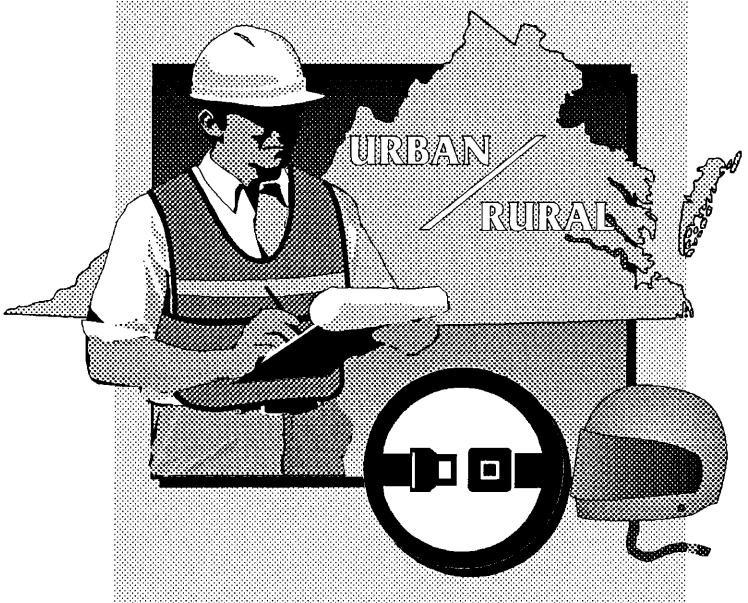
TECHNICAL
ASSISTANCE REPORT

SAFETY BELT AND MOTORCYCLE HELMET USE IN VIRGINIA: RESULTS OF THE 1994 SURVEY



CHARLES B. STOKE
Senior Research Scientist

V · I · R · G · I · N · I · A
VTRC
TRANSPORTATION RESEARCH COUNCIL

VIRGINIA TRANSPORTATION RESEARCH COUNCIL

Standard Title Page — Report on State Project

Report No.	Report Date	No. Pages	Type Report: Technical Assistance Report	Project No.: 9715-040-940
VTRC 95-TAR3	September 1994	22	Period Covered: Summer 1994	Contract No.:

Title and Subtitle

Safety Belt and Motorcycle Helmet Use in Virginia: Results of the 1994 Survey

Key Words

motorcycle helmet
motorcycle helmet use
observational survey
safety belt
safety belt use
seat belt
seat belt use
traffic safety
use rate

Author(s)

Stoke, Charles B.

Performing Organization Name and Address:

Virginia Transportation Research Council
530 Edgemont Road
Charlottesville, Virginia 22903-0817

Sponsoring Agencies' Names and Addresses

Virginia Department of Transportation
1401 E. Broad Street
Richmond, Virginia 23219

Va. Dept. of Motor Vehicles
P.O. Box 27412
Richmond VA 23269

University of Virginia
Charlottesville
Virginia 22903

Supplementary Notes

Abstract

This series of surveys was initiated to qualify the state for Intermodal Surface Transportation Efficiency Act § 153 incentive funds. To qualify for funds in each of the 3 years the program was in operation, states had to meet specific standards with respect to the existence of statutes, as well as for safety belt and motorcycle helmet use rates. In addition, the National Highway Traffic Safety Administration specified the survey criteria the states had to meet in determining their use rates. Over these 3 years, Virginia qualified for approximately $1.5 million in funds.

Even though the § 153 program has ended, the Virginia Department of Motor Vehicles has requested that data collection on safety belt and motorcycle helmet use be continued, and that the same methods, procedures and sites be used as for the § 153 program.

This report describes the methodology used for data collection and gives the results of the 1994 survey. The results show that Virginia's 1994 safety belt use rate was 71.8% and the motorcycle helmet use rate was 100.0%. These rates compare with the motorcycle helmet use rate of 100% in 1992 and 1993, and with safety belt use rates of 71.6% in 1992 and 73.2% in 1993.

TECHNICAL ASSISTANCE REPORT

SAFETY BELT AND MOTORCYCLE HELMET USE IN VIRGINIA: RESULTS OF THE 1994 SURVEY

Charles B. Stoke
Senior Research Scientist

Virginia Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Transportation and the University of Virginia)

Charlottesville, Virginia

September 1994
VTRC 95-TAR3

SAFETY RESEARCH ADVISORY COMMITTEE

W. H. LEIGHTY, Chairman, Deputy Commissioner, Department of Motor Vehicles
J. D. JERNIGAN, Executive Secretary, Senior Research Scientist, VTRC
J. D. AUSTIN, Transportation Engineer Program Supervisor, Department of Rail & Public Transportation
J. L. BLAND, Chief Engineer, Department of Aviation
R. J. BREITENBACH, Director, Transportation Safety Training Center, Virginia Commonwealth University
J. L. BUTNER, Traffic Engineering Division Administrator, VDOT
Maj. J. K. COOKE, Assistant Chief of Law Enforcement, Department of Game & Inland Fisheries
V. L. CROZIER, Associate Specialist, Driver Education, Department of Education
W. S. FELTON, JR., Administrative Coordinator, Commonwealth's Attorneys' Services & Training Council
P. D. FERRARA, Director, Division of Forensic Sciences, Department of General Services
D. R. GEHR, Commissioner, VDOT
J. T. HANNA, Assistant Professor, Transportation Safety Training Center, Virginia Commonwealth University
T. A. JENNINGS, Safety/Technology Transfer Coordinator, Federal Highway Administration
Sgt. P. J. LANTEIGNE, Operations & Tactics Bureau, Virginia Beach Police Department
W. T. McCOLLUM, Executive Director, Commission on VASAP
S. D. McHENRY, Director, Division of Emergency Medical Services, Department of Health
Lt. S. E. NEWTON, Commander, Patrol Division, County of Albemarle Police Department
J. T. PHIPPS, Director, Roanoke Valley ASAP
J. A. SPENCER, Assistant Attorney General, Office of the Attorney General
E. W. TIMMONS, Director of Public Affairs, Tidewater AAA of Virginia
A. R. WOODROOF, Esq., Assistant Attorney General (Retired)

TECHNICAL ASSISTANCE REPORT

SAFETY BELT AND MOTORCYLCLE HELMET USE IN VIRGINIA: RESULTS OF THE 1994 SURVEY

Charles B. Stoke
Senior Research Scientist

INTRODUCTION

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) added a new section (§ 153) to Title 23 of the U.S. Code. This section authorized the Secretary of Transportation to establish a grant program to support states in adopting and implementing laws governing the use of safety belts and motorcycle helmets. To qualify for first-year funds, a state had to have laws requiring the use of a helmet by all motorcycle riders and the use of a belt or child safety seat by all front-seat occupants in cars. To qualify for second and third-year funding, a state had to have mandatory use laws and demonstrate a specified level of compliance. In FY93, states were required to demonstrate statewide belt usage of at least 55% and helmet usage of at least 70%. For FY94, the required usage levels increased to 70% for belts and 85% for helmets. Virginia qualified for funding all 3 years of the program. The total amount received exceeded $1.5 million.

