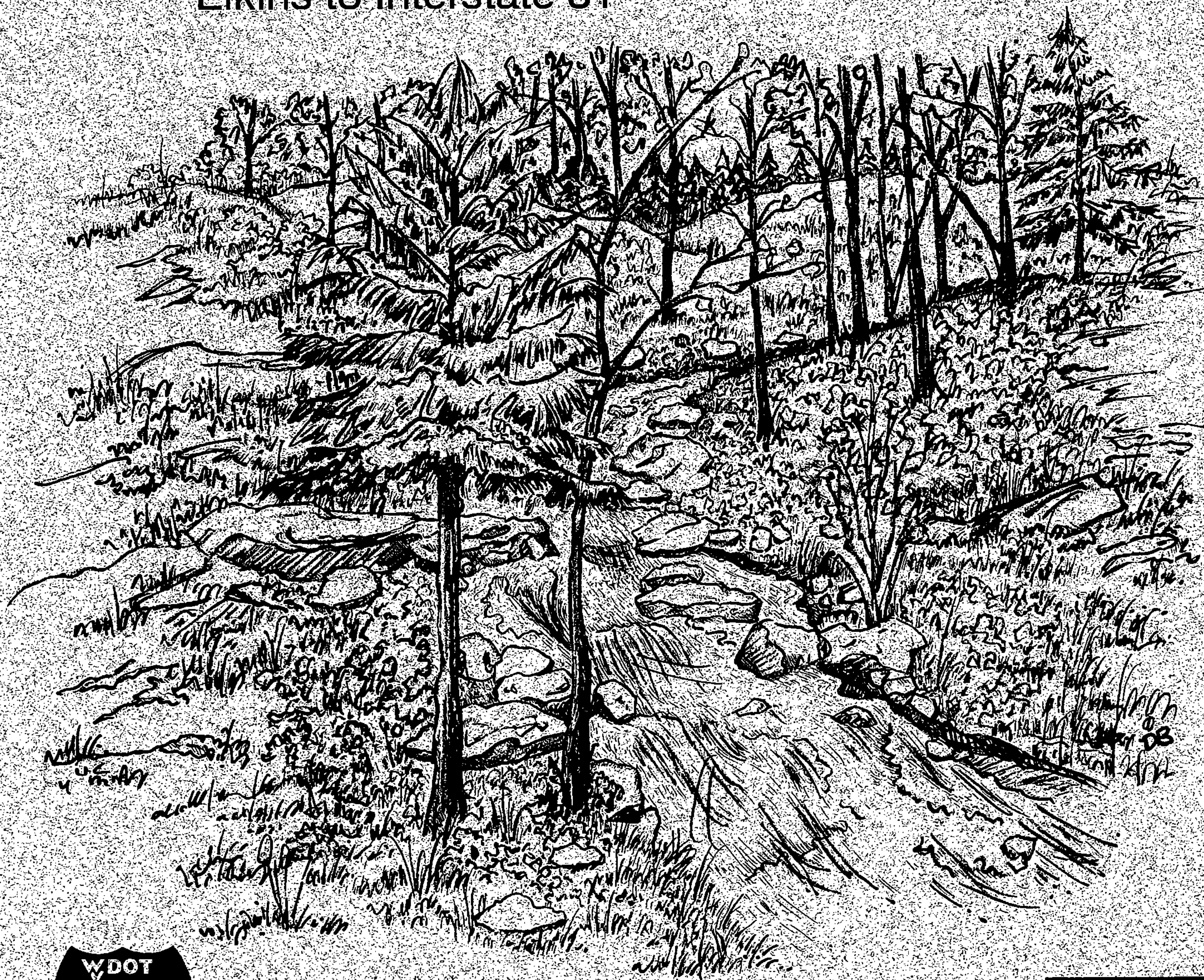
State Project: X142-H-38.99
Federal Project: ADP-484 (59)

STREAMS TECHNICAL REPORT

Alignment Selection SDEIS

APPALACHIAN CORRIDOR H

Elkins to Interstate 81



West Virginia Department of Transportation

Baker

Michael Baker Jr., Inc.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF EXHIBITS

LIST OF APPENDICES

(Under separate cover)

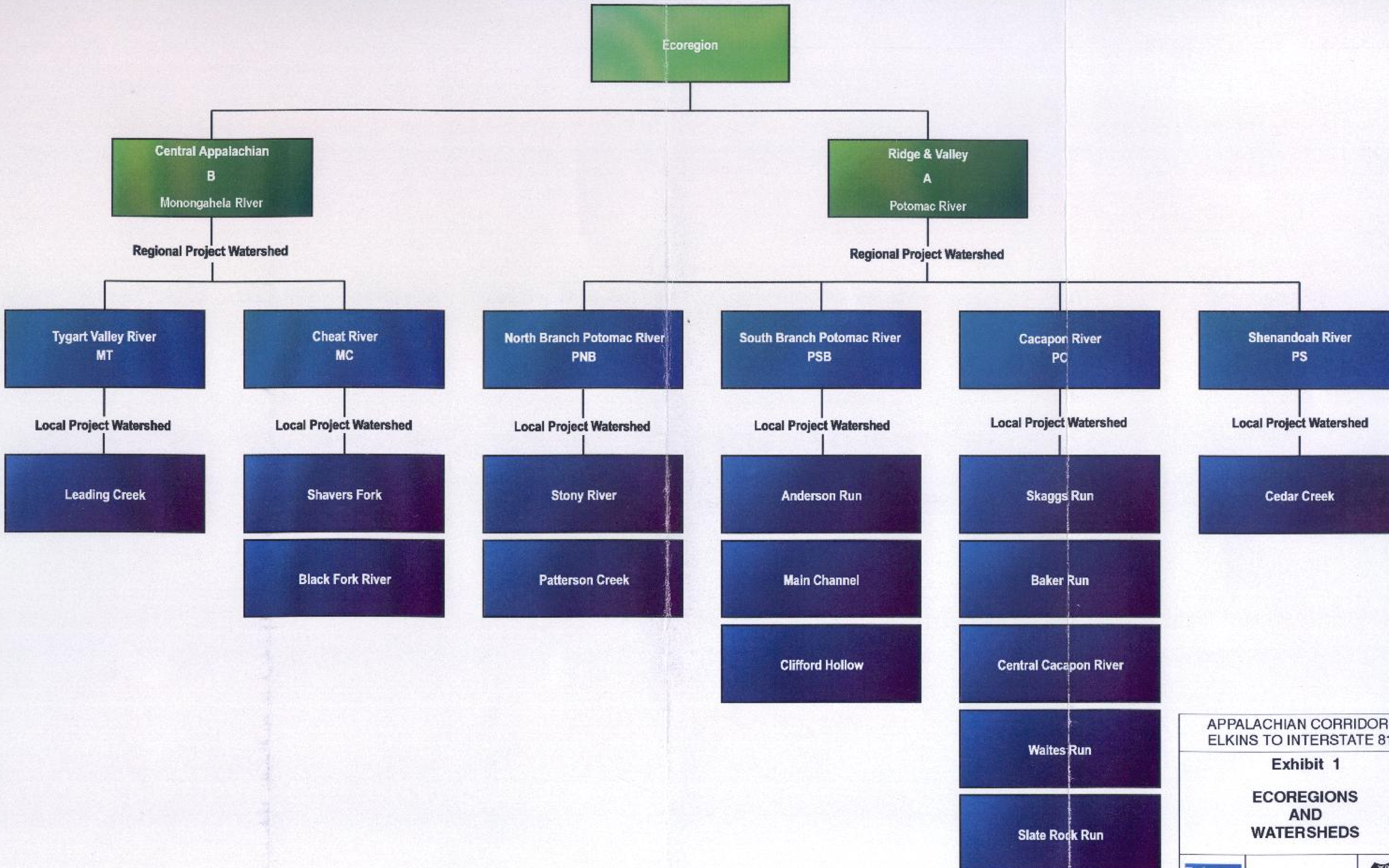
I. INTRODUCTION

This is the Streams Technical Report of the *1994, Alignment Selection Supplemental Draft Environmental Impact Statement* (SDEIS) prepared for the construction of Appalachian Corridor H from Elkins, West Virginia, to Interstate 81 in Virginia. The SDEIS has been prepared in accordance with a two-step study process explained in the preface of the SDEIS. Other documents related to the SDEIS include the *Executive Summary*, the *Alignment and Resource Location Plans*, the *Cultural Resources Technical Report*, the *Secondary and Cumulative Impacts Technical Report*, the *Socioeconomics Technical Report*, the *Vegetation and Wildlife Technical Report*, the *Air, Noise, Energy Technical Report*, the *Wetlands Technical Report*, the October 21, 1992 *Corridor Selection SDEIS* and associated Technical Reports, and the July 26, 1993 *Decision Document.*

Appalachian Corridor H is one of the economic growth highways designated by Congress to serve the Appalachian Region. There are three alternatives under study: the No-Build Alternative, the Improved Roadway Alternative, and the Build Alternative. The No-Build Alternative means that Corridor H would not be constructed in any fashion. The Improved Roadway Alternative consists of a proposed two-lane highway which would utilize existing roads as much as possible. The Build Alternative is a proposed four-lane highway which would be constructed entirely on new location. Please refer to Section II of the SDEIS for more information on the design criteria and design elements of these alternatives.

In order to analyze the direct, secondary, and cumulative impacts to surface waters as a result of the proposed project, a systematic watershed analysis was utilized. The proposed project crosses two river systems: the Monongahela River and the Potomac River. Each river system is composed of several major watersheds (Exhibit 1). Within West Virginia, the proposed project crosses five of these major watersheds: Tygart Valley River, Cheat River, North Branch and South Branch of Potomac River, and the Cacapon River. In Virginia, the proposed project crosses the Shenandoah River watershed.

The six major watersheds cover a large geographic area in comparison to the proposed project. Because of the size disparity between the geographic coverage of each regional project watershed to that of the proposed project within each watershed, the utilization of the total resource base of each regional project watershed would underrepresent the scale and magnitude of the project's potential impact to surface water resources. To adjust for this scale of magnitude effect and to produce a more meaningful and representative ecological impact analysis, each of the six major watersheds were divided into subwatersheds that are directly related in a geographic and ecological context to the proposed location of the project. These subwatersheds are termed the "local project watersheds". In terms of location, these are the subwatersheds of the major regional project watersheds that "surround" the proposed project.



APPALACHIAN CORRIDOR H
ELKINS TO INTERSTATE 81

Exhibit 1

ECOREGIONS AND WATERSHEDS

Baker

Further, analysis of only local project watersheds would overestimate, or miss, the ecological importance of cumulative impacts that occur beyond the boundaries of the local project watersheds. To adjust for this overestimate and to be certain that the ecological importance of impacts outside the local project watersheds were analyzed, "regional project watersheds" were defined for this study. Regional project watersheds cover the portion of the major watershed that is bounded by the Area of Influence defined for this project. Please refer to the SDEIS Section III-A, Economic Environment, for a complete definition of the Area of Influence.

The following sections detail the methods utilized in assessing aquatic habitat and water quality of streams and rivers, impact assessment and alternative comparisons.

II. STREAM IDENTIFICATION AND CLASSIFICATION

Streams within the regional project watersheds were identified through photogrammetric mapping and field investigations. Streams in both states (WV and VA) were classified as perennial if the West Virginia regulatory definition was met. In West Virginia, intermittent streams are defined as "streams which have no flow during sustained periods of no precipitation and which do not support aquatic life whose life history requires residence in flowing waters for a continuous period of at least six (6) months" (Title 46, Series 1, Section 2.5) The inferred definition of perennial streams is a stream which has flow during sustained periods of no precipitation and which do support one or more species of aquatic life which require residence in flowing waters for greater than six months. The approximate locations and extent of intermittent and perennial streams potentially encroached upon are detailed in the *Alignment and Resource Location Plans*. Streams that were not field investigated are represented "as-mapped".

Prior to field investigations of streams, background information relevant to streams was collected from the West Virginia Department of Natural Resources (WVDNR), the Virginia Department of Environmental Quality, and the Potomac and Monongahela River Basin Plans. WV High Quality Streams were identified from the fifth edition of the published list of West Virginia High Quality Streams. Streams containing trout populations were identified based on West Virginia High Quality Streams, Fifth Edition; West Virginia Department of Natural Resources maps; a listing of stocked trout streams published by WVDNR (1989), trout streams as listed in Virginia Water Control Board regulations (VR 680-21-00), and public comments. Stream order, as discussed by Hynes (1970), was determined based on U.S.G.S. topographic and photogrammetric mapping.

In Virginia the following criteria qualify a stream as "Outstanding State Resource Waters" (VR 680-21-07.2):

- All designated rivers under the Virginia Scenic Rivers Act;
- All Class I and II trout streams;
- Waters containing Federal and/or State Endangered or Threatened species.

"National Resource Waters" (NRW) is the West Virginia designation for streams which are afforded the highest level of protection. The following criteria qualify a stream as a NRW:

- Presence of Threatened or Endangered species or habitat;
- Presence of naturally reproducing trout populations;
- All Federally designated rivers under the "Wild and Scenic Rivers Act";
- Located within a state or Federal forest or recreational area.

III. STREAM ASSESSMENT METHODOLOGY

In December of 1986, the EPA initiated a major study for surface water monitoring to address priority pollutants such as toxins, nonpoint source impacts, and documentation of environmental results. This effort led to the accepted practice of evaluating aquatic macroinvertebrates and fish in conjunction with a habitat assessment, in order to assess the ecological integrity of streams and rivers (Plafkin et al. 1989). The result of this endeavor was the development of Rapid Bioassessment Protocol (RBP) procedures which are designed to provide basic aquatic life and habitat data for screening, planning, and management purposes. Examples of its use includes: screening for identification of existing water quality impairment; ranking sites as severely to moderately impaired with respect to reference station or regional database; identifying severe water quality problems; site ranking and trend monitoring.

The EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers - Benthic Macroinvertebrates, Level II* (RBP II; Plafkin et al. 1989) assessment methodology was used in this study. RBP II utilizes basic information collected in the field on ambient physical, chemical, and biological conditions. The following sections summarize RBP II procedures utilized in assessing perennial streams and potential impacts for this project.

A. BASIC WATER QUALITY

Water samples were taken coincident with the habitat assessment and macroinvertebrate sampling. At each potential perennial stream crossing, temperature, conductivity, dissolved oxygen concentration (DO) and pH were measured. Temperature was measured in degrees Celsius (degree Celsius x 1.8 +32 = degree Fahrenheit). Nitrate water samples were taken in areas where agricultural or nonpoint pollution was suspected. In areas where acid-mine drainage was prevalent, dissolved iron concentrations were measured. In addition to water samples, observations were made regarding odors, surface films, and turbidity. Appendix A provides stream data forms for all streams that were sampled in this study.

B. HABITAT ASSESSMENT

At each potential stream crossing, estimates regarding land use and physical stream characteristics were made. This information provides insight into what species may be present or expected to be present in addition to any physical impairment of the stream. Evaluated parameters included:

- Bottom Substrate
- Embeddedness
- Stream Flow
- Channel Alteration
- Bottom Scouring And Deposition

- Pool:Riffle or Run:Riffle Ratio
- Bank Stability
- Bank Vegetative Stability
- Streamside Cover

The habitat assessment was accomplished by weighting the most biologically relevant parameters observed at each site. Habitat parameters that were assessed at each stream sample station were separated into three categories; primary, secondary, and tertiary (Table 1).

Primary parameters include substrate type and stability, availability of refugia, and migration/passage potential for both fish and aquatic invertebrates. These parameters are weighted the highest to reflect their importance to biological communities. Parameters assessed include bottom substrate, embeddedness, and stream flow.

Secondary parameters refer to the physical morphology of the stream channel which is determined by the flow regime of the stream, local geology, land surface form, soil, and, if applicable, human activities. Parameters assessed include degree of channel alteration, bottom scouring, deposition of sediments, and pool/riffle ratios.

Tertiary parameters, refer to the stability or potential for erosion of a stream channel, and is partly determined by the presence or absence of vegetation and other materials on the stream bank. Because riparian and bank structure indirectly affect instream habitat features, they are weighted less than primary and secondary parameters. Parameters assessed include bank stability, bank vegetative stability and streamside cover.

At each sampling station, numerical scores were assigned to each of the nine habitat parameters. A listing of these scores for all perennial streams based on ecoregion (i.e., ridge and valley and central Appalachians), regional project watershed (i.e., Cacapon, Cheat...Tygart), local project watershed (i.e., Central Cacapon, Shavers Fork, Slate Rock...Leading Creek) and stream order is provided in Table 2. The site identification numbers (Site ID #) in this table refer to those on the Alignment and Resource Location Plans.

A total habitat assessment score equal to the sum of the habitat assessment scores for each parameter was calculated at each sampling station. For this study, habitat assessment scores were divided into 5 classes:

- 0 to 30 - Severely Impaired
- 31 to 60 - Impaired
- 61 to 90 - Moderate
- 91 to 120 - Good
- 121 to 135 - Excellent

Individual habitat parameter scores and total habitat scores were analyzed through exploratory data analysis (Appendix B). The analyses allowed for the comparison of individual habitat assessment scores for each stream (of the same order) within both ecoregions, regional project watershed, or local project watershed, and provided a means to identify streams that possessed excellent, moderate, and impaired habitat quality. This initial screening also identified potential reference stations by stream order. This is required when assessing the degree of similarity of sampled streams for the Biotic Integrity analysis.

C. BENTHIC RBP ASSESSMENT AND DATA ANALYSIS METHODOLOGY

Concurrent with the habitat assessment, quantitative macroinvertebrate samples were collected from stream reaches identified as potential crossing areas (see *Alignment and Resource Location Plans*). Samples were taken within riffle/run reaches of streams because these areas provide the greatest surface to volume ratios and are strongly associated with secondary production. Riffle/run reaches also contain many pollution-sensitive taxa of the Scraper and Filtering Collector Functional Feeding Groups.

Aquatic invertebrates were collected utilizing a kick net (Lind 1979). For each kick net sample, the substrate ($1 m^2$) was agitated to a depth of four to six inches for approximately 45-60 seconds. A kick net was selected because of its relatively small size, the velocity of streams sampled, and the quantitative nature of the sampling protocol. Two samples were collected, composited, preserved in isopropyl alcohol with rose bengal dye, and identified in the laboratory. For each composited sample, the organisms were identified to the family taxonomic level utilizing standard references (Schwiebert 1973; McCafferty 1981; Merritt and Cummins 1984; Caucci and Nastasi 1986; Pennak 1989; Terrell and Perfetti 1991). The use of benthic communities based on family-level identifications have been used successfully to address water quality issues in several states (Hilsenhoff 1988; Novak and Bode 1992).

Some headwater streams in this study were too small to be sampled effectively with a kick net. In those streams, macroinvertebrates were collected from small riffles and pools, leaf packs, woody debris, and moss covered cobble using dip nets and by picking. Similar qualitative approaches to multiple habitat sampling have been utilized by the North Carolina Department of Environmental Management (Lenat 1988; Eaton and Lenat 1992; Lenat 1993).

Karr and Dudley (1981) define biological (or biotic) integrity (BI) as "the [habitat's] ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region." Assessment of BI requires a method that integrates ecological concepts with respect to the structure and dynamics of populations, communities, and ecosystems (Karr 1987; Miller et al. 1988).

In order to characterize the BI of each stream sample the following metrics, as detailed by Plafkin et al. (1989), were calculated:

- Metric 1 (taxa richness). This is a measurement of the total number of macroinvertebrate families identified at a sample site. In general, taxa richness (diversity) generally increases with increasing water quality, habitat diversity, stream size, habitat suitability, and is a reliable indicator of water quality (Lenat 1988). Low taxa richness may indicate low water quality or degraded aquatic habitat. However, many headwater streams, which have low organic enrichment, naturally possess low species richness due to a variety of limiting factors.

- Metric 2 (modified family biotic index). In order to assess the relative "health" of each sampled stream, each macroinvertebrate family was assigned a tolerance value (Hilsenhoff 1982, 1987, 1988; Bode 1988), which reflects its sensitivity to organic pollutants (Table 3). Tolerance values range from 0 (sensitive) to 10 (tolerant). The Family Biotic Index (FBI, Hilsenhoff 1988) is the summation of the number of individuals within each taxon multiplied by the tolerance value of each taxon, divided by the total number of organisms within the subsample. Generally, the FBI increases as the benthic community becomes dominated by pollution-tolerant families (Table 4).

  This study utilized two family-level Tolerance Values: One set was developed by the EPA and the other by the Virginia Department of Environmental Quality (VaDEQ; Table 3). The EPA values are taken from the RBP manual (Plafkin et al. 1989) which is partially based on Hilsenhoff (1988). The family level tolerance values developed by Hilsenhoff are based on tolerance to organic pollutants by aquatic insects of the western Great Lakes Region.

The Virginia Tolerance Values are based on those developed by Hilsenhoff, but have been modified to be representative of the species and genera inhabiting the Mid-Atlantic region. For this study, metric calculations were done utilizing the EPA's tolerance values which always equaled or exceeded (i.e. more sensitive) VaDEQ's tolerance values. In cases where a family-level tolerance value is not provided by the EPA RBP manual, the family-level tolerance value developed by VaDEQ was utilized.

- Metric 3 (ratio of scrapers and filtering collector functional feeding groups). This ratio reflects the riffle/run community food base and provides insight into the nature of potential disturbance factors. Differences in the dominance of a feeding type from that of a reference station can be viewed as a community response to an overabundance of a particular food type.

  Functional feeding group designations were taken from Merritt and Cummins (1984). Table 3 provides a listing of identified families and associated feeding groups. Although families can contain genera with differing feeding strategies, functional feeding group classification was based on morphological and behavioral features found in Cummins and Wilzbach (1985). Generally, scrapers tend to dominate when diatoms are abundant while filterers dominate when filamentous algae and mosses predominate.

- Metric 4 (ratio of EPT to Chironomids). This is a measure of the relative abundance of Ephemeroptera (mayflies), Trichoptera (caddisflies), and Plecoptera (stoneflies) to Chironomids within a sample. Good biotic condition is refelcted in communities with an even distribution among all four groups (Plafkin et al. 1989). A disproportionate number of tolerant Chironomids may indicate environmental degradation.

- Metric 6 (EPT index). Generally, greater densities and richness of EPT families represented in a sample indicates good water quality and habitat. EPT families are relatively intolerant of degraded water quality and habitat.

- Metric 7a and 7b (community similarity indices). Community similarity indices are used to compare the similarity of identified families of a particular sample to that predicted based on a regional database or reference station. For this study, both the Community Loss Index (Metric 7a; Courtemanch and Davies 1987) and Jaccard's Coefficient of Community Similarity (Metric 7b; Jaccard 1912; Boesch 1977; EPA 1983) were calculated.

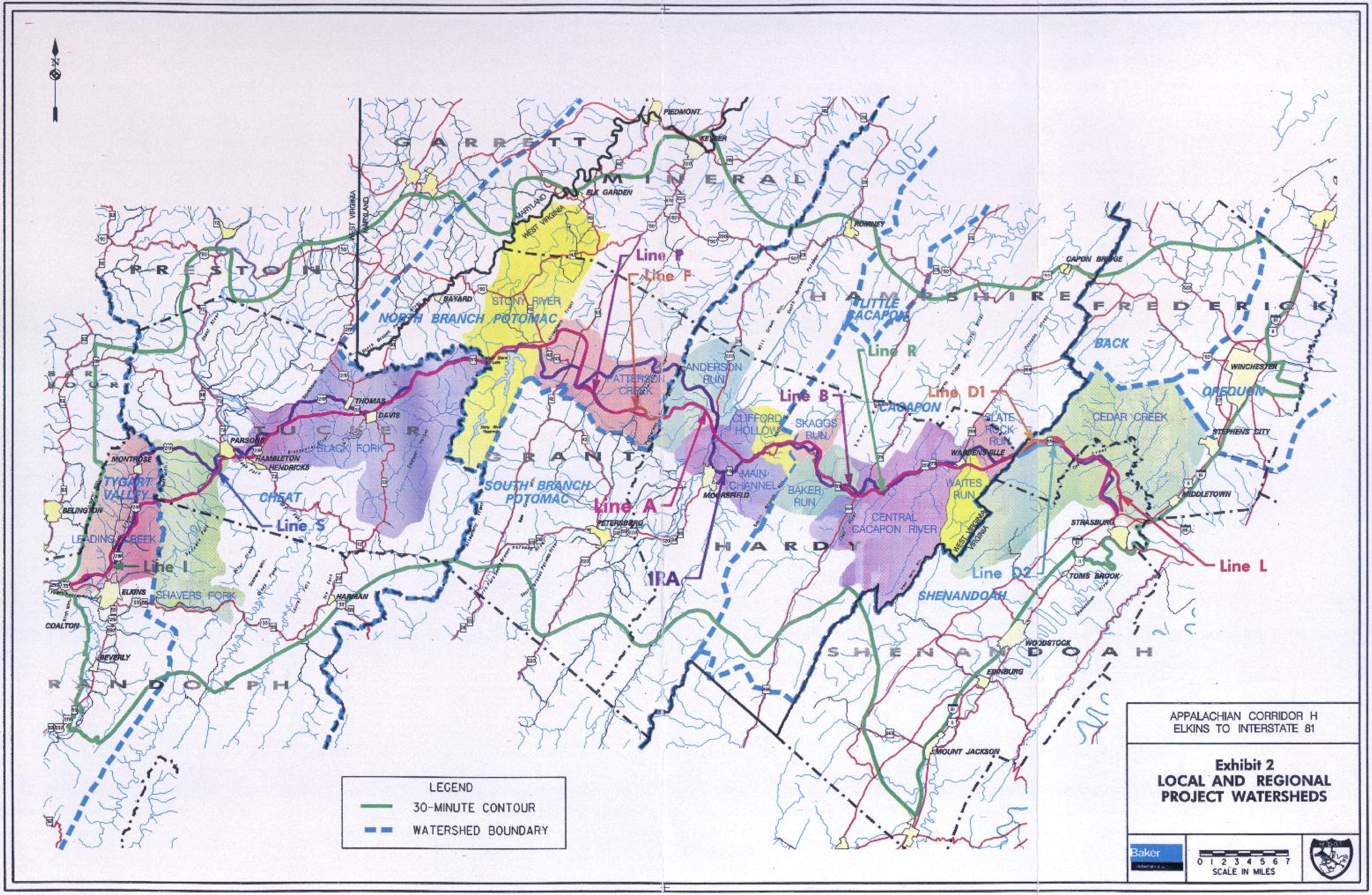
The Community Loss Index measures the loss of benthic taxa between a reference station and the stream sample in question. The Community Loss Index analyzes the compositional dissimilarity between the two samples, with index values increasing as the degree of dissimilarity increases (i.e., 0 is highly similar and approaching 4 is highly dissimilar).

Jaccard's Coefficient of Community Similarity measures the degree of similarity in taxonomic composition between the reference station and the sample in question with respect to taxon presence or absence. The Jaccard Coefficient discriminates between highly similar samples and has values ranging from 0.0 to 1.0, with the degree of similarity between the two samples increasing as the coefficient approaches 1.0.

The data analysis technique utilized in RBP II integrates community, population, and functional parameters into a single evaluation of Biotic Integrity (BI). The seven calculated metrics from each stream sample are compared to values derived from either a reference site within the same region, a reference database applicable to the region, or a control station on the same stream (Plafkin et al. 1989). Reference stations represent undisturbed habitat conditions and are assumed to possess healthy benthic assemblages. Reference stations should be located in the same ecoregion or sub-ecoregion and similar in size and landscape position as the sampling stations. This study utilized reference stations within statistically similar ecoregions whereby stream samples were compared to a reference station of the same stream order.

The project area extends approximately 114 miles west to east (Exhibit 2), crossing two ecoregions: the Central Appalachians and the Central Appalachian Ridges and Valleys. The boundary between these two ecoregions corresponds to the Allegheny Front. Presently, no published stream reference stations exist in either ecoregion. Prior to this study, it was anticipated that significant biological differences would exist in streams between the two ecoregions as a result of differences in watershed use, soil conditions, vegetation type, stream morphology, climate, altitude, and underlying geology. However, exploratory data analysis revealed that a high degree of similarity exists between and within ecoregions with respect to stream order, FBI, habitat score, and Biotic Integrity. Therefore, three representative reference stations were identified for each stream order encountered irrespective of ecoregion.

The criteria used in the selection of reference stations was based on the draft document *Selection Of Reference Sites For Ridge And Valley Stream Biological Monitoring Program* (Gerritsen et al. 1993). Table 5 lists the sites that were used as reference stations in this study. These stations are defined as "Undisturbed Reference Sites" (Gerritsen et al. 1993). This definition assumes that, given a sufficient number of relatively undisturbed streams (e.g., forested watersheds), these streams are a reasonable approximation of pristine, undisturbed conditions, and can be used to characterize reference conditions.


