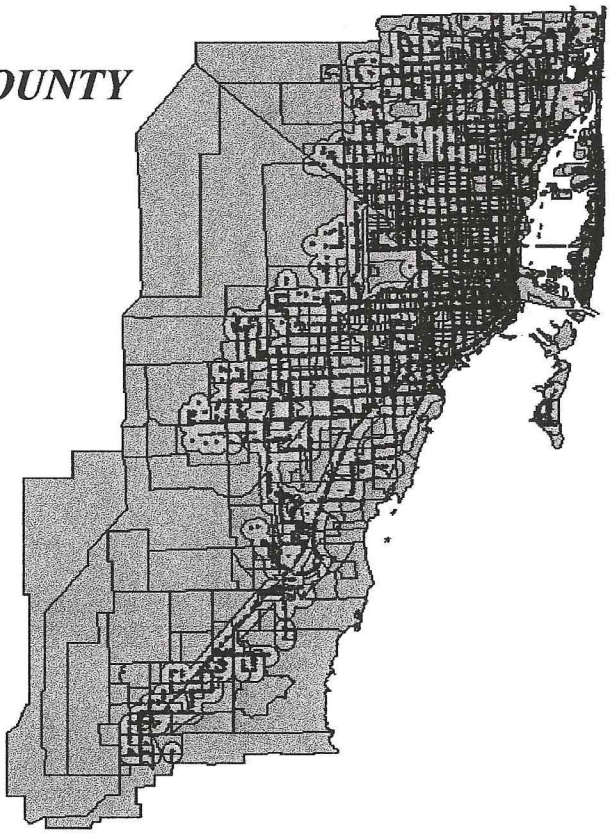
Improving Welfare-To-Work Transportation Planning: A Geographic Information System (GIS) Application

CASE STUDY OF MIAMI-DADE COUNTY



FINAL REPORT

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TABLE OF CONTENTS

1. INTRODUCTION

In the spring of 1996, the Florida Legislature passed a major overhaul to the state's welfare system, legislation that mirrored the federal law that would pass later that year. Florida called its welfare reform program *"Work And Gain Economic Self-sufficiency (WAGES)"*. The time clock officially started on October 1, 1996. Further legislation in 1997 provided technical changes and other amendments found necessary for meeting the needs of the WAGES Program. Florida's Welfare-To-Work Program (WAGES) is a cooperative effort among many agencies including the Department of Children and Families, the Department of Education, the Department of Labor and Employment Security, the Work And Gain Economic Self Sufficiency State Board of Directors, and the local Work And Gain Economic Self Sufficiency Coalitions. Also, an important component of the Work And Gain Economic Self Sufficiency program is the public-private partnership with Florida's business community. The Federal and State funding was about $1.2 billions at FY 98-99. *(Source: Florida Department of Children and Families).*

The goal of the WAGES Program is to emphasize work, self-sufficiency, and personal responsibility. The program strives to meet the transitional needs of participants who do not need ongoing financial assistance by providing one-time cash assistance to meet some immediate need; and, to move temporary cash assistance recipients quickly from Welfare-to-Work. However, welfare recipients face a number of impediments in getting to work and returning home. Chief among these, are home/job location mismatch, access to childcare, varying work schedules, and the absence of personal transportation. By and large; the majority of WAGES clients must rely on the public transportation systems. However, it has been argued that existing transit may not be able to meet their transportation needs.

A Geographic Information Systems (GIS) is a very useful tool to assist in developing solution sets to Welfare-To-Work transportation problems by using its information management, spatial, display, and analysis capabilities. The commonly accepted spatial mismatch theory states that the increasing travel time from the urban core to emerging work places has become a significant barrier to residents with little education or skill to secure sustainable employment in locations distant from their residences or virtually non-existing transit areas. This theory has suggested that economically disadvantaged people are likely to stay in the inner cities, while new employment is increasingly created in the urban fringes. To outline the magnitude of the problem a Geographic Information Systems will be implied. GIS can assist in developing a solution to the home-job location mismatch by using its spatial information management, display, and analysis capabilities. The Welfare-To-Work GIS based analysis involves creating databases of welfare recipients and existing employment centers, and the transportation network in Miami-Dade County.

In this report, we will study the MDT (Miami Dade Transit) Network and determine whether or not welfare recipients can easily access Metro bus/train/mover for "*The Ride of Their Life*". Suggestions to improve the network, if necessary, will be provided since the relocation of the welfare recipients is not a viable option. The report, also, presents a comprehensive review of the original FIU study "*WELFARE TO WORK: TRANSPORTATION ISSUES AND OPPORTUNITIES IN MIAMI-DADE COUNTY*", and an overview of state-of-the art Welfare-To-Work programs adopted by other cities, counties, regions, and states through out the nation.

The review explains how other interested agencies used the demographic welfare data to link the gap between welfare recipients and transit services.

Moreover, this report gives a brief description of the GIS, then emphasizes the GIS Welfare-To-Work applications that have assisted other locations in designing transportation services appropriate for the needs of welfare recipients who wish to access a new job. As part of this task, the report evaluates existing GIS components from different GIS providers. The review is considered an important element in determining if these experiences and existing GIS-welfare applications can be customized for the needs of Miami-Dade County

2. LITERATURE REVIEW

This section provides an overview of some of the programs that seem to offer innovative solutions to the employment problems that the welfare recipients encounter; with a special emphasize on the original FIU study *"WELFARE TO WORK: TRANSPORTATION ISSUES AND OPPORTUNITIES IN MIAMI-DADE COUNTY."* Several agencies and organizations were contacted to share their information with us, many of them responded, and hereinafter some of the most related programs to welfare-to-work transportation issue.

2.1 WELFARE TO WORK:

TRANSPORTATION ISSUES AND OPPORTUNITIES IN MIAMI-DADE COUNTY

In 1998, Florida International University conducted a study of transportation issues in Miami-Dade County related to welfare clients moving into workforce. This research was funded by the Miami-Dade County Metropolitan Planning Organization (MPO). The study consisted of, in addition to the executive summary, six reports covering topics of vital concern for policy-makers in the Miami-Dade community. These reports contained detailed explanations of the research needs, data gathering techniques, analytical methodologies, and findings and recommendations. A thorough description of these reports is presented in the following sections.

2.1.1 General Information about WAGES Clients and the Study Area

In August of 1996, President Clinton signed the "Personal Responsibility and Opportunity Reconciliation Act," which replaced the federal guarantee of life-long welfare assistance to eligible recipients. New grants were established for Temporary Assistance for Needy Families (TANF), replacing the Aid to Families with Dependant Children (AFDC) program. Accordingly, in1996, the state of Florida created the Work and Gain Economic Self-Sufficiency (WAGES) program. This led to the creation of the Miami-Dade Coalition in February 1996.

A typical WAGES participant is a 34-year-old Black or Hispanic female with two children, one of whom is under five-year-old. She likely does not have a high school degree nor has she likely worked in the past two years. WAGES clients are clustered in certain geographic

areas of the county, this study concentrated on five areas: Carol City, Hialeah, Liberty City/Overtown, Little Havana and South Miami-Dade.

The percentage of residents of the study areas who commute to work by driving alone is 68%, carpooling is 19%, mass transit is 7%, and other is 6%. A majority (63%) of commuters in the study areas reach work in less than 30 minutes, between 30 to 44 minutes the percentage is 25, while 2% only commute more than one hour. About 71% of the commuters in the study areas leave for work between 6 a.m. and 9 a.m., and 21% leave for work between 9 p.m. and midnight.

2.1.2 Employment Patterns in Miami-Dade County in Relation to Welfare to Work

This section of the report identifies the employment centers, the location of entry-level jobs, and the number of new entry-level jobs created. Research indicates a decentralizing pattern in employment. The four largest employment centers which are Downtown, Airport, Hialeah, and Coral Gables areas account for nearly half of the county's employment with Downtown as the largest employment center.

Specialization is occurring within employment centers. The Downtown area stands out as a financial and administrative center including 60% of available jobs in the public sector, professional services and finance. The Coral Gables area functions as a second downtown; professional services and finance account for over 40% of its employment. The Airport area has an advantage with its transportation facilities and proximity to the highway system. Hialeah is the manufacturing center for the county with one-third of the county's jobs in this sector.

These patterns suggest that there may be an element of skill mismatch. While the Downtown and Coral Gables areas are best served by public transit, these locations tend to have more specialized service jobs for which residents in the vicinity may not have sufficient skills. Manufacturing, delivery, and wholesale employment are likely to be concentrated in the county's north and western part and are not accessible to the majority of the WAGES clients who live in the east. A majority of entry-level jobs are found in retail and non-professional service industries. These industries are scattered around the county, and the WAGES clients must travel multiple directions to work for such employers.

2.1.3 Facilitating Access to Employment Opportunities in Broward County for Former Welfare Clients

Miami-Dade County serves as one of the largest single employment destinations for Broward residents, representing a significant part of the Broward economic base. Each day, about 100,000 commuters travel south to Miami-Dade County each day.

There are seven major north-south automobile routes from Broward to Miami-Dade County, but only a few public bus routes leave Broward for northern Dade and from northern Dade to southern Broward. For residents of Hialeah and northwest Dade, a trip to southern or western Broward by bus can be both circuitous and time consuming. With the eastern service economy, large malls in the west and the largest private employers in Plantation, Broward may be able to provide entry-level opportunities for the most qualified, job ready welfare clients from Miami-Dade County.

A number of alternative transit options need to be tried to test their viability in providing Dade residents access to Broward jobs. Also, commuting to south Miami-Dade or to the western fringes where public transportation services are minimal would make commuting time a major barrier for obtaining and keeping a job. It may be faster and cheaper for north Miami-Dade welfare recipients to look for jobs in southern or western Broward County.

2.1.4 Public Transportation and WAGES Clients

The focus of this report is on the availability of suitable public transportation linkages between concentrations of WAGES clients and major employment centers with significant entry-level jobs. Previous studies and the U.S. Census reported that few welfare recipients own automobiles, many welfare recipients will need to make multiple trips, most welfare recipients will need to make long trips, and all welfare recipients will not be able to spend much money on transportation.

Six characteristics were identified that influence transportation and work choice: (1) Coverage: the traveler must be within a reasonable distance of the transit line on both home and employment ends of the trip; (2) Continuity: excessive transfers over the course of the trip will cause delays; (3) Wait Time, and (4) Arrival Time: long intervals between transit vehicles require the employee to have extended transfer wait times and arrival times well in advance beginning of the work day to avoid job tardiness; (5) Duration: the total duration of the rider's home-to-work trip should not be excessive; and finally (6) Cost: the cost of the trip should be within the limited financial resources of the welfare recipient.

Two scenarios were taken into consideration, using all the above components, and using only two of the primary components (Duration and Wait Time).

By analyzing the study area to employment center trip ranking, in each of the six characteristics, it was noticed that trips from the study area to the surrounding employment centers ranked most suitable for all study areas. This is because four of the six characteristics are related to the distance.

By using only the two primary components, it is found that those trips between study areas and employment centers that have the least total times are not always those that are physically close. These average time-related characteristics suggest that if welfare recipients have another, more efficient transportation means they will choose it. These two alternatives also require higher levels of financial resources. Unless resources are used for acquiring vehicles, the public transit system will continue to be the primary means of transportation for welfare recipients.

Miami-Dade transit is not able to fully provide the needed transportation network. It has been found that only 22 percent of the trips examined can provide a suitable transit link between the study areas and employment centers. Coordination with the informal carpooling may be one suitable option available to welfare recipients. The development of additional private and public van and mini-bus systems would greatly improve the situation. County policies and regulations with respect to these alternatives may need to change.

2.1.5 Transportation Aspects of Welfare to Work: A Selective Survey of Current Programs

Presented in this report a survey of 23 leading transportation programs designed to assist welfare recipients in transition from welfare to work in the following cities, counties, regions and states: Fresco – California, Portland – Oregon, Glendale/Azalea – Oregon, Pine Bluff - Arkansas, Blytheville – Arkansas, Louisville – Kentucky, seven counties in southeastern Kentucky, Cabarrus County – North Carolina, Sault Ste. Marie – Michigan, Detroit, Michigan, Baltimore – Maryland, Chicago – Illinois, Denver – Colorado, Milwaukee – Wisconsin, St. Louis – Missouri, Sanford – Florida, Pensacola – Florida, Kansas City – Missouri, Philadelphia - Pennsylvania, State of North Carolina, State of Michigan, Broward County – Florida. The successful employment transportation programs in this survey share three crucial characteristics: 1) excellent working relationships among transit providers, human service organizations, employers and other participating agencies; 2) available jobs suited to the skills of welfare-to-work clients, as well as clients who are job-ready; and 3) targeted transportation services that link specific job seekers with specific jobs.

For Miami-Dade County, the implications of this survey means implementing the "best practices" learned from this research. These "best practices" will be highlighted in the Executive Summary section. This report also profiles the first ten of the surveyed programs as the ones that seem to offer innovative solutions to the employment problems that might be encountered in this county. A number of key policy issues and management challenges that emerge from the survey are discussed and possible solutions are offered next:

- Transportation projects will not work if there are not a sufficient number of available jobs. *Solutions:* establish routs to known employment areas, create a metropolitan-wide job placement mechanism, link job placement and transit planning, and create vanpools.
- Different client populations have different transportation needs. *Solutions:* coordinate transportation with other human service agencies, communicate rules regarding no-shows and cancellation to clients, consider including rides to childcare facilities as part of the routes, provide emergency ride service, and be sure that clients are not referred to transportation providers until they are certified job-ready.
- Welfare clients cannot always be reached through conventional marketing mechanism. *Solutions:* implement aggressive and multi-media campaigns to overcome the gap between welfare clients and potential employers, market the programs through a dedicated staff.
- Welfare clients may cause, due to their personal and family challenges, conflicts in the field and wasted transportation resources. *Solutions:* communicate expectations regarding timeliness, cancellations and no-show policies to welfare clients; consider including rides to childcare facilities; coordinate transit projects with other services.
- Even well designed programs encounter a multitude of unexpected problems. *Solutions:* make sure that demonstration projects connect job-ready workers with steady employment, be prepared for multiple route revisions and cancellations, recognize employment and transportation problems, and staff projects with managers who are flexible.

- Defining services too narrowly mean that the program will not serve the needs of its clients, while too broadly will minimize its effectiveness. *Solutions:* free transportation providers to address their issues by coordination between transportation and other service providers, and assigning of responsibilities among agencies and clients.
- Avoid devoting scarce resources to experiments, in the hope of finding a cheaper solution to the transit problems. *Solutions:* use tried-and-true strategies first, conduct pilot programs to assess the viability of other novel strategies, and be prepared to adopt several approaches while avoiding to squandering resources on too many approaches.
- Welfare-to-work clients may not be able to travel long distant pick-up points for fixed route services, on the other hand, door-to-door services may be too expensive for transportation providers. *Solutions:* use GIS data to group jobs and clients, use other technologies to identify strategic locations for targeted commutes.
- Clients have difficulty abiding by free-for-service arrangements, resulting in fare collection difficulties. *Solutions:* use cashless systems, schedule cash payments on a regular basis.
- Transportation providers alone cannot effectively address the employment transportation problems. *Solutions:* establish one agency to lead the welfare-to-work effort and coordinate among transportation providers, human service agencies, and employers; have that lead agency build relationships with participants early.
- Employment transportation programs will need to be subsidized. *Solutions:* apply to the Federal Transit Administration for funding, apply for Department of Labor grants, pool resources from a variety of agencies, and push state legislators to fund pilot programs in employment transportation.
- Federal programs involve paperwork that takes longer to complete than anticipated. *Solutions:* obtain technical assistance from consultants and begin the certification process early.
- Initiating new services can be costly, and few administrators are willing to devote their limited funds to experimental programs. *Solutions:* make the best use of existing resources and programs before embarking on new ones, experiment with small, pilot programs to establish the appropriate operating costs for different transportation options, and establish close linkages between job placement efforts and transportation planning to insure that the transportation options will have sufficient rider-ship.

2.1.6 Existing Transportation Support Services and the Needs of WAGES Clients

This report presents the results of the research on existing arrangements of transportation support services in the welfare-to-work in Miami-Dade County. It identifies a number of areas that require improvements.

Deliberate attempts were made to decentralize the centers of operations to facilitate the WAGES clientele. Evidence of this was the "One-Stop" centers scattered through the county, then the various site offices established by the Miami-Dade Public School system and

Miami-Dade Community College. Proximity and convenience will reduce transportation problems for WAGES clients at the job training stage. Also, it will reduce the unnecessary cost that many providers have had to incur.

The job placement and initial employment stage addresses transportation needs that go far beyond the present abilities of the existing WAGES transportation support system. Though most of the clients have expressed an indication to commute up to an hour each way, many have not been able to accept employment because of transportation considerations. Over 50 percent of the jobs available to WAGES involve late afternoon (2 to 11 p.m.) and overnight shifts. Because of the reduction in the mass transit system during those hours, many of these jobs cannot be obtained.

Table 2.1 presents a sample of 232 WAGES clients, approximately 10 percent of all the WAGES clients placed in a job by all providers from January 1st to September 11th of 1998, which represented the geographical breakdown of the entire county WAGES population.

Table 2.1 Employment Locations of Newly-Hired WAGES Clients

Employment Center	Placed Jobs	Percent
Miami North/I-95 Corridor	37	15.9
Hialeah/Medley/Miami Lakes	28	12.1
Airport West	26	11.2
North Miami/Golden Glades/Aventura	24	10.3
Kendall/Westchester	23	9.9
Downtown/Brickell Area/Coconut Grove	23	9.9
Opa-locka/Carol City	23	9.9
Little Havana/Allapattah	11	4.7
Florida City/Homestead	9	3.9
Coral Gables/West Miami	7	3.0
Perrine/Cutler Ridge/Goulds	4	1.7
Miami Beach/Ball Harbor	2	0.9
Subtotal of major employment centers	**217**	**93.5**
Other areas in Miami-Dade	10	4.3
Outside Miami-Dade	5	2.2
TOTAL	**232**	**100.0**

It also included a presentation of their travel distance to work classified into five categories: immediate neighborhood (within 2.5 miles), surrounding neighborhood (between 2.6 and 4.9 miles), moderate commute (between 5 and 7.9 miles), longer commute (between 8 and 10 miles), and long-distance commute (beyond 10 miles). Finally, the report presented a matrix that relates employment centers to the residential locations of WAGES clients, and addresses the gaps among residential areas and workplace that require alternative transportation solutions.

2.1.7 Executive Summary

This Executive Summary identifies three major policy recommendations, sixteen program recommendations, four "best practices" which are those business procedures and organizational arrangements that lead to high quality and successful programs, and thirty-five findings and their implications that have been drawn from the research.

Three major policy recommendations:

- Provide a continuum of transportation options in order to meet welfare clients' routines and unique transportation needs.
- Provide subsidies in order to ensure the availability of needed transportation options for welfare clients.
- Identify and assign one organization the responsibility to educate WAGES clients about alternative means of getting to work on time.

Other sixteen program recommendations:

- Strengthen communication among WAGES administration, job trainers, job-placement staff, other social service agencies and transportation suppliers.
- Focus on the employment areas identified as best served by transit for job placement.
- Provide WAGES clients with the same information about the areas of employment best served by transit.
- Minimize transportation needs during job training by assigning WAGES clients to trainers based on client proximity to the job trainers' offices.
- Give WAGES clients the flexibility of choosing an alternative job provider before the commencement of any job training.
- Create guidelines to allow job trainers/providers to "trade" clients among themselves to help deal with home/work location and transportation issues.
- Expand current bus and rail subsidies to WAGES clients to include their children.
- Extend the length of time these subsidies are in place from the current six-month limit to nine months or one year after starting a job.

- Expand bus routes to link the Airport, Airport west, Medley, Carol City, Opa-locka, Liberty City, Overtown and Kendall.
- Develop shuttle services using vans or smaller buses to connect residential neighborhoods with the bus-way in South Dade.
- Develop collection/distribution shuttle services connecting Metro-rail stations to major employment centers west of state highway 826.
- Develop a means of transportation to provide a daytime, evening, and weekend link between the downtown area and the port of Miami.
- Extend bus late-evening service hours on selected routes.
- Expand bus service into Broward County to areas with high entry-level job potential.
- Add shuttle vans to fixed routes to and circulation vans inside of industrial areas and locations with large numbers of WAGES clients.
- Add express vans between areas likely to have significant number of clients and employment centers.

