ROUTE 29

CORRIDOR STUDY

CITY OF CHARLOTTESVILLE AND ALBEMARLE COUNTY

TECHNICAL MEMORANDUM
FOR ENVIRONMENTAL IMPACT STATEMENT

AQUATIC RESOURCES AND WATER QUALITY

6029-002-122, PE 100

U.S. Department of Transportation
Federal Highway Administration
and
Virginia Department of Transportation

April 1990

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Route 29 Corridor Study
Aquatic Resources and Water Quality, Technical Memorandum dated April, 1990

All references to alignment 8 or Alternative 8 on tables and figures and in the text should be deleted. Alternative 8 was an earlier expressway alternative that was discarded.

Similarly, references to alignments 11N-12S and 12N-11S should also be deleted as these alternatives were also discarded.

NATURAL ENVIRONMENTAL ANALYSIS TECHNICAL REPORT

Part 1 of 3

Aquatic Resources and Water Quality

U. S. Route 29 Corridor Study -
City of Charlottesville and
Albemarle County, Virginia

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PREFACE

This report has been prepared for the Virginia Department of Transportation as supporting information for the Draft and Final Environmental Impact Statements (D.E.I.S. and F.E.I.S.) for the U.S. Route 29 Corridor Study project in the City of Charlottesville and Albemarle County, Virginia.

The study consists of an examination of nine (9) alternatives for a corridor selection within which to construct a limited access highway facility to provide sufficient traffic capacity to address problems now existing in the area and traffic volumes anticipated to the year 2010. The study area encompasses approximately 63 square miles of Albemarle County, and extends from a point 0.25 miles south of the junction of U.S. Route 29 and the South Fork of the Rivanna River in the north, to U.S. Interstate Route 64 in the south.

This report is one of a series of technical reports which provides detailed supporting documentation for the summary discussions presented in the Draft and Final Environmental Impact Statements. Technical report sections for the project's Natural Environmental Analysis have been prepared for each of the following areas:

- Aquatic Resources and Water Quality
- Aquatic Ecology
- Wetlands
- Groundwater and Surface Hydrology
- Floodplains
- Terrestrial Ecology
- Geology and Soils
- Agricultural Resources
- Forest Resources

Copies of this report and associated project plans and information are available for the public's review during office hours at the Virginia Department of Transportation Offices at 1401 East Broad Street, Richmond, Virginia.

SUMMARY

1.0 INTRODUCTION

The U.S. Route 29 Corridor Study was designed to identify and evaluate transportation alternatives for the improvement of traffic conditions within the existing Route 29 transportation corridors. This study was undertaken to define environmental consequences of road construction within the study area. Effects on water quality in streams and the South Fork Rivanna River Reservoir are considered on a regional- and corridor-wide scale. Specific impacts on water quality, wetlands, groundwater resources, and floodplains are addressed with respect to each of the study alternatives.

2.0 STUDY METHODS

To assess impacts on existing conditions in the study area, an extensive survey was carried out along each study alignment. Water quality sampling was conducted monthly and quarterly for one year at a total of 43 stream and river locations. Macrobenthic sampling was performed in selected streams to supplement analytical data on overall water quality in the study area. Monthly sampling was also conducted on the South Fork Rivanna River Reservoir, the major drinking water source for the City of Charlottesville, Albemarle County, Virginia. In conjunction with this study, a bathymetric survey was conducted on the Reservoir to determine the effects of eutrophication and early sedimentation on this drinking water source. Macrobenthic sampling was also conducted at some sites to supplement overall water quality data in the piedmont streams of Albemarle County.

Impacts on streams and wetlands were determined through examination of U.S.G.S. topographic maps followed by extensive field veritification along each study alignment. Streams were classified by stream order and the number of streams crossed by each alignment was considered in the impact analysis. Wetlands along each alignment were delineated following the routine onsite inspection approach as outlined in the the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989). The wetlands were also classified according to the classification hierarchy of wetlands and deepwater habitats established to Cowardin, et. al. (Classification of Wetlands and Deepwater Habitats of the United States) by Cowardin, Lewis M., et. al.) and the acreage of impact for each site was then calculated.

To address impacts on ground water resources and floodplains, existing literature was used to determine existing conditions and where impacts may occur. Data from the Virginia State Water Control Board were used to determine existing conditions on ground water resources, and soil information from the U.S. Soil Conservation Service provided information on potential recharge sites where contamination might occur. National Flood Insurance Maps were used to determine impacts on 100-year floodplains in the study area. A model of runoff from highways was also utilized to assess impacts of this factor on the study alignments.

3.0 EXISTING CONDITIONS

The piedmont streams of Albemarle County are generally soft and of good water quality. Many small streams drain the study area into three main river basins of the middle James River: the South Fork Rivanna River, North Fork Rivanna River, and the Rivanna River. A large portion of the study area drains into the South Fork Rivanna River Reservoir. Surface waters in the county serve many purposes: drinking water supplies, recreational, commercial, scenic, and drainage. Two rivers, the Moorman's River west of the study area and the Rivanna River south of the study area are designated as State Scenic Waters. The South Fork Rivanna River and the Rivanna River are also designated as natural trout waters.

The South Fork Rivanna River Reservoir, the principal drinking water source for the City of Charlottesville, has experienced problems resulting from early eutrophication in the past. Runoff from agricultural areas has created associated problems due to high nutrient levels, and construction activities within the watershed have increased rates of sedimentation into the reservoir. This has caused major concern within the county due to estimates that the working life of the reservoir may be significantly reduced. Results from a bathymetric survey conducted during the course of this study confirm the estimates of higher siltation rates and a decreased working life for this reservoir.

Due to the topography of the study area, and the well drained nature of soils in Albemarle County, few wetland areas exist in this region. The few sites encountered along the study alignments resulted from small seeps at the base of hills, narrow strips along creeks resulting from regular flooding or shallow ponds that could support emergent vegetation. Due to the small size of the wetlands encountered, a functional assessment of each site scored the functional values on all indicators (hydrological, wildlife, and social values) as low.

Ground water resources within Albemarle County are generally good. Availability and quality are relatively consistent throughout the county. Water bearing zones are generally encountered within 200 feet of the land surface. Yields of less than 10 gallons per minute (gpm) are typical, though yields up to 145 gpm have been recorded in some areas. No major areas of ground water contamination have been identified, though some local problems exist, with underground petroleum spills the most common problem. The depth to the water table is generally quite deep in the county which tends to filter out pollutants as surface waters percolate to the ground water table.

Surface water hydrology in the study area is dominated by three major basins: the South Fork Rivanna River, North Fork Rivanna River, and the Rivanna River Watersheds. Floodplains in this area remain undeveloped, so regular flooding in this area has little detrimental effect. A total of 28 100-year floodplain crossings were examined along all of the study alignments. These range in width from 120 feet wide to 2660 feet wide at proposed crossings. The majority of the floodplains, however, are narrow due to the nature of the hills and valleys in the study area.

4.0 IMPACTS

Impacts related to construction and operation of highways may result in short- and long-term impacts upon water quality and aquatic organisms. Short-term impacts are generally associated with construction and usually cease or decrease immensely after construction. The most important of these will probably result from erosion and associated siltation and sedimentation, which can increase levels of suspended solids and nutrients. Increases in nutrient levels may promote eutrophication, and also can affect levels of dissolved oxygen by increasing biological and chemical oxygen demand.

Sedimentation and increased turbidity can have direct effects upon fish and bottom organisms by smothering stream bottoms with silt and by interfering with early developmental stages. Indirect effects result from changes in water quality and other physical characteristics of streams, such as streambed composition, water depth, stream channel configuration and stream base-flow variability. Normal erosion and siltation controls, as currently practiced by the Virginia Department of Transportation and required by resource agencies prior to issuing permits, will minimize any adverse effects.

Long-term impacts can result from changes to stream habitat and floodplains. Removal of riparian vegetation decreases stream bed shading and increases water temperatures. A reduction in ground cover affects stream bank stabilization, groundwater recharge and also reduces the amount of detrital inputs necessary as a food source for aquatic instream organisms. Planting of grass, replacement wetland mitigation sites, and natural revegetation would all serve to eventually return the stream to a natural state.

Roadway runoff and maintenance activities may introduce toxic substances, such as heavy metals petroleum products, and deicing salts to streams and ground water recharge points. These substances can have toxic effects upon aquatic organisms and may be passed up the food chain to fish and man. Federal Highway Administration (F.H.W.A.) research on water quality of receiving waters indicates that although all highway runoff contains pollutants, pollutant loading does not always constitute a problem for receiving waters. The F.H.W.A. data reports that the impacts of highway runoff pollution on receiving water and aquatic ecosystems are extremely site specific. Grass lined channels or ditches have been found to reduce runoff velocity, encourage filtration, sedimentation, and infiltration of pollutants, thus, able to maintain pollutants at a minimal level.

Impacts tend to be greater along longer stretches of highway. Longer roads will usually cross more streams, wetlands, floodplains, and ground water recharge points. This is of particular concern when alignments run through sensitive areas such as the South Fork Rivanna River Watershed. Table 4.1 summarizes impacts by the proposed alignments on streams, wetlands and floodplains. Included in this table are impacts within the South Fork Rivanna River Watershed. Impacts on ground water resources would not be great along any alignment since water tables tend to run deep. Soils with high water tables that can serve as ground water recharge points are few in the study area, mostly narrow sites along streams.

TABLE 4.1
COMPOSITE LIST OF STREAM, RESERVOIR, WETLANDS, AND FLOODPLAIN IMPACTS ALONG EACH PROPOSED ALIGNMENT

ALIGNMENT	LENGTH (MILES)	STREAM CROSSINGS	LENGTH ACROSS RESERVOIR WATERSHED (MILES)	STREAM CROSSINGS IN RESERVOIR WATERSHED	RESERVOIR CROSSINGS	WETLANDS SITES	TOTAL WETLANDS ACRES	FLOOD-PLAINS CROSSED
6	8.5	27	0	0	0	5	1.512	7
6B	8.5	26	0	0	0	3	0.149	5
7	7.5	26	0	0	0	4	0.178	9
8,9	3.2	4	0	0	0	1	0.146	0
10	5.1	13	4.2	10	0	1	0.138	0
11	8.9	28	7.4	19	1	3	0.293	4
12	12.0	41	8.4	23	1	4	0.571	8
11N/12S	9.8	36	8.3	27	1	4	0.540	5
12N/11S	11.5	34	7.9	16	1	3	0.324	7

5.0 MITIGATION

Measures for reducing on-site erosion during construction should be utilized including: the use of diversion ditches, dikes, sediment dams; minimizing the removal of riparian vegetation; scheduling earthwork activities during dry periods of the year; avoiding stream disturbances during spawning times for commercial and sport fishes; and replanting vegetation as soon as possible after disturbance.

Construction impacts to instream aquatic habitats should also be minimized to the extent practicable by avoiding stream relocations, and crossing streams at right angles to reduce habitat loss. To the extent possible, construction equipment must be restricted from fording and otherwise disrupting the in-stream habitats.

Measures that should be taken to minimize construction phase erosion include: diverting upstream run-off away from the site, limiting the area of denudation of vegetation at any one time, limiting the lengths of exposure time for denuded areas, providing artificial protection for bare soils, slowing the velocity of run-off from the site, and providing sediment traps. This is particularly important in the South Fork Rivanna River Watershed, where restrictions outlined in the Albemarle County Runoff Control Ordinance must be followed to minimize pollution and eutrophication.

Long-term impacts from highway operation and maintenance can be minimized by selection of de-icing salts, pesticides and herbicides which have the least effect upon stream organisms and water quality.

The final design of the selected alignment will not significantly impact the 100-year floodplain and associated floodplain values due to adherence to the policies and procedures established in Executive Order 11988, Floodplain Management (May 1977). The DEIS for this project will state this compliance as required by FHWA Technical Advisory T6640.8A (Guidance for Preparing and Processing Environmental and Section 4(F) Documents, October, 1987).

Specific guidelines governing bridge design should include minimizing the use of fill and other modifications of channel width, constructing bridges instead of culverts, and minimizing the placement of bridge piers within the 100-year floodplain.

TABLE OF CONTENTS

		Page
Preface		i
Summary		ii
Table of Contents		vii
List of Tables		xi
List of Figures		xiv
1.0	Introduction	1-1
2.0	Study Areas and Methods	2-1
2.1	Aquatic Resources and Water Quality	2-1
2.1.1	Rationale for Study	2-1
2.1.2	Selection of Study Streams	2-1
2.1.3	Reservoir Study	2-2
2.1.4	Water Quality	2-3
2.1.5	Fish	2-3
2.1.6	Benthic Macroinvertebrates	2-4
2.1.7	Data Analysis and Impact	2-4
2.2	Wetlands	2-4
2.2.1	Field Methodology	2-5
2.2.2	Wetlands Inventory	2-6
2.2.3	Quality Assurance/Quality Control	2-6
2.3	Ground Water and Surface Hydrology	2-6
2.3.1	Ground water Resources	2-6
2.3.2	Surface Hydrology and Flooding	2-7
2.3.3	Model of Runoff	2-7
3.0	Existing Conditions	3-1
3.1	Aquatic Resources and Water Quality	3-1
3.1.1	Introduction	3-1
3.1.2	Regional Study Area	3-1
3.1.3	Designated Stream Uses/Water Quality Standards	3-2
3.1.4	Water Quality of Streams & Rivers in Albemarle County	3-9
	3.1.4.1 Macrobenthic Conditions	3-15
3.1.5	Reservoir Conditions	3-32

TABLE OF CONTENTS
(continued)

			Page
	3.1.6	Stream Crossings by Alternative	3-35
		3.1.6.1 Alignment 6	3-35
		3.1.6.2 Alignment 6B	3-52
		3.1.6.3 Alignment 7	3-52
		3.1.6.4 Alignment 10	3-52
		3.1.6.5 Alignment 11	3-52
		3.1.6.6 Alignment 12	3-52
		3.1.6.7 Alignment 11N/12S	3-53
		3.1.6.8 Alignment 12N/11S	3-53
3.2	Wetlands		3-53
	3.2.1	Wetland Values	3-58
3.3	Ground Water Resources		3-58
	3.3.1	Groundwater Availability	3-59
	3.3.2	Groundwater Quality	3-62
	3.3.3	Sites of Groundwater Contamination	3-67
3.4	General Hydrological Characteristics		3-67
	3.4.1	Rivanna River Watershed	3-72
	3.4.2	North Fork Rivanna River Watershed	3-74
	3.4.3	South Fork Rivanna River Watershed	3-74
3.5	Federal Flood Insurance Program		3-74
3.6	Other Surface Hydrology Issues		3-75
4.0	Impacts		4-1
4.1	Aquatic Resources and Water Quality		4-1
	4.1.1	General Impacts	4-1

TABLE OF CONTENTS
(continued)

			Page
4.1.2	Specific Impacts		4-3
	4.1.2.1	Alignment 6	4-6
	4.1.2.2	Alignment 6B	4-6
	4.1.2.3	Alignment 7	4-6
	4.1.2.4	Alignment 8,9	4-7
	4.1.2.5	Alignment 10	4-7
	4.1.2.6	Alignment 11	4-7
	4.1.2.7	Alignment 12	4-7
	4.1.2.8	Alignment 11N/12S	4-8
	4.1.2.9	Alignment 12N/11S	4-8
4.2	Wetlands		4-8
4.2.1	Direct Impacts		4-8
4.2.2	Associated Impacts		4-8
4.3	Ground Water		4-9
4.3.1	General Impacts		4-9
4.4	Surface Hydrology		4-10
4.4.1	Flood Impacts Due to Construction		4-10
4.4.2	Potential Flood Problem Areas		4-10
	4.4.2.1	Alignment 6	4-10
	4.4.2.2	Alignment 6B	4-14
	4.4.2.3	Alignment 7	4-15
	4.4.2.4	Alignment 8,9	4-16
	4.4.2.5	Alignment 10	4-16
	4.4.2.6	Alignment 11	4-17
	4.4.2.7	Alignment 12	4-17
	4.4.2.8	Alignment 11N/12S	4-19
	4.4.2.9	Alignment	4-20
4.4.3	Runoff Impacts		4-21
4.5	Aquatic Endangered, Threatened or Special Concern (ETS) Species Impacts		4-22

TABLE OF CONTENTS
(continued)

		Page
5.0	Mitigation	5-1
	5.1 Aquatic Resources and Water Quality	5-1
	5.2 Wetlands	5-1
6.0	Coordination	6-1
	6.1 Agency Scoping	6-1
	6.2 Public Coordination	6-3
7.0	List of Preparers	7-1
References		R-1
Appendices		"A" thru "F"
A.	Stream Water Quality Data	A-1
B.	Reservoir Water Quality Data	B-1
C.	Bathymetric Study	C-1
D.	Wetlands Data Forms	D-1
E.	Fish Species Encountered During Macrobenthic Sampling Effort	E-1
F.	Memorandum Reference James River Spiney Mussel (*Pleurobema collina*)	F-1

LIST OF TABLES

		PAGE
TABLE 2.1	Runoff Constituent Equations Developed for Type III Sites	2-9
TABLE 3.1	Standards For Dissolved Oxygen (DO), pH, and Maximum Temperature	3-3
TABLE 3.2	SWCB Water Quality Standards of the Middle James River Basin Showing Classes and Special Standards for Streams in Albemarle County, Virignia	3-4
TABLE 3.3	Virginia SWCB Water Quality Standards for Public Water Supplies	3-5
TABLE 3.4	Fish of the Study Area - Albemarle County	3-7
TABLE 3.5	Monthly Water Quality Sampling Locations and the Months Sampling Was Conducted	3-10
TABLE 3.6	Quarterly Water Quality Sampling Locations and the Months Sampling Was Conducted	3-12
TABLE 3.7	The Occurrence of Benthic Macrobenthic Invertebrates Among Stream Orders for Streams Sampled	3-17
TABLE 3.8	Percentage of Pollution Sensitive, Facultative, and Tolerant Taxa Based on the Total Found in Each Stream Order	3-19
TABLE 3.9	Statistics of Benthic Invertebrates - Station 01 - Upper End of Flat Branch	3-20
TABLE 3.10	Statistics of Benthic Invertebrates - Station 02 - Tributary to Jacobs Run	3-21
TABLE 3.11	Statisticfs of Benthic Invertebrates - Station 03 - Rocky Hollow at Route 769	3-22
TABLE 3.12	Statistics of Benthic Invertebrates - Station 04 - Upper End of Naked Creek	3-23

LIST OF TABLES
(continued)

		PAGE
TABLE 3.13	Statistics of Benthic Invertebrates - Station 05 - Tributary to Powell Creek by Route 29	3-24
TABLE 3.14	Statistics of Benthic Invertebrates - Station 06 - Tributary to Ivy Creek at Route 657	3-25
TABLE 3.15	Statistics of Benthic Invertebrates - Station 07 - Naked Creek at Route 844	3-26
TABLE 3.16	Statistics of Benthic Invertebrates - Station 08 - Powell Creek at Route 643	3-27
TABLE 3.17	Statistics of Benthic Invertebrates - Station 09 - Redbud Creek at Route 621	3-28
TABLE 3.18	Statistics of Benthic Invertebrates - Station 10 - Jacobs Run at Route 606	3-29
TABLE 3.19	Water Quality Evaluation of the Macrobenthic Stations	3-30
TABLE 3.20	Field Water Quality Measurements at Macrobenthic Sampling Stations	3-31
TABLE 3.21	Secchi Disc Visibility at 3 Stations on the South Fork Rivanna River Reservoir	3-34
TABLE 3.22	Stream Crossings along Alignments	3-36
TABLE 3.23	Vascular Plant Species Identified Along Riparian and Wetland Sites in the Study Area	3-48
TABLE 3.24	Stream and River Crossings by Alignments and Stream Order	3-51
TABLE 3.25	Wetlands along the Study Alignments	3-54
TABLE 3.26	National Wetlands Inventory Classification and Acreage	3-55
TABLE 3.27	Ground Water Quality Criteria - Piedmont Ground Water Area	3-64

LIST OF TABLES
(continued)

		PAGE
TABLE 3.28	Hydrogeologic Units and their Geologic and Water-Bearing Characteristics	3-71
TABLE 4.1	Composite List of Stream, Reservoir, Wetlands, and Floodplain Impacts along each Proposed Alignment	4-3
TABLE 4.2	Stream and River Crossings in the South Fork Rivanna River Reservoir Watershed by Alignments and Stream Order	4-4
TABLE 4.3	Floodplain Data and Traversing Distance	4-23
TABLE 4.4	Calculated Yearly Constituent Loading Along Each Alignment	4-31
TABLE 4.5	Calculated Yearly Constituent Loading Along Portions of Each Alignment Within the South Fork Rivanna River Reservoir Watershed	4-32
TABLE 4.6	Average Constituent Loading (mg/L) in Runoff Waters Along each Alignment	4-33
TABLE 4.7	Average Constituent Loading (mg/L) in Runoff Waters from Segments of Alignments Within the South Fork Rivanna River Reservoir Watershed	4-34

LIST OF FIGURES

		PAGE
FIGURE 1.1	Proposed Alignments of the Route 29 Corridor Study	1-2
FIGURE 1.2	Reservoir Watersheds in the Study Area	1-3
FIGURE 3.1	Monthly Water Quality Sampling Locations	3-13
FIGURE 3.2	Quarterly Water Quality Sampling Locations	3-14
FIGURE 3.3	Location of Macrobenthic Sampling Stations	3-16
FIGURE 3.4	Water Quality Sampling Stations on the South Fork Rivanna River Reservoir	3-33
FIGURE 3.5	Stream and Wetlands Stations Along Study Alignments	3-44
FIGURE 3.6	Stream and Wetlands Stations Along Study Alignments	3-45
FIGURE 3.7	Stream and Wetlands Stations Along Study Alignments	3-46
FIGURE 3.8	Stream and Wetlands Stations Along Study Alignments	3-47
FIGURE 3.9	Classification Hierarchy of Wetlands and Deepwater Habitats, Showing Systems, Subsystems, and Classes	3-56
FIGURE 3.10	Wetlands Station #37 Along Alignment 6 on the Rivanna River	3-57
FIGURE 3.11	Generalized Hydrogeologic Map of Albemarle County	3-60
FIGURE 3.12	Depth of Water-Bearing Zones in Albemarle County	3-61
FIGURE 3.13	Ground Water Availability in Albemarle County	3-63
FIGURE 3.14	Concentration of Total Dissolved Solids in Ground Water in Albemarle County	3-65
FIGURE 3.15	Ground Water Hardness in Albemarle County	3-66
FIGURE 3.16	Concentration of Iron in Ground Water in Albemarle County	3-68
FIGURE 3.17	Hydrogen-Ion Activity (pH) of Ground Water in Albemarle County	3-69
FIGURE 3.18	Concentration of Nitrate-Nitrogen in Ground Water in Albemarle County	3-70

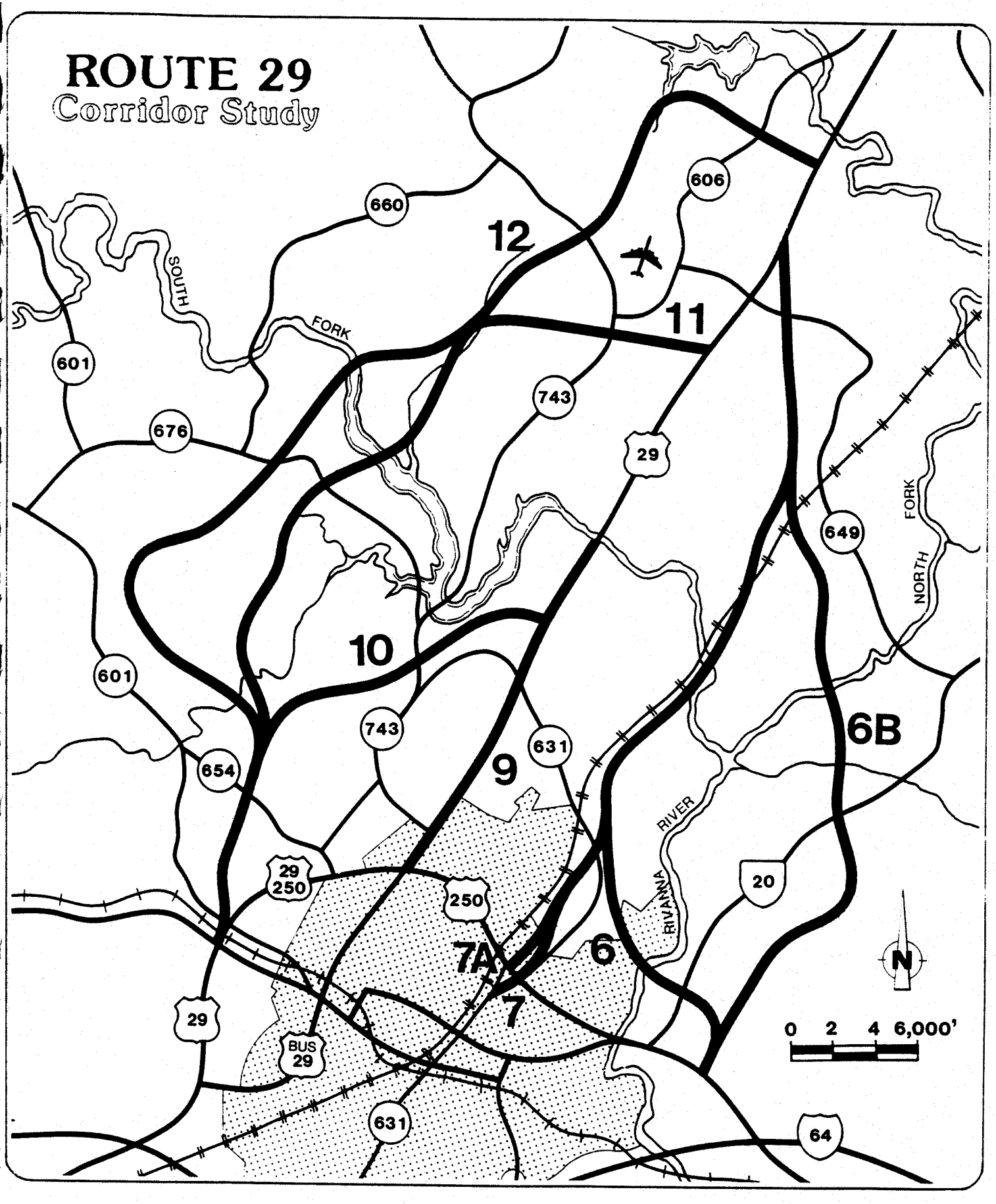
LIST OF FIGURES
(continued)

		PAGE
FIGURE 3.19	Major River Watersheds in the Study Area	3-73
FIGURE 3.20	Floodplain Map 1	3-76
FIGURE 3.21	Floodplain Map 2	3-77
FIGURE 3.22	Floodplain Map 3	3-78
FIGURE 3.23	Floodplain Map 4	3-79
FIGURE 3.24	Floodplain Map 5	3-80
FIGURE 3.25	Floodplain Map 6	3-81
FIGURE 3.26	Floodplain Map 7	3-82
FIGURE 3.27	Floodplain Map 8	3-83
FIGURE 3.28	Floodplain Map 9	3-84
FIGURE 3.29	Floodplain Map 10	3-85
FIGURE 4.1	Index to High Ground Water Soil Maps	4-9A
FIGURE 4.2	High Ground Water Soils Along Study Alignments	4-9B
FIGURE 4.3	High Ground Water Soils Along Study Alignments	4-9C
FIGURE 4.4	High Ground Water Soils Along Study Alignments	4-9D
FIGURE 4.5	High Ground Water Soils Along Study Alignments	4-9E
FIGURE 4.6	High Ground Water Soils Along Study Alignments	4-9F
FIGURE 4.7	High Ground Water Soils Along Study Alignments	4-9G
FIGURE 4.8	High Ground Water Soils Along Study Alignments	4-9H
FIGURE 4.9	High Ground Water Soils Along Study Alignments	4-9I
FIGURE 4.10	High Ground Water Soils Along Study Alignments	4-9J
FIGURE 4.11	High Ground Water Soils Along Study Alignments	4-9K
FIGURE 4.12	Study Area Floodplain Crossing Sites	4-10A

1.0 INTRODUCTION

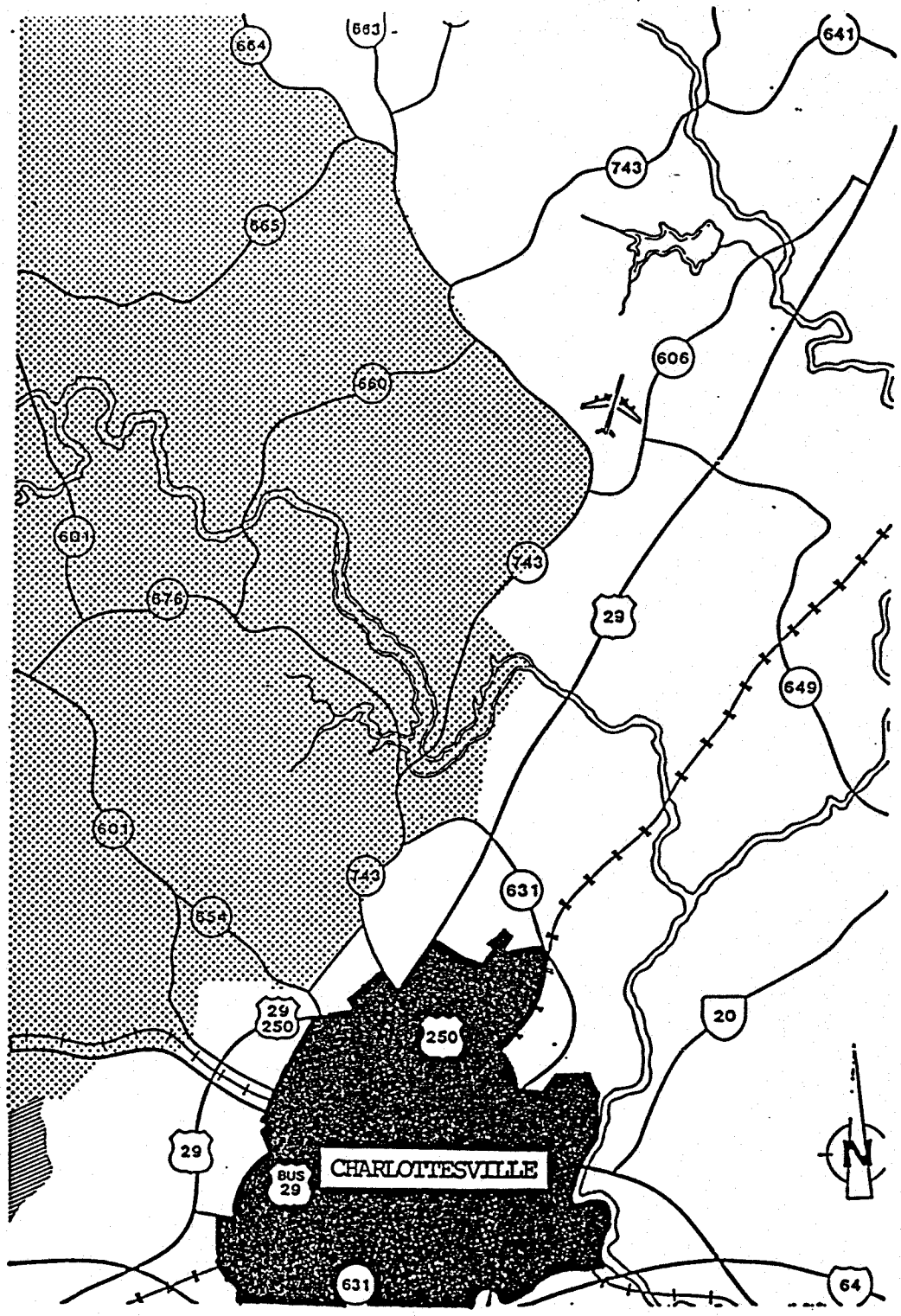
The U.S. Route 29 Corridor Study was designed to identify and evaluate transportation alternatives for the improvement of traffic conditions within the existing Route 29 transportation corridors. The range of alternatives studied include upgrades to the existing roadway and six bypass options with two crossover variations. The study area and proposed alignments are shown in Figure 1.1.

The project study area covers 63 square miles of Albemarle County, Virginia along Route 29 north of the City of Charlottesville. The area is characterized by upland deciduous forest and farmland crossed by numerous streams. Charlottesville is the largest urban area within the county, with several areas of growth extending north along Route 29. The population in Albemarle County in 1990 is projected to number 69,000, with 42,000 (61%) residing in the City of Charlottesville. The primary source of drinking water in the county is the South Fork Rivanna River Reservoir. Water quality and loss of storage capacity due to sedimentation in this reservoir are of great concern to the local population, particularly with respect to this study. Two of the proposed alignments actually cross the South Fork Rivanna River Reservoir, and a third impacts on the Reservoir's watershed (Figure 1.2). As a result of this local concern, studies of water resources along the proposed alignments was of particular importance in the natural environmental analysis performed by James R. Reed and Associates, Inc.



Proposed Alignments of the Route 29 Study Corridor

Figure No. 1.1



RESERVOIR WATERSHEDS

South Fork Rivanna

Ragged Mountain

Figure 1.2

2.0 STUDY AREAS AND METHODS

2.1 Aquatic Resources and Water Quality

2.1.1 Rationale for Study

To characterize aquatic resources within the study area, address issues of concern, and discuss potential impacts of the project, it was necessary to develop an extensive baseline of data on stream and riverine habitats, water quality, aquatic biota, and wetlands impacted by proposed alignments.

Except for previous research on the South Fork Rivanna River Reservoir, and information compiled by the Virginia Department of Game and Inland Fisheries on fishes in Albemarle County, very little site-specific data was available on aquatic resources in Albemarle County. Due to concern regarding the South Fork Rivanna River Reservoir in Albemarle County, a year-long water sampling program was established on the reservoir to address water quality questions coupled with a bathymetric survey designed to assess storage volume loss due to sedimentation. Due to the lack of data, a sampling program was developed for perennial streams crossed by the proposed alignments. Results were used to characterize existing conditions for water quality, fish resources, and the benthic macroinvertebrate communities. Analysis of these results were also used to discuss potential impacts along each proposed alignment.

2.1.2 Selection of Study Streams

To describe the aquatic habitats in streams crossed by the study alignments, all streams were examined and classified to stream order as described by Horton (1945) and modified by Strahler (1957). Since faunas of streams occurring within the same geographical area and of similar size order are typically similar, this system provides a convenient means to group streams when describing existing conditions.

A stream or river system normally consists of a pattern of tributaries joining one another and coalescing more or less in a dendritic pattern to form a drainage net. This pattern lends itself to "drainage analysis", the study of the relationship of stream length to stream order. This is a measure of the position of a stream in the hierarchy of tributaries.

First-order streams have no tributaries, but when two meet they become a second-order stream. Based on Leopold et. al. (1964), first-order streams were defined to be the smallest streams marked on a 1:24,000 scale map. Two second-order streams meet to form one third order and so on, with the proviso that acquisition of extra tributaries of an order lower than that of the receiving stream does not increase the order of that stream. A third-order stream may receive several first or second-order tributaries without becoming a fourth-order stream. Following this scheme, the highest order stream is considered to extend, usually by the straightest route, up to the top of one of the small headwaters.

If the numbers, lengths, and drainage areas of the streams in each order are determined, there are usually some fairly clear relationships between them. Stream order, in a semi-log plot against the number of streams in each order, the mean length of stream in each order, and the average drainage area of streams in each order, gives in each instance a straight line. It is usually found that there are between three and four times as many streams of order N-1 as there are of order N, and that each is, on the average, less than half as long and drains more than one-fifth of the area.

A total of 131 stream crossings were classified in this manner, 89 of which were first-order streams, 18 second-order, 16 third-order, 2 fourth-order, and 6 greater than fourth-order streams. Perennial streams and rivers were selected for water quality sampling based on proximity to alignments to establish baseline data on existing conditions in the study area. Twenty sites were selected for monthly monitoring for one year beginning in January, 1988. An additional ten stations were selected for quarterly sampling. Based on revisions in the locations of the study alignments as this study progressed, revisions in the sampling sites were made mid-way through the project, providing data on a total of 43 streams and rivers in Albemarle County.

2.1.3 Reservoir Study

The major water supply reservoir within Albemarle County is the South Fork Rivanna River Reservoir located northwest of the City of Charlottesville. Since this reservoir was placed in service in August, 1966, there has been a great deal of concern regarding the effects of early eutrophication on the quality of raw water obtained from the reservoir. This reservoir, along with the four other smaller reservoirs in the county have experienced nuisance algal growth, siltation problems, some fish kills, and taste and odor complaints from customers in the past.

In response to concerns about water quality degradation in the South Fork Rivanna River Reservoir, the Rivanna Water and Sewer Authority initiated a comprehensive water quality study for the watershed in 1975. This study was conducted by Betz Environmental Engineers, Inc., and the final report was submitted in June, 1977. This study involved an extensive water quality survey of feeder streams to the reservoir, as well as work on reservoir water quality, and bathymetry to determine the extent of eutrophication and sediment loading for future watershed management planning.

During the course of the Route 29 Bypass study, an eleven month-long survey of water quality was conducted on the South Fork Rivanna River Reservoir by James R. Reed and Associates, Inc. This survey lasted from March, 1988 through January, 1989. Sampling was conducted in conjunction with stream and river water quality sampling within the study area, and with a bathymetric survey of the reservoir. Water samples were collected at three locations on the reservoir: at the dam near the raw water intake, at the Ivy Creek Bridge, and on the upper end of the reservoir above Naked Creek. Grab samples were

collected from the surface, and from depths midway in the water column, and one foot above the bottom of the reservoir. A peristaltic pump was used to collect the deeper samples. Transparency was also determined in the field by measurement of the depth at which a secchi disc was visible.

To supplement the water quality data, a bathymetric survey was undertaken on the reservoir in October, 1988. The purpose of this effort was to assess current storage capacity, and changes in sedimentation rates since the 1980 study. The field effort of the survey was performed on 6 and 7, October, 1988 on the South Fork Rivanna River Reservoir. Results from this study are summarized in Appendix C.

2.1.4 Water Quality

Water quality sampling was conducted monthly on 28 stream stations, and quarterly on 15 additional streams in the study area from January, 1988 through January, 1989. Water samples from streams were preserved in the field and returned to the laboratory of James R. Reed and Associates, Inc. for analysis of total alkalinity, total kjeldahl nitrogen (TKN), nitrate/nitrite, total phosphorus, hardness, total suspended solids (TSS), total dissolved solids (TDS), oil and grease, lead, zinc, ammonia, and turbidity. Water samples taken on the South Fork Rivanna River Reservoir were analyzed for all of the proceeding parameters, plus ortho phosphate, iron, manganese, TOC, and true color. Reservoir samples were collected monthly from March, 1988 through January, 1989. Ice on the reservoir precluded sampling earlier in 1988.

Measurements of pH, dissolved oxygen, and specific conductance were field determined. Temperature and dissolved oxygen were measured with a YSI Model 54 ARC DO meter. Specific conductance was measured with a YSI Model 33-11 S-C-T meter, and pH was measured with an Orion Model 250-A meter. All water quality analyses were performed following EPA methodology with proper quality assurance/quality control procedures.

2.1.5 Fish

Data on fish resources in Albemarle County were derived principally from existing literature. Collections in the James River Basin date back to the work of Cope in the mid 1800's. A fish list for Albemarle County was prepared based on distributional information compiled from many sources, and supplemented by personal communications with personnel from the Commission of Game and Inland Fisheries. Additional data were compiled from fishes encountered during the macrobenthic sampling effort.

2.1.6 Benthic Macroinvertebrates

Macrobenthic sampling was conducted in ten perennial streams crossed by alignments in the study area. Samples were collected using the kick-sampling method of collection with D-frame dip nets. Total sampling effort at each site lasted for ten minutes during which all available habitats (pools, riffles, runs, overhanging banks, etc.) were sampled. Equal effort at each site enabled comparison of streams based on the density and diversity of pollution sensitive, facultative, and tolerant forms. Sites were selected to include all alignments, and to include first, second, and third-order streams for comparison.

2.1.7 Data Analysis and Impact

Streams were evaluated based on analytical results of water quality. Impacts on streams by the projects alignments were evaluated based on the number of crossings of different stream orders. The macrobenthic analysis, though not extensive enough for a detailed comparison of corridor impacts, was used for the purpose of general classification of the piedmont streams in Albemarle County. Evaluation of conditions on the South Fork Rivanna River Reservoir was made by comparison of analytical results with those from the 1977 Betz study.

Data from the bathymetric survey was analyzed based on measurements directly off of the depth finders strip-chart. Each transect was measured to determine the area represented by the reservoir profile. The volume of the reservoir was then calculated using the "average end-area method". This method is designed for reservoirs of fairly uniform width, with transects located perpendicular to the channel. The areas of adjacent transects were averaged and multiplied by the channel distance between them in order to determine the volume of each intermediate segment. Reservoir storage capacity was calculated by the summation of all segments.

2.2 Wetlands

Wetlands, as defined by the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989), are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

The recognition of wetlands as an important natural resource has increased substantially over the past decade. Not only do wetlands provide important habitats for a wide variety of animal and plant species, they also improve water quality, reduce flood and storm damages by serving as storm water

retention areas, provide erosion control through sediment trappings, serve as a food chain support, act as groundwater recharge and discharge systems, and provide such recreational activities as hunting, fishing, canoeing, and outdoor education.

2.2.1 Field Methodology

Section 404 of the Federal Water Pollution Control Act requires authorization from the U.S. Army Corps of Engineers for the discharge of fill material into any water of the United States, including all wetlands. The Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989) provides three diagnostic environmental characteristics by which wetlands are classified during the permitting process. These characteristics are: a) the prevalent vegetation of an area must consist of hydrophytic species which have the ability to grow, effectively compete, reproduce and/or persist in anaerobic soil conditions; b) soils must be present that have been classified as hydric, or they must possess characteristics that are associated with reducing soil conditions; and c) hydrologic indicators must show the area to be inundated, or the soil to be saturated within 12 inches from the surface for at least one week during the growing season. All three parameters must exist in order for a site to be considered a wetland. The "Federal Manual" also describes special circumstances and procedures for delineating areas considered problem area wetlands.

During the course of this study, field investigations for the purpose of locating and delineating wetlands intersected by the various alternates were conducted during the period 3 April, 1989 through 11 May, 1989. Corridor alignments were manually transferred onto 1:24,000 USGS quadrangle mapsheets for field use, and the roadway alignments of all alternates were traversed by foot. An on-site inspection was conducted at each permanent stream and river floodplain, as well as every intermittent stream and adjacent area crossed by the corridors of the six alternates and two crossovers. If it appeared during field reconnaissance that the area might qualify as a wetlands, the Army Corps of Engineers' three parameter approach was applied to make a wetlands determination and delineation. The routine determination method was utilized in the Route 29 wetlands study.

At each sample point, identification was made of the dominant species occurring in each vegetation layer. The plant indicator status categories were utilized in determining if hydrophytic vegetation was present. Reference was made to plant species appearing in Appendix C of the Corps Manual, and the National Wetlands Inventory 1988 Wetlands Plant List, Northeast Region. If the determination was made that hydrophytic vegetation was present, the site was considered a potential wetlands. Additionally, soil core samples were taken at a depth of 12-14" below the soil surface. These soil core samples were compared with the Munsell Soil Color Charts to ascertain if they were hydric soils. Soil characteristics were also examined and compared with the hydric soil indicators listed in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989). Finally, each site was examined for indicators of wetland hydrology. These included: visual observation of inundation, visual observation of soil saturation, watermarks, drift lines, sediment deposits, and drainage patterns within wetlands. The presence of wetlands indicators in all three parameters, or the absence of any one parameter was used to determine the wetlands-nonwetlands nature and boundary of each site inspected.

Data concerning vegetation, hydrology, and soils were recorded during on-site inspections. The following reference manuals were used: Petrides (1986), Little (1984), Elias (1980), and Brockman (1968) for woody plants; Fernald (1950) for flowering plants and ferns; and the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989) and National Wetlands Inventory Plant List for substantiating species geographic distribution and wetlands classification.

2.2.2 Wetlands Inventory

Acreage of existing wetlands intersected by each alternate corridor was determined by site. Wetlands were classified according to the National Wetlands Inventory (NWI) classification (Cowardin et al., 1979). Wetlands areas existing outside of the corridors were also examined to assist in making decisions on possible alignment shifts to minimize wetland impacts. Precise delineation of wetlands areas along the alignments were made on 1" = 200' scale topographic maps for areas of impact greater than 1/4 acre. Only one site along all alignments had an area of impact greater than 1/4 acre.

In addition to delineating and defining wetlands along the alternates, a wetlands functional assessment was made for each wetlands area. This assessment was done following the methodology devised by Paul R. Adamus for the Corps of Engineers in 1987. The method is commonly known as the "WET", The Wetland Evaluation Technique.

2.2.3 Quality Assurance/Quality Control

A variety of techniques were used to assure quality during this study. Coordination with agencies involved with wetlands in Virginia assured the field methodology was correct for the delineation of wetlands sites. Field team members were trained in the delineation of wetlands, including plant identification, soils analysis, and identification of hydrological indicators. Field data was organized with cross references to field maps marking station numbers, wetland data forms, and notes recorded in a field log book.

2.3 Ground Water and Surface Hydrology

2.3.1 Ground Water Resources

Geohydrological characteristics are described for both regional and sub-regional (corridor-wide) scales. Assessment of possible impacts is confined to the area adjacent to and underlain by the proposed alternative as possible impacts to ground water will originate only where pertinent features are in contact with the highway.

Characteristics and occurrences of geologic formations and aquifers were obtained from various publications and maps of the United States Geological Survey, Virginia State Water Control Board, and the United States Soil Conservation Service. Areas with a high water table were mapped and the percentage of each alternative underlain by these factors was calculated. These were considered major artesian aquifer recharge areas.

2.3.2 Surface Hydrology and Flooding

The various alternatives of this study cross a total of 131 creeks, streams, rivers, and reservoir sites. Of this total, only 28 locations are potential encroachments on the 100-year floodplain. The hydrology and flood information was obtained through review of historical documents, gaging records, and studies of possible future floods.

Data revealed that the majority of the areas within the 25 potential floodplain encroachment sites are not extensively developed and the flood problem is not serious. Damage during past flood events has been limited to a few scattered buildings and other structures such as roads and bridges. However, as available sites in the general area are exhausted, pressure to use the floodplain for building purposes will increase.

Topographic Quadrangle Maps Sheets and the National Flood Insurance Program maps were utilized to obtain and cross-reference floodplain, and flood crest elevations. The available data was utilized in defining the existing surface water hydrology in the study area and measuring the impacted floodplain encroachments of each alignment.

2.3.3 Model of Runoff

In order to estimate impacts of highway runoff on water resources in the study area, a predictive model developed for the Federal Highway Administration (FHWA/RD-81/044) was used to estimate runoff volume, pollutant buildup and runoff, and constituent loadings. Calculations for this model were based on data for a type III rural flush-shouldered highway. This was determined to be the most likely type of construction to be used along the proposed alignments.

Daily rainfall records from October, 1986 through May, 1989 provided by the Rivanna Water and Sewer Authority from the South Fork Rivanna River Reservoir were used to calculate the runoff coefficient. This coefficient was calculated by determining the rainfall, and the dry days since the last storm event. For a type III highway, the following equation was used:

$$Q = 0.845R^{1.892}DD^{-0.654}$$

where; Q = runoff volume (inches)
R = rainfall volume (inches)
DD= dry days to last storm event

For 198 storm events recorded, the average runoff coefficient (Q/R) was calculated as 0.68.

Pollutant accumulation estimates were made for each alignment based on estimates of average daily traffic for the year 2010. The following equation used was based on a regression analysis from a number of sites:

$$K_1 = (ADT^{0.88})0.007$$

where; K_1 = surface pollutant accumulation (lbs/mile)
ADT = average daily traffic

Total daily accumulation was estimated by calculating the daily accumulation rate (K_1) for each alignment and multiplying this by the length of highway. This number was then used to estimate yearly pollutant loads along each study alignment.

Since periodic storms with a rainfall intensity greater than 0.5 inches per hour wash off essentially all solids accumulated on the highway, and such storms occur periodically in Albemarle County, the average total solids in runoff was assumed to be the same as that accumulated. This was confirmed by a continuous application of the model for one year along one alignment. The pounds of total solids accumulated and washed off each year was used to calculate the various constituents of the solids accumulated based on the regression equations listed in Table 2.1. These data, along with calculations of runoff volume, average rain days per year (84), and highway area (considered the entire 300-foot right-of-way) were used to determine the volume of runoff water during an "average" year. This information was used to calculate the average concentrations of each constituent in mg/L in highway runoff along each alignment.

TABLE 2.1
RUNOFF CONSTITUENT EQUATIONS DEVELOPED FOR TYPE III SITES

CONSTITUENT			TYPE III
DS	(Dissolved Solids)	=	TS - SS
SS	(Suspended Solids)	=	0.32TS - 36.8*
VSS	(Volatile Suspended Solids)	=	0.061TS - 3.3*
TVS	(Total Volatile Solids)	=	0.32TS - 32.3*
TKN	(Total Kjeldahl Nitrogen)	=	3.1×10^{-3}TS + 0.55*
TOC	(Total Organic Carbon)	=	0.068TS - 5.85*
COD	(Chemical Oxygen Demand)	=	0.087TS + 0.65*
TN	(Total Nitrogen)	=	1.83×10^{-3}TS + 0.054*
TPO_4	(Total Phosphate)	=	2.15×10^{-3}TS - 0.245
Cl^-	(Chloride)	=	0.135TS + 2.6*
Pb	(Lead)	=	4.1×10^{-4}TS - 0.029*
Zn	(Zinc)	=	2.67×10^{-4}TS - 0.011*
Fe	(Iron)	=	0.014TS - 1.61*
Cu	(Copper)	=	7.4×10^{-5}TS + 8.78×10^{-3}
Cd	(Cadmium)	=	4.0×10^{-5}TS + 0.007
Cr	(Chromium)	=	2.3×10^{-4}TS - 0.028

Note: TS = total solids (lb)
* - Variables correlate at the 95 percent confidence level
From: FHWA/RD-81/044

3.0 EXISTING CONDITIONS

3.1 Aquatic Resources and Water Quality

3.1.1 Introduction

Existing conditions are addressed in this section in general due to the large number of study streams. Data on water quality from each stream were compared with other streams, and with state and federal water quality standards established to protect aquatic life. This information provides a general background from which to evaluate impacts.

3.1.2 Regional Study Area

The Commonwealth of Virginia has over 27,000 miles of streams and rivers divided into nine major basins. All of Albemarle County, with the exception of the far northeastern corner, lies within the James River Basin. The James River is the third largest estuary flowing into the Chesapeake Bay, and the most important river system in Virginia. The Rivanna River subbasin is the largest drainage basin in Albemarle County to the James River. Most of the study area for the Route 29 Bypass project lies within the Rivanna River basin, which drains a large part of the northern and central sections of Albemarle County. The principal tributaries of the Rivanna River include the North Fork Rivanna River, South Fork Rivanna River, Buck Mountain Creek, Moormans River, and Mechum River. The southern portion of the county is drained by the Hardware River and a few smaller tributaries to the James River, while the far northeastern corner of the county is within the York River basin.

Surface water within Albemarle County is generally soft and of good quality. There are five drinking water reservoirs within the county, all within the Rivanna River basin. The South Fork Rivanna River Reservoir supplies the bulk of the population of Albemarle County with drinking water. Water quality monitoring by the state within the Rivanna River subbasin has disclosed no problems based on the parameters of temperature, dissolved oxygen, and pH. Levels of coliform bacteria are also usually within acceptable levels. Monitoring of metals and pesticides on the James River below the confluence of the Rivanna River has also revealed no problems.

The major water supply reservoir within Albemarle County is the South Fork Rivanna River Reservoir located northwest of the City of Charlottesville. Since this reservoir was placed in service in August, 1966, there has been a great deal of concern regarding the effects of early eutrophication on the quality of raw water obtained from the reservoir. This reservoir, along with the four other smaller reservoirs in the county have experienced nuisance algal growth, siltation problems, some fish kills, and taste and odor complaints from customers in the past.

In response to concerns about water quality degradation in the South Fork Rivanna River Reservoir, the Rivanna Water and Sewer Authority initiated a comprehensive water quality study for the watershed in 1975. This study was conducted by Betz Environmental Engineers, Inc., and the final report was submitted in June, 1977. This study involved an extensive water quality survey of feeder streams to the reservoir, as well as work on reservoir water quality, and bathymetry to determine the extent of eutrophication and sediment loading for future watershed management planning.

3.1.3 Designated Stream Uses/Water Quality Standards

The state has evaluated streams in the study area that have desirable uses (i.e. designated uses). Table 3.1 lists the classifications of streams in Virginia and established standards for dissolved oxygen, pH, and temperature for each water class. Table 3.2 shows the streams in Albemarle County that have been classified according to the hierarchy in Table 3.1, including special standards that apply to each. Waters considered as Public Water Supplies (PWS) must meet the special water quality standards listed in Table 3.3 prior to distribution.

Surface waters in Albemarle County serve many purposes: drinking water supplies; recreation (swimming, fishing, boating); agriculture (irrigation, livestock); industrial and commericial uses; scenic beauty and open space; aquatic and shoreline habitat; and drainage. Fishing and boating are permitted on all county reservoirs. All the major lakes have self-sustaining fish populations. Major rivers which provide smallmouth and bluegill are the Moorman's, Hardware, North and South Fork Rivanna, Rivanna, and James. Several streams in northwest Albemarle are designated natural trout streams by the State Water Control Board: North and South Fork Moorman's River, Doyle River, Jones Run, and Pond Ridge Branch (Table 3.2). Trout is stocked in the North and South Fork Moorman's River and the Sugar Hollow Reservoir. Public fishing lakes are stocked every 1-2 years with fish which are not self-sustaining: channel catfish, northern pike, and walleye. A list of native fishes of Albemarle County is shown in Table 3.4.

Protection of wildlife and aquatic habitat is accomplished by preserving open and wooded areas, especially wooded areas along streams which help to maintain water temperatures. Protection of water quality also protects aquatic habitat. The State Water Control Board specifically designates and protects trout streams through special water quality standards. In some cases, SWCB public water supply standards may be made more stringent to protect the aquatic community.

Albemarle County has designated the Moorman's River from the bottom of the Charlottesville Water Supply Dam at Sugar Hollow to it's confluence with the Mechums River as a county scenic stream. A Scenic stream designation restricts construction, grading and cutting of trees within 15 feet of the stream, and restricts construction and excessive cutting within 65 feet of the stream.

TABLE 3.1
STANDARDS FOR DISSOLVED OXYGEN (DO), pH, AND MAXIMUM TEMPERATURE

CLASS	DESCRIPTION OF WATERS	DISS. OXYGEN (mg/L) Min.	DISS. OXYGEN (mg/L) Daily Avg.	pH	MAX TEMP. (/C)
I	Open Ocean	5.0	--	6.0-9.0	--
II	Estuarine Waters (Tidal Water-Coastal Zone to Fall Line)	4.0	5.0	6.0-9.0	--
III	Non-tidal Waters (Coastal and Piedmont Zones)	4.0	5.0	6.9-9.0	32
IV	Mountainous Zones Waters	4.0	5.0	6.0-9.0	31
V	Put and Take Trout Waters	5.0	6.0	6.0-9.0	21
VI	Natural Trout	6.0	7.0	6.0-9.0	20
VII	Swamp Water	a	a	a	b

NOTES:

a. This classification recognizes that the natural quality of swamp water may fall outside of the ranges for D.O. and pH set forth above as water quality standards; therefore, on a case-by-case basis, standards for specific swamp waters can be developed that reflect their natural quality.

b. Maximum temperature will be the same as that for Classes I through VI waters as appropriate.

Source: "Water Quality Standards", Commonwealth of Virginia, State Water Control Board, Richmond, Virginia, June 12, 1986, pp 12-13.

TABLE 3.2
SWCB - WATER QUALITY STANDARDS OF THE MIDDLE JAMES RIVER BASIN SHOWING CLASSES AND SPECIAL STANDARDS FOR STREAMS IN ALBEMARLE COUNTY, VIRGINIA

SEGMENT	STREAM	CLASS	SPECIAL STANDARDS
10	James River and tributaries	III	-----
	(includes Put and Take Trout	V	-----
	Waters and Natural Trout Waters)	VI	-----
10e	Totier Creek	III	Public Water Supply
10f	Powell Creek	III	-----
10g	Beaver Creek	III	PWS
10h	Mechums River	III	PWS
10i	Moormans River	III	PWS
Natural trout waters in Section 10:			
	North Fork Moormans	IV	-----
	Pond Ridge Branch	IV	-----
	South Fork Moormans	IV	-----
10j	South Fork Rivanna	III	PWS
10m	Rivanna River (Lake Monticello intake)	III	PWS
10n	Ragged Mountain Reservoir	III	PWS

TABLE 3.3
VIRGINIA SWCB WATER QUALITY STANDARDS FOR PUBLIC WATER SUPPLIES

METALS

CONSTITUENT	MAXIMUM ALLOWABLE LEVEL (mg/L unless otherwise noted)
Arsenic	0.05
Barium	1.0
Cadmium	0.010
Chromium (Total)	0.05
Lead	0.05
Mercury	0.002
Selenium	0.01
Silver	0.05
Iron (Soluble)	0.30
Manganese (Soluble)	0.05
Zinc	5.0
Copper	1.0
Sodium	20

INORGANICS

pH	6.5 - 8.5 Standard Units
Odor	3 Threshold Odor Number
Corrosion Index	Non Corrosive
Fluoride	1.8
Chloride	250
Color (APHA)	15 cu
Hydrogen Sulfide	0.05
Sulfate	250
Nitrate	10.0
Turbidity	1 Turbidity Unit
Total Dissolved Solids	500
Foaming agents (Measured as methylene blue active substances)	0.5

TABLE 3.3
VIRGINIA SWCB WATER QUALITY STANDARDS FOR PUBLIC WATER SUPPLIES
(continued)

ORGANICS

CONSTITUENT	MAXIMUM ALLOWABLE LEVEL (mg/L unless otherwise noted)
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP (Silvex)	0.01
Phenols	0.001
Total Trihalomethanes	0.10

RADIONUCLIDES

Gross Beta Activity	50 pci/L
Gross Alpha Activity	15 pci/L
Radium 226	3 pci/L
Total Radium (Ra-226 & Ra-228)	5 pci/L
Tritium	20,000 pci/L
Strontium - 90	8 pci/L

TABLE 3.4
FISH OF THE STUDY AREA - ALBEMARLE COUNTY

ORDER ANGUILLIFORMES	
Family Anguillidae	
Anguilla rostrata	American Eel
ORDER CLUPEIFORMES	
Family Esocidae	
Esox niger	Chain Pickerel
Family Salmonidae	
Salvelinus fontinalis	Brook Trout
Salmo gairdneri	Rainbow Trout
Salmo trutta	Brown Trout
ORDER CYPRINIFORMES	
Family Catostomidae	
Catostomus commersoni	Common White Sucker
Erimyzon oblongus	Creek Chubsucker
Hypentelium nigricans	Northern Hog Sucker
Moxostoma hamiltoni	Rustyside Sucker
Moxostoma rhothoecum	Torrent Sucker
Family Cyprinidae	
Campostoma anomalum	Central Stoneroller
Clinostomus funduloides	Rosyside Dace
Cyprinus carpio	Carp
Exoglossum maxillingua	Cutlips Minnow
Hybognathus regius	Eastern Silvery Minnow
Nocomis leptocephalus	Bluehead Chub
Nocomis micropogon	River Chub
Nocomis raneyi	Bull Chub
Notemigonus crysoleucas	Golden Shiner
Notropis amoenus	Comely Shiner
Notropis analostanus	Satinfin Shiner
Notropis ardens	Rosefin Shiner
Notropis cornutus	Common Shiner
Notropis hudsonius	Spottail Shiner
Notropis procne	Swallowtail Shiner
Notropis rubellus	Rosyface Shiner
Phoxinus oreas	Mountain Redbelly Dace
Pimephales notatus	Bluntnose Minnow
Rhinichthys atratulus	Blacknose Dace
Rhinichthys cataractae	Longnose Dace
Semotilus atromaculatus	Creek Chub
Semotilus corporalis	Fallfish
Semotilus margarita	Pearl Dace

TABLE 3.4
FISH OF THE STUDY AREA - ALBEMARLE COUNTY
(continued)

ORDER CYPRINIFORMES (continued)	
Family Ictaluridae	
Ictalurus catus	White Catfish
Ictalurus punctatus	Channel Catfish
Ictalurus nebulosus	Brown Bullhead
Noturus gyrinus	Tadpole Madtom
Noturus insignis	Margined Madtom
ORDER PERCIFORMES	
Family Centrarchidae	
Ambloplites rupestris	Rock Bass
Lepomis auritus	Redbreast Sunfish
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Micropterus dolomieui	Smallmouth Bass
Micropterus salmoides	Largemouth Bass
Pomoxis annularis	White Crappie
Pomoxis nigromaculatus	Black Crappie
Family Cottidae	
Cottus bairdi	Mottled Sculpin
Family Percidae	
Etheostoma flabellare	Fantail Darter
Etheostoma longimanum	Longfin Darter
Etheostoma nigrum	Johnny Darter
Etheostoma vitreum	Glassy Darter
Percina gymnocephala	Appalachia Darter
Percina notogramma	Stripeback Darter
Percina peltata	Shield Darter
Percina roanoka	Roanoke Darter

A river may also qualify for designation as a Virginia Scenic River. The Scenic Rivers Act of 1970 provides for the identification, protection and preservation of rivers or sections of rivers which possess natural or pastoral beauty of high quality. A state designation prohibits the construction of a dam or other structure which impedes the natural flow. The Scenic Rivers Act also requires the appointment of an Advisory Committee of local residents to advise the Division of Parks and Recreation concerning the protection or management of a designated river. The Act states that full consideration and evaluation of a river as a scenic resource shall be given in all State planning for the use and development of a scenic river and its related land resources. The following rivers are currently designated as state scenic rivers in Albemarle County:

- Moorman's River from the Charlottesville Reservoir to its junction with the Mechums River
- Rivanna River from the Woolen Mills dam to the Fluvanna County line

3.1.4 Water Quality of Streams and Rivers in Albemarle County

Monthly water quality sampling was conducted from January, 1988 through January, 1989 on twenty streams and rivers within the study area. Midway through this sampling effort, approximately one third of the sampling sites had to be shifted as corridor alignments were eliminated or moved. A summary of sampling sites by month is shown in Table 3.5, with results from each site summarized in Appendix A, Tables A.1 through A.28. An additional ten sites were sampled quarterly, with half of these changing based on corridor revisions. These are listed in Table 3.6, with results summarized in Appendix A, Tables A.29 through A.43. Locations of monthly and quarterly sampling sites are shown in Figures 3.1 and 3.2.

Overall, the results of this sampling revealed that surface water quality in Albemarle County is quite good. Only a few streams flowing through large agricultural areas showed elevated levels of nutrients. Few trends were noticeable over the year of sampling. As expected, temperatures increased in the summer leading to a corresponding drop in dissolved oxygen levels. The only other trend that was consistent through the area was in measures of pH, which tended to be alkaline over the drier summer months, and neutral to slightly acidic in the winter. No significant problems in water quality of streams in the study area were detected. Levels of metals (lead and zinc) were within acceptable ranges, though occasionally lead was detected at levels above drinking water standards. None of the analytical results listed in Appendix A reveal levels of the compounds tested that are considered harmful to aquatic life.

TABLE 3.5
Monthly Water Quality Sampling Locations and the Months Sampling was Conducted

LOCATION	STATION	JAN 1988	FEB 1988	MAR 1988	APR 1988	MAY 1988	JUN 1988	JUL 1988	AUG 1988	SEPT 1988	OCT 1988	NOV 1988	DEC 1988
North Fork Rivanna River @ 649	01	X	X	X	X	X	X	X		X	X	X	X
Buck Mountain Creek @ 665	02	X	X	X	X	X	X	X	X	X	X	X	X
Burruss Branch @ 601	03	X	X	X	X	X	X	X	X	X	X	X	X
Mechums River @ 601	04		X	X	X	X	X	X	X	X	X	X	X
Mechums River @ 614	05	X	X	X	X	X	X	X	X	X	X	X	X
Moormans River @ 601	06	X	X	X	X	X	X	X	X	X	X	X	X
Moormans River @ 671	07		X	X	X	X	X	X	X	X	X	X	X
Ivy Creek @ 601	08	X	X	X	X	X	X	X	X	X	X	X	X
North Fork Rivanna River @ 29	09	X	X	X	X	X	X	X	X	X	X	X	X
Piney Creek @ 601	10	X	X	X	X	X	X	X	X	X	X	X	X
South Fork Rivanna River @ 29	11	X	X	X	X	X	X	X	X	X	X	X	X
South Fork Rivanna River @ 660	12	X	X	X	X	X	X	X	X	X	X	X	X
Jacobs Run @ 743	13	X	X	X	X	X	X	X		X	X	X	X
Buck Island Creek @ 729	14		X	X	X	X	X	X					

TABLE 3.5
Monthly Water Quality Sampling Locations and the Months Sampling was Conducted (continued)

LOCATION	STATION	JAN 1988	FEB 1988	MAR 1988	APR 1988	MAY 1988	JUN 1988	JUL 1988	AUG 1988	SEPT 1988	OCT 1988	NOV 1988	DEC 1988
North Fork Hardware River @ 631	15		X	X	X	X	X	X					
North Fork Rivanna River @ 604	16	X	X	X	X	X	X	X					
Preddy Creek @ 600	17	X	X	X	X	X	X	X					
Preddy Creek @ 640	18		X	X	X	X	X	X					
Redbud Creek @ 20	19	X	X	X	X	X	X	X					
Rivanna River @ 729	20		X	X	X	X	X	X					
Turkey Run @ 20	21		X	X	X	X	X	X					
Naked Creek South of 743	22									X	X	X	X
Ivy Creek @ Reservoir	23									X	X	X	X
Jumping Branch @ Reservoir	24									X	X	X	X
Powell Creek @ Hollymead	25								X	X	X	X	X
Powell Creek @ 643	26								X	X	X	X	X
Redbud Creek @ 621	27									X	X	X	X
Town Branch off 631	28									X	X	X	X

TABLE 3.6
Quarterly Water Quality Sampling Locations and the Months Sampling was Conducted

LOCATION	STATION	APR 1988	JULY 1988	OCT 1988	JAN 1989
Rivanna River @ Key West	29	X	X	X	X
Naked Creek @ 844	30	X	X	X	X
Jumping Branch below 676	31	X	X	X	X
Flannigan Branch @ 20	32	X	X	X	X
Foster Branch @ 20	33	X	X	X	X
Flannigan Branch @ 600	34	X	X		
North Fork Hardware River @ 708	35	X	X		
Houchins Branch @ 729	36	X	X		
Massey Creek @ 795	37	X	X		
Ivy Creek @ 637	38	X	X		
Ivy Creek @ 677	39			X	X
Buck Mountain Creek off 667	40			X	X
North Fork Rivanna River @ 604	41			X	X
Jacobs Run @ 606	42			X	X
Fishing Creek @ 660	43			X	X

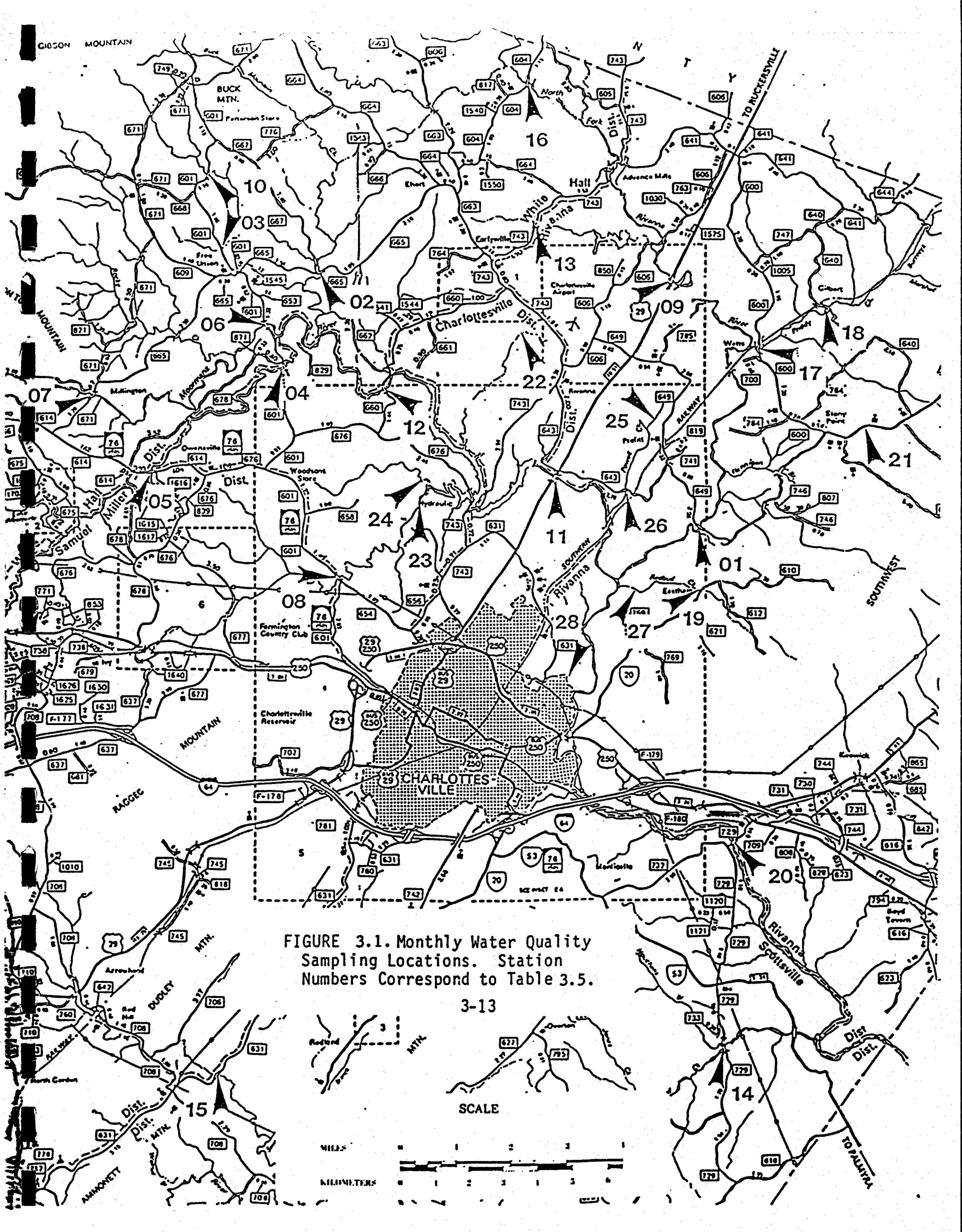


FIGURE 3.1. Monthly Water Quality Sampling Locations. Station Numbers Correspond to Table 3.5.

