U.S. Department
of Transportation

**Research and
Special Programs
Administration**

Yosemite National Park

Traffic Information System

Network Model

Prepared for:

Yosemite National Park
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Prepared by:

John A. Volpe National Transportation Systems Center
Research and Special Programs Administration
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14. ABSTRACT

This project includes a traffic data needs assessment, creation of a network-based travel demand model, and preparation for multi-modal traffic simulation. The network model presents data of daily traffic flows seasonally throughout the park, providing park administrators with a source to consult when assessing the impact of road closure, tour bus rerouting or relocation, or changes in parking lot capacity. Volpe also worked on potentially enhancing traveler information systems that would assist traffic circulation analysis, daily park operations, information distribution, emergency traffic management, and alternative transportation system management and operations.

15. SUBJECT TERMS

Yosemite, national park, transportation planning, traffic model, traffic information system.

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Introduction

This document describes the transportation network planning model that was developed as part the Yosemite Traffic Information System project. It describes what has been developed and how it may be used. It also presents expected vehicular traffic flows based on recently developed trip tables.

Phase I of the Yosemite Traffic Information System project had three major components. First was an assessment of stakeholder needs. This assessment indicated a strong desire for traffic modeling and simulation capability. Second was the development of a preliminary set of system requirements for a traffic data collection and information system. Third is the development of trip tables, a transportation network planning model and requirements for a simulation model. This document discusses the transportation network planning model.

Network and simulation models can help assess the impacts of changes in transportation system facilities and/or operating conditions. Changes in conditions can be either planned (new transit service, roadway expansion or restriction, parking lot changes) or unplanned (a rockslide that closes a road). Possible impacts of such changes include traveler decisions to change mode (i.e., to use transit options instead of driving), decisions to take an alternative route or travel at another time or to another destination and associated traffic / parking congestion consequences of these traveler decisions.

The scope of the planning model includes the entire park transportation network, except for roads in the Hetch Hetchy. It does not include transportation facilities in areas outside the park but does allow for eventual inclusion of regional bus routes that extend into the park.

The transportation network planning model that has been completed and is discussed herein is a rudimentary model that can be extended and expanded in the future.

The remainder of this document is organized in two major sections

- Transportation network planning model overview
- Traffic flows from the model

Transportation Network Planning Model

Given origin-destination (O-D) trip demands and a roadway network, a transportation network planning model does the following:

- Allocates trips among transportation facilities, in this case Yosemite park roads. Trips are allocated in such a way so that no traveler can shorten his/her travel time by changing an assigned trip routing (user equilibrium).
- Estimates both the traffic volume and the level of congestion (volume / capacity) expected for each link on the roadway network based on travel patterns resulting from the allocation and routing of trips within transportation network.

The YNP transportation network planning model is primarily intended to serve park staff in identifying and assessing park transportation issues and opportunities that may arise as a result of transportation system changes. The model would allow staff at the park and decision makers to assess the impacts of various proposed actions and make informed decisions. This model's near-term applications include:

- Analyzing high travel periods: The model can be used to test and evaluate traffic management contingency plans for addressing high park visitation days (e.g., Memorial Day, 4th of July, and Labor Day) by predicting the traffic response to a proactive action such as rerouting vehicles or deploying park staff to perform traffic control duties at key network locations to mitigate traffic congestion and reduce delay.
- Predicting impacts on highway and alternative transportation operations: The model can be used as a planning tool to predict likely impacts and test various options for dealing with planned or unexpected temporary changes in roadway conditions resulting from construction, maintenance, or rockslides.
- Forecast future traffic patterns and develop strategic plans: The model can be used to assess the probable impact of future visitation growth or changes on YNP transportation systems.

Thematic maps are useful for presenting planning model outputs graphically. These aid efforts to visualize traffic patterns or shifts and assess the impacts of various scenarios on congestion levels.

Planning Model Inputs and Outputs

Network planning model inputs include nodes (trip origin / destination points and connecting points joining network links), lines and network links (pathways between network nodes), and an origin-destination matrix comprised of trips within and between traffic zones circumscribed by network links and nodes. Outputs, as mentioned above, include roadway traffic flows and estimated congestion levels on transportation network links. Within this model, inputs and outputs comprise data types (layers) that can be overlaid to display the network graphically. The network planning data types (layers) and flows are depicted below:

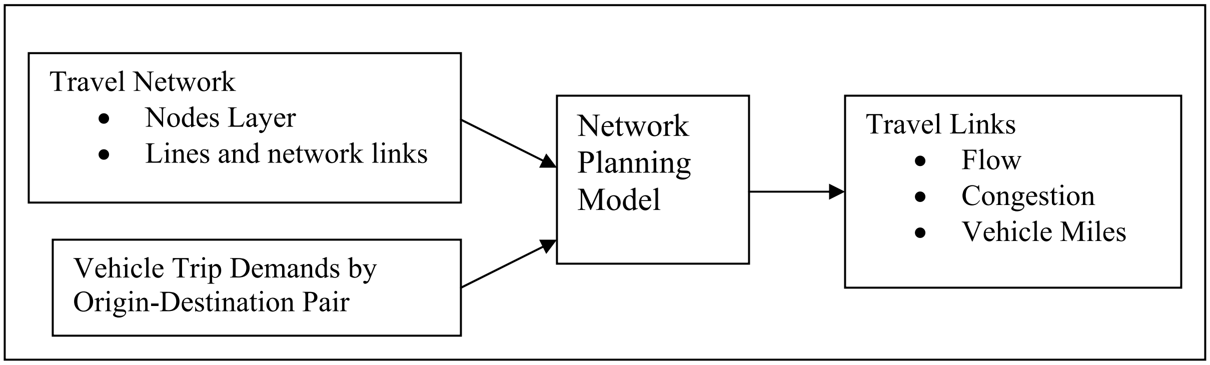

Figure 1 - Data Flows for the Network Planning Model

Node layer

The nodes include:

- Intersections
- Sharp curves in the roadway
- Traffic generators (e.g. the Camp 6 parking lot)
- For transit networks, bus stops.

Critical attributes of each node include a numeric identifier, the latitude, the longitude and whether the node is a centroid. Centroid nodes are those nodes that are associated with traffic generators. Traffic generators include the entrance stations and major attractions within the park. They are the origins and destinations in the network model.

Line and network link layers

The roadway sections (links) are represented in both the line layer and the network layer. The line layer represents the physical attributes of the roadway network, including

- origin node
- destination node
- link distance
- speed limit
- number of lanes
- roadway link classification

The network links represent the operational attributes of the line layer of the roadway network. Link attributes include:

- Associated line (in the line layer)
- Direction (A to B, B to A, or both)
- Free flow travel time, for each direction
- Capacity (vehicles per hour), for each direction
- Exclusion sets. Certain vehicle types, such as private cars, may be excluded from certain network links. The vehicle types considered in the network model include:
    - Administrative Vehicles
    - Day Visitors
    - Overnight Visitors
    - Commercial Buses
    - Transit Vehicles

Within the YNP network planning model, a number of links exclude day visitors, overnight visitors, and commercial buses. Thus, only administrative vehicles and transit vehicles are allowed on these network links.

Figure 2 (below) depicts a small section of the network model for the eastern portion of Yosemite Valley. The red boxes are centroid nodes, the black boxes are ordinary nodes, and the lines are network links. The blue links exclude privately owned vehicles.

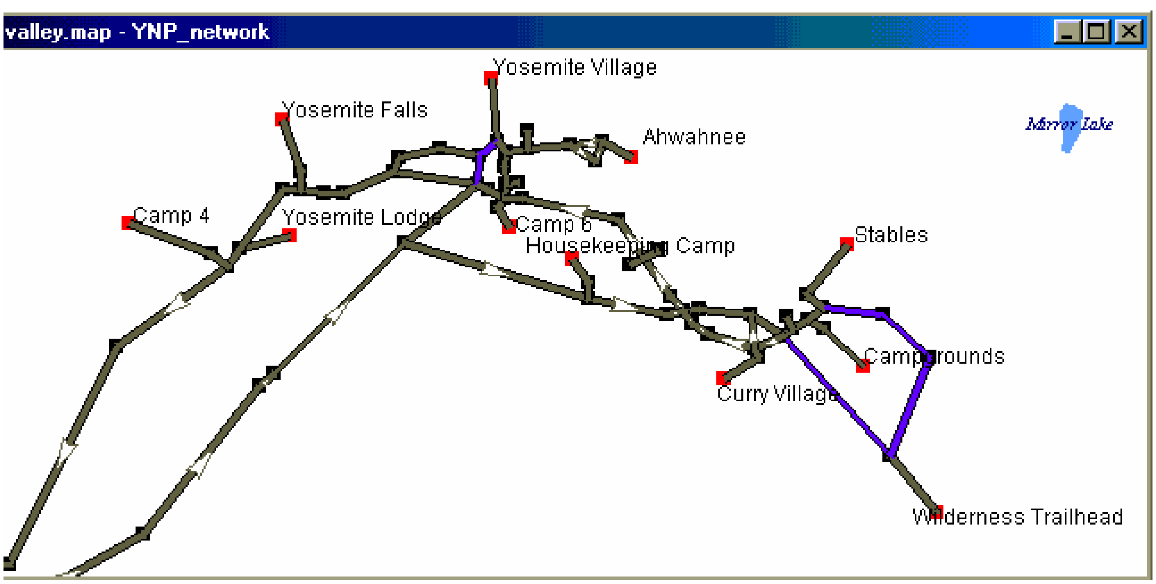

Figure 2 - Yosemite Network (East Valley)

Figure 3 below depicts the transportation network for the entire park (excluding roads in Hetch Hetchy area).

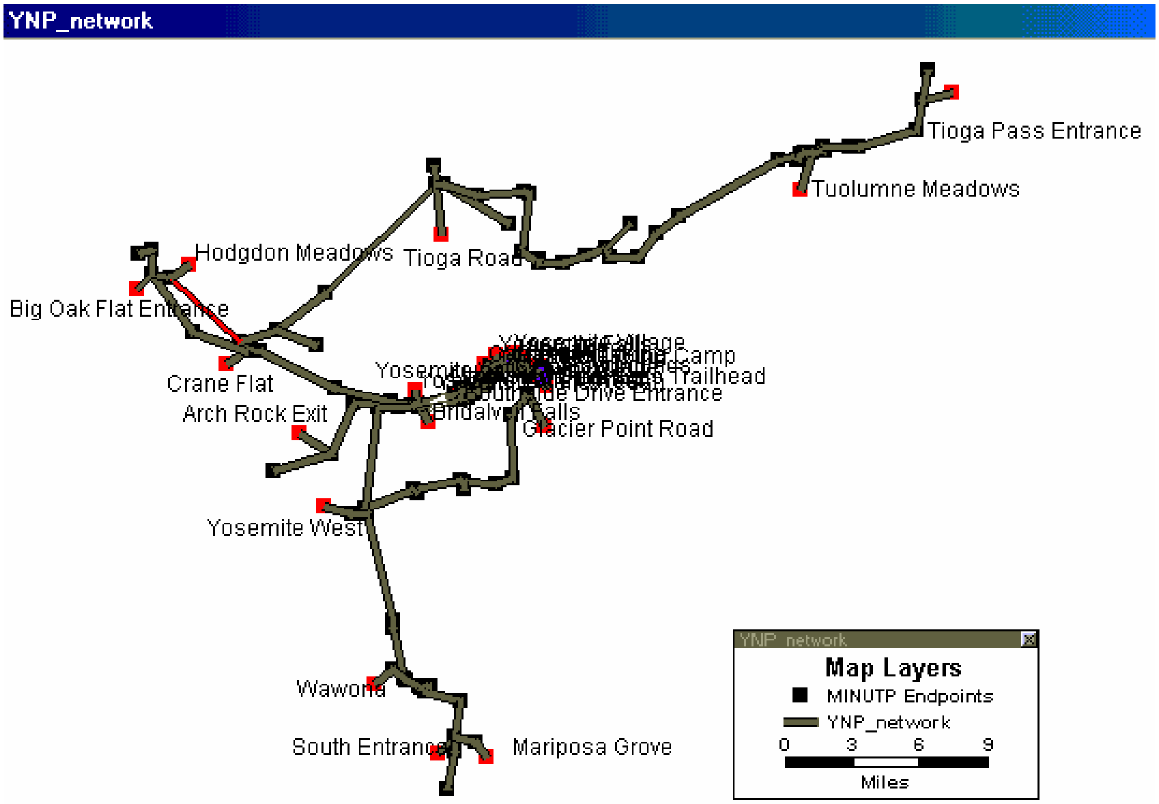

Figure 3 - Yosemite National Park Network

Transit routes (such as the Valley Shuttle) are represented by a similar network map. Finally, since the nodes are mapped to accurate latitude / longitudes, the network developed here can be superimposed on commercially available maps for presentation purposes.

A depiction of the shuttle bus route, superimposed on commercially available mapping and display software (TransCad®), is presented on the following page. Bus stop numbers displayed on the shuttle bus route map were generated automatically by the mapping software, and therefore are slightly different from bus stop numbers actually used in the park.

