ADA Eligibility Process Control Model for DART First State Paratransit

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INTRODUCTION

The ADA paratransit eligibility process control model developed from our previous work is described in this report. The model was developed from a method based on the Americans with Disabilities Act (ADA) of 1990 categories for eligibility. It provides the microstructure of mobility characteristics and the microstructure of the environmental characteristics, thereby allowing for the eligibility analysis of a given individual for a given trip. This approach provides a framework to create a rational solution when determining paratransit eligibility. The model was tested by using a sample of 233 eligible paratransit riders on Delaware Transit Corporation (DTC), New Castle County. From that sample, 53 people with disabilities completed in-person interviews. The physical environments associated with the fixed route trip that respondents indicated they would take most frequently were also assessed. The data were successfully used in the process control model both to determine ADA paratransit eligibility and to analyze fixed routes for overall accessibility and compliance with the regulatory standards.

BACKGROUND

The Americans with Disabilities Act (ADA) of 1990, defines three categories of eligibility for complementary paratransit. The categories address functional, or mobility, limitations of individuals; characteristics of the transit system; and characteristics of the environmental infrastructure to and from bus stops. While the federal mandate is clear, transit providers are challenged to develop and implement eligibility methods that also meet local demographic situations and local governmental needs. Even though fourteen years have passed since the bill's passage, fair, cost-effective, and appropriate methods are still being devised. The project described in this report presents a way to objectively determine an ADA paratransit eligibility method for the State of Delaware.

Delaware Transit Corporation, the State of Delaware's public sector provider of paratransit services operating under the auspices of DART First State Paratransit, had received an average of 173 new applications for paratransit services a month at the beginning of this study. Furthermore, over 98% of all those seeking eligibility were granted unconditional paratransit eligibility status even though the cost of a paratransit trip ($26.00) in Delaware is about 10 times greater than the cost of a fixed route bus trip ($2.50). Because of this, about 30% of the DTC's operating budget is devoted to a paratransit system serving less than 3% of the population. One logical way to limit these costs is to characterize eligibility, as defined by the Americans with Disabilities Act (ADA) of 1990, so that only those who truly need paratransit are eligible.

In 1997, New Castle County, the most populous county in this three-county state and the only one with an extensive fixed route system, received an average of 96 new applications each month. By 2000, New Castle County was receiving 129 applications per month, a 34% increase over 1997. This represents an average increase of 11% a year. While projections for future demand are uncertain, all indicators point to even greater demand based on the trends reported for increased levels of service since the passage of the ADA in 1990.

THE MODEL

The paratransit eligibility process control model compares the mobility attributes of a person with a disability with the environmental attributes associated with the use of a fixed route bus system. The model is shown in FIGURE 1. This model closely resembles a simple process control operation. A good example of process control is the heating system in a house where the temperature is controlled by a thermostat. If the temperature, or the measured value, in the house as measured by a thermometer is different than the thermostat setting, the reference value, then a difference exists. Therefore, a corrective action takes place, which, in this case, means running the furnace until there is an alignment between the measured value (the thermometer) and set value (the thermostat).

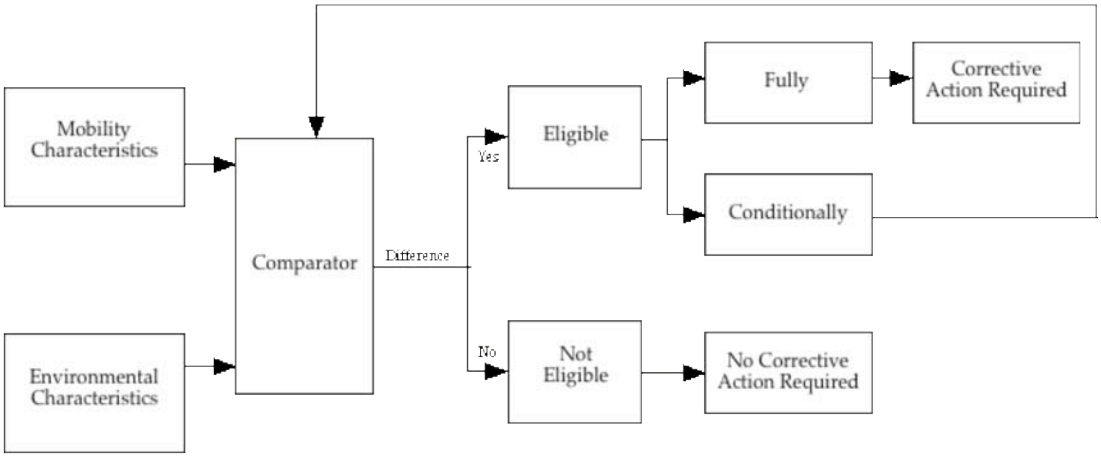

FIGURE 1 Eligibility process flow model.

The process control model provides a framework to objectively evaluate the ADA eligibility status of an individual with a disability who wants to travel from one point to another. The mobility characteristics of an individual, the measured values, and the environmental characteristics (the reference values), provide the critical and objective input data to the model. The mobility attributes include such things as the ability to ambulate, climb steps, stand, wait, see, hear, communicate, etc. (The way these attributes are identified can vary.) The environmental characteristics are fixed points and include the features of pathways and distances between bus stop locations at the origination and destination points, direction of traffic, speed limits, sidewalks, curb cuts, intersections, communication systems, and vehicle accessibility.

Programming was created with 14 sets of variables to evaluate a given rider's mobility skills with the environmental attributes for a given trip. If no difference exists between the mobility skills and environmental attributes, no match is made in the comparator, and the rider can access the fixed route system for this trip. If a difference exists—the specific barriers to using the fixed route exist and corrective action is required—the rider may be eligible for a paratransit trip.

Research Approach

Eligibility was determined using three primary sources of information (1) responses from study participants to an in-depth in-person interview on their use of public transit service, including identification of possible limitations of using fixed route bus services (2) rider, bus route and bus stop records supplied by DTC, and (3) a physical review of the ADA criteria related to pathways that include bus stops, bus routes, walkways, and intersections connecting the participants between their origination (typically their home), their bus stops and their destination.

