

## THE GEOGRAPHY OF WAREHOUSING AND DISTRIBUTION IN SOUTH-CENTRAL PENNSYLVANIA

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**ABSTRACT:** *Over the past decade the I-81 corridor between Hagerstown, Maryland, and Harrisburg, Pennsylvania has seen dramatic growth in warehousing and distribution facilities. Currently there are over 100 warehousing, distribution, and trucking related facilities along this 75 mile stretch of interstate freeway within the Cumberland Valley, with more under construction or in the planning stage. Several factors are responsible for the growth of the trucking industry in this region. Interstate 81 passes through few large cities, unlike I-95 to the east, so urban traffic is minimal. Interstates 70, 76, and 78, which intersect I-81 within the region, provide easy access to both the eastern seaboard and the interior. Municipalities view warehousing as a benign form of economic development, and local land owners are eager to sell to development companies as prices increase. Initially facilities were limited to the freeway interchanges at Hagerstown, Harrisburg, and Carlisle. However, warehousing and distribution has begun to spread throughout the valley, particularly in Chambersburg, which has recently seen a significant increase warehouse construction. This paper describes the geography of warehousing and distribution related facilities within the Cumberland Valley and identifies some of the issues facing the region in light of the continuing growth of this industry.*

### INTRODUCTION

Interstate 81 forms one of the principal north-south corridors in the mid-Atlantic region. Stretching from eastern Tennessee to the Canadian border in New York, I-81 provides easy access to both the large metropolitan areas along the east coast and the more modest Trans-Appalachian cities of the interior. Since the freeway passes through no large cities along its entire length urban traffic is minimal. These characteristics have allowed I-81 to become a major long-haul trucking corridor and one of the busiest truck routes in the country. Perhaps the best connected section of I-81, in terms of both north-south and east-west access, is found in the Cumberland Valley along a 75 mile stretch of freeway from Hagerstown, Maryland to Harrisburg, Pennsylvania. Interstates 68, 70, 76, 78, and 83 all intersect I-81 within this region, providing direct links to Washington D.C., Baltimore, Philadelphia, and New York. The trucking industry has long

recognized the importance of this corridor and many of the mid-sized LTL (less than full-load) trucking companies have been in the region since the 1970s. Over the past decade the warehousing and distribution industries also have recognized the importance of I-81 and the key role south-central Pennsylvania plays in terms of market accessibility. The development of I-81 QUADCO—an economic development alliance covering four counties in four states along I-81 south of Chambersburg, Pennsylvania—has signaled a willingness to forego political boundaries in favor of capitalizing on the region's competitive advantages (Ross, 1994). State and county economic developers have begun specifically targeting warehousing and distribution as a key regional industry and the results of these efforts are easy to see on the landscape in the rapid growth of warehousing and distribution facilities.

As is often the case, uncontrolled growth of an industry results in reactive rather than proactive planning—a situation south-central Pennsylvania currently faces. Three counties in two states fall

within the Cumberland Valley, and although each county is beginning to examine the impacts of warehousing, there has been no effort to examine the cumulative impacts at either the local or regional scale. Given the nature of this industry and the geography of the valley, growth in warehousing in any part of the region will likely have region-wide consequences. Surprisingly, there has been very little research on the spatial aspects of warehousing in the geographic literature. Although location theory has been an active field of geographic research since first introduced by Alfred Weber in 1909, its application in warehouse facility location really only came into its own during the 1980s (Brandeau and Chiu, 1989). The most recent research has typically been formulated as optimization problems where facilities serve some form of demand, with the objective being to minimize travel time or costs (See Tyagi and Das, 1997; Pirkul and Jayaraman, 1996; Ho and Perl, 1995; Cavalier and Sherali, 1986). Logistics and site selection methods research have created a substantial body of literature from which operations managers can draw on when deciding on the location of a new facility, but there has been paucity of research which addresses the cumulative impacts of these decisions. Within the field of industrial location, the research on cumulative impacts with regard to heavy or polluting industries is well established (See Witten, 2001; Piper, 2001), yet the growth of the warehousing and distribution industries has been seen as a benign form of local and regional economic development and therefore little effort has been made to examine the spatial consequences of warehouse and distribution agglomerations.

