EVALUATION OF URBAN TRANSPORTATION INVESTMENTS USING SOCIAL BENEFIT COST ANALYSIS: A CASE STUDY OF THE GEIST ROAD EXTENSION IN FAIRBANKS, ALASKA

By

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ABSTRACT

This paper illustrates the use of Social Benefit-Cost Analysis (SBCA) to evaluate a major highway improvement project proposed for Fairbanks, Alaska. Use of SBCA has been shown to lead to the selection of projects which provide greater net benefits to society than other evaluation methods. Despite this, the majority of resources spent on highway investment in the U.S. each year is programmed based on simple, non-economic investment rules.

The case study employs a detailed analysis of Fairbank's highway transportation system in order to develop estimates of direct user costs over the life of the proposed project. This level of detail provides reliable user costs, sensitive to relationships between costs and traffic volumes, land use patterns, distribution of traffic by time of day, vehicle mix, etc.

It is concluded that the method used in the case study is applicable to and appropriate for use in other medium-sized and small urban areas. The data required for this analysis was found to be available from models routinely generated by most cities. Analyses of this type could be improved with better data on vehicle operating costs, the valuation of travel time and the relationship between accidents and traffic volumes.

The relationship between the technical analysis using SBCA and the broader decision-making framework is discussed. It is concluded that analysts can play a role in ensuring the effective use of the analysis results in the often politicized decision-making framework. It is felt that this is best accomplished by ensuring the active participation of the analyst, the decision-maker and the community in the development of alternatives and the setting of objectives to be used in the analysis.

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CHAPTER ONE

Introduction

1.1 Purpose and Motivation of Study

In the public sector, project evaluation is one of the most important steps in the transportation planning process. It involves both analysts and political decision makers in an activity which usually leads to the committment of an area's resources. Typical of many public investments, transportation projects are usually capital intensive, long-life facilities. Thus, it is essential that care be taken in evaluating transportation projects. Analysts must provide information to decision-makers which allows them to make the best use of limited public resources in accomplishing a community's goals.

Sugden and Williams describe projects and project appraisal (or evaluation) as follows:

> "A *project*, broadly defined, is a way of using resources; a decision between undertaking and not undertaking a project is a choice between alternative ways of using resources. *Project appraisal* is a process of investigation and reasoning designed to assist a decision-maker to reach an informed and rational choice" (Sugden and Williams, pg 3).

Two broad issues arise in the process of evaluating transportation projects (Meyer and Miller, pg 372). First, the public decision-making process is a political one and thus information derived from an evaluation is filtered through the values and objectives of the decision-making group before a final investment decision is made. Second is determining the set of techniques used by analysts in evaluating projects and thus generating information used by decision-makers.

1.1.1 Transportation Investment Decision Making Process

Figure 1-1 illustrates the investment decision-making process typically used by local governments. The evaluation framework overlaps the analysis done by planners and the decision made by the public and its elected representatives. Within the evaluation, the public policy issues (such as traffic congestion, air pollution, community development), which may have motivated study of the problem in the first place, interact with the results of the technical evaluation prepared by planners. Both play important roles in affecting the final investment decision. The project is as likely to be approved because it is perceived as "good for community development" as it is for its direct user benefits. Unfortunately, it is also likely to be approved based on misperceptions despite direct costs outweighing direct benefits (Nowlan, pg 2).

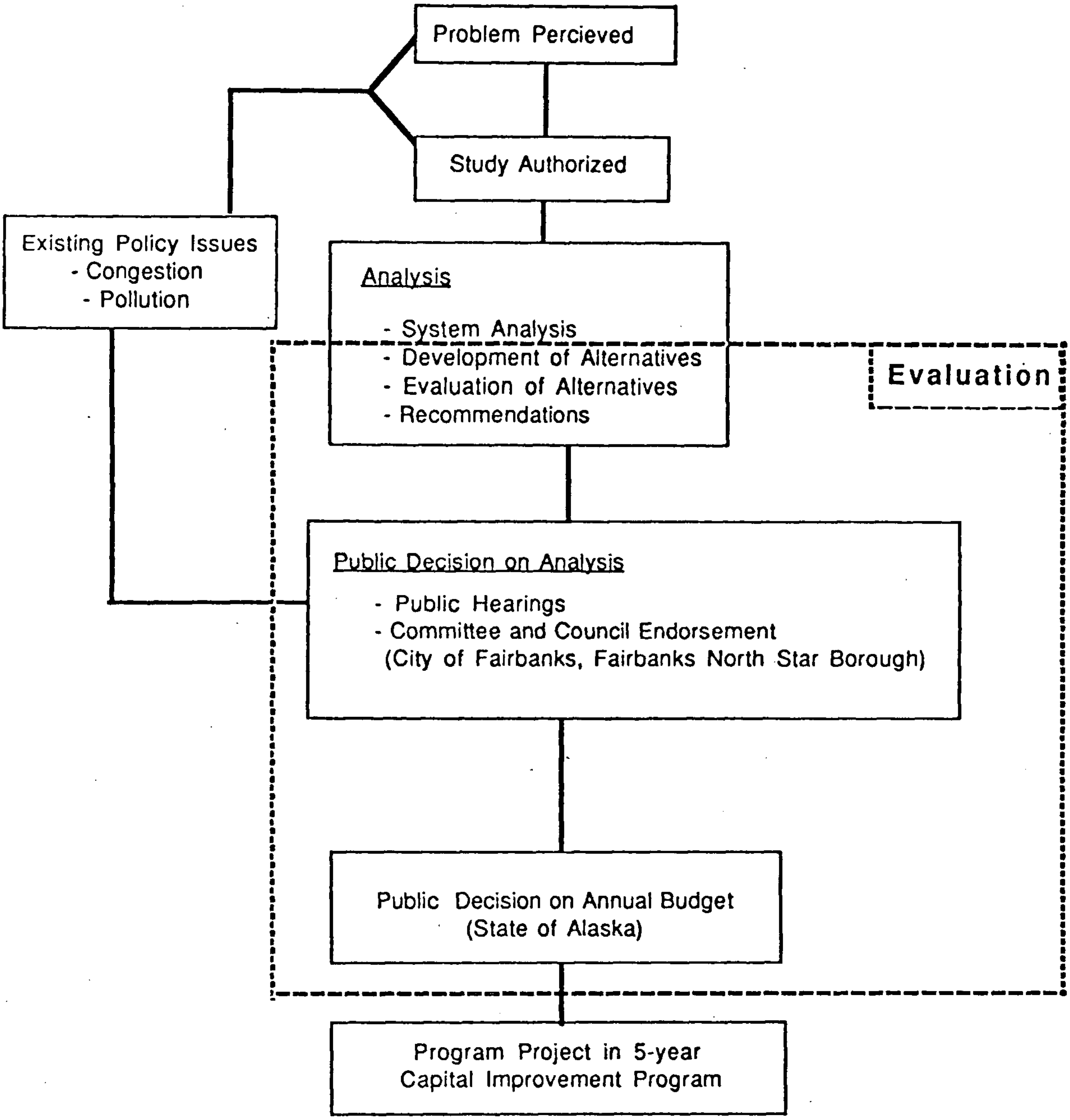
As Nowlan related in his discussion of the evaluation of the Spadina Expressway in Toronto (Nowlan, pg 2):

> ". . . there occurs an interplay between factual analysis and evaluation on one hand and policy debate on the other. This overlap of policy debate and project discussion is an inescapable aspect of much government decision-making, and something which cannot be dispelled by brandishing techniques such as cost-benefit analysis."

The decision-making process through which a community's resources are committed is influenced by and can influence the evaluation of transportation investments. Beyond the information on project use and impact generated by an evaluation, the effectiveness of an evaluation is often determined by the analyst's ability to convey distributional effects

Figure 1-1

Transportation Investment Decision-Making
Process Used by Alaska DOT/PF for
Geist Extension Project



(i.e., who gets what out of the project), trade-offs between alternatives and major areas of uncertainty (Meyer and Miller, pg 373).

1.1.2 Evaluation Techniques

Several very different techniques can be employed in the evaluation of alternative transportation investments. Non-economic methods use simple performance measures such as volume to capacity ratios, travel delay, and road roughness to establish standards (or minimum tolerable conditions) which can be used to guide transportation system investments. Cost-effectiveness techniques attempt to provide information on how alternative transportation investments meet various goals established by a community. Social Benefit-Cost Analysis (SBCA) attempts to establish the costs and benefits of alternative investments, in dollar terms, to society or the community as a whole.

This paper focuses on evaluation techniques, specifically SBCA. The primary difference between SBCA and non-economic evaluation techniques is that non-economic techniques are insensitive to the costs involved in a particular project. While useful in identifying projects, non-economic techniques provide no information on the efficiency of a project. As explained by Gomez-Ibanez and Lee, "there may be conditions under which higher standards would be justified by the incremental benefits and other conditions under which imposing the standard calls for costs that exceed the incremental benefits" (Gomez-Ibanez and Lee, pg 22). Thus, non-economic methods as embodied in improvement standards and sufficiency ratings provide little guidance for the economically efficient allocation of resources to the transportation system.

Comparison of the several techniques available to evaluate transportation investment has been the focus of two recent studies. The first is a 1985 study by Gomez-Ibanez and O'Keefe testing alternative investment rules using U.S. interstate highway investment decisions as test cases. The second study was prepared in 1986 by McFarland and Memmott using added-capacity projects as test cases.

The major findings of these studies indicate that, not only is an explicit use of benefit-cost analysis preferable to other techniques for transportation investment evaluation; because other techniques are generally used in most states in the U.S., a significantly large increase in efficiency would result from using benefit-cost analysis (McFarland and Memmott, pg i; Gomez-Ibanez and O'Keefe, pg 85).

McFarland and Memmott compared sufficiency rating systems, priority formulas and cost-benefit analysis in the evaluation of 1,942 added-capacity projects being considered for funding in Texas.[1] They found that for a ten-year budget of $5.742 billion, the benefit-cost procedure selected projects that give over $22 billion more benefits than does the sufficiency rating system and approximately $7.8 billion more than does the priority formula.

Gomez-Ibanez and O'Keefe compared investment rules which specify minimum tolerable physical conditions (MTC's) beyond which investment is required and cost-benefit analysis.[2] Their principle finding is that the investment rules used for highways by State and Local officials are often excessively simple (Gomez-Ibanez and O'Keefe, pg 3). They note that for many important types of investment, particularly repaving and reconstruction, highway agencies often use MTC rules that do not closely approximate the results of benefit-cost analysis (Gomez-Ibanez, pg 3). From test cases they conclude that "the additional social benefit from using these improved rules (ed. - cost-benefit analysis) could easily amount to ten or twenty percent of the cost of the investments (Gomez-Ibanez, pg 85).

Despite this, the majority of the billions of dollars spent on highway investment in the U.S. each year is programmed based on simple, non-economic investment rules (Gomez-Ibanez and O'Keefe, pg ii).

1.2 Purpose of Study

Given the influences which can prevail on the evaluation process, social benefit-cost analysis cannot stand alone, nor does it have a position which supercedes policy. Rather, it provides "a method by which data can be arranged for easier interpretation in the light of relevant policies" (Nowlan, pg 2).

Social benefit-cost analysis is argued to also provide a framework for resource allocation which may make political decision-makers more accountable to a community (Sugden and Williams, pg 241).

In light of the discussion in Section 1.1.1, an evaluation should have as its objectives: 1) the guiding of much of the technical aspects of the planning process, 2) a summarization in understandable terms of the key issues to be considered by decision-makers, and 3) access for involvement of interested parties (Meyer and Miller, pg 375).

The purpose of this study is to illustrate the application of SBCA in evaluating an urban transportation investment. The ultimate result of a social benefit-cost analysis of a transportation investment is a comparison of the costs and benefits in monetary terms. The development of these project costs and benefits involves a fairly complex series of steps. A case study will be used to show what analytical methods and data are required to develop a reliable estimate of costs and benefits for urban highway projects. The case study involves the evaluation of a highway project in Fairbanks, Alaska.

The focus of the paper is the description of a method of developing a refined set of user costs. This method makes use of a detailed break-down of transportation system activity to estimate the direct effects of a transportation investment.

While the study does emphasize the techniques involved in the evaluation of transportation investments it is recogized that the context within which the evaluation is undertaken (often a political one) is quite important and can influence the effectiveness of such analysis. In this context evaluation is seen as a vital link between planning and decision-making (Meyer and Miller, pg 373). The issue of SBCA in the context of the political decision-making process is addressed in Chapters Five and Six of this paper.

1.3 Structure of Study

Chapter Two describes the case study and method of analysis used in the evaluation. Chapter Three contains an analysis of the highway network used in the case study. Chapter Four develops highway user costs. Chapter Five presents the results of the evaluation. Chapter Six provides a summary of the project evaluation process as presented in this study, discussing how it is affected by the political nature of the decision-making process and drawing on recent empirical research which compares alternative evaluation techniques.

FOOTNOTES

CHAPTER ONE

1. A sufficiency rating is an index usually consisting of three categories, each having several subunits with weights that typically sum to 100 points if the highway is totally sufficient. Highways with the lowest ratings are considered to be the ones most in need of improvement (McFarland and Memmott, pg 5).

Priority formulas are cost-effectiveness techniques which use a formulation (e.g., a ratio) of the change in sufficiency ratings on a road segment and the cost of achieving that change (McFarland and Memmott, pg 7).

The benefit-cost procedure used in the McFarland and Memmott study is a modification of the Highway Economic Evaluation Model II (or HEEM-II) developed by the Federal Highway Administration.

2. Rules using MTC's include both the sufficiency rating systems and priority formulas discussed by McFarland and Memmott.

CHAPTER TWO

Description of Case Study and Method of Analysis

This chapter provides background on the community of Fairbanks, Alaska and the proposed project - the Geist Road Extension. Estimates of project construction and maintenance costs are presented along with a description of the project's layout and construction schedule. The approach used in evaluating the project is also discussed.

2.1 Case Study Background

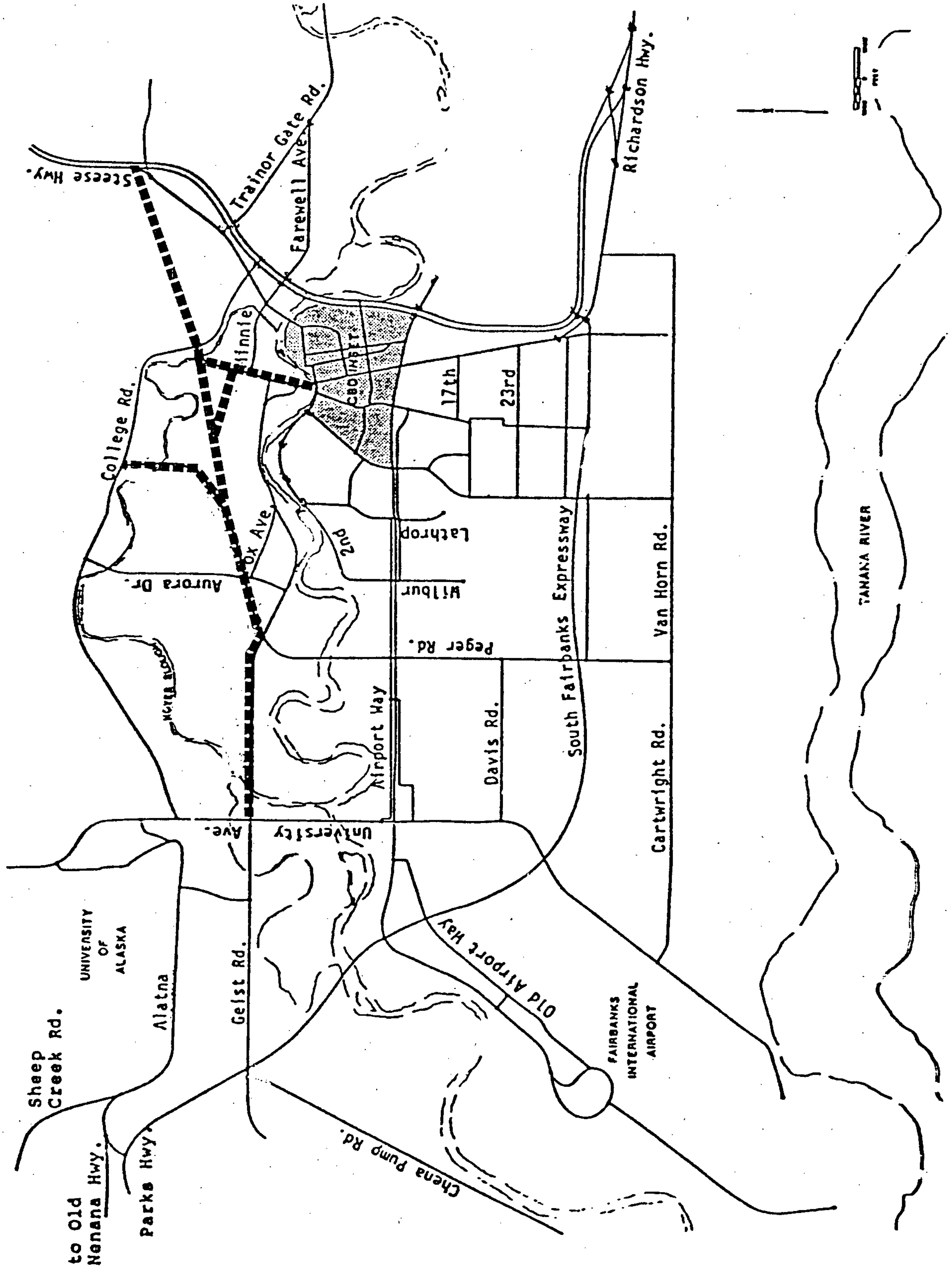
Fairbanks is located in the interior of Alaska, approximately 300 miles north of Anchorage. The 1984 population for the Borough was estimated to be approximately 70,000. Based on continued population growth at historic rates and the build-up of a local military base, the area population is expected to grow to 128,000 by the year 2005 (DCCO, 1985A, pg II-6). As will be discussed further in Chapter Three, this is an admittedly high growth scenario used in the Fairbanks Metropolitan Area Transportation Study (FMATS) Update prepared by DeLeuw Cather Company (DCCO) to assess the "worst-case" traffic generation (DCCO, 1985A, pg II-1).

The case study is a proposed highway project in Fairbanks. Essentially, it is an extension of an existing east-west arterial with connections to downtown Fairbanks. The study horizon is 20 years, extending from 1986 to 2005.

Figure 2-1 shows the proposed project as well as the central area of Fairbanks. The proposed highway project runs through the middle of the relatively undeveloped central part of the community. The addition of more

Figure 2-1

Proposed Project and Surrounding Area



■■■■■■■■ Geist Extension

east-west capacity was anticipated in the original FMATS recommendations made in 1969. However, a formal project proposal was not put forth until 1977 when Alaska Department of Transportation and Public Facilities (ADOT/PF) began preliminary design work. The objective of the project is to relieve congestion on other arterials and provide better access to the downtown area. Several alternative routes were analyzed although no formal analysis was done of alternatives to the construction of additional capacity (e.g., transportation system management alternatives).

Through the input and analysis gained from the preparation of a formal Environmental Impact Statement (EIS), the preferred alternative (shown in Figure 2-1) was selected by ADOT/PF in early 1985.[1]

2.1.1 Sources of Case-Specific Data

The primary source of data for project specifications, costs and the project's environmental impacts come from the ADOT/PF Divisions of Design and Construction, and Maintenance. System analysis data (traffic volumes, road network characteristics, etc.) are taken from the recently completed update of the Fairbanks Metropolitan Area Transportation Study (FMATS) prepared by DeLeuw Cather Company (DCCO) and information provided by ADOT/PF Planning and Programming Section. Information on user costs in Alaska are adapted from a recent economic evaluation prepared by Quadra Engineering, and an earlier regional transportation study of Northern Alaska prepared by Berger and Associates.

2.2 Method of Analysis

2.2.1 Overview of Social Benefit-Cost Analysis

As stated in Chapter One, the objective of the case study is to illustrate the use of Social Benefit Cost Analysis (SBCA) in assessing the costs and benefits of an urban transportation investment, specifically the Geist Road Extension. As a decision-making tool, SBCA strives to provide a rational basis for the allocation of resources in a manner which maximizes the goals of a community (Pearce, pg 6). It does this by attempting to measure individual community members' assessments of the costs and benefits to them of a particular use of social resources.

The measurement of these costs and benefits is theoretically to be based on individual preferences as expressed in markets. To be valid, the analysis must use the true economic cost of resources used as reflected in their "opportunity cost" (Pearce, pg 13). At least three problems exist in the attempt to measure the opportunity cost of resources used in a project:

1) Markets may not exist for some resources (e.g., the value of time, value of life);

2) Markets may be distorted. In other words, the price paid in dollar amounts may not reflect opportunity cost of resource used. This typically happens in developing countries stemming from rapid inflation, government controls, over valuation of the domestic currency, underemployment of labor, etc. (Adler, pg 11);

3) The use of resources associated with a project occurs over an extended period of time.

To address the first two problems, economists use an approach called shadow pricing. Shadow pricing attempts to infer the opportunity cost of resource's use by observing behavior in related markets. For example, the value of time is estimated by what employers are willing to pay or by what wage earners are willing to work for: wage rates plus fringe benefits (Adler, pg 38). The valuation of noise might be inferred from geographic differences in the price of housing (Sugden and Williams, pg 162). Shadow pricing can also include adjustments made to existing markets which are considered distorted.

To provide an accurate comparison of the costs and benefits of the project over time, they should be discounted to a common point in time. This discounting adjusts the costs and benefits to reflect the <u>productivity of capital</u> - a dollar is worth more today than next year; and <u>positive time-preference</u> - individuals prefer now to later (Pearce, pg 38).

To accurately discount costs over the life of the project, costs and benefits must be estimated for each year of the project. This need for year to year data contrasts with most planning practice which often uses one or two target years for analysis.

Typically, an SBCA of the transportation project will include a measure of the following costs:

-Vehicle operating costs,
-User time costs,
-Accident costs,
-Other non-user costs such as noise and air pollution,
-Construction costs,
-Maintenance costs.

These costs are developed for the affected transportation system with and without the project. The underlying criterion which is used in SBCA to determine the worth of a project is the potential Pareto improvement criterion (Sugden and Williams, pg 89). The following is a definition provided by Sugden and Williams of Pareto improvement and potential Pareto improvement (Sugden and Williams, pg 89):

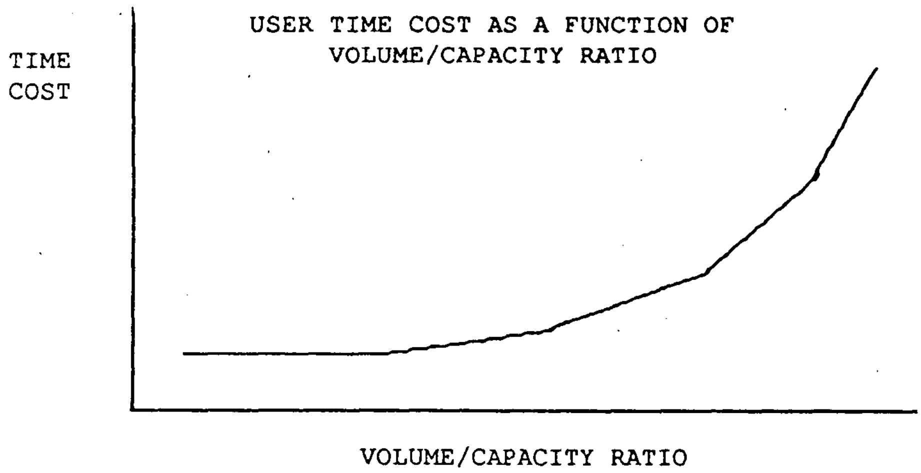
> "In the language of welfare economics, a change that makes at least one member of a community better off and makes none worse off is a Pareto Improvement. Undertaking a project provides a *potential Pareto improvement* if it is *in principle possible* to secure an actual Pareto improvement by linking the project with an appropriate set of transfers of money between gainers and losers - even if *in fact* these transfers will not take place."

Thus, if a transportation investment creates benefits to community members which exceed costs (e.g., through savings in vehicle operating costs, user time savings, etc.), then a potential Pareto improvement exists and the project can be considered worthwhile.

2.2.2 Approach Taken in this Study

Traditional economic evaluations of urban road projects have tended to be made at an aggregate level, using system-wide average speeds applied to an aggregate demand. For example, evaluations of the Spadina Expressway in Toronto assumed an average speed of 20 miles per hour on the affected road network and estimated a daily demand of 155,400 vehicle miles per mile on the network (Nowlan, pg 5). Analysis at this aggregate level ignores the significant variations in speed which exist on an urban network and the variations in demand which exist over the course of a day. This can be illustrated in a graph of user time costs for a typical urban road segment. User time cost as a function of the volume-to-capacity ratio of a road segment is presented in Figure 2-2 below.

FIGURE 2-2



In evaluating the impacts of a project, this cost function raises three issues:

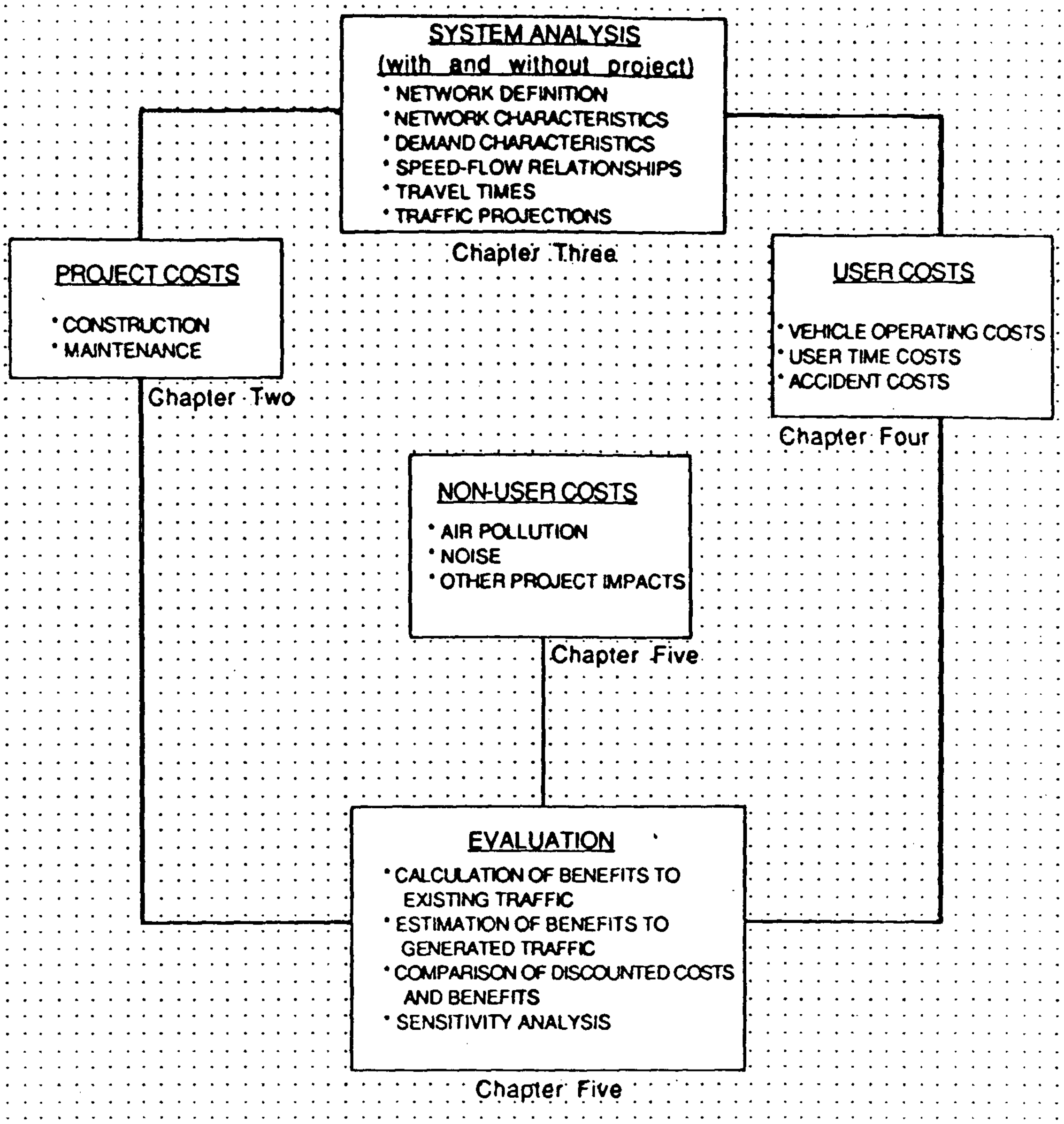
1) Costs do not vary linearly with use on a segment,
2) Use is not uniform along a segment consisting of several intersections, and
3) Inter-relationships between segments exist at a system-wide level and thus changes in the costs on one segment could affect many segments.

The approach used in this study is to undertake a detailed analysis of the road system in Fairbanks. This analysis entails a more refined breakdown of the road network. The network is divided into several links for which operating conditions are to be calculated. Since the operating conditions on urban roads typically exhibit wide variations between peak and off peak use and in user characteristics, link operating conditions are estimated for various times of day, accounting for differing auto occupancy and vehicle mix. This provides a system-wide analysis of the project which recognizes that, as each link is a part of the overall network, a change in an individual link can be expected to have an effect on some or all the other links (Griffiths, pg 36). This approach allows for more accurate estimates of the level of benefits. More importantly, it can be used to determine the distribution of the benefits (for example by time of day, road segments or geographic area).

The process taken in evaluating the project is diagrammed in Figure 2-3. Essentially, the system analysis provides the base data used in determining both user costs and non-user impacts. A dotted line connects the system analysis and project costs in reference to recognize that under normal circumstances, the system analysis would precede the development of alternatives and hence any project cost estimates. The system analysis entails defining that part of the existing road system likely to be affected by the project and developing a set of road system characteristics (e.g., volume, capacity, peaking characteristics, speeds, etc.). This analysis is presented in Chapter Three. User costs include vehicle operating costs, user time costs and accident costs and are presented in Chapter Four. The analysis of project costs provides input for the formal evaluation. Non-user impacts are presented in Chapter Five and, while these impacts would ideally be evaluated in an SBCA, they are not considered in this evaluation as a monetary value can not easily be attached to them. Their importance in the final decision-making process is indicated by a dotted arrow connected to the evaluation. The evaluation itself is presented in Chapter Five and entails the calculation of project benefits to existing traffic (user costs without the project less user costs with the project),

Figure 2-3

Process for Project Evaluation



the estimation of benefits to generated traffic and a comparison of the total project benefits and costs discounted over the life of the project. Sensitivity of the evaluation to changes in the discount rate, population growth, and the value of user time is analyzed.

While a complete study would entail the analysis of present and forecast demand and supply conditions in arriving at a set of possible alternative investments, this case study limits itself to the evaluation of a single project, the Geist Road Extension in Fairbanks, Alaska. As well, given its scale, a separate evaluation of segments of the project might provide more meaningful information on the relative merits of each part. However, given the lack of resources required to carry out this analysis, and to keep the illustration simple, the project as a whole is evaluated in this case study.

2.3 Project Costs

This section presents the estimated project costs for the Geist Road Extension. Generally, these costs are subdivided into construction and maintenance costs. Given the eight-year construction schedule, it is important in evaluating the project to accurately assign the project costs on an annual basis. This ensures that the costs are correctly discounted in calculating their present value. This entails breaking project costs down by the sections which are to be completed each year and assigning maintenance costs only to those sections which are completed.

2.3.1 Construction Costs

Table 2-1 provides a breakdown of construction costs. These costs include project engineering (design), right-of-way acquisition, construction, and utilities costs. Cost estimates of each of these components are made for five sections of the highway. These sections are highlighted in Figure 2-1.

Table 2-1 also presents a schedule of construction is presented indicating when each section is to be started, and the estimated time of completion. Summarizing, construction is scheduled to begin in September of 1985, and will be completed by late 1993. The total cost is estimated to be 116.1 million dollars.

It should be noted that the Illinois Street section of the project involves improvements to existing sections of the network. As this section is not scheduled for construction until 1992, the majority of the added capacity will be completed by 1991.

Table 2-1

GEIST EXTENSION - PROJECT DEVELOPMENT COSTS

	1985 Cost ($ Million)						
Section	P.E.	ROW	Const	Util	Total	Sched. Start Const	Complete Const
Peger - College	0.8	5.9	18.3	1.0	26.0	'86	'87
Lemeta - Birch Hill	0.7	5.6	8.8	0.3	15.4	'88	'89
Aurora - Lemeta	1.2	3.2	18.4	0.7	23.5	'89	'90
Illinois	1.0	13.9	12.4	0.8	28.1	'92	'93
University Ave. - Peger	0.9	5.5	16.5	0.2	23.1	'90	'91
TOTAL	4.6	34.1	74.4	3.0	116.1		

P.E. - Project engineering costs
ROW - Right of way costs
Const. - Construction costs
Util. - Utility costs

Source: ADOT/PF Planning Section.

2.3.2 Maintenance Costs

Maintenance costs were determined over the life of the project based on average per lane mile cost estimates provided by the ADOT/PF Division of Maintenance. As the project will be staged over several years, the maintenance costs werè calculated to reflect the actual amount of the project completed during each year up to 1993. These costs are presented in Table 2-2.

TABLE 2-2

Estimated Maintenance Costs - Geist Road Extension

Year	-Six Lane[1]- Lane Miles	Cost	-Four Lane[2] - Lane Miles	Cost	Total Annual Maint. Cost
1987	4.86	61,236	-0-	-0-	61,236
1988	4.86	61,236	-0-	-0-	61,236
1989	4.86	61,236	20.44	183,960	330,624
1991	11.64	146,664	20.44	183,960	330,624
1992	11.64	146,664	20.44	183,960	330,624
1993	11.64	146,664	21.04	183,960	336,024
1994-2005	11.64	146,664	21.04	189,360	336,024

1. $12,600 per mile.
2. $9,000 per mile.

Source: ADOT/PF Division of Maintenance.

FOOTNOTES

CHAPTER TWO

1. ADOT/PF is the public entity with the resources to carry out much of the planning, design and implementation of most transportation projects in the Fairbanks area.

CHAPTER THREE

System Analysis

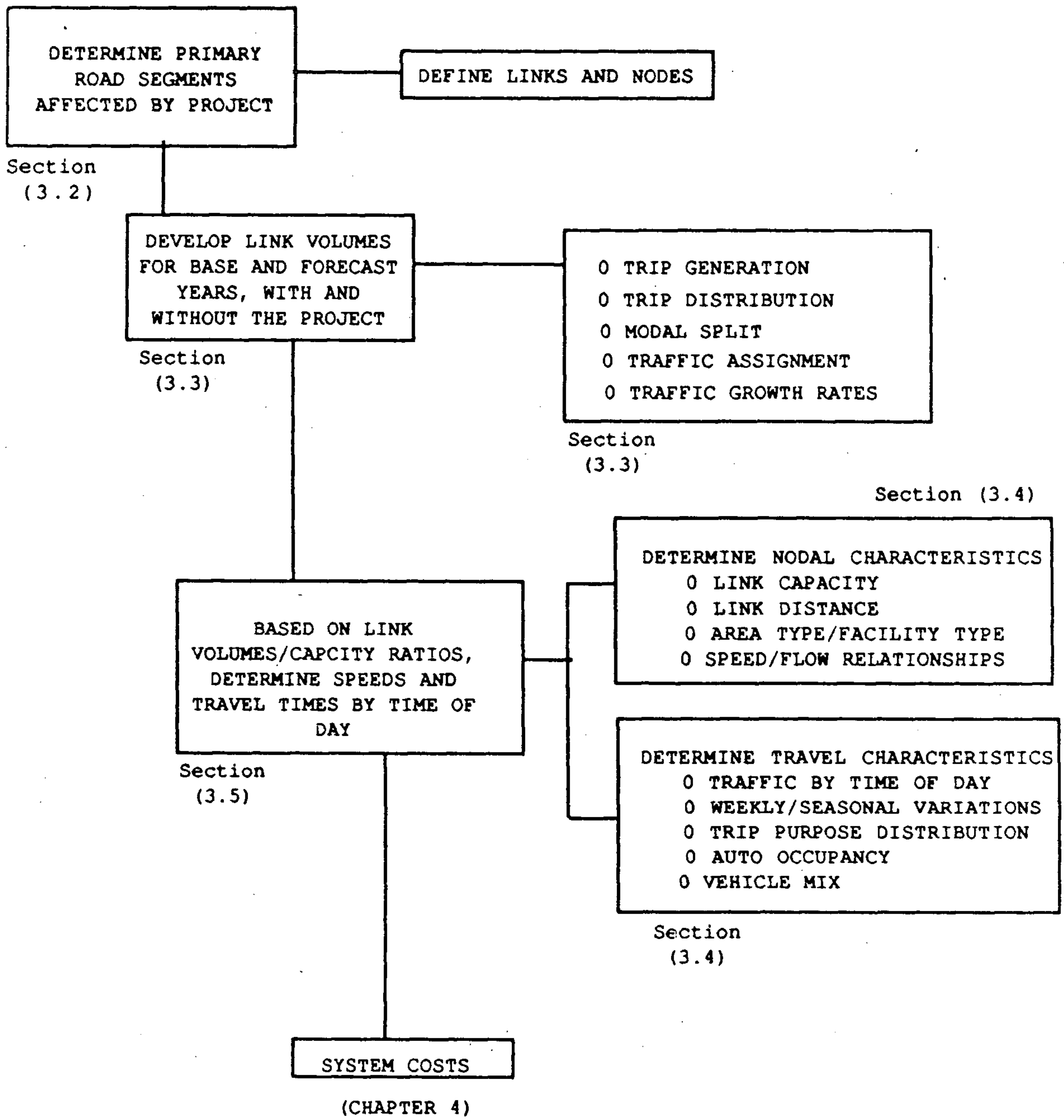
3.1 Introduction

The purpose of this chapter is to assess the operating conditions on that part of the Fairbanks road system most affected by the proposed project. These operating conditions include volume/capacity ratios and speed or travel time. These are inputs to the calculation of vehicle operating costs, user time costs, accident costs and other project impacts.

The data developed from the system analysis underlie all cost calculations used in the economic evaluation. The system analysis is the most data-intensive part of the process. This analysis builds on estimates of the demand for use of the network and projections of future demand, and requires data on operating conditions found on individual links which make up the network.

Figure 3-1 diagrams the process taken in analyzing the road system for this case study. The first step is to determine the primary road segments affected by the new project. These are essentially, the arterials surrounding the project. For the affected network, the next step is to develop traffic volumes for base and forecast years, with and without the project. This is done for each link in the network and can be accomplished using traditional urban transportation modelling techniques. Based on characteristics of the road network (supply) and travel characteristics (demand), the speed or travel time over each link can be calculated. Based on speeds, levels of congestion and travel time, vehicle operating costs, user time costs and accident costs can be estimated for different alternatives.

FIGURE 3-1
DIAGRAM OF SYSTEM ANALYSIS FOR PROJECT EVALUATION



3.2 Development of Network for Analysis

Figure 3-2 presents the road network including the project. Highlighted are the project and the part of the network most affected by the project. Since one of the objectives of the project is to provide more east-west arterial capacity through the central area, the existing east-west arterials are expected to receive the primary impacts. As well, many of the north-south arterials which intersect the east-west roads will also be affected.