A complex relational database was designed to accommodate data from these diverse sources of information using FileMaker Pro® on both Windows and Macintosh computer platforms. The file set includes a generic Stops-By-Route listing from DTC (as of May 2002), a log of all applicants approved for paratransit use from September 2001 through December 2001, a questionnaire for responses from individual in-person interviews with participants, files for ADA criteria for participants' bus stops, general environment for all parts of a participant's trip, the walkways and intersections, and a file for photographs of ADA features of the trip.

The data collection forms were designed in FileMaker Pro® and data entry was completed using the original layouts in each of the files. The files are separately maintained. Data screens for each participant's route have been designed within the database so that necessary components from each of the related files are visible for that participant, along with selections from his or her interview responses. Programming for eligibility is included in the database so that individual eligibility decisions made by staff are checked and verified by computer routines.

Data Collection

Data about mobility characteristics were gathered in face-to-face interviews with respondent paratransit riders. The sample, in this study, consisted of all those individuals in New Castle County who were approved for ADA paratransit eligibility from DART First State Paratransit during the last quarter of 2001, September 1, 2001 through December 31, 2001. New Castle County was selected because it has the largest number of new applicants and the most extensive fixed route service in Delaware. This sampling procedure was provided access to the most recently approved riders, at the time of the study; thus, it allowed for an in-depth analysis of that sample. Rider identification numbers and telephone numbers were provided to the project by DTC.

The interview protocol consisted of a modified questionnaire based on our earlier ADA eligibility research and was approved by the institutional human subjects review process prior to administration. Research teams of graduate and undergraduate students were trained and supervised to conduct the interviews. All researchers signed confidentiality agreements stating that the information obtained during the research process would be held in confidence. The sample was contacted to solicit participation in the study over the five-month period, from March 1 to July 31, 2002. The interviews were conducted between April 1 and August 31, 2002. Although the location of the in-person interviews varied, most interviews were conducted in the applicant's home or at the usual point of origination when traveling.

For the trip indicated by each respondent as the one he or she would take most often, environmental assessments of the entire pathway were completed. All segments from the point of origination to the destination bus stop were measured and evaluated for accessibility. Photographs were also taken to document these environmental attributes. The total input process for the environmental characteristics averaged three hours per applicant, including travel time. Fixed route accessibility and availability of services were examined

as part of the environmental assessment process. (See the discussion below for details about the environmental characterization process.)

Once the input data were obtained, the measured values and the set values were compared, and paratransit eligibility was determined based on whether a difference was generated between the two sets of values. If no difference was evident, the respondent can use the fixed route system for the given trip and would not be eligible for paratransit. When a difference exists, the respondent would be eligible, either fully or conditionally. The conditions contributing to the eligibility circumstances are also built in to the model and are easily identified.

Mobility Characterization Process

Mobility characteristics are defined as intrinsic qualities of an individual as related to the ADA eligibility criteria that states any individual with a disability who:

> —is unable, as a result of a physical or mental impairment (including a vision impairment), and without the assistance of another individual (except the operator of a wheelchair lift or other boarding assistance device), to board, ride, or disembark from any vehicle on the system which is readily accessible to and usable by individuals with disabilities.
>
> —needs the assistance of a wheelchair lift or other boarding assistance device and is able, with such assistance, to board, ride, and disembark from any vehicle which is readily accessible to and usable by individuals with disabilities if the individual wants to travel on a route of the system during the hours of operation of the system, or within a reasonable period of such time, when such a vehicle is not being used to provide designated public transportation on the route.
>
> —has a specific impairment-related condition which prevents such individual from traveling to a boarding location or from a disembarking location on such system. (ADA, 1990)

A questionnaire, or applicant interview schedule, was developed to determine the mobility attributes of the individual when using the fixed route bus system. For example, questions about the ability to get on the bus, ride the bus, get off the bus, and navigate the pathways to and from bus stops were asked.

An underlying condition of the model was that respondents were asked about their mobility to use the fixed route bus during the in-person interview and that this self-reported information was not verified. Also, when calculating eligibility, the comparison of a given rider's mobility characteristics and the environment the rider would encounter on a given route, it was assumed that the rider would be able to navigate the route if that route were fully accessible. Also, weather, while an important variable that can affect mobility on a given day, was not taken into consideration when determining overall eligibility for the assessed route. It was also assumed that the fixed route buses were accessible and the physical characterization of vehicles was not conducted.

Environmental Characterization Process

Environmental characteristics are defined as those external features of pathways to and from boarding locations, generally bus stops, which must be negotiated by an individual when using a fixed route bus. This includes the entire pathway, which is defined as the path that an individual follows from a point of origination to a point of destination for a given trip. For example, an entire pathway may include many, but not necessarily all, of the following features: direction of traffic, speed limits, sidewalks, curb cuts, intersections, communication systems, lighting, bus stop location and features, and distances between bus stop locations. Other features might also be included.

Environmental assessment means to characterize the environment and determine its properties. For ease of use and to obtain the environmental information in a systematic way, three broad categories of properties have been developed: walkways, intersections, and bus stops. The U.S. Department of Justice Guidelines for Accessibility were used in developing these categories and in

determining compliance standards. Many features are contained within each category of which the details must be obtained in a systematic and reproducible way. Walkways are defined as a pedestrian path used to travel to a destination. Walkways contain features such as direction of traffic, lighting, construction/missing sections, width, protruding objects, surface conditions, curb cuts including driveways, and service entrances.

An intersection is defined as any single street or roadway that must be crossed when traveling to a destination point. Driveways and service roads that must be crossed are not considered intersections. The street may contain any number of lanes; both sides of the street are characterized in this process. In addition to curb cut specifications, information is obtained about direction of traffic, traffic control devices, locations where cars are permitted to turn right on a red light, alignment of intersection corners, driver visibility, number of lanes, pedestrian crossing signs, visual and auditory crossings signals, along with other details necessary to complete the assessment. Bus stop is a designated location along a specific route where a bus stops to pick up or let off riders. When transfers from one bus to another bus are required to arrive at a given destination, then bus stop-to-bus stop assessments must be completed as well.

The discrete data from each category are processed using binary logic and summarized into a set of integrated environmental variables. These integrated variables ultimately will be used to complete the comparison with mobility characteristics so that an objective eligibility decision can be made.