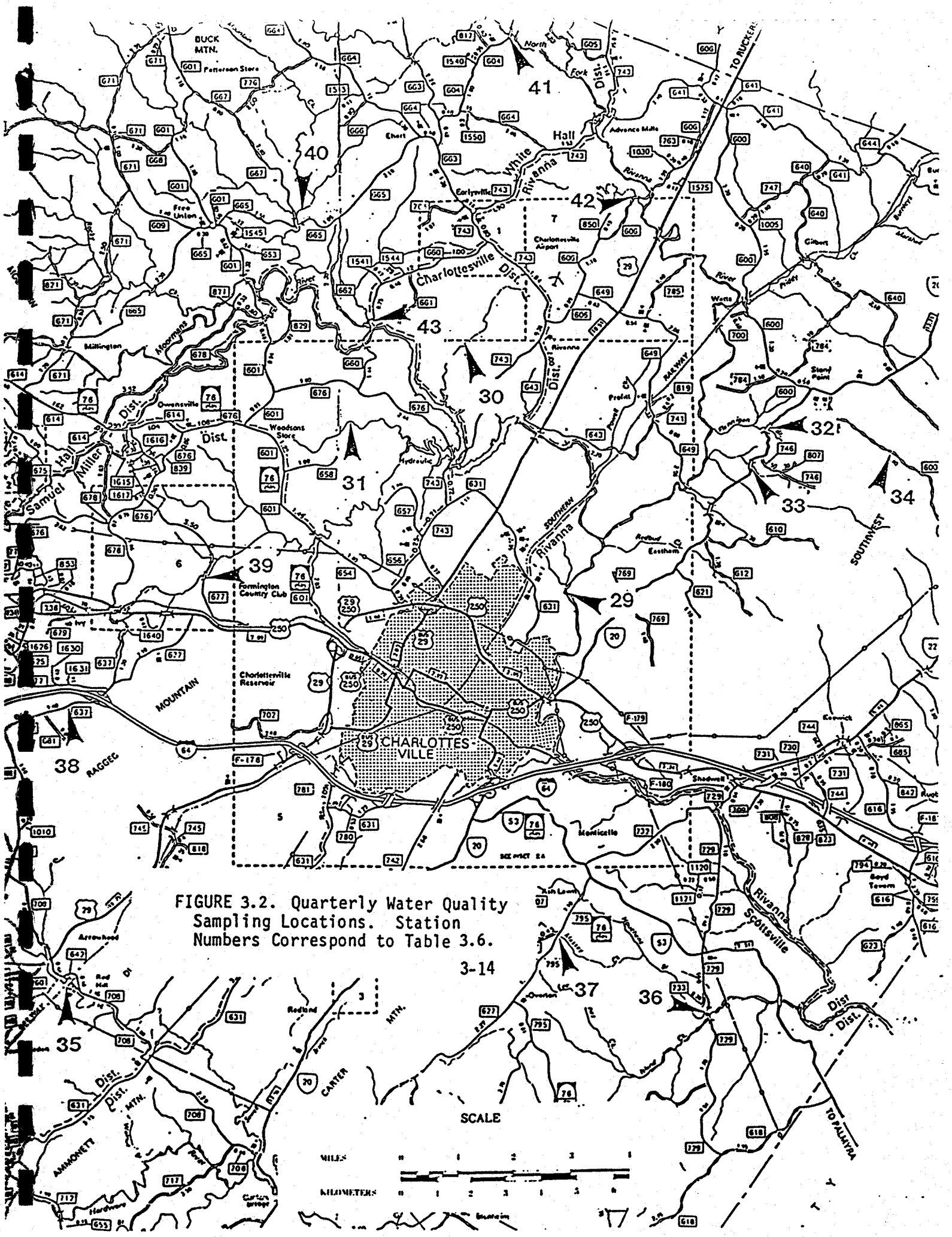


FIGURE 3.2. Quarterly Water Quality Sampling Locations. Station Numbers Correspond to Table 3.6.

3.1.4.1 Macrobenthic Conditions

An analysis of the aquatic ecosystem community structure assists greatly in defining water quality of this environment. This definition is determined by the community structure of benthic macroinvertebrates. The majority of the benthic macroinvertebrates used in water quality analysis come from 4 general groups: insects - adults and larvae; molluscs; crustaceans; and annelid worms. These organisms are important to water quality studies for several reasons. In addition to being the major intermediate constituent of the aquatic food web, benthic macroinvertebrates are considered by biologists as virtually "living recorder" of past as well as present water quality conditions. This is because of their relative immobility and their variable resistance to various contaminants introduced into streams. No two groups of benthic organisms have the same limiting factor for the various chemical and physical constituents encountered in the aquatic ecosystem. Since benthic macroinvertebrates are relatively immobile and have life spans of up to 3 years they respond directly to changes in water quality, whether these changes are sporadic or constant. An evaluation of the community structure of these organisms (their presence, absence, abundance, and distribution) provides the basis for the biological analysis of water.

A total of ten sites were sampled for macrobenthic organisms on 18 July, 1989 (Figure 3.3). Sites were selected from first, second, and third order streams in the study area, and represented areas that would be impacted by all study alignments. Sampling was conducted using the kick sampling method of collection with D-frame dip nets. Total sampling effort at each site lasted for 10 minutes during which all available habitats (pools, ruffles, runs overhanging banks, etc.) were sampled. These samples were preserved in the field and returned to the laboratory of James R. Reed and Associates, Inc. for washing, sorting, and analysis.

Results of this macrobenthic sampling effort are shown in Table 3.7. A total of 2422 individuals were collected at the ten stations, representing 40 species of invertebrates from 33 families. Table 3.7 lists the summary of taxa collected based on stream order. From the three first-order streams, 21 total taxa were identified, with 28 found in the three second-order streams, and 33 in the four third-order streams sampled. All but three taxa found in first-order streams were also found in second and third-order streams, while 6 taxa were unique to second order streams, and 10 were unique to third-order streams.

Third-order streams had more pollution sensitive forms and more pollution tolerant forms than either first or second-order streams. The number of pollution tolerant families found was directly proportional to stream order. Table 3.8 lists the pollution tolerance of taxa found in first, second and third-order streams based on the percentage of the total found in each order stream. This shows the percentage of tolerant forms increasing based on stream order, and supports the theory that higher order streams in this area suffer greater impacts from point and non-point pollution sources. Since 43% of Albemarle County is agricultural, higher order streams are more likely to accumulate pollutants from non-point sources as they drain larger areas of land.

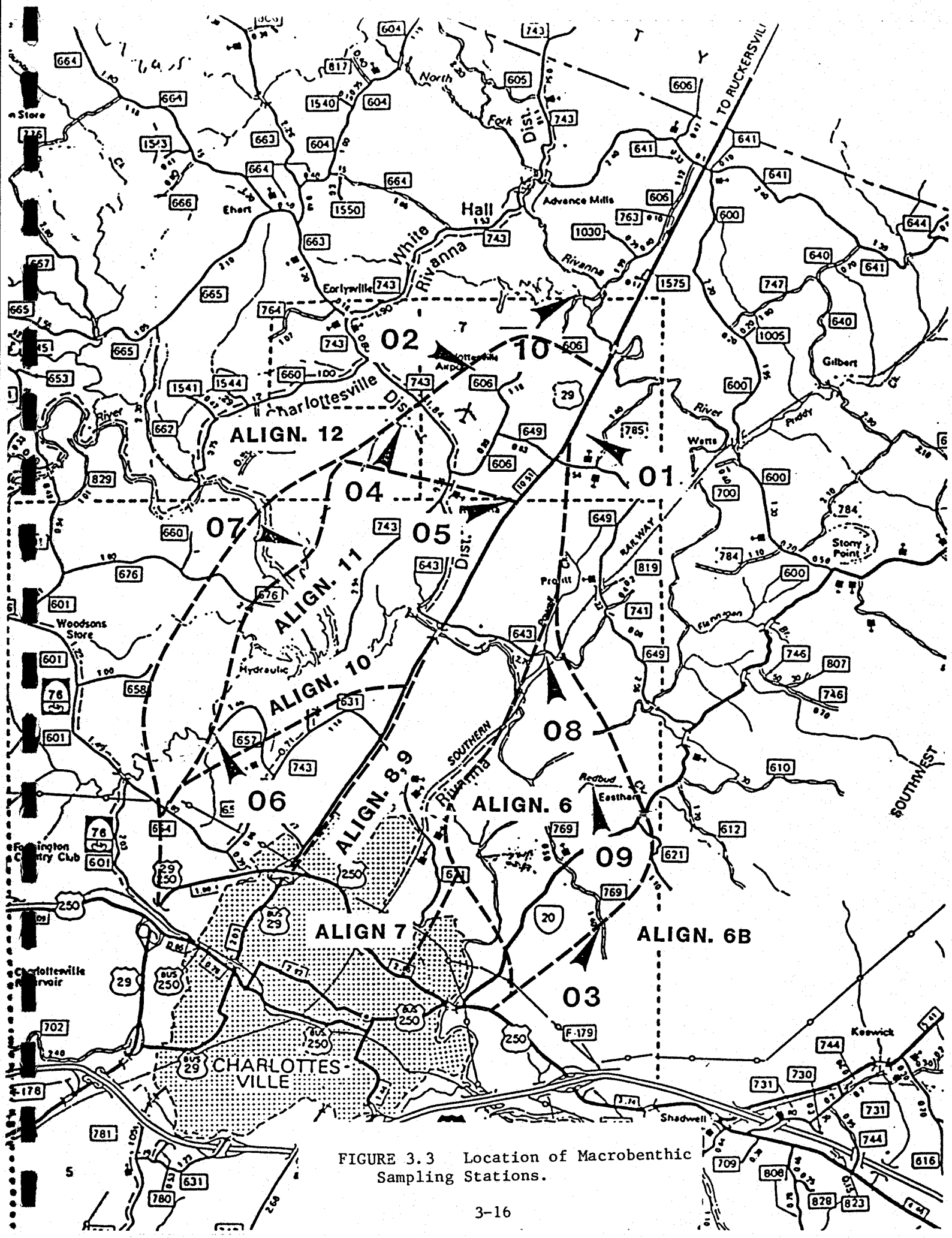


FIGURE 3.3 Location of Macrobenthic Sampling Stations.

TABLE 3.7
The Occurrence of Benthic Macroinvertebrates Among Stream Orders for Streams Sampled

Taxon	Pollution Tolerance Category	Stream Order 1	2	3
ANNELIDA				
Oligochaeta				
Branchiobdellidae	Sensitive			X
Hirudinea				
Glossiphoniidae	Tolerant		X	X
ARTHROPODA				
Crustacea				
Isopoda				
Talitridae	Facultative		X	X
Decapoda				
Cambaridae	Sensitive	X	X	X
Insecta				
Ephemeroptera (Mayflies)				
Baetidae	Facultative	X	X	X
Heptageniidae	Sensitive	X	X	X
Siphlonuridae	Sensitive			X
Odonata (Dragonflies)				
Aeshnidae	Facultative	X	X	X
Gomphidae	Facultative	X		X
Libellulidae				
Species 1	Facultative	X	X	X
Species 2	Facultative			X
Coenagrionidae				
Species 1	Facultative	X	X	X
Species 2	Facultative			X
Plecoptera (Stoneflies)				
Nemouridae	Sensitive			X
Peltoperlidae	Sensitive	X	X	X
Hemiptera (True Bugs)				
Corixidae	Facultative		X	
Gerridae	Facultative	X	X	X
Trichoptera (Caddisflies)				
Brachycentridae	Sensitive	X		
Hydropsychidae				
Species 1	Facultative	X	X	X
Species 2	Facultative		X	
Molannidae	Sensitive	X		
Philopotamidae	Sensitive	X	X	X
Phryganeidae	Sensitive		X	

TABLE 3.7
The Occurrence of Benthic Macroinvertebrates Among Stream Orders for Streams Sampled
(continued)

Taxon	Pollution Tolerance Category	Stream Order 1	2	3
ARTHROPODA (con't)				
Megaloptera (Hellgrammites)				
Corydalidae				
Chauliodes sp.	Facultative	X	X	X
Corydalus cornutus	Facultative			X
Coleoptera (Beetles)				
Dytiscidae				
Species 1	Facultative	X	X	X
Species 2	Facultative		X	
Elmidae	Sensitive	X	X	X
Gyrinidae	Facultative		X	X
Psephenidae	Sensitive	X	X	X
Diptera (Flies)				
Chironomidae	Facultative	X	X	X
Simuliidae	Facultative		X	
Tabanidae	Tolerant		X	
Tipulidae				
Species 1	Facultative	X	X	X
Species 2	Facultative	X	X	X
MOLLUSCA				
Gastropoda (Snails)				
Physidae	Tolerant		X	X
Planorbidae				
Helisoma sp.	Tolerant			X
Species 2	Tolerant			X
Viviparidae	Sensitive			X
Pelecypoda (Clams)				
Corbiculidae	Tolerant			X
Sphaeriidae	Tolerant	X	X	X

From: Virginia State Water Control Board Procedure for Conductingh Qualitative Biological Surveys (DRAFT) by Michael H. Shelor and Richard W. Ayers, (May 1984)

TABLE 3.8
Percentage of Pollution Sensitive, Facultative, and Tolerant Taxa Based on the Total Found in each Stream Order

POLLUTION TOLERANCE	STREAM ORDER 1	2	3
Sensitive Forms	38%	25%	30%
Facultative Forms	57%	61%	52%
Tolerant Forms	5%	14%	18%

From: Virginia State Water Control Board Procedure for Conducting Qualitative Biological Surveys (DRAFT) by Michael H. Shelor and Richard W. Ayers, May 1984.

The taxa found at each site are identified in Tables 3.9 through 3.18, listing counts of individuals and statistics on each community. The Shannon-Weiner index of diversity and evenness indices indicated that water quality was mostly quite good in the streams sampled. No single species dominated the community at most sites. Two sites, stations 04 and 10 did have one species representing over half of the populations, and had subsequently lower diversity and evenness scores. Station 04, the upper end of Naked Creek was the poorest in terms of habitat of the sites sampled. The stream was narrow, and the bottom of soft mud, habitat conducive to the midges that dominated here.

The biological evaluation of water quality at all ten sites is summarized in Table 3.19. This evaluation is based on the density and diversity of pollution sensitive, facultative, and tolerant organisms. Results from this evaluation also indicate that overall, water quality of streams sampled in Albemarle County is considered good, or fair to good. Only Station 04 was considered fair to poor, with few sensitive forms and more tolerant taxa. This site, in a large cattle-grazed field, also had the lowest dissolved oxygen reading, and second highest specific conductance reading of all ten sites (Table 3.20). Station 10, Jacobs Run at Route 606 was considered to be of fair water quality based on this evaluation. This was due largely to the greater number of tolerant forms, and lower representation by sensitive taxa.

TABLE 3.9
Statistics of Benthic Invertebrates
Station 01 - Upper End of Flat Branch
18 July, 1989
First Order Stream
Alignments 6, 6B, 7

TAXA	COUNT	POLLUTION TOLERANCE[1]
Hydropsychidae	34	Facultative
Chironomidae	18	Facultative
Tipulidae	7	Facultative
Peltoperlidae	7	Sensitive
Gerridae	5	Facultative
Philopotamidae	3	Sensitive
Cambaridae	3	Sensitive
Corydalidae	3	Facultative
Dytiscidae	3	Facultative
90% B.P.		
Heptageniidae	2	Sensitive
Baetidae	2	Facultative
Tipulidae	2	Facultative
Psephenidae	1	Sensitive
Coenagrionidae	1	Facultative
Total Number of Taxa	14	
Total Number of Individuals	91	
Shannon-Weiner Diversity (H)	2.0432	
Evenness Index (H/lnS)	0.7742	

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.10
Statistics of Benthic Invertebrates
Station 02 - Tributary to Jacobs Run
18 July, 1989
First Order Stream
Alignment 12

TAXA	COUNT	POLLUTION TOLERANCE[1]
Chironomidae	18	Facultative
Hydropsychidae	12	Facultative
Tipulidae	11	Facultative
Psephenidae	9	Sensitive
Cambaridae	9	Sensitive
Heptageniidae	7	Sensitive
Molannidae	7	Sensitive
Gomphidae	7	Facultative
Brachycentridae	5	Sensitive
Gerridae	5	Facultative
Libellulidae	3	Facultative
90% Breakpoint		
Sphaeriidae	3	Tolerant
Peltoperlidae	2	Sensitive
Aeshnidae	2	Facultative
Dytiscidae	2	Facultative
Tipulidae	1	Facultative

Total Number of Taxa	16
Total Number of Individuals	103
Shannon-Weiner Diversity (H)	2.5427
Evenness Index (H/lnS)	0.9171

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.11
Statistics of Benthic Invertebrates
Station 03 - Rocky Hollow at Route 769
18 July, 1989
First Order Stream
Alignment 6B

TAXA	COUNT	POLLUTION TOLERANCE[1]
Peltoperlidae	68	Sensitive
Hydropsychidae	28	Facultative
Tipulidae	16	Facultative
Cambaridae	14	Sensitive
Corydalidae	8	Facultative
Chironomidae	8	Facultative
Elmidae	7	Sensitive
Heptageniide	6	Sensitive
Psephenidae	5	Sensitive
90% Breakpoint		
Aeshnidae	5	Facultative
Dytiscidae	5	Facultative
Baetidae	4	Facultative
Philopotamidae	1	Sensitive
Gerridae	1	Facultative
Total Number of Taxa	14	
Total Number of Individuals	176	
Shannon-Weiner Diversity (H)	2.0519	
Evenness Index (H/lnS)	0.7775	

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.12
Statistics of Benthic Invertebrates
Station 04 - Upper End of Naked Creek
18 July, 1989
Second Order Stream
Alignment 12

TAXA	COUNT	POLLUTION TOLERANCE[1]
Chironomidae	381	Facultative
Libellulidae	59	Facultative
Corixidae	27	Facultative
Dytiscidae	26	Facultative
Hydropsychidae	26	Facultative
90% Breakpoint		
Physidae	24	Tolerant
Gyrinidae	14	Facultative
Dytiscidae	11	Facultative
Hydropsychidae	3	Facultative
Simuliidae	3	Facultative
Tipulidae	3	Facultative
Aeshnide	2	Facultative
Sphaeriidae	2	Tolerant
Cambaridae	1	Sensitive
Corydalidae	1	Facultative
Glossiphoniidae	1	Tolerant

Total Number of Taxa	16
Total Number of Individuals	584
Shannon-Weiner Diversity (H)	1.3777
Evenness Index (H/lnS)	0.4969

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.13
Statistics of Benthic Invertebrates
Station 05 - Tributary to Powell Creek by Route 29
18 July, 1989
Second Order Stream
Alignment 11

TAXA	COUNT	POLLUTION TOLERANCE[1]
Cambaridae	34	Sensitive
Peltoperlidae	30	Sensitive
Elmidae	24	Sensitive
Baetiscidae	18	Sensitive
Tipulidae	17	Facultative
Libellulidae	15	Facultative
Chironomidae	12	Facultative
Hydropsychidae	9	Facultative
90% Breakpoint		
Baetidae	4	Facultative
Aeshnidae	4	Facultative
Tipulidae	3	Facultative
Gerridae	3	Facultative
Phryganeidae	1	Sensitive
Talitridae	1	Facultative
Corydalidae	1	Facultative
Coenagrionidae	1	Facultative
Tabanidae	1	Tolerant

Total Number of Taxa	17
Total Number of Individuals	178
Shannon-Weiner Diversity (H)	2.3374
Evenness Index (H/lnS)	0.8250

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.14
Statistics of Benthic Invertebrates
Station 06 - Tributary to Ivy Creek at Route 657
18 July, 1989
Second Order Stream
Alignment 10

TAXA	COUNT	POLLUTION TOLERANCE[1]
Heptageniidae	10	Sensitive
Peltoperlidae	8	Sensitive
Hydropsychidae	8	Facultative
Elmidae	5	Sensitive
Philopotamidae	4	Sensitive
Aeshnidae	4	Facultative
Chironomidae	4	Facultative
Tipulidae	3	Facultative
Baetidae	3	Facultative
90% Breakpoint		
Cambaridae	2	Sensitive
Corydalidae	2	Facultative
Psephenidae	1	Sensitive
Tabanidae	1	Tolerant

Total Number of Taxa	13
Total Number of Individuals	55
Shannon-Weiner Diversity (H)	2.3647
Evenness Index (H/lnS)	0.9219

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.15
Statistics of Benthic Invertebrates
Station 07 - Naked Creek at Route 844
18 July, 1989
Third Order Stream
Alignment 11

TAXA	COUNT	POLLUTION TOLERANCE[1]
Hydropsychidae	157	Facultative
Tipulidae	54	Facultative
Heptageniidae	36	Sensitive
Chironomidae	33	Facultative
Corydalidae	26	Facultative
Aeshnidae	18	Facultative
Gomphidae	14	Facultative
Elmidae	12	Sensitive
Libellulidae	11	Facultative
90% Breakpoint		
Philopotamidae	10	Sensitive
Peltoperlidae	9	Sensitive
Cambaridae	6	Sensitive
Psephenidae	3	Sensitive
Baetidae	3	Facultative
Gyrinidae	2	Facultative
Branchiobdellidae	1	Sensitive
Coenagrionidae	1	Facultative
Tipulidae	1	Facultative
Dytiscidae	1	Facultative
Gerridae	1	Facultative
Physidae	1	Tolerant
Sphaeriidae	1	Tolerant

Total Number of Taxa	22
Total Number of Individuals	401
Shannon-Weiner Diversity (H)	2.1410
Evenness Index (H/lnS)	0.6926

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.16
Statistics of Benthic Invertebrates
Station 08 - Powell Creek at Route 643
18 July, 1989
Third Order Stream
Alignments 6,7

TAXA	COUNT	POLLUTION TOLERANCE[1]
Hydropsychidae	41	Facultative
Chironomidae	31	Facultative
Libellulidae	10	Facultative
Tipulidae	8	Facultative
Baetidae	7	Facultative
Cambaridae	5	Sensitive
Elmidae	3	Sensitive
Heptageniidae	3	Sensitive
Siphlonuridae	3	Sensitive
90% Breakpoint		
Aeshnidae	3	Facultative
Sphaeriidae	3	Tolerant
Peltoperlidae	2	Sensitive
Corydalidae	2	Facultative
Psephenidae	1	Sensitive
Talitridae	1	Facultative
Gyrinidae	1	Facultative
Planorbidae	1	Tolerant
Total Number of Taxa	17	
Total Number of Individuals	125	
Shannon-Weiner Diversity (H)	2.1140	
Evenness Index (H/lnS)	0.7461	

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.17
Statistics of Benthic Invertebrates
Station 09 - Redbud Creek at Route 621
18 July, 1989
Third Order Stream
Alignment 6B

TAXA	COUNT	POLLUTION TOLERANCE[1]
Viviparidae	191	Sensitive
Heptageniidae	48	Sensitive
Siphlonuridae	41	Sensitive
Philopotamidae	31	Sensitive
Corydalidae	28	Facultative
Hydropsychidae	27	Facultative
Baetidae	21	Facultative
90% Breakpoint		
Nemouridae	15	Sensitive
Chironomidae	8	Facultative
Corydalidae	5	Facultative
Aeshnidae	5	Facultative
Elmidae	4	Sensitive
Psephenidae	3	Sensitive
Cambaridae	3	Sensitive
Tipulidae	2	Facultative
Gyrinidae	2	Facultative
Physidae	2	Tolerant
Branchiobdellidae	1	Sensitive
Libellulidae	1	Facultative

Total Number of Taxa	19
Total Number of Individuals	438
Shannon-Weiner Diversity (H)	2.0101
Evenness Index (H/lnS)	0.6827

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.18
Statistics of Benthic Invertebrates
Station 10 - Jacobs Run at Route 606
18 July, 1989
Third Order Stream
Alignment 12

TAXA	COUNT	POLLUTION TOLERANCE[1]
Hydropsychidae	175	Facultative
Philopotamidae	21	Sensitive
Corbiculidae	17	Tolerant
Chironomidae	11	Facultative
Libellulidae	8	Facultative
Gomphidae	7	Facultative
Planorbidae	6	Tolerant
90% Breakpoint		
Aeshnidae	4	Facultative
Dytiscidae	4	Facultative
Gyrinidae	4	Facultative
Cambaridae	2	Sensitive
Libellulidae	2	Facultative
Physidae	2	Tolerant
Elmidae	1	Sensitive
Corydalidae	1	Facultative
Coenagrionidae	1	Facultative
Coenagrionidae	1	Facultative
Tipulidae	1	Facultative
Gerridae	1	Facultative
Planorbidae	1	Tolerant
Glossiphoniidae	1	Tolerant

Total Number of Taxa	21
Total Number of Individuals	271
Shannon-Weiner Diversity (H)	1.5279
Evenness Index (H/lnS)	0.5018

[1] Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.19
Water Quality Evaluation of the Macrobenthic Stations Based Upon Virginia State Water Control Board Unpublished Draft Qualitative Procedure (Shelor and Ayers, 1984)

STATION	POLLUTION TOLERANCE OF MACROBENTHICS	DENSITY	DIVERSITY	WATER QUALITY
01 - Upper End of Flat Branch	Sensitive Forms	Moderate	Moderate	Fair to Good
	Facultative Forms	High	High	
	Tolerant Forms	Low	Low	
02 - Tributary to Jacobs Run	Sensitive Forms	Moderate	Moderate	Fair to Good
	Facultative Forms	High	High	
	Tolerant Forms	Low	Low	
03 - Rocky Hollow	Sensitive Forms	High	Moderate	Good
	Facultative Forms	High	High	
	Tolerant Forms	Low	Low	
04 - Upper End of Naked Creek	Sensitive Forms	Low	Low	Fair to Poor
	Facultative Forms	High	High	
	Tolerant Forms	Moderate	Moderate	
05 - Tributary to Powell Creek	Sensitive Forms	Moderate	Moderate	Fair to Good
	Facultative Forms	High	High	
	Tolerant Forms	Low	Low	
06 - Tributary to Ivy Creek	Sensitive Forms	Moderate	Moderate	Good
	Facultative Forms	Moderate	Moderate	
	Tolerant Forms	Low	Low	
07 - Naked Creek	Sensitive Forms	High	Moderate	Good
	Facultative Forms	High	High	
	Tolerant Forms	Low	Low	
08 - Powell Creek	Sensitive Forms	Moderate	Moderate	Fair to Good
	Facultative Forms	High	High	
	Tolerant Forms	Low	Moderate	
09 - Redbud Creek	Sensitive Forms	High	High	Good
	Facultative Forms	High	High	
	Tolerant Forms	Low	Low	
10 - Jacobs Run	Sensitive Forms	Moderate	Moderate	Fair
	Facultative Forms	High	High	
	Tolerant Forms	Moderate	High	

FROM: Shelor, M.H. and R.W. Ayers. 1984.
Procedure for Conducting Qualitative Biological Surveys.
Virginia State Water Control Board Bureau Survey and Field Studies,
Div. Ecol. Studies. Unpublished Draft, May, 1984.

TABLE 3.20
Field Water Quality Measurements at Macrobenthic Sampling Stations

STATION	DATE	pH (Standard Units)	D.O. (mg/L)	SPECIFIC CONDUCTANCE (umhos @ 25°C)
01 - Upper End of Flat Branch	18 July 1989	6.3 @ 26.6°C	8.5 @ 19.5°C	116
02 - Tributary to Jacobs Run	18 July 1989	6.3 @ 21.2°C	9.4 @ 17.0°C	55
03 - Rocky Hollow	18 July 1989	7.3 @ 22.3°C	9.0 @ 20.0°C	72
04 - Upper End of Naked Creek	18 July 1989	6.4 @ 21.5°C	7.3 @ 24.0°C	135
05 - Tributary to Powell Creek	18 July 1989	7.4 @ 23.0°C	8.5 @ 20.5°C	56
06 - Tributary to Ivy Creek	18 July 1989	6.1 @ 22.1°C	8.9 @ 18.0°C	149
07 - Naked Creek	18 July 1989	7.5 @ 25.7°C	8.3 @ 22.5°C	54
08 - Powell Creek	18 July 1989	7.2 @ 23.7°C	8.7 @ 22.5°C	62
09 - Redbud Creek	18 July 1989	7.2 @ 23.5°C	8.7 @ 22.0°C	74
10 - Jacobs Run	18 July 1989	6.5 @ 27.7°C	8.1 @ 24.0°C	31

3.1.5 Reservoir Conditions

Sampling locations on the South Fork Rivanna River Reservoir are shown in Figure 3.4, with analytical results of the water quality sampling shown in appendix B, tables B.1 through B.9. As with the 1977 Betz study, these results indicate that the reservoir is in a eutrophic state. Dissolved oxygen levels became depleted below the surface during the summer months, indicating a high degree of organic decomposition, probably from algae in the bottom waters of the reservoir. Anaerobic conditions at the bottom of the reservoir can release nutrients from the bottom sediments, yet this was not indicated from measures of phosphorus and nitrogen compounds as shown in the Betz study.

Overall, levels of nutrients were considerably lower in 1988 than in 1977, indicating some success with the reservoir management plan. Total phosphorus and total orthophosphate were considerably lower than in 1977, with no apparent seasonal or depth fluctuations. Nitrogen compounds were also lower in 1988. Ammonia did show a slight increase in late summer, a probable result of nitrates being reduced to ammonia under anaerobic conditions. However, ammonia did not reach the high levels encountered in 1977. Since it was the goal after the Betz study to reduce nutrient loading into the reservoir, the actions enacted by the Rivanna Water and Sewer Authority since 1977 appear to have been successful.

Levels of total suspended solids in the reservoir tended to be higher during this study than in 1977. The highest levels found at Station 1 near the dam were at the bottom of the reservoir, while the upriver station above Naked Creek had the highest levels near the surface. Levels of total suspended solids were directly related to the transparency of the water as measured by the visibility of the secchi disc (Table 3.21). Overall, the upper end of the reservoir had the lowest transparency readings and the highest levels of suspended solids throughout the year. Very thick layers of soft silt on the upper end of the reservoir confirm the higher siltation rates at this end. The high levels of suspended solids observed during this study confirm the higher rate of reservoir sedimentation noted by Glaspey (1981) than indicated during the Betz study.

Measures of alkalinity and hardness were also made during this study. Unlike the Betz study, where alkalinity was observed to increase during the late summer months, this study showed a reduction in alkalinity late in the summer. This reduction in alkalinity during late summer is a common trend where algae blooms increase the uptake of CO_2 from the water. Hardness in the reservoir was very low, ranging from 15 to 31 mg/L, indicating the reservoir has soft water. The pH of the reservoir rose slightly during the summer months along with hardness, changing the water from slightly acidic in the winter, to slightly alkaline during the summer.

Samples were also analyzed for lead, zinc, iron, and manganese at all stations. Levels of zinc ranged from 0.01 to 0.22 mg/L, lower than observed during the Betz study, and well below the drinking water standards of 5.0

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

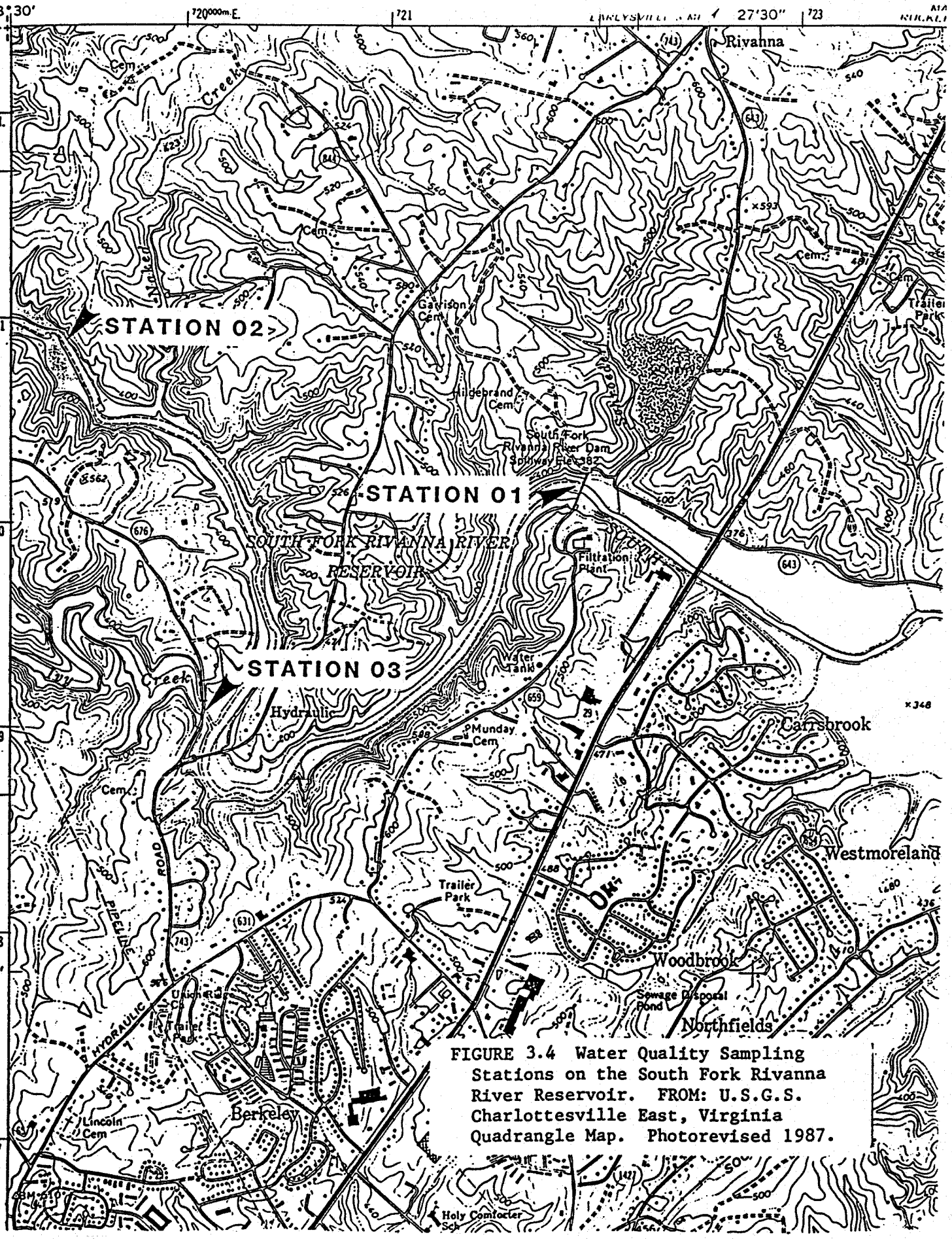


FIGURE 3.4 Water Quality Sampling Stations on the South Fork Rivanna River Reservoir. FROM: U.S.G.S. Charlottesville East, Virginia Quadrangle Map. Photorevised 1987.

TABLE 3.21
Secchi Disc Visibility at 3 Stations on the South Fork Rivanna River Reservoir (meters).

	Station 1 at Dam	Station 2 Upper Reservoir	Station 3 Ivy Creek Bridge
31 March, 1988	0.23	0.46	0.50
19 April, 1988	1.09	0.81	1.09
27 May, 1988	1.01	0.48	0.78
24 June, 1988	1.32	1.53	1.38
20 July, 1988	0.87	0.69	0.80
25 August, 1988	0.95	0.88	1.12
23 September, 1988	1.17	0.89	0.86
24 October, 1988	0.77	0.82	0.82
17 November, 1988	1.99	1.28	1.66
19 December, 1988	1.32	--	1.30
11 January, 1989	1.08	1.58	1.42

mg/L. Lead was observed at levels ranging from below detection limits to 0.20 mg/L, higher levels than observed by the Betz study, and often above the drinking water regulations of 0.05 mg/L. Levels of iron were highly variable, ranging from 0.16 to 7.6 mg/L. The highest levels were observed in the near-bottom samples at all three stations. Manganese levels ranged from 0.01 to 1.26 mg/L, with the highest levels also found at the bottom of the reservoir. Both iron and manganese were frequently above the drinking water standards of 0.30 and 0.05 mg/L respectively. Neither metal is a health concern for humans, and the standards are established for aesthetic and economical purposes. Both metals can affect the taste of drinking water and the use of water for industrial purposes.

Results from this study confirm many conclusions from the Betz (1977) study. Overall, the reservoir is eutrophic and homogeneous, without distinct stratified layers or undergoing turnover as is often found in larger lakes. Nutrient loading has been significantly reduced since the 1977 report. Sediment loading to the reservoir still remains a problem, potentially reducing the initial projections of the useful life of the reservoir by as many as 30 years as determined by Glaspey (1981). The results of a bathymetric survey conducted on the reservoir in October, 1988 also confirm the higher siltation rate noted by Glaspey (1981). Bathymetric results are summarized in Appendix C.

3.1.6 Stream Crossings by Alternative

Using 1:24,000 U.S.G.S. topographic maps, drainage patterns along proposed alignments were determined, and all sites were examined to determine stream impacts in the study area. In this manner, many unmarked streams were encountered, many of which were intermittent, and some of which may have been perennial. Since the perennial nature of many streams could not be determined, intermittent streams were not considered separately in stream order classification. A total of 131 stream crossings were examined along all corridors. Of these, 89 were considered first order streams, 18 second order, 16 third order, 2 fourth order, and 6 greater than fourth order. A summary of all sites examined is listed in Table 3.22, with locations shown in Figures 3.5 through 3.8.

The vegetation community at each site was also characterized as part of the wetlands delineation portion of this study. The list of common plant species identified along these riparian areas is shown in Table 3.23. Table 3.24 lists crossings by stream order along each study alignment, including the two crossover options 11N/12S and 12N/11S. Alignments 8 & 9, the expressway concepts, have few impacts on streams due to the disturbed nature of this portion of Route 29. Stream summaries along each alignment are discussed below.

3.1.6.1 Alignment 6

Alignment 6 crosses a total of 27 streams and rivers, 21 of which (78%) are smaller first-order streams. The one second-order stream crossed is at the

TABLE 3.22
STREAM CROSSINGS ALONG ALIGNMENTS

STATION	DESCRIPTION	AVERAGE WIDTH	STREAM ORDER	ALIGNMENT(S)
01	Upper end of Flat Branch North of Laurel Hill Church	5'	1	6, 6B, 7
02	Upper end of Flat Branch South of Station 01 above Small Pond	3'	1	6, 6B, 7
03	Tributary to Pond by Holly Memorial Gardens	2'	1	6, 6B, 7
04-A	Upper end of Powell Creek North of Hollymead Lake	5'	1	6, 6B, 7
04-B	Side Tributary to Powell Creek at Station 04-A	3'	1	6, 6B, 7
05	Powell Creek below Hollymead Lake	6'	2	6, 6B, 7
06	Powell Creek West of Proffit	12'	3	6, 6B, 7
07	Tributary to Powell Creek along Railroad	4'	1	6B
08	Tributary to Powell Creek	2'	1	6B
09	Tributary to North Fork Rivanna River	1'	1	6B
10	North Fork Rivanna River	70'	>4	6B
11	Tributary to Redbud Creek	4'	1	6B
12	Tributary to Redbud Creek	2'	1	6B
13	Redbud Creek	9'	3	6B
14	Tributary to the Rivanna River North of Route 20	6'	1	6B
15	Tributary to the Rivanna River North of Route 20	3'	1	6B
16	Pond and Creek Upstream of Station 15 South of Route 20	3'	1	6B

TABLE 3.22
STREAM CROSSINGS ALONG ALIGNMENTS
(continued)

STATION	DESCRIPTION	AVERAGE WIDTH	STREAM ORDER	ALIGNMENT(S)
17	Creek Upstream of Pond at Station 16	3'	1	6B
18	Tributary to Rocky Hollow	3'	1	6B
19	Rocky Hollow	3'	1	6B
20	Tributary to the Rivanna River	5'	1	6B
21	Tributary to the Rivanna River North of Route 250	4'	1	6B
22	Powell Creek North of Route 643	12'	3	6,7
23	Powell Creek South of Route 643	15'	3	6,7
24	South Fork Rivanna River at Westmoreland	70'	>4	6,7
25	Tributary to the South Fork Rivanna River by Westmoreland	1.5'	1	6,7
26	Tributary to the South Fork Rivanna River by Westmoreland	5'	1	6,7
27	Town Branch below Griffin Cemetary	6'	1	6,7
28	Tributary to Town Branch	2'	1	6,7
29	Tributary to the Rivanna River	2'	1	6
30	Tributary to the Rivanna River	2'	1	6
31	Tributary to the Rivanna River	3'	1	6
32	Tributary to the Rivanna River below Pond	4'	1	6
33	Tributary to the Rivanna River	3'	1	6
34	Tributary to the Rivanna River on Pen Park Golf Course	3'	1	6

TABLE 3.22
STREAM CROSSINGS ALONG ALIGNMENTS
(continued)

STATION	DESCRIPTION	AVERAGE WIDTH	STREAM ORDER	ALIGNMENT(S)
35	Tributary to the Rivanna River on Pen Park Golf Course below Station 34	3'	1	6
36	Tributary to the Rivanna River on Pen Park Golf Course below Station 35	3'	1	6
37	Rivanna River	70'	>4	6
38-A	Meadow Creek by Railroad	30'	3	7
38-B	Tributary to Meadow Creek at Station 38-A	3'	1	7
39-A	Tributary to Meadow Creek	20'	1	7
39-B	Tributary to Meadow Creek	4'	1	7
40	Meadow Creek	20'	3	7
41	Shenks Brook near Radio Tower	25'	3	7
42	Shenks Brook Upstream of Station 41	25'	2	7
43	Shenks Brook at Route 250	10'	2	7
44	Tributary to South Fork Rivanna River Reservoir	2'	1	10
45	Tributary to South Fork Rivanna River Reservoir	2'	1	10
46	Tributary to South Fork Rivanna River Reservoir below Pond	3'	1	10
47	Tributary to South Fork Rivanna River Reservoir	2'	1	10
48	Tributary to Ivy Creek	5'	1	10
49	Tributary to Ivy Creek	4'	1	10

TABLE 3.22
STREAM CROSSINGS ALONG ALIGNMENTS
(continued)

STATION	DESCRIPTION	AVERAGE WIDTH	STREAM ORDER	ALIGNMENT(S)
50	Tributary to Ivy Creek	6'	2	10
51	Tributary to Ivy Creek	4'	2	10, 11, 12
52	Tributary to Ivy Creek	4'	1	10, 11, 12
53	Tributary to Ivy Creek	2'	1	10, 11, 12
54	Tributary to Morey Creek	2'	1	10, 11, 12
55	Tributary to Morey Creek	3'	1	10, 11, 12
56	Tributary to Morey Creek	3'	1	10, 11, 12
57	Tributary to Powell Creek along Route 29	1'	1	11
58	Tributary to Powell Creek along Route 29	3'	1	11
59	Pond and Tributary to Powell Creek along Route 29	NA	1	11
60	Tributary to Powell Creek along Route 29	10'	2	11
61	Tributary to Powell Creek Upstream of Station 60	5'	2	11
62	Tributary to Powell Creek Upstream of Station 60	3'	1	11
63	Tributary to Naked Creek	2'	1	11
64	Naked Creek	6'	3	11
65	Tributary to Naked Creek	4'	1	11
66	Naked Creek	15'	3	11
67	Tributary to Naked Creek	3'	1	11

TABLE 3.22
STREAM CROSSINGS ALONG ALIGNMENTS
(continued)

STATION	DESCRIPTION	AVERAGE WIDTH	STREAM ORDER	ALIGNMENT(S)
68	Tributary to Naked Creek	2'	1	11
69	Tributary to Naked Creek	5'	1	11
70	Naked Creek North of South Fork Rivanna River Reservoir	18'	3	11
71	South Fork Rivanna River Reservoir	540'	>4	11
72	Tributary to South Fork Rivanna River Reservoir	3'	1	11
73-A	Jumping Branch	10'	3	11
73-B	Tributary to Jumping Branch	1.5'	1	11
74	Tributary to Ivy Creek	3'	1	11
75	Pond along Tributary to Ivy Creek	NA	1	11
76	Pond along Tributary to Ivy Creek	NA	1	11
77	Ivy Creek	30'	4	11
78	North Fork Rivanna River along Route 29	120'	>4	12
79	Tributary to Flat Branch along Route 29	10'	2	12
80	Tributary to Flat Branch along Route 29	1.5'	1	6, 6B, 7
81	Pond and Tributary to Flat Branch along Route 29	2'	1	6, 6B, 7
82	Tributary to Flat Branch along Route 29	1.5'	1	6, 6B, 7
83	Pond on Tributary to Flat Branch along Route 29	NA	1	6, 6B, 7

TABLE 3.22
STREAM CROSSINGS ALONG ALIGNMENTS
(continued)

STATION	DESCRIPTION	AVERAGE WIDTH	STREAM ORDER	ALIGNMENT(S)
84	Tributary to Flat Branch Upstream of Station 79	7'	2	12
85	Tributary to North Fork Rivanna River	1'	1	12
86-A	Tributary to Jacobs Run	3'	1	12
86-B	Tributary to Jacobs Run	2'	1	12
87	Tributary to Jacobs Run	15'	2	12
88	Tributary to Jacobs Run	10'	2	12
89-A	Tributary to Jacobs Run	10'	2	12
89-B	Tributary to Jacobs Run	1'	1	12
90	Tributary to Jacobs Run	2'	1	12
91	Tributary to Jacobs Run	2'	1	12
92	Tributary to Jacobs Run	4'	1	12
93	Tributary to Jacobs Run	4'	1	12
94	Tributary to Jacobs Run	5'	1	12
95	Upper end of Naked Creek	8'	1	12
96	Tributary to Naked Creek	6'	2	12
97-A	Naked Creek	6'	3	12
97-B	Tributary to Naked Creek	2'	1	12
98	Tributary to Naked Creek	4'	2	12
99	Tributary to Naked Creek Upstream of Station 65	2'	1	12

TABLE 3.22
STREAM CROSSINGS ALONG ALIGNMENTS
(continued)

STATION	DESCRIPTION	AVERAGE WIDTH	STREAM ORDER	ALIGNMENT(S)
100	Tributary to South Fork Rivanna River Reservoir	10'	2	12
101	South Fork Rivanna River Reservoir	230'	>4	12
102	Tributary to South Fork Rivanna River Reservoir	3'	1	12
103	Tributary to South Fork Rivanna River Reservoir	3'	1	12
104	Tributary to Jumping Branch	4'	1	12
105	Tributary to Jumping Branch	4'	1	12
106	Jumping Branch	5'	2	12
107	Tributary to Jumping Branch	3'	1	12
108	Tributary to Ivy Creek	3'	1	12
109	Tributary to Ivy Creek Downstream of Station 108	3'	1	12
110	Tributary to Ivy Creek Downstream of Staion 109	6'	3	12
111	Tributary to Ivy Creek	2'	1	12
112	Tributary to Ivy Creek Downstream of Station 110	5'	3	12
113	Ivy Creek	20'	4	12
114	Tributary to Jumping Branch	4'	1	E-W Connector
115	Tributary to Jumping Branch	1.5'	1	E-W Connector
116	Tributary to Jumping Branch	3'	1	E-W Connector

TABLE 3.22
STREAM CROSSINGS ALONG ALIGNMENTS
(continued)

STATION	DESCRIPTION	AVERAGE WIDTH	STREAM ORDER	ALIGNMENT(S)
117-A	Jumping Branch	8'	3	E-W Connector
117-B	Tributary to Jumping Branch	1'	1	E-W Connector
118	Jumping Branch Upstream of Station 117-A	8'	1	E-W Connector
119	Jumping Branch Downstream of Station 117-A	10'	3	N-S Connector
120	Tributary to South Fork Rivanna River along Route 29	2'	1	8,9
121	Tributary to Meadow Creek along Route 29	5'	2	8,9
122	Tributary to Meadow Creek along Route 29	6'	1	8,9
123	Tributary to Meadow Creek along Route 29	3'	1	8,9

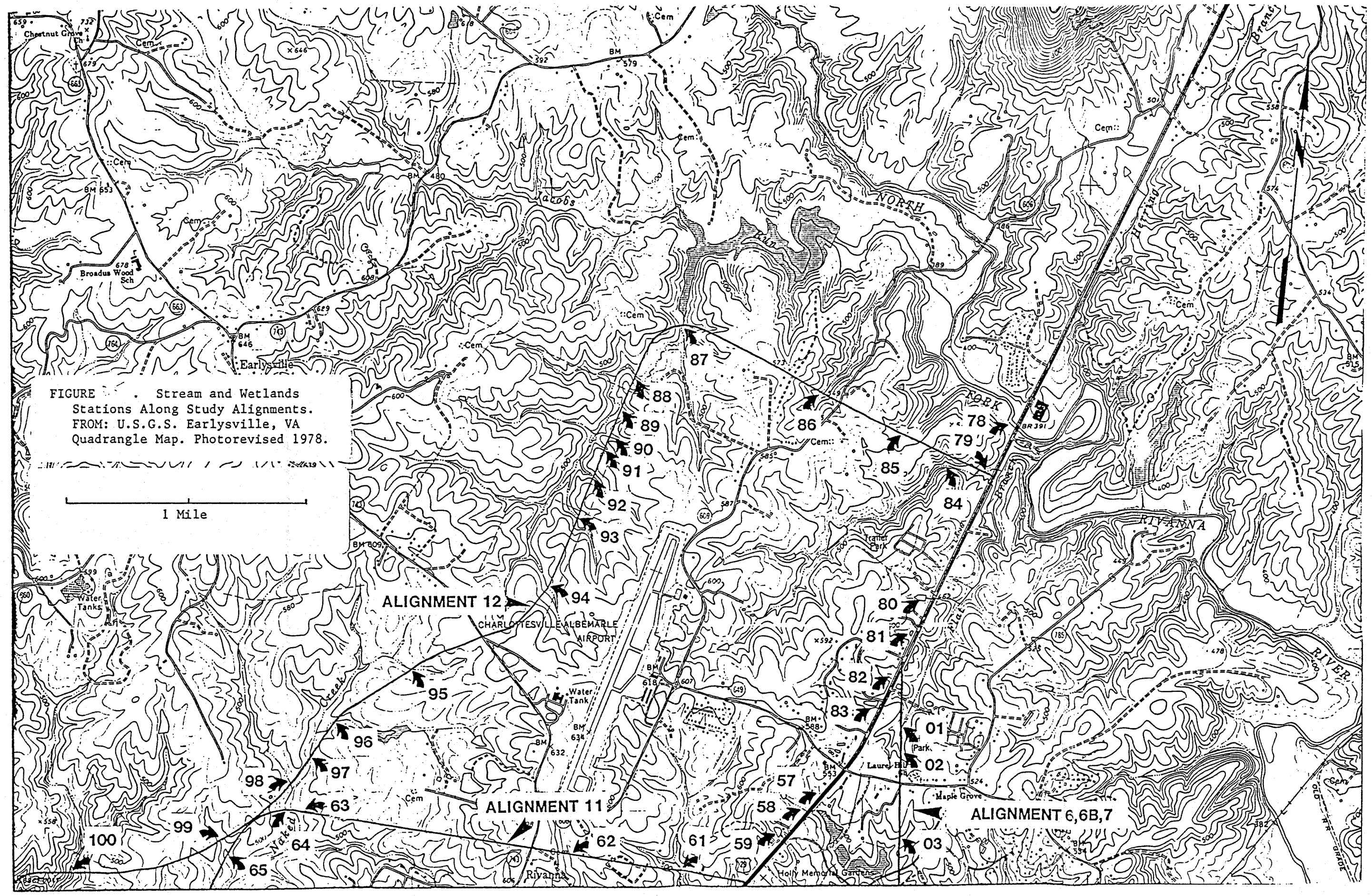


FIGURE . Stream and Wetlands Stations Along Study Alignments. FROM: U.S.G.S. Earlysville, VA Quadrangle Map. Photorevised 1978.

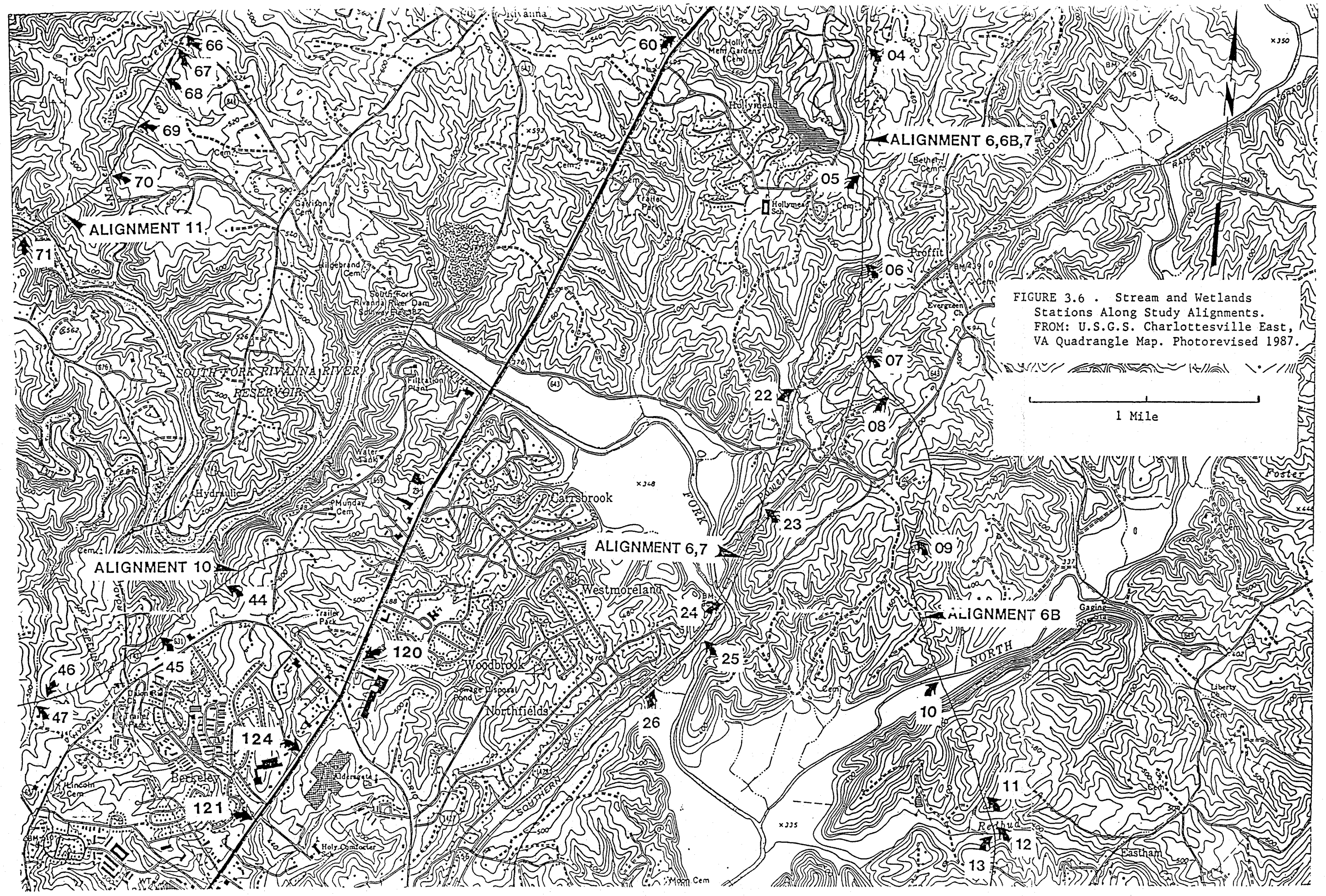


FIGURE 3.6 . Stream and Wetlands Stations Along Study Alignments. FROM: U.S.G.S. Charlottesville East, VA Quadrangle Map. Photorevised 1987.

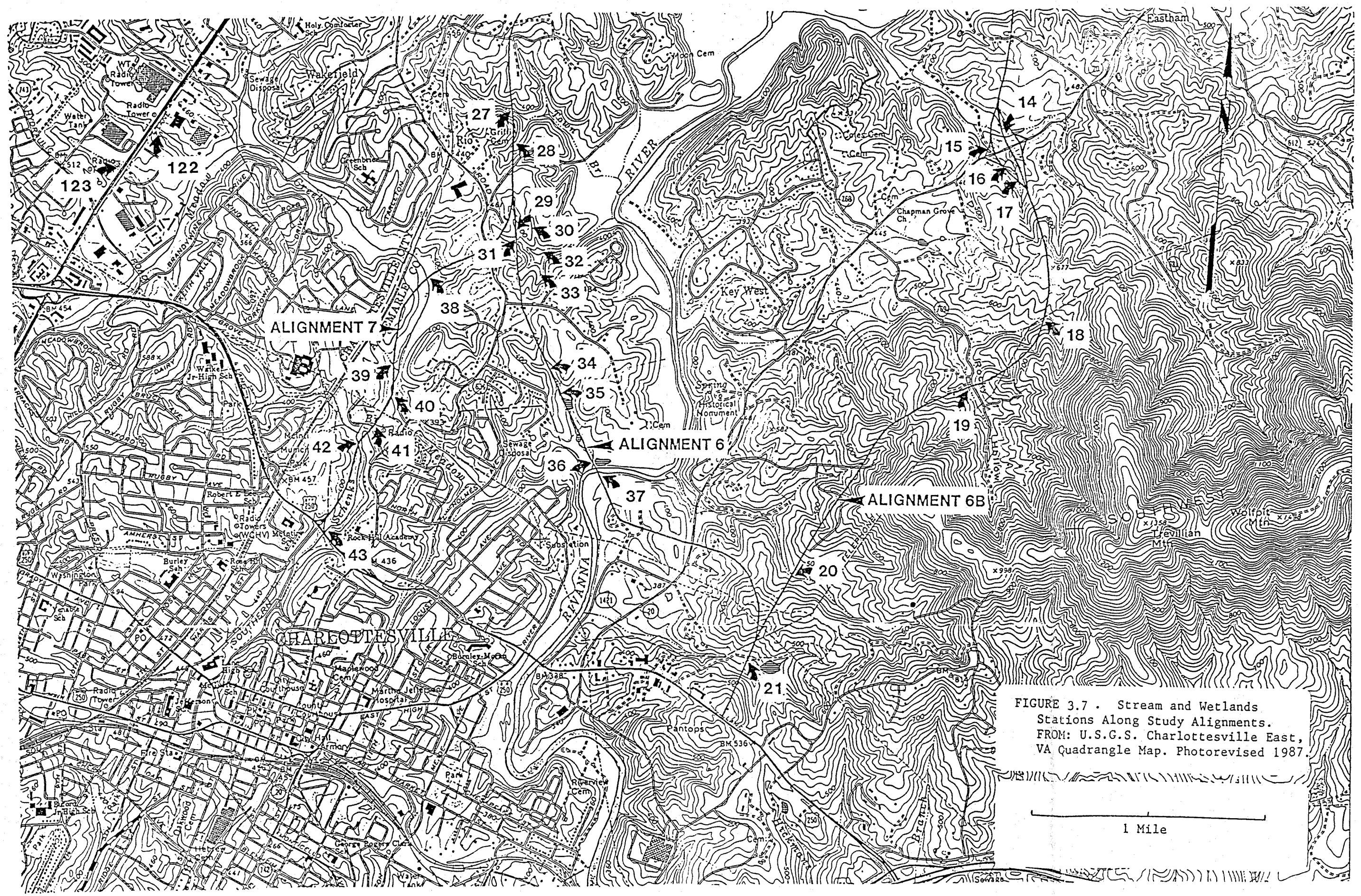
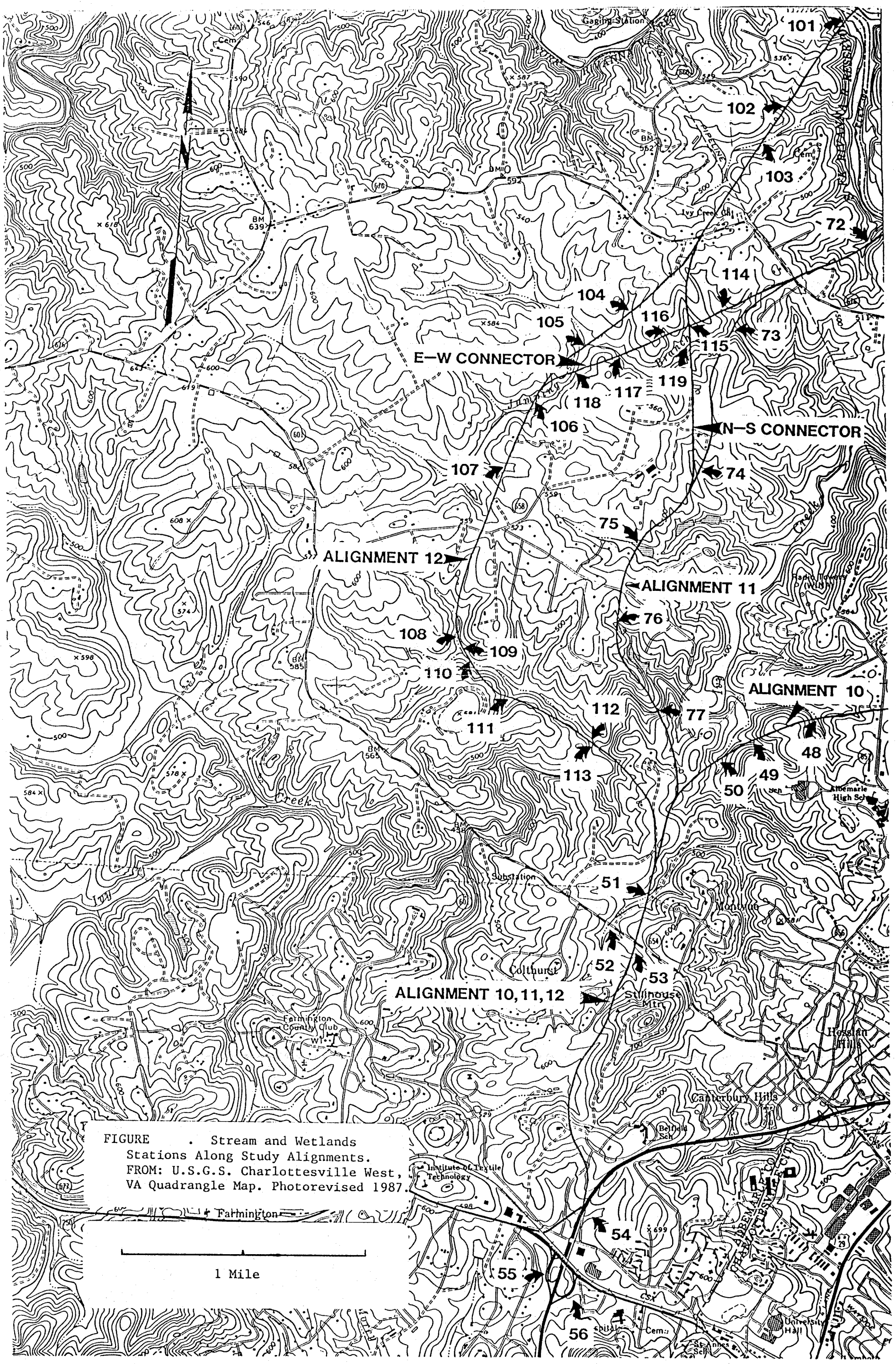


FIGURE 3.7 . Stream and Wetlands Stations Along Study Alignments. FROM: U.S.G.S. Charlottesville East, VA Quadrangle Map. Photorevised 1987.



101
102
103
72
114
104
116
105
73
115
E—W CONNECTOR
119
118
117
106
N—S CONNECTOR
107
74
75
ALIGNMENT 12
ALIGNMENT 11
76
108
109
110
ALIGNMENT 10
111
112
77
48
49
113
50
51
52
53
ALIGNMENT 10,11,12
54
55
56
1 Mile
Gaging Station
Ivy Creek Ch
Radio Towers (WINA)
Albemarle High Sch
Substation
Montvue
Colthurst
Stillhouse Mtn
Farmington County Club
Hessian Hills
Canterbury Hills
Belfield Sch
Institute of Textile Technology
Farmington
University Hall
Cem
Creek

FIGURE . Stream and Wetlands Stations Along Study Alignments. FROM: U.S.G.S. Charlottesville West, VA Quadrangle Map. Photorevised 1987.

TABLE

HYDROGEOLOGIC UNITS AND THEIR GEOLOGIC AND WATER-BEARING CHARACTERISTICS

Hydrogeologic Unit and Individual Formations	Symbol	Age	Estimated Years Since Present	Lithology	Well and Ground Water Statistics+									Water-Bearing Properties
						Well Depth*	Well Yield**	Total Dissolved Solids	Ca, Mg Hardness	Iron	Manganese	Sulfate	pH	
Cataclastic and Metasedimentary Rocks					maximum	1,100 (335)	137 (8.6)	143	121	1.60	0.14	12.8	8.0	Low to moderate yields generally encountered. High yields have been obtained in Crozet area. Water generally of very high quality and is especially low in dissolved mineral matter.
					minimum	90 (27)	1 (0.06)	40	4	0.00	0.00	1.0	5.8	
Mechum River cataclastics	CpCm cgs	Precambrian(?) altered from Precambrian rocks during Paleozoic Era	Possibly older than 600 million 280 million to 600 million	mylonite, protomylonite, mylonite gneiss, conglomerate	average	270 (82)	18 (1.1)	83	33	0.17	0.01	4.1	6.5	
					samples	61	55	27	27	29	29	31	33	
Metasedimentary and Sedimentary Rocks					maximum	845 (258)	125 (7.9)	288	167	11.00	1.50	54.0	8.3	Low to moderate yields. Several high-yield wells have been developed in Matthews Chapel area. Area north of South Fork Rivanna River appears to offer low potential; water there seldom encountered below 200 ft. (61 m). Water tends to be moderately hard. Local iron problems have been noted.
					minimum	30 (9)	1 (0.06)	13	2	0.00	0.00	0.0	5.1	
Newark	TRn	Triassic	181 million to 230 million	phyllite, sandstone, slate, gneiss, metamorphosed sandstone, minor conglomerate and limestone beds	average	246 (75)	17 (1.1)	103	53	0.68	0.81	5.6	6.7	
Everona Harpers Weverton Loudoun	Cev Ch Cw Cl	Cambrian	500 million to 600 million		samples	136	120	43	52	53	53	52	55	
Charlottesville Johnson Mill Lynchburg	pCch pCjm pCly g	Precambrian	older than 600 million											
Metavolcanic Rocks					maximum	647 (197)	150 (9.5)	290	225	0.60	2.20	129.6	7.7	Offer highest potential in Albemarle County. Over one-third of all wells produce in excess of 20 gpm (1.3 l/s). All wells yielding 50 gpm (3.2 l/s) or better are located in the eastern belt. Belt along eastern slope of Blue Ridge consistently produces less than 10 gpm (0.6 l/s). Water more highly mineralized than that found in other areas of county; hard water fairly common.
					minimum	83 (25)	1 (0.06)	58	23	0.00	0.00	2.0	6.2	
Catoctin	CpCc	Precambrian(?)	Possibly older than 600 million	metamorphosed basalt lava flows (principally composed of greenstone), phyllite, some metasandstone	average	297 (91)	19 (1.2)	161	112	0.19	0.35	5.6	7.0	
					samples	68	63	19	21	22	20	23	24	
Igneous and Metasedimentary Rocks					maximum	834 (254)	165 (10.4)	260	177	13.00	1.00	25.0	8.2	Low to moderate yields generally available. Southwest portion of central belt offers poor development potential. Several high-yield wells have been developed in remote locations. Water generally of reasonable quality. Iron concentrations consistently below 0.3 mg/l along base of Blue Ridge.
					minimum	60 (18)	1 (0.06)	28	4	0.00	0.00	0.1	3.7	
Swift Run	CpCs	Precambrian(?)	Possibly older than 600 million	granitic gneiss, granodiorite, some quartzite and conglomerate	average	253 (77)	15 (0.9)	101	49	0.97	0.10	4.7	6.8	
Rockfish Pedlar Lovingston	pCr pCp pClgr	Precambrian	older than 600 million		samples	217	240	84	89	91	87	84	93	

+All quality values in milligrams per litre except pH (no units)
*Top units feet, bottom units metres
**Top units gallons per minute, bottom units litres per second
Source: Geology compiled from various publications of the Virginia Division of Mineral Resources, geohydrology from Virginia State Water Control Board - VRO

TABLE 3.23
VASCULAR PLANT SPECIES IDENTIFIED ALONG RIPARIAN AND WETLAND SITES IN THE STUDY AREA - ALBEMARLE COUNTY

TREES

Scientific Name	Common Name	Indicator[1]
Acer negundo	Box elder	FAC
Acer rubrum	Red maple	FAC
Acer saccharinum	Silver maple	FACW
Amelanchier arborea	Serviceberry	FAC
Carpinus caroliniana	Ironwood	FAC
Carya cordiformis	Bitternut hickory	FACU
Cercis canadensis	Redbud	FACU
Fagus grandifolia	Beech	FACU
Juglans nigra	Black walnut	FACU
Juniperus virginiana	Eastern red cedar	FACU
Liquidamber styraciflua	Sweetgum	FAC
Liriodendron tulipifera	Tulip poplar	FACU
Pinus strobus	Eastern white pine	FACU
Pinus taeda	Loblolly pine	FAC
Pinus virginiana	Scrub pine	--
Platanus occidentalis	Sycamore	FACW
Prunus virginiana	Choke cherry	FACU
Quercus alba	White oak	FACU
Quercus palustris	Pin oak	FACW
Quercus prinus	Chestnut oak	[illegible]
Quercus rubra	Red oak	FACU
Salix nigra	Black willow	FACW

SAPLINGS AND SHRUBS

Acer negundo	Box elder	FAC
Acer rubrum	Red maple	FAC
Acer saccharinum	Silver maple	FACW
Alnus serrulata	Smooth alder	OBL
Carpinus caroliniana	Ironwood	FAC
Cercis canadensis	Redbud	FACU
Cornus alternifolia	Alternate-leaf dogwood	--
Cornus florida	Flowering dogwood	FACU
Fagus grandifolia	Beech	FACU
Gleditsia triacanthos	Honey locust	FAC
Hamamelis virginiana	Common witch-hazel	FAC
Ilex opaca	American holly	FACU
Juniperus virginiana	Eastern red cedar	FACU
Kalmia latifolia	Mountain laurel	FACU

TABLE 3.23
VASCULAR PLANT SPECIES IDENTIFIED ALONG RIPARIAN AND WETLAND SITES IN THE STUDY AREA - ALBEMARLE COUNTY
(continued)

SAPLINGS AND SHRUBS
(continued)

Scientific Name	Common Name	Indicator[1]
Liquidamber styraciflua	Sweetgum	FAC
Liriodendron tulipifera	Tulip poplar	FACU
Pinus virginiana	Scrub pine	--
Platanus occidentalis	Sycamore	FACW
Prunus virginiana	Choke cherry	FACU
Quercus palustris	Pin oak	FACW
Quercus prinus	Chestnut oak	UPL
Rhododendron periclymenoides	Pink azalea	FAC
Rhus glabra	Smooth sumac	--
Rosa multiflora	Multiflora rose	FACU
Rosa palustris	Swamp rose	OBL
Salix nigra	Black willow	FACW
Sasafrass albidum	Sasafrass	FACU
Tsuga canadensis	Eastern hemlock	FACU
Vaccinium corymbosum	Highbush blueberry	FACW
Vaccinium vacillans	Low blueberry	--

HERBS

Achillea millefolium	Yarrow	FACU
Alliaria officinalis	Garlic mustard	--
Allium canadense	Wild garlic	FACU
Allium vineale	Field garlic	FACU
Anemonella thalictroides	Rue anemone	--
Asarum canadense	Wild ginger	--
Athyrium felix-femina	Lady fern	FAC
Barbarea verna	Early wintercress	--
Botrichium virginianum	Rattlesnake fern	FACU
Carex sp.	Sedge	--
Claytonia virginica	Spring beauty	FACU
Corydalis flavula	Yellow corydalis	FACU
Daucus carota	Queen anne's lace	--
Dentaria laciniata	Cut-leaved toothwort	-
Dicentra cucullaria	Dutchman's breeches	--
Duchesnea indica	Indian stawberry	FACU
Equisetum hyemale	Scouring rush	FACW
Galium aparine	Cleavers	FACU
Galium pilosum	Hairy bedstraw	--
Galium tinctorium	Clayton's bedstraw	OBL
Geranium maculatum	Wild geranium	FACU
Glechoma hederacea	Ground ivy	FACU

TABLE 3.23
VASCULAR PLANT SPECIES IDENTIFIED ALONG RIPARIAN AND WETLAND SITES IN THE STUDY AREA - ALBEMARLE COUNTY
(continued)

HERBS
(continued)

Scientific Name	Common Name	Indicator[1]
Hemerocallis fulva	Day-lily	--
Impatiens capensis	Spotted touch-me-not	FACW
Juncus acuminatus	Rush	OBL
Juncus tenuis	Rush	FAC-
Lamium purpureum	Purple deadnettle	--
Lycopodium obscurum	Ground pine	FACU
Mitchella repens	Partridgeberry	FACU
Onoclea sensibilis	Sensitive fern	FACW
Oxalis violacea	Violet wood sorrel	--
Phlox divaricata	Blue phlox	FACU
Phytolacca americana	Pokeweed	FACU
Podophyllum peltatum	May-apple	FACU
Polygonum punctatum	Water smartweed	OBL
Polystichum aerostichoides	Christmas fern	FACU
Potentilla canadensis	Dwarf cinquefoil	--
Ranunculus bulbosus	Bulbous buttercup	UPL
Sanguinaria canadensis	Bloodroot	--
Smilacina racemosa	Wild spikenard	FACU
Stellaria media	Common chickweed	UPL
Stellaria pubera	Star chickweed	--
Taraxacum officinale	Common dandelion	FACU
Trifolium pratense	Red clover	FACU
Typha latifolia	Common cat-tail	OBL
Viola arvensis	Wild pansy	--
Viola canadensis	Tall white violet	--
Viola papilionacea	Common blue violet	FAC
Viola pedata	Birdfoot violet	UPL

WOODY VINES

Campsis radicans	Trumpet creeper	FAC
Lonicera japonica	Japanese honeysuckle	FAC
Parthenocissus quinquefolia	Virginia creeper	FACU
Rubus argutus	Blackberry	FACU
Smilax rotundifolia	Common greenbriar	FAC
Toxicodendron radicans	Poison ivy	FAC
Vitis aestivalis	Summer grape	FACU

[1] Wetland indicator status as listed in the 1988 Wetland Plant List published in cooperation with USF&WS, US Corps of Engineers, US EPA, and US SCS

TABLE 3.24
STREAM AND RIVER CROSSINGS BY ALIGNMENTS AND STREAM ORDER

	STREAM ORDER					
ALIGNMENT	1	2	3	4	>4	TOTAL
6	21	1	3	0	2	27
6B	22	1	2	0	1	26
7	16	3	6	0	1	26
8,9	3	1	0	0	0	4
10	11	2	0	0	0	13
11	19	3	4	1	1	28
12	25	10	3	1	2	41
11N/12S	23	5	6	1	1	36
12N/11S	22	8	2	1	1	34

upper end of Powell Creek, while the three third-order streams crossed are further downstream on Powell Creek between Hollymead and the confluence with the South Fork Rivanna River. The crossings of the South Fork Rivanna River, and the Rivanna River itself constitute the two systems classified as greater than fourth-order.