APPALACHIAN CORRIDOR H
ELKINS TO INTERSTATE 81
Exhibit 2
LOCAL AND REGIONAL PROJECT WATERSHEDS
LEGEND
30-MINUTE CONTOUR
WATERSHED BOUNDARY
0 1 2 3 4 5 6 7
SCALE IN MILES
Baker
GARRETT
MINERAL
PRESTON
HAMPSHIRE
FREDERICK
TUCKER
GRANT
HARDY
SHENANDOAH
RANDOLPH
NORTH BRANCH POTOMAC
STONY RIVER
SOUTH BRANCH POTOMAC
LITTLE CACAPON
CACAPON
BACK
OPEQUON
CEDAR CREEK
SLATE ROCK RUN
WAITES RUN
CENTRAL CACAPON RIVER
BAKER RUN
SKAGGS RUN
CLIFFORD HOLLOW
MAIN CHANNEL
ANDERSON RUN
PATTERSON CREEK
BLACK FORK
CHEAT
TYGART VALLEY
LEADING CREEK
SHAVERS FORK
Line P
Line F
Line R
Line B
Line D1
Line D2
Line A
1RA
Line S
Line I
Line L
PIEDMONT
KEYSER
ELK GARDEN
ROMNEY
CAPON BRIDGE
WINCHESTER
STEPHENS CITY
MIDDLETOWN
STRASBURG
TOMS BROOK
WOODSTOCK
EDINBURG
MOUNT JACKSON
WARDENSVILLE
MOOREFIELD
PETERSBURG
HARMAN
BAYARD
THOMAS
DAVIS
PARSONS
HAMBLETON
HENDRICKS
MONTROSE
BELINGTON
ELKINS
COALTON
BEVERLY
MARYLAND
WEST VIRGINIA
VIRGINIA

D. DATA ANALYSIS

The data analysis for RBP II was performed on the calculated metrics using the methodology outlined below. The seven calculated metrics for each stream sample were compared to metric values derived for each reference site based on stream order. From this, a Biological Condition Category (Table 6) (Non-impaired, Moderately impaired, Impaired, Severely impaired) was developed by comparing metric ratios between the stream sample and the appropriate reference sites. This was accomplished by scoring each metric based on the percent similarity of calculated values to reference values. Finally, scores of each of the seven metrics were totaled and compared to the total metric score of the reference stations (Table 5) to provide an index of Biotic Integrity (BI; Table 7).

All habitat and macroinvertebrate data collected in this study were divided and subdivided by ecoregion, regional project watershed, local project watershed, and stream order (Exhibit 1). This division and subdivision of the data allowed for the statistical comparison of number of individuals, number of families, habitat score, FBI, and Biotic Integrity at the ecoregional, regional project watershed, local project watershed, and stream order scale. It also aided in identifying trends in the data that may not be apparent when the data were analyzed at only one spatial scale (i.e., regional project watershed scale vs. stream order scale). Because the purpose of this study was to determine the quality of streams and rivers potentially impacted in the local project watershed area, statistical analyses were performed to determine if there were significant biological differences between the two ecoregions, regional project watersheds, local project watersheds, and stream orders.

Total habitat assessment scores (which is the sum of Primary, Secondary, and Tertiary scores), FBI, number of families, number of individuals, and Biotic Integrity (BI) ranks were analyzed utilizing SYSTAT for Windows Version 5 (SYSTAT, 1992). Basic statistics (min, max, range, mean, variance, standard deviation, standard error, skewness, kurtosis, Bartlett's test of homogeneity of group variance, and coefficient of variation) were computed to analyze the distribution of population parameters (Appendix B). Normalized probability plots, frequency histograms, log transformations, and chi-square distribution functions were applied to the data (Appendix B) to determine probability distribution functions. FBI's, BI's, number of families, number of individuals, and habitat scores were analyzed using both parametric and nonparametric analyses. Box plots (Box-and-Whiskers Plots), which provide a simple graphical summary of batch data, were utilized in discriminating trends between ecoregions, regional project watersheds, local project watersheds, and stream order for mean number of individuals, families, habitat score FBI, and BI.

Box-and-Whiskers Plots and other exploratory data analyses (EDA's) allowed for the discrimination of trends of the above parameters at the ecoregional, regional project watershed, local project watershed, and stream order scale. To test for significant differences in parameters between the two ecoregions, Kolmogorov-Smirnov two-sample test, Independent Samples T-Test (utilizing pooled variances t), and

Kruskal-Wallis (Mann-Whitney U-test) test, were performed depending on the normality of the data and significance of Bartlett's test of homogeneity of group variances. If significant departures from the normal distribution existed, the data were transformed (log(x+1)) and retested.

Model-One ANOVA's were performed on the dependent variable (BI, FBI, habitat score, number of individuals, number of families) with ecoregion, regional project watershed, stream order, and local project watershed as factors. In instances where the data could not be normalized, Kruskal-Wallis One-way Analysis of Variance's (ANOVA) were computed on the dependent variable with ecoregion, regional project watershed, stream order, and local project watershed as factors. To discriminate significant differences between means of FBI's, BI's, number of families, number of individuals, and habitat scores, (using ecoregion, regional project watershed, and stream order as factors in the ANOVA), pairwise comparisons were performed utilizing Tukey HSD multiple comparisons matrix of pairwise comparison probabilities. The following generic null hypotheses were tested (at $p \leq 0.05$):

$H_{\emptyset}$: mean of Parameter X between ecoregions is the same;
$H_{\emptyset}$: mean of Parameter X between regional project watersheds is the same;
$H_{\emptyset}$: mean of Parameter X between local project watersheds is the same;
$H_{\emptyset}$: mean of Parameter X by stream order is the same;
$H_{\emptyset}$: mean of Parameter X by stream order between ecoregions is the same;
$H_{\emptyset}$: mean of Parameter X by stream order between regional project watersheds is the same.
Where Parameter X = number of families, number of individuals, FBI, BI, and total habitat score.

Sampling in some local project watersheds (e.g. Clifford Hollow) did not produce sufficient stream samples (N) by stream order. In these cases, no statistical tests were conducted between local project watershed and stream order. If such tests had been performed, the likelihood of committing a type-II error (accepting the alternative hypothesis when the null hypothesis is true) would have been significant. Results of these analyses are discussed in the Results Section of this TR. Appendix B details the statistical analyses utilized in this investigation. This test was performed to allow the prediction of biotic ranks from habitat assessment scores.

Additional statistical analyses included computing Pearson product-moment correlation coefficients on the log of habitat score and BI rank. If the Pearson product-moment correlation proved to be significant (Bartlett chi-square test, $p \leq 0.05$) the correlation matrix was retested utilizing Bonferroni-adjusted probabilities, which is a more conservative test of significance than the Pearson product-moment correlation for multiple tests comparisons.

The experimental design utilized in this study is of a mensurative nature. Hurlbert (1984) defines mensurative experiments as those that "involve only the making of measurements at one or more points in space and time; space or time is the only "experimental" variable or "treatment."" Because streams and rivers are dynamic in nature, having the ability to "recover" from perturbations in both space and time, the use of inferential statistics is suspect when there is no replication of "treatments" within and between factors.

Hurlbert (1984) correctly identifies the fallacy of interpreting a "significant difference" between treatments as demonstrating a true difference between treatments when the error term is inappropriate to the hypothesis being considered. This misuse of inferential statistics for significance testing has been coined "pseudoreplication" and is defined as the use of inferential statistics to test for treatment effects with data from experiments where either treatments are not replicated or replicates are not statistically independent. Pseudoreplication is widespread in the literature, particularly in marine and terrestrial ecology. This study, however, is not subject to spatial pseudoreplication because the hypotheses tested are site-specific and not intended to be interpreted as general statements of fact beyond the limits of each site. Hurlbert (1984) points out that the most common type of "controlled" experiment in field ecology involves a single "replicate" per treatment. Additionally, Hurlbert (1984) explains that "replication is often impossible or undesirable when very large-scale systems (watersheds, rivers etc.) are studied." When gross effects of a treatment are anticipated, or when only a rough estimate of effect is required, or when the cost of replication is very great, experiments involving unreplicated treatments may be the only or best option.

E. HABITAT ASSESSMENT RESULTS

A total of 251 stream locations were sampled. Table 8 identifies basic water quality, habitat parameter scores, and total habitat assessment scores by site identification number grouped by ecoregion, regional project watershed, local project watershed, and stream order.

Figures 3, 4, 13, 14, 15, and 16, cluster total habitat assessment scores by ecoregion, regional project watershed, local project watershed, stream order, stream order by ecoregion, and stream order by regional project watershed, respectively. At the ecoregional scale, no significant differences in total habitat assessment scores were observed (Kolmogorov-Smirnov Two Sample Test, $p = 0.767$). Ecoregion A (Ridge and Valley Region) had an overall mean total habitat assessment score of 80.1 (category = Suitable Habitat) and Ecoregion B (Central Appalachian Region) a mean total habitat assessment score of 77.2 (category = Suitable Habitat). As indicated in Figures 1 and 3, both ecoregions displayed a wide range of total habitat assessment values: Ecoregion A's minimum total habitat assessment score was 32 (Degraded Habitat) and maximum score was 126 (Excellent Habitat); Ecoregion B's minimum total habitat assessment score was 28 (Severely Degraded Habitat) and a maximum score of 124 (Excellent Habitat).

At the regional project watershed scale (Figure 4), no significant differences were found in mean total habitat assessment scores (Kruskal-Wallis One-Way ANOVA, $p = 0.38$). All regional project watersheds were categorized as possessing "Suitable Habitat." The Cacapon River regional project watershed had the highest mean total habitat assessment score (82.2) and the Tygart River Valley regional project watershed the lowest mean score (79.2). No significant differences were identified at this scale due to the wide variation in total habitat assessment scores within each regional project watershed (Figure 2).

At the local project watershed scale, no significant differences were detected in mean total habitat assessment scores (Kruskal-Wallis One-Way ANOVA, $p = 0.085$). As was the case with regional project watersheds, local project watersheds (Figure 13) displayed a similar degree of variability in total habitat assessment scores (Figure 5).

Significant differences were identified at the ecoregional scale between mean total habitat assessment scores based on stream order (Model I One-Way ANOVA, $p < 0.01$). Third order streams had significantly higher mean total habitat assessment scores (Good Habitat) than first and second order streams (Figure 14), while second order streams had a significantly higher mean total habitat assessment score than first order streams (Tukey HSD multiple comparisons; Figure 6). There were no significant differences in mean total habitat assessment score between ecoregions (Figure 15) for first and third order streams (Figure 7 and 8). However, Ecoregion A had a significantly (Kolmogorov-Smirnov Two Sample Test, $p = 0.035$) greater mean total habitat assessment score than Ecoregion B for second order streams (Figure 9).

At the regional project watershed scale (Figure 16), no significant differences in mean total habitat assessment scores was detected for first and third order streams (Kruskal-Wallis One-Way ANOVA, $p = 0.23$; Model I One-Way ANOVA, $p = 0.81$; Figures 10, 11, and 12). As discussed previously, no analyses were conducted at the local project watershed scale due to small sample populations by stream order at this spatial scale.

F. MACROINVERTEBRATE RESULTS

Table 9 provides a listing of the number of families and total number of individuals identified for each composited macroinvertebrate sample. For the entire study area, a total number of 93 families and 13,421 individuals were identified. Table 10 provides a summary of total number of individuals/sample, total families, total habitat assessment score, and basic water quality data, by ecoregion, regional project watershed, local project watershed, stream order, and site identification number.

There was a significant difference in mean number of families between Ecoregion A and Ecoregion B (Kolmogorov-Smirnov Two sample Test, $p < 0.001$). Ecoregion A had a greater mean number of families (8.9 families/sample) than Ecoregion B (6.6 families/sample) (Figure 17). Likewise, there was a significant difference in mean number of individuals between Ecoregion A and Ecoregion B (Kolmogorov-Smirnov Two sample Test, $p < 0.05$). Although Ecoregion A had a greater mean number of individuals (60 individuals/sample) than Ecoregion B (45 individuals/sample), both ecoregions exhibited lower densities of macroinvertebrates than was anticipated prior to sampling.

At the regional project watershed scale, significant differences in mean number of families existed between the Cacapon River regional project watershed and the Cheat River regional project watershed (Model-I ANOVA, $p = 0.001$). The Cacapon River regional project watershed had a significantly greater mean number of families than the Cheat River regional project watershed (Tukey HSD, $p < 0.001$). However, no significant differences were detected in mean number of individuals between regional project watersheds ($p = 0.052$). A great deal of variability was associated with both number of families and number of individuals (Figure 18), which is a reflection of local project watershed use, stream order, acid mine drainage, and nonpoint source pollution.

Significant differences were observed between local project watersheds for mean number of families (Model I One-Way ANOVA, $p < 0.001$). The Main Channel local project watershed (mean of 5.1 families/sample) was significantly lower than the Anderson Run local project watershed ($p = 0.021$; mean of 10.2 families/sample), Baker Run local project watershed ($p = 0.003$; mean of 11.0 families/sample), Cedar Creek local project watershed ($p = 0.046$; mean of 8.6 families/sample; Figure 19), Shavers Fork local project watershed ($p = 0.027$; mean of 8.7 families/sample), Slate Rock Run local project watershed ($p = 0.017$; mean of 10.9 families/sample), and Waites Run local project watershed ($p = 0.003$; mean of 11.9 families/sample).

Additionally, the Shavers Fork local project watershed had a greater mean number of families than the Black Fork local project watershed ($p = 0.048$; mean of 5.7 families/sample).

Significant differences were also observed in mean number of individuals at the local project watershed scale (Model I One-Way ANOVA, $p < 0.001$). The Main Channel local project watershed (mean of 32.6 individuals/sample) was significantly lower than the Anderson Run local project watershed ($p = 0.004$; mean of 82), Baker Run local project watershed ($p = 0.012$; mean of 72 individuals/sample), and Cedar Creek local project watershed ($p = 0.02$; mean of 51.6 individuals/sample), Patterson Creek local project watershed ($p = 0.007$; mean of 69.1 individuals/sample), Shavers Fork local project watershed ($p = 0.012$; mean of 52.0 individuals/sample), Slate Rock local project watershed ($p = 0.046$; mean of 62.6 individuals/sample), and Waites Run local project watershed ($p = 0.003$; mean of 86.3 individuals/sample). It is hypothesized that predominant watershed use (i.e., agriculture for the Main Channel local project watershed) and acid mine drainage (Black Fork local project watershed) give rise to the observed significant differences in both mean number of families and total number of individuals at the local project watershed scale.

There was a significant ($p < 0.001$) difference in both mean number of families and mean number of individuals by stream order at the ecoregion scale (Figure 20). As expected, first order streams displayed the lowest mean number of families (6.8). Interestingly, there was a linear trend in mean number of families with increasing stream order. There was a 24 percent increase in the mean number of families identified for second order streams (mean of 8.4 families/sample) to that of first order streams. Similarly, there was a 25 percent increase in the mean number of families identified for third order streams (mean of 10.4 families/sample) to that of second order streams. Mean number of families and individuals for first order streams were statistically similar to that of second order streams ($p = 0.15$), but second and first order streams were significantly lower in mean number of families and individuals to that of third order streams (Tukey HSD multiple comparisons, $p < 0.001$, $p = 0.05$, $p < 0.001$, and $p = 0.002$ respectively).

Between Ecoregions, (Figures 21, 22, and 23) there was a significant difference in mean number of families for both first and third order streams (Kolmogorov-Smirnov Two Sample Test, $p = 0.027$ and $p = 0.008$). There was a significant difference in mean number of families for third order streams (Independent Samples T-Test, $p = 0.001$).

At the regional project watershed scale, there were significant differences between regions by stream order with respect to mean number of families and individuals. For first order streams, only the Cheat River regional project watershed and Cacapon River regional project watershed demonstrated significant differences in mean number of families (Kruskal-Wallis One-Way ANOVA, $p = 0.01$). There was no significant ($p = 0.40$) differences with respect to mean number of individuals between regions for first order streams (Figure 24). No significant differences in mean number of families (Figure 25) and total individuals were identified for second order streams by watershed (Model I One-Way ANOVA, $p = 0.34$). For third order streams (Figure 26), only the Cheat River regional project watershed and the North Branch of the Potomac River regional project watershed exhibited significant differences in mean number of families (Model I One-Way ANOVA, $p = 0.018$). As discussed previously, no analyses were conducted at the local project watershed scale due to small sample populations by stream order for a number of local project watersheds.

FBI's for each stream sample were categorized based on Table 3. Figures 28, 35, 36, 37, 38, and 42, cluster FBI's by ecoregion, regional project watershed, local project watershed, stream order, stream order by ecoregion, and stream order by regional project watershed, respectively. At the ecoregion scale (Figure 28), no significant differences were observed for mean FBI's between ecoregions (Independent Samples T-Test utilizing Pooled Variances T, $p = 0.93$). As indicated in Figure 27, both ecoregions displayed a wide range of FBI values: Ecoregion A's minimum FBI score was 1.6 (Excellent) and a maximum score of 9.0 (Very Poor); Ecoregion B's minimum FBI score was 0.2 (Excellent) and a maximum score of 10.0 (Very Poor).

At the regional project watershed scale (Figure 29 and Figure 35), significant differences in mean FBI's existed between regions (Bartlett's Test for Homogeneity of Group Variances, $p = 0.001$; Model I One-Way ANOVA, $p < 0.001$). The Cacapon River project watershed had the lowest mean FBI score (4.05 = Very Good) and the Tygart River regional project watershed the highest mean FBI score (6.00 = Fairly Poor). The Cacapon River regional project watershed had a mean FBI score that was significantly less than the North Branch of the Potomac River regional project watershed (Tukey HSD, $p = 0.027$), the South Branch of the Potomac River regional project watershed (Tukey HSD, $p = 0.01$), and the Tygart River regional project watershed (Tukey HSD, $p < 0.001$). Additionally, the Cheat River regional project watershed (mean FBI score of 4.70 = Good) had a mean FBI score that was significantly less than the Tygart River regional project watershed (Tukey HSD, $p = 0.005$).

Significant differences (Figure 36) were observed in mean FBI's at the local project watershed scale (Model I One-Way ANOVA, $p < 0.001$). The Baker Run local project watershed (mean of 3.4 = Excellent) was significantly lower than both the Leading Creek local project watershed ($p = 0.004$; mean of 6.0 = Fairly Poor) and Main Channel local project watershed ($p = 0.006$; mean of 6.5 = Fairly Poor). Similarly, Shavers Fork local project watershed (mean of 3.7 = Excellent) was also found to be significantly lower in mean FBI score compared to both the Leading Creek local project watershed (Tukey HSD, $p = 0.002$) and the Main Channel local project watershed (Tukey HSD, $p = 0.006$). There were no significant differences between other local project watersheds (Figure 30).

No significant differences were detected at the ecoregional scale between mean FBI score grouped by stream order (Figure 37 and Figure 31). Similarly, no significant differences in mean FBI scores existed between ecoregions for first, second, and third order streams (Figures 32, 33, 34, and 38).

At the regional project watershed scale, no significant differences in mean FBI scores were detected for first order streams. First order streams exhibited a wide range of FBI scores at this scale (Table 42). For example, first order streams sampled in the Cheat River regional project watershed exhibited a FBI mean of 4.45 (Good) and a range from 10 (Very Poor) to 0.16 (Excellent). Other regional project watersheds displayed a similar spread in scores (Figure 39). The variation in FBI scores is generally attributed to naturally acidic seeps, AMD, agricultural encroachments, and naturally low productivity (i.e., low diversity and density of macroinvertebrates) associated with first order streams.

A clear trend was apparent for second order streams at the regional project watershed scale (Figure 40). The Cacapon River regional project watershed (mean of 3.31 = Excellent) was significantly ($p < 0.001$) lower in mean FBI score than the Cheat regional project watershed (mean of 4.85 = Good; Tukey HSD, $p = 0.026$), the North Branch of the Potomac River regional project watershed (mean of 5.59 = Fairly Poor; Tukey HSD, $p = 0.001$), the South Branch of the Potomac River regional project watershed (mean of 5.84 = Fairly Poor; Tukey HSD, $p = 0.001$), and the Tygart Valley River regional project watershed (mean of 6.93 = Poor; Tukey HSD, $p < 0.001$). The Shenandoah regional project watershed (mean of 4.13 = Very Good; Tukey HSD, $p = 0.006$) was found to be significantly lower in mean FBI score to that of the Tygart Valley River regional project watershed. The Cacapon regional project watershed was only similar in mean FBI score to that of the Shenandoah regional project watershed for second order streams. This is a reflection of the relatively undisturbed stream systems located within these two regional project watersheds (e.g., Waites Run, Baker Run, Duck Run, Sauerkraut Run, Skaggs run, Slate Rock Run).

No significant differences in mean FBI score were identified for third order streams between regional project watersheds (Kruskal-Wallis One-Way ANOVA, $p = 0.30$, Figure 41). Because the South Branch of the Potomac River regional project watershed and the Shenandoah regional project watershed consisted of only three and two third order stream samples, no conclusions regarding differences in mean FBI scores between regional project watersheds could be determined. As discussed previously, no analyses were conducted at the local watershed scale due to small sample populations by stream order for a number of local project watersheds.

G. BIOTIC INTEGRITY RESULTS

Table 11 provides the results of the comparison of sampled stream Biotic Integrity (BI) scores to that of ecoregional reference stations by stream order. Figures 46, 47, 48, 56, 57, and 58, cluster BI's by ecoregion, regional project watershed, local project watershed, stream order, stream order by ecoregion, and stream order by regional project watershed, respectively. At the ecoregional scale (Figure 46), significant differences in BI were observed (Kolmogorov-Smirnov Two Sample Test, $p = 0.002$). Ecoregion A (mean of 0.57 = B; see Table 7 for an explanation of categorical ranks) was significantly higher than Ecoregion B (mean of 0.44 = C; Figure 43). At the regional project watershed scale there was a significant (Model I One-Way ANOVA, $p = 0.023$) difference in mean BI ranks (Figure 44). The Cacapon River regional project watershed (mean of 0.67 = B) was significantly higher in mean BI rank to that of the South Branch of the Potomac River regional project watershed (mean of 0.45 = C; Tukey HSD, $p = 0.022$) and the Tygart Valley River regional project watershed (mean of 0.39 = C; Tukey HSD, $p = 0.001$)

At the local project watershed scale (Figures 45 and 48), significant differences existed in mean BI ranks (Model I One-Way ANOVA, $p = 0.023$). The Baker Run local project watershed (mean BI of 0.77 = B) and Waites Run local project watershed (mean BI of 0.76 = B) had significantly higher mean BI ranks than the Leading Creek local project watershed (mean BI of 0.39 = C; Tukey HSD, $p = 0.005$ and $p = 0.039$, respectively). Similarly, Baker Run local project watershed, Waites Run local project watershed, and Slate Rock local project watershed (mean BI of 0.73 = B) were significantly higher in mean BI rank than the Main Channel local project watershed (mean BI of 0.27 = C; Tukey HSD, $p < 0.001$, $p = 0.003$ and $p = 0.008$ respectively). These results are similar to the preceding analyses at the regional project watershed scale, whereby significant differences in BI rank were detected between the Cacapon regional project watershed and the Tygart Valley River regional project watershed. Lastly, the Shavers Fork local project watershed (mean BI of 0.59 = B) exhibited a significantly higher mean BI rank than that of the Main Channel local project watershed (mean BI of 0.27 = C; Tukey HSD, $p = 0.024$).

Significant differences (Kruskal-Wallis One-Way ANOVA, $p = 0.001$) were detected at the ecoregional scale between mean BI rank grouped by stream order (Figure 49 and 56). Mean BI rank for third order streams (mean BI of 0.65 = B) were greater than both second (mean BI of 0.50 = B) and first order (mean BI of 0.48 = C) streams. No significant differences (Figure 57) were detected in mean BI ranks between Ecoregion A (mean BI of 0.52 = B) and Ecoregion B (mean BI of 0.44 = C) for first order streams (Figure 50). Both second and third order streams (Figure 51, and 52) exhibited significant differences in mean BI rank between ecoregions (Kolmogorov-Smirnov Two Sample Test, $p = 0.009$ and $p = 0.007$ respectively). For second order streams, Ecoregion A (mean BI of 0.55 = B) had a greater mean BI rank than Ecoregion B (mean BI of 0.40 = C). Similarly, mean BI rank for third order streams displayed the same trend where Ecoregion A (mean BI of 0.75 = B) was greater than Ecoregion B (mean BI of 0.53 = B). As discussed previously, no analyses were conducted at the local project watershed scale due to small sample sizes.

At the regional project watershed scale (Figure 53), no significant differences in mean BI ranks were detected for first order streams (Figure 54 and 58). Significant differences in mean BI ranks were detected for second order streams ((Model I One-Way ANOVA, $p = 0.001$). Both the Cacapon River regional project watershed (mean BI of 0.72 = B) and the Shenandoah River regional project watershed (mean BI of 0.58 = B) had significantly greater mean BI ranks to that of the Tygart Valley River regional project watershed (mean BI of 0.22 = C, Tukey HSD, $p < 0.001$ and $p = 0.036$ respectively). For third order streams (Figure 55), the Cacapon River regional project watershed (mean BI of 0.57 = B) exhibited a significantly greater mean BI rank to that of the Cheat River regional project watershed (mean BI of 0.35 = C; Tukey HSD, $p = 0.024$).

IV. EXISTING ENVIRONMENT

Within West Virginia, the proposed project crosses five regional project watersheds: Tygart Valley River, Cheat River, North Branch of the Potomac River, South Branch of the Potomac River, and the Cacapon River. In Virginia, the alignments cross the Shenandoah River regional project watershed. The following sections describe each regional project watershed and a ranking of each sampled stream based on Biotic Integrity scores, local project watershed and stream order.

A. TYGART VALLEY RIVER

The Tygart Valley River rises near Spruce, West Virginia in Pocahontas County and flows northward toward the Monongahela River. The proposed project lies wholly within the drainage area of Leading Creek, which is characterized by wide stream valleys with meandering stream channels, silty substrates, and wide floodplains. The elevations and topography of this regional project watershed are not as high or steep as found in the Cheat River regional project watershed. The Tygart Valley River regional project watershed drains approximately 396 sq. kms (153 sq. miles) north of Elkins, West Virginia. Approximately 26.7 kms (16.6 miles) of the proposed project would traverse this regional project watershed.

Leading Creek and a number of its tributaries have been degraded by agricultural nonpoint source pollution. As a group, the average BI rank was 0.38 or a ranking of "C". This watershed exhibited a significant association (Pearson Correlation, adjusted squared multiple $r = 0.81$; Bartlett chi-square Statistic, $p < 0.001$; Appendix B) between total habitat assessment score and BI rank. The main-stem of Leading Creek is of moderately impaired water quality, with a number of its nonforested third order tributaries having severely impaired water quality.

Land use within the Leading Creek local project watershed is dominated by cattle grazing and agriculture. However, several wetland systems are associated with the floodplain of Leading Creek. These forested and scrub-shrub wetlands enhance the water quality of Leading Creek by performing a variety of wetland functions (e.g., sediment trapping, flood flow alteration and retention, nutrient transformation).

The Leading Creek local project watershed drains 166 sq. kms (64 sq. miles). There are 95 kms (59 miles) of perennial streams within the local project watershed, including Pearcy Run, Wilmoth Run, Claylick Run, and Horse Run. There are no native or stocked trout streams, rivers listed on the Nationwide Rivers Inventory, or streams impacted by acid mine drainage (Table 12).

Twenty seven field investigations were conducted of streams crossed by the proposed project (Table 12). Less than half of the streams have good to excellent water quality. The majority of the streams have moderate to low abundance of macroinvertebrates. Half of the streams have good to excellent habitat while half have fair habitat. Leading Creek and many of its major tributaries have wide floodplains with fine substrates (gravel, sand, and silt), in contrast to narrow floodplains and course substrates typical of streams in the other project watersheds. Agricultural activities dominate the floodplains, which is reflected in the fair habitat and water quality of the streams. Biotic Integrity ranks, clustered by regional project watershed and stream order are presented in Figure 59. Based on the cluster analysis for first order stream samples, no samples received a rank of "A", 3 stream samples a rank of "B", 3 stream samples a rank of "C", and 4 stream samples a rank of "D". Based on the cluster analysis for second order stream samples, no streams received a rank of "A" or "B", 4 stream samples a rank of "C", and 5 stream samples a rank of "D". Based on the cluster analysis for third order streams, 1 stream received a rank of "A", 5 stream samples a rank of "B", 2 stream samples a rank of "C", and no stream samples a rank of "D".

B. CHEAT RIVER

The Cheat River is formed near Parsons, West Virginia at the confluence of the Black Fork and Shavers Fork and flows north to its confluence with the Monongahela River at Point Marion, Pennsylvania. The Cheat River watershed, including all its tributaries, is comprised of parts of Pocahontas, Randolph, Tucker, Preston, and Monongalia Counties in West Virginia.

Much of the Cheat River regional project watershed is composed of undeveloped rural land. This regional project watershed is dominated by deciduous and mixed forests (84%) with cropland and pasture comprising 12% of the existing land use. Part of the Monongahela National Forest (MNF), including the Congressionally designated Otter Creek and Dolly Sods Wilderness areas, lie within the Cheat River regional project watershed. These Wilderness areas are not impacted by the proposed alignments.

Historically, the Cheat River regional project watershed has been an area affected by coal mining, especially in its northern portion and particularly in the drainage area of the Black Fork and Beaver Creek. Active mines continue to operate within this project watershed. As a result, many abandoned deep and surface mines in the area discharge untreated mine drainage. This is the major water quality problem in the regional project watershed.

