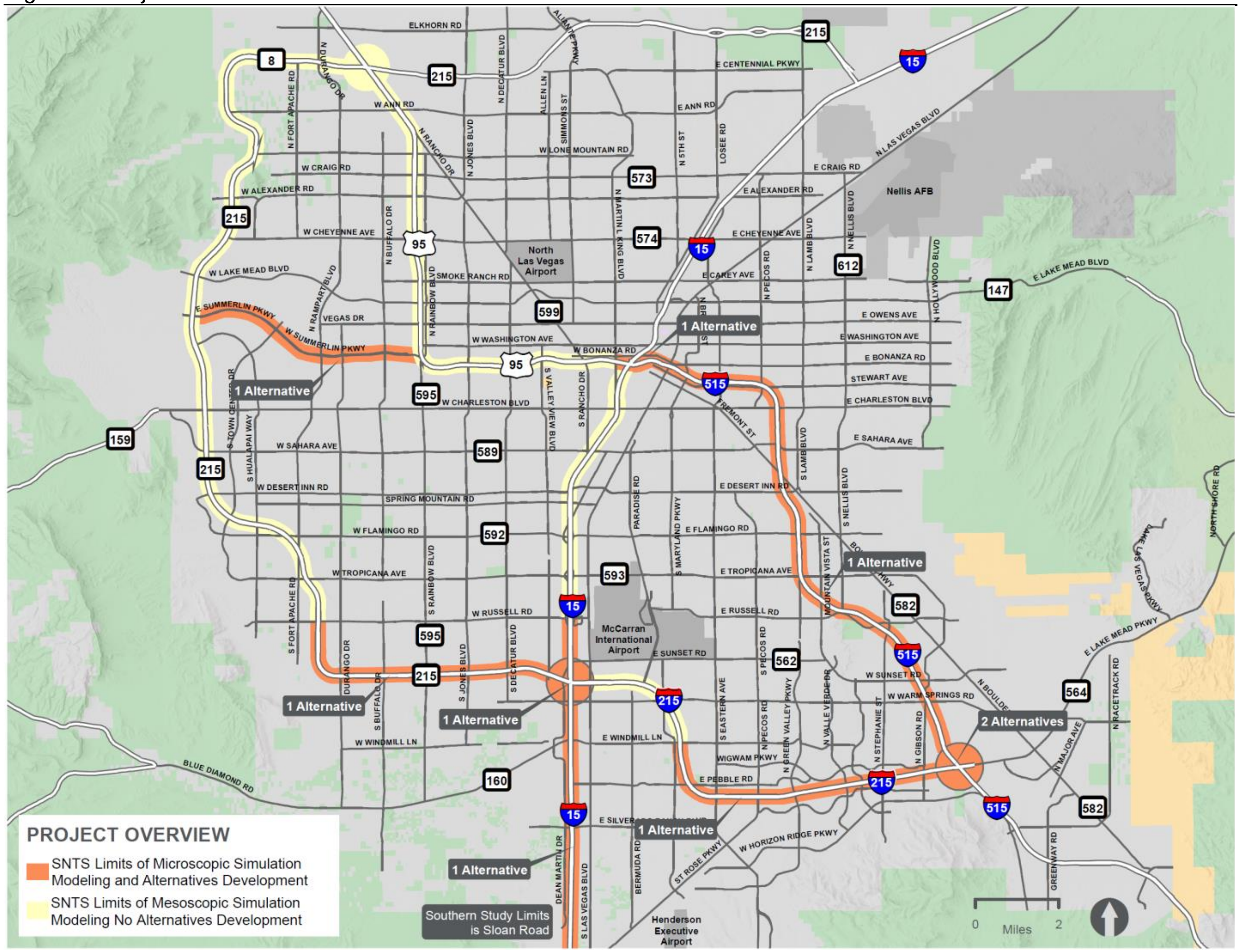


Figure 2: Mesoscopic Simulation Analysis Corridors

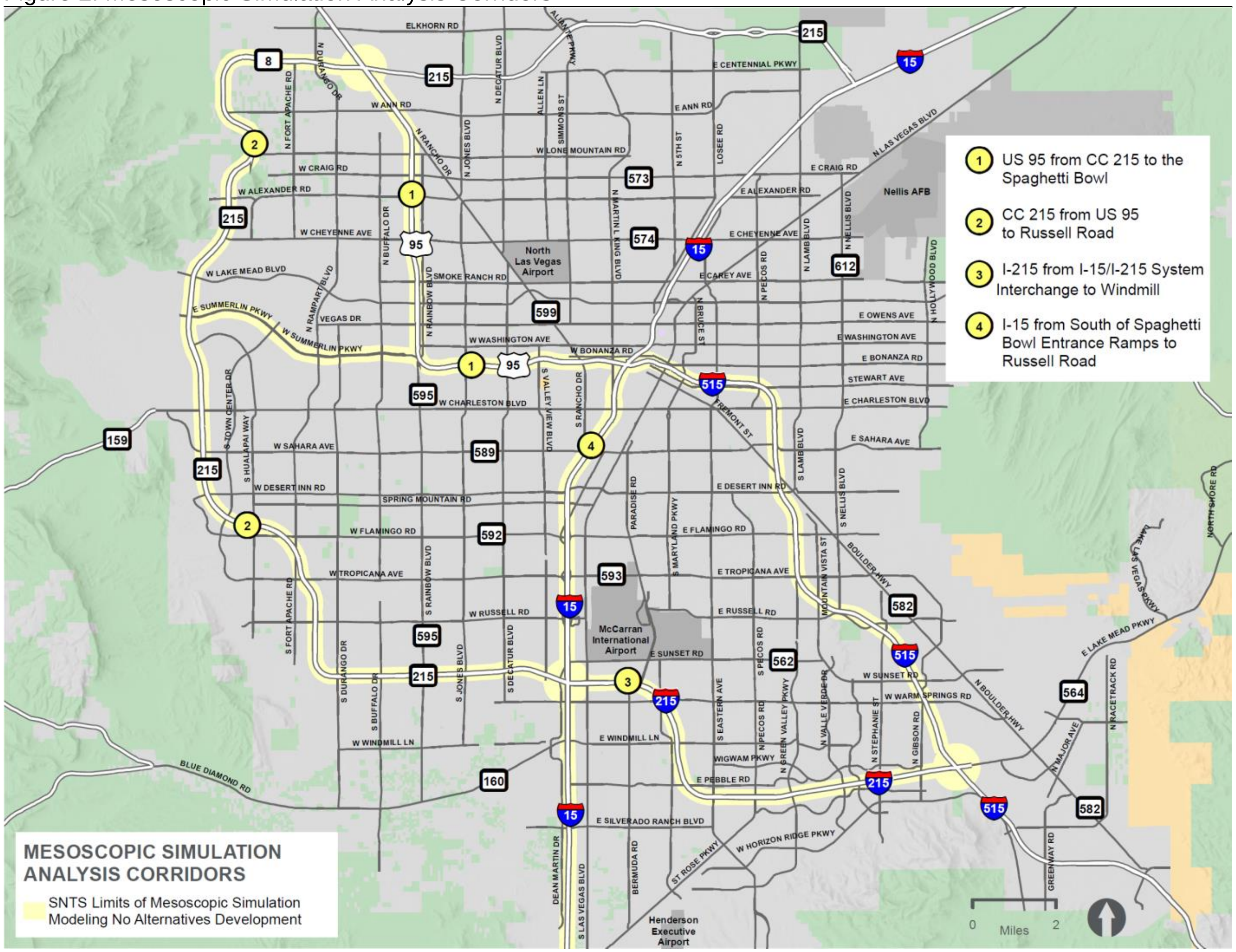
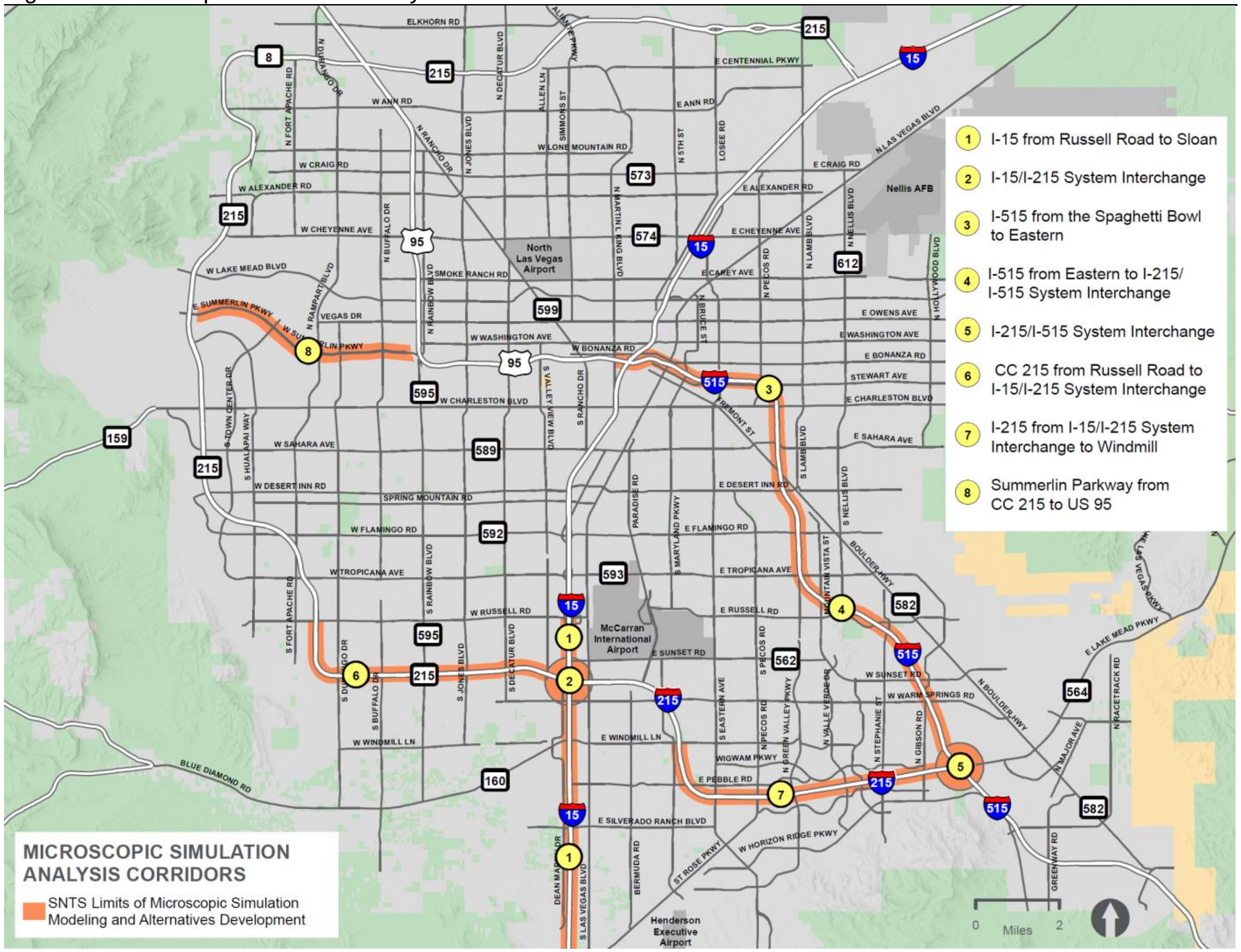


Figure 3: Microscopic Simulation Analysis Corridors



4. Analysis Years and Scenarios for Evaluation

Both meso- and microscopic traffic analyses along the study corridors will be performed for the AM and PM peak periods. Start times for peak periods may differ by corridor depending on congestion levels and the surrounding roadways' traffic patterns, but will at a minimum model 2 hours for AM and 2 hours for PM. The maximum model duration of the macro- and mesoscopic models will run long enough to include AM/PM peak analyses for all study corridors. Analysis years will include existing conditions (2017) and a baseline horizon year (2040) based on the forecasted volumes from the calibrated TransCAD model (see Section 8).

The baseline 2040 network includes projects that are either short term in the Transportation Improvement Plan (TIP) or Statewide Transportation Improvement Program (STIP) or are Regional Transportation Plan (RTP) projects having funding that will be accelerated for construction prior to 2035.

The build 2040 project network includes the baseline 2040 network in addition to the remaining projects identified in the RTP (not accelerated for construction prior to 2035). These additional projects will be included in the SNTS study for analysis; therefore, these projects will have an impact on BCA.

After the build projects have been incorporated into the analysis, additional or remaining traffic congestion (if any) on the freeway network will be identified. Then corridor alternatives, that may or may not be in the current STIP/TIP/RTP, will be developed for congestion mitigation.

Inclusion in the baseline network does not infer project readiness. Projects excluded from the baseline network are likely to be included in the build project network. The baseline network provides a comparison against the build network and is instrumental to the corridor alternatives BCA. An iterative solutions development process along each corridor will involve the Aimsun Next traffic software to reassign the future volumes through each set of improvements, analysis of traffic operations for the mitigation measures, and impacts to the BCA. At this time, anticipated alternatives and scenarios will include the following segments listed organized by routes:

US 95

The **CC 215 to the Spaghetti Bowl** segment (see callout 1 in Figure 2) will be analyzed in a mesoscopic simulation analysis only.

CC 215

The **US 95 to Russell Road** segment (see callout 2 in Figure 2) will be analyzed in mesoscopic scale only with baseline conditions.

I-215

The **I-15/I-215 System Interchange to Windmill Lane** (see callout 3 in Figure 2) will be analyzed in mesoscopic scale. In addition, within this segment, the SNTS project will develop one alternative solution that will be analyzed in microscopic scale (see callout 7 in Figure 3).

I-15

The **South of Spaghetti Bowl Entrance Ramps to Russell Road** segment's baseline conditions (see callout 4 in Figure 2) will be analyzed in mesoscopic simulation. No build alternatives will be included.

The **Russell Road to Sloan** segment (see callout 1 in Figure 3) may have one build alternative to add an additional lane in each direction (this alternative may only require mesoscopic level analysis; however will remain at a microscopic until direction is received from NDOT).

The **I-15/I-215 System Interchange** (see callout 2 in Figure 3) will include microscopic simulation north to Russell Road. However, the only alternatives development in this area will be to address the south to west and east to north movements at the I-15/CC 215 system interchange.

I-515

The **Spaghetti Bowl to Eastern** segment (see callout 3 in Figure 3) will develop one alternative to include one additional lane in each direction of the mainline, to be analyzed with microscopic simulation. This lane will be general purpose and not HOV.

The **Eastern to I-215/I-515 System Interchange** (see callout 4 in Figure 3) will include one alternative to be developed in this area, to be analyzed with microscopic simulation.

I-215/I-515

The **System Interchange** (see callout 5 in Figure 3) will include two alternatives to be developed and screened resulting in one preferred alternative, analyzed with microscopic simulation. This alternative will be used to inform the CCAR.

CC 215

The **Russell Road to I-15/I-215 System Interchange** segment (see callout 6 in Figure 3) will include one additional lane in each direction. Microscopic simulation analysis will be utilized.

Summerlin Parkway

The **CC 215 to US 95** segment (see callout 8 in Figure 3) will be analyzed in microscopic scale only and alternatives will likely include an additional lane in each direction.

5. Technical Guidance and Analysis Tools

Traffic operational analysis will be completed using a series of software tools. The modeling process will:

1. Utilize the southern Nevada regional TransCAD model for the initial travel demand modeling.
2. Import the TransCAD network and trip demand tables into Aimsun Next and run Aimsun Next Macroscopic to reasonably match the TransCAD volume macroscopic results.
3. Update the Aimsun Next model in the study area with meso- and microscopic parameters such as lane-control, geometry, speeds, and signal timings.
4. Calibrate study area mesoscopic Aimsun Next model to represent AM and PM peak period volumes and traffic conditions. Calibration procedure and thresholds detailed in later section.
5. Calibrate microscopic areas of Aimsun Next model to represent more detailed traffic conditions for AM and PM peak periods. Calibration thresholds detailed in later section.

6. Update the Aimsun Next model geometric coding for future conditions modeling (including baseline and build conditions).
7. Output meso- and microscopic simulation analysis along study corridors determined in Figure 2 and Figure 3, respectively, for the SNTS limits and areas with alternative developments.
8. Identify and use Aimsun Next microscopic simulation to analyze alternative improvements for the 2040 AM and PM peak period. Update and compare results to baseline and build conditions.
9. Inform NDOT of the best use of project funds with a BCA of corridors alternatives.

A flow chart describing the general project approach is shown in Figure 4.

Intersection operations will be compared to a study specific delay threshold for signalized intersections. Aimsun Next tracks individual vehicle movements and interactions and quantifies the performance of individual movements, overall intersection delays, queue lengths, and travel times more realistically than typical deterministic methods of calculating MOEs. Performance measures using microscopic simulation tools are inherently different than typical deterministic methodologies. For this study, averaged simulated densities measured from the simulation models over multiple runs will be used as a measure of effectiveness (MOE) to compare scenarios and not an attempt to redefine calculated HCM densities for merge/diverge, weave, and basic freeway sections. In simulation, density can be used as a direct MOE. Simulation density incorporates heavy vehicle interactions with passenger vehicles along the segment. For this study, estimated simulated lane densities (including heavy vehicle interactions) will be compared to study specific density thresholds.

For basic freeway segments, estimated simulated density will be reported by dividing the simulated average segment flow rate by the number of lanes, and then dividing by the average simulated segment speed. This estimated simulated density will be compared to a study specific density threshold. Per the *NDOT CORSIM Modeling Guidelines*, density reporting on tables and figures will provide a disclaimer that states that density is an estimate simulated density along the basic freeway segment.

In this study for weave and merge/diverge segments density will be outputted as an average lane density over a segment in both meso- and microscopic simulation analyses. Simulated average lane densities in these sections will not receive any adjustments for passenger car equivalents. Along with other MOEs reported in these segments, such as speed and travel time, evaluation of possible vulnerabilities in each alternative can be efficiently and consistently achieved and compared to other alternatives by reporting the worst estimated simulated lane density in these segments. This process deviates from deterministic density calculation methodologies for weave and merge/diverse segments which uses hypothetical flow rates demand values (not simulated flow rates) to calculate density. This worst lane density will be assigning a weave or merge/diverge LOS grade. Per the *NDOT CORSIM Modeling Guidelines*, density reporting on tables and figures will provide a disclaimer that states that density is an estimate simulated density along the worst lane in the weave or merge/diverge segment.

Note: Study specific delay and density thresholds will be determined in a future addendum to this document, as well as definition and thresholds of other study MOEs.

Unless otherwise stated, the operational analysis will be prepared to closely follow the recommendations outlined in NDOT's *CORSIM Modeling Guidelines*. These guidelines, geared towards CORSIM, will be adapted to Aimsun Next's mesoscopic and microscopic simulation.

The "Coded Input Data Checklist" will be used to identify errors prior to calibration, by reviewing software warnings, input data, and the animation. Calibration methodology and procedure at a mesoscopic level has not been defined by NDOT or the Federal Highway Administration (FHWA); therefore, through this project, calibration parameters and targets will be determined and presented to NDOT for approval during the project, and a calibration document will be developed.

Selection of a warm-up and warm-down period for microscopic simulation will be determined based on the corridor travel times and rounded up to the nearest 15-minute period. These periods will be used to seed the model and capture the latent demand in the network or along a corridor.

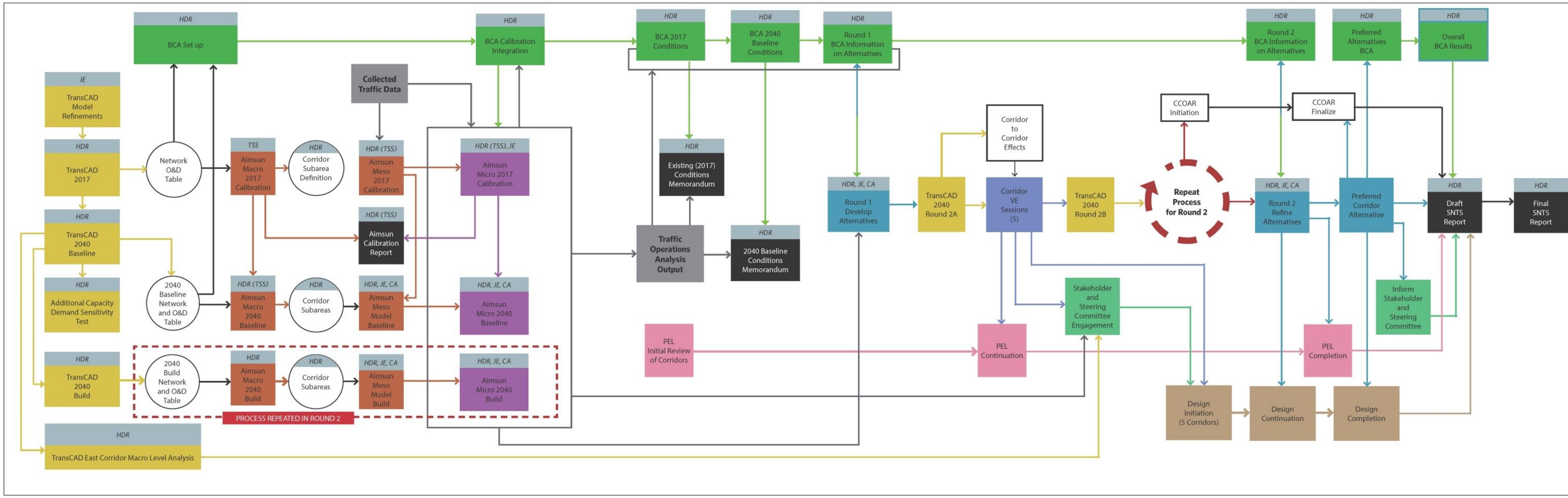
The *CORSIM Modeling Guidelines* will be used as baseline procedures to develop a calibration process, such as the selection of Calibration MOEs, locations to calibrate, a calibration target strategy, the number of model runs, and preferred calibration parameters to adjust. The Aimsun Next model will receive calibration at a mesoscopic level. Once calibrated at a mesoscopic level, select corridors will be modeled at a microscopic level. The two levels of modeling require different calibration targets and parameters. For example, volumes calibrated at a mesoscopic level may not be calibrated at a microscopic level; therefore, calibration at the Microscopic level must be additionally performed to achieve a more detailed level of calibration. Adjustments to the model for calibration at a microscopic level should not override the mesoscopic calibration (specifically, network-wide type parameters). Therefore, the microscopic simulation calibration parameters and model adjustments will be selected on a case-by case basis.

The following is a list of model scenarios that will be analyzed in Aimsun Next:

1. Macroscopic simulation model conversion—AM/PM
   - 2017 Existing
   - 2040 Baseline
   - 2040 Build
   - 2040 Build Alternatives
2. Mesoscopic simulation model—AM/PM
   - 2017 Existing
   - 2040 Baseline
   - 2040 Build
   - 2040 Build Alternatives
3. Sub Area Microscopic simulation models (8 sections)—AM/PM
   - 2017 Existing
   - 2040 Baseline
   - 2040 Build
   - 2040 Build Alternatives

NDOT will review each stage of the model development (at macroscopic and mesoscopic levels) prior to moving onto the next set of models. The review schedule is to be determined for each model stage.

Figure 4: General Project Approach Flow Chart



6. Traffic Data Sources

Traffic data collection is being completed for the study. A data collection plan is available for each corridor that contains information regarding the data types to be collected, as well as locations for data collection and data sources (Appendix B-1). Each data collection plan contains location-specific information for that corridor.

In general, data collection includes turning movement counts, mainline and ramp counts, speed data, travel time data, and queue length. This data will be summarized in GIS to assist in the calibration of the Aimsun Next model.

1. **Turning Movement Counts:** Turning counts will be collected for the AM and PM peak periods at locations identified by the project team, detailed in the data collection plan. Previous turning movement counts collected by cities, counties or NDOT will be used only if the data is newer than January 1, 2013.
2. **Mainline and Ramp Counts:** Mainline and ramp (or ramp connector) traffic volumes will be obtained from NDOT's Traffic Records Information Access (TRINA) website. Where additional data is required, 24-hour tube counts will be obtained.
3. **Speed and Travel Time Data:** Mainline speed and travel time data is being obtained from the Freeway and Arterial System of Transportation (FAST) online database, where available. Further speed and travel time data will be obtained from INRIX on a case-by-case basis, dependent on validation. Spot speed data will be obtained for off-peak periods at locations specified. Field measured travel time runs are to be collected for validation of FAST and INRIX data.
4. **Queue Length:** Queue lengths will be observed and documented by either field personnel or office staff reviewing video recordings.
5. **Traffic Signal Timings:** Traffic signal timing data is being obtained from the FAST online database, and verified in the field, as needed.

7. Benefit-Cost Analysis

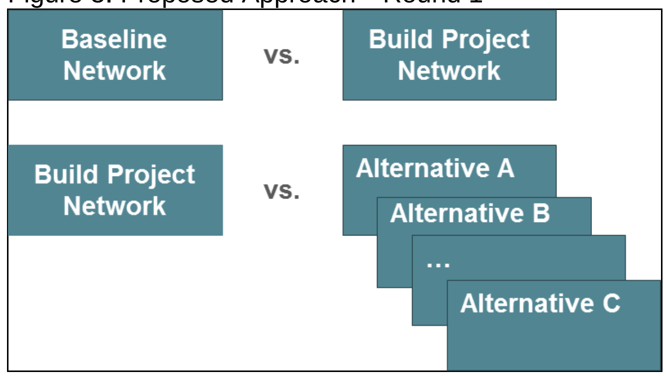
BCA is a conceptual framework that quantifies and monetizes costs and benefits to generate a single "bottom line" value of a project, program, or policy. The approach involves quantifying incremental economic benefits and costs to determine whether the net benefits outweigh the project costs.

BCA is useful because it helps identify the alternative, or mix of alternatives, that maximizes net benefits or "social welfare" per dollar invested. The bottom-line of the analysis can be expressed as a benefit-cost ratio (BCR), an internal rate of return (IRR), a net present value (NPV), or a payback period. Each of these metrics can help inform decision-making about investment priorities and timing.

The impact of identified "With Project" scenarios on travel times, vehicle operating costs, safety, and emissions/air quality are quantified and monetized relative to the "Without Project" scenario.

In this study, the estimation of the net benefits will rely primarily on outputs from Aimsun Next meso- and microscopic simulation models. The benefits will be estimated in two rounds. In the first round, the project team will evaluate the **build project network** against the **baseline network** to understand the benefits generated by the build projects. Then, the project team will evaluate each proposed **corridor alternative** against the **build project network** (see Figure 5). The BCAs for the corridor alternatives will represent the incremental benefits beyond those generated by the build projects. If the build projects generate very few benefits, the project team may suggest comparing the corridor alternatives directly to the baseline network.

Figure 5. Proposed Approach—Round 1

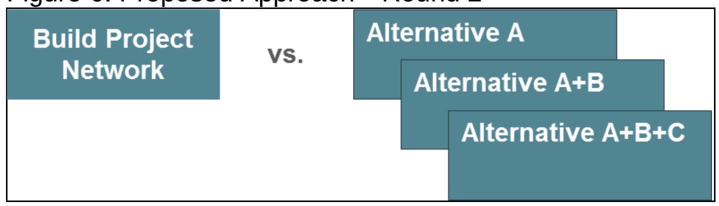


The results of Round 1 will allow the project team to eliminate poorly performing alternatives and refine the more promising alternatives in Round 2, when a more complete BCA will be conducted. The initial evaluation in Round 1 will be less detailed and have the following limitations (to be addressed in Round 2):

1. Impacts on other corridors will not be considered.
2. The BCA analysis will be based on microscopic simulation model data only—the impact of corridor improvements on trip tables will not be considered.
3. The estimated benefits will cover only a portion of the day (e.g., the peak hours modeled in the microscopic simulation tools).
4. Net benefits will be estimated using only two scenarios 2040 Baseline or Build, and 2040 Alternative scenarios.
5. Project opening benefits will be calculated from 2021 by assuming travel conditions grow linearly and the percent improvement in 2040 applies to earlier years.

Some of these limitations will be addressed in Round 2 of the analysis when a new network origin-destination (O&D) table is produced based on a new travel demand model that includes the impact of the alternatives selected in Round 1. This will allow the project team to use the travel demand model data to estimate the impacts on other corridors (which may increase or reduce the initially estimated benefits). In Round 2, the project team will also expand the benefit analysis to include benefits for the entire day (not just peak hours). These benefits will be estimated using hourly traffic data to apportion benefits in the non-modeled hours.

Figure 6. Proposed Approach—Round 2



In addition, the project team will estimate benefits using four scenarios by running the build alternatives not only on the 2040 Build network, but also for 2017 Current Conditions. This will allow the project team to estimate benefits directly for 2017 and 2040 (rather than assuming 2040 percent improvements apply in 2017) and interpolate benefits over the analysis period. The project team may also use the results of the meso- and microscopic simulation modeling and the BCA to look at the phasing of projects by comparing the incremental changes in the refined **corridor alternatives** to the **build project network** (see Figure 6).

For both Round 1 and Round 2, the project team will estimate benefits for alternative scenarios over a common 20-year period from 2021 to 2040. Benefits will be estimated using standard economic parameters defined in conjunction with NDOT for the benefit-cost methodology.

8. Travel Demand Modeling

TransCAD

The Regional Transportation Commission (RTC) of Southern Nevada provided the RTC regional travel demand model for the newly adopted 2040 RTP. These TransCAD files included model years 2015 and 2040. The highway network for the 2015 model was reviewed and adjusted to improve the model's accuracy when compared to 2015 mainline volumes. The updated 2015 highway network was then adjusted to better replicate current (2017) conditions, per 2016 aerials and accounting for recent and ongoing construction projects. Changes made focused on the freeway mainline, ramps and arterials near the freeway. The result was the development of a 2017 highway network for the TransCAD model.

The 2017 highway network will be run with both the 2015 and 2020 land use files provided by the RTC. The TransCAD O&D trip matrices from these two model runs will be averaged to approximate 2017 O&D trip matrices. The O&D trip matrices, along with the 2017 roadway network, will be exported to Aimsun Next for trip assignment at a macroscopic level and for meso- and microscopic simulation along the freeway system.

The entire TransCAD network will be imported into Aimsun Next. This will include the zones, links, and nodes. The Aimsun Next model will not be converted to a full four-step travel demand model. The Aimsun Next model will be used for performing meso- and microscopic simulation for the project. The transfer process is described in detail in Appendix B-2. The process methodology for forecasting future 2040 volumes is addressed in the Travel Forecasting Methodology and Assumptions Memo, submitted June 8, 2017.

To develop the mesosimulation models in Aimsun Next from the converted TransCAD model links inside the Aimsun Next study area will be updated with mesoscopic and/or microscopic simulation level of attributes. Links outside of the study area will not be removed. Aimsun Next will utilize sub-area evaluations to conduct simulations within the study corridors; therefore, links outside will not be active or modified at a meso- or microscopic simulation analysis level. These links can be used for future modeling, as needed. Signal timings and mesoscopic level parameters, such as lane widths, lane drops, turn lanes, and speeds will be entered in the Aimsun Next mesosimulation model. The mesosimulation model trip routes will be reassigned for the Aimsun Next analysis and assignment results will be error checked with the master TransCAD assignments. The mesosimulation model will be calibrated against turn movement count volumes and average speeds along segments from the INRIX data. After the overall mesoscopic model is coded and calibrated, subsections will be refined further at a microscopic simulation level.

9. Aimsun Next Existing O&D Estimation Process

The O&D volumes that will be used for the existing conditions modeling effort will be based on a matrix estimation process. This process will use existing counts and the O&D matrix transferred from TransCAD to Aimsun Next to approximate O&D volumes. Detail of this process is shown in Appendix B-2.

For the future conditions, the SNTS analysis will be based on 2040 conditions as the horizon year for both baseline (no action) and build alternatives Appendix B-3 of this document describes the methodology used to apply the growth patterns forecasted by the RTCSNV TransCAD model to the calibrated 2017 adjusted matrix to develop a refined or “adjusted” 2040 set of traffic forecast volumes..

In Aimsun Next, the project team will use an iterative process to test and refine future build alternatives (see Section 10). Network capacity alternatives identified in the first round through the meso- and microscopic simulation analysis will be incorporated into the TransCAD 2040 highway network and then modeled again to develop O&D trip matrices that reflect the roadway improvements and the potential impact to trip patterns. TransCAD updated trip matrices will be exported for use in the second round of microscopic simulation analysis.

As part of the quality control process, detailed checking of the link volumes generated from the Aimsun Next macroscopic model will be compared, to the TransCAD assignments. Additional global performance measures, such as vehicle miles traveled (VMT) and vehicle hours traveled (VHT) will be compared between the TransCAD and Aimsun Next macroscopic models for quality control. Additional calibration and checks will be made at the sub-area level, described in Section 11: Aimsun Next Calibration of Subarea Models on Page 16.

10. Aimsun Next Existing Sub Area Modeling

To evaluate specific corridors and build alternatives, various study level subareas will be modeled in Aimsun Next’s meso- and microscopic modules after the overall mesosimulation model is completed. This also allows verification of inputs and facilitates model calibration. The procedure involves the following steps:

1. **Run macroscopic assignments on the whole model** to collect path information for a subarea. This step calculates the set of paths of trips that use any portion of the subarea.
2. **Create a subarea** that encompasses the roads included in the individual study corridor.

3. **Run the static traversal procedure** to extract the demand of the subarea. This will result in O&D matrices for any trips that pass through the subarea.
4. **Run an assignment on the subarea** to calculate an initial set of paths. This step yields an initial reasonable set of paths to load traffic and allows for the detection of the most significant vehicle behavior issues before performing dynamic traffic assignment to create corrected paths that are reasonable down to the turning movement level.
5. **Run a one-shot meso- or microscopic simulation** on the subarea.

Transport Simulation Systems (TSS) provided a working document that describes the steps for subarea modeling for the SANDAG Dynamic Traffic Assignment (DTA) model (see Appendix B-4).

Subarea Models

A total of eight subarea models will be evaluated with Aimsun Next as listed in the Microscopic Simulation Analysis and Alternative Development section on Page 2 and shown in Figure 3 on Page 5.

11. Traffic Operations Analysis

Aimsun Next Existing Subarea Refinement and Meso- and Microscopic Simulation Model Development

Existing conditions modeling will be performed for the peak periods (as defined above for a minimum of two hours within each period) based on the various study areas' existing conditions geometry and traffic volumes. With the existing traffic data and baseline TransCAD model, Aimsun Next will be validated to existing counts. Appropriate truck data will be included for modeling purposes based on the existing conditions data; separate truck routes may or may not be necessary depending on the project.

Subareas corridors will be refined within the area-wide macroscopic level Aimsun Next model to produce corridor level Aimsun Next models. These subarea corridor models will include the freeways and ramps, plus ramp terminal intersections and adjacent street signalized intersections in areas where alternative analyses will be conducted. The known geometric improvements for future conditions will be coded as new geometric configurations in Aimsun Next. These geometric configurations will be turned on for all future conditions scenarios (baseline, build and alternatives).

Areas in this study that will have microscopic simulation modeling include one adjacent interchange from the analysis study area and one intersection outside of the study area ramp terminal intersections.

Aimsun Next Model Development

Geometrics

The base model will be transferred from TransCAD into Aimsun Next macroscopic model. This network will be refined from scaled aerial photography, open street map (OSM) data, and G.C. Wallace companies (GCW) design files (where available) and establish intersection lane configurations, stop bar locations, and turn pocket lengths.

Signal Timing

Existing signal timing will be put into Aimsun Next at all modeled signalized intersection in the modeled area. These timings will be provided by FAST and optimized for 2040 baseline and build scenarios

Vehicle Inputs

Vehicle classification reports from the NDOT TRINA website, along with other traffic counts collected throughout the study area, will be used to identify appropriate truck percentages in the study areas.

Vehicle Routing

Vehicle routing in Aimsun Next specifies vehicle distribution and is typically achieved by assigning routes between intersections and interchanges. Vehicle routing through the study area will be determined by evaluating permitted/prohibited movements and calculating the ratios of individual turn movements at each intersection.

Speed Distributions

Speed decisions will be used in the models to generate desired vehicle speeds at various roadway segments. In general, collected desired speed data will be used for freeway speeds, and speed limits will be used to define the speed decisions the arterials and side streets.

Aimsun Next Calibration of Subarea Models

The Aimsun Next meso- and microscopic simulation models will be validated using error checks and reasonableness checks, ensuring that traffic demand and throughput are representative of the existing year (2017) while also providing acceptable speeds, travel times and congestion levels (or queuing).

The error checking process will focus on fixing coding errors. This process involves reviewing data inputs, Aimsun Next error reports, and model animations. When making changes to model parameters, error checking reduces the potential that these changes do not have unintended consequences in the model. Data inputs, such as network geometry, traffic volumes, signal timing, and route choices, will be reviewed by the model developer as well as a quality control reviewer. Aimsun Next produces an error file with multiple error types. This can include vehicle removal, signal issues, end of link errors, and various others. Critical errors in the model will be corrected during this step.

Reasonableness checks for the microscopic level analysis will include review of the animation file for abnormal driving behavior or queuing within the network and to identify coding parameters that may have been overlooked. Additionally, modeled throughput will be compared to the demand volumes to eliminate large differences between demand and modeled volumes.

Aimsun Next will be calibrated from output metrics and visual inspections to the following field-collected information:

1. Volume validation from the Aimsun Next and TransCAD trip assignments and turn movement counts;
2. Speed calibration from INRIX data;
3. Travel time calibration;
4. Visual queue/congestion comparison;

5. Field observations of general driving behavior and headways.

Observations notes consisting of locations with high queue, congestion issues, or slow speeds will be summarized from field notes and/or videos and then geo-located in GIS for reference while coding the Aimsun Next model. These observations will be compared to the Aimsun Next simulation runs through visual inspection to confirm if the field conditions are represented.

The existing conditions Aimsun Next model will be calibrated to match existing volume data. This specific threshold to be met has yet to be determined and will be defined in the NDOT Aimsun Next calibration guidelines document that is under development. The models will also be calibrated to match collected queue and corridor travel time data. The calibration thresholds are to be determined based on data review and updated calibration guidelines.

The adjustment parameters used to calibrate the model will be categorized across all modeled areas, unless necessary to calibrate a specific situation. Parameter adjustments needed to achieve calibration will be validated by TSS. A parameter protocol memorandum will be developed for documentation purposes. If no roadway network exists in an area of new development, no calibration will be necessary and basic driver behavior parameters will be used.

Calibration modeling will include replicating multiple freeway behavior types to imitate the general capacity and representative behaviors of the various types of roadway sections (from high capacity basic freeway to low capacity weaves). The appropriate parameter adjustments will be built and used to gain consistency across various freeway segments within the Aimsun Next model. Because of the stochastic nature of simulation modeling, each subarea model will need to be evaluated to determine the amount of appropriate runs needed, run that amount of times, and averaged for results. Individual runs will be checked for outlying results. Network performance results will be tabulated and graphed, travel time results will be shown in tables and speed results will be shown graphically or in tables and charts.

Aimsun Next 2040 Baseline O&D Estimation

Modifications made from the 2017 O&D matrix from TransCAD will be replicated for the 2040 baseline network. Detail of this process is shown in Appendix B-2.

Aimsun Next 2040 Baseline Subarea Corridor Model Development

The baseline conditions include known future improvements modeled with 2040 estimated traffic volumes. Error checking and model development will again be applied to this step. For a discussion of these processes, see Section 8: TransCAD on Page 13 and Section 11: Aimsun Next Calibration of Subarea Models on Page 16.

12. Development of Alternatives

The traffic analysis of existing conditions and 2040 baseline results is expected to show areas of deficiency. The SNTS team will develop mitigation measures to alleviate congestion. The SNTS team will identify operational challenges of the system mitigate those identified operational challenges, and determine the downstream impacts of those improvements. Only selected corridors will have alternative analyses performed.

Aimsun Next Mesoscopic Simulation Analysis of Non-Alternative Corridors

In summary, the all corridors shown in Figure 2 and listed below will not have alternative analyses performed using Aimsun Next at a mesoscopic simulation level:

1. US 95 from CC 215 to the Spaghetti Bowl
2. CC 215 from US 95 to Russell Road
3. I-215 from I-15/I-215 System Interchange to Windmill Lane (this location does includes one alternative at a microscopic level)
4. I-15 from south of Spaghetti Bowl Entrance Ramps to Russell Road

Aimsun Next Microscopic Simulation Analysis for the 2040 Build Model

The 2040 baseline (no action) calibrated model will be used as the base network for the build models. The geometry will be updated in Aimsun Next and updated O&D tables will be provided from the updated TransCAD and Aimsun Next macroscopic models. The project team will code geometric improvements into Aimsun Next, check errors (see Section 8: TransCAD on Page 13 and Section 11: Aimsun Next Calibration of Subarea Models on Page 16), and run the microscopic simulation models for results. In summary, the following areas, shown in Figure 3, will be analyzed in microscopic simulation in Aimsun Next:

1. I-15 from Russell Road to Sloan
2. I-15/I-215 System Interchange
3. I-515 from the Spaghetti Bowl to Eastern
4. I-515 from Eastern to I-215/I-515 System Interchange
5. I-215/I-515 System Interchange
6. CC 215 from Russell Road to I-15/I-215 System Interchange
7. I-215 from I-15/I-215 System Interchange to Windmill Lane
8. Summerlin Parkway from CC 215 to US 95

Speed, travel time and congestion tables, graphs and figures will be created to compare the results for the baseline, build and alternative models as specified in the scope of work.