3.3 Development of Base and Forecast Link Volumes

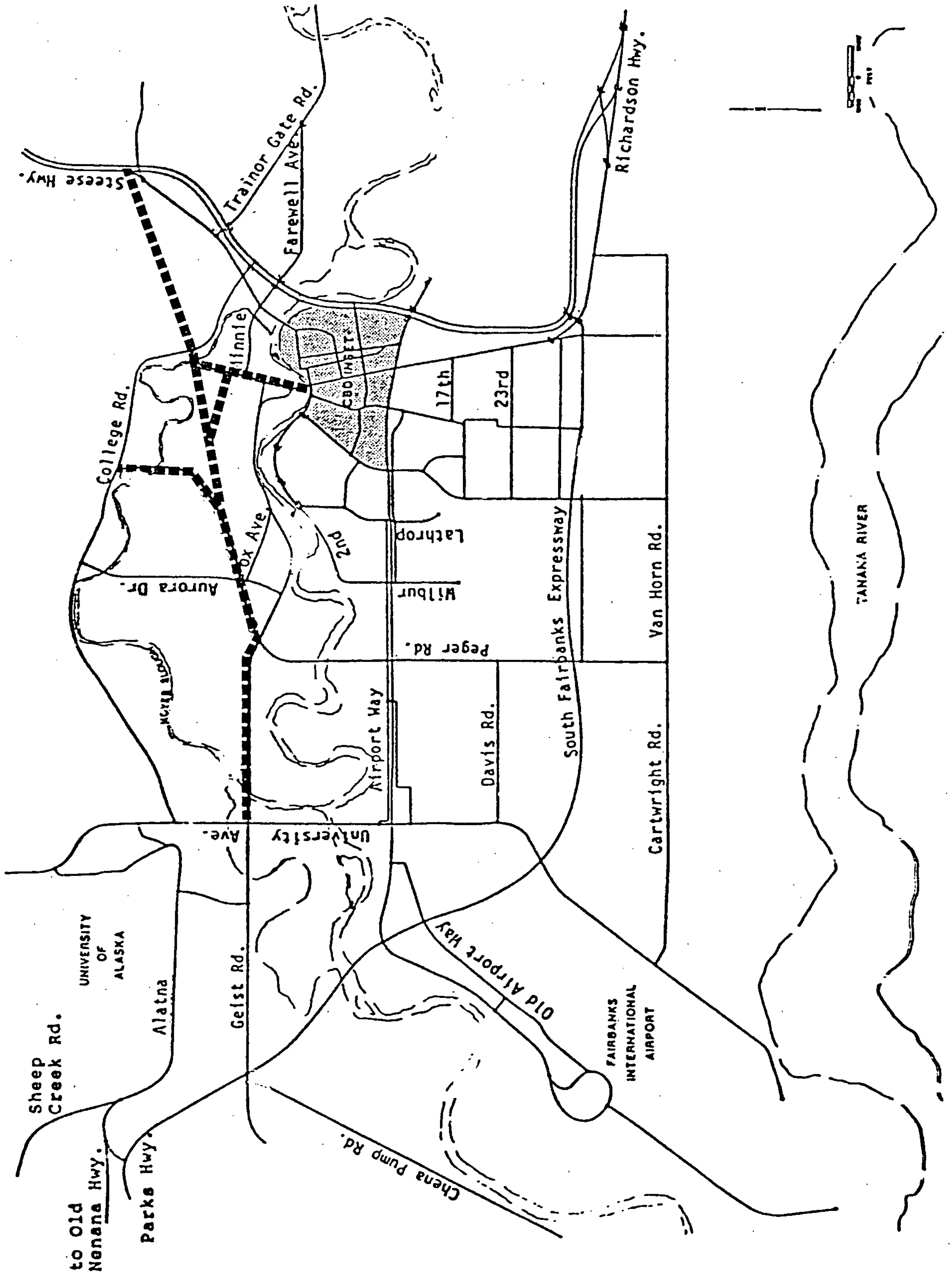
Daily link volumes were established for various scenarios. These scenarios consider the network with and without the project and the growth rate of traffic over the life of the project. This section presents the base and forecast link volumes to be used in the evaluation. The base year of the evaluation is 1986.

3.3.1 Method for Determining Link Volumes

As discusssed in Chapter Two, the source for daily traffic volumes by link is the 1985 FMATS Update. The volumes for the high growth scenarios were produced by the assignment procedure of the traditional four-step modelling process used in the Update. A moderate growth scenario was developed for use in this evaluation by assuming slower growth rates in several of the parameters used to forecast future traffic. The basis for these volumes is discussed in this section through examination of the four-step procedure (trip generation, trip distributions, mode choice, and trip assignment) used in the update.

Figure 3-2

Proposed Project and Affected Network



3.3.1.1 <u>Trip Generation and Distribution</u>

The first two steps are concerned with the geographic interchange of trips in the area being studied. The study area is usually divided into analysis zones. The first step of the modelling process, trip generation determines the number of trips made in the study area. The trip distribution step involves determining the relative attractiveness of each zone and the development of a zone-to-zone trip table.

Trip production for the FMATS Area was derived using a model which generates average daily vehicle trip productions for residential travel for each zone based on average production rates by trip purpose (Home-Based Work (HBW), Home-Based Other (HBO), and Non-Home Based (NHB)) for three household size classifications (DCCO 1983, pg 4):

- o 1 or 2 member households
- o 3 or 4 member households
- o 5 or more member households

The trip production rates for this model were obtained from a 1983 telephone survey of 284 households in the Fairbanks area and are presented in Table 3-1.

Using the 1983 travel survey as a basis, average daily vehicle trip attractions for each zone were derived by DCCO using regression analysis to obtain equations between trip purpose and various parameters including:

- DUS = Number of dwelling units
- TOTEMP = Total employment
- RETEMP = Retail employment
- OTHEMP = Other employment
- SCHATT = School attendance

The final equations used in the update are presented in Table 3-1.[1]

As will be discussed further below, these attraction equations were used in developing estimates for area-wide daily trip volumes where FMATS Update information was not available.

TABLE 3-1

FMATS Trip Generation Factors

Trip Production Rates Per HH (Excludes Ft. Wainwright)

HH Size Group	HBW	HBO	NHB	All Trips
1-2	1.15	1.61	2.87	5.63
3-4	1.57	3.3	3.69	8.56
5-6	2.56	3.36	3.4	9.32
Wt. Avg. Total	1.36	2.15	3.11	6.62

Trip Attraction Equations

Trip Purpose	Equation
Homebased work	HBW = 1.3782 (TOTEMP) - 15.34
Homebased other	HBO = .8276 (DUS) + 3.5659 (RETEMP) + .2837 (OTHEMP) + .2132 (SCHATT) - 3.66
Non-Homebased	NHB = 1.2594 (DUS) + 5.3028 (RETEMP) + 1.240 (OTHEMP) + .02946 (SCHATT) - 3.66

The zone-to-zone trip table was developed using the gravity model expressed as follows (DCCO, 1983, p 17):

$$Tij = Pi^* \frac{Ai\ Fij\ Kij}{\sum_{j=1}^{n} Aj\ Fij\ Kij}$$

where,

Tij = trips produced in analysis area i, and attracted at zone j;

Pi = total trip production at i;

Ai = total trip attraction at j;

Fij = friction factor for trip interchange ij; and represents the "friction" or relative distribution factors representing a diminishing function of Tij;

Kij = socioeconomic adjustment factor for interchange ij if necessary

tij = travel time (or impedance) for interchange ij;

i = origin analysis area number, i = 1,2,3. . .n;

j = destination analysis area number, j = 1,2,3. . .n;

n = number of zones

3.3.1.2 Mode Split

In Fairbanks, public transit has a relatively small share of total household trips, with approximately 1.2 percent of daily person trips. Given the system's small size it is felt that any impacts the project might have on it would be equally small. For this reason the evaluation focuses on auto and truck traffic only.

3.3.1.3 Traffic Assignment

In the evaluation of a project, the final product of the four step modelling process - the link volumes, is a critical input. Link volumes determine the travel time and can affect vehicle operating costs, accident levels, as well as noise and air pollution levels. Thus, it is important to ensure a reasonably accurate assignment of traffic.[2] Ideally the problem of traffic assignment might be better stated in terms of route choice, where the objective of minimizing total travel time can be recognized explicitly and an "equilibrium" solution reached wherein no driver can improve his travel time by changing routes (Kanafani, pg 206).

While practical equilibrium assignment methods have existed for several years and are readily available for use in the well known UTPS package of models, little use has been made of them in practice (Eash, pg 1). Instead, more traditional all-or-nothing and capacity restraint methods have been used (Eash, pg 1).

The FMATS Update included both all-or-nothing and capacity restrained assignments. For purposes of this study the capacity restrained assignments were used as they are closer than the all-or-nothing to an equilibrium assignment.

The selection of a part of the total network for evaluation purposes poses an additional problem in assigning traffic. It is not appropriate to attempt to assign all trips in the area to the partial network (this parallels the problems in an all-or-nothing assignment). The result is that link volumes on the partial network must be taken from a complete network assignment.

An evaluation typically requires two assignments to reflect the network with and without the project, for at least a base year and a horizon year. In addition assignments could be made to assess the sensitivity of the evaluation to the growth in traffic, peak traffic, shifts in land use, and changes in travel behavior (household size, auto ownership, etc). Even though the network used in the FMATS Update is relatively small (160 zones and approximately 1,000 links), and while substantial aggregation of zones might be done to reduce the work, manual assignment is virtually impossible in this case.[3]

Given that resources were not available for this case study to carry out complete computer-assisted network assignments, a method was developed by which link volumes under various scenarios could be approximated. The method involves the use of assignments for 1980 and 2005 developed in the FMATS Update. These assignments represent the network with (2005) and without (1980) the project. To obtain the link volumes required for the evaluation, the ratio of the particular assignment and total area wide weekday trip attractions was calculated and used as an assignment factor.[4] This assignment factor was then applied to forecasts of annual trip attractions during the life of the project. For this approach to be valid, assumptions must be made that zone-to-zone trip interchanges are fixed proportionally during the life of the project (i.e., travel between zone x and zone y is always z percent of total trip ends), In other words, it is assumed that the project will not cause dramatic shifts in travel behavior or land use patterns. This is reasonable because the project is an addition of east-west capacity within the existing urban area. While it might allow for a more efficient routing for some trips, it will not cause a major shift in the relative attractiveness of any area in Fairbanks which might occur if this project were an extension of the urban road system out into undeveloped hinterlands.

In addition, adjustments had to be made to the 1980 assignment to reflect the addition of the South Fairbanks Expressway (completed in 1986), and to reflect more realistically the conditions on the network without the project. While the 1980 assignment provides a relevant base for "without project" assignment factors, it does not reflect the actual level of use (in terms of link AADT/total area-wide attractions) which might be encountered should the capacity of the system remain fixed. To illustrate, based on the 2005 assignment developed in the FMATS Update it was determined that the Geist Extension would handle approximatley 5.8 percent of total attractions.[5] For purposes of the evaluation this represents traffic diverted from existing routes. Thus, without the project, this 5.8 percent must be redistributed to the existing road segments in some manner.

While the majority of these trips should be added to the partial network used in this study, some of the trips would use road segments which were not part of this partial network. It was felt that at least five percent of total attractions (approximately 86 percent of the Geist Extension volume) should be added to the existing network; with two percent added to all links on College Road and Airport Way and 0.5 percent added to Phillips Field Road and the South Fairbanks Expressway. Traffic was also increased on the major north-south routes, with two percent added to links on the Steese Expressway and University Avenue and one percent added to the Illinois - Cushman/Barnett - South Cushman road segment. These allocations were made based on a judgment of the approximate capacities of alternative road segments and likely use of these roads which might occur without the construction of the project. It was felt that Airport Road and College Road would handle the majority of the traffic while the South Fairbanks Expressway and Phillips Field Road would handle relatively little.

Adjustment of the without project assignment to reflect the addition of the South Fairbanks Expressway (SFE) was accomplished by using the SFE assignment factors for 2005 as a base and adding 0.5 percent of total trip attractions as described above.

As project construction is being staged over several years (1986-1993) adjustments to the traffic assignments "with project" were also necessary. To do this requires that the existing network resemble some form of the network "without project" until the project is completed and traffic diversion to the project is 100 percent. This was accomplished by using "without project" assignment factors for each of the existing links to which the Geist volumes had been added (as discussed above). As various parts of the project were added to the network, a reduction in the assignment factors of the "without project" links was made equal to the weighted average volume added to the project.[6] Thus, by 1991, with the completion of the east-west portion of the project, all link assignment factors are "with project". The following percentage reductions were made to the assignment factors of existing links over the period of construction:

1986	-0-
1987	1.21
1988	-0-
1989	0.82
1990	1.63
1991	1.34

Since Illinois Street is also part of the project, its assignment factors were affected somewhat differently then the rest of the existing network. Once the east-west portion of the project ties into Illinois (1989), the assignment factors for this road segment were changed from "without project" to "with project". Its improvements occur in 1993 (widening to increase capacity) and are recognized in the evaluation in 1994.

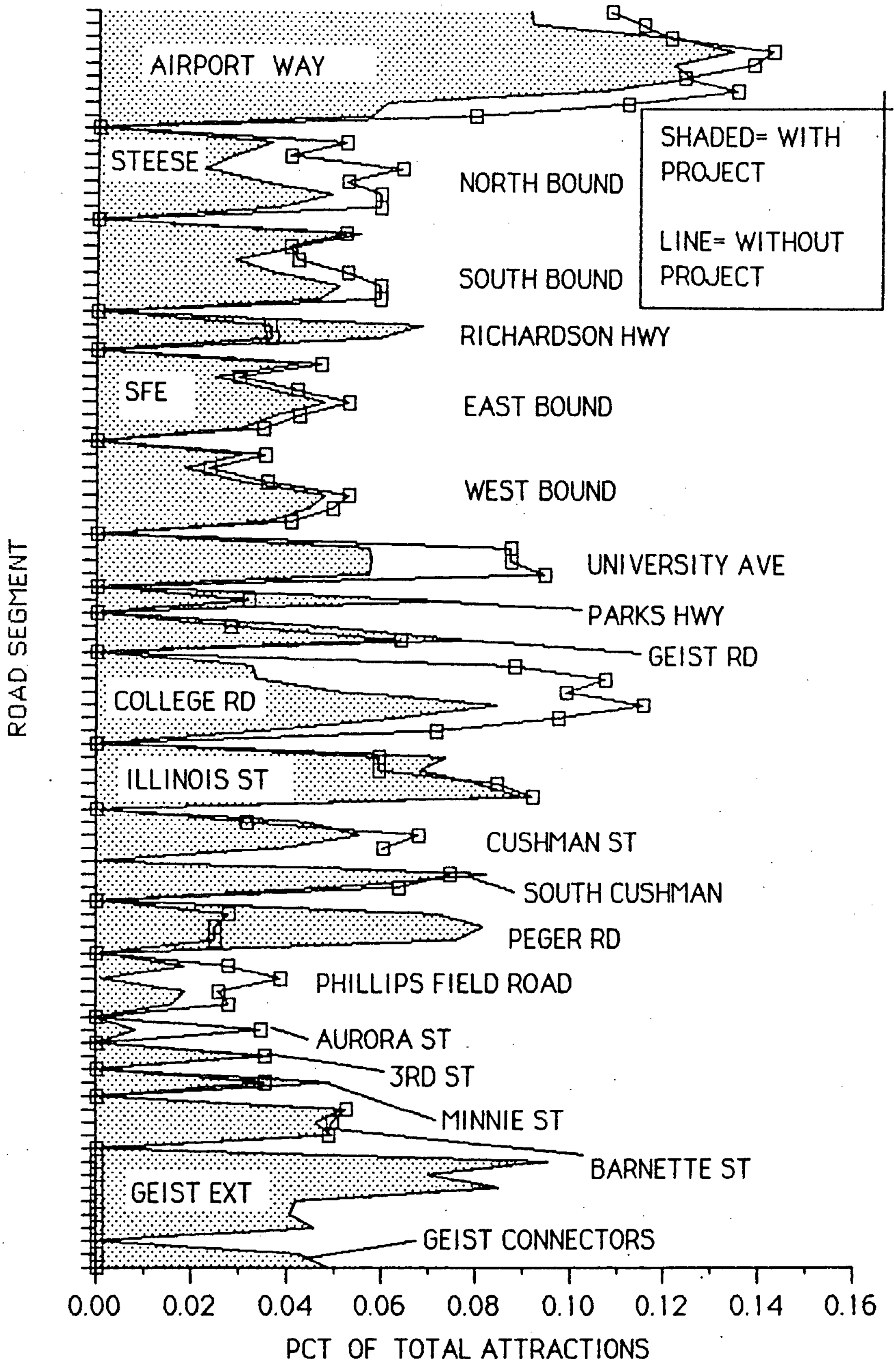
While this is an ad hoc approach to obtaining link volumes it does provide reasonable results for the purposes of this case study. Confidence in the volumes produced by this method can be checked by comparing the assignment factors of both assignments. If there is some consistency between the patterns of the 1980 and 2005 assignments, more confidence can be had when applying the factors to intermediate years (again assuming no major shifts in land use). Figure 3-3 illustrates the comparison of the two assignments. While there are differences in percentage levels, each road segment would appear to have similar patterns of traffic volumes in both 1980 and 2005.

3.3.2 Forecasts of Traffic

Forecasts of traffic were developed for two scenarios; high and moderate growth. For each scenario estimates of total trip attractions were made for 1986, 1995, and 2005. Since 1986 data were not available, estimates of 1986 trip attractions were extrapolated from 1984 data based on average annual growth between 1984 and 1985. As noted previously, the FMATS Update was carried out with the assumption of a high growth scenario "in order to assess the 'worst case' traffic generation" (DCCO, 1985, pg II-9). This scenario had an annual growth rate between 1984 and 1995 of 4-5 percent dropping to 1-3 percent between 1995 and 2005.

Figure 3-3

DAILY LINK VOLUMES AS A PERCENTAGE OF TOTAL ATTRACTIONS (1980 AND 2005)



To test the sensitivity of the evaluation to differences in rate of growth, a more moderate level of growth was forecast. In light of the recent drop in oil prices, a more moderate rate of growth than that presented in the FMATS Update would seem plausible. The moderate growth forecasts were developed by adjusting downward the forecasts of trip attraction parameters (dwelling unit, employment and school attendance) on a zonal basis. The percentage change in these parameters between 1984 and 1995 and 1995 and 2005 were reduced to 75 percent of the high growth estimates.[7] Using the trip attraction equations described above, estimates of total daily vehicle trip attractions were developed for the specified years.

Because there is no explicit recognition in the four-step modelling process of the effects of transportation supply on the level of demand for travel, these forecasts cannot be said to include trips generated as a result of the project (Mainheim, pg 437). To address this ommission and since the estimation of generated traffic requires an estimate of the change in total travel costs, this issue is dealt with in more detail in Chapter Five.

The method described above produces the following forecasts of total daily vehicle trip attractions:

Year	High Growth	Moderate Growth
1986	238335	233601
1995	314447	281592
2005	361800	309443

These trips will be used to determine individual link volumes for the respective years applying the assignment method described in Section 3.3.1. Link volumes by year for each scenario are presented in Appendix A.

3.4 Network and Travel Characteristics

As described in Figure 3-1, once link traffic volumes have been estimated network and travel characteristics need to be identified to aid in the calculation of link operating conditions. Network characteristics include link capacities, distance, facility type, and area type. Travel characteristics include the distribution of traffic by time of day, distribution of daily trips by trip purpose, auto occupancy by trip purpose, directional flows by time of day, and vehicle mix. As well, it is important to consider variations in traffic by day of week (particularly for weekend vs weekday trips) and seasonal fluctuations in traffic.

3.4.1 Network Characteristics

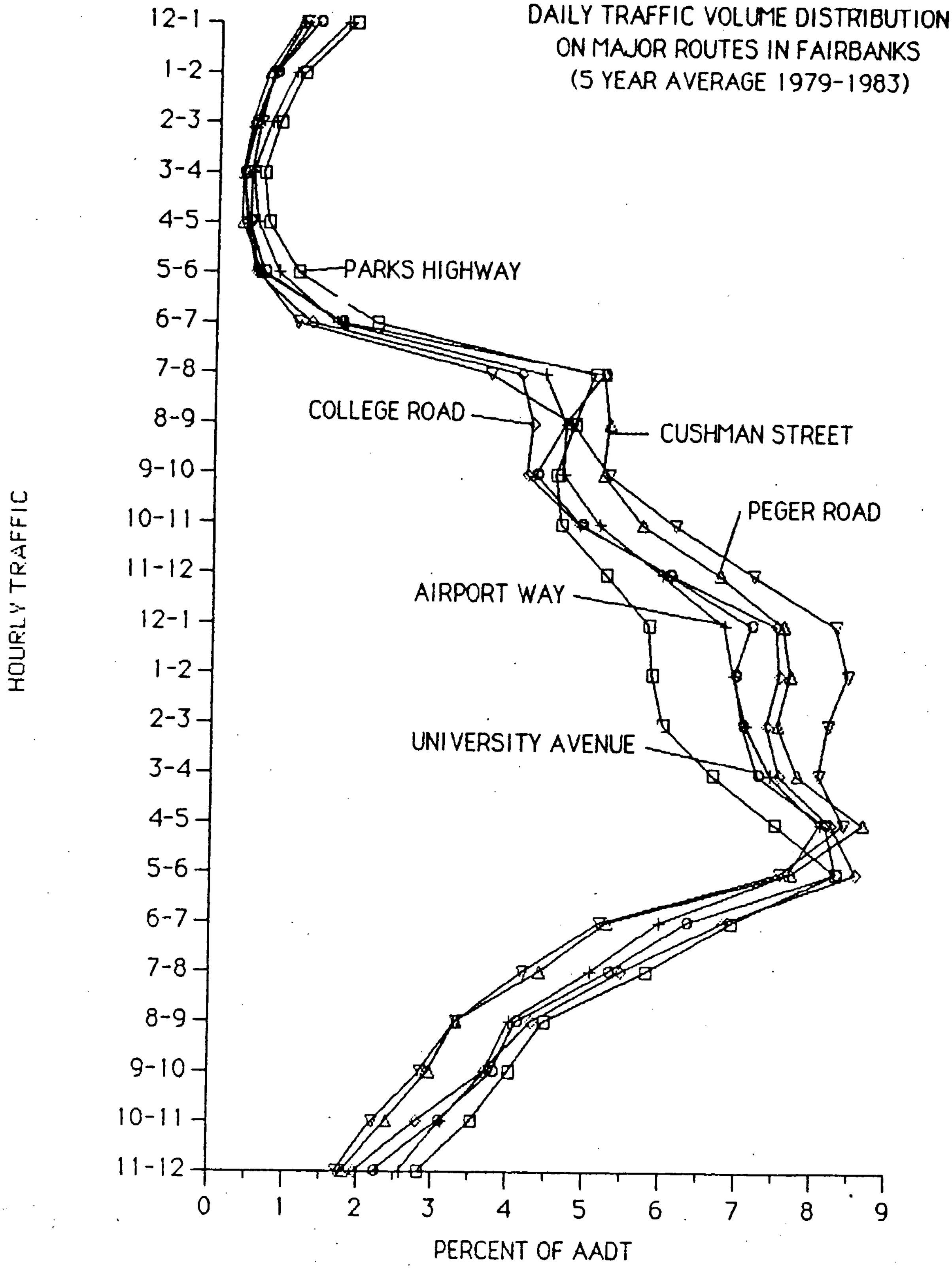
Link capacities, distances, facility types and area types are taken from the FMATS Update. Link capacities are calculated based on the particular facility type and area type in which the link has been classified. The relationship between area/facility type and capacity is based on the research contained in the 1965 Highway Capacity Manual (HRB, 1965).[8] As will be discussed further below, the area/facility type relationships are also the basis for the calculation of link speeds for different levels of use. Link capacities and other network characteristics used in the evaluation are presented in Appendix A.

3.4.2 Travel Characteristics

3.4.2.1 Time of Day Characteristics

Figure 3-4 illustrates a five year average variation in traffic by time of day for many of the road segments affected by the project. While all routes

Figure 3-4



SOURCE: ALASKA DOT/PF TRAFFIC VOLUME REPORTS (1979-1983) tend to follow similar patterns, there does appear to be some differences during the midday period (8 am - 4 pm).

Four time periods were classified for which operating conditions would be calculated:

- o Morning peak - 6 am to 8 pm
- o Midday - 8 am to 4 pm
- o Evening Peak - 4 pm to 6 pm
- o Other - 6 pm to 6 am

For each of these time periods an average hourly distribution was determined for road segments where data were available. These percentages are presented in Table 3-2. For road segments where data were not available percentages from adjacent roads were used. These percentages are used throughout the life of the project, which assumes that hourly variations of traffic will remain constant during this time. This assumption does not invalidate the results of the evaluation, though peak travel often receives the bulk of the benefits of added capacity and an evaluation of the benefits of "spreading" peak travel might yield insights on alternatives to construction of additional capacity.

One concern was the extent to which the directional split of traffic on these road segments might affect the evaluation. Often, one direction (usually inbound to downtown in the morning and outbound in the evening) has much higher volume then the other. This can affect speeds and thus operating costs differently then if a 50-50 split is assumed. Unfortunately, for many of the links, information on the directional split was not available.

TABLE 3-2

Average Annual Hourly Distribution
(% of Road Segment AADT)

Road Segment	6am-8am	8am-4pm	4pm-6pm	6pm-6am
Airport Road	3	6.1	7.89	2.47
University Ave.	3.42	6.05	8.23	2.4
College Road	2.68	6.17	8.41	2.39
Cushman Street	2.38	7.05	7.98	1.93
Peger Road	3.42	6.7	8.19	1.95
Parks Highway	3.6	5.45	7.9	2.8

Source: Alaska DOT/PF Annual Traffic Volume Reports 1979-1983.

However, it was found that, for the network being analyzed, the use of an average percentage of the total traffic moving in both directions (ie, a 50-50 split) did not have a significant affect on estimation of link speeds (the estimation of speeds is discussed in detail in Section 3.5). To illustrate, the greatest variation was exhibited on University Avenue. The differences between the use of an average percentage for both directions and the actual percentages exhibited in the data using 1983 volumes lead to an underestimate of the speed in the northerly direction by .65 mph and an overestimate of the speed in the southerly direction by .94 mph, for a net underestimate in the speed of .29 mph. Taking University Avenue's distance of 1.04 miles, this difference in speeds translates into a difference in travel time per auto of under 3 seconds. While this difference might become more pronounced as traffic volumes approach the capacity of the roadway, for example, a doubling of the AADT, the difference in travel time is still under 15 seconds. Given the imprecise nature of speed-flow relationships (particularly on urban streets), this difference cannot be taken as critical.

On the whole, it is concluded from this analysis that the directional splits exhibited in Fairbanks are not significantly great as to require explicit treatment in the evaluation.

3.4.2.2 Weekly and Seasonal Variation in Traffic

In addition to the hourly distribution of traffic, variations by day of week and seasonal variations were analyzed. The results of these variations affect how the annual costs are to be calculated from daily costs.

From analysis of traffic distribution by day of week on the road segments being evaluated it was found that weekday traffic (Monday-Friday) is approximately 120 percent of the AADT on the road segment; with Saturdays and Sundays averaging 60 and 40 percent of the AADT respectively. Thus, Saturday and Sunday volumes can be said to be 50 and 33 percent, respectively, of average volumes during a weekday (the basis for volumes used in the evaluation).

For purposes of daily costs, the evidence presented above leads to the following conclusions:

Weekdays = 251 days
Saturdays and Holidays = 62 * .5 = 31 days
(assumes 10 weekday holidays equal to Saturday traffic patterns)
Sundays = 52 * .33 = 17 days
Total = 299 days

Thus daily network costs for each scenario developed in Chapter Four will be factored up by 299 days to arrive at annual costs to be used in Chapter Five.

This assumes several things. First, the assumption is made that traffic volumes do not vary significantly Monday through Friday. This pattern has been found to exist in many transportation studies (Dickey, pg 170). Second, when weekend costs are estimated by a percentage reduction of weekday costs dependent on the relationship between weekday and weekend volumes (as is the case here) the assumption is made that there is a linear relationship between daily costs and volumes on a network. Particularly in the case of hourly costs, this is not strictly valid as costs tend to rise more rapidly then the rise in volumes on any given link due to congestion factors.[9] Following from the second assumption, it is also assumed that weekend and weekday traffic exhibit similar peaking characteristics. Again, this is not strictly valid. However, since the impact of weekend costs on the evaluation is sufficiently small (approximately 16 percent of annual costs using this method) it is felt that the additional work involved to compute these costs separately is not warranted. The effect of this method is to likely overestimate weekend daily costs.

3.4.2.3 Distribution of Daily Trips by Trip Purpose

The 1982 household survey conducted during the FMATS Update provided data on the distribution of daily trip by trip purpose as well as the distribution of trip types by time of day. This is useful in assigning different values of time to different trip types (this is discussed further in Chapter Four).

The distribution of daily trips by trip purpose was as follows (DCCO, 1985, page II-37):

Trip Type	Percent of Daily Trips
Home-Based Work (HBW)	21
Home-Based Other (HBO)	34.5
Non Home-Based (NHB)	44.5

Trip types distributed by time of day were as follows:

Time of Day	Trip Type	Percent of Trip Type for this Time of Day	Percent of Total Auto Trips Time of Day
	HBW	26	60.8
6am - 8am	HBO	6	23.4
	NHB	3	15.8
	HBW	20	18.4
8am - 4pm	HBO	21	29.6
	NHB	18	52.0
	HBW	37	21
4pm - 6pm	HBO	43	37.7
	NHB	68	41.3
	HBW	17	21
6pm - 6am	HBO	30	34.5
	NHB	11	44.5

The percentage of total auto trips for each trip type was available from the survey for the AM, Midday and PM peak periods only. The daily distribution percentages were applied to the "other" time period as no specific data were available during this time.

3.4.2.4 Average Auto Occupancy by Trip Purpose

Average auto occupancy will be used to determine person travel time by trip purpose based on the vehicle travel times to be estimated in Section 3.5. While the 1982 travel survey indicated that there was a tendency for auto occupancy to be higher during peak periods, no classification of auto occupancy by trip purpose by time of day was provided in the survey analysis. Thus, average daily auto occupancy rates from the survey were used for all times of day as follows:

- HBW: 1.25
- HBO: 1.64
- NHB: 1.43
- Truck: 1.00

3.4.2.5 <u>Vehicle Mix</u>

An analysis was made in the FMATS Update of vehicle mix data from eight permanent station counters and weighted by AADT volumes. This analysis indicated that approximately 11.6 percent of the area's internal vehicle trips (those trips within the FMATS Study area) were made by commercial vehicles--heavy trucks and light commercial vehicles (DCCO, 1983, pg 8).

The variation of this traffic by time of day was estimated using the following figures, found to be typical for urban areas:

Time of Day	Percent of Total	Avg. Hourly Percent
6am - 8am	10.0	5.0
8am - 4pm	74.7	9.34
4pm - 6pm	12.7	6.35
6pm - 6am	2.6	.22

Source: Levinson H.S. "Urban Travel Characteristics" - Chapter 10 of The Transportation Engineering Handbook, Table 10-38, pg 288, 1985.

3.5 <u>Calculation of Link Operating Conditions</u>

This section presents the method by which link operating conditions were calculated for the evaluation and a summary of the results of the system analysis for the four scenarios outlined earlier.

3.5.1 Development of Link Speed Estimates

Essentially, the method involves determining the average speed on a link given its characteristics. Speeds have been found to be affected by area type and facility type. For example, based on findings in the 1965 Highway Capacity Manual, it was estimated that average speeds increase roughly 50 percent going from CBD locations to residential areas holding volumes constant (Dickey, pg 104). As well, the difference in speeds between a road classified as a two-way arterial with parking and a freeway was found to be approximately 150 percent.

For cases of uninterrupted flow (freeways, rural highways) the relationship of flow and speed is reasonably well-behaved such that speeds can be determined within the above typology as a function of volume-capacity ratios (Dewees, 1978, pg 153). However, the relationship between flow and speed is more complex on urban roads, with intersection capacity limiting the flow of traffic more so than the street capacity between intersections (Dewees, 1978, pg 154). Indeed, the 1965 Highway Capacity Manual[10] states fairly strongly that:

> "It is not feasible to show any 'typical' speed-volume curve for urban arterials. . .where interrupted flow is involved, 'ideals' cannot be readily defined, because too many variables are involved[11] and a combination of flow which is ideal in one case may be totally out of place in another. Neither can any other single speed-v/c ratio curve, or group of curves, represent urban arterial operations all-inclusively, as was done for other highway types; only typical curves can be shown" (Highway Capacity Manual, 1965, pg 319).

Thus, to estimate accurately the speeds on urban arterials at different volumes, it is ideal to simulate not only the operation of individual intersections, but an entire street network (Dewees, 1978, pg 154). This might be accomplished using one of several computer programs which are available for this specific purpose (for example, Transyt 7-F). These programs produce estimates of average speeds (or travel time) through each intersection as well as average delay per auto at each intersection. Thus, accurate speed flow relationships can be established for a network by performing simulations at various volumes. One drawback to these programs is the extensive data required to obtain usable results. Turning movements, light timing, vehicle mix, and other data are required for each intersection to be included in the analysis.[12]

Because of the data requirements of these types of programs this case study is limited to the use of the "typical" speed flow relationships found in the Highway Capacity Manual. However, it is recognized that in practice an evaluation of urban arterials should be based on locality-specific data. The exact speed-flow relationships used here are presented in Table 3-3. They are taken from Dickey's Metropolitan Transportation Planning in which he presents per lane capacities and average speeds for various facility and area types based on material in the Highway Capacity Manual (Dickey, 1983, pg 105). Speeds were determined for four times of day under four scenarios for all links.

One problem that exists with the use of these relationships in the evaluation is lack of any theoretically sound speed-flow relationships at v/c ratios greater than 1.0. Beyond this point flows are unstable and both volumes and speeds decrease to zero. Some links under the high growth scenario, particularly without the project, experience severe congestion (v/c greater than 1.0) during the midday and p.m. peak. It is felt that under these conditions travel behavior would surely change, with drivers shifting routes to avoid the bottlenecks.

To address this problem, it is assumed that, while congestion might remain a problem, the demand on a bottleneck link during congested periods would remain at or not far above the rated capacity as some users transfer to other routes.[13] The cost of this transfer is assumed to be equal to the cost of travelling over the congested link and is applied to the entire demand estimated for the link.

It is recognized that this only roughly approximates the cost involved and does not include an estimate of increased costs to existing users on the route to which traffic has diverted. However, it is felt that by assigning a cost to the diverted traffic which may, in reality, be too high (ie, they have likely transferred to a lower cost route); the total costs of the bottlenecks causing congestion can be roughly approximated.

Table 3-3

Per Lane Capacity and Estimated Average Speed (MPH) on Various Facility Types at Different Locations

Area Type	Capacity (vph)	Speed (MPH) at different v/c ratios: 0	0.50	0.75	1.00
		1. Expressway			
CBD	800	37	34	33	31
Fringe	1000	44	38	35	32
Res.	1100	47	44	31	38
OBD	1000	37	34	33	31
		2. Two-Way Arterial with Parking			
CBD	400	22	20	15	12
Fringe	550	29	27	25	15
Res.	550	32	30	28	15
OBD	550	24	22	18	13
		3. Two-Way Arterial without Parking			
CBD	600	22	20	15	12
Fringe	800	29	27	25	15
Res.	800	32	30	28	15
OBD	800	24	22	18	13
		4. One-Way Arterial			
CBD	700	22	20	15	12
Fringe	550	29	27	25	15
Res.	900	32	30	28	15
OBD	650	24	22	18	13

Note: For facility types 2-4 an optimal signal progression is assumed.

Source: Dickey, page 105.

CBD - central business district; Fringe - area around CBD; Res - residential; and OBD - outlying business district.

FOOTNOTES

CHAPTER THREE

1. Unfortunately, no information was published in any FMATS update reports developed by DCCO regarding the strength of the regression models or individual variables used in trip distribution.

2. Given that this step of the process is built on three previous steps, testing the sensitivity of assignments to several parameters (auto ownership, income, household size, shifts in land use patterns) would seem crucial though this is not typically done in most studies.

3. For example, even if the 160 zones were aggregated into 40 zones, that still implies 1,600 zone to zone interchanges which must be assigned to particular links.

4. Trip attractions are used here as an approximation of total demand for auto travel in the area during an average weekday. The use of average weekday trips follows from the FMATS Update travel survey which was primarily a description of weekday trips (DCCO, 1985, pg II-32).

5. This is based on a weighted average of the year 2005 volumes on the individual links making up the Geist Extension. The weighted average volume is determined as follows:

$$\text{Weighted Average Volume} = \frac{(\text{Link Distance})}{(\text{Road Segment Distance})} * \text{Link Volume}$$

This weighted average was then taken as a percentage of 2005 total trip attractions to arrive at 5.8 percent.

6. This was done in proportion to the percentage which had been added to the link assignment factor. For example, without the project, Airport Road received an additional two percent of total traffic which is equal to 40 percent of the total added (2/5). Thus, for 1987, the assignment factor for Airport Road with the project would be reduced from its 1986 level by (.4 * 1.21) or .484 percent.

7. This reduction is not based on an alternative growth scenario which might underlie the development of lower employment, population, etc. Instead, the parameters were reduced by an arbitrary figure (75%) to reflect in some measure, slower growth in the area.

8. Computer models exist to compute capacity and link speeds. These could have been used in a real situation. However, in the absence of these resources, the 1965 Highway Capacity Manual provides the information required for the case study.

9. This is not so for annual network costs. These costs were found to be linear, following the growth in overall traffic volumes. As discussed further in Chapter Five, it is felt that the aggregation of hourly link costs, first to daily costs and then to network costs removes the nonlinearity.

10. A 1985 version of the HCM was distributed in 1986 (after the methodology for this paper had been established). This version treats flows on urban roads using a different approach than the speed-volume approach used in the 1965 manual. Because the change in approach would require a major revamping of the methodology used in this paper, the 1965 appraoch is retained.

11. These variables include turning traffic, timing of lights on the network, pedestrians, vehicle mix and other interruptions.

12. For this case study, a simulation would involve approximately 42 intersections.

13. There are methods to determine the time required to dissipate queues caused by excess capacity at an intersection (NHCRP 133, Transportation and Traffic Engineering). However, these methods do not take into account the elasticity of demand and are of rather limited use in this case.

CHAPTER FOUR

User Costs

One of the primary objectives of an improvement to or addition of capacity to an urban network is the reduction in user costs over time. These costs include vehicle operating costs, user time costs, and accident costs. This chapter presents an analysis of these costs under the four scenarios about future population and traffic growth described in Chapter Three.

4.1 Vehicle Operating Costs

The calculation of total vehicle operating costs entails estimation of several component costs, both fixed and variable. These component cost's include:

Variable	Fixed
o Fuel and Oil	o Depreciation
o Tires	o Insurance
o Vehicle Maintenance	o Fees and Taxes

Since this analysis is concerned with the change in vehicle operating costs between the network with the project and the network without the project only the variable costs are relevant.

There has been considerable research regarding the effects of various operating conditions on vehicle operating costs on highways. Such factors as grade, road geometry, pavement type, facility type and traffic flow conditions are typically used to adjust a base cost on level, tangent, paved roads under "free-flow" conditions. In addition, total vehicle operating costs are influenced by the composition of the vehicle fleet in terms of vehicle mix, age, and utilization (Heggie, pg 82).

Except in special cases, grade, pavement type and road geometry are not serious issues in urban areas.

It is necessary to have some means of discriminating between costs on different types of facilities and under various operating conditions. This is necessary to assess the impact of alternative types of investment on user's costs. Toward this end, this evaluation makes use of the speed-flow relationships presented in Chapter Three to derive estimates of vehicle operating costs for various facility types and traffic flows. This assumes a given vehicle fleet and level of vehicle utilization.

It is thus necessary to determine the relationships between the "free-flow" speeds on various facility types and vehicle operating costs. This relationship will be adjusted for congestion affects by relating costs to the link volume/capacity ratio as discussed below. Average costs will be estimated for automobile and truck traffic.

4.1.1 Auto Operating Costs

4.1.1.1 Fuel

Recent research indicates that for urban auto trips with an average speed of less then 38 mph, fuel consumption per mile increases linearly with the average trip time per mile (Tobin, pg 590).[1]

It was found that fuel consumption could be estimated using the following function:

$$\phi = K_1 + K_2\ t \quad \text{(Average Speed < ~38 mph)}$$

Where ϕ is fuel consumption per unit distance; K_1 and K_2 are constants related to the mass and idle fuel flow rate of the vehicle, respectively; and t is the average trip time per unit distance (Evans, 1978A, pg 163).

As most of the average link speeds estimated for the evaluation are below 38 mph, the relationship described above will be used to estimate fuel consumption for all facility types and operating conditions. From empirical tests, values of K_1 and K_2 were found to be .03707 gal/mi and .76324 gal/hour respectively (Tobin, pg 590)[2]. Operating conditions in Fairbanks are likely different then those used in the empirical tests. However, because of lack of this specific data these estimates were taken to represent fuel consumption patterns in Fairbanks. Using the speed-flow relationships discussed in the previous chapter, the travel times per mile implied by the volume/capacity ratios were used to calculate fuel consumption. This provided a convenient relationship between the volume/capacity (v/c) ratio on a link and the estimate of fuel consumption for that link.

The fuel consumption per mile estimated for various facility/area types at various volumes is presented in Appendix B. Fuel costs were calculated using the 1986 average price of unleaded gasoline in Fairbanks of $1.00/per gallon (less taxes)[3].

