DEPARTMENT OF TRANSPORTATION

Measuring the Economic Benefits of Rural and Small Urban Transit Services in Greater Minnesota

Jeremy Mattson, Principal Investigator
Upper Great Plains Transportation Institute
North Dakota State University

April 2020

Research Project
Final Report 2020-10

To request this document in an alternative format, such as braille or large print, call 651-366-4718 or 1-800-657-3774 (Greater Minnesota) or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

Technical Report Documentation Page

1. Report No.	2.	3. Recipients Accession No.
MN 2020-10		

4. Title and Subtitle	5. Report Date
Measuring the Economic Benefits of Rural and Small Urban Transit Services in Greater Minnesota	April 2020
	6.

7. Author(s)	8. Performing Organization Report No.
Jeremy Mattson, Del Peterson, Jill Hough, Ranjit Godavarthy, and David Kack	

9. Performing Organization Name and Address	10. Project/Task/Work Unit No.
Upper Great Plains Transportation Institute North Dakota State University 1320 Albrecht Blvd Quentin Burdick Building, Room 448 Fargo, ND 58102	11. Contract (C) or Grant (G) No. (c) 1003323 (wo) 3

12. Sponsoring Organization Name and Address	13. Type of Report and Period Covered
Minnesota Department of Transportation Office of Research & Innovation 395 John Ireland Boulevard, MS 330 St. Paul, Minnesota 55155-1899	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

http://mndot.gov/research/reports/2020/202010.pdf
http://mndot.gov/research/reports/2020/202010S.xlsx

16. Abstract (Limit: 250 words)

The objective of this research was to measure the benefits of rural and small urban transit services in Minnesota. The study accomplished this by first identifying, describing, and classifying the potential benefits of transit. Second, a method was developed for measuring these benefits. Where possible, benefits were quantified in dollar values. Other benefits that could not be monetized were either quantified in another way or described qualitatively. The study included an analysis of societal benefits and economic impacts within local communities. Third, the developed method was applied to a series of six case studies across Greater Minnesota. Data were collected through onboard rider surveys for each of the six transit agencies. Total benefits and benefit-cost ratios were estimated for the six transit agencies—all showed benefits that exceeded costs—and results were generalized to Greater Minnesota. Finally, a spreadsheet tool was developed that can be used by any transit agency to calculate the benefits of its services. This research provides information to assess the benefits of public spending on transit, which gives decision makers the data needed to inform investment decisions.

17. Document Analysis/Descriptors	18. Availability Statement
public transit, benefits, benefit cost analysis, economic impacts, rural areas, small towns, return on investment	No restrictions. Document available from: National Technical Information Services, Alexandria, Virginia 22312

19. Security Class (this report)	20. Security Class (this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	192	

Measuring the Economic Benefits of Rural and Small Urban Transit Services in Greater Minnesota

FINAL REPORT

Prepared by:

Jeremy Mattson
Del Peterson
Jill Hough
Ranjit Godavarthy
Upper Great Plains Transportation Institute
North Dakota State University

David Kack
Western Transportation Institute
Montana State University

April 2020

Published by:

Minnesota Department of Transportation
Office of Research & Innovation
395 John Ireland Boulevard, MS 330
St. Paul, Minnesota 55155-1899

ACKNOWLEDGMENTS

The research team would like to acknowledge Technical Liaison Sara Dunlap, Project Coordinator Thomas Johnson-Kaiser, and members of the Technical Advisory Panel (TAP) for their assistance with the design and conduct of this study. Members of the TAP are:

- Elizabeth Bina, Minnesota Department of Health – Statewide Health Improvement Initiatives
- Dorothy Bliss, Minnesota Department of Health – Statewide Health Assessment
- Frank Douma, UMN, Humphrey School of Public Affairs, Center for Transportation Studies
- Sara Dunlap, Minnesota Department of Transportation – ADA Policy and Implementation
- Melinda Estey, Minnesota Department of Transportation – Transit and Active Transportation
- Michael Iacono, Minnesota Department of Transportation – Investment Planning
- Thomas Johnson-Kaiser, Minnesota Department of Transportation – Research and Innovation
- Shelly Pflaum, Mobility Administrator, United Community Action Partnership
- Ellen Pillsbury, Minnesota Department of Health – Active Transportation
- Craig Rempp, Director, Mankato Transit
- Jake Schutt, Minnesota Department of Transportation – Transit and Active Transportation
- Noel Shughart, Minnesota Department of Transportation – Transit and Active Transportation
- John Wilson, Minnesota Department of Transportation – Investment Planning

The research team would also like to acknowledge the assistance of the transit agencies that participated in the case studies: Paul Bunyan Transit, Southern Minnesota Area Rural Transit (SMART), St. Cloud Metro Bus, St. Peter Transit, Timber Trails, and Trailblazer Transit.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

DEFINITION OF TERMS

Term	Definition
Access to health care benefit	Reduced health care costs and improved quality of life resulting from providing transportation to someone who otherwise would have missed a health care trip.
Benefit-cost analysis	A comparison of quantifiable benefits to project costs for a defined period time, used to determine if a project yields a positive return on investment.
Chauffeuring cost savings	Savings from riding transit instead of getting a ride from someone, which includes vehicle operating costs and the value of time for the driver.
Economic impact	Any effect of a policy or project on the economy of a designated project area.
Economic impact analysis	An estimate of the net change in economic activity, with regard to jobs, income, investment, or value added, resulting from an action.
Efficiency benefits	The benefits from making trips with transit instead of the automobile or some other mode.
Environmental benefits	The difference between the environmental costs of how transit trips would have been made in the absence of transit and the environmental costs of transit, including costs of air pollution and greenhouse gas emissions.
Improved access to shopping impacts	Economic impacts resulting from transit providing trips to local businesses that otherwise would not have been made.
Increased population in community impacts	Economic impacts resulting from transit keeping people living in the community and, therefore, spending money in the local economy.
Low-cost mobility benefits	Value to the user for having transit as a low-cost mobility option.

Term	Definition
Mobility benefits	The benefits of providing trips that otherwise would have been forgone.
Multiple account evaluation	An evaluation approach that catalogues various economic impacts and benefits without adding them together to calculate an overall metric.
Option value	The value of having an option for future transit use.
Public assistance cost savings	Reduction in spending on public assistance programs resulting from transit providing increased access to work.
Relocation cost savings	Cost savings by allowing transit users to remain at their current residence.
Safety benefits	The value of the safety difference between transit and the alternative with no transit.
Societal benefits	Positive outcomes to society, including mobility benefits and efficiency benefits.
Transit spending impacts	Economic impacts resulting from the existence of transit operations, including jobs created by the transit agency, businesses that benefit from selling to the transit agency, and induced economic activity.
Travel time benefits	The value of the travel time difference between transit and an alternative mode.
Vehicle operating cost savings	Savings from riding transit instead of driving.

EXECUTIVE SUMMARY

Rural and small urban transit agencies provide a vital service to their users, connecting them to health care, education, employment, shopping, social activities, and other important activities. As transit systems compete for funding at the local, state, and federal levels, it is important to identify and quantify, where possible, the impacts that these services have within local communities. Transit agencies need data regarding the benefits of investments in transit to inform local investment decisions because local share is required by state law for funding transit systems in Greater Minnesota. Further, the evidence could also be used to inform statewide investment levels.

While there is research showing the positive benefits of rural and small urban transit, the number of previous studies that focused on rural areas and small communities is limited, and the transferability of previous findings to specific agencies in Minnesota is not certain. Results may differ based on the types of trips provided, the geographic and demographic characteristics of the service area, and characteristics of the service provided. While rural Minnesota has some similarities to areas studied in previous research, there may be important differences that could yield different results.

The objective of this research is to measure the economic benefit of rural and small urban transit services in Greater Minnesota. To accomplish this objective, this study first conducted a review of previous research on the benefits of rural and small urban transit. Then a survey was conducted of transit stakeholders across the state to obtain feedback on the perceived benefits of rural and small urban transit in Greater Minnesota. Based on the literature review and input from the stakeholder survey, a method was developed for estimating benefits of transit in Greater Minnesota. This framework was then applied in a series of six case studies across the state. The case studies included a survey of transit riders for each of the six transit agencies and an estimation of the different types of benefits provided by each transit agency. Statewide benefits were then estimated for rural transit and small urban systems in Greater Minnesota. Total benefits as well as benefit-cost ratios were estimated. To acknowledge uncertainty in the results, a range of estimated results given different input assumptions was also presented. Further, the study developed a tool that transit agencies, stakeholders, and others can use to assess the value of services provided. The tool is the practical application of the project that individual providers can use to provide evidence regarding the value of their service.

Respondents to the stakeholder survey largely agreed that transit provides a wide range of benefits within their communities. The benefits they identified as most important stem from the provision of transportation to people who otherwise would not be able to make trips, including older adults, people with disabilities, low-income individuals who cannot afford a vehicle, and others. They especially focused on how transit provides access to jobs and health care, supports independent living, allows seniors to age in place, and keeps people living in the community. Positive impacts for local employers, local businesses, and the community at large were also widely acknowledged.

The potential benefits of transit in Greater Minnesota were conceptualized through the use of a transit benefits assessment tree (Figure E.1). Societal benefits included mobility benefits and efficiency benefits. If transit service was not available, transit users would either make the trip in some other way

or forgo the trip. Mobility benefits were those of providing trips that otherwise would have been forgone, and efficiency benefits were those that originate from making trips with transit instead of by automobile or some other mode.

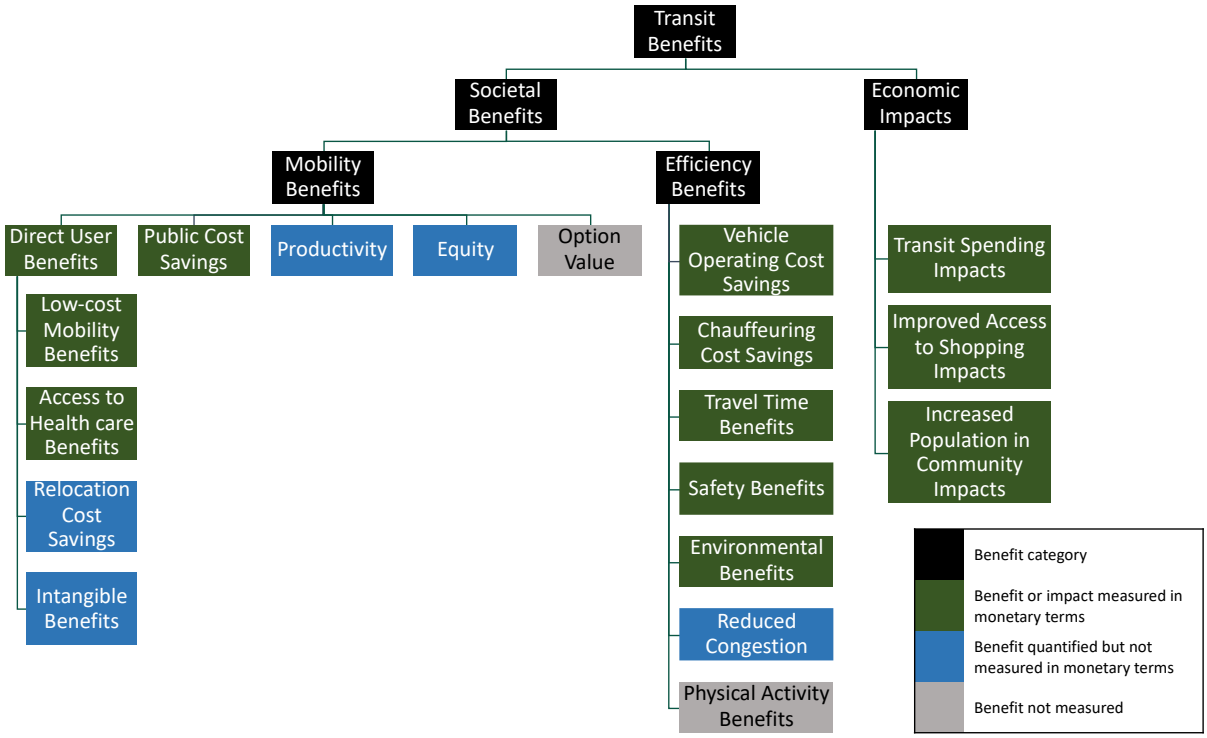

Figure E.1 Transit Benefits Assessment Tree

Rider surveys collected data needed to estimate societal benefits. This included information about the percentage of transit trips that would be forgone and the breakdown of those trips by trip purpose, as well as the number of trips that would have been made in other ways. Some of the societal benefits were measured in monetary terms and others were quantified in other ways.

Economic impacts included those from transit spending, improved access to shopping, and increased population in the community. Economic impacts were estimated using an input-output model, a quantitative economic model that traced the path of spending throughout the local economy. The societal benefits and economic impacts were estimated and reported separately. They could not be added because they represented different forms of analysis.

Transit agencies in Greater Minnesota were categorized into six groups, and one case study was selected from each group. This included five rural agencies with varying characteristics and one urban agency. The six case studies were Paul Bunyan Transit, Southern Minnesota Area Rural Transit (SMART), St. Cloud Metro Bus, St. Peter Transit, Timber Trails, and Trailblazer Transit.

Results from the case studies were used to estimate total benefits of rural and small urban transit services in Greater Minnesota. To do so, data collected for St. Cloud Metro Bus were used to estimate

benefits of section 5307 urbanized transit systems in Greater Minnesota, and the results from the other five case studies were used to estimate statewide benefits of section 5311 rural transit systems.

Survey results showed that transit in Greater Minnesota serves many riders with limited transportation options. Among riders surveyed for five rural systems, nearly three-quarters did not have a driver's license, two-thirds did not have a vehicle in their household, 63% considered themselves as having a disability, and three-quarters had household income below $25,000. Respondents in St. Cloud, the urban system studied, were also predominately low-income and a majority did not have a driver's license or access to a vehicle. Most transit riders in Greater Minnesota were frequent riders, using the service multiple days per week. Many relied on it as a primary means of transportation. This was notably the case for those who rode transit to work.

Because many riders have limited transportation options, they would be severely affected if transit services were not available. Very few can drive themselves, and most would need to rely on someone else to provide transportation, pay a higher cost for taxi or Uber or Lyft services where available, or simply not make the trip. About 35% of riders surveyed said they would not have made their current trip if transit had not been available. This response was fairly similar across the six agencies studied.

For all six transit agencies studied, estimated benefits were found to exceed the costs of providing service. Benefit-cost ratios were found to range from 1.5 to 4.2. Across Greater Minnesota, benefit-cost ratios were found to equal 2.2 for rural transit and 2.9 for urban transit. Because there was uncertainty with many of the parameters used to estimate the results, a simulation model was developed that allowed the values of these parameters to vary. The results showed a range of expected outcomes. Estimated 90% confidence intervals showed that benefit-cost ratios varied from 1.5 to 3.0 for rural transit statewide and from 2.1 to 4.0 for urban transit in Greater Minnesota.

A large share of the transit benefits was driven by the access to health care benefits. These benefits resulted from providing health care trips to riders who otherwise would not make these trips. Other benefits were also demonstrated. Work trips were the most common type of transit trip. Most riders traveling to work relied on transit as their primary means of transportation, and a majority reported they would not be able to keep their jobs without transit. Therefore, by improving access to work, transit reduced spending on public assistance that would be needed to support those who are unemployed. Shopping trips were another common type of transit trip. Shopping trips helped support local businesses and contributed to the local economy. Transit also allowed people to live where they preferred to live; and by keeping people living in small communities there were positive impacts to local economies. Spending on transit also provided jobs and stimulated local economic activity. There were also intangible benefits that were difficult to quantify. Transit was shown to support independent living and improve social connectedness. It was also shown to promote equity and quality of life by increasing access to a range of activities for transportation-disadvantaged populations.

This research provides information to objectively assess the benefits of public spending on transit services in Greater Minnesota. The spreadsheet-based user tool can be used by individual operators to provide evidence regarding the value of their service.

CHAPTER 1: INTRODUCTION

Rural and small urban transit agencies provide a vital service to their users, connecting them to health care, education, employment, shopping, social activities, and other important activities. Rural transit riders, which include a high percentage of seniors, people with disabilities, and others who cannot drive or do not have access to a vehicle, have limited transportation options, and many would not be able to travel without access to transit. While transit systems in rural areas are often viewed as valuable community assets, the value of these services has been largely unmeasured, and there are often benefits that go unidentified.

Transit services in rural and small urban areas differ greatly from those in larger urban areas in terms of types of services provided and challenges faced. Rural transit agencies are challenged by long travel distances, low population densities, and limited resources. In small communities, where demand is not great enough to support a fixed-route system, transit operators typically provide a demand-responsive service. A majority of rural transit agencies across the country and in Minnesota provide demand-response transit for the general public. However, because of limited resources and the cost of the service, availability is often limited. The gap between urban and rural areas in the availability of public transit is significant. Reliance on the automobile is much greater in rural and small urban areas, limiting opportunities for those who cannot drive. Older adults, people with disabilities, low-income households, veterans who need health care services, Native Americans living on reservations, and others face a variety of transportation challenges in rural areas.

An aging population will create further needs for transportation alternatives in rural areas. The percentage of population aged 65 or older has increased in both urban and rural areas across the country in the past decade, but the increase has been greatest among the rural population. In Minnesota, the percentage of the population aged 65 or older is greatest in rural areas and small towns (Minnesota State Demographic Center 2017). Based on projected demographic trends, the share of the rural population that is elderly will continue to grow over the next several decades. As age increases, so does the likelihood that an individual will have a disability that creates mobility needs and limitations. Limited services in small communities make it difficult for older adults to age in place.

To meet the transportation needs of residents in Greater Minnesota, transit services are provided by a number of agencies of different types and sizes. These include seven urbanized systems in metro areas, eight community transit systems that serve individual communities in non-metro areas, six tribal transit systems, and 22 rural providers ranging in size from small, single-county systems to large, multi-county, regional operators. Greater Minnesota refers to all of Minnesota outside the seven-county Twin Cities metro area. It includes a few small urban areas, a number of large towns that function as regional centers, small towns, and some very rural areas. The urbanized transit systems in Greater Minnesota, which are those that serve a metro area with a population of 50,000 or greater and receive section 5307 funding, provide fixed-route services with Americans with Disabilities Act (ADA) complementary paratransit. All other transit agencies in the state, which receive section 5311 funding and are referred to as rural transit providers, provide demand-response transit for the general public.

Although services are more limited, transit agencies in Greater Minnesota serve a large number of riders. In 2017, Greater Minnesota transit provided nearly 12 million trips, including more than 4 million by rural transit. Rural transit ridership has been trending upward over the past decade. Minnesota ranks among the top 10 states in the country in rural transit ridership (Mattson 2017b).

Because of low population densities and long travel distances, transit services in rural and small urban areas are not as efficient as those in urban settings, measured by cost per trip or trips served per mile or per hour. However, the value of these services could potentially be just as great or even greater. Understanding the value of these benefits is essential for making investment decisions. As transit systems compete for funding at the local, state, and federal levels, it is important to identify and quantify, where possible, the impacts that the services have within local communities. Transit providers in Greater Minnesota need quantitative information about the value of their services when generating support for a local financial share of the funding.

Transit benefits include transportation cost savings to the user, trips that would have been forgone had transit service not been available, local economic activity resulting from transit operations, and other less tangible benefits, such as enabling independence and allowing seniors to age in place. Providing trips to those who otherwise would not be able to travel yields substantial benefits. In particular, by providing medical or work trips to individuals who otherwise would not be able to make those trips, rural transit provides significant benefits to its users and the community.

Existing quantitative research on the benefits of rural transit is lacking. While a few studies have attempted to measure the benefits of rural or small urban transit, most of these studies are either outdated, have methodological deficiencies, are limited in scope, or present results that may not be relevant or transferable to Greater Minnesota. This research attempts to fill the gap in the literature and provide information that is relevant to Greater Minnesota transit.

The objective of this research is to document and measure the economic benefit of rural and small urban transit services in Greater Minnesota. The project establishes a method for valuing the benefits and impacts of rural and small urban transit, and results provide evidence of the benefits and impacts in Greater Minnesota. Further, the study develops a tool that transit agencies, stakeholders, and others can use to assess the value of services provided. The tool is the practical application of the project that individual providers can use to provide evidence regarding the value of their service.

This research provides the necessary information to objectively assess the benefits of public spending on rural and small urban transit services, which gives decision makers the data needed to allocate resources to programs that would provide the greatest benefit. The research provides information to local leaders and MnDOT about the benefits of transit in Greater Minnesota, which could be used to inform investment decisions.

The report is organized as follows. Chapter 2 provides a review of previous research on the benefits of rural and small urban transit. This includes a discussion of the different methods for measuring benefits, a description of how studies have defined and categorized the benefits, and a summary of the findings.

Chapter 3 presents the results of a survey conducted of transit stakeholders across the state to obtain feedback on the perceived benefits of rural and small urban transit in Greater Minnesota. Based on the literature review and input from the stakeholder survey, a method is developed for estimating benefits of transit in Greater Minnesota. This method is described in Chapter 4. Chapter 5 presents results from a series of six case studies across the state where this framework is applied. The case studies include a survey of transit riders for each of the six transit agencies and an estimation of the different types of benefits each transit agency provides. The analysis includes an estimation of both societal benefits and economic impacts, the results of which are reported separately. Chapter 6 presents an estimation of the total benefits for Greater Minnesota and the six peer groups. The spreadsheet user tool is described in Chapter 7. Finally, Chapter 8 provides a summary and conclusions.

CHAPTER 2: REVIEW OF LITERATURE

Benefit-cost analyses or economic impact studies could be highly valuable to transit agencies or transportation planners as a means to evaluate the benefits of investments in transit services and justify further funding of these systems. However, Weisbrod et al. (2017) found that only a limited number of transit agencies and transit planners have had experience with economic impact or economic benefit studies. They also found that there is a need for better tools and data for conducting these studies, and that communication of results is important. They noted that the agencies that had conducted such research found positive economic impacts and societal benefits that were useful for making the case for further transit funding. While many existing studies focus on urban transit, some also examine transit in rural areas and small cities, using a variety of approaches. These studies tend to show that even though rural service is costlier than urban transit on a per-trip basis and has limited demand, rural and small urban transit often provides benefits that exceed the costs (Ferrell 2015).

Existing research identifies a number of potential benefits from transit. This literature review will examine different methods for estimating transit impacts or benefits, identify and categorize the various types of transit benefits and discuss their applicability to rural and small urban transit, and summarize the results from previous studies that have focused on rural areas and small cities.

2.1 METHODS

Mjelde et al. (2017) noted there are different methods to evaluate rural transit systems, including multicriteria, input-output, social impact, benefit risk, and cost-benefit analysis. They argued that many of the previous evaluation studies are flawed conceptually and/or use incorrect methods or assumptions. For example, input-output analysis is sometimes mistakenly used to estimate benefits. TCRP Synthesis 128, written by Weisbrod et al. (2017), also concluded that these studies vary widely in terms of rigor and that there is still some confusion regarding the different types of studies, their terminology, and interpretations.

Weisbrod et al. (2017) discussed two types of economic analysis: economic impact studies and economic benefit studies. As they described, economic impact studies estimate the net change in economic activity, with regard to jobs, income, investment, or value added. This differs from an economic valuation of societal benefits, which measures the social welfare value of benefits. The latter is commonly addressed by benefit-cost analysis (BCA). The studies are sometimes conducted in tandem; another approach, called a multiple account evaluation, identifies various economic impacts and benefits without adding them to calculate an overall metric (Weisbrod et al. 2017). Weisbrod et al. (2017) noted that both types of studies have value and can complement each other.

One important distinction between the two types of studies is that some economic impacts would not be considered a net benefit. Rather, these impacts are simply transfers because while they may benefit one party, they are a cost to another. Penet (2011) estimated both economic impacts and societal benefits of transit in South Dakota and advised against adding them together because they result from

two distinct, and potentially overlapping, analyses. An NCHRP report conducted by Horst and Carini (2011) provides more detail and guidance on the two types of analyses.

2.1.1 Analysis of Societal Benefits

Analyses of societal benefits, including BCA, focus on the value of societal benefits rather than impacts on the economy. These studies can capture broader effects than economic impact studies. BCA can include direct transportation benefits (reduced travel costs, accidents avoided, travel time savings, etc.), economic benefits in urban areas that result as the market responds to improved level of service (land use benefits, agglomeration benefits, etc.), environmental and community benefits (reduced emissions, greater access for transit-dependent populations, etc.), the residual value of the project assets, and investments avoided (Horst and Carini 2011).

Some societal benefit studies are formal BCAs, and others are done to show the benefits that are otherwise missed by economic impact or classical BCA studies (Weisbrod et al. 2017). The studies may add monetized benefits together to portray annual benefits, calculate the net value of benefit and cost streams through BCA, or describe benefits accruing to different parties in the form of multiple account evaluation.

It is important to distinguish between different types of benefits based on who is receiving them. Horst and Carini (2011) describe four primary categories of benefits: user benefits, non-user benefits, community benefits, and wider economic benefits.

Most of the studies of rural and small urban transit included an analysis of societal benefits, including studies by Southworth et al. (2002, 2005), HLB/HDR Decision Economics (2003, 2006, 2009), Penet (2011), and Godavarthy et al. (2014, 2015). Penet (2011) outlined the following guiding principles for his analysis: account for all positive and negative effects, assess the "incrementality" of benefits, avoid double-counting, attach monetary values to all benefits, and acknowledge the uncertainty surrounding model assumptions.

2.1.2 Economic Impact Studies and Input-Output Models

Economic impact analyses use input-output models to measure direct impacts, indirect impacts, and induced economic activities. These studies could measure construction impacts, operations and maintenance impacts, new project area development, and tax revenue impacts (Horst and Carini 2011). The direct effect includes the jobs created directly by the transit system, such as drivers, dispatchers, mechanics, bookkeepers, program directors, etc. The indirect effect results from jobs and income spent in industries that supply inputs to public transit, such as fuel, repairs, insurance, etc. Induced economic activity results from the income generated through both the direct and indirect effects. These induced effects occur when people who work for the transit system or earn income by providing inputs to the transit agency spend their new income in the community. This spending supports additional jobs in the local economy.

Chu (2013) developed a tool to estimate the economic impacts of spending on transit. His model estimates the impacts of spending on transit in terms of output (total gross sales), value added (gross domestic product at the local level), earnings, and jobs by tracing the path of spending throughout the local economy. The method uses multipliers to capture this path of effects, relying on the Regional Input-Output Modeling System (RIMS II) of the U.S. Bureau of Economic analysis for the multipliers. The multipliers show the goods and services produced by each industry and the use of those goods and services. The sum of the indirect and induced effects represents the multiplier effect, as explained by Chu (2013), because it represents additional impacts on the local economy beyond the initial impact from the transit expenditures.

The economic impacts in a community vary greatly based on the source of the funds and the share of spending that occurs within the community. If a higher percentage of transit funding comes from the federal or state government, as opposed to local sources, then the economic impact in the area will be more positive. Likewise, if a greater share of the spending goes to locally sourced labor, capital, services, and other local industries, then the economic impact in the area will be greater. The economic impacts could vary significantly based on funding source and spending destination. Chu (2013) concluded that if outside funds are spent on goods and services produced outside the area, there will be no economic impact; if outside funds are spent within the local area, there will be a positive effect; if local funds are spent locally, the effect will approximately be zero because those funds could also be spent locally for non-transit purposes; and if local funds are spent outside the area, there will be a negative effect.

Chu (2013) applied his model to counties in central Florida. He found that the rate of return is much higher for operations and maintenance spending than for capital spending because a much higher percentage of funds spent on capital, such as vehicle purchases, is spent outside the local area. Since transit is relatively labor intensive, it has the potential to have positive economic impacts within a community.

One issue to consider with input-output analysis is that results would depend on the local labor market. If there is a pool of underutilized labor in the area with the skills to fill these positions, then transit could legitimately have a positive effect. However, if the positions within the transit agency are filled by drawing workers from other local employers, then the effect may not be positive.

2.2 CATEGORIZING TRANSIT BENEFITS

Developing a method for estimating transit benefits first requires an identification and classification of the different types of benefits. Various studies have attempted to identify and classify the many benefits of transit, resulting in a variety of classification systems. Despite their differences, the studies generally identify and attempt to measure the same types of benefits. The various models are described in this section. Besides the studies discussed in this section, older reports published by the Transit Cooperative Research Program used similar classifications of benefits (Cambridge Systematics & Apogee Research 1996; Cambridge Systematics, Cervero, & Aschauer 1998; Crain & Associates Inc, Byrd, & Omniversed International 1999; ECONorthwest & Parsons Brinckerhoff Quade & Douglas 2002).

Beimborn et al. (1993) argued that transit has four main impacts: first, it provides an alternative means of travel that may or may not actually be used by any given individual; second, trip-making occurs, resulting in a shift from automobile to transit travel or trips by individuals who would otherwise not travel; third, transit affects land use; and fourth, it exists as an enterprise that employs people in its operation and construction and also uses resources. Following this, Beimborn et al. (1993) developed a transit benefits tree that identifies and categorizes the many potential benefits of transit. Subsequent studies have built upon this framework or used a revised version.

Southworth et al. (2002, 2004, 2005) studied the benefits of transit services in Tennessee. They identified two principal types of public transit benefits: benefits accruing directly from travelers' use of the transit system—termed transit use benefits; and benefits accruing to local areas from the presence of transit services within their region—termed transit supply benefits. They subdivided transit use benefits into 1) mobility-based accessibility benefits from transit use, 2) environmental benefits from transit use, and 3) safety and security benefits from transit use. In addition, transit supply benefits were divided into 1) economic benefits from transit system supply, and 2) societal and community benefits associated with transit supply.

Southworth et al. further categorized each of these five benefits. Mobility-based accessibility benefits include congestion mitigation for non-transit trips (resulting in travel time savings) and trip cost savings, forgone travel savings, and relocation cost savings for transit trips. Trip cost savings refer to what the transit user saves using transit instead of another mode. Forgone cost savings refer to costs that would have been incurred if a trip would not have been made in the absence of transit. For example, this could include the cost of a forgone work trip or medical trip. Relocation cost savings result when the transit service allows an individual to continue living in his or her home and access required services using transit.

Their framework further defined environmental impacts to include impacts on air quality, energy consumption, noise, groundwater, and land conservation; safety and security impacts included accident avoidance, personal security, and oil dependency; economic impacts included transit expenditures, economic growth, and land development; and social and community benefits included impacts on equity and community values and livable community initiatives.

Other studies have developed different frameworks and classifications but have mostly attempted to estimate the same factors. HLB Decision Economics (2003) and a follow-up study by HDR/HLB Decision Economics (2006) studied the benefits of transit in Wisconsin. Their framework identified three main categories of benefits: affordable mobility/cross-sector benefits, congestion management benefits, and economic development benefits. Affordable mobility/cross-sector benefits are those from providing low-cost mobility to transit-dependent households. This includes the benefits from improved access to work, health care, education, retail, etc., and budget savings for welfare and social services due to the presence of transit. Congestion management benefits include vehicle cost, travel time, accident, and environmental emissions savings. Economic development benefits include increased property values and commercial activities due to improved access.

The same framework was used by HDR Decision Economics (2009) in a study of transit benefits in Michigan, by Penet (Penet 2011) in a South Dakota study, and by Godavarthy et al. (2014, 2015) in a nationwide cost-benefit study of rural and small urban transit, with some modifications. These studies simply referred to the affordable mobility/cross-sector benefits as low-cost mobility benefits, and congestion management benefits were referred to as transportation cost savings. Transportation cost savings include out-of-pocket cost savings, travel time cost savings, accident cost savings, and environmental emissions cost savings that result from reduced congestion as well as fewer miles traveled by personal vehicles. In rural areas, these cost savings would result not from congestion reduction but from out-of-pocket cost savings to transit users who can forgo vehicle ownership or reduce vehicle operating costs.

Penet (2011) referred to the transportation cost savings and low-cost mobility benefits as social benefits, which measure the net increase in society's welfare. In addition to societal benefits, he noted there are economic impacts resulting from transit capital and operating expenses and from the spending of a portion of out-of-pocket cost savings accrued to transit riders. These economic impacts can be measured in terms of increased jobs, output, tax revenue, etc. Penet (2011) and Godavarthy et al. (2014) considered the economic impacts of transit expenses in South Dakota and North Dakota, respectively, including direct, indirect, and induced economic activity.

Studies that have focused on rural areas or small cities, such as Penet (2011) and Godavarthy et al. (2014, 2015), have excluded some benefits that would be less likely to occur in these areas, such as land use impacts, congestion reduction, or reduced parking costs. These studies also did not attempt to measure other benefits that are more difficult to quantify, such as relocation cost savings, community cohesion, provision of transportation service during emergencies, etc.

Weisbrod et al. (2017) and Litman (2018) also described and categorized the benefits and impacts of transit. Weisbrod et al. (2017) identified four primary roles of transit that are similar to those from other studies: 1) a source of transportation efficiency improvement, 2) a public service that provides access to employment, education, and health care opportunities for dependent populations, 3) a strategic planning and development tool that affects spatial and economic development, and 4) a generator of jobs and income through transit agency activities.

Table 2.1 summarizes the more extensive review of potential transit benefits provided by Litman (2018). He identified four main types of benefits: mobility benefits, efficiency benefits, land use impacts, and economic development. As he defined them, mobility benefits are those from increased travel that would not otherwise occur. Efficiency benefits are those from reduced motor vehicle traffic. Land use benefits are those from changes in land use patterns. Economic development benefits are those from increased economic productivity and employment.

Efficiency benefits will be greater when transit has a greater impact on reducing automobile traffic, which is more likely to occur in larger urban areas. In rural areas and smaller cities, transit focuses more on providing basic mobility for people who are transportation disadvantaged, so mobility benefits are key. This is especially true for demand-response services. Mobility benefits, as described by Litman

(2018), include direct benefits to the user from improved access to services and activities, cost savings for other government agencies, increased productivity from improved access to education and jobs, increased equity between drivers and non-drivers, and the value of having the option to use transit, which could be critical during personal or community-wide emergencies.

Table 2.1 Categorization of Transit Benefits and Descriptions by Litman (2018)

Benefit Category	Description
Mobility Benefits	**Benefits from increased travel that would not otherwise occur.**
Direct User Benefits	Direct benefits to users from increased mobility.
Public Services	Support for public services and cost savings for government agencies.
Productivity	Increased productivity from improved access to education and jobs.
Equity	Improved mobility that makes people who are also economically, socially, or physically disadvantaged relatively better off.
Option Value/ Emergency Response	Value of having mobility options available in case they are ever needed, including the ability to evacuate and deliver resources during emergencies.
Efficiency Benefits	**Benefits from reduced motor vehicle traffic.**
Vehicle Costs	Changes in vehicle ownership and reduced operating and residential parking costs.
Chauffeuring	Reduced chauffeuring responsibilities by drivers for non-drivers.
Vehicle Delays	Reduced motor vehicle traffic congestion.
Pedestrian Delays	Reduced traffic delay to pedestrians.
Parking Costs	Reduced parking problems and non-residential parking facility costs.
Safety, Security, and Health	Changes in crash costs and personal security and improved health and fitness due to increased walking and cycling.
Roadways Costs	Changes in roadway construction, maintenance and traffic service costs.
Energy and Emissions	Changes in energy consumption and air, noise and water pollution.
Travel Time Impacts	Changes in transit users' travel time costs.
Land Use	**Benefits from changes in land use patterns.**
Transportation Land	Changes in the amount of land needed for roads and parking facilities.
Land Use Objectives	Supports land use objectives, such as infill, efficient public services, clustering, accessibility, land use mix, and preservation of ecological and social resources.
Economic Development	**Benefits from increased economic productivity and employment.**
Direct	Jobs and business activity created by transit expenditures.
Shifted Expenditures	Increased regional economic activity due to shifts in consumer expenditures to goods with greater regional employment multipliers.
Agglomeration Economics	Productivity gains due to more clustered, accessible land use patterns.
Transportation Efficiencies	More efficient transport systems due to economies of scale in transit service, more accessible land use patterns, and reduced automobile dependency.
Land Value Impacts	Higher property values in areas served by public transit.

Source: Litman (2018)

2.3 RESULTS FROM PREVIOUS STUDIES

2.3.1 Benefit Cost Analyses of Rural and Small Urban Transit

A few previous studies have estimated the benefits of rural and small urban transit systems. The major finding of many of these studies is that publicly operated transit provides significant benefits to the community compared with the costs contributed by the community (Table 2.2).

Table 2.2 Results from Previous Benefit Cost Analyses of Rural and Small Urban Transit and Transportation-Disadvantaged Programs

Study	Area Studied	Findings
Skolnik and Schreiner (1998)	Small urban area of Connecticut	Benefit/cost ratio of 9.7 to 1
Peng and Nelson (1998)	Rural Georgia	Economic impact is large and positive, and the fiscal revenue impact is greater than 1.0
Burkhardt (1999)	National and local analyses of rural systems	Returns on investment of 3 to 1, ranging a low of 1.67 to 1 to a high of 4.22 to 1
Southworth et al. (2002, 2005)	Rural and small urban systems in Tennessee	Benefit/cost ratio greater than 1.0, varying significantly between rural systems
HDR/HLB Decision Economics (2003, 2006)	Wisconsin	Returns on investment of 6 to 1
Cronin et al. (2008)	Transportation-disadvantaged programs in Florida	$8.35 in benefits for every dollar invested
Nguyen-Hoang and Yueng (2010)	Paratransit systems in the United States	Net benefits far exceed costs
Penet (2011)	South Dakota	Every dollar spent generated $1.90 in economic activity; social benefits were $9.11 per trip for small urban transit and $2.42 per trip for rural transit
Godavarthy et al. (2014)	United States	Benefit cost ratio of 2.16 for small urban transit and 1.20 for rural transit

Burkhardt (1999) conducted national and local analyses of rural systems and concluded that returns on investment of greater than 3.0 to 1.0 can be achieved by allowing residents to live independently, increasing the level of business activity in the community, allowing residents to live more healthy lives, and making more productive use of scarce local resources.

Analysis by Southworth et al. (2005) in Tennessee yielded benefit-cost ratios greater than 1.0, with most of the benefits coming from increased accessibility. HLB Decision Economics Inc. (2003) concluded that every dollar invested in public transportation provided $6 in economic returns in their research in Wisconsin. Penet (2011) estimated that every dollar spent on public transit in South Dakota generated $1.90 in economic activity, on average, and the social benefits equaled $9.11 per trip in urban areas and $2.42 per trip in rural areas. Skolnik and Schreiner (1998) calculated a benefit/cost ratio of 9.7 to 1 for a small urban system in Connecticut. Godavarthy et al. (2014) conducted a national analysis of rural and small urban systems and found benefit-cost ratios of 2.16 in small urban areas and 1.20 in rural areas.

(In their analysis, small urban transit referred to agencies receiving section 5307 funding but serving areas with a population below 200,000, and rural providers included all agencies receiving section 5311 funding.) Peng and Nelson (1998) analyzed the economic benefits of elderly riders, work trip riders, and school trip riders in rural Georgia and also found benefits to exceed costs.

Other studies have examined the benefits of services for transportation-disadvantaged populations, including both rural and urban areas. For example, Cronin et al. (2008) calculated a return on investment (ROI) of 835% for funds invested with transportation-disadvantaged programs in the state of Florida, such as medical, employment, education, nutrition, and life sustaining/other programs. This result shows $8.35 in benefits for every dollar invested in transportation-disadvantaged programs. Nguyen-Hoang and Yueng (2010) studied paratransit systems in the United States and found the net benefits to far outweigh the costs.

Burkhardt (1999) and Southworth et al. (2005) both showed that the benefits of rural transit systems vary significantly, depending on the characteristics of the service provided and the percentage of transit-dependent riders that they serve. Burkhardt (1999) found that two types of rural transit services generated the greatest economic benefits: employment transportation for riders and services that enable individuals to live independently. Southworth et al. (2005) showed that transit services that provide rides to those who otherwise would not make the trip, and therefore place additional burden on state resources or suffer a significant loss of mobility, are very cost effective. Godavarthy et al. (2014) found similar results, especially for medical and work trips. Cronin et al. (2008) found the highest ROI for nutrition and medical trips (1,252% and 1,108%, respectively), though ROI for education, employment, and life sustaining/other trips for transportation-disadvantaged individuals was also very high (585%, 571%, and 462%, respectively).

As noted previously, these studies vary in terms of rigor. Some studies, such as Southworth et al. (2005), HLB/HDR Decision Economics (2003, 2006), and Penet (2011), appear to be more carefully designed and executed.

2.3.2 Research on Forgone Trips

2.3.2.1 Health Care Trips

Access to transportation is critically important for use of health care services. It has been estimated that 3.6 million Americans do not obtain medical care in a given year because of lack of transportation, and that may be a conservative estimate (Wallace et al. 2005, 2006). Transportation to health care is an issue for both young and old. Survey data reported by Grant et al. (2016) showed that 4% of children in the United States, and 9% of children from lower-income households, missed at least one health care appointment each year because transportation was not available. The researchers further analyzed the risk of transportation barriers to health care in Mississippi and Tennessee and found that the counties with the highest risk of transportation barriers, where residents were more likely to miss health care trips because of lack of transportation, were significantly more rural and also had significantly higher child poverty rates.

Research has shown that those who have a driver's license make more health care trips than those who do not (Arcury et al. 2005), and that those who cannot drive make more trips if someone else in the household can drive or if family or a friend is available to provide transportation (Arcury et al. 2005, Mattson 2011). Arcury et al. (2005) found that those who used public transit in rural North Carolina made significantly more chronic care visits per year than those who did not.

If providing transportation to health care services for those who lack it increases the use of these services, there could be cost savings in terms of reduced need for emergency care and preventable hospitalizations. Missing a trip for routine care or preventive services can often result in a medical trip that is costlier than the trip that was missed. While providing non-emergency medical transportation (NEMT) for those who lack it may be expensive, it has the potential to provide cost savings. Access to NEMT can reduce emergency room and hospital expenditures. Grant et al. (2016) found that 31% of those children who missed a health care appointment subsequently went to the ER for a condition associated with the missed appointment. They concluded that more than 750,000 pediatric ER visits could be avoided nationwide per year with improved transportation access to primary care sites.

A Transit Cooperative Research Program (TCRP) report published by Hughes-Cromwick et al. (2005) found the provision of NEMT to those who lack access to transportation has net societal benefits. The results were also published by Wallace et al. (2006). For the seven chronic conditions and five preventive conditions analyzed in their study, they found that the net health care benefits of increased access to NEMT for those transportation-disadvantaged individuals exceeded the additional costs of transportation for all of these conditions. For some of the conditions they found a net cost savings, and for the others, the improvements in quality of life or life expectancy were found to be sufficient to justify the added expense. Godavarthy et al. (2014) used the tools from Hughes-Cromwick et al. (2005) to estimate the benefits of providing medical trips to those who otherwise would not have made the trips, and they found the benefits to be substantial. They estimated the average cost of a forgone medical trip to be $713 per round trip.

NEMT is not expensive when compared with emergency transportation. Flaherty et al. (2003) argued that a significant number of ambulance rides for Medicare patients are not for true emergencies, especially in rural areas, and that if just half of these ambulance trips could be prevented, the savings to Medicare would be substantial. As Hughes-Cromwick et al. (2005) concluded, transportation is relatively inexpensive compared with the high cost of health care, and adding transportation costs to an otherwise cost-effective health program will not make the program become non-cost-effective.

Other studies have used different approaches to estimate the cost of forgone health care trips. Southworth et al. (2002, 2005) attempted to measure these costs by calculating the costs of likely alternatives, which they assumed to include visits at home by a qualified medical professional or moving into or near a health care facility. HLB Decision Economics (2003) estimated that without access to transit, 1.39 million trips for medical purposes would not be made during a year in the state of Wisconsin, and of these forgone trips, 552,000 would result in home health care visits, with the others

resulting in forgone treatment. Penet (2011) used a similar method to estimate the costs of forgone medical trips in South Dakota.

2.3.2.2 Work Trips

While providing health care trips is a major purpose for rural and small urban transit operators, the provision of work trips is also integral for many transit systems. Without these transit services, many transportation-disadvantaged individuals would not be able to go to work and maintain employment.

Southworth et al. (2002) estimated the value of lost work trips as the average value of a lost work day divided by two (to account for to-work and from-work trips). Skolnik and Schreiner (1998) used a similar method, but to estimate the impact of lost work trips on a household, they subtracted the amount of public assistance the household would receive from their lost wages. This result provides a better estimate of the cost to the household of forgone work trips, but there is an additional cost borne to society when public assistance payments are required.

HLB Decision Economics (2003) estimated the benefit of providing work trips by the impact it has on reducing public assistance spending in the state of Wisconsin. They estimated that without transit there would be a 12% increase in public assistance cases in the state, which, at 2003 spending levels, would have required an additional $74 million in state spending.

Using a similar approach, Penet (2011) estimated the number of new welfare recipients that would be created in the absence of transit in the state of South Dakota, and multiplied that number with the average welfare costs per recipient and the average welfare duration to estimate the monetary value of foregone work trips. Godavarthy et al. (2014) estimated per-trip benefits of transit based on how much public assistance spending it reduces nationally and found the results to be significant. They estimated the cost of a forgone work trip to be $49, although they noted there is significant variation in this number.

Faulk and Hicks (2010) studied the impacts of public transit on unemployment rates, food stamp payments, employment growth, and income in counties with small- to medium-sized cities in the upper Midwest. Using data for 1992-2006, they found that counties with bus service had significantly lower unemployment rates, lower growth in family assistance and food stamp payments, and higher population and employment growth, compared with counties without service, although they did not find a positive impact on income. Although this study is interesting, it may not prove cause and effect, as counties with better economic conditions may be more likely to fund transit services. The authors noted and attempted to address this issue, but it is difficult to disentangle the simultaneous impacts. The study also does not consider variations in service levels.

2.3.2.3 Other Trips

Other common trip purposes for transit users include shopping, personal business, social and recreational activities, education, and nutrition. Previous research has also attempted to place a value on lost trips for many of these purposes using a variety of methods (Southworth et al. 2002, Skolnik and

Schreiner 1998, Peng and Nelson 1998). Some of the benefits for many trips, especially social and recreational trips, are more qualitative and difficult to measure. Bitto et al. (2003) discussed the difficulties for older adults and low-income households in accessing food in rural areas, especially healthy, fresh foods, and the importance of additional transportation options.

2.3.3 Impacts on Quality of Life

Providing transportation to those without other alternatives can have intangible, qualitative benefits, such as reduced social isolation and improved quality of life. A number of studies have evaluated the link between mobility and quality of life. Many of these studies have focused on older adults, people with disabilities, and others who are transportation disadvantaged. The main finding from these studies is that providing transportation to these populations and increasing their access to activities, both needed activities as well as social activities, reduces the risk of social exclusion and improves quality of life and well-being (Banister and Bowling 2004, Spinney et al. 2009, Stanley et al. 2011, Delbosc and Currie 2011, Delbosc 2012). For example, Banister and Bowling (2004) found that engaging in a large number of social activities was an important component of what constitutes quality of life for older adults, and Spinney et al. (2009) found a significant association between transportation mobility benefits and quality of life in a study of elderly Canadians.

Based on survey data of transit users, Mattson et al. (2017) found that those who had recently missed a trip because of lack of transportation or who reported greater difficulties in making trips reported lower overall life satisfaction, after controlling for other factors such as age and health. The results show the benefits that improved mobility have on quality of life. Evidence from Godavarthy et al. (2018) also provides a link between quality of transit service (and other transportation factors) and community livability. This is based on survey responses from not just transit users or transportation-disadvantaged populations but the general public, and the result was found for both urban and rural areas.

Besides allowing for increased trip-making, transit can also improve quality of life by simply making it easier to make trips, thereby reducing stress associated with trip-making. There is less evidence about the effect of public transportation on reducing stress, but a few studies suggest that stress can be an important factor associated with travel. Gee and Takeuchi (2004) found that in urban areas, those who lived in areas with greater vehicular burden and who reported the most traffic stress also had the lowest health status and greatest depressive symptoms, suggesting that use of transit could reduce stress and improve quality of life. Other research has shown that driving is more stressful than other modes of transportation (Legrain et al. 2015, Wener and Evans 2011).

Much of the literature on stress focuses on commuting in urban areas, where congestion is an issue. In rural areas, the issue could be people with limited driving abilities, such as older adults or people with disabilities who would feel more comfortable and less stressed traveling by transit instead of driving. Transit could also reduce stress for people who cannot drive and would otherwise need to worry about how to find transportation. Some research in rural areas suggest that stress can have an impact. A study of intercity transportation in North Dakota found that bus services tend to be perceived as less stressful than the automobile or air services and safer than the automobile, as survey respondents who were

more concerned about safety or stress were more likely to prefer traveling by bus or rail, compared with the automobile (Mattson 2016). In studying access to health care, Mattson (2011) found that providing additional transportation options is important not just for increasing the number of health care trips made but for making it easier and less of a burden for those who cannot drive to find a means of transportation.

2.3.4 Aging in Place

Public transportation provides older adults the opportunity to age in place. AARP defines aging in place as "the ability to live in one's own home and community safely, independently, and comfortably, regardless of age, income, or ability level" (Farber et al. 2011). According to AARP, almost 90% of senior citizens desire to live in their homes as they age. Further, 80% of senior citizens expect to live out their lives in their current homes (Farber et al. 2011). Surveys in North Dakota have shown that while most people in rural areas do not use public transit, they value it as an option for seniors and people who cannot drive and think improved public transportation is important for them to be able to stay in their neighborhood as they age (Mattson 2009, Godavarthy and Mattson 2016). Peterson and Rieck (2017) studied the costs to older adults of living at home and using public transportation versus moving to an assisted living facility. They found that the cost of assisted living was almost always higher compared with other alternatives.

2.3.5 Willingness-to-Pay Research

Other studies have attempted to estimate the value of transit services by estimating the willingness to pay for such services. Research by Painter et al. (2002) and Schwarzlose et al. (2014) applied such methods to rural transit. Painter et al. (2002) used the contingent valuation method (CVM), which is a method of estimating the value a person places on a good or service, to estimate the value of two rural transit systems in Washington. This method has been used to value the provision of public goods. Based on an analysis of data from a CVM survey of users and non-users, the authors estimated a range of the possible total benefits from public transit for the LINK System in Chelan and Douglas counties of $3.4 million to $6.1 million annually and $2.6 million to $4.7 million annually for transit in Challam County (above what users pay in fares).

Schwarzlose et al. (2014) studied the value of rural transit in three counties in Texas by conducting a choice experiment survey of taxpayers in these counties. Results from the survey showed that residents value public transportation options and are willing to pay for specific transportation attributes. The study indicated support for improved transportation for the rural elderly, although the estimated willingness-to-pay by taxpayers may not have been enough to cover costs.

2.4 SUMMARY

The provision of public transportation within a community can provide benefits to its users as well as the community at large by providing trips that would otherwise not occur, shifting trips from the automobile to transit, changing land use patterns, and increasing economic productivity and

employment (Litman 2018). Studies of rural and small urban transit have found the benefits exceed the costs, with the greatest benefits generally resulting from the provision of trips that would otherwise not occur, especially for health care or work purposes, as well as transportation cost savings to users. The previous studies vary in terms of methodologies and rigor, although there are some higher-quality studies using somewhat similar frameworks that show positive benefits of rural transit. Many of these studies focus on the societal benefits of transit, while some also include economic impact analyses. Other studies have focused on the intangible quality-of-life benefits resulting from the provision of transit, showing the reduction of social isolation and improved well-being, as well as the ability for older adults to age in place.

An analysis of societal benefits could involve a formal benefit-cost analysis that adds monetized benefits together, or it could take the form of a multiple account evaluation that describes benefits accruing to different parties. An economic impact analysis could also be conducted, but the results should be reported separately rather than added to the estimated societal benefits. In conducting the analysis, care must be taken to identify who is receiving the benefits, avoid double-counting of benefits, account for both positive and negative effects, and acknowledge uncertainty of model assumptions (Penet 2011).

While there is research showing the positive benefits of rural and small urban transit, the number of studies focused on rural areas and small communities is limited. Most research tends to focus on fixed-route services and larger communities. Further, none of the previous research has been conducted in Greater Minnesota, and the transferability of previous findings to specific agencies in Minnesota is not certain. Results may differ based on the types of trips provided, the geographic and demographic characteristics of the service area, and characteristics of the service provided. While rural Minnesota has some similarities to areas studied in previous research, there may be important differences that could yield different results. Greater Minnesota consists of many small towns, long distances between communities, and transit services that provide trips for social services.

CHAPTER 3: SURVEY OF STAKEHOLDERS

A survey of transit stakeholders was conducted across the state to obtain feedback on the perceived benefits of rural and small urban transit in Greater Minnesota. The benefits of transit outlined in Chapter 2 are all potential benefits of transit, but the importance of each may vary between communities. Some are likely to be more important for small communities, and others may not be relevant at all. Because there are differences between Greater Minnesota and other rural areas previously studied, it is important to understand the benefits of transit most important to communities in Greater Minnesota and how residents in those communities are impacted by the provision of transit.