This document is intended to guide NDOT through the relatively new process of conducting a systemic freeway analysis rather than a corridor analysis. It is intended to gain concurrence on the methodologies and assumptions to be used as part of the SNTS.

Appendix B-1
Data Collection Plans

Data Collection Plan
CC-215: Russell Rd to I-15

for

Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

December 14, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
  - Speed Limits
  - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data and calibration data will be collected simultaneously. Demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections, and adjacent intersections on arterial cross-streets. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Peak period queue lengths at all CC-215 ramp terminal intersections in the study area.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figures 1a through 1c.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
NONE	NONE		

DATA COLLECTION EFFORT	
Intersection Description	**ID**
W Russell Rd / S Jerry Tarkanian Way / SB CC-215 Ramps	1.1
W Russell Rd / Brent Thurman Way / NB CC-215 Ramps	1.2
W Russell Rd / Fort Apache Rd	1.3
W Russell Rd / Durango Dr	1.4
W Sunset Rd / S Roy Horn Way / SB CC-215 Ramps	1.5
W Sunset Rd / Brent Thurman Way / NB CC-215 Ramps	1.6
W Sunset Rd / Fort Apache Rd	1.7
W Sunset Rd / Durango Dr	1.8
S Durango Dr / Rafael Rivera Way / WB CC-215 Ramps	1.9
S Durango Dr / Roy Horn Way / EB CC-215 Ramps	1.10
S Durango Dr / Badura Ave	1.11
S Buffalo Dr / Rafael Rivera Way / WB CC-215 Ramps	1.12
S Buffalo Dr / Roy Horn Way / EB CC-215 Ramps	1.13
S Buffalo Dr / Sunset Rd	1.14
S Buffalo Dr / Badura Ave	1.15
S Rainbow Blvd / Rafael Rivera Way / WB CC-215 Ramps	1.16
S Rainbow Blvd / Roy Horn Way / EB CC-215 Ramps	1.17
S Rainbow Blvd / Sunset Rd	1.18
S Rainbow Blvd / Badura Ave	1.19
S Jones Blvd / Rafael Rivera Way / WB CC-215 Ramps	1.20
S Jones Blvd / Roy Horn Way / EB CC-215 Ramps	1.21
S Jones Blvd / Sunset Rd	1.22
S Jones Blvd / Badura Ave	1.23
S Decatur Blvd / Rafael Rivera Way / WB CC-215 Ramps	1.24
S Decatur Blvd / Roy Horn Way / EB CC-215 Ramps	1.25
S Decatur Blvd / Sunset Rd	1.26
S Decatur Blvd / Badura Ave	1.27

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
CC-215 WB Off-Ramp to S Decatur Blvd	31444	2015
CC-215 WB On-Ramp from S Decatur Blvd	30140	2015
CC-215 EB Off-Ramp to S Decatur Blvd	30132	2015
CC-215 EB On-Ramp from S Decatur Blvd	31445	2015

DATA COLLECTION EFFORT	
Ramp Description	**ID**
CC-215 SB Off-Ramp to W Russell Rd	2.1
CC-215 SB On-Ramp from W Russell Rd	2.2
CC-215 NB Off-Ramp to W Russell Rd	2.3
CC-215 NB On-Ramp from W Russell Rd	2.4

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
CC-215 Count Station Description	**Station ID**
btwn the Decatur Intch 'Exit 13' and the I-15 Intch 'Exit 12'	30152

DATA COLLECTION EFFORT	
Mainline Location Description	**ID**
CC-215 at W Patrick Ln	3.1
CC-215 at S Cimarron Rd	3.2
CC-215 at S Tenaya Way	3.3
CC-215 at S Torrey Pines Dr	3.4

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)
- Mainline, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).
- Mainline radar count summaries (one per site).
- Turning movement count summaries (one per intersection for each time period).
- Intersection configuration sheet per intersection (lane with numbers that match manual queue length observation sheets).
- Manual queue length study including raw data sheets and a data summary prepared in Excel.

CALIBRATION DATA

Field inspection

To be conducted in concurrence with the traffic counts data collection effort. Field inspections will include the following:

- Queue observation
- Weave zone observation (location and length). On an as-needed basis for calibration.
- Lane usage at intersections (Mainline lane utilization will be identified from FAST data.)
- Spillback

Queue Length

- Manual observation by field personnel, or video collection.
- Duration of AM and PM peak periods as noted above.
- Maximum queue length behind stop line, measured as number of vehicles and collected by lane, collected in 2-minute intervals
- Inclusion of stopped vehicles and slow moving vehicles (<5mph) in queue lengths at the end of the queue.

Table 4. Ramp Queue Length Collection Requirements

DATA COLLECTION EFFORT	
Ramp Description	**ID**
CC-215 EB Off-Ramp to S Buffalo Dr	4.1
CC-215 EB Off-Ramp to S Rainbow Blvd	4.2
CC-215 EB Off-Ramp to Decatur Blvd	4.3
CC-215 WB Off-Ramp to Decatur Blvd	4.4

Speed Data

Mainline speed data is to be obtained from the FAST online database, where available. Further speed data may be obtained from INRIX on a case-by-case basis, dependent on validation. Spot speed data to be obtained for off-peak periods at the locations shown in Figures 1a through 1c.

Travel Time Data

Travel time data is to be obtained from the FAST online database, where available. Further travel time data may be obtained from INRIX on a case-by-case basis, dependent on validation. Field measured travel time runs to be collected for validation of FAST and INRIX data.

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors. Traffic count and calibration data will be reviewed for consistency and reasonableness.

Figure 1a. Data Collection Site Map West to East

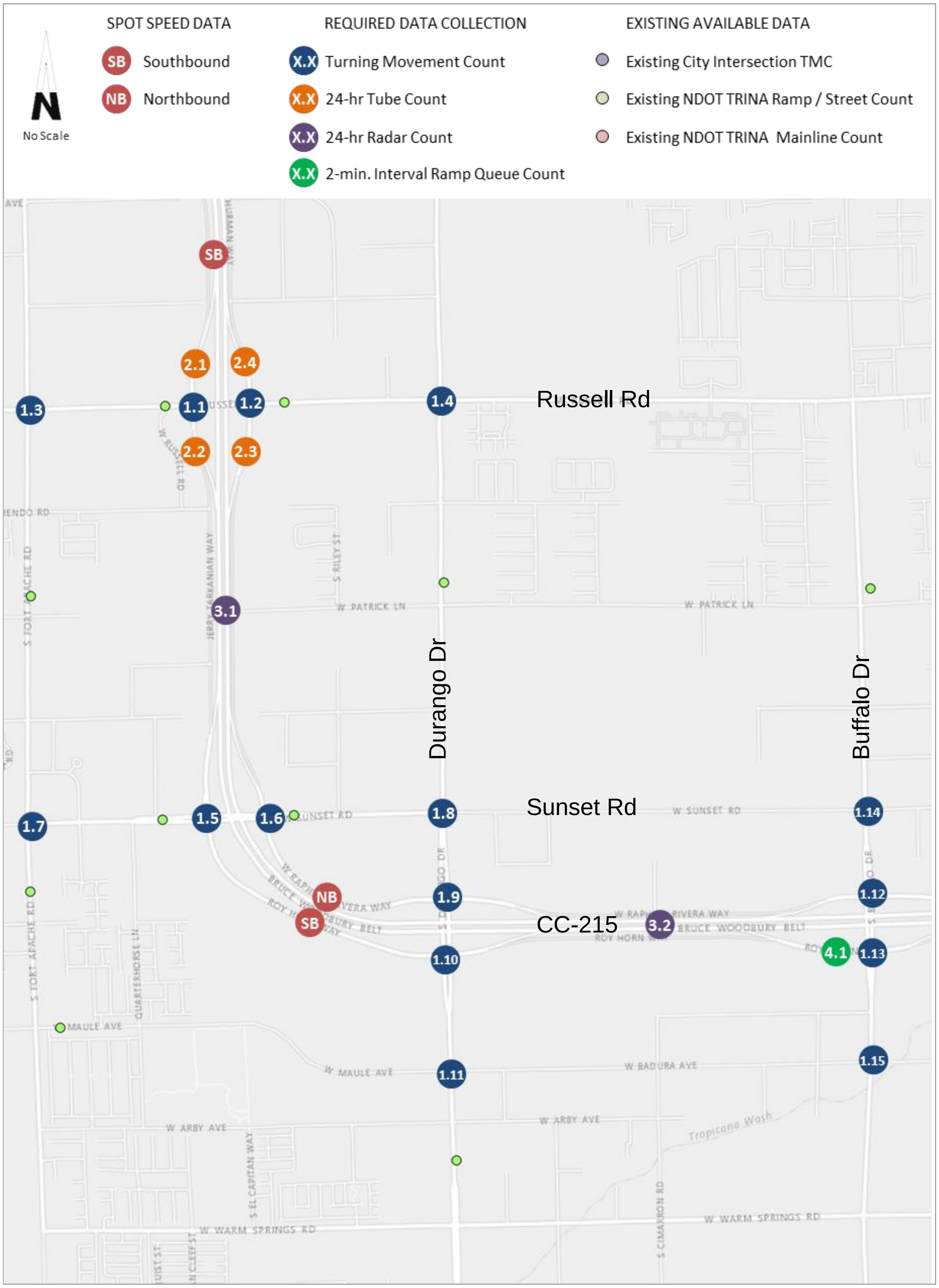


Figure 1b. Data Collection Site Map West to East

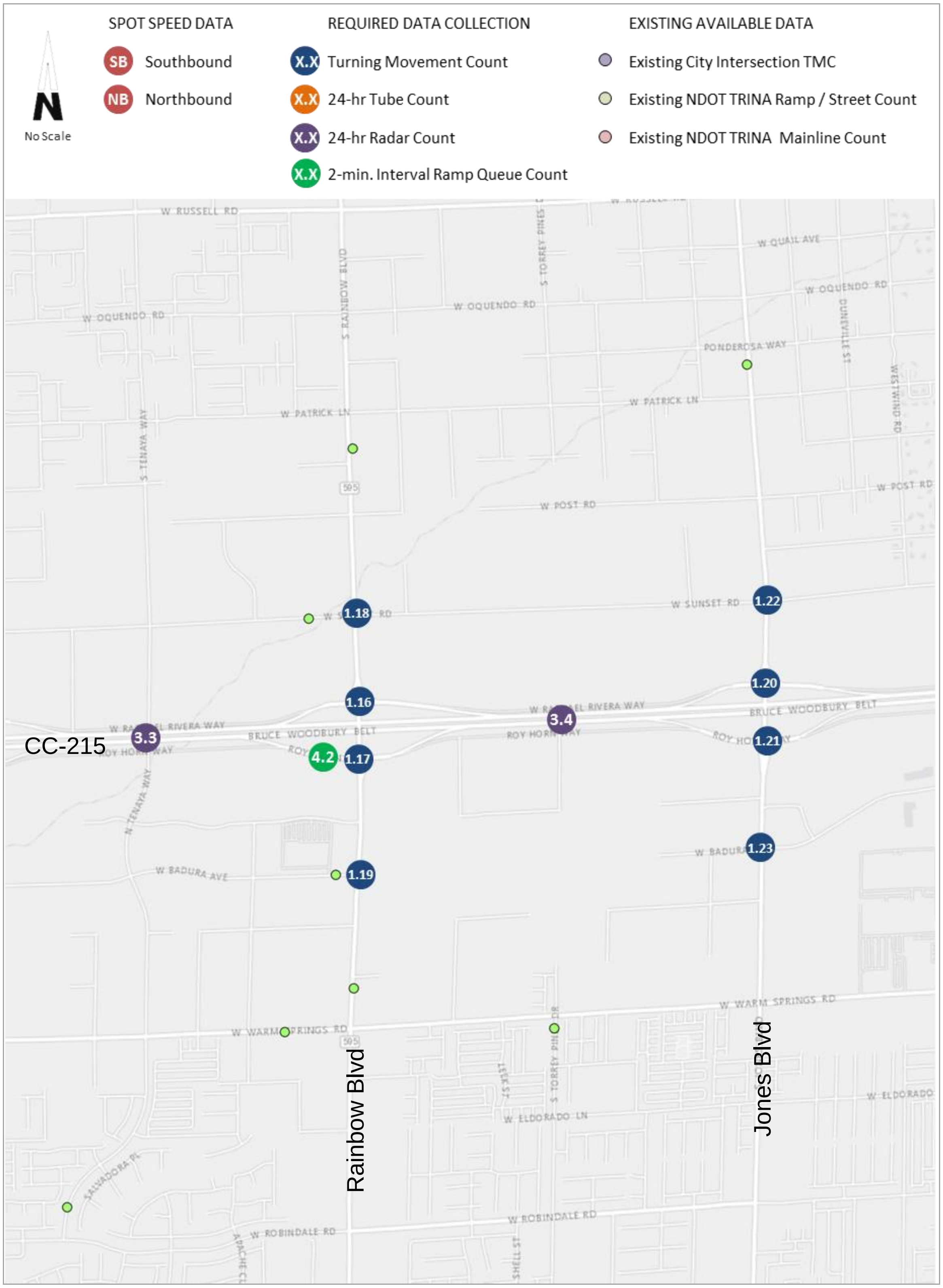
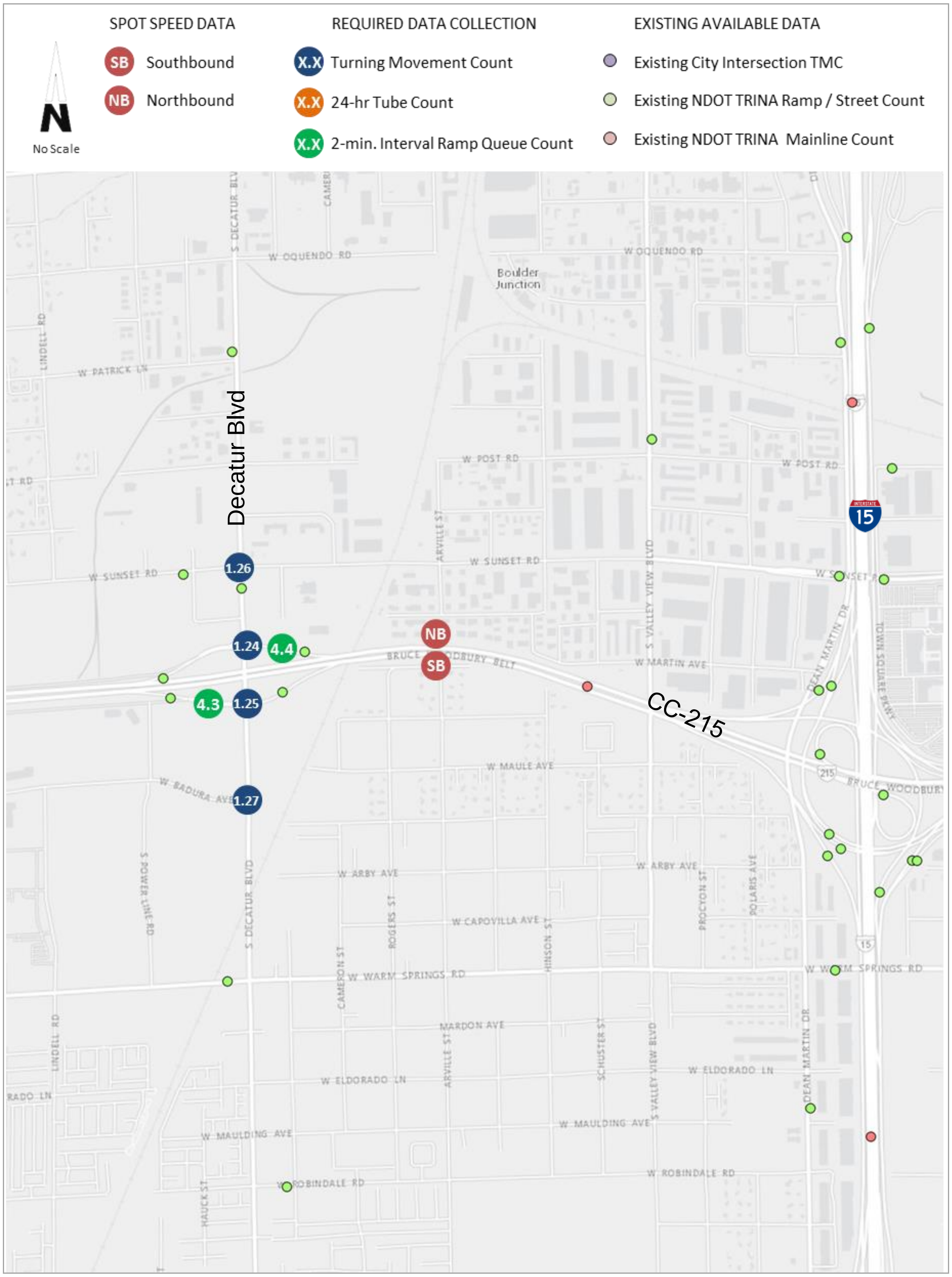


Figure 1c. Data Collection Site Map West to East



Data Collection Plan CC-215: Summerlin Pkwy to Russell Rd

for

Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

December 14, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
  - Speed Limits
  - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figures 1a through 1c.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
Far Hills Ave	CC-215 NB Ramps	27-Oct-15	City of Las Vegas
Far Hills Ave*	Carriage Hill Dr	18-Feb-16	City of Las Vegas
Charleston Blvd	CC-215 NB Ramps	16-Mar-16	City of Las Vegas
Charleston Blvd	CC-215 SB Ramps	17-Mar-16	City of Las Vegas

* Not required for HCS analysis, for information only

DATA COLLECTION EFFORT	
Intersection Description	**ID**
Summerlin Pkwy / CC-215 NB Ramps	1.1
Summerlin Pkwy / CC-215 SB Ramps	1.2
Far Hills Ave / CC-215 SPUI	1.3
Sahara Ave / CC-215 NB Ramps	1.4
Sahara Ave / CC-215 SB Ramps	1.5
Town Center Dr / CC-215 SPUI	1.6
Flamingo Rd / CC-215 NB Ramps	1.7
Flamingo Rd / CC-215 SB Ramps	1.8
Tropicana Ave / CC-215 NB Ramps	1.9
Tropicana Ave / CC-215 SB Ramps	1.10

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
NONE		

DATA COLLECTION EFFORT	
Ramp Description	**ID**
CC-215 SB Off-Ramp to Charleston Blvd	2.1
CC-215 SB On-Ramp from Charleston Blvd	2.2
CC-215 NB Off-Ramp to Charleston Blvd	2.3
CC-215 NB On-Ramp from Charleston Blvd	2.4

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
CC-215 Count Station Description	**Station ID**
NONE	

DATA COLLECTION EFFORT	
Mainline Location Description	**ID**
CC-215 at Alta Dr	3.1
CC-215 at W Hacienda Ave	3.2

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments

- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)
- Mainline, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).
- Mainline radar count summaries (one per site).
- Turning movement count summaries (one per intersection for each time period).

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors.

Figure 1a. Data Collection Site Map North to South

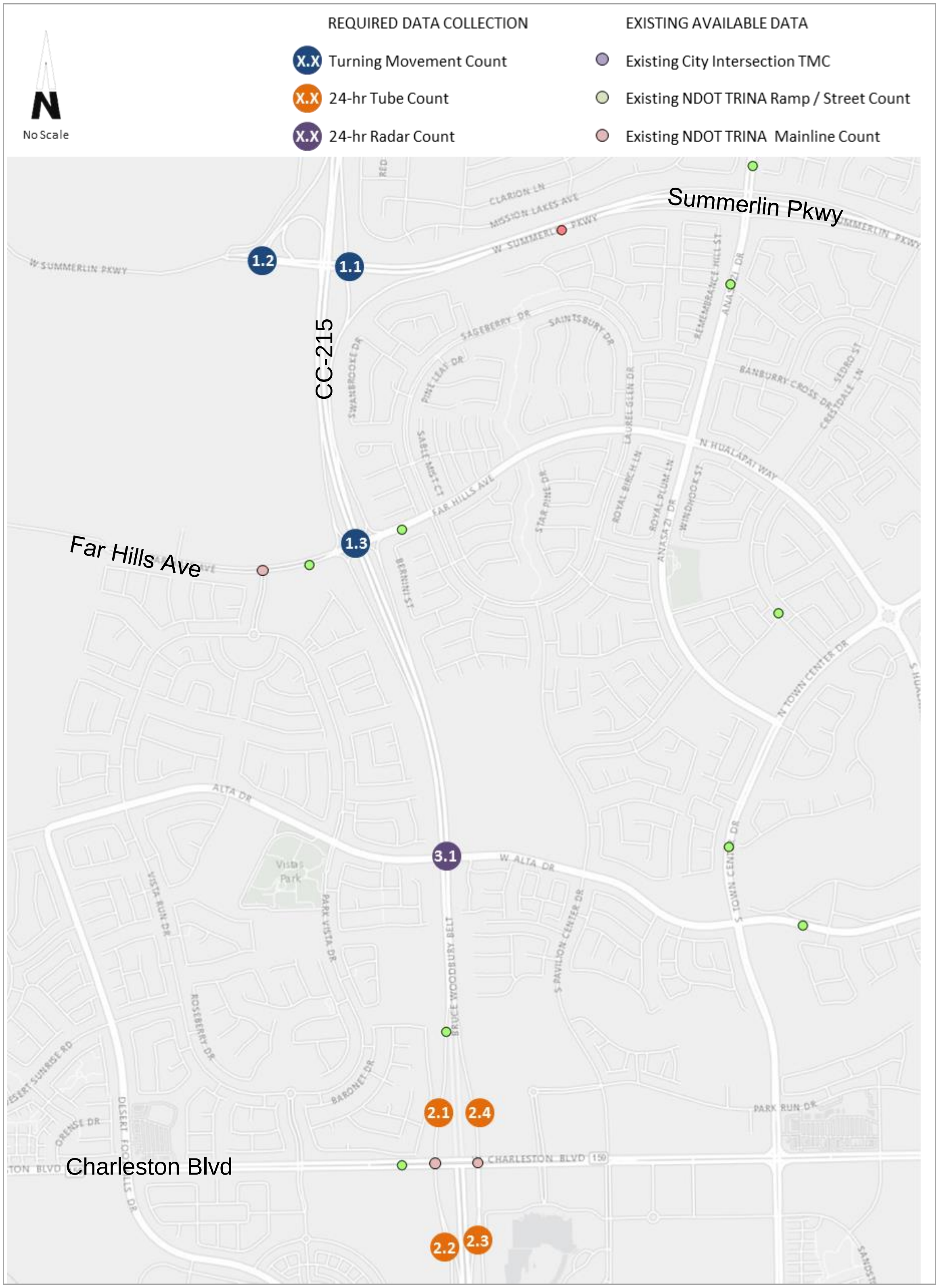


Figure 1b. Data Collection Site Map North to South

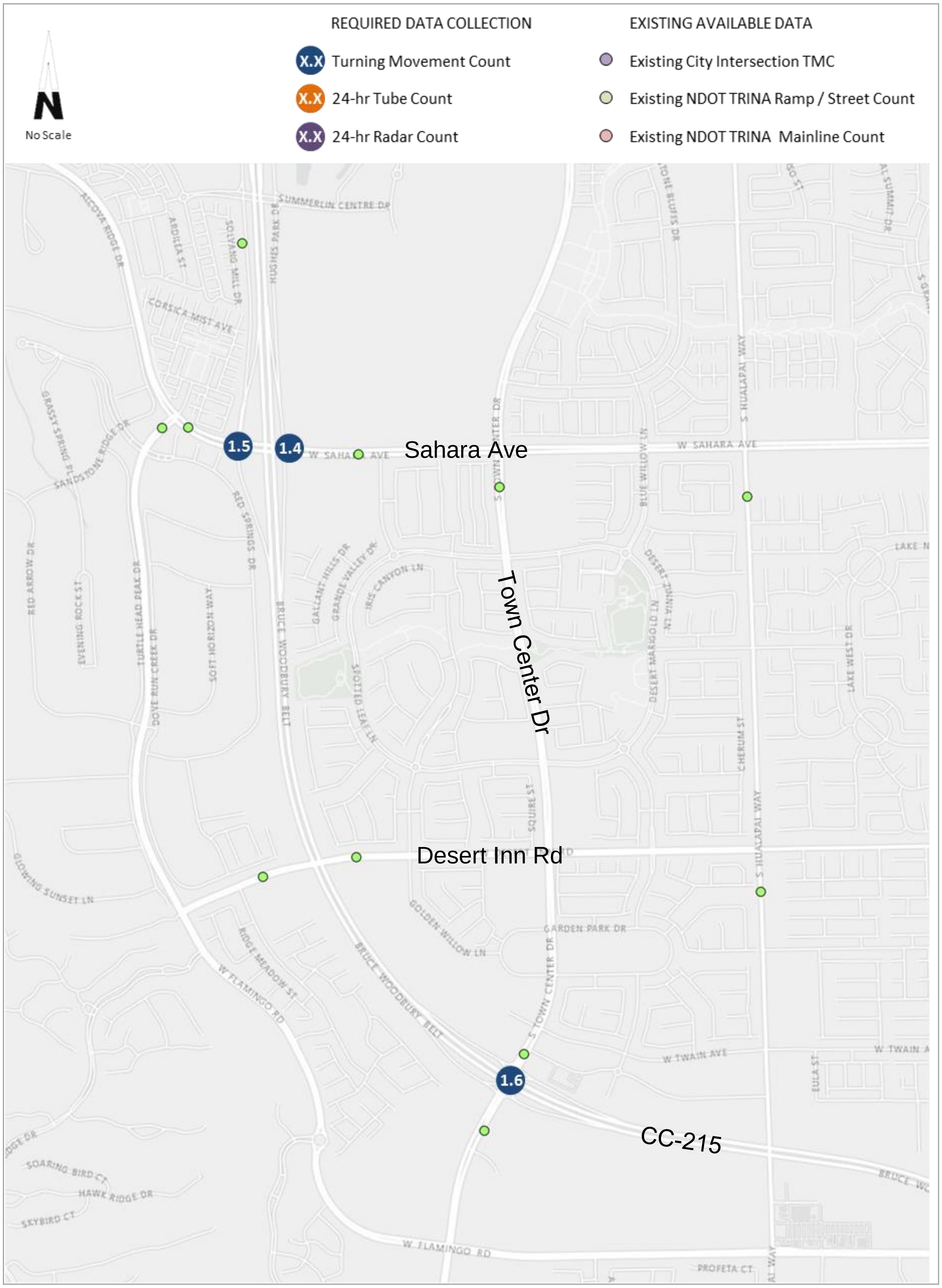
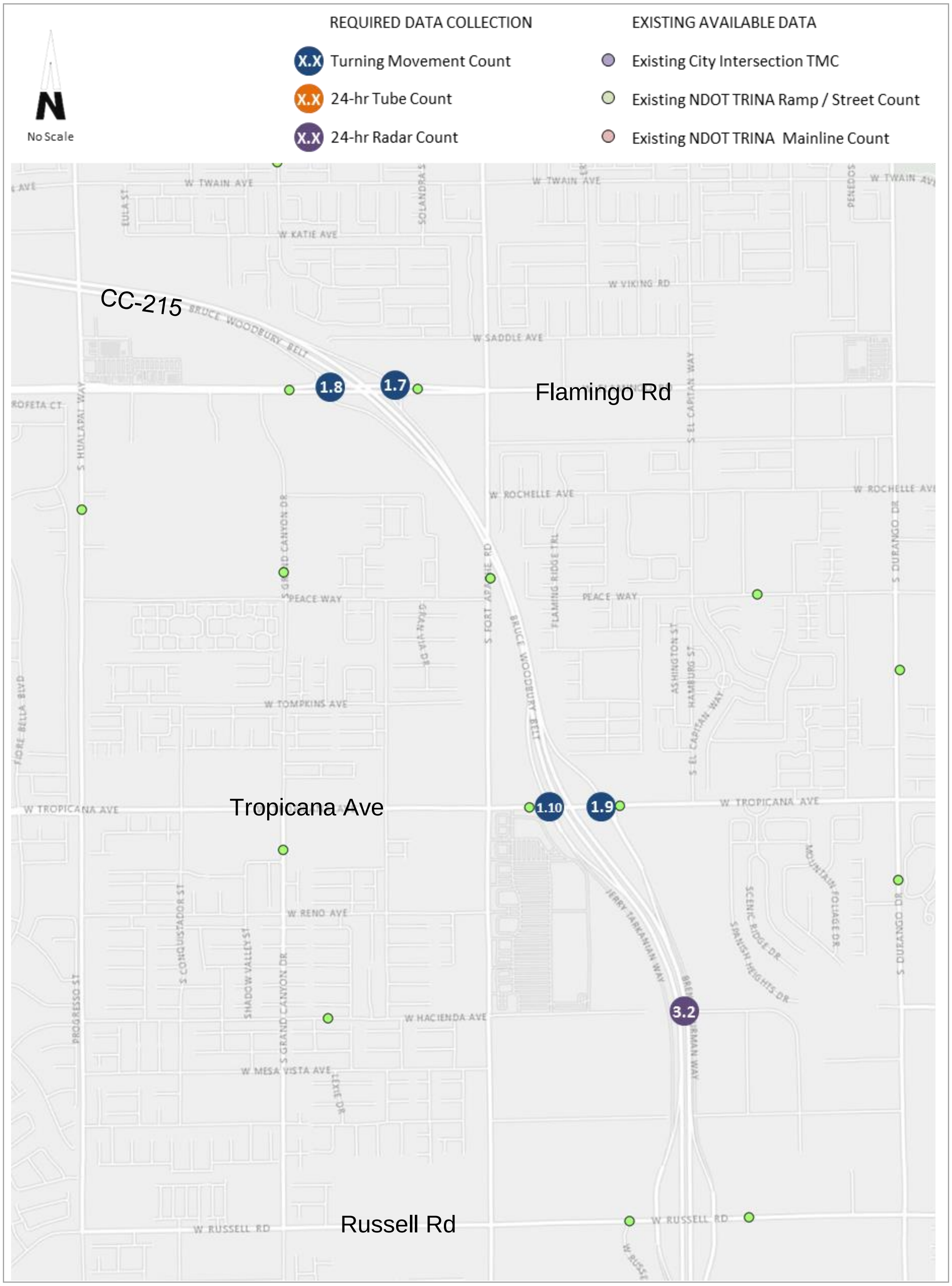


Figure 1c. Data Collection Site Map North to South



Data Collection Plan CC-215: US95 to Summerlin Pkwy

for

Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

December 14, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
  - Speed Limits
  - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections. Limited data has been made available from the City of Las Vegas. When additional data is required, intersection turn movement counts are to be obtained.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figures 1a through 1c.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
Durango Dr*	Deer Springs Way	18-Apr-13	City of Las Vegas
Durango Dr*	Centennial Pkwy	25-May-16	City of Las Vegas
Durango Dr	215 Beltway WB Ramps	31-May-16	City of Las Vegas
Durango Dr	215 Beltway EB Ramps	31-May-16	City of Las Vegas
Hualapai Way*	Deer Springs Way	13-Oct-15	City of Las Vegas
Hualapai Way	215 Beltway WB Ramps	29-Sep-15	City of Las Vegas
Hualapai Way	215 Beltway EB Ramps	29-Sep-15	City of Las Vegas
Cliff Shadows Pkwy*	Novat St	9-Feb-16	City of Las Vegas
Cheyenne Ave*	Shady Timber St	17-Feb-16	City of Las Vegas
Cheyenne Ave	CC-215 NB Ramps	19-Jun-15	City of Las Vegas
Lake Mead Blvd*	Thomas W Ryan Blvd	5-Feb-14	City of Las Vegas
Lake Mead Blvd	CC-215 SPUI	9-Dec-14	City of Las Vegas

* Not required for HCS analysis, for information only

DATA COLLECTION EFFORT	
Intersection Description	**ID**
Oso Blanca / 215 Beltway	1.1
Ann Rd / 215 Beltway	1.2
Lone Mountain Rd / 215 Beltway	1.3
Cheyenne Ave / CC-215 SB Ramps	1.4
Cheyenne Ave / CC-215 NB Ramps	1.5
Lake Mead Blvd / CC-215 SPUI	1.6

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
US95 NB Off-Ramp to WB CC-215	31400	2013

DATA COLLECTION EFFORT	
Ramp Description	**ID**
CC-215 EB On-Ramp from Durango Dr	2.1
CC-215 EB Off-Ramp to Durango Dr	2.2
CC-215 WB On-Ramp from Durango Dr	2.3
CC-215 WB Off-Ramp to Durango Dr	2.4
CC-215 EB On-Ramp from Hualapai Way	2.5
CC-215 EB Off-Ramp to Hualapai Way	2.6
CC-215 WB On-Ramp from Hualapai Way	2.7
CC-215 WB Off-Ramp to Hualapai Way	2.8

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
CC-215 Count Station Description	**Station ID**
NONE	

DATA COLLECTION EFFORT	
Mainline Location Description	**ID**
CC-215, 1000ft east of Sky Pointe Dr	3.1
CC-215 at W Tropical Pkwy	3.2
CC-215 at W Alexander Rd	3.3
CC-215 at Summers End Ave	3.4

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon or US95/CC-215 interchange construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.

- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMCs, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMCs, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)
- Mainline, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).
- Mainline radar count summaries (one per site).
- Turning movement count summaries (one per intersection for each time period).

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors.

Figure 1a. Data Collection Site Map North to South

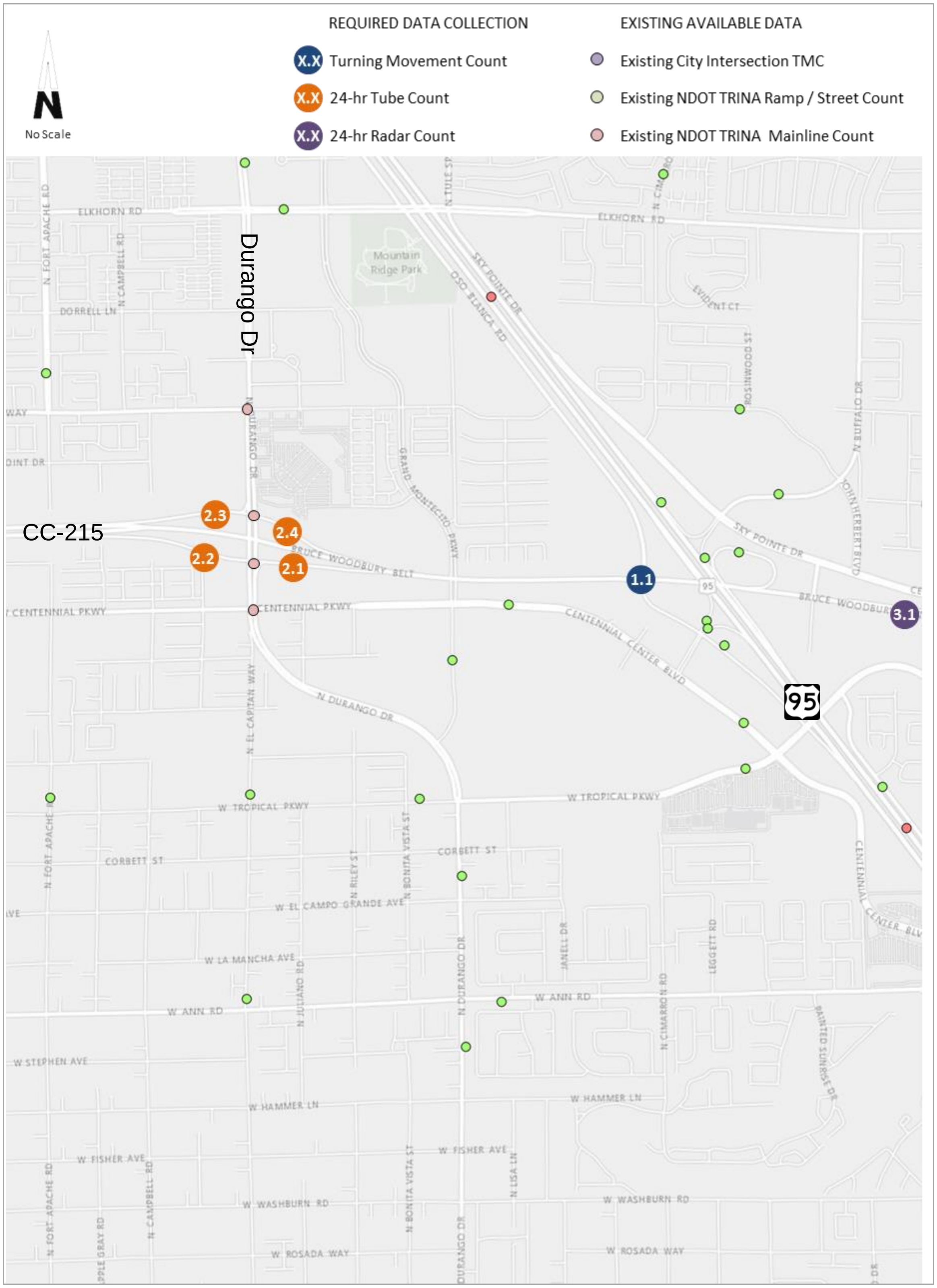


Figure 1b. Data Collection Site Map North to South

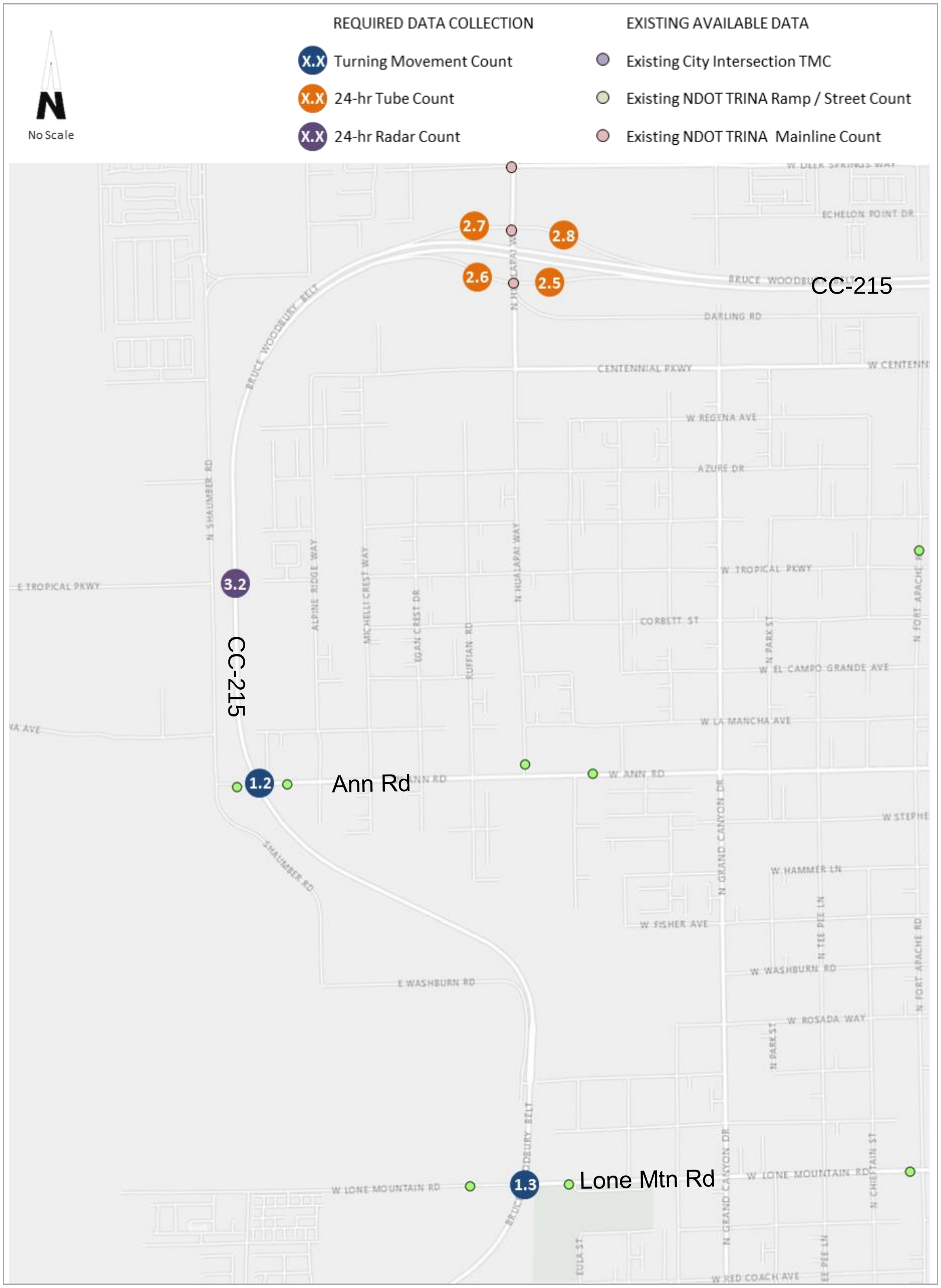
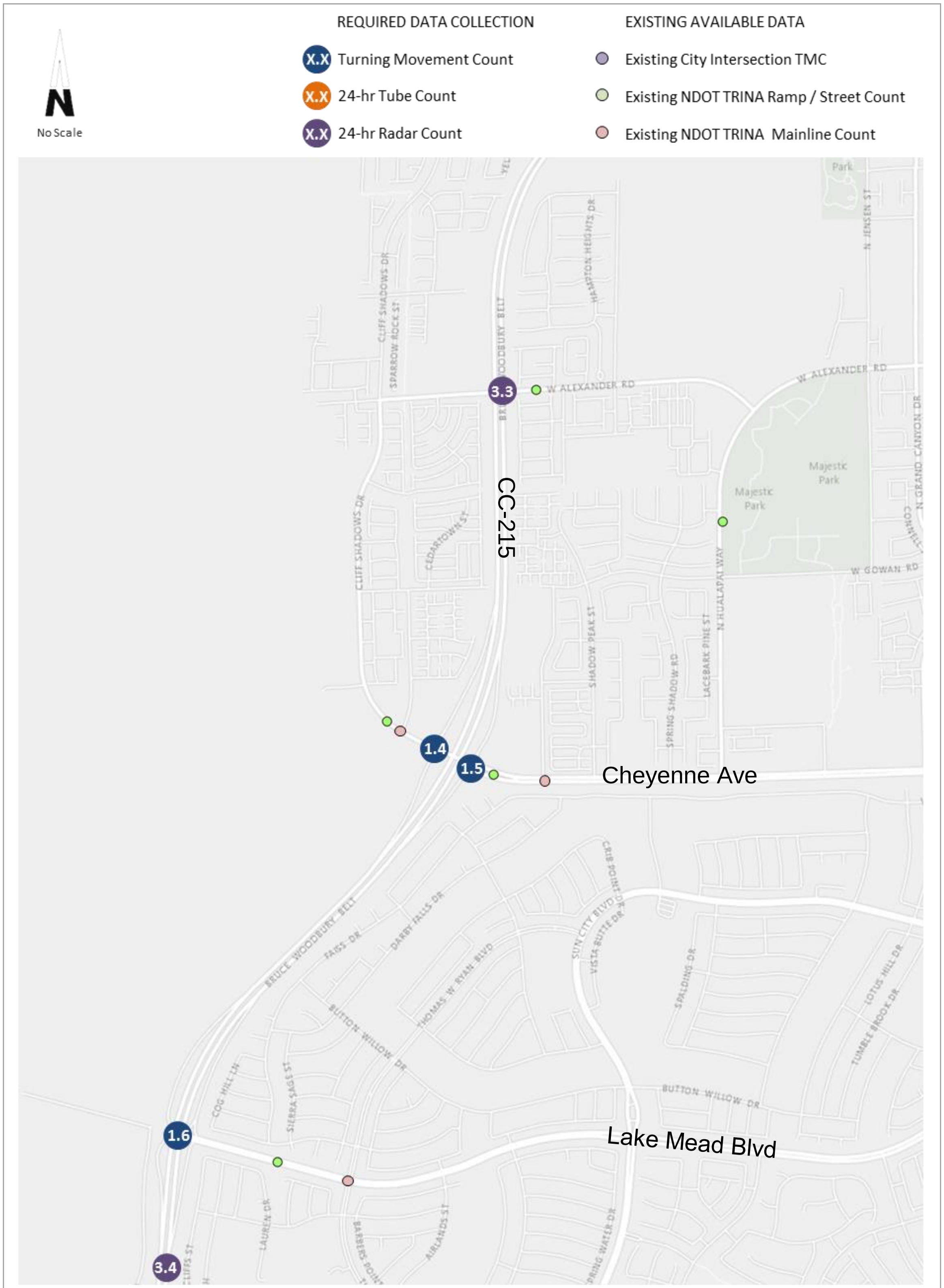


