Carbon Monoxide State Implementation Plan

APPENDIX B
TRANSPORTATION DOCUMENTATION

Las Vegas Valley Non-attainment Area

Clark County, Nevada

August 2000

Department of Comprehensive Planning

Clark County Board of Commissioners

APPENDIX B

TRANSPORTATION DOCUMENTATION

Section	Title
One	Carbon Monoxide Transportation Control Measure Analysis.
Two	Las Vegas Regional Travel Demand Model Documentation Report Update (not available in electronic format).
Three	Regional Transportation Commission Model Enhancement Study Peak-Hour Model (not available in electronic format).

APPENDIX B

Section One
Carbon Monoxide Transportation Control Measure Analysis

CARBON MONOXIDE
TRANSPORTATION CONTROL
MEASURE ANALYSIS

PREPARED FOR
CLARK COUNTY, NEVADA

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MAY 1998

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I. INTRODUCTION AND SUMMARY

PURPOSE

This study analyzed the effectiveness of various Transportation Control Measures (TCMs) in reducing Carbon Monoxide (CO) vehicle emissions in the Las Vegas Valley CO nonattainment area. This final report presents the study methodology and results. A brief background, project overview, and summary of the study findings and recommendations are presented in this chapter.

BACKGROUND

The Las Vegas Valley has historically exceeded the eight-hour National Ambient Air Quality Standard (NAAQS) for CO. On February 20, 1996, the Clark County Board of Commissioners adopted a resolution requesting the U.S. Environmental Protection Agency (EPA) grant Clark County a one-year extension to attain the NAAQS for CO. Having met the requirements for granting an extension, Clark County's attainment deadline was changed to December 31, 1996. Unfortunately, three violations of the standard had occurred in early 1996, and disqualified the County from seeking a second one-year attainment extension. As a result, the EPA is preparing to reclassify Las Vegas Valley as a serious nonattainment rating for CO, a downgrade from the previous moderate classification. Official notice of the reclassification was published in the Federal Register in October 1997.

This action by the EPA necessitates the preparation of a Serious Area Carbon Monoxide Air Quality Implementation Plan (CO AQIP), which must be completed and submitted within a minimum of 18 months from October 1997. The AQIP must address mandatory transportation control measures and demonstrate attainment of the NAAQS by December 31, 2000.

Should the plan for rectifying the serious nonattainment area be ineffective at achieving NAAQS, the Administrator of the EPA may prescribe additional measures and require that deficiencies in the plan be addressed within 18 months. This could be followed by sanctions on highway funds which could then be redirected to increasing public transit and congestion mitigation activities. The Administrator also has the discretion to prepare a Federal Implementation Plan for the Las Vegas Valley Nonattainment Area.

STUDY OBJECTIVES

The overall goal of this study was to estimate the CO reduction due to the implementation of TCM packages. The primary objectives of achieving this goal were to:

- Define a set of reasonable TCMs
- Model trip and vehicle-miles traveled (VMT) reductions for each TCM
- Forecast future traffic for the TCMs
- Develop TCM packages

- Estimate speed and measure VMT performance
- Estimate CO Emissions for each TCM
- Estimate the cost-effectiveness of TCM packages

PROJECT OVERVIEW

As previously noted, the overall goal of this study was to estimate the CO reductions due to various individual TCMs and packages of TCMs. The first step toward this goal was to identify a set of reasonable TCMs for the Las Vegas nonattainment area. Once these TCMs were identified, the next step was to estimate the trip reduction results due to the implementation of each TCM. The RTC Interim Mode Choice Model was used to estimate trip reduction results from transit, high-occupancy vehicle (HOV), and park-and-ride use. Given the trip reductions from the Mode Choice Model and other TCMs, the Las Vegas Regional Travel Demand Model was used to estimate traffic volumes and average speeds on the regional highway network for each TCM. Vehicle-miles traveled were estimated using four population scenarios for the Las Vegas urbanized area.

Trip percentages for other TCMs, such as trip reduction ordinances, were estimated based on studies reported in the professional literature and experience in other areas. The Travel Demand Model's primary output was VMT and average speeds on the regional networks for each TCM. With each TCM in place, the CO emissions produced by each network was estimated as a function of the VMT and CO emission factors. Emission factors were estimated using the EPA MOBILE5a-h emissions factor model.

The project also included analysis of the effectiveness of TCMs in reducing CO emissions. Effectiveness was measured as the vehicle-mile reduction, tons of pollutant reduction, and the cost per ton of pollutant reduction.

STUDY ORGANIZATION

This study was conducted for Clark County under the guidance of the Project Oversight Committee (POC). The committee was composed of individuals from the county; local, state, and federal governments; and other interested parties. Table I-1 shows the individuals on the POC. The committee members contributed the following to the study:

- Actively participated as a member of the Project Oversight Committee
- Reviewed the Modeling Protocol
- Recommended technical approaches regarding TCM modeling
- Assisted in the identification of reasonable TCMs
- Assisted in the development of assumed percentage trip reductions for TCMs
- Provided input to the consultant
- Reviewed future reports and the final report
- Provided feedback to the consultant

TABLE I-1. PROJECT OVERSIGHT COMMITTEE MEMBERS

Name/Title	Affiliation
William Cates, Principal Planner	Clark County Department of Comprehensive Planning
Clete Kus, Principal Planner	Clark County Department of Comprehensive Planning
David Gay, Principal Planner	Clark County Department of Comprehensive Planning
Michael Naylor, Director	Air Pollution Control Division Clark County Health District
Femi Durosinmi, Monitoring Supervisor	Air Pollution Control Division Clark County Health District
Dennis Mewshaw, Principal Planner	McCarran International Airport Department of Aviation
Leslie Long, Environmental Engineer	City of North Las Vegas Department of Public Works
Susan Gray, Community Planner	City of Henderson Planning Department
Patricia Manry, Transportation Analyst II	Nevada Department of Transportation Program Development Office
Jerry Duke, Principal Planner	Regional Transportation Commission of Clark County
Mark Green, Ph.D., Associate Research Professor	Desert Research Institute
Dick Serdoz, Manager, NDEP LV Office	Nevada Division of Environmental Protection
Dr. David James, Assistant Professor	Transportation Research Center, UNLV Department of Civil and Environmental Engineering
Lori Wohletz, Environmental Officer	City of Las Vegas
Scott Bohning, Environmental Engineer	United States Environmental Protection Agency
Interested Parties:	
Steve Smith	TOSCO Corporation
Valerie Larson	ARCO
Johanna Brooks	DRGM
Bob Broadbent	Broadbent Consulting
Cindy Hasenjager	Regent International

STUDY FINDINGS AND RECOMMENDATIONS

Four population scenarios were defined for analyzing the TCMs. The scenario schemes are based on the total forecasted population instead of horizon year, due to the rapid growth experienced by the Las Vegas area. The scenarios are as follows: Scenario A - 1,128,800 population, Scenario B - 1,445,023 population, Scenario C - 1,762,000 population, and Scenario D - 2,454,200 population.

Two TCM packages were also defined and tested: travel behavior and emissions emphasis packages. The travel behavior package contains TCMs designed to modify travel behavior patterns and the emissions emphasis package contains TCMs that affect vehicle emission factors. Comparisons of the TCMs were made against a base case of socioeconomic, roadway, and transit data forecasted by the RTC without additional TCMs.

Study Findings

The following is a summary of the study's major findings:

- TCMs have been effective in other areas in reducing VMT.
- The analysis indicated that TCMs will reduce CO emissions in the Las Vegas area, as shown in Table I-2. The estimated yearly cost for these TCMs are summarized in Table I-3.
- The Inspection/Maintenance (I/M), Alternative Fuel vehicles for government fleets, and Reformulated Gasoline are the most cost-effective measures, while the employer trip reduction ordinance (TRO) and no-drive days measure are the most costly, as shown in Table I-4.
- The employer TRO and the no-drive days measures produced the most substantial decrease in CO emissions among the TCMs designed to modify travel behavior pattern.
- The I/M measure, which requires vehicle emissions testing to be performed at test only facilities, produced the greatest reduction in daily CO emissions among all TCMs.
- The impact of both the travel behavior and vehicle emissions emphasis package is greater than the individual TCMs. Results for the TCM packages are displayed in Table I-5.
- The vehicle emission emphasis package outperforms the travel behavior package.

- Scenarios A and B, for the base case, show air quality attainment to be below the 298.6 tons per day mobile source budget established by Clark County's 1995 CO State Implementation Plan (SIP).

Recommendations

After reviewing the findings of the study, the following recommendations were formulated:

- Implement a "Test only" I/M program before reaching Scenario C level population of 1,762,000.

- Expand the work schedule changes and telecommuting programs already operating throughout the valley. The potential high cost-effectiveness of both measures and the relative ease of implementation make them primary candidates to decrease CO emissions.

- Consider the implementation of area-wide rideshare and carpool matching programs in the near future.

- Implement the Alternative Fuel vehicle fleet for government vehicles, the I/M, and the Reformulated Gasoline measures simultaneously to achieve air quality conformity for Scenario C (1,762,000 population).

- Increase and accelerate local jurisdiction participation in converting vehicle fleets.

- Strengthen local government leadership in taking a more proactive role in the development and implementation of control measures to improve air quality.

- Implement further evaluation of the TCMs for Scenario D (2,454,200 population). This scenario will require further study and re-evaluation of the TCM assumptions using a more aggressive agenda. Socioeconomic, roadway, and environmental data should be refined and tested as the population approaches 2,454,200.

ORGANIZATION OF THE REPORT

Chapter II reviews the modeling protocol used for travel demand modeling. Chapter III presents descriptions of the characteristics of the TCMs analyzed in this study. In addition, this chapter discusses the specific TCM scenarios evaluated. Chapter IV presents the methodology used to compute CO emission factors and also describes estimated daily CO emissions due to the implementation of each TCM. Chapter IV also discusses the analysis results for the TCM packages. A cost-effective analysis of TCMs and TCM packages is presented in Chapter V.

TABLE I-2. SUMMARY OF REGIONAL CARBON MONOXIDE EMISSIONS MONTH OF JANUARY

TCM	Scenario A (1,128,800 Population)		Scenario B (1,445,300 Population)		Scenario C (1,762,000 Population)		Scenario D (2,454,200 Population)	
	CO Emissions Tons/Day	% CO Reduction From Base	CO Emissions Tons/Day	% CO Reduction From Base	CO Emissions Tons/Day	% CO Reduction From Base	CO Emissions Tons/Day	% CO Reduction From Base
Base Case	235.26	-----	270.57	-----	352.24	-----	678.09	----
Congestion Pricing	232.03	1.52%	265.04	2.04%	342.15	2.86%	656.30	3.21%
TRO Employer-Based	233.10	1.06%	264.71	2.17%	341.84	2.95%	656.54	3.18%
Ride Sharing	234.10	0.64%	268.50	0.77%	347.47	1.33%	664.41	2.02%
Bicycles Incentives	235.08	0.22%	270.33	0.09%	351.89	0.10%	677.39	0.11%
Working Schedule	234.75	0.36%	269.05	0.56%	349.14	0.88%	665.50	1.86%
Telecommuting	234.74	0.34%	269.51	0.39%	350.28	0.56%	670.56	1.11%
No Drive Days	232.01	1.52%	264.45	2.26%	340.15	3.43%	636.75	6.10%
Alternative Fuel for Government Fleets	232.80	1.19%	267.61	1.09%	347.76	1.27%	671.18	1.02%
Inspection/Maintenance	203.31	13.71%	233.52	13.69%	303.73	13.77%	584.15	13.85%
Reformulated Gasoline*	214.37	9.00%	246.22	8.98%	320.54	9.00%	617.06	9.00%

* Based on analysis performed by Clark County Health District

TABLE I-3. SUMMARY OF TCM YEARLY COSTS (IN MILLION OF DOLLARS)

	Scenario A (1,128,800 Population)	Scenario B (1,445,300 Population)	Scenario C (1,762,000 Population)	Scenario D (2,454,200 Population)
Congestion Pricing	$19.9	$30.2	$43.5	$40.9
TRO Employer-Based	$97.8	$118.8	$170.8	$199.4
Ride Sharing	$2.4	$4.3	$7.7	$11.0
Bicycles Incentives	$8.8	$13.3	$19.7	$30.9
Working Schedule	$1.4	$2.4	$3.9	$6.2
Telecommuting	$3.8	$5.9	$9.1	$14.5
No Drive Days	$87.8	$152.1	$265.7	$488.0
Alternative Fuel for Government Fleets	$3.4	$4.6	$2.3	$1.7
Inspection/Maintenance	$3.2	$4.0	$4.9	$6.9
Reformulated Gasoline*	$15.3	$15.3	$15.3	$15.3

* Based on analysis performed by the Clark County Health District

TABLE I-4. SUMMARY OF TCM COST-EFFECTIVENESS

TCM	Cost-Effectiveness ($/Ton of CO Emissions)			
	Scenario A (1,128,800 Population)	Scenario B (1,445,300 Population)	Scenario C (1,762,000 Population)	Scenario D (2,454,200 Population)
Congestion Pricing	$22,000	$21,564	$17,035	$7,415
TRO Employer-Based	$154,574	$80,115	$64,902	$36,574
Ride Sharing	$6,384	$8,246	$6,514	$3,180
Bicycles Incentives	$67,269	$219,420	$222,100	$164,987
Working Schedule	$6,400	$6,366	$5,020	$1,955
Telecommuting	$17,410	$22,157	$18,304	$7,628
No Drive Days	$96,632	$98,227	$86,864	$46,655
Alternative Fuel for Government Fleets	$4,828	$6,113	$2,031	$946
Inspection/Maintenance	$387	$432	$402	$289
Reformulated Gasoline*	$2,849	$2,484	$1,908	$991

* Based on analysis performed by the Clark County Health District

TABLE I-5. SUMMARY OF REGIONAL CARBON MONOXIDE EMISSIONS FOR TCM PACKAGES

Scenario	Population	Base CO Emission (Tons/Day)	Travel Behavior Package CO Emission (Tons/Day)	Emission Emphasis Package CO Emission (Tons/Day)
A	1,128,800	235.26	223.80	179.28
B	1,445,300	270.57	259.77	206.21
C	1,762,000	352.24	333.88	267.55
D	2,454,200	678.09	643.94	516.21

II. TRAVEL DEMAND MODELING PROTOCOL

RTC TRAVEL DEMAND MODEL

Regional traffic volumes and VMT were estimated for the TCM scenarios using the RTC travel demand model for the Las Vegas metropolitan region. The RTC travel demand model has recently been revised to include both a mode choice model and a visitor travel model. This chapter describes the travel demand model, the model inputs and outputs, and discusses travel demand modeling assumptions.

The RTC travel demand modeling process includes the following steps:

- Development of transportation network
- Determination of land use and socioeconomic data
- Trip generation - the forecasting of person trips
- Trip distribution - geographical distribution of vehicle trips between origin and destination
- Mode choice - determination of the percentage split of person trips among modes
- Highway trip assignment - the assignment of vehicle trips to specific highway routes
- Transit trip assignment - the assignment of person transit trips to transit routes

The six traffic forecasting steps are briefly summarized in the following sections.

Transportation Networks

The initial step in the traffic forecasting process is the development of a model representation of the transportation networks. The model's highway network consists of nodes and links. A node is an intersection of two or more links, such as an intersection of two street segments. A network link is a street segment between two nodes. An example of a network link is the segment of Tropicana Avenue between Las Vegas Boulevard and Koval Lane.

Various physical and traffic characteristics are associated with each link in the model's network. These are maintained in a database of link characteristics including the following network attributes: node numbers, link distance, posted speed limit, link capacity, local jurisdiction code, functional classification, and the number of lanes.

The transportation network also includes TAZs which are the basic geographical zonal units used for land use and trip generation estimation. The TAZs are generally bounded by major streets (links) in the transportation network. For the Las Vegas region, 751 TAZs have been defined for the regional network. In the transportation network, a TAZ is defined by a node called a centroid. For transportation modeling purposes, all the trips within a TAZ are assumed to be generated at the centroid. Each TAZ is connected to a network street link by "dummy links" called centroid connectors, which function as surrogates for the local or neighborhood street system.

Planning Variables

The socioeconomic characteristics of a TAZ, such as the number of dwelling units and the number of employees, are the primary indicators of the number of trips anticipated as originating within or destined to a TAZ. For the Las Vegas region, the specific socioeconomic characteristics within a particular TAZ are defined in terms of the following planning variables: population, residential households, students, hotel/casino employees, retail employees, non-retail commercial employees, industrial employees, office employees, and special trip generator employees.

Some TAZs have purely residential land uses, some have purely commercial land uses, and others have a mixture of residential and commercial land uses. Specific socioeconomic characteristics are associated with the various land use types within a TAZ. In the Las Vegas Metropolitan Region, the land use and socioeconomic data estimates for each TAZ are presented in the RTC's 1996 Planning Variables Database Update Report (6).

Trip Generation

The product of the trip generation modeling phase is an estimate of the total number of person trips which are anticipated to be produced within and/or attracted to each TAZ. A trip is defined as a one-way movement between an origin and a destination zone. The total number of trips generated within a TAZ is a function of the TAZ's residential and/or commercial land use characteristics and the associated socioeconomic data assumptions. Residential land use is generally referred to as a "producer" of trips, and commercial land use is generally referred to as an "attractor" of trips. The number of trips produced by residential land use is a function of: 1) number of dwelling units, 2) household size, and 3) income classification (low, medium, or high). The number of trips attracted to commercial land uses is typically a function of the number of employees.

Two categories of trip tables are produced: resident and visitor trip tables. Resident trips are generated for the following four trip purposes: 1) home-based work (HBW), 2) home-based school, 3) home-based other (HBO), and 4) non-home based (NHB). Visitor trips are generated for the following six trip purposes: 1) hotel-based convention, 2) hotel-based business, 3) hotel-based gaming, 4) hotel-based other, 5) non-hotel gaming, and 6) non-hotel other.

Trip Distribution

The purpose of trip distribution is to distribute the generated person trips between traffic analysis zones. The product of the trip distribution phase is an origin-destination trip table, which specifies the number of trips which travel from each of the model's 751 TAZs to all other TAZs. Trip tables are estimated for each of the five trip purposes. The distribution of trips between geographical zones is a function of the following variables:

- Number of trips produced in a zone
- Number of trips attracted to a zone
- Travel time between two zones

The number of trips traveling between two zones are directly proportional to the total number of trips generated in the first zone and the total number of trips attracted to the second zone. This number is inversely proportional to the travel time between the two zones. For example, the total number of trips traveling between two zones increases as the number of residential trip increases in those zones, but decreases as the travel time increases between the two zones. The RTC visitor trip model was used to distribute visitor trips between zones.

The final product of the trip distribution phase is a trip matrix for each trip purpose which contains the number of trips from each zone to all the other zones in the network. The number of TAZs in the RTC regional network is 751 zones. Therefore, for each trip purpose the Las Vegas region has a 751 by 751 trip matrix.

Mode Choice

The choice among alternative modes was estimated using the RTC Interim Mode Choice Model based on income, travel time, transit cost, and parking cost. Table II-1 contains the possible travel mode options.

TABLE II-1. TRAVEL MODE OPTIONS

Resident Person Trips	Visitor Person Trips
Walk to - Local Bus	Auto
Walk to - Express Bus	Taxi
1 Person Auto	Transit Bus
2 Person Auto	Shuttle Bus/Van
3+ Person Auto	Walk
Park-n-Ride	Transit Rail
Kiss-n-Ride	
Walk/Bike	
Walk to - Transit Rail	

The Interim Mode Choice Model first splits the total person trips into vehicle and transit trips. Vehicle trips are then subdivided into the following modes: 1 person automobile trips, 2 person automobile trips, and 3+ person automobile trips. The final products of the mode choice phase are vehicle and transit trip matrices by purpose to be assigned to the respective highway and transit networks.

Traffic Assignment

The assignment phase allocates vehicle trips traveling between zones to specific roadway routes and transit person trips to specific transit routes. The number of vehicle trips allocated to a roadway route is based on the travel times between the various zones, while transit person trips are dependent upon the available transit routes between zones. The RTC travel demand model uses equilibrium assignment to assign the vehicle trip matrix to the regional highway network. Equilibrium occurs when a trip in the system cannot be made by an alternate path without increasing the system's total travel time. The final product of the traffic assignment process is a highway network with daily traffic volumes assigned to each link segment. The model also outputs VMT, average vehicle speed, and average vehicle hours. The final product of the transit assignment process is the number of passengers getting on and off the bus as well as passengers remaining on the bus at each bus stop for all routes.

MODELING ASSUMPTIONS

Future Networks

The future transportation networks used for TCM analysis were developed by the RTC and include all roadway and transit system improvements outlined in the Regional Transportation Plan (7 & 8).

Trip Distribution Assumptions

The TCM modeling primarily targeted drive alone work trips. Usually, HBW trips have the longest trip length and occur during peak periods where congestion is prevalent. Also, the HBW purpose has the highest percentage of drive alone trips. By targeting these types of trips, one can expect a substantial reduction of VMT, thus reducing CO emissions. To simulate the various TCMs reduction factors were developed and applied to HBW zonal trips. The reduced trips were then redistributed among the two-person vehicle trip matrixes, three plus person vehicle matrixes, and transit trip matrixes. Table II-2 summarizes the purposes targeted by the TCM and the single occupancy vehicle (SOV) trips redistributed to other travel modes.

Table II-3 tabulates the resulting trip reductions by scenario using the modeling assumptions.

TABLE II-2. SINGLE OCCUPANT VEHICLE RESIDENT TRIP REDISTRIBUTION

Transportation Control Measure	Trip Purposes Targeted	Redistributed to
Trip Reduction Ordinances Employer-Based Transportation Management Programs	HBW	2 person auto, 3+ person auto, and transit
Area-Wide Rideshare Incentives	HBW	2 person auto, 3+ person auto, and transit
Bicycle/Pedestrian Incentives	All purposes	None
Work Schedule Changes	HBW	2 person auto, 3+ person auto, and transit
Telecommuting	HBW	None
No Drive Days	All Purposes	2 person auto, 3+ person auto, and transit

HBW = Home-Based Work

TABLE II-3. SINGLE OCCUPANT VEHICLE PERSON TRIPS REDUCED BY SCENARIO

TCM	Number of SOV Person Trips Redistributed by Scenario			
	A 1,128,000 Population	**B 1,445,300 Population**	**C 1,762,000 Population**	**D 2,454,700 Population**
Trip Reduction Ordinances Employer-Based Transportation Management Programs	55,600	127,800	182,200	228,700
Area-Wide Rideshare Incentives	26,700	47,900	84,600	130,000
Work Schedule Changes	10,400	18,400	29,400	37,200
Telecommuting	6,600	10,300	15,600	16,800
No Drive Days	87,000	176,000	283,000	450,000

SOV = Single Occupancy Vehicle

To convert person trips to vehicle trips the following average auto occupancies for residents and visitors where applied:

TABLE II-4. AVERAGE AUTO OCCUPANCIES

Category	Mode of Travel	Auto Occupancy
Resident	SOV	1 person per car
	2 person auto	2 persons per car
	3+ person auto	3.25 persons per car
Visitors	Auto	2.3 persons per car
	Taxi	1.84 person per car

SOV = Single Occupancy Vehicle

VEHICLE-MILES TRAVELED

The magnitude of the regional VMT is directly related to the magnitude of CO emissions. VMT is determined by multiplying the link distance in miles with the daily link traffic volume. For this study, VMT was calculated for each TCM and for each scenario and tabulated by roadway function classification. Network links representing external stations were included in regional VMT calculations. External links, in all RTC networks, represent the physical distance from the regional transportation study area boundary to the regional non-attainment area boundary. Since the travel demand model does not assign intrazonal trips to the network, intrazonal VMT was calculated separately for each alternative and included in the analysis for this project. Transit VMT was estimated for each bus route by multiplying bus route distance time by the number of daily service runs for the route. The individual bus route VMT was then summed to yield the total transit VMT.

III. TRANSPORTATION CONTROL MEASURES

The basic premise of this study was that TCMs are effective strategies in reducing CO emissions. General categories of TCMs which were identified through an extensive literature search are described in this chapter. Given the general TCM categories, the POC structured specific TCM scenarios to be further analyzed. The characteristics of the specific TCM scenarios, which were modeled by the study, are also described in this chapter.

DEFINITION OF TRANSPORTATION CONTROL MEASURES

Transportation control measure actions are designed to reduce mobile pollutant emissions by either improving transportation efficiency or reducing SOV trips. These measures can be divided into two general management strategies: Transportation System Management (TSM) and Travel Demand Management (TDM). Transportation System Management measures improve efficiency of existing transportation supply such as optimized utilization of capacity and improved speeds to reduce travel time delays. Travel Demand Management measures reduce the number of SOVs on roadways by shifting people from SOVs to transit and HOVs. After a review of possible TCMs by the POC a list of TCMs shown in Table III-l was compiled to be evaluated for the Las Vegas region. The original list of possible TCMs also included HOV lanes. Networks containing HOV lanes were developed for scenarios C and D and model runs were made using the interim mode choice model. However, since the interim mode choice model was not validated using HOV facilities, the model runs yielded questionable results, hence this TCM was not considered for analysis.

Bus Transit

Fixed route and express bus service are the traditional forms of bus transit. Generally, expansion of fixed route services is often used to decrease vehicle trips and increase transit ridership.

- The following three improvement options are among the most popular alternatives to expand transit service, especially in the urban environment:

- Adding standard size buses to increase the frequency of service on popular fixed routes or to extend the route to provide service to new market areas.

- Using smaller buses or vans to provide services to areas where demand exists but population density is too low to warrant a large capacity bus.

- Providing articulated buses could be used to increase passenger capacity along the busiest and most frequented routes.

TABLE III-1. TRANSPORTATION CONTROL MEASURES

Bus and Rail Transit
Congestion Pricing/Parking Fees
Trip Reduction Ordinances Employer-Based Transportation Management Programs
Area-Wide Rideshare Incentives
Bicycle Incentives
Work Schedule Changes
Telecommuting
No-Drive Days
Inspection/Maintenance Enhancement Remote Sensing, Anti-Tampering Program
Alternative Fuels for Government Fleets
Reduce Gasoline Volatility
Increase Oxygen Content of Gasoline Blends
Reformulated Gasoline

Express buses provide service between the suburban communities and urban and central business areas. This service is designed to compete directly with the automobile by providing fast and reliable service. Express service is generally used in conjunction with HOV facilities or express bus routes and park-and-ride lots.

Bus transit improvements are not restricted to system/service operational improvements only. Road Improvements, paratransit services, operation management actions, market strategies, fare structures, and policies influence the overall operation and efficiency of bus transit.

Rail Transit

Often rail transit is referred to as fixed guideway transit. The following types of fixed guideways are found in major US metropolitan areas:

- *Heavy Rail Rapid Transit* - High speed, high capacity transit line using an exclusive right-of-way (75 to 85 mph, 20,000 to 34,000 passengers per hour).

- *Light Rail Transit* - Medium capacity transit line, which operates on a reserved right-of-way or in mixed traffic urban arterial.

- *Commuter Rail Service* - High speed, station-to-station service with increased service during peak periods, which usually operates on existing rail lines between suburban and urban centers.

- *Fully Automated Guideways* - This service is generally used for urban circulation improvements or to facilitate connections between transportation hubs and major destinations.

Many logistic, economic, and strategic concerns need to be addressed and evaluated before considering and implementing a fixed guideway system.

Trip Reduction Ordinances

A considerable variety of TROs have been used around the country with varying degrees of success. Some examples of the use of these ordinances include the following:

- Utilizing trip reduction requirements as a bargaining tool for rezoning an area.
- Implementing work place policies that encourage the provision of commute alternatives at the work place.
- Requiring that employers of a certain size develop and implement a demand management program.
- Requiring that adequate public services and facilities are in place before additional development is approved.
- Incorporating trip reduction measures as a condition for new development approval.
- Imposing fees to fund transportation improvements.

Great care must be exercised when developing TROs. The primary goal of a TRO is not to control travel behavior, but to promote socially beneficial travel choices. Usually, a TRO applies to work trips which translate into a small percentage of trips affected. However, since these trips occur during periods of intense travel, they tend to be heavy contributors to congestion and emission problems. In the Las Vegas area, afternoon peak hour traffic volume is approximately 10.65 percent of the daily traffic volume (1).

Employer-based transportation management programs

Travel Demand Management describes a system of strategies whose purpose is to diminish traffic problems through the management of vehicle trip demand. Employer-based strategies to develop and implement transportation management programs can be grouped into four categories:

- *Improved Commute Alternatives* include carpooling, vanpooling, transit, midday and park-and-ride shuttles, bicycling, and walking.

- *Facility Improvements* include bus shelters and turn-outs, adequate clearance for vans at parking structures, special bicycle facilities and secure bicycle parking/storage, shower and changing facilities, and pedestrian accessible retail services.

- *Financial Incentives* include transit pass subsidies, vanpool provisions, alternative commute subsidies, and transportation allowances.

- *On-site Support* includes sale of transit passes, ride-matching capability, information distribution, employee transportation coordination, commuter assistance office, and providing information on available transportation services as part of the new employee orientation.

Work Schedule Changes

The typical eight-to-five work day schedule contributes to morning and afternoon peak period traffic congestion. Work schedule changes are often used to reduce traffic during this time or to eliminate them all together. The most common work scheduling changes are:

Telecommuting	This change affects the location where work is performed and it allows employees to perform their duty for part or all of the week at home or at a center near their home.
Variable Work Hours	This work schedule change affects the time when work is performed and manifests itself in a variety of choices. Among the most popular are flextime, a compressed work week, and staggered working hours.

The effect of such a measure is difficult to quantify, but all of the pilot programs conducted testify to the positive impact of this particular TCM. For example, recently polled telecommuters in Southern California reported a decrease in the number of trips from 4 to 1.94 trips per day. Similarly, in the Puget Sound region the number of trips dropped from 4.3 per day before telecommuting to 2.6 per day after implementing telecommuting (10).

Area-wide Rideshare Incentives

The primary goal of ridesharing is to encourage drive-alone commuters to use alternate modes of transportation for their work related trips. This incentive also encourages employers to provide programs which promote ridesharing among employees. Three major area-wide ride sharing programs include the following:

- *Area-wide Commute Management Organizations* are "third party" ridesharing agencies which facilitate ridesharing among the general public and assist employers in the development of an in-house ridesharing program.

- *Transportation Management Associations* (TMAs) are proactive organizations formed so that employers, developers, building owners, local government representatives, and others can work together to establish policies, programs, and services that address local transportation problems. Usually a TMA is a non-profit corporation comprised of 10 to 30 members with 8 to 15 members on the governing board.

- *State and Local Tax Incentives and Subsidy* are often offered by governmental agencies to employers and commuters participating in ridesharing programs.

An example of a subsidy program is one developed in Connecticut. The Connecticut Department of Transportation, the Federal Housing Association, and a nonprofit ridesharing organization devised a program in which the state purchased interest-free vans marketed for ridesharing purposes. The partnership included both the public and private sector. During 1983, the first year of the program, 286 persons made use of 27 vanpools. This reduction in automobile travel resulted in a 11,900 mile decrease in daily VMT. In 1986, the vanpools increased to 65 serving 728 people and reduced the VMT by 27,083 miles per day (10).

Bicycle and Walking Incentives Programs

This TCM targets trips between short (½ to 1 mile) to mid-length (5 miles or less) trips which can be performed by bicycling or walking to the desired destination instead of driving alone. To attract travelers to these non-motorized modes of transportation, an aggressive campaign to inform the public should be undertaken. In addition, the following should be provided and in place:

- Safe bicycle lanes and routes
- Attractive shower facilities provided with racks and lockers
- Convenient and easy access to public transit

Tucson, Arizona is one model example of a bicycle program. As of 1991, Tucson had 300 miles of bicycle lanes which carry 3.5 percent of work trips. The Florida Department of Transportation estimated that a 0.5 percent shift from auto trips to bicycle or walk trips will result in a 4,245 ton decrease in CO emissions. This result was based on assumptions of 18.2 miles per gallon of gasoline and an average bicycle trip length of 0.5 miles (10).

Alternative Fuels for State and Federal Fleets

Alternative fuels such as ethanol and natural gas have long been present in the fuel market, particularly after the energy crisis of the 1970s. However, demand for vehicles powered by such fuels and availability of such fuels at the pumps has been almost nonexistent. Recent environmental concerns have rekindled interest in the cleaner burning fuels; thus, demand for them has increased. Replacing old fleet vehicles with alternative fuel vehicles has become a growing trend, especially in public agencies. Tax reduction programs for the purchase of an alternative fuel automobile can also be developed, as in the Phoenix area, to promote this type of TCM.

Congestion and Parking Pricing

This category includes programs that will limit or restrict vehicle use in downtown areas or other areas of emission concentration, particularly during periods of peak use. Example programs under consideration include the following:

- Peak period tolls
- Preferential parking policies for HOVs
- Implementing auto-free zones
- Public sector pricing policies to restrict vehicles
- Pricing on and off-street parking
- Parking requirements in zoning codes
- Control of available parking

Reduce Gasoline Volatility

The volatility of gasoline increases the amount of CO vehicle emissions, particularly in the winter months. Fuel volatility, referred to as "Reid Vapor Pressure" (RVP), varies between 9 psi and 12 psi for temperatures between 45^0 F and 75^0 F. Higher RVP is generally used in the winter months to facilitate vehicle start ups resulting in reduced CO emissions.

Inspection/Maintenance

Many areas around the county, including the Las Vegas area, have implemented I/M programs as a measure to reduce mobile sources of air pollution. These programs test vehicle tailpipe emissions and compare the emissions to a standard CO tailpipe emission rate. All vehicles with tailpipe emissions higher than the standard must be repaired and retested. Inspection/Maintenance programs generally fall into two categories: test and repair, and test only programs. For test and repair programs, vehicles are usually inspected and repaired by the same private service. On the other hand, vehicles in test only programs are tested by a service which usually contracts directly to a government agency. Vehicles failing the test must be serviced by separate repair services and be retested.

Reformulated Gasoline

Reformulated Gasoline is a strategy that the Clark County Health District recently begun to consider. This strategy was added as a TCM toward the end of this study to recognize the recent consideration of Reformulated Gasoline. All gasoline is made from a recipe of basic ingredients. Reformulated Gasoline is a cleaner-burning gasoline composed of the same basic ingredients but less polluting because the recipe requires more cleaner-burning components and fewer toxic compounds. The goals for cleaner-burning gasoline are:

- To reduce benzene emissions by 50 percent
- To lower the amount of fuels that evaporates from vehicles
- To reduce the amount of sulfur in gasoline by 80 percent
- To add oxygen-containing compounds which allows gasoline to burn more completely in a vehicle

TRANSPORTATION CONTROL MEASURE SCENARIOS

The specific modeling scenarios developed for the individual TCMs were identified and developed using projected population estimates from the Planning Variables Database prepared by the Clark County Regional Transportation Commission (6). The Planning Variables Database socioeconomic data is forecasted by horizon year. Due to the rapid growth experienced by the Las Vegas area, the population projections presented for certain horizon years could be reached much earlier then forecasted. Population totals were therefore chosen as the evaluation measure instead of the commonly used horizon years. Table III-2 contains the scenario definitions and population equivalencies used in this study.

TABLE III-2. SCENARIO DEFINITIONS

Scenario	Population
A	1,128,800
B	1,445,300
C	1,762,000
D	2,454,200

The effectiveness of a particular TCM in reducing CO begins with the implementation assumptions for a particular TCM. The following pages describe the assumption calculations and default values used in this study. Table III-3 summarizes the assumptions.

TABLE III-3. SUMMARY OF TCM ASSUMPTIONS BY SCENARIO

TCM	Assumptions			
	A (1,128,000 Population)	**B (1,445,300 Population)**	**C (1,762,000 Population)**	**D (2,454,200 Population)**
Congestion Pricing (Parking fee)	$1.00 for HBW Trips and $2.50 for NHB Trips	$1.00 for HBW Trips and $2.50 for NHB Trips	$1.00 for HBW Trips and $2.50 for NHB Trips	$1 for HBW Trips and $2.50 for NHB Trips
TRO Employer-based	10% HBW Trip Reduction	20% HBW Trip Reduction	25% HBW Trip Reduction	30% HBW Trip Reduction
Ride Sharing	2.5% HBW Trip Reduction	4% HBW Trip Reduction	6% HBW Trip Reduction	7.1% HBW Trip Reduction
Bicycle Incentives	0.08% VMT Reduction	0.09% VMT Reduction	0.10% VMT Reduction	0.11% VMT Reduction
Working Schedule	3% HBW Trip Reduction	4.5% HBW Trip Reduction	6% HBW Trip Reduction	7.5% HBW Trip Reduction
Telecommuting	3% HBW Trips Reduction	4% HBW Trip Reduction	5% HBW Trip Reduction	6% HBW Trip Reduction
No Drive Days	5% HBW Trip Reduction 3% HBO 3% NHB	8% HBW Trip Reduction 5% HBO 4% NHB	10% HBW Trip Reduction 7% HBO 5% NHB	15% HBW Trip Reduction 10% HBO 7% NHB
Alternative Fuel for Government Fleets	2.42 tons/day CO Reduction	2.96 tons/day CO Reduction	4.48 tons/day CO Reduction	6.91 tons/day CO Reduction
Inspection/Maintenance	Full Operation	Full Operation	Full Operation	Full Operation
Reformulated Gasoline	Adopted	Adopted	Adopted	Adopted

HBW = Home-Based Work
NHB = Nonhome-Based
HBO = Home-Based Other
VMT = Vehicle-Miles Traveled

Bus and Rail Transit

The RTC bus and rail transit routes planned for the various scenario years were assumed to be in place for those years. Therefore, the analysis of each of the other TCMs assume the bus and rail transit improvements are in place. No additional systems or routes were tested. The following equivalent cash fare assumptions were utilized:

- Resident transit bus fare $0.47
- Resident transit express bus fare $0.77
- Resident fixed guideway fare $0.77
- Free bus transfers —
- Visitor transit bus fare $0.77
- Visitor express bus fare $1.00
- Visitor fixed guideway fare $1.00

Congestion and Parking Pricing

The primary focus of this TCM is to reduce the number of trips made by SOVs, primarily in the Resort Corridor and Downtown area. Parking cost is the chief incentive used in reducing the number of SOV trips. The costs were stratified by trip purpose for residents and by trip purpose and establishment location for visitors. Parking cost assumptions are:

- Residents' HBW per trip cost is $1.00
- Residents' NHB per trip cost is $2.50
- Downtown visitor nonhotel-based, nonhotel-based gaming, and hotel-based other purposes for the area between Bonneville and Stewart and from Main Street to Las Vegas Boulevard, parking charges range from $1.50 to $3.00.

Employer Based Trip Reduction Ordinance

The goal of this TCM is to reduce vehicle trips through employee based trip ordinances. The targeted percent reductions of HBW person trips for the various scenarios are tabulated in Table III-4.

TABLE III-4. TARGETED PERCENT HOME-BASED WORK PERSON TRIP REDUCTION EMPLOYER TRIP REDUCTION ORDINANCE

Scenario	Population	Targeted Percent Reduction
A	1,128,000	10%
B	1,445,300	20%
C	1,762,000	25%
D	2,454,200	30%

The Dun and Bradstreet database, containing all employers with 100 or more employees, was acquired for use in defining this TCM. Employers were identified by TAZ used for the RTC travel demand model. A table was then developed containing the total number of employees for employers with 100 or more employees. Computations were performed to determine the percentage decrease in trips within a TAZ due to implementation of the TRO. The following equation was used to determine the HBW trip reduction factors.

where:	TE	Total TAZ Employment
	TE_{100}	Total Employment for firms with 100 or more employees by TAZ
	TPR	Targeted Percent Reduction of HBW trips

A file containing the TAZ reduction factors was created and used as input to the modeling process.

Ride Sharing

The purpose of a ride share program is to reduce the number of vehicle trips by increasing ride sharing in the region. For this, work trip reductions were estimated based on the number of employees.

Two files were created for this TCM: one containing the number of employees for employers having 100 through 349 employees; the other containing the number of employees for employers having 350 or more employees. These distinctions were necessary due to the different success rates exhibited by the two categories. The following equation was used to derive the reduction factors to be applied to zonal HBW trips.

where:	TE_{100}	Total employment for firms with 100 to 349 employees by TAZ
	TE_{350}	Total employment for firms with 350 and more employees by TAZ
	TE	Total TAZ employment
	ACO	Average Carpool Occupancy
	ASR	Average Success Rate

Table III-5 lists the default values used for average carpool occupancy and the average success rates (9). These values were developed by the Maricopa Association of Governments (MAG), Arizona after observing the result of this type of TCM in the Phoenix area.

TABLE III-5. AVERAGE CARPOOL OCCUPANCY AND SUCCESS RATES

Description	Success Rates			
	A 1,128,000 Population	**B 1,445,300 Population**	**C 1,762,000 Population**	**D 2,454,200 Population**
Avg. success rate of carpool conversion for a firms with 100 through 349 employees	1.17%	2.20%	3.00%	4.00%
Avg. success rate of carpool conversion for a firm with 350 and more employees	2.33%	3.50%	5.00%	7.00%
Avg. carpool person occupancy	2.18%	2.30%	2.50%	2.70%

Bicycle Incentives

Bicycle incentives are facilities and programs to encourage bicycling including bike lanes, bike paths, shower facilities, locker facilities, and other amenities. In the Las Vegas area, the Citizens Area transit (CAT) promotes bicycling by providing bicycle racks on all buses. For this study, the Bicycle Incentive TCM assumes that a comprehensive and broad incentive program is in place. To analyze this TCM, the maximum travel time and trip length was assumed to be eight minutes and four miles, respectively, for all scenarios. The total number of person trips with less than eight minutes travel time was tabulated by trip purpose and was converted to vehicle trips using the auto occupancy factors by purpose, as shown in Table III-6 (5). Based on a review of the literature, assumptions were made about the possible number of conversions from vehicle to bicycle trips for each scenario. Table III-7 shows the values tested for this TCM.

TABLE III-6. AUTO OCCUPANCY

Trip Purpose	Auto Occupancy
Home-Based Work	1.10
Home-Based School	1.50
Home-Based Shop	1.60
Home-Based Other	1.56
Nonhome-Based	1.50

TABLE III-7. PERCENT OF VEHICLE TRIPS CONVERTING TO BICYCLE TRIPS

Scenario	Population	Percent Change
A	1,128,000	0.50%
B	1,445,300	0.60%
C	1,762,000	0.70%
D	2,454,700	1.00%

The trip conversion factor was applied to the total number of vehicle trips under eight minutes to yield the total number of reduced vehicle trips for each scenario. The total number of vehicle trips were then converted to VMT by using an average trip length of 2.5 miles. Table III-8 summarizes the results.

