

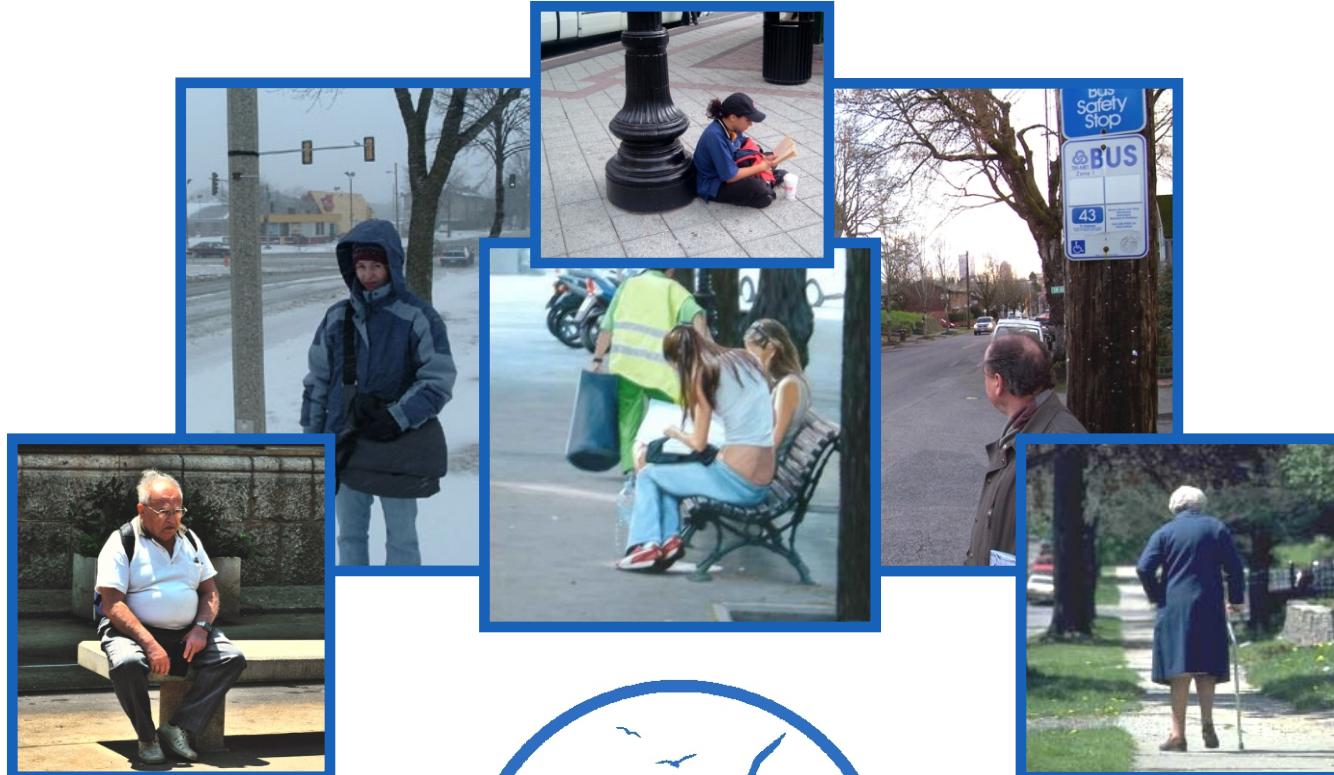
# Hampton Roads

## 2030 Regional Transportation Plan

### Non-Driver Transportation in 2030

#### Part II

#### Improving the Mobility of Non-Drivers Age 18 - 64 Using the NHTS



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# **HAMPTON ROADS 2030 REGIONAL TRANSPORTATION PLAN**

## **NON-DRIVER TRANSPORTATION IN 2030**

### **PART II - IMPROVING THE MOBILITY OF NON-DRIVERS AGE 18-64 USING THE NHTS**

**This report was included in the Work Program  
for Fiscal Year 2006-2007, which was approved by the  
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**PREPARED BY  
HAMPTON ROADS PLANNING DISTRICT COMMISSION**

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## REPORT DOCUMENTATION

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Non-Driver Transportation in 2030  
Part II- Improving the Mobility of Non-Drivers Age 18-64  
Using the NHTS

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**ABSTRACT**

A study of non-driver transportation in the year 2030 is being conducted as part of the development of the Hampton Roads 2030 Regional Transportation Plan. The first part of the study investigated improving the mobility of elderly non-drivers using the National Household Travel Survey (NHTS). In this second part of the study, the NHTS is used to determine ways to improve the mobility of non-drivers age 18-64.

**ACKNOWLEDGEMENTS**

This report was prepared by the Hampton Roads Planning District Commission (HRPDC) in cooperation with the Virginia Department of Transportation (VDOT) and with assistance from the City of Virginia Beach. The PDC staff is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of VDOT or the HRPDC. This report does not constitute a standard, specification, or regulation.

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## Task #1 of VDOT Grant

In 2004, HRPDC staff began studying transportation-disadvantaged persons, and published “Part I, Improving Elderly Transportation Using the NHTS” in June 2005. The HRPDC received a State Transportation Planning Grant in 2005 to further its study of transportation-disadvantaged populations. Task #1 of the grant is the use of the 2001 National Household Travel Survey (NHTS) to analyze the mobility needs of non-drivers age 18-64 and to formulate strategies for improving their mobility.

Details concerning the required components of task #1 can be found on the following page.

# Task #1 of VDOT Grant- Details

## Task 1.1 Investigate Mobility Needs of Handicapped Persons

- Use NHTS data to compare the mobility of handicapped persons to other persons.
- Compare the mobility of handicapped persons who drive to that of those who do not drive.
- Determine the mobility of handicapped persons vs. age.
- Forecast the number of handicapped persons in 2030 for Hampton Roads.

## Task 1.2 Determine Factors Significantly Related to Mobility of Handicapped Persons

- Modify NHTS data for regression, quantifying variables as necessary.
- Regress modified data to determine factors significantly related to the mobility of handicapped persons.

## Task 1.3 Develop Strategy for Improving Mobility of Handicapped Persons

- Perform detailed analysis of factor(s) from Task 1.2 which local government can employ to improve handicapped mobility.
- Develop strategy whereby individuals and local government might improve handicapped mobility.

## Task 1.4 Report Findings for Task#1

- Prepare presentation.
- Present findings.
- Prepare report.



# Target Population

The original target of this task was handicapped persons. Those persons who answered “yes” to the NHTS question “[Do you] have a medical condition that makes it difficult to travel outside of the home?” were considered “handicapped”. HRPDC staff examined the mobility of handicapped drivers and handicapped non-drivers, both of which—by definition—have lower mobility than non-handicapped persons.

Using a regression of the NHTS survey results, HRPDC staff determined that the lower mobility of handicapped drivers is largely related to health, which is beyond the scope of this study. Examining handicapped non-drivers, staff determined that 65% of this population are elderly and therefore already covered by the pre-grant phase of this study. The remaining 35% of handicapped non-drivers who are younger than 65 are rare, found in only 1% of US households.

In order to study more common travel-challenged persons, this task now targets all non-drivers age 18-64. These persons are found in 6% of US households.