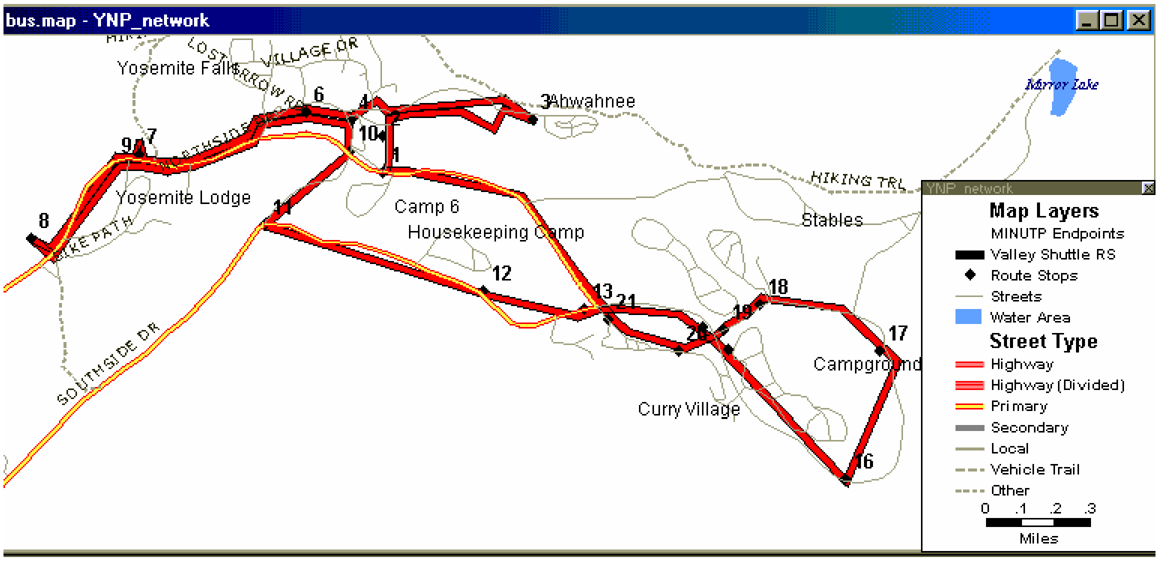

Figure 4 - Shuttle Bus Route

Origin – Destination (O-D) Matrix

The origin destination matrix is based on a series of trip tables developed for the U.S. DOT Volpe Center by David Evans and Associates (DEA) as part of this overall effort. Individual trip tables have been developed to represent midweek and weekend traffic, and various traffic components (i.e., visitor, administrative, and commercial) during representative midweek days (Monday – Thursday) and a representative weekend day (Saturday). Because Friday and Sunday traffic have unique, transitional blends of midweek and weekend characteristics, supplemental development is necessary to model these days explicitly. Modeling the special cases of Friday and Sunday traffic was not considered to be essential as part of initial YNP transportation network planning model development.

Each trip table contains 28 origins and destinations that correspond to the centroid nodes, which appeared as red boxes in Figures 2 and 3. These centroid nodes are listed in Table 1, with latitudes and longitudes given in millionths of a degree. To reduce the number of entries in the trip tables, the nodes in the eastern part of Yosemite Valley (nodes 1 through 13) are treated separately from the other nodes (nodes 14 through 28). This means that any trip between a point in the east Valley and a point elsewhere in the Park is represented as two trips: one from the point in the east Valley to the Valley exit/entrance, and the other from the Valley exit/entrance to the specific point elsewhere in the park. For example, a trip from Yosemite Lodge to the Arch Rock Entrance is represented as follows:

- Yosemite Lodge (node 12) to Northside Drive Exit (node 1), and
- Northside Drive Exit (node 1) to Arch Rock Entrance (node 14)

Segregating the in-valley and out-of-valley nodes in this way allows traffic within Yosemite Valley to be analyzed in greater detail with ease.

Table 1. Network Link – Node Locations

Link ID	Location	Latitude	Longitude
1	Northside Drive Exit	-119627985	37726635
2	Southside Drive Entrance	-119627523	37720857
3	Ahwanhee	-119576499	37747003
4	Camp 4	-119607471	37743733
5	Camp 6	-119584019	37743559
6	Campgrounds	-119562124	37736726
7	Curry Village	-119570747	37736154
8	Housekeeping Camp	-119580100	37741985
9	Stables	-119563134	37742686
10	Wilderness Trailhead	-119557619	37729601
11	Yosemite Falls	-119597932	37748779
12	Yosemite Lodge	-119597535	37743173
13	Yosemite Village	-119585078	37750755
14	Arch Rock Entrance	-119736510	37686460
15	Big Oak Flat Entrance	-119876826	37804399
16	South Entrance	-119635751	37502434
17	Tioga Pass Entrance	-119243385	37913693
18	Bridalveil Falls	-119643365	37715189
19	Crane Flat	-119803206	37740804
20	Glacier Point Road	-119571362	37658007
21	Hodgdon Meadows	-119862494	37790598
22	Mariposa Grove	-119581452	37508085
23	Tioga Road	-119567551	37797049
24	Tuolumne Meadows	-119346450	37863614
25	Wawona	-119654286	37549107
26	Yosemite West	-119719457	37652712
27	Yosemite Valley (East)	-119623041	37724629
28	Yosemite Valley (West)	-119679837	37727213

Transportation Network Planning Model Outputs

The outputs of the transportation network planning model include the traffic flows (volume) on each link, and the volume / capacity (v/c) ratio for each link. A typical way of representing these in a planning model is to depict link line thickness in proportion to the flows, with or without corresponding numerical values, and depict the range of v/c ratio by designated link line colors, as is illustrated below. Roughly speaking, the line colors correspond to capacity as follows:

- Dark green, traffic volume is well within capacity
- Light green, traffic volume is within capacity

- Yellow, traffic volume is near or at capacity, and traffic backups may occur
- Orange or red, traffic volume consistently exceeds capacity

As is typical in traffic networks, the capacity problems tend to occur near intersections, such as Yosemite Falls and Camp 6. Therefore, only a small link (near the intersection) is shown as being near or at capacity. However, the backup from that link may extend onto other links, links that by themselves are not running at capacity.

It is also important to remember that although the network and/or simulation model can be used to predict the traffic impacts of incidents (such as an order to evacuate Yosemite Valley), the traffic flows presented in this model only reflect normal conditions. Furthermore, the results presented here are based on current roadway configuration. As the Yosemite Valley Plan is implemented, both roadway capacities and traffic flows will change significantly.

In addition to the illustrations in this report, an accompanying spreadsheet, yose_traffic_flow.xls, gives both a list of nodes with locations and a list of links with link lengths, flows, and (for the hourly flows) volume/capacity ratios.

Based on the network link lengths and travel patterns of various vehicle types, the planning model can compute vehicle miles of travel by vehicle type. This is useful as an input to most vehicle emissions models used for regional air quality analysis.

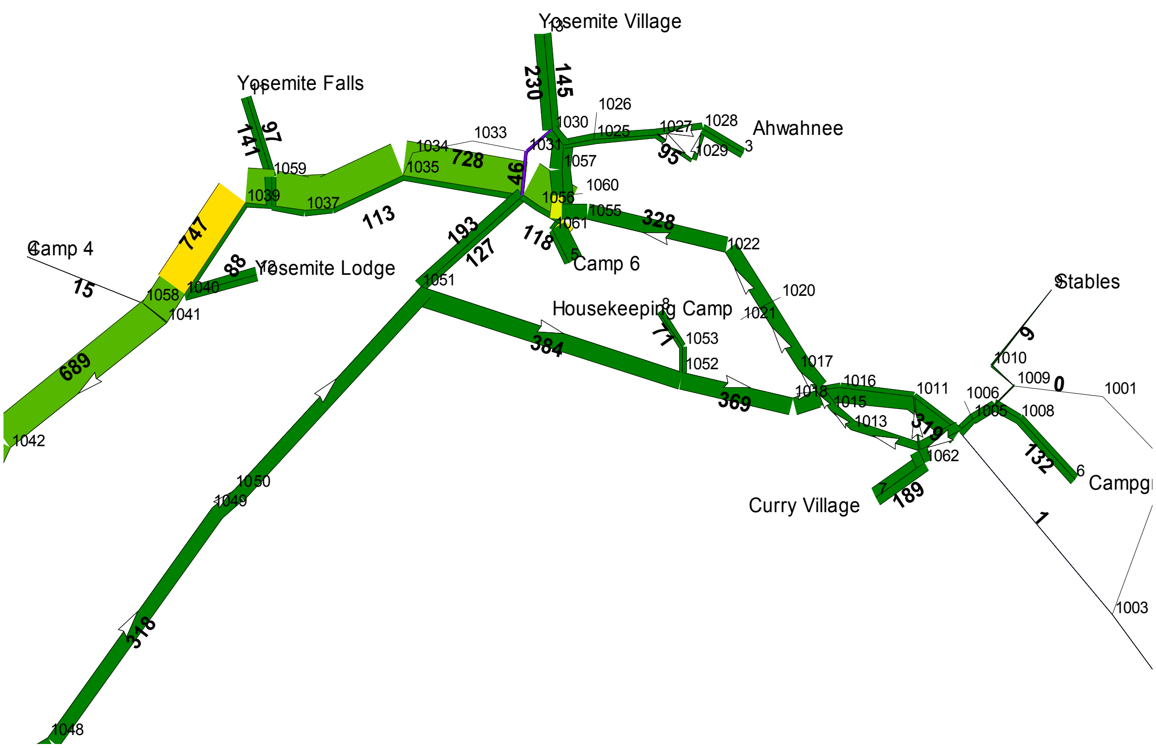

Figure 5 - East Valley PM Peak Hour Flows

Transportation Network Planning Model Limitations

In its initial incarnation, the YNP transportation network planning model has some limitations. Many of these limitations arise from a lack of data on origin-to-destination trips by transportation that does not involve motor vehicles, specifically bicycle and pedestrian movements.

Modeling of person trips

The origin-destination demands used in the planning model are for vehicles, not people. While this does not matter much outside of Yosemite Valley (few people walk from an entrance station to El Capitan), it does matter for trips within Yosemite Valley, where a variety of modes (walk, shuttle bus, bike) may be used.

For the trips within Yosemite Valley pedestrians currently are modeled only as they impact roadway capacity (for example, the pedestrian crossing near Yosemite Falls). This is satisfactory for traffic analysis (where the impacts of a given number of vehicle trips is the primary concern), but is not sufficient for more complex analyses requiring a mode split model component to assess potential transit usage or when the effects of significant pedestrian and/or bicycle movements within a network are to be considered as well.

This shortcoming can be overcome for the time being by using available vehicle occupancy data to convert vehicle trips to passenger trips. For example, if on average each vehicle carries two to three people, each vehicle trip represents two to three person trips (with the implicit assumption that all people in a vehicle have the same ultimate destination). This technique works fairly well at an aggregate level, but not so well at a more detailed level or for vehicles (such as buses) that contain a large number of people who are not traveling as a group with a common itinerary.

Intersection and crosswalk capacity

Pedestrian movements at intersections and designated pedestrian crosswalks (e.g. Yosemite Falls / Yosemite Lodge) have a substantial effect on roadway capacity. Since most transportation planning models are not designed for detailed modeling of such intersections or crossings, the usual approach is to adjust the capacity on the link that contains the pedestrian crossing, or to set up corresponding “vehicle turning” penalties at such intersections as a surrogate for the reduction in vehicle throughput due to pedestrian movements.

Determination of adjusted link capacities due to pedestrian movements can be based on any or all of the following:

- theoretical results, and/or "rule-of-thumb" capacities from sources such as the Highway Capacity Manual
- simulation model results
- field observations during peak periods

For the initial YNP transportation network planning model, adjusted link capacities have been developed for two key locations: the Yosemite Lodge / Northside Drive intersection and the Camp 6 intersection. Since the vehicle throughput of an intersection can increase substantially if a park ranger or other staff member is controlling traffic, the controlled and uncontrolled cases are treated separately. Furthermore, since vehicle throughput capacity at the Yosemite Lodge intersection is primarily determined by conflicting pedestrian volumes, separate capacities are listed for different pedestrian volume ranges. Roadway capacities (ranging from 400 to 800 vehicles per hour per direction) are presented in Table 2 below for several pedestrian and intersection traffic control conditions.

Table 2. Roadway Network Capacity Adjustment due to Pedestrian Cross Traffic

Location	Control?	Capacity	Comment
Yosemite Lodge	yes	800	Since ranger control is assumed, this vehicular capacity can be attained even with high (800 ped / hr) pedestrian volumes. This capacity is based on theoretical results and corresponds to observed throughput during peak periods
Yosemite Lodge	no	400	A high (750 pedestrian / hour) pedestrian volume is assumed, as shortly before 4 PM on a typical peak Saturday. The capacity of 400 vehicles per hour is based on theoretical results and corresponds to observed throughput during peak periods.
Yosemite Lodge	no	600	A lower (< 450 pedestrian / hour) pedestrian volume is assumed.
Camp 6	yes	500	Based on rule-of-thumb capacities for controlled intersections, with one exclusive pedestrian "cycle" every 90 seconds.[1]
Camp 6	no	400	Based on rule-of-thumb capacities for 4-way stop controlled intersections, adjusted downwards to account for the expected pedestrian conflicts.[2]

[1] NCHRP 365 gives an initial capacity for single lane (plus exclusive left) approach with medium priority as 825 vehicles per hour. If a 30 second exclusive pedestrian phase is inserted, this capacity drops to about 500 vehicles per hour. Therefore, it is advisable to verify this capacity via simulation and/or field observation.

[2] NCHRP 365 gives a worst-case capacity for 4-way stops of 500 vehicles per hour per approach (without pedestrian conflicts). This number was adjusted downward to account for expected pedestrian conflicts. However, it would be advisable to verify this capacity via simulation and/or field observation.

The planning model results presented here use capacities of 800 and 500 for Yosemite Lodge, and Camp 6, respectively.

Transit

Currently transit vehicles are only modeled as one part of the traffic mix, with a fixed number of vehicles on a section of roadway. Although the route for the existing Valley Shuttle has been incorporated into the existing network model, no Valley Shuttle origin-destination passenger trip counts have been included.

In order to explicitly include transit services and demands as part of the network model, the following additional inputs would be required:

- Transit routes and stops
- Transit headways and capacity
- Matrix of transit travel times
- Origin-destination trips for people (not just vehicles)
- Detailed information on expected parking availability
- An assessment of the relative attractiveness of transit versus privately owned vehicle (POV) to visitors, given transit service quality (wait time, travel time, comfort), POV travel time, and POV parking availability.

Outputs would include the expected demand for each transit link, as well as the number of trips served by transit.

Without the above data, the impact of changed transit services can still be assessed, provided that the expected number of trips diverted from privately owned vehicles is estimated outside of the network model. Such an assessment may be based on transit ridership for comparable services and an analysis of parking availability (lack of parking typically provides an extremely strong incentive to use transit). This estimate can then be used to make appropriate adjustments to the trip tables. The network planning model then can be run again with the modified trip tables. The model output would reflect the expected changes in overall traffic patterns and conditions.

Walk / Bicycle Modes

Walking and bicycle modes may or may not be explicitly included in the network model. Two arguments for leaving them out are as follows:

First, people choosing these modes are doing so because the trip is the attraction (e.g. people who hike the 4-mile Trail are doing so for the experience of the hike, not because the parking lot at Glacier Point is full. Similarly, the person who is driving to Glacier Point probably does not consider the 4-mile Trail to be a viable alternative mode.)

Typically travelers are not likely to switch from a non-motorized to a motorized mode (or vice versa).

