

## STUDY METHODOLOGY

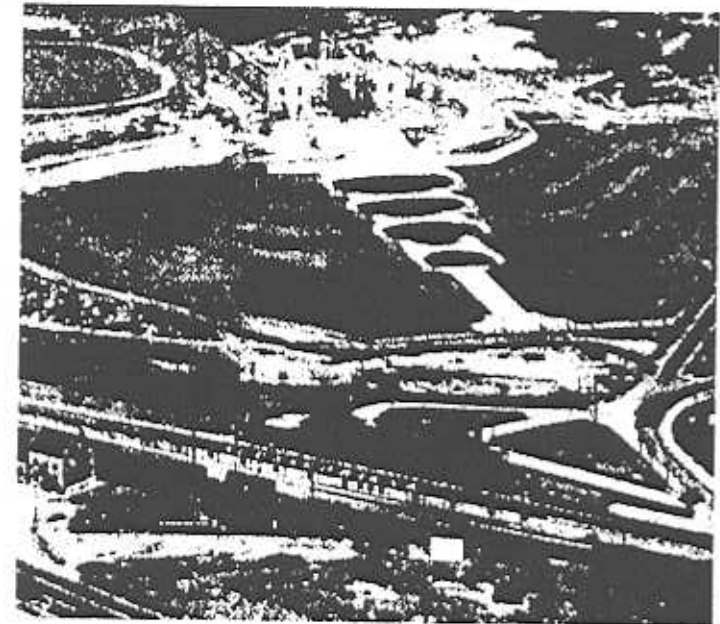
# II

### A. Chapter Summary

The concept for this two-phased study was organized around two hypotheses: 1) that introducing a new commuter rail system into a suburban setting may result in future land use pattern changes that might not otherwise have occurred, and 2) that the characteristics and intensity of these potential land use changes would decrease with distance from the rail stations. A series of basic questions were identified for guiding Phases I and II of the study process and for help in selecting data variables which would address the study questions.

This Phase I report would establish base line conditions for later comparison with future conditions to identify resulting changes. Data variables which reflect public- and private-sector land use activities were selected for long-term monitoring. Methodologies were chosen to help identify rail-related land use changes and to monitor them geographically.

Study boundaries were identified. A series of concentric impact areas were defined which radiated from the commuter rail stations. These were: Station Nodes, Primary Catchment Areas, and Secondary Catchment Areas. The purpose of the concentric areas was to focus data analysis and to help track the geographical extent of future land use changes. Land use plans, transportation policies, zoning amendments, new residential building permits, employment numbers and job categories, and similar variables were identified for monitoring. Data on



### *Defining and Measuring the Impact of VRE Commuter Rail*

*RF&P railroad and freight shed (1920s) near King Street in Alexandria. Background, construction of the Masonic Memorial and the West End School.*

these variables were collected from each study area jurisdiction for the period 1984 to mid-1992, the years selected for establishing base line conditions or trends. Data were aggregated by concentric area to facilitate future comparisons. Surveys were identified as another means of obtaining potentially useful information on changes in commuter patterns, on private-sector land use change decisions and on "soft (qualitative) data impressions" of potential commuter rail impacts which might not be revealed through analysis of local data sources.

This study would not evaluate local decisions on land use planning or policy; these were taken as givens to be monitored over time. Also, the format of this "before and after" section of a study does not employ projections of land use change, economic costs or benefits, or of long-term environment results from potential land use changes occurring as a result of the new commuter rail system.

## B. Study Hypotheses

1) Hypothesis—New Commuter Rail Service May Result in Future Land Use Changes - This study process began with the hypothesis that introduction of new commuter rail service into a metropolitan suburban area may influence certain future land use changes; land use changes which may not have occurred if the rail service had not been introduced.

A corollary to the hypothesis was that if future rail-influenced land use changes did occur, they would be initiated by both the public and private sectors. Public sector actions would take the form of land use management activities (planning, zoning, provision of infrastructure) to either encourage certain land use activities or to prohibit others. The private sector, it was hypothesized, would anticipate or respond to market location opportunities which they saw as deriving from the new commuter rail service. The market opportunities would be created by a new transit alternative which would encourage house hunters to locate within the corridor, and allow the marketing of exurban living and metropolitan center employment, without the tensions and stress of daily SOV commuting on congested I-95 or I-66. Future two-way rail service could also provide a potential "critical mass" of commercial customers at rail station nodes, and offer the opportunity to locate office-related activities in suburban areas, with their attendant economic and "quality-of-life" perceptions. The private sector's activities would be reflected in land purchases, zoning amendment requests, new building permits or expansion of existing permitted land use activities.

