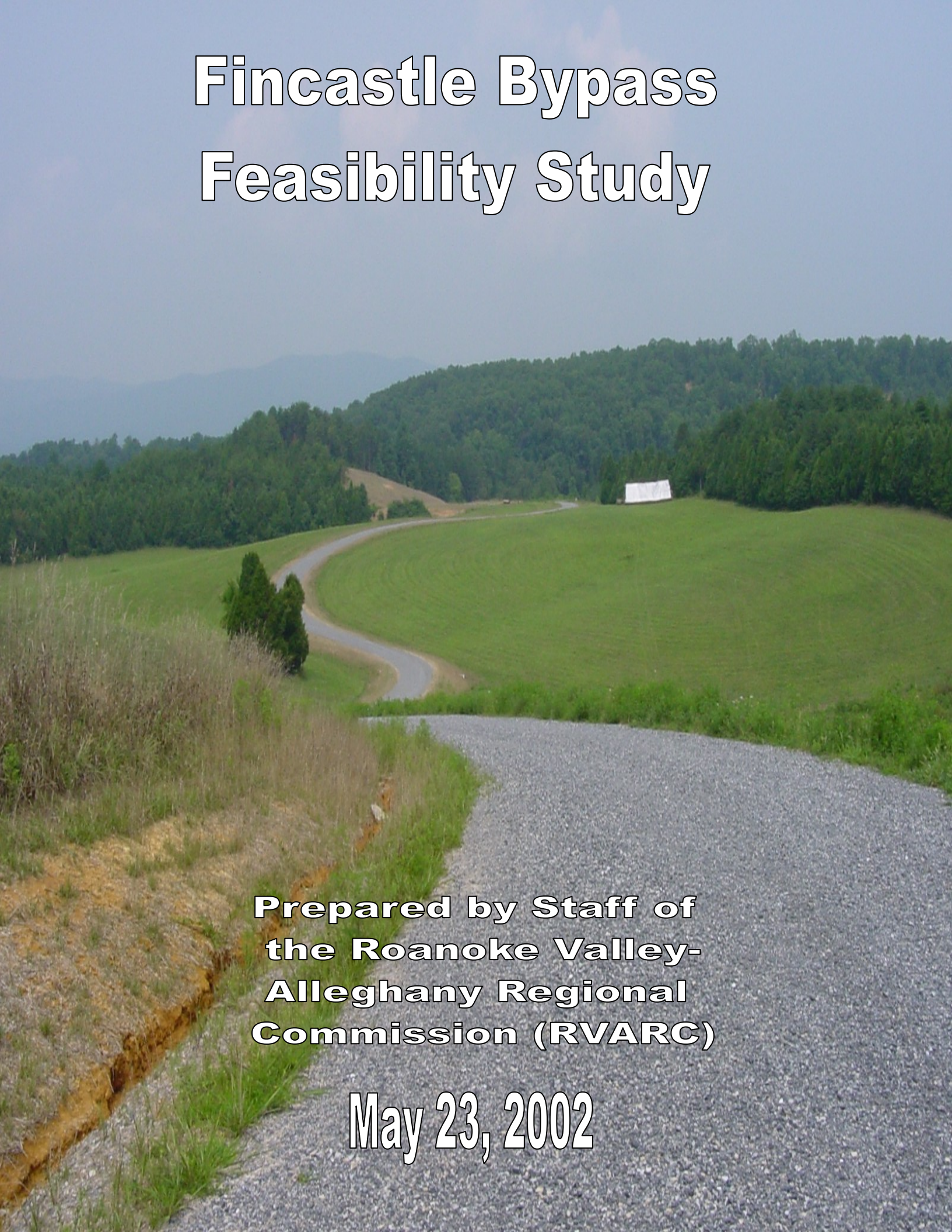
Fincastle Bypass Feasibility Study



Prepared by Staff of the Roanoke Valley-Alleghany Regional Commission (RVARC)

May 23, 2002

This report was prepared by the staff of the Roanoke Valley-Alleghany Regional Commission and funded with FY 2002 Rural Planning Assistance, State Highway Planning and Research funds.

- Accepted as fulfilling the intent of the "Fincastle Bypass Study" item in the FY2002 Rural Transportation Assistance Program by the Roanoke Valley-Alleghany Regional Commission (RVARC) Policy Board on May 23, 2002.
- Accepted by Botetourt County Board of Supervisors July, 16, 2002

Table of Contents

List of Figures and Tables

Executive Summary

Due to its relatively early settlement and existing historic structures, much of the Town of Fincastle is designated as a historic district. The historic district is served by a small grid of town streets that are narrow (12 – 20 feet) by modern standards. These narrow streets lend the historic district its intended historic atmosphere; however, current traffic volumes pose circulation and safety issues on the historic district's grid. Local officials have noted circulation problems in the historic district on several occasions. Specifically, in the early 1990's, the Fifth Planning District Commission, now operating as the Roanoke Valley-Alleghany Regional Commission (RVARC), in conjunction with state and local officials, completed the Fincastle Bus Circulation Studies Phases I and II. These studies noted the difficulties full size school busses had in navigating the narrow streets of the historic district. Phase II of the Bus Circulation Study recommended exploring the option of building either a northern or southern new terrain bypass around the historic district to alleviate school bus safety concerns. This study expands the analysis to include various traffic and congestion considerations. In total, four alternatives are evaluated using a multi-criteria weighting framework formulated by Botetourt County, Virginia Department of Transportation and RVARC Staff. The alternatives can be summarized as follows: alternative 1 – no build; alternative 2 – minor improvements; alternative 3 – northern new terrain bypass; and alternative 4 – southern new terrain bypass. The alternatives are compared relative to one another and the alternative with the highest score is recommended. A summary of the criteria and resulting scores appear in the following table:

Comparison of Scores	**Alt. 1**	**Alt. 2**	**Alt. 3**	**Alt. 4**
Safety	2	4	8	6
Traffic Volume	2	4	8	6
Impact on Historic District	1	2	4	3
Access to Educational Facilities	1	2	4	3
Financial Considerations	4	3	1	2
Total Score	**10**	**15**	**25**	**20**

Alternative 3 – northern new terrain bypass is recommended by project staff as the most appropriate concept for further investigation and analysis.