The survey collected input from the community of stakeholders that connect and partner with transit providers to serve communities in Greater Minnesota. These stakeholders included human service agencies, transportation providers, public health departments, health care providers, county or city employees, local elected officials, community organizations, private businesses, schools, or other organizations that have an interest in the public transit system or serve individuals who use public transit.

The stakeholder survey had two main objectives. The first was to help inform the development of the framework for estimating transit benefits. This framework identifies and describes potential benefits of transit in Greater Minnesota and provides a method for estimating these benefits. Survey respondents identified benefits they believed to be most important and relevant in their communities and provided examples of those benefits. This input is important for ensuring that the study framework captures the relevant benefits.

The second objective of the survey was to provide qualitative evidence to complement the quantitative findings. Stakeholder responses complement the quantitative findings by further describing benefits and providing examples to support the quantitative results. Providing both quantitative estimates and a qualitative analysis of stakeholder input yields a greater understanding of the benefits of transit.

3.1 SURVEY DEVELOPMENT AND ADMINISTRATION

The survey first collected information about the organization the respondent works for, including the name of the organization, the type of organization, populations served, and location(s) within the state where services are provided. This information provides context regarding the characteristics of the respondents and the distribution of the survey among different types of stakeholders and different areas of the state.

The survey then listed a number of potential benefits of transit and asked the respondent to indicate for each if it is a major benefit, benefit, minor benefit, or not a benefit. The respondent also had the option of answering that they do not know or are unsure. The following language was used to instruct survey participants:

> Public transit, as defined for this survey, includes shared-ride transportation services available to the public. In Greater Minnesota, this includes demand-response, or dial-a-ride, services, fixed-route and flexible-route bus services, and paratransit. Public transit services are available in every county in Minnesota and is a community resource. With that understanding, please respond to the following questions.
>
> This section focuses on the potential benefits of these transit services to the local community. The survey provides a list of potential benefits. Thinking about the transit services in your community or service area, indicate if you think these are benefits of transit and, if so, the importance of the benefit. Your response should be specific to your community or service area. If your organization serves a large area and you find that the benefits are different in different parts of your service area, you may clarify your responses in the text boxes.

The list of potential benefits was developed based on findings from the literature review, as well as input from the project's Technical Advisory Panel (TAP). The benefits were categorized into five areas and presented as such to improve the ease of response. In addition to asking respondents to rank the importance of the benefits, respondents were given open-ended questions to provide examples of the different types of benefits in their communities or to further explain or clarify their responses.

Respondents were also asked to describe any other types of transit service benefits in their community. They were asked to identify what they think are the most important benefits of transit in their community, and lastly, they were asked for input regarding how they think the benefits of transit could be measured. The complete survey is shown in Appendix A.

The survey was conducted online using Qualtrics survey software and distributed via email by TAP members to individuals and organizations within their networks.

3.2 RESPONSE RATE

A total of 417 respondents completed the survey, answering all or most of the questions. An additional 76 respondents did not complete the survey but answered at least some of the questions regarding the benefits of transit. These responses are included in the analysis, yielding 493 responses. There were a number of additional respondents who answered the first questions about their organization but then failed to answer any questions about the benefits of transit. These responses were excluded. The response rate is not known because the number of potential participants who received the survey was not recorded.

3.3 CHARACTERISTICS OF RESPONDENTS

A diversity of stakeholders responded to the survey, as shown in Figure 3.1. The largest share of respondents was from human service agencies, while many were from counties or cities, public health departments, community organizations, and health care providers. Some responses also came from

schools, transportation providers, private companies, local elected officials, planning organizations, and others.

In many cases there was more than one respondent from an individual organization, so the number of responses represents the number of individuals rather than the number of organizations responding to the survey. Twenty-two respondents were from transportation providers. This includes responses from 19 different transit agencies in Greater Minnesota.

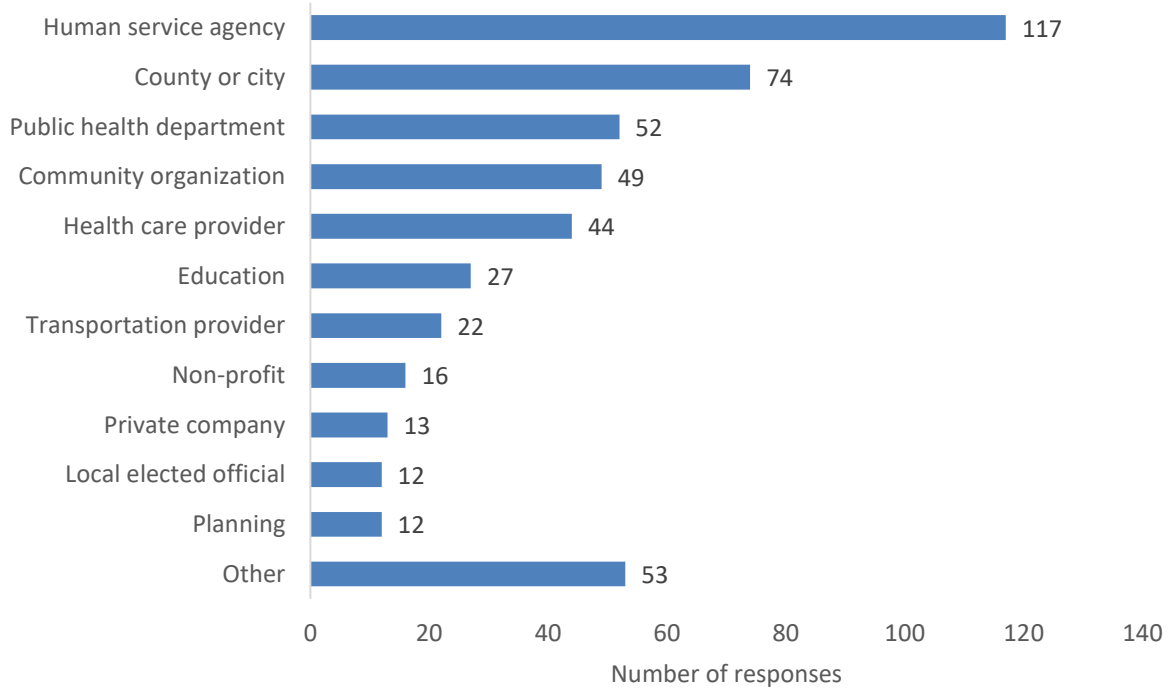

Figure 3.1 Number of Stakeholder Survey Responses by Type of Organization

The human service agencies and public health departments represented in the survey serve a wide variety of populations. Most of these organizations serve people with disabilities or mental health issues, low-income individuals, older adults, and children and families; and many serve people with addictions and the homeless.

Geographically, there was a good distribution of responses throughout the state. All areas of Greater Minnesota were represented in the survey. The largest shares of responses were from the southern and northeast regions (Figure 3.2).

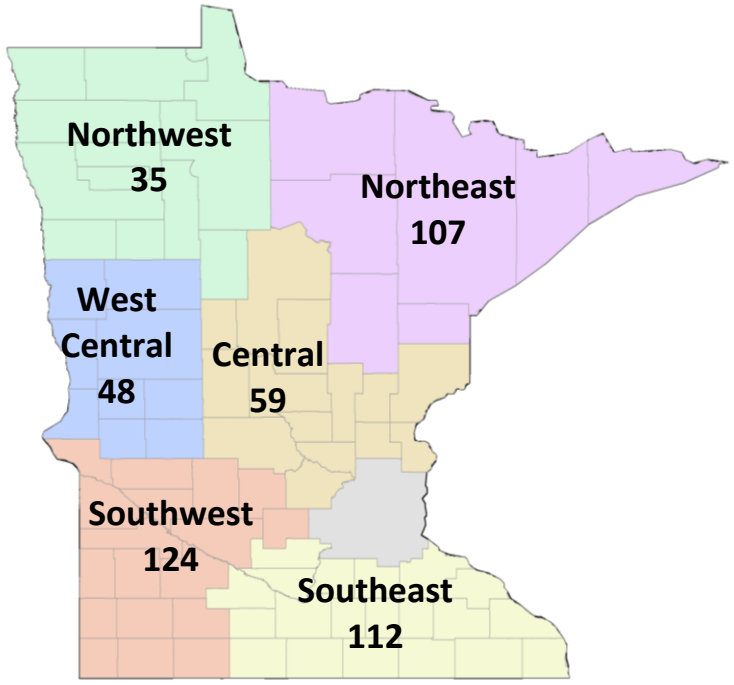

Figure 3.2 Number of Stakeholder Survey Responses by Region of the State

3.4 SURVEY RESULTS

The survey categorized potential transit benefits into five areas:

1. Benefits to transit users who otherwise would not be able to make trips due to the inability to drive or lack of access to transportation.
2. Benefits to communities and states that could result from improved access to jobs, health care, and other activities.
3. Benefits that could result when individuals switch from traveling by automobile to traveling by transit.
4. Benefits to the community from providing an alternative transportation option.
5. Economic benefits to the community.

3.4.1 Benefits to Transit Users Who Otherwise Would Not Be Able to Make Trips

The survey provided eight potential benefits among the first category. These include improved access to health care, jobs, shopping, education, social or recreational events, and other types of trips, as well as improved quality of life and reduced stress. Most respondents viewed these as being benefits of transit, and a majority viewed improved access to health care, improved quality of life, and improved access to jobs as being major benefits (Table 3.1). Improved access for social or recreational trips or other types of trips were least likely to be viewed as a major benefit.

Table 3.1 Perceived Importance of Transit Benefits to Transit Users from Improved Mobility

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
	----------percentage of respondents----------				
Improved access to health care	74	20	4	1	0
Improved quality of life	61	32	4	2	1
Improved access to jobs	61	27	8	2	3
Reduced stress	47	36	9	4	3
Improved access to shopping	46	42	9	2	1
Improved access to education	44	34	13	5	4
Improved access for social or recreational trips	35	42	16	4	3
Improved access for other types of trips	29	42	20	3	7

Many respondents elaborated and provided examples of how transit provides these benefits in their community. Below is a sample of some of the comments received, which were echoed by a number of respondents.

> *"Medical appointments are huge in very rural districts. If transit was not available, it would make it very difficult for these people to get to their appointments."*

> *"Ability to access quality food and groceries. Ability to pursue post-secondary education. Ability to get to work. Ability to access healthcare. These basic needs are met or can be met when there is access to public transportation. The extra benefit is then when public transit would be available for people to enjoy social outings, which then improves quality of life."*

> *"Access to jobs, healthcare, and shopping (especially grocery stores) is a big issue in the region we serve. This impacts low income individuals, the elderly, and those around who suffer from mental illness. Transit would provide easy methods for these vulnerable populations to access their basic needs."*

> *"After I had surgery and could not bike or drive it was the only way we could get to doctor appointments or even groceries. There are many in Wabasha that this is true for every day and not just after surgery."*

> *"Clients regularly utilize public transportation to access medical appointments. They may not have access to get to those appointments without the public transportation. Clients also use public transportation for getting groceries and other necessary shopping."*

> *"I run a crisis unit. This is a short-term stay facility. I can set up appointments for people and refer them to the food shelf, Ruby's pantry, vocational supports, etc., but if there is no transportation to these places they will decompensate and end up on an ER and/or back on our*

doorsteps. The people we serve struggle with organization and finances. They need to see their therapists, psychiatrists and primary care. If there is no transportation, then these appointments are not followed through and they may be seen as non-compliant. Then their provider drops them. Nutrition is huge for brains/bodies to work and lack of access to nutrition creates more health problems which again end up in the ER. Jobs are key to reducing the cycle and being able to afford transportation. Getting to work is key for success!"

"I serve individuals age 65 and up. Crow Wing County Transit is huge to their quality of life. Those who cannot or choose to not drive, need this service for their daily lives. It is their only way to get groceries, medical and prescription supplies and have social contact with others. It is not a perfect solution, as the bus service does not run on weekends, but Monday through Friday during the day it is a great assistance for these individuals."

Many commented on how these benefits are invaluable where transit services are available, but some also noted that these benefits are limited depending on the availability of the service. As noted in the last quote, services often do not run on the weekends, and some respondents commented on limited hours or limited reach of the service that limits the potential benefits. Many who made this point argued that services should be expanded so that these benefits could be more fully realized.

3.4.2 Reductions in Health Care Costs and Government Spending on Other Programs

The second category of benefits result when the provision of transit leads to cost savings for other programs or other areas. For example, providing access to jobs could result in reductions in government spending on public assistance programs such as welfare and other social services. Providing access to health care could result in reduced health care costs. The provision of transit could potentially lead to reductions in spending on other programs as well. Compared with the previous group of benefits, survey respondents were less likely to perceive these as being important (Table 3.2). However, a majority of respondents did view reduced health care costs and reductions in government spending on public assistance programs as being either a major benefit or a benefit.

Table 3.2 Perceived Importance of Transit Benefits Stemming from Reduced Spending in Other Areas

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
	----------percentage of respondents----------				
Reduced health care costs	38	36	7	6	13
Reductions in government spending on public assistance programs	32	33	9	10	16
Reductions in spending on other programs	14	22	4	5	55

Below are a sample of comments from survey respondents regarding these potential benefits:

"Health care costs could be reduced if people are able to make it to their doctor for health maintenance, so they do not end up in the hospital or emergency rooms. Also, transportation

would allow them to go to the pharmacy and get their medication in a timely manner, which would likely prevent exacerbations of chronic diseases that end up with the person in the hospital or emergency room."

"Working in health care, it is witnessed that people are hesitant to make appointments because they simply do not have access to transportation. If they had increased access to transportation, this would allow them to come in to be seen sooner resulting in fewer ER trips lowering health care costs as a whole."

"Transportation to jobs can reduce the costs of public welfare. If transportation is not an issue, more people could get to low-cost clinics and regular checkups, reducing health care costs.

Reductions in isolation issues improves mental and physical health. Transportation to early childhood education programs would reduce future costs of remediation for education."

Most respondents agreed that transit provides improved access to jobs and health care, and a number thought this might lead to reduced public assistance spending or health care costs. Some, however, were unsure or skeptical if it would lead to reduced spending. One respondent commented that "reductions in government spending on public assistance would be greater IF the jobs they connect to also paid well, not minimum wage service jobs."

3.4.3 Benefits That Could Result When Individuals Switch from Automobile to Transit

Transit can yield benefits not just from providing mobility to those who otherwise would not be able to make trips but also from shifting automobile trips to transit. The survey included the following as potential such benefits:

- Transportation cost savings for transit users (savings on vehicle ownership costs, gas costs, taxi costs, etc.)
- Reduced chauffeuring responsibilities by drivers for non-drivers
- Improved safety/reduction in crashes
- Reduced stress
- Environmental benefits from reduced emissions and energy consumption
- Health benefits from increased walking and cycling to and from transit stops or from reduced stress
- Reduced congestion
- Reduced parking costs or need for parking
- Reduced need for spending on roadway construction
- Reduced travel times

Table 3.3 shows how survey participants perceived the importance of each of these potential benefits. Transportation cost savings for transit users was identified as the most important among these benefits, followed by environmental benefits, reduced chauffeuring responsibilities, reduced stress, and improved safety. Respondents identified reduced travel times, reduced need for spending on roadway construction, reduced congestion, and reduced parking costs or parking needs as being least important. This is not surprising, as most respondents were from smaller communities, and these benefits are most relevant for larger urban areas.

Table 3.3 Perceived Importance of Benefits Resulting from a Shift in Trips from Automobile to Transit

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
	----------percentage of respondents----------				
Transportation cost savings for transit users	44	40	11	2	3
Environmental benefits from reduced emissions and energy consumption	34	38	18	4	6
Reduced chauffeuring responsibilities by drivers for non-drivers	33	46	15	2	4
Reduced stress	29	45	16	5	4
Improved safety/reduction in crashes	28	42	18	4	8
Health benefits	28	35	22	7	8
Reduced parking costs or need for parking	22	28	23	21	5
Reduced congestion	19	34	23	19	5
Reduced need for spending on roadway construction	15	33	24	17	11
Reduced travel times	14	25	24	29	9

When asked to elaborate, respondents who identified benefits tended to focus on the transportation cost savings to users. Some also commented on improved safety, reduced chauffeuring responsibilities, or other benefits, while others argued that many of these benefits do not exist in their communities. Below is a sample of comments.

> *"Affordable housing is difficult to find in our area. Reduced transportation costs help people afford other vital portions of their budgets such as housing and health care."*

> *"Cost savings to individuals that do not need to own a vehicle is substantial. If they need a vehicle to reach areas outside of the public transit service area the savings is greatly diminished."*

> *"Anyone would agree that having to come up with money for gas is a burden for our low-income families. Having an option that's both safe and reliable, especially in the wintertime in Minnesota, is extremely helpful to the people we serve. Many people today struggle with keeping active and fit when we live in a society that encourages over-eating and moving less. For some the trip to the bus accounts for much of their physical activity."*

> *"We would see a large benefit in chauffeuring responsibilities and transportation cost savings for our clients. Reduced stress and improved safety would also be a result of providing transportation services to our clients through a transit service. All these center on the fact that traveling in a rural location equates to long trips in open country where response time to accidents, engine failure, or the like have extended wait times. We also have large costs in fuel*

because of those long trips so fuel saving for our clients is key if we can transport multiple people in one trip to the same destination."

While most agreed that reduced transportation costs to transit users is a benefit, some argued that because of the rural setting and limited service availability, a transit user may not be able to completely give up vehicle ownership. Many respondents noted that some of these benefits are not realized in a rural setting, as reflected in the following comments:

> *"Parking is not a problem and getting somewhere by car is faster than waiting for the bus. Stress is probably increased, not reduced, by the waiting."*

> *"Being located in a rural area, traffic congestion, reduced travel times, parking costs, etc. are not an issue in our location. So, transit services would not provide a benefit to us for these areas of concern."*

3.4.4 Benefits to the Community from Providing an Alternative Transportation Option

There may be benefits to the community at large from the provision of alternative transportation options. Transit may keep people living in the community, allow seniors to age in place, support independent living, improve social connectedness, provide an option to non-users in case of an emergency (e.g., if a car breaks down or the individual is temporarily unable to drive), or support emergency response services (e.g., ability to evacuate and deliver resources during an emergency).

Survey participants viewed many of these as being major benefits (Table 3.4). Notably, 70% said that supporting independent living is a major benefit, and about two-thirds said the same about allowing seniors to age in place and keeping people living in the community.

Table 3.4 Perceived Importance of Benefits to the Community from Providing an Alternative Transportation Option

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
	----------percentage of respondents----------				
Supports independent living	70	26	3	0	1
Allows for seniors to age in place	66	28	3	0	2
Keeps people living in the community	64	28	5	0	2
Improves social connectedness	55	35	8	1	1
Provides an option to non-users in case of emergency	48	42	7	1	2
Supports emergency response services	39	34	12	4	12

Many respondents commented on how transit supports independent living in their community, allows seniors to age in place, and keeps people living in the community, as reflected in the following comments:

> *"As more of the population ages it will be crucial to have more viable transportation options, besides driving. People should have transportation options that allow them to continue living as independently as possible when they can't drive."*

> *"If transit did not exist, we would have more elderly individuals placed in assisted living, group homes, and/or apartment-type settings. Most individuals live on remote farm places or in small towns that don't have a grocery store, so transportation is key to allowing those individuals to remain in those locations."*

> *"Individuals with disabilities who have historically relied on others for transportation are now experiencing more independence as they are able to access the community without assistance. This in turn allows them to build more relationships in the community vs. only having relationships with paid staff and/or family."*

> *"Having community-to-community transportation would keep people from moving in many instances. People report that smaller communities have cheaper housing options, people don't want to move away from their family, etc."*

Some respondents also commented on the benefits of transit during emergencies:

> *"Because our region has such a vulnerable population, if a disaster were to occur, many would struggle to evacuate because of money issues and lack of access to reliable transportation. Increased transit would provide this benefit to vulnerable populations."*

> *"Buses have been used for emergency response services in the winter as warming shelters during emergencies."*

> *"DTA services have been used twice for emergency evacuations of hundreds of people including full senior residences."*

> *"I have my own car but have used public transit when my car was being repaired and when I was recovering from an injury and could not drive."*

3.4.5 Economic Benefits to the Community

Lastly, there may be economic benefits to the community. These could include the following:

- Allows residents to remain in the community when they can no longer drive and increases desirability of living in the community, thereby supporting local businesses
- Supports local businesses by providing potential workers a means of transportation to work (thereby expanding the pool of available labor or improving employee retention rates)
- Supports local shopping, restaurants, and other businesses by providing improved access for potential customers

- Provides jobs in the community for people working for the transit agency
- Supports businesses in the community that sell products or services to the transit agency
- Changes land use patterns, allowing for more efficient use of land (e.g., supporting infill development, higher density development, or a mix of different types of land use)

Table 3.5 shows how respondents rated the importance of each of these. A majority of respondents thought that supporting local businesses is a major benefit by allowing residents to remain in the community when they can no longer drive, or providing potential workers a means of transportation to work. Most also thought that supporting local shopping is a benefit. Respondents were least likely to think that changing land use patterns is an important benefit, which is not surprising since this is more likely to impact larger urban areas.

Table 3.5 Perceived Importance of Economic Benefits to the Community

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
	----------percentage of respondents----------				
Allows residents to remain in community when they can no longer drive and increases desirability of living in the community, thereby supporting local businesses	65	30	2	0	2
Supports local businesses by providing potential workers a means of transportation to work	55	35	6	2	2
Supports local shopping, restaurants, etc. by providing improved access for potential customers	45	43	9	1	2
Provides jobs in the community for people working for the transit agency	43	38	15	1	3
Supports businesses in the community that sell products or services to the transit agency	31	35	24	5	5
Changes land use patterns, allowing for more efficient use of land	22	29	17	11	22

Some respondents commented on how transit supports local businesses by providing workers a means of transportation to work.

> *"A group of us worked very hard with local businesses, the bus provider, the city and the DOT to get hours expanded so that our local bus started running earlier, allowing more people to take higher paying jobs that start at 6 am. This was a huge help to employers."*

> *"Digi-Key is hiring hundreds of new employees each year and several of these people can't access our facility unless they are able to access public transit."*

"Finding and retaining workers is an issue for businesses in our region. Increased transportation access would provide a more reliable workforce for businesses."

"I know many community members that work at the local pork processing plant rely on the bus or taxi to get to work. This manufacturing company employs 2,500 very diverse employees from our community and surrounding communities as far as 45 minutes (one-way) away."

"Many of our employers are struggling to find employees. And I have heard from at least one employer that potential employees' lack of reliable transportation is a major issue."

Some also commented on how supporting local jobs provides further economic benefit to the local community as these workers then spend money in the community, supporting other local businesses. As one respondent summarized it, "All of the above are sort of a 'trickle down' list of benefits. If people can get to their employment, it is good for everyone."

Others discussed how local businesses are supported when transit provides access for those who cannot drive, and a few noted that the transit system itself provides jobs and purchases supplies and services from local vendors.

"While our service does provide some employment trips, a far greater contribution to the community is in the rides that we provide to local businesses. Multiple daily trips to Coborn's, Shopko, banks and agencies."

"Our service is projected to bring more than $485,000 tax dollars, through wages, right back here to our region in 2019. These dollars flow right into our local economy; we buy groceries, gas, fix our vehicles and eat at restaurants all locally. Further, a lot of the expenses for running the bus service are paid to local vendors - repairs and maintenance on the buses, parts and materials, grounds-keeping and advertising."

One respondent agreed that there are definitely jobs provided by transit agencies but was unsure of the benefit as those workers might just work someplace else within the community if the transit agency was not there.

Many respondents did not think that changes in land use patterns was a relevant benefit for their communities. Most tended to think that transit was not impacting land use. However, a few respondents from larger communities did stress the importance of this benefit. They noted that transit can alleviate parking concerns in downtowns, and if fewer parking spaces are needed, that land could be used for other purposes. One respondent commented on the financial importance of maintaining existing infrastructure rather than continuing to expand outward, and that transit can help facilitate this by supporting mixed-use and higher density developments that use existing facilities.

3.4.6 Other Benefits

The survey provided respondents the opportunity to identify other benefits not listed in the survey. Many provided responses that tended to echo what was already covered in the survey. Some noted that transit provides access to other activities or locations not mentioned in the survey, such as religious facilities or special events. A few commented on how transit is important to children and youth; that it allows children to participate in community events and provides transportation to preschool and

daycare and is a means of transportation for those who cannot drive yet. Some noted the importance of the service to immigrants. The important role that transit plays in promoting equity and community connections was also noted, as well as the safety benefit it provides by allowing people an alternative to driving after drinking. A sample of comments is shown below.

> *"I think often underscored is the community connection - being able to maintain relationships and sense of belonging (e.g., being able to get accessible transportation to the hair salon you've gone to your entire life when previously you didn't need accessible transportation) - this of course includes work and common places where people share space."*
>
> *"Children with working parents are able to participate in community events, including after school programs, sports, YMCA, and summer activities."*
>
> *"Equity. Everyone can access regardless of income, neighborhood, employment status, and disability."*
>
> *"Our new residents and immigrants need help in this area to get to education, citizenship classes, jobs, etc. We should help them as much as possible to make them feel welcomed, confident, and capable of getting to a place where they feel at home and an important, integrated part of our community."*
>
> *"Public transit has been used to bring groups of persons to various outings. It has been used for community concerts, and other events where parking is limited. It has been utilized for paid programs to bring people home safely after drinking too much on New Year's Eve, and other major dates where there is such a need."*
>
> *"Transit reduces the burden on those informal supports that are currently using their own resources to provide transportation for others in the community, often not really being able to afford it themselves."*

3.4.7 Most Important Benefits

The potential benefits most often rated as a major benefit or benefit are shown in Figure 3.3. These include supporting independent living, improving access to health care, jobs, and shopping, allowing seniors to age in place, and keeping people living in small communities; these benefits support local businesses and improve quality of life for those dependent on transit services.

Respondents were given an open-ended question with the opportunity to comment on what they thought were the most important benefits of public transportation in their community. Responses tended to follow the results shown in Figure 3.3. Many spoke of the importance of how transit allows individuals to live independently by providing access to jobs, health care, grocery stores, and other destinations they cannot drive to themselves. The importance of transit to seniors and people with disabilities was commonly mentioned.

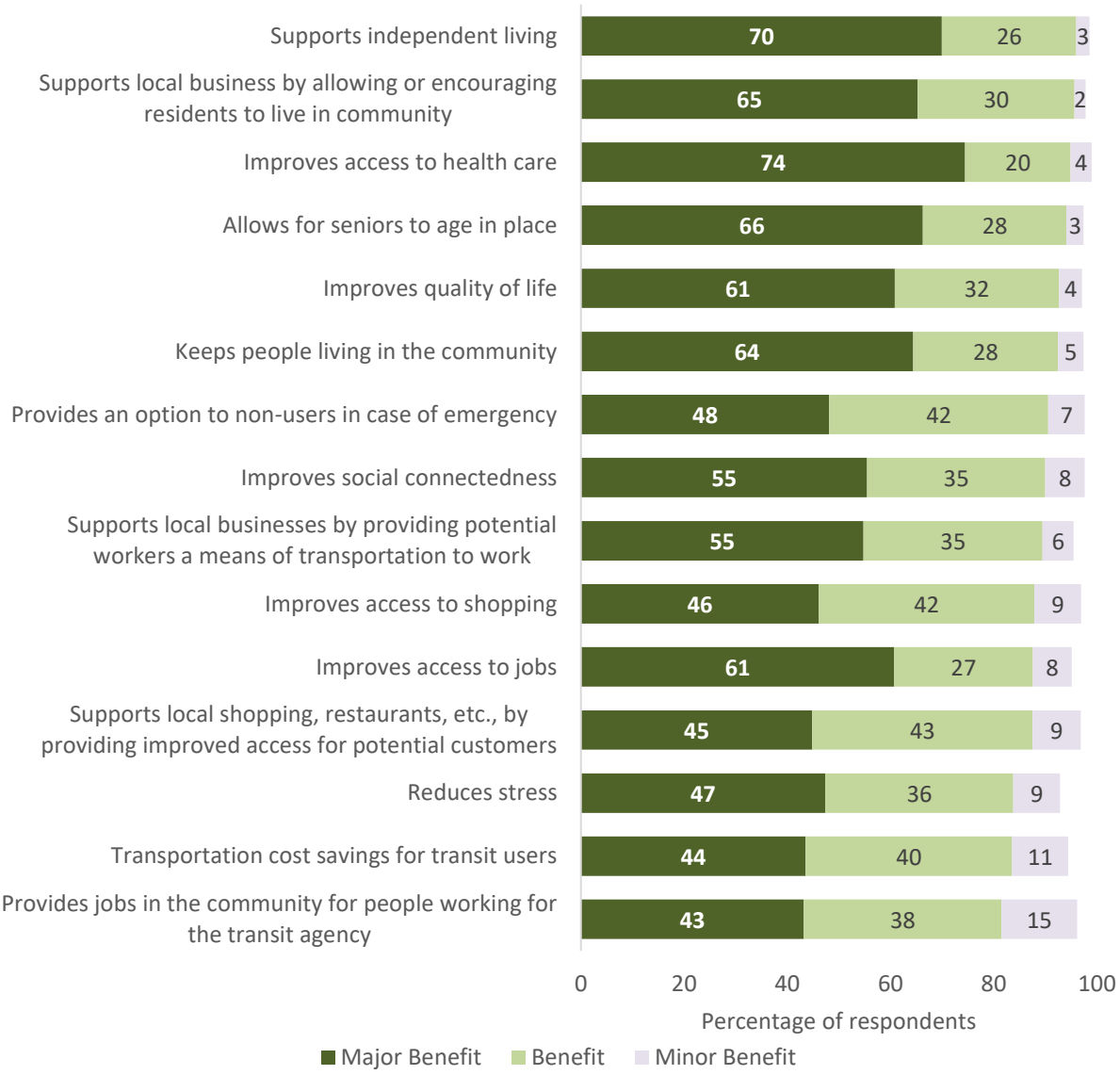

Figure 3.3 Benefits Perceived by Respondents as Being Most Important

The selected responses below summarize the main themes found in the survey.

> *"It allows people independence, plain and simple. In rural areas such as ours, being able to access anything in the community is more difficult, and having the transit bus available opens up a lot of areas where people struggled just to do the things they had to do just to survive. Now they are able to do those things as well as stay connected with others in their communities."*

> *"Creating independence for the disabled, elderly, and low income. Transportation has allowed individuals to access the community without having to rely on others. It has added jobs to the economy. It has also opened up travel between cities."*

3.4.8 Variations in Responses

The positive results from the survey were not surprising given that many of the respondents work for organizations that serve the transportation disadvantaged. Many of the respondents, for example, work for human service agencies. We might expect the responses to differ depending on the background of the respondent. The survey response data were, therefore, analyzed further to determine if there were significant differences in opinions depending on the type of organization to which the respondent belonged.

In most cases, responses from different types of organizations were largely similar to the overall response, or the difference was not great enough to be considered statistically significant. Some differences were not surprising. For example, respondents from public health departments were more likely to identify health benefits, as well as environmental benefits, as being major benefits. Health care providers were more likely to view reduced stress as a major benefit.

Transportation providers were, in general, more likely to rate benefits as being major benefits, compared with the overall sample. For example, they were more likely to say that improving access to education, reducing congestion and need for parking, allowing for seniors to age in place, keeping people living in the community, supporting emergency response services, and providing jobs for people working for the transit agency are major benefits, compared with the overall sample.

On the other hand, respondents from private companies and local elected officials were generally less likely to identify potential benefits as being major benefits. These respondents were more likely to view a potential benefit as just a benefit or minor benefit, rather than a major benefit. However, because of the small number of responses from private companies and local elected officials, most differences are not statistically significant, and it is difficult to draw too many conclusions. There are some exceptions, as well. For example, out of ten local elected officials who responded, nine said that allowing for seniors to age in place is a major benefit of transit in their community.

While most survey participants were from rural areas of Greater Minnesota, some were from metro areas. These include the Duluth, Rochester, St. Cloud, and Fargo-Moorhead metro areas in Greater Minnesota; and a small number of respondents also serve people within the Twin Cities Metro area. About 8% of all respondents were identified as being from one of these metro areas. In many cases, responses from the urban participants were not significantly different from those of rural respondents, and some of the differences found were not surprising. For example, urban respondents were more likely to view reduced parking costs or need for parking and reduced congestion as major benefits. They were also more likely to view improved access to jobs and education as major benefits.

3.4.9 Measuring the Benefits of Transit

The survey asked respondents how they thought the benefits of transit could best be measured in their communities. The most common responses were to conduct surveys and collect ridership data. Many different types of surveys were suggested, such as surveys of riders, potential users, community

members, family members of transit users, employers, businesses, human service agencies, and drivers. Surveys would collect information on how transit improves access to different activities, including access to health care and work, how it meets the needs of the users and improves quality of life, and how it impacts local businesses. Surveys would provide information on who is using the services and why.

Many respondents mentioned some type of measure regarding employment, such as number of workers using transit to get to work, number of jobs filled, or job retention. Some mentioned measuring the impact it has on reducing the number of people receiving public assistance. Respondents mentioned looking at how many riders use transit for different trip purposes. Many mentioned the impact on access to different activities or looking at changes in attendance or participation. Some specifically focused on health care and suggested measuring how many health care trips are provided and how many appointments would be missed without transit. Medical outcomes could potentially be measured, such as reduced ER trips, better maintenance of health, and lower health care costs. Some respondents focused on measuring how many people are able to stay in their residence longer because of transit and how transit impacts population in the community.

3.5 SUMMARY AND CONCLUSION

Survey respondents, who represented a variety of transit stakeholders across Greater Minnesota, largely agreed that transit provides a wide range of benefits within their communities. The benefits they identified as most important stem from the provision of transportation to people who otherwise would not be able to make trips, including older adults, people with disabilities, low-income individuals who cannot afford to own a vehicle, and others. They especially focused on how transit provides access to jobs and health care, supports independent living, allows seniors to age in place, and keeps people living in the community. Positive impacts for local employers, local businesses, and the community at large were also widely acknowledged. Other benefits more typically associated with large urban transit, such as land use impacts or reduced congestion, travel times, parking costs, or roadway construction costs, were least likely to be identified as benefits, although some respondents did recognize them as such. Results from the survey suggest that an analysis of the benefits of rural and small urban transit should focus on the benefits to individuals who would not be able to make trips without transit, with some attention also paid to the economic benefits to the community and the transportation cost savings to transit users.

The survey objectives were to help inform the framework development for estimating the benefits of transit in Greater Minnesota and to provide qualitative evidence to support quantitative findings. The survey was successful in achieving both of these objectives. First, the survey identified a number of benefits perceived to be important in Greater Minnesota. Some of these benefits have not typically been included in previous research of rural transit or have gone largely unmeasured, such as positive economic impacts from improving access and keeping people living in the community. Finally, the survey provided a wealth of qualitative evidence regarding the benefits of transit in Greater Minnesota. Respondents provided many comments describing the benefits within their communities. The comments help contextualize the study and provide support for the research method.

CHAPTER 4: METHODS

4.1 TYPE OF ANALYSIS

There are different approaches to evaluating the benefits or impacts of transit services. These approaches include a benefit-cost analysis (BCA), a multiple account evaluation, and an economic impact study. Weisbrod et al. (2017) described the differences between these types of analyses and examples of their use in evaluating transit.

A key to understanding the difference between the types of analyses is knowing the difference between the terms "benefit" and "impact." An economic impact is any effect of a policy or project on the economy of a designated project area. These could include changes in jobs, income, business sales, value added, or tax revenue. Impacts are not necessarily net benefits, because the impact could represent a benefit to one party but a cost to another. For example, an increase in business sales is a benefit to businesses but a cost to consumers, and jobs represent a benefit to employees and costs to employers. These are transfer payments rather than net benefits. A benefit strictly represents a positive outcome. Economic impact studies also use multipliers to estimate indirect effects and induced economic activity that result from the initial spending. However, some level of these multiplier-induced impacts would also have occurred if the same funds were spent on another project. Therefore, most economic impacts are not included in a BCA.

Fundamentally, an economic impact analysis (EIA) and a BCA address different questions. An EIA addresses how an economy is likely to change as a result of an action, and a BCA addresses whether society is better off by performing a certain action versus doing nothing. A BCA is used to determine whether a project yields a positive return on investment (ROI) by comparing the quantifiable benefits to the project costs for a defined period of time (Horst and Carini 2011). Both an EIA and a BCA are useful, and projects often include both types of analysis. However, the analyses and results must be kept separate. The economic impacts cannot be added to the BCA benefits because they represent two different types of analysis. Adding them together could result in some benefits being double counted.

A third approach, multiple account evaluation (MAE), is a type of hybrid approach, as described by Weisbrod et al. (2017). This approach catalogues various economic impacts and benefits without adding them together to calculate an overall metric. MAE may be appropriate when there are a number of different types of benefits and impacts to consider and converting them all to dollar terms and calculating a single metric is not feasible. The problem with a BCA is that it requires converting all benefits and costs to dollar terms, which can be difficult and often includes significant uncertainty. MAE addresses this problem by calculating various types of benefits and costs differently and not converting them all to monetary terms.

The type of approach most appropriate for this study depends on the types of outcomes we wish to consider. A primary benefit of providing transit in rural and small urban areas is that it provides improved mobility for transportation-disadvantaged individuals, such as older adults, people with

disabilities, and those with low incomes. These benefits are not typically included in an EIA or studies that focus on the impacts on the economy, but they are included in studies that focus on the value of societal benefits (Weisbrod et al. 2017).

An analysis of societal benefits can include estimating the value of user benefits, environmental benefits, economic development benefits, social/community benefits, low-income mobility benefits, and avoided public costs (Weisbrod et al. 2017). Many of these benefits are of interest when evaluating rural and small urban transit. As Weisbrod et al. noted, these societal benefits have value to people but do not directly affect business growth, and, therefore, societal benefit studies may capture broader effects than an EIA. On the other hand, a BCA, or strictly focusing on societal benefits, would also fail to capture some economic impacts that may be of interest.

The best approach for this study is a form of a multiple account evaluation that considers different types of benefits and impacts. Such an approach allows for both societal benefits and economic impacts to be considered and includes different types of benefits, even if they cannot be monetized or added together. Wherever possible, benefits were monetized and added together. If a benefit could not be monetized but could be quantified in some other way, then the benefit was measured that way. If a benefit could not be quantified in any way, then it was described qualitatively. Benefits were categorized, and economic impacts were reported separately.

4.2 BENEFITS TO BE CONSIDERED

As described in the literature review and the survey sections, there are many potential benefits of transit. This study focuses on benefits most relevant to Greater Minnesota. For example, benefits such as land use impacts, congestion mitigation, and reduced need for parking might be significant in urban areas but are not relevant or as important in Greater Minnesota. Based on the literature review and results from the survey, the following list of benefits are those most likely to be pertinent to transit in Greater Minnesota:

- Benefits to users by providing access to jobs
- Benefits to employers by expanding the potential labor pool
- Benefits to society by improving access to jobs
- Benefits to users by providing access to health care, including improved quality of life and reduced health care costs
- Benefits to users by providing access to shopping, education, etc.
- Benefits to the community by providing access to local businesses
- Benefits to the community by keeping people living in the community
- Benefits to seniors by allowing them to age in place
- Quality of life benefits to users by reducing social isolation or stress
- Transportation cost savings for users
- Jobs and economic impacts created from the transit system
- Others (potentially): safety benefits to users and society, chauffeuring cost savings, environmental benefits, emergency/option value benefits

Most of these can be categorized as societal benefits, and some are economic impacts. Some are benefits to the user and others are benefits to the community or society at large.

4.3 TRANSIT BENEFITS ASSESSMENT TREE

The potential benefits of transit are conceptualized through the use of a transit benefits assessment tree. Figure 4.1 identifies and categorizes the benefits to be included in this study. This transit benefits assessment tree is a modification of the categorization of benefits provided by Litman (2018).

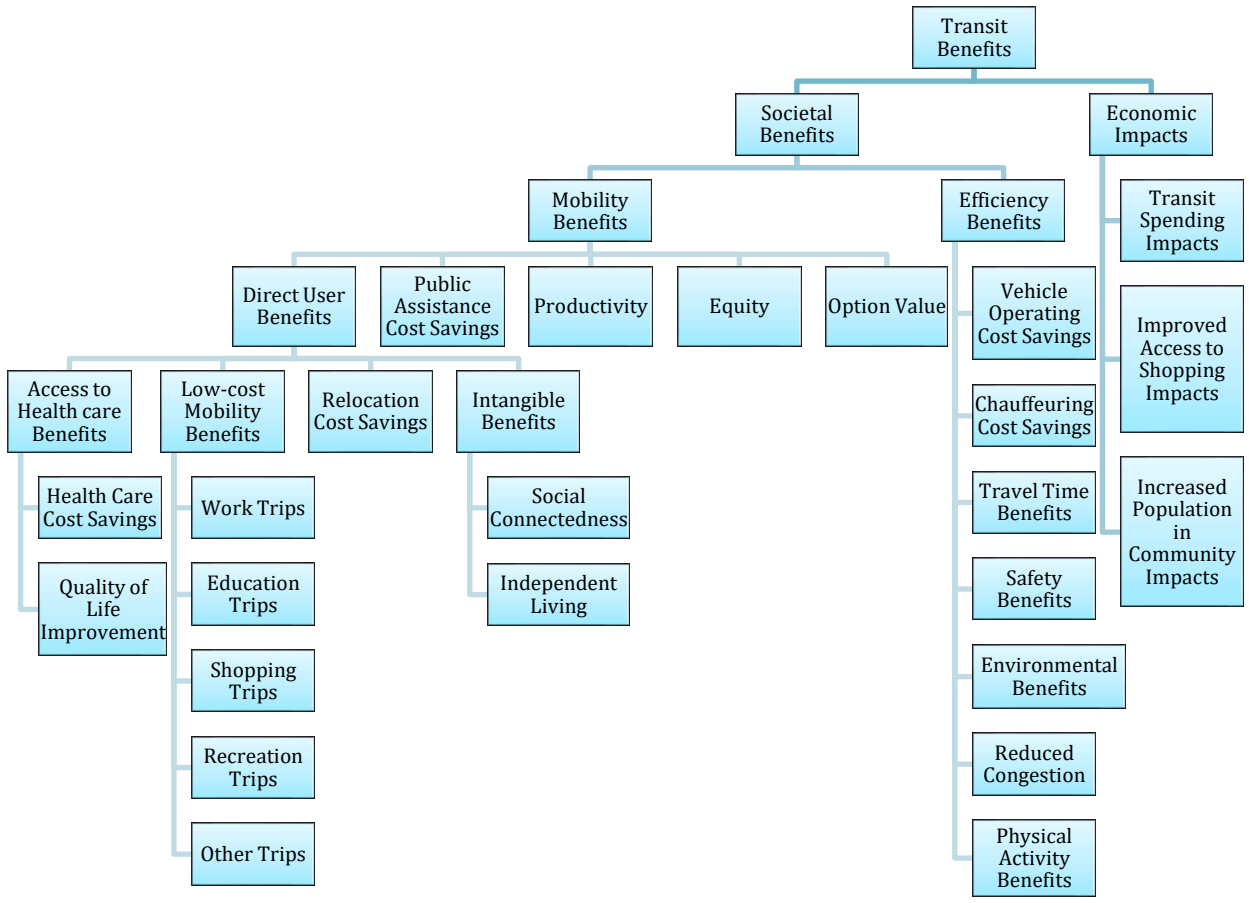

Figure 4.1 Transit Benefits Assessment Tree

Two main types of benefits are identified: societal benefits and economic impacts. Economic impacts are not strictly net benefits and are estimated using an economic impact analysis. These impacts are reported separately and not added to the societal benefits.

4.3.1 Societal Benefits

Societal benefits include mobility benefits and efficiency benefits. If transit service was not available, transit users would either make the trip in some other way or forgo the trip. Mobility benefits are the benefits of providing trips that otherwise would have been forgone, and efficiency benefits are the benefits from making trips with transit instead of the automobile or some other mode.

4.3.1.1 Mobility Benefits

Mobility benefits include direct user benefits, public assistance cost savings, productivity gains, equity, and the option value (Litman 2018).

Direct user benefits: Direct user benefits are benefits to transit users for making trips they otherwise would not have made. This includes health benefits from making additional health care trips. If transit users are able to access health care services for routine care or care for chronic conditions, they can better manage their health, which can lead to reduced need for more expensive care later and improved quality of life. In addition to health care trips, transit riders benefit from taking trips for other purposes that would have been forgone in the absence of transit. Low-cost mobility benefits represent the economic value of providing an affordable transportation mode. They accrue to low-income, transit-dependent individuals who would forgo the trip if they did not have access to transit.

Some transit users would potentially need to relocate if the service was not available. Without transit, a transportation-disadvantaged individual may not be able to access needed activities, such as health care, work, nutrition, etc., and may need to relocate to somewhere with better access. This could include moving to an assisted living facility, either in the same or a different community, or simply moving to a different community with better access. There may be significant costs involved with relocating. An assisted living facility can be significantly more expensive than aging in place, and those who move to another community for improved access usually move to a larger city that may have a higher cost of living.

There are other intangible benefits to improving mobility and providing trips that would otherwise be forgone. Transit reduces social isolation and improves social connectedness, especially for older adults and those with disabilities that make travel difficult. Increased participation of people in the community leads to greater levels of interaction and connection. For example, having a job increases social connections and contributes to a sense of belonging and purpose. Having strong social networks also increases employment opportunities. Transit also promotes independent living, which was commonly noted in the stakeholder survey as one of the main benefits of rural transit. Increasing social connections and allowing for independent living can result in significant quality of life benefits and have mental health implications.

Public assistance cost savings: Transit may be able to reduce government spending in other areas. Notably, by providing transportation to work for people who would otherwise be unable to travel to work, transit could reduce unemployment and decrease the need for public assistance spending.

Productivity: Productivity could increase by providing increased access to jobs and education. Transit benefits local businesses by providing transportation to work. This increases the potential labor pool for local businesses that can lead to positive impacts on their productivity. Increasing access to education and job training also increases the skill level of the local labor pool, further impacting productivity. Transit allows many, including immigrant populations, who struggle with mobility and inclusion to have an impact on the economic viability of rural communities.

Equity: Transit promotes equity within a community by giving the opportunity for people of all abilities, incomes, and situations to access work, health care, shopping, recreation, and other services and activities. As Litman (2018) stated, it increases economic and social opportunities for people who are economically, physically, and socially disadvantaged. Specifically, disadvantaged groups include low-income households, carless households, youth, older adults, people with disabilities, and racial and ethnic minorities, including immigrants. Immigrants can face several disadvantages, including discrimination and social exclusion, as well as language and economic barriers. Socially disadvantaged groups refer to those whose members have been subjected to discrimination or some form of social exclusion.

Option Value: Transit provides an option to non-users in case of an emergency. For example, if their car breaks down or is temporarily unavailable, or if they temporarily cannot drive due to health or some other reason, transit provides them an option for making those trips. Although they do not use transit now, future use is uncertain, and there is value to having transit as an option. Transit can also support emergency response services, such as evacuating during an emergency.

4.3.1.2 Efficiency Benefits

If the trip is made some other way, such as by individuals driving themselves, getting a ride from someone, taking a taxi, getting a ride from a Transportation Network Company (TNC) such as Uber or Lyft, walking, or biking, then additional costs would be incurred. Efficiency benefits include the costs avoided by using transit instead of another mode.

The analysis, however, does not include taxi or TNC cost savings as benefits, because this results in offsetting costs for taxi or TNC operators. If someone takes transit instead of a taxi, the taxi service loses money; and in a small town, moving limited-mobility individuals could be a major aspect of that taxi service's business. Therefore, these are not net benefits.

The money riders save by taking transit could be spent at local businesses or on housing, benefiting the local economy. However, the analysis does not include both the cost savings to the transit user and the benefits to local businesses if those savings are spent at their businesses, because that would result in double counting.

Shifting trips to transit also impacts travel time, safety, the environment, and congestion, which should also be considered when calculating efficiency benefits. For rural and small urban transit, the most significant benefit within this category would likely be vehicle cost savings or chauffeuring cost savings.

There could be physical activity benefits from shifting trips to transit as well if it results in increased walking.

4.3.2 Economic Impacts

Economic impacts include those from transit spending, improved access to shopping, and increased population in the community. The first of these are commonly estimated in economic impact studies of transit, while the others are not. The impacts from transit spending are those that result from the existence of transit operations, including direct effects, indirect effects, and induced economic activity. The direct effect includes the jobs created directly by the transit system – drivers, dispatchers, mechanics, bookkeepers, program directors, etc. The indirect effect results from jobs and income spent in industries that supply inputs or services to public transit, such as fuel, repairs, insurance, etc. Induced economic activity results from the income generated through both the direct and indirect effects. These induced effects occur when the people who work for the transit system and the people who work for businesses indirectly affected by transit spend their new income in the community. This spending supports additional jobs in the local economy.

Transit impacts the local economy in other ways. Transit improves access to local businesses for those who cannot or do not drive. Without transit, transportation-disadvantaged individuals may purchase more goods online rather than from local stores and make few, if any, trips to restaurants and other local businesses. Therefore, with transit, more spending may occur within the local community. As previously noted, if transit is not available, some may decide to relocate to another community. Therefore, transit has the potential to keep people living in the community, and it may even attract some people to move to the community. The people who stay in or move to the community spend money within the community, supporting the local economy. If these people left, there could be negative impacts for local businesses.

4.4 MEASURING BENEFITS

This section describes how each of the benefits were measured. The method first requires determining how transit users would behave if transit services were not available. Estimates were needed for the percentage of transit trips that would be forgone and the percentage made by other modes, including the percentage of trips where the rider would have driven themselves, obtained a ride from someone else, walked, or traveled some other way. Data were also needed to estimate the number of work trips, health care trips, and other trips that would be forgone. These and other data were collected through surveys of transit riders.

4.4.1 Societal Benefits

4.4.1.1 Mobility Benefits

The rider survey collected much of the data needed to estimate mobility benefits. This included information about the percentage of transit trips that would be forgone and the breakdown of those

trips by purpose. A summary of the mobility benefits and the measurement approaches is shown in Table 4.1.

Table 4.1 Summary of Mobility Benefits and Measurement Approaches

Category	Description	How to Measure	Measurement Type
User Benefits	Direct user benefits from the additional mobility provided by public transit.	Rider surveys to determine the degree that users depend on transit and the types of trips they make.	Monetary / Quantitative / Qualitative
Access to health care benefits	Reduced health care costs and improved quality of life.	Method developed by Hughes-Cromwick et al. (2005)	Monetary
Low-cost mobility benefits	Value to the user for having transit as an option.	Change in consumer surplus resulting from new trips.	Monetary
Relocation cost savings	Cost savings by allowing transit user to remain at current residence.	Costs that would have been incurred for those who would have needed to move to an assisted living facility or another community.	Monetary
Intangible benefits	Benefits of social connectedness and independent living.	Number of transit users with no other travel option and impact on quality of life.	Quantitative but not monetary/ Qualitative
Public Assistance Cost Savings	Supports public services and reduces government agency costs.	Estimate reduction in public assistance spending.	Monetary
Increased Productivity	Increased education and employment participation by non-drivers.	Survey transit users to determine the portion that rely on transit for education and employment.	Quantitative but not monetary
Equity	Degree to which transit helps achieve equity objectives such as basic mobility for physically, economically, and socially disadvantaged people.	Portion of transit users who are economically, socially or physically disadvantaged. Impact on quality of life.	Quantitative but not monetary / Qualitative
Option Value	The value of having an option for possible future use.	Portion of riders who are not regular transit users.	Quantitative but not monetary

The benefits to users for those who otherwise would not make trips without transit are difficult to measure and monetize. A large component of these benefits is the improvement in quality of life from reducing social isolation and allowing for independent living. Nonetheless, there are methods for quantifying and monetizing, where possible, some of these benefits.

Access to health care benefits: The benefit to the user of providing health trips that would have been forgone was measured based on the impacts on health care costs to the user and quality of life. Godavarthy et al. (2014) used a tool developed by Hughes-Cromwick et al. (2005) to estimate net benefits for providing transportation to those who otherwise would not make the trip. The benefit from providing a trip for health care is the difference between well-managed and poorly managed care, which can include a reduction in more costly care and improved quality of life. Well-managed care is significantly less expensive than poorly managed care because it reduces expensive emergency room visits and hospitalizations.

Hughes-Cromwick et al. (2005) estimated the number of health care visits required for various chronic diseases by examining the disease management literature. They determined the number of trips a patient with a specific disease would be required to take per year so their condition would be considered well managed. They determined the characteristics of a poorly managed patient so they could estimate the benefit of moving from poorly to well-managed care. Having well-managed care means that complications are minimized, costly care is avoided, and quality of life is enhanced. Poorly managed care could be a result of patient noncompliance, but lack of transportation can also play a significant role.