Method

Environmental assessment involves an on-site, in-the-field evaluation of all features of a given pathway. Objective physical measures are obtained, which can be analyzed quantitatively in making eligibility determinations. When obtaining physical measures in those situations where more than one alternative is available, the following assumptions apply. The route requiring the shortest travel distance between point A and point B is evaluated; all streets are crossed at

intersections (not in mid-block); parking lanes count as a separate lane to be crossed; and, when documenting levels of traffic, the highest quantity of traffic on a given street is noted. Standard tools to measure the properties of the environment and its characteristics include a digital level, measuring wheel, hand-held GPS device, and a digital camera. Evaluator's observations about such items as safety, distractions, and other features that may affect accessibility for individuals with disabilities are also noted as part of the characterization process. Photographs of all segments of the pathway are taken so that a visual record is also available. These data are entered into a computer program that is further discussed below.

Walkways All walkways along the route to the bus stop are characterized. This includes details of when a) the route turns onto a new street; b) the route crosses an intersection, even if continuing on the same street; and c) the walkways used when making a bus transfer. The accessibility features for each walkway and total number of walkways required of a pathway are obtained.

Intersections Each intersection crossed, including those encountered when crossing to a bus stop located in an island or median of a street or roadway is evaluated. Coordinates of each intersection are located along with street names and a brief description of the crossing. The total number of intersections along the pathway is recorded.

Bus Stops Each bus stop used in completing a given trip is characterized. This includes the origination and destination stops plus any transfer stops in between the starting and end points. The assessment process identifies coordinates of the stops and total number of stops that must be negotiated per individual trip.

The Integrated Environment The general or integrated environment presents the "big picture" view of the pathway. The integrated environment synthesizes the discrete data from each of the categories into one useable format, thereby providing an overall picture of the environment that includes evaluator observations. Observations provide descriptors such as area type, such as urban

or rural; neighborhood type, such as residential, business, or commercial; terrain type; roads; walking surfaces; speed limit; amount of traffic; and vehicle type. Irreducible characteristics of the environment—those features that are not readily quantifiable such as general safety of an area—that could ultimately affect the mobility of people with certain disabilities are also observed and noted.

Data Reduction and Management

The array of information collected during the assessment process is organized and presented so that qualitative decisions can be made. To accomplish this, a relational database was specifically designed to accommodate the characterization data. A relational database is a hierarchical database that contains unique fields or identifiers that are linked to many data files. This is necessary in bringing together the disparate information essential when making eligibility decisions. Ultimately, computer routines were programmed into the system to determine quantitatively eligibility, based on the comparison between the mobility and environmental characteristics. Bus routes and bus stop locations were easily linked into the database as well. Digital photographs of environmental characteristics were linked to the characterization data using this relational database. The photographic files support and enhance use of the database by persons other than the evaluators in the process of determining eligibility and trip requests. FileMaker Pro® on both Windows and Macintosh computer platforms was used to create the database.

RESULTS

Seven primary data files and one file for pictures were created to manage the information collected in this study. DTC supplied the information used to create two files: paratransit rider logs (N=233) and DelDOT New Castle County bus stop locations (N=4546). The rider logs include DTC's rider list (the sample) and trip data for the sample for the period between January 1, 2002 and April 30, 2002. Trip data include date of trip; time of trip; type of trip, regular or subscription; ADA or non-ADA; disability type; ambulatory status; status of trip (taken or no show); and whether accompanied by an aide or companion. The

telephone log data (telephone contact information to participate in the study), the participant or respondent list, and reasons given for not participating in the study are also included in this file.

The remaining five files were based on original data collected from the in-person interview information (N=53) as well as from the related four environmental assessments. The environmental files include the physical assessment data of the trip most frequently taken by the respondent. The entire pathwayfrom the point of origination to the closest fixed route bus stop and from there to the destination bus stop location, including all transfer points, was assessed, i.e. observed, measured, and photographed. The environmental files contain data from 107 unique general environment assessments, 93 (2 percent of New Castle County's bus stops) unique bus stop locations, 143 unique intersections, and 142 unique walkways. In addition to linking the rider identifier to the environmental data files, the data were constructed to allow for aggregated analyses of environmental characteristics independent to individual rider characteristics. The picture files are also linked to all data files.

The Sample

The sample (N=233) was contacted by telephone to solicit participation in the study. When calling, the researchers asked to speak to the person in the household who was eligible for paratransit. A minimum of seven calls was placed at varying days of the week and times of the day before being coded as "could not contact." Of the sample, 53 (22.3%) participated in the study. The remaining 180 riders were not able, or willing, to be interviewed for the reasons as reported in TABLE 1. Reasons for not participating stated by the person contacted by telephone were accepted and the information given was not verified. When telephone numbers were incorrect or missing from the rider's file, every attempt was made to locate the correct number. In the "could not contact" category, 40.3 percent (N=21) were due to disconnected or incorrect telephone numbers.

TABLE 1 Sample Response Rates

	Frequency (N=180)	*Percentage*
Refused	55	30.6%
Disability or medical	31	17.2%
No interest	21	11.7%
Decease	12	6.7%
Does not use service	9	5.0%
Could not contact	52	28.9%

The paratransit trip records were analyzed for use by the sample. Beginning January 2002, 100 percent of the sample had access to paratransit for the first time; consequently, it was logical to review the trip records for the first four months of 2002. Of the 233 eligible riders, 58.3% (N=136) had not used the system; 61.1 percent (N=110) of non-study participants, and 54.7 percent (N=29) of the respondents. A total of 4140 trips had been provided to the remaining 94 sample members, 3141 to the non-respondents and 999 to the respondents. On average, 44 rides were provided per rider over this four month-period, or about 11 rides per month per rider.

Other interesting observations in the trip files were found. For instance, of the nine that indicated no use of paratransit as a reason for not participating, one had actually taken two trips. Of the reportedly deceased individuals, one had taken 84 and another respondent had taken 2 trips during the first quarter of 2002. This apparent conflict of information can be explained many ways, but may include that the person answering the telephone did not understand the question, the person other than the eligible rider responded and was unaware of the eligibility status of the rider, the person did not want to be bothered, or the information given was purposefully incorrect.

The Respondents

Over three-fourths (77.4percent) of the respondents completed the interview independently, while a secondary respondent was either present or completed the interview on behalf of 12 respondents. Typically the secondary the

respondent was a family member. A total of 23 males and 30 females completed the interview questionnaire.