3.1.6.2 Alignment 6B

Alignment 6B crosses 26 streams and rivers, with 22 (85%) of these classified as first-order. The one second and two third-order streams crossed are Powell Creek crossing in common with Alignment 6. The crossing of the North Fork Rivanna River (Station 10) is considered to be greater than fourth-order.

3.1.6.3 Alignment 7

Alignment 7 crosses 26 streams and rivers, with 16 (62%) of these classified as first order. One second-order, two third-order, and the one greater than fourth-order streams are sites in common with Alignment 6. On the south end of this Alignment, Meadow Creek is crossed twice (both third-order), and Schenks Brook three times, twice where the stream is second-order, and once third-order near the confluence with Meadow Creek. The six third-order stream crossings constitute 23% of the total crossings on this alignment.

3.1.6.4 Alignment 10

Alignment 10, the shortest of the proposed corridors subsequently crosses the fewest streams of the 8 alignments. A total of 13 streams and rivers are crossed by this alignment, 11 of which (85%) are first order streams. The other two stations (#50 and 51) are second-order tributaries to Ivy Creek.

3.1.6.5 Alignment 11

Alignment 11 crosses a total of 28 streams, with 19 (68%) of these classified as first-order. Three crossings impact second-order streams (a tributary to Ivy Creek, Station 51; and a tributary to Powell Creek west of Route 29, Stations 60 and 61). Four crossings are considered third-order streams, three on Naked Creek (Stations 64, 66 and 70) and one on Jumping Branch (Station 73-A). One fourth-order stream (Ivy Creek, Station 77) and one greater than fourth-order site (South Fork Rivanna River Reservoir, Station 71) would also be impacted by this alignment.

3.1.6.6 Alignment 12

As the longest of the proposed corridors, Alignment 12 also crosses the greatest number of streams. Of the 41 crossings, 23 (61%) are over first-order streams. Ten other crossings (24%) are over second-order streams. Of the three third-order streams crossed, one is on Naked Creek (Station 97-A), and two are on a tributary to Ivy Creek (Stations 110 and 112). Ivy Creek (Station

113) is the one fourth-order stream crossed, while two sites greater than fourth-order would be impacted by development of this Alignment (North Fork Rivanna River by Route 29, Station 78; and the South Fork Rivanna River Reservoir, Station 101).

3.1.6.7 Alignment 11N/12S

The East-West connector that combines the north portion of Alignment 11 with the southern portion Alignment 12 crosses five first-order streams and one third-order stream (Jumping Branch, Station 117-A). This crossover variation crosses a total of 36 streams, 23 of which (64%) are first-order streams. Five second-order streams are crossed (14%), six third-order streams (17%), one fourth-order stream (Ivy Creek), and one site greater than fourth-order (South Fork Rivanna River Reservoir).

3.1.6.8 Alignment 12N/11S

The North-South connector that combines the north portion of Alignment 12 with the southern portion of Alignment 12 with the southern portion of Alignment 11 crosses only one first-order stream and one third-order stream, Jumping Branch (Station 119). Though nearly as long as Alignment 12, this option crosses 12% fewer streams. Of 36 crossings, 22 (64%) are over first-order streams, 8 (22%) over second-order streams, two over third-order streams, one over a fourth-order stream (Ivy Creek) and two over greater than fourth-order streams (North Fork Rivanna River and South Fork Rivanna River Reservoir).

3.2 Wetlands

In accordance with Executive Order 11990, "Protection of Wetlands," the proposed build alternates have been evaluated for potential impacts on wetland areas. During field examination of stream crossings by the project alignments, a thorough investigation of wetlands sites impacted by the alignments was conducted. Only twelve wetlands sites were encountered during this survey, mostly small isolated areas along or adjacent to streams where springs saturate the ground. A summary of the wetlands stations is shown in Table 3.25, with station numbers corresponding to the locations illustrated in Figures 3.5 through 3.8. The National Wetlands Inventory (NWI) classification is shown on Table 3.25, with a summary of wetlands impacts for each NWI classification type summarized in Table 3.26. The NWI classification hierarchy is illustrated in Figure 3.9.

Only one site impacted on an area greater than 1/4 acre, Station 37 on the Rivanna River, and this site is shown on 1" = 200' scale mapping in Figure 3.10. This site represented a large sand flat at a bend on the river. The site was sparsely vegetated as a result of frequent flooding. Wetlands data forms for each site are included in Appendix D.

TABLE 3.25
WETLANDS ALONG THE STUDY ALIGNMENTS

STATION	DESCRIPTION	NWI CLASSIFICATION	ACRES IMPACTED	ALIGNMENTS
01	Upper End of Flat Branch North of Laurel Hill Church	PF01E	0.009	6, 6B, 7
02	Upper End of Flat Branch South of Station 01 above Small Pond	PF01E	0.052	6, 6B, 7
05	Pond along Powell Creek below Hollymead Lake	PEM3	0.088	6, 6B, 7
23	Powell Creek South of Route 643	PF01E	0.029	6, 7
37	Rivanna River (sand bar)	R3FL2	1.334	6
56	Tributary to Morey Creek on SW side of Route 29/ Route 250 Interchange	PF01E	0.138	10, 11, 12
60	Tributary to Powell Creek along Route 29	PF01E	0.069	11
81	Pond along Tributary to Flat Branch along Route 29	PEM3	0.086	11
95	Upper end of Naked Creek	PSS1	0.180	12
100	Tributary to South Fork Rivanna River Reservoir	PF01E	0.006	12
108/109	Tributary to Ivy Creek	PF01E POWK PSS1	0.247	12
124	Ponded Area along Route 29	PEM3	0.146	8,9

TABLE 3.26
NATIONAL WETLANDS INVENTORY CLASSIFICATION AND ACREAGE

NWI CLASSIFICATION	CLASSIFICATION LEGEND	STATION/ ALTERNATE	ACRES
PFO1E	Palustrine, Forested, Broad-leaved Deciduous, Seasonal Saturated	01/6, 6B, 7	0.009
		02/6, 6B, 7	0.052
		23/6, 7	0.029
		56/10, 11, 12	0.138
		60/11	0.069
		100/12	0.006
		108/12	0.046
PEM3	Palustrine, Emergent, Narrow-leaved Non-persistent	05/6, 6B, 7	0.088
		81/11	0.086
		124/8,9	0.146
PSS1	Palustrine, Scrub/Shrub, Broad-leaved Deciduous	95/12	0.180
		109/12	0.086
POWK	Palustrine, Open Water, Artificial	109/12	0.115
R3FL2	Riverine, Upper Perennial, Flat, Sand	37/6	1.334

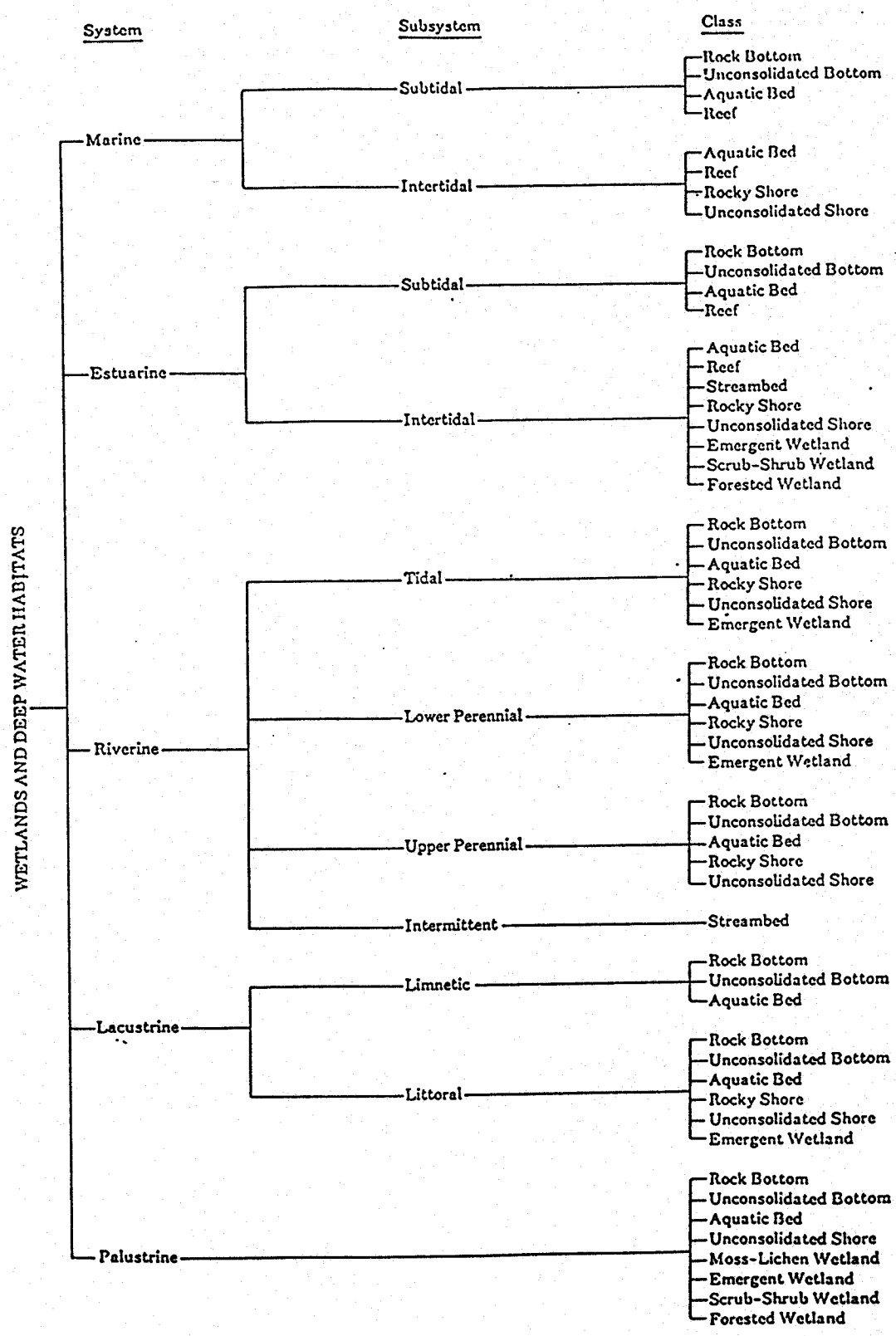


FIGURE 3.9 Classification hierarchy of wetlands and deepwater habitats, showing systems, subsystems, and classes. The Palustrine System does not include deepwater habitats.

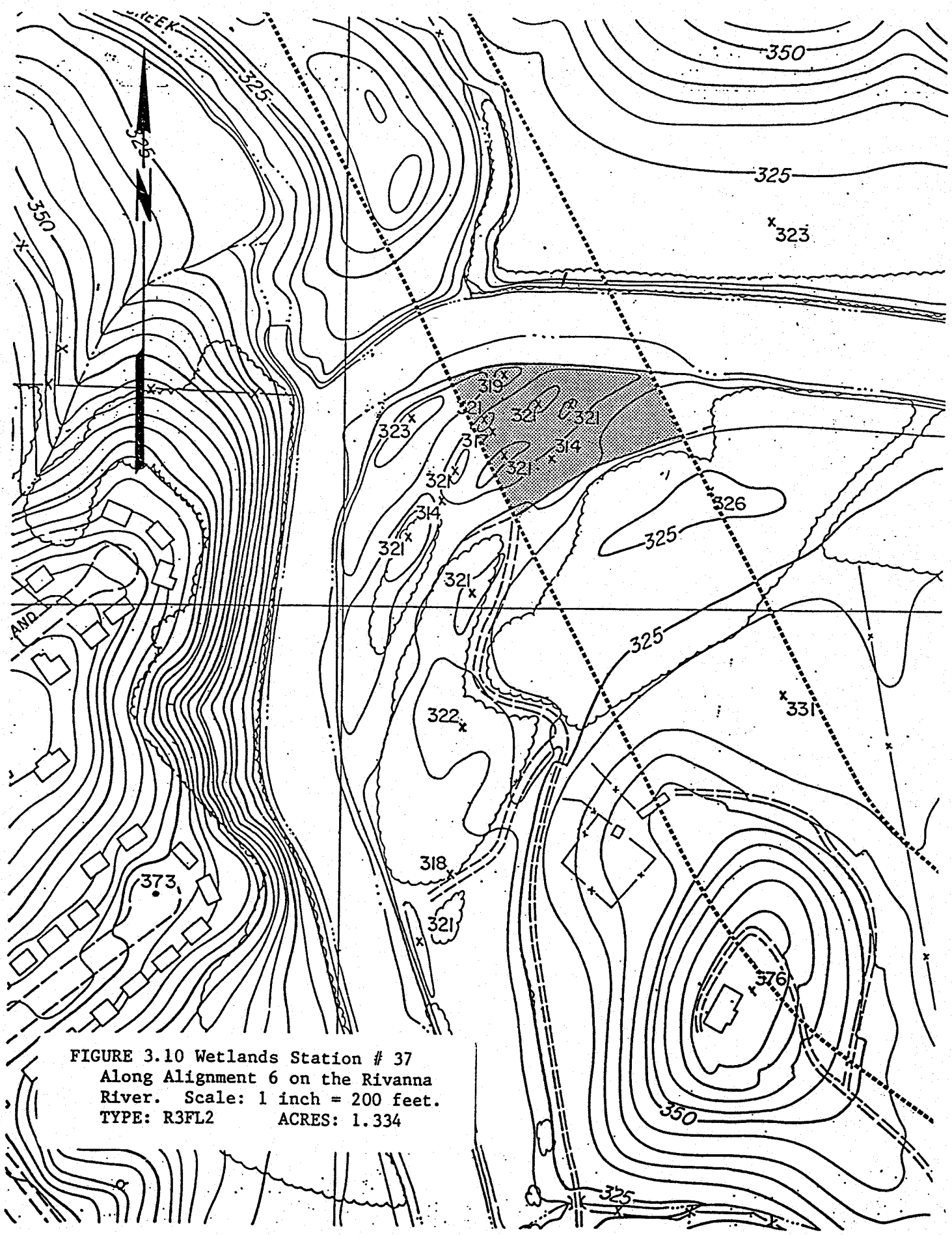


FIGURE 3.10 Wetlands Station # 37
Along Alignment 6 on the Rivanna
River. Scale: 1 inch = 200 feet.
TYPE: R3FL2 ACRES: 1.334

3.2.1 Wetland Values

In addition to delineating and defining wetlands along the alignments, a wetlands functional assessment was made for each wetlands area. The method used is commonly referred to as "WET", the Wetland Evaluation Technique developed by Paul R. Adamus (1987). This method consists of ranking wetlands based on the functional values of various aspects of Hydrology, Wildlife, and Recreational Uses.

Hydrological parameters include the ability of a wetland to recharge or discharge groundwater, function as an area to buffer floodwaters, anchor and trap sediments, and remove and export nutrients. Wildlife values address overall diversity and abundance as well as a wetland's ability to function as breeding, migration, and wintering grounds for sensitive species. The ability to provide habitat for fish and benthic invertebrates is also considered. Finally, a wetlands function to society for it's uniqueness (heritage value) and recreation is considered.

The small, isolated wetlands encountered along the Route 29 Study alignments rated low in terms of social significance (considering special designations, potential economic value, and strategic location) and effectiveness (considering the capability of a wetland to perform a particular function) for all wetland functions addressed by the WET method.

3.3 Ground Water Resources

Precipitation probably is the ultimate source of all the ground water occurring in Albemarle County. The sequence in which water circulates from land to ocean to air and back to land in the solid, liquid and gaseous states is referred to as the hydrologic cycle. Water enters the atmosphere and forms clouds by evaporation from oceans, lakes and rivers, and from plant life by means of evapotranspiration. The water is then returned to the land surface where it once again may evaporate, take the form of runoff to streams, lakes and oceans, or filter down into the soil and rock.

Water occurring in the zone extending from the land surface downward to the point at which all rock and soil pores are filled with water is said to be in the zone of aeration. Water occurring below the zone of aeration is said to be in the zone of saturation, and it is this water that commonly is referred to as ground water. The top surface of the zone of saturation (the dividing point between the zone of saturation and the zone of aeration) is known as the water table.

Ground water is governed by the principles of recharge and discharge. Ground water will flow by gravity from an area of recharge toward a discharge point. Water may be discharged from the ground water reservoir through springs, seepage into streams, evaporation and transpiration, and through wells.

Streams may discharge water into the ground water system, in which case they are known as losing streams, or they may be recharged by ground water flowing into them, in which case they are called gaining streams. It is the latter situation which explains why ground water discharge into streams and the base flow of streams during extended dry periods are one and the same.

Ground water movement and storage in Albemarle County occurs in both soil and rock. Saprolite, an earthy, clay-rich residual material created by the decomposition of igneous and metamorphic rocks, forms a mantle covering much of the county. This layer of soil and saprolite is up to 100 feet (30 m) deep in places and averages about 50 feet (15 m). Many wells encountered bedrock at depths as great as 110 feet (34 m), but the majority fall in the 40 to 50 foot (12 to 15 m) range. Saprolite is thickest in Albemarle County where it occurs on upland flats.

The saprolite zone acts as an important recharge mechanism for the underlying bedrock, and also yields water to many wells. The saprolite acts as a giant sponge and stores vast amounts of water, allowing it to percolate downward at a very slow rate to recharge the underlying crystalline rocks. It may yield water to wells by means of primary porosity, a term which refers to porosity which was created at the time the saprolite was formed.

Bedrock in Albemarle County is composed of igneous and metamorphic rocks, with minor amounts of sedimentary rocks present in the eastern areas. Igneous and metamorphic rocks are very dense and relatively impermeable. Groundwater movement and storage takes place only in fractures which have developed in the rocks as a result of weathering and, to a lesser extent, structural deformation. This type of porosity is known as secondary porosity, since the water-bearing features developed after the rock was formed. Well yield is directly influenced by the frequency and interconnection of water-bearing fractures which the well intersects. The number and size of fractures decreases with depth, and generally it is assumed that water-bearing fractures seldom are encountered in these rocks at depth greater than 250-300 feet (76-91 m). For selected counties in the Virginia Piedmont, fracturing typically occurred between 30 and 350 feet (9 and 107 m) and was most frequent between approximately 80 and 125 feet (24 and 38 m). Data for Albemarle County indicate that 58 percent of the 302 rock wells for which water zone information is available encountered water within 100 feet (30 m) of the land surface, and 87 percent encountered water within 200 feet (61 m) of the land surface. (State Water Control Board, Bureau of Water Control Management Planning Bulletin 326, Ground Water Resources of Albemarle County, Virginia, December 1980).

3.3.1 Ground Water Availability

The entire Route 29 Study Area lies within the Piedmont Ground Water Area, as described by the Virginia Water Control Board Information Bulletin 565, April 1986. Bedrock in Albemarle County is composed of igneous and metamorphic rocks, with minor amounts of sedimentary rocks present in the eastern areas. Ground water availability is consistent throughout the county, varying slightly according to the geologic setting. A generalized hydrogeologic map of Albemarle County is shown in Figure 3.11, with Figure 3.12 illustrating the basic depth to water-bearing zones in the study area.

Middle James River Basin

Hardware River
James River
North Fork Rivanna River
Rivanna River
South Fork Rivanna River

York River Basin

South Anna River
Rapidan River

The major river watersheds in the study area include the Rivanna River, North Fork Rivanna River and South Fork Rivanna River (Figure 3.19).

3.4.1 Rivanna River Watershed

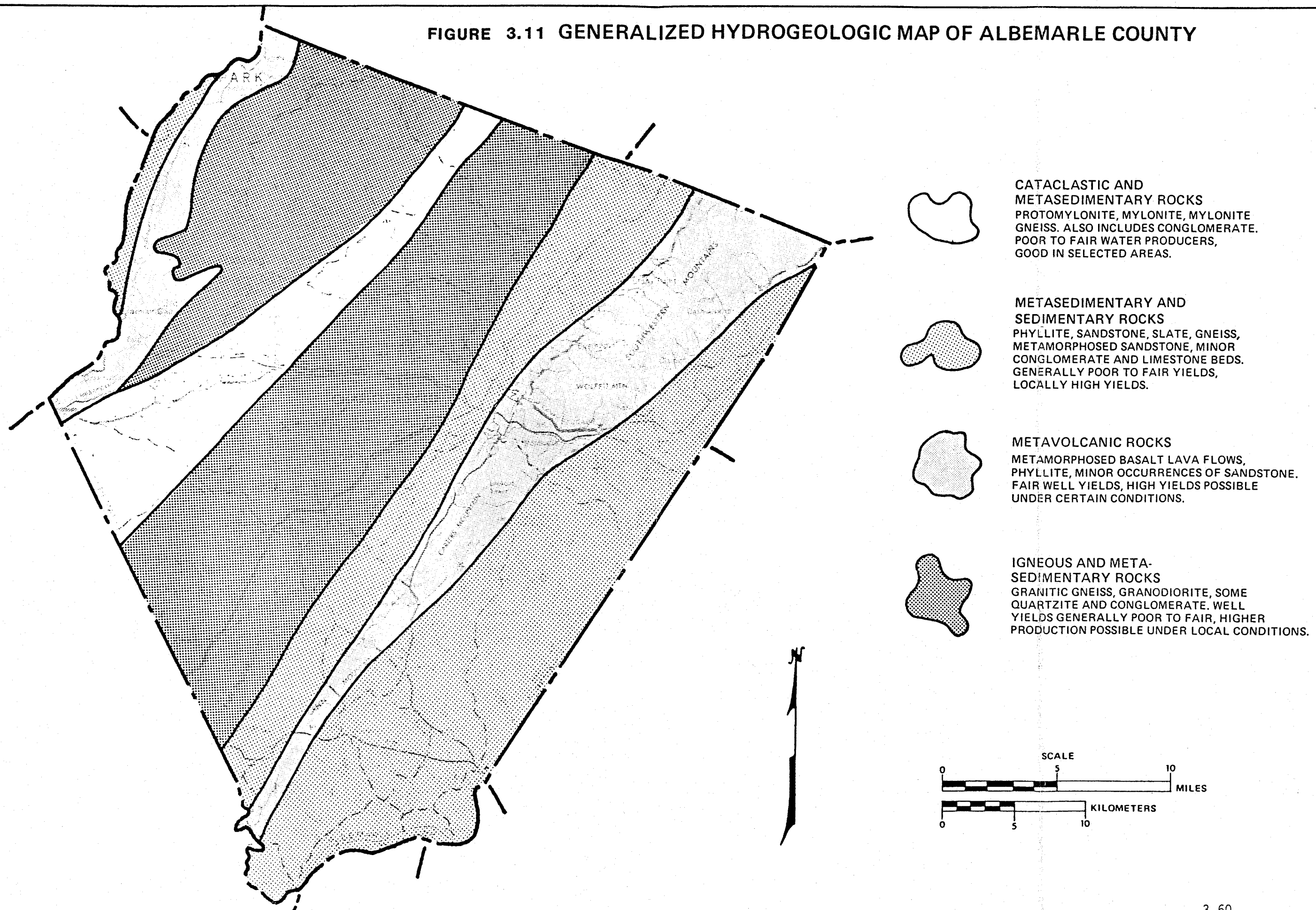
The Rivanna River Basin covers an area of 775 square miles located in the central part of Virginia. The basin is fan shaped, has a length of about 45 miles and a maximum width of about 30 miles near its headwaters. It is adjacent to the Rappahannock and York River watersheds on the north and forms a part of the larger James River Basin.

The Rivanna River rises on the eastern slopes of the Blue Ridge Mountains at an elevation of 2,700 feet mean sea level. The stream flows generally in a southeasterly direction for about 65 miles to its confluence with the main stem of the James River. The principle tributaries are the North and South Forks of the Rivanna which merge about 5 miles upstream from Charlottesville to form the main stem stream.

The Rivanna River Watershed lies within two physiographic regions known as the Blue Ridge Province, and the Piedmont Plateau. The summits of the Blue Ridge Mountains rise to 3585 feet above mean sea level. Tributary streams in the mountainous area are precipitous.

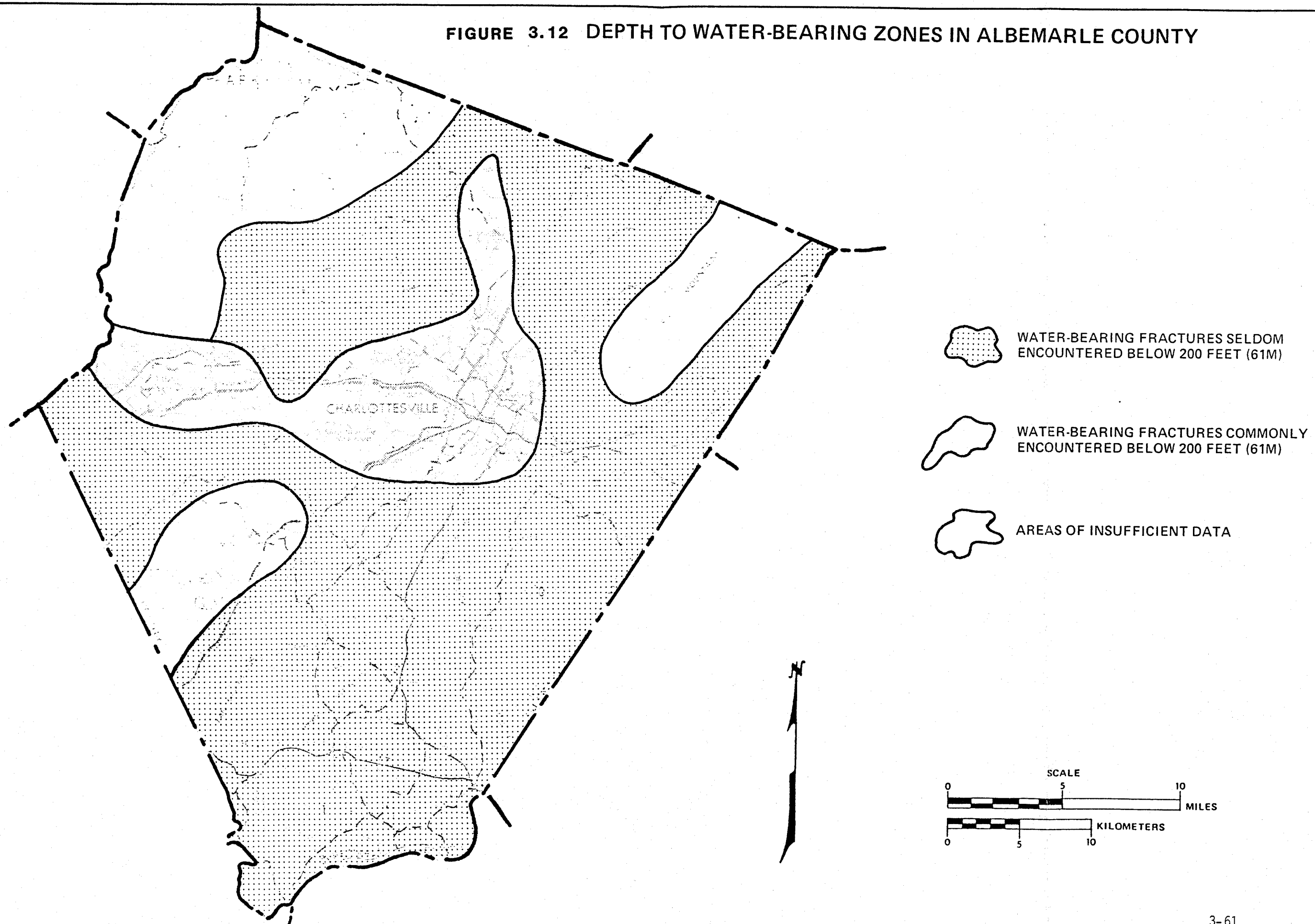
The Piedmont Plateau is located east of the Blue Ridge Mountains. The land slopes gradually eastward from the base of the mountains and is characterized by rolling terrain with elevations ranging from 1000 feet above mean sea level in the foothills to 300 feet near the eastern limits of the plateau. It is traversed by highlands which are cut by numerous small valleys.

FIGURE 3.11 GENERALIZED HYDROGEOLOGIC MAP OF ALBEMARLE COUNTY



Source: Compiled from Various Publications of the Virginia Division of Mineral Resources

FIGURE 3.12 DEPTH TO WATER-BEARING ZONES IN ALBEMARLE COUNTY



Source: Virginia State Water Control Board – VRO

Water-bearing zones are generally encountered within 200 feet of the land surface. Water yields of up to 125 gallons per minute have been obtained in the Piedmont Area with yields of less than 10 gpm being typical. One landowner reported a rate of 1.5 gpm from his 400-foot deep well, located on a tributary of Ivy Creek. The land surface elevation of this particular well is approximately 540 ft msl. Figure 3.13 illustrates ground water availability in the study area as measured in gallons per minute.

3.3.2 Ground Water Quality

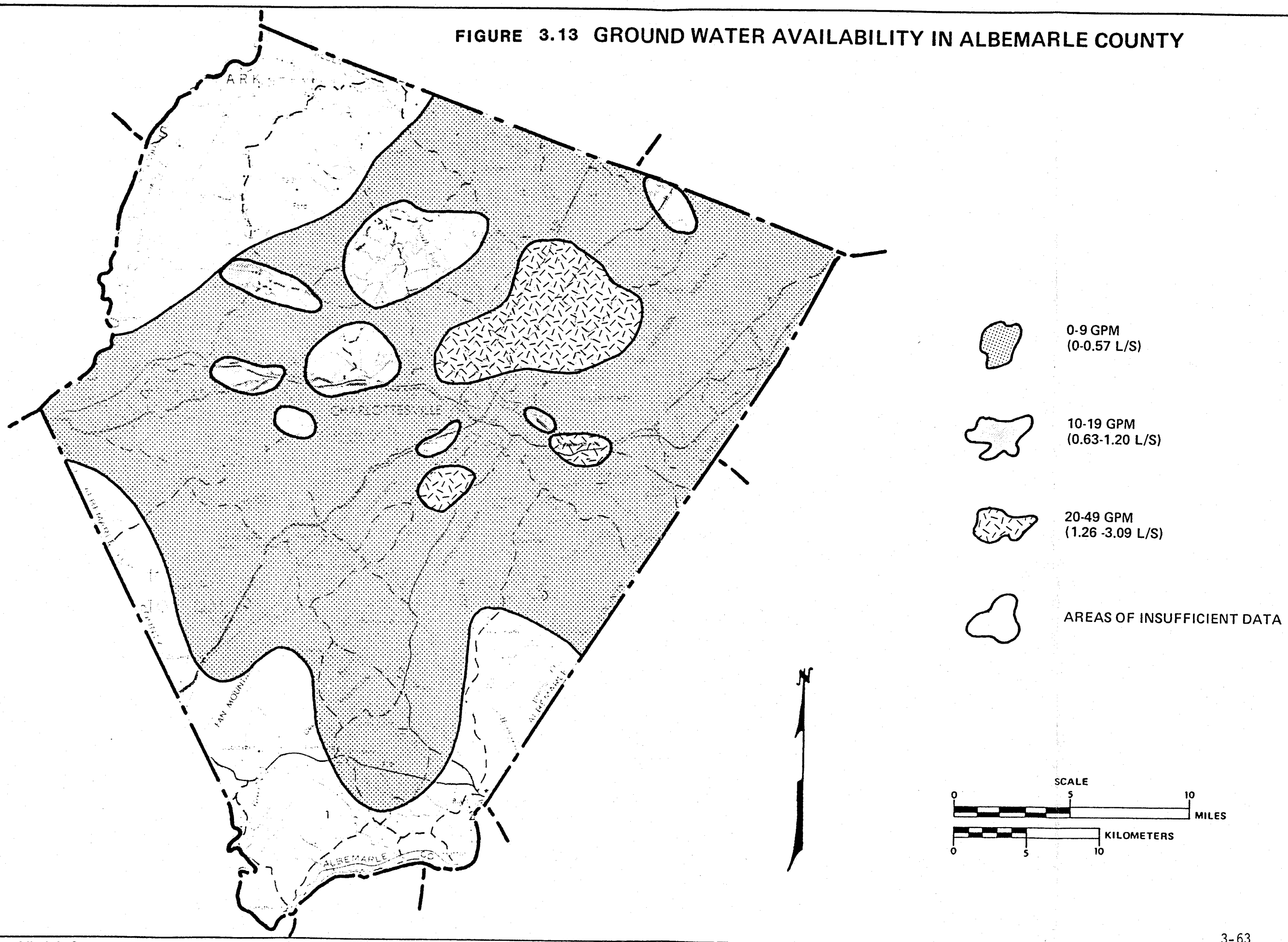
The Virginia State Water Control Board has designated groundwater criteria for the Piedmont Region of Virginia (Table 3.27). Overall, groundwater throughout the county is of high quality, only isolated wells have exhibited significant quality variations. Dissolved mineral matter content is relatively low. The total dissolved solids content throughout the county was less than 150 mg/L according to a 1980 State Water Control Board Planning Bulletin. Figure 3.14 shows the zones of average concentration of total dissolved solids.

Water hardness is the property of water which retards soponafication or the production of soap lather. Hardness is described as low throughout Albemarle county. Durfor and Becker developed a hardness classification as noted in Hem (1970).

Hardness Range mg/L of $CaCO_3$	Classification
0 - 60	Soft
61 - 120	Moderately hard
121 - 180	Hard
> 180	Very Hard

Figure 3.15 illustrates the general boundaries of ground water hardness in Albemarle County.

FIGURE 3.13 GROUND WATER AVAILABILITY IN ALBEMARLE COUNTY

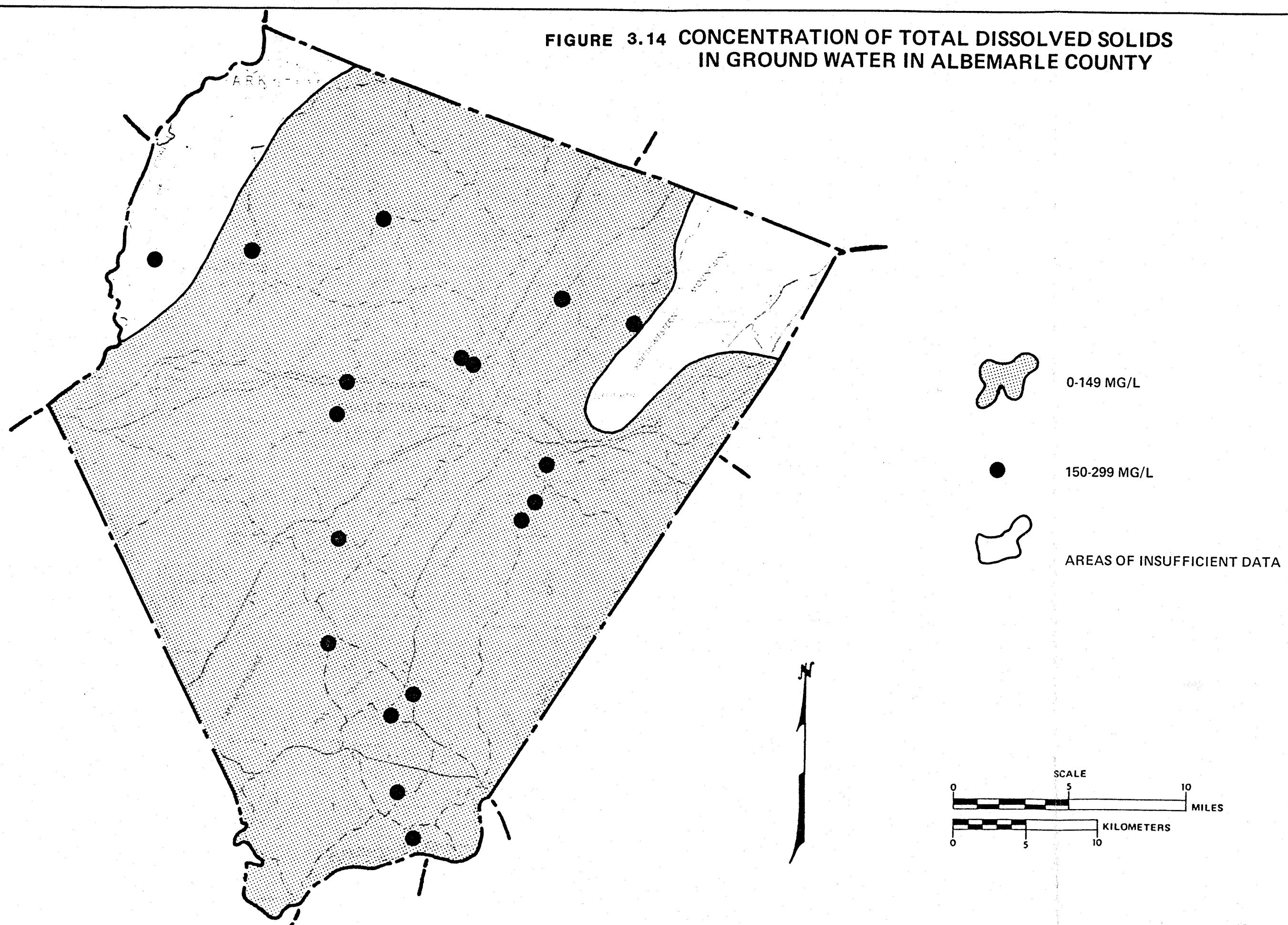


Source: Virginia State Water Control Board — VRO

TABLE 3.27
GROUND WATER QUALITY CRITERIA -
PIEDMONT GROUND WATER AREA
(Virginia State Water Control Board)

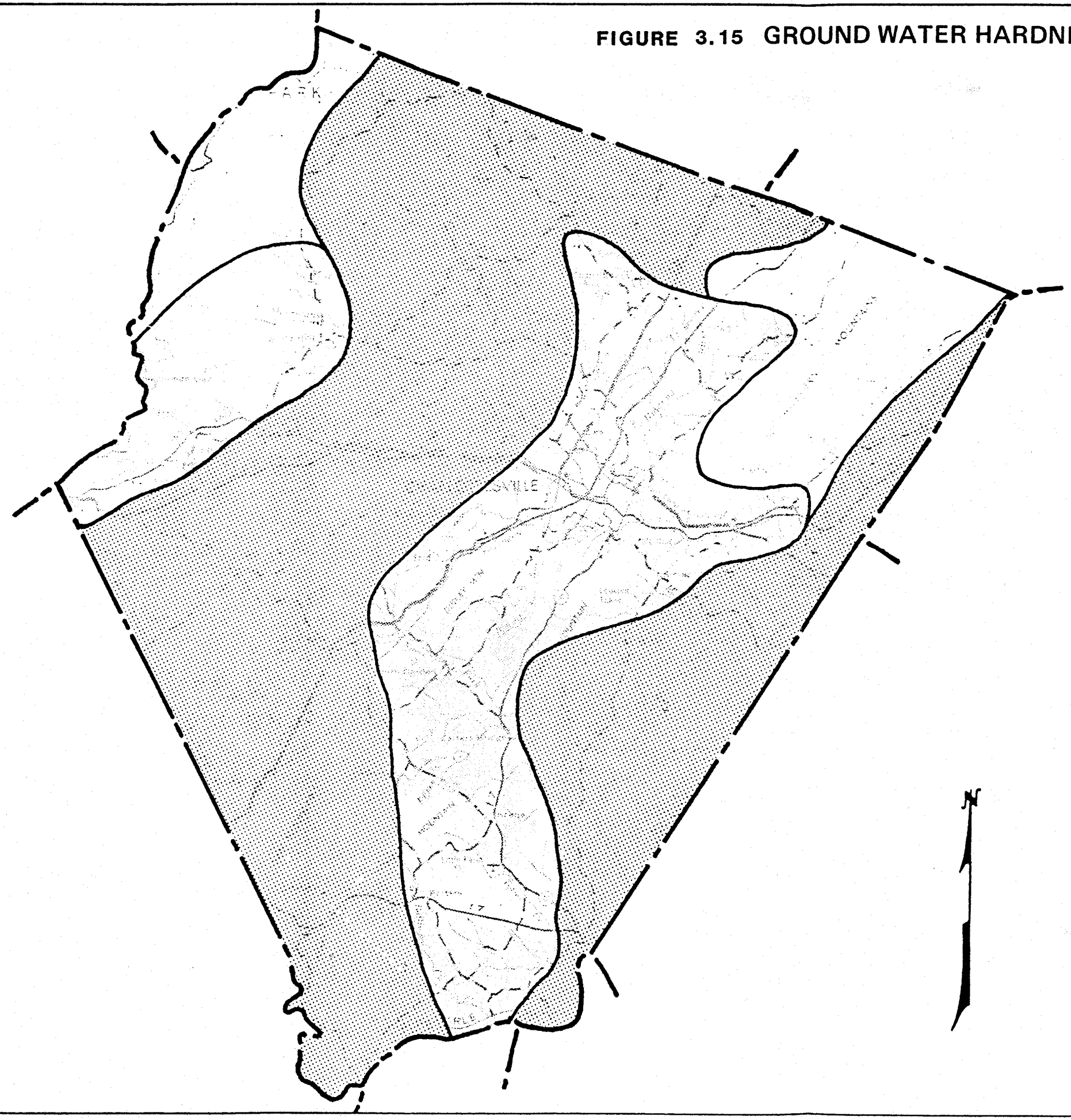
Constituent	Concentration
Alkalinity	10 - 200 mg/L
Chloride	25 mg/L
Color	15 color units
Flouride	1.4 mg/L
Hardness	120 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Sodium	25 mg/L
Sulfate	25 mg/L
Total Dissolved Solids	250 mg/L
Total Organic Carbon	10 mg/L

FIGURE 3.14 CONCENTRATION OF TOTAL DISSOLVED SOLIDS IN GROUND WATER IN ALBEMARLE COUNTY



Source: Virginia State Water Control Board – VRO

FIGURE 3.15 GROUND WATER HARDNESS IN ALBEMARLE COUNTY



0-60 MG/L
SOFT

61-180 MG/L
MODERATELY HARD TO HARD

AREAS OF INSUFFICIENT DATA

N

SCALE
0 5 10 MILES
0 5 10 KILOMETERS

Source: Virginia State Water Control Board – VRO

Iron concentrations are within the 0.3 mg/L limit established by the Commonwealth of Virginia Department of Health. Hydrogen ion concentration, or pH, falls within a range of 6.5 - 7.4 throughout most of the county. Figures 3.16 and 3.17 illustrate the iron concentrations and pH levels in the study area. Nitrate concentrations in groundwater in Albemarle County are shown in Figure 3.18. Table 3.28 outlines the hydrologic units in Albemarle County based on geologic and water bearing characteristics.

3.3.3 Sites of Ground Water and Contamination

Ground water pollution conditions exist when foreign matter enters the ground water system and alters the natural quality of the water. Within the study area, no major areas of ground water contamination have been identified, however, localized contamination occasionally does occur. Sources of such contamination include septic drainfields, hazardous chemical and petroleum product spillage and seepage, sanitary landfill and waste treatment lagoon seepage, and agricultural runoff from croplands, feedlots, and barnyards.

Nitrate contamination is likely to occur during rainfall runoff from barnyards and feedlots. Cropland runoff may result in the introduction of herbicides and pesticides into the ground water. Bacterial contamination is often the result of runoff from [illegible] sections of the study area.

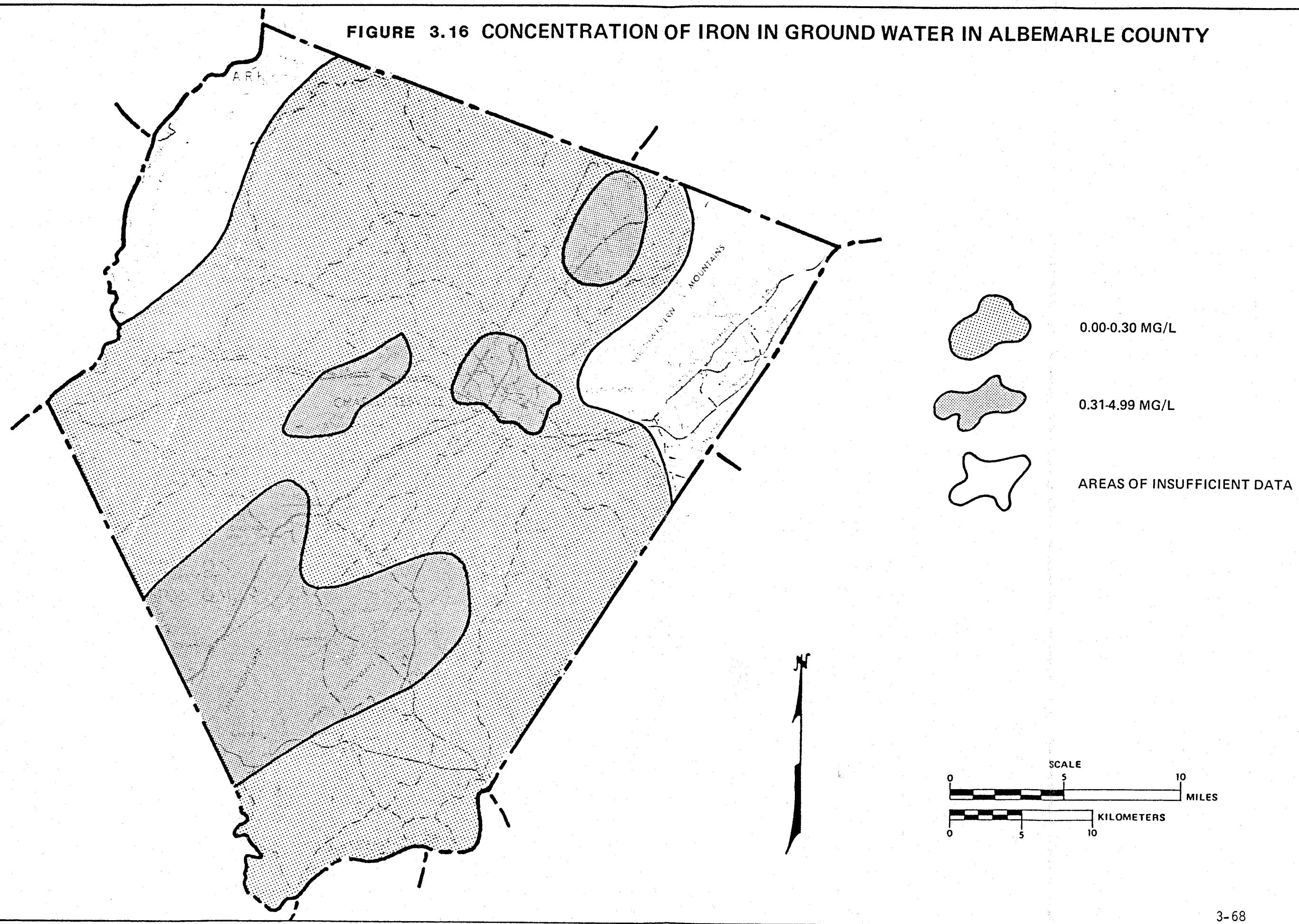
The State Water Control Board planning bulletin reported hydrocarbon contamination caused by leakage and spillage of petroleum products in several areas of Albemarle County prior to 1980. The petroleum contamination incidents involved leaks from underground gasoline storage tanks which resulted in the contamination of a few domestic wells. Albemarle County has exhibited no known ground water pollution from waste disposal sites as recorded in the SWCB planning bulletin.

3.4 General Hydrological Characteristics

This section summarizes the surface water hydrology of the study area. The summary includes a discussion of the general hydrologic features of the area and hydrologic characteristics within each alignment. The information presented includes general descriptions, sizes of major drainage basins, relative stream size, direction of drainage, and flooding characteristics.

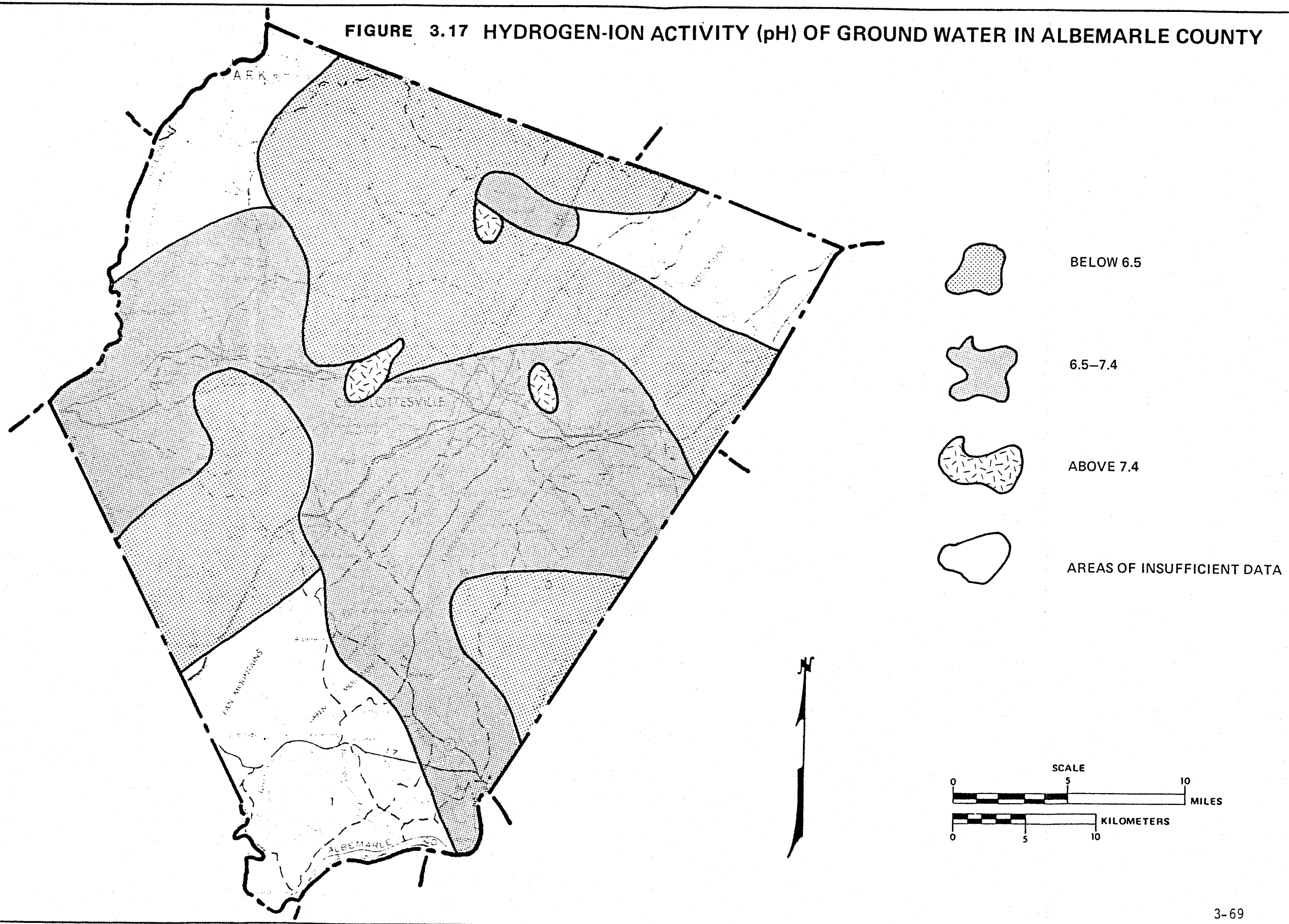
Albemarle County forms the headwaters for the Middle James River Basin, with only a small portion of northeast Albemarle County draining into the York River Basin. The entire County is part of the Chesapeake Bay Basin. The major watershed divisions in the County are as follows:

FIGURE 3.16 CONCENTRATION OF IRON IN GROUND WATER IN ALBEMARLE COUNTY



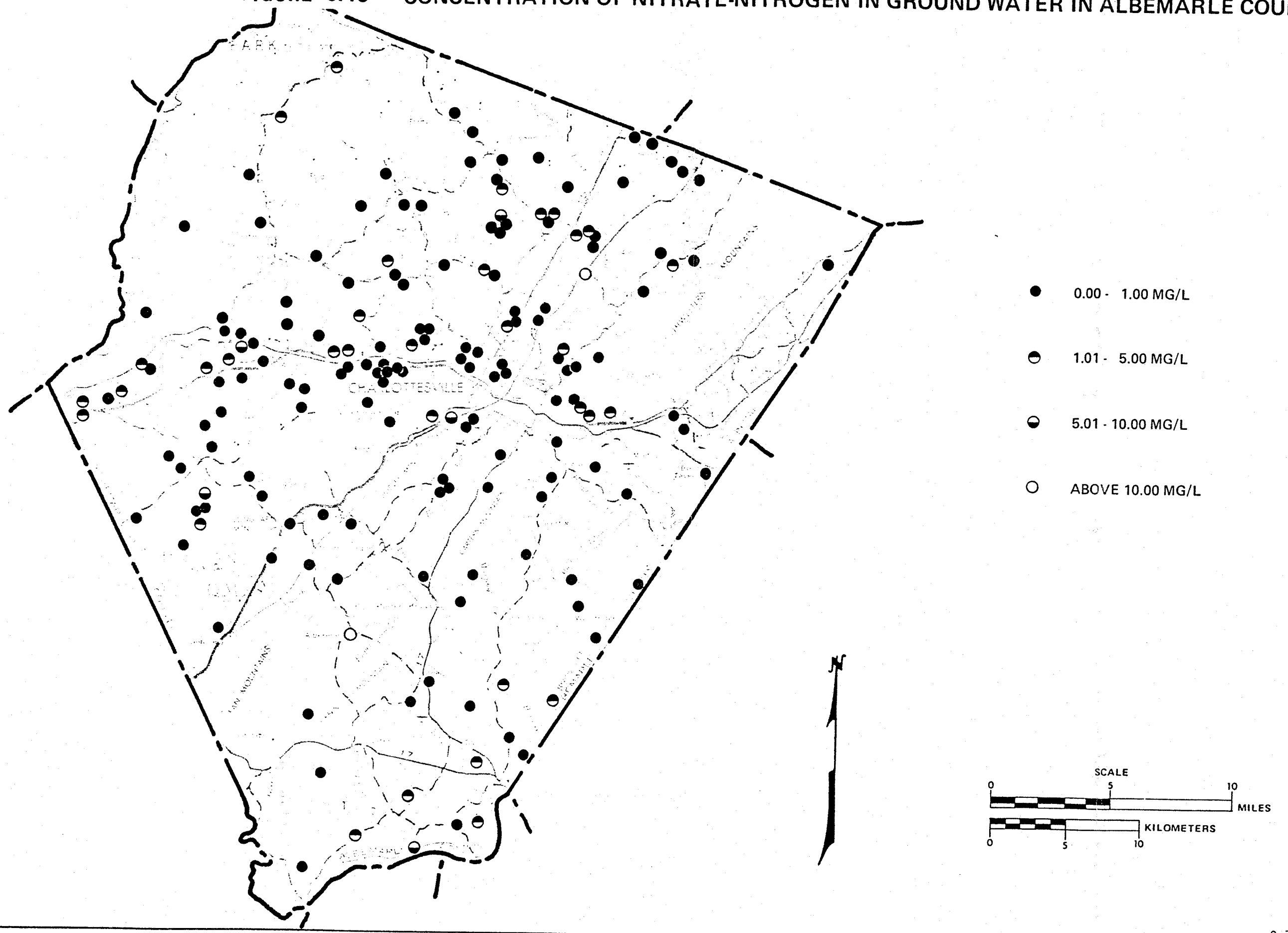
Source: Virginia State Water Control Board – VRO

FIGURE 3.17 HYDROGEN-ION ACTIVITY (pH) OF GROUND WATER IN ALBEMARLE COUNTY

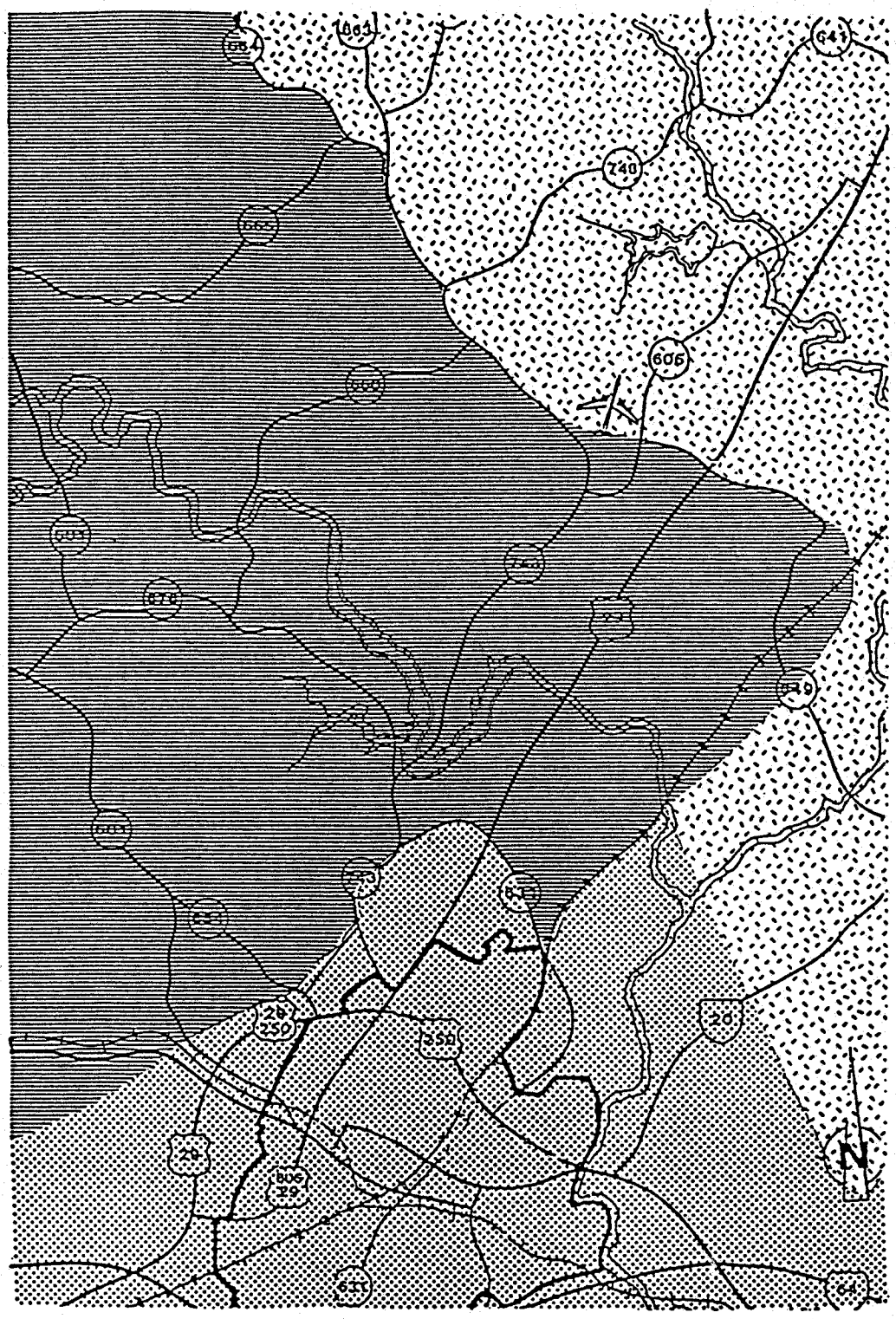


Source: Virginia State Water Control Board – VRO

FIGURE 3.18 CONCENTRATION OF NITRATE-NITROGEN IN GROUND WATER IN ALBEMARLE COUNTY



Source: Virginia State Water Control Board – VRO



MAJOR RIVER WATERSHEDS

- South Fork Rivanna River
- North Fork Rivanna River
- Rivanna River

Figure 3.19

3.4.2 North Fork Rivanna River Watershed

Located in the west central part of Albemarle County, the North Fork Rivanna River at its mouth receives run-off from about 176 square miles. The watershed measures approximately 22 miles long and has an average width of 8 miles. Its shape can best be described as resembling a rectangle. The North Fork Rivanna River merges with the South Fork Rivanna River at a point located about 5 miles upstream from Charlottesville to form the Rivanna River. The major tributaries to North Fork Rivanna River are Foster Branch, Flannigan Branch, Preddy Creek, Flat Branch, Herring Branch, Jacobs Run and Marsh Run.

The North Fork Rivanna River watershed lies within two physiographic regions known as the Blue Ridge Province, and the Piedmont Plateau. Both regions have been discussed in section 3.4.1 of this report.

The larger portion of the North Fork Rivanna River and its watershed are located in Albemarle and Greene Counties. A small portion of the drainage basin is in Orange County. The stream flows generally in a southwardly direction for about 31 miles, as measured along the center line of the main stream channel, from the upper reaches of the watershed to its mouth at the confluence with South Fork Rivanna River. Maximum relief within the drainage basin is about 3000 feet.

3.4.3 South Fork Rivanna River Watershed

The South Fork Rivanna River has a drainage of 268 square miles which is located in the northwestern quadrant of Albemarle County. The South Fork Rivanna River Basin is fan shaped and has a length of approximately 20 miles.

The tributaries of the river rise for the most part in the Shenandoah National Park on the eastern slopes of the Blue Ridge Mountains. The upper reach of the river originates at the confluence of Mechums and Moormans Rivers and flows in a southeasterly direction for 12.81 miles to its confluence with the main stem of the Rivanna River. The average slope for the river is 6.6 feet per mile while its tributaries, which reach into the Blue Ridge Mountains, have much steeper slopes.

3.5 Federal Flood Insurance Program

Changes in flood elevations and floodplain widths may result from encroachment in the floodplain of rivers and streams. The United States Department of Transportation, Federal Highway Administration (FHWA) in conjunction with the United States Department of Housing and Urban Development (HUD), Federal Insurance Administration (FIA) (currently administered by FEMA) have established rules and regulations with regard to the location and design of encroachment in the floodplains.

The National Flood Insurance Program (NFIP) was established in 1968. The NFIP was created to provide flood-prone areas with flood insurance at a reasonable rate. Guidelines for development in the floodplain were also established by the program. The Federal Emergency Management Agency (FEMA) acts as the lead agency in the administration of NFIP as well as coordinating Federal response to flood disaster victims.

In December, 1980, new flood hazard maps and the Flood Hazard Overlay District were adopted as part of the County's zoning ordinance. Figures 3.20 through 3.29, Floodplain Maps 1-10, became effective on December 16, 1980, and illustrate the potential encroachment by each proposed alignment.

In compliance with Executive Order 11988, regarding floodplain management, the project was evaluated to determine potential impacts to floodplains. These potential impacts include displacement of floodplains due to filling, alteration of drainage patterns, water quality degradation, reduction in flood storage capacity, and effects on floral and faunal communities. Given the proximity of existing crossings of floodplains to those of the project, it is not anticipated that the proposed project will have any significant adverse effects on natural and beneficial floodplain values. The project as proposed will not increase the risk of flood loss. Also, no increase in flood related risks to human safety, health, or welfare should occur as a result of this project.

3.6 Other Surface Hydrology Issues

Potential effects of low flow and high flow conditions are the other surface hydrology issues identified during the study. High flows have the potential to damage man-made structures in the floodplains as well as the potential to cause injury or death. Silt deposition, bank erosion, increased turbidity and scour may also occur during a high flow event. Low flow can result in reduced dissolved oxygen levels and thus, influence aquatic organisms. Availability of water for industrial users and irrigation becomes critical while, at the same time, the impact of municipal and industrial discharges on receiving streams increases during low flow.