Four "best practice" recommendations:

- Program Goals: the goal of a welfare-to-work transportation program is to increase access to jobs; it is not to build a transportation program by itself.
- Organizational Design: a lead agency and clear lines of authority and responsibility are crucial to the success of a welfare-to-work program.
- Managerial Philosophy: transportation providers need to adopt an entrepreneurial attitude toward fulfilling their scope of work within the welfare-to-work partnership, a willingness to stay flexible, and an aggressive customer service orientation.
- Strategic Approach: a multi-phase strategy: (1) map the location of welfare-to-work clients, entry-level jobs, and existing transportation options; (2) assess the viability of creating new fixed route transit services between areas of high job growth and areas with many job seekers; (3) create small-scale pilot programs using vanpools or subscription buses; (4) expand point-to-point transit planning for all welfare clients; and (5) implement aggressive marketing efforts to create van pools among non-welfare workers so welfare clients can "piggy-back" on existing van pools.

The findings and their implications:

The findings and their implications are summarized in terms of three categories: Clients, Employment Patterns and Transportation Patterns as follow:

	Finding	Implications
WAGES Clients	• A typical WAGES participant is a Black or Hispanic 34-year-old female with 2 children, one under the age of five, without a high school diploma, who has not worked in the past two years. • The majority of WAGES clients can be found in the corridor linking Little Havana to Carol City and the northeastern part of Hialeah - areas well served by public transit, with a smaller concentration in South Dade – areas not well served by public transit. • Approximately 4,000 welfare clients in the county have stopped receiving benefits within the past 2 years. • As of April 1998, the county had 16,170 adult clients under a 24-month limit, 8,100 adult clients under a 36-month limit, and 4,320 clients, children and adult, who may be forced off the welfare in the last quarter of 1998. • In other parts of the county, program costs for welfare to work transportation ranged between $5 and $117 per passenger per day while annual cost per client ranged from $720 to $4,200. • Over 50percent of the jobs available to WAGES involve late afternoon (2 pm. to 11pm) and overnight shifts. • Countrywide, about 48 percent of recently employed clients live less than five miles from work. • The majority of newly employed clients (68%) work within eight miles of their residence, while only 10% travel between 8 to 10 miles. • Of the newly employed, 23% are commuting more than ten miles to work. • Less than 3% are commuting to areas where jobs are more plentiful (Broward and Upper Keys).	• The primary issue facing welfare reform in the county is the insufficient amount of entry-level jobs. • In the short term, Miami-Dade needs to look to the more robust economy in Broward County for entry-level jobs. • In the long term, providing more individualized transportation options for welfare clients may be the only way to get them to work and keep them working.
Employment Patterns	• Emerging employment centers are too far from inner-city residents (west Dade and Hialeah). • Analysis demonstrated a great deal of complexity in decentralized spatial patterns in the growth of employment opportunities in the county. • Twelve employment centers were identified in the county; the largest four were the Downtown / Brickell, Airport West, Hialeah / Medley / Miami Lakes, and the Coral Gables / Westchester areas.	• The amount of growth in entry-level jobs is so small that their impact on trip generation is insignificant. • South Dade is a special case with distances to major employment centers a true barrier.

	Finding	Implications
	• About 30% of employment in the county can be found within five miles of downtown; 50% are within eight miles of downtown; while approximately 40% of all jobs in the county are within four miles of Liberty City, where many of WAGES clients live. • Downtown specialized as a financial and administrative center; while Coral Gables acts as a second downtown, specialized in finance and administrative jobs with over 40% of its employment in these two sectors. Other employment centers are less specialized. • The majority of Miami-Dade's non-professional services and retail employment is highly scattered. • Entry-level employment in the county totals 28% of all jobs, while an estimated 5,000 entry-level jobs will be created in the county each year. • Now, more entry-level jobs are found in the Airport West, Kendall and Coral Gables than in Downtown Miami. In the future, the entry-level jobs will be created in the same areas in addition to Hialeah, with few will be scattered in South Dade.	• Skill mismatch, ethnic differences and language barriers may be working to the disadvantage of WAGES clients. • There is no single geographic focal point for the creation of new entry-level jobs in the county. • Most new entry-level jobs are being created in more affluent areas, not near the homes of WAGES clients.
Transportation Patterns	• The airport and Biscayne Bay are major physical barriers between central city WAGES clients and jobs in west Miami-Dade County and on the beach, which limits existing fixed bus suitability for this area. • On average in the five study areas, a greater percentage of individuals carpool than in the county as a whole (20% vs. 16%). • Liberty City / Overtown and Little Havana reflect a higher level of transit use than the county as a whole (14% and 11% vs. 6%, respectively). • South Dade has a higher percentage of worker carpooling (25%) than any other study areas as well as a higher percentage than the county as a whole. • The majority of county residents workers travel less than 30 minutes to work in all study areas as well as the county as a whole. • Only 15% of Miami-Dade workers travel more than 45 minutes to work in the county and only 3% travel more than one hour.	• Transportation planning which caters to workers who reside in the suburban areas but work downtown needs to be adjusted. • As the demand for individualized transportation increases, our fixed-route transit system will have an uphill battle to expand rider ship. • A travel time of more than one hour is likely to be a barrier for prospective welfare-to-work clients. • If WAGES clients have other, more time efficient alternatives to mass transit, they are likely to take it.

	Finding	Implications
	• Only 9% of all transit trips between the study areas and employment centers could be completed in less than 30 minutes. • The average of all trips in the study areas and employment centers was 82 minutes from portal to portal for all schedules reviewed.	

2.2 Using Geographic Information Systems for Welfare To Work Transportation Planning and Service Delivery

This handbook was developed to assist transportation planners, human service agencies, and transportation providers in developing geographic information systems (GIS) to support welfare to work transportation planning and service delivery. Examples of maps and visual displays that can assist in identifying and addressing transportation issues are included. Guidance on creating an information system with the cooperation of all agencies involved in welfare reform efforts is provided. It provides a brief description of welfare reform legislation and important background information about the population being served. Information about the current mobility and transportation needs of welfare recipients is highlighted and some of the unique and challenging issues in developing welfare to work transportation services are described.

An overview of GIS is provided. The components of a complete information system are noted. Some of the basic functions that can be performed by GIS software are described. Sources of information for a more detailed discussion of GIS are also provided. It provides guidance on getting started in the development of a GIS for welfare to work transportation planning and service delivery. Some key issues to consider when purchasing GIS software are noted. Hardware considerations are also discussed. Interagency cooperation and coordination, a critical issue in developing a comprehensive and consistent information system, are described. Some successful examples of interagency and state-level coordination are presented. Guidance on internal staffing and organization of a GIS effort are also noted. Alternatives for developing outside technical assistance and support are also provided.

At the heart of any GIS effort is the collection and maintenance of a complete and accurate set of data on individuals being served, employment opportunities, day care and support services, and current transportation services. In addition, background geographic information is needed to make the creation of maps and displays possible. The report, also, provides a detailed review of each type of data needed for a welfare to work transportation GIS. Possible sources of information are identified. Important related data attributes, which can be useful in analyzing transportation needs, are described. Guidance is also provided on data updating and maintenance needs.

It then provides several examples of maps and displays that can be developed to assist with welfare to work transportation. Model GIS applications that support welfare to work policy

development, transportation service planning, trip planning, and evaluation are included. These examples were developed largely from research on current exemplary GIS applications across the country. The types of data and the level of expertise needed to create each application are indicated.

2.3 Connecting People to Work: A Technical Guidebook for Using Data Analysis and Mapping as Tools to Develop Local Strategies

This guidebook is being offered to provide technical assistance to community development officials, their staff, and others who face the challenge of developing local strategies for helping residents move into gainful employment, including welfare-to-work strategies. The technical assistance provided within this guidebook will help readers understand how to use data analysis tools, desktop mapping /GIS, and other simple information technology to: 1) gain a better understanding of the people seeking jobs, the number and types of jobs that might be available, the possible barriers to employment, and the services and resources that are available or that are needed to help place people in jobs; 2) identify what employment strategies will need to accomplish if they are to be most effective; and 3) create clear illustrations of the characteristics of the local welfare population, employment base, services, etc., in order to call attention to the challenges that must be overcome, help others understand the situation, and present a strong case for needed resources.

The guidebook does not offer possible employment strategies, as each community has individual characteristics that warrant special consideration. It does provide information about identifying, acquiring, and analyzing data that describes people, jobs, and services so that the reader can develop a thorough understanding of the issues that must be considered as employment strategies are developed.

Part One of this guidebook is a non-technical overview of a technical topic the use of data analysis, mapping, and other information technology as tools for developing employment strategies. This part provides an overview of why data analysis and mapping are important tools, the types of data that are available, where data can be obtained, how data can be obtained through data sharing arrangements, and the tools and personnel required to perform the technical tasks involved in data analysis. This section also includes several illustrations of how maps can communicate a great deal of useful information about the characteristics of the people, businesses, and other attributes associated with particular places.

Part Two is intended for staff who will be responsible for performing the types of analyses described in this guide, and for others who want to get an understanding of the types of tasks involved in performing geographic analysis and mapping. This part provides details about how to work with employment and welfare caseload data. Instructions are included on how to aggregate data to develop geographic profiles of existing employment and the welfare population. This section also includes descriptions of how to use *HUD's Community 2020* software to address- match data, create thematic maps and pin maps, and add additional layers of information to maps.

This guide places a great deal of emphasis on the use of data analysis and maps as planning tools. It must also be noted that data analysis is not meant to replace the need to work with individual job seekers, employers, job trainers, and service providers. Planning and implementing effective strategies must include the active involvement of all of these stakeholders. Yet analysis and application of specific types of data and information can take planners a long way toward developing welfare-to-work and other employment strategies. If analyzed and presented properly, good data can lay the foundation for an effective planning process by helping to clarify the issues that need to be addressed. This guidebook provides a general understanding of how data can be used as a planning tool, and with specific information about how to generate maps and perform certain types of data analysis that can contribute to the development of effective employment strategies.

2.4 BROWARD COUNTY, FLORIDA: REGIONAL JOB ACCESS AND REVERSE COMMUTE TRANSPORTATION PLAN

This report addresses new or expanded transportation services targeted at filling transportation gaps to transport welfare recipients who are in transition and low-income individuals to and from jobs and other employment related activities such as child-care and job training.

The Federal Transit Administration's (FTA) new Job Access and Reverse Commute Grant Program is intended to establish a regional approach to job access challenges through the establishment of a Regional Job Access and Reverse Commute Transportation Plan. Projects derived from this plan support the implementation of a variety of transportation services that connect welfare recipients who are transitioning to jobs and related employment activities.

The Regional Job Access and Reverse Commute Transportation Plan is an integral part of the overall transportation planning process. The development of the project is based on a well established process for the planning and programming of transportation/transit system improvements. The process includes adhering to the established transportation/transit goals and policies, monitoring and evaluating existing service and needs, developing improvements, and public review. This project is consistent with the state, regional and local plans.

It identifies, through GIS, base data information about Broward County: service area profile, demographic base data, welfare recipients, employment centers, child-care facilities, and public transportation services. Using a GIS buffer analysis, it was determined that the majority of welfare recipients live within ¼ mile of a public transit route. Then, the same buffers were applied to the other geocoded files of childcare facilities, home-based daycare, and family service centers. There were 98 subsidized childcare facilities in the county that welfare recipients may utilize. Of those 22% are within ¼ mile of a bus route. With home-based childcare, of 38 facilities, 76% are within ¼ mile of a bus route. Of the 27 family service centers, 100% are within ¼ mile of a public transportation.

The existing transit services provide a portion of the needs of the targeted welfare population. The transportation system for targeted population should meet all welfare-related activities utilizing existing services as much as possible. Where existing services are insufficient, the

supplemental transportation system should creatively arrange the services of contractual providers to complement public transportation and enable participants to go where they need to be. Four transportation options have been recognized for enhancement and expansion to meet the needs of welfare recipients: 1) public transportation fares and passes, 2) fixed-route shuttle or van service, 3) demand-response service, and 4) donated cars and taxi cabs. These options are arranged from easiest-to-serve to hardest-to-serve, from most participants to fewest participants, and from least costly to most costly.

2.5 WELFARE REFORM AND ACCESS TO JOBS IN BOSTON

This study identifies the requirement that the poor work in return for assistance is inextricably linked to the issue of mobility. Clearly, work requires mobility, safe and efficient transportation not only to jobs but also to day-care centers and other services that make work possible. Thus, adequate transportation is a prerequisite for work and for welfare reform. Yet, people receiving welfare face tremendous mobility challenges. Welfare recipients are disproportionately concentrated in big cities and very few own an automobile, so most must rely on transit to access employment and related services. Moreover, because more than 90 percent of welfare parents are single mothers, their transportation needs will be much greater once they are working.

It shows that poor working mothers spend more than twice as much on transportation as welfare-reliant mothers. Single working mothers also must make several intermediate stops during the commute to and from work: to drop off children at day care or school, shop for groceries, or pick up children on the way home. Finally, many of the entry-level jobs for which recipients are qualified are located in the outer suburbs of metropolitan areas, which are not typically served by public transit. Today, about 70 percent of jobs in manufacturing and trade, sectors employing large numbers of entry-level workers, are suburban.

The U.S. Department of Transportation's Bureau of Transportation Statistics and Volpe National Transportation Systems Center are engaged in an effort to better understand the dimensions of the mobility problem facing welfare recipients across the country. This study uses a geographic information system (GIS) to assess mobility for welfare recipients living in the City of Boston. Although the scope and specific nature of the mobility problem vary considerably among U.S. cities, Boston presents a good case study for older Frostbelt cities with mature central areas and well-developed transit systems.

This study has three objectives: 1) determine welfare recipients' overall access to transit service; 2) estimate where in the metropolitan area welfare recipients are likely to find work and determine these potential employers' proximity to transit; and 3) ascertain how well mass transit in Boston connects welfare recipients and employers and thus meets recipients' mobility needs.

This study did not address other key mobility considerations, such as the locations of day care centers and other services upon which working mothers rely.

It profiles the welfare recipient population nation-wide and describes their most significant mobility challenges, namely, the transportation demands of single parenthood and the

changing spatial patterns of employment. It also looks at the spatial distribution and key characteristics of welfare recipients in Boston, and assesses recipients' job opportunities and the location of potential employers. It provides an analysis of recipients' access to jobs and of transit system performance, and presents key conclusions and suggests areas for future analysis.

3. WELFARE REFORM AND THE WELFARE TO WORK TRANSPORTATION CHALLENGE

3.1 OVER VIEW OF WELFARE REFORM

The purpose of this chapter is to provide basic information concerning welfare recipients in Miami-Dade County who are eligible for the Work And Gain Economic Self-Sufficiency (WAGES) program. This chapter includes a summary of recent changes in welfare reform as well as the current development of the WAGES program in Miami-Dade. It also provides relevant information about the five communities that were chosen as our study areas because of their high concentrations of WAGES clients within the county. Finally, it summarizes characteristics of transportation to work in these five areas.

3.2 HISTORICAL BACKGROUND

In August of 1996, President Clinton signed the "Personal Responsibility and Work Opportunity Reconciliation Act" which ended the federal guarantee of providing life-long welfare assistance to eligible recipients. The Act allowed individual states to create their own reform in welfare programs under Federal guidelines. New work requirements and time limits on welfare benefits were imposed and block grant for Temporary Assistance for Needy Families (TANF) were created to replace the decade-old Aid to Families with Dependent Children (AFDC) program.

In 1996, the State of Florida enacted legislation limiting welfare assistance to two years over a five-year period or a maximum of three years over a six-year period if recipients had serious job placement problems. Over a lifetime, cash assistance would be available for only four years. The Florida reform is tougher than the federal law limitation of five years over a lifetime. The legislation also provides funding and services for welfare recipients to meet transitional needs. It requires local regions to establish their WAGES coalition to plan and coordinate the delivery of services under the state welfare reform program.

In February of 1997, Miami-Dade County established its 32-member board for WAGES coalition which is comprised of appointed community leaders, government officials, social service agencies, and private sector companies. Unlike WAGES in other countries, the day-to-day operation of the Miami-Dade WAGES Coalition is independent of the jobs and education partnership regional board and is not attached to any existing agency. Rather, it establishes a new administrative office and develops its own supporting staff with new executive positions and staff on loan from various state and county agencies.

In June of 1997, the state allocated $26 million to the Miami-Dade/Monroe WAGES district. In October of that year, the Miami-Dade office of the Florida Department of Children and Families (FDCF) announced it would be cease its day-to-day overseeing of the county's welfare-to-work efforts. In November, WAGES hired Lockheed Martin IMS and thirteen other providers to furnish case management, job placement screening, and supporting services for the WAGES clients.

In January of 1998, Miami-Dade/Monroe WAGES opened its office in downtown Miami. In the following month, County Mayor Alex Penelas appointed a director to a county position, the office of Job Creation and Welfare-To-Work, to help coordinate efforts among the various agencies and organizations involved in the county's welfare-to-work effort.

Meanwhile sixteen "One-Stop Service Centers" were established throughout the county by WAGES to facilitate the eligibility determination of TANF recipients to join the WAGES program. These centers also provide work registration, and orientation and assessment services. After that, WAGES clients who are job-ready will join a six-week job placement process with Florida Department of Labor and Employment Security (FDOL). If they cannot get jobs, they will join the rest of the WAGES clients to work with providers for training.

During the 1998 session, the Florida Legislature voted to withdraw FDOL from any further participation in Welfare-To-Work efforts, effective October 1, 1998. As a result, the WAGES Coalition is transferring the responsibility of initial job placement screening from "One-Stop Service Centers" to the providers to Miami-Dade County Public Schools and Miami-Dade Community College. As of August 1998, the WAGES Coalition hired thirteen providers for job training and placement and nine for teenage pregnancy services. The primary providers hired another 50-some subcontractors in job placement and other supporting services.

In eight months' time the Miami-Dade and Monroe WAGES Coalition has undergone a number of reorganizations and numerous changes. While these changes were necessary in response to the withdrawal of DFOL and FDCF, the separation of WAGES administration from other agencies and the long preparation time has affected coordination and strategic planning. By July 1998, the WAGES administration completed its reorganization and a permanent executive director was hired. It is now actively strengthening its capacity and is in the final stage of completing the WAGES strategic plan.

3.3 TRENDS OF TANF CASELOADS

Since the enactment of welfare reform in 1996, the welfare population in Florida has sharply declined. The number of people (including children) receiving cash assistance dropped from 531,500 to 263,300 between September 1996 and May 1998. In the same period, the number of adult welfare recipients declined from 155,100 to 677,600. The number of cases (i.e., total number of families on welfare) correspondingly decreased from 200,300 to 101,600. In all categories, there has been a net decline of approximately 50%.

The declines in Miami-Dade County have lagged behind the rest of the state. Being the poorest urban county in Florida, its central city the fourth poorest in the country (according to 1990 census), Miami-Dade already had the highest concentration of welfare recipients in 1996. At that time, about one out of every four AFDC recipients in the state resided in

Miami-Dade County. During the last two years, as other parts of the state experienced sharper declines in their welfare population, Miami-Dade fell behind to the point that it now holds about one-third of the state's TANF recipients.

Approximately 4,200 TANF adult recipients have stopped receiving benefits within the last two years. Though the decline is substantial, it is far below the statewide 50% decline. It should be noted that the drop in caseloads could not be fully explained by recipients finding employment. Withdrawal from welfare involves many factors, including obtaining a job, out-migration, and receiving support from immediate family members or other relatives.

FDCF figures in April 1998 show that in Miami-Dade 16,170 TANF adult recipients are under a 24-month limit, and 8,100 TANF adult recipients under the 36-month limit. The FDCF also estimates that, when time limits begin to expire in October of this year, benefits will run out for about 2,190 TANF adult recipients, followed by 1,260 in November and 870 in December, totaling 4,320 for the last quarter of 1998. Between January 1999 and October 2000, another 11,800 adult recipients will be forced off TANF assistance.

Recognizing the difficulty of obtaining employment for the most difficult cases, the State of Florida is allowing for 7,300 hardship exemptions between October 1, 1998 and September 30, 1999 for Miami-Dade. These exemptions provide an extension of benefits from one to twelve months to those who are deemed to have major barriers to employment. The WAGES Coalition has selected approximately thirty individuals to perform pro-bono work to determine hardship exemptions. In the summer of 1998, changes were made in the way welfare eligibility was calculated and a large number of the 2,190 TANF recipients had their cutoff deadline extended. As a result, only about 780 recipients would have lost their benefit by October 1 and nearly all of them were granted the hardship exemption.