On June 29, 1992, the National Highway Traffic Safety Administration (NHTSA) published the final guidelines for the conduct of surveys of belt and helmet use in the states.[1] The guidelines required that the selection of survey samples be based on a single "probability based" survey design and that only direct observational data be used to demonstrate compliance. The sample design had to include predetermined protocols for (1) determining sample size; (2) selecting sites; (3) selecting alternate sites when necessary; (4) determining which route, lane, and direction of traffic flow were to be observed; (5) collecting the observational data; and (6) beginning and concluding an observation period. The guidelines further stated that the relative error of the estimate could be no more than ± 5% and that all drivers and outboard front-seat passengers had to be eligible for observation. Also, both motorcycle drivers and passengers had to be eligible for observation. The guidelines required that at least 85% of the state's population be eligible for inclusion and that only the smallest counties, based on population, could be eliminated from the sampling frame. Finally, all daylight hours and all days of the week had to be eligible for inclusion in the sample, and the scheduling of the time and day for each sample site must be done randomly.

PURPOSE AND SCOPE

The purpose of this project was to conduct a survey of safety belt and motorcycle helmet use that conformed with NHTSA's guidelines. Even though the § 153 program has ended, 1994 safety belt and motorcycle helmet data were collected using the same methods and procedures that qualified the state for incentive funds in previous years. In this way, longitudinal data can be compared between years and over a period of years. When methods of data collection change, the

making of comparisons is compromised to the extent that differences in collection procedures affect the results.

METHOD

This survey included five major tasks: (1) defining the population from which the sample was drawn, (2) determining the sample size, (3) developing the sampling plan, (4) developing procedures and collecting data, and (5) determining how estimates would be weighted to approximate statewide figures.

Population

According to federal guidelines, localities in each state with the smallest populations and making up less than 15% of its total population could be removed from the population from which sites are chosen. In Virginia, determining which localities made up 15% was somewhat complex. In most states, cities are a part of their surrounding counties. In Virginia, although towns are considered to be part of their surrounding counties, the 41 independent cities are not. In order to accommodate this arrangement of political jurisdictions, both counties and independent cities were considered in establishing the sampling population.

In Table 1, the 136 counties and independent cities in Virginia are ordered by population. The total population in Virginia is about 6.2 million according to 1990 census figures. However, most of that 6.2 million is located in the four population centers: Northern Virginia, Tidewater, Richmond, and Roanoke. Thus, there is a great disparity between the population size of the rural counties and cities and the more urban ones. For instance, the least populated county, Highland, has fewer than 2,700 residents, and the least populated city, Norton, has fewer than 4,300. Twenty-seven of the 136 political jurisdictions have a population less than 10,000. On the other hand, 13 jurisdictions have a population of more than 100,000 and account for more than 48% of the total population of the state. Because of this disparity in population, the 74 least populated jurisdictions make up just under 15% of the state's population; thus they were excluded from sampling. See Figure 1 for a map that shows the jurisdictions that were excluded (the shaded portion). All other locations in the state were equally eligible for inclusion in the sample.

Sample Size

The next step in the project was to determine the number of statewide sites necessary to fulfill NHTSA's requirement of a relative error of ± 5% and 95% confidence. When computations were carried out to determine the number of sites necessary to meet the NHTSA's requirements for relative error and confidence, it was found that 78 sites would be adequate. After reviewing the project work plan, the NHTSA wrote, on September 4, 1992, that they would require Virginia to use 120 sites to have an approved project capable of qualifying for the incentive funds. The same 120 sites used in 1992 and 1993 were used in 1994. In addition, data were collected on the same day of the week and the same hour of the day at each site during the three years.

Table 1
POPULATION BY POLITICAL JURISDICTION

Jurisdiction	Jurisdiction Population	Cumulative Population	Cumulative Percent
Highland County	2,635	2,635	0.04
Norton	4,247	6,882	0.11
Craig County	4,372	11,254	0.18
Clifton Forge	4,679	15,933	0.26
Bath County	4,799	20,732	0.34
Emporia	5,306	26,038	0.42
Bedford	6,073	32,111	0.52
Surrey County	6,145	38,256	0.62
Charles City County	6,282	44,538	0.72
King and Queen County	6,289	50,827	0.82
Buena Vista	6,406	57,233	0.92
Bland County	6,514	63,747	1.03
Rappahannock County	6,622	70,369	1.14
Galax	6,670	77,039	1.25
Manassas Park	6,734	83,773	1.35
Lexington	6,959	90,732	1.47
Covington	6,991	97,723	1.58
South Boston	6,997	104,720	1.69
Richmond County	7,273	111,993	1.81
Cumberland County	7,825	119,818	1.94
Franklin	7,864	127,682	2.06
Mathews County	8,348	136,030	2.20
Middlesex County	8,653	144,683	2.34
Essex County	8,689	153,372	2.48
Amelia County	8,787	162,159	2.62
Greensville County	8,853	171,012	2.76
Falls Church	9,578	180,590	2.92
Sussex County	10,248	190,838	3.08
Greene County	10,297	201,135	3.25
New Kent County	10,445	211,580	3.42
Northumberland County	10,524	222,104	3.59
Lancaster County	10,896	233,000	3.77
King William County	10,913	243,913	3.94
Poquoson	11,005	254,918	4.12
Lunenburg County	11,419	266,337	4.30
Williamsburg	11,530	277,867	4.49
Charlotte County	11,688	289,555	4.68
Madison County	11,949	301,504	4.87
Floyd County	12,005	313,509	5.07
Clarke County	12,101	325,610	5.26
Appomattox County	12,298	337,908	5.46
Fluvanna County	12,429	350,337	5.66
Nelson County	12,778	363,115	5.87
Buckingham County	12,873	375,988	6.08
Northampton County	13,061	389,049	6.29
Alleghany County	13,176	402,225	6.50
King George County	13,527	415,752	6.72
Goochland County	14,163	429,915	6.95
Nottoway County	14,993	444,908	7.19
Powhatan County	15,328	460,236	7.44
Westmoreland County	15,480	475,716	7.69
Radford	15,940	491,656	7.95
Brunswick County	15,987	507,643	8.20
Colonial Heights	16,064	523,707	8.46
Martinsville	16,162	539,869	8.73
Grayson County	16,278	556,147	8.99
Giles County	16,366	572,513	9.25
Prince Edward County	17,320	589,833	9.53
Patrick County	17,473	607,306	9.82
Southampton County	17,550	624,856	10.10
Dickenson County	17,620	642,476	10.38
Rockbridge County	18,350	660,826	10.68
Bristol	18,426	679,252	10.98
Waynesboro	18,549	697,801	11.28
Fredericksburg	19,027	716,828	11.59
Caroline County	19,217	736,045	11.90
Fairfax	19,622	755,667	12.21
Louisa County	20,325	775,992	12.54
Dinwiddie County	20,960	796,952	12.88
Orange County	21,421	818,373	13.23
Page County	21,690	840,063	13.58
Winchester	21,947	862,010	13.93
Hopewell	23,101	885,111	14.31
Scott County	23,204	908,315	14.68
Salem	23,756	932,071	15.06
Staunton	24,461	956,532	15.46
Lee County	24,496	981,028	15.86
Botetourt County	24,992	1,006,020	16.26
Isle of Wight County	25,053	1,031,073	16.66
Wythe County	25,466	1,056,539	17.08
Warren County	26,142	1,082,681	17.50
Carroll County	26,594	1,109,275	17.93
Prince George County	27,394	1,136,669	18.37
Culpeper County	27,791	1,164,460	18.82
Manassas	27,957	1,192,417	19.27
Amherst County	28,578	1,220,995	19.73
Russell County	28,667	1,249,662	20.20
Halifax County	29,033	1,278,695	20.67
Mecklenburg County	29,241	1,307,936	21.14
Glouchester County	30,131	1,338,067	21.63
Harrisonburg	30,707	1,368,774	22.12
Buchanan County	31,333	1,400,107	22.63
Shenandoah County	31,636	1,431,743	23.14
Accomack County	31,703	1,463,446	23.65
Smyth County	32,370	1,495,816	24.18
Pulaski County	34,496	1,530,312	24.73
James City County	34,859	1,565,171	25.30
Petersburg	38,386	1,603,557	25.92
Franklin County	39,549	1,643,106	26.56
Wise County	39,573	1,682,679	27.20
Charlottesville	40,341	1,723,020	27.85
York County	42,422	1,765,442	28.53
Bedford County	45,656	1,811,098	29.27
Frederick County	45,723	1,856,821	30.01
Washington County	45,887	1,902,708	30.75
Tazewell County	45,960	1,948,668	31.49
Campbell County	47,572	1,996,240	32.26
Fauquier County	48,741	2,044,981	33.05
Suffolk	52,141	2,097,122	33.89
Danville	53,056	2,150,178	34.75
Augusta County	54,677	2,204,855	35.63
Pittsylvania County	55,655	2,260,510	36.53
Henry County	56,942	2,317,452	37.45
Spotsylvania County	57,403	2,374,855	38.38
Rockingham County	57,482	2,432,337	39.31
Stafford County	61,236	2,493,573	40.30
Hanover County	63,306	2,556,879	41.32
Lynchburg	66,049	2,622,928	42.39
Albemarle County	68,040	2,690,968	43.49
Montgomery County	73,913	2,764,881	44.69
Roanoke County	79,332	2,844,213	45.97
Loudoun County	86,129	2,930,342	47.36
Roanoke	96,397	3,026,739	48.92
Portsmouth	103,907	3,130,646	50.60
Alexandria	111,183	3,241,829	52.39
Hampton	133,793	3,375,622	54.56
Chesapeake	151,976	3,527,598	57.01
Newport News	170,045	3,697,643	59.76
Arlington County	170,936	3,868,579	62.52
Richmond	203,056	4,071,635	65.81
Chesterfield County	209,274	4,280,909	69.19
Prince William County	215,686	4,496,595	72.67
Henrico County	217,881	4,714,476	76.20
Norfolk	261,229	4,975,705	80.42
Virginia Beach	393,069	5,368,774	86.77
Fairfax County	818,584	6,187,358	100.00
Total Population	6,187,358		