Second, counts are difficult to collect for these modes (for example, while vehicle counts can be collected with automatic equipment, pedestrian and bicycle counts often have to be collected manually)

An argument for including the non-motorized modes is that for many trips, particularly within Yosemite Valley, travel times between the motorized (automobile, shuttle bus) and non-motorized modes (bike, walk) are competitive. Therefore, users who are sensitive to travel time may switch among modes. For example, given traffic congestion and the time required to search for parking, a bicycle may well prove to be the fastest mode for many trips within the Valley. In addition, greater alternative transportation use in the Valley may well depend on an integrated network of transit, walking and bicycle components. During the peak season many in-valley trips have alternative transportation travel times that are comparable to automobile travel times, the YNP transportation network planning model should be evolved to more explicitly consider these alternative transportation modes.

The initial YNP transportation network planning model, with its ability to limit links to certain modes, can easily be extended to include the bicycle mode. Data requirements for such an extension include

- Current bicycle trips (by origin and destination)
- Link data for the shared use paths
- Assumed bicycle speeds (so that travel times may be computed)
- An assessment of the desirability of park roadways versus shared use paths to cyclists. Since the roadways that are shared with auto traffic may be viewed by many cyclists as less desirable, they could be modeled as being open to cyclists, but with a penalty.
- Rental bicycle availability
- Bicycle parking availability

Planning Model Applications

Some examples of applications for the initial YNP transportation network planning model are listed below:

1. Assess the impact of a road closure. The road can be designated as unavailable in the model. The model will then re-route traffic to other available roads, where we can review expected traffic volumes, and areas where congestion may be expected.

2. Assess the impact of moving tour bus parking to another part of the park. In this case, the commercial bus sections of the trip tables are modified to reflect the new parking location. The model will then re-route the buses to and from this new location, and impacts on traffic can be assessed.

3. Assess the impact of changing parking capacity in a parking lot. The appropriate flows (to and from the lot) in the trip tables are modified. The output of the model will then reflect the impacts of these trip table modifications.

Traffic Flows

Trip tables were prepared for the following time periods:
- 1999 Summer Weekend Daily (base trip tables)
- 1999 Summer Weekday Daily
- 1999 Summer AM Peak Hour
- 1999 Summer PM Peak Hour
- 1999 Shoulder (fall) Weekend Daily
- 1999 Shoulder Weekday Daily
- 1999 Shoulder AM Peak Hour
- 1999 Shoulder PM Peak Hour
- 1999 Winter Weekend Daily
- 1999 Winter Weekday Daily
- 1999 Winter AM Peak Hour
- 1999 Winter PM Peak Hour
- 2002 Summer Weekend Daily
- 2002 Summer AM Peak Hour
- 2002 Summer PM Peak Hour

This section of the report presents the network model flows for these trip tables. It is in seven sub-sections:
- 1999 Summer Weekend (daily and hourly)
- 1999 Summer Weekday (daily)
- 1999 Shoulder (fall) Weekend (daily and hourly)
- 1999 Shoulder Weekday (daily)
- 1999 Winter Weekend (daily and hourly)
- 1999 Winter Weekday (daily)
- 2002 Summer Weekend (daily and hourly)

1999 Summer Weekend

We first present daily flows, and compare them to traffic counts on selected links. We then present the hourly flows.

Daily Traffic Flows

Figure 6 presents the daily flows for Yosemite Valley. The width of each link is proportional to the traffic volume. Since the concept of volume / capacity (v/c) applies to hourly and not daily traffic flow, no v/c information is presented. Therefore, the links are gray on the depictions of daily traffic flow. The larger numbers by the links are traffic volumes, and the smaller numbers are network node numbers. The red squares are centroid nodes (origins/destinations) while the green squares are other nodes. Centroid nodes correspond to major attractions (or groups of attractions) that act as origins and destinations for the traffic flows.

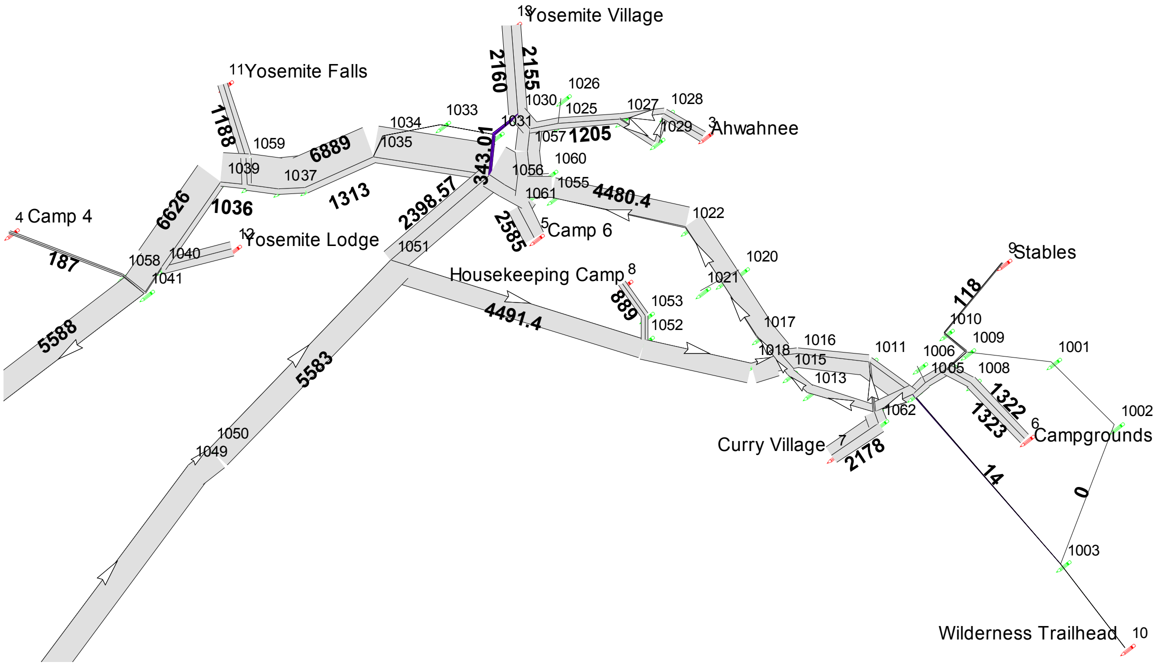

Figure 6 - Yosemite Valley 1999 Summer Weekend Daily

Figure 7 presents flows for the remainder of the park.

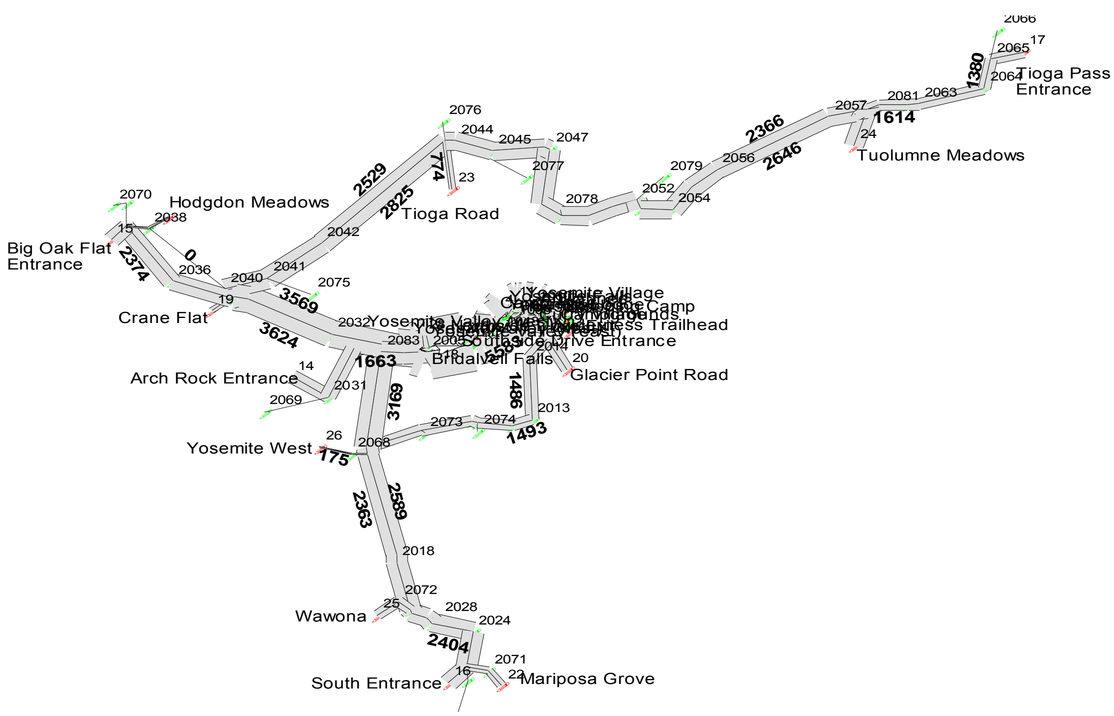

Figure 7 - Parkwide 1999 Summer Weekend Daily

Table 3 presents the daily flows for selected links, compared to traffic counts from the 1999 Visitor Use Study.

Table 3 – Daily Flows Compared to Traffic Counts

Counts from 1999 Visitor Use Study. Direction 1 = east / north; Direction 2 = south / west							
	Observed counts		Flows from Network Model				
Location	Dir 1: Peak Day Traffic Counts	Dir 2: Peak Day Traffic Counts	Link number	Dir 1: Predicted Counts	Dir 2: Predicted Counts	% Difference ((predicted-actual)/actual) Dir 1	% Difference ((predicted-actual)/actual) Dir 2
Southside Dr W of Pines Campground	2196	2286	38	3344	1155	52%	-49%
NSD E of Sentinel	3168	6731	85	2933	7254	-7%	8%
Ahwahnee Rd	1221	1270	92	1205	1206	-1%	-5%
NSD W of Ranger WYE	1312	6886	118	1313	6889	0%	0%
Southside Dr, E of Housekeeping	4145	0	155	4491	0	8%	0%
Southside Dr, E of Pohono Bridge	6565	0	184	7417	0	13%	0%
Wawona Rd S of SSD	2850	2966	193	3169	2959	11%	0%
Arch Rock Rd	1655	1655	250	1663	1949	1%	18%
Big Oak Flat Rd	3248	2998	255	3624	3569	12%	19%
Tioga Pass	1218	1489	334	1614	1380	32%	-7%
El Cap Bridge	1092	345	178&339	1353	361	24%	5%
Glacier Point Road			198	1493	1486		
Maraposa Grove			22	1022	991		

Hourly Traffic Flows

Figures 8 and 9 present the AM and PM Peak flows for Yosemite Valley. The line color represents the volume/capacity ratio ranging from green (low v/c) to yellow. Yellow represents a link near or at capacity, with congestion that may back up onto other (green) links.

Since the node numbers and centroid nodes in this and all future figures are unchanged from the figures 6 and 7, they are not shown.

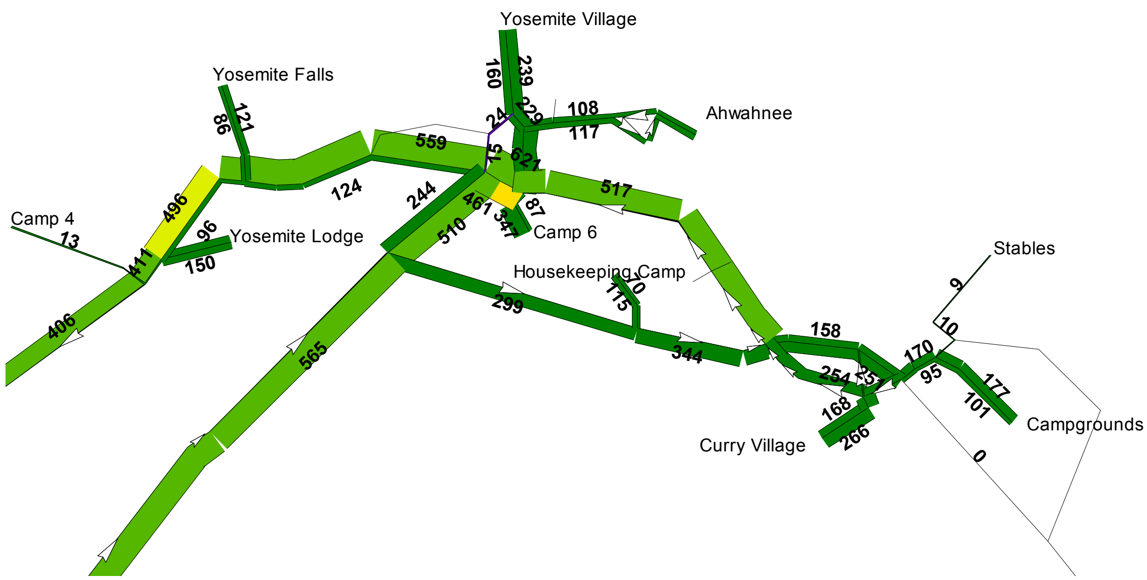

Figure 8 – Yosemite Valley 1999 Summer Weekend AM Peak Hourly

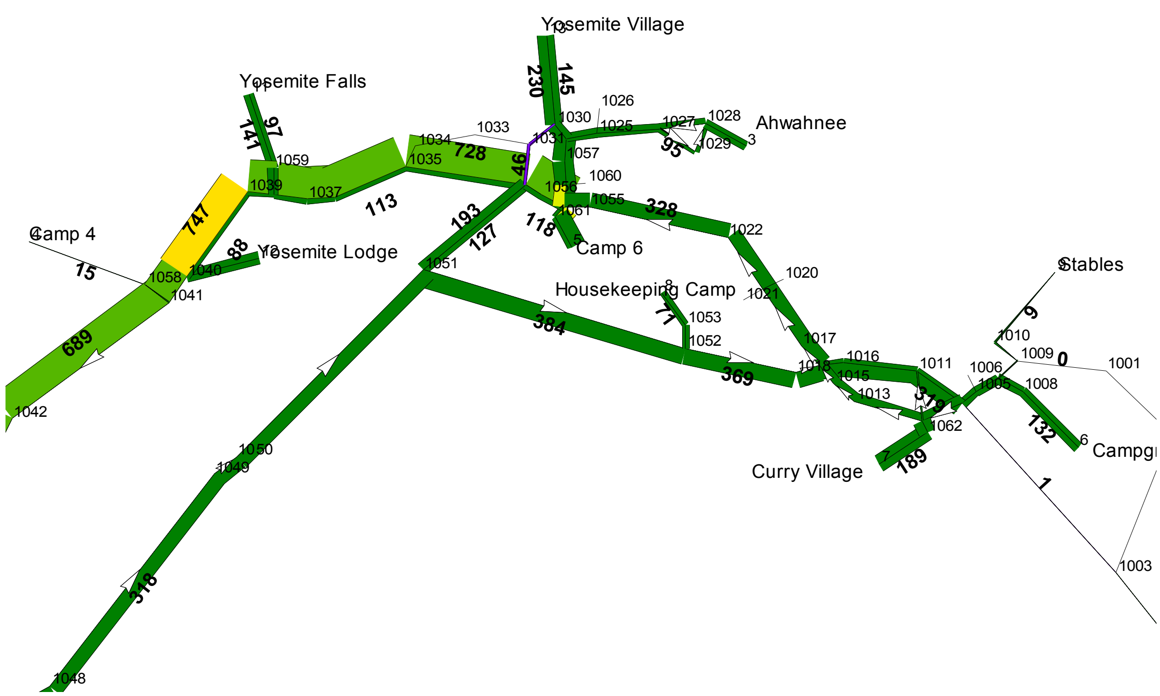

Figure 9 - Yosemite Valley 1999 Summer Weekend PM Peak Hourly

Figures 10 and 11 represent the parkwide hourly flows, for the AM and PM peak hours, respectively.