There are 293 kms (183 miles) of perennial streams within the Cheat River regional project watershed, including the major drainages of the Shavers Fork and the Black Fork. The Cheat River regional project watershed drains approximately 1,751 sq. kms (676 sq. miles). Within portions of the regional project watershed which have not been subjected to mining, excellent streams and rivers exist including Shavers Fork and three trout streams (Roaring Run, Pleasant Run and Slip Hill Mill Run). Shavers Fork is also listed on the Nationwide Rivers Inventory (Table 12).

The Shavers Fork local project watershed within the vicinity of the proposed project is dominated by deciduous and mixed forests. As a group, the average BI rank for the Shavers Fork local project watershed was 0.59 or a ranking of "B". This watershed also exhibited a significant positive association (Pearson Correlation, adjusted squared multiple r = 0.906; Bartlett chi-square statistic, p = 0.025; Appendix B) between total habitat assessment score and BI rank. Within this local project watershed, only Pleasant Run is reported to contain trout.

The Shavers Fork local project watershed drains 186 sq. kms (72 sq. miles) of land along the eastern slopes of Cheat Mountain and the western slopes of Shavers Mountain. There are an estimated 106 kms (66 miles) of perennial stream including Pleasant Run and Haddix Run. The project would cross approximately 12.6 kms (7.8 miles) of this local project watershed. Within this local project watershed, only Pleasant Run is reported to contain trout. Shavers Fork is stocked, but not within the vicinity of the proposed project. None of the streams have been impacted by acid mine drainage.

Within the Black Fork local project watershed, the average BI rank was 0.59 or a ranking of "B". This watershed also exhibited a significant positive association (Pearson Correlation, adjusted squared multiple r = 0.76; Bartlett chi-square statistic, p = 0.001; Appendix B) between total habitat assessment score and BI rank. This local project watershed is composed of stream systems (North Fork of the Blackwater River, Long Run, Big Run, Pendleton Creek, Blackwater River, and Beaver Creek) with differing water quality.

The Black Fork local project watershed drains 396 sq. kms (153 sq. miles) of land along Backbone Mountain, Canaan Mountain, Canaan Valley, and Beaver Creek. There are an estimated 188 kms (117 miles) of perennial streams within this local project watershed, including the North Fork of the Blackwater River, Long Run, Big Run, Pendleton Creek, Blackwater River, and Beaver Creek. The proposed project would cross approximately 28.6 kms (24 miles) of this local project watershed. A large portion of the land has been subjected to deep and surface coal mining, including the drainage areas for Beaver Creek, the North Fork, Pendleton Creek, Long Run and Middle Run. Within the vicinity of the project there are two native trout streams (Roaring Run and Slip Hill Mill Run). None of the streams are listed on the Nationwide Rivers Inventory. Sixteen out of 63 streams sampled showed evidence of acid mine drainage.

Several restoration and reclamation projects are currently being undertaken along the Blackwater River and portions of the Black Fork, Long Run and Middle Run. WVDEP is constructing a limestone treatment station along the Blackwater River, approximately one mile upstream from Davis and above the confluence with Beaver Creek. The goal is to reduce the acidity of a five mile segment of the river sufficiently to sustain a year-round trout population. Completion of this project is anticipated for late 1994. Portions of the watersheds of Middle Run, Long Run and the North Fork of the Blackwater River have been recently modified as part of the Albert Highwall and Douglas Highwall Reclamation projects. These projects included grading, covering and planting highwall areas and partial treatment of acid mine drainage.

Eighty four field investigations were conducted of streams crossed by the proposed project (Table 12) within this project watershed. Seventy percent of the streams have good to excellent water quality and fifty-seven percent of the streams have high diversity and good to excellent habitat. Most of the streams with good water quality and habitat are located within Monongahela National Forest (MNF).

Forty percent of the streams have low pH due to either acid mine drainage or naturally acidic conditions. Naturally acidic conditions are found in the headwaters of Big Run, Tub Run, Long Run and Middle Run which drain bog-like wetlands resulting in tannic water and naturally low pH. Big Run and Tub Run are located on Backbone Mountain within the MNF. The headwaters of Long Run and Middle Run are located in the MNF, but these streams flow through strip mined areas where the water quality of the stream is affected by acid mine drainage from numerous seeps and springs. A number of streams which drain wetlands along Beaver Creek also exhibited tannic water, low pH and low dissolved oxygen.

Sixteen out of 84 streams exhibited substantial evidence of effects from acid mine drainage. These streams included Beaver Creek and some of its tributaries, Pendleton Creek, North Fork of the Blackwater River, and the lower portions of Long Run and Middle Run. These streams are located in previously mined areas surrounded by mining spoil or receiving acidic groundwater discharges.

Biotic Integrity ranks clustered by stream order for this regional project watershed are presented in Figure 60. Based on the cluster analysis, 1 first order stream received a BI rank of "A", 7 stream samples a rank of "B", 2 stream samples a rank of "C", and 1 stream a rank of "D". For second order streams, 1 stream received a rank of "A", 2 stream samples a rank of "B", 2 stream samples a rank of "C", and no stream samples a rank of "D". Based on the cluster analysis for third order streams, 1 stream received a rank of "A", 4 stream samples a rank of "B", and no stream samples a rank of "C" or "D". For first order streams sampled in the Black Fork local project watershed, 4 stream samples received a rank of "A", 15 stream samples a rank of "B", 12 stream samples a rank of "C", and 12 stream samples a rank of "D". For second order streams, 1 stream received a rank of "A", 6 stream samples a rank of "B", 4 stream samples a rank of "C", and 3 stream samples a rank of "D". For third order streams, no stream received a rank of "A", 2 stream samples a rank of "B", 3 stream samples a rank of "C", and 3 stream samples a rank of "D".

C. NORTH BRANCH OF THE POTOMAC RIVER

The North Branch of the Potomac River regional project watershed covers portions of Grant, Hampshire, and Mineral Counties in West Virginia and drains approximately 1,197 sq. kms (462 sq. miles). The river itself runs generally northeastward within a basin between the Allegheny Front and Backbone Mountain. Nonpoint sources of pollution in the North Branch of the Potomac River include sediment runoff from agriculture, timbering, oil and gas exploration, and coal refuse piles. Acid mine drainage, mainly from abandoned mines, also poses a major problem, generally limited to the drainage's of Stony River and Abrams Creek. In the Patterson Creek drainage, there are native and stocked trout streams.

The North Branch of the Potomac River watershed is dominated by deciduous and mixed forests (79%) with cropland and pasture comprising 17% of the existing land use. A portion of Seneca Rocks National Recreation Area lies in the southwest portion of this watershed. Greenland Gap, located near the town of Scherr, West Virginia, is a unique topographic feature within this watershed. The gap is considered to be the least disturbed and most distinctive water gap in West Virginia, with towering sandstone cliffs that arch upward over 244 meters (800 feet) (Scott 1991). The above two areas are not impacted by the proposed alignments.

There were 39 field investigations conducted of streams crossed by the proposed project (Table 12). Approximately sixty percent of the streams have good to excellent water quality, high diversity, and good to excellent habitat. An equal number of streams have high versus moderate to low abundance of macroinvertebrates. This project watershed can be divided into two local project watersheds - the Patterson Creek local project watershed and the Stony River and Abrams Creek local project watershed.

The Stony River local project watershed, possessed an average BI rank of 0.39, a ranking of "C". This watershed did not exhibit a significant association between total habitat assessment score and BI rank. The Patterson Creek local project watershed possessed an average BI rank of 0.55 or a ranking of "B". This watershed also exhibited a significant positive association (Pearson Correlation, adjusted squared multiple $r = 0.79$; Bartlett chi-square statistic, $p < 0.001$; Appendix B) between total habitat assessment score and BI rank.

Stony River and Abrams Creek drain the valley west of the Allegheny Front surrounding Mount Storm Lake. The Stony River local project watershed drains approximately 285 sq. kms (110 sq. miles). The proposed project would cross approximately 8.3 km (5.2 miles) of the Stony River local project watershed. This local project watershed contains approximately 114 kms (71 miles) of perennial streams as well as the Mount Storm Reservoir. Four of the 8 streams sampled indicated impacts by acid mine drainage. West of the Allegheny Front, the major streams are adversely affected by acid mine drainage, including Little Creek, Abrams Creek, and Stony River. There are no streams listed on the Nationwide Rivers Inventory or which contain native or stocked trout. There are a number of very small, headwater streams located south of Bismarck which have good to excellent water quality.

The Patterson Creek local project watershed lies between Patterson Creek Mountain on the east and the Allegheny Front on the west. The Patterson Creek local project watershed drains approximately 166 sq. kms (64 sq. miles) of agricultural and forested land. The project would cross approximately 44 kms (15 miles) of the local project watershed. This local project watershed contains approximately 55 kms (32 miles) of perennial streams, including one native trout stream (Elklick Run), and one stocked trout stream (North Fork of Patterson Creek). None of the streams have been impacted by acid mine drainage or are listed on the Nationwide Rivers Inventory (Table 12). The small streams east of Patterson Creek are located in pasture which results in fair to poor water quality. The Middle Fork and North Fork of Patterson Creek, including tributaries, are predominately forested headwater streams having having excellent water quality and habitat with high abundance and diversity of macroinvertebrates. There is pasture along the Middle Fork of Patterson Creek and Elklick Run, but much of the remaining area is forested including New Creek Mountain and Knobly Mountain.

Biotic Integrity ranks clustered by stream order for the North Branch of the Potomac regional project watershed are presented in Figure 61. Based on the cluster analysis for first order streams, 6 stream samples received a rank of "A", 3 samples a rank of "B", 1 sample a rank of "C", and 8 samples a rank of "D". For second order streams, 3 stream samples received a rank of "A", 2 samples a rank of "B", 4 samples a rank of "C", and 4 samples a rank of "D". For third order streams, 4 stream samples received a rank of "A", 3 samples a rank of "B", 1 sample a rank of "C", and no samples a rank of "D".

D. SOUTH BRANCH OF THE POTOMAC RIVER

The South Branch of the Potomac River is the larger of the two major branches of the Potomac River. The South Branch rises in Highland County, Virginia and flows in a general northeast direction into West Virginia to its confluence with the North Branch. Within West Virginia, the South Branch of the Potomac River regional project watershed drains approximately 1,331 sq kms (514 sq. miles) within Pendleton, Grant, Hardy, and Hampshire Counties. This regional project watershed is dominated by deciduous and mixed forests (72%) with cropland and pasture comprising 26% of the existing land use.

Existing land use within the South Branch of the Potomac River regional project watershed is dominated by deciduous forests, cropland, and pasture. Although the water quality of the South Branch is considered excellent and is renowned for its smallmouth bass (*Micropterus dolomieui*) fishery, a number of its tributaries within the regional project watershed are impacted by non-point source pollution associated with agriculture, cattle, swine, rabbit, poultry, and forestry production. Of growing concern is the effect of the poultry industry on ground and surface waters (USFWS 1994; Constantz 1990; Ritter 1986; Ritter and Chirnside 1987). It is also assumed that fecal coliform levels within this watershed are high and probably exceed clean water standards (Water Resources Board 1990).

The extensive stream channel work conducted as a result of the November 1985 flood has modified a number of the streams in this watershed. Within the South Branch watershed, there are no native or stocked trout streams or streams impacted by acid mine drainage, but the tributaries to Anderson Run exhibit impacts from agricultural activities. The South Branch of the Potomac River is listed on the Nationwide Rivers Inventory (Table 12). Within the project area, the South Branch of the Potomac River regional project watershed contains approximately 102 kms (64 miles) of perennial streams and is divided into three local project watersheds - Clifford Hollow, Main Channel of the South Branch, and Anderson Run.

The Anderson Run local project watershed is located west of the community of Old Field, West Virginia and drains approximately 104 sq. kms (40 sq. miles) of predominantly agricultural land along the eastern flank of Patterson Mountain. The proposed project would cross 7.6 kms (4.75 miles) of the southern portion of the local project watershed and involves Walnut Bottom Run and Toombs Hollow. This local project watershed is drained by an estimated 56 kms (35.3 miles) of perennial streams.

The Clifford Hollow local project watershed is located at the eastern edge of the South Branch watershed. This local project watershed drains approximately 31 sq. kms (12 sq. miles) of the western slope of South Branch Mountain. The proposed project crosses approximately 8.4 kms (5.2 miles) of the headwaters of Clifford Hollow local project watershed near existing WV 55. This local project watershed contains approximately 16.7 kms (10.4 miles) of perennial streams.

The central portion of this watershed is the Main Channel local project watershed, which includes drainage from Williams Hollow, Fort Run and several small tributaries. This local project watershed drains approximately 106 sq. kms (41 sq. miles). The proposed project will require 10 kms (6.2 miles) of construction, including a crossing of the South Branch. This local project watershed contains approximately 29 kms (18 miles) of perennial streams.

The Anderson Run local project watershed possessed an average BI rank of 0.59 or a ranking of "B". However, this watershed did not exhibit a significant association between total habitat assessment score and BI rank. The Main Channel of the South Branch local project watershed possessed an average BI rank of 0.27 or a ranking of "C". This watershed exhibited a significant positive association (Pearson Correlation, adjusted squared multiple $r = 0.68$; Bartlett chi-square statistic, $p = 0.001$; Appendix B) between total habitat assessment score and BI rank. The Clifford Hollow local project watershed possessed an average BI rank of

0.80 or a ranking of "A". This watershed did not exhibit a significant association between total habitat assessment score and BI rank because of a lack of stream samples (2 samples).

There were 22 field investigations conducted on streams crossed by the proposed project (Table 12). Less than half of the streams have good to excellent water quality. The majority of the streams have moderate to low abundance of macroinvertebrates. Half of the streams have good to excellent habitat while half have fair habitat. The South Branch of the Potomac River, has high diversity and abundance, as well as good to excellent habitat. High quality streams were located in Clifford Hollow and the upper portions of Walnut Bottom Run, which are forested. The streams with fair to poor habitat are affected by the surrounding agricultural land use. These streams include Dumpling Run, Fort Run, Walnut Bottom Run, Anderson Run, and small tributaries to the South Branch and Clifford Hollow.

Biotic Integrity ranks clustered by stream order for this regional project watershed are presented in Figure 62 for the three local project watersheds . Based on the cluster analysis for first order streams, 1 stream sampled received a rank of "A", 2 samples a rank of "B", 1 sample a rank of "C", and 2 samples a rank of "D". Based on the cluster analysis for second order streams, 2 stream samples received a rank of "A", 4 samples a rank of "B", 3 samples a rank of "C", and 4 samples a rank of "D". For third order streams, no stream received a rank of "A" or "D", 2 samples a rank of "B", and 1 stream a rank of "C".

E. CACAPON RIVER

The Cacapon River originates in the southeastern portion of Hardy County on West Mountain. Within West Virginia, the Cacapon River regional project watershed drains approximately 1,191 sq kms (460 sq. miles) in Hardy, Hampshire, and Morgan Counties. This watershed contains two unique geologic features; the Lost River and Hanging Rock. The Lost River is the name given to the upper part of the Cacapon River where the river, during periods of low flow, goes underground. Approximately 6.4 kilometers (4 miles) west of Wardensville, the river cuts an underground passage in the existing limestone and remains underground for 3.2 kilometers (2 miles) until it emerges west of Wardensville. Hanging Rock is a unique rock formation that appears to hang approximately 42 meters (136 feet) above WV 55 (approximately 5 kilometers (3 miles) east of Baker, West Virginia). This feature is an example of the geologic process called differential weathering which produces an undercutting of the cap rock, creating the "hanging" feature of Hanging Rock.

This watershed contains several regions of karst topography. Karst topography is created by the chemical solution of carbonate rocks, more commonly know as limestone. This topography is characterized by landscape features such as sinkholes, dry valleys, springs, caves, and sinking streams (the Lost River). Subsurface features include groundwater flow through caves, or other dissolutionally enlarged cavities.

The Cacapon River's water quality varies significantly depending on location and water level (Constantz et al. 1993). Both the Lost River and Middle Cacapon River sections receive non-point source pollutants and have been identified by Constantz et al. (1993) as being relatively more polluted than other stream reaches further downstream in the basin. It is also assumed that fecal coliform levels within this watershed are high, and depending upon the season, exceed state water quality standards (Constantz et al. 1993). Many of the non-point source pollution problems that plague the South Branch of the Potomac River were observed in the upper reaches of the Lost River basin and its tributaries. However, as a whole the Lost/Cacapon River system is in relatively "good" health (Constantz et al. 1993). The streams analysis performed for this study support those of Constantz et al. (1993). Furthermore, this report also identifies a number of tributaries to both stream systems within this regional project watershed that are either severely degraded or of excellent water quality.

The Cacapon River watershed is dominated by deciduous and mixed forests (82%) with cropland and pasture comprising 17% of the existing land use. The eastern end of this watershed lies within the George Washington National Forest. Wardensville is the major municipality in this watershed.

The Cacapon River regional project watershed contains an estimated 153 kms (96 miles) of perennial streams, including Baker Run, Trout Run, Waites Run, Slate Rock Run, and Skaggs Run. Approximately 35.4 kms (22 miles) of the proposed project crosses this watershed. Water quality within the watershed is excellent, with limited nonpoint source pollution associated with agricultural and timber harvesting activity. Waites Run, Trout Run and portions of the Lost River are stocked with trout and the Lost River is listed on the Nationwide Rivers Inventory (Table 12). This watershed is divided into five local project watersheds - Skaggs Run; Baker Run; Central Cacapon River and adjacent streams; Waites Run; and Slate Rock Run.

Skaggs Run is located at the western edge of the Cacapon watershed. Skaggs Run local project watershed possessed an average BI rank of 0.54 or a ranking of "B" but did not exhibit a significant association between total habitat assessment score and BI rank. This local project watershed drains approximately 21 sq. kms (8 sq. miles) toward North River, a major tributary to the Cacapon River north of the project area. The proposed project crosses 4.5 kms (2.8 miles) of the headwaters of Skaggs Run. There are an estimated 11.3 kms (7 miles) of perennial streams within this local project watershed.

The Baker Run local project watershed possessed an average BI rank of 0.77 or a ranking of "B". This local project watershed consists of the entire 62 sq. kms (24 sq. mile) drainage area of Baker Run, including Long Lick Run, Camp Branch, Parker Hollow Run and Bears Hell Run. The proposed project crosses 9 kms (5.6 miles) of the local project watershed, following the general course of Baker Run from its mouth to its headwaters. There are an estimated 29.6 kms (18.4 miles) of perennial streams within this local project watershed.

The Central Cacapon local project watershed includes the main channel of the Lost/Cacapon River from Wardensville upstream to Baker, West Virginia, as well as the drainage area for the major tributaries along this length including Trout Run, Sauerkraut Run, and Three Springs Run. The Central Cacapon River local project watershed possessed an average BI rank of 0.58 or a ranking of "B", but did not exhibit a significant association between total habitat assessment score and BI rank. This is due to several first order stream samples possessing high total habitat assessment scores but low Biotic Integrity scores. These headwater streams are located on steep forested slopes and are naturally low in macroinvertebrate diversity and density. This local project watershed drains approximately 243 sq. kms (94 sq. miles). The proposed project crosses 15 kms (9.3 miles) following the general west to east orientation of the Lost River and WV 55. There are an estimated 85 kms (53 miles) of perennial streams within this local project watershed. Trout Run and portions of the Lost River are stocked with trout. The Lost River is listed on the Nationwide Rivers Inventory.

The Waites Run local project watershed possessed an average BI rank of 0.76 or a ranking of "B". This watershed exhibited a significant positive association (Pearson Correlation, adjusted squared multiple $r = 0.98$; Bartlett chi-square statistic, $p = 0.002$; Appendix B) between total habitat assessment score and BI rank. Waites Run local project watershed drains approximately 49 sq. kms (19 sq. miles) of mostly forested land along the western slopes of Paddy Mountain and Great North Mountain. The proposed project crosses approximately 2.6 kms (1.6 miles) of this local project watershed, east of Wardensville, West Virginia. There are an estimated 21 km (13.1 miles) of perennial streams within this local project watershed. Waites Run is a stocked trout stream.

The proposed project crosses approximately 4.7 kms (2.9 miles) of the headwaters of Slate Rock Run, Harness Run and Sine Run along the western flank of Great North Mountain. The Slate Rock Run local project watershed possessed an average BI rank of 0.73 or a ranking of "B". However, this watershed did not exhibit a significant association between total habitat assessment score and BI rank. The Slate Rock Run local project watershed drains approximately 21 sq. kms (8 sq. miles) of forested land. The majority of the land in this local project watershed is within the George Washington National Forest. There are an estimated 7.7 kms (4.8 miles) of perennial streams within this local project watershed.

There were 57 field investigations conducted of streams crossed by the proposed project (Table 12). The majority of the streams have good to excellent water quality and a high diversity of macroinvertebrates but moderate to low abundance of macroinvertebrates. The low abundance of organisms reflects the number of headwater streams which typically have low productivity. There are no streams affected by acid mine drainage, but a few streams in open pasture exhibit some habitat degradation.

Biotic Integrity ranks clustered by stream order for the Cacapon River regional project watershed are presented in Figure 63. For first order streams within this regional project watershed, 10 streams received a rank of "A", 12 samples a rank of "B", 9 samples a rank of "C", and 1 sample a rank of "D". Based on the cluster analysis for second order streams, 8 stream samples received a rank of "A", 3 samples a rank of "B", 3 samples a rank of "C", and 1 sample a rank of "D". Based on the cluster analysis for third order streams, 7 stream samples received a rank of "A", 1 sample a rank of "B", 2 samples a rank of "C", and no samples a rank of "D".

F. SHENANDOAH RIVER

The Shenandoah River regional project watershed drains approximately 875 sq. kms (338 sq. miles) in Augusta, Rockingham, Page, Frederick, Shenandoah, Warren, and Clarke Counties in Virginia and Jefferson and Hardy Counties in West Virginia. The Hardy/Frederick County line and the axis of Great North Mountain mark the division between the Shenandoah River regional project watershed and the Cacapon River regional project watershed to the west.

The Shenandoah River regional project watershed existing land use is composed of deciduous and mixed forests (52%), and cropland and pasture (40%). The western portion of this watershed lies within the George Washington National Forest. This watershed portions of both Frederick and Shenandoah counties and includes the municipalities of Strasburg and Winchester, Virginia.

The proposed project lies within the Cedar Creek local project watershed and drains approximately 414 sq. kms (160 sq. miles) within Frederick and Shenandoah Counties. There are approximately 209 kms (130 miles) of perennial streams within this local project watershed including Duck Run, Eishelman Run, Turkey Run, Zanes Run and Mulberry Run. Approximately 21 kms (13 miles) of the proposed project crosses this watershed. The headwaters of Town Run are located along the eastern end of the project. In order to simplify the discussions, Town Run has been included into the Cedar Creek local project watershed.

As a group, the Cedar Creek local project watershed possessed an average BI rank of 0.54 or a ranking of "B". However, this watershed did not exhibit a significant association between total habitat assessment score and BI rank. The Cedar Creek local project watershed is largely private property and is predominately forest or agriculture. Cedar Creek has been stocked with trout under the state's put-and-take program. Cedar Creek is listed on the Nationwide Rivers Inventory. Duck Run, located along the eastern slope of Great North Mountain is an important native trout stream and protected as an Outstanding State Waters. A headwater tributary to Paddy Run, a native trout stream, is located along the western edge of the watershed (Table 12).

There were 22 field investigations conducted of streams crossed by the proposed project (Table 12). The majority of the streams have good to excellent water quality and a high diversity of macroinvertebrates but moderate to low abundance of macroinvertebrates. There are no streams impacted by acid mine drainage, but several streams are in areas of open pasture and exhibit some habitat degradation.

Biotic Integrity ranks clustered by stream order for the Shenandoah River regional project watershed are presented in Figure 64. For first order streams, no stream received a rank of "A", 3 stream a rank of "B", 4 stream samples a rank of "C", and 2 stream samples a rank of "D". For second order streams, 1 stream received a rank of "A", 9 stream samples a rank of "B", 1 stream a rank of "C", and no streams a rank of "D". For third order streams, 2 stream samples received a rank of "A".

V. IMPACT ASSESSMENT

A. METHODOLOGY

Direct impacts to streams and rivers were measured using 200 scale engineering drawings. The following section details the methodology used in assessing the impact of enclosures (i.e. culverts and pipes) and channel relocations on baseline aquatic habitat. In addition to analyzing impacts to perennial streams, direct impacts to intermittent streams were also assessed.

For perennial streams potentially enclosed in a box culvert or pipe, the size and length of structure was determined. The physical impact assessment assumed a worse case scenario where all existing drainage structures, such as those along portions of the IRA, would require resizing and replacement. Replacement would be required for many of the existing drainage structures due to the age of existing structures and the requirement to meet current highway drainage design criteria.

Stream relocation, in this report, is defined as any longitudinal encroachment into a perennial stream channel, diversion of a perennial stream along the construction limits, or elimination of a perennial stream channel within the construction limits of the proposed project. For each perennial stream impacted by a relocation, the length of the relocation was determined using GIS.

In order to assess the physical impacts of the proposed project at the regional project watershed scale, the total length of enclosed streams was compared to an estimate of the total length of perennial streams within each regional project watershed. This was accomplished by calculating the total length of perennial streams from U.S.G.S. 7.5 minute quadrangles for each regional project watershed.

B. NO-BUILD ALTERNATIVE

The No-Build Alternative would not result in direct impacts to streams due to construction, but the streams would be subject to on-going secondary and cumulative impacts. Routine highway operation and maintenance would result in impacts to streams presently crossed by the existing roadways. Traffic volumes would increase under the No-Build Alternative, but not to the extent which it would under the IRA or the Build Alternative. Commercial, industrial and residential development would also occur under the No-Build which would result in incremental impacts to surface water resources.

C. IMPROVED ROADWAY ALTERNATIVE

The direct impact of the IRA on perennial streams is presented in Table 13. For each local project watershed, the number and total length of box culverts, open bottom box culverts, pipes and relocations by Biotic Integrity is presented. Bridges, which are considered an avoidance measure, are also included in Table 13 in order to provide a complete summary of stream and river crossings. Figure 65 clusters individual stream crossing samples by BI rank and Figure 66 clusters stream crossings by total habitat assessment score for the six regional project watersheds.

The following section details for each local project watershed potential direct physical impacts to surface waters. The following section details for each local project watershed potential direct physical impacts to surface waters.

1. TYGART VALLEY RIVER REGIONAL PROJECT WATERSHED

No streams potentially crossed by the IRA possess a BI category rank of "A" within this local project watershed (Table 14). The IRA would require two box culverts, ten pipes, and one stream relocation. Both box culverts would impact streams with low Biotic Integrity (BI = "D") scores. Of the ten streams identified for pipe crossings, four possess BI ranks of "C" and four of "D" and two possess BI ranks of "B". The stream segment that will need to be relocated possesses a BI rank of "C" and impaired (total habitat assessment score = 59) habitat (Table 13).

Based on the estimate of the total length of perennial streams within the Leading Creek local project watershed (Table 15), the proposed stream enclosures and relocation would impact approximately 0.8 percent of the total length of perennial streams within this local project watershed. Based on baseline conditions within this local project watershed, no "measurable" direct impacts to stream systems are expected. A measurable impact is defined here as one that permanently alters or degrades a stream system from which incomplete recovery is the result of such a disturbance (i.e., a permanent and measurable reduction in Biotic Integrity rank).

2. CHEAT RIVER REGIONAL PROJECT WATERSHED

For the Shavers Fork local project watershed (Table 14), the IRA would require six pipes, and one stream relocation. Of the six streams identified for pipe crossings, one possesses a BI rank of "A", four possess BI ranks of "B" and one of "C". The stream segment proposed for relocation possesses a BI of "C" and moderate (total habitat assessment score = 83) habitat (Table 13).

With respect to stream systems within this local project watershed, the IRA may measurably impact Haddix Run, which is located within the Shavers Fork local project watershed. This is based on the proximity, number, and location of cuts adjacent to Haddix Run, which could alter surface water hydrology, water temperature, and reduce aquatic habitat as a result of sedimentation and encroachment into the floodplain of Haddix Run.

For the Black Fork local project watershed, the IRA would require three box culverts, 24 pipes, and two stream relocations (Table 13). For streams that will require box culverts, one possesses a BI rank of "A", one a BI rank of "C", and one of "D". Of the 24 streams identified for pipe crossings, two possess BI ranks of "A", seven a BI rank of "B", seven a BI rank of "C", and eight a BI rank of "D". Streams segments that would require relocation possess BI's of "B" and "C" and good (total habitat assessment score = 117) and moderate (total habitat assessment score = 66) habitat respectively.

Roaring Run could be impacted by the IRA. This impact could reduce the Biotic Integrity of Roaring Run in comparison to its reference station. Additonally, the IRA may impact a small tributary to Slip Hill Mill Run. This potential impact which could result in increased silt loads to Slip Hill Mill Run, but may be avoided through proper erosion and sedimentation control measures. No other stream systems within the Black Fork local project watershed are expected to incur measurable reductions in Biotic Integrity ranks due to construction of the IRA based on existing landuse and surface water quality.

