Economic Impact of Selected Sections of Interstate Routes on Land Value and Use

P. D. CRIBBINS, W. T. HILL, and H. O. SEAGRAVES
Respectively, Associate Professor of Civil Engineering, North Carolina State College; Highway Planning Engineer, North Carolina State Highway Commission; and 1st Lieutenant, United States Air Force

This study is an attempt to ascertain the economic effects of controlled-access facilities in North Carolina on surrounding property values and development. Techniques employed to isolate economic influence of highways include the use of the before-and-after method in combination with a multiple regression analysis for each period.

Three sections of Interstate routes (I-95, I-40, and I-85) in three counties (Cumberland, Guilford, and Rowan) across the State were chosen for investigation. To estimate the influence of these facilities, factors other than those associated with the highway are evaluated. Land value, selected as the indicator of economic influence, is determined by obtaining sales prices for parcels sold in the study periods. The effects of eight non-highway and two highway variables are estimated by utilizing a multiple regression analysis. The data are processed by standard procedures and then analyzed by electronic computer. Results of the analysis indicate that the average unit price of property increased significantly within all sites. However, patterns of significance for the independent variables are most erratic and, as a result, these increases cannot necessarily be attributed to the construction of the test facilities. The predominant type of land use within the study areas is farm land, whereas the most active category in terms of sales is vacant property. The statistical analysis indicates that the investigated highways have had no measurable effect on development within the study areas.

Conclusions are based on a lack of significant regression coefficients for the highway variables. If the roadway had exerted a strong independent influence, the influence would have been indicated by some consistency in in the factors affecting land value and land use. It is, therefore, concluded that the controlled-access facilities under investigation have done little to stimulate or depress surrounding property values and development during the study periods.

•WITH THE PASSAGE of the Federal Aid Highway Act of 1956, the largest highway construction program in the history of the United States was initiated. Under the program, some 41,000 miles of Interstate and Defense Highways are to be built at a total cost expected to exceed $41 billion. To North Carolina, this will mean the eventual construction of approximately 770 miles of controlled-access facilities at an expenditure estimated to approach $400 million.

Although it is generally agreed that these facilities will generate economic activity, quantitative measures of their impact on area economies are lacking. Yet such measures are urgently needed for the formulation of land planning policies, for public and private investment decisions and for fair evaluation of property values for right-of-way purposes.

In an attempt to satisfy this need, research, which has been concerned primarily with the collection of data on prices, uses, and number of sales of properties that

Paper sponsored by Committee on Indirect Effects of Highway Improvements.

have been affected by the construction of a roadway, has been conducted in various sections of the country. Although the results of these different studies have shown qualitative agreement, the quantitative agreement has been poor. Thus, the development of generally applicable quantitative measures and/or predictors of highway economic impact must await the collection of additional data.

This report contains the initial information obtained on the economic impact of controlled-access highways in North Carolina. Data concerning land prices, land uses and factors affecting land prices are presented for properties within three selected corridors along existing sections of the North Carolina Interstate System. For each corridor, data are provided for a period before and a period after construction of the facility, thus facilitating at least a quantitative estimate of the effect of the roadway. However, the major contribution of this study is its addition to the general body of information to permit the eventual development of valid and usable impact models.

METHODOLOGY

Multiple regression techniques were combined with a comparison of the areas before and after public notice of construction to ascertain the economic impact of the selected sections of Interstate routes. The general hypothesis investigated was that land value decreases with an increasing distance from the highway in the after period, whereas in the pre-highway period, land value follows no particular pattern with respect to the Interstate route. To test this hypothesis, correlations between the logarithms of sales prices of parcels of land and shortest straight-line distances from these parcels to Interstate access and right-of-way were determined for a 5-mile-wide band centered on the facility. Selected non-highway variables were also included in the analysis to remove non-highway effects and to gain a better insight into factors affecting land value and land use.

The sale price of each transaction was determined from the value of revenue stamps shown on warranty deeds, together with the outstanding balances of deeds of trust. In the original form, the unit prices obtained were grossly non-normal. It was found that a natural log transformation normalized them. This transformation was necessitated by the dependence of statistical tests on normality of data. Selection of influence area on previous impact studies has been arbitrary but generally has not exceeded 4½ miles.

Site Selection

As of July 1960 there were approximately 200 miles of completed Interstate highways in North Carolina. Selection of test sites from this mileage was limited to those sections of highways which had existed a sufficient time to exhibit an influence on the surrounding land. (Public notice of highway construction at least 3 years before July 1960 was necessary for a facility to be considered as a possible test site. Five sections totaling about 57 miles satisfied this condition. The locations of these sections are shown in Figure 1.

These five sections of Interstate routes can be classified as follows:

1. Radial-interurban highways passing through the rural-urban fringe (I-95 northeast of Fayetteville, I-85 southwest of Salisbury, and I-40 west of Greensboro),
2. Tangential or circumferential highways bypassing major urbanized areas in their immediate proximity (I-85 bypassing Charlotte), and
3. Urban freeways bisecting urbanized areas (I-40 passing through Winston-Salem).

This study concentrated on the radial highways in rural-urban fringe areas. The study of radial highways has the advantage over that of tangential roads on the edges of urbanized areas to the extent that distances from the facility and from the nearest central business district are perpendicular to each other. It is, therefore, less difficult to isolate the influence of the highway from the influence of the city per se. Moreover, the rural-urban fringe, being largely undeveloped, permits tracing of geographic change with greater clarity. Where radial roads pass through the fringes of urbanized areas, conditions on these roads are comparable to conditions on urban bypasses, so a study of circumferential highways was not considered to be essential. The only urban Inter-

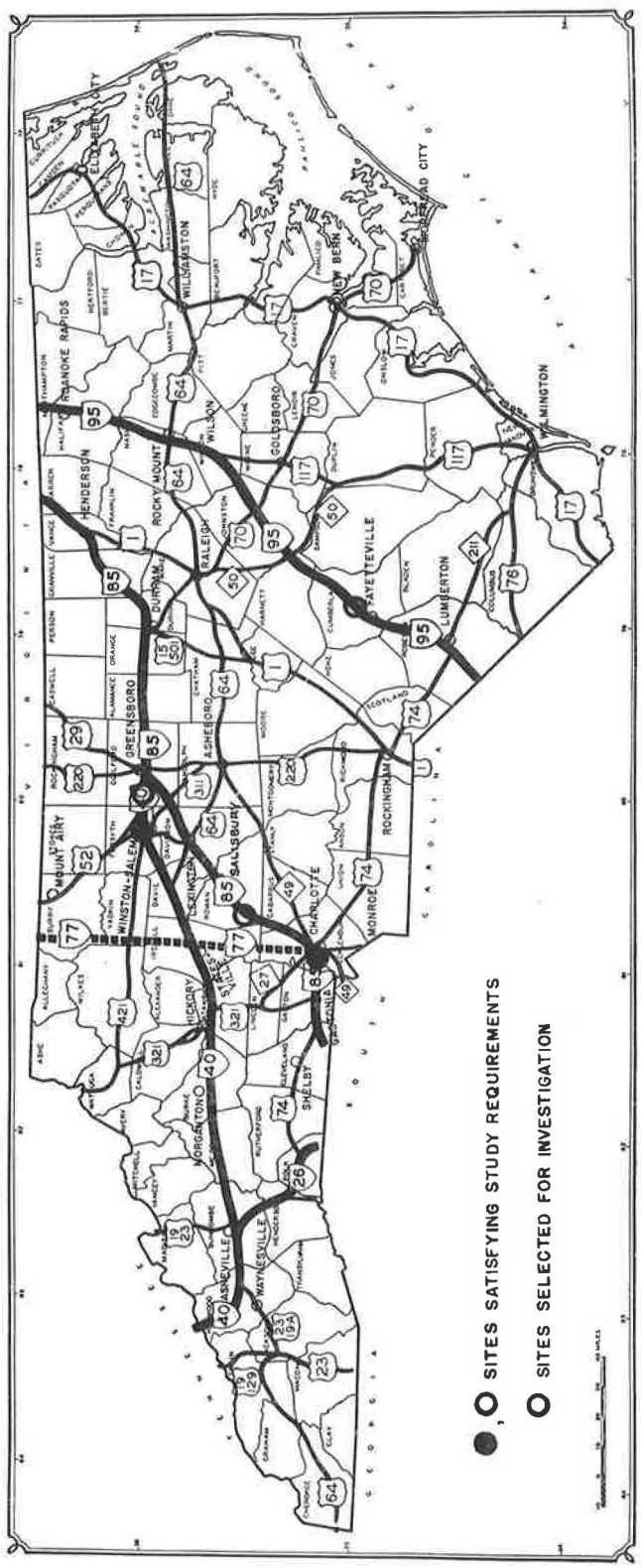

Figure 1. Location of test sites.