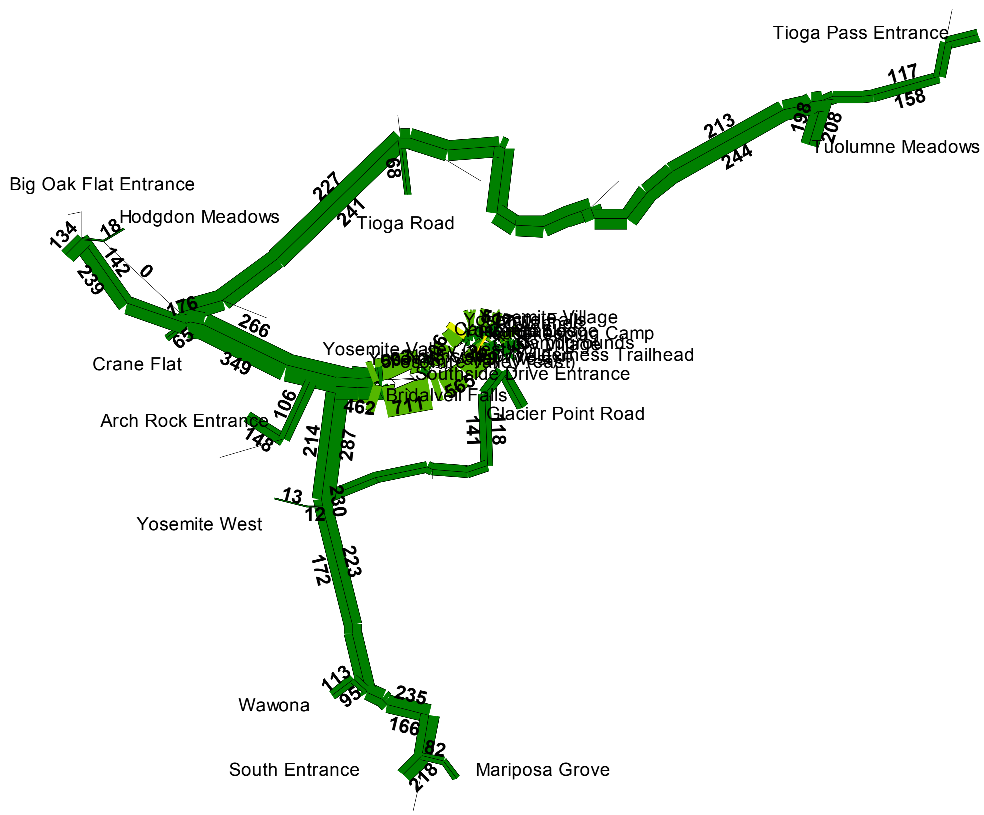

Figure 10 - Parkwide 1999 Summer Weekend AM Peak Hourly

Tables 3 and 4 show the predicted peak hour flows for selected locations.

Table 1 - Peak Hour Flows

Direction 1 = east/north		Peak HR AM		Peak Hour PM	
Location	Link number	Dir 1: Predicted Counts	Dir 2: Predicted Counts	Dir 1: Predicted Counts	Dir 2: Predicted Counts
Southside Dr W of Pines Campground	38	251	158	319	89
NSD E of Sentinel	85	461	624	118	768
Ahwahnee Rd	92	117	108	95	117
NSD W of Ranger WYE	118	124	559	113	728
Southside Dr, E of Housekeeping	155	344		369	
Southside Dr, E of Pohono Bridge	184	494		766	
Wawona Rd S of SSD	193	287	214	244	297
Arch Rock Rd	250	148	106	99	209
Big Oak Flat Rd	255	349	266	278	340
Tioga Pass	334	117	158	114	138
El Cap Bridge	178&339	108	18	107	18
Glacier Point Road	198	118	141	140	129
Maraposa Grove	22	83	82	88	92

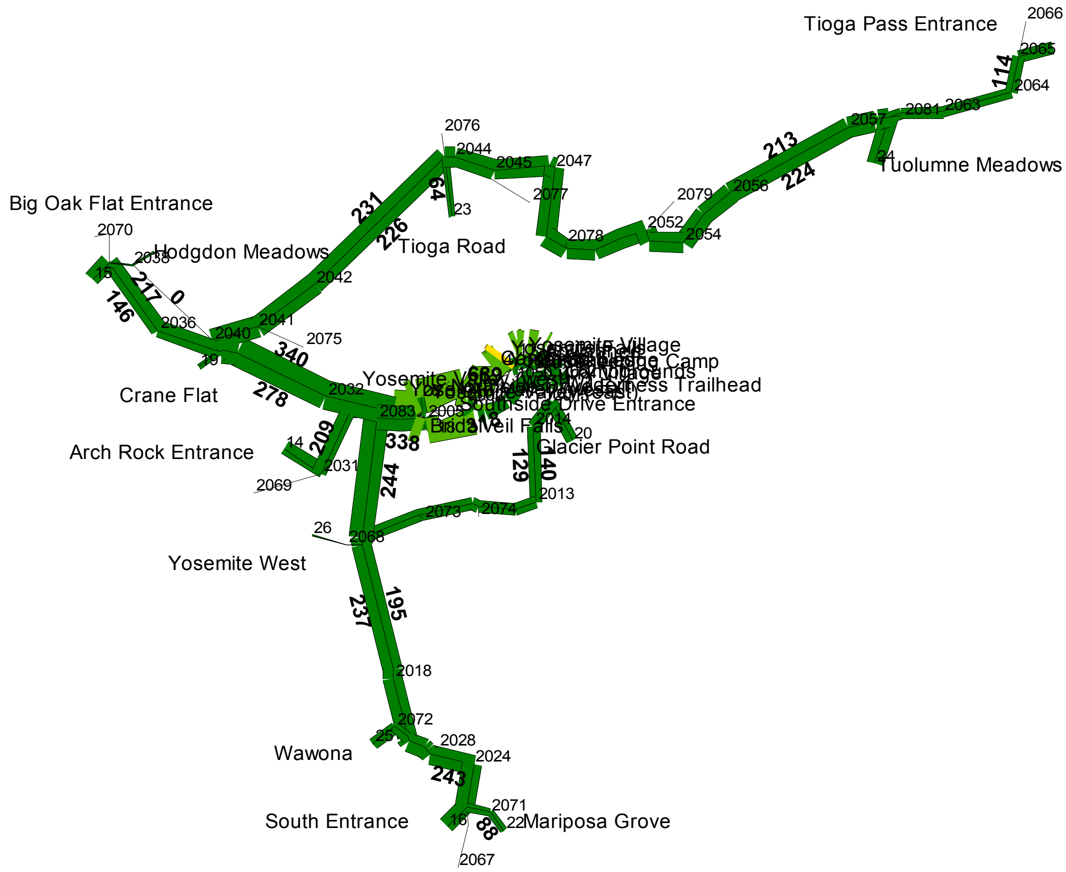

Figure 11 - Parkwide 1999 Summer Weekend PM Peak Hourly

Table 2 - Peak Hour Entrance Station Flows

Direction 1 = entering

Location	Link number	Peak HR AM Dir 1: Predicted Counts	Peak HR AM Dir 2: Predicted Counts	Peak Hour PM Dir 1: Predicted Counts	Peak Hour PM Dir 2: Predicted Counts
Arch Rock Entrance	14	148	106	99	209
Big Oak Flat Entrance	15	231	134	140	209
South Entrance	16	218	148	145	219
Tioga Pass Entrance	17	117	158	114	138
Entrance Station Subtotal		***714***	***546***	***498***	***775***