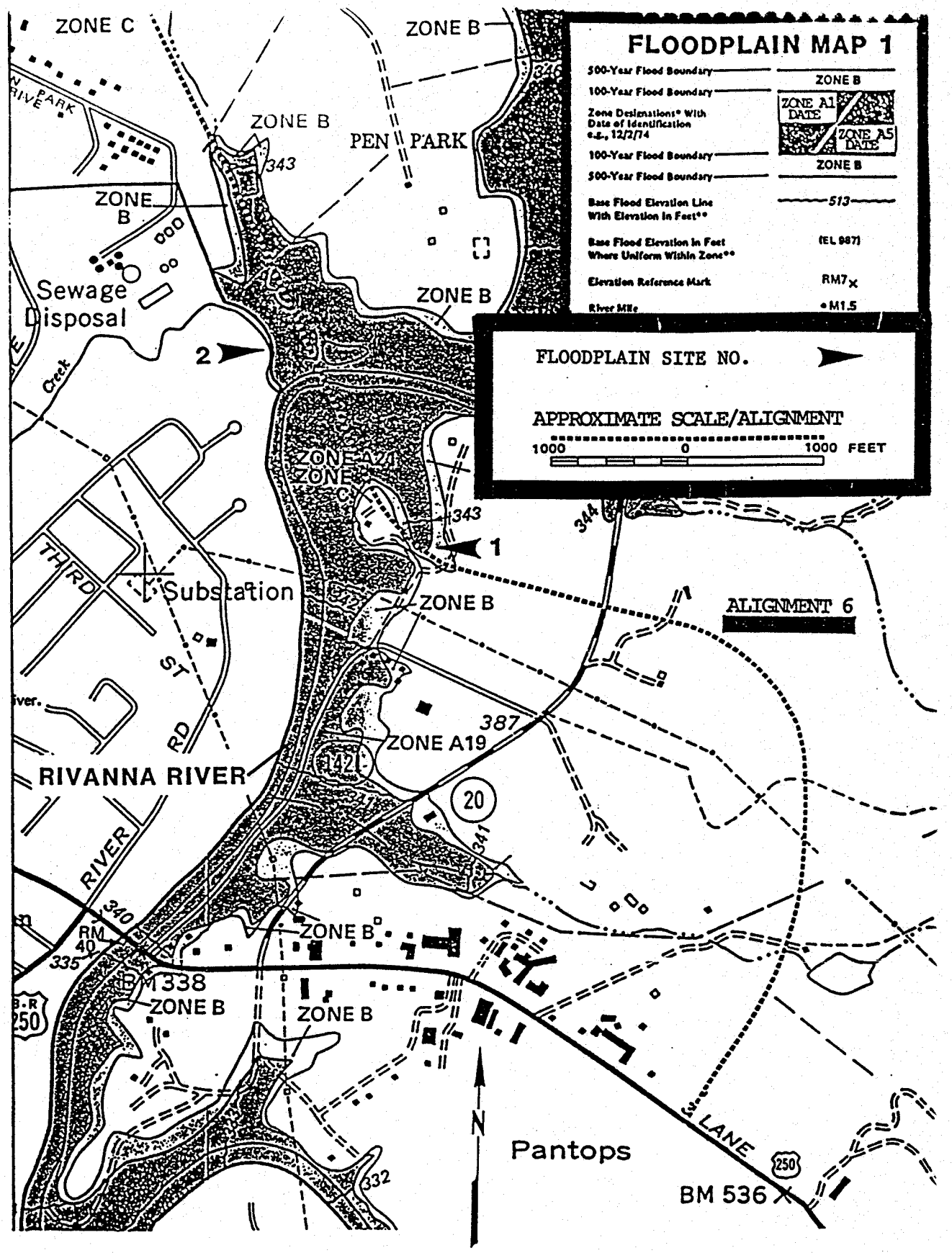

FLOODPLAIN MAP 1
500-Year Flood Boundary
100-Year Flood Boundary
Zone Designations* With Date of Identification e.g., 12/2/74
100-Year Flood Boundary
500-Year Flood Boundary
Base Flood Elevation Line With Elevation In Feet**
Base Flood Elevation In Feet Where Uniform Within Zone**
Elevation Reference Mark
River Mile
ZONE B
ZONE A1 DATE
ZONE A5 DATE
ZONE B
513
(EL 987)
RM7
M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
1000 0 1000 FEET
ZONE C
ZONE B
PEN PARK
ZONE B
343
ZONE B
Sewage Disposal
ZONE B
2
ZONE A21
ZONE C
343
1
344
Substation
ZONE B
ALIGNMENT 6
THIRD ST RD
387
ZONE A19
142
20
RIVANNA RIVER
RIVER
341
340
RM 40
335
ZONE B
BM 338
ZONE B
ZONE B
250
N
Pantops
LANE
250
332
BM 536

Figure 3.20

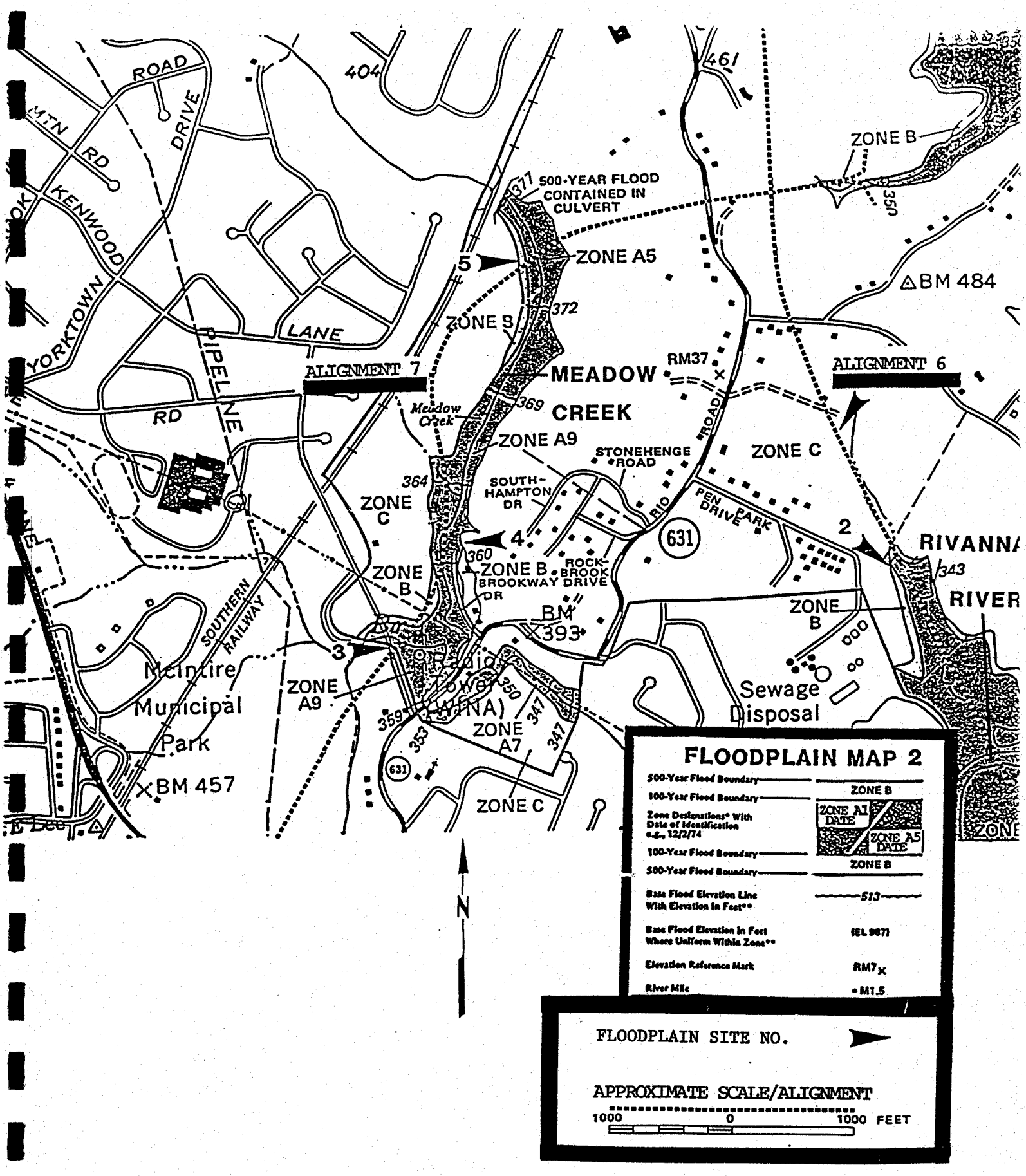

FLOODPLAIN MAP 2
500-Year Flood Boundary
100-Year Flood Boundary
ZONE B
Zone Designations* With Date of Identification e.g., 12/2/74
ZONE A1 DATE
ZONE A5 DATE
100-Year Flood Boundary
500-Year Flood Boundary
ZONE B
Base Flood Elevation Line With Elevation In Feet**
513
Base Flood Elevation In Feet Where Uniform Within Zone**
(EL 987)
Elevation Reference Mark
RM7
River Mile
M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
1000 0 1000 FEET
N
500-YEAR FLOOD CONTAINED IN CULVERT
ZONE A5
ZONE B
ZONE A9
ZONE C
ZONE A7
MEADOW CREEK
Meadow Creek
ALIGNMENT 7
ALIGNMENT 6
RM37
BM 484
BM 457
BM 393
STONEHENGE ROAD
SOUTH-HAMPTON DR
ROCK-BROOK BROOKWAY DRIVE
PEN PARK DRIVE
RIO ROAD
YORKTOWN RD
KENWOOD
MTN RD
ROAD
DRIVE
LANE
PIPELINE
SOUTHERN RAILWAY
McIntire Municipal Park
Sewage Disposal
RIVANNA RIVER
631
404
461
371
372
369
364
360
359
353
350
347
343

Figure 3.21

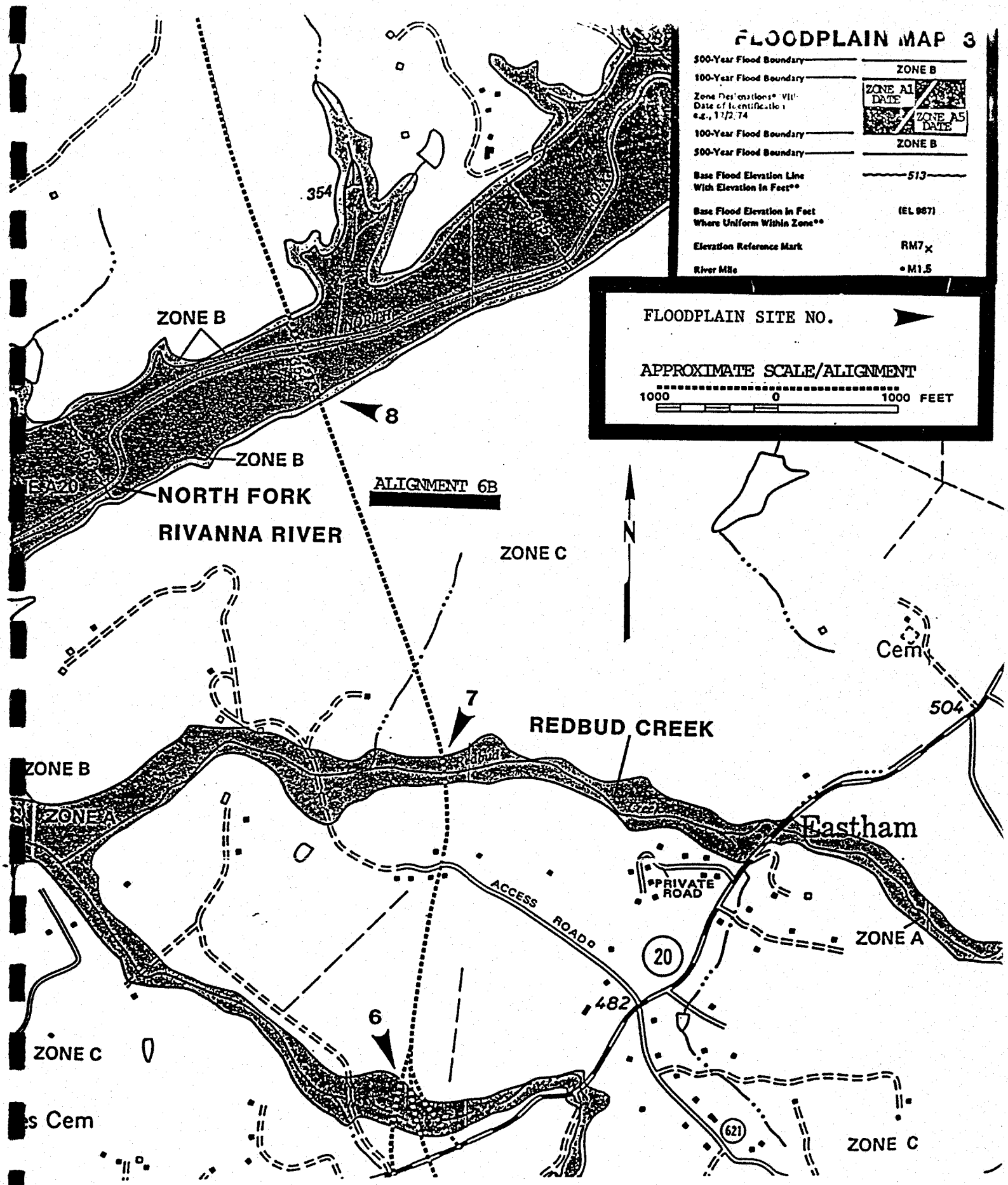

FLOODPLAIN MAP 3
500-Year Flood Boundary
ZONE B
100-Year Flood Boundary
ZONE A1 DATE
ZONE A5 DATE
100-Year Flood Boundary
ZONE B
500-Year Flood Boundary
Base Flood Elevation Line With Elevation in Feet**
513
Base Flood Elevation in Feet Where Uniform Within Zone**
(EL 987)
Elevation Reference Mark
RM7
River Mile
M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
1000 0 1000 FEET
ZONE B
354
8
ZONE B
NORTH FORK
RIVANNA RIVER
ALIGNMENT 6B
ZONE C
N
Cem
504
7
REDBUD CREEK
ZONE B
ZONE A
Eastham
PRIVATE ROAD
ACCESS ROAD
20
ZONE A
482
6
ZONE C
s Cem
621
ZONE C

Figure 3.22

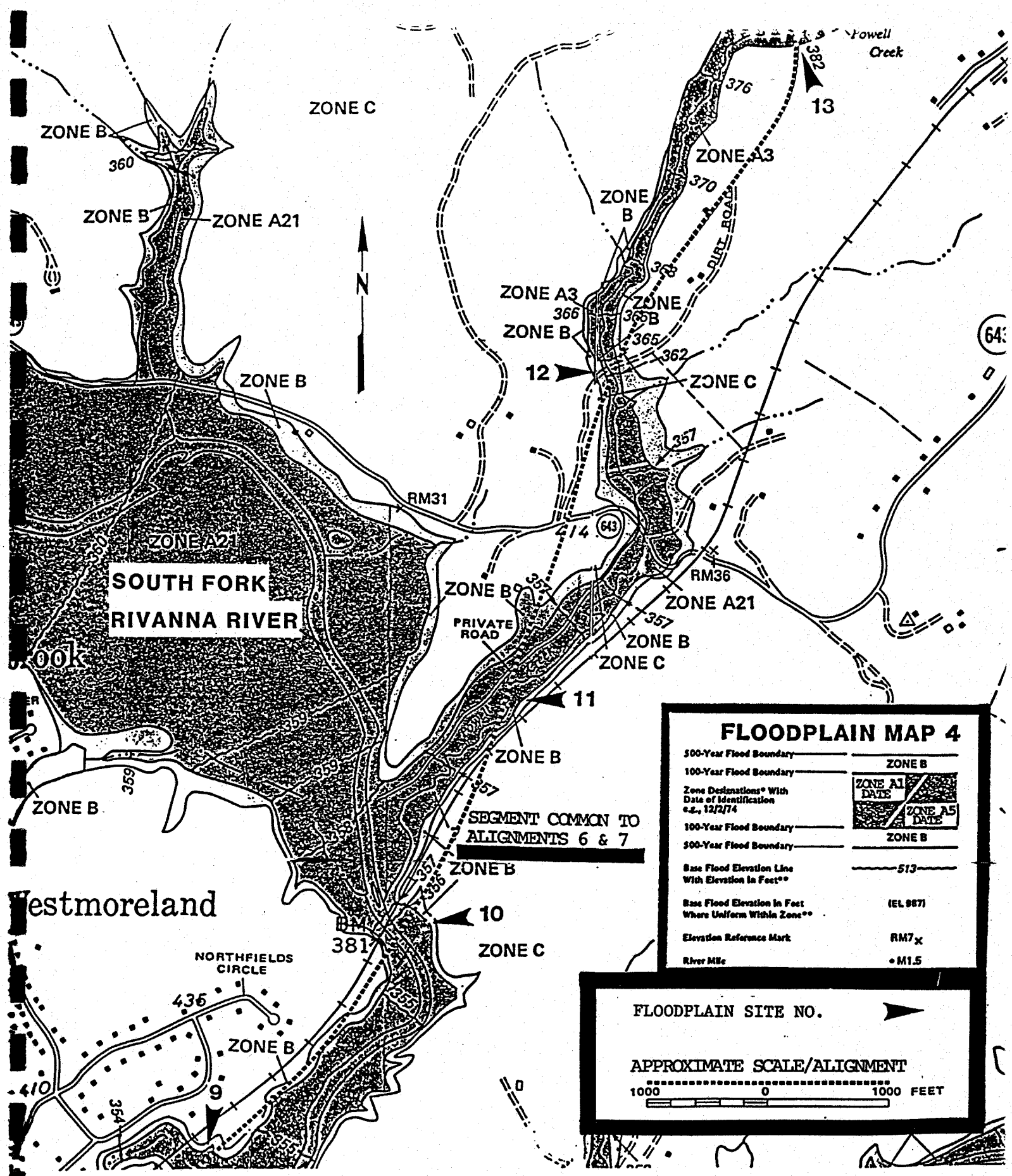

FLOODPLAIN MAP 4
500-Year Flood Boundary
ZONE B
100-Year Flood Boundary
Zone Designations* With Date of Identification e.g., 12/2/74
ZONE A1 DATE
ZONE A5 DATE
100-Year Flood Boundary
500-Year Flood Boundary
ZONE B
Base Flood Elevation Line With Elevation in Feet**
513
Base Flood Elevation in Feet Where Uniform Within Zone**
(EL 987)
Elevation Reference Mark
RM7x
River Mile
• M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
1000 0 1000 FEET
SOUTH FORK RIVANNA RIVER
ZONE C
ZONE B
ZONE A21
ZONE A3
RM31
RM36
PRIVATE ROAD
SEGMENT COMMON TO ALIGNMENTS 6 & 7
NORTHFIELDS CIRCLE
Westmoreland
Powell Creek
N
10
11
12
13
9

Figure 3.23

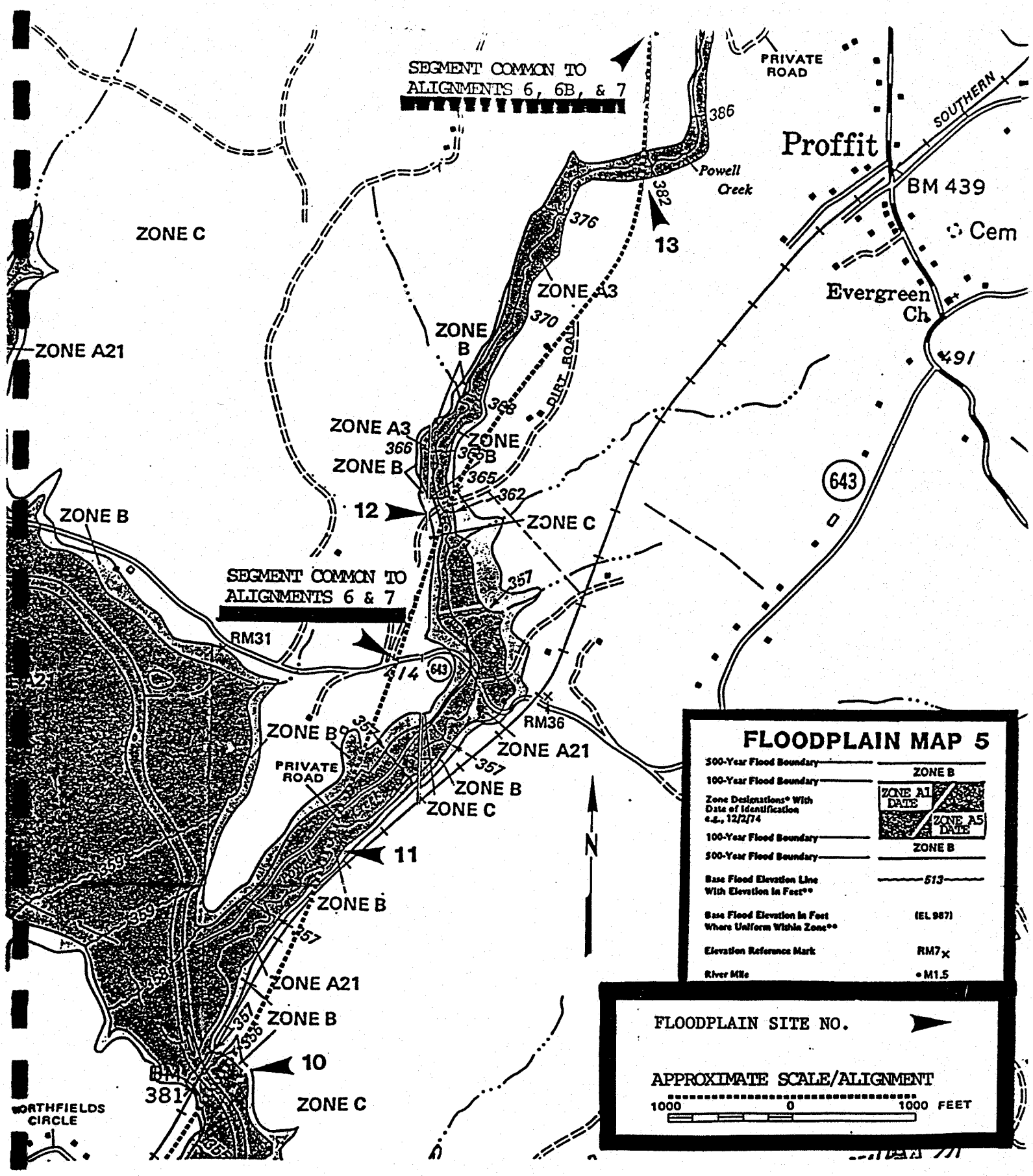

SEGMENT COMMON TO ALIGNMENTS 6, 6B, & 7
PRIVATE ROAD
386
Proffit
SOUTHERN
Powell Creek
382
BM 439
Cem
376
13
ZONE C
ZONE A3
Evergreen Ch
370
ZONE B
ZONE A21
PIPE ROAD
491
ZONE A3
366
ZONE B
ZONE B
365
362
643
12
ZONE C
ZONE B
SEGMENT COMMON TO ALIGNMENTS 6 & 7
357
RM31
314
643
RM36
ZONE B
ZONE A21
PRIVATE ROAD
ZONE B
ZONE C
11
N
ZONE B
ZONE A21
ZONE B
10
BM
381
ZONE C
NORTHFIELDS CIRCLE
FLOODPLAIN MAP 5
500-Year Flood Boundary
ZONE B
100-Year Flood Boundary
Zone Designations* With Date of Identification e.g., 12/2/74
ZONE A1 DATE
ZONE A5 DATE
100-Year Flood Boundary
500-Year Flood Boundary
ZONE B
Base Flood Elevation Line With Elevation In Feet**
513
Base Flood Elevation In Feet Where Uniform Within Zone**
(EL 987)
Elevation Reference Mark
RM7
River Mile
M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
1000
0
1000 FEET

Figure 3.24

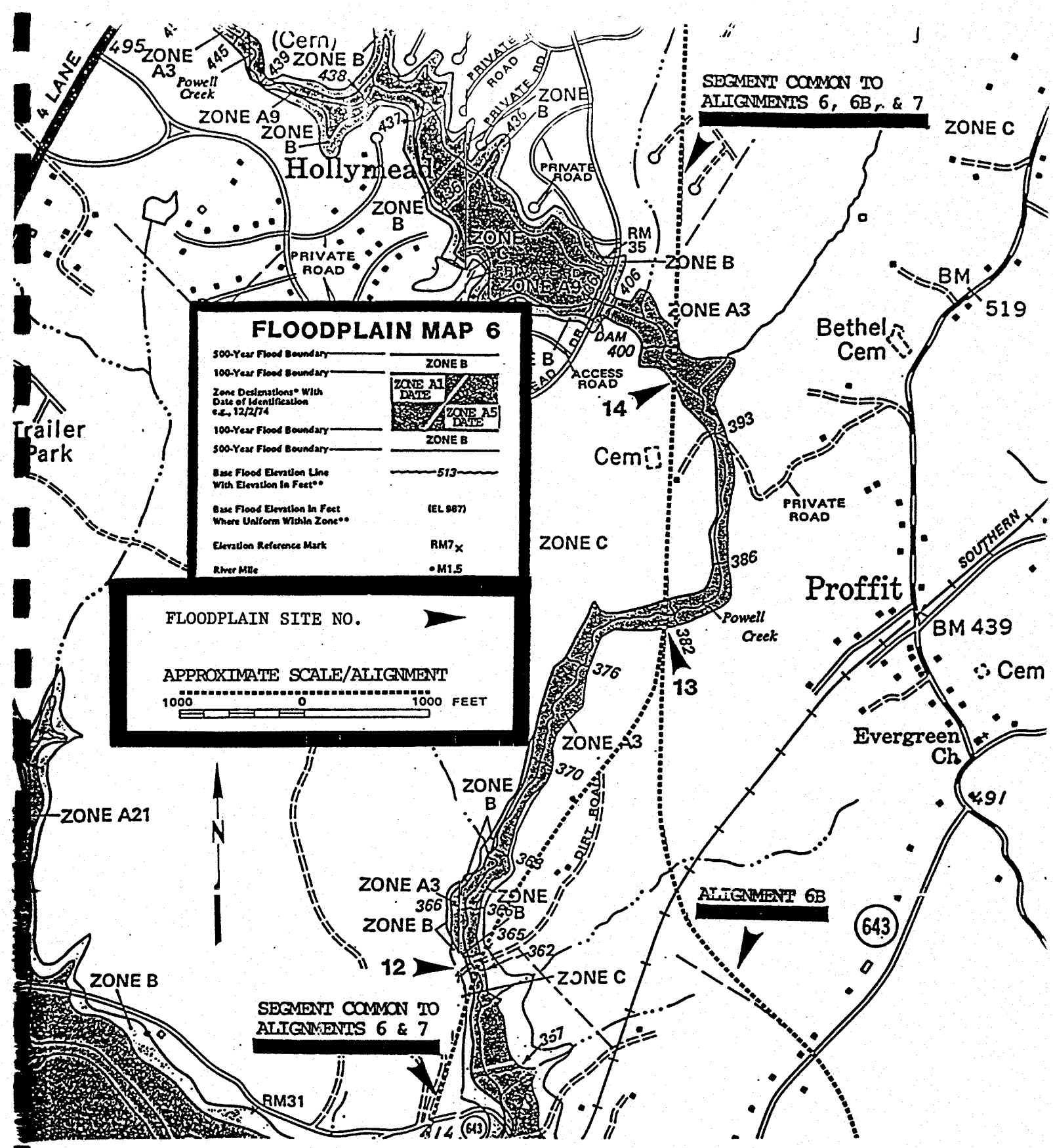

FLOODPLAIN MAP 6
500-Year Flood Boundary
100-Year Flood Boundary
ZONE B
Zone Designations* With Date of Identification e.g., 12/2/74
ZONE A1 DATE
ZONE A5 DATE
100-Year Flood Boundary
500-Year Flood Boundary
ZONE B
Base Flood Elevation Line With Elevation in Feet**
513
Base Flood Elevation in Feet Where Uniform Within Zone**
(EL 987)
Elevation Reference Mark
RM7
River Mile
M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
1000 0 1000 FEET
SEGMENT COMMON TO ALIGNMENTS 6, 6B, & 7
SEGMENT COMMON TO ALIGNMENTS 6 & 7
ALIGNMENT 6B
4 LANE
Powell Creek
Hollymead
Trailer Park
Bethel Cem
Proffit
Evergreen Ch
SOUTHERN
ACCESS ROAD
PRIVATE ROAD
DAM 400
RM 35
BM 519
BM 439
RM31
ZONE A3
ZONE A9
ZONE A21
ZONE B
ZONE C
ZONE A1
ZONE A5
495
445
439
438
437
436
406
393
386
382
376
370
366
365
362
357
14
13
12
N
643

Figure 3.25

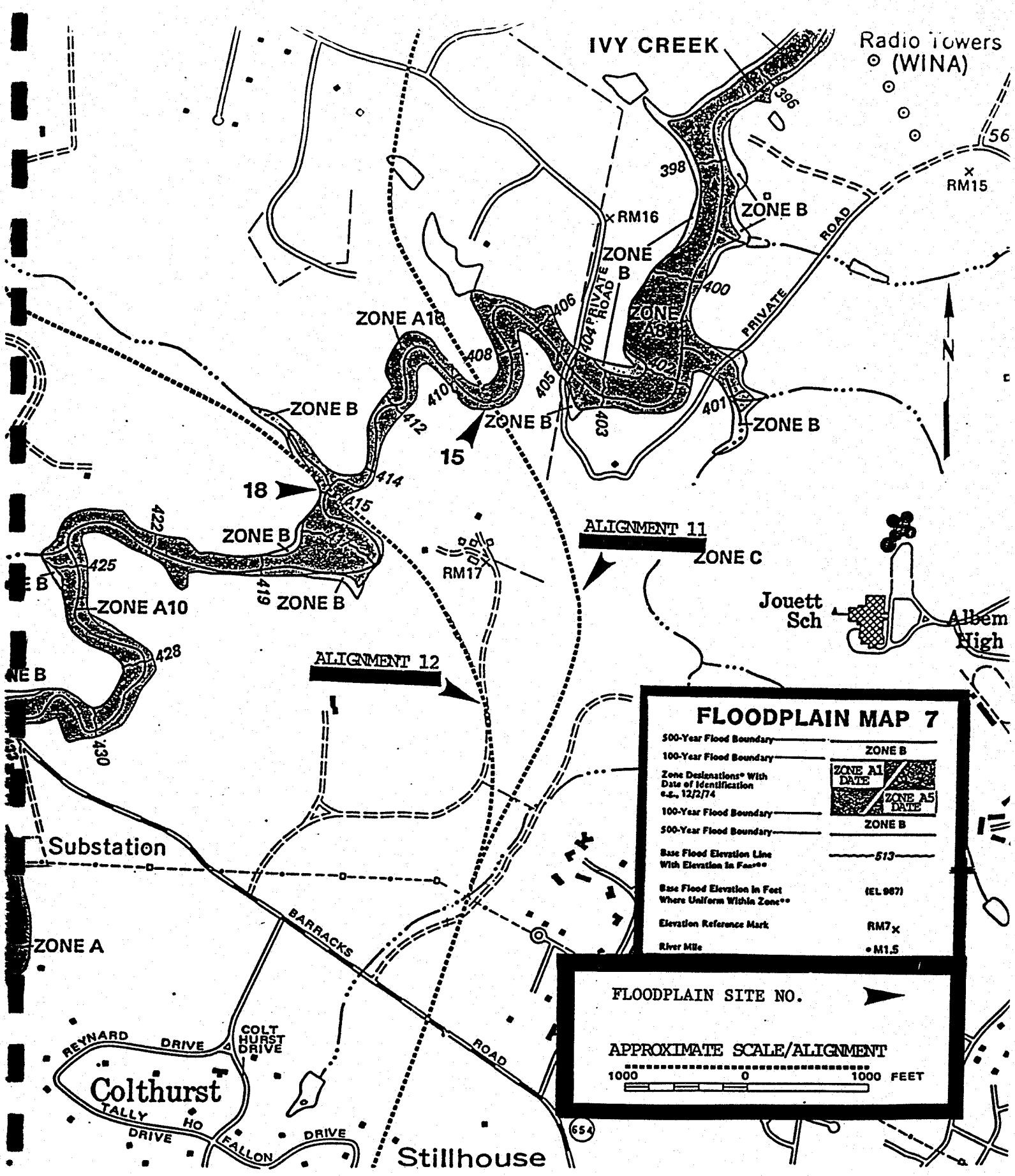

IVY CREEK
Radio Towers (WINA)
396
56
398
RM15
ZONE B
RM16
ZONE B
ROAD
PRIVATE
400
PRIVATE ROAD
ZONE A8
406
404
ZONE A10
408
405
402
N
410
401
ZONE B
ZONE B
ZONE B
412
403
15
414
18
415
422
ZONE B
ALIGNMENT 11
ZONE C
425
RM17
419
ZONE B
ZONE A10
Jouett Sch
Albem High
428
ALIGNMENT 12
430
Substation
BARRACKS
ROAD
ZONE A
REYNARD
DRIVE
COLT HURST DRIVE
Colthurst
TALLY HO
DRIVE
FALLON
DRIVE
Stillhouse
654
FLOODPLAIN MAP 7
500-Year Flood Boundary
100-Year Flood Boundary
ZONE B
Zone Designations* With Date of Identification e.g., 12/2/74
ZONE A1 DATE
ZONE A5 DATE
100-Year Flood Boundary
500-Year Flood Boundary
ZONE B
Base Flood Elevation Line With Elevation In Feet**
513
Base Flood Elevation In Feet Where Uniform Within Zone**
(EL 987)
Elevation Reference Mark
RM7
River Mile
M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
1000
0
1000 FEET

Figure 3.26

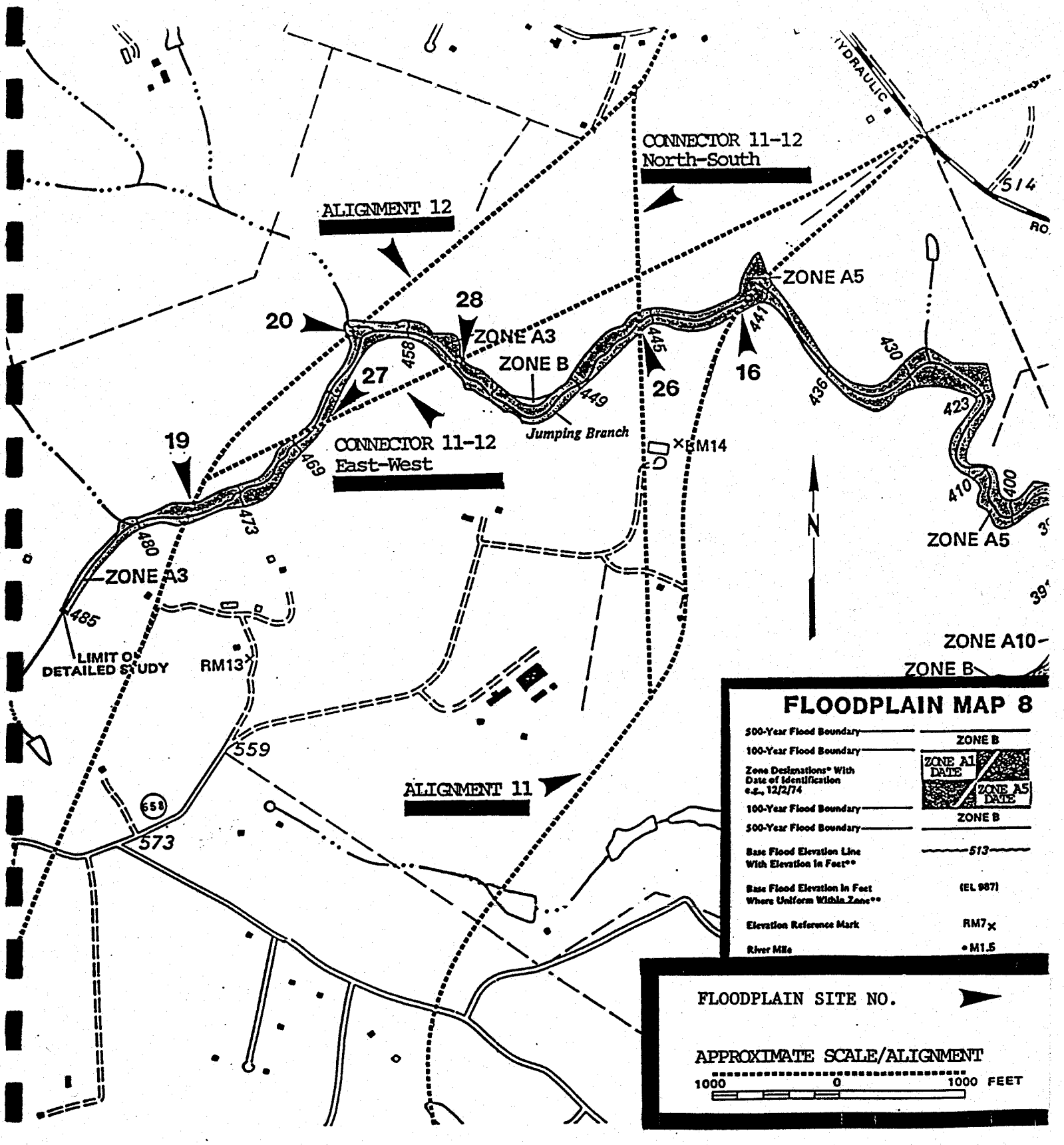

CONNECTOR 11-12
North-South
ALIGNMENT 12
ZONE A5
28
20
ZONE A3
ZONE B
27
26
16
Jumping Branch
CONNECTOR 11-12
East-West
19
RM14
ZONE A5
ZONE A3
LIMIT OF
DETAILED STUDY
RM13
ZONE A10
ZONE B
ALIGNMENT 11
FLOODPLAIN MAP 8
500-Year Flood Boundary
100-Year Flood Boundary
ZONE B
Zone Designations* With Date of Identification e.g., 12/2/74
ZONE A1 DATE
ZONE A5 DATE
100-Year Flood Boundary
500-Year Flood Boundary
ZONE B
Base Flood Elevation Line With Elevation In Feet**
513
Base Flood Elevation In Feet Where Uniform Within Zone**
(EL 987)
Elevation Reference Mark
RM7
River Mile
M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
1000
0
1000 FEET

Figure 3.27

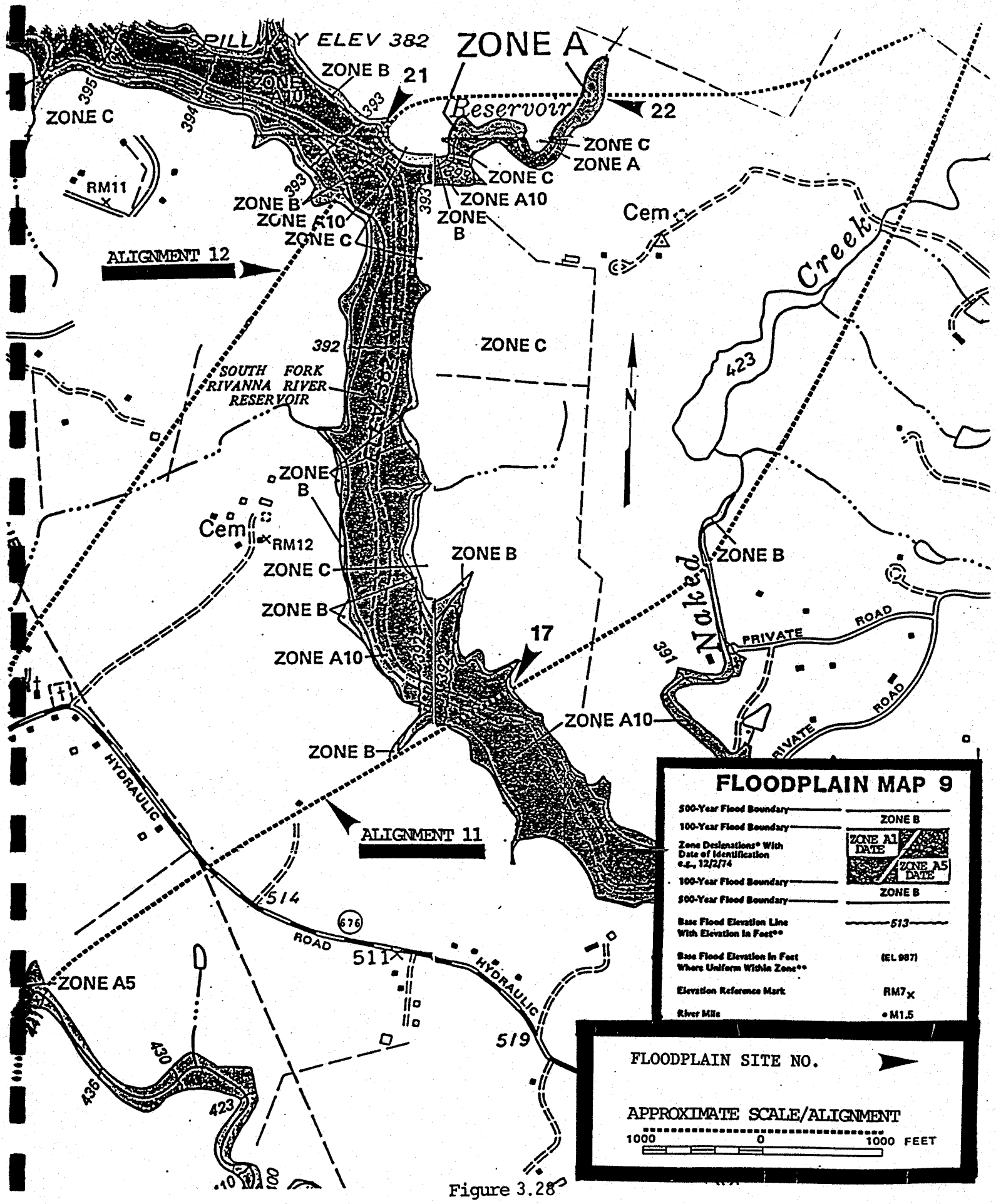

PILLWAY ELEV 382
ZONE A
ZONE B
21
ZONE A10
Reservoir
22
ZONE C
395
394
393
ZONE C
ZONE A
RM11
ZONE C
ZONE B
ZONE A10
ZONE A10
ZONE C
ZONE B
Cem
ALIGNMENT 12
Creek
392
ZONE C
423
SOUTH FORK
RIVANNA RIVER
RESERVOIR
N
ZONE B
Cem
RM12
ZONE B
ZONE C
ZONE B
ZONE B
Naked
PRIVATE ROAD
17
ZONE A10
391
ZONE A10
ZONE B
HYDRAULIC
ALIGNMENT 11
514
676
ROAD
511
HYDRAULIC
ZONE A5
519
430
436
423
FLOODPLAIN MAP 9
500-Year Flood Boundary
ZONE B
100-Year Flood Boundary
Zone Designations* With Date of Identification e.g., 12/2/74
ZONE A1 DATE
ZONE A5 DATE
100-Year Flood Boundary
500-Year Flood Boundary
ZONE B
Base Flood Elevation Line With Elevation In Feet**
513
Base Flood Elevation In Feet Where Uniform Within Zone**
(EL 987)
Elevation Reference Mark
RM7
River Mile
M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
1000
0
1000 FEET

Figure 3.28

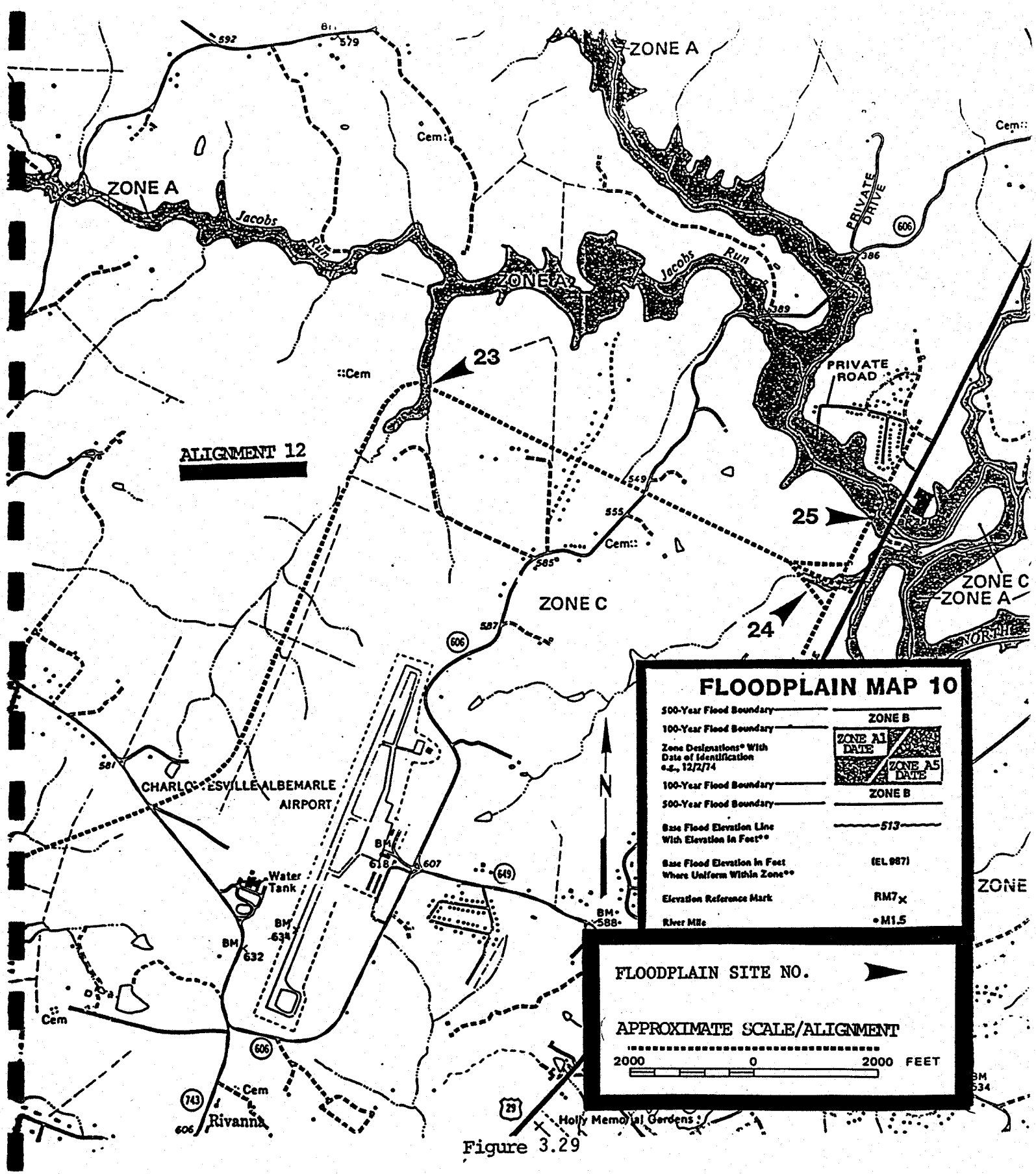

ZONE A
ZONE A
Jacobs Run
ZONE A
Jacobs Run
PRIVATE DRIVE
PRIVATE ROAD
23
24
25
ALIGNMENT 12
ZONE C
ZONE C
ZONE A
CHARLOTTESVILLE-ALBEMARLE AIRPORT
Water Tank
Rivanna
Holly Memorial Gardens
FLOODPLAIN MAP 10
500-Year Flood Boundary
100-Year Flood Boundary
ZONE B
Zone Designations* With Date of Identification e.g., 12/2/74
ZONE A1 DATE
ZONE A5 DATE
100-Year Flood Boundary
ZONE B
500-Year Flood Boundary
Base Flood Elevation Line With Elevation In Feet**
513
Base Flood Elevation In Feet Where Uniform Within Zone**
(EL 987)
Elevation Reference Mark
RM7
River Mile
M1.5
FLOODPLAIN SITE NO.
APPROXIMATE SCALE/ALIGNMENT
2000 0 2000 FEET

Figure 3.29

4.0 IMPACTS

4.1 AQUATIC RESOURCES AND WATER QUALITY

4.1.1 General Impacts

Water quality impacts to streams from construction and operation of roadways may result in short and long-term impacts. Short-term water quality impacts are generally associated with construction and usually cease or greatly decrease upon completion of construction. Long-term impacts result from highway operation and maintenance and these are usually minimal and often may be completely avoided by proper construction procedures.

The most significant short-term water quality impact will result from erosion and associated sedimentation. Erosion will result from excavation activities such as clearing and grubbing, rechannelization, stream relocation, removal of riparian vegetation, bridging, and movement of equipment. After entering streams, the eroded material will increase turbidity levels and sedimentation downstream. Excessive quantities of suspended solids can harm fish and other aquatic life by coating gills, smothering benthic organisms, reducing solar radiation intensity, and thus, affecting the food chain. Deposition of suspended solids may significantly alter the substrate composition of stream beds. It may interfere with primary production, the spawning of freshwater fishes, smother benthic fauna, and reduce substrate utilization.

Eroded material may contain large amounts of organic matter and nutrients, such as nitrogen and phosphorus. High inputs of organic matter may result in an increase in biochemical oxygen demand decreasing dissolved oxygen concentrations. Additionally, inputs of nutrients can increase both turbidity and eutrophication by increasing algae production. This in turn may affect the dissolved oxygen concentration by increasing photosynthetic activity during the day and increasing community respiration at night. Increased primary production could result in supersaturated DO values, whereas increased community respiration, and oxygen consumption, could result in low dissolved oxygen concentrations in area streams.

Erosion typically results in short-term impacts, although some affects may be long-term. Alteration of streambed substrates as a result of sedimentation may destroy benthic habitat and displace invertebrates; recovery could take years, and habitats are likely to be permanently altered. Sedimentation in reservoirs and lakes would reduce suitable fish and wildlife habitats.

Siltation traps organic matter on the bottom and creates an oxygen demand which may result in gas evolution and objectionable anaerobic conditions. Turbidity delays self purification of water and allows distant transport of organic wastes. Silt flocculates planktonic algae and carries it to the bottom to die. Absorption of particulate matter increases the settling rate of bacteria. Silt absorbs oil and precipitates, which remains a source of pollution since agitation of the bottom can ultimately resuspend the oil in the water column.

Roadway runoff may introduce toxic substances such as heavy metals, petroleum products, and deicing salts to streams. These substances are associated with the use and maintenance of the roadway. Heavy metals such as lead, iron, zinc, and cadmium are deposited on roadways from automobile attrition, gasoline combustion, and spills. After entering a body of water, heavy metals can become bound to sediments and uptaken by lower trophic level organisms and ultimately may be passed up the food chain to fish and man. Van Hassel et. al. (1980) showed that metal concentration increased during maximum runoff periods and that sediment metal concentrations could be correlated with traffic volume.

Highway runoff is a source of petroleum based chemicals from vehicles and pavement leachates. These substances coat and destroy benthic invertebrates, algae, and plankton, they interfere with reaeration and photosynthesis, and may produce direct toxic effects on in-stream organisms if intake concentrations are high. These substances may taint the odor and taste of fish tissue and render it useless for food to man.

The use of deicing salts during winter may impact aquatic biota by increasing salt concentrations in streams. The effects may be limited to the vicinity of the highway, depending upon the amounts of salt applied and precipitation/runoff. The effects of deicing salts may cause long-term adverse impacts on stream biota.

In summary, water quality impacts from construction and operation of a roadway may have both short-term and long-term components. Short-term impacts result from erosion and sedimentation during construction, whereas long-term impacts result from both sedimentation and operation of the roadway (i.e., runoff, right of way maintenance). Construction activities may increase erosion of exposed soils and increase runoff. Increased runoff may further increase inputs of nitrogen and phosphorus promoting eutrophication. The major impact on surface water quality, however, will be due to an increase in suspended solids and sedimentation in stream ecosystems.

4.1.2 Specific Impacts

Each alignment is characterized on the basis of water quality, numbers of stream crossings, and impacts on watersheds. Of particular concern were impacts on the South Fork Rivanna River Reservoir, as well as impacts on designated scenic and natural trout waters. Models of runoff were used to assess ecological impacts upon completion of highway construction. A summary of impacts on streams, the reservoir, wetlands, and floodplains is outlined for each alignment in Table 4.1, with specific impacts on streams within the South Fork Rivanna River watershed listed in Table 4.2.

TABLE 4.1
COMPOSITE LIST OF STREAM, RESERVOIR, WETLANDS, AND FLOODPLAIN IMPACTS ALONG EACH PROPOSED ALIGNMENT

ALIGNMENT	LENGTH (MILES)	STREAM CROSSINGS	LENGTH ACROSS RESERVOIR WATERSHED (MILES)	STREAM CROSSINGS IN RESERVOIR WATERSHED	RESERVOIR CROSSINGS	WETLANDS SITES	TOTAL WETLANDS ACRES	FLOOD-PLAINS CROSSED
6	8.5	27	0	0	0	5	1.512	7
6B	8.5	26	0	0	0	3	0.149	5
7	7.5	26	0	0	0	4	0.178	9
8,9	3.2	4	0	0	0	1	0.146	0
10	5.1	13	4.2	10	0	1	0.138	0
11	8.9	28	7.4	19	1	3	0.293	4
12	12.0	41	8.4	23	1	4	0.571	8
11N/12S	9.8	36	8.3	27	1	4	0.540	5
12N/11S	11.5	34	7.9	16	1	3	0.324	7

TABLE 4.2
STREAM AND RIVER CROSSINGS IN THE SOUTH FORK RIVANNA RIVER RESERVOIR WATERSHED BY ALIGNMENTS AND STREAM ORDER

	STREAM ORDER					
ALIGNMENT	1	2	3	4	>4	TOTAL
6	0	0	0	0	0	0
6B	0	0	0	0	0	0
7	0	0	0	0	0	0
8,9	0	0	0	0	0	0
10	8	2	0	0	0	10
11	12	1	4	1	1	19
12	13	5	3	1	1	23
11N/12S	16	3	6	1	1	27
12N/11S	10	3	2	1	0	16

Overall, water quality within the study area is good. No problem areas were identified based on results from the year-long sampling effort. Pollution sources are generally non-point, resulting from runoff from highways and agricultural areas. This tends to impact on larger bodies of water such as the South Fork Rivanna River Reservoir. Construction of a large highway would certainly add to the non-point pollution sources in the county, and possibly contribute to point sources given the possibility of a hazardous waste spill.

4.1.2.1 Alignment 6

Alignment 6 crosses a total of 27 streams, impacting portions of the North Fork Rivanna River, South Fork Rivanna River, and the Rivanna River Watersheds. None of these stream crossings impact the South Fork Rivanna River Reservoir Watershed. The majority of stream crossings impacted on this alignment are over smaller, first-order streams (78%). Crossings of the South Fork Rivanna River and over the Rivanna river area each 70 feet wide, and should be given special consideration. Both are designated class III natural trout waters. Furthermore, the Rivanna River is designated as a State Scenic River south of Interstate 64, where possible degradation of water quality could occur as a result of highway construction. This degradation would of course be temporary and would be mitigated by following best management practices to reduce sediment runoff during construction.

4.1.2.2 Alignment 6B

Alignment 6B crosses 26 streams, impacting portions of the North Fork Rivanna River, South Fork Rivanna River, and Rivanna River Watersheds. None of the crossings impact on the South Fork Rivanna River Reservoir Watershed. Most stream crossings are over smaller, first-order streams (85%), with one crossing over a 70 foot wide stretch of the North Fork Rivanna River. As with Alignment 6, impacts on trout waters and the Scenic portion of the Rivanna River must be considered during upstream construction.

4.1.2.3 Alignment 7

Alignment 7 overlaps with Alignment 6 over most of the corridor. A total of 26 streams are crossed by this option, impacting portions of the North Fork Rivanna, South Fork Rivanna, and Rivanna River Watersheds. No stream crossings affect the South Fork Rivanna River Reservoir Watershed. A lower proportion of streams crossed by this alignment are smaller first-order streams (62%), with an increased percentage falling into the third-order classification (23%). This option crosses the 70 foot wide stretch of the South Fork Rivanna River like Alignment 6, but avoids a second crossing of the Rivanna River. Impacts on state designated trout and scenic waters must be considered as with Alignment 6 and 6B.

4.1.2.4 Alignments 8 and 9

Upgrades to existing Route 29 are considered by Alignment 8 (8-lane expressway) and 9 (10-lane expressway) from 1/4 mile south of the South Fork Rivanna River to the Route 29/250 bypass. Three first-order streams and one second-order stream may be impacted by this upgrade. This area is developed and the stream areas disturbed. These streams are in the South Fork Rivanna River and Rivanna River Watersheds, and do not impact on the Reservoir Watershed.

4.1.2.5 Alignment 10

Alignment 10 represents the shortest of the study options, and crosses the fewest number of creeks, 13, with 85% of these representing smaller, first-order streams. Ten of these streams are within the South Fork Rivanna River Watershed. Though this alignment is within the watershed of the reservoir, it does not actually cross the reservoir or any major tributaries to the reservoir, with the other two streams (15%) crossed representing second-order tributaries.

4.1.2.6 Alignment 11

Alignment 11 is predominately within the watershed of the South Fork Rivanna River Reservoir, with 19 of the 28 stream crossings potentially impacting the reservoir. This alignment actually crosses the reservoir at one site, and crosses Naked Creek three times and Jumping Branch once (third-order streams), and Ivy Creek once (fourth-order), all major tributaries to the reservoir. Six other streams are within the South Fork Rivanna River Watershed (below the Reservoir), with the other three sites in common with Alignments 10 and 12 in the Rivanna River Watershed. Of the 28 crossings along this alignment, 68% are over smaller, first-order streams, with second and third-order streams representing 10% and 14% of the total respectively.

4.1.2.7 Alignment 12

Alignment 12 is the longest of the options considered, and crosses a total of 41 streams, more than any other alignment. Just over half (56%) of these stream crossings are within the South Fork Rivanna River Reservoir Watershed, with second, third, fourth, and greater than fourth-order streams crossed 5,3,1 and 1 times respectively. As with Alignment 11, Naked Creek, Jumping Branch, and Ivy Creek are all crossed by this alignment as well as the reservoir itself. The rest of the stream crossings on the north side of Alignment 12 drain into the North Fork Rivanna River, with three on the south side draining into the Rivanna River Watershed.

4.1.2.8 Alignment 11N/12S

This crossover option, though not much longer than Alignment 11, crosses 29% more streams for a total of 36 sites. Of these, 27 (75%) are within the reservoir watershed, more streams within the watershed than any other option. One third of these streams are larger third-order or greater sites. With crossings over the South Fork Rivanna River Reservoir and some of the larger tributaries to this site, this option would have the greatest potential impact of all options on the counties largest drinking water supply.

4.1.2.9 Alignment 12N/11S

This option is nearly as long as Alignment 12, yet crosses fewer streams (34), with less than half of these (16) within the South Fork Rivanna River Reservoir. It also crosses fewer streams in the reservoir watershed than Alignment 11, though still crosses the reservoir and some major tributaries.

4.2 Wetlands

4.2.1 Direct Impacts

Assuming road construction would eliminate by filling all wetlands sites, alignments were compared based on the number, acreage, and functional values of the wetlands identified. Table 4.1 includes this comparison of sites and total acreage. Few wetlands sites were encountered during this study, and all but one were over 1/4 acre in size. This one sand bar by the Rivanna River would not be impacted greatly by bridging, or could be avoided altogether by a slight shift of Alignment 6. Including this site, Alignment 6 impacts on the greatest number (5) and area (1.512 acres) of wetlands. No other alignment impacts on more than 0.57 acres of wetlands.

4.2.2 Indirect Impacts

Due to the small size and low functional values of the wetlands encountered during the Route 29 bypass study, few indirect impacts are likely from elimination. These wetlands were not large enough to control erosion or water quality, and had little merit in terms of wildlife habitat. The one site along the Rivanna River could provide recreational value with improved access. It is quite possible that road construction along any of the build alignments may alter hydrology in some areas. In this manner, more wetlands may be created than are disturbed as a result of the construction process.

4.3 Ground Water

4.3.1 General Impacts

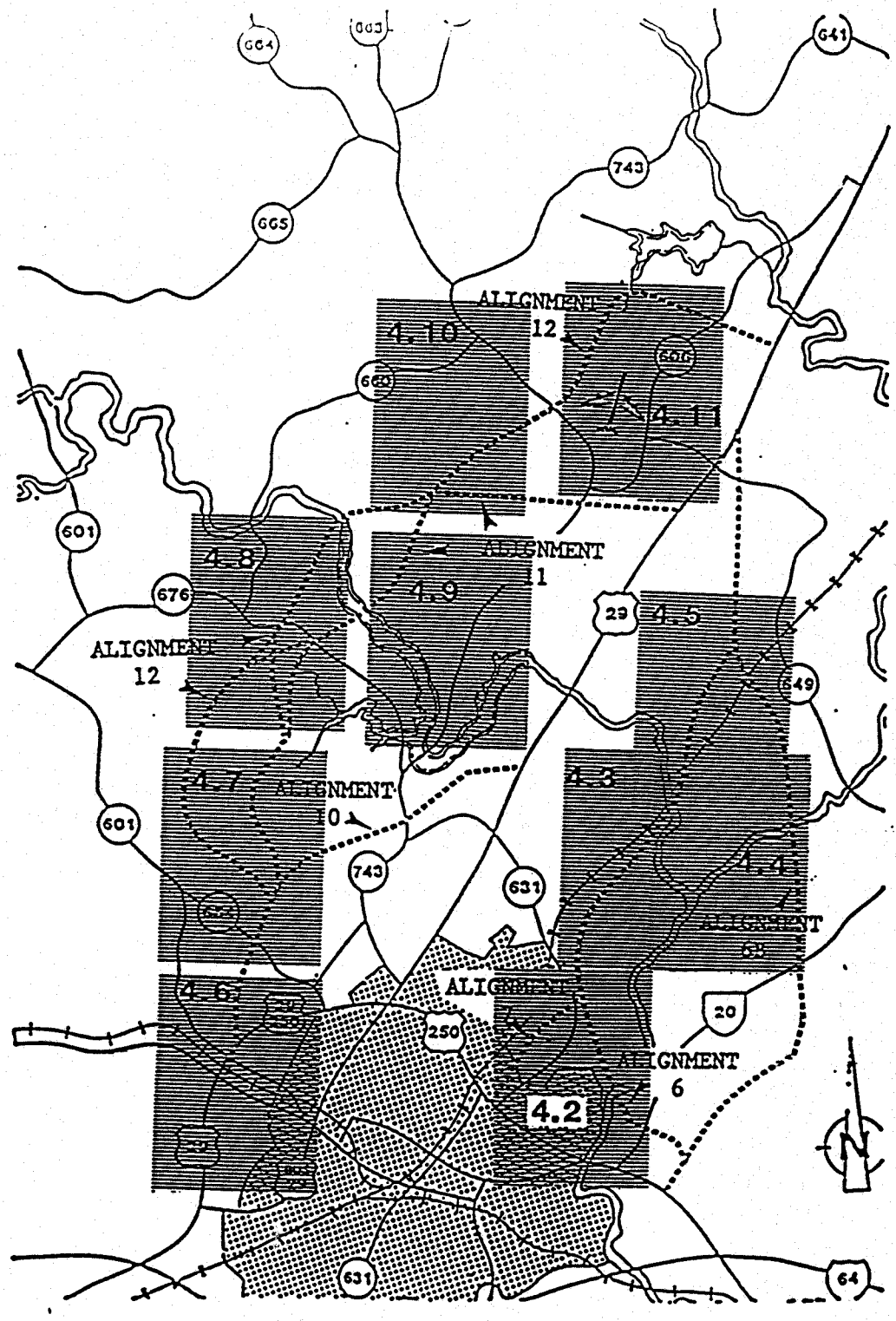
Highway construction can influence ground water storage levels by interrupting groundwater flow, reducing aquifer recharge area, and lowering the water table in the surrounding area. In addition, runoff from the highway can potentially degrade water quality.

On a regional scale, ground water impacts of the proposed highway would be minimal. Numerous aquifers are available for use in the project area and ample precipitation exists for aquifer recharge. The recharge areas of the major aquifers are relatively extensive; and the project area water table aquifer provides a reservoir for ground water which recharges the confined aquifers. Water quality is generally acceptable in the study area, and the nature of the piedmont sediments helps filter out pollutants that enter the ground water.

In areas where the water table is less than six feet below the base course of the proposed highway, the drainage pattern could be altered such that flow is diverted away from the road bed, thus interfering with ground water flow. This could decrease the amount of ground water available to wells in the immediate area which rely on the water table aquifer. The water table in the project area is typically greater than six feet beneath the surface. Areas exhibiting high water tables are identified in Figures 4.1 through 4.11.

Another potential impact of the proposed highway on ground water storage (of artesian aquifers) involves a reduction of recharge potential. This impact will be minimal however, as the recharge areas of the major aquifers are very large in comparison to the area which would be covered by the highway. However, subsequent secondary development along the route will increase this impact.

Ground water contamination may occur along the highway. Potential pollutants include deicers, pesticides and herbicides, accidental spills of hazardous materials during transportation, pavement tars, and vehicle emissions. The soils in the project area typically have low clay contents, therefore, pollutants have a good chance of reaching ground water and localized contamination may occur. The unconsolidated nature of the sediments however, will help filter pollutants and decrease the possibility of regional ground water quality impacts. Impacts on artesian aquifers would be basically limited to recharge areas. If a major spill of hazardous material occurred within one of these areas, the water within the aquifer could become contaminated.



