MEETING SMALL URBAN TRANSIT NEEDS IN NORTH DAKOTA: A CASE STUDY PERSPECTIVE

Del Peterson*
Dustin Ulmer
Jill Hough

Small Urban & Rural Transit Center
Upper Great Plains Transportation Institute
North Dakota State University

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* Peterson is an Associate Research Fellow, Ulmer is a Graduate Research Assistant, and Hough is the Director of the Small Urban & Rural Transit Center.

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Disclaimer

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EXECUTIVE SUMMARY

Mobility and the connectivity it provides are important elements in our economy and society. They are essential for the economic success and social integration of the individual. Yet, these elements are sometimes minimal or absent in small urban and rural settings. Many of the Northern Plains states' (North Dakota, South Dakota, Montana, Wyoming, and parts of Iowa and Minnesota) elderly, disabled and low income residents rely on public transportation services. In some cases, these services are very limited. The lack of funds forces transit managers to make difficult choices to the point of reducing or eliminating services. Within North Dakota, many transit systems offer primarily paratransit (on demand response) services. The James River Transit system is an example of a system that is exclusively paratransit in nature.

James River Transit is a paratransit system serving the Jamestown community. It provided 50,180 one-way rides in 2000 and 45,100 one-way rides in 2001 while traveling 130,476 miles and 129,118 miles for those two calendar years, respectively. The system operates seven days per week, and its ridership may warrant some form of fixed-route system.

Jamestown also has a large population of individuals with special needs. This large demographic group, along with ADA requirements, will not allow for the complete elimination of James River Transit's current paratransit system. However, implementing a fixed-route system and reducing the number of miles traveled and the number of individual trips provided by the paratransit service would allow James River Transit to reduce costs and charge lower fares for fixed-route service.

Fixed-route service may help Jamestown adapt to the emerging trends of the state which suggest that providing transit service in the future will become even more challenging. One trend is the increasing age of North Dakota's rural population. In 1970, roughly 10 percent of the U.S. population was older than 65. In 2020, an estimated 17 percent of the U.S. population will be older than 65. Many of these people are unwilling to leave their small urban and rural communities for more urbanized areas offering a greater range of services. Census data from 2000 reveals that Jamestown's population was 15,571 in 1990 and 15,527 in 2000, a decrease of only 44 people, while the population of residents 65 and older went from 2,633 in 1990 to 2,806 in 2000, a 6.2 percent increase.

The James River Transit survey was distributed to current transit users. The questionnaire was divided into two main parts. The first part dealt with the existing paratransit service provided by James River Transit as well as feelings towards potential fixed-route service. The second part identified demographic characteristics of James River Transit riders. The total number of survey respondents (55) consisted of 15 male and 40 females. Respondents' ages ranged from 18 to 83 with almost 60 percent being 50 years old or older.

Numerous computer simulations were also performed to develop the most effective fixed-route for Jamestown with many routes being considered for implementation. The cost-effectiveness of the Jamestown fixed-route system was analyzed. The evaluation included discussion on a proposed fare structure and general calculations to determine necessary subsidies for James River Transit.

A primary goal of the James River study is to provide a useful tool for other transit agencies to utilize in determining whether or not a fixed-route bus system is feasible in their communities. Comparisons between Jamestown and other communities can provide insight into what options are available to transit agencies in small towns in addition to standard paratransit services. Ultimately, the goal of this research is to provide a stepping stone to the modernization of transit agencies throughout North Dakota and the entire country.

1. INTRODUCTION

Mobility and the connectivity it provides are important elements in our economy and society. They are not only critical but essential for the economic success and social integration of the individual. Yet, these elements are sometimes minimal or absent in small urban and rural settings. Many of the Northern Plains states' (North Dakota, South Dakota, Montana, Wyoming, and parts of Iowa and Minnesota) elderly, disabled and low income residents rely on available public transportation services. In some cases, these services are very limited. Lack of funds forces transit managers to make difficult choices to the point of reducing or eliminating services. Within North Dakota, many transit systems offer primarily paratransit (demand response) services. The James River Transit system is an example of a system that is exclusively paratransit.

North Dakota has 45 transit systems serving parts of all 53 counties within the state. Forty-one of these systems offer paratransit service while only four systems, located in Fargo, Minot, Grand Forks, and Bismarck offer both paratransit and fixed-route service. Some of North Dakota's larger communities (classified as small urban) such as Jamestown are candidates for fixed-route service in either its traditional form, or in a modified form based on community needs.

Cost is a primary reason a fixed-route system has potential to succeed in a community such as Jamestown. The cost of providing a paratransit ride for James River Transit is approximately $5.96 per passenger. The cost of providing fixed-route service is generally lower per passenger. For example, the cost of providing fixed-route service in Fargo is $2.72 per passenger and the cost of providing fixed-route service in Minot is $2.36 per passenger. Transit systems with a large number of miles traveled each year accompanied by increased ridership may reduce their costs by utilizing a fixed-route system. Cost savings could also be passed on to riders, reducing the cost and increasing ridership.

The Research Problem

James River Transit is a paratransit system serving the Jamestown community. It provided 50,180 one-way rides in 2000 and 45,100 one-way rides in 2001 while traveling 130,476 miles and 129,118 miles for those years, respectively. The system operates seven days per week and its ridership may warrant some form of fixed-route system.

Jamestown also has a large population of individuals with special needs. This large demographic group, along with FTA requirements, will not allow for the complete elimination of James River Transit's current paratransit system. However, implementing a fixed-route system and reducing the number of miles traveled and the number of individual trips provided by the paratransit service may allow James River Transit to reduce costs and charge lower fares for fixed-route service.

Changing North Dakota Trends

Fixed-route service may help Jamestown adapt to the emerging trends of the state which suggest that providing transit service in the future will become even more challenging. One trend is the increasing age of North Dakota's rural population. In 1970, roughly 10 percent of the United States population was older than 65. In 2020, an estimated 17 percent of the U.S. population will be more than 65 years old. Many of these people are unwilling to leave their small urban and rural communities for more urban areas offering a greater range of services. Census data from 2000 reveals that Jamestown's population was 15,571 in 1990 and 15,527 in 2000, a decrease of only 44 people, while the population of residents 65 and older went from 2,633 in 1990 to 2,806 in 2000, a 6.2 percent increase that continues to rise every year.

A second trend is the changing socioeconomic landscape of North Dakota's rural communities. Continued out-migration of young rural residents affects transit in two ways: It reduces the tax base which leads to limited funding for transit in rural areas, and it leaves fewer family members available to provide transportation to aging family members. A third trend is the federal government's involvement in small urban and rural public transit. The federal government has long been involved in public transit, and changes in administration and transportation policies have influenced transportation in the past and will continue to do so into the future. Transit systems rely heavily upon federal, state, and local funding. Systems need to be prepared to adjust when change occurs and they must look for ways to reduce costs which is paramount to the success of any system. Looking for innovative ways to better serve customers with limited funding will enable rural and small urban systems to remain viable while providing much-needed service to local residents.

Study Objective

The objective of this study is to evaluate the operational feasibility of altering the James River Transit paratransit system to include fixed-route service and measure the improvement in service to residents as well as cost savings to the transit system and riders.

Report Organization

This report is organized into four main chapters. Chapter Two discusses recent literature pertaining to fixed-route implementation and its feasibility. Chapter Three describes research methodology used in the study. Chapter Four contains survey results along with computer simulation and cost-effectiveness analysis. Chapter Five discusses conclusions and recommendations of the study and is followed by appendices containing the survey instrument and proposed fixed-route maps for Jamestown.

2. OPERATIONAL FEASIBILITY OF DEMAND-RESPONSE AND FIXED-ROUTE IMPLEMENTATION

Decades before the 1990 passage of the Americans with Disabilities Act (ADA), Ed Roberts, along with other leaders of the independent living movement from both congressional and grass-root perspectives, stressed access to fixed-route transit for people with disabilities. Fixed-route transit is defined by APTA (2003) as service provided on a repetitive, fixed-schedule along a specific route with vehicles stopping to pick up and deliver passengers to specific locations. Special services, such as demand-response, independent living activists argued, are too limiting and go against the integrationist spirit of their cause (Bowe 1979). Demand-response transit service is defined by Kirby et al. (1974) as transportation that Aprovides door-to-door service on demand to a number of travelers with different origins and destinations.@ Making fixed-route busses accessible to people with disabilities has been emphasized, and despite initial and continuing resistance from the transportation industry, definite progress has been made (Denson 1998).

To better understand the process of fixed-route implementation, several factors must be addressed. The discussion will begin with a state-of-the-practice description for integrated transit services throughout the United States, followed by a comparison between demand-response and fixed-route transportation, and concluded by discussing technology advancements that have aided fixed-route implementation for people with disabilities.

State-of-the-Practice Description for Integrated Transit Services

In the United States, many transit agencies are considering integrating their demand-response service with traditional fixed-route service. In some cases, it may be advantageous to the transit agency or to the passenger to coordinate traditional demand-response transit service with fixed-route services. The demand-response service connects passengers from their origin to the fixed-route service and (or) from the fixed-route service to their final destination. Using this concept, transit agencies can extend demand-response service into low-density markets or may substitute demand-response service for fixed-route service. Many rural areas do not run fixed-route service because of a lack of demand and funding. In these cases, operating costs may be reduced and the level of service to passengers may increase by providing door-to-door service (Hickman and Blume 2001).

Three main studies highlighting the transition and implementation of fixed-route services are discussed in the following subsections. These include studies conducted in British Columbia, Delaware, and Kentucky. All involved the transition of demand-response customers to fixed-routes.

British Columbia Transit

British Columbia (BC) Transit is committed to ongoing improvements in the accessibility of fixed-route transit services for mobility, health, economic, and social benefits. To maximize the benefits to the customer, the transit system, and the community at large, BC Transit must continue to assess needs while developing and promoting programs and services to support those able to use fixed-route services (Sowden and Wick 2001).

BC Transit offers a full range of transportation options, including accessible buses, door-to-door handy Daily Access Rapid Transit (DART) service, the Taxi Saver program and Community Travel Training. Demand-response provides door-to-door transportation service for clients who have demonstrated difficulty using accessible buses or for individuals who cannot otherwise use or travel to an accessible bus stop. Individuals must pre-register for custom transit services and may have to attend an orientation interview and provide a letter from their doctor to ensure that they meet eligibility criteria (Sowden and Wick 2001).

Because of increasing demand, moving custom service clients to fixed-route wherever possible is uppermost in the planning strategy and was a key factor in developing Community Travel Training and the concept of a registration and training center. Research and planning by BC Transit and input by the Accessible Transportation Advisory Committee resulted in the development of the Community Travel Training Program to meet the needs of BC Transit and the community (Sowden and Wick 2001).

The Community Travel Training Program is designed to be a short-term, comprehensive, sequential, consistent, individual and community-based support effort. Over the past two years the program trained more than 150 seniors and individuals with disabilities, ranging in age from 12 to older than 80, and has established and maintained partnerships with more than 300 representative organizations, schools, hospitals, and residential and recreational facilities. Roughly one-third of the 150 individuals who were trained through the program indicated during follow-up that they now use fixed-route service for their primary transportation requirements, using custom transit only in inclement weather, at night or when their medical condition requires (Sowden and Wick 2001).

BC Transit estimated the cost per trip for demand-response services to be $12.50. The first year that training was offered, 50 clients switched from demand-response to fixed-route service, saving a potential demand-response transit cost of $195,000. Subtracting $45,000 for training costs and $50,000 for added fixed-route costs, BC Transit saved roughly $100,000 last year with similar savings and results indicated for the current year (Sowden and Wick 2001).

New Castle County, Delaware Transit

New Castle County, Delaware, was the only county in the state with an extensive fixed-route system at the time this study was conducted. Approximately one-third of the fixed-route buses were equipped with lifts and a Acall-a-lift@ program was just being made available in the county. The use of accessible fixed-route transit was not a viable option at the time of the study. The study=s intent was to explore the Awillingness@ or receptivity of the current riders to the concept of transitioning to fixed-route services for planning purposes (Denson 1998).

A total of 1,266 eligible riders were surveyed and individuals who had questions or who wished to register by telephone were encouraged to call the research office. To further encourage participation, the surveys were mailed with a solicitation letter explaining that respondents who completed the survey would be entered in a drawing for one of two $50 cash awards (Denson 1998). The mailing generated 174 responses, an initial response rate of 14 percent.

The majority of survey respondents (69 percent) reported that, if accessible, they would be unable to use the fixed-route bus system. The most common reason given for not using fixed-route buses was the inability to travel to and from the bus stop. Others stated that a lack of availability as the reason for not using the fixed-route buses. Respondents with a physical disability were more likely than respondents with a sight disability to explain that they did not ride the fixed-route bus because of their specific disability, showing that those with physical issues would not adjust as easily to fixed-route ridership (Denson 1998).

The average cost of providing a paratransit trip in the study=s state is $26.89 with riders paying $2 for a one-way trip, and each fixed-route trip is $2.67 with riders paying $1.15 per trip (Benson 1998). The potential savings of any significant move to fixed-route services become apparent based on the previous demand-response and fixed-route transit cost differences.

The results of this study support two key themes of the general literature on transportation for people with disabilities. First, an accessible bus fleet is just one aspect of the systematic accessibility required to make fixed-route public transit a viable option for people with disabilities. Second, even when steps are taken to improve accessibility within the entire public transportation system, a significant number of paratransit riders will be unwilling to stop using a service with which they are generally satisfied.