## A. Mobility Needs of Non-Drivers 18-64 in Hampton Roads

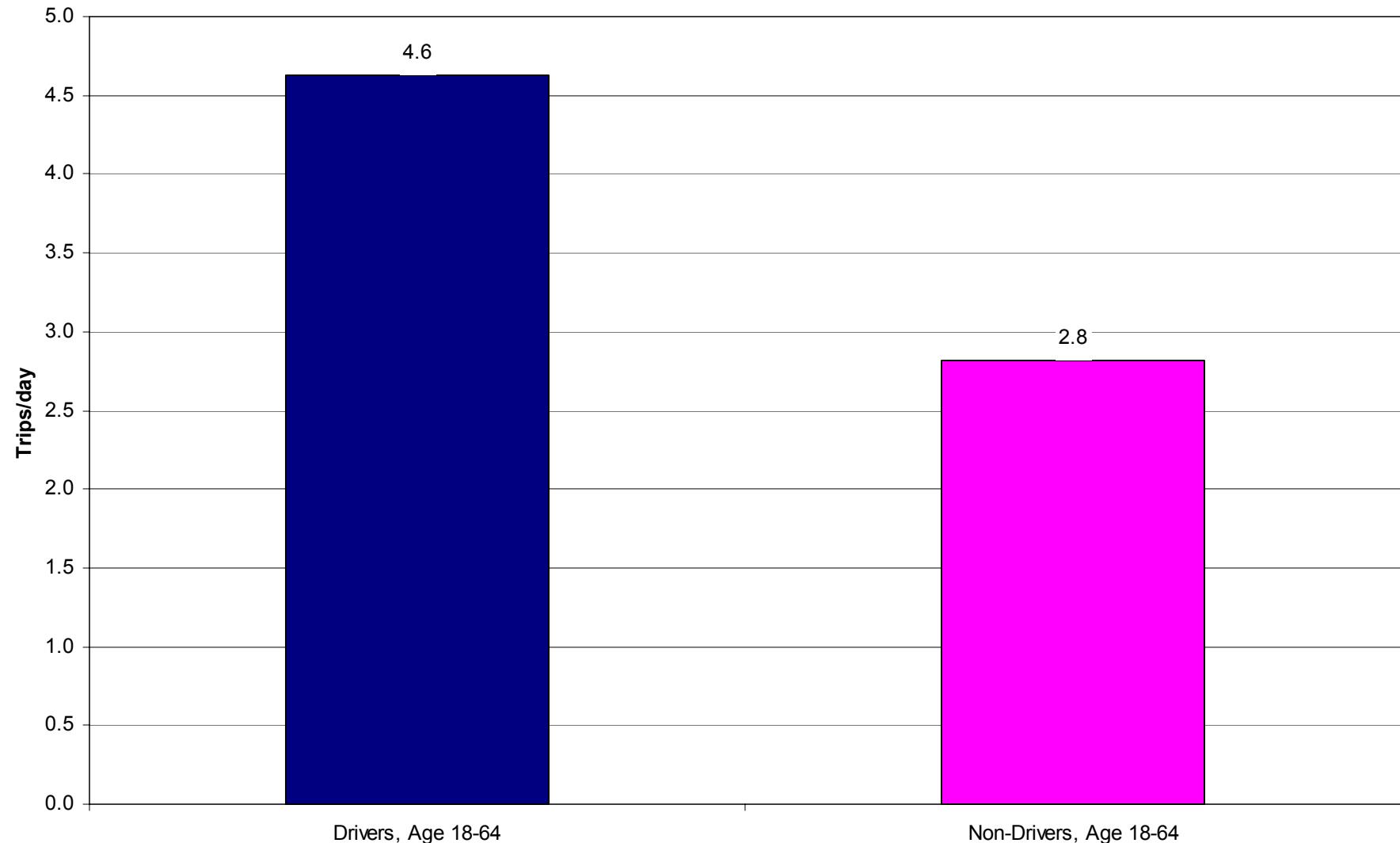
The size of the mobility problem of non-drivers 18-64 in Hampton Roads is a function of the mobility needs of individual non-drivers and the quantity of such persons in Hampton Roads.

### 1. Mobility Needs of Non-Drivers 18-64 in US

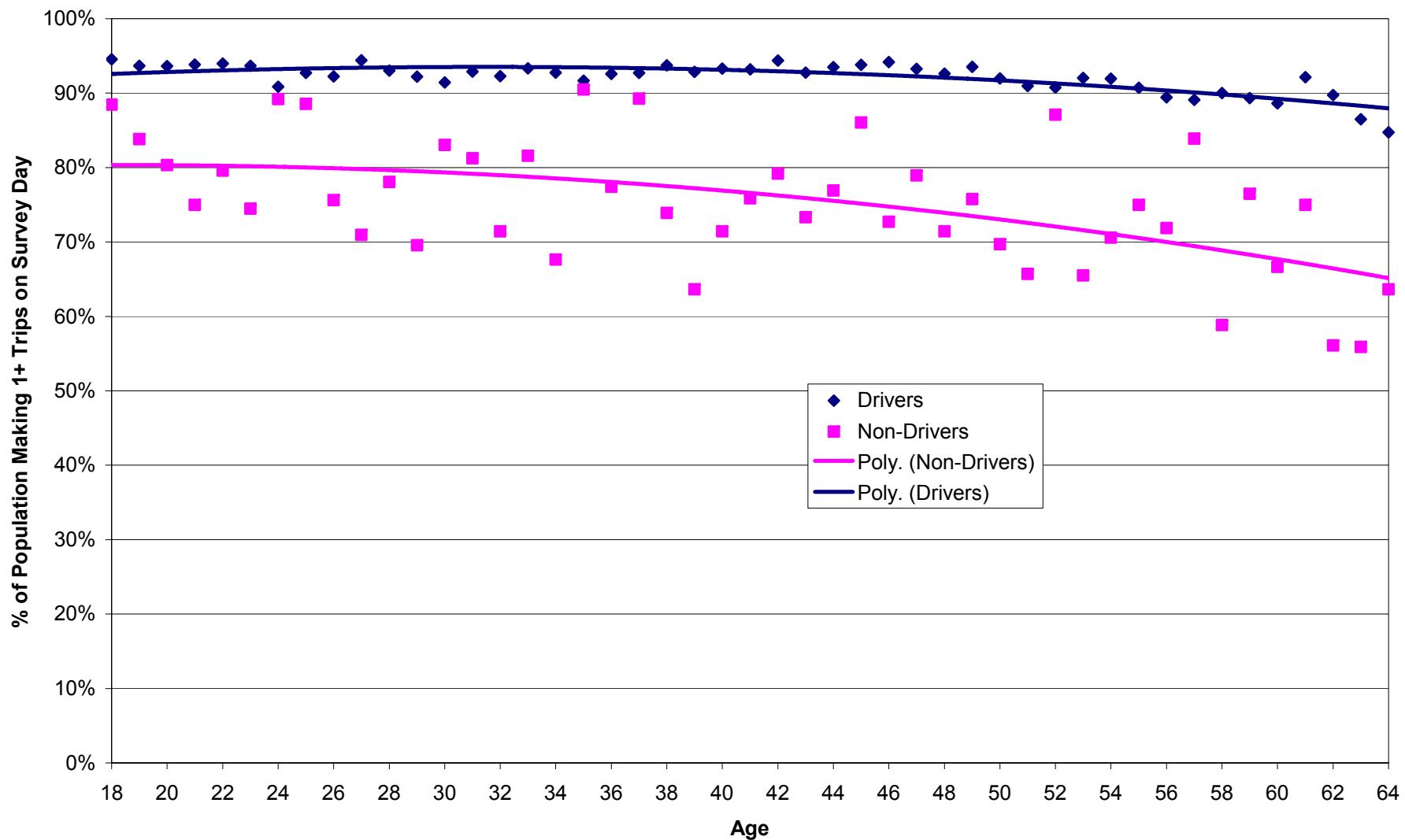
It is assumed that the mobility needs of non-drivers 18-64 in Hampton Roads are somewhat similar to the average needs of the US population of non-drivers age 18-64.

