final report

Anchorage Congestion Management System

"Status of the System Report"

prepared by

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1.0 Executive Summary

1.1 Purpose

The "Status of the System Report" represents the first attempt at a comprehensive look at the performance of Anchorage's transportation system. This assessment is based on a set of 16 performance measures. The performance measures cover all modes of travel including the automobile, public transportation, vanpooling, carpooling, walking, and bicycling. An extensive effort was undertaken to collect data for each of the performance measures. This information was then reviewed to see what conclusions could be drawn concerning the magnitude and nature of congestion in Anchorage today.

The following executive summary contains the highlights from these findings by mode of transportation.

1.2 Status of the Road System

Seven out of the sixteen performance measures are primarily used to assess the status of the road system, including:

1. Roadway Segment Level of Service (How well does a particular stretch of road function?)
2. Intersection Level of Service (How well do our intersections operate?)
3. Vehicle Miles Traveled (How much traveling by automobile are we doing?)
4. Vehicle Miles Traveled per Capita (How many miles per day does an average person travel?)
5. Total Vehicle Miles Traveled Under Congested Conditions (How many miles do we travel when conditions are at there worst?)
6. Travel Time by Corridor (How long does it take us to get from one place to another?)
7. Travel Time Ratio by Corridor (How much slower is it to travel on a particular road during the busiest time of day compared to the midday period?)

Based on the analysis conducted for each of the above performance measures, intersection level of service appears to be the key determinant of congestion in Anchorage. Intersections at various critical locations on the Anchorage transportation network are often the cause of bottlenecks or delays. Many of the congested intersections are concentrated in the central part of the Anchorage Bowl where major east-west and north-south arterial streets cross each other. There are relatively few congested intersections in the southwest and southeast parts of the Anchorage Bowl and in Chugiak-Eagle River.

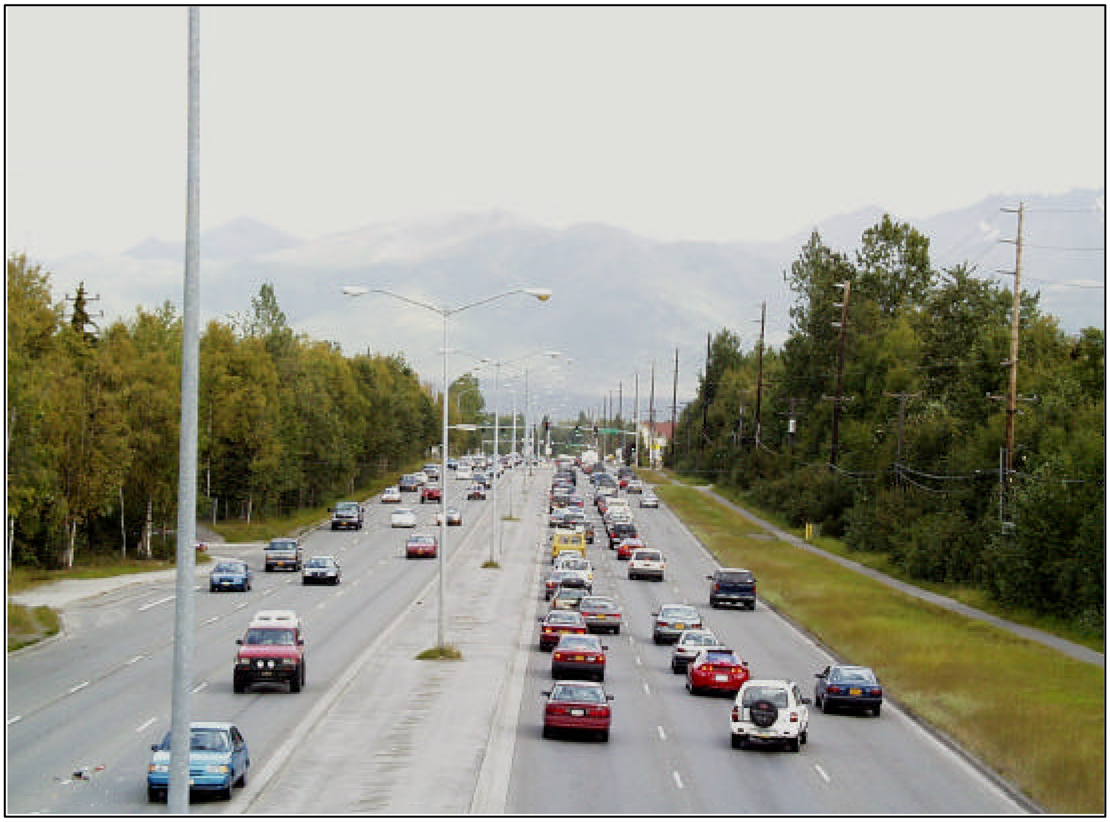
Intersection congestion appears to be the worse during the afternoon peak period. During this period, 20 out of the 30 (67%) intersections analyzed in this report operate at poor levels of service (“D” to “E”). For comparison purposes, 12 intersections operate at levels of service worse than “D” in the morning peak period. (Note: Level of service is categorized into six levels, A through F, with LOS A representing the best possible condition and LOS F representing the worst.)

Some of the worse performing intersections are those that are congested not only during the morning and afternoon peak periods but are also congested during the middle of the day. The names of these 8 most congested intersections will not surprise many Anchorage residents. They include the following:

- Boniface Parkway and Northern Lights Boulevard
- Bragaw Street and DeBarr Road
- C Street and Tudor Road
- Lake Otis Parkway and 36th Avenue
- Lake Otis Parkway and Northern Lights Boulevard
- Lake Otis Parkway and Tudor Road
- New Seward Highway and 36th Avenue
- Old Seward Highway and Dimond Boulevard

While intersection bottlenecks are generally the cause of most of the delay on the roadway system both the roadway segment level of service analysis and the travel time by corridor analysis reveal congestion along some of the major roadway corridors. Consistent with the intersection analysis, the afternoon peak period is more congested than the morning peak period.

Congestion appears to be particularly intense along the east-west corridors. Arterial roadways serving east Anchorage are widely spaced, some as much as one mile apart (e.g., Northern Lights Boulevard and Tudor Road). As a result, there is simply not enough roadway capacity available on the major east-west corridors to handle the traffic demand, especially during the afternoon peak period when people want to travel the most.



Northern Lights Blvd. East of LaTouche (5:15 p.m. on August 7, 2000)

Two of the four major east-west corridors show poor to severe levels of service over a significant portion of their roadway segments. The Glenn Highway between Medfra Street and Airport Heights Road operates at a LOS F in the afternoon peak period. This section of the Glenn Highway is characterized by a bottleneck where the number of lanes is reduced from three to two lanes. Tudor Road between the New Seward Highway and Boniface Parkway is another corridor experiencing severe congestion problems with a roadway segment LOS of "E".

The two remaining east-west corridors also experience their share of traffic delays which are reflected in some of the slowest travel times in Anchorage. The average speed of travel along the DeBarr Road/15th Avenue corridor during the afternoon peak period is about 21 miles per hour compared to an average speed of 30 miles per hour during the midday period (an increase of about 31% in the amount of time it takes the average driver to travel the length of the corridor). Drivers on Northern Lights Boulevard are also required to slow down considerably in the afternoon peak with travel speeds falling to an average of about 18 to 19 miles per hour from the midday speed of about 27 miles per hour. In other words it takes about 43% longer to travel this corridor during the afternoon peak as compared to the midday period.

Although the roadway segment level of service analysis showed some congestion on north-south streets (primarily C Street south of Tudor and the Old Seward Highway between Dowling and Dimond Boulevard) these corridors are soon to be reconstructed.

C Street is programmed to be improved as a limited access highway and expanded from two to four lanes. The Old Seward Highway is scheduled to be expanded from two to four-lanes with a center turn lane. This will leave the New Seward Highway as the only major north-south corridor that experiences significant congestion.

■ 1.3 Status of the Transit System

Seven out of the sixteen performance measures are primarily used to assess the status of the public transportation system (bus, carpooling, and vanpooling), including:

8. Commuter and Total Transit Mode Share (What percentage of Anchorage trips are made by bus?)
9. Auto Occupancy Index (How many people are in each car/truck?)
10. VMT per Year Saved by Bus Transit Service (Of the total miles traveled, how much of it is reduced by people using transit?)
11. VMT per Year Saved by Share-a-Ride (Of the total miles traveled, how much of it is reduced by the Municipal carpool program?)
12. VMT per Year Saved by Vanpool Program (Of the total miles traveled, how much of it is reduced by the Municipal vanpool program?)
13. Frequency of Bus Service (How often do the buses run?)
14. Ratio of Bus Travel Time to Auto T ravel Time (What is the time difference between the same two points when traveling by car versus the bus?)

The results of the performance measure analysis reveals that the bus transit, capooling, and vanpooling programs contribute to a substantial reduction in the number of vehicle miles traveled on the roadway system with a combined reduction of over 23 million vehicle miles traveled per year.

Bus transit alone accounts for about 1.8 percent of all commuter trips and has recently been accruing substantial ridership gains. The automobile occupancy rate as measured by an annual survey, has risen from 1.12 persons per vehicle in 1985 to 1.19 in 1998 thanks largely to the success of the Municipal Share-A-Ride program. The auto occupancy rate has remained steady the last several years. Of the three programs, vanpool is the newest and growing the fastest. The vanpool service to the Mat-Su Valley is experiencing particularly strong growth.

The transit performance measures point out several areas where improvements to the bus transit system might improve the transit mode share. Both the time between buses and the ratio of bus to automobile travel time performance measures indicate that bus service in Anchorage is well below the national average.

In general, the auto travel times are considerably faster than the transit travel times. On average, it takes about twice as long to travel by bus to midtown, downtown, and the University area employment centers than by automobile. The industry standard for bus travel time is 1.5 times the auto travel time. Bus headways (or frequency of service) also fail to meet industry standards. The average time between bus departures is 72 minutes in the morning peak period, 88 minutes during the midday peak period, and 61 minutes in the afternoon peak period. The industry standard for bus headways is 15 minutes for peak periods and 30 minutes for non-peak periods. In order to influence riders to use the bus system, the amount of time a trip takes on transit should not be excessively longer than the time in an auto. Frequent bus service is also strongly correlated to higher ridership levels.

■ 1.4 Status of the Pedestrian and Bicycle System

Due to the difficulty of collecting good information, only two performance measures were utilized to keep track of pedestrian and bicycle modes of transportation. They include:

15. Number of Miles of Bicycle Paths
16. Pedestrian Environmental Factors (How easy is it to get around using sidewalks and trails?)

The Pedestrian Environmental Factors performance measure was designed to assess the quality of the pedestrian environment of Anchorage neighborhoods using criteria such as sidewalk availability, street connectivity, and topological barriers. **The resulting composite scores show that much of Anchorage (with the exception of downtown and its surrounding neighborhoods) has a relatively poor pedestrian environment.** This affects the performance of other transportation modes such as bus transit and carpooling which rely on walking to either access the mode or provide mobility once the destination is reached.

A total of 124 miles of paved bike trails currently exist in the Anchorage Bowl. The Chugiak-Eagle River area appears to be substantially underserved by bicycle paths with only 20 miles of paved pathways available for use. It should be noted that the number of miles of bicycle paths does not address the issue of connectivity. Thus, **while the number of miles of bicycle paths may be substantial, there may be important gaps in the pathway system**.

2.0 Introduction

2.1 Purpose

The ensuing "Status of the System Report" represents the first attempt at a comprehensive, multi-modal assessment and documentation of Anchorage's transportation system performance. Since it is the first such report, the data contained in it can only realistically be expected to provide a snapshot of Anchorage's transportation system. By periodically updating the report, however, trends will begin to emerge and additional, more interesting analysis can be conducted.

While the "Status of the System Report" is intended to be used by the general public as a source of transportation related data, it is also designed to be used by transportation planners and engineers. As a result, a substantial amount of technical information is included in the main text of the report as well as in the appendices. This technical information will have the added benefit of making it easier to replicate the report in the future.

The four broad purposes of this study include the following:

- Identify the locations, magnitude, and nature of congestion in the Anchorage region
- Develop the "Status of the System Report" of 1998 conditions of the Anchorage transportation system to be used as a baseline database to analyze changes over time
- Collect data to compute a series of base-year (1998) transportation system performance indicators identified by the AMATS and MOA for its Congestion Management System (CMS). The data collected as a part of the performance measures will serve as a powerful tool in the evaluation of existing congestion management strategies as well as aid in the identification and implementation of the new strategies;
- Identify potential ongoing transportation system monitoring programs for future data collection needs, data storage and maintenance needs, and level of service standards

2.2 Background

The Transportation Efficiency Act of the 21st Century (TEA21) requires that each Transportation Management Area (TMA) with a population over 200,000 develops and implements a Congestion Management System (CMS). The Municipality of Anchorage, as the designated TMA, has the responsibility for developing the CMS in cooperation with the Alaska Department of Transportation.

TEA21 regulations state that "within a transportation management area, the transportation planning process shall include a congestion management system that provides for effective management of new and existing transportation facilities through the use of travel demand reduction and operational management strategies." The regulations further state that a CMS should have five main components:

1. Performance Measures

2. Data Collection and System Monitoring

3. Identification and Evaluation of Potential Strategies

4. Implementation of Strategies

5. Evaluation of the Effectiveness of Implemented Strategies

AMATS has already made significant progress in the development of its Congestion Management System with the adoption of the Congestion Management Program in October 1994. The Congestion Management Program, which primarily focused on component #3, identified over 50 strategies that are either currently being implemented or are suitable for future implementation in Anchorage. The Congestion Management Program also briefly addressed components #2. While this work is very useful, it needed to be expanded to cover more systemwide measures of congestion as well as measures of the effectiveness of existing strategies such as bus transit and the new vanpool program.

This report will focus on the development of a comprehensive set of performance measures and standards and its associated data collection and system monitoring activities (components 1, 2, and 5). This report will also benefit strategy implementation (component 4), as a result of developing a better understanding of the extent and nature of congestion in Anchorage.

Performance measures are the central element of any CMS. According to federal requirements, performance measures will provide the basis for identifying the extent, severity and specific locations of congestion on a systemwide basis as well as evaluate the effectiveness of implemented actions. This information has several practical uses. One of the most important uses is to track changes in congestion over time and identify potential congestion causes. Decision-makers need this information as they deliberate on investment decisions intended to improve the performance of the region's transportation system.

The development of the "Status of the System Report" and the CMS also represents an opportunity for AMATS to coordinate and integrate the transportation planning at the local level with several ongoing transportation planning efforts including:

- Anchorage Bowl Comprehensive Land Use Plan being prepared by the MOA
- Anchorage Long-Range Transportation Plan being prepared by the MOA
- Glenn Highway and Seward Highway Major Investment Study projects being prepared by the ADOT&PF
- Air Quality Conformity Plan and Mobile Source Emissions Inventory being prepared by the MOA
- Public Transportation Development Plan being prepared by the Public Transportation Department

The "Status of the System Report" provides a baseline of transportation performance data that will help facilitate interagency coordination of the various ongoing planning efforts in the Anchorage region. It should be remembered, however, that many transportation improvement decisions are based on long-range (20-year) projections. Although many roads are currently operating at an acceptable level, future growth will likely cause many of these roadways to become severely congested in the future.

■ 2.3 Sections of Report

This report contains the following sections:

- Section 2.0: Performance Measure Analysis and Results
- Section 3.0: Transportation System Congestion
- Section 4.0: Ongoing Transportation System Monitoring

3.0 Performance Measure Analysis and Results

On March 27, 1998, AMATS adopted 16 performance measures as a part of its Congestion Management System (see Table 3.1). These performance measures were designed to give the Municipality the ability to comprehensively evaluate congestion for all transportation modes in Anchorage while minimizing the need to collect additional information. Three general categories of transportation performance measures are covered by this list, including; (1) measures of vehicle movement, (2) overall congestion indices, and (3) congestion-reduction and mobility enhancement strategy measures. This section presents the computation methods and results of each performance measure.

Table 3.1 Adopted Performance Measures for the Anchorage CMS

Performance Measures
1. Roadway Segment Level of Service
2. Intersection Level of Service
3. Vehicle Miles Traveled (VMT)
4. VMT per Capita
5. Total Vehicle Miles Occurring Under Congested Conditions
6. Travel Time by Corridor
7. Travel Time Ratio by Corridor (midday travel time / peak travel time)
8. Transit Mode Share (commuter and total)
9. Auto Occupancy Index
10. VMT per Year Saved by Bus Transit Service
11. VMT per Year Saved by Share-a-Ride
12. VMT per Year Saved by Vanpool Program
13. Frequency of Bus Service
14. Ratio of Bus Travel Time to Auto Travel Time
15. Number of Miles of Bicycle Paths / Lanes
16. Pedestrian Environmental Factors (PEF)

Source: MOA, 1998.

3.1 Roadway Segment Level of Service – Performance Measure #1

For purposes of this analysis, the level of service for each roadway segment was measured using a volume-to-capacity ratio. The volume to capacity (v/c) ratio is a conventional level of service measure which equates roadway demand to supply. Demand is expressed by roadway volume and supply is expressed as the carrying capacity of a roadway. Level of service is categorized into six levels, A through F, with LOS A representing the best possible condition and LOS F representing the worst. Table 3.2 provides the v/c ratios used in this report as well as a description of the associated travel characteristics.

Table 3.2 Roadway Level of Service Categories

Level of Service	Volume/Capacity Ratio	General Description
LOS "A" and LOS "B"	Less than 0.50	Primarily operates at free-flow or reasonably free-flow speeds.
LOS "C"	0.51 – 0.75	Provides for flow with speeds still at or near the free-flow speeds. Ability to maneuver is more restricted than LOS B. Motorist will experience appreciable tension while driving.
LOS "D"	0.76 – 0.85	Borders on a range in which small increases in flow may cause substantial increases in delay.
LOS "E"	0.86 – 1.00	Operates at capacity and is characterized by significant delays.
LOS "F"	1.01 and above	Vehicular flows breakdown and results in extremely low speeds.

Source: 1994 Highway Capacity Manual.

A total of 259 roadway segments within the Municipality of Anchorage were evaluated for this performance measure. The number of roadway segments analyzed is a little over 10 percent of the total and are believed to be representative of the system as a whole. However, it should be noted that, due to the limited sample, not all of the poorly performing roadway segments have been identified.

For the most part, the volume portion of the ratio was obtained using actual 1998 morning (a.m.)- and afternoon (p.m.)-peak-period traffic counts. (The two-hour morning-peak period is from 7:00 a.m. to 9:00 a.m. and the three-hour afternoon-peak period is from 3:00 p.m. to 6:00 p.m.) However, hourly traffic volumes were not available for many important roadway corridors. In order to supplement this data and fill in some of the gaps, additional peak hour percentage estimates were obtained using hourly data from adjacent roadway segments located along the same corridor. The percentage estimates were then multiplied by the actual daily traffic counts for the roadway segment to obtain hourly estimates. The hourly traffic volumes were further refined utilizing the directional flow output from the Municipality of Anchorage's regional transportation model (TransCAD). The capacity portion of the v/c ratio utilized the capacities found in the regional transportation planning model. Capacity varies depending on roadway characteristics such as functional class, area type, and number of lanes.