Based on the estimate of the total length of perennial streams within the Cheat River regional project watershed (Table 15), the proposed stream enclosures and relocations for both Shavers Fork and Black Fork local project watersheds would impact approximately 0.6 percent of the total length of perennial streams within this regional project watershed (Table 15).

3. NORTH BRANCH OF THE POTOMAC RIVER REGIONAL PROJECT WATERSHED

This regional project watershed is divided into two local project watersheds which include the Stony River local project watershed and the Patterson Creek local project watershed.

For the Stony River local project watershed (Table 14), the IRA would require four pipes and one stream relocation. Of the four streams identified for pipe crossings, one possesses a BI rank of "A" and three BI ranks of "D". The Stream segment that will require relocation possess a BI rank of "D" and impaired (total habitat assessment score = 53) habitat (Table 14). Only minor and temporary physical impacts are anticipated for streams within this local project watershed.

For the Patterson Creek local project watershed, the IRA would require two box culverts and one pipe crossing (Table 13). Streams with box culverts possess BI ranks of "A" and the one stream with a pipe crossing has a BI rank of "B". Only minor and temporary physical impacts are anticipated for streams within this local project watershed.

The proposed stream enclosures and relocations for both local project watersheds would impact approximately 0.4 percent of the total estimated length of perennial streams within this regional project watershed (Table 15).

4. SOUTH BRANCH OF THE POTOMAC RIVER REGIONAL PROJECT WATERSHED

The IRA will have little impact on streams in this regional project watershed. No stream crossings are proposed for the Anderson Run local project watershed. For the Main Channel local project watershed (Table 14), the IRA would require one pipe, and one stream relocation. The stream that requires a pipe crossing possesses a BI rank of "B". The stream segment required to be relocated possesses a BI of "D" and impaired (total habitat assessment score = 32) habitat (Table 14).

The proposed stream enclosures and relocations for both local project watersheds would impact approximately 0.1 percent of the total length of perennial streams within this regional project watershed (Table 15).

5. CACAPON RIVER REGIONAL PROJECT WATERSHED

For the Skaggs Run local project watershed, the IRA would require four streams to be piped, all of which possess BI ranks of "B". For the Baker Run local project watershed, the IRA would require 5 pipe crossings (Table 14). Of the five streams identified for pipe crossings, two possess BI ranks of "A", two a BI rank of "B", and one a BI rank of "C". Only minor and temporary physical impacts are expected in this local project watershed.

In the Central Cacapon local project watershed, the IRA would require two box culverts and seven pipe crossings (Table 13). For stream that require box culverts, one possesses a BI rank of "A" and one a BI rank of "C". Of the seven streams requiring pipe crossings, two possess BI ranks of "A", two a BI rank of "B", two a BI rank of "C", and one a BI rank of "D". Only minor and temporary physical impacts are expected in this local project watershed.

In the Slate Rock Run local project watershed, the IRA would require six pipes and two stream relocations (Table 13). Of the six streams identified for pipe crossings, three possess BI ranks of "A", one a BI rank of "B", and two a BI rank of "C". The stream segment identified for relocation possesses a BI rank of "A" and moderate (total habitat assessment score = 86) habitat. Only minor and temporary physical impacts are expected in this local project watershed.

The proposed stream enclosures and relocations for local project watersheds would impact approximately 1.2 percent of the total estimated length of perennial streams within this regional project watershed (Table 15).

6. SHENANDOAH RIVER REGIONAL PROJECT WATERSHED

The divide between the Central Cacapon River regional project watershed to the west and the Shenandoah regional project watershed to the east demarcates West Virginia from Virginia. The Cedar Creek local project watershed is entirely within Virginia. The IRA would require six pipe crossings and two stream relocations (Table 13). Of the six streams identified for pipe crossings, five possess BI ranks of "B" and one a BI rank of "C". The stream segment proposed for relocation possesses a BI rank of "C" and moderate (total habitat assessment score = 69) habitat.

In Duck Run, there is the potential for habitat degradation and alterations in water quality. The Biotic Integrity of Duck Run could be reduced. The IRA would require more encroachments to Duck Run compared to Line A and Option Alignments.

The proposed stream enclosures and relocations for local project watersheds would impact approximately 0.2 percent of the total estimated length of perennial streams within this regional project watershed (Table 15).

7. PROPOSED BRIDGES - IRA

Within West Virginia, the proposed IRA would bridge rivers listed on the Nationwide Rivers Inventory (Shavers Fork, South Branch of the Potomac River, and Lost River) and cross 6 native or stocked trout streams in West Virginia (Slip Hill Mill Run, Roaring Run, North Fork of Patterson Creek, Lost River, Waites Run, Trout Run). In addition, the North Fork of Patterson Creek, Lost River, Waites Run and Trout Run would also be bridged. Since the IRA crosses Slip Hill Mill Run at the extreme headwaters of the stream, a pipe would be used. The IRA would also require a piped crossing of Roaring Run at its headwaters and a short relocation further downstream. Within Virginia, the IRA would bridge Cedar Creek (NWI, Stocked Trout).

D. BUILD ALTERNATIVE - LINE A

The number and total length of box culverts, open bottom culverts, pipes, and potential stream relocations for Line A are presented in Table 13. Bridges, which are considered an avoidance measure, are also included in Table 13 in order to provide a complete summary of stream and river crossings. Figure 67 clusters individual stream crossing samples by BI rank and Figure 68 cluster stream crossings by total habitat assessment score for the six regional project watersheds. The following section details for each local project watershed potential direct physical impacts to surface waters.

1. TYGART VALLEY RIVER REGIONAL PROJECT WATERSHED

As was the case with the IRA, no streams potentially crossed by Line A possess a BI rank of "A" within this local project watershed (Table 14). Line A would require two box culverts, three pipes, and two stream relocations. Both stream segments that would require box culverts possess low Biotic Integrity (BI = "D") scores. Of the three streams proposed for pipe crossings, two possess BI ranks of "D" and one a BI rank of "B". Of the two stream segments proposed for relocation, one stream possesses a BI rank of "C" and impaired (total habitat assessment score = 59) habitat, and the other a BI rank of "B" and moderate (total habitat assessment score = 89) habitat (Table 13). Only minor and temporary physical impacts are anticipated as a result of construction and operation of Line A within this local project watershed.

The proposed stream enclosures and relocation would impact approximately 1.0 percent of the total length of perennial streams within this regional project watershed (Table 16).

2. CHEAT RIVER REGIONAL PROJECT WATERSHED

For the Shavers Fork local project watershed (Table 14), Line A would require one pipe crossing and one stream relocation. The stream segment requiring a pipe crossing possesses a BI rank of "B". The stream segment proposed for relocation possesses a BI rank of "D" and impaired (total habitat assessment score = 37) habitat (Table 13). Line A could impact Pleasant Run, a native trout stream. Although Line A would impact marginal riparian areas, Line A would require substantial deforestation and cuts on a regionally steep slope paralleling the entire length of Pleasant Run.

For the Black Fork local project watershed, Line A would require ten box culverts, eighteen pipe crossings, and four stream relocations (Table 13). For streams requiring box culverts, one possesses a BI rank of "A", six a BI rank of "B", two a BI rank of "C". and one a BI rank of "D". Of the eighteen streams proposed for pipe crossings, one possesses a BI ranks of "A", seven a BI rank of "B", five a BI rank of "C", and five a BI rank of "D". Of the four stream segments proposed for relocation, one possesses a BI rank of "B" (total habitat assessment score = 84, moderate habitat), two posses a BI rank of "C" (total habitat assessment score = 84, moderate habitat), and one a BI rank of "D" (total habitat assessment score = 76, moderate habitat). Measurable physical and biological impacts to Roaring Run are expected as a result of construction of Line A. As was the case for the IRA, a potential exists for impacting Slip Hill Mill Run.

The proposed stream enclosures and relocations for both Shavers Fork and Black Fork local project watersheds would impact approximately 1.3 percent of the total length of perennial streams within this regional project watershed (Table 16).

3. NORTH BRANCH OF THE POTOMAC RIVER REGIONAL PROJECT WATERSHED

For the Stony River local project watershed (Table 14), Line A would require two box culverts, one pipe crossing, and four stream relocations. Both stream segments that require box culvert crossings possessed BI ranks of "D" (average total habitat assessment score = 50.5, impaired habitat). The stream identified for the pipe crossing possesses a BI rank of "A". Of the four stream segments required to be relocated, two possess BI ranks of "A" (average total habitat assessment score = 74, moderate habitat) and two possess BI ranks of "D" (average total habitat assessment score = 65, moderate habitat). Only minor and temporary impacts are expected for this local project watershed.

For the Patterson Creek local project watershed, Line A would require two box culverts, five pipe crossings, and four stream relocations (Table 14). Both streams thata require box culverts possesses BI ranks of "C" (average total habitat assessment score = 60, impaired habitat). Of the five streams requiring pipe crossings, one possesses a BI rank of "C" and the other four, BI ranks of "D". Of the four stream segments required to be relocated, two possess BI ranks of "B" (average total habitat assessment score = 71, moderate total habitat) and two possess BI ranks of "D" (average total habitat assessment score = 69, moderate habitat). Only minor and temporary impacts are expected for this local project watershed.

The proposed stream enclosures and relocations for both local project watersheds would impact approximately 1.5 percent of the total length of perennial streams within this regional project watershed (Table 16).

4. SOUTH BRANCH OF THE POTOMAC RIVER REGIONAL PROJECT WATERSHED

One box culvert crossing is proposed within the Anderson Run local project watershed for Line A. The BI rank for this stream crossing was "B" (total habitat assessment score = 69, moderate habitat). For the Main Channel local project watershed (Table 14), Line A would require one stream relocation. The stream segment proposed for relocation possesses a BI rank of "C" (total habitat assessment score = 68, moderate habitat). Only minor and temporary impacts are expected for this local project watershed.

The proposed stream enclosures and relocations for both local project watersheds would impact approximately 0.5 percent of the total length of perennial streams within this regional project watershed (Table 16).

5. CACAPON RIVER REGIONAL PROJECT WATERSHED

For the Skaggs Run local project watershed, Line A would require two box culverts, four pipe crossings, and two stream relocations (Table 14). Both streams that require box culverts received BI ranks of "B". Of the four streams requiring pipe crossings, two received BI ranks of "B" and two BI ranks of "C". Of the two stream segments identified for relocation, one received a BI rank of "A" (total habitat assessment score = 75, moderate habitat) and the other a BI rank of "C" (total habitat assessment score = 76, moderate habitat). Only minor and temporary impacts are expected for this local project watershed.

For the Baker Run local project watershed, Line A would require one box culvert, three pipe crossings (Table 14). Of the three streams requiring pipe crossings, two possess BI ranks of "B" and one a BI rank of "D". The stream requiring a box culvert received a BI rank of "A". Only minor and temporary impacts are expected for this local project watershed.

For the Central Cacapon local project watershed, Line A would require one box culvert, four pipe crossings and one stream relocation (Table 13). Of the four streams requiring pipe crossings, two possess BI ranks of "A", one a BI rank of "C", and one a BI rank of "D". The stream requiring a box culvert crossing received a BI rank of "C". Only minor and temporary impacts are expected for this local project watershed.

For the Waites Run local project watershed, Line A would require one box culvert and one pipe crossing (Table 14). The stream requiring a box culvert received a BI rank of "A" and the stream requiring a pipe crossing a BI rank "B". Only minor and temporary impacts are expected for this local project watershed.

For the Slate Rock Run local project watershed, Line A would require two box culverts and four pipe crossings (Table 13). Of the four streams requiring pipe crossings, two possess BI ranks of "A", one a BI rank of "B", and one a BI rank of "C". Both stream requiring box culvert crossings received BI ranks of "A". Only minor and temporary impacts are expected for this local project watershed.

The proposed stream enclosures and relocations for local project watersheds would impact approximately 2.2 percent of the total length of perennial streams within this regional project watershed (Table 16).

6. SHENANDOAH RIVER REGIONAL PROJECT WATERSHED

The divide between the Central Cacapon River regional project watershed to the west and the Shenandoah regional project watershed to the east, demarcates West Virginia from Virginia. The Cedar Creek local project watershed is the only watershed within Virginia affected by the proposed project. Line A would require three box culverts, three pipes, and two stream relocations (Table 14). Of the three streams requiring box culvert crossings, two possess BI ranks of "B" and one a BI rank of "C". Of the three streams requiring pipe crossings, one possesses a BI rank of "B", one a BI rank of "C", and one a BI rank of "D". Of the two stream segments requiring relocation, one possess a BI rank of "C" and the other a BI rank of "D". Line A (including Option Area Alignments) would traverse a large portion of the Duck Run watershed. Line A and Option Area Alignments would require substantial cuts, fill, and deforestation resulting in potential alterations in hydrology, increased sedimentation, and variability in surface water temperature. No other stream systems are expected to incur physical impacts within this local project watershed.

The proposed stream enclosures and relocations for the Cedar Creek local project watershed would impact approximately 0.3 percent of the total length of perennial streams within this regional project watershed (Table 16).

7. PROPOSED BRIDGES - LINE A

Within West Virginia, Line A would bridge the three rivers listed on the Nationwide Rivers Inventory (Shavers Fork, South Branch of Potomac River, and Lost River). Line A would bridge all 9 native or stocked trout streams crossed in West Virginia (Pleasant Run, Roaring Run, Elklick Run, North Fork of Patterson Creek, Lost River, Waites Run, Trout Run) and 13 of 15 West Virginia High Quality Streams (Table 20).

Within Virginia (Shenandoah regional project watershed), Line A would bridge Cedar Creek (NWI, Stocked Trout) and Duck Run (Native Trout and Outstanding State Resource Water) and avoid all of Duck Run's perennial tributaries. Line A would require a crossing of a tributary to Paddy Run (Native Trout). An open bottom culvert would be employed to minimize direct impacts to the tributary to Paddy Run.

VI. ALTERNATIVE COMPARISON

At the regional project watershed and local watershed scale, a comparison of potential physical impacts to streams was conducted between Line A, the IRA, and Option Areas. The comparisons are broken down by local project watershed, stream order, structure type, and BI ranks (Table 14). The following discussion compares the alignment alternatives at the regional project watershed scale based on the number, type, and cumulative length of physical impacts clustered by BI rank.

A. IMPACT COMPARISON - IRA TO LINE A

For the entire project area, the IRA and Line A would require a similar number of stream crossings and relocations (Table 14). However, Line A would incur approximately 111 percent more physical stream impacts compared to that of the IRA. The following sections detail the differences and similarities of physical stream impacts to local project watersheds between the IRA, Line A, and Option Areas.

1. TYGART VALLEY RIVER REGIONAL PROJECT WATERSHED

Although Line A will require only 7 stream enclosures to the 13 proposed for the IRA, the length of stream impact for Line A is approximately 33 percent greater than that of the IRA (Table 14). The Leading Creek local project watershed would incur similar physical stream impacts as a result of construction of either the IRA or Line A.

2. CHEAT RIVER REGIONAL PROJECT WATERSHED

In the Shavers Fork local project watershed, Line A would require 2 stream enclosures to the 7 proposed for the IRA (Table 14). Line A would have approximately 21 percent more physical stream impacts compared to the IRA. However, the IRA will require physically impacting 6 streams to the one proposed for Line A. Additionally, the IRA will require relocating a greater length of a higher BI ranked stream than that proposed for Line A (Table 14). Both alignments will impact similar stream systems (Pleasant Run and Haddix Run).

For the Black Fork local project watershed, the IRA will have approximately 122 percent less physical stream impacts than that of Line A (Table 14). Both alternatives will physically impact a similar number of streams (i.e., 29 crossings for the IRA and 32 crossings for Line A).

3. NORTH BRANCH OF THE POTOMAC RIVER REGIONAL PROJECT WATERSHED

For the Stony River local project watershed, Line A would have approximately 101 percent more physical stream impacts compared to the IRA (Table 14). However, the IRA will require physically impacting a similar number of streams to that of Line A. Line A will impact higher quality (higher BI ranks) streams and cause greater temporary physical stream impacts in this local project watershed to that of the IRA (Table 14).

For the Patterson Creek local project watershed, Line A will have substantially greater (839%) physical impacts to that of the IRA (Table 14). The majority of proposed stream crossings and relocations for Line A are on low quality streams with low BI ranks.

4. SOUTH BRANCH OF THE POTOMAC RIVER REGIONAL PROJECT WATERSHED

For the Anderson Run and Main Channel local project watersheds, Line A would have approximately 100 and 218 percent additional physical stream impacts compared to that of the IRA (Table 14). The South Branch of the Potomac River regional project watershed would have similar physical stream impacts as a result of construction of either alignment.

5. CACAPON RIVER REGIONAL REGIONAL PROJECT WATERSHED

For the Skaggs Run local project watershed, Line A would have approximately 323 percent additional physical stream impacts compared to that of the IRA (Table 14). For the Baker Run local project watershed, Line A would have approximately 5 percent additional physical stream impacts compared to that of the IRA (Table 14). For the Central Cacapon local project watershed, Line A would have approximately 64 percent additional physical stream impacts compared to that of the IRA (Table 14). For the Waites Run local project watershed, Line A would have approximately 100 percent additional physical stream impacts compared to that of the IRA (Table 14). For the Slate Rock Run local project watershed, Line A would have approximately 4 percent additional physical stream impacts compared to that of the IRA (Table 14).

6. SHENANDOAH RIVER REGIONAL PROJECT WATERSHED

For the Cedar Creek local project watershed, Line A would have approximately 102 percent additional direct stream impacts compared to that of the IRA (Table 14).

B. IMPACT COMPARISON - OPTION AREAS

A comparison of the impacts (Table 14) of the alignments within each Option Area in West Virginia and Virginia is summarized in Table 17 and Table 18. The following summarizes the differences in alternatives for each Option Area:

- Within the Interchange Option Area, Line A and Line I would have similar impacts on streams (Table 17).
- For the Shavers Fork Option Area, Line A and Line S would require no enclosures and minimal relocations of perennial streams. Line A would require a double bridge crossing of Shavers Fork while Line S would avoid crossing Shavers Fork by remaining along the slope of McGowen Mountain (Table 17).
- Within the Patterson Creek Option Area, Line A would minimize impacts to perennial streams, particularly the Middle Fork of Patterson Creek. Line P would require a greater number and longer enclosures and relocations of perennial streams. Line A would bridge the Middle Fork of Patterson Creek while Line P would utilize a box culvert (Table 17).
- Within the Forman Option Area, Line A and Line F would have similar lengths of stream enclosures (Table 17).
- Within the Baker Option Area, Line A would require a bridge over the Lost River, two bridges over Baker Run and piping of a perennial tributary to Baker Run. Line B would require a bridge over Lost River but would avoid crossing Baker Run. Line B would require a 650 foot box culvert of an perennial tributary to Baker Run. Within the Baker Option Area, Line A would result in the least impacts to perennial streams (Table 17).
- Within the Hanging Rock Option Area, both Line A and Line R would bridge the Lost River. There would be minimal differences in impacts to perennial streams between Line A and Line R (Table 17).
- There are three lines within the Duck Run Option Area: Line A, D1, and D2. Line A would bridge Duck Run (native trout, Outstanding State Waters) twice and require a culvert across a tributary of Paddy Run (native trout). Line D1 would require bridging Duck Run three times, but would avoid the tributary to Paddy Run and minimize construction within the George Washington National Forest. Line D2 would not cross Duck Run, but would cross the tributary to Paddy Run and require the greatest amount of construction within the George Washington National Forest (Table 18).
- Line A within the Lebanon Church Option Area is aligned across the headwaters of Mulberry Run and Town Run. This position in the watershed results in crossing of several tributaries to these streams. Line L on the other hand is located further to the north which minimizes the number of perennial streams the line crosses, but increases the number of intermittent stream crossed. Within the Lebanon Church Option Area, Line L would result in the least impacts to perennial streams (Table 18).

VII. AVOIDANCE, MINIMIZATION AND MITIGATION

The preliminary design of the proposed project included employing general avoidance and minimization measures. During the later stages of the design process, field reviews by highway engineers, environmental scientists and regulatory agency personnel identified additional opportunities where avoidance and minimization measures could be incorporated into the design.

A. GENERAL AVOIDANCE AND MINIMIZATION MEASURES

During the preliminary design process, impacts to streams were avoided to the extent possible based on a set of general guiding principles:

- Attempt to avoid Native and Stocked Trout streams, bridge where practicable;
- Attempt to avoid longitudinal impacts to perennial streams and riparian forests;
- Attempt to bridge perennial streams, if practicable, to avoid culverts and/or relocations.
- Attempt to avoid transverse crossings of perennial streams in order to minimize the length of culverts and pipes. Perpendicular stream crossings were utilized wherever practicable.

Avoidance and minimization measures developed during preliminary design included adjustments to the location of the alignment (horizontal alignment) and the width of the construction limits (vertical alignment). The horizontal and vertical alignments were adjusted to avoid and/or minimize the number and length of relocations and enclosures. However, the adjustments were constrained by the presence of other sensitive resources (e.g. adjacent streams, wetlands, known cultural resources, residences). Where practicable, the vertical alignment was modified to reduce the width of the construction limits in order to avoid stream encroachments. Construction limits were also narrowed by increasing the steepness of fill slopes. The adjustments in vertical alignment and slopes resulted in the avoidance of 2,006 meters (6,580') of stream relocations or encroachments (Table 19). In three cases, retaining walls were included in the preliminary design to avoid an additional 579 meters (1,900') of stream relocations. A total of 2,585 meters (8,480') of stream relocations were avoided during the design process.

B. SPECIFIC AVOIDANCE AND MINIMIZATION MEASURES

Specific avoidance and minimization measures were developed and incorporated into the preliminary alignments following stream sampling and field reviews with state and federal resource agencies. The following sections detail specific avoidance and mitigation measures that would reduce the physical and ecological impacts of the proposed project on surface waters within the immediate vicinity of the proposed project.

1. BRIDGES

Bridges, when compared to stream enclosures, avoid physical and ecological impacts to surface waters (e.g. alteration in hydrology and sedimentation, reduction in forested buffer strips, interference with movement of aquatic organisms). Bridges do, however, effect streams with respect to shading and localized sources of stormwater runoff. Because bridges cost approximately 8 times more to construct and maintain, the use of bridges for all stream crossings is not cost effective nor practicable.

Prior to alignment field reviews with resource agencies, 35 bridge crossings had been proposed for Line A representing approximately 5,902 meters (19,385 linear feet) of construction (Table 20). The 35 bridges represent a cost of approximately $217.6 million and would avoid approximately 3,889 meters (12,760') of stream enclosures. Following the alignment field reviews, four additional streams were identified for bridging where box culverts were initially proposed (Table 21). The four bridges would avoid an additional 1,146 meters (3,760') of stream enclosures at an additional cost of approximately $27.4 million dollars. For Line A, the 39 proposed bridge crossings represent 6,945 meters (22,785 linear feet) of construction at a cost of approximately $184 million (Table 20).

Line A would bridge the four rivers listed on the Nationwide Rivers Inventory as well as nine of the 10 native or stocked trout streams (Pleasant Run, Roaring Run, Elklick Run, North Fork of Patterson Creek, Lost River, Waites Run, Trout Run, Duck Run, and Cedar Creek). Thirteen out of 15 West Virginia designated High Quality Streams crossed by Line A will be bridged as well as Duck Run, which Virginia lists as an Outstanding State Resource Waters.

2. ENCLOSURES

After alignment field reviews with resource agencies, additional opportunities to minimize the length of physical impacts to surface waters were identified. This included alignment shifts and reductions in construction limits which, as a whole, reduced the length of box culverts and pipes by approximately 175 meters (575') (Table 21).

Enclosures which do not incorporate environmental considerations in their design, can create a barrier to movement of aquatic organisms, physical loss of aquatic habitat, alterations in stream hydrology, and localized sedimentation. One mitigation measure is to use open bottm culverts, which minimize impacts to stream habitat and hydrology by maintaining the existing substrate. Open bottom culverts cost approximately 15 percent more to construct than conventional box culverts. Another mitigation measure is to Countersink the bottom of culverts and pipes, which allows substrate to fill the culverts and pipes. The natural substrate re-establishes aquatic habitat within the enclosures and also aids in the movement of organisms. This design measure requires larger pipes and culverts, thus increasing the cost of construction.

Low flow diversions would be used on all multiple box culverts, in order to ensure continuation of stream flow during periods of low stream flow. This design measure allows fish and other organisms to retreat downstream during periods of low stream flow, and maintains uninterrupted stream flow to downstream areas.

Table 13 lists all stream crossings and the associated enclosure type. In order to determine, or justify the use of a particular type of enclosure (i.e., pipe, box culvert, open box culvert), an evaluation was made regarding enclosure type as a function of Biotic Integrity (BI) rank and total habitat assessment score. Streams that possess a BI rank of "B" or higher and a total habitat assessment score of "B" or higher are identified in Table 22. Table 22 includes streams potentially crossed by the IRA, Line A and Option Areas. These streams have been selected, on the basis of habitat quality and similarity to undisturbed reference stations, for additional physical impact minimization (i.e., open bottom culverts and countersinking of culverts). This methodology provided a means to identify and mitigate the loss of stream habitat based on ecological considerations.

3. RELOCATIONS

Relocations of major streams were avoided by shifting alignments, increasing slope angles, and use of retaining walls. Approximately 2,585 meters (8,480') of stream relocations were avoided (Table 19). Relocations were generally limited to small first order headwater streams. In many cases, a small stream was aligned perpendicular to a larger stream. The relocation of the smaller stream was often required in order to minimize impacts to the larger stream.

C. MITIGATION

This section discusses other mitigative measures that fall into two categories: additional design measures and construction techniques.

1. ADDITIONAL DESIGN MEASURES

a. Fencing

Many of the streams and rivers potentially crossed by the proposed project possess minimal vegetative cover in agricutural areas. In many instances cattle were observed defecating directly into surface waters. It is recommended that fencing be utilized to physically block livestock from access to surface waters within 150 feet of proposed construction limits. This serves two purposes: first, it would protect stream habitat and reduce organic input from livestock; second, it would provide, in time, a vegetated riparian buffer along stream reaches. The importance of vegetated riparian buffer strips is discussed in Section G of this report.

b. Stream Channel Enhancement

Avoidance of parallel construction along streams would provide the greatest reduction in potential impacts to riparian habitat. However, complete avoidance of impacts to riparian forests is not possible due to the length of the proposed project, the terrain, and the necessity to cross numerous watersheds and streams. During preliminary design, proposed parallel construction adjacent to perennial streams was minimized to the extent possible. By placing the roadway along stream valley slopes instead of along the valley floor, parallel stream encroachments were minimized but this effort resulted in more perpendicular crossings of tributary streams. In general, the impact of a perpendicular stream crossing on riparian forest is less than the impact from parallel construction.

During construction, clearing of riparian vegetation would be limited to the minimum required to accommodate the construction of the facility. Areas not intended to be cleared would be protected from accidental intrusion by flagging or fencing. After clearing and grading, riparian areas would be revegetated to control erosion and sedimentation.

There are a variety methods for increasing the habitat quality of mountain streams. Many streams possess an inadequate number of deep pools and runs which are critical. This is particularly true during spawning, periods of low stream flow, and cold weather. This is particularly true of the sampled streams in the study area which have been damaged by floods and human disturbances.

There are a number of structures that can be used to increase fish and macroinvertebrate habitat. Structures would include log dams, channel deflectors, over hanging bank cover, lunker structures, and introduced boulders. Priority should be given to the use of natural materials such as locally collected logs and boulders. The installation of 25 stream structures per mile of stream is considered ideal, but would vary depending on the quality of the existing habitat within the stream and the amount of habitat being replaced (i.e. amount of habitat loss to stream relocation).

c. Fishing Access

A fisherman's access has been incorporated into the alignment plans for the Build Alternative at the Tygart Valley River near existing Route 33. Where practicable, other such facilities could be included in the construction plans.

2. CONSTRUCTION TECHNIQUES

a. Bridges

Bridging would avoid permanent impacts to streams, but would result in temporary impacts during construction due to temporary stream crossings, bank stabilization, placement of piers for larger bridges, and clearing of riparian vegetation. General construction measures which would be employed to minimize impacts during bridge construction include:

- Provide temporary construction access with non-erodible materials which would be completely removed upon completion of construction;
- Stabilize stream slopes with non-erodible materials or with vegetation where practicable;
- Construction of all instream piers for large bridges within nonerodible cofferdams;
- Adequately settle and filter water pumped from coffer dams prior to returning to stream;
- Remove only vegetation which interferes with the construction of the proposed bridge.

b. Enclosures

General construction measures taken to avoid or minimize impacts to perennial streams during construction of enclosures would include:

- Use of erosion and sedimentation controls;
- Proper instream construction techniques, including temporary diversions;
- Minimizing clearing along stream, particularly of riparian forests;
- Construction during periods of low stream flow.

c. Relocations

General construction measures taken to minimize impacts to perennial streams being relocated would include:

- Providing a natural, meandering channel design;
- Replicating the pool-riffle ratio of the channel being replaced;
- Stabilizing the relocation channels "in the dry" prior to diversion of water.