1999 Summer Weekday Daily Traffic Flows

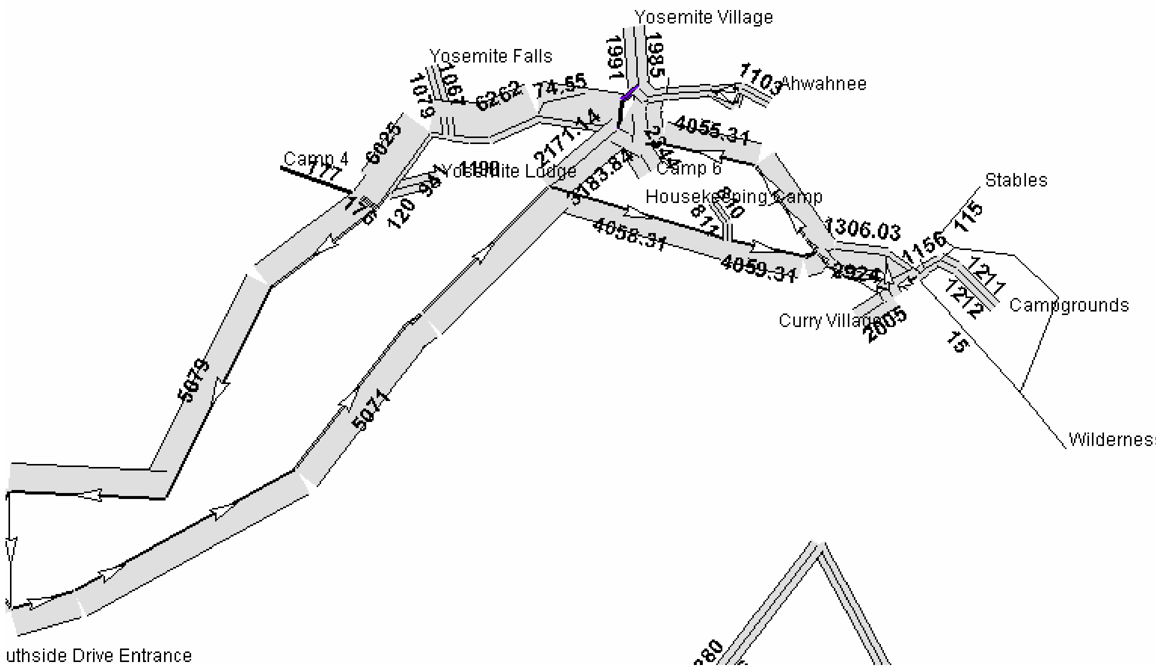

Figure 12 - Yosemite Valley 1999 Summer Weekday Daily

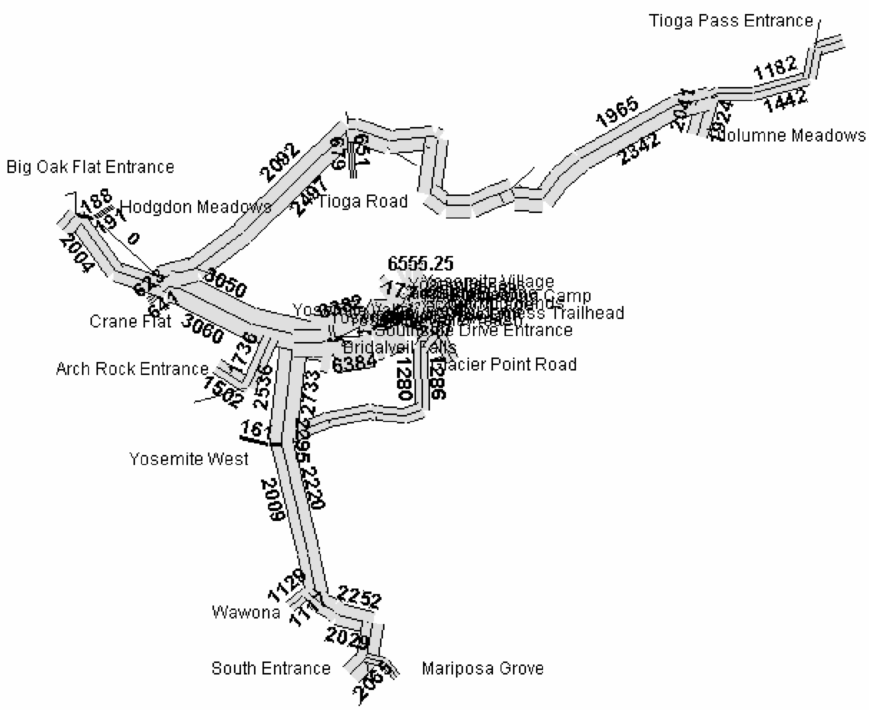

Figure 13 - Parkwide 1999 Summer Weekday Daily

1999 Shoulder (fall) Weekend

Daily Traffic Flows

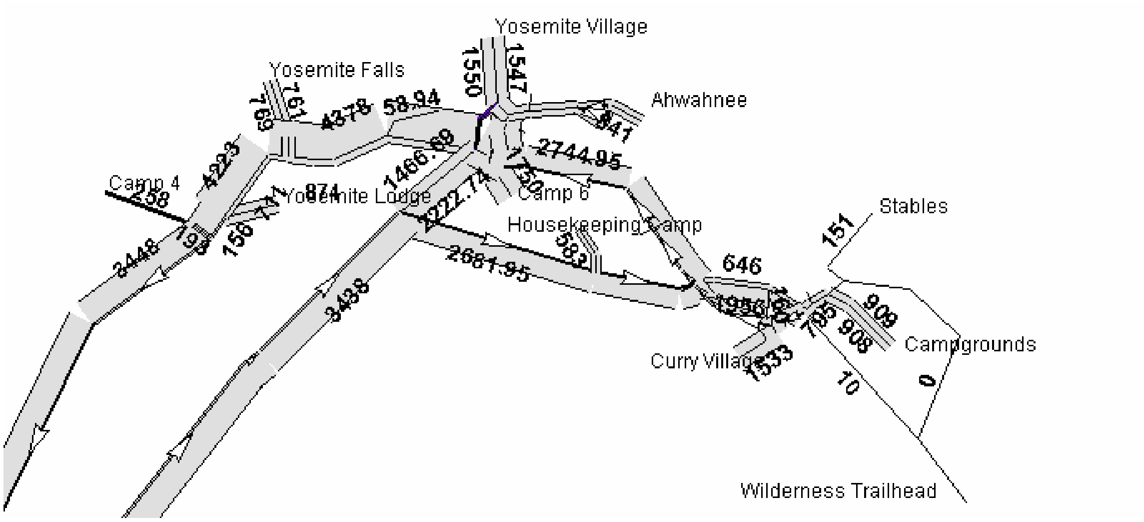

Figure 14 - Yosemite Valley 1999 Shoulder Weekend Daily

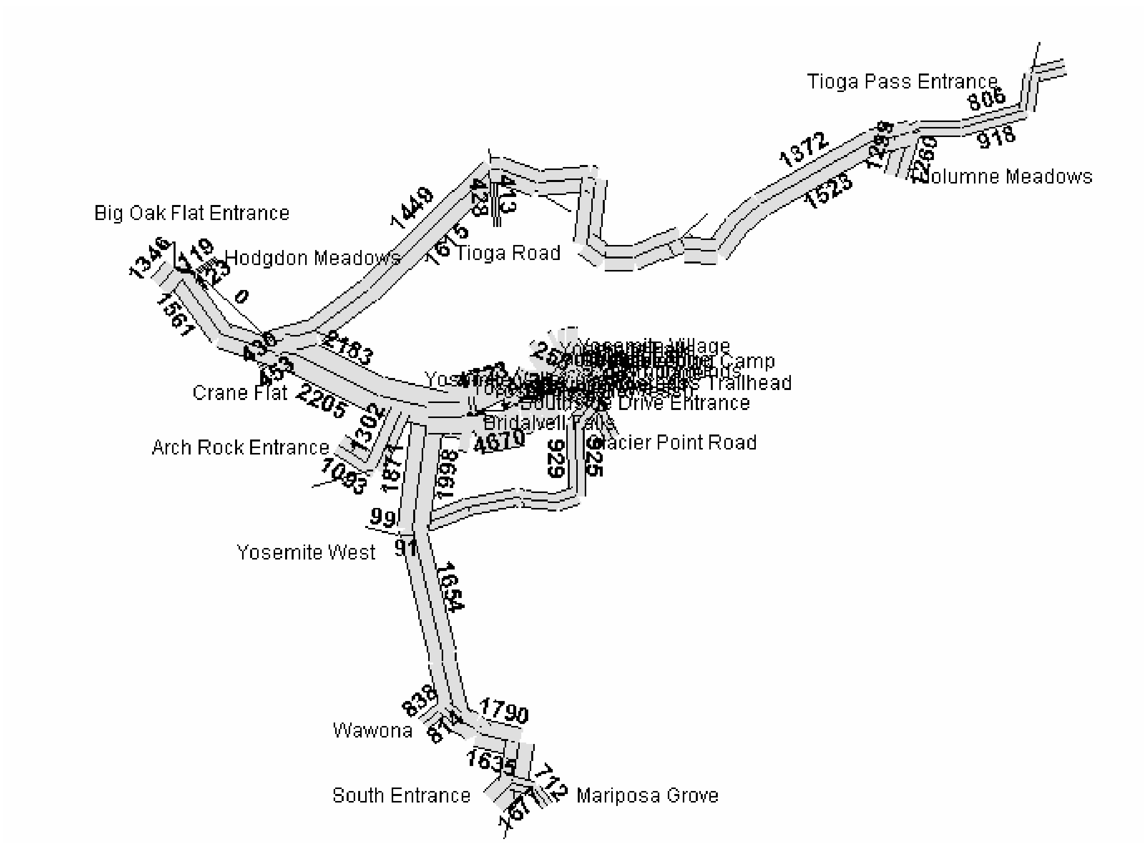

Figure 15 - Parkwide 1999 Shoulder Weekend Daily

AM Hourly Traffic Flows

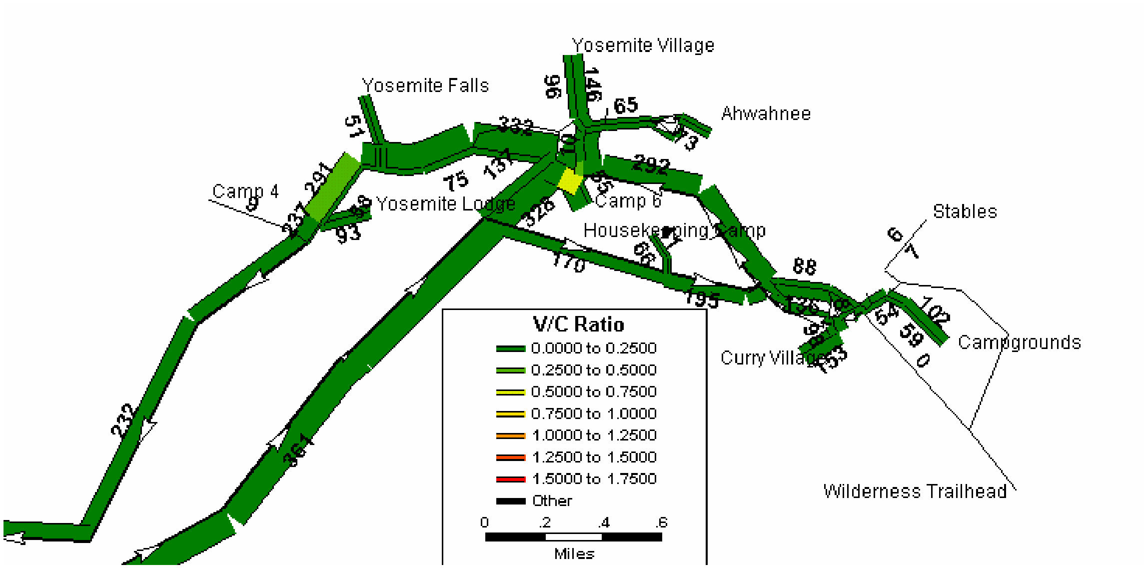

Figure 16 - Yosemite Valley 1999 Shoulder Weekend AM Peak Hourly

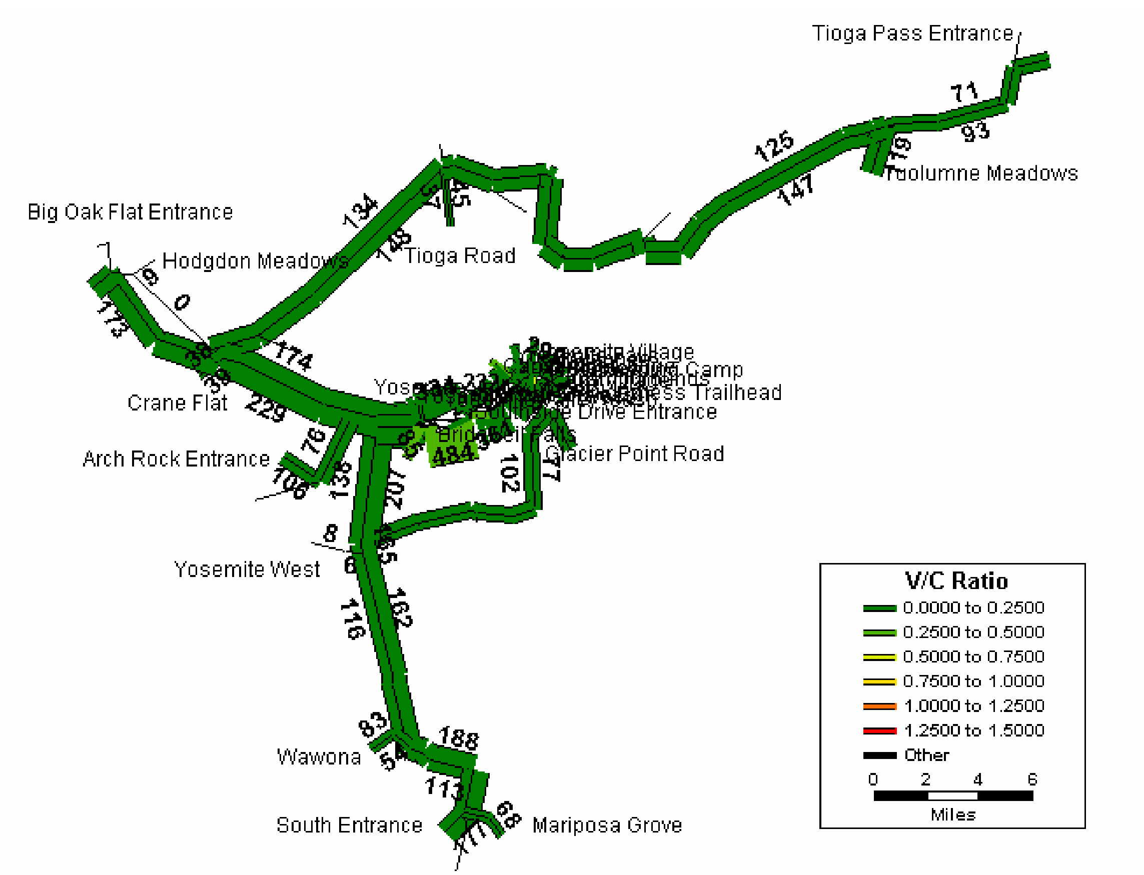