CHAPTER 1
INTRODUCTION

General Background

Due to its relatively early settlement and existing historic structures, much of the Town of Fincastle is designated as a historic district. In fact, the registered historic district and the town limits are nearly the same with a few property parcels serving as the exception. The historic district is served by a small grid of town streets that are narrow (12 – 20 feet) by modern standards. These narrow streets lend the historic district its intended historic atmosphere; however, current traffic volumes pose circulation and safety issues on the historic district's grid. These issues are compounded by the fact that the only connections between routes 630, 681,and U.S. 220 pass through the historic district. Along routes 630 and 681 there are 3 schools, a school administration building, and a school bus garage. These school related traffic generators are documented in ***Fincastle Bus Circulation Study Phases I and II***, adopted in 1994 and 1996 respectively by the Fifth Planning District Commission (currently operating as the Roanoke Valley-Alleghany Regional Commission - RVARC).

Although the scope of the bus circulation studies focused on school bus related transportation and safety issues, some specific recommendations from the Phase II study serve as an appropriate starting point for this study. Phase II considered the possibility of creating alternate routes that would largely bypass the historic district (see figure 1 a & b).

Fincastle Bus Study

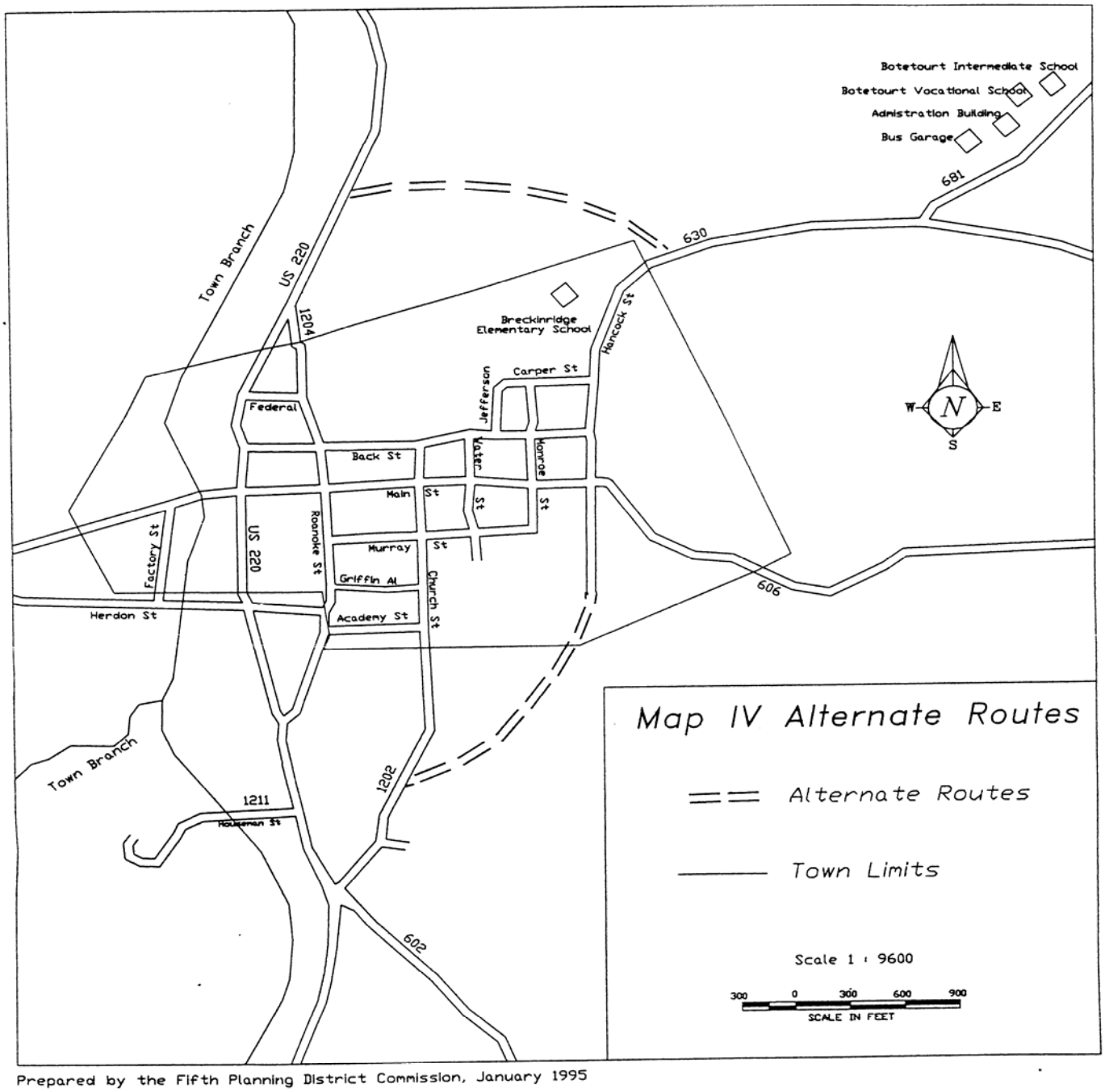


Figure 1a

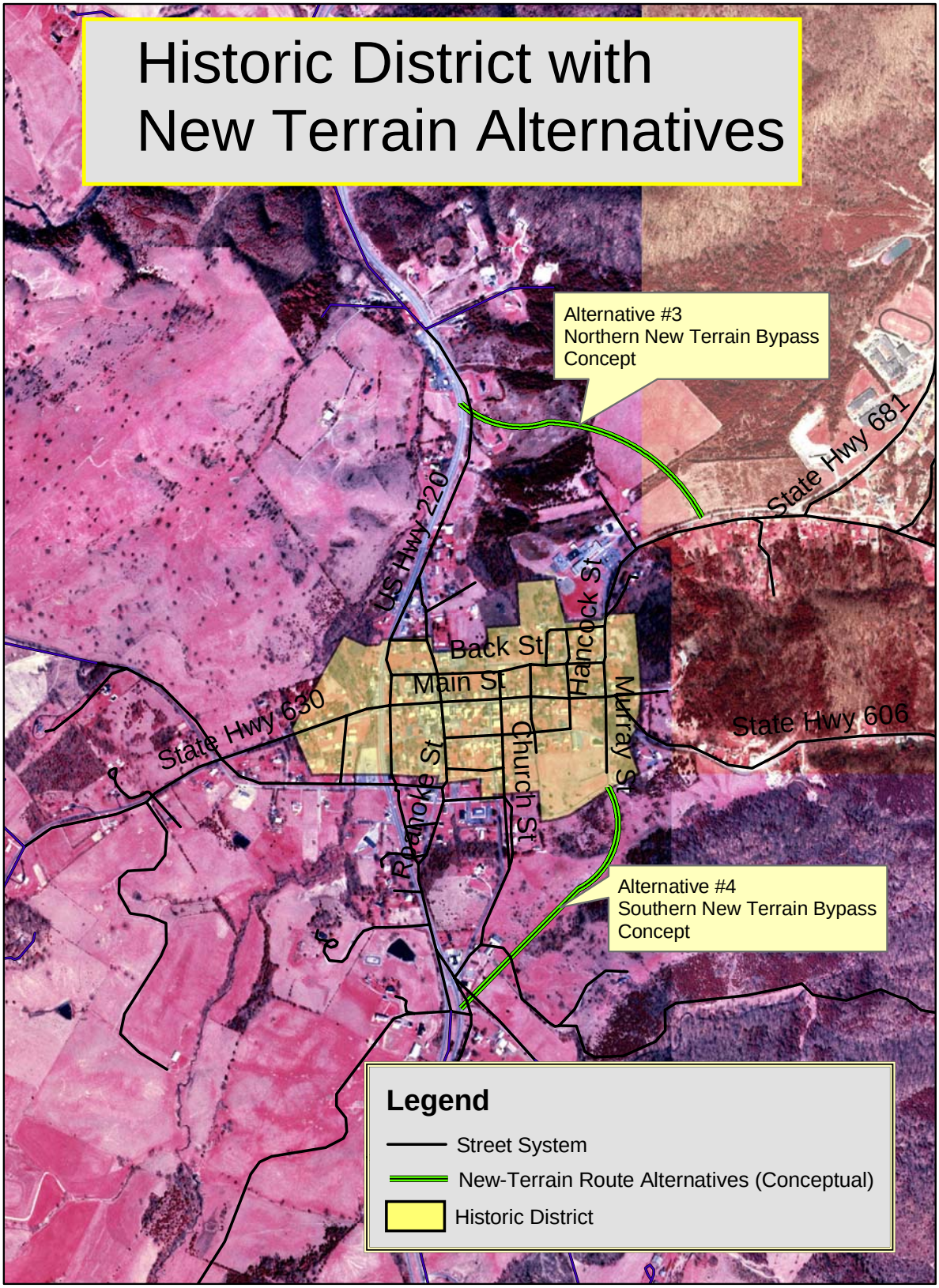

Historic District with
New Terrain Alternatives
Alternative #3
Northern New Terrain Bypass
Concept
US Hwy 220
State Hwy 681
Hancock St
Back St
Main St
State Hwy 630
Murray St
State Hwy 606
Church St
Roanoke St
Alternative #4
Southern New Terrain Bypass
Concept
Legend
Street System
New-Terrain Route Alternatives (Conceptual)
Historic District

Figure 1b

These alternate routes as well as a "no-build" and an "minor-improvements" scenario will serve as the four alternatives considered in the analysis section of this report.

Goals and Objectives