Their analysis included a noncompliance factor, which accounted for providers who do not adhere to standards of well-managed care, patients who do not adhere to treatment, and patients whose disease is considered uncontrollable despite all best efforts. Their study assumed different rates of compliance for each condition, based on previous research.

Impacts of a treatment on quality of life can be measured using the Quality Adjusted Life-Year (QALY) measure. QALY was developed in an attempt to combine quality of life and length of life into a single measure and is often used to compare the cost effectiveness of treatments (Prieto and Sacristán 2003). It assumes that one year of life lived in perfect health is equal to one QALY, and one year of life lived with less than perfect health is worth less than one QALY. Hughes-Cromwick et al. (2005) cited research from health economics showing that investments that provide one additional QALY are valued at $50,000.

The benefits of non-emergency medical trips (NEMT) are calculated as the cost difference between well-managed and poorly managed care, plus improvements in quality of life, minus costs of additional medical treatment incurred, divided by the number of trips required. Based on the tool developed by Hughes-Cromwick et al. (2005), this results in a net benefit of $713 per round trip, or $357 per one-way trip. This estimate was based on national norms regarding the types of health care trips and conditions being treated, but it could be refined at the local level with more detailed information.

Other studies have also used the tool from Hughes-Cromwick et al. to measure the benefits of NEMT transportation (Ducote and Ducote 2016). Since the tool was published in 2005 and has not been updated or adjusted for inflation, cost estimates are likely conservative. However, to our knowledge, a better, more recent, tool has not been developed. If the dollar figure is adjusted based on the Consumer Price Index, $713 in 2005 dollars would equal $917 in 2018 dollars.

Low-cost mobility benefits: Low-cost mobility benefits to users for all types of trips were estimated by analyzing changes in consumer surplus. This is a method used by economists when conducting benefit-cost analysis to measure the change in welfare for consumers. HDR Decision Economics used this method for measuring benefits of transit in Wisconsin, Michigan, and South Dakota (HDR/HLB Decision Economics Inc. 2006; HDR Decision Economics 2009; Penet 2011).

Consumer surplus is the difference between the maximum price a consumer is willing to pay and the price they actually do pay. Providing transit service increases consumer surplus by decreasing the amount users must pay for a trip, as illustrated in Figure 4.2. The lower price not only reduces costs for those who would otherwise travel by another mode but also increases the total number of trips made.

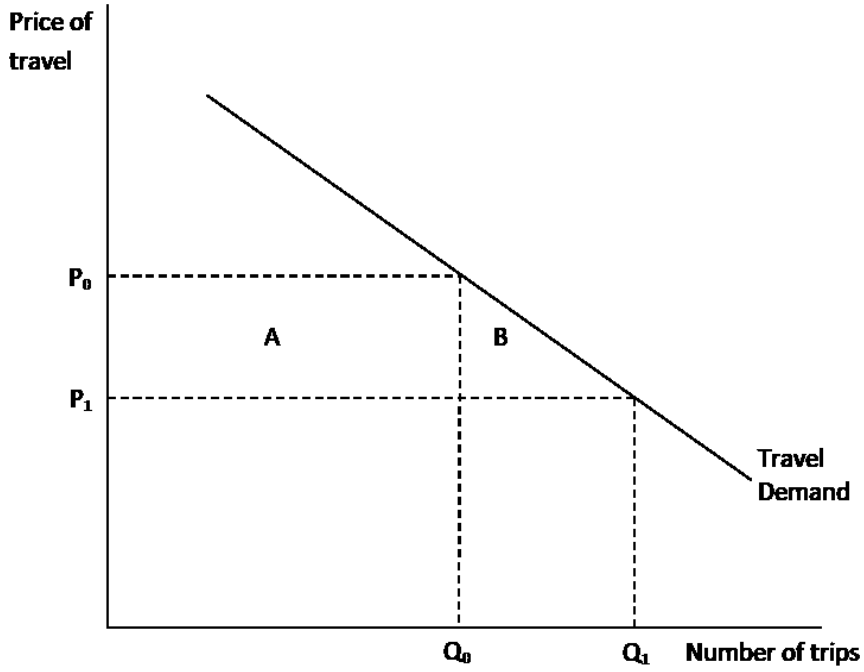

Figure 4.2 Change in Consumer Surplus with the Introduction of Transit

In Figure 4.2, P_0 is the price travelers would pay for a trip in the absence of transit. This price represents the least costly alternative available, which could be the cost per trip of owning and operating an automobile, getting a ride from someone else, using a taxi, and other means. At this price, the number of trips taken is Q_0. P_1 represents price to travel by transit. By introducing transit, the price of travel decreases from P_0 to P_1, and the number of trips increases from Q_0 to Q_1. The difference between Q_0 and Q_1 is the number of trips that would be forgone in the absence of transit.

Consumer surplus is the difference between the price that a traveler is willing to pay (represented by the travel demand curve) and the actual price paid. When price decreases from P_0 to P_1, the increase in consumer surplus is $(P_0 – P_1)*Q_0 + 0.5*[(P_0-P_1)*(Q_1-Q_0)]$, which is equal to A + B in Figure 4.2. Area A is the benefit consumers achieve by having access to an alternative mode of travel that costs less than the

mode they would use in the absence of transit. Area B represents consumer surplus resulting from new trips that are made that would have been forgone in the absence of transit. It represents benefits accruing to low-income people who depend on transit. Estimating area B requires making assumptions regarding the shape of the travel demand curve. This study assumes a linear demand curve, following previous studies that have used this method (HDR/HLB Decision Economics Inc. 2006; HDR Decision Economics 2009; Penet 2011).

The increase in consumer surplus resulting from new trips made is equal to $0.5*[(P_0-P_1)*(Q_1-Q_0)]$, and the total number of new trips made is Q_1-Q_0. On a per-trip basis, the increase in consumer surplus is $0.5*(P_0-P_1)$. Determining the cost of a forgone trip, therefore, requires information about transit fares (P_1) and the cost of traveling by the most likely alternative (P_0).

A problem with this approach is that it assumes P_0, the price of the least-costly alternative to transit, is the same for everyone. However, different transit users have different options available to them, with different costs associated with each. Previous research that used this approach defined P_0 as the average cost per trip for other transportation modes weighted by the expected percentage of trips that would be made for each mode (Penet 2011). This is a reasonable approach and is appropriate for estimating the benefits to low-income transit users who could not afford another transportation mode. However, some transit users would forgo trips because they cannot drive, or cannot get a driver's license, and do not have access to a taxi or another mode of transportation. For them, the estimate for P_0 would not apply. This study employs the consumer surplus approach and uses the weighted-average cost of transportation modes to define P_0, but it recognizes that this does not fully capture the benefits of providing transit to seniors and people with disabilities in rural areas who do not have access to other modes.

P_1, the transit fare, is estimated by calculating total fare revenue per trip. P_0 is the cost per trip of alternative modes, weighted by the likelihood that each mode would be taken. Q_0, the number of trips without transit, is estimated based on the percentage of survey respondents who said they would not have made the trip, and Q_1 is the total number of unlinked trips for the year.

Relocation cost savings: Another component of direct user benefits is the relocation cost saving for those who would relocate if transit was not available. Relocation cost savings are the difference between the cost of individuals staying in their current home and using transit versus the cost of moving to and living in another community or an assisted living facility. For those who would need to move to an assisted living facility if transit were not available, relocation cost savings could be estimated following a method used by Peterson and Rieck (2017). This involves comparing the cost of senior citizens living independently while using home-based health services and transit as opposed to moving to an assisted living facility. For those who would move to a different city, relocation cost savings could be estimated by calculating likely differences in cost of living. To estimate the number of riders who would move, the survey asks riders if they would likely move if transit was not available.

Estimating relocation cost savings presents several challenges. First, there is uncertainty regarding where the transit users would relocate and the magnitude of the cost of living increase. This survey does

not provide information on the percentage of transit users who would relocate to assisted living facilities. Collecting this information in a rider survey would be difficult, as many transit users may not be able to accurately assess whether they would move to such a facility.

There are also potential benefits to individuals who move, which further complicates the analysis. For example, while aging in place is viewed as desirable, there may be benefits to moving to an assisted living facility, such as living longer with a higher quality of life. If the assisted living facility is located within the same community, then the money spent by the individual stays within the community, benefiting the community. Further, if the individual has long-term care insurance, then the community economy benefits from that outside spending at a local assisted living facility, although moving to an assisted living facility often requires moving to another city.

Because of these many complications, the study did not attempt to measure the relocation cost savings in dollar terms. Rather, the results provide some evidence regarding the degree to which transit allows users to live where they prefer.

Intangible benefits: Many of the potential benefits of transit to users cannot be measured in dollar terms. These include increased social interaction, reduced stress, independent living, and improved quality of life. The survey asked respondents the degree to which they agree or disagree that transit provides these benefits.

Public assistance cost savings: If an individual cannot go to work because of a lack of transportation, he or she may be eligible for public assistance. Providing transit, therefore, has the potential to reduce government spending on public assistance programs. The rider survey collected information about the number of riders who use transit to get to work and how important the service is for them to be able to travel to work and maintain employment.

The Minnesota Department of Human Services provides economic support to qualifying individuals through various programs. These include food and nutrition support through the Supplemental Nutrition Assistance Program (SNAP) and the Minnesota Food Assistance Program (MFAP), housing support, and income assistance through the General Assistance (GA) or Minnesota Supplemental Aid (MSA) programs, the Minnesota Family Investment Program (MFIP), and the Diversionary Work Program (DWP). This study focused on two main public assistance spending programs in Minnesota, MFIP and SNAP.

The amount of assistance received per household depends on the size of the household and the level of household income. Even though transit allows many users to maintain employment, household income for transit riders is low, so many who are using transit to get to work may still be receiving MFIP and SNAP benefits. However, they are receiving fewer benefits than they would if they were not working at all, so transit allows for a reduction in spending on these programs. For example, a family of four with no household income would receive $1,198 per month, while the same family of four with someone working 30 hours per week at $9.86 per hour would receive $714 per month (World Institute on Disability 2019). Both would also receive $110 per month for housing assistance.

The cost of a forgone one-way work trip, which accounts for the expected increase in MFIP and SNAP payments, was estimated based on assumptions regarding the income and household sizes of workers and number of transit trips needed per year. SNAP payments are assumed to be reduced by $363 per month for someone making $25,000 or less, $509 per month for someone making $25,000 to $49,999, and $537 per month for someone making $50,000 or more. MFIP payments are made only to households with children, so it is assumed payments would only be made to those in the 25-44 or 45-64 age ranges. MFIP payments are assumed to be reduced by $400 per month for someone making $25,000 or less, $800 per month for someone making $25,000 to $49,999, and $1,198 per month for someone making $50,000 or more. Per month payments are converted to per trip assuming 20 work trips per month, or 40 transit trips.

The percentage of transit trips that are for work and the percentage of those trips that would have been forgone in the absence of transit was estimated based on survey responses.

Increased productivity: Stakeholder survey respondents noted the benefit to local employers who have access to a larger labor pool as a result of transit providing trips to work. Transit could, therefore, help local employers become more viable and productive. Few, if any, studies have estimated the value of this effect in small communities. The impact is quantified by estimating the number of workers in the community who commute by transit, and the number of those commuters who do not have other transportation options, as well as the number of riders who rely on the service for education purposes.

Equity: Quantifying the equity benefit in monetary terms is also difficult. Equity is not commonly measured within a benefit-cost analysis. This study quantifies the equity benefit by estimating the number or percentage of riders who are economically, physically, or socially disadvantaged. This includes low-income riders, those who do not have access to an automobile, people with physical or mental disabilities, older adults, and minorities. Data were collected through the survey of transit users.

Option value: The option value could potentially be estimated by determining non-users' willingness to pay for the provisions of transit services. However, this would require a community-wide survey of non-users. Instead, this study, through the user survey, estimates the number of riders who are not regular transit users, showing the extent to which the service is valued not just by regular users but also those who usually have other options.

4.4.1.2 Efficiency Benefits

Efficiency benefits apply to those transit users who would make their trips some other way. These benefits are measured as the differences in costs from traveling by transit rather than another mode, whether it be driving an automobile, getting a ride from someone, or walking or biking. Estimating these benefits requires knowing how transit users would behave in the absence of transit. For example, to estimate the vehicle cost savings requires knowing if the transit user had access to a vehicle and the ability to drive. This information was collected through the survey of transit users, and an estimate was made of the percentage of transit riders who would drive themselves, get a ride from someone, take a taxi or ridesharing service, walk or bike, or forgo the trip.

To compare transit fare costs to costs by other modes, an average transit trip distance needs to be estimated. This could be estimated for a specific agency based on expertise from the transit agency or survey input from riders. Without local data, trip distance data from the National Household Travel Survey for rural or small urban areas could be used. A summary of the efficiency benefits is shown in Table 4.2.

Table 4.2 Summary of Efficiency Benefits and Measurement Approaches

Category	Description	How to Measure	Measurement Type
Vehicle Operating Cost Savings	Savings from riding transit instead of driving.	Cost of automobile travel minus the cost of transit fares for trips diverted from driving to transit.	Monetary
Chauffeuring Cost Savings	Savings from riding transit instead of getting a ride.	Cost of chauffeured trips, including automobile costs and value of time for the driver, minus the costs of transit fares for trips diverted to transit.	Monetary
Travel Time Benefits	The value of the travel time difference between transit and an alternative mode.	Difference in travel time between transit and alternative modes, for trips diverted to transit, multiplied by the value of time.	Monetary
Safety Benefits	The value of the safety difference between transit and an alternative mode.	Difference in number of crashes between transit and alternative modes, for trips diverted to transit, multiplied by the cost of crashes.	Monetary
Environmental Benefits	Environmental cost savings from riding transit instead of an alternative mode.	Environmental cost of automobile travel, for trips diverted to transit, minus the environmental cost of transit, including costs of air pollution and GHG emissions.	Monetary
Reduced Congestion	Reduction in automobile trips.	Number of trips diverted from the automobile to transit.	Quantitative but not monetary
Health Benefits	Increased physical activity from riding transit.	Change in walking and biking activity for those who use transit.	Quantitative but not monetary

Vehicle operating cost savings: By taking transit instead of driving an automobile, users save money on gasoline and other mileage-related costs, such as depreciation and maintenance. Some transit users may be able to forgo vehicle ownership, or they may be able to reduce the number of vehicles owned within the household, which would provide greater cost savings. MnDOT's recommended per-mile cost for automobile travel is $0.26 for FY 2019. This includes the variable costs associated with operating a vehicle, including fuel, maintenance, tires, repair, and depreciation. It does not include any fixed costs of automobile ownership.

Transit users could save more if they are able to reduce vehicle ownership. Other studies of transit benefits have used higher automobile costs, likely because they included the cost of vehicle ownership. AAA (2018) estimated in 2018 that total per-mile vehicle costs, including operating and ownership costs, averaged $0.59 if one drove 15,000 miles per year and $0.75 if one drove 10,000 miles per year. However, it is likely that many transit users in Greater Minnesota who are capable of driving a vehicle will continue to own one even if they use transit. Survey data of transit users could provide a more accurate estimate of the extent to which transit users in Greater Minnesota are able to forgo automobile ownership. Therefore, the $0.26 estimate could be adjusted based on local information regarding the percentage of transit riders who are able to forgo vehicle ownership. Vehicle cost savings were estimated as follows:

Vehicle cost savings = $t_a \times d_a \times \$0.26 - t_a \times p_t$

Where t_a = number of trips shifted from automobile to transit

d_a = average trip distance by automobile

p_t = price of transit fare

Chauffeuring cost savings: While some will drive themselves in the absence of transit, many cannot drive or do not have access to an automobile and will get a ride from someone else, such as a family member or friend. Chauffeuring trips are additional automobile trips made specifically for a passenger. These chauffeuring trips can be expensive, inefficient, and burdensome for the driver. Such trips often include an empty return trip, doubling the actual miles traveled. Chauffeuring costs include vehicle costs plus the value of time for the driver. MnDOT recommends a value of time for automobile travel of $18.90 per hour. Based on MnDOT recommended values, the cost of a chauffeured trip can be estimated as $1.52 per passenger mile. The analysis assumed an average 5-mile trip, which has a travel time of 20 minutes, including waiting time and empty backhauls. The analysis derived the driver travel time savings as $1.26 per passenger mile and vehicle cost of $0.26 per passenger mile. Chauffeuring costs savings were estimated as follows:

Chauffeuring cost savings = $t_p \times d_p \times \$1.52 - t_p \times p_t$

Where t_p is number of trips made as a passenger (excluding any trips made as a passenger in a taxi or TNC where a fare is paid) in the absence of transit, d_p is the average trip distance, and the other variable is previously defined.

Travel time benefits: In addition to out-of-pocket costs, there are additional costs associated with travel, such as the amount of time devoted to travel. Because travel times differ between transit and other modes, these differences need to be taken into consideration when valuing the benefits of transit. Travel time is likely to be greater for those traveling by transit instead of automobile, but it would be shorter for those who otherwise would walk or ride bike. The previous estimate of chauffeuring costs included the value of time for the driver but not the passenger.

Travel times were estimated based on average trip distances and speed by mode. Travel time was multiplied by a dollar value that represents the value of time. MnDOT recommended a value of travel time savings per person-hour of $18.90 for automobile travel and $17.60 for transit.

Value of time may be lower for using transit because transit could be less stressful and it allows riders to use their time spent traveling doing other things, although transit value of time carries a fairly small discount relative to auto in MnDOT's default values. Travel time cost savings were estimated as follows:

Travel time cost savings = $\sum_i t_i \times \frac{d_i}{s_i} \times VOT_i - t_t \times \frac{d_t}{s_t} \times VOT_t$

Where t_i = trips diverted from mode i to transit

d_i = average trip distance for mode i

s_i = average speed for mode i

VOT_i = value of time for mode i

t_t = total number of trips diverted from other modes to transit

d_t = average trip distance for transit

s_t = average speed for transit

VOT_t = value of time for transit

The number of trips diverted from other modes to transit were estimated based on transit user survey data. Average trip distance and speed for each mode were estimated, and these estimates vary among different transit systems. Average transit speed was determined by dividing vehicle miles by vehicle hours, as reported by the NTD. Automobile speed was assumed to be 1.5 times faster than transit. Biking and walking speeds were estimated to be 8 mph and 2 mph, respectively. Average trip distance was estimated separately for individual transit systems.

Safety benefits: Transit is a relatively safe mode of travel. The fatality rate for transit users is very low when compared with that of car occupants (one-tenth of the rate for car occupants) (Litman 2018). Measuring the value of transit requires an estimate of the value it provides by reducing crash costs. Crashes were categorized as property damage only (PDO), injury, and fatal. Injury crashes were further categorized as suspected serious, suspected minor, and possible injury.

To analyze safety benefits of transit, 10 years of safety data for Minnesota transit agencies were collected for 2008-2017 from the NTD. Data for the Twin Cites metro area were excluded. The NTD reports data for total incidents, injuries, and fatalities. During this period there were 124 reported incidents, 81 injuries, and 6 fatalities. These data were divided by the total number of vehicle revenue miles for these transit agencies over the 10-year period to convert them to a per-vehicle-mile basis.

These data were then converted to a per-passenger-mile basis, based on an assumed average trip distance per person or average vehicle load.

Transit safety data were compared with the overall crash data from the National Highway Transit Safety Administration (NHTSA) for Minnesota for 2012-2017. These data include total fatalities, injuries, and property-damage-only (PDO) crashes, which were converted to a per-mile basis. Injuries were categorized as severe/serious, moderate/minor, and minor/possible. The NTD does not categorize injuries by severity, so it was assumed that the distribution of injuries between categories was the same for transit. Further, all incidents listed in the NTD not categorized as injuries or fatalities were treated as PDO crashes.

Costs of crashes were based on MnDOT's crash values of $11,100,000 per fatal crash, $600,000 per suspected serious injury crash, $180,000 per suspected minor injury crash, $87,000 per possible injury crash, and $7,200 per PDO crash. These crash values include the value of a statistical life.

The safety benefits of transit were measured by comparing the number and severity of crashes caused by transit with those caused by automobiles. Safety cost savings were estimated as follows:

Safety cost savings = $\sum_i (c_{ai} - c_{ti}) \times v_i \times m_s - \sum_i c_{ti} \times v_i \times m_n$

Where c_{ai} = crashes per vehicle mile for automobiles of crash type i

c_{ti} = crashes per vehicle mile for transit of crash type i

v_i = value of crash type i

m_s = vehicle miles shifted from automobile to transit

m_n = induced transit vehicle miles

The model accounts for trips shifted from automobile to transit, but also includes the effect of induced travel. In other words, some of the transit trips are trips diverted from automobile travel, but some are new trips that would not have been made, which results in increased crash risk.

Environmental benefits: Environmental costs of transportation include air pollution and greenhouse gas (GHG) emissions. Public transit reduces environmental emissions when enough passengers use the service. This effect is more pronounced in larger communities where there is a large demand for transit.

MnDOT recommends an emissions cost of $0.06 per mile for automobiles and $0.22 per mile for trucks. This applies to average on-road vehicle emission rates for Minnesota derived from the EPA's 2014 National Emissions Inventory to account for the social cost of carbon and health damage from the criteria pollutants of volatile organic compounds (ozone precursor), nitrogen oxides, particulate matter (PM 2.5), and sulfur dioxide. These costs are similar to those recommended by Litman (2016) for urban off-peak travel (Table 4.3). Costs are higher for a diesel bus on a per-vehicle-mile basis, but they could be lower on a per-passenger-mile basis depending on the number of passengers on board the bus.

Table 4.3 Estimated Air Pollution Costs per Mile (Litman 2016)

	Urban Off-Peak	Rural
	----------$ per vehicle mile----------	
Non-GHG Air Pollution Costs		
Average Car	0.052	0.004
Diesel Bus	0.160	0.013
GHG Costs		
Average Car	0.017	0.015
Diesel Bus	0.086	0.077
Total GHG and Non-GHG Air Pollution Costs		
Average Car	0.069	0.019
Diesel Bus	0.246	0.090

The MnDOT costs were used for the analysis, with the truck cost used as a proxy for the bus cost. However, there is much uncertainty regarding these rates, and other studies have cited lower costs (Parry et al. 2007). Differences in assumptions regarding fuel economy and the per-ton marginal social costs of CO_2 emissions yield different results. Further, as shown in Table 4.2, air pollution costs vary depending on the environment in which vehicles operate, with lower costs in rural areas. GHG costs are the same regardless of location, but air pollution costs are lower in rural areas because of lower traffic densities and because fewer people are exposed to the pollution. Therefore, while the MnDOT values were used as default values, sensitivity analysis was conducted using different values to show how estimated costs change with changes in assumptions. Environmental cost savings were estimated as follows:

Environmental cost savings = $t_a \times d_a \times \$0.06 - VMT_t \times \$0.22$

where VMT_t = vehicle miles traveled by transit, and all other variables were previously defined.

Reduced congestion: Based on the survey results and the literature review, reduced congestion is not likely to be a significant benefit of transit in Greater Minnesota, though there could be some benefit in the urban areas. Since the focus of this study is largely on rural transit, congestion was not studied in much depth. The impact on congestion was quantified simply by estimating the number of trips shifted from personal automobile to transit.

Physical activity benefits: Fixed-route transit users may experience increased physical activity because of the need to walk or bike to and from transit stops. On the other hand, if transit replaces walking or biking, there would be a decrease. Estimating the physical activity benefits requires information on changes in walking or biking activity as a result of using transit. However, questions about walking or biking to and from transit stops and about increased physical activity were dropped from the rider survey due to concerns about the length and complexity of the survey. Therefore, this study did not estimate this benefit.

4.4.2 Economic Impacts

Economic impacts were estimating using an input-output model, which is a quantitative economic model that traces the path of spending throughout the local economy. The method uses multipliers to capture this path of effects. Economic impacts were not added to the societal benefits but were reported separately.

Impacts from transit spending: TREDTransit was used to estimate economic impacts from transit spending. The TREDTransit calculator, which was developed by EDR Group in conjunction with the American Public Transportation Association (APTA), calculates economic impacts of an agency's capital and operating budget. The analysis estimated total jobs supported, labor income, value-added, and output. Value-added includes labor income, taxes, and other income or profit. Output is the total change in local sales.

The TREDTransit calculator uses regional economic data obtained from IMPLAN for the specific impact area. IMPLAN is a modeling system that can track the impacts of expenditures through the local economy. The calculator accounts for the type of spending done by transit agencies and the proportion of the agency's demand that can be met locally.

TREDTransit is an online software tool produced by TREDIS. It can be accessed from the TREDIS website (TREDIS n.d.). APTA also provides access to the tool from their website, referring to it as the "Economic Impact Tool" (American Public Transportation Association n.d.). The tool is free to use for all APTA members, and it is available to non-members as an annual subscription service. For more details, APTA provides a guidebook on how to use the tool and interpret the results (Petraglia et al., n.d.).

Impacts from improved access to shopping: To estimate impacts for local businesses from increased access, the rider survey collected information about the number of transit trips that support local businesses, such as for shopping and restaurants, that otherwise would not have been made had transit not been available. Estimates were made for the average amount of spending made on these trips, based on survey responses, to estimate total new spending in the community; and economic multipliers were used estimate the overall impacts of this increased spending in terms of output, earnings, and jobs created. The result of this analysis was considered economic impacts rather than net benefits, because while the increased spending is a benefit to local businesses, it is a cost to consumers.

Estimating the amount of additional money spent in the community as a result of transit presents some challenges. First, we need to know if the shopping trip would have been made some other way. This includes the possibility of local businesses providing delivery services. If the trip would not have been made and delivery services were not an option, we need to determine if the spending represents new spending that otherwise would not have been made or if the spending is simply diverted from another trip. In other words, will someone actually spend more overall in the community because of transit or are they spending the same amount but spreading the spending over a greater number of trips, thereby spending less per trip? Another consideration is if the transit agency provides trips to a larger city with

more shopping options, is it promoting increased shopping in the other city, thereby reducing spending with local businesses?

The study did not attempt to estimate a total increase in local shopping or spending resulting from transit service. Rather, it focused specifically on local shopping trips that would have been replaced with online shopping if transit were not available. Any shopping trips made in place of online shopping with non-local businesses, such as Amazon, clearly represent gains to the local economy. The survey collected information about the number of riders who would spend more money online if transit were not available.

Spending by transit users in the community has a multiplier effect. It supports local jobs, which supports additional economic activity as those employees also spend money in the local economy. To capture these effects, RIMS II multipliers were obtained. RIMS II multipliers, produced by the Bureau of Economic Analysis, are estimates of regional input-output multipliers for any state, county, or combination of states or counties. The multipliers estimate the impact from changes in final demand for one or more regional industries in terms of output, employment, and labor earnings. Type II multipliers account for not only the direct and indirect effects but also induced economic activity.

Multipliers are defined as follows:

- Output: Total industry output per $1 change in final demand
- Earnings: Total earnings per $1 change in final demand
- Employment: Total jobs per $1 million change in final demand
- Value added: Total value added per $1 change in final demand

Multipliers for general merchandise stores were chosen because this likely represents much of the shopping done by transit riders. In RIMS II, output for retail trade is measured by sales receipts less the cost of goods sold. Therefore, to analyze the impact of an increase in retail sales requires multiplying retail sales by the retail margin. This is necessary if we assume that the goods purchased were not actually produced in the local economy. For this analysis, a retail margin of 30% was assumed.

Impacts from increased population in community: Similarly, the economic impacts of keeping people living in the community were estimated using RIMS II multipliers. First, the survey collected information about the percentage of riders that would need to relocate to a different community in the absence of transit. The economic impact of keeping those individuals in the community was estimated using the RIMS II household multipliers. Average income for those leaving the community was estimated based on the income distribution of transit riders, according to survey responses. Average income multiplied by the total number of individuals moving represents total income that would be lost to the community. Total income was multiplied by the household multipliers to estimate the economic impacts from keeping these people in the community.

4.4.3 Other Benefits

The benefits analyzed in this study are those most relevant to Greater Minnesota, as identified from the survey and the review of literature related to rural transit. Other benefits, such as parking cost savings or reduced need for parking, and land use impacts can be substantial for urban areas but not relevant or less important for Greater Minnesota. However, in some urban areas of Greater Minnesota, such as Duluth, Rochester, and St. Cloud, these impacts might be important. Since the focus of this study is largely on rural transit, these benefits were not studied.

4.5 SIMULATION MODEL

All societal benefits measured in monetary terms were added to obtain the total monetary benefits of transit, and those total monetary benefits were compared with costs to obtain a benefit-cost ratio. However, there is a degree of uncertainty with these results. The calculations in this study required a number of assumptions and parameters that involve a degree of uncertainty. For example, there was a margin of error for the survey responses, trip distances and speed were not known with certainty, the percentage of walking trips would likely be lower in the winter, costs of forgone health care trips would vary depending on the characteristics of the population, responses to how riders would make the trip without transit may represent short-term behavioral change but not long-term changes, different cost parameters could be considered, and the replacement of local shopping with online shopping is not known with certainty. Therefore, this analysis was re-run, allowing these parameters to vary within a given range. The results show the expected range that the estimated benefits will fall within.

The analysis was conducted using @Risk, an add-in to Microsoft Excel that estimates all possible outcomes to a situation and the likeliness of their occurrence using Monte Carlo simulation. Simulations were conducted by assigning distributions to the input variables. Rather than taking the input variables as given, they were allowed to vary based on a given distribution. Simulations were conducted to estimate the range and distribution of expected total benefits. The 90% confidence interval shows the range in which 90% of the simulated estimates for total benefits occur.

CHAPTER 5: CASE STUDIES

Using the methods detailed in Chapter 4, case studies were conducted to estimate benefits for individual transit systems in the state. This task involved the selection of case studies, the collection of data through rider surveys and other means, and the estimation of transit benefits. Those benefits were then compared with the costs of providing service to calculate a benefit-cost ratio.

5.1 PEER GROUPS AND CASE STUDY SELECTION

Because case study results may differ based on the characteristics of the transit system, it is beneficial to conduct case studies among agencies with different characteristics. These characteristics include the level of service provided, the size and population of the service area, types of services and trips provided, and demographic characteristics of the transit users and the service area. To ensure that different types of transit agencies were represented in the case study analysis, transit systems were grouped based on these characteristics, and one case study was chosen from each group. The role of peer groups in this study was to facilitate the selection of case studies and allow for easier extrapolation of results from case study agencies to other transit agencies.

Most simply, transit agencies in Greater Minnesota could be grouped as follows:

- Urbanized (serving a metro area with population of 50,000 or more and receiving section 5307 FTA funds)
- Community (serving a single city with population of 2,500 to 49,999)
- Rural single-county (rural agency serving a single county)
- Rural multi-county (rural agency serving multiple counties)

The urbanized systems provide fixed-route services and ADA paratransit. The community and rural agencies provide demand-response and/or deviated fixed-route service and are differentiated by the size of their service areas (city, county, or multi-county region). Penet (2011) used a similar grouping of transit agencies in South Dakota and estimated total benefits within each group.

If this grouping were used, the multi-county group would have a large number of transit agencies, and some small multi-county agencies may be more similar to the single-county systems than to the large multi-county agencies. This grouping also does not account for differences in other service area characteristics, operating characteristics, or rider characteristics. Therefore, a method was developed, using cluster analysis, to group the rural single-county and multi-county systems.

Peer groups provide two purposes. The first is to ensure that different types of systems are represented in the case studies. Selecting one case study from each group ensures some diversity. The second purpose is to allow for other transit agencies in the state to identify case study results most relevant to their own system. Other agencies in the state could estimate the benefits of their system based on data and estimates for similar agencies where case studies were conducted. The peer groups were not intended for any other purpose.

5.1.1 Cluster Analysis

A cluster analysis was conducted of all rural single-county and multi-county agencies to group them. Since the urbanized systems, the community systems serving a single city, and the tribal transit agencies are significantly different from other transit agencies, these were grouped into three separate categories, and the remaining rural agencies were grouped using hierarchical cluster analysis with SAS software.

This form of cluster analysis begins with each entity, in our case an individual transit agency, as a cluster. During each iteration of the process, the two most-like clusters, as determined by a distance measure, are combined. The distance measure is a measure of similarity between each pair of observations. The components of the new cluster are recorded. The process continues until all entities have been joined into a single cluster. The final number of clusters to be used is determined by employing any of a number of subjective techniques.

This analysis was based on operational variables, service area characteristics, trip types, and rider demographics. The operation variables included vehicle revenue miles, vehicle revenue hours, fleet size, and orientation toward fixed-route service (percentage of trips that were fixed-route). The two service area characteristics were the size of service area in square miles and population density of the service area. Percentage of trips for school was the one measure of trip type, and the three demographic measures were percentages of riders under age 18, aged 18 to 24, or a minority. Other variables were considered, such as other trip purposes or other demographics (e.g., work trips, older adults, low-income), but were not included because there was not as much variation in these variables between agencies. All variables were standardized with a mean of 0 and standard deviation of 1 so they would be weighted equally.

The operational data were from 2017, as reported in the National Transit Database. Service areas were based on the most recently available data, with population data from the 2017 ACS five-year estimates. For rural agencies serving an area that included a city served by an urbanized or community system, the population of that city was not included. For example, the populations of Duluth and Hibbing were not included in the service area population of Arrowhead Transit, since those cities have their own systems. Trip purpose and rider demographic data were obtained from rider surveys conducted of Greater Minnesota transit agencies in 2015 for the Greater Minnesota Transit Investment Plan.

Results of the cluster analysis are shown in Figure 5.1. The analysis separated Arrowhead Transit into a cluster by itself because it is significantly different from all other agencies. It is substantially larger than all other systems in terms of both operational characteristics (fleet size, vehicle miles, vehicle hours) and the size of the service area. It also serves a very low population density area. Chisago-Isanti County Heartland Express and Trailblazer Transit were grouped together because they serve higher density areas (close to the Minneapolis-St. Paul metro area) and a higher percentage of school trips and younger riders.

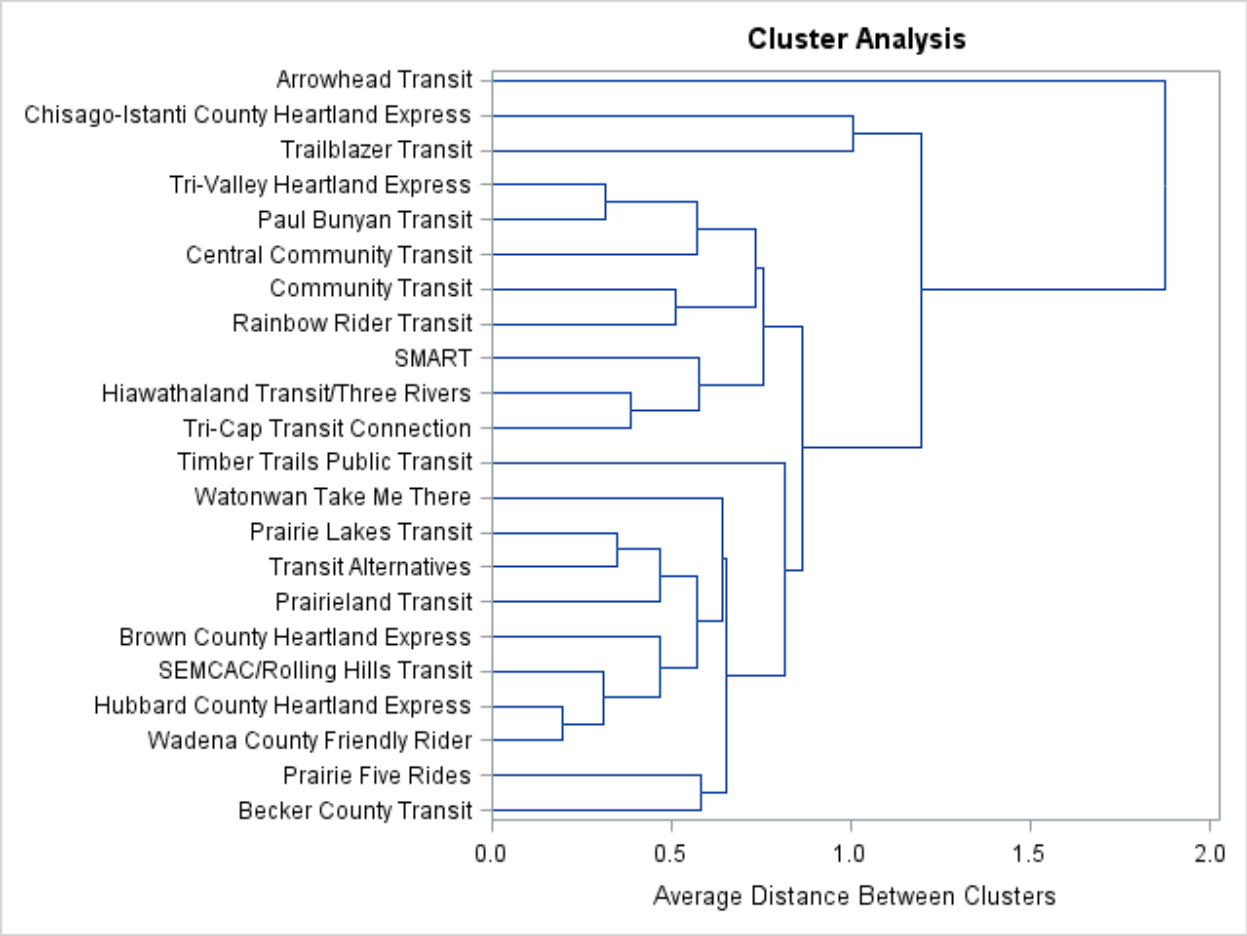

Figure 5.1 Results of Cluster Analysis of Rural Single and Multi-County Transit Agencies in Greater Minnesota

5.1.2 Description of Peer Groups and Selected Case Studies

After discussing the results of the cluster analysis with MnDOT, a few edits were made to the classifications, and seven groups were established. Tri-Valley Heartland Express and Paul Bunyan Transit were combined with Arrowhead Transit since these systems are large regional operations that cover very rural, low-density areas across the northern part of the state. The groupings are shown in Table 5.1. The peer groups include seven urbanized systems, seven community transit systems that serve individual communities, six tribal transit systems, and 22 rural systems divided into four groups: large and very rural, multi-county near the metro area, regional transit systems, and small systems.

Table 5.1 Grouping of Greater Minnesota Transit Agencies

Peer Group	Transit Agencies
Urbanized	East Grand Forks Transit
	Moorhead Metro Area Transit
	Mankato-Greater Mankato Transit
	La Crescent Apple Express
	Rochester Public Transit
	St. Cloud Metro Bus
	Duluth Transit Authority
Community Transit	Fosston Transit
	Granite Falls Heartland Express
	Morris Transit
	Winona Transit Service
	Hibbing Area Transit
	Brainerd & Crow Wing Public Transit
	Minnesota River Valley Transit – City of Le Sueur and City of St. Peter
Large and Very Rural	Arrowhead Transit
	Tri-Valley Heartland Express
	Paul Bunyan Transit
Multi-County, Near Metro Area	Chisago-Isanti Heartland Express
	Trailblazer Transit
Regional Transit Systems	Central Community Transit
	Community Transit
	Rainbow Rider Transit
	SMART
	Hiawatha Transit/Three Rivers
	Tri-Cap Transit Connection
Smaller Systems	Timber Trails Public Transit (Kanabec County)
	Watonwan Transit
	Prairie Lakes Transit
	Transit Alternatives
	Prairieland Transit (Nobles County)
	Brown County Heartland Express
	SEMCAC/Rolling Hills Transit
	Hubbard County Heartland Express
	Wadena County Friendly Rider
	Prairie Five Rides
	Becker County Transit
Tribal	Red Lake Transit
	White Earth Nation Transit
	Fond Du Lac Band Transit
	Grand Portage
	Bois Forte
	Leech Lake

With the exception of the tribal transit systems, one case study was chosen from each group. The six case studies are Paul Bunyan Transit, Trailblazer Transit, SMART, Timber Trails, St. Peter Transit, and St. Cloud Metro Bus. Figure 5.2 maps the six peer groups (excluding tribal transit), and Figure 5.3 shows the locations of the selected case studies.

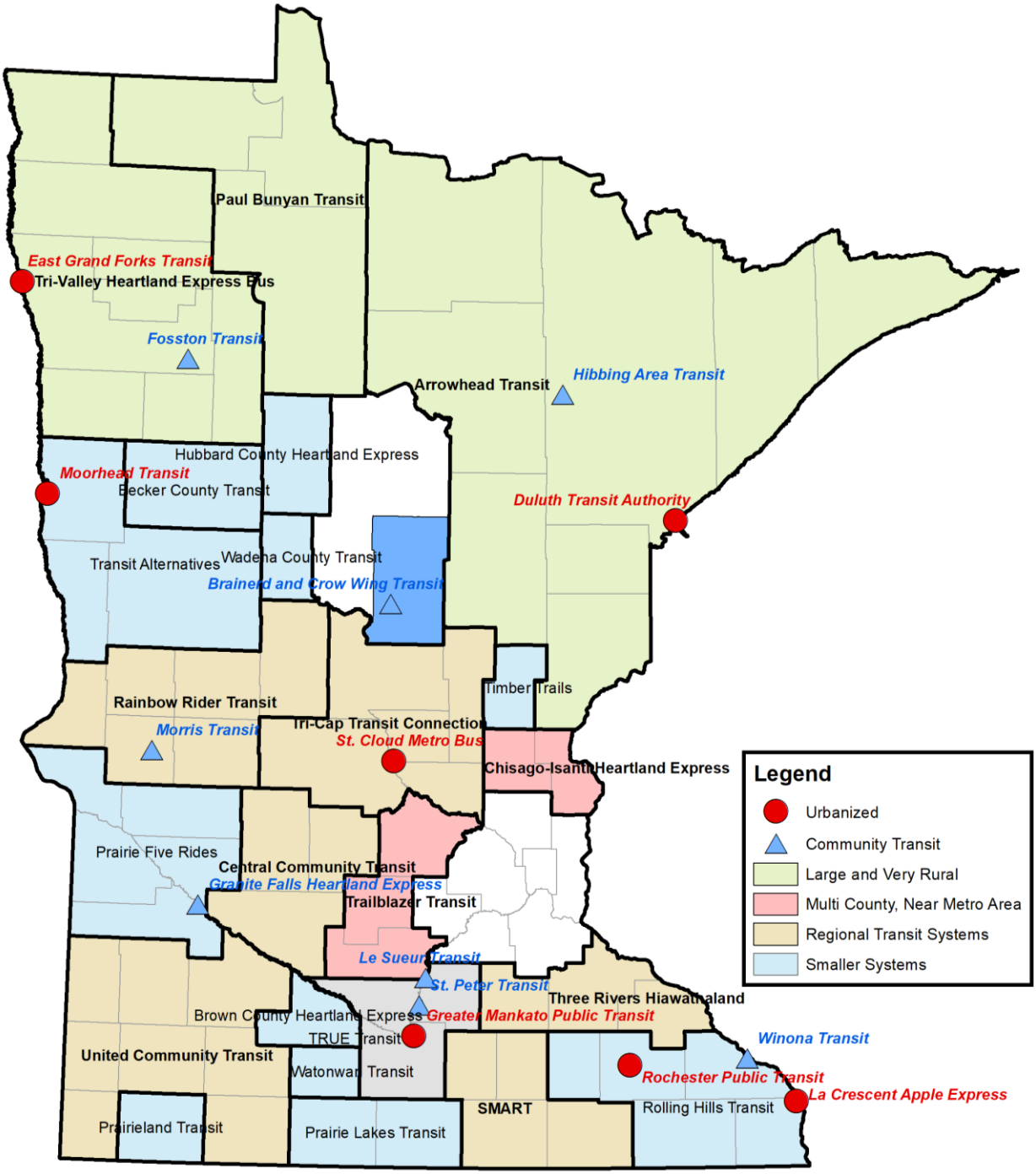

Figure 5.2 Greater Minnesota Transit Agencies and Peer Groups

Note: TRUE Transit, shaded in gray, was not classified because of a lack of data. It could potentially fit with either the regional transit systems or the smaller systems.

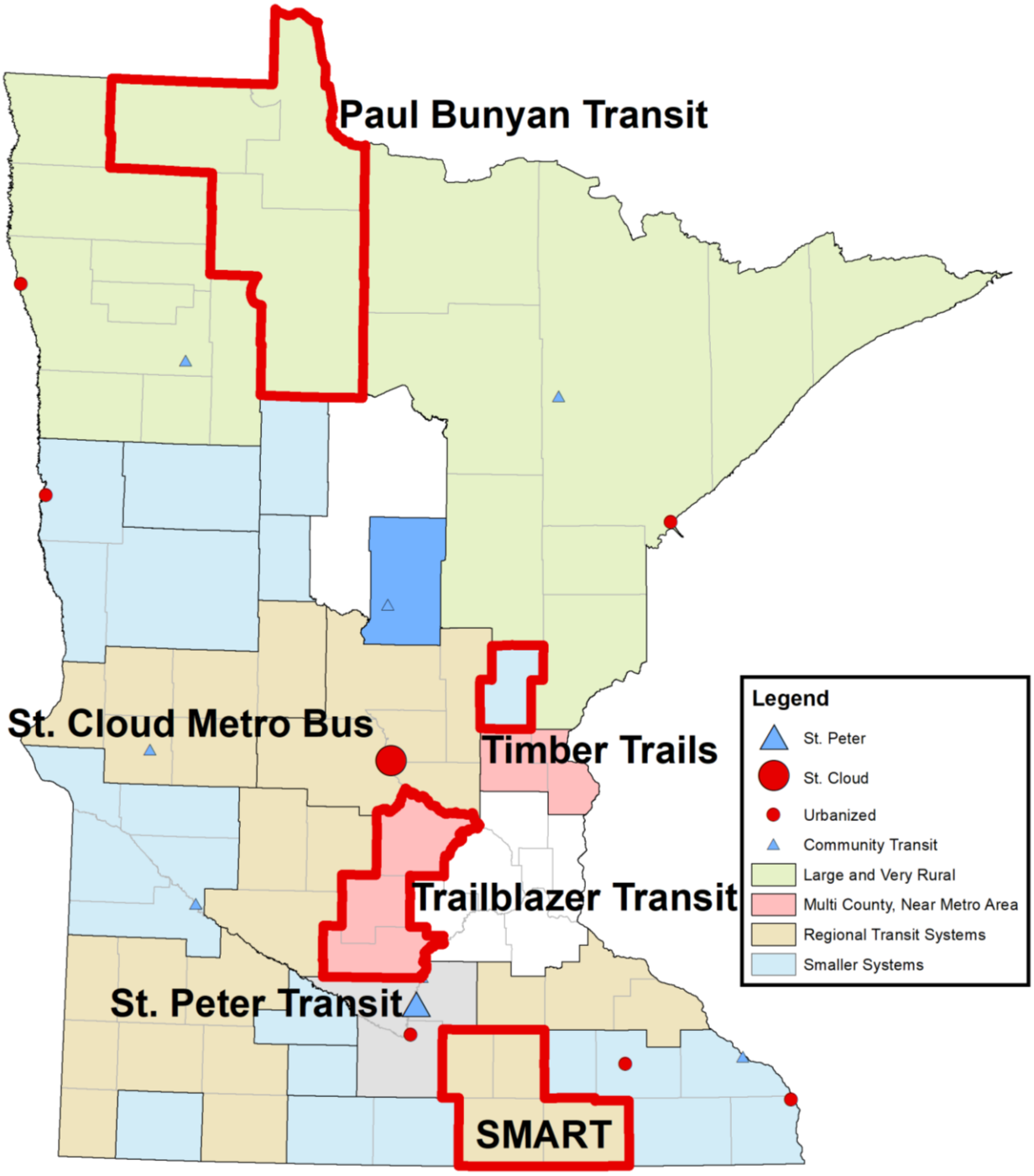

Figure 5.3 Selected Case Studies

Table 5.2 shows the characteristics of the average agency within each group. While the table shows how the six groups differ, on average, there still are significant variations within each group. Appendix B provides more detailed data for each group, showing not just averages but also the standard deviation and range for each characteristic. Data for the selected case studies are also shown in Appendix B for comparison purposes.

Large and Very Rural: The large and very rural group includes three large systems that cover the northern third of Minnesota. These systems are similar in that they serve large, very rural areas with low population densities. On average, they provide the most trips and the most vehicle hours and miles of service, while maintaining the largest fleet size, of all rural agencies. Paul Bunyan Transit is chosen as the case study from this group. While it is the smallest of the three agencies in this group, it is still one of the largest systems in the state in terms of service area. Its trip purpose and rider demographics data are similar to the other systems in its group.

Multi-County Near Metro Area: The multi-county, near metro area group consists of two agencies that are not as large as some of the other multi-county systems in terms of service area but serve a more densely populated area near the Twin Cities metro. They are also characterized by serving a higher percentage of youth riders and a lower percentage of minority riders. Trailblazer transit is selected as the case study from this group. It is the larger of the two systems in this group in terms of service area and operating statistics, and it ranks among the largest rural systems in the state with regard to trips provided and vehicle miles of service.

Regional Transit Systems: The regional transit systems are multi-county systems that have fairly large service areas and operations. Compared to the large and very rural systems, they have smaller service areas but higher population densities, serving, on average, similar population sizes. SMART is chosen as the case study from this group. It is a four-county system in southern Minnesota that serves a large percentage of low-income riders.

Smaller Systems: The smaller systems include single-county systems as well as some multi-county systems. Some of the multi-county systems in this group, such as Prairie Five Rides, Rolling Hills Transit, and Transit Alternatives, could easily fit in the group of regional transit systems based on the size of service area, but they have other characteristics that also make them similar to the smaller systems, such as smaller populations or similar rider demographics or operating statistics. Among the county and multi-county groups, this group is smallest, on average, in terms of service area, population, trips provided, vehicle miles and hours, and fleet size. It also serves a high percentage of low-income and elderly riders, and a lower percentage of minority riders and school trips. The selected case study from this group is Timber Trails from Kanabec County. This is one of the smaller systems in the state in terms of both service area and population served.

Community Transit: The community transit systems serve individual communities in non-metropolitan areas. They, therefore, serve smaller areas with more concentrated demand. These systems, on average, are the smallest in the state in terms of population served, vehicle miles and hours of service, and fleet size. Average fleet size is just four vehicles, ranging from one to nine. On average, they provide a similar

number of trips as the smaller systems. There is significant variation, however, in the operating statistics between the smaller-town agencies, such as those in Fosston and Granite Falls, to a much larger system in Winona, which is somewhat of an outlier for this group. The selected case study is St. Peter, which is among the medium-sized agencies in this group and has typical trip purpose and rider demographics, serving a higher percentage of low-income users.

Urbanized Systems: The last group is the urbanized systems, serving individual cities in the metro areas of Greater Minnesota. These systems provide a significantly greater number of rides while operating mostly fixed-route service, with complementary paratransit, in more densely populated urban areas. St. Cloud Metro Bus is chosen as the case study for this group. It is fairly typical among the urbanized systems.

Table 5.2 Average Transit Agency Data for Each Peer Group

	Large and Very Rural	Multi-County, Near Metro	Regional Transit Systems	Small Systems	Community Transit	Urbanized
Service area characteristics						
Area (square miles)	11,158	1,296	3,230	1,521	32	34
Population	130,561	137,358	133,080	37,794	11,288	81,645
Population density (per square mile)	11	107	46	27	949	2,560
Trip purpose						
Work trips	38%	36%	40%	30%	29%	31%
School trips	8%	17%	16%	5%	15%	24%
Shopping trip	25%	22%	23%	32%	27%	19%
Rider demographics						
Under 18	2%	14%	5%	4%	10%	4%
Aged 18 to 24	10%	13%	8%	5%	9%	28%
Aged 65 or older	16%	19%	28%	38%	23%	10%
Minority	21%	9%	16%	7%	15%	22%
Low income	63%	65%	74%	78%	67%	70%
Operational characteristics						
Unlinked passenger trips	309,159	159,406	200,186	67,001	65,366	1,297,954
Vehicle revenue miles	1,193,530	815,138	629,829	256,895	95,867	1,137,008
Vehicle revenue hours	63,808	35,105	45,642	18,408	8,091	84,766
Number of vehicles	53	22	34	13	4	34
Trips fixed route (%)	41%	38%	37%	20%	28%	95%
Number of agencies	3	2	6	11	8	7

Notes:

- Operational data are from the 2017 National Transit Database, and trip purpose and rider demographics data are from rider surveys conducted of Greater Minnesota transit agencies in 2015 for the Greater Minnesota Transit Investment Plan.
- Population data for county and multi-county systems do not include the population of cities that have their own transit agencies. (For example, the service area population for Arrowhead Transit does not include the population of Duluth or Hibbing.)
- Brainerd is included among the community transit systems, even though it provides some service within Crow Wing County.
- For urbanized systems, NTD data were not reported separately for East Grand Forks and La Crescent. Therefore, the service area and operations characteristics for East Grand Forks includes the combined Grand Forks/East Grand Forks system, and the data for La Crescent includes the combined La Crosse/La Crescent system. Moorhead data, on the other hand, are reported separately.