2) Hypothesis—VRE-Influenced Land Use Changes will Decrease with Distance from Rail Stations - A second hypothesis—that rail service-associated land use changes would differ in character and decrease with distance from rail stations—guided the es-

establishment of concentric areas around rail stations for purposes of monitoring land use changes. Three primary impact areas were established for purposes of data collection and comparison. The three impact areas were called: Station Nodes, Primary Catchment Areas and Secondary Catchment Areas. Because commercial uses would either be service commercial for rail users or, potentially, employment destinations if two-way service was instituted, commercial use was examined only in Station Node areas. A fourth concentric area was identified only for the purpose of defining the commuter market area for Northern Virginia and Washington, DC employment (see Chapter II.F). These impact areas were established and mapped early in the study process to guide data gathering. Results from the first VRE Ridership Survey of September, 1992 were used to compare ridership residential locations with the mapped areas of influence. Results of that comparison are discussed in Chapter VIII.B.

### C. Study Questions

Seven questions were formulated around which potential land use changes or management actions could be identified. Potential variables and data sources were identified from which to establish base line conditions relating to these questions. Future comparisons of the same variables with the base line conditions would enable the seven questions to be answered. The basic questions were:

Question: *Have local governments made any land use changes in rail corridors in anticipation of or in response to potential impacts from commuter rail services? If so, what types and amounts of land uses have changed?*

Question: *Have developers shown by their new project locations that they believed their customers wanted to live, work, and have commercial uses close to commuter rail services? If so, has this activity led to changes in land use activity and patterns?*

Question: *Have buyers' residential choices indicated preferences to be near commuter rail services? If so, what was the primary radius of impact most affected?*

Question: *Has employment increased or decreased near commuter rail stations? If so, what types of employment changes occurred?*

Question: *What were the pre-opening regional paratransit and local commuter services, ridership levels, routes, pricing, and service frequencies in operation? What effects have there been on them and other transportation-related factors resulting from the new commuter rail services?*

Question: *Have there been any inter- or intra-jurisdictional transportation management policies introduced in anticipation of or in response to commuter rail services?*

Question: *What were the regional air emissions impacts resulting from introduction of commuter rail service?*

#### D. Selection of Data Variables

Four major concerns guided selection of data variables for the study: 1) would the variable help answer one or more of the basic questions; 2) availability of data—was it available from all jurisdictions in the study area now and would the same data records be maintained in the future; 3) was the compatibility of the data sought from multi-jurisdictional sources; and 4) was there a sufficient record of annual data to establish multi-year base line trends. Trends would prove more representative for future comparisons than reliance upon “snapshot” data from a single year, such as 1992.

The VRE commuter rail system operates through five counties, four cities, and two towns in Virginia and into the District of Columbia. Most of these jurisdictions maintain individual land use and zoning maps, records on local land use activities, real estate tax values, and similar records. A variety of multi-jurisdictional organizations in the VRE service area maintain their own data records. Variables were needed which would provide total study area coverage, if possible. At the very least, data had to provide sufficient area coverage that future changes could be considered representative of similar situations in the study area. Variables recorded by subareas within large jurisdictions were also sought.

Subarea records would allow localized monitoring of land activity impacts which could differ from impacts on the overall jurisdiction; for example, land use changes in close proximity to commuter rail stations might vary in response to VRE influences from land use changes in the jurisdiction as a whole. Directly comparable or close surrogate data from all affected jurisdictions would provide the best comparisons for detecting similar changes or trend changes within the study area. Where directly comparable data were not available for all the jurisdictions, the potential findings would require more assumptions and be less certain.

The following variables and data sources were selected for use in establishing base line information to use in future change determinations:

#### Land use designations:

- adopted future land use plans for the jurisdictions and catchment areas
- adopted future land use acreage for the jurisdictions and catchment areas
- existing land use patterns in the Station Nodes
- existing land use acreage in the Station Nodes

#### Land development (activity) data:

- zoning amendment applications
- residential building permits issued
- local economic development policies

#### Transportation policies:

- local transportation plan policies for commuter rail
- local policies for public transit and commuter feeder services
- inter-jurisdictional transportation management plans and policies

Employment in Station Nodes:

- business identification surveys
- economic development projects and plans
- current employment in Station Nodes by Standard Industrial Classification (SIC) code

Commuting data:

- number of daily express commuter buses in operation
- number of daily express commuter bus riders
- number of registered carpools, vanpools and daily ridership
- number of vehicles and riders using high occupancy vehicle (HOV) lanes per day
- average daily traffic counts on major commuter routes in the study area
- location and percentage of occupancy of Park & Ride lots in the study area

Survey data:

- commuter rail ridership information on distances traveled, previous commuting modes, influence on housing location, travel times before and after using commuter rail
- VRE impacts on land use perceived by public officials and others

These particular variables and data sources were selected as being potentially available from all jurisdictions or other agencies in the study area. It was fairly certain that the same data would be maintained annually by jurisdictions or regional agencies into the future. While the transportation-related variables would not directly reflect land use changes, they would be indicators of study area population and traffic generation change. Surveys of perceived impacts were seen as providing qualitative data against which to compare future reality. Future comparisons would provide information on the success of local governments in anticipating and preparing for potential land use changes influenced by the new VRE. Surveys of VRE riders would provide data with which to compare study assumptions on potential impact areas made before the VRE began operations.

No one variable or set of variables may accurately define changes directly resulting from commuter rail influence. Many factors influence movements of people, changes in demographics, new land uses, and employment growth. However, only by examining a variety of data variables common to the jurisdictions in the VRE study area, can an attempt at understanding associated land use changes be made.

### E. Establishing the Base Year(s)

Documented base line information provides the starting point from which to measure future change. That change may be indicated with numerical data—such as acres of land use change, employment increases by SIC code in Station Nodes, population, etc. A base year was required for which to document base line conditions. Further, identification of the “year of first substantial commitment to commuter rail development” was needed to enable the documentation of trends during the gestational period that preceded actual initiation of VRE service. The VRE began operations in June, 1992 on the Manassas line and in July, 1992 on the Fredericksburg line. Selection of 1992 as a base year would appear obvious. However, there were data collection problems associated with selection of a half-year as a base. (The mid-year data collection problems are discussed further in Chapter II.G - Study Caveats.)

Changes over time may also be reflected by differences in trend profiles. For example, the frequency of certain land activities, such as townhouse construction, may increase or decrease at a different rate over time near the rail than in the past, or at a different rate than that for the larger jurisdiction. Monitoring trends, especially for defined subareas, provides a better way to track changes than does reliance solely upon “snapshot” data. Land use-related point data may vary widely from year to year for any number of reasons and so give a false

impression. Trend lines show annual variances. Therefore, they present a better understanding of activity over time.

Looking at trend lines would be particularly useful for the following reasons:

- Northern Virginia was still experiencing the effects of a national economic recession in 1992. The recession had significantly reduced land use-related activities for up to five years (see Chapter VII.C and VII.D). Trend information from 1984 to 1992 would reflect land use change and development activities in both active and recessionary periods. This trend data would enable future conditions to be analyzed more accurately.
- The study would use many indicator variables for which annual records were locally maintained. The Phase II study could plot the same variables for the interval between Phases I and II to compare annual land use-related activities as Northern Virginia came out of the recession and as the VRE commuter rail potentially influenced land use changes.
- Local data would enable some variables to be plotted for defined subareas, such as Station Nodes. Establishing subarea trends for these

variables would enable commuter rail-influenced changes to be compared more easily than from either point-in-time data or from jurisdiction-wide data.

The third phase of a commuter rail feasibility study for Northern Virginia was completed for the Metropolitan Washington Council of Governments in 1984. The study concluded the feasibility of commuter rail based on a projected daily ridership of 3,000 persons. Predicated on the findings of the 1984 study, the Northern Virginia Transportation Commission made the decision to move forward on developing a commuter rail system which became the Virginia Railway Express (VRE). Chapter III.F.2 - Chronology of the Northern Virginia Commuter Rail System, outlines major points and activities in development of the commuter rail system from 1964, to official acceptance of the feasibility study completed in 1984, through development and to opening of the VRE in 1992.)

The year 1984 was, therefore, selected as the year to begin documenting trends where data were available. The development sector was usually quick to position itself to take advantage of potential value enhancement opportunities. Creation of a new commuter rail system potentially offered such opportunities. By tracing land use activities from 1984 onward, it would be potentially possible to identify early private sector activities influenced by commuter rail which occurred prior to open-

ing of the system. The time frame from 1984 to mid-year 1992 became the base line period for this study, and 1992 became the "snapshot" year for data presentation where earlier data were not available.