The goals of this ***Fincastle Bypass Feasibility Study*** are to develop and recommend solutions that will improve traffic safety and circulation from the area around route 630 and route 681 to U.S. 220. Four alternatives will be considered: 1.) A "no-build" scenario with no non-maintenance related improvements or new terrain components; 2.) Minor improvements to existing streets with no new terrain components; 3.) A new terrain bypass from 630 to U.S. 220 North of the historic district *(Northern alternative route, Figure 1 a & b)*; and, 4.) A new terrain bypass connecting 630 (Hancock Street) to route 1202 (Church Street) South of the historic district *(Southern alternative route, Figure 1 a & b).*

Study Area

The study area is bounded by U.S. 220 to the West, Central Academy Middle School to the North, 0.25 mile east of the 630/681 intersection to the east and Route 602 to the south.

Methodology

Clearly many factors influence the need or lack thereof of a new terrain bypass around the Fincastle Historic District. After consultation with stakeholders including Botetourt County and Virginia Department of Transportation (VDOT) staff, the aforementioned alternatives were analyzed using a multi-criteria framework assigning weights in the following relative manner:

Criterion	Relative Weight
Safety	2
Traffic Volume	2
Impact on Historic District	1
Access to Educational Facilities	1
Financial Considerations	1

Table 1

The four alternatives will be ranked on a scale of 4 (best of alternatives) to 1 (worst of alternatives) concerning each criterion. The rankings will be tallied and a total score for the alternative will result. The alternative with the highest score will be deemed most desirable relative to the other alternatives. A tie score is possible.

CHAPTER 2
DATA COLLECTION AND ANALYSIS

Sources of Traffic Data

The Virginia Department of Transportation (VDOT) tabulates traffic volume data on secondary roads that it maintains. Tabulations are separated by county and are generally published every three years. However, it should be noted that each three-year cycle reflects a partial count of the secondary system in any given county. A complete count of the whole secondary system in any given county could take up to 4 or more cycles, or 12 or more years. On another note, the tabulations for Botetourt County published in 1999 could contain counts taken at any time between 1996 and 1999. Despite these limitations, published secondary tabulations can be useful in capturing general trends and issues.