3.4 WAGES CLIENTS

The number of WAGES clients in Miami-Dade County is subject to change. While almost all TANF adult recipients are eligible, not all choose to participate in the WAGES program. In early 1998, the FDCF anticipated about 23,000 TANF adult recipients would participate in the WAGES program. However, it is likely that the ultimate number of WAGES clients will be smaller because of the continuing decline in the number of TANF adult recipients. Through June 1998, 14,766 TANF adult recipients have been referred to the WAGES program for job training and assistance in locating employment opportunities. The number increased to 16,495 in August. Based on the trends, the final number of WAGES clients will probably be 19,000 in the year 2000.

The key issue of welfare reform is the job readiness of the TANF adult recipients. In an attempt to assess the work readiness of eligible WAGES clients, FDCF developed three broad profile classifications using skills, education and work experience of recipients. Profile A includes those clients with some job skills and experience and higher levels of education, Profile B consists of those who require work preparation and support to gain employment and Profile C represents those who face significant barriers to employment and require substantial assistance and training to enter the labor market. Based on information from open cases in late 1997, about 30% of the potential WAGES clients can be classified under Profile A, 25% under Profile B, and 45% under Profile C. In other words, about 10,000 TANF of

19,000 adult recipients will need assistance, training and rehabilitation after October 2000. If these FDCF estimates are correct, thousands of TANF adult recipients will be forced out of assistance before they are fully prepared to join the labor market.

Meanwhile employment placement for WAGES clients progress steadily through contracted providers. Through April 1998, about 835 former TANF adult recipients obtained unsubsidized employment. By June 1998, the number increased to 1,285 and by September 1998, it reached 2,200. As expected, these are entry-level jobs that require minimal skills and little prior work experience. Preliminary analysis showed that about half of them are either part-time or shift jobs.

In addition, Miami-Dade's economy is stagnant with an on-going unemployment rate of 6.3% (as of Aug 1998). This is much higher than the 4.5% of the state and the nation. With about 68,000 people unemployed and seeking jobs in Miami-Dade, the local labor market clearly is incapable of absorbing all former TANF recipients. In chapter3, we estimate that the county is currently generating about 5,000 entry-level jobs (i.e., jobs that require low skills and minimal education) annually. With this low rate of the creation of appropriate jobs, even assuming no competition from other entry-level job seekers, it will take considerable time to provide every TANF adult recipient currently in the WAGES program with a job.

3.5 TRANSPORTATION PATTERNS OF RESIDENTS IN THE STUDY AREAS

The 1990 census provides some useful information on the patterns of travel between work and residence. We analyzed the relevant data for the five study areas. The results are provided in Table 3.1 to Table 3.3. Though these patterns are for all workers residing in these areas, we believe that WAGES clients in the respective communities will likely adopt the same pattern once they start working. In other words, these results should be viewed as a reasonable indicator of the future travel characteristics of the WAGES clients.

Regarding the means of transportation to work, Table 3.1 shows that 68% of the workers in these study areas drive alone compared to 72% of all workers in the county. Among the five study areas, Hialeah and Carol City/Opa-Locka have the highest rate of workers who drive alone, most closely mirroring the county's average. Carpooling is the second most popular means of transportation. About 20% of all workers in the study arrears carpool, the highest percentage of which occurs in South Dade (25%). In general, the rate of carpooling overall in the study areas is higher than the 16% figure for the county.

Census data show that countrywide, only 6% of workers use public transportation. Among the five study areas, the percentages vary a great deal: two percent in South Dade, three percent in Hialeah, eleven percent in little Havana, and fourteen percent in liberty city/Overtown. The use of transit is, in part, a function of the availability and quality of transit services. Therefore, we would expect a more intense use of transit in liberty city/Overtown and little Havana. On the other hand, residents in Hialeah and South Dade may continue to rely more on non-transit means because of limited transit access to employment centers. It should be further noted that even under the most favorable conditions, few places in the county use public transportation at rates higher than 20%. While it is imperative to encourage the use of public transportation, policy makers should recognize that a majority of WAGES clients would probably find individualized transportation more appealing.

Table: 3.1 Use of means of transportation to work in 1990, all workers (in %)

Study Areas	Drive Alone	Carpool	Transit	Others
Carol City/Opa-Locka	71%	18%	7%	4%
Hialeah	74%	18%	3%	6%
Liberty City/Overtown	60%	20%	14%	6%
Little Havana	61%	20%	11%	9%
South Dade	66%	25%	2%	7%
Total Study Area	68%	20%	7%	6%
Miami-Dade County	72%	16%	6%	6%

Source: Metropolitan Center, FIU, analysis of the 1990 Census STF3B file (table P-49), 1998.

Travel time is a critical issue a long-distance commute is a barrier to employment, especially when children are involved. Table 3.2 shows the travel time of workers in the study areas in 1990. The 1990 Census defines travel time as "the total number of minutes that it usually took the person to get from home to work during the reference week." It includes time spent waiting for public transportation, picking up passengers in carpools, and in other activities related to getting to work. In all five-study areas, the work trip was more than an hour for only two percent of the workers; similarly in the county, only 3% spent more than an hour getting to work. This percentage was similar to the 3% for the whole county. About 10% of workers in the five study areas spent between 45 to 59 minutes in their travel to work. This was a bit lower than the 12% for the county.

Table 3.2: Travel time to work in 1990, all workers (in %)

Study Areas	Less than 30 minutes	30 – 44 minutes	45 – 59 minutes	More than 60 minutes
Carol City/Opa-Locka	53%	33%	12%	2%
Hialeah	69%	22%	7%	2%
Liberty City/Overtown	60%	26%	12%	2%
Little Havana	62%	25%	10%	3%
South Dade	64%	20%	15%	2%
Total Study Area	63%	25%	10%	2%
Miami-Dade County	59%	26%	12%	3%

Source: Metropolitan Center, FIU, analysis of the 1990 Census STF3B file (table P-50), 1998.

On the other hand, about 63% of the workers in the study traveled less than 30 minutes, which is a bit higher than the 59% in the county. In fact, the average travel time for the county is 25 min. These figures show that a travel time of more than one hour is almost an insurmountable barrier to the majority of workers. We expect that typical WAGES clients will respond to a long commute time in a similar fashion. Therefore, any transportation linkage program designed for WAGES clients should aim at achieving travel time of about 30 min and should not exceed one hour. We need to remember that working mothers may also have to get their children to child-care facility or school and this will increase the average travel times noted above.

Census data also provide information regarding the time leaving home to work, presented in Table 3.3 below. A majority of workers leave home between 6 am and 9am. The patterns were uniform throughout the study areas and the county. About 70% of the travel began within that three-hour period. However, one-quarter of the trips were made between 9 am and midnight. Despite the small portion of workers who work on shift or start their work trips off-peak hours, finding an adequate transit solution for them may be very difficult. Since we expect a higher percentage of WAGES clients to travel off-peak, decision makers need to devise a more flexible solution to cater the off-peak needs.

Table 3.3: Time leaving home to work in 1990, all workers (in %)

Study Areas	12:00 am –4:59 am	5:00 am –5:59 am	6:00am–6:59 am	7:00am-7:59am	8:00am-8:59am	9:00am-11:59am
Carol City/Opa-Locka	3%	6%	23%	30%	14%	24%
Hialeah	2%	5%	23%	32%	19%	20%
Liberty City/Overtown	3%	7%	25%	30%	14%	22%
Little Havana	2%	6%	20%	31%	20%	22%
South Dade	2%	8%	25%	31%	15%	20%
Total Study Area	2%	6%	23%	31%	17%	21%
Miami-Dade County	2%	4%	18%	30%	21%	25%

Source: Metropolitan Center, FIU, analysis of the 1990 Census STF3B file (table P-52), 1998

While the 1990 census data provides useful transportation planning information for WAGES clients, it should be emphasized that this information is already dated. A better guideline might be found by examining the actual travel patterns of former TANF recipients who have been hired recently.

3.6 CONCLUSION AND IMPLICATIONS

The welfare reform efforts in Miami-Dade County are challenging because it has the highest concentration of welfare recipients in the State of Florida. During the last two years, while the rest of the state has been experiencing rapid decline of TANF caseload, the decline in Miami-Dade has been slower to the point that one out of every three TANF recipients in the state resides in Miami-Dade County.

Despite strong community efforts and initiatives from the county, matching jobs for each WAGES client will take considerable time because of the sluggish local economy. Our study concludes that the county will generate about 5,000 new enter-level jobs each year. While over 4,000 former TANF adult recipients have left the welfare rolls in the last two years, there are still 23,000 potential WAGES clients. As of June 1998, employment has been secured for about 1,300 WAGES clients, but more effort is needed. Hopefully the booming economy in neighboring Broward County will help to resolve the lack of entry-level jobs in Miami-Dade, but transportation from Dade to Broward may be problematic.

One of the major barriers facing WAGES clients is that they are not job ready. Low levels of education and lack of employment experience have made it difficult for them to find employment. Furthermore, childcare needs pose tremendous difficulties to those working full-time. Additional barriers include the language requirement in some labor markets and the lack of reliable and affordable transportation to work.

The analysis of transportation patterns from the 1990 Census in the five study areas shows that driving alone was the predominant way of workers going to work. The use of public transportation never exceeded 15% in these areas and in some places it was as low as 2%. Almost three quarters of workers in these study areas began their commute to work between 6 am and 9am and, for a majority, their commute was less than 30 minutes. If these are reasonable predictors for WAGES clients, future transportation proposals must be flexible and be client-oriented. The Census data strongly suggest that more individualized modes of transportation should be explored so that WAGES clients can travel to work, shop and take children to child care facilities.

Finally, our on-going interviews with job placement providers reveal that no systematic efforts regarding transportation has been in place. The "One-Stop Centers" provided by the MDTA do not appear to have had an immediate impact because caseworkers are preoccupied with case management and screening. In our opinion, trip planning and other transportation services are most effective when they are provided as part of the job placement effort after a specific job has been identified.

4. OVERVIEW OF GEOGRAPHIC INFORMATION SYSTEMS (GIS)

4.1 WHAT IS GIS?

GIS is often thought of as computerized, automated mapping, however a GIS is much more. It is an information system that contains spatial data. Spatial data describes the position of a feature on the surface of the earth. Spatial data for a particular geographic feature consists

one or more sets of "x" and "y" coordinates (longitude and latitude, for example). Because information on the location of each feature is incorporated into the data, a GIS is able to: 1) illustrate on a map the spatial relationships between features, and 2) perform analyses based on spatial relationships (e.g. adjacency, proximity, paths and clustering).

Perhaps the best way to grasp the meaning of GIS is to describe the types of problems a GIS is designed to solve. In general, a GIS is developed because a user needs information about the location of something in relation to something else. So for example, a GIS might be used to show the location of welfare recipients relative to the location of transit stations or bus stops. A user could calculate the walk distance to the nearest bus stop for a given recipient. Transportation agencies might use such a system to identify recipients that are outside the transit system service area. Welfare recipients might use such a system to identify the nearest bus stop.

A GIS for transportation contains more information than just the location of features relative to each other. A transportation GIS is capable of producing routes or paths across the lines that represent the roadways and rail lines, allowing the user to find the shortest route from the recipient's residence to the place of work. Sophisticated GIS systems can identify the shortest route across multiple modes (for example walk, bus, rail). Some such systems can even estimate travel times.

A summary of the most common GIS terms and definitions presented in *Table 3.1* at the end of this section.

4.2 GIS APPLICABILITY TO WELFARE-TO-WORK TRANSPORTATION ISSUE

There are two GIS functions that are providing insight into the welfare to work problem: proximity, and routing. There are also two activities within a transit agency that can make use of these GIS functions: 1) service planning, and 2) trip planning. Typically, proximity calculations are used for service planning, while routing algorithms are used for trip planning. So, for example, the GIS's ability to determine the proximity of welfare recipients to places of employment provides a transit agency with information that can be used to analyze and modify service in order to more effectively serve the recipients and employers. The ability that a GIS has to calculate shortest paths can assist the welfare case worker to identify the best way for a recipient to get to potential jobs.

While there are many aspects of the welfare to work problem that cannot be addressed with transportation specific planning activities, many transportation aspects of the problem can be addressed. For example, transit agencies could identify the areas with high concentrations of welfare recipients and areas with high concentrations of jobs available for recipients. This information can be used to design new services to serve the population leaving the welfare roles. As another example, transportation agencies could provide incentives for businesses with a large number of appropriate job openings to locate in close proximity to transit facilities that serve the recipients' home location.

It is important to recognize that spatial analysis addresses only part of the welfare to work transportation challenge. Temporal functions are also critically important to the successful

delivery of service to welfare recipients. Welfare recipients may live near public transit routes, but buses may not run at the times when jobs are available. The integration of a temporal dimension to the state of the practice of GIS is currently a topic of extensive study and development. It will most certainly become an important aspect of the future uses of GIS for welfare to work applications.

4.3 TYPES OF DATABASES

GIS uses two types of data. *Feature* data is required for any GIS application. Feature data includes all the information that describes the location, size and shape of a particular geographic feature. A database includes all of the features of a particular type, for example, streets, census tracts, employer locations, and bus routes would each be a separate database. Each database must generally be one of three basic types: points, lines, or polygons (areas). The feature data includes an ID for each feature (i.e. for each segment of a road or for each bus stop) and the coordinates for describing the location of that feature. Each type of feature database is described in more detail below.

In addition to the feature data, a GIS is most useful when there is *attribute* data. Attribute data is data that is linked to the features by the ID mentioned above. Attribute data is basically any data about its related feature that describes the feature beyond the basic size, shape, and location feature data. Attribute data, which may be used in welfare to work applications, is also described below.

4.3.1 Features Data

The three most common types of GIS features data are points, lines and polygons (areas). Lines are constructed out of a series of points, and areas are constructed out of a series of lines. Each feature type is described below.

4.3.1.1 POINT DATABASES

A point feature type is the simplest, requiring only a single set of coordinates to describe its location. Points can be used to describe the location of many different objects, depending upon the scale at which the geographic data is recorded and displayed.

The features which one might want to identify with points, for trip planning purposes, include the location of recipients, bus stops, rail stations, child care services, other support services, potential employers, and various landmarks required for giving the user context for location on the map.

4.3.1.2 LINE DATABASES

Line features require at least two points and may include a large number of intermediate points, depending upon the limitations of the software. Typically two nodes, the start node and the ending node define lines. Nodes are simply points, which are used to identify the beginning and ending of a line, and therefore, lines may not necessarily be straight. Line databases typically include information about direction of the line (from node and to node),

about which polygon lies on each side of the line, and information as to the ID of the line which immediately proceeds it and the ID of the line which immediately follows. This is the data structure that allows the GIS to calculate shortest paths and/or routes.

Line databases can be used to describe a wide variety of features including roadways, rail lines, geo-political boundaries, and rivers. The incorporation and display of line features will also depend upon scale. For example on a map of a geographical region one would not want to display all the local roads because they would be too close together to distinguish and would look like a large mass of ink.

4.3.1.3 PLYGON DATABASES

Areas are made up of lines and may differ substantially in how they are represented depending upon the software that is employed. For example, some GIS software represents each polygon as a separate feature, requiring that the border between two polygons be digitized twice, once for each polygon. Other software products will identify places where two polygons share a border, and attempt to generate a single line, which is shared by both adjacent polygons. The choice of methods for building a polygon database can have a substantial impact on the types of analysis the user can employ. As with points and lines, the decision to use areas to represent features depends upon the scale that is used. For example, an airport may be displayed as a point in larger scale maps while on smaller scale maps a point would totally misrepresent the size and location of the airport.

Polygon features are more likely to be used in service planning rather than trip planning. Some of the area databases which one might want to use in addressing welfare to work issues include neighborhood boundaries, town boundaries, Para transit service areas, ridesharing program service areas, and in the event that the transit agency employs a zone based fare, the boundaries of the fare zones.

4.3.2 Attribute Data

Attributes are the data items that describe the characteristics of the features. For example the points representing the potential employers might have attributes which describe the business, such as company name, number of open positions, product or service provided, address, and phone number. Attributes of transit route lines might include times of operation, average headway and common name of the route. Another example of attributes for welfare to work applications might be the number of welfare recipients in a given neighborhood or area.

Attributes describe the characteristics of a feature and can be used in database queries to select and categorize features for map display or analysis.

4.4 GIS FUNCTIONS

Because the GIS contain location data, the user is able to perform spatial analyses using GIS functions. Several basic GIS functions are described below.

4.4.1 Layering

One of the most valuable functions that a GIS provides is the ability to layer many types of spatial data and evaluate the resulting information. Layering is used to combine two or more spatially located data sources to produce new information that is the spatial integration of the two. For example, the location of welfare recipients is overlaid on zones, the total population of each zone, and the street network. The number of recipients in each zone is then calculated. In welfare to work applications, many planners overlay the residential locations of welfare recipients and the transit market served by existing bus and train lines to determine if existing service is within reach of the potential new users.

Typically, layering refers to the visual display of multiple layers. The actual combination of multiple layers is discussed under "Overlay" below.

4.4.2 Thematic Mapping

In addition to the power of spatial analysis, GIS provides a powerful visual analysis of geographic data. Simply showing the data in a geographic format will provide insight into the data that statistical analysis cannot provide.

Thematic mapping generally refers to using colors and symbols to visualize the characteristics of features as describes by attribute data. A map showing color-coded census tracts coded to represent the number of employers per tract is a thematic map. Similarly, a map of bus routes can be color coded to indicate the different headways of each route.

4.4.3 Selection Subsets

Because GIS integrates data with locations, it is possible to use the GIS to identify features that meet specific criteria. These criteria may be related to size or location (i.e., proximity or distance), or may be based on attribute data. For example, the user can select all day care centers within a ¼ mile of a transit station. The GIS then calculates the distance from the station and identifies all day care centers within that distance. The selected set can be copied into a new database, used in a calculation and/or displayed in a highlighted color on a display or map. The user could then use attribute data to select, from those day care centers within the ¼ mile distance, those that are licensed for infant care.

Most GISs also allow for selection by interacting with the map. For example a user might draw a polygon around a general neighborhood and have the GIS select all the welfare recipients within that area. The user can select one or more features by pointing the mouse at them. The result of this type of selection is not only the highlighting of the feature on the map, but also a selection of the data records from the linked database. It is the interaction between the map display and the underlying database that makes a GIS a powerful tool.

4.4.4 Buffering

Buffering refers to a capability to identify the geographic area that is within a given distance of a feature, such as a bus stop or a route. For example, buffers can be created around bus stops. Recipients living within and outside these buffer areas are thematically shown. Most GIS packages are capable of generating a buffer of a specified distance. Buffering is

frequently used by transit planners and operators to identify the households or businesses that are within the transit market area. This is the technique used to determine if a welfare recipient has access to transit, and whether or not a place of business can be served by transit. Other ways in which buffering can be used to assist in the welfare to work programs might be to buffer the home and work locations to identify any day care facilities within a reasonable distance.

Once a buffer has been calculated for a feature, a new layer can be created which contains the buffer, or buffers, as polygons. This new layer can be used in layering and thematic mapping as described above.

4.4.5 Overlaying

Overlaying is a generic term for functions that either generate a new layer from the combination of two or more separate layers, or that transfer the attributes of one layer to another. Overlay processing is similar to layering, but overlaying requires the actual generation of new features or new data, whereas layering implies that layers are simply displayed together for a visual analysis.

4.4.5.1 POLYGON OVERLAY

The user might overlay two area layers in order to remove features from one of the layers. For example, one might remove all of the features that fall within a quarter-mile of a bus stop, and, create a new layer containing only those areas beyond a quarter-mile of a bus stop. This activity is often what is thought of as *intersecting*.

Two area layers may also be overlayed in order to estimate new attribute data in one layer based on the attribute data in another layer. For example, an area layer of buffers around a bus route could be overlayed on census tract data containing counts of welfare recipients as attribute data in order to estimate the number of recipients within walking distance of the bus route.