VIII. SECONDARY IMPACTS

Secondary impacts are those impacts that are "caused by an action and are later in time or farther removed in distance but still reasonably foreseeable" (40 CFR 1508.8). Permanent and temporary secondary impacts would occur as a result of the construction of the proposed project. Secondary impacts to surface waters include degradation of water quality and aquatic habitat as a result of runoff from sediments and highway pollutants, hindered movement of aquatic organisms in streams and rivers due to enclosures, and impacts to riparian forests adjacent to waterways.

The proposed project may impact water quality during construction, operation, and maintenance. During construction, the erosion of soils from the construction area and subsequent sedimentation of streams represents the most substantial potential impact to water quality. During operation and maintenance of the highway, toxic compounds such as heavy metals, petroleum products, and herbicides may also impact water quality.

A. EROSION AND SEDIMENTATION: EFFECTS AND MITIGATION

The combination of steep slopes, erodible soils, extensive excavation, clearing, and grading would result in a high potential for erosion and sedimentation. Controlling potential erosion from the construction area and subsequent sedimentation in local streams is a major concern.

A variety of substrate types is important in maintaining a productive aquatic habitat. Boulders, cobble, and gravel with relatively little sand, silt, and clay create an optimal substrate for fish and invertebrates. Sedimentation of streams during and after construction of the proposed project would adversely impact both aquatic invertebrates and fishes by altering the existing substrate. When sedimentation of the stream results in the silt content of the substrate exceeding 15 percent, trout populations may be reduced by 50 percent (Hunter, 1991).

Sedimentation can have acute and chronic effects on aquatic invertebrates and fish. Suspended sediment concentrations must be very high (above 20,000 ppm) to cause mortality in adult fish by clogging the gill filaments and preventing normal water circulation and aeration of blood. However, abrasion damage to gills begins to occur at sediment concentrations as low as 200 ppm (Welsch, 1991). Low concentrations can cause behavior changes and disrupt normal reproduction by covering spawning areas and preventing the emergence of fry.

The effects of silt (suspended particulate matter) has also been reported to be a limiting factor in the distribution and density of invertebrate organisms (Bartsch 1916; Ellis 1936; National Technical Advisory Committee 1968; Luedtke and Brusven 1976; Marking and Bills 1980; Brzezinski and Holton 1981; Gray and Ward 1982; Buikema et al. 1983; Cowie 1985; Duncan and Brusven 1985; Garie and McIintosh 1986; Aldridge et al. 1987; Dewalt and Olive 1988; Wolcott and Neves 1990; Hogg and Norris 1991; Corkum 1992; Layzer and Anderson 1992; Houp 1993). Filter feeding organisims utilize minute cilia on the surface of their gills to collect food particles. Silt particles clog the cilia which in turn reduces food ingestion and, depending on the silt load and sensitivity of the organism can lead to suffocation. Silt impacts the colonization and distribution of invertebrates by modifying the benthic habitat. As silt settles out of the water column, the rate of accretion can be greater than the escape rate of many invertebrates that are less motile or sedentary in nature. The modification in substrates as a result of sedimentation excludes many invertebrate species that utilize the interstitial zones of cobbel/gravel stream beds.

For each section of highway designed, a comprehensive erosion and sedimentation control plan would be implemented to minimize impacts. The erosion and sedimentation plans would include best management practices (BMP's), as described in the WVDOT DOH *Erosion and Sedimentation Control Manual* (1993) and *Standard Specifications Road and Bridges (1993).* In Virginia, the construction of the proposed project would adhere to Virginia's Stormwater Management Regulations (1990) and VDOTs *Road and Bridge Specification*, as well as the *Virginia Erosion and Sedimentation Control Handbook (1993).* To ensure that the erosion and sediment control plan would be adhered to during the construction phase, routine inspections in the field would be conducted. Temporary erosion and sediment controls which would be used during construction include the following:

Vegetative Soil Stabilization Methods: Seeding and mulching would be performed on a continual basis to reduce the potential for erosion from cut and fill slopes, haul roads, waste sites and borrow pits during the construction phase. Clearing and grading would be minimized to allow natural vegetation to serve as erosion control. Those areas that are cleared and graded would be stabilized by planting fast-growing annual plant species.

Water Conveyance And Energy Dissipation: Erosion would be reduced by utilizing structures which slow the flow of water and reduce its ability to create erosion. These structures would include temporary berms, slope drains, temporary pipes, contour ditches, check dams and ditch checks.

Clear Water Diversion: Relatively sediment-free stormwater runoff would be intercepted and diverted around the construction site. Clear water diversions would reduce the amount of stormwater flowing across and through the construction site, thus reducing erosion and minimizing the amount of stormwater runoff requiring treatment.

Sediment Retention Structures: Sediment barriers and sediment basins would be used to reduce the amount of eroded sediment carried by stormwater runoff from the construction site. Sediment barriers, such as straw bales and silt fencing would be used along the toe of slope and other areas where sheet flow would be intercepted. Concentrated runoff would be routed to sediment basins and traps before being redirected to a stream below the construction site. The channels utilized to transport the sediment-laden stormwater runoff would be lined with properly anchored erosion resistant materials so as not to create additional erosion problems.

Stream Bank Protection: Construction in and/or near streams would require additional erosion control measures to minimize stream bank erosion and sedimentation. Typically, this requires limiting construction activities within streams to periods of low flow; establishing temporary bridge or culvert crossings of streams for construction equipment; stockpiling excavated material outside the floodplain; limiting clearing of stream bank vegetation; and placing silt fencing along streams.

After construction of the facility is completed, permanent erosion control measures would be instituted. These measures would include stabilizing cut and fill slopes, shoulders, medians, and any other areas of exposed soils as well as drainage swales and ditches. Stabilization could be established with perennial vegetation or the use of non-erosive materials (i.e. riprap, geotextiles, etc.). Establishing a permanent vegetative cover (grass, shrubs, and trees) capable of preventing erosion may require considerable site preparation including seeding, transplanting, fertilization, mulching, watering, and, on steep slopes, the use of natural or synthetic matting. The location of permanent discharge points for stormwater should be designed to dissipate streamflow velocity and prevent erosion into the receiving stream.

B. HIGHWAY POLLUTANTS

After construction of the proposed project, major sources of pollutants include vehicles, dustfall, and precipitation (Charbeneau et al. 1993). A variety of factors (e.g., traffic volume and type, local land use, and weather patterns) affect the type and amounts of pollutants. Additionally, roadway maintenence practices such as sanding, deicing, and application of herbicides on highway right-of-ways, can also act as sources of pollutants. Table 23 lists the types of potential contaminants associated with roadway development. From this list, deposition of pollutants from vehicles (both direct and indirect) is the largest source of pollutants during most of the year, while deicing salts (sodium chloride and calcium chloride) and abrasives are the largest source of pollutants during periods of snow and ice (Gupta et al. 1981). The rate of deposition and subsequent magnitude of these pollutants in highway runoff are site specific and affected by: traffic characteristics, highway design, maintenance activities, surrounding land use, climate, and accidental spills.

Highway pollutants are removed from the highway through a number of mechanisms which include stormwater runoff, wind, vehicle turbulence, and the vehicles themselves. The effects of highway runoff on streams are variable and depend on the length of time since the last storm event, traffic volume, natural surface winds, the quantity of stormwater runoff delivered to the stream, volume of flow in the stream, and the duration of the storm event (Charbeneau et al. 1993). The most important factor contributing to the accumulation of pollutants from highway operation and maintenance is the build up of fine particulate matter. Many toxic compounds such as heavy metals and hydrocarbons adhere to fine particles and are easily transported by stormwater runoff to nearby streams. The accumulation of particulate matter on a highway is also directly proportional to the amount of traffic on the highway. However, vehicle turbulence also can remove solids and other pollutants from highway lanes and shoulders (Kerri et al. 1985 and Asplund et al. 1980) which distorts the relationship between traffic volume and pollutant concentrations in runoff.

Highway runoff may adversely affect the water quality through acute (i.e. short-term) loadings (i.e. storm events) and through chronic effects as a result of long-term accumulation and exposure. Research on rural highways similar to the proposed project indicates few substantial effects from highway runoff are apparent for highways with an Average Daily Traffic (ADT) of less than 30,000 vehicle per day, and that toxic effects are limited to urban highways with high ADTs (>50,000 ADT)(Maestri et al. 1981). Driscoll et al. (1990) concluded that runoff concentrations are two two four times higher for highways that are subject to ADTs > 30,000. Dupuis and Kobriger (1985) reported that there were no apparent water quality impacts during storm events on benthic invertebrates. Based on the volume of traffic predicted for the proposed project (23,000 vehicles per day), it is anticipated that there will be no measurable differences in water quality on receiving streams.

C. MITIGATION OF HIGHWAY POLLUTANTS

Even though the impact on water quality from highway stormwater runoff is predicted to be minimal based on the ADT projections, mitigation measures designed to control storms producing less than one inch of rainfall will control nonpoint pollution discharges for approximately 90 percent of the storms each year. The majority of pollutant loads from a storm are delivered by a relatively small percentage of the runoff volume during the initial storm stages. Mitigation measures in the final design should address the control of this "first flush" and the removal of heavy metals and other pollutants which tend to adhere to sediment particles.

Two methods have been shown to be highly effective in removing pollutant from runoff (Masestri et al. 1981). The first is the use of vegetated surfaces (grass) to manage highway stormwater runoff pollution which capitalizes on the natural capability of vegetated surfaces to reduce runoff velocity, enhance sedimentation, filter suspended solids, and increase infiltration. Secondly, the use of wet detention basins which maintain a permanent pool of water, are capable of highly effective pollutant removal, principally through sedimentation. These methods have been found to be the most effective in removing a significant percentage of the pollutant load from stormwater runoff (Table 24).

In Virginia, the project would be subject to Virginia's *Stormwater Management Regulations* (1993). The goal of these regulations is to inhibit the deterioration of the aquatic environment by instituting a stormwater management program that maintains both water quantity and quality equal to or better than that prior to construction. The regulations require detaining the first 0.5 inch of rainfall. Numerous studies have shown that the greatest concentrations of highway pollutants are contained within the first flush of a storm event. By requiring the detainment of the first 0.5 inches of rainfall, the water quality of receiving streams will not be subjected to this intial pulse. In West Virginia, there are no requirements for permanent management of highway stormwater quantity or quality.

To control stormwater runoff during the operation of the highway, the proper management of chemicals used for highway maintenance is an important element in minimizing water quality impacts. Proper application and storage of deicing chemicals, pesticides and herbicides would minimize the introduction of these pollutants into surface waters.

D. AQUATIC HABITAT: IMPACTS AND MITIGATION

As described in previous sections, potential impacts to streams include alterations in stream hydrology, geometry, and the degradation of water quality. These potential impacts could impact the stream's capacity to provide habitat suitable for aquatic life, including game and non-game fish, amphibians, and invertebrates.

Impacts to the aquatic environment change with time and space. Spatially, the movement of aquatic invertebrates and fish within streams is important to the colonization of portions of streams temporarily disturbed during construction and to the natural colonization of undisturbed streams (Lancaster, 1990). During periods of low stream flow, movement of fish and aquatic invertebrates along a stream to areas of deeper water is necessary.

Colonization of stream substrate by aquatic invertebrates comes from four major sources: downstream drift, upstream movement, vertical movement from deep within the substrate and aerial movements of adults. The contribution of each source of recruitment varies for each taxa (e.g. caddisflys move with the drift).

William and Hynes (1976) found that for the organisms sampled by their traps, 41% came from downstream drift; 18% from upstream movement along the substrate, 19% from vertical movement through the substrate and 28% from aerial deposition of eggs by adults. It was also discovered that an additional source of colonization was due to movement of adults between streams.

Many aquatic invertebrates exhibit a daily drift downstream, generally occurring near dusk. Aquatic invertebrates which exhibit downstream drift including various taxa of the following: Oligochatea, Amphipoda, Isopoda, Ephemeratera, Plecoptera, Odonata, Hemiptera, Diptera, Coleoptera, Hydracarina, and Mollusca (Hynes 1970). Drift can be divided into broad and overlapping categories (Waters 1961,1962a, 1962b, 1965; as cited by Pearson and Kramer 1972):

- Constant drift due to normal accidental dislodgement;
- Behavioral drift due to active response by organisms;
- Drift due to catastrophic events (e.g. floods, toxics, low streamflows).

Aquatic invertebrates appear to enter the drift both actively and passively. When food resources become scarce, aquatic invertebrates actively enter the drift to find suitable feeding areas. Aquatic invertebrates may also actively enter the drift to avoid predation or passively due to the loss of a limb after a predatory attack (Williams and Levens 1988).

Drift has been shown to be a major contributing source of colonization of disturbed areas (42%-82%) as reported by various researchers in Lock and Williams (1981). Colonization of disturbed areas solely by drift required from 2-4 weeks to several years (Lock and Williams 1981).

Although Williams and Hynes (1976) reported an average of 18% of organism were recruited from upstream movement along the substrate, the percentage varied greatly depending on the species in question. Some Ephemeroptera (mayflies) move as much as 1.6 km upstream (Lock and Williams 1981). In many cases however, upstream movement is equivalent to less than 5 percent of the downstream drift.

Many species, particularly during early life stages, are now known to move vertically into the gravel and cobble substrate to depths of at least 100 cm. Organisms located deep within the substrate are protected from short-term disturbances such as temperature changes, streamflow fluctuations, and release of toxics or sediments. Movement vertically, horizontally, and laterally within the substrate can contribute substantially to the colonization of disturbed streams. Populations inhabiting deeper zones within the substrate are important in colonizing streams which may be temporarily impacted by the proposed project.

Disturbed areas can also be colonized by adult insects depositing eggs into the stream or substrate. The adults of many species move upstream before depositing their eggs, which may compensate for downstream drift of immature aquatic invertebrates. Upstream movement of adults have been documented in Tricoptera, Plecoptera, Ephemeroptera, and Simuliidae. Some caddisflies undertake a definite upstream migration estimated at 2-3 km. (Pearson and Kramer, 1972). The importance of adult deposition of eggs for colonization varies based on the location of the stream within the watershed. Headwater streams are more dependent on adult deposition than are streams located lower in the watershed. In headwater streams, adult recruitment can lead to restoration of the trophic structure of a disturbed stream within two years although the taxa may differ from pre-construction conditions due to the lack of taxa with poor dispersal abilities such as some stoneflies (Wallace et al. 1986).

Although a majority of the colonization of disturbed portions of streams would be from movement of aquatic invertebrates within the same stream, movements between streams by adults can also contribute to the colonization. Taxa with strong dispersal capabilities as adults include Odonata, Simuliidae, Culicadae, and various Coleoptera, Hemiptera, and Tricoptera. Many adult Ephemeroptera, Tricoptera, Chronimidae and Plecoptera are weak fliers and are unlikely to contribute substantially to colonization by actively moving between streams.

Bridging avoids permanent impacts to aquatic habitat, but enclosures and relocations would have temporary and permanent impacts. Many of the general, specific and construction period minimization measures previously discussed would avoid and minimize impacts to the aquatic habitat provided by the streams crossed by the proposed project.

The proposed project would require bridging, enclosing and relocating a number of streams, each of which would have different secondary impacts on the aquatic habitat of a stream. The use of bridges to cross 39 streams avoids impacts to the aquatic habitat of those streams.

Enclosures (e.g. pipes and box culverts) would have temporary and permanent impacts on aquatic habitat. Streams would be temporarily diverted or dammed while the pipe or culvert is constructed. A portion of the streams immediately adjacent to the construction of the enclosure would be disturbed during construction. Once construction is completed and the construction site stabilized, normal colonization processes would repopulate disturbed portions of the streams. Counter sinking the enclosure below the level of the streambed will allow upstream and downstream movement of aquatic invertebrates and fish within the stream, thus maintaining natural colonization processes. The placement of a culvert under a large amount of fill which effectively block stream valleys may impede the upstream movement of adult insects. This would likely impede only a portion of the adult population which hatch downstream of the crossing. Those adults which emerge upstream of the culvert and those which are capable of flying over the fill would not be affected.

If proper mitigation measures are implemented, the relocation of stream channels should not detrimentally impact the movement of aquatic invertebrates or fish in areas where an acceptable ratio of pools and riffles are established. Based on the identified areas where secondary development is expected to occur (intersections and industrial parks) the ecological importance of such disturbances is minimal due to the relative diversity, abundance, analyzed biotic integrity, and existing habitat of these identified streams.

E. RIPARIAN HABITAT

The proposed project would impact the terrestrial environment immediately adjacent to stream corridors. The productivity of a stream, its water quality, and aquatic habitat, are affected by the type of riparian habitat along its banks and associated floodplain.

Overland surface runoff conveys nutrients (i.e., particulate organic matter (POM), particulate inorganic matter (PIM), dissolved organic matter (DOM), and dissolved inorganic matter (DIM)), into streams thereby affecting aquatic habitat and water quality. Forested riparian buffer strips adjacent to streams substantially reduce the impacts of overland surface runoff on receiving streams by removing sediment and other suspended solids from overland surface runoff. As a result of this filtering action, silt-clogging material does not buildup in the interstitial regions within the substrate of a stream. In addition, the biological oxygen demand (BOD) of the stream is also reduced. A major source of pollutant in agricultural areas is phosphorus. Phosphorus adheres to small size particles and is transported into streams through overland runoff. The filtering action of a forested riparian buffer strip can result in a reduction of approximately 80% of the phosphorus in overland runoff, thus greatly reducing phosphorus loading to streams (Welsch 1991).

In addition to filtering, forested riparian buffer strips can intercept and transform pollutants into less toxic compounds. For example, the most common form of nitrogen, nitrate, is soluble in surface and groundwater. The amount of nitrogen in runoff and shallow groundwater can be reduced by as much as 80% after passing through a riparian forest (Welsch 1991). Nitrate concentrations are reduced through the processes of plant uptake, nitrification and denitrification. Some estimates indicate that 25% of the nitrogen removed by forested riparian buffer strips is assimilated in tree growth which may be stored for extended periods of time. Forested riparian buffer strips can also retain and transform pesticides and herbicides into less toxic compounds (Welsch 1991).

Forested riparian buffer strips also influence other factors which contribute to the quality of aquatic habitat for fish and macroinvertebrates. One factor, water temperature, is a function of both air temperature and solar radiation. The optimal conditions for streams supporting cold water fish (e.g. trout, dace) is a water temperature of 8 to 15 degrees C and approximately 75% shading (Hunter 1991). The loss of forested riparian buffer strips can result in an increase in water temperature. The increase in water temperature reduces the dissolved oxygen concentration within the water and also increases the basal metabolic rate (i.e., the demand for oxygen at a resting state) of fish. First through third order streams typically comprise about 85% of the total length of running waters in a watershed (Welsch 1991). Because of their small ratio of streamflow to shoreline, these streams are particularly vulnerable to increased water temperature due to loss of forested riparian buffer strips.

Forested riparian buffer strips enhance habitat structure by stabilizing undercut stream banks which provide habitat for a variety of aquatic organisms. Forested riparian buffer strips also contribute large woody debris (limbs, trunks, stumps) to the stream system. Large woody debris creates dams and jams in the stream, forming pools which serve many purposes. Sand and silt can be temporarily stored in these pools, which may otherwise be deposited in spawning areas. Organic material can be trapped behind log dams, providing the aquatic invertebrate community with greater food resources. The woody material itself is consumed by some aquatic invertebrates and provides attachment sites for many other species. Debris provides refugees from predators and periods of high flows.

Riparian vegetation also provides a source of organic material (leaves, twigs, bark, seeds) to the stream and serves as the base of the detrital food chain. This material is consumed by a variety of aquatic invertebrates which are a primary source of food for other organisms. In small first order mountain streams, input of organic material (DOM and PIM) from the riparian forest accounts for the majority (75%) of the productivity of the stream.

Lastly, forested riparian buffer strips provide suitable habitat for terrestrial wildlife. Stream corridors are often used as travel routes and foraging areas by many species of wildlife.

Within the project area, most of the smaller, mountainous first order streams possess a riparian forest composed of hardwoods (oaks, yellow birch, maples, and sycamore), while steeper stream valleys with cooler and moister microclimate support hemlock and rhododendron. Along relatively flat second and third order stream valleys within the project area, much of the valley bottom has been converted to agricultural use, resulting in the complete loss of a forested riparian buffer strip or one that is reduced to a narrow fringe along the stream banks. Many of the existing roadways in the study area are located along streams, thus reducing the abundance of riparian habitat.

Any construction near streams would result in some level of impact to the existing riparian habitat. The greatest potential for impact would be along streams which have well developed riparian forests. Construction along stream valleys could not be avoided, but impacts to riparian forests were minimized where possible by placing the alignments a minimum of 23 meters (75') up slope of the stream. To quantitatively determine potential impacts of the proposed project to existing riparian forest buffers, the following study was conducted.

1. METHODOLOGY

GIS analysis identified parallel limits of proposed highway construction within 30 meters (100') of existing perennial streams for both the IRA and Build Alternative. This parallel limit was used as a reference for identifying potential encroachments within 23 meters (75') of ripiarian bufferes for both the IRA and Line A. Construction of this nature would encroach upon the existing riparian buffer. This would produce a parallel strip of land, varying in width, between the proposed construction limits and the existing perennial streams.

Croonquist and Brooks (1993) suggested that protecting a forested corridor at least 25 meters (80 ft.) wide on each bank provides feeding, resting, or migrating corridors for sensitive species including forest interior neotropical migrants birds. Welsch (1991) determined that a minimum width of 23 meters (75') of forested buffer is required to protect water quality and aquatic habitats. Based on the above literature, the average width and vegetative cover type within each resultant 23 meter (75') buffer strip was determined to assess potential wildlife utilization and highway runoff impacts associated with parallel stream construction. The nearest stream reference station to each resultant buffer strip was identified to provide a quantitative assessment of stream conditions within the potential impact area. This information was used in the development of minimization, avoidance, and mitigation measures.

2. RIPARIAN IMPACTS

Within each regional project watershed, an assessment was made of the number and length of riparian buffer zones less than 23m (75') from the proposed construction limits. These buffer zones are of particular concern because they fall below the minimum width determined to provide benefits to water quality and some wildlife species (Welsch 1991; Croonquist and Brooks 1993). In addition, the reduction of riparian zone buffers below this minimum width may have a greater impact on stream resources categorized as non-impaired or moderately impaired (BI rank A or B) than on those categorized as impaired to severely impaired (BI rank C or D).

a. Estimated Impacts - IRA

Table 25 presents a summary of the impact to riparian buffers under the IRA. The IRA would impact 59 riparian buffers paralleling 9,463 meters (31,045 feet) of first, second, and third order perennial streams (Table 26). Riparian buffers less than 23 meters (75 feet) are less capable of providing water quality and wildlife benefits. A majority of these narrower riparian buffers (86%) would contain either forest, shrub and brush, or emergent wetlands thus providing some benefits for wildlife and water quality. Agricultural and herbaceous rangeland would comprise the remaining 14% and would be of limited water quality and wildlife value (Figure 69). The Cheat River regional project watershed would contain the largest number and length of riparian buffer zone impacts (Table 25). Seventy three percent of the riparian buffer zones impacted bordered streams categorized as non-impaired or moderately impaired (BI rank of A or B). The water quality and aquatic communities of these streams may be more susceptible to construction induced runoff than streams with lower categorical rankings (BI rank C or D). The IRA would impact almost five times the length of riparian buffer as would Line A.

b. Estimated Impacts - Line A

Table 27 presents a summary of the impact to riparian buffers under Line A. Line A would impact 19 riparian buffers paralleling 1,739 meters (5,792') of 24 first, second, and third order perennial streams (Table 28). Seventy nine percent of these buffers would be either forested, shrub and brush, or emergent wetlands and would provide some benefits for wildlife and water quality. Agricultural land would comprise the remaining 21% and would be of limited water quality and wildlife value (Figure 69). The Cheat River regional project watershed would contain the greatest number of riparian buffer zone impacts, while the South Branch of the Potomac River regional project watershed would contain the greatest length (Table 27). Stream BI rankings associated with these riparian zones ranged from non-impaired (A) to severely impaired (D). Sixty three percent of the riparian buffers less than 23 m bordered streams categorized as impaired or severely impaired (BI rank of C or D). The water quality and aquatic communities of these streams may be less susceptible to construction induced runoff than streams with higher categorical rankings (BI rank A or B).

c. Alignment Comparison

An alignment comparison of riparian impacts within Biotic Rank (BI) categories by regional project watershed is summarized in Table 29. The IRA would impact 43 riparian buffers paralleling 7,899 m (25,909') of streams categorized as non-impaired or moderately impaired (Biotic Rank A or B), while Line A would impact 7 riparian buffers paralleling 909 m (3,014'). The water quality and aquatic communities of these streams may be more susceptible to construction induced runoff than streams with lower categorical rankings (Biotic Rank C or D).

The Cheat River regional project watershed has the greatest number of riparian impacts for both the IRA and Line A (28 vs. 6). The greatest length of IRA riparian impact also occurs in this watershed (4,072 m, 12,330'), while the North Branch of the Potomac River regional project watershed contains the greatest length of riparian impact for Line A (457 m, 1,384').

Within both the Cacapon and Shenandoah River regional project watersheds, the IRA would impact a greater number and length of riparian buffer zone than would Line A. Both the Cacapon and Shenandoah River regional project watersheds contain sensitive water resources such as the Lost River, Baker Run and Duck Run. The loss of forested riparian buffers could result in an increase in water temperature and a reduction of the dissolved oxygen concentration. This could negatively affect existing aquatic organism populations, including the native brook trout (*Salvelinus fontanalis*) population in Duck Run.

3. MITIGATION

Where possible, alignments were developed to avoid riparian habitat areas. However, some encroachment upon the riparian buffer zone of perennial streams is unavoidable. One possible mitigation strategy would be to make design modifications during final design that would provide a minimum riparian buffer of 23 m (75'). A commitment would also be made to re-vegetate areas that are disturbed during the construction process within 30 m (100') of perennial streams. Several existing riparian buffers could also be improved through mitigation measures designed to enhance wildlife and/or water quality functions. Presently, 525 m (1,750') of perennial stream is bordered by an agricultural or disturbed land riparian buffer. This land use provides limited water quality benefits or wildlife habitat value. A riparian buffer zone management plan could be developed to plant tree and shrub species that would both increase sedimentation/nutrient reduction capabilities and provide more productive habitat for a variety of wildlife species.

IX. CUMULATIVE IMPACTS

Cumulative impacts are those impacts "which result from the incremental consequences of an action when added to other past and reasonably foreseeable future actions" (40 CFR 1508.7). Analysis of a project's cumulative impacts is a requirement of the National Environmental Policy Act of 1969 (NEPA) and the Council on Environmental Quality's NEPA regulations (40 CFR 1508). However, the subject has received limited treatment in the assessment of highway projects (Banks 1992). In 1992, the FHWA issued a position paper which states, "to fulfill the general NEPA mandate of environmentally sensitive decision making, the FHWA and States must develop and use techniques to incorporate secondary and cumulative impact issues in the highway project development process" (Banks 1992).

A. CUMULATIVE IMPACTS ANALYSIS - STREAM SYSTEMS

With respect to streams and rivers, the significance and magnitude of potential cumulative impacts are closely associated with existing surface water conditions. A variety of studies have demonstrated the degradative influence of agricultural and urban land use on the diversity of fishes and other biota of streams (Larimore and Smith 1963; Ragan and Dietemann 1975; Klein 1979; Goldstein 1981; Karr et al. 1985; Scott et al. 1986; Steedman 1988). The abiotic and biotic processes involved in stream degradation are often complex and reflect the types of human activities within a watershed (Steedman 1988).

It is estimated that 70-90% of the waterways in the eastern United States have been drastically altered by human activities (Brinson et al. 1981; Swift 1984; Hunt 1985). It is clear that streams and rivers are a reflection of surrounding watershed land use. What is less obvious and in need of further investigation, is whether biotic communities respond to incremental changes within a watershed over time (Schindler 1987; Karr 1987). If biotic communities do behave predictably, then they are a suitable tool for measuring long-term cumulative effects at the watershed scale to that of a reference watershed.

The riparian zone, as defined by Hunt (1985), is the zone between rivers, wetlands, and adjacent uplands. This zone, which was previously discussed in this report, has the potential to buffer the stream channel from point and non-point sources of pollution. Recent studies have focused on the dynamics between terrestrial landscape patterns and its influence on a stream system's biotic diversity, which may serve as an indicator of an environment's "health". For example, streams and rivers within watersheds that are subject to agricultural, industrial, and commercial use would require a greater degree of developmental pressure to "significantly" alter the biotic communities established as a result of prior watershed development. Conversely, watersheds that are undeveloped and forested, are sensitive to developmental pressure and require less watershed degradation to alter biotic communities. The degree of biotic change is debatable as it relates to its ecological significance. A "significant" impact or alteration is defined here as a disturbance that permanently alters or degrades a stream system from which incomplete recovery is the result of such a disturbance. For example, if a stream possesses an average Biotic Integrity (BI) rank of "A", which assumes a great deal of similarity to its regional reference station, then the reduction in BI rank to "C" is of significance. However, if the stream is already impacted relative to its reference station (for example a BI rank of "C") then a greater degree of watershed degradation would be required before that particular stream assemblage would be altered such that it would receive a BI rank of "D". This is due to the broad ecological tolerance of species associated with degraded ecosystems.