The NHTS indicates (as shown on the following pages) that the mobility of non-drivers 18-64 is significantly lower than that of drivers of the same age.

### Trip-Making of Persons 18-64, by Driver Status, NHTS, National Sample, 2001



### Mobility of Persons 18-64, by Driver Status, NHTS, 2001



## 2. Non-Drivers 18-64 in Hampton Roads

HRPDC staff estimated both the current and future populations of non-drivers 18-64 in Hampton Roads.

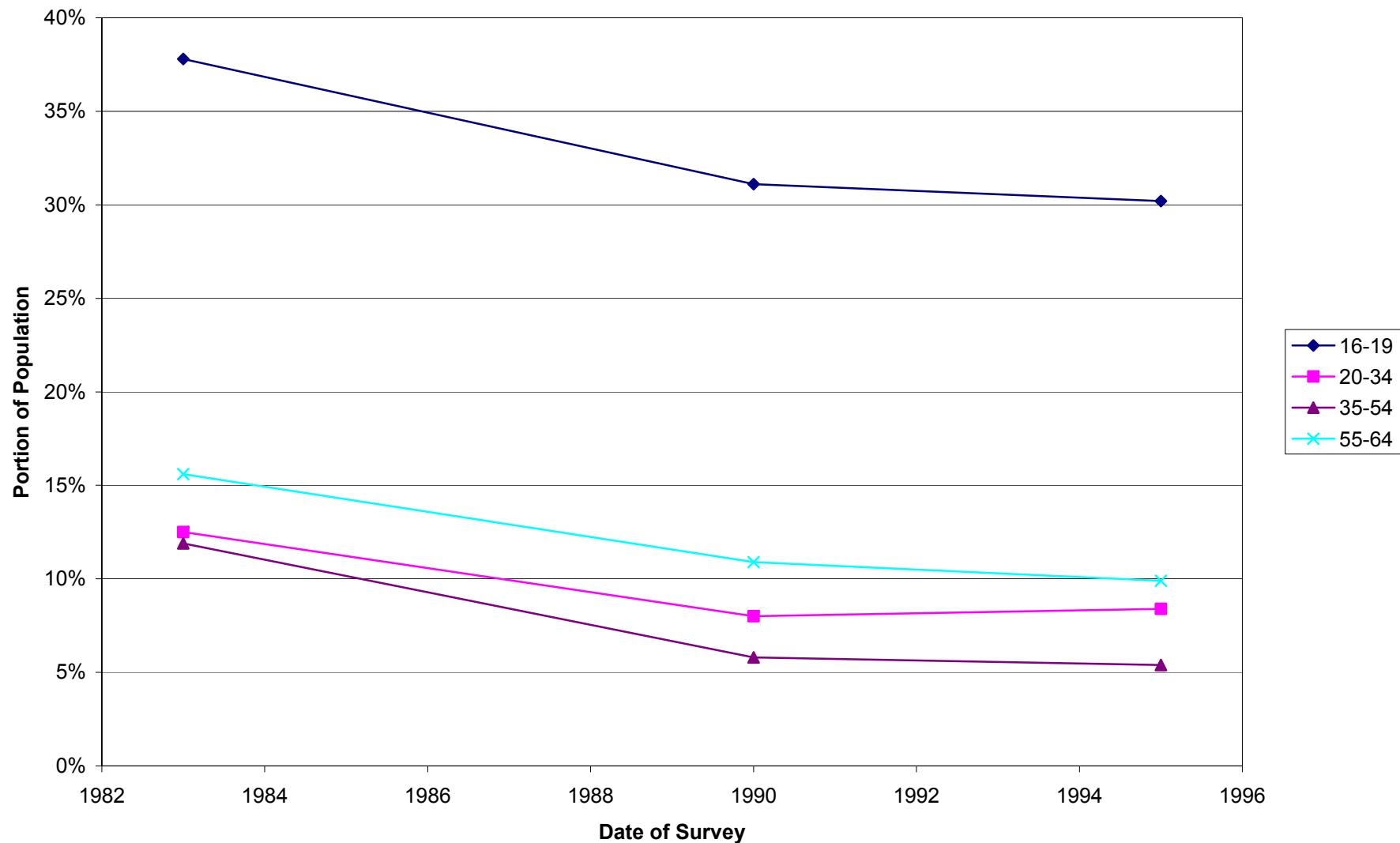
Staff used national 2001 non-driver rates by age group to estimate the current number of non-drivers 18-64 in Hampton Roads.

In preparing to forecast the number of non-drivers 18-64 expected in Hampton Roads in the year 2030, HRPDC staff encountered a problem in the NHTS data: the survey question concerning driving had changed. Prior to 2001, the NHTS tracked driver licensing. But in 2001—in order to account for persons who are licensed but do not drive—the NHTS simply asked “Are you a driver?” This change in the question made it impossible to directly extrapolate driver rates into the future. As a solution, expected changes in licensing rates (based on historical data) were applied to the 2001 driver rates in order to estimate future driver rates.

Surveys in the 1980s and 1990s indicate (as shown on the following page) that the tendency to not have a license has decreased but that declines in rates of not being a licensed driver have slowed significantly.



### Not a Licensed Driver, 16-64, NPTS



Note: The National Personal Transportation Survey (NPTS) is the predecessor to the NHTS.



## 18-64 Non-Drivers, Hampton Roads

In order to estimate the number of non-drivers in 2000, HRPDC staff assumed that year 2000 non-driver rates equal 2001 NHTS rates. (The NHTS is not conducted every year.)

Based on the slowing of declines in non-licensing rates over recent years as shown on the previous page, it is expected that the 2030 non-driver rates will be only slightly lower than the 2001 NHTS rates. This decrease in non-driver rates coupled with an increase in total population is expected to result in a slight increase in non-drivers.