5.2 BACKGROUND INFORMATION ABOUT CASE STUDY AGENCIES

Characteristics of the service areas for the six transit agencies selected for case studies are shown in Table 5.3.

Table 5.3 Characteristics of Transit Agencies Selected for Case Studies

	Paul Bunyan Transit	Trailblazer Transit	SMART	Timber Trails	St. Peter Transit	St. Cloud Metro Bus
Area Served	Beltrami, Lake of the Woods, and Roseau Counties	Wright, McLeod, and Sibley Counties	Freeborn, Mower, Steele, and Waseca Counties	Kanabec County	City of Saint Peter	St. Cloud metro area
Service Area Characteristics						
Square miles	5,474	1,742	2,271	522	6	29
Population	65,225	181,834	125,515	15,948	11,682	103,018
Minority (%)	21%	5%	8%	4%	9%	10%
Poverty (%)	16%	6%	11%	12%	21%	13%
Aged 65 or older (%)	15%	13%	18%	19%	14%	14%
Disability (%)	12%	9%	12%	18%	14%	11%
Operational Characteristics						
Unlinked passenger trips	119,500	250,596	241,444	52,493	29,284	1,890,755
Vehicle revenue miles	356,389	1,209,211	596,057	201,374	45,747	1,873,581
Vehicle revenue hours	26,857	48,665	54,392	12,578	3,626	142,525
Trips per revenue-hour	4.45	5.15	4.44	4.17	8.08	13.27
Number of vehicles	33	33	27	7	3	53

5.2.1 Paul Bunyan Transit

Paul Bunyan Transit provides services to residents within Beltrami, Lake of the Woods, and Roseau Counties in northern Minnesota. The three rural counties combine for a population of 65,225 within an area of 5,474 square miles. The largest city in this area is Bemidji, with a 2018 estimated population of 15,404. Other cities include Roseau (2,660), Warroad (1,796), and Baudette (1,003).

Paul Bunyan Transit provides demand-response, or curb-to-curb dial-a-ride, service. Service is provided within areas near Bemidji, Roseau, Warroad, and Baudette, as well as other intercity services. The Bemidji service extends within a 10-mile radius of downtown, while the Roseau and Warroad services

extend within a 4-mile radius of the center of each community, and the Baudette service extends to neighboring towns of Clementson, Pitt, Graceton, and Williams. Service is provided six days a week in Bemidji, with 7:00 am to 6:00 pm service Monday-Friday and 8:00 am to 5:00 pm service on Saturday. All other services operate five days a week, Monday-Friday. Service times are 6:30 am to 5:00 pm for the Roseau service, 6:30 am to 4:30 pm for the Warroad service, and 7:30 am to 5:15 pm for the Baudette service.

Inter-community services are also provided between Warroad and Roseau and from other outlying communities into Roseau or Warroad. Rides are also provided from a number of small communities into Bemidji twice a month. Paul Bunyan Transit also provides service to a Jefferson Lines bus stop in Bemidji, providing connections to a multi-state intercity bus service.

The city of Bemidji has two colleges, Bemidji State University and Northwest Technical College.

5.2.2 Trailblazer Transit

Trailblazer Transit serves the counties of Wright, McLeod, and Sibley, as well as some neighboring communities. These three counties, which have a population of 181,834 within 1,742 square miles, is adjacent to the seven-county Twin Cities metro area to the west. Trailblazer Transit serves a total of 32 cities plus all of the rural areas within these counties. Compared with the service area of Paul Bunyan Transit and other rural areas of the state, this is a more populated area with a greater number of cities. Wright County, in particular, has a few cities that may be considered exurbs of the Twin Cities metro. The larger cities in the service area include St. Michael (17,892), Otsego (17,357), Buffalo (16,315), Monticello (13,747), and Albertville (7,044) in Wright County and Hutchinson (13,979) in McLeod County. Sibley is a more rural county, with the largest city being Gaylord (2,244).

The agency provides demand-response and contract service. Buses operate Monday-Friday from 6:30 am to 5:30 pm. The agency requests that rides are scheduled at least 24 hours in advance, although same-day requests can be accommodated.

5.2.3 Southern Minnesota Area Rural Transit (SMART)

SMART provides demand-response and deviated route service in Freeborn, Mower, Steele, and Waseca Counties in Southern Minnesota. These four counties have a population of 125,515 over 2,271 square miles. A majority of the residents in these counties live in the four largest cities: Owatonna (25,766), Austin (25,190), Albert Lea (17,647), and Waseca (8,904). Deviated fixed-route service is provided in these cities, and demand-response services are provided countywide. Deviated route service allows deviations up to three blocks from the route. Demand-response riders are encouraged to schedule trips at least 24 hours in advance, though it is not required. An intercity service is also provided between Austin and Albert Lea.

In Freeborn County, SMART primarily serves the city of Albert Lea. This includes a deviated route that operates Monday-Friday from 7:00 am to 9:00 pm. A demand-response service also operates seven days

a week within the city and countywide. It runs from 5:00 am to 6:00 pm Monday-Friday, from 9:00 am to 1:00 pm on Saturday, and from 8:00 am to 12:00 pm on Sunday.

The service in Mower County primarily serves the city of Austin. SMART operates two deviated routes in Austin, one of which runs seven days a week and the other six days. They operate from 7:00 am to 9:00 pm Monday-Friday, from 9:00 am to 3:00 pm on Saturday, and from 1:00 pm to 5:00 pm on Sunday (only one route runs on Sundays). Demand-response service is provided within the city and also countywide. This service operates from 5:00 am to 6:00 pm and 9:30 pm to 2:30 am Monday-Friday and from 9:00 am to 3:00 pm Saturday.

In Steele County, service is primarily provided in the city of Owatonna. Two deviated routes operate five days a week in Owatonna. One route runs from 7:00 am to 9:00 pm, while the other operates from 5:00 am to 9:00 am, 2:00 pm to 7:00 pm, and 9:00 pm to 12:00 am. Demand-response service is provided within city limits and also countywide seven days a week, with service from 5:00 am to 7:00 pm Monday-Friday, 9:00 am to 3:00 pm on Saturday, and 7:30 am to 1:00 pm on Sunday.

The service in Waseca County is primarily in the city of Waseca. Deviated route service is provided Monday-Friday from 7:00 am to 5:00 pm. Demand-response service operates seven days a week within the city and countywide. It runs from 6:00 am to 6:00 pm Monday-Friday, 9:00 am to 1:00 pm Saturday, and 8:00 am to 12:00 pm Sunday.

5.2.4 Timber Trails

Timber Trails Transit serves Kanabec County in east central Minnesota. Kanabec County has a population of 15,948 and an area of 522 square miles. The largest city is Mora, with a population of 3,540. Demand-response services are provided from 6:00 am to 6:00 pm Monday-Friday and from 8:00 am to 5:00 pm on Saturday. They also operate a daily route from Mora to Pine City in Pine County, where riders can connect to Arrowhead Transit. Connections are also made with Isanti County Heartland transit service.

In addition to those services for the general public, Timber Trails also provides Non-Emergency Medical Transportation (NEMT) to residents of Kanabec County who have no way to get to medical and other necessary appointments, and it coordinates veteran's transportation for Kanabec County. The NEMT program uses volunteers donating their time and using personal vehicles, and there are eligibility criteria for riders. The veteran's transportation uses vans to take veterans to the VA in Minneapolis and St. Cloud. These trips are scheduled several days in advance.

5.2.5 St. Peter Transit

Saint Peter Transit merged with Le Sueur Transit in 2017 to create Minnesota River Valley Transit (MRVT). Saint Peter, which has a population of 11,935, and Le Sueur, population 4,019, are located in southern Minnesota. Demand-response service is provided six days a week in the two cities, from 6:30 am to 8:00 pm Monday-Friday and 9:00 am to 7:00 pm Saturday. Prior to 2019, a fixed-route bus also operated in Saint Peter. That service was discontinued in 2019, and they began operating a second demand-response bus in the city. MRVT also operates an intercity service that runs from Le Sueur to

Saint Peter and into Mankato, a larger city south of Saint Peter. This route operates on Mondays and Thursdays and the second Saturday of the Month.

5.2.6 St. Cloud Metro Bus

St. Cloud Metro Bus is an urbanized system serving the St. Cloud metro area, including the cities of St. Cloud, Waite Park, Sauk Rapids, and Sartell in central Minnesota. The St. Cloud Metropolitan Transit Commission (Metro Bus) was formed in July of 1969 and started service in October of that year. The service area population is 103,018.

Metro Bus operates fixed-route service seven days a week, 359 days a year. Routes begin service as early as 5:00 am and end as late as 10:43 pm on weekdays, 7:45 am to 7:12 pm on Saturdays, and 8:30 am to 6:12 pm on Sundays. The system includes 17 year-round fixed routes and several seasonal contracted routes, as well as the Northstar Link commuter bus. Northstar Link connects with Northstar commuter rail in Big Lake, which provides connections to Minneapolis. St. Cloud Metro Bus also provides connections to intercity bus carrier Jefferson Lines.

In addition to the fixed-route service, St. Cloud Metro Bus provides complementary paratransit service (Dial-a-Ride) within ¾ of a mile of all fixed routes, seven days a week, with hours comparable to the fixed-route service. The paratransit service is available to riders who are unable to use the fixed-route service due to a combination of a disability and physical barriers.

5.3 SURVEY RESPONSE

Onboard rider surveys were conducted by each of the six case study transit agencies. These surveys were distributed on all buses for a consecutive seven-day period in July-August of 2019. The survey instrument is shown in Appendix C. St. Cloud Metro Bus surveys included both fixed-route and paratransit service. A total of 930 responses were received between the six agencies, with approximately half being from St. Cloud Metro Bus. Table 5.4 shows the number of responses by agency. Responses from the rider survey were used to demonstrate the benefits of transit services, which are detailed in the following sections.

Table 5.4 Number of Transit Rider Survey Responses by Agency

Transit Agency	Number of Survey Responses
Paul Bunyan Transit	136
SMART	103
St. Cloud Metro Bus	477
St. Peter Transit/MRVT	27
Timber Trails (Kanabec County)	31
Trailblazer Transit	156

5.4 HOW RIDERS USE TRANSIT

Knowing how often users rely on transit and the purposes for which they use it helps provide some information about the value of transit. As shown in Table 5.5, most riders are frequent users of the services, riding multiple times per week. For some agencies, close to half, or more, ride at least five days per week, suggesting significant reliance on the service.

Table 5.5 Frequency that Riders Use Transit

	Paul Bunyan Transit (n=131)	SMART (n=99)	St. Cloud Metro Bus (n=443)	St. Peter Transit (n=23)	Timber Trails (n=31)	Trailblazer Transit (n=143)
	----------Percentage of respondents----------					
5-7 days per week	35	45	59	48	32	43
2-4 days per week	46	39	28	13	48	38
About once a week	11	4	6	22	3	8
A few days per month	6	10	5	13	16	7
Once a month or less	1	1	2	4	0	2
This is my first time	2	0	0	0	0	1

Respondents were asked to identify why they were riding the bus that day (Table 5.6). Some respondents identified more than one trip purpose. The calculations in Table 5.6 are based on the total number of responses received, so each column sums to 100%. Riders were found to use the service for a wide range of activities. The most common trip purposes included work, shopping/eating out, health care, and errands. Responses varied somewhat between agencies. For example, Trailblazer Transit and Timber Trails provide a high percentage of work trips, and Timber Trails also has a high percentage of health care trips. St. Cloud provides a greater range of trip purposes, with a higher percentage of social/recreational and school trips, compared with the other transit agencies.

Table 5.6 Purpose of Trip

	Paul Bunyan Transit (n=136)	SMART (n=102)	St. Cloud Metro Bus (n=474)	St. Peter Transit (n=27)	Timber Trails (n=31)	Trailblazer Transit (n=156)
	----------Percentage of responses----------					
Errands or other family/personal business	14	20	13	18	0	5
Health care/medical or dental appointment	17	14	15	18	34	9
School or job training	5	3	6	2	0	2
Shopping or eating out	16	28	19	29	16	13
Social or recreation	4	9	11	7	0	7
Taking someone else somewhere	0	1	2	4	0	3
Work	36	22	30	16	50	54
Other	8	4	4	7	0	8

Figures 5.4 through 5.9 show how often survey respondents reported using the service for different purposes. For most agencies, at least half or more of respondents use transit for getting to work. Among those who use transit for work, nearly all ride multiple days per week, and many ride every work day, indicating a reliance on transit as the primary means of transportation to work. Only a small percentage of riders use transit to get to school or job training, but among those who use it for that purpose, again, they tend to use it as their primary means of transportation, riding multiple days per week. Many riders use transit, at least sometimes, for errands or other family or personal business. Among those who use it for this purpose, many ride multiple times a week, and others do so less frequently. Health care is another common use of transit, with a significant majority reporting use of transit for health care purposes. In general, health care trips are less frequent than other types of trips, such as for work or school, so it is not surprising that a smaller percentage reported riding the bus multiple times per week for health care trips. Still, many ride transit at least once a week for health care purposes. Lastly, shopping or eating out is another common use of transit.

There are some notable differences between the transit services. For example, Trailblazer Transit has fewer riders using the service for shopping, errands, health care, and visiting family and friends, as compared with other agencies.

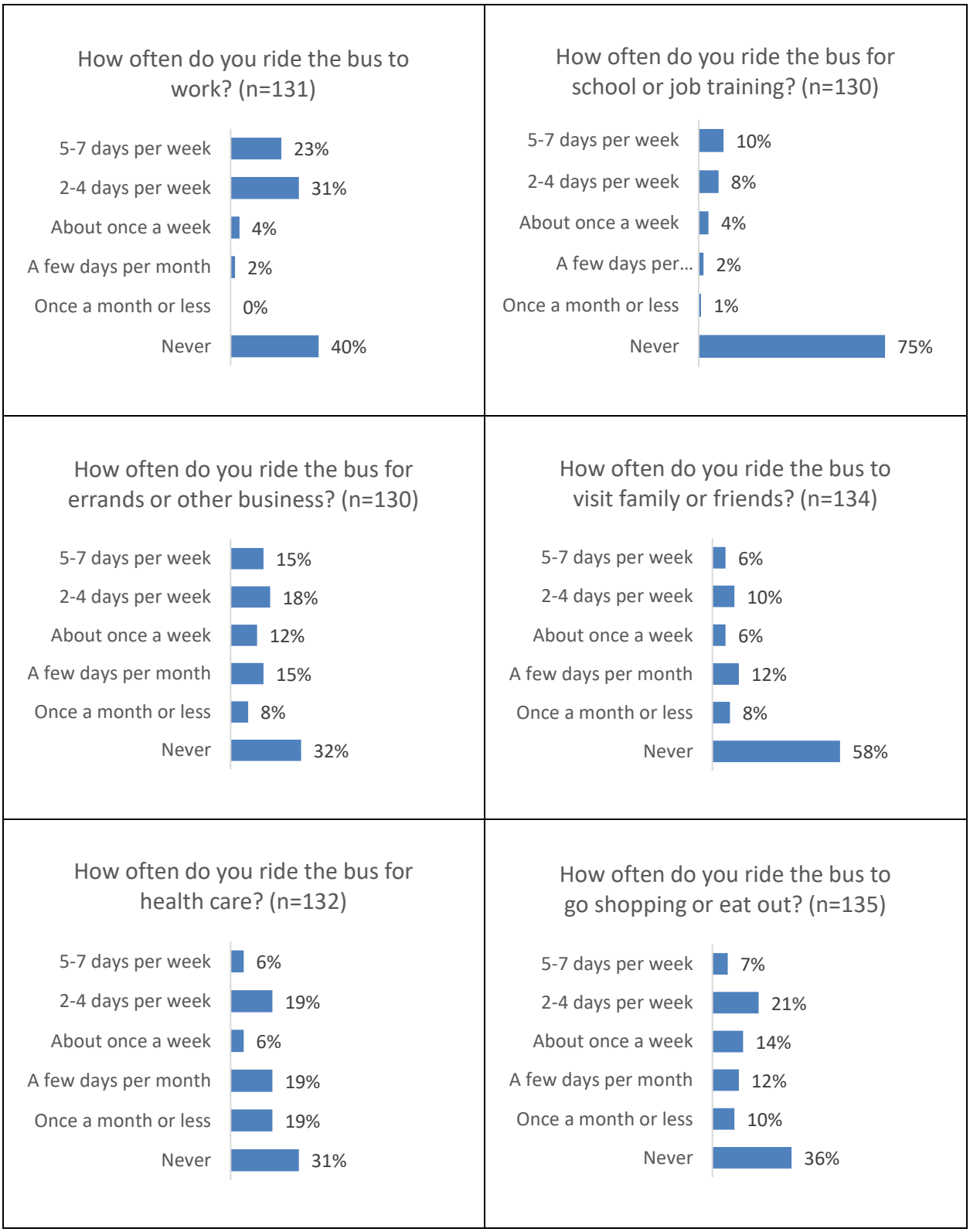

Figure 5.4 Frequency of Transit for Different Purposes, Paul Bunyan Transit

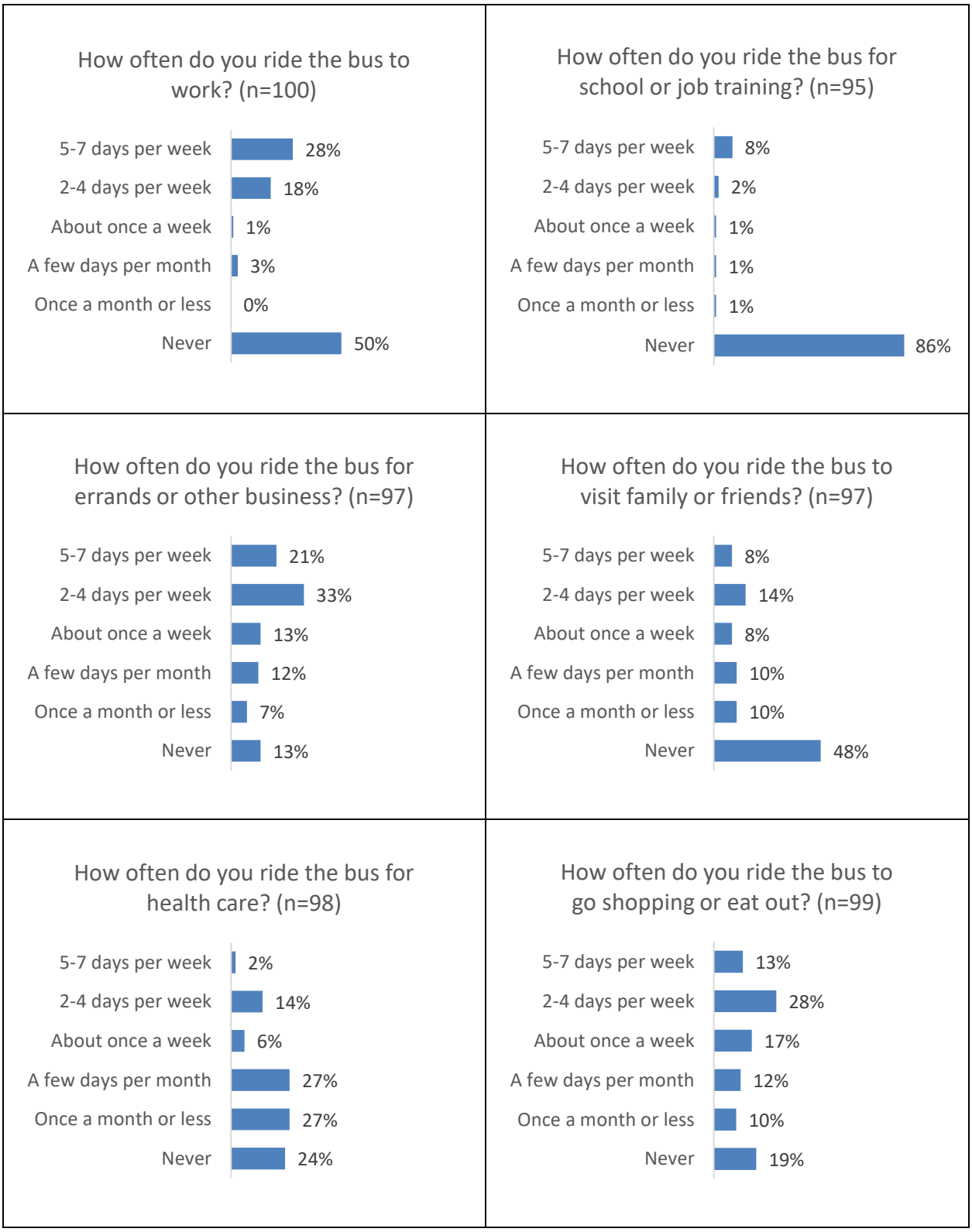

Figure 5.5 Frequency of Transit for Different Purposes, SMART

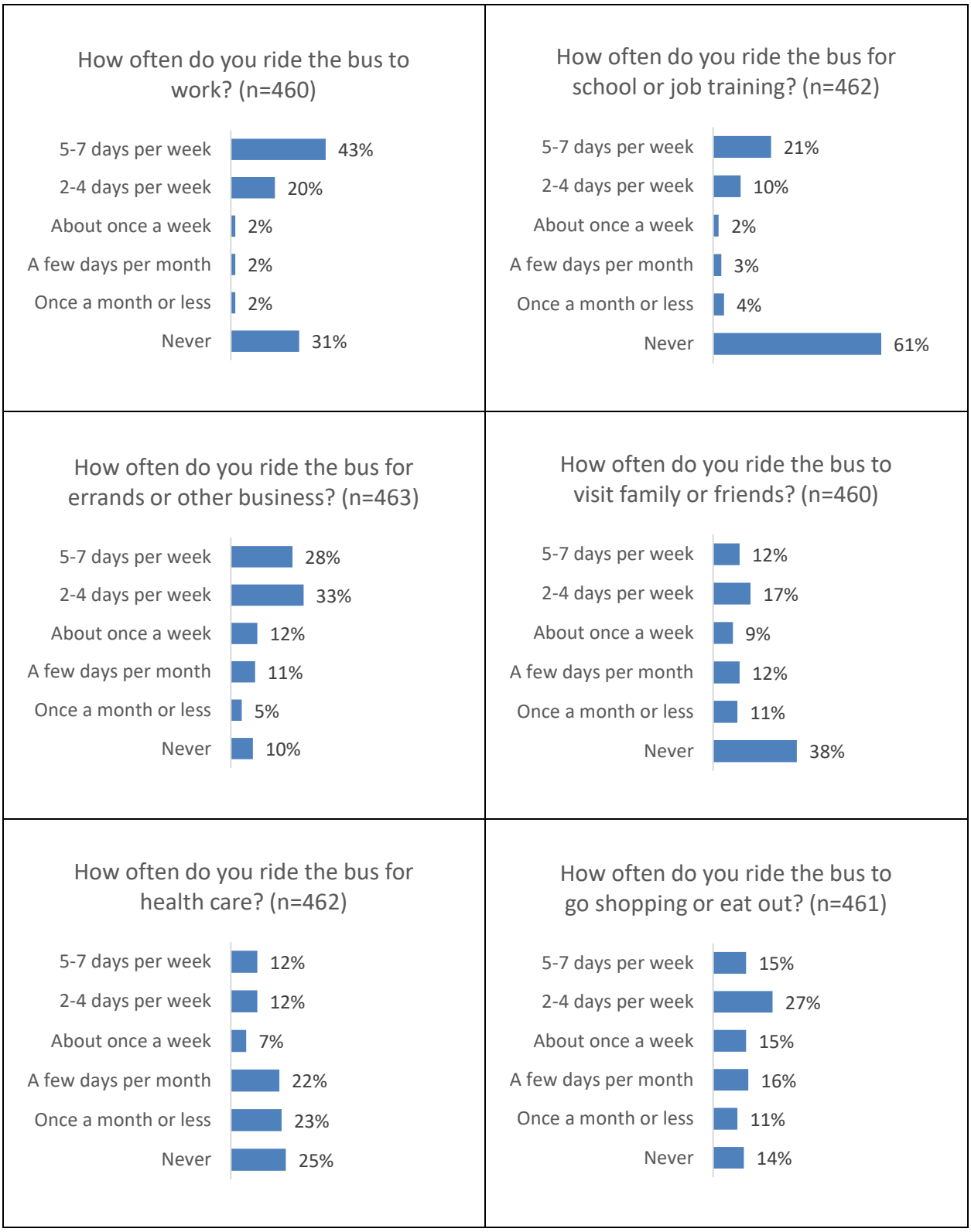

Figure 5.6 Frequency of Transit for Different Purposes, St. Cloud Metro Bus

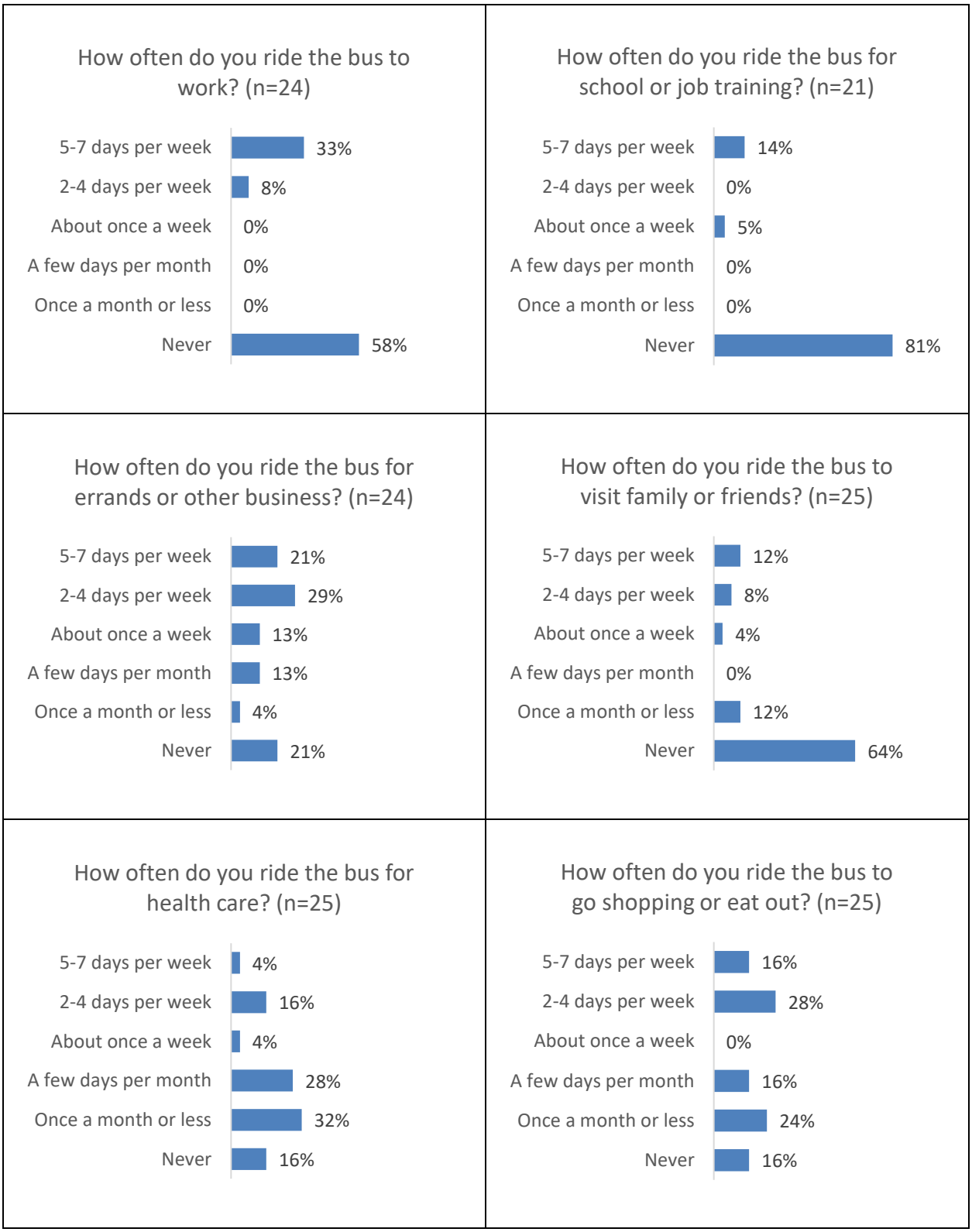

Figure 5.7 Frequency of Transit for Different Purposes, St. Peter Transit

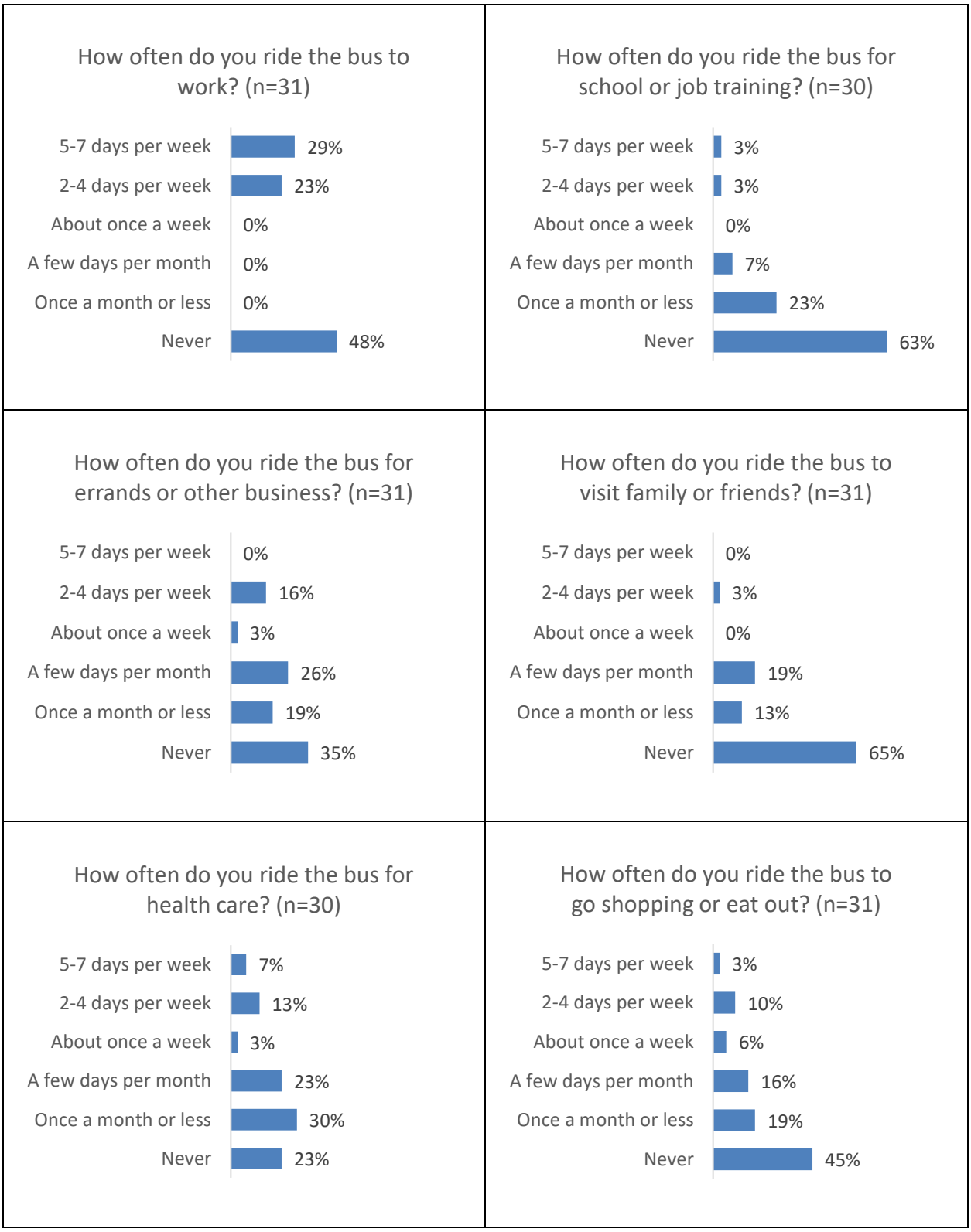

Figure 5.8 Frequency of Transit for Different Purposes, Timber Trails

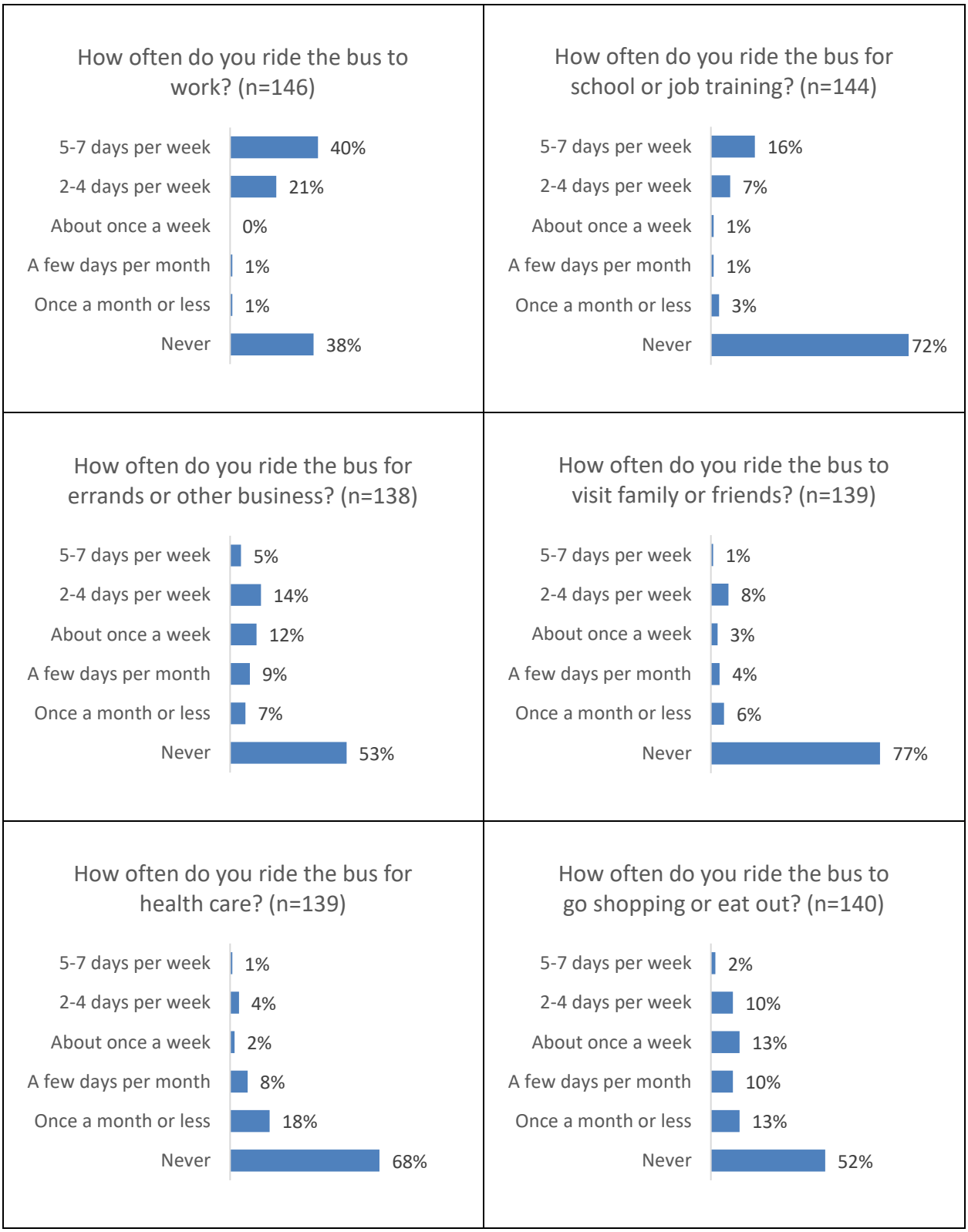

Figure 5.9 Frequency of Transit for Different Purposes, Trailblazer Transit

5.5 CLASSIFICATION AND QUANTIFICATION OF BENEFITS

As discussed in Chapter 4, potential benefits and impacts of transit services were identified and categorized using a transit benefits assessment tree. Benefits were quantified in monetary terms where possible and reasonable. Benefits not expressed in monetary terms were quantified in some other manner. Figure 5.10 shows the transit benefits assessment tree with color coding to show which benefits or impacts were monetized, which were quantified in another manner, and which were not measured at all.

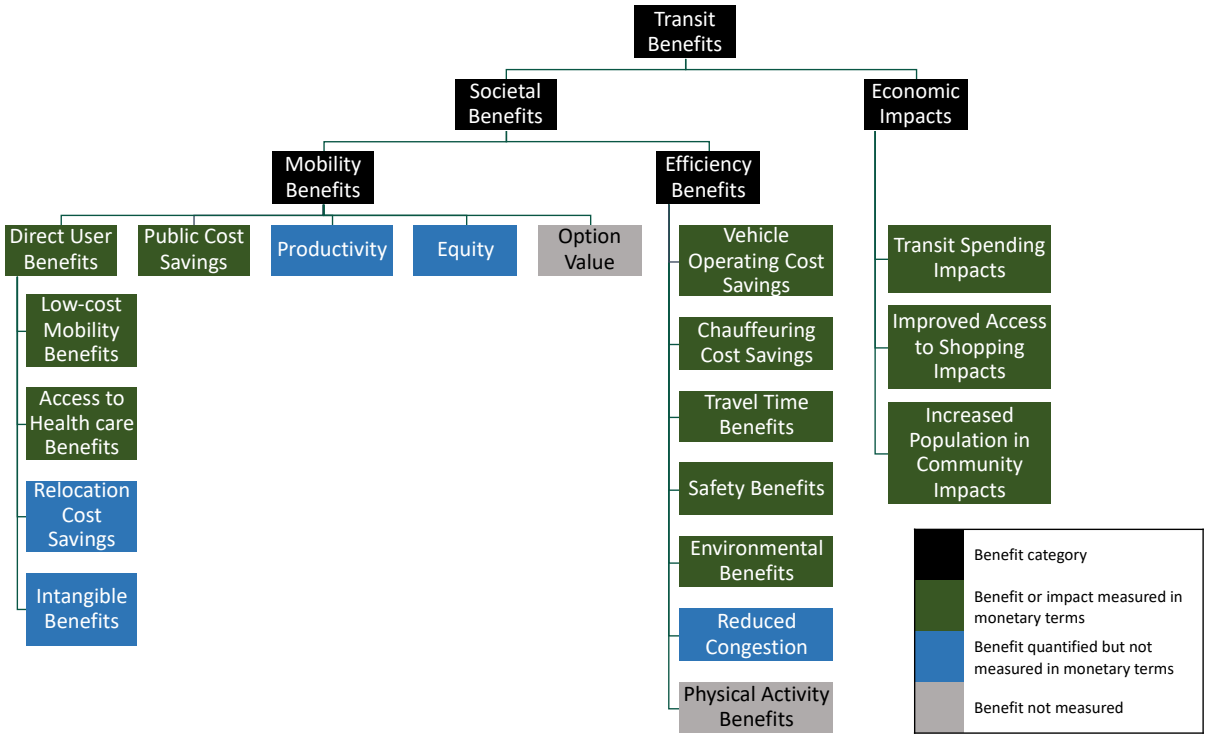

Figure 5.10 Transit Benefits Assessment Tree, Color-Coded by Measurement Type

5.6 MOBILITY BENEFITS

Survey results show that transit significantly enhances the mobility of its users. Many of the riders cannot drive or do not have access to a vehicle (Figures 5.11 through 5.16). For most of the transit agencies, only 24% to 30% of riders surveyed had a driver's license. A majority of respondents were from households with no vehicle. The percentage of riders with a disability ranged from 47% for SMART and St. Cloud Metro Bus to 81% for Timber Trails. Lastly, most riders were from low-income households. The percentage of riders with household incomes less than $25,000 ranged from 66% for St. Cloud Metro Bus to 90% for Timber Trails.

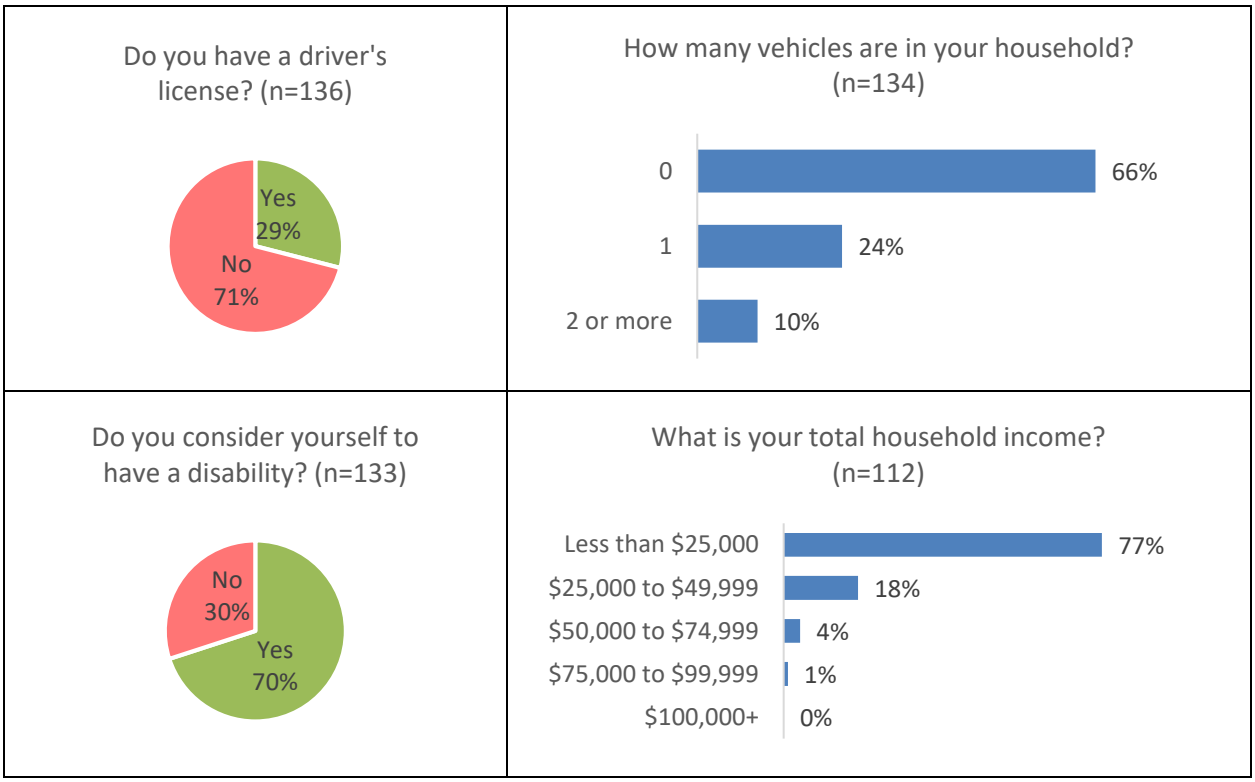

Figure 5.11 Characteristics of Survey Respondents Indicating Transit Dependence, Paul Bunyan Transit

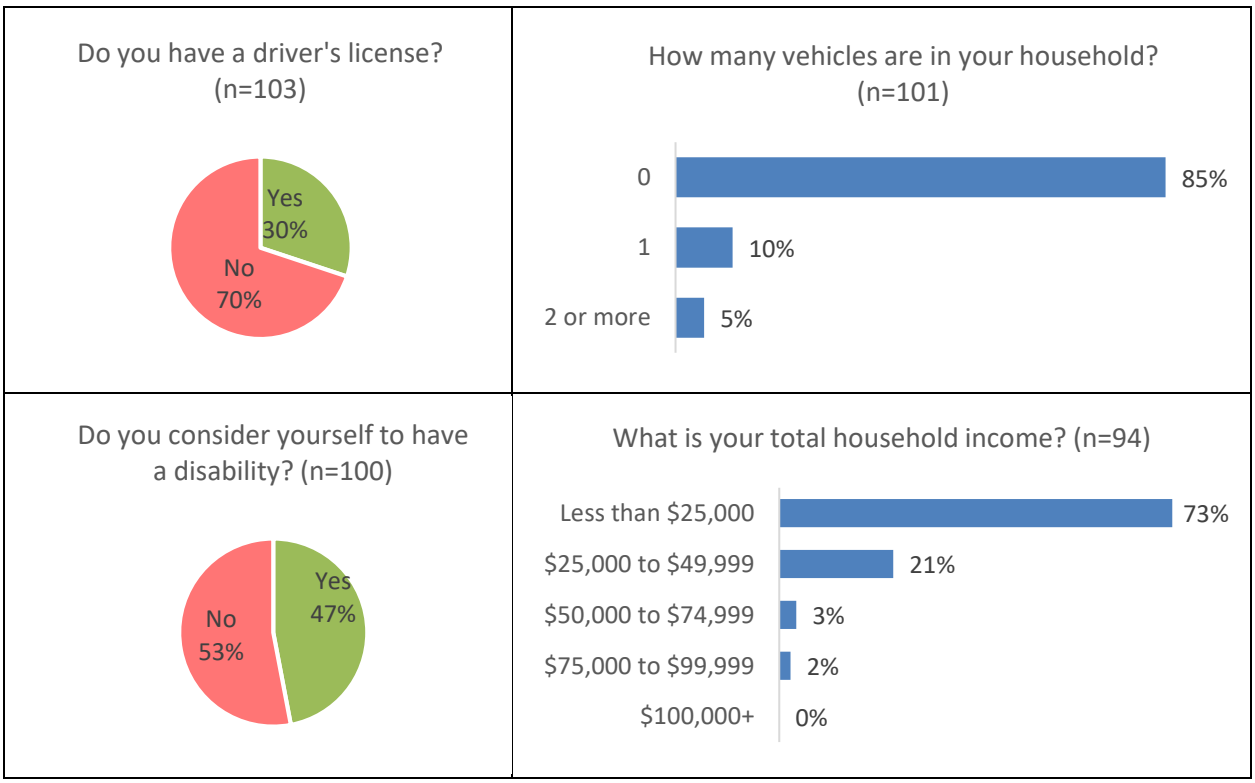

Figure 5.12 Characteristics of Survey Respondents Indicating Transit Dependence, SMART

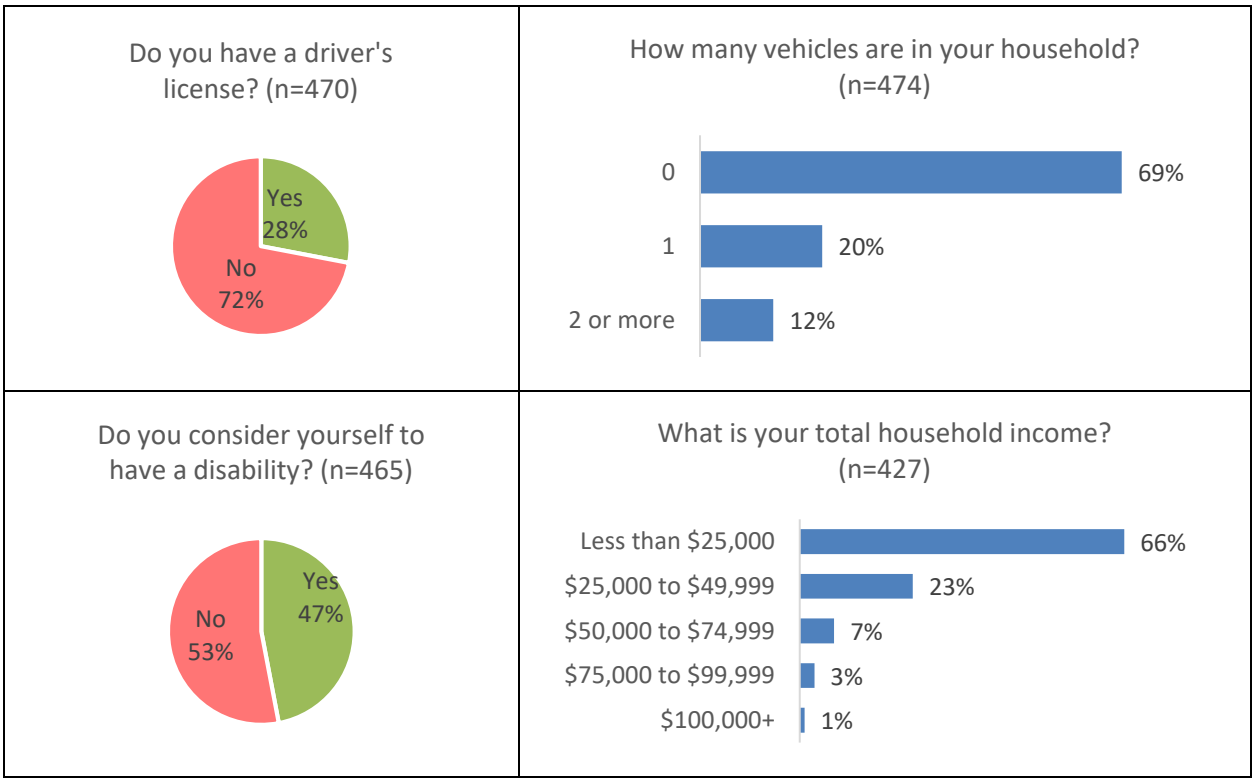

Figure 5.13 Characteristics of Survey Respondents Indicating Transit Dependence, St. Cloud Metro Bus

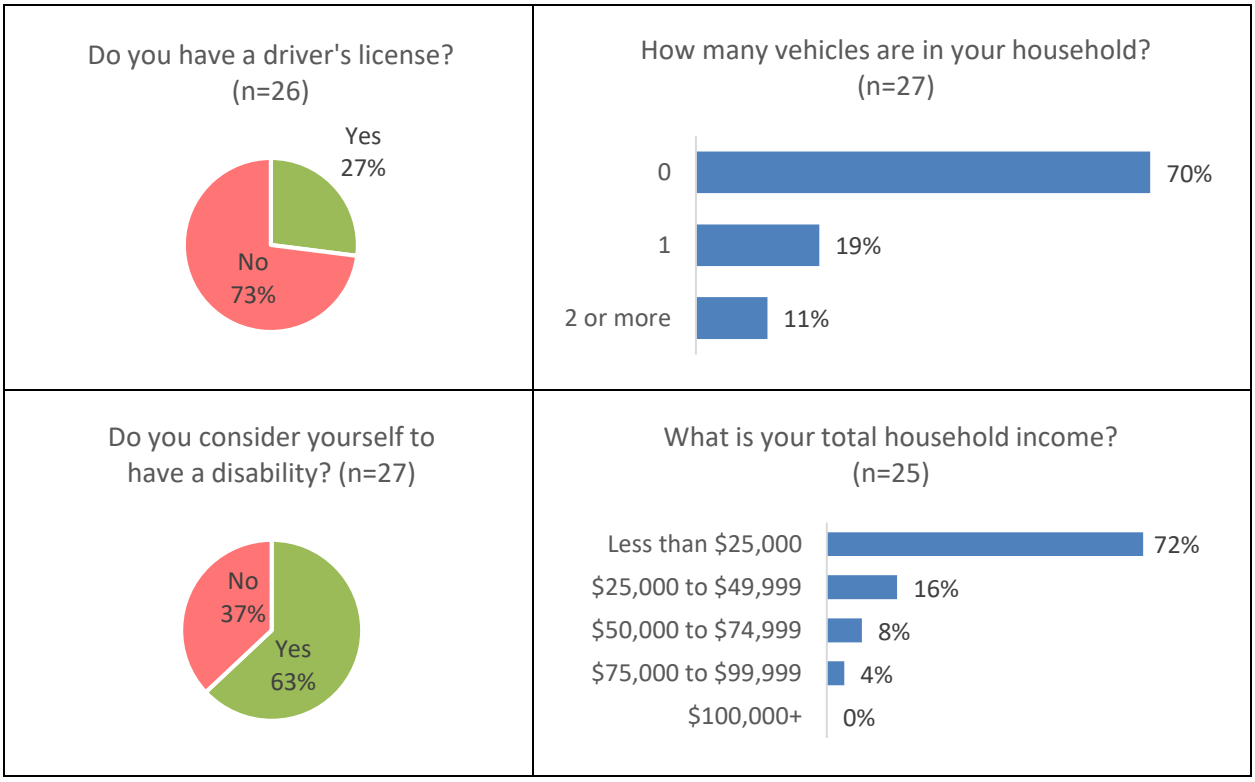

Figure 5.14 Characteristics of Survey Respondents Indicating Transit Dependence, St. Peter Transit

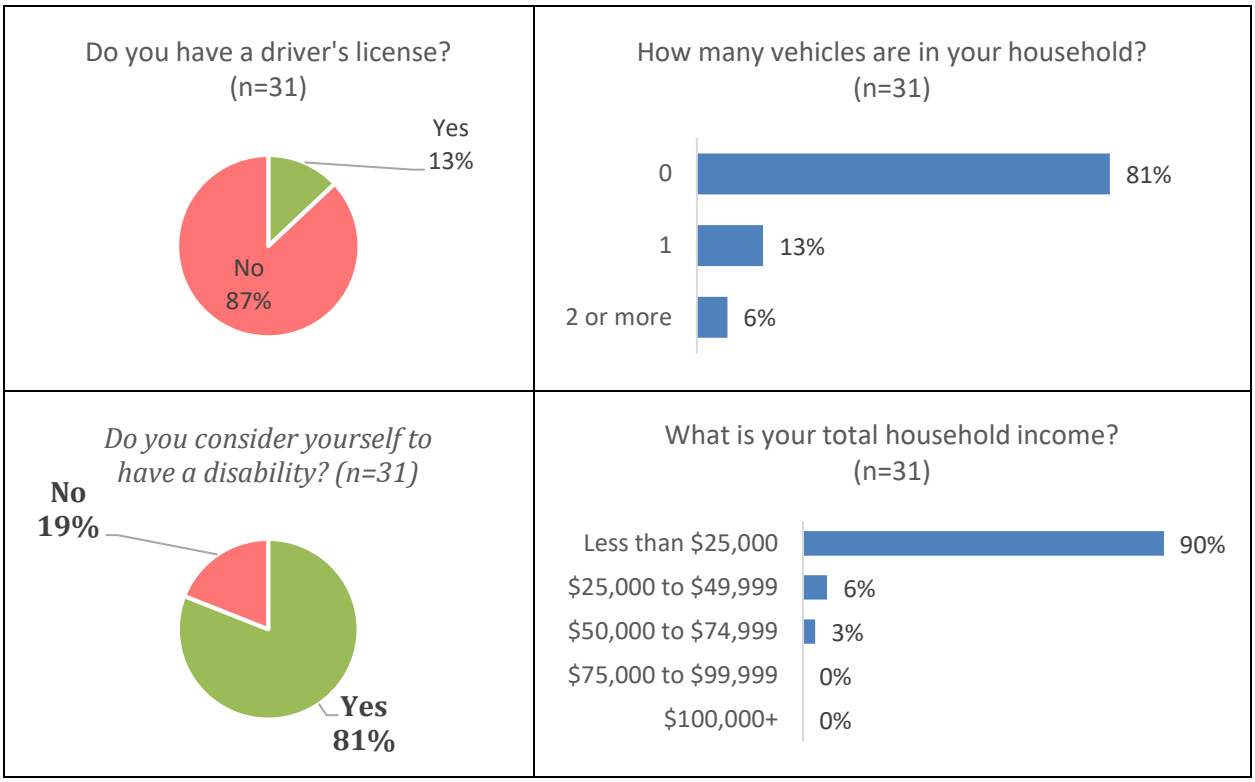

Figure 5.15 Characteristics of Survey Respondents Indicating Transit Dependence, Timber Trails

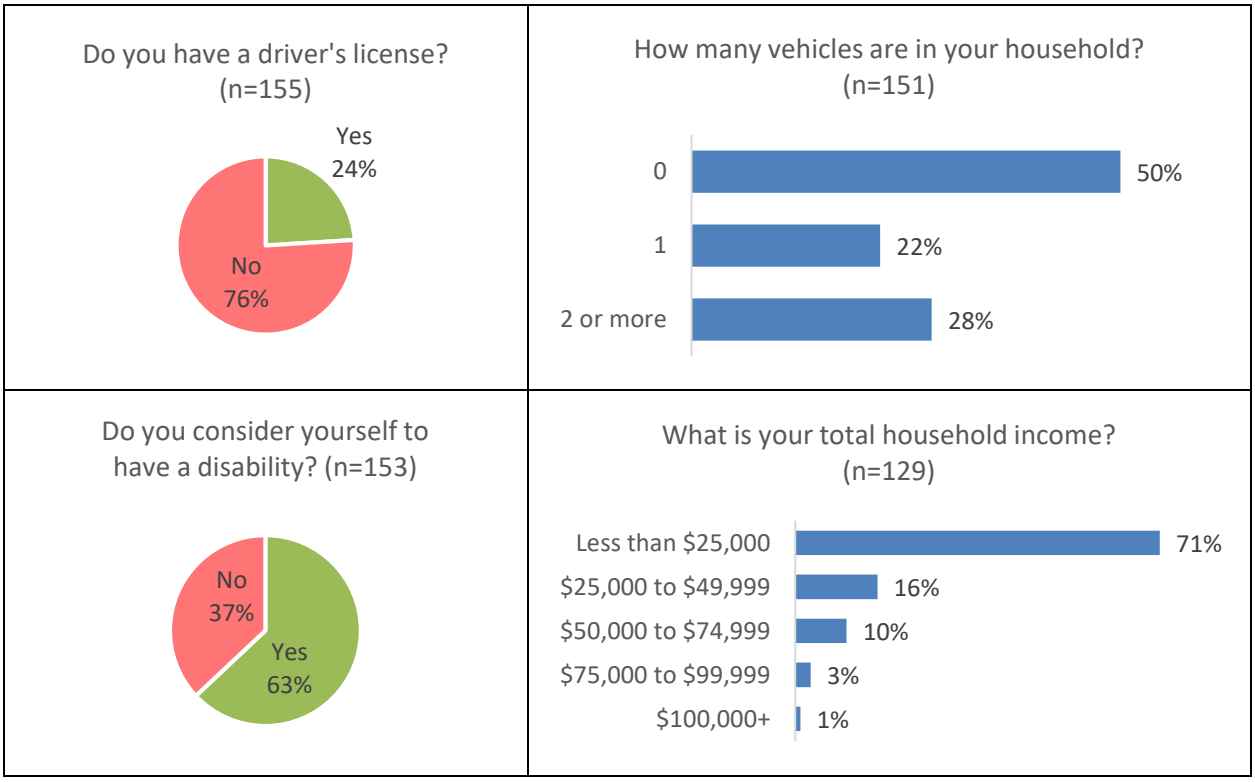

Figure 5.16 Characteristics of Survey Respondents Indicating Transit Dependence, Trailblazer Transit

When asked why they ride the bus, the most common answers from survey respondents were that they cannot drive or do not like to drive, they do not have access to a vehicle, and that it is important to be independent (Table 5.7). Dependence on transit is demonstrated by how survey participants responded when asked how they would have made their trip if transit was not available (Table 5.8). Overall, about one-third answered that they would not have made that trip, and this response was fairly consistent among transit agencies. Most others would have relied on family or friends for a ride, taken a taxi or TNC, or walked. Very few would have driven themselves. Overall, only 3% of respondents would have driven themselves, and this response, again, was consistent among agencies. The percentage of respondents saying that they would have missed the trip varies by the type of trip being made, equaling 21% for work trips, 38% for health care trips, 38% for school or job training trips, 48% for shopping or eating out trips, 44% for errands and personal business, and 40% for social and recreational trips.