4.4.5.2 POINT IN POLYGON OVERLAY

Like polygon overlay, points can be overlayed on polygons. Point in polygon functions do not generate new layers with new features, but rather result in attaching attributes from a polygon onto the attributes table of the points. For example, the welfare recipient point layer may be overlayed with the ¼ mile polygons around bus stops. A new attribute of the welfare recipient point table would then be assigned the number of the bus stop represented by the polygon.

4.4.5.3 LINE IN POLYGON OVERLAY

Lines can also be overlayed on polygons. Line in polygon functions also do not generate new layers with new features, but rather result in attaching attributes from a polygon onto the attributes table of the lines. Line in Polygon processing can be performed in three ways: 1) to identify all lines that are completely within a polygon or 2) to identify all lines that are completely or partially inside a polygon, and 3) identify all lines that cross the boundary of a polygon. The welfare to work applications are concerned with the second function. This can

be used to identify transit routes that are partially or completely within an area of high numbers of employers.

4.4.6 Geocoding

Some of the obvious pieces of information that are required for a welfare to work application are the locations of the recipients, the locations of potential employers, and the locations of support services. These locations are usually easily available in the form of addresses. Most mainstream GISs are capable of approximating the longitudes and latitudes of a given address if they are populated with the appropriate address range information. Address range data is typically provided as a part of the GIS roadway line features.

4.4.7 Origin-Destination Links/Desire Lines (flows)

Transportation planners have been integrating spatial data with transportation models since before the popularization of GIS. One of the important ways that spatial data was integrated into travel modeling was to calculate distances between origins and destinations in the study area. Typically the study area is broken up into discrete zones from which people travel and to which people are ending their trip. The travel times and distances from each of these zones to every other zone is used to calculate and calibrate models. Understanding the relationship of travel between zones is very difficult unless there is an easy way to describe them. Early attempts to describe the travel between these zones involved drawing lines (referred to as desire lines) from one zone to all other zones to which people will travel. Variation of the buffer width of the straight line reflects the number of trips destined to each other zone.

Automated mapping programs made the generation of desire line maps feasible. More recent advances in GIS software make it possible to design an interactive system for studying the demand for travel between zones. With the GIS a user can select a zone as the origin zone and request the GIS to thematically display all the destination zones for trips originating in the origin zone, thematically coding them to indicate volume of travel. The user can also look at the distribution of trips destined to the selected zone. This kind of analysis uses GIS to aid the modeler in both calibrating trip tables and networks as well as evaluating the results of a model run.

For welfare to work transportation planning, the evaluation of origin-destination data can be used to illustrate major work trip flows between areas or regions. It may also be used to identify pairs of recipients and employers which may constitute enough volume to warrant some type of service. This might be a bus route in the extremely high volume pairs of zones; or it might be a vanpool or shuttle bus service.

4.4.8 Distance and Shortest Path Functions

One of the most basic function that a GIS provides is the ability to measure distance. Most GIS products provide a utility to select two or more points and calculate the distance between them. A user might want to use this to estimate the distance a recipient will need to walk on each end of their trip. Shortest path functions are more complex and involve measuring distances over a network made up of one or more line databases. They are used to estimate the total distance, time, and/or cost of a trip to work, including walk distance. By measuring

distance along the route, and because the GIS contains information about the mode or type of travel (bus, walk, drive, etc.) the GIS will also have the ability to calculate travel times for recipients.

Table 4. 1 GIS Terms and Definitions

Term	Definition
address matching	A mechanism for relating two files using address as the relate item. Geographic coordinates and attributes can be transferred from one address to the other. For example, a data file containing student addresses can be matched to a street coverage that contains addresses creating a point coverage of where the students live.
analysis	Analysis is the process of identifying a question or issue to be addressed, modeling the issue, investigating model results, interpreting the results, and possibly making a recommendation.
area	1. A homogeneous extent of the Earth bounded by one or more arc features (polygon) or represented as a set of polygons (region). Examples: states, counties, lakes, land-use areas, and census tracts. 2. The size of a geographic feature measured in unit squares. ArcInfo stores an area measure for each polygon and region.
attribute	1. A characteristic of a geographic feature described by numbers, characters, images and CAD drawings, typically stored in tabular format and linked to the feature by a user-assigned identifier (e.g., the attributes of a well might include depth and gallons per minute). 2. A column in a database table.
backup	A copy of a file, a set of files, or whole disk for safekeeping in case the original is lost or damaged.
base map	A map containing geographic features used for locational reference. Roads, for example, are commonly found on base maps.
buffer (or band)	A zone of a specified distance around coverage features. Both constant- and variable-width buffers can be generated for a set of coverage features based on each feature's attribute values. The resulting buffer zones form polygons-areas that are either inside or outside the specified buffer distance from each feature. Buffers are useful for proximity analysis (e.g., find all bus routes within 1/2 mile of a welfare client origin).

Table 4. 1 GIS Terms and Definitions

Term	Definition
character	1. A letter (e.g., a, b, c, or d), digit (e.g., 1, 2, or 3), or special graphic symbol (e.g., *, |, or -) treated as a single unit of data. 2. A data type for an attribute designating that values for the attribute will be represented using characters. For example, the character data type would be appropriate for the attribute COUNTRY, if the values assigned are like United States, Brazil, Canada, Thailand, and so on.
column	The vertical dimension of a table. A column has a name and a data type applied to all values in the column.
coordinate	A set of numbers that designate location in a given reference system, such as x,y in a planar coordinate system or an x,y,z in a three-dimensional coordinate system. Coordinates represent locations on the Earth's surface relative to other locations.
coordinate system	A reference system used to measure horizontal and vertical distances on a planimetric map. A coordinate system is usually defined by a map projection, a spheroid of reference, a datum, one or more standard parallels, a central meridian, and possible shifts in the x- and y-directions to locate x,y positions of point, line, and area features.
database	A logical collection of interrelated information, managed and stored as a unit, usually on some form of mass-storage system such as magnetic tape or disk. A GIS database includes data about the spatial location and shape of geographic features recorded as points, lines, areas, as well as their attributes.
data conversion	The translation of data from one format to another. An example is saving an .xls (EXCEL) file as a .dbf (dBase) or converting an .e00 (ArcInfo Export file) into a .dbd (TransCAD Standard Geographic file).
data dictionary	A catalog of all data held in a database, or a list of items giving data names and structures.
data set	A named collection of logically related data items arranged in a prescribed manner.
data type	The characteristic of columns and variables that defines what types of data values they can store. Examples include character, floating point and integer.

Table 4. 1 GIS Terms and Definitions

Term	Definition
datum	A set of parameters and control points used to accurately define the three-dimensional shape of the Earth (e.g., as a spheroid). The datum is the basis for a planar coordinate system. For example, the North American Datum for 1983 (NAD83) is the datum for map projections and coordinates within the United States and throughout North America.
desire lines	A geographic file of line features that is used to illustrate the flow of people or goods between two points. Line thickness acts as themes to distinguish between different volumes of travel.
destination	In spatial interaction, the location of the end of a trip. For example, a transitioning individuals place of employment (for a work-based trip).
digitize	To encode geographic features in digital form as x,y coordinates.
edit	To correct errors within, or modify, a computer file, a geographic data set, or a tabular file containing attribute data. For example, one might want to edit a street file to add new housing developments or malls.
field	In a database, another term for column.
format	The pattern into which data are systematically arranged for use on a computer. A file format is the specific design of how information is organized in the file.
geocode	The process of identifying the coordinates of a location given its address. For example, an address can be matched against a TIGER street network to determine the location of a home. Also referred to as address geocoding.
geographic data	The locations and descriptions of geographic features. The composite of spatial data and descriptive data.
GIS	Geographic Information System. An organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.
index	Special data structure used in a database to speed searching for records in tables or spatial features in geographic data sets.
integer	A number without a decimal (0, 1, 25, 173, 1032, etc.). Integer values can be less than, equal to, or greater than zero.

Table 4. 1 GIS Terms and Definitions

Term	Definition
intersect	The topological integration of two spatial data sets that preserves features that fall within the area common to both input data sets.
join	The act of linking records in one layer or database to features in another layer or database by matching the values of a field in both files
latitude-longitude	A spherical reference system used to measure locations on the Earth's surface. Latitude and longitude are angles measured from the Earth's center to locations on the Earth's surface. Latitude measures angles in a north-south direction. Longitude measures angles in the east-west direction.
layer	Organize a database or map library by subject matter (e.g., welfare recipients, roads, and routes).
least-cost path/shortest path	The path, among possibly many, between two points which has the lowest traversal cost, where cost is a function of time, distance, or other user-defined factors.
legend	1. The reference area on a map that lists and explains the colors, symbols, line patterns, shadings, and annotation used on the map. The legend often includes the scale, origin, orientation, and other map information. 2. The symbol key used to interpret a map.
line	A set of ordered coordinates that represents the shape of geographic features too narrow to be displayed as an area at the given scale (e.g., streets), or linear features with no area (e.g., state and county boundary lines).
map	An abstract representation of the physical features of a portion of the Earth's surface graphically displayed on a planar surface. Maps display signs, symbols, and spatial relationships among the features.
map projection	A mathematical model that transforms the locations of features on the Earth's surface to locations on a two-dimensional surface. Because the Earth is three-dimensional, some method must be used to depict a map in two dimensions. Some projections preserve shape; others preserve accuracy of area, distance, or direction.

Table 4. 1 GIS Terms and Definitions

Term	Definition
map query	The process of selecting information from a GIS by asking spatial or logical questions of the geographic data. Spatial query is the process of selecting features based on location or spatial relationship (e.g., select all welfare clients within 1/4 mile of a route; point at a set of features to select them). Logical query is the process of selecting features whose attributes meet specific logical criteria (e.g., select all polygons whose value for POP is greater than 10,000 or select all streets whose name is 'Main St.'). Once selected, additional operations can be performed, such as drawing them, listing their attributes or summarizing attribute values.
map scale	The reduction needed to display a representation of the Earth's surface on a map. A statement of a measure on the map and the equivalent measure on the Earth's surface, often expressed as a representative fraction of distance, such as 1:24,000 (one unit of distance on the map represents 24,000 of the same units of distance on the Earth). Map scale can also be expressed as a statement of equivalence using different units; i.e., 1 inch = 1 mile or 1 inch = 2,000 feet.
network	An interconnected set of lines representing possible paths for the movement of resources from one location to another.
origin	The place where a trip starts. This is usually the home for most clients. For a population group, an origin could be a census tract or a city.
path	An ordered set of network links and network nodes which connects an origin to a destination
point	A single x,y coordinate that represents a geographic feature too small to be displayed as a line or area; for example, the location of a child care facility or job location on a small-scale map.
polygon	A feature used to represent areas. A polygon is defined by the lines that make up its boundary and a point inside its boundary for identification. Polygons have attributes that describe the geographic feature they represent.
precision	Refers to the number of significant digits used to store numbers, and in particular, coordinate values. Precision is important for accurate feature representation, analysis and mapping.
real numbers	Decimal numbers (e.g., 3.1417, 0.25, 1.8992, 6.0).
record	The horizontal dimension of a table.

Table 4. 1 GIS Terms and Definitions

Term	Definition
relational database	A method of structuring data as collections of tables that are logically associated to each other by shared attributes. Any data element can be found in a relation by knowing the name of the table, the attribute (column) name, and the value of the primary key.
resolution	Resolution is the accuracy at which a given map scale can depict the location and shape of geographic features. The larger the map scale, the higher the possible resolution. As map scale decreases, resolution diminishes and feature boundaries must be smoothed, simplified, or not shown at all. For example, small areas may have to be represented as points.
route	A special type of feature that is defined as a list of two or more line features, connected in a particular order.
route system	Contains one or more routes
spatial analysis	The process of modeling, examining, and interpreting model results. Spatial analysis is useful for evaluating suitability and capability, for estimating and predicting, and for interpreting and understanding.
spatial data	Information about the location and shape of, and relationships among, geographic features, usually stored as coordinates and topology.
stop	Stops are locations visited in a path or tour; they may represent bus stops along a route or cities in a highway system
symbol	A graphic pattern used to represent a feature. For example, line symbols represent arc features; marker symbols, points; shades symbols, polygons; and text symbols, annotation. Many characteristics define symbols, including color, size, angle, and pattern.
table	A set of data elements that has a horizontal dimension (rows) and a vertical dimension (columns) in a relational database system. A table has a specified number of columns but can have any number of rows. A table is often called a relation. Rows stored in a table are structurally equivalent to records from flat files in that they must not contain repeating fields.
template	A coverage containing common feature boundaries, such as land-water boundaries, for use as a starting place in automating other coverages. Templates save time and increase precision of topological overlays.

Table 4. 1 GIS Terms and Definitions

Term	Definition
themes/thematic mapping	A method for illustrating data on a map, typically using colors, symbols, patterns, or symbol sizes to illustrate variations in data
topology	The spatial relationships between connecting or adjacent coverage features (e.g., lines, nodes, points, and areas). Topological relationships are built from simple elements into complex elements: points (simplest elements), lines (sets of connected points), areas (sets of connected lines), and routes (sets of sections, which are lines or portions of lines).

5. GIS SOFTWARES

Advances in the GIS software industry are developing so rapidly that the products selected by an organization at the beginning of the implementation are out dated before the implementation is completed. Such a dynamic environment benefits the consumer by making new and effective features available at increasingly reasonable costs. But it is also frustrating to need to be constantly upgrading software. However, the intensely competitive environment for GIS software vendors assures the users that effective features available today in one package are likely to be made available in all other comparable products within a short time frame. Consequently, as long as users select a GIS package from among the major contenders they need not be overly concerned about choosing the "wrong" software package. However, factors such as flexibility for customization, network-based software (versus a desktop solution), and the popularity of various packages should be considered. A summary of the major GIS software products can be found in *Table 4.1*.

For the basic display and query of the locations of recipients and places of employment, most commercially available software packages will be adequate. However, if the user wants to perform trip planning and service planning, transportation planning functions are required. Transportation planning functions are not commonly included in all packages, but are included in the three major products: *TransCAD*, *ArcInfo/ArcView*, and *GeoMedia*. *MapInfo* is generally considered to be one of the major GIS products available on the market. It does not, however, provide any network analysis functions that are required for trip planning and/or service planning. Future enhancements to add routing capabilities are planned.

TransCAD, from Caliper Corporation tightly integrates a wide array of transportation planning functions, particularly transit analysis functions, with GIS functions. Planning functions such as routing a trip are already available and packaged with the *TransCAD* package.

If compared to other major desktop packages, *TransCAD* will appear considerably more expensive. However, it is important to recognize that many of the data development and analysis capabilities of *TransCAD* are not available in the other desktop packages without investing in more expensive add-ons and non-desktop products.

ArcView is the second major desktop GIS vendor. Modules such as *ArcLogistics*, *Network Analyst*, and *ArcRoute* can be added to *ArcView* for routing or trip planning functions. With these added modules, the user will have all the tools needed to develop trip planning and service planning. However, trip planning and service planning will need to be specifically developed.

The ease of use of *ArcView* is an appealing feature, however, *ArcView* is not an ideal platform for some of the more complex data development and feature editing. Transportation functions, such as building routes, require the use of *ArcInfo*, the larger, more expensive non-desktop GIS software. *ArcInfo* may be required for initial setup of the system, and for periodic update and maintenance of the data. The *ArcInfo* software is considerably more expensive and requires a large investment in specialized training.

The third major vendor of desktop GIS software is Intergraph with its *GeoMedia* product. Like the ESRI products, Intergraph relies on its larger, more expensive product, *MGE*, for major data development and maintenance, while marketing *GeoMedia* as an inexpensive, easy to use desktop platform for applications. An important feature of *GeoMedia* is its ability to read and display data from most major GIS and database products, without conversion. Also, like *ArcView*, *GeoMedia* requires an additional add-on product, *GeoMedia Network*, for implementation of transportation functions for routing, trip planning and service planning.

Regardless of the software product chosen, a program for use in addressing Welfare to Work issues will require additional programming to implement the specific application. All of the major products can be customized for specific applications.

Another option that is becoming available is the ability to develop the trip planning or service planning application in a Web-based software product. Both ESRI and Intergraph offer Internet server products. This approach will require more intensive programming and will limit the functionality to only what is programmed. However, because it is web-enabled it requires only a server license. Individual licenses for the GIS software do not need to be installed on each computer running the Welfare to Work applications.

Table 5. 1 Sources of GIS Software

Product	Manufacturer	Brief Description	Functions
Arc/Info	ESRI	Professional GIS with advanced modeling and analysis capabilities	Open Database support, data updating, address matching and geocoding, Network analysis and management, Topological map overlay, Buffer generation, Proximity analysis, Spatial and logical query, Network modeling, tabular analysis, Report generation , Cartographic map production

Table 5. 1 Sources of GIS Software

Product	Manufacturer	Brief Description	Functions
ArcNetwork	ESRI	Arc/Info extension, model and analyze spatial networks in the ArcInfo environment	Vehicle routing, transportation analysis and planning , bus routing, shipping and delivery optimization, and political redistricting
ArcView	ESRI	Mapping and GIS software for the desktop	Integrate data and work with the data geographically, make maps and create interactive displays by linking charts, tables, drawings, photographs, and other files, develop custom tools, interfaces, and complete applications using Avenue
ArcView Network Analyst	ESRI	ArcView Extension, solve problems using geographic networks (i.e., streets, highways, rivers, pipelines, electric lines, etc.)	Finding the most efficient travel route, generating travel directions, finding the closest facility, defining service areas based on travel time
ArcView StreetMap 1.0a	ESRI	ArcView Extension, nationwide (U.S.) address geocoding and street map display	Street and landmark database for the entire United States
ArcView StreetMap 2000	ESRI	An enhanced version of ArcView StreetMap Version 1.0a	Uses the GDT® DYNAMAP 2000(tm) street database, includes a compressed street and landmark database for the entire United States
Spatial Database Engine (SDE)	ESRI	Client/server software that enables spatial data to be stored, managed, and quickly retrieved from database management systems like Oracle, Microsoft SQL Server, Sybase, IBM DB2, and Informix.	Manage very large databases, Support multiple users, Provide open data access, Develop custom applications , Integrate with existing applications

Table 5. 1 Sources of GIS Software

Product	Manufacturer	Brief Description	Functions
MapObjects	ESRI	An extensive library of mapping and GIS software components	Adds GIS maps to applications like Microsoft Access, Word, such that users can pan, zoom, and query GIS datasets from within these familiar software , working in Windows development environments such as Visual Basic to create stand-alone custom applications .
ArcLogistics Route	ESRI	Desktop vehicle routing and scheduling software and database	Creates dynamic routes and schedules to minimize costs and meet time windows, selects service area from the included street database of the United States, connects to popular databases through the Open Database Connectivity (ODBC) standard, generates route summary reports
NetEngine	ESRI	Programmer's library designed for network analysis	Provides the programmer with the capability to define, store, traverse, and analyze many kinds of networks through either a C application program interface (API) or Visual Basic via a type library
PC ARC/INFO	ESRI	GIS for Windows and DOS computers	Cartographic design and query, data entry and editing, data translation, polygon overlay and buffering, network analysis and modeling
MGE (5 base modules, several specialized application modules)	Intergraph	High-end GIS data maintenance and analysis tool	Layering, thematic mapping, banding/buffering, intersect/overlay, selection subsets, origin-destination links/desire lines, distance functions
GeoMedia	Intergraph	Desktop GIS analysis tool	Layering, thematic mapping, banding/buffering, intersect/overlay, selection subsets distance functions

Table 5. 1 Sources of GIS Software

Product	Manufacturer	Brief Description	Functions
GeoMedia Pro	Intergraph	Desktop GIS data maintenance tool	Layering, thematic mapping, banding/buffering, intersect/overlay, selection subsets, distance functions
GeoMedia Network	Intergraph	Routing and network data maintenance and analysis tool	Layering, banding/buffering, intersect/overlay, selection subsets, origin-destination links/desire lines, distance functions
MicroStation GeoGraphics	Bentley Systems	GIS data maintenance, analysis and development tool	Layering, thematic mapping, banding/buffering, intersect/overlay, selection subsets, distance functions
MicroStation GeoAddress	Bentley Systems	Routing and network data maintenance and analysis tool	Layering, banding/buffering, intersect/overlay, selection subsets, origin-destination links/desire lines, distance functions
MapInfo Professional	MapInfo	Desktop GIS	Layering, thematic mapping, banding/buffering, intersect/overlay, selection subsets, distance functions
Autodesk World	Autodesk	Desktop GIS analysis tool	Layering, thematic mapping, banding/buffering, intersect/overlay, selection subsets, origin-destination links/desire lines, distance functions
AutoCAD Map	Autodesk	GIS data maintenance tool	Layering, thematic mapping, banding/buffering, intersect/overlay, selection subsets, origin-destination links/desire lines, distance functions

Table 5. 1 Sources of GIS Software

Product	Manufacturer	Brief Description	Functions
TransCAD	Caliper	Software for transportation professionals to store, display, manage, and analyze transportation data	Transportation database development and maintenance, demand forecasting, operations management, vehicle routing and scheduling, polygon overlay, buffering, geocoding, data sharing on local- and wide-area networks, creating and manipulating matrices, create, display, edit, and manipulate routes, dynamic segmentation analysis, merge and analyze multiple linear-referenced data sets, create hypertext links between individual map features and images, maps, and Microsoft Office documents
Maptitude	Caliper	A combination of software and geographic data that provides desktop mapping and spatial analysis	Mapwizard automatic mapping, map editing and customization, open data access, geographic data translators, nationwide pin mapping by address, zip code, and more, feature selection/ geographic queries, geographic analysis, GPS interface, statistics, shortest and fastest route, US and worldwide data

6. GIS START-UP CONSIDERATIONS

Desktop GIS has been coming down in price, up in features, and up in user friendliness over recent years. And in addition, many vendors are providing substantial data along with the software. In the near future we may see the interchangeability of data as well, making the choice of software less and less a function of compatibility of data. In the following sections we discuss some of the issues you will face in setting up your GIS.