Figure 17 - Parkwide 1999 Shoulder Weekend AM Peak Hourly

PM Hourly Traffic Flows

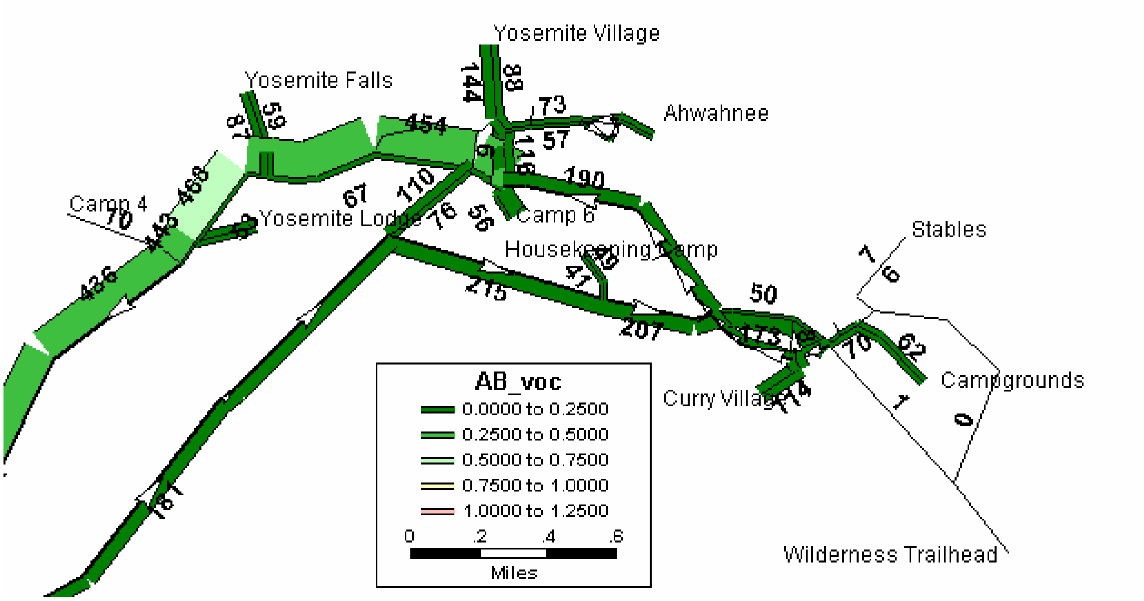

Figure 18 - Yosemite Valley 1999 Shoulder Weekend PM Peak Hourly

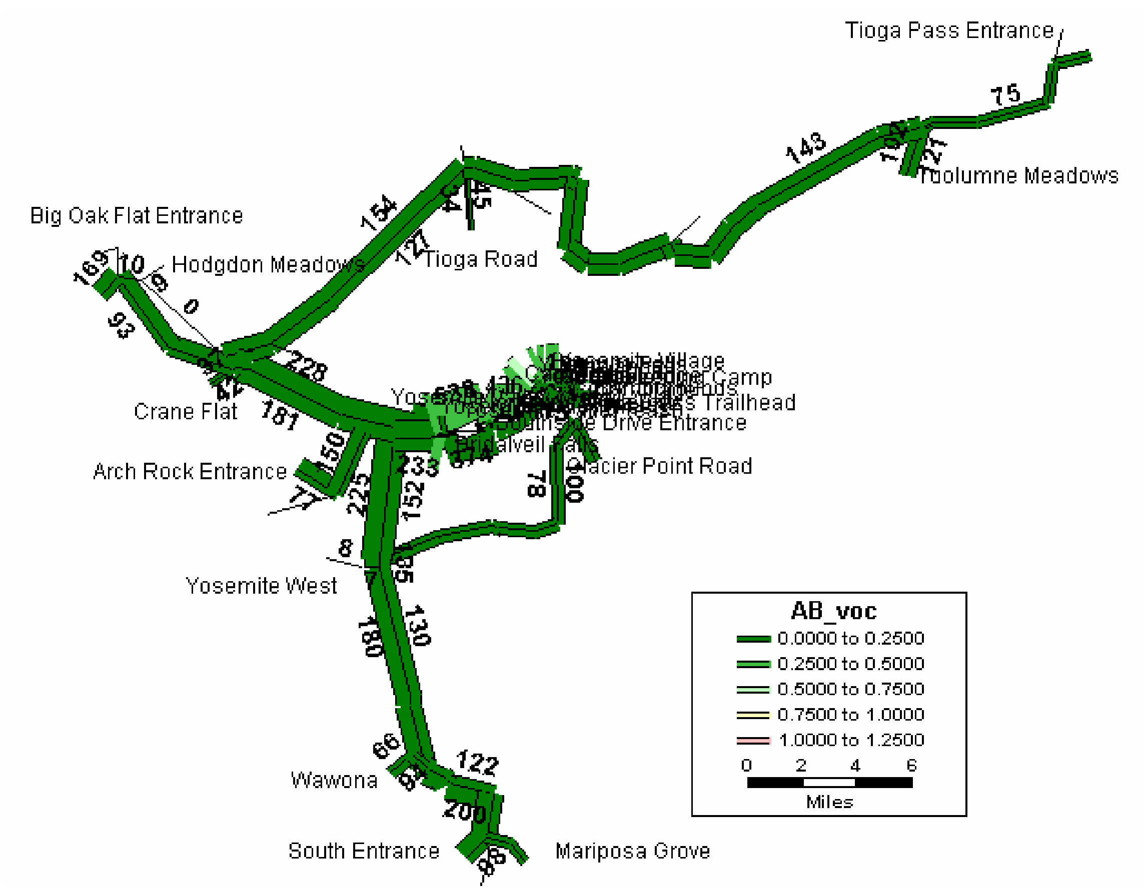

Figure 19 - Parkwide 1999 Shoulder Weekend PM Peak Hourly

1999 Shoulder (fall) Weekday Daily Traffic Flows

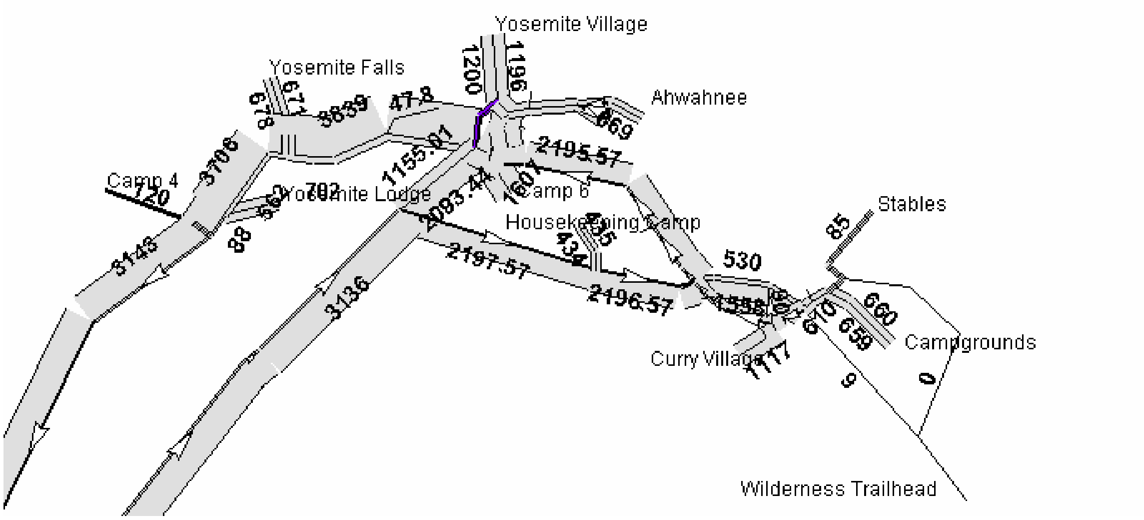

Figure 20 - Yosemite Valley 1999 Shoulder Weekday Daily

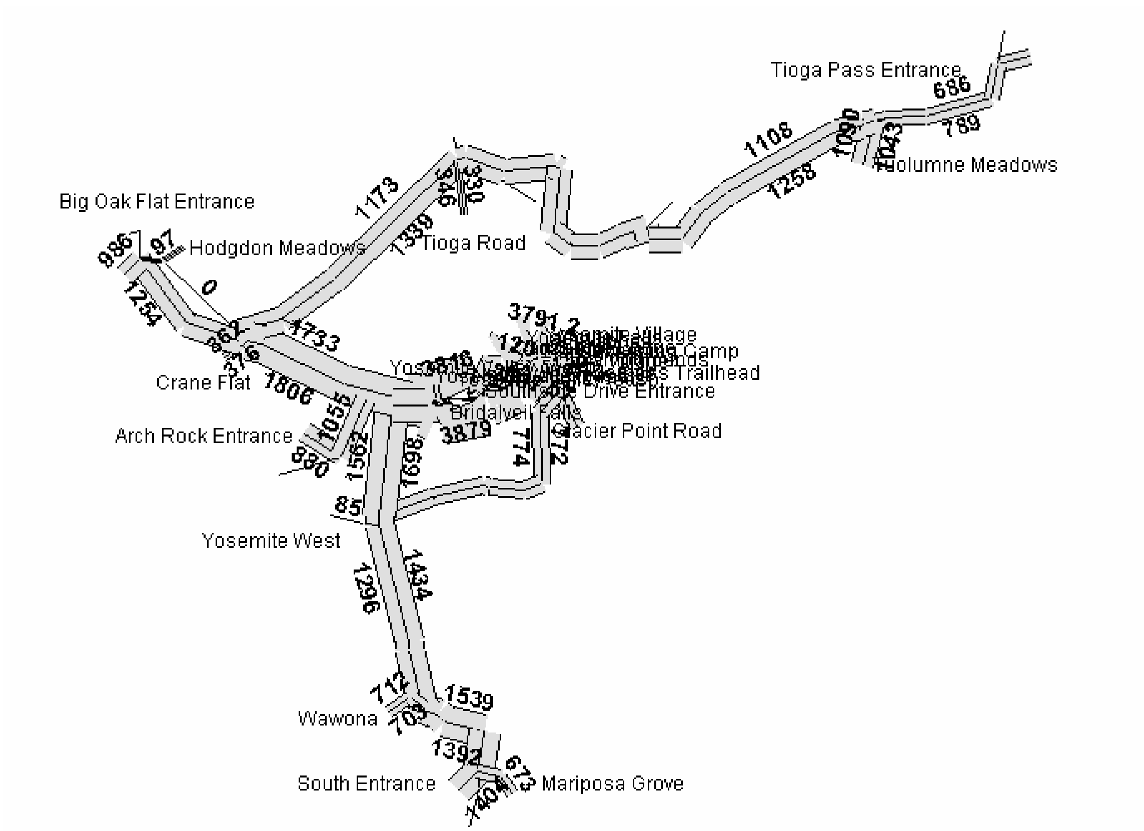

Figure 21 - Parkwide 1999 Shoulder Weekday Daily

1999 Winter Weekend

Traffic flows shown on Glacier Point Road are to the Badger Pass ski area.