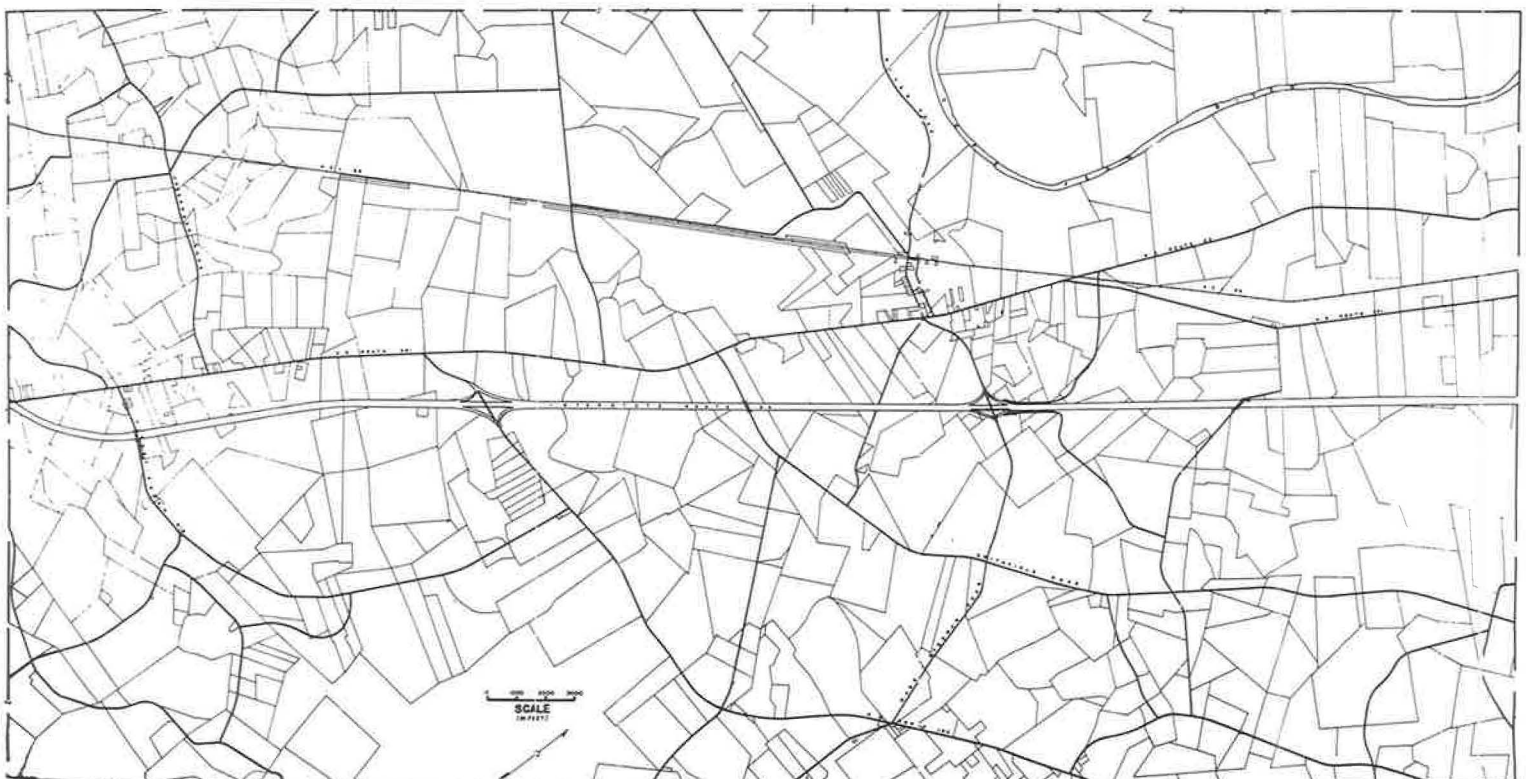

Figure 2. Site map of I-95 in Cumberland County.

Figure 3. Before-period aerial view of I-95 site.

Figure 4. After-period aerial view of I-95 site.

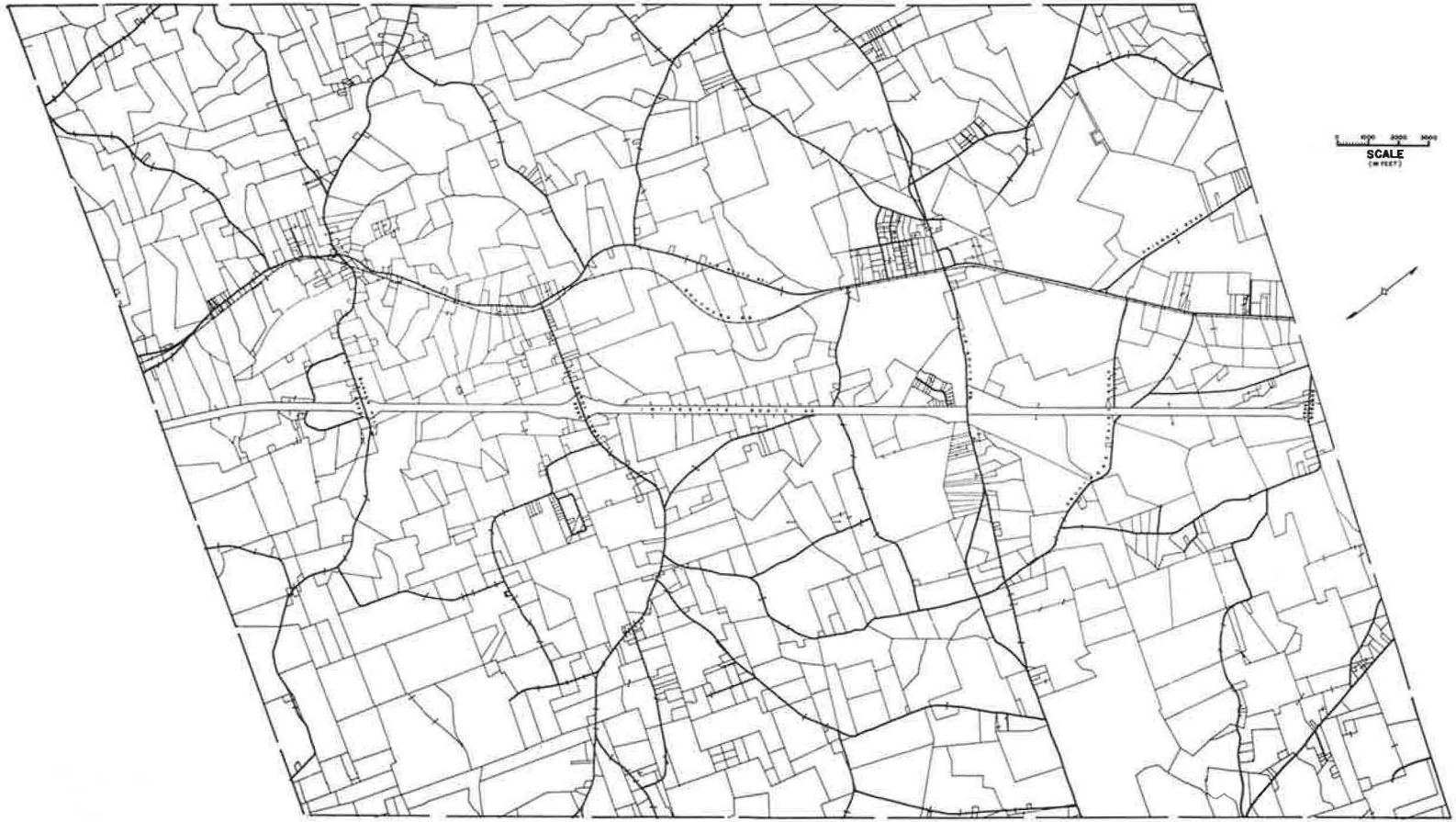

Figure 5. Site map of I-40 in Guilford County.

