ADOT REGIONAL TRANSPORTATION PLAN FREEWAY PROGRAM
Lessons Learned Document

Traffic Volume Projections and Operational Analysis

I. Introduction:

The purpose of this document is to convey the "lessons learned" in recent years to obtain traffic volume projections from the Maricopa Association of Governments (MAG) Transportation Division, and to perform operational analysis on the major Regional Transportation Plan Freeway Program (RTPFP) projects.

This document is not intended to be a policy document or procedures manual, but to develop consistency between all parties participating in the development of Project Assessments, Design Concept Reports, traffic studies and other scoping or final design documents.

A number of processes were also confirmed at a meeting held on June 20, 2005 with representatives of ADOT, MAG, and the Management Consultants for the RTPFP.

II. Traffic Data and Projections:

A. Existing Condition Volumes:

Freeway and arterial street traffic count data is routinely obtained and published by ADOT's Transportation Planning Division, Transportation Technology Group, MAG, and local agencies. As necessary, additional traffic count data should be obtained for the project to establish current A.M. and P.M. peak hour and average daily traffic volumes, vehicle classification data, peak hour factor, and other project specific data needed for the project.

Turning movement counts should also be obtained at interchange and arterial street intersections. This information can be used to establish current traffic conditions, evaluate the current operational performance at existing intersections, and verify the distribution of the intersection turning movements for the volumes received from MAG.

B. Traffic Volume Projections:

The design year for the project should be determined by the Department. A request for the design year traffic volume projections shall be transmitted from the ADOT Project Manager to MAG. The letter should include the date the traffic data must be delivered to the Department or designated recipient to avoid impacting the project schedule, and include a lane diagram that depicts the roadway alternative(s) that should be input into the model for analysis. It may be desirable to meet with MAG staff to discuss the goals, alternatives, traffic data requirements, and the schedule requirements for the project.

The following traffic volume data should be requested for the evaluation of alternatives:

- current year A.M. and P.M. peak hour and average daily traffic (ADT) traffic volume projections
- desired interim and design year daily traffic volume projections (ADT)
- desired interim and design year A.M. and P.M. peak hour traffic volume projections and peak hour factor
- design year A.M. and P.M. peak hour and daily truck volumes
- design year AM and PM peak hour volumes of vehicles in High Occupancy Vehicle (HOV) lanes
- design year A.M. and P.M. turning movement volumes at interchanges and/or intersections
- road network diagram showing number of roadway lanes and classification on the freeway and adjacent arterial streets
- special requests for data or plots including level-of-service, selected-link analysis, model statistical summaries, or other data required for the project

Prior to MAG running the model, the transportation network should be reviewed by the designer to ensure the network conforms to the lane diagrams provided with the request letter. The network review should also include an evaluation to determine if the arterial street network in the vicinity of the project is in conformance with adopted regional and local agency transportation plans. If there are any discrepancies with the transportation networks that could inflate or understate the volumes, corrected networks should be transmitted back to the MAG.

The traffic volume projections should be reviewed for reasonableness based on current traffic volume data and existing and proposed land uses. If the traffic projections do not appear to be reasonable, a meeting should be scheduled with MAG staff to discuss and resolve any concerns regarding the model results.

For the initial alternatives development phase, each directional ramp at a system interchange should be modeled as a two-lane ramp for the purpose of obtaining traffic volume projections. This methodology will allow the MAG model to provide volume projections on the directional ramps without constraining the model.

During the alternatives development phase, it is typical to combine the desired features of alternatives to develop new alternatives for further study. Once the specific alternatives have been selected for detailed study, the final alternatives should be resubmitted to MAG for updated traffic volume projections.

Once the preferred alternative has been selected, it should be submitted to MAG for inclusion into the regional transportation network.

C. Operational Analysis Assumptions:

A peak hour factor of 0.92 to 0.95 has been commonly applied to the traffic volume projections to represent the peak 15 minute period within the peak hour. Traffic counts should be obtained to develop the peak hour factors based on existing conditions and verify the peak hour factor that will be used for the operational analysis of the proposed improvements. Otherwise, the peak hour volumes provided from MAG should not be adjusted prior to incorporation into the operational analysis. The same peak hour factor should be used for the "No-Build" and "Build" alternatives to ensure all alternatives are evaluated under the same traffic conditions. However, the Department may request the completion of a sensitivity analysis to evaluate impacts to the operating conditions on the mainline and ramp with increased volumes.