#### F. Geographical Influence Areas

After a literature review of various impact studies, a methodology was selected which used concentric impact areas for defining the potential extent of commuter rail influence on land uses. Similar study approaches have been used in projecting land use impacts and development potential around the Northern Virginia Metrorail stations<sup>1</sup> and other transit nodes.<sup>2</sup>

The Northern Virginia study area was divided into a concentric series of impact areas designated as: Station Nodes, Primary Catchment Areas, and Secondary Catchment Areas.

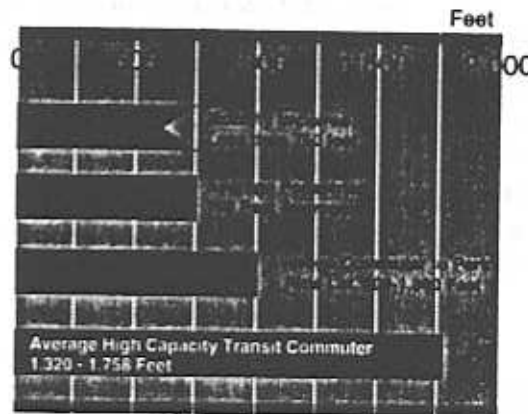
1) Station Nodes - *Station Nodes* were defined around each rail station planned for operation in 1992. The Station Node consisted of a 1500 foot radius from the center of the station site. This distance was slightly over one-quarter (1/4) of a mile. A one-quarter mile distance was recommended in the US Department of Transportation publication entitled *Guidelines for Transit-Sensitive Suburban Land Use Design* as the maximum pedestrian distance to rail stations.<sup>3</sup> This was also about mid-range of the distance determined as that which pe-

destrians of high capacity transit were willing to walk, as shown in a second US Department of Transportation document entitled *A Guide to Land Use and Public Transportation*<sup>4</sup> (Figure 1). Therefore, 1500 feet was selected as representing the approximate walking distance limit to or from a VRE rail station before people would want an alternate means of transportation.<sup>5</sup>

Land use activities that relied upon pedestrian access to or from rail stations would be expected to occur within

Figure 1

**Pedestrian Walking Distances Under Normal Conditions**



Source: *A Guide to Land Use and Public Transportation*, U.S. Department of Transportation, pages 3-4.

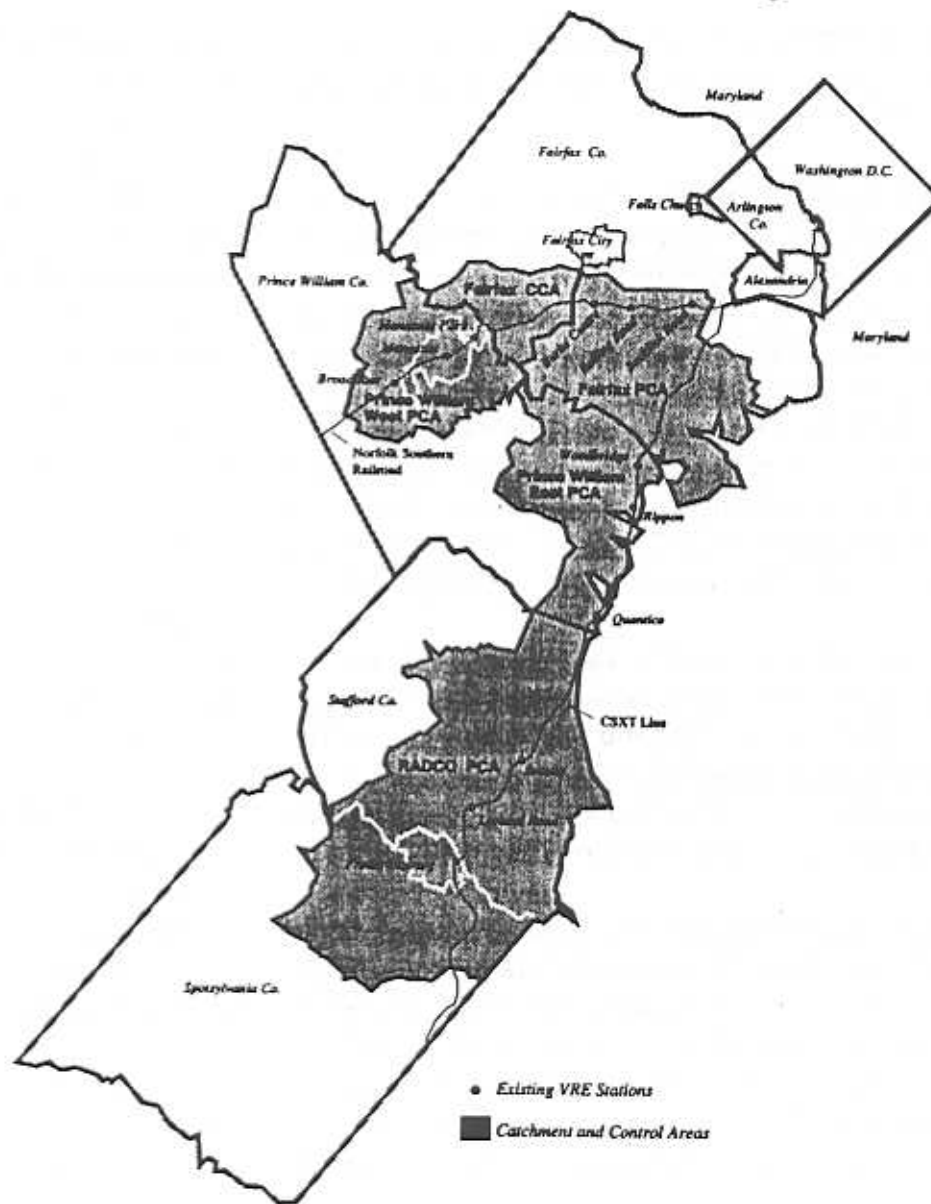
the 1500 foot radius. Pedestrian access would make the locations attractive for residential, commuter convenience retail, office employment and high activity recreational or public uses. Because they represented locations which would be attractive for potential development or re-development, actual land use and employ-