Figure 6. Before-period aerial view of I-40 site.

Figure 7. After-period aerial view of T-40 site.

state freeway in North Carolina is a 1-mile section of I-40 through Winston-Salem; the complexity of this urban situation placed it beyond the scope of this study. Because of these limitations, sites in three counties (Cumberland, Guilford, and Rowan) were selected for investigation.

Cumberland County Site.—As shown in Figure 2, the Cumberland County site includes a ten-mile section of I-95 lying northeast of Fayetteville. First public notice was given in January 1957, and the section was opened to traffic in October 1960. The surrounding area is primarily rural in nature with development scattered throughout the site (Figs. 3 and 4). Within the site, I-95 parallels US 301.

Guilford County Site.—As indicated in Figure 5, the Guilford County site includes a 5-mile section of I-40 located west of Greensboro. First public notice was given in September 1955, and the section was opened to traffic in August 1958. A considerable amount of development has taken place within the study area (Figs. 6 and 7). I-40 is parallel to US 421.

Rowan County Site.—The Rowan County site includes 5 miles of I-85 southwest of Salisbury (Fig. 8). First public notice was given in September 1955, and the section was opened to traffic in July 1958. Development in the area has been quite substantial in recent years (Figs. 9 and 10). I-85 in this area is parallel to US 29-601.

Before and After Periods

The time of public notice of proposed construction was used to segregate sales into the before or after period. As previously indicated, no facility was considered for study for which public notice of proposed construction had not been given before July 1957. This restriction was necessary to insure sufficient sales in the after period for determining post-highway conditions. Therefore, January 1, 1947, to June 30, 1961, was selected as the overall study period for all test sections. The beginning date was selected to provide an adequate number of sales in the before period to determine pre-highway conditions. The closing date, June 30, 1961, marked the beginning of data collection procedures in the field.

Data Collection

To perfect data collection procedures, a pilot study was conducted on a 3 ½-mile section of US 15-501 between Durham and Chapel Hill. Although the section was not an Interstate route, it was chosen because its nearness to Raleigh permitted any complication in data collection procedures to be resolved with expediency. Before and after airphotos of this site are shown in Figures 11 and 12.

The primary sources of information were found to be the county offices of the Tax Supervisor and Registrar of Deeds. Using property tax maps and records it was possible to prepare current base maps and determine present property ownership. Tax records and warranty deeds were used to trace successive ownership of each parcel back to the beginning study date. During this process, needed sales data (Fig. 13) were abstracted and property boundary changes were noted on the base map. Tax maps and records, warranty deeds, Agricultural Stabilization and Conservation airphotos, and field checks were used to determine land use. The pilot study base map and before and after land-use maps are shown in Figures 14, 15 and 16, respectively.

As previously mentioned, the land values obtained in this study were determined from revenue stamps affixed to the deeds of sale, together with outstanding balances due on deeds of trust. The validity of this procedure was investigated by a small home-interview survey conducted as part of the pilot study. The results of this survey indicated that for large samples, the tax stamp evaluation could be used as an approximate indicator of the actual sale price of land.

Data Analysis Techniques

The multiple regression equation used in this study is as follows:

Figure 8. Site map of I-85 in Rowan County.

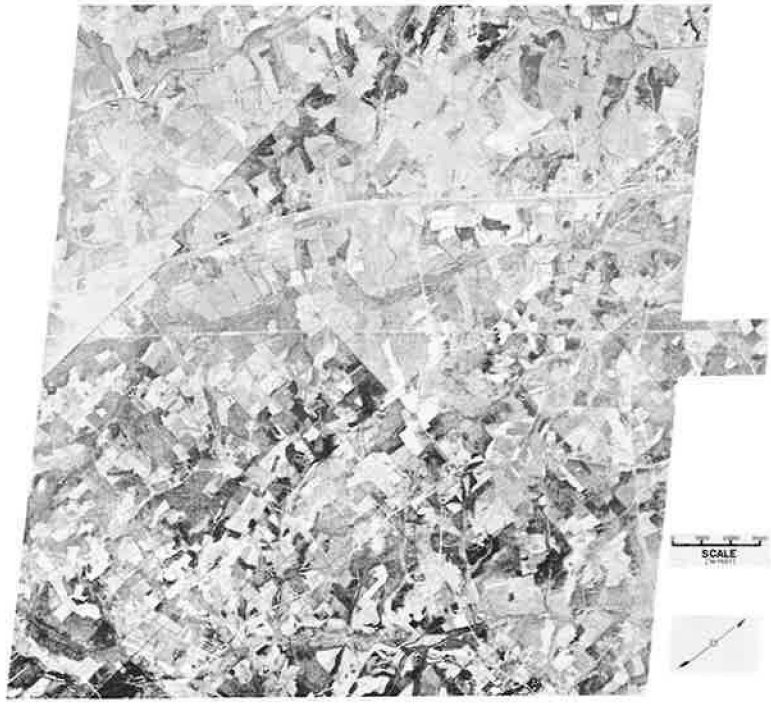

Figure 9. Before-period aerial view of I-85 site.

Figure 10. After-period aerial view of I-85 site.

$$y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} \quad (1)$$

in which

y = land value;
x_1 = size of parcel;
x_2 = year of sale;
x_3 = vacant-non-vacant land use;
x_4 = rural-urban land use;
x_5 = subdivision;
x_6 = roadside;
x_7 = alternate roadway;
x_8 = distance to right-of-way;
x_9 = distance to central business district;
x_{10} = distance to access;
b_0 = intercept on y axis; and
$b_1, \ldots b_{10}$ = contributions of $x_1, \ldots x_{10}$, respectively.

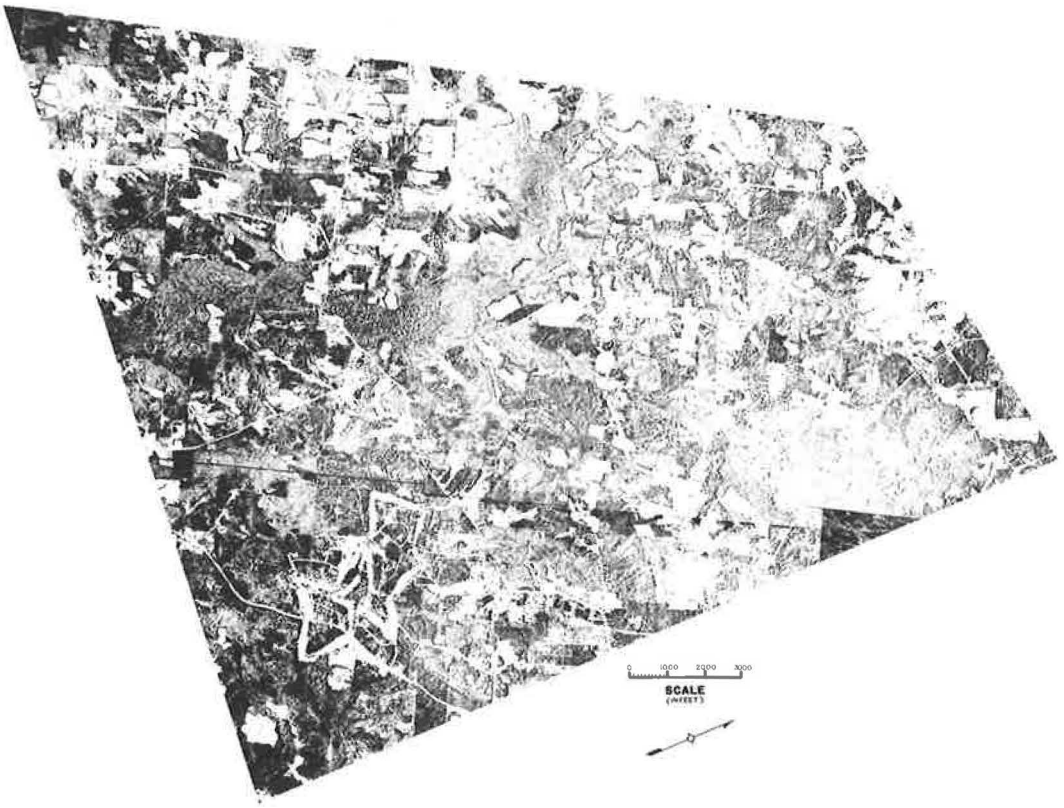

Figure 11. Before-period aerial view of US 15-501 site, Durham County.