Of the roadway segments evaluated for the morning-peak period:

- 225 (87%) operate with volume-to-capacity levels of .50 or less; equivalent to excellent levels of service from "A" to "B"
- 31 (12%) operate with volume-to-capacity ratios of .51 to .75; typically good levels of service through the grade of "C"
- Two (0.7%) operate with volume-to-capacity ratios of .76 to .86; typically fair to poor levels of service through the grade of "D"
- One (0.3%) operates with volume-to-capacity ratios of .86 to 1.00; typically poor levels of service through the grade of "E"

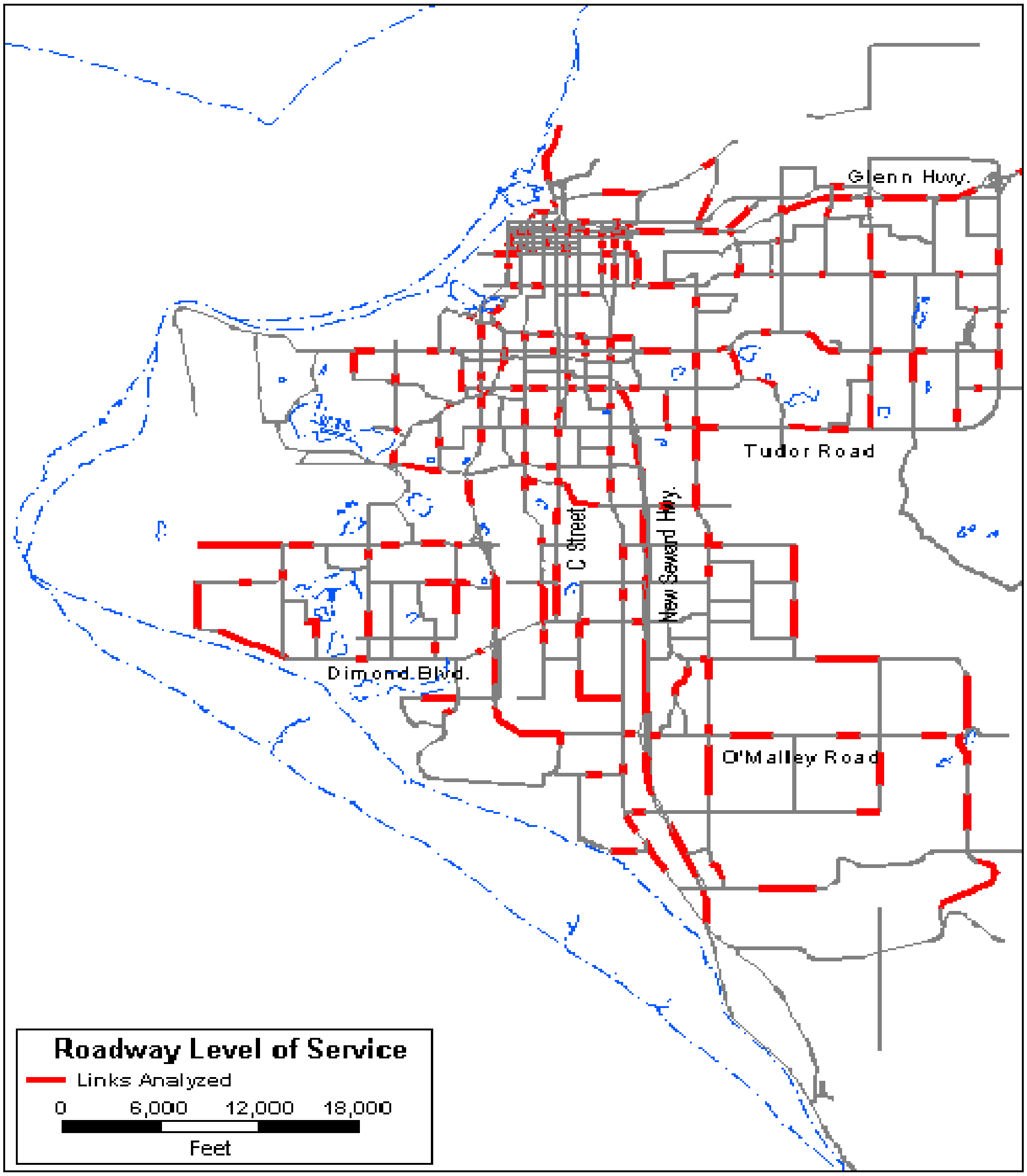
Of the roadway segments evaluated for the afternoon-peak period:

- 183 (70%) operate with volume-to-capacity levels of .50 or less; equivalent to excellent levels of service from "A" to "B"
- 51 (20%) operate with volume-to-capacity ratios of .51 to .75; typically good levels of service through the grade of "C"
- 10 (4%) operate with volume-to-capacity ratios of .76 to .85; typically fair to poor levels of service through the grade of "D"
- 7 (3%) operate with volume-to-capacity ratios of .86 to 1.00; typically poor levels of service through the grade of "E"
- 8 (3%) operate with a volume-to-capacity ratio of over 1.00; typically failing levels of service "F"

This analysis indicates that most of the roadways segments (99%) are operating at a level of service "A", "B", or "C" during the morning peak period. Only three of the roadway segments analyzed in this report are operating at LOS "D" or worse.

An examination of the roadway levels of service in the afternoon-peak period indicates that about 90% of the roadway segments are operating at level of service "A", "B", or "C". The remaining 10% are operating at level of service "D" or worse (see Map 4.1 for the location of the poorly operating roadway segments).

Figure 3.1 Roadway Segments Evaluated for Level of Service Analysis



■ 3.2 Intersection Level of Service – Performance Measure #2

The MOA Traffic Engineering Department provided volume turning movement, signal timing, and geometric data for the 30 intersections selected for analysis in this report. These locations, shown in Figure 3.2, include a large proportion of the high volume intersections plus a representative sample of lower volume intersections. The lower volume intersections were included not so much to identify existing congested conditions but rather to help track changes in intersection congestion in high growth areas. The intersection volume and turning movement data were formatted and input into standard intersection analysis software to generate intersection v/c, LOS, and average delay ratings for morning-peak-hour, midday off-peak-hour, and afternoon-peak-hour analysis. The methods used in this analysis followed the guidance and procedures approved in the Highway Capacity Manual (HCM).

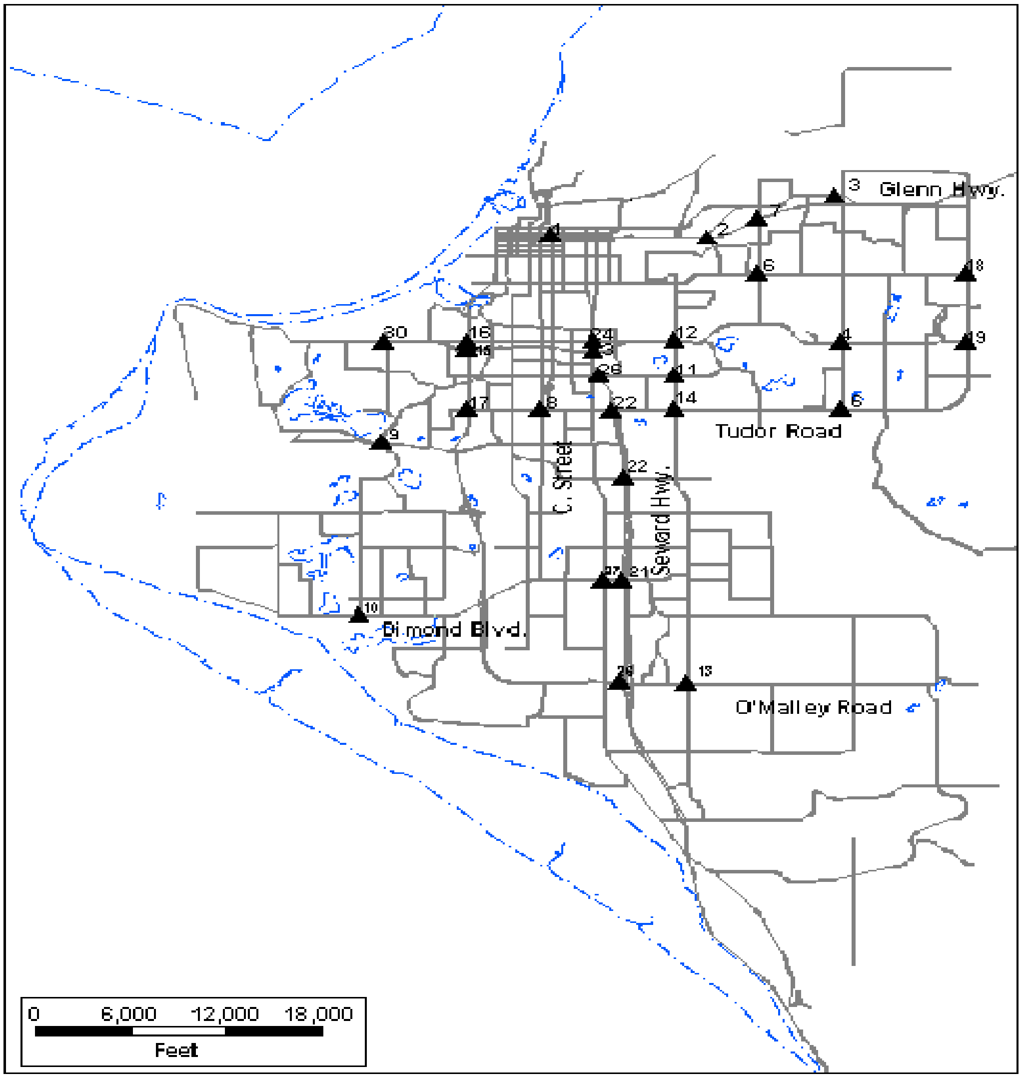
As with the roadway level of service performance measure presented in Section 3.1, intersection level of service is a quantitative measure categorized into six levels, A through F, with LOS "A" representing the best condition and LOS "F" representing the worst. Level of service for intersections is defined in terms of delay, which is different from the way level of service is measured for roadway segments (see Table 3.3).

Table 3.3 Intersection Level of Service Categories

Level of Service	Stopped Delay per Vehicle (Sec.)	General Description
LOS "A"	≤5.0	Intersection operates with very low delay.
LOS "B"	>5.0 and ≤ 15.0	More vehicles stop than with LOS "A".
LOS "C"	>15.0 and ≤ 25.0	The number of vehicles stopping is significant, though many pass through the intersection without stopping.
LOS "D"	>25.0 and ≤ 40.0	Many vehicles stop, and the proportion of vehicles not stopping declines.
LOS "E"	>40.0 and ≤ 60.0	This level is considered by many agencies to be the limit of acceptable delay.
LOS "F"	>60.0	This level, considered to be unacceptable to most drivers, often occurs with oversaturation, that is, the arrival flow rates exceed the capacity of the intersection.

Source: 1994 Highway Capacity Manual.

Figure 3.2 Intersections Evaluated for Level of Service Analysis



Note: Two intersections in Eagle River were also analyzed: (1) Eagle River Road and Eagle River Loop Road and (2) Old Glenn Hwy. and Eagle River Loop Road.

Table 3.4 shows the level of service results for the morning-peak, midday off-peak, and afternoon-peak hours. Typically, the evening-peak hour is more congested than either the morning-peak hour or midday off-peak hour. For example, 20 of the intersections evaluated were either level of service "D" or "E" in the evening-peak hour compared to 12 in the morning-peak hour and 8 in the midday off-peak hour. Level of service grades "D" and "E" are considered close to failing (i.e., heavy congestion) in the Anchorage region and are clear indicators of intersection locations expected to worsen in the near future.

Due to limitations in the methodology used to calculate intersection level of service, some or most of the intersections reported to be operating at level of service "E" may actually operate at level of service “F”. Typically, p.m. peak counts (used to calculate intersection level of service) total only the vehicles, which actually pass through the intersection. The number of vehicles that are counted is ultimately limited by the capacity of the intersection. In highly congested intersections, actual demand includes peak traffic counts plus those vehicles, which have backed up through the previous signals. If the intersections were analyzed under actual demand volumes, level of service may be worse than what is shown in this report.

Table 3.4 Anchorage Intersection Baseline Peak-Hour Level of Service Results

Intersections	Average A.M.-Peak LOS	Average Midday LOS	Average P.M.-Peak LOS
1. A Street and 5th Avenue	B	B	B
2. Airport Heights Road and Glenn Highway	C	C	D
3. Boniface Parkway and Mountain View Drive	C	C	B
4. Boniface Parkway and Northern Lights Boulevard	E	D	E
5. Boniface Parkway and Tudor Road	F	C	C
6. Bragaw Street and DeBarr Road	D	D	E
7. Bragaw Street and Glenn Highway	C	C	E
8. C Street and Tudor Road	D	D	E
9. Jewel Lake Road and International Airport Road	D	C	D
10. Jewel Lake Road and Dimond Boulevard	C	C	D
11. Lake Otis Parkway and 36th Avenue	D	D	E
12. Lake Otis Parkway and Northern Lights Boulevard	D	D	E
13. Lake Otis Parkway and O’Malley Road	D	C	D
14. Lake Otis Parkway and Tudor Road	E	E	E
15. Minnesota Drive and Benson Boulevard	C	C	C
16. Minnesota Drive and Northern Lights Boulevard	B	C	D
17. Minnesota Drive and Tudor Road	D	C	D
18. Muldoon Road and DeBarr Road	B	B	C
19. Muldoon Road and Northern Lights Boulevard	B	B	C
20. New Seward Highway and 36th Avenue	D	D	E
21. New Seward Highway and Dimond Blvd. sb ramps	B	C	C
22. New Seward Highway and Dowling Road sb ramps	B	C	E
23. New Seward Highway and Benson Boulevard	C	C	D
24. New Seward Highway and Northern Lights Boulevard	C	C	D
25. New Seward Highway and O’Malley Road sb ramps	A	B	C
26. New Seward Highway and Tudor Road west ramp	B	C	C
27. Old Seward Highway and Dimond Boulevard	D	D	E
28. Eagle River Loop and Eagle River Road	C	C	D
29. Old Glenn Highway and Eagle River Loop	C	C	C
30. Wisconsin Street and Northern Light Boulevard	C	C	D

Source: Rader Econometrics & Engineering, 1999.
Note: 1998 improvements were included in the calculations for Lake Otis Blvd. and Tudor Rd.

3.3 Vehicle Miles Traveled – Performance Measure #3

Vehicle miles traveled (VMT) is an important performance measure for the purposes of air quality analysis due to the fact that it is directly related to the amount of carbon monoxide emitted. It is also a useful indicator for the overall effectiveness of congestion management strategies that are designed to reduce automobile travel.

Vehicle miles traveled are a function of the number of automobile trips times the length of the trips. The VMT estimate developed for this report was calculated using the Anchorage transportation model estimate of traffic volume by roadway segment. Total daily VMT of the base-year (1994) Anchorage transportation model was estimated as 3,872,000. This estimate does not include local roads since the TransCAD roadway database only includes major roadway classifications. As a result, the VMT estimates contained in this report will differ from the VMT estimates found in the State of Alaska Highway Performance Monitoring System. The above estimate of VMT will be primarily used to analyze VMT growth by comparing it to future model projections.

3.4 VMT per Capita – Performance Measure #4

One of the drawbacks of performance measure #3 (VMT) is that it does not take into account population growth as a factor in automobile travel. VMT per Capita provides a useful measure of traffic growth while controlling for population. It is particularly useful when comparing the transportation impacts of various land use alternatives.

VMT per capita was measured by dividing the total daily VMT computed for Performance Measure #3 (3,872,000) by the total 1994 population (250,000). Based on this calculation the daily VMT per Capita for the Anchorage region was estimated to be 42.5 VMT per household and 15.4 VMT per person. According to the 1990 National Personal Transportation Survey, reasonable ranges of VMT per person are 17-24 miles per day for large urban areas and 10-16 miles per day for small urban areas.

3.5 Total Vehicle Miles Occurring Under Congested Conditions – Performance Measure #5

The TransCAD roadways database was used to calculate this measure using the VMT generated for Performance Measure #3 by the time-of-day trip assignment models recently validated for the Anchorage Travel Model Update. Congested conditions were identified by searching for roadway links with a v/c ratio greater than 0.75 based upon observed volumes for the morning- and afternoon-peak periods. This threshold represents poor roadway levels of service of "D" or worse. Through this analysis, it was determined that four percent of the total vehicle miles traveled during the average weekday in Anchorage occur under congested conditions (levels of service of "D" or worse). Care should be taken when using this performance measure since it is based strictly on roadway segment congestion and does not take into account other sources of congestion such as intersection delay.

3.6 Travel Time by Corridor – Performance Measure #6

Travel time is considered by many as the best measure of system congestion. There are a number of advantages to utilizing travel time as a performance measure. First, travel time allows for consistent measurements. Second, these measures are relatively reliable in that a measurement can be taken for the same route or within the same geographic area over a number of years. Comparisons can then be made which will indicate the effectiveness of congestion strategies over time. Third, travel time is a measurement which is applicable to all modes of travel, including autos, trucks, transit, carpools, vanpools, and bicycles. Consequently, travel time comparisons can be made across various modes of travel as well as within modes.

Traffic time by corridor alone is not sufficient to measure all of the dynamics and effects due to congestion, however. While travel time by corridor is a useful quantification of congestion, it may not always accurately reflect the traveler's perception of the problem. Most people in Anchorage do not travel in straight lines along a single corridor. In order to arrive at a destination, travelers often have to make multiple left and right hand turns. As a result, intersection delay, which is more intense for turning movements than through movements, is also an important performance measure.

Travel time is measured as the amount of time required to transverse a segment or a complete route. Travel time data was collected for nine corridors as part of this project. The nine corridors included the following roadways:

- Corridor #1 – New Seward Highway (5th Avenue to Rabbit Creek Road)
- Corridor #2 – Glenn Highway (Artillery Road Interchange to C Street)
- Corridor #3 – Minnesota Drive (5th Avenue to New Seward Highway overpass)
- Corridor #4 – Northern Lights Boulevard (Minnesota Drive to Muldoon Road)
- Corridor #5 – Tudor Road / Muldoon Road (Minnesota Drive to Glenn Hwy. overpass)
- Corridor #6 – Lake Otis Parkway (15th Avenue to O'Malley Road)
- Corridor #7 – C Street (Oceandock Road at Port of Anchorage entrance to Dimond Blvd.)
- Corridor #8 – Debarr Road / 15th Avenue (I Street to Muldoon Road)
- Corridor #9 – Dimond Boulevard / Abbott Road (Jewel Lake Road to Lake Otis Blvd.)