## **METHODS**

To examine the geography of warehousing and distribution in the Cumberland Valley the locations of all warehousing, distribution, and trucking activities were gathered during the Fall of 2002. An extensive driving survey was conducted along the length of I-81 and coordinates for each facility were gathered using a hand-held global positioning system (GPS) unit. The facility coordinates were then entered into a geographic information systems for subsequent mapping and

analysis. Additionally, regional economic planners and a sample of facility operators from each of the three counties were interviewed during the data gathering phase of the project. Many warehouse operators were reluctant to discuss the particulars of their operations, especially questions concerning the number of trucks their facility generates. Mid-sized operators were the most cooperative, so the information gleaned from these interviews were biased toward this group.

For the purposes of this research all facilities related to product storage, accumulation, and/or distribution were classified into one of three categories. The first category is warehouses and distribution facilities. Warehouses are those facilities where goods may be deposited without payment of duty. They may be operated by a single company and house only that company's products (e.g. Whirlpool) or they may be space providers that store products from a variety of manufacturers. A distributor is a buying, warehousing, and distributing organization that delivers merchandise to retail stores in their own trucks (e.g. a wholesaler or direct-buying retail chain such as Target). The second category is trucking and long-distance hauling facilities. These are operations that move goods by truck to and from accumulation points but do not produce or purchase goods (e.g. Consolidated Freight). Companies that perform logistics<sup>1</sup> functions also fall within this category. The final category is that of associated industries, and includes trucking related service facilities such as truck maintenance and repair, equipment sales and service, scales, and fueling. Of the 134 facilities located near I-81 within the region, 46 were classified as category 1, 42 were classified as category 2, and 46 were classified as category 3.

## **REGIONAL SETTING**

The study region is comprised of Franklin and Cumberland counties in Pennsylvania and Washington county in Maryland (Figure 1). These three counties encompass the Cumberland Valley, an area that has played a pivotal role in the transportation history of the Mid-Atlantic region (Marr, 2002). The region remains an important transportation link between the east coast and the

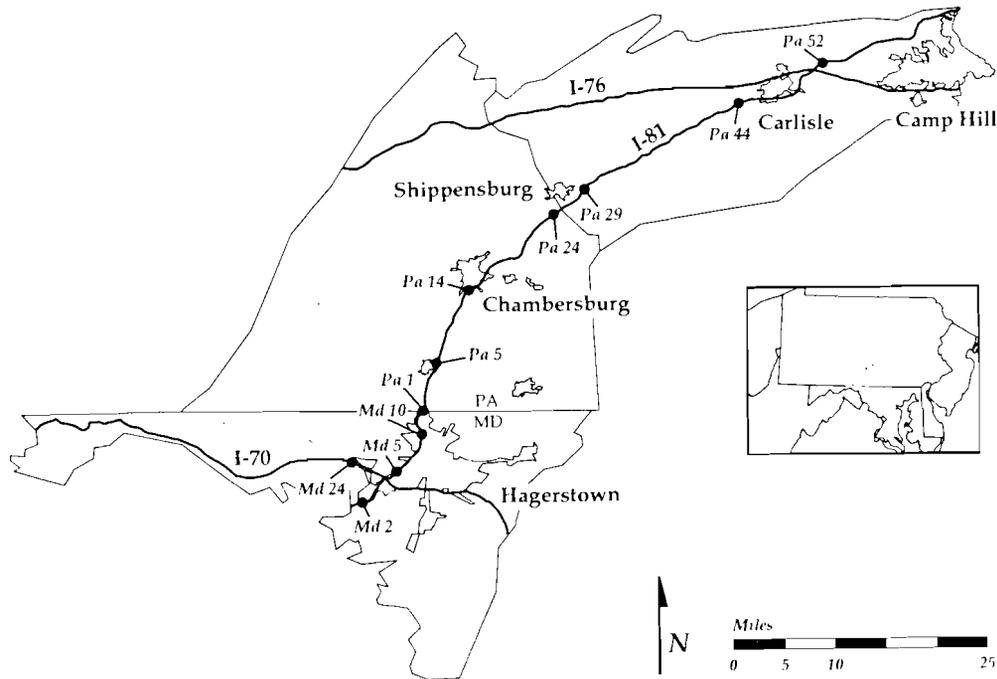


Figure 1: Cumberland Valley study region.