This equation gives a measure of the linear effect of each of the specified variables on the log of the unit price. A brief discussion of each of the variables follows:

1. Size of Parcel.—The parcel area, measured to the nearest 0.1 acre, was recorded for each sale. This variable was included to isolate any log price variation attributable to parcel size.

2. Year of Sale.—The date of sale was recorded for each transaction. This variable removed any linear increase in log price occurring during the study period.

3. Vacant—Non-Vacant Land Use.—All sales were classified as being either vacant or non-vacant. This variable determined whether there was a significant difference in the sales prices of raw land as opposed to improved land.

4. Rural-Urban Land Use.—All sales were also classified as either rural or urban. This variable was included to disclose any difference in the sales prices of land primarily rural in nature and land located in urban surroundings.

5. Subdivision.—Each sale occurring within a subdivision was noted. This variable was included to ascertain if a significant difference existed between sales prices of parcels located in subdivisions and those located elsewhere.

6. Roadside.—Each sale was classified according to its roadside location with respect to the test facility. Because the Interstate route paralleled an existing major route within each test area, it was desirable to determine whether there was a significant difference between the sales prices of parcels with access to an alternate major route and those with access only to the Interstate route.

7. Alternate Roadway.—Sales of parcels fronting the existing major route were also noted. This variable determined any difference in impact on these parcels vs all other parcels.

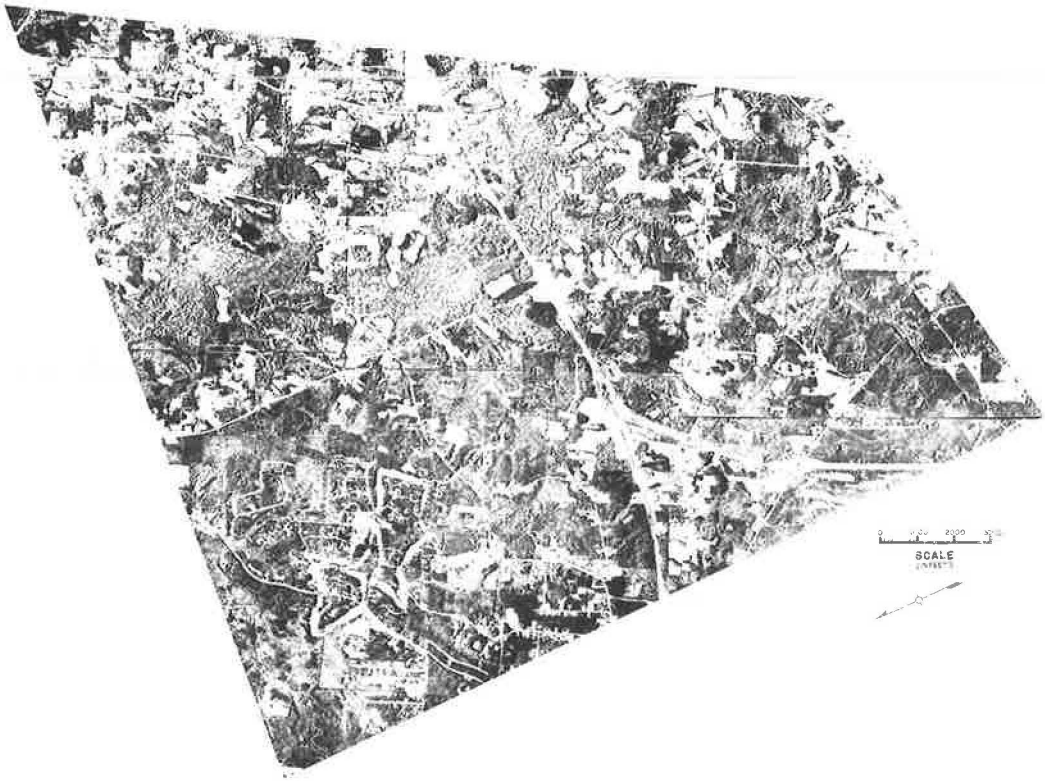

Figure 12. After-period aerial view of US 15-501 site, Durham County.

Site No. Deed Book Page

Map Block Lot

Recorder:

Grantee: Grantor:

Parcel Location:

Sale Date Day Mo. Yr.

No. Acres

Tax Stamps

Unit Price

Land Use Description

ROW ACC CBD

Index No. Land Use Roadside Period

Figure 13. Sample data card.

Figure 14. Site map of US 15-501 in Durham County.

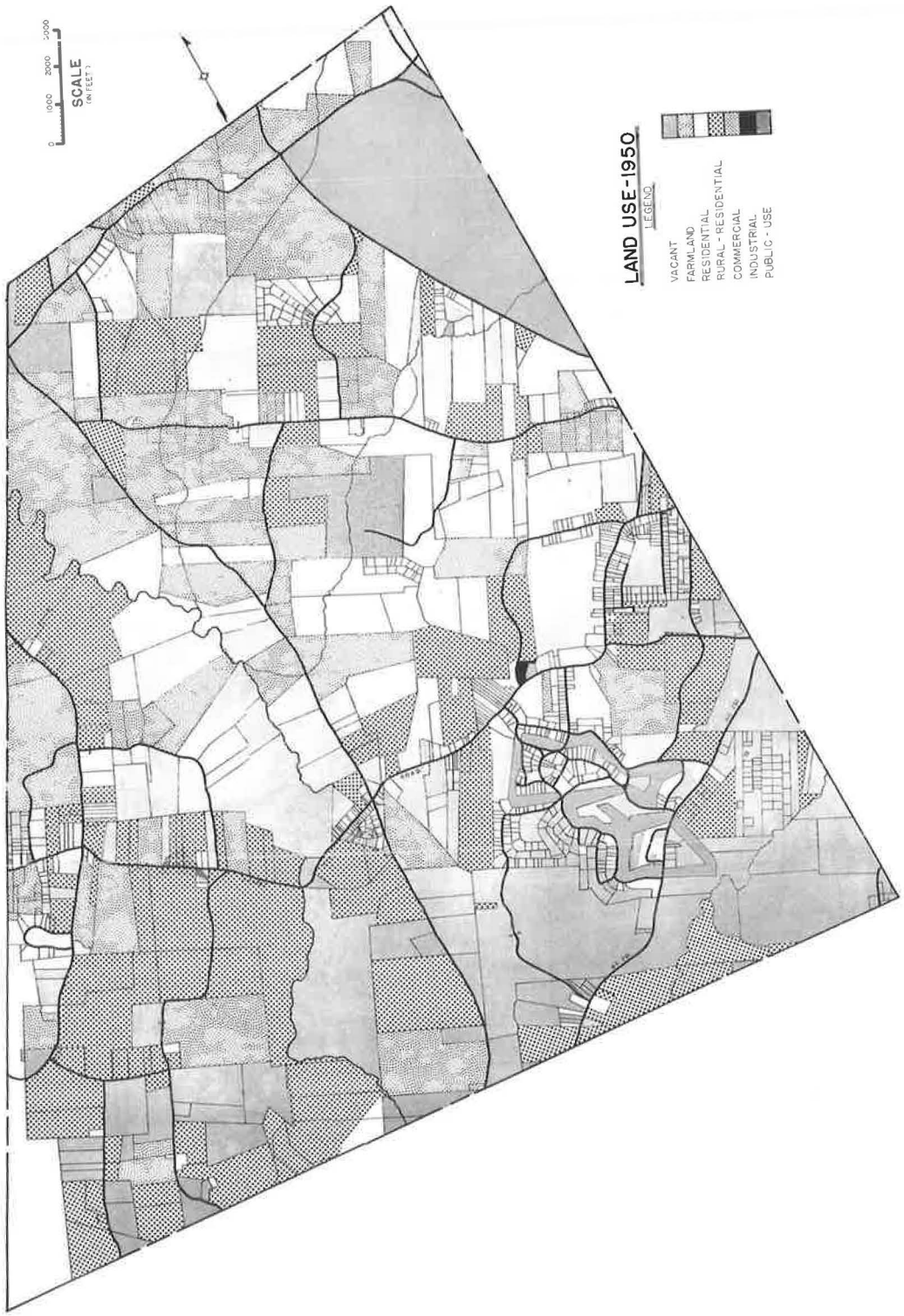
SCALE
(IN FEET)
0
1000
2000
3000
LAND USE-1950
LEGEND
VACANT
FARMLAND
RESIDENTIAL
RURAL - RESIDENTIAL
COMMERCIAL
INDUSTRIAL
PUBLIC - USE

Figure 16. Land use after US 15-501.