Travel time and average speed calculations for each corridor were conducted using an Excel spreadsheet model using travel distance and time data collected in the field. Tables 3.5 and 3.6 show the average travel times and travel speeds for each corridor evaluated by time-of-day. Time periods evaluated were consistent with the intersection level of service analysis conducted for Performance Measure #2 (see Section 3.2) and included the morning-peak (7:00 a.m. to 9:00 a.m.), the midday off-peak (11:00 a.m. to 1:00 p.m.), and the afternoon-peak periods (3:00 p.m. to 6:00 p.m.).

Figure 3.3 Average Speed by Corridor (Morning Peak-Period)

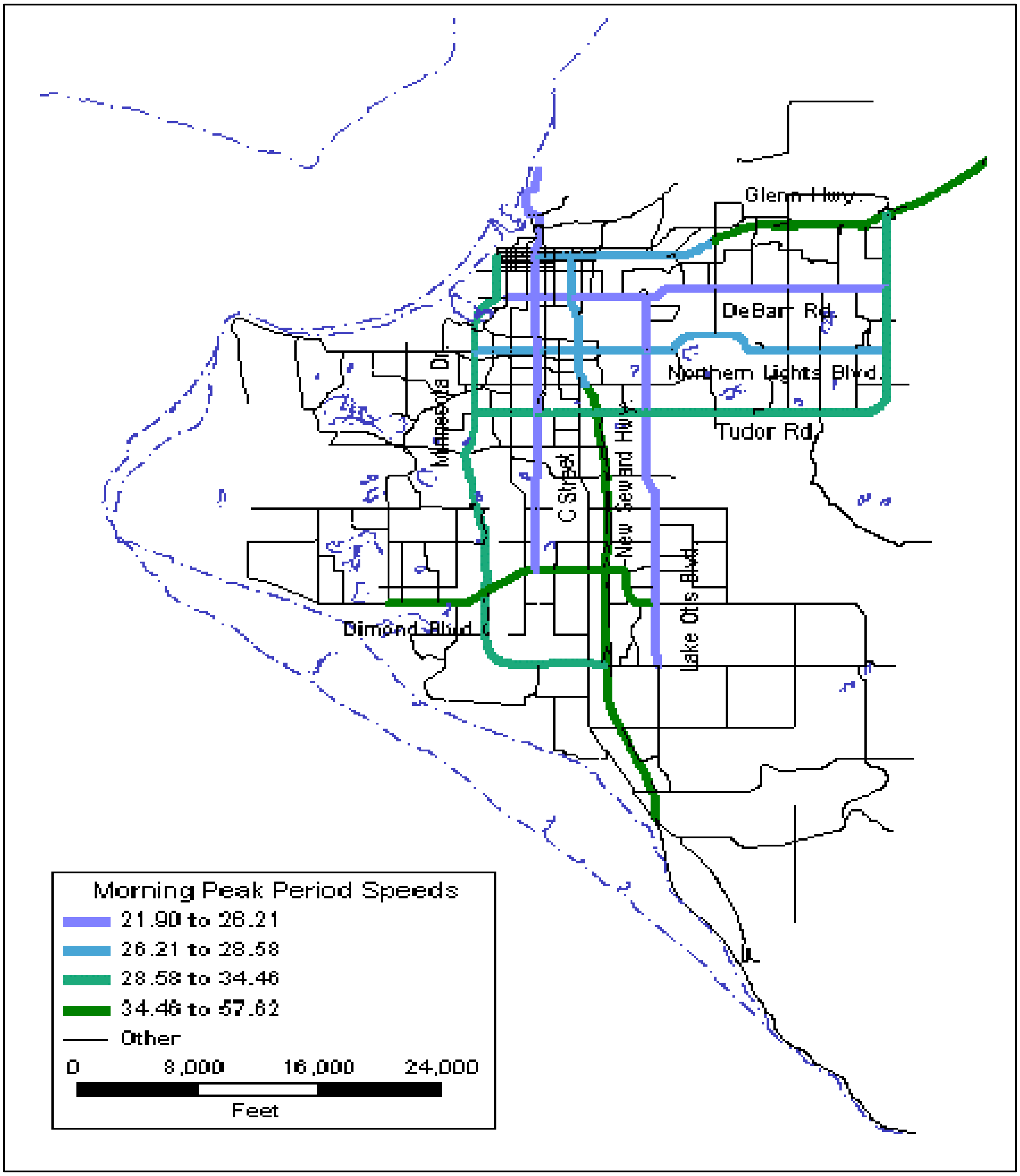


Figure 3.4 Average Speed by Corridor (Afternoon Peak Period)

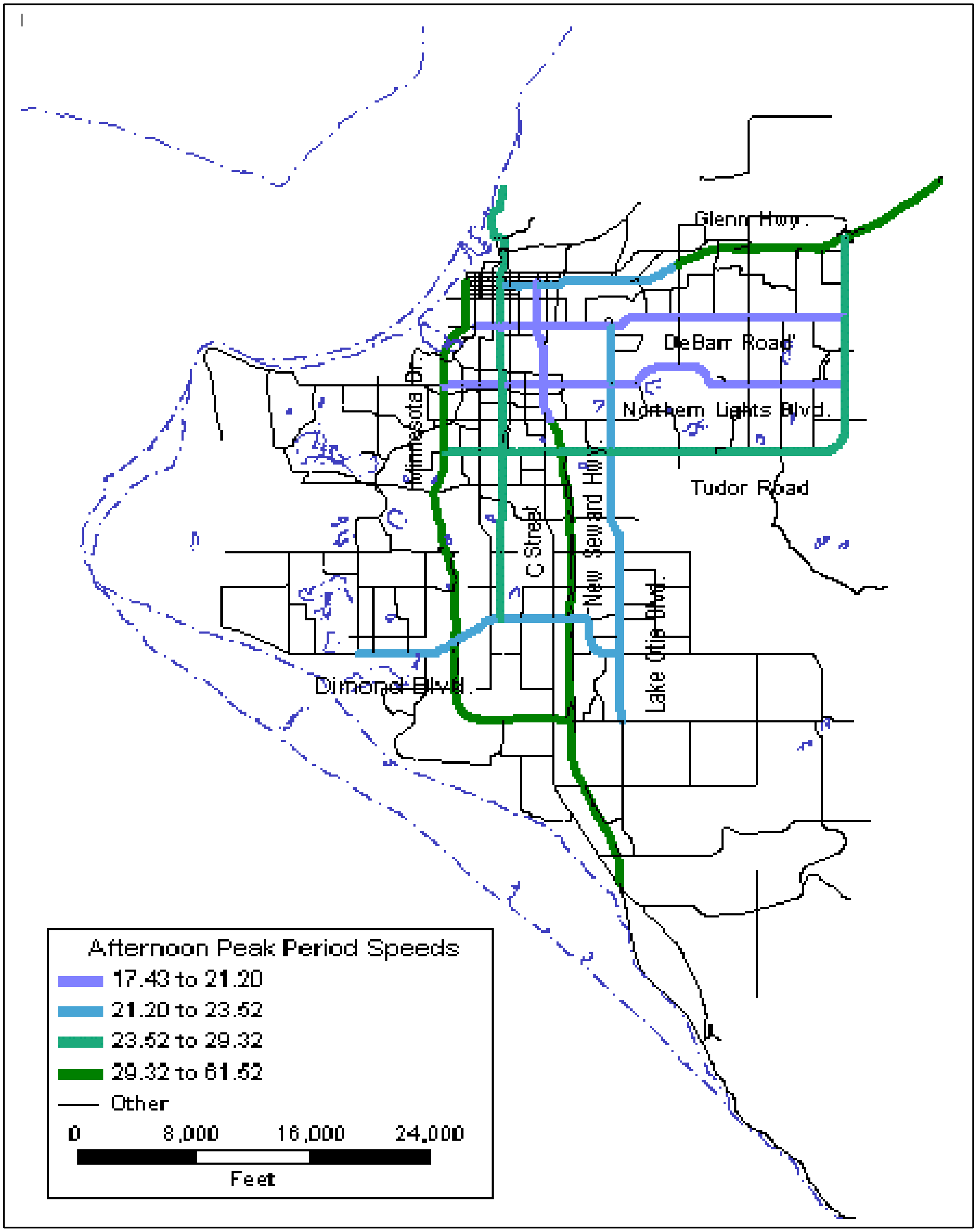


Table 3.5 Anchorage Travel Times – Morning-Peak Period, Midday Off-Peak Period, and Afternoon-Peak Period

Corridor	Direction	Corridor Length (miles)	Morning Peak (minutes)	Midday Off-Peak (minutes)	Afternoon Peak (minutes)
C Street	NB	6.40	14.16	12.18	14.57
C Street	SB	6.40	14.66	12.97	15.90
DeBarr Road / 15th Avenue	EB	5.60	11.77	11.18	16.10
DeBarr Road / 15th Avenue	WB	5.60	13.55	12.76	13.80
Dimond Boulevard / Abbott Road	EB	4.50	7.20	8.74	9.32
Dimond Boulevard / Abbot Road	WB	4.50	7.45	10.69	11.79
Glenn Highway					
Freeway (Bragaw to Eagle River)	EB	11.3	10.81	10.48	11.02
Arterial (C St. to Bragaw)		2.7	5.15	5.52	7.52
Freeway (Bragaw to Eagle River)	WB	11.2	11.66	10.74	10.74
Arterial (C St. to Bragaw)		2.7	6.01	5.53	5.53
Lake Otis Parkway	NB	5.90	16.16	12.06	15.76
Lake Otis Parkway	SB	5.90	12.88	12.86	14.18
Minnesota Drive	NB	8.20	15.07	14.08	14.12
Minnesota Drive	SB	8.20	13.02	13.84	15.15
Muldoon Road / Tudor Road	NB, EB	9.00	16.10	16.04	20.65
Muldoon Road / Tudor Road	SB, WB	9.00	17.88	15.67	18.85
New Seward Highway					
Freeway (36th Ave. to Rabbit Ck.)	NB	7.1	8.63	7.36	7.88
Arterial (5th Ave. to 36th Ave.)		2.1	4.07	4.84	6.64
Freeway (36th Ave. to Rabbit Ck.)	SB	7.1	7.51	7.23	7.99
Arterial (5th Ave. to 36th Ave.)		2.1	4.73	5.63	7.23
Northern Lights Boulevard	EB	6.20	13.04	13.99	19.97
Northern Lights Boulevard	WB	6.20	14.19	13.78	15.50

Source: Cambridge Systematics, Inc.

Table 3.6 Anchorage Average Speed by Corridor – Morning-Peak Period, Midday Off-Peak Period, and Afternoon-Peak Period

Corridor	Direction	Corridor Length (miles)	Morning Peak (mph)	Midday Off-Peak (mph)	Afternoon Peak (mph)
C Street	NB	6.40	27.12	31.54	26.36
C Street	SB	6.40	26.20	29.61	24.15
DeBarr Road / 15th Avenue	EB	5.60	28.56	30.04	20.87
DeBarr Road / 15th Avenue	WB	5.60	24.80	26.32	24.34
Dimond Boulevard / Abbott Road	EB	4.50	37.50	30.88	28.96
Dimond Boulevard / Abbott Road	WB	4.50	36.26	25.26	22.89
Glenn Highway					
Freeway (Bragaw to Eagle River)	EB	11.3	62.71	64.69	61.52
Arterial (C St. to Bragaw)		2.7	31.46	29.35	21.53
Freeway (Bragaw to Eagle River)	WB	11.2	57.62	62.59	62.45
Arterial (C St. to Bragaw)		2.7	26.94	29.31	27.06
Lake Otis Parkway	NB	5.90	21.90	29.36	22.46
Lake Otis Parkway	SB	5.90	27.48	27.54	24.96
Minnesota Drive	NB	8.20	32.65	34.93	34.84
Minnesota Drive	SB	8.20	37.80	35.54	32.48
Muldoon Road / Tudor Road	NB, EB	9.00	33.55	33.66	26.16
Muldoon Road / Tudor Road	SB, WB	9.00	30.20	34.46	28.65
New Seward Highway					
Freeway (36th Ave. to Rabbit Ck.)	NB	7.1	49.38	57.89	54.10
Arterial (5th Ave. to 36th Ave.)		2.1	30.98	26.02	18.96
Freeway (36th Ave. to Rabbit Ck.)	SB	7.1	56.69	58.96	53.31
Arterial (5th Ave. to 36th Ave.)		2.1	26.63	22.37	17.43
Northern Lights Boulevard	EB	6.20	28.52	26.59	18.63
Northern Lights Boulevard	WB	6.20	26.22	26.99	24.00

Source: Cambridge Systematics, Inc.

Travel time or speed is basically a function of facility type and volume density. Congestion occurs when travel time increases abruptly with increased flow density exceeding the normal capacity. As with the intersection levels of service analysis conducted in Section 3.2, the afternoon-peak period is more congested than the morning-peak and midday off-peak periods. Generally, the travel times are greater and the average travel speeds are slower in the afternoon-peak period. For the afternoon-peak period, the most congested corridors include: New Seward Highway non-freeway segments northbound and southbound, Glenn Highway non-freeway segments eastbound, DeBarr Road/15th Avenue eastbound, Lake Otis Parkway northbound, and Northern Lights Boulevard eastbound.

■ 3.7 Travel Time Ratio by Corridor (Free Flow-Travel Time/Peak-Travel Time) – Performance Measure #7

Free flow travel times, typically representing midday off-peak travel conditions, were set equal to the uncongested travel speeds collected for each corridor. Congested travel times were equivalent to those collected for the afternoon-peak period (see Performance Measure #6). This measure was calculated for the nine corridors specified for analysis in Performance Measure #6. Travel time ratios were computed from the afternoon-peak travel times collected in Performance Measure #6 divided by the midday uncongested travel time. The results of this analysis are shown in Table 3.7.

Similar to the analysis conducted in Section 2.6, the corridors most congested include, DeBarr Road/15th Avenue eastbound, Lake Otis Parkway northbound, Tudor/Muldoon Road eastbound, and Northern Lights Boulevard eastbound. All of the worse congested roads are located in the eastern portion of the Anchorage Bowl. Northern Lights Blvd. eastbound and DeBarr/15th Ave. are the most congested corridor with an off-peak to afternoon peak ratio of about 70%. Another way of looking at congestion along corridors is that it takes about 42% longer to travel eastbound along Northern Lights Blvd. during the afternoon peak than it does during uncongested periods.

Table 3.7 Anchorage Travel Time Ratio by Corridor – Midday-to-Afternoon Peak

Corridor	Direction	Midday Travel Time (minutes)	Afternoon Travel Time (minutes)	Off-Peak to Peak Ratio
C Street	NB	12.18	14.57	84%
C Street	SB	12.97	15.90	82%
DeBarr Road / 15th Avenue	EB	11.18	16.10	69%
DeBarr Road / 15th Avenue	WB	12.76	13.80	92%
Dimond Boulevard / Abbott Road	EB	8.74	9.32	94%
Dimond Boulevard / Abbott Road	WB	10.69	11.79	91%
Glenn Highway	EB	16.00	18.54	86%
Glenn Highway	WB	16.26	16.75	97%
Lake Otis Parkway	NB	12.06	15.76	77%
Lake Otis Parkway	SB	12.86	14.18	91%
Minnesota Drive	NB	14.08	14.12	100%
Minnesota Drive	SB	13.84	15.15	91%
Muldoon Road / Tudor Road	NB, EB	16.04	20.65	78%
Muldoon Road / Tudor Road	SB, WB	15.67	18.85	83%
New Seward Highway	NB	12.20	14.52	84%
New Seward Highway	SB	12.86	15.22	84%
Northern Lights Boulevard	EB	13.99	19.97	70%
Northern Lights Boulevard	WB	13.78	15.50	89%

Source: Cambridge Systematics, Inc.

3.8 Transit Mode Share (Commuter and Total) – Performance Measure #8

According to ridership data collected by the Municipal Public Transportation Department, about 4,000 out of a total of 10,500 daily transit trips in the Anchorage metropolitan area are considered commuters or home-to-work generated transit trips. This represents a transit share of 1.8 percent of all commuter trips (222,000) and 1.2 percent of total trips (875,000) for the Anchorage region. (Note: Total trips were calculated using the TransCAD transportation planning model.)

3.9 Auto Occupancy Index – Performance Measure #9

Vehicle occupancy data were obtained from the Vehicle Occupancy Survey conducted by the Municipality of Anchorage Public Transportation Department. This data was used to compute an auto occupancy index for the Anchorage region. The Vehicle Occupancy Survey is conducted annually for 21 roadway locations throughout the Anchorage region (see Figure 3.7). All of the sites are employment centers so it is assumed that most of the trips are home-based work. Each location is surveyed once during the morning-peak period (between 6:30 a.m. and 8:30 a.m.) on a Tuesday, Wednesday, or Thursday. The Vehicle Occupancy Survey is intended to provide a snapshot of vehicle occupancy rates in Anchorage. Year –to-year results can vary depending on weather conditions and special events.

Table 3.8 shows the average auto occupancies surveyed in the Anchorage region from 1985 to 1998. As shown by the data, the average vehicle occupancy for Anchorage in 1998 was 1.19 persons per vehicle. This number has risen from 1.12 in 1985. The data also shows that auto occupancies were highest in 1992 at 1.26 persons per vehicle. Auto occupancies in other cities of similar size have very different average auto occupancies including Amarillo, Texas at 1.45, Fort Collins, Colorado at 1.65, and Tucson, Arizona at 1.3. Similar to Anchorage, the average auto occupancies for these cities have remained relatively constant over the past five years.