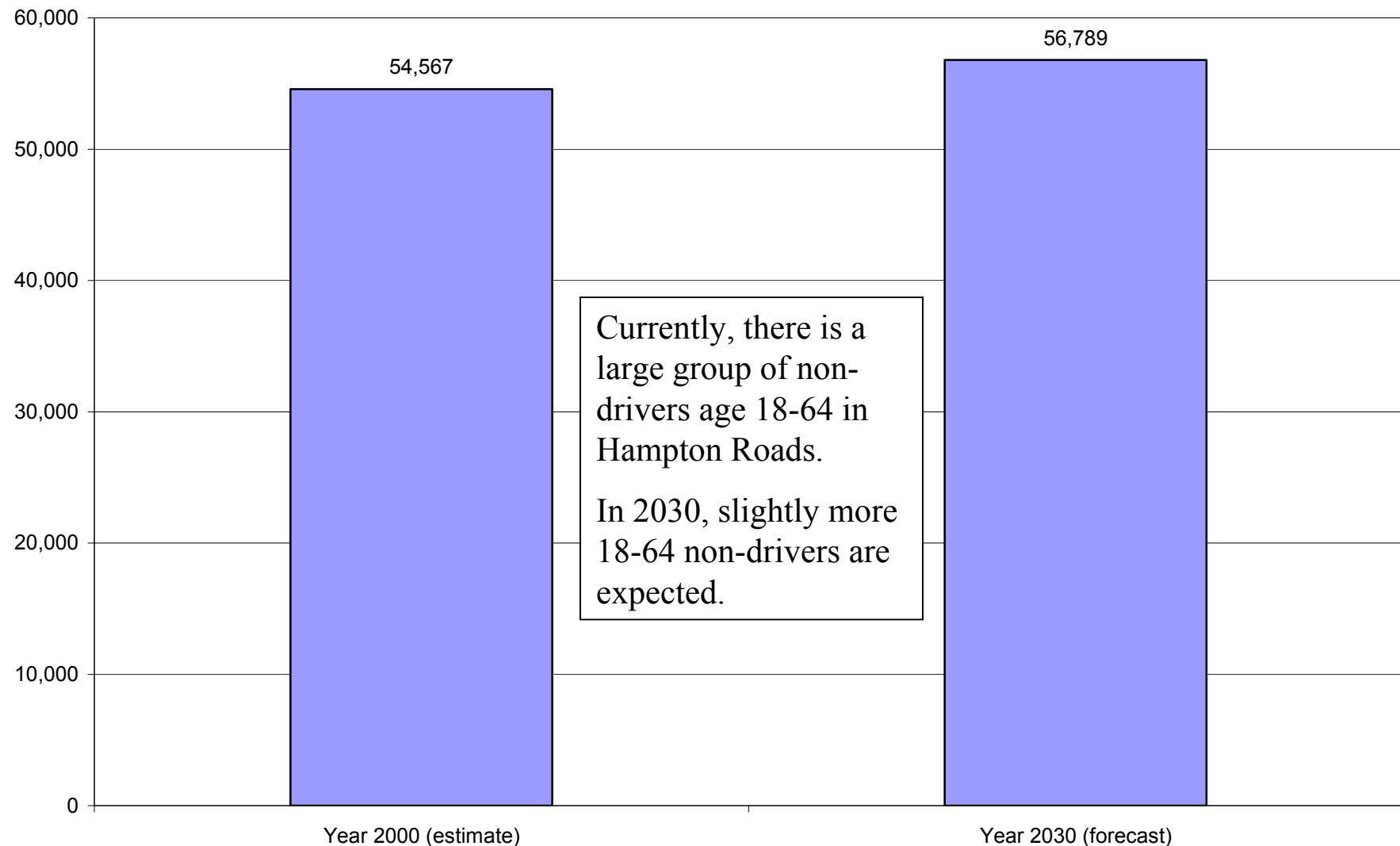
The calculation of 2000 and 2030 non-driver population estimates in Hampton Roads are shown below and on the following page:

<u>Age</u>	Year 2000		Year 2030	
	<u>Population</u>	<u>Non-drivers</u>	<u>Population</u>	<u>Non-drivers</u>
18-19	47,834	16%	56,249	14%
20-34	356,459	7%	436,900	6%
35-54	470,999	4%	460,298	4%
55-64	122,418	5%	187,184	4%
	997,710		1,140,630	
		<b>54,567</b>		<b>56,789</b>

Source of population forecast: HRPDC.



### 18-64 Non-Drivers, Hampton Roads



### 3. Mobility Needs of Non-Drivers 18-64 in Hampton Roads- Conclusion

In light of:

- the lower mobility of 18-64 non-drivers,
- the estimated 55,000 non-drivers age 18-64 who live in Hampton Roads today, and
- the forecast that there will be approximately 55,000 non-drivers age 18-64 living in Hampton Roads in any given year through the year 2030,

there exists a significant need to improve the mobility of 18-64 non-drivers in Hampton Roads.

## B. Factors Related to Mobility of Age 18-64 Non-Drivers

### 1. Regression of NHTS Data

Having determined that the need exists for the improvement of the mobility of non-drivers age 18-64 in Hampton Roads, NHTS data was used to identify the factors which affect the mobility of this population.

## Data and Technique

The full NHTS data set (national sample plus add-on surveys requested by various states, regions, and cities) was used to identify the factors which affect the mobility of this population. The details of one day's travel for a total of 4,945 persons was available. Staff converted the raw survey results from these 4,945 persons into 186 descriptive variables, then used regression techniques to search for factors related to mobility. Mobility was defined as "making one or more trips on the survey day" (i.e. getting out of home). On the survey day, each person either got out of the home (given a value of "1") or did not get out of the home (given a value of "0"). Because of the binary nature of the dependent variable (i.e. having exactly two possible values), staff chose binary logistic regression to conduct the analysis.

# Factors Related to Mobility of 18-64 Non-Drivers

Of the 186 candidate variables, regression indicates that the following 20 variables are significantly related to the mobility of non-drivers age 18-64:

<u>Variable</u>	<u>Meaning</u>	<u>Range of Values</u>	<u>Sig. (2)</u>	<u>Exp[B] (3)</u>
Diarycmp_1	Travel diary completed	0,1	0.000	3.23
Dtspeed_m	Drivers speeding considered a problem	1-5	0.000	1.26
Educ_x	Education level	0-8	0.015	1.06
Hbh_uc	Home in a population "center"	0,1	0.000	1.41
Hbhtnrnt_m	Portion renter occupied, by tract	0.00-1.00	0.003	1.60
Hhc_4472	LA-Riverside-O.C. MSA/CMSA	0,1	0.016	1.97
Hhr_race01	Household respondent race is White	0,1	0.009	0.81
lif_cyc07	One adult, youngest child 16-21	0,1	0.015	2.17
lif_cyc09	One adult, retired, no children	0,1	0.021	0.70
Medcond6t5	Med. cond., travel difficult, not lifelong	0,1	0.000	0.46
Msacat_2	MSA of 1 million or more, no rail	0,1	0.001	0.74
Proxy_no	Travel day info from respondent	0,1	0.000	1.61
R_age50p	Age 50-64	0,1	0.013	0.81
R_relat6	Subject is "Other Relative" of HH resp. (1)	0,1	0.002	0.60
R_sex_male	Male	0,1	0.004	1.25
Smp_westat	Survey completed by Westat	0,1	0.000	2.13
Trav_wkend	Travel day was on weekend	0,1	0.000	0.75
Webacc1	Access to internet	0,1	0.002	1.29
Wherborn01	Born in US Territories	0,1	0.001	0.44
Wrk_oth_y	Worker in house other than self	0,1	0.003	0.79
Constant	n.a.	n.a.	0.000	0.38

## Notes

- (1) Subject is a relative of household respondent, but not a spouse, child, parent, or sibling.
- (2) "Sig.": Significance, i.e. the probability of being incorrect when assuming the subject variable is correlated to the dependent variable.  
(The lower the "sig." number, the more certain the correlation.)
- (3) "Exp[B]":  $e^B$ , where B is the coefficient of the subject variable in the logistic regression equation; measures variable's impact on the odds of "getting out".



## Meaning of Coefficients

Because the regression form is “binary logistic”, the exponent of each model variable’s coefficient, “ $\text{Exp}(B)$ ”, indicates the variable’s impact on the odds of getting out of the home on a given day. For example, the  $\text{Exp}(B)$  value of the gender variable (“R\_sex\_male”) is 1.25. Therefore, if a female non-driver with certain characteristics had 2-to-1 odds (i.e. 67% chance) of getting out of the home on a given day, a male non-driver with the same characteristics would have odds higher by a factor of 1.25, or 2.5-to-1 odds\* (i.e. 71% chance).