Table 5.7 Reasons Survey Respondents Use Transit

	Paul Bunyan Transit (n=136)	SMART (n=103)	St. Cloud Metro Bus (n=477)	St. Peter Transit (n=27)	Timber Trails (n=31)	Trailblazer Transit (n=156)
	----------Percentage of respondents----------					
I can't drive or don't like to drive	54	52	51	56	77	63
No access to a vehicle	45	50	42	48	32	35
It is important to be independent	36	43	40	37	19	31
It is convenient	40	42	35	33	19	31
Too difficult to get rides from others	39	36	34	37	13	22
To save money	26	25	32	11	6	19
It is good for the environment	18	19	19	15	6	13
Other	9	1	6	4	3	13

Table 5.8 How Respondents Would Have Made the Trip If Transit Was Not Available

	Paul Bunyan Transit (n=112)	SMART (n=93)	St. Cloud Metro Bus (n=370)	St. Peter Transit (n=23)	Timber Trails (n=30)	Trailblazer Transit (n=135)
	----------Percentage of respondents----------					
I would not have made this trip	32	32	30	35	23	41
Family member or friend	23	27	20	35	10	16
Used a taxi, Uber, or Lyft	5	16	23	9	0	3
Walked	9	14	14	13	10	8
Volunteer driver	5	2	3	4	3	5
Driven myself	3	2	4	0	0	4
Bicycled	2	3	3	0	3	3
Other	21	3	3	4	50	20

Since transit ridership data are reported in the NTD as unlinked passenger trips, unlinked trips had to be converted to round trips to calculate some of the benefits. For the rural transit agencies, it was assumed that a round trip consisted of two unlinked passenger trips. St. Cloud, however, operates a fixed-route system with transfers, which could lead to additional unlinked trips. A transfer rate of 55% was assumed for St. Cloud, based on survey results from its 2016 Transit Development Plan. Therefore, 3.1 unlinked transit trips were assumed per round trip.

5.6.1 Low-Cost Mobility Benefits

Because of the lower cost of traveling by transit, many low-income riders who cannot afford to own a car or travel by taxi are able to make trips they otherwise would not have made. This is the low-cost mobility benefit of transit, and it is measured as the change in consumer surplus resulting from new trips. As previously described in Chapter 4, the increase in consumer surplus resulting from new trips made is equal to $0.5*[(P_0-P_1)*(Q_1-Q_0)]$, where P_0 is the price travelers would pay for a trip in the absence of transit, P_1 is the price of transit, Q_0 is the number of trips taken without transit, and Q_1 is the number of trips taken with transit. The number of new trips is, therefore, $Q_1 – Q_0$. Table 5.9 shows estimated low-cost mobility benefits for each transit agency.

Table 5.9 Estimated Low-Cost Mobility Benefit

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Low-cost mobility benefit ($)	114,532	110,108	985,722	14,124	34,752	389,096

5.6.2 Access to Health Care Benefits

Missing health care trips can have negative consequences for quality of life, while increasing health care costs. The access to health care benefit, therefore, is the reduced health care costs and improved quality of life resulting from providing health care trips that otherwise would have been forgone. This does not include all potential health benefits of transit. For example, other health benefits could include increased physical activity or mental health benefits from reducing social isolation. This study measures the health care cost savings and the value of quality-of-life improvements from improving access to health care.

As shown in Table 5.10, many respondents reported that they would miss at least some doctor visits or prescriptions if bus service was not available. The response was fairly consistent between agencies, with the exception of Trailblazer Transit, where fewer indicated they would miss health care trips. Overall, 17% said they would miss many health care trips, and an additional 23% answered that they would miss at least some trips. The importance of transit is more significant when focusing on those who frequently use transit for health care trips. Among those who use transit multiple days per week for health care, 37% would miss many health care trips and an additional 27% would miss at least some trips if transit were not available.

Table 5.10 Percentage of Respondents That Would Miss Health Care Trips Without Transit

	Paul Bunyan Transit (n=132)	SMART (n=99)	St. Cloud Metro Bus (n=455)	St. Peter Transit (n=22)	Timber Trails (n=30)	Trailblazer Transit (n=140)
	----------Percentage of respondents----------					
Yes, many	18	14	22	27	17	4
Yes, few	23	23	28	14	20	11
No	59	63	50	59	63	84

The number of health care trips that would have been forgone in the absence of transit was estimated for each agency based on the percentage of transit trips that are for health purposes and percentage of respondents that said they would not have made the trip without transit. The cost of a forgone health care trip one-way was estimated as $518, based on using the tool developed by Hughes-Cromwick et al., (2005), as discussed by Godavarthy et al. (2014), and adjusted for inflation. Table 5.11 shows the estimated total cost of forgone health care trips for each agency. This is the health benefit of providing transit services to those who would miss health care trips.

Table 5.11 Estimated Access to Health Care Benefit

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Access to health care benefit ($)	3,520,587	5,514,718	29,466,106	980,629	2,180,975	4,623,828

5.6.3 Relocation Cost Savings

The survey asked respondents if they would need to move if transit service was not available. The percentage responding that they would need to move ranged from 17% for Trailblazer Transit to 45% for St. Cloud. Overall, about 34% said they would move, including 19% who would move somewhere nearby and 16% who would move to another city (Table 5.12). Respondents in St. Cloud were most likely to indicate that they would move to another city if transit was not available.

Table 5.12 Need to Relocate

Survey Response	Paul Bunyan Transit (n=127)	SMART (n=98)	St. Cloud Metro Bus (n=457)	St. Peter Transit (n=24)	Timber Trails (n=31)	Trailblazer Transit (n=138)
	----------Percentage of respondents----------					
I could continue living in my current place	73	73	55	75	81	83
I would move somewhere nearby	18	13	24	8	6	10
I would move to a different town or city	9	13	21	17	13	7

Analyzing responses by age groups shows that older adults were least likely to say they would need to move. This result may be surprising given that older adults are less likely to drive and have greater needs for mobility services. However, respondents of all ages were shown to be transit dependent, and older adults are less likely to require transportation for work, which could influence location choice. Responses are also dependent on the individual's ability to accurately assess whether or not they would need to move.

The need to relocate could result in significant costs to the individual. Those who need to move to a larger city with better transit or better access to amenities could incur higher housing costs and an increased cost of living. Some may need to move to an assisted living facility, which is significantly more expensive than aging in place and using transit.

5.6.4 Intangible Benefits

Many of the potential benefits of transit to users cannot be measured in dollar terms. These include increased social interaction, reduced stress, independent living, and improved quality of life. The survey asked respondents the degree to which they agree or disagree that transit provides these benefits. As shown in Tables 5.13 through 5.17, a significant majority of respondents agreed or strongly agreed that transit provides these benefits. Overall, between all transit agencies, 59% of respondents strongly agreed that transit allows them to make more trips, 45% strongly agreed that it increases social

interaction, 41% strongly agreed that it reduces their stress level, 55% strongly agreed that is allows them to live independently, and 52% strongly agreed that it improves their overall quality of life.

Table 5.13 Intangible Benefits: Allows Rider to Make More Trips

Survey Response	Paul Bunyan Transit (n=129)	SMART (n=94)	St. Cloud Metro Bus (n=446)	St. Peter Transit (n=20)	Timber Trails (n=30)	Trailblazer Transit (n=134)
	----------Percentage of respondents----------					
Strongly agree	52	68	65	35	43	47
Agree	26	21	25	40	43	41
Neutral	10	10	8	25	13	8
Disagree	7	1	1	0	0	1
Strongly Disagree	5	0	1	0	0	2

Table 5.14 Intangible Benefits: Increases Social Interaction with Other People

Survey Response	Paul Bunyan Transit (n=130)	SMART (n=93)	St. Cloud Metro Bus (n=444)	St. Peter Transit (n=21)	Timber Trails (n=30)	Trailblazer Transit (n=133)
	----------Percentage of respondents----------					
Strongly agree	45	54	44	52	37	41
Agree	31	23	29	5	37	30
Neutral	16	23	21	29	27	24
Disagree	4	1	3	14	0	4
Strongly Disagree	4	0	3	0	0	2

Table 5.15 Intangible Benefits: Reduces Stress Level

Survey Response	Paul Bunyan Transit (n=129)	SMART (n=93)	St. Cloud Metro Bus (n=447)	St. Peter Transit (n=22)	Timber Trails (n=30)	Trailblazer Transit (n=134)
	----------Percentage of respondents----------					
Strongly agree	35	52	42	41	30	40
Agree	30	34	28	32	33	31
Neutral	27	13	21	18	30	26
Disagree	5	1	5	9	7	1
Strongly Disagree	3	0	4	0	0	2

Table 5.16 Intangible Benefits: Allows Rider to Live Independently

Survey Response	Paul Bunyan Transit (n=129)	SMART (n=93)	St. Cloud Metro Bus (n=444)	St. Peter Transit (n=22)	Timber Trails (n=30)	Trailblazer Transit (n=134)
	----------Percentage of respondents----------					
Strongly agree	46	69	58	32	37	50
Agree	35	23	31	50	20	30
Neutral	12	9	9	14	27	16
Disagree	4	0	1	5	17	1
Strongly Disagree	3	0	1	0	0	3

Table 5.17 Intangible Benefits: Improves Overall Quality of Life

Survey Response	Paul Bunyan Transit (n=129)	SMART (n=93)	St. Cloud Metro Bus (n=448)	St. Peter Transit (n=22)	Timber Trails (n=30)	Trailblazer Transit (n=135)
	----------Percentage of respondents----------					
Strongly agree	44	65	52	64	50	47
Agree	36	24	32	23	40	30
Neutral	15	12	12	14	10	19
Disagree	3	0	2	0	0	1
Strongly Disagree	2	0	2	0	0	2

Survey results also demonstrate the impact transit has on keeping riders connected to their town, another intangible benefit. Nearly all respondents agreed that the service helps keep them connected to their town (Table 5.18).

Table 5.18 Intangible Benefits: Keeping Riders Connected to Their Town

Survey Response	Paul Bunyan Transit (n=135)	SMART (n=100)	St. Cloud Metro Bus (n=463)	St. Peter Transit (n=24)	Timber Trails (n=31)	Trailblazer Transit (n=140)
	----------Percentage of respondents----------					
Yes	93	99	94	96	100	84
No	7	1	6	4	0	16

5.6.5 Public Assistance Cost Savings

The survey showed that most of those who use public transit for work rely on it as their primary means of transportation. Without transit, many of these users would not be able to get to work or maintain employment, which could result in increased public assistance spending. To illustrate this point, respondents who use transit for work were asked how important the transit service is to them for getting to work. For most transit systems, a majority of respondents noted that the service is very important and that they would lose their job without it (Table 5.19). Note that those who do not use transit to get to work did not answer this question, and the number of responses for St. Peter Transit and Timber Trails is very low.

Table 5.19 Importance of Transit Service for Getting to Work

Survey Response	Paul Bunyan Transit (n=69)	SMART (n=43)	St. Cloud Metro Bus (n=307)	St. Peter Transit (n=7)	Timber Trails (n=1)	Trailblazer Transit (n=94)
	----------Percentage of respondents----------					
Very important, I would lose my job	58	86	68	43	100	56
Somewhat important, I might lose my job	17	2	13	14	0	29
Slightly important, I would probably keep my job	15	7	13	14	0	10
Not important, I would keep my job	10	5	6	29	0	5

Survey responses show that transit is important for all riders for getting to work, but it is especially important for the low-income and those who cannot drive. Table 5.20 shows the percentages of respondents from all transit agencies who answered that transit was either very important or not important for getting to work. Results are shown for different demographic groups. Low-income individuals and those without access to a vehicle were most likely to answer that transit was very important for getting to work.

Table 5.20 Importance of Transit for Getting to Work, by Demographics

Population Group	Very important, I would lose my job	Not Important, I would keep my job
	----Percentage of respondents----	
Disability (n=509)		
Has disability	68	5
Does not have disability	64	8
Driver's License (n=516)		
Has driver's license	58	10
Does not have driver's license	68	5
Number of Vehicles in Household (n=512)		
None	75	4
1 or more	52	10
Household Income (n=461)		
Less than $25,000	73	4
$25,000 or more	54	10

Among the riders who were traveling to work when surveyed, 21% said they would not have made the trip that day if the bus was not available. However, among those who would have found another way to get to work, the alternatives were not long-term options. Many would have taken a taxi or Uber or Lyft, which may be feasible for occasional use but would be too expensive to rely on as a primary means of transportation. Others would rely on family or friends or walk, which, again, may be feasible for some trips but would not be a reliable primary means of transportation for many of the riders.

The percentage of transit trips for work were estimated based on survey responses shown in Table 5.6, and the percentage of those trips that would have been forgone in the absence of transit was estimated based on survey responses shown in Table 5.8. Table 5.21 shows estimated public assistance cost savings.

Table 5.21 Estimated Public Assistance Cost Savings

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Public assistance cost savings ($)	282,661	295,324	2,203,861	25,902	109,474	1,144,721

5.6.6 Increased Productivity

Increased productivity is demonstrated by the percentage of riders who rely on transit as a primary means of transportation to work or education. Improving access to work increases the pool of potential labor for local businesses, thereby positively impacting their productivity. Improving access to education

or job training increases the ability of the individual to obtain employment and become a productive member of society.

Many riders rely on transit as a primary means of transportation to work or education. At least half of the respondents for most agencies use the service to get to work; and among those who use transit for work, most ride to work multiple days per week, indicating a reliance on the service (Table 5.22). Further, as previously shown in Table 5.19, a majority of transit commuters for most agencies said they would not be able to keep their job if the service was not available.

Table 5.22 Reliance on Transit for Commuting

	Paul Bunyan Transit (n=131)	SMART (n=100)	St. Cloud Metro Bus (n=460)	St. Peter Transit (n=24)	Timber Trails (n=31)	Trailblazer Transit (n=146)
	----------Percentage of respondents----------					
Riders who use transit to work at least sometimes	60	50	69	42	52	62
Transit commuters who ride multiple days per week	90	92	91	98	100	98

Among those who were traveling to work when surveyed, 21% would not have made the trip if the bus was not available, but this likely underestimates the importance of transit because the alternatives are not likely to be feasible long-term options for most.

A smaller percentage of riders use the service for education or job training, as shown previously in Figures 5.4 through 5.9, but those who use it for education or job training tend to ride multiple days per week.

5.6.7 Equity

Transit promotes equity by serving population groups that are not well served by the existing transportation system, such as those who are economically, physically, or socially disadvantaged. This is demonstrated by the percentage of riders who are low-income, elderly, minorities, have a disability, or do not have access to a vehicle.

As shown in Table 5.23, transit serves a high percentage of these disadvantaged populations. An especially high percentage of riders are low-income, cannot drive or do not have access to a vehicle, and/or have a disability. If transit was not available, these population groups would be at a significant disadvantage.

Table 5.23 Demographics of Transit Riders

Population group	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
	----------Percentage of respondents----------					
Minority (non-white)	29	20	31	21	6	9
Income less than $25,000	77	73	66	72	90	71
Income less than $50,000	95	95	89	88	96	87
No driver's license	71	70	72	73	87	76
No vehicles in household	66	85	69	70	81	50
Disability	70	47	49	63	81	63
Age 65 or older	22	21	21	50	12	19
Age 75 or older	11	17	8	31	6	5

For comparison purposes, Table 5.24 shows the demographics of the total service area population for each transit agency. Transit is serving a disproportionately higher percentage of all of these population groups. This is also illustrated in Figure 5.17, which shows the percentages of transit riders who are a minority, do not have a vehicle in the household, are low-income, or have a disability; and it compares those percentages to the percentages of the general population in each transit service area that belongs to each of those population groups. If transit did not exist, these population groups would be disproportionately impacted.

Table 5.24 Demographics of Service Area Population

Population group	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
	----------Percentage of population----------					
Minority (non-white)	21	8	10	9	4	5
Income less than $25,000	24	21	27	21	22	13
Income less than $50,000	51	45	53	49	49	33
No driver's license	NA	NA	NA	NA	NA	NA
No vehicles in household	7	6	9	9	5	4
Disability	12	12	11	14	18	9
Age 65 or older	15	18	14	14	19	13
Age 75 or older	7	9	6	7	8	6

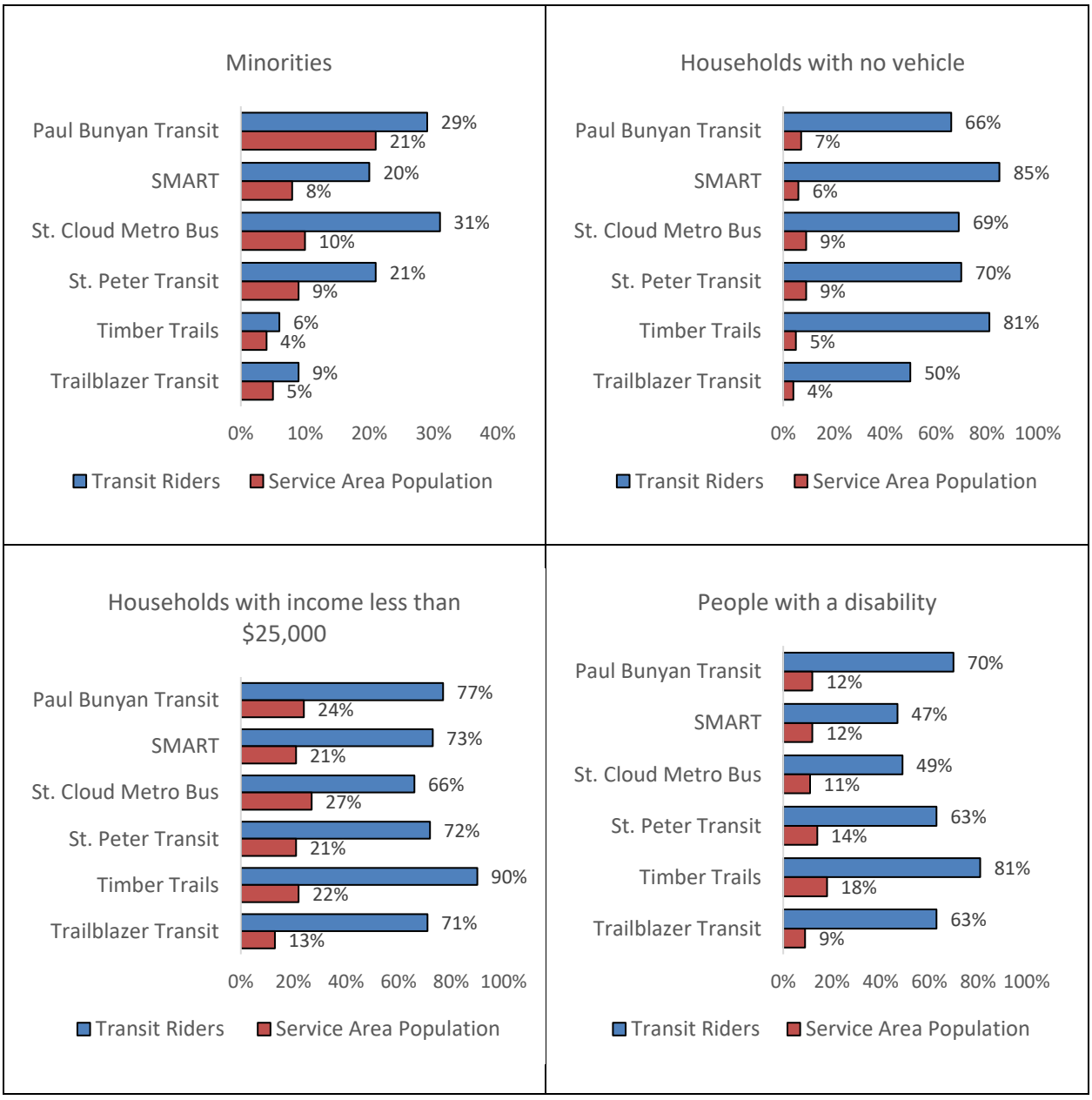

Figure 5.17 Comparison of Demographics Between Transit Riders and General Population

5.6.8 Option Value

Option value is the value non-users place on having the option of transit available to them. This could be estimated through a community-wide survey, which was not conducted as part of this study. Lacking that information, the survey of users provided information on how many riders are infrequent users who typically have other options available to them. Results show that most users are frequent riders who have limited options, although the services are not used strictly by frequent riders. About 1% of all

survey respondents reported it was the first time they had used the service, and another 2% use the service once a month or less. Some comments by respondents indicated that they typically have other options but temporarily need to ride transit. This study, however, does not provide strong evidence regarding the option value. A survey of non-users would be required to estimate this value.

5.7 EFFICIENCY BENEFITS

Efficiency benefits are those of shifting trips from some other mode to transit. The percentage of transit trips that would have been replaced by personal driving trips, trips provided by a family member or friend (chauffeuring trips), trips made by taxi, Uber or Lyft, walking trips, or biking trips in the absence of transit were estimated based on survey responses for each agency. Cost-saving estimates were calculated using equations and cost values described in Chapter 4. Calculations were made assuming an average trip distance of three miles for SMART, St. Cloud Metro Bus, and St. Peter Transit; five miles for Paul Bunyan Transit and Timber Trails; and seven miles for Trailblazer Transit. These estimates were based on the types of trips and percentages of in-town versus out-of-town trips being made by each transit agency.

5.7.1 Vehicle Operating Cost Savings

Vehicle operating cost savings accrue to those who would have driven themselves, which accounts for a small percentage of transit trips (ranging from 0% for St. Peter Transit and Timber Trails to 4% for St. Cloud Metro Bus and Trailblazer Transit). The cost savings are minor, or negative in some cases, because it is assumed that few would drive themselves, and that those who would drive already own a vehicle, so the cost would just be the operating costs (Table 5.25).

Table 5.25 Estimated Vehicle Operating Cost Savings

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Vehicle operating cost savings ($)	1,738	-1,944	-2,660	0	0	12,427

5.7.2 Chauffeuring Cost Savings

Chauffeuring cost savings occur when riders would have been given a ride by someone else. It includes the vehicle operating cost and the value of time for the driver. These cost savings are larger because many transit trips would have been chauffeured trips (Table 5.26).

Table 5.26 Estimated Chauffeuring Cost Savings

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Chauffeuring cost savings ($)	379,660	265,241	1,818,205	38,454	232,596	1,014,388

5.7.3 Travel Time Benefits

Travel time benefits consider the differences in travel times between transit and other modes and assigns it a dollar value. Travel time benefits are considered for trips that would have been made by some other mode. For those who would have traveled by automobile, there is a negative effect, because travel times are greater for transit. However, some transit riders would walk or bike without transit, so transit reduces their travel time. The overall estimate is highly dependent on estimates of average trip distances and speeds by mode, the percentage of trips that would have been made by walking, and the value of time. For some agencies, the travel time benefit was found to be positive, and for others it was negative, but overall, the size of the impact is small (Table 5.27).

Table 5.27 Estimated Travel Time Benefits

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Travel time benefits ($)	-93,121	-10,037	316,290	3,572	-32,568	-80,562

5.7.4 Safety Benefits

The calculations show a slightly lower per-mile fatality rate for transit, and a significantly lower rate of injuries and PDO crashes. This is offset to an extent by transit creating new trips that otherwise would not have been made. The total safety benefit was estimated to be positive but minor (Table 5.28).

Table 5.28 Estimated Safety Benefits

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Safety benefits ($)	6,255	6,578	65,750	470	6,651	838

5.7.5 Environmental Benefits

Environmental benefits were estimated based on the number of trips shifted from the automobile to transit, the emissions costs per vehicle-mile for autos and transit, and the number of new trips created by the transit system. Total estimated environmental benefits were negative for each agency because many of the trips made on transit would not have been made if the service was not available, and some would have been made by walking (Table 5.29). The transit service creates new trips, which lead to increased emissions. Further, the vehicle load needs to be greater to offset the lower fuel economy and greater rate of emissions from buses.

Table 5.29 Estimated Environmental Benefits

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Environmental benefits ($)	-58,880	-109,169	-233,741	-7,429	-34,329	-215,350

5.7.6 Reduced Congestion

The effect on congestion was measured by the number of trips converted from the automobile to transit. This includes automobile trips made alone, chauffeured trips, and trips made by taxi, Uber, or Lyft. Table 5.30 shows the total number of unlinked transit trips that would have been made by automobile.

Table 5.30 Reduction in Congestion

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Number of transit trips that would have been made by automobile	65,085	122,020	991,369	14,642	33,246	120,657

5.8 SUMMARY OF SOCIETAL BENEFITS

Table 5.31 provides a summary of the estimated monetary benefits. These can be added to estimate the total societal benefits. To compare these benefits to the total costs of providing the service, Table 5.32 shows the total benefits, total costs, and the benefit-to-cost ratio. Benefit-to-cost ratios were found to range from 1.5 to 4.2, showing that in all cases benefits were found to exceed costs. Tables 5.33 and 5.34 show the benefit and cost data on a per-trip basis.

Table 5.31 Summary of Estimated Monetary Benefits

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Mobility Benefits						
Low-cost mobility benefit ($)	114,532	110,108	985,722	14,124	34,752	389,096
Access to health care benefit ($)	3,520,587	5,514,718	29,466,106	980,629	2,180,975	4,623,828
Public assistance cost savings ($)	282,661	295,324	2,203,861	25,902	109,474	1,144,721
Efficiency Benefits						
Vehicle operating cost savings ($)	1,738	-1,944	-2,660	0	0	12,427
Chauffeuring cost savings ($)	379,660	265,241	1,818,205	38,454	232,596	1,014,388
Travel time benefits ($)	-93,121	-10,037	316,290	3,572	-32,568	-80,562
Safety benefits ($)	6,255	6,578	65,750	470	6,651	838
Environmental benefits ($)	-58,880	-109,169	-233,741	-7,429	-34,329	-215,350
Total ($)	**4,153,434**	**6,070,819**	**34,619,532**	**1,055,723**	**2,497,552**	**6,889,385**

Table 5.32 Comparison of Benefits to Costs

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Benefits ($)	4,153,434	6,070,819	34,619,532	1,055,723	2,497,552	6,889,385
Costs						
Operating ($)	1,441,430	2,492,624	12,115,421	177,693	941,968	4,369,810
Capital ($)	148,957	373,423	3,413,309	73,959	75,166	75,794
Total ($)	1,590,387	2,866,047	15,528,730	251,652	1,017,134	4,445,604
Benefit-cost ratio	**2.6**	**2.1**	**2.2**	**4.2**	**2.5**	**1.5**

Table 5.33 Summary of Estimated Monetary Benefits, Per Trip

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Mobility Benefits						
Low-cost mobility benefit ($)	0.96	0.46	0.52	0.48	0.66	1.55
Access to health care benefit ($)	29.46	22.84	15.58	33.49	41.55	18.45
Public assistance cost savings ($)	2.37	1.22	1.17	0.88	2.09	4.57
Efficiency Benefits						
Vehicle operating cost savings ($)	0.01	-0.01	0.00	0.00	0.00	0.05
Chauffeuring cost savings ($)	3.18	1.10	0.96	1.31	4.43	4.05
Travel time benefits ($)	-0.78	-0.04	0.17	0.12	-0.62	-0.32
Safety benefits ($)	0.05	0.03	0.03	0.02	0.13	0.00
Environmental benefits ($)	-0.49	-0.45	-0.12	-0.25	-0.65	-0.86
Total ($)	**34.76**	**25.14**	**18.31**	**36.05**	**47.58**	**27.49**

Table 5.34 Comparison of Benefits to Costs, Per Trip

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Benefits ($)	34.76	25.14	18.31	36.05	47.58	27.49
Costs						
Operating ($)	12.06	10.32	6.41	6.07	17.94	17.44
Capital ($)	1.25	1.55	1.81	2.53	1.43	0.30
Total ($)	13.31	11.87	8.21	8.59	19.38	17.74
Benefit-cost ratio	**2.6**	**2.1**	**2.2**	**4.2**	**2.5**	**1.5**

These benefits include only those that were monetized, and they also do not include the economic impact analysis. As the analysis showed, there are also many other benefits that were not converted to dollar terms, including the intangible user benefits (e.g., increased social interaction, reduced stress, independent living, improved quality of life), increased productivity, equity, and relocation avoidance.

5.9 SIMULATION RESULTS

A simulation model was used to allow for uncertainty in the input parameters and to calculate a range of expected total benefits. This analysis included uniform or triangular distributions for the survey responses, trip distance, and many of the cost parameters, as well as the transfer rate for St. Cloud. Uniform distributions for survey responses were used based on estimated margins of error. The margin of error was estimated to range from 4% for the St. Cloud survey to 15% for St. Peter Transit and Timber

Trails, due to low survey response for those two agencies. A uniform distribution includes a lower and upper bound, and all values are equally likely within that range.

A triangular distribution includes a minimum and maximum value but also includes a peak value, or most likely value. Values closer to the peak value are more likely to occur. A triangular distribution was used for trip distance, cost parameters, and transfer rate for St. Cloud. The peak values were the same as those previously used for the analysis, while minimum and maximum values were added. For value-of-time parameters, the original per-hour values were $17.60 for transit and $18.90 for all other modes. Significantly lower minimum values were used to provide a greater discount to transit and also lower values overall. Value of time is often estimated in terms of wages, and since transit riders were found to be of lower income, their value of time may be lower. Therefore, lower bounds of $5.25 were used for transit, chauffeuring, and taxi or TNC trips, and $7.50 for automobile, walking, and biking trips. These values are close to those used by Litman (2016). An upper bound of $18.90 was used for all modes. For emissions costs, lower values were assigned that are similar to those found by Parry et al. (2007). The distribution of all input parameters is shown in Appendix D.

Simulations were conducted for each transit agency to estimate the range and distribution of expected total benefits. Figures 5.18 through 5.23 show the results. Of interest is the 90% confidence interval, which is the range in which 90% of the simulated estimates for total benefits occur. Only 5% of values are below this range and 5% are above. These ranges are estimated to be $2.46 million to $5.36 million for Paul Bunyan Transit, $2.58 million to $10.50 million for SMART, $24.54 million to $46.65 million for St. Cloud Metro Bus, $0.28 million to $2.04 million for St. Peter Transit, $0.87 million to $4.34 million for Timber Trails, and $2.82 million to $10.02 million for Trailblazer Transit. The probability of total benefits being lower than total costs is shown to be very low for each transit agencies. Given these estimated ranges, a range of benefit-cost ratios is shown in Figure 5.24.

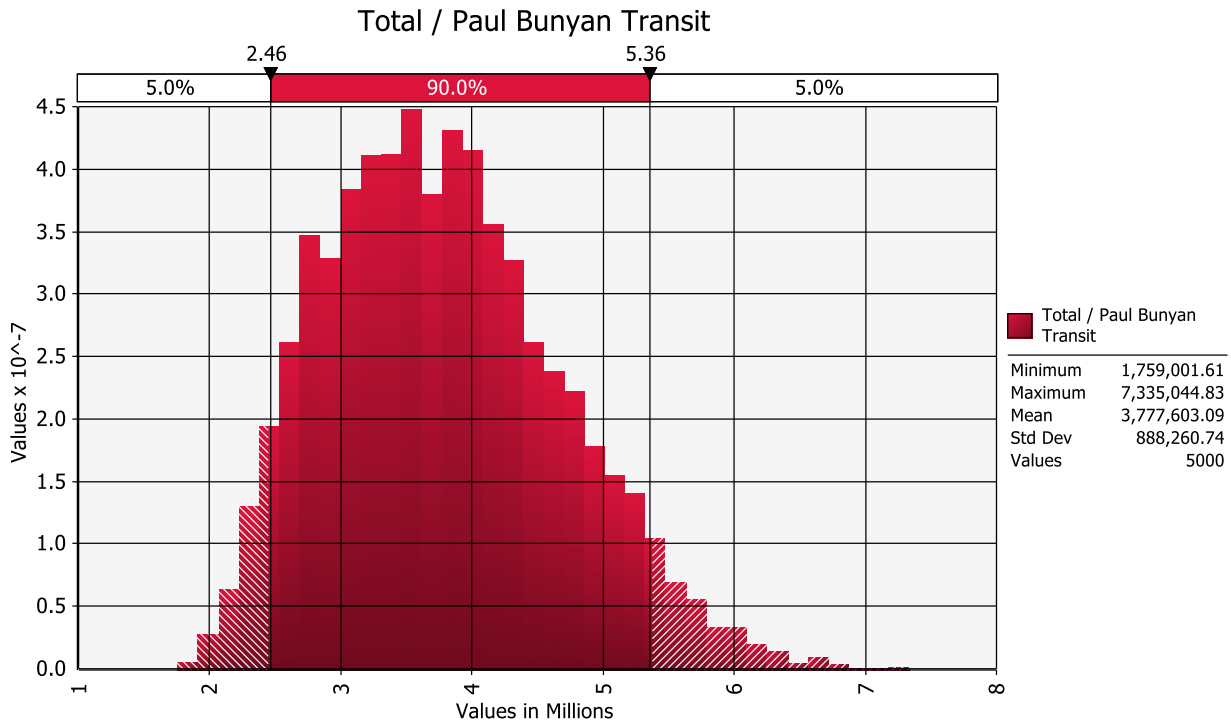

Figure 5.18 Simulation of Total Monetized Benefits for Paul Bunyan Transit

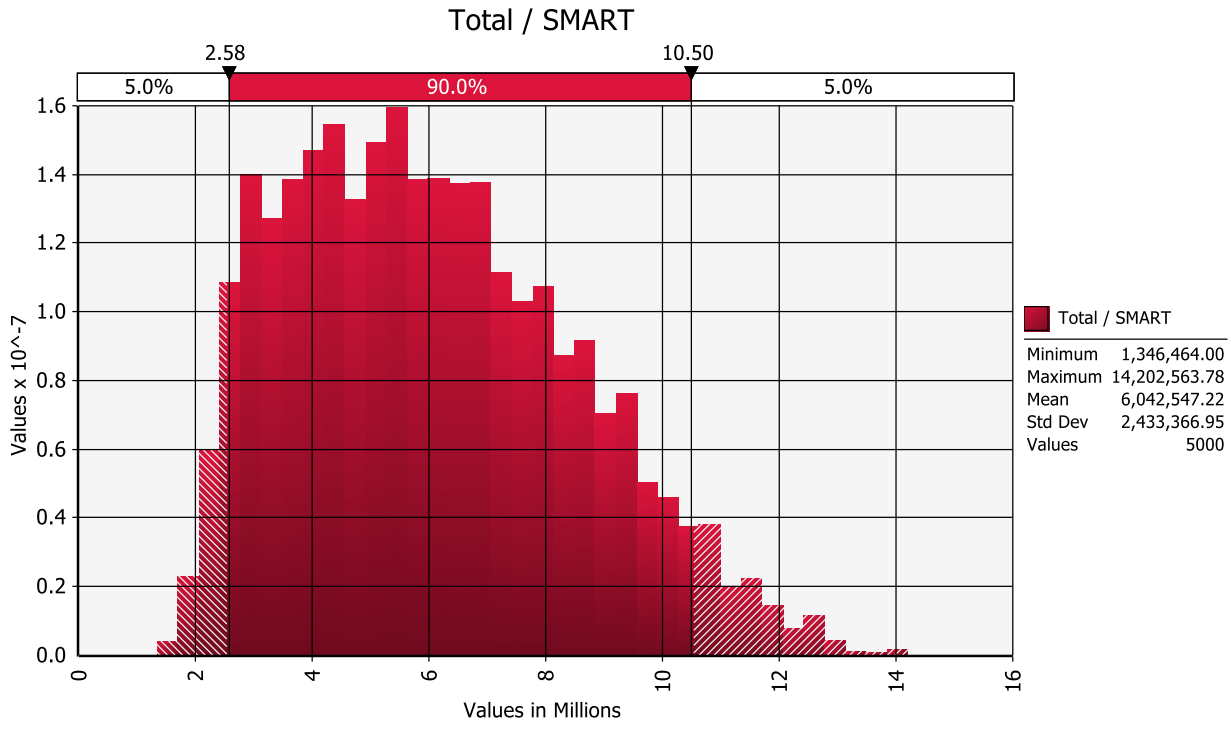

Figure 5.19 Simulation of Total Monetized Benefits for SMART

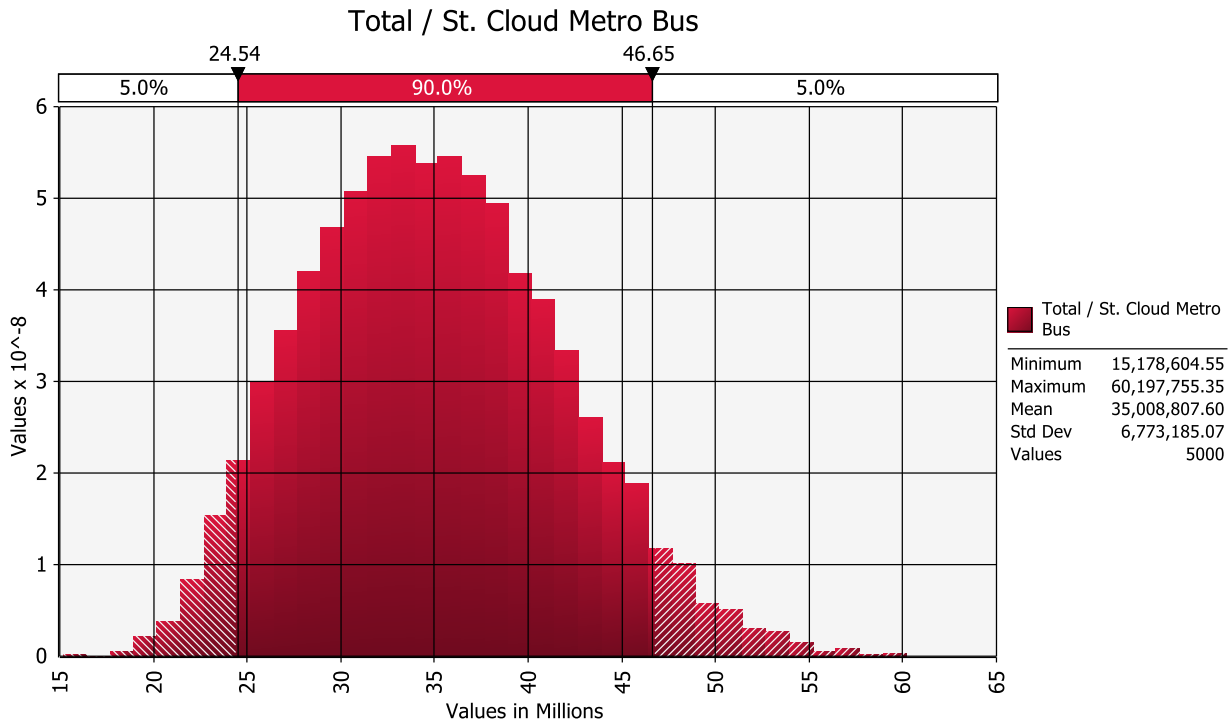

Figure 5.20 Simulation of Total Monetized Benefits for St. Cloud Metro Bus

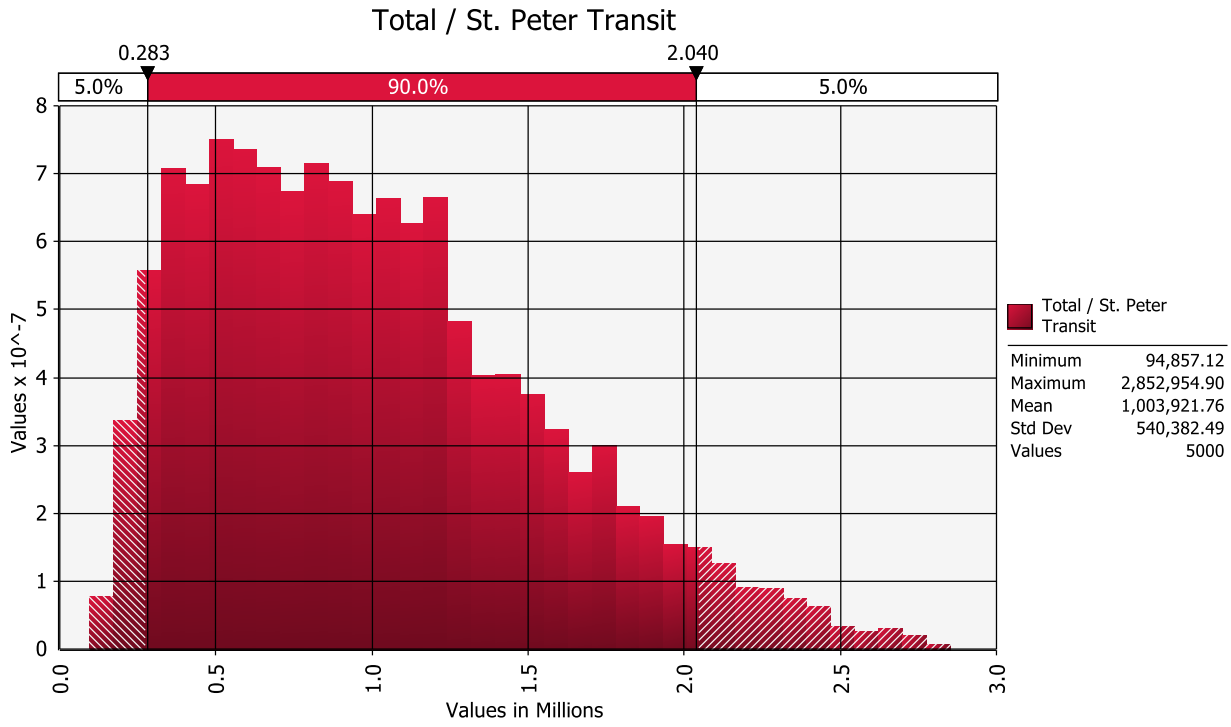

Figure 5.21 Simulation of Total Monetized Benefits for St. Peter Transit

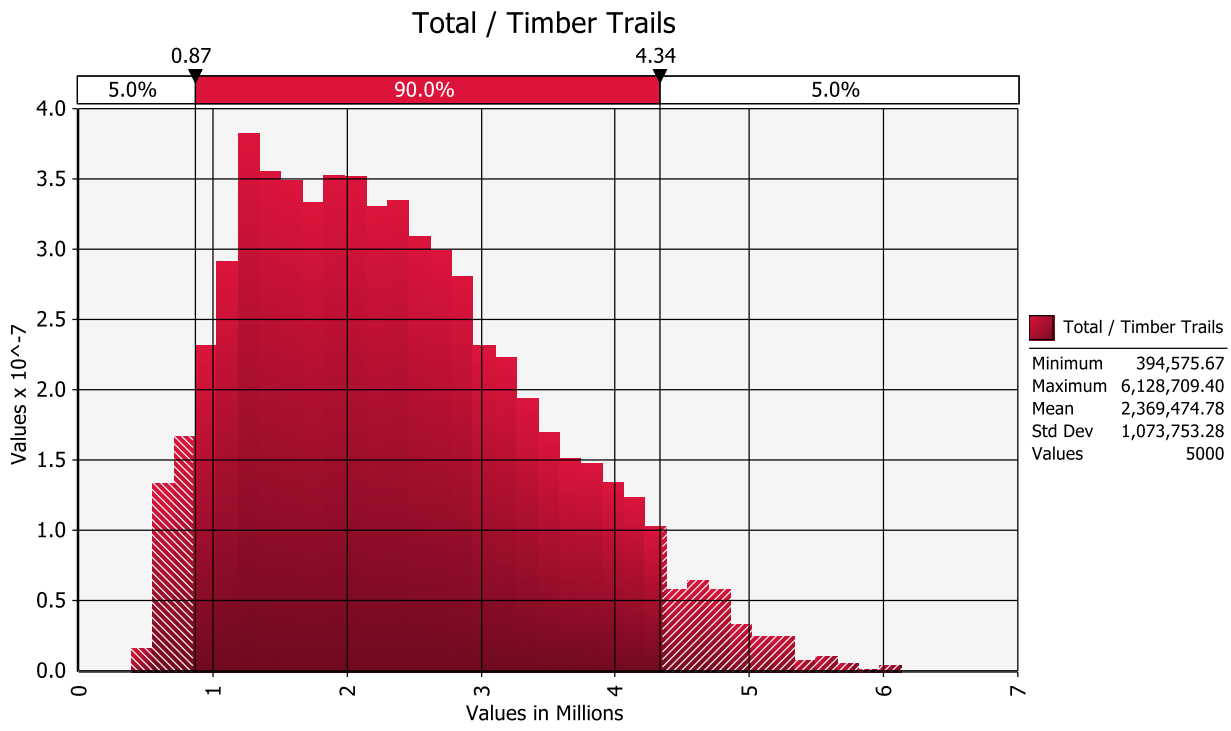

Figure 5.22 Simulation of Total Monetized Benefits for Timber Trails

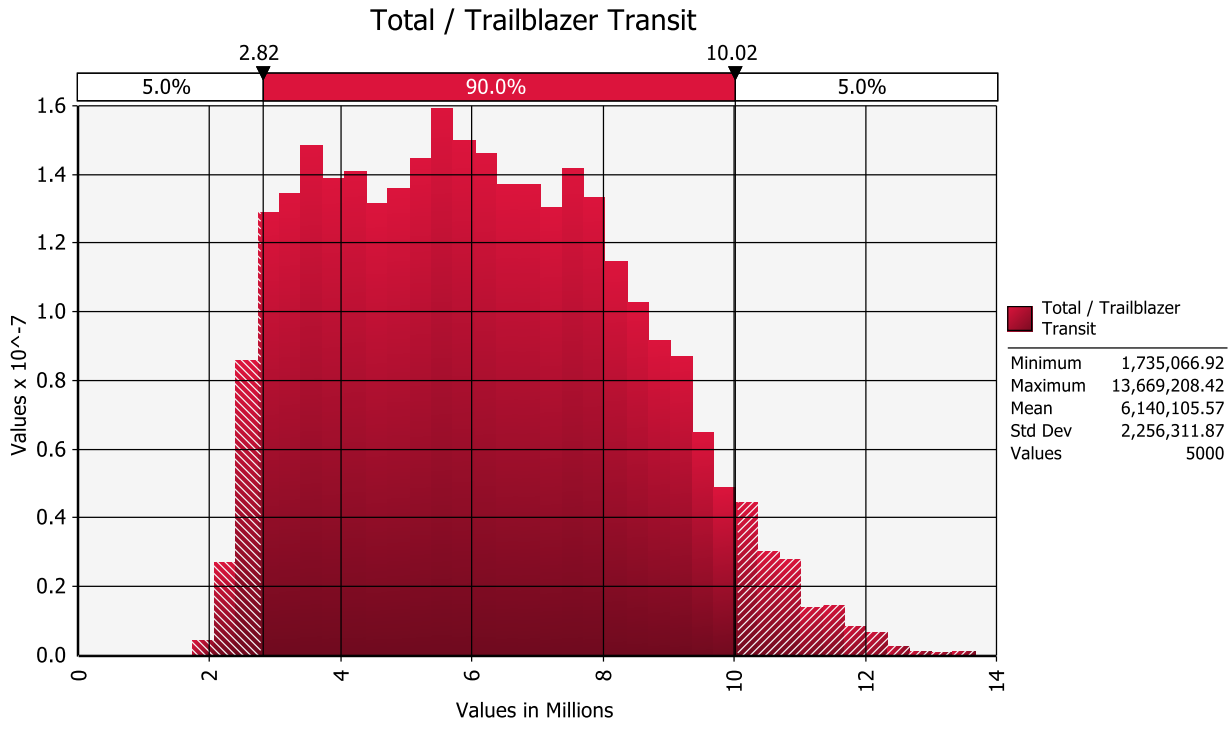

Figure 5.23 Simulation of Total Monetized Benefits for Trailblazer Transit

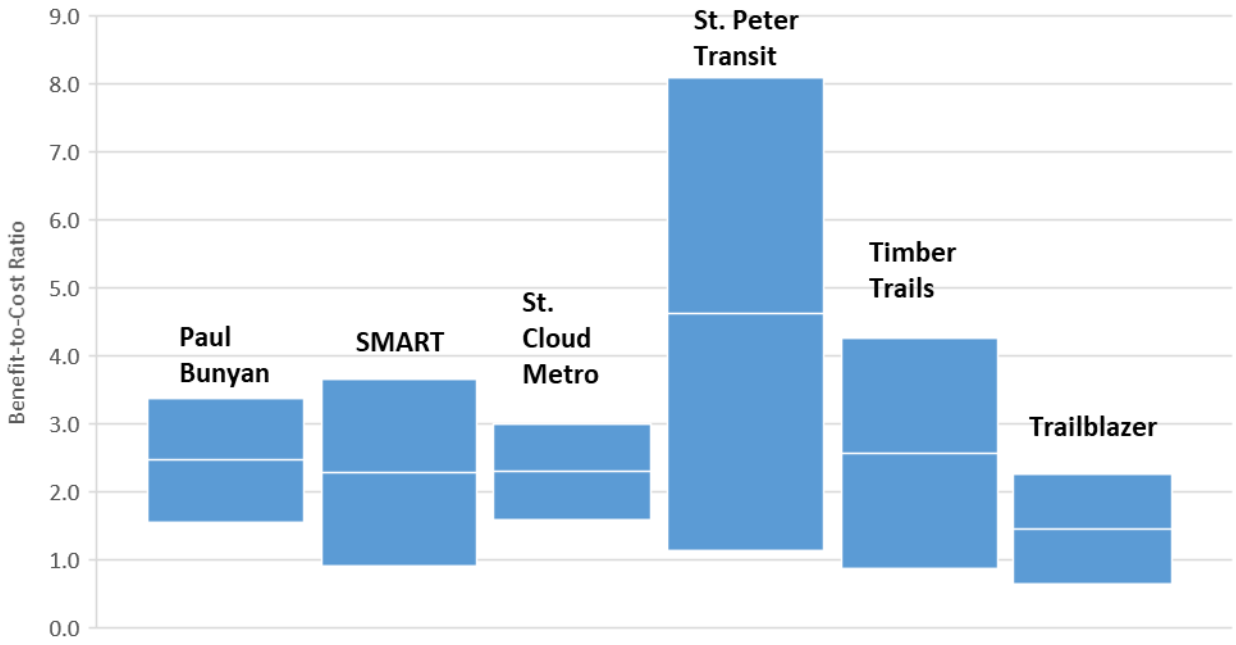

Figure 5.24 Ninety-Percent Confidence Intervals for Estimated Benefit-to-Cost Ratios

Estimated benefit-cost ratios range from 1.5 to 3.4 for Paul Bunyan Transit, 0.9 to 3.7 for SMART, 1.6 to 3.0 for St. Cloud Metro Bus, 1.1 to 8.1 for St. Peter Transit, 0.9 to 4.3 for Timber Trails, and 0.6 to 2.3 for Trailblazer Transit. There is only a 5% chance the benefit-cost ratios would be below these ranges, and a 5% chance they would he higher.