Figure 1c. Data Collection Site Map North to South



Data Collection Plan
I-15: Sahara to I-215

for

Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

November 28, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
    - Speed Limits
    - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data and calibration data will be collected simultaneously. Demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections, and adjacent intersections on arterial cross-streets. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Peak period queue lengths at all I-15 ramp terminal intersections in the study area.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figures 1a through 1c.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
Sahara Ave	Las Vegas Blvd	28-May-14	City of Las Vegas

DATA COLLECTION EFFORT	
Intersection Description	**ID**
Sahara Ave / I-15 NB Ramps	1.1
Sahara Ave / Rancho Dr	1.2
Sahara Ave / Palace Station	1.3
Sahara Ave / Teddy Dr	1.4
Spring Mountain Rd / I-15 SB Ramps	1.5
Spring Mountain Rd / Polaris Ave	1.6
Spring Mountain Rd / Mel Torme Way	1.7
Spring Mountain Rd / Las Vegas Blvd	1.8
Flamingo Rd / I-15 SB Ramps	1.9
Flamingo Rd / I-15 NB Ramps	1.10
Flamingo Rd / Hotel Rio Dr	1.11
Flamingo Rd / Las Vegas Blvd	1.12
Tropicana Ave / I-15 SB Ramps	1.13
Tropicana Ave / I-15 NB Ramps	1.14
Tropicana Ave / Dean Martin Dr	1.15
Tropicana Ave / Las Vegas Blvd	1.16
Russell Rd / I-15 SB Ramps	1.17
Russell Rd / I-15 NB Ramps	1.18
Russell Rd / Polaris Ave	1.19
Russell Rd / Frank Sinatra Dr	1.20

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
I-15 SB Off-Ramp to Sahara Ave WB	30079	2016
I-15 SB Off-Ramp to Sahara Ave EB (Highland Dr)	31439	2016
I-15 SB Off-Ramp to Sahara Ave EB (Flyover)	31136	2016
I-15 SB On-Ramp from Sahara Ave	30081	2016
I-15 NB Off-Ramp to Sahara Ave	30075	2016
I-15 NB On-Ramp from Sahara Ave	30077	2016
I-15 SB Off-Ramp to Spring Mtn Rd WB	30072	2016
I-15 SB Off-Ramp to Spring Mtn Rd EB (Flyover)	30952	2016
I-15 SB On-Ramp from Spring Mtn Rd	30174	2016
I-15 NB Off-Ramp at Spring Mtn Rd	30229	2016
I-15 NB On-Ramp from Spring Mtn Rd EB	30984	2016
I-15 NB On-Ramp from Spring Mtn Rd WB	30070	2016
I-15 SB Off-Ramp to Flamingo Rd WB	30065	2016
I-15 SB Off-Ramp to Flamingo Rd EB	30792	2016
I-15 SB On-Ramp from Flamingo Rd	30066	2016
I-15 NB Off-Ramp to Flamingo Rd	30062	2016
I-15 NB On-Ramp from Flamingo Rd	30064	2016
I-15 SB Off-Ramp to Tropicana Ave	30057	2016
I-15 SB Off-Ramp to Tropicana Ave EB (Flyover)	30923	2014
I-15 SB On-Ramp from Tropicana Ave	30060	2016
I-15 NB Off-Ramp to Tropicana Ave	30053	2016
I-15 NB On-Ramp from Tropicana Ave	30055	2016
I-15 SB Off-Ramp to Russell Rd	31015	2016
I-15 SB On-Ramp from Russell Rd	31016	2016
I-15 NB Off-Ramp to Russell Rd	31017	2016
I-15 NB On-Ramp from Russell Rd	31018	2016

DATA COLLECTION EFFORT	
Ramp Description	**ID**
I-15 NB Off-Ramp to Spring Mtn Rd EB	2.1
I-15 NB Off-Ramp to Spring Mtn Rd WB	2.2
I-15 NB On-Ramp from Russell Rd connector	2.3
I-15 NB Off-Ramp to Tropicana Ave connector	2.4
I-15 NB Off-Ramp to Russell Rd @ I-215	2.5
I-15 NB Off-Ramp to Charleston Blvd	2.6
I-15 SB On-Ramp from Charleston Blvd	2.7

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
I-15 Count Station Description	**Station ID**
IR-15 1.5 mi S of Sloan Intch	35360
IR-15 1.0 mi S of SR 160 (Blue Diamond Rd Intch)	35340
0.9 mi S of the St Rose Intch 'Exit 27'	30842
0.5 mi N of the Spring Mountain Intch 'Exit 39'	30074
1.3 mi S of the IR-215 Intch 'Exit 34'	30453
btwn the St Rose Intch 'Exit 27' and the Blue Diamond Intch 'Exit 33'	30728
S of the Tropicana Intch 'Exit 37'	30052
0.3 mi S of the Spring Mountain Intch 'Exit 39'	30067
0.4 mi S of the Flamingo Intch 'Exit 38'	30061
0.2 mi S of mp 36 S of the Russell Intch 'Exit 36'	31021
IR-15 0.2 mi N of SR-589 (Sahara Ave Intch)	31210
0.1 mi N of the Cactus Intch 'Exit 30'	31535

DATA COLLECTION EFFORT
None

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).

- Turning movement count summaries (one per intersection for each time period).
- Intersection configuration sheet per intersection (lane with numbers that match manual queue length observation sheets).
- Manual queue length study including raw data sheets and a data summary prepared in Excel.

CALIBRATION DATA

Field inspection

To be conducted in concurrence with the traffic counts data collection effort. Field inspections will include the following:

- Queue observation
- Weave zone observation (location and length). On an as-needed basis for calibration.
- Lane usage at intersections (Mainline lane utilization will be identified from FAST data.)
- Spillback

Queue Length

- Manual observation by field personnel, or video collection.
- Duration of AM and PM peak periods as noted above.
- Maximum queue length behind stop line, measured as number of vehicles and collected by lane, collected in 2-minute intervals
- Inclusion of stopped vehicles and slow moving vehicles (<5mph) in queue lengths at the end of the queue.

Table 4. Ramp Queue Length Collection Requirements

DATA COLLECTION EFFORT	
Ramp Description	**ID**
I-15 NB Off-Ramp to Sahara Ave	3.1
I-15 SB Off-Ramp to Spring Mtn Rd WB	3.2
I-15 NB Off-Ramp to Flamingo Rd	3.3
I-15 NB Off-Ramp to Tropicana Ave	3.4
I-15 NB Off-Ramp to Russell Rd	3.5

Speed Data

Mainline speed data is to be obtained from the FAST online database, where available. Further speed data may be obtained from INRIX on a case-by-case basis, dependent on validation. Spot speed data to be obtained for off-peak periods at the locations shown in Figures 1a through 1c.

Travel Time Data

Travel time data is to be obtained from the FAST online database, where available. Further travel time data may be obtained from INRIX on a case-by-case basis, dependent on validation. Field measured travel time runs to be collected for validation of FAST and INRIX data.

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors. Traffic count and calibration data will be reviewed for consistency and reasonableness.

Figure 1a. Data Collection Site Map North to South

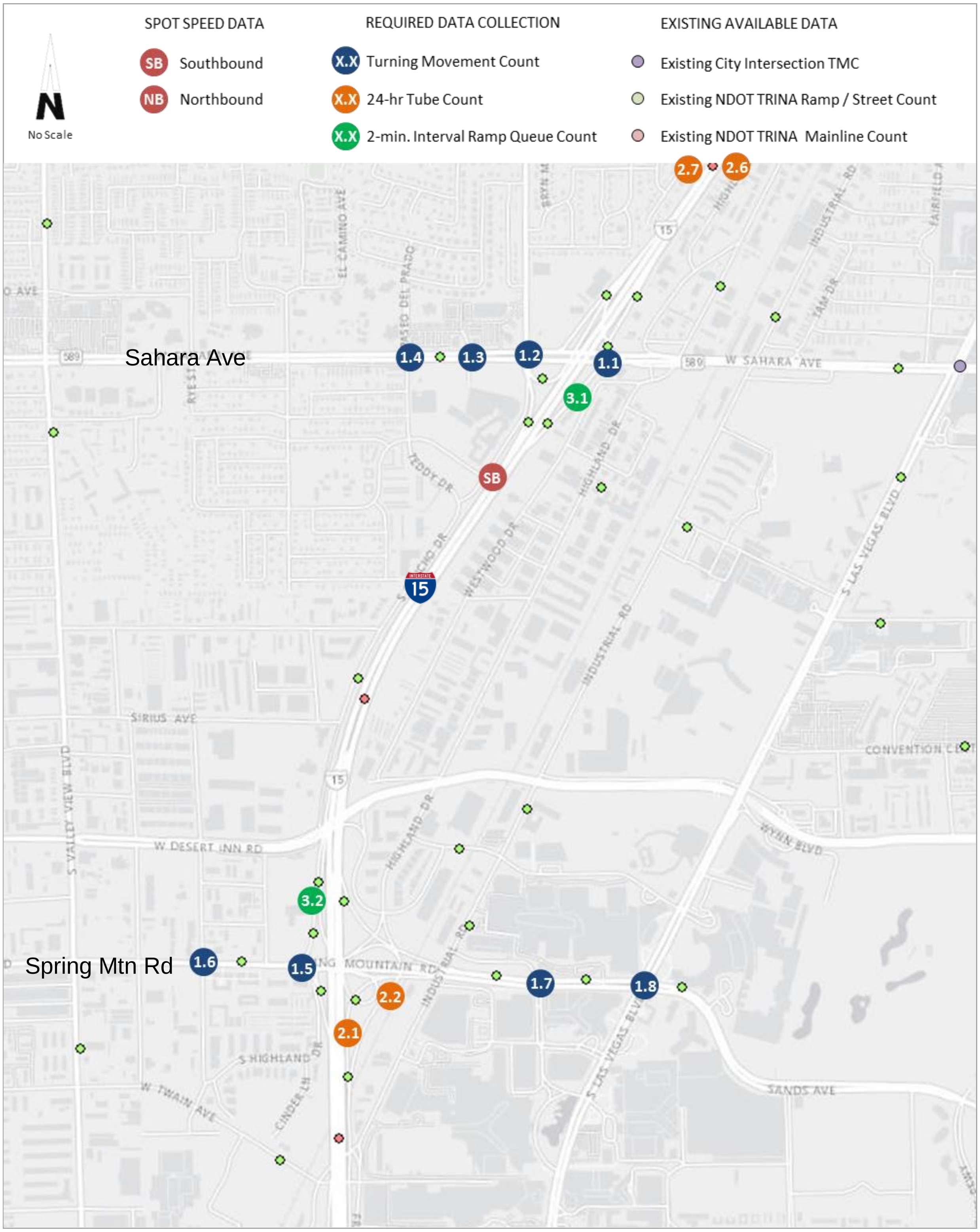


Figure 1b. Data Collection Site Map North to South

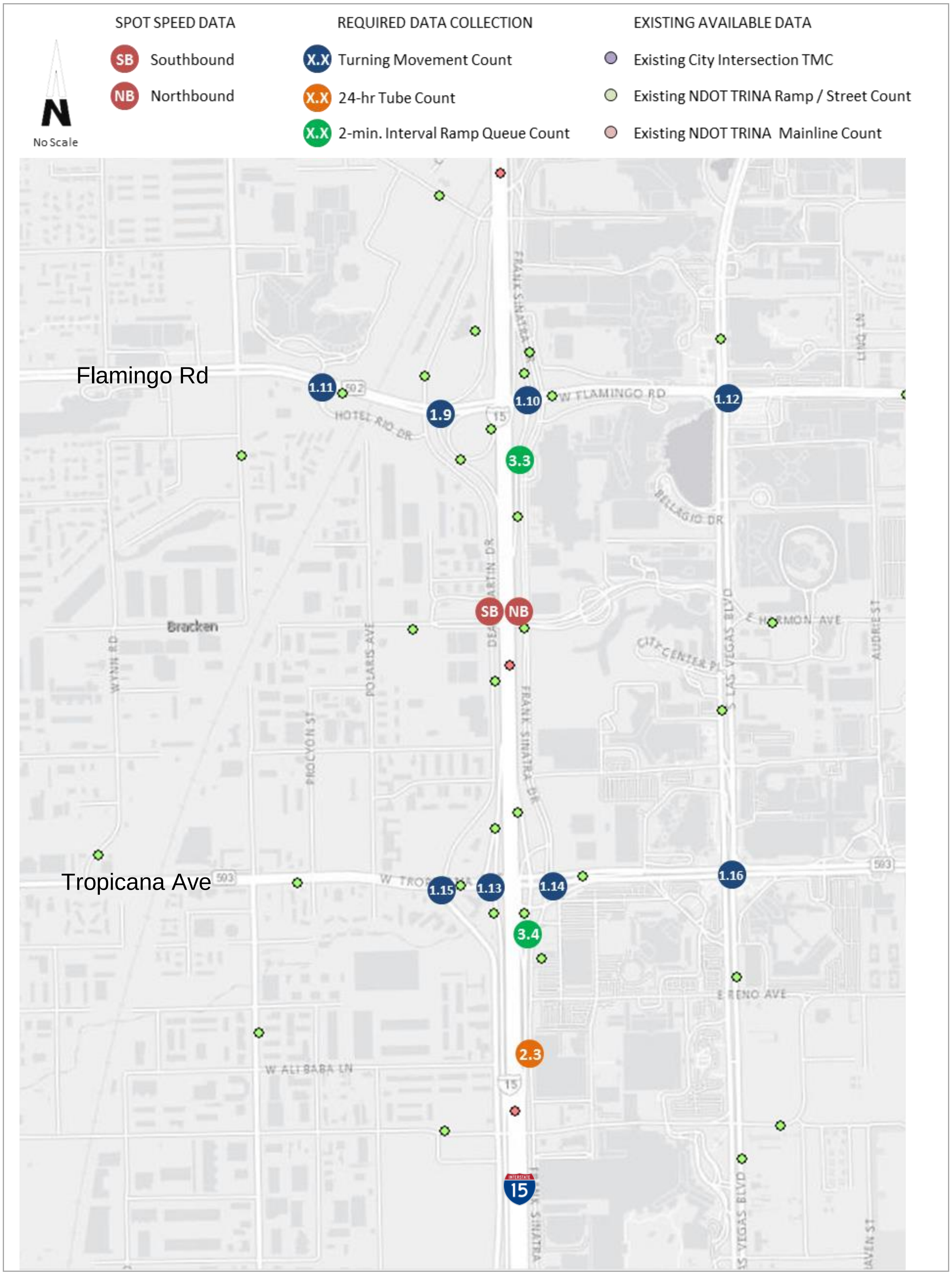
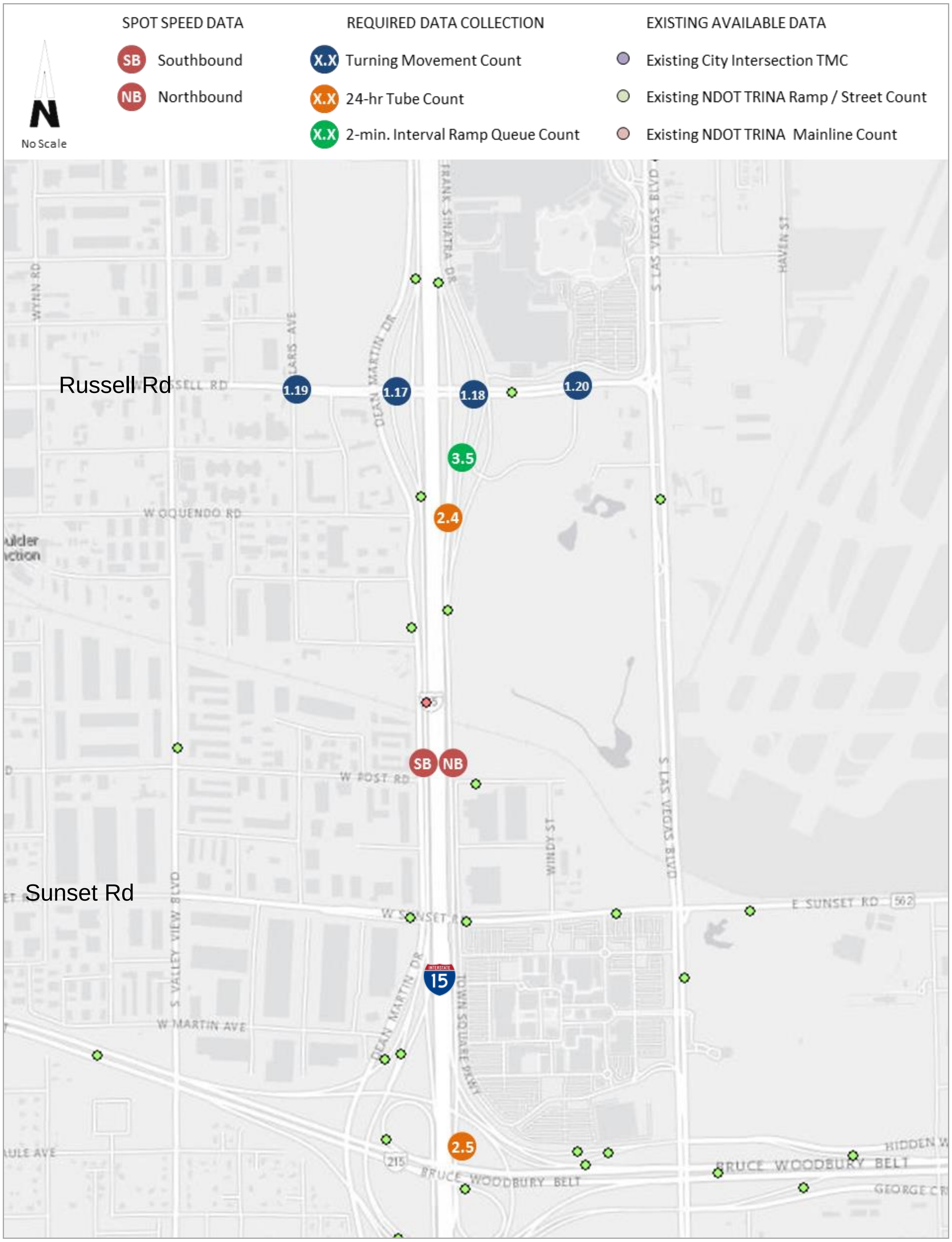


Figure 1c. Data Collection Site Map North to South



Data Collection Plan
I-15: I-215 to Sloan Rd
for
Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

November 28, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
  - Speed Limits
  - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data and calibration data will be collected simultaneously. Demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections, and adjacent intersections on arterial cross-streets. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Peak period queue lengths at all I-15 ramp terminal intersections in the study area.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figures 1a through 1d.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
None Available	None Available		

DATA COLLECTION EFFORT	
Intersection Description	**ID**
Blue Diamond Rd / SB I-15 Ramps	1.1
Blue Diamond Rd / NB I-15 Ramps	1.2
Blue Diamond Rd / Dean Martin Dr	1.3
Blue Diamond Rd / Las Vegas Blvd	1.4
Silverado Ranch Blvd / SB I-15 Ramps	1.5
Silverado Ranch Blvd / NB I-15 Ramps	1.6
Silverado Ranch Blvd / Dean Martin Dr	1.7
Silverado Ranch Blvd / South Point Dr	1.8
W Cactus Ave / SB I-15 Ramps	1.9
W Cactus Ave / NB I-15 Ramps	1.10
W Cactus Ave / Dean Martin Dr	1.11
W Cactus Ave / Las Vegas Blvd	1.12
St Rose Pkwy SPUI / NB and SB I-15 Ramps	1.13
St Rose Pkwy / Southern Highlands Pkwy	1.14
St Rose Pkwy / Las Vegas Blvd	1.15
Sloan Rd / SB I-15 Ramps	1.16
Sloan Rd / NB I-15 Ramps	1.17

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
I-15 SB Off-Ramp to Blue Diamond EB	30043	2016
I-15 SB Off-Ramp to Blue Diamond WB	31618	2016
I-15 SB On-Ramp from Blue Diamond	30045	2016
I-15 NB Off-Ramp at Blue Diamond	30037	2016
I-15 NB On-Ramp from Blue Diamond EB (Flyover)	31540	2016
I-15 (and I-215) NB On-Ramp from Blue Diamond	30040	2016
I-15 SB Off-Ramp to Silverado Ranch Blvd	31465	2016
I-15 SB On-Ramp from Silverado Ranch Blvd	31462	2016
I-15 NB Off-Ramp to Silverado Ranch Blvd	31463	2016
I-15 NB On-Ramp from Silverado Ranch Blvd	31464	2016
I-15 SB Off-Ramp to Cactus Ave	31532	2016
I-15 SB On-Ramp from Cactus Ave	31531	2016
I-15 NB Off-Ramp to Cactus Ave	31534	2016
I-15 NB On-Ramp from Cactus Ave	31533	2016
I-15 SB Off-Ramp to St Rose Pkwy	30035	2016
I-15 SB On-Ramp from St Rose Pkwy	30036	2016
I-15 NB Off-Ramp to St Rose Pkwy	30028	2016
I-15 NB On-Ramp from St Rose Pkwy	30032	2016
I-15 SB Off-Ramp to Sloan Rd	30025	2015
I-15 SB On-Ramp from Sloan Rd	30026	2015
I-15 NB Off-Ramp at Sloan Rd (to Las Vegas Blvd)	30020	2015
I-15 NB On-Ramp at Sloan Rd (from Las Vegas Blvd)	30027	2015

DATA COLLECTION EFFORT	
Ramp Description	**ID**
I-15 SB On-Ramp from I-215 at Blue Diamond	2.1
I-15 NB Off-Ramp to Blue Diamond	2.2
I-15 NB On-Ramp from Blue Diamond	2.3

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
I-15 Count Station Description	**Station ID**
IR-15 1.5 mi S of Sloan Intch	35360
IR-15 1.0 mi S of SR 160 (Blue Diamond Rd Intch)	35340
.9 mi S of the St Rose Intch 'Exit 27'	30842
1.3 mi S of the IR-215 Intch 'Exit 34'	30453
btwn the St Rose Intch 'Exit 27' and the Blue Diamond Intch 'Exit 33'	30728
.1 mi N of the Cactus Intch 'Exit 30'	31535

DATA COLLECTION EFFORT
None

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).
- Turning movement count summaries (one per intersection for each time period).
- Intersection configuration sheet per intersection (lane with numbers that match manual queue length observation sheets).
- Manual queue length study including raw data sheets and a data summary prepared in Excel.

CALIBRATION DATA

Field inspection

To be conducted in concurrence with the traffic counts data collection effort. Field inspections will include the following:

- Queue observation
- Weave zone observation (location and length). On an as-needed basis for calibration.
- Lane usage at intersections (Mainline lane utilization will be identified from FAST data.)
- Spillback

Queue Length

- Manual observation by field personnel, or video collection.
- Duration of AM and PM peak periods as noted above.
- Maximum queue length behind stop line, measured as number of vehicles and collected by lane, collected in 2-minute intervals
- Inclusion of stopped vehicles and slow moving vehicles (<5mph) in queue lengths at the end of the queue.

Table 4. Ramp Queue Length Collection Requirements

DATA COLLECTION EFFORT	
Ramp Description	**ID**
I-15 SB Off-Ramp to Blue Diamond Rd	3.1
I-15 NB Off-Ramp to Blue Diamond Rd	3.2
I-15 SB Off-Ramp to Silverado Ranch Blvd	3.3
I-15 NB Off-Ramp to Silverado Ranch Blvd	3.4

Speed Data

Mainline speed data is to be obtained from the FAST online database, where available. Further speed data may be obtained from INRIX on a case-by-case basis, dependent on validation. Spot speed data to be obtained for off-peak periods at the locations shown in Figures 1a through 1d.

Travel Time Data

Travel time data is to be obtained from the FAST online database, where available. Further travel time data may be obtained from INRIX on a case-by-case basis, dependent on validation. Field measured travel time runs to be collected for validation of FAST and INRIX data.

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors. Traffic count and calibration data will be reviewed for consistency and reasonableness.

Figure 1a. Data Collection Site Map North to South

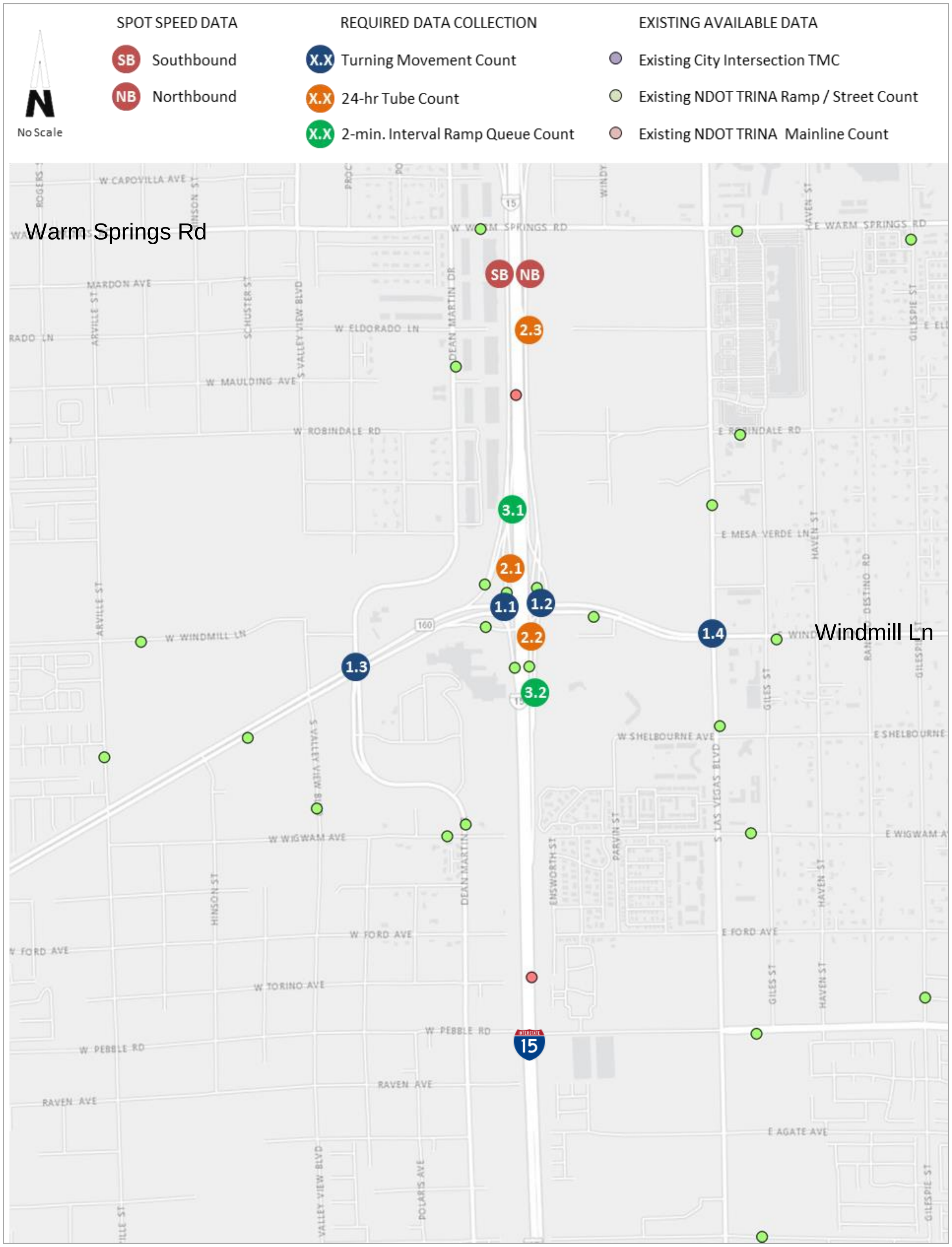


Figure 1b. Data Collection Site Map North to South

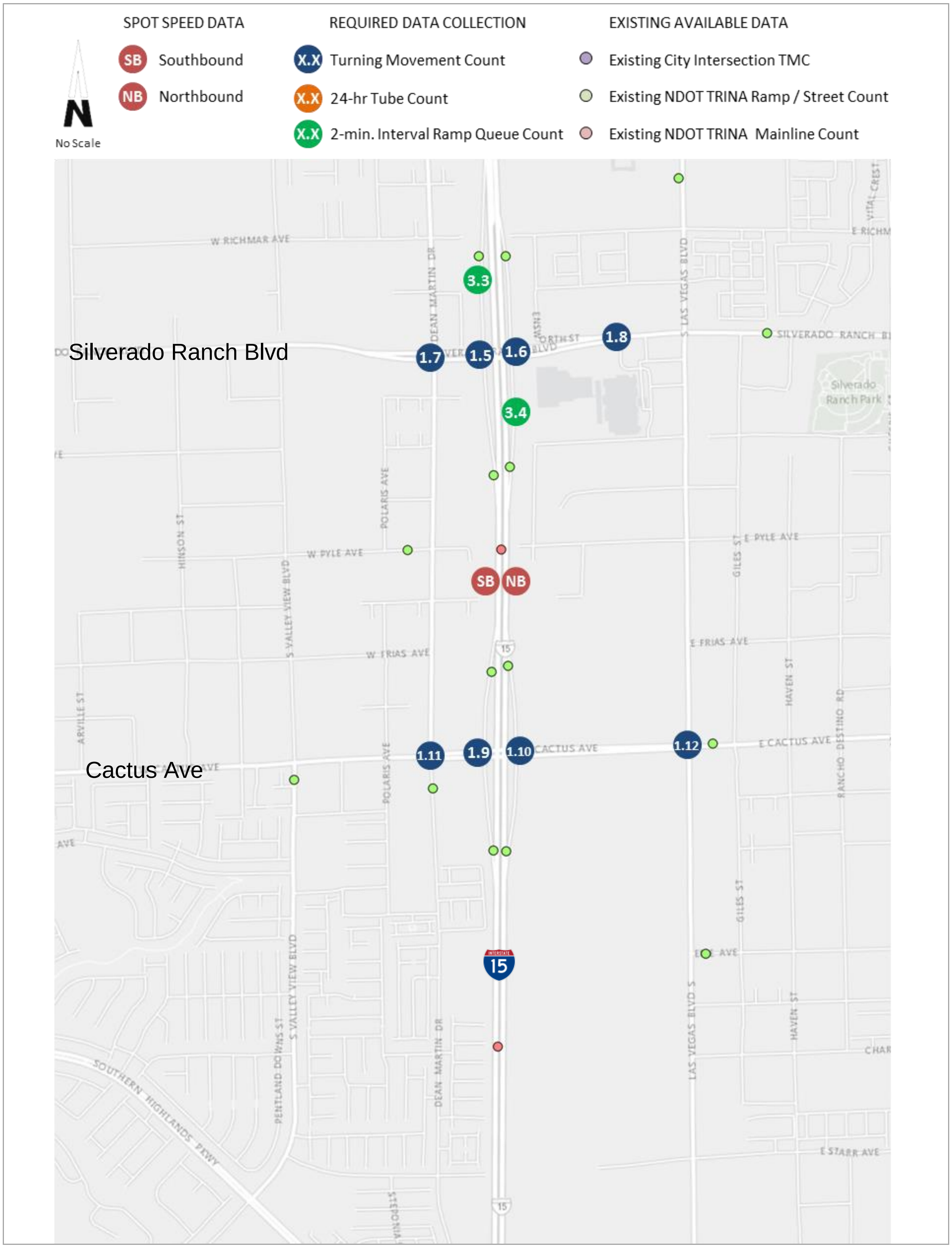


Figure 1c. Data Collection Site Map North to South

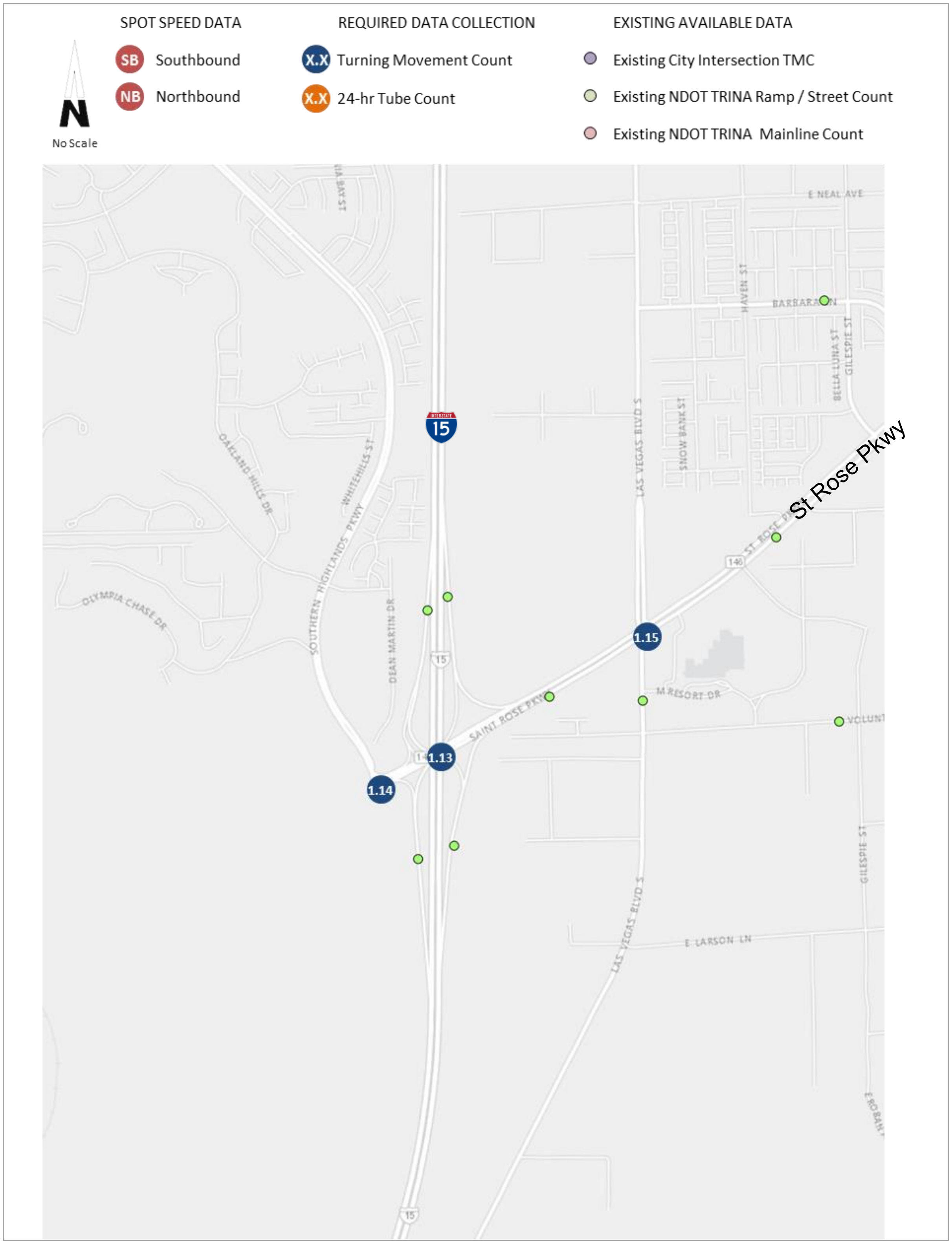
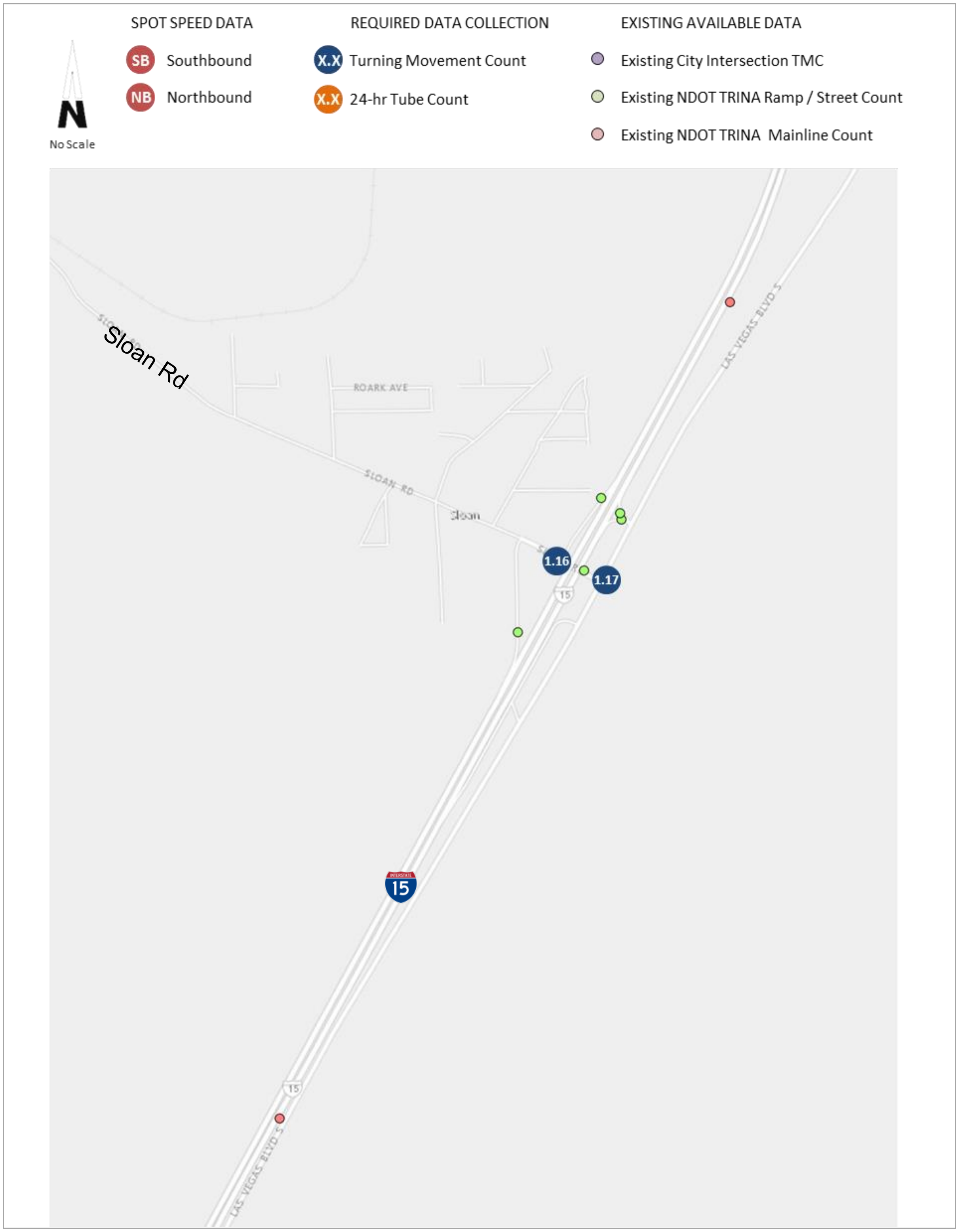


Figure 1d. Data Collection Site Map North to South



Data Collection Plan
I-15 / I-215 Interchange
for
Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

November 28, 2016

Contents

Figures

Tables

INTERCHANGE ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full interchange analysis and should only be used as reference for the above named interchange.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
    - Speed Limits
    - Traffic Control

DEMAND DATA

All traffic demand data and calibration data will be collected simultaneously. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- Tables 1 and 2 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figure 1.