Daily Traffic Flows

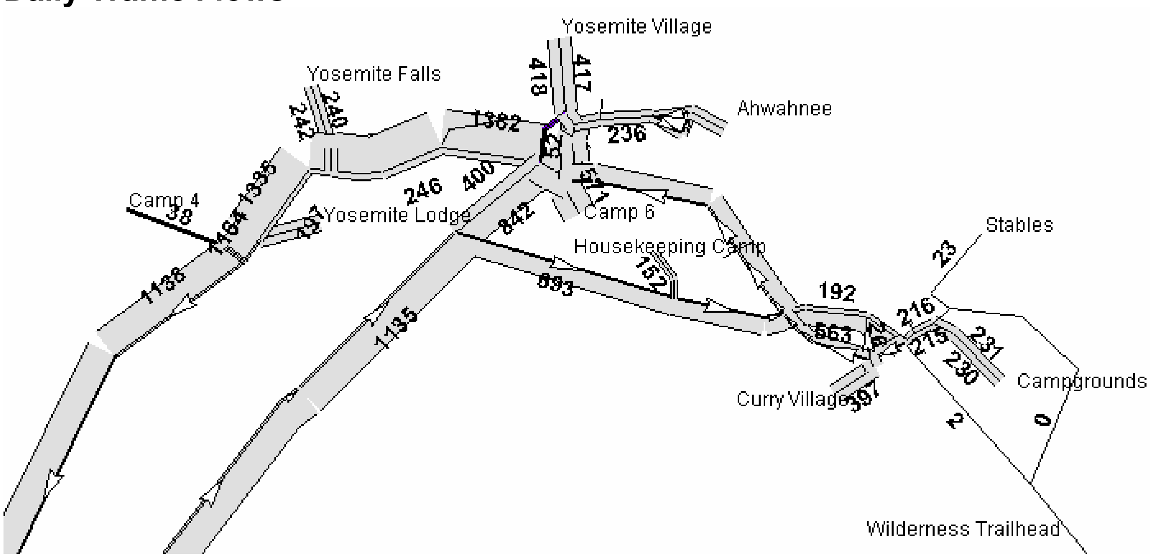

Figure 22 - Yosemite Valley 1999 Winter Weekend Daily

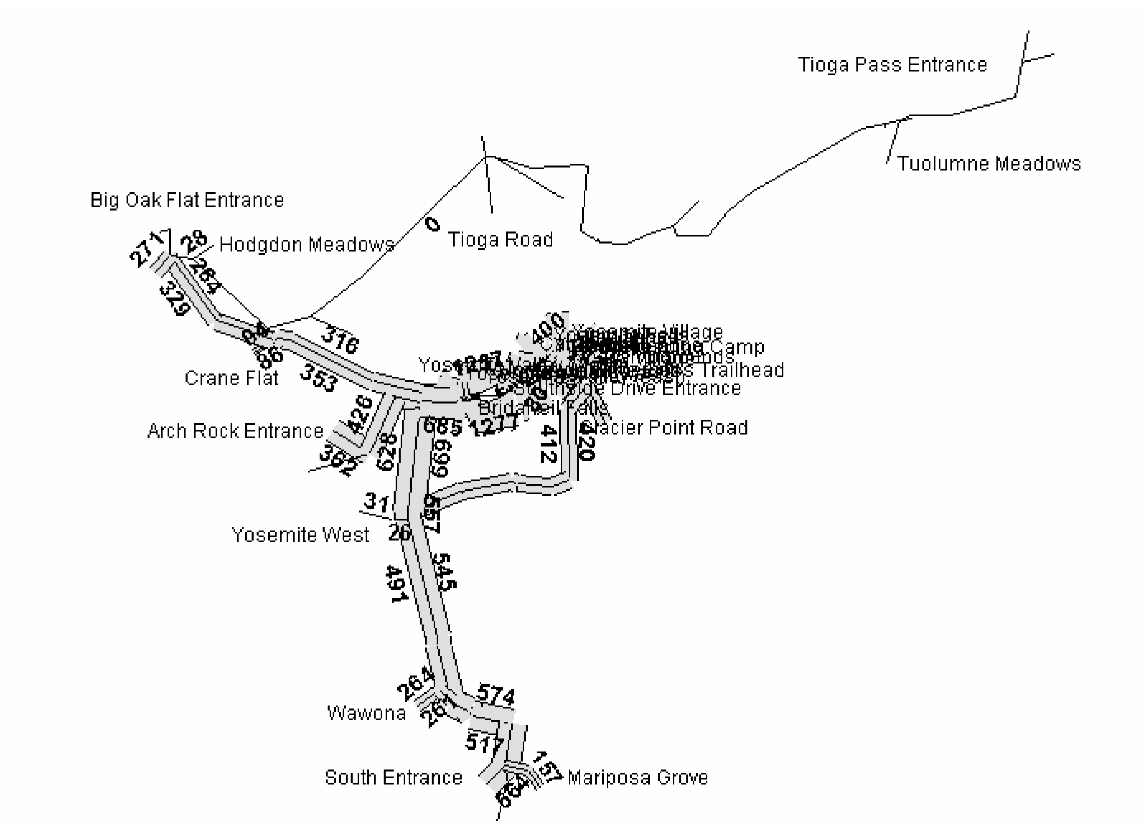

Figure 23 - Parkwide 1999 Winter Weekend Daily

AM Hourly Traffic Flows

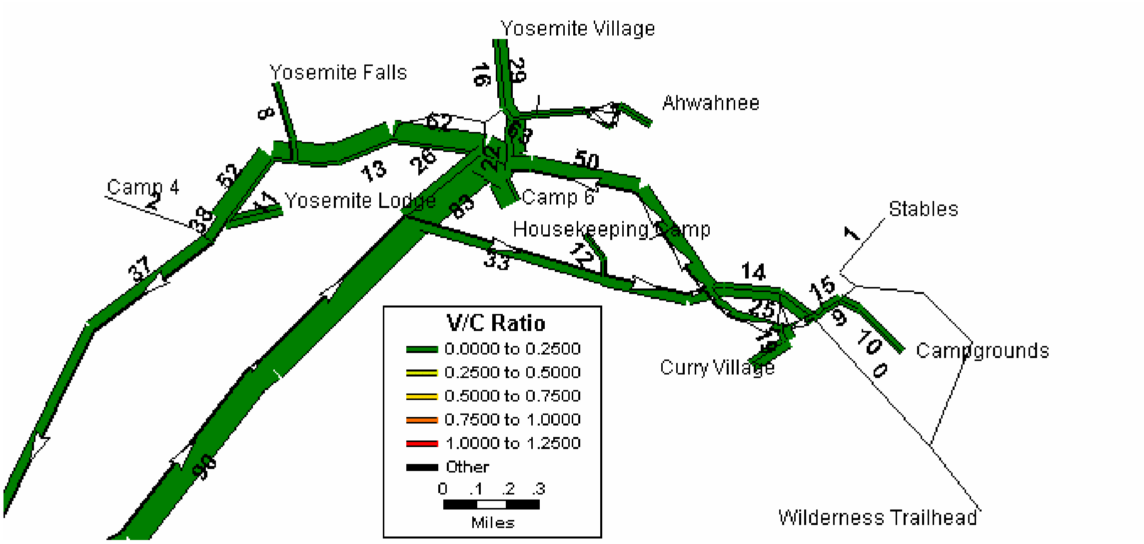

Figure 24 - Yosemite Valley 1999 Winter Weekend AM Peak Hourly

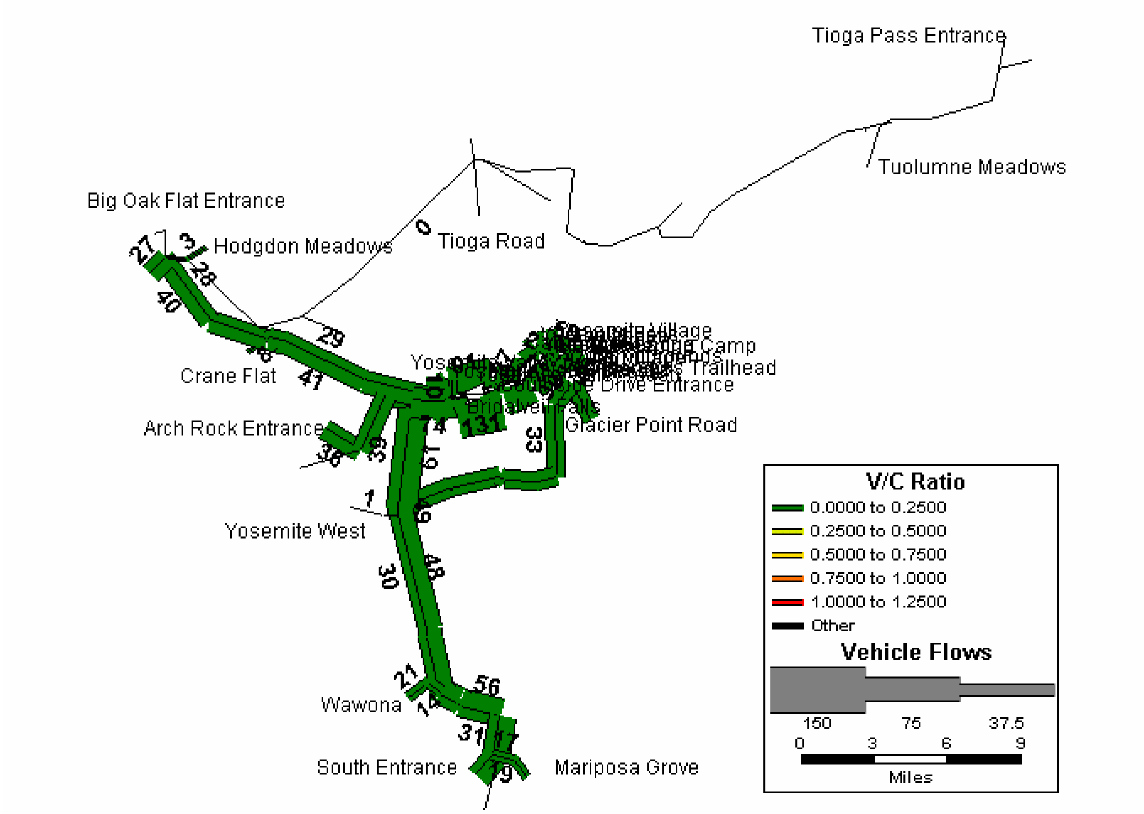

Figure 25 - Parkwide 1999 Winter Weekend AM Peak Hourly

PM Hourly Traffic Flows

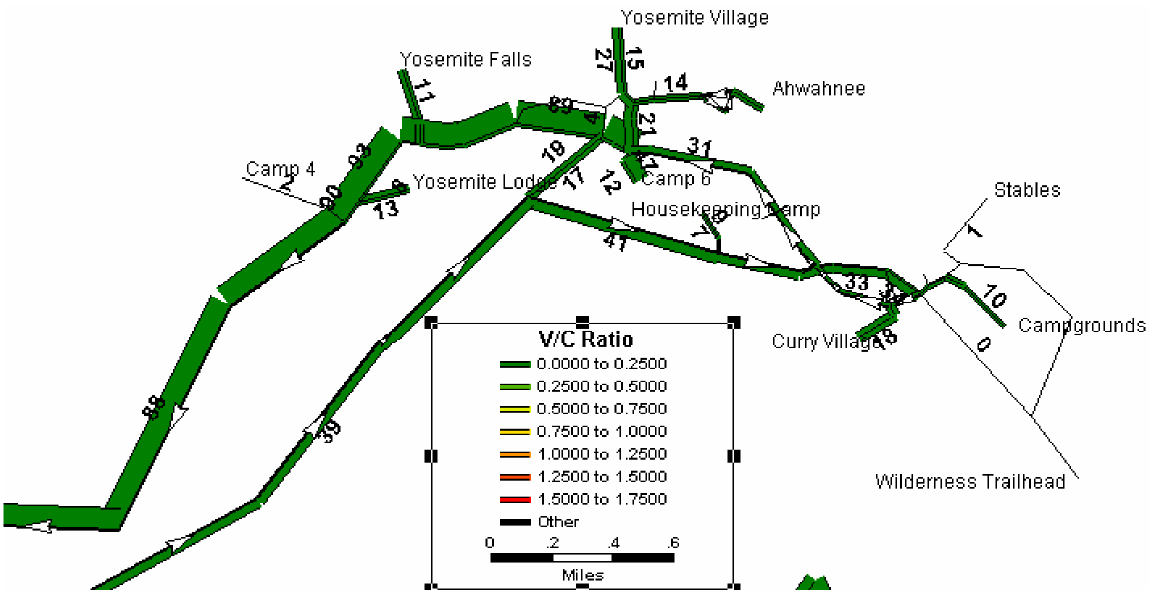

Figure 26 - Yosemite Valley 1999 Winter Weekend PM Peak Hourly

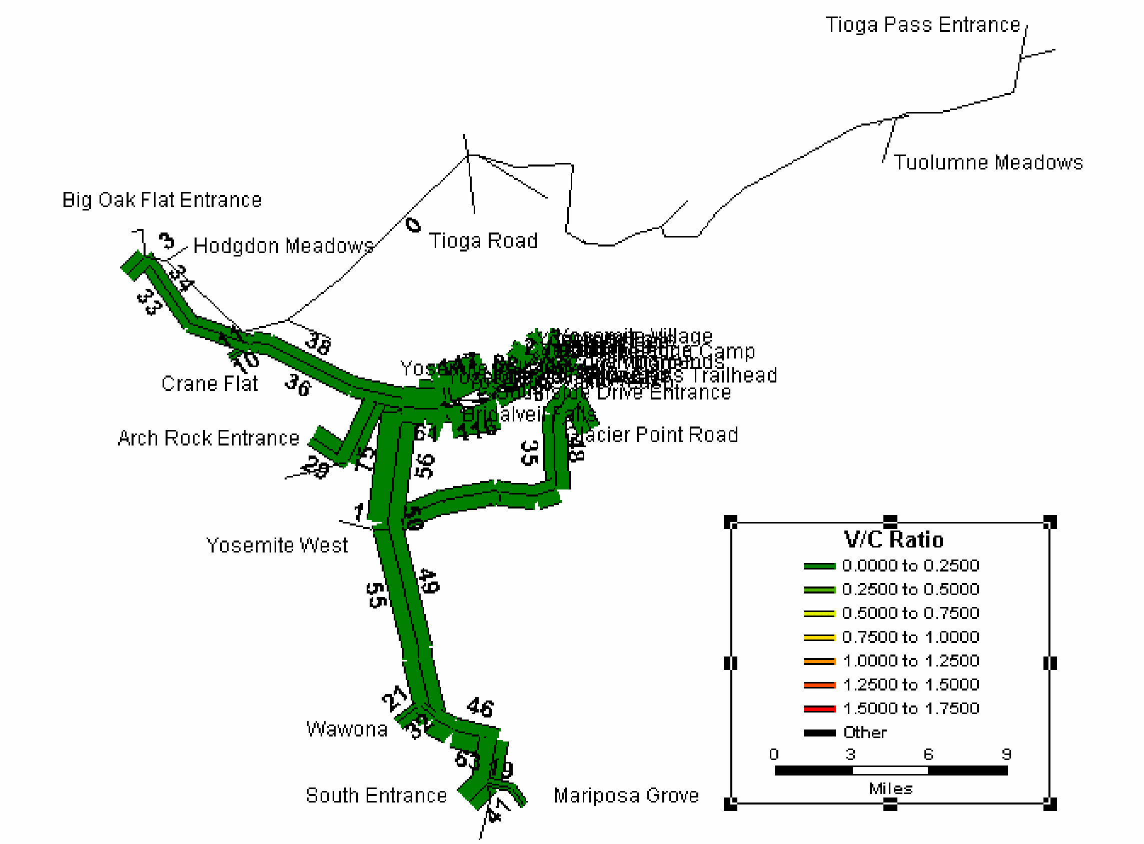

Figure 27 - Parkwide 1999 Winter Weekend PM Peak Hourly

1999 Winter Weekday Daily Traffic Flows

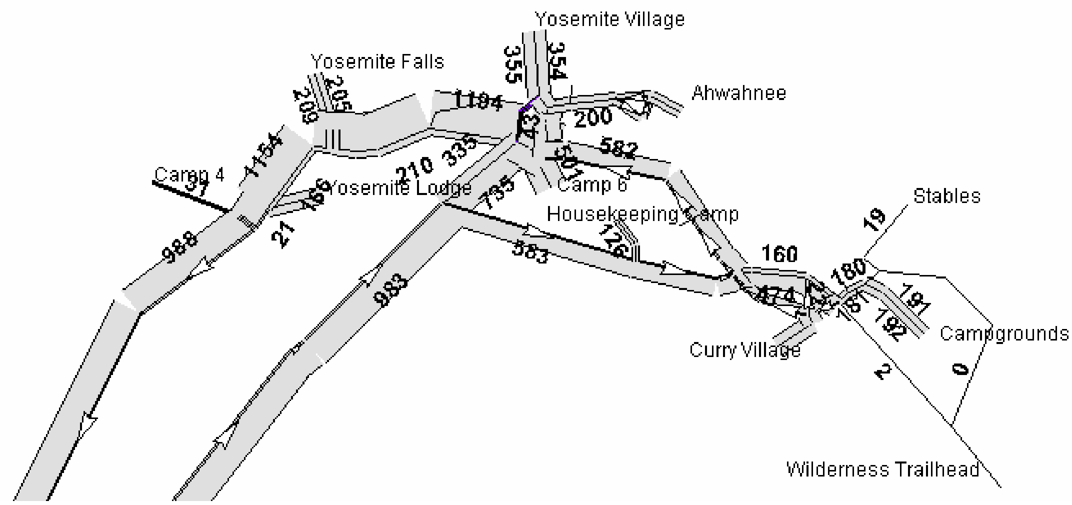

Figure 28 - Yosemite Valley 1999 Winter Weekday Daily

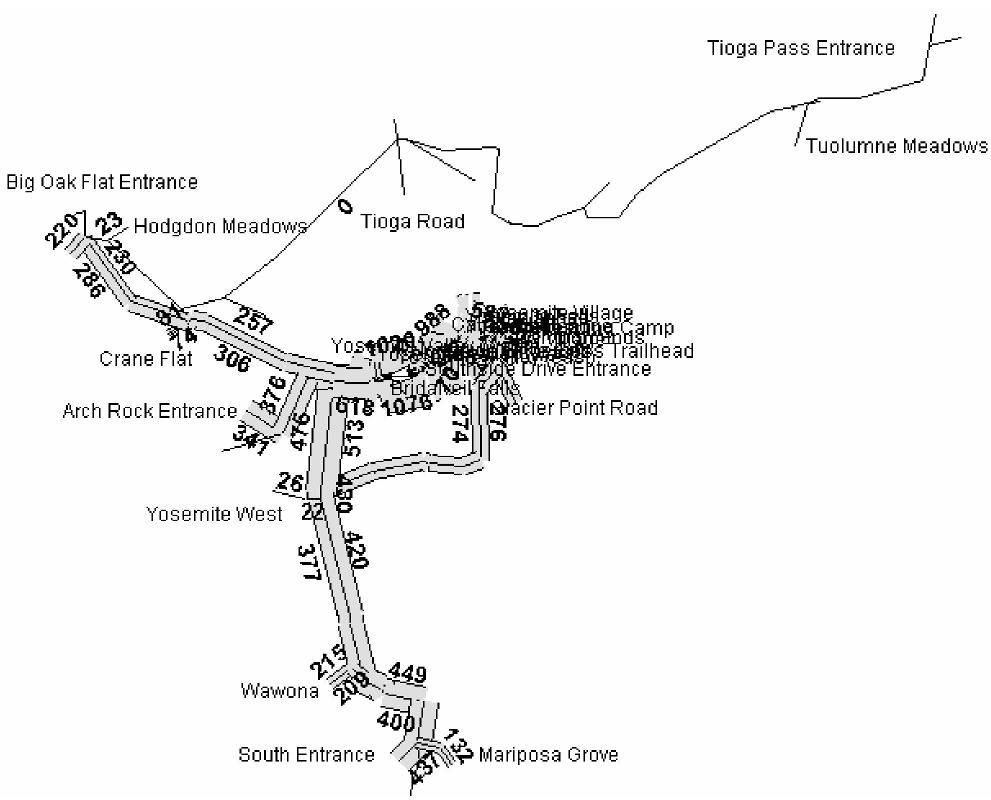

Figure 29 - Parkwide 1999 Winter Weekday Daily

2002 Summer Weekend

Daily Traffic Flows

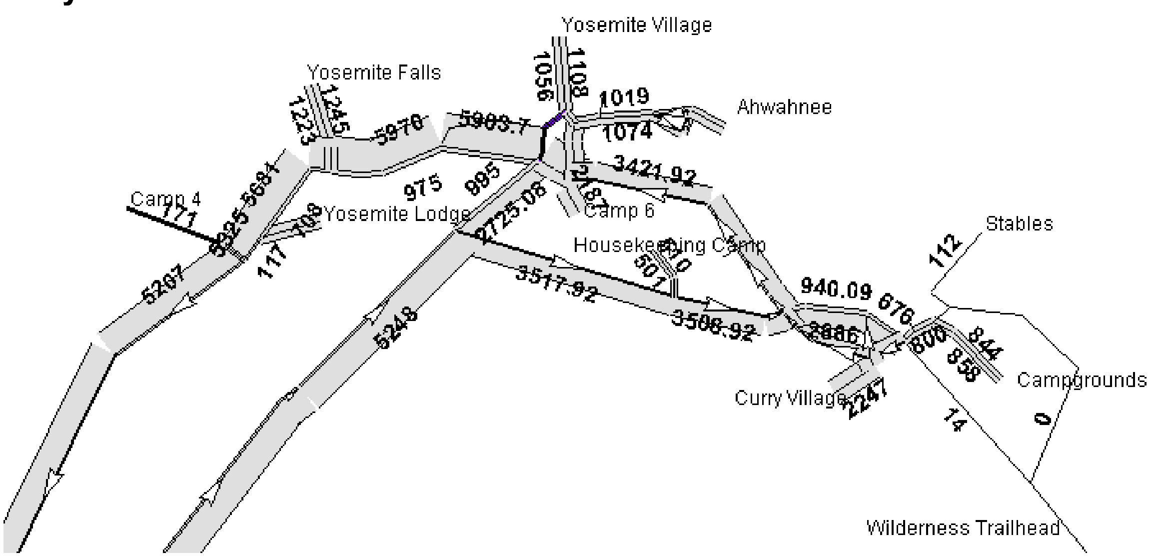

Figure 30 - Yosemite Valley 2002 Summer Weekend Daily

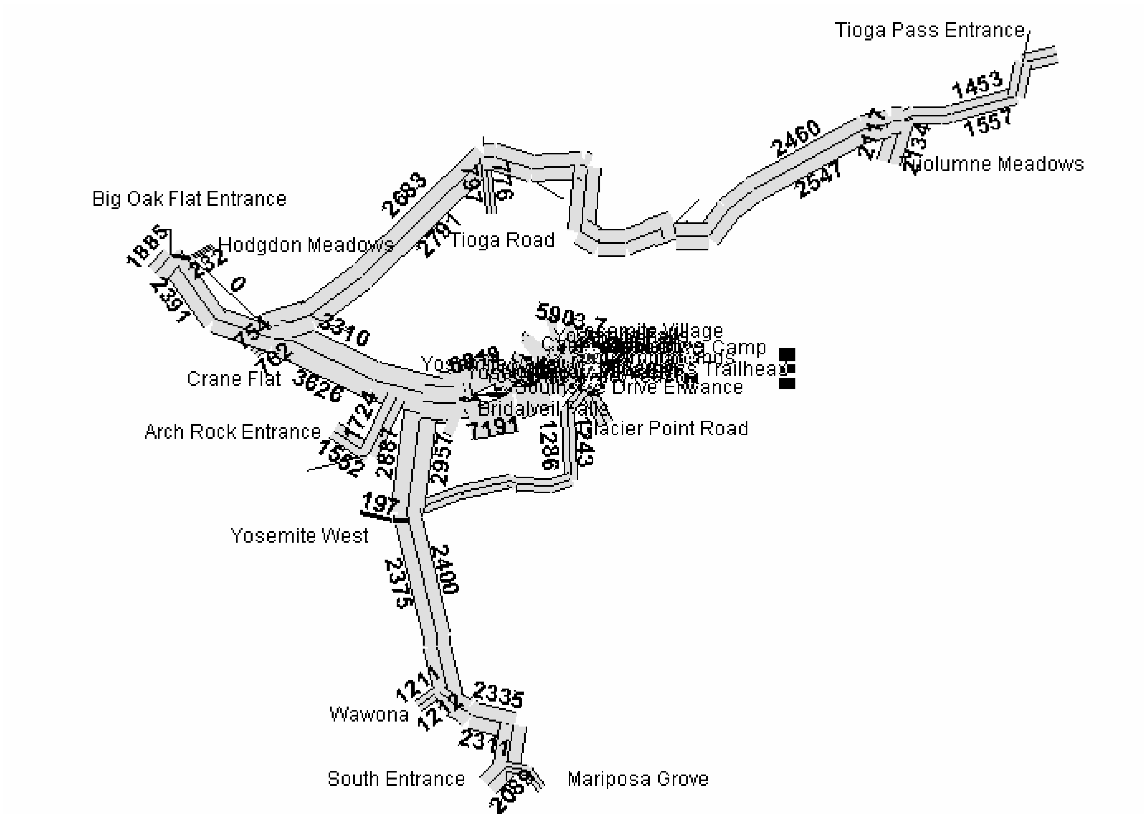

Figure 31 - Parkwide 2002 Summer Weekend Daily

AM Hourly Traffic Flows

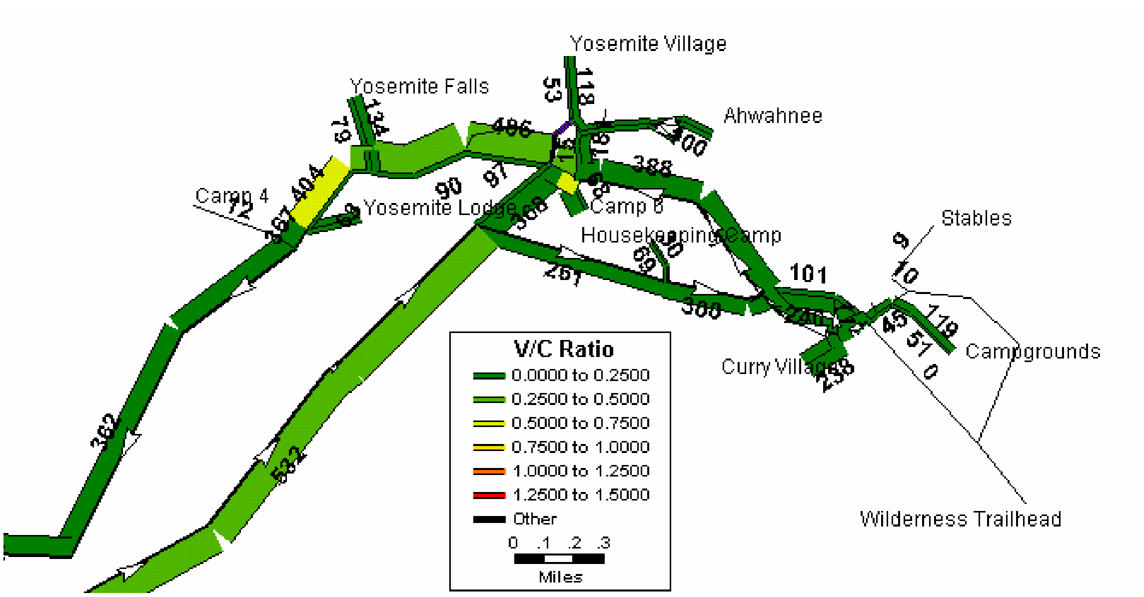