Existing conditions operational analysis of signalized intersections (isolated intersections and at traffic interchanges) must be conducted using the existing signal timing provided by ADOT or the local agency responsible for the signal operations. For the evaluation of future intersection and interchange situations, the anticipated signal timing plans should be obtained from the local agency or ADOT Regional Traffic Engineer for input into the software used for the operational analysis.

III. Freeway Mainline:

An evaluation of the freeway corridor should be conducted to assess the needs of the mainline and existing and planned interchanges. Auxiliary lanes should also be considered between interchanges spaced at about a mile or less. Auxiliary lanes that are greater than one mile in length should be input as a general-purpose lane in the MAG model, and evaluated as a general-purpose lane with the operational analysis.

A new freeway mainline should include a minimum of three general-purpose lanes in each direction of travel, auxiliary lanes between service interchanges, an open median to accommodate a future HOV lane, and sufficient width along the outside shoulder to accommodate the future addition of a fourth general-purpose lane. The additional future lane could also be considered within the median. A minimum of three general-purpose lanes and one HOV lane should be accommodated in each direction of travel through a system interchange.

For scoping documents, the operational analysis for a freeway corridor should be conducted with a system-wide approach for the A.M. and P.M. peak hours in the design year. The operational analysis should be conducted by computer techniques (CORSIM or VISSIM) that can evaluate and simulate the freeway operations within the study area. The simulation should include the freeway mainline, directional ramps, and service interchange ramps. The results of the simulation must conform to the latest edition of the Highway Capacity Manual, and be verified with the Highway Capacity Software (HCS).

For final design documents, HCS has been typically used as the primary analysis tool.

HOV lanes should be evaluated separately from the general-purpose lanes. Therefore, the HOV lane volumes should not be added to the traffic volume projections provided for the general-purpose lanes. The capacity of HOV lanes is provided in MAG's *High Occupancy Lanes and Value Lanes Study*, 2001.

IV. Auxiliary Lanes:

Incorporation of auxiliary lanes into the Regional Freeway System for all new construction was implemented in 1995. The *"Interim" Auxiliary Lane Design Guidelines"* ALDG) was prepared by the Design Issue Resolution Panel (DIRP) Auxiliary Lane Subcommittee in November 1996. An ADOT design memorandum was also distributed in May 2001 regarding the required use of parallel entrance and exit ramps.

The ALDG indicates that the length available for auxiliary lanes is dependent on the geometric and traffic operations requirements of the following:

- the storage length of the ramp
- entrance ramp acceleration length
- mainline weaving section
- exit ramp weave/sort length between the exit ramp gore to the beginning of the vehicle storage
- vehicle storage length on the frontage road at the crossroad (if applicable)
- weave/sort length on the frontage road from the crossroad to the entrance ramp diverge point (if applicable)

The ALDG also provides substantial information regarding the mainline weaving section. The primary analysis tool used for evaluating the general-purpose and auxiliary lane in the weaving section is the HCS weaving area analysis module. Even though ramp metering may not be installed initially, the vehicle acceleration length requirements must account for vehicles stopped at the ramp meter in the future. Due to the vehicle acceleration required with ramp metering, the weave length available for entering traffic is considerably less than the striped auxiliary lane. To account for this difference, an effective weave length should be used as defined in the ALDG.

The Highway Capacity Manual (HCM) presents several types of weaving conditions that can be used for operational analysis. Type 'A' weaving areas most accurately represent the lane configuration and type of weaving associated with a typical auxiliary lane situations between service interchanges. To account for traffic that enters the freeway on an entrance ramp and exits the freeway at the subsequent exit ramp, an additional 50 vehicles should be added to the ramp volumes provided from MAG to account for this traffic movement.

V. Service Interchanges:

Service interchanges are typically provided at each arterial street with a minimum spacing of one mile. The crossroad portion of the interchange is typically designed to match the existing or future street section as defined by the local agency's adopted transportation plan. This includes the number of through lanes, lane widths, and inclusion of bicycle lanes. Sufficient crossroad width is generally provided for bicycle lanes, but the bike lanes are not defined with pavement markings.

The primary purpose of the operational analysis at service interchanges is to evaluate the number of ramp and crossroad turn lanes necessary to provide an acceptable level-of-service with the anticipated traffic demand. The interchange analysis would include an evaluation of applicable interchange configurations, single versus dual left-turn lanes on the crossroad, right-turn lanes from the crossroads to the entrance ramps, and the number of lanes on the exit ramp approaching the crossroad intersection.