Table 1. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
I-15 NB Off-Ramp to I-215 WB	31232	2015
I-15 NB Off-Ramp to I-215 EB	30056	2015
I-15 NB Off-Ramp to Las Vegas Blvd	30046	2015
I-15 SB Off-Ramp to Las Vegas Blvd	30003	2015
I-215 EB Of-Ramp to I-15 NB	31229	2015
I-215 WB Off-Ramp to I-15 NB	30118	2015
I-15 NB On-Ramp from Las Vegas Blvd	30879	2015
I-215 WB On-Ramp from Las Vegas Blvd	31420	2015
I-15 SB Off-Ramp to I-215 WB (from Russelll Rd)	31428	2015
I-15 SB Off-Ramp to I-215 EB and LVB (from Russell Rd)	30033	2015
I-215 WB Off-Ramp to I-15 SB	30155	2015
I-215 EB Off-Ramp to I-15 SB and Las Vegas Blvd	31234	2015
I-215 EB Off-Ramp to Las Vegas Blvd	31233	2015

DATA COLLECTION EFFORT	
Ramp Description	**ID**
I-15 SB Off-Ramp to I-215 EB and Las Vegas Blvd	2.1

Table 2. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
I-15 Count Station Description	**Station ID**
btwn the Decatur Intch 'Exit 13' and the I-15 Intch 'Exit 12'	30152
1.3 mi S of the IR-215 Intch 'Exit 34'	30453
E of SR-604 (Las Vegas Bl)	30162
.2 mi S of mp 36 S of the Russell Intch 'Exit 36'	31021

DATA COLLECTION EFFORT
NONE

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.

- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.

Time Periods

- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).

CALIBRATION DATA

Field inspection

To be conducted in concurrence with the traffic counts data collection effort. Field inspections will include the following:

- Queue observation
- Weave zone observation (location and length). On an as-needed basis for calibration.
- Spillback

Speed Data

Mainline speed data is to be obtained from the FAST online database, where available. Further speed data may be obtained from INRIX on a case-by-case basis, dependent on validation.

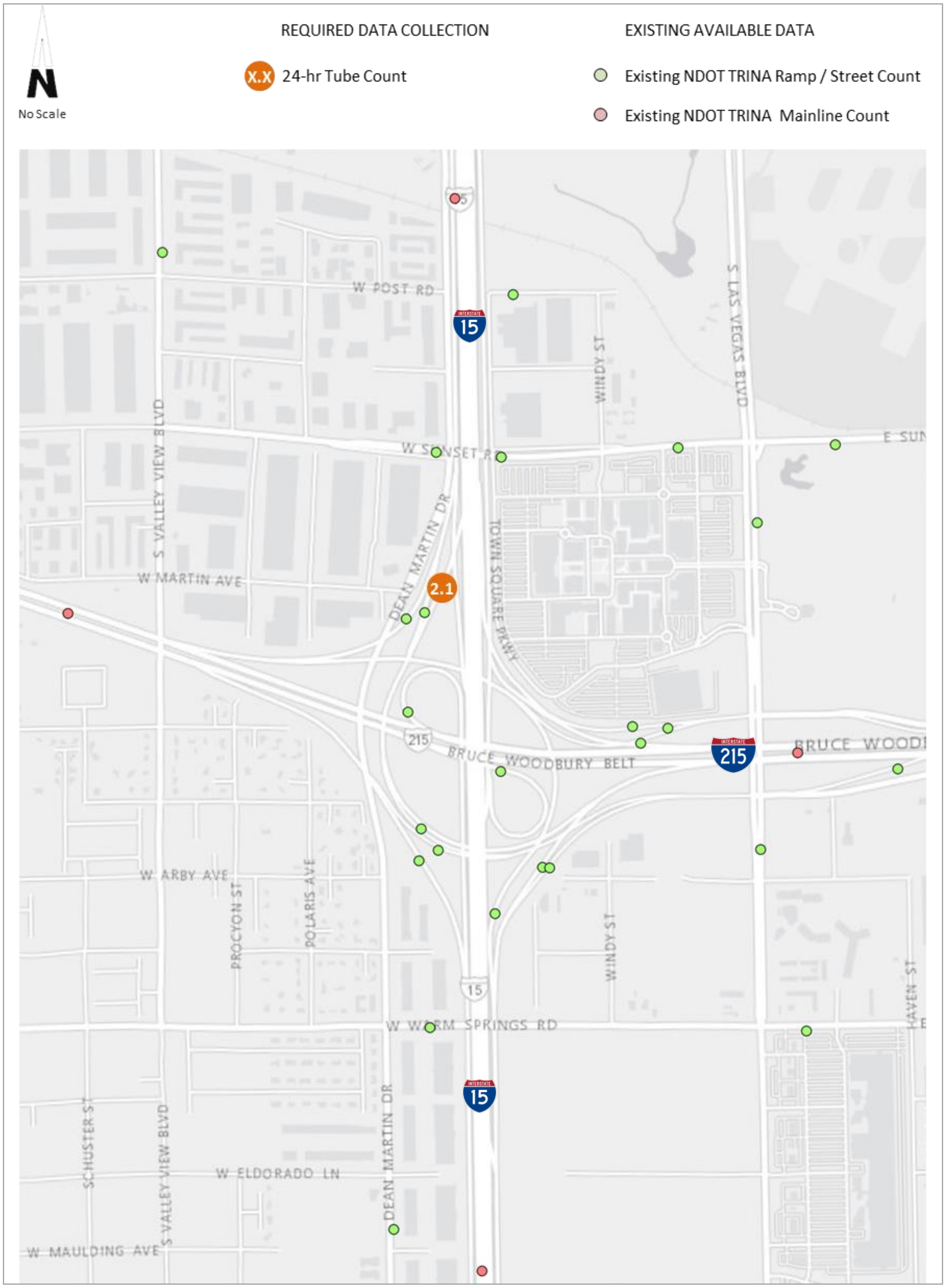
Travel Time Data

Travel time data is to be obtained from the FAST online database, where available. Further travel time data may be obtained from INRIX on a case-by-case basis, dependent on validation

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors. Traffic count and calibration data will be reviewed for consistency and reasonableness.

Figure 1. Data Collection Site Map



Data Collection Plan
I-215: I-15 to I-515
for
Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

November 28, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
  - Speed Limits
  - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data and calibration data will be collected simultaneously. Demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections, and adjacent intersections on arterial cross-streets. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Peak period queue lengths at all I-215 ramp terminal intersections in the study area.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figures 1a through 1d.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
Stephanie St	I-215 EB Ramps	2015	City of Henderson
Stephanie St	I-215 WB Ramps	2015	City of Henderson
Stephanie St	Wigwam Pkwy	2015	City of Henderson
Stephanie St	Paseo Verde Pkwy	2015	City of Henderson
Gibson Rd	I-215 EB Ramps	2015	City of Henderson
Gibson Rd	I-215 WB Ramps	2015	City of Henderson
Gibson Rd	Wigwam Pkwy	2015	City of Henderson

DATA COLLECTION EFFORT	
Intersection Description	**ID**
Warm Springs Rd / I-215 SB Ramps	1.1
Warm Springs Rd / I-215 NB Ramps	1.2
Warm Springs Rd / Paradise Rd	1.3
Warm Springs Rd / Shadow Crest Dr	1.4
Warm Springs Rd / Amigo St	1.5
Windmill Lane / I-215 Ramps	1.6
Windmill Lane / Paradise Rd	1.7
Windmill Lane / S Spencer St	1.8
Eastern Ave / I-215 EB Ramps	1.9
Eastern Ave / I-215 WB Ramps	1.10
Eastern Ave / Pebble Rd	1.11
Eastern Ave / Serene Ave	1.12
Pecos Rd / I-215 EB Ramps	1.13
Pecos Rd / I-215 WB Ramps	1.14
Pecos Rd / Pebble Rd	1.15
Pecos Rd / Paseo Verde Pkwy	1.16
Green Valley Pkwy / I-215 Ramps	1.17
Green Valley Pkwy / Corporate Cir	1.18
Green Valley Pkwy / Village Walk Dr	1.19
Valle Verde Dr / I-215 Ramps	1.20
Valle Verde Dr / Valle Verde Plaza	1.21
Valle Verde Dr / Paseo Verde Pkwy	1.22
Gibson Rd / Las Palmas Entrada Ave	1.23

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
I-215 EB off-ramp to McCarran Connector	30126	2014
I-215 EB on-ramp from McCarran Connector	30727	2014
I-215 WB on-ramp from McCarran Connector	30308	2014
I-215 WB on-ramp from Warm Springs Rd WB	30704	2014
I-215 EB off-ramp to Warm Springs Rd	30400	2015
I-215 EB on-ramp from Warm Springs Rd	30438	2014
I-215 WB on-ramp from Warm Springs Rd EB	30535	2014
I-215 WB off-ramp to Warm Springs Rd	30445	2015
I-215 SB Off-Ramp to Windmill Ln	30048	2015
I-215 SB On-Ramp from Windmill Ln	30034	2015
I-215 NB Off-Ramp to Windmill Ln	30042	2015
I-215 NB On-Ramp from Windmill Ln	30071	2015
I-215 WB Off-Ramp to Eastern Ave	30086	2015
I-215 WB On-Ramp from Eastern Ave	30090	2015
I-215 EB Off-Ramp to Eastern Ave	30047	2015
I-215 EB On-Ramp from Eastern Ave	30082	2015
I-215 WB Off-Ramp to Pecos Rd	30216	2015
I-215 WB On-Ramp from Pecos Rd	30109	2015
I-215 EB Off-Ramp to Pecos Rd	30121	2015
I-215 EB On-Ramp from Pecos Rd	30869	2015
I-215 WB Off-Ramp to Green Valley Pkwy	30949	2015
I-215 WB On-Ramp from Green Valley Pkwy	30938	2015
I-215 EB Off-Ramp to Green Valley Pkwy	30948	2015
I-215 EB On-Ramp from Green Valley Pkwy	30950	2015
I-215 WB Off-Ramp to Valle Verde Dr	31427	2015
I-215 WB On-Ramp from Valle Verde Dr	31237	2015
I-215 EB Off-Ramp to Valle Verde Dr	30974	2015
I-215 EB On-Ramp from Valle Verde Dr	30965	2015
I-215 WB Off-Ramp to Stephanie St	30750	2015
I-215 WB On-Ramp from Stephanie St	30861	2015
I-215 EB Off-Ramp to Stephanie St	31236	2015
I-215 EB On-Ramp from Stephanie St	30108	2015
I-215 WB Off-Ramp to Gibson Rd	31260	2015
I-215 WB On-Ramp from Gibson Rd	31261	2015
I-215 EB Off-Ramp to Gibson Rd	31258	2015
I-215 EB On-Ramp from Gibson Rd	31259	2015

DATA COLLECTION EFFORT	
Ramp Description	**ID**
NONE	

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
I-215 Count Station Description	**Station ID**
btwn Windmill Intch 'Exit 8' and the Eastern Intch 'Exit 7'	30078
IR-215 0.5 mi W of Gibson Intch	35370
btwn Las Vegas Bl Intch 'Exit 11' and the Sunset/McCarran Intch 'Exit 10'	30129
btwn the Sunset/McCarran Intch 'Exit 10' and the Warm Springs Intch 'Exit 9'	30131
IR-215 0.2 mi E of Eastern Ave Intch	31250
btwn the Pecos Intch 'Exit 6' and the Green Valley Intch 'Exit 5'	30933
btwn the Valle Verde Intch 'Exit 3B' and the Stephanie Intch 'Exit 3A'	31239
btwn the Decatur Intch 'Exit 13' and the I-15 Intch 'Exit 12'	30152
btwn Warm Springs Intch 'Exit 9' and the Windmill Intch 'Exit 8'	30959
btwn the Green Valley Intch 'Exit 5' and the Valle Verde Intch 'Exit 3B'	31238
E of SR-604 (Las Vegas Bl)	30162
btwn the Gibson Intch Exit 2 and the US-95 Henderson Intch Exit 1	30246

DATA COLLECTION EFFORT
NONE

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).

- Turning movement count summaries (one per intersection for each time period).
- Intersection configuration sheet per intersection (lane with numbers that match manual queue length observation sheets).
- Manual queue length study including raw data sheets and a data summary prepared in Excel.

CALIBRATION DATA

Field inspection

To be conducted in concurrence with the traffic counts data collection effort. Field inspections will include the following:

- Queue observation
- Weave zone observation (location and length). On an as-needed basis for calibration.
- Lane usage at intersections (Mainline lane utilization will be identified from FAST data.)
- Spillback

Queue Length

- Manual observation by field personnel, or video collection.
- Number of queued vehicles behind each stop line, collected by lane.
- Duration of AM and PM peak periods as noted above.
- Data collection at 2-minute intervals.
- Inclusion of stopped vehicles and slow moving vehicles (<5mph) in queue lengths at the end of the queue.

Speed Data

Mainline speed data is to be obtained from the FAST online database, where available. Further speed data may be obtained from INRIX on a case-by-case basis, dependent on validation. Spot speed data to be obtained for off-peak periods at the locations shown in Figures 1a through 1d.

Travel Time Data

Travel time data is to be obtained from the FAST online database, where available. Further travel time data may be obtained from INRIX on a case-by-case basis, dependent on validation.

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors. Traffic count and calibration data will be reviewed for consistency and reasonableness.

Figure 1a. Data Collection Site Map West ot East

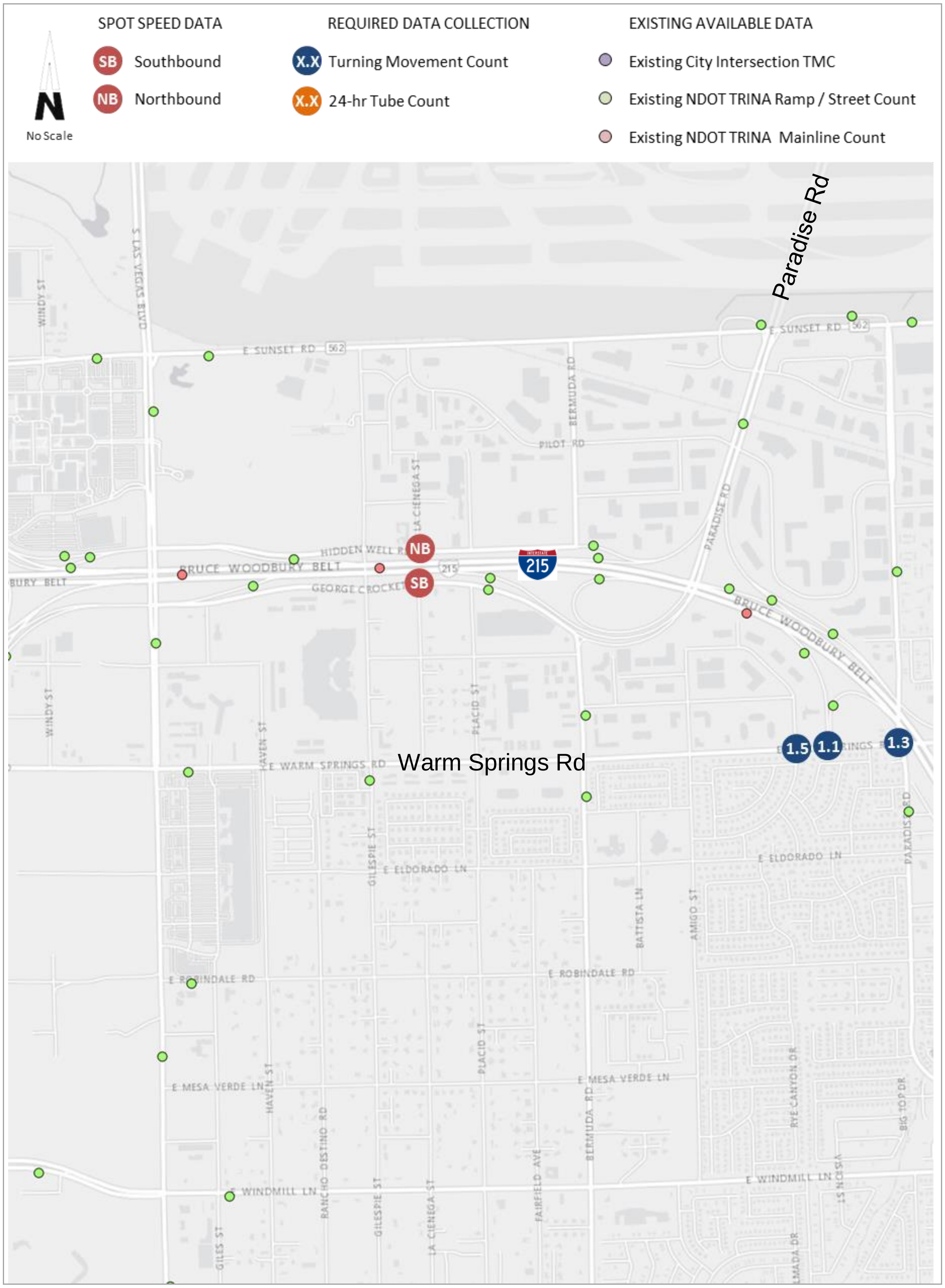


Figure 1b. Data Collection Site Map West ot East

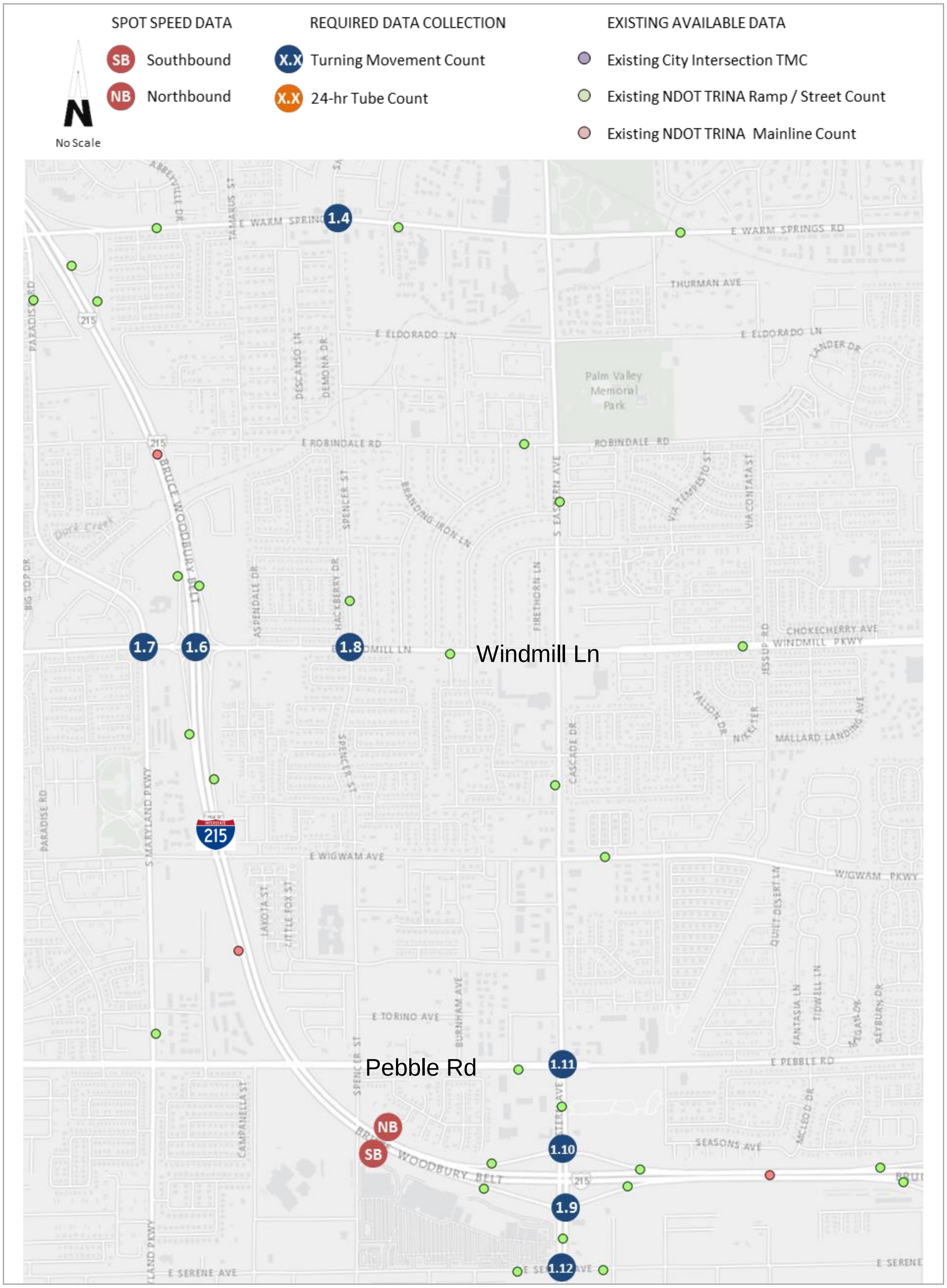


Figure 1c. Data Collection Site Map West ot East

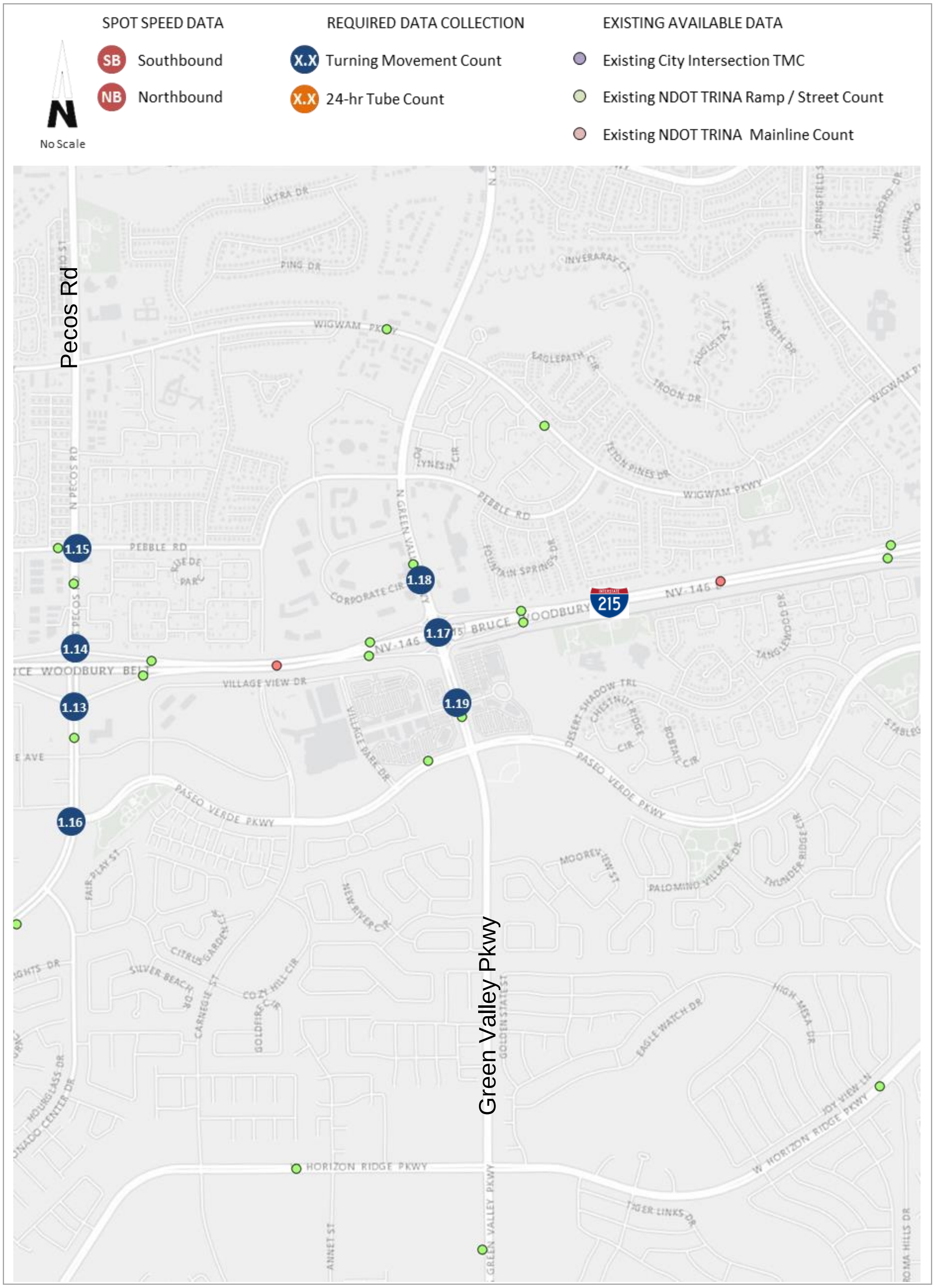
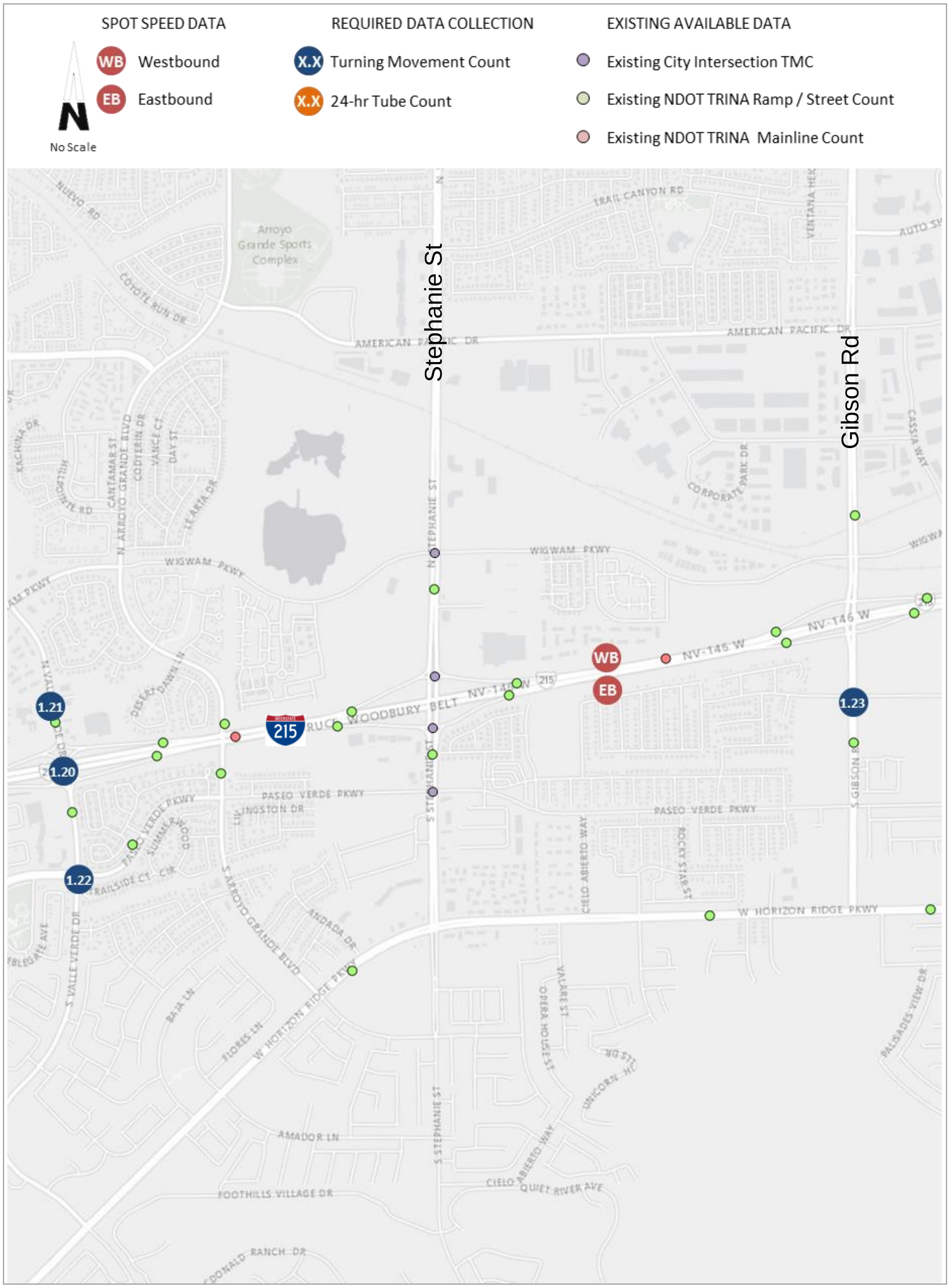


Figure 1d. Data Collection Site Map West ot East



Data Collection Plan
I-515: Charleston Blvd to I-215
for
Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

November 28, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
    - Speed Limits
    - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data and calibration data will be collected simultaneously. Demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections, and adjacent intersections on arterial cross-streets. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Peak period queue lengths at all I-515 ramp terminal intersections in the study area.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figures 1a through 1d.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
Russell Rd	I-515 NB Ramps	2015	City of Henderson
Russell Rd	I-515 SB Ramps	2015	City of Henderson
Russell Rd	Stephanie St	2015	City of Henderson
Russell Rd	Whitney Ranch Dr	2015	City of Henderson

DATA COLLECTION EFFORT	
Intersection Description	**ID**
Charleston Blvd / I-515 NB Ramps	1.1
Charleston Blvd / I-515 SB Ramps	1.2
Charleston Blvd / Honolulu St	1.3
Charleston Blvd / Sacramento Dr	1.4
Boulder Hwy / I-515 NB Ramps	1.5
Boulder Hwy / I-515 SB Ramps	1.6
Boulder Hwy / Sahara Ave	1.7
Boulder Hwy / Lamb Blvd	1.8
Flamingo Rd / I-515 NB Ramps	1.9
Flamingo Rd / I-515 SB Ramps	1.10
Flamingo Rd / Sandhill Rd	1.11
Flamingo Rd / Mountain Vista St	1.12
Tropicana Ave / I-515 NB Ramps	1.13
Tropicana Ave / I-515 SB Ramps	1.14
Tropicana Ave / Sandhill Rd	1.15
Tropicana Ave / Mountain Vista St	1.16
Galleria Dr / I-515 NB Ramps	1.17
Galleria Dr / I-515 SB Ramps	1.18
Galleria Dr / Stephanie St	1.19
Galleria Dr / Gibson Rd	1.20
Sunset Rd / I-515 NB Ramps	1.21
Sunset Rd / I-515 SB Ramps	1.22
Sunset Rd / Marks St	1.23
Sunset Rd / Gibson Rd	1.24
Auto Show Dr / I-515 NB Ramps	1.25
Auto Show Dr / I-515 SB Ramps	1.26
Auto Show Dr / Gibson Rd	1.27
Auto Show Dr / Eastgate Rd	1.28

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
I-515 SB Off-Ramp to Charleston Blvd	30791	2015
I-515 SB On-Ramp from Charleston Blvd	30801	2015
I-515 NB Off-Ramp to Charleston Blvd	30800	2015
I-515 NB On-Ramp from Charleston Blvd	30779	2015
I-515 SB Off-Ramp to Boulder Hwy	30806	2015
I-515 SB On-Ramp from Boulder Hwy	30805	2015
I-515 NB Off-Ramp to Boulder Hwy	30804	2015
I-515 NB On-Ramp from Boulder Hwy	30803	2015
I-515 SB Off-Ramp to Flamingo Rd	30809	2015
I-515 SB On-Ramp from Flamingo Rd EB	30812	2015
I-515 SB On-Ramp from Flamingo Rd WB	30810	2015
I-515 NB Off-Ramp to Flamingo Rd	30813	2015
I-515 NB On-Ramp from Flamingo Rd EB	30811	2015
I-515 NB On-Ramp from Flamingo Rd WB	30808	2015
I-515 SB Off-Ramp to Tropicana Ave	30815	2015
I-515 SB On-Ramp from Tropicana Ave	30818	2015
I-515 NB Off-Ramp to Tropicana Ave	30817	2015
I-515 NB On-Ramp from Tropicana Ave	30807	2015
I-515 SB Off-Ramp to Russell Rd	30823	2015
I-515 SB On-Ramp from Russell Rd	30822	2015
I-515 NB Off-Ramp to Russell Rd	30821	2015
I-515 NB On-Ramp from Russell Rd	30820	2015
I-515 SB Off-Ramp to Galleria Dr	31459	2015
I-515 SB On-Ramp from Galleria Dr	31458	2015
I-515 NB Off-Ramp to Galleria Dr	31457	2015
I-515 NB On-Ramp from Galleria Dr	31456	2015
I-515 SB Off-Ramp to Sunset Rd	30828	2015
I-515 SB On-Ramp from Sunset Rd	30829	2015
I-515 NB Off-Ramp to Sunset Rd	30827	2015
I-515 NB On-Ramp from Sunset Rd	30826	2015
I-515 SB Off-Ramp to Auto Show Dr	31424	2015
I-515 SB On-Ramp from Auto Show Dr	31411	2015
I-515 NB Off-Ramp to Auto Show Dr	31423	2015
I-515 NB On-Ramp from Auto Show Dr	31441	2015

DATA COLLECTION EFFORT	
Ramp Description	**ID**
NONE	

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
I-215 Count Station Description	**Station ID**
btwn the Tropicana Intch 'Exit 68' and the Russell Intch 'Exit 65'	30819
btwn the Boulder Highway Intch 'Exit 69' and the Charleston Intch 'Exit 71'	30799
South of the Auto Show Mall Intch 'Exit 62'	31422
US-95 0.3 mi S of Russel Rd	32230
btwn the Boulder Highway Intch 'Exit 69' and the Flamingo Intch 'Exit 68'	30798
btwn the Flamingo Intch 'Exit 38' and the Tropicana Intch 'Exit 37'	30814
500ft S of Mojave Rd btwn Eastern Av Intch Exit 73 and Charleston Bl Intch Exit 72	30789
btwn the Sunset Intch 'Exit 64A' and the Auto Show Mall Intch 'Exit 62'	30831

DATA COLLECTION EFFORT
NONE

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).
- Turning movement count summaries (one per intersection for each time period).
- Intersection configuration sheet per intersection (lane with numbers that match manual queue length observation sheets).

- Manual queue length study including raw data sheets and a data summary prepared in Excel.

CALIBRATION DATA

Field inspection

To be conducted in concurrence with the traffic counts data collection effort. Field inspections will include the following:

- Queue observation
- Weave zone observation (location and length). On an as-needed basis for calibration.
- Lane usage at intersections (Mainline lane utilization will be identified from FAST data.)
- Spillback

Queue Length

- Manual observation by field personnel, or video collection.
- Duration of AM and PM peak periods as noted above.
- Maximum queue length behind stop line, measured as number of vehicles and collected by lane, collected in 2-minute intervals
- Inclusion of stopped vehicles and slow moving vehicles (<5mph) in queue lengths at the end of the queue.

Table 4. Ramp Queue Length Collection Requirements

DATA COLLECTION EFFORT	
Ramp Description	**ID**
I-515 NB Off-Ramp to Charleston Blvd	3.1
I-515 SB Off-Ramp to Boulder Hwy	3.2
I-515 SB Off-Ramp to Flamingo Rd	3.3
I-515 NB Off-Ramp to Russell Rd	3.4
I-515 SB Off-Ramp to Auto Show Dr	3.5

Speed Data

Mainline speed data is to be obtained from the FAST online database, where available. Further speed data may be obtained from INRIX on a case-by-case basis, dependent on validation. Spot speed data to be obtained for off-peak periods at the locations shown in Figures 1a through 1d.

Travel Time Data

Travel time data is to be obtained from the FAST online database, where available. Further travel time data may be obtained from INRIX on a case-by-case basis, dependent on validation. Field measured travel time runs to be collected for validation of FAST and INRIX data.

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors. Traffic count and calibration data will be reviewed for consistency and reasonableness.