4.1.1.2 Other Variable Costs

Other variable costs include vehicle repair and maintenance, tires and oil. A 1979 study of nationwide automobile operating costs indicated that these costs represented approximately 25 percent of total vehicle operating cost (derived from Dickey, pages 133 to 149). Based on a 1983 study, the total nationwide average cost was found to be 23.9 cents per mile. Making an 11 percent adjustment for higher operating conditions in Alaska (based on costs in Anchorage) the cost of maintenance, tires and oil is estimated to be 6.7 cents per mile (Quadra, pg 5-8).

To adapt this cost to the various facility types and operating conditions the assumption was made that this cost was representative of those experienced by traffic on an urban arterial in the fringe area under stable flow conditions (v/c ratio of approximately .6, speed = approximately 26 mph).

To adjust this cost to the various operating conditions on a particular facility, a relationship between speed reduction and cost increase was established. This relationship was based on research carried out by Winch in the early sixties in a comparison of free-flow and stop-and-go conditions. Winch calculated that brake and clutch maintenance costs, tire costs, and other maintenance costs increased by 50 percent between operating conditions at 45 mph with no stops and 30 mph with five stops per mile (Winch, page 68). Interpollating between the two operating conditions, a relationship between speed reduction and cost increase was obtained:

Congestion Cost Adjustments to Base Costs

Winch's 1961 Cost Estimate

Speed	% Speed Reduction	Cost (Cents/Mile)	% Cost Increase
45	---	0.48	---
42.5	05.6	---	08.3
40	11.1	---	16.7
37.5	16.7	---	25.0
35	22.2	---	33.3
32.5	27.8	---	41.7
30	33.3	.72	50.0

A linear estimate of the above relationship resulted in the following:

Percent change in cost = 1.5 (percent speed change) - .0571

This function was applied to the speed-flow relationships to allow for a change in the unit operating cost per mile with changes in the flow of traffic for each facility type.

To adjust the estimated average cost of 6.7 cents per mile to other faciltiy types it was first adjusted to a free-flow (approximately 30 mph) cost of 5.74 cents per mile using the relationship described above. Using relationships between speeds and costs under free-flow conditions, the cost estimate for 30 mph was adjusted to other speeds and assigned to various facility types in the manner shown in Table 4-1:

Table 4-1

Basic Costs at Various Constant Speeds - Automobiles

Cost Item (Cents/Mile)	Speed Category (MPH) 20	25	30	35	40
Tires[1]	0.3	0.4	0.5	0.6	0.9
Oil[1]	0.2	0.2	0.2	0.2	0.2
Maintenance[1]	3.9	4.0	4.3	4.5	5.0
TOTAL	4.4	4.6	5.0	5.1	6.1
% of Cost at 30 mph	0.88	0.92	1.0	1.02	1.22
Est. Base Cost	5.05	5.28	5.74 [2]	5.85	7.01
Facility/ Area Type[3]	2,3,4/1	2,3,4/4	2,3,4/2,3	1/1,4	1/2,3

1. From Berger and Associates Table 3.6-1, 1978 costs.
2. Described above.
3. From Typology presented in Chapter Three.

4.1.1.3 Results of Variable Cost Estimates

The base costs assigned to each facility are taken in combination with the adjustments for flow conditions to estimate unit operating costs for each link. Tables showing the fuel and other auto related vehicle operating cost estimates for each facility type and flow condition are presented in Appendix B. Table 4-2 presents examples of the effects of facility type and congestion on variable operating costs as estimated by the methods described above.

Table 4-2

Examples of Variable Operating Costs (Auto)
for Various Facilities and Conditions
(Cents/Mile)

Facility Type/ Area Type	Free Flow[1] V/C=.1	Stable Flow[1] V/C=.7	Unstable Flow[1] V/C=1
Arterial/CBD	12.40	15.60	18.56
Arterial/Outlying Business Area	12.33	13.86	18.49
Arterial/Fringe	12.22	13.52	18.70
Expressway/CBD	11.77	12.76	13.44
Expressway/Fringe	12.71	14.87	15.97

1. Flow condition descriptions and estimated V/C taken from Carter, et al, page 494 (Chapter 16 of Transportation and Traffic Engineering Handbook).

This table shows that the free-flow cost estimates move as expected, falling up to a certain speed (approximately 35 mph) and then rising at higher speeds. As well, cost increases due to congestion are not as severe on higher speed facilities. This is to be expected as the average speeds, even at levels of high congestion, are quite high relative to those on other facilities.

4.1.2 Truck Costs

Less precise data were available regarding truck fuel consumption. Thus, estimates of truck costs were made by taking an average total variable cost of .24 cents/mile (Quadra, pg 5-7) to derive cost estimates for various facility types. For the purposes of this study the operating costs of a 3.5 ton truck are used to represent average truck operating costs.

On a facility with a design speed of 30 mph, the speed at stable flow equals ~26 mph. This represents a three percent increase from the free-flow cost according to adjustment factors for traffic interaction developed in a recent regional transportation study in Alaska (Berger, Table 3.6-4). Thus, using .24 cents/mile to represent the variable operating costs of stable flow, the free-flow cost is approximately 23.3 cents/mile.

Table 4-3 below shows how truck costs were developed for the evaluation. Based on differences in operating costs at different speeds estimated in an earlier study, base costs were established. New component costs (fuel, oil, tires and maintenance) were calculated in proportion to the estimates from the older study.

Based on traffic interaction factors developed in the regional study cited above, fuel and tire costs were adjusted depending on the reduction in speed from the design speed (free-flow speed) resulting from the interaction of traffic (Berger, pg 67).

Table 4-3

Basic Costs at Constant Speeds - Trucks[5]

Speed Category[4]

Cost Items	20	25	30	35	40
Fuel[1]	09.7	08.6	08.1	08.1	09.0
Tires[1]	01.0	01.3	01.6	02.0	02.9
Oil[1]	00.3	00.3	00.3	00.3	00.2
Maintenance[1]	17.3	18.2	19.7	21.2	25.0
TOTAL	28.3	28.4	29.7	31.6	37.1
% of Cost at 30 mph	00.953	00.956[2]	001.0	001.06	001.25
Est. Base Cost	22.20	22.27	23.32	24.70	29.13
Fuel[3]	02.61	06.74	06.35	06.33	07.07
Tires[3]	00.78	01.02	01.26	01.56	02.28
Oil[3]	00.24	00.24	00.24	00.24	00.16
Maintenance[3]	13.57	14.27	15.45	16.57	19.62

1. Taken from Berger Table 3.6-4 (3.5 ton trucks) 1978 Alaskan costs.
2. As derived above.
3. Proportional to earlier cost study component costs.
4. These speed categories correspond to the same facility/area types identified for auto costs.
5. The higher costs in the earlier study result from the higher cost of living in the region for which those costs were originally developed.

However, the actual effects of specific speed cycles (ie, deceleration-acceleration cycles) could not be calculated from data available. The interaction costs, reflected in Table 4-4 below, provide for some change in costs with volume on each facility type.

4.1.3 Total Vehicle Operating Costs

Total vehicle operating costs were estimated for each link by time of day under all scenarios being evaluated. Based on the volume/capacity ratios during each time of day (established in Chapter Three), a unit operating cost per mile was established for autos and trucks. This per mile cost was multiplied by the link distance to arrive at individual link operating costs by time of day. Total vehicle operating costs for auto and truck were then calculated based on total link volumes. An example of the worksheet used to tabulate vehicle operating costs is presented in Appendix B.

Table 4-4

Truck Operating Costs Adjusted for Traffic Interaction

(Cents/Mile)

Operating	Design Speed (mph)				
Speed (mph)	20	25	30	35	40
15	22.59	22.88	24.71	27.53	----
20	22.20	22.68	23.99	26.44	----
25	----	22.27	23.78	25.51	----
30	----	----	23.30	25.14	32.13
35	----	----	----	24.70	31.10
40	----	----	----	----	29.89
45	----	----	----	----	29.13

4.2 <u>Value of Time in Transportation</u>

The value of user time savings represents the primary benefit of virtually all transportation investments. However, much debate exists as to the exact nature of the value of time and how it should be applied in the evaluation of transportation projects. The reasons for this debate stem from the interrelationship of the value of time with several factors including:

- User income
- The time increment over which the value is to be applied
- The mode and quality of service
- Trip purpose

It has been shown that the user's value of time changes in proportion to his or her net wage (DeDonnea, pg 208). The value of time has also been shown to vary with the amount of time saved, with people generally valuing greater time savings at a higher rate then shorter time savings (Heggie, 1982, pg 421). Travelers have also been found to attach a comfort factor to their value of time. Thus, people may value in-vehicle time differently then out-of-vehicle time, and value time on different modes differently (DeDonnea, pg 38). A study of auto restraint policies in downtown Boston suggests that a higher value of time be put on travel during congested periods to account for the higher disutility involved (Gomez-Ibonez and Fauth, pg 145). Finally, different trip purposes have a different social value (Heggie, 1972, pg 93). Generally, the work related trips are thought to have a higher disutility than shopping trips or leisure trips.

To determine the value of time for a particular community would involve the study of travel behavior at a very disaggregate level, usually beyond the resources of most planning agencies. Thus, average values are used based on empirical studies. For example, the American Association of State Highway and Transportation Officials in its 1977 "Manual of User Benefit Analysis of Highway and Bus-Transit Improvements" uses the values presented in Table 4-5 which are based on a study of choice between toll roads and non-toll roads.

Another study presented the average values in terms of the percentage of average hourly family income (Dickey, pg 137). Assuming Dickey's percentages represent the net family income, average values of time for various trip types and levels of time savings were derived reflecting 1983 Alaskan wage levels (Quadra, page 5-10) and are presented in Table 4-6.

Table 4-5

Value of Time Estimates
from Manual of User Benefit Analysis of
Highway and Bus-Transit Improvements[1]

Annual Family Income (Dollars)	Time Savings (Minutes)	Value of Time By Trip Purpose (Dollars)	
		Avg Trips	Work Trips
	0-5	0.07	0.15
$ 5,000	5-15	0.58	0.77
	Over 15	1.26	1.26
	0-5	0.13	0.31
$10,000	5-15	1.55	
	Over 15	2.52	2.52
	0-5	0.21	0.48
$15,000	5-15	1.80	2.40
(Average)	Over 15	3.90	3.90
	0-5	0.27	0.62
$20,000	5-15	2.32	3.10
	Over 15	5.03	5.03
	0-5	0.41	0.92
$30,000	5-15	3.48	4.65
	Over 15	7.55	7.55

1. American Association of State Highway and Transportation officials.

Table 4-6

Value of Time Estimates - Alaska

	Percentage Average Hourly Family Income[1]	Value of Time ($/Hr)[1]
Low time savings (0-5 minutes)		
Non-work trips	2.8	0.63
Work trips	6.4	1.43
Truck trips[2]	---	2.75
Medium time savings (5-15 minutes)		
Non-work trips	24.2	5.36
Work trips	32.2	7.15
High time savings (over 15 minutes)		
Non-work trips	52.3	11.62
Work trips	52.3	11.62
Truck trips[2]	---	23.71

1. Dickey, page 137.
2. Quadra, page 5-10.

The values in Table 4-6 have been applied to total users by trip purpose (as determined by auto occupancy figures discussed in Chapter Three) for each time of day to arrive at total user time costs for each link. An example of the worksheet used to calculate user time costs is provided in Appendix B.

4.3 Accident Costs

The method used to estimate accident costs entails use of an accident rate equation and recommended average costs for accidents of various types. While accident costs are not always considered in transportation studies, a significant amount of research (and equal amount of debate) exists regarding the distribution of accidents by severity, and the economic costs to society resulting from these accidents. A primary source of controversy is what value is to be put on the more indirect costs associated with accidents (i.e., loss of life, pain and suffering, etc.).

Adler, in his text "Economic Appraisal of Transport Projects" discusses the problems the World Bank has had with quantifying accident costs. He concludes that, from a practical standpoint, it is prudent "to limit the value of accident reduction. . . to estimates of vehicle and other property damage, medical costs and losses of output. An indication of lives saved and the order of magnitude for other costs, such as pain and suffering, may be helpful, but they can rarely serve as a meaningful basis for investment decisions" (Adler, pg 43).

For purposes of this study, recent extensive research conducted by Miller, et al for the National Highway Traffic Safety Administration provides a useful set of costs associated with accidents. While it is recognized that some of these costs are difficult to measure, it is also understood that these costs are legitimate cost to society and therefore should be addressed by SBCA. Analysis in Chapter Five will examine the sensitivity of the project evaluation to accident cost using Miller's data.

In the approach used here, accident costs are divided into direct and indirect costs. These costs are estimated for various accident classes organized along a Maximum Abbreviated Injury Scale or MAIS. These classes are described in Table 4-7 and represent categorization developed by the American Association for Automotive Medicine primarily based on the threat to life posed by a particular injury (Miller, et al, pg 16).

The direct cost components normally considered include (Miller, et al, pg 19):

- Emergency medical services costs
- Medical costs
- Legal and court costs
- Property damage costs

Table 4-7

Representative Motor Vehicle Injuries by Abbreviated Injury Scale Level

AIS Code	Injury-Severity Level	Representative Injuries
1	Minor Injury	Superficial abrasions, sprains, first-degree burns, headache or dizziness
2	Moderate Injury	Major abrasions, cerebral concussion (unconcious less than 15 minutes), Finger or toe crush/amputation, closed pelvic fracture
3	Serious Injury	Major nerve laceration, multiple rib fracture, abdominal organ contusion, hand, foot or arm crush/ amputation
4	Severe Injury	Spleen rupture, leg crush, chest-wall perforation, cerebral concussion with neurological signs (unconcious less than 24 hours)
5	Critical Injury	Spinal cord injury, extensive second or third-degree burns, cerebral concussion with severe neurological signs (unconcious more than 24 hours)
6	Maximum Injury (Fatal)	Decapitation, torso transection, massively crushed chest

Source: Miller, et al, pg 18.

The indirect cost components normally considered include (Miller, et al, page 30):

- Social mechanism costs
- Productivity losses
- Psychosocial costs

Social mechanism cost include those costs incurred by the public agencies listed in Table 4-9 (police, fire, coroner, etc.) which are more follow-up in nature and thus considered as "indirect" costs.

Productivity losses are an attempt to measure the loss of human capital caused by accidents.

Psychosocial costs reflect pain and suffering which may be incurred by accident victims after the accident or, indirectly by those people associated with accident victims.

A detailed breakdown of the recommended direct and indirect costs used in this evaluation are presented in Tables 4-8 and 4-9, respectively.

While satisfactory estimates exist for most of these costs, no well developed methods and measures exist for psychosocial costs (Miller, et al, pg 57). Thus, psychosocial costs are not considered in this evaluation[5].

The costs presented in Tables 4-8 and 4-9 are based on national studies using 1980 accident data and 1980 dollars. Table 4-10 presents these costs in 1985 dollars with an 11 percent upward adjustment made to reflect the higher costs experienced in Alaska (based on recommended adjustments to average nationwide operating costs in Quadra, 1983, pg 5-7).

Table 4-8

Accident Costs
Recommended Direct Cost Estimates
(1980 Dollars)

Per Victim MAIS Category

Cost	Per Vehicle PDO[1]	1	2	3	4	5	Fatal
Prop. Damage	$750	811	1354	2120	2865	2845	3406
Emer. Medical Service[1]	---	92	128	126	126	126	124
Emer. Room Care	---	42	110	153	253	363	---
Initial Hosp.	---	70	888	2054	5146	2981[3]	1370
Phys. Surgeon Service	---	19	319	771	2059	2981[3]	---
Follow On Care, First Yr.	---	35	60	96	139	2782	---
Home Modify	---	---	---	---	---	3739	---
Second Yr. Unique Service[4]	---	---	---	---	455	1584	---
Follow On Care, Annual[4]	---	---	---	81	2277	96,238	---
Legal & Court	11	532	583	2688	5147	7864	13,394
TOTAL	761	1601	3442	8089	18,467	138,684	18,294

1. Based on reported accidents only.
2. Based on NHTSA's urban-rural distribution assumptions.
3. Physician and surgeon services included in initial hospitalization cost estimate for spinal cord injuries.
4. Based on a four percent discount rate.

Source: Meyer, et al, page 123.

Table 4-9

Accident Costs
Recommended Indirect Capital Cost Estimates
(1980 Dollars)

<u>Per Victim MAIS Category</u>

Cost	Per Vehicle PDO	1	2	3	4	5	Fatal
Police	8[1]	38	54	77	107	129	129
Fire Dept.	---	---	---	---	44	44	44
Coroner Medical Exam	---	---	---	---	---	---	168
Insur. Admin.	120	550	550	550	12,540	12,540	12,540
Welfare & Public Asst.	4	4	4	16	398	398	576
State Motor Veh. Agency	C	C	C	C	C	C	C
State/ Local Hwy. Dept.	C	C	C	C	C	C	C
Human Capital	---	98	557	1574	19,475	109,786	356,884
Psycho Social	C	C	C	C	C	C	C
TOTAL	132	690	1165	2217	32,564	122,897	370,341

A. Reported accidents only.
B. Tentative estimates.
C. No estimates available.
D. Based on a four percent discount rate.

Source: Miller, et al, page 125.

The following accident costs will be used in the evaluation:

Table 4-10

Adjusted Accident Costs

Accident Class	Total Direct Costs	Total Indirect Costs	Total Costs
Property Damage Only	1,102	191	1,294
MAIS 1	2,319	999	3,319
MAIS 2	4,986	1,688	6,673
MAIS 3	11,717	3,211	14,929
MAIS 4	26,750	47,171	73,921
MAIS 5	200,891	178,022	378,913
Fatality	26,500	536,457	562,957

Source: Tables 4-7 and 4-8. Adjusted to 1985 dollars using U.S. Consumer Price Index.

The distribution of accidents by type was determined by use of a percentage breakdown of 1980 nationwide traffic accidents as follows (Miller, et al, page 20):

Table 4-11

Incidence of Traffic Accident Types

	Number of Accidents (x1000)	% of Total
Property Damage Only[1]	44,783	91.76
MAIS 1	3,273	6.71
MAIS 2	452	.93
MAIS 3	200	.41
MAIS 4	35	.07
MAIS 5	12	.02
Fatalities	51	.10
TOTAL	48,806	100.00

1. Reported plus estimate of unreported.

The number of accidents was estimated for each road segment using an accident rate equation. This equation was developed by the Colorado Department of Highways based on their own empirical studies of the relationship between accidents per vehicle mile and traffic volume (DCCO, 1983, pg C-1). The equation for uban arterials was as follows:

$$Y = 8.5 + 0.335X - 0.233X^2$$

where X = (ADT - 27,500/5000) and

Y = Accidents/million vehicle miles

Because of the lack of more solid local data on all aspects of accident costs (accident rate, per accident costs, severity distribution), the estimates developed here will be used to illustrate the potential costs of accidents under the various scenarios and will be treated separately in the evaluation.

4.4 Summary

In this chapter the set of user costs have been developed which will be used in the social benefit-cost analysis presented in Chapter Five. These user costs include:

1) Vehicle operating costs for both truck and auto trips
2) User time costs for work, non-work, and truck trips
3) Accident costs

In general, these costs were developed to be applied to estimating user costs under a variety of conditions, for each link, both with and without the proposed project.

For each link, these costs can be considered to be sensitive to different:

- o Traffic volumes
- o Times of day
- o Trip purposes
- o Vehicle types

which might be experienced with and without the project.

FOOTNOTES

CHAPTER FOUR

1. Details on this research are presented in Evans, et al, 1976 and 1978B, and Chang, et al, 1976.

2. The original research used metric units and has been translated to U.S. measures for this application.

3. A more accurate estimate of fuel cost might be made using a weighted average of different fuel types based on the composition of the community's vehicle fleet. Without data on the vehicle fleet the use of the higher cost unleaded fuel is assumed to provide a conservative estimate of fuel costs.

4. This facility/area type and operating condition is felt to be representative of the average traffic conditions in Fairbanks and thus, the average cost estimate was assigned here.

5. For more detailed discussion of these costs and their derivation readers are referred to Miller et al (1984), National Highway Traffic Safety Administration (1983), and McFarland and Rollins (1982). It should be noted that Miller et al, by way of review and comparison of available accident cost estimates, recommended against the use of estimates given in such standard references as AASHTO's "Red Book", the National Safety Council's bulletin on the issue, and TRB's Report on evaluating highway safety improvements. Lack of comprehensiveness, documentation, improper methodology were cited as reasons for the recommendation (Miller et al, page 29).

CHAPTER FIVE

Comparison of Costs and Benefits

To this point analysis has focused on establishing the parameters of the project and its likely impact on users of the highway system in Fairbanks. Those impacts which are quantifiable in dollar terms are used in this chapter to establish network-wide resource flows over the life of the project. Benefits of the project are simply the difference between the discounted resource flows with and without the project. Given the fairly extensive measurements of impacts illustrated in previous chapters it is easy for the analyst to lose sight of the purpose of the analysis. This chapter presents the calculation of project benefits, the comparison of project costs and benefits and the conclusions which result from this analysis.

5.1 Calculation of User Benefits

User benefits are those benefits of the project which accrue directly to those making trips on the affected network. Table 5-1 provides a summary of costs with and without the project and annual user benefits for 1986-2005. Daily vehicle operating costs (VOC) and user time cost (VOT) are summed to obtain a daily operating cost. An annual operating cost is factored from the daily cost using factors discussed in Chapter Three. Annual user costs are calculated by adding annual operating costs and accident costs. Annual user benefits resulting from construction of the Geist Extension are the difference between annual user costs with and without the project. Having calculated the costs to users of the network with and without the project, annual user benefits are calculated as the difference between annual user costs with and without the project.

TABLE 5-1: CALCULATION OF BENEFIT STREAM

	COST SUMMARY WITHOUT PROJECT						COST SUMMARY WITH PROJECT						
YEAR	VOC	VOT	DAILY OPERATING COST	ANNUAL OPERATING COST	ANNUAL ACCIDENT COST	ANNUAL USER COST	VOC	VOT	DAILY OPERATING COST	ANNUAL OPERATING COST	ANNUAL ACCIDENT COST	ANNUAL USER COST	ANNUAL PROJECT BENEFITS
1986	80941	333451	414392	123,903,291	2511512	126,414,803	80941	333451	414392	123,903,291	2511512	126,414,803	$0
1987	87530	364992	452522	135,304,147	2704157	138,008,304	84313	355362	439675	131,462,766	2510958	133,973,724	$4,034,580
1988	90392	377991	468382	140,046,264	2789787	142,836,051	88763	372667	461430	137,967,667	2626587	140,594,254	$2,241,797
1989	93347	391452	484799	144,954,884	2878129	147,833,013	89724	392949	482673	144,319,274	2678365	146,997,639	$835,374
1990	96400	405392	501792	150,035,860	2969268	153,005,128	94445	396768	491213	146,872,726	2803634	149,676,360	$3,328,768
1991	99553	419829	519382	155,295,255	3063294	158,358,549	94008	402654	496662	148,502,047	2875326	151,377,373	$6,981,176
1992	102810	434780	537590	160,739,344	3160296	163,899,640	97864	419110	516974	154,575,299	3006015	157,581,314	$6,318,326
1993	106173	450263	556437	166,374,621	3260371	169,634,992	101154	433163	534317	159,760,818	3116103	162,876,921	$6,758,071
1994	109648	466298	575946	172,207,812	3363614	175,571,426	104555	447687	552242	165,120,377	3230223	168,350,600	$7,220,826
1995	113236	482904	596140	178,245,877	3470127	181,716,004	108070	462698	570769	170,659,820	3348522	174,008,342	$7,707,661
1996	116157	501451	617609	184,664,952	3546245	188,211,196	110810	475457	586266	175,293,682	3471347	178,765,030	$9,446,167
1997	117878	511100	628978	188,064,383	3593264	191,657,646	112432	482828	595260	177,982,701	3536213	181,518,914	$10,138,732
1998	119625	520934	640558	191,526,954	3640906	195,167,861	114078	490313	604391	180,712,998	3602291	184,315,289	$10,852,572
1999	121397	530957	652354	195,053,848	3689180	198,743,029	115748	497915	613663	183,485,207	3669604	187,154,811	$11,588,218
2000	123196	541173	664369	198,646,268	3738094	202,384,363	117443	505634	623077	186,299,973	3738175	190,038,147	$12,346,215
2001	125021	551586	676607	202,305,440	3787657	206,093,097	119162	513473	632635	189,157,948	3808027	192,965,975	$13,127,122
2002	126874	562199	689072	206,032,614	3837877	209,870,491	120907	521434	642340	192,059,798	3879184	195,938,982	$13,931,509
2003	128754	573016	701769	209,829,062	3888763	213,717,824	122677	529518	652195	195,006,195	3951671	198,957,866	$14,759,959
2004	130661	584041	714703	213,696,081	3940323	217,636,404	124473	537727	662200	197,997,824	4025512	202,023,336	$15,613,068
2005	132598	595279	727876	217,634,992	3992567	221,627,559	126296	546063	672359	201,035,380	4100733	205,136,113	$16,491,446

Thus, a stream of benefits is created over the life of the project. Figure 5-1 presents the user operating costs with and without the project under the high population growth scenario. The portion of the graph between the two lines represents user benefits. Appendix C contains the worksheets used to develop data used in Sections 5.1-5.4.

The project is complete by 1993. Variations in operating costs with the project stem from the phasing of the project over time.[1] The change in the slope of the cost curves results from a change in the annual population growth rate beginning in 1996 as discussed in Chapter Three.

5.2 Generated Traffic

The reduction in user costs brought about by a project causes an increase in the demand for trips on the overall network. This is illustrated in Figure 5-2. User costs without the project are at level OA which intersects the demand curve at B giving a demand of OC. The project reduces the user costs to a level OD. Assuming a downward sloping demand curve and depending on the elasticity of demand and thus the slope of the demand curve, demand for trips on the network will increase to a level OF. Benefits to existing trips are represented by the area in rectangle DABI. Benefits to generated traffic are represented by the area in triangle BIE. The increase in trips caused by the addition of generated traffic causes a rise in user costs to a level OG which again affects the demand for trips on the network. This secondary effect reduces the overall level of demand to a level OK. The benefits lost as a result of the reduction in demand are represented by the area in rectangle DGHJ. The net benefits to generated traffic are the

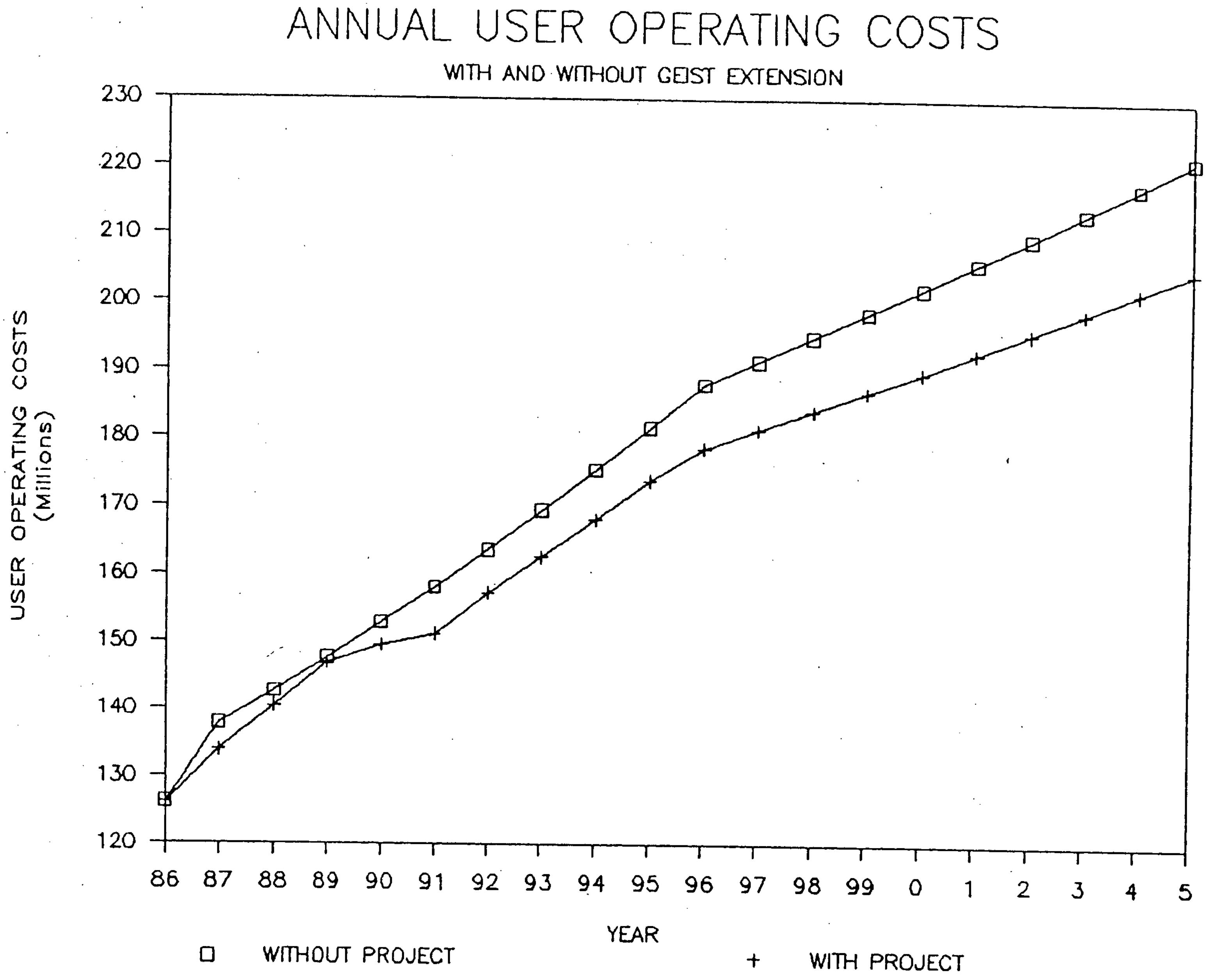
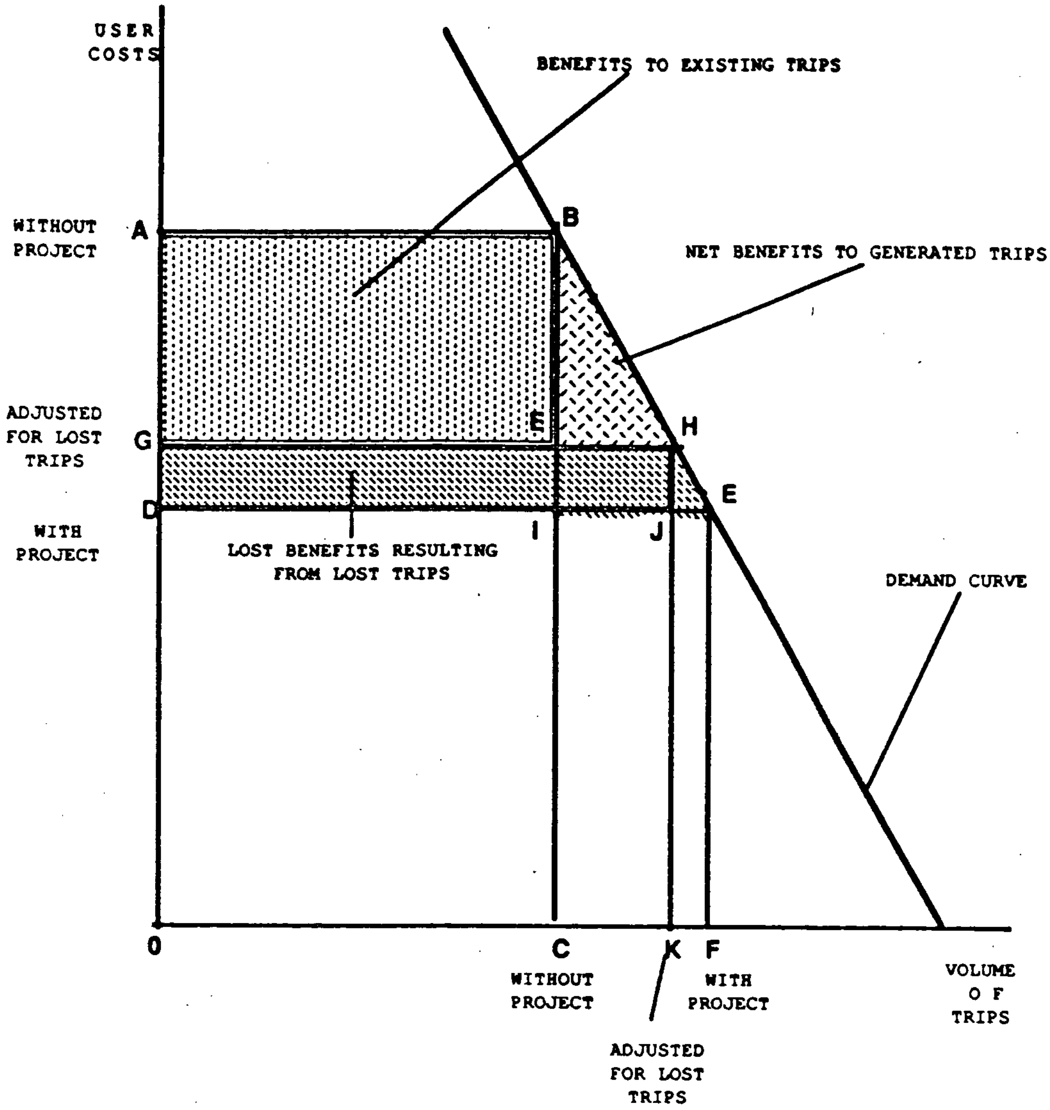


Figure 5-1
Annual User Operating Costs for Fairbanks Urban Area (1986-2005)

FIGURE 5-2
BENEFITS TO GENERATED TRAFFIC



difference between rectangle DGHJ and triangle BIE. These benefits are added to benefits to existing trips to determine total user benefits (i.e., net user benefits are ABEG+BEH).

This concept was applied to the evaluation of Geist Extension. The results are presented in Table 5-2. The actual amount of traffic generated by the project was estimated on an annual basis using elasticities developed by Charles River Associates in 1968 (Manheim, pg 131). This study suggests elasticities for work and shopping trips in urban areas of -0.494 and -0.878, respectively. Using the annual percentage change in user costs with and without the project an annual level of generated traffic was estimated. Using 1995 as an example, the calculation was performed as follows:

1995 Existing Demand * % Change in Costs *
% Work Trips * Elasticity = Generated Work Trips
or; (65,813,757) * (4.26%) * (.65) * (.494) = 899,402
For shopping trips:
(65,813,757) * (4.26%) * (.35) * (.878) = 860,747
Total 1995 Generated Trips = 1,760,149

The increase in user costs resulting from the addition of generated trips to the network was calculated by estimating a relationship between user costs and volume of trips on the network. This volume-cost relationship was estimated as the percentage change in cost for a percentage change in volume using total annual user costs and network demand without the project. The relationship established is as follows:

% Change in Cost = .0293 + .9735 (% Change in Volume)

TABLE 5-2
CALCULATION OF BENEFITS
TO GENERATED TRAFFIC

YEAR	ANNUAL DEMAND-EXISTING	ANNUAL GENERATED TRAFFIC	ADDED DAILY TRAFFIC	TOTAL DEMAND E+G	%INCREASE IN TRAFFIC E TO G	ESTIMATED % RISE IN COSTS E+G	LOSS IN TRAFFIC	PER UNIT BENEFITS-EXISTING TRAFFIC	LOST BENEFITS FROM LOST TRAFFIC	BENEFITS TO GENERATED TRAFFIC	NET BENEFITS GENERATED TRAFFIC	NET PROJECT BENEFITS
1986	49883516	0	0	49883516	0.000	0.000	0	0.000	0	0	0	0
1987	51443428	917788	3070	52361217	0.018	0.020	11456	0.075	855	34267	33411	4,067,992
1988	53052318	494811	1655	53547129	0.009	0.012	3668	0.039	144	9693	9550	2,251,347
1989	54711229	150755	504	54861984	0.003	0.005	519	0.012	6	876	870	836,243
1990	56422257	747497	2500	57169753	0.013	0.016	7294	0.056	409	20953	20544	3,349,313
1991	58186656	1599471	5349	59786127	0.027	0.029	28992	0.117	3385	93368	89983	7,071,159
1992	60006310	1446028	4836	61452338	0.024	0.026	23360	0.103	2400	74270	71871	6,390,197
1993	61882894	1545863	5170	63428757	0.024	0.027	25768	0.107	2754	82608	79854	6,837,925
1994	63818082	1650502	5520	65468584	0.025	0.027	28359	0.111	3149	91650	88500	7,309,326
1995	65813757	1760149	5887	67573906	0.026	0.028	31144	0.115	3590	101442	97852	7,805,514
1996	66743468	2128428	7118	68871895	0.031	0.033	43984	0.140	6176	149423	143248	9,589,414
1997	67686364	2280152	7626	69966516	0.033	0.035	49470	0.149	7368	169811	162443	10,301,175
1998	68642447	2435475	8145	71077921	0.034	0.036	55336	0.158	8718	191843	183125	11,035,697
1999	69612134	2594472	8677	72206605	0.036	0.038	61594	0.166	10236	215584	205348	11,793,565
2000	70595425	2757205	9221	73352629	0.038	0.039	68252	0.175	11936	241101	229165	12,575,380
2001	71592530	2923743	9778	74516273	0.039	0.041	75322	0.184	13832	268463	254631	13,381,753
2002	72603868	3094168	10348	75698036	0.041	0.043	82815	0.192	15938	297741	281803	14,213,312
2003	73629438	3268543	10932	76897981	0.043	0.044	90741	0.201	18268	329007	310739	15,070,698
2004	74669659	3446952	11528	78116610	0.044	0.046	99111	0.210	20837	362337	341500	15,954,568
2005	75724740	3629470	12139	79354210	0.046	0.047	107938	0.219	23661	397808	374147	16,865,593

The loss of trips was estimated using the elasticities described above and calculated in a similar manner as generated traffic. The exception is that generated volume is used instead of existing demand.

A per unit benefit (total annual benefits/annual existing demand) was calculated and used to determine benefits to generated traffic and benefits lost to lost traffic.

To estimate benefits to generated traffic it was assumed that the demand curve was linear in the area of analysis (line segment BE in Figure 5-2). This assumption allows an approximation of per unit benefits to generate traffic equal to one-half the per unit benefits to existing traffic.

As indicated in Table 5-2 the net impact of generated traffic for this project is small relative to the level of overall user benefits. This is likely due to the relatively low level of benefits produced by the project and thus the low level of traffic generated. As will be shown in the following section, the impacts of generated traffic on the outcome of the evaluation are insignificant.

5.3 Comparison of Costs and Benefits

With a stream of user benefits and project costs having been established the analysis can now move to a comparison of these benefits and costs to determine the economic feasibility of the Geist Road Extension. In this comparison the annual resource flows must be brought to comparable values at a common point in time. This is accomplished by discounting the resource flows to 1986, the first year in which an expenditure on the project is made. Discounting raises the issue of what the discount rate should be for a public project. Other issues resolved in this section include choice of the method to be used in comparing costs and benefits (ie, Benefit/Cost ratio, Internal Rate of Return, Net Present Value) and the sensitivity of the comparison to changes in some of the underlying assumptions.

5.3.1 The Discount Rate

As mentioned above, it is not in the scope of this paper to resolve the issue of an appropriate discount rate in a satisfactory manner. However, given that minor shifts in the discount rate can affect the outcome of the analysis, a discussion of the rationale for discounting is provided along with a discussion of how highway funding in the U.S. might affect the rate of discount.

There are two distinct arguments put forth for discounting a project's resource flows to a common point in time. First, if there is to be an efficient allocation of limited resources (labor, capital, land, etc.), the project must be at least as efficient as projects (private or public) it might be displacing (Pearce, pg 83). This is the idea that resources required for a project have an opportunity cost and that there exists a social opportunity cost of capital. Second, it is recognized that people, in general, would prefer their benefits today as opposed to tomorrow. This is the idea that there exists a positive social time preference rate (Pearce, pg 38). Either one of these could serve as a discount rate for this project.

Under ideal conditions, where there is an optimal level of investment in the economy, the social opportunity cost and social time preference rate would be equal (Pearce, pg 44). However, in reality the two differ with social opportunity costs being higher than the rate of social time preference (Pearce, pg 46).[2]

In the course of determining a discount rate for this project it is important to keep in mind that the level of decision for the project rests with a public agency (ADOT/PF) which receives the bulk of its capital financing through direct grants from government funds (both federal and state). The funds to be used on the project are earmarked at the federal level for use specifically in highway-related projects. Further, the state must allocate this money to all urban areas in the state on the basis of population or miles of major highways. This restricts the alternative opportunities to use these capital resources.