6.1 SELECTING THE RIGHT SOFTWARE

The authors make no recommendation on which specific software package should be purchased and used for welfare-to-work applications. Advances in the GIS software industry are developing so rapidly that the products selected by an organization at the beginning of the implementation are out dated before the implementation is completed. Such a dynamic environment benefits the consumer by making new and effective features available at increasingly reasonable costs. But it is also frustrating to need to be constantly upgrading software. However, the intensely competitive environment for GIS software vendors assures the users that effective features available today in one package are likely to be made available in all other comparable products within a short time frame. Consequently, as long

as users select a GIS package from among the major contenders they need not be overly concerned about choosing the "wrong" software package. However, factors such as flexibility for customization, network-based software (versus a desktop solution), and the popularity of various packages should be considered. A summary of the major software products can be found in Appendix B.

For the basic display and query of the locations of recipients and places of employment, most commercially available software packages will be adequate. However, if the user wants to perform trip planning and service planning, transportation-planning functions are required. Transportation planning functions are not commonly included in all packages, but are included in the three major products (ref: MapInfo is generally considered to be one of the major GIS products available on the market. It does not, however, provide any network analysis functions that are required for trip planning and/or service planning. Future enhancements to add routing capabilities are planned.

TransCAD, ArcInfo (and ArcView), and GeoMedia. Furthermore, TransCAD and GeoMedia are capable of reading file formats of their competitors, and ESRI (maker of ArcInfo and ArcView) is likely to follow suit in the future. Therefore, compatibility with databases developed by other departments is quickly becoming a non-issue.

TransCAD, from Caliper Corporation tightly integrates a wide array of transportation planning functions, particularly transit analysis functions, with GIS functions. Planning functions such as routing a trip are already available and packaged with the TransCAD package.

If compared to other major desktop packages, TransCAD will appear considerably more expensive (approximately $10,000 vs. $1,000 - $1,500). However, it is important to recognize that many of the data development and analysis capabilities of TransCAD are not available in the other desktop packages without investing in more expensive add-ons and non-desktop products.

ArcView is the second major desktop GIS vendor. The base ArcView price is approximately $1,100, but each additional module adds another $1,000 - $1,500. Modules such as ArcLogistics, Network Analyst, and ArcRoute can be added to ArcView for routing or trip planning functions. With these added modules, the user will have all the tools needed to develop trip planning and service planning. However, trip planning and service planning will need to be specifically developed.

The ease of use of ArcView is an appealing feature, however, ArcView is not an ideal platform for some of the more complex data development and feature editing. Transportation functions, such as building routes, require the use of ArcInfo, the larger, more expensive non-desktop GIS software. ArcInfo may be required for initial setup of the system, and for periodic update and maintenance of the data. The ArcInfo software is considerably more expensive and requires a large investment in specialized training. In many cases public agencies may rely on a sister agency or a consortium to provide the data clearinghouse for data for the region. In such an arrangement, the planning agency may feel comfortable with an ArcView only choice.

The third major vendor of desktop GIS software is Intergraph with its GeoMedia product. Like the ESRI products, Intergraph relies on its larger, more expensive product, MGE, for major data development and maintenance, while marketing GeoMedia as an inexpensive, easy to use desktop platform for applications. An important feature of GeoMedia is its ability to read and display data from most major GIS and database products, without conversion. Also, like ArcView, GeoMedia requires an additional add-on product, GeoMedia Network, for implementation of transportation functions for routing, trip planning and service planning.

Regardless of the software product chosen, a program for use in addressing Welfare to Work issues will require additional programming to implement the specific application. All of the major products can be customized for specific applications.

Another option that is becoming available is the ability to develop the trip planning or service planning application in a Web-based software product. Both ESRI and Intergraph offer Internet server products. This approach will require more intensive programming and will limit the functionality to only what is programmed. However, because it is web-enabled it requires only a server license. Individual licenses for the GIS software do not need to be installed on each computer running the Welfare to Work applications.

6.2 HARDWARE NEEDS

As hardware power increases and hardware prices decrease, the selection of hardware is becoming easier and easier. Most GIS software and applications will run well on the state of the practice hardware. However, if the user is intending to run the application on old existing hardware some consideration must be given to determining the lower limit to hardware configuration.

If the user chooses to implement an Internet solution, then the hardware configuration must include an adequate computer to be used as the server, and sufficient speed on the communications hardware to support access.

An Internet solution may still reduce the overall hardware investment required, since more inexpensive workstations can be purchased. An Internet solution can also have advantages other than hardware costs, such as eliminating the need to distribute updated data to multiple sites.

Because GIS software and the necessary hardware and developing so rapidly, it is difficult to make any specific recommendations for minimum hardware requirements. Such minimum requirements would be quickly outdated. It is recommended that guidance from the specific GIS vendors be followed when making hardware investments.

6.3 STAFFING A GIS PROGRAM

The simplest GIS installation can be as simple as a single PC with one of the desktop GIS packages installed and data available free from federal and state agencies loaded. In this

configuration a user would work with consultants and/or service providers to specify and develop applications specific to their needs. An organization may have as few as one GIS user with basic training in the use of the GIS software and the specific application provided. This configuration would require periodic maintenance of data to be provided by an outside vendor. Extensive dedicated staff with substantial training would not be required.

The most comprehensive GIS program will involve a more sophisticated GIS software package, to allow for data update and maintenance and applications development. Typically, the most comprehensive GIS installation consists of an integrated network with a client server configuration. There would be a variety of GIS users and staff. Staff for this comprehensive configuration would require at a minimum a system administrator, a data manager, and an applications developer. Depending on the size of the installation, there may be many systems analysts and programmers working on applications, assisting users with training, and updating and maintaining the database. Usually these larger GIS installations supplement their GIS software with a third party database management software package, integrated with the GIS software.

Because GIS is operating in a very dynamic environment, with changes in software capabilities, hardware capabilities and increasing awareness of GIS in the workplace, organizations typically will start with a small GIS installation and develop the staff expertise over time and as the number of applications and users grow.

Making a Commitment to GIS

The successful GIS installation requires that the organization make a commitment to the development of GIS data and applications. Without a commitment to GIS, an organization can install a basic desktop application such as a trip planner, and never use the GIS beyond the specific application. However, in order to gain the full advantage of the purchase of hardware, software, data and applications development, an organization should plan for and implement a staffed, fully functioning GIS program.

Most successful installations began the implementation of GIS with a needs assessment and implementation plan. The needs assessment process involves working with all departments and agencies that have an interest in using GIS to define their needs and assess the availability of data and applications. An implementation plan will be a fiscally constrained guide to the staged implementation of hardware, software, data, applications, and staff.

The needs assessment process not only results in an understanding of what is needed but also serves as a vehicle for building a commitment to GIS among the various departments. As applications are discussed, the participants in the needs assessment begin to see the value to themselves of the GIS. It is important to foster this commitment throughout the implementation. One way to support this commitment is to plan the implementation to allow for early installation of significant applications, allowing the organization to reap some of the benefits of the GIS installation early. Demonstrations and pilot studies are other tools that can be used to build an organization's commitment.

Dedicated Staff

As noted above, GIS staffing needs will vary widely depending upon the size of the system installed. In the most basic installation, dedicated GIS staff is not required. However, without dedicated GIS staff the organization will need to rely on outside vendors for periodic data updates, applications enhancements, and servicing.

In the larger installations it may be necessary to dedicate full time staff to system administration, database management, applications development and support.

It may be possible to integrate GIS with other parts of the organization, through the IT Department. The IT department may even have experience working with a network-based GIS. For example, another department may have collected detailed road and employment information, and may be using a network-based system to access this data. Users interested in creating a welfare-related application may be able to tap into the existing information, arrange for additional welfare-related data to be structured and stored, and, with the help of existing staff, complete the project using an existing network-based (compared to a desktop) solution. If an existing network-based GIS option exists, it would be worth considering before a desktop GIS is selected.

Internal Structure

Regardless of the size and organization of the GIS, it is important to allow users the opportunity to explore the capabilities of GIS at all levels of expertise. GIS is still somewhat new as a tool and requires the users to think differently about how they accomplish their objectives. Sometimes staff will discover more effective ways of accomplishing a task by using GIS rather then older methods.

A rigid internal structure is one in which all data is restricted and GIS functionality is limited to specifically developed programs. Users are unable to access the variety of features that each software package makes available, and are prohibited from making copies of the data for experimentation. A flexible system will require safeguards against corrupting data and software, but will allow users at all levels of sophistication to copy data or ad-hoc experimentation.

A successful integration of GIS into an organization will involve the full integration of the maintenance of GIS features data (for example, locations of bus stops) with other data collection and maintenance activities.

Where to Get Assistance

There are many sources of information about the uses of and implementation of GIS at all levels of expertise. The Web provides an almost overwhelming amount of information about GIS, data standards, data sources and applications. Because GIS is a computer-based technology, most of the resources for assistance make use of computer-based information dissemination and can be found on the Internet.

Many states have developed centralized GIS organizations, targeted at sharing data across towns, regions and agencies, and providing a resource to assist state organizations make effective use of GIS. In addition, at the federal level there are organizations primarily

focused on standards and data development. These organizations also provide information that is useful in evaluating and implementing a GIS.

There are a substantial number of professional organizations that are providing information about GIS. Many of these organizations sponsor monthly meetings for an exchange of information about GIS. In addition some of them sponsor conferences aimed at supporting GIS users at all levels of expertise.

Academic GIS programs have evolved in many colleges and universities across the country, and provide an important source of both training as well as system applications. Finally, GIS software vendors and consultants can provide information about the capabilities of various GIS systems. GIS consultants are experienced at performing needs assessments, which is the first step in determining how to meet your immediate GIS needs.

6.4 GETTING BASELINE DATA

It is likely that the biggest expense in setting up your GIS will be found in local data development, and maintenance.

Many of the GIS vendors are making a substantial amount of baseline data available with the software. Often this includes large-scale data sets of roads, waterways, state and county boundaries and point locations for cities and towns.

More and more baseline data is becoming available through federal and state GIS programs. For example the Federal Transit Administration (FTA) GIS database, compiled by the Geo-Graphics Lab at Bridgewater State College, contains geographic features data for all the transit routes in the country's 550 transit properties. The data is free and downloadable from the Geo-Graphics Lab Web site at http://geolab.bridgew.edu/home. In addition, other nationwide transportation data, including highways, airports, navigable waterways, intermodal sites and rail lines, can be downloaded from the Bureau of Transportation Statistics (BTS) web site at http://www.bts.gov/gis/ntatlas/networks.html. This data is available in ASCII text file formats and can be translated to other popular GIS software formats using the BTS Viewer program, also available for download from the BTS web site.

Regardless of the availability of freely available data, an organization implementing a Welfare-To-Work application will find that additional local data, both features and attributes, will need to be incorporated into the application. Such data might include geocoded locations of employers, new streets built since the most recent street database, forecasted travel times, and childcare resources. The gathering and structuring of this data should be planned with an understanding of the database maintenance issues. The next chapter provides information about the common types of data that will be needed to develop GIS for welfare to work transportation planning and service delivery applications.

Maintaining Data Integrity

One of the most difficult aspects of implementing and operating a GIS is maintaining currency and accuracy of the data; both features and attributes. Just as the world around us is

constantly changing, the data, which describes the world, must change. New roads are built, rivers flood and change shape, towns annex property and change their limits, welfare recipients and employers move, and transit lines change to reflect the changing demographics of a city. Additionally, attribute data changes. Headways on bus lines change, employers change their product line and therefore have different labor needs, and welfare recipients' children grow older and require different schooling and daycare options.

It is important that in this dynamic environment a GIS is maintained with good version control, metadata and verification. It is important for example that you not have the transit service provider changing the route of a bus on one version of the data while the scheduler is changing headways on another version of the data.

In many areas of the country, local, regional and state GIS users are coordinating their efforts and orchestrating shared data and data management. This approach is ideal because it allows the users that know their geographic data better than anyone else to update their own data. At the same time the user can depend on other participants to maintain the currency and integrity of the data that they contribute.

In the absence of this cooperative environment, an agency should develop a procedure for updating data, which assures the user that he/she is working with the most recent, clean and accurate data.

6.5 INTERAGENCY COOPERATION

As described in Chapter 5 of this handbook, setting up welfare to work GIS will involve getting and maintaining data from a variety of agencies. Information about existing transportation services will need to be obtained from transit providers or planning agencies. Information about welfare recipients will need to be obtained from state or county welfare agencies. Employer/employment information, childcare and other support service information will also need to be gathered from other sources. Maintaining accurate and up-to-date information from all of these sources can be a daunting task. The task of data collection and maintenance can be made easier if the GIS system is developed in a cooperative way by all agencies that are likely to benefit from the effort.

Interagency coordination can also be useful in developing standards for data development. This might include developing standards for common projections that are used in developing spatial data. Interagency coordination can also ensure that all agencies involved in implementing welfare reform initiatives benefit from the GIS applications and data that is eventually developed. Information can be used not only for transportation planning and service delivery, but job placement, identification of needed support services, recruitment by employers, or in decisions about where best to locate services or jobs.

Some good examples of this type of interagency cooperation are described below.

Interagency GIS Efforts in New Jersey

In 1997, the New Jersey Department of Transportation and the New Jersey Department of Human Services co-sponsored a Transportation Summit for human service professionals, transportation professionals and workforce/economic development professionals. Work begun at the summit continued as a statewide effort to develop coordinated transportation plans for each county that aimed to remove barriers that prevent welfare clients from getting jobs by recognizing the interrelationship of transit service and various support services. GIS databases of transit and supporting services such as day care, shopping, banking, and employment locations, as well as other demographic characteristics, were used extensively throughout the design of all countywide transportation plans. Since the plans were created as part of a coordinated statewide effort, all of the GIS databases that were collected from various state, county and local agencies were maintained in one central location. At project completion, all of the databases were turned over to a central GIS contact person at New Jersey Transit, who now, upon request, provides these GIS data and maps to various state and county agencies. NJ Transit continues to add additional geographic databases to the state's geographic "library".

Southern California Council of Governments

The TranStar trip planner is utilized throughout the Southern California area and is operated under the management of SCAG. In Los Angeles, TranStar is used by five transit agencies, over 80 employers with rideshare programs, and a growing number of welfare-to-work centers to produce real-time transit itineraries. SCAG's rideshare services include telephone ride matching that includes transit itineraries. The Internet services currently account for 2,500 user accesses per day.

As with any system that incorporates data received from multiple agencies, data entry, standardization and on-going file maintenance can be a challenge. In the Los Angeles service area, several carriers enter and maintain their own route, schedule and fare data, but the majority of transit-related data is entered, maintained, and quality-assured by SCAG. TranStar supports on-line, real-time entry of transit data, placing it into production immediately upon certification of its correctness. Data can also be loaded for multiple route patterns in batch mode.

SCAG maintains the geographic databases as well as a group of technical support staff to train users of TranStar. SCAG also maintains the computer-operating environment for TranStar in-house, performs software upgrades, data backups, systems administration, etc. Chapter 8 further discusses the different levels of GIS-based trip planners. For more information on the TranStar trip planner, see Chapter 8 and Appendix D.

Statewide GIS development in New York

- Partnerships are needed to share in the creation and coordinated use of GIS data sets between governments and private entities at all levels. To achieve this purpose, the State of New York has implemented a NYS GIS Coordination Program, an innovative model for data sharing and partnerships (source: Source: GIS Coordinating in NY State: Center for Technology in Government, October 1998.)

The program helped address some of the issues pertinent to a GIS coordination effort, such as:

- Lack of awareness of existing data sets
- Lack of or inadequate metadata
- Lack of uniform policies on access, cost recovery, revenue generation, and pricing
- Lack of uniform policies on data ownership, maintenance and liability
- Lack of incentives, tools, and guidelines for sharing

Furthermore, the New York State GIS Clearinghouse was created and established on the World Wide Web (http://www.nysl.nysed.gov/gis/) by the New York State Library. It includes a metadata repository describing GIS data sets held by many different organizations as well as information about how to obtain the data. It also has extensive information about New York's GIS Data Sharing Coordination Program, information on and links to GIS education and training opportunities, other state and federal GIS resources, GIS user groups throughout New York, and GIS-related listservs. In addition, members of the Cooperative can have direct access to selected data sets from the Department of Transportation (DOT), the Office of Real Property Services (ORPS) and the Adirondack Park Agency (APA). Recently, Cornell University created a linked companion data repository to house information from a variety of agencies too small to set up their own repositories.

7. DATA ANALYSIS FOR WELFARE TO WORK GIS APPLICATIONS

In order to undertake GIS-based transportation service planning or service delivery, information about current transportation systems, recipients, job opportunities, and other key services must first be obtained and mapped. Some basic geographic databases about the area to be served will also be needed. Demographic information about the service area also might be useful. Different steps for analyzing the GIS application is narrated as follows:

7.1 DATA COLLECTION

The data used in this study are obtained from the GIS Lab at FIU: Dade County Public Access Data, FIU: The Metropolitan Center and LCTR (Lehman Center for Transportation Research), FDOLES (Florida Department of Labor and Employment Security, and Florida Department of Children & Families.

The first step in this project was to download some of the available data from the web. For example, the following files for Miami Dade County were downloaded from the web: road network file, bus route file, and the bus stop file. After the data was downloaded, it was converted from the ARC/INFO format to Arc View shape files. This was done using Arc View's Import71. The basic shape files were then brought into Arc View using add theme. These imported shape files were used to form a "base map".

The following is a listing of the data used in this project.

Data Used	*Source*	*Format*	*Content*
Bus stops in Miami Dade County	GIS lab at FIU	ARC/INFO	*lbusstop* file
Bus routes in Miami Dade County	GIS lab at FIU	ARC/INFO	*lbusroute* file
Miami Dade County street network	GIS lab at FIU	ARC/INFO	*adade* file
Boundaries of census block areas in Miami Dade County	GIS lab at FIU	ARC/INFO	*d_blkgrp* file
Script	GIS lab at FIU:	Arc View	***calcarea***
Wages Customers in Miami Dade County	Florida Department of Children & Families	Excel file	Number of WAGES customers per census blocks
Employment centers' characteristics	OSHA Occupational Safety & Health Administration U.S. Department of Labor	Hard copy of SIC codes and characteristics	Listing of SIC codes and characteristics
Employment centers	Florida Department of Labor and Employment Security	Florida Micro-OIS Version 3.0	Employment centers information
Employment centers	Institute of Government, FIU Metropolitan Center	Excel file	Employment Centers etc.