interior and the landscape plays a major part in the valley's role in that capacity. The valley is the northern extension of the Great Valley system and is bounded on the north by the Susquehanna River and on the south by the Potomac River, to the east by the broad South Mountain complex, and to the west by the folded ridges of the Kittatinny and North Mountains. As the valley enters Pennsylvania it bends rather sharply toward the east, making the valley an attractive route either east-west or north-south. Freeway planners recognized the importance of the valley for surface transportation, as evidenced by the number interstate freeways which meet here. Interstate 81 traverses the length of the valley, while to the south I-70 and to the north I-76 cross the valley. Interstates 83 and 78 meet I-81 in the far northern section of the valley near Harrisburg.

The valley's topography is one of low, gently rolling hills, and land use within the study region is primarily agricultural. The population of the

study area's three counties was just under 475,000 in 2000<sup>1</sup>. Median family income for the three counties was approximately \$42,600, or just above the national median of \$42,000. Urban - rural populations differ markedly among the counties. Cumberland county has the highest percent urban population (75%), followed by Washington county (68%), and Franklin (53%). By far the largest city in the region is Hagerstown with a 2000 population of just under 37,000. Carlisle and Chambersburg are both slightly less than 18,000, followed by Mechanicsburg (9,000), Camp Hill (7,600), and Shippensburg (5,600) (U.S. Census Bureau 2002). Franklin is one of the fastest growing counties in Pennsylvania, reporting a 6.8% growth rate between 1990-2000. Manufacturing, wholesale, and retail trade services, and government are the largest employers, accounting for more than 75% of the regional employment.

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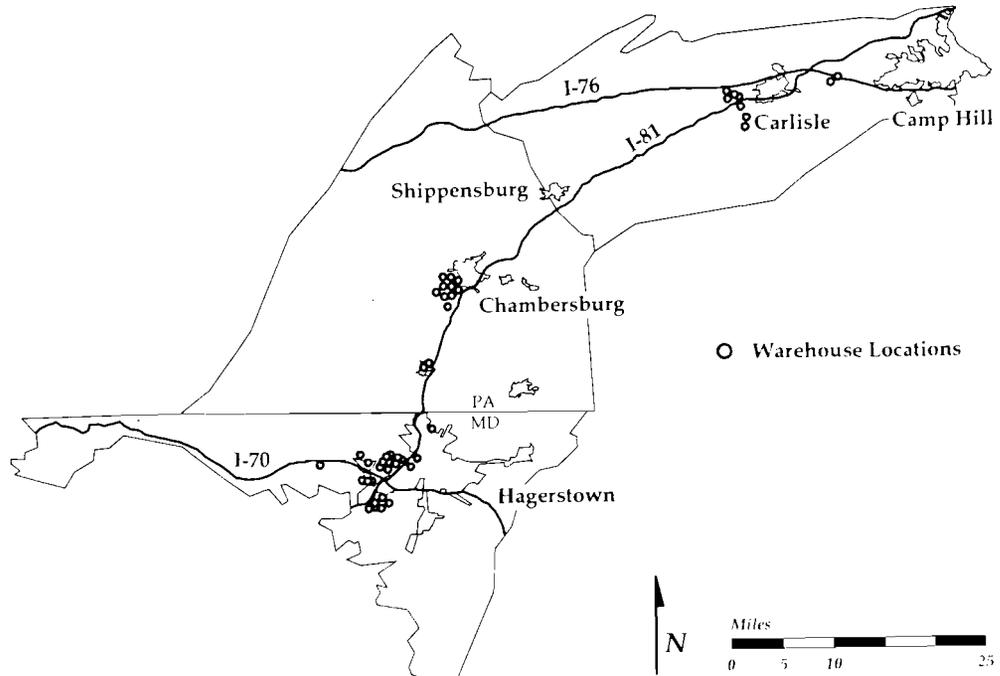


Figure 2: Warehouse and distribution facilities, 2002.