8. Distance to Central Business District. —Distance to central business district was determined for each sale by measuring the shortest, straight-line distance from the parcel to the center of the adjoining city. This variable isolated any linear increase in log price associated with this factor.

9. Distance to Right-of-Way. —Distance to right-of-way was determined for each sale by measuring the shortest, straight-line distance from the parcel to the Interstate right-of-way.

10. Distance to Access. —Distance to access was determined for each sale by measuring the shortest, straight-line distance from the parcel to the nearest Interstate interchange.

As previously indicated, the variables directly associated with the highway are distance to right-of-way and distance to access. The significance of these two variables in influencing sales prices of land served to measure the economic impact of the selected sections of Interstate routes.

A regression analysis, using the preceding regression equation, was first performed for each test site on all parcels of land sold in the before period and on all parcels of land sold in the after period. All analyses were performed on the UNIVAC 1105 Computer at the Computation Center of the University of North Carolina. The program utilized was the multiple regression or correlation program NCGBC9. The results of this analysis indicated that the land-use variables x_3 (vacant-non-vacant land use) and x_4 (rural-urban land use) were highly significant factors in influencing sales prices. Therefore, a more detailed land-use classification was made and a second analysis was performed for each test site on each of the classifications. The land-use classifications utilized are: (a) vacant, (b) farm land, (c) residential, (d) public, (e) commercial, (f) industrial, and (g) rural-residential.

Because the x_3 and x_4 variables remain constant for each specific land use, they were omitted from the regression equation in the second analysis. The analysis provided the following statistical measures for each test site: (a) means and standard deviations of unit prices; (b) means and standard deviations of each independent variable; (c) simple correlation coefficients between the independent variables; (d) simple correlation coefficients between the dependent variable and independent variables; and (e) estimates of regression parameters, including b values, t values, standard errors, and multiple correlation coefficients.

ANALYSIS OF LAND VALUE FINDINGS

Discussion is restricted here to those classes of land use for which 30 or more samples were obtained in both the before and after periods. The use of this minimum sample size is necessitated by the large variation in the data. Vacant land in the Cumberland County site is omitted from the discussion because of the presence of an obviously abnormal sample. Although an attempt was also made to determine the impact of the test facilities on land values at interchanges, an insufficient number of parcel sales in the immediate interchange areas was available for such an analysis.

The results of this study indicate that the construction of a controlled-access roadway has no disruptive effect on the overall property values in the general area in which the roadway is constructed. This conclusion is based on the absence of significant correlation coefficients for the highway variable.

In each site, the average price of all land was significantly higher in the after period as compared to the before period (Table 1). This same general increase is also found at each site in all but one of the separate land-use categories. The single exception was rural-residential land in Rowan County, where the land value decreased 27 percent. The cause of this decrease could not be ascertained, but it did not appear to be directly connected with the construction of the highway.

Accompanying the consistent increase in price of land was a consistent decrease in the average size of parcels sold (Table 2). For all sites and land-use categories, smaller parcels were sold in the after period than in the before period. This, however, rather than necessarily reflecting any direct effect of the roadway, may simply indicate the effect of an increasing population on a fixed land supply.

TABLE 1

MEAN UNIT PRICES

Site	Land Use	Mean Values ($/acre)						% Change
		Before			After			
		N	Price	Std. Dev.	N	Price	Std. Dev.	
Cumberland Co.	All	199	2,592	11,769	115	2,687	7,756	3.6
	Vacant	81	5,352	17,961	32	3,891	11,881	-27.3
	Farm	109	168	289	66	203	331	21.2
Guilford Co.	All	367	1,059	4,252	304	2,632	5,166	58.7
	Vacant	164	949	2,161	127	1,166	1,499	22.9
	Farm	110	170	173	90	507	719	198.2
	Residential	55	6,327	6,836	58	7,976	7,390	26.1
	Commercial	13	5,781	11,298	10	10,817	13,195	87.1
	Rural residential	23	428	613	14	1,272	1,155	197.2
Rowan Co.	All	468	1,769	3,386	358	4,124	7,083	133.0
	Vacant	290	999	1,566	153	1,451	3,207	45.2
	Farm	43	160	144	21	205	116	28.1
	Residential	85	5,496	5,815	141	8,124	8,995	47.8
	Rural residential	41	563	603	31	422	465	-24.8

TABLE 2

AVERAGE VALUES OF INDEPENDENT VARIABLES

Site	Land-Use Type	No. Obser.	Period	Independent Variables							
				Size of Parcel	Year of Sale[a]	Subdi-vision	Road-side	Alt. Roadway	Dist. to ROW	Dist. to CBD	Dist. to Access
Cumberland	Vacant	81	Before	4.000	6.037	0.308	0.308	0.012	0.927	10.127	1.272
		32	After	1.456	12.937	0.250	0.187	-	0.498	9.380	0.999
	Farm	109	Before	44.506	5.733	0.247	0.385	-	1.078	9.732	1.444
		66	After	46.831	12.303	0.106	0.378	-	1.148	9.455	1.499
Guilford	Vacant	164	Before	8.849	5.128	0.158	0.579	0.408	1.068	10.281	1.389
		127	After	4.574	11.850	0.102	0.590	0.370	0.936	10.416	1.217
	Farm	110	Before	41.709	4.540	0.036	0.545	-	1.167	10.611	1.474
		90	After	30.398	11.177	0.033	0.411	-	1.118	10.607	1.375
	Resi-dential	55	Before	1.780	5.036	0.272	0.781	0.309	0.898	10.776	1.279
		58	After	1.479	11.586	0.137	0.672	0.293	0.980	9.954	1.261
	Com-mercial	13	Before	8.930	4.923	0.769	1.000	0.307	0.506	8.091	0.678
		10	After	29.590	11.200	0.400	0.800	0.200	0.568	9.010	0.703
	Rural-resi-dential	23	Before	12.817	4.782	0.043	0.391	-	1.292	11.372	1.623
		14	After	6.407	11.500	0.071	0.357	-	1.252	10.080	1.467
Rowan	Vacant	290	Before	5.872	4.727	0.241	0.682	0.627	0.979	5.022	1.081
		153	After	5.017	11.627	0.091	0.542	0.392	1.142	4.494	1.245
	Farm	43	Before	55.841	3.953	0.023	0.465	0.046	1.083	4.813	1.217
		21	After	78.057	11.666	-	0.333	-	1.371	4.885	1.449
	Resi-dential	85	Before	1.341	4.823	0.117	0.776	0.505	1.187	3.943	1.310
		141	After	.736	11.822	0.071	0.588	0.496	1.078	4.134	1.169
	Rural-resi-dential	41	Before	9.978	4.634	0.024	0.195	0.024	1.270	5.093	1.401
		31	After	8.254	11.580	-	0.129	-	1.047	4.975	1.178

[a]To determine the year of sale, add figure in column to base year 1947.