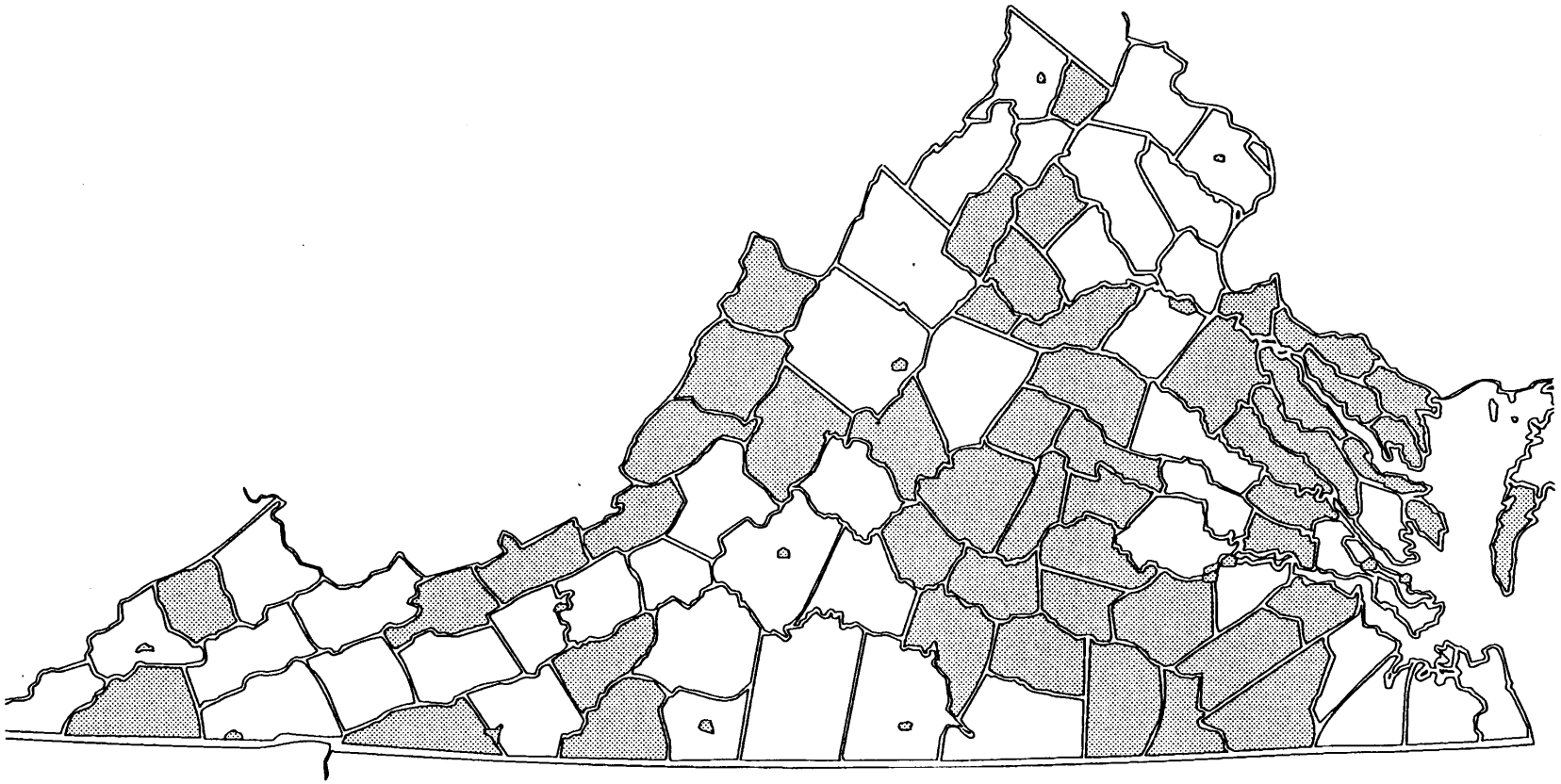


Figure 1. Areas excluded from sampling procedures (shaded).

Sampling Plan

To select the sample of sites, a grid with 1/4-in by 1/4-in sections was placed over a standard map of Virginia issued by the Virginia Department of Transportation (VDOT) and drawn to a scale of 1 in = 13 miles. Figure 2 shows a sample section of the map. Each grid box contained approximately 10.5 square miles. This procedure produced a system of 144 sections across the horizontal axis and 63 sections across the vertical axis. However, because Virginia is not perfectly rectangular and because political jurisdictions representing Virginia's smallest 15% of the population were excluded from the sample, some boxes fell outside the geography or were wholly within excluded areas. To keep these boxes from affecting the random nature of the sample, they were not defined as part of the study population. Each valid grid box containing at least one intersection in an included part of Virginia was numbered. Random numbers were generated to select 120 of the 2,572 valid grid boxes, without replacement, from which specific intersections were selected.