Richmond, Kentucky Transit

The city of Richmond (population 27,000) is located in central Kentucky, approximately 30 miles south of Lexington. Over the past decade its population has expanded rapidly. At the time of the study, Richmond did not have a fixed-route system. Transit-eligible citizens are served by a local non-profit transit service. The service operates a demand-response system of buses and vans (O=Connell et. al. 2002).

This analysis attempted to determine which citizens would most likely ride public transportation. Four main socioeconomic characteristics where selected to determine a citizens' likelihood of riding public transit. These included vehicle status, percent of population over age 65, household income, and percent of African-American population. Census data were used to identify the areas within the city of Richmond that exhibited the previous socioeconomic characteristics. All data were analyzed at the block-group level (O=Connell et. al. 2002).

To determine the best place for bus routes, census blocks were identified where the percentage of households with no vehicle was higher than the median for Richmond. Also identified were the census blocks in which the percent of individuals over age 65 was higher than the median, as well as the blocks in which the median household income fell below the county median. Last, the blocks where the percentage of African Americans was above the median were identified. The blocks tended to overlap, which facilitated drawing a 7-mile loop bus route that could be run hourly. The route was designed to maximize contact with the most likely production areas and attractions (O=Connell et. al. 2002).

After identifying the best area for a fixed-route, the next step was to estimate the number of current demand-response riders who could be transferred to the new route. To do this, the researchers worked with the directors of the local transit operation. It was estimated that the proposed fixed-route would make it possible to reduce the present demand-response fleet from seven to five vehicles. This reduction in demand-response vehicle use will result in an estimated annual savings of $71,544 (O=Connell et. al. 2002).

The Richmond study concluded that a portion of those citizens currently riding in demand response vehicles could be shifted to a fixed-route in the city. Also, with the data from the study of Richmond, an example is provided of the savings that could be generated by transferring a relatively small portion of those who ride the demand-response buses to a bus in a fixed-route system. It was found that Richmond could obtain a fixed-route bus service with little or no additional spending, as the combination of reduced cost for the lessening of demand-response service and new revenue from fare-box customers would cover much, and perhaps all, of the additional expense (O=Connell et. al. 2002).

Demand-Response versus Fixed-Route Transportation

Two broad trends characterize the current evolution of public transportation in the United States. First, as the population moves out of larger cities to the suburbs, small cities, and towns, fewer Americans rely on fixed-route public transportation. This results in growing reliance on the personal automobile with resulting effects on the social and physical environment. Second, as the population ages, reliance on publicly funded demand-response systems for transportation to medical and other facilities increases. The two trends work against each other with respect to fixed-route implementation.

Pros and Cons of Demand-Response and Fixed-Route

The decline in the use of fixed-route service has some undesirable consequences. Demand-response systems can be very expensive to operate, because there are few passengers in the vehicle, sometimes only one. Cost per trip for demand-response service range from $5 to $27, whereas fixed-route service costs range from $1.75 to $4 per trip, a substantial cost difference. In fact, it is often the case that government pays local taxi companies to transport eligible citizens to doctors= offices and other destinations. Also, demand-response systems, unlike fixed-routes, do not reduce use of the private automobile. In cities with fixed-route transit systems, the average vehicle miles traveled tend to be lower. Such cities also tend to have more concentrated populations and therefore less urban sprawl relative to their general population (O=Connell et. al. 2002).

In other situations, longer trip lengths and growing support for demand-response service may lead a transit agency to consider providing at least part of the trip on fixed-route service, thereby reducing operating costs (Hickman and Blume 2001). Operating costs of demand-response service have increased as a result of the difficulties encountered by the elderly and the disabled in utilizing transit services and increased driver wages. The ADA requires that complementary paratransit services be provided to eligible elderly and disabled riders. Demand-response service is well suited to the provision of such complimentary service, but is very expensive. Integrated services have the potential to reduce the costs of providing this service.

Relationship of Demand Response and Fixed-Route Transit

Historically, fixed-route transit and demand-response developed independently. Transit operators provided fixed-route transit, and social service agencies provided demand-response, although there were notable exceptions. Demand-response became the only public transit operation in many small cities in the states that provided funding for this type of transportation. The notion that demand-response and fixed-route transit both have a role in a family of services for specific markets has been slow to spread (Lave and Mathis 2001).

Changes in organizational structures, internal procedures, and the use of technology are reducing the distinction between regular-route services and demand-response. Service planning will continue to move toward incorporating appropriate roles for a range of modes instead of a Aone-size-fits-all@ approach. Future systems will deploy a range of services in different geographic areas, by different time of day or day of week to make public transit more attractive while increasing overall system efficiency. Demand-response and fixed-route transit will be seen as comprising a number of options for public transportation agencies (Lave and Mathis 2001).

Technology Advancements

The transit industry has shown significant interest in new technology such as vehicle-location systems and automated fares. However, these applications are typically agency specific. Advanced technology across two or more agencies is far less common (Giuliano et. al. 2002). The most advanced integrated transit services exist today in the United States in the form of Afeeder service@ and Asmart shuttle@ programs that utilize computer-assisted scheduling routines in the integration of transit services. Others, however, do not involve such sophisticated technology and may rely on simple computer dispatching software to schedule their services (Hickman and

Blume 2001). Concepts and tools used to incorporate advanced technology into integrated transit systems are discussed in the following sections.

Concepts for Integrating Transit Services

Integrating demand-response service with other modes is the main goal of a flexible operation system. The objectives have always been to integrate rail, fixed-route bus and demand-response services into a homogenous public transit network. In a complex transit system, demand-response modes are effectively used to supplement fixed-route service in areas where the traffic demand is too low and scattered to provide acceptable fixed-routes or schedules (Greschner 2001).

The success of flexible operation systems can be measured in three ways. First, the increased productivity of the revenue vehicles because of the ability to change the operations mode in area and time in accordance with changing traffic demand can be evaluated. Second, savings in run time and performance because, in demand-response mode, trip requests can be satisfied over the individual shortest route and stops. Third, operational experience shows fixed-route services can be supplemented or substituted by demand-response modes when and where area-wide transit coverage at low traffic demand is required (Greschner 2001). Evaluating these three attributes will gauge the effectiveness of integrated transit services.

Tools for Integrating Transit Services

For many years, people have designed concepts to integrate demand-response with fixed-route service. Implementing such concepts results in an increase in the quality and productivity of transit service. However, hardware and software tools have to support such concepts (Greschner 2001). A recent Federal Transit Administration report describes the roles and successes of advanced technologies such as geographic information systems (GIS), Advanced Vehicle Location (AVL), and operations software at North American Transit Agencies (Hickman and Blume 2001).

GIS has the ability to integrate and maintain large-size spatial transportation databases from different data sources and can conduct and support spatial and temporal analysis. Particularly, GIS has the ability to model and refine large-scale networks and control quality of information flow among various models. To integrate itinerary planning and GIS technologies, the functionality of a GIS system needs to be extended or modified. The key to the successful integration is the design of spatial network databases and associated management tools to meet the various spatial function needs of itinerary planning (Li and Kurt 2001).

Highly-sophisticated AVL techniques for demand response and fixed-route planning have provided enormous break-throughs for scheduling. The advantages are based on data and communication systems allowing for the transfer of information and messages. This element reduces voice communication traffic. Also, the transfer of information to the vehicle operator via data radio avoids the usage of paper and allows the dispatcher to change and delete trips online when the vehicle is in service (Greschner 2001).

Transit services and costs vary substantially throughout the United States. Whether or not fixed-route or demand-response service is better for a given area is very subjective and often based on many underlying factors. Factors may include age, socioeconomic status, and physical

limitations of riders as well as a given community's size and geographic landscape. Technology can add to the efficiency of almost any system, but a cost/benefit analysis should preclude any advanced technology procurement as many technologies may be unnecessary or too costly for a given transit system. The following chapter will highlight the research methods used within the study, and how the demographics and available technologies may influence fixed-route implementation with the James River Transit Center.

3. RESEARCH METHODS

This study investigated the feasibility of fixed-route implementation within small urban and rural communities. Fixed-route studies are often done within large urban areas, but there is a lack of research available pertaining to smaller communities. The following discussion highlights the research methods utilized to investigate the community of Jamestown, ND, which was used as a case study model for this research.

The research methods section is separated into four sections. First, the survey instrument used in the study and its design are discussed. This is followed by focus group meeting perceptions. Focus groups were developed to allow the research team to gain first-hand knowledge of Jamestown's current transit systems and to gain a better understanding of local riders' perceptions toward a fixed-route transit system in Jamestown. Geographic Information Systems (GIS) analysis is then examined and used to analyze different routes and their timing. Finally, methods used to evaluate the cost effectiveness of implementing a fixed-route system in Jamestown are discussed.

Survey Instrument Design

A five-page survey was developed by the research team and the James River Transit Center. It will be described in this section (Copy of survey in Appendix A). James River Transit tried to survey as many of its current riders as possible. The research team conducted a drawing for 'Buffalo Bucks,' which can be used to purchase goods and services at select businesses within the city limits of Jamestown, for anyone who completed the survey. The prizes consisted of two $50 buffalo bucks prizes, two $25 buffalo bucks prizes, and two $10 buffalo bucks prizes. Respondents who wanted to be considered for the drawing had to provide their name and contact information on the finished survey, but had the option of not providing their contact information to the research team. Therefore, respondents had the right to remain anonymous if they felt it was necessary to do so.

The survey contained 21 questions. Questions dealt with respondents' current usage of James River Transit, rider travel patterns, and how they felt about the current service. Further questions asked respondents to indicate their views towards a new fixed-route system which would compliment, not eliminate, the already existing paratransit service. Demographic information comprised questions fifteen through nineteen of the survey. The final two questions were designed to be open-ended to solicit suggestions for improving the current James River Transit service and to learn what riders like best about James River Transit.

Many of the questions included a "check all that apply" option. For example, respondents were asked about the kinds of transportation they used. Options included taking the bus, rides from family and friends, and taxi. The "check all that apply" option provided the research team with a better understanding of all the transportation options available to perspective riders.

Focus Group Meetings

Focus group meetings were held March 3, 2004. Feedback from James River Transit riders obtained during the focus group meetings were given considerable attention when fixed-route scheduling and timing were developed. The goal of the focus group meetings was to gain first-hand knowledge of the day-to-day operations of James River Transit.

Two separate meetings were held March 3to provide flexibility for attendees. The turnout of riders was favorable, and they did a good job of representing the ridership as a whole, according to the James River Transit Center's executive director, Carol Wright. Everyone attending the focus group meetings filled out the above-mentioned survey, and all were given the opportunity to voice their opinions, either favorable or unfavorable, towards the James River Transit Center.

Most attendees voiced overall satisfaction with James River Transit. The drivers were given praise time and again for the kindness and helpfulness they provide for all riders. A select few indicated they felt the rates were too high and that if they were increased, a dramatic decrease in ridership would occur. It was explained to attendees that the current paratransit rate of $2.50/ride was very reasonable compared to other communities offering the same service. Also, the research team, along with Executive Director Carol Wright, stated numerous times that the addition of a fixed-route system would provide an additional service to riders and potential riders at a reduced cost to the present paratransit service. This statement was met with mixed responses by attendees.

The research team, based on findings from the focus group meetings, emphasized the need for a rigorous training effort on the part of James River Transit to successfully implement a fixed-route system. James River Transit agreed that some type of rider-training effort would have to be undertaken. Overall, the focus group meetings were a success and served their intended purpose of familiarizing the research team with the problem at hand.

Geographic Information Systems (GIS) Analysis

GIS has the ability to model and refine bus routing networks and control quality-of-information flow among various models. This fits perfectly with the needs of the research team in determining optimal fixed routes for James River Transit and their timing. In order to model the bus route flow more accurately, an average route speed of 12 miles per hour was used on all applicable routes. Although all speed limits on routes fell between 25 and 40 miles per hour, using 12 miles per hour as the benchmark allowed time for stops and the loading and unloading of riders who might be traveling with the aid of a wheelchair or other travel aid.

ArcView Network Analyst was the GIS software used to analyze potential James River Transit fixed routes. Network Analyst utilizes Dijkstra's Algorithm to solve the problem of finding the shortest path from a point (the source) to a destination. Dijkstra's Algorithm is often referred to as the single-source shortest path algorithm. A simplified mathematical formulation is represented below as explained in (Taylor 2002).

Assume the James River road system is represented as **G** below. Given this, the formulation can be stated as:

G = (V,E) where
V is a set of vertices and
E is a set of edges

Dijkstra's algorithm keeps two sets of vertices:

S is the set of vertices whose shortest paths from the source have already been determined and **V – S** are the remaining vertices.

The other data structures needed are:

D which is an array of best estimates of shortest path to each vertex and

pi which is an array of predecessors for each vertex.

The basic mode of operation is:

1. Initialize **d** and **pi**,
2. Set **S** to empty,
3. While there are still vertices in **V – S**,
    a. Sort the vertices in **V – S** according to the current best estimate of their distance from the source
    b. Add **u**, the closest vertex to **V – S**, to **S**,
    c. Relax all the vertices still in the **V – S** connected to **u**

The relaxation process updates the costs of all the vertices, **v**, connected to a vertex, **u**, if one could improve the best estimate of the shortest path to **v** by including (**u, v**) in the path to **v**.