When asked to classify disability, indicating all that apply, 70 disabilities were reported among the 53 respondents. TABLE 2 shows the self-reported disability categories. Of those reporting multiple disabilities, 13 of 14 had a physical disability in addition to other disabilities. Almost 95 percent indicated that their disability was permanent, three people reported temporary disabilities.

TABLE 2 Disability Category and Permanency

	Frequency (N=53)	*Percentage*
Type		
Cognitive	2	3.8%
Multiple	14	26.4%
Physical	27	50.9%
Sensory	6	11.3%
Other	4	7.5%
Permanency		
Temporary	3	5.7%
Permanent	49	92.4%
Don't know	1	1.9%

The average age of the respondents was 57.5 the youngest being 17 and the oldest 95. Just over half (52.8 percent) were under 60 years of age. Of those over 60, 32.1 percent were 75 and older. The distribution of disability category by age is shown in TABLE 3.

TABLE 3 Disability Category by Age

	<40 (N=10)	*40-59 (N=18)*	*60-74 (N=8)*	*75+ (N=17)*
Type				
Cognitive	1.9%	-	-	1.9%
Multiple	7.5%	7.5%	5.7%	5.7%
Physical	9.4%	20.8%	7.5%	13.2%
Sensory	-	1.9%	1.9%	7.5%
Other	-	3.8%	-	3.8%
Total	18.8%	34.0%	15.1%	32.1%

Mobility characteristics including limitations, use of travel aids and personal care attendants are reported in TABLE 4. Respondents were asked to check all characteristics that apply. Both walking and negotiating steps or stairs were problematic for about two-thirds of all respondents while standing was limitation for more than 60 percent. Limitations due to vision and confusion when traveling where reported as factors that affect travel by about one-third of all respondents and wheelchairs and walking aids were required by 60 percent. The ability to travel independently without a personal care attendant was reported by 62.3 percent of the respondents.

TABLE 4 Mobility Characteristics and Travel Aids

	Frequency (N= 53)	*Percentage*
Mobility Limitations		
Afraid or nervous	1	1.9%
Communication	8	15.1%
Confused	16	30.2%
Gets lost	8	15.1%
Hearing	5	9.4%
Size/weight	2	3.8%
Stairs/steps	34	64.1%
Standing	32	60.3%
Vision	17	32.1%
Walking	35	66.0%
Other	10	18.9%
Travel Aids		
Walking aid	18	34.0%
Wheelchair—Power	6	11.3%
Wheelchair—Standard	8	15.1%
Other	6	11.3%
None	21	39.6%
Personal Care Attendant (PCA)		
Yes	14	26.4%
No	33	62.3%
Sometimes	6	11.3%

*Note: The sum of the above percentages may exceed 100%, because for some questions respondents were asked to indicate everything that applied to their travel patterns.

During the first four months of 2002, 54.7 percent (N=29) of the respondents did not use paratransit. Of the respondents with a ride history, 8 percent were taken

by riders with cognitive disabilities, 21 percent with multiple disabilities, 67 per cent with physical disabilities, 4 percent with sensory, and 0 for others. Almost 88 percent of all rides were allocated to respondents with some type of physical limitation. Disability category by percentage of total trips is shown in TABLE 5.

TABLE 5 Disability Category by Percentage of Total Trips

Number of Trips		0	*1-14*	*15-90*	*91+*	*Total*	
Category	**N**						
Cognitive	(2)	-	-	1.9%	1.9%	8%	(80)
Multiple	(14)	17.0%	5.7%	3.8%	-	21%	(210)
Physical	(27)	20.8%	13.2%	13.2%	3.8%	67%	(669)
Sensory	(6)	9.4%	-	-	1.9%	4%	(40)
Other	(4)	7.5%	-	-	-	-	(0)
Total	(53)	54.7%	18.9%	18.9%	7.5%	100%	(999)

Environmental Characteristics of Routes

During the in-person interviews, respondents identified the trip that they need to take most frequently. Those trip routes were evaluated for accessibility and compliance with the federal standards and are shown in the map below. See Figure 2. The environmental features evaluated for each of the 53 respondents, resulted in the assessment of

- 107 unique general environment assessments
- 93 bus stop locations
- 142 walkways
- 143 intersections