Figure 1a. Data Collection Site Map North to South

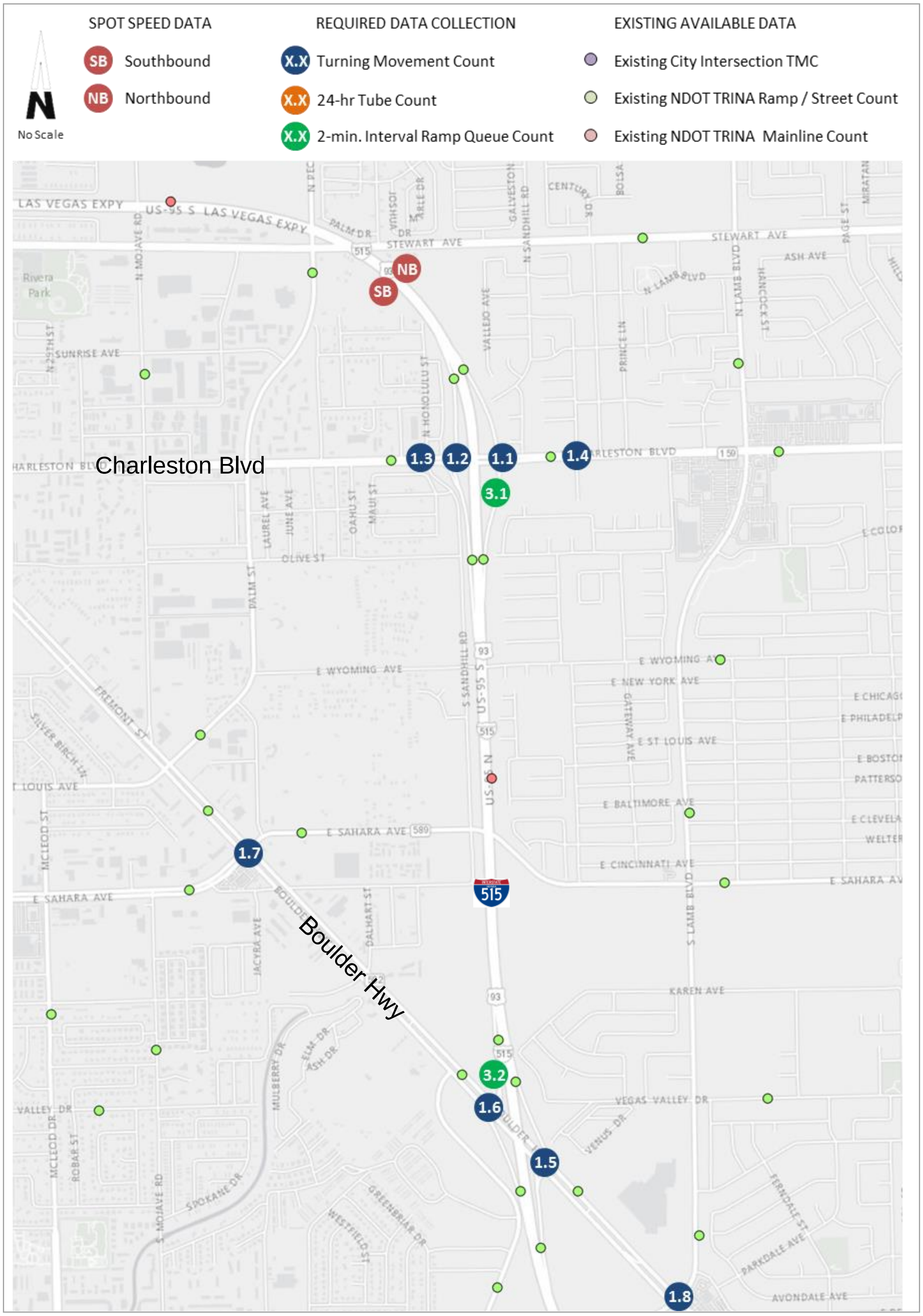


Figure 1b. Data Collection Site Map North to South

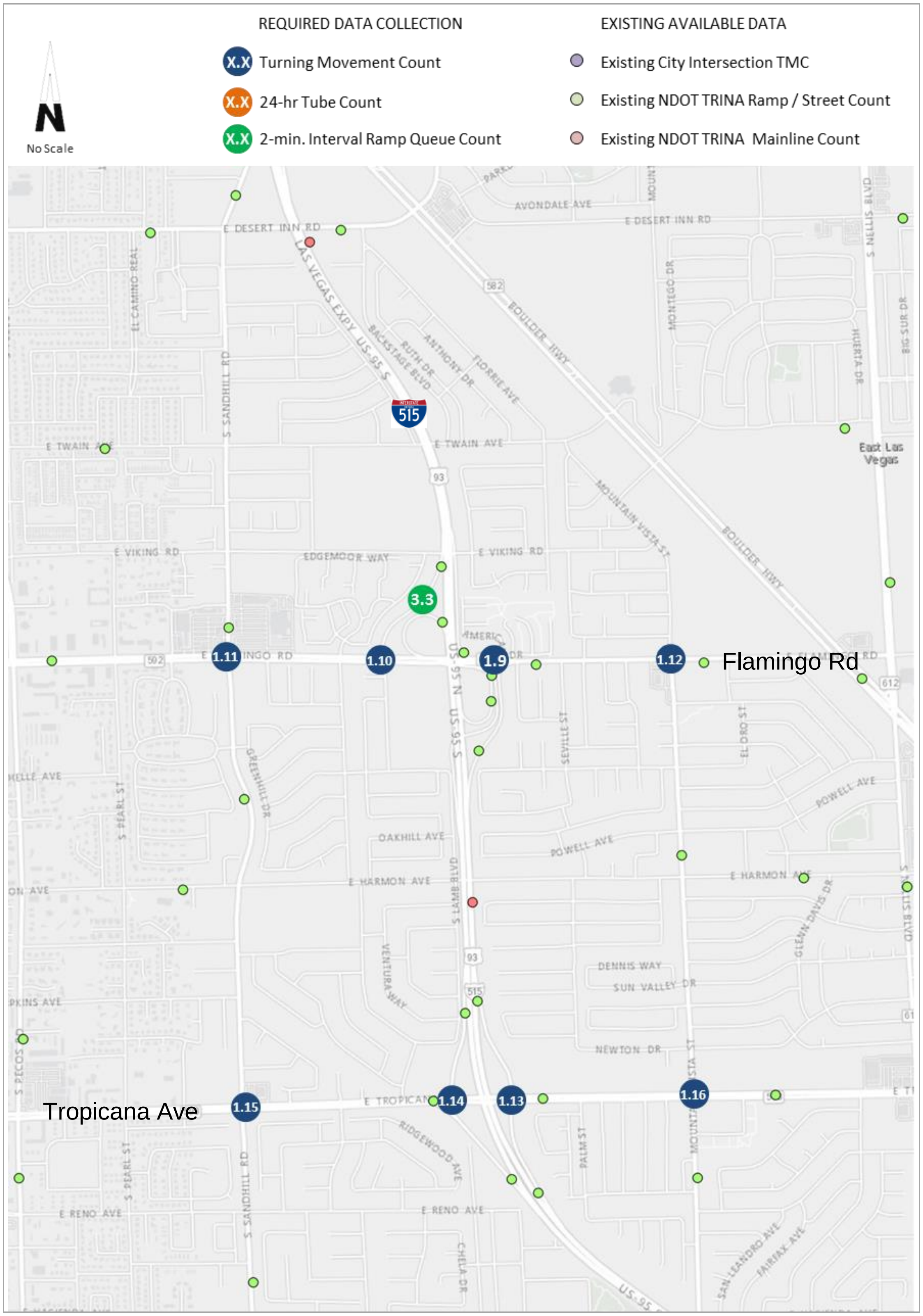


Figure 1c. Data Collection Site Map North to South

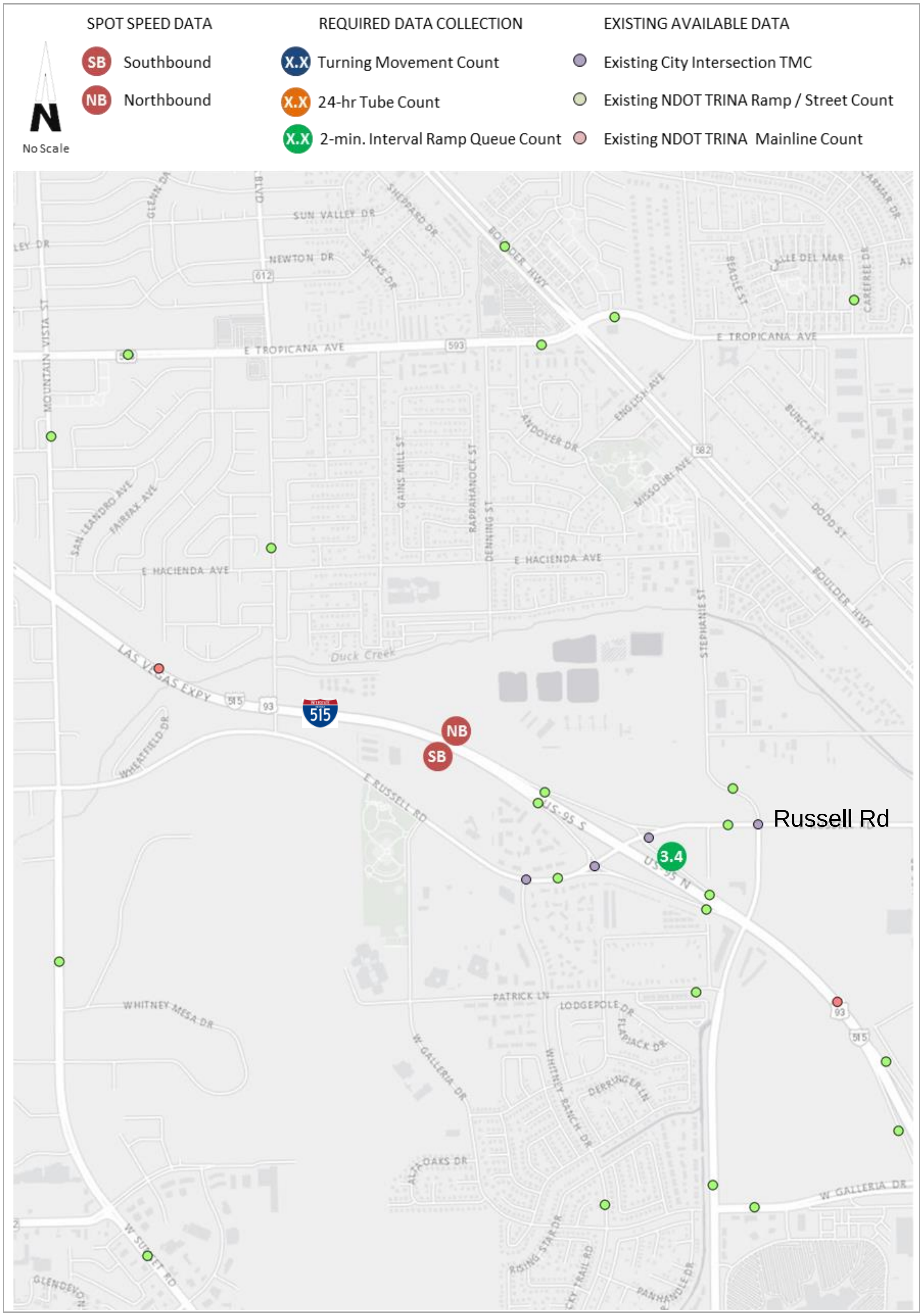
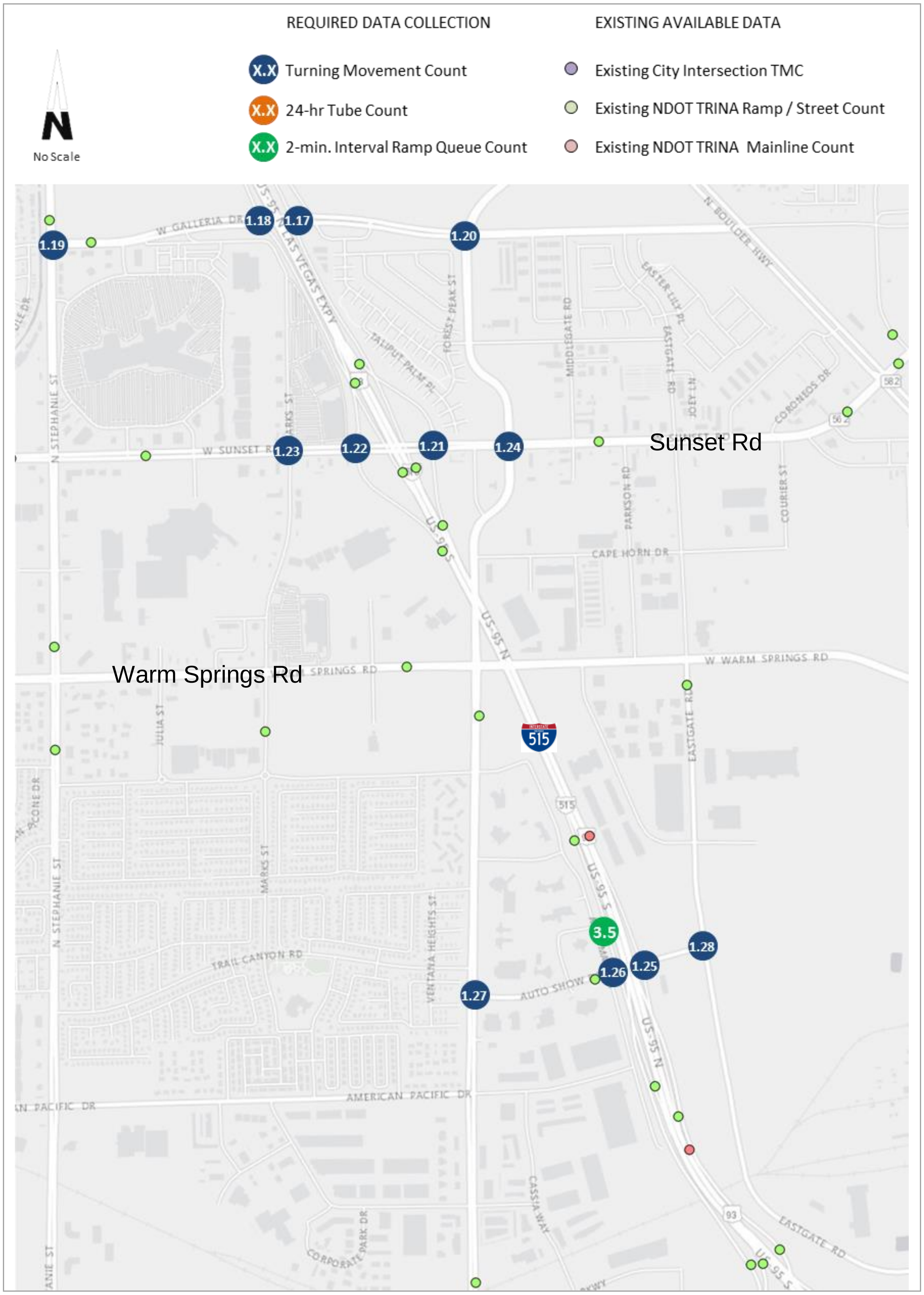


Figure 1d. Data Collection Site Map North to South



Data Collection Plan
I-515 / I-215 Interchange

for

Southern Nevada Traffic Study

Prepared for:

Prepared by:

November 28, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
    - Speed Limits
    - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data and calibration data will be collected simultaneously. Demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections, and adjacent intersections on arterial cross-streets. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Peak period queue lengths at all ramp terminal intersections in the study area.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figure 1.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
NONE	NONE		

DATA COLLECTION EFFORT	
Intersection Description	**ID**
Lake Mead Pkwy / Eastgate Rd	1.1

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
I-515 NB On-Ramp from Lake Mead Pkwy WB	30832	2015
I-515 NB Off-Ramp to Lake Mead Pkwy EB & I-215 WB	30895	2014
I-515 NB Off-Ramp to I-215 WB	31264	2014
I-515 NB On-Ramp from I-215 EB	31440	2015
I-515 SB Off-Ramp to Lake Mead Pkwy EB	31425	2015
I-515 SB Off-Ramp to I-215 WB	30833	2015
I-515 SB On-Ramp from I-215 EB	31417	2015
I-515 SB On-Ramp from Lake Mead Pkwy WB	30894	2015
I-515 SB On-Ramp from Lake Mead Pkwy WB	30894	2015

DATA COLLECTION EFFORT	
Ramp Description	**ID**
NONE	

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
I-515 / I-215 Count Station Description	**Station ID**
South of the Auto Show Mall Intch 'Exit 62'	31422
btwn the 215/Henderson Intch 'Exit 61' and the Horizon Intch 'Exit 59'	30896
btwn the Gibson Intch Exit 2 and the US-95 Henderson Intch Exit 1	30246
.2 mi E of the 215/Henderson Intch 'Exit 61'	30834

DATA COLLECTION EFFORT
NONE

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).
- Turning movement count summaries (one per intersection for each time period).
- Intersection configuration sheet per intersection (lane with numbers that match manual queue length observation sheets).
- Manual queue length study including raw data sheets and a data summary prepared in Excel.

CALIBRATION DATA

Field inspection

To be conducted in concurrence with the traffic counts data collection effort. Field inspections will include the following:

- Queue observation
- Weave zone observation (location and length). On an as-needed basis for calibration.
- Lane usage at intersections (Mainline lane utilization will be identified from FAST data.)
- Spillback

Queue Length

- Manual observation by field personnel, or video collection.
- Number of queued vehicles behind each stop line, collected by lane.
- Duration of AM and PM peak periods as noted above.
- Data collection at 2-minute intervals.
- Inclusion of stopped vehicles and slow moving vehicles (<5mph) in queue lengths at the end of the queue.

Speed Data

Mainline speed data is to be obtained from the FAST online database, where available. Further speed data may be obtained from INRIX on a case-by-case basis, dependent on validation. Spot speed data to be obtained for off-peak periods at the locations shown in Figure 1.

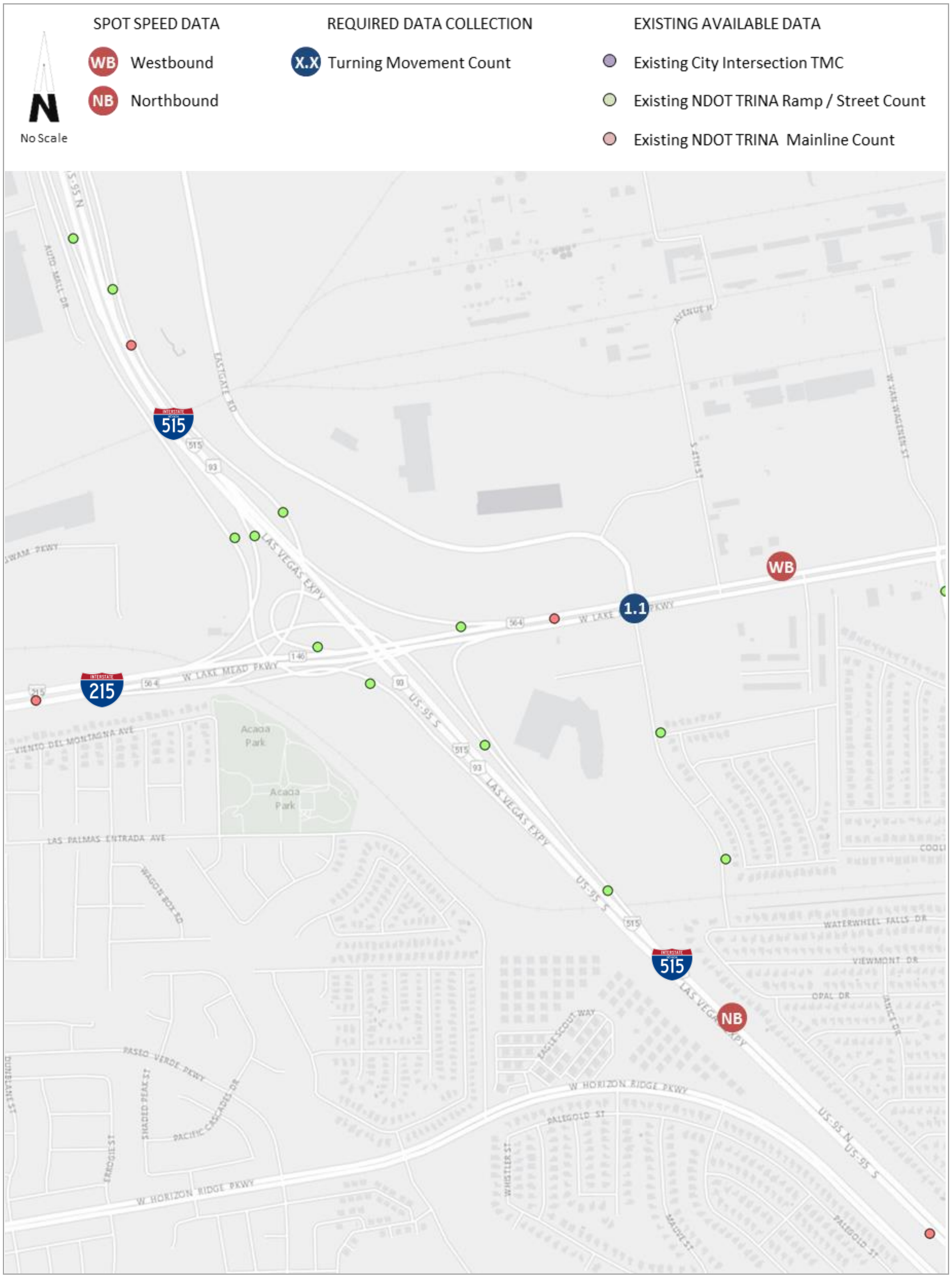
Travel Time Data

Travel time data is to be obtained from the FAST online database, where available. Further travel time data may be obtained from INRIX on a case-by-case basis, dependent on validation

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors. Traffic count and calibration data will be reviewed for consistency and reasonableness.

Figure 1. Data Collection Site Map



Data Collection Plan Summerlin Pkwy: CC-215 to US95

for

Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

December 14, 2016

Contents

Page No.

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
  - Speed Limits
  - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data and calibration data will be collected simultaneously. Demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections, and adjacent intersections on arterial cross-streets. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Peak period queue lengths at all Summerlin Parkway ramp terminal intersections in the study area.
- Tables 1 through 4 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figures 1a through 1c.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
Anasazi Dr	Summerlin Pkwy EB Ramps	6-May-15	City of Las Vegas
Anasazi Dr	Summerlin Pkwy WB Ramps	6-May-15	City of Las Vegas
Anasazi Dr	Thomas W Ryan Blvd	12-May-15	City of Las Vegas
Anasazi Dr	Banburry Cross Dr	7-Oct-15	City of Las Vegas
Town Center Dr	Summerlin Pkwy EB Ramps	12-Mar-13	City of Las Vegas
Town Center Dr	Summerlin Pkwy WB Ramps	14-Mar-13	City of Las Vegas
Rampart Blvd	Summerlin Pkwy EB Ramps	1-Mar-16	City of Las Vegas
Rampart Blvd	Summerlin Pkwy WB Ramps	2-Mar-16	City of Las Vegas
Rampart Blvd	Tournament Hills	10-Dec-14	City of Las Vegas
Rampart Blvd	Canyon Run Dr	5-May-16	City of Las Vegas
Durango Dr	Summerlin Pkwy EB Ramps	18-Jun-14	City of Las Vegas
Durango Dr	Washington Ave	24-Jul-14	City of Las Vegas
Durango Dr	Westcliff Dr	12-Nov-14	City of Las Vegas
Buffalo Dr	Summerlin Pkwy EB Ramps	5-Mar-13	City of Las Vegas
Buffalo Dr	Summerlin Pkwy WB Ramps	28-Feb-13	City of Las Vegas
Buffalo Dr	Washington Ave	9-Jan-13	City of Las Vegas
Buffalo Dr	Westcliff Dr	10-Jan-13	City of Las Vegas

DATA COLLECTION EFFORT	
Intersection Description	**ID**
CC-215 NB Ramps / Summerlin Pkwy	1.1
Town Center Dr / Covington Cross Dr	1.2
Durango Dr / Summerlin Pkwy WB Ramps	1.3
Durango Dr / Summerlin Pkwy EB Ramps	1.4
Summerlin Pkwy / US95 / Rainbow Blvd (SPUI)	1.5

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
US95 SB Off-Ramp to Summerlin Pkwy WB	30855	2014
US95 SB Off-Ramp to Rainbow Blvd	30856	2015
US95 SB On-Ramp from Summerlin Pkwy	30857	2015
US95 NB On-Ramp from Rainbow Blvd	30722	2015
US95 SB On-Ramp from Rainbow Blvd	30864	2015
US95 NB Off-Ramp to Summerlin Pkwy	30865	2013
US95 NB Off-Ramp to Rainbow Blvd	30853	2015

DATA COLLECTION EFFORT	
Ramp Description	**ID**
CC-215 NB Off-Ramp to Summerlin Pkwy WB	2.1
CC-215 NB Off-Ramp to Summerlin Pkwy EB	2.2
CC-215 NB On-Ramp from Summerlin Pkwy	2.3
CC-215 SB Off-Ramp to Summerlin Pkwy	2.4
CC-215 SB On-Ramp from Summerlin Pkwy	2.5
Summerlin Pkwy WB Off-Ramp to Anasazi Dr	2.6
Summerlin Pkwy WB On-Ramp from Anasazi Dr	2.7
Summerlin Pkwy EB Off-Ramp to Anasazi Dr	2.8
Summerlin Pkwy EB On-Ramp from Anasazi Dr	2.9
Summerlin Pkwy WB Off-Ramp to Town Center Dr	2.10
Summerlin Pkwy WB On-Ramp from Town Center Dr	2.11
Summerlin Pkwy EB Off-Ramp to Town Center Dr	2.12
Summerlin Pkwy EB On-Ramp from Town Center Dr	2.13
Summerlin Pkwy WB Off-Ramp to Rampart Blvd	2.14
Summerlin Pkwy WB On-Ramp from Rampart Blvd	2.15
Summerlin Pkwy EB Off-Ramp to Rampart Blvd	2.16
Summerlin Pkwy EB On-Ramp from Rampart Blvd	2.17
Summerlin Pkwy WB Off-Ramp to Buffalo Dr	2.18
Summerlin Pkwy WB On-Ramp from Buffalo Dr NB	2.19
Summerlin Pkwy WB On-Ramp from Buffalo Dr SB	2.20
Summerlin Pkwy EB Off-Ramp to Buffalo Dr	2.21
Summerlin Pkwy EB On-Ramp from Buffalo Dr	2.22

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
Summerlin Pkwy Count Station Description	**Station ID**
.6 mi W of Buffalo Dr	31122
.2 mi E of Buffalo Dr	31123
btwn N Anasazi Dr and Towncenter Dr.	31453
btwn I-215 and N Anasazi Dr	31294
.1 mi W of Rampart Bl	30866

DATA COLLECTION EFFORT
NONE

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Ramps, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Ramp tube count summaries (one per site).
- Turning movement count summaries (one per intersection for each time period).
- Intersection configuration sheet per intersection (lane with numbers that match manual queue length observation sheets).
- Manual queue length study including raw data sheets and a data summary prepared in Excel.

CALIBRATION DATA

Field inspection

To be conducted in concurrence with the traffic counts data collection effort. Field inspections will include the following:

- Queue observation
- Weave zone observation (location and length). On an as-needed basis for calibration.
- Lane usage at intersections (Mainline lane utilization will be identified from FAST data.)
- Spillback

Queue Length

- Manual observation by field personnel, or video collection.
- Duration of AM and PM peak periods as noted above.
- Maximum queue length behind stop line, measured as number of vehicles and collected by lane, collected in 2-minute intervals
- Inclusion of stopped vehicles and slow moving vehicles (<5mph) in queue lengths at the end of the queue.

Table 4. Ramp Queue Length Collection Requirements

DATA COLLECTION EFFORT	
Ramp Description	**ID**
Summerlin Pkwy EB Off-Ramp to Town Center Dr	3.1
Summerlin Pkwy WB Off-Ramp to Town Center Dr	3.2
Summerlin Pkwy EB Off-Ramp to Rampart Blvd	3.3
Summerlin Pkwy WB Off-Ramp to Rampart Blvd	3.4
Summerlin Pkwy EB Off-Ramp to Buffalo Dr	3.5
Summerlin Pkwy EB Off-Ramp to Rainbow Blvd	3.6

Speed Data

Mainline speed data is to be obtained from the FAST online database, where available. Further speed data may be obtained from INRIX on a case-by-case basis, dependent on validation. Spot speed data to be obtained for off-peak periods at the locations shown in Figures 1a through 1c.

Travel Time Data

Travel time data is to be obtained from the FAST online database, where available. Further travel time data may be obtained from INRIX on a case-by-case basis, dependent on validation. Field measured travel time runs to be collected for validation of FAST and INRIX data.

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors. Traffic count and calibration data will be reviewed for consistency and reasonableness.

Figure 1a. Data Collection Site Map West to East

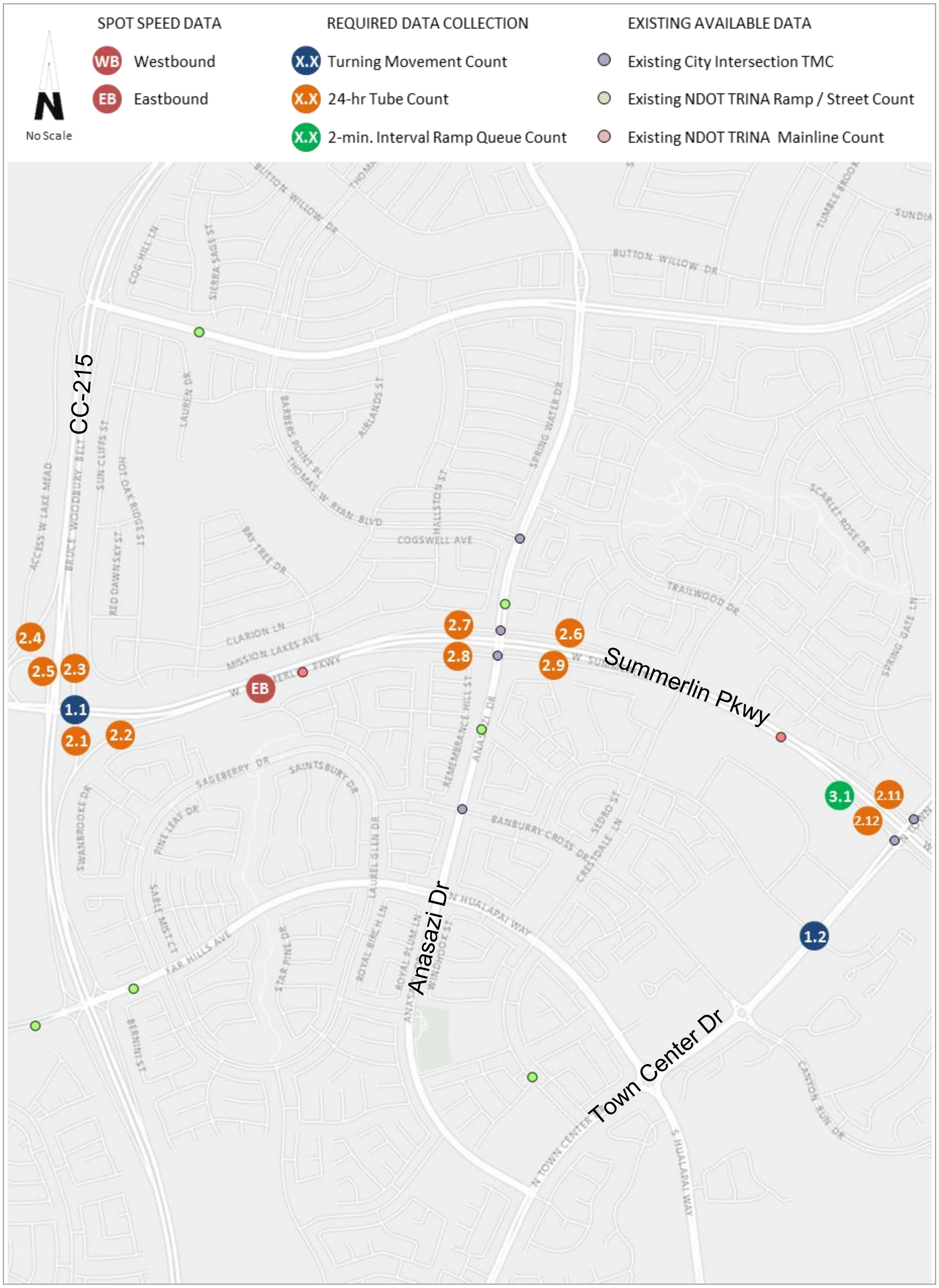


Figure 1b. Data Collection Site Map West to East

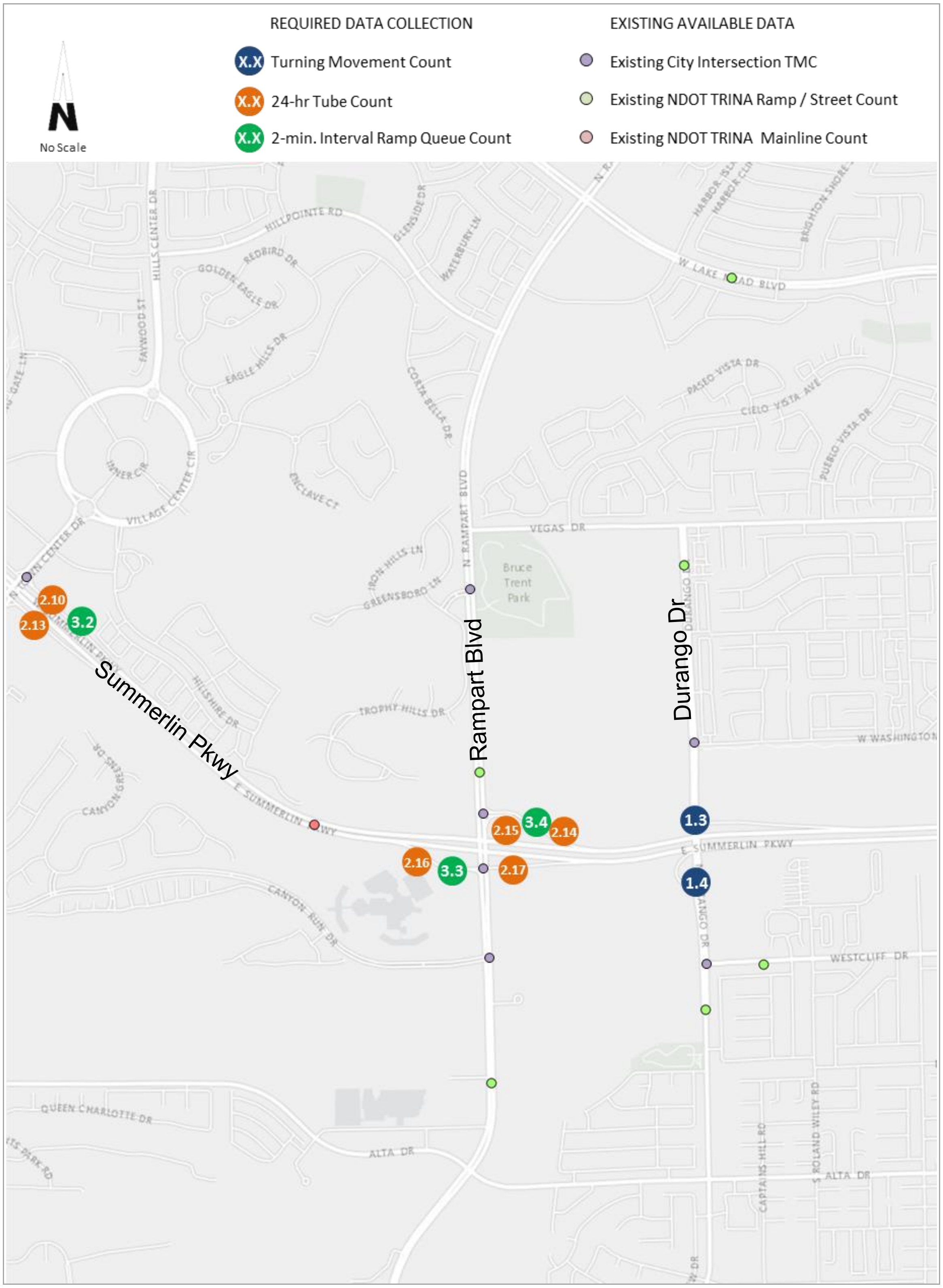
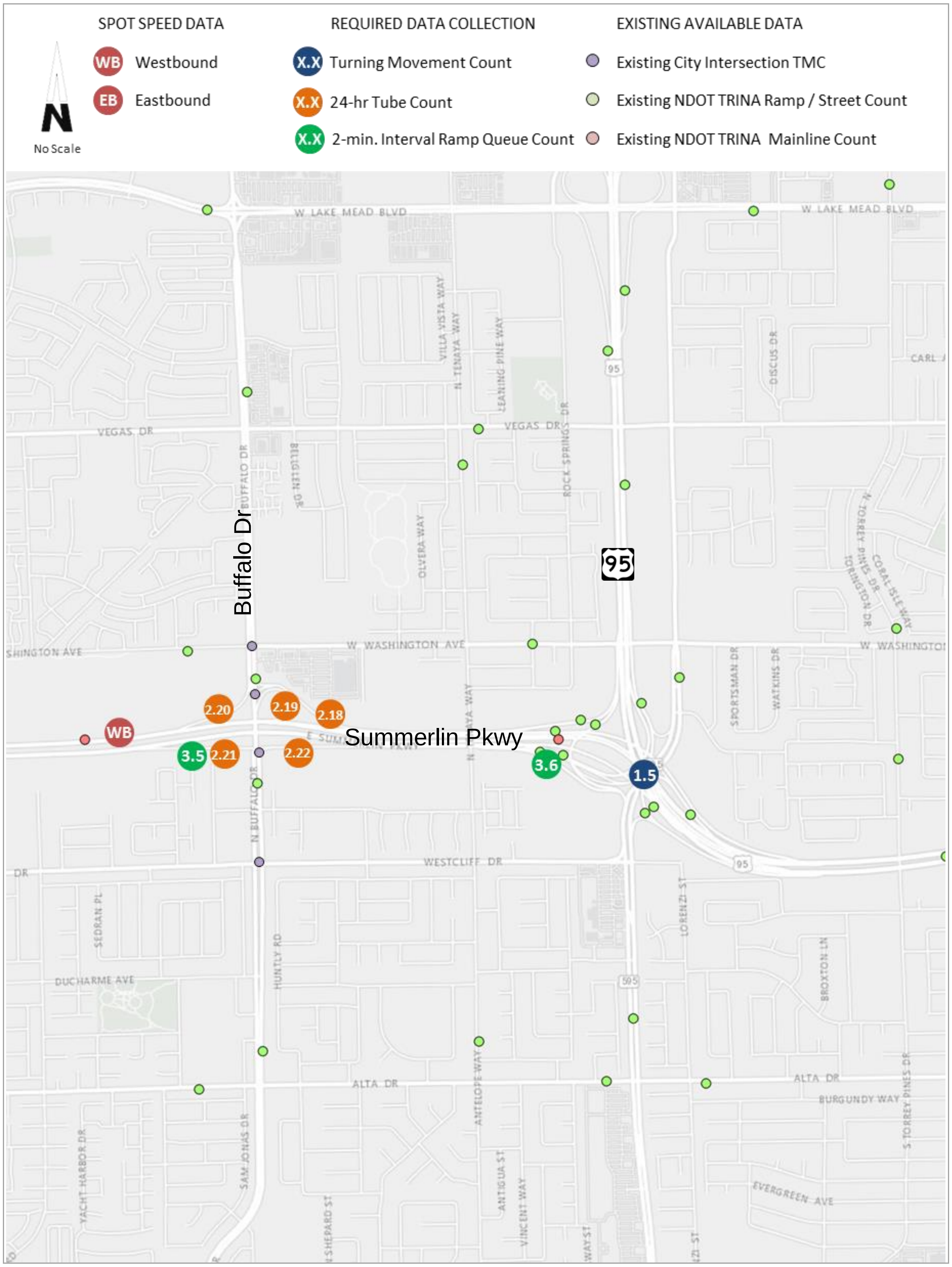


Figure 1c. Data Collection Site Map West to East



Data Collection Plan
US95 / CC-215 Interchange

for

Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

November 28, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
  - Speed Limits
  - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data and calibration data will be collected simultaneously. Demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained. Lane utilization factors will be developed from FAST data.
- AM and PM peak period turning movement counts at ramp terminals/intersections, and adjacent intersections on arterial cross-streets. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Peak period queue lengths at all ramp terminal intersections in the study area.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figure 1.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	Ramps / Other	Date	Agency
None	None		

DATA COLLECTION EFFORT	
Intersection Description	ID
Oso Blanca Rd / CC-215	1.1
Sky Pointe Dr / CC-215	1.2
Centennial Center Blvd / US95 SB Ramps	1.3
Sky Pointe Dr / US95 NB Ramps	1.4

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	Station ID	Year
US95 NB Off-Ramp to WB CC-215	31400	2013
US95 NB Off-Ramp to N Buffalo Dr	31401	2013
US95 NB On-Ramp from N Buffalo Dr	31402	2013
US95 SB Off-Ramp to Centennial Center Blvd	31403	2015
US95 SB On-Ramp from CC-215	30536	2013
US95 SB On-Ramp from Centennial Center Blvd	31404	2015

DATA COLLECTION EFFORT	
Ramp Description	ID
NONE	

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
US95 Count Station Description	Station ID
.4 mi N of the Rancho/Ann Intch 'Exit 86'	30720
US-95 0.8 mi S of the Durango Dr. Intch.	35320

DATA COLLECTION EFFORT	
CC-215, 1000ft east of Sky Pointe Dr	3.1
CC-215, 1500ft west of Oso Blanca Rd	3.2

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon or US95/C-215 interchange construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.
- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments
- Mainline, 24-hour counts: 12:00 AM to 12:00 AM (15-minute increments)

Deliverables

- Mainline radar count summaries (one per site).
- Turning movement count summaries (one per intersection for each time period).
- Intersection configuration sheet per intersection (lane with numbers that match manual queue length observation sheets).

CALIBRATION DATA

Field inspection

To be conducted in concurrence with the traffic counts data collection effort. Field inspections will include the following:

- Queue observation
- Weave zone observation (location and length). On an as-needed basis for calibration.
- Lane usage at intersections (Mainline lane utilization will be identified from FAST data.)
- Spillback

Queue Length

- Manual observation by field personnel, or video collection.
- Number of queued vehicles behind each stop line, collected by lane.