Numerous hypothetical routes were evaluated to determine an optimal fixed-route system for James River Transit. The first step in the route design was to determine riders' residential addresses. Next, frequent stop locations for the present paratransit system were needed to determine a feasible fixed-route. Both rider addresses and present stop locations were obtained and geocoded in the Jamestown street map using ArcView. Geocoding, also known as address matching, is the process of creating geometric representations for descriptions of locations. A geocoding service defines the process for converting these descriptions into geometric shapes. A geocoding service can be used to find individual addresses and to geocode tables of addresses. Existing addresses that have already been converted into geometric shapes may also be reviewed and rematched to more efficiently represent available data.

Representing real-life situations through computer simulation allowed the research team to see James River Transit's situation from a different perspective. Using computer simulations to represent real-world situations have shortfalls, but the accuracy with respect to Jamestown and James River Transit's needs was proficient.

Fixed-Route Cost Effectiveness

Evaluating the implementation of the fixed-route system involved determining a suitable cost structure for the new system and also evaluating its effect on the existing paratransit system. The proposed cost structure was based largely on a comparison between James River Transit and other transit agencies. A wide variety of transit systems were used in this comparison. Fargo, ND, Minot, ND, and Hibbing, MN, are three transit agencies representing various sizes and complexities whose present fixed-route and paratransit systems were analyzed. Developing funding sources for the fixed-route system was another issue that was addressed. Local businesses and employers who would benefit from the service were thought to be the main funding sources from which to draw additional financial support.

The largest obstacle to overcome with respect to the fixed-route system running alongside the paratransit system was the initial confusion that potential and current riders may face. Passenger training was again suggested as necessary for riders to understand the similarities and differences between the two systems and how they will coexist. Training could consist of sessions held by James River Transit explaining the fixed-route system and how it will work incorporating real-

life examples (ie. A rider boards the bus at the senior center and wants to travel to Walmart). The steps necessary for the rider would then be explained to familiarize riders with the route functioning. Also, having attendants at bus stops during the first couple days of fixed-route service answering rider questions and explaining the route more thoroughly at individual stops would be helpful. James River Transit's willingness to change the coloring and/or markings of buses to distinguish between fixed-route and paratransit vehicles will give the riders the ability to distinguish between the two services quite easily as well.

4. RESULTS AND FINDINGS

This chapter presents results of the James River Transit user survey along with computer simulation results of potential fixed-route implementations in Jamestown. The survey was divided into two main parts. The first part dealt with the existing paratransit service provided by James River Transit as well as respondents' feelings towards potential fixed-route service. The second part identified demographic characteristics of James River Transit Riders (Appendix A). Numerous computer simulations were also performed to develop the most effective fixed-route for Jamestown. Only the routes which were considered for implementation will be discussed in the following chapter. Finally, a cost-effectiveness evaluation of the Jamestown fixed-route system will be discussed. The evaluation will include discussion on a proposed fare structure and general calculations to determine needed subsidies for James River Transit.

Survey Results

Some general demographics of respondents will be discussed first to identify how respondents compare to the general population. The total number of survey respondents (55) consisted of 15 male and 40 females (Figure 3.1). Respondents' ages ranged from 18 to 83 with almost 60 percent being 50 years old or older (Figure 3.2).

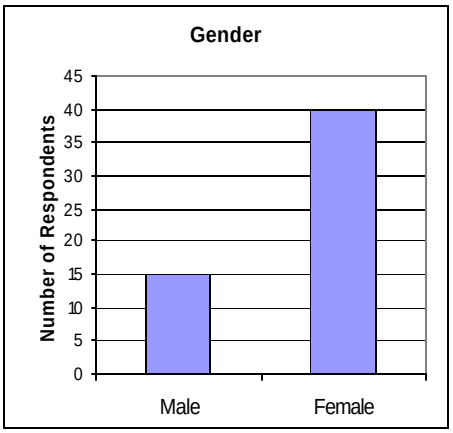

Figure 3.1 Respondent gender

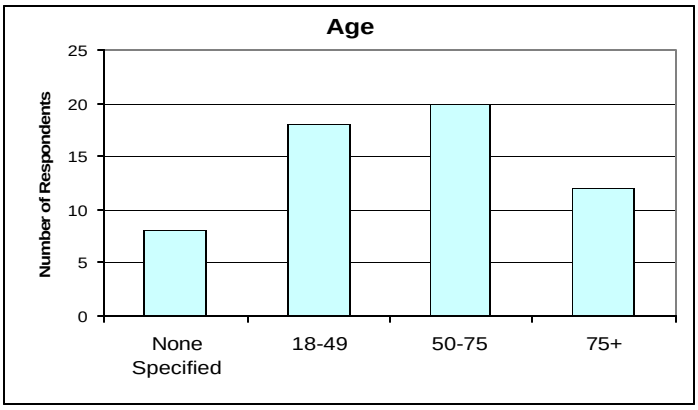

Figure 3.2 Age of respondents

Nearly half of respondents indicated that they had completed high school while the other half had attained various levels of education (Figure 3.3). Also, less than 10 percent of all respondents specified that they were full-time workers while nearly half of respondents indicated that they were retired (Figure 3.4). Therefore, based on these findings, most James River Transit riders based on these findings indicate that most riders are predominantly senior citizens, unemployed and female.

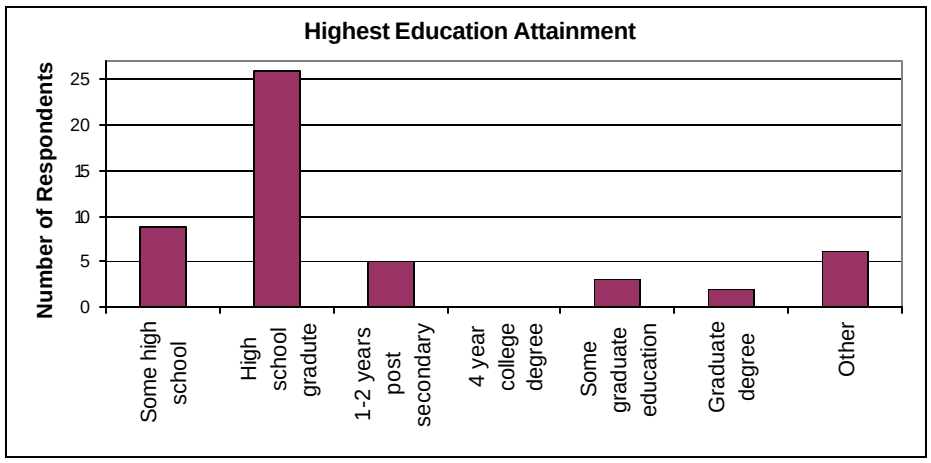

Figure 3.3 Educational levels of respondents

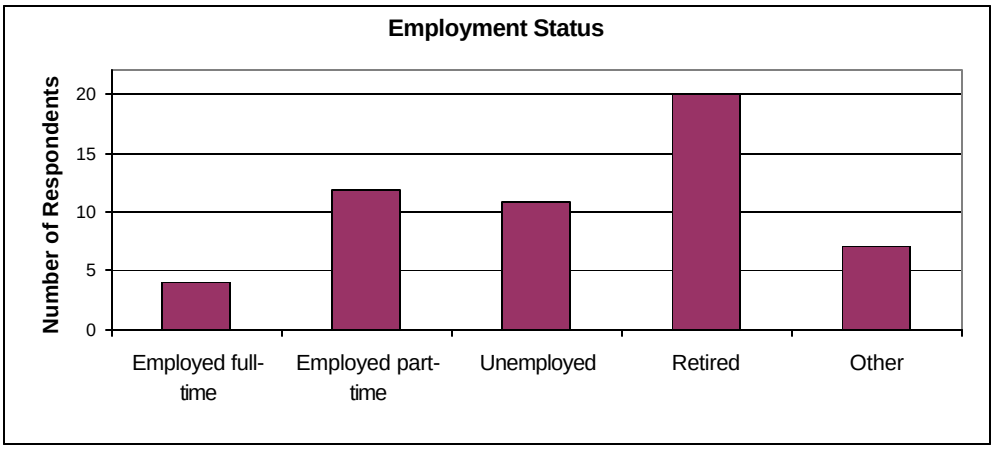

Figure 3.4 Employment status of respondents

The following results show opinions towards James River Transit's existing service as well as feelings towards the potential fixed-route system. Results indicate that the bus along with family members and friends are the main sources of transportation among respondents (Figure 3.5). Taxi service is also utilized frequently by transit riders. Very few respondents indicated that they drive a personal automobile themselves. Their responses show how dependent the handicapped and elderly population in Jamestown is on James River Transit.

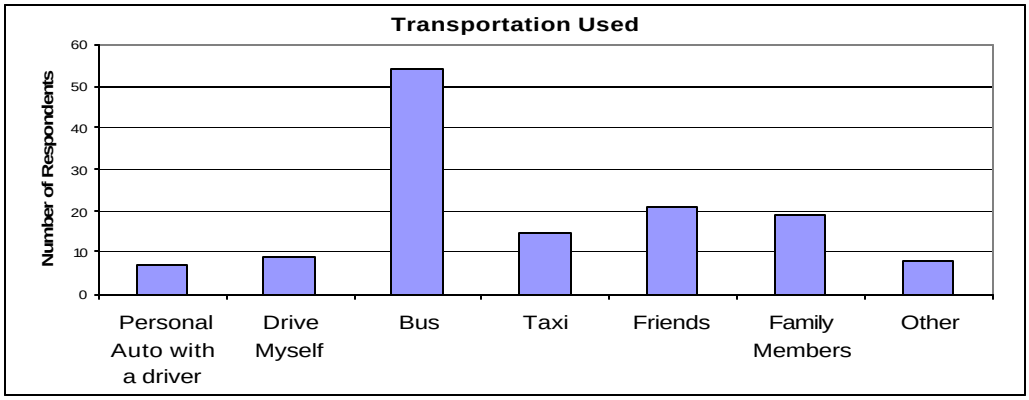

Figure 3.5 Transportation methods of respondents

Almost all respondents specified their ridership to be either daily or 2 to 3 times per week (Figure 3.6). This shows both the need and demand for the service on a daily basis. Also, over 90 percent of respondents rated the current paratransit service as either very good or good (Figure 3.7). This is a testament to the quality of service provided by James River Transit and its drivers.

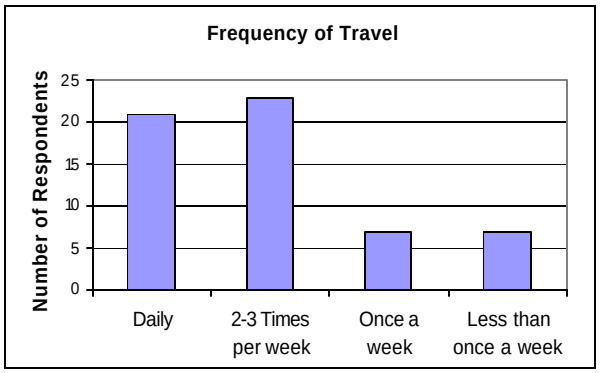

Figure 3.6 Transit travel frequency

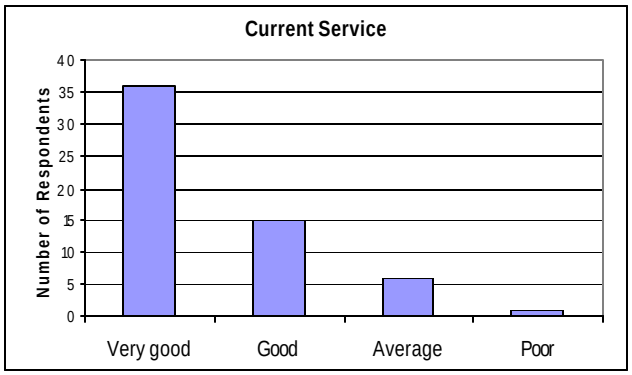

Figure 3.7 Opinions toward current service

More than 50 percent of respondents indicated specifically that driver courteousness was the best feature of James River Transit with no one indicating a negative response towards the service (Figure 3.8). Dependability of the service and the service's ability to get riders to work on time were among other positive responses.

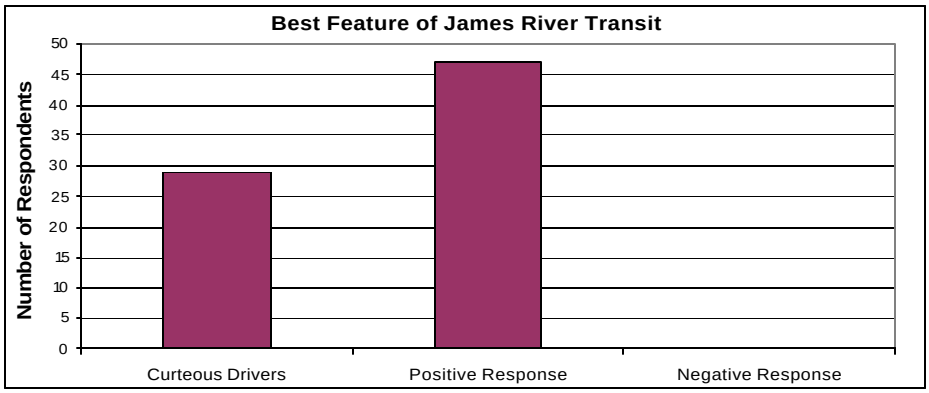

Figure 3.8 Best features of James River Transit

An important step in determining the fixed-route stops was to determine travel patterns of current riders. Main travel destinations will be used as stops along the fixed-route system. The major retail stores (Walmart, Kmart) and grocery stores (Hugos, County Market) were found to be the most-traveled-to locations in the Jamestown area currently served by James River Transit (Figure 3.9).