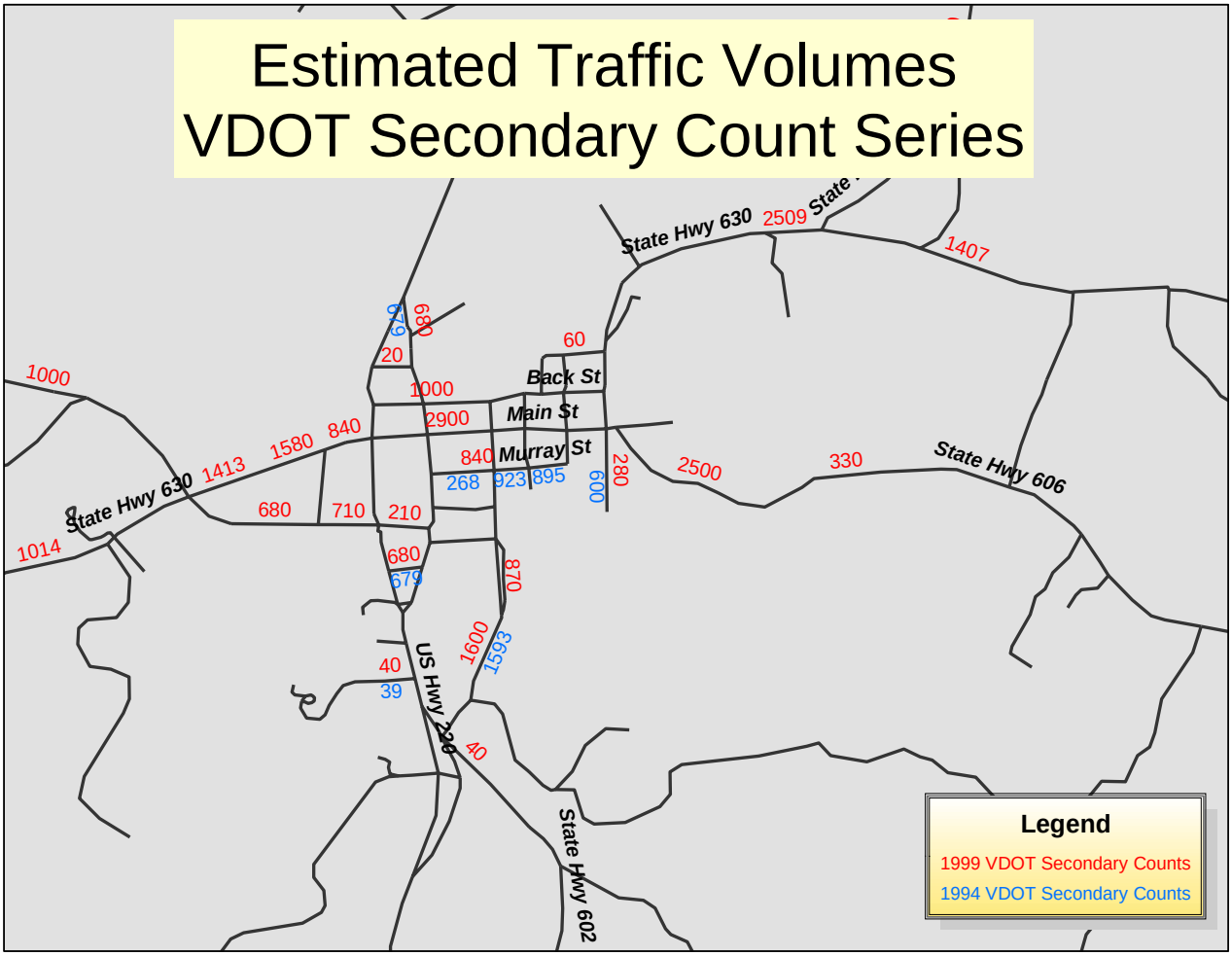


Figure 2

Figure 2 presents a geographical representation of the Average Annual Daily Traffic (AADT) volumes published in both the 1999 and 1994 tabulation books. The data in the

tabulations was appended to the attribute tables of U.S. Census TIGER line data that was linked to VDOT's State Highway Inventory Planning System (ShiPS) data by RVARC staff. The result of this process is that the segments in the geographic representation (Figure 2) and the segments described in the secondary tabulations may not be exactly identical in all cases. Nevertheless, some general trends stand out from the representation in Figure 2. Chief among these trends is that the 1999 AADT on Main Street is the same as the 1999 AADT on Route 630 implying that all traffic between Route 630 and U.S. 220 is using Main Street in the historic district. This result could be a counting coincidence as Route 606 feeds into the intersection of Route 630 and Main Street and could account for some of the volumes on both of the routes. This result could also be the product of the limitations to the secondary tabulation data cited above.

The Virginia Department of Transportation (VDOT) supplied supplemental 24 hour Traffic Counts which were taken on either 9/26/2001 or 9/27/2001 depending on location. Traffic Count locations and results are described in Figure 3.