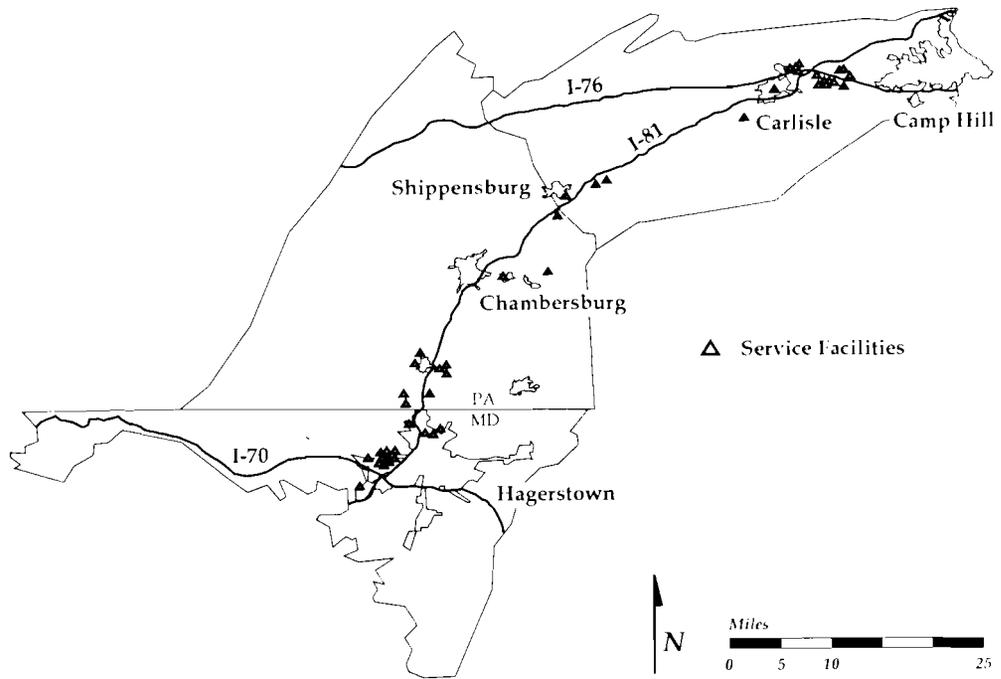


Figure 3: Trucking and logistics facilities, 2002.