INDEX TO HIGH GROUNDWATER SOIL MAPS

Figure 4.1

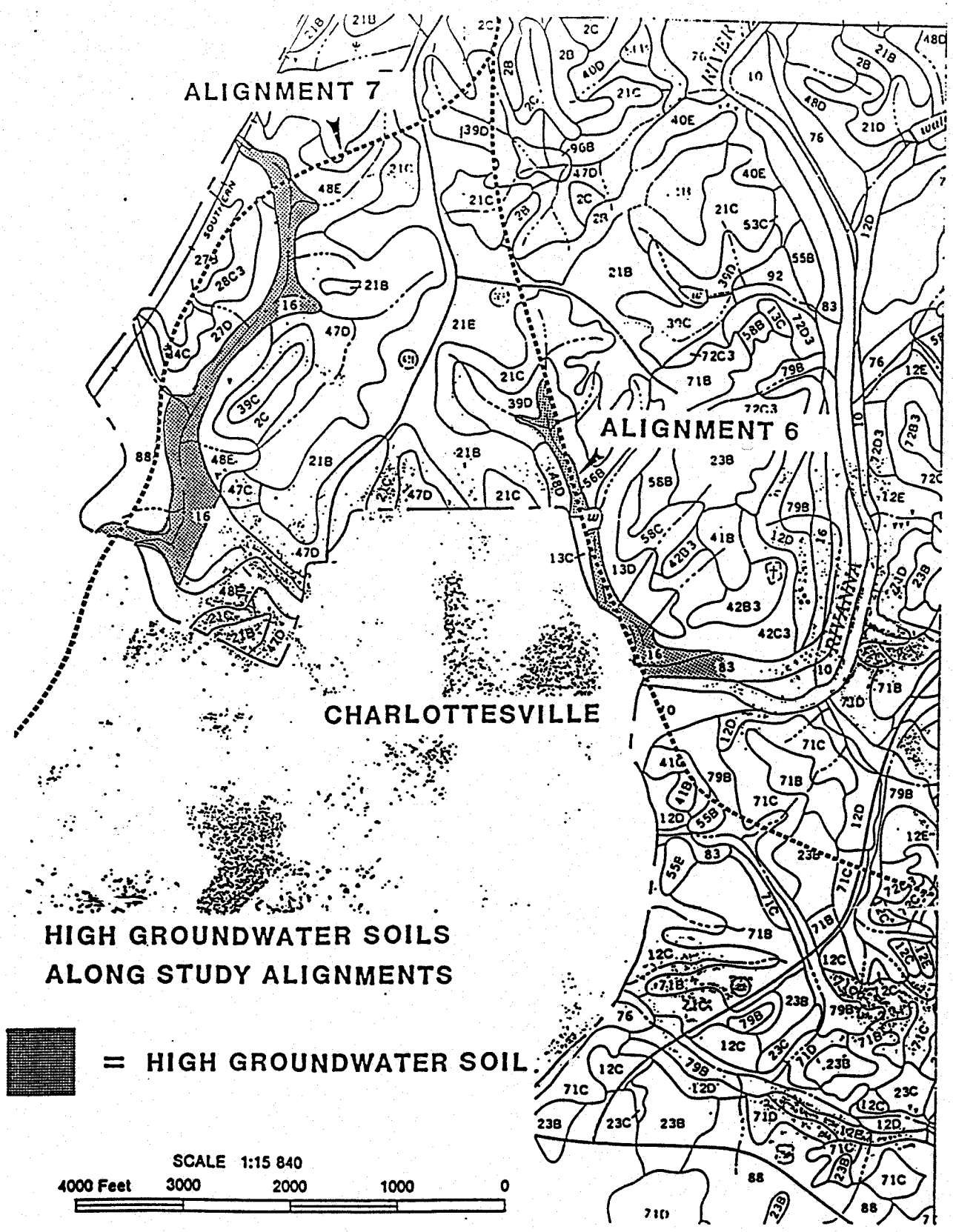

ALIGNMENT 7
ALIGNMENT 6
CHARLOTTESVILLE
HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL.
SCALE 1:15 840
4000 Feet 3000 2000 1000 0

Figure 4.2

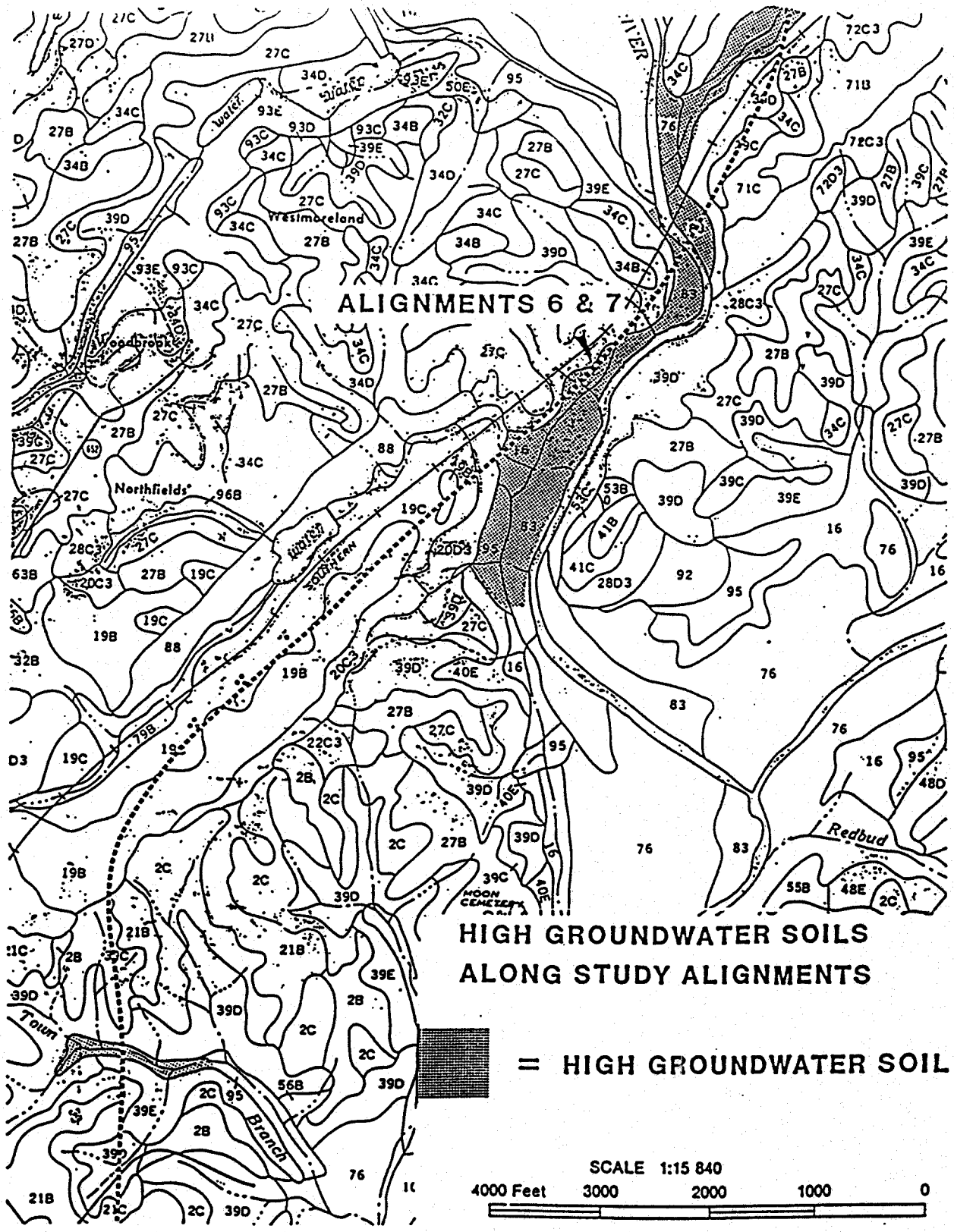

ALIGNMENTS 6 & 7
HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL
SCALE 1:15 840
4000 Feet 3000 2000 1000 0
Westmoreland
Woodbrook
Northfields
Redbud
Town
Branch
MOON CEMETERY

Figure 4.3

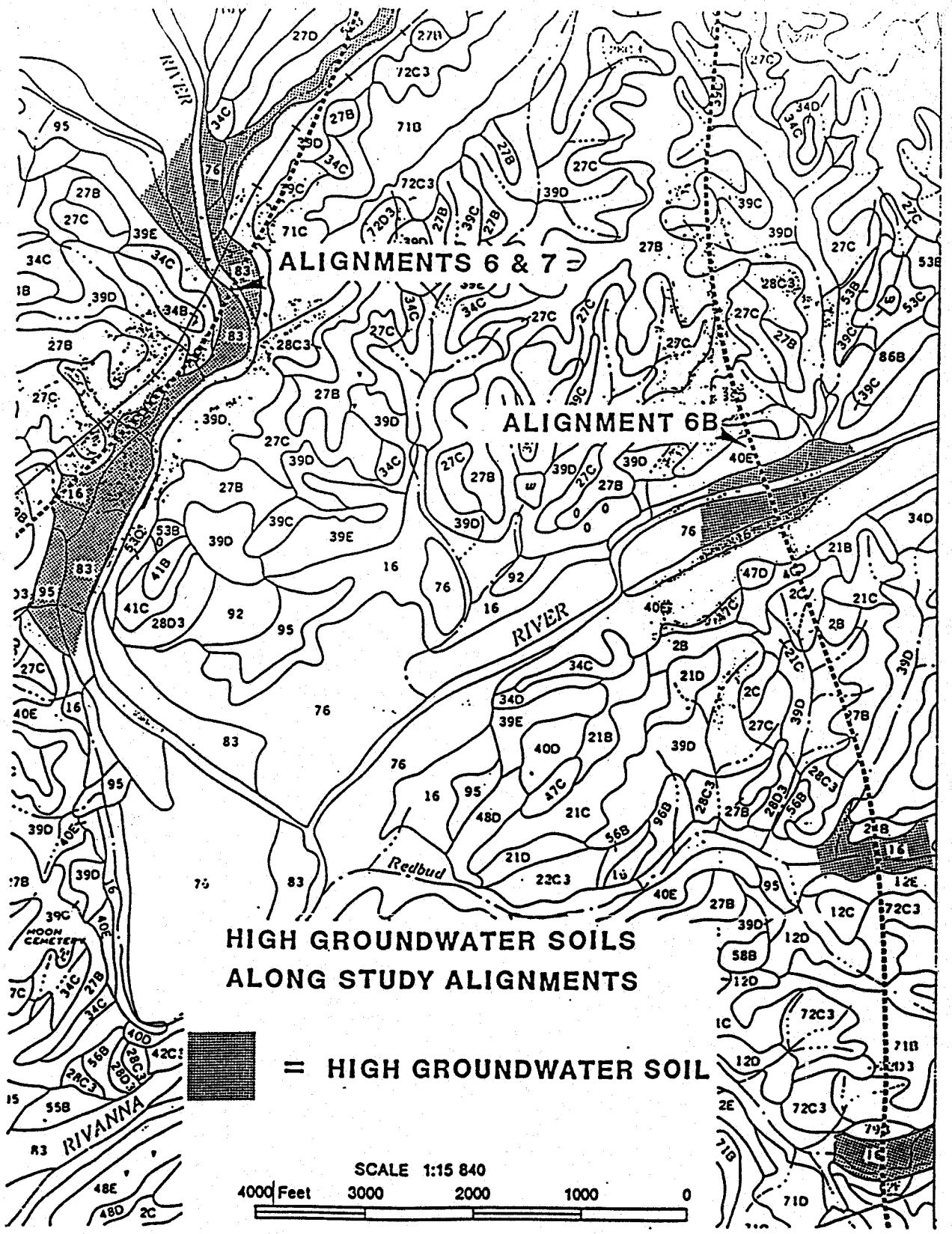

ALIGNMENTS 6 & 7
ALIGNMENT 6B
RIVER
Redbud
RIVANNA
HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL
SCALE 1:15 840
4000 Feet 3000 2000 1000 0

Figure 4.4

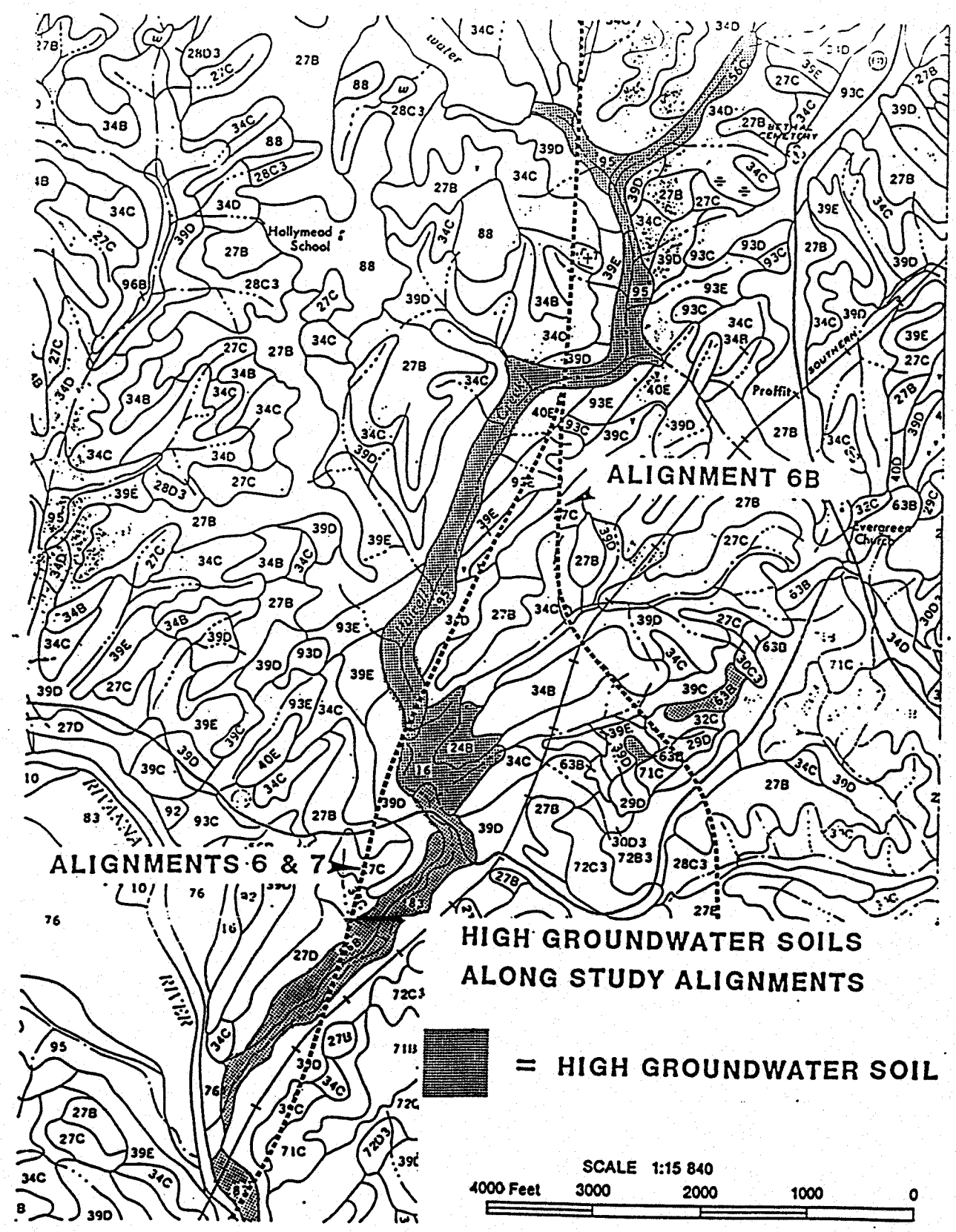

ALIGNMENT 6B
ALIGNMENTS 6 & 7
Hollymead School
Proffit
Evergreen Church
HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL
SCALE 1:15 840
4000 Feet 3000 2000 1000 0

Figure 4.5

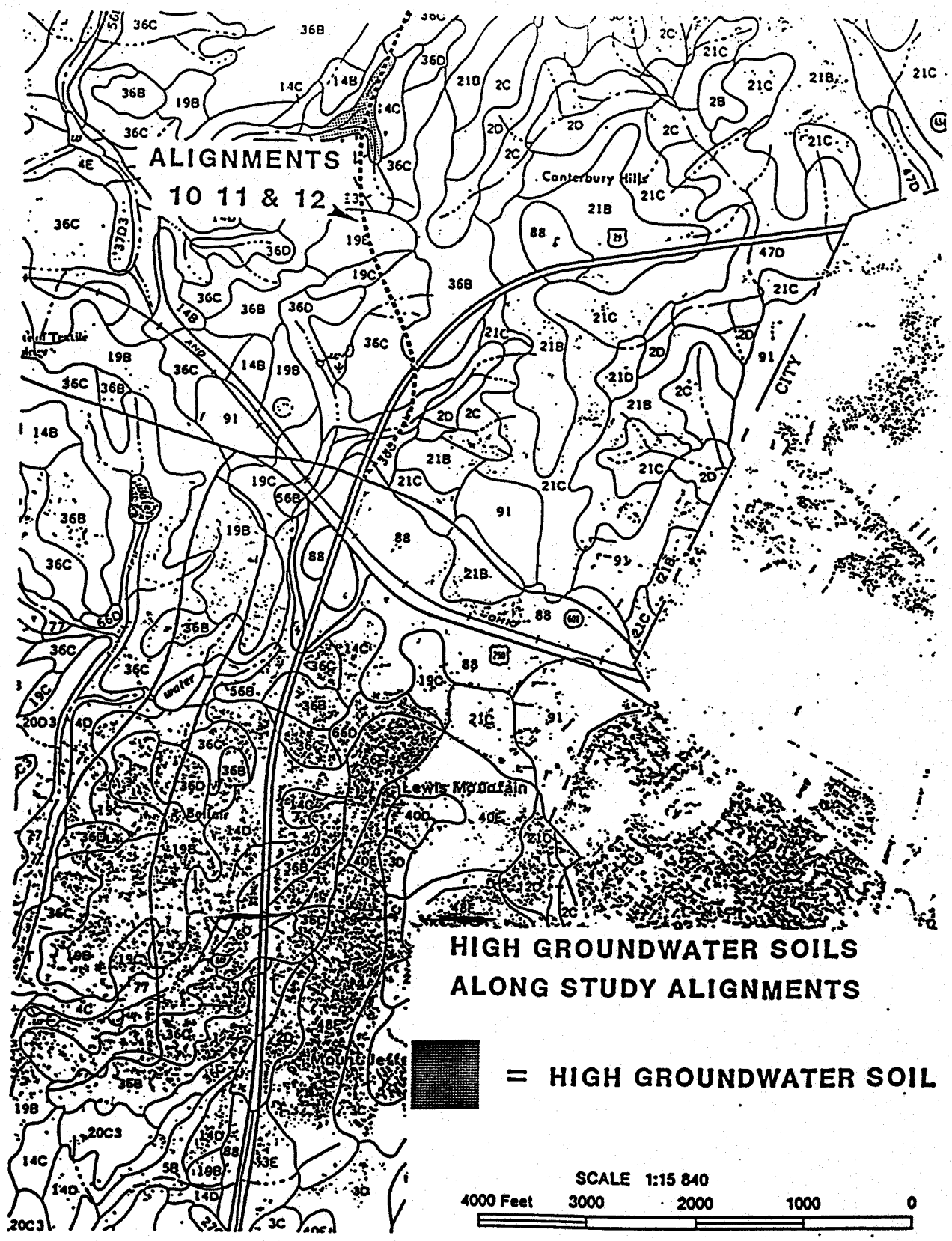

ALIGNMENTS
10 11 & 12
Canterbury Hills
Lewis Mountain
Mount Dell
CITY
HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL
SCALE 1:15 840
4000 Feet 3000 2000 1000 0

Figure 4.6

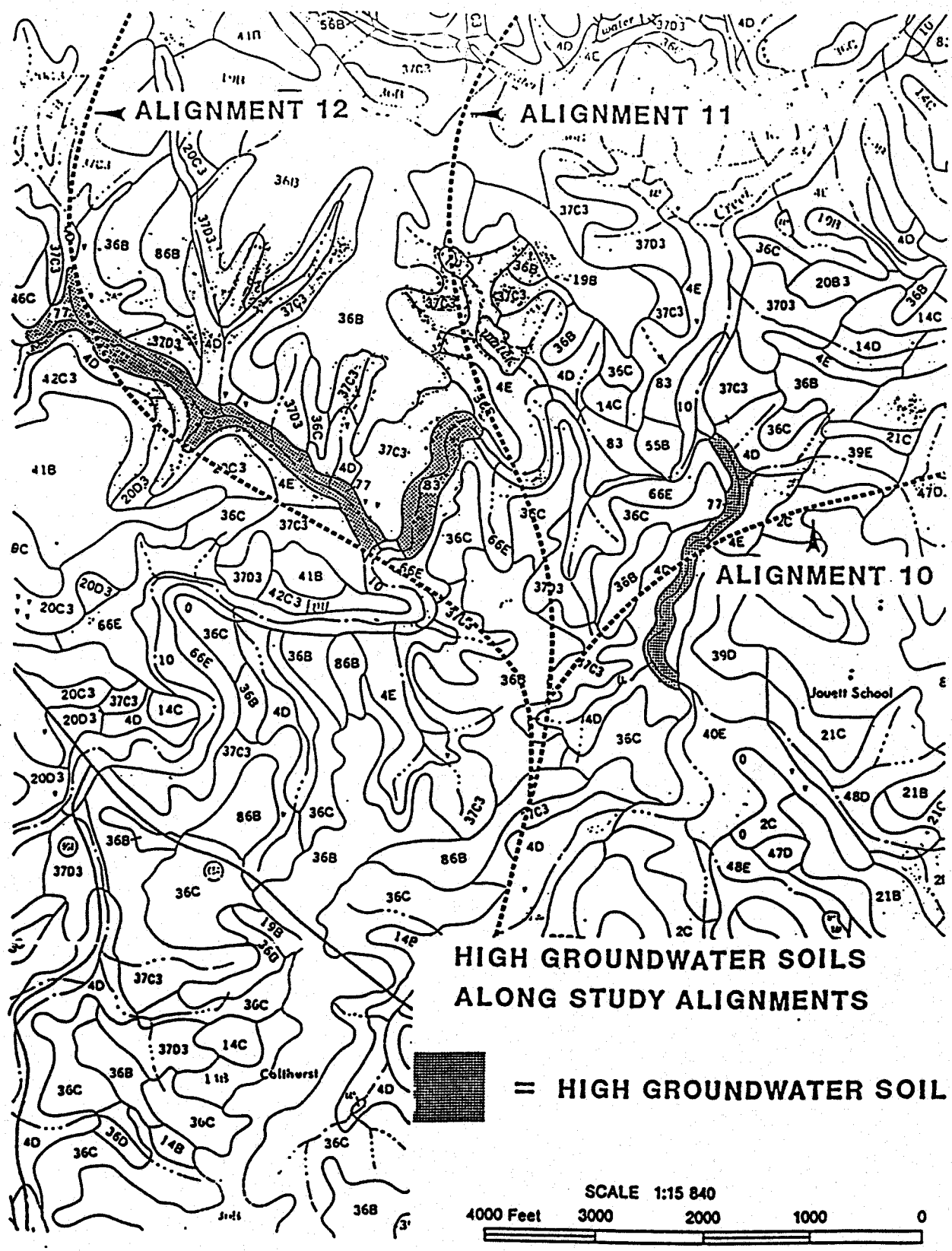

ALIGNMENT 12
ALIGNMENT 11
ALIGNMENT 10
Jovett School
Colthurst
HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL
SCALE 1:15 840
4000 Feet
3000
2000
1000
0

Figure 4.7

HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL
SCALE 1:15 840
4000 Feet 3000 2000 1000 0
ALIGNMENT 12
ALIGNMENT 11
CONNECTOR 11–12
(E–W)
CONNECTOR 11–12
(N–S)
SOUTH FORK
RIVANNA
RIVER
ROSEMONT
Ivy Creek Church

Figure 4.8

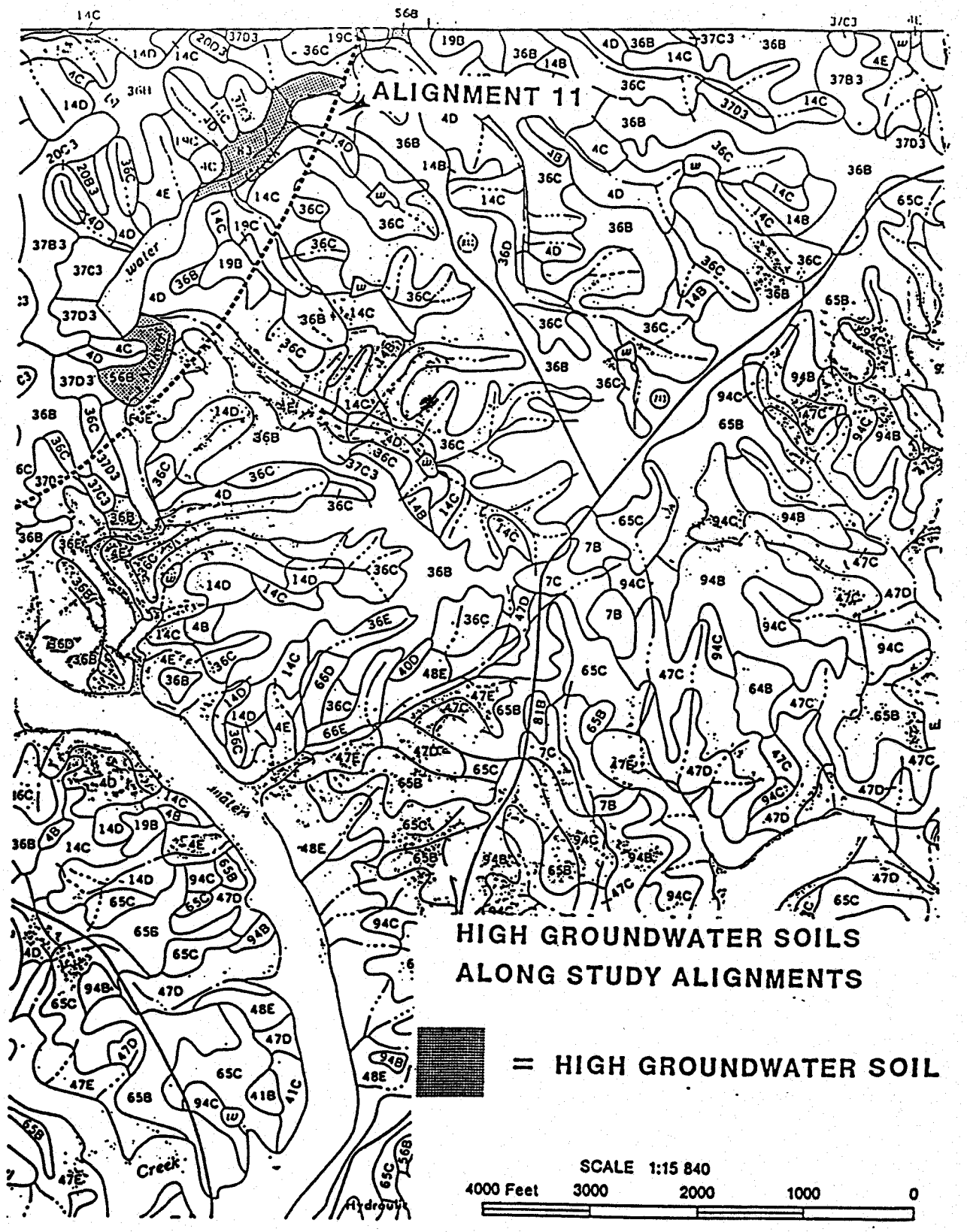

ALIGNMENT 11
HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL
SCALE 1:15 840
4000 Feet
3000
2000
1000
0

Figure 4.9

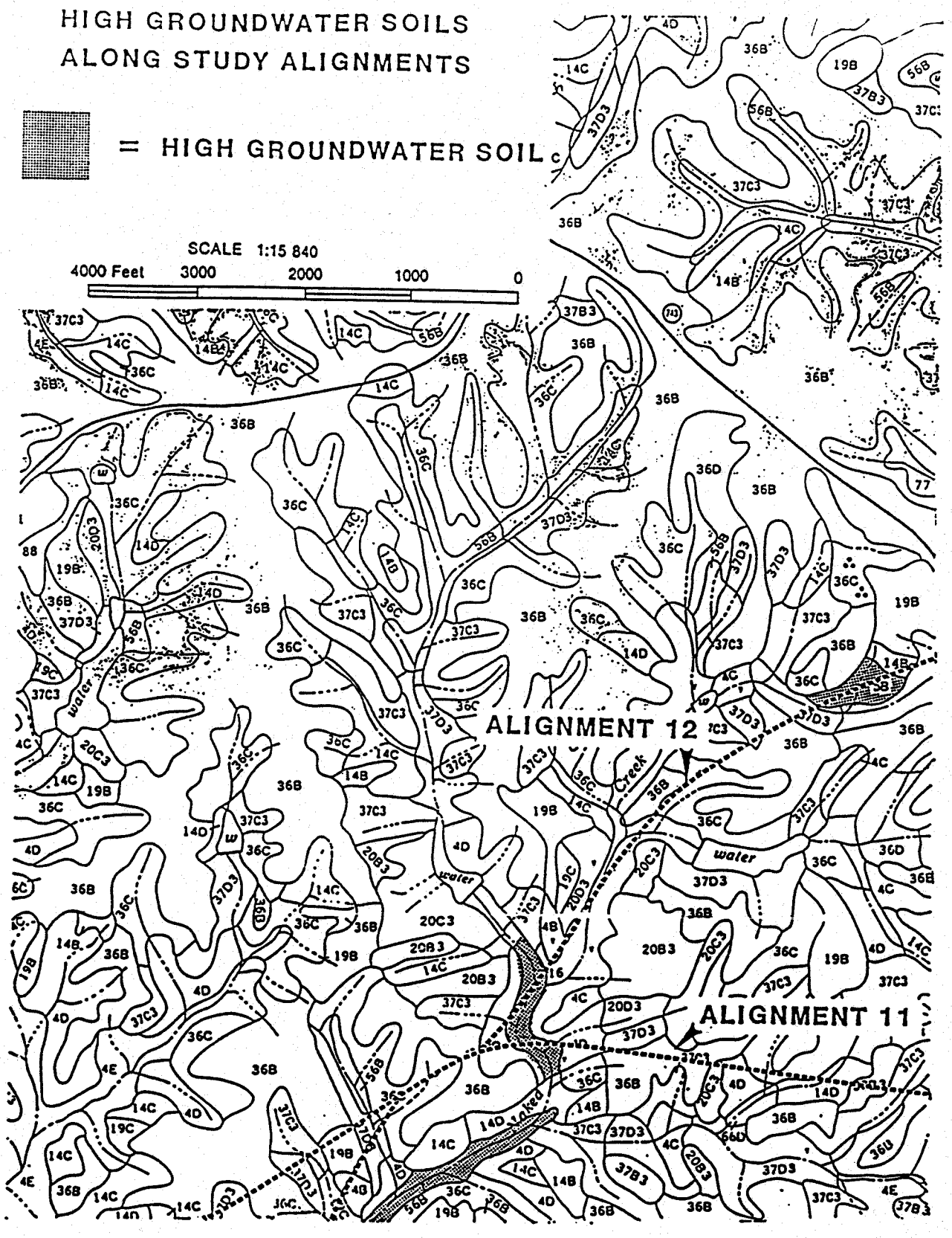

HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL
SCALE 1:15 840
4000 Feet 3000 2000 1000 0
ALIGNMENT 12
ALIGNMENT 11
Creek
water

Figure 4.10

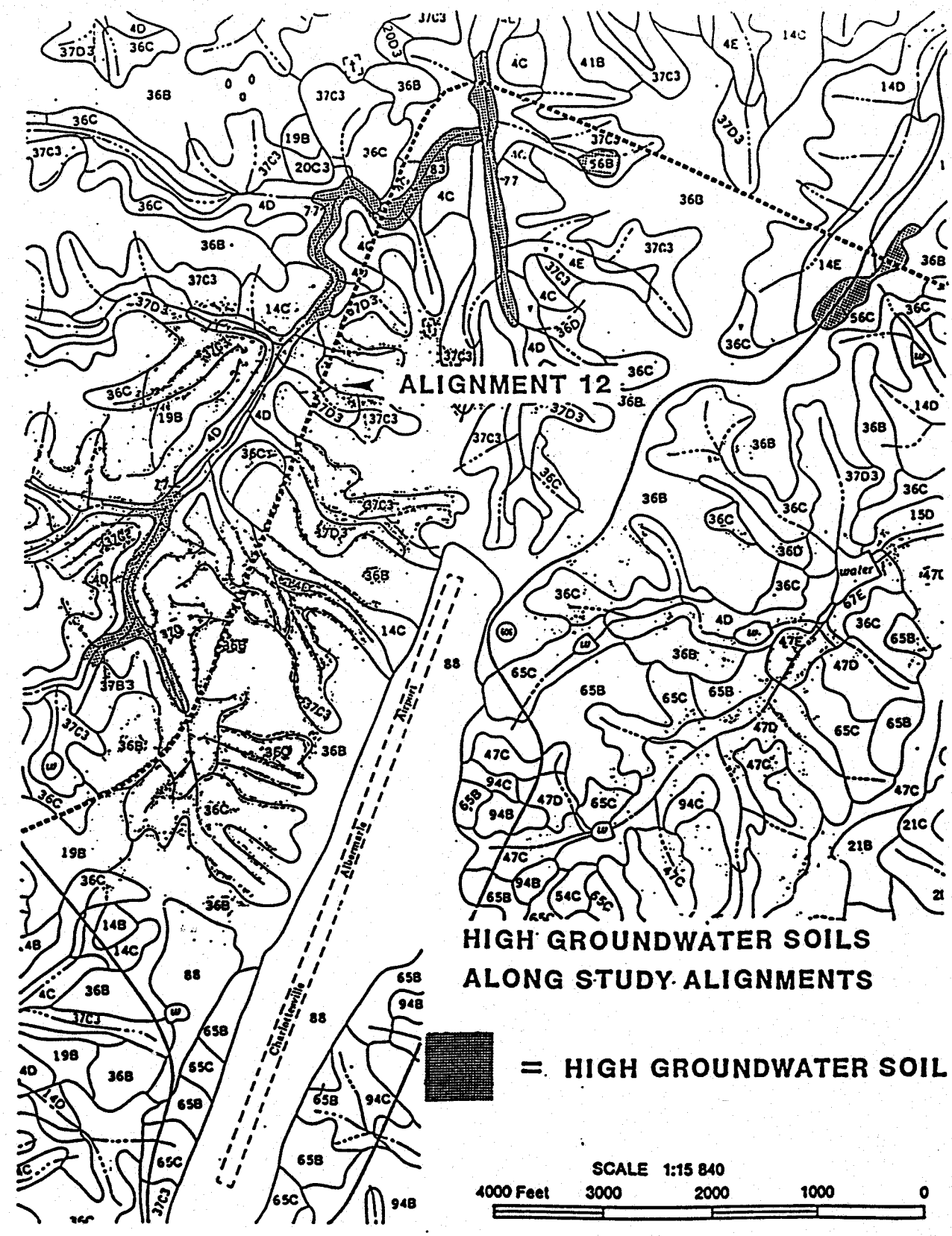

ALIGNMENT 12
HIGH GROUNDWATER SOILS
ALONG STUDY ALIGNMENTS
= HIGH GROUNDWATER SOIL
SCALE 1:15 840
4000 Feet
3000
2000
1000
0
Airport
Charlottesville
Albermarle
water

Figure 4.11

4.4 Surface Hydrology

4.4.1 Flood Impacts Due To Construction

This section of the study involved assessing the overall impacts of location and simple design of encroachments on floodplains for twenty-eight stream crossings (Figure 4.12). The important aspects of the design criteria included avoidance of longitudinal encroachments and significant encroachments. Encroachment is defined as any construction, reconstruction, repair, rehabilitation, or improvement undertaken within the limits of the 100-year floodplain.

Encroachment into floodplain lands by development or other land uses can result in increased danger to life, health and property; public costs for flood control measures, rescue and relief efforts; soil erosion, sedimentation and siltation; pollution of water resources, and general degradation of the natural and man-made environment.

The extent to which construction will impact flooding is directly associated to the amount of area the construction occupies within the floodplain. Increased stream velocity, created by construction activities, is also a critical concern during a flood condition.

The physical size of the support structure required to traverse the floodplain and the goal of minimizing the amount of encroachment in the floodplain are the primary considerations during the preliminary design phase. A structure that spans a large floodplain, such as the Rivanna River north of Route 250, has the least impact on the floodplain. A culvert type structure would have greater encroachment on the floodplain and would require an elevated roadway. The culvert type design may be inappropriate for a large floodplain due to the extreme water volume during flooding, and the impact in upstream areas.

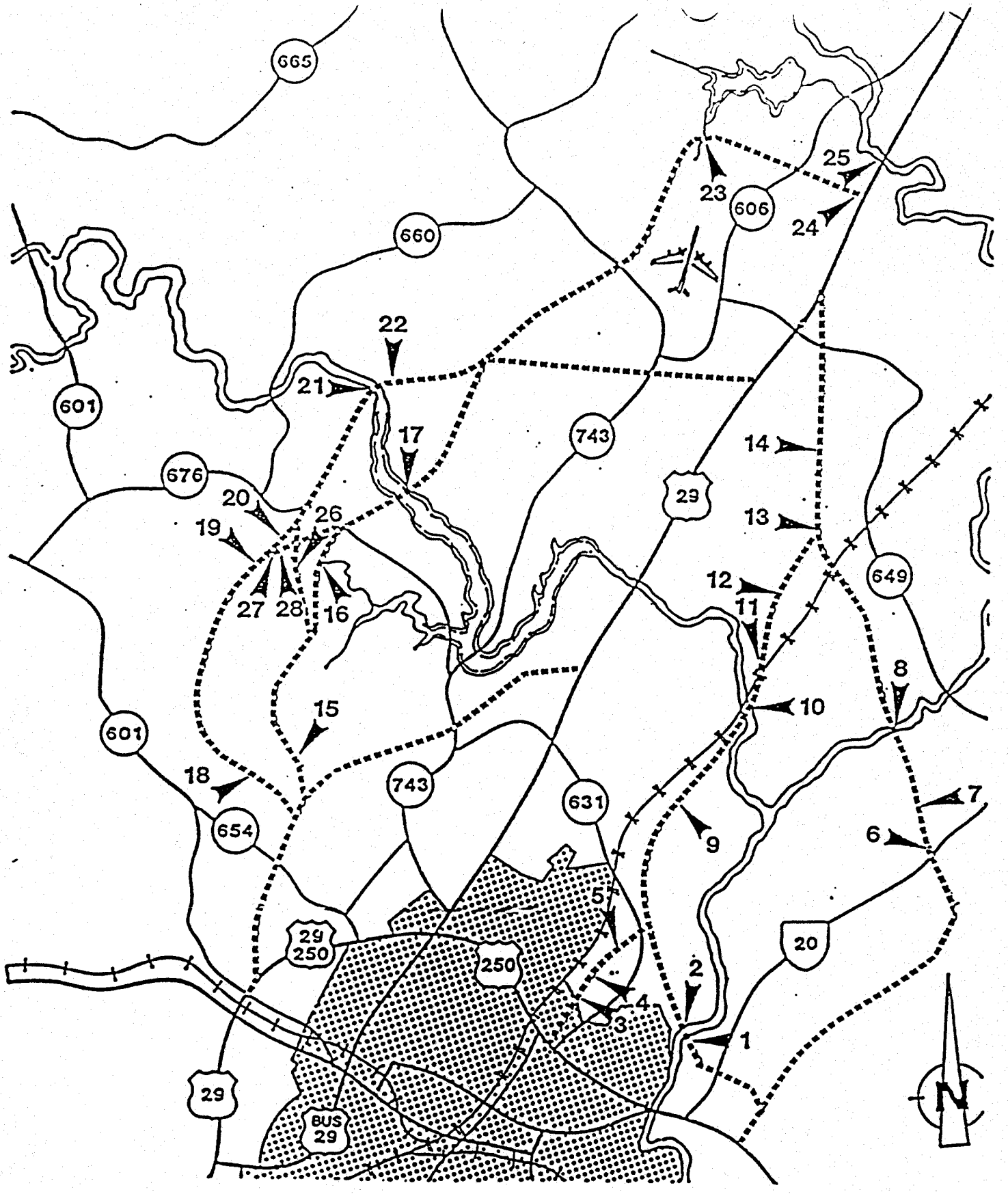
4.4.2 Potential Flood Problem Areas

The description of each 100-year floodplain area will begin with the southernmost site of each alignment and progress north. Fifteen of the twenty-eight floodplains are common to more than one alignment, as shown on Table 4.3, Floodplain Data and Traversing Distance. Floodplain Maps 1 through 10 (Figures 3.20 through 3.29) illustrate the floodplain locations and the proposed alignments.

4.4.2.1 Alignment 6

Floodplain Site Numbers 1 and 2 - Rivanna River.

The distances required to traverse the Rivanna River floodplain are 200 feet and 2,600 feet. The 200 foot distance is a result of the alignment passing between two floodplain borders, as shown on Floodplain Map 1. This site is common to alignments 6 and 7.



Study Area Floodplain Crossing Sites

FIGURE 4.12

TABLE 4.3
FLOODPLAIN DATA AND TRAVERSING DISTANCE

FLOODPLAIN SITE NO.	FLOODPLAIN MAP NO.	STREAM	ALIGNMENT	100-YR FLOODPLAIN LENGTH (FT)
1	1	Rivanna River	6	200
2	1	Rivanna River	6	2,660
3	2	Schenks Brook	7	220
4	2	Meadow Creek (Downstream)	7	1,000
5	2	Meadow Creek (Upstream)	7	340
6	3	Unnamed Stream (South of Redbud Creek)	6B	380
7	3	Redbud Creek	6B	220
8	3	North Fork Rivanna River	6B	680
9	4	Unnamed Stream (South of Westmoreland)	6 & 7	400
10	4 & 5	South Fork Rivanna River	6 & 7	420
11	4 & 5	Powell Creek (Downstream)	6 & 7	780
12	4, 5 & 6	Powell Creek (Upstream)	6 & 7	180
13	4, 5 & 6	Powell Creek (West of Proffit)	6, 6B & 7	220
14	6	Powell Creek (Southeast of Hollymead)	6, 6B & 7	440
15	7	Ivy Creek	11 & 12N/11S	220
16	8	Jumping Branch (South of Ivy Creek Church)	11	380
17	9	South Fork Rivanna River Reservoir	11 & 11N/12S	580

TABLE 4.3
FLOODPLAIN DATA AND TRAVERSING DISTANCE
(continued)

FLOODPLAIN SITE NO.	FLOODPLAIN MAP NO.	STREAM	ALIGNMENT	100-YR FLOODPLAIN LENGTH (FT)
18	7	Ivy Creek	12 & 11N/12S	300
19	8	Jumping Branch	12 & 11N/12S	160
20	8	Unnamed Tributary to Jumping Branch	12	180
21	9	South Fork Rivanna River Reservoir	12 & 12N/11S	540
22	9	Unnamed Tributary to South Fork Rivanna River Reservoir	12 & 12N/11S	180
23	10	Unnamed Tributary to Jacobs Run	12 & 12N/11S	160
24	10	Unnamed Tributary to North Fork Rivanna River	12 & 12N/11S	440
25	10	North Fork Rivanna River	12 & 12N/11S	640
26	8	Jumping Branch	12N/11S	160
27	8	Jumping Branch (Upstream)	11N/12S	280
28	8	Jumping Branch (Downstream)	11N/12S	120

Floodplain Site No. 10 - South Fork Rivanna River

The distance required to traverse the floodplain is 420 feet. The upper elevation of the 100-year floodplain is 356 feet while the river surface elevation fluctuates at slightly above 330 feet (msl). Small rapids exist at the proposed crossing site with many large, submerged boulders channeling the water to create increased water velocity. This site is common to alignments 6 and 7.

Floodplain Site No. 11 - Powell Creek (downstream)

The distance required to traverse the floodplain is 780 feet. The upper elevation of the 100-year floodplain is 357 feet (msl) while the creek surface elevation fluctuates at 350 feet (msl). This site is common to alignments 6 and 7.

Floodplain Site No. 12 - Powell Creek (upstream)

The distance required to traverse the floodplain is 180 feet. The upper elevation of the 100-year floodplain is 365 feet (msl) while the creek surface elevation fluctuates at 355 feet (msl). This site is common to alignments 6 and 7.

Floodplain Site No. 13 - Powell Creek (west of Proffit)

The distance required to traverse the floodplain is 220 feet. The upper elevation of the 100-year floodplain is 382 feet (msl) while the creek surface elevation fluctuates at 376 feet (msl). This site is common to alignments 6, 6B and 7.

Floodplain Site No. 14 - Powell Creek (southeast of Hollymead)

The distance required to traverse the floodplain is 440 feet. The upper elevation of the 100-year floodplain is 400 feet (msl) while the creek surface elevation fluctuates at 395 feet (msl). This site is common to alignments 6, 6B and 7. Construction of a residential area is underway north of site No. 14 along the stream bed which parallels Hollymead Drive.

4.4.2.2 Alignment 6B

Floodplain Site No. 6 - Unnamed Stream South of Redbud Creek

The distance required to traverse this stream is 380 feet. The upper elevation of the 100-year floodplain is 400 feet (msl) while the stream surface elevation fluctuates at 390 feet (msl). This floodplain has a one-way ramp on either side of the main alignment roadway, thus, consideration must be given to three floodplain crossings at one site.

Floodplain Site No. 7 - Redbud Creek

The distance required to traverse this creek is 220 feet. The upper elevation of the 100-year floodplain is 370 feet (msl) while the creek surface elevation fluctuates at 365 feet (msl).

Floodplain Site No. 8 - North Fork Rivanna River

The distance required to traverse the floodplain is 680 feet. The upper elevation of the 100-year floodplain is 354 feet (msl) while the river surface elevation fluctuates at 330 feet (msl). Immediately south of the river lies a grass plateau which drops 15 feet vertically to the river bottom. The north bank of the river has a similar vertical drop, however, the wood line extends nearly to the edge of the drop-off from the adjacent slope.

Floodplain Site No. 13 - Powell Creek (west of Proffit)

The distance required to traverse the floodplain is 220 feet. The upper elevation of the 100-year floodplain is 382 feet (msl) while the creek surface elevation fluctuates at 376 feet (msl). This site is common to alignments 6, 6B and 7.

Floodplain Site No. 14 - Powell Creek (southeast of Hollymead)

The distance required to traverse the floodplain is 440 feet. The upper elevation of the 100-year floodplain is 400 feet (msl) while the creek surface elevation fluctuates at 395 feet (msl). This site is common to alignments 6, 6B, and 7. Construction of a residential area is underway north of site No. 14 along the stream bed which parallels Hollymead Drive.

4.4.2.3 Alignment 7

Floodplain Site No. 3 - Schenks Brook

The distance required to traverse the floodplain is 220 feet. The upper elevation of the 100-year floodplain is 359 feet (msl) while the creek surface elevation fluctuates at 350 feet (msl).

Floodplain Site No. 4 - Meadow Creek (downstream)

The distance required to traverse the floodplain is 1,000 feet. The upper elevation of the 100-year floodplain at the south edge is 360 feet (msl) and 365 feet (msl) at the north edge. The creek surface elevation fluctuates at 353 feet (msl). A six-foot vertical bank is on both sides of Meadow Creek with sparse woods along the bank's edge. Field observations indicate ongoing erosion of the creek's side walls, particularly during flooding events.

Floodplain Site No. 5 - Meadow Creek (upstream)

The distance required to traverse the floodplain is 340 feet. The upper elevation of the 100-year floodplain is 374 feet (msl) while the creek surface elevation fluctuates at 366 feet (msl). The distance required to traverse this floodplain may preclude the construction of a culvert type structure.

Floodplain Site No. 9 - Unnamed Stream South of Westmoreland

The distance required to traverse the unnamed stream, south of Westmoreland, is 400 feet. The upper elevation of the 100-year floodplain is 354 feet (msl) while the stream surface elevation is slightly less than 340 feet (msl). This site is common to alignments 6 and 7.

Floodplain Site No. 10 - South Fork Rivanna River

The distance required to traverse the floodplain is 420 feet. The upper elevation of the 100-year floodplain is 356 feet while the river surface elevation fluctuates at slightly above 330 feet (msl). Small rapids exist at the proposed crossing site with many large, submerged boulders channeling the water to create increased water velocity. This site is common to alignments 6 and 7.

Floodplain Site No. 11 - Powell Creek (downstream)

The distance required to traverse the floodplain is 780 feet. The upper elevation of the 100-year floodplain is 357 feet (msl) while the creek surface elevation fluctuates at 340 feet (msl). This site is common to alignments 6 and 7.

Floodplain Site No. 12 - Powell Creek (upstream)

The distance required to traverse the floodplain is 180 feet. The upper elevation of the 100-year floodplain is 365 feet (msl) while the creek surface elevation fluctuates at 355 feet (msl). This site is common to alignments 6 and 7.

Floodplain Site No. 13 - Powell Creek (west of Proffit)

The distance required to traverse the floodplain is 220 feet. The upper elevation of the 100-year floodplain is 382 feet (msl) while the creek surface elevation fluctuates at 376 feet (msl). This site is common to alignments 6, 6B and 7.

Floodplain Site No. 14 - Powell Creek (southeast of Hollymead)

The distance required to traverse the floodplain is 440 feet. The upper elevation of the 100-year floodplain is 400 feet (msl) while the creek surface elevation fluctuates at 395 feet (msl). This site is common to alignments 6, 6B and 7. Construction of a residential area is underway north of site No. 14 along the stream bed which parallels Hollymead Drive.

4.4.2.4 Alignment 8,9

Alignments 8 and 9 contain no floodplain encroachment sites.

4.4.2.5 Alignment 10

Alignment 10 contains no floodplain encroachment sites.

4.4.2.6 Alignment 11

Floodplain Site No. 15 - Ivy Creek

The distance required to traverse the Ivy Creek floodplain is 220 feet. The upper elevation of the 100-year floodplain is 409 feet (msl) while the creek surface elevation fluctuates at 398 feet (msl). This site is common to alignment 12 North/11 South, if the north-south crossover is utilized.

Floodplain Site No. 16 - Jumping Branch (south of Ivy Creek Church)

The distance required to traverse the Jumping Branch floodplain is 380 feet. The upper elevation of the 100-year floodplain is 441 feet (msl) while the stream surface elevation fluctuates at 432 feet (msl).

Floodplain Site No. 17 - South Fork Rivanna River Reservoir

The distance required to traverse the reservoir floodplain is 580 feet. The upper elevation of the 100-year floodplain is 392 feet (msl) while the reservoir surface elevation is 382 feet (msl). This site is common to alignment 11 North/12 South, if the east-west connector is utilized.

4.4.2.7 Alignment 12

Floodplain Site No. 18 - Ivy Creek

The distance required to traverse the floodplain is 300 feet. The upper elevation of the 100-year floodplain is 415 feet (msl) while the creek surface elevation fluctuates at 410 feet (msl). This site is common to alignment 11 North/12 South, if the east-west connector is utilized.

Floodplain Site No. 19 - Jumping Branch

The distance required to traverse the floodplain is 160 feet. The upper elevation of the 100-year floodplain is 477 feet (msl) while the stream surface elevation fluctuates at 475 feet (msl). Gently sloping pastures are adjacent to the rocky stream.

Floodplain Site No. 20 - Unnamed Tributary to Jumping Branch

The distance required to traverse the floodplain is 180 feet. The upper elevation of the 100-year floodplain is 462 feet (msl) while the creek surface elevation fluctuates at 461 feet (msl). Gently sloping pastures are adjacent to the stream.

Floodplain Site No. 21 - South Fork Rivanna River Reservoir

The distance required to traverse the floodplain is 393 feet (msl). The upper elevation of the 100-year floodplain is 393 feet (msl) while the reservoir surface elevation is 382 feet (msl). The north bank of the reservoir crossing is strewn with outcropping rock and scattered saplings.

Floodplain Site No. 22 - Unnamed Tributary to South Fork Rivanna River Reservoir

The distance required to traverse the floodplain is 180 feet. The upper elevation of the 100-year floodplain is 400 feet (msl) while the creek surface elevation fluctuates at 397 feet (msl). The hillside, located east of the creek, has received heavy cutting and bulldozing of approximately 90% of the trees. An extreme erosion situation may exist as a result of the clearing activities, while siltation into the reservoir backwater was easily visible during an early April, 1989 field trip.

Floodplain Site No. 23 - Unnamed Tributary to Jacobs Run

The distance required to traverse the floodplain is 160 feet. The upper elevation of the 100-year floodplain is 430 feet (msl) while the creek surface elevation fluctuates at 425 feet (msl). The 15-foot wide tributary is the backwater from Green Reservoir.

Floodplain Site No. 24 - Unnamed Tributary to North Fork Rivanna River

The distance required to traverse the floodplain is 440 feet. The upper elevation of the 100-year floodplain is 390 feet (msl) while the stream surface elevation fluctuates at 481 feet (msl). A recently constructed gravel road exists on the south bank of this tributary. Fire hydrants and numerous property survey stakes are located adjacent to the gravel road on which the proposed alignment and south ramp are planned. In addition to the main alignment and ramp, a proposed roadway parallels Route 29 in a northeast-southwest direction.

Floodplain Site No. 25 - North Fork Rivanna River

The distance required to traverse the floodplain is 640 feet. The upper elevation of the 100-year floodplain is 380 feet (msl) while the river surface elevation fluctuates at 362 feet (msl).

4.4.2.8 Alignment 11N/12S

Floodplain Site No. 18 - Ivy Creek

The distance required to traverse the floodplain is 300 feet. The upper elevation of the 100-year floodplain is 415 feet (msl) while the creek surface elevation fluctuates at 410 feet (msl).

Floodplain Site No. 19 - Jumping Branch

The distance required to traverse the floodplain is 160 feet. The upper elevation of the 100-year floodplain is 477 feet (msl) while the stream surface elevation fluctuates at 475 feet (msl). Gently sloping pastures are adjacent to the rocky stream.

Floodplain Site No. 27 - Jumping Branch (upstream)

The distance required to traverse the floodplain is 280 feet. The upper elevation of the 100-year floodplain is 469 feet (msl) while the stream surface elevation fluctuates at 467 feet (msl). Gently sloping pastures are adjacent to the rocky stream.

Floodplain Site No. 28 - Jumping Branch (downstream)

The distance required to traverse the floodplain is 120 feet. The upper elevation of the 100-year floodplain is 456 feet (msl) while the stream surface elevation fluctuates at 454 feet (msl). Gently sloping pastures are adjacent to the rocky stream.

Floodplain Site No. 17 - South Fork Rivanna River Reservoir

The distance required to traverse the reservoir floodplain is 580 feet. The upper elevation of the 100-year floodplain is 392 feet (msl) while the reservoir surface elevation is 382 feet (msl).

4.4.2.9 Alignment 12N/11S

Floodplain Site No. 15 - Ivy Creek

The distance required to traverse the Ivy Creek floodplain is 220 feet. The upper elevation of the 100-year floodplain is 409 feet (msl) while the creek surface elevation fluctuates at 398 feet (msl).

Floodplain Site No. 26 - Jumping Branch

The distance required to traverse the floodplain is 160 feet. The upper elevation of the 100-year floodplain is 446 feet (msl) while the stream surface elevation fluctuates at 440 feet (msl). The stream bottom is bedrock with large rock outcrops along the banks and side slopes.

Floodplain Site No. 21 - South Fork Rivanna River Reservoir

The distance required to traverse the floodplain is 393 feet (msl). The upper elevation of the 100-year floodplain is 393 feet (msl) while the reservoir surface elevation is 382 feet (msl). The north bank of the reservoir crossing is strewn with outcropping rock and scattered saplings.

Floodplain Site No. 22 - Unnamed Tributary to South Fork Rivanna River Reservoir

The distance required to traverse the floodplain is 180 feet. The upper elevation of the 100-year floodplain is 400 feet (msl) while the creek surface elevation fluctuates at 397 feet (msl). The hillside, located east of the creek, has received heavy cutting and bulldozing of approximately 90% of the trees. An extreme erosion situation may exist as a result of the clearing activities, while siltation into the reservoir backwater was easily visible during an early April, 1989 field trip.

Floodplain Site No. 23 - Unnamed Tributary to Jacobs Run

The distance required to traverse the floodplain is 160 feet. The upper elevation of the 100-year floodplain is 430 feet (msl) while the creek surface elevation fluctuates at 425 feet (msl). The 15-foot wide tributary is the backwater from Green Reservoir.

Floodplain Site No. 24 - Unnamed Tributary to North Fork Rivanna River

The distance required to traverse the floodplain is 440 feet. The upper elevation of the 100-year floodplain is 390 feet (msl) while the stream surface elevation fluctuates at 481 feet (msl). A recently constructed gravel road exists on the south bank of this tributary. Fire hydrants and numerous property survey stakes are located adjacent to the gravel road on which the proposed alignment and south ramp are planned. In addition to the main alignment and ramp, a proposed roadway parallels Route 29 in a northeast-southwest direction.

Floodplain Site No. 25 - North Fork Rivanna River

The distance required to traverse the floodplain is 640 feet. The upper elevation of the 100-year floodplain is 380 feet (msl) while the river surface elevation fluctuates at 362 feet (msl).

4.4.3 Runoff Impacts

The results of the Federal Highway Administration runoff model are shown in Tables 4.4 through 4.7 for each alignment. Table 4.4 lists the average yearly pollutant loading for alignments 6, 6B, 7, 10, 11, and 12 based on traffic estimates for the year 2010. Table 4.5 shows impacts within the South Fork Rivanna River Reservoir watershed, impacted by portions of alignments 10, 11, and 12. Based on an average rainfall of 45 inches, 30.6 inches of runoff would be expected averaged over 84 rain days. This rainfall would translate into average runoff concentrations of the constituents shown in Tables 4.6 and 4.7. The concentrations shown here are only an average, and may fluctuate from levels near zero to more than three to four times the levels listed in Tables 4.6 and 4.7 during individual storm events. Thus, these levels, though not at concentrations harmful to aquatic organisms, may at times become toxic for short periods of time.

Overall, Alignment 7 would accumulate the greatest volume of solids of the six alignments, and Alignment 10 the least. Considering runoff concentrations, however, Alignment 6B would contribute the lowest concentrations of constituents in runoff, followed by Alignments 12 and 11. This is a function of traffic volume and highway length (and area), with less traveled alignments accumulating less solids per mile, and longer segments having a greater dilution factor during rainfall events. Within the South Fork Rivanna River Reservoir Watershed, Alignment 12 would accumulate the greatest volume of solids, and Alignment 10 the least, though in terms of impacts based on runoff concentrations, Alignment 10 is projected to be more heavily traveled and would have the greatest impacts. Conversely, Alignment 12 would have a lesser impact based on runoff concentrations.

This model of runoff estimates conditions only after construction has been completed, and erosion control measures are completed. Impacts during construction would increase runoff over a short term, until construction was completed and the area revegetated to reduce erosion.

The complex determination of the exact resulting impact on the public water supply in the year 2010 is beyond the scope of this analysis, however, average constituent loading and concentrations may be compared with F.H.A. data to evaluate the anticipated impact. For purpose of the receiving water impact, the pounds of pollutant is more important than runoff concentration. Concentration alone is meaningless unless some estimate of flow is available to determine total load and resulting concentrations in the receiving water body. A more meaningful representation of the impact potential of various pollutants can be determined by expressing the loads on an annual basis. This procedure accounts for variation in rainfall, flows, and concentrations of individual events by generating the annual loading. To overcome these variations, the runoff data is normalized to the pounds per acre per year values.

The Federal Highway Administration (F.H.W.A) manual, Constituents of Highway Runoff, Volume III, utilized the parameters of biochemical oxygen demand (BOD), chemical oxygen demand (COD) and total suspended solids (TSS) to provide an indication of the impact potential on highway runoff on receiving water. The Environmental Protection Agency (EPA) published a water quality criteria for possible constituents found in highway runoff, however, it cannot be assumed that the criteria will remain the same through the year 2010. Interim results of ongoing F.H.W.A. research indicates that runoff from highways with low to medium traffic volumes [less than 30,000 Average Daily Traffic (A.D.T.)] typically does not have a serious effect on receiving water. The segments of alignments 10, 11, and 12 that are within the South Fork Rivanna River Reservoir watershed have an estimated A.D.T. of 12,200 to 14,600, and 9,500 to 15,100, 17,4000 to 17,900 respectively, for the year 2010. Highways with high traffic volumes (greater than 30,000 A.D.T.) have a potential for adverse "first flush" effects, whereby the receiving water may undergo acute loadings during the runoff event. Given the maximum A.D.T., and excluding the possibility of an accidental spill directly into the reservoir, it is anticipated that neither alignment will greatly affect the public water supply.

TABLE 4.4
CALCULATED YEARLY CONSTITUENT LOADING ALONG EACH ALIGNMENT BASED ON ESTIMATED TRAFFIC VOLUME (2010) AND HIGHWAY LENGTH

	ALIGNMENT					
	6	6B	7	10	11	12
Highway Length (Miles)	8.5	8.5	7.5	5.1	8.9	12.0
Acres on ROW	309.1	309.1	272.7	185.4	323.6	436.4
Daily Accumulation (lbs)	418	228	457	216	306	360
Yearly Accumulation (lbs)	152570	83220	166805	78840	111690	131400
PARAMETER	YEARLY ACCUMULATION (lbs)					
DS	106839	59681	116519	56702	79040	92443
SS	45731.2	23539.2	50286.4	22137.6	32649.6	38956.8
VSS	9030.6	4799.2	9897.9	4532.0	6535.9	7738.2
TVS	46109.2	23917.2	50664.4	22515.6	33027.6	39334.8
TKN	519.2	304.2	563.3	290.6	392.4	453.5
TOC	9883.4	5167.6	10851.3	4869.7	7103.5	8443.8
COD	13328.2	7294.7	14566.6	6913.7	9771.6	11486.4
TN	283.7	156.8	309.8	148.8	208.9	245.0
TPO_4	307.4	158.3	338.0	148.9	219.6	261.9
Cl^-	20815.4	11453.1	22737.1	10861.8	15296.6	17957.4
Pb	60.1	31.7	66.0	29.9	43.4	51.4
Zn	39.8	21.3	43.6	20.1	28.9	34.2
Fe	2000.7	1029.8	2200.0	968.5	1428.4	1704.4
Cu	12.03	6.90	13.08	6.57	9.00	10.46
Cd	6.69	3.92	7.26	3.74	5.06	5.84
Cr	32.74	16.79	36.01	15.78	23.34	27.87

From: FHWA/RD-81/044

TABLE 4.5
CALCULATED YEARLY CONSTITUENT LOADING ALONG PORTIONS OF EACH ALIGNMENT WITHIN THE SOUTH FORK RIVANNA RIVER RESERVOIR WATERSHED BASED ON TRAFFIC VOLUME ESTIMATES (2010) AND HIGHWAY LENGTH

	ALIGNMENT					
	6	6B	7	10	11	12
Highway Length (Miles)	---	---	---	4.2	7.4	8.4
Acres in Watershed	---	---	---	152.7	269.1	305.4
Daily Accumulation (lbs)	---	---	---	178	251	256
Yearly Accumulation (lbs)	---	---	---	64970	91615	93440
PARAMETER	YEARLY ACCUMULATION (lbs)					
DS	---	---	---	47271	65389	66630
SS	---	---	---	17699.2	26225.6	26809.6
VSS	---	---	---	3686.0	5311.3	5422.6
TVS	---	---	---	18077.2	26603.6	27187.6
TKN	---	---	---	247.6	330.2	335.9
TOC	---	---	---	3926.6	5738.4	5862.5
COD	---	---	---	5707.0	8025.1	8183.9
TN	---	---	---	123.4	172.2	175.5
TPO_4	---	---	---	119.1	176.4	180.3
Cl^-	---	---	---	8989.4	12586.4	12832.8
Pb	---	---	---	24.2	35.1	35.9
Zn	---	---	---	16.4	23.5	24.02
Fe	---	---	---	774.3	1147.4	1172.9
Cu	---	---	---	5.55	7.52	7.65
Cd	---	---	---	3.19	4.25	4.33
Cr	---	---	---	12.59	18.72	19.14

From: FHWA/RD-81/044

TABLE 4.6
AVERAGE CONSTITUENT LOADING (mg/L) IN RUNOFF WATERS ALONG EACH ALIGNMENT. CALCULATIONS BASED ON AN AVERAGE RAINFALL VOLUME OF 45 INCHES/YEAR

PARAMETER	ALIGNMENT 6	6B	7	10	11	12
TS	71.18	38.82	88.20	61.30	49.77	43.42
DS	49.84	27.84	61.61	44.09	35.22	30.55
SS	21.34	10.98	26.59	17.21	14.55	12.87
VSS	4.21	2.24	5.23	3.52	2.91	2.56
TVS	21.51	11.16	26.79	17.51	14.72	13.00
TKN	0.24	0.14	0.30	0.23	0.17	0.15
TOC	4.61	2.41	5.74	3.79	3.16	2.79
COD	6.22	3.40	7.70	5.38	4.35	3.80
TN	0.13	0.07	0.16	0.12	0.09	0.08
TPO_4	0.14	0.07	0.18	0.12	0.10	0.09
Cl^-	9.71	5.34	12.02	8.45	6.82	5.93
Pb	0.028	0.015	0.035	0.023	0.019	0.017
Zn	0.019	0.010	0.023	0.016	0.013	0.011
Fe	0.933	0.480	1.163	0.753	0.636	0.563
Cu	0.006	0.003	0.007	0.005	0.004	0.004
Cd	0.003	0.002	0.004	0.003	0.002	0.002
Cr	0.015	0.008	0.019	0.012	0.010	0.009

From: FHWA/RD-81/044

TABLE 4.7
AVERAGE CONSTITUENT LOADING (mg/L) IN RUNOFF WATERS FROM SEGMENTS OF ALIGNMENTS WITHIN THE SOUTH FORK RIVANNA RIVER RESERVOIR WATERSHED. CALCULATIONS BASED ON AN AVERAGE RAINFALL VOLUME OF 45 INCHES/YEAR

PARAMETER	ALIGNMENT 6	6B	7	10	11	12
TS	---	---	---	61.34	49.10	44.11
DS	---	---	---	44.63	35.05	31.45
SS	---	---	---	16.71	14.05	12.66
VSS	---	---	---	3.48	2.85	2.56
TVS	---	---	---	17.07	14.26	12.84
TKN	---	---	---	0.23	0.18	0.16
TOC	---	---	---	3.71	3.08	2.77
COD	---	---	---	5.39	4.30	3.86
TN	---	---	---	0.12	0.09	0.08
TPO_4	---	---	---	0.11	0.09	0.08
Cl^-	---	---	---	8.49	6.74	6.06
Pb	---	---	---	0.023	0.019	0.017
Zn	---	---	---	0.016	0.013	0.011
Fe	---	---	---	0.731	0.615	0.554
Cu	---	---	---	0.005	0.004	0.004
Cd	---	---	---	0.003	0.002	0.002
Cr	---	---	---	0.012	0.010	0.009

From: FHWA/RD-81/004

4.5 Aquatic Endangered, Threatened or Special Concern Species (ETS) Impacts

No impacts to aquatic endangered or threatened species have been determined to exist in the streams crossed by the alignments due to their absence in these water bodies. However, the federally listed endangered James River Spiny Mussel (Pleurobema collina) has been located in the headwaters of Mechums River and in Rocky Run, a tributary to the Moormans River. Both of these locations are well out of the study area and appear to be small populations and restricted in distribution. However, in the Spring of 1990, VDOT will confirm the absence of the species in the study area through a survey conducted by Dr. R.J. Neves of the Virginia Cooperative Wildlife Research Unit. (See Memorandum Appendix F).

5.0 MITIGATION

5.1 Aquatic Resources and Water Quality

Various measures will serve to mitigate anticipated impacts along the study alignments. Implementation of erosion control measures can serve to minimize water quality impacts from increased levels of sedimentation and turbidity during construction. Highway design features can serve to reduce long term impacts on water quality from runoff. Control measures designed to reduce the magnitude and duration of runoff impacts may include the use of berms, dikes, sediment basins, fiber mats, straw silt barriers, netting, mulch, grasses and other methods. Highway design features can also be employed to lessen the chance of a serious accident and the potential of a hazardous waste spill.

Construction impacts to instream aquatic habitats will be minimized to the extent practicable by avoiding stream relocations; crossing streams at right angles to minimize habitat loss. To the extent possible, construction equipment will be restricted from fording and otherwise disrupting the in-stream habitats of major waterways. In the South Fork Rivanna River Watershed, construction methods will follow restrictions as outlined in the Albemarle County runoff control ordinance to minimize pollution and eutrophication of the reservoir.

Instream impacts on aquatic resources can be mitigated through design features and construction methods. Impacts on fishes can be mitigated bvy avoiding instream construction during the spawning season. Floodplain impacts can be reduced by modifying engineering, design, and construction methods. Bridges elevated above the 100-year base flood level will reduce flood impacts. Bridging of floodplain areas can reduce impacts on drainage patterns and effects on floral and faunal communities.

Long-term impacts from highway operation and maintenance will be minimized by selection of de-icing salts, pesticides and herbicides which have the least effect upon stream organisms.

5.2 Wetlands

In accordance with Executive Order 11990, wetlands were given special consideration in developing and evaluating alternatives for the proposed action. All practicable measures to mitigate both short term and long term impacts have been incorporated into the preliminary planning process and would be implemented with the project should a build alternate be selected.

Mitigation of impacts to wetlands would involve avoidance, reduction, and/or replacement measures. Avoidance of wetlands is required by Executive Order 11990 as the first step in the mitigation process.

The technical wetland studies have been developed to meet the requirements of NEPA, CEQ guidelines, and Federal and state wetland regulatory agencies. The "worst case" scenario is not the appropriate basis, however, for mitigation development because specific stream crossing design information is not available. When the preferred alignment is selected, specific information should be developed as follows:

- Selection of project design parameters for each stream crossing that may affect wetlands.

- Determination of specific wetlands, impacts, including acres by type and affected functional values.

- Selection of a reasonable mitigation approach based on the wetland area effected and its functional value.

The development of mitigation may include project design measures which will reduce potential impacts to acceptable levels rectifying impacts by restoring the affected environment and compensating by replacement of wetland resources on a 1:1 basis.

6.0 COORDINATION

Methods to gather comments in the preparation of this report included publication of a Notice of Intent to prepare an Environmental Impact Statement in the Federal Register; preparation of an early coordination letter and Plan of Study; development and distribution of study newsletters; establishment of mail and telephone communications between the Study Team and interested agencies, public officials and individuals; verbal and written communication with various agencies, groups and individuals; and a series of meetings and exhibits with key agencies, local officials and the general public.

These coordination- and comments-gathering efforts have been an integral part of the planning and environmental studies prepared for the U.S. Route 29 Corridor Study. As a result, the alternatives under consideration reflect numerous changes, major and minor, which were made in response to ideas and concerns raised by people outside of the Study Team. This process has led to the development of alternatives which sensitively reflect these ideas and concerns while achieving the desired transportation objectives.

6.1 Agency Scoping

An Interagency Coordination Meeting for the U.S. Route 29 Corridor Study was held by the Virginia Department of Transportation on September 22, 1988. The purpose of this meeting was to solicit comments regarding the selection of the Candidate Build Alternatives, and to allow concerned agencies the opportunity to make recommendations for inclusion in the Draft Environmental Impact Statement (DEIS). An information packet was provided to all agencies outlining the study methodologies and references for the Natural Environmental Analysis task, and the considerations that were being given to the environment during the selection process for the build alternatives. The following agencies and or organizations were coordinated with, or provided information on the U.S. Route 29 Corridor Study during its conduct (partial list):

* U.S. Department of Agriculture
  - Soil Conservation Service

* U.S. Department of the Army
  - Army Corps of Engineers, Regulatory Branch

* U.S. Environmental Protection Agency (Region III)

* U.S. Federal Highway Administration
  - Transportation Research Board

* U.S. Geological Service

* U.S. Department of Interior
  - National Park Service, Mid-Atlantic Region
  - Fish and Wildlife Service

* Virginia Council on the Environment

* Virginia Department of Agriculture and Consumer Services
* Virginia Department of Conservation and Historic Resources
* Virginia Department of Forestry
* Virginia Department of Game and Inland Fisheries
* Virginia Department of Transportation
* Virginia Natural Heritage Program
* Virginia Water Control Board
* The Nature Conservancy
* Piedmont Environmental Council
* Virginia Native Plant Society
* Virginia Society of Ornithology
* Virginia Wildlife Federation
* County of Albemarle, Department of Engineering
* County of Albemarle, Department of Planning and Community Development
* County of Albemarle, Office of Watershed Management
* Rivanna Water and Sewer Authority

The following agencies/organizations were represented at the Interagency Coordination Meeting (partial list):

* U.S. Department of the Army
  - Army Corps of Engineers
* U.S. Department of the Interior
  - Fish and Wildlife Service
* U.S. Environmental Protection Agency (Region III)
* U.S. Federal Highway Administration
* Virginia Council on the Environment

* Virginia Department of Game and Inland Fish

* Virginia Department of Transportation

* Virginia Marine Resources Commission

6.2 Public Coordination

An exceedingly large number of community meetings have been held during the course of this study. These meetings include one-on-one sessions between study team members and public officials as well as private citizens, talks to residents associations and civic groups, monthly meetings of the City of Charlottesville and Albemarle County Route 29 Joint Task Force, a series of Public Information Meetings, and a Route 29 Project Open House. Attendance at the public meetings have varied from several hundred to in excess of 1,500 persons with varying degrees of interests in the project.

Ideas and comments received at these meetings and exhibit sessions were instrumental in the location and details of preliminary alternates selection, and in refining the process of selecting the study alternates evaluated in this report. These meetings were often general in nature but by and large they usually dealt with specific issues of importance to a particular individual or group.