- Duration of AM and PM peak periods as noted above.
- Data collection at 2-minute intervals.
- Inclusion of stopped vehicles and slow moving vehicles (<5mph) in queue lengths at the end of the queue.

Speed Data

Mainline speed data is to be obtained from the FAST online database, where available. Further speed data may be obtained from INRIX on a case-by-case basis, dependent on validation. Spot speed data to be obtained for off-peak periods at the locations shown in Figure 1.

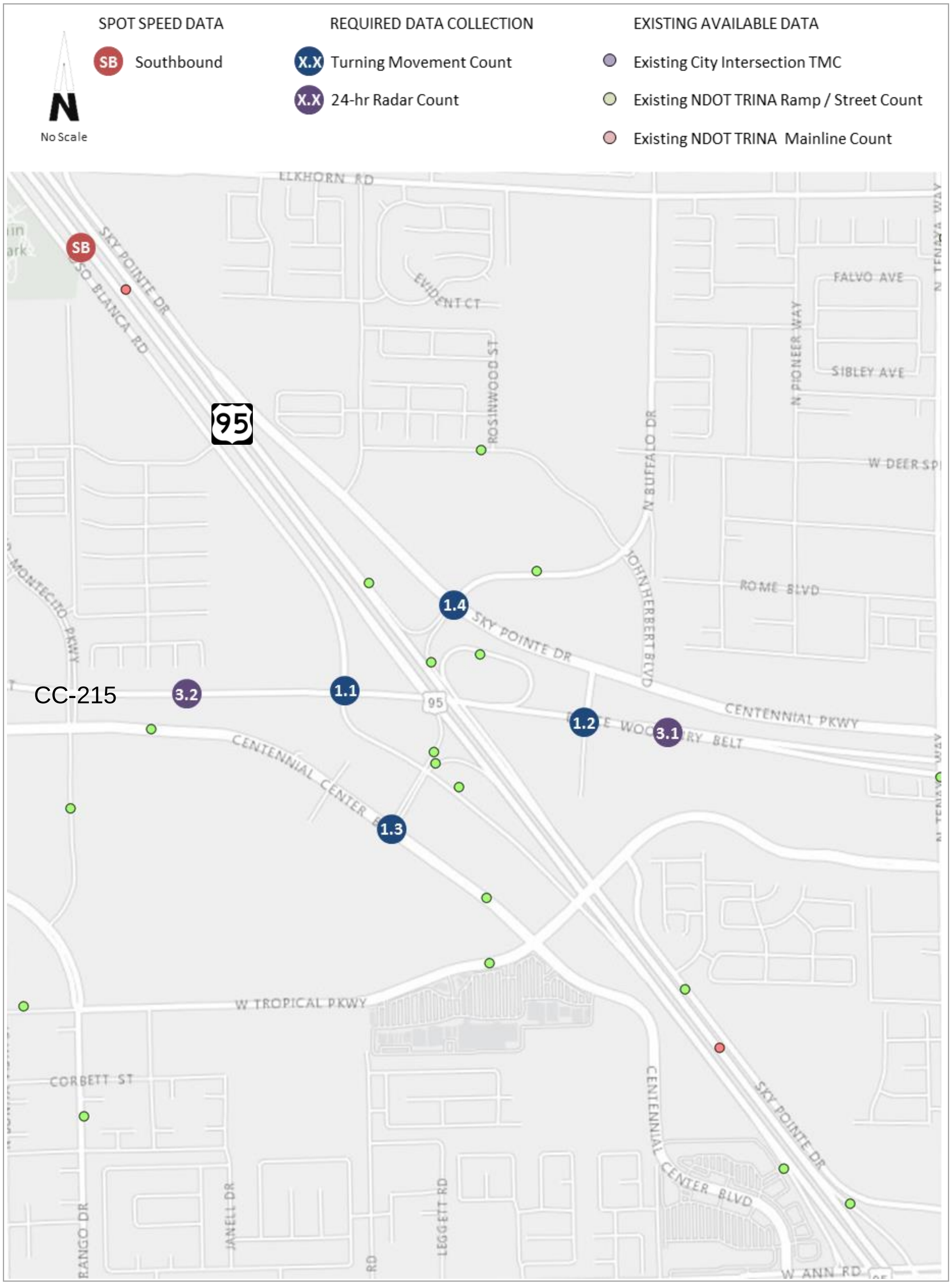
Travel Time Data

Travel time data is to be obtained from the FAST online database, where available. Further travel time data may be obtained from INRIX on a case-by-case basis, dependent on validation.

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors. Traffic count and calibration data will be reviewed for consistency and reasonableness.

Figure 1. Data Collection Site Map



Data Collection Plan
US95: CC-215 to I-15

for

Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

November 28, 2016

Contents

Figures

Tables

CORRIDOR ANALYSIS DATA COLLECTION

This data collection plan provides details of existing data and sources, as well as additional data to be obtained, collection methods and assumptions. This data collection plan is tailored to the requirements for full corridor analysis and should only be used as reference for the above named corridor.

GEOMETRIC DATA

Required geometric data will be obtained from available construction drawings, field surveys, aerial photographs, geographical information system (GIS) files, and Google Earth / Streetview online tools. Data may include:

- Number and width of lanes
- Link length
- Vehicle storage length (turn bays)
- Lane add/drop/auxiliary location and length
- Ramp length
- Lane channelization
- Road Curvature

CONTROL DATA

The following control data will be collected using Google Earth and Streetview online tools:

- Sign data (field review)
    - Speed Limits
    - Traffic Control
- Signal control data for intersections identified in Table 1 will be requested from the Nevada Freeway and Arterial System of Transportation (FAST) and local agencies, including but not limited to Clark County, City of Las Vegas, City of North Las Vegas, and City of Henderson.

DEMAND DATA

All traffic demand data at intersections will be collected in 15-minute increments during AM and PM peak periods. Peak periods will be determined from existing FAST data and approved by NDOT prior to data collection. Mainline and ramp demand data will be collected in 15-minute increments for 24-hour periods. The following demand data will be collected, at locations as identified within this collection plan:

- Turning Movements.
- Entry volumes (ramp and mainline counts).
- Mainline highway vehicle mix (light truck and heavy truck volume), available from NDOT.

TRAFFIC COUNTS

Assumptions and Data Needs

- Existing data to be used where identified as available. Only existing data newer than January 1st, 2013 to be used. 2013 has been identified as including significantly more data from existing sources than 2012, forming a natural cut-off for inclusion from existing sources.
- Ramp (or ramp connector) traffic volumes from NDOT TRINA. Where additional data is required, 24-hour tube counts are to be obtained.
- Mainline traffic volumes from NDOT TRINA. If additional count data is required, supplemental radar counts will be obtained.
- AM and PM peak period turning movement counts at ramp terminals/intersections. Limited data has been made available from the City of Las Vegas and the City of Henderson. When additional data is required, intersection turn movement counts are to be obtained.
- Tables 1 through 3 identify existing available data, and required data collection. Site maps of existing data availability and required data collection are provided in Figures 1a through 1d.

Table 1. Intersection TMC Data – Available Data / Collection Requirements

AVAILABLE DATA			
Cross-Street	**Ramps / Other**	**Date**	**Agency**
Ann Rd	US95 NB Ramps	3-Jun-15	City of Las Vegas
Ann Rd	US95 SB Ramps	4-Jun-15	City of Las Vegas
Ann Rd*	Tenaya Way	25-Mar-15	City of Las Vegas
Ann Rd*	Centennial Center Blvd	24-Sep-15	City of Las Vegas
Rainbow Blvd*	Rancho Dr	26-Jun-14	City of Las Vegas
Craig Rd	US95 NB Ramps	15-Jan-13	City of Las Vegas
Craig Rd	US95 SB Ramps	15-Jan-13	City of Las Vegas
Craig Rd*	Tenaya Way	22-Jan-14	City of Las Vegas
Cheyenne Ave	US95 NB Ramps	16-Jun-15	City of Las Vegas
Cheyenne Ave	US95 SB Ramps	17-Jun-15	City of Las Vegas
Cheyenne Ave*	Tenaya Way	10-Dec-13	City of Las Vegas
Rainbow Blvd*	Westcliff Dr	8-Sep-16	City of Las Vegas
Jones Blvd	US95 EB Ramps	25-Sep-13	City of Las Vegas
Jones Blvd	US95 WB Ramps	19-Sep-13	City of Las Vegas
Jones Blvd*	Washington Ave	5-Sep-13	City of Las Vegas
Jones Blvd*	Alta Dr	9-Jul-14	City of Las Vegas
Decatur Blvd	US95 EB Ramps	28-Oct-15	City of Las Vegas
Decatur Blvd	US95 WB Ramps	16-Apr-13	City of Las Vegas
Decatur Blvd*	Meadows Ln	29-May-14	City of Las Vegas
Valley View Blvd*	Meadows Mall Dr	6-Mar-13	City of Las Vegas
Valley View Blvd*	Bonanza Rd	17-Sep-13	City of Las Vegas
Rancho Dr	US95 Ramps (SPUI)	10-Sep-13	City of Las Vegas
Rancho Dr*	Bonanza Rd	18-Sep-13	City of Las Vegas

* Not required for HCS analysis, for information only

DATA COLLECTION EFFORT	
Intersection Description	**ID**
Lake Mead Blvd / Rock Springs Dr	1.1
Lake Mead Blvd / Rainbow Blvd	1.2
Valley View Blvd / US95 EB Ramps	1.3
Valley View Blvd / US95 WB Ramps	1.4

Table 2. 24-hour Ramp Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA		
Ramp Description	**Station ID**	**Year**
US95 SB Off-Ramp to Ann Rd	30196	2015
US95 SB On-Ramp from Ann Rd	30183	2015
US95 NB Off-Ramp to Ann Rd	30179	2015
US95 NB On-Ramp from Ann Rd	30184	2015
US95 SB Off-Ramp to Rancho Dr	30018	2015
US95 NB Off-Ramp to Rancho Dr	30177	2015
US95 NB On-Ramp from Rancho Dr	32285	2015
US95 SB Off-Ramp to Craig Rd	30877	2013
US95 SB On-Ramp from Craig Rd	30878	2015
US95 NB Off-Ramp to Craig Rd	30875	2015
US95 NB On-Ramp from Craig Rd	30876	2015
US95 SB Off-Ramp to Cheyenne Ave	30872	2015
US95 SB On-Ramp from Cheyenne Ave	30873	2015
US95 NB Off-Ramp to Cheyenne Ave	30874	2015
US95 NB On-Ramp from Cheyenne Ave	30871	2015
US95 NB On-Ramp from Rainbow Blvd (@ Lake Mead)	30921	2015
US95 NB Off-Ramp to Lake Mead Blvd EB	30917	2015
US95 NB Off-Ramp to Lake Mead Blvd WB	30920	2015
US95 SB Off-Ramp to Lake Mead Blvd	30922	2015
US95 SB On-Ramp from Lake Mead Blvd EB	30918	2015
US95 SB On-Ramp from Lake Mead Blvd WB	30919	2015
US95 WB Off-Ramp to Jones Blvd	30707	2015
US95 WB On-Ramp from Jones Blvd	30708	2015
US95 EB Off-Ramp to Jones Blvd	30709	2015
US95 EB On-Ramp from Jones Blvd	30710	2015
US95 WB Off-Ramp to Decatur Blvd	30451	2015
US95 WB On-Ramp from Decatur Blvd	30452	2015
US95 EB Off-Ramp to SB Decatur Blvd	31461	2015
US95 EB Off-Ramp to NB Decatur Blvd	30449	2015
US95 EB On-Ramp from Decatur Blvd	30450	2015
US95 WB Off-Ramp to Valley View Blvd	30700	2015

AVAILABLE TRINA DATA CONTINUED….		
Ramp Description	**Station ID**	**Year**
US95 WB On-Ramp from Valley View Blvd	30701	2015
US95 EB Off-Ramp to Valley View Blvd	30702	2015
US95 EB On-Ramp from Valley View Blvd	30703	2015
US95 WB Off-Ramp to Rancho Dr	30397	2015
US95 WB On-Ramp from Rancho Dr	30398	2015
US95 EB Off-Ramp to Rancho Dr	30399	2015
US95 EB and I-15 SB On-Ramp from Rancho Dr	31460	2015
US95 EB On-Ramp from Rancho Dr	30396	2015
US95 EB Off-Ramp to Martin Luther King Blvd	31048	2016
US95 WB On-Ramp from Martin Luther King Blvd	31001	2016

DATA COLLECTION EFFORT	
Ramp Description	**ID**
NONE	

Table 3. 24-hour Mainline Data – Available Data / Collection Requirements

AVAILABLE TRINA DATA	
US95 Count Station Description	**Station ID**
US-95 0.2 mi S of SR-596 (Jones Bl)	32220
.3 mi S of the Lake Mead Intch 'Exit 82A'	30718
500ft S of the Valley View Intch 'Exit 78'	30322
.4 mi N of the Rancho/Ann Intch 'Exit 86'	30720
100ft S of the Cheyenne Intch 'Exit 83'	30716
300ft S of Summerlin/Rainbow Intch 'Exit 81'	30719
.1 mi S of the Craig Intch 'Exit 85'	30715
.5 mi S of Lone Mountain Rd	30713
btwn the Decatur Intch 'Exit 79' and the Valley View Intch 'Exit 78'	30323

DATA COLLECTION EFFORT
NONE

General Requirements

- Traffic data will be collected when no construction activities, street, or lane closures are occurring at nearby locations. Where Project Neon construction activities render data collection unusable, NDOT will be consulted to determine an appropriate course of action.

- All data collection will be conducted on Tuesday, Wednesday, and Thursday and when school is in session, unless explicitly noted otherwise.
- All collected TMC data is to be classified by car / light vehicles, heavy vehicles, bicycles, and pedestrians

Time Periods

- Intersection TMC and queues, 3-hour AM Peak Period as approved by NDOT, 15-minute increments
- Intersection TMC and queues, 3-hour PM Peak Period as approved by NDOT, 15-minute increments

Deliverables

- Turning movement count summaries (one per intersection for each time period).
- Intersection configuration sheet per intersection (lane with numbers that match manual queue length observation sheets).

QUALITY ASSURANCE AND RECONCILIATION

Data collected will be reviewed and checked for errors.

Figure 1a. Data Collection Site Map North to South

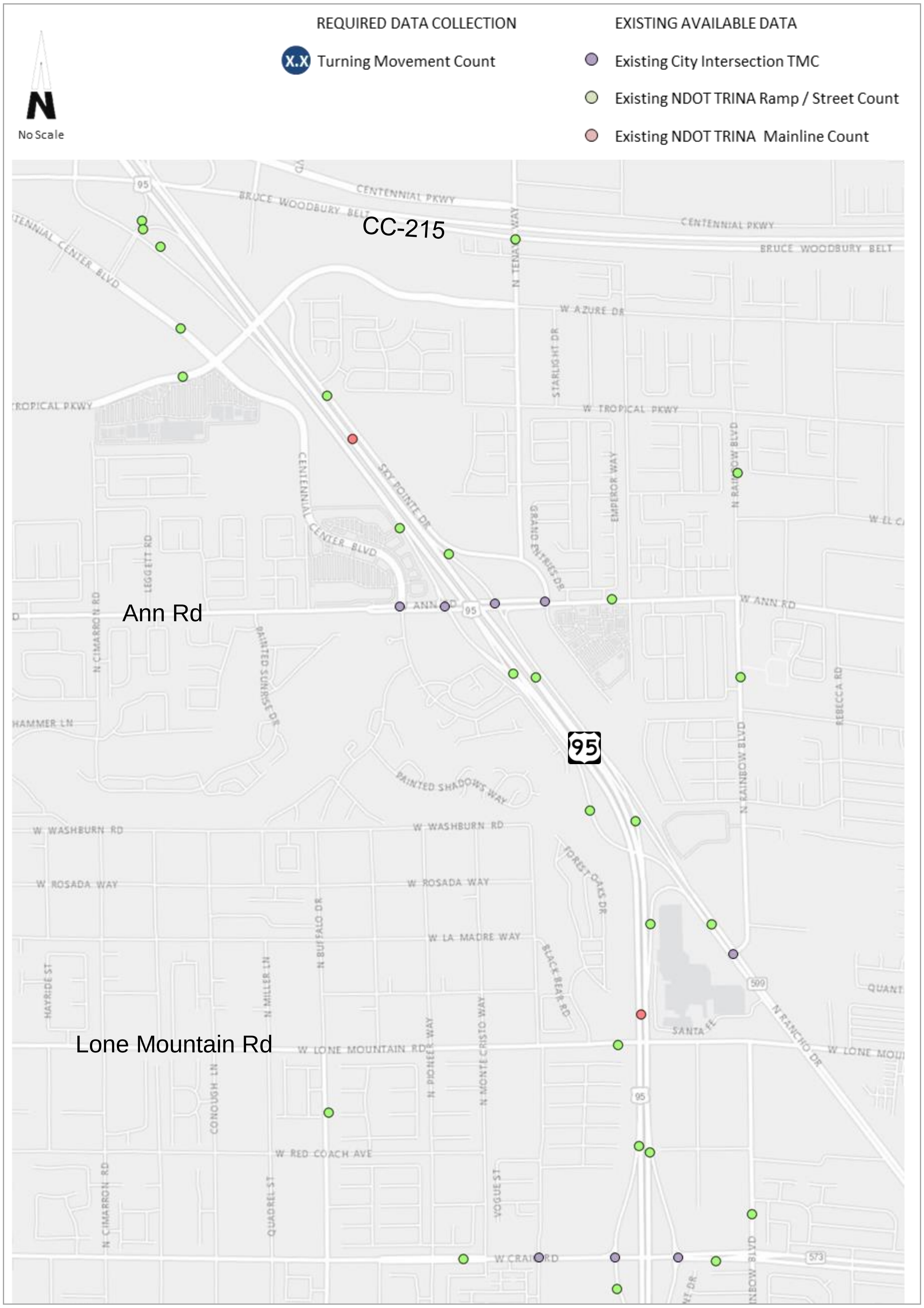


Figure 1b. Data Collection Site Map North to South

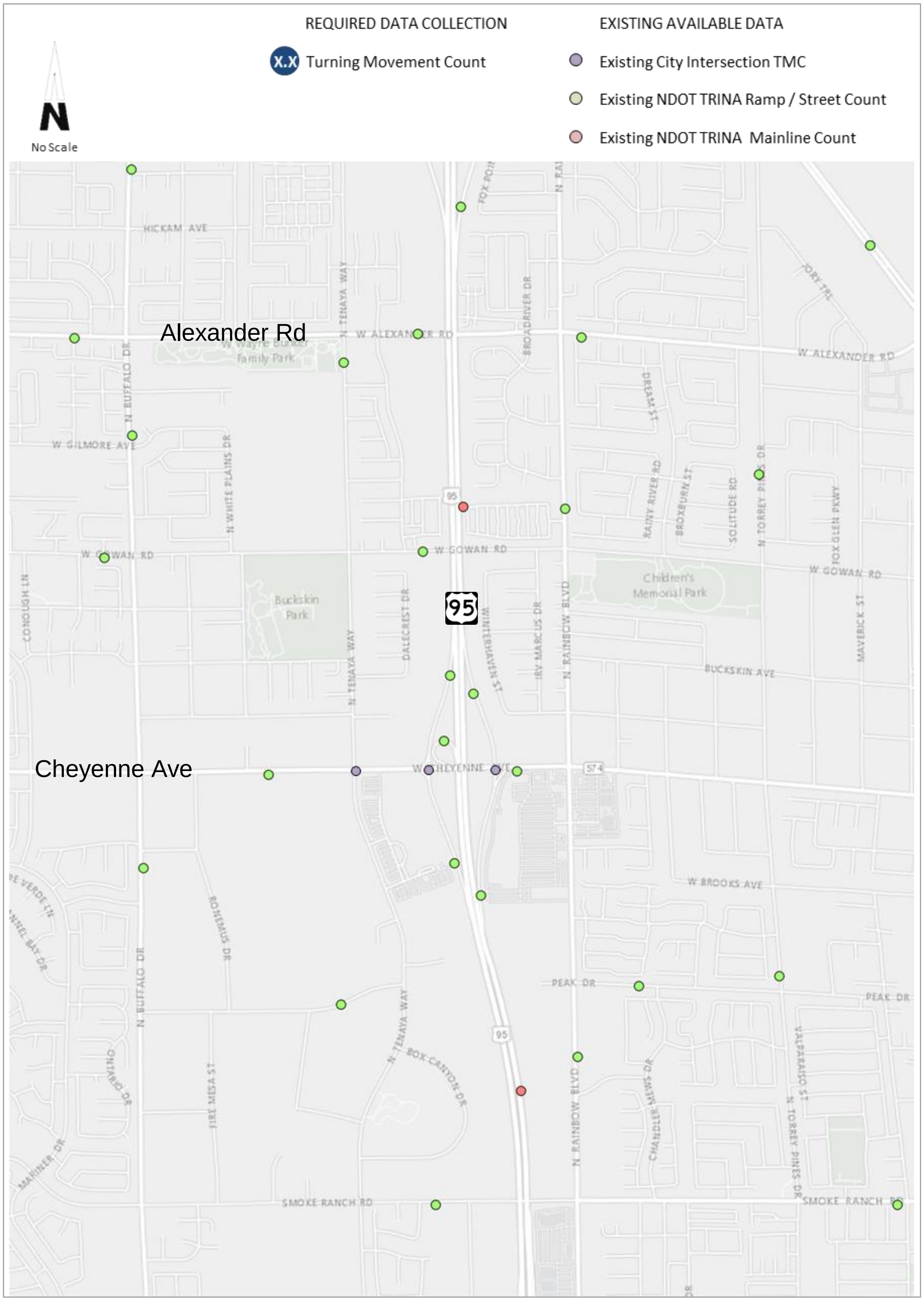


Figure 1c. Data Collection Site Map North to South

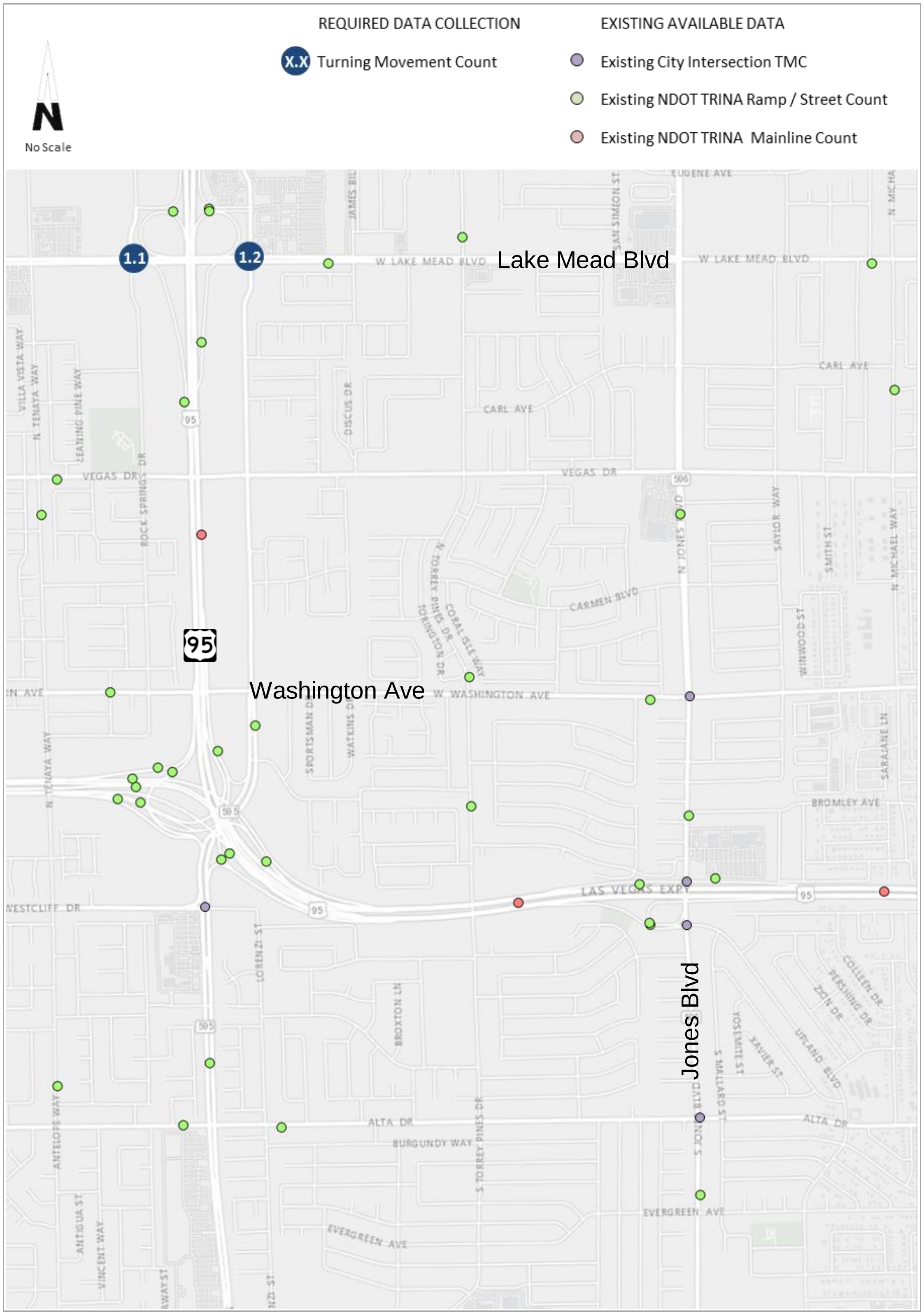
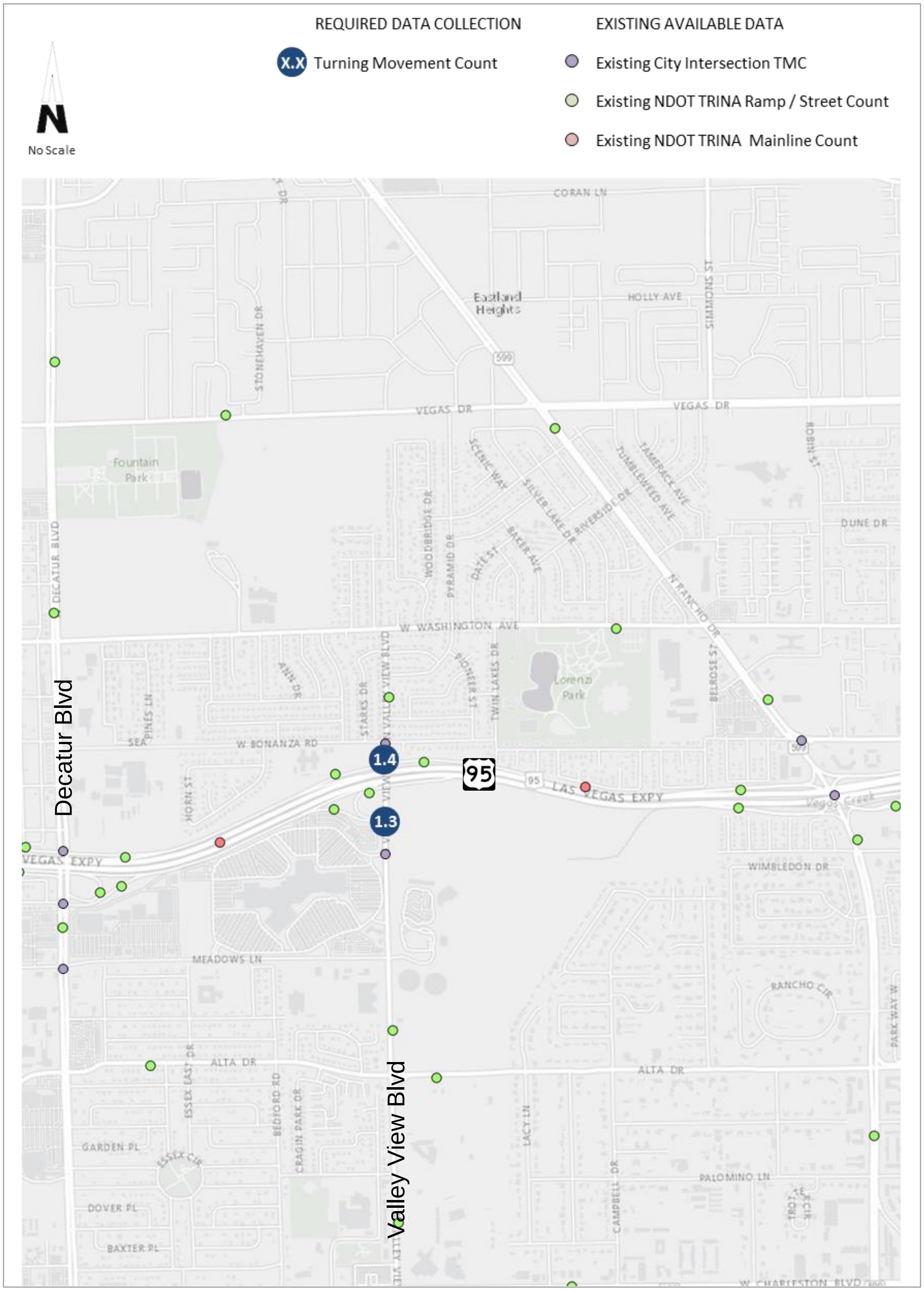


Figure 1d. Data Collection Site Map North to South



Appendix B-2
Importing a TRANSCAD Model to Aimsun Next

Importing a TransCAD model to Aimsun

1. Introduction

This guide shows the steps required to import an existing TransCAD model to Aimsun.

The data that can currently be transferred are:

- Road network, including all the attributes that are associated to links and nodes
- Centroids and centroid connectors
- OD matrices

The next chapter describes the preparation of the preparation and the export of the network and the matrices from TransCAD, in such a format that can be easily read by Aimsun.

The last chapter describes the procedure to read into Aimsun the files exported from TransCAD.

2. Exporting the data from TransCAD

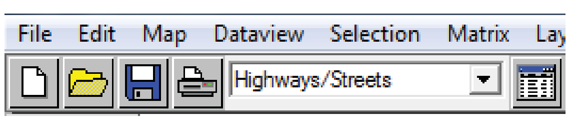
This chapter describes the steps required to export from TransCAD the network as a link and node shapefile, and the matrices as text files, structured as required to be imported by Aimsun. Not only the file format is important, but also the data fields and their structure.

2.1. Exporting the network

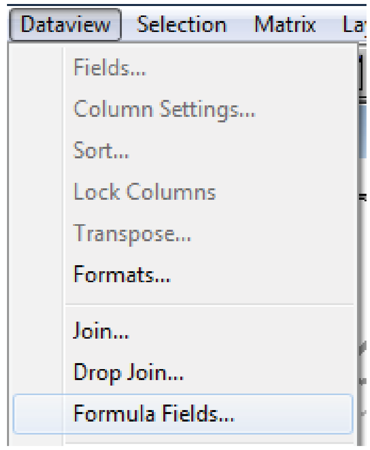
Open in TransCAD the geographic file that contain the network (links, nodes, centroid connectors and centroids).

Before saving the links and the nodes as shapefiles, you have to associate to each link the From Node ID and To Node ID, otherwise Aimsun will not be able to create the turning movements between the links.

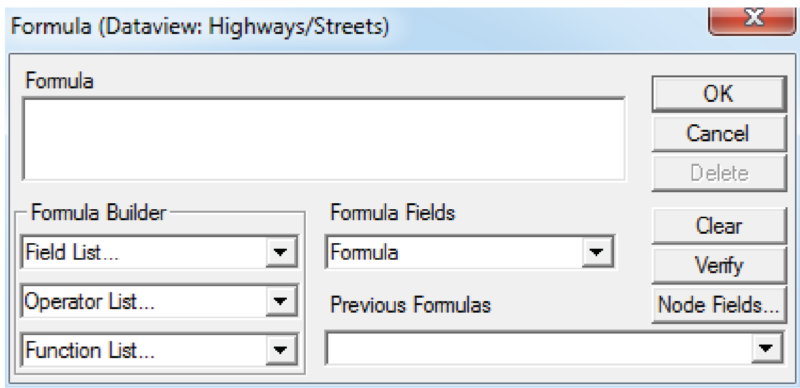
For this purpose, activate the *Highways/Street* layer



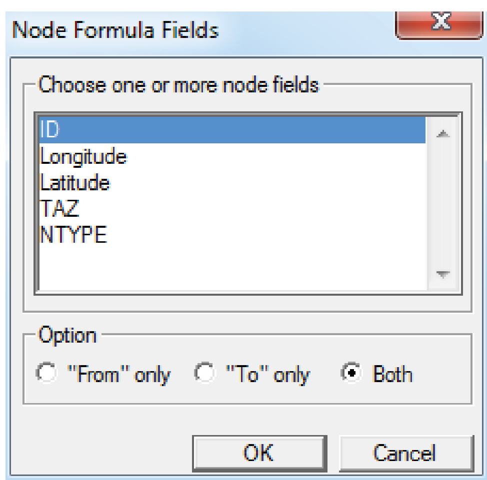
Go to the *Dataview* -> *Formula Fields...* menu



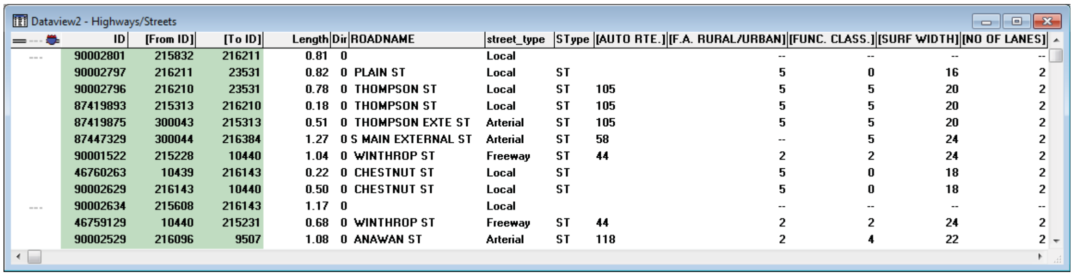
Press *Node Fields...*



Select *ID*, check *Both* and finally press *OK*

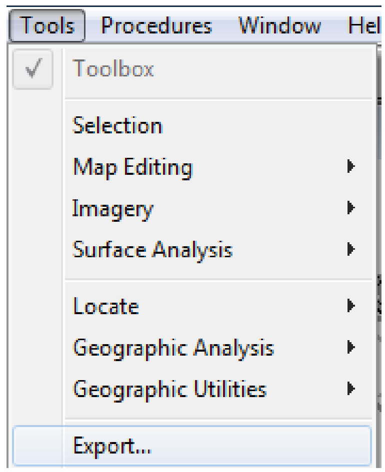


If you open the dataview, you can check that it now contains two additional fields, *[From ID]* and *[To ID]*

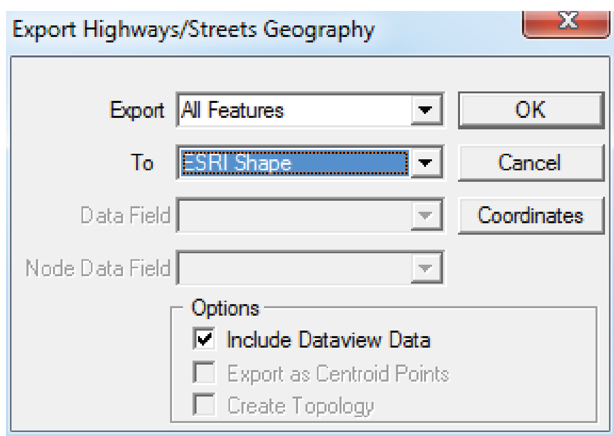


ID	[From ID]	[To ID]	Length	Dir	ROADNAME	street_type	SType	[AUTO RTE.]	[F.A. RURAL/URBAN]	[FUNC. CLASS.]	[SURF WIDTH]	[NO OF LANES]
90002801	215832	216211	0.81	0		Local			--	--	--	--
90002797	216211	23531	0.82	0	PLAIN ST	Local	ST		5	0	16	2
90002796	216210	23531	0.78	0	THOMPSON ST	Local	ST	105	5	5	20	2
87419893	215313	216210	0.18	0	THOMPSON ST	Local	ST	105	5	5	20	2
87419875	300043	215313	0.51	0	THOMPSON EXTE ST	Arterial	ST	105	5	5	20	2
87447329	300044	216384	1.27	0	S MAIN EXTERNAL ST	Arterial	ST	58	--	5	24	2
90001522	215228	10440	1.04	0	WINTHROP ST	Freeway	ST	44	2	2	24	2
46760263	10439	216143	0.22	0	CHESTNUT ST	Local	ST		5	0	18	2
90002629	216143	10440	0.50	0	CHESTNUT ST	Local	ST		5	0	18	2
90002634	215608	216143	1.17	0		Local			--	--	--	--
46759129	10440	215231	0.68	0	WINTHROP ST	Freeway	ST	44	2	2	24	2
90002529	216096	9507	1.08	0	ANAWAN ST	Arterial	ST	118	2	4	22	2

You can now save the links as a shapefile. For this purpose, go to the *Tools* -> *Export...* menu

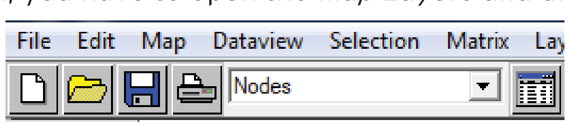


Choose *All Features* as filter and *ESRI Shape* as format, press *Coordinates* and ensure that the *Coordinate System* is set as *Longitude, Latutude*, ensure that the *Include Dataview Data* option is checked, and finally press *OK*

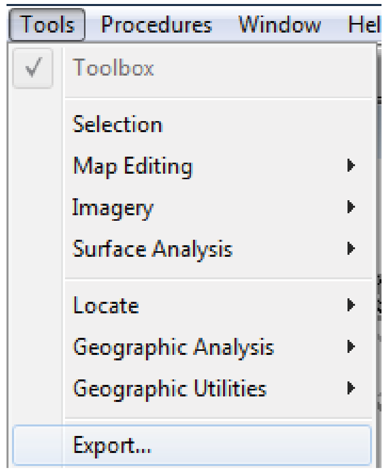


Exporting the nodes is optional: Aimsun doesn't need a node shapefile to import the network. However, if you provide it, all the node attributes will be available in Aimsun.

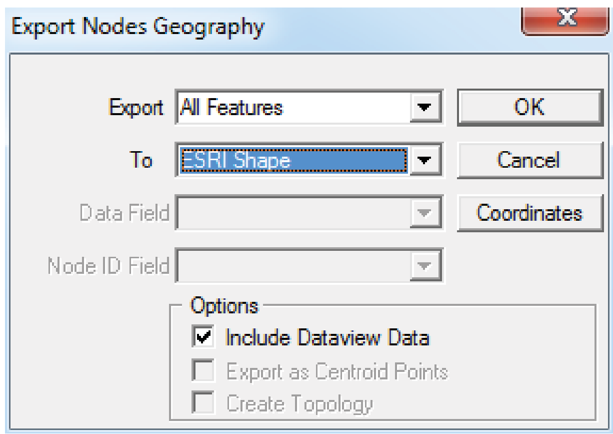
To save the nodes as a shapefile, activate the *Nodes* layer (if it is not shown in the drop-down box, you have to open the *Map Layers* and unhide it)



Go to the *Tools* -> *Export...* menu



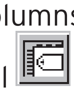
Choose *All Features* as filter and *ESRI Shape* as format, and finally press *OK*

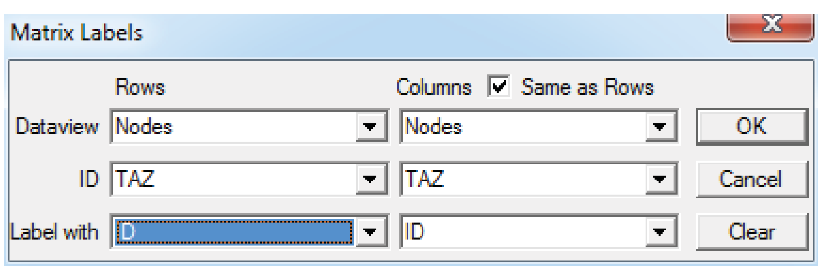


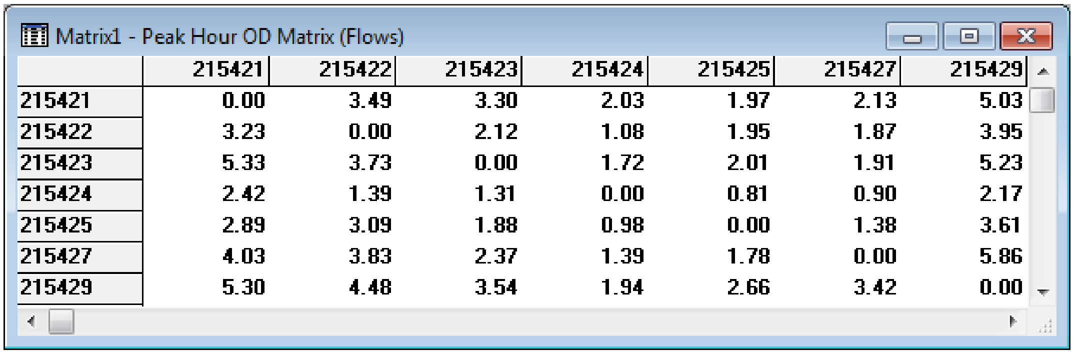
2.2. Exporting the matrices

Without closing the network, open the matrix file.