There are also problems in the use of a social time preference rate. As noted by Sugden and Williams:

> "If private marginal time preference rates (MTPR) differ - as they do - a social MTPR can be constructed from these private rates only in a highly arbitrary way" (Sugden and Williams, pg 223).

Again, it is not the purpose of this paper to resolve these issues. Rather, the importance of discounting the costs and benefits of the project is recognized and the alternative approaches to determining an appropriate discount rate have been discussed.

As a basis of comparison and guidelines for this study the following discount rates are referenced from other studies:

12 percent: Used by Pakistan Planning Commission and recommended for developing countries (Adler, 1987, pg 54);
5.13 percent: Used in analysis of Alaska's Dalton Highway (1986) as representative of U.S./Canadian social time preference rate (Olson, pg 9)[3];
Range of 5-15 percent: Used in Sitka Bypass Study (1984) (Quadra, pg 3).

A range of discount rates between 5 and 15 percent will be used to assess the sensitivity of the analysis to changes in the rate.

5.3.2 Methods for Comparing Costs and Benefits

There are three commonly used methods for comparing the discounted costs and benefits of public investments in transportation projects:
1) Net Present Value (NPV) of a project - the difference between the discounted value of costs and benefits,
2) Benefit/Cost Ratio (B/C Ratio) - the discounted project benefits divided by discounted project costs, and
3) Internal Rate of Return (IRR) - the discount rate at which the difference between project costs and benefits equals zero.

In general, a project can be said to be acceptable if:
1) the NPV is greater than zero at an acceptable discount rate, or
2) the B/C Ratio is greater than one at an acceptable discount rate, or
3) the IRR exceeds the acceptable discount rate.

Where there is a need to determine the best of a set of alternative solutions to a transportation problem, or where there is a need to get the most value out of a limited capital budget, the appropriate measure to use is NPV.

In most cases the analysis will be of two or more alternative projects (i.e., between building at-grade or an overpass over the railroad tracks, etc.). However, given the lack of resources necessary to evaluate the various alternatives proposed for the Geist Extension, and because the primary purpose of this study is to illustrate the tasks involved in generating the project resource flows which underly an economic analysis, only one alternative project (the one chosen as the "build" alternative) is analyzed. In this case, a positive NPV at an acceptable discount rate would indicate that the project is worthwhile.

If SBCA were used by ADOT/PF to determine projects to be included in its capital budget, the objective would be to maximize the NPV of benefits per unit of capital budgeted. If this project's NPV is greater than zero, it would be considered as a potential project in the budgeting process.

If there is no need to prioritize or rank one project over another, then either a B/C ratio greater than one or an IRR which exceeds a threshold discount rate would indicate that a project is justified. This approach is used by the World Bank in the evaluation of transportation projects submitted to it for financing (Adler, pg 53). Adler notes that there are two reasons for the World Bank's approach (Adler, pg 53):

> "First, it has not been practical for the Bank to estimate appropriate discount rates for the more than one hundred developing countries who are members of the Bank. Second, the Bank must assure itself only that the project is justified; it need not be the highest priority project in the country".

Without further analysis, it cannot be determined whether the Geist Extension as described in this study represents the best alternative or whether it would be included in the most efficient set of ADOT/PF capital expenditures for 1985. However, by assuring that the project's IRR exceeds a target discount rate or by observing whether the B/C ratio is greater than one at an acceptable discount rate, a decision can be made on the project's general acceptability.

Results of the analysis are presented below using all three methods:

NPV (discounted at 5%)	- $5,579,985
B/C Ratio (discounted at 5%)	.944
IRR	4.28%

Using any of these measures the recommendation would be to not make the investment as presently proposed. Assuming five percent is the minimum acceptable discount rate, the NPV is negative, the B/C Ratio is less than one, and the IRR falls below the threshold.

The above figures reflect high growth and high value of time assumptions. The sensitivity of the analysis to changes in these and other assumptions is discussed below.

5.3.3 Sensitivity Analysis

Given the complexity involved in generating project cash flows, it is important for the analyst to determine the sensitivity of the cash flows to changes in the underlying assumptions.

For this study the following parameters were analyzed to assess their impact on net project benefits:

- Generated traffic,
- Accident cost savings,
- Value of time,
- Population growth,
- Discount rate, and
- Project construction costs.

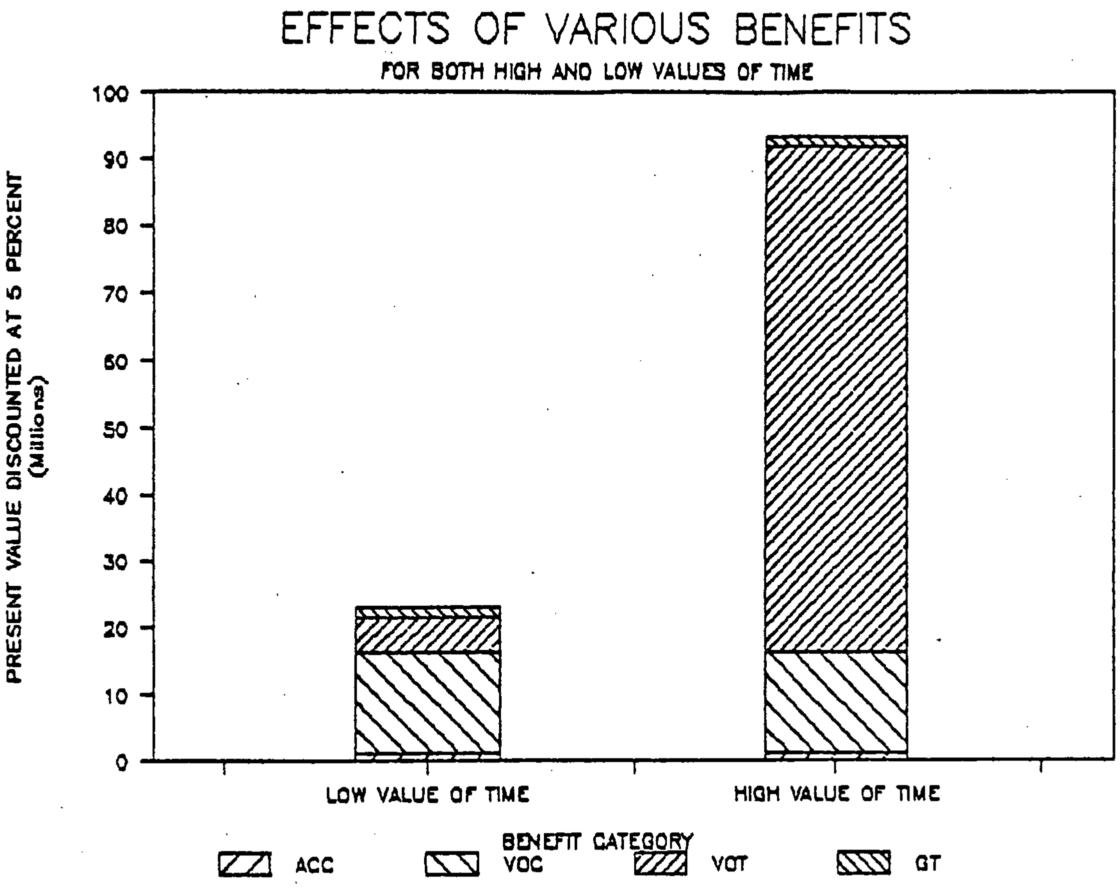
5.3.3.1 Generated Traffic, Accident Cost Savings, and Value of Time

Figure 5-3 illustrates the distribution of the project's benefits among vehicle operating costs (VOC), Time Costs (TC), Accident Costs (ACC) and Generated Traffic (GEN). Figure 5-3 also present the difference in this distribution using high and low values of time (discussed in Chapter Four). For reference, the values of time discussed in Chapter Four are as follows:

Low Value of Time	Value of Time ($/Hr)
Non-Work Trips	$ 0.63
Work Trips	1.43
Truck Trips	2.75
High Value of Time	
Non-Work Trips	$11.62
Work Trips	11.62
Truck Trips	23.71

The benefits resulting from accident cost savings are relatively insignificant. The impacts of generated traffic, are also insignificant. Time and vehicle operating cost savings are the major areas of project benefit. This is typical of most highway projects of this type.

Figure 5-3



EFFECTS OF VARIOUS BENEFITS
FOR BOTH HIGH AND LOW VALUES OF TIME
PRESENT VALUE DISCOUNTED AT 5 PERCENT
(Millions)
100
90
80
70
60
50
40
30
20
10
0
LOW VALUE OF TIME
HIGH VALUE OF TIME
BENEFIT CATEGORY
ACC
VOC
VOT
GT

The most uncertain assumptions related to the calculation of savings to generated traffic and accident costs relate to the elasticity of demand and accident rates respectively. Given their relatively minor contribution to overall project benefits it is safe to conclude that no reasonable change in these assumptions would significantly alter the analysis.

The significant effect of a lower value of time is that total net benefits are lower. As indicated in Figure 5-3, the Present Value of the projects benefits, discounted at five percent and using a high value of time is -$5.6 million; four times higher than the project's benefits using a low value of time. The effect of value of time on overall benefits is to be expected given the differences in low and high unit values of time. As discussed in Chapter Four, these values were estimated from the perspective of time saved per trip - the more time saved per trip, the higher the value. It is not possible to determine the actual time saved for each trip, nor is it possible to determine each individuals trip maker's value of time. What can be said is that there is likely to be a range of travel time savings and a range of individual valuations of that savings. It is reasonable to conclude that the range between the high and low values of time used for various trip types are probable averages and thus provide an adequate range of values for this analysis. The outcome of the analysis (rejection of the project) is insensitive the value of time within this range of values.

5.3.3.2 Population Growth and Discount Rate

Figure 5-4 illustrates the effects of different growth and discount rates. Using the benefit-cost ratio as a means of comparison, benefits only exceed costs in the range of negative discount rates when moderate growth is assumed. Assuming high growth, benefits exceed costs when the discount rate is 4.28 percent or less. This is well below the 5.13 percent used in the Dalton Highway Benefit-Cost analysis and the 5 to 15 percent used in the Sitka Bypass study.

5.3.3.3 Project Costs

While every effort is made to estimate project costs accurately, these are typically a source of uncertainty in economic analysis. Figure 5-5 illustrates the impact of changes in project costs. Increases from the base cost estimate are made ranging from 10 to 40 percent. Benefit-cost ratios are calculated using discount rates of zero and five percent; assuming a high growth rate and high value of time.

With a discount rate of five percent the project has a B/C ratio less than one even under the relatively optimistic high growth assumptions and using a high value of time. Thus, should costs actually exceed those estimated for the base case, the project is even more unacceptable.

When no discount rate is used benefits exceed costs throughout the range of cost increases analyzed. While this is an unrealistically low discount rate it illustrates that even under infeasible assumptions the project is only marginally acceptable. As in the case using a five percent discount rate, should costs exceed those estimated for the base case, the project becomes less and less attractive.

Figure 5-4

EFFECTS OF GROWTH AND DISCOUNT RATE

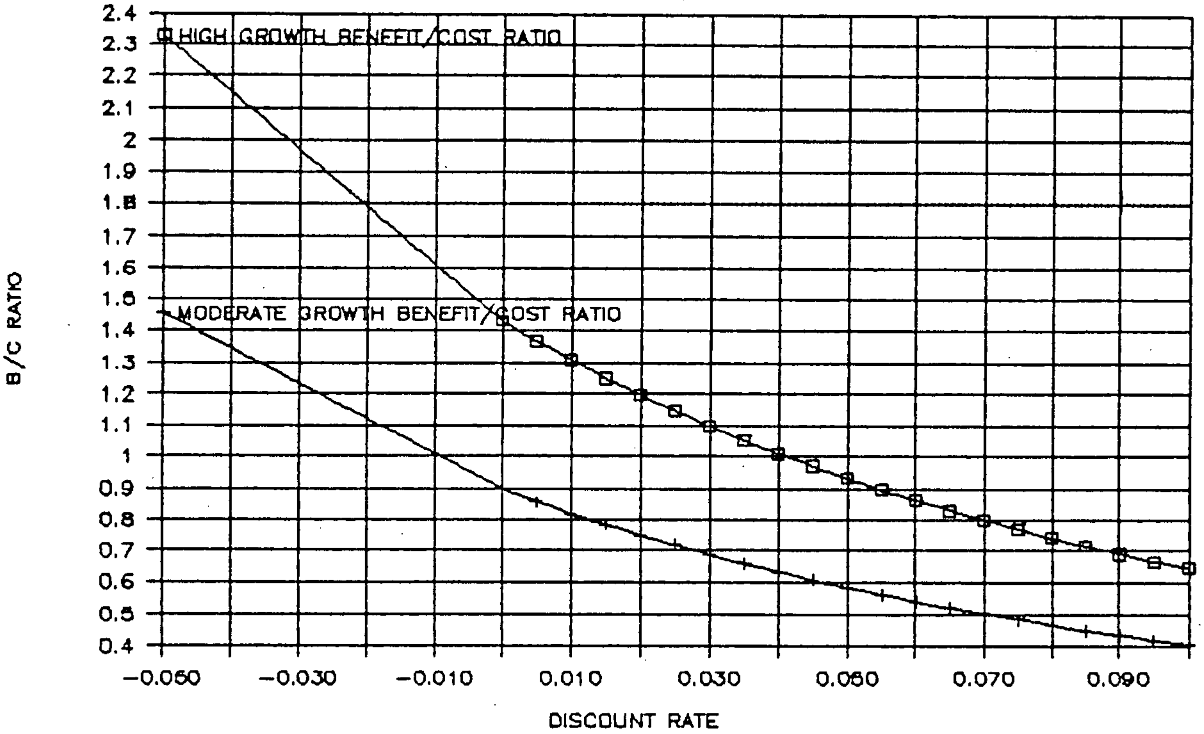
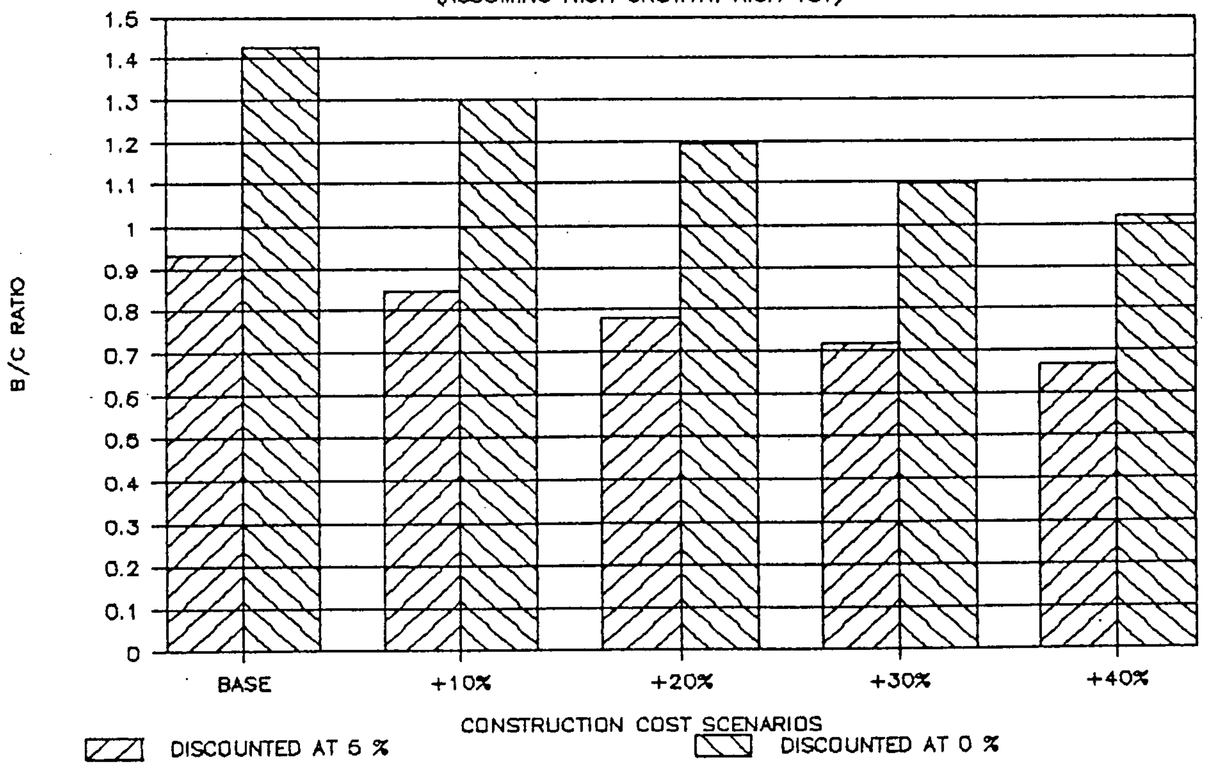


Figure 5-5

IMPACT OF CHANGES IN CONSTRUCTION COSTS

(ASSUMING HIGH GROWTH, HIGH VOT)



5.4 Results of Analysis

Meyer and Miller note that there are three major purposes in the evaluation process which leads to investment of public resources (Meyer and Miller, pg 373):

1) Evaluation is the process whereby determination is made defining how value is to be measured and estimates of the source and timing of benefits and costs of proposed actions are made;

2) Evaluation provides information to decision makers on the impact of policy proposals, trade-offs, and major areas of uncertainty; and

3) Evaluation provides planners with an opportunity to identify areas of further study.

This section provides a summary of the economic evaluation based on these purposes. Specifically this summary provides estimates of the source and timing of benefits and costs of the project, and discusses areas of uncertainty, conclusions from the study and areas of further study. While much of the information below is a repetition of the analysis presented in sections 5.1-5.3, this section provides information on the evaluation which would likely be presented by the analyst in the public decision step outlined in Figure 1-1.

Table 5-3 provides estimates of project costs and benefits for 1986 through 2005. Benefits are presented by category: savings in accident costs, vehicle operating costs, time costs and generated traffic. These figures are developed assuming a high growth scenario and a high value of time.

TABLE 5-3
SUMMARY OF GEIST EXTENSION COSTS AND BENEFITS

	ANNUAL BENEFITS					ANNUAL COSTS		
YEAR	VEHICLE OPERATING COST SAVINGS	TIME COST SAVINGS	ACCIDENT COST SAVINGS	SAVINGS TO GENERATED TRAFFIC	TOTAL BENEFITS	CONSTRUCTION COSTS	MAINTENANCE COSTS	TOTAL COSTS
1986	0	0	0	0	$0	26000000	61236	$26,061,236
1987	961883	2879498	193199	33411	$4,067,992	0	61236	$61,236
1988	486844	1591754	163200	9550	$2,251,347	15400000	115236	$15,515,236
1989	1083360	-447751	199764	870	$836,243	23500000	330624	$23,830,624
1990	584584	2578550	165634	20544	$3,349,313	23100000	330624	$23,430,624
1991	1657966	5135242	187968	89983	$7,071,159	0	330624	$330,624
1992	1478852	4685193	154281	71871	$6,390,197	28100000	336024	$28,436,024
1993	1500856	5112947	144267	79854	$6,837,925	0	336024	$336,024
1994	1522751	5564683	133391	88500	$7,309,326	0	336024	$336,024
1995	1544508	6041548	121605	97852	$7,805,514	0	336024	$336,024
1996	1598918	7772351	74897	143248	$9,589,414	0	336024	$336,024
1997	1628438	8453244	57050	162443	$10,301,175	0	336024	$336,024
1998	1658481	9155475	38615	183125	$11,035,697	0	336024	$336,024
1999	1689058	9879584	19576	205348	$11,793,565	0	336024	$336,024
2000	1720176	10626119	-80	229165	$12,575,380	0	336024	$336,024
2001	1751846	11395645	-20370	254631	$13,381,753	0	336024	$336,024
2002	1784077	12188739	-41307	281803	$14,213,312	0	336024	$336,024
2003	1816879	13005988	-62908	310739	$15,070,698	0	336024	$336,024
2004	1850261	13847996	-85189	341500	$15,954,568	0	336024	$336,024
2005	1884234	14715379	-108166	374147	$16,865,593	0	336024	$336,024

	BENEFIT/ COST RATIO	NET PRESENT VALUE	INTERNAL RATE OF RETURN
HIGH GROWTH	0.94	($5,579,985)	4.28%
MODERATE GROWTH	0.56	($43,500,571)	-1.20%

OTHER IMPACTS

IMPACT AREAS	RESULTS OF EIS
AIR	Reduction in Carbon Monoxide emmissions.
NOISE	Minor decreases along major existing roads. Increases along Geist Rd. and project area.
WETLANDS	No significant impacts.
HISTORIC	Seven historic sites require some relocation.
DISPLACEMENT	14 rental units 6 residences 17 businesses

Using these assumptions time costs savings provide the major source of benefits. Accident cost savings and savings to generated traffic are relatively insignificant.[4] Construction would take place over seven years at a cost of $116.1 million. Using a discount rate of 5 percent the project has a net present value of -$5.6 million with a benefit/cost ratio of .94. The project's internal rate of return is 4.28 percent.

While the measure of value used to evaluate the project is the economic cost expressed in dollar terms, there are project impacts which are difficult to quantify in this manner. These impacts include possible increases in air and noise pollution, destruction or disruption of wetlands areas, disruption of historic sites and displacement of households and businesses. Table 5-3 includes a brief summary of project impacts in these categories based on an Environmental Impact Statement (EIS) prepared by the Alaska Department of Transportation and Public Facilities.

5.4.1 Recommendations

Given the results of the economic analysis, the project is not recommended as an acceptable public investment. This recommendation is strengthened given the current recessionary trends in the Fairbanks economy and the slowed growth in population which has occured. Table 5-3 also provides the results of the economic analysis using a more moderate growth assumption. Under this more realistic assumption, the net present value of the project is -$43.5 million with a benefit/cost ratio of .56. The internal rate of return of the project is -1.2 percent.

While this analysis indicates that the project as proposed does not make economic sense, it does not follow that no investment is required. The analysis which was done to establish the project resource flows indicated areas of severe congestion even under moderate population growth assumptions. The project analyzed is really a set of several smaller projects. It is possible that some of these projects' benefits may exceed their costs.

These smaller projects should be analyzed individually using the method presented in this study to determine a more efficient "package" of projects to invest in.

Figure 5-6 illustrates the several smaller projects which should be analyzed on an individual basis. These smaller projects include the following:

-Geist Extension to downtown with improvements to Illinois Street (with and without railroad overpass);

-Linking College Road and the Steese Highway;

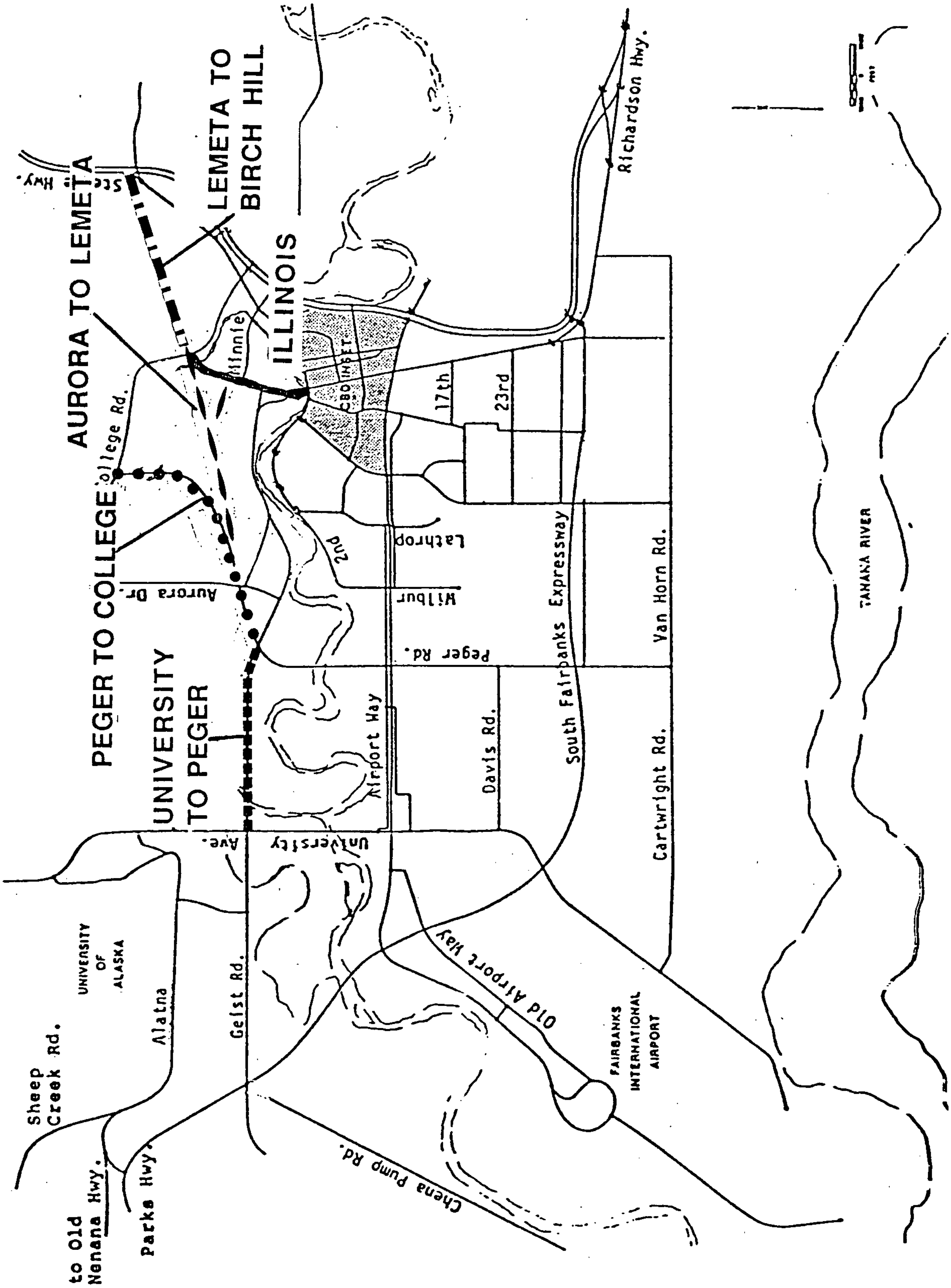
-New North-South Link of Peger Road and College Road.

These projects could be analyzed in combinations to determine the most efficient use of resources available.

Given the uncertainty of population growth in Alaska, another area of further research would be to determine the optimum timing of the projects under various growth assumptions.

Figure 5-6

Potential Sub-Projects for Further Analysis



The actual presentation to public decision-makers would provide more succinct conclusions and recommendations (i.e., congestion exists along Airport Road, College Road; recommend construction of XYZ project). Given the results of this study - that the "package" is not feasible but individual parts may be good investments and that the system analysis indicates problems in the future; it is likely that the information would not be presented to elected officials. Rather, a management decision at the Department of Transportation would likely be made to carry-out further analysis as suggested above. Elected officials would be presented with the results of more detailed analysis on the smaller projects.

FOOTNOTES

CHAPTER FIVE

1. This variation in costs occurs as the result of two factors. First, the various phases of the project affect overall operating differently (e.g., major downward impacts on costs seem to result from phases built in 1990-1993). Second, operating costs without the project are driven primarily by the population forecasts which determine overall traffic demand. The growth between 1986 and 1987 is in anticipation of an increase in personnel at a nearby army base. After that, population is interpolated between 1987, 1995 and 2005. Operating costs wit the project are driven both by population forecasts and impacts of the different project phases.

One oddity in Figure 5-1 is that user costs with the project rise at a faster rate than those without the project between 1987 and 1989. This results from the way in which the project is phased. Construction of various sections in 1986-1989 increase volumes on existing sectionf of the network (Illinois for example) which are not improved until later phases (Illinois is widened in 1993). This causes operating costs to rise on some road segments faster with the project than without the project.

2. The primary reasons for this difference have been attributed to (Pearce, pg 45):

1) Corporate taxation, and
2) The apparent difference in risk between private and public projects.

3. Olson references the following study: Kula, Erhun, "Derivation of Social Time Preference Rates for the United States and Canada," Quarterly Journal of Economics, Vol. 99 (November, 1984), p. 873-878.

4. As discussed earlier, benefits to generate traffic are negative over the life of the project. The negative time cost savings in 1989 stems from the way the project was phased as discussed in Section 5-2. The negative accident cost savings in years 2001-2005 result in part from the linear extrapolation which was used to derive values between 1995 and 2005. The 2005 accident cost analysis indicated 1,795 accidents on the network without the project and 1,844 accidents with the project.

It is not improbable that there would be more accidents with the project than without it. While vehilce miles of travel are approximately the same (252.3 mvm without vs. 252.06 with); travel is redistributed over the network, increasing dramatically on some road segments. As a result, accident rates on each road segment are changed and the distribution of accident types is affected. For example, in 2005, without the project the analysis indicated 1,795 fatal accidents at a cost of $774,710. This compares to 1,844 fatal accidents with the project at a cost of $795,719; a $21,000 difference.

CHAPTER SIX

Conclusions

In the introduction to this study two issues were raised as central to the discussion of evaluation of transportation investments: 1) specifying the set of techniques used in the analysis, and 2) recognizing the political nature of the decision-making process which uses the information generated by the analysis. This study has focused on the techniques used in evaluating investments; specifically economic analysis. This chapter summarizes the methodology used to assess the proposed investment presented in the case study and presents the findings of recent empirical research comparing economic analysis and other evaluation techniques.

Understanding the political nature of the decision-making process in which analysis is presented is at least as important as using proper analytical techniques. For this reason, as a means of tying the technical analysis into the broader decision-making framework, the use of economic analysis in this process is also discussed briefly in this chapter.

6.1.2 <u>Conclusions Regarding Evaluation Technique Used in Geist Extension Case Study</u>

The economic analysis used in this study to evaluate the Geist Extension was carried out based on a fairly detailed analysis of the road network affected by the project. Assumptions had to be made regarding several interrelated variables. The analysis was shown to be sensitive to both the level of future population growth and the value of time assumed. User costs were based on assumptions of the relationship between speed and traffic volumes, land use patterns, distribution of traffic by time of day, vehicle mix, etc. The complexity of the interrelationships and their variability over the course of a single road segment points to the need for the detail taken.

Most of the data used in the system analysis is generated routinely by transportation planning efforts in most cities. Thus, the approach used in this study could tie fairly easily into the types of analysis currently being performed in most urban areas. Systems data required for development of various scenarios used in an economic analysis could be produced without much additional effort.

The data which are not always available at the local level pertain more to the economic aspects of urban transportation. For example, better data would be welcomed regarding vehicle operating costs and their relationship to speed and relative travel conditions (i.e. traffic volumes, delay, etc.). More precise data on how people value time for various trips, the response of travelers to congestion on a particular road (i.e., the extent to which people switch modes or travel paths) and the relationship between accidents and traffic volumes would also improve the analysis. However, the need for this data is not a detraction from the use of benefit-cost analysis. Even with existing data benefit-cost analysis is superior to the simple minimum conditions standards often employed. As Gomez-Ibonez and O'Keefe point out, "benefit-cost analysis makes the need for or benefits from this data more obvious" (Gomez-Ibanez and O'Keefe, pg 86).

6.2 The Role of Analysts in the Transportation Investment Decision Making Process

6.2.1 Description of the Transportation Investment Decision Making Process

The decision-making process which leads to the investment of public resources in transportation facilities was described breifly in Section 5.1. It was noted that there is often an overlap of policy debate and project discussion in this process. George Wilson has noted that politicians are often affected by what he calls the "Great Transportation Mystique" - the mindset that investment in transportation infrastructure can solve the economic problems faced by a region (Wilson, pg 43). In the pursuit of social and economic development adequate transportation can, in some instances, be a prerequisite - though no guarantee of success. Despite the factual analysis presented in the process of making the investment decision political considerations can, and often do, dominate the process.

Michael Meyer quotes an insightful observation made by J.F. Coates on public policy decision-making in the U.S. context:

> "Decision-making is disaggregated among at least three levels of government and numerous agencies at each level. No one has plenipotentiary power. While no one person, agency or institution is in charge or has a clear field or the authority to accomplish things, often dozens, if not scores, of units of government have the power to intervene, to slow down, or to stop action by others" (in Meyer, 1981, page 3).

This observation leads to the conclusion that there are, regardless of the existence of an underlying objective process in the selection of projects, and to a certain extent their prioritization, many points at which politicians and their lobbyists can exert influence.

6.2.2 <u>The Role of Analysts</u>

Sugden and Williams, in their book "The Principles of Practical Cost-Benefit Analysis" discuss the limits of the role of the analyst and what the relationship between the analyst and decision-maker ought to be in determining the nature of a cost-benefit analysis.

They note that cost-benefit analysis has two essential characteristics: consistency and explictness (Sugden and Williams, pg 236). The analysis should be consistent in that decisions between alternatives should be in line with objectives. It should be explicit in showing that a particular decision is a logical implication of particular, stated objectives (Sugden and Williams, pg 234).

Objectives in particular need to be explicit and consistent. Without this, cost-benefit analysis is little more than window-dressing (Sugden and Williams, pg 234). If objectives are not explicit a decision maker need only revise his to ensure the analysis provides the 'right' answer.

Some analysts feel strongly that "At present so many issues and conflicts are concealed, both among objectives and alternative means, that the discretion of the policy maker is augmented beyond what is necessary or desirable" (Steiner, pg 297).

The decision maker should be responsible to the community. Given that his decision-making rights "stem from the consent of the community, expressed through the political system"; the community ought to have the right to hold the decision maker accountable for his decisions (Sugden and Williams, pg 241).

From this perspective cost-benefit analysis "assists the decision-maker to pursue objectives that are, by virtue of the community's assent to the decision-making process, social objectives. And by making explicit what these objectives are, it makes the decision-maker more accountable to the community" (Sugden and Williams, pg 241).

Thus, the role of the analyst is to assist, "not simply a decision-maker, but a decision-making process that has the assent of the community as a whole" (Sugden and Williams, pg 240).

Within this framework the role of the analyst includes the following tasks:

1. The analyst should assist in a thorough development of alternatives ensuring that "important and practicable policy options are not ignored" (Sugden and Williams, pg 231). For example, as discussed in Chapter Five, the decision faced by the community of Fairbanks would have benefited from, not only a broader range of alternatives, but a more detailed analysis on specific parts of the project as analyzed in the case study.

2. Given that cost-benefit analysis requires "a unique, measurable and operational social objective function" (Waters, pg 25), the analyst needs to elicit the objectives of the decision-makers which are to determine a particular course of action (Sugden and Williams, pg 233). While this may not always be possible, the analyst needs to at least make explicit what objectives he is assuming in the analysis (i.e., maximize social welfare, minimize direct user cost, etc). The stated objectives in the case study were to relieve congestion on existing arterials and provide better access to downtown, in economic terms, to lower the direct user costs on the highway network.

3. In presenting the analysis, the analyst should show "what judgements remain to be made and what relationships exist between particular valuations of the 'unvalued' costs and benefits and particular final decisions" (Sugden and Williams, pg 238). This might be accomplished by noting that the analysis presented includes only those impacts which could be quantified. Judgement must be made on the value of unquantified impacts and how they are to affect the final decision. It was noted in the analysis that these impacts were relatively insignificant, possibly contributing more to the cost of the project.

4. At the end of the analysis, the analyst should "ensure that his findings are not misinterpreted, or read as implying more than they really do" (Sugden and Williams, pg 231).[1]

Carrying out these tasks, aware of the political nature of the investment decision-making process, the analyst can ensure a more effective use of cost-benefit analysis in the process.

6.3 Conclusions

This study has shown the importance of evaluating transportation investments carefully. There is a complex set of relationships which underly the calculated demand for transportation and its effect on the existing supply. These relationships can effect the development of project resource flows used in an economic analysis. Assumptions regarding population growth, the value of time, the relationship of traffic volumes to speed on a given road network, etc. can affect the attractiveness of a particular transportation investment as determined by the economic analysis.

Economic analysis as a technique was shown to be useful in evaluating the impacts of a project on a community. Conclusions from empirical studies were drawn on which indicated that economic analysis was superior to evaluation methods commonly used at the state and local levels. Economic analysis was shown to provide useful insights to the relationship of supply and demand on an urban road network and the development of alternative government actions.

The case study utilized a fairly detailed analysis of the road network as a whole to develop the project resource flows used in the economic evaluation of the proposed project. It was found that the project's costs exceeded its benefits, though it was noted that this was likely due to the fact that the project was actually a series of several smaller projects. Given that the systems analysis indicated areas of high congestion on the network without the project, it is likely that some parts of the project would be efficient investments if analyzed independently.

It is felt that the method used in the case study to develop the data required for the economic analysis is applicable to and appropriate for use in the evaluation of transportation investments in other medium-sized and small urban area. Most of the data required for the systems analysis is routinely generated by the local governments. While there is a cost involved in deriving some of the economic values used in the analysis, the values, once established, can be utilized in several analyses.

It was also found to be important to consider the political nature of the investment decision-making process and the affects this can have on cost-benefit analysis.

It was concluded that while, in the normative sense the analyst should stress explicitness and consistency in the analysis, this is often difficult to do given the discretion of the political decision-maker. It is likely more practical to reduce the potential inefficiencies which occur, focusing more on keeping grossly inefficient expenditures out of the budget. As Wildavsky notes, "avoiding the worst where one can't get the best is no small accomplishment" (Wildavsky, 1968, pg 380).

This might be best accomplished by ensuring the active participation of the analyst, the decision-maker and the community in the development of alternatives and the setting of objectives to be used in the analysis.

FOOTNOTES

CHAPTER SIX

1. Sugden and Williams feel strongly on this point noting that the analyst has "the professional duty to set the record straight, for otherwise analysis in general is brought into disrepute" (Sugden and Williams, pg 231).

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Notes on Appendices

The following appendices contain data used to develop the case study and copies of spreadsheets used to calculate volumes, costs, and the evaluation. The layout of the Appendices is diagrammed in Figures A-1 through A-3.

Appendix A contains data and spreadsheets related to the system analysis discussed in Chapter Three. Using forecasts of system-wide daily trips traffic volumes are developed for individual links. Using speed-flow look-up tables for different facility types and land uses, volume/capacity ratios, speeds and travel times are calculated for four times of day, for high and moderate growth scenarios, with and without the project.

Appendix B contains data and spreadsheets related to user costs discussed in Chapter Four. Using the network evaluation outlined in Appendix A, vehicle operating costs, user time costs and accident costs are calculated for each link. Data for the high growth - with project scenario are presented here.

Vehicle operating costs are calculated using cost-volume look-up tables for both auto and truck. Value of time is estimated for four times of day for three trip purposes. Accident costs are calculated using the accident-volume relationships discussed in Chapter Four.

The user costs are used in the development of the project evaluation spreadsheets presented in Appendix C. These spreadsheets are used to prepare the results of the analysis and sensitivity texts described in Chapter Five. Project benefits are calculated for eight different scenarios:

Scenario	Description
1	Benefits to existing users assuming high value of time
2	Benefits to existing users assuming low value of time
3	Scenario 1 plus accident cost savings
4	Scenario 2 plus accident cost savings
5	Scenario 1 plus benefits to generated traffic
6	Scenario 2 plus benefits to generated traffic
7	Scenario 1 plus accident cost savings plus benefits to generated traffic
8	Scenario 2 plus accident cost savings plus benefits to generated traffic

A NPV, BC/Ratio and IRR are calculated for each of these scenarios.

Notes on Computer Spreadsheet Used

The spreadsheet used for the case study was VP-Planner which is a combination spreadsheed-database. Four databases were developed to handle the data generated during system analysis and user cost analysis:

1) High Growth - with project

2) High Growth - without project

3) Moderate Growth - with project

4) Moderate Growth - without project

Documentation on the structure of the databases is provided in Table A-1.