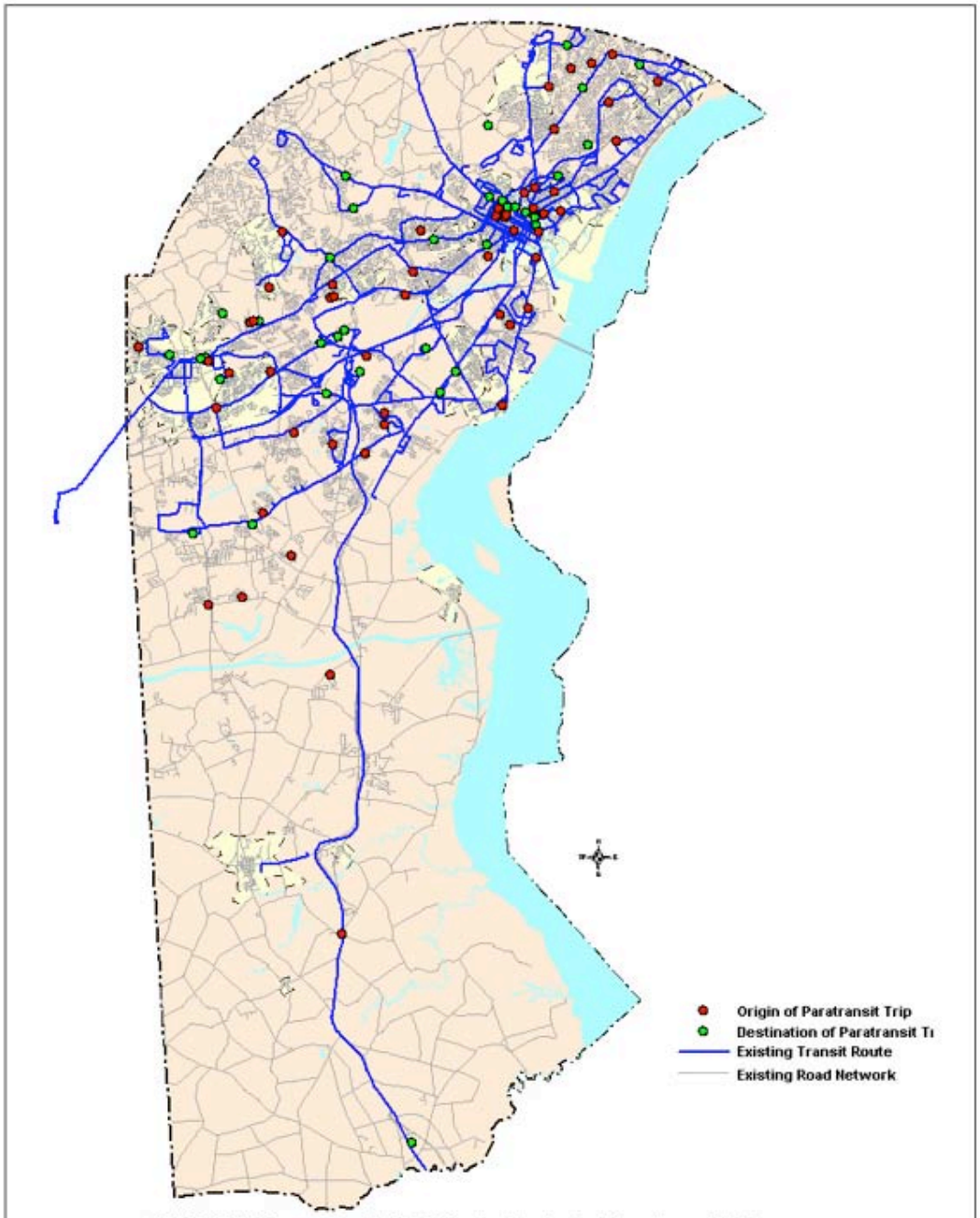

FIGURE 2: Respondent's Trip Routes Evaluated for Accessibility

Bus Stops

Forty-eight riders, or 90.6 percent of the respondents (N=53) needed a total of 93 unique bus stops. If the distance from point of origination to the nearest bus stop

was greater than three-fourths of a mile, the route was deemed inaccessible; five respondents' routes fell in this category and were not evaluated beyond the general environment.

The number of bus stops used by respondents for the primary trip is shown in TABLE 6. Less than 10 percent of the trips involved only two bus stops (no transfers required) while over 81 percent involved at least one bus transfer, and one trip required negotiating five different bus stops. Although most bus stops evaluated were for use by a single respondent, several stops had multiple users. For example, 10 bus stops had common use by two respondents on the primary trip, two stops had use by three respondents, one by four respondents, two by five respondents, and three stops by as many as 11 respondents. These high use bus stops were major bus hubs for transfer points, two in the city and one at a mall. See Appendix A for a list of the bus stops evaluated along with the associated routes and number of riders. Thirty percent (N=28) of the bus stops evaluated were not in compliance with the accessibility standards. The most prevalent violation for 38 percent of all bus stops assessed was the lack of, or condition of, the pad area.

TABLE 6 Number of Bus Stops per Trip

Bus Stops	N=53	Percentage
0	5	9.4%
2	5	9.4%
3	36	67.9%
4	6	11.3%
5	1	1.9%

Walkways

The 48 primary trip routes accessed involved between 0 and 6 walkways for a total of 142 unique walkways. For 87.5 percent (N=42), at least a portion of the walkways was not compliant with accessibility standards. Upon further examination, it was found that 66.9 percent of all walkway portions (N=142) were non-compliant. The number of walkway portions required per trip is an

indication that intersections must also be navigated along the pathway to bus stops. Over 64 percent traveled to bus stops using three or fewer walkways, while 26 percent encountered five or more walkways. Common use of walkways is reported in TABLE 7.

TABLE 7 Number of Walkways per Trip

Walkways	N=53	Percentage
0	5	9.4%
2	11	20.8%
3	18	34.0%
4	5	9.4%
5	7	13.2%
6	7	13.2%

Intersections

The number of unique intersections assessed was 143. Of the 143, 138 (96.5%) were not in compliance with accessibility standards because of crossing distance—a distance greater than 24 feet, the standard currently used by DTC when determining accessibility. The federal guidelines do not set crossing distance standards. When crossing distance was removed from the analysis, 54.5 percent (N=78) of the intersections were non-compliant. Overall, 83 percent (N=44) of the respondents had non-compliant intersections when distance was included, and 67.9 percent (N=36) faced non-compliant intersections when crossing distance was removed. The distribution of intersections encountered per trip per respondent is reported in TABLE 8.

TABLE 8 Number of Intersections per Trip

Intersections	N=53	Percentage
0	6	11.3%
1	6	11.3%
2	11	20.8%
3	8	15.1%
4	7	13.2%
5	6	11.3%
6	5	9.4%
7	2	3.8%
8	1	1.9%
10	1	1.9%

Eligibility Determination

In the model three respondents were not eligible, one was conditionally eligible, and 50 were fully eligible for the specific trip evaluated. See FIGURE 3. The conditional determination was related to weather because the mobility characteristics associated with walking and balance led to the inability to negotiate the fixed route in extreme cold or icy conditions. This was the only barrier identified for the respondent.