There are no other consistent trends discernible in the data. Although the average price of land increased in all sites, the magnitudes and percentages of these increases varied greatly between sites and between land uses. A further verification of the variability of the results is found in the simple correlation and multiple regression analyses of factors affecting land value (Tables 3 and 4). The most important single factor influencing land value for all of the land-use types is size of parcel. As expected, unit prices of property were consistently correlated negatively with size of parcel indicating that the smaller the parcel, the higher the unit price. The variables, year of sale,

TABLE 3

SIMPLE CORRELATION COEFFICIENTS

Site	Land-Use Type	No. Obser.	Period	Independent Variables							
				Size of Parcel	Year of Sale	Subdi-vision	Road-side	Alt. Roadway	Dist. to ROW	Dist. to CBD	Dist. to Access
Cumberland	Vacant	81	Before	-0.524[a]	0.207	0.176	-0.093	-0.073	-0.131	-0.222[a]	-0.093
		32	After	-0.354[a]	0.252	0.069	-0.376[a]	-	-0.127	-0.385[a]	-0.014
	Farm	109	Before	-0.400[a]	0.136	0.254	-0.053	-	-0.155	0.152	-0.212[a]
		66	After	-0.121	-0.006	0.033	0.330[a]	-	-0.193	0.114	-0.198
Guilford	Vacant	164	Before	-0.462[a]	0.142	0.153	0.374[a]	0.237[a]	-0.154	0.094	-0.143
		127	After	-0.399[a]	0.245[a]	0.134	0.409[a]	0.386[a]	-0.183	-0.199[a]	-0.275[a]
	Farm	110	Before	-0.273[a]	0.126	0.114	0.058	-	-0.049	-0.044	-0.102
		90	After	-0.225[a]	-0.016	0.221	0.241[a]	-	0.046	-0.429[a]	-0.045
	Resi-dential	55	Before	-0.432[a]	-0.063	0.319[a]	0.376[a]	-0.003	-0.096	0.181	-0.198
		58	After	-0.511[a]	0.333[a]	0.185	0.328[a]	0.120	0.145	-0.125	0.014
	Com-mercial	13	Before	-0.422	0.189	0.453	0.474	-0.039	-0.100	-0.085	0.820[a]
		10	After	-0.426	0.472	0.531	0.619	0.424	0.099	-0.002	0.071
	Rural-resi-dential	23	Before	-0.342	0.191	0.355	0.594[a]	-	-0.009	0.353	0.202
		14	After	-0.170	0.043	0.176	0.347	-	0.222	-0.071	0.068
Rowan	Vacant	290	Before	-0.403[a]	0.137	0.442[a]	0.263[a]	0.454[a]	-0.178	0.043	-0.210[a]
		153	After	-0.336[a]	0.186	0.298[a]	0.391[a]	0.386[a]	-0.110	-0.219[a]	-0.154
	Farm	43	Before	-0.435[a]	-0.191	0.318	0.037	0.071	0.122	-0.194	0.100
		21	After	-0.118	0.173	-	-0.223	-	-0.184	-0.339	-0.231
	Resi-dential	85	Before	-0.414[a]	0.040	0.126	0.330[a]	0.296[a]	-0.226[a]	-0.181	-0.283[a]
		141	After	-0.495[a]	0.042	0.169	0.357[a]	0.063	-0.134	-0.105	-0.136
	Rural-resi-dential	41	Before	-0.583[a]	0.114	0.090	-0.107	-0.055	0.386[a]	0.354[a]	0.424[a]
		31	After	-0.195	0.242	-	-0.230	-	0.436[a]	0.135	0.443

[a]Indicates significant coefficients at 95 percent level.

TABLE 4

MULTIPLE REGRESSION COEFFICIENTS AND STUDENT "T" VALUES

Site	Land-Use Type	Period	b & t Values	Independent Variables: Size of Parcel	Year of Sale	Subdivision	Roadside	Alt. Roadway	Dist. to ROW	Dist. to CBD	Dist. to Access
Cumberland	Vacant	Before	b	-0.104	0.083	0.912	-0.209	-2.301	0.924	-0.139	-0.195
			t	-4.874[a]	1.274	1.799	-0.439	1.333	1.359	-1.396	-0.350
		After	b	-0.241	0.340	0.105	-1.393	-	-0.067	-0.204	0.816
			t	-2.588[a]	1.480	0.134	-1.906	-	-0.061	-1.718	0.784
	Farm	Before	b	-0.008	0.062	0.613	0.071	-	0.671	0.117	-0.911
			t	-4.568[a]	1.914	2.030	0.307	-	2.176[a]	2.824[a]	-2.893[a]
		After	b	-0.001	0.023	0.348	0.891	-	0.175	-0.012	-0.309
			t	-0.595	0.184	0.581	2.385[a]	-	0.334	-0.172	-0.566
Guilford	Vacant	Before	b	-0.028	0.098	-0.048	0.774	0.058	-0.488	-0.072	-0.090
			t	-5.574[a]	2.393[a]	-0.154	3.892[a]	0.262	-1.407	-0.937	-0.271
		After	b	-0.019	0.160	0.744	0.784	0.245	0.158	-0.170	-0.369
			t	-2.230[a]	3.807[a]	2.506[a]	4.686[a]	1.478	0.576	-3.361[a]	-1.322
	Farm	Before	b	-0.007	0.062	0.341	0.086	-	0.268	-0.024	-0.363
			t	-3.260[a]	1.460	0.684	0.473	-	1.051	-0.426	-1.235
		After	b	-0.006	0.029	1.176	0.529	-	0.713	-0.174	-0.685
			t	-1.592	0.492	2.320	2.627[a]	-	1.636	-3.030[a]	-1.559
	Residential	Before	b	-0.164	0.001	0.487	1.397	-0.432	-0.071	0.027	-0.625
			t	-3.427[a]	0.005	0.995	2.585[a]	-0.957	-0.090	0.182	-1.096
		After	b	-0.336	0.121	0.814	0.626	-0.053	0.422	-0.063	-0.347
			t	-4.649[a]	1.795	2.048[a]	1.874	-0.163	1.008	-0.693	-0.793
	Commercial	Before	b	-0.092	-0.179	0.729	-	3.673	-7.460	-0.850	-1.606
			t	-2.086[a]	-0.693	0.586	-	2.560[a]	-2.435[a]	-2.053[a]	0.725
		After	b	-0.006	0.673	1.601	0.829	1.175	-0.940	0.251	0.251
			t	-0.650	1.884	1.391	0.472	0.886	-0.354	0.582	0.082
	Rural-residential	Before	b	-0.059	0.158	1.325	0.921	-	-0.423	-0.046	1.103
			t	-2.786[a]	1.406	1.040	1.278	-	-0.436	-0.158	1.242
		After	b	-0.041	0.030	-0.382	1.095	-	3.722	0.334	-3.971
			t	0.339	-0.710	0.108	-0.221	-	1.284	2.090[a]	-1.843
Rowan	Vacant	Before	b	-0.016	0.081	1.040	0.176	1.040	0.023	-0.302	-0.013
			t	-4.707[a]	3.068[a]	6.973[a]	1.412	7.346[a]	0.049	-6.146[a]	-0.027
		After	b	-0.031	0.095	0.771	0.513	0.785	1.254	-0.122	-1.277
			t	-3.886[a]	2.105[a]	2.376[a]	2.580[a]	3.924[a]	-1.708	-1.944	-1.659
	Farm	Before	b	-0.007	-0.021	2.478	0.478	-1.903	-0.267	-0.212	0.625
			t	-2.557[a]	-0.417[a]	2.353	1.571	-2.222[a]	-0.167	-2.072[a]	0.361
		After	b	0.002	-0.018	-	-0.458	-	1.937	-0.078	-2.263
			t	0.773	-0.189	-	-1.158	-	1.273	-0.671	-1.350
	Residential	Before	b	-0.177	0.067	0.162	0.619	0.394	-2.456	-0.215	1.902
			t	-3.521[a]	1.090	0.334	1.475	1.381	-1.935	-1.593	1.429
		After	b	-1.222	0.019	0.422	0.624	-0.354	-2.068	0.023	1.779
			t	-5.608[a]	0.324	0.910	2.334[a]	-1.417	-2.048[a]	0.243	1.742
	Rural-residential	Before	b	-0.057	-0.005	2.003	-1.310	-1.300	-3.627	-0.466	4.648
			t	-3.715[a]	-0.076	2.287[a]	-2.826[a]	-1.631	-3.092[a]	-3.487[a]	3.432[a]
		After	b	-0.055	0.163	-	-0.771	-	-0.639	-0.191	1.203
			t	-1.547	1.647	-	-1.408	-	-0.409	-1.098	0.694

[a]Indicates significant values at 95 percent level.

subdivision, roadside, alternate roadway and distance to central business district, failed to indicate any pattern of significance in these analyses. For specific land-use types, certain of the factors showed high simple correlations with price; however, these correlations vanished when the multiple regression analysis was used, indicating relationships between the independent variables rather than between the unit price and the independent variables.