ment conditions in the Station Nodes as of mid-1992 were documented to assist in monitoring change. Maps of the Station Node land uses are shown in Chapter VI.D on Figures 12, 13, 14 and 15.

2) **Primary Catchment Areas (PCAs)** - Beyond the 1500 foot radii of the Station Nodes, non-pedestrian modes of access would be required. This "ring" would accommodate convenient commuting and shuttle distances to rail stations. Within this second ring, potentially more extensive VRE-related land use changes might occur. The *Primary Catchment Areas (PCAs)* were conceived at the beginning of the study as those areas from which the *presumed majority* of VRE ridership would be drawn. The PCA boundaries ranged from 1-10 miles in distance around the rail stations, depending upon existing land development patterns, defined county data collection subareas, and the distance to alternative commuting routes or to locations for public transit connections. The accuracy of the initial PCA boundary delineations would be tested by comparison with commuter rail ridership surveys of home-to-station travel distances after rail operations began. The individual PCAs were grouped into four catchment areas (Fairfax, Prince William East, Prince William West and RADCO PCAs) and a "control" catchment area (Fairfax CCA) for purposes of data comparison. Alexandria and Arlington County were excluded because of the proxim-

Figure 2

VRE Primary Catchment Areas (PCAs)



ity of their VRE stations to the Metrorail stations with their much greater ridership. The five catchment areas are shown on Figure 2.

Census blocks and Fairfax County's defined "sub-census block" areas were used to delineate the actual boundaries of the PCAs. Census block identification would assist in disaggregating county data and would provide better monitoring of local indicator distribution. In the counties which did not maintain data by census blocks, it would be necessary to match individual addresses on applications or permits with county street maps to determine if the activity location lay within the census blocks comprising the PCAs. The 1990 census block numbers within the PCAs are identified in Appendix D.

The *Fairfax PCA* covered the southeastern portion of the county contained approximately 105 square miles, and comprised 26 percent of Fairfax County's land area. The Fairfax PCA contained the three initial commuter rail station sites in the county. Two VRE station sites planned for future construction were also within the PCA.

A second catchment area was defined in Fairfax County to serve as a comparison area for future trend change comparisons. It was called the *Fairfax Control Catchment Area (CCA)*. It was not selected as a "control" area in the classic method of scientific study selection; instead, it was selected to provide a related basis for comparison to the adjacent portion of Fairfax

County which contained the commuter stations. One line of the proposed commuter rail ran through the CCA, but it did not contain a rail station for boarding purposes. It was bordered by I-66, a major commuting artery. Much of the CCA lay within a protected watershed where only low density development was allowed. It was intended to use as a comparison site to identify differences between base trends in PCAs with rail stations and what occurred in a similar area without immediate rail access. The Fairfax CCA contained 39 square miles, or approximately 10 percent of Fairfax County's land area.