\*  $2 \times 1.25 = 2.5$

## Variable of Interest

The regression indicates that 20 variables (listed two pages prior) are significantly related to the mobility of non-drivers 18-64. Two of these variables—education and medical condition—are beyond the scope of this study. Other variables, e.g. “Age 50-64” and “Male”, are not changeable. Of the 20 significant variables, the land use variable (“Hbh\_uc”) appears to be the most promising for improving the mobility of 18-64 non-drivers via this study. The “Hbh\_uc” variable indicates that persons living in Central Areas have 40% higher odds of getting out of the home on a given day.

The land use variable is examined in detail in the following section.

## 2. Details Concerning Land-use Variable

### a. Five Area Types

Claritas, a company contracted by the federal government to work on the NHTS project, divided the US into 900,000 squares (called “grids”), each approximately 4 sq. mi. in area. Each grid was classified according to five Area Types.

The development of the five Area Types is described below.



## 3 Density Classes

Each of the 900,000 US grids was classified according to the relationship of its density\* to the densities assigned to all other US grids, by percentile. The percentiles were grouped into three classes:

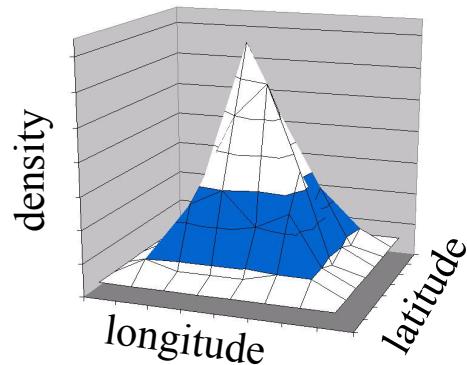
0% - 20%	“Low Density”
20% - 40%	“Med/Low Density”
40% - 100%	“Med-to-High Density”

\*A “contextual density” was calculated for each grid, being the density of the 3x3 matrix of grids with the subject grid at the center of the matrix. In other words, instead of simply calculating the density of each grid, each grid was assigned the density of the 3x3 matrix of grids of which it is the center.

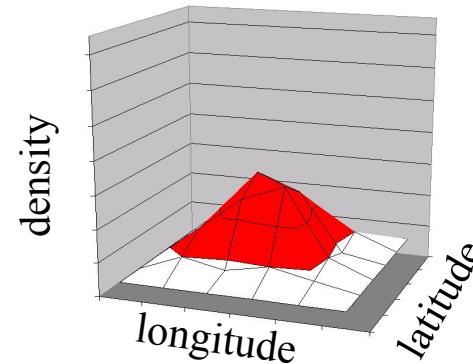


## Two Relational Natures

Claritas then determined the “relational nature” of the grids in the highest of the three density classes. The relational nature describes the centrality of the subject area, i.e. its density *relative to that which is near it*. Using this concept, Claritas labeled grids as one of two natures: “Central Area” or “Surrounding Area”. “Central Areas” are defined as those areas which have density higher than the areas adjacent to them; “Surrounding Areas” are defined as those areas which have density lower than the areas which they surround. See below.

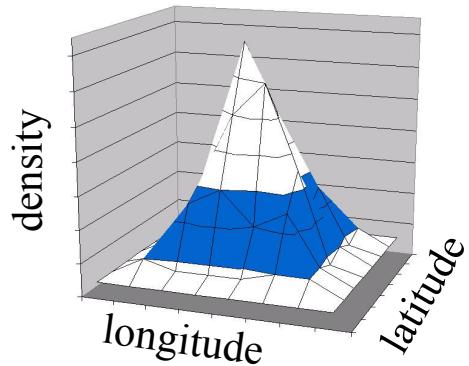


“Surrounding Area”

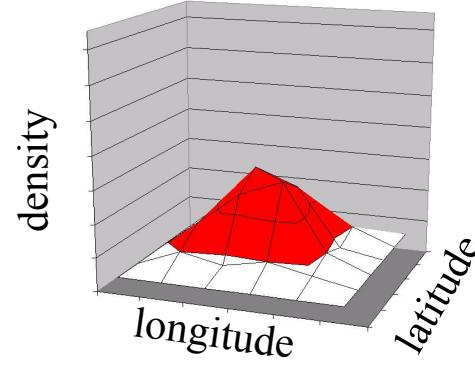


“Central Area”

## Two Relational Natures (cont.)



“Surrounding Area”



“Central Area”

Note that an area's density, by itself, does not determine whether it is a Surrounding Area or a Central Area. In the example diagrams repeated above, one notices that the red Central Area (right-hand diagram) does not have a density higher than the blue Surrounding Area (left-hand diagram); the red Central Area simply has a density higher than the white area which surrounds it. Because an area's type is defined by its density relative to its own nearby areas, some areas labeled as Central Areas (e.g. Annapolis, MD) actually have densities lower than the densities of some areas labeled as Surrounding Areas (e.g. NYC suburbs).

## Five Area Types

Finally, Claritas' combination of the three density classes (which are based solely on density) and the two relational natures (which are based on density relative to nearby densities) resulted in the following five Area Types:

- 1) Low Density Area
- 2) Medium/Low Density Area
- 3) Surrounding Area with Medium-to-High Density
- 4) Central Area with Medium Density
- 5) Central Area with High Density

## b. Mobility Associated with each Area Type

Having examined the development of the five Area Types, the mobility for non-drivers age 18-64 is examined according to the Area Type in which they live.

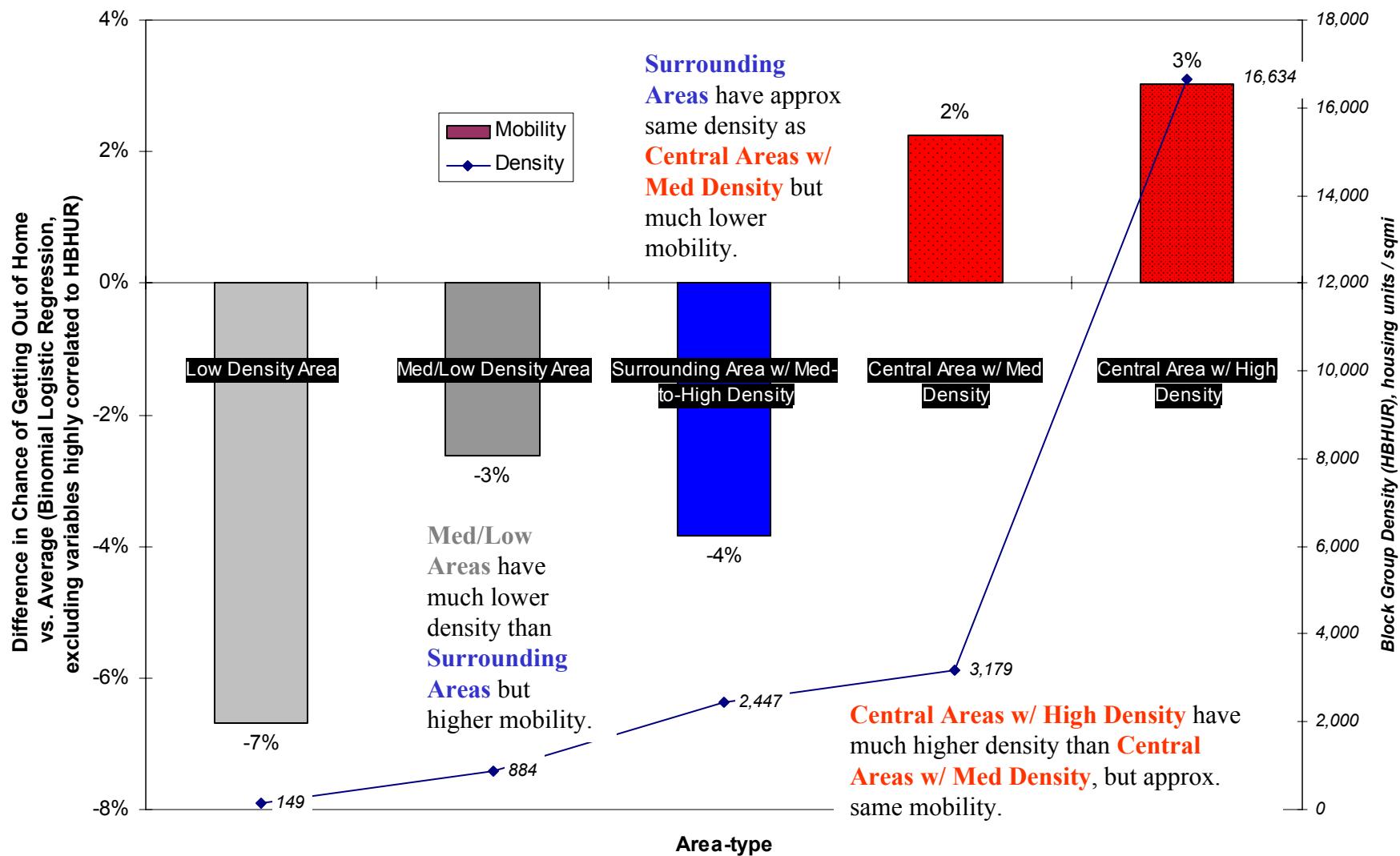
As shown on the following chart, mobility is a function of Area Type, i.e. both density and centrality. A careful examination reveals that: 1) higher density is sometimes—but not always—associated with higher mobility; 2) centrality is the key to mobility. Med/Low Density Areas have higher mobility than Low Density Areas- demonstrating the impact of density on mobility. Yet Surrounding Areas with Medium-to-High Density have no higher mobility than Med/Low Density Areas- demonstrating the ineffectiveness of density in Surrounding Areas. Central Areas with Medium Density, although having approximately the same density as Surrounding Areas with Medium-to-High Density, have much higher mobility than those Surrounding Areas- demonstrating the effectiveness of centrality.