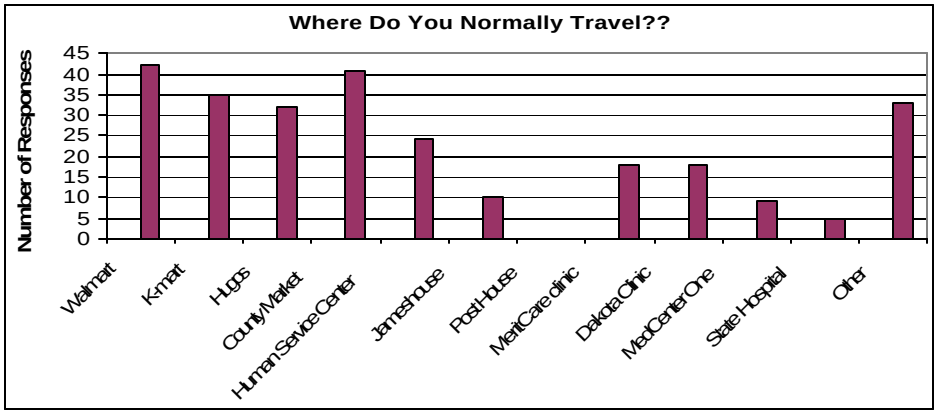

Figure 3.9 Travel destinations for James River Transit riders

Another important aspect of determining a feasible fixed-route option for Jamestown is the timing of the route. James River Transit riders were asked to indicate what time of day they normally ride. This question did not provide a clear answer to determine the desired start and finish time of the route. More than 80 percent (45) of respondents indicated that their travel pattern varies (Figure 3.10).

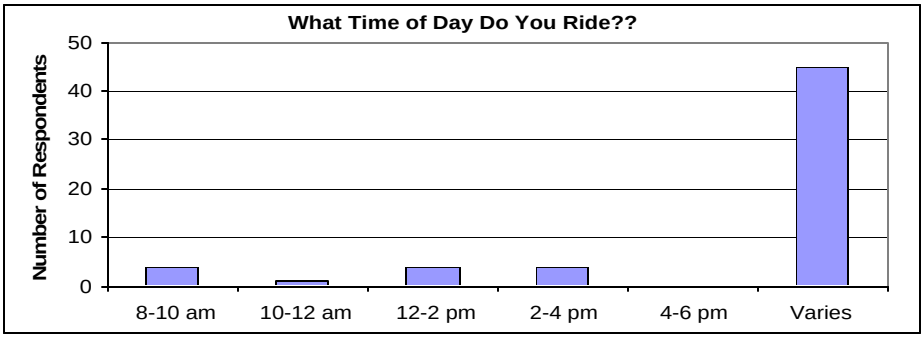

Figure 3.10 Travel times of James River Transit riders

Important features of the fixed-route must also be determined to maximize its daily ridership. Riders were asked what would encourage them to use the fixed-route system. Responses indicated that increased flexibility, with numerous routes and schedules, along with accessibility were important to maximize ridership in Jamestown (Figure 3.11). Also, nearly 30 percent (15) of respondents indicated they were unaware of ways to increase the ridership of a fixed-route system. This result shows that many respondents are unaware of what a fixed-route system can do in Jamestown, or they are unfamiliar as to how a fixed-route system works. This shows the need for travel training along with the implementation of the new service.

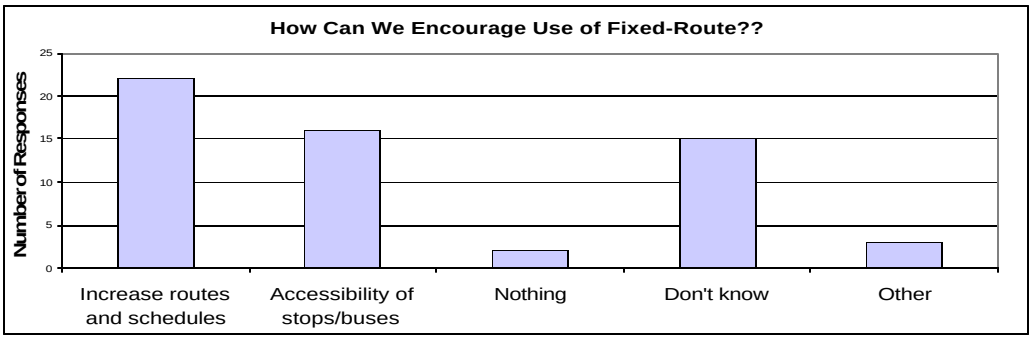

Figure 3.11 Ways to encourage fixed-route usage

Riders were then asked why they, personally, would be unable to use a fixed-route bus. Nineteen riders (nearly 40 percent) indicated they did not know why they could not ride the bus (Figure 3.12). Disabilities and the inability to walk from their residence to a fixed-route bus stop were other common replies. These results show the need for flexibility in service with a fixed-route system.

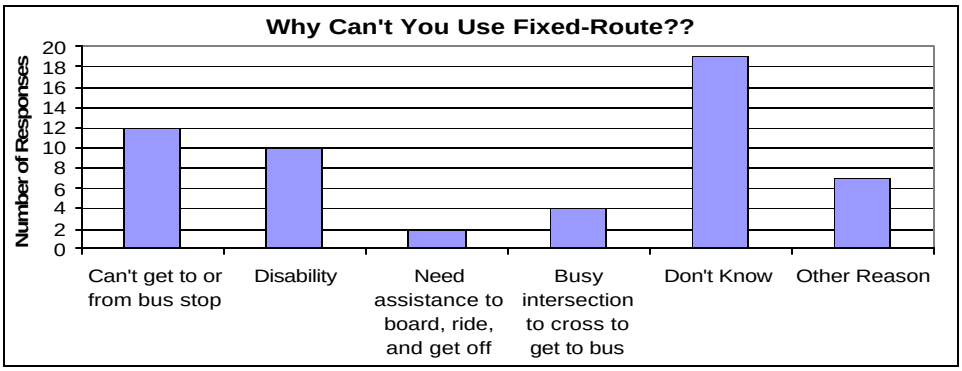

Figure 3.12 Reasons respondents cannot use fixed-route service

The following results are based on survey questions dealing directly with the usage of the proposed fixed-route service. Riders were asked to estimate how often they would use the fixed-route bus. Twenty-seven people (almost 50 percent) indicated they would ride the bus 1 to 5 times a week or 1 to 4 times per month (Figure 3.13), while 21 respondents indicated they did not know how often they would ride. This is likely due to current riders not understanding how a fixed-route system would function, or current riders not knowing how they would use the service.

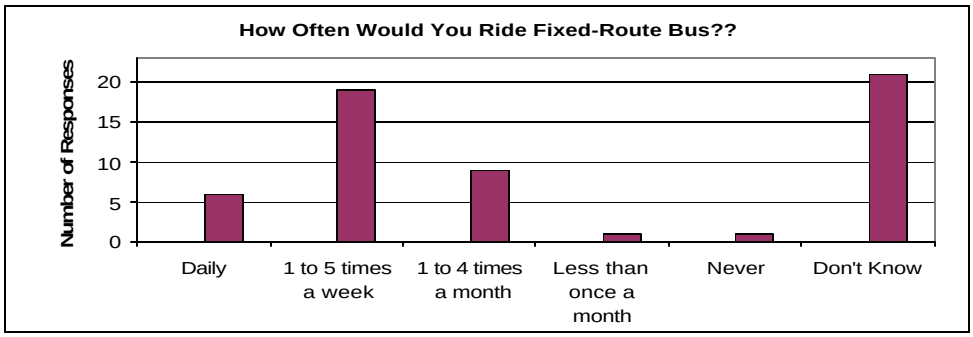

Figure 3.13 Respondents estimated use of fixed-route service

James River Transit riders were then asked whether they need assistance getting in and out of vehicles and whether or not they can board a bus independently. Thirty-nine respondents indicated they do not need help getting out of vehicles while 41 replied they could not board a bus independently (Figures 3.14 and 3.15). At first glance these results seem to contradict each other, however, climbing the steps of a bus is often far more difficult for the elderly and handicapped than simply getting into or out of a personal automobile. This line of reasoning may explain the responses to these questions.

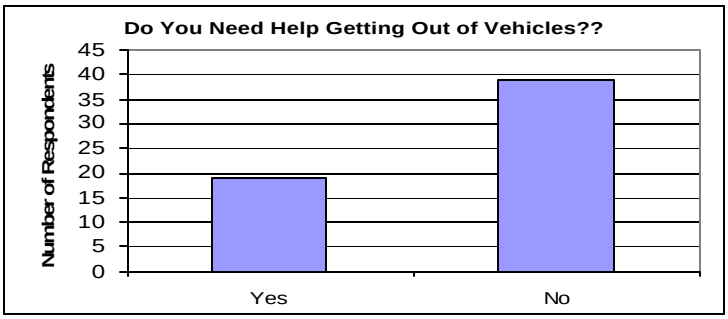

Figure 3.14 Can riders get in and out of vehicles without assistance?

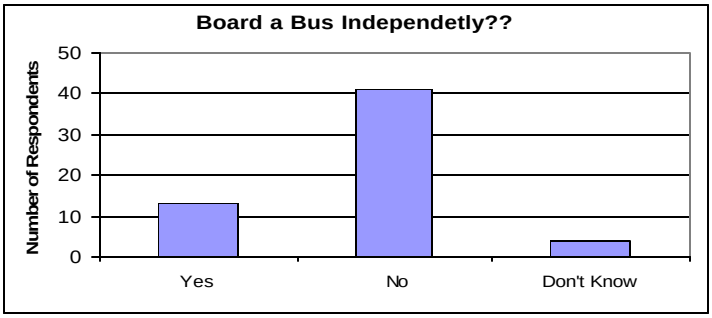

Figure 3.15 Can riders board a bus independently?

Current riders were also asked if they would use a fixed-route bus if it were less expensive than the current service; 40 respondents (73 percent) indicated they would (Figure 3.16). Many of the respondents who answered 'yes' to this question may not have taken time to think about whether or not they could physically ride the bus, but rather responded directly to the cheaper alternative. Potential riders were asked if they would be interested in taking travel training for fixed-route service; only 15 respondents indicated such a willingness (Figure 3.17). Thirteen did indicate they did not know and will probably be willing if they see the service as being responsive to their transportation needs.

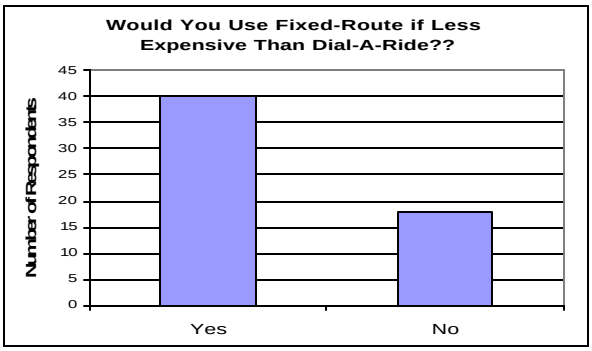

Figure 3.16 Willing if cheaper

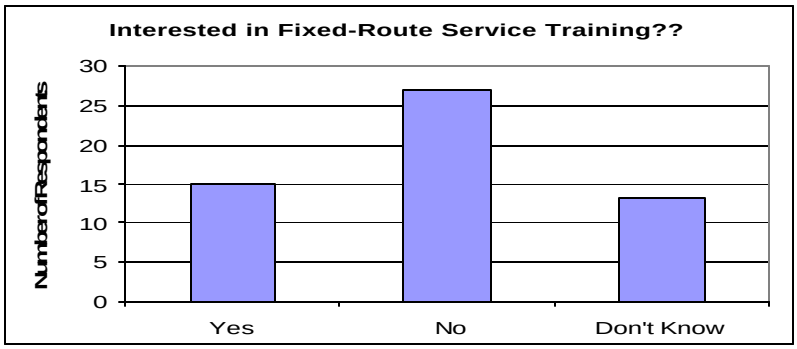

Figure 3.17 Respondents interested in training?

Finally, questions of improving the current service and advantages of fixed-route versus paratransit service were asked. Sixteen respondents indicated they felt nothing could be improved upon with regards to the current service (Figure 3.18) while eight responses highlighted the request for cheaper service. This will be addressed with a fixed-route bus as the per-ride fare will be less than the per ride paratransit fare. Evening bus service was another sought-after improvement by respondents with six people indicating this as a need. Running the fixed-route bus in the evening a couple of days per week is an option that was recommended by the research team and is being considered by James River Transit.

The main advantage of fixed-route service compared to paratransit is cheaper fares. More than 60 percent (34 respondents) indicated this as an advantage with 50 percent indicating that scheduled service would be an advantage (Figure 3.19). Forty percent of respondents also indicated that fixed-route service being more environmentally friendly than paratransit was a noteworthy benefit.