Figure A-1

Guide to Appendix A:
System Analysis

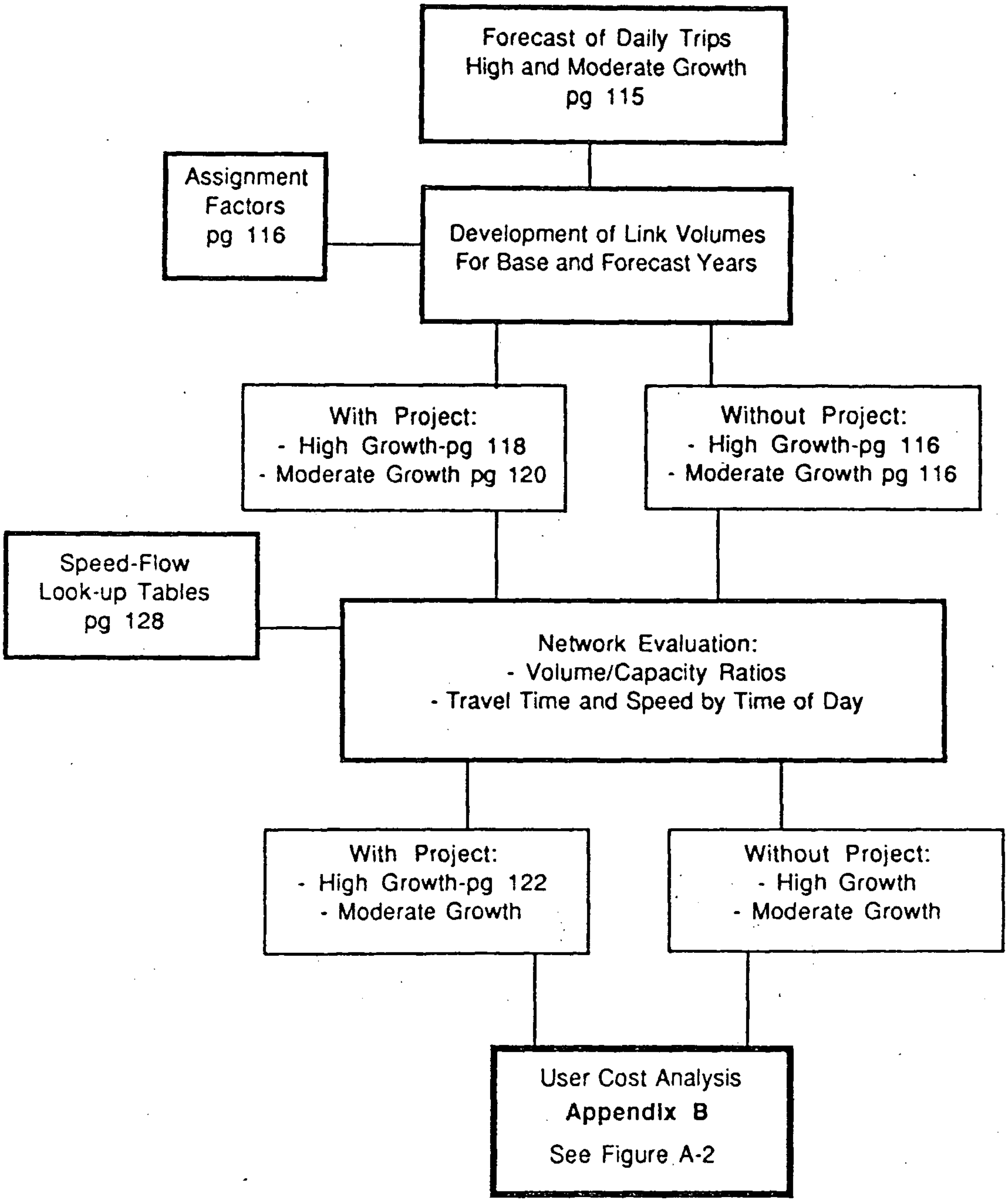

Figure A-2

Guide to Appendix B:
User Cost Analysis

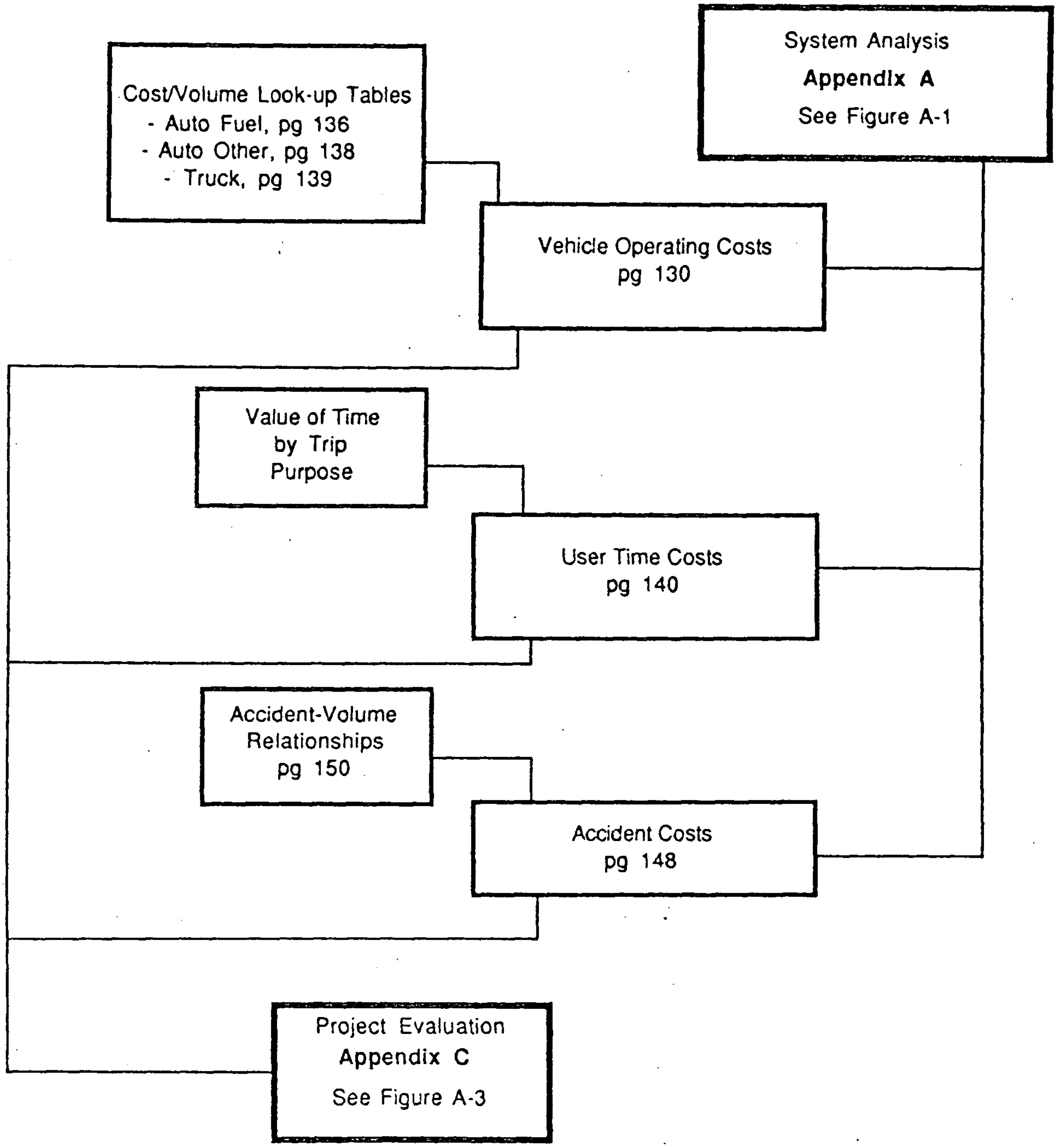

Figure A-3

Guide to Appendix C:
Evaluation

User Cost Analysis
Appendix B
See Figure A-2

Project Evaluation	High Growth	Moderate Growth
- Existing User Costs Without Project,	pg 152	pg 158
- Existing User Costs With Project,	pg 152	pg 158
- Calculation of Generated Traffic Benefits,	pg 153	pg 159
- Accident Costs With and Without the Project,	pg 154	pg 160

Project Benefits Under Various Scenarios	High Growth	Moderate Growth
1 - Existing User Benefits, High Value of Time,	pg 154	pg 160
2 - Existing User Benefits, Low Value of Time,	pg 154	pg 160
3 - #1 plus Accident Cost Savings,	pg 154	pg 160
4 - #2 plus Accident Cost Savings,	pg 154	pg 160
5 - #1 plus Generated Traffic Benefits,	pg 154	pg 160
6 - #2 plus Generated Traffic Benefits,	pg 154	pg 160
7 - #1 plus Accident Cost Savings and Generated Traffic Benefits,	pg 154	pg 160
8 - #1 plus Accident Cost Savings and Generated Traffic Benefits,	pg 154	pg 160

Discount Rate Sensitivity Analysis For Each Scenario:	High Growth	Moderate Growth
- Net Present Value,	pg 155	pg 161
- Benefit/Cost Ratio,	pg 156	pg 162
- Internal Rate of Return,	pg 157	pg 163

Table A-1

Structure of Database

General Information:
****

Database Name: G4.DIM
Number of Dimensions: 3
Length of Names: Short - 8 characters.
Long - 30 characters.
Decimal Place Dimension is dimension 2.
Number display:
- Amounts are displayed to 4 Decimal Places.
- Rates are displayed to 4 Decimal Places.

Dimensions:
****

Dimension 1 is: ROAD SEGMENTS
The short name is: LINK
There are 100 categories in this dimension.

	Short Names	Long Names
1.	1	
2.	2	
3.	3	
4.	4	
5.	5	
6.	6	
7.	7	
8.	8	
9.	9	
10.	AIR	AIRPORT WAY TOTALS
11.	10	
12.	11	
13.	12	
14.	13	
15.	14	
16.	15	
17.	STNB	STEESE NB TOTALS
18.	16	
19.	17	
20.	18	
21.	19	
22.	20	
23.	21	
24.	STWB	STEESE WB TOTALS
25.	22	
26.	23	
27.	RICH	RICHARDSON HWY TOTALS
28.	24	
29.	25	
30.	26	
31.	27	
32.	28	
33.	29	
34.	SFEEB	SOUTH FBKS EXPWY EB TOTS

Table A-1

Structure of Database (cont'd)

35.	30	
36.	31	
37.	32	
38.	33	
39.	34	
40.	35	
41.	SFEWB	S FBKS EPWY WB TOTALS
42.	36	
43.	37	
44.	38	
45.	UNIV	UNIVERSITY AVE TOTALS
46.	39	
47.	PARKS	PARKS HWY TOTAL
48.	40	
49.	41	
50.	GEIST	GEIST RD TOTALS
51.	42	
52.	43	
53.	44	
54.	45	
55.	46	
56.	47	
57.	COLL	COLLEGE RD TOTALS
58.	48	
59.	49	
60.	50	
61.	51	
62.	ILL	ILLINOIS ST TOTALS
63.	52	
64.	53	
65.	54	
66.	CUSH	CUSHMAN ST TOTALS
67.	55	
68.	56	
69.	SCUSH	SOUTH CUSHMAN TOTALS
70.	57	
71.	58	
72.	59	
73.	PEG	PEGER RD TOTALS
74.	60	
75.	61	
76.	62	
77.	63	
78.	PHIL	PHILLIPS FIELD RD TOTS
79.	64	
80.	AUR	AURORA ST TOTALS
81.	65	
82.	THIRD	THIRD ST TOTALS
83.	66	
84.	MIN	MINNIE ST TOTALS
85.	67	
86.	68	
87.	69	
88.	BARN	BARNETTE ST TOTALS

Table A-1

Structure of Database (cont'd)

89.	70	
90.	71	
91.	72	
92.	73	
93.	74	
94.	75	
95.	GEXT	GEIST EXTENSION TOTALS
96.	76	
97.	GILL	GEIST-ILLINOIS CONN TOTS
98.	77	
99.	COLCON	COLLEGE CONNECTOR
100.	NETWORK	NETWORK TOTALS

Dimension 2 is: NETWORK CHARACTERISTICS
The short name is: CHAR
There are 24 categories in this dimension.

	Short Names	Long Names	
1.	AADT	AVERAGE ANNUAL DAILY TRAFFIC	Amount
2.	TVOLAM	TOTAL VOLUME	Amount
3.	TVOLMD		Amount
4.	TVOLPM		Amount
5.	TVOLO		Amount
6.	VCRAM	VOLUME/CAPACITY RATIO	Rate
7.	VCRMD		Amount
8.	VCRPM		Amount
9.	VCRO		Amount
10.	TIMEAM	TRAVEL TIME PER AUTO TRIP	Rate
11.	TIMEMD		Amount
12.	TIMEPM		Amount
13.	TIMEO		Amount
14.	AUTO	ADJUSTED OPERATING COST-AUTO	Amount
15.	CV	COMMERCIAL VEHICLE COSTS(ADJ)	Amount
16.	TTTHBW		Amount
17.	TTTHBO		Amount
18.	TTTNHB		Amount
19.	TIMEHBW	TIME COST HBW HIGH	Rate
20.	TIMEHBO		Amount
21.	TIMENHB		Amount
22.	LTIMEHBW	LOW TIME COST HBW TOTAL	Amount
23.	LTIMEHBO		Amount
24.	LTIMENHB		Amount

Table A-1

Structure of Database (cont'd)

Dimension 3 is: YEAR(1984-2005)
The short name is: YEAR
There are 8 categories in this dimension.

	Short Names	Long Names
1.	1986	BASE YEAR
2.	1987	
3.	1988	
4.	1989	
5.	1990	
6.	1991	
7.	1995	INTERMEDIATE FORECAST YEAR
8.	2005	PROJECT HORIZON YEAR

APPENDIX A

FORECASTS OF TOTAL
DAILY TRIPS BY YEAR
1984-2005

	HIGH	LOW	HIGH	MODERATE
1984	224100	224100	GROWTH	GROWTH
1985	231108	228801	RATES	RATES
1986	238335	233601	84-95	84-95
1987	245788	238501	.031272	.020978
1988	253475	243505	95-05	95-2005
1989	261401	248613	.014126	.009476
1990	269576	253828		
1991	278006	259153		
1992	286700	264590		
1993	295666	270140		
1994	304912	275807		
1995	314447	281592		
1996	318889	284260		
1997	323394	286954		
1998	327962	289673		
1999	332595	292418		
2000	337293	295189		
2001	342057	297986		
2002	346889	300810		
2003	351789	303660		
2004	356759	306538		
2005	361800	309443		

LINK	ASSIGNMENT FACTORS WITH PROJECT	WITHOUT PROJECT	FORECASTED LINK VOLUMES WITHOUT PROJECT-MODERATE GROWTH SCENARIO 1986	1995	2005	FORECASTED LINK VOLUMES WITHOUT PROJECT- HIGH GROWTH SCENARIO 1986	1995	2005
1	.0913	.1153	26931	32464	35674	27477	36251	41710
2	.0915	.1248	29153	35142	38617	29743	39242	45151
3	.1227	.1321	30861	37202	40881	31487	41542	47798
4	.1346	.1605	37496	45199	49670	38256	50473	58074
5	.1219	.1549	36189	43624	47939	36923	48714	56050
6	.1257	.1364	31857	38401	42199	32502	42882	49339
7	.1069	.1510	35285	42533	46740	36000	47496	54649
8	.0610	.1205	28147	33930	37286	28718	37889	43594
9	.0574	.0779	18195	21933	24103	18564	24492	28181
AIR	.0000	.0000	0	0	0	0	0	0
10	.0367	.0422	9852	11875	13050	10051	13261	15258
11	.0287	.0269	6283	7574	8323	6410	8457	9731
12	.0224	.0579	13521	16298	17910	13795	18200	20941
13	.0347	.0423	9876	11905	13082	10076	13293	15295
14	.0491	.0518	12111	14600	16043	12357	16303	18758
15	.0380	.0516	12063	14541	15980	12308	16238	18683
STNB	.0000	.0000	0	0	0	0	0	0
16	.0555	.0422	9852	11875	13050	10051	13261	15258
17	.0419	.0269	6283	7574	8323	6410	8457	9731
18	.0292	.0289	6761	8150	8957	6898	9101	10472
19	.0374	.0423	9878	11907	13085	10078	13296	15298
20	.0509	.0519	12113	14602	16046	12359	16306	18761
21	.0467	.0516	12063	14541	15980	12308	16238	18683
STWB	.0000	.0000	0	0	0	0	0	0
22	.0685	.0473	11058	13330	14648	11282	14885	17126
23	.0594	.0481	11239	13548	14888	11467	15128	17407
RICH	.0000	.0000	0	0	0	0	0	0
24	.0422	.0551	12879	15525	17061	13140	17337	19948
25	.0248	.0324	7579	9136	10040	7733	10202	11738
26	.0370	.0484	11304	13627	14975	11533	15217	17508
27	.0478	.0625	14594	17593	19333	14890	19645	22604
28	.0376	.0491	11473	13830	15198	11706	15444	17770
29	.0299	.0390	9119	10993	12080	9304	12276	14124
SFEEB	.0000	.0000	0	0	0	0	0	0
30	.0306	.0400	9333	11250	12363	9522	12563	14455
31	.0186	.0243	5667	6832	7507	5782	7629	8778
32	.0310	.0404	9448	11390	12516	9640	12718	14634
33	.0479	.0625	14611	17613	19355	14907	19668	22630
34	.0445	.0581	13582	16372	17992	13857	18283	21036
35	.0358	.0467	10918	13161	14463	11139	14697	16910
SFEWB	.0000	.0000	0	0	0	0	0	0
36	.0574	.0884	20658	24902	27365	21077	27808	31995
37	.0577	.0884	20658	24902	27365	21077	27808	31995
38	.0574	.0977	22819	27507	30228	23282	30717	35343
UNIV	.0000	.0000	0	0	0	0	0	0
39	.0728	.0417	9741	11742	12904	9938	13112	15087
PARKS	.0000	.0000	0	0	0	0	0	0
40	.0473	.0370	8645	10421	11452	8820	11637	13390
41	.0785	.0837	19552	23569	25900	19949	26319	30282
GEIST	.0000	.0000	0	0	0	0	0	0

42	.0329	.0895	20897	25190	27682	21321	28130	32366
43	.0338	.1145	26740	32233	35421	27282	35994	41415
44	.0522	.1033	24126	29083	31959	24615	32476	37367
45	.0846	.1252	29253	35263	38750	29846	39377	45307
46	.0642	.1011	23624	28477	31293	24102	31799	36588
47	.0353	.0678	15833	19086	20973	16154	21312	24522
COLL	.0000	.0000	0	0	0	0	0	0
48	.0739	.0648	15129	18237	20041	15436	20365	23432
49	.0682	.0648	15129	18237	20041	15436	20365	23432
50	.0804	.0973	22719	27386	30095	23179	30582	35187
51	.0899	.1075	25101	30258	33251	25610	33789	38877
ILL	.0000	.0000	0	0	0	0	0	0
52	.0448	.0284	6635	7998	8789	6769	8931	10276
53	.0553	.0757	17693	21327	23437	18051	23816	27402
54	.0389	.0658	15380	18540	20374	15692	20703	23821
CUSH	.0000	.0000	0	0	0	0	0	0
55	.0823	.0843	19703	23751	26100	20102	26522	30516
56	.0500	.0701	16386	19752	21706	16718	22057	25378
SCUSH	.0000	.0000	0	0	0	0	0	0
57	.0722	.0366	8547	10303	11322	8720	11505	13237
58	.0815	.0327	7640	9210	10120	7795	10284	11833
59	.0759	.0327	7640	9210	10120	7795	10284	11833
PEG	.0000	.0000	0	0	0	0	0	0
60	.0187	.0299	6987	8422	9255	7128	9405	10821
61	.0011	.0443	10354	12481	13716	10564	13938	16036
62	.0186	.0271	6333	7634	8389	6461	8525	9809
63	.0158	.0301	7037	8482	9321	7179	9472	10899
PHIL	.0000	.0000	0	0	0	0	0	0
64	.0084	.0454	10605	12784	14049	10820	14276	16426
AUR	.0000	.0000	0	0	0	0	0	0
65	.0366	.0463	10807	13027	14315	11026	14547	16737
THIRD	.0000	.0000	0	0	0	0	0	0
66	.0492	.0463	10807	13027	14315	11026	14547	16737
MIN	.0000	.0000	0	0	0	0	0	0
67	.0519	.0557	13018	15693	17245	13282	17523	20162
68	.0463	.0516	12063	14541	15980	12308	16238	18683
69	.0496	.0506	11812	14238	15647	12051	15900	18294
BARN	.0000	.0000	0	0	0	0	0	0
70	.0956	.0000	0	0	0	0	0	0
71	.0701	.0000	0	0	0	0	0	0
72	.0848	.0000	0	0	0	0	0	0
73	.0420	.0000	0	0	0	0	0	0
74	.0410	.0000	0	0	0	0	0	0
75	.0459	.0000	0	0	0	0	0	0
GEXT	.0000	.0000	0	0	0	0	0	0
76	.0428	.0000	0	0	0	0	0	0
GILL	.0000	.0000	0	0	0	0	0	0
77	.0489	.0000	0	0	0	0	0	0
COLCON	.0000	.0000	0	0	0	0	0	0
NETWORK	.0000	0.0000	0	0	0	0	1437145	1653566

HIGH GROWTH SCENARIO
FORECASTED LINK VOLUMES- WITH PROJECT
1986-2005

LINK	1986	1987	1988	1989	1990	1991	1995	2005
1	28336	27960.87	28835.34	28866.76	29769.53	27357.96	36251	41710
2	30673	30267.45	31214.07	31248.07	32225.32	29612.47	39242	45151
3	32472	32041.75	33043.85	33079.85	34114.39	31346.7	41542	47798
4	39452	38930.2	40147.74	40191.48	41448.43	38079.62	50473	58074
5	38077	37573.39	38748.49	38790.71	40003.84	36753.44	48714	56050
6	33519	33075.02	34109.44	34146.6	35214.49	32356.64	42882	49339
7	37125	36634.05	37779.78	37820.94	39003.75	35835.32	47496	54649
8	29616	29223.75	30137.72	30170.56	31114.1	28592.33	37889	43594
9	19144	18891.07	19481.88	19503.11	20113.04	18492.94	24492	28181
AIR	0	0	0	0	0	0	0	0
10	10365	10228.31	10548.2	10559.69	10889.94	10025.77	13261	15258
11	6611	6523.158	6727.17	6734.499	6945.112	6404.277	8457	9731
12	14226	14037.84	14476.87	14492.64	14945.88	13749.29	18200	20941
13	10391	10253.36	10574.03	10585.55	10916.61	10050.26	13293	15295
14	12743	12574.56	12967.83	12981.96	13387.95	12319.05	16303	18758
15	12692	12524.46	12916.17	12930.24	13334.62	12270.08	16238	18683
STNB	0	0	0	0	0	0	0	0
16	10365	10228.31	10548.2	10559.69	10889.94	10025.77	13261	15258
17	6611	6523.158	6727.17	6734.499	6945.112	6404.277	8457	9731
18	7114	7019.962	7239.511	7247.398	7474.052	6889.864	9101	10472
19	10393	10255.45	10576.19	10587.71	10918.83	10052.3	13296	15298
20	12745	12576.65	12969.98	12984.11	13390.18	12321.09	16306	18761
21	12692	12524.46	12916.17	12930.24	13334.62	12270.08	16238	18683
STWB	0	0	0	0	0	0	0	0
22	11635	11480.76	11839.82	11852.72	12223.4	11221.54	14885	17126
23	11825	11668.63	12033.56	12046.67	12423.42	11405.17	15128	17407
RICH	0	0	0	0	0	0	0	0
24	13551	13372	13790.21	13805.23	14236.97	13077.18	17337	19948
25	7974	7868.869	8114.967	8123.809	8377.871	7698.303	10202	11738
26	11894	11736.74	12103.8	12116.99	12495.93	11478.84	15217	17508
27	15356	15152.65	15626.55	15643.58	16132.81	14817.63	19645	22604
28	12072	11911.91	12284.46	12297.84	12682.44	11650.06	15444	17770
29	9595	9468.219	9764.336	9774.975	10080.68	9261.542	12276	14124
SFEEB	0	0	0	0	0	0	0	0
30	9820	9689.815	9992.863	10003.75	10316.61	9478.135	12563	14455
31	5963	5884.134	6068.16	6074.771	6264.753	5758.38	7629	8778
32	9941	9809.81	10116.61	10127.63	10444.36	9595.421	12718	14634
33	15374	15170.17	15644.62	15661.66	16151.46	14834.75	19668	22630
34	14291	14101.6	14542.63	14558.47	15013.77	13790.31	18283	21036
35	11488	11335.59	11690.11	11702.84	12068.83	11086.75	14697	16910
SFEWB	0	0	0	0	0	0	0	0
36	21736	21448.14	22118.93	22143.03	22835.53	20992.28	27808	31995
37	21736	21448.14	22118.93	22143.03	22835.53	20992.28	27808	31995
38	24010	23692.11	24433.08	24459.7	25224.65	23185.58	30717	35343
UNIV	0	0	0	0	0	0	0	0
39	10249	10113.5	10429.8	10441.17	10767.7	9885.158	13112	15087
PARKS	0	0	0	0	0	0	0	0
40	9096	8975.866	9256.585	9266.67	9556.474	8773.205	11637	13390
41	20572	20300.07	20934.95	20957.76	21613.19	19841.73	26319	30282

GEIST	0	0	0	0	0	0	0	0
42	21988	21696.55	22375.1	22399.48	23100	21235.07	28130	32366
43	28135	27762.56	28630.83	28662.03	29558.4	27164.13	35994	41415
44	25385	25048.93	25832.33	25860.48	26669.23	24511.77	32476	37367
45	30779	30371.83	31321.7	31355.83	32336.44	29714.48	39377	45307
46	24856	24527.08	25294.16	25321.72	26113.62	24001.7	31799	36588
47	16659	16438.36	16952.47	16970.94	17501.68	16095.61	21312	24522
COLL	0	0	0	0	0	0	0	0
48	15918	15707.77	16199.02	16216.67	16723.83	15367.31	20365	23432
49	15918	15707.77	16199.02	16216.67	16723.83	15367.31	20365	23432
50	23904	23587.74	24325.45	24351.95	25113.53	23069.37	30582	35187
51	26411	26061.32	26876.39	26905.67	27747.11	25487.1	33789	38877
ILL	0	0	0	0	0	0	0	0
52	6981	6888.455	7103.891	7111.631	7334.038	6747.126	8931	10276
53	18616	18369.21	18943.71	18964.35	19557.44	17968.67	23816	27402
54	16183	15968.69	16468.11	16486.05	17001.63	15622.35	20703	23821
CUSH	0	0	0	0	0	0	0	0
55	20731	20456.62	21096.4	21119.39	21779.87	20008.95	26522	30516
56	17241	17012.4	17544.46	17563.57	18112.85	16642.49	22057	25378
SCUSH	0	0	0	0	0	0	0	0
57	8993	8873.583	9151.103	9161.074	9447.575	8673.232	11505	13237
58	8039	7932.161	8180.238	8189.151	8445.256	7753.065	10284	11833
59	8039	7932.161	8180.238	8189.151	8445.256	7753.065	10284	11833
PEG	0	0	0	0	0	0	0	0
60	7351	7253.752	7480.613	7488.763	7722.965	7097.074	9405	10821
61	10894	10750.16	11086.38	11098.45	11445.54	10514.54	13938	16036
62	6664	6575.344	6780.987	6788.375	7000.673	6433.983	8525	9809
63	7404	7305.937	7534.43	7542.639	7778.526	7148.081	9472	10899
PHIL	0	0	0	0	0	0	0	0
64	11159	11011.09	11355.46	11367.83	11723.35	10762.48	14276	16426
AUR	0	0	0	0	0	0	0	0
65	11370	11219.83	11570.73	11583.34	11945.59	10966.51	14547	16737
THIRD	0	0	0	0	0	0	0	0
66	11370	11219.83	11570.73	11583.34	11945.59	10966.51	14547	16737
MIN	0	0	0	0	0	0	0	0
67	13697	13515.98	13938.7	13953.88	14390.27	13225.02	17523	20162
68	12692	12524.46	12916.17	12930.24	13334.62	12255.88	16238	18683
69	12428	12263.54	12647.08	12660.86	13056.81	12000.85	15900	18294
BARN	0	0	0	0	0	0	0	0
70	0	0	0	0	0	26578.85	0	0
71	0	17228.26	17767.07	18322.64	18895.65	19486.55	0	0
72	0	0	0	0	0	23574.42	0	0
73	0	0	0	0	0	11664.27	0	0
74	0	0	0	10721.92	11057.24	11403.01	0	0
75	0	0	0	11986.3	12361.15	12747.7	0	0
GEXT	0	0	0	0	0	0	0	0
76	0	0	0	0	0	11910.15	0	0
GILL	0	0	0	0	0	0	0	0
77	0	12010.87	12386.46	12148.92	13173.31	13585.26	0	0
COLCON	0	0	0	0	0	0	0	0
NETWORK	0	0	0	0	0	0	1437145	1653566

MODERATE GROWTH SCENARIO
FORECASTED LINK VOLUMES- WITH PROJECT
1986-2005

LINK	1986	1987	1988	1989	1990	1991	1995	2005
1	20965	26287	26839	26584	27142	24533	25705	28248
2	22695	28474	29071	28796	29400	26574	25777	28326
3	24025	30156	30789	30497	31137	28144	34559	37977
4	29190	36687	37457	37102	37880	34239	37916	41666
5	28173	35401	36144	35801	36552	33038	34324	37719
6	24800	31136	31789	31488	32148	29058	35409	38911
7	27468	34510	35234	34900	35633	32207	30097	33074
8	21912	27484	28061	27795	28378	25650	17165	18863
9	14165	17688	18059	17888	18263	16507	16166	17765
AIR	0	0	0	0	0	0	0	0
10	7669	9474	9673	9581	9782	8842	10346	11369
11	4891	5961	6086	6029	6155	5564	8074	8873
12	10526	13086	13361	13234	13512	12213	6294	6917
13	7688	9498	9697	9605	9807	8864	9782	10749
14	9428	11699	11944	11831	12079	10918	13821	15188
15	9391	11651	11896	11783	12030	10874	10710	11769
STNB	0	0	0	0	0	0	0	0
16	7669	9474	9673	9581	9782	8842	15628	17174
17	4891	5961	6086	6029	6155	5564	11809	12977
18	5264	6432	6567	6505	6642	6003	8213	9026
19	7690	9500	9699	9607	9809	8866	10538	11581
20	9430	11701	11946	11833	12081	10920	14337	15755
21	9391	11651	11896	11783	12030	10874	13136	14436
STWB	0	0	0	0	0	0	0	0
22	8608	10885	11114	11008	11239	10159	19303	21212
23	8749	11063	11295	11188	11423	10325	16724	18378
RICH	0	0	0	0	0	0	0	0
24	10026	12622	12887	12765	13033	11780	11882	13058
25	5900	7405	7560	7489	7646	6911	6992	7684
26	8800	11072	11304	11197	11432	10333	10429	11461
27	11362	14311	14611	14473	14776	13356	13465	14796
28	8932	11238	11474	11365	11604	10488	10585	11632
29	7099	8921	9108	9022	9211	8326	8414	9246
SFEEB	0	0	0	0	0	0	0	0
30	7265	9131	9323	9235	9428	8522	8610	9462
31	4412	5523	5639	5585	5703	5154	5229	5746
32	7355	9245	9439	9350	9546	8628	8717	9579
33	11375	14327	14628	14489	14793	13371	13480	14814
34	10573	13314	13594	13465	13747	12426	12531	13770
35	8499	10692	10916	10813	11039	9978	10073	11069
SFEWB	0	0	0	0	0	0	0	0
36	16082	20112	20534	20340	20766	18770	16157	17755
37	16082	20112	20534	20340	20766	18770	16253	17861
38	17764	22240	22706	22491	22963	20756	16157	17755
UNIV	0	0	0	0	0	0	0	0
39	7583	9589	9790	9697	9901	8949	20493	22520
PARKS	0	0	0	0	0	0	0	0
40	6730	8510	8689	8606	8787	7942	13312	14629
41	15221	19247	19651	19465	19873	17963	22099	24284
GEIST	0	0	0	0	0	0	0	0
42	16268	20348	20775	20578	21009	18990	9270	10186
43	20817	26099	26647	26394	26948	24357	9523	10465

44	18782	23526	24020	23792	24291	21956	14705	16159
45	22773	28573	29172	28896	29502	26666	23813	26168
46	18391	23031	23515	23292	23780	21494	18083	19872
47	12326	15362	15685	15536	15862	14337	9941	10924
COLL	0	0	0	0	0	0	0	0
48	11778	14781	15091	14948	15262	13795	20820	22879
49	11778	14781	15091	14948	15262	13795	19208	21108
50	17686	22252	22719	22504	22976	20767	22649	24889
51	19541	24598	25114	24876	25398	22956	25311	27814
ILL	0	0	0	0	0	0	0	0
52	5165	6419	6554	6492	6628	5991	12612	13859
53	13773	17305	17668	17500	17867	16150	15580	17121
54	11973	15029	15344	15199	15517	14026	10948	12031
CUSH	0	0	0	0	0	0	0	0
55	15338	19284	19688	19502	19911	17997	23183	25476
56	12756	16018	16354	16199	16539	14949	14079	15471
SCUSH	0	0	0	0	0	0	0	0
57	6653	8413	8590	8508	8687	7852	20329	22339
58	5948	7521	7678	7606	7765	7019	22954	25224
59	5948	7521	7678	7606	7765	7019	21379	23493
PEG	0	0	0	0	0	0	0	0
60	5439	6822	6965	6899	7043	6366	5271	5793
61	8061	10137	10349	10251	10466	9460	314	345
62	4930	6178	6308	6248	6379	5766	5250	5769
63	5478	6871	7015	6949	7095	6413	4450	4890
PHIL	0	0	0	0	0	0	0	0
64	8256	10440	10659	10558	10779	9743	2356	2589
AUR	0	0	0	0	0	0	0	0
65	8413	10638	10861	10758	10984	9928	10294	11312
THIRD	0	0	0	0	0	0	0	0
66	8413	10638	10861	10758	10984	9928	13842	15211
MIN	0	0	0	0	0	0	0	0
67	10134	12703	12970	12847	13116	11855	14611	16056
68	9391	11763	12010	11896	12146	10978	13031	14320
69	9195	11516	11757	11646	11890	10747	13971	15352
BARN	0	0	0	0	0	0	0	0
70	0	0	0	0	0	24776	26922	29584
71	0	16717	17068	17426	17792	18165	19738	21690
72	0	0	0	0	0	21976	23879	26240
73	0	0	0	0	0	10873	11815	12983
74	0	0	0	10197	10411	10630	11550	12692
75	0	0	0	11400	11639	11883	12912	14189
GEXT	0	0	0	0	0	0	0	0
76	0	0	0	0	0	11102.46	12064	13257
GILL	0	0	0	0	0	0	0	0
77	0	11654.78	11899.3	12148.92	12403.76	12663.97	13760	15121
COLCON	0	0	0	0	0	0	0	0
NETWORK	0	0	0	0	0	0	0	0

GEIST EVALUATION		TIME OF DAY FACTOR				HOURS IN EACH TIME OF DAY			
LINK	AADT	TODFAM	TODFMD	TODFPM	TODFO	HRSAM	HRSMD	HRSPM	HRSO
1	25796	.03	.061	.079	.0245	2	8	2	12
2	27531	.03	.061	.079	.0245	2	8	2	12
3	28865	.03	.061	.079	.0245	2	8	2	12
4	34046	.03	.061	.079	.0245	2	8	2	12
5	33026	.03	.061	.079	.0245	2	8	2	12
6	29643	.03	.061	.079	.0245	2	8	2	12
7	32319	.03	.061	.079	.0245	2	8	2	12
8	26746	.03	.061	.079	.0245	2	8	2	12
9	18975	.03	.061	.079	.0245	2	8	2	12
AIR	0	0	0	0	0	0	0	0	0
10	12459	.036	.055	.079	.0275	2	8	2	12
11	9673	.036	.055	.079	.0275	2	8	2	12
12	15325	.036	.055	.079	.0275	2	8	2	12
13	12478	.036	.055	.079	.0275	2	8	2	12
14	14224	.036	.055	.079	.0275	2	8	2	12
15	14186	.036	.055	.079	.0275	2	8	2	12
STNB	0	0	0	0	0	0	0	0	0
16	12459	.036	.055	.079	.0275	2	8	2	12
17	9673	.036	.055	.079	.0275	2	8	2	12
18	10046	.036	.055	.079	.0275	2	8	2	12
19	12480	.036	.055	.079	.0275	2	8	2	12
20	14226	.036	.055	.079	.0275	2	8	2	12
21	14186	.036	.055	.079	.0275	2	8	2	12
STWB	0	0	0	0	0	0	0	0	0
22	8635	.036	.055	.079	.0275	2	8	2	12
23	8776	.036	.055	.079	.0275	2	8	2	12
RICH	0	0	0	0	0	0	0	0	0
24	11249	.03	.061	.0789	.0245	2	8	2	12
25	7110	.03	.061	.0789	.0245	2	8	2	12
26	10019	.03	.061	.0789	.0245	2	8	2	12
27	12588	.03	.061	.0789	.0245	2	8	2	12
28	10151	.03	.061	.0789	.0245	2	8	2	12
29	8313	.03	.061	.0789	.0245	2	8	2	12
SFEEB	0	0	0	0	0	0	0	0	0
30	8479	.03	.061	.0789	.0245	2	8	2	12
31	5617	.03	.061	.0789	.0245	2	8	2	12
32	8570	.03	.061	.0789	.0245	2	8	2	12
33	12601	.03	.061	.0789	.0245	2	8	2	12
34	11798	.03	.061	.0789	.0245	2	8	2	12
35	9717	.03	.061	.0789	.0245	2	8	2	12
SFEWB	0	0	0	0	0	0	0	0	0
36	20898	.034	.0605	.0823	.0236	2	8	2	12
37	20898	.034	.0605	.0823	.0236	2	8	2	12
38	22586	.034	.0605	.0823	.0236	2	8	2	12
UNIV	0	0	0	0	0	0	0	0	0
39	7606	.036	.0545	.079	.0275	2	8	2	12
PARKS	0	0	0	0	0	0	0	0	0
40	6751	.0342	.0605	.0823	.0236	2	8	2	12
41	15268	.0342	.0605	.0823	.0236	2	8	2	12
GEIST	0	0	0	0	0	0	0	0	0
42	21085	.0268	.0617	.0841	.0237	2	8	2	12
43	25647	.0268	.0617	.0841	.0237	2	8	2	12
44	23606	.0268	.0617	.0841	.0237	2	8	2	12

51	21984	.0238	.0705	.0798	.0191	2	8	2	12
ILL	0	0	0	0	0	0	0	0	0
52	7564	.0238	.0705	.0798	.0191	2	8	2	12
53	16199	.0238	.0705	.0798	.0191	2	8	2	12
54	14393	.0238	.0705	.0798	.0191	2	8	2	12
CUSH	0	0	0	0	0	0	0	0	0
55	17769	.0238	.0705	.0798	.0191	2	8	2	12
56	15178	.0238	.0705	.0798	.0191	2	8	2	12
SCUSH	0	0	0	0	0	0	0	0	0
57	6674	.0342	.0669	.0819	.0194	2	8	2	12
58	5966	.0342	.0669	.0819	.0194	2	8	2	12
59	5966	.0342	.0669	.0819	.0194	2	8	2	12
PEG	0	0	0	0	0	0	0	0	0
60	6647	.0342	.0669	.0819	.0194	2	8	2	12
61	9277	.0342	.0669	.0819	.0194	2	8	2	12
62	6137	.0342	.0669	.0819	.0194	2	8	2	12
63	6686	.0342	.0669	.0819	.0194	2	8	2	12
PHIL	0	0	0	0	0	0	0	0	0
64	8281	.0268	.0617	.0841	.0237	2	8	2	12
AUR	0	0	0	0	0	0	0	0	0
65	8438	.0268	.0617	.0841	.0237	2	8	2	12
THIRD	0	0	0	0	0	0	0	0	0
66	8438	.0268	.0617	.0841	.0237	2	8	2	12
MIN	0	0	0	0	0	0	0	0	0
67	12549	.0238	.0705	.0798	.0191	2	8	2	12
68	11803	.0238	.0705	.0798	.0191	2	8	2	12
69	11607	.0238	.0705	.0798	.0191	2	8	2	12
BARN	0	0	0	0	0	0	0	0	0
70	0	.0268	.0617	.0841	.0237	2	8	2	12
71	0	.0268	.0617	.0841	.0237	2	8	2	12
72	0	.0268	.0617	.0841	.0237	2	8	2	12
73	0	.0268	.0617	.0841	.0237	2	8	2	12
74	0	.0268	.0617	.0841	.0237	2	8	2	12
75	0	.0268	.0617	.0841	.0237	2	8	2	12
GEXT	0	0	0	0	0	0	0	0	0
76	0	.0268	.0617	.0841	.0237	2	8	2	12
GILL	0	0	0	0	0	0	0	0	0
77	0	.0268	.0617	.0841	.0237	2	8	2	12
COLCON	0	0	0	0	0	0	0	0	0
NETWORK	0	0	0	0	0	0	0	0	0