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APPENDIX A

WATER QUALITY RESULTS FROM STREAMS AND RESERVOIRS IN THE STUDY AREA

TABLE A.1. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE NORTH FORK RIVANNA RIVER AT ROUTE 649, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-22-88	02-26-88	03-30-88	04-19-88
Time	08:20	08:50	16:40	09:00
Sample #	88-0432	88-1274	88-1857	88-2303
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	38	19	22	24
Total Kjeldahl Nitrogen	0.33	0.41	0.28	<0.09
Nitrate/Nitrite	0.43	0.27	0.22	0.10
Total Phosphorus	0.03	0.06	<0.01	0.25
Hardness @ $CaCO_3$	17	18	22	20
Total Suspended Solids	30	8	20	5
Total Dissolved Solids	80	3	30	37
Oil and Grease	4	1	<1	<1
Lead	<0.04	<0.04	0.05	0.10
Zinc	0.02	<0.01	0.06	0.01
Conductivity (umhos/cm,field)	57 @ 25.0°C	57 @ 25.0°C	56 @ 25.0°C	51 @ 25.0°C
Dissolved Oxygen (field)	12.2 @ 4.2°C	12.6 @ 1.0°C	10.0 @ 14.8°C	9.0 @ 11.4°C
pH (field)	6.4 @ 4.2°C	6.8 @ 1.0°C	6.4 @ 14.8°C	6.2 @ 11.4°C
Turbidity (ntu)	28	8	10	6
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-20-88	09-22-88
Time	17:48	14:45	16:10	11:55
Sample #	88-3222	88-4055	88-4635	88-6901
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	33	38	37	25
Total Kjeldahl Nitrogen	0.34	0.50	0.58	<0.09
Nitrate/Nitrite	0.22	0.21	0.47	<0.02
Total Phosphorus	0.03	<0.01	0.03	0.01
Hardness @ $CaCO_3$	21	20	21	25.8
Total Suspended Solids	57	11	13	3
Total Dissolved Solids	40	53	132	13
Oil and Grease	<1	<1	<1	<1
Lead	0.06	0.04	0.14	0.10
Zinc	0.03	0.03	0.01	0.06
Conductivity (umhos/cm,field)	57 @ 25.0°C	29 @ 25.0°C	57 @ 25.0°C	57 @ 25.0°C
Dissolved Oxygen (field)	8.6 @ 16.5°C	8.6 @ 27.5°C	7.2 @ 28.0°C	8.4 @ 19.0°C
pH (field)	6.5 @ 17.5°C	8.1 @ 28.4°C	7.6 @ 28.0°C	7.9 @ 19.4°C
Turbidity (ntu)	22	20	30	
Ammonia	<0.05	0.06	0.05	

Station was not sampled in August

TABLE A.1. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE NORTH FORK RIVANNA RIVER AT ROUTE 649, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	10-20-88	11-16-88	12-12-88	01-10-89
Time	12:15	17:05	15:30	16:30
Sample #	88-7600	88-8373	88-9190	89-0392
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	26	21	19	17
Total Kjeldahl Nitrogen	<0.09	0.46	0.60	0.49
Nitrate/Nitrite	<0.02	<0.05	0.28	0.20
Total Phosphorus	0.06	0.03	0.02	0.02
Hardness @ $CaCO_3$	25.8	22.2	20.2	23.0
Total Suspended Solids	6	5	5	1
Total Dissolved Solids	58	43	117	37
Oil and Grease	2	1	1	1
Lead	0.10	0.1	0.1	0.1
Zinc	0.04	0.02	0.04	0.03
Conductivity (umhos/cm,field)	58 @ 25.0°C	83 @ 25.0°C	42 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	7.8 @ 10.0°C	9.5 @ 11.0°C	12.8@ <0.1°C	13.2 @ 4.0°C
pH (field)	7.9 @ 10.6°C	7.5 @ 11.6°C	6.6 @ 0.4°C	7.3 @ 4.9°C

TABLE A.2. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM BUCK MOUNTAIN CREEK AT ROUTE 665, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-21-88	02-25-88	03-30-88	04-18-88
Time	15:00	13:00	12:12	14:22
Sample #	88-0425	88-1263	88-1846	88-2289
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	17	15	20	27
Total Kjeldahl Nitrogen	0.50	0.16	<0.09	0.24
Nitrate/Nitrite	0.38	0.28	0.20	0.09
Total Phosphorus	0.05	0.03	<0.01	<0.01
Hardness @ $CaCO_3$	13	14	20	13
Total Suspended Solids	10	3	23	3
Total Dissolved Solids	73	63	13	13
Oil and Grease	3	<1	1	<1
Lead	0.07	<0.04	0.15	0.06
Zinc	0.02	0.04	0.06	0.05
Conductivity (umhos/cm,field)	42 @ 25.0°C	43 @ 25.0°C	46 @ 25.0°C	48 @ 25.0°C
Dissolved Oxygen (field)	10.9 @ 5.6°C	11.2 @ 3.8°C	9.8 @ 13.4°C	8.4 @ 13.5°C
pH (field)	6.5 @ 5.6°C	6.7 @ 3.8°C	6.0 @ 13.4°C	6.3 @ 13.5°C
Turbidity (ntu)	14	4	9	6
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88	08-24-88
Time	12:56	11:30	16:40	15:15
Sample #	88-3212	88-4068	88-4624	88-5568
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	20	30	24	19
Total Kjeldahl Nitrogen	0.26	0.82	0.44	0.41
Nitrate/Nitrite	0.18	0.23	0.60	0.27
Total Phosphorus	0.03	<0.01	0.03	0.05
Hardness @ $CaCO_3$	16	15	18	21.0
Total Suspended Solids	3	28	<1	3
Total Dissolved Solids	45	53	43	64
Oil and Grease	<1	1	1	<1
Lead	0.07	0.05	0.10	0.07
Zinc	0.03	0.02	0.03	0.02
Conductivity (umhos/cm,field)	46 @ 25.0°C	56 @ 25.0°C	46 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	9.2 @ 15.5°C	8.4 @ 25.0°C	7.2 @ 29.5°C	8.5 @ 27.0°C
pH (field)	6.8 @ 16.2°C	8.3 @ 26.5°C	7.7 @ 29.5°C	7.6 @ 25.0°C
Turbidity (ntu)	14	16	16	12
Ammonia	<0.05	0.06	0.05	<0.05

TABLE A.3. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM BURRUSS BRANCH AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-21-88	02-25-88	04-18-88	05-26-88
Time	15:40	12:25	13:55	12:20
Sample #	88-0427	88-1261	88-2287	88-3210
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	28	14	26	24
Total Kjeldahl Nitrogen	0.49	0.33	0.18	0.31
Nitrate/Nitrite	0.36	0.34	0.22	0.19
Total Phosphorus	0.02	<0.01	0.01	0.04
Hardness @ $CaCO_3$	15	12	11	17
Total Suspended Solids	10	4	3	8
Total Dissolved Solids	73	73	61	42
Oil and Grease	2	2	2	4
Lead	0.04	0.07	0.09	0.07
Zinc	0.06	0.03	0.02	0.02
Conductivity (umhos/cm,field)	43 @ 25.0°C	40 @ 25.0°C	29 @ 25.0°C	45 @ 25.0°C
Dissolved Oxygen (field)	11.9 @ 5.8°C	13.2 @ 3.9°C	11.1 @ 13.0°C	9.2 @ 15.5°C
pH (field)	5.9 @ 5.8°C	6.2 @ 3.9°C	6.2 @ 13.0°C	6.6 @ 16.7°C
Turbidity (ntu)	15	4	6	11
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	06-23-88	07-19-88	08-24-88	09-22-88
Time	11:00	16:00	15:00	14:35
Sample #	88-4066	88-4622	88-5567	88-6892
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	120	68	20	29
Total Kjeldahl Nitrogen	11.8	0.73	1.79	7.65
Nitrate/Nitrite	0.29	0.26	0.16	0.05
Total Phosphorus	0.03	<0.01	0.07	0.01
Hardness @ $CaCO_3$	26	23	22.0	23.0
Total Suspended Solids	323	24	34	160
Total Dissolved Solids	84	67	70	79
Oil and Grease	1	<1	<1	<1
Lead	<0.04	0.12	0.10	0.19
Zinc	0.05	0.03	0.02	0.10
Conductivity (umhos/cm,field)	100 @ 25.0°C	50 @ 25.0°C	53 @ 25.0°C	69 @ 25.0°C
Dissolved Oxygen (field)	4.2 @ 25.0°C	6.2 @ 32.0°C	7.4 @ 29.0°C	4.7 @ 24.2°C
pH (field)	7.9 @ 25.8°C	7.7 @ 32.6°C	7.3 @ 25.0°C	7.8 @ 26.2°C
Turbidity (ntu)	122	56	35	
Ammonia	0.56	0.15	0.06	

Station was not sampled in March

TABLE A.3. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM BURRUSS BRANCH AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	10-19-88	11-16-88	12-12-88	01-10-89
Time	15:00	13:45	12:30	11:55
Sample #	88-7591	88-8387	88-9184	89-0384
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	20	16	17	16
Total Kjeldahl Nitrogen	1.13	1.33	0.58	<0.09
Nitrate/Nitrite	<0.02	0.09	0.34	0.28
Total Phosphorus	0.10	0.02	<0.02	0.03
Hardness @ $CaCO_3$	18.6	16.0	19.6	19.8
Total Suspended Solids	6	10	4	3
Total Dissolved Solids	147	63	100	57
Oil and Grease	1	3	2	1
Lead	0.04	0.1	<0.1	<0.1
Zinc	0.07	0.01	0.05	0.02
Conductivity (umhos/cm,field)	48 @ 25.0°C	55 @ 25.0°C	33 @ 25.0°C	40 @ 25.0°C
Dissolved Oxygen (field)	7.7 @ 14.5°C	9.6 @ 13.0°C	12.0 @ <0.1°C	14.0 @ 3.8°C
pH (field)	7.4 @ 15.0°C	8.4 @ 13.5°C	6.9 @ 0.7°C	7.4 @ 4.2°C

TABLE A.4. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM MECHUMS RIVER AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	02-25-88	03-30-88	04-18-88	05-26-88
Time	13:30	12:45	14:50	13:35
Sample #	88-1265	88-1848	88-2291	88-3214
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	15	26	24	32
Total Kjeldahl Nitrogen	0.34	0.17	<0.09	0.41
Nitrate/Nitrite	0.44	0.45	0.10	0.33
Total Phosphorus	0.01	0.02	0.01	0.03
Hardness @ $CaCO_3$	19	19	20	20
Total Suspended Solids	13	7	17	26
Total Dissolved Solids	54	37	57	64
Oil and Grease	<1	<1	<1	<1
Lead	<0.04	0.08	0.07	0.06
Zinc	0.01	0.05	0.04	0.03
Conductivity (umhos/cm,field)	55 @ 25.0°C	72 @ 25.0°C	25 @ 25.0°C	48 @ 25.0°C
Dissolved Oxygen (field)	13.1 @ 3.4°C	10.5 @ 13.2°C	10.8 @ 13.9°C	9.4 @ 17.0°C
pH (field)	6.8 @ 3.4°C	6.5 @ 13.2°C	6.6 @ 13.9°C	7.3 @ 17.8°C
Turbidity (ntu)	4	10	4	12
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	06-23-88	07-19-88	08-24-88	09-22-88
Time	12:00	17:15	16:00	15:35
Sample #	88-4070	88-4626	88-5570	88-6896
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	39	22	21	21
Total Kjeldahl Nitrogen	0.22	0.46	1.03	0.13
Nitrate/Nitrite	0.33	0.84	0.23	0.02
Total Phosphorus	0.02	0.02	0.05	0.02
Hardness @ $CaCO_3$	17	20	28.0	21.8
Total Suspended Solids	8	5	5	10
Total Dissolved Solids	60	96	75	68
Oil and Grease	3	3	<1	<1
Lead	0.10	0.20	0.11	0.17
Zinc	0.05	0.02	0.02	0.04
Conductivity (umhos/cm,field)	30 @ 25.0°C	53 @ 25.0°C	66 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	8.6 @ 26.5°C	6.8 @ 28.5°C	9.0 @ 25.0°C	9.2 @ 21.8°C
pH (field)	8.3 @ 27.2°C	7.8 @ 29.5°C	7.5 @ 25.0°C	8.4 @ 22.2°C
Turbidity (ntu)	8	10	8	
Ammonia	0.06	<0.05	0.13	

Station was not sampled in January

TABLE A.4. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM MECHUMS RIVER AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	10-19-88	11-16-88	12-12-88	01-10-89
Time	16:20	14:35	13:15	12:35
Sample #	88-7595	88-8383	88-9188	89-0366
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	24	21	20	14
Total Kjeldahl Nitrogen	0.46	1.11	0.58	0.54
Nitrate/Nitrite	0.03	0.06	0.14	0.17
Total Phosphorus	0.04	0.03	0.02	0.02
Hardness @ $CaCO_3$	23.0	22.0	24.0	23.9
Total Suspended Solids	3	<1	4	2
Total Dissolved Solids	33	67	69	117
Oil and Grease	6	<1	1	2
Lead	0.11	0.1	<0.1	<0.1
Zinc	0.06	0.02	0.03	0.02
Conductivity (umhos/cm,field)	55 @ 25.0°C	66 @ 25.0°C	45 @ 25.0°C	50 @ 25.0°C
Dissolved Oxygen (field)	8.5 @ 13.5°C	10.2 @ 9.0°C	12.8 @ 0.0°C	13.8 @ 3.5°C
pH (field)	8.5 @ 13.5°C	8.2 @ 9.5°C	6.8 @ 0.1°C	7.4 @ 4.7°C

TABLE A.5. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM MECHUMS RIVER AT
ROUTE 614, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-21-88	02-25-88	03-30-88	04-18-88
Time	16:25	11:50	10:50	13:15
Sample #	88-0429	88-1259	88-1842	88-2285
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	35	18	24	21
Total Kjeldahl Nitrogen	0.75	0.58	<0.09	0.14
Nitrate/Nitrite	0.66	0.44	0.44	0.11
Total Phosphorus	0.03	<0.01	<0.01	<0.01
Hardness @ $CaCO_3$	21	19	21	17
Total Suspended Solids	37	4	30	10
Total Dissolved Solids	87	20	75	33
Oil and Grease	4	8	1	2
Lead	0.05	0.12	0.08	0.16
Zinc	0.05	0.03	0.05	0.03
Conductivity (umhos/cm,field)	57.0 @ 25.0°C	58 @ 25.0°C	68 @ 25.0°C	75 @ 25.0°C
Dissolved Oxygen (field)	12.2 @ 5.3°C	11.2 @ 4.0°C	10.6 @ 11.3°C	9.7 @ 13.3°C
pH (field)	6.7 @ 5.3°C	7.5 @ 4.0°C	6.4 @ 11.3°C	6.5 @ 13.3°C
Turbidity (ntu)	27	4	16	4
Ammonia	0.07	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88	08-24-88
Time	11:50	10:25	15:20	13:15
Sample #	88-3208	88-4064	88-4620	88-5564
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	28	35	21	20
Total Kjeldahl Nitrogen	0.46	0.42	<0.09	0.48
Nitrate/Nitrite	0.34	0.34	0.66	0.25
Total Phosphorus	0.02	0.03	<0.01	0.05
Hardness @ $CaCO_3$	21	21	22	23.0
Total Suspended Solids	3	5	6	13
Total Dissolved Solids	55	53	36	67
Oil and Grease	1	<1	3	<1
Lead	0.08	0.05	0.13	0.09
Zinc	0.04	0.02	0.03	0.04
Conductivity (umhos/cm,field)	60 @ 25.0°C	73 @ 25.0°C	48 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	9.0 @ 15.0°C	7.7 @ 25.0°C	9.2 @ 32.5°C	5.8 @ 25.5°C
pH (field)	7.1 @ 15.9°C	8.1 @ 26.5°C	7.8 @ 34.0°C	7.3 @ 25.0°C
Turbidity (ntu)	12	8	10	8
Ammonia	<0.05	<0.05	<0.05	<0.05

TABLE A.5. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM MECHUMS RIVER AT
ROUTE 614, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	09-22-88	10-19-88	11-16-88	12-12-88
Time	13:45	13:55	12:55	11:45
Sample #	88-6890	88-7589	88-8384	88-9182
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	20	21	21	20
Total Kjeldahl Nitrogen	0.58	0.57	1.11	0.89
Nitrate/Nitrite	0.03	0.04	0.06	0.15
Total Phosphorus	0.04	0.07	0.02	0.13
Hardness @ $CaCO_3$	23.4	23.8	23.6	23.0
Total Suspended Solids	3	<1	5	115
Total Dissolved Solids	42	43	73	70
Oil and Grease	<1	1	<1	1
Lead	0.16	0.07	0.1	0.1
Zinc	0.09	0.13	<0.01	0.04
Conductivity (umhos/cm,field)	54 @ 25.0°C	54 @ 25.0°C	76 @ 25.0°C	47 @ 25.0°C
Dissolved Oxygen (field)	9.6 @ 21.0°C	9.8 @ 14.5°C	8.6 @ 12.0°C	13.2 @ 1.0°C
pH (field)	8.2 @ 20.9°C	7.8 @ 14.8°C	8.2 @ 12.5°C	6.9 @ 0.5°C

Date taken	01-10-89
Time	11:20
Sample #	89-0383
Analysis - Results in mg/L unless otherwise stated.	
Total Alkalinity @ $CaCO_3$	20
Total Kjeldahl Nitrogen	0.40
Nitrate/Nitrite	0.16
Total Phosphorus	0.03
Hardness @ $CaCO_3$	23.6
Total Suspended Solids	1
Total Dissolved Solids	63
Oil and Grease	2
Lead	<0.1
Zinc	0.2
Conductivity (umhos/cm,field)	43 @ 25.0°C
Dissolved Oxygen (field)	13.6 @ 3.5°C
pH (field)	7.7 @ 4.3°C

TABLE A.6. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM MOORMANS RIVER AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-21-88	02-25-88	03-30-88	04-18-88
Time	16:05	13:15	12:30	14:40
Sample #	88-0428	88-1264	88-1847	88-2290
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	17	12	11	19
Total Kjeldahl Nitrogen	0.35	0.31	<0.09	0.16
Nitrate/Nitrite	0.25	0.18	0.07	0.04
Total Phosphorus	0.06	<0.01	<0.01	<0.01
Hardness @ $CaCO_3$	12	13	14	14
Total Suspended Solids	13	4	2	7
Total Dissolved Solids	77	60	2	20
Oil and Grease	4	<1	<1	<1
Lead	0.04	<0.04	0.05	0.12
Zinc	0.02	0.04	0.06	0.06
Conductivity (umhos/cm,field)	35 @ 25.0°C	43 @ 25.0°C	45 @ 25.0°C	38 @ 25.0°C
Dissolved Oxygen (field)	12.0 @ 5.4°C	13.2 @ 3.4°C	10.2 @ 13.3°C	10.5 @ 13.9°C
pH (field)	6.5 @ 5.4°C	6.5 @ 3.4°C	6.6 @ 13.3°C	6.8 @ 13.9°C
Turbidity (ntu)	5	2	6	2
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88	08-24-88
Time	13:19	11:50	17:00	15:40
Sample #	88-3213	88-4069	88-4625	88-5569
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	10	30	17	18
Total Kjeldahl Nitrogen	2.41	0.33	0.36	0.36
Nitrate/Nitrite	0.06	0.09	0.28	0.06
Total Phosphorus	0.71	0.01	0.02	0.03
Hardness @ $CaCO_3$	21	15	20	24.0
Total Suspended Solids	47	3	3	1
Total Dissolved Solids	27	42	20	65
Oil and Grease	2	<1	2	<1
Lead	<0.04	<0.04	0.14	0.11
Zinc	0.05	0.03	0.02	0.02
Conductivity (umhos/cm,field)	34 @ 25.0°C	45 @ 25.0°C	41 @ 25.0°C	52 @ 25.0°C
Dissolved Oxygen (field)	9.3 @ 17.0°C	8.6 @ 28.5°C	7.2 @ 27.5°C	8.0 @ 26.0°C
pH (field)	7.0 @ 16.8°C	8.2 @ 28.2°C	7.7 @ 30.0°C	7.8 @ 25.0°C
Turbidity (ntu)	5	6	4	4
Ammonia	<0.05	<0.05	<0.05	<0.05

TABLE A.6. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM MOORMANS RIVER AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	09-22-88	10-19-88	11-16-88	12-12-88
Time	15:10	16:05	14:00	13:00
Sample #	88-6895	88-7594	88-8382	88-9186
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	19	20	17	16
Total Kjeldahl Nitrogen	0.23	0.54	1.08	0.65
Nitrate/Nitrite	<0.02	<0.02	0.02	0.04
Total Phosphorus	0.01	0.04	0.02	<0.02
Hardness @ $CaCO_3$	20.8	17.4	19.4	17.8
Total Suspended Solids	11	3	3	1
Total Dissolved Solids	44	33	60	67
Oil and Grease	<1	2	<1	1
Lead	0.19	0.10	0.1	<0.1
Zinc	0.06	0.07	0.02	0.02
Conductivity (umhos/cm,field)	47 @ 25.0°C	48 @ 25.0°C	64 @ 25.0°C	33 @ 25.0°C
Dissolved Oxygen (field)	8.3 @ 22.8°C	8.9 @ 14.0°C	10.4 @ 10.5°C	12.6 @ 0.0°C
pH (field)	8.2 @ 22.1°C	8.1 @ 14.2°C	8.3 @ 11.0°C	6.8 @ 0.4°C

Date taken	01-10-89
Time	12:25
Sample #	89-0367
Analysis - Results in mg/L unless otherwise stated.	
Total Alkalinity @ $CaCO_3$	21
Total Kjeldahl Nitrogen	0.56
Nitrate/Nitrite	0.02
Total Phosphorus	<0.02
Hardness @ $CaCO_3$	20.1
Total Suspended Solids	1
Total Dissolved Solids	53
Oil and Grease	2
Lead	<0.1
Zinc	0.04
Conductivity (umhos/cm,field)	36 @ 25.0°C
Dissolved Oxygen (field)	12.2 @ 4.0°C
pH (field)	7.5 @ 4.2°C

TABLE A.7. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM MOORMANS RIVER AT
ROUTE 671, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	02-25-88	03-30-88	04-18-88	05-26-88
Time	12:10	11:05	13:40	11:58
Sample #	88-1260	88-1843	88-2286	88-3209
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	10	13	18	18
Total Kjeldahl Nitrogen	0.25	0.12	0.12	0.19
Nitrate/Nitrite	0.17	0.12	<0.02	0.07
Total Phosphorus	0.01	<0.01	<0.01	0.03
Hardness @ $CaCO_3$	12	17	10	16
Total Suspended Solids	8	20	3	7
Total Dissolved Solids	67	57	23	20
Oil and Grease	3	1	2	<1
Lead	0.07	0.08	0.10	<0.04
Zinc	0.04	0.07	0.07	0.09
Conductivity (umhos/cm,field)	37 @ 25.0°C	43 @ 25.0°C	32 @ 25.0°C	35 @ 25.0°C
Dissolved Oxygen (field)	13.0 @ 2.7°C	10.8 @ 10.5°C	10.2 @ 12.5°C	9.8 @ 13.5°C
pH (field)	6.2 @ 2.7°C	6.2 @ 10.5°C	6.6 @ 12.5°C	7.1 @ 14.6°C
Turbidity (ntu)	1	3	2	5
Ammonia	<0.05	0.05	<0.05	<0.05

Date taken	06-23-88	07-19-88	08-24-88	09-22-88
Time	10:35	15:40	14:20	14:05
Sample #	88-4065	88-4621	88-5565	88-6891
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	14	21	18	18
Total Kjeldahl Nitrogen	0.65	0.32	0.39	2.35
Nitrate/Nitrite	0.14	0.39	0.23	<0.02
Total Phosphorus	0.01	0.01	0.02	0.10
Hardness @ $CaCO_3$	16	21	20.0	20.2
Total Suspended Solids	8	2	3	6
Total Dissolved Solids	32	26	73	32
Oil and Grease	<1	<1	1	2
Lead	0.10	0.13	0.05	0.15
Zinc	0.10	0.02	0.04	0.04
Conductivity (umhos/cm,field)	34 @ 25.0°C	40 @ 25.0°C	53 @ 25.0°C	41 @ 25.0°C
Dissolved Oxygen (field)	5.9 @ 26.5°C	10.0 @ 29.0°C	8.5 @ 26.0°C	10.8 @ 20.2°
pH (field)	8.3 @ 26.2°C	8.2 @ 32.0°C	8.0 @ 25.0°C	8.4 @ 20.6°C
Turbidity (ntu)	6	4	5	
Ammonia	<0.05	<0.05	<0.05	

Station was not sampled in January

TABLE A.7. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM MOORMANS RIVER AT
ROUTE 671, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	10-19-88	11-16-88	12-12-88	01-10-89
Time	14:15	13:15	12:00	11:30
Sample #	88-7590	88-8380	88-9183	89-0381
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	19	17	15	14
Total Kjeldahl Nitrogen	0.40	1.08	0.25	0.31
Nitrate/Nitrite	0.03	<0.05	0.07	0.28
Total Phosphorus	0.02	0.02	0.02	<0.02
Hardness @ $CaCO_3$	21.2	17.6	18.4	20.6
Total Suspended Solids	<1	3	18	2
Total Dissolved Solids	40	67	87	57
Oil and Grease	8	<1	<1	2
Lead	0.16	0.1	0.1	<0.1
Zinc	0.08	0.02	0.04	0.02
Conductivity (umhos/cm,field)	43 @ 25.0°C	65 @ 25.0°C	42 @ 25.0°C	28 @ 25.0°C
Dissolved Oxygen (field)	9.8 @ 13.0°C	10.8 @ 11.5°C	12.8 @ 0.8°C	13.4 @ 4.0°C
pH (field)	7.8 @ 13.5°C	8.0 @ 14.3°C	7.1 @ 1.4°C	7.5 @ 4.5°C

TABLE A.8. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM IVY CREEK AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-21-88	02-25-88	03-30-88	04-18-88
Time	16:45	11:30	10:23	12:40
Sample #	88-0430	88-1258	88-1841	88-2284
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	38	19	22	21
Total Kjeldahl Nitrogen	0.56	0.26	<0.09	0.25
Nitrate/Nitrite	0.88	0.83	0.66	0.45
Total Phosphorus	0.01	<0.01	<0.01	<0.01
Hardness @ $CaCO_3$	17	18	28	19
Total Suspended Solids	27	7	7	6
Total Dissolved Solids	60	80	44	58
Oil and Grease	6	<1	1	2
Lead	<0.04	<0.04	0.07	0.08
Zinc	0.02	0.03	0.04	0.06
Conductivity (umhos/cm,field)	56 @ 25.0°C	55 @ 25.0°C	64 @ 25.0°C	53 @ 25.0°C
Dissolved Oxygen (field)	12.0 @ 7.2°C	13.1 @ 4.2°C	11.6 @ 10.5°C	10.6 @ 12.9°C
pH (field)	6.4 @ 7.2°C	6.7 @ 4.2°C	6.4 @ 10.5°C	6.7 @ 12.9°C
Turbidity (ntu)	29	5	14	6
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88	08-24-88
Time	10:53	10:00	15:00	13:15
Sample #	88-3207	88-4063	88-4619	88-5563
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	15	32	18	19
Total Kjeldahl Nitrogen	2.08	0.23	0.66	0.50
Nitrate/Nitrite	0.44	0.57	0.64	0.49
Total Phosphorus	0.87	0.01	<0.01	0.04
Hardness @ $CaCO_3$	19	18	22	28.0
Total Suspended Solids	37	10	22	11
Total Dissolved Solids	33	50	41	90
Oil and Grease	<1	1	<1	<1
Lead	0.11	0.04	0.13	0.10
Zinc	0.03	0.03	0.04	0.04
Conductivity (umhos/cm,field)	57 @ 25.0°C	60 @ 25.0°C	53 @ 25.0°C	60 @ 25.0°C
Dissolved Oxygen (field)	9.6 @ 14.0°C	8.3 @ 23.0°C	8.7 @ 27.0°C	8.8 @ 23.5°C
pH (field)	7.0 @ 16.5°C	8.2 @ 23.4°C	8.5 @ 31.2°C	7.6 @ 25.0°C
Turbidity (ntu)	22	18	22	15
Ammonia	0.32	0.09	<0.05	<0.05

TABLE A.8. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM IVY CREEK AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	09-22-88	10-19-88	11-16-88	12-12-88
Time	13:15	12:55	12:25	11:15
Sample #	88-6889	88-7588	88-8381	88-9181
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	21	17	17	17
Total Kjeldahl Nitrogen	0.55	0.46	1.14	0.68
Nitrate/Nitrite	0.22	0.40	0.38	0.69
Total Phosphorus	0.03	0.05	0.03	0.05
Hardness @ $CaCO_3$	23.6	28.6	20.2	20.6
Total Suspended Solids	16	2	1	9
Total Dissolved Solids	30	39	63	83
Oil and Grease	<1	3	<1	4
Lead	0.17	0.10	0.1	0.1
Zinc	0.03	0.09	0.01	0.05
Conductivity (umhos/cm,field)	56 @ 25.0°C	47 @ 25.0°C	58 @ 25.0°C	45 @ 25.0°C
Dissolved Oxygen (field)	8.6 @ 19.5°C	9.8 @ 13.0°C	10.2 @ 11.5°C	12.8 @ 0.0°C
pH (field)	8.3 @ 20.7°C	8.1 @ 13.8°C	8.5 @ 12.0°C	5.7 @ 1.9°C

Date taken	01-10-89
Time	10:45
Sample #	89-0382
Analysis - Results in mg/L unless otherwise stated.	
Total Alkalinity @ $CaCO_3$	16
Total Kjeldahl Nitrogen	0.30
Nitrate/Nitrite	0.64
Total Phosphorus	0.02
Hardness @ $CaCO_3$	23.0
Total Suspended Solids	1
Total Dissolved Solids	50
Oil and Grease	2
Lead	<0.1
Zinc	0.02
Conductivity (umhos/cm,field)	40 @ 25.0°C
Dissolved Oxygen (field)	13.5 @ 4.0°C
pH (field)	7.9 @ 5.4°C

TABLE A.9. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE NORTH FORK RIVANNA RIVER AT ROUTE 29, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-22-88	02-26-88	03-30-88	04-18-88
Time	09:10	08:25	14:45	16:25
Sample #	88-0435	88-1273	88-1852	88-2295
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	30	22	17	26
Total Kjeldahl Nitrogen	0.23	0.24	0.12	0.13
Nitrate/Nitrite	0.42	0.27	0.25	0.04
Total Phosphorus	0.03	0.01	<0.01	0.01
Hardness @ $CaCO_3$	15	16	14	15
Total Suspended Solids	27	26	7	10
Total Dissolved Solids	47	3	37	17
Oil and Grease	3	<1	<1	<1
Lead	<0.04	0.06	<0.04	0.08
Zinc	0.02	0.02	0.10	0.08
Conductivity (umhos/cm,field)	53 @ 25.0°C	57 @ 25.0°C	54 @ 25.0°C	46 @ 25.0°C
Dissolved Oxygen (field)	12.7 @ 3.7°C	13.0 @ 1.6°C	10.3 @ 13.4°C	10.0 @ 14.3°C
pH (field)	6.4 @ 3.7°C	5.8 @ 1.6°C	6.6 @ 13.4°C	6.4 @ 14.3°C
Turbidity (ntu)	19	8	6	4
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88	08-24-88
Time	20:35	13:30	19:30	17:20
Sample #	88-3227	88-4053	88-4629	88-5572
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	28	22	20	18
Total Kjeldahl Nitrogen	0.29	0.59	0.41	0.72
Nitrate/Nitrite	0.21	0.17	0.29	0.02
Total Phosphorus	0.04	<0.01	<0.01	0.03
Hardness @ $CaCO_3$	17	14	16	21.0
Total Suspended Solids	14	5	3	<1
Total Dissolved Solids	27	21	87	3
Oil and Grease	2	<1	<1	<1
Lead	0.12	<0.04	0.15	0.09
Zinc	0.03	0.03	0.04	0.03
Conductivity (umhos/cm,field)	52 @ 25.0°C	52 @ 25.0°C	38 @ 25.0°C	47 @ 25.0°C
Dissolved Oxygen (field)	8.4 @ 16.5°C	8.2 @ 27.5°C	*	8.4 @ 26.5°C
pH (field)	6.8 @ 17.3°C	8.3 @ 27.9°C	7.9 @ 29.9°C	7.4 @ 25.0°C
Turbidity (ntu)	8	8	12	6
Ammonia	<0.05	0.06	<0.05	0.71

* Equipment Malfunction

TABLE A.9. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM NORTH FORK RIVANNA RIVER AT ROUTE 29, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	09-22-88	10-20-88	11-16-88	12-12-88
Time	17:15	11:15	15:55	14:30
Sample #	88-6898	88-7598	88-8376	88-9193
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	20	21	19	17
Total Kjeldahl Nitrogen	0.20	0.55	<0.09	0.73
Nitrate/Nitrite	<0.02	<0.02	0.05	0.09
Total Phosphorus	0.01	0.06	0.02	0.02
Hardness @ $CaCO_3$	21.8	17.2	19.4	19.6
Total Suspended Solids	9	2	1	1
Total Dissolved Solids	73	53	53	20
Oil and Grease	<1	<1	1	<1
Lead	0.13	<0.04	0.1	<0.1
Zinc	0.08	0.07	0.02	0.03
Conductivity (umhos/cm,field)	47 @ 25.0°C	45 @ 25.0°C	62 @ 25.0°C	37 @ 25.0°C
Dissolved Oxygen (field)	9.4 @ 22.5°C	7.8 @ 10.5°C	10.6 @ 9.5°C	12.2 @ 1.5°C
pH (field)	8.3 @ 22.3°C	7.4 @ 11.1°C	7.8 @ 10.5°C	6.6 @ 1.9°C

Date taken	01-10-89
Time	15:40
Sample #	89-0375
Analysis - Results in mg/L unless otherwise stated.	
Total Alkalinity @ $CaCO_3$	16
Total Kjeldahl Nitrogen	0.72
Nitrate/Nitrite	0.13
Total Phosphorus	0.03
Hardness @ $CaCO_3$	18.7
Total Suspended Solids	27
Total Dissolved Solids	53
Oil and Grease	1
Lead	<0.1
Zinc	0.02
Conductivity (umhos/cm,field)	116 @ 25.0°C
Dissolved Oxygen (field)	11.2 @ 5.0°C
pH (field)	7.3 @ 5.9°C

TABLE A.10. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM PINEY CREEK AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-21-88	02-25-88	03-30-88	04-18-88
Time	15:25	12:40	11:45	14:10
Sample #	88-0426	88-1262	88-1845	88-2288
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	21	17	19	27
Total Kjeldahl Nitrogen	0.38	0.32	0.12	0.30
Nitrate/Nitrite	0.29	0.27	0.19	0.17
Total Phosphorus	0.01	<0.01	<0.01	0.01
Hardness @ $CaCO_3$	11	12	13	13
Total Suspended Solids	20	13	7	19
Total Dissolved Solids	77	60	23	97
Oil and Grease	4	<1	1	<1
Lead	0.07	<0.04	0.14	0.09
Zinc	0.06	0.04	0.04	0.04
Conductivity (umhos/cm,field)	41.1 @ 25.0°C	36 @ 25.0°C	43 @ 25.0°C	38 @ 25.0°C
Dissolved Oxygen (field)	11.9 @ 6.1°C	12.0 @ 3.7°C	10.2 @ 12.3°C	11.0 @ 12.2°C
pH (field)	6.1 @ 6.1°C	6.2 @ 3.7°C	6.7 @ 12.3°C	6.1 @ 12.2°C
Turbidity (ntu)	15	4	10	6
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88	08-24-88
Time	12:36	11:15	16:15	14:37
Sample #	88-3211	88-4067	88-4623	88-5566
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	21	35	28	18
Total Kjeldahl Nitrogen	0.38	0.46	0.29	0.38
Nitrate/Nitrite	0.15	0.40	0.51	0.26
Total Phosphorus	0.03	0.03	0.02	0.03
Hardness @ $CaCO_3$	18	15	18	21.0
Total Suspended Solids	3	21	3	13
Total Dissolved Solids	30	40	25	83
Oil and Grease	<1	<1	1	<1
Lead	0.07	0.08	0.16	0.09
Zinc	0.03	0.05	0.02	0.03
Conductivity (umhos/cm,field)	41 @ 25.0°C	48 @ 25.0°C	39 @ 25.0°C	45 @ 25.0°C
Dissolved Oxygen (field)	8.7 @ 14.5°C	7.3 @ 22.0°C	7.4 @ 29.5°C	7.8 @ 23.0°C
pH (field)	6.2 @ 15.3°C	8.4 @ 22.0°C	7.9 @ 29.5°C	7.7 @ 25.0°C
Turbidity (ntu)	14	10	14	10
Ammonia	<0.05	<0.05	<0.05	<0.05

TABLE A.10. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM PINEY CREEK AT
ROUTE 601, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	09-22-88	10-19-88	11-16-88	12-12-88
Time	14:20	14:45	13:30	12:15
Sample #	88-6893	88-7592	88-8386	88-9187
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	17	17	16	15
Total Kjeldahl Nitrogen	1.07	0.76	1.19	0.68
Nitrate/Nitrite	0.12	<0.02	0.10	0.23
Total Phosphorus	0.02	0.03	0.02	<0.02
Hardness @ $CaCO_3$	22.4	14.4	13.8	16.0
Total Suspended Solids	58	2	2	1
Total Dissolved Solids	69	27	62	67
Oil and Grease	<1	2	<1	<1
Lead	0.14	<0.04	0.1	0.1
Zinc	0.07	0.08	0.01	0.04
Conductivity (umhos/cm,field)	39 @ 25.0°C	43 @ 25.0°C	45 @ 25.0°C	27 @ 25.0°C
Dissolved Oxygen (field)	7.9 @ 19.0°C	8.7 @ 13.0°C	8.8 @ 10.5°C	12.4 @ 0.0°C
pH (field)	8.3.@ 19.0°C	7.6 @ 13.8°C	7.9 @ 13.7°C	6.8 @ 0.5°C

Date taken	01-10-89
Time	11:45
Sample #	89-0380
Analysis - Results in mg/L unless otherwise stated.	
Total Alkalinity @ $CaCO_3$	16
Total Kjeldahl Nitrogen	0.30
Nitrate/Nitrite	0.23
Total Phosphorus	0.02
Hardness @ $CaCO_3$	19.6
Total Suspended Solids	1
Total Dissolved Solids	40
Oil and Grease	1
Lead	<0.1
Zinc	0.01
Conductivity (umhos/cm,field)	26 @ 25.0°C
Dissolved Oxygen (field)	12.8 @ 3.0°C
pH (field)	7.6 @ 3.8°C

TABLE A.11. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM SOUTH FORK RIVANNA RIVER AT ROUTE 29, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-21-88	02-26-88	03-30-88	04-19-88
Time	13:00	08:00	17:00	10:45
Sample #	88-0423	88-1272	88-1858	88-2305
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	22	28	63	21
Total Kjeldahl Nitrogen	0.30	0.35	0.49	0.17
Nitrate/Nitrite	0.36	0.42	0.41	0.13
Total Phosphorus	0.04	0.01	0.02	<0.01
Hardness @ $CaCO_3$	18	17	18	15
Total Suspended Solids	7	6	27	3
Total Dissolved Solids	73	13	57	13
Oil and Grease	<1	<1	6	<1
Lead	<0.04	<0.04	0.08	0.13
Zinc	0.02	<0.01	0.06	0.01
Conductivity (umhos/cm,field)	49.6 @ 25.0°C	62 @ 25.0°C	64 @ 25.0°C	53 @ 25.0°C
Dissolved Oxygen (field)	12.1 @ 5.1°C	12.3 @ 2.6°C	8.1 @ 14.0°C	8.9 @ 12.4°C
pH (field)	6.7 @ 5.1°C	6.7 @ 2.6°C	6.4 @ 14.0°C	6.4 @ 12.4°C
Turbidity (ntu)	8	7	56	8
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88	08-24-88
Time	15:02	13:45	19:05	19:00
Sample #	88-3216	88-4054	88-4628	88-5575
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	19	17	23	20
Total Kjeldahl Nitrogen	0.33	0.48	0.60	0.58
Nitrate/Nitrite	0.24	0.16	0.34	0.12
Total Phosphorus	0.01	<0.01	0.04	0.02
Hardness @ $CaCO_3$	20	18	23	21.0
Total Suspended Solids	15	2	16	6
Total Dissolved Solids	23	29	72	40
Oil and Grease	<1	<1	1	1
Lead	0.06	0.04	0.17	0.14
Zinc	0.03	0.03	0.04	0.02
Conductivity (umhos/cm,field)	52 @ 25.0°C	61 @ 25.0°C	52 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	7.2 @ 19.0°C	9.3 @ 27.8°C	*	6.8 @ 28.5°C
pH (field)	6.2 @ 19.8°C	8.3 @ 28.5°C	7.5 @ 30.0°C	7.9 @ 25.0°C
Turbidity (ntu)	12	6	20	12
Ammonia	<0.05	0.09	0.08	0.09

* Equipment Malfunction

TABLE A.11. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM SOUTH FORK RIVANNA RIVER AT ROUTE 29, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	09-22-88	10-20-88	11-16-88	12-12-88
Time	12:25	09:00	16:35	15:00
Sample #	88-6899	88-7597	88-8374	88-9195
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	19	20	18	18
Total Kjeldahl Nitrogen	0.55	1.53	0.84	0.56
Nitrate/Nitrite	0.05	0.09	0.16	0.16
Total Phosphorus	0.10	0.04	0.04	0.03
Hardness @ $CaCO_3$	22.2	17.0	19.8	20.8
Total Suspended Solids	8	4	6	5
Total Dissolved Solids	69	40	40	38
Oil and Grease	3	2	<1	2
Lead	0.12	0.10	0.1	<0.1
Zinc	0.10	0.07	0.03	0.05
Conductivity (umhos/cm,field)	61 @ 25.0°C	45 @ 25.0°C	70 @ 25.0°C	50 @ 25.0°C
Dissolved Oxygen (field)	7.1 @ 21.5°C	8.5 @ 12.0°C	9.6 @ 11.0°C	9.6 @ 3.0°C
pH (field)	8.2 @ 22.0°C	8.0 @ 11.5°C	8.0 @ 11.5°C	6.6 @ 3.1°C

Date taken	01-10-89
Time	13:45
Sample #	89-0376
Analysis - Results in mg/L unless otherwise stated.	
Total Alkalinity @ $CaCO_3$	18
Total Kjeldahl Nitrogen	0.82
Nitrate/Nitrite	0.20
Total Phosphorus	0.05
Hardness @ $CaCO_3$	21.8
Total Suspended Solids	21
Total Dissolved Solids	50
Oil and Grease	6
Lead	<0.1
Zinc	0.02
Conductivity (umhos/cm,field)	116 @ 25.0°C
Dissolved Oxygen (field)	11.2 @ 5.0°C
pH (field)	7.1 @ 5.8°C

TABLE A.12. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM SOUTH FORK RIVANNA RIVER AT ROUTE 660, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-22-88	02-25-88	03-30-88	04-18-88
Time	10:10	13:50	13:05	15:10
Sample #	88-0437	88-1266	88-1849	88-2292
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	27	18	21	20
Total Kjeldahl Nitrogen	0.38	0.34	0.32	0.30
Nitrate/Nitrite	0.40	0.36	0.30	0.07
Total Phosphorus	0.03	<0.01	<0.01	<0.01
Hardness @ $CaCO_3$	16	16	15	17
Total Suspended Solids	30	3	30	15
Total Dissolved Solids	57	23	13	65
Oil and Grease	10	3	2	<1
Lead	<0.04	<0.04	0.11	0.08
Zinc	0.02	0.03	0.05	0.03
Conductivity (umhos/cm,field)	53 @ 25.0°C	50 @ 25.0°C	60 @ 25.0°C	41 @ 25.0°C
Dissolved Oxygen (field)	11.8 @ 4.2°C	11.7 @ 3.4°C	8.1 @ 12.1°C	8.0 @ 14.6°C
pH (field)	6.7 @ 4.2°C	5.9 @ 3.4°C	6.5 @ 12.1°C	6.6 @ 14.6°C
Turbidity (ntu)	21	3	11	4
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88	08-24-88
Time	13:55	12:20	17:40	16:25
Sample #	88-3215	88-4071	88-4627	88-5571
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	25	51	23	19
Total Kjeldahl Nitrogen	0.48	0.45	0.49	0.59
Nitrate/Nitrite	0.19	0.24	0.89	0.11
Total Phosphorus	0.08	0.03	<0.01	0.09
Hardness @ $CaCO_3$	20	18	19	25.0
Total Suspended Solids	6	172	6	12
Total Dissolved Solids	61	68	94	73
Oil and Grease	<1	<1	1	<1
Lead	0.06	0.11	0.17	0.11
Zinc	0.05	0.04	0.02	0.03
Conductivity (umhos/cm,field)	60 @ 25.0°C	92 @ 25.0°C	49 @ 25.0°C	55 @ 25.0°C
Dissolved Oxygen (field)	8.3 @ 17.0°C	7.2 @ 29.5°C	7.4 @ 30.5°C	9.3 @ 28.0°C
pH (field)	7.0 @ 16.8°C	7.6 @ 31.8°C	7.9 @ 30.8°C	7.4 @ 25.0°C
Turbidity (ntu)	14	16	10	8
Ammonia	<0.05	0.11	<0.05	0.05

TABLE A.12. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM SOUTH FORK RIVANNA RIVER AT ROUTE 660, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989
(continued)

Date taken	09-22-88	10-19-88	11-16-88	12-12-88
Time	15:45	17:05	14:55	13:30
Sample #	88-6897	88-7596	88-8375	88-9197
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	19	24	20	20
Total Kjeldahl Nitrogen	0.29	0.47	0.34	4.72
Nitrate/Nitrite	<0.02	0.03	0.06	0.10
Total Phosphorus	0.02	0.04	0.02	0.41
Hardness @ $CaCO_3$	22.2	21.2	23.4	28.6
Total Suspended Solids	9	2	5	248
Total Dissolved Solids	62	20	40	50
Oil and Grease	4	1	1	1
Lead	0.16	0.10	0.1	0.1
Zinc	0.07	0.09	0.02	0.17
Conductivity (umhos/cm,field)	56 @ 25.0°C	55 @ 25.0°C	66 @ 25.0°C	48 @ 25.0°C
Dissolved Oxygen (field)	7.8 @ 23.0°C	9.0 @ 13.0°C	8.8 @ 8.5°C	12.8 @ 1.0°C
pH (field)	8.0 @ 24.2°C	8.0 @ 13.4°C	8.0 @ 9.0°C	6.9 @ 1.5°C

Date taken	01-10-89
Time	13:05
Sample #	89-0369
Analysis - Results in mg/L unless otherwise stated.	
Total Alkalinity @ $CaCO_3$	17
Total Kjeldahl Nitrogen	0.50
Nitrate/Nitrite	0.15
Total Phosphorus	<0.02
Hardness @ $CaCO_3$	20.1
Total Suspended Solids	4
Total Dissolved Solids	40
Oil and Grease	3
Lead	0.1
Zinc	0.01
Conductivity (umhos/cm,field)	43 @ 25.0°C
Dissolved Oxygen (field)	12.6 @ 4.0°C
pH (field)	7.4 @ 4.5°C

TABLE A.13. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM JACOBS RUN AT
ROUTE 743, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1989

Date taken	01-21-88	02-25-88	03-30-88	04-18-88
Time	14:37	14:25	13:35	15:50
Sample #	88-0424	88-1267	88-1850	88-2293
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	51	24	33	25
Total Kjeldahl Nitrogen	0.47	0.45	0.77	0.24
Nitrate/Nitrite	0.63	0.29	0.22	0.15
Total Phosphorus	0.19	0.04	0.09	<0.01
Hardness @ $CaCO_3$	19	12	16	14
Total Suspended Solids	67	3	153	19
Total Dissolved Solids	87	20	17	48
Oil and Grease	3	<1	3	<1
Lead	0.05	<0.04	0.10	0.05
Zinc	0.03	0.03	0.06	0.03
Conductivity (umhos/cm,field)	41 @ 25.0°C	39 @ 25.0°C	45 @ 25.0°C	35 @ 25.0°C
Dissolved Oxygen (field)	11.6 @ 6.8°C	12.0 @ 5.2°C	9.3 @ 17.4°C	10.0 @ 13.7°C
pH (field)	6.2 @ 6.8°C	6.8 @ 5.2°C	6.6 @ 17.4°C	6.2 @ 13.7°C
Turbidity (ntu)	41	10	22	8
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88	09-22-88
Time	15:35	12:50	20:00	16:10
Sample #	88-3217	88-4051	88-4630	88-6900
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	21	37	37	18
Total Kjeldahl Nitrogen	0.47	0.56	0.50	0.40
Nitrate/Nitrite	0.08	0.15	0.45	<0.02
Total Phosphorus	0.05	0.01	0.03	0.01
Hardness @ $CaCO_3$	20	15	15	22.6
Total Suspended Solids	48	12	6	25
Total Dissolved Solids	48	48	83	83
Oil and Grease	4	<1	1	<1
Lead	0.10	<0.04	0.11	0.06
Zinc	0.05	0.02	0.04	0.08
Conductivity (umhos/cm,field)	46 @ 25.0°C	50 @ 25.0°C	42 @ 25.0°C	36 @ 25.0°C
Dissolved Oxygen (field)	8.2 @ 19.5°C	7.8 @ 26.5°C	*	7.5 @ 21.5°C
pH (field)	6.4 @ 20.3°C	8.4 @ 27.8°C	7.1 @ 26.9°C	8.1 @ 22.4°C
Turbidity (ntu)	24	16	20	
Ammonia	<0.05	0.05	<0.05	

* Equipment Malfunction

TABLE A.13. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM JACOBS RUN AT
ROUTE 743, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JANUARY, 1988
(continued)

Date taken	10-20-88	11-16-88	12-12-88	01-10-89
Time	10:00	15:35	14:00	14:30
Sample #	88-7599	88-8377	88-9196	89-0374
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	17	15	14	12
Total Kjeldahl Nitrogen	0.26	0.57	0.29	0.58
Nitrate/Nitrite	<0.02	0.06	0.13	0.11
Total Phosphorus	0.04	0.02	0.02	0.03
Hardness @ $CaCO_3$	15.8	15.8	12.2	12.1
Total Suspended Solids	1	8	5	11
Total Dissolved Solids	52	40	17	30
Oil and Grease	2	<1	3	2
Lead	<0.04	0.1	0.1	<0.1
Zinc	0.04	0.03	0.05	0.02
Conductivity (umhos/cm,field)	33 @ 25.0°C	50 @ 25.0°C	22 @ 25.0°C	17 @ 25.0°C
Dissolved Oxygen (field)	9.8 @ 9.5°C	8.4 @ 11.0°C	12.1 @ 0.2°C	12.7 @ 5.0°C
pH (field)	7.9 @ 10.1°C	7.9 @ 11.5°C	6.8 @ 1.5°C	7.2 @ 5.9°C

TABLE A.14. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM BUCK ISLAND CREEK AT
ROUTE 729, ALBEMARLE COUNTY, VIRGINIA. FEBRUARY, 1988 - JULY, 1988

Date taken	02-26-88	03-30-88	04-19-88
Time	10:45	18:00	13:20
Sample #	88-1277	88-1859	88-2307
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	24	36	31
Total Kjeldahl Nitrogen	0.44	0.15	0.14
Nitrate/Nitrite	0.17	0.19	0.06
Total Phosphorus	<0.01	<0.01	0.01
Hardness @ $CaCO_3$	26	28	21
Total Suspended Solids	8	9	3
Total Dissolved Solids	10	30	20
Oil and Grease	2	2	<1
Lead	<0.04	0.03	0.13
Zinc	0.03	0.05	<0.01
Conductivity (umhos/cm,field)	67 @ 25.0°C	62 @ 25.0°C	101 @ 25.0°C
Dissolved Oxygen (field)	13.6 @ 1.8°C	8.8 @ 14.3°C	7.7 @ 11.0°C
pH (field)	7.2 @ 1.8°C	6.3 @ 14.3°C	6.7 @ 11.0°C
Turbidity (ntu)	5	18	5
Ammonia	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-20-88
Time	19:04	17:20	18:20
Sample #	88-3225	88-4061	88-4638
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	22	47	34
Total Kjeldahl Nitrogen	0.24	0.35	0.39
Nitrate/Nitrite	0.13	0.21	0.20
Total Phosphorus	<0.01	0.01	<0.01
Hardness @ $CaCO_3$	24	39	28
Total Suspended Solids	8	23	8
Total Dissolved Solids	57	66	116
Oil and Grease	1	<1	<1
Lead	0.09	<0.04	0.14
Zinc	0.03	0.02	0.01
Conductivity (umhos/cm,field)	59 @ 25.0°C	94 @ 25.0°C	77 @ 25.0°C
Dissolved Oxygen (field)	8.7 @ 16.0°C	7.6 @ 25.0°C	6.5 @ 26.0°C
pH (field)	6.5 @ 17.1°C	8.1 @ 25.2°C	7.4 @ 26.1°C
Turbidity (ntu)	8	7	20
Ammonia	<0.05	<0.05	<0.05

TABLE A.15. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM NORTH FORK HARDWARE RIVER AT ROUTE 631, ALBEMARLE COUNTY, VIRGINIA. FEBRUARY, 1988 - JULY, 1988

Date taken	02-26-88	03-30-88	04-19-88
Time	09:55	19:10	12:05
Sample #	88-1276	88-1861	88-2306
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	14	18	16
Total Kjeldahl Nitrogen	0.23	0.16	0.09
Nitrate/Nitrite	0.45	0.38	0.36
Total Phosphorus	<0.01	0.01	0.01
Hardness @ $CaCO_3$	14	16	12
Total Suspended Solids	10	3	3
Total Dissolved Solids	27	10	7
Oil and Grease	4	4	<1
Lead	<0.04	0.12	0.12
Zinc	0.07	0.07	<0.01
Conductivity (umhos/cm,field)	49 @ 25.0°C	52 @ 25.0°C	62 @ 25.0°C
Dissolved Oxygen (field)	13.3 @ 1.8°C	9.0 @ 15.9°C	10.7 @ 10.6°C
pH (field)	6.6 @ 1.8°C	6.3 @ 15.9°C	6.3 @ 10.6°C
Turbidity (ntu)	6	14	6
Ammonia	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-20-88
Time	19:50	18:00	19:25
Sample #	88-3226	88-4062	88-4639
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	20	30	32
Total Kjeldahl Nitrogen	0.27	0.31	0.75
Nitrate/Nitrite	0.32	0.63	0.48
Total Phosphorus	0.09	<0.01	0.13
Hardness @ $CaCO_3$	19	18	15
Total Suspended Solids	10	7	53
Total Dissolved Solids	35	26	83
Oil and Grease	2	<1	<1
Lead	0.09	<0.04	0.13
Zinc	0.03	0.03	0.05
Conductivity (umhos/cm,field)	56 @ 25.0°C	50 @ 25.0°C	49 @ 25.0°C
Dissolved Oxygen (field)	8.2 @ 17.5°C	7.3 @ 26.0°C	7.9 @ 26.5°C
pH (field)	6.9 @ 18.2°C	8.4 @ 26.4°C	7.5 @ 26.5°C
Turbidity (ntu)	8	12	60
Ammonia	<0.05	<0.05	<0.05

TABLE A.16. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM NORTH FORK RIVANNA RIVER AT ROUTE 604, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JULY, 1988

Date taken	01-22-88	02-25-88	03-30-88	04-18-88
Time	09:40	14:45	13:55	16:10
Sample #	88-0436	88-1268	88-1851	88-2294
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	16	12	18	18
Total Kjeldahl Nitrogen	0.44	0.46	0.16	<0.09
Nitrate/Nitrite	0.44	0.27	0.22	0.07
Total Phosphorus	<0.01	<0.01	<0.01	<0.01
Hardness @ $CaCO_3$	15	16	14	16
Total Suspended Solids	10	3	3	3
Total Dissolved Solids	43	10	72	23
Oil and Grease	<1	<1	1	<1
Lead	0.05	0.08	<0.04	0.10
Zinc	0.01	0.02	0.06	<0.01
Conductivity (umhos/cm,field)	45 @ 25.0°C	40 @ 25.0°C	50 @ 25.0°C	50 @ 25.0°C
Dissolved Oxygen (field)	12.4 @ 3.4°C	12.1 @ 3.1°C	10.7 @ 13.7°C	10.0 @ 13.8°C
pH (field)	6.5 @ 3.4°C	6.5 @ 3.1°C	6.5 @ 13.7°C	6.6 @ 13.8°C
Turbidity (ntu)	8	2	4	3
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-19-88
Time	15:53	13:00	20:30
Sample #	88-3218	88-4052	88-4631
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	22	24	31
Total Kjeldahl Nitrogen	0.43	0.72	0.49
Nitrate/Nitrite	0.16	0.22	0.39
Total Phosphorus	0.06	<0.01	0.01
Hardness @ $CaCO_3$	19	19	16
Total Suspended Solids	27	177	16
Total Dissolved Solids	62	50	75
Oil and Grease	<1	9	1
Lead	0.08	<0.04	0.10
Zinc	0.05	0.02	0.04
Conductivity (umhos/cm,field)	52 @ 25.0°C	60 @ 25.0°C	48 @ 25.0°C
Dissolved Oxygen (field)	9.2 @ 17.0°C	9.2 @ 28.5°C	*
pH (field)	6.6 @ 21.9°C	8.3 @ 28.9°C	7.0 @ 27.1°C
Turbidity (ntu)	12	8	12
Ammonia	<0.05	0.07	0.05

* Equipment Malfunction

TABLE A.17. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM PREDDY CREEK AT
ROUTE 600, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JULY, 1988

Date taken	01-22-88	02-25-88	03-30-88	04-18-88
Time	08:50	15:25	15:15	16:50
Sample #	88-0434	88-1269	88-1853	88-2296
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	36	24	29	34
Total Kjeldahl Nitrogen	0.31	0.32	<0.09	0.31
Nitrate/Nitrite	0.33	0.24	0.14	0.09
Total Phosphorus	0.05	0.03	<0.01	0.01
Hardness @ $CaCO_3$	19	22	21	21
Total Suspended Solids	43	6	12	7
Total Dissolved Solids	60	17	108	27
Oil and Grease	<1	3	<1	2
Lead	<0.04	<0.04	0.07	0.10
Zinc	0.02	0.05	0.06	0.01
Conductivity (umhos/cm,field)	63 @ 25.0°C	55 @ 25.0°C	65 @ 25.0°C	90 @ 25.0°C
Dissolved Oxygen (field)	12.0 @ 3.9°C	12.7 @ 3.4°C	9.9 @ 13.5°C	8.4 @ 13.8°C
pH (field)	6.5 @ 3.9°C	6.8 @ 3.4°C	6.5 @ 13.5°C	6.5 @ 13.8°C
Turbidity (ntu)	26	7	11	8
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-20-88
Time	16:37	15:00	14:40
Sample #	88-3219	88-4056	88-4633
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	36	48	17
Total Kjeldahl Nitrogen	0.30	0.64	0.69
Nitrate/Nitrite	0.16	0.20	0.45
Total Phosphorus	0.03	<0.01	<0.01
Hardness @ $CaCO_3$	24	24	20
Total Suspended Solids	26	7	206
Total Dissolved Solids	81	48	125
Oil and Grease	<1	<1	<1
Lead	0.05	0.04	0.15
Zinc	0.03	0.03	0.05
Conductivity (umhos/cm,field)	64 @ 25.0°C	74 @ 25.0°C	55 @ 25.0°C
Dissolved Oxygen (field)	8.7 @ 16.5°C	7.5 @ 24.0°C	6.8 @ 27.0°C
pH (field)	6.5 @ 16.7°C	7.8 @ 25.9°C	7.5 @ 27.3°C
Turbidity (ntu)	18	20	80
Ammonia	<0.05	0.08	0.08

* Equipment Malfunction

TABLE A.18. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM PREDDY CREEK AT
ROUTE 640, ALBEMARLE COUNTY, VIRGINIA. FEBRUARY, 1988 - JULY, 1988

Date taken	02-25-88	03-30-88	04-18-88
Time	16:05	15:45	17:10
Sample #	88-1271	88-1854	88-2297
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	28	26	37
Total Kjeldahl Nitrogen	0.38	<0.09	0.16
Nitrate/Nitrite	0.26	0.15	0.10
Total Phosphorus	<0.01	<0.01	0.01
Hardness @ $CaCO_3$	21	19	20
Total Suspended Solids	18	33	7
Total Dissolved Solids	20	50	50
Oil and Grease	<1	<1	<1
Lead	<0.04	<0.04	0.09
Zinc	0.02	0.07	0.02
Conductivity (umhos/cm,field)	56 @ 25.0°C	64 @ 25.0°C	122 @ 25.0°C
Dissolved Oxygen (field)	11.4 @ 3.6°C	9.4 @ 15.5°C	9.4 @ 14.5°C
pH (field)	6.7 @ 3.6°C	5.6 @ 15.5°C	6.5 @ 14.5°C
Turbidity (ntu)	10	13	8
Ammonia	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-20-88
Time	17:06	15:30	14:10
Sample #	88-3220	88-4058	88-4632
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	38	46	77
Total Kjeldahl Nitrogen	0.35	0.41	0.90
Nitrate/Nitrite	0.17	0.21	0.52
Total Phosphorus	<0.01	<0.01	0.01
Hardness @ $CaCO_3$	23	23	24
Total Suspended Solids	47	18	61
Total Dissolved Solids	73	37	97
Oil and Grease	5	<1	<1
Lead	0.14	0.04	0.17
Zinc	0.03	0.07	0.02
Conductivity (umhos/cm,field)	64 @ 25.0°C	72 @ 25.0°C	58 @ 25.0°C
Dissolved Oxygen (field)	7.3 @ 18.0°C	7.7 @ 25.5°C	7.2 @ 27.5°C
pH (field)	6.7 @ 18.9°C	7.8 @ 27.1°C	7.7 @ 28.0°C
Turbidity (ntu)	22	12	80
Ammonia	<0.05	<0.05	0.07

TABLE A.19. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM REDBUD CREEK AT
ROUTE 20, ALBEMARLE COUNTY, VIRGINIA. JANUARY, 1988 - JULY, 1988

Date taken	01-22-88	02-26-88	03-30-88	04-19-88
Time	08:05	09:00	16:25	08:45
Sample #	88-0433	88-1275	88-1856	88-2302
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	64	24	47	32
Total Kjeldahl Nitrogen	0.23	0.23	0.23	<0.09
Nitrate/Nitrite	0.25	0.19	0.12	0.14
Total Phosphorus	0.04	<0.01	<0.01	0.01
Hardness @ $CaCO_3$	20	27	24	27
Total Suspended Solids	27	6	12	17
Total Dissolved Solids	83	19	90	40
Oil and Grease	3	1	<1	<1
Lead	<0.04	<0.04	0.05	0.13
Zinc	0.02	0.02	0.04	<0.01
Conductivity (umhos/cm,field)	58 @ 25.0°C	69 @ 25.0°C	64 @ 25.0°C	90 @ 25.0°C
Dissolved Oxygen (field)	12.0 @ 4.6°C	14.0 @ 1.7°C	9.5 @ 16.6°C	9.7 @ 10.9°C
pH (field)	6.5 @ 4.6°C	6.7 @ 1.7°C	6.5 @ 16.6°C	6.3 @ 10.9°C
Turbidity (ntu)	39	8	28	6
Ammonia	<0.05	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-20-88
Time	18:03	16:00	16:50
Sample #	88-3223	88-4059	88-4636
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	40	35	47
Total Kjeldahl Nitrogen	0.20	0.40	0.43
Nitrate/Nitrite	0.12	0.29	0.46
Total Phosphorus	<0.01	0.01	0.01
Hardness @ $CaCO_3$	29	29	38
Total Suspended Solids	19	8	22
Total Dissolved Solids	86	17	119
Oil and Grease	<1	<1	<1
Lead	0.11	<0.04	0.15
Zinc	0.02	0.02	0.01
Conductivity (umhos/cm,field)	58 @ 25.0°C	120 @ 25.0°C	79 @ 25.0°C
Dissolved Oxygen (field)	8.1 @ 19.0°C	7.5 @ 27.0°C	9.0 @ 26.5°C
pH (field)	6.9 @ 19.4°C	7.4 @ 27.8°C	7.3 @ 26.3°C
Turbidity (ntu)	22	16	22
Ammonia	<0.05	<0.05	<0.05

TABLE A.20. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM RIVANNA RIVER AT
ROUTE 729, ALBEMARLE COUNTY, VIRGINIA. FEBRUARY, 1988 - JULY, 1988

Date taken	02-26-88	03-30-88	04-19-88
Time	11:30	18:25	13:35
Sample #	88-1278	88-1860	88-2308
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	23	35	25
Total Kjeldahl Nitrogen	0.97	0.73	0.97
Nitrate/Nitrite	0.43	0.39	0.42
Total Phosphorus	<0.01	0.09	0.18
Hardness @ $CaCO_3$	23	23	23
Total Suspended Solids	9	13	20
Total Dissolved Solids	23	50	7
Oil and Grease	<1	3	<1
Lead	<0.04	0.04	0.12
Zinc	<0.01	0.07	0.03
Conductivity (umhos/cm,field)	85 @ 25.0°C	80 @ 25.0°C	89 @ 25.0°C
Dissolved Oxygen (field)	12.0 @ 5.0°C	9.1 @ 13.6°C	10.8 @ 11.8°C
pH (field)	7.8 @ 5.0°C	6.4 @ 13.6°C	6.7 @ 11.8°C
Turbidity (ntu)	8	26	6
Ammonia	0.28	0.27	0.67

Date taken	05-26-88	06-23-88	07-20-88
Time	18:41	17:10	17:55
Sample #	88-3224	88-4060	88-4637
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	30	42	39
Total Kjeldahl Nitrogen	0.65	0.75	0.43
Nitrate/Nitrite	0.28	0.52	0.57
Total Phosphorus	0.03	0.01	0.13
Hardness @ $CaCO_3$	22	22	26
Total Suspended Solids	69	34	48
Total Dissolved Solids	76	47	112
Oil and Grease	5	<1	<1
Lead	0.11	0.07	0.16
Zinc	0.05	0.05	0.02
Conductivity (umhos/cm,field)	69 @ 25.0°C	86 @ 25.0°C	82 @ 25.0°C
Dissolved Oxygen (field)	8.4 @ 19.0°C	7.7 @ 27.0°C	7.8 @ 28.5°C
pH (field)	7.3 @ 19.7°C	7.5 @ 27.0°C	7.4 @ 28.5°C
Turbidity (ntu)	19	16	34
Ammonia	0.09	<0.05	0.09

TABLE A.21. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM TURKEY RUN AT
ROUTE 20, ALBEMARLE COUNTY, VIRGINIA. FEBRUARY, 1988 - JULY, 1988

Date taken	02-25-88	03-30-88	04-19-88
Time	15:45	16:05	10:15
Sample #	88-1270	88-1855	88-2304
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	22	28	31
Total Kjeldahl Nitrogen	0.40	<0.09	<0.09
Nitrate/Nitrite	0.11	0.03	0.03
Total Phosphorus	<0.01	<0.01	<0.01
Hardness @ $CaCO_3$	27	23	25
Total Suspended Solids	7	7	57
Total Dissolved Solids	27	47	47
Oil and Grease	<1	2	<1
Lead	0.05	<0.04	0.10
Zinc	0.03	0.04	0.13
Conductivity (umhos/cm,field)	56 @ 25.0°C	70 @ 25.0°C	53 @ 25.0°C
Dissolved Oxygen (field)	12.2 @ 4.4°C	9.8 @ 15.3°C	10.6 @ 9.6°C
pH (field)	6.8 @ 4.4°C	7.0 @ 15.3°C	5.7 @ 9.6°C
Turbidity (ntu)	5	10	10
Ammonia	<0.05	<0.05	<0.05

Date taken	05-26-88	06-23-88	07-20-88
Time	17:26	15:20	15:00
Sample #	88-3221	88-4057	88-4634
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	37	24	35
Total Kjeldahl Nitrogen	0.11	0.15	0.20
Nitrate/Nitrite	0.04	0.17	0.38
Total Phosphorus	0.01	0.01	<0.01
Hardness @ $CaCO_3$	26	32	48
Total Suspended Solids	11	5	1
Total Dissolved Solids	68	57	140
Oil and Grease	<1	<1	<1
Lead	0.11	<0.04	0.16
Zinc	0.02	0.03	<0.01
Conductivity (umhos/cm,field)	66 @ 25.0°C	70 @ 25.0°C	83 @ 25.0°C
Dissolved Oxygen (field)	9.0 @ 15.2°C	7.6 @ 25.5°C	6.2 @ 29.5°C
pH (field)	7.5 @ 16.1°C	8.3 @ 26.0°C	7.8 @ 29.5°C
Turbidity (ntu)	18	5	6
Ammonia	<0.05	<0.05	<0.05

TABLE A.22. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM NAKED CREEK SOUTH OF ROUTE 743, ALBEMARLE COUNTY, VIRGINIA. SEPTEMBER, 1988 - JANUARY, 1989

Date taken	09-22-88	10-20-88	11-16-88
Time	16:35	09:35	15:15
Sample #	88-6903	88-7605	88-8378
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	25	28	26
Total Kjeldahl Nitrogen	0.83	1.32	2.10
Nitrate/Nitrite	<0.02	0.08	0.11
Total Phosphorus	0.07	0.06	0.12
Hardness @ $CaCO_3$	27.0	27.6	25.6
Total Suspended Solids	11	39	12
Total Dissolved Solids	26	70	63
Oil and Grease	3	<1	1
Lead	0.12	0.05	0.1
Zinc	0.05	0.04	0.03
Conductivity (umhos/cm,field)	66 @ 25.0°C	64 @ 25.0°C	86 @ 25.0°C
Dissolved Oxygen (field)	7.0 @ 23.8°C	8.5 @ 11.5°C	7.7 @ 13.0°C
pH (field)	8.0 @ 24.3°C	7.8 @ 11.8°C	7.8 @ 13.5°C

Date taken	12-19-88	01-10-89
Time	14:30	14:15
Sample #	88-9387	89-0377
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	24	21
Total Kjeldahl Nitrogen	1.43	1.57
Nitrate/Nitrite	0.19	0.32
Total Phosphorus	0.07	0.08
Hardness @ $CaCO_3$	22.8	22.4
Total Suspended Solids	6	80
Total Dissolved Solids	60	53
Oil and Grease	<1	6
Lead	0.2	<0.1
Zinc	0.05	0.03
Conductivity (umhos/cm,field)	62 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	10.8 @ 5.5°C	12.0 @ 5.0°C
pH (field)	7.5 @ 10.9°C	7.0 @ 6.5°C
Turbidity (ntu)	6	

TABLE A.23. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM IVY CREEK ON THE SOUTH FORK RIVANNA RIVER RESERVOIR, ALBEMARLE COUNTY, VIRGINIA. SEPTEMBER, 1988 - JANUARY, 1989

Date taken	09-23-88	10-24-88	11-17-88
Time	11:15	15:00	11:30
Sample #	88-6905	88-7680	88-8388
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	20	19	17
Total Kjeldahl Nitrogen	0.44	0.27	1.18
Nitrate/Nitrite	0.12	0.20	0.27
Total Phosphorus	0.03	0.03	0.02
Hardness @ $CaCO_3$	24.0	17.2	20.8
Total Suspended Solids	18	1	3
Total Dissolved Solids	13	10	67
Oil and Grease	3	<1	1
Lead	0.12	0.05	0.1
Zinc	0.09	0.03	0.01
Conductivity (umhos/cm,field)	51 @ 25.0°C	58 @ 25.0°C	64 @ 25.0°C
Dissolved Oxygen (field)	8.8 @ 17.5°C	9.5 @ 11.0°C	8.9 @ 11.5°C
pH (field)	8.1 @ 20.1°C	8.3 @ 12.5°C	6.6 @ 12.1°C

Date taken	12-19-88	01-11-89
Time	15:30	12:30
Sample #	88-9386	89-0388
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	16	16
Total Kjeldahl Nitrogen	0.37	0.27
Nitrate/Nitrite	0.67	0.60
Total Phosphorus	0.04	<0.02
Hardness @ $CaCO_3$	19.6	21.2
Total Suspended Solids	1	8
Total Dissolved Solids	13	37
Oil and Grease	1	1
Lead	0.1	0.1
Zinc	0.03	0.02
Conductivity (umhos/cm,field)	43 @ 25.0°C	51 @ 25.0°C
Dissolved Oxygen (field)	11.4 @ 1.0°C	13.4 @ 2.2°C
pH (field)	7.8 @ 3.8°C	7.3 @ 2.5°C
Turbidity (ntu)	1	

TABLE A.24. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM JUMPING BRANCH ON THE SOUTH FORK RIVANNA RIVER RESERVOIR, ALBEMARLE COUNTY, VIRGINIA. SEPTEMBER, 1988 - JANUARY, 1989

Date taken	09-23-88	10-24-88	11-17-88
Time	10:45	14:45	11:45
Sample #	88-6908	88-7681	88-8389
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	20	20	16
Total Kjeldahl Nitrogen	<0.09	0.22	1.35
Nitrate/Nitrite	0.58	0.20	0.70
Total Phosphorus	0.02	0.04	0.06
Hardness @ $CaCO_3$	21.6	17.6	19.4
Total Suspended Solids	2	2	3
Total Dissolved Solids	<1	10	70
Oil and Grease	<1	2	<1
Lead	0.10	0.06	0.1
Zinc	0.08	0.03	<0.01
Conductivity (umhos/cm,field)	50 @ 25.0°C	62 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	8.1 @ 18.0°C	13.9 @ 12.5°C	9.8 @ 11.5°C
pH (field)	7.7 @ 20.5°C	8.5 @ 13.0°C	8.3 @ 13.1°C

Date taken	12-19-88	01-11-89
Time	15:00	12:05
Sample #	88-9385	89-0389
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	12	15
Total Kjeldahl Nitrogen	0.16	0.68
Nitrate/Nitrite	1.50	1.13
Total Phosphorus	0.03	0.12
Hardness @ $CaCO_3$	16.6	22.0
Total Suspended Solids	6	17
Total Dissolved Solids	50	27
Oil and Grease	1	2
Lead	0.1	0.1
Zinc	0.04	0.04
Conductivity (umhos/cm,field)	37 @ 25.0°C	41 @ 25.0°C
Dissolved Oxygen (field)	12.2 @ 0.8°C	13.2 @ 2.5°C
pH (field)	7.5 @ 8.1°C	7.2 @ 2.1°C
Turbidity (ntu)	2	

TABLE A.25. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM POWELL CREEK AT THE HOLLYMEAD SUBDIVISION, ALBEMARLE COUNTY, VIRGINIA. AUGUST, 1988 - JANUARY, 1989

Date taken	08-24-88	09-22-88	10-20-88
Time	18:35	16:55	11:35
Sample #	88-5574	88-6904	88-7602
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	27	30	26
Total Kjeldahl Nitrogen	1.45	1.80	0.41
Nitrate/Nitrite	0.08	<0.02	0.11
Total Phosphorus	0.09	<0.01	0.75
Hardness @ $CaCO_3$	22.0	26.6	28.2
Total Suspended Solids	15	26	13
Total Dissolved Solids	16	14	70
Oil and Grease	4	2	1
Lead	0.14	0.13	0.06
Zinc	0.03	0.04	0.03
Conductivity (umhos/cm,field)	94 @ 25.0°C	85 @ 25.0°C	62 @ 25.0°C
Dissolved Oxygen (field)	6.0 @ 19.0°C	5.7 @ 18.0°C	7.3 @ 13.5°C
pH (field)	7.6 @ 25.0°C	7.6 @ 19.4°C	7.5 @ 14.0°C
Turbidity (ntu)	118		
Ammonia	0.86		

Date taken	11-16-88	12-12-88	01-10-89
Time	16:16	14:45	16:05
Sample #	88-8379	88-9194	89-0373
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	20	19	17
Total Kjeldahl Nitrogen	0.77	0.86	0.78
Nitrate/Nitrite	0.11	0.18	0.19
Total Phosphorus	0.09	0.03	0.02
Hardness @ $CaCO_3$	24.2	20.6	21.1
Total Suspended Solids	22	9	8
Total Dissolved Solids	63	47	43
Oil and Grease	<1	2	2
Lead	0.1	<0.1	<0.1
Zinc	0.06	0.05	0.02
Conductivity (umhos/cm,field)	76 @ 25.0°C	50 @ 25.0°C	54 @ 25.0°C
Dissolved Oxygen (field)	9.0 @ 10.5°C	10.6 @ 3.2°C	12.0 @ 4.5°C
pH (field)	8.5 @ 11.7°C	6.6 @ 2.9°C	7.1 @ 5.7°C

TABLE A.26. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM POWELL CREEK AT
ROUTE 643, ALBEMARLE COUNTY, VIRGINIA. AUGUST, 1988 - JANUARY, 1989