The minimum number of turning lanes necessary to achieve an intersection approach and overall interchange Level-of-Service 'D' forms the basis of RTPFP funding. A local agency may request additional turn lanes be provided on the crossroad to facilitate additional future traffic demand. The additional turn lanes may be added provided the local agency provides a funding commitment of 50% of all added costs of the additional turn lanes, which include design, environmental documentation, right-of-way, utility relocation and construction costs.

It may be necessary to compare the operational characteristics of a diamond interchange with a single-point urban interchange (SPUI), or other interchange configurations, based on site conditions and constraints. It is imperative that this evaluation be conducted with an "apples-to-apples" comparison. Guidance can be provided on this process for the methodology used for previous comparative analysis.

The analysis of a diamond interchanges has been conducted with the PASSER III (latest edition) computer software, while the Synchro computer program has been used to evaluate single-point urban (SPUI) interchanges.

A memorandum from the Phoenix District Traffic Engineer established the minimum storage lengths for turn lanes. A minimum storage bay of 300 feet was established for left-turns, and a minimum storage bay of 250 feet was established for right-turns. This memorandum is provided as an attachment to this document.

Service interchange ramps should generally be developed as single-lane entrance and exit ramps. Exceptions to this recommendation would occur at exit ramps departing a system interchange or other high volume ramp locations, which could be developed as a two-lane exit with an AASHTO lane drop. All entrance ramps are designed as two-lane ramps to the back of gore, and transitioning to a single lane entrance into an auxiliary lane.

VI. System Interchanges:

At system interchanges, the transportation network should include an evaluation of the overall freeway system approaching and departing the interchange including the interim and ultimate number of lanes planned for each freeway corridor, the number of added lanes approaching the interchange to facilitate the interchange exit ramps, and the number of added lanes departing the interchange due to the directional ramps. The lane balance evaluation should include the service interchanges upstream and downstream of the system interchange.

Service interchanges must be carefully considered if located within two miles of a system interchange. Braided ramps, auxiliary lanes, collector-distributor (C-D) roads, and restricted access (half diamond) alternatives should be considered to ensure the safety and operational characteristics of the freeway mainline and system interchange directional ramps are not compromised by the service interchange ramps.

For the initial alternatives development phase, each directional ramp should be evaluated as two-lane ramps for the purpose of obtaining traffic volume projections. This methodology will allow the MAG model to provide volume projections on the ramps without constraining the model. Once the volume projections are received from MAG, a workshop should be scheduled with the ADOT Project Team members to present the projections and determine which ramps should be considered for single versus two-lane ramps.

Years of operational experience on the existing freeway system have resulted in the development of refined design guidelines within the area of system interchanges. All directional ramp lanes departing the system interchange should transition into a mainline lane. The additional lanes provided with the directional ramps should be "dropped" with a minimum spacing of one "lane-drop" per mile. The lane drops can usually be accomplished with an AASHTO lane drop at each service interchange.

Freeway lanes that are added approaching a system interchange should also be provided with a frequency of one lane per mile. The additional lanes can usually be accomplished with the service interchange entrance ramps.

The preferred method of developing directional ramp exit and entrance conditions with the freeway mainlines is with "exit-exit" and "entrance-entrance" designs. However, the ramp designs should be evaluated on a case-by-case basis in conjunction with right-of-way constraints and local access requirements.

The weaving area between a system interchange and adjacent service interchanges should be developed to minimize the number of lane changes required for a traveler to enter or exit the freeway.

A signing concept should be prepared for each system interchange alternative to ensure a guide signing plan can be implemented to provide a clear message to freeway travelers, and is in conformance with the requirements of the MUTCD and Arizona Traffic Control Manual.

An example of these design considerations is provided with the attached lane diagram developed for the SR 202L/US 60 “SuperRedTan” system interchange.

February 22, 2000

Mr. Steve Jimenez. P.E.
Assistant State Engineer
Arizona Department of Transportation
205 S. 17th Avenue, Room 295
Phoenix, Arizona 85007