To respond to a concern expressed by NHTSA that a pure statewide random sample of 120 sites would overrepresent the nonurban areas of Virginia, the originally proposed procedures were changed. The selection of sites was based on the proportion of the population in the urban and rural areas of the state. Excluding the lowest 15% of the state's population, the urban areas have about 68% of the remaining population, and the rural areas have about 32%. Of the 120 total sites, 84 were randomly selected from the four metropolitan areas, and 36 were randomly selected from the remainder of the state.

Using detailed maps of urban areas available in book form from ADC map publishers[2-6] and county maps prepared by VDOT, each intersection in a selected grid box was numbered, and a random number was generated to select the specific intersection to be sampled. Two alternate sites were also selected randomly from the box. For each primary and alternate site, random numbers were used to select which route and direction of travel, and whether traffic entering or exiting the selected intersection, would be observed. Figures 3 and 4 show examples of urban and rural grid boxes and potential sites.

Members of the study team visited and evaluated each site to determine whether data could be safely and adequately collected. The safety of the observer was the primary criterion for judging each site, followed by the ability to observe traffic. If the intersection was found to be inadequate, attempts were made to find an adequate observation point downstream if traffic exiting the intersection was to be observed and upstream if entering traffic was to be observed. In either case, if an adequate site could not be found before the next intersection was reached, an alternate site was investigated. Choosing a point before the next intersection ensured that the same traffic characteristics would be present at the upstream or downstream sites as would have been present at the original intersection. Very few original sites were discarded in favor of alternates. Those that were discarded had no safe area for the observer to stand or park or required the observer to be below the level of the roadway, making observation impossible.

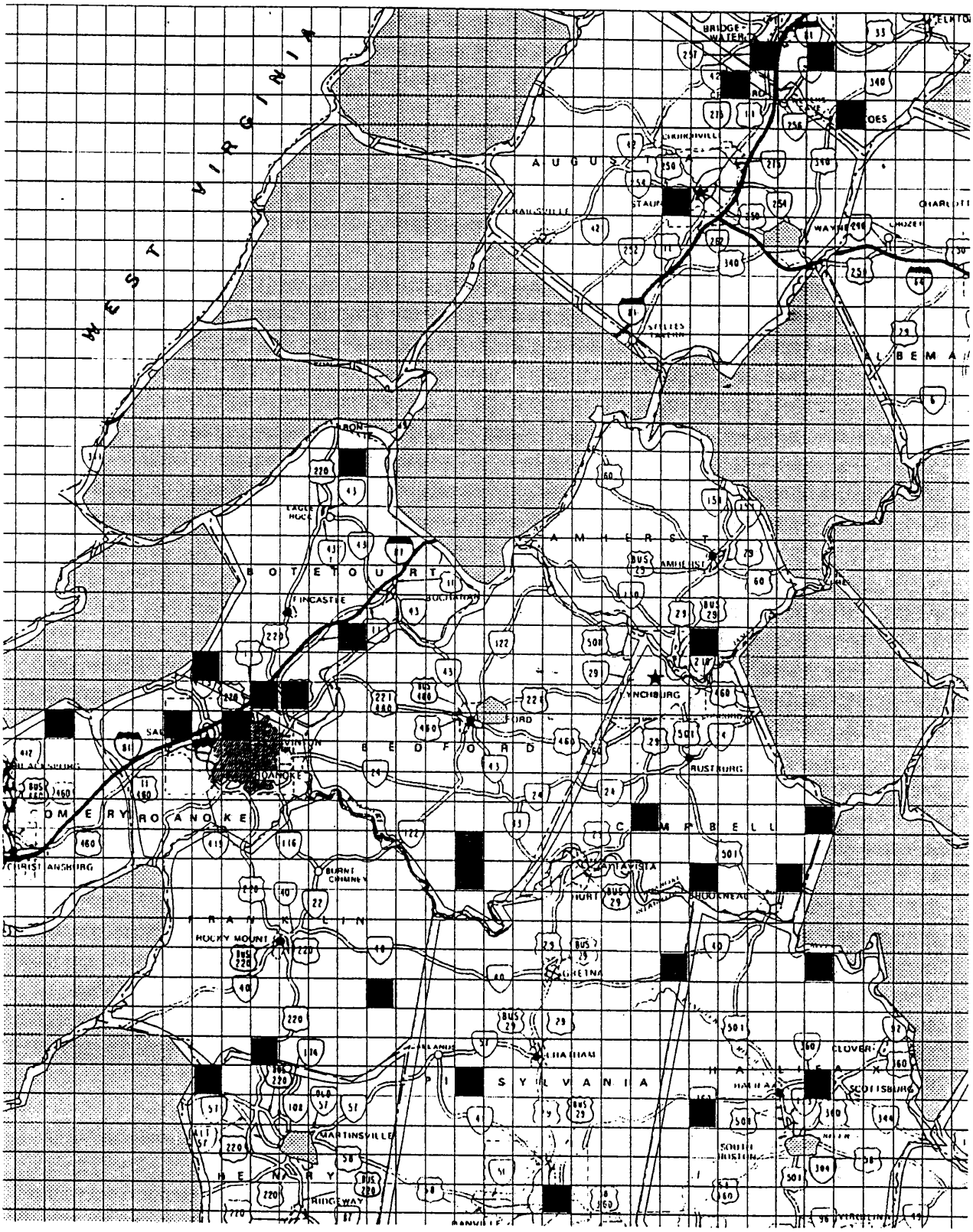


Figure 2. Sample section of state map showing grid boxes.