Date taken	08-24-88	09-22-88	10-20-88
Time	18:10	12:10	12:00
Sample #	88-5573	88-6906	88-7604
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	18	20	24
Total Kjeldahl Nitrogen	0.35	0.24	<0.09
Nitrate/Nitrite	0.45	0.35	<0.02
Total Phosphorus	0.02	<0.01	0.02
Hardness @ $CaCO_3$	15.0	25.2	26
Total Suspended Solids	7	5	3
Total Dissolved Solids	50	17	55
Oil and Grease	<1	2	2
Lead	0.11	0.08	<0.04
Zinc	0.02	0.08	0.03
Conductivity (umhos/cm,field)	57 @ 25.0°C	58 @ 25.0°C	52 @ 25.0°C
Dissolved Oxygen (field)	7.8 @ 23.0°C	8.9 @ 17.0°C	9.3 @ 9.5°C
pH (field)	7.5 @ 25.0°C	8.3 @ 17.3°C	7.3 @ 10.2°C
Turbidity (ntu)	23		
Ammonia	<0.05		

Date taken	11-16-88	12-12-88	01-10-89
Time	16:50	15:15	16:25
Sample #	88-8370	88-9191	89-0387
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	20	19	19
Total Kjeldahl Nitrogen	0.68	0.79	0.52
Nitrate/Nitrite	0.16	0.38	0.37
Total Phosphorus	0.02	<0.02	<0.02
Hardness @ $CaCO_3$	22.2	22.2	26.6
Total Suspended Solids	5	3	2
Total Dissolved Solids	52	47	40
Oil and Grease	<1	2	<1
Lead	0.1	0.1	0.2
Zinc	0.04	0.06	0.02
Conductivity (umhos/cm,field)	70 @ 25.0°C	45 @ 25.0°C	54 @ 25.0°C
Dissolved Oxygen (field)	9.4 @ 10.0°C	12.4 @ 0.2°C	12.6 @ 4.5°C
pH (field)	8.1 @ 11.0°C	6.6 @ 1.0°C	7.2 @ 5.6°C

TABLE A.27. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM REDBUD CREEK AT
ROUTE 621, ALBEMARLE COUNTY, VIRGINIA. SEPTEMBER, 1988 - JANUARY, 1989

Date taken	09-22-88	10-20-88	11-16-88
Time	11:15	13:05	17:25
Sample #	88-6902	88-7601	88-8371
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	39	40	32
Total Kjeldahl Nitrogen	0.26	0.44	0.24
Nitrate/Nitrite	0.14	<0.02	0.07
Total Phosphorus	0.02	0.02	0.01
Hardness @ $CaCO_3$	39.8	41.0	35.2
Total Suspended Solids	11	16	1
Total Dissolved Solids	45	77	23
Oil and Grease	<1	1	<1
Lead	0.11	<0.04	0.1
Zinc	0.05	0.09	0.06
Conductivity (umhos/cm,field)	82 @ 25.0°C	81 @ 25.0°C	57 @ 25.0°C
Dissolved Oxygen (field)	9.8 @ 16.0°C	8.5 @ 12.5°C	8.8 @ 11.5°C
pH (field)	8.0 @ 19.4°C	7.9 @ 13.3°C	7.6 @ 12.1°C

Date taken	12-12-88	01-11-89
Time	15:45	08:10
Sample #	88-9192	89-0391
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	29	27
Total Kjeldahl Nitrogen	0.49	0.41
Nitrate/Nitrite	0.21	0.17
Total Phosphorus	0.02	<0.02
Hardness @ $CaCO_3$	35.6	33.2
Total Suspended Solids	3	14
Total Dissolved Solids	37	27
Oil and Grease	2	<1
Lead	0.1	<0.1
Zinc	0.03	0.02
Conductivity (umhos/cm,field)	57 @ 25.0°C	51 @ 25.0°C
Dissolved Oxygen (field)	12.6 @ 0.8°C	12.8 @ 1.5°C
pH (field)	6.9 @ 1.3°C	7.3 @ 2.4°C

TABLE A.28. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM TOWN BRANCH OFF
ROUTE 631, ALBEMARLE COUNTY, VIRGINIA. SEPTEMBER, 1988 - JANUARY, 1989

Date taken	09-22-88	10-20-88	11-16-88
Time	10:30	13:55	17:58
Sample #	88-6907	88-7603	88-8372
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	29	31	29
Total Kjeldahl Nitrogen	0.42	0.15	0.29
Nitrate/Nitrite	0.56	0.20	0.463
Total Phosphorus	<0.01	0.03	0.02
Hardness @ $CaCO_3$	34.0	34.2	33.0
Total Suspended Solids	3	10	1
Total Dissolved Solids	31	103	57
Oil and Grease	3	1	1
Lead	0.11	0.07	0.1
Zinc	0.02	0.02	0.02
Conductivity (umhos/cm,field)	77 @ 25.0°C	72 @ 25.0°C	85 @ 25.0°C
Dissolved Oxygen (field)	9.3 @ 14.5°C	9.2 @ 10.0°C	8.8 @ 9.5°C
pH (field)	7.7 @ 20.1°C	7.6 @ 10.8°C	7.5 @ 10.0°C

Date taken	12-12-88	01-11-89
Time	16:15	08:50
Sample #	88-9189	89-0390
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	26	26
Total Kjeldahl Nitrogen	0.35	0.29
Nitrate/Nitrite	0.86	0.72
Total Phosphorus	<0.02	<0.02
Hardness @ $CaCO_3$	32.2	15
Total Suspended Solids	1	5
Total Dissolved Solids	160	57
Oil and Grease	<1	<1
Lead	0.1	0.1
Zinc	0.03	0.02
Conductivity (umhos/cm,field)	63 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	12.4 @ 0.0°C	12.9 @ 1.5°C
pH (field)	6.8 @ 0.2°C	7.2 @ 2.5°C

TABLE A.29. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM THE RIVANNA RIVER AT THE KEY WEST SUBDIVISION, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JANUARY, 1989

Date taken	04-19-88	07-20-88
Time	08:15	17:15
Sample #	88-2311	88-4612
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	26	14
Total Kjeldahl Nitrogen	<0.09	1.28
Nitrate/Nitrite	0.15	0.31
Total Phosphorus	0.01	0.13
Hardness @ $CaCO_3$	19	30
Total Suspended Solids	3	294
Total Dissolved Solids	37	66
Oil and Grease	1	1
Lead	0.12	0.18
Zinc	<0.01	0.08
Conductivity (umhos/cm,field)	40 @ 25.0°C	48 @ 25.0°C
Dissolved Oxygen (field)	8.0 @ 12.1°C	7.8 @ 28.0°C
pH (field)	5.9 @ 12.1°C	7.3 @ 28.3°C
Turbidity (ntu)	6	160
Ammonia	<0.05	0.16

Date taken	10-20-88	01-11-89
Time	13:25	08:30
Sample #	88-7608	89-0395
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	21	18
Total Kjeldahl Nitrogen	0.38	0.51
Nitrate/Nitrite	0.08	0.18
Total Phosphorus	0.02	<0.02
Hardness @ $CaCO_3$	21.6	25.8
Total Suspended Solids	1	9
Total Dissolved Solids	27	27
Oil and Grease	2	1
Lead	0.08	0.1
Zinc	0.02	0.02
Conductivity (umhos/cm,field)	57 @ 25.0°C	37 @ 25.0°C
Dissolved Oxygen (field)	7.8 @ 13.0°C	12.5 @ 1.5°C
pH (field)	7.8 @ 13.2°C	7.3 @ 2.2°C

TABLE A.30. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM NAKED CREEK AT
ROUTE 844, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JANUARY, 1989

Date taken	04-18-88	07-19-88
Time	15:30	18:10
Sample #	88-2310	88-4613
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	26	40
Total Kjeldahl Nitrogen	0.21	1.20
Nitrate/Nitrite	0.21	0.89
Total Phosphorus	0.03	0.11
Hardness @ $CaCO_3$	11	28
Total Suspended Solids	3	55
Total Dissolved Solids	33	81
Oil and Grease	<1	<1
Lead	0.09	<0.04
Zinc	0.18	0.03
Conductivity (umhos/cm,field)	50 @ 25.0°C	62 @ 25.0°C
Dissolved Oxygen (field)	11.8 @ 13.9°C	*
pH (field)	6.8 @ 13.9°C	7.4 @ 26.7°C
Turbidity (ntu)	8	48
Ammonia	<0.05	0.25

Date taken	10-19-88	01-10-89
Time	18:00	13:35
Sample #	88-7609	89-0370
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	21	14
Total Kjeldahl Nitrogen	0.40	0.63
Nitrate/Nitrite	0.07	0.37
Total Phosphorus	0.07	0.03
Hardness @ $CaCO_3$	19.6	16.3
Total Suspended Solids	1	5
Total Dissolved Solids	28	45
Oil and Grease	16	2
Lead	0.04	<0.1
Zinc	0.02	0.02
Conductivity (umhos/cm,field)	50 @ 25.0°C	36 @ 25.0°C
Dissolved Oxygen (field)	7.8 @ 12.0°C	13.0 @ 4.0°C
pH (field)	7.2 @ 12.5°C	7.4 @ 5.0°C

* Equipment Malfunction

TABLE A.31. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM JUMPING BRANCH BELOW
ROUTE 676, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JANUARY, 1989

Date taken	04-20-88	07-19-88
Time	09:00	14:30
Sample #	88-2309	88-4616
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	23	16
Total Kjeldahl Nitrogen	0.16	0.84
Nitrate/Nitrite	1.24	1.12
Total Phosphorus	0.03	<0.01
Hardness @ $CaCO_3$	15	22
Total Suspended Solids	3	39
Total Dissolved Solids	13	97
Oil and Grease	<1	<1
Lead	0.09	0.06
Zinc	<0.01	0.03
Conductivity (umhos/cm,field)	133 @ 25.0°C	54 @ 25.0°C
Dissolved Oxygen (field)	12.3 @ 7.0°C	8.3 @ 26.0°C
pH (field)	6.7 @ 7.0°C	8.1 @ 32.8°C
Turbidity (ntu)	10	80
Ammonia	<0.05	0.09

Date taken	10-19-88	01-10-89
Time	16:40	13:00
Sample #	88-7610	89-0372
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	17	12
Total Kjeldahl Nitrogen	0.49	0.76
Nitrate/Nitrite	0.94	1.35
Total Phosphorus	0.05	0.04
Hardness @ $CaCO_3$	19.4	18.7
Total Suspended Solids	3	1
Total Dissolved Solids	33	43
Oil and Grease	<1	2
Lead	0.08	<0.1
Zinc	0.02	0.01
Conductivity (umhos/cm,field)	55 @ 25.0°C	40 @ 25.0°C
Dissolved Oxygen (field)	10.0 @ 12.0°C	12.8 @ 4.0°C
pH (field)	8.0 @ 14.2°C	7.5 @ 4.9°C

TABLE A.32. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM FLANNIGAN BRANCH AT
ROUTE 20, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JANUARY, 1989

Date taken	04-19-88	07-20-88
Time	09:35	15:45
Sample #	88-2313	88-4610
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	37	40
Total Kjeldahl Nitrogen	<0.09	0.22
Nitrate/Nitrite	0.11	0.46
Total Phosphorus	<0.01	0.01
Hardness @ $CaCO_3$	26	35
Total Suspended Solids	7	4
Total Dissolved Solids	47	116
Oil and Grease	4	2
Lead	0.13	<0.04
Zinc	0.02	0.02
Conductivity (umhos/cm,field)	55 @ 25.0°C	75 @ 25.0°C
Dissolved Oxygen (field)	10.9 @ 9.8°C	7.8 @ 27.0°C
pH (field)	6.4 @ 9.8°C	7.9 @ 27.5°C
Turbidity (ntu)	4	6
Ammonia	<0.05	<0.05

Date taken	10-20-88	01-10-89
Time	12:30	16:40
Sample #	88-7606	89-0394
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	40	26
Total Kjeldahl Nitrogen	<0.09	0.36
Nitrate/Nitrite	<0.02	0.05
Total Phosphorus	0.02	<0.02
Hardness @ $CaCO_3$	40.8	31.8
Total Suspended Solids	1	3
Total Dissolved Solids	53	40
Oil and Grease	6	<1
Lead	<0.04	0.1
Zinc	0.02	0.02
Conductivity (umhos/cm,field)	78 @ 25.0°C	49 @ 25.0°C
Dissolved Oxygen (field)	9.5 @ 9.5°C	12.9 @ 4.8°C
pH (field)	8.1 @ 10.2°C	7.3 @ 5.4°C

TABLE A.33. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM FOSTER BRANCH AT
ROUTE 20, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JANUARY, 1989

Date taken	04-19-88	07-20-88
Time	09:20	16:30
Sample #	88-2312	88-4611
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	33	40
Total Kjeldahl Nitrogen	<0.09	0.22
Nitrate/Nitrite	0.06	0.57
Total Phosphorus	<0.01	0.02
Hardness @ $CaCO_3$	33	33
Total Suspended Solids	7	4
Total Dissolved Solids	40	87
Oil and Grease	<1	1
Lead	0.11	0.08
Zinc	0.01	0.02
Conductivity (umhos/cm,field)	70 @ 25.0°C	84 @ 25.0°C
Dissolved Oxygen (field)	11.2 @ 9.8°C	7.7 @ 25.0°C
pH (field)	6.5 @ 9.8°C	7.6 @ 24.8°C
Turbidity (ntu)	2	8
Ammonia	<0.05	0.17

Date taken	10-20-88	01-10-89
Time	12:45	16:50
Sample #	88-7607	89-0393
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	43	30
Total Kjeldahl Nitrogen	0.73	0.37
Nitrate/Nitrite	1.80	0.14
Total Phosphorus	0.03	<0.02
Hardness @ $CaCO_3$	44.8	37.2
Total Suspended Solids	1	1
Total Dissolved Solids	54	30
Oil and Grease	<1	2
Lead	<0.04	<0.1
Zinc	0.11	0.01
Conductivity (umhos/cm,field)	85 @ 25.0°C	59 @ 25.0°C
Dissolved Oxygen (field)	9.9 @ 9.5°C	12.4 @ 5.0°C
pH (field)	8.0 @ 10.2°C	7.5 @ 5.2°C

TABLE A.34. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM FLANNIGAN BRANCH AT
ROUTE 600, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JULY, 1988

Date taken	04-19-88	07-20-88
Time	10:00	15:25
Sample #	88-2314	88-4609
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	28	33
Total Kjeldahl Nitrogen	<0.09	0.53
Nitrate/Nitrite	0.06	0.66
Total Phosphorus	0.18	0.01
Hardness @ $CaCO_3$	25	37
Total Suspended Solids	16	82
Total Dissolved Solids	35	119
Oil and Grease	<1	<1
Lead	0.12	0.06
Zinc	0.06	0.03
Conductivity (umhos/cm,field)	109 @ 25.0°C	66 @ 25.0°C
Dissolved Oxygen (field)	9.8 @ 9.3°C	7.2 @ 27.0°C
pH (field)	6.7 @ 9.3°C	8.0 @ 27.0°C
Turbidity (ntu)	4	18
Ammonia	<0.05	<0.05

TABLE A.35. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM THE NORTH FORK HARDWARE RIVER
AT ROUTE 708, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JULY, 1988

Date taken	04-19-88	07-21-88
Time	11:55	19:50
Sample #	88-2316	88-4617
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	21	38
Total Kjeldahl Nitrogen	0.58	0.80
Nitrate/Nitrite	0.36	0.49
Total Phosphorus	<0.01	<0.01
Hardness @ $CaCO_3$	12	19
Total Suspended Solids	20	47
Total Dissolved Solids	17	79
Oil and Grease	5	<1
Lead	0.15	0.10
Zinc	0.01	0.06
Conductivity (umhos/cm,field)	131 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	10.4 @ 9.3°C	8.0 @ 27.0°C
pH (field)	6.4 @ 9.3°C	8.0 @ 26.7°C
Turbidity (ntu)	6	72
Ammonia	<0.05	0.09

TABLE A.36. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM HOUCHINS BRANCH AT
ROUTE 729, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JULY, 1988

Date taken	04-19-88	07-20-88
Time	13:15	18:25
Sample #	88-2319	88-4614
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	24	28
Total Kjeldahl Nitrogen	<0.09	0.27
Nitrate/Nitrite	0.09	0.06
Total Phosphorus	0.04	<0.01
Hardness @ $CaCO_3$	24	27
Total Suspended Solids	10	7
Total Dissolved Solids	77	67
Oil and Grease	6	2
Lead	0.12	0.09
Zinc	<0.01	0.03
Conductivity (umhos/cm,field)	77 @ 25.0°C	53 @ 25.0°C
Dissolved Oxygen (field)	10.6 @ 9.9°C	6.9 @ 25.5°C
pH (field)	6.2 @ 9.9°C	7.7 @ 25.7°C
Turbidity (ntu)	4	10
Ammonia	<0.05	<0.05

TABLE A.37. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM MASSEY CREEK AT
ROUTE 795, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JULY, 1988

Date taken	04-19-88	07-20-88
Time	13:00	18:45
Sample #	88-2318	88-4615
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	44	21
Total Kjeldahl Nitrogen	<0.09	0.99
Nitrate/Nitrite	0.35	0.33
Total Phosphorus	0.02	0.09
Hardness @ $CaCO_3$	28	30
Total Suspended Solids	160	197
Total Dissolved Solids	77	97
Oil and Grease	5	<1
Lead	0.09	0.07
Zinc	<0.01	0.06
Conductivity (umhos/cm,field)	70 @ 25.0°C	58 @ 25.0°C
Dissolved Oxygen (field)	10.8 @ 8.9°C	8.3 @ 23.5°C
pH (field)	6.5 @ 8.9°C	8.0 @ 24.0°C
Turbidity (ntu)	26	160
Ammonia	<0.05	0.05

TABLE A.38. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM IVY CREEK AT
ROUTE 637, ALBEMARLE COUNTY, VIRGINIA. APRIL, 1988 - JULY, 1988

Date taken	04-19-88	07-20-88
Time	11:20	20:30
Sample #	88-2315	88-4618
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	25	66
Total Kjeldahl Nitrogen	<0.09	1.03
Nitrate/Nitrite	0.44	0.50
Total Phosphorus	<0.01	0.06
Hardness @ $CaCO_3$	14	16
Total Suspended Solids	27	52
Total Dissolved Solids	20	79
Oil and Grease	<1	1
Lead	0.12	0.07
Zinc	0.04	0.05
Conductivity (umhos/cm,field)	59 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	10.0 @ 9.6°C	7.7 @ 24.5°C
pH (field)	6.8 @ 9.6°C	8.0 @ 25.0°C
Turbidity (ntu)	8	80
Ammonia	<0.05	0.11

TABLE A.39. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM IVY CREEK AT
ROUTE 677, ALBEMARLE COUNTY, VIRGINIA. OCTOBER, 1988 - JANUARY, 1989

Date taken	10-19-88	01-10-89
Time	13:35	11:05
Sample #	88-7611	89-0386
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	18	16
Total Kjeldahl Nitrogen	0.23	1.12
Nitrate/Nitrite	0.40	0.59
Total Phosphorus	0.03	0.13
Hardness @ $CaCO_3$	21.6	25.8
Total Suspended Solids	1	21
Total Dissolved Solids	39	43
Oil and Grease	<1	<1
Lead	0.05	<0.1
Zinc	0.02	0.06
Conductivity (umhos/cm,field)	61 @ 25.0°C	57 @ 25.0°C
Dissolved Oxygen (field)	10.2 @ 13.0°C	13.0 @ 4.0°C
pH (field)	8.0 @ 13.3°C	7.7 @ 5.1°C

TABLE A.40. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM BUCK MOUNTAIN CREEK OFF ROUTE 667, ALBEMARLE COUNTY, VIRGINIA. OCTOBER, 1988 - JANUARY, 1989

Date taken	10-19-88	01-10-89
Time	15:20	12:05
Sample #	88-7612	89-0385
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	19	16
Total Kjeldahl Nitrogen	0.30	0.50
Nitrate/Nitrite	0.05	0.09
Total Phosphorus	0.05	0.02
Hardness @ $CaCO_3$	15.8	19.2
Total Suspended Solids	1	1
Total Dissolved Solids	30	52
Oil and Grease	1	1
Lead	0.07	<0.1
Zinc	0.04	0.01
Conductivity (umhos/cm,field)	42 @ 25.0°C	32 @ 25.0°C
Dissolved Oxygen (field)	8.9 @ 14.5°C	13.8 @ 3.2°C
pH (field)	7.4 @ 15.0°C	7.6 @ 4.0°C

TABLE A.41. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM THE NORTH FORK RIVANNA RIVER
AT ROUTE 604, ALBEMARLE COUNTY, VIRGINIA. OCTOBER, 1988 - JANUARY, 1989

Date taken	10-20-88	01-10-89
Time	10:20	14:55
Sample #	88-7615	89-0379
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	20	16
Total Kjeldahl Nitrogen	33	0.33
Nitrate/Nitrite	0.06	0.15
Total Phosphorus	0.05	<0.02
Hardness @ $CaCO_3$	20.2	21.6
Total Suspended Solids	2	2
Total Dissolved Solids	37	63
Oil and Grease	<1	<1
Lead	<0.04	<0.1
Zinc	0.04	0.03
Conductivity (umhos/cm,field)	46 @ 25.0°C	36 @ 25.0°C
Dissolved Oxygen (field)	7.4 @ 10.0°C	13.2 @ 4.0°C
pH (field)	7.9 @ 10.5°C	7.2 @ 5.1°C

TABLE A.42. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM JACOBS RUN AT
ROUTE 606, ALBEMARLE COUNTY, VIRGINIA. OCTOBER, 1988 - JANUARY, 1989

Date taken	10-20-88	01-10-89
Time	10:55	15:20
Sample #	88-7614	89-0378
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	17	17
Total Kjeldahl Nitrogen	0.41	0.75
Nitrate/Nitrite	0.05	0.09
Total Phosphorus	0.02	0.04
Hardness @ $CaCO_3$	12.4	19.2
Total Suspended Solids	1	17
Total Dissolved Solids	27	37
Oil and Grease	<1	3
Lead	0.10	<0.1
Zinc	0.02	0.02
Conductivity (umhos/cm,field)	39 @ 25.0°C	31 @ 25.0°C
Dissolved Oxygen (field)	7.8 @ 10.0°C	13.0 @ 3.8°C
pH (field)	7.5 @ 10.5°C	7.2 @ 5.7°C

TABLE A.43. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
QUARTERLY WATER QUALITY ANALYTICAL RESULTS FROM FISHING CREEK AT
ROUTE 660, ALBEMARLE COUNTY, VIRGINIA. OCTOBER, 1988 - JANUARY, 1989

Date taken	10-19-88	01-10-89
Time	17:30	13:15
Sample #	88-7613	89-0371
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	19	16
Total Kjeldahl Nitrogen	0.27	0.77
Nitrate/Nitrite	0.09	0.16
Total Phosphorus	0.06	0.04
Hardness @ $CaCO_3$	19.0	15.5
Total Suspended Solids	4	4
Total Dissolved Solids	45	120
Oil and Grease	1	1
Lead	0.07	<0.1
Zinc	0.02	0.01
Conductivity (umhos/cm,field)	55 @ 25.0°C	21 @ 25.0°C
Dissolved Oxygen (field)	8.5 @ 14.0°C	13.0 @ 6.0°C
pH (field)	8.0 @ 14.4°C	7.2 @ 6.1°C

TABLE A.44. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
WATER QUALITY ANALYTICAL RESULTS FROM THREE STATIONS SAMPLED
ONLY ONCE DURING THE STUDY, ALBEMARLE COUNTY, VIRGINIA.

Sample Identification	Meadow Creek @ 631	Trib. to Piney Creek @ 601	Sowell Branch @ 20
Date taken	01-22-88	03-30-88	04-19-88
Time	07:40	11:30	12:30
Sample #	88-0431	88-1844	88-2317
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	41	17	37
Total Kjeldahl Nitrogen	0.49	0.15	<0.09
Nitrate/Nitrite	1.14	0.25	0.18
Total Phosphorus	0.03	<0.01	0.01
Hardness @ $CaCO_3$	50	15	26
Total Suspended Solids	13	34	17
Total Dissolved Solids	147	47	3
Oil and Grease	<1	1	6
Lead	<0.04	0.14	0.05
Zinc	0.07	0.07	0.01
Conductivity (umhos/cm,field)	220 @ 25.0°C	46 @ 25.0°C	110 @ 25.0°C
Dissolved Oxygen (field)	11.6 @ 4.6°C	9.4 @ 12.7°C	9.7 @ 10.6°C
pH (field)	7.0 @ 4.6°C	6.0 @ 12.7°C	6.4 @ 10.6°C
Turbidity (ntu)	13	12	11
Ammonia	0.14	<0.05	<0.05

APPENDIX B

WATER QUALITY RESULTS FROM THE

SOUTH FORK RIVANNA RIVER RESERVOIR

TABLE B.1. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 1, SURFACE

Date taken	03-31-88	04-19-88	05-27-88	06-24-88
Time	09:51	15:40	09:50	08:55
Sample #	88-1864	88-2322	88-3230	88-4042
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	53	19	16	30
Total Kjeldahl Nitrogen	0.54	0.21	0.27	0.46
Nitrate/Nitrite	0.38	0.18	0.20	0.04
Total Phosphorus	0.13	0.02	0.03	0.01
Hardness @ $CaCO_3$	19	20	16	15
Total Suspended Solids	80	3	6	8
Total Dissolved Solids	153	20	41	57
Oil and Grease	1	2	<1	<1
Lead	0.11	0.15	0.08	0.04
Zinc	0.05	0.05	0.05	0.02
Ortho Phosphate	0.08	<0.01	<0.01	<0.01
Ammonia	<0.05	<0.05	<0.05	<0.05
Iron	2.84	0.64	0.80	0.32
Manganese	0.01	0.08	0.02	0.06
TOC	3	<1	<1	<1
True Color (c.u.)	45	15	20	35
Conductivity (umhos/cm,field)	59 @ 25.0°C	66 @ 25.0°C	50 @ 25.0°C	88 @ 25.0°C
Dissolved Oxygen (field)	9.9 @ 12.2°C	9.2 @ 13.2°C	10.3 @ 19.8°C	7.7 @ 26.0°C
pH (field)	6.5 @ 12.2°C	6.5 @ 13.2°C	7.2 @ 20.5°C	7.4 @ 26.5°C
Turbidity (ntu)	48	8	8	6

TABLE B.1. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 1, SURFACE
(continued)

Date taken	07-20-88	08-25-88	09-23-88	10-24-88
Time	09:30	14:45	08:00	12:00
Sample #	88-4640	88-5576	88-6880	88-7682
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	31	22	20	16
Total Kjeldahl Nitrogen	0.46	0.66	0.88	0.88
Nitrate/Nitrite	0.03	0.70	<0.02	0.24
Total Phosphorus	0.01	0.03	0.02	0.02
Hardness @ $CaCO_3$	27	26.0	21.2	18.0
Total Suspended Solids	6	7	5	2
Total Dissolved Solids	63	50	39	13
Oil and Grease	1	<1	3	1
Lead	<0.04	0.06	0.16	<0.04
Zinc	0.04	0.02	0.07	0.03
Ortho Phosphate	<0.01	0.02	0.01	0.01
Ammonia	0.09	0.18	0.18	0.12
Iron	0.76	0.95	0.27	0.56
Manganese	0.10	0.29	0.19	0.16
TOC	1	2	3	2
True Color (c.u.)	20	35	30	30
Conductivity (umhos/cm,field)	52 @ 25.0°C	43 @ 25.0°C	52 @ 25.0°C	48 @ 25.0°C
Dissolved Oxygen (field)	6.8 @ 27.5°C	10.6 @ 29.0°C	5.4 @ 23.0°C	7.7 @ 14.5°C
pH (field)	7.4 @ 29.6°C	7.7 @ 25.0°C	7.6 @ 21.3°C	8.0 @ 14.9°C
Turbidity (ntu)	8	8	6	6

TABLE B.1. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 1, SURFACE
(continued)

Date taken	11-17-88	12-19-88	01-11-89
Time	08:50	11:40	09:55
Sample #	88-8390	88-9388	89-0345
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	17	17	18
Total Kjeldahl Nitrogen	1.63	0.48	0.36
Nitrate/Nitrite	0.04	0.14	0.18
Total Phosphorus	0.02	<0.02	0.03
Hardness @ $CaCO_3$	17.6	16.8	20.2
Total Suspended Solids	13	5	6
Total Dissolved Solids	110	80	20
Oil and Grease	3	1	1
Lead	<0.1	0.1	<0.1
Zinc	0.04	0.05	0.02
Ortho Phosphate	0.01	<0.01	0.02
Ammonia	0.30	<0.02	<0.02
Iron	0.43	0.48	0.50
Manganese	0.10	0.07	0.08
TOC	2	4	1
True Color (c.u.)	15	15	15
Conductivity (umhos/cm,field)	65 @ 25.0°C	42 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	6.8 @ 11.0°C	9.2 @ 4.0°C	11.0 @ 3.5°C
pH (field)	8.0 @ 11.0°C	8.0 @ 5.0°C	7.4 @ 3.4°C
Turbidity (ntu)	6	1	6

TABLE B.2. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 1, 20 FEET

Date taken	03-31-88	04-19-88	05-27-88	06-24-88
Time	09:40	15:38	09:35	09:25
Sample #	88-1863	88-2321	88-3229	88-4044
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	46	20	18	16
Total Kjeldahl Nitrogen	0.43	0.25	0.37	0.50
Nitrate/Nitrite	0.34	0.18	0.20	0.09
Total Phosphorus	0.04	0.02	0.03	0.02
Hardness @ $CaCO_3$	18	15	16	19
Total Suspended Solids	70	7	10	<1
Total Dissolved Solids	153	37	60	30
Oil and Grease	7	2	3	2
Lead	0.15	0.14	0.12	0.04
Zinc	0.04	0.01	0.04	0.02
Ortho Phosphate	0.04	0.01	<0.01	<0.01
Ammonia	<0.05	<0.05	<0.05	<0.05
Iron	2.43	0.63	0.86	0.33
Manganese	0.01	0.08	0.03	0.10
TOC	2	<1	<1	<1
True Color (c.u.)	35	20	20	35
Conductivity (umhos/cm,field)	62 @ 25.0°C	74 @ 25.0°C	53 @ 25.0°C	60 @ 25.0°C
Dissolved Oxygen (field)	10.0 @ 12.6°C	8.7 @ 13.0°C	9.8 @ 18.8°C	5.6 @ 23.0°C
pH (field)	6.3 @ 12.6°C	6.2 @ 13.0°C	6.9 @ 19.7°C	8.0 @ 24.0°C
Turbidity (ntu)	40	8	10	8

TABLE B.2. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 1, 20 FEET
(continued)

Date taken	07-20-88	08-25-88	09-23-88	10-24-88
Time	09:54	15:10	08:30	12:20
Sample #	88-4642	88-5578	88-6881	88-7684
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	25	21	19	16
Total Kjeldahl Nitrogen	0.50	0.61	0.85	0.64
Nitrate/Nitrite	0.03	0.16	<0.02	0.06
Total Phosphorus	<0.01	0.03	0.01	0.02
Hardness @ $CaCO_3$	21	25.0	20.2	16.0
Total Suspended Solids	2	6	<1	5
Total Dissolved Solids	72	13	50	17
Oil and Grease	3	3	1	10
Lead	0.10	0.07	0.15	<0.04
Zinc	0.03	0.02	0.08	0.03
Ortho Phosphate	<0.01	0.01	0.01	<0.01
Ammonia	0.26	0.17	0.20	0.13
Iron	0.43	1.13	0.40	0.35
Manganese	0.13	0.37	0.17	0.17
TOC	1	2	3	2
True Color (c.u.)	20	40	30	40
Conductivity (umhos/cm,field)	56 @ 25.0°C	58 @ 25.0°C	64 @ 25.0°C	54 @ 25.0°C
Dissolved Oxygen (field)	2.2 @ 25.5°C	4.9 @ 28.5°C	2.6 @ 22.5°C	7.0 @ 14.5°C
pH (field)	7.5 @ 28.7°C	8.0 @ 25.0°C	7.2 @ 22.3°C	8.1 @ 16.0°C
Turbidity (ntu)	4	8	8	8

TABLE B.2. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 1, 20 FEET
(continued)

Date taken	11-17-88	12-19-88	01-11-89
Time	09:15	12:00	10:25
Sample #	88-8391	88-9389	89-0346
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	18	17	17
Total Kjeldahl Nitrogen	1.60	0.54	0.23
Nitrate/Nitrite	0.08	0.14	0.19
Total Phosphorus	0.05	0.04	0.03
Hardness @ $CaCO_3$	18.4	17.2	20.5
Total Suspended Solids	16	3	5
Total Dissolved Solids	86	67	40
Oil and Grease	1	<1	<1
Lead	0.1	0.1	0.1
Zinc	0.04	0.05	0.02
Ortho Phosphate	0.03	0.01	0.02
Ammonia	0.36	<0.02	<0.02
Iron	1.05	0.57	0.67
Manganese	0.17	0.08	0.07
TOC	2	2	<1
True Color (c.u.)	25	15	15
Conductivity (umhos/cm,field)	64 @ 25.0°C	49 @ 25.0°C	40 @ 25.0°C
Dissolved Oxygen (field)	5.0 @ 10.5°C	9.0 @ 3.8°C	10.2 @ 3.5°C
pH (field)	7.0 @ 11.0°C	7.7 @ 5.0°C	7.3 @ 4.0°C
Turbidity (ntu)	12	1	6

TABLE B.3. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 1, 40 FEET

Date taken	03-31-88	04-19-88	05-27-88	06-24-88
Time	09:10	15:20	09:10	09:05
Sample #	88-1862	88-2320	88-3228	88-4043
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	32	24	30	27
Total Kjeldahl Nitrogen	0.15	0.19	0.40	0.56
Nitrate/Nitrite	0.26	0.20	0.39	0.13
Total Phosphorus	0.04	0.01	0.03	0.01
Hardness @ $CaCO_3$	18	18	16	18
Total Suspended Solids	203	17	20	3
Total Dissolved Solids	137	57	57	42
Oil and Grease	2	4	2	<1
Lead	0.08	0.15	0.06	0.07
Zinc	0.06	<0.01	0.04	0.03
Ortho Phosphate	0.04	0.01	<0.01	<0.01
Ammonia	<0.05	<0.05	0.09	0.10
Iron	1.74	0.77	1.06	0.52
Manganese	0.02	0.09	0.15	0.20
TOC	1	<1	<1	<1
True Color (c.u.)	20	20	15	40
Conductivity (umhos/cm,field)	49 @ 25.0°C	66 @ 25.0°C	40 @ 25.0°C	62 @ 25.0°C
Dissolved Oxygen (field)	9.2 @ 11.0°C	7.4 @ 12.6°C	8.4 @ 17.5°C	4.5 @ 21.5°C
pH (field)	6.8 @ 11.0°C	6.3 @ 12.6°C	6.6 @ 18.3°C	7.8 @ 22.5°C
Turbidity (ntu)	50	8	16	6

TABLE B.3. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 1, 40 FEET
(continued)

Date taken	07-20-88	08-25-88	09-23-88	10-24-88
Time	09:41	14:50	08:10	12:05
Sample #	88-4641	88-5577	88-6888	88-7683
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	30	23	20	16
Total Kjeldahl Nitrogen	0.68	1.11	1.09	1.03
Nitrate/Nitrite	<0.02	0.13	<0.02	0.07
Total Phosphorus	<0.01	0.04	0.02	0.05
Hardness @ $CaCO_3$	24	27.0	23.6	18.2
Total Suspended Solids	4	13	14	22
Total Dissolved Solids	73	55	41	3
Oil and Grease	1	<1	<1	<1
Lead	0.07	0.11	0.16	<0.04
Zinc	0.02	0.03	0.08	0.02
Ortho Phosphate	<0.01	0.03	0.01	0.01
Ammonia	0.44	0.60	0.30	0.15
Iron	1.00	6.30	0.71	1.27
Manganese	1.26	1.18	0.62	0.20
TOC	2	3	4	2
True Color (c.u.)	50	140	20	45
Conductivity (umhos/cm,field)	53 @ 25.0°C	77 @ 25.0°C	55 @ 25.0°C	55 @ 25.0°C
Dissolved Oxygen (field)	1.8 @ 28.5°C	4.2 @ 27.0°C	1.7 @ 22.0°C	5.7 @ 13.0°C
pH (field)	7.5 @ 28.4°C	7.9 @ 25.0°C	7.1 @ 21.7°C	8.1 @ 16.6°C
Turbidity (ntu)	14	29	25	26

TABLE B.3. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 1, 40 FEET
(continued)

Date taken	11-17-88	12-19-88	01-11-89
Time	09:00	11:45	10:10
Sample #	88-8392	88-9390	89-0347
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	17	17	19
Total Kjeldahl Nitrogen	1.54	0.56	0.18
Nitrate/Nitrite	0.11	0.14	0.20
Total Phosphorus	0.07	<0.02	0.03
Hardness @ $CaCO_3$	20.8	16.2	20.9
Total Suspended Solids	17	7	7
Total Dissolved Solids	73	40	40
Oil and Grease	2	2	1
Lead	0.1	<0.1	0.1
Zinc	0.05	0.05	0.03
Ortho Phosphate	0.05	<0.01	0.02
Ammonia	0.32	<0.02	<0.02
Iron	1.65	0.52	0.74
Manganese	0.18	0.08	0.07
TOC	2	1	<1
True Color (c.u.)	25	15	15
Conductivity (umhos/cm,field)	65 @ 25.0°C	49 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	4.7 @ 9.5°C	8.7 @ 4.0°C	10.0 @ 3.5°C
pH (field)	7.3 @ 10.5°C	7.7 @ 4.7°C	7.4 @ 4.0°C
Turbidity (ntu)	20	1	6

TABLE B.4. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 2, SURFACE

Date taken	03-31-88	04-19-88	05-27-88	06-24-88
Time	11:15	16:15	10:50	09:45
Sample #	88-1867	88-2323	88-3233	88-4045
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	21	18	26	15
Total Kjeldahl Nitrogen	0.87	0.11	0.48	0.49
Nitrate/Nitrite	0.37	0.07	0.20	0.04
Total Phosphorus	0.03	0.03	0.02	0.03
Hardness @ $CaCO_3$	17	16	16	16
Total Suspended Solids	60	10	12	3
Total Dissolved Solids	147	43	58	19
Oil and Grease	1	3	<1	<1
Lead	0.15	0.12	0.08	0.10
Zinc	0.04	0.04	0.03	0.02
Ortho Phosphate	0.02	0.01	<0.01	<0.01
Ammonia	0.35	<0.05	0.08	<0.05
Iron	1.42	1.00	1.02	0.35
Manganese	0.02	0.05	0.04	0.01
TOC	1	<1	<1	<1
True Color (c.u.)	30	25	20	30
Conductivity (umhos/cm,field)	56 @ 25.0°C	71 @ 25.0°C	49 @ 25.0°C	57 @ 25.0°C
Dissolved Oxygen (field)	10.2 @ 15.4°C	8.2 @ 13.8°C	6.8 @ 20.0°C	9.2 @ 27.5°C
pH (field)	6.6 @ 15.4°C	6.8 @ 13.8°C	7.1 @ 20.0°C	8.2 @ 27.5°C
Turbidity (ntu)	16	10	17	4

TABLE B.4. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 2, SURFACE
(continued)

Date taken	07-20-88	08-25-88	09-23-88	10-24-88
Time	11:30	15:42	09:30	13:00
Sample #	88-4646	88-5579	88-6882	88-7685
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	25	17	17	15
Total Kjeldahl Nitrogen	0.62	0.62	0.81	0.59
Nitrate/Nitrite	0.03	<0.02	<0.02	0.06
Total Phosphorus	0.01	0.05	0.02	0.02
Hardness @ $CaCO_3$	21	21.0	23.6	19.2
Total Suspended Solids	4	9	6	8
Total Dissolved Solids	103	47	41	17
Oil and Grease	<1	<1	1	9
Lead	0.07	0.05	0.15	<0.04
Zinc	0.03	0.03	0.10	0.02
Ortho Phosphate	<0.01	0.02	0.01	0.01
Ammonia	<0.05	0.08	<0.05	0.08
Iron	0.37	0.77	0.22	0.38
Manganese	0.06	0.06	0.03	0.06
TOC	1	2	3	2
True Color (c.u.)	30	35	25	35
Conductivity (umhos/cm,field)	49 @ 25.0°C	49 @ 25.0°C	52 @ 25.0°C	54 @ 25.0°C
Dissolved Oxygen (field)	7.6 @ 29.0°C	13.8 @ 30.0°C	8.3 @ 23.0°C	9.0 @ 14.0°C
pH (field)	7.6 @ 33.2°C	7.8 @ 25.0°C	7.3 @ 22.6°C	7.9 @ 14.6°C
Turbidity (ntu)	8	6	10	8

TABLE B.4. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 2, SURFACE
(continued)

Date taken	11-17-88	01-11-89
Time	09:45	11:30
Sample #	88-8392	89-0348
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	19	18
Total Kjeldahl Nitrogen	1.50	<0.09
Nitrate/Nitrite	0.07	0.16
Total Phosphorus	0.03	<0.02
Hardness @ $CaCO_3$	19.4	20.9
Total Suspended Solids	11	10
Total Dissolved Solids	93	51
Oil and Grease	1	<1
Lead	<0.1	0.1
Zinc	0.07	0.04
Ortho Phosphate	0.02	0.02
Ammonia	0.22	<0.02
Iron	0.49	0.49
Manganese	0.06	0.05
TOC	2	1
True Color (c.u.)	15	20
Conductivity (umhos/cm,field)	65 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	9.0 @ 12.0°C	12.4 @ 3.0°C
pH (field)	6.8 @ 11.5°C	7.2 @ 2.0°C
Turbidity (ntu)	6	4

TABLE B.5. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 2, 7.5 FEET

Date taken	03-31-88	04-19-88	05-27-88	06-24-88
Time	11:05	16:35	10:39	10:30
Sample #	88-1866	88-2325	88-3232	88-4047
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	19	21	26	15
Total Kjeldahl Nitrogen	0.19	0.29	0.31	0.61
Nitrate/Nitrite	0.30	0.07	0.19	0.03
Total Phosphorus	0.04	0.03	0.04	0.03
Hardness @ $CaCO_3$	17	21	16	16
Total Suspended Solids	67	43	13	4
Total Dissolved Solids	147	107	50	41
Oil and Grease	1	2	<1	<1
Lead	0.13	0.11	0.07	0.10
Zinc	0.07	0.03	0.04	0.02
Ortho Phosphate	0.01	0.01	0.01	0.02
Ammonia	<0.05	<0.05	0.03	<0.05
Iron	1.07	1.10	1.54	0.38
Manganese	0.01	0.05	0.05	0.02
TOC	3	<1	<1	1
True Color (c.u.)	20	25	25	40
Conductivity (umhos/cm,field)	57 @ 25.0°C	74 @ 25.0°C	49 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	9.6 @ 15.1°C	7.5 @ 13.5°C	6.8 @ 17.2°C	10.8 @ 26.5°C
pH (field)	6.5 @ 15.1°C	6.3 @ 13.5°C	7.1 @ 18.1°C	8.8 @ 26.6°C
Turbidity (ntu)	12	10	17	6

TABLE B.5. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 2, 7.5 FEET
(continued)

Date taken	07-20-88	08-25-88	09-23-88	10-24-88
Time	11:50	16:05	10:00	13:00
Sample #	88-4648	88-5581	88-6883	88-7687
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	20	19	16	16
Total Kjeldahl Nitrogen	0.72	0.66	0.91	0.81
Nitrate/Nitrite	0.04	0.19	<0.02	0.06
Total Phosphorus	<0.01	0.03	0.02	0.04
Hardness @ $CaCO_3$	28	23.0	21.4	18.4
Total Suspended Solids	7	8	7	5
Total Dissolved Solids	88	54	48	7
Oil and Grease	2	<1	1	1
Lead	<0.04	<0.04	0.16	<0.04
Zinc	0.02	0.05	0.06	0.03
Ortho Phosphate	<0.01	0.01	0.01	<0.01
Ammonia	0.10	<0.05	<0.05	0.06
Iron	0.45	0.55	0.29	0.26
Manganese	0.09	0.07	0.04	0.05
TOC	2	2	4	2
True Color (c.u.)	30	35	25	35
Conductivity (umhos/cm,field)	52 @ 25.0°C	50 @ 25.0°C	52 @ 25.0°C	54 @ 25.0°C
Dissolved Oxygen (field)	6.5 @ 28.5°C	10.4 @ 28.0°C	8.2 @ 23.0°C	8.6 @ 14.0°C
pH (field)	7.6 @ 32.5°C	8.0 @ 25.0°C	7.1 @ 23.3°C	7.6 @ 15.0°C
Turbidity (ntu)	12	8	8	8

TABLE B.5. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 2, 7.5 FEET
(continued)

Date taken	11-17-88	01-11-88
Time	10:10	11:45
Sample #	88-8394	88-0349
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	18	18
Total Kjeldahl Nitrogen	1.42	0.26
Nitrate/Nitrite	0.07	0.14
Total Phosphorus	0.03	0.02
Hardness @ $CaCO_3$	19.0	19.7
Total Suspended Solids	6	2
Total Dissolved Solids	80	62
Oil and Grease	3	<1
Lead	0.1	0.1
Zinc	0.04	0.03
Ortho Phosphate	0.02	0.02
Ammonia	0.23	<0.02
Iron	0.49	0.52
Manganese	0.05	0.04
TOC	2	<1
True Color (c.u.)	15	15
Conductivity (umhos/cm,field)	64 @ 25.0°C	50 @ 25.0°C
Dissolved Oxygen (field)	8.9 @ 11.0°C	12.0 @ 3.0°C
pH (field)	6.7 @ 11.5°C	7.2 @ 3.8°C
Turbidity (ntu)	6	4

TABLE B.6. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 2, 15 FEET

Date taken	03-31-88	04-19-88	05-27-88	06-24-88
Time	10:50	16:20	10:25	10:15
Sample #	88-1865	88-2324	88-3231	88-4046
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	38	19	31	30
Total Kjeldahl Nitrogen	0.37	0.34	0.37	0.87
Nitrate/Nitrite	0.35	<0.02	0.19	0.04
Total Phosphorus	0.09	0.03	0.03	0.03
Hardness @ $CaCO_3$	17	16	18	18
Total Suspended Solids	70	40	17	11
Total Dissolved Solids	140	90	50	13
Oil and Grease	2	1	1	<1
Lead	0.10	0.11	0.04	0.10
Zinc	0.04	0.04	0.04	0.02
Ortho Phosphate	0.04	0.03	0.03	0.01
Ammonia	<0.05	<0.05	0.02	<0.05
Iron	1.73	1.72	1.47	0.49
Manganese	0.01	0.09	0.06	0.06
TOC	2	<1	<1	<1
True Color (c.u.)	35	25	20	35
Conductivity (umhos/cm,field)	56 @ 25.0°C	72 @ 25.0°C	52 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	9.4 @ 13.1°C	7.7 @ 13.0°C	7.4 @ 16.0°C	7.3 @ 24.5°C
pH (field)	6.2 @ 13.1°C	6.2 @ 13.0°C	7.1 @ 17.2°C	8.2 @ 25.1°C
Turbidity (ntu)	22	12	16	10

TABLE B.6. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 2, 15 FEET
(continued)

Date taken	07-20-88	08-25-88	09-23-88	10-24-88
Time	11:35	15:50	09:40	12:45
Sample #	88-4647	88-5580	88-6884	88-7686
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	28	17	18	17
Total Kjeldahl Nitrogen	0.75	0.67	0.83	0.48
Nitrate/Nitrite	0.05	0.16	<0.02	0.12
Total Phosphorus	<0.01	0.04	0.02	0.04
Hardness @ $CaCO_3$	24	23.0	20.0	19.2
Total Suspended Solids	7	6	5	10
Total Dissolved Solids	85	61	58	3
Oil and Grease	1	<1	<1	1
Lead	0.06	0.05	0.14	<0.04
Zinc	0.05	0.02	0.07	0.01
Ortho Phosphate	<0.01	0.01	0.01	<0.01
Ammonia	0.18	<0.05	0.07	0.06
Iron	0.38	0.72	0.53	0.59
Manganese	0.09	0.11	0.08	0.06
TOC	1	2	3	2
True Color (c.u.)	30	40	20	35
Conductivity (umhos/cm,field)	54 @ 25.0°C	50 @ 25.0°C	54 @ 25.0°C	54 @ 25.0°C
Dissolved Oxygen (field)	1.0 @ 26.5°C	8.0 @ 28.0°C	5.9 @ 22.5°C	7.8 @ 12.0°C
pH (field)	7.7 @ 31.1°C	8.0 @ 25.0°C	7.2 @ 22.6°C	7.7 @ 14.6°C
Turbidity (ntu)	12	8	12	11

TABLE B.6. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 2, 15 FEET
(continued)

Date taken	11-17-88	01-11-89
Time	09:58	11:35
Sample #	88-8395	89-0350
Analysis - Results in mg/L unless otherwise stated.		
Total Alkalinity @ $CaCO_3$	20	17
Total Kjeldahl Nitrogen	0.17	0.39
Nitrate/Nitrite	0.09	0.13
Total Phosphorus	0.04	0.04
Hardness @ $CaCO_3$	23.4	21.3
Total Suspended Solids	10	1
Total Dissolved Solids	87	63
Oil and Grease	2	<1
Lead	0.1	0.1
Zinc	0.01	0.05
Ortho Phosphate	0.02	0.02
Ammonia	0.05	<0.02
Iron	0.84	0.55
Manganese	0.06	0.06
TOC	2	<1
True Color (c.u.)	20	20
Conductivity (umhos/cm,field)	66 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	8.7 @ 9.5°C	12.2 @ 3.0°C
pH (field)	6.6 @ 10.1°C	7.2 @ 3.6°C
Turbidity (ntu)	8	3

TABLE B.7. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 3, SURFACE

Date taken	03-31-88	04-19-88	05-27-88	06-24-88
Time	12:15	16:55	11:06	10:30
Sample #	88-1870	88-2326	88-3234	88-4048
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	32	17	26	20
Total Kjeldahl Nitrogen	0.28	0.14	0.29	0.60
Nitrate/Nitrite	0.35	0.12	0.31	0.04
Total Phosphorus	0.07	0.01	0.01	0.02
Hardness @ $CaCO_3$	15	18	18	16
Total Suspended Solids	73	23	17	6
Total Dissolved Solids	160	90	60	52
Oil and Grease	1	2	<1	2
Lead	0.12	0.11	0.05	<0.04
Zinc	0.08	0.15	0.06	0.03
Ortho Phosphate	0.04	<0.01	<0.01	<0.01
Ammonia	<0.05	<0.05	<0.05	<0.05
Iron	1.58	0.66	0.93	0.37
Manganese	0.01	0.04	0.05	0.01
TOC	2	<1	<1	<1
True Color (c.u.)	35	20	25	35
Conductivity (umhos/cm,field)	57 @ 25.0°C	92 @ 25.0°C	55 @ 25.0°C	56 @ 25.0°C
Dissolved Oxygen (field)	10.2 @ 15.5°C	10.1 @ 13.4°C	7.2 @ 22.0°C	9.7 @ 27.8°C
pH (field)	6.8 @ 15.5°C	6.5 @ 13.4°C	6.7 @ 23.2°C	8.4 @ 27.9°C
Turbidity (ntu)	22	8	12	8

TABLE B.7. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 3, SURFACE
(continued)

Date taken	07-20-88	08-25-88	09-23-88	10-24-88
Time	10:40	16:35	08:50	14:00
Sample #	88-4643	88-5582	88-6885	88-7688
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	30	20	18	16
Total Kjeldahl Nitrogen	0.50	0.64	0.55	0.75
Nitrate/Nitrite	<0.02	0.22	<0.02	0.06
Total Phosphorus	0.01	0.03	0.02	0.03
Hardness @ $CaCO_3$	20	25.0	23.4	16.6
Total Suspended Solids	1	6	4	5
Total Dissolved Solids	103	17	55	17
Oil and Grease	3	1	2	<1
Lead	0.07	<0.04	0.17	<0.04
Zinc	0.02	0.03	0.22	0.02
Ortho Phosphate	<0.01	0.01	0.01	<0.01
Ammonia	<0.05	<0.05	0.08	0.13
Iron	0.16	0.33	0.18	0.44
Manganese	0.05	0.08	0.04	0.10
TOC	2	2	3	2
True Color (c.u.)	20	30	15	40
Conductivity (umhos/cm,field)	52 @ 25.0°C	54 @ 25.0°C	55 @ 25.0°C	59 @ 25.0°C
Dissolved Oxygen (field)	8.2 @ 28.5°C	15.2 @ 29.0°C	8.8 @ 22.5°C	7.7 @ 15.0°C
pH (field)	7.6 @ 30.0°C	7.9 @ 25.0°C	7.3 @ 22.6°C	7.4 @ 16.0°C
Turbidity (ntu)	8	8	23	7

TABLE B.7. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 3, SURFACE
(continued)

Date taken	11-17-88	12-19-88	01-11-89
Time	10:35	12:30	11:00
Sample #	88-8396	88-9391	89-0351
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	17	18	18
Total Kjeldahl Nitrogen	1.41	0.28	0.25
Nitrate/Nitrite	0.07	0.14	0.16
Total Phosphorus	0.06	0.03	0.02
Hardness @ $CaCO_3$	21.0	20.2	21.9
Total Suspended Solids	10	7	3
Total Dissolved Solids	73	80	40
Oil and Grease	4	<1	1
Lead	0.1	<0.1	0.1
Zinc	0.05	0.04	0.02
Ortho Phosphate	0.02	<0.01	0.02
Ammonia	0.25	<0.02	<0.02
Iron	0.40	0.48	0.58
Manganese	0.08	0.04	0.04
TOC	2	1	1
True Color (c.u.)	15	15	15
Conductivity (umhos/cm,field)	64 @ 25.0°C	43 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	7.7 @ 12.0°C	10.0 @ 3.0°C	12.2 @ 3.0°C
pH (field)	6.5 @ 12.0°C	7.6 @ 3.6°C	7.3 @ 3.3°C
Turbidity (ntu)	6	<1.0	4

TABLE B.8. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 3, 14.5 FEET

Date taken	03-31-88	04-19-88	05-27-88	06-24-88
Time	12:10	17:10	11:29	11:15
Sample #	88-1869	88-2327	88-3236	88-4050
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	70	19	36	19
Total Kjeldahl Nitrogen	0.43	0.18	0.33	0.92
Nitrate/Nitrite	0.51	0.16	0.36	0.07
Total Phosphorus	0.14	0.01	0.06	0.03
Hardness @ $CaCO_3$	18	15	16	17
Total Suspended Solids	80	20	3	18
Total Dissolved Solids	147	110	47	31
Oil and Grease	1	1	<1	4
Lead	0.13	0.14	0.06	<0.04
Zinc	0.07	0.04	0.08	0.03
Ortho Phosphate	0.09	0.01	0.04	<0.01
Ammonia	0.05	<0.05	0.09	<0.05
Iron	3.26	0.60	1.94	0.45
Manganese	0.03	0.08	0.13	0.02
TOC	2	<1	<1	<1
True Color (c.u.)	70	20	30	45
Conductivity (umhos/cm,field)	62 @ 25.0°C	62 @ 25.0°C	55 @ 25.0°C	59 @ 25.0°C
Dissolved Oxygen (field)	9.0 @ 16.6°C	9.7 @ 12.5°C	5.8 @ 18.0°C	9.9 @ 24.8°C
pH (field)	6.8 @ 16.6°C	6.2 @ 12.5°C	6.9 @ 20.5°C	8.2 @ 25.7°C
Turbidity (ntu)	58	8	33	12

TABLE B.8. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 3, 14.5 FEET
(continued)

Date taken	07-20-88	08-25-88	09-23-88	10-24-88
Time	11:00	16:55	09:15	14:15
Sample #	88-4645	88-5584	88-6886	88-7690
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	31	29	18	16
Total Kjeldahl Nitrogen	0.90	0.64	0.86	0.71
Nitrate/Nitrite	0.07	0.71	<0.02	0.06
Total Phosphorus	0.01	0.03	0.01	0.03
Hardness @ $CaCO_3$	24	26.0	21.4	19.8
Total Suspended Solids	11	6	7	11
Total Dissolved Solids	100	37	61	59
Oil and Grease	<1	<1	2	1
Lead	<0.04	<0.04	0.23	<0.04
Zinc	0.03	0.03	0.12	0.01
Ortho Phosphate	<0.01	0.01	<0.01	<0.01
Ammonia	0.11	<0.05	<0.05	0.13
Iron	0.42	0.64	0.26	0.66
Manganese	0.10	0.15	0.04	0.11
TOC	2	2	3	3
True Color (c.u.)	40	30	20	30
Conductivity (umhos/cm,field)	51 @ 25.0°C	53 @ 25.0°C	50 @ 25.0°C	54 @ 25.0°C
Dissolved Oxygen (field)	3.7 @ 30.0°C	9.0 @ 27.0°C	8.4 @ 22.5°C	6.5 @ 13.5°C
pH (field)	7.7 @ 32.2°C	7.9 @ 25.0°C	7.1 @ 22.8°C	7.5 @ 15.0°C
Turbidity (ntu)	10	8	14	9

TABLE B.8. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 3, 14.5 FEET
(continued)

Date taken	11-17-88	12-19-88	01-11-89
Time	10:55	12:50	11:10
Sample #	88-8397	88-9392	89-0352
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	17	18	18
Total Kjeldahl Nitrogen	1.47	0.30	0.14
Nitrate/Nitrite	0.07	0.15	0.17
Total Phosphorus	0.06	0.04	0.03
Hardness @ $CaCO_3$	19.2	19.2	20.9
Total Suspended Solids	16	2	3
Total Dissolved Solids	70	77	63
Oil and Grease	1	<1	3
Lead	0.1	0.1	0.1
Zinc	0.03	0.03	0.06
Ortho Phosphate	0.03	<0.01	0.02
Ammonia	0.30	<0.02	<0.02
Iron	0.74	0.45	0.54
Manganese	0.07	0.03	0.05
TOC	1	<1	<1
True Color (c.u.)	15	15	20
Conductivity (umhos/cm,field)	57 @ 25.0°C	45 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	6.8 @ 10.5°C	9.6 @ 3.0°C	10.8 @ 3.0°C
pH (field)	7.2 @ 11.7°C	7.5 @ 4.0°C	7.2 @ 3.9°C
Turbidity (ntu)	8	<1.0	5

TABLE B.9. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 3, 29 FEET

Date taken	03-31-88	04-19-88	05-27-88	06-24-88
Time	11:55	17:00	11:15	10:55
Sample #	88-1868	88-2328	88-3235	88-4049
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	45	32	46	30
Total Kjeldahl Nitrogen	0.44	0.35	0.44	0.98
Nitrate/Nitrite	0.39	0.37	0.48	0.08
Total Phosphorus	0.04	0.05	0.08	0.01
Hardness @ $CaCO_3$	19	20	17	22
Total Suspended Solids	90	50	31	16
Total Dissolved Solids	133	83	50	56
Oil and Grease	1	2	1	<1
Lead	0.20	0.14	0.05	0.04
Zinc	0.06	0.04	0.03	0.03
Ortho Phosphate	0.04	0.03	0.05	<0.01
Ammonia	0.08	<0.05	0.08	0.22
Iron	2.75	2.89	3.15	1.32
Manganese	0.06	0.22	0.19	0.61
TOC	2	<1	<1	<1
True Color (c.u.)	60	20	35	45
Conductivity (umhos/cm,field)	63 @ 25.0°C	85 @ 25.0°C	58 @ 25.0°C	70 @ 25.0°C
Dissolved Oxygen (field)	6.8 @ 14.9°C	6.3 @ 12.4°C	5.2 @ 17.0°C	1.6 @ 21.8°C
pH (field)	6.7 @ 14.9°C	6.0 @ 12.4°C	6.4 @ 18.9°C	7.6 @ 23.4°C
Turbidity (ntu)	36	22	43	20

TABLE B.9. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 3, 29 FEET
(continued)

Date taken	07-20-88	08-25-88	09-23-88	10-24-88
Time	10:45	16:40	08:55	14:00
Sample #	88-4644	88-5583	88-6887	88-7689
Analysis - Results in mg/L unless otherwise stated.				
Total Alkalinity @ $CaCO_3$	31	19	19	16
Total Kjeldahl Nitrogen	0.81	0.66	1.13	0.66
Nitrate/Nitrite	<0.02	0.03	<0.02	0.16
Total Phosphorus	<0.01	0.09	0.04	0.06
Hardness @ $CaCO_3$	26	31.0	21.4	19.8
Total Suspended Solids	3	22	16	50
Total Dissolved Solids	97	65	64	10
Oil and Grease	<1	<1	<1	1
Lead	0.09	<0.04	0.16	<0.04
Zinc	0.04	0.03	0.11	0.04
Ortho Phosphate	<0.01	0.03	0.04	0.02
Ammonia	0.41	<0.05	0.19	0.10
Iron	2.38	7.6	1.20	1.65
Manganese	0.60	0.44	0.20	0.13
TOC	2	2	3	2
True Color (c.u.)	45	35	30	70
Conductivity (umhos/cm,field)	62 @ 25.0°C	53 @ 25.0°C	74 @ 25.0°C	54 @ 25.0°C
Dissolved Oxygen (field)	1.5 @ 24.5°C	8.7 @ 26.0°C	4.0 @ 22.0°C	6.8 @ 12.0°C
pH (field)	7.6 @ 29.1°C	7.7 @ 25.0°C	7.1 @ 22.4°C	7.5 @ 15.1°C
Turbidity (ntu)	12	21	40	37

TABLE B.9. ROUTE 29 STUDY - CHARLOTTESVILLE BYPASS
MONTHLY WATER QUALITY ANALYTICAL RESULTS FROM THE SOUTH FORK RIVANNA RIVER RESERVOIR
ALBEMARLE COUNTY, VIRGINIA. MARCH, 1988 - JANUARY, 1989
STATION 3, 29 FEET
(continued)

Date taken	11-17-88	12-19-88	01-11-89
Time	10:45	12:40	10:50
Sample #	88-8398	88-9393	89-0353
Analysis - Results in mg/L unless otherwise stated.			
Total Alkalinity @ $CaCO_3$	18	17	16
Total Kjeldahl Nitrogen	1.34	0.43	0.44
Nitrate/Nitrite	0.20	0.31	0.42
Total Phosphorus	0.09	0.10	0.08
Hardness @ $CaCO_3$	19.6	19.6	20.5
Total Suspended Solids	30	22	19
Total Dissolved Solids	60	57	60
Oil and Grease	<1	2	1
Lead	0.1	<0.1	0.1
Zinc	0.02	0.04	0.04
Ortho Phosphate	0.06	0.01	0.07
Ammonia	0.18	<0.02	<0.02
Iron	2.38	1.03	1.09
Manganese	0.10	0.09	0.09
TOC	1	<1	<1
True Color (c.u.)	20	20	25
Conductivity (umhos/cm,field)	64 @ 25.0°C	42 @ 25.0°C	43 @ 25.0°C
Dissolved Oxygen (field)	6.5 @ 10.5°C	8.6 @ 3.5°C	10.7 @ 3.5°C
pH (field)	6.7 @ 11.1°C	7.4 @ 4.2°C	7.1 @ 4.0°C
Turbidity (ntu)	20	6	20

APPENDIX C

BATHYMETRIC SURVEY OF THE

SOUTH FORK RIVANNA RIVER RESERVOIR

OCTOBER, 1988

A BATHYMETRIC SURVEY OF THE SOUTH FORK RIVANNA RIVER RESERVOIR
OCTOBER, 1988

Prepared for:

Sverdrup Corporation
7799 Leesburg Pike
Suite 700 - South Tower
Falls Church, Virginia 22043

By:

James R. Reed and Associates, Inc.
813 Forrest Drive
Newport News, Virginia 23606

1.0 INTRODUCTION

The South Fork Rivanna River Reservoir was put into operation in August, 1966. Concern regarding the quantity and quality of drinking water contained in the reservoir has led to several studies on sedimentation and water quality within this reservoir. In 1975, Betz Environmental Engineers, Inc. was commissioned by the Rivanna Water and Sewer Authority to perform a comprehensive water quality management study of the reservoir and its tributary area (Betz, 1977). Measurements of water quality, sedimentation and storage capacity were used for watershed management recommendations in this study. A more extensive survey of sedimentation on the South Fork Rivanna River Reservoir was undertaken in 1980 (Glaspey, 1981). At this time, storage capacity measurements on the reservoir indicated a higher degree of sedimentation than was found in the Betz study, reducing the working life estimation of the reservoir by 30 years, to the year 2010.

In January, 1988 an extensive survey of water quality in Albemarle County was undertaken by James R. Reed and Associates, Inc. as part of the environmental analysis for the Route 29 Corridor study. Much of this work involved the South Fork Rivanna River Reservoir tributary area, as well as the reservoir itself. To supplement the water quality data, a bathymetric survey was undertaken on the reservoir in October, 1988. The purpose of this effort was to assess current storage capacity, and changes in sedimentation rates since the 1980 study. The results of that bathymetric survey are reported below.

2.0 MATERIALS AND METHODS

2.1 Data Collection:

The field effort of the survey was performed on 6 and 7, October, 1988 on the South Fork Rivanna River Reservoir. At this time, the reservoir water level was at the spillway elevation of 382 feet msl. Field work was conducted from a 14-foot flat bottom "jon" boat equipped with a 25 horse power gasoline engine. Transects established in the Betz (1977) study and modified in the Glaspey (1981) study were also used in this mapping effort. However, the original Betz survey maps were not available for this work, and slight shifts in transect locations precluded exact segment by segment comparisons with the Glaspey (1981) study.

A SI-TEX model HE-357 strip-chart depth indicator was used to record reservoir profiles along each transect. A weighted line was used to calibrate the chart record at the start of the field work, and upon each scale change on the meter in the shallower portions of the reservoir. Flagging or painted stakes were used to mark start and end points of each transect. After noting the transect number and direction in the field log and map, the depth indicator was turned on as a slow, uniform speed run was made across the reservoir. The end point of the run was then marked on the strip chart along with the transect number and azimuth.

2.2 Data Analysis:

Each transect was measured to determine the area represented by the reservoir profile. The volume of the reservoir was then calculated using the "average end-area method". This method is designed for reservoirs of fairly uniform width, with transects located perpendicular to the channel. The areas of adjacent transects were averaged and multiplied by the channel distance between them in order to determine the volume of each intermediate segment. Reservoir storage capacity was calculated by the summation of all segments (Table 1).

3.0 RESULTS AND DISCUSSION

Glaspey (1981) found the average end-area method an accurate assessment of reservoir volume, accounting for 97% of the design volume of the reservoir. In that first fourteen years of reservoir operation, storage loss was calculated at 2.4 X 10^7cf, or 10.65% of the original volume. This indicated an average annual loss of 0.76%. In the following eight years, an additional 1.3 X 10^7cf of volume has been lost to sedimentation, for a total loss of 16.42% of the original volume.

Estimates of storage loss based on the Glaspey (1981) survey indicated a significantly higher rate of sedimentation than estimates in the Betz (1976) study. Results of this 1988 study confirm the higher rate of storage loss noted by Glaspey (Table 2). Storage loss over the past eight years has averaged 1.64 X 10^6cf a year, only slightly lower than the 1.73 X 10^6cf observed by Glaspey. The 22 year average annual loss has been 1.70 X 10^6 cf based on the results of this survey.

4.0 LITERATURE CITED

Betz Environmental Engineers, Inc. 1977. Water Quality Management Study of the South Fork Rivanna Reservoir and Tributary Areas. Vol. 1 and 2: Rivanna Water and Sewer Authority, Charlottesville, VA.

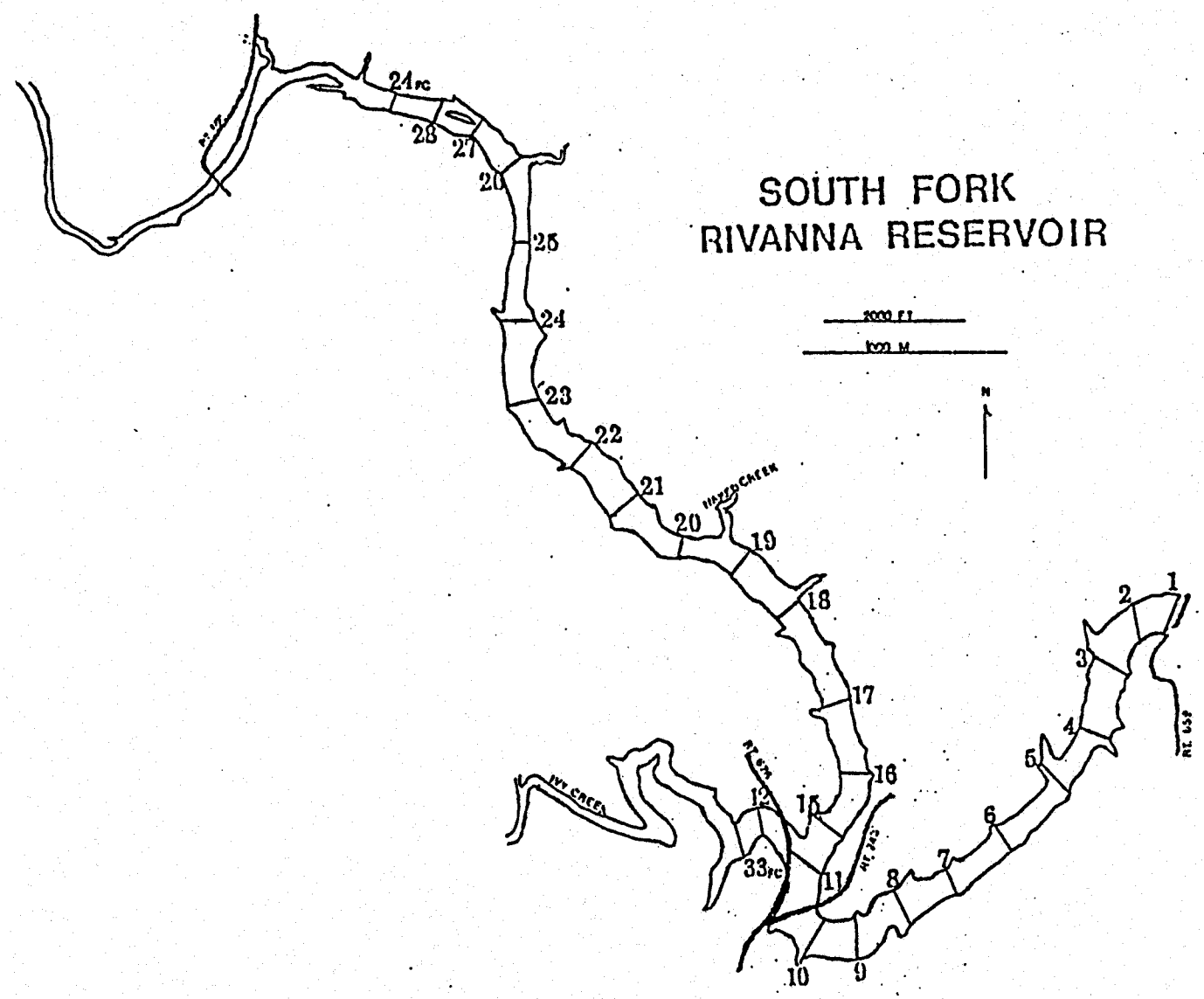
Glaspey, R. G. 1981. A Sediment Budget of the South Fork Rivanna Reservoir. Unpublished M.S. Thesis, University of Virginia, Charlottesville, VA.