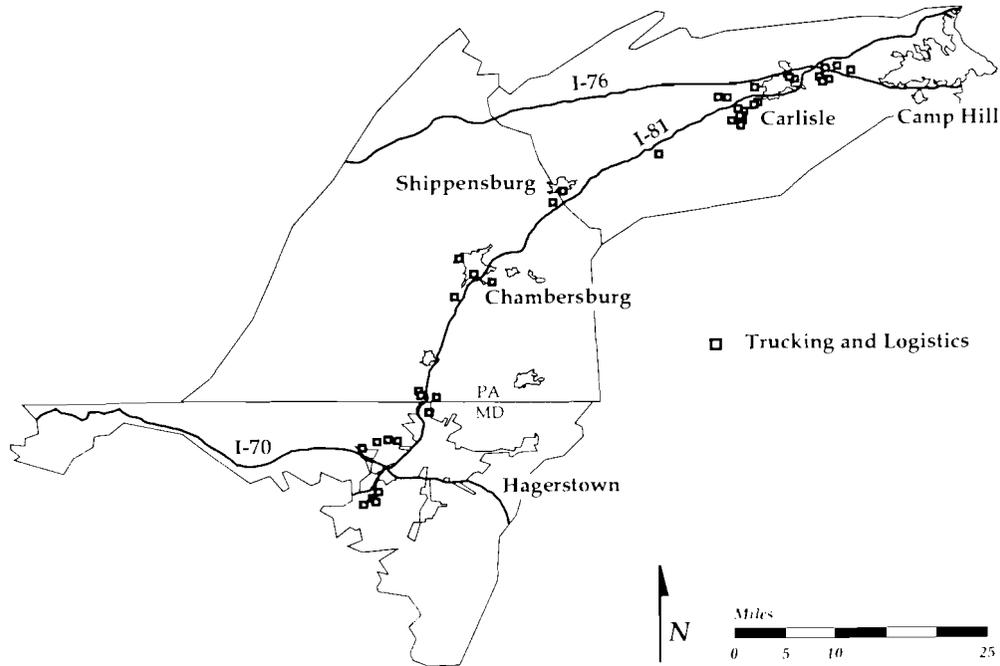


Figure 4: Service facilities, 2002.

## WAREHOUSING AND DISTRIBUTION IN THE REGION

Within the three country region there are (as of Fall, 2002) 46 warehousing and distribution facilities accounting for 34% of the total locations. Most of these facilities are clustered in the largest cities near the areas of greatest freeway accessibility, principally in Hagerstown near the I-81 and I-70 interchange and south of Carlisle near exit 44 on I-81 (Figure 2). Another sizable cluster is found near PA Exit 14 in Chambersburg, which contains 10 warehouses or 22% of the total. In total these three locations account for 85% of all warehouses in the region (39 of 46). There are 42 trucking and logistics companies within the study area, accounting for 31% of the total locations. Trucking and logistics facilities are more widely distributed, with locations in both Chambersburg and Shippensburg. There are two large clusters located near PA Exits 44 and 52 in

Carlisle, and a smaller cluster near MD Exit 2 (Figure 3). Service industries account for 46 of the 134 total facilities (34%). Service facilities are also more widely scattered, again with two large clusters occurring near the I-81 and I-70 interchange and the I-81 and I-76 interchange (Figure 4).

To better understand the spatial distribution of activities relative to site specific characteristics a classification scheme was developed using freeway exits as an observation unit. Within the study region there are 31 freeway exits on I-81, ten of which have some form of warehousing or trucking related activities. Based on their proximity, each trucking related location was assigned to a freeway exit. The freeway exits were then categorized based on the types and frequencies of activities that occur there (Table 1). Freeway exit *Use Type W* have predominantly warehousing and trucking activities. Exit *Use Type S* are primarily service oriented. *Use Type M* exits were considered mixed, with no particular activity being predominant.

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Table 1. Freeway exit types and activities

Exit	Facilities	Warehouses	Trucking	Services	Exit Class <sup>§</sup>	Exit Type
MD 2	11	6 (55)	5 (45)	0 (0)	PC	W
MD 5	21	8 (38)	4 (19)	9 (43)	D	M
MD 10	6	2 (33)	0 (0)	4 (66)	C	S
PA 1	7	0 (0)	4 (57)	3 (43)	PC	S
PA 5	7	2 (29)	0 (0)	5 (71)	C	S
PA 14	14	10 (71)	3 (21)	1 (7)	PC	W
PA 24	2	0 (0)	1 (50)	1 (50)	D	S
PA 29	2	0 (0)	0 (0)	2 (100)	D	S
PA 44	20	8 (40)	11 (55)	1 (5)	D	S
PA 52	25	2 (8)	9 (36)	14 (56)	PC	S
<b>Subtotal</b>	115	38	37	40		
<b>All Others</b>	19	8	5	6		
<b>Total</b>	134	46	42	46		

\* Percentages of total appear in italics.

§ Exit class refers to the design of the exit: C– full cloverleaf, PC– partial cloverleaf, D– diamond.