A final possible trend can be noted in the variances in the data (Tables 1 and 5). The variances of most of the land prices are slightly higher in the after period than in the before period. This indicated that the roadways may have introduced additional price fluctuations into the local land markets. Eventually, when a new state of equilibrium is reached, the variances should approach their original values. Perhaps this

TABLE 5

STANDARD DEVIATIONS OF EACH INDEPENDENT VARIABLE

Site	Land-Use Type	No. Obser.	Period	Independent Variables							
				Size of Parcel	Year of Sale	Subdi-vision	Road-side	Alt. Roadway	Dist. to ROW	Dist. to CBD	Dist. to Access
Cumberland	Vacant	81	Before	9.471	2.874	0.465	0.465	0.111	0.692	2.312	0.669
		32	After	3.017	1.162	0.439	0.396	-	0.451	2.665	0.440
	Farm	109	Before	60.125	3.011	0.433	0.488	-	0.828	2.495	0.769
		66	After	100.664	1.300	0.310	0.488	-	0.777	2.538	0.734
Guilford	Vacant	164	Before	19.143	2.265	0.366	0.507	0.493	0.654	1.988	0.666
		127	After	9.615	1.877	0.304	0.493	0.484	0.649	1.737	0.684
	Farm	110	Before	42.015	2.236	0.188	0.500	-	0.784	1.926	0.731
		90	After	25.752	1.666	0.180	0.494	-	0.704	1.901	0.725
	Resi-dential	55	Before	4.056	2.142	0.449	0.416	0.466	0.409	1.932	0.502
		58	After	1.893	1.882	0.347	0.473	0.459	0.532	1.850	0.523
	Com-mercial	13	Before	9.288	2.325	0.438	-	0.480	0.223	1.259	0.255
		10	After	72.564	1.475	0.516	0.422	0.422	0.304	1.672	0.321
	Rural-resi-dential	23	Before	11.224	2.109	0.208	0.499	-	0.563	1.406	0.684
		14	After	5.799	1.556	0.267	0.497	-	0.640	1.464	0.582
Rowan	Vacant	290	Before	16.871	2.105	0.428	0.466	0.484	0.658	1.380	0.627
		153	After	10.796	1.894	0.289	0.499	0.589	0.740	1.664	0.709
	Farm	43	Before	43.750	2.170	0.152	0.504	0.213	0.849	1.447	0.814
		21	After	93.922	1.591	-	0.483	-	0.793	1.178	0.752
	Resi-dential	85	Before	3.550	2.284	0.324	0.419	0.502	0.555	1.486	0.517
		141	After	0.614	1.924	0.257	0.493	0.501	0.461	1.379	0.455
	Rural-resi-dential	41	Before	8.531	2.199	0.156	0.401	0.156	0.871	1.439	0.781
		31	After	5.509	1.928	-	0.340	-	0.814	1.490	0.760

trend represents a direct impact of the roadways on the economies of their respective areas. However, this impact is supported by such meager evidence that it should be regarded as speculation rather than fact.

ANALYSIS OF LAND-USE FINDINGS

A visual representation of the land use within the study areas both before and after construction of the test facilities is accomplished here by including before and after land-use maps for each site. Sources of information for determining land use were tax maps and records, warranty deeds, Agricultural Stabilization and Conservation airphotos and field checks.

As illustrated in Figures 17 through 22, the predominant types of land use are farm land and vacant property. In Guilford and Rowan Counties, the vacant property classification experienced the greatest number of sales, whereas in Cumberland County farm land was the most active classification.

The magnitude of the change in parcel size was erratic. A land-use category that doubled in size in one site increased only a small percentage in another. The location of property sales with respect to distance to central business district also followed no pattern between the before and after periods. In Guilford County, there was no significant change in the average distance to Greensboro for property sold in the before and after periods. In Cumberland County, the location of property sales moved significantly closer to Fayetteville. In Rowan County, vacant land moved closer to Salisbury, farm land moved farther away and residential land remained unchanged. Location with respect to access and/or right-of-way of the roadway was also inconsistent. A specific land-use type would move closer to Interstate right-of-way and/or access in one site, whereas in another site the converse would be true. The other location measures—roadside, alternate roadway and subdivision—showed the same absence of pattern.

Figure 17. Land use before I-95, Cumberland County.

Figure 18. Land use after I-95, Cumberland County.

Figure 19. Land use before I-40, Guilford County.

Figure 20. Land use after I-40, Guilford County.

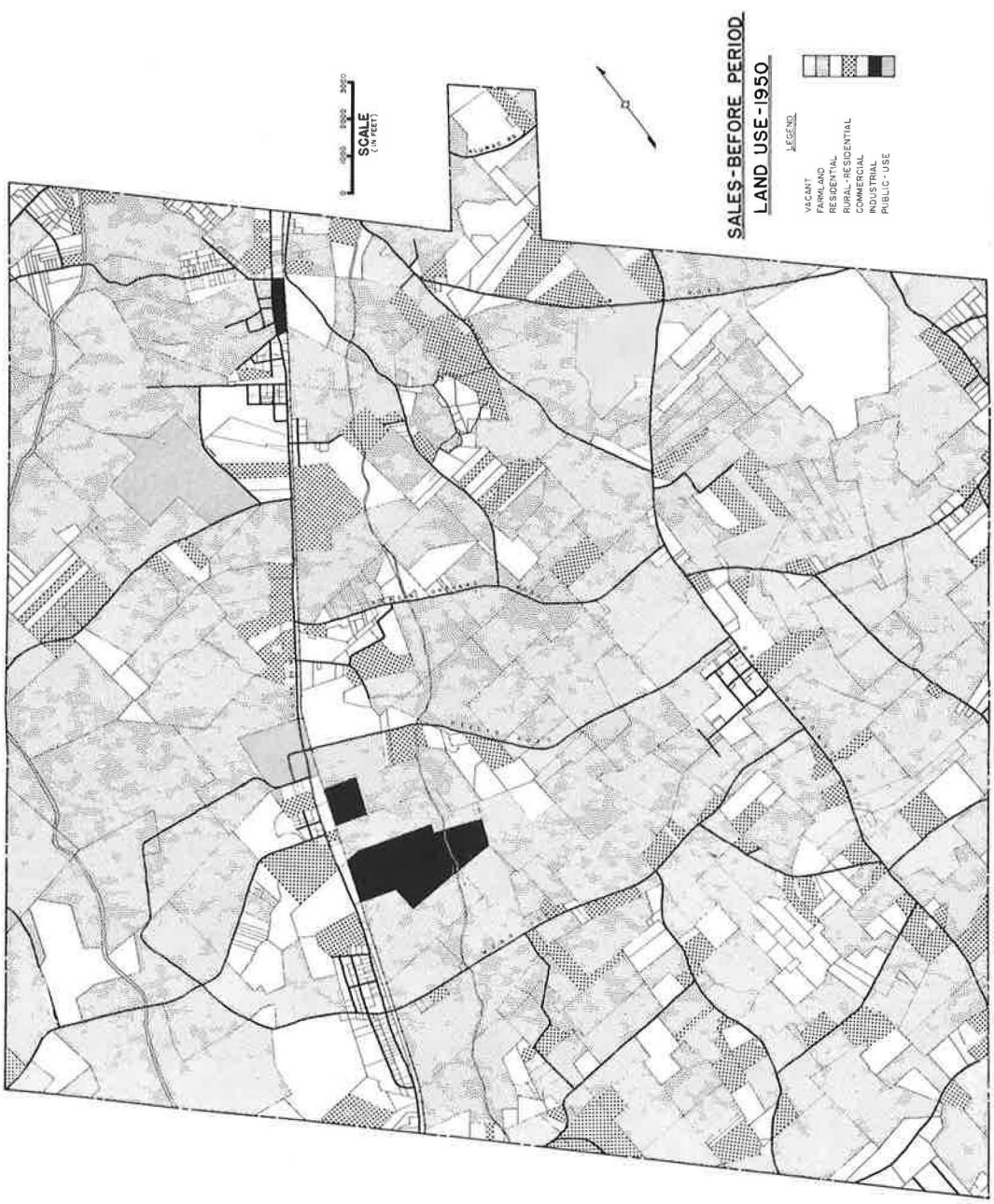

Figure 21. Land use before I-85, Rowan County.