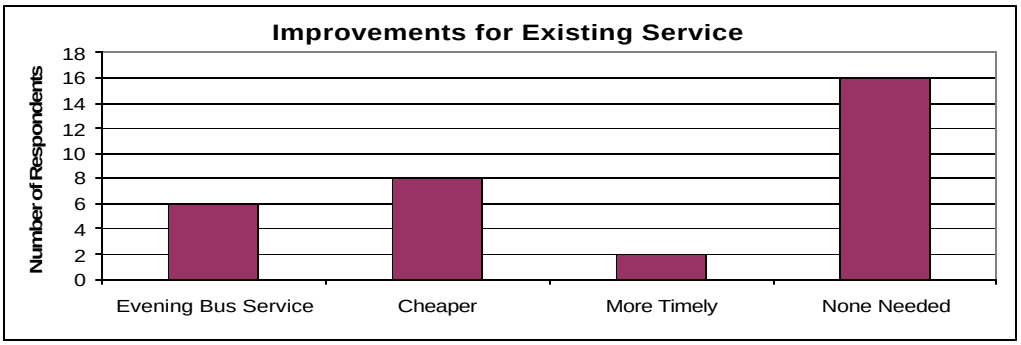

Figure 3.18 Possible improvements to existing paratransit service

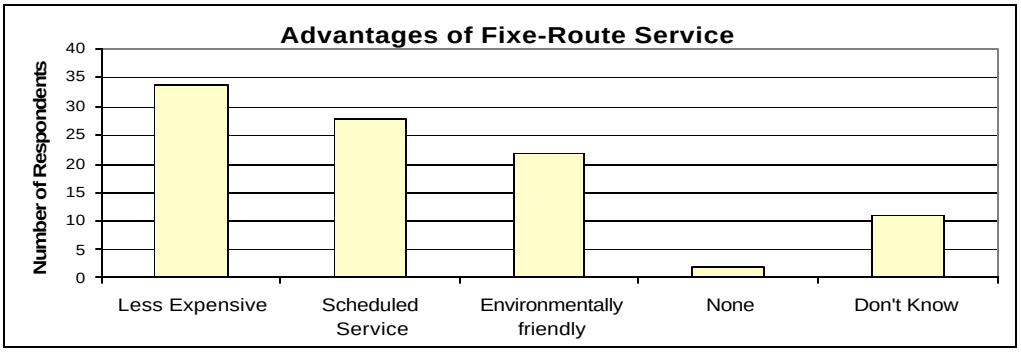

Figure 3.19 Advantages to fixed-route service versus paratransit

Overall, the survey results indicate that James River Transit is doing an excellent job providing its current paratransit service. Like most small towns, Jamestown is home to a large aging population that continues to age as the younger generation relocates to larger cities in search of greater opportunity. The concerns of the James River Transit riders are echoed throughout the country. Riders desire better and cheaper service, things which are virtually impossible to provide. A fixed-route system, or something similar, will make riding the bus in Jamestown more affordable for current riders and potential riders who currently use other means of transportation. Also, there seems to be a stigma connected to paratransit service in that only the elderly and handicapped use such a service, making a fixed-route option all the more desirable to increase James River's ridership as a whole.

Fixed-Route Options

Computer simulation results of routes that were considered for implementation will be discussed in this section. Routes considered for implementation included:

1) Full Town Route
2) Full Town Two Bus Route
3) Half Town Route
4) Circulator Route

5) Specialized Route
6) Flex Route

The first route considered (Full Town Route) was a one to one and one-half hour route using a single bus which covered all of the main stops in town. The second proposed route (Full Town Two Bus Route) covered most of the same area as the first, but it would use two buses running simultaneously to fully cover the route in 30 minute cycles. The third route (Half Town Route) was a one-hour route using one or two buses, but it covered a more limited area than the first and second routes. The fourth route considered (Circulator Route) was a circulator route that would stop at the major shopping points in town using a single bus and run on a 30 minute cycle. The fifth consideration (Specialized Route) was a hybrid deviated fixed-route where certain days of the week a bus would travel to assigned destinations (i.e. Walmart) at a discount to the riders. The sixth and final route considered for implementation (Flex Route) was another hybrid route which served a fixed-route schedule but allowed for deviations off the scheduled route to accommodate rider needs. All of the above routes are discussed with more detail in the following subsections.

Full Town Route

The Full Town Route (map located in Appendix B) was the first route considered for implementation. Initial steps included geocoding the addresses of passenger residences and paratransit stop locations. The first Full Town Route simulation was run to minimize travel time while stopping at all of the assigned stops. Stops were allocated at various high volume paratransit stops and residential locations. For example, the County Market grocery store and Dewey Apartments have high-volume ridership with the paratransit service and were included as stops on the Full Town Route.

Incorporating every stop on the Full Town Route which are used within the paratransit service would be infeasible and unrealistic. A fixed-route system is designed to stop at high-volume ridership locations to maximize efficiency. Riders may be required to walk a distance to and from their desired locations, but this inferior customer service, when compared to the paratransit service, is offered at a cost discount to riders.

The Full Town Route design was discussed with James River Transit management and drivers. It was found to provide good service to all major areas of town, but it was clumsy to operate with many awkward turns and stops. Also, the route took far too long to cover with an estimated route time of one and a half hours when driven by James River Transit drivers. A major point of discussion with this route and others was whether or not to provide service to the Jamestown State Hospital on the southeast corner of town. Serving the hospital was considered to be inefficient as it took far too long to get to and from the hospital with limited ridership between it and the next scheduled stop. James River Transit employees, along with the research team, felt very few potential riders could use a fixed-route service in order to travel to and from the hospital, due primarily to physical or mental disabilities of patients doctoring at the hospital.

Based on the above analysis, the Full Town Route was found to be an unviable option for Jamestown. The length and awkwardness of the route were the major concerns. The next step would be to break the route down further while considering other options. Utilizing two buses to serve different parts of town was thought to be a better scenario.

Two Bus Route

The Two Bus Route (map located in Appendix B) was a hybrid route based on the Full Town Route discussed previously. A main concern with the Full Town Route was the length of the route resulting in long ride times for users. To solve this problem, the Two Bus Route was developed with one bus serving the north part of the original route and another bus serving the south part. The Jamestown State Hospital was the only major change between the single and two bus routes. The Two Bus Route did not provide service to the State Hospital which was agreed upon through discussion of the Full Town Route.

Initially, the Two Bus Route was well-received. The research team along with James River Transit felt it had real promise to succeed in Jamestown. The main considerations with two buses running fixed-routes in opposite parts of town are the location of a route transfer point and the timing of the routes to facilitate transfers. Any fixed-route system must operate on time to maintain its integrity and to avoid frustration on the part of riders and drivers. Two routes that have to run simultaneously in different parts of town are two to three times more difficult than one as both buses must arrive at their scheduled stops on time and transfers between buses must be coordinated successfully. This is a tough task for any transit organization, let alone one that has never run a fixed-route system.

The only feasible spot to locate the transfer point in Jamestown was thought to be the James River Community Center. It has the most central location of any potential transfer point and many of the riders currently travel to the community center for meals and activities. Also, the buses are garaged at the community center, thereby providing a good spot for the routes to begin in the morning and end in the evening.

The problems with the Two Bus Route were ones of coordination and location. The difficulty in running two buses with the transfer point was too complicated. The likelihood of routinely being off schedule was considered high, especially with the need to load and unload numerous elderly and handicapped riders. Therefore, either one bus running one route, or two buses running the same route was thought to be the best system for Jamestown. The next step was to develop a route that was more efficient. The new route would cover less area, but its path would not decrease potential ridership compared to the first route, and the potential for two buses to run the same route on a half-hour staggered schedule appeared reasonable. Based on these findings, the Half Town Route was developed.

Half Town Route

The Half Town Route (map located in Appendix B) utilizes features of both the Full Town Route and the Two Bus Route. It has a single route to be traveled like the Full Town Route, but it does not serve the southeast part of town or the Jamestown State Hospital, similar to the Two Bus Route. Additionally, all points on this route can be met within the one-hour time frame. The route path that traveled east on 3rd Street Southwest and north on 12th Avenue Northeast in the Full Town Route was also eliminated as it created timing problems. It was also thought to be a 'dead zone' for the route with few riders and stops along those route segments.

At the June 22nd meeting drivers brought up the point of running two buses down the same route and staggering them half an hour apart. Initially, according to the current setup of the route, one bus would leave Gardenette Center II at the top of the hour and the second bus would leave Gardenette Center II at the bottom of the hour. This would stagger the buses perfectly from a

timing aspect and double the service of the route to its riders. Also, one bus could begin serving the route initially with another added as previously stated if demand was found sufficient.

The main concern with the Half Town Route was whether or not enough riders were going to be served to warrant the route's existence. Ultimately, this will not be known until the route is running daily, which is characteristic of any new fixed-route. Further research was done to investigate comparable communities which are currently running fixed-route bus systems. It was found that smaller, less complicated circulator routes are a feasible option for towns with similar characteristics to Jamestown. Based on these findings, a circulator route was designed by the research team and presented to James River Transit as another fixed-route option.

Circulator Route

The Circulator Route (map located in Appendix B) is essentially a smaller version of the Half Town Route. The Circulator Route is designed to serve the major retail shopping and grocery shopping areas in Jamestown. It travels north from the County Market grocery store, making a full circle serving the downtown area before heading south to the Jamestown Mall and Walmart and KMart area. This route is designed to run in half-hour cycles using one bus.

The main advantages of the Circulator Route are its small, concentrated route and the half-hour running time. The paratransit service would serve as a feeder system to the Circulator Route in bringing riders from their place of residence to one of the stops on the route. Riders would then board the circulator and ride, for a reduced fare, to another stop on the route. They would also have the option of returning, via the circulator route, to where the paratransit service first dropped them off. Riders can then call the paratransit service which would provide a return trip to their homes when they have finished shopping for the full rate, or riders may choose to take the circulator to another point on the fixed-route for a reduced fare.

The Circulator Route would enable riders to save money by doing the bulk of their shopping once or twice a week and using the circulator to get to and from the different shopping sites. Also, riders could use the circulator if they wanted to get from Walmart to Hugos without having to park their vehicle, walk from their parking spot, and deal with traffic. This would be even more helpful in the winter months when walking long distances and starting a vehicle can be an inconvenience. Fargo and Hibbing, MN, are two examples of communities which utilize circulators to move people around highly congested shopping areas, thereby lessening the need for personal automobiles.

The main concerns with the Circulator Route are that current drivers in a small town like Jamestown will not understand or appreciate its function and that current paratransit riders will not be able to use the route on a regular basis. Current riders may want to travel from County Market to Walmart, but if they have many bags of groceries they will be unable to take the groceries with them to Walmart. Proper scheduling, however, would have the rider travel to Walmart first and then take the circulator to County Market, shop and take the paratransit bus home with their groceries. There would be a learning curve involved with any of the fixed-route system option, but the Circulator Route may posses the steepest curve.

Specialized Routes

The specialized route option was also proposed to James River Transit. James River Transit currently offers service on a shopping bus one night a week which takes riders to a local grocery store at a reduced fare. This same idea could be expanded to serve other high-volume shopping areas throughout Jamestown. For example, once or twice a week service could be offered to Walmart on a shopping bus and to another retailer on a different day at a reduced fare. Riders could then choose which day and at which location they would want to shop, saving them and the transit agency money. This would be the easiest addition to the current service, but it may not provide enough of a benefit to either the riders or James River Transit to warrant serious consideration.

Flex Route

The final route proposed to James River Transit was a Flex Route. The Flex Route (map located in appendix B) would provide fixed-route service at a reduced fare to riders willing to walk to the route's path. However, the route would deviate within a few blocks on either side of its designated route to provide regular paratransit service, at the paratransit fare, to riders. James River Transit saw the Flex Route as the most acceptable proposal to meet its needs. Similar flex routes in Hibbing, MN, and Apple Valley, MN, have been very successful in providing door-to-door along with fixed-route service at the same time.

The Flex Route will start with one bus serving the route and an area within a few blocks of the fixed-route. If needed, another bus may be added to increase service to the ridership. The route will run with one-hour cycles including large time gaps between scheduled stops to allow for deviation as needed.

The main concerns with the Flex Route are that deviations will result in timing inconsistencies for the fixed-route and that riders will be unable to understand the route's functioning and pricing. Initially, it will take more trial and error for the Flex Route to function properly than would a normal fixed-route. Providing training services for potential riders will be even more imperative for a Flex Route compared to other routes as well. However, once the Flex Route passes its preliminary phase, the service it provides should fit the needs of James River Transit successfully.

Cost Effectiveness Evaluation

A main goal of this research was to determine the cost effectiveness of a fixed-route service in Jamestown. The current fare for the James River Transit paratransit service is $2.50 per ride. Local fixed routes in Minnesota, North Dakota, and South Dakota range from $1 to $2 per ride. A fare of $1.50 per ride was recommended for Jamestown's fixed route based on these findings.

Analysis was performed to determine savings for James River Transit comparing its current service with one offering paratransit and fixed-route service. Another analysis looked at the cost savings to Jamestown residents. Analyses were based on the assumption that James River Transit would provide 50,000 one-way rides per year (they provided 50,180 in 2000 and 45,100 in 2001). The cost of providing paratransit service would be $6 per ride (their current cost estimate is $5.96 per ride). It was also assumed that the cost of providing a fixed-route ride would be $2.50 per ride. This was based on the cost of providing fixed-route service in Fargo and Minot which are estimated at $2.72 and $2.36 per ride. Finally, based on other local route fares, the fixed-route

fare for Jamestown would be $1.50 per ride, and the paratransit fare would be the current $2.50 per ride.