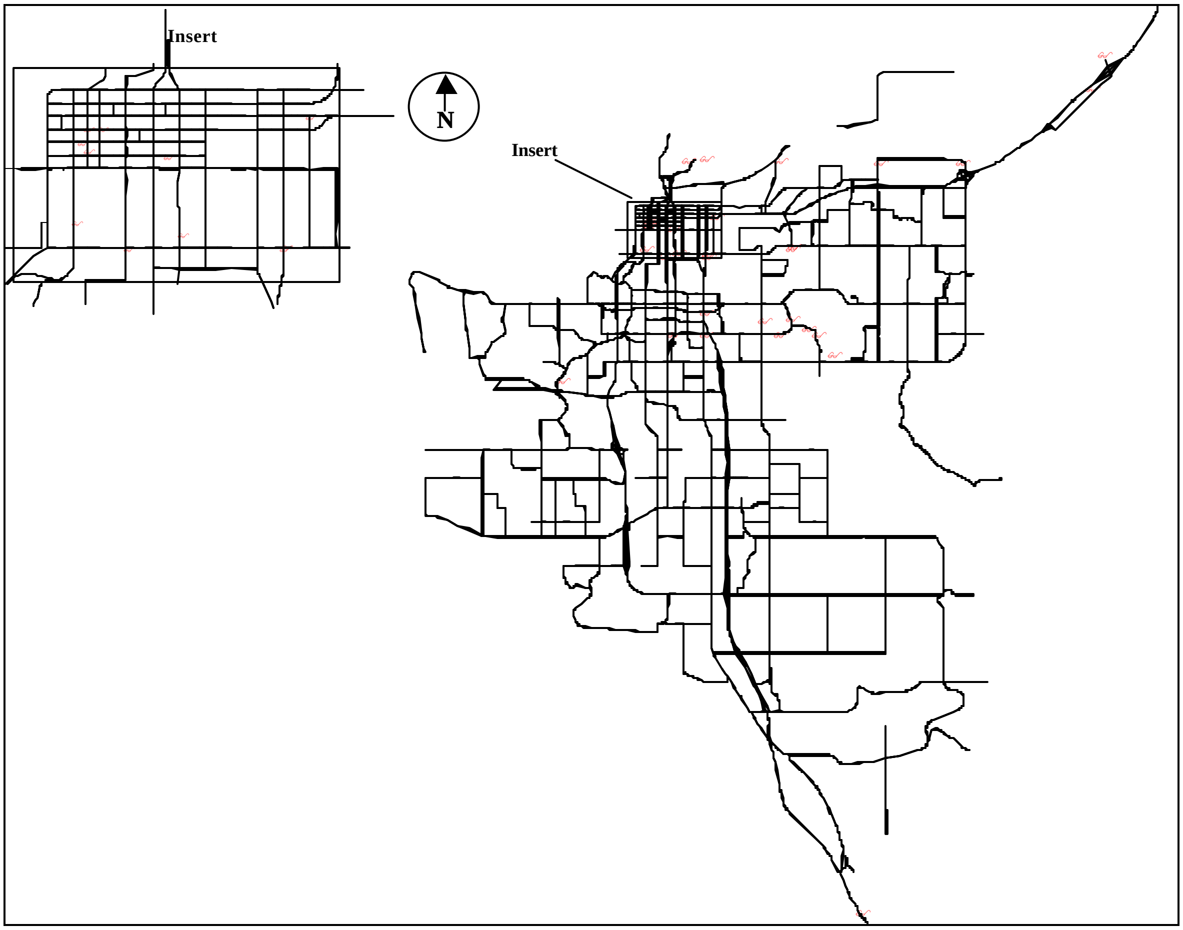
Table 3.8 Anchorage Bowl Auto Occupancy Summary from 1985 to 1998

Year	Auto Occupancy[1]	Year	Auto Occupancy[1]
1985	1.12	1992	1.26
1986	1.19	1993	1.20
1987	1.15	1994	1.17
1988	1.19	1995	1.18
1989	1.19	1996	1.22
1990	1.22	1997	1.19
1991	1.25	1998	1.19

Notes: [1] Auto occupancy index = average passengers per vehicle surveyed at various sites, weighted by number of vehicles at each site.

Source: MOA.

Figure 3.5 Anchorage Auto Occupancy Survey Locations



3.10 VMT per Year Saved by Bus Transit Service – Performance Measure #10

Total annual unlinked transit boarding and average transit trip length data were obtained from the March 1996 PeopleMover On-Off Ridership Survey. This data was used to calculate the relationship of auto VMT saved by the use of bus transit. The annual unlinked transit boardings were converted into average daily weekday, Saturday, and Sunday boardings by using factors based on the results of this survey. Vehicle miles of travel per year saved by bus transit were calculated using the following formula:

= Average weekday boardings x average weekday transit trip length x weekdays per year

\+ Average Saturday boardings x average Saturday transit trip length x Saturdays per year

\+ Average Sunday boardings x average Sunday transit trip length x Sunday per year.

This formula assumes that each transit trip removes one Single Occupancy Vehicle (SOV) from the transportation system.

Table 3.9 shows the annual VMT (in millions) saved by bus service from 1980 to 1997. In 1980, the level of VMT savings by bus service was 12,850,000. This improved to 14,420,000 VMT saved in 1997 – a 12% increase. Anchorage area population during the same time frame increased from 174,431 in 1980 to 254,849 in 1997 – a 46% increase. During the past 17 years, the amount of bus service provided has dropped 30%, resulting in VMT fluctuations peaking at 18,410,000 in 1982 and dropping to 13,270,000 in 1988.

Table 3.9 Anchorage Annual VMT Saved by Bus Service from 1980 to 1997

Year	VMT Saved (in Millions) from 1980 to 1997	Annual Service Hours
1980	12.85	NA
1981	14.66	NA
1982	18.41	156,000
1983	18.36	148,000
1984	16.44	129,000
1985	16.91	133,000
1986	15.52	135,000
1987	14.02	125,000
1988	13.75	122,000
1989	13.27	110,000
1990	13.73	106,000
1991	14.54	105,000
1992	14.00	105,000
1993	14.04	104,000
1994	13.91	105,000
1995	13.86	105,000
1996	14.01	106,000
1997	14.42	107,000

Source: People Mover On-Off Ridership Survey.

3.11 VMT per Year Saved by Share-a-Ride – Performance Measure #11

Relevant data used to compute this measure were provided by the MOA Public Transportation Department's Share-A-Ride program. Similar data and formulas as identified for Performance Measure #10 was used to compute VMT (in millions) saved for carpools.

Table 3.10 shows the results of this analysis for VMT saved by carpools in the Anchorage region from 1988 to 1997. VMT savings generated by carpools increased steadily from 1988 to 1994 from 3,210,000 to 8,660,000.

In January 1995 Share-A-Ride began the first van pool program in Anchorage and the State of Alaska. Participation in the vanpool program increased yearly. When the van pool program began, many car pools merged together to create van pools, which caused a reduction in car pools and a corresponding reduction in carpool VMT saved.

3.12 VMT per Year Saved by Vanpool Program – Performance Measure #12

Relevant data used to compute this measure were provided by the MOA Public Transportation Department's Share-A-Ride program. Similar data and formulas as identified for Performance Measures #10 and #11 were used to compute VMT (in millions) saved for vanpools.

Table 3.10 shows the results of this analysis from 1995 to 1997. The vanpool program has grown from eight active vanpools in 1995 to 14 in December 1999. In January 2000 an additional six new vans were added to the fleet.

Table 3.10 Anchorage Annual VMT Saved by Carpools (Shared-A-Ride) and Vanpool Programs from 1988 to 1997

Year	VMT Saved by Carpool Program (in Millions) from 1988 to 1997	VMT Saved by Vanpool Program (in Millions) from 1995 to 1997
1988	3.21	
1989	5.15	
1990	5.94	
1991	6.54	
1992	6.90	
1993	7.60	
1994	8.66	
1995	7.05	2.30
1996	6.36	2.56
1997	6.03	2.75

Source: MOA Share-A-Ride.

■ 3.13 Frequency of Bus Service – Performance Measure #13

Minimum service frequencies are established to assure that transit service will be of reasonable quality to be viewed as a viable alternative to automobile use. Nationally, the industry standard for bus headways is 15 minutes for peak periods and 30 minutes for non-peak periods

The average time interval between buses is calculated from timetables published by the Municipal Public Transportation Department. The average time between bus departures is 72 minutes in the morning peak period (7:00 to 9:00 am), 88 minutes in the midday off-peak period, and 61 minutes in the afternoon peak period (3:00 to 6:00 p.m.) It should be noted that the bus frequencies are shortened to 30 minutes on many routes during the busiest part of the peak periods.

3.14 Ratio of Bus Travel Time to Auto Travel Time – Performance Measure #14

To influence riders to use the bus system, the amount of time a trip takes on transit should not be excessively longer than the time in an auto. Auto travel times generated from the TransCAD roadway database (and modeling process) in addition to the travel times from the bus schedules provided by the MOA were used to compute this ratio. This performance measure was calculated for the 18 origin and destination pairs specified by MOA and shown in Table 3.11. The destinations were identified to correspond with the four major employment centers which include downtown, midtown, the University area, and the Anchorage International Airport. The origins were identified to correspond with transit routes and stop locations.

The bus to auto travel time ratios for each of the origin and destination pairs were computed and evaluated. The results of this analysis are shown in Table 3.11. Transit travel times include in-vehicle and transfer times while auto travel times include in-vehicle only.

Table 3.11 Auto versus Bus Travel Times Analysis by Origin/Destination Pair

	Origin															
	Jewel Lake and Dimond Boulevard (SW)		N Lights and Aero (NW)		Business Boulevard Transit Center (Eagle River)		Independence and Abbott (SE)		DeBarr and Muldoon (East)		Hillside and O'Malley (Hillside)*		Johns and Klatt (South)		Bragaw and Parsons (N Mountain View)	
Destination	**Auto**	**Transi**	**Auto**	**Tra**	**Auto**	**Transi**	**Auto**	**Transit**	**Auto**	**Tra**	**Auto**	**Transi**	**Auto**	**Tran**	**Auto**	**Transi**
Anchorage International Airport Terminal	6	25	13	39	39	85	16	72	29	59	18	NA	13	105	29	67
36th Avenue and C Street (Midtown)	13	27	16	18	27	51	11	18	17	28	16	NA	13	47	17	31
6th Avenue and G Street Transit Center (Downtown)	18	34	12	17	24	52	18	31	17	42	23	NA	18	39	14	20
Providence Avenue and UAA Drive (University)	19	36	16	27	21	41	11	29	5	21	16	NA	16	30	11	22

Source: Cambridge Systematics, Inc.

*Due to budget reductions, there is no bus service to the Hillside area.

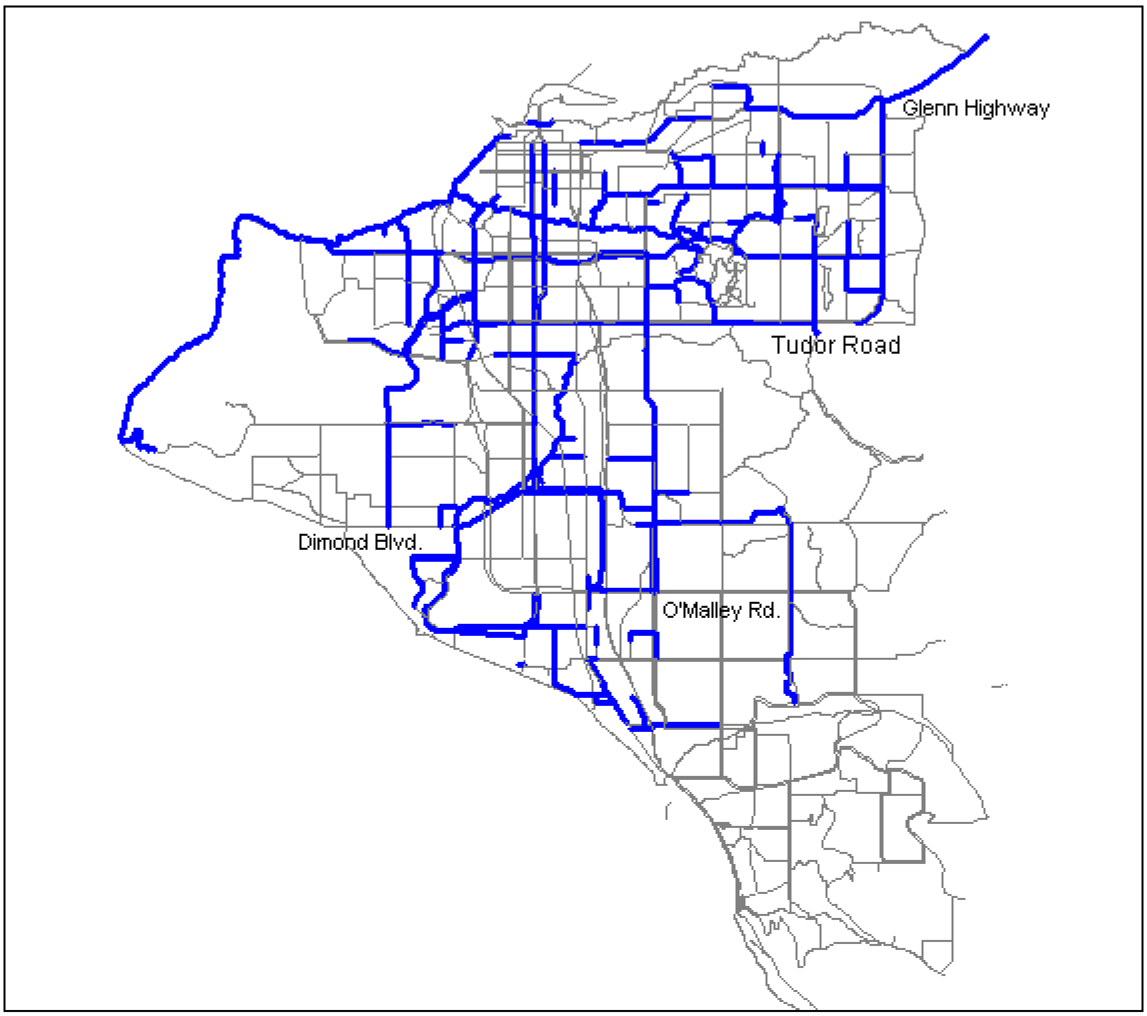
In general, the auto travel times are considerably faster than the transit travel times. Traveling by bus to the airport appears to be the most difficult. On average it takes about 44 additional minutes to travel by bus to the airport compared to the automobile. This is due in large part to the fact that there is only one route that goes to the airport and transfers are usually required to get there. The other major employment centers are much easier to access by bus with the downtown transit center taking an average of 16 minutes longer to access by bus, midtown 13 minutes, and the University area 15 minutes.

On average, it takes about twice as long to travel by bus to midtown, downtown, and the University area than by automobile. The industry standard for bus travel time is 1.5 times the auto travel time.

3.15 Number of Miles of Bicycle Paths/Lanes – Performance Measure #15

This measure was calculated from the bicycle path/lane information obtained from the MOA. Figure 3.8 illustrates the location of bike trails (both paved and unpaved) in the Anchorage Bowl. A total of 124 miles of paved bike trails currently exist in the Anchorage Bowl. An additional 20 miles of paved bike trails currently exist in Chugiak-Eagle River. There are also unpaved bike trails which are available for use by bicyclists.

Figure 3.6 Bike Lanes/Paths/Trails in the Anchorage Bowl Area



3.16 Pedestrian Environmental Factors – Performance Measure #16

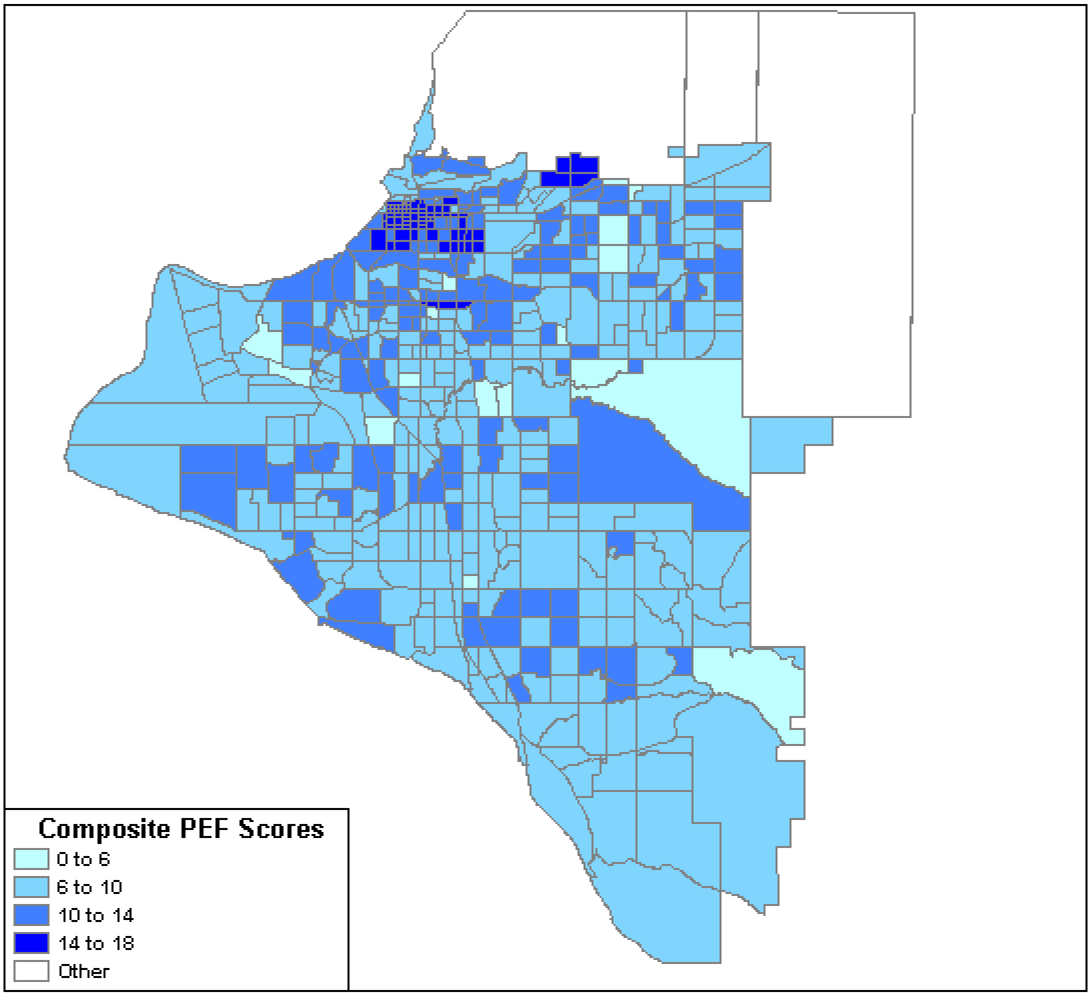
Pedestrian Environmental Factors (PEFs) were collected in the fall of 1997 by local staff from the MOA, Alaska Department of Transportation, and other municipal agencies. PEF data were collected for the following variables:

- Sidewalk availability
- Building setbacks
- Street connectivity
- Ease of street crossings – internal and external to Traffic Analysis Zones (TAZ)
- Existence of topological barriers
- Seasonal maintenance

Composite ratings for each of the above variables were computed and included in the new mode choice models developed for the Anchorage Travel Model Update. Composite ratings for each variable were mapped using TransCAD database features. Figure 3.9 presents the PEF composite score for each of the transportation analysis zones (TAZs) contained in the Anchorage transportation network. The dark blue colors represent areas with the best pedestrian environments while the light blue colors represent areas than have the worse pedestrian environments.

The most pedestrian friendly areas in the Bowl are older neighborhoods, such as downtown, South Addition, Mountain View and Fairview. These areas typically have sidewalks and street crossing enhancements, such as striping and crossing lights. Factors which impede pedestrian movement elsewhere include a lack of sidewalks; large building setbacks, poor street connectivity characterized by cul-de-sac developments, difficulty in crossing arterial streets with dual left and right lanes, and a lack of sidewalk snow removal.