TABLE III-8. VEHICLE-MILES TRAVELED REDUCTION PERCENTAGES BICYCLE INCENTIVES

Scenario	Population	Regional VMT Percent Reduction
A	1,128,000	0.08%
B	1,445,300	0.09%
C	1,762,000	0.10%
D	2,454,700	0.11%

Work Schedule Changes

Changes to employee work schedules can reduce vehicle trips. For this TCM, only the following employment categories were considered for possible work schedule changes: office, government, utilities, hospital, and industrial. Two types of flexible schedules were considered: 4 days/40 hours and 9 days/80 hours.

For the eligible groups of employees, it was assumed that only a certain percentage of employees will participate in either program. Table III-9 lists the assumed percentages for each scenario.

TABLE III-9. PERCENTAGE OF EMPLOYEE PARTICIPATION WORK SCHEDULE CHANGES

Scenario	Population	Percent of Employees Participation
A	1,128,000	10.0%
B	1,445,300	15.0%
C	1,762,000	20.0%
D	2,454,700	25.0%

The HBW trip reduction was calculated using the following equation and assumed the percentage participation did not differ among the two types of schedules.

Table III-10 contains the HBW trip reduction results for each scenario.

TABLE III-10. HOME-BASED WORK TRIP REDUCTION ASSUMPTIONS WORK SCHEDULE CHANGES

Scenario	Population	Percent HBW Trip Reduction
A	1,128,000	3.0%
B	1,445,300	4.5%
C	1,762,000	6.0%
D	2,454,700	7.5%

HBW = Home-Based Work Trip

The ratio of the number of eligible employees to the total number of employees in the study area was calculated for each scenario. The resulting overall trip reduction percentage was calculated by multiplying the ratio by the percentage of HBW trip reductions (see Table III-11).

TABLE III-11. TOTAL TRIP REDUCTION

WORK SCHEDULE CHANGES

Scenario	Population	Percent Total Trip Reduction
A	1,128,000	0.0108%
B	1,445,300	0.0154%
C	1,762,000	0.0202%
D	2,454,700	0.0240%

The decrease in the percentage trip reduction can be attributed to the relatively stable ratio between total employment and employment for each category used in this TCM. For instance, for scenario A, the ratio of eligible employees to total area employment was 36 percent. The HBW trip reduction percentage was three percent; thus, the percentage of HBW trip reduction is .0108 (1-.36*.03).

Telecommuting

This new form of flexible scheduling, which eliminates work and sometimes nonwork vehicle trips, is becoming very popular. However, the unique characteristics of the gaming industry prevent a large portion of the Las Vegas work force from participating in this type of program. Employment categories considered for this TCM were: office, utilities, and government. The procedure developed to estimate trip reductions for work schedule changes was also employed for this TCM. Table III-12 presents the assumed percentages of possible HBW trip reductions.

TABLE III-12. HOME-BASED WORK TRIP REDUCTION ASSUMPTIONS TELECOMMUTING

Scenario	Population	Percent HBW Trip Reduction
A	1,128,000	3.0%
B	1,445,300	4.0%
C	1,762,000	5.0%
D	2,454,700	6.0%

The resulting overall HBW trip reduction factors are summarized by scenario in Table III-13.

TABLE III-13. TOTAL TRIP REDUCTION TELECOMMUTING

Scenario	Population	Percent Total Trip Reduction
A	1,128,000	0.006%
B	1,445,300	0.008%
C	1,762,000	0.011%
D	2,454,700	0.013%

No Drive Days

This measure targets the months in which CO exceeded standards, primarily in January and February. For these months, drive alone trips are restricted through voluntary or mandatory policies. This not only influences the work trip, but also changes the trip making characteristics of other trip purposes. The targeted percent reduction used in this TCM was developed using results from the Phoenix metropolitan area after the implementation of a voluntary no drive days ordinance (9). Table III-14 gives the values used to test this TCM.

TABLE III-14. PERCENT TRIP REDUCTION ASSUMPTIONS NO DRIVE DAYS

Scenario	Population	Percent HBW Trip Reduction	Percent HBNW Trip Reduction	Percent NHB Trip Reduction
A	1,128,000	5.0%	3.0%	3.0%
B	1,445,300	8.0%	5.0%	4.0%
C	1,762,000	10.0%	7.0%	5.0%
D	2,454,700	15.0%	10.0%	7.0%

HBW =Home-Based Work
HBNW = Home-Based Non Work
NHB = Nonhome-Based

Alternative Fuels for Government Fleets

The purpose of this TCM is to reduce CO emissions through the use of vehicles using alternative fuels. Federal, state, county and local governments own numerous vehicle fleets that include autos, vans, heavy- and light-duty trucks, and various heavy equipment vehicles, such as tractors, bulldozers, and cranes.

Clark County provided 1997 vehicle data for all governmental jurisdictions. The data contained the number of vehicles powered by gasoline as well as alternative fuels. This data was projected to other scenarios using population growth ratios. Special attention was given to the state mandate requiring 90 percent of all newly purchased county vehicles to use alternative fuels beginning in the year 2000. Diesel and compressed natural gas fuels were considered for this TCM. The predominant alternative fuel vehicle was assumed to use compressed natural gas. Table III-15 presents the estimated number of vehicles using alternative fuels for each scenario.

TABLE III-15. ALTERNATIVE FUEL VEHICLES FOR GOVERNMENT FLEETS

Scenario	Population	Federal/State	Local	Buses
A	1,128,000	2,412	5,763	670
B	1,445,300	3,087	7,377	695
C	1,762,000	3,766	9,000	721
D	2,454,700	5,246	12,536	748

As noted above, the 1997 alternative fuel data was provided by the Clark County Comprehensive Planning Department. The scenario year projections were estimated using population growth factors. Table III-16 outlines the expected agency participation rates in converting fleets to alternative fuels.

TABLE III-16. EXPECTED PARTICIPATION RATES FOR PUBLIC AGENCIES

Scenario	Population	Federal/State	Local	Buses
A	1,128,000	50.0%	45.0%	90.0%
B	1,445,300	90.0%	50.0%	90.0%
C	1,762,000	90.0%	75.0%	90.0%
D	2,454,700	90.0%	90.0%	90.0%

Table III-17 contains variables and the default values for those variables used to complete the CO reduction estimates. Since current local data was not available, default values were taken from test data for the Phoenix Metropolitan area produced by the Arizona Department of Environmental Quality (9).

TABLE III-17. DEFAULT VALUES USED FOR ALTERNATIVE FUELS ANALYSIS

Variables	Scenario A	Scenarios B-D
Average vehicle miles/day	35.0	35.0
Average bus miles/day	50.5	50.5
Average light duty gasoline vehicle CO	12.23	10.95
Average light duty gasoline truck CO emissions	14.29	13.35
Average gasoline bus emissions	31.14	12.91
Average light duty gasoline vehicle compressed natural gas emissions	2.94 g/mile	1.22 g/mile
Average light duty gasoline truck compressed natural gas emissions	3.43 g/mile	1.43 g/mile
Average bus, diesel, or compressed emissions	7.47 g/mile	3.11 g/mile

The difference in emission values among the scenarios is due to the forecasted fuel burning efficiency of future vehicles. Assuming there are 59 percent light- duty gasoline vehicles, 41 percent light-duty gasoline trucks, and an average CO emission, the total CO emission reduction was calculated by scenario using the following equation:

$$CO = [ADM*(TF*\%CV)]*[(\%_{ldgv}*E_{ldgv})+(\%_{ldgt}*E_{ldgt})] - [ADM*(TF*\%CV)]*[(\%_{ldcngv}*E_{ldcngv})+(\%_{ldcngt}*E_{ldcngt})]$$

where: ADM = Average Daily Mileage (vehicle or buses)
TF = Total number of vehicles in the fleet
%CV = Percent of vehicles converted to alternative fuel
$\%_{ldgv}$ = Percent light duty gasoline vehicles in the fleet
E_{ldgv} = Average light duty gasoline vehicle CO emission
$\%_{ldgt}$ = Percent light duty gasoline trucks in the fleet
E_{ldgt} = Average light duty gasoline trucks CO emissions
$\%_{ldcngv}$ = Percent light duty compressed natural gas vehicles in the fleet
E_{ldcngt} = Average light duty compressed natural gas trucks CO emission
$\%_{ldcngv}$ = Percent light duty compressed natural gas vehicles in the fleet
E_{ldcngt} = Average light duty compressed natural gas trucks CO emission

Table III-18 presents the resulting total CO reductions by scenario.

TABLE III-18. CARBON MONOXIDE REDUCTIONS FOR ALTERATIVE FUELS IN GOVERNMENT FLEETS

Scenario	Population	CO Reduction g/day			Total
		State/Fed	Local	Buses	Tons/Day
A	1,128,000	551,87	1,186,7	720,787	2.42
B	1,445,300	1,160,4	1,540,6	309,560	2.96
C	1,762,000	1,415,7	2,819,4	321,141	4.48
D	2,454,700	1,972,0	4,712,5	333,167	6.91

Reduce Gasoline Volatility

The gasoline volatility, especially during the winter months, increases the percentage of CO vehicle emissions. The Las Vegas area has already implemented this measure to reduce seasonal volatility resulting in a reduction from 10.0 psi to 9.0 psi. This data has been included in all TCM CO emission factor calculations. The measure affects primarily the input default values of Mobile5a-h.

Inspection/Maintenance

The Las Vegas area currently requires motorists to have a yearly inspection performed on their vehicles. The inspection is performed at test and repair facilities, such as gasoline stations and automobile repair services. However, the test only station system is considered by the EPA to be more accurate and a better method to control vehicle emissions (11). The I/M program TCM in this study assumes that a test only program is in place in the Las Vegas area. The EPA Mobile5a-h emission factors software was used to estimate the vehicle emission factors assuming that such a program is in place. Table III-19 lists the Mobile5a-h default values used to describe the Las Vegas area proposed I/M program.

Reformulated Gasoline

The Clark County Health District has recently drafted regulations to mandate that all gasoline sold in the Las Vegas area conforms to the California reformulated fuel standard. The Reformulated Gasoline TCM was added to the list of potential TCMs at the end of this study. Since analyzes for all remaining TCMs were already complete, the analysis for the Reformulated Gasoline TCM was based on Clark County Health Department estimates of CO reduction (see Appendix B). Additional technical analysis on reformulated gasoline must be conducted to further evaluate the impact of reformulated gasoline on air quality.

TABLE III-19. PROPOSED INSPECTION/MAINTENANCE PROGRAM DEFAULT VARIABLES AND VALUES

Variables	Values
Start year	1988
Expected failure rate	
pre 1981 vehicles	18%
pre 1984 light-duty trucks	18%
Earliest model year	1968
Latest model year	2020
Compliance rate	85%
Program type	Test Only
Inspection frequency	Annual
Test type	2500/Idle

IV. CARBON MONOXIDE EMISSIONS

The ultimate goal of the TCM modeling was to estimate the regional CO emission reductions produced by the various TCMs. This section describes the emission modeling assumptions and summarizes CO emission estimations for the various TCMs.

CO EMISSION FACTORS

The Mobile5a-h emission factor model developed by the EPA was used to compute CO emission factors in grams of CO per mile of travel. CO emissions were calculated for various vehicle types as well as for gasoline and diesel powered vehicles. The base input Mobile5a-h files were provided by Clark County Department of Comprehensive Planning and are shown in Appendix A. The following Mobile5a-h parameters were used for all CO emission factor calculations:

TABLE IV-1. MOBILE5a-h PARAMETERS

Parameter		Value
Gasoline Volatility	Period 1	13.5 psi
	Period 2	9.0 psi
Oxygenated Fuels	Market Shares for Ether blends	0.0%
	Market Shares for Alcohol blends	100.0%
	Oxygen Content for Ether Blends	0.0%
	Oxygen Content for Alcohol Blends	3.5%
Local VMT Mix	Light Duty Gas Vehicles	73.5%
	Light Duty Gas Trucks (<6,000 lbs.)	12.3%
	Light Duty Gas Trucks (>6,000 &<8,500 lbs.)	6.7%
	Heavy Duty Gas Vehicles (>8,500 lbs.)	1.2%
	Light Duty Diesel Vehicles	1.9%
	Light Duty Diesel Trucks	0.7%
	Heavy Duty Diesel Trucks	2.7%
	Motor Cycles	1.0%
I/M Program	Test and Repair	
Daily Temperature	Minimum	36.0º F
	Maximum	64.0º F
Stage II Vapor Recovery Systems	Start Year - 1992	
	Phase in Period - 3 years	
	Percentage Efficiency - Light-Duty Vehicles	95.0%
	Percentage Efficiency - Heavy-Duty Vehicles	95.0%

Speed is critical to the Mobile5a-h emission factor model. Congested speeds were input by facility type and were calculated using the following modified Bureau of Public Roads equation:

where: V = Facility Type Volume
C = Facility Type Capacity

Table IV-2 presents the assumed free flow speeds by facility type.

TABLE IV-2. FREE FLOW SPEED BY FACILITY TYPE

Facility Type	Free Flow Speed
External Links	65.0
System Ramps	35.0
Minor Arterials	35.0
Major Arterials	45.0
Ramps	25.0
Interstate	60.0
Freeway	55.0
Expressway	45.0
Collector Streets	30.0
Local Streets	15.0
Intrazonal Trips	15.0
Fixed Route Transit	13.5

TCM REGIONAL CO EMISSIONS

Two variables were used to estimate the regional CO emissions: VMT and emission factors. The final product of travel demand modeling is VMT by roadway functional classification while Mobile5a-h modeling yields the emission factors by functional classification. Since CO emission exceeds the standard during the winter months, the regional CO emissions were estimated for the month of January. The travel demand model produces daily average VMT for a scenario year. Therefore, the January VMT was calculated by multiplying the average daily VMT by a monthly traffic adjustment factor and a yearly regional conservative growth factor of 4.0 percent. The Nevada Department of Transportation reports a traffic adjustment factor of 0.92 for the month of January for the Las Vegas area. The adjusted VMT was then multiplied by the corresponding CO emission factors for each functional class to yield the total regional CO emissions. Table IV-3 illustrates sample calculation results used in determining the regional CO emissions for a particular TCM. Tables IV-4 through IV-7 summarize the adjusted VMT, average speed, and regional CO emissions for each TCM by scenarios.

REGIONAL CO EMISSIONS FOR TCM PACKAGES

Pairing TCMs with other TCMs having complementary characteristics increases the effectiveness of individual TCMs. Many measures complement one another; however, situations may arise where jointly implemented measures can detract from individual effectiveness. For example, working schedule changes may adversely affect a ridesharing program because service is not available for the new hours. Under such circumstances, employees may stop participating in the ride sharing program in order to comply with schedule changes in the work place.

Several analytical approaches could be used in packaging TCMs, such as using professional judgment to network simulation or benefit-cost considerations. The most useful and practical approaches combine quantitative and qualitative considerations to determine which TCMs should be packaged together.

Table IV-8 summarizes the compatibility characteristics of various TCMs evaluated in this project. Based on an analysis of the table, two packages were defined: a travel behavior package and an emission emphasis package. The travel behavior package consists of TCMs affecting travel behavior patterns including:

- Congestion Pricing
- TRO Employer-Based
- Ridesharing
- Bicycle Incentives
- Working Schedule Changes
- Telecommuting
- No Drive Days

The emission emphasis package contains TCMs that affect emission facts and Mobile5a-h input variables that include:

- Alternative Fuel for Government Fleets
- Inspection/Maintenance - Emissions Test Only Facilities
- Reformulated Gasoline

The travel behavior package was evaluated using individual TCM assumptions and adjustment factors to account for any synergetic effect created by their aggregation. No conflicts existed among the TCMs in the emphasis package, therefore, adjustments were not necessary. CO emissions are tabulated for each package by each scenario in Table IV-9.

TABLE IV-3. SAMPLE SPREADSHEET CALCULATION FOR REGIONAL CO EMISSIONS
SCENARIO A - BASE CASE

Facility Type	Average VMT	Jan VMT	VHT Congested	Capacity Available	Free Flow Speed	Congested Speed	CO Factor (g/Mile)	Jan CO Volume (KG)
External	765,708.00	732,629.41	11,788.48	4,245,601.00	65.00	64.95	14.06	10,300.77
System Ramps	90,842.60	86,918.20	2,611.63	292,772.00	35.00	34.78	8.93	776.18
Minor Arterials	7,195,042.60	6,884,216.76	209,678.35	17,318,950.00	35.00	34.31	9.06	62,371.00
Major Arterials	3,464,978.00	3,315,290.95	78,730.09	8,097,825.00	45.00	44.01	6.99	23,173.88
Ramps	273,887.40	262,055.46	11,214.88	631,812.00	25.00	24.42	12.98	3,401.48
Interstates	3,878,236.00	3,710,696.20	67,410.64	7,710,752.00	60.00	57.53	8.33	30,910.10
Freeways	1,512,619.00	1,447,273.86	27,950.48	3,830,618.00	55.00	54.12	6.43	9,305.97
Expressways	278,511.10	266,479.42	5,095.03	899,624.00	55.00	54.66	6.43	1,713.46
Collectors	2,895,582.00	2,770,492.86	96,769.97	11,607,840.00	30.00	29.92	10.48	29,034.77
Local	2,189,558.00	2,094,969.09	146,247.68	9,491,583.00	15.00	14.97	19.31	40,453.85
Interzonal Trips	74,726.00	71,497.84	4,981.73			15.00	19.31	1,380.62
Public Transit	66,900.00	66,900.00	4,955.56			13.50	15.74	1,053.01
Total All	22,686,590.70	21,709,420.06	667,434.51					213,875.10
							Tons/Day	235.26
							System Average Speed	33.99

VMT - Vehicle Miles Traveled
VHT - Vehicle Hours Traveled

TABLE IV-4. TCM SYSTEM WIDE RESULTS COMPARISON
SCENARIO A - MONTH OF JANUARY

TCM	Total VMT	Speed (mph)	CO Emissions tons/day	Percent CO Reduction From Base
Base Case	21,709,420	33.99	235.26	
Congestion Pricing	21,399,969	34.03	232.03	1.52%
TRO Employer-Based	21,506,626	34.03	233.10	1.06%
Ride Sharing	21,604,529	34.02	234.10	0.64%
Bicycles Incentives	21,692,106	33.99	235.08	0.22%
Working Schedule	21,633,644	34.00	234.75	0.36%
Telecommuting	21,658,911	34.00	234.74	0.37%
No Drive Days	21,409,451	34.05	232.01	1.52%
Alternative Fuel for Government Fleets	21,709,420	33.99	232.80	1.19%
Inspection/Maintenance	21,709,420	33.99	203.31	13.71%
Reformulated Gasoline*	21,709,420	33.99	214.37	9.00%

* Based on analysis performed by Clark County Health District

TABLE IV-5. TCM SYSTEM WIDE RESULTS COMPARISON
SCENARIO B - MONTH OF JANUARY

TCM	Total VMT	Speed (mph)	CO Emissions tons/day	Percent CO Reduction From Base
Base Case	30,157,398	33.40	270.57	
Congestion Pricing	29,701,925	33.52	265.04	2.04%
TRO Employer-Based	29,697,745	33.56	264.71	2.17%
Ride Sharing	30,023,737	33.49	268.50	0.77%
Bicycles Incentives	30,138,924	33.40	270.33	0.09%
Working Schedule	30,074,255	33.47	269.05	0.56%
Telecommuting	30,076,272	33.41	269.51	0.39%
No Drive Days	29,670,987	33.56	264.45	2.26%
Alternative Fuel for Government Fleets	30,157,398	33.40	267.61	1.09%
Inspection/Maintenance	30,157,398	33.40	233.52	13.69%
Reformulated Gasoline	30,157,398	33.40	246.22	8.98%

* Based on analysis performed by the Clark County Health District

TABLE IV-6. TCM SYSTEM WIDE RESULTS COMPARISON
SCENARIO C - MONTH OF JANUARY

TCM	Total VMT	Speed (mph)	CO Emissions tons/day	Percent CO Reduction From Base
Base Case	38,380,196	32.00	352.24	
Congestion Pricing	37,500,134	32.19	342.15	2.86%
TRO Employer-Based	37,524,595	32.22	341.84	2.95%
Ride Sharing	37,977,140	32.10	347.57	1.33%
Bicycles Incentives	38,350,532	32.00	351.89	0.10%
Working Schedule	38,114,103	32.06	349.14	0.88%
Telecommuting	38,240,016	32.04	350.28	0.56%
No Drive Days	37,348,947	32.27	340.15	3.43%
Alternative Fuel for Government Fleets	38,380,196	32.00	347.76	1.27%
Inspection/Maintenance	38,380,196	32.00	303.73	13.77%
Reformulated Gasoline*	38,380,196	32.00	320.54	9.00%

* Based on analysis performed by the Clark County Health District

TABLE IV-7. TCM SYSTEM WIDE RESULTS COMPARISON
SCENARIO D - MONTH OF JANUARY

TCM	Total VMT	Speed (mph)	CO Emissions tons/day	Percent CO Reduction From Base
Base Case	58,650,094	26.06	678.09	
Congestion Pricing	57,638,529	26.45	656.30	3.21%
TRO Employer-Based	57,693,901	26.48	656.54	3.18%
Ride Sharing	58,032,119	26.32	664.41	2.02%
Bicycles Incentives	58,594,314	26.06	677.35	0.11%
Working Schedule	58,039,787	26.29	665.50	1.86%
Telecommuting	58,270,123	26.20	670.56	1.11%
No Drive Days	56,861,435	26.83	636.75	6.10%
Alternative Fuel For Government Fleets	58,650,094	26.06	671.18	1.02%
Inspection/Maintenance	58,650,094	26.06	584.15	13.85%
Reformulated Gasoline*	58,650,094	26.06	617.06	9.00%

* Based on analysis performed by the Clark County Health District

TABLE IV-8. GENERAL SUMMARY OF TCM COMPATIBILITY

	Congestion Pricing	TRO Employer-Based	Ride Sharing	Bicycles Incentives	Working Schedule	Telecom-muting	No Drive Days	Alternative Fuel/ Reformulated Gasoline	Inspection/ Maintenance
Congestion Pricing		+	+	0	0	0	+	0	0
TRO Employer-Based	+		+	+	+	+	+	0	0
Ride Sharing	+	+		0	–	0	+	0	0
Bicycle Incentives	0	+	0		+	0	0	0	0
Working Schedule	0	+	–	+		0	+	0	0
Telecommuting	0	+	0	0	0		+	0	0
No Drive Days	+	+	+	0	+	+		0	0
Alternative Fuel/Reformulated Gasoline	0	0	0	0	0	0	0		0
Inspection/Maintenance	0	0	0	0	0	0	0	0	

+ Supportive
0 Neutral
– Conflicting

TABLE IV-9. CARBON MONOXIDE EMISSIONS COMPARISON FOR TCM PACKAGES

Scenario	Population	Base CO Emission (tons/day)	Travel Behavior Package CO Emission (tons/day)	Emission Emphasis Package CO Emission (tons/day)
A	1,128,800	235.26	223.80	179.28
B	1,445,300	270.57	259.77	206.21
C	1,762,000	352.24	333.88	267.55
D	2,454,200	678.09	643.94	516.21

V. COST-EFFECTIVENESS ANALYSIS

COST OF TRANSPORTATION CONTROL MEASURES

The cost of a TCM is comprised of the following expenses: capital, operating, administrative, travel, and productivity costs. Capital, operating, and administrative costs are incurred by governments and/or employers and relate to TCM expenditures associated with the administrative expenses of operating a particular program and with operation and capital transit improvements. Travel costs are time costs and inconvenience incurred by travelers. These costs include increased trip time, the inconvenience of diverting from a preferred route, and the loss of privacy from sharing a ride. Productivity costs include those incurred to governments and/or firms arising from reduced access for employers, customers, suppliers, and others.

This analysis focuses only on the categories of capital, operating, and administrative costs for TCMs since these expenditures are more direct and are also more readily quantified. Table V-1 presents the costs per trip avoided for various TCMs. Estimated costs for all scenarios are in constant dollars per vehicle trip avoided. Annual costs were computed based on 253 working days. The components for these costs are described below.

TABLE V-1. TCM COST ESTIMATES

TCM	Cost Per Vehicle Trip Avoided
Congestion/Parking Pricing[1]	$1.75
Employer Trip Reduction	$5.15
Area-wide Ridesharing	$0.50
Bicycle Facilities	$5.30
Work Schedule Changes	$0.50
Telecommuting	$2.17
No Drive Days[2]	$6.00

1 - Value assumed for mode choice modeling
2 - Based on the cost of the employer trip reduction measure

Congestion and Parking Pricing

For this study, the congestion/parking pricing cost is primarily the administrative costs of regulating and enforcing the parking price. Both work and nonwork trip parking costs are considered in this analysis. Estimated administrative cost ranges from 8.3 to 12.5 percent of revenue (1). Therefore, 10 percent is used in this analysis. The estimated total administrative cost is 10 percent of the revenue from the number of trips eliminated. The average cost for both work and nonwork trips is $1.75 per trip avoided.

Employer Trip Reductions

The costs for an employer trip reduction program include staff time spent on developing and coordinating trip reduction plans, expenses for facilities such as bicycle and shuttle facilities, and subsidies for transit. Survey data show that employers spend between $12 and $750 annually per employee. A 1994 study conducted in southern California of five firms found the annual average to be $80 per each employee participating in the program (2).

Area-wide Ridesharing

Costs for area-wide ridesharing programs include the administrative costs of operating an educational and marketing program. An area-wide ridesharing program can be subsidized by government, business, or both. The average cost for a new carpooler ranges between $76 and $120. The average cost of $84 per each commuter participating in the program is used in this analysis to determine the reduced cost per vehicle trip (2).

Bicycle and Pedestrian Facilities

The costs for this category is derived primarily from the needs of travelers using bicycles as a transit access mode. The costs include transit station modification to accommodate or improve access for bicycles and to provide showers and bicycle storage facilities at the work place (2).

Work Schedule Changes

The costs generated by this measure can include administrative costs for rearranging and supervising the schedule, additional leasing and utility costs for extended hours of operation, and cost for extended security coverage. No conclusive cost data is available, but some studies indicate the cost would be minimal. For this analysis, the cost was assumed to be $.50 per vehicle trip avoided (2).

Telecommuting

Telecommuting costs vary based on type, home, or satellite. For our analysis, home telecommuting was assumed. A recent California Telecommuting Pilot Project report offers the following assumptions and costs. A computer costs $3,000 and is replaced after five years for an annual cost of $600. Most telecommuters already own a personal computer, thereby the annual cost was adjusted to $500. Training costs $60 per year and is repeated every five years. Average telephone charges are $360 per year and computer maintenance cost approximately $250 per year. Assuming one in three telecommuters need a printer at a cost of $800, there is an added cost of $107 per telecommuter. The conservative total cost per telecommuter is approximately $1,375 a year, or $5.43 per day (12).

No-Drive Days

The implementation of no-drive days are very costly. Costs include time spent on logistic and strategic implementation plans, marketing using various media, aggressive public awareness campaign, and monitoring personnel to ensure compliance. Since cost data for no-drive days is not conclusive, the cost determined for the employer trip reductions program was used as base to estimate the no-drive days cost per vehicle trip reduced.

Alternative Fuel for Government Fleets

Most public agencies have already budgeted for these vehicles in order to comply with the Energy Policy Act and Clean Fuel Fleet Program. By the year 2000, the State of Nevada mandates that 90 percent of newly purchased vehicles for government fleets must use an alternative fuel. For this TCM the following conversion costs per vehicle are assumed:

Scenario A	$4,000 per vehicle
Scenario B	$2,000 per vehicle
Scenario C	$1,000 per vehicle
Scenario D	$ 500 per vehicle

Cost of additional alternative fuel pumps or stations is assumed to be nominal. The cost of converting a vehicle to an alternative fuel should decrease in future scenarios due to a decrease in conversion technology costs.

Inspection/Maintenance

The implementation of emissions testing requires funds to build, maintain, and operate emissions testing facilities. In addition, there is a direct cost to the user for obtaining the emissions test. The annual cost used in this analysis was derived from the projected operational cost of such facilities in the Phoenix metro area. The projections prepared by the Arizona Department of Environmental Quality (ADEQ) (3) for the Phoenix area were adjusted for the Las Vegas area using population growth ratios. Estimated annual costs by scenario are shown in Table V-2.

TABLE V-2. ESTIMATED YEARLY OPERATIONAL COST FOR TEST ONLY FACILITIES

Scenario	Population	Yearly Operational Costs
A	1,128,000	$3,160,640.00
B	1,445,300	$4,046,840.00
C	1,762,000	$4,933,600.00
D	2,454,700	$6,871,833.00

Reformulated Fuel

The annual cost for Reformulated Gasoline was estimated by the Clark County Health District to be approximately $15.3 million. This cost estimate was used to compute cost-effectiveness for all population scenarios. Further technical analysis should be performed to refine future costs.

Additional Considerations

Cost-effectiveness varies depending on the magnitude of the CO emissions reduction and the cost of trips avoided. The estimated values used in the calculations were developed using data for specific areas around the country. Local characteristics, however, may alter some of the assumptions and results. In addition, if the cost-effectiveness of a TCM is attractive, it does not necessarily mean that by doubling its effect on reducing trips that the cost-effectiveness will be reduced by half. Moreover, if spending on a TCM is pushed beyond a reasonable scale of operation, the cost-effectiveness of that TCM would decline rapidly. Also, vehicle trip reduction estimates usually reflect the degree of the TCM measure now in place. As the degree of the existing TCM measure increases, the effect of the measure on trip reduction will change. For example, the current level of carpooling may be very low and a rideshare program might reduce vehicle trips by a reasonable amount. However, any further vehicle trip reduction may be relatively small after the rideshare program is in place.

COST-EFFECTIVENESS ESTIMATES

Tables V-3 through V-6 summarize the cost-effective results for the TCMs tested in this study. Inspection/Maintenance of vehicles for emissions control significantly reduces the estimated CO more than the other measures. In addition, the I/M TCM is the most cost-effective measure among all the measures tested.

TABLE V-3. TCM COST-EFFECTIVENESS ANALYSIS
SCENARIO A - 1,128,000 POPULATION

TCM	Cost/Vehicle Trip	Daily Vehicle Trips Reduced	Daily CO ton	Daily Co Tons Reduction	Annual CO Tons Reduced	Annual $/Ton Reduced
Base			235.6			
Congestion Pricing	$1.75	44,900	232.0	3.6	903.0	$22,000
Employer Trip Reduction	$5.15	75,000	233.1	2.5	632.5	$154,574
Area-wide Ridesharing	$0.50	19,200	234.1	1.5	379.5	$6,384
Bicycle/Pedestrian Facilities	$5.30	6,600	235.1	0.5	131.6	$67,269
Working Schedule Changes	$0.50	10,900	234.8	0.9	215.1	$6,400
Telecommuting	$2.17	6,900	234.7	0.9	217.6	$17,410
No drive days	$6.00	57,800	232.0	3.6	908.3	$96,632
Alternative Fuel for Government Fleets	N.A.	N.A.	232.8	2.8	708.4	$4,828
Inspection/Maintenance	N.A.	N.A.	203.3	32.3	8,169.4	$387
Reformulated Gasoline*	N.A.	N.A.	214.1	21.5	5,442.0	$2,811

* Based on analysis performed by the Clark County Health District

TABLE V-4. TCM COST-EFFECTIVENESS ANALYSIS
SCENARIO B - 1,445,300 POPULATION

TCM	Cost/Vehicle Trip	Daily Vehicle Trips Reduced	Daily CO ton	Daily Co Tons Reduction	Annual CO Tons Reduced	Annual $/Ton Reduced
Base			270.6			
Congestion Pricing	$1.75	68,100	265.0	5.5	1,399.1	$21,564
Employer Trip Reduction	$5.15	91,200	264.7	5.9	1,482.6	$80,115
Area-wide Ridesharing	$0.50	34,100	268.5	2.1	523.7	$8,247
Bicycle/pedestrian Facilities	$5.30	9,900	270.3	0.2	60.7	$219,420
Working Schedule Changes	$0.50	19,400	269.1	1.5	384.6	$6,366
Telecommuting	$2.17	10,800	269.5	1.1	268.2	$22,157
No drive days	$6.00	100,200	264.5	6.1	1,548.4	$98,227
Alternative Fuel for Government Fleets	N.A.	N.A.	267.6	3.0	748.9	$6,113
Inspection/Maintenance	N.A.	N.A.	233.5	37.1	9,373.7	$432
Reformulated Gasoline*	N.A.	N.A.	246.2	24.4	6,160.6	$2,484

* Based on analysis performed by the Clark County Health District

TABLE V-5. TCM COST-EFFECTIVENESS ANALYSIS
SCENARIO C - 1,762,000 POPULATION

TCM	Cost/Vehicle Trip	Daily Vehicle Trips Reduced	Daily CO ton	Daily Co Tons Reduction	Annual CO Tons Reduced	Annual $/Ton Reduced
Base			352.2			
Congestion Pricing	$1.75	98,200	342.2	10.1	2,552.8	$17,034
Employer Trip Reduction	$5.15	131,100	341.8	10.4	2,631.2	$64,902
Area-wide Ridesharing	$0.50	60,800	347.6	4.7	1,181.5	$6,514
Bicycle/pedestrian Facilities	$5.30	14,700	351.9	0.4	88.6	$222,100
Working Schedule Changes	$0.50	31,100	349.1	3.1	784.3	$5,020
Telecommuting	$2.17	16,500	350.3	2.0	495.9	$18,304
No drive days	$6.00	175,000	340.2	12.1	3,058.8	$86,864
Alternative Fuel for Government Fleets	N.A.	N.A.	347.8	4.5	1,133.4	$2,031
Inspection/Maintenance	N.A.	N.A.	303.7	48.5	12,273.0	$402
Reformulated Gasoline*	N.A.	N.A.	320.5	31.7	8,020.1	$1,908

* Based on analysis performed by the Clark County Health District

TABLE V-6. TCM COST-EFFECTIVENESS ANALYSIS
SCENARIO D - 2,452,300 POPULATION

TCM	Cost/Vehicle Trip	Daily Vehicle Trips Reduced	Daily CO ton	Daily Co Tons Reduction	Annual CO Tons Reduced	Annual $/Ton Reduced
Base			678.1			
Congestion Pricing	$1.75	92,300	656.3	21.8	5,512.9	$7,415
Employer Trip Reduction	$5.15	153,000	565.5	112.6	28,475.2	$36,574
Area-wide Ridesharing	$0.50	87,000	664.4	13.7	3,461.0	$3,180
Bicycle/pedestrian Facilities	$5.30	23,000	677.4	0.7	187.2	$164,988
Working Schedule Changes	$0.50	49,200	665.5	12.6	3,185.3	$1,955
Telecommuting	$2.17	26,500	670.6	7.5	1,905.1	$7,628
No drive days	$6.00	321,500	636.8	41.3	10,459.0	$46,655
Alternative Fuel for Government Fleets	N.A.	N.A.	671.2	6.9	1,748.2	$946
Inspection/Maintenance	N.A.	N.A.	584.2	93.9	23,766.8	$289
Reformulated Gasoline*	N.A.	N.A.	617.1	61.0	15,440.0	$991

* Based on analysis performed by the Clark County Health District

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APPENDIX B

Section Two
Las Vegas Regional Travel Demand Model Documentation Report Update

FINAL REPORT

LAS VEGAS REGIONAL TRAVEL DEMAND MODEL

DOCUMENTATION REPORT UPDATE

Regional Transportation Commission

Clark County, Nevada

Lima & Associates

August 1995

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CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

The Regional Transportation Commission (RTC) of Clark County maintains a travel demand model to forecast traffic volumes on the Las Vegas regional road and street system. The Nevada Department of Transportation (NDOT) developed the first transportation model for the Las Vegas region. The original model was significantly revised by the RTC and NDOT in the early 1990s as part of an update of the Las Vegas Regional Transportation Plan. In 1993, the RTC undertook a set of further enhancements to the travel demand model. These enhancements included a thorough review of the modeling process, the revision to network attributes, and a recalibration of the model. Concurrently with the model enhancement process the RTC undertook the development, calibration, and validation of a peak period/peak hour travel demand model. The separate report "Regional Transportation Commission Model Enhancements Study Peak-Hour Model," January 1994 documents this new addition to the array of tools available to transportation planners in the Las Vegas Metropolitan Area.

This report describes the RTC modeling procedures and documents the updated daily travel demand model.

1.2 ORGANIZATION OF THIS DOCUMENT

The next section of this document gives an overview of the modeling process. Chapter 2 discusses the development and coding of the road and street regional networks. The next chapter describes the trip generation processes to estimate the number of trips generated by different land use types. Chapter 4 then discusses the trip distribution methodology. The mode split process necessary to estimate the percentage of transit trips is described in Chapter 5. Chapter 6 discusses the assignment of vehicle trips to the network. Chapter 7 documents the validation results for the 1990 travel demand model. The final chapter is provided as a guide for model users.

1.3 RTC MODELING PROCESS

This section provides a brief discussion of the travel demand process. The following discussion of the traffic forecasting steps relates to the specific methodology conducted by the RTC. Further details on the modeling process are provided in Chapters 2 through 8.

The process includes the following steps:

1. Development of a transportation network(s)
2. Determination of land use and socioeconomic data
3. Trip generation - the forecasting of person and vehicle trips

4. Trip distribution - geographical distribution of vehicle trips between origins and destinations
5. Mode split - determination of the percentage split between auto and transit modes.
6. Trip assignment - the assignment of traffic volumes to specific highway routes.

Figure 1-1 illustrates the overall RTC model process. The following sections provide an overview of each of the six traffic forecasting steps. Each step is discussed in more detail in subsequent chapters.

1.3.1 Transportation Networks

The initial step in the traffic forecasting process is the development of a model representation of the transportation network(s). The model's highway network consists of nodes and links. A node is an intersection of two or more links such as an intersection of two street segments. A network link is a street segment between two nodes. An example of a network link is the segment of Tropicana Avenue between Las Vegas Boulevard and Koval Lane.

Various physical and traffic characteristics are associated with each link in the model's network. These are maintained in a database of the link characteristics. This database includes the following network attributes:

- Node numbers
- Link distance
- Posted speed
- Link capacity
- Local jurisdiction code
- Facility type
- Number of lanes
- A one-way segment flag

The transportation network also includes transportation analysis zones (TAZs) which are the basic geographical zonal unit used for land use and trip generation estimation. Figure 2-1 in Chapter 2 includes a figure which illustrates the 751 TAZs for the Las Vegas Metropolitan Region. The TAZs are generally bounded by major streets (links) in the transportation network. In the Las Vegas region, 751 TAZs have been defined for the regional network. In the transportation network, a TAZ is defined by a node called a centroid. For transportation modeling purposes, all the trips within a TAZ are assumed to be generated at the centroid. Each TAZ is connected to a network street link by "dummy links" called centroid connectors which function as surrogates for the local or neighborhood street system.

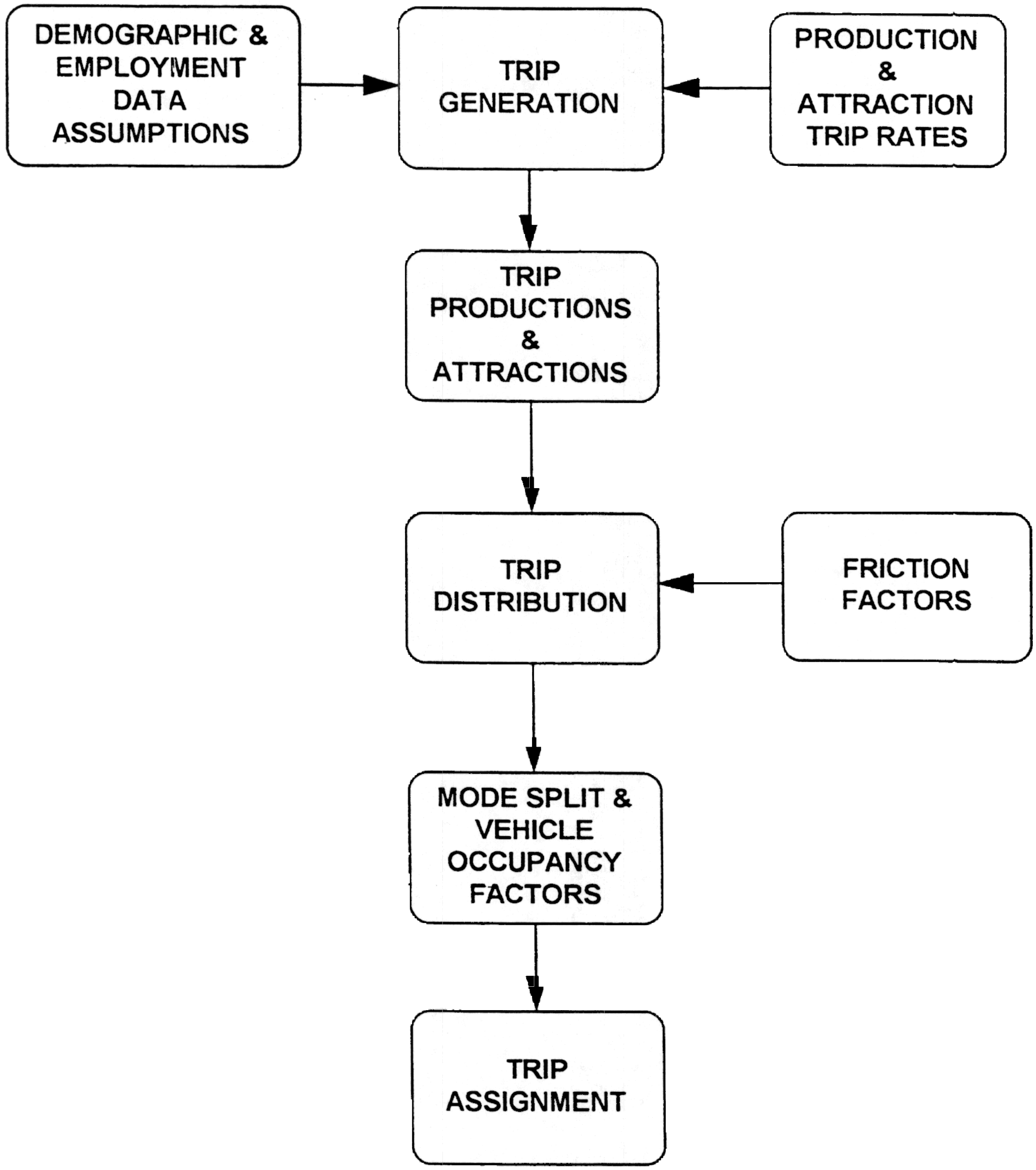


FIGURE 1-1. TRAVEL DEMAND MODEL PROCESS

1.3.2 Socioeconomic Forecasting

The socioeconomic characteristics of a TAZ, such as the number of dwelling units and the number of employees, are the primary indicators of the number of trips anticipated as originating within or destined to a TAZ. For the Las Vegas region, the specific socioeconomic characteristics within a particular TAZ are defined in terms of the following items:

Population
Residential households
Students
Hotel/casino employees
Retail employees
Non-retail commercial employees
Industrial employees
Office employees
Employees at special trip generators

Some TAZs have purely residential land uses, some have purely commercial land uses and others have a mixture of residential and commercial land uses. Specific socioeconomic characteristics are associated with the various land use types within a TAZ. In the Las Vegas Metropolitan Region, the land use and socioeconomic data estimates for each TAZ are documented in the RTC's Planning Variables Report.