RE: Storage Lengths for Turn Lanes in Urban Areas

Dear Mr. Jimenez,

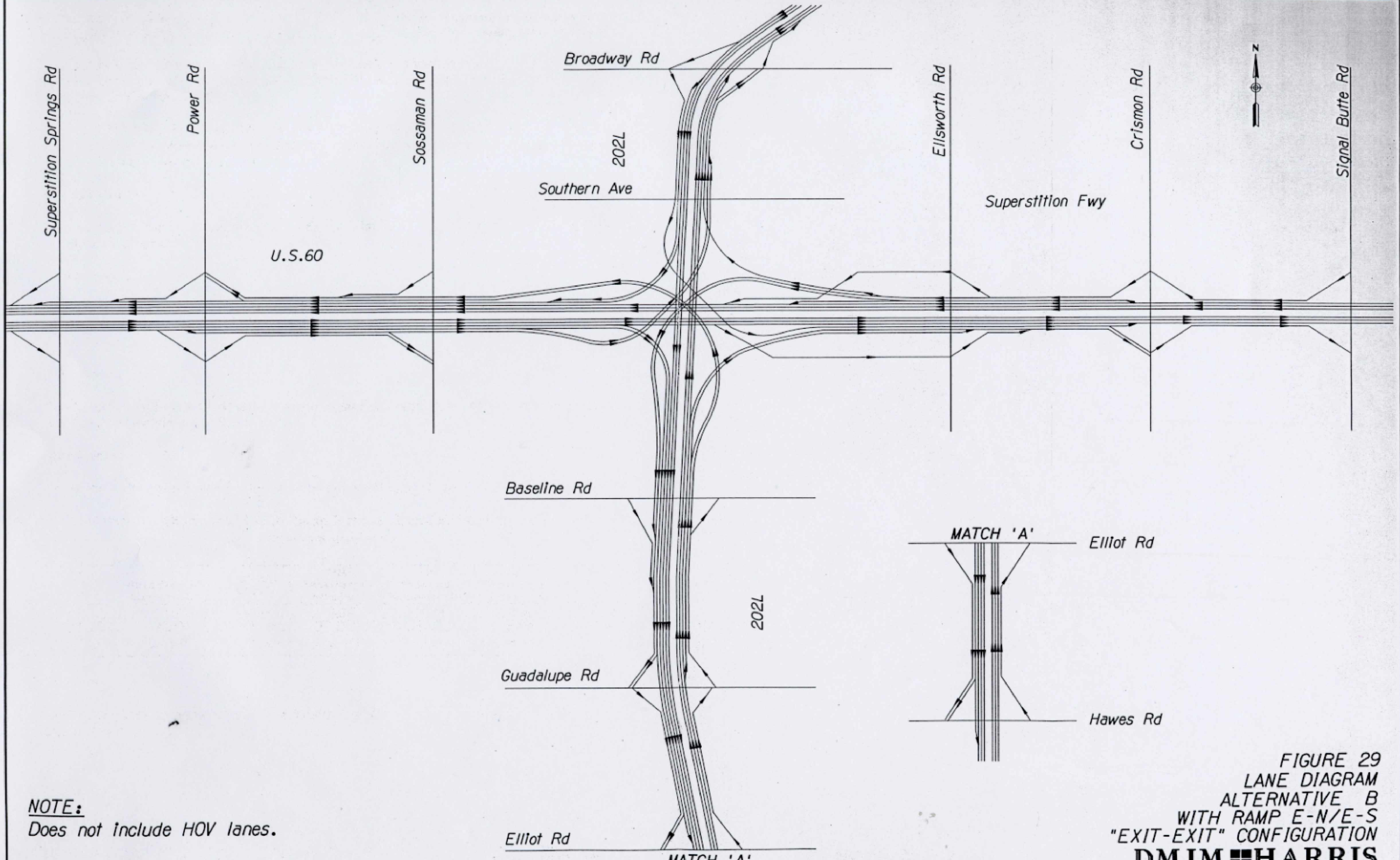
The Phoenix ADOT District has reviewed the material provided by DMJM regarding the procedure to determine adequate turn lane storage lengths currently being implemented on the Regional Freeway System. We agree that under signalized operations in urban areas, it is appropriate to account for the green time of each intersection approach in the calculation of turn lane storage lengths. Please implement the DMJM procedure for the calculation of turn lane storage lengths in lieu of the *ADOT Informational Bulletin 99-09, Turn Lane Design Guidelines* on the remaining segments of the freeway system.

However, based on our field observations of the freeway segments already open in the Phoenix area, the Phoenix District requests that the minimum default storage lengths be modified for any segment of freeway that has not already been submitted as thirty percent complete. The default storage length for left turn lanes and right turn lanes shall be 300 and 200 feet respectively. Thank you for your consideration in this matter.

Sincerely,

George Chin, P.E.
Regional Traffic Engineer
ADOT Phoenix District

Cc: T. Monchak - DMJM



NOTE:
Does not include HOV lanes.

FIGURE 29
LANE DIAGRAM
ALTERNATIVE B
WITH RAMP E-N/E-S
"EXIT-EXIT" CONFIGURATION

DMJM HARRIS

NOT TO SCALE - SCHEMATIC ONLY

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