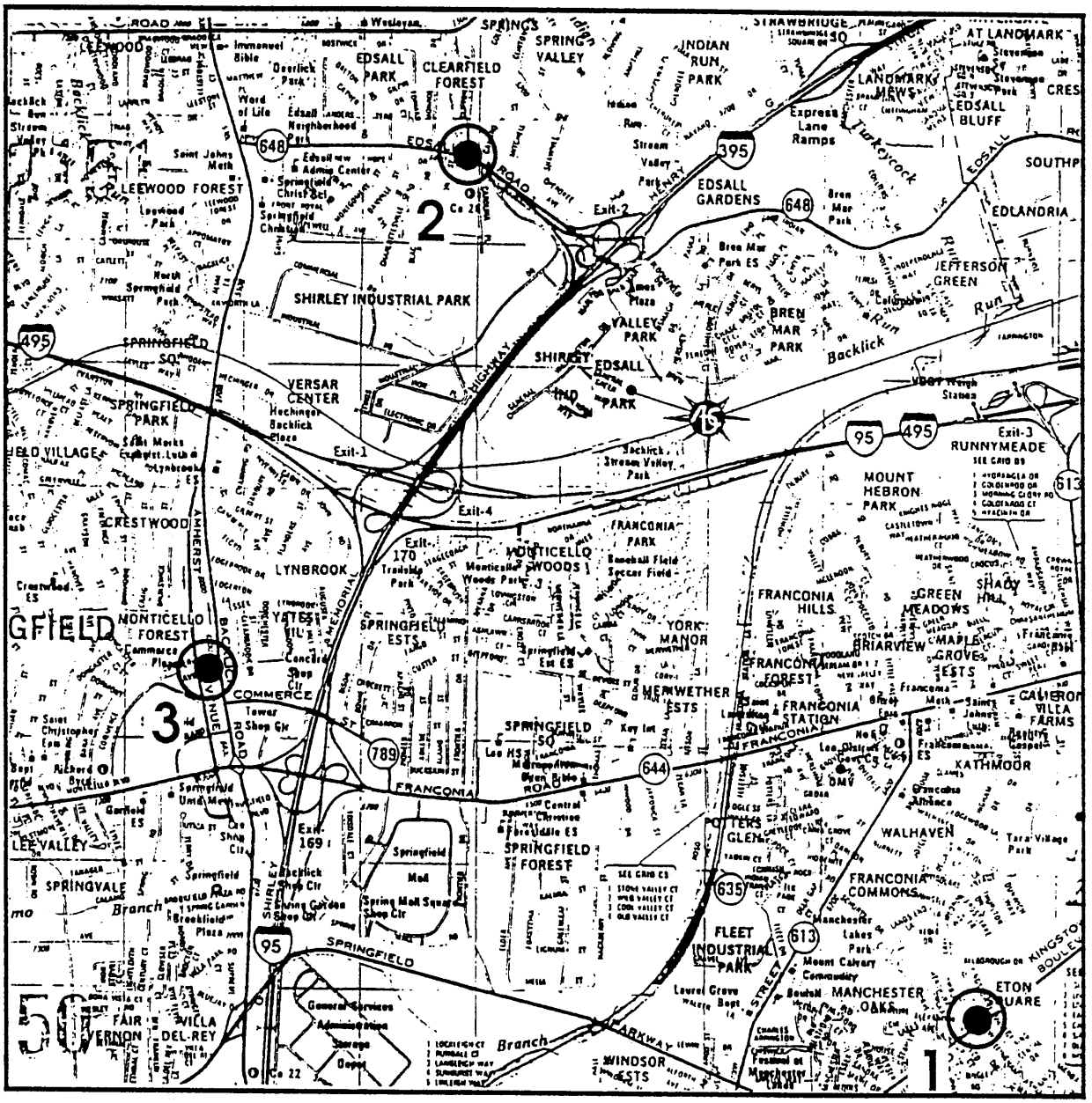


Figure 3. Detail of urban grid showing intersection choices.

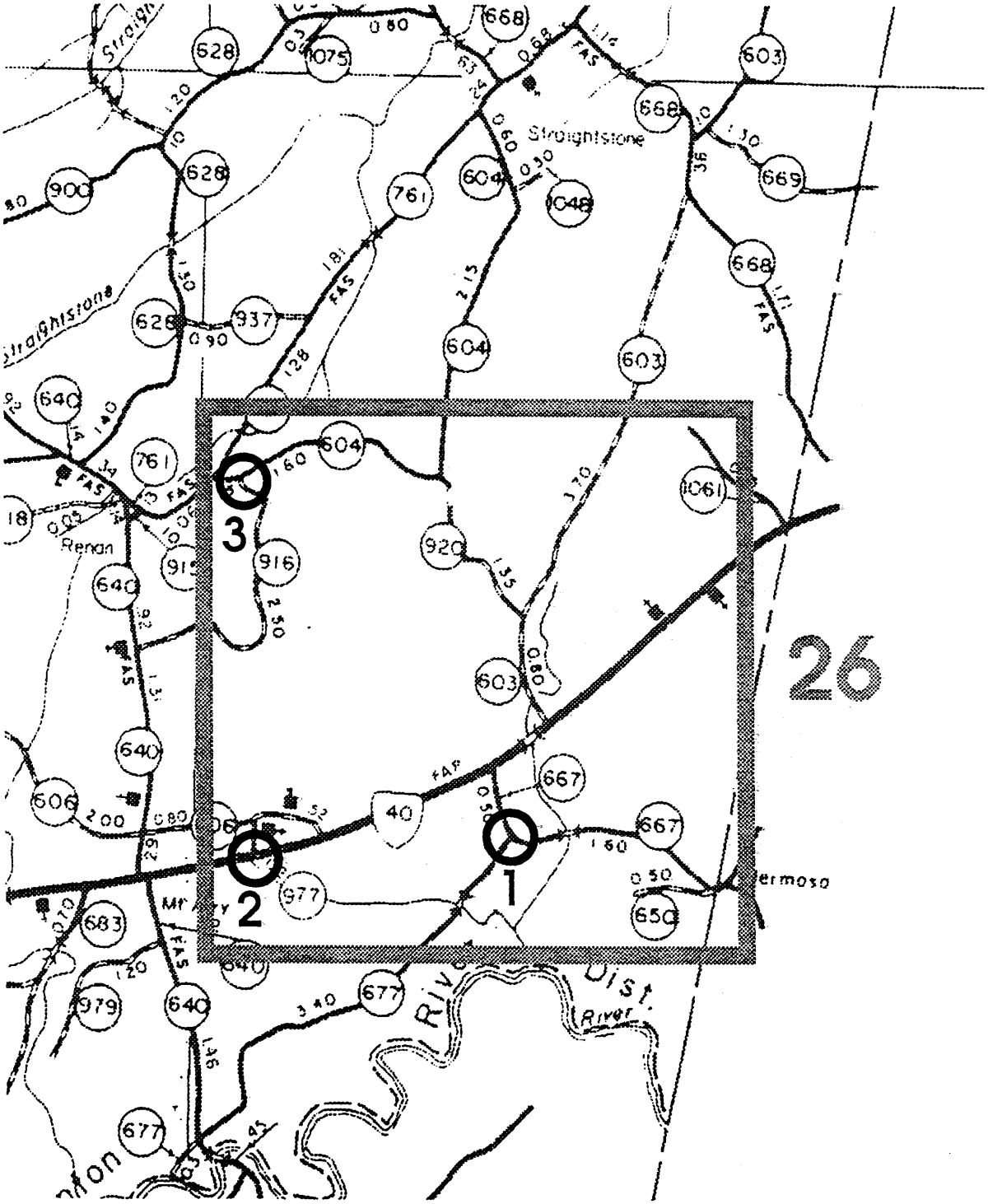


Figure 4. Detail of rural grid showing intersection choices.

After selection, the sites were sorted geographically into seven groups. The days of the week were randomly assigned, without replacement, to each geographic group. Data were collected for one hour at each site all three years. For each day, the sites in a geographic group were assigned a random hour to begin, without replacement, from 7 A.M. to 6 P.M. When inclement weather precluded the collection of data at a site, data were collected at that site at a later date but at the originally specified time and on the same day of the week.

Data Collection Procedures

All passenger cars in the curb lane were observed for shoulder belt use. (Dedicated turning lanes were not considered to be curb lanes for the purpose of this study.) All observations began precisely on the hour and ended on the hour. If a momentary interruption occurred, the observer was instructed to resume observing vehicles, but to ensure that the beginning observation was not a nonrandom selection by the observer, data collection resumed with the fifth vehicle to pass the site after the observer was ready.