1.3.3 Trip Generation

The product of the trip generation modeling phase is an estimate of the total number of trips which are anticipated to be produced within and/or attracted to each TAZ. A trip is defined as a one way movement between an origin and a destination zone. The total number of trips generated within a TAZ is a function of the TAZ's residential and/or commercial land use characteristics and the associated socioeconomic data assumptions. Residential land use is generally referred to as a "producer" of trips and commercial land use is generally referred to as an "attractor" of trips. The number of trips produced by residential land use is a function of: 1) number of dwelling units; 2) household size; and 3) income classification (low, medium, or high). The number of trips produced by commercial land uses is typically a function of the number of employees.

Trips are generated for the following five trip purposes: 1) home-based work; 2) home-based school; 3) home-based shopping; 4) home-based other; and 5) non home based.

1.3.4 Trip Distribution

The purpose of the trip distribution step is to distribute the generated trips between geographical zones (TAZs). The product of the trip distribution phase is an origin and destination trip table which specifies the number of trips which travel from each of the model's 751 TAZs to all other TAZs. Trip tables are estimated for each of the trip purposes. The distribution of trips between geographical zones is a function of the following variables:

Number of trips produced in a zone
Number of trips attracted to a zone
Travel time between one zone and another zone

The number of trips traveling between one zone and another zone are directly proportional to the total number of trips generated in the first zone and the total number of trips attracted to the second zone and is inversely proportional to the travel time between the two zones. For example, the total number of trips traveling between two zones increases as the number of residential trips, but decreases as the travel time increases between the zones.

The final product of the trip distribution phase is a trip table (matrix) for each trip purpose which contains the number of trips from each zone to all the other zones in the network. Remember, the number of TAZs in the RTC regional network is 751 zones. The trip table for each purpose for the Las Vegas region is, therefore, a 751 by 751 trip matrix.

1.3.5 Mode Split and Vehicle Occupancy Factors

The mode split phase splits person trips between the automobile mode and the transit mode. The mode split procedure in the Las Vegas Region uses a transit mode share percentage matrix. The mode split percentages between various zones are a function of the availability of transit service and automobile and transit travel impedances between the zones. The mode split percentages are then multiplied by the person trip table output in the trip distribution phase to produce a person-transit trip table and a person-vehicle trip table. The vehicle-trip table is then produced by multiplying the person-vehicle trip table by the average number of persons per vehicle by trip purpose (as derived from the 1990 Household Travel Survey).

The final products of the mode split phase are vehicle and transit trip tables for assignment to the respective highway and transit networks. The vehicle occupancies are:

Trip Purpose	Persons Per Vehicle
Home-Based Work	1.20
Home-Based School	1.50
Home-Based Shopping	1.42
Home-Based Other	1.47
Non Home-Based	1.30
Average	1.32

1.3.6 Traffic Assignment

The traffic assignment phase allocates those trips traveling between zones to specific highway routes. The number of trips allocated to a route is based on the travel times between the various zones. The RTC travel demand model uses equilibrium assignment to assign the vehicle trip table to the regional network. Equilibrium occurs when a trip in the system cannot be made by an alternate path without increasing the system's total travel time. The final product of the traffic assignment process is a network with traffic volumes assigned to each link segment.

The next sections of the report documents each of the travel demand modeling phases for the RTC Travel Demand Model more fully.

CHAPTER 2. BASE NETWORK

This chapter discusses the base 1990 regional transportation network, the coding of the network, and the network attributes. The initial step in the traffic forecasting process is the development of the geographical transportation network(s). The network is a representation of the major streets in the region. Various physical and traffic characteristics are then associated with each link in the network. These characteristics, or attributes, are used by the transportation model to simulate regional traffic volumes.

2.1 NETWORK CODING

The highway network consists of nodes and links. A node is an intersection of two or more links such as an intersection of two street segments. A link is a street segment between two nodes. Figure 2-1 schematically illustrates how a network is represented by nodes and links for transportation modeling.

The 1990 base year network for the Las Vegas region is shown in Figure 2-2. The network includes 751 TAZs, 8,810 links, and 3,129 nodes. The regional TAZ system is illustrated in Figure 2-3. Each link within the network is coded with a set of descriptive attributes such as the link distance and speed. The TRANPLAN fields and network attributes for the RTC network are shown in Table 2-1.

TABLE 2-1. TRANPLAN ATTRIBUTES

TRANPLAN Field	Attribute Description
Anode	The number of the A node
Bnode	The number of the B node
Dist	Distance (Miles)
Asg	Functional Class
Speed1	Free Flow Speed
LG1	Link Group 1 - Number of Lanes
LG2	Link Group 2 - Intersection Control Type
LG3	Link Group 3 -Jurisdictional Code
Capacity1	Capacity Field 1 - Daily Directional Capacity
Capacity2	Capacity Field 2 - Actual Ground Counts

Source: Lima & Associates, 1990 RTC Network

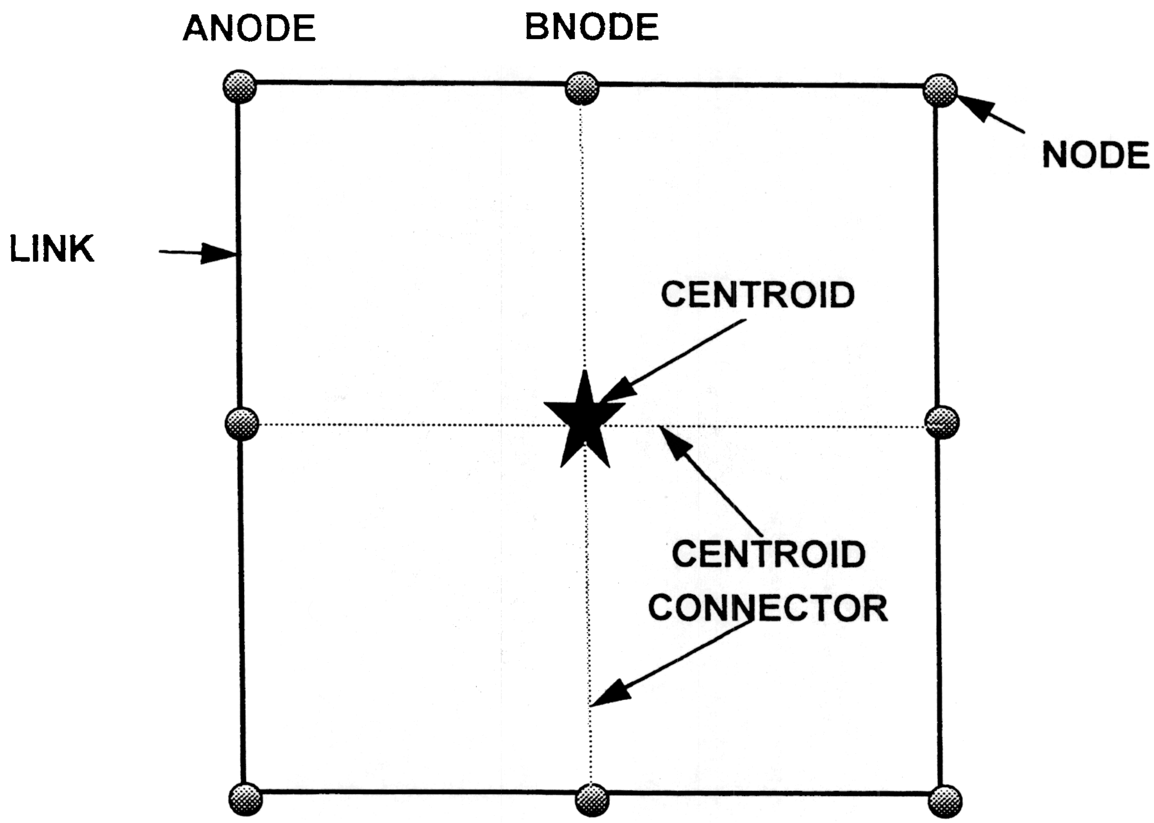


FIGURE 2-1 . SCHEMATIC OF TRANSPORTATION NETWORK

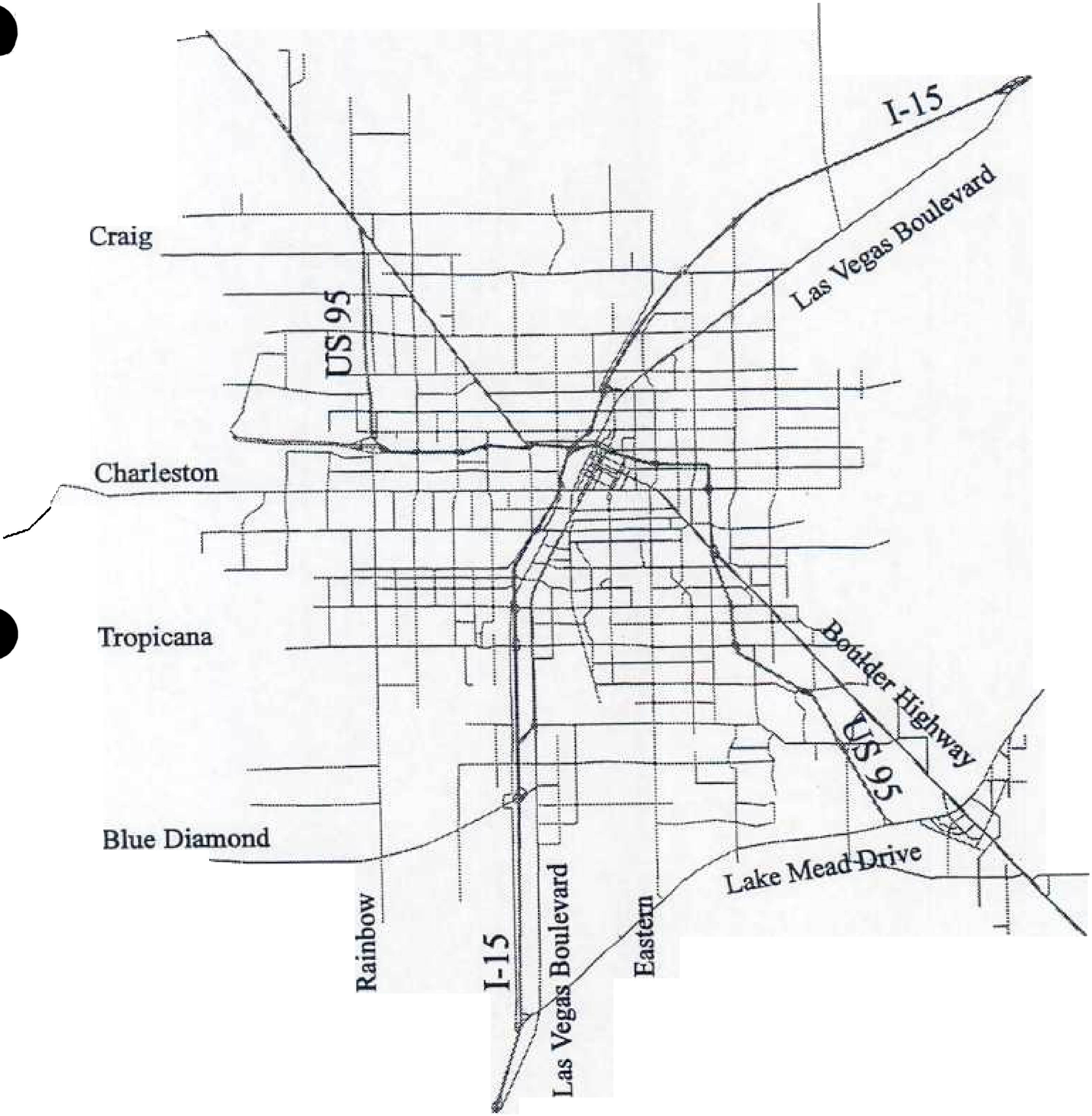
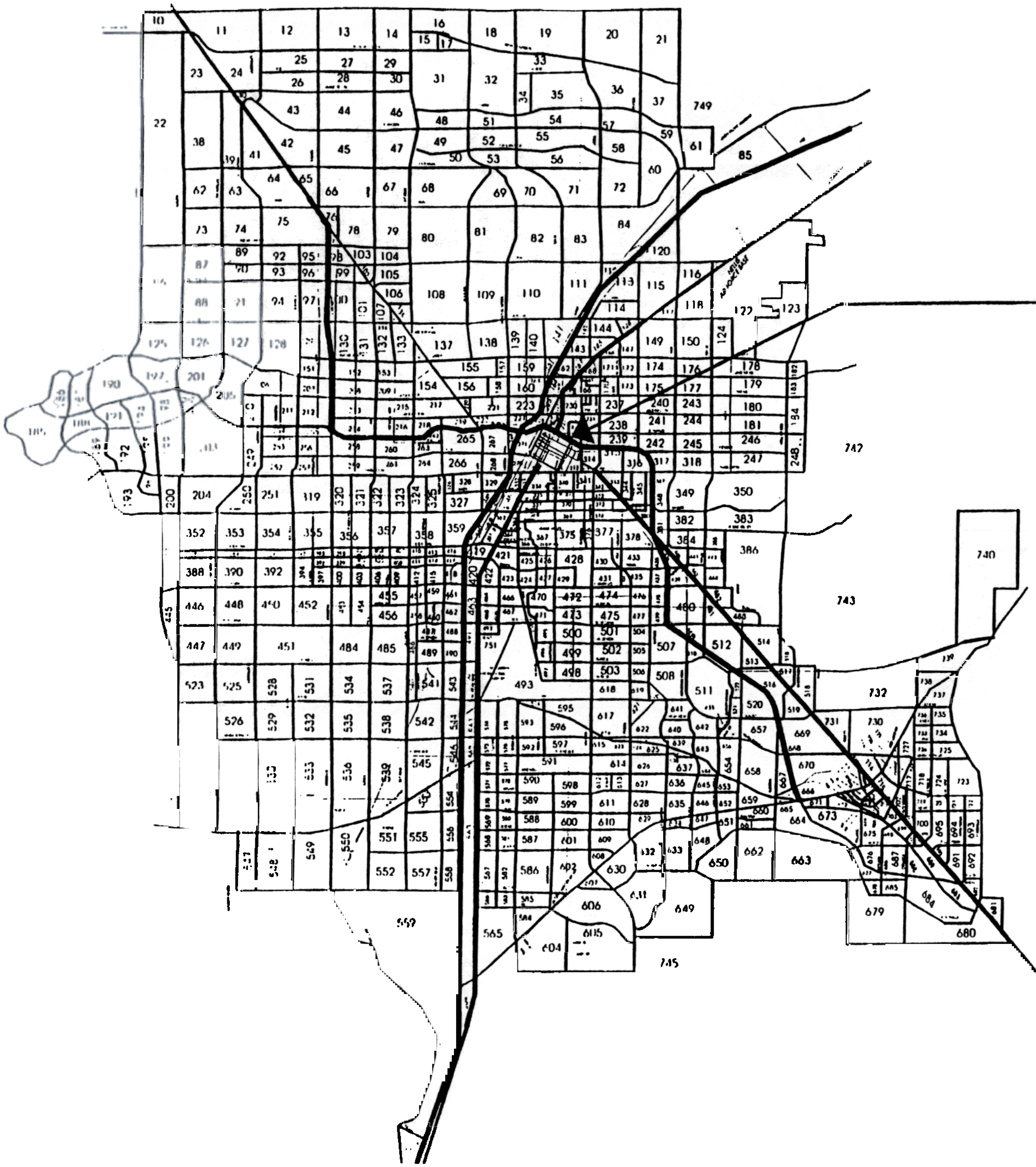
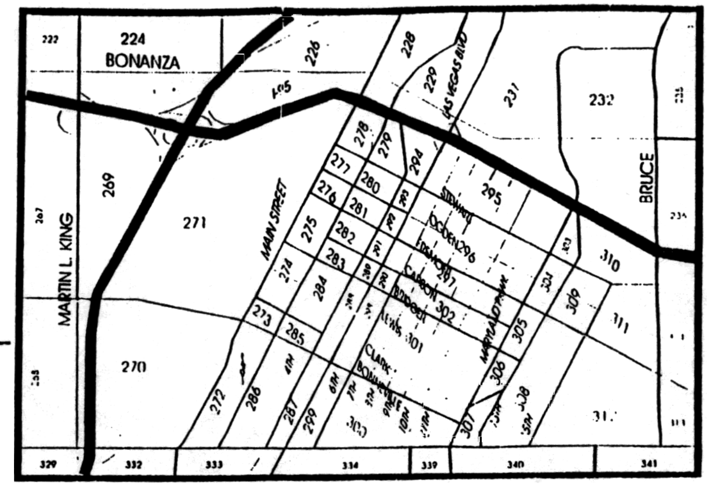


Figure 2-2. 1990 REGIONAL TRANSPORTATION NETWORK





DOWNTOWN LAS VEGAS

FIGURE 2-3

TRAFFIC ANALYSIS ZONE SYSTEM

The default speeds and directional capacities for the various roadway facility types are shown in Table 2-2.

TABLE 2-2. REGIONAL NETWORK ATTRIBUTES

Facility Type	Assignment Group	Default Model Speed (mph)	Adjusted Speed (mph)*	Daily Capacity Per Lane
External Connector	0	99	65	99,999
Freeway System Ramps	1	50	35	12,000
Minor Arterial	2	45	35	9,500
Major Arterial	3	45	45	9,500
Ramp	4	25	25	9,000
Interstate	5	60	60	22,500
Freeway	6	60	55	22,500
Expressway	7	50	55	9,000
Collector	8	45	30	9,500
Centroid Connector	9	15	15	99,999

* Adjusted speeds are used for air quality analysis
Source: Lima & Associates, 1990 RTC Network

2.2 VEHICLE SPEED ADJUSTMENTS

The default vehicle speeds shown in Table 2-2 are adjusted according to the link's location within the region. Table 2-3 shows the adjustments made to the vehicle speeds. The TRANPLAN Update Network function is used to factor the speeds. The speeds were adjusted further on the Westside of the region (West of I-15) to reflect the impact of traffic signalization on the east/west speeds. The speeds on links in the east/west directions were reduced by 80 percent for subareas 5, 11, and 12. As is standard practice, the default speed for external connectors is adjusted to 99 mph reflecting a lack of delay on these links.

In addition to the adjustments to the speeds, the capacities of the streets in Downtown Las Vegas were reduced by 50 percent to reflect the reduction in capacity due to traffic signal timing, parking, and pedestrian activity.

TABLE 2-3. LOCATIONS USED FOR SPEED ADJUSTMENTS

Subarea	Location	Assignment Group		
		2	3	8
1	Downtown Las Vegas - Martin Luther King Blvd. to Bruce/Charleston to US 95	25	30	25
2	Extension of Martin Luther King Blvd. to Paradise/Charleston to Sahara	35	35	
3	Industrial to Koval/Tropicana to Sahara	35	35	
4	Henderson CBD/Lake Mead to Green Valley to Boulder Highway		35	
5	Industrial to Valley View/Tropicana to US 95	45	45	45
6	Green Valley to Boulder Highway/Lake Mead to Sunset		35	
7	Bruce to Pecos/Charleston to US 95	35	35	35
8	Paradise to Pecos/Charleston to Sahara	35	35	35
9	Koval to Pecos/Tropicana to Sahara	40	40	40
10	Valley View to Pecos/US 95 to Vegas Drive	35	35	35
11	Valley View to Rainbow/Tropicana to US 95	45	45	45
12	Industrial to Martin Luther King/Sahara to US 95	45	45	45

Source: Lima & Associates, 1990 RTC Network

2.3 TURN PENALTIES AND PROHIBITORS

Turning penalties are used to better reflect actual operations of turning vehicles and to prevent multiple turns resulting in circuitous routing. Time penalties for turning movements are assigned with the use of the link's direction codes. Each link is assigned a Direction Code based upon the direction of traffic as shown in Table 2-4.

TABLE 2-4. DIRECTION CODE DESIGNATION

Code Number	Direction
1	Northbound
2	Eastbound
3	Southbound
4	Westbound

Source: BRW Inc., Las Vegas Regional Transportation Mode Documentation Report, December 13, 1991

A right turn is assigned a penalty of 0.10 minutes and a left turn is assigned a penalty of 0.5 minutes. Table 2-5 summarizes the time penalties for each turning movement.

TABLE 2-5. TIME PENALTIES BY TURNING MOVEMENT

Turning Movement	Direction	Time Penalty (Minutes)
Right	1-2, 2-3, 3-4, 4-1	0.10
Left	1-4, 2-1, 3-2, 4-3	0.50

Source: Lima & Associates, based on 1990 RTC Network

In addition to the turn penalties, three left turn prohibitors are coded for the 1990 network. Two turn prohibitors are assigned at the location of the I-15/Flamingo interchange. One prohibitor is assigned to the I-15/Flamingo westbound off-ramp to prohibit traffic from making a left turn to go eastbound on Flamingo. Another turn prohibitor is assigned to the eastbound loop ramp to allow only the southbound to eastbound movement. The third turn prohibitor is assigned at the location of the I-15/Charleston interchange. Northbound traffic exiting at the first off-ramp is prohibited from turning left at Charleston.

CHAPTER 3. TRIP GENERATION

As previously discussed, the purpose of the trip generation model phase is to estimate the number of trips which are generated within each TAZ. This chapter describes the RTC trip generation process.

3.1 GENERAL METHODOLOGY

The RTC trip generation process, as shown in Figure 3-1, includes the following steps:

1. Estimation of TAZ socioeconomic data including dwelling units, income class, and employment.

2. Computation of zonal trip productions based on trip generation rates established in the 1990 Las Vegas Regional Household Travel Survey and/or drawn from other recognized national sources.

3. Computation of zonal trip attractions based on trip attraction rates developed for the regional model based largely on recognized national sources.

4. Balancing the zonal trip productions and attractions

Both trip productions and trip attractions are estimated based on the values of the socioeconomic variables for each TAZ within the region. The socioeconomic planning variables are input to the trip generation model which consists of the appropriate trip production and attraction rates. The trip rates are multiplied by the socioeconomic variables to produced the number of trips within a zone. For example, the household work trip production rates are multiplied by the number of households in the TAZ to produce the total number of home-based work trip productions.

The RTC modeling process generates trips for the following trip purposes: 1)home-based work; 2) home-based shopping; 3) home-based school; 4) home-based other; and 5) non home-based.

3.2 PLANNING VARIABLES

The primary categories of the planning variables are dwelling units, school enrollment, and employment. Table 3-1 summarizes the planning variables for the years 1990, 2000, and 2010.

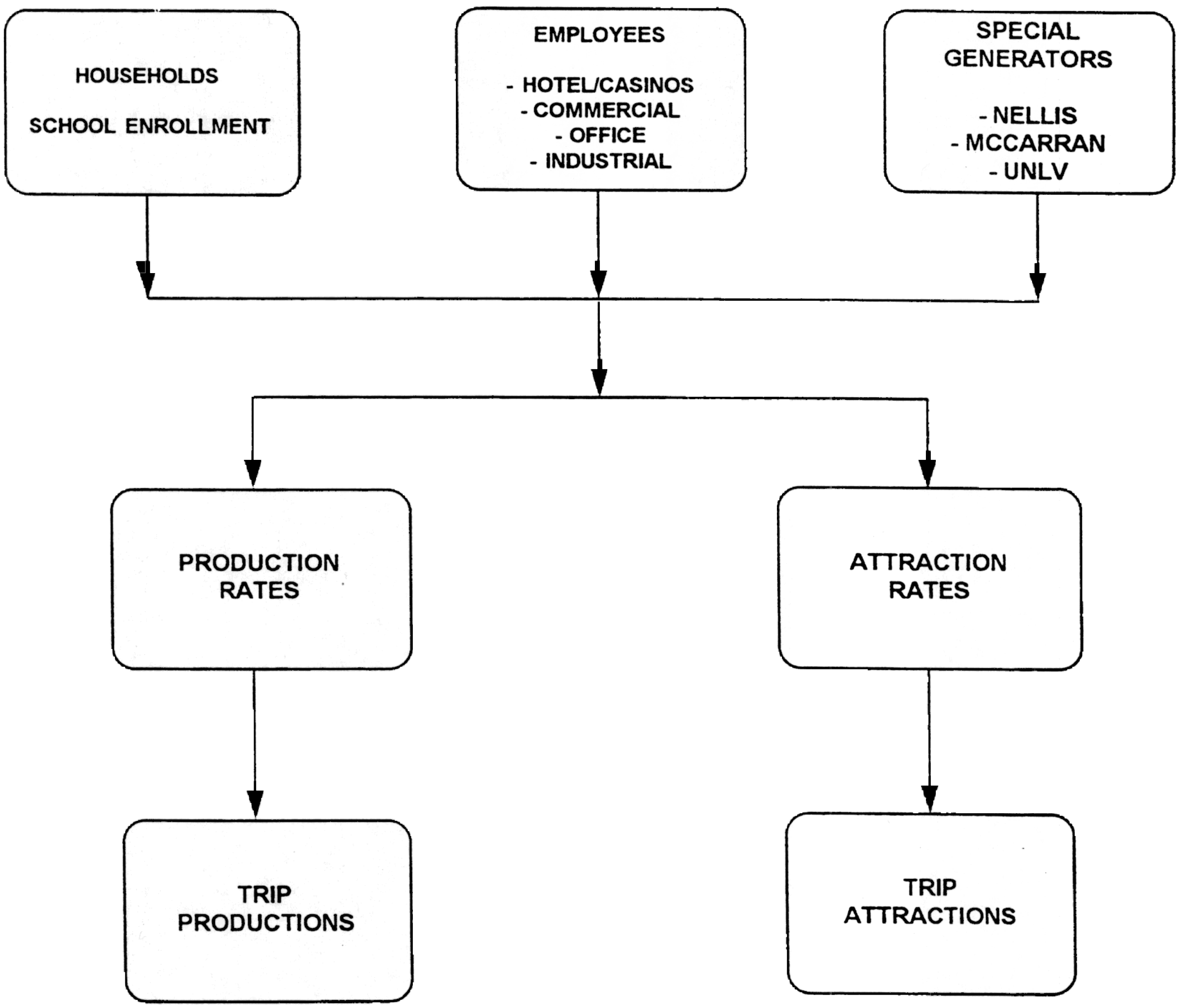


FIGURE 3-1. RTC TRIP GENERATION PROCESS

TABLE 3-1. PLANNING VARIABLES

Planning Variable	Year		
	1990	**2000**	**2010**
Resident Population	709,876	1,049,305	1,324,307
Dwelling Units	275,789	411,591	522,493
Hotel Employment	99,524	140,430	176,257
Regional Retail Employment	4,442	9,640	9,640
Community Retail Employment	44,136	60,849	77,491
Other Retail Employment	53,940	74,372	94,711
Other Non-Retail Employment	60,618	94,040	126,632
Office Employment	46,872	66,083	82,903
Industrial Employment	38,039	53,776	112,434
Total Employment	372,380	528,280	663,032
School Enrollment			
Grades K-8	90,867	143,048	228,750
Grades 9-12	30,706	55,845	85,020
Grades 13+	23,925	37,328	48,646
Total School Enrollment	145,498	236,221	362,416
Special Generator Employment			
Nellis Air Force Base	14,449	14,550	14,556
UNLV	1,664	2,398	3,060
McCarran International Airport	8,651	12,467	15,804
Total Special Generator	24,764	29,415	33,420

Source: Coppers & Lybrand, Planning Variables Report, Adopted November 1992

The number of households by income category is tabulated for each TAZ. The number of employees is tabulated for the following places of employment: 1) hotels/casinos; 2) regional retail centers, 3) community retail centers, 4) other retail establishments; 5) other non-retail employment; 6) office employment; and 7) industrial employment. Employees are also tabulated for special types of generators which include: Nellis Air Force Base, UNLV, and McCarran International Airport. Another variable used to compute trip attractions is school enrollment disaggregated for grades K-8, 9-12, and 12+.

3.3 HOUSEHOLD CROSS CLASSIFICATION MODEL

The RTC trip generation model has a general cross classification format. The model was developed based on the trip generation information gained during the Las Vegas 1990 Household Travel Survey. The 1990 Household Travel Survey provided data on the socioeconomic characteristics of households, the number of trips generated by households, household trip purpose, and the travel time of trips. The cross classification trip generation model classifies households by income level (low, medium, and high). The average number of trips per household category has been tabulated from the data of the 1990 Household Travel Survey. The number of household trips within a TAZ is computed from the multiplication of the number of households within each income category by the average number of trips per household in the respective income categories. The average household trip production rate for the entire region is 7.65 person trips per household. The household trip production rates are shown in Table 3-2. The distribution of household trips by trip purpose is shown in Table 3-3.

TABLE 3-2. HOUSEHOLD PERSON TRIP PRODUCTION RATES

Household Income Class	Trip Productions Per Household
1	6.59
2	7.78
3	8.54
Average	7.65

Source: 1990 RTC Trip Generation Spreadsheet

TABLE 3-3. HOUSEHOLD TRIP PURPOSE DISTRIBUTION

Income Class	Home-Based Work	Home-Based School	Home-Based shopping	Home-Based Other	Non Home-Based
1	27.10%	6.20%	19.00%	24.80%	22.90%
2	29.70%	9.00%	18.00%	22.00%	21.30%
3	31.60%	12.00%	17.60%	19.50%	19.80%

Source: 1990 RTC Trip Generation Spreadsheet

3.4 TRIP ATTRACTION RATES

Trip attractions are a function of the number of employees for the specific land use type and the number of enrolled students. The RTC model uses a trip rate model to estimate the number of attractions for each land use type. Trip rates per employee are first identified for the land use type. The number of trip attractions is computed by multiplying the respective trip rate by the number of employees. Trip attraction rates used in the RTC trip attraction model are shown in Tables 3-4 and 3-5.

TABLE 3-4. PERSON TRIP ATTRACTION RATES
TRIPS PER EMPLOYEE BY TRIP PURPOSE

Purpose	Hotel	Reg. Shop	Com. Shop	Retail	Non Retail	NABF
HBW	1.756	1.770	1.590	1.590	1.450	1.513
HBSHOP	0.000	1.670	3.322	5.831	0.002	0.228
HBOTHER	1.207	2.624	1.799	2.527	1.128	0.485
NON HB	1.507	4.578	5.287	10.784	1.265	0.486
TOTAL	4.470	10.642	11.998	20.732	3.845	2.710
Purpose	**MIA**	**UNLV**	**Office**	**Indust.**	**DU**	
HBW	1.600	1.550	1.680	2.050	0.000	
HBSHOP	0.000	0.095	0.000	0.000	0.000	
HBOTHER	0.800	0.892	0.464	0.044	0.468	
NON HB	0.800	1.092	0.560	0.098	0.112	
TOTAL	3.200	3.629	2.704	2.192	0.580	

Source: 1990 RTC Trip Generation Spreadsheet

TABLE 3-5. SCHOOL TRIP ATTRACTION RATES
TRIPS PER STUDENT

School Grade	Person Trip Rate
1 - 8	1.00
9 - 12	1.10
13 +	1.75

Source: 1990 RTC Trip Generation Spreadsheet

3.5 TRIP PRODUCTION AND ATTRACTION BALANCING

The trip productions and attractions produced in the trip generation process are balanced by trip purpose. Within a closed regional network, such as the Las Vegas Metropolitan Region, the trip productions must equal the trip attractions. However, the regional trip productions and trip attractions which are produced by trip generation are generally not equal. In order to correct the inequality, trip productions and attractions are balanced. The trip balancing for the RTC model uses the following controls for each trip purpose:

Trip Purpose	Control
Home-based work	Productions
Home-based school	Attractions
Home-based shopping	Productions
Home-based other	Productions
Non home-based	Productions

The trip attractions are balanced to the home-based productions except for school trips which are balanced to the attractions. The ratio of productions to attractions is used to adjust the number of attractions for each trip purpose. The non home-based trip productions are set equal to the non home-based trip attractions since the estimation of non home-based trip attractions is generally considered more accurate than non home-based trip productions.

3.6 SUMMARY OF TRIP PRODUCTIONS AND ATTRACTIONS

The final set of daily person trips for 1990 is shown in Table 3-6. Approximately 2.9 million daily trips are generated within the region.

TABLE 3-6. 1990 INTERNAL DAILY PERSON TRIP SUMMARY

Trip Purpose	Trips
Home-Based Work	623,020
Home-Based School	166,508
Home-Based Shopping	441,428
Home-Based Other	522,513
Non-Home Based	1,139,239
Total	2,892,708

Source: 1990 Gravity Model Output

3.7 EXTERNAL VEHICLE TRIP TABLE

An external vehicle trip is a trip which has either an origin or destination outside of the Las Vegas metropolitan region. For example, an automobile trip from California to the Las Vegas "strip" is an external vehicle trip. External vehicle trips include three types: 1) external-to-external trips; 2) external-to-internal trips; and 3) internal-to-external trips. An external-to-external vehicle trip originates outside of the Las Vegas metropolitan region and also ends outside of the region. A trip from California to Utah on I-15 through the region without a stop is an example of an external-to-external trip. An external-to-internal trip originates outside of the region and ends within the region. Conversely, an internal-to-external trip begins within the region and ends outside of the region. A trip from California to the "strip" is an external-to-internal trip and the return trip from the "strip" to California is an internal-to-external trip.

A recent origin-destination survey of the external trips conducted by Parsons Brinckerhoff in 1992-1993 was undertaken to update the region's external origin-destination trip table.

3.8 COMMERCIAL VEHICLE TRIP TABLE

Commercial trips include trucks and taxi vehicle trips. Commercial trips are represented in the RTC travel demand model as a commercial vehicle origin-destination trip table.

CHAPTER 4. TRIP DISTRIBUTION

This chapter describes the trip distribution process and discusses the trip tables which are produced by this process. The trip distribution phase estimates the number of trips from each individual TAZ to all other TAZs. The final product of the trip distribution process is a trip origin-destination table.

4.1 GENERAL METHODOLOGY

The distribution of person trips within the Las Vegas Metropolitan Region is computed using the Gravity Model. The gravity model formulation states that the number of trips between two zones (TAZs) is directly proportional to the number of productions and the number of attractions produced in those zones and inversely proportional to the travel time between the two zones. According to this formulation, the number of trips between two zones increases as the number of productions and/or the number of attractions increases. But, the number of trips decreases as the travel time between two zones increases. The negative impact of travel time, in the gravity model, is represented by a term called a friction factor. A friction factor is a mathematical function of travel time between geographical zones. The gravity model has the following mathematical form:

$$T_{ij} = \frac{P_i A_j F_{ij}}{\sum A_j F_{ij}}$$

where

Tij = number of trips between zones i and j
Pi = Productions at zone i
Aj = Attractions at zone j
Fij = Friction factor between zones i and j

The Gravity Model was calibrated by BRW Inc. based on the revised 1990 network and travel times gathered during the 1990 Household Travel Survey. The calibration of the Gravity Model involves the computation of the travel time factors (Friction Factors) which replicates the zone-to-zone base year trip tables using the base year productions and attractions. The calibrated Friction Factors are included in Appendix B.

The calibrated Gravity Model must also replicate the base year travel time frequencies which give the percentage of trips within specified time increments. The 1990 Household Travel Survey provided the base year person trip tables as well as the 1990 travel time distributions. Appendix C includes the surveyed and modeled travel time frequency curves for each trip purpose as reported by BRW Inc.

4.2 EVALUATION OF GRAVITY MODEL

Table 4-1 provides a comparison of the observed and modeled 1990 trip lengths in minutes for each trip purpose. Averaged trip lengths produced by the gravity model full within approximately seven and a half percent of the average trips observed from the 1990 Household Travel Survey. The average trip length for a home-based work trip in the Las Vegas region is approximately 12 minutes. The average trip length for all trips is approximately ten minutes.

TABLE 4-1. COMPARISON OF SURVEY AND GRAVITY MODEL

Trip Purpose	Survey Trip Length (minutes)	Gravity Model Trip Length (minutes)	Percent Difference
Home-Based Work	12.05	13.10	+8.81
Home-Based School	8.12	8.29	+2.09
Home-Based Shopping	7.17	7.67	+6.97
Home-Based Other	10.09	10.63	+5.35
Non Home-Based	8.78	9.98	+13.67
Average	9.76	10.49	+7.48

Source: BRW, Inc., Memorandum dated December 7, 1993

4.3 SUMMARY OF GRAVITY MODEL OUTPUT

The Gravity Model outputs production-attraction (P-A) daily person trip tables. However, the P-A table does not reflect the direction of trips, only the magnitude of the trip interchanges. An origin-destination trip table, which reflects the direction of trips, is produced by adding the P-A table to its transpose, A-P table, and then multiplying by 0.5 for daily trips. The output is a daily origin-destination trip table.

A summary of the 1990 daily person trips was previously presented in Chapter 3

CHAPTER 5. MODE SPLIT AND VEHICLE OCCUPANCY

This chapter describes the mode split and vehicle occupancy process developed for the regional transportation model. The mode split process includes 1) the production of transit mode share percentage matrices; 2) the multiplication of the transit share matrices by the person trip matrices to produce transit trips; and 3) the use of vehicle occupancy rates to derive automobile trip tables.

5.1 GENERAL METHODOLOGY

The mode split procedure uses transit mode share percentage matrices which were developed through the use of the QRS Version 2.1 software. The percentage of transit trips between zones was estimated using the QRS mode split procedure. The transit share matrices were established for residential trips only. A more detailed description of the procedure used to develop the transit share matrix is provided in the documentation of the 1990 model Las Vegas Regional Transportation Model (LVRTM) Documentation Report, December 12, 1991.

The transit share matrices are multiplied by the person trip table to produce a residential transit trip table. The transit trip tables are then subtracted from the total person trip table to produce person-vehicle trip tables. Vehicle occupancies for each trip purpose are then applied to the person-vehicle trip tables to give vehicle trip tables for each trip purpose.

The vehicle trip tables for each trip purpose are summed across the trip purposes to produce a composite vehicle trip table. This is added to the external vehicle trip table, the taxi/rental car trip table, and the commercial truck trip table to produce a final vehicle trip table.

5.2 VEHICLE OCCUPANCY

The 1990 Household Travel Survey assisted in the establishment of the number of persons per vehicle for each trip purpose. Table 5-1 gives the 1990 vehicle occupancy rates. The average daily vehicle occupancy rate for all trips is 1.32 persons per vehicle. The average occupancy rate for home-based work trips is approximately 1.20 persons per vehicle.

5.3 SUMMARY OF 1990 VEHICLE TRIPS

The output of the mode split procedure includes the following:

Transit trip table
Vehicle trip tables by purpose
Total trip table

Table 5-2 summarizes the 1990 trips following the Mode Split procedure.

TABLE 5-1. 1990 VEHICLE OCCUPANCY

Trip Purpose	Persons Per Vehicle
Home-Based Work	1.20
Home-Based School	1.50
Home-Based Shopping	1.42
Home-Based Other	1.47
Non Home-Based	1.30
Average	1.32

Source: BRW Inc Las Vegas Regional Transportation Model Documentation Report, December 13, 1991

TABLE 5-2. 1990 VEHICLE TRIP SUMMARY

Trip Type	Number of Trips
Home-Based Transit Trips	13,100
Vehicle Trips	
Home-Based Work	552,060
Home-Based School	110,230
Home-Based Shopping	307,439
Home-Based Other	352,331
Non-Home Based	876,724
Tax/Rental Car, Truck, and External	395,748
Total	2,594,532

Source: Lima & Associates, 1990 RTC Trip Matrices

CHAPTER 6. TRIP ASSIGNMENT

This chapter documents the trip assignment process used for the RTC travel demand model. The purpose of trip assignment is to assign vehicle trips to specific paths (or routes) in the transportation network

6.1 GENERAL METHODOLOGY

Trip assignment is a function of the travel time paths between zones (TAZs) and the level of link congestion. Vehicle trips for the region are assigned to the street network using the TRANPLAN Equilibrium Assignment Algorithm. The Equilibrium Assignment Algorithm reads the vehicle origin-destination trip table and the regional highway network. The algorithm then assigns the vehicle trip table to the network based on the equilibrium assignment method. Equilibrium occurs when a trip in the system cannot be made by an alternate path without increasing the system's total travel time.

The traffic assignment process includes the following steps:

1. Compute the minimum time paths between the TAZs based on free flow link speeds.

2. Initially assign the trips made between TAZs to the links which lie on the minimum time paths between the TAZs.

3. Compute the volume-to-capacity (v/c) ratios on the links after the initial assignment.

4. Compute new travel times on the links as a function of the v/c (travel time increases as v/c (congestion) increases).

The assignment process iterates through the process until traffic volumes on links replicate the observed traffic ground counts.

Link travel times are estimated as a function of the v/c using the Bureau of Public Roads formulation. The mathematical relationship between speed and v/c is the following:

$$S = S_o[1+0.15(v/c)]^4$$

where

S = Operating speed
S_o = Free flow speed
v/c = Volume-to-capacity ratio

6.2 1990 TRAFFIC ASSIGNMENT RESULTS

Table 6-1 presents the model's estimate of vehicle-miles and vehicle-hours for each class of facility resulting from the 1990 traffic assignment. The average speeds for the 1990 traffic assignment are also shown in Table 6-1.

TABLE 6-1. MODEL PERFORMANCE MEASURES

Functional Classification	Vehicle Miles	Percent of Total	Vehicle Hours	Percent of Total	Avg. Speed (mph)
External	411,083	3.18%	10,796	2.83%	38.08
Freeway System Ramps	20,385	0.16%	544	0.14%	37.47
Minor Arterial	2,895,897	22.38%	79,290	20.78%	36.52
Major	3,945,609	30.49%	110,959	29.08%	35.56
Ramp	144,277	1.11%	7,648	2.00%	18.86
Interstate	1,228,859	9.50%	22,104	5.79%	55.59
Freeway	1,459,497	11.28%	25,577	6.70%	57.06
Expressway	205,613	1.59%	4,612	1.21%	44.58
Collector	1,333,112	10.30%	33,609	8.81%	39.67
Centroid Connector	1,296,027	10.02%	86,402	22.65%	15.00
Total	12,940,359	100.00%	381,541	99.99%	33.92

Source: Lima & Associates, 1990 RTC Assigned Network

CHAPTER 7. MODEL VALIDATION

The model validation phase compares the results of the model with the 1990 socioeconomic estimates to actual study area data and to data from other comparable studies. The following performance measures were reviewed:

Vehicle-miles traveled (VMTs)

Vehicle-hours traveled (VHTs)

Percent difference between the observed and the assigned traffic counts

Percent root-mean square (RMS) between pairs of assigned and counted volumes

The performance measures of VMT and VHT, for the 1990 calibrated model were previously presented in Table 6-1. The total daily modeled VMT for 1990 of approximately 12.9 million is in comparison to the NDOT estimate of approximately 12.0 million VMT. The total modeled 1990 VHT is approximately 382,000 vehicle hours. The average daily speed is approximately 34 mph.