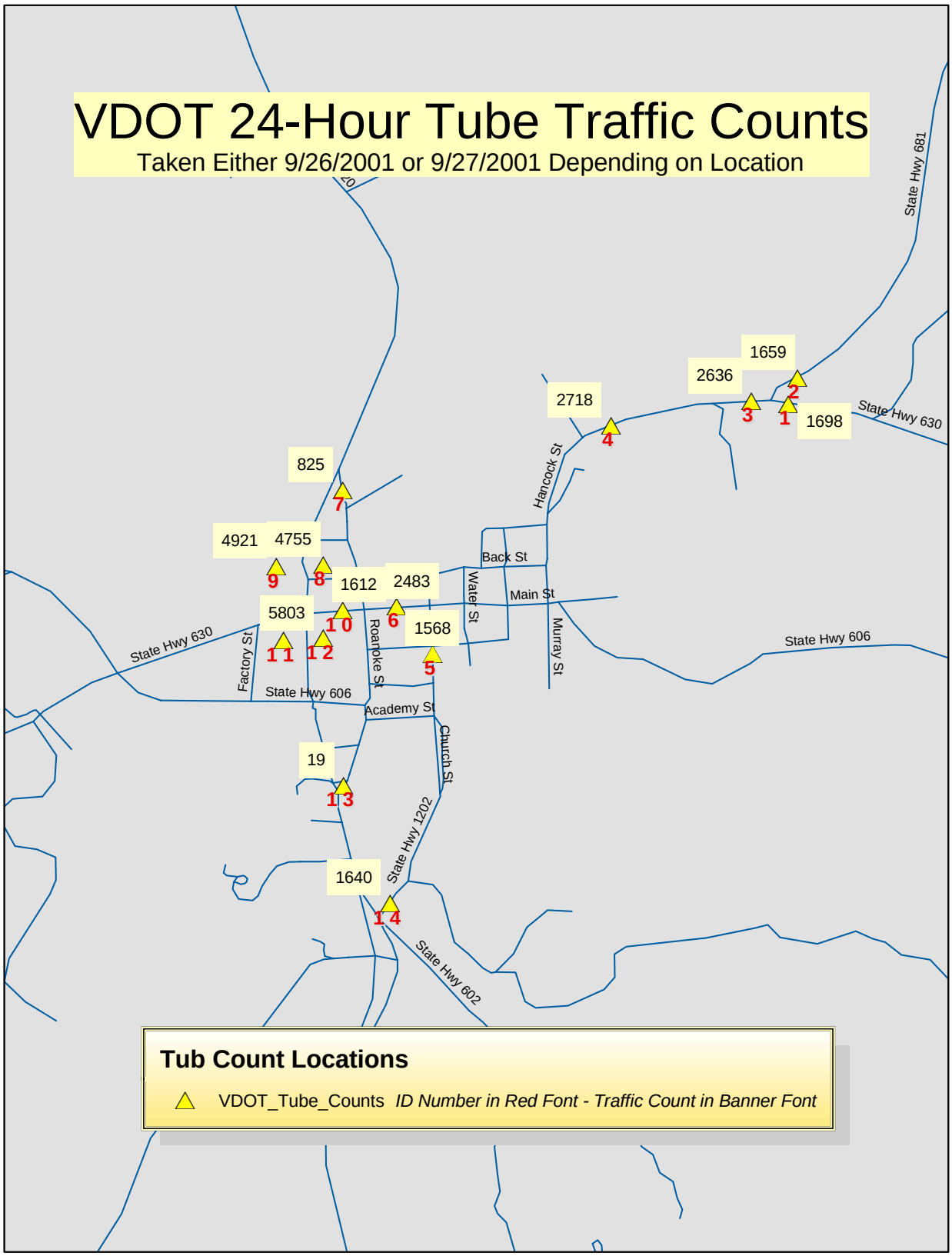

VDOT 24-Hour Tube Traffic Counts
Taken Either 9/26/2001 or 9/27/2001 Depending on Location
State Hwy 681
1659
2636
2
3
1
1698
State Hwy 630
2718
4
Hancock St
825
7
4921
4755
9
8
Back St
1612
2483
Water St
Main St
5803
10
6
1568
Murray St
State Hwy 606
State Hwy 630
Factory St
11
12
Roanoke St
5
State Hwy 606
Academy St
Church St
19
13
State Hwy 1202
1640
14
State Hwy 602
Tub Count Locations
VDOT_Tube_Counts ID Number in Red Font - Traffic Count in Banner Font

Figure 3

Traffic Data Projections

In urban areas travel demand is typically forecasted using a four-step travel demand model consisting of Trip Generation, Trip Distribution, Mode Choice and Traffic Assignment. That travel demand model is not entirely appropriate for a small area such as Fincastle, because such models were developed for larger urbanized areas with a higher population density. Also, the cost and data requirements required by a four-step travel demand model for the study area would be beyond the scope of this study. Unfortunately, there is no clear method of forecasting the travel demand for the Town of Fincastle that would not be problematic or beyond the scope of this study. Under these circumstances, this report will forecast existing traffic data using a continuous compound function using three annual growth rates: low (1.5%), medium (3.0%) and high (4.5%). The alternatives will be analyzed using the three growth rates and differences in impacts or recommendations will be noted. A summary of traffic volume projections are listed below:

			Estimated	Growth Rates: Continuous Compounding												
			AADT	2010 at	2010 at	2010 at	2015 at	2015 at	2015 at	2020 at	2020 at	2020 at	2025 at	2025 at	2025 at
Route	From	To	1999	1.50%	3%	4.50%	1.50%	3%	4.50%	1.50%	3%	4.50%	1.50%	3%	4.50%
681	630	Boundary	2300	2709	3184	3733	2919	3691	4651	3144	4279	5797	3387	4960	7224
Springwod Roac	681	Boundary	1407	1657	1948	2283	1785	2258	2845	1923	2617	3546	2072	3034	4419
630	Historic District	681	2509	2955	3473	4072	3184	4026	5074	3430	4667	6323	3695	5411	7880
630	Main St.	Previous	2900	3416	4014	4706	3680	4654	5865	3964	5395	7309	4271	6254	9108
Main St.	220	630	2900	3416	4014	4706	3680	4654	5865	3964	5395	7309	4271	6254	9108
Church St.	Historic District	Historic Distric	870	1025	1204	1412	1104	1396	1759	1189	1618	2193	1281	1876	2732
Roanoke Road	Near 220	Church ST.	1600	1885	2215	2597	2030	2568	3236	2187	2976	4032	2356	3451	5025
Dead END	630	606	280	330	388	454	355	449	566	383	521	706	412	604	879

Table 2

				Continuous Compounding					
				2010	2010	2010	2015	2015	2015
Location	Description	Date	24 hour Volume	1.50%	3.00%	4.50%	1.50%	3.00%	4.50%
1	Rt 630 E of Rt. 681	9/27/2001	1698	1941	2216	2523	2092	2568	3145
2	Rt 681 N of Rt 630	9/27/2001	1659	1897	2165	2465	2043	2509	3072
3	Rt 630 W of Rt 681	9/27/2001	2636	3014	3439	3917	3247	3987	4882
4	Rt 630 b/t Fincastle & 681	9/27/2001	2718	3108	3546	4039	3348	4111	5034
5	T 1202 b/t T 1206 & Rt 630	9/26/2001	1568	1793	2046	2330	1931	2372	2904
6	Rt 630 b/t T 1204 & T 1202	9/27/2001	2483	2839	3240	3690	3058	3756	4598
7	Rt 1204 b/t Fincastle & 220	9/27/2001	825	943	1076	1226	1016	1248	1528
8	220 b/t 630 & T 1204 Nbound	9/27/2001	4755	5437	6204	7066	5857	7192	8806
9	220 b/t 630 & T 1204 Sbound	9/27/2001	4921	5627	6421	7313	6061	7443	9113
10	Rt 630 b/t 220 & Rt 606	9/26/2001	1612	1843	2103	2396	1986	2438	2985
11	US 220 b/t 606 & 630 Sbounc	9/27/2001	4876	5575	6362	7246	6006	7375	9030
12	US 220 b/t 606 & 630 Nbounc	9/27/2001	5803	6635	7572	8624	7148	8778	10747
13	Rt 1213 b/t Dead End & 1204	9/26/2001	19	22	25	28	23	29	35
14	Rt 1202 N of US 220	9/26/2001	1640	1875	2140	2437	2020	2481	3037