There are two dominant types of freeway exits, those that primarily serve warehousing and trucking and those that operate primarily in a service capacity (Figure 5). Exits MD Exit 2 (near the I-81 and I-70 interchange), PA Exit 14 (Chambersburg), and PA Exit 44 (Plainfield near the I-81 and I-76 interchange) have primarily warehousing activities, which is to be expected given that these locations offer high accessibility, good access to infrastructure (e.g. electrical service, sewer, water), and are close to the urban centers. The trucking and service activities also found here are likely a function of scale and agglomeration economies, however the percentage of service activities at these exits is small (< 7% of the total facilities at each exit). Outside of the urban areas the freeway exits are dominated by service activities, yet the number of facilities at rural exits is expectedly small, ranging from 2 to 5 service locations per exit. Field examination of these service facilities suggest that most predate the mid-1990s warehouse boom. The sole mixed use freeway exit (MD Exit 5 in Hagerstown) appears to be in a transitional stage. This exit had been dominated by trucking service facilities such as fueling stations, truck sales, scales, and repair shops. Within the last five years local farmers have been selling their land to developers and several very large parcels have been converted to warehousing and distribution. There is currently a road under construction that will

link MD Exit 5 on I-81 to MD Exit 24 on I-70, and this bridge route will no doubt make the area much more attractive to the warehousing industry.

Chambersburg is unusual in that it has the single largest clustering of warehouses without the attendant service operations. The two service facilities that are near Chambersburg are wholesalers that sell truck parts throughout the area and are therefore not actually performing a local service function. The number of warehouses in Chambersburg can not be explained based on land prices. The price of land here averages approximately \$74,000 per acre, similar to the \$79,000 average cost per acre near the Plainfield exit west of Carlisle. The price of land drops significantly outside of the three major warehousing locations, but this price differential is offset by the costs associated with infrastructural improvements. For example, the cost of land near PA Exit 29 in Shippensburg averages around \$37,000 per acre and currently there is a 200 acre non-zoned parcel for sale here. However, it has been estimated by the Franklin County Economic Development Corporation that the costs per acre rises to over \$65,000 once infrastructural improvements are added.

Incentive programs certainly have some influence on the growth of warehousing in Chambersburg. While Cumberland and Washington counties offer no specific incentive packages to

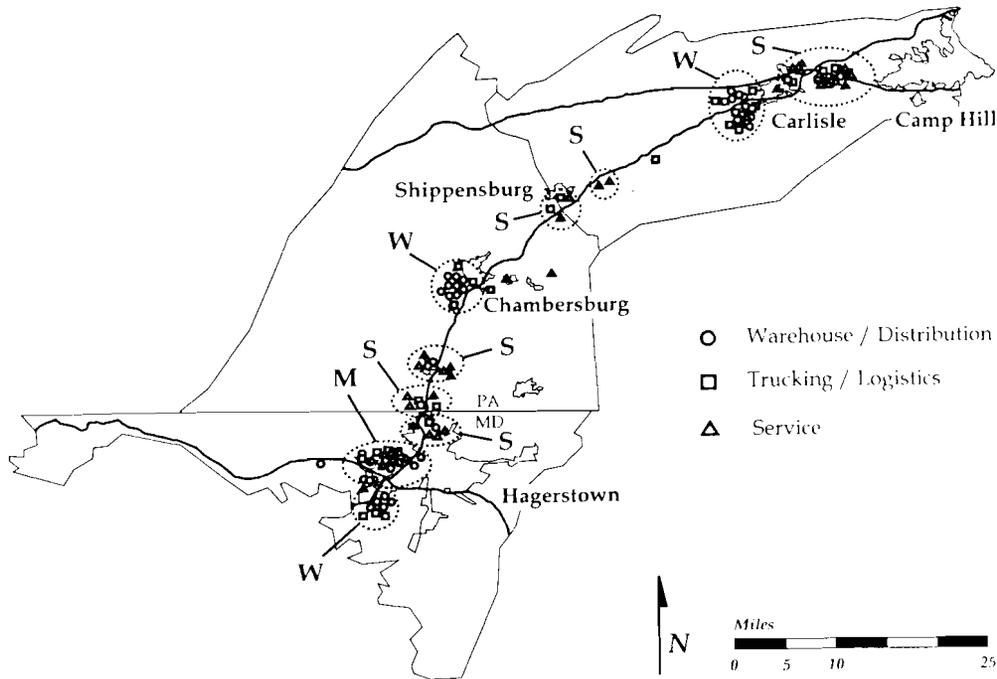


Figure 5: Exit classification based on the type of trucking related activities. Some warehouse, trucking, and service locations have been removed for clarity.