7.1 SCREENLINE ANALYSIS

A screenline analysis was conducted for 36 screenlines cutting across streets within the regional network. The set of screenlines shown in Figure 7-1 was defined in the region as a basis for computing the percent difference between observed and assigned traffic volumes, and the percent Root Mean Square Error (RMSE).

A summary of the 1990 observed and assigned traffic volumes for all the screenlines is presented in Table 7-1. The percent difference between the observed and assigned traffic volumes is calculated by divided the difference in volume by the observed volume. The overall percent difference for all the screenlines is approximately 3.6 percent. The Federal Highway Administration's publication Calibration and Adjustment of System Planning Models recommends a maximum difference of five percent for a regional network. Some individual screenlines do exceed the recommended five percent difference. Appendix D presents the observed and assigned traffic volumes for the streets comprising each screenline.

Another key measure of the model's ability to assign traffic volumes is the percent root-mean square. The RMSE measures the deviation between the assigned traffic volumes and the counted traffic volumes and is given as:

$$RMSE=\sqrt{(count_i - vol._i)^2/(n-1)}$$

Figure 7-1. 1990 REGIONAL NETWORK SCREENLINES

TABLE 7-1. 1990 SCREENLINE COMPARISON

Screenline	Observed	Assigned	Difference	Percent Difference
1	61,800	58,000	(3,800)	-6.15%
2	96,400	112,300	15,900	16.49%
3	67,000	75,000	8,000	11.94%
4	41,700	45,500	3,800	9.11%
5	215,400	226,000	10,600	4.92%
6	155,500	176,300	20,800	13.38%
7	273,800	263,500	(10,300)	-3.76%
8	123,900	120,900	(3,000)	-2.42%
9	277,600	270,000	(7,600)	-2.74%
10	209,700	196,000	(13,700)	-6.53%
11	216,300	202,800	(13,500)	-6.24%
12	165,000	166,400	1,400	0.85%
13	122,000	117,400	(4,600)	-3.77%
14	242,500	251,800	9,300	3.84%
15	167,800	162,800	(5,000)	-2.98%
16	214,400	206,300	(8,100)	-3.78%
16A	123,900	117,400	(6,500)	-5.25%
17A	50,300	53,700	3,400	6.76%
17B	204,705	205,100	395	0.19%
Subtotal	3,029,705	3,027,200	(2,505)	-0.08%

Source: RTC, Screenline Analysis, April 1994

TABLE 7-1. 1990 SCREENLINE COMPARISON (continued)

Screenline	Observed	Assigned	Difference	Percent Difference
18A	105,260	124,800	19,540	18.56%
19	124,050	101,100	(22,950)	-18.50%
20	176,585	162,100	(14,485)	-8.20%
21	145,685	112,800	(32,885)	-22.57%
22	271,290	250,300	(20,990)	-7.74%
23	107,085	101,200	(5,885)	-5.50%
24	203,455	171,300	(32,155)	-15.80%
25	127,365	136,100	8,735	6.86%
26	74,250	92,800	18,550	24.98%
27	19,095	18,000	(1,095)	-5.73%
28	128,115	131,700	3,585	2.80%
29	95,355	99,200	3,845	4.03%
30	99,180	81,700	(17,480)	-17.62%
31	139,990	117,400	(22,590)	-16.14%
32	42,155	24,600	(17,555)	-41.64%
33	121,075	86,700	(34,375)	-28.39%
34	73,865	60,500	(13,365)	-18.09%
Subtotal	2,053,855	1,872,300	(181,555)	-8.84%
Total All Screenlines	5,083,560	4,899,500	(184,060)	-3.62%

Source: RTC, Screenline Analysis, April 1994

where: count = actual traffic volume count on link I,
vol. = model assigned traffic volume on link I, and
n = total number of links in the traffic volume group.

The percent RMSE is derived by dividing the RMSE by the average traffic count for a particular traffic volume group. A large percent RMSE indicates a large deviation between the assigned and counted traffic volumes whereas a small percent RMS indicates a small deviation between the assigned and counted traffic volumes.

Table 7-2 gives a summary of the percent RMSE by volume groups for 1990 volume groups. The percent RMSE for each link volume group is well within an acceptable range. The highest RMSE is for the lowest volume group which is normally expected. Appendix D presents the RMSE comparisons by volume group.

TABLE 7-2 ROOT MEAN SQUARE ERROR

Link Volume Group	Percent Root Mean Square Error
<50,000	29.46
50,000 - 99,999	16.22
100,000 - 149,999	16.18
150,000 - 199,999	7.78
200,000 - 249,999	10.33
>250,000	7.61

Source: RTC, Screenline Analysis, April 1994

CHAPTER 8. RTC MODEL USER'S GUIDE

This chapter gives a brief procedural guide to the user of the RTC Travel Demand Model. The guide first describes the use of the LOTUS 1-2-3 ® spreadsheet to perform trip generation. Next, the TRANPLAN functions to perform trip distribution, mode split/vehicle occupancy, and traffic assignment are described.

8.1 TRIP GENERATION SPREADSHEET

The RTC trip generation process is carried out using algorithms in a LOTUS 123 ® spreadsheet. The spreadsheet is divided into the following areas:

Area 1 - TAZ planning variables input

Area 2 - Trip production and attraction trip rate lookup tables

Area 3 - Calculation macro

Area 4 - Computed productions and attractions

Area 5 - Totals for productions and attractions by trip purpose

The calculation macro works in the following steps:

Trip productions for each trip purpose are computed and copied to Area 4

Trip attractions for each trip purpose are computed and copied to Area 4

Trips are balanced by trip purpose using the respective trip production or attraction factors computed in Area 5 outside of the calculation macro

- Balanced trip productions and attractions are output in a text file format

Trip productions and attractions are computed by first looking up the respective planning variable and multiplying by the trip production or trip attraction trip rate. For example, total trip productions are computed by first looking up the trip production rate by the income category for the TAZ and multiplying by the number of household units.

8.2 TRANPLAN FUNCTIONS

The RTC travel demand modeling process uses the TRANPLAN model to perform trip distribution and traffic assignment. This section presents an overview of TRANPLAN functions and the control file which contains the TRANPLAN commands, files, and parameters. The user should refer to the Urban Analysis Group's TRANPLAN and NIS documentation for additional information.

The functions described herein to perform trip distribution and traffic assignment are contained in a TRANPLAN control file (See Appendix E for the assignment control file). The RTC has separate control files for the years 1995, 2000, and 2010. In addition to the functions for trip distribution and traffic assignment, TRANPLAN functions are also described for reporting and plotting.

Minimum Time Paths

The first step in the TRANPLAN modeling process is to compute the minimum time paths between zones. The HIGHWAY PATHS function produces a minimum travel time matrix. The function first reads the speeds from the network and computes the minimum travel time paths, or skim matrix. The output is a zone-to-zone matrix of travel times. The next function INTRAZONAL IMPEDANCES computes the travel times within each zone or intrazonal impedances. The minimum time paths and intrazonal travel times are added together using the MATRIX MANIPULATE function.

Trip Distribution (Gravity Model)

The next step in the process is trip distribution which is performed using the GRAVITY MODEL function. The function first reads the travel time matrix and a file which contains the production, attractions, and friction factors. The GRAVITY MODEL distributes trips between zones using the gravity model algorithm. The function outputs a production-attraction person trip table. This table contains the zone-to-zone interchanges matching productions and attractions.

Person Trip Table Production

The production-attraction person trip table is transposed by the MATRIX TRANSPOSE function to produce an attraction-production person trip table. The production-attraction and attraction-production trip tables are then added together using the MATRIX MANIPULATE function. The output of this function is a total production attraction trip table. At this point, the total number of trip interchanges between zones is known, but the specific directional split is not known. For a daily trip table, the trips are split equally by direction by multiplying the trip interchange matrix by a factor of 0.5 to produce an origin-destination person trip table. The output of the function is a matrix of person trip origins and destinations.

8.2.4 Vehicle Trip Table

The next step in the process is to produce an automobile vehicle trip table by adjusting the person trip table for transit trips and for the number of persons per vehicle. The transit trip matrix is subtracted out from the person trip table to produce a net number of person trips by automobile. MATRIX MANIPULATE is used to subtract the transit trip table from the person trip table. An automobile vehicle origin-destination trip table is produced by multiplying the trip table by a person-per-vehicle factor for each trip purpose. The MATRIX UPDATE function is used to multiply the person origin-destination trip table by the inverse of vehicle occupancy, the number of persons per vehicle. The output is an automobile origin-destination table.

Traffic Assignment

The final step in the TRANPLAN modeling process is the traffic assignment phase. The EQUILIBRIUM ASSIGNMENT function is used to assign the automobile origin-destination table to the network. The output of this function is the assigned, or loaded, highway network.

8.2.6 Reporting

There are several TRANPLAN reports available to the user to produce information and summary statistics on the respective TRANPLAN run. The HIGHWAY SUMMARY report function can output information on vehicle-miles traveled, vehicle-hours traveled, and lane capacity-miles. The INCREMENTAL SUMMARY report function outputs information on the performance of the network including a comparison of assigned traffic volumes to actual ground traffic counts.

Plotting

Plot files can be produced for the highway network and for the loaded highway network. The PLOT HIGHWAY function uses as an input the highway network and outputs a plot of the highway network given certain plot parameters. The network can be plotted with or without network attributes such as the number of lanes, speed, or capacity. The PLOT HIGHWAY LOAD function inputs the loaded highway network and outputs a display of the loaded volumes on the highway network.

REFERENCES

Regional Transportation Commission, 1990 Las Vegas Regional Household Travel Survey, 1990.

Regional Transportation Commission, Las Vegas Regional Transportation Model (LVRTM) Documentation Report, Las Vegas Regional Transportation Plan Update, December 1991.

Regional Transportation Commission, Planning Variables Report: 1992, Adopted December 10, 1992.

Urban Analysis Group, TRANPLAN/NIS User's Manual.

GLOSSARY

ADT:	Average Daily Traffic - average daily traffic volume as derived from observations of traffic conduced over a number of days.
Calibration:	The process of defining and adjusting model parameters until the model replicates the travel patterns exhibited in the study area.
Capacity:	The maximum number of vehicles, or persons, that can be carried past a point on a transportation system in a specified time.
Capacity Restraint:	Traffic assignment which restrains the amount of traffic traveling on a link by the congestion on that link as measured by the volume-to-capacity ratio on the link.
Centroid:	A node in the transportation network which represents a point which is assumed to be the location of all trips generated to and from a zone.
Ground count:	An actual traffic volume count.
Home-Based Trip:	A trip with either its origin or destination end at home.
Intra-zonal Trips:	Those trips occurring totally within a zone (TAZ).
Link:	An element in a transportation network representing a street section which connects two nodes.
Minimum Path:	The travel route between two points which gives the minimum travel time between the two points.
Network:	A system of links and nodes that describes a transportation system.
Network Coding:	The process of representing a real transportation system in terms of a network "model" used for computer processing.
Node:	A point on a highway network where links intersect, end or change direction.
Non Home-Based Trip:	A trip with both its origin and destination at a non home location.
Skim Matrix:	A table of the minimum travel times between each TAZ.

	Traffic Analysis Zone - a geographical area used as a basis for estimating socioeconomic variables and trip generation.
Travel Time Frequency Distribution:	A table or graphical representation which shows the percentage of total trips within each travel time increment.
Trip Assignment:	A process that assigns trips to various paths or routes in a network.
Trip Distribution:	The process which estimates the number of trips traveling between geographical zones in a transportation network.
Trip Generation:	The process which estimates the number of trips generated by the land use within each zone.
Trip Table:	A table (matrix) which illustrates the number of trips from each zone to every other zone in the study area.
Validation:	Running the calibrated model(s) with the current socioeconomic data and comparing it to the ground traffic counts.
	Vehicle miles of travel - the number of vehicles on a link, generally for a daily period, multiplied by the length of the link, in miles. The VMT for a study area is the sum of the VMTs for each link.

APPENDIX A. UPDATE NETWORK CONTROL FILE

```
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV90N.NET$
 OUTPUT FILE = MACOUT, USER ID = $LV902.NET$
$DATA
 ASSIGNMENT GROUP=1, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=2, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=3, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=4, CHANGE, SPEED 1 = R 2500
 ASSIGNMENT GROUP=5, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=6, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=7, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=8, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=9, CHANGE, SPEED 1 = R 1500
 ASSIGNMENT GROUP=1, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 12000
 ASSIGNMENT GROUP=1, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 20000
 ASSIGNMENT GROUP=2, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 9500
 ASSIGNMENT GROUP=2, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 18000
 ASSIGNMENT GROUP=2, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 25000
 ASSIGNMENT GROUP=3, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 9500
 ASSIGNMENT GROUP=3, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 18000
 ASSIGNMENT GROUP=3, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 25000
 ASSIGNMENT GROUP=3, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 48500
 ASSIGNMENT GROUP=4, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 9000
 ASSIGNMENT GROUP=4, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 16000
 ASSIGNMEMT GROUP=5-6, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 45000
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 67500
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 90000
 ASSIGNMENT GROUP=7, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 18000
 ASSIGNMENT GROUP=7, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 27000
 ASSIGNMENT GROUP=7, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 36000
 ASSIGNMENT GROUP=8, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 9500
 ASSIGNMENT GROUP=8, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 18000
 ASSIGNMENT GROUP=8, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 26000
 ASSIGNMENT GROUP=8, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 36600
 ASSIGNMENT GROUP=9, CHANGE, CAPACITY 1, R 99999
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV202.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV203.NET$
$DATA
 ASSIGNMENT GROUP=2,8, LINK GROUP 3=1, CHANGE, SPEED 1, R 2500
 ASSIGNMENT GROUP=3, LINK GROUP 3=1, CHANGE, SPEED 1, R 3000
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=2,3, CHANGE, SPEED 1, R 3500
```

```
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3= 7,8,10, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=9, CHANGE, SPEED 1, R 4000
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=5,11,12, CHANGE, SPEED 1, R 4500
 ASSIGNMENT GROUP=3, LINK GROUP 3=4,6, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=5, LINK GROUP 3=0, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, CAPACITY 1, *0.5
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV203.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV204.NET$
$DATA
 LINK GROUP 3 = 5,11,12, DIRECTION CODE = 1,3, CHANGE, SPEED 1=*.8
$END TP FUNCTION
```

APPENDIX B. FRICTION FACTORS

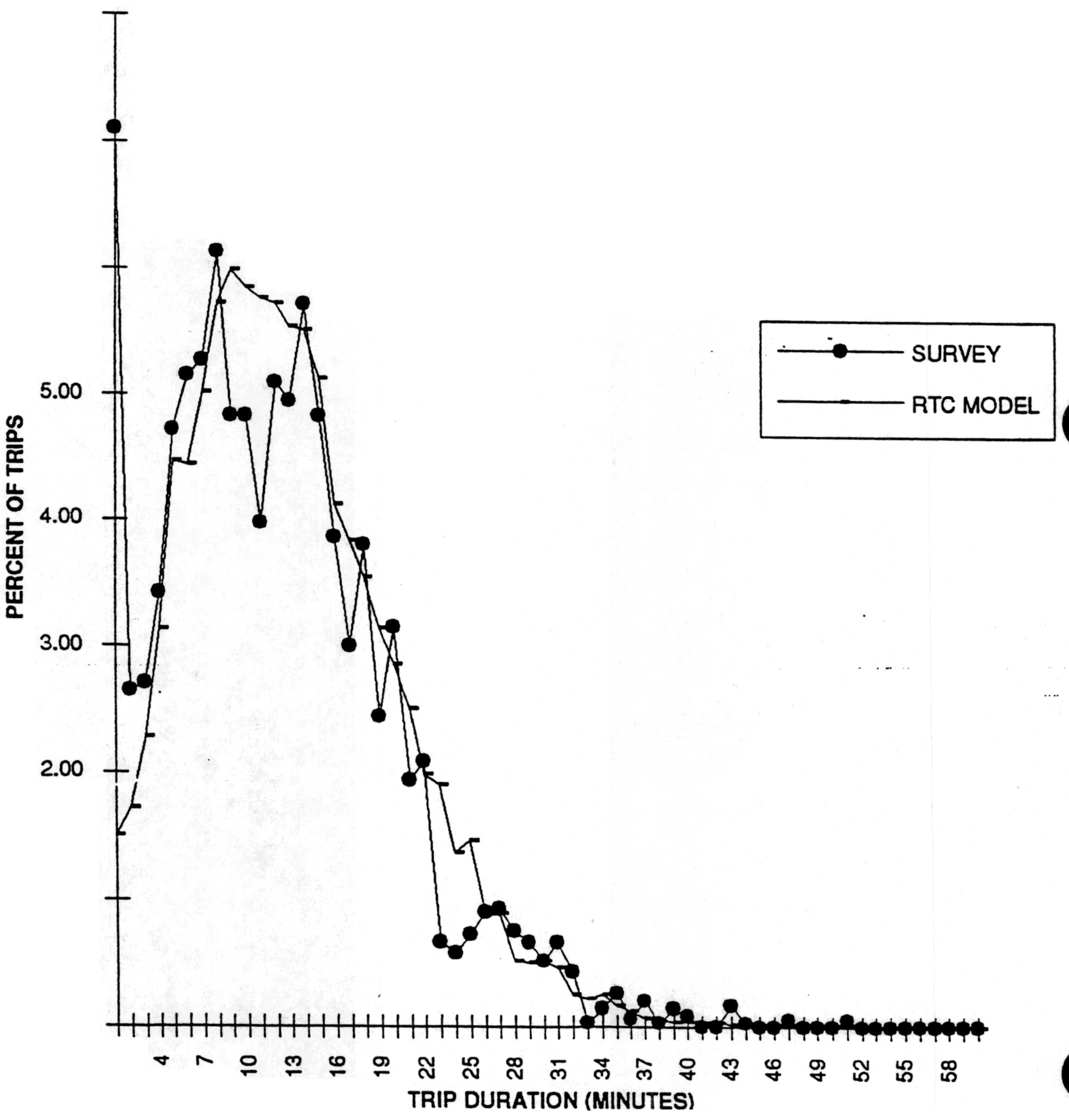
Prepared by BRW Inc December 7, 1993

Time(min.)	HBW	HBSC	HBSH	HBO	NHB
-	248742	500409	320000	805899	72096
	166515	274428	167000	583135	54941
	114087	156051	102000	429716	42136
	79940	91883	64000	322082	32523
	57242	55941	38000	245226	25262
	41856	35168	22000	189422	19747
	31229	22798	13500	148252	15534
	23757	15218	9000	117416	12296
	18413	10445	6300	93984	9794
	14529	7362	4500	75932	7850
	11662	5321	3300	61843	6331
	9516	3938	2525	50710	5137
	7887	2980	1950	41810	4194
14	6634	2303	1550	34617	3445
15	5660	1815	1300	28746	2847
	4894	1457	1025	23911	2368
	4285	1189	860	19896	1980
	3796	986	720	16541	1667
	3401		610	13722	1411
	3078	705	525	11344	1202
	2813	607	450	9334	1030
	2593	528		7634	
	2410	463		6199	
	2256	408	270	4990	
25	2126	363	225	3978	
	2015			3136	
	1919			2442	
28	1836			1876	
	1762			1420	
	1696			1057	
	1635		72		
32	1579				276
33	1525				
34	1473		38		
35	1421			181	
	1368	96			
	1314	82	15	77	
38	1258				
39	1199			29	
	1137	47			
	1073	38			
	1006				
	936	23			
44					
45					
46					
47					
48					
49	502				135
	372				
52					
54	214				
55	172				152
56					

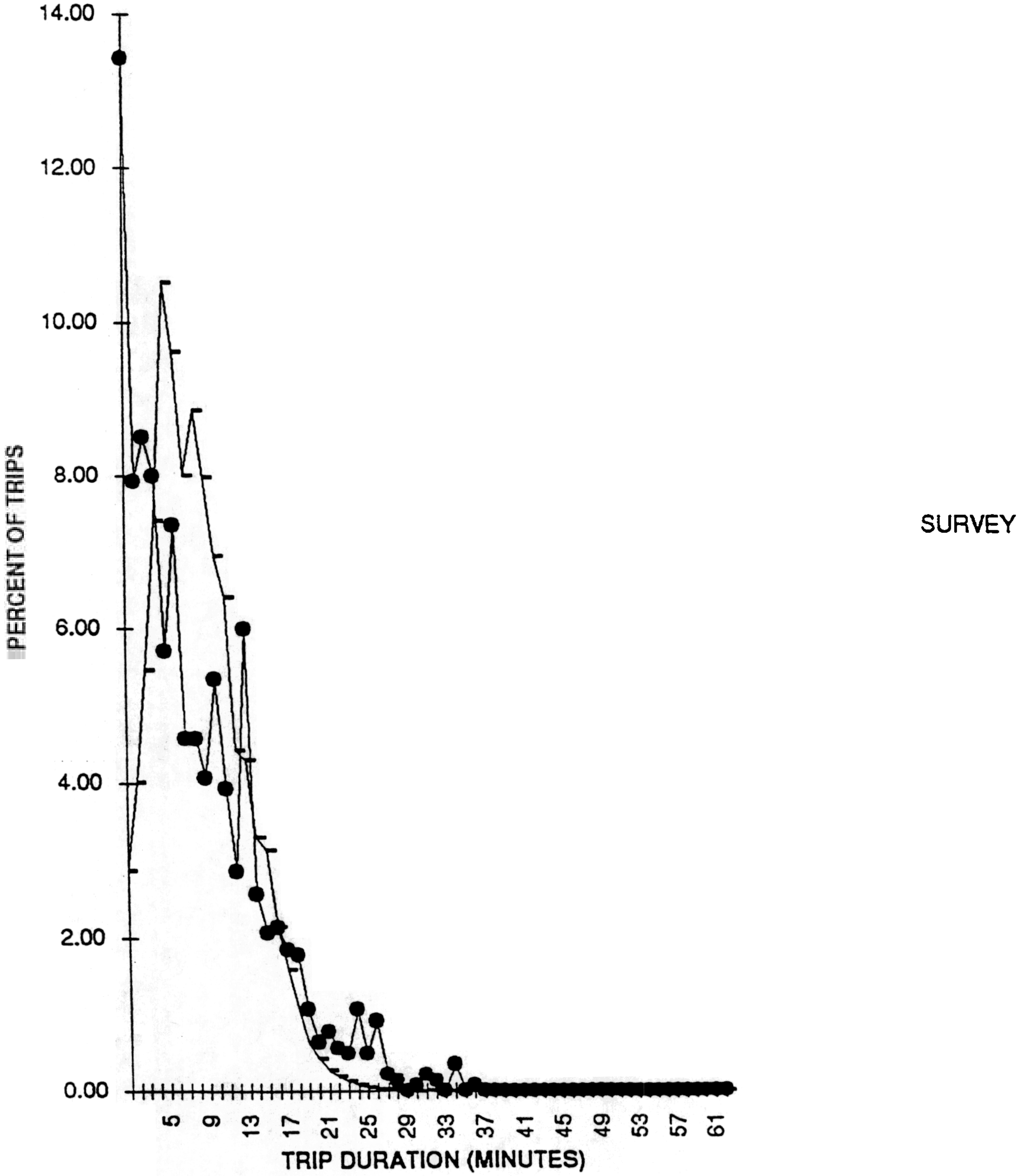
APPENDIX C. TRAVEL TIME DISTRIBUTIONS

Prepared by BRW Inc December 7, 1993

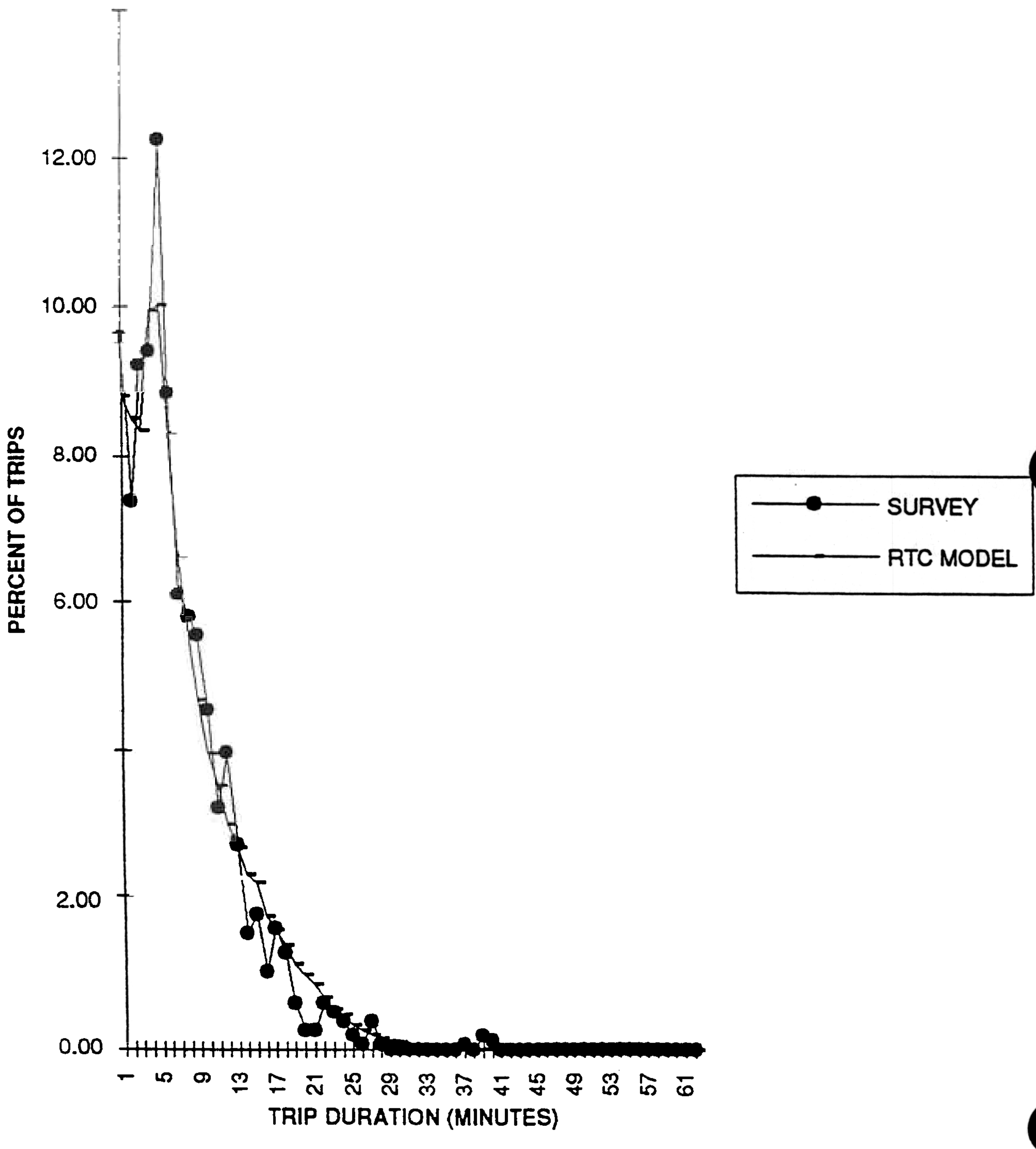
HOME-BASED WORK TRIP LENGTH FREQUENCY



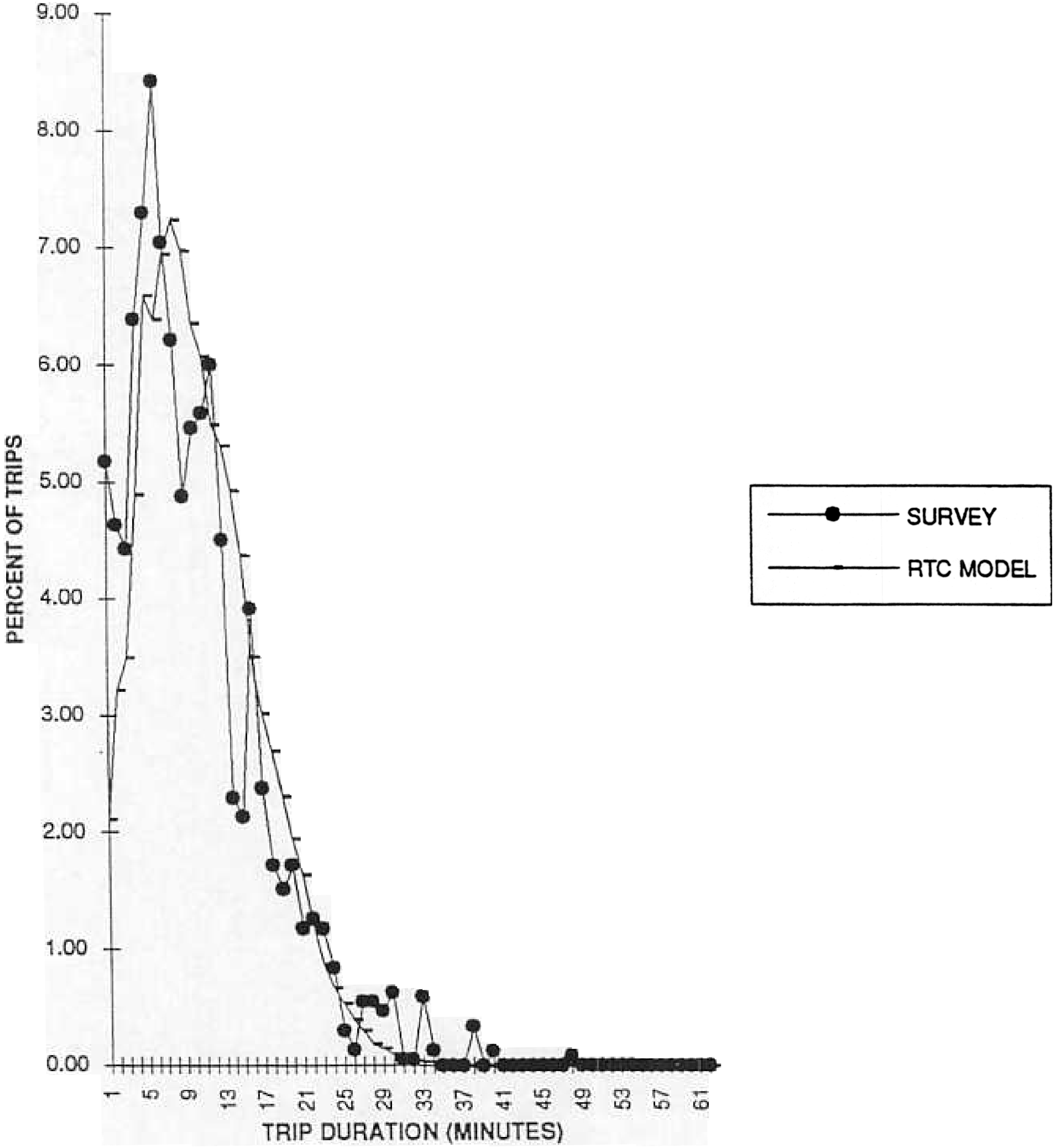
HOME-BASED SCHOOL TRIP LENGTH FREQUENCY



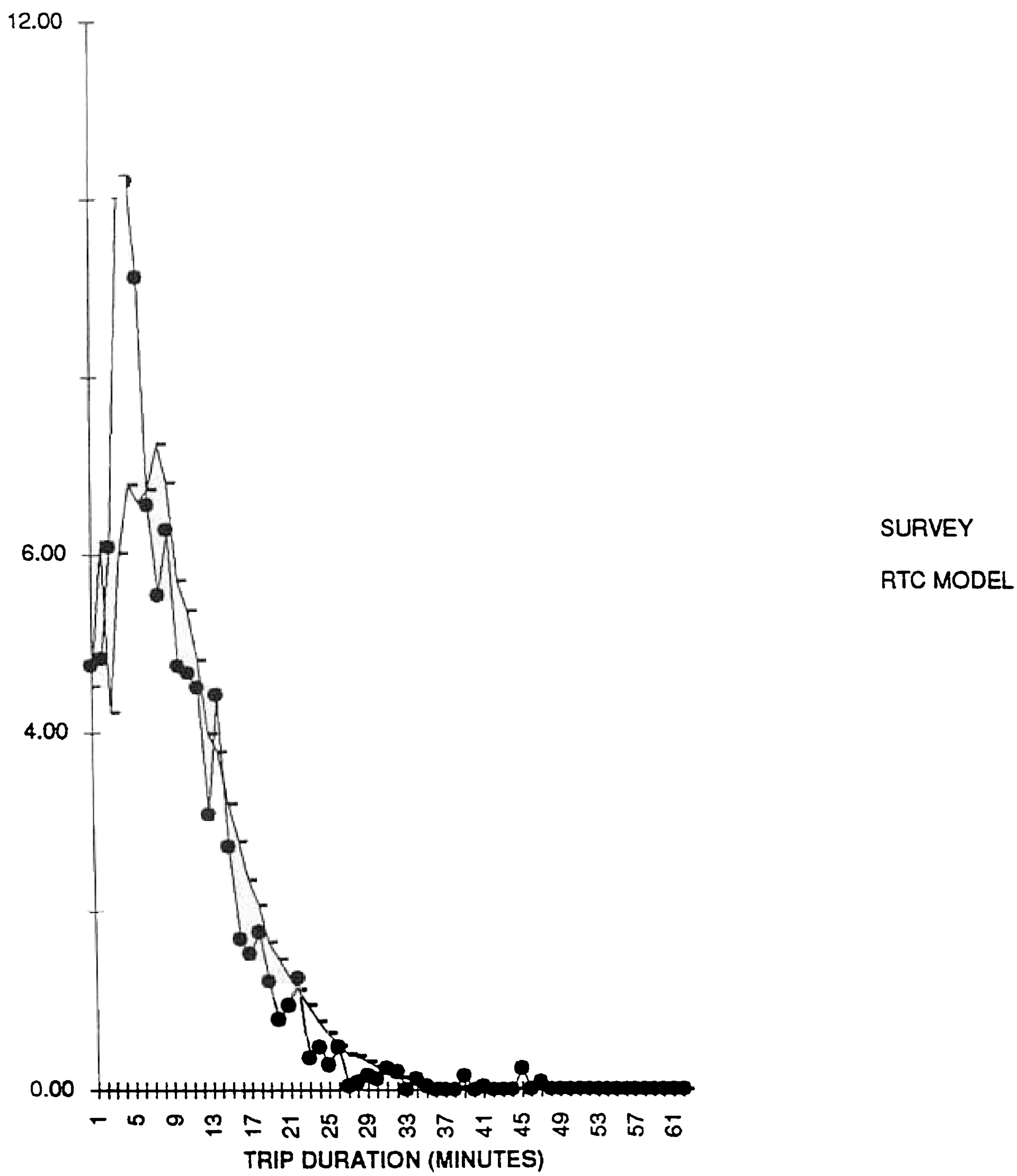
HOME-BASED SHOPPING TRIP LENGTH FREQUENCY



HOME-BASED OTHER TRIP LENGTH FREQUENCY



NON HOME-BASED TRIP LENGTH FREQUENCY



APPENDIX D. SCREENLINE COMPARISONS

LAS VEGAS, NV
REGIONAL TRAVEL DEMAND MODEL
SCREENLINE ANALYSIS – LV90 "N" NETWORK

TABLE #6

April 26, 1994

Screenline #1

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
I-15	Blue Diamond to LV Blvd	37,400	33,900	(3,500)	-9.4%
Las Vegas Blvd	Robindale to Warm Sprgs	10,000	11,500	1,500	15.0%
Eastern	Robindale to Warm Sprds	14,400	12,600	(1,800)	-12.5%
SCREENLINE TOTALS:		61,800	58,000	(3,800)	-6.1%

Screenline #2

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Russell Road	Stephanie to Boulder Hwy	6,400	6,200	(200)	-3.1%
Sunset Road	Camarlo Park Rd to Stephanie	17,500	20,100	2,600	14.9%
Lake Mead Dr.	Green Valley Pkwy to Valle Verd	7,000	6,600	(400)	-5.7%
Boulder Hwy	Russell Rd to Stephanie	24,300	24,100	(200)	-0.8%
US-93/95	Sunset to Russell Rd	41,200	55,200	14,000	34.0%
SCREENLINE TOTALS:		96,400	112,200	15,800	16.4%

Screenline #3

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Craig Rd	Walnut to Lamb	17,100	17,800	700	4.1%
I-15	Craig Rd. to Lamb Blvd	10,900	11,200	300	2.8%
Las Vegas Blvd	Alexander to Nellis	10,600	14,700	4,100	38.7%
Lamb Blvd	Alexander to Craig	5,100	7,700	2,600	51.0%
Nellis Blvd	Cheyenne to Las Vegas Blvd	23,300	23,600	300	1.3%
SCREENLINE TOTALS:		67,000	75,000	8,000	11.9%

Screenline #4

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Craig Rd	Rancho to Jones	4,500	3,800	(700)	-15.6%
US-95 Expressway	Cheyenne to Alexander	19,200	20,300	1,100	5.7%
Rancho Rd	Alexander to Craig	11,000	14,700	3,700	33.6%
Jones Blvd	Craig Rd. to Lone Mtn Rd	7,000	6,700	(300)	-4.3%
SCREENLINE TOTALS:		41,700	45,500	3,800	9.1%

LAS VEGAS, NV
REGIONAL TRAVEL DEMAND MODEL
SCREENLINE ANALYSIS – LV90 "N" NETWORK

TABLE #6

April 26, 1994

Screenline #5

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Lake Mead Blvd	Michael Wy to Decatur	5,500	5,100	(400)	–7.3%
Vegas Dr.	Michael Wy to Decatur	11,200	9,000	(2,200)	–19.6%
Washington Ave	Michael Wy to Decatur	11,000	10,300	(700)	–6.4%
US–95 Expressway	Michael Wy to Decatur	88,200	69,400	(18,800)	–21.3%
Alta Dr.	Torrey Pines to Jones	8,000	14,100	6,100	76.3%
Charleston Blvd	Torrey Pines to Jones	22,400	26,800	4,400	19.6%
Rancho	Lake Mead to Smoke Ranch	21,000	27,700	6,700	31.9%
Jones Blvd	Alta Dr to US–95	27,600	39,000	11,400	41.3%
Decatur Blvd	Vegas Dr to Lake Mead Blvd	20,500	24,600	4,100	20.0%
SCREENLINE TOTALS:		215,400	226,000	10,600	4.9%

Screenline #6

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
I–15	Washington to Lake Mead Blvd	74,300	84,000	9,700	13.1%
M.L. King	Vegas Dr. to Lake Mead Blvd	11,500	10,300	(1,200)	–10.4%
Las Vegas Blvd	Main St. to Lake Mead Blvd	22,200	30,500	8,300	37.4%
North Fifth Street	Las Vegas Blvd to Lake Mead Blv	2,800	7,600	4,800	171.4%
Bruce St.	Owens to Lake Mead Blvd	5,500	9,200	3,700	67.3%
Civic Center Dr.	Owens to Lake Mead Blvd	21,000	22,400	1,400	6.7%
Pecos Rd.	Owens to Lake Mead Blvd.	18,200	12,300	(5,900)	–32.4%
SCREENLINE TOTALS:		155,500	176,300	20,800	13.4%

Screenline #7

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Fremont St.	Oakey Blvd to Charleston	20,600	15,900	(4,700)	–22.8%
Rancho	Oakey Blvd to Charleston	20,700	28,500	7,800	37.7%
I–15	Sahara to Charleston	144,000	116,300	(27,700)	–19.2%
Western Ave	Wyoming to Wall	7,700	2,800	(4,900)	–63.6%
Las Vegas Blvd	4th Street to Charleston	30,800	30,200	(600)	–1.9%
Main Street	Wyoming to Charleston	23,400	28,900	5,500	23.5%
Eastern Ave	Oakey to Charleston	26,600	40,900	14,300	53.8%
SCREENLINE TOTALS:		273,800	263,500	(10,300)	–3.8%

Screenline #8

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Rainbow Blvd	Desert Inn to Sahara	36,900	36,400	(500)	–1.4%
Jones Blvd	Desert Inn to Sahara	26,500	19,800	(6,700)	–25.3%
Decatur Blvd	Desert Inn to Sahara	31,000	28,000	(3,000)	–9.7%
Valley View	Desert Inn to Sahara	29,500	36,700	7,200	24.4%
SCREENLINE TOTALS:		123,900	120,900	(3,000)	–2.4%

LAS VEGAS, NV
REGIONAL TRAVEL DEMAND MODEL
SCREENLINE ANALYSIS – LV90 "N" NETWORK

TABLE #6

April 26, 1994

Screenline #9

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Valley View Blvd	Desert Inn to Sahara	29,500	36,700	7,200	24.4%
I–15	Sprg Mtn to Sahara	128,000	108,100	(19,900)	–15.5%
Las Vegas Blvd	Circus Circus to Sahara	45,000	43,300	(1,700)	–3.8%
Paradise Rd.	Karen to Sahara	40,900	43,900	3,000	7.3%
Maryland Pkwy	Karen to Sahara	34,200	38,000	3,800	11.1%
SCREENLINE TOTALS:		277,600	270,000	(7,600)	–2.7%

Screenline #10

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Eastern Ave.	Karen to Sahara	29,000	31,900	2,900	10.0%
Pecos Rd.	Karen to Sahara	11,700	8,600	(3,100)	–26.5%
Lamb Blvd	Vegas Valley to Sahara	23,000	26,500	3,500	15.2%
Nellis Blvd	Vegas Valley to Sahara	29,900	31,200	1,300	4.3%
I–515	Vegas Valley to Sahara	84,600	63,300	(21,300)	–25.2%
Boulder Hwy	Karen to Sahara	31,520	34,500	2,980	9.5%
SCREENLINE TOTALS:		209,720	196,000	(13,720)	–6.5%