Figure 22. Land use after I-85, Bowen County

SUMMARY AND CONCLUSIONS

This study has investigated certain factors associated with highway impact in an attempt to determine what influence the construction of controlled-access highways has had on surrounding land values and uses. Factors other than those directly associated with the highway were included in the analysis to remove their effect and thereby obtain a better estimate of highway influence. Land values were determined by converting the revenue stamp value to sale price and adding any balances due on deeds of trust at time of sale.

The effects of the independent variables were investigated by use of multiple regression techniques. It was determined that this analysis must be performed on each land use and test site separately because large variances prohibited the pooling of data. Factors that were highly correlated to unit price in the simple correlation failed to be so in the multiple regression analysis, indicating the existence of relationships among the independent variables rather than among the dependent variable and the independent variables. No discernible pattern in the significance of the highway variables appeared either within or between test sites. Although there were significant increases in unit prices of property, the results of this analysis do not allow these increases to be attributed to the construction of the highways alone.

The greater variances for the after period indicate that this period has not reached a state of equilibrium. This perhaps indicates that the highways have introduced additional land market fluctuations within the test sites. Possibly this is a direct effect of the roadways on the economies of the areas.

It must be concluded from this study that the controlled-access facilities under investigation have had little, if any, disruptive economic influence on surrounding property values and development during the study periods. This conclusion is based on the absence of any discernible pattern in the data. If the roadways had exerted a strong independent influence, this influence would have been indicated by some consistency in the investigated variables. The data indicate that general increases in land value appear to be determined largely by natural forces existing within the localities studied, and that these forces are interrelated with the facilities. Therefore, the findings of this study cannot be used as quantitative predictors of land prices and development.

Considerable justification can be provided to refute the general public belief that controlled-access highways will either rapidly stimulate or depress an area's land economy. The major effects of such construction will be gradual and intermixed with the effects of other factors controlling an area's economic development. If the economy of an area is basically sound and is growing, then it will continue to grow; if it is basically depressed, then it will remain depressed. This should not be interpreted to mean that the roadway will not immediately hurt owner A and help owner B. In the construction of any large public facility, there obviously will be benefactors and victims. However, through careful planning and location, major discrepancies in benefits can be minimized and any overall disturbing effects of the facility eliminated.

REFERENCES

1. Adkins, William G. Effects of the Dallas Central Expressway on Land Values and Use. Texas Transportation Institute Bulletin No. 6, 1957.
2. Adkins, William G. Land Value Impacts of Expressway in Dallas, Houston, and San Antonio, Texas. Texas Transportation Institute Reprint No. 7, 1959.
3. "Before and After" Study of Effects of a Limited Access Highway Upon the Business Activity of By-Passed Communities and Upon Land Value and Land Use. Univ. of Denver, Bureau of Bus. and Social Research, 1958.
4. Bone, A. J. Economic Impact Study of Massachusetts Route 128. Transportation Engineering Div., Dept. of Civil and Sanitary Engineering, Massachusetts Institute of Technology, 1958.
5. Borchert, John R. Beltline Commercial Industrial Development—A Case Study in the Minneapolis-St. Paul Metropolitan Area. Minnesota Highway Research Project, Dept. of Agricultural Economics and Dept. of Geography, Univ. of Minnesota, 1960.

6. Bowersox, Donald J. Influence of Highways on Selection of Six Industrial Locations. Highway Research Board Bull. 268, pp. 13-28, 1960.
7. Burnight, Robert G., and Callender, Willard D. The Economic and Social Effects of the Connecticut Turnpike on Eastern Connecticut—Population Change and Distribution, Progress Report 30. Storrs Agricultural Experiment Station, Univ. of Connecticut, 1960.
8. Carroll, Donald D., et al. The Economic Impact of Highway Development Upon Land Use and Value, Development and Methodology and Analysis of Selected Highway Segments in Minnesota. Univ. of Minnesota, 1958.
9. Childs, George W. The Influence of Limited Access Highways on Land Values and Land Use—The Lexington, Virginia, Bypass—Studies on the Economic Effects of Limited Access Highways and Bypasses, Progress Report No. 1. Virginia Council of Highway Investigation and Research, Charlottesville, 1958.
10. Economic Impact of Highway Improvement Conference Proceedings. Highway Research Board Spec. Rept. 28, 1957.
11. Economic and Social Impact of Highways, A Progress Summary of the Monroesville Case Study, Progress Report 219. Pennsylvania State Univ., Agricultural Experiment Station, 1960.
12. Garrison, William L., et al. Studies of Highway Development and Geographic Change. Seattle, University of Washington Press, 1959.
13. Guide for Highway Impact Studies. U. S. Bureau of Public Roads, Div. of Highway and Land Administration, 1959.
14. Gustafson, Dale. The Economic Effects of a Highway Change on Faribault, Minnesota. Minnesota Highway Research Project, Dept. of Agricultural Economics and Dept. of Geography, Univ. of Minnesota, 1960.
15. Gustafson, Dale, and Smith, Everett G., Jr. A Highway Change in Changing Faribault. Minnesota Highway Research Project, Univ. of Minnesota, 1959.
16. Harrison, Joseph W. The Economic Effects of Limited Access Highways and Bypasses. Virginia Council of Highway Investigation and Research, Charlottesville, 1957.
17. Harrison, Joseph W. A Study of the Economic Effects of the United States Route 11 Bypass at Lexington, Virginia, on Business Volumes and Composition, Economic Studies, Progress Report No. 2. Virginia Council of Highway Investigation and Research, Charlottesville, 1958.
18. Harrison, Joseph W. Methods Used in the Study of the Lexington, Virginia, Bypass on Business Volumes and Composition. Virginia Council of Highway Investigation and Research, Charlottesville, 1958.
19. Horwood, Edgar M. Freeway Impact on Municipal Land Planning Effort. Highway Research Board Bull. 268, pp. 1-12, 1960.
20. Iowa: Economic Impact of Highway Improvements Study Procedure. Iowa State Highway Commission, Safety and Traffic Dept., 1959.
21. Lang, A. S., and Wohl, Martin. Evaluation of Highway Impact. Highway Research Board Bull. 268, pp. 105-119, 1960.
22. Lemly, James H. Expressway Influence on Land Use and Value (Atlanta 1941-1956). Bureau of Business and Economic Research, Georgia State College of Bus. Adm., Atlanta, 1958.
23. McKain, Walter C., Jr., and Weir, James R. The Social and Economic Effects of the Connecticut Turnpike on Eastern Connecticut—Recreation, Progress Report 35. Storrs Agricultural Experiment Station, Univ. of Connecticut, 1960.
24. Social and Economic Impact of Highways, Review of Important Studies and Selected Bibliography. Massachusetts Dept. of Public Works, 1961.
25. Some Evaluations of Highway Improvement Impacts. Highway Research Board Bull. 268, 1960.
26. Stroup, Robert H., and Vargha, Louis A. Reflections on Concepts for Impact Research. Highway Research Board Bull. 311, pp. 1-12, 1962.

27. Taylor, Paul N. New Manufacturing and the Connecticut Turnpike, Progress Report 43. Storrs Agricultural Experiment Sation, Univ. of Connecticut, 1960.
28. Warner, A. E. The Impact of Highways on Land Uses and Property Values. Highway Traffic Safety Center, Michigan State Univ., 1958.