Sensitivity analysis identifies the variables that have the greatest impact on estimated benefits. Figures 5.25 through 5.30 rank the input variables for each transit agency by the effects they have on the output mean, which is estimated total benefits. The graphs show the range in which total benefits vary given changes in the input variable, holding all other variables constant.

For each transit agency, the three most important variables are the percentage of health care trips that they provide, the percentage of trips that would be forgone if transit was not available, and the cost assigned to a forgone health care trip. Changes in these variables have significant effects on total estimated benefits. This makes sense, given that providing health care trips to those who otherwise would not have made the trip represents a large share of the benefits of transit in Greater Minnesota. Results suggest that transit agencies that serve a higher percentage of health care trips, especially for those with a chronic condition where the cost of a missed trip is high, and agencies that serve more transit dependent riders will provide a greater benefit.

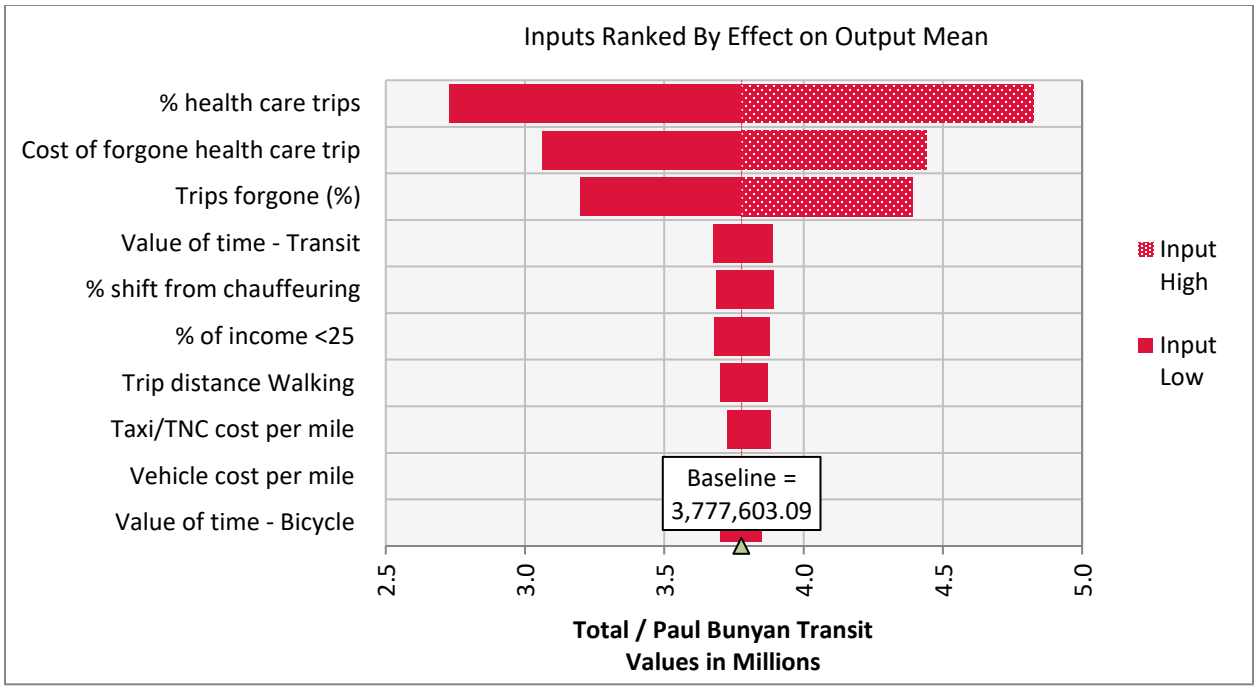

Figure 5.25 Effects of Input Variables on Total Benefits, Paul Bunyan Transit

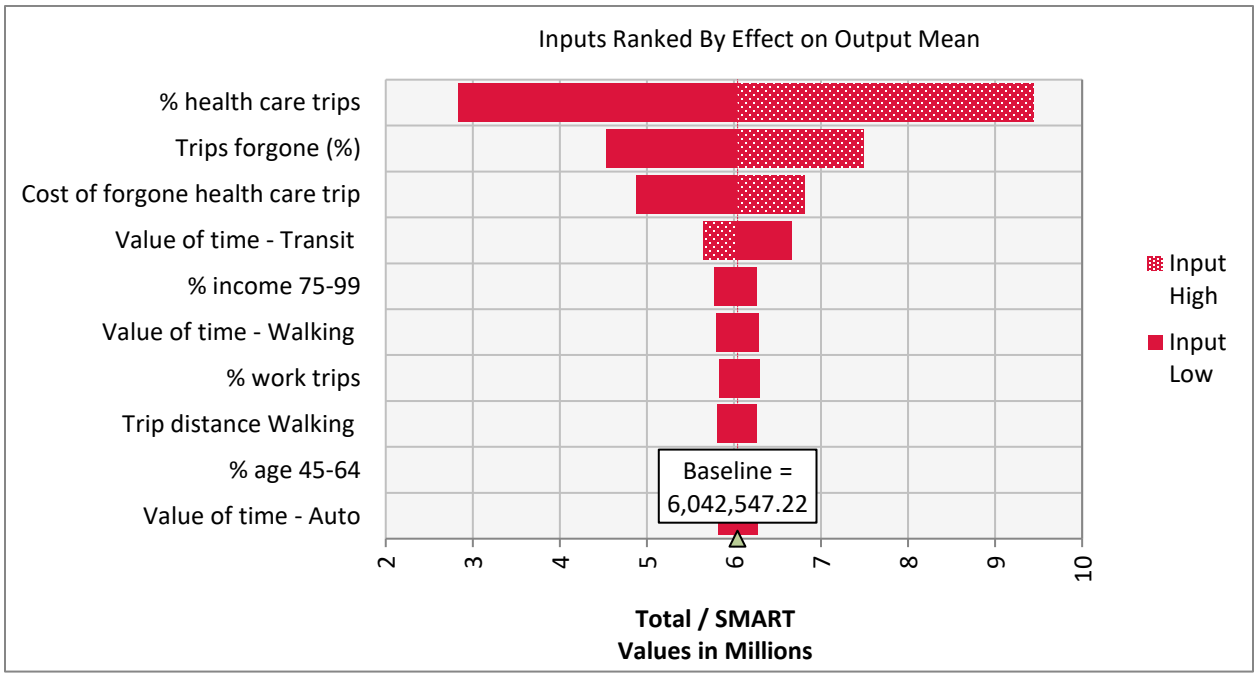

Figure 5.26 Effects of Input Variables on Total Benefits, SMART

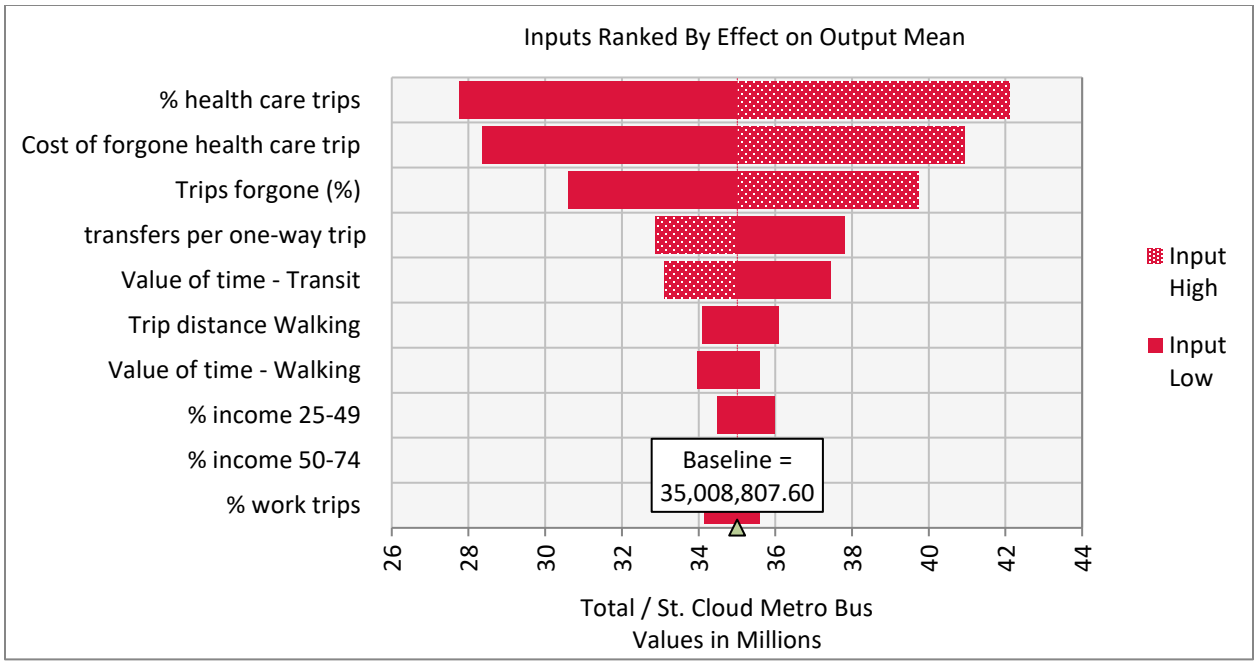

Figure 5.27 Effects of Input Variables on Total Benefits, St. Cloud Metro Bus

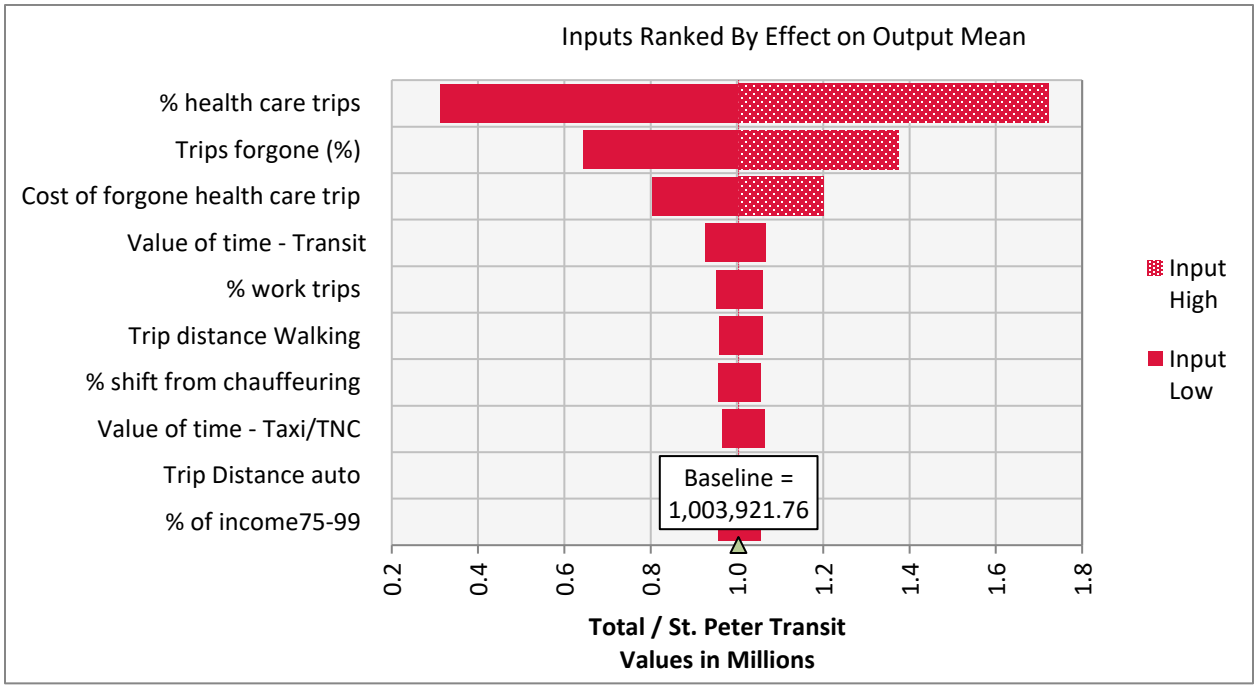

Figure 5.28 Effects of Input Variables on Total Benefits, St. Peter Transit

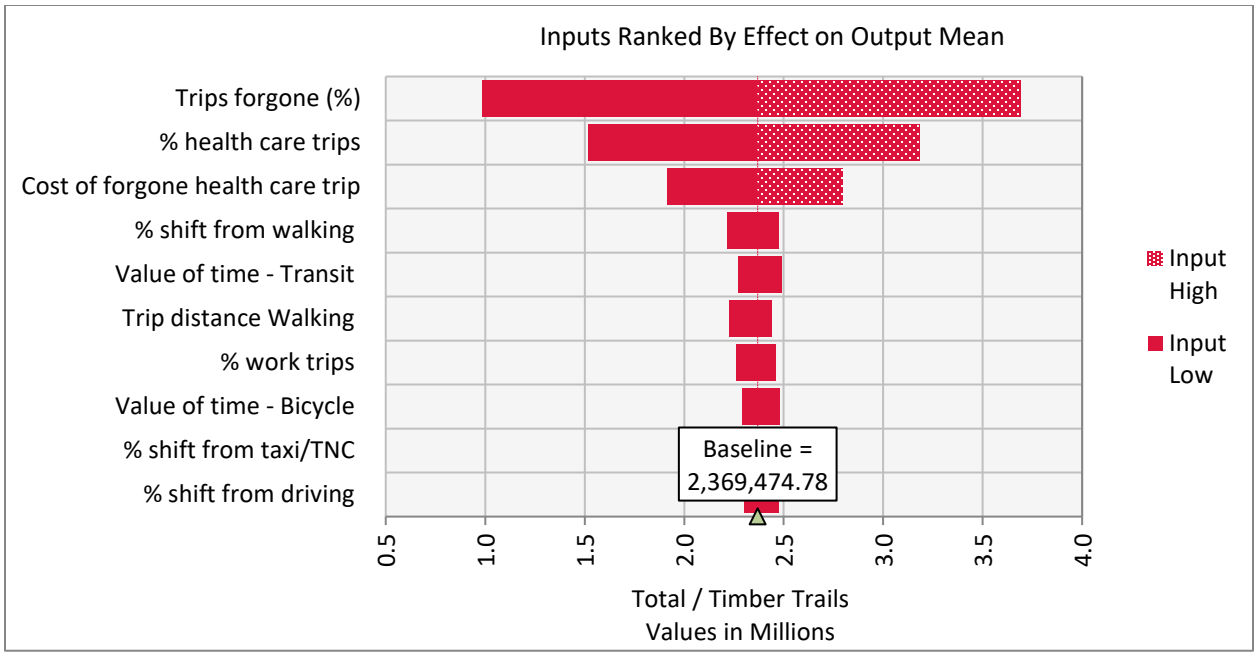

Figure 5.29 Effects of Input Variables on Total Benefits, Timber Trails

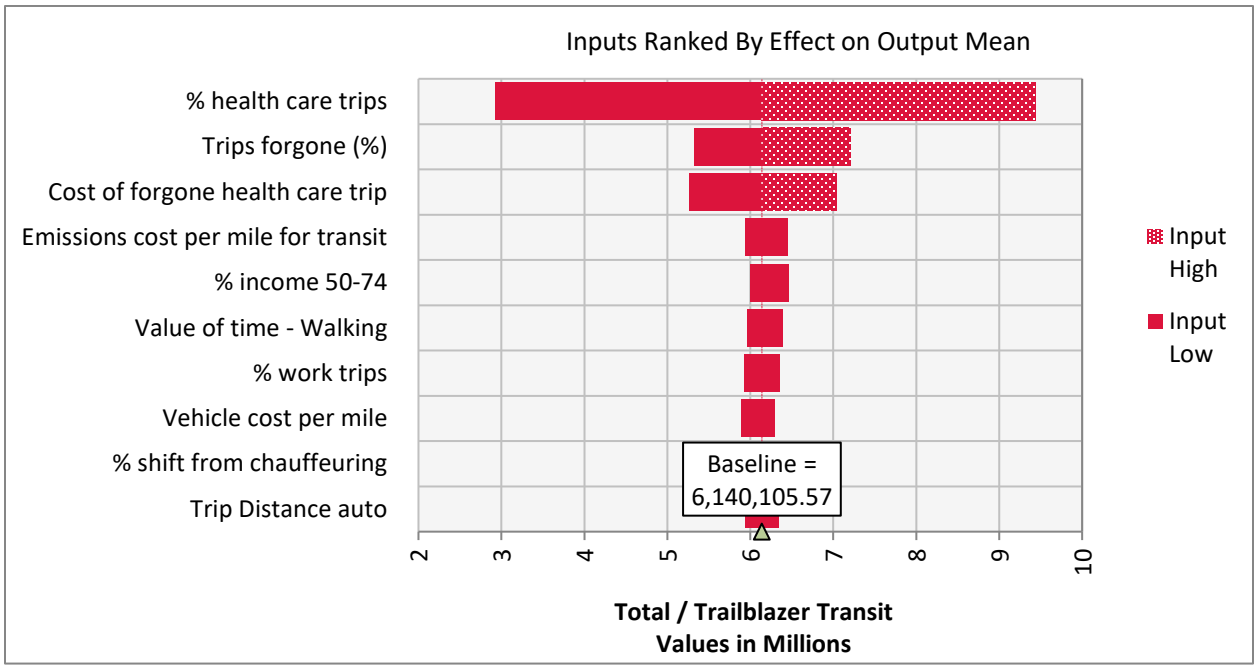

Figure 5.30 Effects of Input Variables on Total Benefits, Trailblazer Transit

5.10 ECONOMIC IMPACTS

The mobility benefits and efficiency benefits are societal benefits from providing trips to people who otherwise would not be able to travel or from shifting trips from other modes to transit. There are other economic impacts of transit within the local community that can be estimated separately. The economic impact analysis shows impacts to the local economy. These are not net benefits and cannot be added to the monetary social benefits, but they show how spending on transit service, improved access to shopping, and retaining population impacts jobs, earnings, and value-added in the local economy.

5.10.1 Impacts from Transit Spending

Economic impact estimates were developed for each agency using TREDTransit. The impacts from transit spending are those that result from the existence of transit operations, including direct effects, indirect effects, and induced economic activity. The direct effect includes the jobs created directly by the transit system. The indirect effect results from jobs and income spent in industries that supply inputs to public transit. Induced economic activity results from the income generated through both the direct and indirect effects. The analysis estimates total jobs supported, labor income, value-added, and output. Value-added includes labor income, taxes, and other income or profit. Output is the total change in local sales.

For each case study, the area of analysis included the county or counties in which the transit agency provides service. With the exception of St. Cloud Metro Bus, all economic impacts result from spending on operations and none on capital spending. It was assumed that all employees live within the local area, so wages earned stay within the local economy. On the other hand, it was assumed that capital expenditures leave the local economy. For most transit agencies, buses are not produced locally. St. Cloud, however, is an exception. New Flyer, one of the largest bus manufacturers, has a plant in St. Cloud, so the purchase of buses by St. Cloud Metro Bus can also support the local economy. Purchases of New Flyer buses by other transit agencies could also impact the St. Cloud economy. That effect was not reflected in this analysis, but it is included in the statewide analysis in Chapter 6. All results were based on 2017 expenditures.

Paul Bunyan Transit: Paul Bunyan Transit directly supports 35 jobs, and nine additional jobs are supported through the indirect and induced effects. Labor income is $1.10 million, plus an additional $0.3 million through indirect and induced effects. The direct value-added is $1.10 million, and indirect and induced value-added provide an additional $0.49 million. The estimated output effects include $1.45 million in direct effects plus an additional $1.13 million through indirect and induced effects. Total impacts are 44 jobs supported, $1.40 million in labor income, $1.59 million in value added, and $2.58 million in output (Table 5.35). The results can be interpreted to show that for every $1 spent on transit operations yields $1.08 in labor income, $1.30 in value added, and $2.04 in total output.

Table 5.35 Economic Impacts from Transit Spending for Paul Bunyan Transit

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)
Direct Effect	35	1.10	1.10	1.45
Indirect (Supplier) Effect	3	0.11	0.15	0.48
Induced (Income Re-spending) Effect	6	0.19	0.34	0.65
Total Effect	**44**	**1.40**	**1.59**	**2.58**

SMART: Sixty-five jobs are directly supported by SMART, and an additional 15 jobs are supported through indirect effects and induced economic activity. Labor income is $1.94 million for SMART, plus an additional $0.82 million through indirect and induced effects. The direct value-added is $1.94 million, and indirect and induced value-added provide an additional $1.37 million. The estimated output effects include $2.54 million in direct effects plus an additional $2.65 million through indirect and induced effects. Total impacts are 80 jobs supported, $2.75 million in labor income, $3.31 million in value added, and $5.19 million in output (Table 5.36). The results can be interpreted to show that every $1 spent on transit operations yields $0.97 in labor income, $1.10 in value added, and $1.78 in total output.

Table 5.36 Economic Impacts from Transit Spending for SMART

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)
Direct Effect	65	1.94	1.94	2.54
Indirect (Supplier) Effect	3	0.18	0.24	0.76
Induced (Income Re-spending) Effect	12	0.64	1.13	1.89
Total Effect	**80**	**2.75**	**3.31**	**5.19**

St. Cloud Metro Bus: St. Cloud Metro Bus directly supports 174 jobs, and 90 additional jobs are supported through the indirect and induced effects. Direct labor income is $10.79 million, and an additional $4.71 million in labor income is created through indirect and induced effects. The direct value-added is $11.13 million, and indirect and induced value-added provide an additional $7.98 million. The estimated output effects include $14.78 million in direct effects plus an additional $14.63 million through indirect and induced effects. Total impacts are 264 jobs supported, $15.50 million in labor income, $19.11 million in value added, and $29.41 million in output (Table 5.37). Most of these impacts are driven by operations and maintenance, but some impact is also driven by capital investment, largely due to the location of the bus manufacturing plant in St. Cloud. The impact of capital investment was estimated based on the number of New Flyer buses operated by St. Cloud Metro Bus and the percentage of New Flyer buses produced in St. Cloud. The results can be interpreted to show that every $1 spent on transit yields $1.05 in labor income, $1.29 in value added, and $1.99 in total output.

Table 5.37 Economic Impacts from Transit Spending for St. Cloud Metro Bus

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)
Direct Effect	174	10.79	11.13	14.78
Indirect (Supplier) Effect	21	1.13	1.63	3.96
Induced (Income Re-spending) Effect	69	3.58	6.35	10.67
Total Effect	**264**	**15.50**	**19.11**	**29.41**

St. Peter Transit: Minnesota River Valley Transit (including St. Peter Transit) directly supports 35 jobs, and four additional jobs are supported through the indirect and induced effects. Direct labor income is $0.57 million, plus an additional $0.13 million through indirect and induced effects. The direct value-added is $0.57 million, and indirect and induced value-added provide an additional $0.21 million. The estimated output effects include $0.73 million in direct effects plus an additional $0.43 million through indirect and induced effects. Total impacts are 39 jobs supported, $0.70 million in labor income, $0.78 million in value added, and $1.16 million in output (Table 5.38). The results can be interpreted to show that every $1 spent on transit operations yields $0.96 in labor income, $1.07 in value added, and $1.59 in total output.

Table 5.38 Economic Impacts from Transit Spending for St. Peter Transit

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)
Direct Effect	35	0.57	0.57	0.73
Indirect (Supplier) Effect	2	0.06	0.08	0.19
Induced (Income Re-spending) Effect	2	0.07	0.14	0.24
Total Effect	**39**	**0.70**	**0.78**	**1.16**

Timber Trails: Timber Trails directly supports 34 jobs, and three additional jobs are supported through the indirect and induced effects. Direct labor income is $0.73 million, and an additional $0.09 million in labor income is created though indirect and induced effects. The direct value-added is $0.73 million, and indirect and induced value-added provide an additional $0.18 million. The estimated output effects include $0.95 million in direct effects plus an additional $0.48 million through indirect and induced effects. Total impacts are 14 jobs supported, $0.82 million in labor income, $0.91 million in value added, and $1.43 million in output (Table 5.39). The results can be interpreted to show that every $1 spent on transit operations yields $0.86 in labor income, $0.96 in value added, and $1.51 in total output.

Table 5.39 Economic Impacts from Transit Spending for Timber Trails

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)
Direct Effect	11	0.73	0.73	0.95
Indirect (Supplier) Effect	1	0.03	0.04	0.24
Induced (Income Re-spending) Effect	2	0.06	0.14	0.23
Total Effect	**14**	**0.82**	**0.91**	**1.43**

Trailblazer Transit: Trailblazer Transit directly supports 68 jobs, and 26 additional jobs are supported through the indirect and induced effects. Direct labor income is $3.10 million, and an additional $0.93 million in labor income is created through indirect and induced effects. The direct value-added is $3.10 million, and indirect and induced value-added provide an additional $1.47 million. The estimated output effects include $4.40 million in direct effects plus an additional $3.14 million through indirect and induced effects. Total impacts are 93 jobs supported, $4.03 million in labor income, $4.57 million in value added, and $7.54 million in output (Table 5.40). The results can be interpreted to show that every $1 spent on transit operations yields $0.92 in labor income, $1.04 in value added, and $1.71 in total output.

Table 5.40 Economic Impacts from Transit Spending for Trailblazer Transit

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)
Direct Effect	68	3.10	3.10	4.40
Indirect (Supplier) Effect	12	0.49	0.61	1.59
Induced (Income Respending) Effect	14	0.44	0.86	1.55
Total Effect	**93**	**4.03**	**4.57**	**7.54**

5.10.2 Impacts from Improved Access to Shopping

Shopping and eating out are common uses of transit. Given that many shopping trips would not have occurred if the transit service was not available, transit promotes and increases shopping at local businesses and restaurants. Among those who were making a shopping or eating out trip when surveyed, approximately half said they would not have made the trip if transit was not available.

The survey shows that transit provides increased access to local businesses, increasing the total number of trips made. The impact on the local economy depends on the amount of spending per trip and the expected overall impact on local spending. Without transit, individuals may reduce overall spending or purchase more products online instead of at local businesses, negatively impacting the local economy. On the other hand, while they may reduce the number of shopping trips, they may also consolidate their trips and spend more per trip, mitigating the potential impact; or some local businesses may provide delivery.

Survey results do not fully capture all of the potential impacts on the local economy, but they do help support the conclusion that transit benefits the local economy through improved access to shopping. First, it is clear that most transit riders prefer to shop at local businesses and stores. While some may purchase products online or through mail-order catalogs, most would prefer to shop locally (Table 5.41). Among all survey respondents, 90% said they preferred to shop locally, and among those on a shopping trip when surveyed, 97% preferred to shop at local businesses.

Table 5.41 Shopping Preference of Transit Riders

Shopping Preference	Paul Bunyan Transit (n=124)	SMART (n=91)	St. Cloud Metro Bus (n=412)	St. Peter Transit (n=23)	Timber Trails (n=27)	Trailblazer Transit (n=121)
	----------Percentage of respondents----------					
Local businesses	94	96	91	83	85	86
Mail-order catalogs	0	2	0	0	4	2
Online	6	2	9	17	11	12

About one-third of respondents said they would spend more money buying products online if transit was not available, indicating that spending in the local economy would decrease (Table 5.42). Survey results indicate that transit riders most commonly spend about $20-$30 per shopping trip, although there is a wide range of spending.

Table 5.42 Would Transit Riders Spend More Money Online If Transit Was Not Available?

Survey Response	Paul Bunyan Transit (n=109)	SMART (n=71)	St. Cloud Metro Bus (n=306)	St. Peter Transit (n=17)	Timber Trails (n=19)	Trailblazer Transit (n=113)
	----------Percentage of respondents----------					
Spend more online	20	34	38	42	39	31
Not spend more online	80	66	62	58	61	69

Table 5.43 provides an estimate of the amount of money transit riders spend in the community when riding transit, as well as an estimate of the amount of that spending that would be lost to online shopping if transit was not available. The estimate for total spending is based on the estimated percentage of trips that are for shopping and an average of $25 spent per trip. The estimate of spending that would be lost to online sales is based on the percentage of respondents who said they would shop more online and an estimate of how much of their local shopping would be replaced by online shopping. Among those who would replace some local shopping with online shopping, the extent to which they replace local shopping is not known. The estimates in Table 5.43 are based on an assumption of 50% of their local shopping being replaced with online shopping.

Table 5.43 Impact of Shopping Trips to Local Communities

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Amount spent by transit riders ($)	239,000	846,865	2,245,272	106,155	104,986	407,219
Spending lost to online shopping without transit ($)	23,900	143,967	426,602	22,292	20,472	63,119

Spending by transit users in the community has a multiplier effect. It supports local jobs, which support additional economic activity as those employees also spend money in the local economy. To capture

these effects, RIMS II multipliers were obtained. Table 5.44 shows the Type II multipliers for general merchandise stores.[1]

Table 5.44 RIMS II Multipliers for General Merchandise Stores

	Final-demand Output (dollars)	Final-demand Earnings (dollars)	Final-demand Employment (number of jobs)	Final-demand Value-added (dollars)
Paul Bunyan Transit	1.32	0.38	15.62	0.83
SMART	1.49	0.45	17.13	0.92
St. Cloud Metro Bus	1.47	0.43	16.86	0.91
St. Peter Transit	1.39	0.42	16.56	0.87
Timber Trails	1.47	0.43	16.86	0.91
Trailblazer Transit	1.47	0.43	16.86	0.91

Based on those multipliers, Table 5.45 shows the economic impacts of shopping trips made by transit riders. This is the total impact of shopping trips made by transit. If transit was not available, some of the spending made by transit riders would still occur. However, some of the spending and resulting economic impacts would be lost due to fewer trips, reduced spending, and increased online shopping. Table 5.46 specifically shows the economic impacts of the spending made by transit riders who would have shopped online if transit was not available. This captures the impacts that transit has by preventing local sales from being lost to online shopping. This is likely a conservative estimate of the overall impacts from improved access to shopping. While transit can reduce or prevent local shopping from being replaced by online sales, it also allows for additional shopping that would not occur at all, which is not captured in Table 5.46.

Table 5.45 Economic Impacts of Total Shopping Trips Made by Transit Riders

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Earnings ($)	27,533	115,368	290,785	13,366	13,597	52,739
Jobs	1	4	11	1	1	2
Value-added ($)	59,576	234,878	614,643	27,573	28,740	111,476

[1] Multipliers were available at the MnDOT district level. Therefore, the multipliers for Paul Bunyan Transit are for District 2; those for St. Cloud, Timber Trails, and Trailblazer Transit are for District 3; those for SMART are for District 6; and those for St. Peter are for District 7.

Table 5.46 Economic Impacts of Shopping That Would Have Occurred Online

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Earnings ($)	2,753	19,613	55,249	2,807	2,651	8,175
Jobs	0	1	2	0	0	0
Value-added ($)	5,958	39,929	116,782	5,790	5,604	17,279

5.10.3 Impacts from Increased Population in the Community

Transit can further impact the local economy by allowing residents to continue living in the community. As previously discussed, without transit, some may need to move to another city with improved access to amenities. Transit, therefore, supports population, which then supports the local economy. Based on survey response, 7% to 21% of transit riders, depending on the transit agency, said they would move to another town or city if the bus service was not available in their community. Translating these results to economic impacts first requires an estimate of the actual number of people who would move out of the community. We can estimate the number of individual riders for each agency if we assume the average rider rides four days per week, with two trips per day (3.1 unlinked trips per day for St. Cloud assuming transfers). Based on that, an estimate for the total number of individuals who would move to a different city is shown in Table 5.47. Table 5.48 details the economic impacts of keeping these individuals in the local community.

Table 5.47 Number of Riders Who Would Move to a Different City if Transit Were Not Available

Riders who would move to a different city	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Percentage	9%	13%	21%	17%	13%	7%
Number	27	78	640	12	17	44

Table 5.48 Economic Impacts of Keeping People in the Community

	Paul Bunyan Transit	SMART	St. Cloud Metro Bus	St. Peter Transit	Timber Trails	Trailblazer Transit
Earnings ($)	118,662	418,243	3,294,278	67,728	83,720	293,509
Jobs	3	11	93	2	2	8
Value-added ($)	235,814	781,552	6,414,782	128,370	163,024	571,535

CHAPTER 6: GREATER MINNESOTA BENEFITS

Results from the case studies were used to estimate benefits of rural and small urban transit services in Greater Minnesota. To do so, data collected for St. Cloud Metro Bus were used to estimate statewide benefits of section 5307 urbanized transit systems in Greater Minnesota, and results from the other five case studies were used to estimate statewide benefits of section 5311 rural transit systems. Although tribal transit was not included in the case studies, the statewide estimates for rural transit include the tribal transit systems. Results were also calculated for each of the peer groups established in Chapter 5.

6.1 TRANSIT DATA FOR GREATER MINNESOTA

Public transit services in Greater Minnesota consists of seven urbanized systems, sometimes labeled 5307 in reference to the federal funding number, in Duluth, Rochester, St. Cloud, Mankato, Moorhead, East Grand Forks, and La Crescent. Including six tribal transit providers, there are 28 rural transit systems in Greater Minnesota. The rural public transit providers are 5311 funding codes. Figure 6.1 shows the trends in transit ridership in Greater Minnesota from 2000 to 2017. Data for rural systems were not available prior to 2007. Transit agencies in Greater Minnesota provided 11.8 million rides in 2017. This includes 7.8 million from the urbanized 5307 systems and 4.0 million from the rural 5311 systems.[2] Rural transit ridership has grown steadily since data were first reported to the NTD in 2007. Ridership for the urban systems began to grow significantly in 2006 and 2007 and continued to increase through 2013; and it has since leveled off or declined slightly. Table 6.1 presents some additional data for transit in Greater Minnesota for 2017.

[2] Note that the urban 5307 data do not include East Grand Forks or La Crescent. Transit in East Grand Forks is provided by Cities Area Transit, based in Grand Forks, ND, and data specific to East Grand Forks are not reported to the NTD. Similarly, transit in La Crescent are provided by La Crosse Municipal Transit, based in La Crosse, WI, and data specific to La Crescent are not reported to the NTD.

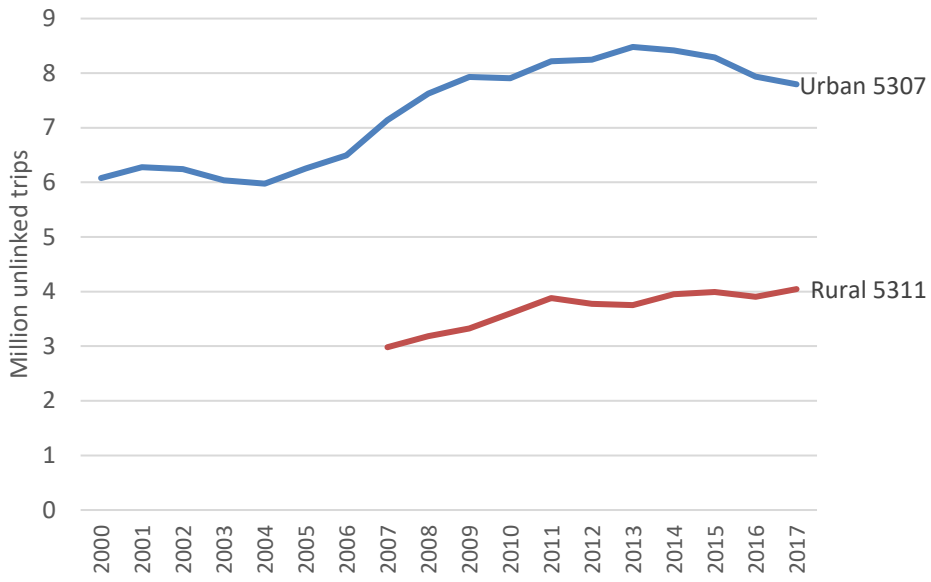

Figure 6.1 Public Transit Ridership in Greater Minnesota, 2007-2017

Table 6.1 Transit Data for Greater Minnesota, 2017

	Rural	Urban
Ridership (million rides)	4.05	7.79
Vehicle Revenue Miles (million miles)	14.82	6.56
Vehicle Revenue Hours (million hours)	0.92	0.48
Number of Vehicles	727	188
Operating Expense (million $)	51.06	42.05
Capital Expense (million $)	6.70	8.03
Trips Per Vehicle Mile	0.27	1.19
Trips Per Vehicle Hour	4.41	16.12
Operating Expense Per Trip ($)	12.62	5.40
Operating Expense Per Mile ($)	3.44	6.41
Operating Expense Per Hour ($)	55.68	86.98
Farebox Recovery Ratio	8%	18%

6.2 SUMMARY OF RURAL TRANSIT SURVEY RESULTS

The previous task included case studies of five rural transit systems and one urban system, and data were collected through rider surveys. Survey results were reported separately for each of the six case study transit agencies in Chapter 5. This section shows the combined survey results for the five rural

agencies. This includes 453 total responses from Paul Bunyan Transit, SMART, St. Peter Transit, Timber Trails, and Trailblazer Transit.

Figure 6.2 shows that most riders use transit multiple days per week, and the most common trip purposes are work, shopping or eating out, health care, and errands or personal business (Figure 6.3). Many of the riders who use the service do not have other options. As shown in Figure 6.4, only 26% have a driver's license, 66% do not have access to a vehicle in their household, 63% have a disability, and 75% have a household income of less than $25,000. Many ride because they cannot drive or prefer not to drive or do not have access to a vehicle, and many believe that transit is convenient and they value the independence it provides them (Figure 6.5). If transit was not available, 35% of respondents said they would not have made the trip. A majority of the remainder would have received a ride from a family member or friend, walked, or used a taxi, Uber, or Lyft (Figure 6.6). Only 3% would have driven themselves. For those who said they would have made the trip some other way, many would have received a ride from staff or someone else.

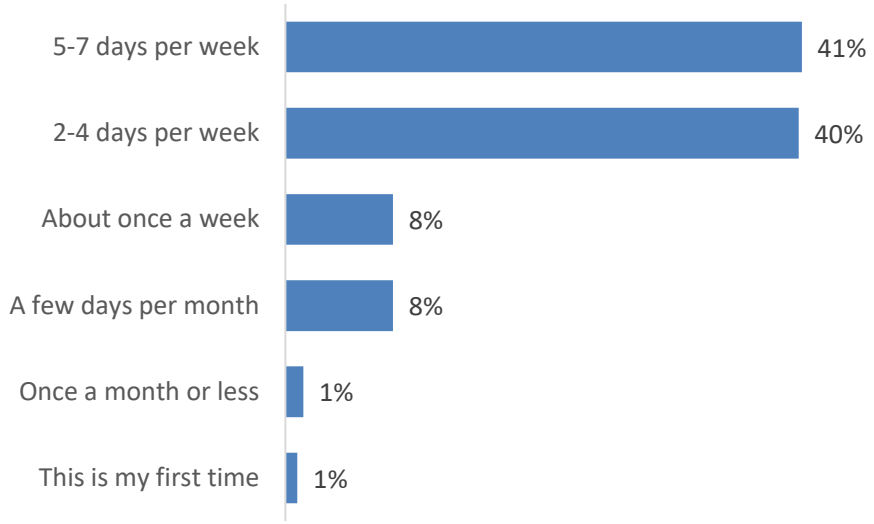

Figure 6.2 Frequency that Rural Riders Use Transit

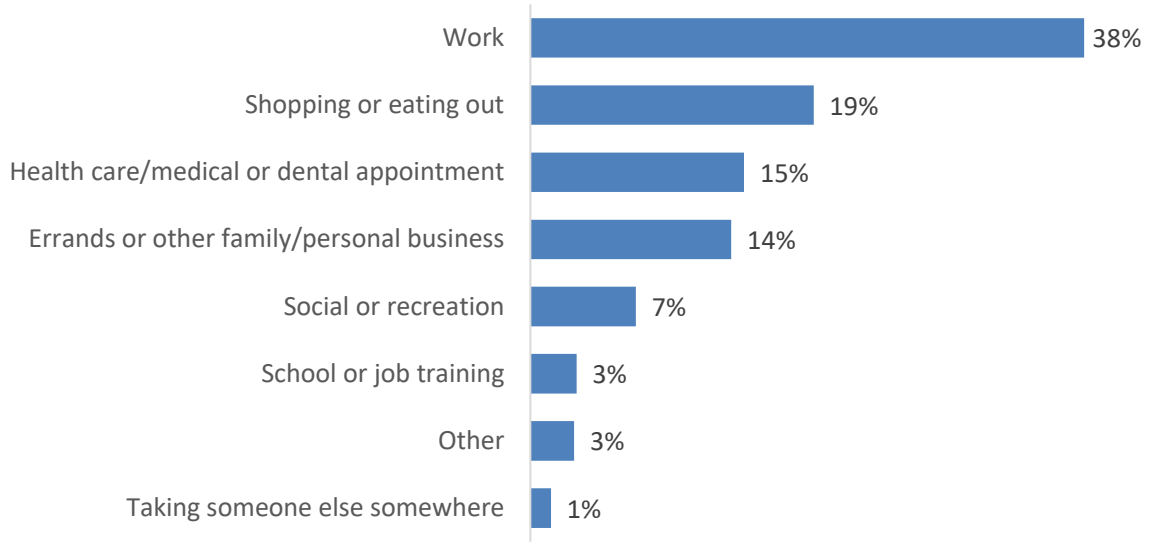

Figure 6.3 Purpose of Trip for Rural Passengers

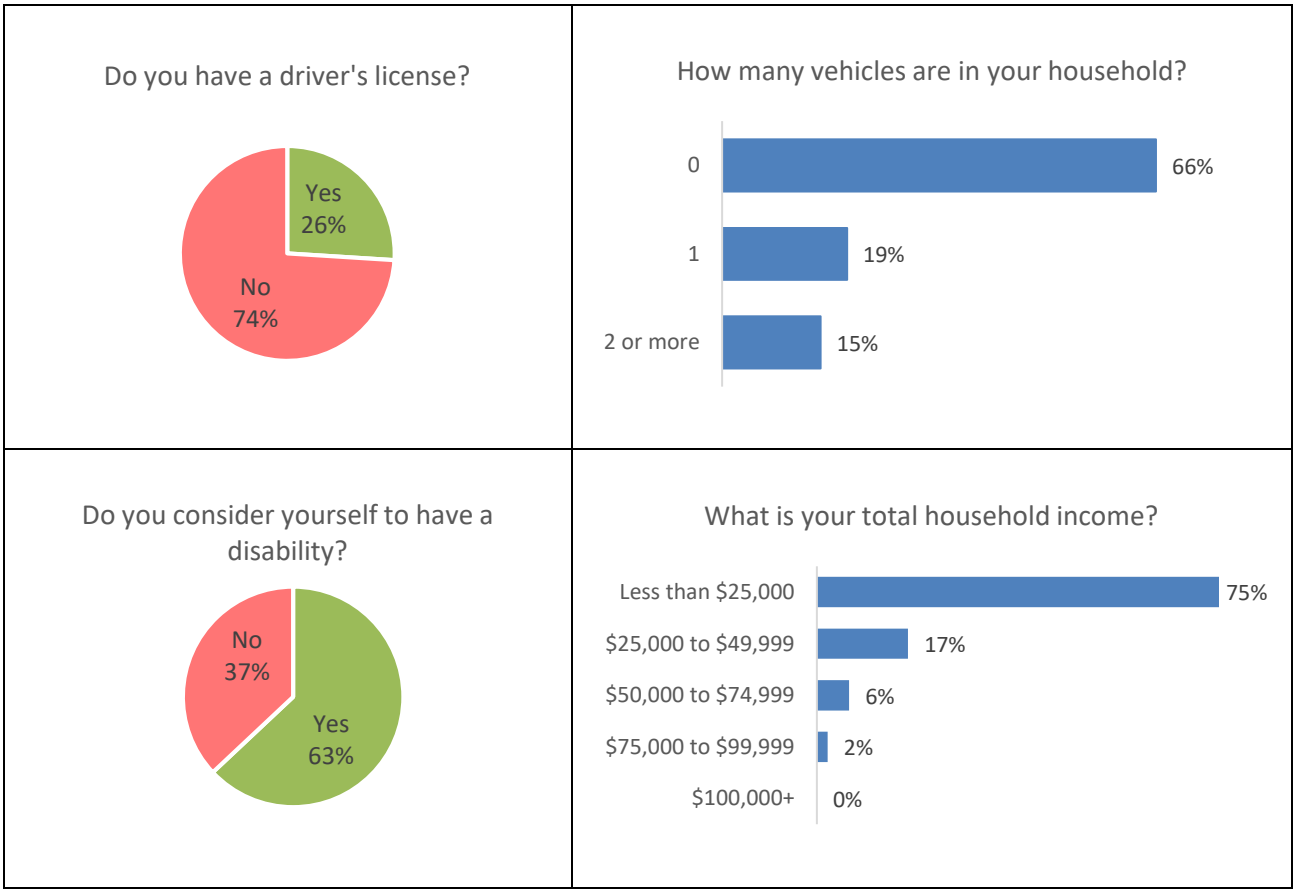

Figure 6.4 Characteristics of Rural Survey Respondents Indicating Transit Dependence

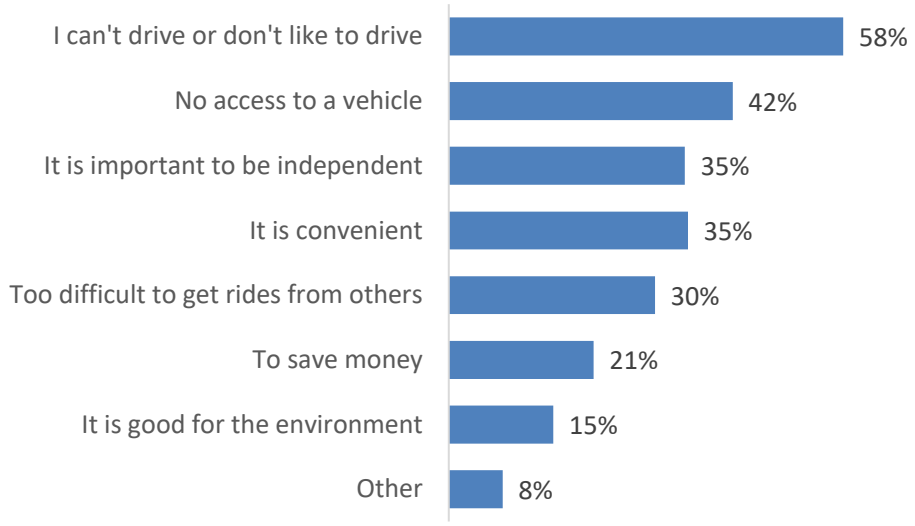

Figure 6.5 Reasons Rural Survey Respondents Use Transit

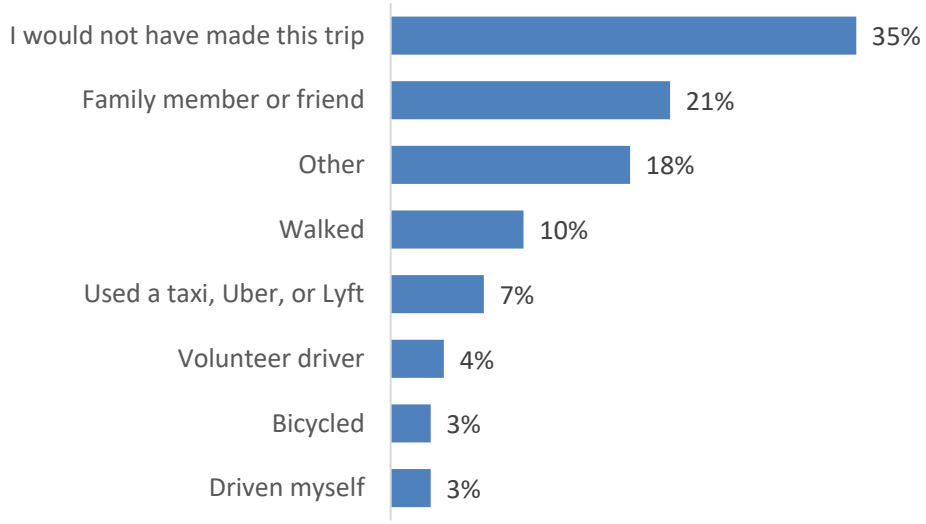

Figure 6.6 How Rural Respondents Would Have Made Trip If Transit Was Not Available

The likelihood that a rider would not have made the trip varies by the by the type of trip. The percentage of riders who would not have made the trip was highest for shopping trips or eating out (54%), errands or personal/family business (52%), school or job training (47%), social or recreational trips (46%), and health care trips (40%). The importance of transit for health care trips is further

illustrated by Figure 6.7, which shows that 13% of riders would miss many health care trips, and an additional 18% would miss at least some health care trips without transit.