Screenline #11

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
I–15	Tropicana to Flamingo	67,900	56,100	(11,800)	–17.4%
Las Vegas Blvd	Harmon to Flamingo	50,300	39,500	(10,800)	–21.5%
Koval Ln	Harmon to Flamingo	22,800	19,400	(3,400)	–14.9%
Paradise	Harmon to Flamingo	30,200	30,400	200	0.7%
Swenson	Harmon to Flamingo	15,800	14,900	(900)	–5.7%
Maryland Pkwy	Rochelle to Flamingo	29,300	42,500	13,200	45.1%
SCREENLINE TOTALS:		216,300	202,800	(13,500)	–6.2%

Screenline #12

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Boulder Hwy	Harmon to Nellis	26,000	29,200	3,200	12.3%
US–93/95	Harmon to Flamingo	67,500	61,800	(5,700)	–8.4%
Eastern Ave.	Rochelle to Flamingo	28,000	23,800	(4,200)	–15.0%
Pecos	Rochelle to Flamingo	26,500	26,200	(300)	–1.1%
Nellis Blvd	Harmon to Boulder Hwy	17,000	25,400	8,400	49.4%
SCREENLINE TOTALS:		165,000	166,400	1,400	0.8%

LAS VEGAS, NV
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SCREENLINE ANALYSIS – LV90 "N" NETWORK

TABLE #6

April 26, 1994

Screenline #13

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Sprg Mountain Rd.	Decatur to Arville	30,000	35,800	5,800	19.3%
Flamingo	Cameron to Arville	52,400	36,400	(16,000)	−30.5%
Tropicana	Cameron to Arville	39,600	45,200	5,600	14.1%
SCREENLINE TOTALS:		122,000	117,400	(4,600)	−3.8%

Screenline #14

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Sahara Ave	Las Vegas Blvd to Paradise	52,600	59,000	6,400	12.2%
Convention Center	Las Vegas Blvd to Paradise	8,900	13,100	4,200	47.2%
Desert Inn	Las Vegas Blvd to Paradise	10,100	21,000	10,900	107.9%
Sands	Koval to Paradise	37,000	38,700	1,700	4.6%
Flamingo	Koval to Paradise	48,500	44,600	(3,900)	−8.0%
Tropicana	Koval to Paradise	58,400	51,400	(7,000)	−12.0%
Harmon	Koval to Paradise	27,000	24,000	(3,000)	−11.1%
SCREENLINE TOTALS:		242,500	251,800	9,300	3.8%

Screenline #15

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Sahara	Maryland to Eastern	45,800	39,100	(6,700)	−14.6%
Desert Inn	Maryland to Eastern	31,800	32,400	600	1.9%
Flamingo	Maryland to Eastern	47,700	42,900	(4,800)	−10.1%
Tropicana	Maryland to Eastern	42,500	48,400	5,900	13.9%
SCREENLINE TOTALS:		167,800	162,800	(5,000)	−3.0%

Screenline #16

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Vegas Dr.	Decatur to Rancho	7,800	7,200	(600)	−7.7%
Washington	Decatur to Valley View	13,600	12,500	(1,100)	−8.1%
US−95 Expressway	Decatur to Valley View	102,500	79,300	(23,200)	−22.6%
SCREENLINE SUBTOTALS:		123,900	99,000	(24,900)	−20.1%
ROUTE	**CROSS STREETS**	**OBSERVED**	**ASSIGNED**	**DELTA**	**%DELTA**
Meadows Lane	Decatur to Valley View	8,200	13,300	5,100	62.2%
Alta	Decatur to Valley View	7,600	15,500	7,900	103.9%
Charleston	Decatur to Valley View	29,700	36,300	6,600	22.2%
Sahara	Decatur to Valley View	45,000	42,200	(2,800)	−6.2%
SCREENLINE SUBTOTALS:		90,500	107,300	16,800	18.6%
SCREENLINE TOTALS:		214,400	206,300	(8,100)	−3.8%

Screenline #17

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Lake Mead Blvd	Rancho to M.L. King	4,000	6,000	2,000	50.0%
Vegas Drive	Decatur Blvd to Rancho Rd	7,830	12,700	4,870	62.2%
Washington Ave	Valley View to Rancho Rd	12,020	12,000	(20)	−0.2%
Rancho Rd.	Vegas to Lake Mead	26,450	23,000	(3,450)	−13.0%
SCREENLINE SUBTOTALS:		50,300	53,700	3,400	6.8%

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
US95 Expressway	Valley View to Rancho	110,500	95,300	(15,200)	−13.8%
Alta Dr.	Valley View to Rancho	8,230	9,800	1,570	19.1%
Charleston Blvd	Valley View to Rancho	31,075	34,700	3,625	11.7%
Sahara Ave.	Valley View to Rancho	54,900	65,300	10,400	18.9%
SCREENLINE SUBTOTALS:		204,705	205,100	395	0.2%
SCREENLINE TOTALS:		**255,005**	**258,800**	**3,795**	**1.5%**

Screenline #18

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Cheyenne Ave	Civic Center Dr to Pecos Rd	18,400	21,100	2,700	14.7%
Carey Ave	Belmont to Pecos	3,040	12,800	9,760	321.1[illegible]
Lake Mead Blvd	Belmont to Pecos	21,880	29,600	7,720	35[illegible]
Owens	Mojave to Pecos	9,255	9,300	45	0.[illegible]
Washington Ave	Mojave to Pecos	6,505	10,100	3,595	55.3%
Bonanza Rd	Mojave to Pecos	23,165	19,200	(3,965)	−17.1%
Las Vegas Blvd.	Belmont to Pecos	23,015	22,700	(315)	−1.4%
SCREENLINE SUBTOTALS:		105,260	124,800	19,540	18.6%

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
I−515	Mojave to Pecos	116,555	72,900	(43,655)	−37.5%
Stewart Ave.	Mojave to Pecos	9,915	8,000	(1,915)	−19.3%
Charleston Blvd.	Mojave to Pecos	24,000	16,300	(7,700)	−32.1%
Sahara Ave.	Mojave to Boulder Hwy	38,600	33,700	(4,900)	−12.7%
Boulder Hwy	Sahara to St Louis	28,500	26,500	(2,000)	−7.0%
SCREENLINE SUBTOTALS:		217,570	157,400	(60,170)	−27.7%
SCREENLINE TOTALS:		322,830	282,200	(40,630)	−12.6%

Screenline #19

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Charleston Blvd.	Lamb to Nellis	33,350	31,100	(2,250)	−6.7%
Sahara Ave.	Lamb to Nellis	15,650	13,900	(1,750)	−11.2%
Flamingo	Mtn. Vista to Boulder Hwy	18,300	14,000	(4,300)	−23.5%
Tropicana	Mtn. Vista to Nellis	26,250	18,800	(7,450)	−28.4%
Boulder Hwy	Flamingo Rd. to Indios	30,500	23,300	(7,200)	−23.6%
SCREENLINE TOTALS:		**124,050**	**101,100**	**(22,950)**	**−1[illegible]**

LAS VEGAS, NV
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TABLE #6

April 26, 1994

Screenline #20

ROUTE	CROSS STREETS	OBSERVED		ASSIGNED		DELTA	%DELTA
Tropicana	Nellis to Boulder Hwy	10,315		15,400		5,085	49.3%
Russell Rd.	Mtn. Vista to Whitney Ranch	9,290		8,800		(490)	−5.3%
Sunset Rd	Green Valley Pkwy to Mtn. Vista	28,950		18,300		(10,650)	−36.8%
Boulder Hwy	Tropicana to Harmon	25,200		32,400		7,200	28.6%
US 93/95	Russell to Tropicana	47,180		56,900		9,720	20.6%
Green Valley	Highview to Sunset	31,150		14,100		(17,050)	−54.7%
Mountain Vista	Sunset to Russell	24,500		16,200		(8,300)	−33.9%
SCREENLINE TOTALS:			176,585		162,100	(14,485)	−8.2%

Screenline #21

ROUTE	CROSS STREETS	OBSERVED		ASSIGNED		DELTA	%DELTA
Desert Inn Rd.	Mojave to Sandhill	29,900		24,900		(5,000)	−16.7%
Flamingo Rd	Pecos to Sandhill	40,000		34,100		(5,900)	−14.8%
Tropicana Ave	Pecos to Sandhill	42,550		37,300		(5,250)	−12.3%
Sunset Rd.	Pecos to Sandhill	33,235		16,500		(16,735)	−50.4%
SCREENLINE TOTALS:			145,685		112,800	(32,885)	−22.6%

Screenline #22

ROUTE	CROSS STREETS	OBSERVED		ASSIGNED		DELTA	%DELTA
I−15	Flamingo to Sprg Mtn.	100,955		79,900		(21,055)	−20.9%
Las Vegas Blvd	Flamingo to Spring Mtn	54,300		46,000		(8,300)	−15.3%
Paradise	Flamingo to Sands	30,915		35,200		4,285	13.9%
Swenson	Flamingo to Sands	16,070		17,100		1,030	6.4%
Maryland Pkwy	Flamingo to Twain	40,400		43,800		3,400	8.4%
Eastern	Flamingo to Twain	28,650		28,300		(350)	−1.2%
SCREENLINE TOTALS:			271,290		250,300	(20,990)	−7.7%

Screenline #23

ROUTE	CROSS STREETS	OBSERVED		ASSIGNED		DELTA	%DELTA
Tropicana	Torrey Pines to Jones	27,500		26,000		(1,500)	−5.5%
Flamingo	Torrey Pines to Jones	27,800		26,700		(1,100)	−4.0%
Sprg Mountain	Torrey Pines to Jones	17,985		18,100		115	0.6%
Sahara	Torrey Pines to Jones	33,800		30,400		(3,400)	−10.1%
SCREENLINE TOTALS:			107,085		101,200	(5,885)	−5.5%

LAS VEGAS, NV
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SCREENLINE ANALYSIS – LV90 "N" NETWORK

TABLE #6

April 26, 1994

Screenline #24

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Tropicana	Rainbow to Torrey Pines	19,800	18,700	(1,100)	-5.6%
Flamingo	Rainbow to Torrey Pines	25,950	19,000	(6,950)	-26.8%
Sprg Mountain	Rainbow to Torrey Pines	16,800	15,300	(1,500)	-8.9%
Sahara	Rainbow to Torrey Pines	30,800	23,200	(7,600)	-24.7%
Charleston	Rainbow to Torrey Pines	21,725	25,300	3,575	16.5%
Alta	Rainbow to Torrey Pines	8,135	10,900	2,765	34.0%
US 95 Expressway	Rainbow to Jones	67,150	44,500	(22,650)	-33.7%
Washington	Rainbow to Torrey Pines	11,360	6,800	(4,560)	-40.1%
Vegas Dr.	Rainbow to Torrey Pines	1,735	7,600	5,865	338.0%
SCREENLINE TOTALS:		203,455	171,300	(32,155)	-15.8%

Screenline #25

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Valley View Blvd	Alta Dr. to Meadows Ln	23,675	23,900	225	1.0%
Decatur Blvd.	Alta to Meadows Lane	39,290	40,600	1,310	3.3%
Jones	Alta Dr. to US-95 Expressway	27,600	39,000	11,400	41.3%
Rainbow	Alta to Westcliff	36,800	32,600	(4,200)	-11.4%
SCREENLINE TOTALS:		127,365	136,100	8,735	6[illegible]

Screenline #26

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Decatur Blvd.	Smoke Ranch to Rancho	10,100	11,700	1,600	15.8%
Jones	Smoke Ranch to Cheyenne	14,750	14,000	(750)	-5.1%
Rancho Rd.	Smoke Ranch to Decatur	17,400	33,700	16,300	93.7%
US-95 Expressway	Smoke Ranch to Cheyenne	32,000	33,400	1,400	4.4%
SCREENLINE TOTALS:		74,250	92,800	18,550	25.0%

Screenline #27

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Jones	Lone Mtn. to Ann Rd.	3,245	3,900	655	20.2%
Rancho Rd.	Lone Mountain to US-95 Expres	6,120	5,500	(620)	-10.1%
US-95 Expressway	Lone Mtn to Rancho Rd.	9,730	8,600	(1,130)	-11.6%
SCREENLINE TOTALS:		19,095	18,000	(1,095)	-5.7%

LAS VEGAS, NV
REGIONAL TRAVEL DEMAND MODEL
SCREENLINE ANALYSIS – LV90 "N" NETWORK

TABLE #6

April 26, 1994

Screenline #28

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Nellis Blvd	Carey Ave. to Cheyenne	26,700	27,700	1,000	3.7%
Lamb Blvd	Carey Ave. to Cheyenne	6,290	15,500	9,210	146.4%
Pecos Rd.	Carey to Las Vegas Blvd	14,180	12,200	(1,980)	–14.0%
Civic Center	Carey to Cheyenne	11,100	12,700	1,600	14.4%
Las Vegas Blvd	Belmont to Pecos	23,015	22,700	(315)	–1.4%
I–15	Lake Mead to Cheyenne	46,830	40,900	(5,930)	–12.7%
SCREENLINE TOTALS:		128,115	131,700	3,585	2.8%

Screenline #29

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Las Vegas Blvd	Alexander to Nellis	10,570	14,700	4,130	39.1%
Stewart Ave.	Lamb to Nellis	12,475	14,800	2,325	18.6%
Bonanza	Lamb to Nellis	25,500	17,100	(8,400)	–32.9%
Lake Mead Blvd	Lamb to Nellis	17,650	20,700	3,050	17.3%
Carey	Lamb to Nellis	2,070	4,900	2,830	136.7%
Cheyenne	Lamb to Nellis	9,790	11,700	1,910	19.5%
Craig	Lamb to Nellis	17,300	15,300	(2,000)	–11.6%
SCREENLINE TOTALS:		95,355	99,200	3,845	4.0%

Screenline #30

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Mountain Vista	Russell to US 93/95	23,000	15,700	(7,300)	–31.7%
Pecos	Russell to Hacienda	29,000	9,100	(19,900)	–68.6%
US 93/95	Russell to Tropicana	47,180	56,900	9,720	20.6%
SCREENLINE TOTALS:		99,180	81,700	(17,480)	–17.6%

Screenline #31

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Lake Mead Dr.	Eastern to Gomer	5,140	3,800	(1,340)	–26.1%
Wigwam	Jessup to Pecos	6,800	5,600	(1,200)	–17.6%
Warm Sprgs.	Eastern to Pecos	10,800	14,000	3,200	29.6%
Sunset	Eastern to Pecos	25,750	13,100	(12,650)	–49.1%
Tropicana	Eastern to Pecos	41,900	44,800	2,900	6.9%
Flamingo Rd.	Eastern to Mojave	49,600	36,100	(13,500)	–27.2%
SCREENLINE TOTALS:		139,990	117,400	(22,590)	–16.1%

LAS VEGAS, NV
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SCREENLINE ANALYSIS – LV90 "N" NETWORK

TABLE #6

April 26, 1994

Screenline #32

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Bonanza	M.L. King to H Street	17,850	4,500	(13,350)	−74.8%
Washington	M.L. King to H Street	10,000	8,300	(1,700)	−17.0%
Lake Mead Blvd	M.L. King to H Street	7,505	6,500	(1,005)	−13.4%
Craig Rd.	5th Street to Bruce	6,200	5,300	(900)	−14.5%
SCREENLINE TOTALS:		41,555	24,600	(16,955)	−40.8%

Screenline #33

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
I−15	Tropicana to Flamingo	67,885	56,100	(11,785)	−17.4%
Decatur Blvd.	Tropicana to Harmon	15,500	9,600	(5,900)	−38.1%
Jones	Tropicana to Harmon	17,590	5,600	(11,990)	−68.2%
Rainbow	Tropicana to Harmon	20,100	15,400	(4,700)	−23.4%
SCREENLINE TOTALS:		121,075	86,700	(34,375)	−28.4%

Screenline #34

ROUTE	CROSS STREETS	OBSERVED	ASSIGNED	DELTA	%DELTA
Horizon Dr.	Pacific to Greenway	6,695	6,800	105	1.[illegible]
Lake Mead Dr.	Burkholder to Warm Sprgs	16,300	17,200	900	5.5%
Water St	Pacific to Basic	8,270	10,700	2,430	29.4%
Boulder Hwy	Basic to Pacific	42,600	25,800	(16,800)	−39.4%
SCREENLINE TOTALS:		73,865	60,500	(13,365)	−18.1%

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LAS VEGAS, NV
LV90 "N" NETWORK
ROOT MEAN SQUARE ERROR ANALYSIS

TABLE #7

April 26, 1994

VOLUME GROUP < 50,000

		Obser.	Assign		RMSE	% RMSE
Screenline #s	4	41,700	45,500	14,440,000		
	27	19,095	18,000	1,199,025		
	32	41,555	24,600	287,472,025		
TOTALS:	**3**	**102,350**	**88,100**	**303,111,050**	**10,052**	**29.46%**
		34,117	29,367			

VOLUME GROUP 50,000 – 99,999

		Obser.	Assign		RMSE	% RMSE
Screenline #s	1	61,800	58,000	14,440,000		
	2	96,400	112,300	252,810,000		
	3	67,000	75,000	64,000,000		
	16B	90,500	107,300	282,240,000		
	17A	50,300	53,700	11,560,000		
	26	74,250	92,800	344,102,500		
	29	95,355	99,200	14,784,025		
	30	99,180	81,700	305,550,400		
	34	73,865	60,500	178,623,225		
TOTALS:	**9**	**708,650**	**740,500**	**1,468,110,150**	**12,772**	**16.22%**
		78,739	82,278			

VOLUME GROUP 100,000 – 149,999

		Obser.	Assign		RMSE	% RMSE
Screenline #s	8	123,900	120,900	9,000,000		
	13	122,000	117,400	21,160,000		
	16A	123,900	99,000	620,010,000		
	18A	105,260	124,800	381,811,600		
	19	124,050	101,100	526,702,500		
	21	145,685	112,800	1,081,423,225		
	23	107,085	101,200	34,633,225		
	25	127,365	136,100	76,300,225		
	28	128,115	131,700	12,852,225		
	31	139,990	117,400	510,308,100		
	33	121,075	86,700	1,181,640,625		
TOTALS:	**11**	**1,368,425**	**1,249,100**	**4,455,841,725**	**20,127**	**16.18%**
		124,402	113,555			

LAS VEGAS, NV
LV90 "N" NETWORK
ROOT MEAN SQUARE ERROR ANALYSIS

TABLE #7

April 26, 1994

VOLUME GROUP 150,000 – 199,999		Obser.	Assign		RMSE	% RMSE
Screenline #s	6	155,500	176,300	432,640,000		
	12	165,000	166,400	1,960,000		
	15	167,800	162,800	25,000,000		
	20	176,585	162,100	209,815,225		
TOTALS:	**4**	**664,885**	**667,600**	**669,415,225**	**12,937**	**7.78%**
		166,221	166,900			

VOLUME GROUP 200,000 – 249,999		Obser.	Assign		RMSE	% RMSE
Screenline #s	5	215,400	226,000	112,360,000		
	10	209,720	196,000	188,238,400		
	11	216,300	202,800	182,250,000		
	14	242,500	251,800	86,490,000		
	16	214,400	206,300	65,610,000		
	17B	204,705	205,100	156,025		
	18B	217,570	157,400	3,620,428,900		
	24	203,455	171,300	1,033,944,025		
TOTALS:	6	1,724,050	1,616,700	5,289,477,350	29,691	10.33%
		287,342	269,450			

VOLUME GROUP > 250,000		Obser.	Assign		RMSE	% RMSE
Screenline #s	7	273,800	263,500	106,090,000		
	9	277,600	270,000	57,760,000		
	17	255,005	258,800	14,402,025		
	18	322,830	282,200	1,650,796,900		
	22	271,290	250,300	440,580,100		
TOTALS:	**5**	**1,400,525**	**1,324,800**	**2,269,629,025**	**21,306**	**7.61%**
		280,105	264,960			

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APPENDIX E. ASSIGNMENT CONTROL FILE

```
$HIGHWAY SELECTED SUMMATION
$FILES
  INPUT FILE = HWYNET, USER ID = $LV90N.NET$
  OUTPUT FILE = HWYSKIM, USER ID = $LVTEM.SKM$
$HEADER
    LV90 NETWORK INTERZONAL SKIMS
$PARAMETERS
  IMPEDANCE = TIME 1
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
            (3-2,50) (4-3,50) (1-4,50) (2-1,50)
$DATA
  TABLE = TIME 1
$END TP FUNCTION
$BUILD INTRAZONAL IMPEDANCES
$FILES
  INPUT FILE = IZIN, USER ID = $LVTEM.SKM$, UNLOAD
  OUTPUT FILE = IZOUT, USER ID = $LV90.SKM$
$HEADER
    LV90 NETWORK INTRAZONAL SKIMS
$OPTION
~ PRINT DETAIL
$PARAMETERS
  NUMBER OF ADJACENT ZONES = 2
$END TP FUNCTION
$GRAVITY MODEL
$FILES
  INPUT FILE = GMSKIM, USER ID = $LV90.SKM$, UNLOAD
  INPUT FILE = GRVDATA, USER ID = $NEWPA90$
  OUTPUT FILE = GMVOL, USER ID = $LV90.PA$
$HEADER
     LV90 NETWORK & 1990 TRIPS
     GRAVITY MODEL OUTPUT -- FIVE PURPOSES
$OPTIONS
  GRVDATA
  MERGED PURPOSE FILE
~ PRINT TRIP LENGTH STATISTICS
$PARAMETERS
  MAXIMUM TIME = 75
  MAXIMUM PURPOSE = 5
  ITERATIONS ON ATTRACTIONS = 5
$END TP FUNCTION
$MATRIX TRANSPOSE
$FILES
  INPUT FILE = TRNSPIN, USER ID = $LV90.PA$
  OUTPUT FILE = TRNSPOT, USER ID = $LV90.AP$
```

```
$HEADER
    LV90 NETWORK TRANSPOSED TRIP TABLE
$OPTION
$PARAMETERS
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $LV90.PA$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $LV90.AP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $PAANDAP.TMP$
$HEADER
    LV90 NETWORK P/A TABLE + A/P TABLE
$DATA
  TMAN3,T1 = TMAN1,T1 + TMAN2,T1
  TMAN3,T2 = TMAN1,T2 + TMAN2,T2
  TMAN3,T3 = TMAN1,T3 + TMAN2,T3
  TMAN3,T4 = TMAN1,T4 + TMAN2,T4
  TMAN3,T5 = TMAN1,T5 + TMAN2,T5
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PAANDAP.TMP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $NELV90OD.VOL$
$HEADER
    LV90 NETWORK O & D TABLE PERSON TRIPS
$DATA
  MP, 1-5, 1-751, 1-751, *0.5
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
   INPUT FILE = TMAN1, USER ID = $NELV90OD.VOL$
   INPUT FILE = TMAN2, USER ID = $TRN90A.SHR$
   OUTPUT FILE = TMAN3, USER ID = $LV90TRN.TMP$
$HEADERS
   APPLICATION OF TRANSIT MODE SHARES TO DERIVE TRANSIT TRIPS
$DATA
   TMAN3, T1 = TMAN1, T1 * TMAN2, T1
   TMAN3, T2 = TMAN1, T2 * TMAN2, T1
   TMAN3, T3 = TMAN1, T3 * TMAN2, T1
   TMAN3, T4 = TMAN1, T4 * TMAN2, T1
$END TP FUNCTION
$MATRIX UPDATE
$FILES
   INPUT FILE = UPDIN, USER ID = $LV90TRN.TMP$, UNLOAD
   OUTPUT FILE = UPDOUT, USER ID = $LV90TRN.TRP$
```

```
$HEADERS
   FACTOR TRANSIT TRIPS BY .0001
$OPTIONS
$DATA
   T1, 1-751, 1-751, * .0001
   T2, 1-751, 1-751, * .0001
   T3, 1-751, 1-751, * .0001
   T4, 1-751, 1-751, * .0001
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $NELV90OD.VOL$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $LV90TRN.TRP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $LV90PAV.TRP$
$HEADERS
  SUBTRACT TRANSIT TRIPS FROM PERSON TRIPS TO DERIVE PERSON
  AUTO VEHICLE TRIPS
$DATA
  TMAN3, T1 = TMAN1, T1 - TMAN2, T1
  TMAN3, T2 = TMAN1, T2 - TMAN2, T2
  TMAN3, T3 = TMAN1, T3 - TMAN2, T3
  TMAN3, T4 = TMAN1, T4 - TMAN2, T4
  TMAN3, T5 = TMAN1, T5
$END TP FUNCTION
$MATRIX UPDATE
$FILES
 INPUT FILE = UPDIN, USER ID = $LV90PAV.TRP$, UNLOAD
 OUTPUT FILE = UPDOUT, USER ID = $NEWLV90.VOL$
$HEADER
    LV90 NETWORK PERSON TRIPS TO VEHICLE TRIPS
      (AVG. 1.32 PERSONS PER VEHICLE)
$OPTION
$DATA
 P1, 1-751, 1-751, *0.8929
 P2, 1-751, 1-751, *0.6666
 P3, 1-751, 1-751, *0.7042
 P4, 1-751, 1-751, *0.6803
 P5, 1-751, 1-751, *0.7692
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $NEWLV90.VOL$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $LVSUM90.TRP$
  OUTPUT FILE = TMAN3, USER ID = $NEWLV90.DAT$
$HEADER
```

```
   LV90 NETWORK TOTAL VEHICLE TRIP TABLE
$DATA
 TMAN3,T1 = TMAN1,T1 + TMAN1,T2 + TMAN1,T3 + TMAN1,T4
 + TMAN1,T5 + TMAN2,T1
$END TP FUNCTION
$EQUILIBRIUM HIGHWAY LOAD
$FILES
  INPUT FILE = HWYNET, USER ID = $LV90N.NET$
  INPUT FILE = HWYTRIP, USER ID = $NEWLV90.DAT$
  OUTPUT FILE = LODHIST, USER ID = $NEWLV90G.LOD$
$HEADER
   LV90 "G" NETWORK 1990 PROD'S AND ATTR'S LOADED
$PARAMETERS
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
            (3-2,50) (4-3,50) (1-4,50) (2-1,50)
  EQUILIBRIUM ITERATIONS = 6
  EPS = 0.05
~  ASSIGNMENT GROUP = 5,6,7, XYDATA = (0,1) (0.6,0.95) (0.8,0.88) (0.9,0.8)
~                         (0.95,0.72) (1.0,0.5)
~  ASSIGNMENT GROUP = 2,3,8, XYDATA = (0,1) (0.5,0.96) (0.75,0.84) (0.88,0.68)
~                         (1,0.56)
$END TP FUNCTION
```

APPENDIX B

Section Three
Regional Transportation Commission Model Enhancement Study Peak-Hour Model

REGIONAL TRANSPORTATION COMMISSION
MODEL ENHANCEMENTS STUDY
PEAK-HOUR MODEL

FINAL REPORT

REGIONAL TRANSPORTATION COMMISSION

LAS VEGAS, NEVADA

LIMA & ASSOCIATES
PHOENIX, ARIZONA

MARCH 1995

The preparation of this document was financed, in part, by a grant from the United States Department of Transportation, Federal Transit Administration under Section 8 of the Urban Mass Transportation Act of 1964, as amended, and the Federal Highway Administration under Title 23, Section 134 of the United States Code.

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CHAPTER 1. INTRODUCTION

ORGANIZATION OF THIS REPORT

This report documents the research, analysis and development of Peak-Hour Regional Travel Demand Models for the Las Vegas Metropolitan Planning Area. Peak-Hour Models were created for 1995, 2000 and 2010 forecast years, and were based upon model calibrations performed against 1990 base line traffic count data. The organization of this report follows the sequence of the models' development. It begins with a description of research conducted into Las Vegas travel patterns and the nature of hotel/casino related travel. In the next section the characteristics of peak-period and peak-hour travel is discussed in detail. The 1990 Peak-Period Network section describes the road network and link attribute assumptions. The Trip Distribution & Assignment section discusses the distribution of trips to traffic analysis zone pairs and subsequent assignment of vehicle trips to the network. Finally, summary results of the trip assignments for Peak-Period and Peak-Hour Models are presented.

BACKGROUND

In 1991 the Regional Transportation Commission (RTC) of Clark County, Nevada completed an update of the Regional Transportation Plan (RTP). This study, which included a significant update of the Las Vegas Regional Transportation Model (LVRTM), also documented the need for a regional Peak-Hour Model. This study of model enhancements, which was initiated in 1992, undertook the evaluation of the LVRTM to improve the overall calibration of the regional model. The travel demand models employed in Las Vegas to date have produced only Average Daily Traffic (ADT) volumes which may be obscuring peak-hour deficiencies by averaging vehicular travel demand over a 24-hour period. Therefore, the goal of the current study is the development of a Peak-Hour Model which better simulates peak-hour travel patterns in the Las Vegas region.

PEAK-PERIOD AND PEAK-HOUR TRAVEL DEMAND

The consultant's approach to the Peak-Hour Model enhancements concentrated on preparation and validation of a 1990 Peak "Period" Model, which then allowed the establishment of the Peak "Hour" Models. The Peak-Period (between 3 p.m. and 6 p.m.) was chosen for initial analysis because it contains the three highest hours of trip-making in Las Vegas, based upon the Household Travel Survey described below. Therefore, using a three-hour Peak "Period" model permits capture of the maximum peak volumes of trip-making.

For more detailed analysis of hourly volumes, a Peak-Hour Model ensures that the maximum highest peak-hour would also be captured. Although the overall highest hour of trip-making in the Valley occurs between 3 p.m. and 4 p.m., the hour in which the greatest hourly volumes occur can vary substantially by location and direction.

SUMMARY OF FINDINGS

The complete results of the modeling effort are presented elsewhere in this document. Chapter 7, in particular, shows the analysis for the peak-hour model. A brief summary of key statistics is presented below, along with the travel demand characteristics which were developed from an analysis of the 1990 Household Travel Survey data. This approach makes the findings unique to the Las Vegas region, and therefore should be more related to the Valley's traffic conditions than would have otherwise been possible if typical average or national statistics had been applied.

- PEAK-PERIOD - (3 p.m. to 6 p.m.) receives 25 percent of total daily traffic.

- PEAK-HOUR - (nominally 3 p.m. to 4 p.m.) is 43 percent of peak-period traffic, or 10.65 percent of the daily total.

- PEAK-HOUR MODE SPLIT - shows 95.12 percent by personal vehicles, 0.7 percent by public mass transit, and 4.18 percent by all other modes (walk, bike, carpool, taxi, etc.).

- PEAK-HOUR DIRECTIONAL SPLIT - means that 40 percent of all home-based trips occurring in the peak-period and the peak-hour are driving toward home.

- VEHICLE OCCUPANCY - averages 1.32 persons per vehicle across all trip purposes.

- VEHICLE MILES OF TRAVEL (VMT) - reveals approximately 13 million daily miles in 1990, while 3,080,620 VMT were assigned in the 1990 Peak-Period Model.

- PERCENT VARIANCE - statistics on model accuracy showed only a 2.9 percent variance over the entire network (assigned trips versus actual counts) during the peak-period.

- ROOT MEAN SQUARE - similar statistics showed a percent root mean square error term of 50.5 percent over the entire network. This percent deviation of the assigned traffic volumes from the actual traffic counts is acceptable for an urban, regional model.

- SPEED - Growing congestion resulting from increased development will reduce peak-hour traveling speeds from 39.3 miles per hour in 1990 to 33.3 miles per hour in 2010.

CHAPTER 2. PREVIOUS STUDIES

Two previous studies researched in the development of the RTC Peak-Hour Models contain primary data or information which was used directly in the development of the computer models. Other studies provided supplementary peak travel information which supported or aided the development of the models. The discussion below distinguishes between these two kinds of studies.

PRIMARY STUDIES

The 1990 Las Vegas Regional Household Travel Survey, prepared as part of the Regional Transportation Plan Update for the Las Vegas Metropolitan Area, 1991, was the primary research document for this current study. The survey documented the patterns of travel demand exhibited in the Las Vegas Metropolitan Area. It provided the methodology used to collect the data, and an extensive summary of findings. The actual survey data is stored in a separate electronic database, and it was analyzed at length for use in the development of the peak-period models as described in the next section.

The report Las Vegas Regional Transportation Model (LVRTM) Documentation Report, 1991, was also used in the current study. This previous study lists the parameters of the traffic zones, the regional street and highway network, and the gravity model trip distribution curves developed in 1991 for use in the traffic model which assigns trips to the regional network. Note that in automating data, trip length frequency curves by trip purpose were reviewed and revised by others leading to adoption of new gravity model friction factors. Some of the original network attributes were modified during ongoing travel demand model enhancement activities. The peak-hour networks include the most recent regional network attributes.

SUPPLEMENTARY STUDIES

Several other documents were used to research planning issues or questions which arose during the development of the RTC Peak-Hour Models. These documents included National Cooperative Highway Research Program (NCHRP) Report No. 255, Highway Traffic Data for Urbanized Area Project Planning and Design, an Arizona Department of Transportation (ADOT) report entitled Analysis of Temporal Demand Shifts to Improve Highway Speed Modeling, the 1993 Las Vegas Visitor Profile Study, 1993, Las Vegas Convention and Visitors Authority, and the Trip Generation Analysis Report - Hotels & Casinos within the Las Vegas Urbanized Area, 1991, Transportation Research Center, University of Nevada, Las Vegas.

NCHRP Report No. 255 was reviewed to ensure that reasonable and correct approaches to the computer modeling processes were used for the creation of the base year (1990) peak-hour model, as well as for the creation of the forecast year models of 1995, 2000, and 2010.

Research of two of the supplementary studies led to the following additional considerations for the Peak-Hour Model.

The Trip Generation Analysis Report - Hotels & Casinos within the Las Vegas Urbanized Area provided a detailed look at the makeup of trip generation related to hotels and casinos, including trip-making by mode, time of day and effects of proximity on nearby casinos. It also examined the number of employees, parking spaces and other indicators offering the best predictors of trip-making rates. The observations made by this study helped to refine the approach to the Peak-Hour Model by adjusting employment factors in the vicinities of the hotels and casinos.

Based on the findings of this report, the number of hotel/casino employees appears to be the best single predictor of trip generation, although this measure is weaker for the afternoon period than the morning period. The original daily trip generation model for the Valley contained only trip attractions for the number of hotel/casino employees by TAZ in the trip generation database. Therefore, an additional employee based trip production factor was added to those TAZs to better estimate overall hotel trips and trip distribution. With these additions to the original model, traffic generated at hotels and casinos was deemed to be more adequately accounted for and to not require further factoring or adjustment for the Peak-Hour Model.

The 1993 Visitor Profile Study was a general reference on the nature of the tourist and entertainment industry. It supported the findings of the Trip Generation Analysis Report.

Because increases in traffic over time normally lead to increases in congestion as roadway development lags behind, the technical issue of freeway speeds in peak-hours was examined in the study Analysis of Temporal Demand Shifts to Improve Highway Speed Modeling. This study found a basis for the 'spreading' of demand across a peak-period as traffic levels grow, reducing the sharpness of the peak during the period, along with a companion reduction in average speeds. The study postulated potential peak-hour speed reductions of as much as 10 percent in the Las Vegas Region through 2010. However, the study did not provide any rational basis on which to make such adjustments in the RTC peak-hour models. Since the level of development of the freeway network, future population and population density will all have an effect on peak-hour speeds, the study was unable to determine a consistent factor or method with which to adjust peak-hour speeds. Although these generalized adjustments could be readily introduced into future year models, the degree of adjustment is highly dependent on many factors, and it is unclear, at this time, how effectively such adjustments could model the phenomena of future year congestion spreading. For these reasons, speeds were not adjusted in future years to account for particular levels of congestion in the peak-hour models.

In retrospect this appears to have been the correct assumption, as the future year models produced traffic flow at ever decreasing speeds, attributed to reductions in capacity resulting from increased congestion. Chapter 7 documents the statistics for the future model runs.

CHAPTER 3. PEAK TRAVEL PATTERNS IN LAS VEGAS, NEVADA

A database containing the 1990 travel survey for the Las Vegas Metropolitan Area of Clark County, Nevada was analyzed as part of this study. The analysis also served to cross-check the validity of the database when compared to the survey results contained in a previous report, entitled 1990 Las Vegas Regional Household Travel Survey. The analysis of the data was a key step in the model enhancement study, helped determine contemporary travel patterns within the county, and more specifically helped determine parameters for use in the development of a Peak-Hour Travel Model for the metropolitan area.

RECOMMENDATIONS

For the Peak-Hour Model Enhancements Study, travel patterns of interest include behavior by various trip purposes, such as trips from home to work or home to shop, or trips made between locations unrelated to the home end (called Non-Home-Based Trips). The analysis also covered the time periods during the day in which the highest proportion of these trips are made. As a result of this analysis, draft recommendations on travel pattern assumptions to be used in the Peak-Hour Model have been developed. The recommended parameters are:

1. A Peak-Period of three hours, approximating trip generation made between 3 p.m. and 6 p.m., accounts for 25 percent of total daily travel.
2. A related Peak-Hour Factor for the highest hour is 10.65 percent of the daily total, or 43 percent of the peak-period. In terms of trip generation, this occurs between 3 p.m. and 4 p.m., but because the duration of trips varies widely, the impacts on the Valley's streets will occur throughout the peak-period, depending on location and direction.
3. The following mode split percentages:

Peak-Hour Model Mode Split:	
Personal Vehicles	95.12%
Public Transit	0.7%
Other Modes (walk, school bus, taxi etc.)	4.18%

The recommendations shown above are discussed in more detail in the following paragraphs. Data supporting these conclusions are included in Appendices A through F.

CHARACTERISTICS OF TRIP MAKING

As shown in the tables of Appendix A, the household travel survey database contains 11,862 good records with identifiable trip purposes. Five trip purpose categories have been utilized and include the following Home-Based trips: Work, School, Shop, and Other. The fifth category is Non-Home-Based Trips.

Work trips make up 29.9 percent of all trips. School trips are 12.3 percent of trips. Shopping trips make up 12.7 percent of all trips, and Home-Based Other trips are 21.4 percent of all trips. The Non-Home-Based trips are 22.7 percent of all trips. This distribution compares very favorably with the distribution reported in the 1990 Household Travel Survey, where Work trips made up 30.1 percent of all trips. School trips were 11.8 percent of trips, shopping trips were 13.4 percent of all trips, and Home-Based Other trips were 21.6 percent of all trips. The Non-Home-Based trips were 23.1 percent of all trips.

PEAK-HOUR TRIP MAKING

Since both the database records and the Household Survey report revealed that Valley traffic volumes reach their peak flows in the afternoon, the analysis looked at four afternoon peak-hours: 3-4 p.m., 4-5 p.m., 5-6 p.m. and 6-7 p.m. The analysis also considered combinations of peak-hours which might form reasonable peak-periods. Based upon the analysis of the data, the absolute peak-hour of travel is the hour between 3 p.m. and 4 p.m. During this hour, 10.65 percent of all daily trips are undertaken. This peak is one hour earlier than reported in the Household Survey, and is about two percentage points higher in volume. The peak percentage of 10.65 percent is reasonable for an urban area, and the 3-4 p.m. hour is adjacent in time to the previously reported peak of 4-5 p.m. Therefore, the use of the peak determined by the data is recommended, but is also recommended to be part of a larger peak-period sample as described below. Detailed analyses of all four peak-hours are included in Appendix B.

Because the peak-hour of travel on the region's streets may vary from location to location across the Valley, and because it also may vary by direction of travel, an analysis was made of the peaking characteristics of selected arterials. This research showed that eastbound travel, for example, tended to peak earlier in the day, usually by 4 p.m. Westbound travel, on the other hand, tended to peak by 5 p.m. or 6 p.m. Furthermore, southbound travel also tended to peak by 4 p.m., with the particular exception of Eastern Avenue, which peaked by 6 p.m. Finally, northbound travel peaked during all three intervals for the arterials studied, during either 4 p.m., 5 p.m., and 6 p.m., depending on the location of the section. These characteristics are shown in the table in Appendix C.

As mentioned above, the analysis also showed that more trips are made in the 3-4 p.m. hour (1263) than in any other. Among the kinds of trips, however, there exist different peaking characteristics. More work trips are made in the 5-6 p.m. hour (428 trips), but more school trips (211) and more non-home-based trips (181) are made in the 3-4 p.m. hour. The most home-based trips are made in the 3-4 p.m. hour (10.83 percent of all trips), followed by the 4-5 p.m. hour (9.34 percent). These different peaking factors may become important if directional distributions are highly skewed.

To capture as much of this varying travel behavior as possible, a long peak-period was recommended as a basis for a peak-hour model. The absolute peak-period of travel is the three-hour period between 3 p.m. and 6 p.m. in the afternoon, when 25.009 percent of all trips are made (this analysis is contained in Chapter 5).

Appendix D contains the analysis material on the combined peak-periods. The absolute peak-hour of travel within this period accounts for 10.65 percent of daily trips, as mentioned above, which therefore represents the maximum impact or "worst case" scenario of peak-hour impacts.

MODE SPLIT

As shown in the tables in Appendix E, some variation exists among the daily average mode split, the peak-period mode split, and the peak-hour mode split. On a daily basis, 95.6 percent of all trips are made in personal vehicles, 0 .54 percent are made by city bus, and 3.87 percent are made by other modes of travel, including walking, bicycling and taxis. The following table shows daily mode split.

Daily Mode Split:

Personal Vehicles	95.6%
Public Transit	0.54%
Other Modes	3.87%

Note from the discussion below how closely daily mode split compares with the peak-period mode split. The following table shows peak-period mode split.

Peak-Period Model Mode Split:

Personal Vehicles	95.12%
Public Transit	0.65%
Other Modes	4.23%

During the peak three hour period between 3 p.m. and 6 p.m., this distribution shifts only slightly. Then, 95.12 percent of all trips are made in personal vehicles, 0.65 percent are made by city bus and 4.23 percent are made by the other modes. In a shorter period, between 3 p.m. and 5 p.m., the mode split for transit rises to be as high as 1 percent of trips.

For the peak-hour which occurs between 3 p.m. and 4 p.m., the distribution pattern changes between the daily and the peak-period. Then, in the peak-hour, 91.6 percent of all trips are made in personal vehicles, 0.85 percent are made by city bus and 7.56 percent are made by the other modes. This probably reflects school-related traffic and workers who travel by foot or by bicycle. Notice that the proportion of travelers using the city bus services did not rise significantly. It must also be remembered that this data is based upon the trip generation shown in the 1990 household survey, and is a generalized characteristic of trip making in the Valley. The following table shows the maximum peak-hour mode split.

Peak-Hour Mode Split:

Personal Vehicles	91.6%
City Bus	0.85%
Other Modes	7.6%

The peak-hour factor described above (10.65 percent of daily trips) is a rate or factor which characterizes the peak-hour of trip-making across the Valley, regardless of location or localized circumstances. The mode split, on the other hand, shows a declining rate of usage of motor vehicles in the 3-4 p.m. hours. Using this particular hourly factor runs contrary to the concept of determining the maximum impacts or worst case scenario for the network as a whole, however, because it means that fewer vehicles would be assigned in this hour than in the hour before or after it. Furthermore, the locations where this factor would tend to occur in practice would tend to be concentrated around schools or groups of casinos where walking might be more prevalent during winter months than summer months. Again, this does not represent a worst case for the network.