Figure 3.9 Composite Score for Pedestrian Environmental Factor within Anchorage Bowl TAZs



4.0 Transportation System Congestion

■ 4.1 Identify Congested Locations

Roadways

Roadway segment volume-to-capacity ratios were developed for Performance Measure #1 – Roadway Segment Level of Service. Volume-to-capacity ratios were computed to identify both morning- and afternoon-peak-period congestion on the Anchorage Bowl transportation network. However, the volume-to-capacity ratio only provides a portion of the answer associated with roadway level of service. The average travel time and speed analysis conducted to compute Performance Measure #6 – Travel Time by Corridor was also used to identify peak-period roadway congestion in the Anchorage Bowl area.

Table 4.1 shows the roadway segments that currently have high volume-to-capacity ratios or poor levels of service for either the morning or afternoon-peak periods. Figure 4.1 shows the locations of these roadway segments in the Anchorage Bowl for the afternoon-peak hours. These corridors, typically operating at poorer volume-to-capacity ratios and levels of service in the afternoon-peak period include portions of the New Seward Highway, Old Seward Highway, Spenard Road, Tudor Road, C Street, and 5th Avenue. Only the Glenn Highway between Medfra Street and Airport Heights Road and Spenard Road north of International Airport Road contain segments that are worse than a LOS "C" in the morning peak period. There are, however, several other roadway segments that are very close to LOS "D" which starts at v/c = 0.76. These roads include Tudor Road East of Lake Otis, Dowling Road between New Seward and Lake Otis, and C Street South of Tudor.

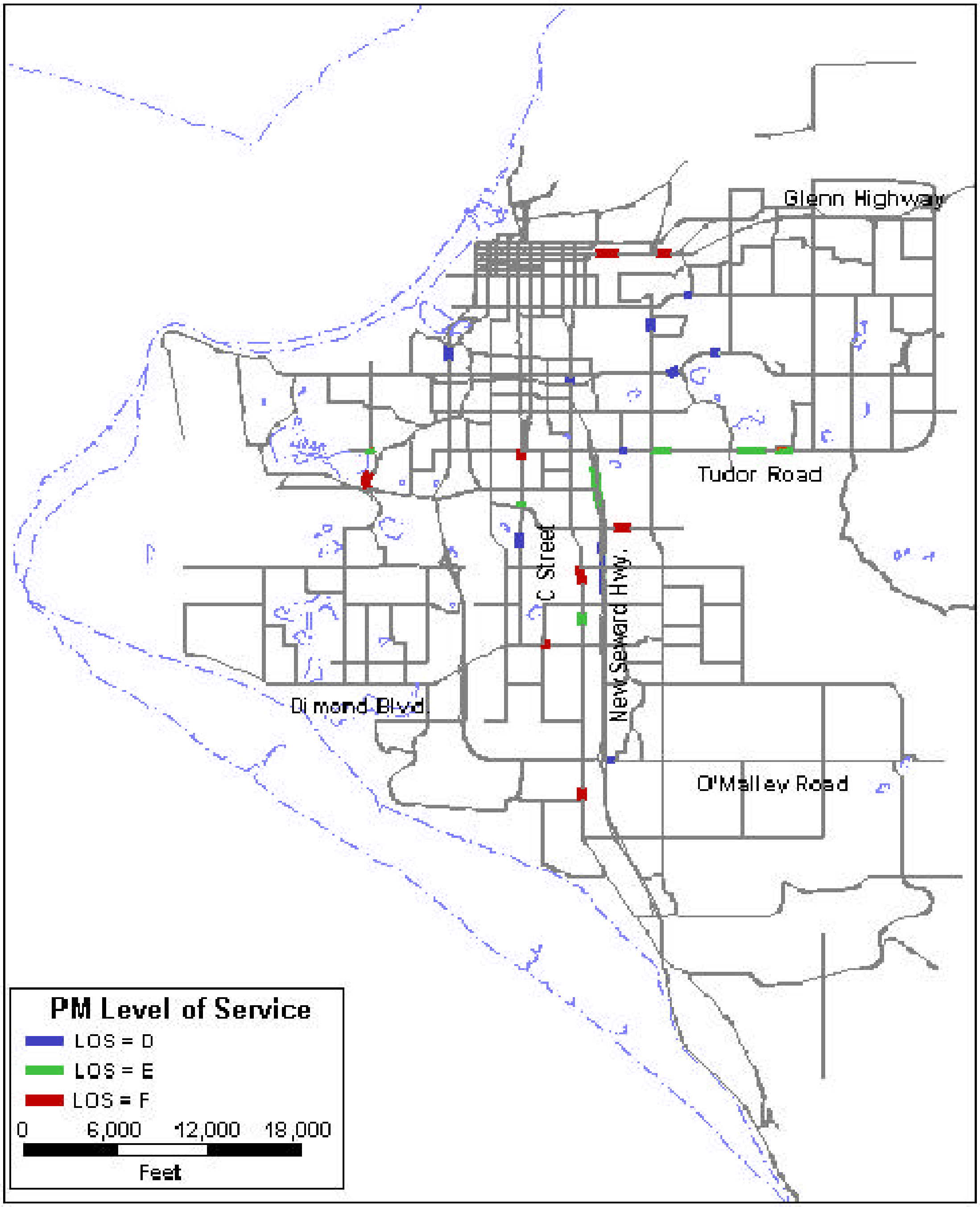
The travel time surveys collected for this analysis were used to compute average travel speeds for the nine selected corridors in the Anchorage Bowl. Average travel speed data can also be used to identify roadway levels of service as specified in procedures defined by the 1994 Highway Capacity Manual (HCM). Table 4.2 shows the criteria used to compute both expressway and principal arterial levels of service based on average travel speeds for the roadways. Tables 4.3 and 4.4 show the morning and afternoon-peak period average travel speeds and level of service grades for the roadway corridors evaluated as part of Performance Measure #6 – Travel Time by Corridor.

Table 4.1 Locations of Morning- and Afternoon-Peak-Period Volume-to-Capacity Ratios of Congested Locations in the Anchorage Bowl

Location	Volume-to-Capacity Ratios (LOS)	
	Morning	Afternoon
1. New Seward Highway South of Dowling	0.55 (C)	0.76 (D)
2. C Street South of Dowling Road	0.62 (C)	0.76 (D)
3. O'Malley Road East of New Seward Highway	0.52 (C)	0.76 (D)
4. Northern Lights Blvd. Between UAA Dr. and Bragaw	0.48 (B)	0.77 (D)
5. Northern Lights Blvd. Between Lake Otis and UAA Drive	0.48 (B)	0.77 (D)
6. DeBarr Road West of Airport Heights	0.51 (C)	0.78 (D)
7. Minnesota Drive North of Northern Lights Blvd.	0.58 (C)	0.80 (D)
8. Tudor Road West of Lake Otis	0.60 (C)	0.80 (D)
9. New Seward Highway Bet. Northern Lights and Benson	0.56 (C)	0.82 (D)
10. Lake Otis Boulevard Between DeBarr and 20th Ave.	0.58 (C)	0.84 (D)
11. Tudor Road Between Bragaw and Wesleyan	0.64 (C)	0.86 (E)
12. Tudor Road Between Wesleyan and Boniface	0.65 (C)	0.87 (E)
13. New Seward Highway Between Dowling and Tudor	0.63 (C)	0.88 (E)
14. Wisconsin Street Between Lakeshore and Spenard	0.60 (C)	0.93 (E)
15. C Street North of Potter	0.64 (C)	0.93(E)
16. Tudor Road East of Lake Otis	0.72 (C)	0.95 (E)
17. Old Seward Highway Between Dimond and 76th Avenue	0.50 (B)	0.96 (E)
18. Old Seward Highway South of 68th	0.51 (C)	1.02 (F)
19. Dowling Road Between New Seward and Lake Otis	0.74 (C)	1.04 (F)
20. C Street South of Tudor	0.75 (C)	1.05 (F)
21. Dimond Boulevard Between Old Seward and King	0.48 (B)	1.06 (F)
22. 5th Avenue East of Reeve (Between Reeve and Mountain View)	0.83 (D)	1.06 (F)
23. 5th Avenue East of Medfra (when 6th merges with 5th)	0.84 (D)	1.08 (F)
24. Spenard Road North of International Airport	0.95 (E)	1.11 (F)
25. Old Seward Highway North of Klatt	0.75 (C)	1.15 (F)

Source: MOA and Cambridge Systematics, Inc.

Figure 4.1 Roadway Segments where PM Peak V/C Ratio is Higher than 0.75 (Worse than LOS C)



Note: C Street between Tudor and Int'l Airport Road has been recently upgraded from 2 to 6 lanes. As a result, it is assumed that its level of service has been substantially improved.

Based on the travel time data presented below, Anchorage Bowl corridors appear to operate at very good levels of service during the morning-peak period ranging from grades of "A" to "C". The only exception is the Lake Otis Parkway corridor in the northbound direction which has a moderate grade of “C”. The same corridors do not operate as well during the afternoon peak period. Corridors which exhibit the worse operating levels in the afternoon peak periods include the Glenn Highway arterial segments eastbound, the New Seward Highway arterial segments northbound, DeBarr Rd. eastbound, Lake Otis Pkwy. northbound, and Northern Lights Blvd. eastbound all of which operate at a grade of C. The arterial segment of the New Seward Highway southbound is the only corridor which operates at a grade of “D” which is considered to be a poor service level.

Table 4.2 Levels of Service Criteria for Expressways and Principal Arterials

	Expressways	Principal Arterials
Range of Free Flow Speeds (mph)	45 to 35	35 to 30
Typical Free Flow Speeds (mph)	40	33
Level Of Service	***Average Travel Speed (MPH)***	
A	≥35	≥30
B	≥28	≥24
C	≥22	≥18
D	≥17	≥14
E	≥13	≥10
F	<13	<10

Note: Average travel speed is calculated using free flow speed and intersection delay.

Source: 1994 Highway Capacity Manual.

Consistent with the volume-to-capacity analysis performed for roadway segment level of service, the afternoon-peak period is more congested than the morning-peak period based on average travel times. Moreover, the average travel speeds for the afternoon-peak period decrease significantly from the free flow speeds as represented by midday travel times (see Table 4.5 based on Performance Measure #6). Corridors showing a significant reduction in freeflow travel speeds during the afternoon-peak period include:

- DeBarr Road / 15th Avenue eastbound shows a decrease of travel speed by 44 percent
- Glenn Highway eastbound shows a decrease of travel speed by 16 percent (Note: This represents the decrease in travel speed for the entire corridor from Ingra Street to Eagle River. The decrease in travel speed along the arterial portion of the corridor would be much greater.)
- Muldoon Road / Tudor Road northbound / eastbound shows a decrease in travel speed by 29 percent
- New Seward Highway northbound and southbound show a decrease of travel speed by 19 and 15 percent respectively
- Northern Lights Boulevard eastbound shows a decrease of travel speed by 43 percent

These corridors tend to contain the Anchorage intersections that operate at poorer levels of service as indicated in the next section.

Table 4.3 Average Speed and Level of Service by Anchorage Corridor for the Morning-Peak Period

Corridor	Direction	Average Speed (mph)	Level of Service (grade)
C Street	NB	27.12	B
C Street	SB	26.20	B
DeBarr Road / 15th Avenue	EB	28.56	B
DeBarr Road / 15th Avenue	WB	24.80	B
Dimond Boulevard / Abbott Road	EB	37.50	A
Dimond Boulevard / Abbott Road	WB	36.36	A
Glenn Highway			
Freeway	EB	62.71	A
Arterial		31.46	A
Freeway	WB	57.62	A
Arterial		26.94	B
Lake Otis Parkway	NB	21.90	C
Lake Otis Parkway	SB	27.48	B
Minnesota Drive	NB	32.65	A
Minnesota Drive	SB	37.80	A
Muldoon Road / Tudor Road	NB, EB	33.55	A
Muldoon Road / Tudor Road	SB, WB	30.20	A
New Seward Highway			
Freeway	NB	49.38	A
Arterial		30.98	A
Freeway	SB	56.69	A
Arterial		26.63	B
Northern Lights Boulevard	EB	28.52	B
Northern Lights Boulevard	WB	26.22	B

Source: Cambridge Systematics, Inc.

Table 4.4 Average Speed and Level of Service by Anchorage Corridor for the Afternoon-Peak Period

Corridor	Direction	Average Speed (mph)	Level of Service (grade)
C Street	NB	26.36	B
C Street	SB	24.15	B
DeBarr Road / 15th Avenue	EB	20.87	C
DeBarr Road / 15th Avenue	WB	24.34	B
Dimond Boulevard / Abbott Road	EB	28.96	B
Dimond Boulevard / Abbott Road	WB	22.89	B
Glenn Highway			
Freeway	EB	61.52	A
Arterial		21.53	C
Freeway	WB	62.45	A
Arterial		27.06	B
Lake Otis Parkway	NB	22.46	C
Lake Otis Parkway	SB	24.96	B
Minnesota Drive	NB	34.84	A
Minnesota Drive	SB	32.48	A
Muldoon Road / Tudor Road	NB, EB	26.16	B
Muldoon Road / Tudor Road	SB, WB	28.65	B
New Seward Highway			
Freeway	NB	54.10	A
Arterial		18.96	C
Freeway	SB	53.31	A
Arterial		17.43	D
Northern Lights Boulevard	EB	18.63	C
Northern Lights Boulevard	WB	24.00	B

Source: Cambridge Systematics, Inc.

Table 4.5 Percent Congested Travel Time Increase by Corridor

Corridor	Direction	Midday Travel Time (minutes)	Afternoon Travel Time (minutes)	Percent Increase Travel Time
C Street	NB	12.18	14.57	20%
C Street	SB	12.97	15.90	23%
DeBarr Road / 15th Avenue	EB	11.18	16.10	44%
DeBarr Road / 15th Avenue	WB	12.76	13.80	8%
Dimond Boulevard / Abbott Road	EB	8.74	9.32	7%
Dimond Boulevard / Abbott Road	WB	10.69	11.79	10%
Glenn Highway	EB	16.00	18.54	16%
Glenn Highway	WB	16.26	16.75	3%
Lake Otis Parkway	NB	12.06	15.76	31%
Lake Otis Parkway	SB	12.86	14.18	10%
Minnesota Drive	NB	14.08	14.12	0%
Minnesota Drive	SB	13.84	15.15	9%
Muldoon Road / Tudor Road	NB, EB	16.04	20.65	29%
Muldoon Road / Tudor Road	SB, WB	15.67	18.85	20%
New Seward Highway	NB	12.20	14.52	19%
New Seward Highway	SB	12.86	15.22	15%
Northern Lights Boulevard	EB	13.99	19.97	43%
Northern Lights Boulevard	WB	13.78	15.50	12%

Source: Cambridge Systematics, Inc.

Intersections

The Boniface Parkway and Tudor Road intersection is the only intersection in the region operating at a failing level of service of "F". This occurs during the morning-peak hour. Other intersections operating at poor levels of service ("D" and "E") for each of the three time periods, morning-peak, midday off-peak, and afternoon-peak hours include:

- #4 – Boniface Parkway and Northern Lights Boulevard
- #6 – Bragaw Street and DeBarr Road
- #8 – C Street and Tudor Road
- #11 – Lake Otis Parkway and 36th Avenue
- #12 – Lake Otis Parkway and Northern Lights Boulevard
- #14 – Lake Otis Parkway and Tudor Road
- #20 – New Seward Highway and 36th Avenue
- #27 – Old Seward Highway and Dimond Boulevard

The eight intersections identified above are considered the primary congested intersection locations that occur in Anchorage regardless of the time-of-day.

Other morning-peak-hour intersections with poor ("D" or "E") levels of service, also considered operating at congested levels, include:

- #9 – Jewel Lake Road and International Airport Road
- #13 – Lake Otis Parkway and O'Malley Road
- #17 – Minnesota Drive and Tudor Road

Other afternoon-peak-hour intersections with poor ("D" or "E") levels of service include:

- #2 – Airport Heights Road and Glenn Highway
- #7 – Bragaw Street and Glenn Highway
- #9 – Jewel Lake Road and International Airport Road
- #10 – Jewel Lake Road and Dimond Boulevard
- #13 – Lake Otis Parkway and O'Malley Road
- #16 – Minnesota Drive and Northern Lights Boulevard
- #17 – Minnesota Drive and Tudor Road
- #23 – New Seward Highway and Benson Boulevard
- #24 – New Seward Highway and Northern Lights Boulevard
- #28 – Wisconsin Street and Northern Lights Boulevard
- #30 – Eagle River Loop and Old Glenn Highway

The congested intersection locations for each time period are shown in Figures 4.2, 4.3, and 4.4. It should be noted that only 30 intersections were analyzed for this study. As a result, there may be other intersections not identified in the following figures that operate at LOS "D", "E", or "F".