7.2 DATA BASES

The large data base file that we received from the FIU Metropolitan Center was in a Microsoft Access database. This file was converted and brought into Arc View using the SQL Connect function in Arc View. A section of this table is found in *Appendix B, Table 1.* The spread sheet in Excel format that we received from the Department of Children and Families was used in order to create a database of the number of WAGES customers per census block in Miami Dade County. This database was created in Arc View. A copy of the format of this table can be found in *Appendix B, Table 2.* Another database was created in Microsoft Excel for the number of employment centers and number of jobs per census block. This database was then converted into a Microsoft Access database and brought into Arc View using the SQL Connect function. This table can be found in *Appendix B, Table 3.* Also, another database was created in Microsoft Excel with the characteristics of the jobs by SIC code to become a "look up" table. This database was then converted into a Microsoft Access database from Excel and brought into Arc View using the SQL Connect function. The table is displayed in *Appendix B, Table 4.* A copy of the complete table is also included in *Appendix D.*

7.3 INITIAL ANALYSIS OF TRANSIT SYSTEM

The Miami-Dade transportation system is inter-modal: buses, light train and metro mover. The light train and metro mover link Okeechobee to South Miami through the Downtown

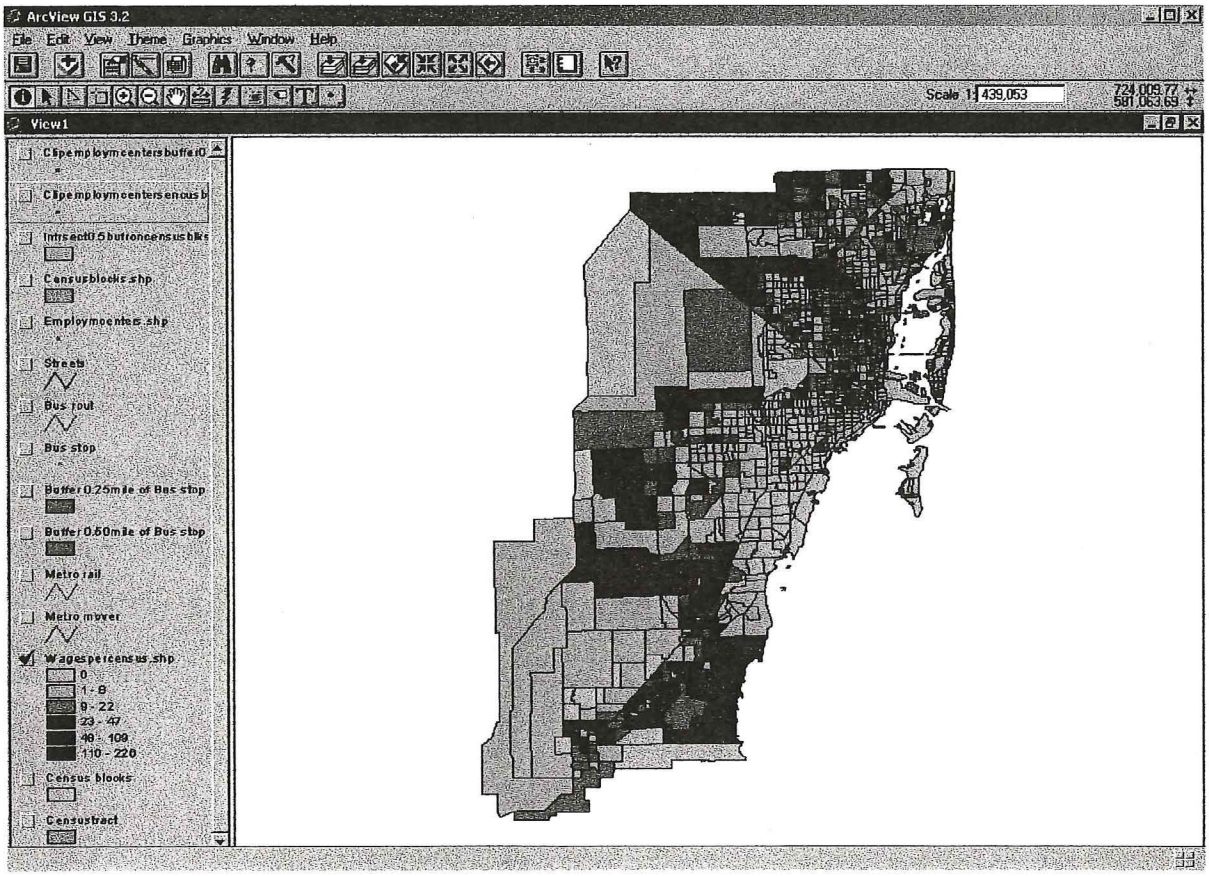
area and the former only serves the Downtown loop. They are not very helpful in moving people from diverse area in South Florida to the major job centers.

The first overlay was created using the themes: census block, metro rail, metro-mover, and bus themes. Analyzing this map, we realized that the bus routes are present at most if not all locations where there are metro rail and metro mover routes. Therefore, we decided to limit our analysis to the bus system in Miami Dade County since its system covers the areas served by mass transit in the County. A map was produced using an overlay of the census block, bus routes and bus stops. This map can be found in *Appendix A, Layout #2.*

7.4 INITIAL ANALYSIS OF WAGES CUSTOMERS

The welfare people are scattered all over the County. Because of the privacy issue, we were not able to obtain their direct location. We obtained a spreadsheet file of their location by census block and then database for the WAGES clients was created in Arc View *Appendix B, Table 2.* Now, the WAGES customers were in a database including the number of WAGES customers per census block. This table was joined with the table for the census block shape file. The new joined table was converted into a shape file and the WAGES customers were displayed using graduated color showing the distribution of WAGES customers in the county. This map is presented below (Figure 1) and can be found in *Appendix A, Layout #1.*

Figure 1



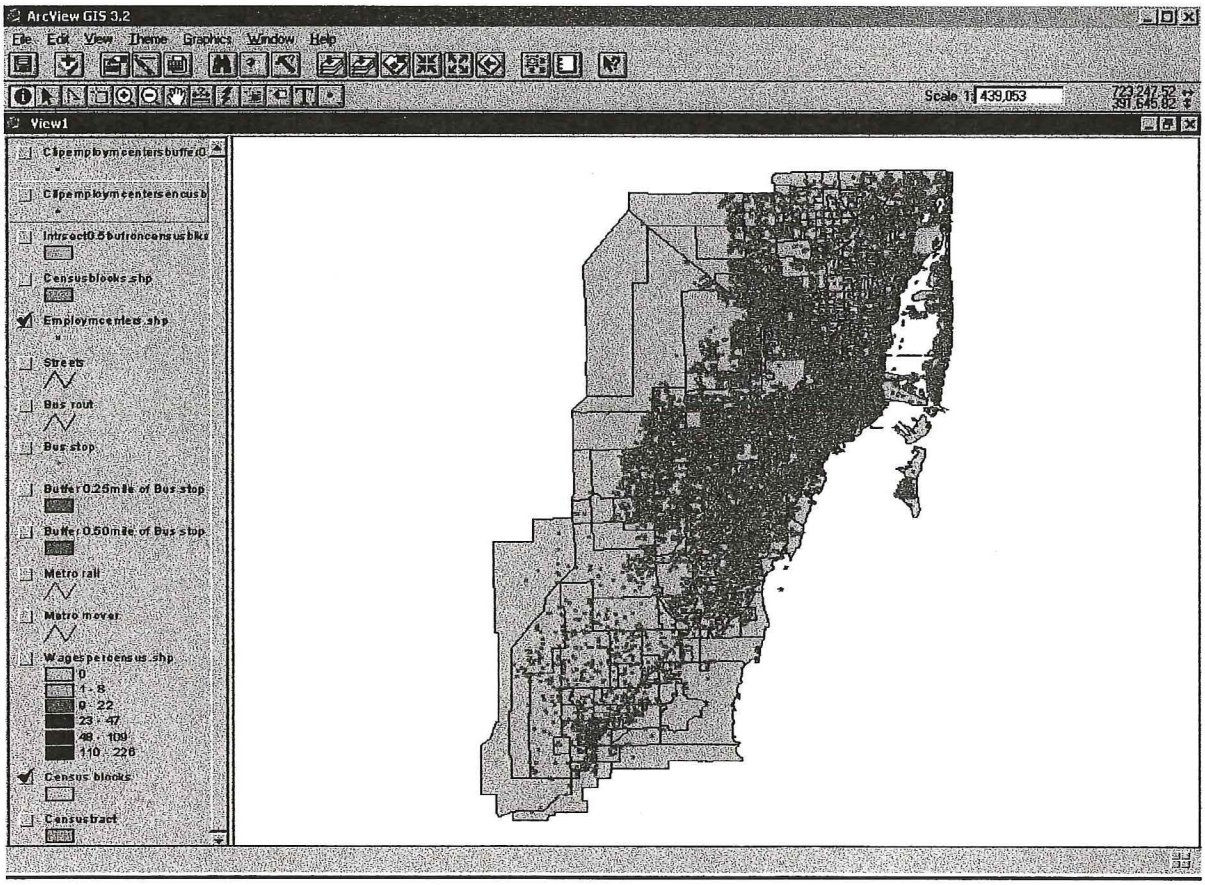
7.5 INITIAL ANALYSIS OF EMPLOYMENT CENTERS

The lack of high technical skills of the wages clients may seriously hamper their chances to join certain industries. But, our first task consisted of identifying all the job centers in Dade-County, which were narrowed down to the entry-level jobs more suitable for the WAGES recipients.

From Florida Micro-OIS CD-ROM data fifty-three (53) occupations were identified that require minimal skill and training, it was found that in 1994 these occupations absorb 28% of the country's employment (263,000 workers). In this project, we were mainly concerned with entry-level jobs as defined by the Florida Department of Labor and Employment Security.

We had complete addresses for many but not all of the entry-level employment centers in the County. For the sake of locating the employment centers, we initially decided to address match as many addresses of the employment centers as possible. The shape file used to address match the employment centers was the *adade* shape file, which contains the street network of Miami Dade County. We were able to successfully address match about 50,000 of the employment centers in Dade County. After some minor adjustments of "% accuracy", we were able to geocode some additional addresses and the final number of addresses geocoded were 56,424. The map showing these address matched employment centers is displayed below (Figure 2) and attached in *Appendix A, Layout #3.*

Figure 2



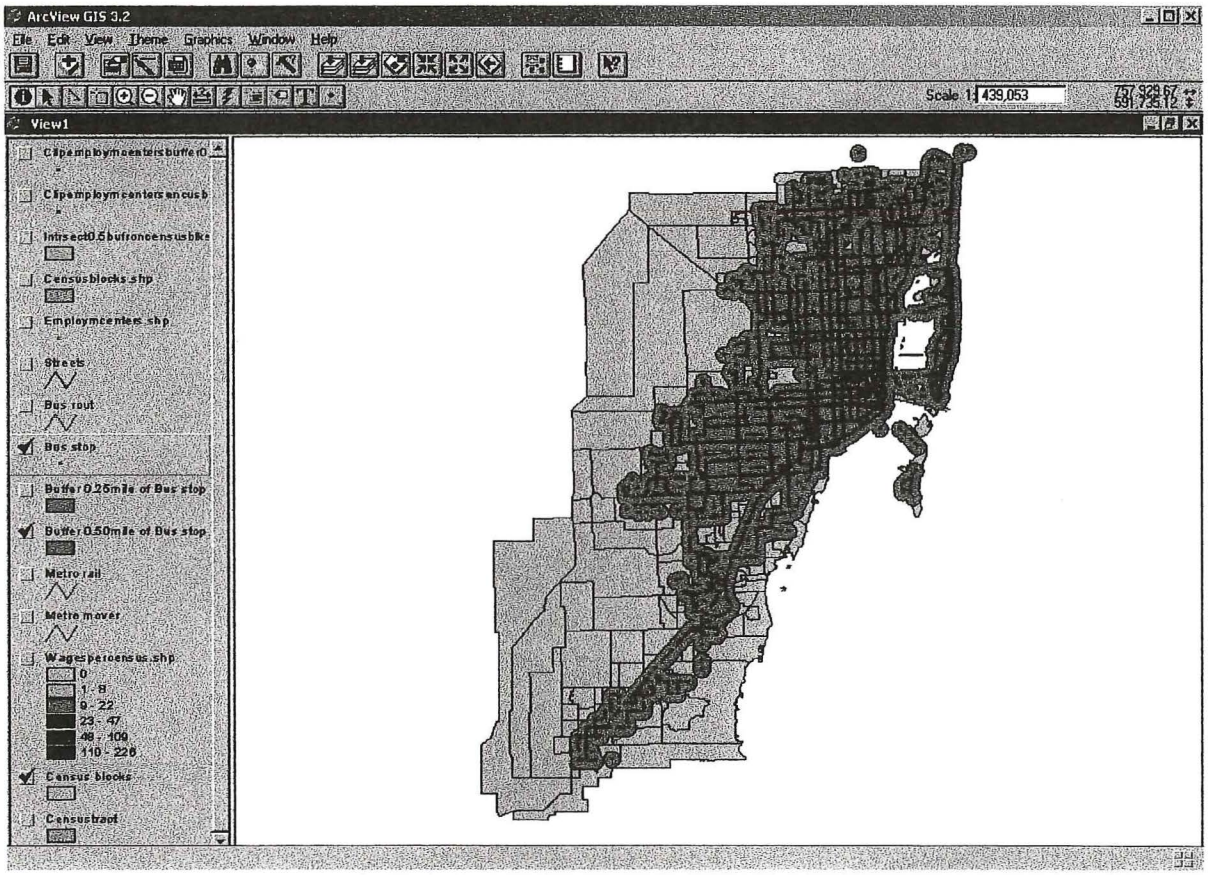
7.6 FURTHER ANALYSIS OF TRANSIT SYSTEM-BUFFERING

There are 11,691 bus stops in the Miami-Dade transit system that cover 75 routes over 1066 census blocks in Miami-Dade county We decided to stem our analysis around the bus stops in order to do an accessibility study for the WAGES customers as well as the employment centers with respect to the bus stops. This would provide us with means of concluding what areas of the census block that were sufficiently served by the bus system in Dade County.

According to the Institute of Transportation Engineers Handbook (ITE), the average person walks at a rate of 4 feet per second, at this rate a person will cover a quarter-mile (1320') block in just under six minutes and the half-mile (2640') distance in twice that time. We concluded that these were reasonable to expect people to walk in order to get to a bus stop distances

This study performed a buffer analysis where the bus stops were buffered in two rings: one ring of a quarter mile radius and the other one of a half-mile radius. This gave us further means of visualizing the areas that have "acceptable" accessibility to the bus system in Dade County. The coverage of the buffered bus stops is displayed below (Figure 3) and in *Appendix A, Layout #4.*

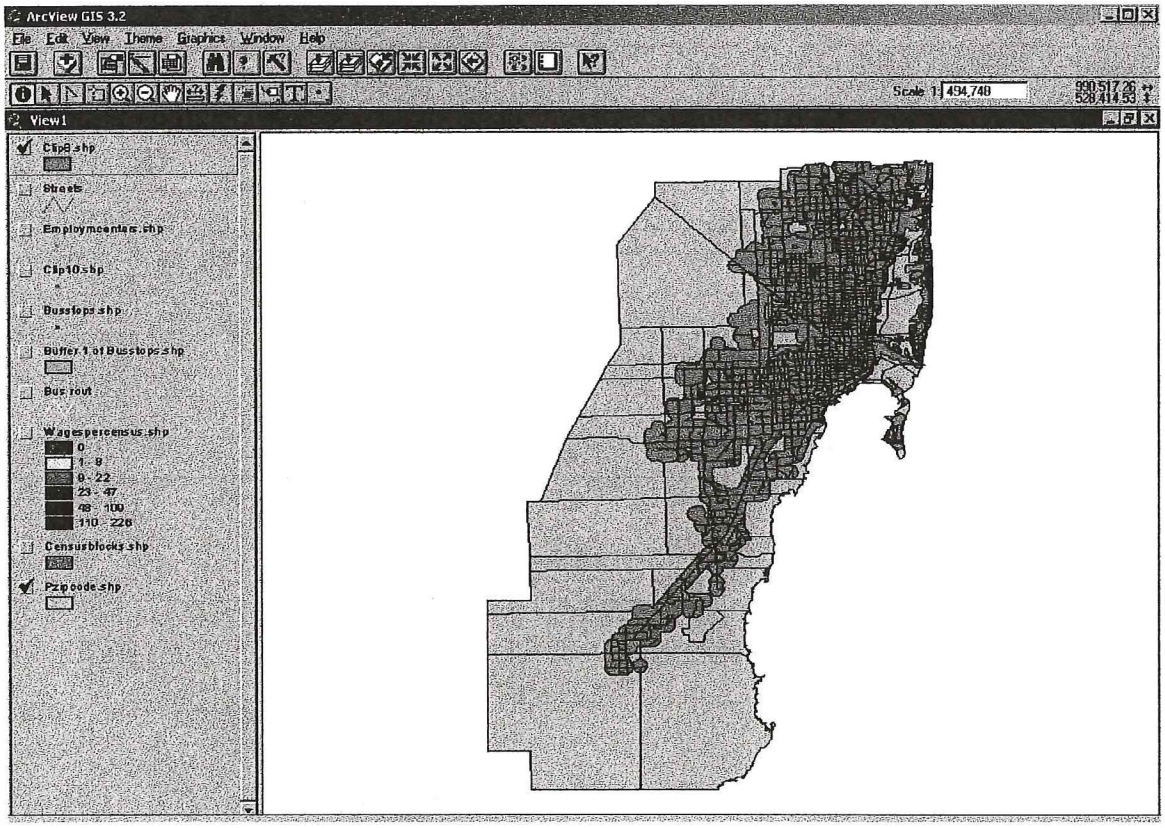
Figure 3



7.7 CLIPPING OF THEMES (*IN CASE IF WAGES CLIENTS*)

The buffer analysis provided us with visual means of analyzing the areas of interest, but we also needed some real data and characteristics of the buffered zones with respect to the census block areas. The geo-processing method of *Clipping* was used in order to extract the features of the clipped themes of the (buffer of bus stops and the census blocks). The resulting map can be viewed below (Figure 4) and in *Appendix A, Layout #5.*

Figure 4



7.8 ANALYSIS USING SCRIPT (*IN CAES OF WAGES CLIENTS*)

With the aim of taking the spatial analysis further, we decided to use the script: *calcarea* in order to get an exact area clipped within each one of the census blocks. This script was obtained from scripts available in FIU GIS lab. The new areas retrieved by running the script for the clip constituted the areas covered by the clip within each one of the census blocks.