				Continuous Compounding					
				2020	2020	2020	2025	2025	2025
Location	Description	Date	24 hour Volume	1.50%	3.00%	4.50%	1.50%	3.00%	4.50%
1	Rt 630 E of Rt. 681	9/27/2001	1698	2253	2977	3919	2427	3452	4883
2	Rt 681 N of Rt 630	9/27/2001	1659	2201	2909	3829	2372	3372	4771
3	Rt 630 W of Rt 681	9/27/2001	2636	3498	4622	6084	3768	5358	7581
4	Rt 630 b/t Fincastle & 681	9/27/2001	2718	3607	4766	6273	3885	5525	7817
5	T 1202 b/t T 1206 & Rt 630	9/26/2001	1568	2081	2749	3619	2241	3187	4510
6	Rt 630 b/t T 1204 & T 1202	9/27/2001	2483	3295	4354	5730	3549	5047	7141
7	Rt 1204 b/t Fincastle & 220	9/27/2001	825	1095	1447	1904	1179	1677	2373
8	220 b/t 630 & T 1204 Nbound	9/27/2001	4755	6310	8338	10974	6797	9666	13675
9	220 b/t 630 & T 1204 Sbound	9/27/2001	4921	6530	8629	11357	7035	10003	14153
10	Rt 630 b/t 220 & Rt 606	9/26/2001	1612	2139	2827	3720	2304	3277	4636
11	US 220 b/t 606 & 630 Sbounc	9/27/2001	4876	6470	8550	11253	6970	9912	14023
12	US 220 b/t 606 & 630 Nbounc	9/27/2001	5803	7700	10176	13393	8295	11796	16690
13	Rt 1213 b/t Dead End & 1204	9/26/2001	19	25	33	44	27	39	55
14	Rt 1202 N of US 220	9/26/2001	1640	2176	2876	3785	2344	3334	4717

Table 3

Table 2 summarizes the forecasts of the Average Annual Daily Traffic (AADT) which is published in the aforementioned county count summaries (figure 2), while Table 3 summarizes the forecasts of the 24-hour count provided by VDOT under a special count program by request (figure 3). The 24-hour counts in Table 3 are not adjusted by day of week, month or by any other annual adjustment factor before being forecasted. The data in the two tables follow similar trends. This is due in part to the fact that both sets of data were forecasted using the same low (1.5%), medium (3.0%) and high (4.5%) growth rates; also, the base data is similar once the segments are compared on a street-by-street basis. Therefore, the use of the data in either or both tables does not change the results in the subsequent alternatives analysis. A complete level-of-service (LOS) analysis for present and future conditions may point to some deviations in LOS depending on which data were used, but such an analysis is beyond the scope of this study.

Accident Data

Unfortunately accidents of one type or another are unavoidable on any transportation system, which involves unpredictable quantities such as the weather or human behavior. Accident rates are determined on the basis of exposure data, such as traffic volume, and the length of the road section being considered. Accidents are typically classified as fatality, personal injury and/or property damage only. Sometimes the different classifications of accidents are weighted by severity so that fatalities and injuries are weighted more than property damage alone. Law enforcement agencies are the first on the scene to investigate and document an accident. Law enforcement agencies submit the accident reports into the Virginia Department of Motor Vehicles (DMV). The DMV submits these reports to VDOT and VDOT codes the crash information into the Highway Traffic Record Information System (HTRIS). The crash rates cited in this report are from HTRIS and are calculated in the following manner:

> *"Crash rates are used to compare crashes on different roadways by also taking into account traffic volumes. Sections can include multiple intersections. In order to differentiate between sections and intersections, section rates are described as the number of crashes per one hundred million vehicle miles traveled.*
>
> $$\textit{Section Crash Rate} = \frac{\textit{Number of Crashes} * 100{,}000{,}000}{365 * \textit{Number of Years} * \textit{Section Length} * \textit{AADT}}$$
>
> *Injury and fatality (or death) rates can be calculated by substituting the number of people injured or killed for the number of crashes in the above equation.*
>
> *Intersection rates are described as the number of crashes per one million entering vehicles. The entering AADT is the summation of the AADT on each leg entering the intersection.*

$$\textit{Intersection Crash Rate} = \frac{\textit{Number of Crashes} * 100{,}000{,}000}{365 * \textit{Number of Years} * \textit{Entering AADT}}$$

Injury and fatality (or death) rates can be calculated by substituting the number of people injured or killed for the number of crashes in the above equation."[1]

Figure 4 indicates the total number of accidents (all types of accidents non-weighted) per location as provided by HTRIS. And, Figure 5 indicates the crash rate at various locations.

It should be noted that the spatial distribution of accidents center around Main Street, Route 630 and US 220. This spatial distribution will be important in the subsequent alternatives analysis, as different alternatives will impact the existing accident patterns in different ways. It should also be noted that crash rates do not necessarily follow a linear coordination with increased daily traffic. Volume on any given facility could pass a threshold in which accidents become much more common at an increasing rate.

[1] Equations and narrative provided by VDOT Traffic Engineering Division – Highway Safety Engineering Section – 1100 East Bank Street, Richmond, VA 23219