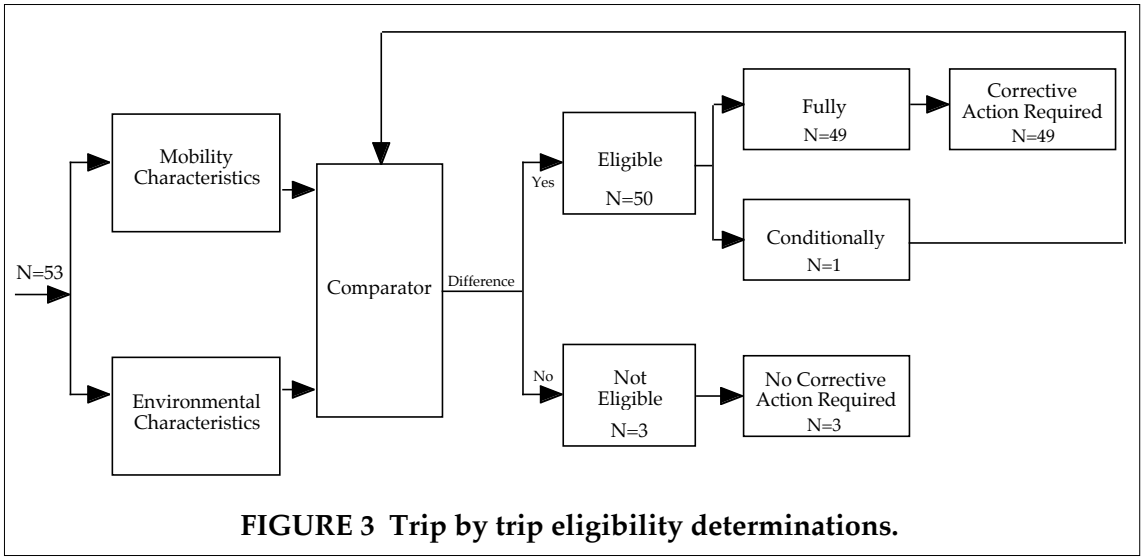

FIGURE 3 Trip by trip eligibility determinations.

A maximum of 742 combinations (53 riders X 14 sets) were possible among the 14 variable sets in the comparator. Matches, indicating a difference exists, were

made for 30 percent (N=225) of the items among the 53 respondents. Seventy percent had 5 or fewer matches, while the remaining 30 percent had between 6 and 10. For three respondents no matches were made; consequently, they would not be eligible for a paratransit trip.

Any difference that exists can be evaluated in the model. For example, in the general environment (which included the weather variable), differences existed for 73.5 percent of the respondents. When removing the weather variable, 57 percent could not use the fixed route because of terrain and or distances that rendered the route inaccessible for a given set of mobility characteristics. Bus stops were inaccessible for 74 percent, intersections 72 percent, and walkways for 47 percent of the respondents. FIGURE 4 shows the number of barriers per respondent identified in the model. The model also identifies specific features such as a curb cut, section of walkway, or bus stop that is in violation of the accessibility standards. From this information, transit providers can evaluate and determine corrective environmental strategies as well.

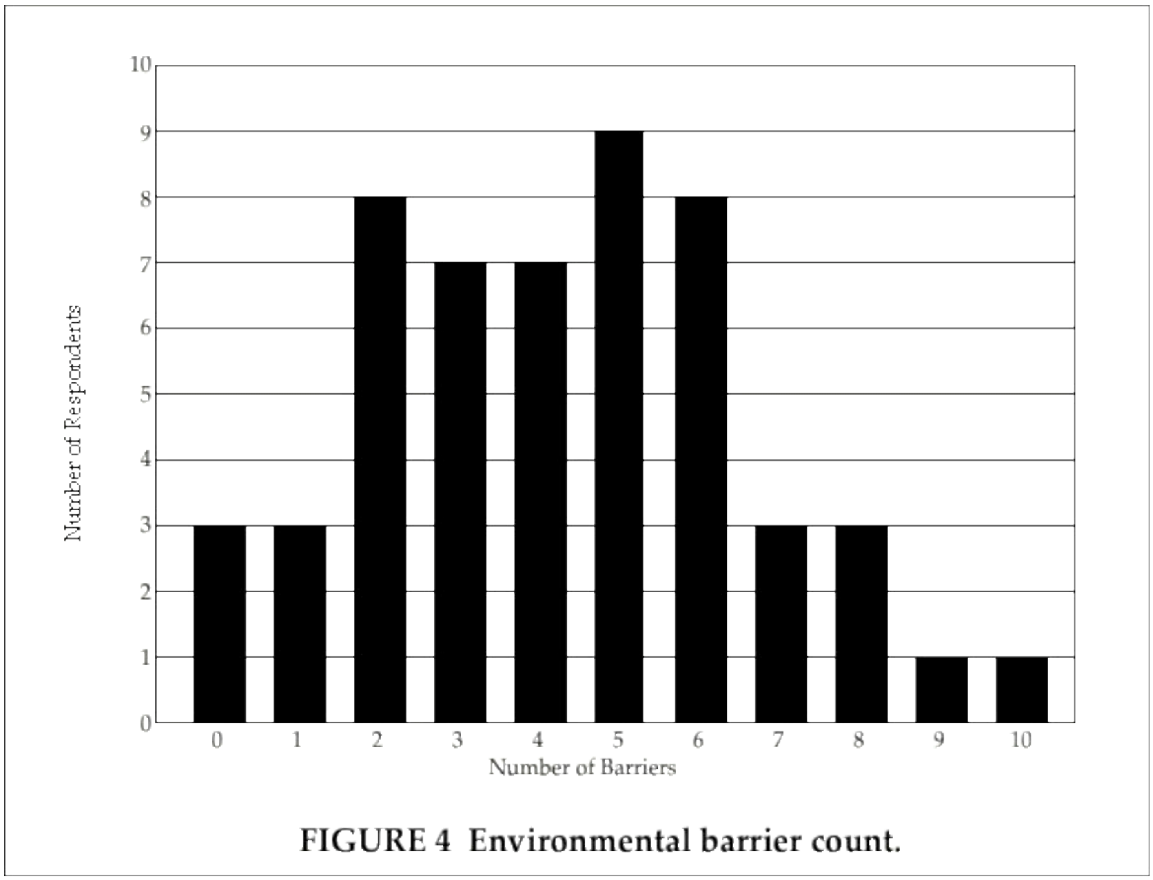

FIGURE 4 Environmental barrier count.

Almost an equal number of total or matches were identified in the four environmental categories. There were 39 matches in the general environment, 39 for bus stops, 38 for intersections, and 25 for walkways. FIGURE 5 shows the total number of matches identified by the comparator when evaluating the routes for the respondents. A match occurs if there is a difference between mobility characteristics and the environmental characteristics for the given trip. A programmed example in the comparator measures if there is a difference between the rider who uses a mobility aid and the walkway is unpaved, under construction, or is missing a section, thereby making it impossible for the respondent to use of the fixed route. Another example, in the general environment, that the comparator evaluates occurs when mobility aids are required or mobility limitations with walking (on inclines, declines) are part of the mobility characteristics and the general environment of the pathway terrain is hilly. In many cases, only one or two minor features of a given pathway, not the entire pathway, resulted in the need for a paratransit over a fixed route trip.