Figure 4.2 Intersections with LOS "D", "E", or "F" During the Morning Peak-Period

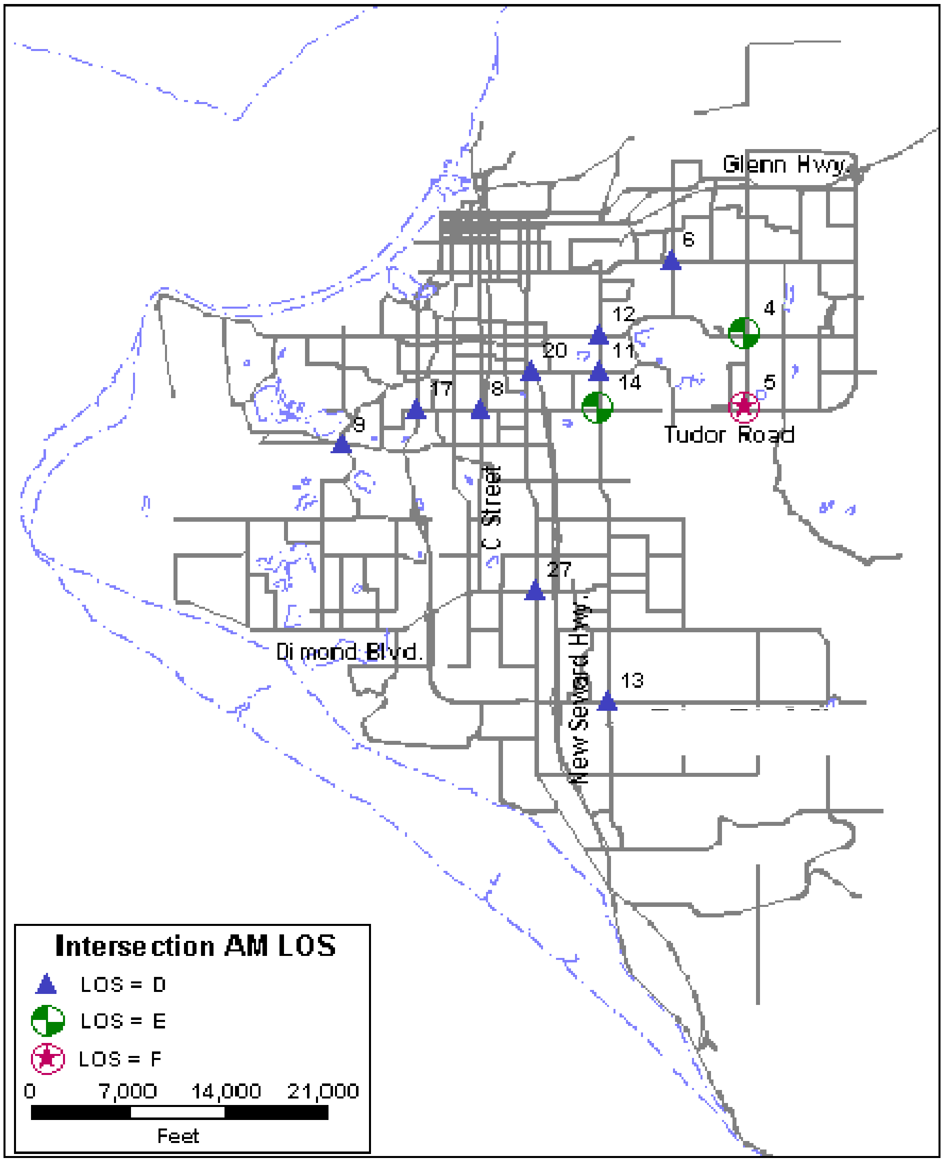


Figure 4.3 Intersections with LOS "D", "E", or "F" During Midday Peak Period

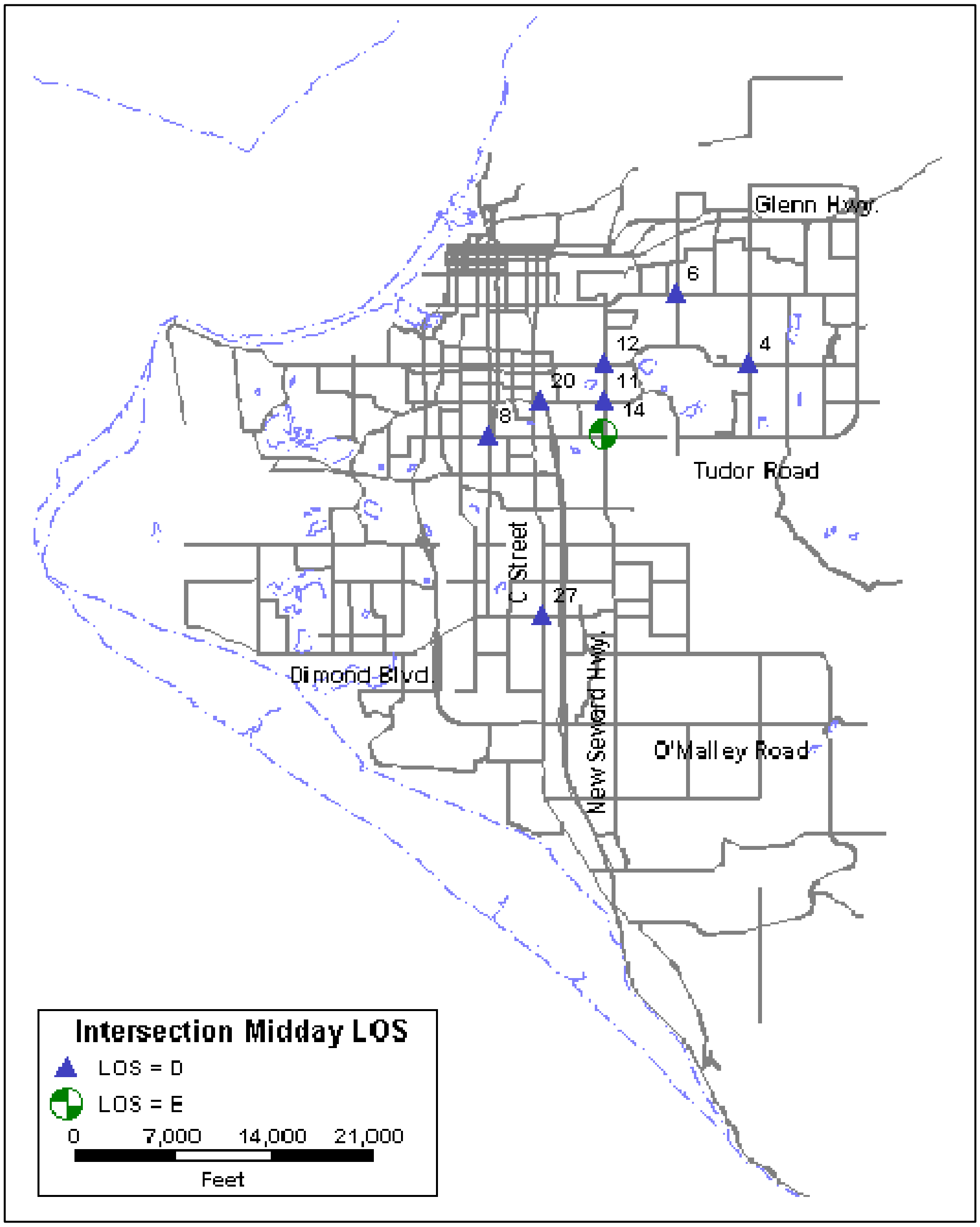
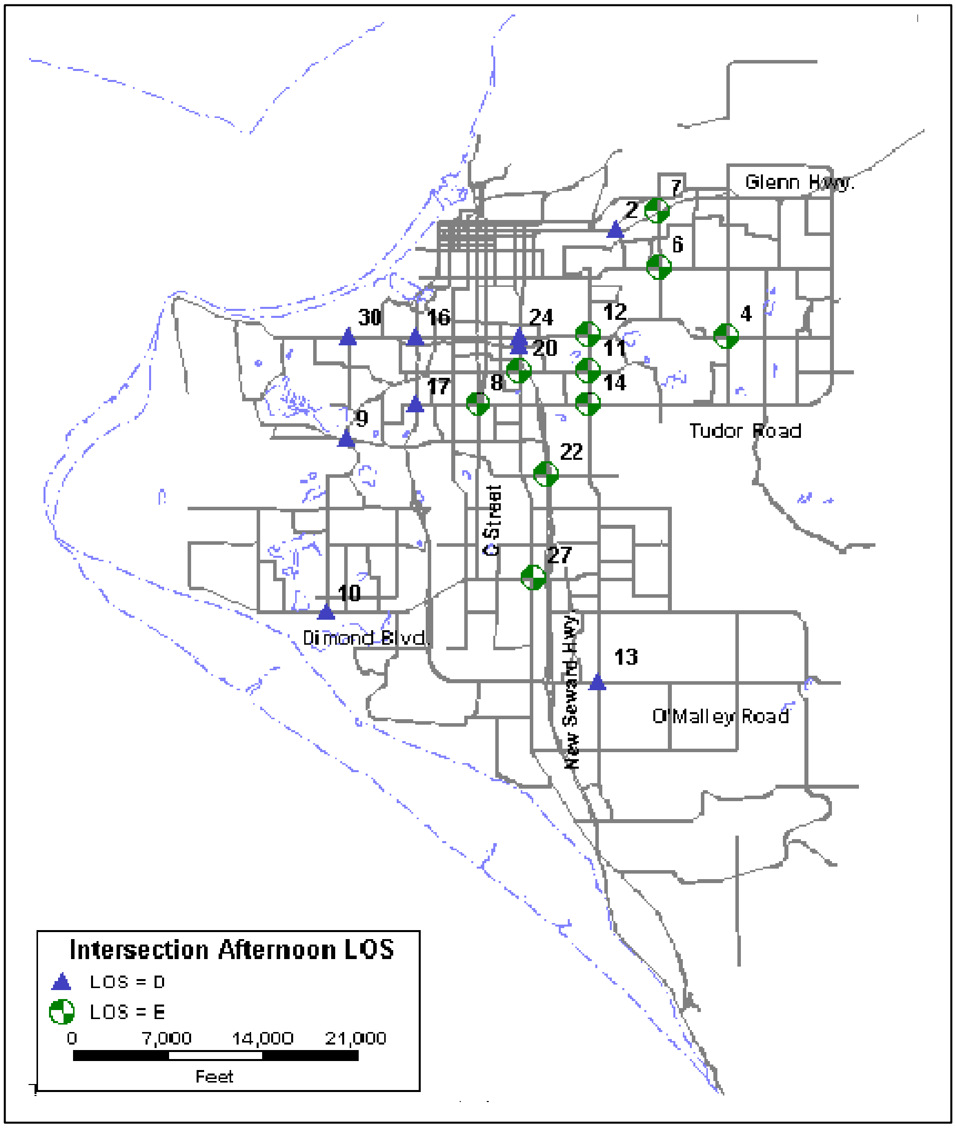


Figure 4.4 Intersections with LOS "D", "E", or "F" During the Afternoon Peak Period



4.2 Magnitude and Nature of Congestion

Based on the analysis conducted for each performance measure presented in Section 3.0 of this report, intersection level of service appears to be the key determinant of congestion in the Anchorage region. Intersections at various critical locations on the Anchorage transportation network are often the cause of bottlenecks or delay. These intersection bottlenecks generally cause delay on the transportation system roadway segments.

Intersections with a level of service of "D" or worse ("E" to "F") should be considered congested. This occurs during base-year conditions at the following intersections during each period of the day – morning, midday, afternoon – evaluated for the Congestion Management System (CMS).

- #4 – Boniface Parkway and Northern Lights Boulevard
- #6 – Bragaw Street and DeBarr Road
- #8 – C Street and Tudor Road
- #11 – Lake Otis Parkway and 36th Avenue
- #12 – Lake Otis Parkway and Northern Lights Boulevard
- #14 – Lake Otis Parkway and Tudor Road
- #20 – New Seward Highway and 36th Avenue
- #27 – Old Seward Highway and Dimond Boulevard

The afternoon-peak period should also be considered the most congested period during the course of the average weekday in Anchorage. Including the intersections identified above, a total of 19 intersections out of the 30 evaluated for the CMS operate at poor levels of service ("D" to "E") in the afternoon-peak period. For comparison purposes, 12 intersections operate at levels of service worse than "D" in the morning-peak period and eight intersections operate at poor conditions during the midday period.

4.3 Congestion Management Standards

While collecting data on performance measures can be valuable in and of itself, it does not tell anything about whether or not congestion is exceeding a level considered to be unacceptable to the community. In order to determine when something needs to be done about congestion, performance standards need to be established. Performance standards are used to establish the level of desired operation for the transportation system. This function is distinctly different from performance measures that are used to identify current or anticipated operating conditions on the transportation system.

Metropolitan regions throughout the U.S. have implemented various forms of performance standards. In order to decide which type of performance standard is best suited for Anchorage, the following issues need to be addressed.

1. Which type of standards should AMATS adopt?

   A traditional performance standard has been minimum level of service (e.g., achieve at least a LOS C or D). Other performance standards could be established depending on which performance measures are adopted, including:

   - Minimum average speed

- Maximum VMT/lane miles
- Maximum delay per VMT
- Ratio of travel time over free flow speed
- Minimum average vehicle ridership
- Maximum delay/vehicle at intersections

2. Should AMATS establish a uniform performance standard for the entire study area?

   Should the roadway standards be the same throughout the region or should they recognize that a specific level of performance might be appropriate or acceptable in one area while not in another area? For example, the downtown, university, or airport areas may have different expectations from the traveling public than other areas of the region.

3. How high should the standards be set?

   Should the performance standards be set high (e.g., LOS C or D) even though they may not be achievable, with the possibility of roadways being shown as deficient even after improvement or should the performance standards be set low (e.g., LOS E) with the acceptance of some congestion, but with a practical ability to achieve the goal?

4. Should duration of congestion be included in the standard (e.g., LOS E for two hours of the day)?

With respect to issue #1, the Municipality should continue to rely on level of service as its primary traffic standard for both roadway segments and intersections. Level of service (LOS) is a universally accepted measure of roadway and intersection performance. Level of service is often used as a trigger for initiating a more detailed examination of transportation problems, and in particular, a method to identify the magnitude of congestion. In some metropolitan areas, although relatively effective as an indicator of congestion, LOS is not particularly useful in providing insight or analysis of congestion effects or solutions. However, for Anchorage, LOS measurement provides a good starting point for evaluating the impacts of intersections on transportation system congestion. Level of Service has several advantages; it is relatively easy for the general public to understand and data is readily available to monitor the standard.

A travel time standard based on the ratio of peak travel time over free flow travel time should be reconsidered for use in the future as a replacement or supplement to the level of service standard. The main problem with the use of this type of standard at the present time involves the selection of a ratio that is meaningful and truly reflects what residents consider to be an unacceptable level of congestion. Without an historical database, it would be difficult to determine if the standard represents a high or low level of congestion in Anchorage.

With respect to issue #2, many cities that experience severe congestion problems have adopted multiple standards. These standards are generally set lower for the urban core areas where existing development densities preclude significant transportation system expansion at an acceptable cost due to high right-of-way acquisition costs. In suburban areas located outside of commercial centers standards are generally set higher in response to higher expectations regarding what is an acceptable level of congestion.

According to the information contained in Chapter 3.0, the Municipality of Anchorage appears to experience a lower degree of congestion than many other cities in the Lower 48. Moreover, there is no evidence to suggest that the expectations of the traveling public regarding congestion differs from one part of the city to another. As a result, the Municipality should adopt a uniform performance standard at least for the time being.

With respect to issue #3, staff recommends that the preferred level of service be set at LOS "C" and that the acceptable level of service be set at LOS "D". This standard is consistent with the 1991 Anchorage Bowl Long-Range Transportation Plan which states as one of its objectives: "Provide a roadway network that operates at Level of Service (LOS) "D" or better for 95 percent of the projected 2010 travel demands". Adjustments to the level of service standards should be considered as a part of the next Long-Range Transportation Plan update if the standards prove to be unrealistic given the financial constraints.

With respect to issue #4, staff recommends that the Municipality adopt a one-hour standard. Most of the MPOs surveyed for this report only used peak hour to measure congestion levels. This is also in line with the relatively short duration of congestion experienced in Anchorage.

Table 4.6 Recommended Intersection and Roadway Performance Standards

	Preferred Operating Standard	Acceptable Operating Standard	Exceeds Deficiency Threshold
Intersections	C	D	E
Roadway	C	D	E

■ 4.4 Congestion Management Strategy Implementation

Intersection delay is the primary cause of congestion on the Anchorage transportation network. Moreover, intersection delay predominately occurs during the p.m.-peak period when workers are attempting to return home. As a result, some of the most effective non-operational congestion management strategies will involve demand management strategies that are aimed at reducing the number of single-occupancy vehicle commuter trips. The Congestion Management Program identified a long list of existing and potential demand management strategies for the Municipality of Anchorage to implement (see Tables 4.7 and 4.8). Of these strategies, many directly target the work trip. These include various carpool and transit strategies, alternative work hours, telecommuting, and the voluntary trip reduction ordinance.

With respect to transit strategies, the performance measures reviewed in Section 3.0 point out several areas where improvements to the bus transit system might improve the transit mode share. Both the performance measure # 13 (time between buses) and performance measure #14 (ratio of bus to automobile travel time) indicate that bus service in Anchorage is well below the national standard. According to the Municipal Public Transportation Department, infrequent bus service is sited as the number 1 reason why people don't ride the bus.

Performance measure # 16 (Pedestrian Environment Factors) illustrates other areas where improvements might be made. The PEF measure shows that much of the Anchorage Bowl (with the exception of downtown) has a relatively poor pedestrian environment. This affects a number of strategies including carpooling, vanpooling, and transit which rely on walking to either access the mode or provide mobility once the destination is reached.

Table 4.7 Existing Congestion Management Strategies

Access Management	Ridesharing Program
Priority Parking for Carpools / Vanpools	Employer Subsidized Transit Use
On-Site Transportation Coordinator	Rideshare / Transit / Bike Marketing Programs
Alternative Work Hours	Telecommuting
Improvements to Bus Routes and Schedules	More Frequent Service
Transit Passenger Amenities	Transit Marketing and Information Programs
Monthly Transit Passes	Improved Feeder Bus Service
Improved Express Bus Service	Park and Ride Facilities
Road Operational Changes	Paratransit Service
Intersection Improvements	Signal System Improvements
Roadway Improvements	Enforcement
Turn Prohibitions	Public Sector Parking Pricing
On-Street Parking Controls	Bicycle Plans and Maps
Bicycle Lockers, Racks, and Other Storage	Pedestrian Connections with Transit
Integration of Facilities for Bicyclists w / Transit[1]	Safety Consideration for Sidewalks

Note: [1]The program to integrate facilities for bicyclist with transit was a new strategy recommended in the 1994 Congestion Management Program which was subsequently implemented since the plan was adopted.

Source: MOA.

Table 4.8 New Congestion Management Strategies

Voluntary Trip Reduction Ordinance	Land Use Policies to Reduce Single Occupancy Vehicles
Site Design Criteria to Increase Transit Use	Parking Requirements in Zoning Codes
Ordinance to require Bicycle Facilities	Education Programs
Guaranteed Ride Home	Employee Transportation Allowance
Eliminate Existing Employee Parking Subsidies	Joint Development Activities
Bus Traffic Signal Preemption	HOV Applicability
Arterial Concurrent-Flow HOV Lanes	Arterials with Limited Access
Reversible-Lane Systems	Parking Supply Control
Preferential Parking for HOV Vehicles	Trails Coordinator
Education Programs for Bicyclists and Potential Cyclists	Showers and Clothing Lockers for Bicyclists / Pedestrians
Bicycle Media and Promotion Campaign	

Source: MOA.

It appears from the analysis contained in Chapter 3.0 that at least eight of Anchorage's intersections are congested for most of the day. In addition, other intersections experience high levels of congestion during either the afternoon- or morning-peak periods or both. Congestion at these intersections will probably not be significantly relieved by demand management strategies which only focus on reducing work-related trips. In these cases, transportation supply strategies such as road operational changes, intersection improvements (including interchanges), and roadway improvements (including construction of missing roadway links) should be actively considered.

Identify Potential Deficiency Plan Process

Intersection delay will likely continue to occur in the near-term if transportation system improvement or mitigation strategies for intersections are not evaluated and deployed. Increases in intersection delay and congestion will also cause roadway congestion to worsen significantly from the good (or acceptable) levels reported in Section 3.0 of this report.

The identification of congestion mitigation strategies for the Anchorage transportation network described above could be integrated with the development of intersection level of service standards and a deficiency plan process. Level of service standards recommended in Section 4.3 could be used by the Municipality to flag those intersections considered to be operating at poor levels of service and to be major contributors to network congestion. The deficiency plan process could be developed by the Municipality to mitigate congestion at those intersections with levels of service falling below the established standard and ensure that a mechanism is in place to help improve congestion for ongoing transportation monitoring.