Before exporting it, you have to label the rows and columns with the node IDs.

This can be done with the *Row and Columns Label* tool 

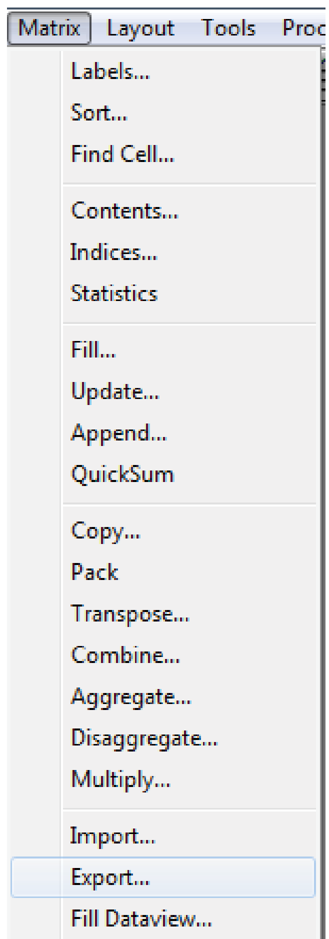




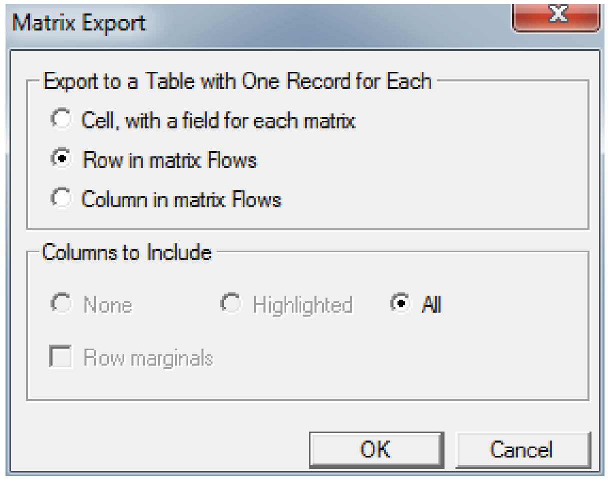
	215421	215422	215423	215424	215425	215427	215429
215421	0.00	3.49	3.30	2.03	1.97	2.13	5.03
215422	3.23	0.00	2.12	1.08	1.95	1.87	3.95
215423	5.33	3.73	0.00	1.72	2.01	1.91	5.23
215424	2.42	1.39	1.31	0.00	0.81	0.90	2.17
215425	2.89	3.09	1.88	0.98	0.00	1.38	3.61
215427	4.03	3.83	2.37	1.39	1.78	0.00	5.86
215429	5.30	4.48	3.54	1.94	2.66	3.42	0.00

If the file contains several matrices, select the one to export from the drop-down box 

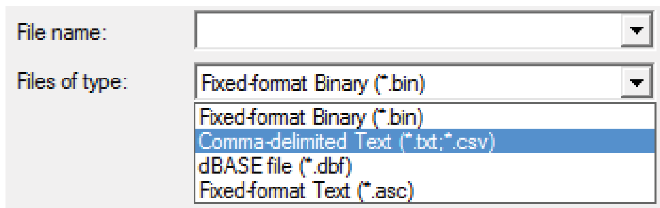
, then go to the *Matrix* -> *Export*... menu



Check the option to export one record for each row in the matrix and press OK



And finally select *Comma-delimited Text* or *dBASE file* as file type



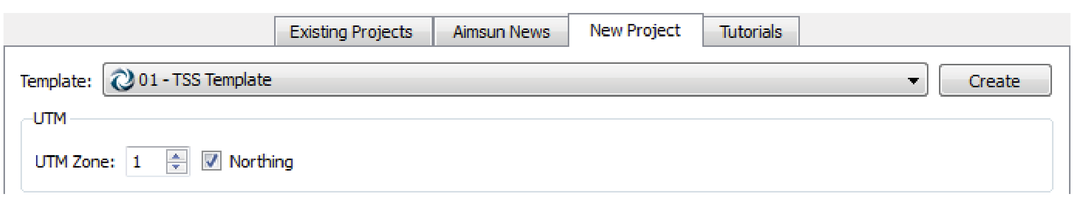
Repeat the process for all the matrices you want to export.

3. Importing the data in Aimsun

This chapter describes the steps required to import in Aimsun the files exported from TransCAD.

3.1. Preparing the template

Create a new project using a template. If you didn't change the default coordinate system when exporting the shapefiles, it's not necessary to set the UTM zone, as it will be determined from the latitude and longitude.

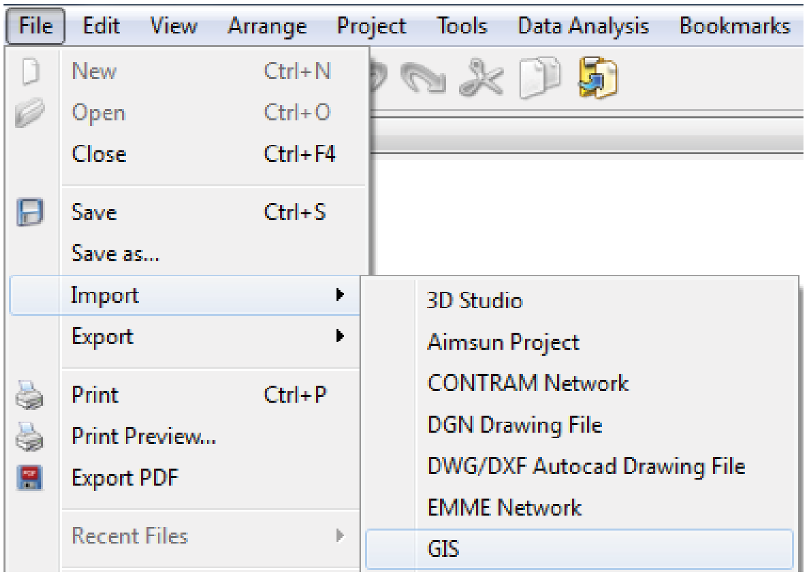


Before staring the import process, you have to create the Road Types and the Volume Delay Functions that will have to be associated to the links imported from TransCAD: the importer will ask you which Road Types in Aimsun correspond to different values of an attribute in TransCAD (e.g. TYPE or STREET_TYPE), and which Volume Delay Functions in Aimsun correspond to different values of an attribute in TransCAD (e.g. TYPE or LTYPE).

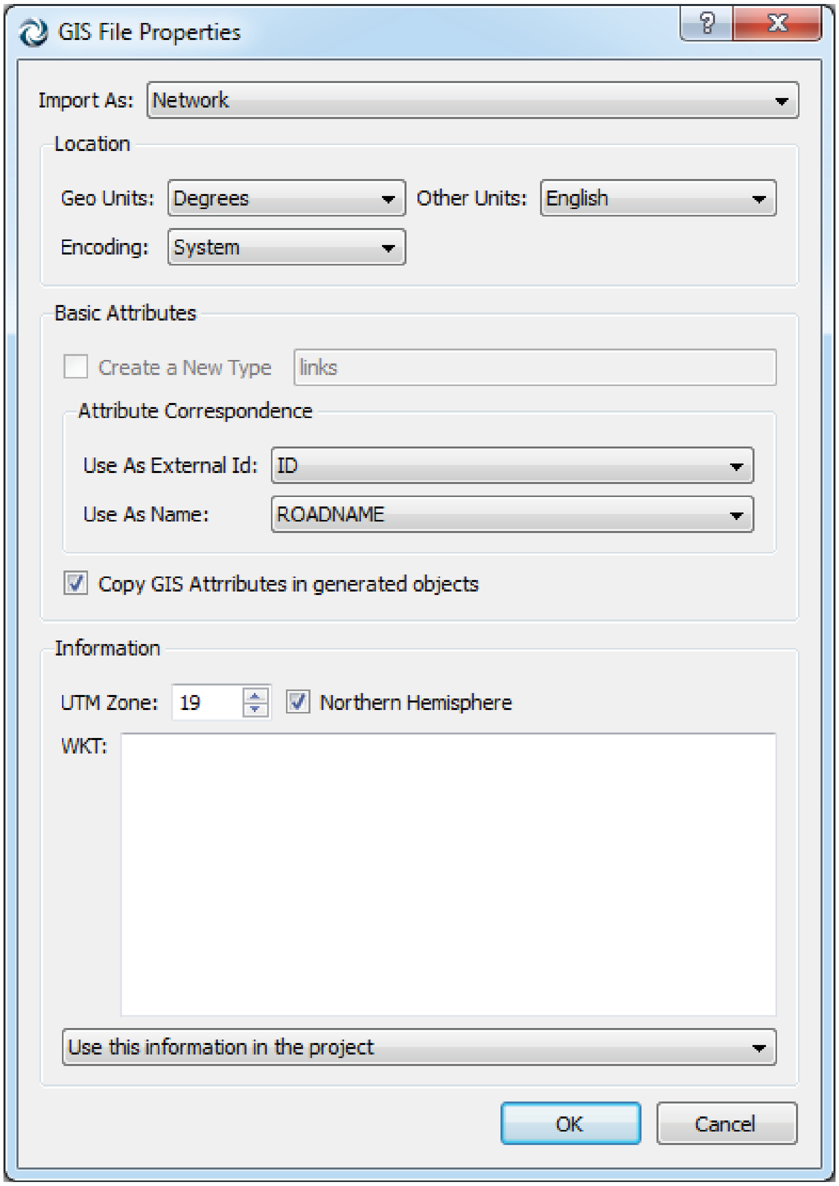
You can set them later, but if done beforehand the import process is smoother.

3.2. *Importing the network*

Go to the *File* -> *Import* -> *GIS* menu.



Select the link shapefile exported from TransCAD. Choose *Import As: Network*, set the *Location* options as appropriate, and select the fields to be used as External ID and as Name for the road sections (Aimsun automatically proposes its best guess). The *Copy GIS Attributes in generated objects* ensures that all the fields in the shapefile will be available as attributes in Aimsun. Verify that the UTM Zone has been recognized correctly, and press *OK*.

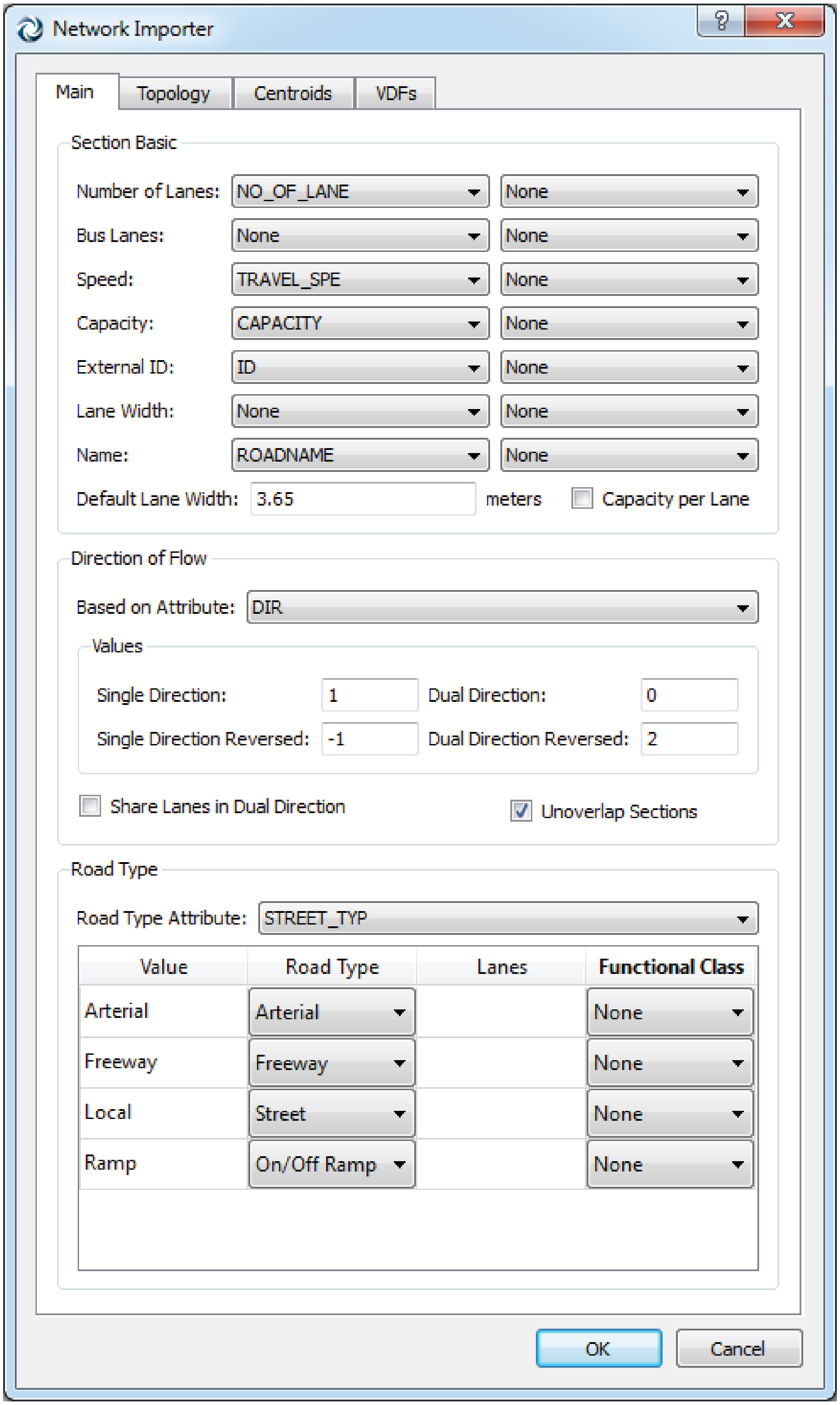


In the next window you have to define a set of conditions to map the attributes, to define the topology, to identify the centroids and centroid connectors, and to map the Volume Delay Functions.

In the *Main* tab, under *Section Basic* chose the fields in the shapefile that correspond to number of lanes, bus lanes, speed, capacity, external ID, lane width and name. The second column of dropdown boxes allows choosing a different field for each direction if the link is bidirectional. If the lane width is not specified in a field, set the default lane width. Check *Capacity per Lane* if the value in the capacity field is per lane and not per link.

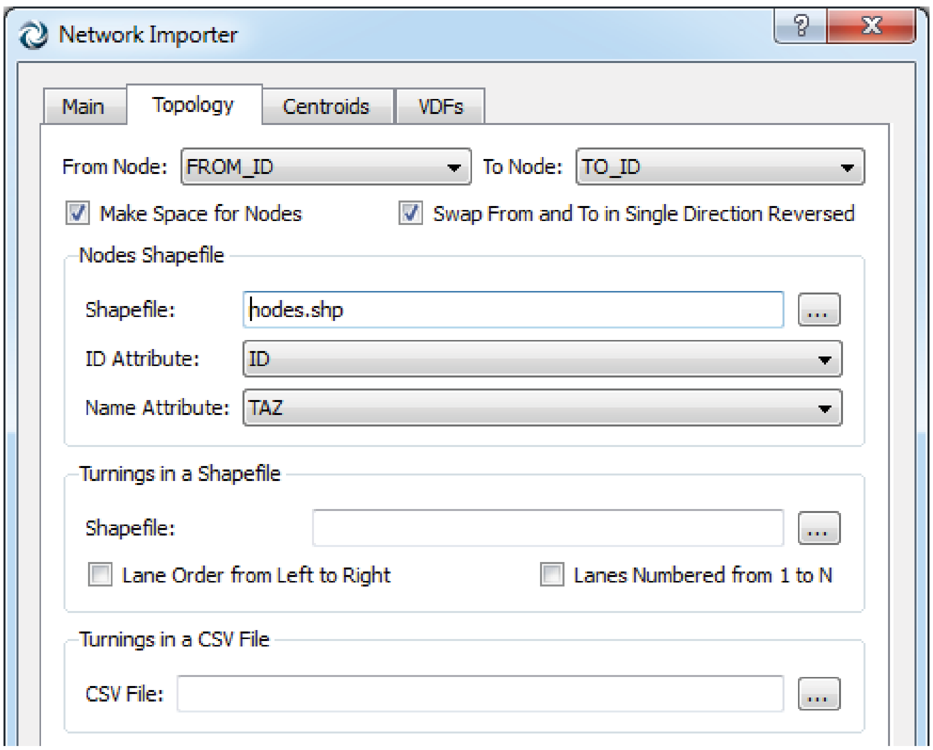
Under *Direction of Flow*, select the DIR field and set 1 for single direction, -1 for single direction reversed, 0 for dual direction and any other number for dual direction reversed (it's not used in TransCAD). Check *Unoverlap Sections* and uncheck *Share Lanes in Dual Direction*, unless the number of lanes in the shapefiles is the total for both directions when the link is bidirectional.

Under *Road Type*, select the field (typically TYPE or STREET_TYPE) that provides the type of the link, and map each different value to a Road Type in Aimsun (if you didn't customise the road types, just choose between those in the template). The Lanes column can be used to set a default number of lanes for the different road types, in case it is not specified on a link by link basis.



Go to the *Topology* tab and select FROM_ID as *From Node* and TO_ID as *To Node*. Check both *Make Space for Nodes* (to offset the beginning and end of the sections so that there is space for the intersection area) and *Swap From and To in Single Direction Reversed* (to specify that the From Node is TO_ID and the To Node is FROM_ID in case the direction is -1).

If you want the node fields to be available in Aimsun as attributes of the intersections, under *Node Shapefile* select the file exported from TransCAD. Choose the field to be used as external ID and the one to be used as name.



At each node, Aimsun will generate all the turns from all the sections that have this node as FROM_ID to all the sections that have it as TO_ID (except u-turns).

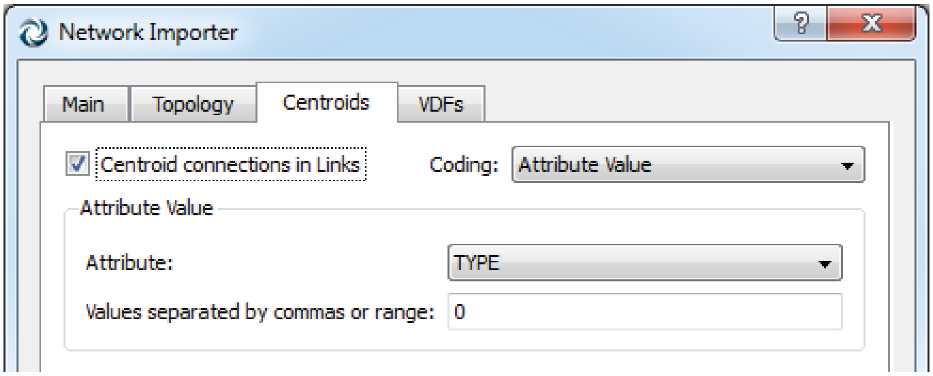
In alternative, you can produce a .csv file (comma separated, no header) that contains the three following fields

node ID, from section ID, to section ID

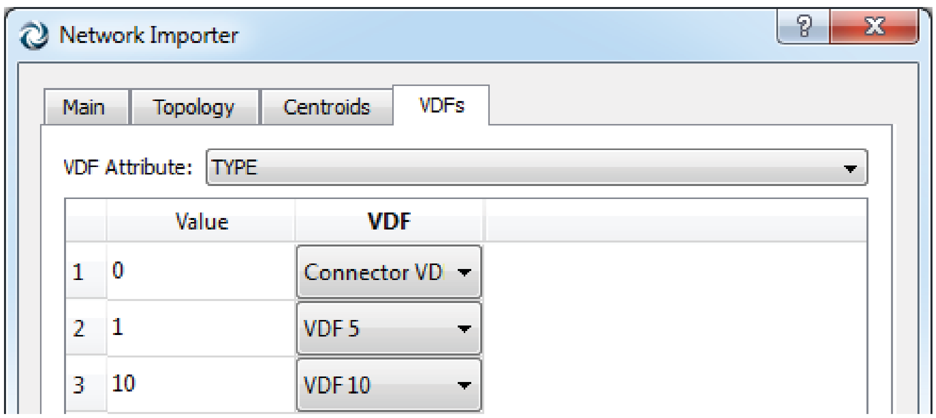
and select it under the *Turnings in a CSV File*[1].

Go to the *Centroids* tab, check *Centroid connections in Links* and select *Attribute Value*. Choose below the attribute and the value(s) that identify a link as a centroid connector (typically TYPE = 0).

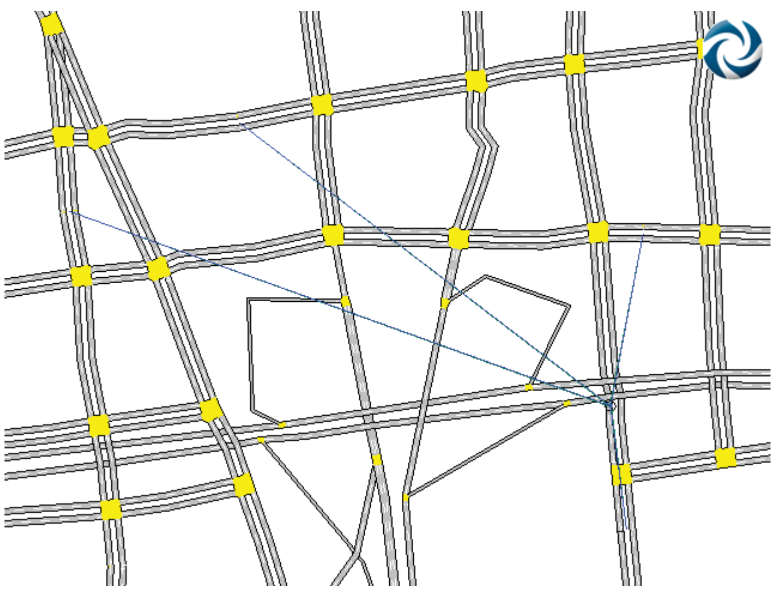
[1] In this case, the importer will create only the turns that are listed in the file, so it's not necessary to add to the fields From_ID and To_ID to the links in TransCAD.



If you created the volume-delay functions that correspond to the ones used in TransCAD before starting the import process, go to the *VDFs* tab, choose the attribute that should be used to select the proper function (typically TYPE or LTYPE), and assign one function for each different value. Otherwise the volume delay functions will be associated to the sections according to the Road Type in Aimsun.



Now press OK to start the conversion process.



If the network is big, some sections are hidden because their Functional Class is higher than 2; if this is the case, just zoom in to make them appear.

If you have coded in TransCAD the turn penalties, you can save that data file in .csv format (*File* -> *Save As...* and choose Comma-delimited text) and write a script that deletes the prohibited turns, creates the Turn Penalty Functions in Aimsun, and assigns them to the turns.

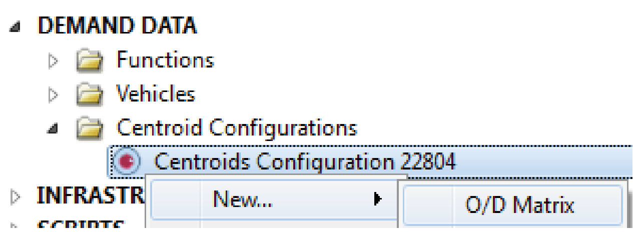
The GIS importer saves an XML file in the same folder of the shapefile containing the entire configuration used in the process. If you try to import the same file again, you will notice that the settings are maintained.

3.3. *Importing the matrices*

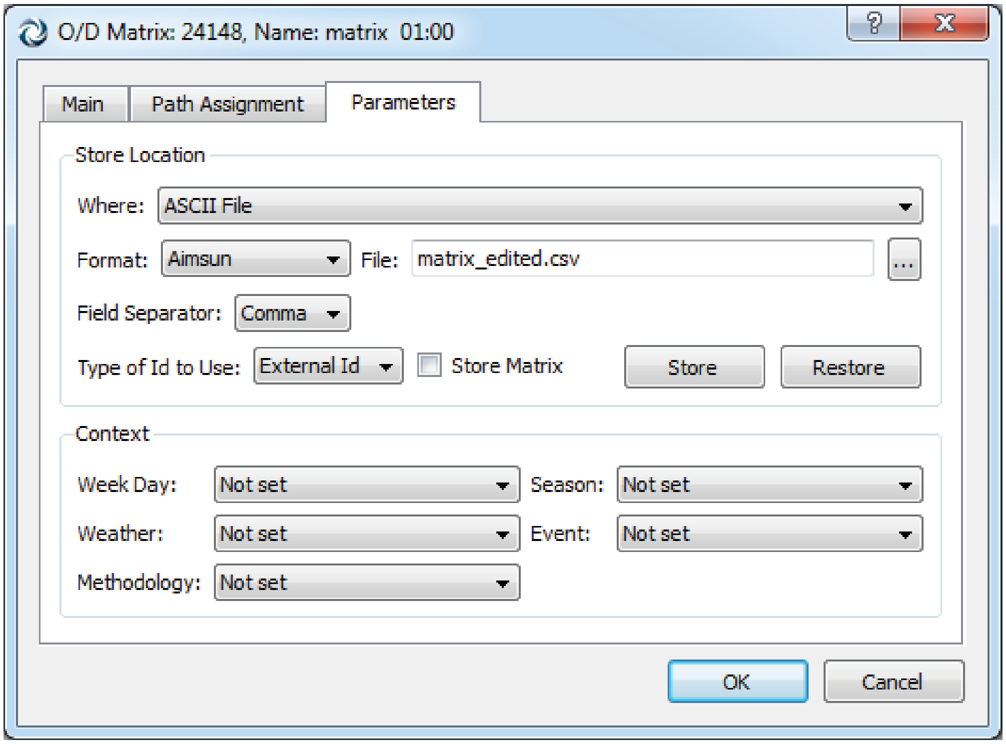
Open the file exported from TransCAD with Excel. Copy the first column, containing the origin identifiers, and paste it transposed, as first line, containing the destination identifiers. Save the file as CSV (comma delimited).

	A	B	C	D	E	F
1		215421	215422	215423	215424	215425
2	215421	0.00	3.49	3.30	2.03	1.97
3	215422	3.23	0.00	2.12	1.08	1.95
4	215423	5.33	3.73	0.00	1.72	2.01
5	215424	2.42	1.39	1.31	0.00	0.81
6	215425	2.89	3.09	1.88	0.98	0.00

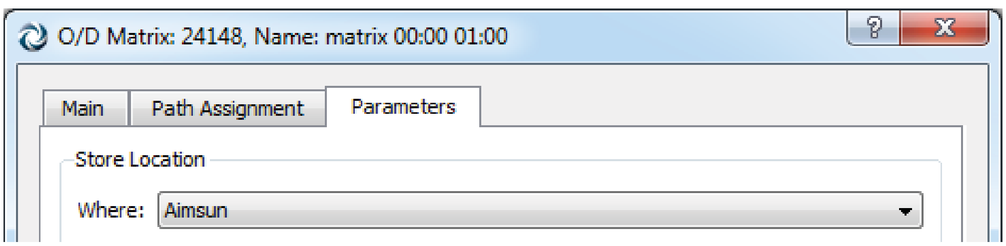
Create a new O/D Matrix in Aimsun and double click on it.



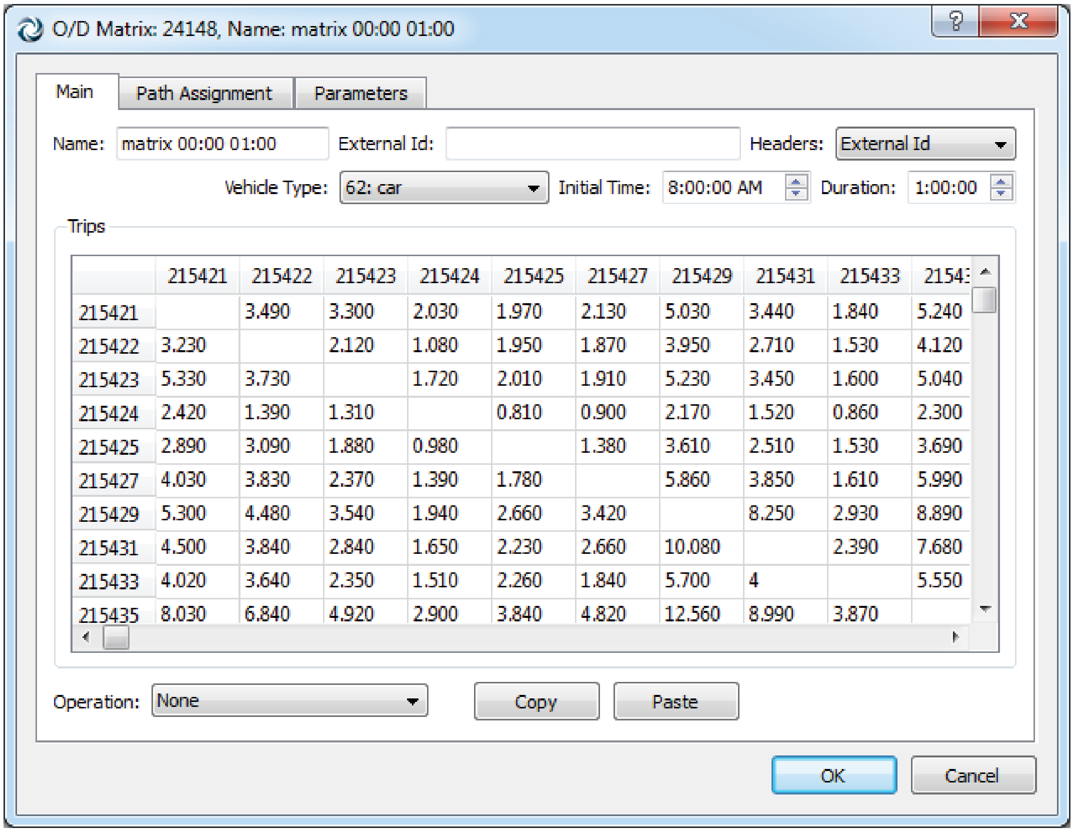
Go to the *Parameters* tab. Under Store Location choose *Where*: *ASCII File*, *Format*: *Aimsun*, *Field Separator*: *Comma*, *Type of Id to Use*: *External Id*, and select the CSV file saved in Excel (ignore the warning that the file already exists). Now press Restore.



If the import has been successful, switch back the store location to Aimsun, so that the trips are stored in the .ang file the first time you save.



Go to the *Main* tab, set the *Vehicle Type*, the *Initial Time* and the *Duration*, and press *OK*.



Repeat the procedure for all the matrices exported from TransCAD.

Appendix B-3
2040 Micro/Meso Future Volume Development Technical Memorandum

Southern Nevada Traffic Study

2040 Micro/Meso Future Volume Development Technical Memorandum

September 2018

Nevada DOT

HDR

2040 Micro/Meso Future Volume Development Technical Memorandum

for

Southern Nevada Traffic Study

Prepared for:

NEVADA DOT

Prepared by:

HDR

September 2018

Contents

Figures

INTRODUCTION

This document outlines the approach used to develop 2040 future traffic volumes for the Southern Nevada Traffic Study (SNTS), using standard methodologies to adjust the demand matrices outside of the Aimsun and TransCAD software packages. Input demand data sets were based on the Regional Transportation Commission of Southern Nevada's (RTCSNV) TransCAD travel demand model. Traffic counts collected in the field were used to create calibrated base year 2017 ("adjusted") traffic volumes for the study. This document describes the methodology used to apply the growth patterns forecasted by the RTCSNV TransCAD model to the calibrated 2017 adjusted matrix to develop a refined or "adjusted" 2040 set of traffic forecast volumes.

This document also provides an overview of why these methodologies were necessary and the benefits of the methodology selected.

2040 MICRO/MESO FUTURE VOLUME DEVELOPMENT

2040 "No-Build" macro-level future volume matrices were created using TransCAD and imported into Aimsun Next in the same manner as the 2017 matrices (as described in section 4.3 of the *2017 Aimsun Next Model Development and Calibration Report*). The macro-level TransCAD assignment volumes provided an initial demand set. However, it is standard industry practice to post-process travel demand model demand matrices by referencing observed field traffic counts in the base year. These post-processing adjustments are applied in the future year to produce refined traffic forecasts that are suitable for micro/meso analysis. The Aimsun software was not capable of providing these refined/post-processed demand sets. Thus, a methodology was developed that utilized the calibrated/adjusted 2017 traffic flows and the unique forecasted traffic patterns from the TransCAD model for the SNTS study area to establish refined/adjusted 2040 traffic volume forecasts.

The process of creating individual calibrated 2017 subnetwork matrices (as outlined in section 4.3 of the *2017 Aimsun Next Model Development and Calibration Report*) required a combination of creating subnetwork traversals and origin-destination (O-D) matrix adjustments. However, a new process was required to develop refined forecasts of 2040 future volume matrices.

Two methods were tested for development of the refined 2040 future volume matrices. The terms defined below are used in the discussion of the two methods.

- 2017 Unadjusted—A matrix that represents the subnetwork 2-hour O-D traversals that were created based on the full network 2017 TransCAD assignment using Aimsun Next static assignment process. These reflect "unadjusted" matrices as the full network matrices were taken directly from TransCAD output.
- 2017 Adjusted—A matrix that represents the product of O-D adjustments at the subnetwork level. The matrices were "adjusted" through an O-D matrix estimation (ODME) approach that refines individual O-D volume pairs to better fit observed traffic counts on subnetwork turns and sections.
- 2040 Unadjusted—A matrix that represents the subnetwork 2-hour O-D traversals (similar to the 2017 Unadjusted), that were generated based on the full network 2040 TransCAD assignment volumes. The

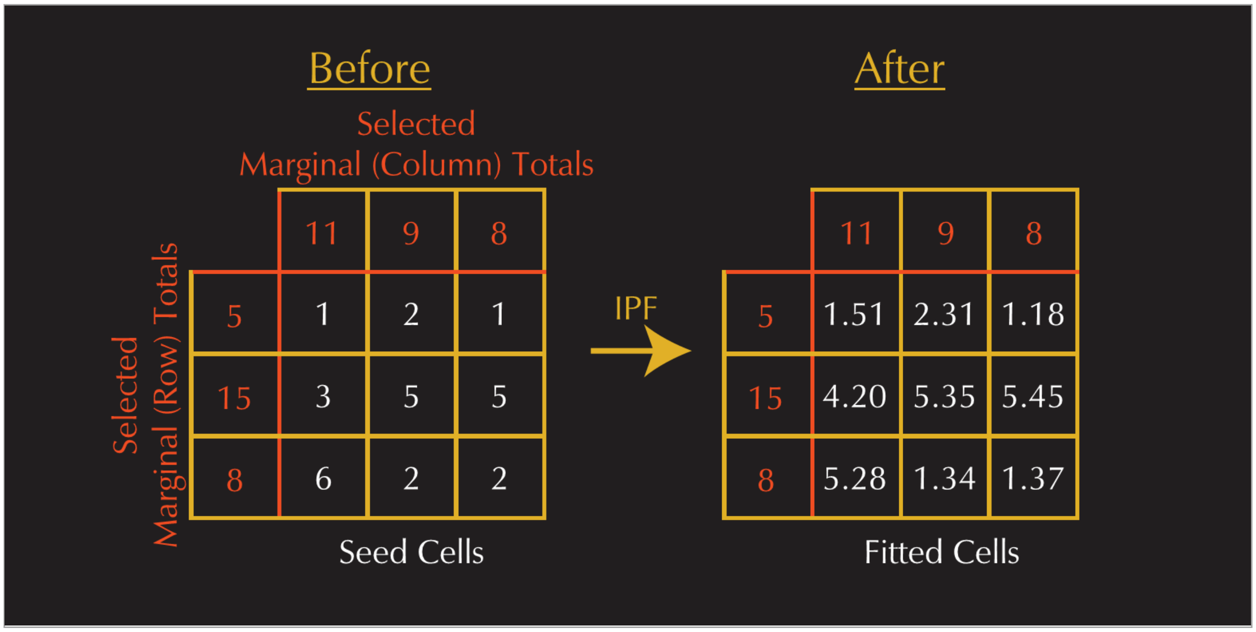
development of these matrices was created by running traversals of specific subnetworks based on the 2040 TransCAD full network matrices. No O-D adjustments were ran on "Unadjusted" matrices.

- 2040 Adjusted—A matrix that represents the refined "finished product" that was the result of applying the preferred matrix growth methodology detailed below.

Iterative Proportional Fitting Method

Sometimes referred to as the 'Raking' method, the Iterative Proportional Fitting (IPF) Method is an iterative procedure for adjusting a table of data cells such that they add up to the selected totals for both the columns and rows of the table. The unadjusted values in each data cell are referred to as the 'seeds' and the selected totals are referred to as the 'marginal' totals. Figure 1 shows an example of what the IPF Method looks like before and after application to a matrix.

Figure 1. Example of IPF Application



As illustrated in Figure 1, the row and column totals of the seeds from the "Before" matrix seed cells do not match the desired "selected" column and row marginal totals. The IPF Method adjusts the individual cell values, using the seeds as the starting point, until all row and column sums are equal to, or are as close as possible to, the desired marginal totals.

In the case of the SNTS study, the "Before" matrix was the 2017 unadjusted matrix and the "After" matrix was the 2017 adjusted matrix. A flow chart of how the IPF Method was applied to the SNTS study is presented in Figure 2.

Figure 2. Illustration of Potential IPF Approach Framework for the SNTS Study

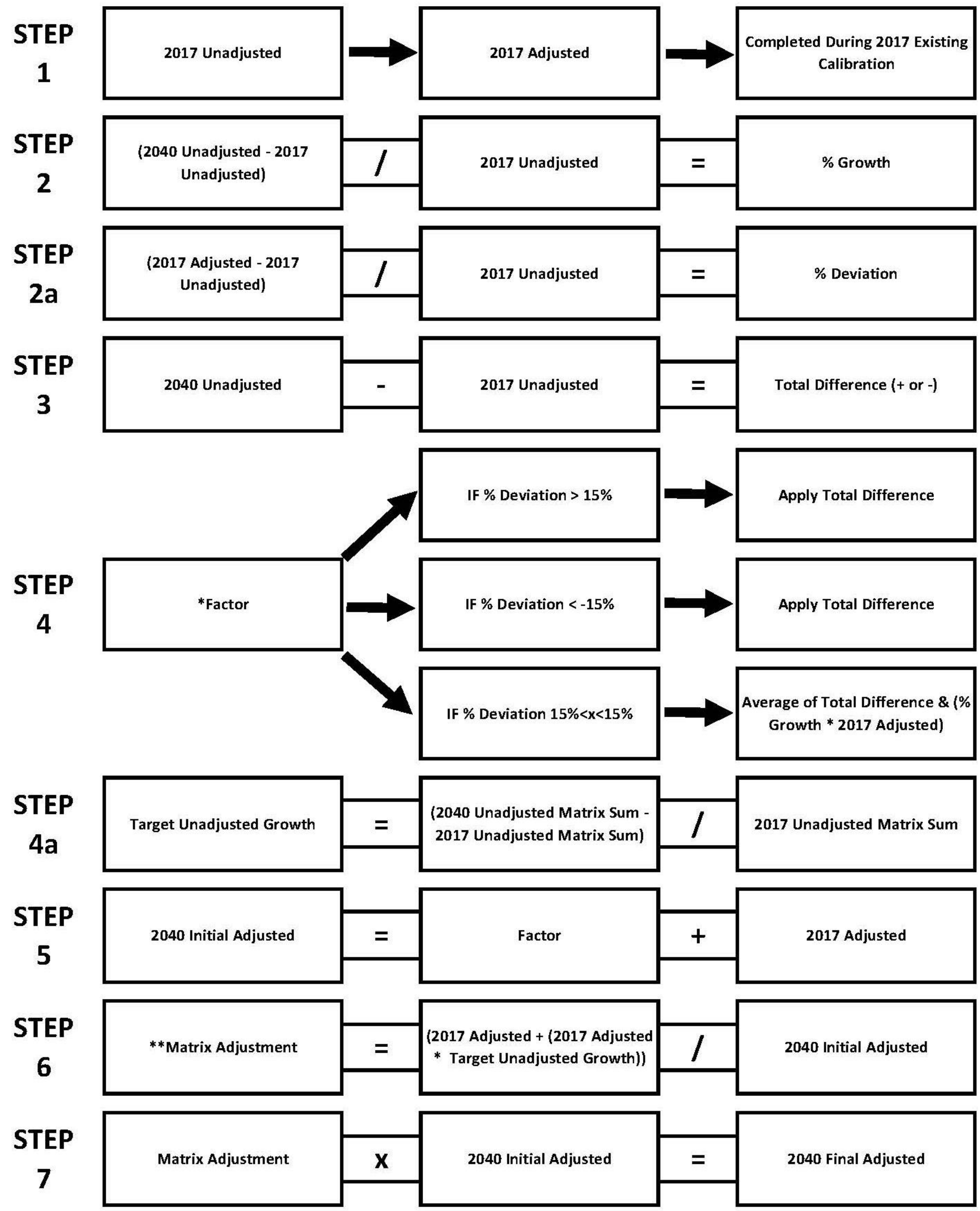
STEP 1	**2017 Unadjusted**	→	**2017 Adjusted**	→	**Completed During 2017 Existing Calibration**
STEP 2	**2040 Unadjusted**	**-**	**2017 Unadjusted**	**=**	**2040 Marginal Growth**
STEP 3	**2017 Adjusted**	**+**	**2040 Marginal Growth**	**=**	**2040 Target Origins & Destinations**
STEP 4	**Run Iterative Proportional Fitting (IPF)**	→	**2017 Adjusted Seed + 2040 Target Origins & Destinations**	→	**Continue iterative process until convergence is hit. (test was done at 100 iterations and 10% delta (cell changes)**

The IPF is a methodology that has been used in travel modeling for many years, and the results of the IPF Method are acceptable and reasonable at the macro level. The IPF methodology focuses on the "margin" for its growth-factoring approach, meaning that, it applies a growth factor according to the growth of all origins or destinations for that zone. It does not focus on the individual zone-to-zone growth patterns reflected between the 2017 and 2040 Unadjusted matrices. When applied for the SNTS study area, the IPF Method application provided a set of matrices that were passable. However, this method did not result in an optimal match when comparing the total growth rates of the 2040 Adjusted to 2017 Adjusted matrices. Because of the methodological issue identified above, and the imprecision of the IPF application results, a zone-to-zone growth percentage, or "Pivot-Point" Method, was tested and applied.