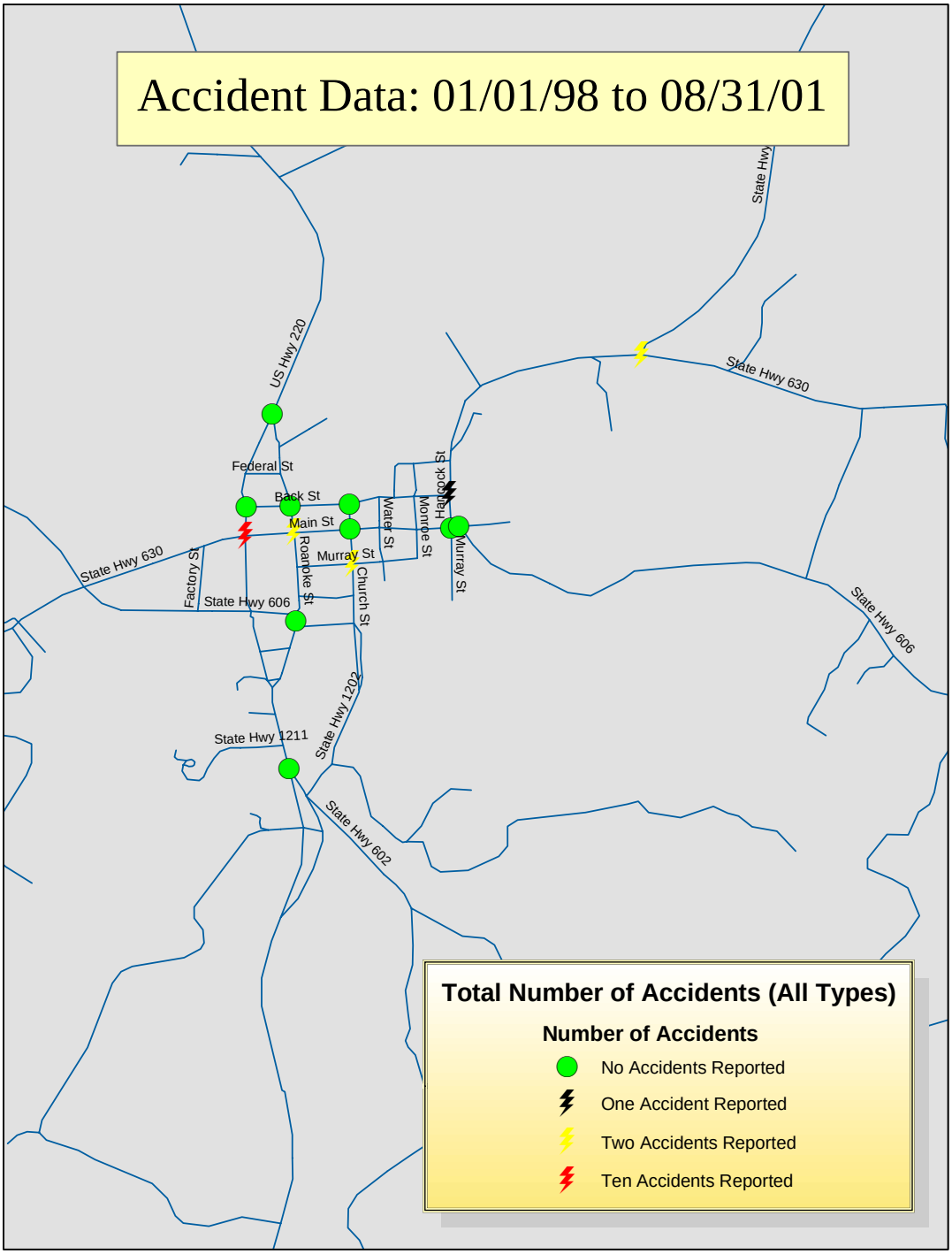

Accident Data: 01/01/98 to 08/31/01
US Hwy 220
State Hwy
State Hwy 630
Federal St
Back St
Main St
Water St
Monroe St
Hancock St
Murray St
Roanoke St
Church St
Factory St
State Hwy 606
State Hwy 1202
State Hwy 1211
State Hwy 602
Total Number of Accidents (All Types)
Number of Accidents
No Accidents Reported
One Accident Reported
Two Accidents Reported
Ten Accidents Reported

Figure 4

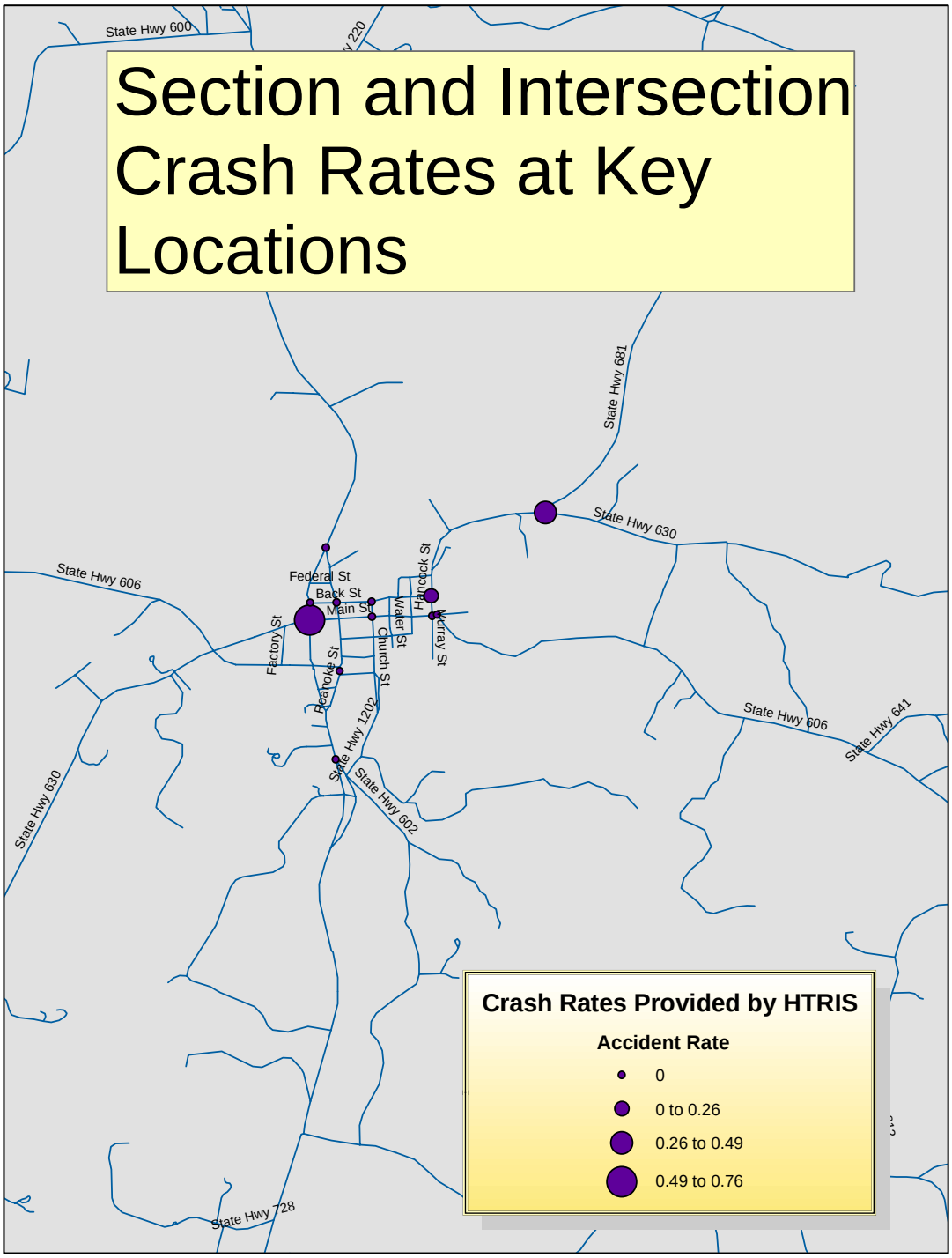

Section and Intersection Crash Rates at Key Locations
State Hwy 600
State Hwy 681
State Hwy 630
State Hwy 606
Federal St
Back St
Main St
Hancock St
Water St
Church St
Murray St
Factory St
Roanoke St
State Hwy 1202
State Hwy 602
State Hwy 606
State Hwy 641
State Hwy 630
State Hwy 728
Crash Rates Provided by HTRIS
Accident Rate
0
0 to 0.26
0.26 to 0.49
0.49 to 0.76