In order to identify areas where such watershed degradation may potentially occur, a cumulative watershed impacts analysis was conducted. The analysis utilized in this study included analyzing baseline stream data (Rapid Bioassessment Protocol II results), basic water quality results, review of predominant local project watershed use, and review of published information on spatial and temporal changes in community structure as a result of catastrophic events. The goal of this analysis is to predict, with some level of confidence at both the local project watershed scale and the regional project watershed scale, the magnitude and ecological importance of cumulative impacts as a result of the construction and operation of the proposed project on surface water resources.

1. METHODOLOGY

In order to predict the significance or magnitude of an impact attributable to the construction and operation of the proposed project, a clear understanding of baseline surface water conditions is required. The proposed project traverses two ecoregions, both of which include "impacted" and "non-impacted" local project watersheds. Therefore, the proposed project would have markedly different impacts to local project watersheds based on the particular local project watershed traversed.

Streams and rivers in the project area are systems that are subject to seasonal catastrophic events (i.e. flood events). Floods frequently "reset" macrophytic, macroinvertebrate, and fish communities by scouring biota out of long reaches of stream channels (Bilby 1977; Gray and Fisher 1981; Fisher et al. 1982, Kimmerer and Allen 1982; Fisher 1983; Molles 1985; Matthews 1986; Harvey 1987; Power and Stewart 1987; Erman et al. 1988; Power 1992). Large regional storm events trigger flooding of rivers in different watersheds such that watershed systems with different community structures and habitat quality are reset simultaneously. Also of importance is the fact that organisms in flood-prone streams and rivers have had long histories of exposure to floods, and are constituted of species, many with short generation times, that can recover quickly (Power 1992).

Similar to flooding, a number of streams within the project area are subject to organic and inorganic enrichment from allochthonous (terrestrial) sources (AMD, fertilizers, stockpiled poultry manure, cattle excrement, pesticides, herbicides) that consequently impact surface and ground water quality, aquatic habitat, and the metabolism of aquatic organisms. In addition to allochthonous sources, autochchthonous (in-stream) sources such as increased BOD as a result of detrital breakdown and siltation of interstitial zones, impact the types and diversity of macroinvertbrates that are capable of inhabiting a stream.

The elasticity or resiliency of a stream system to physical and biological disturbances is a complex and dynamic issue. Streams are systems that are both spatio-temporal and seasonal by nature. As Power (1992) points out, most natural communities exhibit a sharp drop in densities of organisms as a result of major disturbances (e.g., floods, fire, landslides). However, as communities recover, community structure and accrual of trophic level biomass may reflect historical accident, differential dispersal capabilities, and population growth rates of early colonizing species or those residual species that survived the period of disturbance. In this study, the degradation of a stream system was measured by its relative similarity to the regional reference stations as detailed in Table 8.

For each stream system, land use, total habitat assessment scores, and BI ranks were identified. Exhibit 3 details baseline stream conditions and land use data for the IRA and Line A. Color codes were used to distinguish differences between streams with differing BI ranks. For streams that possessed more than one sample point, BI ranks were averaged. Streams that were subject to AMD were identified with a separate color code.

2. LEADING CREEK LOCAL PROJECT WATERSHED

The Leading Creek local project watershed is stream system is subject to a number of anthropogenic pollutants. As a group, the average BI rank was 0.38 or a ranking of "C". This watershed exhibited a significant association (Pearson Correlation, adjusted squared multiple $r = 0.81$; Bartlett chi-square Statistic, $p < 0.001$; Appendix B) between total habitat assessment score and BI rank. This association suggests that there is a positive association between total habitat quality and the biotic integrity of this stream system. Because no defined functional relationship exists between these two parameters, it is assumed that other variables such as non-point source pollutants, geomorphology, and land use (as examples), also affect both parameters independently. As Exhibit 3 illustrates, the main-stem of Leading Creek is of moderately impaired water quality, with a number of its nonforested third order tributaries having severely impaired water quality.

Land use within the Leading Creek local project watershed is dominated by cattle grazing and agriculture. However, there are several wetland systems associated with the floodplain of Leading Creek. These forested and scrub-shrub wetlands enhance the water quality of Leading Creek by performing a variety of wetland functions (e.g., sediment trapping, flood flow alteration and retention, nutrient transformation). It is important to note that third order streams that emanate from within forested regions are of higher water quality than those that flow through agricultural zones (Exhibit 3). This relationship generally holds true for the entire project area between both ecoregions. Baseline conditions for this stream system indicate that Leading Creek is a stressed system. Evidence of severe flooding, low quality first order tributaries, uncontrolled agricultural runoff of fertilizers, animal excrement, and siltation are the predominant sources of pollutants. It is also assumed that fecal coliform levels within this watershed are high. Fecal coliforms, which are bacteria that inhabit the intestines of birds and mammals, are released into the environment through feces.

Projected cumulative impacts as a result of the construction and operation of either the IRA or Line A would not measurably alter baseline surface water quality within the Leading Creek local project watershed. This is based on the nature and history of on-going cumulative impacts (e.g., deforestation, conversion to grazing and agricultural production) within this watershed. The institution of sound watershed management practices would greatly enhance Leading Creek's potential as a warm water fishery and it's water quality to down stream users (Tygart River).

3. SHAVERS FORK LOCAL PROJECT WATERSHED

The Shavers Fork local project watershed within the vicinity of the proposed IRA and Line A alternative is dominated by deciduous and mixed forests. As Exhibit 4 illustrates, the IRA will bridge the Shavers Fork in the town of Parsons, West Virginia in an area that is extensively developed. The IRA would follow US 219 adjacent to Haddix Run, a tributary that possesses both good riparian and aquatic habitat. In contrast, Line A would cross the Shavers Fork upstream of the IRA within an undeveloped agricultural area. Line A would then traverse the Pleasant Run watershed, which is identified as a trout stream possessing excellent riparian habitat.

The IRA would have negligible impacts to the habitat and biotic integrity of the Shavers Fork. Foreseeable cumulative impacts as a result of the proposed IRA would include deforestation and increased sediment loads to Haddix Run. Additional development within this watershed is not anticipated. Haddix Run has been previously disturbed as a result of the construction and operation of US 219. However, the IRA could significantly reduce the biotic integrity of Haddix Run primarily as a result of direct and secondary impacts. This is based on the proximity, number, and location of cuts adjacent to Haddix Run, which could alter surface water hydrology, water temperature, and could result in the loss of aquatic habitat due to sedimentation and encroachment into the floodplain.

Line A would also have negligible impacts to the habitat and biotic integrity of the Shavers Fork. It is believed that Line A could impact Pleasant Run for similar reasons as those outlined for Haddix Run. Although Line A would impact marginal riparian areas, Line A will require substantial deforestation and cuts on a regionally steep slope paralleling the entire length of Pleasant Run.

As a group, the average BI rank for the Shavers Fork local project watershed was 0.59 or a ranking of "B". This watershed also exhibited a significant positive association (Pearson Correlation, adjusted squared multiple r = 0.906; Bartlett chi-square statistic, p = 0.025; Appendix B) between total habitat assessment score and BI rank. Unlike the Leading Creek local project watershed, the Shavers Fork local project watershed is composed primarily of forest (Exhibit 4). As Exhibit 4 illustrates, all stream systems within this local project watershed are of moderate to high water quality and habitat value. Within this local project watershed, only Pleasant Run is reported to contain trout. Shavers Fork is stocked, but not within the vicinity of the proposed project.

4. BLACK FORK LOCAL PROJECT WATERSHED

As a group, the average BI rank for the Black Fork local project watershed was 0.59 or a ranking of "B". This watershed also exhibited a significant positive association (Pearson Correlation, adjusted squared multiple r = 0.759; Bartlett chi-square statistic, p = 0.001; Appendix B) between total habitat assessment score and BI rank. This local project watershed is composed of stream systems (North Fork of the Blackwater River, Long Run, Big Run, Pendleton Creek, Blackwater River, and Beaver Creek) with differing water quality. Within this local project watershed large portions of the watershed have been subjected to deep and surface coal mining. As Exhibit 5 illustrates, these areas include drainage areas for Beaver Creek, the North Fork of the Blackwater River, Pendleton Creek, Long Run and Middle Run.

The Black Fork River possessed a BI ranking of "C" within the vicinity of Parsons, West Virginia. Based on existing land use within this local watershed, it is anticipated that no significant cumulative impacts would be attributed to construction of either the IRA or Line A for this river.

Roaring Run, a native trout stream that received an average BI ranking of "B", will be impacted by construction of either the IRA or Line A. However, the IRA will impact this stream system to a greater degree than Line A. This local watershed is composed of forest, agricultural, and rangeland within its mid to lower basin and entirely forested near its headwaters. Aside from the construction and operation of the proposed project, no additional alterations to this watershed are anticipated.

No significant cumulative impacts are anticipated for stream systems within the Monongahela National Forest (Big Run, Tub Run, Long Run, and Middle Run, North Fork Blackwater River). This is based on planned avoidance measures to minimize physical encroachments of stream channels and forested riparian buffer zones and the impact of AMD on the North Fork Blackwater River and sections of Middle and Long Run. AMD has significantly impacted these stream systems (Exhibit 5).

No additional cumulative impacts are expected to occur within this local project watershed as a result of construction and operation of either alignment alternative. This is based on baseline surface water conditions of Pendleton Creek (BI rank = "C"), lack of foreseeable future development, existing land use adjacent to Pendleton Creek, and the proposed location of alignment crossings within this watershed.

Beaver Creek and a majority of its tributaries (Exhibit 5) received BI ranks of "C". Both the IRA and Line A parallel Beaver Creek and WV 93. The vast majority of Beaver Creek flows through exposed mine spoil areas, newly reclaimed areas, and large wetland systems (e.g., Elder Swamp). Many of the intermittent and perennial tributaries to this stream system showed evidence of AMD. Based on existing surface water quality and riparian habitat quality, no significant reduction in BI ranking is anticipated for this stream system. This stream system is significantly degraded to that of its reference stream. Additionally, in most instances, when the IRA and Line A diverge from SR 93, SR 93 is positioned between Beaver Creek and the IRA and Line A.

In summary, cumulative impacts as a result of the construction and operation of the proposed facility could potentially impact five primary stream systems within the Black Fork local project watershed. These stream systems include the Black Fork River, North Branch of the Blackwater River, Pendleton Creek, and Beaver Creek. However, based on existing water quality, local project watershed land use, and the projected ancillary development (or lack of) within these local watersheds, it is concluded that only Roaring Run may be subject to a significant reduction in BI rank relative to its reference station as a result of either alignment alternative.

5. NORTH BRANCH OF THE POTOMAC RIVER REGIONAL PROJECT WATERSHED

This regional project watershed is divided into two local project watersheds which include the Stony River local project watershed and the Patterson Creek local project watershed (Exhibit 6). Suspected sources of pollution in the North Branch of the Potomac River include sediment runoff from agriculture, timbering, oil and gas exploration, and coal refuse piles. Acid mine drainage, primarily from abandoned mines also poses a major problem, but is generally limited to the drainages of the Stony River and Abrams Creek.

As a group, the Stony River local project watershed, possessed an average BI rank of 0.39 or a ranking of "C". This watershed did not exhibit a significant association between total habitat assessment score and BI rank (Exhibit 6). No measurable cumulative impacts are anticipated within this local project watershed as a result of the proposed project.

As a group, the Patterson Creek local project watershed possessed an average BI rank of 0.55 or a ranking of "B". This watershed exhibited a significant positive association (Pearson Correlation, adjusted squared multiple $r = 0.79$; Bartlett chi-square statistic, $p < 0.001$; Appendix B) between total habitat assessment score and BI rank (Exhibit 7). No measurable cumulative impacts are anticipated within this local project watershed as a result of the proposed project.

6. SOUTH BRANCH OF THE POTOMAC RIVER REGIONAL PROJECT WATERSHED

Existing land use within the South Branch of the Potomac River regional project watershed is dominated by deciduous forests, cropland, and pasture. Although the water quality of the South Branch is considered excellent and is renowned for its smallmouth bass (*Micropterus dolomieui*) fishery, a number of its tributaries within the regional project watershed are impacted by non-point source pollution associated with agriculture, cattle, swine, rabbit, poultry, and forestry production. Of growing concern is the effect of the poultry industry on ground and surface waters (USFWS 1994; Constantz 1990; Ritter 1986; Ritter and Chirnside 1987) and fecal coliform levels which may exceed clean water standards (Water Resources Board 1990). Problems associated with expansion of this industry include floodplain disruption, silt and fecal contamination from improper disposal of poultry manure, and contamination from the improper disposal of dead poultry.

Results of the stream analysis indicate that small forested headwater streams are marginally productive with respect to macroinvertebrate diversity and density, yet are of high habitat and ecological value to the South Branch. However, many of these streams eventually flow through poultry, pasture, and grazing lands that are subject to non-point source pollution. These streams have been identified in Exhibits 8 and 9 and include the upper reaches of Toombs Hollow, long reaches of Walnut Bottom, Anderson Run, Dumpling Run, and Fort Run.

Baseline conditions for this regional project watershed indicate that it is a stressed system. Current and projected land use and lack of watershed management practices have led to a significant degradation of surface water resources in the lower reaches of streams within this local project watershed. Therefore, additional cumulative impacts to surface water resources as a result of the construction and operation of the proposed project will be inconsequential when compared to that of existing land use impacts. Cumulative impacts to surface water resources will continue within this regional project watershed with or without construction of the proposed facility. As is the case with Leading Creek, implementation of sound watershed management practices and restoration of forested riparian buffers would improve (i.e., increase in BI rank) baseline surface water resources.

As a group, the Anderson Run local project watershed possessed an average BI rank of 0.59 or a ranking of "B" (Exhibit 8). However, this watershed did not exhibit a significant association between total habitat assessment score and BI rank. The Main Channel of the South Branch local project watershed possessed an average BI rank of 0.27 or a ranking of "C". This watershed exhibited a significant positive association (Pearson Correlation, adjusted squared multiple $r = 0.68$; Bartlett chi-square statistic, $p = 0.001$; Appendix B) between total habitat assessment score and BI rank. The Clifford Hollow local project watershed possessed an average BI rank of 0.80 or a ranking of "A" (Exhibit 9). This watershed did not exhibit a significant association between total habitat assessment score and BI rank because of the small sample size (2 samples). No measurable cumulative impacts are anticipated within this local project watershed as a result of the proposed project.

7. CACAPON RIVER REGIONAL PROJECT WATERSHED

The Cacapon River regional project watershed can be divided into two distinct river systems. Those that drain into the Lost River (upstream of WV 55 bridge crossing) and those that drain into the Middle Cacapon River (beginning near Wardensville, WV).

The Cacapon River's water quality varies significantly depending on location and water level (Constantz et al. 1993). Both the Lost River and Middle Cacapon River sections receive non-point source pollutants and have been identified by Constantz et al. (1993) as being relatively more polluted than other stream reaches further downstream in the basin. It is also known that fecal coliform levels within this watershed are high, and depending upon the season, exceed state water quality standards (Constantz et al. 1993). Many of the non-point source pollution problems that plague the South Branch of the Potomac River were observed in the upper reaches of the Lost River basin and its tributaries. However, as a whole the Lost/Cacapon River system is in relatively "good" health (Constantz et al. 1993). The streams analysis performed for this study support those of Constantz et al. (1993). Furthermore, this report also identifies a number of tributaries to both stream systems within this regional project watershed that are either severely degraded or of excellent water quality.

With respect to foreseeable cumulative impacts, a number of impacts have already been identified as concerns for this regional project watershed. They include population growth, growth of the poultry industry, and multiple dam construction. The construction of the proposed project may encourage growth in the region and the poultry industry. The third projected impact (multiple dam construction) would permanently alter the Lost/Cacapon River system. Dams constitute the "death" of a free-flowing river in that they turn a river into a series of navigation pools, whereby species that require shallow flowing water and riffles will be extirpated from the river system. For example, many daces, darters, macroinvertebrates, and freshwater mussel could be lost.

Skaggs Run local project watershed possessed an average BI rank of 0.54 or a ranking of "B" (Exhibit 10). This watershed did not exhibit a significant association between total habitat assessment score and BI rank. Skaggs Run is located at the western edge of the Cacapon watershed and drains toward the North River, a major tributary to the Cacapon River north of the project area. Skaggs Run flows through a combination of mixed forest and agricultural land. The construction and operation of either the IRA or Line A is not expected to induce cumulative impacts within this local project watershed. Presently this local project watershed is already subject to nonpoint source pollution from poultry, cattle, and crop production.

The Baker Run local project watershed possessed an average BI rank of 0.77 or a ranking of "B". This watershed includes Baker Run, Long Lick Run, Camp Branch, Parker Hollow Run, and Bears Hell Run. This watershed exhibited a significant positive association (Pearson correlation, adjusted squared multiple $r = 0.96$; Bartlett chi-square statistic, $p = 0.016$; Appendix B) between total habitat assessment score and BI rank. Both proposed alignments generally parallel Baker Run from its confluence with the Lost River to its headwaters (Exhibit 10). Construction of the proposed project could facilitate cumulative impacts to surface waters within this local project watershed by increasing expansion of livestock and poultry production and the ensuing changes in habitat associated with these industries.

The Central Cacapon River local project watershed possessed an average BI rank of 0.58 or a ranking of "B". This watershed did not exhibit a significant association between total habitat assessment score and BI rank. This was due to several first order stream samples possessing high total habitat assessment scores but low Biotic Integrity scores. These headwater streams are located on steep forested slopes and are naturally low in macroinvertebrate diversity and density (Exhibit 10). The IRA and Line A would follow the Lost River north of WV 55 (from Hanging Rock to WV 55 bridge crossing), however, there will be no physical impacts to the river channel or its riparian buffer zone (this also includes Sauerkraut Run, a wild trout stream). As Exhibit 10 illustrates, the majority of this local project watershed is forested, adjacent to George Washington National Forest, and not conducive to floodplain development. Therefore, no foreseeable cumulative impacts to this local project watershed would be attributed to construction of either alternative.

The Waites Run local project watershed possessed an average BI rank of 0.76 or a ranking of "B" (Exhibit 11). This watershed exhibited a significant positive association (Pearson Correlation, adjusted squared multiple $r = 0.98$; Bartlett chi-square statistic, $p = 0.002$; Appendix B) between total habitat assessment score and BI rank. Both Waites Run and Trout Run are stocked trout streams that drain into the

Middle Cacapon. Both these streams are productive coldwater fisheries. One foreseeable cumulative impact as a result of constructing either alternative will be an increase in fishing pressure on these streams. However, this impact is a positive economic/recreation impact for Wardensville.

Lastly, the Slate Rock Run local project watershed (Exhibit 11) possessed an average BI rank of 0.73 or a ranking of "B". This watershed did not exhibit a significant association between total habitat assessment score and BI rank. Because this local project watershed is located within the George Washington National Forest, no cumulative impacts are anticipated.

8. SHENANDOAH RIVER REGIONAL PROJECT WATERSHED

The Shenandoah River regional project watershed, which is wholly within Virginia, is composed of deciduous and mixed forests, cropland, and pasture. Streams potentially impacted within this local project watershed include Duck Run, Eishelman Run, Turkey Run, Zanes Run and Mulberry Run. The headwaters of Town Run are located along the eastern end of the project area. As Exhibit 12 illustrates, the Duck Run and Cedar Creek watersheds are dominated by forest while tributaries to Turkey, Mulberry, and Town Run are dominated by farmland. For subwatersheds that are dominated by agriculture and cattle production, existing impacts include low quality first order tributaries, organic loading from fertilizers and animal excrement, and siltation. Duck Run, which is protected as an Outstanding State Waters resource, and a headwater tributary to Paddy Run, are native trout streams. Cedar Creek, which is stocked under VA's put-and-take program, is listed on the Nationwide Rivers Inventory. These subwatersheds are more sensitive to watershed degradation than those currently impacted by agricultural development (Mulberry Run and Town Run).

As a group, the Cedar Creek local project watershed possessed an average BI rank of 0.54 or a ranking of "B". This watershed did not exhibit a significant association between total habitat assessment score and BI rank. Cumulative impacts could occur within the Duck Run local project watershed. Although this watershed is wholly within the George Washington National Forest, there is the potential for aquatic habitat degradation a result of deforestation, increased surface water temperature, and alterations in surface flow. It is speculated that consistent water chemistry, baseline flow, and low water temperature are important reasons Duck Run can maintain native trout throughout the year. Both the IRA and Line A (including Option Alignments) would traverse a large portion of the Duck Run watershed (see the Alignment and Resource Location Plans, Sheets 67 and 68). The IRA would require more encroachments to Duck Run while Line A and Option Alignments would require substantial cuts and deforestation. These impacts are discussed in the Environmental Consequences Section of this report.

No additional significant cumulative impacts to surface waters are anticipated within this regional project watershed based on existing land use and baseline aquatic habitat conditions.

B. CUMULATIVE IMPACTS SUMMARY

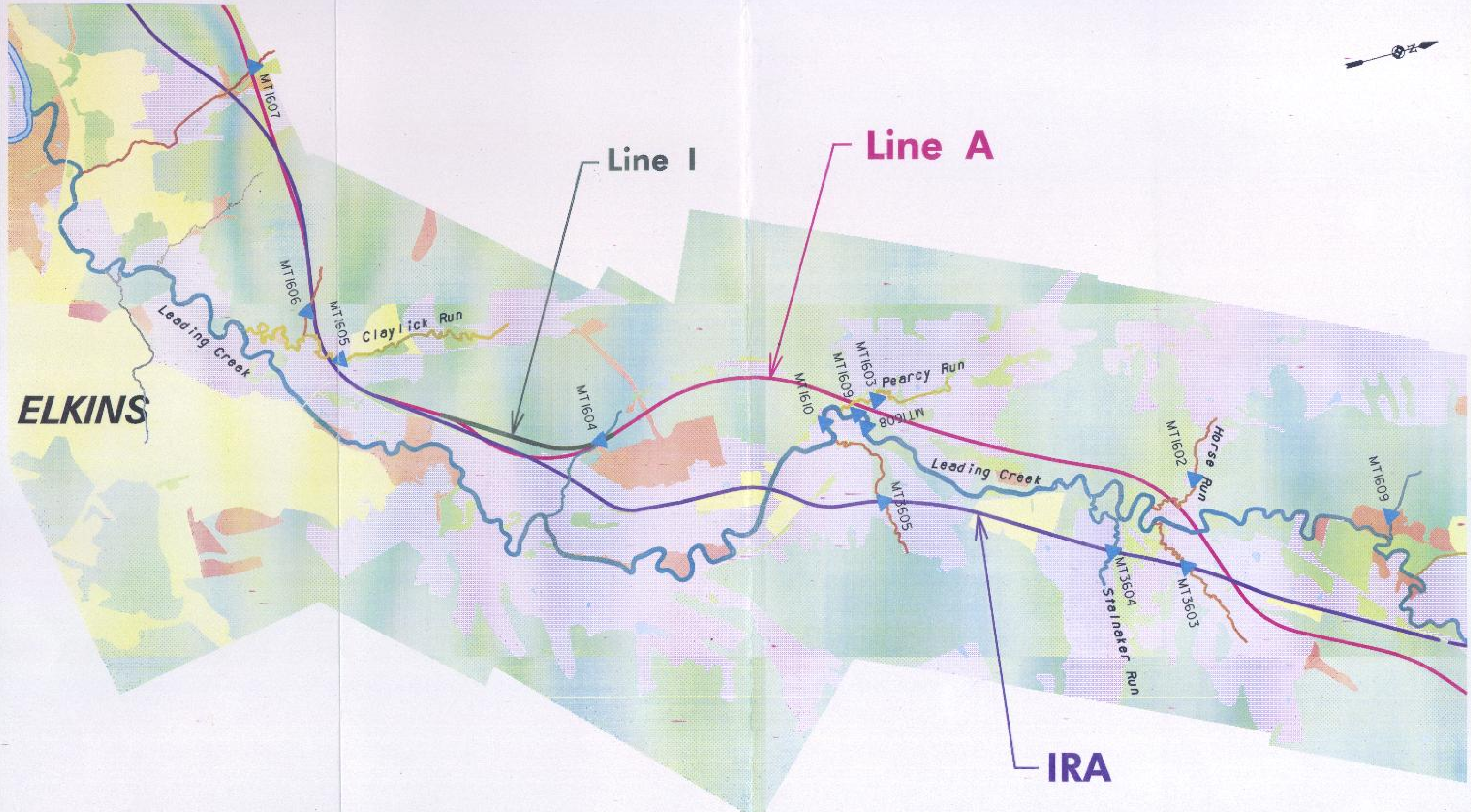
Cumulative impacts as a result of the proposed project are dependent on two factors. First, the type and degree of previous development within a watershed which dictates the impact of additional development within that watershed. Second, the difference in the rate of predicted growth due to the construction of the proposed project in comparison to the rate of growth and development without the project. The question is whether the construction of the proposed facility would facilitate development to such a degree that significant impacts to surface waters occur. Regional project watersheds and local project watersheds were analyzed for existing conditions. A number of trends were clearly apparent from this analysis.

- The project area largely occurs within rural environs. Major industries are tied to natural resources (coal, timber, gas) and agricultural goods (livestock, poultry, crop production). Surface waters exposed to these industries are degraded in comparison to undisturbed reference streams. It is concluded that the proposed project may accelerate previously planned development. However, construction and operation of the proposed facility would not facilitate development to such a degree that significantly greater impacts to surface waters occur.

- Streams that are within forested watersheds are generally of good water quality. However, many of these streams empty into large floodplains where the dominant land use is cattle and agricultural production. Non-point source pollution has been identified as a serious problem (human health) for streams associated with these land uses. Acid Mine Drainage (AMD) has also been identified as a problem, particularly in the Black Fork local project watershed.

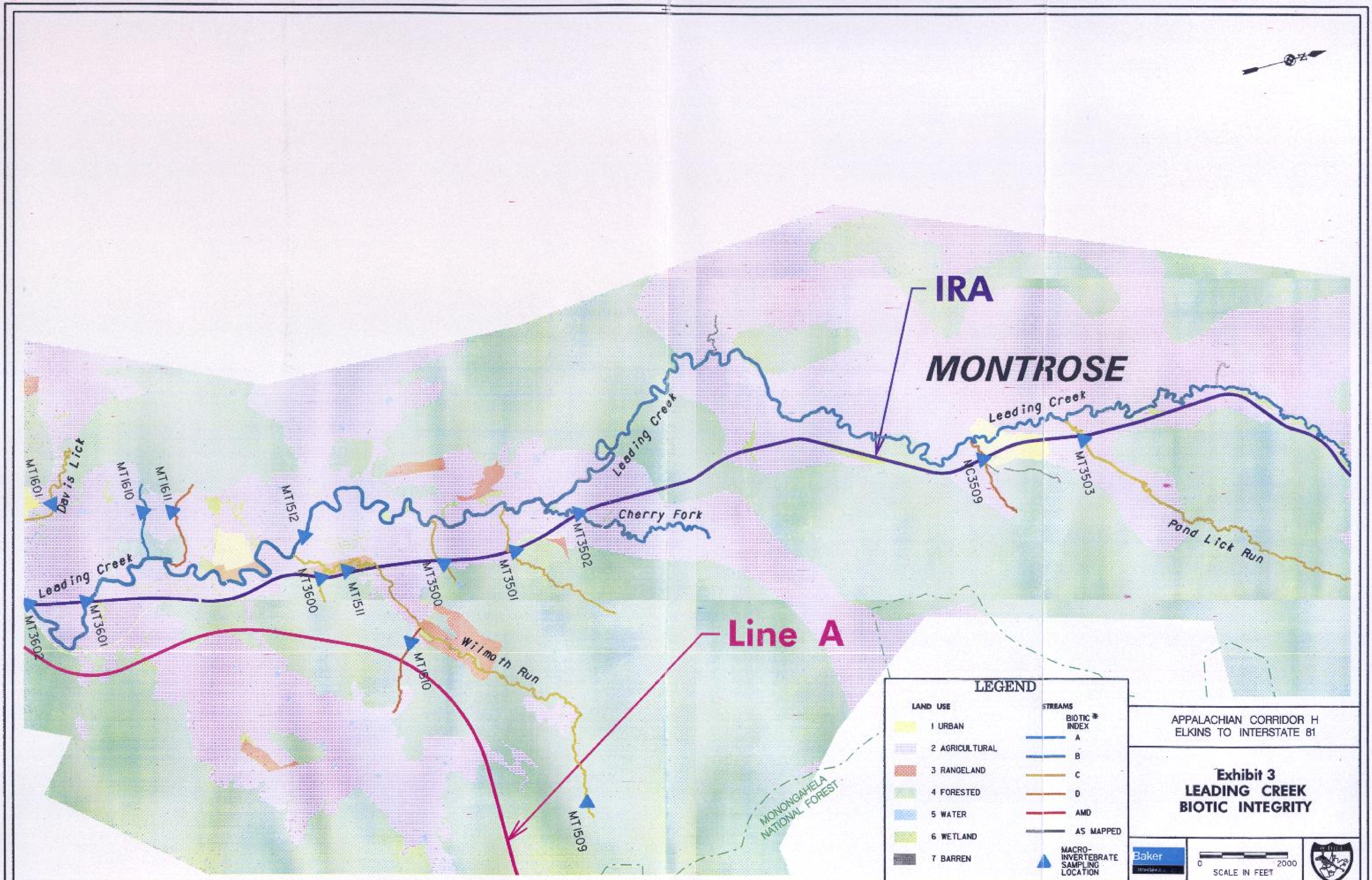
- Local project watersheds that are subject to degradation as a result of agricultural practices (e.g., fecal contamination, degraded riparian buffer strips, organic loading of fertilizers) include Leading Creek, Black Fork River (also AMD), Stony River (also AMD), Anderson Run, Main Channel, and portions of Patterson Creek, Skaggs Run, Baker Run, Central Cacapon (Lost River/Middle Cacapon), and Cedar Creek. It should be noted, however, that streams of good water quality do exist within a number of these local project watersheds and that Waites Run and Slate Rock Run local project watersheds are of good water quality.