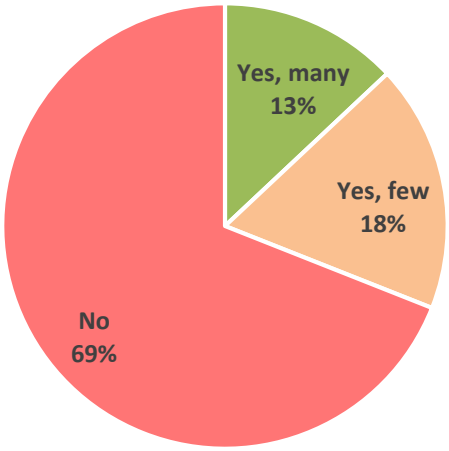

Figure 6.7 Percentage of Rural Respondents That Would Miss Health Care Trips Without Transit

Among those traveling to work, 21% said they would not have made the trip without transit. However, this result may underestimate the importance of transit for work trips because while many riders may temporarily be able to find another means to get to work, those other options (e.g., getting a ride from someone, taking a taxi, or walking) may not be feasible long-term options. The importance of transit for getting to work is illustrated in Figure 6.8. A majority of those riding transit to work said that the service is very important and that they would not be able to keep their job without it.

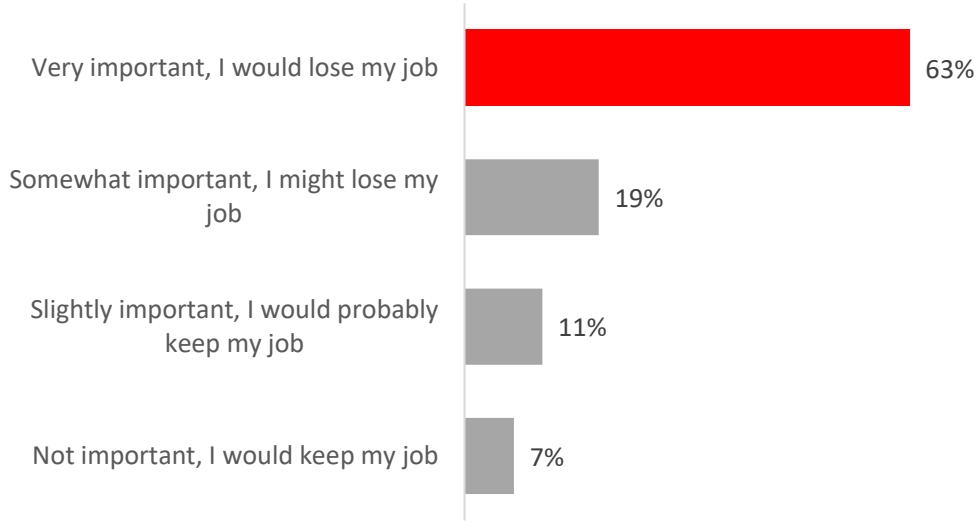

Figure 6.8 Importance of Transit for Getting to Work for Rural Passengers

Overall, 23% of rural respondents said they would move if transit was not available, including 10% who would move to a different town or city (Figure 6.9). Table 6.2 shows the importance of intangible benefits. Most respondents agreed, and many strongly agreed, that transit allows them to make more trips, increases their social interaction, reduces their stress, allows them to live independently, and improves their overall quality of life. Nearly all respondents also agreed that transit keeps them connected to their town (Figure 6.10). Ninety percent of rural respondents prefer to shop locally, and 29% said they would spend more money buying products online if transit was not available (Figure 6.11).

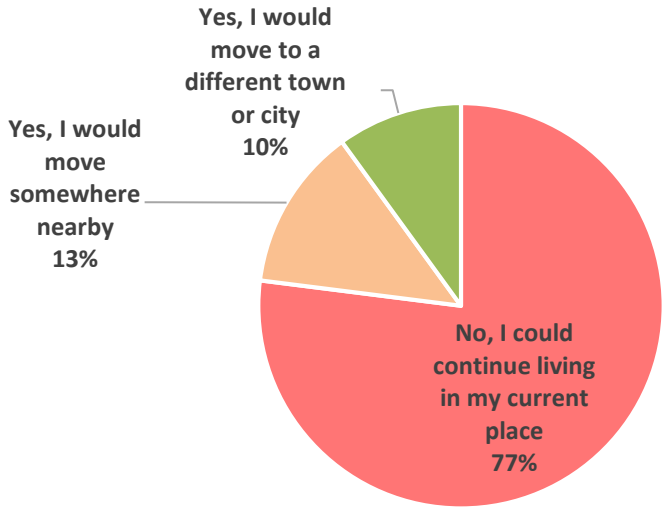

Figure 6.9. Percentage of Rural Respondents That Would Relocate Without Transit

Table 6.2 Intangible Benefits for Rural Passengers

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Allows me to make more trips	53%	32%	10%	3%	2%
Increases my social interaction with other people	45%	28%	22%	3%	2%
Reduces my stress level	40%	32%	23%	3%	2%
Allows me to live independently	51%	30%	14%	3%	2%
Improves my overall quality of life	51%	31%	15%	1%	1%

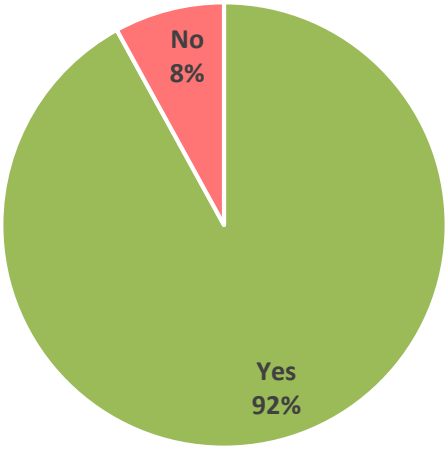

Figure 6.10 Percentage of Rural Respondents Answering Whether Transit Keeps Them Connected to Their Town

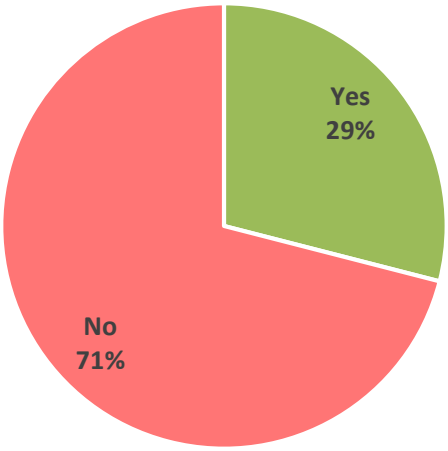

Figure 6.11 Percentage of Rural Respondents Answering Whether They Would Spend More Money Buying Products Online if Transit Were Not Available

6.3 ESTIMATION OF BENEFITS

Statewide benefits of rural transit systems were estimated based on survey results from the five rural transit systems and 2017 operational data for all rural operations in the state. Total benefits of urban transit in Greater Minnesota were estimated based on results from the St. Cloud rider survey and transit data for urban systems in Greater Minnesota.

6.3.1 Estimated Monetary Benefits

A summary of results is shown in Table 6.3. Total benefits are estimated at $128 million for the rural systems, $143 million for urban providers, and $271 million overall. Benefits are categorized as either mobility benefits or efficiency benefits. Mobility benefits are those resulting from providing trips to people who otherwise would not be able to make the trip. Efficiency benefits are those from individuals taking transit instead of driving, getting a ride from someone, walking or biking, or making the trip some other way.

Table 6.3 Summary of Estimated Greater Minnesota Monetary Benefits

	Rural	Urban	Total
Mobility Benefits			
Low-cost mobility benefit ($)	3,750,469	3,857,064	7,607,533
Access to health care benefit ($)	107,041,780	121,451,153	228,492,933
Public assistance cost savings ($)	10,072,423	9,083,705	19,156,128
Efficiency Benefits			
Vehicle operating cost savings ($)	27,821	-65,125	-37,305
Chauffeuring cost savings ($)	11,144,524	7,151,127	18,295,650
Travel time benefits ($)	-1,619,399	2,058,385	438,986
Safety benefits ($)	152,708	271,003	423,711
Environmental benefits ($)	-2,632,430	-708,102	-3,340,532
Total ($)	**127,937,896**	**143,099,209**	**271,037,104**

Access to health care benefits comprises a large share of these benefits. These benefits result from providing trips to health care service for individuals who otherwise would not be able to make those trips. Public assistance cost savings, chauffeuring cost savings, and low-cost mobility benefits comprise most of the remainder of the benefits. Public assistance cost savings result when transit is able to provide access to work to individuals who otherwise would not be able to travel to work. Transit allows more people to go to work and maintain a job, which reduces the need for government spending on assistance programs. Chauffeuring cost savings are benefits to family members and friends who would need to provide transportation to transit riders if transit was not available. These savings include the cost of operating the vehicle as well as the value of their time for providing the trip. It does not include savings from using transit instead of TNCs or taxis. Low-cost mobility benefits are benefits to transit riders who would not be able to afford to make the trip any other way if transit was not available.

A comparison of the benefits to total costs shows a benefit-to-cost ratio of 2.2 for rural transit, 2.9 for urban systems, and 2.5 overall. These estimates are based on 2017 data and could change based on inflation. However, both benefits and costs would increase with inflation, so the ratios may not change significantly. Per-trip benefits and costs are detailed in Tables 6.5 and 6.6. These data are specific to Minnesota, but they could also be consistent with rural providers in other states. Some operators in very rural areas may have higher per trip costs, but per trip benefits could also be higher, especially if they are providing long-distance trips and serving a high percentage of health care and work trips for people without other options.

Table 6.4 Comparison of Greater Minnesota Benefits and Costs

	Rural	Urban	Total
Benefits ($)	127,937,896	143,099,209	271,037,104
Costs			
Operating ($)	51,059,548	42,054,185	93,113,733
Capital ($)	6,702,255	8,033,024	14,735,279
Total ($)	57,761,803	50,087,209	107,849,012
Benefit-cost ratio	**2.2**	**2.9**	**2.5**

Table 6.5 Summary of Greater Minnesota Estimated Monetary Benefits, Per Trip

	Rural	Urban	Total
Mobility Benefits			
Low-cost mobility benefit ($)	0.93	0.49	0.64
Access to health care benefit ($)	26.46	15.58	19.30
Public assistance cost savings ($)	2.49	1.17	1.62
Efficiency Benefits			
Vehicle operating cost savings ($)	0.01	-0.01	0.00
Chauffeuring cost savings ($)	2.75	0.92	1.55
Travel time benefits ($)	-0.40	0.26	0.04
Safety benefits ($)	0.04	0.03	0.04
Environmental benefits ($)	-0.65	-0.09	-0.28
Total ($)	**31.63**	**18.36**	**22.89**

Table 6.6 Comparison of Greater Minnesota Benefits to Costs, Per Trip

	Rural	Urban	Total
Benefits ($)	31.63	18.36	22.89
Costs			
Operating ($)	12.62	5.40	7.87
Capital ($)	1.66	1.03	1.24
Total ($)	14.28	6.43	9.11
Benefit-cost ratio	**2.2**	**2.9**	**2.5**

6.3.2 Sensitivity Analysis

Similar to the case studies, a simulation model was run to show how total estimated benefits vary with changes in input variables. Input variables include costs associated with driving, value of time, percentage of transit trips that would be forgone without transit, the cost associated with a missed health care trip, the percentage of transit trips for different purposes, and others. Simulations estimate the range and distribution of expected total benefits. Appendix D provides more details about the distributions of the input data. One difference from the case studies is that by combining the responses from the five rural rider surveys, the margin of error was reduced to 5%.

Figures 6.12 and 6.13 show the results of the simulations. The 90% confidence intervals are estimated to be $87.7 million to $173.7 million for rural transit and $107.6 million to $199.9 million for urban transit. Results show that benefits almost certainly exceed costs. Not only are costs lower than the 5% percentile for estimated benefits, they are lower than the lowest simulated value for benefits for both rural and urban transit. Based on the 90% range, benefit-cost ratios are estimated to range from 1.5 to 3.0 for rural transit and from 2.1 to 4.0 for urban transit in Greater Minnesota.

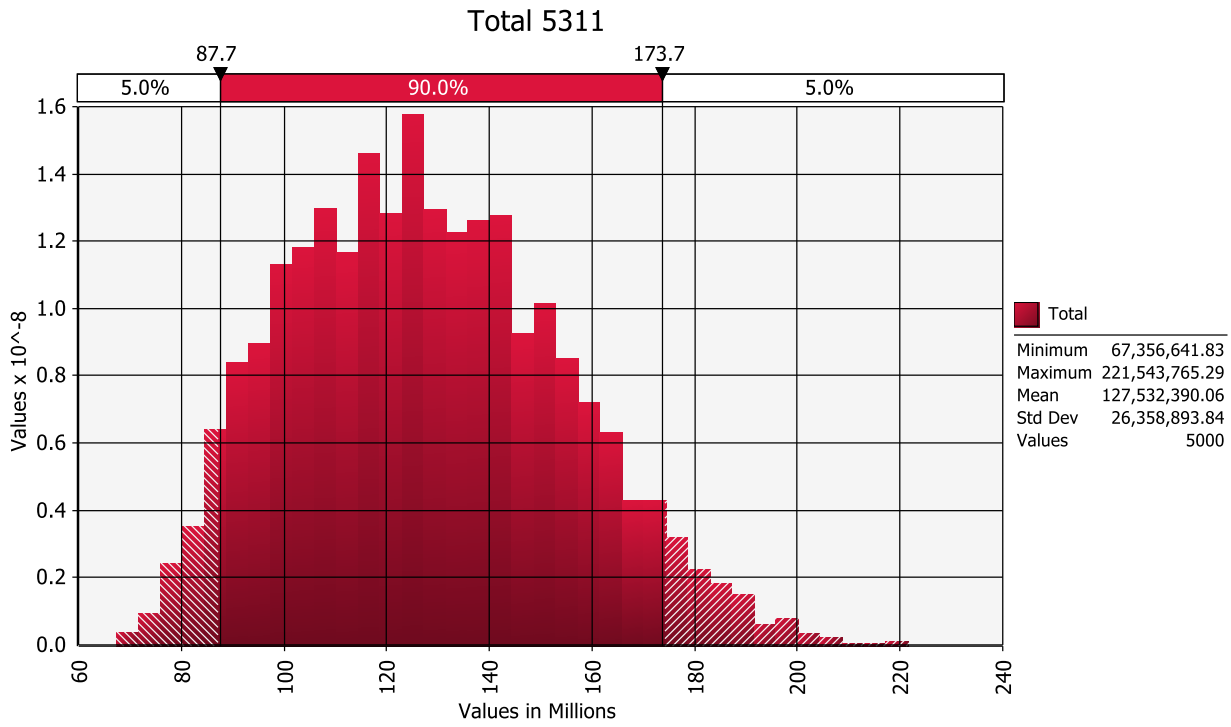

Figure 6.12 Simulation of Total Estimated Benefits for Rural Transit

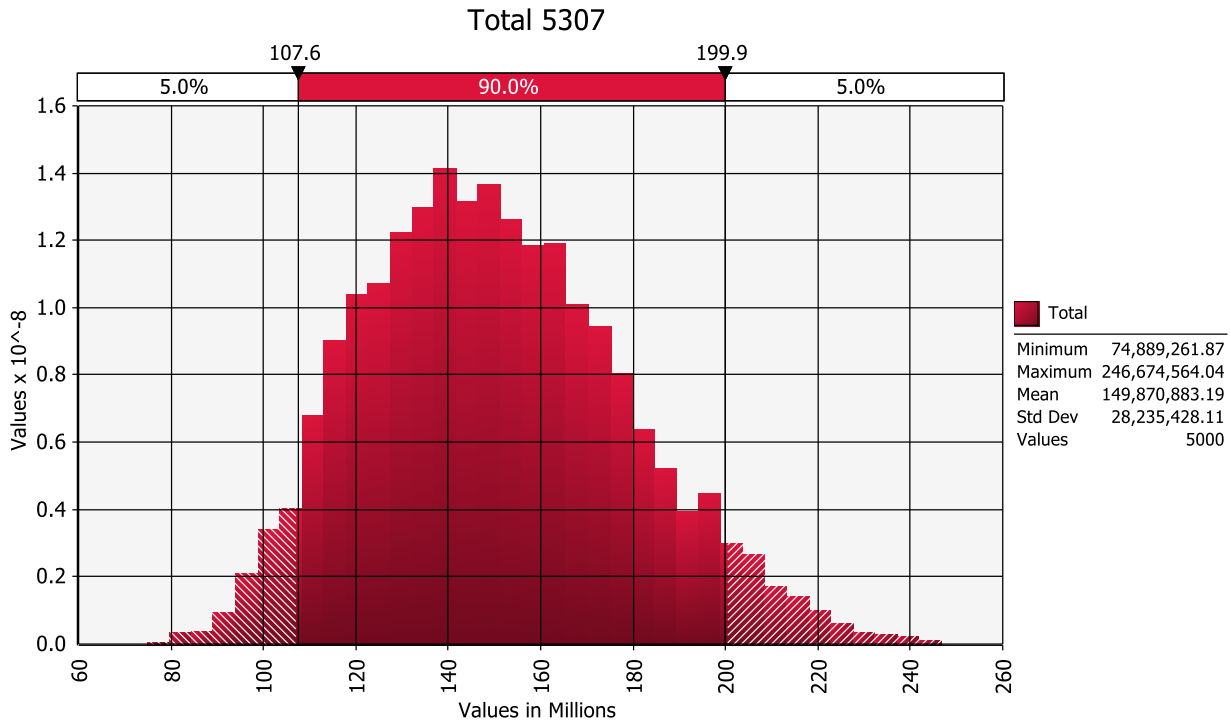

Figure 6.13 Simulation of Total Estimated Benefits for Urban Transit in Greater Minnesota

Figures 6.14 and 6.15 rank the input variables by the effects they have on the output mean, which is estimated total benefits. The graphs show the range in which total benefits vary given changes in the input variable, holding all other variables constant. Like the case studies showed, the three most important variables are percentage of health care trips provided, the cost assigned to a forgone health care trip, and the percentage of trips that would be forgone in the absence of transit. Again, results show that transit agencies that serve a higher percentage of health care trips, especially for those with a chronic condition where the cost of a missed trip is high, and agencies that serve more transit dependent riders will provide a greater benefit. The value of time is shown to be the next most important. If we assume a lower value of time, then estimated benefits will be higher. This is because the longer travel times with transit, in comparison with automobile travel, are less costly if the value of time is lower. The assumed rate of transfers is also important for urban systems because it is needed for translating the given number of unlinked passenger trips to the number of roundtrips that are made.

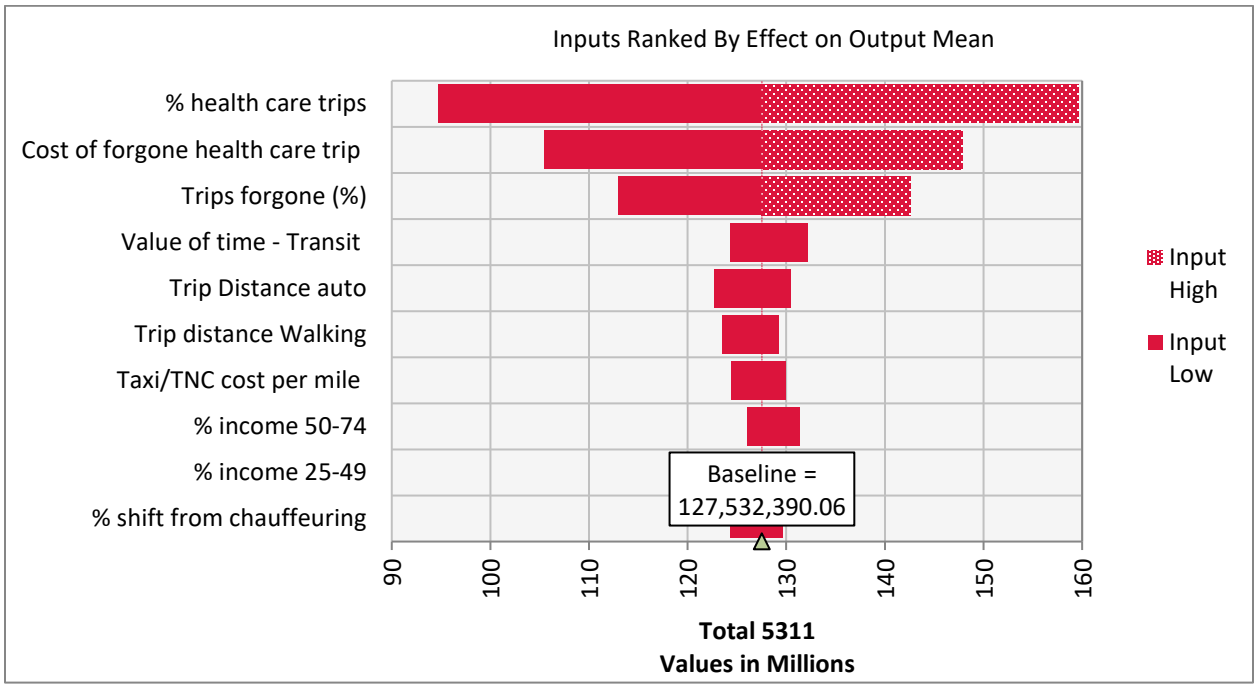

Figure 6.14 Effect of Input Variables on Total Benefits, Rural Transit

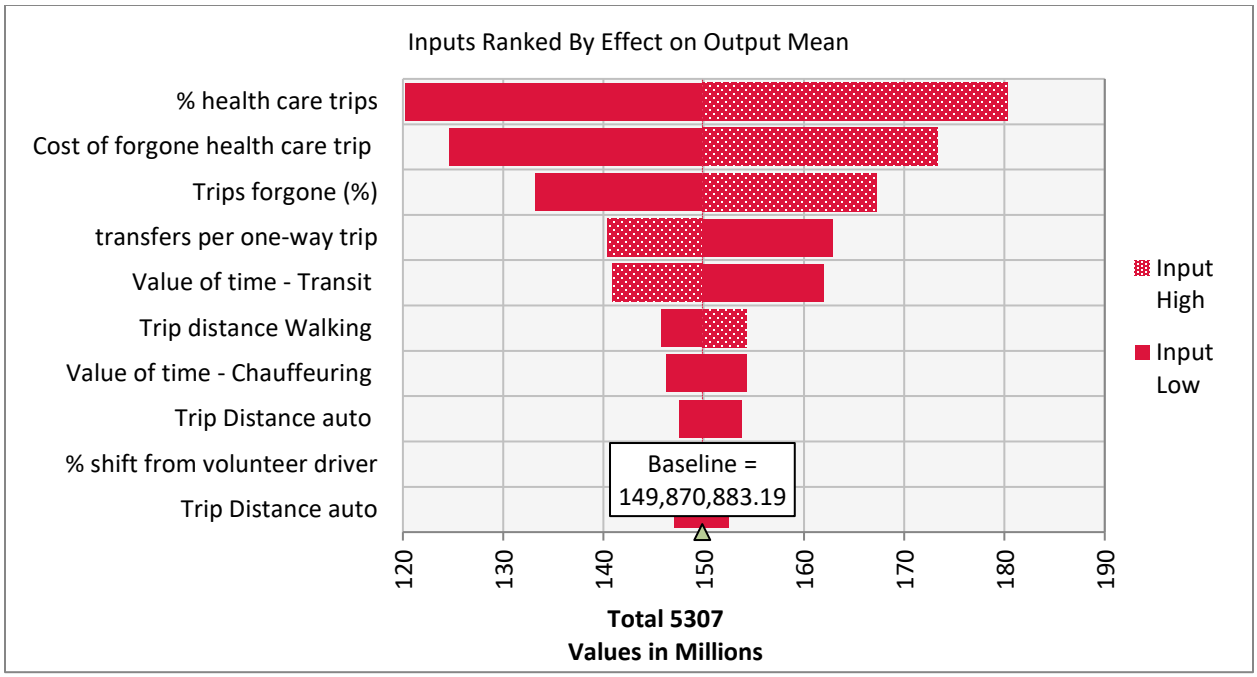

Figure 6.15 Effect of Input Variables on Total Benefits, Urban Transit in Greater Minnesota

6.3.3 Other Benefits

The benefits presented in the previous sections do not include those that were not quantified in dollar terms. Other benefits include relocation cost savings, intangible user benefits, increased productivity, equity, and the option value. Relocation cost savings refer to costs avoided if the transit rider is able to remain living in their current location. It is estimated that 23% of rural transit riders and 45% of urban riders in Greater Minnesota would relocate if transit was not available, including many who would move to a different town or city and some who would need to move to an assisted living facility. The intangible benefits listed in Table 6.2 demonstrate the positive effect transit has by improving social connectedness, reducing stress, allowing for independent living, and improving overall quality of life. Increased productivity is a result of the improved access to work and education, which is demonstrated by the high percentage of riders that rely on transit for those purposes.

Finally, another important benefit of transit is promoting equity by serving population groups not well served by other transportation options. Table 6.7 shows the percentage of transit riders belonging to transportation-disadvantaged or minority groups. The rural estimates are based on the results from the rider surveys from the five rural case studies, and the urban estimates are based on the St. Cloud rider survey. As the table shows, transit serves a disproportionately higher percentage of these populations. For example, among the Greater Minnesota population, 20% have household income below $25,000, 6% do not have any vehicles in the household, and 12% have a disability. Among transit riders, however, 75% of rural riders and 66% of urban riders have household income below $25,000, about two-thirds do not have a vehicle, and 63% of rural riders and 49% of urban riders have a disability. Transit also serves a disproportionately higher percentage of minorities and older adults.

Table 6.7 Demographics of Population and Transit Riders in Greater Minnesota

Population Group	Rural Transit Riders (%)	Urban Transit Riders (%)	Greater Minnesota Population (%)
Minority (non-white)	18	31	8
Income less than $25,000	75	66	20
Income less than $50,000	92	89	43
No driver's license	74	72	NA
No vehicles in household	66	69	6
Disability	63	49	12
Age 65 or older	27	21	17
Age 75 or older	11	8	8

NA=not available

6.4 PEER GROUP RESULTS

Within rural transit agencies there are five peer groups identified for this study, as described in Chapter 5. The five rural case study agencies each belong to a different peer group. Those peer groups are large and very rural systems, multi-county near metro area systems, regional transit systems, smaller systems, and community transit. The urbanized systems comprise a sixth peer group. Total peer group benefits were estimated using transit data for each of the transit agencies in each peer group, along with survey data from the case study conducted within that peer group. As described in Chapter 5, Paul Bunyan Transit belongs to the large and very rural group, Trailblazer Transit belongs to the multi-county near metro area group, SMART belongs to the regional transit systems, Timber Trails belongs to the smaller systems, and St. Peter Transit belongs to the community transit systems. The tribal transit systems are not included in the peer group analysis.

Peer group results are shown in Tables 6.8 through 6.11. Benefit-cost ratios are estimated as 5.1 for community transit, 3.1 for smaller systems, 2.9 for urbanized transit, 2.4 for large and very rural systems, 1.9 for regional transit, and 1.4 for multi-county near metro area systems. Per-trip benefits are highest for the smaller systems. Per-trip benefits are lowest for the urbanized systems, but the urban agencies also have the lowest per-trip costs. Community transit systems also have lower per-trip costs, along with high per-trip benefits, which results in the highest benefit-cost ratio. Per-trip costs are lower for urbanized and community transit likely because they serve a more concentrated demand with shorter travel distances.

Table 6.8 Summary of Estimated Monetary Benefits for Peer Groups

	Large and Very Rural Systems	Multi-County Near Metro	Regional Transit	Smaller Systems	Community Transit	Urbanized Transit
Mobility Benefits						
Low-cost mobility benefit ($)	945,797	489,836	1,003,783	217,479	296,395	3,857,064
Access to health care benefit ($)	27,324,413	5,882,486	27,434,147	30,621,479	17,590,652	121,451,153
Public assistance cost savings ($)	2,193,826	1,456,326	1,469,155	1,537,052	464,642	9,083,705
Efficiency Benefits						
Vehicle operating cost savings ($)	22,468	14,680	-4,007	0	0	-65,125
Chauffeuring cost savings ($)	3,102,325	1,280,163	2,380,876	1,550,776	786,616	7,151,127
Travel time benefits ($)	45,097	-166,340	-1,053,218	21,654	-27,659	2,058,385
Safety benefits ($)	48,551	1,066	54,538	121,473	8,433	271,003
Environmental benefits ($)	-636,187	-294,190	-649,269	-481,652	-122,040	-708,102
Total ($)	**33,046,291**	**8,664,027**	**30,636,005**	**33,588,261**	**18,997,038**	**143,099,209**

Table 6.9 Comparison of Benefits to Costs for Peer Groups

	Large and Very Rural Systems	Multi-County Near Metro	Regional Transit	Smaller Systems	Community Transit	Urbanized Transit
Benefits ($)	33,046,291	8,664,027	30,636,005	33,588,261	18,997,038	143,099,209
Costs						
Operating ($)	11,731,454	5,759,450	14,345,962	9,996,698	2,957,503	42,054,185
Capital ($)	2,173,395	358,373	1,998,780	808,845	738,034	8,033,024
Total ($)	13,904,849	6,117,823	16,344,742	10,805,543	3,695,537	50,087,209
Benefit-cost ratio	**2.4**	**1.4**	**1.9**	**3.1**	**5.1**	**2.9**

Table 6.10 Summary of Estimated Monetary Benefits, Per Trip, for Peer Groups

	Large and Very Rural Systems	Multi-County Near Metro	Regional Transit	Smaller Systems	Community Transit	Urbanized Transit
Mobility Benefits						
Low-cost mobility benefit ($)	1.02	1.54	0.84	0.30	0.56	0.49
Access to health care benefit ($)	29.46	18.45	22.84	41.55	33.49	15.58
Public assistance cost savings ($)	2.37	4.57	1.22	2.09	0.88	1.17
Efficiency Benefits						
Vehicle operating cost savings ($)	0.02	0.05	0.00	0.00	0.00	-0.01
Chauffeuring cost savings ($)	3.34	4.02	1.98	2.10	1.50	0.92
Travel time benefits ($)	0.05	-0.52	-0.88	0.03	-0.05	0.26
Safety benefits ($)	0.05	0.00	0.05	0.16	0.02	0.03
Environmental benefits ($)	-0.69	-0.92	-0.54	-0.65	-0.23	-0.09
Total ($)	**35.63**	**27.18**	**25.51**	**45.57**	**36.16**	**18.36**

Table 6.11 Comparison of Benefits to Costs, Per Trip, for Peer Groups

	Large and Very Rural Systems	Multi-County Near Metro	Regional Transit	Smaller Systems	Community Transit	Urbanized Transit
Benefits ($)	35.63	27.18	25.51	45.57	36.16	18.36
Costs						
Operating ($)	12.65	18.07	11.94	13.56	5.63	5.40
Capital ($)	2.34	1.12	1.66	1.10	1.40	1.03
Total ($)	14.99	19.19	13.61	14.66	7.04	6.43
Benefit-cost ratio	**2.4**	**1.4**	**1.9**	**3.1**	**5.1**	**2.9**

6.5 ECONOMIC IMPACTS

Statewide economic impacts from transit spending for rural and urban transit in Greater Minnesota were estimated using TREDTransit and statewide transit expenditures data. These are economic impacts that are separate from the benefits previously reported. For rural transit, the area of analysis is all Minnesota counties, excluding the seven-county Twin Cities metro area. For urban transit, the area of analysis is counties of Greater Minnesota where urban systems are located. Results are shown in Tables 6.12 and 6.13.

Table 6.12 Economic Impacts from Spending on Rural Transit in Greater Minnesota

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)
Direct Effect				
Transit Operations & Maintenance	1,753	37.50	37.50	51.05
Transit Capital Investment	5	0.26	0.38	0.79
Total Direct Effect	*1,758*	*37.76*	*37.88*	*51.84*
Indirect (Supplier) Effect				
Driven by Operations & Maintenance	143	4.68	5.66	16.47
Driven by Capital Investment	1	0.04	0.05	0.12
Total Indirect Effect	*143*	*4.71*	*5.71*	*16.58*
Induced (Income Re-spending) Effect				
Driven by Operations & Maintenance	25	0.86	1.53	2.90
Driven by Capital Investment	2	0.05	0.10	0.18
Total Induced Effect	*26*	*0.92*	*1.63*	*3.08*
Total Effect	**1,928**	**43.39**	**45.23**	**71.50**

Table 6.13 Economic Impacts from Spending on Urban Transit in Greater Minnesota

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)
Direct Effect				
Transit Operations & Maintenance	894	24.16	24.16	42.06
Transit Capital Investment	21	1.13	1.67	3.06
Total Direct Effect	*916*	*25.29*	*25.83*	*45.12*
Indirect (Supplier) Effect				
Driven by Operations & Maintenance	218	7.99	9.42	21.35
Driven by Capital Investment	2	0.12	0.18	0.37
Total Indirect Effect	*220*	*8.11*	*9.60*	*21.71*
Induced (Income Respending) Effect				
Driven by Operations & Maintenance	44	1.60	2.78	5.05
Driven by Capital Investment	7	0.25	0.44	0.79
Total Induced Effect	*51*	*1.85*	*3.22*	*5.85*
Total Effect	**1,187**	**35.25**	**38.65**	**72.68**

Rural transit directly supports 1,758 jobs, and 169 additional jobs are supported through the indirect and induced effects. The indirect effect refers to businesses that benefit from the existence of transit, such as those that provide products and services to the transit agency. Individuals that work for the transit agency or other businesses that benefit from the transit agency then spend money in the local economy, which supports additional jobs and economic activity. For rural systems, direct labor income is $37.8 million, plus an additional $5.6 million through indirect and induced effects. The direct value-added is $37.9 million, and indirect and induced value-added provide an additional $7.4 million. The estimated output effects include $51.8 million in direct effects, plus an additional $19.7 million through

indirect and induced effects. Total impacts are 1,928 jobs supported, $43.4 million in labor income, $45.2 million in value added, and $71.5 million in output.

Urban transit directly supports 916 jobs, and 271 additional jobs are supported through the indirect and induced effects. Labor income is $25.3 million, plus an additional $10.0 million through indirect and induced effects. The direct value-added is $25.8 million, and indirect and induced value-added provide an additional $12.8 million. The estimated output effects include $45.1 million in direct effects plus an additional $27.6 million through indirect and induced effects. Total impacts are 1,187 jobs supported, $35.3 million in labor income, $38.7 million in value added, and $72.7 million in output.

Transit also impacts local economies by improving access to shopping. Table 6.14 estimates the amount spent by transit riders in a year across Greater Minnesota and the spending that would be lost to online shopping without transit. See Chapters 4.4.2 and 5.10.2 for more details on how the impacts of increased access to shopping were estimated.

Table 6.14 Impact of Shopping Trips to Local Communities in Greater Minnesota

	Rural	Urban	Total
Amount spent by transit riders ($)	9,724,228	11,941,148	21,665,376
Spending lost to online shopping without transit ($)	1,410,013	2,268,818	3,678,831

Spending by transit users in the community has a multiplier effect. It supports local jobs, which support additional economic activity as those employees also spend money in the local economy. To capture these effects, RIMS II multipliers for general merchandise stores were used.[3] Table 6.15 shows the estimated economic impacts of total shopping trips made by transit riders in Greater Minnesota. Some of these shopping trips would still occur if transit was not available, but some would be lost to out-of-state online shopping. Table 6.16 estimates the economic impacts of shopping supported by transit that would have occurred online if there were no transit.

Table 6.15 Economic Impacts of Total Shopping Trips Made by Transit Riders in Greater Minnesota

	Rural	Urban	Total
Earnings ($)	1,227,824	1,527,483	2,755,307
Jobs	48	60	108
Value-added ($)	2,566,598	3,190,431	5,757,029

Table 6.16 Economic Impacts in Greater Minnesota of Shopping That Would Have Occurred Online

	Rural	Urban	Total
Earnings ($)	178,034	290,222	468,256
Jobs	7	11	18
Value-added ($)	372,157	606,182	978,339

[3] Multipliers were available at the level of the MnDOT districts. Statewide multipliers were estimated by taking an average of the district multipliers, weighted by the percentage of transit trips within each district.

The case studies also included an analysis of the economic impacts from increasing the population, or keeping people living in the community. These impacts are important at the local level, but at the statewide level they are less meaningful because the statewide population is not likely to be affected. While some residents, especially those in border communities, may move to another state, most residents who move because of lack of transit are likely to move to another community within Minnesota, so the impacts would be canceled out at the statewide level. Therefore, statewide impacts from increased population were not estimated.

CHAPTER 7: USER TOOL

An Excel spreadsheet user tool was developed to allow for the estimation of benefits and benefit-cost ratios for individual transit agencies. It is intended for use by transit agencies in Greater Minnesota. The tool calculates benefits using the methods and cost parameters described in this report. It simply requires the transit agency to input their own operating and financial data. Default values are provided for all other input variables. Estimates for trip purposes, how trips would have been made without transit, and the income and age distribution of riders are based on results from the case study surveys. However, transit agencies can replace these default values with their own data if available.

The user tool is the practical application of this research that individual operators can use to provide evidence regarding the value of their service. It shows the types of benefits provided by the agency, the estimated value of those benefits, and an estimated benefit-cost ratio. It also estimates the economic impacts of shopping trips and the economic impacts of keeping people living in the community. It does not show the economic impacts from spending on transit. These impacts can be estimated separately using the TREDTransit Calculator, which was described previously in section 4.4.2.

The spreadsheet tool contains a tab with instructions and four tabs for input data and results. These tabs are described below.

Tab 1. Transit System Profile. This tab requires the following transit agency data to be inputted: ridership, fare revenue, vehicle revenue miles, vehicle revenue hours, operating expenses, and capital expenses (Figure 7.1). The user must also identify if the transit agency is a rural system receiving section 5311 funding or an urban system receiving section 5307 funding, and they can identify which of the peer groups to which they belong.

Once the peer group or rural/urban categorization is selected, the remaining boxes in the tab will populate with default values. Results will automatically be calculated using these default values. The default values for rural agencies are based on case study surveys of transit riders for five rural agencies in Minnesota, and the default values for urban agencies are based on a survey of transit riders in St. Cloud, MN. The user can input data specific to the transit agency, if available, to override the default values (Figure 7.2). The data include the following:

- *Trip purposes*: Percentage of transit trips for work, health care, shopping, and other.
- *Estimated trip distance*: Estimate for average trip distance in miles from origin to destination for trips provided by transit.
- *Transfers per one-way trip*: For rural systems, it is assumed that no transfers are made. For urban systems, the default transfer rate is 55%.
- *How trips would have been made without transit*: An estimate of how transit trips would have been made if transit was not available, including the percentage of trips that would not have been made and the percentage of trips that would have been made some other way. Unless updated survey data are available, it is recommended that the default values be used.

- *Income distribution of riders*: Percentage of riders in each income group, including all household income.
- *Age distribution of riders*: Percentage of riders in each age group.
- *Riders who would spend more online*: Estimate for percentage of riders who would spend more online instead of shopping locally if transit was not available to provide shopping trips.
- *Riders who move to a different city*: Estimate for percentage of riders who would move to a different city if transit was not available locally.

INPUT DATA IN THE BLUE CELLS BELOW.

Operating data - INSERT YOUR DATA

Provide annual data for your entire system.

	Your data
Total annual ridership	119,500
Total annual fare revenue ($)	$90,470
Total annual vehicle revenue miles	356,389
Total annual vehicle revenue hours	26,857
Total annual operating expenses ($)	$1,441,430
Total annual capital expenses ($)	$148,957

Is your agency urban or rural?	Rural 5311
Rural agencies may choose to use rural averages or select a peer group to further refine default values. Urban agencies should leave this cell blank.	Large and Very Rural

Figure 7.1 Transit System Profile Data to be Entered in Tab 1

For the following data you may use default values or enter your own data. Default values will be used automatically if you do not enter anything. If you choose to enter your data, these values will be used in place of the default values.

Trip purposes

Estimate the percentage of trips for work, health care, shopping, and other.

Trip purposes	*Default*	*Your data or leave blank*
Work trips (%)	37%	
Health care trips (%)	17%	
Shopping trips (%)	16%	
Other trips (%)	31%	

How trips would have been made without transit

Estimate the percentage of trips that would have been forgone or made some other way if transit was not available.

	Default	*Your data or leave blank*
Percentage of trips not made	34%	
Percentage of trips driven themselves	3%	
Percentage of trips getting a ride from someone	46%	
Percentage of trips using a taxi or TNC	5%	
Percentage of trips made biking	2%	
Percentage of trips made walking	10%	

Income distribution of riders

Income groups	*Default*	*Your data or leave blank*
Less than $25,000 (%)	77%	
$25,000 to $49,999 (%)	18%	
$50,000 to $74,999 (%)	4%	
$75,000 to $99,999 (%)	1%	
$100,000 or more (%)	0%	

Age distribution of riders

Age ranges	*Default*	*Your data or leave blank*
Younger than 18 (%)	1%	
Age 18-24 (%)	5%	
Age 25-44 (%)	25%	
Age 45-64 (%)	46%	
Age 65-74 (%)	11%	
Age 75 or older (%)	11%	

Estimated average trip distance (miles)	*Default*	*Your data or leave blank*
	5	

Estimated number of transfers per one-way trip for fixed-route transit. *Leave as zero if not applicable.*	*Default*	*Your data or leave blank*
	0.00	

Use default values for the following.	*Default*
Riders who would spend more online (%)	29%
Riders who move to a different city (%)	9%

Figure 7.2 Additional Transit System Data to Enter or Use Default Values

Tab 2. Cost Parameters. The following data are provided: transportation costs, value of time, crash costs, emissions costs, cost of forgone trips, crash rate data, and other data needed to calculate benefits (Figure 7.3). The provided default values should be used unless more specific data are available. Over time, the data will need to be updated. The tab provides information about the data sources and how to update the data.

Tab 3. Multipliers. Multipliers are used for estimating economic impacts. RIMS II Type II multipliers are provided for general merchandise stores and households. RIMS II multipliers are updated periodically and can be purchased specifically for any state, county, or combination of states or counties. They are purchased from the Bureau of Economic Analysis. The provided default multipliers can be replaced if updated or regionally specific multipliers are available, otherwise the default values should be used.

Tab 4. Results. The user tool estimates the following benefits, as shown in Figure 7.5:

- Estimated monetary benefits: Each category of mobility and efficiency benefits that were quantified in monetary terms is presented. The total estimated benefits and benefits per trip is provided.
- Total estimated monetary benefits are compared to costs, both in total dollars and dollars per trip, and a benefit-cost ratio is provided.
- Reduced congestion: Calculations show the number of unlinked transit trips that replace an automobile trip.
- Economic impacts of shopping trips: The total amount of shopping done on transit trips is estimated, along with the economic impacts of those trips. The amount of local shopping that would have been done online had transit not been available is also estimated, along with the economic impacts of those trips.
- Economic impacts of keeping people living in the community: The number of residents who would move to another town or city if transit was not available is estimated, along with the economic impacts of keeping those residents living in the community.

This tab provides cost data used for calculations, including transportation costs, value of time, crash costs, emissions costs, cost of forgone trips, crash data, and other data need to calculate benefits. Use the provided default values unless updated data are available. Updated values may be found at the sources provided. Many cost values are based on MnDOT recommended values. Data for FY19 were used in the study.

Transportation Costs ($/mile)

Vehicle cost per mile	$0.26
Chauffeuring cost per mile	$1.52
Taxi/TNC cost per mile	$2.50
Bike cost per mile	$0.00
Walk cost per mile	$0.00

Source: MnDOT Recommended standard values for use in cost-effectiveness and benefit cost analysis
http://www.dot.state.mn.us/planning/program/appendix_a.html
Note: Vehicle cost per mile includes only auto variable vehicle operting costs. Chauffeuring cost per trip includes vehicle cost per mile and auto value of time. The analysis assumed an average 5-mile trip, which has a travel time of 20 minutes, including waiting time and empty backhauls. The analysis derived the driver travel time savings as $1.26 per passenger mile (divide value of time per hour by 3 to get value of time for 20 minutes and divide by 5 to get value of time per passenger mile) and vehicle cost of $0.26 per passenger mile. No available data source was used for taxi or TNC costs, so estimates were made. No costs were assumed for bike and walk trips.

Value of Time ($/hour)

Value of time - Auto	$18.90
Value of time - Chauffeuring	$18.90
Value of time - Taxi/TNC	$18.90
Value of time - Bicycle	$18.90
Value of time - Walking	$18.90
Value of time - Transit	$17.60

Source: MnDOT Recommended standard values for use in cost-effectiveness and benefit cost analysis
http://www.dot.state.mn.us/planning/program/appendix_a.html
Note: The value of time for auto, chauffeuring, and Taxi/TNC is equal to MnDOT's value ot travel time savings per person-hour for auto. The value of time for transit is equal to MnDOT's value of travel time savings per person-hour for a transit passenger. No value of time data are given by MnDOT for bicyling or walking, so the auto values were used.

Crash Costs ($/crash)

Crash costs - Fatal	$11,100,000
Crash costs - Suspected serious injury	$600,000
Crash costs - Suspected minor injury	$180,000
Crash costs - Possible injury	$87,000
Crash costs - PDO	$7,200

Source: MnDOT Recommended standard values for use in cost-effectiveness and benefit cost analysis
http://www.dot.state.mn.us/planning/program/appendix_a.html

Emissions costs ($/mile)

Emissions cost per mile for autos	$0.06
Emissions cost per mile for transit	$0.22

Source: MnDOT Recommended standard values for use in cost-effectiveness and benefit cost analysis
http://www.dot.state.mn.us/planning/program/appendix_a.html
Note: Emissions cost for trucks were used for transit.

Cost of Forgone Trip ($/trip)

Cost of forgone health care trip	$518.00
SNAP cost per trip by income	
<$25,000	$9.07
$25,000 - $49,999	$12.73
$50,000 - $74,999	$13.43
$75,000 - $99,999	$13.43
$100,000 or more	$13.43
MFIP savings per month by income	
<$25,000	$400.00
$25,000 - $49,999	$800.00
$50,000 or more	$1,198.00

Description: The cost of a forgone health care trip is estimated using a tool developed by Hughes-Cromwick et al. (2005) and adjusted for inflation to 2019 dollars. The report, TCRP Web-Only Document 29: Cost-
http://www.trb.org/Publications/Blurbs/156625.aspx

The cost of a forgone one-way work trip, which accounts for the expected increase in Minnesota Family Investment Program (MFIP) and Supplemental Nutrition Assistance Program (SNAP) payments, was estimated based on assumptions regarding the income and household sizes of workers and number of transit trips needed per year. SNAP payments are assumed to be reduced by $363 per month for someone making $25,000 or less, $509 per month for someone making $25,000 to $49,999, and $537 per month for someone making $50,000 or more. MFIP payments are made only to households with children, so it is assumed payments would only be made to those in the 25-44 or 45-64 age ranges. MFIP payments are assumed to be reduced by $400 per month for someone making $25,000 or less, $800 per month for someone making $25,000 to $49,999, and $1,198 per month for someone making $50,000 or more. Per month payments are converted to per trip assuming 20 work trips per month, or 40 transit trips.

Crash data

Auto crashes/mile Fatal	6.66846E-09
Auto crashes/mile Suspected serious injury	2.459E-08
Auto crashes/mile Suspected minor injury	1.43586E-07
Auto crashes/mile Possible injury	3.48815E-07
Auto crashes/mile PDO	9.45946E-07
Transit crashes/mile Fatal	6.28415E-09
Transit crashes/mile Suspected serious injury	4.03511E-09
Transit crashes/mile Suspected minor injury	2.35619E-08
Transit crashes/mile Possible injury	5.7239E-08
Transit crashes/mile PDO	3.87522E-08

Description: To analyze safety benefits of transit, 10 years of safety data for Minnesota transit agencies were collected for 2008-2017 from the National Transit Database (NTD). Data for the Twin Cites metro area were excluded. The NTD reports data for total incidents, injuries, and fatalities. During this period there were 124 reported incidents, 81 injuries, and 6 fatalities. These data were divided by the total number of vehicle revenue miles for these transit agencies over the 10-year period to convert them to a per-vehicle-mile basis. These data were then converted to a per-passenger-mile basis, based on an assumed average trip distance per person or average vehicle load.
Transit safety data were compared with the overall crash data from the National Highway Transit Safety Administration (NHTSA) for Minnesota for 2012-2017. These data include total fatalities, injuries, and property-damage-only (PDO) crashes, which were converted to a per-mile basis. Injuries were categorized as severe/serious, moderate/minor, and minor/possible. The NTD does not categorize injuries by severity, so it was assumed that the distribution of injuries between categories was the same for transit. Further, all incidents listed in the NTD not categorized as injuries or fatalities were treated as PDO crashes.

Average amount spent per shopping trip	$25
Percentage of local shopping that would be replaced by online shopping among those who would shop more online if transit was not available	50%

Source: Based on survey responses.

Figure 7.3 Cost Parameter Data in Tab 2

Type II multipliers for General merchandise stores

Final-demand Output /1/ (dollars)	1.4106
Final-demand Earnings /2/ (dollars)	0.4209
Final-demand Employment /3/ (number of jobs)	16.4794
Final-demand Value-added /4/ (dollars)	0.8798

Retail margin	0.3

Type II multipliers for Households

Final-demand Output /1/ (dollars)	0.6346
Final-demand Earnings /2/ (dollars)	0.1926
Final-demand Employment /3/ (number of jobs)	5.3366
Final-demand Value-added /4/ (dollars)	0.3700

Figure 7.4 Multipliers in Tab 3

RESULTS

Estimated Monetary Benefits			Per trip statewide averages for Greater Minnesota	
	Total	Per trip	Rural	Peer Group
Mobility Benefits				
Low-cost mobility benefit	$ 114,532	$ 0.96	$ 0.93	$ 1.02
Access to healthcare benefit	$ 3,520,587	$ 29.46	$ 26.46	$ 29.46
Public assistance cost savings	$ 282,661	$ 2.37	$ 2.49	$ 2.37
Efficiency Benefits				
Vehicle operating cost savings	$ 1,738	$ 0.01	$ 0.01	$ 0.02
Chauffeuring cost savings	$ 379,660	$ 3.18	$ 2.75	$ 3.34
Travel time impacts	$ (93,607)	$ (0.78)	$ (0.40)	$ 0.05
Safety benefits	$ 6,255	$ 0.05	$ 0.04	$ 0.05
Environmental benefits	$ (59,200)	$ (0.50)	$ (0.65)	$ (0.69)
Total	**$ 4,152,627**	**$ 34.75**	**$ 31.63**	**$ 35.63**

Reduced Congestion	
Number of unlinked transit trips that replaced an automobile trip	65,085

Economic Impacts of Shopping Trips	
Amount spent by transit riders	$ 239,000
Spending that would have been lost to online shopping without transit	$ 34,655
Economic Impacts of Total Shopping Trips Made by Transit Riders	
Earnings	$ 30,177
Jobs	1
Value-added	$ 63,081
Economic Impacts of Shopping That Would Have Occurred Online	
Earnings	$ 4,376
Jobs	0
Value-added	$ 9,147

Comparison of Benefits and Costs			Per trip statewide averages for Greater Minnesota	
	Total	Per trip	Rural	Peer Group
Total Benefits	$ 4,152,627	$ 34.75	$ 31.63	$ 35.63
Costs				
Operating	$ 1,441,430	$ 12.06	$ 12.62	$ 12.65
Capital	$ 148,957	$ 1.25	$ 1.66	$ 2.34
Total	$ 1,590,387	$ 13.31	$ 14.28	$ 14.99
Benefit-cost ratio	**2.6**		**2.2**	**2.4**

Economic Impacts of Keeping People Living in the Community	
Number of riders who would move to a different community	27
Economic Impacts of Keeping People in the Community	
Earnings	$ 132,209
Jobs	4
Value-added	$ 253,944

Description of Benefits

Mobility benefits	Benefits of providing trips that otherwise would have been forgone.
Efficiency benefits	Benefits from making trips with transit instead of the automobile, walking, or some other mode.
Low-cost mobility benefit	The economic value of providing an affordable transportation mode to transit users who could not afford other options.
Access to healthcare benefit	Health care cost savings and improved quality of life for transit users who would forgo health care trips if transit were not available.
Public assistance cost savings	Reduced state spending on public assistance spending resulting for improved access to employment.
Vehicle operating cost savings	Vehicle operating costs avoided for the transit user by taking transit instead of driving.
Chauffeuring cost savings	Costs avoided by transit rider using transit instead of getting a ride from family member or friend, includes vehicle operating costs and value of time for the driver.
Travel time impacts	Difference in travel time by transit versus other modes that would have been used had transit not been availble, multiplied by the value of time.
Safety benefits	Difference in number of crashes by transit versus other modes that would have been used had transit not been available, multiplied by the costs of crashes.
Environmental benefits	Difference in the environmental cost of transit use and environmental costs of other modes that would have been used if transit was not available.
Economic impacts	Effects of transit systems on the economy of the local area. These include jobs, household earnings, and value-added. Value-added includes labor income, taxes, and business profits. Economic impacts do not necessarily represent net benefits and are estimated separate of benefits.