Observations were recorded using eight counters mounted on a hand-held board. A "yes" or "no" count was made for shoulder belt use for drivers and outboard front-seat passengers for each passenger car in the curb travel lane and for motorcycle driver and passenger helmet use in any lane at the intersection. The data collectors were required to complete a training program on the use of the counter board and on how the data were to be collected and recorded. The data collectors were checked for inter-rater reliability in training sessions before beginning the survey. Since observation points were pre-selected at each site, the data collectors were instructed to use intersection diagrams and photographs to locate the point at which observations were to be made (see Figures 5 and 6).

Calculation of Use and Error Rates

Because safety belt use was observed only in the curb lane, the NHTSA guidelines required that the observations taken on multilane highways be weighted by the number of lanes of travel. However, no such weighting was necessary for motorcycles, which were observed in all lanes of travel. For passenger cars at each site, the number of driver and passenger observations was multiplied by the number of lanes in the observed direction of travel. Thus, at a site with two lanes in the travel direction, the number of observations would be doubled to estimate the total number of drivers and passengers who crossed the site.

As previously discussed, the selection of sites was stratified to represent the urban and rural areas of the Commonwealth in proportion to their populations. Thus, more than two thirds of the sites were in urban areas.

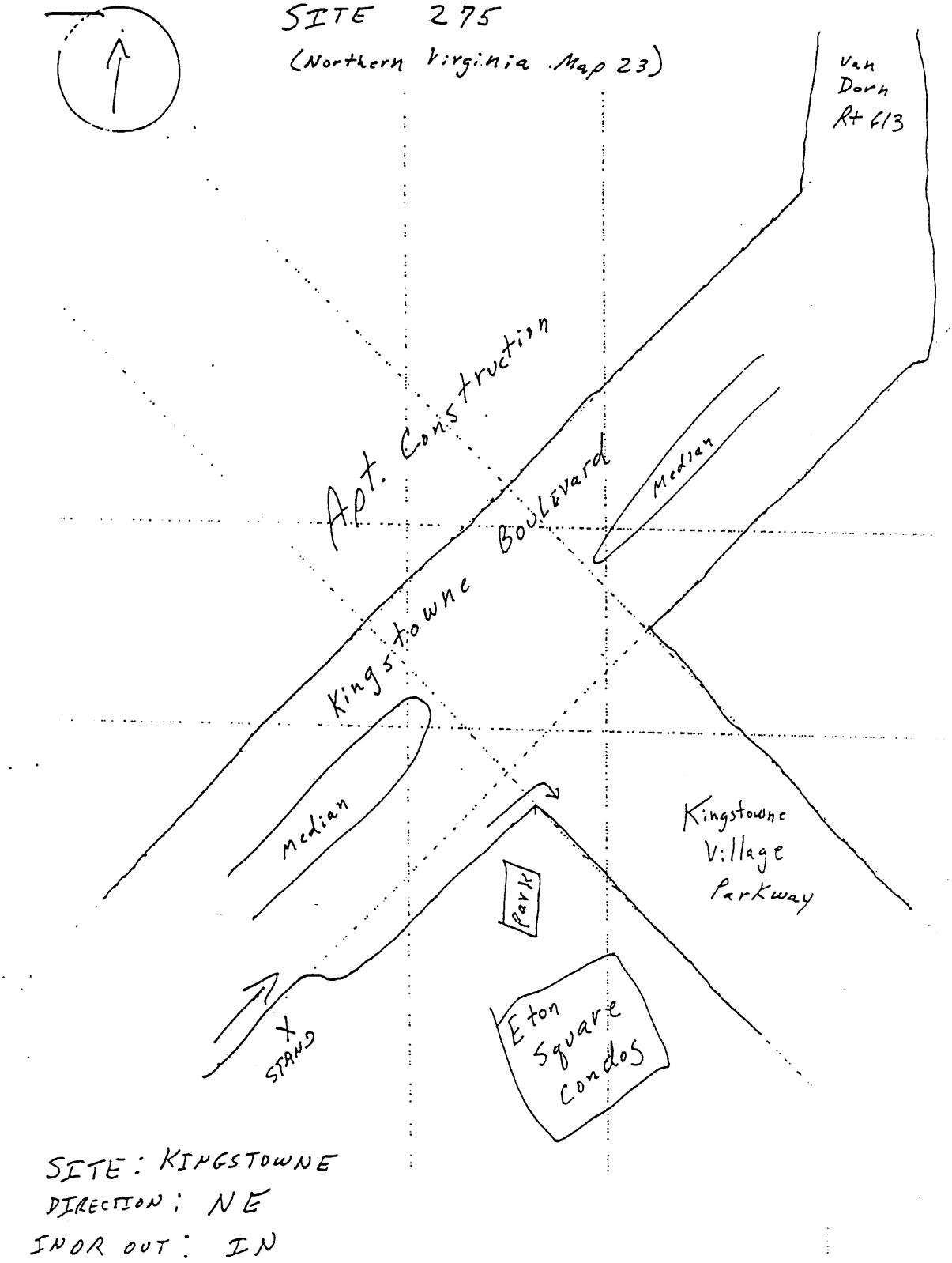


Figure 5. Urban site intersection diagram.