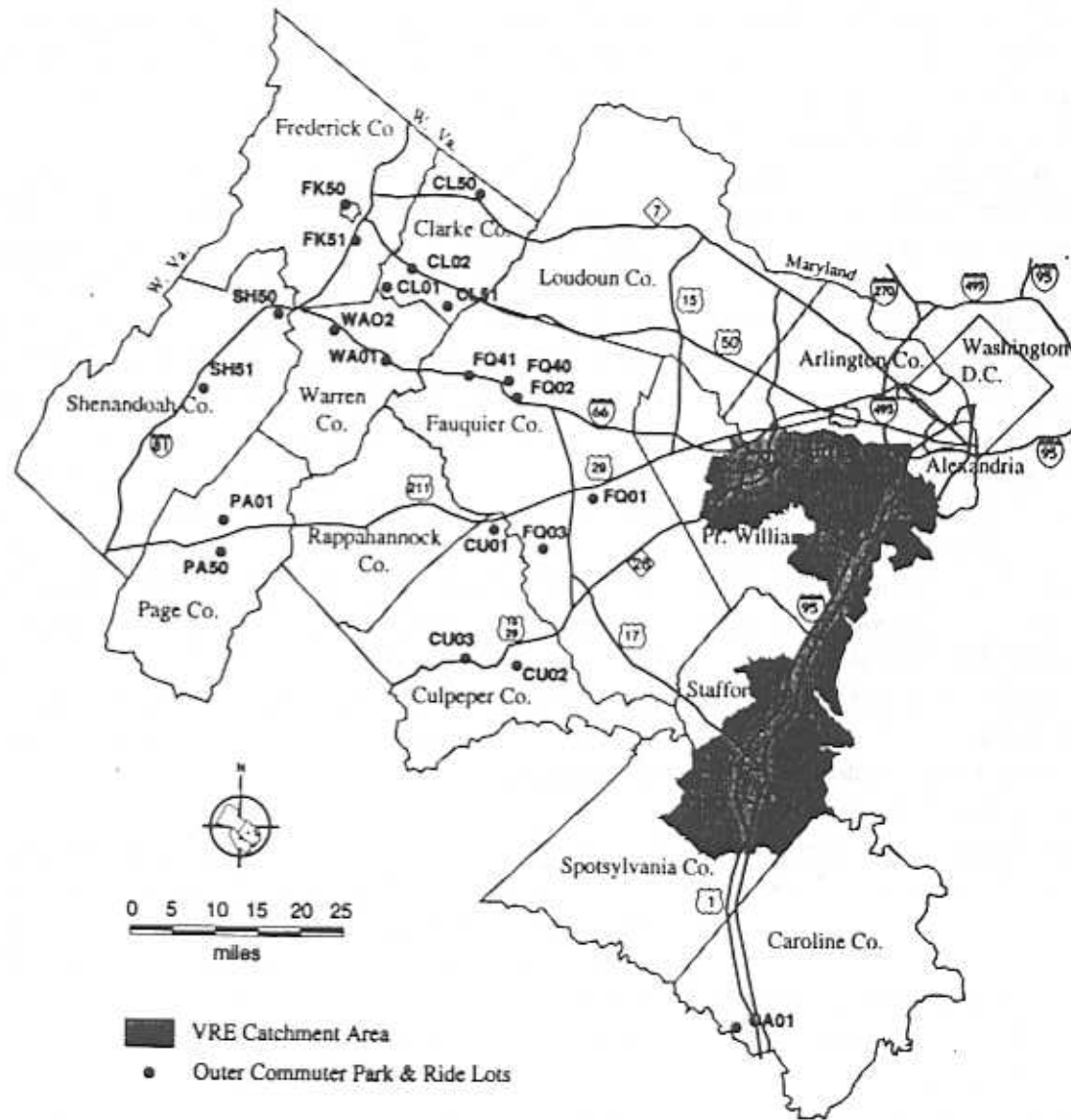
The *Prince William East PCA* focused on the I-95 corridor and the CSXT rail line commuter stations. It comprised 79 square miles, approximately 22 percent of the combined land area of Prince William County, Manassas, and Manassas Park. The towns of Dumfries, Occoquan and Quantico were located within this PCA.

The *Prince William West PCA* was organized around the Norfolk Southern Railway stations in the county and in the cities of Manassas and Manassas Park. The western PCA contained 68 square miles, or 19 percent of the combined area of Prince William County, Manassas and Manassas Park.

The PCA on the southern end of the CSXT line was called the *RADCO PCA*. The three VRE study jurisdictions comprising the PCA were members of the

Figure 3

Northern Virginia Commuting Region



RADCO Planning District Commission. The RADCO PCA comprised 38 percent of the combined land area of Stafford and Spotsylvania Counties and the city of Fredericksburg, and the following percentages of the three jurisdictions' individual land areas: Fredericksburg - 100 percent, Stafford County - 60 percent, and Spotsylvania County - 22 percent.