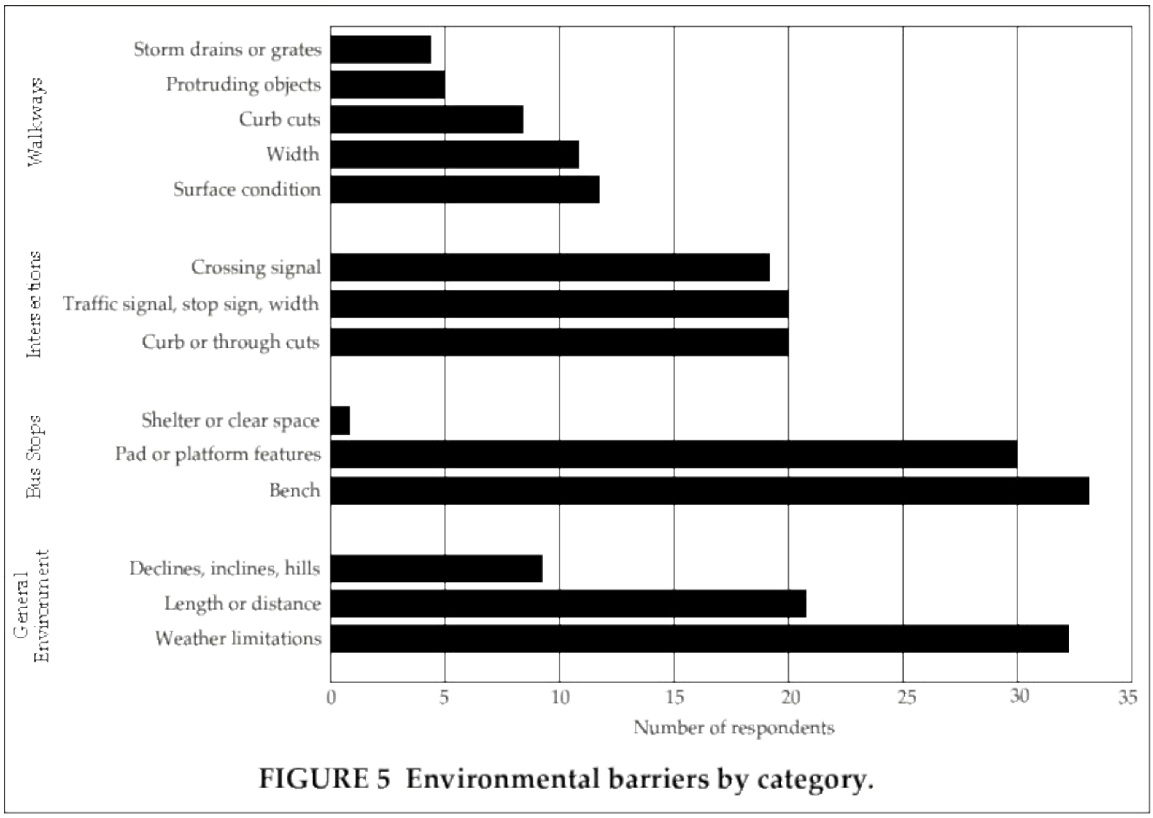

FIGURE 5 Environmental barriers by category.

Eligibility Status and Ride History

The eligibility results of respondents (N=24) who also used paratransit during the first quarter of 2002 were compared. Interestingly, just over 19 percent of all trips were provided to respondents reporting temporary disabilities. For instance, a sixty-eight-year-old rider with a temporary disability took 98 trips, almost 10 percent of all trips. This rider was ineligible for paratransit according to the output from the model. The other riders reporting temporary disabilities used paratransit for 18 and 75 trips. Another respondent with only one qualifying characteristic that was related to the inability to use fixed route during extremely cold and icy weather took 105 trips.

For those deemed eligible by the model (N=50), between one and nine barriers prevented their use of fixed route service. It might be expected that riders with the greatest number of matches in the model would have the greatest need and

use paratransit more frequently than other riders. However, this was not the case; 60.9 percent of the riders had fewer than only five matches, while the rest had between six and nine barriers.

CONCLUSION

The process flow model for ADA eligibility tested successfully in evaluating the microstructure of mobility characteristics and the microstructure of the environmental characteristics that allows for the eligibility analysis of a given individual for a given trip or trip-by-trip determination.

The model meets the spirit and intent of the ADA. Eligibility decisions are focused on the environmental characteristics related to accessibility of a given route, rather than to disability. Using the model, transit providers can base eligibility decisions on mobility characteristics, not on disability, as they relate to the specific route environment and can evaluate cost-effective approaches to increase use of fixed route service by increasing environmental accessibility. Adding curb cuts at intersections or repairing bus stop pads to bring them into accessibility compliance would increase use of fixed route for several respondents in this study.

A critical and central element of the process is the computer program from which almost infinite possibilities can be used in putting together the pieces. For example, once a walkway, intersection, or bus stop has been evaluated, then any portion of the pathway information can be retrieved and used to determine accessibility of routes for new applicants and to evaluate given trip requests. The data elements can also be exported to other programs for statistical analyses that focus on the correctness of decisions for eligibility and for the identification and quantification of improvements needed to facilitate accessibility for people with disabilities when using fixed route systems. Generation of this objective, quantifiable information, leads to the ability to make informed, rational decisions by transit properties that are cost effective and increase opportunities for use of fixed routes by riders with disabilities.