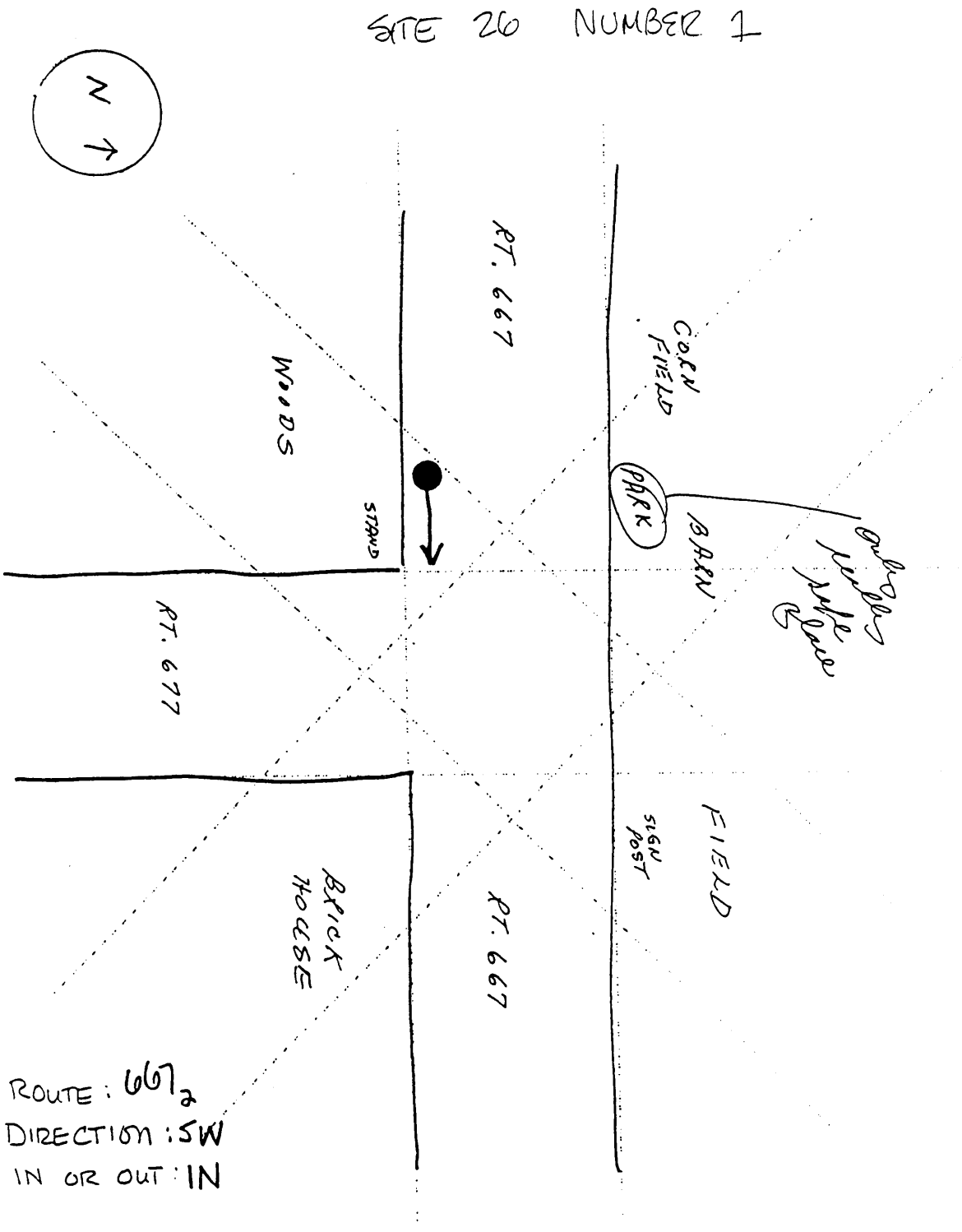


Figure 6. Rural site intersection diagram.

Calculation of Use and Error Rates

Because safety belt use was observed only in the curb lane, the NHTSA guidelines required that the observations taken on multilane highways be weighted by the number of lanes of travel. However, no such weighting was necessary for motorcycles, which were observed in all lanes of travel. For passenger cars at each site, the number of driver and passenger observations was multiplied by the number of lanes in the observed direction of travel. Thus, at a site with two lanes in the travel direction, the number of observations was doubled to estimate the total number of drivers and passengers who crossed the site.

As previously discussed, the selection of sites was stratified to represent urban and rural areas in proportion to their populations. Thus, more than two thirds of the sites were in urban areas.

The use rate, P_B, is the estimated proportion of drivers and passengers using safety belts and is calculated by the formula:

$$P_B = \frac{\sum_{t=1}^{2} \frac{N_t}{n_t} \sum_{i=1}^{n_t} N_{ti} B_{ti}}{\sum_{t=1}^{2} \frac{N_t}{n_t} \sum_{i=1}^{n_t} N_{ti} O_{ti}} \qquad [1]$$

where t = stratum (1 = urban, 2 = rural)
ti = each site within a stratum
N_t = total number of grid boxes within stratum t
n_t = number of grid boxes selected from each stratum t
N_{ti} = total number of intersections within each sampled grid box
B_{ti} = number of belted occupants observed at site ti (weighted by lanes)
O_{ti} = total number of occupants observed at site ti (weighted by lanes).

The variance of the estimated belt use, $V(P_B)$, was approximated by the formula:

$$V(P_B) = \frac{1}{\bar{O}^2} [V(B) + P_B^2 V(O) - 2P_B COV(B, O)] \qquad [2]$$

where $\bar{O}$ is the weighted average number of occupants observed per site and is computed by the formula:

$$\bar{O} = \frac{1}{2}\sum_{t=1}^{2} \frac{\sum_{i=1}^{n_t} N_{ti}O_{ti}}{n_t}$$

and where *V(B)* is the variance of the number of belted occupants and is computed by the formula:

$$V(B) = \frac{1}{(N_1 + N_2)^2} \sum_{t=1}^{2} \frac{N_t^2}{n_t(n_t - 1)} \sum_{i=1}^{n_t} (N_{ti}B_{ti} - \bar{B}_t)^2$$

$$\text{where } \bar{B}_t = \frac{\sum_{i=1}^{n_t} N_{ti}B_{ti}}{n_t}$$

and where *V(O)* is the variance of the number of observed occupants and is computed by the formula:

$$V(O) = \frac{1}{(N_1 + N_2)^2} \sum_{t=1}^{2} \frac{N_t^2}{n_t(n_t - 1)} \sum_{i=1}^{n_t} (N_{ti}O_{ti} - \bar{O}_t)^2$$

$$\text{where } \bar{O}_t = \frac{\sum_{i=1}^{n_t} N_{ti}O_{ti}}{n_t}$$

and where *COV(B, O)* is the covariance of the number of belted and observed occupants and is computed by the formula:

$$COV(B,O) = \frac{1}{(N_1+N_2)^2} \sum_{t=1}^{2} \frac{N_t^2}{n_t(n_t-1)} \sum_{i=1}^{n_t} (N_{ti}B_{ti} - \bar{B}_t)(N_{ti}O_{ti} - \bar{O}_t)$$

The standard error of the estimate was calculated by the formula:

$$SE = \frac{\sqrt{V(P_B)}}{n-1} \quad [3]$$

where SE = standard error of the estimate
n = total number of sites sampled.

The relative error of the estimate was calculated by the formula:

$$RE = \frac{SE}{P_B} \quad [4]$$

where RE = relative error of the estimate.

RESULTS

As can be seen from the data in Table 2, there were 29,584 weighted observations of occupants in passenger cars. Of these, there were 15,632 drivers and 4,521 right-front passengers who were observed to be using a shoulder belt. Passenger car occupants had a weighted safety belt use rate of 70.2%. The relative error of the estimate was 0.15%.

Table 2

Summary of 1995 Survey Results

	Weighted Observations	Drivers Protected	Passengers Protected	Use Rate	Variance	Standard Error	Relative Error
Passenger cars	29,584	15,632	4,521	70.2% (p = .702)	0.01523	0.001037	0.001477
Motor-cycles	247	208	39	100% (p = 1)	0	0	0

Longitudinal Results

The results from the fall 1992 survey are shown in Table 3 and those from the summer of 1993 are shown in Table 4. In each of the 3 years (1992-1994), 100% of the motorcycle drivers and passengers observed were using a helmet. For the passenger car drivers and right front passengers observed, use rates were 71.6%, 73.2%, and 71.8% over these 3 years. As a practical matter, there is no difference in these rates of use.

Table 3: SUMMARY OF THE 1992 SURVEY RESULTS

	Weighted Observations	Drivers Protected	Passengers Protected	Use Rate	Variance	Standard Error	Relative Error
Passenger Cars	26,320	14,701	4,233	71.6% (p = .716	0.011124	0.000886	0.001238
Motorcycles	53	47	6	100% (p = 1)	0	0	0

Table 4: SUMMARY OF THE 1993 SURVEY RESULTS

	Weighted Observations	Drivers Protected	Passengers Protected	Use Rate	Variance	Standard Error	Relative Error
Passenger Cars	24,299	13,045	4,396	73.2% (p = .732)	0.008885	0.000792	0.001083
Motorcycles	236	208	28	100% (p = 1)	0	0	0

Acknowledgments

The efforts of Jason Goodloe and James Jennings, who travelled nearly 15,000 miles throughout Virginia collecting data at the 120 sites, are gratefully acknowledged. They carried out their data collecting task while working more than 8 hours per day, including several weekends, and they did so in an accurate and professional manner.