The Municipality could also incorporate into this process the option of “grandfathering” intersections currently operating below standard without the implementation of a deficiency plan. The deficiency plan process would then be focused on those intersections that fail to meet the standard for the first time. As congestion increases over time, this “grandfathering” process could be re-visited and potentially discontinued in order for the Municipality to begin to mitigate consistently poorly operating intersections.

The deficiency planning process outlined in this section has been developed to solicit local agency comment and review. If this general process meets the needs of regional congestion management, then the Municipality will need to further refine and fully develop an appropriate process for Anchorage.

Deficiency planning will provide the Municipality with a method to focus on areas where congestion problems have diminished transportation system performance below the adopted standards. These plans also provide an opportunity to analyze the cause of the deficiency and determine whether the implementation of improvements or measures could improve overall system efficiency, air quality, and general mobility for the region.

This general deficiency planning process considers three basic steps. Each are outlined below:

Identify deficient intersections. Use the data collection, monitoring, and analysis methods to determine if a deficiency exists at the 30 intersections evaluated in the CMS. Data collection (turning intersection counts by period) should be conducted at the 30 intersections every two years for monitoring purposes. Subsequent intersection capacity analysis should be conducted using 1998 Highway Capacity Manual-based software and techniques approved by the Municipality. This process will be used to determine or flag those intersections, by time period, that fall below the established LOS standard.

Identify causes of congestion and prepare the deficiency plan. Identify the land use development projects or general growth patterns that contributed to the exceedance of the level-of-service standard. Once identified, a deficiency plan program should be developed and evaluated to identify the impacts of potential implementation strategies and to identify the most appropriate mitigation strategies that most effectively improve intersection performance. Initially, transportation system management strategies, such as intersection-lane re-striping, signal timing, and phasing adjustments, and signal progression strategies, should be considered along with potential transportation demand management strategies. Locations where TSM/TDM strategies (see Tables 4.7 and 4.8) do not work to improve levels of service could consider the evaluation of geometric and other infrastructure improvements.

Review, adopt, and implement the plan. This step would include the adoption and approval of the plan by the Municipality and other member jurisdiction responsible for the given intersection. This process may also require the appropriate environmental review in the case of infrastructure improvements.

This process, while general, can be implemented by the Municipality as the foundation for enforcement of an Anchorage-based LOS standard to ensure that congested locations (intersections) will be mitigated as they worsen over time. This process would also be used by the Municipality to maintain the efficiency of the transportation system. Both the deficiency planning process and the intersection LOS standards could also be expanded to incorporate roadway segments. This may become necessary in Anchorage in the future as population and traffic levels increases. Improving roadway connections could improve the connectivity of the transportation system and thus relieve intersection pressure.

5.0 Ongoing Transportation System Monitoring

5.1 Future Monitoring of Level of Service Standards

Every other year, the Municipality should determine if the established LOS standards should be re-defined. This process may include several elements:

- Re-defining the regional LOS standard. As congestion increases, this standard may be changed from LOS "D" to "E".
- Developing area-specific LOS standards. As growth occurs, the Municipality may want to establish different LOS standards by area in the region. For example, in the future, Downtown Anchorage may warrant a lower LOS standard ("E") than a predominantly suburban area such as Eagle River (LOS "D").
- Re-defining the intersections evaluated for congestion. As growth occurs, additional intersections in the region may become congested and critical to the mobility and accessibility of the population. If this occurs, the Municipality must consider adding intersections to the current list of 30.

Regardless, if the LOS standards are not met and congestion still occurs, then a deficiency plan (as described in Section 4.3) should be implemented. The deficiency plan must identify the most effective strategies for improving current and future system performance whether the improvements are implemented for roadway segments or intersections.

5.2 Ongoing Data Collection and Monitoring

Ongoing data collection and monitoring of the transportation system should be conducted every other year. The Municipality should conduct this monitoring by updating the actual data collected as part of the initial submittal (presented in this report) and recalculating the levels of service for those intersections operating at LOS "D" or worse. Turning movement count data should be conducted every two years for each of the 30 intersections. Level of service analysis should be conducted for those intersections operating at levels of service worse than "D". For those intersections operating better than level of service "D" (i.e., "A" to "C"), the Municipality should identify the increase in traffic volume for the total (all movements combined) intersection and compare the volumes to the previous volumes. If the volume increases by 50 or more vehicles for a given peak-hour condition, then the Municipality should analyze the intersection to determine the change in level of service. This process ensures that those intersections with relatively high increases in peak-hour traffic volumes will be evaluated to determine if they meet the established LOS standard. It also ensures that not all intersections need to be evaluated for each monitoring year (every two years).

Travel time runs on the nine corridors should be conducted every four years because of the relatively acceptable roadway segment levels of service for 1998. This monitoring and data collection schedule may change over time based on population and traffic growth and the potential for intersection delay and congestion eventually negatively impacting delay on the region's roadway segments. Similar procedures used to collect travel time data in 1998 should be used by the Municipality for future monitoring.

Additional travel time runs should be conducted on a select number of corridors which exhibit congested conditions (i.e., LOS D) or conditions approaching congestion. In particular, additional travel time runs should be conducted for Northern Lights Blvd. and the arterial portion of the Seward Highway which already are experiencing relatively slow travel times during the afternoon peak period. Additional travel time runs on selected corridors will help to refine the Municipality's understanding of the intensity and duration of congestion along these corridors.

Information contained in the Anchorage Travel Demand Model and also maintained and collected by the various agencies within the Municipality should be used to compute the remaining CMS performance measures reported in Section 3.0.

APPENDIX A

Detailed Travel Time Data

Copies of Appendix A can be obtained from the Municipality of Anchorage Planning Department located at: 632 W. 6th Avenue, Suite 260 or by calling Jon Spring, Senior Transportation Planner at 343-4553.

APPENDIX B

Travel Time Data Collection Methodology

1.0 Travel Time Data Collection Methodology

Numerous methods have been documented and tested for obtaining travel time information to support transportation systems monitoring.[1, 2] In summary, these methods include:

- The *floating car method*, a test car attempts to "float" in the traffic stream by passing as many vehicles that pass the test car.
- The *follow car method*, test car drivers select representative vehicles in the traffic stream in which to follow.
- The *license plate method* positions surveyors at the start and end of a test section (roadway segment or corridor). Surveyors record the time when vehicles pass the start and end points including the last few numbers of the license plate of each vehicle passing the observation points.
- The *photographic method* uses video surveillance equipment to record traffic traveling on a test section.
- Finally, the *interview method* uses surveyors to ask commuters to record the origin, destination, start time, and end time of their daily trips.

Working with the Municipality of Anchorage (MOA), the floating car method was selected for this study. This method is widely used by municipalities throughout the United States to obtain travel time performance data.

The follow car method was not selected because it may result in an inaccurate representation of traffic conditions if the test car follows a vehicle driving much faster or slower than prevailing traffic. The license plate method was not selected because it requires a very large number of surveyors if travel times between intermediate checkpoints along the test section are desired. The photographic method requires specialized equipment. While the interview method can be used to collect a large amount of information, it was not selected for this study because but there is little control over data collection procedures, which may result in unreliable data.

The basic floating car method includes a test car to drive from a starting point to an ending point along a designated route. Surveyors in the test cars are asked to record the travel times at starting, ending, and intermediate points along the given route. The test car is staffed with two people, a driver and a recorder. The driver operates the vehicle along the route and tries to "float" in traffic by driving as close to the prevailing speed as possible. The recorder records the

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[1] Wolfgang S. Homburger, Jerome W. Hall, Roy C. Loutzenheiser, William R. Reilly, **Fundamentals of Traffic Engineering, 14th Edition**, May 1996, pp. 7-1 through 7-7.

[2] Tim Lomax, Shawn Turner, Gordon Shunk, Herbert S. Levinson, Richard H. Pratt, Paul N. Bay, G. Bruce Douglas, **Quantifying Congestion, Volume 2, User's Guide**, NCHRP Report 398, 1997, pp. 86-97.

travel time information as designated checkpoints are passed. Specially equipped test cars may have automated recording equipment on-board that eliminates the need for a human recorder. (Note that automated recording equipment was installed and used to collect travel time data using a MOA vehicle.)

2.0 Travel Time Data Collection Specifics

2.1 Time of Year

Data collection for this project was implemented on Tuesdays, Wednesdays, and Thursdays between November 2, 1998, and December 3, 1998. This time period was selected because:

1. MOA wanted to collect data to represent average weekday travel conditions.
2. MOA wanted to complete data collection before potential heavy snowstorms hit the Anchorage area (i.e., once there is heavy snowfall, travel patterns in Anchorage become erratic due to poor road conditions on days with snow, and impeded passage caused by snow banks on other days).
3. MOA wanted to wait until construction at the Lake Otis Parkway / Tudor Road intersection and other roadway locations were completed. This is a key intersection in the Anchorage transportation network and MOA was concerned that construction at this location would severely affect travel patterns throughout the Anchorage Bowl area.

2.2 Corridors

MOA selected 9 corridors in which to collect travel time data including:

1. New Seward Highway from 5th Avenue to Old Seward Highway
2. Glenn Highway from C Street to Artillery Road
3. Minnesota Drive from 5th Avenue to New Seward Highway
4. Northern Lights Boulevard from Minnesota Drive to Muldoon Road
5. Tudor / Muldoon from Minnesota Drive to Glenn Highway
6. Lake Otis Parkway from Debarr Road to O'Malley Road
7. C Street from Ocean Dock Road to Dimond Boulevard
8. Debarr / 15th Avenue from I Street to Muldoon Road
9. Dimond / Abbott from Jewel Lake Road to Lake Otis Parkway

These corridors represented the major travel routes in the Anchorage Bowl area. Figures 1, 2, and 3 shows the location of each of the travel time corridors selected for this study.

The data collection plan considered collecting data for the Priority 1 corridors first, then the Priority 2 corridors, and finally, the Priority 3 corridors. However, because of interference caused by construction at the Lake Otis Parkway/Tudor Road intersection, data was first collected on those corridors least affected by this construction (i.e., Glenn Highway, Minnesota Drive, C Street).

2.3 Time of Day

Data was collected for three time periods including:

- AM peak period (7-9AM),
- PM peak period (4-6PM)
- midday off-peak period (11:30AM-1:30PM)

The midday off-peak period was included to identify off-peak congestion levels, and to provide the basis for comparing any potential future year congestion and potential peak period spreading.

2.4 Number of Runs

Travel time runs were designed to have a 90% confidence of being accurate to within 10%. For the class of roadway most often represented in the 9 corridors under study - arterials with 3-6 signals per mile - NCHRP Report 398 recommends collecting at least four to six data points (see Table 2).[3] In this case a data point was equivalent to one round-trip travel time run.

Table 3 shows the number of runs planned and the actual number of runs completed for each corridor. The number of planned runs reflects MOA's estimate of the potential number of runs that could potentially be completed in a given 2-hour period. The original data collection plan considered having at least six data points for each corridor in the AM and PM peak periods. Fewer runs were collected in the midday off-peak period because much less congestion was expected.

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[3] Tim Lomax, Shawn Turner, Gordon Shunk, Herbert S. Levinson, Richard H. Pratt, Paul N. Bay, G. Bruce Douglas, **Quantifying Congestion, Volume 2, User's Guide**, NCHRP Report 398, 1997, pp. 13-14.

2.5 Staffing and Scheduling

Due to the availability of MOA staff and cars, two manually operated cars were available during all periods analyzed, and one automatically operated car was available during the PM peak and midday off-peak periods. The data collection schedule considered having, at most, two cars in the field at any given time.

The majority of the corridors required two days of surveying to obtain the specified number of data points. The Tudor Road / Muldoon Road corridor required three days while the Dimond Road / Abbott Road required one day (six runs were completed in one-day for this corridor). Multiple day runs were scheduled to occur on different days (Tuesdays, Wednesdays, or Thursdays). Tables 5 and 6 show the schedule of planned runs and actual runs.

2.6 Step-by-Step Data Collection Procedures

This section presents a brief description of the step-by-step data collection procedures performed by MOA staff. Table 6 shows the materials required for travel time data collection using the floating car method.

At the beginning of each week, the consultants mailed MOA a package of materials for use during the week's surveys. This package contained a set of envelopes: one for each 2-hour data collection period per car. Each envelope contained all the forms required for one 2-hour period of surveying including:

- Detailed instruction sheet for how to collect travel time data using the floating car method
- Route map showing each corridor including intermediate checkpoint
- Twelve blank data collection forms

Each envelope was labeled with the date and time of use, the corridor, car number, and surveyor staff. Each envelope was used on the day and time indicated on the label.

During the evening before a planned survey day, the MOA data collection coordinator determined whether the road conditions were good enough to survey the following morning. If not, he informed the data collection staff of unsatisfactory roadway conditions and canceled the following day's surveys. If road conditions worsened later on a given night, then the surveying teams made their own judgment on the appropriateness of surveying the next day. The data collection coordinator also decided whether to proceed with data collection a few hours before each midday and PM peak survey period.

3.0 Recommendations for Future Data Collection

We recommend beginning data collection sooner than November 2 for purposes of future transportation system monitoring. We were fortunate in this study to have nearly completed all of our data collection before the first major snowstorm. Only a few PM peak period runs on the Tudor Road / Muldoon Road corridor were cancelled because of the onset of heavy snow on December 3, 1998.

We also recommend continued use of the floating car method including the use of equipment to automate the travel time data collection. The methods and procedures contained herein should also be used as the basis for collecting travel time data for previous corridors as well as for potential new corridors.

Table 1. Travel Time Corridors

Corridor	Start Point	End Point
New Seward Highway	5th Avenue	Exit Ramp at Seward Highway / Rabbit Creek Road
Glenn Highway	C Street	Exit Ramp at Artillery Road in Eagle River
Minnesota Drive	5th Avenue	New Seward Highway
Tudor Road / Muldoon Road	Minnesota Drive	Glenn Highway
Northern Lights Boulevard	Minnesota Drive	Muldoon Road
Lake Otis Parkway	Debarr Road	O'Malley Road
C Street	Ocean Dock / Anchorage Port Road Fork	Dimond Boulevard
Debarr Road / 15th Avenue	I Street	Muldoon Road
Dimond Road / Abbott Road	Jewel Lake Road	Lake Otis Parkway

Source: MOA and Cambridge Systematics, Inc., 1998.

Table 2 Suggested Sample Size for Data Collection on Arterial Streets

Signal Density	Minimum runs for 80% confidence, 10% relative error	Minimum runs for 85% confidence, 10% relative error	Minimum runs for 90% confidence, 10% relative error	Minimum runs for 95% confidence, 5% relative error
Less than 3 per mile	2 (6)*	2 (6)*	3 (6)*	13
3-6 per mile	3 (6)*	3 (6)*	4 (6)*	23
More than 6 per mile	4 (6)*	5 (6)*	7	35

*A minimum of six runs are needed to provide reasonable assurance that data are not affected by unusual conditions (e.g., driver behavior, signal malfunctions)

Source: NCHRP Report 398, 1997.

Table 3. Number of Planned and Actual Data Collection Runs per Corridor*

Corridor	Planned Number of Runs			Actual Number of Runs		
	AM Peak	PM Peak	Midday	AM Peak	PM Peak	Midday
Glenn Highway	6	6	3	6	5	5
New Seward Highway	6	6	3	8	6	3[4]
Minnesota Drive	6	6	3	8	5	2[5]
Tudor Road / Muldoon Road	6	6	2	9	4	3
Northern Lights Boulevard	6	6	3	6	6	3
Lake Otis Parkway	6	6	3	6	5	5[6]
C Street	6	6	3	6	5	2[7]
Debarr Road / 15th Avenue	6	6	3	7	5[8]	7
Dimond Road / Abbott Road	4	4	4	5[8]	3	3

*The numbers shown are the number of round trips. That is, 6 runs = 6 runs in each direction.

Source: Cambridge Systematics, Inc., 1998.

[4] 4 southbound runs were completed.

[5] 3 northbound runs were completed.

[6] 6 southbound runs were completed.

[7] 3 southbound runs were completed.

[8] 6 eastbound runs were completed.

Table 4. Travel Time Run Schedule for Car #1

Date	Time Period	Planned		Actual	
		Corridor	Recording	Corridor	Recording
3 Nov	AM Peak	Minnesota	Manual	Minnesota	Manual
	Midday	Minnesota	Automatic	Minnesota	Automatic
	PM Peak	Minnesota	Automatic	Minnesota	Automatic
4 Nov	AM Peak	C St	Manual	C St	Manual
	Midday	C St	Automatic	C St	Automatic
	PM Peak	C St	Automatic	C St	Automatic
5 Nov	AM Peak	Dimond / Abbott	Manual	Dimond / Abbott	Manual
	Midday	Dimond / Abbott	Automatic	Dimond / Abbott	Automatic
	PM Peak	Dimond / Abbott	Automatic	Dimond / Abbott	Automatic
10 Nov	AM Peak	Seward Hwy	Manual	Seward Hwy	Manual
	Midday	Seward Hwy	Automatic	Seward Hwy	Automatic
	PM Peak	Seward Hwy	Automatic	NONE	
12 Nov	AM Peak	Northern Lights	Manual	Northern Lights	Manual
	Midday	Northern Lights	Automatic	Northern Lights	Automatic
	PM Peak	Northern Lights	Automatic	Northern Lights	Automatic
17 Nov	AM Peak	Glenn Hwy	Manual	Glenn Hwy	Manual
	Midday	NONE		Glenn Hwy	Automatic
	PM Peak	Glenn Hwy	Automatic	Glenn Hwy	Automatic
18 Nov	AM Peak	Tudor / Muldoon	Manual	Tudor / Muldoon	Manual
	Midday	Tudor / Muldoon	Automatic	Tudor / Muldoon	Automatic
	PM Peak	Tudor / Muldoon	Automatic	Tudor / Muldoon	Automatic
19 Nov	AM Peak	Lake Otis	Manual	Lake Otis	Manual
	Midday	NONE		Lake Otis	Automatic
	PM Peak	Lake Otis	Automatic	Lake Otis	Automatic
24 Nov	Midday	NONE		Seward Hwy	Automatic
	PM Peak	NONE		Seward Hwy	Automatic
1 Dec	AM Peak	Debarr / 15th	Manual	Debarr / 15th	Manual
	Midday	NONE		Debarr / 15th	Automatic
	PM Peak	Debarr / 15th	Automatic	Debarr / 15th	Automatic
2 Dec	PM Peak	NONE		NONE	

Source: MOA and Cambridge Systematics, Inc., 1998.