Note: The chart (following page) can be used to compare the mobility associated with any two Area Types by calculating the difference in their chart values. For example, on average, the chance of a particular type of 18-64 non-driver “getting out” while living in a Central Area with Medium Density is 9% higher\* than the chances for a similar person living in a Low Density Area.

\* The difference between 2% and -7% is 9%.



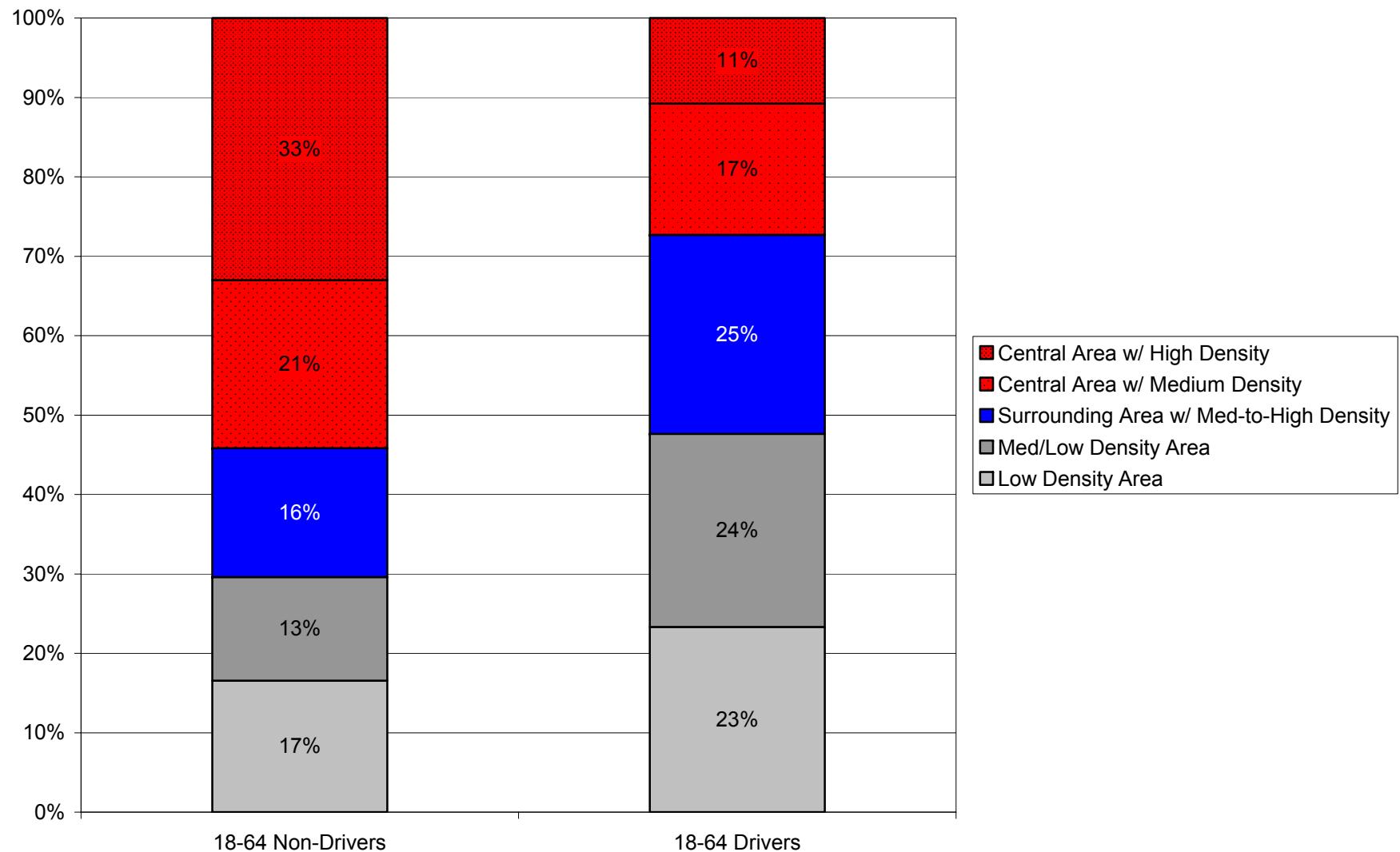
## Area Type vs Getting Out of Home, 18-64 Non-Drivers, NHTS, Full Data Set, 2001



## Choice of Location Reflects Mobility

As shown on the following chart, non-drivers choose to live in Central Areas more so than do drivers. The fact that non-drivers tend to be located in Central Areas is an indication that living in Central Areas actually *provides* higher mobility (as opposed to a spurious relationship between non-driver mobility and Central Areas).

### Residential Location by Driver Status, NHTS, National Sample, 2001



### 3. Factors Behind Central-Area Result

Centrality (i.e. being surrounded by lower density), in and of itself, would not be expected to cause higher mobility. Therefore, centrality must be a surrogate for the actual factors which cause higher mobility.

As a step toward finding the actual factors which cause higher mobility (and which tend to be found in Central Areas), the difference in trip-making between Area Types by mode of travel is examined on the following pages.