TOTAL VOLUME ON LINK					VOLUME TO CAPACITY RATIO				SPEED IN MPH		
TVOLAM	TVOLMD	TVOLPM	TVOLD	NLC	VCRAM	VCRMD	VCRPM	VCRD	SPDAM	SPDMD	SPDPM
1367	11119	3600	6699	3333	.2051	.4170	.5401	.1675	28.22	27.40	27.00
1371	11154	3611	6720	3333	.2057	.4183	.5417	.1680	28.22	27.40	27.00
1839	14957	4843	9011	3333	.2759	.5609	.7265	.2253	28.01	26.64	25.40
2016	16399	5310	9880	3333	.3025	.6150	.7965	.2470	27.81	26.22	25.00
1826	14852	4809	8948	3333	.2739	.5570	.7214	.2237	31.01	29.63	28.40
1883	15318	4959	9228	3333	.2825	.5745	.7440	.2307	31.01	29.63	28.40
1602	13026	4218	7848	2909	.2753	.5597	.7249	.2248	31.01	29.63	28.40
914	7432	2406	4478	2909	.1571	.3194	.4136	.1283	28.43	27.81	27.40
859	6990	2263	4211	2909	.1477	.3004	.3890	.1206	28.64	27.81	27.60
0	0	0	0	0	0	0	0	0	0	0	0
661	4037	1450	3028	3500	.0944	.1442	.2071	.0721	43.75	43.07	41.75
515	3146	1130	2360	1500	.1716	.2622	.3766	.1311	42.40	41.10	39.83
402	2454	881	1840	1500	.1338	.2045	.2937	.1022	43.07	41.75	41.10
625	3817	1371	2863	1500	.2082	.3181	.4569	.1590	35.84	35.22	34.30
882	5390	1936	4043	1500	.2940	.4492	.6452	.2246	35.53	34.60	33.60
683	4174	1499	3130	1500	.2277	.3478	.4996	.1739	35.84	35.22	34.30
0	0	0	0	0	0	0	0	0	0	0	0
995	6082	2184	4562	3500	.1422	.2172	.3120	.1086	43.07	41.75	40.46
753	4604	1653	3453	1500	.2511	.3836	.5510	.1918	41.10	39.83	37.46
525	3209	1152	2407	1500	.1750	.2674	.3841	.1337	42.40	41.10	39.83
673	4111	1476	3083	1500	.2242	.3426	.4921	.1713	35.84	35.22	34.30
915	5589	2007	4192	1500	.3049	.4658	.6690	.2329	35.22	34.30	33.40
839	5128	1841	3846	1500	.2797	.4273	.6138	.2137	35.53	34.60	33.60
0	0	0	0	0	0	0	0	0	0	0	0
1232	7529	2704	5647	2400	.2567	.3922	.5633	.1961	41.10	39.83	37.46
1067	6523	2342	4892	2100	.2541	.3883	.5577	.1941	41.10	39.83	37.46
0	0	0	0	0	0	0	0	0	0	0	0
632	5141	1662	3097	2000	.1580	.3213	.4156	.1290	42.40	40.46	39.21
372	3024	978	1822	1000	.1859	.3780	.4889	.1518	42.40	39.83	38.60
555	4513	1459	2719	1000	.2774	.5641	.7296	.2266	41.10	37.46	35.60
716	5827	1884	3511	1000	.3582	.7284	.9421	.2925	39.83	35.60	33.21
563	4583	1482	2761	2000	.1409	.2864	.3705	.1150	43.07	41.10	39.83
448	3640	1177	2193	2000	.1119	.2275	.2943	.0914	43.07	41.75	41.10
0	0	0	0	0	0	0	0	0	0	0	0
458	3722	1203	2242	1000	.2288	.4652	.6017	.1869	41.75	38.60	36.83
279	2268	733	1366	1000	.1394	.2835	.3667	.1139	43.07	41.10	39.83
463	3768	1219	2270	1000	.2317	.4710	.6093	.1892	41.75	38.60	36.83
716	5827	1884	3511	1000	.3582	.7284	.9421	.2925	39.83	35.60	33.21
666	5420	1753	3265	1000	.3332	.6775	.8763	.2721	40.46	36.21	33.83
536	4362	1410	2628	1050	.2554	.5192	.6716	.2085	41.10	38.00	36.21
0	0	0	0	0	0	0	0	0	0	0	0
974	6933	2358	4057	2667	.1826	.3249	.4420	.1268	31.43	30.81	30.40
981	6979	2373	4084	2667	.1838	.3271	.4450	.1276	31.43	30.81	30.40
974	6933	2358	4057	2667	.1826	.3249	.4420	.1268	31.43	30.81	30.40
0	0	0	0	0	0	0	0	0	0	0	0
1308	7918	2869	5993	1667	.3922	.5938	.8607	.2996	44.91	43.45	39.83
0	0	0	0	0	0	0	0	0	0	0	0
807	5710	1942	3341	2923	.1380	.2442	.3322	.0953	31.64	31.22	30.81
1340	9482	3225	5548	2909	.2303	.4074	.5543	.1589	31.22	30.40	29.63
0	0	0	0	0	0	0	0	0	0	0	0
441	4059	1383	2338	2667	.0826	.1902	.2593	.0731	23.87	23.44	23.02
452	4165	1419	2400	3091	.0732	.1684	.2296	.0647	23.87	23.44	23.23
699	6435	2193	3708	2667	.1310	.3016	.4111	.1159	31.64	30.81	30.40

1069	12662	3583	5146	2833	.1886	.5587	.6324	.1514	28.43	26.64	26.22
0	0	0	0	0	0	0	0	0	0	0	0
532	6304	1784	2562	2167	.1228	.3637	.4116	.0985	21.66	20.61	20.40
658	7796	2206	3168	2250	.1462	.4331	.4903	.1173	21.66	20.40	20.20
462	5471	1548	2223	1950	.1184	.3507	.3970	.0950	21.66	20.61	20.61
0	0	0	0	0	0	0	0	0	0	0	0
978	11587	3279	4709	1455	.3361	.9955	1.1268	.2697	20.81	12.60	12.00
594	7044	1993	2862	1455	.2043	.6051	.6850	.1639	21.23	18.20	17.07
0	0	0	0	0	0	0	0	0	0	0	0
1232	9643	2951	4195	1167	.5280	1.0329	1.2645	.2995	30.00	15.00	8.00
1392	10893	3334	4738	1417	.4912	.9610	1.1764	.2787	30.20	17.60	12.00
1296	10141	3104	4411	1385	.4679	.9152	1.1204	.2654	30.20	20.65	12.00
0	0	0	0	0	0	0	0	0	0	0	0
320	2500	765	1087	1333	.1199	.2344	.2870	.0680	31.64	31.22	31.01
20	153	47	67	1083	.0090	.0177	.0216	.0051	32.00	32.00	32.00
318	2487	761	1082	1545	.1029	.2012	.2464	.0584	28.64	28.22	28.22
271	2117	648	921	1545	.0876	.1713	.2097	.0497	28.85	28.43	28.22
0	0	0	0	0	0	0	0	0	0	0	0
112	1035	353	596	1417	.0397	.0913	.1245	.0351	32.00	31.85	31.64
0	0	0	0	0	0	0	0	0	0	0	0
489	4506	1535	2596	1385	.1766	.4067	.5543	.1562	28.43	27.40	26.64
0	0	0	0	0	0	0	0	0	0	0	0
658	6059	2065	3491	1385	.2375	.5468	.7453	.2100	28.22	27.00	25.40
0	0	0	0	0	0	0	0	0	0	0	0
617	7313	2069	2972	3400	.0908	.2688	.3043	.0728	21.87	21.02	20.81
550	6519	1845	2649	2550	.1079	.3196	.3617	.0866	21.66	20.81	20.61
590	6990	1978	2841	1700	.1735	.5140	.5818	.1392	21.44	20.00	19.42
0	0	0	0	0	0	0	0	0	0	0	0
1279	11776	4013	6785	4250	.1504	.3464	.4721	.1330	28.43	27.81	27.20
938	8635	2942	4975	4250	.1103	.2540	.3462	.0976	31.64	31.01	30.81
1134	10447	3560	6019	2545	.2229	.5131	.6994	.1971	31.22	30.00	28.81
562	5176	1764	2982	2833	.0992	.2284	.3113	.0877	31.85	31.22	30.81
549	5059	1724	2915	2833	.0969	.2232	.3042	.0857	23.87	23.23	22.81
613	5647	1924	3254	2833	.1082	.2492	.3396	.0957	23.65	23.23	22.81
0	0	0	0	0	0	0	0	0	0	0	0
574	5282	1800	3043	2833	.1012	.2331	.3177	.0895	28.64	28.22	27.81
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	2833	.0000	.0000	.0000	.0000	29.00	29.00	29.00
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

TRAVEL TIME IN MINUTES

DISTANCE	TIMEAM	TIMEMD	TIMEPM	TIMEO
.17	.3614	.3722	.3778	.3588
.14	.2976	.3066	.3111	.2954
.25	.5354	.5631	.5906	.5315
.38	.8199	.8696	.9120	.8079
.31	.5997	.6276	.6549	.5958
.9	1.7412	1.8222	1.9014	1.7297
.28	.5417	.5669	.5915	.5381
.78	1.6461	1.6829	1.7079	1.6340
.76	1.5921	1.6398	1.6519	1.5921
0	0	0	0	0
.62	.8502	.8636	.8911	.8502
.68	.9622	.9928	1.0244	.9472
.28	.3900	.4024	.4088	.3900
.21	.3516	.3578	.3673	.3485
.5	.8444	.8670	.8928	.8370
.35	.5859	.5963	.6122	.5808
0	0	0	0	0
.76	1.0586	1.0923	1.1271	1.0586
.66	.9636	.9943	1.0571	.9339
.28	.3962	.4088	.4218	.3900
.21	.3516	.3578	.3673	.3485
.52	.8860	.9096	.9341	.8705
.35	.5911	.6069	.6249	.5859
0	0	0	0	0
.97	1.4162	1.4613	1.5536	1.3725
1.04	1.5184	1.5667	1.6657	1.4716
0	0	0	0	0
.5	.7075	.7415	.7651	.6965
.83	1.1744	1.2504	1.2902	1.1744
1.13	1.6498	1.8098	1.9045	1.6241
.99	1.4914	1.6685	1.7886	1.4454
1.11	1.5462	1.6206	1.6722	1.5462
.5	.6965	.7186	.7300	.6857
0	0	0	0	0
.48	.6899	.7461	.7819	.6792
.83	1.1562	1.2118	1.2504	1.1562
1.13	1.6241	1.7565	1.8408	1.5989
.99	1.4914	1.6685	1.7886	1.4454
1.11	1.6462	1.8393	1.9684	1.6206
.33	.4818	.5211	.5468	.4743
0	0	0	0	0
.21	.4009	.4090	.4145	.3983
.64	1.2218	1.2464	1.2631	1.2137
.44	.8400	.8569	.8684	.8344
0	0	0	0	0
.43	.5745	.5937	.6478	.5668
0	0	0	0	0
1.04	1.9723	1.9987	2.0254	1.9593
.51	.9801	1.0065	1.0326	.9736
0	0	0	0	0
.88	2.2123	2.2527	2.2938	2.2123
.87	2.1871	2.2271	2.2473	2.1871
1.1	2.0861	2.1423	2.1710	2.0861

.09	.1899	.2027	.2060	.1899
0	0	0	0	0
.08	.2216	.2329	.2353	.2194
.26	.7203	.7646	.7723	.7203
.12	.3325	.3494	.3494	.3292
0	0	0	0	0
.61	1.7586	2.9048	3.0500	1.7412
.41	1.1587	1.3513	1.4414	1.1472
0	0	0	0	0
.86	1.7200	3.4400	6.4500	1.6638
.65	1.2914	2.2169	3.2500	1.2576
1	1.9868	2.9055	5.0000	1.9346
0	0	0	0	0
.36	.6827	.6919	.6965	.6782
.41	.7687	.7687	.7687	.7687
.6	1.2569	1.2756	1.2756	1.2476
.16	.3327	.3377	.3402	.3310
0	0	0	0	0
.66	1.2375	1.2434	1.2517	1.2375
0	0	0	0	0
.17	.3588	.3722	.3829	.3588
0	0	0	0	0
.57	1.2118	1.2667	1.3465	1.2118
0	0	0	0	0
.15	.4115	.4282	.4324	.4115
.23	.6372	.6631	.6697	.6309
.17	.4757	.5100	.5253	.4710
0	0	0	0	0
1.13	2.3847	2.4381	2.4926	2.3671
.81	1.5361	1.5671	1.5775	1.5260
.45	.8648	.9000	.9373	.8591
1.26	2.3737	2.4215	2.4539	2.3737
.75	1.8855	1.9373	1.9727	1.8855
.75	1.9026	1.9373	1.9727	1.8855
0	0	0	0	0
.9	1.8853	1.9134	1.9418	1.8715
0	0	0	0	0
.9	1.8621	1.8621	1.8621	1.8621
0	0	0	0	0
0	0	0	0	0

SPEED-FLOW LOOKUP TABLES

V/C	1/1&4	1/2	1/3	2,3,4/1	2,3,4/2	2,3,4/3	2,3,4/4
0	37.00	44.00	47.00	22.00	29.00	32.00	24.00
.05	36.80	43.75	46.77	21.87	28.85	31.85	23.87
.1	36.48	43.07	46.46	21.66	28.64	31.64	23.65
.15	36.16	42.40	46.14	21.44	28.43	31.43	23.44
.2	35.84	41.75	45.83	21.23	28.22	31.22	23.23
.25	35.53	41.10	45.52	21.02	28.01	31.01	23.02
.3	35.22	40.46	45.21	20.81	27.81	30.81	22.81
.35	34.91	39.83	44.91	20.61	27.60	30.60	22.61
.4	34.60	39.21	44.60	20.40	27.40	30.40	22.40
.45	34.30	38.60	44.30	20.20	27.20	30.20	22.20
.5	34.00	38.00	44.00	20.00	27.00	30.00	22.00
.55	33.81	37.46	43.45	19.42	26.64	29.63	21.42
.6	33.60	36.83	42.83	18.20	26.22	29.22	20.51
.65	33.40	36.21	42.21	17.07	25.81	28.81	19.64
.7	33.20	35.60	41.60	16.00	25.40	28.40	18.80
.75	33.00	35.00	41.00	15.00	25.00	28.00	18.00
.8	32.63	34.47	40.46	14.59	24.75	28.43	17.49
.85	32.22	33.83	39.83	13.89	21.84	24.23	16.24
.9	31.81	33.21	39.21	13.23	19.27	20.65	15.08
.95	31.40	32.60	38.60	12.60	17.00	17.60	14.00
1	31.00	32.00	38.00	12.00	15.00	15.00	13.00

APPENDIX B

LINK	VOLUMES	TVOLAM	TVOLMD	TVOLPM	TVOLO	TRUCKAM	TRUCKMD	TRUCKPM	TRUCKO	AUTOAM	AUTOMD
1	39159	2350	19110	6187	11513	454	3393	577	118	1895	15717
2	41793	2508	20395	6603	12287	485	3621	616	126	2023	16773
3	43819	2629	21383	6923	12883	508	3797	646	132	2121	17586
4	51683	3101	25221	8166	15195	600	4478	761	156	2501	20743
5	50134	3008	24465	7921	14739	582	4344	739	151	2426	20121
6	44998	2700	21959	7110	13229	522	3899	663	136	2178	18060
7	49062	2944	23942	7752	14424	569	4251	723	148	2375	19691
8	40601	2436	19813	6415	11937	471	3518	598	122	1965	16295
9	28804	1728	14056	4551	8468	334	2496	424	87	1394	11561
AIR	0	0	0	0	0	0	0	0	0	0	0
10	18914	1362	8322	2988	6242	219	1639	279	57	1142	6683
11	14684	1057	6461	2320	4846	170	1272	216	44	887	5188
12	23263	1675	10236	3676	7677	270	2016	343	70	1405	8220
13	18942	1364	8335	2993	6251	220	1641	279	57	1144	6693
14	21593	1555	9501	3412	7126	250	1871	318	65	1304	7630
15	21535	1551	9476	3403	7107	250	1866	317	65	1301	7609
STNB	0	0	0	0	0	0	0	0	0	0	0
16	18914	1362	8322	2988	6242	219	1639	279	57	1142	6683
17	14684	1057	6461	2320	4846	170	1272	216	44	887	5188
18	15251	1098	6710	2410	5033	177	1322	225	46	921	5389
19	18945	1364	8336	2993	6252	220	1642	279	57	1144	6694
20	21595	1555	9502	3412	7126	251	1871	318	65	1304	7631
21	21535	1551	9476	3403	7107	250	1866	317	65	1301	7609
STWB	0	0	0	0	0	0	0	0	0	0	0
22	13108	944	5767	2071	4326	152	1136	193	40	792	4632
23	13322	959	5862	2105	4396	155	1154	196	40	805	4707
RICH	0	0	0	0	0	0	0	0	0	0	0
24	17076	1025	8333	2695	5020	198	1480	252	52	826	6853
25	10793	648	5267	1703	3173	125	935	159	33	522	4332
26	15209	913	7422	2400	4471	176	1318	224	46	736	6104
27	19109	1147	9325	3015	5618	222	1656	282	58	925	7669
28	15409	925	7520	2432	4530	179	1335	227	46	746	6184
29	12619	757	6158	1991	3710	146	1093	186	38	611	5065
SFEEB	0	0	0	0	0	0	0	0	0	0	0
30	12872	772	6282	2031	3784	149	1115	190	39	623	5166
31	8527	512	4161	1346	2507	99	739	126	26	413	3422
32	13009	781	6348	2053	3825	151	1127	192	39	630	5221
33	19129	1148	9335	3019	5624	222	1658	282	58	926	7677
34	17909	1075	8740	2826	5265	208	1552	264	54	867	7188
35	14751	885	7198	2328	4337	171	1278	217	44	714	5920
SFEWB	0	0	0	0	0	0	0	0	0	0	0
36	31724	2157	15354	5222	8984	368	2749	467	96	1789	12605
37	31724	2157	15354	5222	8984	368	2749	467	96	1789	12605
38	34286	2331	16594	5643	9710	398	2971	505	103	1934	13623
UNIV	0	0	0	0	0	0	0	0	0	0	0
39	11547	831	5034	1824	3810	134	1001	170	35	697	4034
PARKS	0	0	0	0	0	0	0	0	0	0	0
40	10248	701	4960	1687	2902	119	888	151	31	582	4072
41	23177	1585	11218	3815	6564	269	2008	341	70	1316	9209
GEIST	0	0	0	0	0	0	0	0	0	0	0
42	32007	1716	15799	5384	9103	371	2773	472	97	1344	13025
43	38933	2087	19217	6549	11073	452	3374	574	117	1635	15844

44	35835	1921	17688	6027	10191	416	3105	528	108	1505	14583
45	41912	2246	20688	7050	11920	486	3632	617	126	1760	17056
46	35239	1889	17394	5927	10022	409	3054	519	106	1480	14340
47	26004	1394	12836	4374	7396	302	2253	383	78	1092	10582
COLL	0	0	0	0	0	0	0	0	0	0	0
48	21552	1026	12155	3440	4940	250	1868	318	65	776	10288
49	21552	1026	12155	3440	4940	250	1868	318	65	776	10288
50	30548	1454	17229	4876	7002	354	2647	450	92	1100	14582
51	33373	1589	18822	5326	7649	387	2892	492	101	1201	15930
ILL	0	0	0	0	0	0	0	0	0	0	0
52	11483	547	6476	1833	2632	133	995	169	35	413	5481
53	24590	1171	13869	3925	5636	285	2131	362	74	885	11738
54	21850	1040	12323	3487	5008	253	1893	322	66	787	10430
CUSH	0	0	0	0	0	0	0	0	0	0	0
55	26974	1284	15213	4305	6182	313	2337	397	81	971	12876
56	23041	1097	12995	3677	5281	267	1997	339	69	829	10999
SCUSH	0	0	0	0	0	0	0	0	0	0	0
57	10131	693	5422	1659	2359	118	878	149	31	575	4544
58	9056	619	4847	1483	2108	105	785	133	27	514	4062
59	9056	619	4847	1483	2108	105	785	133	27	514	4062
PEG	0	0	0	0	0	0	0	0	0	0	0
60	10091	690	5401	1653	2349	117	874	149	30	573	4526
61	14083	963	7537	2307	3278	163	1220	207	42	800	6317
62	9316	637	4986	1526	2169	108	807	137	28	529	4179
63	10150	694	5432	1663	2363	118	880	150	31	577	4553
PHIL	0	0	0	0	0	0	0	0	0	0	0
64	12572	674	6205	2115	3575	146	1089	185	38	528	5116
AUR	0	0	0	0	0	0	0	0	0	0	0
65	12810	687	6323	2155	3643	149	1110	189	39	538	5213
THIRD	0	0	0	0	0	0	0	0	0	0	0
66	12810	687	6323	2155	3643	149	1110	189	39	538	5213
MIN	0	0	0	0	0	0	0	0	0	0	0
67	19049	907	10744	3040	4366	221	1651	281	57	686	9093
68	17917	853	10105	2860	4107	208	1553	264	54	645	8553
69	17619	839	9937	2812	4038	204	1527	260	53	634	8411
BARN	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0
GEXIT	0	0	0	0	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0
GILL	0	0	0	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0	0	0	0
COLCON	0	0	0	0	0	0	0	0	0	0	0
NETWORK	0	0	0	0	0	0	0	0	0	0	0

	VCRAM	VCRMD	VCRPM	VCRO	AUTO FUELAM	AUTO FUELMD	AUTO FUELPM	AUTO FUELO	AUTO OTHERAM	AUTO OTHERMD	AUTO OTHERPM
1	.3525	.7167	.9282	.2878	21.27	182.92	74.60	127.07	19.82	181.83	82.28
2	.3762	.7649	.9906	.3072	18.69	161.92	70.08	112.04	17.42	162.60	77.95
3	.3944	.802	1.0386	.3221	35.00	304.55	140.80	209.77	32.61	307.74	155.27
4	.4652	.9459	1.225	.3799	63.15	616.54	252.42	377.25	59.61	679.97	278.37
5	.4513	.9175	1.1883	.3685	47.83	471.00	199.75	286.04	46.80	548.31	229.58
6	.405	.8235	1.0666	.3308	124.31	1059.67	520.52	743.37	120.88	1088.57	598.24
7	.506	1.0288	1.3324	.4132	42.39	494.62	176.56	253.51	41.72	568.48	202.93
8	.4187	.8514	1.1026	.3419	101.50	933.75	407.03	606.41	95.21	999.51	448.87
9	.2971	.604	.7822	.2426	69.51	593.08	216.25	416.57	63.88	576.56	217.17
AIR	0	0	0	0	0.00	0.00	0.00	0.00	.00	.00	.00
10	.1945	.2972	.4269	.1486	39.78	235.17	96.88	214.29	52.32	319.05	136.94
11	.3524	.5384	.7733	.2692	34.59	205.68	85.91	185.30	48.26	297.77	130.99
12	.5583	.853	1.2252	.4265	23.05	139.99	57.99	122.82	33.71	217.17	92.14
13	.4546	.6946	.9976	.3473	14.54	85.91	35.68	77.94	15.59	94.18	40.89
14	.5182	.7917	1.1372	.3959	39.59	234.24	97.33	212.21	42.77	259.23	112.44
15	.5168	.7896	1.1342	.3948	27.64	163.53	67.95	148.15	29.86	180.98	78.50
STNB	0	0	0	0	0.00	0.00	0.00	0.00	.00	.00	.00
16	.1945	.2972	.4269	.1486	48.77	288.27	118.76	262.67	64.14	391.09	167.86
17	.3524	.5384	.7733	.2692	33.57	199.63	83.38	179.85	46.84	289.01	127.14
18	.366	.5592	.8032	.2796	14.79	88.41	36.95	79.25	20.64	129.29	56.80
19	.4547	.6946	.9978	.3473	14.54	85.92	35.68	77.95	15.59	94.19	40.89
20	.5183	.7918	1.1373	.3959	41.18	243.64	101.23	220.72	44.48	269.63	116.95
21	.5168	.7896	1.1342	.3948	27.64	163.53	67.95	148.15	29.86	180.98	78.50
STWB	0	0	0	0	0.00	0.00	0.00	0.00	.00	.00	.00
22	.1966	.3004	.4315	.1502	43.14	256.32	105.04	233.53	56.73	352.79	148.47
23	.2284	.3489	.5012	.1745	47.25	279.32	115.72	254.48	63.14	384.44	167.53
RICH	0	0	0	0	.00	.00	.00	.00	.00	.00	.00
24	.2561	.5208	.6736	.2092	23.45	199.77	72.45	140.27	31.82	289.21	108.32
25	.3238	.6584	.8516	.2644	24.74	213.24	77.95	147.94	34.05	318.82	120.93
26	.4563	.9277	1.2	.3726	48.23	422.50	152.79	286.84	69.01	661.09	242.77
27	.5733	1.1656	1.5077	.4682	53.65	471.81	168.18	319.17	78.45	749.68	267.24
28	.2311	.47	.6079	.1888	46.74	398.01	144.25	279.56	62.46	569.52	213.36
29	.1893	.3849	.4978	.1546	17.15	145.25	52.34	103.13	22.56	202.66	74.89
SFEEB	0	0	0	0	.00	.00	.00	.00	.00	.00	.00
30	.3862	.7852	1.0156	.3154	17.15	148.92	54.93	102.58	23.93	227.07	87.28
31	.2558	.5201	.6728	.2089	19.44	165.60	60.06	116.28	26.38	239.73	89.79
32	.3903	.7935	1.0264	.3187	40.81	354.31	130.69	244.05	56.94	540.24	207.66
33	.5739	1.1669	1.5093	.4687	53.70	472.30	168.36	319.50	78.54	750.46	267.52
34	.5373	1.0924	1.413	.4388	56.09	495.77	176.73	333.57	81.20	787.76	280.81
35	.4215	.857	1.1084	.3442	13.59	118.83	43.28	80.81	19.20	184.34	68.76
SFEWB	0	0	0	0	0.00	0.00	0.00	0.00	.00	.00	.00
36	.4044	.7196	.9789	.2807	24.88	181.22	83.47	122.45	23.34	180.15	92.85
37	.4044	.7196	.9789	.2807	75.83	552.30	254.39	373.17	71.13	549.03	282.96
38	.4371	.7778	1.058	.3034	56.34	413.31	202.83	278.15	52.85	415.06	223.67
UNIV	0	0	0	0	0.00	0.00	0.00	0.00	.00	.00	.00
39	.2494	.3775	.5472	.1905	16.43	95.66	39.48	88.78	21.79	129.65	54.61
PARKS	0	0	0	0	.00	.00	.00	.00	.00	.00	.00
40	.1199	.2121	.2885	.0827	37.79	265.73	100.49	185.90	35.32	251.83	95.87
41	.2725	.482	.6557	.188	42.24	298.66	114.86	207.26	40.30	292.19	116.85
GEIST	0	0	0	0	.00	.00	.00	.00	.00	.00	.00

42	.3216	.7405	1.0093	.2844	85.10	908.05	422.31	567.73	67.07	801.55
43	.3376	.7771	1.0593	.2985	102.34	1117.35	507.85	682.72	80.65	1000.30
44	.3601	.829	1.13	.3184	104.71	1045.80	542.70	699.67	101.19	1074.32
45	.4212	.9696	1.3216	.3724	46.89	587.73	242.36	313.29	45.59	686.50
46	.3541	.8152	1.1112	.3131	56.67	576.15	281.40	378.46	52.80	582.17
47	.2613	.6016	.82	.2311	6.45	64.29	24.88	43.07	5.93	62.50
COLL	0	0	0	0	.00	.00	.00	.00	.00	.00
48	.1811	.5363	.6071	.1453	13.15	178.26	54.80	82.37	11.91	169.33
49	.1811	.5363	.6071	.1453	7.08	95.99	29.51	44.35	6.41	91.18
50	.2566	.7602	.8605	.206	7.94	110.60	35.76	49.70	7.29	111.07
51	.2804	.8305	.94	.225	7.09	99.31	34.03	44.43	6.52	100.35
ILL	0	0	0	0	.00	.00	.00	.00	.00	.00
52	.1261	.3736	.4228	.1012	2.44	33.15	10.11	15.33	1.71	24.24
53	.2601	.7705	.8721	.2087	17.23	273.79	86.93	107.71	12.39	227.59
54	.2667	.79	.8942	.214	7.06	112.28	35.65	44.17	5.08	93.34
CUSH	0	0	0	0	.00	.00	.00	.00	.00	.00
55	.4412	1.307	1.4794	.3541	45.00	806.53	244.77	281.32	33.16	666.85
56	.3769	1.1164	1.2637	.3025	25.71	463.06	140.53	160.72	18.80	382.87
SCUSH	0	0	0	0	.00	.00	.00	.00	.00	.00
57	.2969	.5808	.711	.1684	31.13	250.44	84.71	125.29	29.84	251.59
58	.2186	.4276	.5234	.124	20.98	167.45	55.95	84.43	19.95	164.00
59	.2236	.4374	.5355	.1269	32.28	257.62	86.08	129.89	30.70	252.31
PEG	0	0	0	0	.00	.00	.00	.00	.00	.00
60	.2589	.5064	.62	.1469	12.98	103.89	34.90	52.10	12.44	103.15
61	.4447	.8699	1.065	.2523	20.80	181.14	77.21	83.47	20.37	203.66
62	.2062	.4034	.4938	.117	20.76	166.04	55.35	83.48	18.95	155.73
63	.2247	.4395	.5381	.1275	6.03	48.24	16.13	24.25	5.50	45.25
PHIL	0	0	0	0	.00	.00	.00	.00	.00	.00
64	.2378	.5474	.7461	.2103	21.87	215.29	83.05	146.50	20.72	211.87
AUR	0	0	0	0	.00	.00	.00	.00	.00	.00
65	.2479	.5707	.7778	.2192	5.98	59.41	23.04	40.07	5.46	57.05
THIRD	0	0	0	0	.00	.00	.00	.00	.00	.00
66	.2479	.5707	.7778	.2192	20.05	199.19	77.26	134.36	18.30	191.29
MIN	0	0	0	0	.00	.00	.00	.00	.00	.00
67	.1333	.395	.4471	.107	7.59	103.11	31.45	47.67	5.31	75.39
68	.1672	.4954	.5607	.1342	11.00	150.19	46.51	68.75	7.77	111.48
69	.2467	.7307	.8271	.198	8.03	123.63	39.57	50.21	5.73	101.70
BARN	0	0	0	0	.00	.00	.00	.00	.00	.00
70	0	0	0	0	.00	.00	.00	.00	.00	.00
71	0	0	0	0	.00	.00	.00	.00	.00	.00
72	0	0	0	0	.00	.00	.00	.00	.00	.00
73	0	0	0	0	.00	.00	.00	.00	.00	.00
74	0	0	0	0	.00	.00	.00	.00	.00	.00
75	0	0	0	0	.00	.00	.00	.00	.00	.00
GEXT	0	0	0	0	.00	.00	.00	.00	.00	.00
76	0	0	0	0	.00	.00	.00	.00	.00	.00
GILL	0	0	0	0	.00	.00	.00	.00	.00	.00
77	0	0	0	0	.00	.00	.00	.00	.00	.00
COLCON	0	0	0	0	.00	.00	.00	.00	.00	.00
NETWORK	0	0	0	0					.00	.00

	TRUCK TVARAM	TVARMD	TVARPM	TVARO	TOTAL AUTO	TOTAL TRUCK
1	18.17	137.00	23.87	4.71	806.58	183.76
2	15.97	120.56	21.14	4.15	724.40	161.83
3	29.91	227.57	39.88	7.77	1379.88	305.13
4	53.76	414.21	71.49	13.94	2678.84	553.40
5	43.00	330.63	56.58	11.11	2105.73	441.31
6	111.68	856.03	147.43	28.85	4969.39	1143.99
7	38.13	294.14	50.01	9.85	2026.72	392.12
8	86.57	662.89	115.28	22.45	4153.53	887.20
9	59.61	449.34	76.69	15.48	2533.16	601.13
AIR	.00	.00	.00	.00	.00	.00
10	40.19	302.55	52.12	10.41	1371.56	405.28
11	34.79	263.31	45.75	8.97	1239.90	352.82
12	23.10	176.67	30.32	5.93	860.47	236.02
13	11.43	85.94	14.75	2.96	446.26	115.08
14	31.08	233.96	40.08	8.04	1221.72	313.16
15	21.70	163.34	27.98	5.61	852.94	218.63
STNB	.00	.00	.00	.00	.00	.00
16	49.27	370.87	63.89	12.76	1681.26	496.79
17	33.77	255.57	44.40	8.70	1203.43	342.44
18	14.88	113.10	19.63	3.83	533.64	151.44
19	11.44	85.95	14.75	2.96	446.32	115.09
20	32.33	243.34	41.69	8.37	1270.73	325.72
21	21.70	163.34	27.98	5.61	852.94	218.63
STWB	.00	.00	.00	.00	.00	.00
22	43.58	329.31	56.51	11.33	1503.15	440.73
23	47.67	358.85	62.12	12.35	1646.55	480.99
RICH	.00	.00	.00	.00	.00	.00
24	29.49	225.16	38.78	7.64	1052.74	301.07
25	31.06	239.33	41.31	8.04	1138.38	319.74
26	60.41	467.62	80.01	15.57	2283.44	623.61
27	67.08	518.01	88.07	17.29	2564.88	690.44
28	58.85	449.10	77.35	15.24	2081.57	600.55
29	21.63	164.24	28.17	5.62	753.60	219.65
SFEEB	.00	.00	.00	.00	.00	.00
30	21.53	166.50	28.76	5.57	803.03	222.37
31	24.44	186.64	32.15	6.33	872.65	249.56
32	51.23	396.15	68.43	13.25	1910.59	529.06
33	67.15	518.55	88.16	17.31	2567.57	691.17
34	70.18	544.33	92.54	18.09	2683.43	725.14
35	17.04	132.03	22.66	4.39	640.04	176.12
SFEWB	.00	.00	.00	.00	.00	.00
36	18.21	137.10	24.07	4.72	820.90	184.10
37	55.50	417.82	73.35	14.37	2501.80	561.05
38	41.24	310.85	54.92	10.69	1899.64	417.70
UNIV	.00	.00	.00	.00	.00	.00
39	16.65	125.33	21.48	4.32	563.26	167.77
PARKS	.00	.00	.00	.00	.00	.00
40	28.83	216.73	36.97	7.47	1145.44	290.00
41	32.28	244.28	42.07	8.34	1307.44	326.97
GEIST	.00	.00	.00	.00	.00	.00

42	73.44	554.62	95.35	19.07	3680.74	742.48
43	88.31	668.21	114.67	22.93	4488.05	894.12
44	108.35	833.20	143.49	28.08	4864.01	1113.13
45	48.54	375.70	64.08	12.58	2505.66	500.90
46	55.80	424.60	74.40	14.49	2588.22	569.29
47	6.37	48.04	8.27	1.65	271.55	64.33
COLL	.00	.00	.00	.00	.00	.00
48	15.22	114.72	19.53	3.95	637.15	153.45
49	8.20	61.77	10.53	2.13	343.08	82.63
50	9.15	69.24	11.96	2.38	406.01	92.73
51	8.18	62.40	10.77	2.12	369.82	83.47
ILL	.00	.00	.00	.00	.00	.00
52	2.35	17.72	3.02	.61	105.15	23.71
53	16.46	125.00	21.32	4.27	875.07	167.06
54	6.75	51.26	8.74	1.75	358.86	68.51
CUSH	.00	.00	.00	.00	.00	.00
55	42.57	324.36	55.15	11.05	2485.70	433.13
56	24.40	186.23	31.66	6.33	1424.47	248.63
SCUSH	.00	.00	.00	.00	.00	.00
57	23.73	178.61	30.48	6.15	979.63	238.97
58	16.01	120.21	20.49	4.15	647.35	160.86
59	24.63	184.93	31.52	6.39	995.93	247.47
PEG	.00	.00	.00	.00	.00	.00
60	9.89	74.37	12.68	2.56	403.78	99.50
61	15.78	120.86	21.02	4.09	751.80	161.75
62	15.20	114.14	19.43	3.94	627.61	152.72
63	4.42	33.16	5.65	1.15	182.54	44.38
PHIL	.00	.00	.00	.00	.00	.00
64	22.59	172.02	29.63	5.87	923.52	230.11
AUR	.00	.00	.00	.00	.00	.00
65	5.92	44.64	7.63	1.54	250.72	59.73
THIRD	.00	.00	.00	.00	.00	.00
66	19.86	149.68	25.58	5.16	840.66	200.28
MIN	.00	.00	.00	.00	.00	.00
67	7.32	55.13	9.39	1.90	327.06	73.75
68	10.57	79.78	13.61	2.74	479.28	106.71
69	7.70	58.47	9.97	2.00	397.35	78.14
BARN	.00	.00	.00	.00	.00	.00
70	.00	.00	.00	.00	.00	.00
71	.00	.00	.00	.00	.00	.00
72	.00	.00	.00	.00	.00	.00
73	.00	.00	.00	.00	.00	.00
74	.00	.00	.00	.00	.00	.00
75	.00	.00	.00	.00	.00	.00
GEXT	.00	.00	.00	.00	.00	.00
76	.00	.00	.00	.00	.00	.00
GILL	.00	.00	.00	.00	.00	.00
77	.00	.00	.00	.00	.00	.00
COLCON	.00	.00	.00	.00	.00	.00
NETWORK	.00	.00	.00	.00	186189.25	23270.66

Auto Fuel Cost Look-Up Table
(By Land Use/Facility Type)

V/C	1/1&4	TIME/ MILE	FUEL USED	MULTIPLE FROM BASE	1/2				1/3	TIME/ MILE	FUEL USED	MULTIPLE FROM BASE
0	37.00	.0270	.0577	1.0000	44.00	.0227	.0544	1.0000	47.00	.0213	.0533	1.0000
.05	36.80	.0272	.0578	1.0020	43.75	.0229	.0545	1.0018	46.77	.0214	.0534	1.0015
.1	36.48	.0274	.0580	1.0051	43.07	.0232	.0548	1.0069	46.46	.0215	.0535	1.0036
.15	36.16	.0277	.0582	1.0083	42.40	.0236	.0551	1.0120	46.14	.0217	.0536	1.0057
.2	35.84	.0279	.0584	1.0116	41.75	.0240	.0554	1.0172	45.83	.0218	.0537	1.0078
.25	35.53	.0281	.0586	1.0148	41.10	.0243	.0556	1.0225	45.52	.0220	.0538	1.0099
.3	35.22	.0284	.0587	1.0181	40.46	.0247	.0559	1.0279	45.21	.0221	.0540	1.0120
.35	34.91	.0286	.0589	1.0214	39.83	.0251	.0562	1.0334	44.91	.0223	.0541	1.0142
.4	34.60	.0289	.0591	1.0248	39.21	.0255	.0565	1.0389	44.60	.0224	.0542	1.0164
.45	34.30	.0292	.0593	1.0281	38.60	.0259	.0568	1.0446	44.30	.0226	.0543	1.0186
.5	34.00	.0294	.0595	1.0315	38.00	.0263	.0572	1.0503	44.00	.0227	.0544	1.0208
.55	33.81	.0296	.0596	1.0338	37.46	.0267	.0574	1.0556	43.45	.0230	.0546	1.0249
.6	33.60	.0298	.0598	1.0361	36.83	.0272	.0578	1.0620	42.83	.0234	.0549	1.0297
.65	33.40	.0299	.0599	1.0385	36.21	.0276	.0581	1.0686	42.21	.0237	.0552	1.0346
.7	33.20	.0301	.0601	1.0409	35.60	.0281	.0585	1.0752	41.60	.0240	.0554	1.0395
.75	33.00	.0303	.0602	1.0433	35.00	.0286	.0589	1.0820	41.00	.0244	.0557	1.0446
.8	32.63	.0306	.0605	1.0479	34.47	.0290	.0592	1.0882	40.46	.0247	.0559	1.0493
.85	32.22	.0310	.0608	1.0531	33.83	.0296	.0596	1.0958	39.83	.0251	.0562	1.0548
.9	31.81	.0314	.0611	1.0584	33.21	.0301	.0601	1.1036	39.21	.0255	.0565	1.0605
.95	31.40	.0318	.0614	1.0638	32.60	.0307	.0605	1.1115	38.60	.0259	.0568	1.0663
1	31.00	.0323	.0617	1.0692	32.00	.0313	.0609	1.1195	38.00	.0263	.0572	1.0721