APPENDIX A

ADA Paratransit Eligibility Project

List of All Bus Stops

Unique BS #	Route	Seq	On Street	At Street	City	# Riders
1	24	082	10th St.	Kirkwood Hwy	Wilm	1
2	28	010	10th St.	Market St.	WILM	11
3	35	166	11th St.	King St.	WILM	3
4	2	142	18th St	Broom St.	Wilm	1
5	4	098	4th St.	Jefferson St.	Wilm	1
6	15	144	6th St.	Delaware St.	NCAS	2
7	8	060	8th St.	Clayton St	Wilm	1
8	8	034	8th St.	Orange St. (West)	WILM	1
9	8	054	8th St.	N. Franklin St	Wilm	1
10	8	032	8th St	Shipley Ave	WILM	2
11	8	020	9th St	Dupont St.	WILM	1
12	8	026	9th St	Franklin St	Wilm	1
13	8	050	9th St	Market St	WILM	1
14	15	046	Basin Rd	Penn Mart Sh. Ctr.	NCAS	1
15	9	018	Boxwood Rd.	Newport Gap Pike	Wilm	1
16	2	134	Broom St	25th St.	Wilm	1
17	9	067	Broom St.	Cedar St.	Wilm	1
19	1	123	Carr Rd	Electric Pay	Wilm	1
20	16	014	Casho Mill Rd	Church Rd	Newk	1
21	33	052	Chestnut Hill Rd	Augusta Rd	NEWK	1
22	33	072	Chestnut Hill Rd	Salem Church Rd	NEWK	1
23	33	046	Chestnut Hill Road	DE Route 72 PNR	NEWK	1
24	33	031	Christiana	Hospital	NEWK	5
25	54	002	Christiana Mall	PNR	NEWK	11
26	15	010	Churchmans Rd	Cavalier Apartments	CHRI	1
27	1	40	Darley Rd	Peachtree Rd	WILM	1
28	10	036	DE Ave	DuPont St.	Wilm	1
29	10	026	DE Ave	Harrison St. (West)	WILM	1
30	34	016	DE Ave	Tyre Avenue	NEWK	1
31	6	029	DE Ave	Univ. Courtyard Apts.	NEWK	1
32	5	168	Delaware Route 4	Kentucky Ave	WILM	1
33	5	166	Delaware Route 4	Old Churchman's Rd	WILM	1
34	22	026	Dupont Hwy	OP Memorial Ave	NCAS	1
35	22	090	DuPont Hwy	Wildel Ave	NCAS	1
36	33	002	Elkton Road	Municipal Bldg.	NEWK	3
37	36	064	Faulkland Rd (34)	Centre Rd (141)	WILM	1
38	21	042	Foulk Rd	Annwood Dr.	WILM	1

ADA Paratransit Eligibility Project

List of All Bus Stops

Unique BS #	Route	Seq	On Street	At Street	City	# Riders
39	21	066	Foulk Rd	Foulk Manor (Nursing Home North)	WILM	1
40	21	046	Foulk Rd	Foulkwoods Rd	WILM	1
41	21	048	Foulk Rd.	Silverside Rd	WILM	1
42	21	044	Foulk Rd	Weldin Rd	WILM	1
43	12	006	Franklin St	39th	Wilm	1
44	3	058	King St	14th St	Wilm	1
45	10	112	King St	9th St	WILM	1
46	19	002	King St	10th St	WILM	11
47	21	110	King St.	8th St	WILM	5
48	6	140	Kirkwood Hwy	Limestone Rd	NEWK	1
49	6	148	Kirkwood Hwy	Milltown Rd	WILM	1
50	6	174	Kirkwood Hwy	Polly Drummond Rd	NEWK	1
51	6	178	Kirkwood Hwy	Rose Circle	NEWK	2
52	6	86	Kirkwood Hwy	St. James Ch. Rd	Wilm	1
53	6	086	Kirkwood Hwy	Veterans Hospital	WILM	1
54	20	062	Lancaster Pike	Loveville Rd	Wilm	1
55	12	008	Lea Blvd	OP Coverly Rd	Wilm	1
56	19	134	Limestone Rd	Medical Ctr	WILM	1
57	34	002	Main St.	Newark Sh. Ctr.	NEWK	2
58	6	198	Main Street	Emergency Room	NEWK	2
59	34	024	Marrows Rd	White Chapel Dr	NEWK	1
60	5	226	Maryland Ave	Alban Dr	Wilm	1
61	17	068	Memorial Dr.	Lind Ave	NCAS	1
62	19	026	Mermaid Blvd	Pike Creek Sh. Ctr.	NEWK	1
63	20	048	Millcreek Rd	Treeline Ct	WILM	1
64	21	002	Naamans Rd	Trinity Church PNR	Wilm	1
65	35	046	Naamans Rd	Ebright Rd.	WILM	2
66	21	034	Naamans Rd	OP DEL TRMST	WILM	1
67	17	126	New Castle Ave	Rose Ln	NCAS	1
68	15	178	New Castle Ave	A Street	WILM	1
69	19	006	New Linden Hill Rd.	Henderson Hill Rd.	NEWK	1
70	34	026	Newark Sr. Center	On Site	Newk	1
71	24	070	North East Blvd	27th St.	Wilm	1
72	55	050	Old Baltimore Pike	Walther Rd.	Newk	1
73	36	008	Old Cap Trail	Othoson St	Wilm	2
74	62	006	Old Churchman's Rd	American Heart Ass.	NEWK	1
75	22	126	Old Forge Rd	OP Chelton Apts	NCAS	1

ADA Paratransit Eligibility Project

List of All Bus Stops

Unique BS #	Route	Seq	On Street	At Street	City	# Riders
76	5	258	Orange St.	8th St (North)	WILM	2
77	6	026	Penn Ave	Broom St.	Wilm	1
78	15	036	Reads Way	OP One Reads Way	NCAS	1
79	28	006	Rockland Center Rd	Nemours Clinic	WILM	1
80	54	020	Route 40	Buckley Blvd	NCAS	1
81	40	012	Route 40	Scotland Drive	New k	1
82	35	084	Shipley Road	Silverside Rd	WILM	1
83	54	034	Songsmith Rd	Smalleys Dam Rd	NEWK	1
84	22	056	Sunset Blvd	OP Arby's Rest.	NCAS	1
85	64	016	Thornhill Dr.	Kilgore Dr.	New k	1
86	23	009	University Plaza	Burlington Coats	New k	2
87	9	008	Vandever Ave	Thatcher St.	Wilm	1
88	11	038	Veale Rd	Woodbrook Dr	Wilm	1
89	11	138	Washington St	18th St	Wilm	1
90	11	110	Washington St	32nd St	Wilm	1
91	11	022	Washington St (N)	14th Street	WILM	4
92	2	156	Washington St (S)	14th Street	WILM	2
93	54	014	Wilton Blvd	Berkley Way	NCAS	1
94	8	008	Woodlaw n Ave (North 2300 Pa Ave	Penn Ave	WILM	1