It was further assumed that the use of the private transit fleet would continue to carry a very small percentage (0.65 - 0.85 percent) of Valley traffic. This assumption also allows the position of the bus fleet to worsen in terms of the percent mode split during the next decade, in the scenario where use of transit continues to decline.

Therefore, in order that a worst case or maximum impact be represented by the peak-hour model, neither peak-period nor peak-hour mode split factors were used in the model. This effectively puts more cars on the streets during the peak-hour, and therefore indicates the maximum impact on the system.

VEHICLE OCCUPANCY

Results from the Household Survey did not contain reliable data on vehicle occupancy during the peak-period or peak-hour. Lacking good peak-hour/peak-period data, the vehicle occupancy rate was determined by trip purpose based upon the daily Survey data. A table showing this data is located in Chapter 5, under the heading Vehicle Trips. Vehicle occupancy for carpools was assumed to be greater than but in the same order of magnitude as the overall rates, but was not assumed to be significant enough to be accounted for separately in the model.

CHAPTER 4. PEAK-PERIOD NETWORKS

Computer-based regional freeway and highway networks were provided to the study by RTC staff. These networks have been continuously updated so that the latest available system would be available for the Peak-Hour study.

PEAK-PERIOD NETWORKS

The Peak-Period Model was calibrated based on the 1990 regional network. The model was also calibrated against actual ground counts of traffic volumes. After the calibration was completed, the Peak-Period Model was applied to the future networks for the years 1995, 2000 and 2010. These future networks include the expected improvements to the regional network over the twenty-year time span of the study. Arterials have been added to accommodate new housing growth and freeways were added to complete the regional network. All of these additions are consistent with the adopted regional transportation plan.

The traffic assignment process produces statistics on the size and components of the network, as well as on the model assignments. These are described in subsequent sections. For the RTC Peak-Period Model, the following network statistics were produced (Table 4-1):

TABLE 4-1. 1990 PEAK-PERIOD MODEL NETWORK STATISTICS

Network Features	Statistic
Number of Zones	751
Maximum Node No.	4934
Number of Links	8813

NETWORK WINDOWS FOR FACTORING DIRECTIONAL GROUND COUNTS

The Peak-Hour Model is calibrated by comparing the traffic assigned by the model against actual counts taken on the streets. The observed volume data available to the study team included 24-hour ADT counts, and hourly intersection and mid-block counts at numerous locations around the region. To facilitate the comparison of model assignments to actual counts it was necessary to factor down the ADTs to peak-period and peak-hour levels.

As described in the previous chapter, the peak-period of the day normally occurs between 3 p.m. and 6 p.m. Depending upon the location of the street within the region, however, the direction of this flow can vary substantially. Using plots of the existing counts, patterns of these flows were developed for four large quadrants covering the entire region. Within these quadrants, traffic flow factors were developed for northbound, southbound, eastbound or westbound traffic; these factors are shown below in Table 4-2. Using the quadrants, these factors were applied appropriately throughout the region to factor the ADTs into a directional peak-period or peak-hour count as required.

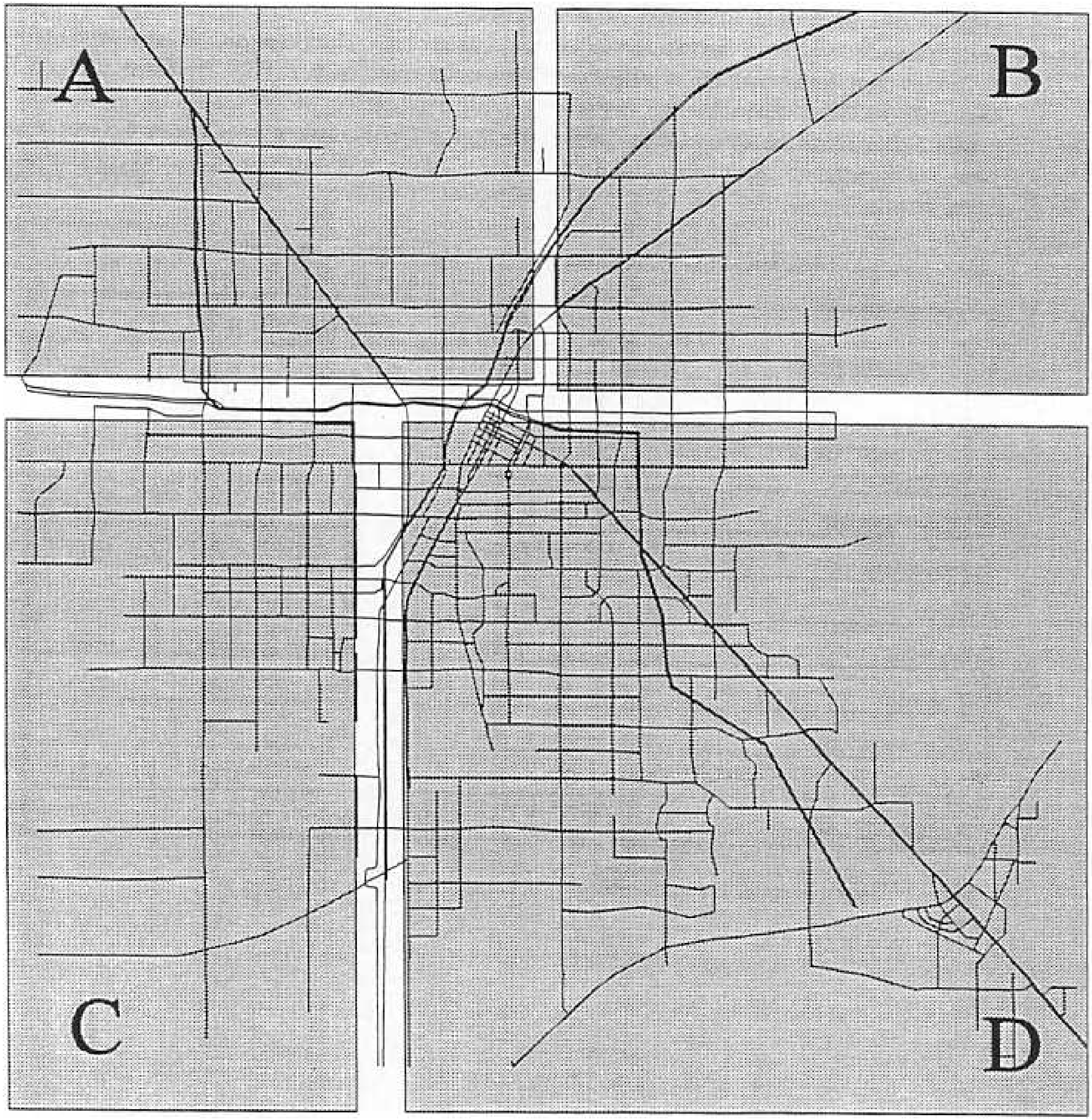
TABLE 4-2. PEAK-PERIOD DIRECTIONAL ADJUSTMENT FACTORS FOR 2-WAY DAILY TRAFFIC

Place		Directional Split %		Directional Split %	
Quadrant	**Location**	**North Bound**	**South Bound**	**East Bound**	**West Bound**
A	NW	59	41	43	57
B	NE	45	55	56	44
C	SW	49	51	40	60
D	SE	43	57	58	42

Note: Directional split percentages add to 100 percent, since they are used to factor two-way average daily traffic on any given street. Additional factors are required to adjust daily traffic to peak-period traffic.

The four quadrants include the northwest and northeast portions of the region, bounded by Craig Road on the south and separated approximately at Commerce Street. The northwest quadrant is as shown as area A in Figure 4-1, while area B is the northeast quadrant. There are also a southwest and southeast quadrant, bounded on the north by Charleston. The southwest quadrant, shown as area C on Figure 4-1, is bounded on the east by Valley View. The southeast quadrant (area D on Figure 4-1) is bounded on the west by Las Vegas Boulevard. The windows are not connected, creating subareas or corridors along the freeways. For these subareas outside the windows, actual intersection count data was entered manually to document the peak-period ground counts.

FIGURE 4-1
DIRECTIONAL FLOW AREAS
BY QUADRANT



REGIONAL TRANSPORTATION COMMISSION
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PEAK-PERIOD CAPACITIES

The traffic assignment module loads traffic onto the network by constraining trips as congestion builds, requiring three iterations of the model ran to fully load all trips. Therefore, to accurately reflect real conditions, it was necessary to factor network capacities down from daily capacities to peak-period and peak-hour capacities. The peak-period and peak-hour capacities used in the Peak-Hour Model were developed based on the 1985 "Highway Capacity Manual" (HCM), local planning experience, and engineering judgement. The peak-hour capabilities derived are approximately 8.5 percent of the daily capacities. Tables 4-3 and 4-4 show the directional capacity in direction of flow only for both hourly and period capacities, respectively.

TABLE 4-3. PEAK-HOUR CAPACITIES AND SPEEDS

Facility Type	Assignment Group	Free-Flow Speed	Directional Peak-Hour Capacity		
			Per Lane	2 Lane	3 Lane
External	0	65	99999	–	–
System Ramps	1	50	660	1250	–
Minor Arterial	2	45	900	1700	2475
Major Arterial	3	45	1100	2100	3000
Ramp	4	30	800	1525	–
Interstate	5	55	2000	4000	6000
Freeway	6	55	2000	4000	6000
Expressway	7	50	1950	3900	5600
Collector	8	35	660	1250	1825
Centroid Connector	9	15	99999	–	–

Note: Hourly capacity is approximately 8.5 percent of daily capacity.

TABLE 4-4. PEAK-PERIOD CAPACITIES AND SPEEDS

Facility Type	Assignment Group	Free-Flow Speed	Directional Peak-Period Capacity		
			Per Lane	2 Lane	3 Lane
External	0	65	99999	–	–
System Ramps	1	50	1980	3700	–
Minor Arterial	2	45	2700	5100	7425
Major Arterial	3	45	3300	6300	9000
Ramp	4	30	2400	4575	–
Interstate	5	55	6000	12000	18000
Freeway	6	55	6000	12000	18000
Expressway	7	50	5850	11700	16800
Collector	8	35	1980	3750	5475
Centroid Connector	9	15	99999	–	–

Note: Peak-period capacity is three times hourly capacity.

CHAPTER 5. PEAK-PERIOD DISTRIBUTION AND ASSIGNMENT

The Peak-Period assignment module operates within a larger computer program known as TRANPLAN. This program requires batched computer control operations through several steps in the process. The control files for the Peak-Period Model are contained in the Appendix.

TRIP GENERATION

In the regional transportation model, daily trips are generated by purpose, and by the origin of the trip (trip origins are classified as either Home-Based or Non-Home-Based). The five trip purposes used in this model include four Home-Based purposes: Work Trips, School Trips, Shopping Trips, Other Trips; this model also includes one other purpose called Non-Home-Based Trips.

These trips are the result of the 1990 Household Travel Survey and are made up of household trips by income class and household size, which strongly influence the levels of trip-making. Daily trips in the region are provided to the Gravity Model as both productions in a zone and attractions in a zone. Through a factoring process, regional attractions by purpose are equalized or balanced to regional attractions.

TRIP DISTRIBUTION

The process for producing a peak-period vehicle trip table is shown in Figure 5-1. Daily trip distribution for the Peak-Hour Model is performed using the Gravity Model. Inputs to this daily trip distribution model consist of a single data file containing zonal person-trip productions and attractions and friction factors by time increment. Trips for all of the five purposes described above are distributed among TAZs by the model using trip length frequency distribution curves. These trips, for all five purposes, are then merged into a single production-attraction person trip table.

The model then inverts the production-attraction matrix. This 'mirror image' creates the attraction production trip table. The daily production-attraction and attraction-prodution trip tables are factored by appropriate directional factors and peak-period factors to produce the total peak-period person trip table. The person trip table is subsequently factored by the appropriate vehicle occupancy factors (by purpose) to produce the peak-period vehicle trip table.

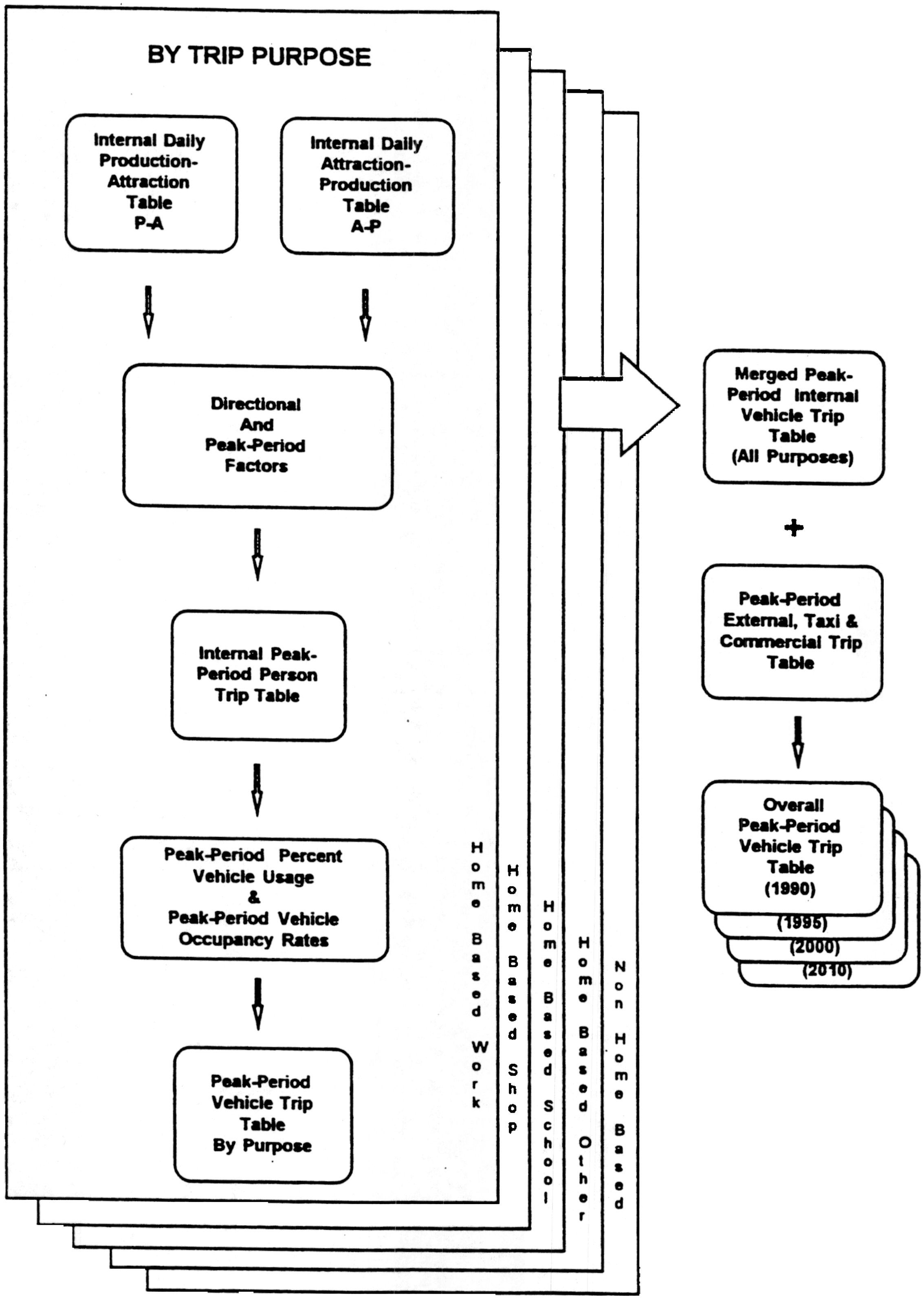

FIGURE 5-1. PEAK-PERIOD TRIP TABLE FLOW CHART

Table 5-1 below shows the distribution of productions and attractions by trip purpose.

TABLE 5-1. DISTRIBUTION OF PRODUCTIONS AND ATTRACTIONS (DIRECTIONALITY SPLIT)

Trip Purposes	Production to Attraction Factor	Attraction to Production Factor
HB Work	0.204	0.796
HB School	0.193	0.807
HB Shop	0.451	0.549
HB Other	0.343	0.657
NHB Trips	0.895	0.105

PEAK-PERIOD FACTORS

The resulting daily trips are factored by purpose to the peak-period or peak-hour for assignment. The factors are based on an analysis of the 1990 Household Survey, and its composition of trips by purpose. Table 5-2 gives the peak-period proportion of trips by purpose.

TABLE 5-2. PEAK-PERIOD TRIPS AS A PERCENTAGE OF DAILY TRIPS (PEAK-PERIOD FACTOR)

Trip Purpose	Percentage of Daily Trips
HB Work	28.00%
HB School	22.39%
HB Shop	25.55%
HB Other	23.76%
NHB Trips	22.39%

Each of the factors reflects the percentage of trips which occur during the peak-period, by trip purpose. Since, trip productions and attractions are available to the model by purpose, the factors shown above are used to factor daily trips in each of the categories. For example, the factor for the non-home-based trips of 22.39 percent simply states that 22.39 percent of all daily non-home-based trips occur during the peak-period.

By calculating the weighted average of all trips made in the peak-period as a percentage of all trips made daily, an overall factor for the peak period trip making can be determined. As shown in Table 5-3, this overall peak-period factor was 25.009 percent. For the purpose of this study, this figure was rounded to 25 percent when used as a factor for analysis purposes.

TABLE 5-3. PEAK-PERIOD TRIPS AS A RATIO OF DAILY TRIPS

Trip Purpose	Trips by Purpose	Trips as a % of Period	Trips as a % of Daily	Weighted Average of Period Trips
HB Work	990	33.719	28.00	0.09441
HB School	326	11.104	22.39	0.02486
HB Shop	415	14.135	25.55	0.03611
HB Other	603	20.538	23.76	0.04880
NHB Trips	602	20.504	22.39	0.04591
TOTALS:	2936	100.00	N/A	0.25009

PERSON TRIPS MADE IN VEHICLES

As described above in the section on Mode Split, the transit share of traffic is so small (0.65 percent) that it has not been factored into the model. This means, effectively, that all person trips are made in vehicles. Vehicle trips are discussed below.

OTHER TRIPS

Miscellaneous trips include several types of trip making: commercial truck trips which occur within the boundaries of the metropolitan area, taxi trips in that same area, and 'internal-external' and 'external-external' trips made by all types of vehicles which have at least one end of their trip located somewhere outside of the Valley.

External-to-external trips begin somewhere outside the Valley and end somewhere outside the Valley, passing through nonstop on the Valley's street and freeway systems in the process. Internal-to-external trips are trips made to or from a destination somewhere outside the region but which have an origin or destination in one of the model's traffic analysis zones.

All of this information on miscellaneous vehicles was provided to the study as a daily trip table file of all the external trips described above. Since no reliable count data was available which documented the composition, percentage, or duration of peak-period commercial vehicle and taxi travel, this travel was assumed to be similar in proportion to the overall peak-period factors discussed above. The peak-period distribution of external trips was checked using data from the Nevada Department of Transportation's (NDOT) automatic traffic recorders on facilities at the external stations. The traffic count data at these stations indicated that the peak-period traffic was approximately 20 to 25 percent of the daily traffic.

VEHICLE TRIPS

The final step in the model process prior to the assignment of traffic to the network is the conversion of person trips into vehicle trips.

At this stage, a trip table of peak-period person trips by trip purpose can be divided by the regional vehicle occupancy rate for each trip purpose (averaging 1.32 persons per vehicle as shown below), or multiplied by the appropriate vehicle occupancy factors. These factors were taken from the 1991 Las Vegas Regional Transportation Plan Update. Vehicle occupancy factors for the 1990 Peak-Period Model are shown in Table 5-4.

The cumulative result of these factoring operations is a trip table which includes peak-period vehicle trips for each of the five trip purposes. These trips are assigned to the peak-period network (which also has appropriately reduced peak-hour capacities) in the final operation of the model.

TABLE 5-4. VEHICLE OCCUPANCY RATES - 1990

Trip Purpose	Occupancy Rate	Occupancy Factor
HB Work	1.12	.8929
HB School	1.50	.6666
HB Shopping	1.42	.7042
HB Other	1.47	.6803
Non-Home-Based	1.30	.7692
Average	1.32	N/A

Note: occupancy factor = 1/occupancy rate

CHAPTER 6. RESULTS OF THE PEAK-PERIOD MODEL

This chapter presents the results of the calibration of the peak-period model. A summary is given for the performance statistics of vehicle miles traveled, vehicle hours and average speed. The percent error is also presented by functional classification for the assigned traffic volumes as compared to actual traffic volume counts.

CALIBRATION FOR 1990

A common test of accuracy for the modeling process is the comparison of assigned volumes on the network to actual ground count volumes taken in approximately the same time frame as the assignment year. Using the assignment file as a database, a statistical summation program searches the database and retrieves and summarizes data for the network. It also summarizes data and statistics for each of the assignment groups which also have had ground counts assigned to their links on the network.

The calibration, or expected validity of the model, increases as the percent error term approaches zero. In practice a model with zero errors is unachievable, but very low percent error terms usually indicate very close approximations of existing conditions. If the differences are scattered among the facility types (freeways, arterials, collectors, etc.) and not concentrated in one particular facility then the approximations are further improved. In guidelines published by the National Cooperative Highway Research Program, acceptable screenline error terms range from 29 percent down to about 20 percent depending on the magnitude of the screenline volumes involved. Screeline error terms were checked at almost twenty locations around the Valley. Almost all of these had error terms less than 10 percent. None exceeded 20 percent.

SUMMARY OF MODEL RESULTS

Each assignment produces statistics covering the travel characteristics of the assignment. These statistics include vehicle-miles-of-travel, vehicle hours of travel, (volume/capacity) ratio and average speed. The 1990 Peak-Period Model produced the travel statistics shown in Table 6-1.

As shown in Table 6-1, the 1990 peak-period assignment produced 2,784,162 vehicle miles of travel by personal and commercial vehicles. The vehicles required 66,631 hours to travel this distance, yielding an average 1990 peak-period network speed of approximately 42 miles per hour. The percent error (difference between observed and assigned link volumes) was very low at approximately 2.3 percent for the overall network (see Table 6-2.), while the percent root mean square was 50.5 percent.

TABLE 6-1. PEAK-PERIOD MODEL CALIBRATION STATISTICS

Facility Type:	Assignment Group:	Vehicle Miles	Vehicle Hours	Average Speed
Externals	0	103,225.5	1,588.1	65.0
System Ramps	1	4,936.2	101.8	48.5
Minor Art	2	659,318.2	17,135.8	38.5
Major Art	3	998,235.1	25,602.8	39.0
Ramp	4	34,234.4	1,646.9	20.8
Interstate	5	307,363.7	5,453.0	56.4
Freeway	6	336,506.0	5,830.5	57.7
Expressway	7	52,744.8	1,054.7	50.0
Collector	8	287,598.1	8,217.1	41.0
Network	all	2,784,162.0	66,630.7	41.8

TABLE 6-2. PEAK-PERIOD MODEL CALIBRATION PERCENT ERROR

Facility Type:	Assignment Group:*	Actual Volume Count	Assigned Volume Count	Percent Error
Minor Art	2	556,260.0	495,726.0	12.2
Major Art	3	1,217,561.0	1,241,210.0	-1.9
Interstate	5	146,950.0	140,969.0	4.2
Freeway	6	198,425.0	198,321.0	0.1
Expressway	7	45,653.0	52,504.0	-13.1
Collector	8	123,232.0	108,061.0	14.0
Network	all	2,288,081.0	2,236,791.0	2.3

*Note: Actual volume counts not available for assignment groups 0, 1, 4, or 9.

CHAPTER 7. PEAK-HOUR MODELING

Model control batch files for peak-hour traffic assignment were developed and traffic was assigned to appropriate networks for the years 1990, 1995, 2000 and 2010. For each of the four scenario years, trip productions by traffic analysis zone (TAZ) and a road network containing road improvements and projects which correspond with adopted regional transportation plans were provided to the study team by RTC staff. With these control files available, computer model runs were made for each of the four years, producing network plots, traffic volume plots, and travel statistics.

Following a description of the assumptions made during the evolution of the models, brief summaries of the results for each year are presented below. These sections are followed by a comparison of future years to the 1990 model. The chapter is completed by a section containing general conclusions on the peak-hour model.

ASSUMPTIONS

Several assumptions were necessary for the creation of the peak-hour models. Prominent among these was the assumption that the proportion of peak-hour travel as a percent of daily travel will remain relatively constant over the next 15 years. Given past trends, this is not an unreasonable assumption. Peak-hour characteristics tend to be peculiar to an area and to remain constant. On the other hand, there are also many future lifestyle trends which could lead to both more and less travel in the peak-hour. These trends are related to the work environment, and include home offices, telecommuting, family travel (affecting the number and kind of tourists), HOV usage, electric or other similar vehicles, etc. It is impossible to predict whether the combined impact of these trends in Las Vegas will lead to more or less peak-hour travel.

Another similar assumption is that the proportion of peak trips made, by purpose, will remain relatively constant over the next 15 years. This assumption too is subject to several of the same considerations listed above.

Rather than adjust future speeds downward to account for congestion (as was suggested by the literature researched), the study approach allowed the model to account for the increasing impacts of congestion. As shown by Table 7-6 this phenomena occurred, and did so in about the expected order of magnitude as had been suggested by the literature. Speeds dropped from 39.3 miles per hour in 1990 to 33.7 miles per hour by 2010, approximately a 15 percent decrease. This also means that VMT has 'spread' into the adjacent two hourly periods which occur just before or after the 'peak' hour. This spreading is caused by the slower speeds on congested facilities, which cause traffic to both take longer trips and to take trips in the adjacent hourly periods. This means that the peak congestion starts occurring earlier in the day and lasts longer during the day.

1990 PEAK-HOUR MODEL

The 1990 Peak-Hour assignment data is tabulated below by the functional classifications of the RTC regional highway network. Not included in the table are mileages or trips made on the 'centroid connectors'. The centroid connectors are mathematical links in the database which represent the connection between the center of population of a traffic analysis zone and the street network.

TABLE 7-1. RTC PEAK-HOUR MODEL - 1990

Facility Type:	Assignment Group:	Vehicle Miles of Travel:	Vehicle Hours of Travel:	Average Travel Speed:
External Trips	0	43,704.8	672.4	65.0
System Ramps	1	1,778.0	98.6	18.0
Minor Art.	2	290,278.9	7,837.0	37.0
Major Art.	3	455,005.6	12,599.7	36.1
Ramp	4	14,182.4	902.8	15.7
Interstate	5	129,811.7	2,397.3	54.1
Freeways	6	144,094.7	2,540.2	56.7
Expressway	7	22,329.1	450.3	49.6
Collector	8	134,480.8	3,955.3	34.0
Network	all	1,235,716.0	31,453.6	39.3

The 1990 Peak-Hour Model run produced 1,235,716 vehicle miles of travel (VMT) for the Valley's peak-hour. With estimates of total daily VMT in 1990 at about 12,000,000, the peak-hour figure from the model represents about 11 percent of daily VMT in 1990. This compares favorably with the study parameter that the peak-hour represents 10.65 percent of daily trip making. The model required 31,453.6 hours of driving to produce the network VMT shown in the table above, yielding an average peak-hour speed of 39.3 miles per hour.

1995 PEAK-HOUR MODEL

The 1995 Peak-Hour assignment data is shown below for the same array of functionally classified streets and highways. The 1995 Peak-Hour Model run forecast 1,740,403.4 VMT for the 1995 peak-hour. A daily model (covering 24 hours) for the same year produced

16,431,179 VMT on a daily basis. Thus, the 1995 peak-hour represents 10.6 percent of daily VMT.

TABLE 7-2. RTC PEAK-HOUR MODEL - 1995

Facility Type:	Assignment Group:	Vehicle Miles of Travel:	Vehicle Hours of Travel:	Average Travel Speed:
External Trips	0	62,314.4	958.7	65.0
System Ramps	1	3,952.6	142.8	27.7
Minor Art.	2	492,280.3	14,036.7	35.1
Major Art.	3	525,462.8	14,562.9	36.1
Ramp	4	20,057.4	1,092.8	18.4
Interstate	5	172,821.2	3,233.6	53.4
Freeways	6	222,798.7	4,238.6	52.6
Expressway	7	40,973.2	830.1	49.4
Collector	8	199,742.8	5,909.6	33.8
Network	all	1,740,403.4	45,005.8	38.7

The 1995 daily VMT 16,431,179 is solidly in the range of what would be expected if the region continues to expand at the current level at a 5 to 6 percent annual growth rate, based on today's daily VMT of between 12,000,000 and 13,000,000. Such growth in VMT is experienced by many rapidly expanding western cities.

Again, the peak-hour represents about 10-11 percent of daily VMT. The model required 45,005.8 hours of driving to produce this VMT, yielding an average peak-hour speed of 38.7 miles per hour. This shows that improvements from 1990 to 1995 were adequate in meeting the demands of traffic congestion in peak-hours.

2000 PEAK-HOUR MODEL

The 2000 Peak-Hour assignment data is shown below for the same array of functionally classified streets and highways. The 2000 Peak-Hour Model run forecast 2,110,256.7 VMT for the 2000 peak-hour. A daily model for the same year produced 839,188 VMT daily. Thus, the 2000 peak-hour represents 10.6 percent of daily VMT.

TABLE 7-3. RTC PEAK-HOUR MODEL - 2000

Facility Type:	Assignment Group:	Vehicle Miles of Travel:	Vehicle Hours of Travel:	Average Travel Speed:
External Trips	0	79,719.1	1,226.5	65.0
System Ramps	1	8,096.4	285.7	28.3
Minor Art.	2	588,943.8	25,467.2	23.1
Major Art.	3	551,993.8	15,087.7	36.6
Ramp	4	24,301.3	1,342.7	18.1
Interstate	5	193,425.9	3,598.5	53.8
Freeways	6	337,338.4	6,594.1	51.2
Expressway	7	56,259.8	1,166.4	48.2
Collector	8	270,178.2	8,017.2	33.7
Network	all	2,110,256.7	62,786.0	33.6

The 2000 Peak-Hour Model run forecast 2,110,257 VMTs for the Valley's peak-hour under those future conditions.

The model required 62,786.0 hours of driving to produce this VMT, yielding an average peak-hour speed of 33.6 miles per hour. This model shows that Valley speeds are being significantly impacted by the friction of congestion, since they were reduced more than 13 percent from the average peak-period speed of 38.7 miles per hour in 1995. This also could indicate that street improvements are not being completed in time to counter the relatively increasing pressures of congestion during peak-hours.

2010 PEAK-HOUR MODEL

The 2010 Peak-Hour assignment data is shown below for the same array of functionally classified streets and highways. The 2010 Peak-Hour Model run forecast 3,024,796 VMT for the 2010 peak-hour. A daily model for the same year produced 28,271,934 VMT on a daily basis. Thus, the 2010 peak-hour represents 10.7 percent of daily VMT.

TABLE 7-4. RTC PEAK-HOUR MODEL - 2010

Facility Type:	Assignment Group:	Vehicle Miles of Travel:	Vehicle Hours of Travel:	Average Travel Speed:
External Trips	0	118,708.5	1,826.3	65.0
System Ramps	1	11,074.0	643.0	17.2
Minor Art.	2	804,614.8	32,277.9	24.9
Major Art.	3	688,036.4	20,868.3	33.0
Ramp	4	40,693.7	2,582.7	15.8
Interstate	5	256,278.3	5,187.0	49.4
Freeways	6	546,939.7	11,851.9	46.1
Expressway	7	100,287.5	2,161.2	46.4
Collector	8	458,162.7	12,396.8	37.0
Network	all	3,024,795.6	89,795.1	33.7

The 2010 Peak-Hour Model run produced 3,024,795 VMT for the Valley's peak-hour. This represents the build out of the current transportation plan, and the expectation that VMT will continue its strong increases into the future. The model required 90,734 hours of driving to produce this VMT, almost three times that spent by drivers in 1990. At an average peak-hour speed of 33.7 miles per hour, drivers will be spending increasing proportions of their time in their vehicles during peak-hours, as this represents a 14 percent decrease in speed compared to 1990 conditions.

COMPARISONS WITH EXISTING CONDITIONS

Vehicle Miles of Travel

Comparing the vehicle miles of travel made on each type of roadway from year to year provides some insight into the patterns of congestion in the peak-hour, as well as the impact of various roadway improvements. In Table 7-5 VMT is compared from year to year.

TABLE 7-5. RTC PEAK-HOUR MODEL COMPARISON OF VEHICLE MILES TRAVELED (VMT)

Facility Type:	1990 VMT	1995 VMT	2000 VMT	2010 VMT
External Trips	43,704.8	62,314.4	78,719.1	118,708.5
System Ramps	1,778.0	3,952.6	8,096.4	11,074.0
Minor Art	290,278.9	492,280.3	588,943.8	804,614.8
Major Art	455,005.6	525,462.8	551,993.8	688,036.4
Ramp	14,182.4	20,057.4	24,301.3	40,693.7
Interstate	129,811.7	172,821.2	193,425.9	256,278.3
Freeway	144,094.7	222,798.7	337,338.4	546,939.7
Expressway	22,329.1	40,973.2	56,259.8	100,287.5
Collector	134,480.8	199,742.8	270,178.2	458,162.7
Network	1,235,716.0	1,740,403.4	2,110,256.7	3,024,795.6

Note: **Figures are rounded from previous tables.**

In terms of travel demand, the largest increase in traffic volumes occurs on the minor arterials, freeways, and collector streets, in that order. In terms of proportional increases in traffic over the base (1990) condition, the greatest changes occur on the surface streets. Almost half of the peak-hour vehicle miles traveled are carried on the arterial systems (minor and major arterials together). About one-quarter of the miles are traveled on the interstate/freeway/expressway facilities, with the remainder taking place on the collectors, and external roads.

Vehicle Speed

Vehicle speeds by facility type are derived by dividing vehicle miles of travel by the corresponding vehicle hours of travel. Comparing vehicle speeds by each type of roadway from year to year is also useful, as it provides information on the performance of various roadway improvements across the study duration, and indicates how peak-hour congestion impacts the quality of traffic movements. In Table 7-6, vehicle speeds are compared from year to year.

TABLE 7-6. RTC PEAK-HOUR MODEL COMPARISON OF VEHICLE SPEED (MILES PER HOURS)

Facility Type:	1990 Speed	1995 Speed	2000 Speed	2010 Speed
External Trips	65.0	65.0	65.0	65.0
System Ramps	18.0	27.7	28.3	17.2
Minor Arterial	37.0	35.1	23.1	24.9
Major Arterial	36.1	36.1	36.6	33.0
Ramp	15.7	18.4	18.1	15.8
Interstate	54.1	53.4	53.8	49.4
Freeway	56.7	52.6	51.2	46.1
Expressway	49.6	49.4	48.2	46.4
Collector	34.0	33.8	33.7	37.0
Network	39.3	38.7	33.6	33.7

The network speeds shown in the table indicate that in general improvements would keep pace with increases in travel demand from 1990 through 1995, but that after that time overall network speed will decline more than 14 percent in the next 15 years. In hourly terms, this means that, on each work day, travelers in the valley could spend at least 10,000 more hours in their cars.

Among the nonfreeway type facilities, the speeds on the minor arterials were most impacted by the increasing peak-hour congestion, while the major arterials appeared to be fairly stable. This could be accounted for by increasing densities in outlying areas made possible by freeway extensions, or by similar extensions of major arterials without corresponding development of the minor arterials system.

The freeway type facilities (interstates, freeways, expressways, ramps) appear to be planned in pace with the area's development through the year 2000, but then would see their average peak-hour speeds slowed by as much as 19 percent by the year 2010.

CONCLUSIONS

The peak-hour models developed for the Las Vegas, Nevada region appear to produce future forecasts which are reasonable and explainable. They show that the development of the street and freeway system will not keep pace with increasing congestion. The models' statistical output points to facilities which may be the most impacted by development. Furthermore, when the future year networks are loaded with traffic and these volumes are plotted onto network maps, it will be possible to search out and follow the development of congestion on a link-by-link basis and target these facilities for improvement.

In the broadest terms, the population growth forecast for the area will cause a corresponding growth in travel demand, which will in turn spread congestion through many parts of the Valley and decrease peak-hour speeds on many facilities by as much as 19 percent by the year 2010.

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APPENDIX A. DISTRIBUTION OF DAILY TRIPS

The distribution of overall daily trips by purpose and by household size are included in this appendix for reference purposes.

APPENDIX: A

NUMBER OF TRIPS BY
HOUSEHOLD SIZE
AND TRIP PURPOSE:
DAILY

	TRIP PURPOSE:					
	1	2	3	4	5	
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	TOTALS
1	305	29	206	281	290	1111
2	1353	205	674	1067	1203	4502
	689	304	324	469	581	2367
4+	1205	918	420	723	616	3882
TOTALS:	3552	1456	1624	2540	2690	11862

APPENDIX B. ANALYSIS OF PEAK-PERIOD

This appendix contains tables for the analysis of each of the peak-hour periods, showing trips made in the peak-hour, the percentage of daily trips made during a particular peak-hour by purpose, and the overall peak-hour factor for that hour.

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips starting between 3 - 4 pm)

APPENDIX:

HOUSEHOLD SIZE	TRIP PURPOSE: 1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
1	14	1	15	19	22	
2	114	9	58	89	81	351
3	74	34	23	36	72	239
4	98	129	42	46	43	358
TOTALS:	300	173	138	190	218	1019

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips ending between 3 - 4 pm, and
starting before 3pm)

HOUSEHOLD SIZE	TRIP PURPOSE: 1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
	4	0	2	4	6	16
	17	5	22	21	25	90
3	25	12	5	7	10	59
		21	8	24	11	79
TOTALS:	61	38	37	56	52	244

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR:
(including trips starting between 3 - 4pm)
and trips ending between 3-4pm but which started)
before 3pm.)

APPENDIX: B

	TRIP PURPOSE:					
	1	2	3	4	5	
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	TOTALS
	18	1	17	23	28	87
	131	14	80	110	106	441
	99	46	28	43	82	298
	113	150	50	70	54	437
TOTALS:	361	211	175	246	270	1263

HOUSEHOLD SIZE, TRIP PURPOSE
AND P.M. PEAK HOUR PERIOD TRIP DISTRIBUTION:
(including trips starting between 3 - 4pm)
and trips ending between 3-4pm but which started)
before 3pm.)
PEAK HOUR TRAVEL AS A PERCENT OF DAILY TRAVEL

	TRIP PURPOSE:					MODAL
	1	2	3	4	5	AVERAGE OF
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	PURPOSES
	5.902%	3.448%	8.252%	8.185%	9.655%	
2	9.682%	6.829%	11.869%	10.309%	8.811%	
3	14.369%	15.132%	8.642%	9.168%	14.114%	12.590%
	9.378%	16.340%	11.905%	9.682%	8.766%	11.257%
PERCENT OF DAILY	10.163%	14.492%	10.776%	9.685%	10.037%	10.647%

HOME BASED ONLY: 10.826%

HB WORK+SHOP ONLY: 10.355%

APPENDIX B

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips starting between 4 - 5 pm)

	TRIP PURPOSE					
	1	2	3	4	5	
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	TOTALS
1	36	3	11	30	24	104
2	114	11	54	68	66	313
3	58	27	29	46	38	198
4	92	27	22	45	33	219
TOTALS:	300	68	116	189	161	834

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips ending between 4 - 5 pm, and
starting before 4pm)

	TRIP PURPOSE:					
	1	2	3	4	5	
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	TOTALS
1	8	0	4	2	5	
2	37	3	8	23	25	
3	28	1	10	5		
	26	11	7	11	17	72
TOTALS:	99	15	29	41	51	235

APPENDIX

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR:
(including trips starting between 4 - 5pm)
and trips ending between 4-5pm but which started)
before 4pm.)

	TRIP PURPOSE:					
HOUSEHOLD SIZE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	NHB	TOTALS
1	44	3	15	32	29	123
2	151	14	62	91	91	409
3	86	28	39	51	42	246
4	118	38	29	56	50	291
TOTALS:	399	83	145	230	212	1069

HOUSEHOLD SIZE, TRIP PURPOSE
AND P.M. PEAK HOUR PERIOD TRIP DISTRIBUTION:
(including trips starting between 4 - 5pm)
and trips ending between 4-5pm but which started)
before 4pm.)
PEAK HOUR TRAVEL AS A PERCENT OF DAILY TRAVEL

	TRIP PURPOSE:					
HOUSEHOLD SIZE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	MODAL AVERAGE O PURPOSES
1	14.426%	10.345%	7.282%	11.388%	10.000%	11.071%
2	11.160%	6.829%	9.199%	8.529%	7.564%	9.085%
3	12.482%	9.211%	12.037%	10.874%	7.229%	10.393%
	9.793%	4.139%	6.905%	7.746%	8.117%	7.496%
PERCENT OF DAILY	11.233%	5.701%	8.829%	9.055%	7.881%	9.012%

HOME BASED ONLY: 9.344%

HB WORK+SHOP ONLY 10.510%

APPENDIX B

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips starting between 5 - 6 pm)

HOUSEHOLD SIZE	TRIP PURPOSE: 1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
1	25	3	20	16	12	76
2	137	12	48	59	77	333
3	50	16	16	16	31	129
	126	12	36	70	22	266
TOTALS	338	43	120	161	142	804

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips ending between 5 - 6 pm, and
starting before 5pm)

HOUSEHOLD SIZE	TRIP PURPOSE: 1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
1	8	2	4	6	5	25
2	37	1	11	32	19	100
3	21	2	6	6	6	41
4	24	12	4	7	9	56
TOTALS:	90	17	25	51	39	222

APPENDIX

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR :
(including trips starting between 5 - 6pm)
and trips ending between 5-6pm but which started)
before 5pm.)