- Four stream systems have been identified as potentially incurring significant additive effects of direct and secondary impacts as a result of the proposed facility. They include Pleasant Run (Line A) and Haddix Run (IRA) within the Shavers Fork local project watershed, Roaring Run (IRA and Line A) within the Black Fork local project watershed, and Duck Run within the Cedar Creek local project watershed. For differing reasons it is believed that these streams may exhibit a significant reduction in BI ranks as a result of the proposed project. Other stream systems would be impacted to a lesser degree. However, based on projected development within watersheds that are already subject to various degrees of degradation, additional cumulative impacts as a result of the proposed project can be offset by implementing and enforcing sound watershed management practices and watershed-level restoration of degraded riparian buffer strips.

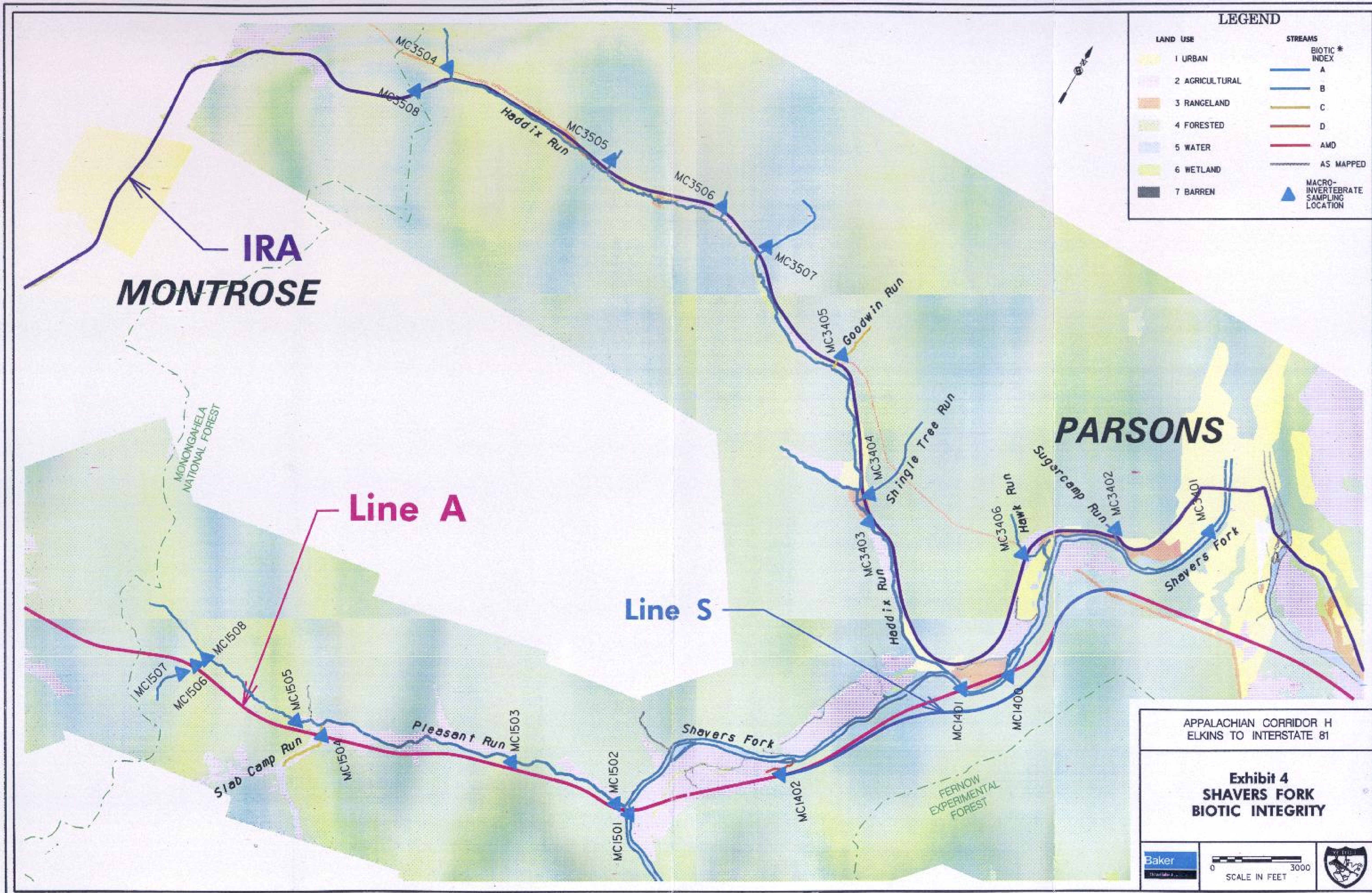

Line I
Line A
IRA
ELKINS
Leading Creek
Leading Creek
Claylick Run
Pearcy Run
Horse Run
Stalnaker Run
MT1607
MT1606
MT1605
MT1604
MT1610
MT1609
MT1603
MT1608
MT3605
MT1602
MT3604
MT3603
MT1609
N

3

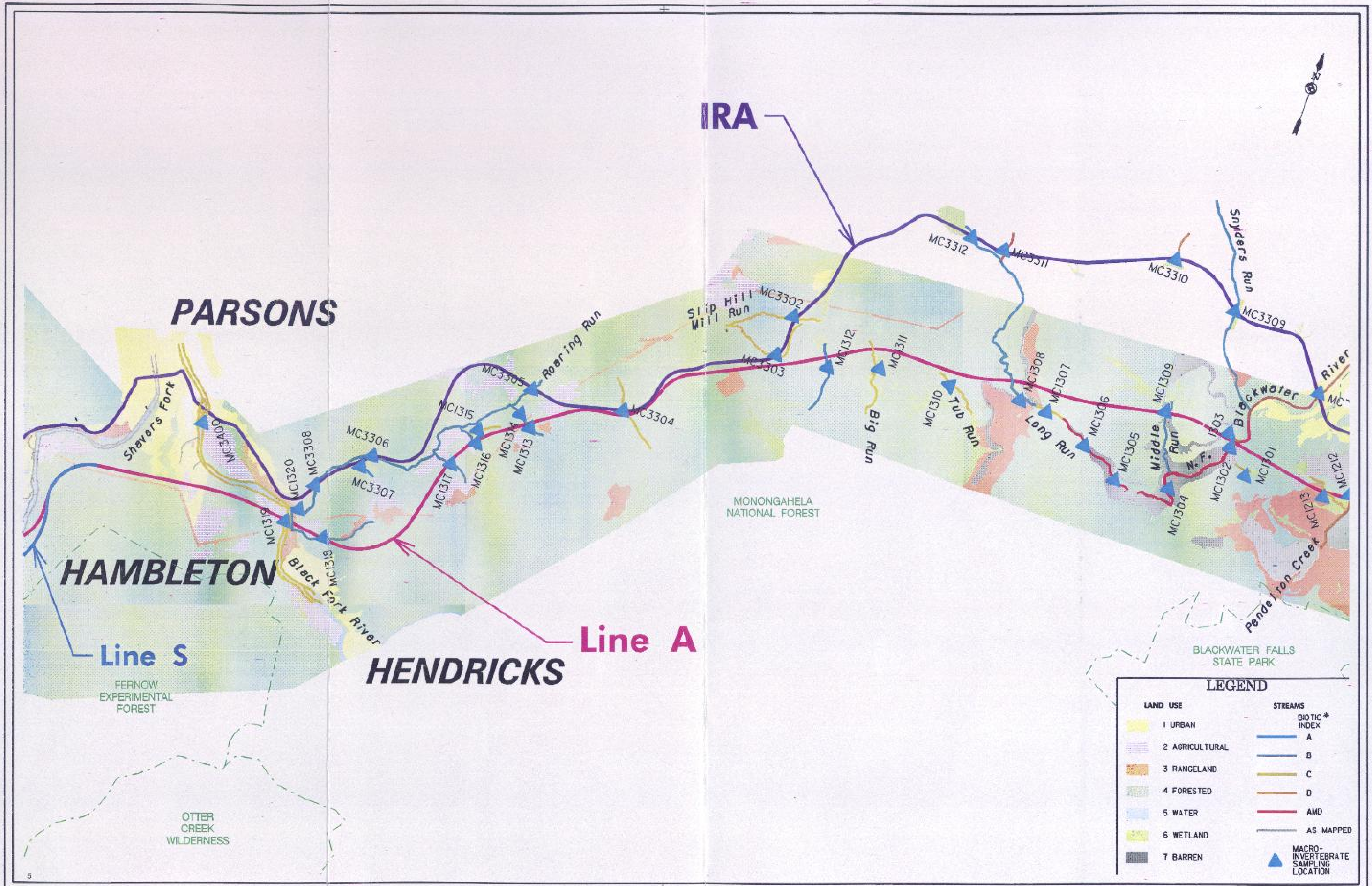
29-NOV-1994



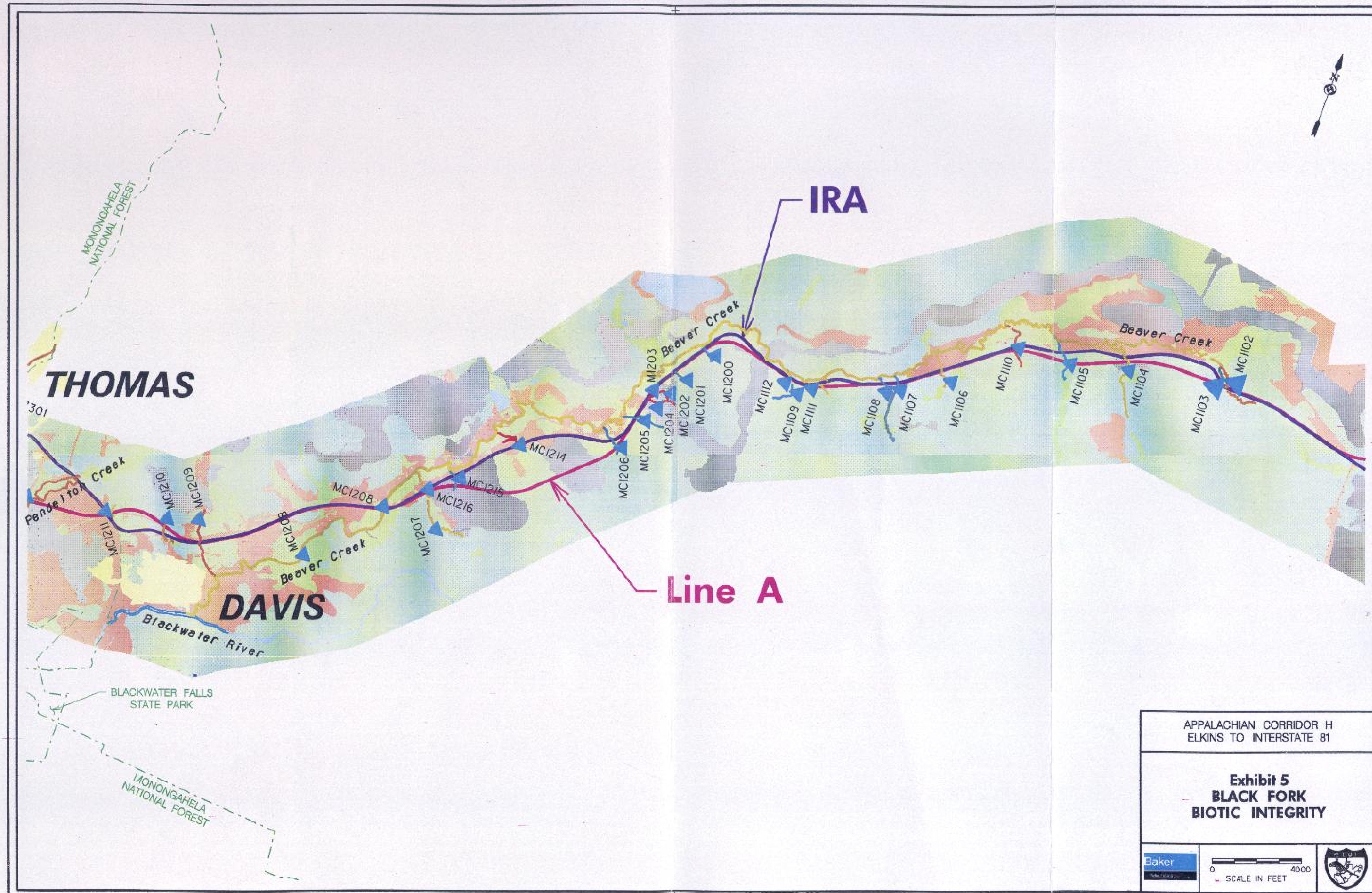
/corh/shtplot/find/streams/bleod2.dgn 29-NOV-1994 11:23



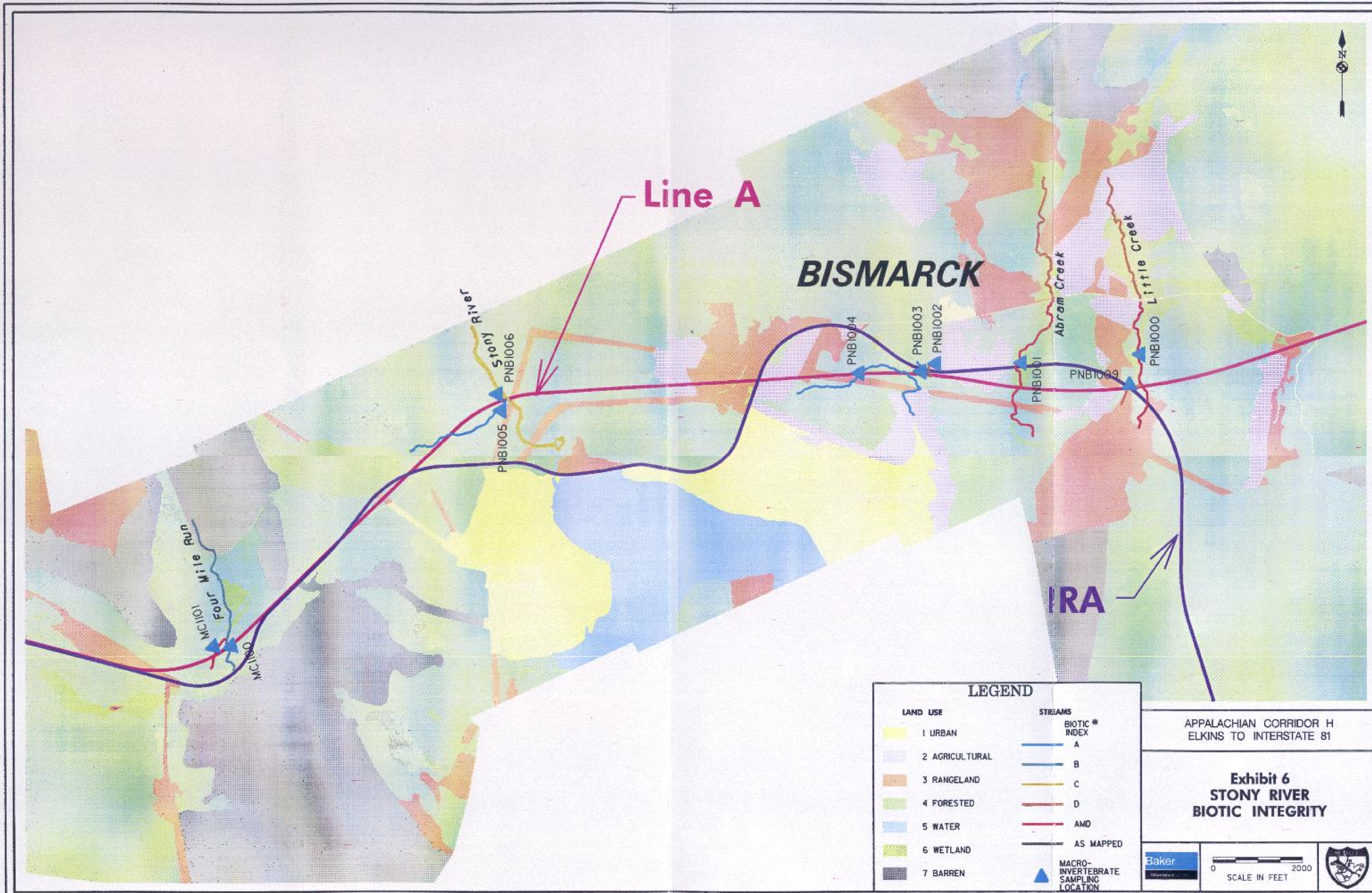
/corh/shtplot/find/streams/bshover.dgn 29-NOV-1994 11:26



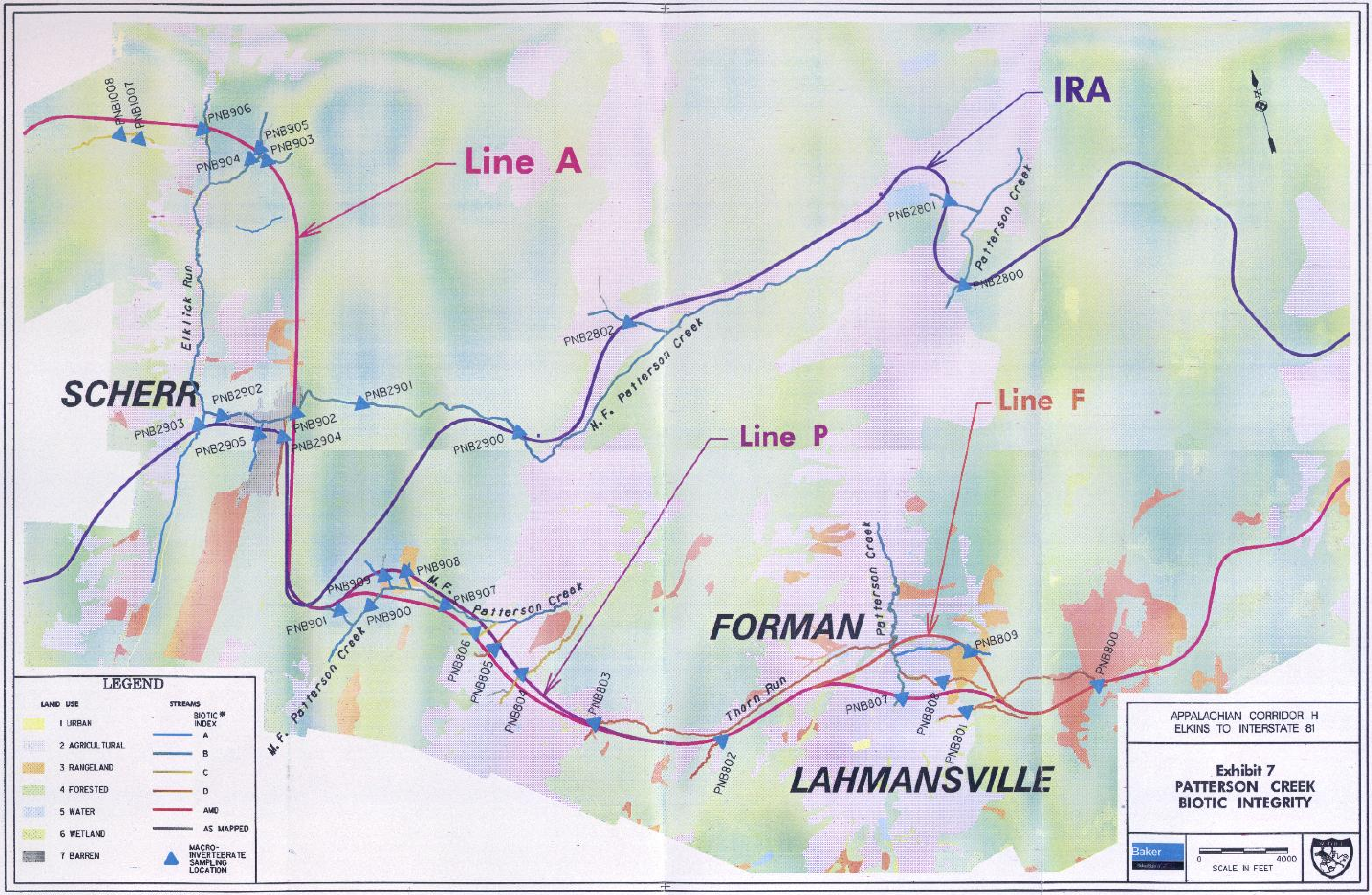
/oorf/ahtplot/final/streams/bkfk2.dgn 29-NOV-1994 11:24