2,3,4/1	TIME/ MILE	FUEL USED	MULTIPLE FROM BASE	2,3,4/2	TIME/ MILE	FUEL USED	MULTIPLE FROM BASE	2,3,4/3	TIME/ MILE	FUEL USED	MULTIPLE FROM BASE	2,3,4/4	TIME/ MILE	FUEL USED	MULTIPLE FROM BASE
22.00	.0455	.0718	1.0000	29.00	.0345	.0634	1.0000	32.00	.0313	.0609	1.0000	24.00	.0417	.0689	1.0000
21.87	.0457	.0720	1.0028	28.85	.0347	.0635	1.0021	31.85	.0314	.0610	1.0019	23.87	.0419	.0690	1.0026
21.66	.0462	.0723	1.0077	28.64	.0349	.0637	1.0052	31.64	.0316	.0612	1.0045	23.65	.0423	.0693	1.0068
21.44	.0466	.0727	1.0126	28.43	.0352	.0639	1.0083	31.43	.0318	.0614	1.0071	23.44	.0427	.0696	1.0111
21.23	.0471	.0730	1.0175	28.22	.0354	.0641	1.0114	31.22	.0320	.0615	1.0098	23.23	.0431	.0699	1.0154
21.02	.0476	.0734	1.0225	28.01	.0357	.0643	1.0146	31.01	.0322	.0617	1.0125	23.02	.0434	.0702	1.0197
20.81	.0480	.0737	1.0276	27.81	.0360	.0645	1.0178	30.81	.0325	.0618	1.0151	22.81	.0438	.0705	1.0241
20.61	.0485	.0741	1.0327	27.60	.0362	.0647	1.0210	30.60	.0327	.0620	1.0179	22.61	.0442	.0708	1.0285
20.40	.0490	.0745	1.0379	27.40	.0365	.0649	1.0242	30.40	.0329	.0622	1.0206	22.40	.0446	.0711	1.0329
20.20	.0495	.0749	1.0431	27.20	.0368	.0651	1.0275	30.20	.0331	.0623	1.0233	22.20	.0450	.0715	1.0374
20.00	.0500	.0752	1.0483	27.00	.0370	.0653	1.0308	30.00	.0333	.0625	1.0261	22.00	.0455	.0718	1.0420
19.42	.0515	.0764	1.0643	26.64	.0375	.0657	1.0368	29.63	.0337	.0628	1.0312	21.42	.0467	.0727	1.0556
18.20	.0549	.0790	1.1008	26.22	.0381	.0662	1.0440	29.22	.0342	.0632	1.0373	20.51	.0488	.0743	1.0786
17.07	.0586	.0818	1.1397	25.81	.0388	.0666	1.0514	28.81	.0347	.0636	1.0434	19.64	.0509	.0759	1.1026
16.00	.0625	.0848	1.1813	25.40	.0394	.0671	1.0588	28.40	.0352	.0639	1.0496	18.80	.0532	.0777	1.1277
15.00	.0667	.0880	1.2256	25.00	.0400	.0676	1.0664	28.00	.0357	.0643	1.0559	18.00	.0556	.0795	1.1539
14.59	.0686	.0894	1.2457	24.75	.0404	.0679	1.0714	28.43	.0352	.0639	1.0492	17.49	.0572	.0807	1.1720
13.89	.0720	.0920	1.2822	21.84	.0458	.0720	1.1362	24.23	.0413	.0686	1.1255	16.24	.0616	.0841	1.2208
13.23	.0756	.0948	1.3205	19.27	.0519	.0767	1.2098	20.65	.0484	.0740	1.2152	15.08	.0663	.0877	1.2733
12.60	.0794	.0976	1.3607	17.00	.0588	.0820	1.2931	17.60	.0568	.0804	1.3203	14.00	.0714	.0916	1.3298
12.00	.0833	.1007	1.4029	15.00	.0667	.0880	1.3875	15.00	.0667	.0880	1.4437	13.00	.0769	.0958	1.3907

ESTIMATES OF OTHER AUTO VOC BY FACILITY/AREA TYPE (CENTS/MILE)

V/C	1/1&4			1/2			1/3		
0.00	37.00	0.000	.000	44.00	0.000	7.010	47.00	0.000	7.010
.05	36.80	.548	5.895	43.75	.559	7.065	46.77	.479	7.056
.10	36.48	1.418	5.971	43.07	2.105	7.227	46.46	1.153	7.127
.15	36.16	2.280	6.047	42.40	3.627	7.387	46.14	1.822	7.198
.20	35.84	3.135	6.122	41.75	5.125	7.545	45.83	2.487	7.268
.25	35.53	3.982	6.196	41.10	6.599	7.700	45.52	3.148	7.337
.30	35.22	4.822	6.270	40.46	8.051	7.853	45.21	3.804	7.406
.35	34.91	5.654	6.343	39.83	9.481	8.003	44.91	4.455	7.474
.40	34.60	6.479	6.415	39.21	10.888	8.151	44.60	5.102	7.542
.45	34.30	7.297	6.487	38.60	12.273	8.296	44.30	5.745	7.610
.50	34.00	8.108	6.558	38.00	13.636	8.440	44.00	6.383	7.677
.55	33.81	8.629	6.604	37.46	14.858	8.568	43.45	7.546	7.799
.60	33.60	9.179	6.652	36.83	16.293	8.719	42.83	8.880	7.940
.65	33.40	9.726	6.700	36.21	17.704	8.868	42.21	10.194	8.078
.70	33.20	10.270	6.748	35.60	19.091	9.013	41.60	11.489	8.214
.75	33.00	10.811	6.795	35.00	20.455	9.157	41.00	12.766	8.348
.80	32.63	11.807	6.883	34.47	21.663	9.284	40.46	13.920	8.470
.85	32.22	12.931	6.981	33.83	23.105	9.435	39.83	15.258	8.610
.90	31.81	14.040	7.079	33.21	24.520	9.584	39.21	16.576	8.749
.95	31.40	15.135	7.175	32.60	25.909	9.730	38.60	17.872	8.885
1.00	31.00	16.216	7.270	32.00	27.273	9.874	38.00	19.149	9.020

2,3,4/2			2,3,4/3			2,3,4/4		
29.00	0.000	5.740	32.00	0.000	5.740	24.00	0.000	5.280
28.85	.503	5.780	31.85	.473	5.777	23.87	.555	5.321
28.64	1.234	5.843	31.64	1.132	5.834	23.65	1.451	5.392
28.43	1.960	5.906	31.43	1.787	5.891	23.44	2.338	5.462
28.22	2.681	5.968	31.22	2.437	5.947	23.23	3.218	5.532
28.01	3.397	6.029	31.01	3.083	6.002	23.02	4.090	5.601
27.81	4.107	6.090	30.81	3.725	6.057	22.81	4.954	5.669
27.60	4.812	6.151	30.60	4.362	6.112	22.61	5.811	5.737
27.40	5.512	6.211	30.40	4.996	6.167	22.40	6.659	5.804
27.20	6.207	6.271	30.20	5.625	6.221	22.20	7.500	5.871
27.00	6.897	6.331	30.00	6.250	6.275	22.00	8.333	5.937
26.64	8.142	6.438	29.63	7.392	6.373	21.42	10.751	6.128
26.22	9.589	6.562	29.22	8.696	6.485	20.51	14.549	6.429
25.81	11.012	6.685	28.81	9.982	6.596	19.64	18.185	6.717
25.40	12.414	6.806	28.40	11.250	6.705	18.80	21.667	6.993
25.00	13.793	6.924	28.00	12.500	6.813	18.00	25.000	7.257
24.75	14.666	6.999	28.43	11.156	6.697	17.49	27.143	7.427
21.84	24.705	7.864	24.23	24.281	7.827	16.24	32.347	7.839
19.27	33.563	8.627	20.65	35.467	8.790	15.08	37.179	8.222
17.00	41.379	9.299	17.60	45.000	9.611	14.00	41.667	8.577
15.00	48.276	9.893	15.00	53.125	10.311	13.00	45.833	8.907

ESTIMATES OF TRUCK OPERATING COSTS BY AREA/FACILITY TYPE

V/C	1/1,4		1/2		1/3	
RATIO	SPEED	COST	SPEED	COST	SPEED	COST
0.00	37.00	24.44	44.00	29.20	47.00	28.62
.05	36.80	24.47	43.75	29.32	46.77	28.69
.10	36.48	24.51	43.07	29.43	46.46	28.76
.15	36.16	24.55	42.40	29.55	46.14	28.83
.20	35.84	24.59	41.75	29.66	45.83	28.91
.25	35.53	24.62	41.10	29.78	45.52	28.98
.30	35.22	24.66	40.46	29.89	45.21	29.06
.35	34.91	24.7	39.83	30.04	44.91	29.13
.40	34.60	24.74	39.21	30.17	44.60	29.21
.45	34.30	24.78	38.60	30.30	44.30	29.29
.50	34.00	24.82	38.00	30.43	44.00	29.36
.55	33.81	24.86	37.46	30.57	43.45	29.44
.60	33.60	24.89	36.83	30.70	42.83	29.51
.65	33.40	24.93	36.21	30.83	42.21	29.59
.70	33.20	24.97	35.60	30.97	41.60	29.66
.75	33.00	25.01	35.00	31.1	41.00	29.74
.80	32.63	25.05	34.47	31.20	40.46	29.81
.85	32.22	25.08	33.83	31.30	39.83	29.89
.90	31.81	25.12	33.21	31.40	39.21	30.3
.95	31.40	25.16	32.60	31.50	38.60	30.7
1.00	31.00	25.2	32.00	31.6	38.00	31

2,3,4/2		2,3,4/3		2,3,4/4	
SPEED	COST	SPEED	COST	SPEED	COST
29.00	23.32	32.00	23.12	24.00	22.3
28.85	23.35	31.85	23.24	23.87	22.33
28.64	23.38	31.64	23.32	23.65	22.36
28.43	23.41	31.43	23.39	23.44	22.39
28.22	23.44	31.22	23.47	23.23	22.42
28.01	23.48	31.01	23.54	23.02	22.45
27.81	23.51	30.81	23.62	22.81	22.48
27.60	23.54	30.60	23.70	22.61	22.51
27.40	23.57	30.40	23.77	22.40	22.53
27.20	23.60	30.20	23.85	22.20	22.56
27.00	23.63	30.00	23.93	22.00	22.59
26.64	23.66	29.63	24.00	21.42	22.62
26.22	23.69	29.22	24.08	20.51	22.65
25.81	23.72	28.81	24.16	19.64	22.68
25.40	23.75	28.40	24.24	18.80	22.72
25.00	23.78	28.00	24.32	18.00	22.77
24.75	23.97	28.43	24.39	17.49	22.81
21.84	24.16	24.23	24.47	16.24	22.85
19.27	24.34	20.65	24.55	15.08	22.89
17.00	24.52	17.60	24.63	14.00	22.94
15.00	24.71	15.00	24.71	13.00	22.98

LINKS	VOLUMES	TVOLAM	TVOLMD	TVOLPM	TVOLD	TRUCKAM	TRUCKMD	TRUCKPM	TRUCKD	AUTOAM	AUTOMD	AUTOPM
1	34034	2042	16609	5377	10006	395	2949	501	103	1647	13660	4876
2	36323	2179	17726	5739	10679	421	3147	535	110	1758	14578	5204
3	38083	2285	18585	6017	11197	442	3300	561	115	1843	15285	5456
4	44919	2695	21920	7097	13206	521	3892	662	135	2174	18028	6435
5	43572	2614	21263	6884	12810	505	3776	642	131	2109	17488	6243
6	39109	2347	19085	6179	11498	454	3389	576	118	1893	15696	5603
7	42640	2558	20808	6737	12536	495	3695	628	129	2064	17114	6109
8	35287	2117	17220	5575	10374	409	3058	520	106	1708	14162	5056
9	25034	1502	12217	3955	7360	290	2169	369	76	1212	10047	3587
AIR	0	0	0	0	0	0	0	0	0	0	0	0
10	16438	1184	7233	2597	5425	191	1424	242	50	993	5808	2355
11	12762	919	5615	2016	4211	148	1106	188	38	771	4509	1828
12	20218	1456	8896	3195	6672	235	1752	298	61	1221	7144	2897
13	16463	1185	7244	2601	5433	191	1427	243	50	994	5817	2359
14	18766	1351	8257	2965	6193	218	1626	276	57	1133	6631	2689
15	18717	1348	8235	2957	6177	217	1622	276	56	1130	6614	2682
STNB	0	0	0	0	0	0	0	0	0	0	0	0
16	16438	1184	7233	2597	5425	191	1424	242	50	993	5808	2355
17	12762	919	5615	2016	4211	148	1106	188	38	771	4509	1828
18	13255	954	5832	2094	4374	154	1149	195	40	801	4684	1899
19	16465	1185	7245	2602	5434	191	1427	243	50	995	5818	2359
20	18769	1351	8258	2965	6194	218	1626	276	57	1134	6632	2689
21	18717	1348	8235	2957	6177	217	1622	276	56	1130	6614	2682
STNB	0	0	0	0	0	0	0	0	0	0	0	0
22	11392	820	5013	1800	3759	132	987	168	34	688	4025	1632
23	11579	834	5095	1829	3821	134	1003	171	35	699	4091	1659
RICH	0	0	0	0	0	0	0	0	0	0	0	0
24	14841	890	7242	2342	4363	172	1286	219	45	718	5956	2123
25	9380	563	4578	1480	2758	109	813	138	28	454	3765	1342
26	13218	793	6451	2086	3886	153	1145	195	40	640	5305	1891
27	16608	996	8105	2621	4883	193	1439	245	50	804	6666	2376
28	13392	804	6535	2113	3937	155	1160	197	40	648	5375	1916
29	10967	658	5352	1731	3224	127	950	162	33	531	4402	1569
SFEEB	0	0	0	0	0	0	0	0	0	0	0	0
30	11187	671	5459	1765	3289	130	969	165	34	541	4490	1601
31	7411	445	3617	1169	2179	86	642	109	22	359	2974	1060
32	11306	678	5518	1784	3324	131	980	167	34	547	4538	1618
33	16625	998	8113	2623	4888	193	1441	245	50	805	6673	2379
34	15565	934	7596	2456	4576	181	1349	229	47	753	6247	2227
35	12820	769	6256	2023	3769	149	1111	189	39	621	5145	1834
SFENB	0	0	0	0	0	0	0	0	0	0	0	0
36	27572	1875	13345	4538	7808	320	2389	406	83	1555	10956	4132
37	27572	1875	13345	4538	7808	320	2389	406	83	1555	10956	4132
38	29798	2026	14422	4905	8439	346	2582	439	90	1681	11840	4466
UNIV	0	0	0	0	0	0	0	0	0	0	0	0
39	10035	723	4375	1586	3312	116	870	148	30	606	3506	1438
PARKS	0	0	0	0	0	0	0	0	0	0	0	0
40	8907	609	4311	1466	2522	103	772	131	27	506	3539	1335
41	20143	1378	9749	3316	5705	234	1745	297	61	1144	8004	3019
BEIST	0	0	0	0	0	0	0	0	0	0	0	0
42	27818	1491	13731	4679	7911	323	2410	410	84	1168	11321	4269
43	33837	1814	16702	5691	9623	393	2932	498	102	1421	13770	5193
44	31145	1669	15373	5239	8858	361	2699	459	94	1308	12674	4780
45	36426	1952	17980	6127	10360	423	3156	537	110	1530	14824	5590
46	30627	1642	15117	5151	8710	355	2654	451	92	1286	12464	4700
47	22600	1211	11156	3801	6428	262	1958	333	68	949	9197	3468
COLL	0	0	0	0	0	0	0	0	0	0	0	0
48	18731	892	10564	2989	4293	217	1623	276	56	674	8941	2714
49	18731	892	10564	2989	4293	217	1623	276	56	674	8941	2714
50	26550	1264	14974	4237	6085	308	2301	391	80	956	12674	3846

51	29005	1381	16359	4629	6648	336	2513	427	87	1044	13845	4202
ILL	0	0	0	0	0	0	0	0	0	0	0	0
52	9980	475	5629	1593	2287	116	865	147	30	359	4764	1446
53	21372	1017	12054	3411	4898	248	1852	315	64	769	10202	3096
54	18990	904	10710	3031	4352	220	1646	280	57	684	9065	2751
CUSH	0	0	0	0	0	0	0	0	0	0	0	0
55	23443	1116	13222	3742	5373	272	2031	345	71	844	11191	3396
56	20026	953	11294	3196	4590	232	1735	295	60	721	9559	2901
BCUSH	0	0	0	0	0	0	0	0	0	0	0	0
57	8805	602	4713	1442	2050	102	763	130	27	500	3950	1313
58	7871	538	4213	1289	1832	91	682	116	24	447	3531	1173
59	7871	538	4213	1289	1832	91	682	116	24	447	3531	1173
PEG	0	0	0	0	0	0	0	0	0	0	0	0
60	8770	600	4694	1437	2042	102	760	129	26	498	3934	1307
61	12239	837	6551	2005	2849	142	1061	180	37	695	5490	1825
62	8097	554	4333	1326	1885	94	702	119	24	460	3632	1207
63	8822	603	4721	1445	2054	102	764	130	27	501	3957	1315
PHIL	0	0	0	0	0	0	0	0	0	0	0	0
64	10926	586	5393	1838	3107	127	947	161	33	459	4446	1677
AUR	0	0	0	0	0	0	0	0	0	0	0	0
65	11133	597	5495	1873	3166	129	965	164	34	468	4531	1709
THIRD	0	0	0	0	0	0	0	0	0	0	0	0
66	11133	597	5495	1873	3166	129	965	164	34	468	4531	1709
MIN	0	0	0	0	0	0	0	0	0	0	0	0
67	16556	788	9338	2642	3795	192	1435	244	50	596	7903	2398
68	15572	741	8783	2485	3569	181	1349	229	47	561	7433	2256
69	15313	729	8637	2444	3510	178	1327	226	46	551	7310	2218
BARN	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0
GEIT	0	0	0	0	0	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0
GILL	0	0	0	0	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0	0	0	0	0
COLCON	0	0	0	0	0	0	0	0	0	0	0	0
NETWORK	0	0	0	0	0	0	0	0	0	0	0	0

NHBAM	NHBMD	NHBPM	NHBO	TIMEAM	TIMEMD	TIMEPM	TIMEO
1.43	41.49	12.46	24.09	.3668	.3890	.4122	.3641
1.26	37.05	12.41	21.17	.3021	.3255	.3847	.2998
2.36	69.37	26.34	39.64	.5394	.5813	.7785	.5354
4.29	129.68	60.66	71.61	.8321	.9213	1.5200	.8199
3.04	90.70	48.00	51.14	.6078	.6643	1.2400	.6037
7.92	233.02	90.86	132.40	1.7645	1.9014	2.6149	1.7412
2.71	92.65	42.43	45.51	.5526	.6934	1.1200	.5489
6.87	203.74	86.30	114.61	1.6954	1.8425	2.7529	1.6705
4.68	132.49	39.30	78.64	1.6277	1.6889	1.7670	1.6157
.00	.00	.00	.00	.0000	.0000	.0000	.0000
2.07	41.05	13.64	31.02	.8773	.9052	.9340	.8636
1.84	37.21	12.78	27.25	1.0085	1.0570	1.1268	.9774
1.26	26.32	9.43	18.63	.4352	.4719	.5250	.4218
.85	17.03	5.72	12.87	.3609	.3750	.3911	.3578
2.35	46.50	15.93	34.93	.8746	.8982	.9554	.8519
1.63	32.46	11.12	24.38	.6069	.6287	.6688	.5963
.00	.00	.00	.00	.0000	.0000	.0000	.0000
2.53	50.32	16.72	38.02	1.0754	1.1096	1.1449	1.0586
1.79	36.12	12.40	26.45	.9788	1.0259	1.0936	.9486
.79	15.91	5.46	11.65	.4153	.4352	.4640	.4024
.85	17.03	5.72	12.87	.3609	.3750	.3911	.3578
2.45	48.37	16.57	36.33	.9096	.9341	.9936	.8860
1.63	32.46	11.12	24.38	.6069	.6287	.6688	.5963
.00	.00	.00	.00	.0000	.0000	.0000	.0000
2.24	44.51	14.79	33.63	1.3725	1.4162	1.4613	1.3512
2.44	49.27	16.37	37.23	1.4716	1.5424	1.5915	1.4716
.00	.00	.00	.00	.0000	.0000	.0000	.0000
1.22	36.14	10.54	20.41	.7186	.7772	.8008	.7075
1.31	39.07	11.64	21.76	1.2118	1.3293	1.3989	1.1930
2.58	81.48	24.85	43.07	1.7023	1.9670	2.1187	1.6758
2.93	96.60	27.35	48.92	1.5389	1.8562	1.8562	1.5149
2.45	71.28	20.82	40.90	1.5954	1.6986	1.7526	1.5706
.89	25.48	7.44	14.85	.7075	.7415	.7651	.6965
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.91	27.88	8.45	15.24	.7119	.7954	.8512	.7008
1.02	29.96	8.74	16.92	1.1930	1.2902	1.3293	1.1744
2.18	66.34	20.10	36.27	1.6758	1.8724	2.0039	1.6498
2.94	96.70	27.38	48.97	1.5389	1.8562	1.8562	1.5149
3.08	97.81	28.74	50.60	1.7254	2.0053	2.0813	1.6722
.73	22.35	6.91	12.01	.4971	.5562	.6074	.4818
.00	.00	.00	.00	.0000	.0000	.0000	.0000
1.52	36.89	13.32	20.83	.4117	.4313	.5200	.4036
4.63	112.42	40.61	63.49	1.2547	1.3143	1.5848	1.2300
3.44	84.73	35.40	47.48	.8626	.9165	1.2784	.8512
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.81	15.62	5.19	12.26	.5629	.5706	.5824	.5591
.00	.00	.00	.00	.0000	.0000	.0000	.0000
2.37	54.86	16.65	32.67	1.9723	1.9855	2.0120	1.9593
2.66	62.90	19.33	36.71	.9801	1.0065	1.0326	.9736
.00	.00	.00	.00	.0000	.0000	.0000	.0000
6.36	227.56	86.09	118.89	2.2938	2.5746	3.2519	2.2732
7.65	285.81	111.49	144.27	2.2678	2.6584	3.4622	2.2678
6.65	229.97	111.15	124.61	2.1423	2.3239	3.7500	2.1281
2.99	102.59	58.24	56.02	.8234	.8864	1.6800	.8180
3.82	133.33	59.67	71.53	1.2514	1.3701	2.0471	1.2422
.43	14.36	4.57	8.13	.1913	.2000	.2126	.1913
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.88	40.04	9.72	15.42	.5487	.5735	.5778	.5447
.47	21.56	5.23	8.30	.2954	.3088	.3111	.2933
.53	25.31	6.20	9.31	.2339	.2558	.2598	.2321

.47	22.98	5.69	8.32	.1913	.2126	.2182	.1899
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.19	8.58	2.09	3.31	.2216	.2306	.2329	.2194
1.34	72.81	19.97	23.50	.7348	.9141	1.0400	.7275
.55	29.86	8.19	9.64	.3391	.4219	.4800	.3358
.00	.00	.00	.00	.0000	.0000	.0000	.0000
3.56	266.49	64.23	62.31	1.7762	3.0500	3.0500	1.7586
2.02	145.72	36.88	35.42	1.1820	1.9524	2.0500	1.1703
.00	.00	.00	.00	.0000	.0000	.0000	.0000
1.97	53.04	14.38	22.05	1.6638	1.7200	1.7661	1.6310
1.32	35.13	9.40	14.90	1.2409	1.2743	1.2914	1.2327
2.02	54.04	14.46	22.92	1.9091	1.9605	1.9868	1.8965
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.82	21.82	5.84	9.19	.6919	.7105	.7200	.6827
1.33	37.66	13.48	14.81	.8038	.8786	1.1912	.7880
1.38	36.98	9.83	15.63	1.2662	1.3041	1.3138	1.2569
.40	10.75	2.88	4.54	.3377	.3478	.3529	.3352
.00	.00	.00	.00	.0000	.0000	.0000	.0000
1.38	45.52	14.09	25.88	1.2684	1.3113	1.3554	1.2600
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.40	13.27	4.19	7.51	.3614	.3750	.3953	.3588
.00	.00	.00	.00	.0000	.0000	.0000	.0000
1.34	44.48	14.04	25.18	1.2118	1.2574	1.3253	1.2029
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.59	26.68	6.50	10.30	.4156	.4324	.4368	.4115
.85	39.26	9.56	15.00	.6372	.6764	.6832	.6372
.63	31.98	8.77	11.01	.4804	.5603	.6375	.4757
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000
.00	.00	.00	.00	.0000	.0000	.0000	.0000

TRAM	TRMD	TRPM	TRO	HBWAM	HBWMD	HBWPM	HBWO	HBOAM	HBOMD	HBOPM	HBOO
6.64	52.58	9.47	1.71	10.94	29.13	12.57	22.56	2.43	27.08	13.05	21.42
5.83	46.96	9.44	1.51	9.62	26.01	12.52	19.82	2.14	24.19	13.00	18.82
10.92	87.92	20.02	2.82	18.01	48.70	26.57	37.12	4.01	45.29	27.58	35.25
19.87	164.36	46.10	5.09	32.77	91.05	61.20	67.05	7.29	84.66	63.50	63.67
14.08	114.96	36.48	3.64	23.22	63.68	48.43	47.89	5.16	59.21	50.25	45.47
36.69	295.33	69.05	9.41	60.50	163.60	91.66	123.97	13.46	152.12	95.12	117.72
12.53	117.43	32.25	3.24	20.66	65.05	42.81	42.61	4.60	60.49	44.42	40.46
31.81	258.22	65.59	8.15	52.45	143.04	87.07	107.31	11.67	133.01	90.35	101.90
21.66	167.92	29.87	5.59	35.72	93.02	39.65	73.63	7.95	86.49	41.14	69.92
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7.67	59.10	10.37	1.96	15.78	28.82	13.76	29.04	3.51	26.80	14.28	27.58
6.84	53.57	9.71	1.72	14.08	26.13	12.89	25.52	3.13	24.29	13.37	24.23
4.68	37.89	7.17	1.18	9.63	18.48	9.51	17.45	2.14	17.18	9.87	16.57
3.16	24.52	4.35	.81	6.50	11.96	5.77	12.05	1.45	11.12	5.99	11.44
8.73	66.94	12.11	2.21	17.96	32.65	16.07	32.70	3.99	30.36	16.68	31.06
6.04	46.73	8.45	1.54	12.43	22.79	11.22	22.83	2.76	21.19	11.64	21.68
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9.40	72.44	12.71	2.41	19.34	35.33	16.87	35.60	4.30	32.85	17.50	33.80
6.64	52.00	9.42	1.67	13.67	25.36	12.51	24.76	3.04	23.58	12.98	23.52
2.93	22.91	4.15	.74	6.02	11.17	5.51	10.91	1.34	10.39	5.72	10.36
3.16	24.52	4.35	.81	6.50	11.96	5.77	12.05	1.45	11.12	5.99	11.44
9.08	69.63	12.59	2.30	18.68	33.96	16.71	34.02	4.15	31.58	17.34	32.30
6.04	46.73	8.45	1.54	12.43	22.79	11.22	22.83	2.76	21.19	11.64	21.68
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
8.31	64.08	11.24	2.13	17.11	31.25	14.92	31.49	3.81	29.06	15.48	29.90
9.06	70.93	12.44	2.36	18.64	34.59	16.52	34.86	4.15	32.16	17.14	33.10
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
5.67	45.81	8.02	1.45	9.35	25.38	10.64	19.12	2.08	23.60	11.04	18.15
6.04	49.52	8.86	1.55	9.97	27.43	11.75	20.37	2.22	25.51	12.19	19.35
11.96	103.26	18.91	3.06	19.73	57.20	25.07	40.33	4.39	53.19	26.01	38.29
13.59	122.43	20.82	3.48	22.41	67.82	27.59	45.80	4.98	63.06	28.63	43.49
11.36	90.35	15.85	2.91	18.73	50.05	21.01	38.29	4.17	46.54	21.80	36.36
4.13	32.30	5.67	1.06	6.80	17.89	7.51	13.91	1.51	16.64	7.79	13.21
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
4.23	35.34	6.43	1.08	6.98	19.58	8.52	14.27	1.55	18.20	8.84	13.55
4.70	37.97	6.65	1.20	7.75	21.04	8.82	15.84	1.72	19.56	9.15	15.05
10.07	84.08	15.30	2.58	16.61	46.58	20.28	33.96	3.70	43.31	21.04	32.25
13.60	122.56	20.84	3.48	22.43	67.89	27.62	45.85	4.99	63.13	28.66	43.54
14.28	123.96	21.87	3.60	23.54	68.67	29.00	47.38	5.24	63.85	30.09	44.99
3.39	28.32	5.26	.85	5.59	15.69	6.97	11.24	1.24	14.59	7.23	10.68
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
6.04	47.23	9.68	1.54	11.60	25.90	13.44	19.51	2.58	24.08	13.95	18.52
18.39	143.92	29.50	4.69	35.34	78.93	40.97	59.45	7.86	73.39	42.51	56.45
13.67	108.46	25.72	3.51	26.26	59.48	35.72	44.46	5.84	55.31	37.06	42.22
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3.00	22.74	3.95	.78	6.18	10.97	5.24	11.48	1.37	10.20	5.44	10.90
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9.34	70.23	12.10	2.41	18.07	38.52	16.80	30.59	4.02	35.82	17.44	29.05
10.50	80.52	14.04	2.71	20.31	44.16	19.50	34.38	4.52	41.06	20.24	32.64
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
33.93	284.44	61.08	8.74	48.54	159.77	86.86	111.32	10.80	148.56	90.13	105.71
40.80	357.25	79.10	10.61	58.38	200.66	112.48	135.09	12.99	186.59	116.72	128.28
35.47	287.45	78.86	9.16	50.76	161.46	112.14	116.68	11.29	150.13	116.36	110.80
15.95	128.23	41.32	4.12	22.82	72.03	58.76	52.45	5.08	66.97	60.97	49.81
20.38	166.65	42.33	5.26	29.16	93.61	60.20	66.97	6.49	87.04	62.46	63.60
2.30	17.95	3.24	.60	3.29	10.08	4.61	7.61	.73	9.38	4.79	7.23
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
5.46	42.66	7.31	1.41	6.70	28.11	9.81	14.44	1.49	26.14	10.18	13.71
2.94	22.97	3.93	.76	3.61	15.14	5.28	7.77	.80	14.07	5.48	7.38
3.30	26.97	4.66	.85	4.05	17.77	6.25	8.72	.90	16.52	6.49	8.28

2.95	24.49	4.27	.76	3.62	16.14	5.74	7.79	.80	15.00	5.95	7.40
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1.18	9.14	1.57	.30	1.44	6.02	2.11	3.10	.32	5.60	2.19	2.94
8.35	77.59	15.01	2.15	10.24	51.12	20.14	22.00	2.28	47.53	20.90	20.89
3.42	31.82	6.15	.88	4.20	20.96	8.26	9.02	.93	19.49	8.57	8.57
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
22.14	283.97	48.28	5.70	27.15	187.10	64.80	58.34	6.04	173.97	67.25	55.40
12.58	155.28	27.72	3.24	15.43	102.31	37.21	33.16	3.43	95.13	38.61	31.49
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7.79	60.15	10.50	1.99	15.07	37.24	14.50	20.65	3.35	34.63	15.05	19.60
5.19	39.83	6.86	1.34	10.05	24.66	9.48	13.95	2.24	22.93	9.84	13.25
7.99	61.29	10.56	2.06	15.46	37.94	14.58	21.46	3.44	35.28	15.13	20.38
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3.23	24.75	4.26	.83	6.24	15.32	5.89	8.61	1.39	14.25	6.11	8.17
5.23	42.71	9.84	1.33	10.12	26.44	13.60	13.87	2.25	24.59	14.11	13.17
5.45	41.94	7.18	1.41	10.55	25.96	9.92	14.63	2.35	24.14	10.29	13.89
1.58	12.19	2.10	.41	3.07	7.54	2.90	4.25	.68	7.01	3.01	4.04
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7.37	56.90	10.00	1.90	10.54	31.96	14.22	24.24	2.35	29.72	14.75	23.01
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2.14	16.58	2.97	.55	3.06	9.31	4.23	7.03	.68	8.66	4.38	6.68
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7.17	55.60	9.96	1.85	10.26	31.23	14.17	23.58	2.28	29.04	14.70	22.39
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3.66	28.43	4.88	.94	4.49	18.73	6.55	9.64	1.00	17.42	6.80	9.15
5.28	41.83	7.18	1.37	6.47	27.56	9.64	14.04	1.44	25.63	10.01	13.33
3.91	34.08	6.59	1.01	4.80	22.45	8.85	10.31	1.07	20.88	9.18	9.79
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

TOTAL LOW TIME COST	TOTAL HIGH TIME COST
289.07	3864.25
261.75	3500.46
501.92	6716.80
972.84	13030.08
705.36	9457.98
1692.82	22653.83
669.81	8963.52
1502.08	20109.08
927.69	12402.79
.00	.00
326.44	4342.17
294.58	3916.47
207.40	2756.94
135.59	1803.96
371.17	4936.60
258.92	3444.28
.00	.00
400.15	5322.65
285.91	3801.15
125.98	1674.85
135.61	1804.18
386.05	5134.59
258.92	3444.28
.00	.00
353.94	4708.10
391.25	5205.99
.00	.00
248.63	3321.75
268.53	3587.52
553.38	7390.56
639.92	8539.87
492.86	6585.70
177.08	2366.47
.00	.00
191.09	2552.71
206.10	2753.53
454.63	6073.28
640.59	8548.80
656.72	8765.06
153.05	2043.87
.00	.00
266.63	3557.62
812.56	10841.71
628.77	8398.51
.00	.00
126.12	1677.47
.00	.00
390.94	5213.58
446.19	5949.94
.00	.00
1588.78	21296.74
1988.17	26652.02
1712.93	23006.67
798.35	10736.36
972.49	13053.41
99.31	1330.86
.00	.00
233.48	3138.58
125.71	1689.94
146.12	1964.00

132.39	1779.36
.00	.00
50.07	673.04
415.83	5589.00
170.53	2292.09
.00	.00
1396.73	18743.40
775.64	10412.20
.00	.00
331.95	4430.26
220.35	2941.54
339.01	4525.52
.00	.00
136.71	1824.73
244.53	3268.83
231.53	3090.59
67.36	899.12
.00	.00
313.85	4205.12
.00	.00
91.64	1227.99
.00	.00
307.27	4117.27
.00	.00
155.76	2093.85
228.44	3071.22
185.29	2490.96
.00	.00
.00	.00
.00	.00
.00	.00
.00	.00
.00	.00
.00	.00
.00	.00
.00	.00
.00	.00
.00	.00
.00	.00
32269.23	431707.62

GEIST EVALUATION			WEIGHTED
LINK	AADT	DISTANCE	AVG VOL
1	25705	.17	1101
2	25777	.14	909
3	34559	.25	2176
4	37916	.38	3629
5	34324	.31	2680
6	35409	.9	8027
7	30097	.28	2123
8	17165	.78	3372
9	16166	.76	3095
AIR	0	3.97	27113
10	10346	.62	2430
11	8074	.68	2080
12	6294	.28	668
13	9782	.21	778
14	13821	.5	2618
15	10710	.35	1420
STNB	0	2.64	9992.60
16	15628	.76	4273
17	11809	.66	2804
18	8213	.28	827
19	10538	.21	796
20	14337	.52	2682
21	13136	.35	1654
STWB	0	2.78	13035.11
22	19303	.97	19303
23	16724	1.04	16724
RICH	0	0	0
24	11882	.5	1174
25	6992	.83	1147
26	10429	1.13	2329
27	13465	.99	2634
28	10585	1.11	2322
29	8414	.5	831
SFEEB	0	5.06	10437.98
30	8610	.48	849
31	5229	.83	891
32	8717	1.13	2023
33	13480	.99	2740
34	12531	1.11	2856
35	10073	.33	683
SFEWB	0	4.87	10041.43
36	16157	.21	2630
37	16253	.64	8064
38	16157	.44	5511
UNIV	0	1.29	16204.79
39	20493	.43	20493
PARKS	0	0	0
40	13312	1.04	8932
41	22099	.51	7271
GEIST	0	1.55	16203.17
42	9270	.88	2070
43	9523	.87	2103
44	14705	1.1	4105
45	23813	.42	2538
46	18083	.58	2662
47	9941	.09	227
COLL	0	3.94	13706.12
48	20820	.26	9022
49	19208	.14	4482
50	22649	.11	4152

51	25311	.09	3797
ILL	0	.60	21452.59
52	12612	.08	2193
53	15580	.26	8806
54	10948	.12	2856
CUSH	0	.46	13855.65
55	23183	.61	13865
56	14079	.41	5659
SCUSH	0	1.02	19523.76
57	20329	.86	6965
58	22954	.65	5944
59	21379	1	8517
PEG	0	2.51	21426.78
60	5271	.36	1240
61	314	.41	84
62	5250	.6	2059
63	4450	.16	465
PHIL	0	1.53	3848.42
64	2356	.66	2356
AUR	0	0	0
65	10294	.17	10294
THIRD	0	0	0
66	13842	.57	13842
MIN	0	0	0
67	14611	.15	3985
68	13031	.23	5449
69	13971	.17	4318
BARN	0	.55	13752.48
70	26922	1.13	5907
71	19738	.81	3104
72	23879	.45	2086
73	11815	1.26	2891
74	11550	.75	1682
75	12912	.75	1880
GEXT	0	5.15	17551.02
76	12064	.9	12064
GILL	0	0	
77	13761	.9	13761
COLCON	0	0	
NETWORK	0	0	

ROAD SEGMENT	ADT	ACCDNT'S PER MVM	ANNUAL VM(MILS)	TOTAL ACCDNT'S	DISTRIBUTION OF ACCIDENTS PDO	MAIS1	MAIS2	MAIS3	MAIS4	MAIS5	FATALS
AIR	27112.69	8.4727	32.1836	272.6803	250.2114	18.2968	2.5359	1.1180	.1909	.0545	.2727
STNB	9992.602	4.4703	7.8878	35.2610	32.3555	2.3660	.3279	.1446	.0247	.0071	.0353
STSB	13035.11	5.5808	10.8350	60.4682	55.4856	4.0574	.5624	.2479	.0423	.0121	.0605
RICHNB	19302.83	7.3245	5.5984	41.0057	37.6269	2.7515	.3814	.1681	.0287	.0082	.0410
SFEEB	10437.98	4.6437	15.7920	73.3331	67.2905	4.9207	.6820	.3007	.0513	.0147	.0733
SFEWB	10041.43	4.4895	14.6216	65.6442	60.2351	4.4047	.6105	.2691	.0460	.0131	.0656
UNIV	16204.79	6.5542	6.2503	40.9658	37.5902	2.7488	.3810	.1680	.0287	.0082	.0410
PARKS	20492.86	7.5729	2.6348	19.9529	18.3087	1.3388	.1856	.0818	.0140	.0040	.0200
GEIST	16203.17	6.5537	7.5094	49.2142	45.1589	3.3023	.4577	.2018	.0344	.0098	.0492
COLLEGE	13706	5.8025	16.1466	93.6905	85.9704	6.2866	.8713	.3841	.0656	.0187	.0937
ILL	21452.59	7.7540	3.8486	29.8419	27.3830	2.0024	.2775	.1224	.0209	.0060	.0298
CUSH	13855.65	5.8507	1.9057	11.1498	10.2310	.7482	.1037	.0457	.0078	.0022	.0111
SCUSH	19523.76	7.3726	5.9544	43.8994	40.2821	2.9456	.4083	.1800	.0307	.0088	.0439
PEG	21426.78	7.7493	16.0806	124.6139	114.3457	8.3616	1.1589	.5109	.0872	.0249	.1246
PHIL	3848.42	1.7018	1.7605	2.9960	2.7491	.2010	.0279	.0123	.0021	.0006	.0030
AUR	2355.94	.9230	.4649	.4291	.3938	.0288	.0040	.0018	.0003	.0001	.0004
THIRD	10294	4.5880	.5232	2.4006	2.2028	.1611	.0223	.0098	.0017	.0005	.0024
MINNIE	13842.22	5.8464	2.3591	13.7925	12.6560	.9255	.1283	.0565	.0097	.0028	.0138
BARN	13752.48	5.8175	4.6466	27.0313	24.8039	1.8138	.2514	.1108	.0189	.0054	.0270
GEIST	17551.02	6.9109	27.0259	186.7737	171.3836	12.5325	1.7370	.7658	.1307	.0374	.1868
GEXT	12063.78	5.2450	3.2464	17.0273	15.6242	1.1425	.1584	.0698	.0119	.0034	.0170
GILL	13761	5.8202	3.7031	21.5529	19.7769	1.4462	.2004	.0884	.0151	.0043	.0216
RICHSB	16724.29	6.6958	5.2006	34.8222	31.9529	2.3366	.3238	.1428	.0244	.0070	.0348
NETWORK T				1268.55	1164.02	85.1195	11.7975	5.2010	.8880	.2537	1.2685