The analysis showed that if just 5 percent of the current riders switched from paratransit to fixed-route, based on the above assumptions, the annual service cost for James River Transit would drop nearly $9,000 from $300,000 to $291,250 (Table 3.1). Furthermore, if 20 percent of the rides switched from paratransit to fixed-route, $35,000 in annual service costs would be saved (Figure 3.20).

Table 3.1 Cost of Providing Service

Ridership (Annual)		**Per Ride Cost of Providing Service**		
Paratransit	Fixed-Route	Paratransit	Fixed-Route	**Total Cost**
50,000	0	$6.00	$2.50	**$300,000.00**
47,500	2,500	$6.00	$2.50	**$291,250.00**
45,000	5,000	$6.00	$2.50	**$282,500.00**
42,500	7,500	$6.00	$2.50	**$273,750.00**
40,000	10,000	$6.00	$2.50	**$265,000.00**

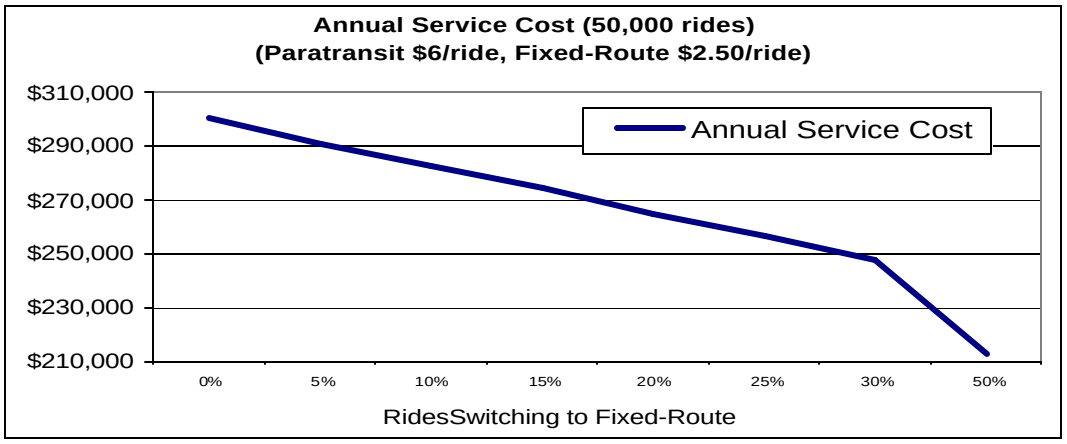

Figure 3.20 Annual service cost for James River Transit

The senior population of Jamestown (65 and older) grew from 2,633 in 1990 to 2,806 in 2000, a 6.2 percent increase. This trend is projected to continue throughout and beyond the next 5 to 10 years. An aging population leads to an increase in the demand for transportation services, which James River Transit has observed in recent years. Ridership has increased by roughly 12 percent during the past 5 years. Considering a conservative ridership gain of 1 percent per year, ridership would increase from the current estimate of 50,000 rides for 2004 to more than 53,000 rides by 2010 (Table 3.2). Assuming the fixed-route system would handle 20 percent of the total rides and half of the new rides each year, the annual subsidy required for James River Transit will be $158,571 in 2010 with fixed-route service as compared to $185,766 without a fixed-route system. This nearly $30,000 in savings is because the fixed-route service only would be subsidized $1 per ride (revenue $1.50, cost $2.50) while the paratransit service is subsidized $3.50 per ride (revenue $2.50, cost $6.00).

Table 3.2 Annual Subsidy Required with and without Fixed-Route Service

Year	Ridership (Annual) Total Rides	Paratransit	Fixed-Route	Annual Cost	Annual Rev.	Total Subsidy Required With Fixed-Route	Without Fixed-Route
2004	50,000	50,000	0	$300,000	$125,000	**$175,000**	**$175,000**
2005	50,500	40,150	10,350	$266,775	$115,900	**$150,875**	**$176,750**
2006	51,005	40,552	10,454	$269,443	$117,059	**$152,384**	**$178,518**
2007	51,515	40,957	10,558	$272,137	$118,230	**$153,908**	**$180,303**
2008	52,030	41,367	10,664	$274,859	$119,412	**$155,447**	**$182,106**
2009	52,551	41,780	10,770	$277,607	$120,606	**$157,001**	**$183,927**
2010	53,076	42,198	10,878	$280,383	$121,812	**$158,571**	**$185,766**

The current annual subsidy required for the James River Transit service was also analyzed (Figure 3.21). Analysis, based once again on the previous assumptions, indicated that if just 5 percent of rides switched from paratransit to fixed-route, the annual subsidy required would be reduced by more than $6,000. Also, if 20 percent of rides switched from paratransit to fixed route, the annual subsidy required for the James River operation would decrease by $25,000. This analysis does not take into account potential riders who do not currently use the paratransit service, but may use a fixed-route system. Jamestown College students are a prime example of potential riders with prospective interest in fixed-route bus transportation.

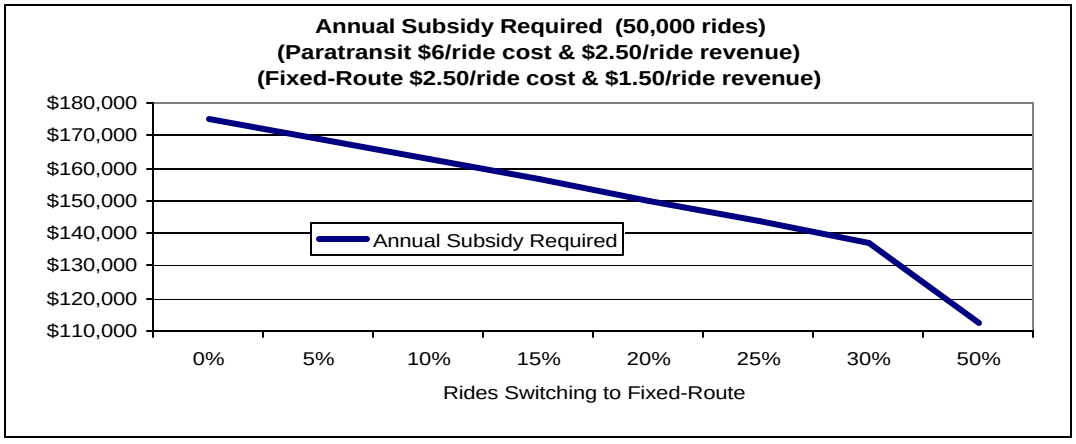

Figure 3.21 Annual subsidy required for James River Transit

The savings riders will experience using the fixed-route system is also worth noting. In a survey of James River transit riders, more than 60 percent of respondents indicated their income was less than $10,000 per year and 82 percent indicated there income was less than $15,000 per year. Low-income riders, such as these, could save a large percentage of their income by utilizing a fixed-route system for their transportation needs.

Assume a frequent user of the current paratransit system uses the service three times a week (6 one-way trips). That amounts to more than 300 one-way trips every year if the rider chose to ride the fixed-route system 25 percent of the time (75 one-way rides), they would save between $75 and $115 per year depending on the magnitude of difference between paratransit and fixed-route

fares (Table 3.3). A difference of $2.50 to $3 between paratransit fares was assumed for this analysis. The current paratransit fare is $2.50 and $3 is the projected fare for 2005. A savings of $100 a year may not seem substantial, but to someone with an annual income is $10,000, the savings can have a large impact on their way of life. A proportionate savings for a dual-income earning family of $60,000 per year would equal roughly $600 annually, enough to heat the average sized American single-family home for three to four months during a North Dakota winter.

Table 3.3 Cost Savings for Switching to Fixed Route (Fixed-Route Fare $1.50)

					Total Savings	
					$2.50	$3.00
Annual Trips	%Fixed-Route	Paratransit Fares		Fixed-Route	Paratransit Fare	Paratransit Fare
300	5%	$2.50	$3.00	$1.50	**$15**	**$23**
300	15%	$2.50	$3.00	$1.50	**$45**	**$68**
300	25%	$2.50	$3.00	$1.50	**$75**	**$113**
300	35%	$2.50	$3.00	$1.50	**$105**	**$158**
300	45%	$2.50	$3.00	$1.50	**$135**	**$203**
300	55%	$2.50	$3.00	$1.50	**$165**	**$248**
300	65%	$2.50	$3.00	$1.50	**$195**	**$293**
300	75%	$2.50	$3.00	$1.50	**$225**	**$338**
300	85%	$2.50	$3.00	$1.50	**$255**	**$383**
300	95%	$2.50	$3.00	$1.50	**$285**	**$428**

James River may decide to offer fixed-route service at a cost of $1 per ride to its customers. This would offer an even greater cost savings to riders. A rider paying for 300 annual trips who switches 25 percent of those trips to the fixed-route system from paratransit would save between $113 and $150 per year (Table 3.4).

Table 3.4 Cost Savings for Switching to Fixed Route (Fixed-Route Fare $1)

					Total Savings	
Annual					$2.50 Paratransit	$3.00
Trips	%Fixed-Route	Paratransit Fares		Fixed-Route	Fare	Paratransit Fare
300	5%	$2.50	$3.00	$1.00	**$23**	**$30**
300	15%	$2.50	$3.00	$1.00	**$68**	**$90**
300	25%	$2.50	$3.00	$1.00	**$113**	**$150**
300	35%	$2.50	$3.00	$1.00	**$158**	**$210**
300	45%	$2.50	$3.00	$1.00	**$203**	**$270**
300	55%	$2.50	$3.00	$1.00	**$248**	**$330**
300	65%	$2.50	$3.00	$1.00	**$293**	**$390**
300	75%	$2.50	$3.00	$1.00	**$338**	**$450**
300	85%	$2.50	$3.00	$1.00	**$383**	**$510**
300	95%	$2.50	$3.00	$1.00	**$428**	**$570**

Numerous fixed-route options along with cost evaluations were presented to James River Transit. The cost savings will aid James River Transit in moving towards a more efficient public transit system. The fare reduction with the addition of a fixed-route system will also save the riders' income to spend on other necessities. Start-up costs do apply with training, signage, etc., but will not require an additional bus purchase as paratransit vehicles already in James River's fleet will be used to run the fixed route initially. Ridership may take some time to meet projections for the fixed route. The campus circulator at North Dakota State University, for example, took two years before its ridership reached expectations. The following discussion will present conclusions and recommendations based on the research and findings of the study.

5. CONCLUSIONS & RECOMMENDATIONS

The demographic profile of Jamestown is dominated by an aging, diminishing population. Almost all current riders of James River's paratransit service are either elderly, physically or mentally handicapped, or both. Because of this, fixed-route requirements have to be specialized to allow a percentage of current riders to utilize the service. Currently, new ridership will not provide a sufficient amount of riders to make a fixed-route feasible.

The research team believes that the two best options for Jamestown to consider are the Half Town Fixed-Route and the Flex Route. The Half Town Route would cover a large portion of town giving it the ability to attract both current and potential riders. Also, with its current route it would have the ability to stop hourly at Jamestown College to offer service to both students and faculty. Marketing the service on campus will be critical to promote ridership, especially for students who do not have an automobile available for their own personal transportation. Offering introductory free service would allow students to become familiar with the service and its positive attributes.

The Flex Route is likely the most feasible route based on James River's current ridership. It allows riders to use a combination of the paratransit and fixed-route services at a lower cost than using the paratransit service solely. The Flex Route will also encourage riders to plan ahead and walk to designated stops to save money by paying the reduced fare. It will also lessen the pressure on James River's current paratransit service area allowing it to focus on an area outside of the Flex Route's service area. The Flex Route will not serve as large a potion of town as the Half Town Route, however, thereby limiting its attraction to potential riders who want service to and from their place of residence.

The cost evaluation shows that switching a large portion of current rides from paratransit to fixed-route is not necessary to save money when comparing the two services. However, it is quite obvious that the more rides taken on a fixed-route, the more affordable the service becomes for both the riders and the transit association. Unfortunately, many of James River Transit's current riders have physical or mental disabilities which may inhibit their ability to utilize a fixed-route service. This fact has been taken into consideration throughout the research process. The attraction of new riders to a fixed-route, whether they be college students, local residents, or some other source, is important to the longevity of a fixed-route's success in Jamestown.

A main goal of the James River Transit study is to provide a useful tool for other transit agencies to utilize in determining whether or not a fixed-route bus system is a feasible alternative in their community. Comparisons between Jamestown and other communities can provide insights into what options are available to local transit agencies. Ultimately, the goal of this research is to promote the responsiveness and efficiency of transit agencies throughout North Dakota and the entire country.

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APPENDIX A. SURVEY

James River Transit Survey

James River Transit is considering the implementation of a regularly scheduled bus route system. A regularly scheduled bus route system is a service provided on a repetitive, fixed-schedule basis along a specific route with vehicles stopping to pick up and deliver passengers to specific locations.

Example:

A rider boards a bus at 15 minutes past the hour at a scheduled bus-stop. The rider gets off the bus at another bus-stop located at the Jamestown Mall at 30 minutes past the hour. An hour later, the rider boards the same bus at 30 minutes past the hour at the Jamestown Mall and returns to their original bus-stop at 15 minutes past the following hour.