7.9 SPATIAL ANALYSIS OF NUMBER OF WAGES CLIENTS SERVED

After running the script to get the area covered by the "bus stop zones", we came up with a way to find a relationship between the area covered by the clip and the number of WAGES customers served by the transit system. This type of analysis includes one major assumption: the WAGES customers are uniformly distributed in within each one of the census blocks, which may not necessarily be the case for many areas. But, due to the limitations of this

project, we thought that this could serve as a mean of analyzing the areas. We renamed the "new areas" found within the clip (by running the script) to New Area and used the following formula to find the number of WAGES customers served:

[New Area/Total Area] × Num = NumServ

Where:	**New Area:**	actual area covered by clip within census block
	Total Area:	total area of each census block, and
	Num:	number of WAGES clients within each census block
	NumServ:	number of WAGES clients served within each census block

Moreover, a percentage served was calculated as follows:

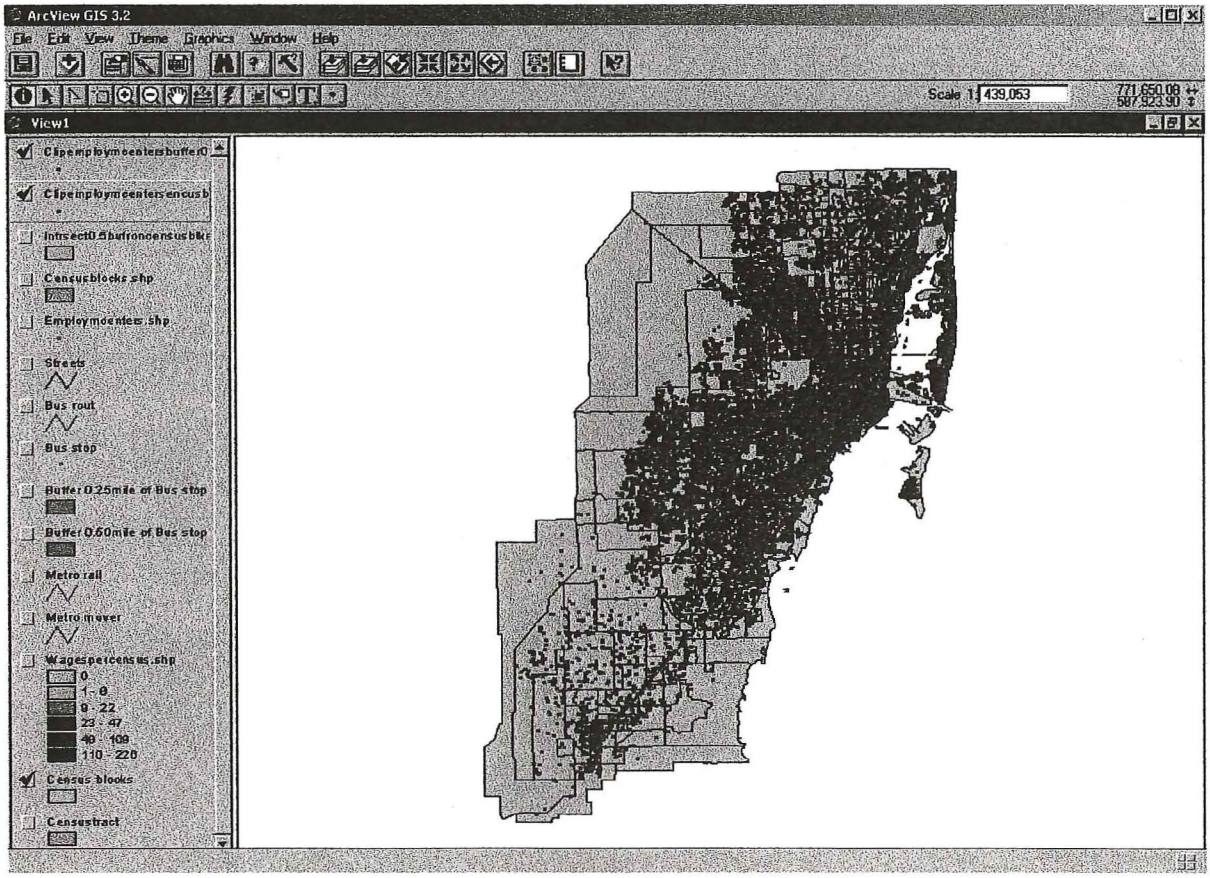
[NumServ /Num] × 100 = PerServ

Where:	**PerServ:**	percentage served WAGES clients within each census block

7.10 CLIPPING OF THEMES (*IN CASE OF EMPLOYMENT CENTERS*)

The geo-processing method of *Clipping* was used again in order to extract the features of the clipped themes: employment centers and bus stops buffer. The total number of employment centers in each case was recorded for analysis and comparison with the total number of centers. The resulting map can be viewed below (Figure 5) and in *Appendix A, Layout #6.*

Figure 5



8. ANALYSIS AND RESULTS

Statistics was used as a tool all through the analysis process but we found it especially useful in these final analysis steps in order to get information about the different attributes in the tables. We used the dissolved boundaries buffer analysis in order to eliminate the overlapping and the repetitions in the resulting values.

We found out that there are 11,469 WAGES recipients in Miami-Dade county, however, only 10,120 recipients are served by the 0.5 mile buffer(s) of bus stops. This is about 88% of the total WAGES recipients population in Miami-Dade county. Further analysis shows that out of total 1066 census blocks in Miami-Dade county only 33 blocks that are not covered by the 0.5 mile buffer area(s). The percentage of coverage in this case is about 97. The 33 non-covered census blocks are mostly of fewer WAGES populations, and located in the western and southern areas of Miami-Dade county.

The analysis table resulting is displayed below in Table 4.

Table 4

Attributes of Clip0.5bufroncensusblks.shp

FID_cens	Area	NewArea	# of wages	# Served	% Served
1031	572616.688	572616.697	9	9	100
1031	34730.645	34730.645	9	9	100
1031	82905736.000	345231.221	9	0	0
1031	82905736.000	682836.794	9	0	0
1031	82905736.000	1414.069	9	0	0
1031	82905736.000	67557030.429	9	7	78
1032	7846310.500	7846310.521	6	6	100
1032	5198064.000	55749.511	6	0	0
1032	980572.438	980572.412	6	6	100
1032	5198064.000	2739354.341	6	3	50
1033	7440830.500	7440830.402	21	21	100
1041	59229588.000	55999419.911	1	1	100
1042	941270.188	941270.176	0	0	
1043	3102308.500	3102308.404	0	0	
1051	18409082.000	17827856.788	2	2	100
1051	340713.875	650.733	2	0	0
1051	64202.129	64202.129	2	2	100
1051	244063.875	2113.378	2	0	0
1051	244063.875	189385.786	2	2	100
1051	970201.250	970201.271	2	2	100
1052	5193326.000	5193326.041	0	0	
1063	18127060.000	18127060.615	1	1	100
1071	10534254.000	10534254.281	0	0	
1072	3541228.750	3541228.664	2	2	100
1073	2688550.500	2688550.438	0	0	
1079	14897698.000	14897698.461	13	13	100
1089	13093983.000	13093983.307	4	4	100

The results of the analysis of the employment centers did not vary much of that of the WAGES recipients. Out of 56,424 employment centers in Miami-Dade county only 46,751 centers are covered by the 0.5 mile buffer(s) – taking into consideration the same approach used in case of WAGES recipients analysis. This is about 83% of the total employment centers in Miami-Dade county. Most of the non-covered employment centers are in the area of south west Miami-Dade county. Moreover, if we consider the jobs, we find that there are 649,539 entry-level jobs in Miami-Dade county and only 530,836 ones are served by the bus system. The percentage in this case is 82.

9. CONCLUSIONS AND RECOMMENDATIONS

Through the spatial analysis of the available variables pertaining to WAGES clients, employment centers and Transit we have cursory evidence about the performance of the WAGES Program in Miami-Dade County. The data has shown that there is a surplus of jobs. This suggests that other variables are preventing Miami-Dade County's WAGES clients from joining the job market. Perhaps, the 649,539 entry-level jobs available are not matched by the dispositions, skills or aptitudes of the 11,148 WAGES clients. This study cannot conclude that jobs remain unfilled for one reason or another, but we can state that at least 453 WAGES clients who are not within the half-mile radius of the most basic transit are motley located in south and west Miami-Dade county. We lack detailed demographic data, which are essential for a study of this nature. The same conclusion in case of the employment centers can by understood, which is more attention should be paid to south west Miami-Dade to cover the center rapidly growing in these locations.

The Geographic Information System that was developed effectively describes the available data, in a format that can be easily understood, accessed, analyzed and displayed.

How Useful was GIS in this Project?

Extremely useful; there is no other technology at this time that has the ability to perform such comprehensive spatial and data analysis while simultaneously providing plug in options throughout the process.

Explanation of their Implications and Significance

From this study it is clear that there is a need for further work in this field, and also that not enough of the available technology (GIS) is being applied to the problem of welfare administration; this means that ISTEA 1991's mandate is being under fulfilled. WAGES client's characteristics including vocation, skills, employability and willingness to work are questionable at best: since there are approximately 649,539 positions unfilled. Furthermore, when furnished with the consummate addresses for all data sets, it is conceivable that a bunch of college kids can develop a GIS (in a number of weeks) that can define and analyze – with a view to providing real solutions to - a problem that absorbs hundreds of millions of dollars and whose solution can enhance the overall quality of life in Miami-Dade County and the USA

Project Limitations

One of the main limitations of this project was not being able to access data with exact addresses of the WAGES customers. This made it quite difficult to geocode and perform a conclusive analysis. More importantly, the successful integration of WAGES customers to the job market depends of individual skills of every candidate; this data was not available either.

Possible Improvements

Improvements in the results could be obtained by getting access to complete addresses of WAGES customers. Also, more detailed information about the WAGES clients such as

demographic data, job skills and language abilities could greatly improve the results of this study.

The methodology developed for this study uses a buffer zone, instead, it would be better if we can define accessibility by walking distance. The difference is that additional land use information is used, which gives a better picture as how population is distributed. The effects of barriers can also be investigated.

FUTURE WORK

There is scope for further work in this field such as:

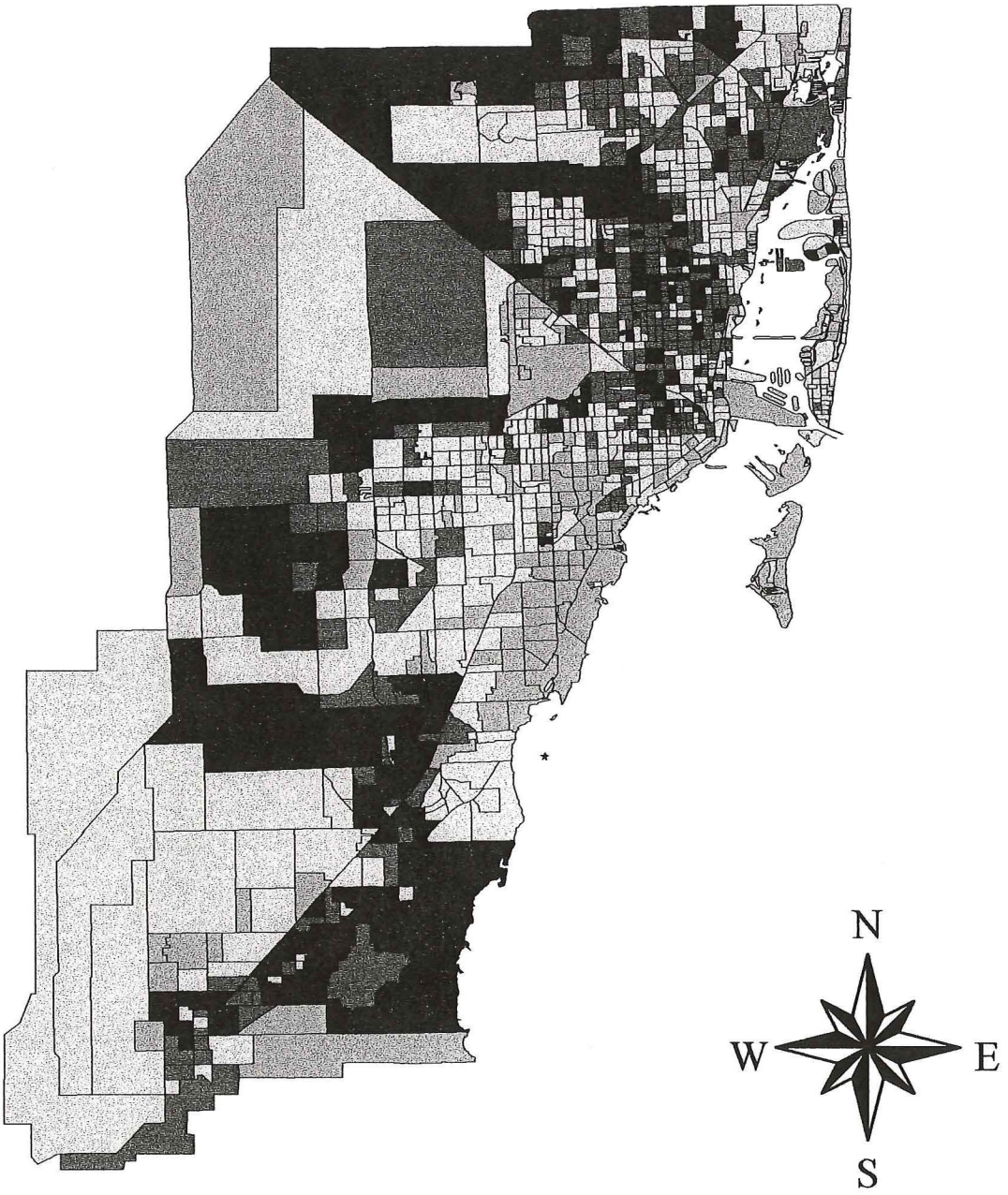
- Awareness programs for WAGES clients about Transit and Employment opportunities
- More accessible medium to relay this information to its intended audience e.g. the internet and WAGES' kiosks.

REFERENCES

- The Institute of Government Metropolitan Center at Florida International University (1998). *"The Transportation Issues and Opportunities in Miami-Dade County."* Miami, Florida.
- The Strategic Planning and Growth Management dept., the Community Service dept. and, the Employment and Training Administration at Broward County (1998). *"Broward County, Florida Regional Job Access and Reverse Commute Transportation Plan."* Fort Lauderdale, Florida.
- Jim Vandermillen (1999). "Connecting People to Work: a technical guidbook for using data anaysis and mapping as tools to develop local strategies." Community Development Training Institute, Washington, D.C.
- Annalynn Lacombe (1998). "Welfare Reform and Access to Jobs in Boston." Volpe national Transportation Systems Center, Washington, D.C.

Appendix (A)

Layout # 1
Distribution of WAGES Clients per Census Blocks

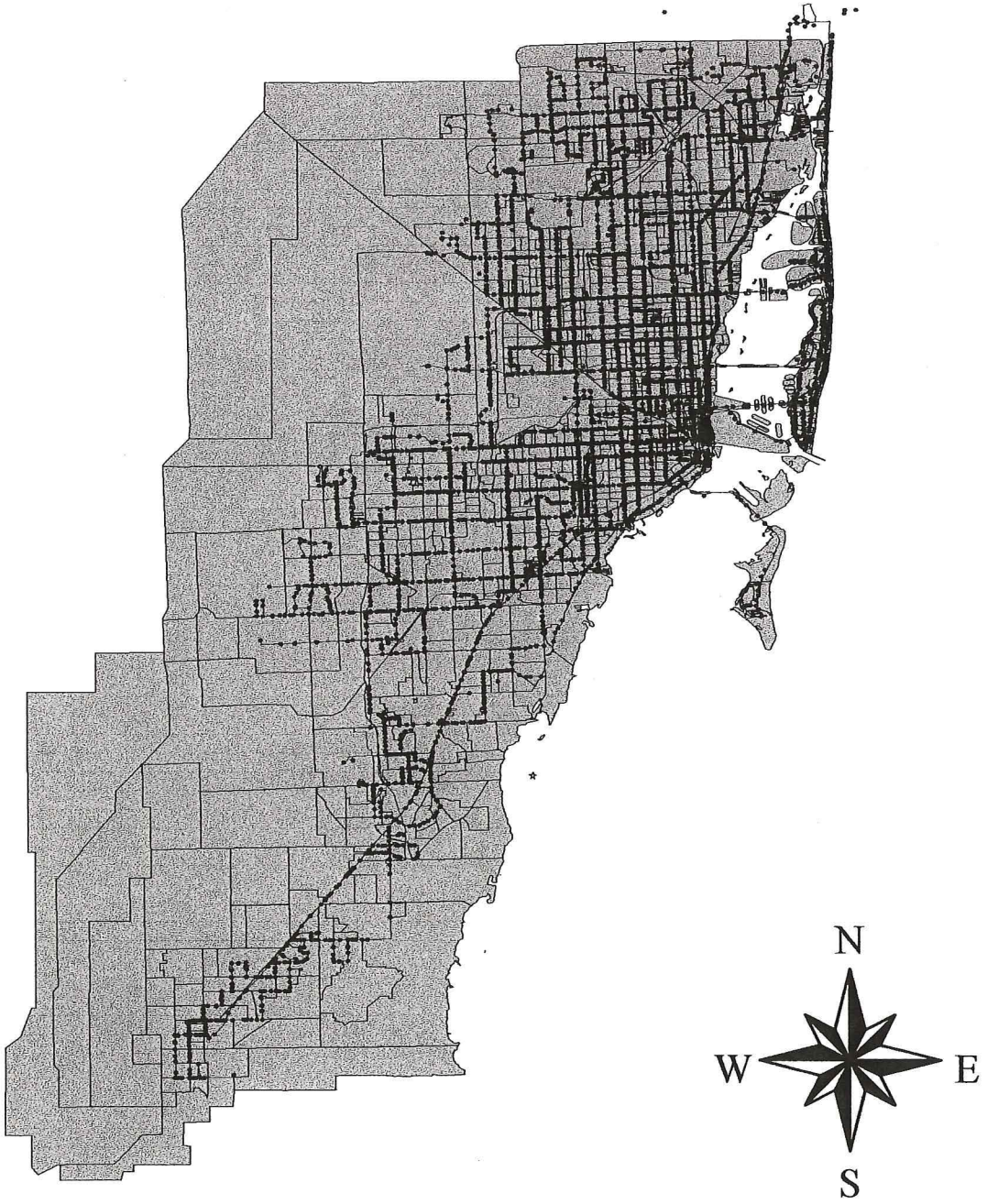


Wagespercensus.shp

- 0
- 1 - 8
- 9 - 22
- 23 - 47
- 48 - 109
- 110 - 226

9 0 9 18 Miles

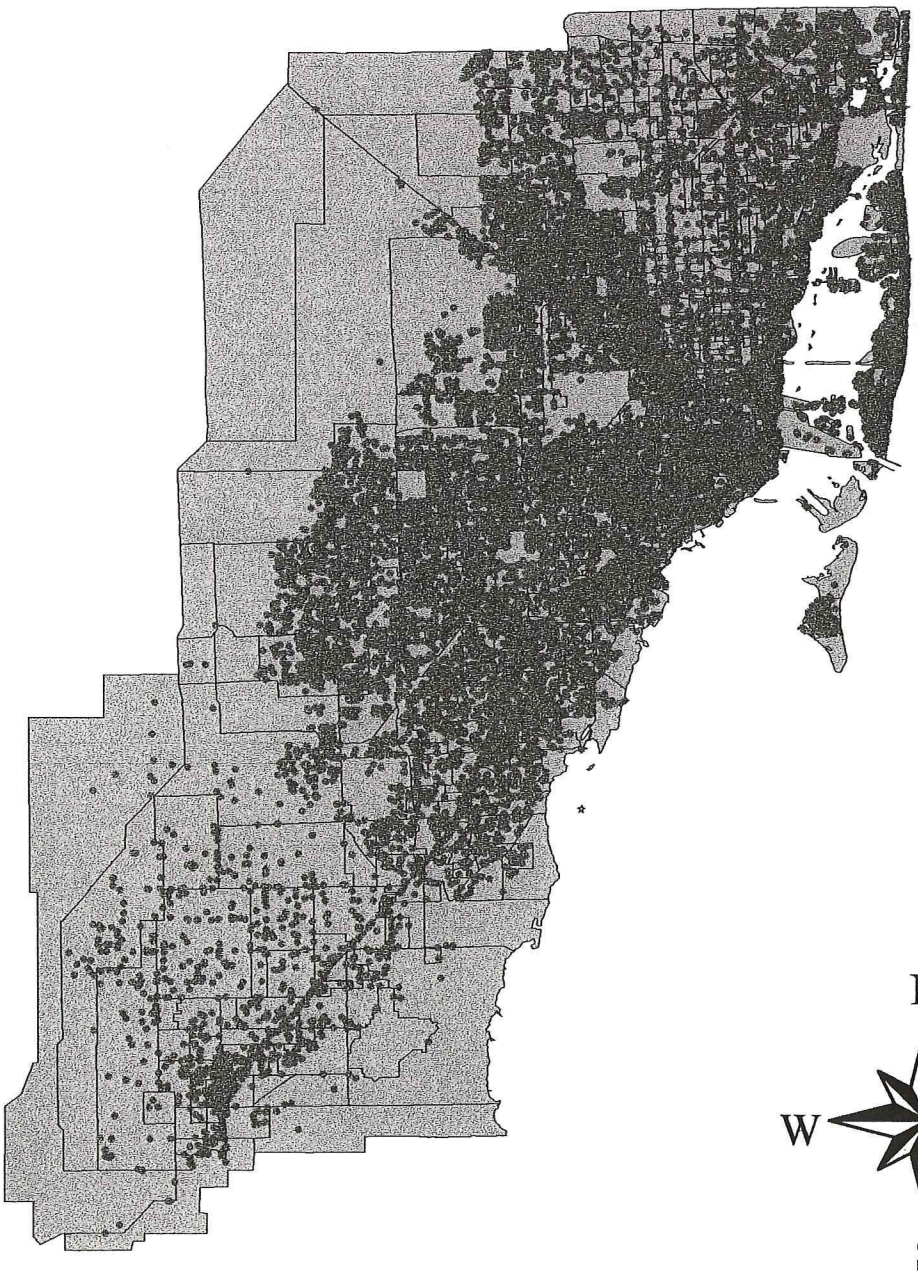
Layout # 2
Bus Routes and Bus Stops in Miami-Dade County