TABLE 1. Storage Volume of South Fork Rivanna Reservoir, October, 1988.

TRANSECTS BOUNDING	1988 VOLUME (cf X 10^6)
1-2	11.36
2-3	12.52
3-4	12.46
4-5	12.61
5-6	19.23
6-7	9.73
7-8	10.89
8-9	9.20
9-10	7.88
10-11	14.66
11-15	6.60
15-16	7.26
16-17	7.81
17-18	7.91
18-19	5.86
19-20	5.07
20-21	7.54
21-22	3.58
22-23	4.01
23-24	2.29
24-25	3.78
25-26	2.44
26-27	1.75
27-28	1.29
28-FC (24)	0.65
12-FC (33)	1.45
TOTAL	189.83

TABLE 2. Summary of South Fork Rivanna Reservoir Bathymetric Surveys

YEAR (SURVEY)	VOLUME (X $10^6 FT^3$)	LOSS (X $10^6 FT^3$)	ANNUAL LOSS (X $10^6 FT^3$)
1988 (Reed & Assoc.)	189.83	37.29	1.70
1980 (Glaspey)	202.94	24.18	1.73
1976 (Betz)	216.42	10.7	1.07
1966 (Original)	227.12	--	--



- Location of Reservoir Bathymetric Transects

APPENDIX D

WETLAND DETERMINATION FORMS:

DATA FORM

ROUTINE ONSITE DETERMINATION METHOD

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Stierhoff Date: 4 April 1989
Project/Site: Rt. 29- Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 01
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Quercus palustris	FACW	Tree	11.		
2. Liriodendron tulipifera	FACU	Tree	12.		
3. Acer rubrum	FAC	Tree	13.		
4. Sassafras albidum	FACU	Shrub	14.		
5. Fagus grandifolia	FACU	Shrub	15.		
6. Acer rubrum	FAC	Shrub	16.		
7. Polystichum acrostichoides	FACU	Herb	17.		
8. Lonicera japonica	FAC	Vine	18.		
9. Smilax rotundifolia	FAC	Vine	19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 56
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: > 50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Meadowville Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 2.5 Y 4/2 Mottle Colors: 5YR 5/8
Other hydric soil indicators: In small spring area * only in small 15x20' spring area.
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soils

HYDROLOGY

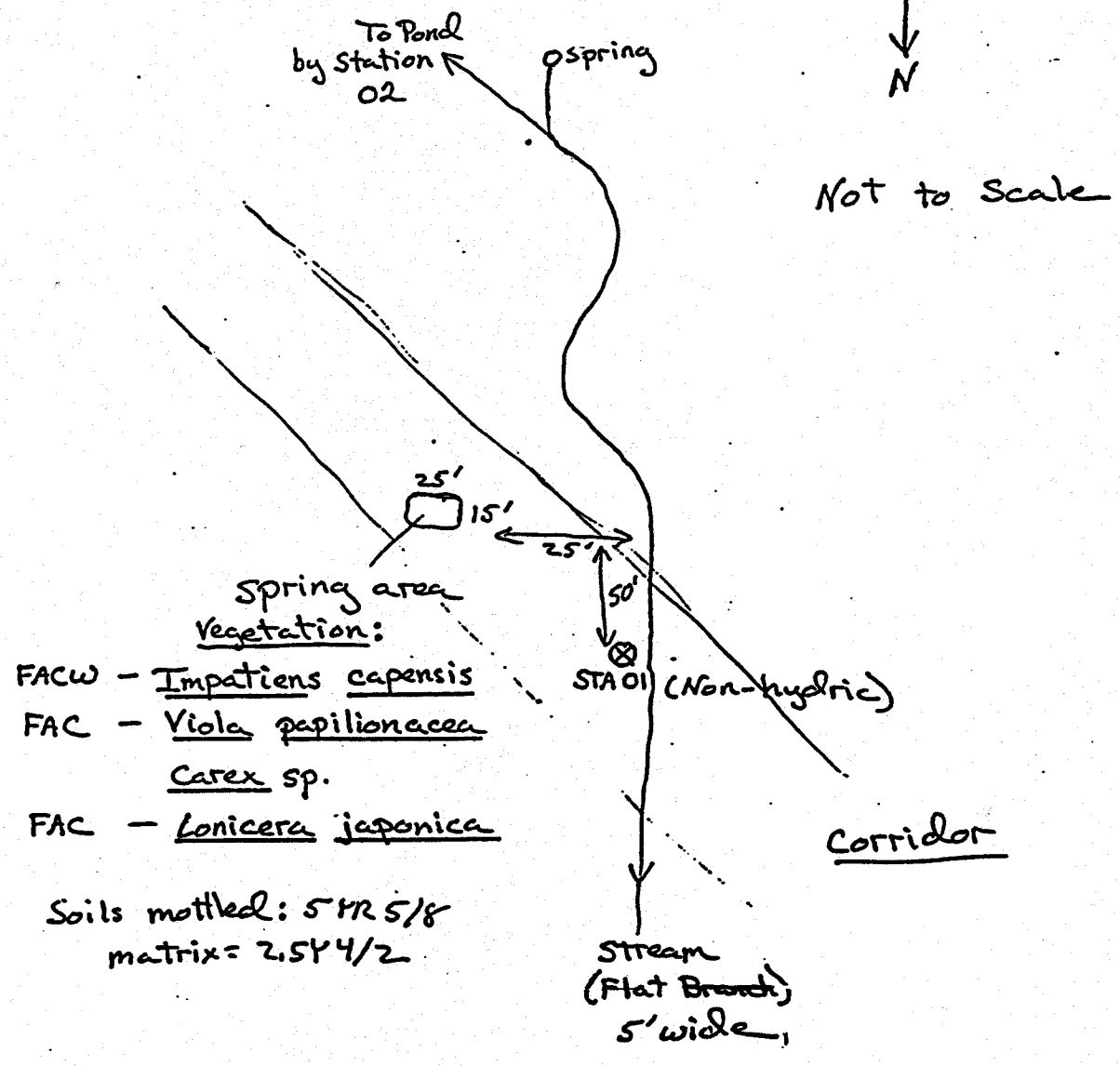
Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: 1-8" in creek
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: In spring area
List other field evidence of surface inundation or soil saturation.
Spring at base of hill
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Soils and plants in spring

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Upper End of Flat Branch N. of Laurel Hill Church (Field ID #15)



Vegetation:

FACW – Impatiens capensis

FAC – Viola papilionacea

Carex sp.

FAC – Lonicera japonica

Soils mottled: 5YR 5/8

matrix = 2.5Y 4/2

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Sterhoff Date: 4 April 1989
Project/Site: Rt. 29-Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 02
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description.

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Quercus palustris	FACW	Tree	11. Lonicera japonica	FAC	Vine
2. Fagus grandifolia	FACU	Tree	12. Smilax rotundifolia	FAC	Vine
3. Platanus occidentalis	FACW	Tree	13.		
4. Carpinus caroliniana	FAC	Shrub	14.		
5. Fagus grandifolia	FACU	Shrub	15.		
6. Acer rubrum	FAC	Shrub	16.		
7. Polystichum acrostichoides	FACU	Herb	17.		
8. Athyrium Felix-femina	FAC	Herb	18.		
9. Viola papilionacea	FAC	Herb	19.		
10. Smilacina racemosa	FACU	Herb	20.		

Percent of dominant species that are OBL, FACW, and/or FAC 75
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Meadowville Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 2.5Y 4/2 Mottle Colors: 5YR 5/8
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soils

HYDROLOGY

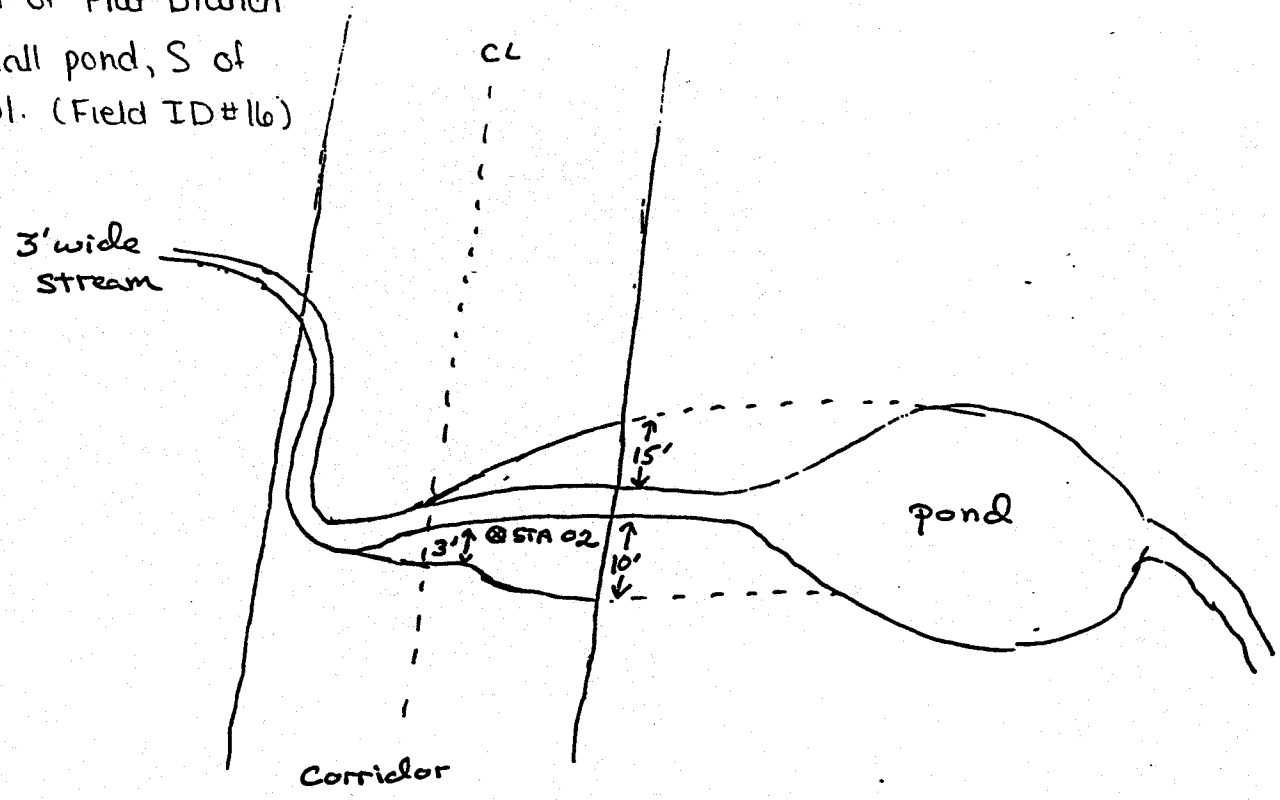
Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: 1-3" in stream
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface
List other field evidence of surface inundation or soil saturation.
Water-stained leaves
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of soil saturation

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Upper end of Flat Branch above small pond, S of station 01. (Field ID #16)



DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Stierhoff Date: 4 April 1989
Project/Site: Rt. 29 - Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 05
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Quercus palustris	FACW	Tree	11. Smilax rotundifolia	FAC	Vine
2. Liriodendron tulipifera	FACU	Tree	12. Toxicodendron radicans	FAC	Vine
3. Acer rubrum	FAC	Tree	13.		
4. Sassafras albidum	FACU	Shrub	14.		
5. Acer negundo	FAC	Shrub	15.		
6. Corydalis flavula	FACU	Herb	16.		
7. Galium tinctorium	OBL	Herb	17.		
8. Allium vineale	FACU	Herb	18.		
9. Typha latifolia	OBL	Herb	19.		
10. Lonicera japonica	FAC	Vine	20.		

Percent of dominant species that are OBL, FACW, and/or FAC 67
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Wehadkee Subgroup:[2]
Is the soil on the hydric soils list? Yes ✓ No ___ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 5Y 4/2 Mottle Colors: 10YR 5/8
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soils.

HYDROLOGY

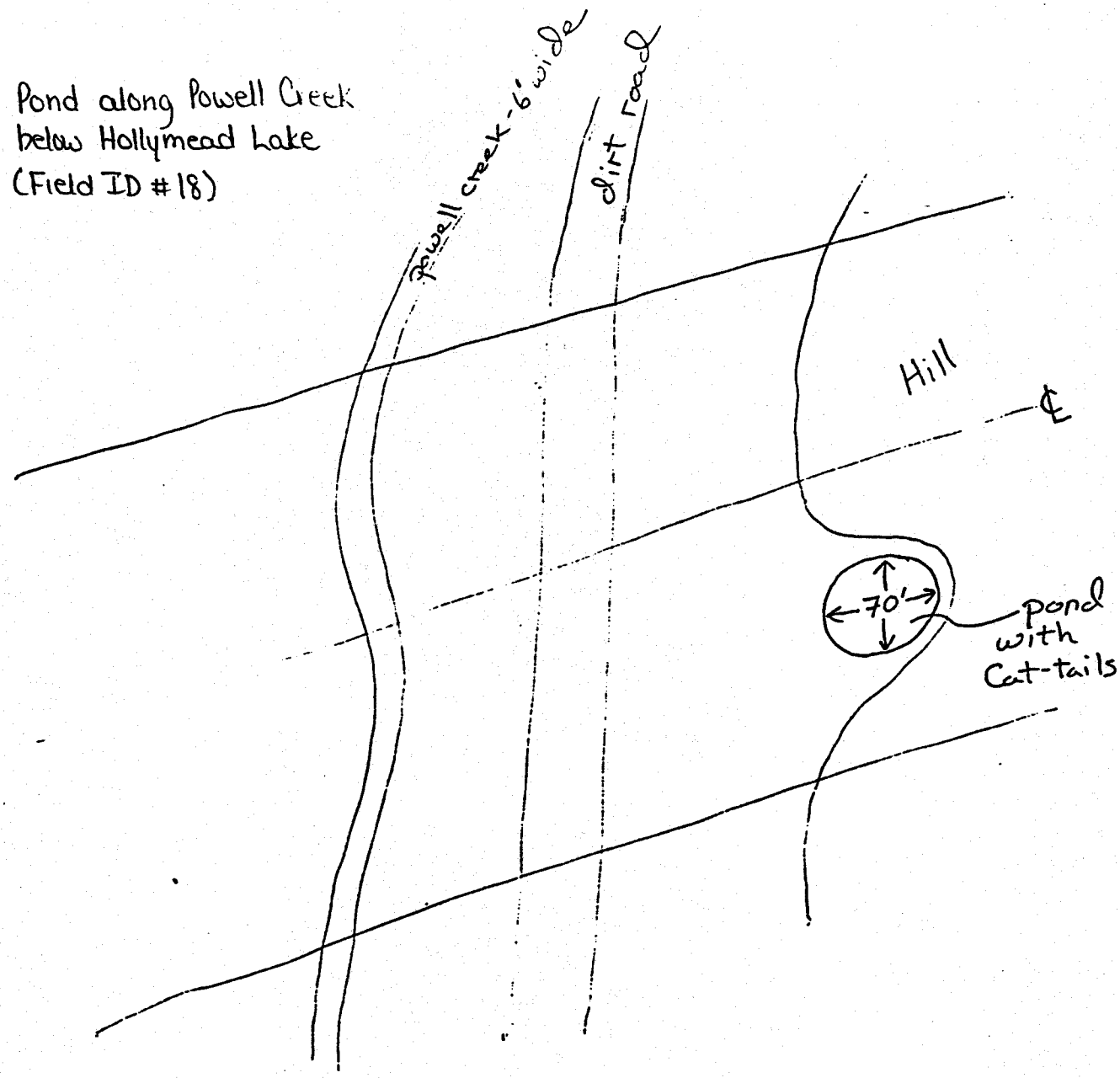
Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: ~2' in pond
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface at edge of pond
List other field evidence of surface inundation or soil saturation.
Typha latifolia (cattails) in pond
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Pond; Visual observation of saturated soils.

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Pond along Powell Creek
below Hollymead Lake
(Field ID #18)



DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Stierhoff Date: 5 April 1989
Project/Site: Rt. 29- Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT- Sverdrup Plant Community #/Name: Station 23
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description.

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Platanus occidentalis	FACW	Tree	11. Smilax rotundifolia	FAC	Vine
2. Quercus palustris	FACW	Tree	12.		
3. Carpinus caroliniana	FAC	Tree	13.		
4. Sassafras albidum	FACU	Shrub	14.		
5. Carpinus caroliniana	FAC	Shrub	15.		
6. Fagus grandifolia	FACU	Shrub	16.		
7. Polystichum acrostichoides	FACU	Herb	17.		
8. Claytonia virginica	FACU	Herb	18.		
9. Equisetum hyemale	FACW	Herb	19.		
10. Lonicera japonica	FAC	Vine	20.		

Percent of dominant species that are OBL, FACW, and/or FAC 64
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50 % of species are OBL, FACW and/or FAC

SOILS

Series/phase: Toccoa Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 5Y 4/1 Mottle Colors: 10YR 4/6
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soils

HYDROLOGY

Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: 2-24" in stre
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface on E bank of stream
List other field evidence of surface inundation or soil saturation.
Springs along E bank of stream
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of soil saturation

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Powell Creek south of Rte. 643 near confluence with Rivanna River
(Field ID #22)
Uniform 5' wide wetland area along E bank of Powell Creek
~250' of creek will be impacted.

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Sterhoff Date: 6 April 1989
Project/Site: Rt. 29 - Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 37
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Acer negundo	FAC	Shrub	11.		
2. Salix nigra	FACW	Shrub	12.		
3. Acer rubrum	FAC	Shrub	13.		
4. Barbarea verna			14.		
5.			15.		
6.			16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 75
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: > 50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Buncombe Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 10YR 5/3 Mottle Colors: 5YR 4/6
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Entisol with hue between 10YR and 10Y and mottles, with matrix chroma of 3 or less

HYDROLOGY

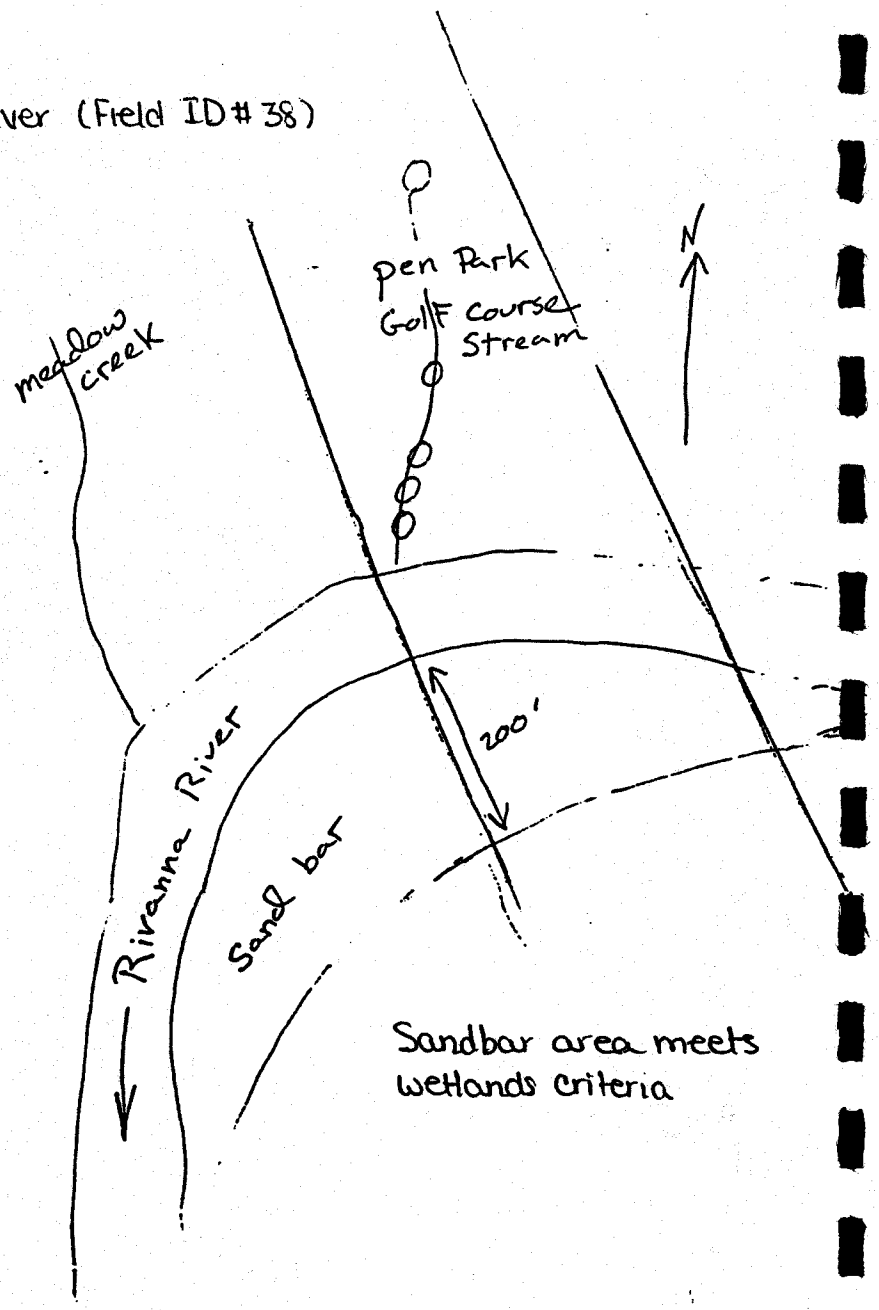
Is the ground surface inundated? Yes ___ No ✓ Surface Water Depth: ___
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: 12"
List other field evidence of surface inundation or soil saturation.
drift lines from river flooding
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: frequent flooding apparent

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Sandbar along Rivanna River (Field ID # 38)



DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Stierhoff Date: 9 May 1989
Project/Site: Rt. 29 - Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 56
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Acer rubrum	FAC	Tree	11. Toxicodendron radicans	FAC	Vine
2. Quercus palustris	FACW	Tree	12. Parthenocissus quinquefolia	FACU	Vine
3. Liriodendron tulipifera	FACU	Tree	13.		
4. Cornus florida	FACU	Shrub	14.		
5. Acer rubrum	FAC	Shrub	15.		
6. Cercis canadensis	FACU	Shrub	16.		
7. Impatiens capensis	FACW	Herb	17.		
8. Viola papilionacea	FAC	Herb	18.		
9. Onoclea sensibilis	FACW	Herb	19.		
10. Lonicera japonica	FAC	Vine	20.		

Percent of dominant species that are OBL, FACW, and/or FAC 75
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Chester Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 10YR 6/1 Mottle Colors: 10YR 6/8
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soils

HYDROLOGY

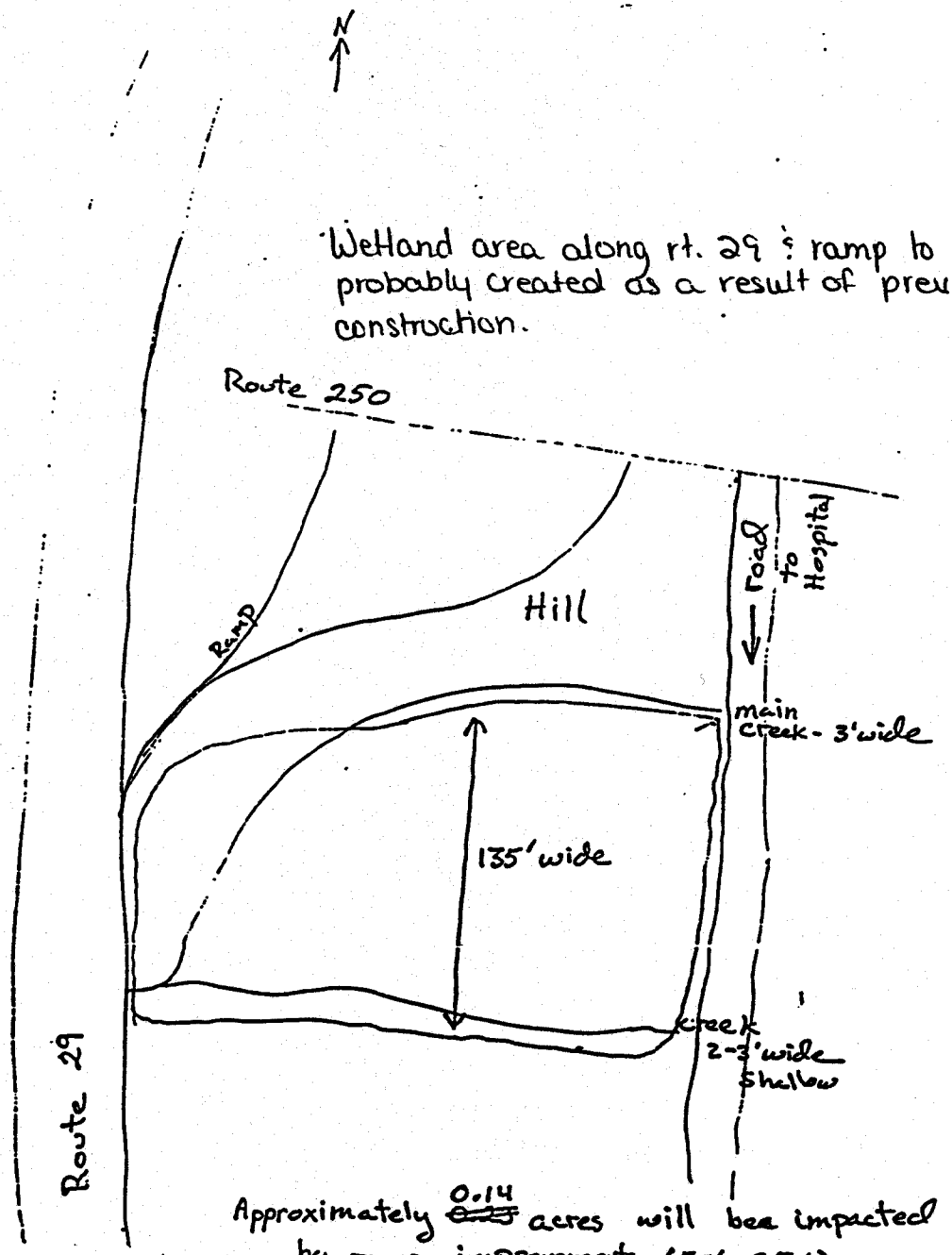
Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: 1-2" in depressions
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface
List other field evidence of surface inundation or soil saturation.
Water-stained leaves
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of soil saturation

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Tributary to Morey Creek on SE side of Rt. 29 / Rt. 250 Interchange
(Field ID # 103)



Approximately ~~0.23~~ 0.14 acres will be impacted by ramp improvements ~~(20' x 300')~~ (20' x 300')

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Siterhoff Date: 4 April 1989
Project/Site: Rt. 29-Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT- Sverdrup Plant Community #/Name: Station 60
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Acer rubrum	FAC	Tree	11.		
2. Platanus occidentalis	FACW	Tree	12.		
3. Platanus occidentalis	FACW	Shrub	13.		
4. Acer rubrum	FAC	Shrub	14.		
5. Rosa multiflora	FACU	Shrub	15.		
6. Juncus tenuis	FAC	Herb	16.		
7. Impatiens capensis	FACW	Herb	17.		
8. Lonicera japonica	FAC	Vine	18.		
9. Smilax rotundifolia	FAC	Vine	19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 89
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Hazel Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ___ No ✓ Gleyed? Yes ✓ No ___
Matrix Color: 5GY 5/1 Mottle Colors:
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Gleyed Soils

HYDROLOGY

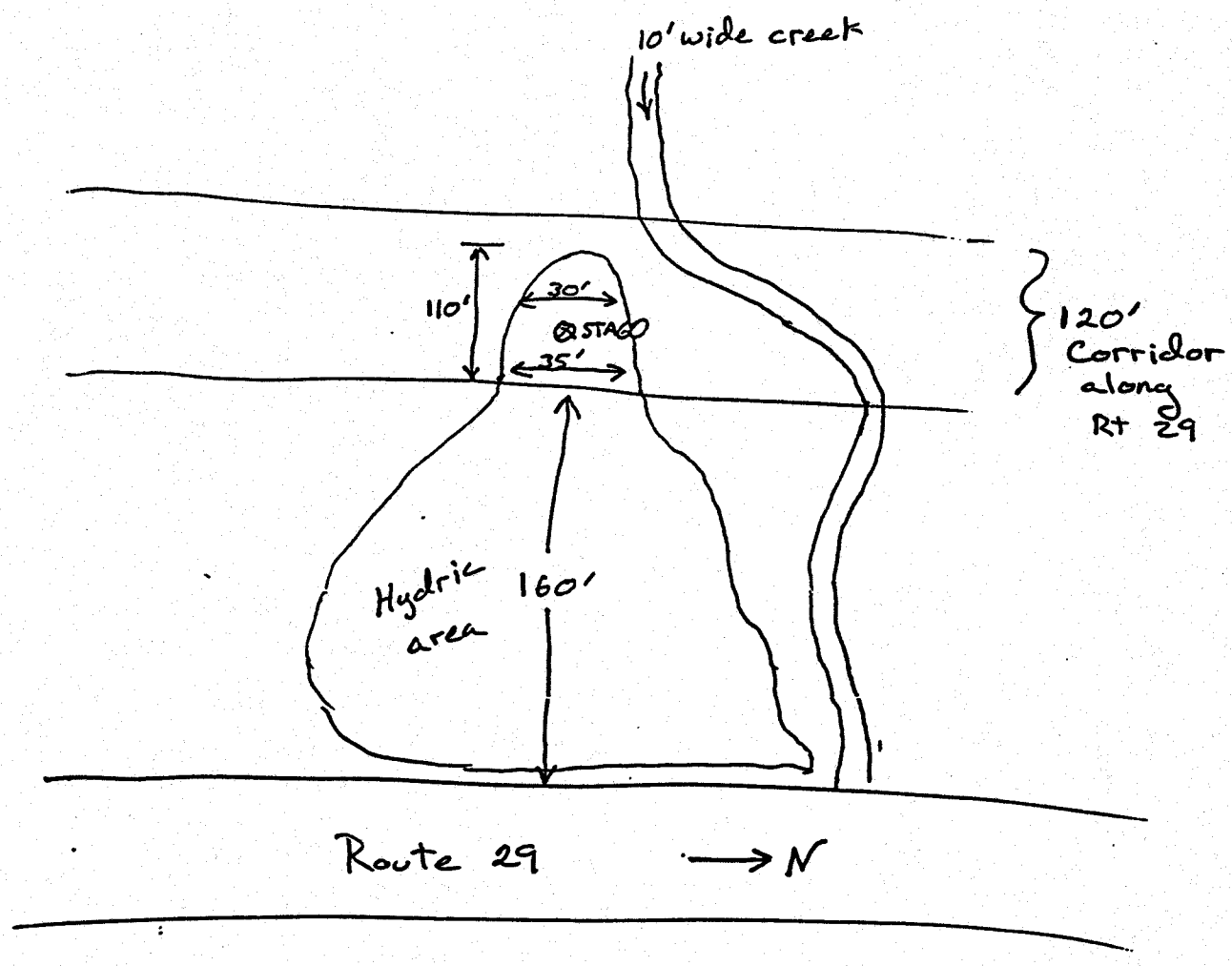
Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: to 6"
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface
List other field evidence of surface inundation or soil saturation.
Inundation in low spots
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of inundation

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Tributary to Powell Creek along Route 29 (Field ID # 13)



DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Stierhoff Date: 4 April 1989
Project/Site: Rt. 29 - Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 81
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Quercus palustris	FACW	Tree	11. Smilax rotundifolia	FAC	Vine
2. Liriodendron tulipifera	FACU	Tree	12.		
3. Fagus grandifolia	FACU	Tree	13.		
4. Cornus florida	FACU	Shrub	14.		
5. Acer rubrum	FAC	Shrub	15.		
6. Quercus palustris	FACW	Shrub	16.		
7. Polystichum acrostichoides	FACU	Herb	17.		
8. Duchesnea indica	FACU	Herb	18.		
9. Typha latifolia	OBL	Herb	19.		
10. Lonicera japonica	FAC	Vine	20.		

Percent of dominant species that are OBL, FACW, and/or FAC 55
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Culpeper Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 5Y 4/2 Mottle Colors: 10YR 5/8
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soils

HYDROLOGY

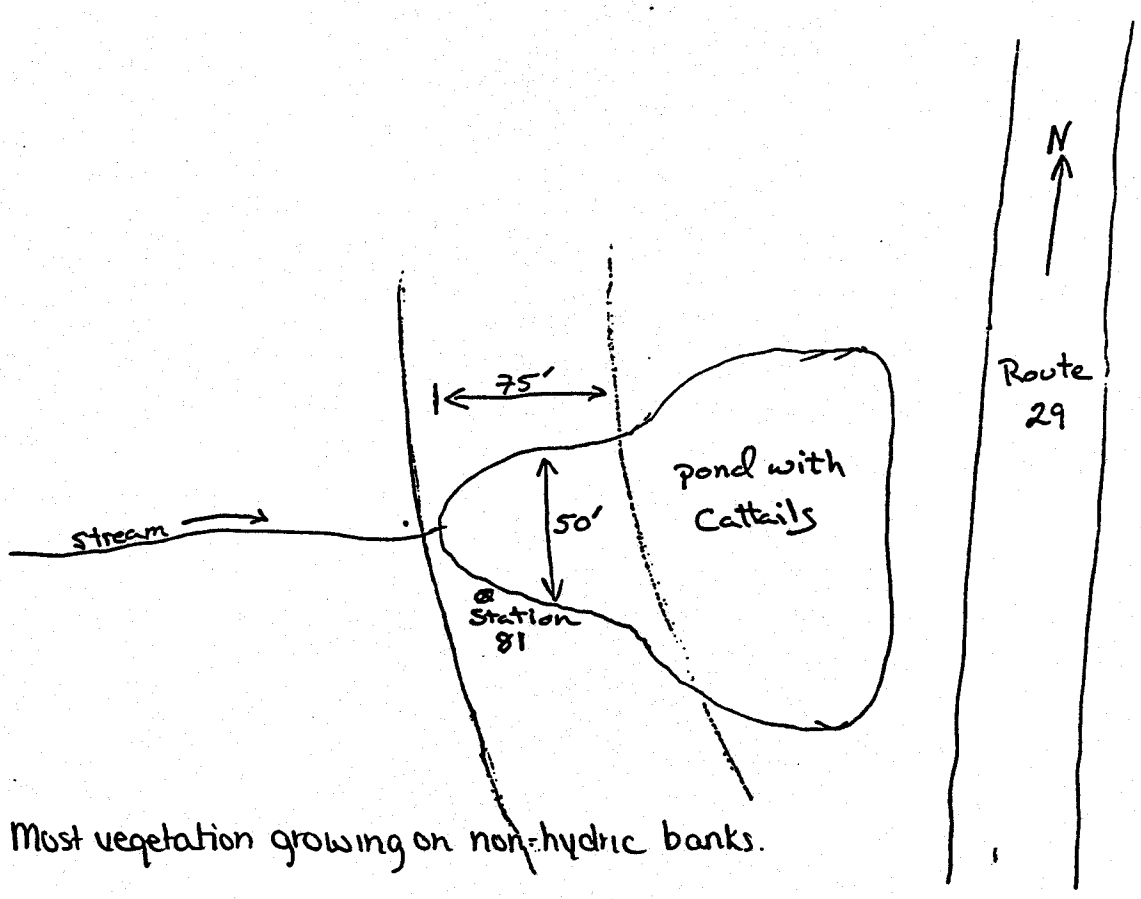
Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: 6"-3' in pon
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface
List other field evidence of surface inundation or soil saturation.
Pond with emergent vegetation
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of inundation

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Pond along tributary to Flat Branch, along Route 29 (Field ID# 08)



Most vegetation growing on non-hydric banks.

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Stierhoff Date: 10 May 1989
Project/Site: Rt. 29-Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT- Sverdrup Plant Community #/Name: Station 95
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Liriodendron tulipifera	FACU	Tree	11.		
2. Rosa multiflora	FACU	Shrub	12.		
3. Impatiens capensis	FACW	Herb	13.		
4. Juncus tenuis	FAC	Herb	14.		
5. Polygonum punctatum	OBL	Herb	15.		
6.			16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 60
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Ashe Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 5Y 4/2 Mottle Colors: 7.5YR 4/6
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soils.

HYDROLOGY

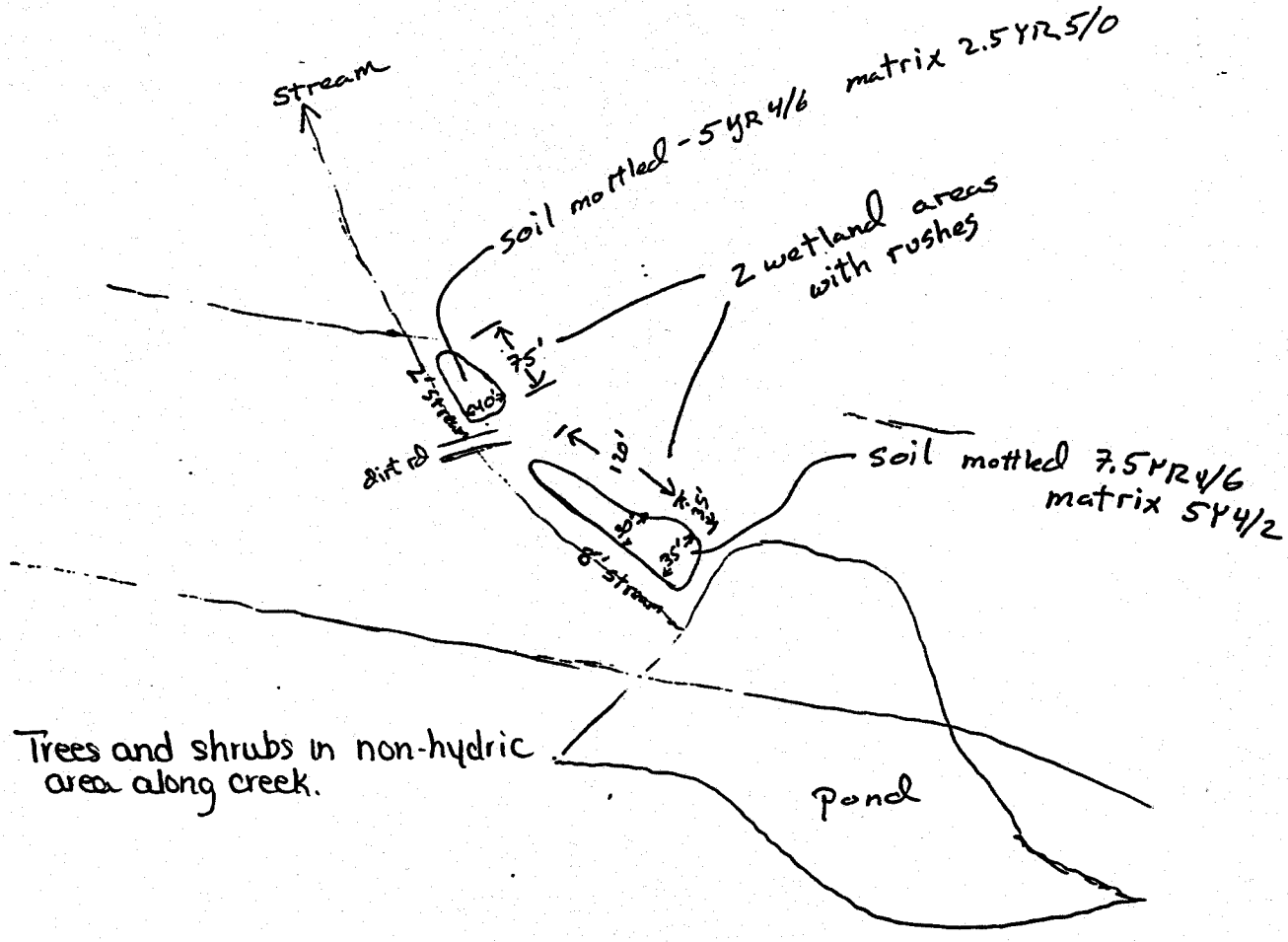
Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: to 3" (above creek)
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface
List other field evidence of surface inundation or soil saturation.
Inundation from springs on hillside
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of inundation and saturated soils.

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Upper end of Naked Creek - Pond & stream (Field ID# 91)



DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Stierhoff Date: 25 April 1989
Project/Site: Rt. 29 - Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 100
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Quercus palustris	FACW	Tree	11.		
2. Platanus occidentalis	FACW	Tree	12.		
3. Carpinus caroliniana	FAC	Shrub	13.		
4. Cornus florida	FACU	Shrub	14.		
5. Fagus grandifolia	FACU	Shrub	15.		
6. Podophyllum peltatum	FACU	Herb	16.		
7. Botrichium virginianum	FACU	Herb	17.		
8. Lonicera japonica	FAC	Vine	18.		
9. Toxicodendron radicans	FAC	Vine	19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 56
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW, and/or FAC

SOILS

Series/phase: Ashe Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 2.5 Y 4/2 Mottle Colors: 7.5 YR 4/6
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soils

HYDROLOGY

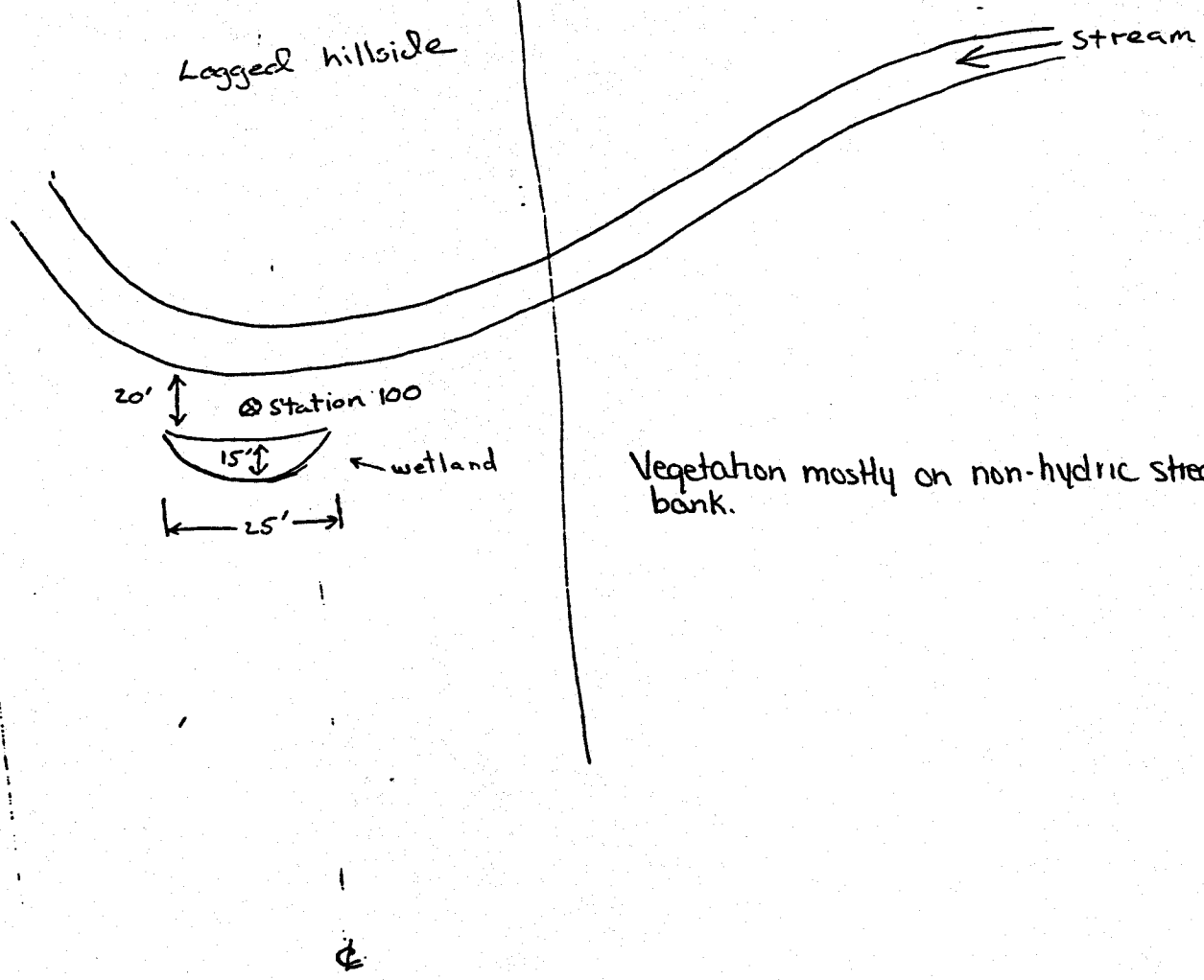
Is the ground surface inundated? Yes ___ No ✓ Surface Water Depth: ___
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface
List other field evidence of surface inundation or soil saturation.
Water-stained leaves
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of soil saturation, spring area

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Tributary to South Fork Rivanna River Reservior (Field ID# 55)



Vegetation mostly on non-hydric stream bank.

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Stierhoff Date: 26 April 1989
Project/Site: Rt. 29 - Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 108
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Juniperus virginiana	FACW	Tree	11.		
2. Alnus serrulata	OBL	Shrub	12.		
3. Rosa multiflora	FACW	Shrub	13.		
4. Impatiens capensis	FACW	Herb	14.		
5. Viola papilionacea	FAC	Herb	15.		
6. Lonicera japonica	FAC	Vine	16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 67
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW and/or FAC.

SOILS

Series/phase: Ashe Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 2.5Y 4/2 Mottle Colors: 5Y 4/4
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soils

HYDROLOGY

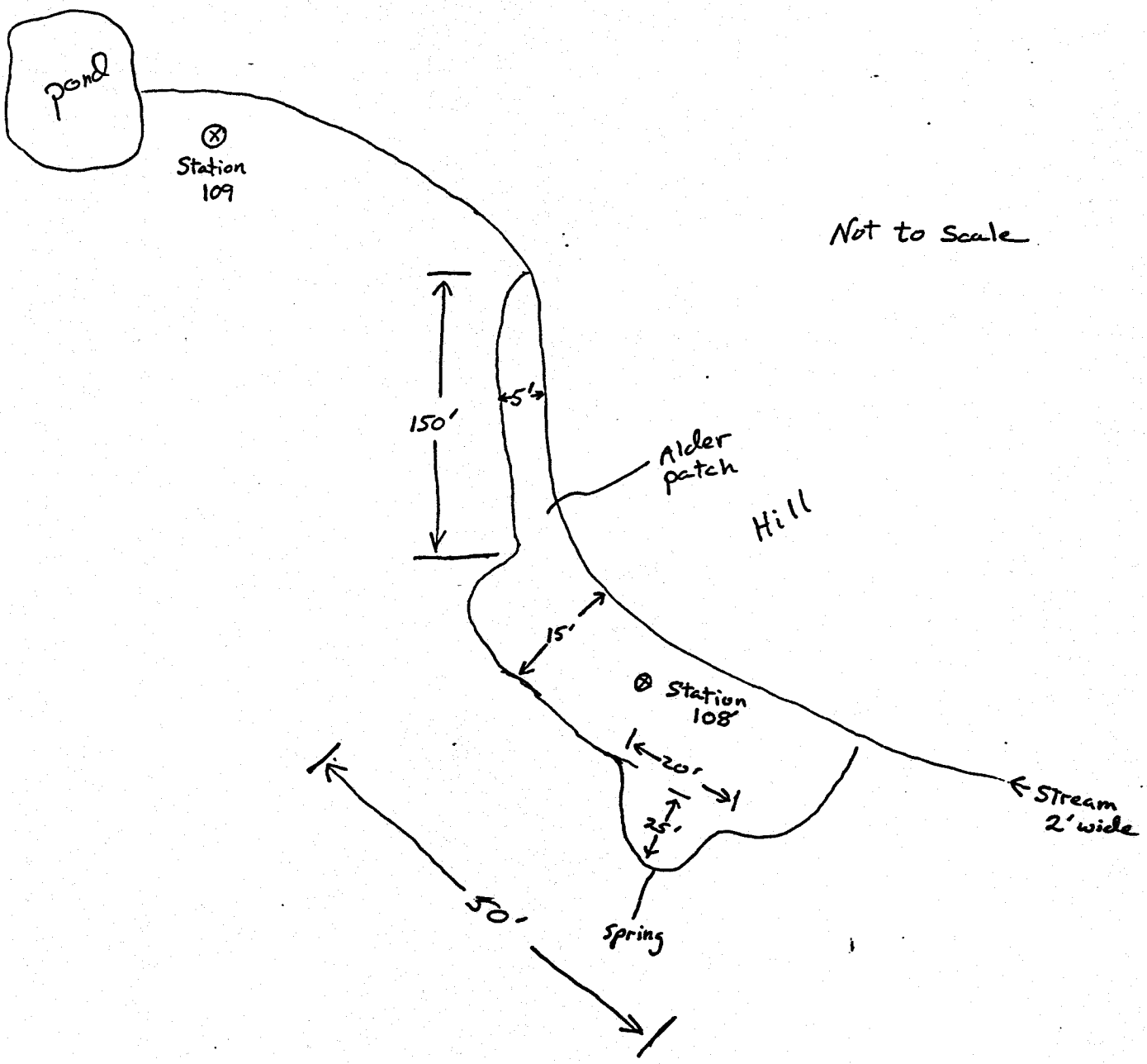
Is the ground surface inundated? Yes ___ No ✓ Surface Water Depth: ___
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface
List other field evidence of surface inundation or soil saturation.
Springs along bank, drift lines indicate flooding
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of saturated soils, footprints fill with water rapidly

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Tributary to Ivy Creek just upstream of station 109 (Field ID# 72)



Area disturbed by cattle grazing. This area and station 109 considered together for acreage calculation.

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Stierhoff Date: 26 April 1989
Project/Site: Rt. 29-Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 109
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Salix nigra	FACW	Shrub	11.		
2. Juncus acuminatus	OBL	Herb	12.		
3. Viola papilionacea	FACW	Herb	13.		
4. Stellaria media	UPL	Herb	14.		
5. Glecoma hederacea	FACU	Herb	15.		
6.			16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 60
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Riverview-Chewacla complex Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ___ No ✓ Gleyed? Yes ___ No ✓
Matrix Color: 10YR 3/1 Mottle Colors:
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 1 or less in ~~unmottled~~ soils

HYDROLOGY

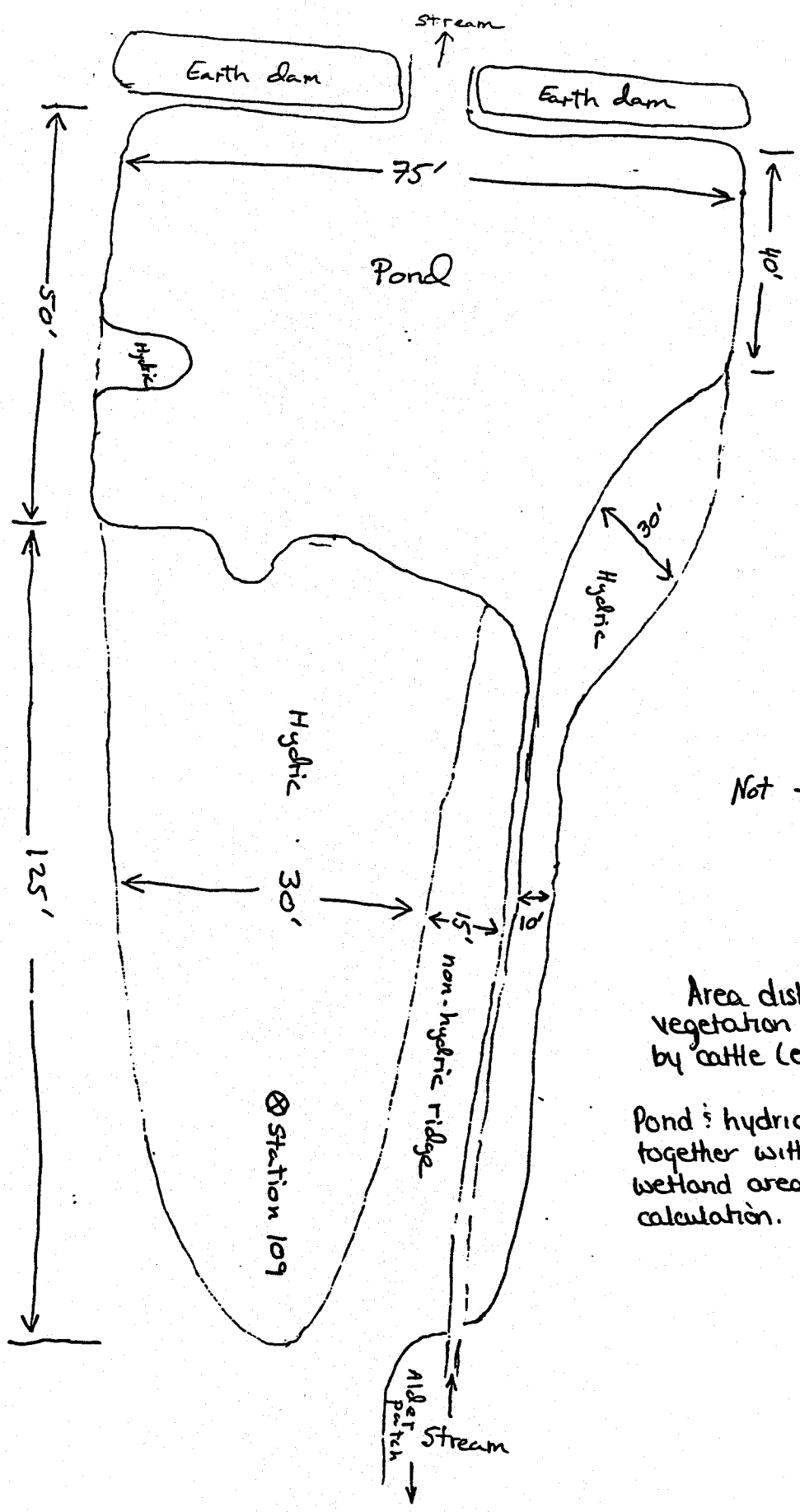
Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: ~6" in pond
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface
List other field evidence of surface inundation or soil saturation.
Matted vegetation from floods
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of saturated soil, drift lines.

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Tributary to Ivy Creek



Not to Scale

Area disturbed: most vegetation heavily grazed on by cattle (except rushes).

Pond: hydric areas included together with station 108 wetland area for acreage calculation.

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Thomas Sherhoff Date: 18 July 1989
Project/Site: Rt. 29 - Charlottesville Bypass State: VA County: Albemarle
Applicant/Owner: VDOT - Sverdrup Plant Community #/Name: Station 124
Note: If a more detailed site description is necessary, use the back of data form or a field notebook. * See reverse side for more detailed description

****

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

****

VEGETATION

Dominant Plant Species	Indic. Stat.	Strat.	Dominant Plant Species	Indic. Stat.	Strat.
1. Alnus serrulata	OBL	Shrub	11.		
2. Salix nigra	FACW	Shrub	12.		
3. Acer saccharinum	FACW	Shrub	13.		
4. Typha latifolia	OBL	Herb	14.		
5. Carex spp.		Herb	15.		
6. Polygonum punctatum	OBL	Herb	16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 83
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: >50% of species are OBL, FACW and/or FAC

SOILS

Series/phase: Glenelg Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ✓ No ___ Gleyed? Yes ___ No ✓
Matrix Color: 7.5YR3/2 Mottle Colors: 5YR3/4
Other hydric soil indicators:
Is the hydric soil criterion met? Yes ✓ No ___
Rationale: Matrix chroma of 2 or less in mottled soil

HYDROLOGY

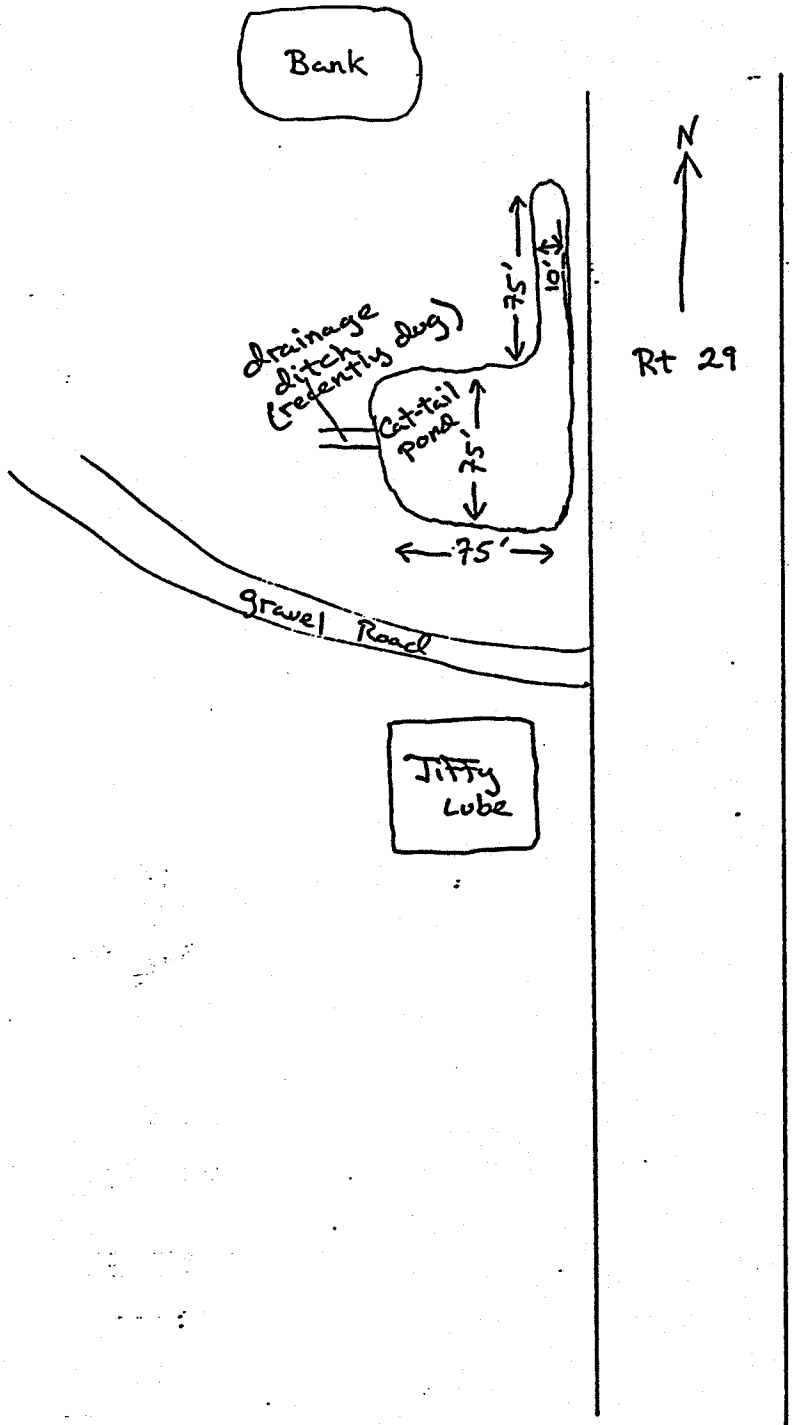
Is the ground surface inundated? Yes ✓ No ___ Surface Water Depth: 0-2" (A)
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: surface
List other field evidence of surface inundation or soil saturation.
Typha latifolia choked pond area
Is the wetland hydrology criterion met? Yes ✓ No ___.
Rationale: Visual observation of soil saturation. Pond (recently drained in part - see reverse side).

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: All parameters meet wetlands criteria

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] See classification according to "Soil Taxonomy."

Ponded area on W side of Rt. 29, N of Jiffy Lube



Soil with a strong, oil-like odor (not H_2S)

APPENDIX E

FISH SPECIES ENCOUNTERED DURING MACROBENTHIC SAMPLING EFFORT

TABLE E.1
Fish Species Collected During Macrobenthic Sampling Effort

	TRIB. TO IVY CREEK	TRIB. TO JACOBS RUN	NAKED CREEK ON CHIS-HOLM	JACOBS RUN AT 606	FLAT-BRANCH	NAKED CREEK AT 844	TRIB. TO POWELL CREEK BY 29	POWELL CREEK AT 643	REDBUD CREEK AT 621	ROCKY HOLLOW AT 769
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
ORDER CYPRINIFORMES										
Family Catostomidae										
Moxostoma hamiltoni	1	1					1			
Family Cyprinidae										
Hybognathus regius		5								
Nocomis micropogon						4		4	8	
Notropis hudsonius				1						
Phoxinus oreas		9					18			4
Rhinichthys atratulus	4	23			1		28			12
Rhinichthys catarache		2								4
Semotilus atromaculatus							25			
Family Ictaluridea										
Noturus gyrinus						1				
ORDER PERCIFORMES										
Family Centrarchidae										
Lepomis marcrochirus			1	1						
Micropterus salmoides			1							
Family Percidae										
Etheostoma nigrum						6				
Etheostoma vitreum	2	1			2	9	1	1	1	3
Salamander										
Eurycea bislineata	1	2	3				1			19
Tadpole										
Pseudacris sp. OR *Hyla* sp.			1							

TABLE E.2
Age Classes of Vertebrates Collected at Each Station During Macrobenthic Sampling Effort

SITE	SPECIES	COMMON NAME	NUMBER/AGE
#1	*Etheostoma vitreum*	Glassy Darter	2 Adult
	Eurycea bislineata	Two-lined Salamander	1 Juvenile
	Moxostoma hamiltoni	Rustyside Sucker	1 Adult
	Rhinichthys atratulus	Blacknose Dace	4 Adult
#2	*Etheostoma vitreum*	Glassy Darter	1 Adult
	Eurycea bislineata	Two-lined Salamander	2 Juvenile
	Hybognathus regius	Eastern Silvery Minnow	4 Adult
			1 Juvenile
	Moxostoma hamiltoni	Rustyside Sucker	1 Adult
	Phoxinus oreas	Mountain Redbelly Dace	4 Adult
			5 Juvenile
	Rhinichthys atratulus	Blacknose Dace	17 Adult
			6 Juvenile
	Rhinichthys cataractae	Longnose Dace	2 Adult
#3	*Eurycea bislineata*	Two-lined Salamander	3 Juvenile
	Lepomis macrochirus	Bluegill	1 Adult
	Micropterus salmoides	Largemouth Black Bass	1 Adult
	Pseudacris sp. or *Hyla* sp.	Tadpole	1
#4	*Lepomis macrochirus*	Bluegill	1 Juvenile
	Notropis hudsonius	Spottail Shiner	1 Juvenile
#5	*Etheostoma vitreum*	Glassy Darter	2 Adult
	Rhinichthys atratulus	Blacknose Dace	1 Adult
#6	*Etheostoma nigrum*	Johnny Darter	6 Adult
	Etheostoma vitreum	Glassy Darter	6 Adult
			3 Juvenile
	Nocomis micropogon	River Chub	4 Adult
	Noturus gyrinus	Tadpole Madtom	1 Adult

TABLE E.2
Age Classes of Vertebrates Collected at Each Station During Macrobenthic Sampling Effort
(Continued)

SITE	SPECIES	COMMON NAME	NUMBER RANGE
#7	Etheostoma vitreum	Glassy Darter	1 Adult
	Eurycea bislineata	Two-lined Salamander	1 Juvenile
	Moxostoma hamiltoni	Rustyside Sucker	1 Adult
	Phoxinus oreas	Mountain Redbelly Dace	18 Adult
	Rhinichthys atratulus	Blacknose Dace	12 Adult
			16 Juvenile
	Semotilus atromaculatus	Creek Chub	25 Adult
#8	Etheostoma vitreum	Glassy Darter	1 Juvenile
	Nocomis micropogon	River Chub	4 Adult
#9	Etheostoma vitreum	Glassy Darter	1 Adult
	Nocomis micropogon	River Chub	8 Adult
#10	Etheostoma vitreum	Glassy Darter	3 Adult
	Eurycea bislineata	Two-lined Salamander	14 Juvenile
			4 Adult
	Phoxinus oreas	Mountain Redbelly Dace	4 Adult
	Rhinichthys atratulus	Blacknose Dace	9 Adult
			3 Juvenile
	Rhinichthys cataractae	Longnose Dace	4 Adult

APPENDIX F

MEMORANDUM CONCERNING THE JAMES RIVER SPINY MUSSEL (*PLEUROBEMA COLLINA*)

Bill Beauter

RECEIVED
OCT 3 1989
ENVIRONMENTAL DIV.

COPY

M E M O R A N D U M

TO: FWS, VDGIF, VNHP

FROM: R. J. Neves, Virginia Cooperative Research Unit

DATE: September 21, 1989

SUBJECT: Correction for Occurrence of James spinymussel in Virginia

Qualitative surveys for the James spinymussel (Pleurobema collina) in Virginia during 1989 have resulted in the location of additional headwaters populations to supplement those reported in the status survey of Clarke (1984). At this time, the James spinymussel has been collected in the following streams of the James River basin:

Craig Creek drainage - Craig and Botetourt nties
- Craig Creek
- Johns Creek
- Dicks Creek
- Patterson Creek

South Fork Potts Creek - Monroe Co.
Pedlar River - Amherst Co.
Mechums River - Albemarle Co.
Rocky Run (Moormans River) - Albemarle Co.
Catawba Creek - Botetourt Co.

Each of the additional headwater populations appears to be small and restricted in distribution. Mark Hove, MS student conducting research on the life history of this species, is expected to complete his thesis in December 1989. A full report on our knowledge of this species will be completed at that time.

This memo corrects the memo of September 13, 1989.

STREAM AND FLOODPLAIN
MUSSEL SURVEY OF RT. 29
CHARLOTTESVILLE BY-PASS

An instream and floodplain mussel survey was conducted on all perennial and intermittent streams in the corridor study area. All streams were very clear except Naked Creek (downstream from a pond) and the Rivanna River (South Fork & North Fork). The Rivanna River had high water & high turbidity so an instream survey was not done.

No mussel species were found in any of the streams surveyed except Ivy creek which contained at least three live mussel species including Corbicula. The Ivy Creek watershed should be surveyed by Neves in the spring.
Redbud Creek had snail species in abundance but no mussel species were found.

Alignment 6 & 6B (North to South)

Crossings	Stream
3	Powell Creek - Upstream of 643. Substrate - silt,sand,pebbles,cobbles and bedrock. Pool to Riffle Ratio (P:R) = 40:60 Width = 3'-6' Depth = 6"-3'. Local land owner (Biologist) lived in area for 10 years and said he had never seen any live or dead mussels instream or in the floodplain.
1	Powell Creek - Downstream of 643. Substrate - More pebbles & cobbles with less sand. P:R = 20:80

Alignment 6

1	Unnamed intermittent stream of S.F. Rivanna River - East of 1428 Substrate - pebbles,cobbles & bedrock. P:R = 10:90 Width = 3'-5' Depth = 1"-2' Probably dry in summer.
1	Unnamed intermittent stream of Town Branch. Substrate - sand & pebbles P:R = 50-50 Width =1'-2' Depth - 0-3" Probably dry in summer Drainage area being timbered and is under construction.
1	Unnamed intermittent stream and pond to the Rivanna River - Golf course. Stream probably dry in summer.

Alignment 6B (South to North)

1	Unnamed intermittent stream to the Rivanna R.- Downstream from a pond. North of 250. Substrate - cobbles & bedrock. P:R = 50-50 Width = 1'-3' Depth = 1"-2' Probably dry in summer.

CROSSINGS

Alignment 6B (conti.)

1 Two unnamed intermittent streams to the Rivanna R. Substrate - sand,pebbles & cobbles. Width = 1'-3' Depth = 1"-3" P:R = 50:50 Probably dry in summer.

1 Two unnamed intermittent streams to the Rivanna R. - East & West of 769. Substrate - Pebbles,cobbles & bedrock Width = 2'-3' Depth = 1"-3" Probably dry in summer.

1 Two unnamed intermittent streams to Redbud Creek - West of 20 Substrate - silt, sand, pebbles & cobbles. Width = 2'-3' Depth = 1"-3" Probably dry in summer.

1 Redbud Creek - Substrate - sand,pebbles,cobbles & bedrock. Depth = 6"-4' Width = 4'-7' P:R = 30:70

1 Unnamed intermittent stream to Redbud Creek - Headwater stream probably dry in summer.

1 Unnamed intermittent stream to N.F. Rivanna R. - Headwater Stream probably dry in summer.

1 Unnamed intermittent stream to Powell Creek - West of 643 Headwater stream Probably dry in summer.

Alignment 7

3 Meadow Creek - Substrate - High percentage sand with pebbles, cobbles & boulders. Depth = 2'-4' Width = 5'-15' P:R = 80:20. Smell of sewerage in stream with high concentrations of algae.

1 Schenks Branch - Stream discription same as Meadow Ck. Except Depth = 4"-4' and Width = 5'-10' Substrate also has boulders.

1 Unnamed intermittent stream to Schenks Branch - Substrate - sand, pebbles & cobbles. Width = 2'-5' Depth = 1"-3" P:R = 50:50 Probably dry in summer.

Alignment 9

1 Most of these unnamed intermittent streams had development in or around the drainage area. Most of the streams would also be dry in summer. All had low flow and drain into Meadow Ck. in which we also surveyed for mussel species, none were found.

Alignment 10 (South to North)

1 Unnamed intermittent stream to Ivy Creek - North of 654 Substrate - sand,pebbles & cobbles Width = 1'-2' Depth = 1"-6" Probably dry in summer.

Alignment 11 $ 10

1 Ivy Creek - Substrate - Sand dominated the substrate with pebbles & Cobbles. Width - 10'- 25' Depth = 1'-4' P:R =70:30 Mussel species were found instream & floodplain.

Alignment 11

1 Jumping Branch - Substrate - silt,sand,pebbles,cobbles & bedrock. Width = 1'- 4' Depth = 1"- 3' P:R = 90:10. Algae instream , most of the drainage area was cowpasture.

1 Unnamed intermittent streams to Naked Creek - Substrate -silt, sand, pebbles, cobbles & bedrock Width = 1'-3' Depth = 1"-2'. Most intermittent streams probably dry in summer.

1 Naked creek - Upstream from Pond. Substrate - silt,sand,pebbles & cobbles. Sand was ~~moe~~ more than 50% of substrate. Width = 4'-6' Depth = 1'-4' P:R = 80:20

1 Naked creek - Downstream from pond. Substrate - silt,sand,cobbles & boulders. Width = 6'-10' Depth = 6"-3' P:R = 50:50. Algae was abundant on substrate.

Alignment 12

1 Unnamed intermittent streams to Jacobs Run. Substrate - silt,sand, pebbles,cobbles & bedrock. Width = 1'-2' Depth = 3"-1' Probably dry in summer.