Implementing fixed-route service will add flexibility to the current system allowing able riders to travel without calling ahead or waiting for the existing dial-a-ride service. The existing dial-a-ride transit service is transportation that provides door-to-door service on demand to a number of travelers with different needs. The following survey is designed to gain a better understanding of the James River Community towards a regularly scheduled bus route system and its benefits.

Prizes

Once all of the surveys are collected a drawing will be held for Buffalo bucks to be used at local Jamestown businesses. The prizes will consist of two $50 buffalo bucks prizes, two $25 buffalo bucks prizes, and two $10 buffalo bucks prizes.

If you would like to be considered for the drawing please indicate your Name, Address, and Phone number below.

Thank you for your time and participation!!!

Name: _____

Address: _____

Phone Number: _____

1) What kind of transportation do you use? (please check all that apply)

Personal automobile with a driver
Drive Myself
Bus
Taxi
Friends
Family Members
Other_____

2) How frequently do you travel?

Daily
2 – 3 times per week
Once a week
Less than once a week

3) Have you used James River Transit?

Yes
No

4) How would you rate the current James River Dial-A-Ride service?

Very Good
Good
Average
Poor
Very Poor

5) Can you use regularly scheduled bus route service?

Yes
No
Don't know

6) If there was regularly scheduled bus route service available in Jamestown, how often would you use the service?

Daily
1 to 5 times a week
1 to 4 times a month
Less than once a month
Never
Don't Know

7) What time of day do you currently ride James River Transit?

8 – 10 am
10 – 12 am
12 – 2 pm
2 – 4 pm
4 – 6 pm

8) Where do you <u>normally</u> travel? (check all that apply)

Walmart
K-mart
Hugos
County Market
Human Service Center
Jameshouse
Post House
MeritCare Clinic
Dakota Clinic
MedCenter One
State Hospital
Other _____

9) If regularly scheduled bus route service were available are there reasons that you may not use it?

Can't get to or from bus stop
Disability
Need assistance to board, ride, and get off
Busy intersection
Don't know
Other reason_____

10) Would you use regularly scheduled bus route service if it was less expensive than dial-a-ride service?

Yes
No

11) What advantages do you see to using regularly scheduled bus route service?

(check all that apply)
Less expensive
Scheduled service
Environmentally friendly
None
Don't know

12) Do you need help getting in and out of vehicles?

Yes
No

13) How can we encourage the use of regularly scheduled bus route service?

Increase routes and schedules
Accessibility of stops/buses
Nothing
Don't know
Other_____

14) Are you interested in regularly scheduled bus route service travel training?
Yes
No
Don't know

15) Gender
Male Female

16) Age
_____

17) Household Income ($)
0 - 15,000
15,001 - 30,000
30,000 - 45,000
45,000 - 60,000
60,000 or more

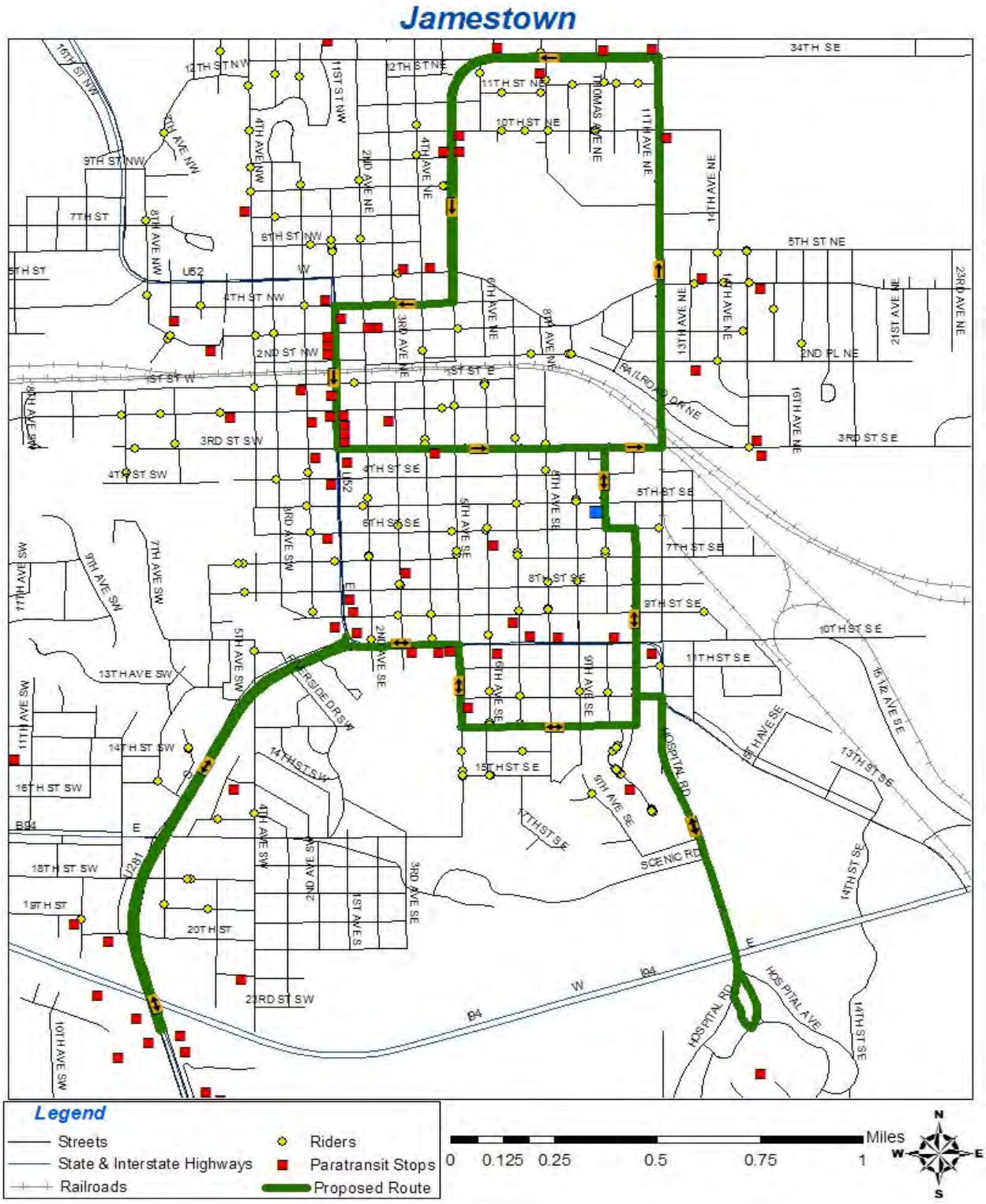
18) Highest Education Attainment
Some high school
High school graduate
1-2 years post secondary
4 year college degree
Some graduate education
Graduate degree
Other_____

19) Employment Status
Employed full-time
Employed part-time
Unemployed
Retired
Other_____

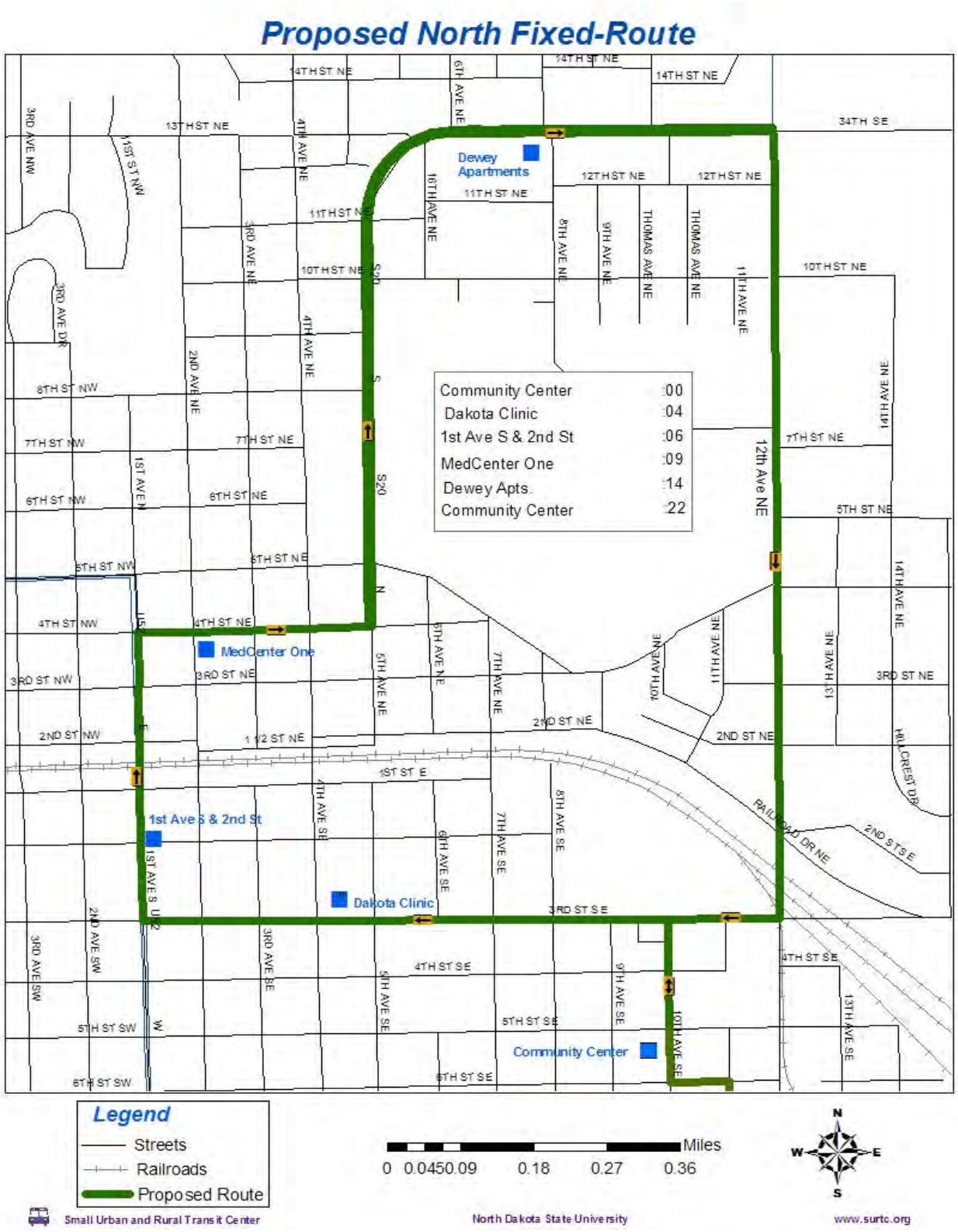
20) Suggestions for improving the current James River Transit Dial-A-Ride Service