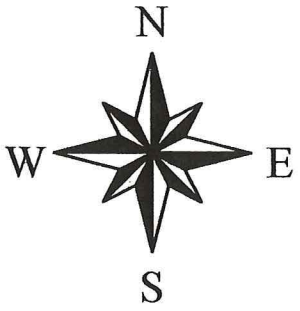


Bus rout
Bus stop
Census blocks

9 0 9 18 Miles

Layout # 3
Employment Centers in Miami-Dade County

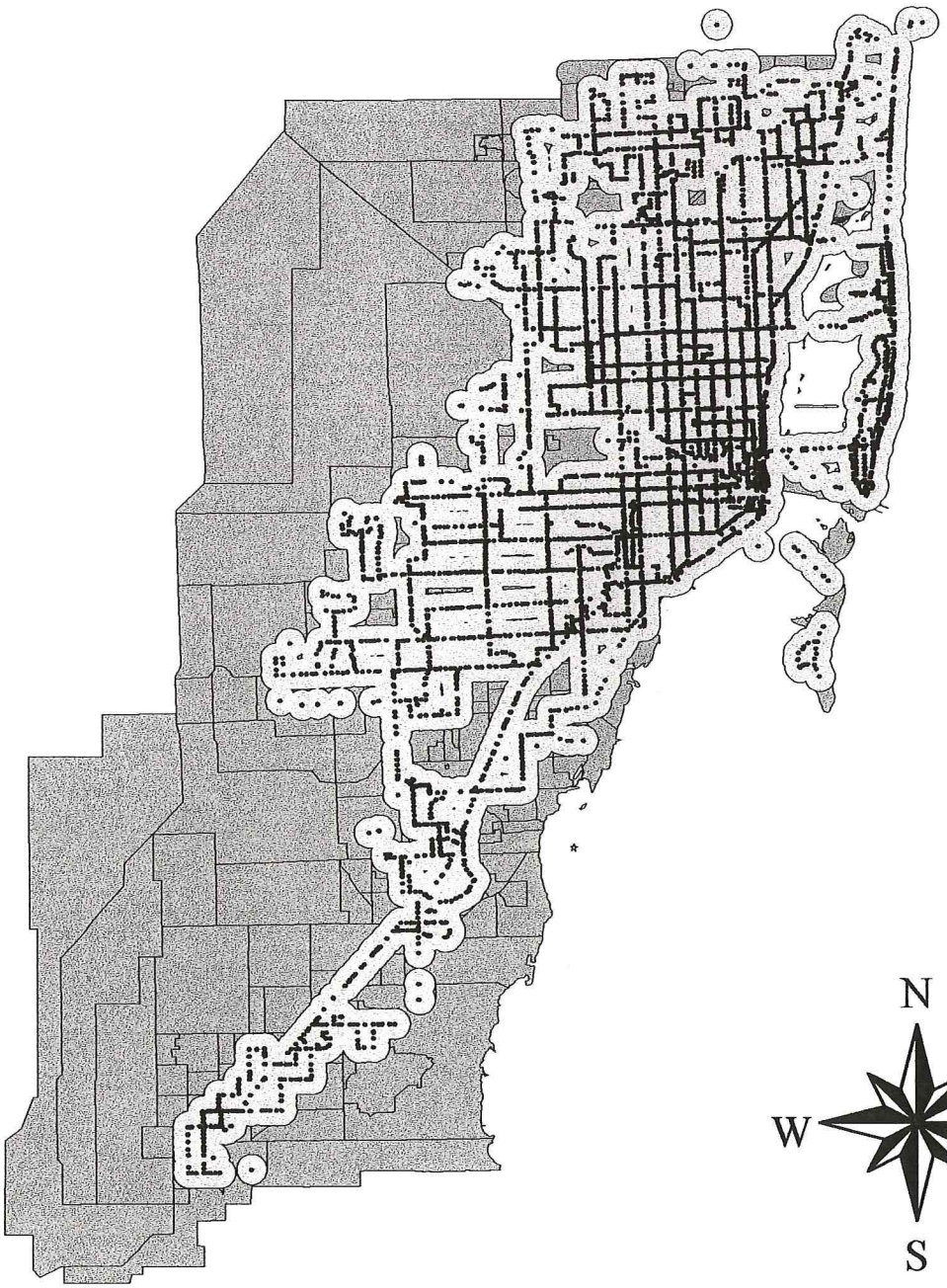




Employmcenters.shp
Census blocks

9 0 9 18 Miles

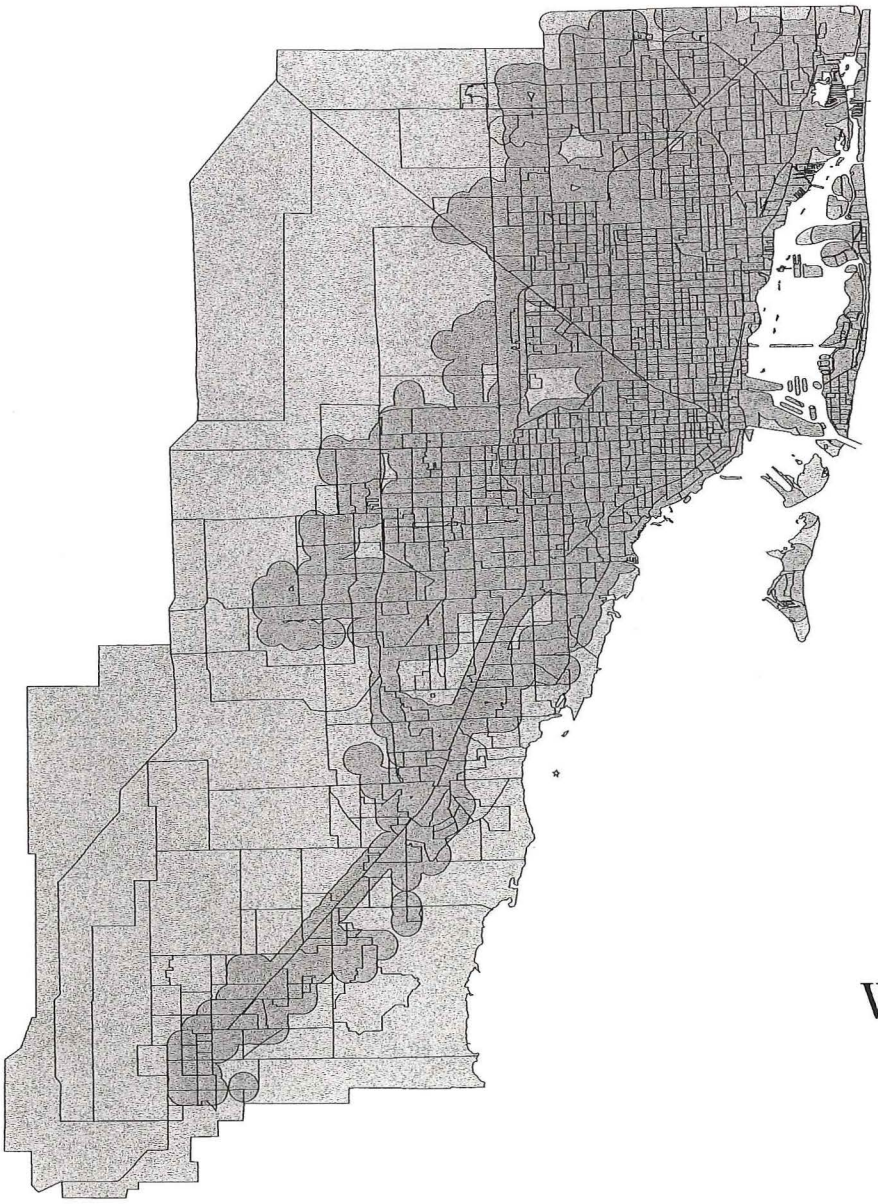
Layout # 4
Coverage of 0.5 mile Buffers of Bus Stops

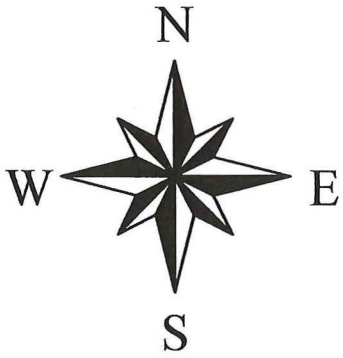


Bus stop
Buffer 0.5 mile of Bus stop
Census blocks

9 0 9 18 Miles

Layout # 5
Clip of Census Blocks with Buffer of Bus Stops

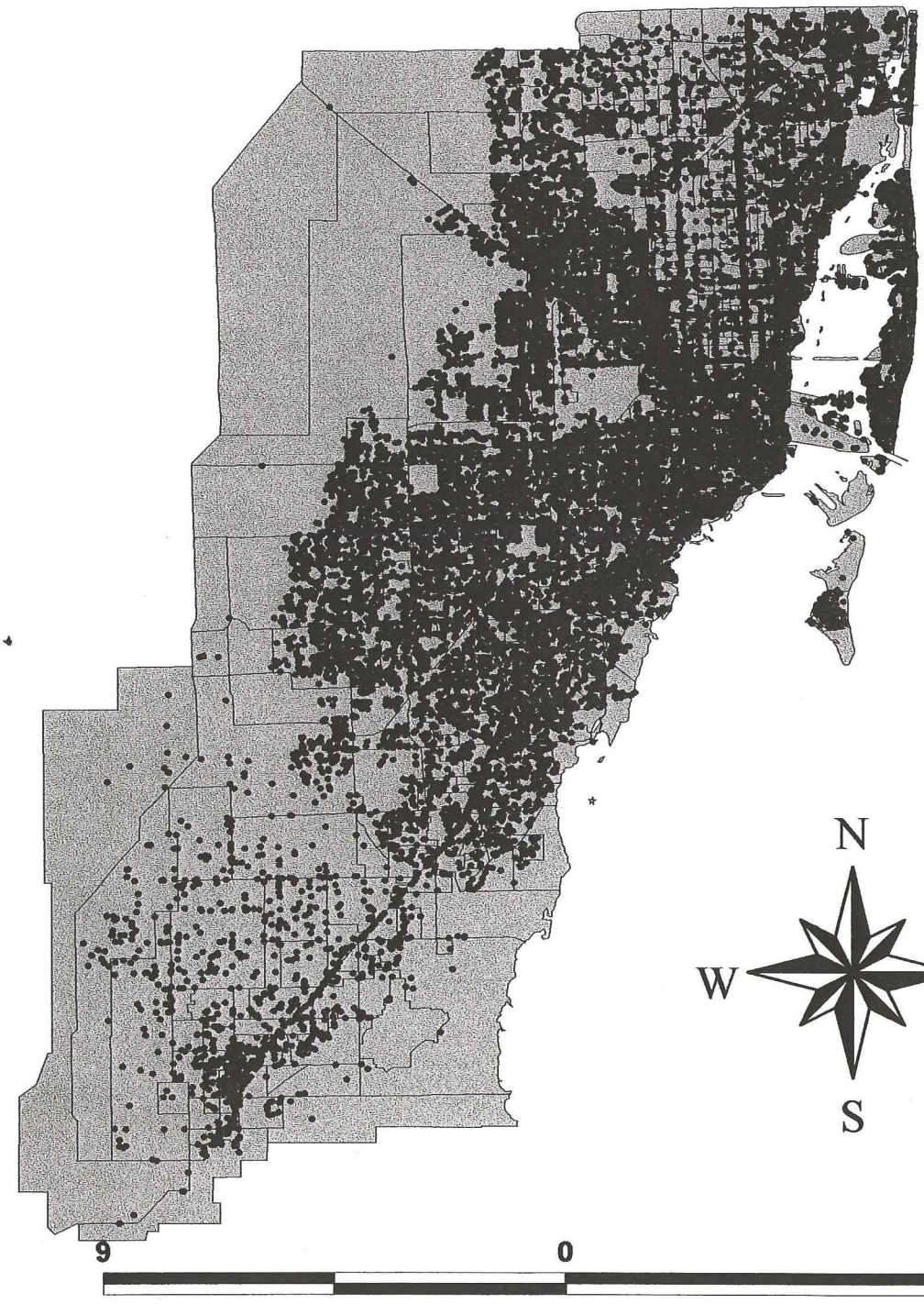




Clip8.shp
Censusblocks.shp

10 0 10 20 Mi

Layout # 6
Clip of Employment Centers with Buffer of Bus Stops Compared to Total Employment Centers



- Clip2.shp
- Employmcenters.shp
- Census blocks

BACKGROUND

In the spring of 1996, the Florida Legislature passed a major overhaul to the state's welfare system, legislation that mirrored the federal law that would pass later that year. Florida called its welfare reform program "Work And Gain Economic Self-sufficiency (WAGES)". The time clock officially started on October 1, 1996. Further legislation in 1997 provided technical changes and other amendments found necessary for meeting the needs of the WAGES Program. Florida's Welfare-To-Work Program (WAGES) is a cooperative effort among many agencies including the Department of Children and Families, the Department of Education, the Department of Labor and Employment Security, the Work And Gain Economic Self Sufficiency State Board of Directors, and the local Work And Gain Economic Self Sufficiency Coalitions. Also, an important component of the Work And Gain Economic Self Sufficiency program is the public-private partnership with Florida's business community.

The goal of the WAGES Program is to emphasize work, self-sufficiency, and personal responsibility. The program strives to meet the transitional needs of participants who do not need ongoing financial assistance by providing one-time cash assistance to meet some immediate need; and, to move temporary cash assistance recipients quickly from Welfare-to-Work. However, welfare recipients face a number of impediments in getting to work and returning home. Chief among these, are home/job location mismatch, access to childcare, varying work schedules, and the absence of personal transportation. By and large; the majority of WAGES clients must rely on the public transportation systems. However, it has been argued that existing transit may not be able to meet their transportation needs.

In December 1998, the Florida International University (FIU) conducted a study for the Metropolitan Planning Organization (MPO). As a result of this study, the MPO realized the need for developing a more effective and efficient mechanism for both monitoring ongoing program assessment and status, and for evaluating existing and potential new transportation alternatives for participants in the WAGES program. Based on this fact, the Lehman Center for Transportation Research (LCTR) at FIU conducts this study.

SCOPE OF WORK

The Florida International University (FIU) Lehman Center for Transportation Research (LCTR) conducts the study project to develop a Geographic Information System (GIS) application for data handling and analysis for determining the mobility needs of participants in the WAGES program. Additionally, this software application will be developed as a transportation planning tool for evaluating innovative and nontraditional transportation services that can be considered in providing mobility alternatives under the Welfare-to-Work (WtW) program.

According to the scope of work of the project, the project methodology consists of the following tasks:

1. Literature Research and Review
2. Coordination
3. Data Collection and Database Development
4. Development of Applications and Analysis
5. Data Maintenance
6. Software Documentation and Training
7. Final Report and Recommendations

GIS APPLICATION

GIS is often thought of as computerized, automated mapping, however a GIS is much more. It is an information system that contains spatial data. Spatial data describes the position of a feature on the surface of the earth. Because information on the location of each feature is incorporated into the data, a GIS is able to: 1) illustrate on a map the spatial relationships between features, and 2) perform analyses based on spatial relationships (e.g. adjacency, proximity, paths and clustering).

There are two GIS functions that are providing insight into the WtW problem: proximity, and routing. There are also two activities within a transit agency that can make use of these GIS functions: 1) service planning, and 2) trip planning. Typically, proximity calculations are used for service planning, while routing algorithms are used for trip planning. It is important to recognize that spatial analysis addresses only part of the WtW transportation challenge. Temporal functions are also critically important to the successful delivery of service to welfare recipients. They may live near public transit routes, but buses may not run at the times when jobs are available.

DATA COLLECTION

The data used in this study are obtained from the GIS Lab at FIU: Dade County Public Access Data, The FIU's Metropolitan Center and LCTR, Florida Department of Labor and Employment Security, and Florida Department of Children & Families.

- Downloading some of the available Miami-Dade county data from the web: road network file, bus route file, and the bus stop file.
- Converting the employment centers data base file that was received from the FIU Metropolitan Center from Microsoft Access database. into Arc View. The process involved also an address matching and geocoding of some addresses.
- The welfare people are scattered all over the county. Because of the privacy issue, we were not able to obtain their addresses. We obtained a spreadsheet file of their location by census block and then database for the WAGES clients was created in Arc View.

DATA ANALYSIS

- A buffer analysis was performed. The bus stops were buffered in a half-mile radius. This provides means of visualizing areas with "acceptable" accessibility to the bus system in Dade County.
- In order to analize the WAGES clients, the geo-processing method of *Clipping* was used in order to extract the features of the clipped themes of the buffer of bus stops and the census blocks.
- Script: calcarea was used in order to get an exact area clipped within each one of the census blocks.
- The following formula was used in order to get the number of clients served by the buffer:

  [New Area/Total Area] × TotalNum = NumServ
- The geo-processing method of *Clipping* was used again in order to extract the features of the clipped themes: employment centers and bus stops buffer. The total number of employment centers was recorded for analysis.

RESULTS AND RECOMMENDATIONS

Out of the 11,469 WAGES recipients in Miami-Dade county, however, only 10,120 recipients are served by the 0.5 mile buffer of bus stops. This is about 88% of the total WAGES recipients population in Miami-Dade county. Further analysis shows that out of total 1066 census blocks in Miami-Dade county only 33 blocks that are not covered by the 0.5 mile buffer area. The percentage of coverage in this case is about 97. The 33 non-covered census blocks are mostly of fewer WAGES populations, and located in the western and southern areas of Miami-Dade county.

The results of the analysis of the employment centers did not vary much of that of the WAGES recipients. Out of 56,424 employment centers in Miami-Dade county only 46,751 centers are covered by the 0.5 mile buffer. This is about 83% of the total employment centers in Miami-Dade county. Most of the non-covered employment centers are in the area of south west Miami-Dade county. Moreover, if we consider the jobs, we find that there are 649,539 entry-level jobs in Miami-Dade county and only 530,836 ones are served by the bus system. The percentage in this case is 82.

The data has shown that there is a surplus of jobs. This suggests that other variables are preventing Miami-Dade County's WAGES clients from joining the job market. Perhaps, the 649,539 entry-level jobs available are not matched by the dispositions, skills or aptitudes of the 11,469 WAGES clients. This study cannot conclude that jobs remain unfilled for one reason or another. The need for detailed demographic data are essential for a study of this nature. The same conclusion in case of the employment centers can by understood, which is more attention should be paid to south west Miami-Dade to cover the center rapidly growing in these locations.

Improvements in the results could be obtained by getting access to complete addresses of WAGES customers. Also, more detailed information about the WAGES clients such as demographic data, job skills and language abilities could greatly improve the results of this study.

MPO

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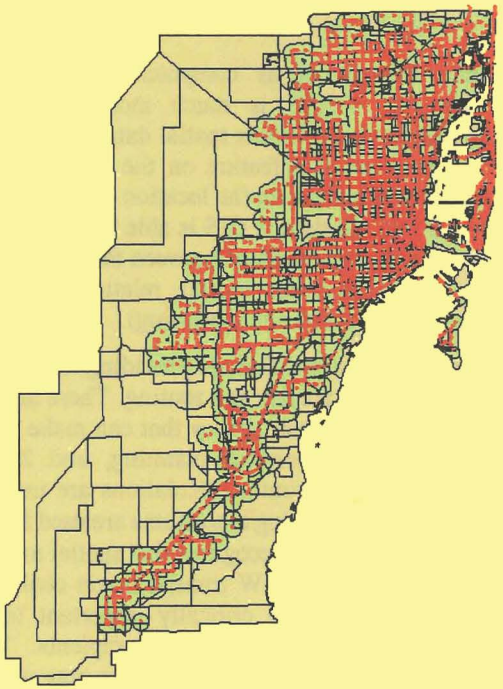

FIU

FLORIDA INTERNATIONAL UNIVERSITY

IMPROVING WELFARE-TO-WORK TRANSPORTATION PLANNING

A GEOGRAPHIC INFORMATION SYSTEM (GIS) APPLICATION

CASE STUDY OF MIAMI-DADE COUNTY

By:
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Lehman Center for Transportation Research

May **2002**