companies wishing to locate there. Franklin county has a variety of incentives which are administered by the Franklin County Area Development Corporation. These incentives are tied to company investment and target mid to small size companies (those projects with construction costs totaling less than \$50 million). One incentive program—Community and Economic Development Opportunity grants—are state funds that can be used by private companies for construction, infrastructure, acquisition of land or buildings, site preparation, purchase or upgrading of machinery, and equipment, as well as working capital. Employee tax credits are incentives that can increase the take-home pay of employees at no cost to the employer. The New Job Creation Tax Credit provides a \$1,000 tax credit to approved businesses that agree to create a minimum of 25 new jobs or new jobs equaling at least 20% of its existing work force within three years. Company tax abatements are typically not part of an incentive package in Franklin county. Yet these programs target small to mid-size

companies and the warehouses currently being built in Chambersburg are by large corporations (such as Target and K-Mart) not eligible for many of these programs.

The physical layout of the individual exits apparently plays no significant role in determining how it will be used by the trucking industry. Many of the exits within the valley have short acceleration lanes (e.g. PA Exits 14 and 44), non-signalized surface road crossings (e.g. PA Exit 1 and MD Exit 10), or inefficient design (e.g. PA Exits 14 and 24). In fact trucks leaving the Target warehouse in Chambersburg cross over to the other side of the freeway using a local road flyover in order to avoid accessing PA Exit 14 from the west. Trucking related activities also showed no apparent preference toward any particular exit design. Most activities (113 of 134) were found within 1.5 miles of the nearest exit, suggesting that exit availability rather than design is the driving force. Warehouses showed the greatest spatial preference, with 90% being located within 1.5

miles of the nearest exit. Trucking and logistics showed the least spatial preference towards exits (79%), although even this figure is quite high. The majority of the trucking and logistics facilities that were greater than 1.5 miles from the nearest exit were found in Carlisle, clustered east of PA Exit 52 along State Highway 11 within easy access of both I-81 and I-76. Only two of the 134 facilities could really be described as having low accessibility, and those were the two truck parts wholesalers in Chambersburg.

Shippensburg, on the boundary between Franklin and Cumberland counties, marks the geographic center of the study area and when it is used as a break-point it appears that there is a southern bias in trucking related activity with 62% located south of Shippensburg. Warehouses are more prevalent in the southern half of the study area, with 78% occurring south of Shippensburg. Trucking facilities are more evenly distributed with approximately 50% located in each half of the study area. There is a modest southern bias in service facilities, with 59% occurring south of Shippensburg. This southern orientation may be a function of land availability, in that Franklin county is predominantly rural and has not yet seen the level of urbanization found in Cumberland county, especially along the interstates. Local warehouse operators and county economic planners stated that most trucks generated within the study area move southward. However, truck traffic count data from both the Pennsylvania and Maryland Departments of Transportation (2003) show that truck traffic generated within the study area on I-81 move in approximately equal numbers north and south.

## **REGIONAL IMPLICATIONS OF WAREHOUSING GROWTH**

The most visible impacts of the growth of warehousing and distribution in the Cumberland Valley are loss of agricultural land and increased truck traffic. Agricultural land preservation is a pressing issue in the region and both the state and local governments have obligated substantial resources in an effort to maintain the valley's rural character. From 1992 to 2000 Franklin county spent

nearly \$4.5 million on purchasing preservation easements for 3978 acres of farm land. Zoning could be used as a tool for agricultural land preservation, but zoning within the valley is a haphazard affair at best and variances are the norm. Townships with zoning ordinances have zoned much of the land near I-81 for industrial use, and many townships and boroughs along the interstate have no zoning.