Pivot-Point Method

The modified Pivot-Point Method established an enhanced base-year matrix and then "pivots" off that enhanced base-year matrix based on unique zone-to-zone growth characteristics. The zone-to-zone change in tripmaking came from the RTCSNV regional model's base year model and future year model unadjusted matrices. The technique takes advantage of the adjusted base year matrix, which was refined with available traffic counts, while maintaining the regional model's zone-to-zone future tripmaking patterns and changes. In this case, the purpose is to "pivot" from a fixed base year matrix (the 2017 Adjusted matrix) by adjusting individual cells of the matrix according to unique levels of growth identified by the TransCAD unadjusted matrices for 2017 and 2040. A flow chart of the modified Pivot-Point Method is presented in Figure 3.

Figure 3. Potential Pivot-Point Approach Framework for the SNTS Study



*15% threshold for deviation between base year unadjusted and adjusted

**Matrix Adjustment applied to each individual OD pair

All calculations are performed for each OD pair (individual cell)

The modified Pivot-Point Method combines elements of absolute (or additive) matrix adjustments and relative (or multiplicative) matrix adjustments. In instances where there were large matrix corrections between the 2017 Unadjusted and Adjusted matrices, there can be a tendency for a purely relative/multiplicative factor to skew growth unreasonably high. The following is a hypothetical situation for a single matrix cell between two zones i and j (also called an "i-j pair"):

- The TransCAD model estimates only 1 trip between zones i and j for 2017 (this is the 2017 Unadjusted matrix value).
- Based on observed data, the adjusted matrix indicates 100 trips between zones i and j for 2017 (this is the 2017 Adjusted matrix value).
- The TransCAD model estimates 2 trips between zones i and j for 2040 (this is the 2040 Unadjusted matrix value).

In this case, because of high levels of base year deviation between unadjusted and adjusted, using a relative/multiplicative factor would indicate 200 trips between zones i and j for 2040 (because of the growth factor of 2.0—1 trip in 2017 doubled to 2 trips in 2040).

For this reason, a 15 percent threshold was applied for use of a relative/multiplicative factor for creating the 2040 Adjusted matrix. Thus, in developing the unique 2040 Adjusted matrix cell values:

- For all i-j pairs where the 2017 Unadjusted and Adjusted values deviated by more than 15 percent, only an absolute trip adjustment was applied to the 2040 Unadjusted matrix. This means, in the example above, instead of doubling the number of 2017 Adjusted trips (100 trips in 2017 x 2.0 = 200 trips in 2040), the Pivot-Point Method would add 1 trip (100 trips in 2017 + 1 new trip = 101 trips in 2040).
- For all i-j pairs where the 2017 Unadjusted and Adjusted values deviate by 15 percent or less, the average of the absolute (using addition) and relative (using multiplication) trip corrections was applied to the 2040 Unadjusted matrix.

This is similar to a link-based forecasting methodology applied in NCHRP 255 (now updated as NCHRP 765).

The calculations described in Figure 3 are performed for each i-j pair of the matrix. An example of the modified Pivot-Point Method is presented in Figure 4.

Figure 4. Example of Pivot-Point Approach Methodology

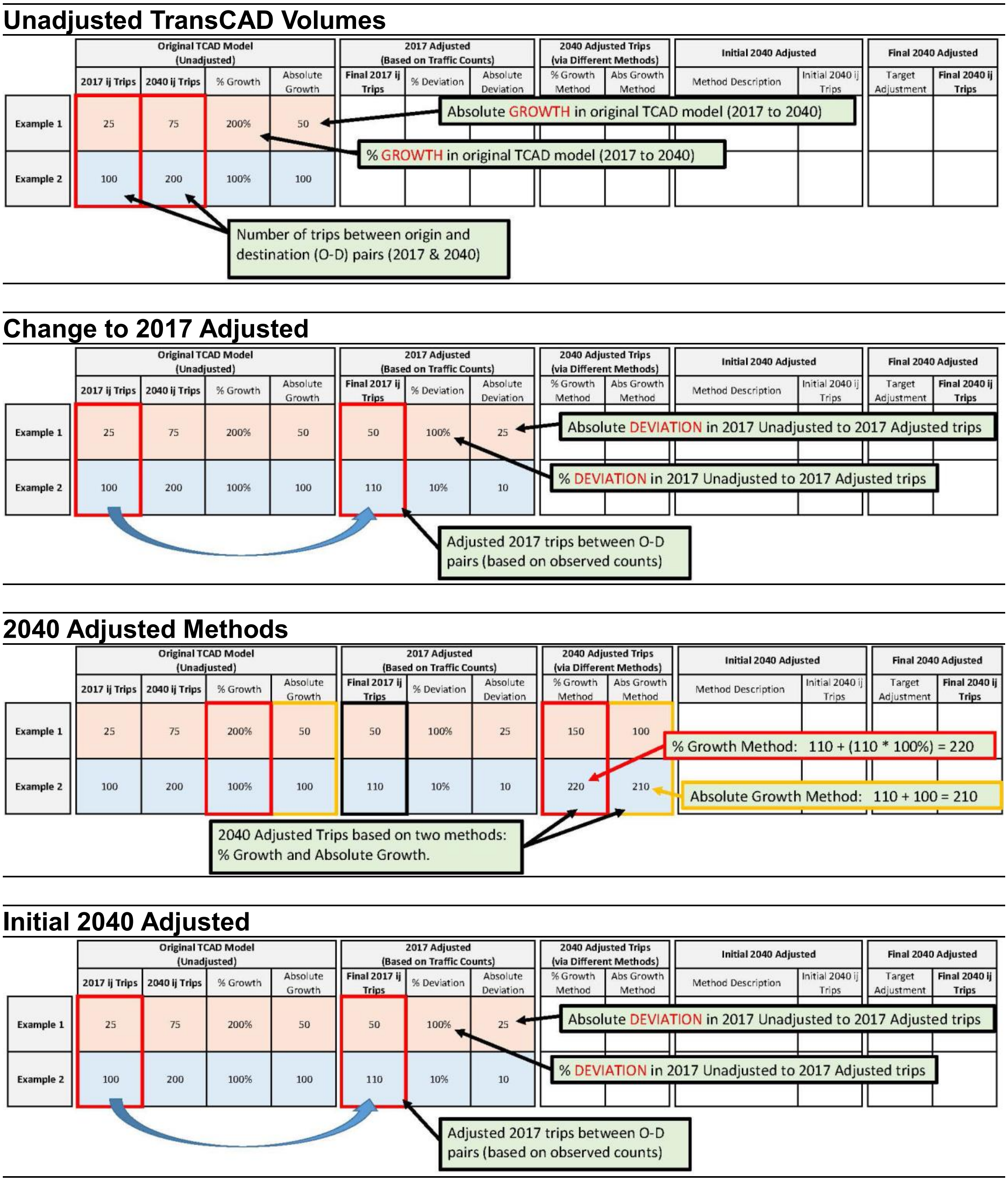


Figure 4. Example of Pivot-Point Approach Methodology

Final 2040 Adjusted

	Original TCAD Model (Unadjusted)				2017 Adjusted (Based on Traffic Counts)			2040 Adjusted Trips (via Different Methods)		Initial 2040 Adjusted		Final 2040 Adjusted	
	2017 ij Trips	2040 ij Trips	% Growth	Absolute Growth	Final 2017 ij Trips	% Deviation	Absolute Deviation	% Growth Method	Abs Growth Method	Method Description	Initial 2040 ij Trips	Target Adjustment	Final 2040 ij Trips
Example 1	25	75	200%	50	50	100%	25	150	100	% Deviation > 15%, so ABSOLUTE GROWTH	100	-5%	95
Example 2	100	200	100%	100	110	10%	10	220	210	15% > % Deviation > -15%, so AVERAGE	215	-5%	204

Target adjustment is applied to all cells within a matrix and is based on the 2017 Unadjusted to 2040 Unadjusted matrix overall growth. The "-5%" is an example.

Note: Calculation for matrix target adjustment is **(2017adj + (2017adj * TargetGrowth)) / 2040adj INITIAL**

All Steps

	Original TCAD Model (Unadjusted)				2017 Adjusted (Based on Traffic Counts)			2040 Adjusted Trips (via Different Methods)		Initial 2040 Adjusted		Final 2040 Adjusted	
	2017 ij Trips	2040 ij Trips	% Growth	Absolute Growth	Final 2017 ij Trips	% Deviation	Absolute Deviation	% Growth Method	Abs Growth Method	Method Description	Initial 2040 ij Trips	Target Adjustment	Final 2040 ij Trips
Example 1	25	75	200%	50	50	100%	25	150	100	% Deviation > 15%, so ABSOLUTE GROWTH	100	-5%	95
Example 2	100	200	100%	100	110	10%	10	220	210	15% > % Deviation > -15%, so AVERAGE	215	-5%	204

CONCLUSION

Although both methods provide acceptable results, the Pivot-Point Method provided the best representation for 2040 No-Build volume matrices compared to the IPF Method.

The main benefit of the Pivot-Point Method is its ability to maintain the unique zone-to-zone growth patterns identified by the TransCAD model. In this respect, a negative aspect of the IPF Method is that, it implements a “margin-based” approach, where a single origin or destination factor is applied to all origins or destinations for each zone.

A second benefit of the Pivot-Point Method is its ability to employ a 15 percent deviation factor, which limits any multiplicative growth factors only to those matrix cells that have a good base year fit between the TransCAD model and observed counts. This eliminates the issue of a traffic movement having an unreasonably high multiplicative factor applied to it in situations where the model is under-estimating or over-estimating demand.

Appendix B-4
Subarea Simulation in Aimsun Next

Working on Subareas with the SANDAG DTA Model

March 2015

About this Manual

This document describes how to run a simulation on a subarea of the SANDAG DTA model built in Aimsun.

We at TSS-Transport Simulation Systems have tried to make the information contained in this manual as accurate as possible. We cannot guarantee, however, that it is error-free.

Copyright

Trademark

Introduction

The SANDAG DTA model is a large-scale mesoscopic simulation model that may be difficult to calibrate because of the runtime and of the extent of the network.

In order to facilitate the verification of the inputs and perform a first pass of calibration, the idea is to run the simulation on individual subareas, so that errors and locations where the default parameters have to be changed can be spot easily and quickly.

This document describes the procedure to run a simulation on a subarea starting from the complete model at the end of the import process.

Procedure

The procedure to run a simulation on a subarea involves the following steps:

- Run macro assignments on the whole model to collect path information to cut the demand of the subareas
- Create a subnetwork
- Run the static traversal procedure to extract the demand of the subarea
- Run a macro assignment on the subarea to calculate an initial set of paths
- Run a one-shot mesoscopic simulation on the subarea

Macro assignment on the whole model

The purpose of this step is calculating the set of paths that will be used to identify the trips that use at least a section in the subarea.

Since the static traversal calculation doesn't take into account within-period dynamics, in order to produce a subarea demand sliced in 15-minute periods, you have to run one macro assignment for each 15-minute period.

Create a traffic demand for each 15-minute period, and add the O/D matrices that correspond to that period for the 11 user classes (Figure 1).

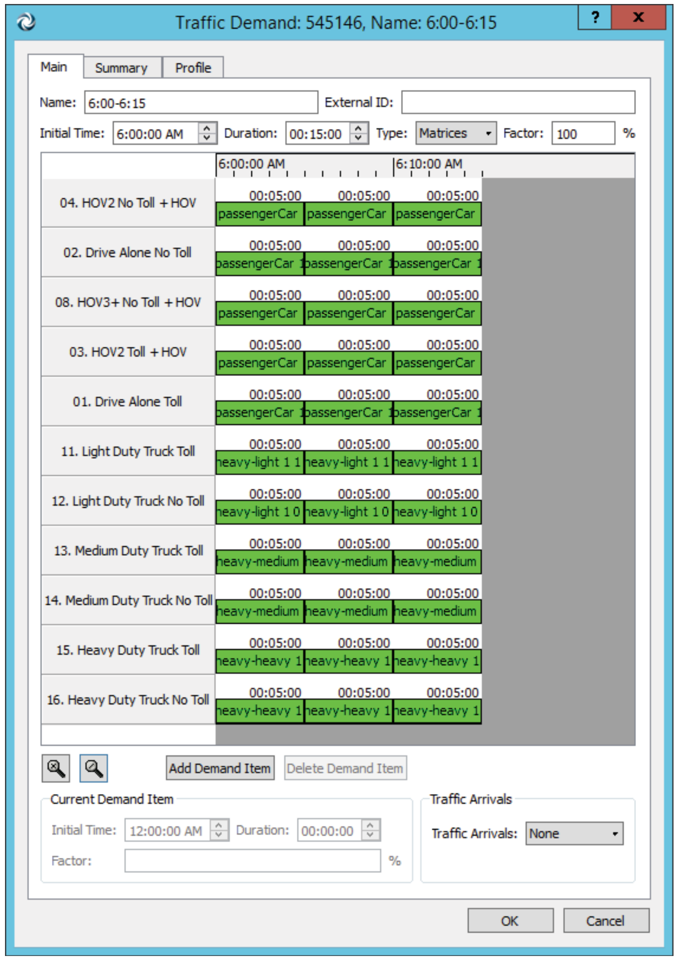


Figure 1. Traffic demand including the O/D matrices from 6:00 to 6:15 AM for the 11 user classes.

Create a macro assignment scenario for each 15-minute period; set as input the corresponding traffic demand (Figure 2).

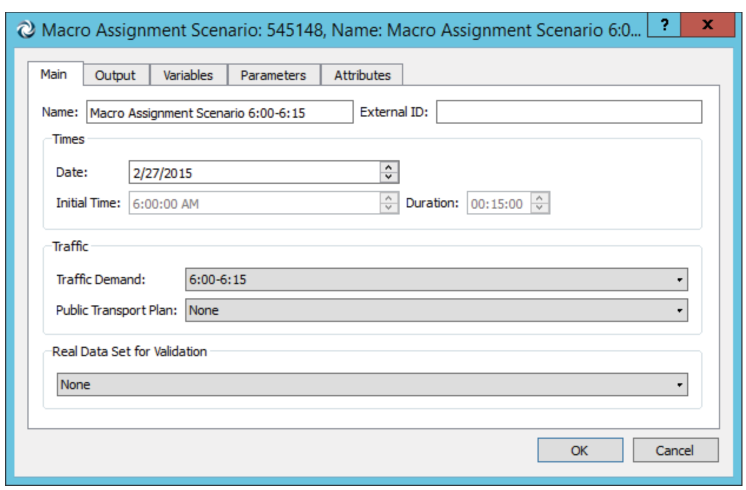


Figure 2. Macro assignment scenario inputs.

Activate path assignment results in the output tab. If you want to be able to run a traversal calculation at a later stage without having to rerun the assignment, enable storing the section & turn statistics and the path assignment results, so that you will be able to retrieve this information from file (Figure 3).

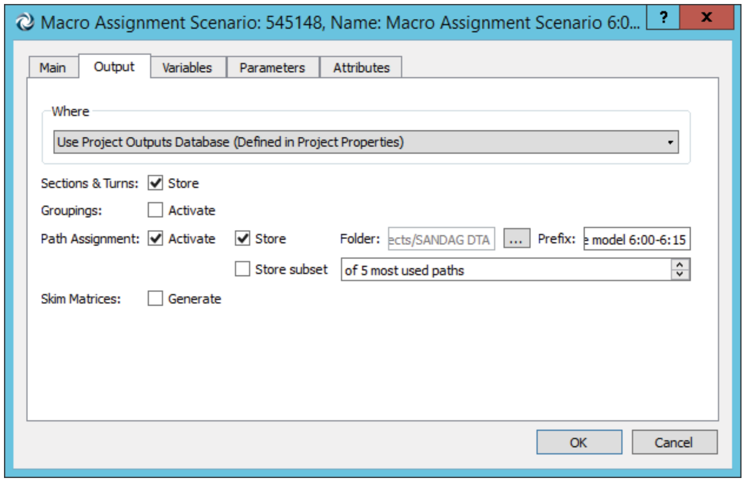


Figure 3. Macro assignment scenario outputs.

Create a macro assignment experiment inside each scenario, choose Frank and Wolfe equilibrium and set the stopping criteria to be loose enough to avoid running too many iterations (Figure 4).

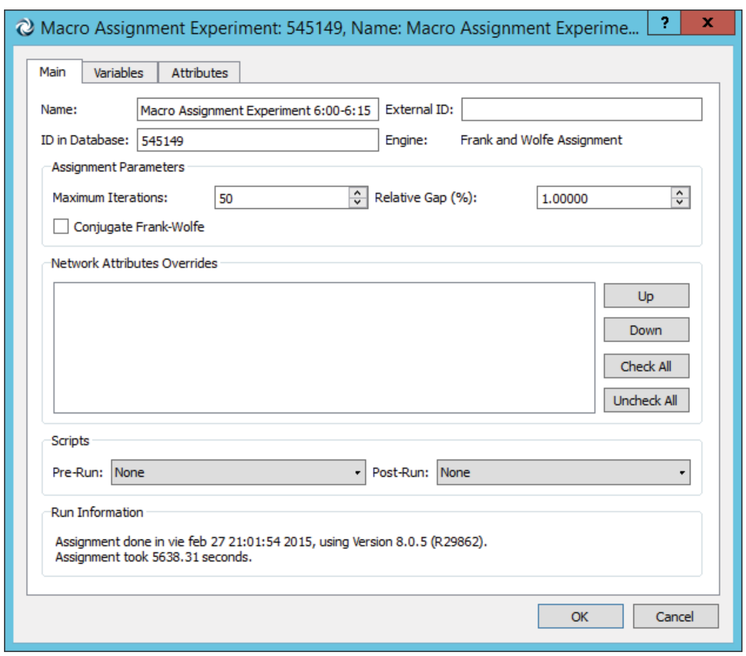


Figure 4. Macro assignment experiment.

Finally, run each macro assignment experiment.

If you have already run the assignment in the past and you have saved the statistics and paths as suggested, you can retrieve the results by right-clicking on the macro assignment experiment and selecting “retrieve static traffic assignment results” and “retrieve path assignment results”.

Subnetwork creation

A subnetwork is a filtering condition applied to the objects of the model based on being located inside a polygon or be part of a list.

To create a subarea create a polygon, right-click on it and convert it to a subnetwork (Figure 5).

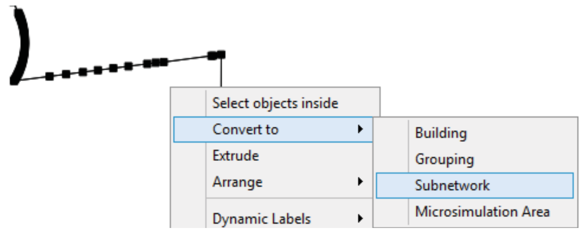


Figure 5. Creating a subnetwork.

The template includes a shapefile of polygons with the municipal boundaries. Therefore instead of creating a new polygon you can click on one of the municipal boundaries and convert it to a subnetwork.

For your convenience you can hide the part of the model outside of the subnetwork by right-clicking on the view and selecting a subnetwork under “filters” (Figure 6).

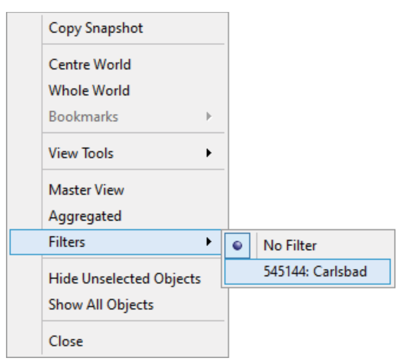


Figure 6. Showing just the subnetwork.

Static traversal

To extract from the matrices for the whole model the trips that use any links of the subarea, right-click on a subnetwork and select “calculate static traversal” (Figure 7).

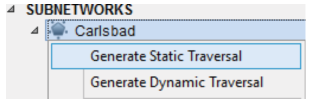


Figure 7. Calculating the traversal demand.

Select one macro assignment experiment and repeat this process for all periods. Note that the results of the experiment have to be loaded in memory, so you either have to run the assignment or to retrieve the results of a previously run assignment prior to calculating the traversal.

The procedure creates automatically the centroids at the boundary of the subnetwork and one O/D matrix for each user class (Figure 8).

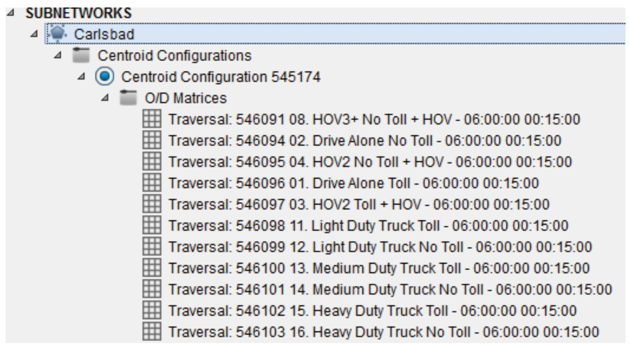


Figure 8. Subarea O/D matrices.

Create a traffic demand inside the subnetwork and add all traversal O/D matrices (Figure 9).

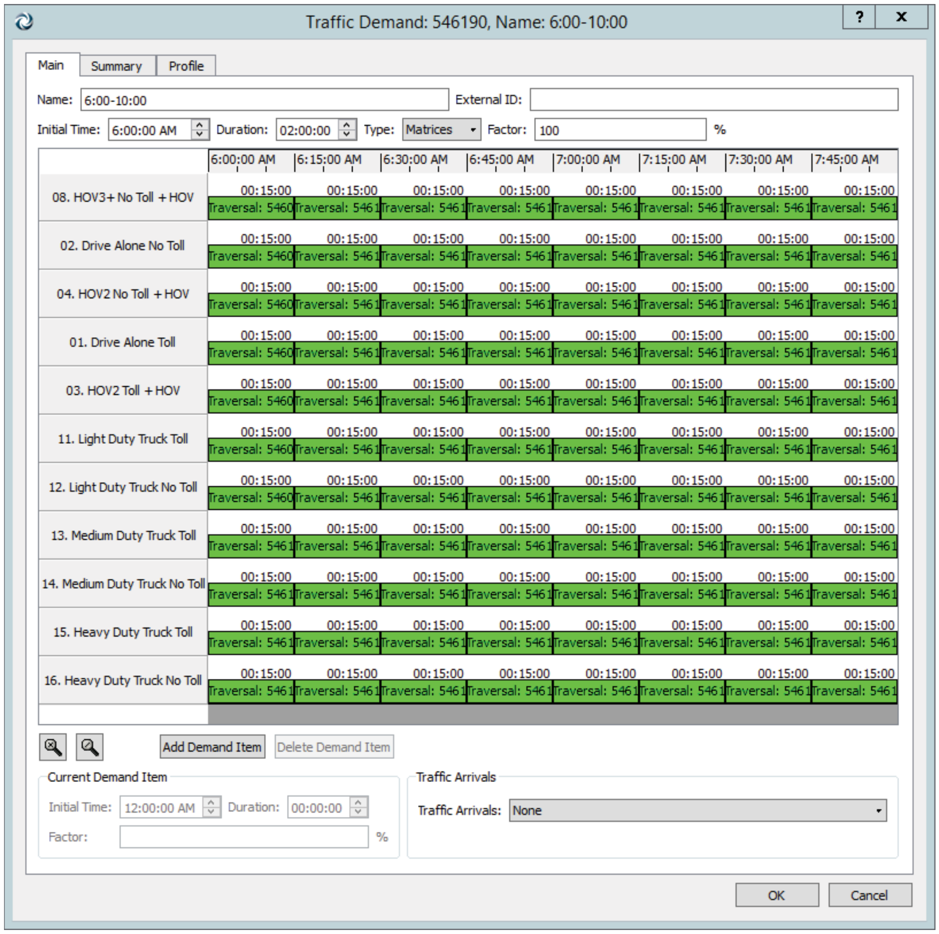


Figure 9. Subarea demand.

You can check the time distribution of the trips by going to the “profile” tab (Figure 10).

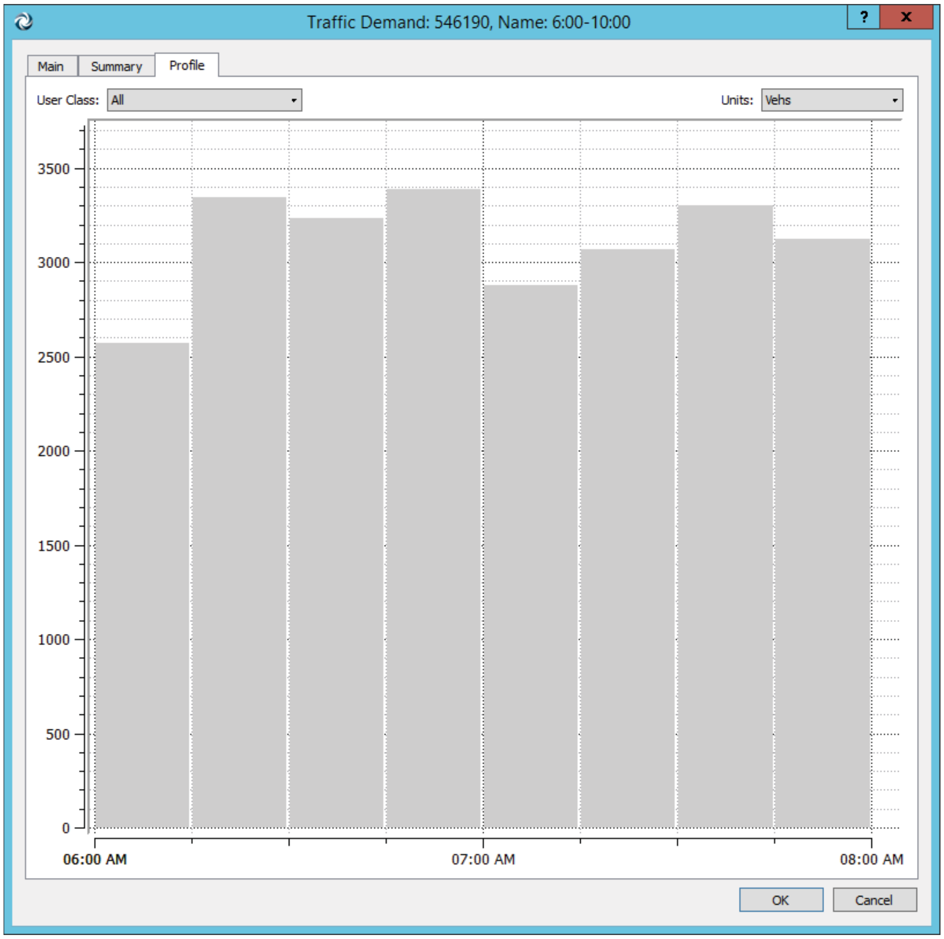


Figure 10. Subarea demand profile.

Macro assignment on the subarea

The purpose of this step is having an initial reasonable set of paths to load traffic, so that you can start detecting the most significant vehicle behaviour issues before calibrating dynamic traffic assignment.

Create a macro assignment scenario and set as input the demand you created for the subnetwork (Figure 11).

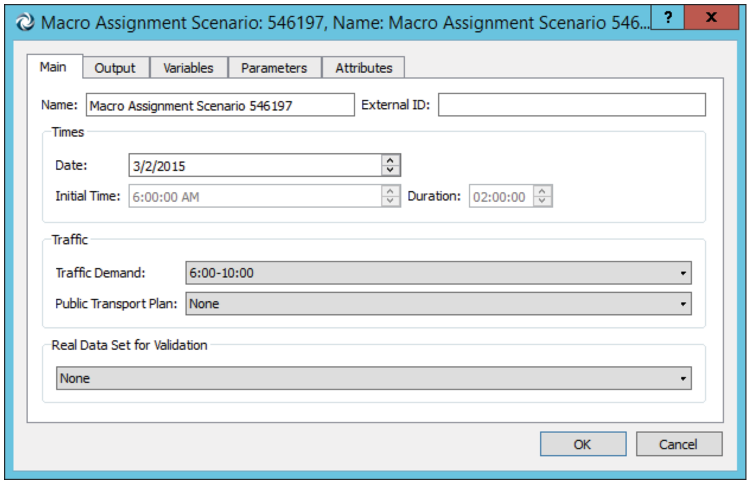


Figure 11. Macro assignment scenario inputs.

Activate in the output tab path assignment results and the option to store a subset of 5 best paths (Figure 12).

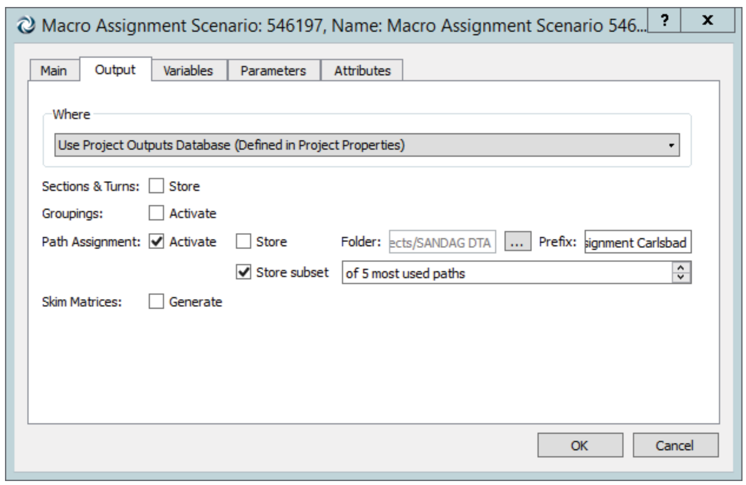


Figure 12. Macro assignment scenario outputs.

Create a macro assignment experiment inside the scenario, choose Frank and Wolfe equilibrium and set the stopping criteria to be loose enough to avoid running too many iterations (Figure 13).

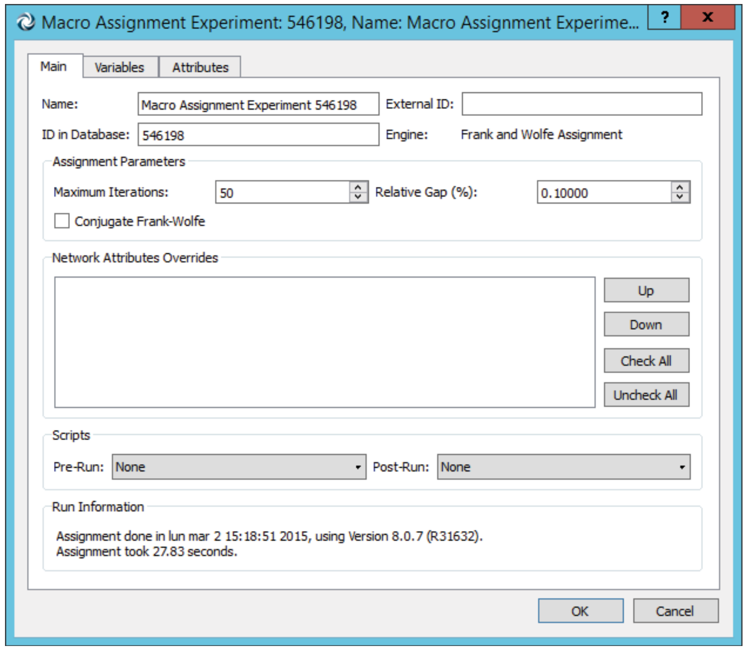


Figure 13. Macro assignment experiment.

Finally, run the macro assignment experiment.

One-shot mesoscopic simulation on the subarea

Create e new dynamic scenario in the subnetwork and set as input the demand you have created for the subnetwork, the master control plan for the whole model (Aimsun will filter automatically the plans that apply to the subarea), the public transport plan for the whole model (Aimsun will filter automatically the lines that operate in the subarea) and the path assignment file you have created with the macro assignment on the subarea (Figure 14).

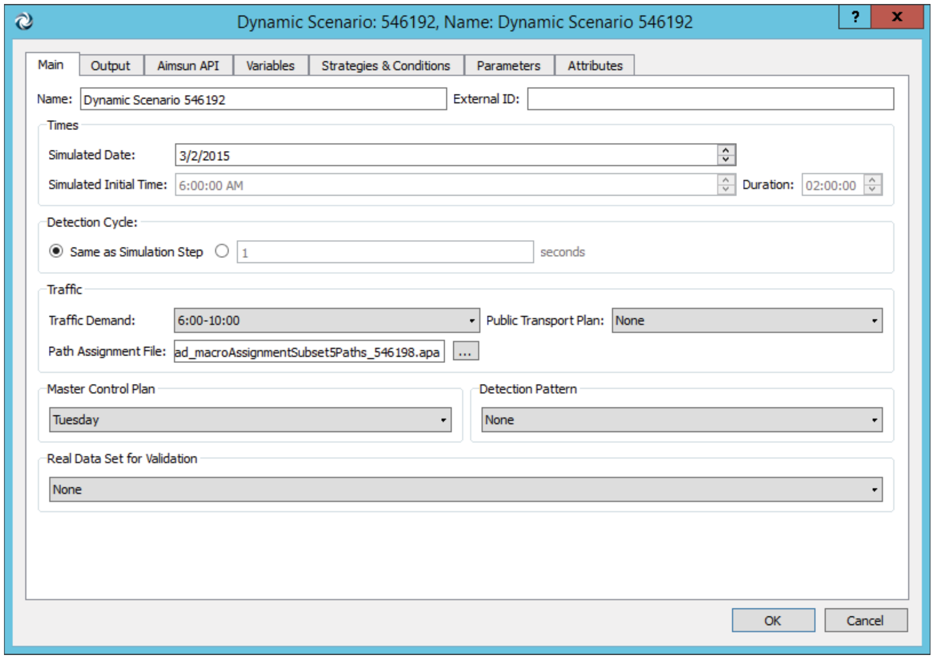


Figure 14. Dynamic scenario.

In the output tab activate only statistics and the corresponding keep in memory option and set a time aggregation interval short enough to capture with detail the evolution of congestion (e.g. 5 or 10 minutes, Figure 15)

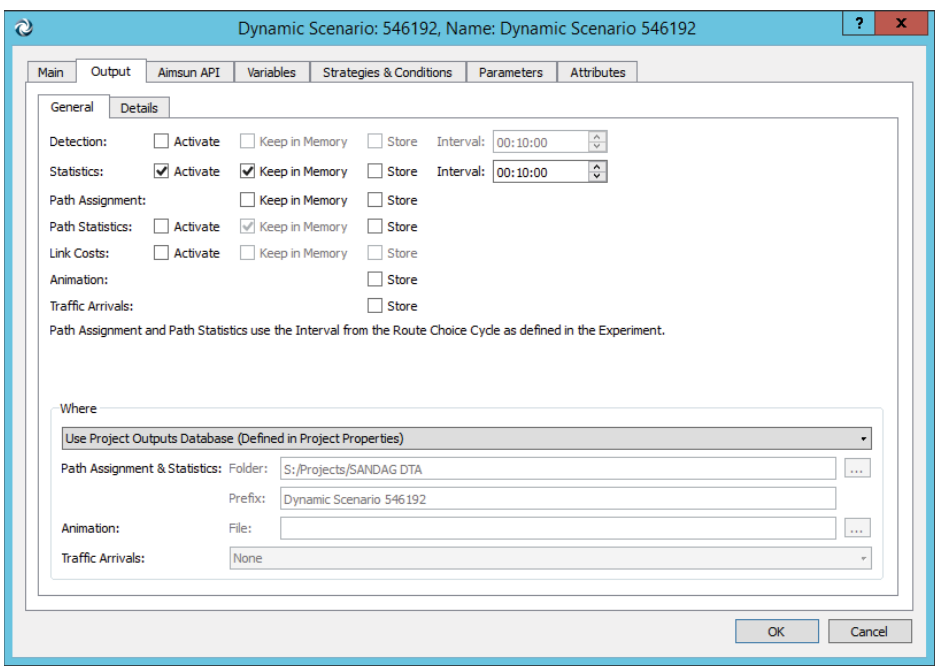


Figure 15. Dynamic scenario outputs.

Under strategies & conditions, activate all traffic conditions (TOD lane closures, Figure 16; Aimsun will filter automatically those that affect the subarea).

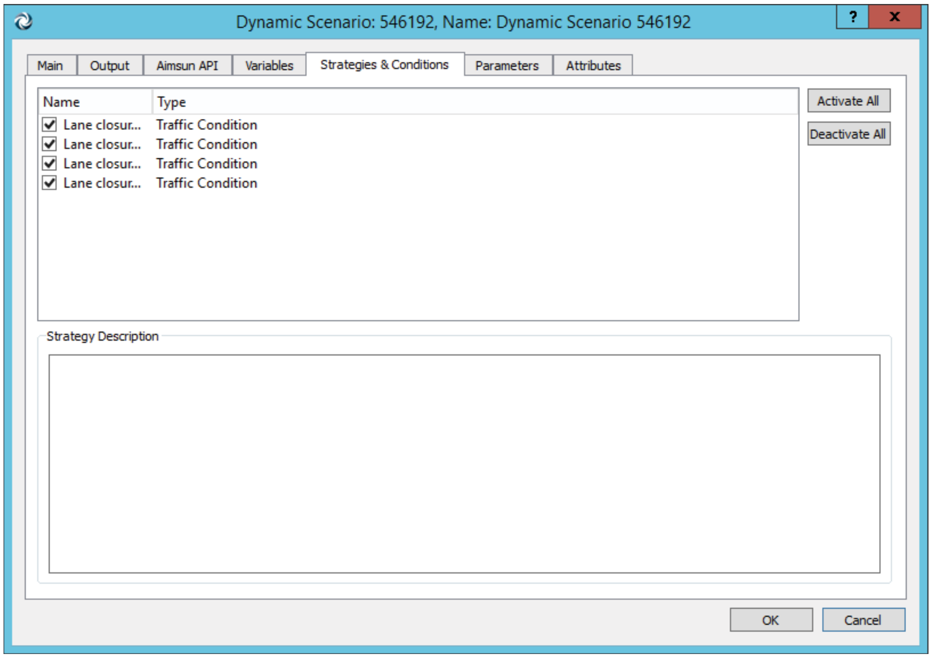


Figure 16. Dynamic scenario strategies & conditions.

Create a new experiment inside the scenario and choose mesoscopic network loading with stochastic route choice.

Create a new replication inside the experiment and run the simulation. Aimsun creates automatically view modes that visualise the results of the run. The most useful to detect gridlocks is the one called “simulated density”; advance the time of the view (Figure 17) and as soon as you notice a location where density increases and expands over space investigate the reason at the location where the increase of density starts.

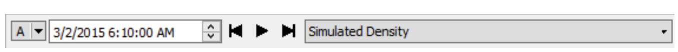


Figure 17. Simulated density view mode and time of the view.