HOUSEHOLD SIZE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	NHB	TOTALS
	TRIP PURPOSE:					
1	33	5	24	22	17	101
2	174	13	59			
3	71	18	22	22		
	150	24	40	77	31	322
TOTALS	428	60	145	212	181	1026

HOUSEHOLD SIZE, TRIP PURPOSE
AND P.M. PEAK HOUR PERIOD TRIP DISTRIBUTION:
(including trips starting between 5 - 6pm)
and trips ending between 5-6pm but which started)
before 5pm.)
PEAK HOUR TRAVEL AS A PERCENT OF DAILY TRAVEL

HOUSEHOLD SIZE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	MODAL AVERAGE PURPOSES
	TRIP PURPOSE:					
	10.820%	17.241%	11.650%	7.829%	5.862%	9.09
2	12.860%	6.341%	8.754%	8.529%	7.980%	9.61
3	10.305%	5.921%	6.790%	4.691%	6.368%	
	12.448%	2.614%	9.524%	10.650%	5.032%	8.29
PERCENT OF DAILY	12.050%	4.121%	8.929%	8.346%	6.729%	8.64

HOME BASED ONLY: 9.213%

HB WORK+SHOP ONLY: 11.070%

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips starting between 6 - 7 pm)

APPENDIX B

	TRIP PURPOSE:					
	1	2	3			
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	TOTALS
	12	4	14	18	15	63
	60	17	45	46	22	190
	42	7	40	35	18	142
	64	20	62	53	30	229
TOTALS:	178	48	161	152	85	624

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips ending between 6 - 7 pm, and
starting before 6pm)

	TRIP PURPOSE:					
	1	2	3	4	5	
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	TOTALS
1	10	0	2	3	2	17
2	37	0	16	8	15	76
3	9	6	2	5	2	24
4	40	3	1	15		66
TOTALS	96	9	21	31	26	183

APPENDIX: B

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR:
(including trips starting between 6 - 7pm)
and trips ending between 6-7pm but which started)
before 6pm.)

HOUSEHOLD SIZE	TRIP PURPOSE: 1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
	22	4	16	21	17	80
2	97	17	61	54	37	266
	51	13	42	40	20	166
	104	23	63	68	37	295
TOTALS:	274	57	182	183	111	807

HOUSEHOLD SIZE, TRIP PURPOSE
AND P.M. PEAK HOUR PERIOD TRIP DISTRIBUTION:
(including trips starting between 6 - 7pm)
and trips ending between 6-7pm but which started)
before 6pm.)
PEAK HOUR TRAVEL AS A PERCENT OF DAILY TRAVEL

HOUSEHOLD SIZE	TRIP PURPOSE: 1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	MODAL AVERAGE O PURPOSES
1	7.213%	13.793%	7.767%	7.473%	5.862%	7.201%
2	7.169%	8.293%	9.050%	5.061%	3.076%	5.908%
	7.402%	4.276%	12.963%	8.529%	3.442%	7.013%
	8.631%	2.505%	15.000%	9.405%	6.006%	7.599%
PERCENT OF DAILY	7.714%	3.915%	11.207%	7.205%	4.126%	6.803%

HOME BASED ONLY: 7.588%

HB WORK+SHOP ONLY: 8.810%

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK PERIOD:
(trips starting between 3 - 6pm)

APPENDIX: B

	TRIP PURPOSE:					
	1	2	3	4	5	
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	TOTALS
1	75	6	46	65	58	250
2	365	32	160	216	224	997
3	182	77	68	98	141	566
	316	168	100	161	117	862
TOTALS	938	283	374	540	540	2675

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips ending between 3 - 6 pm, and
starting before 3pm)

	TRIP PURPOSE:					
	1	2	3	4	5	
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	TOTALS
	7	0	2	4	6	19
2	18	6	24	23	32	103
3	11	12	5	7	10	45
4	17	23	3 8	24	11	86
TOTALS:	53	41	39	58	59	250

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(including trips starting between 3 - 6pm)
and trips ending between 3-6pm but which started)
before 3pm.)

	TRIP PURPOSE:					
HOUSEHOLD SIZE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
1	82	6	48	69	64	269
2	383	38	184	239	256	1100
3	193	89	73	105	151	611
	333	191	108	185	128	945
TOTALS:	991	324	413	598	599	2925

NUMBER OF TRIPS BY PEAK PERIOD
PEAK HOUR TRAVEL AS A PERCENT OF DAILY TRAVEL
(including trips starting between 3 - 6pm)
and trips ending between 3-6pm but which started)
before 3pm.)

	TRIP PURPOSE					MODAL
HOUSEHOLD SIZE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	AVERAGE O PURPOSES
1	26.885%	20.690%	23.301%	24.555%	22.069%	24.212%
2	28.307%	18.537%	27.300%	22.399%	21.280%	24.434%
3	28.012%	29.276%	22.531%	22.388%	25.990%	25.813%
4	27.635%	20.806%	25.714%	25.588%	20.779%	24.343%
PERCENT OF DAILY:	27.900%	22.253%	25.431%	23.543%	22.268%	24.659%

HOME BASED ONLY: 25.360%

HB WORK+SHOP ONLY: 27.125%

APPENDIX C. ARTERIAL PEAK-HOURS

A table showing when the peak-hour occurs along sections of several major arterials. The table shows the peak-hour by direction, and the hour in which the combined directions peak.

PEAK HOUR* DIRECTIONAL ANALYSIS
SELECTED ARTERIALS, LAS VEGAS, NEVADA

STREET & LOCATION	2WAY	N	S	E	W
Ann, E of Durango	5			4	6
Ann, W of Ft Apache	4			4	6
Cheyenne,W of Tenya	4			4	5
Cheyenne,E of Seren	6			5	6
Chey.,E of Decatur	5			4	5
Craig,E of 5th St	5			4	5
Craig,E of Clayton	4			4	6
Desert Inn,WofVegas Vall	5			2	5
Desert Inn,EofJones	5			4	6
Eastern,S of Desert Inn	6	5	6		
Eastern,S of Charleston	5	6	4		
Eastern,S of TropIcana	6	4	6		
Eastern,S of Sunset	6	4	6		
Green Valley,N of Warm	6	4	6		
Lamb,S of Vegas Val	5	6	5		
Lamb,N of Charlston	6	5	4		
Lamb,N of Washington	5	6	5		
Lamb,N of Cheyenne	4	4	4		
ML King,N of Alta	5	5	4		
ML King,NofWashington	5	6	4		
ML King,S of Cheyenne	6	6	4		
ML King, S of Craig	6	6	4		
Sahara,W of Buffalo	6			2	6
Sumerlin Pkwy,E of Buff	4			4	6
Russel,W of Eastern	6			5	7
*Peak Hour End Time	Street Pk	Northbnd	Southbnd	Eastbnd	Westbnd

APPENDIX D. ANALYSIS OF PEAK-HOUR

It is a summary of the peak-hour analysis, and is compiled by peak-hour for reference.

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK PERIOD:
(trips starting between 3 - 6pm)

APPENDIX: D

HOUSEHOLD SIZE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	NHB	TOTALS
			TRIP PURPOSE:			
	75	6	46	65	58	250
	365	32	160	216	224	997
3	182	77	68	98	141	566
	316	168	100	161	117	862
TOTALS:	938	283	374	540	540	2675

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(trips ending between 3 - 6 pm, and
starting before 3pm)

HOUSEHOLD SIZE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
			TRIP PURPOSE:			
1	7	0	2	4	6	
2	18	6	24	23	32	
3	11	12	5	7	10	
4	17	23	3 8	24	11	86
TOTALS:	53	41	39	58	59	250

NUMBER OF TRIPS BY
HOUSEHOLD SIZE, TRIP PURPOSE
AND PEAK HOUR PERIOD:
(including trips starting between 3 - 6pm)
and trips ending between 3-6pm but which started)
before 3pm.)

	TRIP PURPOSE:					
	1	2	3	4	5	
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	TOTALS
1	82	6	48	69	64	269
2	383	38	184	239	256	1100
3	193	89	73	105	151	611
4	333	191	108	185	128	94[illegible]
TOTALS	991	324	413	598	599	2925

NUMBER OF TRIPS BY PEAK PERIOD
PEAK HOUR TRAVEL AS A PERCENT OF DAILY TRAVEL
(including trips starting between 3 - 6pm)
and trips ending between 3-6pm but which started)
before 3pm.)

	TRIP PURPOSE:					MODAL
		2	3	4	5	AVERAGE O
HOUSEHOLD SIZE	HB WORK	HB SCHOOL	HB SHOP	HB OTHER	NHB	PURPOSES
	26.885%	20.690%	23.301%	24.555%	22.069%	24.212%
	28.307%	18.537%	27.300%	22.399%	21.280%	24.434%
	28.012%	29.276%	22.531%	22.388%	25.990%	25.813%
	27.635%	20.806%	25.714%	25.588%	20.779%	24.343%
PERCENT OF DAILY	27.900%	22.253%	25.431%	23.543%	22.268%	24.659%

HOME BASED ONLY	25.360%
HB WORK+SHOP ONLY	27.125%

B

PEAK HOUR/PERIOD ANALYSIS

PEAK HOUR TRIPS AS A PERCENT OF DAILY TRIPS: APPENDIX D

PEAK HOUR OR PERIOD:	ALL HB ONLY	HB WORK WORK+SHOP	OVERALL
3-4pm	10.826%	10.355%	10.647%
4-5pm	9.344%	10.510%	9.012%
5-6pm	9.213%	11.070%	8.649%
6-7pm	7.588%	8.810%	6.803%

(---------SUMMARY OF TRIP PURPOSES------------)

PEAK PERIOD TRIPS AS A PERCENT OF DAILY TRIPS:

(---------SUMMARY OF TRIP PURPOSES------------)

PEAK PERIOD	ALL HB ONLY	HB WORK WORK+SHOP	OVERALL
3-6PM	25.36%	27.13%	24.66%

PEAK HOUR

	3-4PM	4-5PM	5-6PM	6-7PM	
TOTAL DAILY TRIPS:					11862
TOTAL PEAK PERIOD TRIPS:					2925
TOTAL PEAK HR TRIPS	1263	1069	1026	807	
PEAK HR AS % OF DAILY:	10.65%	9.01%	8.65%	6.80%	
PEAK HR AS % OF PERIOD:	43.18%	36.55%	35.08%	27.59%	
PEAK HOUR HB TRIPS AS A PERCENT OF TOTAL TRIPS MADE IN PEAK HOUR:	78.622%	80.168%	82.359%	86.245%	
PEAK HOUR NHB TRIPS AS A PERCENT OF TOTAL TRIPS MADE IN PEAK HOUR:	21.378%	19.832%	17.641%	13.755%	
TOTALS:	100.00%	100.00%	100.00%	100.00%	
PEAK HOUR HB TRIPS AS A PERCENT OF TOTAL TRIPS IN PEAK PERIOD:	33.949%	29.299%	28.889%	23.795%	
PEAK HOUR NHB TRIPS AS A PERCENT OF TOTAL TRIPS IN PEAK PERIOD:	9.231%	7.248%	6.188%	3.795%	
PEAK PERIOD HB TRIPS AS A PERCENT OF PEAK PERIOD:					79.521%
PEAK PERIOD NHB TRIPS AS A PERCENT OF PEAK PERIOD:					20.479%
TOTAL:					100.00%

APPENDIX E. ANALYSIS OF MODE SPLIT

This appendix includes an analysis of mode split for daily traffic as well as for the peak-period and hour.

NUMBER OF TRIPS
BY MODE, TRIP PURPOSE
AND TIME OF DAY

APPENDIX: E

MODE OF TRAVEL	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	NHB	TOTALS
1 - Driver*	3223	828	1215	2021	2276	9563
2 - Psgr*	242	292	386	462	363	1745
3 - City Bus	23	8	9	19	5	64
--All Other Modes---						
4 - School Bus	1	187	4	0	0	192
5 - Taxi	2	0	3	5	1	11
6 - Motorcycle	10	0	0	20	16	46
7 - Walk to work	27	112	2	5	5	151
8 - Bicycle to work	12	10	2	2	5	31
9 - Other	2	8	1	0	16	27
**TOTALS:	3542	1445	1622	2534	2687	11830

*trips using personal vehicles
**database totals do not add to 11,862 records

MODE SPLIT BY TRIP PURPOSE

DAILY

MODE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	MODE SPLIT
PERSONAL VEHICLES	97.83%	77.51%	98.71%	97.99%	98.21%	95.59%
CITY BUS	0.65%	0.55%	0.55%	0.75%	0.19%	0.54%
ALL OTHERS	1.52%	21.94%	0.74%	1.26%	1.60%	3.87%

B

NUMBER OF TRIPS BY
MODE, TRIP PURPOSE
AND PEAK PERIOD:
(including trips starting between 3 - 6pm)

APPENDIX E

MODE	TRIP PURPOSE: 1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
1 - Driver	856	137	280	438	458	2169
2 - Psgr	64	74	90	95	67	390
3 - City Bus	7	1	0	5	0	13
4 - All Other Modes	13	69	5	7	12	106
TOTALS	940	281	375	545	537	2678

NUMBER OF TRIPS BY
MODE, TRIP PURPOSE
AND PEAK PERIOD:
(including trips ending between 3-6pm but which started)
before 3pm.)

MODE	TRIP PURPOSE: 1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
- Driver	50	22	31	39	49	191
2 - Psgr	3	2	8	16	8	37
3 - City Bus	0	1	0	3	2	6
4 - All Other Modes	0	17	0	0	1	18
TOTALS	53	42	39	58	60	252

NUMBER OF TRIPS BY
MODE, TRIP PURPOSE
AND PEAK PERIOD:
(including trips starting between 3 - 6pm)
and trips ending between 3-6pm but which started)
before 3pm.)

APPENDIX E

TOTAL TRIPS MADE DURING PEAK PERIOD, BY MAJOR MODE:

MODE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
1 - Driver	906	159	311	477	507	2360
2 - Psgr	67	76	98	111	75	427
3 - City Bus	7	2	0	8	2	
4 - All Other Modes	13	86	5	7	13	124
TOTALS	993	323	414	603	597	2930

MODE, TRIP PURPOSE AND
P.M. PEAK HOUR PERIOD TRIP DISTRIBUTION:
(including trips starting between 3 - 6pm)
and trips ending between 3-6pm but which started)
before 3pm.)

PEAK PERIOD TRAVEL AS A PERCENT OF DAILY TRAVEL BY MODE:

MODE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	MODAL AVERAGE O PURPOSES
1 - Driver	28.110%	19.203%	25.597%	23.602%	22.276%	24.678%
2 - Psgr	27.686%	26.027%	25.389%	24.026%	20.661%	24.470%
3 - City Bus	30.435%	25.000%	0.000%	42.105%	40.000%	29.688%
All Other Modes	24.074%	27.129%	41.667%	21.875%	30.233%	27.074%
PERCENT OF DAILY:	28.035%	22.353%	25.524%	23.796%	22.218%	24.768%

HOME BASED ONLY: 25.517%

HB WORK+SHOP ONLY: 27.246%

MODE SPLIT BY TRIP PURPOSE AND

P.M. PEAK HOUR PERIOD TRIP DISTRIBUTION:

(including trips starting between 3 - 6pm)

and trips ending between 3-6pm but which started)

before 3pm.)

MODE	HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	MODAL AVERAGE OF PURPOSES
	TRIP PURPOSE:					
PERSONAL VEHICLES	97.99%	72.76%	98.79%	97.51%	97.49%	95.12%
CITY BUS	0.70%	0.62%	0.00%	1.33%	0.34%	0.65%
ALL OTHERS	1.31%	26.63%	1.21%	1.16%	2.18%	4.23%

NUMBER OF TRIPS BY
MODE, TRIP PURPOSE
AND PEAK HOUR:
(including trips starting between 3 - 4pm)

APPENDIX: E

MODE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
1 - Driver	271	48	108	164	192	783
2 - Psgr	24	56	27	71	20	198
3 - City Bus	0	1	0	4		
4 - All Other Modes	5	66	4	2	4	81
TOTALS:	300	171	139	241	216	1067

NUMBER OF TRIPS BY
MODE, TRIP PURPOSE
AND PEAK PERIOD:
(including trips ending between 3-4pm but which started)
before 3pm.)

MODE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
1 - Driver	42	20	29	37	44	172
2 - Psgr	3	2	8	16	6	35
3 - City Bus	0	1	0	3	2	6
All Other Modes	0	16	0	0	1	17
TOTALS:	45	39	37	56	53	230

B

NUMBER OF TRIPS BY
MODE, TRIP PURPOSE
AND PEAK PERIOD:
(including trips starting between 3 - 6pm)
and trips ending between 3-6pm but which started)
before 3pm.)

APPENDIX: E

TOTAL TRIPS MADE DURING PEAK PERIOD, BY MAJOR MODE:

MODE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	TOTALS
1 - Driver	313	68	137	201	236	955
2 - Psgr	27	58	35	87	26	233
3 - City Bus	0	2	0	7	2	11
4 - All Other Modes	5	82	4	2	5	98
TOTALS:	345	210	176	297	269	1297

MODE, TRIP PURPOSE AND
P.M. PEAK HOUR PERIOD TRIP DISTRIBUTION:
(including trips starting between 3 - 6pm)
and trips ending between 3-6pm but which started)
before 3pm.)

PEAK PERIOD TRAVEL AS A PERCENT OF DAILY TRAVEL BY MODE:

MODE	1 HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	MODAL AVERAGE OF PURPOSES
1 - Driver	9.711%	8.213%	11.276%	9.946%	10.369%	9.986%
2 - Psgr	11.157%	19.863%	9.067%	18.831%	7.163%	13.352%
City Bus	0.000%	25.000%	0.000%	36.842%	40.000%	17.188%
All Other Modes	6.494%	25.231%	19.048%	3.922%	10.417%	21.397%
PERCENT OF DAILY	9.740%	14.533%	10.851%	11.721%	10.011%	10.964%

HOME BASED ONLY: 11.244%

HB WORK+SHOP ONLY: 10.089%

MODE SPLIT BY TRIP PURPOSE AND P.M. PEAK HOUR PERIOD TRIP DISTRIBUTION: (including trips starting between 3 - 6pm) and trips ending between 3-6pm but which started) before 3pm.)

APPENDIX: E

MODE	TRIP PURPOSE: HB WORK	2 HB SCHOOL	3 HB SHOP	4 HB OTHER	5 NHB	MODAL AVERAGE OF PURPOSES
PERSONAL VEHICLES	98.55%	60.00%	97.73%	96.97%	97.40%	91.60%
CITY BUS	0.00%	0.95%	0.00%	2.36%	0.74%	0.85%
ALL OTHERS	1.45%	39.05%	2.27%	0.67%	1.86%	7.56%

APPENDIX F. TRANPLAN CONTROL FILES

Contains the control files for the operation of the Peak-Hour Model.

LAS VEGAS 1990 PEAK PERIOD TRANPLAN FILES

Task		File Name	Description
CONTROL FILE		CTRL90PH.IN	PEAK HOUR CONTROL FILE - RESTRAINED
		CONG90PH.IN	PEAK HOUR CONTROL FILE - TWICE RESTRAINED
NETWORK			
	INPUT FILE	LV90N.NET	1990 LAS VEGAS NETWORK FILE FROM RTC
	OUTPUT FILE	LV90PKHR.NET	PEAK HOUR NETWORK
DISTRIBUTION			
	INPUT FILE	NEWPA90.RTC	P/A TABLE FROM RTC
	OUTPUT FILE	LVPKHR90.TRP	PEAK HOUR INTERNAL TRIP TABLE
FINAL TRIP TABLE			
	INPUT FILE	LVPKHR90.TRP	PEAK HOUR INTERNAL TRIP TABLE
	INPUT FILE	LVSUM90.TRP	INT/EXT TRIP TABLE FROM RTC
	OUTPUT FILE	IE90PKHR.TRPS	PEAK HOUR INT/EXT MATRIX
	OUTPUT FILE	LVPKHR90.VEH	PEAK HOUR VEHICLE TRIP MATRIX
ASSIGNMENT			
	INPUT FILE	LV90PKHR.NET	PEAK HOUR NETWORK
	INPUT FILE	LVPKHR90.VEH	PEAK HOUR VEHICLE TRIP MATRIX
	OUTPUT FILE	LVPKHR90.LOD	PEAK HOUR 1990 RESTRAINED ASSIGNMENT
	OUTPUT FILE	CONGHR90.LOD	PEAK HOUR 1990 TWICE-RESTRAINED ASSIGNMENT

1990 PEAK HOUR TRANPLAN CONTROL FILES

```
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV90N.NET$
 OUTPUT FILE = MACOUT, USER ID = $LV90G2.NET$
$DATA
 ASSIGNMENT GROUP=1, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=2, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=3, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=4, CHANGE, SPEED 1 = R 2500
 ASSIGNMENT GROUP=5, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=6, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=7, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=8, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=1, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 660
 ASSIGNMENT GROUP=1, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1250
 ASSIGNMENT GROUP=2, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 900
 ASSIGNMENT GROUP=2, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1700
 ASSIGNMENT GROUP=2, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 2475
 ASSIGNMENT GROUP=3, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 1100
 ASSIGNMENT GROUP=3, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 2100
 ASSIGNMENT GROUP=3, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 3000
 ASSIGNMENT GROUP=3, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 4000
 ASSIGNMENT GROUP=4, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 800
 ASSIGNMENT GROUP=4, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1525
 ASSIGNMEMT GROUP=5-6, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 4000
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 6000
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 8000
 ASSIGNMENT GROUP=7, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 3900
 ASSIGNMENT GROUP=7, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 5600
 ASSIGNMENT GROUP=7, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 7400
 ASSIGNMENT GROUP=8, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 660
 ASSIGNMENT GROUP=8, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1250
 ASSIGNMENT GROUP=8, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 1825
 ASSIGNMENT GROUP=8, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 2400
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV90G2.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV90G3.NET$
$DATA
 ASSIGNMENT GROUP=2,8, LINK GROUP 3=1, CHANGE, SPEED 1, R 2500
 ASSIGNMENT GROUP=3, LINK GROUP 3=1, CHANGE, SPEED 1, R 3000
```

```
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=2,3, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3= 7,8,10, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=9, CHANGE, SPEED 1, R 4000
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=5,11,12, CHANGE, SPEED 1, R 4500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=5, LINK GROUP 3=0, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, CAPACITY 1, *0.5
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV90G3.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV90G4.NET$
$DATA
 CAPACITY 2 = 0-72127, CHANGE, CAPACITY 2=*.1065
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV90G4.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV90PKHR.NET$
$DATA
 LINK GROUP 3 = 5,11,12, DIRECTION CODE = 1,3, CHANGE, SPEED 1=*.8
$END TP FUNCTION
$HIGHWAY SELECTED SUMMATION
$FILES
  INPUT FILE = HWYNET, USER ID = $LV90PKHR.NET$
  OUTPUT FILE = HWYSKIM, USER ID = $PKHR90EZ.SKM$
$HEADER
    LV90 PEAK HOUR NETWORK INTERZONAL SKIMS
$PARAMETERS
  IMPEDANCE = TIME 1
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
          (3-2,50) (4-3,50) (1-4,50) (2-1,50)
$DATA
  TABLE = TIME 1
$END TP FUNCTION
$BUILD INTRAZONAL IMPEDANCES
$FILES
  INPUT FILE = IZIN, USER ID = $PKHR90EZ.SKM$, UNLOAD
  OUTPUT FILE = IZOUT, USER ID = $PKHR90IZ.SKM$
$HEADER
    LV90 PEAK HOUR NETWORK INTRAZONAL SKIMS
$OPTION
~ PRINT DETAIL
$PARAMETERS
  NUMBER OF ADJACENT ZONES = 2
```

```
$END TP FUNCTION
$GRAVITY MODEL
$FILES
  INPUT FILE = GMSKIM, USER ID = $PKHR90IZ.SKM$, UNLOAD
  INPUT FILE = GRVDATA, USER ID = $NEWPA90.RTC$
  OUTPUT FILE = GMVOL, USER ID = $DAILY90.PA$
$HEADER
    LV90 NETWORK & 1990 PEAK HOUR TRIPS
    GRAVITY MODEL OUTPUT -- FIVE PURPOSES
$OPTIONS
  GRVDATA
  MERGED PURPOSE FILE
~ PRINT TRIP LENGTH STATISTICS
$PARAMETERS
  MAXIMUM TIME = 75
  MAXIMUM PURPOSE = 5
  ITERATIONS ON ATTRACTIONS = 5
$END TP FUNCTION
$MATRIX TRANSPOSE
$FILES
  INPUT FILE = TRNSPIN, USER ID = $DAILY90.PA$
  OUTPUT FILE = TRNSPOT, USER ID = $DAILY90.AP$
$HEADER
    LV90 NETWORK TRANSPOSED PEAK HOUR TRIP TABLE
$OPTION
$PARAMETERS
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY90.PA$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR904.PA$
$HEADER
     FACTORING DAILY GRAVITY MODEL PRODUCTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.204
  T2,1-751,1-751,*0.193
  T3,1-751,1-751,*0.451
  T4,1-751,1-751,*0.343
  T5,1-751,1-751,*0.895
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY90.AP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR904.AP$
```

```
$HEADER
    FACTORING DAILY GRAVITY MODEL ATTRACTIONS TO A PEAK HOUR
    DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.796
  T2,1-751,1-751,*0.807
  T3,1-751,1-751,*0.549
  T4,1-751,1-751,*0.657
  T5,1-751,1-751,*0.105
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $PKHR904.PA$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $PKHR904.AP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $PKHOUR90.VOL$
$HEADER
    LV90 PEAK HOUR NETWORK P/A TABLE + A/P TABLE
$DATA
  TMAN3,T1 = TMAN1,T1 + TMAN2,T1
  TMAN3,T2 = TMAN1,T2 + TMAN2,T2
  TMAN3,T3 = TMAN1,T3 + TMAN2,T3
  TMAN3,T4 = TMAN1,T4 + TMAN2,T4
  TMAN3,T5 = TMAN1,T5 + TMAN2,T5
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHOUR90.VOL$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR90VH.TRP$
$HEADERS
   FACTOR DAILY PERSON TRIPS BY TRIP PURPOSE TO DETERMINE
   PEAK HOUR TRIPS
$OPTIONS
$DATA
  T1,1-751,1-751,*0.1204
  T2,1-751,1-751,*0.0963
  T3,1-751,1-751,*0.1099
  T4,1-751,1-751,*0.1022
  T5,1-751,1-751,*0.0963
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHR90VH.TRP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $LVPKHR90.TRP$
$HEADER
    LV90 NETWORK PEAK HOUR PERSON TRIPS TO VEHICLE TRIPS
```

```
    (AVG. 1.32 PERSONS PER VEHICLE)
$OPTION
$DATA
  P1, 1-751,1-751,*0.8929
  P2, 1-751,1-751,*0.6666
  P3, 1-751,1-751,*0.7042
  P4, 1-751,1-751,*0.6803
  P5, 1-751,1-751,*0.7692
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $LVSUM90.TRP$,
  OUTPUT FILE = UPDOUT, USER ID = $IE90PKHR.TRP$
$HEADERS
   FACTOR INTERNAL-EXTERNAL TRIPS BY .1065 TO DETERMINE PEAK HOUR
   INTERNAL-EXTERNAL TRIPS
$OPTIONS
$DATA
  T1, 1-751, 1-751, *.1065
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $LVPKHR90.TRP$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $IE90PKHR.TRP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $LVPKHR90.VEH$
$HEADER
  MERGING PURPOSES
$OPTION
$DATA
 TMAN3,T1=TMAN1,T1+TMAN1,T2+TMAN1,T3+TMAN1,T4+TMAN1,T5+TMAN2,T1
$END TP FUNCTION
$EQUILIBRIUM HIGHWAY LOAD
$FILES
  INPUT FILE = HWYNET, USER ID = $LV90PKHR.NET$, UNLOAD
  INPUT FILE = HWYTRIP, USER ID = $LVPKHR90.VEH$, UNLOAD
  OUTPUT FILE = LODHIST, USER ID = $FREEHR90.LOD$
$HEADER
   LV90 "N" NETWORK 1990 PEAK HOUR PROD'S AND ATTR'S LOADED
$PARAMETERS
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
           (3-2,50) (4-3,50) (1-4,50) (2-1,50)
  EQUILIBRIUM ITERATIONS = 6
  EPS = 0.01
$END TP FUNCTION
$HIGHWAY SELECTED SUMMATION
```

```
$FILES
  INPUT FILE = HWYNET, USER ID = $FREEHR90.LOD$
  OUTPUT FILE = HWYSKIM, USER ID = $PKHR90EZ.SKM$
$HEADER
    **SECOND ITERATION ON CONGESTED SPEEDS BEGINS HERE**
    LV90 PEAK HOUR NETWORK INTERZONAL SKIMS
$PARAMETERS
  IMPEDANCE = TIME 1
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
            (3-2,50) (4-3,50) (1-4,50) (2-1,50)
$DATA
  TABLE = TIME 1
$END TP FUNCTION
$BUILD INTRAZONAL IMPEDANCES
$FILES
  INPUT FILE = IZIN, USER ID = $PKHR90EZ.SKM$, UNLOAD
  OUTPUT FILE = IZOUT, USER ID = $PKHR90IZ.SKM$
$HEADER
    LV90 PEAK HOUR NETWORK INTRAZONAL SKIMS
$OPTION
~ PRINT DETAIL
$PARAMETERS
  NUMBER OF ADJACENT ZONES = 2
$END TP FUNCTION
$GRAVITY MODEL
$FILES
  INPUT FILE = GMSKIM, USER ID = $PKHR90IZ.SKM$, UNLOAD
  INPUT FILE = GRVDATA, USER ID = $NEWPA90.RTC$
  OUTPUT FILE = GMVOL, USER ID = $DAILY90.PA$
$HEADER
     LV90 NETWORK & 1990 PEAK HOUR TRIPS
     GRAVITY MODEL OUTPUT -- FIVE PURPOSES
$OPTIONS
  GRVDATA
  MERGED PURPOSE FILE
~ PRINT TRIP LENGTH STATISTICS
$PARAMETERS
  MAXIMUM TIME = 75
  MAXIMUM PURPOSE = 5
  ITERATIONS ON ATTRACTIONS = 5
$END TP FUNCTION
$MATRIX TRANSPOSE
$FILES
  INPUT FILE = TRNSPIN, USER ID = $DAILY90.PA$
  OUTPUT FILE = TRNSPOT, USER ID = $DAILY90.AP$
```

```
$HEADER
   LV90 NETWORK TRANSPOSED PEAK HOUR TRIP TABLE
$OPTION
$PARAMETERS
$END TP FUNCTION
$MATRIX UPDATE
  INPUT FILE = UPDIN, USER ID = $DAILY90.PA$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR904.PA$
$HEADER
     FACTORING DAILY GRAVITY MODEL PRODUCTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.204
  T2,1-751,1-751,*0.193
  T3,1-751,1-751,*0.451
  T4,1-751,1-751,*0.343
  T5,1-751,1-751,*0.895
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY90.AP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR904.AP$
$HEADER
     FACTORING DAILY GRAVITY MODEL ATTRACTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.796
  T2,1-751,1-751,*0.807
  T3,1-751,1-751,*0.549
  T4,1-751,1-751,*0.657
  T5,1-751,1-751,*0.105
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $PKHR904.PA$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $PKHR904.AP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $PKHOUR90.VOL$
$HEADER
     LV90 PEAK HOUR NETWORK P/A TABLE + A/P TABLE
$DATA
  TMAN3,T1 = TMAN1,T1 + TMAN2,T1
  TMAN3,T2 = TMAN1,T2 + TMAN2,T2
  TMAN3,T3 = TMAN1,T3 + TMAN2,T3
  TMAN3,T4 = TMAN1,T4 + TMAN2,T4
  TMAN3,T5 = TMAN1,T5 + TMAN2,T5
```

```
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHOUR90.VOL$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR90VH.TRP$
$HEADERS
    FACTOR DAILY PERSON TRIPS BY TRIP PURPOSE TO DETERMINE
    PEAK HOUR TRIPS
$OPTIONS
$DATA
  T1,1-751,1-751,*0.1204
  T2,1-751,1-751,*0.0963
  T3,1-751,1-751,*0.1099
  T4,1-751,1-751,*0.1022
  T5,1-751,1-751,*0.0963
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHR90VH.TRP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $LVPKHR90.TRP$
$HEADER
    LV90 NETWORK PEAK HOUR PERSON TRIPS TO VEHICLE TRIPS
      (AVG. 1.32 PERSONS PER VEHICLE)
$OPTION
$DATA
  P1, 1-751, 1-751, *0.8929
  P2, 1-751, 1-751, *0.6666
  P3, 1-751, 1-751, *0.7042
  P4, 1-751, 1-751, *0.6803
  P5, 1-751, 1-751, *0.7692
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $LVSUM90.TRP$,
  OUTPUT FILE = UPDOUT, USER ID = $IE90PKHR.TRP$
$HEADERS
    FACTOR INTERNAL-EXTERNAL TRIPS BY .1065 TO DETERMINE PEAK HOUR
    INTERNAL-EXTERNAL TRIPS
$OPTIONS
$DATA
  T1, 1-751, 1-751, *.1065
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $LVPKHR90.TRP$, UNLOAD
```

```
 INPUT FILE = TMAN2, USER ID = $IE90PKHR.TRP$, UNLOAD
 OUTPUT FILE = TMAN3, USER ID = $LVPKHR90.VEH$
$HEADER
 MERGING PURPOSES
$OPTION
$DATA
 TMAN3,T1=TMAN1,T1+TMAN1,T2+TMAN1,T3+TMAN1,T4+TMAN1,T5+TMAN2,T1
$END TP FUNCTION
$EQUILIBRIUM HIGHWAY LOAD
$FILES
 INPUT FILE = HWYNET, USER ID = $FREEHR90.LOD$, UNLOAD
 INPUT FILE = HWYTRIP, USER ID = $LVPKHR90.VEH$, UNLOAD
 OUTPUT FILE = LODHIST, USER ID = $CONGHR90.LOD$
$HEADER
   LV90 "N" NETWORK 1990 PEAK HOUR PROD'S AND ATTR'S LOADED
   *** CONGESTED SPEED NETWORK ***
$PARAMETERS
 TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
          (3-2,50) (4-3,50) (1-4,50) (2-1,50)
 EQUILIBRIUM ITERATIONS = 6
 EPS = 0.01
$END TP FUNCTION
$REPORT HIGHWAY NETWORK SUMMARY
$FILE
 INPUT FILE = LODHIST, USERID = $CONGHR90.LOD$
$OPTIONS
 SPEED SUMMARY
 VC SUMMARY
$PARAMETERS
$DATA
 TABLE=1, UNITS = VEHICLE-DISTANCE, LINK CODE = ASSIGNMENT GROUP
 TABLE=2, UNITS = VEHICLE-HOURS, LINK CODE = ASSIGNMENT GROUP
$END TP FUNCTION
```

LAS VEGAS 1995 PEAK PERIOD TRANPLAN FILES

Task		File Name	Description
CONTROL FILE		CTRL95PH.IN	PEAK HOUR CONTROL FILE - RESTRAINED
		CONG95PH.IN	PEAK HOUR CONTROL FILE - TWICE RESTRAINED
NETWORK			
	INPUT FILE	LV95N.NET	1995 LAS VEGAS NETWORK FILE FROM RTC
	OUTPUT FILE	LV95PKHR.NET	PEAK HOUR NETWORK
DISTRIBUTION			
	INPUT FILE	NEWPA95.RTC	P/A TABLE FROM RTC
	OUTPUT FILE	LVPKHR95.TRP	PEAK HOUR INTERNAL TRIP TABLE
FINAL TRIP TABLE			
	INPUT FILE	LVPKHR95.TRP	PEAK HOUR INTERNAL TRIP TABLE
	INPUT FILE	LVSUM95.TRP	INT/EXT TRIP TABLE FROM RTC
	OUTPUT FILE	IE95PKHR.TRPS	PEAK HOUR INT/EXT MATRIX
	OUTPUT FILE	LVPKHR95.VEH	PEAK HOUR VEHICLE TRIP MATRIX
ASSIGNMENT			
	INPUT FILE	LV95PKHR.NET	PEAK HOUR NETWORK
	INPUT FILE	LVPKHR95.VEH	PEAK HOUR VEHICLE TRIP MATRIX
	OUTPUT FILE	LVPKHR95.LOD	PEAK HOUR 1995 RESTRAINED ASSIGNMENT
	OUTPUT FILE	CONGHR95.LOD	PEAK HOUR 1995 TWICE-RESTRAINED ASSIGNMENT