Figure 32 - Yosemite Valley 2002 Summer Weekend AM Peak Hourly

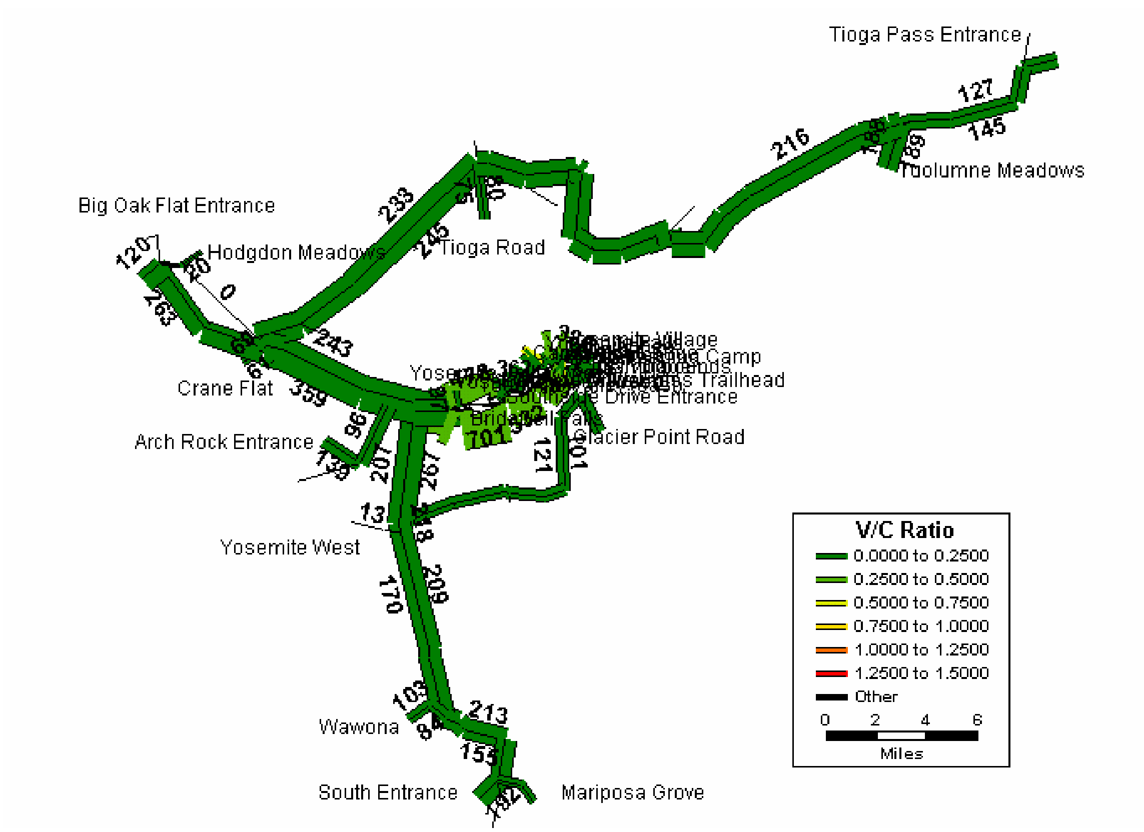

Figure 33 - Parkwide 2002 Summer Weekend AM Peak Hourly

PM Hourly Traffic Flows

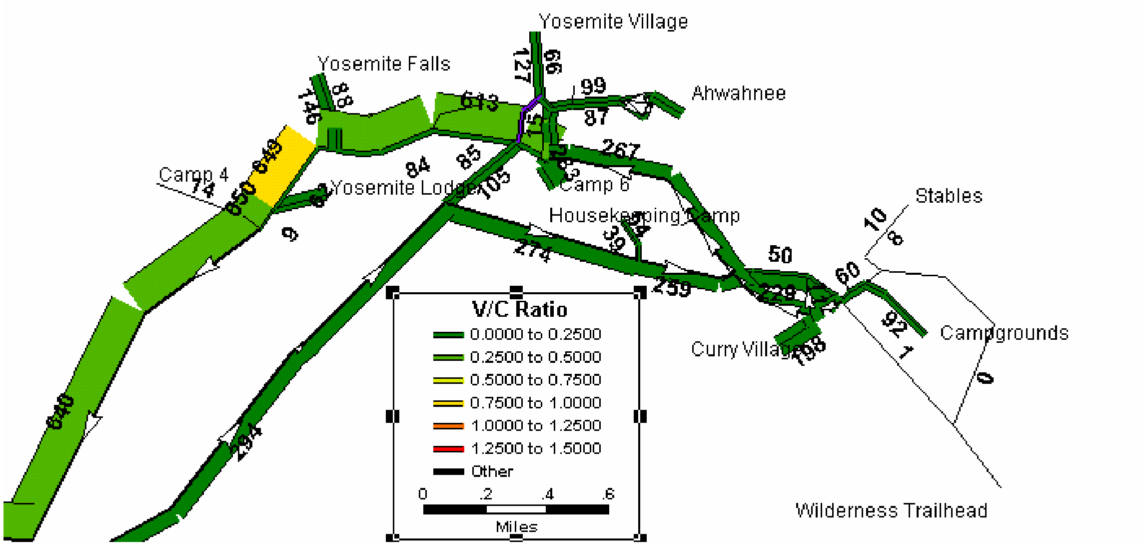

Figure 34 - Yosemite Valley 2002 Summer Weekend PM Peak Hourly

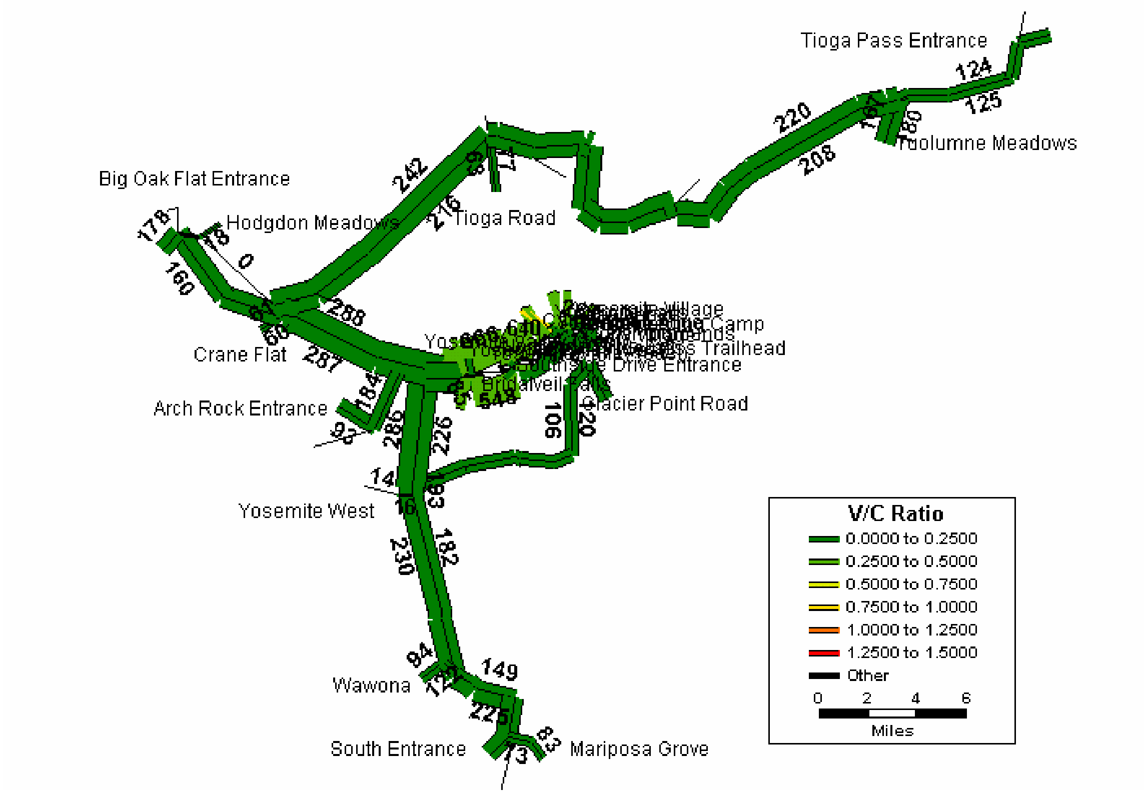

Figure 35 - Parkwide 2002 Summer Weekend PM Peak Hourly

References

National Cooperative Highway Research Program (NCHRP) Report 365: ***Travel Estimation Techniques for Urban Planning***, Transportation Research Board, 1998.

Yosemite National Park Traffic Information System: Network and Simulation Models (September 2002).

This memorandum describes the development of the network model, and requirements for a simulation model. Note that the material on the development of the network model has also been presented in the first part of this report.

Yosemite National Park Traffic Information System Trip Table Summary Report (February 2003).

This report presents the trip tables, and their development.

yose_traffic_flow.xls (February 2003)

This is a spreadsheet with nodes, links and traffic flows.

NPS D-1215 / July 2005