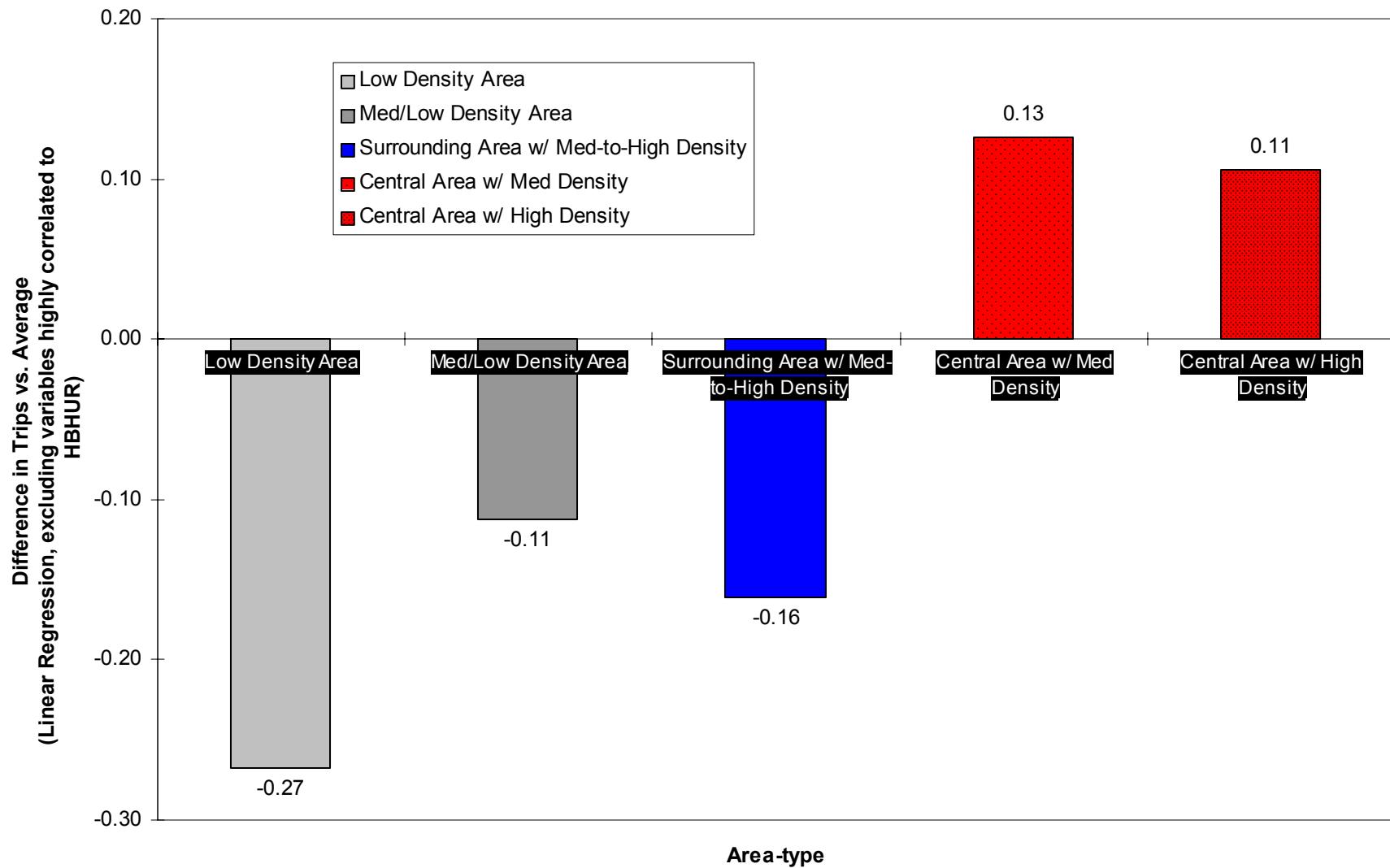
## a. Mode of Travel by Area Type

When non-drivers use multiple modes in one day (which they often do), it is not possible to attribute their mobility to one particular mode. Therefore, in this section, modal data is examined on the basis of *trips* made per day (as opposed to the basis of whether or not a person got out of the home).

The first step is to determine the relationship between Area Type and the number of trips made in a day (as was done previously for the relationship between Area Type and getting out of the home). This was achieved by excluding the Area Type variables (and variables closely correlated to them) from the original data set, using this new data set to prepare a model that explains the trips recorded in the NHTS, and calculating the un-explained portion of trip-making (the “residuals”, in statistical terminology) by Area Type. The results are shown on the following page.

For example, based on the following chart, a particular type of 18-64 non-driver living in a Central Area with Medium Density takes 0.40 more trips per day (i.e. the difference between the 0.13 and -0.27 values shown on the chart) than a similar person living in a Low Density Area.

## Trip Differences, by Area Type



## Modal Components of Trip Differences, by Area Type

The preceding chart shows how trip-making varies by Area Type. The next step is to break down these differences by mode, thereby showing how each mode contributes to the difference in mobility provided by each Area Type. This break-down was achieved by preparing models for each mode using the variables from the previous model. The dependent variable in each model is the number of trips made via that mode, e.g. number of bike trips made on subject day.

As described previously for total trips, the average un-explained trip-making was calculated by Area Type for each model. Using these results, some Area Type comparisons are shown on the following pages.

## Med/Low Density Area vs. Low Density Area

<u>Med/Low Density Area vs. Low Density Area</u>	<u>Trip Difference</u>
Bike	0.02
Bus	0.08
Local Train	0.00
Other	-0.01
Pers Veh	-0.08
Taxi	0.03
Walk	0.10
	<hr/>
	0.16

Walking and bus riding give 18-64 non-drivers higher mobility in Med/Low Density areas (vs. Low Density areas).



## Central Area w/ Medium Density vs. Surrounding Area w/ Medium-to-High Density

<u>Central Area w/ Med Density vs.</u>	<u>Trip</u>
<u>Surrounding Area w/ Med-to-High Density</u>	<u>Difference</u>
Bike	0.04
Bus	-0.06
Local Train	-0.05
Other	-0.03
Pers Veh	0.14
Taxi	0.05
Walk	0.21
	0.29

Walking and personal vehicle riding give 18-64 non-drivers higher mobility in Central Areas w/ Med. Density (vs. Surrounding Areas w/ Med-High Density).

## Central Area w/ High Density vs. Surrounding Area w/ Medium-to-High Density

<u>Central Area w/ High Density vs.</u>	<u>Trip</u>
<u>Surrounding Area w/ Med-to-High Density</u>	<u>Difference</u>
Bike	-0.01
Bus	0.22
Local Train	0.23
Other	-0.02
Pers Veh	-0.63
Taxi	0.04
Walk	0.43
	<hr/>
	0.27

Walking, bus riding, and local train riding give 18-64 non-drivers higher mobility in Central Areas w/ High Density (vs. Surrounding Areas w/ Med-High Density).



## Significance of Alternative Modes

As shown in the preceding tables, alternative modes—primarily walking, bus riding, and local train riding, to a lesser extent biking and taxi riding—are the modes which account for the additional trips made by 18-64 non-drivers in Central Areas. The actual factors which cause higher mobility in Central Areas must, therefore, be associated with alternative modes.

## b. Factors Contributing to Travel by Alternative Modes

The NHTS does not contain information on the availability of bus service, the presence of sidewalks, or the number of destinations in the environs of the home of the subject interviewee. Although the factors contributing to travel by alternative modes can not be extracted from the NHTS data, a common-sense analysis can provide some insight.

Due to the speed of traveling by foot or wheelchair, it is expected that persons living near destinations walk more frequently than similar persons who do not live near destinations. Destinations may include businesses, shopping, public facilities (rec. centers, libraries, parks), and residences of friends and family. In addition, it is expected that persons are more likely to walk if their environment is pedestrian-friendly. Pedestrian-friendly environments have pedestrian infrastructure (such as sidewalks), low crime, and low traffic speeds.