1995 PEAK HOUR TRANPLAN CONTROL FILES

```
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV95N.NET$
 OUTPUT FILE = MACOUT, USER ID = $LV95G2.NET$
$DATA
 ASSIGNMENT GROUP=1, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=2, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=3, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=4, CHANGE, SPEED 1 = R 2500
 ASSIGNMENT GROUP=5, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=6, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=7, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=8, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=1, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 660
 ASSIGNMENT GROUP=1, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1250
 ASSIGNMENT GROUP=2, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 900
 ASSIGNMENT GROUP=2, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1700
 ASSIGNMENT GROUP=2, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 2475
 ASSIGNMENT GROUP=3, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 1100
 ASSIGNMENT GROUP=3, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 2100
 ASSIGNMENT GROUP=3, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 3000
 ASSIGNMENT GROUP=3, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 4000
 ASSIGNMENT GROUP=4, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 800
 ASSIGNMENT GROUP=4, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1525
 ASSIGNMEMT GROUP=5-6, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 4000
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 6000
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 8000
 ASSIGNMENT GROUP=7, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 3900
 ASSIGNMENT GROUP=7, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 5600
 ASSIGNMENT GROUP=7, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 7400
 ASSIGNMENT GROUP=8, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 660
 ASSIGNMENT GROUP=8, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1250
 ASSIGNMENT GROUP=8, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 1825
 ASSIGNMENT GROUP=8, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 2400
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV95G2.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV95G3.NET$
$DATA
 ASSIGNMENT GROUP=2,8, LINK GROUP 3=1, CHANGE, SPEED 1, R 2500
```

```
 ASSIGNMENT GROUP=3, LINK GROUP 3=1, CHANGE, SPEED 1, R 3000
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=2,3, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3= 7,8,10, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=9, CHANGE, SPEED 1, R 4000
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=5,11,12, CHANGE, SPEED 1, R 4500
 ASSIGNMENT GROUP=3, LINK GROUP 3=4,6, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=5, LINK GROUP 3=0, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, CAPACITY 1, *0.5
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV95G3.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV95PKHR.NET$
$DATA
 LINK GROUP 3 = 5,11,12, DIRECTION CODE = 1,3, CHANGE, SPEED 1=*.8
$END TP FUNCTION
$HIGHWAY SELECTED SUMMATION
$FILES
  INPUT FILE = HWYNET, USER ID = $LV95PKHR.NET$
  OUTPUT FILE = HWYSKIM, USER ID = $PKHR95EZ.SKM$
$HEADER
    LV95 PEAK HOUR NETWORK INTERZONAL SKIMS
$PARAMETERS
  IMPEDANCE = TIME 1
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
           (3-2,50) (4-3,50) (1-4,50) (2-1,50)
$DATA
  TABLE = TIME 1
$END TP FUNCTION
$BUILD INTRAZONAL IMPEDANCES
$FILES
  INPUT FILE = IZIN, USER ID = $PKHR95EZ.SKM$, UNLOAD
  OUTPUT FILE = IZOUT, USER ID = $PKHR95IZ.SKM$
$HEADER
    LV95 PEAK HOUR NETWORK INTRAZONAL SKIMS
$OPTION
~ PRINT DETAIL
$PARAMETERS
  NUMBER OF ADJACENT ZONES = 2
$END TP FUNCTION
$GRAVITY MODEL
$FILES
  INPUT FILE = GMSKIM, USER ID = $PKHR95IZ.SKM$, UNLOAD
  INPUT FILE = GRVDATA, USER ID = $NEWPA95.RTC$
```

```
  OUTPUT FILE = GMVOL, USER ID = $DAILY95.PA$
$HEADER
    LV95 NETWORK & 1995 PEAK HOUR TRIPS
    GRAVITY MODEL OUTPUT -- FIVE PURPOSES
$OPTIONS
  GRVDATA
  MERGED PURPOSE FILE
  PRINT TRIP LENGTH STATISTICS
$PARAMETERS
  MAXIMUM TIME = 75
  MAXIMUM PURPOSE = 5
  ITERATIONS ON ATTRACTIONS = 5
$END TP FUNCTION
$MATRIX TRANSPOSE
$FILES
  INPUT FILE = TRNSPIN, USER ID = $DAILY95.PA$
  OUTPUT FILE = TRNSPOT, USER ID = $DAILY95.AP$
$HEADER
    LV95 NETWORK TRANSPOSED PEAK HOUR TRIP TABLE
$OPTION
$PARAMETERS
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY95.PA$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR954.PA$
$HEADER
    FACTORING DAILY GRAVITY MODEL PRODUCTIONS TO A PEAK HOUR
    DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.204
  T2,1-751,1-751,*0.193
  T3,1-751,1-751,*0.451
  T4,1-751,1-751,*0.343
  T5,1-751,1-751,*0.895
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY95.AP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR954.AP$
$HEADER
    FACTORING DAILY GRAVITY MODEL ATTRACTIONS TO A PEAK HOUR
    DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.796
```

```
  T2,1-751,1-751,*0.807
  T3,1-751,1-751,*0.549
  T4,1-751,1-751,*0.657
  T5,1-751,1-751,*0.105
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $PKHR954.PA$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $PKHR954.AP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $PKHOUR95.VOL$
$HEADER
    LV95 PEAK HOUR NETWORK P/A TABLE + A/P TABLE
$DATA
  TMAN3,T1 = TMAN1,T1 + TMAN2,T1
  TMAN3,T2 = TMAN1,T2 + TMAN2,T2
  TMAN3,T3 = TMAN1,T3 + TMAN2,T3
  TMAN3,T4 = TMAN1,T4 + TMAN2,T4
  TMAN3,T5 = TMAN1,T5 + TMAN2,T5
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHOUR95.VOL$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR95PT.TRP$
$HEADERS
   FACTOR DAILY PERSON TRIPS BY TRIP PURPOSE TO DETERMINE
   PEAK HOUR TRIPS
$OPTIONS
$DATA
  T1,1-751,1-751,*0.1204
  T2,1-751,1-751,*0.0963
  T3,1-751,1-751,*0.1099
  T4,1-751,1-751,*0.1022
  T5,1-751,1-751,*0.0963
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHR95PT.TRP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $LVPKHR95.TRP$
$HEADER
    LV95 NETWORK PEAK HOUR PERSON TRIPS TO VEHICLE TRIPS
      (AVG. 1.32 PERSONS PER VEHICLE)
$OPTION
$DATA
  P1, 1-751, 1-751, *0.8929
  P2, 1-751, 1-751, *0.6666
```

```
  P3, 1-751, 1-751, *0.7042
  P4, 1-751, 1-751, *0.6803
  P5, 1-751, 1-751, *0.7692
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $LVSUM95.TRP$,
  OUTPUT FILE = UPDOUT, USER ID = $IE95PKHR.TRP$
$HEADERS
   FACTOR INTERNAL-EXTERNAL TRIPS BY .1065 TO DETERMINE PEAK HOUR
   INTERNAL-EXTERNAL TRIPS
$OPTIONS
$DATA
  T1, 1-751, 1-751, *.1065
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $LVPKHR95.TRP$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $IE95PKHR.TRP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $LVPKHR95.VEH$
$HEADER
  MERGING PURPOSES
$OPTION
$DATA
  TMAN3,T1=TMAN1,T1+TMAN1,T2+TMAN1,T3+TMAN1,T4+TMAN1,T5+TMAN2,T1
$END TP FUNCTION
$EQUILIBRIUM HIGHWAY LOAD
$FILES
  INPUT FILE = HWYNET, USER ID = $LV95PKHR.NET$, UNLOAD
  INPUT FILE = HWYTRIP, USER ID = $LVPKHR95.VEH$, UNLOAD
  OUTPUT FILE = LODHIST, USER ID = $FREEHR95.LOD$
$HEADER
    LV95 "N" NETWORK 1995 PEAK HOUR PROD'S AND ATTR'S LOADED
$PARAMETERS
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
           (3-2,50) (4-3,50) (1-4,50) (2-1,50)
  EQUILIBRIUM ITERATIONS = 6
  EPS = 0.01
$END TP FUNCTION
$HIGHWAY SELECTED SUMMATION
$FILES
  INPUT FILE = HWYNET, USER ID = $FREEHR95.LOD$
  OUTPUT FILE = HWYSKIM, USER ID = $PKHR95EZ.SKM$
$HEADER
    **SECOND ITERATION ON CONGESTED SPEEDS BEGINS HERE**
```

```
   LV95 PEAK HOUR NETWORK INTERZONAL SKIMS
$PARAMETERS
  IMPEDANCE = TIME 1
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
            (3-2,50) (4-3,50) (1-4,50) (2-1,50)
$DATA
  TABLE = TIME 1
$END TP FUNCTION
$BUILD INTRAZONAL IMPEDANCES
$FILES
  INPUT FILE = IZIN, USER ID = $PKHR95EZ.SKM$, UNLOAD
  OUTPUT FILE = IZOUT, USER ID = $PKHR95IZ.SKM$
$HEADER
   LV95 PEAK HOUR NETWORK INTRAZONAL SKIMS
$OPTION
~ PRINT DETAIL
$PARAMETERS
  NUMBER OF ADJACENT ZONES = 2
$END TP FUNCTION
$GRAVITY MODEL
$FILES
  INPUT FILE = GMSKIM, USER ID = $PKHR95IZ.SKM$, UNLOAD
  INPUT FILE = GRVDATA, USER ID = $NEWPA95.RTC$
  OUTPUT FILE = GMVOL, USER ID = $DAILY95.PA$
$HEADER
    LV95 NETWORK & 1995 PEAK HOUR TRIPS
    GRAVITY MODEL OUTPUT -- FIVE PURPOSES
$OPTIONS
  GRVDATA
  MERGED PURPOSE FILE
  PRINT TRIP LENGTH STATISTICS
$PARAMETERS
  MAXIMUM TIME = 75
  MAXIMUM PURPOSE = 5
  ITERATIONS ON ATTRACTIONS = 5
$END TP FUNCTION
$MATRIX TRANSPOSE
$FILES
  INPUT FILE = TRNSPIN, USER ID = $DAILY95.PA$
  OUTPUT FILE = TRNSPOT, USER ID = $DAILY95.AP$
$HEADER
   LV95 NETWORK TRANSPOSED PEAK HOUR TRIP TABLE
$OPTION
$PARAMETERS
$END TP FUNCTION
```

```
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY95.PA$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR954.PA$
$HEADER
     FACTORING DAILY GRAVITY MODEL PRODUCTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.204
  T2,1-751,1-751,*0.193
  T3,1-751,1-751,*0.451
  T4,1-751,1-751,*0.343
  T5,1-751,1-751,*0.895
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY95.AP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR954.AP$
$HEADER
     FACTORING DAILY GRAVITY MODEL ATTRACTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.796
  T2,1-751,1-751,*0.807
  T3,1-751,1-751,*0.549
  T4,1-751,1-751,*0.657
  T5,1-751,1-751,*0.105
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $PKHR954.PA$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $PKHR954.AP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $PKHOUR95.VOL$
$HEADER
    LV95 PEAK HOUR NETWORK P/A TABLE + A/P TABLE
$DATA
  TMAN3,T1 = TMAN1,T1 + TMAN2,T1
  TMAN3,T2 = TMAN1,T2 + TMAN2,T2
  TMAN3,T3 = TMAN1,T3 + TMAN2,T3
  TMAN3,T4 = TMAN1,T4 + TMAN2,T4
  TMAN3,T5 = TMAN1,T5 + TMAN2,T5
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHOUR95.VOL$, UNLOAD
```

```
 OUTPUT FILE = UPDOUT, USER ID = $PKHR95PT.TRP$
$HEADERS
  FACTOR DAILY PERSON TRIPS BY TRIP PURPOSE TO DETERMINE
  PEAK HOUR TRIPS
$OPTIONS
$DATA
 T1,1-751,1-751,*0.1204
 T2,1-751,1-751,*0.0963
 T3,1-751,1-751,*0.1099
 T4,1-751,1-751,*0.1022
 T5,1-751,1-751,*0.0963
$END TP FUNCTION
$MATRIX UPDATE
$FILES
 INPUT FILE = UPDIN, USER ID = $PKHR95PT.TRP$, UNLOAD
 OUTPUT FILE = UPDOUT, USER ID = $LVPKHR95.TRP$
$HEADER
   LV95 NETWORK PEAK HOUR PERSON TRIPS TO VEHICLE TRIPS
    (AVG. 1.32 PERSONS PER VEHICLE)
$OPTION
$DATA
 P1, 1-751, 1-751, *0.8929
 P2, 1-751, 1-751, *0.6666
 P3, 1-751, 1-751, *0.7042
 P4, 1-751, 1-751, *0.6803
 P5, 1-751, 1-751, *0.7692
$END TP FUNCTION
$MATRIX UPDATE
$FILES
 INPUT FILE = UPDIN, USER ID = $LVSUM95.TRP$,
 OUTPUT FILE = UPDOUT, USER ID = $IE95PKHR.TRP$
$HEADERS
  FACTOR INTERNAL-EXTERNAL TRIPS BY .1065 TO DETERMINE PEAK HOUR
  INTERNAL-EXTERNAL TRIPS
$OPTIONS
$DATA
 T1, 1-751, 1-751, *.1065
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
 INPUT FILE = TMAN1, USER ID = $LVPKHR95.TRP$, UNLOAD
 INPUT FILE = TMAN2, USER ID = $IE95PKHR.TRP$, UNLOAD
 OUTPUT FILE = TMAN3, USER ID = $LVPKHR95.VEH$
$HEADER
  MERGING PURPOSES
```

```
$OPTION
$DATA
  TMAN3,T1=TMAN1,T1+TMAN1,T2+TMAN1,T3+TMAN1,T4+TMAN1,T5+TMAN2,T1
$END TP FUNCTION
$EQUILIBRIUM HIGHWAY LOAD
$FILES
  INPUT FILE = HWYNET, USER ID = $FREEHR95.LOD$, UNLOAD
  INPUT FILE = HWYTRIP, USER ID = $LVPKHR95.VEH$, UNLOAD
  OUTPUT FILE = LODHIST, USER ID = $CONGHR95.LOD$
$HEADER
    LV95 "N" NETWORK 1995 PEAK HOUR PROD'S AND ATTR'S LOADED
    *** CONGESTED SPEED NETWORK ***
$PARAMETERS
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
            (3-2,50) (4-3,50) (1-4,50) (2-1,50)
  EQUILIBRIUM ITERATIONS = 6
  EPS = 0.01
$END TP FUNCTION
$REPORT HIGHWAY NETWORK SUMMARY
$FILE
 INPUT FILE = LODHIST, USERID = $CONGHR95.LOD$
$OPTIONS
  SPEED SUMMARY
  VC SUMMARY
$PARAMETERS
$DATA
 TABLE=1, UNITS = VEHICLE-DISTANCE, LINK CODE = ASSIGNMENT GROUP
 TABLE=2, UNITS = VEHICLE-HOURS, LINK CODE = ASSIGNMENT GROUP
$END TP FUNCTION
```

LAS VEGAS 2000 PEAK PERIOD TRANPLAN FILES

Task		File Name	Description
CONTROL FILE		CTRL20PH.IN	PEAK HOUR CONTROL FILE - RESTRAINED
		CONG20PH.IN	PEAK HOUR CONTROL FILE - TWICE RESTRAINED
NETWORK			
	INPUT FILE	LV20N.NET	2000 LAS VEGAS NETWORK FILE FROM RTC
	OUTPUT FILE	LV20PKHR.NET	PEAK HOUR NETWORK
DISTRIBUTION			
	INPUT FILE	NEWPA20.RTC	P/A TABLE FROM RTC
	OUTPUT FILE	LVPKHR20.TRP	PEAK HOUR INTERNAL TRIP TABLE
FINAL TRIP TABLE			
	INPUT FILE	LVPKHR20.TRP	PEAK HOUR INTERNAL TRIP TABLE
	INPUT FILE	LVSUM20.TRP	INT/EXT TRIP TABLE FROM RTC
	OUTPUT FILE	IE20PKHR.TRPS	PEAK HOUR INT/EXT MATRIX
	OUTPUT FILE	LVPKHR20.VEH	PEAK HOUR VEHICLE TRIP MATRIX
ASSIGNMENT			
	INPUT FILE	LV20PKHR.NET	PEAK HOUR NETWORK
	INPUT FILE	LVPKHR20.VEH	PEAK HOUR VEHICLE TRIP MATRIX
	OUTPUT FILE	LVPKHR20.LOD	PEAK HOUR 2000 RESTRAINED ASSIGNMENT
	OUTPUT FILE	CONGHR20.LOD	PEAK HOUR 2000 TWICE-RESTRAINED ASSIGNMENT

2000 PEAK HOUR TRANPLAN CONTROL FILES

```
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV20N.NET$
 OUTPUT FILE = MACOUT, USER ID = $LV20G2.NET$
$DATA
 ASSIGNMENT GROUP=1, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=2, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=3, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=4, CHANGE, SPEED 1 = R 2500
 ASSIGNMENT GROUP=5, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=6, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=7, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=8, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=1, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 660
 ASSIGNMENT GROUP=1, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1250
 ASSIGNMENT GROUP=2, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 900
 ASSIGNMENT GROUP=2, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1700
 ASSIGNMENT GROUP=2, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 2475
 ASSIGNMENT GROUP=3, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 1100
 ASSIGNMENT GROUP=3, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 2100
 ASSIGNMENT GROUP=3, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 3000
 ASSIGNMENT GROUP=3, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 4000
 ASSIGNMENT GROUP=4, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 800
 ASSIGNMENT GROUP=4, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1525
 ASSIGNMEMT GROUP=5-6, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 4000
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 6000
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 8000
 ASSIGNMENT GROUP=7, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 3900
 ASSIGNMENT GROUP=7, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 5600
 ASSIGNMENT GROUP=7, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 7400
 ASSIGNMENT GROUP=8, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 660
 ASSIGNMENT GROUP=8, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1250
 ASSIGNMENT GROUP=8, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 1825
 ASSIGNMENT GROUP=8, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 2400
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV20G2.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV20G3.NET$
$DATA
 ASSIGNMENT GROUP=2,8, LINK GROUP 3=1, CHANGE, SPEED 1, R 2500
```

```
 ASSIGNMENT GROUP=3, LINK GROUP 3=1, CHANGE, SPEED 1, R 3000
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=2,3, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3= 7,8,10, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=9, CHANGE, SPEED 1, R 4000
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=5,11,12, CHANGE, SPEED 1, R 4500
 ASSIGNMENT GROUP=3, LINK GROUP 3=4,6, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=5, LINK GROUP 3=0, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, CAPACITY 1, *0.5
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV20G3.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV20PKHR.NET$
$DATA
 LINK GROUP 3 = 5,11,12, DIRECTION CODE = 1,3, CHANGE, SPEED 1=*.8
$END TP FUNCTION
$HIGHWAY SELECTED SUMMATION
$FILES
  INPUT FILE = HWYNET, USER ID = $LV20PKHR.NET$
  OUTPUT FILE = HWYSKIM, USER ID = $PKHR20EZ.SKM$
$HEADER
    LV20 PEAK HOUR NETWORK INTERZONAL SKIMS
$PARAMETERS
  IMPEDANCE = TIME 1
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
           (3-2,50) (4-3,50) (1-4,50) (2-1,50)
$DATA
  TABLE = TIME 1
$END TP FUNCTION
$BUILD INTRAZONAL IMPEDANCES
$FILES
  INPUT FILE = IZIN, USER ID = $PKHR20EZ.SKM$, UNLOAD
  OUTPUT FILE = IZOUT, USER ID = $PKHR20IZ.SKM$
$HEADER
    LV20 PEAK HOUR NETWORK INTRAZONAL SKIMS
$OPTION
~ PRINT DETAIL
$PARAMETERS
  NUMBER OF ADJACENT ZONES = 2
$END TP FUNCTION
$GRAVITY MODEL
$FILES
  INPUT FILE = GMSKIM, USER ID = $PKHR20IZ.SKM$, UNLOAD
  INPUT FILE = GRVDATA, USER ID = $NEWPA20.RTC$
```

```
  OUTPUT FILE = GMVOL, USER ID = $DAILY20.PA$
$HEADER
    LV20 NETWORK & 2000 PEAK HOUR TRIPS
    GRAVITY MODEL OUTPUT -- FIVE PURPOSES
$OPTIONS
  GRVDATA
  MERGED PURPOSE FILE
  PRINT TRIP LENGTH STATISTICS
$PARAMETERS
  MAXIMUM TIME = 75
  MAXIMUM PURPOSE = 5
  ITERATIONS ON ATTRACTIONS = 5
$END TP FUNCTION
$MATRIX TRANSPOSE
$FILES
  INPUT FILE = TRNSPIN, USER ID = $DAILY20.PA$
  OUTPUT FILE = TRNSPOT, USER ID = $DAILY20.AP$
$HEADER
    LV20 NETWORK TRANSPOSED PEAK HOUR TRIP TABLE
$OPTION
$PARAMETERS
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY20.PA$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR204.PA$
$HEADER
     FACTORING DAILY GRAVITY MODEL PRODUCTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.204
  T2,1-751,1-751,*0.193
  T3,1-751,1-751,*0.451
  T4,1-751,1-751,*0.343
  T5,1-751,1-751,*0.895
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY20.AP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR204.AP$
$HEADER
     FACTORING DAILY GRAVITY MODEL ATTRACTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.796
```

```
  T2,1-751,1-751,*0.807
  T3,1-751,1-751,*0.549
  T4,1-751,1-751,*0.657
  T5,1-751,1-751,*0.105
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $PKHR204.PA$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $PKHR204.AP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $PKHOUR20.VOL$
$HEADER
     LV20 PEAK HOUR NETWORK P/A TABLE + A/P TABLE
$DATA
  TMAN3,T1 = TMAN1,T1 + TMAN2,T1
  TMAN3,T2 = TMAN1,T2 + TMAN2,T2
  TMAN3,T3 = TMAN1,T3 + TMAN2,T3
  TMAN3,T4 = TMAN1,T4 + TMAN2,T4
  TMAN3,T5 = TMAN1,T5 + TMAN2,T5
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHOUR20.VOL$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR20PT.TRP$
$HEADERS
    FACTOR DAILY PERSON TRIPS BY TRIP PURPOSE TO DETERMINE
    PEAK HOUR TRIPS
$OPTIONS
$DATA
  T1,1-751,1-751,*0.1204
  T2,1-751,1-751,*0.0963
  T3,1-751,1-751,*0.1099
  T4,1-751,1-751,*0.1022
  T5,1-751,1-751,*0.0963
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHR20PT.TRP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $LVPKHR20.TRP$
$HEADER
     LV20 NETWORK PEAK HOUR PERSON TRIPS TO VEHICLE TRIPS
       (AVG. 1.32 PERSONS PER VEHICLE)
$OPTION
$DATA
  P1, 1-751, 1-751, *0.8929
  P2, 1-751, 1-751, *0.6666
```

```
  P3, 1-751, 1-751, *0.7042
  P4, 1-751, 1-751, *0.6803
  P5, 1-751, 1-751, *0.7692
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $LVSUM20.TRP$,
  OUTPUT FILE = UPDOUT, USER ID = $IE20PKHR.TRP$
$HEADERS
   FACTOR INTERNAL-EXTERNAL TRIPS BY .1065 TO DETERMINE PEAK HOUR
   INTERNAL-EXTERNAL TRIPS
$OPTIONS
$DATA
  T1, 1-751, 1-751, *.1065
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $LVPKHR20.TRP$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $IE20PKHR.TRP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $LVPKHR20.VEH$
$HEADER
  MERGING PURPOSES
$OPTION
$DATA
  TMAN3,T1=TMAN1,T1+TMAN1,T2+TMAN1,T3+TMAN1,T4+TMAN1,T5+TMAN2,T1
$END TP FUNCTION
$EQUILIBRIUM HIGHWAY LOAD
$FILES
  INPUT FILE = HWYNET, USER ID = $LV20PKHR.NET$, UNLOAD
  INPUT FILE = HWYTRIP, USER ID = $LVPKHR20.VEH$, UNLOAD
  OUTPUT FILE = LODHIST, USER ID = $FREEHR20.LOD$
$HEADER
    LV20 "N" NETWORK 2000 PEAK HOUR PROD'S AND ATTR'S LOADED
$PARAMETERS
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
            (3-2,50) (4-3,50) (1-4,50) (2-1,50)
  EQUILIBRIUM ITERATIONS = 6
  EPS = 0.01
$END TP FUNCTION
$HIGHWAY SELECTED SUMMATION
$FILES
  INPUT FILE = HWYNET, USER ID = $FREEHR20.LOD$
  OUTPUT FILE = HWYSKIM, USER ID = $PKHR20EZ.SKM$
$HEADER
    **SECOND ITERATION ON CONGESTED SPEEDS BEGINS HERE ***
```

```
    LV20 PEAK HOUR NETWORK INTERZONAL SKIMS
$PARAMETERS
  IMPEDANCE = TIME 1
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
            (3-2,50) (4-3,50) (1-4,50) (2-1,50)
$DATA
  TABLE = TIME 1
$END TP FUNCTION
$BUILD INTRAZONAL IMPEDANCES
$FILES
  INPUT FILE = IZIN, USER ID = $PKHR20EZ.SKM$, UNLOAD
  OUTPUT FILE = IZOUT, USER ID = $PKHR20IZ.SKM$
$HEADER
    LV20 PEAK HOUR NETWORK INTRAZONAL SKIMS
$OPTION
~ PRINT DETAIL
$PARAMETERS
  NUMBER OF ADJACENT ZONES = 2
$END TP FUNCTION
$GRAVITY MODEL
$FILES
  INPUT FILE = GMSKIM, USER ID = $PKHR20IZ.SKM$, UNLOAD
  INPUT FILE = GRVDATA, USER ID = $NEWPA20.RTC$
  OUTPUT FILE = GMVOL, USER ID = $DAILY20.PA$
$HEADER
    LV20 NETWORK & 2000 PEAK HOUR TRIPS
    GRAVITY MODEL OUTPUT -- FIVE PURPOSES
$OPTIONS
  GRVDATA
  MERGED PURPOSE FILE
  PRINT TRIP LENGTH STATISTICS
$PARAMETERS
  MAXIMUM TIME = 75
  MAXIMUM PURPOSE = 5
  ITERATIONS ON ATTRACTIONS = 5
$END TP FUNCTION
$MATRIX TRANSPOSE
$FILES
  INPUT FILE = TRNSPIN, USER ID = $DAILY20.PA$
  OUTPUT FILE = TRNSPOT, USER ID = $DAILY20.AP$
$HEADER
    LV20 NETWORK TRANSPOSED PEAK HOUR TRIP TABLE
$OPTION
$PARAMETERS
$END TP FUNCTION
```

```
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY20.PA$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR204.PA$
$HEADER
     FACTORING DAILY GRAVITY MODEL PRODUCTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.204
  T2,1-751,1-751,*0.193
  T3,1-751,1-751,*0.451
  T4,1-751,1-751,*0.343
  T5,1-751,1-751,*0.895
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY20.AP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR204.AP$
$HEADER
     FACTORING DAILY GRAVITY MODEL ATTRACTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.796
  T2,1-751,1-751,*0.807
  T3,1-751,1-751,*0.549
  T4,1-751,1-751,*0.657
  T5,1-751,1-751,*0.105
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $PKHR204.PA$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $PKHR204.AP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $PKHOUR20.VOL$
$HEADER
     LV20 PEAK HOUR NETWORK P/A TABLE + A/P TABLE
$DATA
  TMAN3,T1 = TMAN1,T1 + TMAN2,T1
  TMAN3,T2 = TMAN1,T2 + TMAN2,T2
  TMAN3,T3 = TMAN1,T3 + TMAN2,T3
  TMAN3,T4 = TMAN1,T4 + TMAN2,T4
  TMAN3,T5 = TMAN1,T5 + TMAN2,T5
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHOUR20.VOL$, UNLOAD
```

```
  OUTPUT FILE = UPDOUT, USER ID = $PKHR20PT.TRP$
$HEADERS
   FACTOR DAILY PERSON TRIPS BY TRIP PURPOSE TO DETERMINE
   PEAK HOUR TRIPS
$OPTIONS
$DATA
  T1,1-751,1-751,*0.1204
  T2,1-751,1-751,*0.0963
  T3,1-751,1-751,*0.1099
  T4,1-751,1-751,*0.1022
  T5,1-751,1-751,*0.0963
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHR20PT.TRP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $LVPKHR20.TRP$
$HEADER
    LV20 NETWORK PEAK HOUR PERSON TRIPS TO VEHICLE TRIPS
      (AVG. 1.32 PERSONS PER VEHICLE)
$OPTION
$DATA
  P1, 1-751, 1-751, *0.8929
  P2, 1-751, 1-751, *0.6666
  P3, 1-751, 1-751, *0.7042
  P4, 1-751, 1-751, *0.6803
  P5, 1-751, 1-751, *0.7692
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $LVSUM20.TRP$,
  OUTPUT FILE = UPDOUT, USER ID = $IE20PKHR.TRP$
$HEADERS
   FACTOR INTERNAL-EXTERNAL TRIPS BY .1065 TO DETERMINE PEAK HOUR
   INTERNAL-EXTERNAL TRIPS
$OPTIONS
$DATA
  T1, 1-751, 1-751, *.1065
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $LVPKHR20.TRP$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $IE20PKHR.TRP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $LVPKHR20.VEH$
$HEADER
  MERGING PURPOSES
```

```
$OPTION
$DATA
  TMAN3,T1=TMAN1,T1+TMAN1,T2+TMAN1,T3+TMAN1,T4+TMAN1,T5+TMAN2,T1
$END TP FUNCTION
$EQUILIBRIUM HIGHWAY LOAD
$FILES
  INPUT FILE = HWYNET, USER ID = $FREEHR20.LOD$, UNLOAD
  INPUT FILE = HWYTRIP, USER ID = $LVPKHR20.VEH$, UNLOAD
  OUTPUT FILE = LODHIST, USER ID = $CONGHR20.LOD$
$HEADER
    LV20 "N" NETWORK 2000 PEAK HOUR PROD'S AND ATTR'S LOADED
$PARAMETERS
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
            (3-2,50) (4-3,50) (1-4,50) (2-1,50)
  EQUILIBRIUM ITERATIONS = 6
  EPS = 0.01
$END TP FUNCTION
$REPORT HIGHWAY NETWORK SUMMARY
$FILE
  INPUT FILE = LODHIST, USERID = $CONGHR20.LOD$
$OPTIONS
  SPEED SUMMARY
  VC SUMMARY
$PARAMETERS
$DATA
  TABLE=1, UNITS = VEHICLE-DISTANCE, LINK CODE = ASSIGNMENT GROUP
  TABLE=2, UNITS = VEHICLE-HOURS, LINK CODE = ASSIGNMENT GROUP
$END TP FUNCTION
```

LAS VEGAS 2010 PEAK PERIOD TRANPLAN FILES

Task		File Name	Description
CONTROL FILE		CTRL10PH.IN	PEAK HOUR CONTROL FILE - RESTRAINED
		CONG10PH.IN	PEAK HOUR CONTROL FILE - TWICE RESTRAINED
NETWORK			
	INPUT FILE	LV10N.NET	2010 LAS VEGAS NETWORK FILE FROM RTC
	OUTPUT FILE	LV10PKHR.NET	PEAK HOUR NETWORK
DISTRIBUTION			
	INPUT FILE	NEWPA10.RTC	P/A TABLE FROM RTC
	OUTPUT FILE	LVPKHR10.TRP	PEAK HOUR INTERNAL TRIP TABLE
FINAL TRIP TABLE			
	INPUT FILE	LVPKHR10.TRP	PEAK HOUR INTERNAL TRIP TABLE
	INPUT FILE	LVSUM10.TRP	INT/EXT TRIP TABLE FROM RTC
	OUTPUT FILE	IE10PKHR.TRPS	PEAK HOUR INT/EXT MATRIX
	OUTPUT FILE	LVPKHR10.VEH	PEAK HOUR VEHICLE TRIP MATRIX
ASSIGNMENT			
	INPUT FILE	LV10PKHR.NET	PEAK HOUR NETWORK
	INPUT FILE	LVPKHR10.VEH	PEAK HOUR VEHICLE TRIP MATRIX
	OUTPUT FILE	LVPKHR10.LOD	PEAK HOUR 2010 RESTRAINED ASSIGNMENT
	OUTPUT FILE	CONGHR10.LOD	PEAK HOUR 2010 TWICE-RESTRAINED ASSIGNMENT

2010 PEAK HOUR TRANPLAN CONTROL FILES

```
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV10N.NET$
 OUTPUT FILE = MACOUT, USER ID = $LV10G2.NET$
$DATA
 ASSIGNMENT GROUP=1, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=2, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=3, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=4, CHANGE, SPEED 1 = R 2500
 ASSIGNMENT GROUP=5, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=6, CHANGE, SPEED 1 = R 6000
 ASSIGNMENT GROUP=7, CHANGE, SPEED 1 = R 5000
 ASSIGNMENT GROUP=8, CHANGE, SPEED 1 = R 4500
 ASSIGNMENT GROUP=1, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 660
 ASSIGNMENT GROUP=1, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1250
 ASSIGNMENT GROUP=2, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 900
 ASSIGNMENT GROUP=2, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1700
 ASSIGNMENT GROUP=2, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 2475
 ASSIGNMENT GROUP=3, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 1100
 ASSIGNMENT GROUP=3, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 2100
 ASSIGNMENT GROUP=3; LINK GROUP 1=3, CHANGE, CAPACITY 1, R 3000
 ASSIGNMENT GROUP=3, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 4000
 ASSIGNMENT GROUP=4, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 800
 ASSIGNMENT GROUP=4, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1525
 ASSIGNMEMT GROUP=5-6, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 4000
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 6000
 ASSIGNMENT GROUP=5-6, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 8000
 ASSIGNMENT GROUP=7, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 3900
 ASSIGNMENT GROUP=7, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 5600
 ASSIGNMENT GROUP=7, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 7400
 ASSIGNMENT GROUP=8, LINK GROUP 1=1, CHANGE, CAPACITY 1, R 660
 ASSIGNMENT GROUP=8, LINK GROUP 1=2, CHANGE, CAPACITY 1, R 1250
 ASSIGNMENT GROUP=8, LINK GROUP 1=3, CHANGE, CAPACITY 1, R 1825
 ASSIGNMENT GROUP=8, LINK GROUP 1=4, CHANGE, CAPACITY 1, R 2400
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV10G2.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV10G3.NET$
$DATA
 ASSIGNMENT GROUP=2,8, LINK GROUP 3=1, CHANGE, SPEED 1, R 2500
```

```
 ASSIGNMENT GROUP=3, LINK GROUP 3=1, CHANGE, SPEED 1, R 3000
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=2,3, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3= 7,8,10, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=9, CHANGE, SPEED 1, R 4000
 ASSIGNMENT GROUP=2,3,8, LINK GROUP 3=5,11,12, CHANGE, SPEED 1, R 4500
 ASSIGNMENT GROUP=3, LINK GROUP 3=4,6, CHANGE, SPEED 1, R 3500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=5, LINK GROUP 3=0, CHANGE, SPEED 1, R 5500
 ASSIGNMENT GROUP=6, LINK GROUP 3=6, CHANGE, CAPACITY 1, *0.5
$END TP FUNCTION
$MACRO HIGHWAY NETWORK UPDATE
$FILES
 INPUT FILE = MACIN, USER ID = $LV10G3.NET$, UNLOAD
 OUTPUT FILE = MACOUT, USER ID = $LV10PKHR.NET$
$DATA
 LINK GROUP 3 = 5,11,12, DIRECTION CODE = 1,3, CHANGE, SPEED 1=*.8
$END TP FUNCTION
$HIGHWAY SELECTED SUMMATION
$FILES
  INPUT FILE = HWYNET, USER ID = $LV10PKHR.NET$
  OUTPUT FILE = HWYSKIM, USER ID = $PKHR10EZ.SKM$
$HEADER
    LV10 PEAK HOUR NETWORK INTERZONAL SKIMS
$PARAMETERS
  IMPEDANCE = TIME 1
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
           (3-2,50) (4-3,50) (1-4,50) (2-1,50)
$DATA
  TABLE = TIME 1
$END TP FUNCTION
$BUILD INTRAZONAL IMPEDANCES
$FILES
  INPUT FILE = IZIN, USER ID = $PKHR10EZ.SKM$, UNLOAD
  OUTPUT FILE = IZOUT, USER ID = $PKHR10IZ.SKM$
$HEADER
    LV10 PEAK HOUR NETWORK INTRAZONAL SKIMS
$OPTION
~ PRINT DETAIL
$PARAMETERS
  NUMBER OF ADJACENT ZONES = 2
$END TP FUNCTION
$GRAVITY MODEL
$FILES
  INPUT FILE = GMSKIM, USER ID = $PKHR10IZ.SKM$, UNLOAD
  INPUT FILE = GRVDATA, USER ID = $NEWPA10.RTC$
```

```
 OUTPUT FILE = GMVOL, USER ID = $DAILY10.PA$
$HEADER
    LV10 NETWORK & 2010 PEAK HOUR TRIPS
    GRAVITY MODEL OUTPUT -- FIVE PURPOSES
$OPTIONS
 GRVDATA
 MERGED PURPOSE FILE
 PRINT TRIP LENGTH STATISTICS
$PARAMETERS
 MAXIMUM TIME = 75
 MAXIMUM PURPOSE = 5
 ITERATIONS ON ATTRACTIONS = 5
$END TP FUNCTION
$MATRIX TRANSPOSE
$FILES
 INPUT FILE = TRNSPIN, USER ID = $DAILY10.PA$
 OUTPUT FILE = TRNSPOT, USER ID = $DAILY10.AP$
$HEADER
    LV10 NETWORK TRANSPOSED PEAK HOUR TRIP TABLE
$OPTION
$PARAMETERS
$END TP FUNCTION
$MATRIX UPDATE
$FILES
 INPUT FILE = UPDIN, USER ID = $DAILY10.PA$, UNLOAD
 OUTPUT FILE = UPDOUT, USER ID = $PKHR104.PA$
$HEADER
    FACTORING DAILY GRAVITY MODEL PRODUCTIONS TO A PEAK HOUR
    DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
 T1,1-751,1-751,*0.204
 T2,1-751,1-751,*0.193
 T3,1-751,1-751,*0.451
 T4,1-751,1-751,*0.343
 T5,1-751,1-751,*0.895
$END TP FUNCTION
$MATRIX UPDATE
$FILES
 INPUT FILE = UPDIN, USER ID = $DAILY10.AP$, UNLOAD
 OUTPUT FILE = UPDOUT, USER ID = $PKHR104.AP$
$HEADER
    FACTORING DAILY GRAVITY MODEL ATTRACTIONS TO A PEAK HOUR
    DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
 T1,1-751,1-751,*0.796
```

```
  T2,1-751,1-751,*0.807
  T3,1-751,1-751,*0.549
  T4,1-751,1-751,*0.657
  T5,1-751,1-751,*0.105
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $PKHR104.PA$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $PKHR104.AP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $PKHOUR10.VOL$
$HEADER
     LV10 PEAK HOUR NETWORK P/A TABLE + A/P TABLE
$DATA
  TMAN3,T1 = TMAN1,T1 + TMAN2,T1
  TMAN3,T2 = TMAN1,T2 + TMAN2,T2
  TMAN3,T3 = TMAN1,T3 + TMAN2,T3
  TMAN3,T4 = TMAN1,T4 + TMAN2,T4
  TMAN3,T5 = TMAN1,T5 + TMAN2,T5
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHOUR10.VOL$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR10PT.TRP$
$HEADERS
    FACTOR DAILY PERSON TRIPS BY TRIP PURPOSE TO DETERMINE
    PEAK HOUR TRIPS
$OPTIONS
$DATA
  T1,1-751,1-751,*0.1204
  T2,1-751,1-751,*0.0963
  T3,1-751,1-751,*0.1099
  T4,1-751,1-751,*0.1022
  T5,1-751,1-751,*0.0963
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHR10PT.TRP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $LVPKHR10.TRP$
$HEADER
     LV10 NETWORK PEAK HOUR PERSON TRIPS TO VEHICLE TRIPS
      (AVG. 1.32 PERSONS PER VEHICLE)
$OPTION
$DATA
  P1, 1-751, 1-751, *0.8929
  P2, 1-751, 1-751, *0.6666
```

```
  P3, 1-751, 1-751, *0.7042
  P4, 1-751, 1-751, *0.6803
  P5, 1-751, 1-751, *0.7692
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $LVSUM10.TRP$,
  OUTPUT FILE = UPDOUT, USER ID = $IE10PKHR.TRP$
$HEADERS
   FACTOR INTERNAL-EXTERNAL TRIPS BY .1065 TO DETERMINE PEAK HOUR
   INTERNAL-EXTERNAL TRIPS
$OPTIONS
$DATA
  T1, 1-751, 1-751, *.1065
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $LVPKHR10.TRP$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $IE10PKHR.TRP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $LVPKHR10.VEH$
$HEADER
  MERGING PURPOSES
$OPTION
$DATA
  TMAN3,T1=TMAN1,T1+TMAN1,T2+TMAN1,T3+TMAN1,T4+TMAN1,T5+TMAN2,T1
$END TP FUNCTION
$EQUILIBRIUM HIGHWAY LOAD
$FILES
  INPUT FILE = HWYNET, USER ID = $LV10PKHR.NET$, UNLOAD
  INPUT FILE = HWYTRIP, USER ID = $LVPKHR10.VEH$, UNLOAD
  OUTPUT FILE = LODHIST, USER ID = $FREEHR10.LOD$
$HEADER
    LV10 "N" NETWORK 2010 PEAK HOUR PROD'S AND ATTR'S LOADED
$PARAMETERS
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
             (3-2,50) (4-3,50) (1-4,50) (2-1,50)
  EQUILIBRIUM ITERATIONS = 6
  EPS = 0.01
$END TP FUNCTION
$HIGHWAY SELECTED SUMMATION
$FILES
  INPUT FILE = HWYNET, USER ID = $FREEHR10.LOD$
  OUTPUT FILE = HWYSKIM, USER ID = $PKHR10EZ.SKM$
$HEADER
    *** SECOND ITERATION CONGESTED SPPEDS BEGINS HERE ***
```

```
   LV10 PEAK HOUR NETWORK INTERZONAL SKIMS
$PARAMETERS
 IMPEDANCE = TIME 1
 TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
          (3-2,50) (4-3,50) (1-4,50) (2-1,50)
$DATA
 TABLE = TIME 1
$END TP FUNCTION
$BUILD INTRAZONAL IMPEDANCES
$FILES
 INPUT FILE = IZIN, USER ID = $PKHR10EZ.SKM$, UNLOAD
 OUTPUT FILE = IZOUT, USER ID = $PKHR10IZ.SKM$
$HEADER
   LV10 PEAK HOUR NETWORK INTRAZONAL SKIMS
$OPTION
~ PRINT DETAIL
$PARAMETERS
 NUMBER OF ADJACENT ZONES = 2
$END TP FUNCTION
$GRAVITY MODEL
$FILES
 INPUT FILE = GMSKIM, USER ID = $PKHR10IZ.SKM$, UNLOAD
 INPUT FILE = GRVDATA, USER ID = $NEWPA10.RTC$
 OUTPUT FILE = GMVOL, USER ID = $DAILY10.PA$
$HEADER
    LV10 NETWORK & 2010 PEAK HOUR TRIPS
    GRAVITY MODEL OUTPUT -- FIVE PURPOSES
$OPTIONS
 GRVDATA
 MERGED PURPOSE FILE
 PRINT TRIP LENGTH STATISTICS
$PARAMETERS
 MAXIMUM TIME = 75
 MAXIMUM PURPOSE = 5
 ITERATIONS ON ATTRACTIONS = 5
$END TP FUNCTION
$MATRIX TRANSPOSE
$FILES
 INPUT FILE = TRNSPIN, USER ID = $DAILY10.PA$
 OUTPUT FILE = TRNSPOT, USER ID = $DAILY10.AP$
$HEADER
   LV10 NETWORK TRANSPOSED PEAK HOUR TRIP TABLE
$OPTION
$PARAMETERS
$END TP FUNCTION
```

```
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY10.PA$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR104.PA$
$HEADER
     FACTORING DAILY GRAVITY MODEL PRODUCTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.204
  T2,1-751,1-751,*0.193
  T3,1-751,1-751,*0.451
  T4,1-751,1-751,*0.343
  T5,1-751,1-751,*0.895
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $DAILY10.AP$, UNLOAD
  OUTPUT FILE = UPDOUT, USER ID = $PKHR104.AP$
$HEADER
     FACTORING DAILY GRAVITY MODEL ATTRACTIONS TO A PEAK HOUR
     DIRECTIONAL DISTRIBUTION TABLE, BY TRIP PURPOSE
$DATA
  T1,1-751,1-751,*0.796
  T2,1-751,1-751,*0.807
  T3,1-751,1-751,*0.549
  T4,1-751,1-751,*0.657
  T5,1-751,1-751,*0.105
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
  INPUT FILE = TMAN1, USER ID = $PKHR104.PA$, UNLOAD
  INPUT FILE = TMAN2, USER ID = $PKHR104.AP$, UNLOAD
  OUTPUT FILE = TMAN3, USER ID = $PKHOUR10.VOL$
$HEADER
     LV10 PEAK HOUR NETWORK P/A TABLE + A/P TABLE
$DATA
  TMAN3,T1 = TMAN1,T1 + TMAN2,T1
  TMAN3,T2 = TMAN1,T2 + TMAN2,T2
  TMAN3,T3 = TMAN1,T3 + TMAN2,T3
  TMAN3,T4 = TMAN1,T4 + TMAN2,T4
  TMAN3,T5 = TMAN1,T5 + TMAN2,T5
$END TP FUNCTION
$MATRIX UPDATE
$FILES
  INPUT FILE = UPDIN, USER ID = $PKHOUR10.VOL$, UNLOAD
```

```
 OUTPUT FILE = UPDOUT, USER ID = $PKHR10PT.TRP$
$HEADERS
   FACTOR DAILY PERSON TRIPS BY TRIP PURPOSE TO DETERMINE
   PEAK HOUR TRIPS
$OPTIONS
$DATA
 T1,1-751,1-751,*0.1204
 T2,1-751,1-751,*0.0963
 T3,1-751,1-751,*0.1099
 T4,1-751,1-751,*0.1022
 T5,1-751,1-751,*0.0963
$END TP FUNCTION
$MATRIX UPDATE
$FILES
 INPUT FILE = UPDIN, USER ID = $PKHR10PT.TRP$, UNLOAD
 OUTPUT FILE = UPDOUT, USER ID = $LVPKHR10.TRP$
$HEADER
   LV10 NETWORK PEAK HOUR PERSON TRIPS TO VEHICLE TRIPS
    (AVG. 1.32 PERSONS PER VEHICLE)
$OPTION
$DATA
 P1, 1-751, 1-751, *0.8929
 P2, 1-751, 1-751, *0.6666
 P3, 1-751, 1-751, *0.7042
 P4, 1-751, 1-751, *0.6803
 P5, 1-751, 1-751, *0.7692
$END TP FUNCTION
$MATRIX UPDATE
$FILES
 INPUT FILE = UPDIN, USER ID = $LVSUM10.TRP$,
 OUTPUT FILE = UPDOUT, USER ID = $IE10PKHR.TRP$
$HEADERS
   FACTOR INTERNAL-EXTERNAL TRIPS BY .1065 TO DETERMINE PEAK HOUR
   INTERNAL-EXTERNAL TRIPS
$OPTIONS
$DATA
 T1, 1-751, 1-751, *.1065
$END TP FUNCTION
$MATRIX MANIPULATE
$FILES
 INPUT FILE = TMAN1, USER ID = $LVPKHR10.TRP$, UNLOAD
 INPUT FILE = TMAN2, USER ID = $IE10PKHR.TRP$, UNLOAD
 OUTPUT FILE = TMAN3, USER ID = $LVPKHR10.VEH$
$HEADER
   MERGING PURPOSES
```

```
$OPTION
$DATA
  TMAN3,T1=TMAN1,T1+TMAN1,T2+TMAN1,T3+TMAN1,T4+TMAN1,T5+TMAN2,T1
$END TP FUNCTION
$EQUILIBRIUM HIGHWAY LOAD
$FILES
  INPUT FILE = HWYNET, USER ID = $FREEHR10.LOD$, UNLOAD
  INPUT FILE = HWYTRIP, USER ID = $LVPKHR10.VEH$, UNLOAD
  OUTPUT FILE = LODHIST, USER ID = $CONGHR10.LOD$
$HEADER
    LV10 "N" NETWORK 2010 PEAK HOUR PROD'S AND ATTR'S LOADED
    *** CONGESTED SPEED NETWORK ***
$PARAMETERS
  TURN PENALTIES = (3-4,10) (4-1,10) (1-2,10) (2-3,10)
           (3-2,50) (4-3,50) (1-4,50) (2-1,50)
  EQUILIBRIUM ITERATIONS = 6
  EPS = 0.01
$END TP FUNCTION
$REPORT HIGHWAY NETWORK SUMMARY
$FILE
 INPUT FILE = LODHIST, USERID = $CONGHR10.LOD$
$OPTIONS
  SPEED SUMMARY
  VC SUMMARY
$PARAMETERS
$DATA
  TABLE=1, UNITS = VEHICLE-DISTANCE, LINK CODE = ASSIGNMENT GROUP
  TABLE=2, UNITS = VEHICLE-HOURS, LINK CODE = ASSIGNMENT GROUP
$END TP FUNCTION
```