3) Secondary Catchment Areas (SCAs) - The third concentric area of potential land use impact consisted of the whole counties through which the commuter rail system was to operate. This tier of impact areas comprised the *Secondary Catchment Areas (SCAs)*. (See Figure 2.) The SCAs consisted of *the Counties of Fairfax, Prince William, Stafford and Spotsylvania and their included Station Nodes and PCAs*. County-wide data would be used as trend indicators against which to compare changes in trends at the Station Node and PCA levels. The SCAs were initially expected to provide nearly all of the commuter rail system's ridership. Results of a rail ridership survey to be conducted after operations began would be used to verify the accuracy of this presumption. (See Chapter VIII.) The SCAs provided the study limits for monitoring land use and economic pattern changes.

Fairfax County was considered as a whole in developing SCA trend data. It was recognized, however, that portions of the County lying north of the Fairfax PCA and Fairfax CCA would not contribute riders to the pro-

posed commuter rail system. The northern portion of Fairfax County had easier access to other public rail and bus systems for commuting and local travel.

4) Comprehensive Northern Virginia Commuting Region (CNVCR) - At its most comprehensive, the commuter rail region of influence included all the counties, independent cities and towns of Virginia from which commuters traveled daily to employment locations in the Washington metropolitan area. With only limited route exceptions from the northwest, most commuters on the major radials could alter travel patterns to reach commuter rail stations, if rail served their destinations. This most comprehensive region was identified, for purposes of this study, by the locations of Park & Ride lots for rideshare travel to metropolitan employment centers. Thus defined, the *Comprehensive Northern Virginia Commuting Region (CNVCR)* shown on Figure 3 included 14 counties, six independent cities and 28 towns. It covered a land area of approximately 5,040 square miles.

Identifying distances between a central feature, such as the Pentagon in Arlington County, and the outermost Park & Ride lot, provided a method of understanding the large geographical area involved in the CNVCR. The distances to the lots from the Pentagon ranged from 75 miles south to the Park & Ride lot in Caroline County, 62 miles southwest to the lot in Culpeper County, 78 miles west to the lot in Page

County, and 65 miles northwest to the Park & Ride lot in the city of Winchester. Commuting access from the counties generally lay in the I-95, US 1, I-66, US 50, US 29/211, Route 28 (south of I-66) and Route 7 radial corridors to Northern Virginia.

No data was obtained from these outlying counties, cities and towns as linkages between commuter rail influence and land use changes would be too tenuous to make. Only information on Park & Ride lot utilization was included from these jurisdictions.

#### G. Study Caveats

1) Local Governmental Land Use Decisions Were Not Evaluated - Local land use decisions—land use planning, Comprehensive Plan policies, zoning, zoning amendment decisions, etc.—are the prerogatives of local governments under Virginia law. These prerogatives were not evaluated or assessed in this study. Products of local decisions were examined for purposes of establishing base line parameters against which to compare future conditions. This study does not make any value judgments, recommend any actions or suggest any changes to local plans and policies. The data presented, and any implications to be drawn from the data, are for informational purposes only.

2) Two Study Phases are Required - It is important to note that this study is the first of an intended two

phased process to monitor land use changes over time in Northern Virginia. This phase documents the base conditions against which future conditions will be compared. The second phase will follow after a period of time has transpired (estimated 5-7 years) with commuter rail in operation. It is intended that the Phase II study will gather and analyze the same variable data sources and *draw conclusions* as to what land use changes in the study area jurisdictions, if any, could be associated with commuter rail stimulus.

3) Statistical Validity of Base Line Data - Many factors—political, economic, locational and market driven—affect land use. National and regional conditions, especially economic cycles, influence local land use activity. Many of the contributing factors in individual land use decision making—particularly in the private sector—are not available as recorded data for analysis. Therefore, many assumptions as to particular influences have to be made when examining actual changes.

“Soft (qualitative) data”—interviews, newspaper articles, and informed opinions—may eventually provide more insights to the influences and impacts of the VRE on land use than will comparisons of quantitative data. Acknowledging this reality, this study was not oriented toward having all data be statistically valid when measured in terms of scientific accuracy. *Phases I and II of this study are expected to generate reasonably accu-*

*rate and documented impressions of what happened with regard to land use, real estate values and economic development over time in Northern Virginia and whether commuter rail influenced any of those changes.*

4) 1992 Mid-Year versus Annual Data - Base line data for this report should only reflect pre-VRE conditions. Mid-1992 should have been the cut-off point for all base line and base year data collection, since the VRE system was in operation during the second half of 1992. The study team's previous experiences with local data recording had shown that mid-year data would not be available "after the fact" for some variables and from all jurisdictions. Some jurisdictions maintained cumulative records. It was not always possible to accurately identify mid-year numbers from annual totals. In other cases, the effort to hand process large volumes of individual applications or permits to identify pre-opening data would have exceeded study resources. Annual data from 1992 was used, and is noted, where mid-year figures were not available.