Figure 7.5 Results in Tab 4 of User Tool for Hypothetical Transit Agency

CHAPTER 8: CONCLUSIONS

Survey results show that transit in Greater Minnesota serves many riders with limited transportation options. Among riders surveyed for five rural systems, nearly three-quarters did not have a driver's license, two-thirds did not have a vehicle in their household, 63% considered themselves as having a disability, and three-quarters had household income below $25,000. Respondents in St. Cloud, the urban system studied, were also predominately low-income, and a majority did not have a driver's license or access to a vehicle.

Most transit riders in Greater Minnesota are frequent riders, using the service multiple days per week. Many rely on it as a primary means of transportation. This is notably the case for those who ride transit to work.

Because many riders have limited transportation options, they would be severely affected if public transportation services were not available. Very few can drive themselves, and most would need to rely on someone else to provide transportation, pay a higher cost for taxi or Uber or Lyft services where available, or simply not make the trip. About 35% of transit riders surveyed said they would not have made their current trip had the transit service not been available. This response was fairly similar across the six transit agencies studied.

The consequences of missing trips are significant and multi-faceted, affecting the individual, community, and society. Missed trips mean individuals have decreased access to important activities and amenities, such as work, shopping, health care, social and recreational activities, personal errands, education, etc. These trips all provide value to the individual in various ways. For communities, missed trips could have economic consequences, as fewer trips to local businesses are made; they also have important social implications, because they reduce social interaction between community members, and some of those who miss trips may feel less connected to their town. Society is also affected if individuals cannot access work, education, or health care. Productivity could decline and spending on public assistance programs could increase to support those who cannot access work. Further, the loss of trips would lead to an inequitable transportation system that does not well serve segments of the population who are more reliant on this form of transportation.

Among those who said they would have made the trip even if transit had not been available, most would have relied on a family member, friend, or someone else to give them a ride, while a smaller percentage would have walked or used a taxi, Uber, or Lyft. Very few would have driven themselves. Relying on others to provide transportation also has its consequences. Most notable is the time requirement for the person who provides the ride. In addition, riders often said they prefer the feeling of independence that transit provides and not needing to rely on others or to feel like a burden to others. While taxi services and TNCs such as Uber and Lyft are an option for some trips, they are a more expensive form of transportation, and many transit riders cannot afford to rely on these options.

The survey likely underestimated the percentage of trips that would not be made without transit. Many respondents said they could have made their trip if transit had not been available, but while they may

have been able to use another option for their particular trip, these options are often not viable over the long term. This is illustrated by the fact that 63% of rural respondents and 68% of St. Cloud respondents said they would not be able to keep their job if they were not able to use transit.

8.1 HEALTH BENEFITS

There are many potential health benefits from providing transit in Greater Minnesota. First, transit improves access to health care services. Half of St. Cloud respondents and 31% of rural respondents said they would miss at least some health care trips if transit were not available. Second, transit can have positive mental health benefits by reducing social isolation and stress. Improving access to work could also have positive mental health benefits. Third, use of transit in areas with fixed-route services often leads to increased physical activity as transit riders walk more to access transit service. Finally, transit also improves access to nutritious food.

This study focuses on the first of these health benefits. Improving access to health care services can result in reduced health care expenses and improved quality of life. If someone misses a health care trip, it can result in more expensive health care later on, such as emergency trips or hospitalization. Improving access to health care allows the individual to maintain well-managed care, reduces the need for more expensive services, and improves quality of life. Research from Hughes-Cromwick et al. (2005) has shown the significant benefits, in monetary terms, of providing non-emergency medical transportation (NEMT). This study applies the results from Hughes-Cromwick et al. to demonstrate the substantial health benefits that transit services in Greater Minnesota provide. These health benefits alone are greater than the cost of providing rural and small urban transit services in Minnesota. These benefits are estimated to total $228.5 million for Greater Minnesota, or $19.30 per trip.

The study also provides some evidence regarding aspects of mental health and quality of life, though it is not measured in monetary terms. Most transit riders agreed, and many strongly agreed, that transit increases their social interaction with other people, reduces their stress level, allows them to live independently, and improves their overall quality of life. Most also agreed that it helps keep them connected to their town.

8.2 LOW-COST MOBILITY BENEFITS

Many use transit because they cannot afford to own a vehicle, other transportation services such as taxis or TNCs are too expensive, and there is no one who can afford the time to provide them a ride. Without transit, all other options would be too expensive, so they would not make the trip. Transit provides a lower-cost option. It is less expensive to the rider to use transit, as compared with all other options. As a lower-cost option, transit, therefore, allows them to make more trips. This allows them to access additional activities and amenities. The value of this improved access to the transit user is captured by low-cost mobility benefits. Total low-cost mobility benefits for Greater Minnesota are estimated to be $7.6 million, or $0.64 per trip.

8.3 PUBLIC ASSISTANCE COST SAVINGS

Work trips were found to be the most common use of transit, and most that use transit for work rely on it as their primary means of transportation. Without transit, some riders would not be able to maintain employment. This would result in a need for increased public assistance spending to support those without a job. Spending on transit, therefore, provides the opportunity to reduce spending in other areas. This study focuses on two programs, MFIP and SNAP. The analysis is complicated by the fact that individuals may continue to receive payments even when employed if their income is below the threshold, and since many transit riders have low income, they may still collect payments. Therefore, conservative estimates were made of the reduction in payments from these two programs as a result of increased access to work provided by transit. Total cost savings are estimated to be $19.1 million, or $1.62 per trip for Greater Minnesota. While this study focuses on these two important programs, transit could also reduce spending for other programs in the state.

8.4 EQUITY

The primary benefit of transportation investment is that it provides access to activities, amenities, and opportunities. The distribution of these benefits, however, is not always fair or equitable. Martens et al. (2012) argues that access levels vary substantially among individuals because of differences in geographic characteristics, income, and mode availability—especially automobile availability.

Conventional transportation planning has tended to be most beneficial to the most mobile individuals (Martens et al. 2012). For example, a focus on roadway investments to reduce congestion delay leads to transportation investments that benefit those who drive the most and who are responsible for the congestion (Martens 2006). Martens (2006) argues that the current planning process is flawed because it predicts future trip rates based on current travel patterns, while ignoring that current travel patterns are influenced by previous transportation investments. Automobile owners, and those with fewer travel constraints, are predicted to make more trips because they have made more trips in the past. This leads to policies that favor the automobile and those with the least travel constraints. However, non-automobile owners and those with significant travel constraints have similar needs for accessing activities, amenities, and opportunities, and their trips have been limited because of a lack of transportation options. Martens (2006) argues for a social justice approach that would use need-based models with the intent of securing a minimal level of accessibility for all population groups. Martens et al. (2012) further describes a set of equity principles that focus on minimizing accessibility gaps and increasing average access levels.

Investment in transit would clearly help reduce accessibility gaps and improve average access levels. Results from the case study surveys show that transit in Greater Minnesota serves a disproportionately higher percentage of disadvantaged populations. An especially high percentage of riders are low-income, cannot drive or do not have access to a vehicle, and/or have a disability. If transit is not available, these population groups would be disproportionately affected, putting them at a significant disadvantage. Transit is clearly shown to reduce the accessibility gaps between these population groups

and the most mobile individuals, while increasing average access levels. This is a benefit of transit that cannot be easily expressed in monetary terms.

8.5 EFFICIENCY BENEFITS

Efficiency benefits result when trips shift from the automobile or some other mode to transit. The main efficiency benefit identified and measured in Greater Minnesota is the chauffeuring cost savings. Many of the transit users in Greater Minnesota cannot drive or do not have access to a vehicle and need to rely on others, often a family member or friend, to provide transportation if transit were not available. However, a family member or friend is not always available to provide a ride. To do so, they may need to take time off from work or other commitments to provide a special trip. The cost of the chauffeured trip is the value of time to the driver, as well as the cost of operating the automobile.

Transit provides an estimated chauffeuring cost savings of $18.3 million in Greater Minnesota. This refers to the value of time to the driver and the vehicle operating costs for trips that would have been provided by a family member or friend had transit not been available. Besides these monetary benefits, transit reduces stress for the riders when they know they have an option available to them and do not have to rely on others or feel like a burden to others. It promotes independent living.

Automobile cost savings are often touted as a significant cost savings for transit riders. It is true that transit use can result in large household cost savings if it allows users to forgo vehicle ownership or reduces the number of vehicles needed in the household. This study, however, does not find significant automobile cost savings because it is assumed, based on survey responses, that very few transit riders would drive themselves if transit were not an option. A majority of riders do not have a driver's license and would rely on others for transportation. If the level of transit service in Greater Minnesota were to increase and serve a greater percentage of choice for riders who have the ability to drive, then the automobile cost savings could increase. For this to occur, the quality of transit service would need to be great enough that choice riders would feel that the service sufficiently meets their needs, allowing them to reduce the number of cars needed in their household.

Shifting trips to transit also has some implications with regard to travel time, safety, and environmental impacts. This study finds these benefits to be minor and, in some cases, negative. The overall effect of these impacts is small. Travel time is greater for transit compared with the automobile, but there is a potential for some positive travel time benefits when riders are able to take transit instead of walking. Transit provides safety benefits to its users as a result of reduced crash and injury risk, but this is offset to some degree by the fact that transit results in additional trips being made, which increases risk. Environmental benefits are negative, partly for this same reason. Additional trips are being made, which leads to increased emissions. Transit vehicles also have poor fuel efficiency compared with automobiles, so the vehicle load factor needs to be great enough to offset the difference. Transit, especially fixed-route transit in urban areas, provides individuals the opportunity to reduce their environmental footprint, but for the system as a whole to have a positive environmental benefit requires a large enough displacement of vehicle trips.

In urban areas, major efficiency benefits could include reduced congestion, reduced parking costs for the individual or less need for the city to supply parking, and changes in land-use patterns, allowing for more efficient use of land. These are significant benefits of transit in large urban areas and can also be important in the small urban areas of Greater Minnesota. This study, however, does not focus on these benefits.

8.6 OTHER BENEFITS

Transit also provides other benefits that were not measured in monetary terms, such as relocation cost savings, productivity gains, and intangible quality-of-life benefits. Transit allows users to live in their preferred location. Without transit, some would need to move somewhere with better access, which could result in increased costs to the individual. The surveys show that a significant percentage of respondents, 23% of rural respondents and 45% of St. Cloud respondents, would move if transit were not available, including many who would move to another town or city.

By increasing access to work and education, transit can increase productivity in a community. Better access to work benefits employers by increasing their pool of potential labor, and better access to education leads to a more educated workforce. Survey results show that work trips are the most common transit trip, and those who use transit for work or education rely on it as their primary means of transportation.

8.7 ECONOMIC IMPACTS

The benefits previously discussed are societal benefits that show how society is better off as a result of investment in transit. There are other economic impacts also worth studying. Economic impacts refer to any effect of a policy or project on the economy of an area. Impacts are not necessarily net benefits, but they capture some impacts of interest not included in the benefit-cost analysis.

First, spending on transit directly creates jobs. It also supports other businesses that provide inputs or services to transit agencies, and income earned by employees of transit agencies and their input suppliers is spent within the local community, generating additional activity in the local economy. The analysis shows the multiplier effect of the initial investment in transit, leading to additional jobs, labor income, and value added in local communities across the state. While government investment in other activities could also generate jobs, income, and economic activity, investment in transit is particularly effective in generating economic impacts because labor costs represent a large majority of transit costs, and transit employees typically live within the communities they serve. Therefore, dollars spent on transit are likely to stay within the local community.

Second, transit increases access to businesses within the community, contributing to increased spending and economic activity in the community. Shopping is among the most common purpose in transit trips. Without transit, some of these trips would not be made and some local spending would be lost. The study specifically shows that some local spending would be lost to online shopping.

Finally, transit can further impact the local economy by keeping people living in the community. Local businesses benefit from having more people living in the community.

8.8 OVERALL BENEFITS AND IMPLICATIONS

For all six transit agencies studied, estimated benefits were found to exceed the costs of providing service. Benefit-cost ratios were found to range from 1.5 to 4.2, indicating that the benefits of transit ranged from $1.50 to $4.20 for every $1 spent on transit. Across Greater Minnesota, benefit-cost ratios were found to equal 2.2 for rural transit and 2.9 for urban transit. Among the different peer groups, these ratios ranged from 1.4 to 5.1. Because there was uncertainty with many of the parameters used to estimate the results, a simulation model was developed that allowed the values of these parameters to vary. The results showed a range of expected outcomes. Estimated 90% confidence intervals showed that benefit-cost ratios varied from 1.5 to 3.0 for rural transit statewide and from 2.1 to 4.0 for urban transit in Greater Minnesota. There was only a 5% chance that statewide benefit-cost ratios would be below that range and virtually no chance they would be below 1.0.

Note that these are ratios of total benefits to total costs, but costs are covered by a combination of local, state, and federal sources. From the state perspective, all of the benefits accrue within the state, but some costs are covered by federal funds. Therefore, the state's return on investment would equal total benefits divided by total non-federal sources of funding. From the local perspective, return on investment would be much greater. Most of the benefits accrue at the local level, but a minority of funding originates locally. The local share for most rural transit operators in Greater Minnesota is about 15% to 20%, and for the urbanized systems in Greater Minnesota, it is about 20% to 25%. For example, a benefit-cost ratio of 2.2 indicates that $1 in investment yields $2.20 in benefits, but if the local share is 20%, then $1 in local investment yields $11 in benefits, most of which accrues locally.

Sensitivity analysis shows that the most important determinants of the benefit-cost ratios are the percentage of health care trips provided, the estimated cost of a forgone health care trip, and the percentage of trips that would have been forgone had transit not been available. In other words, benefit-cost ratios will be greater for transit agencies that provide a higher percentage of health care trips, especially those providing trips for serious chronic conditions and those that serve a higher percentage of transit-dependent riders who would not make these trips if transit were not available.

A large share of the transit benefits is driven by the health care benefits. These benefits result from providing health care trips to riders who otherwise would not make these trips. The costs of transit can be justified solely by these benefits.

Compared with the access to health care benefit, other benefits are estimated to be considerably smaller. It may be tempting to conclude that transit in Greater Minnesota is justified solely as a means of providing transportation to health care and that other trip types are not justified. This, however, would be a mistake. Transit is shown to provide value in a number of other areas, some of which are difficult to monetize or even quantify. Work trips are the most common type of transit trip. Most riders traveling to work rely on transit as their primary means of transportation, and a majority report that

they would not be able to keep their jobs without transit. Shopping trips are another common type of transit trip. Shopping trips help support local businesses and contribute to the local economy. Transit allows people to live where they prefer to live; by keeping people living in small communities, there are positive impacts to local economies. Spending on transit also provides jobs and stimulates local economic activity.

Lastly, there are the intangible benefits that are difficult to quantify. Stakeholders across the state note that some of the most important benefits of transit in their communities are that it supports independent living, allows seniors to age in place, improves quality of life, and improves social connectedness. Most transit riders agree that transit provides these benefits. Transit promotes equity and quality of life by increasing access to a range of activities for transportation-disadvantaged populations.

8.9 PRACTICAL APPLICATIONS

The spreadsheet user tool is the practical application of this project. The tool can be used by transportation providers, the state DOT, or other interested organizations to estimate benefits, impacts, and benefit-cost ratios for individual transit systems. Calculations are made using the estimation methods developed in this study. Transit providers can obtain results specific to their system by inputting their own data. Results from the case studies are used to provide default input values where agency-specific data are not available. The tool provides useful information for informing investment decisions. Transit providers and the state DOT can use this information when making the case for local or state investment in transit.

8.10 LIMITATIONS AND FUTURE RESEARCH

The benefits of public transportation services are wide-ranging and often difficult to quantify or express in monetary terms. For that reason, some benefits get overlooked or not included when calculating total benefits. This study attempted to quantify and monetize as many benefits as possible, but some benefits were not expressed in dollar terms and a few were not measured. The scope of this project was wide-ranging, but more focused research on specific benefits could yield more detailed information about those benefits. Benefits that were measured in some way but not expressed in monetary terms included relocation cost savings, intangible benefits, productivity, and equity.

Transit can allow older adults to age in place and other transportation-disadvantaged individuals to continue living at their current location, which could provide cost savings by avoiding the cost of relocation. Because of many complications from attempting to estimate costs and benefits from moving, this study does not estimate relocation cost savings but simply estimates the number of riders who would likely move without transit. Further research could be conducted to measure the benefits to individuals from avoiding the need to relocate.

The study shows that many riders rely on transit as their primary source of transportation to access work or education. Improving access to work through the provision of transit benefits not just

employees but also employers by increasing the pool of available labor. In rural communities, increasing the size of the local labor pool can be critical for businesses to succeed and grow. Improving access to education and job training also produces a more skilled workforce. Additional research could be conducted on the productivity benefits to local businesses from increased access to work and education.

Additional research could also be conducted of the health benefits of transit in Greater Minnesota. The study found there are important intangible benefits, including improved social connectedness, independent living, and reduced stress. These outcomes could provide positive mental health benefits, which could be studied further. The effects of reducing social isolation for older adults in rural areas could yield significant benefits that are not fully captured in this study. The measurement of access to health care benefits in this study relied on previous research conducted by Hughes-Cromwick et al. (2005). While the methods and tools developed in that study are very valuable, an update to that research would be useful given changes in health care costs over time.

This study focuses on rural areas and small communities but also includes smaller metropolitan areas in Greater Minnesota. While most of the benefits of rural transit also apply to urban areas, there are other benefits to providing transit in urban areas, such as reducing congestion, reducing the need for parking, and changing land-use patterns. The use of fixed-route transit also provides potential health benefits through increased physical activity. Because of the rural focus of this project, these benefits were either not included or not emphasized. However, these benefits may be important in small urban areas of Greater Minnesota and could be studied further.

Finally, this study provides evidence about the value of existing investments in transit, but it does not estimate the marginal benefits of future investments. Future investments may or may not yield the same returns as existing investments. This would depend on the extent to which additional investment in transit allows for new trips to be made, especially for high-value trips such as to access health care. Mattson (2017a) developed a model of rural demand-response transit ridership, showing the extent to which increases in span of service can increase ridership. Projected increases in ridership could be used to illustrate the expected benefit from additional investment. For urban fixed-route bus systems, a number of studies have estimated elasticities of demand with respect to quality of service factors. These elasticities can be used to estimate projected increases in ridership following service improvements, such as increased frequency, span of service, or service coverage.

REFERENCES

AAA. 2018. Your Driving Costs: How Much Are You Really Paying to Drive? AAA Association Communication, Heathrow, FL.

American Public Transportation Association. n.d. My Economic Impact Tool. Retrieved from https://www.apta.com/research-technical-resources/my-economic-impact-tool/

Arcury, T. A., W. M. Gesler, J. S. Preisser, J. Sherman, J. Spencer, and J. Perin. 2005. The Effects of Geography and Spatial Behavior on Health Care Utilization among the Residents of a Rural Region. *Health Services Research, 40*(1),135–55. https://doi.org/10.1111/j.1475-6773.2005.00346.x

Banister, D., and A. Bowling. 2004. Quality of Life for the Elderly: The Transport Dimension. *Transport Policy, 11,* 105–15. https://doi.org/10.1016/S0967-070X(03)00052-0

Beimborn, E., A. Horowitz, J., Schuetz, and G. Zejun. 1993. *Measurement of Transit Benefits.* Prepared by the Center for Urban Transportation Studies, University of Wisconsin-Milwaukee, for Federal Transit Administration, Washington, DC.

Bitto, E. A., L. Wright Morton, M. J. Oakland, and M. Sand. 2003. Grocery Store Acess Patterns In Rural Food Deserts. *Journal for the Study of Food and Society, 6*(2), 35–48. https://doi.org/10.2752/152897903786769616

Burkhardt, J. E. 1999. Economic Impact of Rural Transit Services. *Transportation Research Record*, *1666,* 55–64.

Cambridge Systematics, Inc., and Apogee Research, Inc. 1996. *TCRP Report 20: Measuring and Valuing Transit Benefits and Disbenefits Summary*. National Academy Press, Transit Cooperative Research Program, Washington, DC.

Cambridge Systematics, Inc., R. Cervero, and D. Aschauer. 1998. *TCRP Report 35 Economic Impact Analysis of Transit Investments: Guidebook for Practitioners*. National Academy Press, Transit Cooperative Research Program, Washington, DC.

Chu, X. 2013. *A Tool for Assessing the Economic Impacts of Spending on Public Transit*. National Center for Transit Research, Center for Urban Transportation Research, University of South Florida.

Crain & Associates Inc., R. Byrd, and Omniversed International. 1999. *TCRP Report 49 Using Public Transportation to Reduce the Economic, Social, and Human Costs of Personal Immobility.* National Academy Press, Transit Cooperative Research Program, Washington, DC.

Cronin, J. J., J. Hagerich, and J. Horton. 2008. *Florida Transportation Disadvantaged Programs: Return On Investment Study.* The Marketing Institute, Florida State University College of Business, Tallahassee, FL.

Delbosc, A. 2012. The Role of Well-Being in Transport Policy. *Transport Policy, 23*, 25–33. https://doi.org/10.1016/j.tranpol.2012.06.005

Delbosc, A., and G. Currie. 2011. Exploring the Relative Influences of Transport Disadvantage and Social Exclusion on Well-Being. *Transport Policy, 18*, 555–62.

https://doi.org/10.1016/j.jtrangeo.2011.04.005

Ducote, N., and K. Belton Ducote. 2016. *Gap Analysis and Cost-Benefit Modeling: Northeast Oregon Public Transit's Rides to Wellness Program*. Prepared by Ducote Consulting LLC for Community Connection of Northeast Oregon and Northeast Oregon Public Transit, La Grande, OR.

ECONorthwest, and Parsons Brinckerhoff Quade & Douglas. 2002. *TCRP Report 78: Estimating the Benefits and Costs of Public Transit Projects: A Guidebook for Practitioners*. National Academy Press, Transit Cooperative Research Program, Washington, DC.

Farber, N., D. Shinkle, J. Lynott, W. Fox-Grage, and R. Harrell. 2011. *Aging in Place: A State Survey of Livability Policies and Practices.* National Conference of State Legislatures and the AARP Public Policy Institute.

Faulk, D., and M. Hicks. 2010. The Economic Effects of Bus Transit in Small Cities. *Public Finance Review, 38*(5), 513–39. https://doi.org/10.1177/1091142110373611

Ferrell, C. E. 2015. *The Benefits of Transit in the United States: A Review and Analysis of Benefit-Cost Studies.* Report WP 12-04, Mineta Transportation Institute, San Jose State University, San Jose, CA.

Flaherty, J. H., B. Stalvey, and L. Rubenstein. 2003. Guest Editorial: A Consensus Statement on Nonemergent Medical Transportation Services for Older Persons. *Journal of Gerontology: Medical Sciences*, *58*(9), 826–31.

Gee, G. C., and D. T. Takeuchi. 2004. Traffic Stress, Vehicular Burden and Well-Being: A Multilevel Analysis. *Social Science & Medicine, 59,* 405–14. https://doi.org/10.1016/j.socscimed.2003.10.027

Godavarthy, R., and J. Mattson. 2016. *Exploring Transit's Contribution to Livability in Rural Communities: Case Study of Valley City, ND, and Dickinson, ND*. SURLC 18-008. Montana State University, Bozeman: Small Urban and Rural Livability Center.

Godavarthy, R., J. Mattson, J. Brooks, J. Jain, L. Quadrifoglio, I. Sener, and C. Simek. 2018*. Transit and Livability: Results from the National Community Livability Survey.* SURLC 16-004. Montana State University, Bozeman: Small Urban and Rural Livability Center.

Godavarthy, R., J. Mattson, and E. Ndembe. 2014. *Cost-Benefit Analysis of Rural and Small Urban Transit*. University of South Florida, Tampa: National Center for Transit Research. https://doi.org/10.3141/2533-16

Godavarthy, R., J. Mattson, and E. Ndembe. 2015. Cost-Benefit Analysis of Rural and Small Urban Transit in the United States. *Transportation Research Record, 2533*, 141-48. https://doi.org/10.3141/2533-16

Grant, R., G. Goldsmith, D. Gracy, and D. Johnson. 2016. Better Transportation to Health Care Will Improve Child Health and Lower Costs. *Advances in Pediatrics, 63,* 389–401. https://doi.org/10.1016/j.yapd.2016.04.003

HDR/HLB Decision Economics Inc. 2006. *The Socio-Economic Benefits of Transit in Wisconsin: Phase II-Benefit Cost Analysis.* Wisconsin Department of Transportation.

HDR Decision Economics. 2009*. Economic and Community Benefits of Local Bus Transit Service (Phase*

One). Michigan Department of Transportation.

HLB Decision Economics. 2003. *The Socio-Economic Benefits of Transit in Wisconsin*. Wisconsin Department of Transportation.

Horst, T., and S. Carini. 2011. *Understanding How to Develop and Apply Economic Analyses: Guidance for Transportation Planners.* NCHRP 08-36, Task 101. National Academy Press, National Cooperative Highway Research Program, Washington, DC.

Hughes-Cromwick, P., R. Wallace, H. Mull, J. Bologna, C. Kangas, J. Lee, and S. Khasnabis. 2005. *Cost Benefit Analysis of Providing Non-Emergency Medical Transportation.* TCRP Web-Only Document 29. Transportation Research Board of the National Academies, Transit Cooperative Research Program, Washington, DC.

Legrain, A., N. Eluru, and A. M El-geneidy. 2015. Am Stressed, Must Travel: The Relationship Between Mode Choice and Commuting Stress. *Transportation Research Part F: Psychology and Behavior, 34,* 141–51. https://doi.org/10.1016/j.trf.2015.08.001

Litman, T. 2016. *Transportation Cost and Benefit Analysis Techniques, Estimates and Implications, Second Edition.* Victoria Transport Policy Institute. Retrieved from https://www.vtpi.org/tca/

Litman, T. 2018. *Evaluating Public Transit Benefits and Costs: Best Practices Guidebook*. Victoria Transport Policy Institute. Retrieved from http://web.islandnet.com/~litman/tranben.pdf

Martens, K. 2006. Basing Transport Planning on Principles of Social Justice. *Berkeley Planning Journal, 19,* 1-17.

Martens, K., A. Golub, and G. Robinson. 2012. A Justice-Theoretic Approach to the Distribution of Transportation Benefits: Implications for Transportation Planning Practice in the United States. *Transportation Research Part A: Policy and Practice*. Retrieved from https://doi.org/10.1016/j.tra.2012.01.004

Mattson, J. 2009. *North Dakota Transportation Survey: Aging and Mobility*. DP-221. North Dakota State University, Fargo: Upper Great Plains Transportation Institute.

Mattson, J. 2011. Transportation, Distance, and Health Care Utilization for Older Adults in Rural and Small Urban Areas. *Transportation Research Record, 2265,* 192–99. https://doi.org/10.3141/2265-22

Mattson, J. 2016. *Innovative Approach to Estimating Demand for Intercity Bus Services in a Rural Environment*. University of South Florida, Tampa: National Center for Transit Research.

Mattson, J. 2017a. Estimating Ridership of Rural Demand-Response Transit Services for the General Public. *Transportation Research Record, 2647*, 127–133. https://doi.org/10.3141/2647-15

Mattson, J. 2017b. *Rural Transit Fact Book 2017.* Small Urban and Rural Transit Center, Upper Great Plains Transportation Institute, North Dakota State University.

Mattson, J., J. Miller, J. Goodwill, P. S. Sriraj, and J. Hough. 2017. Impacts of Mobility Management and Human Service Transportation Coordination Efforts and End-User Quality of Life. *Journal of the Transportation Research Forum, 56*(1), 77–91.

Minnesota State Demographic Center. 2017. *Greater Minnesota Refined & Revisited.* Minnesota State Demographic Center.

Mjelde, J. W., R. Dudensing, J. Brooks, G. Battista, M. Carrillo, B. Counsil, A. Giri, M. K. Kim, V. D. Pyrialakou, and S. Ullerich. 2017. *Economics of Transportation Research Needs for Rural Elderly and Transportation Disadvantaged Populations*. White Paper Submitted to the United States Department of Agriculture, National Institute of Food and Agriculture. Retrieved from https://static.tti.tamu.edu/tti.tamu.edu/documents/TTI-2017-1.pdf

Nguyen-Hoang, P., and R. Yeung. 2010. What Is Paratransit Worth? *Transportation Research Part A: Policy and Practice, 44,* 841–53. https://doi.org/10.1016/j.tra.2010.08.006

Painter, K. M., R. D. Scott II, P. R Wandschneider, and K. L. Casavant. 2002. Using Contingent Valuation to Measure User and Nonuser Benefits: An Application to Public Transit. *Review of Agricultural Economics, 24*(2), 394–409. http://www.jstor.org/stable/1349768

Parry, I. W.H., M. Walls, and W. Harrington. 2007. Automobile Externalities and Policies. *Journal of Economic Literature, XLV*(June), 373–99.

Penet, B. 2011. *Costs and Benefits of Public Transit in South Dakota*. Prepared for the South Dakota Department of Transportation by HDR Decision Economics.

Peng, Z.-R., and A. C. Nelson. 1998. Rural Transit Services: A Local Economic and Fiscal Impact Analysis. *Transportation Research Record, 1623,* 57–62.

Peterson, D., and T. Rieck. 2017. *Aging in Place in Small Urban and Rural Communities*. SURLC 17-006. Montana State University, Bozeman: Small Urban and Rural Livability Center. Retrieved from https://www.ugpti.org/resources/reports/downloads/surlc17-006.pdf

Petraglia, L., N. Stein, S. Kamin, and G. Weisbrod. n.d. *My Economic Impact Tool—How to Use It*. Retrieved from https://www.apta.com/wp-content/uploads/Resources/resources/APTA-My-Economic-Impact-Tool-How-to-Use-It.pdf

Prieto, L., and J. A. Sacristán. 2003. Problems and Solutions in Calculating Quality-Adjusted Life Years (QALYs). *Health and Quality of Life Outcomes, 1*(80).

Schwarzlose, A., A. Israel, J. W. Mjelde, R. M. Dudensing, Y. Jin, L. K. Cherrington, and J. Chen. 2014. Willingness to Pay for Public Transportation Options for Improving the Quality of Life of the Rural Elderly. *Transportation Research Part A: Policy and Practice*, 61, 1–14. https://doi.org/10.1016/j.tra.2013.12.009

Skolnik, J., and R. Schreiner. 1998. Benefits of Transit in Small Urban Areas: A Case Study. *Transportation Research Record, 1623,* 47–56.

Southworth, F., D. P. Vogt, and T. R.Curlee. 2005. Rural Transit Systems Benefits in Tennessee: Methodology and an Empirical Study. *Environment and Planning A, 37,* 861–75.

Southworth, F., D. P. Vogt, and T. R. Curlee. 2004. Estimation of Statewide Urban Public Transit Benefits in Tennessee. *Transportation Research Record*, *1887,* 83–91. https://doi.org/10.3141/1887-10

Southworth, F., D. P. Vogt, T. R. Curlee, A. Chatterjee, and F. J. Wegmann. 2002. *An Assessment of Future*

Demands for and Benefits of Public Transit Services in Tennessee. Prepared for Office of Public Transportation, Tennessee Department of Transportation, Nashville, TN.

Spinney, J. E. L., D. M. Scott, and K. B. Newbold. 2009. Transport Mobility Benefits and Quality of Life: A Time-Use Perspective of Elderly Canadians. *Transport Policy*, 16, 1–11. https://doi.org/10.1016/j.tranpol.2009.01.002

Stanley, J. K., D. A. Hensher, J. R. Stanley, and D. Vella-Brodrick. 2011. Mobility, Social Exclusion and Well-Being: Exploring the Links. *Transportation Research Part A: Policy and Practice,* 45(8), 789–801. https://doi.org/10.1016/j.tra.2011.06.007

TREDIS. n.d. TREDTransit Calculator. Retrieved from https://tredis.com/products/tredtransit

Wallace, R., P. Hughes-Cromwick, and H. Mull. 2006. Cost-Effectiveness of Access to Nonemergency Medical Transportation: Comparison of Transportation and Health Care Costs and Benefits. *Transportation Research Record, 1956,* 86–93. https://doi.org/10.3141/1956-11

Wallace, R., P. Hughes-Cromwick, H. Mull, and S. Khasnabis. 2005. Access to Health Care and Nonemergency Medical Transportation: Two Missing Links. *Transportation Research Record, 1924,* 76–84. https://doi.org/10.3141/1924-10

Weisbrod, G., N. Stein, C. Duncan, and A.Blair. 2017. *TCRP Synthesis 128: Practices for Evaluating the Economic Impacts and Benefits of Transit.* The National Academies Press, Transit Cooperative Research Program, Washington, DC. https://doi.org/10.17226/24768

Wener, R. E, and G. W. Evans. 2011. Comparing Stress of Car and Train Commuters. *Transportation Research Part F: Psychology and Behavior, 14*(2), 111–16. https://doi.org/10.1016/j.trf.2010.11.008

World Institute on Disability. 2019. *Disability Benefits 101: Minnesota Family Investment Program.* Retrieved from https://mn.db101.org/mn/programs/income_support/mfip/program2.htm#family_rules

APPENDIX A STAKEHOLDER SURVEY

Organization Information
Please provide some information about the organization you work for.

Name of organization you work for: _____

Describe your role at the organization: _____

Describe the type of organization you work for:

- ○ Transportation provider
- ○ Human service agency
- ○ Public health department
- ○ Health care provider
- ○ County or city
- ○ Local elected official
- ○ Community organization
- ○ Private company
- ○ Other, please specify: _____

What populations does your organization serve (check all that apply)?

- ☐ Children and families
- ☐ Older adults
- ☐ The homeless
- ☐ Low-income individuals
- ☐ People with physical disabilities
- ☐ People with sensory disabilities
- ☐ People with intellectual disabilities
- ☐ People with mental health issues
- ☐ People with addictions
- ☐ Other, please identify: _____

List the counties or cities where your organization provides services or is located.

_____

Benefits of Transit

Public transit, as defined for this survey, includes shared-ride transportation services available to the public. In Greater Minnesota, this includes demand-response, or dial-a-ride, services, fixed-route and flexible-route bus services, and paratransit. Public transit services are available in every county in Minnesota and is a community resource. With that understanding, please respond to the following questions.

This section focuses on the potential benefits of these transit services to the local community. The survey provides a list of potential benefits. Thinking about the transit services *in your community or service area*, indicate if you think these are benefits of transit and, if so, the importance of the benefit. Your response should be specific to your community or service area. If your organization serves a large area and you find that the benefits are different in different parts of your service area, you may clarify your responses in the text boxes.

The first group of benefits refer to benefits to transit users who otherwise would not be able to make trips due to the inability to drive or lack of access to transportation.

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
Improved access to jobs	○	○	○	○	○
Improved access to health care	○	○	○	○	○
Improved access to education	○	○	○	○	○
Improved access to shopping	○	○	○	○	○
Improved access for social or recreational trips	○	○	○	○	○
Improved access for other types of trips	○	○	○	○	○
Improved quality of life	○	○	○	○	○
Reduced stress	○	○	○	○	○

Provide examples from your community or service area about how transit provides these types of benefits, or if you do not think these benefits exist at this time, please provide a brief explanation as to why they do not. Please also clarify your response to the question above if you find that some benefits

exist or are more important in some communities within your service area and don't exist or are less important in other communities.

_____

_____

_____

_____

The next group of benefits are potential benefits to communities and states that could result from improved access to jobs, health care, and other activities.

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
Reductions in government spending on public assistance programs such as welfare and other social services	○	○	○	○	○
Reduced health care costs	○	○	○	○	○
Reductions in spending on other programs, Please describe:	○	○	○	○	○

Provide examples from your community or service area about how transit provides these types of benefits, or if you do not think these benefits exist at this time, please provide a brief explanation as to why they do not. Please also clarify your response to the question above if you find that some benefits exist or are more important in some communities within your service area and don't exist or are less important in other communities.

_____

_____

_____

_____

The next group of benefits could result when individuals switch from traveling by automobile to traveling by transit.

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
Transportation cost savings for transit users (savings on vehicle ownership costs, gas costs, taxi costs, etc.)	○	○	○	○	○
Reduced chauffeuring responsibilities by drivers for non-drivers	○	○	○	○	○
Improved safety/reduction in crashes	○	○	○	○	○
Reduced stress	○	○	○	○	○
Environmental benefits from reduced emissions and energy consumption	○	○	○	○	○
Health benefits from increased walking and cycling to and from transit stops or from reduced stress	○	○	○	○	○
Reduced congestion	○	○	○	○	○
Reduced parking costs or need for parking	○	○	○	○	○
Reduced need for spending on roadway construction	○	○	○	○	○
Reduced travel times	○	○	○	○	○

Provide examples from your community or service area about how transit provides these types of benefits, or if you do not think these benefits exist at this time, please provide a brief explanation as to why they do not. Please also clarify your response to the question above if you find that some benefits exist or are more important in some communities within your service area and don't exist or are less important in other communities.

_____

_____

_____

_____

Next are potential benefits to the community from providing an alternative transportation option.

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
Supports independent living	○	○	○	○	○
Allows for seniors to age in place	○	○	○	○	○
Keeps people living in the community	○	○	○	○	○
Improves social connectedness	○	○	○	○	○
Provides an option to non-users in case of emergency (for example, car breaks down or individual is temporarily unable to drive)	○	○	○	○	○
Supports emergency response services (for example, ability to evacuate and deliver resources during an emergency)	○	○	○	○	○

Provide examples from your community or service area about how transit provides these types of benefits, or if you do not think these benefits exist at this time, please provide a brief explanation as to why they do not. Please also clarify your response to the question above if you find that some benefits exist or are more important in some communities within your service area and don't exist or are less important in other communities.

_____

_____

_____

_____

Last are potential economic benefits to the community.

	Major Benefit	Benefit	Minor Benefit	Not a Benefit	Do Not Know or Unsure
Supports local businesses by providing potential workers a means of transportation to work (thereby expanding the pool of available labor or improving employee retention rates)	○	○	○	○	○
Supports local shopping, restaurants, etc., by providing improved access for potential customers	○	○	○	○	○
Provides jobs in the community for people working for the transit agency	○	○	○	○	○
Supports businesses in the community that sell products or services to the transit agency	○	○	○	○	○
Allows residents to remain in community when they can no longer drive and increases desirability of living in the community, thereby supporting local businesses	○	○	○	○	○
Changes land use patterns, allowing for more efficient use of land (for example, supporting infill development, higher density development, or a mix of different types of land use)	○	○	○	○	○

Provide examples from your community or service area about how transit provides these types of benefits, or if you do not think these benefits exist at this time, please provide a brief explanation as to why they do not. Please also clarify your response to the question above if you find that some benefits exist or are more important in some communities within your service area and don't exist or are less important in other communities.

_____

_____

_____

_____

Other Benefits
Please describe any other types of benefits of transit services in your community and provide examples.

_____

_____

_____

_____

Most Important Benefits
What do you think are the most important benefits of transit services in your community?

_____

_____

_____

_____

Measuring Benefits
How do you think the benefits of transit could best be measured for communities such as yours?

_____

_____

_____

_____

APPENDIX B DESCRIPTIVE STATISTICS FOR PEER GROUPS AND SELECTED CASE STUDIES

Table B.1 Data for Large and Very Rural Systems and Selected Case Study

	Average	Standard Deviation	Minimum	Maximum	Paul Bunyan Transit
Service area characteristics					
Area (square miles)	11,158	7,513	5,474	19,675	5,474
Population	130,561	105,450	65,225	252,212	65,225
Population density (per square mile)	11	2	9	13	12
Trip purpose					
Work trips	38%	8%	29%	44%	29%
School trips	8%	3%	6%	12%	6%
Shopping trip	25%	5%	20%	30%	30%
Rider demographics					
Under 18	10%	2%	7%	11%	11%
Aged 18 to 24	16%	4%	13%	20%	13%
Aged 65 or older	21%	9%	11%	26%	26%
Minority	63%	27%	32%	81%	76%
Low income	10%	2%	7%	11%	11%
Operational characteristics					
Unlinked passenger trips	309,159	262,271	119,500	608,459	119,500
Vehicle revenue miles	1,193,530	1,246,756	356,389	2,626,397	356,389
Vehicle revenue hours	63,808	56,253	26,857	128,547	26,857
Number of vehicles	53	41	25	100	33
Trips fixed route (%)	41%	24%	22%	68%	34%

Table B.2 Data for Multi-County, Near Metro Area Systems and Selected Case Study

	Average	Standard Deviation	Minimum	Maximum	Trailblazer Transit
Service area characteristics					
Area (square miles)	1,296	630	851	1,742	1,742
Population	137,358	62,899	92,881	181,834	181,834
Population density (per square mile)	107	3	104	109	104
Trip purpose					
Work trips	36%	9%	29%	42%	42%
School trips	17%	1%	17%	17%	17%
Shopping trip	22%	4%	19%	25%	19%
Rider demographics					
Under 18	14%	2%	13%	16%	16%
Aged 18 to 24	13%	8%	8%	19%	8%
Aged 65 or older	19%	5%	15%	23%	15%
Minority	9%	2%	8%	11%	11%
Low income	65%	13%	56%	73%	56%
Operational characteristics					
Unlinked passenger trips	159,406	128,963	68,215	250,596	250,596
Vehicle revenue miles	815,138	557,304	421,064	1,209,211	1,209,211
Vehicle revenue hours	35,105	19,177	21,544	48,665	48,665
Number of vehicles	22	16	11	33	33
Trips fixed route (%)	38%	54%	0%	77%	0%

Table B.3 Data for Regional Transit Systems and Selected Case Study

	Average	Standard Deviation	Minimum	Maximum	SMART
Service area characteristics					
Area (square miles)	3,230	1,285	1,776	5,124	2,271
Population	133,080	74,143	80,480	278,106	125,515
Population density (per square mile)	46	25	19	75	55
Trip purpose					
Work trips	40%	11%	27%	61%	35%
School trips	16%	5%	9%	21%	9%
Shopping trip	23%	8%	9%	32%	32%
Rider demographics					
Under 18	5%	4%	1%	9%	1%
Aged 18 to 24	8%	2%	4%	11%	4%
Aged 65 or older	28%	6%	20%	34%	25%
Minority	16%	6%	8%	24%	24%
Low income	74%	7%	64%	82%	82%
Operational characteristics					
Unlinked passenger trips	200,186	76,025	118,527	320,434	241,444
Vehicle revenue miles	629,829	117,779	426,924	751,439	596,057
Vehicle revenue hours	45,642	10,229	29,465	54,392	54,392
Number of vehicles	34	18	16	67	27
Trips fixed route (%)	37%	20%	12%	60%	43%

Table B.4 Data for Small Systems and Selected Case Study

	Average	Standard Deviation	Minimum	Maximum	Timber Trails (Kanabec County)
Service area characteristics					
Area (square miles)	1,521	1,265	435	3,768	522
Population	37,794	33,309	10,936	117,814	15,948
Population density (per square mile)	27	8	11	41	31
Trip purpose					
Work trips	30%	15%	12%	56%	33%
School trips	5%	4%	0%	12%	8%
Shopping trip	32%	8%	18%	46%	31%
Rider demographics					
Under 18	4%	3%	0%	9%	4%
Aged 18 to 24	5%	3%	0%	10%	4%
Aged 65 or older	38%	9%	24%	51%	42%
Minority	7%	7%	0%	18%	0%
Low income	78%	8%	61%	93%	78%
Operational characteristics					
Unlinked passenger trips	67,001	47,598	27,307	174,705	52,493
Vehicle revenue miles	256,895	173,611	79,699	607,300	201,374
Vehicle revenue hours	18,408	11,294	8,138	41,997	12,578
Number of vehicles	13	11	3	40	7
Trips fixed route (%)	20%	29%	0%	95%	95%

Table B.5 Data for Community Transit Systems and Selected Case Study

	Average	Standard Deviation	Minimum	Maximum	St. Peter Transit
Service area characteristics					
Area (square miles)	32	62	2	182	6
Population	11,288	9,573	1,613	27,153	11,682
Population density (per square mile)	949	548	89	1,915	1,915
Trip purpose					
Work trips	29%	14%	7%	49%	36%
School trips	15%	21%	0%	64%	12%
Shopping trip	27%	11%	11%	42%	36%
Rider demographics					
Under 18	10%	16%	0%	49%	7%
Aged 18 to 24	9%	5%	0%	14%	14%
Aged 65 or older	23%	8%	14%	38%	29%
Minority	15%	8%	3%	28%	15%
Low income	67%	14%	44%	82%	81%
Operational characteristics					
Unlinked passenger trips	65,366	77,914	11,098	248,960	29,284
Vehicle revenue miles	95,867	86,454	15,794	240,663	45,747
Vehicle revenue hours	8,091	6,286	1,793	17,262	3,626
Number of vehicles	4	3	1	9	3
Trips fixed route (%)	28%	34%	0%	100%	16%

Table B.6 Data for Urbanized Systems and Selected Case Study

	Average	Standard Deviation	Minimum	Maximum	St. Cloud Metro Bus
Service area characteristics					
Area (square miles)	34	16	24	69	29
Population	81,645	26,496	47,061	104,230	103,018
Population density (per square mile)	2,560	846	1,483	3,723	3,552
Trip purpose					
Work trips	31%	12%	16%	49%	NA
School trips	24%	23%	10%	65%	NA
Shopping trip	19%	11%	9%	36%	NA
Rider demographics					
Under 18	4%	4%	0%	11%	NA
Aged 18 to 24	28%	27%	6%	73%	NA
Aged 65 or older	10%	6%	2%	17%	NA
Minority	22%	8%	12%	33%	NA
Low income	70%	11%	56%	85%	NA
Operational characteristics					
Unlinked passenger trips	1,297,954	918,617	333,194	2,817,089	1,890,755
Vehicle revenue miles	1,137,008	708,271	348,285	2,181,774	1,873,581
Vehicle revenue hours	84,766	54,493	26,929	171,553	142,525
Number of vehicles	34	20	11	64	53
Trips fixed route (%)	95%	5%	84%	99%	93%

Note: Trip purpose and rider demographic data were not available for St. Cloud Metro Bus or Rochester Public Transit.

APPENDIX C RIDER SURVEY

Please help us understand how you use the bus.
This survey will take about 5 minutes.

1. What is your age?

☐ Younger than 18 ☐ 18-24 ☐ 25-44 ☐ 45-64 ☐ 65-74 ☐ 75 or older

2. What is your race or ethnicities?

☐ White
☐ Black or African American
☐ American Indian or Alaska Native
☐ Asian
☐ Hispanic or Latino
☐ Other:_____

3. What is your total annual household income (for all people in your household combined)?

☐ Less than $25,000
☐ $25,000 to $49,999
☐ $50,000 to $74,999
☐ $75,000 to $99,999
☐ $100,000+

4. Do you have a driver's license?

☐ Yes ☐ No

5. How many vehicles are in your household?

☐ 0 ☐ 1 ☐ 2 or more

6. Do you consider yourself to have a disability?

☐ Yes ☐ No

7. Why are you riding the bus today?

☐ Work
☐ Health care/medical or dental appointment
☐ School or job training
☐ Shopping or eating out
☐ Errands or other family/personal business
☐ Social or recreation
☐ Taking someone else somewhere (for example, taking your child to school or a family member to a medical appointment)
☐ Other:_____

8. If bus service **was not** available, how would you have made this trip?

☐ I would not have made this trip
☐ Driven myself
☐ Family member or friend
☐ Volunteer driver
☐ Used a taxi, Uber or Lyft
☐ Walked
☐ Bicycled
☐ Other: _____

9. How often do you ride the bus?

- ☐ 5-7 days per week
- ☐ 2-4 days per week
- ☐ About once a week
- ☐ A few days per month
- ☐ Once a month or less
- ☐ This is my first time

10. Why do you ride the bus? *Check all that apply.*

- ☐ I can't drive or don't like to drive
- ☐ No access to a vehicle
- ☐ Too difficult to get rides from others
- ☐ It is important to be independent
- ☐ To save money
- ☐ It is convenient
- ☐ It is good for the environment
- ☐ Other:_____

11. If bus service wasn't available, would you need to move someplace else?

- ☐ No, I could continue living in my current place
- ☐ Yes, I would move somewhere nearby
- ☐ Yes, I would move to a different town or city

12. How often do you take the bus to work?

- ☐ Never
- ☐ 5-7 days per week
- ☐ 2-4 days per week
- ☐ About once a week
- ☐ A few days per month
- ☐ Once a month or less

13. How important is the bus service for getting to your job?

- ☐ Not applicable
- ☐ Very important, I would lose my job
- ☐ Somewhat important, I might lose my job
- ☐ Slightly important, I would probably keep my job
- ☐ Not important, I would keep my job

14. How often do you ride the bus for school or job training?

- ☐ Never
- ☐ 5-7 days per week
- ☐ 2-4 days per week
- ☐ About once a week
- ☐ A few days per month
- ☐ Once a month or less

15. How often do you ride the bus for errands or other business?

- ☐ Never
- ☐ 5-7 days per week
- ☐ 2-4 days per week
- ☐ About once a week
- ☐ A few days per month
- ☐ Once a month or less

16. How often do you ride the bus to visit family or friends?

- ☐ Never
- ☐ 5-7 days per week
- ☐ 2-4 days per week
- ☐ About once a week
- ☐ A few days per month
- ☐ Once a month or less

17. How often do you ride the bus for health care? (doctor visit, dentist, physical therapy, etc.)

- ☐ Never
- ☐ 5-7 days per week
- ☐ 2-4 days per week
- ☐ About once a week
- ☐ A few days per month
- ☐ Once a month or less

18. Would you skip doctor visits or prescriptions if bus service was not available?

☐ Yes, many ☐ Yes, few ☐ No

19. Where do you prefer to shop?

- ☐ At local businesses or stores
- ☐ Online, website, internet, etc.
- ☐ Mail-order catalogs

20. How often do you use the bus to go shopping or to eat out?

- ☐ 5-7 days per week
- ☐ 2-4 days per week
- ☐ About once a week
- ☐ A few days per month
- ☐ Once a month or less
- ☐ Never

21. When you take the bus, how much money do you typically spend on shopping or eating out per trip?

- ☐ Not applicable
- ☐ Approximately $5 - $15
- ☐ Approximately $20 - $30
- ☐ Approximately $30 - $50
- ☐ Approximately $50 or more

22. Does the bus help keep you connected to your town? ☐ Yes ☐ No

23. If the bus was not available, would you spend more money buying products online?

☐ Yes ☐ No

24. Please rate how strongly you agree or disagree with the following statements:

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Using transit:					
Allows me to make more trips	☐	☐	☐	☐	☐
Increases my social interaction with other people	☐	☐	☐	☐	☐
Reduces my stress level	☐	☐	☐	☐	☐
Allows me to live independently	☐	☐	☐	☐	☐
Improves my overall quality of life	☐	☐	☐	☐	☐

Is there any other feedback or information that you would like to provide regarding how public transportation impacts your life?

_____

_____

_____

_____

_____

Thank you for completing this survey!
Please give the survey to the driver.

APPENDIX D DISTRIBUTION DATA FOR SIMULATIONS

Many of the input variables for the simulation analysis were assumed to have a triangular distribution with minimum, peak, and maximum values shown in Table D.1. All survey data used in the analysis were assumed to have a uniform distribution with a range of values equal to the mean value +/- the survey margin of error. Data were truncated at zero so that all percentages were non-negative. Estimated margins of error for the surveys are shown in Table D.2, assuming a 95% confidence interval.

Table D.1 Distribution Data for Input Variables with Triangular Distribution

Input Variable	Minimum	Peak	Maximum
Vehicle cost per mile	0.26	0.26	0.6
Taxi/TNC cost per mile	2	3	5
Value of time - Auto	7.5	18.9	18.9
Value of time - Chauffeuring	5.25	17.6	18.9
Value of time - Taxi/TNC	5.25	17.6	18.9
Value of time - Bicycle	7.5	18.9	18.9
Value of time - Walking	7.5	18.9	18.9
Value of time - Transit	5.25	17.6	18.9
Emissions cost per mile for autos	0.023	0.06	0.069
Emissions cost per mile for transit	0.085	0.022	0.025
Cost of forgone health care trip	357	518	650
SNAP cost per trip by income			
<$25,000	4.54	9.07	13.61
$25,000-$49,999	6.37	12.73	19.10
$50,000-$74,999	6.72	13.43	20.15
$75,000-$99,999	6.72	13.43	20.15
$100,000+	6.72	13.43	20.15
Transfers per one-way trip for St. Cloud	0.33	0.55	0.67
Average trip distance			
Paul Bunyan Transit	2.5	5	7.5
SMART	1.5	3	4.5
St. Cloud Metro Bus	1.5	3	4.5
St. Peter Transit	1.5	3	4.5
Timber Trails	2.5	5	7.5
Trailblazer Transit	3.5	7	10.5
Average trip distance - Bicycle	1	2	4
Average trip distance - Walking	0.25	1	2

Table D.2 Estimated Margin of Error for Rider Surveys

Transit Agency	Margin of Error
Paul Bunyan Transit	6%
SMART	9%
St. Cloud Metro Bus	4%
St. Peter Transit	15%
Timber Trails	15%
Trailblazer Transit	7%