Table 5. Travel Time Run Schedule for Car #2

Date	Time Period	Planned		Actual	
		Corridor	Recording	Corridor	Recording
3 Nov	AM Peak	C St	Manual	C St	Manual
	Midday	NONE		NONE	
	PM Peak	C St	Manual	C St	Manual
4 Nov	AM Peak	Minnesota	Manual	Minnesota	Manual
	Midday	NONE		NONE	
	PM Peak	Minnesota	Manual	Minnesota	Manual
5 Nov	AM Peak	Glenn Hwy	Manual	Glenn Hwy	Manual
	Midday	Glenn Hwy	Manual	Glenn Hwy	Manual
	PM Peak	Glenn Hwy	Manual	Glenn Hwy	Manual
10 Nov	AM Peak	Debarr/15th	Manual	Debarr/15th	Manual
	Midday	Debarr/15th	Manual	Debarr/15th	Manual
	PM Peak	Debarr/15th	Manual	NONE	
12 Nov	AM Peak	Seward Hwy	Manual	Seward Hwy	Manual
	Midday	NONE		NONE	
	PM Peak	Seward Hwy	Manual	Seward Hwy	Manual
17 Nov	AM Peak	Northern Lights	Manual	Northern Lights	Manual
	Midday	NONE		NONE	
	PM Peak	Northern Lights	Manual	Northern Lights	Manual
18 Nov	AM Peak	Lake Otis	Manual	Lake Otis	Manual
	Midday	Lake Otis	Manual	Lake Otis	Manual
	PM Peak	Lake Otis	Manual	Lake Otis	Manual
19 Nov	AM Peak	Tudor/Muldoon	Manual	Tudor/Muldoon	Manual
	Midday	NONE		NONE	
	PM Peak	Tudor/Muldoon	Manual	Tudor/Muldoon	Manual
24 Nov	Midday	NONE		NONE	
	PM Peak	NONE		NONE	
1 Dec	AM Peak	Tudor/Muldoon	Manual	Tudor/Muldoon	Manual
	Midday	NONE		NONE	
	PM Peak	Tudor/Muldoon	Manual	Northern Lights	Manual
2 Dec	PM Peak	NONE		Debarr/15th	Manual

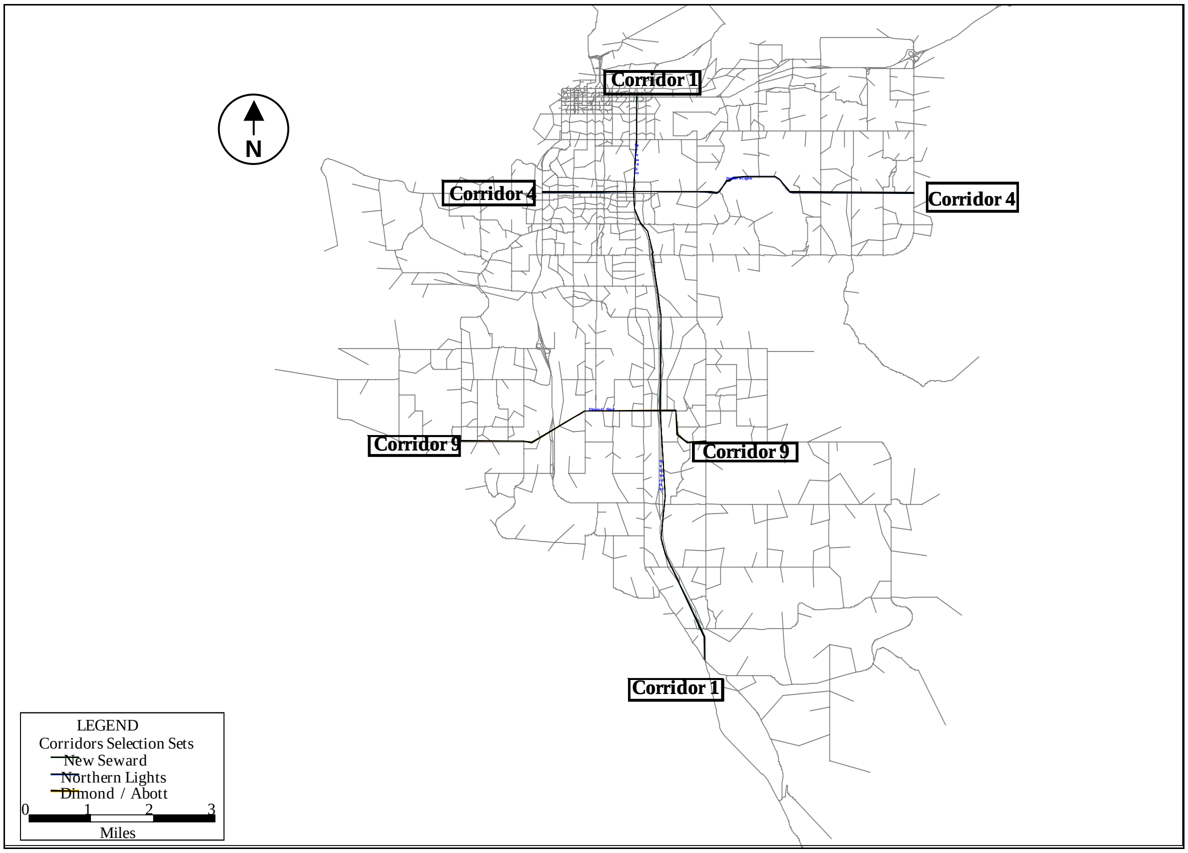
Source: MOA and Cambridge Systematics, Inc., 1998.

Table 6. Travel Time Data Collection Materials Provided to MOA Staff

Provided by Cambridge Systematics	Provided by Municipality of Anchorage
Maps of Corridors and Checkpoints Data Collection Schedule Blank Data Collection Forms	Data Collection Cars Clipboards Stopwatches Writing Instruments

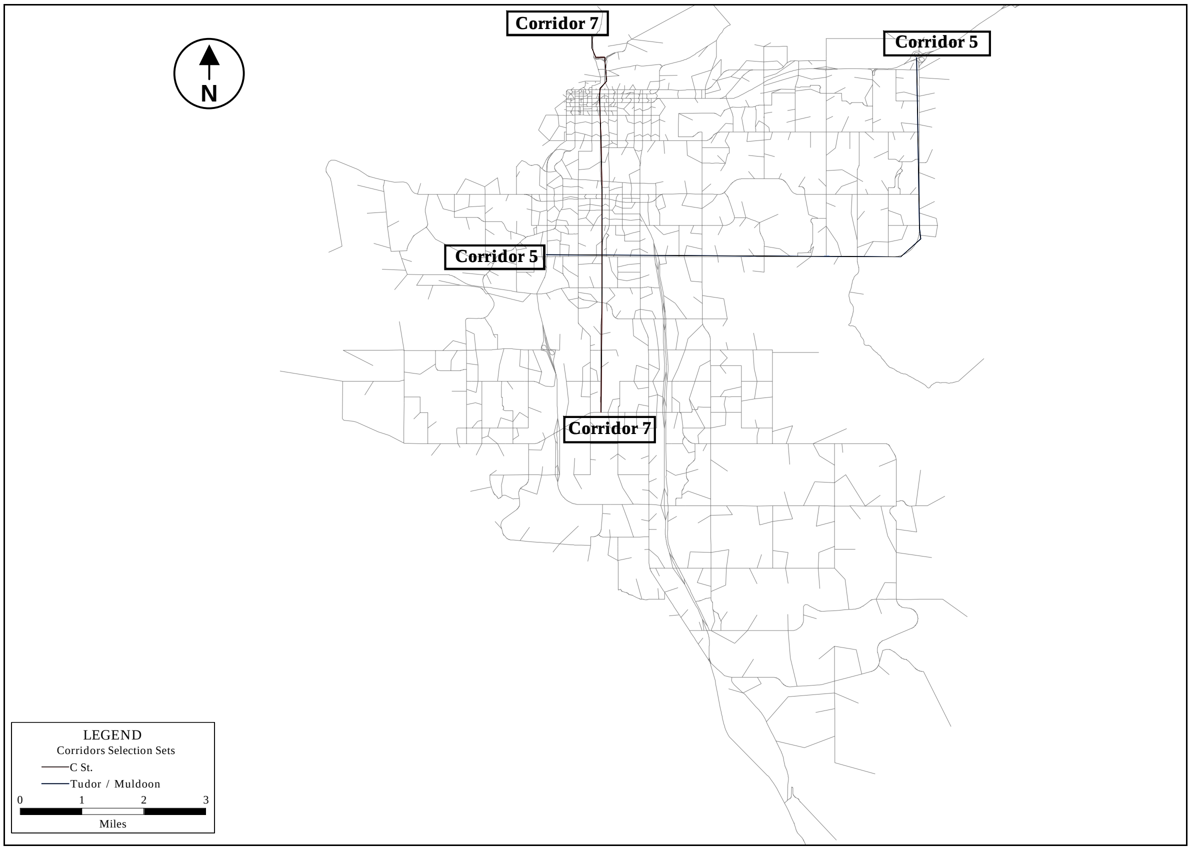
Source: Cambridge Systematics, Inc., 1998.

Figure 1 Corridors 1, 4, and 9 Evaluated for Travel Times



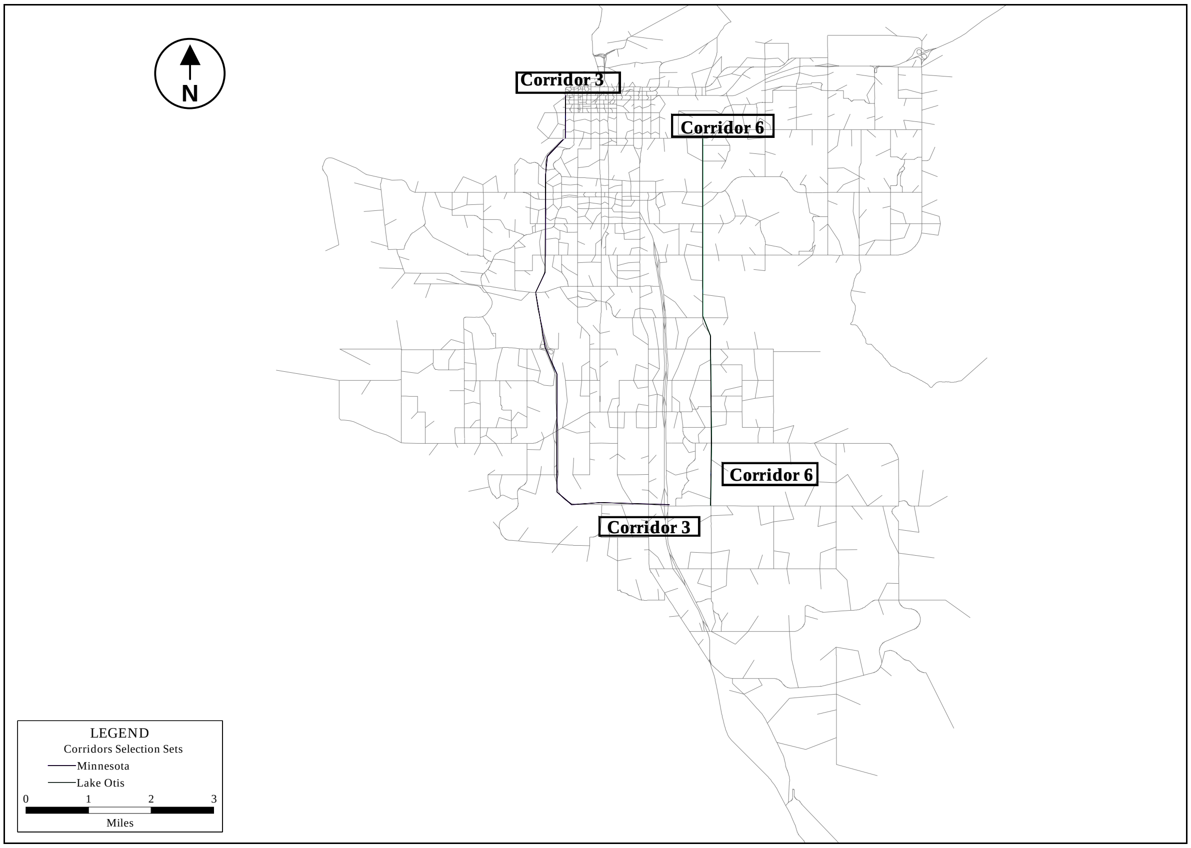
Source: Municipality of Anchorage and Cambridge Systematics, Inc., August, 1999.

Figure 2   Corridors 5 and 7 Evaluated for Travel Times



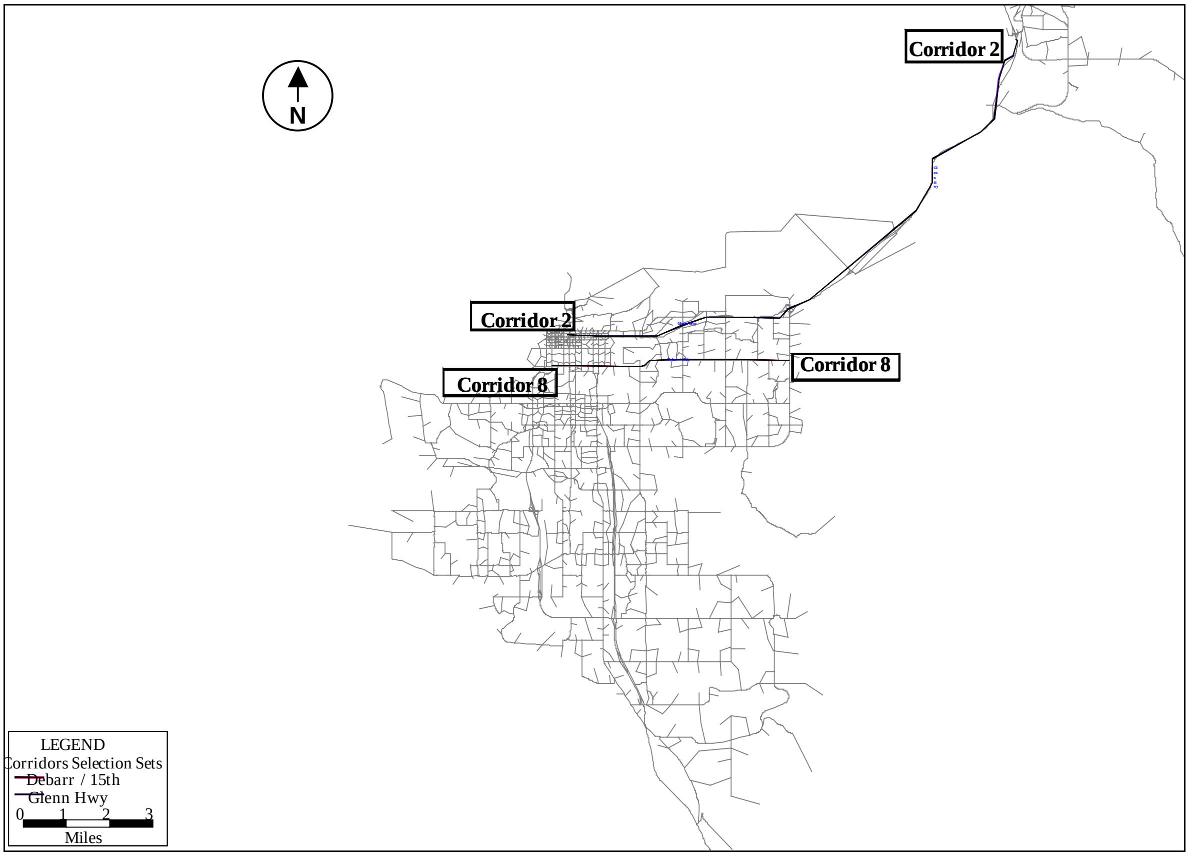
Source: Municipality of Anchorage and Cambridge Systematics, Inc., August 1999.

Figure 3 Corridors 3 and 6 Evaluated for Travel Times



Source: Municipality of Anchorage and Cambridge Systematics, Inc., August 1999.

Figure 4 Corridors 2 and 8 Evaluated for Travel Times



Source: Municipality of Anchorage and Cambridge Systematics, Inc, August 1999.

APPENDIX C

Vehicle Occupancy Survey Locations

1. Federal Building – Counts taken as cars enter the underground parking garages.
2. State of Alaska Dept. of Transportation – Counts taken at two locations: Aviation Dr and International Airport Dr exits.
3. 14th & A St – Counts include all northbound traffic (A St is one way).
4. 13th & I St – Counts taken on I St just north of 13th Ave.
5. University Plaza – Counts taken as cars enter the office building parking lot. Office building is located on the northeast corner of 36th Ave and the New Seward Hwy.
6. Elmendorf Air Force Base – Counts taken at all four gates, including: Hospital gate off of Muldoon Rd.; Post Rd gate; Government Hill gate; and the main Boniface gate.
7. Fort Richardson – Count taken at the only gate to Fort Richardson which is off of the Glenn Hwy between Highland Rd and Muldoon Rd.
8. Arctic & 15th Ave.- Count taken of northbound traffic just north of 15th Ave.
9. 15th & Ingra St – Counts taken at two locations: on Ingra just north of 15th Ave and on 15th Ave just west of Ingra.
10. UAA/APU – Composite of four different counts, including: eastbound traffic on Providence Dr near the McLaughlin Youth Center (midway between UAA Dr and Lake Otis); at the Lake Otis entrance to the UAA campus which is approximately ¼ mile north of 36th Ave. intersection; northbound traffic on Bragaw St just south of the intersection with Providence Dr; and southbound traffic on UAA Dr near the entrance to the Consortium Library parking lot.
11. Providence Hospital – Composite count of the cars entering the three entrances to Providence Hospital.
12. 6th & G St Garage – Composite counts of cars entering both parking garages: one entrance is on G St and the other is on H St.
13. BP Exploration – Composite count of cars entering the BP Exploration parking lot. BP Exploration office building is located on the southeast corner of the New Seward Hwy and Benson Blvd. The entrances are located on Benson and the New Seward Hwy.
14. Alascom – Counts taken as cars enter the parking lot of the Alascom building (Long Distance telephone provider). Alascom is located in Government Hill at 210 E. Bluff Dr.

15. 5th Ave. & Karluk – Counts taken on 5th Ave (one-way westbound) near the split from two way to one-way.
16. Glenn Hwy – All three westbound lanes are counts at a location just west of Ship Creek near the Fort Richardson entrance.
17. Alaska Regional Hospital – Counts taken at the two hospital entrances: one is off of Airport Heights Rd and the other is off of DeBarr Rd.
18. Alaska Native Medical Center – Three counts are taken around the perimeter of the Alaska Native Medical Center, including: Tudor Center east, Tudor Center west, and Diplomacy Dr.
19. Frontier Building – Counts taken of cars entering Frontier Building parking lot/garage from A St, C St, and 36th Ave.
20. Weight station – The weight station is located on the Seward Hwy just south of Potter's Marsh.
21. ARCO Alaska – Composite count of cars entering the main parking lot for ARCO employees. The Parking lot occupies the entire block between 7th and 8th and H and I Sts. The entrances are off of H St and 7th Ave.

Source: MOA.