COSTS BY TYPE OF ACCIDENT PDO	MAIS1	MAIS2	MAIS3	MAIS4	MAIS5	FATALS	TOTAL COST
291383	58263	16239	16015	13539	19828	147297	562565
37679	7534	2100	2071	1751	2564	19047	72747
64616	12920	3601	3551	3002	4397	32664	124752
43818	8762	2442	2408	2036	2982	22150	84599
78363	15669	4367	4307	3641	5333	39613	151293
70147	14026	3909	3855	3259	4773	35460	135430
43776	8753	2440	2406	2034	2979	22129	84516
21321	4263	1188	1172	991	1451	10778	41165
52590	10516	2931	2891	2444	3579	26585	101533
100117	20019	5580	5503	4652	6813	50610	193292
31889	6376	1777	1753	1482	2170	16120	61567
11915	2382	664	655	554	811	6023	23003
46910	9380	2614	2578	2180	3192	23714	90568
133161	26626	7421	7319	6187	9061	67314	257090
3202	640	178	176	149	218	1618	6181
459	92	26	25	21	31	232	885
2565	513	143	141	119	175	1297	4953
14738	2947	821	810	685	1003	7450	28455
28885	5776	1610	1588	1342	1966	14602	55768
199584	39908	11123	10970	9273	13582	100891	385331
18195	3638	1014	1000	845	1238	9198	35129
23031	4605	1284	1266	1070	1567	11642	44466
37211	7440	2074	2045	1729	2532	18810	71841
1082537	216459	60332	59500	50299	73666	547232	2617129

APPENDIX C

YEAR	VEHICLE OPERATING COST-AUTO	VEHICLE OPERATING COST-TRUCK	TIME COST HIGH	TIME COST LOW	TOTAL COST HIGH	TOTAL COST LOW	ANNUAL COST HIGH	ANNUAL COST LOW
1986	64609	16332	333451	24934	414392	105875	123,903,291	31,656,503
1987	70161	17369	364992	27290	452522	114819	135,304,147	34,331,002
1988	72530	17862	377991	28261	468382	118652	140,046,264	35,477,088
1989	74979	18368	391452	29267	484799	122614	144,954,884	36,661,607
1990	77511	18889	405392	30308	501792	126709	150,035,860	37,885,854
1991	80128	19425	419829	31387	519382	130940	155,295,255	39,151,168
1992	82834	19976	434780	32504	537590	135314	160,739,344	40,458,930
1993	85631	20542	450263	33661	556437	139835	166,374,621	41,810,572
1994	88523	21125	466298	34859	575946	144507	172,207,812	43,207,570
1995	91512	21724	482904	36100	596140	149336	178,245,877	44,651,454
1996	93932	22225	501451	37495	617609	153652	184,664,952	45,941,901
1997	95348	22530	511100	38219	628978	156097	188,064,383	46,672,989
1998	96786	22839	520934	38957	640558	158582	191,526,954	47,415,891
1999	98245	23152	530957	39709	652354	161106	195,053,848	48,170,803
2000	99726	23470	541173	40476	664369	163672	198,646,268	48,937,921
2001	101229	23792	551586	41258	676607	166279	202,305,440	49,717,447
2002	102755	24119	562199	42055	689072	168928	206,032,614	50,509,585
2003	104304	24450	573016	42867	701769	171621	209,829,062	51,314,541
2004	105876	24785	584041	43695	714703	174356	213,696,081	52,132,527
2005	107472	25126	595279	44539	727876	177136	217,634,992	52,963,757

YEAR	VEHICLE OPERATING COST-AUTO	VEHICLE OPERATING COST-TRUCK	TIME COST HIGH	TIME COST LOW	TOTAL COST HIGH	TOTAL COST LOW	ANNUAL COST HIGH	ANNUAL COST LOW
1986	64609	16332	346386	25901	427327	106842	127,770,753	31,945,876
1987	67326	16987	355362	26571	439675	110884	131,462,766	33,154,242
1988	70929	17834	372667	27833	461430	116597	137,967,667	34,862,450
1989	71700	18024	392949	29305	482673	119029	144,319,274	35,589,805
1990	75519	18926	396768	29660	491213	124105	146,872,726	37,107,482
1991	75087	18921	402654	30098	496662	124106	148,502,047	37,107,599
1992	78258	19606	419110	31335	516974	129198	154,575,299	38,630,333
1993	80954	20200	433163	32390	534317	133544	159,760,818	39,929,695
1994	83744	20811	447687	33481	552242	138036	165,120,377	41,272,845
1995	86629	21441	462698	34609	570769	142680	170,659,820	42,661,260
1996	88880	21930	475457	35562	586266	146372	175,293,682	43,765,224
1997	90204	22228	482828	36113	595260	148545	177,982,701	44,414,971
1998	91547	22531	490313	36673	604391	150750	180,712,998	45,074,379
1999	92911	22837	497915	37241	613663	152989	183,485,207	45,743,591
2000	94295	23148	505634	37817	623077	155260	186,299,973	46,422,754
2001	95699	23463	513473	38403	632635	157565	189,157,948	47,112,016
2002	97124	23782	521434	38998	642340	159905	192,059,798	47,811,527
2003	98571	24106	529518	39602	652195	162279	195,006,195	48,521,440
2004	100039	24434	537727	40215	662200	164689	197,997,824	49,241,909
2005	101529	24767	546063	40838	672359	167134	201,035,380	49,973,092

ANNUAL DEMAND-EXISTING	% DECREASE IN USER COSTS WITH PROJECT	ANNUAL GENERATED TRAFFIC WORK	OTHER	TOTAL	ADDED DAILY TRAFFIC	TOTAL DEMAND E+G	%INCREASE IN TRAFFIC E TO G	% RISE IN COSTS E+G	ESTIMATED ESTIMATED LOSS IN TRAFFIC AS A RESULT OF GENERATED TRAFFIC WORK	OTHER
49883516	0	0	0	0	0	49883516	0	0	0	0
51443428	.0284	468972	448817	917788	3070	52361217	.0175	.0183	307681	294458
53052318	.0148	252839	241972	494811	1655	53547129	.0092	.0142	244155	233661
54711229	.0044	77033	73722	150755	504	54861984	.0027	.0183	322376	308521
56422257	.0211	381956	365541	747497	2500	57169753	.0131	.0178	326758	312715
58186656	.0437	817298	782173	1599471	5349	59786127	.0268	.0318	610475	584238
60006310	.0383	738892	707136	1446028	4836	61452338	.0235	.0265	522907	500434
61882894	.0398	789905	755958	1545863	5170	63428757	.0244	.0235	478624	458054
63818082	.0412	843374	807128	1650502	5520	65468584	.0252	.0205	430950	412429
65813757	.0426	899401	860748	1760149	5887	67573906	.0260	.0175	379715	363396
66743468	.0507	1087585	1040843	2128428	7118	68871895	.0309	.0204	451141	431752
67686364	.0536	1165113	1115039	2280152	7626	69966516	.0326	.0217	487518	466565
68642447	.0565	1244480	1190995	2435475	8145	71077921	.0343	.0231	527214	504556
69612134	.0593	1325724	1268748	2594472	8677	72206605	.0359	.0245	568046	543633
70595425	.0622	1408877	1348327	2757205	9221	73352629	.0376	.0258	607681	581565
71592530	.0650	1493975	1429768	2923743	9778	74516273	.0392	.0271	648426	620559
72603868	.0678	1581059	1513109	3094168	10348	75698036	.0409	.0284	690309	660641
73629438	.0706	1670161	1598382	3268543	10932	76897981	.0425	.0298	735820	704196
74669659	.0735	1761324	1685627	3446952	11528	78116610	.0441	.0311	780089	746563
75724740	.0763	1854587	1774882	3629470	12139	79354210	.0457	.0324	825573	790092

PER UNIT BENEFITS TO EXISTING TRAFFIC HIGH	LOW	LOST BENEFITS FROM LOST TRAFFIC HIGH	LOW	BENEFITS TO GENERATED TRAFFIC HIGH	LOW	NET BENEFITS TO GENERATED TRAFFIC HIGH	LOW
0	0	0		0	0	0	0
.0747	.0229	44963	13774	34267	10497	-10696	-3277
.0392	.0116	18721	5536	9693	2866	-9028	-2669
.0116	.0196	7329	12359	876	1477	-6454	-10883
.0561	.0138	35850	8822	20953	5156	-14897	-3666
.1167	.0351	139481	41959	93368	28087	-46113	-13872
.1027	.0305	105121	31185	74270	22033	-30851	-9152
.1069	.0304	100108	28470	82608	23493	-17501	-4977
.1111	.0303	93663	25568	91650	25019	-2013	-550
.1153	.0302	85655	22471	101442	26613	15787	4142
.1404	.0326	123965	28793	149423	34707	25459	5913
.1489	.0334	142108	31828	169811	38033	27703	6205
.1575	.0341	162545	35195	191843	41539	29297	6344
.1662	.0349	184747	38762	215584	45232	30837	6470
.1749	.0356	207985	42370	241101	49117	33116	6746
.1836	.0364	233041	46182	268463	53201	35422	7020
.1925	.0372	259994	50203	297741	57492	37747	7289
.2013	.0379	289900	54626	329007	61995	39107	7369
.2102	.0387	320957	59100	362337	66719	41380	7619
.2192	.0395	354170	63809	397808	71671	43638	7862

Benefits Under Various Scenarios

ANNUAL BENEFITS HIGH	ANNUAL BENEFITS LOW	WITHOUT PROJECT ANNUAL ACCIDENT COSTS	WITH PROJECT ANNUAL ACCIDENT COSTS	ANNUAL BENEFITS INCLUDING ACCIDENT HIGH	ANNUAL BENEFITS INCLUDING ACCIDENT LOW	BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITHOUT ACCIDENT HIGH	BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITHOUT ACCIDENT LOW	BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITH ACCIDENT HIGH	BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITH ACCIDENT LOW	ANNUAL CONSTRUCTION COSTS	ANNUAL MAINTENANCE COSTS
0	0	2226891	2226891	0	0	0	0	0	0	26000000	61236
3,841,382	1,176,761	2435970	2335863	3,941,489	1,276,868	3852078	1180038	3952186	1280145	0	61236
2,078,597	614,638	2522367	2449452	2,151,512	687,553	2087625	617307	2160540	690222	15400000	115236
635,610	1,071,802	2611828	2529623	717,814	1,154,006	642063	1082684	724268	1164889	23500000	330624
3,163,134	778,372	2704461	2548588	3,319,008	934,246	3178031	782038	3333905	937912	23100000	330624
6,793,209	2,043,569	2800381	2564057	7,029,532	2,279,892	6839322	2057441	7075645	2293764	0	330624
6,164,045	1,828,598	2899702	2717166	6,346,581	2,011,134	6194896	1837750	6377431	2020286	28100000	336024
6,613,803	1,880,877	3002545	2841193	6,775,156	2,042,229	6631304	1885854	6792656	2047206	0	336024
7,087,435	1,934,725	3109037	2970882	7,225,590	2,072,880	7089448	1935275	7227603	2073430	0	336024
7,586,056	1,990,193	3219305	3106490	7,698,871	2,103,008	7570269	1986051	7683084	2098866	0	336024
9,371,269	2,176,678	3290092	3220438	9,440,924	2,246,332	9345811	2170764	9415465	2240419	0	336024
10,081,682	2,258,018	3333788	3280615	10,134,855	2,311,191	10053979	2251813	10107152	2304986	0	336024
10,813,957	2,341,512	3378065	3341917	10,850,105	2,377,660	10784659	2335169	10820807	2371317	0	336024
11,568,641	2,427,212	3422930	3404364	11,587,207	2,445,777	11537804	2420742	11556369	2439307	0	336024
12,346,296	2,515,167	3468390	3467979	12,346,707	2,515,578	12313179	2508421	12313591	2508832	0	336024
13,147,492	2,605,431	3514454	3532782	13,129,165	2,587,104	13112070	2598411	13093742	2580084	0	336024
13,972,816	2,698,057	3561130	3598795	13,935,151	2,660,392	13935069	2690769	13897404	2653104	0	336024
14,822,867	2,793,101	3608426	3666043	14,765,250	2,735,484	14783760	2785732	14726143	2728115	0	336024
15,698,257	2,890,618	3656350	3734547	15,620,060	2,812,421	15656877	2882998	15578681	2804802	0	336024
16,599,612	2,990,665	3704911	3804331	16,500,192	2,891,245	16555974	2982803	16456554	2883383	0	336024

DISCOUNT RATE	NPV ANNUAL BENEFITS HIGH	NPV ANNUAL BENEFITS LOW	NPV OF ANNUAL BENEFITS INCLUDING ACCIDENT HIGH	ANNUAL BENEFITS INCLUDING ACCIDENT LOW	NPV OF BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITHOUT ACCIDENT HIGH	LOW	NPV OF BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITH ACCIDENT HIGH	LOW
-.0500	358584605	77349850	359885562	78650808	357955866	77252005	359256823	78552962
0	172386160	39015992	173515169	40145001	172164219	38992059	173293228	40121068
.0050	161028701	36632882	162134641	37738821	160829905	36613026	161935845	37718966
.0100	150556439	34428255	151639070	35510886	150378700	34412086	151461330	35494716
.0150	140892728	32387023	141951932	33446227	140734150	32374183	141793354	33433387
.0200	131968103	30495486	133003868	31531252	131826964	30485653	132862729	31521419
.0250	123719562	28741202	124731966	29753606	123594296	28734083	124606700	29746487
.0300	116089924	27112858	117079119	28102053	115979108	27108186	116968304	28097381
.0350	109027255	25600161	109993460	26566366	108929595	25597694	109895801	26563900
.0400	102484355	24193741	103427843	25137228	102398673	24193261	103342160	25136748
.0450	96418296	22885061	97339382	23806147	96343517	22886369	97264603	23807455
.0500	90790006	21666339	91689044	22565378	90725153	21669252	91624192	22568291
.0550	85563901	20530471	86441278	21407848	85508084	20534826	86385461	21412203
.0600	80707553	19470975	81563677	20327098	80659960	19476622	81516084	20332745
.0650	76191386	18481925	77026685	19317224	76151276	18488728	76986575	19324027
.0700	71988409	17557905	72803326	18372822	71955107	17565740	72770024	18380657
.0750	68073974	16693959	68868964	17488948	68046865	16702713	68841854	17497703
.0800	64425559	15885548	65201081	16661071	64404078	15895120	65179601	16670643
.0850	61022566	15128516	61779087	15885038	61006201	15138812	61762722	15895334
.0900	57846149	14419050	58584138	15157038	57834431	14429986	58572419	15167974
.0950	54879054	13753652	55598976	14473574	54871552	13765151	55591474	14485073
.1000	52105468	13129112	52807789	13831433	52101793	13141104	52804114	13843425
.1050	49510898	12542478	50196080	13227660	49510691	12554900	50195873	13240082
.1100	47082045	11991040	47750545	12659540	47084978	12003833	47753478	12672333
.1150	44806702	11472301	45458970	12124569	44812476	11485413	45464745	12137681
.1200	42673654	10983964	43310135	11620445	42681997	10997348	43318478	11633828
.1250	40672596	10523914	41293725	11145043	40683256	10537526	41304385	11158655
.1300	38794047	10090199	39400253	10696404	38806796	10104000	39413001	10710205
.1350	37029283	9681020	37620984	10272721	37043910	9694974	37635611	10286675
.1400	35370268	9294717	35947874	9872323	35386583	9308792	35964189	9886398
.1450	33809601	8929756	34373512	9493668	33827427	8943922	34391339	9507834
.1500	32340453	8584718	32891061	9135326	32359631	8598949	32910239	9149557
.1550	30956528	8258294	31494213	8795979	30976911	8272566	31514596	8810251
.1600	29652010	7949269	30177144	8474402	29673464	7963560	30198597	8488693
.1650	28421530	7656520	28934473	8169463	28443931	7670810	28956874	8183754
.1700	27260123	7379006	27761227	7880110	27283360	7393278	27784464	7894382
.1750	26163199	7115762	26652805	7605368	26187168	7130000	26676774	7619607
.1800	25126508	6865892	25604949	7344333	25151115	6880083	25629556	7358523
.1850	24146117	6628566	24613714	7096163	24171277	6642695	24638873	7110292
.1900	23218382	6403011	23675447	6860077	23244015	6417068	23701080	6874133
.1950	22339922	6188510	22786760	6635348	22365958	6202484	22812795	6649322
.2000	21507604	5984396	21944508	6421300	21533977	5998277	21970881	6435181
.3000	172386160	39015992	11533848	3658105	11271593	3381510	11559382	3669300
.4000	172386160	39015992	7128314	2380675	6947882	2188291	7148824	2389233
.5000	172386160	39015992	4909552	1690884	4778110	1550006	4925543	1697438
.6000	172386160	39015992	3638256	1274804	3538174	1167274	3650806	1279905

BENEFIT-COST RATIOS

DISCOUNT RATE	1	2	3	4	5	6	7	8
-.0500	2.307	.498	2.315	.506	2.303	.497	2.311	.505
0	1.413	.320	1.422	.329	1.411	.320	1.420	.329
.0050	1.349	.307	1.359	.316	1.348	.307	1.357	.316
.0100	1.290	.295	1.299	.304	1.288	.295	1.297	.304
.0150	1.233	.283	1.242	.293	1.232	.283	1.241	.293
.0200	1.180	.273	1.189	.282	1.179	.273	1.188	.282
.0250	1.130	.262	1.139	.272	1.129	.262	1.138	.272
.0300	1.082	.253	1.092	.262	1.081	.253	1.091	.262
.0350	1.038	.244	1.047	.253	1.037	.244	1.046	.253
.0400	.995	.235	1.005	.244	.995	.235	1.004	.244
.0450	.955	.227	.965	.236	.955	.227	.964	.236
.0500	.918	.219	.927	.228	.917	.219	.926	.228
.0550	.882	.212	.891	.221	.881	.212	.890	.221
.0600	.848	.205	.857	.214	.847	.205	.856	.214
.0650	.816	.198	.825	.207	.816	.198	.824	.207
.0700	.786	.192	.794	.200	.785	.192	.794	.201
.0750	.757	.186	.766	.194	.756	.186	.765	.195
.0800	.730	.180	.738	.189	.729	.180	.738	.189
.0850	.704	.174	.712	.183	.703	.175	.712	.183
.0900	.679	.169	.688	.178	.679	.169	.688	.178
.0950	.656	.164	.664	.173	.656	.164	.664	.173
.1000	.634	.160	.642	.168	.634	.160	.642	.168
.1050	.613	.155	.621	.164	.613	.155	.621	.164
.1100	.593	.151	.601	.159	.593	.151	.601	.160
.1150	.574	.147	.582	.155	.574	.147	.582	.155
.1200	.556	.143	.564	.151	.556	.143	.564	.151
.1250	.538	.139	.547	.148	.539	.139	.547	.148
.1300	.522	.136	.530	.144	.522	.136	.530	.144
.1350	.506	.132	.514	.140	.507	.133	.515	.141
.1400	.492	.129	.500	.137	.492	.129	.500	.137
.1450	.477	.126	.485	.134	.478	.126	.486	.134
.1500	.464	.123	.472	.131	.464	.123	.472	.131
.1550	.451	.120	.459	.128	.451	.121	.459	.128
.1600	.439	.118	.446	.125	.439	.118	.447	.126
.1650	.427	.115	.435	.123	.427	.115	.435	.123
.1700	.416	.113	.423	.120	.416	.113	.424	.120
.1750	.405	.110	.412	.118	.405	.110	.413	.118
.1800	.395	.108	.402	.115	.395	.108	.403	.116
.1850	.385	.106	.392	.113	.385	.106	.393	.113
.1900	.375	.104	.383	.111	.376	.104	.383	.111
.1950	.366	.101	.374	.109	.367	.102	.374	.109
.2000	.358	.100	.365	.107	.358	.100	.365	.107
.3000								
.4000								
.5000								
.6000								

PROJECT CASH FLOWS AND INTERNAL RATE OF RETURN

YEAR	1	2	3	4	5	6	7	8
1986	-26061236	-26061236	-26061236	-26061236	-26061236	-26061236	-26061236	-26061236
1987	3780146	1115525	3880253	1215632	3790842	1118802	3890950	1218909
1988	-13436639	-14900598	-13363724	-14827683	-13427611	-14897929	-13354696	-14825014
1989	-23195014	-22758822	-23112810	-22676618	-23188561	-22747940	-23106356	-22665735
1990	-20267490	-22652252	-20111616	-22496378	-20252593	-22648586	-20096719	-22492712
1991	6462585	1712945	6698908	1949268	6508698	1726817	6745021	1963140
1992	-22271979	-26607426	-22089443	-26424890	-22241128	-26598274	-22058593	-26415738
1993	6277779	1544853	6439132	1706205	6295280	1549830	6456632	1711182
1994	6751411	1598701	6889566	1736856	6753424	1599251	6891579	1737406
1995	7250032	1654169	7362847	1766984	7234245	1650027	7347060	1762842
1996	9035245	1840654	9104900	1910308	9009787	1834740	9079441	1904395
1997	9745658	1921994	9798831	1975167	9717955	1915789	9771128	1968962
1998	10477933	2005488	10514081	2041636	10448635	1999145	10484783	2035293
1999	11232617	2091188	11251183	2109753	11201780	2084718	11220345	2103283
2000	12010272	2179143	12010683	2179554	11977155	2172397	11977567	2172808
2001	12811468	2269407	12793141	2251080	12776046	2262387	12757718	2244060
2002	13636792	2362033	13599127	2324368	13599045	2354745	13561380	2317080
2003	14486843	2457077	14429226	2399460	14447736	2449708	14390119	2392091
2004	15362233	2554594	15284036	2476397	15320853	2546974	15242657	2468778
2005	16263588	2654641	16164168	2555221	16219950	2646779	16120530	2547359
IRR:	.039	-.119	.041	-.118	.039	-.119	.040	-.119

COST-VOLUME RELATIONSHIP FOR LINK#4

AADT	COST		
34328	0	2518	0
36687	.0687	2670	.0604
37102	.0808	2704	.0739
37457	.0912	2727	.0830
37880	.1035	2747	.0909
37916	.1045	2847	.1307
38079	.1093	2903	.1529
38930	.1341	2986	.1859
40147	.1695	2971	.1799
40191	.1708	2980	.1835
41448	.2074	3074	.2208
41666	.2138	3269	.2983
42379	.2345	3377	.3411
48716	.4191	4074	.6180

YEAR	VEHICLE OPERATING COST-AUTO	VEHICLE OPERATING COST-TRUCK	TIME COST HIGH	TIME COST LOW	TOTAL COST HIGH	TOTAL COST LOW	ANNUAL COST HIGH	ANNUAL COST LOW
1986	63137	15994	326025	24373	405156	103504	121,141,629	30,947,820
1987	65817	16568	341377	25520	423762	107906	126,704,863	32,263,884
1988	67272	16897	349439	26123	433608	110292	129,648,888	32,977,402
1989	68760	17232	357692	26740	443684	112732	132,661,416	33,706,744
1990	70280	17574	366140	27371	453993	115225	135,744,042	34,452,259
1991	71834	17922	374787	28018	464543	117774	138,898,401	35,214,309
1992	73422	18277	383639	28679	475338	120379	142,126,163	35,993,260
1993	75045	18640	392700	29357	486385	123042	145,429,038	36,789,489
1994	76704	19010	401974	30050	497688	125764	148,808,776	37,603,380
1995	78400	19386	411468	30760	509255	128546	152,267,170	38,435,325
1996	79761	19649	420183	31411	519593	130821	155,358,427	39,115,397
1997	80656	19833	425620	31817	526109	132306	157,306,711	39,559,597
1998	81561	20019	431127	32229	532708	133809	159,279,547	40,008,888
1999	82477	20206	436705	32645	539389	135329	161,277,247	40,463,330
2000	83403	20396	442356	33068	546154	136866	163,300,126	40,922,982
2001	84339	20587	448079	33495	553005	138421	165,348,502	41,387,904
2002	85286	20779	453877	33929	559942	139994	167,422,697	41,858,157
2003	86243	20974	459750	34367	566967	141585	169,523,039	42,333,804
2004	87212	21170	465698	34812	574080	143194	171,649,859	42,814,905
2005	88191	21368	471724	35262	581283	144821	173,803,491	43,301,525

YEAR	VEHICLE OPERATING COST-AUTO	VEHICLE OPERATING COST-TRUCK	TIME COST HIGH	TIME COST LOW	TOTAL COST HIGH	TOTAL COST LOW	ANNUAL COST HIGH	ANNUAL COST LOW
1986	63137	15994	297563	22423	376695	101555	112,631,749	30,364,818
1987	62861	15959	337172	25171	415992	103991	124,381,519	31,093,421
1988	65556	16595	347482	25874	429633	108025	128,460,287	32,299,470
1989	65465	16598	353466	26921	435529	108983	130,223,079	32,586,060
1990	68267	17257	360636	26945	446160	112470	133,401,832	33,628,430
1991	66966	17029	357545	26728	441540	110723	132,020,539	33,106,237
1992	69243	17506	370922	27734	457671	114484	136,843,638	34,230,583
1993	71231	17930	382468	28602	471629	117763	141,017,039	35,211,213
1994	73275	18365	394373	29497	486013	121137	145,318,034	36,220,095
1995	75378	18810	406649	30420	500838	124609	149,750,532	37,258,047
1996	76756	19125	411718	30809	507599	126690	151,772,030	37,880,186
1997	77651	19333	415334	31084	512318	128069	153,183,096	38,292,553
1998	78556	19545	418981	31362	517082	129463	154,607,456	38,709,458
1999	79472	19758	422661	31643	521890	130873	156,045,237	39,130,950
2000	80398	19974	426372	31926	526744	132298	157,496,569	39,557,081
2001	81336	20192	430117	32212	531644	133739	158,961,581	39,987,902
2002	82284	20412	433894	32500	536590	135196	160,440,403	40,423,466
2003	83243	20635	437705	32790	541583	136668	161,933,169	40,863,824
2004	84213	20860	441548	33084	546622	138157	163,440,011	41,309,031
2005	85195	21088	445426	33380	551709	139663	164,961,064	41,759,141

ANNUAL BENEFITS HIGH	ANNUAL BENEFITS LOW	WITHOUT PROJECT ANNUAL ACCIDENT COSTS	WITH PROJECT ANNUAL ACCIDENT COSTS	ANNUAL BENEFITS INCLUDING ACCIDENT HIGH	ANNUAL BENEFITS INCLUDING ACCIDENT LOW	BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITHOUT ACCIDENT HIGH	BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITHOUT ACCIDENT LOW	BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITH ACCIDENT HIGH	BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITH ACCIDENT LOW	ANNUAL CONSTRUCTION COSTS	ANNUAL MAINTENANCE COSTS
0	0	2226891	2226891	0	0	0	0	0	0	26000000	61236
2,323,343	1,170,463	2435970	2335863	2,423,451	1,270,570	2336983	1177334	2437091	1277442	0	61236
1,188,601	677,933	2522367	2449452	1,261,516	750,848	1195845	682064	1268759	754979	15400000	115236
2,438,336	1,120,684	2611828	2529623	2,520,541	1,202,889	2452619	1127248	2534824	1209453	23500000	330624
2,342,211	823,829	2704461	2548588	2,498,084	979,703	2355996	828678	2511869	984551	23100000	330624
6,877,862	2,108,072	2800381	2564057	7,114,185	2,344,396	6912572	2118711	7148895	2355035	0	330624
5,282,524	1,762,677	2899702	2717166	5,465,060	1,945,213	5310856	1772131	5493392	1954667	28100000	336024
4,411,999	1,578,277	3002545	2841193	4,573,351	1,739,629	4436339	1586984	4597691	1748336	0	336024
3,490,742	1,383,285	3109037	2970882	3,628,897	1,521,440	3510645	1391172	3648800	1529327	0	336024
2,516,638	1,177,277	3219305	3106490	2,629,453	1,290,092	2531531	1184245	2644346	1297060	0	336024
3,586,397	1,235,210	3290092	3220438	3,656,051	1,304,865	3607026	1242316	3676681	1311970	0	336024
4,123,615	1,267,043	3333788	3280615	4,176,788	1,320,217	4146808	1274170	4199982	1327343	0	336024
4,672,091	1,299,430	3378065	3341917	4,708,239	1,335,578	4698102	1306665	4734250	1342813	0	336024
5,232,010	1,332,380	3422930	3404364	5,250,575	1,350,945	5260873	1339730	5279438	1358296	0	336024
5,803,557	1,365,901	3468390	3467979	5,803,968	1,366,313	5834945	1373288	5835356	1373700	0	336024
6,386,921	1,400,002	3514454	3532782	6,368,593	1,381,675	6420812	1407431	6402485	1389104	0	336024
6,982,294	1,434,692	3561130	3598795	6,944,629	1,397,027	7018676	1442167	6981011	1404502	0	336024
7,589,870	1,469,979	3608426	3666043	7,532,254	1,412,363	7629230	1477602	7571614	1419986	0	336024
8,209,848	1,505,874	3656350	3734547	8,131,651	1,427,677	8251741	1513558	8173544	1435361	0	336024
8,842,427	1,542,385	3704911	3804331	8,743,007	1,442,965	8886867	1550136	8787447	1450716	0	336024

DISCOUNT RATE	NPV ANNUAL BENEFITS HIGH	NPV ANNUAL BENEFITS LOW	NPV OF ANNUAL BENEFITS INCLUDING ACCIDENT HIGH	ANNUAL BENEFITS INCLUDING ACCIDENT LOW	NPV OF BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITHOUT ACCIDENT HIGH	LOW	NPV OF BENEFITS ADJUSTED FOR GENERATED TRAFFIC-WITH ACCIDENT HIGH	LOW	NPV ANNUAL CONST. COSTS	NPV ANNUAL MAINT. COSTS
-.0500	186328451	47794296	187629409	49095253	187323185	48053066	188624142	49354023	144273904	11154169
0	92301285	25655394	93430294	26784403	92798467	25795631	93927476	26924640	116100000	5933916
.0050	86535998	24246668	87641938	25352608	87002536	24379324	88108475	25485264	113744695	5601437
.0100	81213755	22938065	82296385	24020696	81651982	23063674	82734613	24146305	111460935	5292589
.0150	76296187	21721348	77355391	22780552	76708237	21840398	77767441	22899603	109246041	5005439
.0200	71748537	20589027	72784303	21624793	72136362	20701969	73172128	21737735	107097450	4738228
.0250	67539298	19534289	68551702	20546693	67904683	19641536	68917087	20653940	105012712	4489355
.0300	63639883	18550927	64629079	19540123	63984466	18652862	64973662	19642058	102989480	4257359
.0350	60024343	17633289	60990549	18599495	60349624	17730262	61315829	18696468	101025509	4040912
.0400	56669102	16776218	57612589	17719705	56976457	16868553	57919944	17812040	99118649	3838798
.0450	53552725	15975007	54473811	16896093	53843418	16063003	54764503	16984089	97266841	3649908
.0500	50655711	15225359	51554750	16124398	50930904	15309292	51829943	16208331	95468112	3473230
.0550	47960306	14523344	48837683	15400720	48221067	14603469	49098444	15480846	93720572	3307836
.0600	45450335	13865367	46306458	14721491	45697647	13941921	46553771	14798045	92022409	3152877
.0650	43111048	13248140	43946347	14083439	43345817	13321342	44181116	14156641	90371886	3007578
.0700	40928992	12668648	41743909	13483565	41152053	12738699	41966970	13553616	88767339	2871225
.0750	38891880	12124127	39686869	12919116	39104002	12191216	39898992	12986206	87207169	2743164
.0800	36988488	11612042	37764011	12387565	37190384	11676344	37965906	12451866	85689844	2622798
.0850	35208556	11130065	35965078	11886587	35400880	11191742	36157402	11948263	84213894	2509573
.0900	33542694	10676058	34280682	11414046	33726054	10735259	34464042	11473248	82777906	2402984
.0950	31982305	10248053	32702227	10967975	32157264	10304920	32877186	11024842	81380527	2302565
.1000	30519516	9844241	31221838	10546562	30686594	9898903	31388915	10601225	80020453	2207886
.1050	29147107	9462955	29832289	10148137	29306785	9515535	29991967	10200717	78696437	2118553
.1100	27858453	9102659	28526953	9771158	28011178	9153270	28679678	9821770	77407276	2034201
.1150	26647474	8761937	27299742	9414205	26793661	8810685	27445929	9462953	76151816	1954495
.1200	25508583	8439482	26145064	9075963	25648617	8486466	26285098	9122946	74928950	1879122
.1250	24436645	8134088	25057774	8755217	24570885	8179399	25192014	8800528	73737610	1807798
.1300	23426936	7844638	24033142	8450844	23555714	7888363	24161920	8494569	72576771	1740257
.1350	22475108	7570102	23066809	8161802	22598734	7612322	23190435	8204022	71445447	1676253
.1400	21577154	7309524	22154760	7887130	21695917	7350314	22273523	7927920	70342690	1615561
.1450	20729382	7062020	21293294	7625932	20843550	7101452	21407462	7665363	69267587	1557968
.1500	19928386	6826771	20478994	7377379	20038211	6864911	20588819	7415519	68219260	1503282
.1550	19171024	6603018	19708709	7140703	19276739	6639928	19814424	7177614	67196863	1451320
.1600	18454391	6390054	18979524	6915188	18556215	6425794	19081349	6950928	66199583	1401915
.1650	17775804	6187226	18288747	6700170	17873943	6221850	18386886	6734794	65226634	1354911
.1700	17132783	5993925	17633887	6495029	17227426	6027485	17728530	6528589	64277263	1310164
.1750	16523030	5809585	17012636	6299191	16614358	5842130	17103964	6331736	63350741	1267537
.1800	15944420	5633679	16422860	6112119	16032599	5665255	16511039	6143695	62446369	1226907
.1850	15394981	5465717	15862577	5933313	15480169	5496367	15947765	5963963	61563470	1188156
.1900	14872887	5305242	15329952	5762308	14955231	5335007	15412296	5792073	60701393	1151176
.1950	14376443	5151829	14823281	5598666	14456081	5180748	14902919	5627585	59859511	1115864
.2000	13904075	5005080	14340979	5441984	13981137	5033188	14418041	5470092	59037217	1082127
.3000	7844211	3038239	8132001	3326029	7888091	3055449	8175881	3343239	45937257	635256
.4000	5057111	2059855	5258053	2260797	5085614	2071604	5286556	2272546	37261694	418992
.5000	3551182	1501280	3698614	1648712	3571327	1509892	3718759	1657325	31224874	298855
.6000	2643284	1150517	2755915	1263149	2658363	1157149	2770995	1269781	26845375	225348

BENEFIT-COST RATIOS

DISCOUNT RATE	1	2	3	4	5	6	7	8
-.0500	1.199	.308	1.207	.316	1.205	.309	1.214	.318
0	.756	.210	.766	.219	.760	.211	.770	.221
.0050	.725	.203	.734	.212	.729	.204	.738	.214
.0100	.696	.196	.705	.206	.699	.198	.709	.207
.0150	.668	.190	.677	.199	.671	.191	.681	.200
.0200	.642	.184	.651	.193	.645	.185	.654	.194
.0250	.617	.178	.626	.188	.620	.179	.629	.189
.0300	.593	.173	.603	.182	.597	.174	.606	.183
.0350	.571	.168	.580	.177	.574	.169	.584	.178
.0400	.550	.163	.560	.172	.553	.164	.563	.173
.0450	.531	.158	.540	.167	.534	.159	.543	.168
.0500	.512	.154	.521	.163	.515	.155	.524	.164
.0550	.494	.150	.503	.159	.497	.151	.506	.160
.0600	.478	.146	.487	.155	.480	.146	.489	.155
.0650	.462	.142	.471	.151	.464	.143	.473	.152
.0700	.447	.138	.456	.147	.449	.139	.458	.148
.0750	.432	.135	.441	.144	.435	.136	.444	.144
.0800	.419	.131	.428	.140	.421	.132	.430	.141
.0850	.406	.128	.415	.137	.408	.129	.417	.138
.0900	.394	.125	.402	.134	.396	.126	.405	.135
.0950	.382	.122	.391	.131	.384	.123	.393	.132
.1000	.371	.120	.380	.128	.373	.120	.382	.129
.1050	.361	.117	.369	.126	.363	.118	.371	.126
.1100	.351	.115	.359	.123	.353	.115	.361	.124
.1150	.341	.112	.350	.121	.343	.113	.351	.121
.1200	.332	.110	.340	.118	.334	.110	.342	.119
.1250	.323	.108	.332	.116	.325	.108	.333	.116
.1300	.315	.106	.323	.114	.317	.106	.325	.114
.1350	.307	.104	.315	.112	.309	.104	.317	.112
.1400	.300	.102	.308	.110	.302	.102	.310	.110
.1450	.293	.100	.301	.108	.294	.100	.302	.108
.1500	.286	.098	.294	.106	.287	.098	.295	.106
.1550	.279	.096	.287	.104	.281	.097	.289	.105
.1600	.273	.095	.281	.102	.274	.095	.282	.103
.1650	.267	.093	.275	.101	.268	.093	.276	.101
.1700	.261	.091	.269	.099	.263	.092	.270	.100
.1750	.256	.090	.263	.097	.257	.090	.265	.098
.1800	.250	.088	.258	.096	.252	.089	.259	.096
.1850	.245	.087	.253	.095	.247	.088	.254	.095
.1900	.240	.086	.248	.093	.242	.086	.249	.094
.1950	.236	.084	.243	.092	.237	.085	.244	.092
.2000	.231	.083	.239	.091	.233	.084	.240	.091

PROJECT CASH FLOWS AND INTERNAL RATE OF RETURN

YEAR	1	2	3	4	5	6	7	8
1986	-26061236	-26061236	-26061236	-26061236	-26061236	-26061236	-26061236	-26061236
1987	2262107	1109227	2362215	1209334	2275747	1116098	2375855	1216206
1988	-14326635	-14837303	-14253720	-14764388	-14319391	-14833172	-14246477	-14760257
1989	-21392288	-22709940	-21310083	-22627735	-21378005	-22703376	-21295800	-22621171
1990	-21088413	-22606795	-20932540	-22450921	-21074628	-22601946	-20918755	-22446073
1991	6547238	1777448	6783561	2013772	6581948	1788087	6818271	2024411
1992	-23153500	-26673347	-22970964	-26490811	-23125168	-26663893	-22942632	-26481357
1993	4075975	1242253	4237327	1403605	4100315	1250960	4261667	1412312
1994	3154718	1047261	3292873	1185416	3174621	1055148	3312776	1193303
1995	2180614	841253	2293429	954068	2195507	848221	2308322	961036
1996	3250373	899186	3320027	968841	3271002	906292	3340657	975946
1997	3787591	931019	3840764	984193	3810784	938146	3863958	991319
1998	4336067	963406	4372215	999554	4362078	970641	4398226	1006789
1999	4895986	996356	4914551	1014921	4924849	1003706	4943414	1022272
2000	5467533	1029877	5467944	1030289	5498921	1037264	5499332	1037676
2001	6050897	1063978	6032569	1045651	6084788	1071407	6066461	1053080
2002	6646270	1098668	6608605	1061003	6682652	1106143	6644987	1068478
2003	7253846	1133955	7196230	1076339	7293206	1141578	7235590	1083962
2004	7873824	1169850	7795627	1091653	7915717	1177534	7837520	1099337
2005	8506403	1206361	8406983	1106941	8550843	1214112	8451423	1114692
IRR:	-.031	-.173	-.030	-.174	-.031	-.172	-.030	-.174