It is expected that the use of public transit is promoted by factors associated with both the transit service and the environment in which they operate. Due to the speed of walking, one is more likely to use public transit if routes are within walking distance. Due to the need to coordinate transit and personal schedules, and due to the convenience of lower waiting times, one is more likely to use public transit if the service runs at higher frequencies. Due to lower speeds of transit travel, one is more likely to use public transit if destinations are closer.

### c. Characteristics of “Central Areas”

Although the Claritas Area Type classifications for the U.S. are proprietary (including “Central Area” designations), the Area Types in the vicinity of DC have been published. Therefore, the characteristics of Central Areas can be studied by examining the twelve Central Areas in the vicinity of DC.

The Central Areas in the vicinity of DC include Frederick, Manassas, Gaithersburg, Annapolis, western Fairfax County (including Herndon and Chantilly), Baltimore, and the District itself. These Central Areas are mostly large cities, small cities, or “edge cities”. Most of these areas have public transit; all of them appear to have many business, shopping, and government facility destinations.

## d. Conclusion

# Factors which Increase Mobility for 18-64 Non-Drivers

In light of:

- Central Areas having higher mobility,
- this higher mobility being obtained via alternative modes,
- closer destinations, adequate transit service, and pedestrian-friendliness being conducive to travel by alternative mode, and
- Central Areas tending to have public transit service and destinations close to residences,

it appears that:

- closer destinations
- transit service
- pedestrian-friendly environment

are factors which increase the mobility of 18-64 non-drivers.

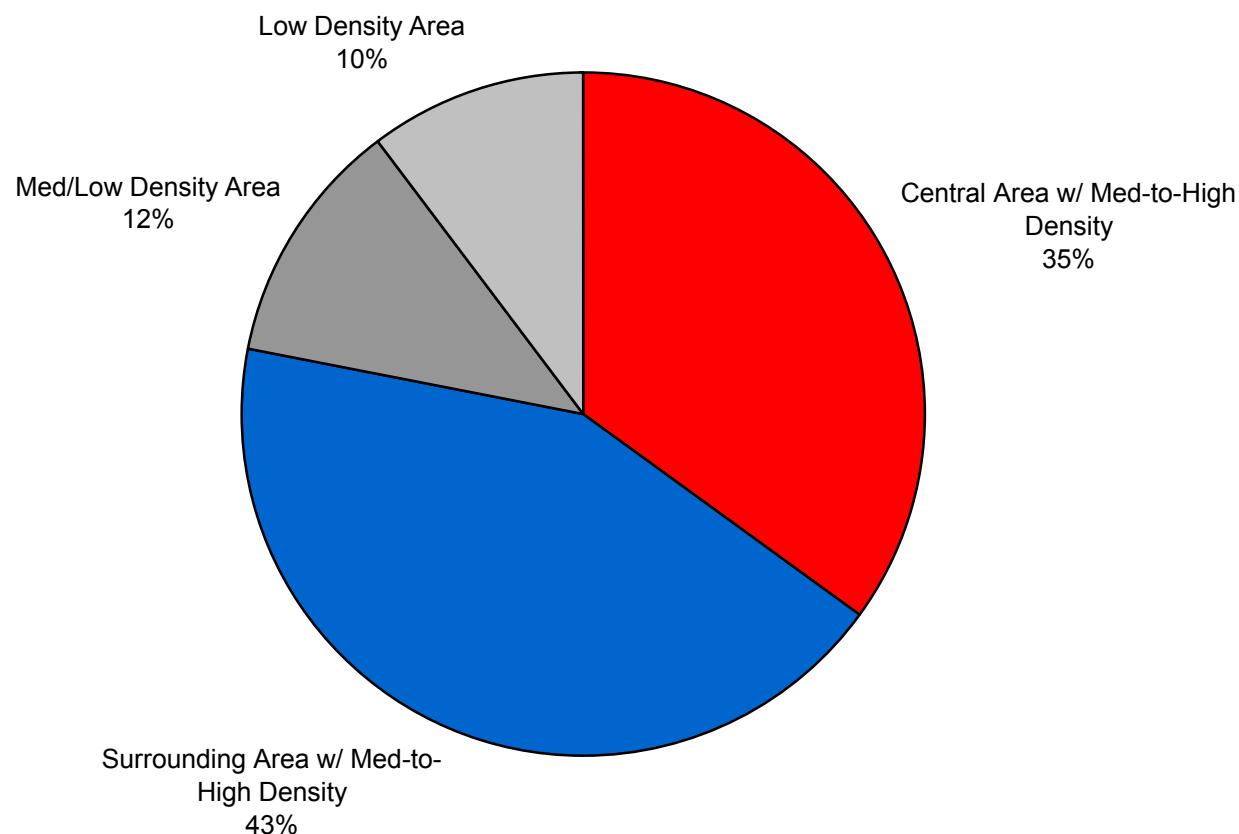
## C. Improving the Mobility of Non-Drivers Age 18-64 in Hampton Roads

As shown on the following chart, a significant portion of Hampton Roads residents live in Central Areas.

It is assumed that the non-drivers living in these areas are experiencing the higher mobility which tends to be present in Central Areas.

# Central Areas in Hampton Roads

Norfolk-VB-NN MSA, 2001 NHTS: 341 persons surveyed



## Possible Actions for Improving Mobility

Both individuals and local government can take actions to improve the mobility of 18-64 non-drivers.

18-64 Non-Drivers who live in those portions of Hampton Roads with poor non-driver mobility may wish to move to areas where destinations are near and pedestrian and transit infrastructure are provided. Considering the discussion of Central Areas in the U.S. above, it is likely that the Central Areas of Hampton Roads have the necessary destinations and infrastructure for higher 18-64 non-driver mobility.

Local governments can take steps to improve the mobility of 18-64 non-drivers, via zoning and infrastructure.

A local government in Hampton Roads can use its zoning authority to promote the development of areas where residences are near destinations. Localities can use zoning to encourage development of more residences in areas where business, shopping, and government facility destinations already exist. This is already being done in some areas, e.g. Downtown Norfolk and Oyster Point. Conversely, localities can use zoning to encourage the location of business and shopping destinations in areas where many residences already exist. Finally, localities can use zoning to encourage mixed-use developments which simultaneously add residences and destinations to the same area. This is already being done in some areas, e.g. New Towne, Port Warwick, and Town Center.



## Possible Actions for Improving Mobility (cont.)

A local government can use its budget to improve the mobility of 18-64 non-drivers. It can locate government facilities (rec. centers, libraries, etc.) in areas where many residences already exist. And localities can invest in improvements to pedestrian and transit infrastructure, particularly in those areas where destinations are near residences.

In summary, this analysis using NHTS data and common-sense transportation assumptions indicates that the combination of walk-able areas, transit infrastructure, and destinations and residences being near each other will result in measurably higher mobility for 18-64 non-drivers in Hampton Roads.

Note: This analysis and resulting recommendations were based on the assumption that pedestrian environments, transit infrastructure, and destinations close to residences are the factors which provide higher mobility for 18-64 non-drivers in Central Areas. Further research could test these assumptions, measuring the impact of each factor. The next portion of this study will investigate the factors behind the higher mobility found in Central Areas by gathering data on bus service, sidewalks, and closer destinations via a phone survey of non-drivers in Hampton Roads (survey is underway).