Interviews with several warehouse operators suggest that on average warehouses and distribution facilities generate approximately 70 trucks per day and this figure is supported by daily truck counts gathered by PennDOT (2003). Each interviewee stated that changes at the national scale in how companies conduct business and distribute products have begun to impact warehousing in the Cumberland Valley. Mega-stores such as Target, Wal-Mart, and Sam's Club have built or are in the process of constructing larger warehousing facilities in the region which generate increasing truck traffic, both on the freeway and the surface streets. The freeway entrances were not designed to accommodate the current level of truck traffic and many trucks use the smaller rural roads to bypass difficult or congested entrances. Local residents concerned about the increasing volume of rural truck traffic have begun to voice their opposition to future warehouse construction (Figure 6). Interstate 81 was originally designed to handle 15% truck traffic, but currently there are sections of I-81 that now handle over 30% truck traffic (Pennsylvania Department of Transportation, 2003).

The movement toward larger warehousing facilities also impacts currently existing smaller warehousing facilities. Development companies which built warehouses on speculation just a few years ago are finding it difficult to get tenants if the buildings are less than 400,000 square feet. The situation in the valley now is that there are newer, larger warehouses being built while smaller warehouses sit vacant. Developers are paying premium land prices for warehousing in a market that has a glut of warehouse space. To some companies this creates a market opportunity if they are willing to utilize multiple small warehouses rather than a single large unit. For example, the Cadbury-Schwepps manufacturing plant in neighboring Adams county uses multiple small warehouses in Carlisle. Although much of their market is east of the plant, the dual attraction of location near I-81 and available



Figure 6: Warehouse protest sign in South Middleton Township, Pennsylvania near the site of a proposed 2.2 million square foot retail-goods distribution center project.

warehouse space allows the plant to move and store its product to the west in Carlisle at less cost. Unfortunately there is not a direct freeway route between the Cadbury-Schwepps plant and Carlisle, so these trucks use rural roads which were never designed to for this level of truck traffic.

Another important impact of the trucking industry is the creation of jobs. Warehousing and distribution is becoming one of the larger employment sectors in the study area, especially in Franklin and Cumberland counties. At present there are approximately 3000 warehousing and distribution jobs in Cumberland county, with at least three new large warehousing facilities under construction, employment is expected to grow to over 4000 by 2004 (Cumberland County Planning Commission, 2003). Although most facilities are found in Hagerstown, Carlisle, and Chambersburg, smaller towns along I-81 are also beginning to see employment growth in this industry. Greencastle, Shippensburg, and Marion have all seen some growth in trucking related activity and economic development planners anticipate that this trend will continue.

## SUMMARY

Over the last decade the Cumberland Valley has experienced rapid growth in the warehousing and distribution industry. Initially the two most accessible locations, Hagerstown and Carlisle, had the greater competitive advantage due to their location near freeway interchanges. However there are currently few site specific characteristics which are driving warehouse location. Land values are roughly equal throughout the region if the cost of extending or upgrading the infrastructure are factored into the price. Communities typically do not offer substantial incentive packages. Chambersburg—which does offer a modest incentive program—links these incentives directly to company size. This research suggests that the entire valley has high locational appeal, but that the southern counties, especially Franklin, will likely see more growth in this industry due to the availability of land and the greater number of non-urbanized exits.

The three study area counties are not well prepared for the impacts that continued growth in the warehousing and distribution industries is likely to bring. In particular, the smaller towns along I-81 lack

the infrastructure, and in many cases the zoning ordinances, to adequately handle warehousing growth. High land prices and the movement toward larger operations results in continued loss of farm land and a fundamental change in the landscape and character of the valley. Although warehousing and distribution have brought jobs into the region, there has also been an increase in the truck traffic, both on the highway and on surface streets. The nature of the valley is such that warehousing growth in one area will have impacts that are felt along the entire I-81 corridor. While municipal or county level studies of warehousing impacts are important, future investigations must also consider that these political entities do not operate in isolation and that a regional approach to research and planning is needed.

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<sup>1</sup> Broadly speaking, logistics is that part of the supply chain process that plans, implements, and controls the flow and storage of goods between the point of origin and the point of consumption in order to meet the requirements of the customer. Logistics operations are often used by companies that do not own trucking and storage facilities, so these operations are outsourced.

<sup>2</sup> All population and income figures were taken from the U.S. Census Bureau Summary Tape File 1A database and rounded to the nearest 100. Percentages were rounded to the nearest whole number.