5) Availability of Transportation Data - In collecting transportation data, it was found that certain "snapshots" were collected at less than yearly intervals. Available data closest to the years 1984 and 1992 had to be used in some cases. Further, the processing time for responsible-agency (e.g., VDOT) correlation, evaluation and publishing prevented some 1992 data from being available in time to be included in this report. In such

cases, the latest data available prior to 1992 have been cited. (During Phase II, study researchers should attempt to update the Phase I database to incorporate missing 1992 data that subsequently have been published.)

#### H. Areas and Questions that Were Not Addressed in This Study

Contrary to most study formats, a base conditions study does not produce final answers. A subsequent comparative study will do that. In a similar manner, the observation and monitoring process approved by the Federal Transit Administration (a "before and after" study) was not the appropriate format for projecting future conditions or impacts. Other study formats provide more appropriate scenarios when forecasts are sought. It was necessary, then, to identify what topic-related areas *were not* considered appropriate to be addressed in this Phase I base conditions study and why they were excluded.

1) Fiscal Impacts from Land Use Changes - Public transit systems are rarely designed to be self-supporting from farebox collections. Federal, state or local subsidies—frequently all three—are needed to meet collection shortfalls. Any new development which follows as a consequence of transit service may help offset local subsidies. The offset will be indirect—through increased taxes, employee spending, local business expenditures, licenses and fees—and will benefit the lo-

cality as a whole. New development, then, can provide political and economic "offsets" against local transit subsidies.

Jurisdictions to be served by the VRE were interested in the long-term fiscal impacts that might be expected from VRE commuter service. They wanted to know if employment would increase or if commercial and residential development would follow. They asked what the fiscal comparisons would be if residential development occurred but new employment did not follow. It was conceivable that the VRE could attract residential development which would cost local governments more in infrastructure and services than would be returned through increased tax collections. In such circumstances, the VRE could create double fiscal impacts—local subsidies for VRE operations and greater costs for infrastructure and services to transit-induced new development that did not generate an equal amount in tax revenues.

These were very interesting and locally important questions. This study, however, was structured to monitor land use changes over time and not to project what impacts those changes would create. *This study does not project fiscal impacts of potential VRE-influenced land use changes.* A fiscal analysis study would be the appropriate format in which to address the potential economic impacts from the VRE.

2) Population, Land Use and Trip Generation Change Projections Resulting from VRE Service - *This study also was not designed to project future population, land use, or commuting implications, such as trip generation, from introduction of commuter rail services.*

3) Projections of Employment Changes Resulting from Land Use Changes - *Just as this study does not project fiscal or land use changes, it does not project employment changes that may be induced by commuter rail service.* Employment increases may be anticipated as new development occurs. New development may be commuter rail-induced, or it may be completely unrelated to commuter rail influences. New employment projections would appropriately be made in a fiscal analysis study, not in a land use study.

4) Air Quality and Environmental Impact Resulting from Land Use Changes - Chapter XII presents a generalized estimate of daily air quality impacts derived from results of a VRE Ridership Survey conducted in September, 1992. Computer model estimates were based on survey derived reductions in miles traveled in single occupancy vehicles (SOVs) by riders of the VRE. The reduction in SOV use translated into less vehicle emissions over pre-VRE conditions. *The computer model used ridership survey results. No projections of emission reductions based on future VRE ridership levels were made.* Achieving the air quality goals of the Clean Air Act Amendments of 1990 was much on the

minds of local elected officials at the time of this study. The generalized air quality impact estimate was included to indicate to local officials the extent to which the VRE and shuttle service to VRE stations could play a role in regional air quality programs, as well as in congestion relief programs.

Land use changes in themselves also produce environmental changes. The amount of environmental change is related to the amount of land development, site conditions prior to development, and the quality of site planning and design. Just as land use decisions are the prerogative of local governments, so local governments are also responsible for addressing the environmental affects of their decisions. *As this study does not make other projections, it also does not project environmental impacts that may result from future land use changes induced by VRE rail service.*