REFERENCES

1. *Federal Register*, Docket No. 92-12, Notice No. 02, Guidelines for State Observational Surveys of Safety Belt and Motorcycle Helmet Use, Monday June 29, 1992.

2. ADC of Alexandria, Inc., "Street Map of Northern Virginia," 34th Edition, Alexandria, Va., 1992.

3. ADC of Alexandria, Inc., "Street Map of Prince William County," 17th Edition, Alexandria, Va., 1992.

4. ADC of Alexandria, Inc., "Street Map of Richmond and Vicinity," 9th Edition, Alexandria, Va., 1991.

5. ADC of Alexandria, Inc., "Street Map of Tidewater," 15th Edition, Alexandria, Va., 1991.

6. ADC of Alexandria, Inc., "Street Map of Virginia Peninsula," 14th Edition, Alexandria, Va., 1991.

Appendix

Rural and Urban Safety Belt and Motorcycle Helmet Use:

Raw Data by Site

Table A-1

URBAN SAFETY BELT AND MOTORCYCLE HELMET USE: RAW DATA BY SITE

Site ID	Lanes	Nti	Bti	Oti	MC Bti	MC Oti
2	1	10	14	17	0	0
7	1	408	48	71	0	0
8	1	7	0	1	0	0
11	1	82	0	2	0	0
15	3	6	522	747	4	4
17	3	115	273	438	3	3
19	1	10	85	111	0	0
20	1	7	17	26	0	0
21	1	148	34	45	2	2
28	1	3	6	6	0	0
30	2	3	178	294	1	1
32	1	244	34	44	0	0
40	3	254	852	1068	0	0
41	1	211	256	313	0	0
42	1	36	6	9	0	0
46	1	5	11	22	0	0
49	1	6	1	3	0	0
54	2	504	832	1016	1	1
58	1	15	66	88	2	2
67	1	5	3	5	0	0
68	1	24	5	7	0	0
69	3	721	636	909	0	0
81	1	6	22	43	0	0
86	2	7	132	246	0	0
90	1	17	60	91	0	0
92	3	142	564	714	3	3
105	1	24	51	68	0	0
118	1	7	29	39	0	0
119	3	32	885	1032	3	3
120	1	546	26	38	0	0
121	1	7	195	251	4	4
136	1	23	54	77	1	1
140	3	3	1359	1680	3	3
154	1	8	59	72	1	1
169	2	4	114	236	2	2
170	1	19	3	5	0	0
173	2	331	646	830	0	0

Table A-1

URBAN SAFETY BELT AND MOTORCYCLE HELMET USE: RAW DATA BY SITE

Site ID	Lanes	Nti	Bti	Oti	MC Bti	MC Oti
183	1	8	5	10	1	1
202	1	59	54	74	0	0
206	1	17	7	9	0	0
210	2	73	376	460	2	2
211	1	253	175	259	1	1
213	1	376	227	291	3	3
234	1	197	9	12	0	0
236	1	87	75	99	2	2
250	1	16	6	7	0	0
259	3	532	813	1095	1	1
275	2	526	148	214	0	0
280	1	104	8	11	0	0
290	1	3	143	193	2	2
300	1	110	4	4	0	0
306	1	12	2	4	0	0
313	3	186	600	897	0	0
315	1	9	110	150	0	0
317	2	444	104	150	0	0
322	1	1	35	52	1	1
324	2	82	212	312	1	1
330	1	16	11	16	0	0
332	3	8	720	960	8	8
353	1	11	107	152	2	2
359	1	9	53	64	0	0
371	2	64	200	280	0	0
372	3	5	615	786	4	4
374	1	26	13	14	0	0
375	1	12	207	274	2	2
385	3	30	393	633	6	6
388	1	10	4	4	0	0
400	1	385	8	8	0	0
403	2	341	398	560	2	2
406	2	374	336	482	1	1
411	1	19	75	93	0	0
420	1	223	90	109	1	1
425	1	365	38	56	0	0
426	2	626	452	718	0	0
434	1	25	0	3	0	0
450	1	15	121	149	0	0

Table A-1

URBAN SAFETY BELT AND MOTORCYCLE HELMET USE: RAW DATA BY SITE

Site ID	Lanes	Nti	Bti	Oti	MC Bti	MC Oti
458	2	180	128	202	2	2
464	1	21	36	51	2	2
471	1	13	1	1	0	0
476	1	13	519	675	3	3
477	1	11	16	24	0	0
483	1	2	85	106	0	0
508	2	628	518	830	2	2
512	1	15	111	132	0	0

Site ID = identifier of site sampled.

Lanes = number of lanes in sampled direction at site.

N_{ti} = total number of intersections within sampled grid.

B_{ti} = number of belted occupants observed at site.

O_{ti} = total number of occupants observed at site.

MC B_{ti} = number of motorcycle occupants with helmets at site.

MC O_{ti} = total number of motorcycle occupants observed at site.

Table A-2

RURAL SAFETY BELT AND MOTORCYCLE HELMET USE: RAW DATA BY SITE

Site ID	Lanes	Nti	Bti	Oti	MC Bti	MC Oti
1	1	15	36	49	0	0
4	1	9	10	18	2	2
5	1	9	0	0	0	0
6	1	16	23	42	0	0
9	1	6	12	23	0	0
10	1	5	3	5	0	0
12	1	4	284	400	1	1
13	1	17	30	46	0	0
16	1	4	31	42	0	0
18	1	8	0	2	0	0
22	1	12	5	15	0	0
23	1	7	36	84	0	0
25	1	6	31	41	0	0
26	1	9	1	6	0	0

Table A-2

RURAL SAFETY BELT AND MOTORCYCLE HELMET USE: RAW DATA BY SITE

Site ID	Lanes	Nti	Bti	Oti	MC Bti	MC Oti
27	1	13	1	7	0	0
29	1	6	2	7	0	0
31	1	7	1	8	0	0
33	1	15	97	116	2	2
35	1	9	21	60	0	0
36	1	12	0	0	0	0
37	1	1	47	76	0	0
39	1	10	15	26	2	2
44	1	7	6	15	0	0
45	1	7	41	91	0	0
47	3	18	768	999	8	8
48	1	15	3	5	0	0
50	1	8	36	62	0	0
51	1	11	2	4	0	0
52	1	3	3	10	0	0
53	1	2	6	20	0	0
55	1	12	26	62	2	2
56	2	5	52	98	0	0
57	1	13	1	5	0	0
59	1	7	1	2	0	0
62	2	13	288	420	8	8
63	1	15	52	76	1	1

Site ID = identifier of site sampled.
Lanes = number of lanes in sampled direction at site.
N_{ti} = total number of intersections within sampled grid.
B_{ti} = number of belted occupants observed at site.
O_{ti} = total number of occupants observed at site.
MC B_{ti} = number of motorcycle occupants with helmets at site.
MC O_{ti} = total number of motorcycle occupants observed at site.