Figure 5

Chapter 3
Alternatives Analysis

Alternative 1 – No Build

Alternative 1 would essentially obligate no improvements or construction above regularly scheduled maintenance programs over the 23-year study time frame. Using the criteria and weights described in Table 1. it is obvious that the no-build alternative would not do anything to increase safety. Although the accident ratios displayed in Figure 5 are not currently above the state average for facility type, the concerns detailed in the *Fincastle Bus Circulation Study Phases I and II* are still valid for educational related traffic through the historic district. Additionally, the traffic volume forecasts under the low, medium and high scenarios would increase ADT by at least 1000 vehicles per day for most routes (Tables 2 and 3). This increase under prevailing conditions could increase the accident ratios significantly. The no build scenario rates the lowest out of the four scenarios with regards to safety earning a score of one. Likewise the no build alternative would do little to ease an increased traffic burden on the historic district thus earning a score of one for this criteria. The no build scenario would have the least immediate impact on the historic district due to lack of construction on modification; however the no build scenario would do nothing to improve conditions in the historic district, thus earning a score of one for this criteria. Alternative 1 would do the least to improve access to the nearby educational facilities, again earning a score of one. This alternative would have the least direct financial impact on the state or locality thus earning a score of four. For the purposes of this study "financial impacts" refer to immediate financial impacts on local or state budgets due to engineering, right-of-way acquisition, construction etc. They do not refer to potential long-term economic benefits either tangible or intangible. A summary of the scores and weights for alternative 1 follows:

Alternative 1 – No Build	Weight	Impact	Score
Safety	2	1	2
Traffic Volume	2	1	2
Impact on Historic District	1	1	1
Access to Educational Facilities	1	1	1
Financial Considerations	1	4	4
Total Score			**10**

Table 4

Alternative 2 – Improvements to Historic District

Alternative 2 would prescribe minor to intermediate improvements to the streets in the historic district where feasible and unobtrusive to the rules and regulations governing historic structures and districts. Some approach and gateway improvements may also be possible. Safety would be marginally improved but not substantially earning a score of two. Likewise traffic flow would be marginally but not adequately improved again earning a score of two. The immediate impact on the historic district would be somewhat intrusive during modifications, however, the long-term impact would only be marginally

better than the no-build scenario, but less effective than either of the new terrain options, thus earning a score of two. Access to educational facilities would not be substantially improved under this scenario earning a score of two. Financially, limited improvements would fall between the two bypass options and the no build alternative earning a score of three. A summary of scores and weights for this alternative follows:

Alternative 2 – Minor Improvements	Weight	Impact	Score
Safety	2	2	4
Traffic Volume	2	2	4
Impact on Historic District	1	2	2
Access to Educational Facilities	1	2	2
Financial Considerations	1	3	3
Total Score			**15**

Table 5

Alternative 3 – Northern New Terrain Bypass Linking Rt. 630 with US 220

Alternative 3 would follow the conceptual route indicated in Figure 1 a & b. Depending on final alignment the new terrain portion would likely be slightly longer than the new terrain portion Alternative 4. However Alternative 3 will intersect at only 2 points Route 630 and US 220, while Alternative 4 intersects a large part of the historic district. For these reasons Alternative 3 is likely the safest of all alternatives earning a score of four. Alternative 3 would allow all school related traffic to avoid the historic district completely earning a score of four. Alternative 3 would have little or no negative impact on the historic district during construction, and it would divert traffic away from the historic district long-term, thereby earning a four for this category. Alternative 3 could be the costliest of the alternatives due to length of new terrain segment and earth moving considerations earning a score of one. A summary of scores and weights for this alternative follows:

Alternative 3– New Terrain (Northern Scenario)	Weight	Impact	Score
Safety	2	4	8
Traffic Volume	2	4	8
Impact on Historic District	1	4	4
Access to Educational Facilities	1	4	4
Financial Considerations	1	1	1
Total Score			**25**

Table 6

Alternative 4 – Southern New Terrain Bypass Linking T202 with 630

As previously mentioned Alternatives 3 and 4 are very similar in their potential benefits and costs. The major difference is that Alternative 4 would intersect with Route 630 in the historic district requiring traffic to traverse at least three intersections in the historic district. Also, Alternative 4 would not directly intersect US 220, instead it would tie into Route 1202 before the US 220 intersection. With these factors in mind a summary of scores and weights for Alternative 4 follows:

Alternative 4– New Terrain (Southern Scenario)	**Weight**	**Impact**	**Score**
Safety	2	3	6
Traffic Volume	2	3	6
Impact on Historic District	1	3	3
Access to Educational Facilities	1	3	3
Financial Considerations	1	2	2
Total Score			**20**

Table 7

A summary of the alternatives and their respective scores follows:

Comparison of Scores	**Alt. 1**	**Alt. 2**	**Alt. 3**	**Alt. 4**
Safety	2	4	8	6
Traffic Volume	2	4	8	6
Impact on Historic District	1	2	4	3
Access to Educational Facilities	1	2	4	3
Financial Considerations	4	3	1	2
Total Score	**10**	**15**	**25**	**20**

Table 8

Chapter 4
Recommendation

The alternatives analysis clearly favors Alternative 3 as the most viable course of action. This conclusion is consistent with the recommendations of *Fincastle Bus Circulation Study Phase II*, which supported either of the new terrain options as beneficial to educational institution related traffic, especially full-sized school buses. The northern new terrain route would connect Route 630 with U.S. 220 so it would likely qualify for inclusion in the secondary system if constructed to VDOT standards. Upon consultation with VDOT officials, RVARC staff learned that there is little precedent for construction of a new terrain secondary route for immediate inclusion in the secondary system. Exact details would have to be worked out between the County Board of Supervisors and VDOT Salem Residency Staff at the annual 6-year Plan and Construction Budget public hearings for the secondary system. Essentially, the Botetourt County Board of Supervisors would have to name Alternative 3 as one of their priority projects for planning, engineering, right-of-way acquisition and then construction. Additional restrictions on such a secondary route would likely include limited or no private driveway access.

The recommendations of the previous bus circulation studies and this study point to a new terrain option as being the most beneficial due to historic district concerns. This study finds that a Northern new terrain location will likely be more beneficial than a Southern location due to the present location of education related traffic North of the historic district. A Northern new terrain option could also bypass much if not all of the historic district. A Southern option would tie into at least 3 intersections in the historic district.