APPENDIX B. FIXED-ROUTE OPTIONS

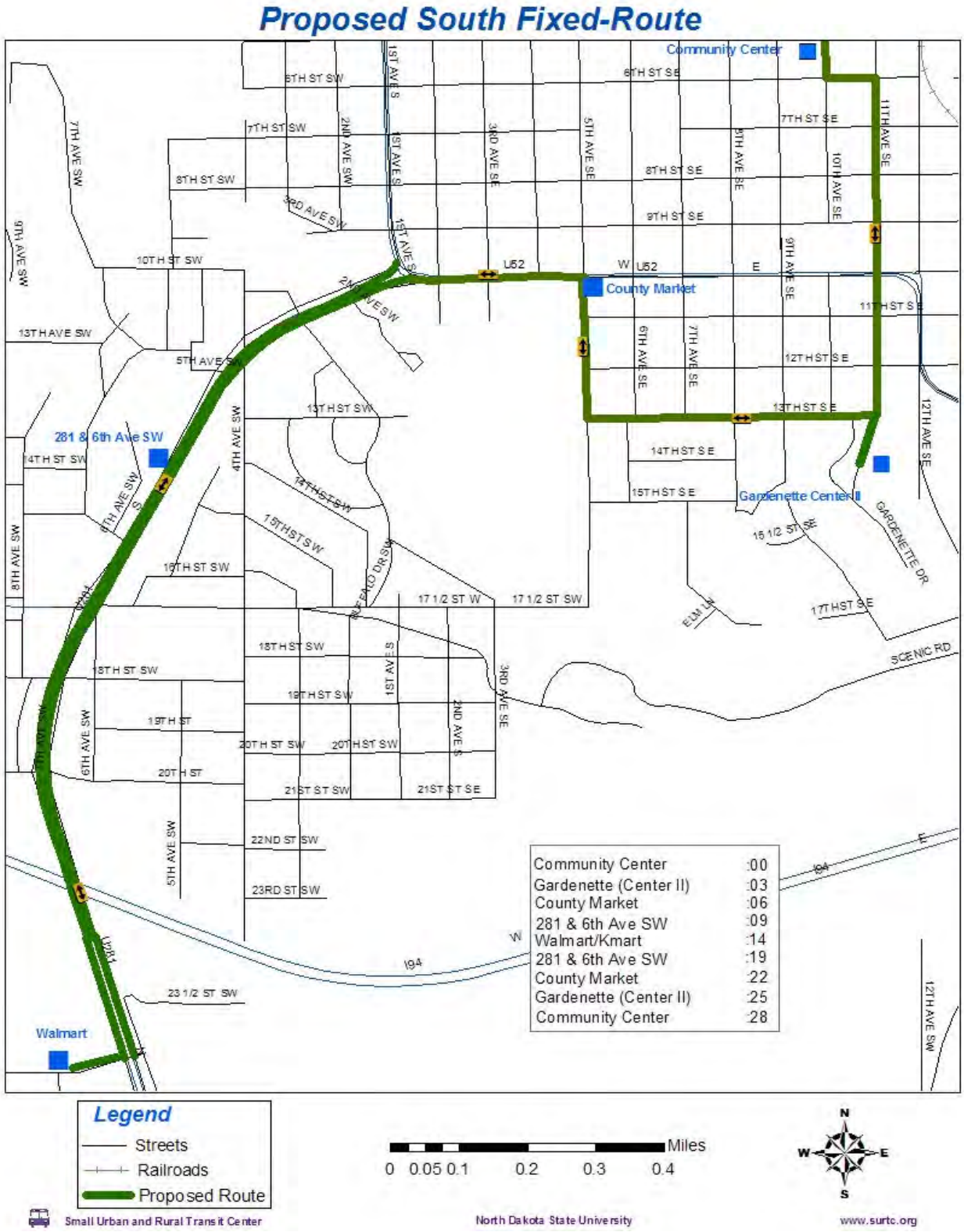
Full Town Route



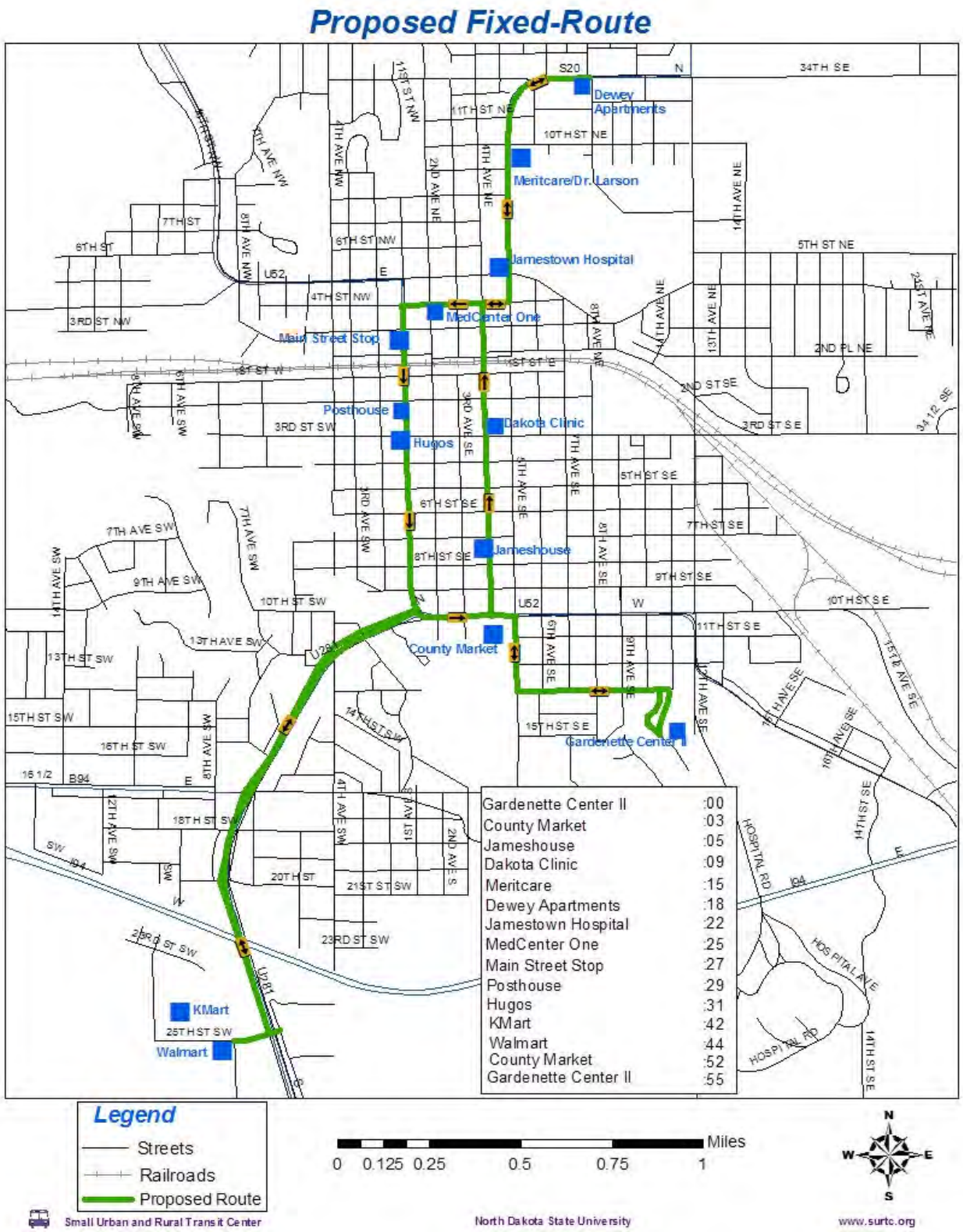
Two Bus Route



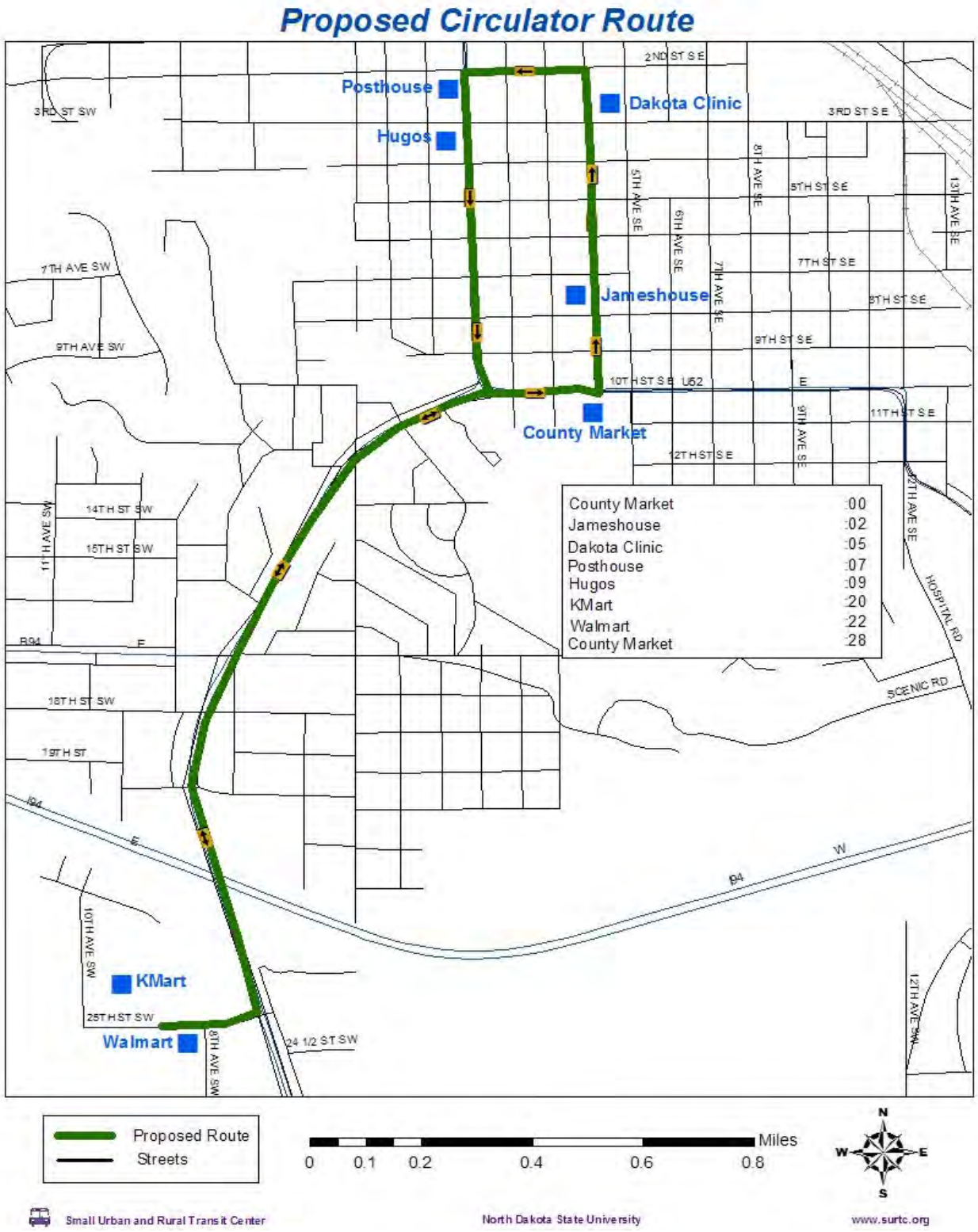
Two Bus Route



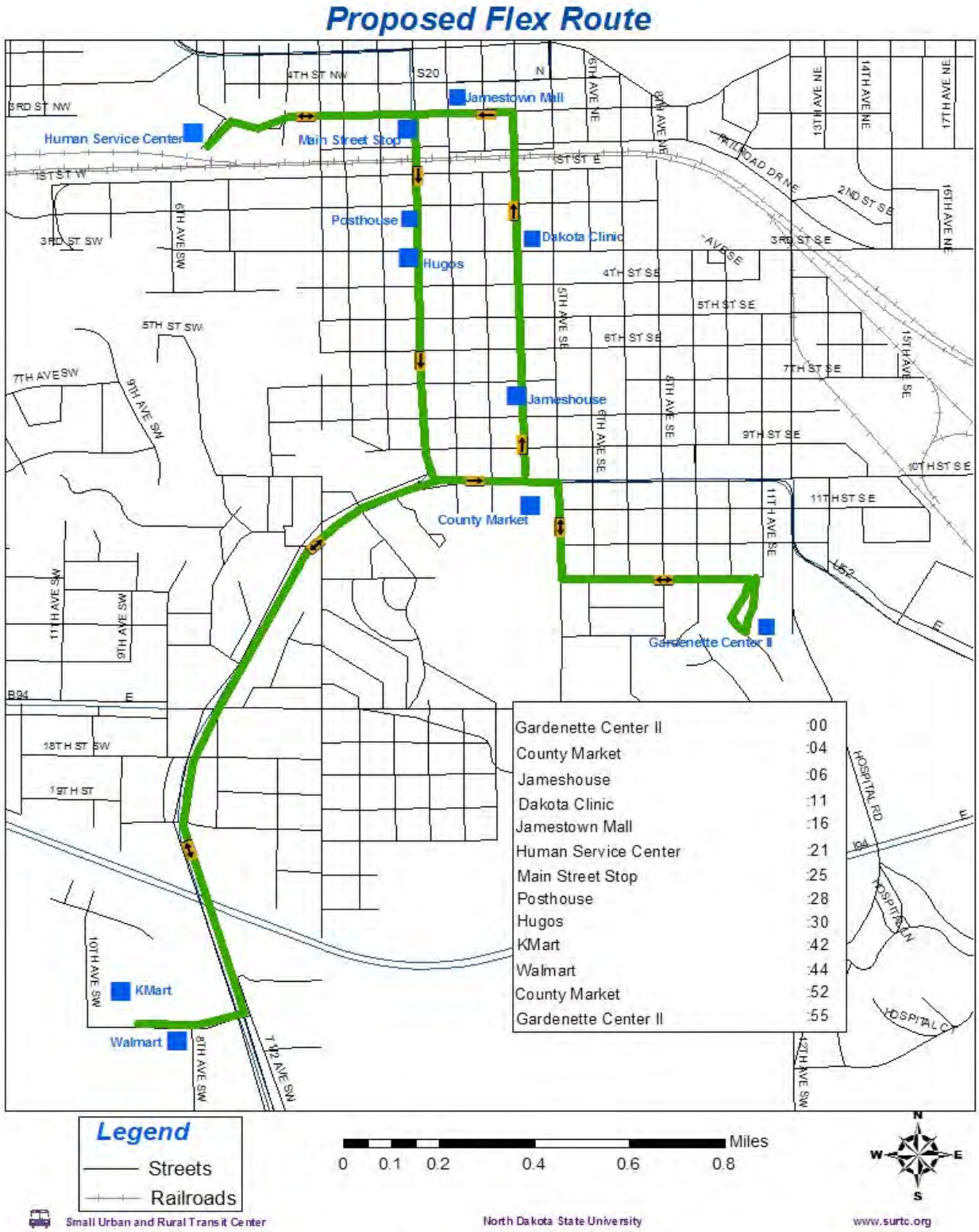
Half Town Route



Circulator Route



Flex Route


Proposed Flex Route
Human Service Center
Main Street Stop
Jamestown Mall
Posthouse
Dakota Clinic
Hugos
Jameshouse
County Market
Gardenette Center II
KMart
Walmart
Gardenette Center II :00
County Market :04
Jameshouse :06
Dakota Clinic :11
Jamestown Mall :16
Human Service Center :21
Main Street Stop :25
Posthouse :28
Hugos :30
KMart :42
Walmart :44
County Market :52
Gardenette Center II :55
Legend
Streets
Railroads
Miles
0 0.1 0.2 0.4 0.6 0.8
Small Urban and Rural Transit Center
North Dakota State University
www.surtc.org