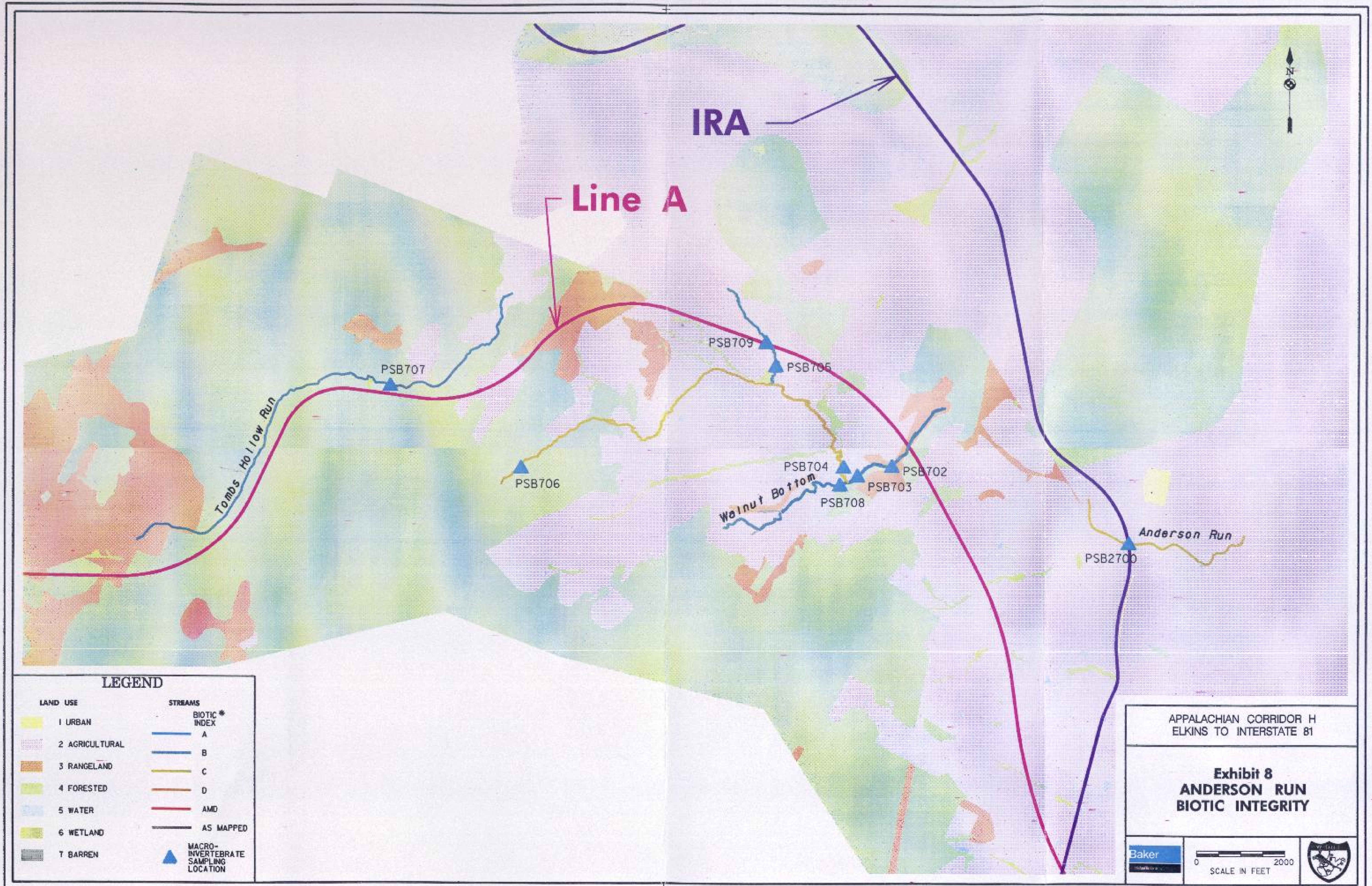
29-NOV-1994 11:23



/corh/shtplot/final/streams/bstony.dgn 29-NOV-1994 11:26



/corh/shtplot/final/streams/bpatter.dgn 29-NOV-1994 11:25



29-NOV-1994 15:59

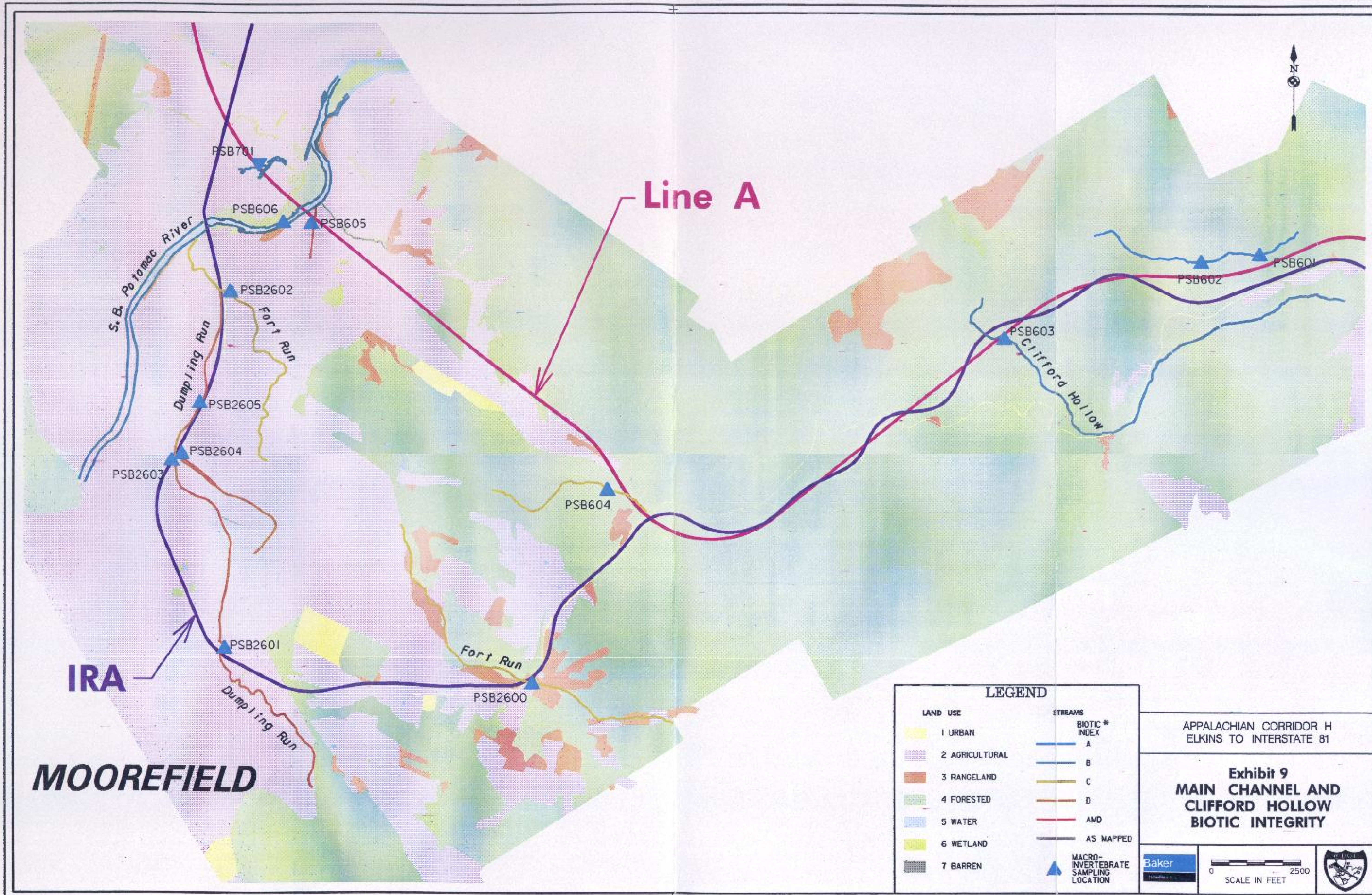
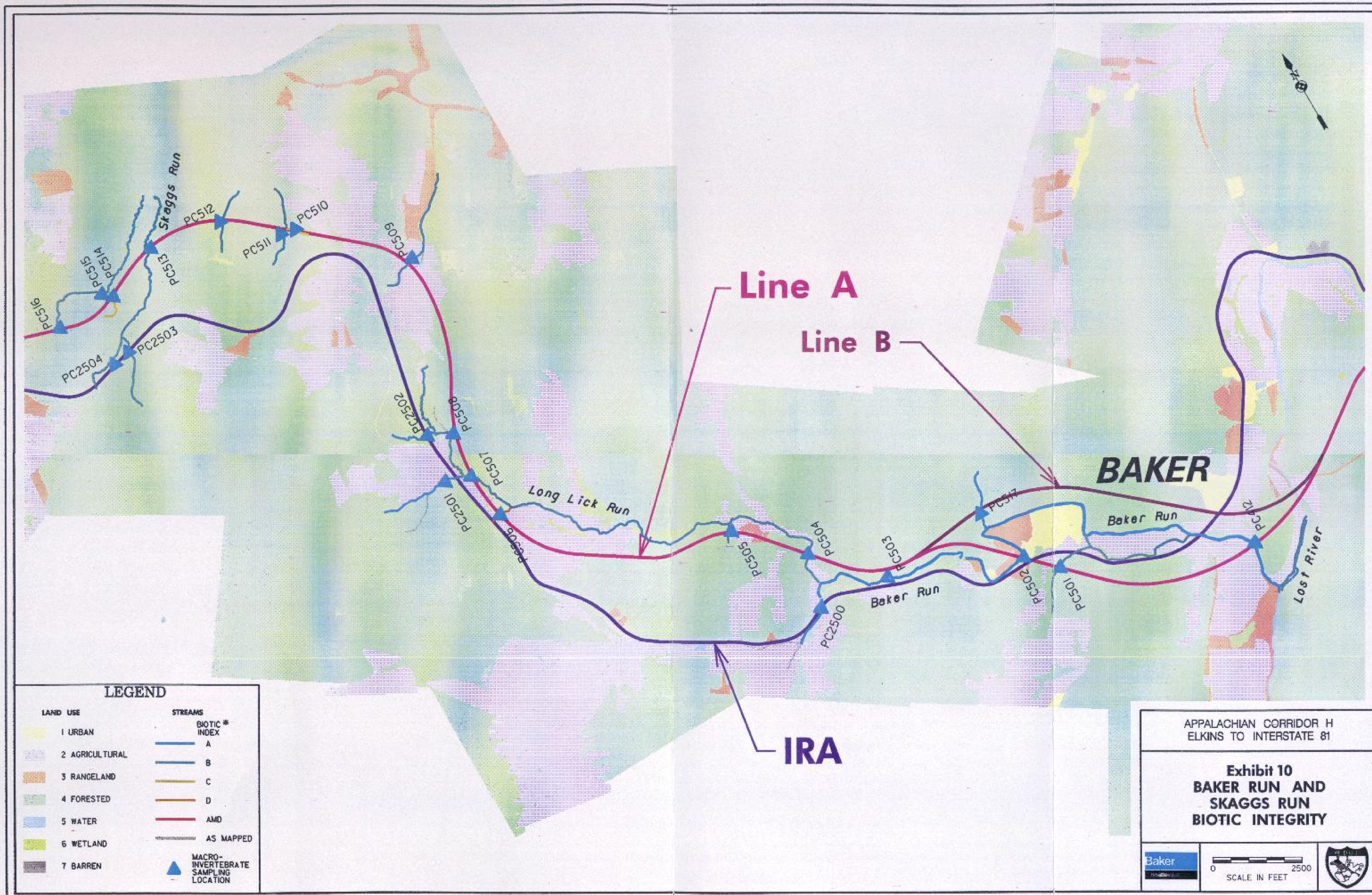
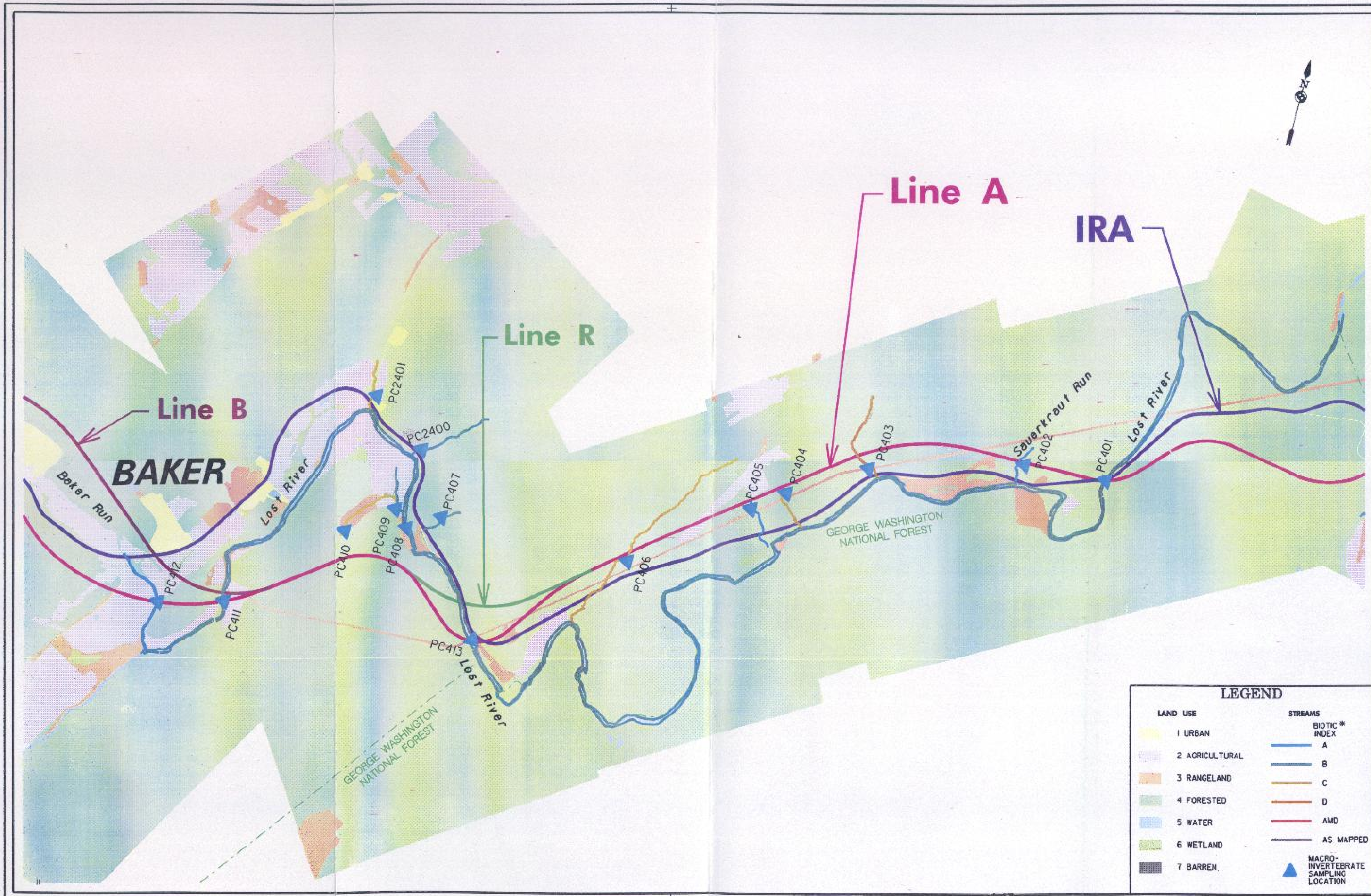
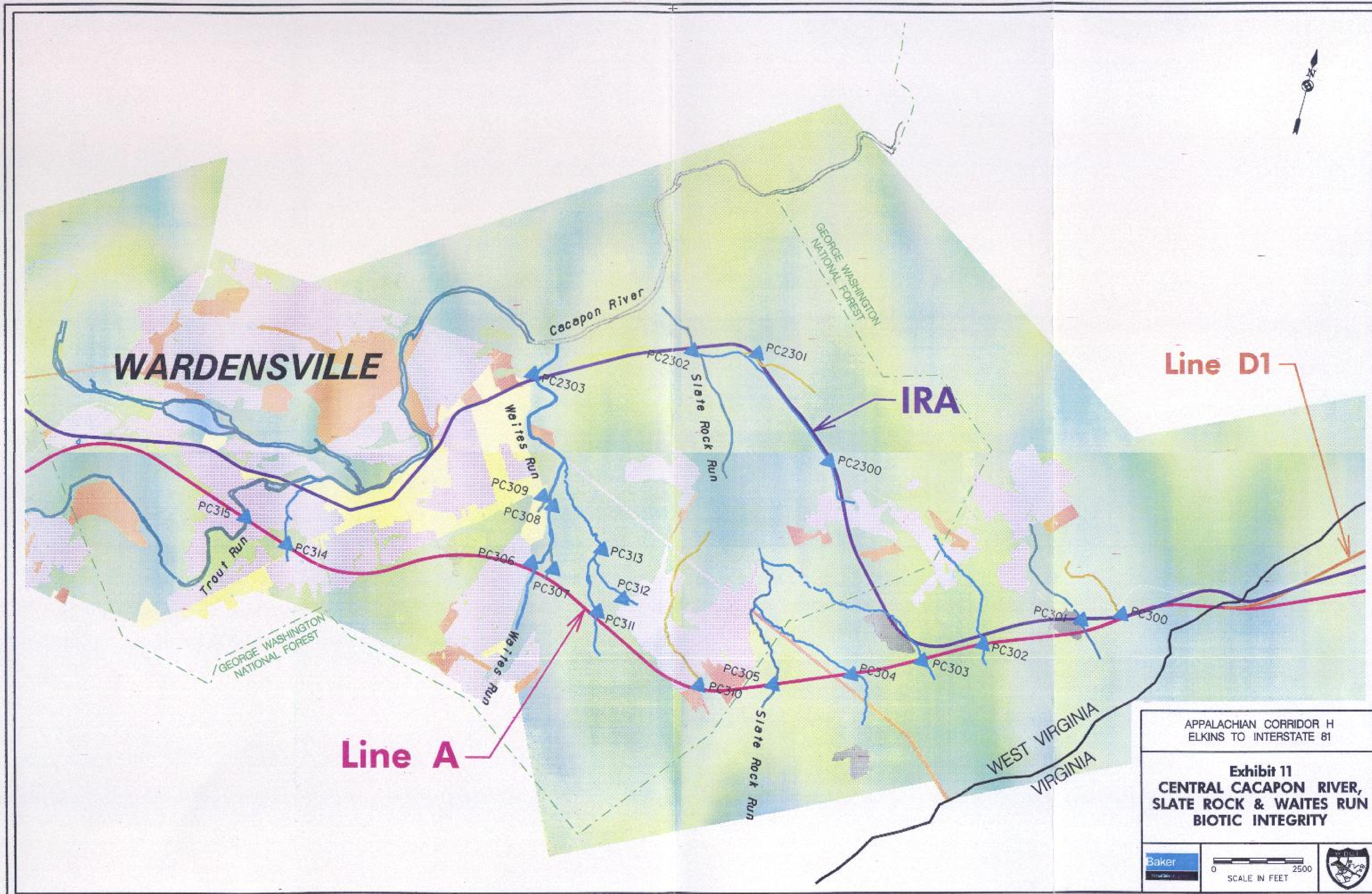


Exhibit 9
MAIN CHANNEL AND CLIFFORD HOLLOW BIOTIC INTEGRITY

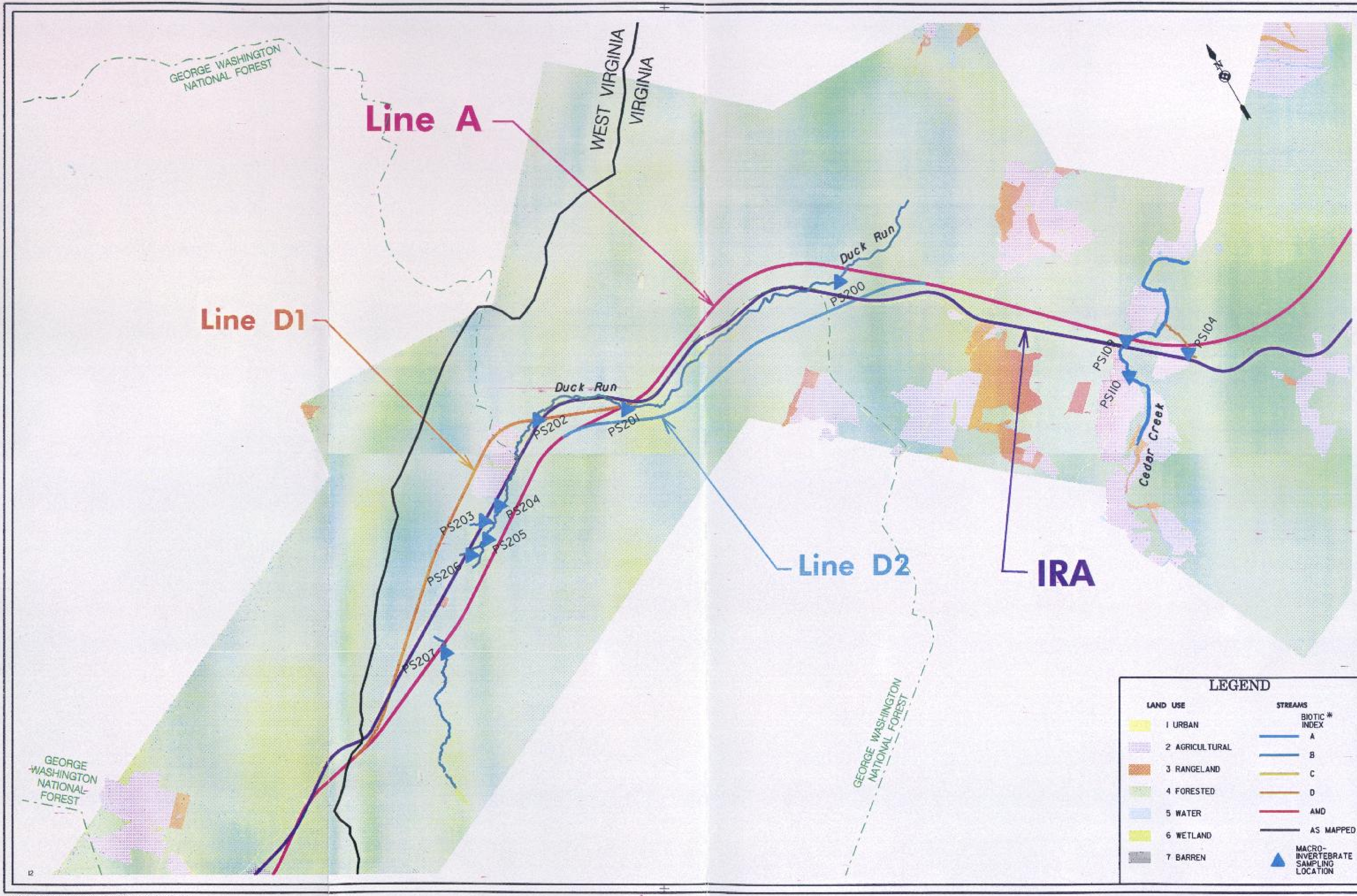


/corr/shtplot/final/streams/bbaker.dgn 29-NOV-1994 15:30

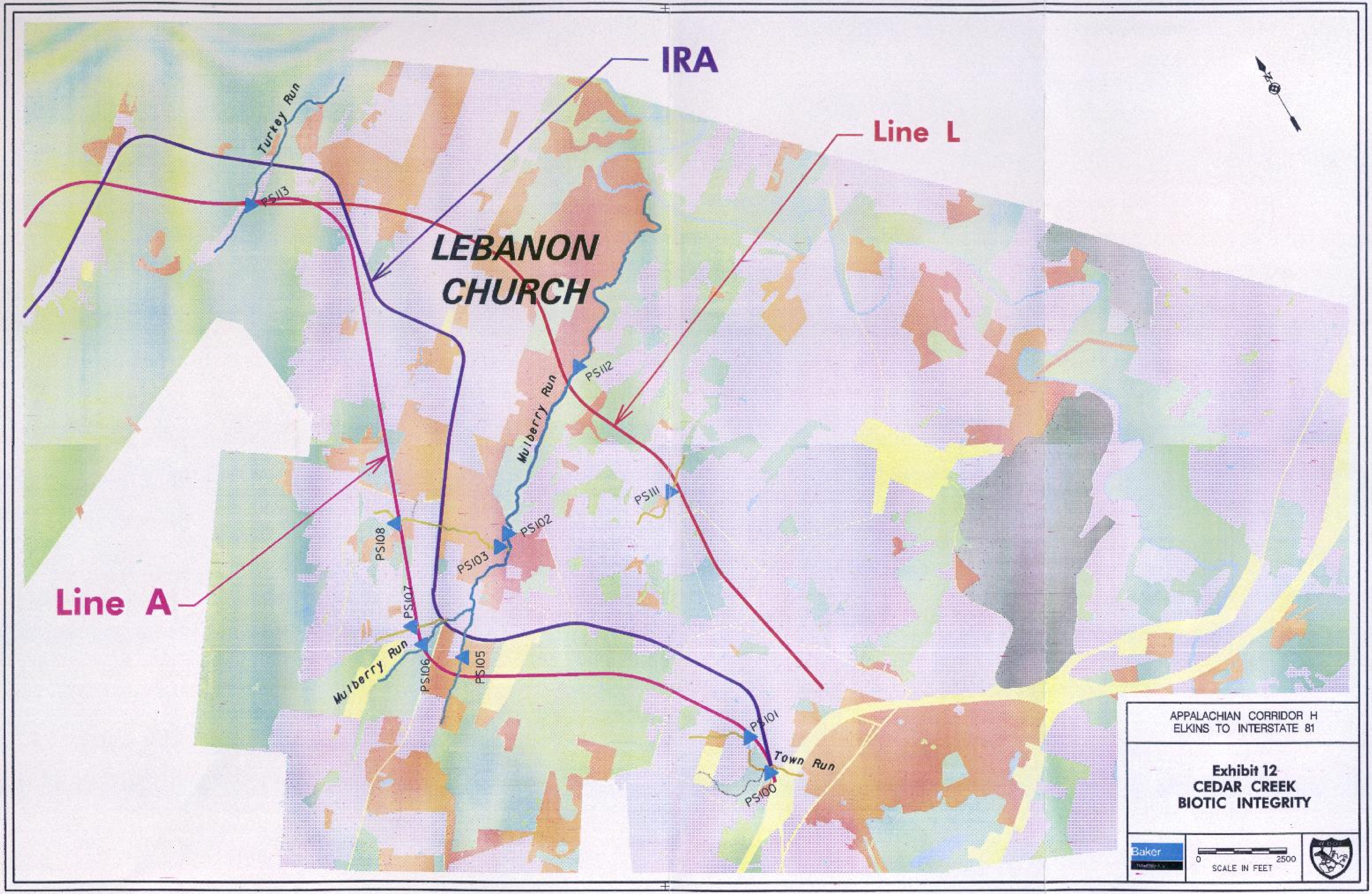

Line A
IRA
Line R
Line B
BAKER
Baker Run
Lost River
Sauerkraut Run
PC2401
PC2400
PC407
PC409
PC408
PC410
PC412
PC411
PC413
PC406
PC405
PC404
PC403
PC402
PC401
GEORGE WASHINGTON NATIONAL FOREST
GEORGE WASHINGTON NATIONAL FOREST
LEGEND
LAND USE
1 URBAN
2 AGRICULTURAL
3 RANGELAND
4 FORESTED
5 WATER
6 WETLAND
7 BARREN
STREAMS
BIOTIC* INDEX
A
B
C
D
AMD
AS MAPPED
MACRO-INVERTEBRATE SAMPLING LOCATION



/earh/shtplot/final/streams/bcacap2.dgn 29-NOV-1994 11:21



/aarh/shtplot/final/streams/boadar2.dgn 29-NOV-1994 13:30


IRA
Line L
Line A
LEBANON CHURCH
Turkey Run
Mulberry Run
Mulberry Run
Town Run
PS113
PS112
PS111
PS108
PS107
PS106
PS105
PS103
PS102
PS101
PS100
APPALACHIAN CORRIDOR H
ELKINS TO INTERSTATE 81
Exhibit 12
CEDAR CREEK
BIOTIC INTEGRITY
Baker
0
2500
SCALE IN FEET

X. REFERENCES

Aldridge, D.W., B.S. Payne, and A.C. Miller. 1987. The effects of intermittent exposure to suspended solids and turbulence on three species of freshwater mussels. *Environmental Pollution, 45:17-28.*

Asplund, R. L., J. F. Ferguson, and B. W. Mar. 1980. Total suspended solids in highway runoff in Washington State. *J. Env. Eng. Div. ASCE*, 108:391-404.

Bailey, R.G. 1976. Ecoregions of the United States (Map scale 1:7,500,000). USDA, Forest Service, Ogden, Utah.

Bartsch, P. 1916. The Missouri River as a faunal barrier. *Nautilus*, 30(8):92.

Bilby, R. 1977. Effects of a spate on the macrophyte vegetation of a stream pool. *Hydrobiologia*, 56:109-112.

Bode, R.W. 1988. Quality assurance workplan for biological stream monitoring in New York State. New York State Department of Environmental Conservation, Albany, NY.

Boesch, D.F. 1977. Application of a numerical classification in ecological investigation of water pollution. Report No. EPA-600/3-77-033. U.S. EPA, Corvallis, Oregon.

Brinson, M.M., B.L. Swift, R.C. Plantico, and J.S. Barclay. 1981. Riparian ecosystems, their ecology and status. FWS/OBS-81/17. USFWS, Washinton, DC.

Brooks, A. 1989 *Alternatives in Regulated River Management.* Edited by J.A. Gore and G.E. Petts, CRC Press, Inc. Boca Raton, Fl.

Brzezinski, M. A., and R. L. Holton. 1981. Vertical distribution and abundance of macroinvertebrates in the Columbia River Estuary following the deposition of volcanic ash from the May 18, 1980 eruption of Mount St. Helens. *Estuaries*, 4(3): 276.

Buikema, A. L., Jr., E. F. Benfield, and C. A. Pittinger. 1983. Effects of pollution on freshwater invertebrates. *J. Wat. Poll. Cont. Fed.*, 55(6): 829-833.

Caucci, A., and B. Nastasi. 1986. Hatches II, a complete guide to fishing hatches of North American trout streams. Lyons and Burford, Publ., PA.

Charbeneau, R. J., M. E. Barrett, R. D. Zuber, E. R. Collins, J. F. Malina Jr., and G.H. Ward. 1993. Areview and evaluation of literature pertaining to the quantity and control of pollution from highway runoff and contstruction. CRWR Technical Report 239, 140 pp.

Constantz, G., N. Ailes, and D. Malakoff. 1993. Portrait of a river: The ecological baseline of the Cacapon River. Pine Cabin Run Ecological Laboratory, High View, WV, 32 pp.

Constantz, G. 1990. What will happen to all the chicken manure? *Cacapon*, 4(4):1.

Cooper, E.L. 1983. *The Impact of Stream Relocation on Fish Populations and Bottom Fauna.* University Park: Institute for Research on Land and Water Resources.

Courtemanch, D.L. and S.P. Davies. 1987. A coefficient of community loss to assess detrimental change in aquatic communities

Corkum, L. 1992. Spatial distribution patterns of macroinvertebrates along rivers within and among biomes. *Hydrobiologia*, 239:101-114.

Cowie, B. 1985. An analysis of changes in the invertebrate community along a southern New Zealand mountain stream. *Hydrobiologia,* 120:35-46.

Croonquist, M.J. and R.P. Brooks. 1993. Effects of habitat disturbance on bird communities in riparian corridors. *Journal of Soil and Water Conservation*, 48(1):65-70.

Cummins, K. W.; Wilzbach, M. A. 1985. Field procedures for analysis of functional feeding groups of stream macroinvertebrates. Univ. Maryland 18 pp. NBPLEC

Dewalt, R. E. and J. H. Olive. 1988. Effects of eroding glacial silt on the benthic insects of Silver Creek, Portage County, Ohio. *Ohio J. Sci.*, 88(4): 154-159.

Diamond, J.M., W. Bower and D. Gruber 1993. "Use of Man-made Impoundment in Mitigating Acid Mine Drainage in the North Branch Potomac River." *Environmental Management.* 17(2) 225-238.

Driscoll, E. D., P. E. Shelley, and E. W. Strecker. 1990. Pollutant loadings and impacts from highway stormwater runoff, Vol. II: analytical investigation and research report. Federal Highway Administration, Office of Research and Development Report No. FHWA-RD-88-008.

Duncan, W. F. A., and M. A. Brusven. 1985. Benthic macroinvertebrates in logged and unlogged low-order southeast Alaskan streams. *Freshw. invert. Biol.*, 5: 125-132.

Dupuis T.V. and N.P. Kobriger. 1985. *Effects of Highway Runoff on Receivving Waters, Vol. IV: Procedural Guidelines for Environmental Assessments.* Report FHWA/RD-84/065, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C.

Eaton, L.E. and D.R. Lenat. 1991. "Comparison of a Rapid Bioassessment Method with North Carolina's Qualitativve Macroinvertabrate Collection Method." *Journal of the North American Benthological Society.* 10(3):335-338.

Ellis, M.M. 1936. Erosion silt as a factor in aquatic environments. *Ecology* 17:29-42.

Energy Mines and Resources Canada. 1986. Canada wetland regions (Map scale 1:7,500,000). MCR 4108. Canada Map Office, Energy, Mines, and Resources Canada, Ottawa, Ontario.

Erman, D. C., E. D. Andrews, and M. Yoder-Williams. 1988. Effects of winter floods on fishes in the Sierra Nevada. *Canadien Journal of Fisheries and Aquatic Sciences*, 45:2195-2200.

Fisher, S.G. 1983. Succession in streams. In J. R. Barnes and G.W. Minshall (eds.), *Stream ecology: applicaltion and testing of general ecological theory*. Plenum, New York, NY, pp. 7-27.

Fisher, S.G. L.J. Gray, N.B. Grimm, and D.E. Busch. 1982. Temporal succession in a desert stream ecosystem following flash flooding. *Ecological Monographs*, 52:93-110.

Garie, H. L., and A. McIntosh. 1986. Distribution of benthic macroinvertebrates in a stream exposed to urban runoff. *Wat. Resour. Bull.*, 22(3):447-455.

Geldreich, E. E. 1966. Sanitary significance of fecal coliforms in the environment. Federal Water Pollution Control Administration, U.S. Dept. of the Interior, 110 pp.

Gerritsen, J., J. Green, and M. T. Barbour. 1993. Selection of reference sites for Ridge and Valley Stream Biological Monitoring Program - Draft Report. USEPA Region 3.

Goldstein, R. M.. 1981. Longitudinal succession in impact assessment of river system fish communities. *Water Res. Bull.*, 17:75-81.

Gray, L.J. and S.G. Fisher. 1981. Postflood recolonization pathways of macroinvertebrates in a lowland Sonoran Desert stream. *American Midland Naturalist*, 106:249-257.

Gray, L. J., and J. V. Ward. 1982. Effects of sediment release from a reservoir on stream macroinvertebrates. *Hydrobiologia*, 96:177-184.

Gupta, M.K., R.W. Agnew, and N.P. Kobriger. Constituents of Highway Runoff, Volume I, State-of-the-Art Report. FHWA/RD-81/042.

Harvey, B.C. 1987. Susceptibility of young-of-the-year fishes to downstream displacement by flooding. *Transactions of the American Fisheries Society*, 116:851-855.

Hilsenhoff, W.L. 1972. Aquatic insects of the Pine-Popple River, Wisconsin. I. Sampling sites and procedures. Wis. Dep. Nat. Resour. Tech. Bull. No. 54:2-8.

Hilsenhoff, W.L. 1982. Using a biotic index to evaluate water quality in streams. Wis. Dep. Nat. Resour. Tech. Bull. No. 132:1-23.

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist, 20:31-39.

Hilsenhoff, W.L. 1988. "Rapid Field Assessement of Organic Pollution with a Family-Leval Biotic Index." *Journal of the North American Benthological Society*. 7(1):65-68.

Hogg, I. D., and R. H. Norris. 1991. Effects of runoff from land clearing and urban development on the distribution and abundance of macroinvertebrates in pool areas of a river. *Australian Journal of Marine and Freshwater Research*, 42(5):507-518.

Horner R.R. and M.V. Brenner. 1992. "Environmental Evaluation of Calcium Magnesium Acetate for highway deicing applications." *Resources Conservation and Recycling*. 7(1-3):213-237.

Houp, R.E. 1993. Observations on long-term effects of sedimentation on freshwater mussels (Mollusca: Unionidae) in the North Fork of Red River, Kentucky. *Transactions of the Kentucky Academy of Science*, 54(3-4):93-97.

Hughes, R.M. , and D. P. Larsen. 1988. Ecoregions: an approach to surface water protection. *J. WPCF*, 60(4):486-493.

Hunt, C. 1985. The need for riparian habitat protection. *National Wetlands Newsletter*, 7(5):5-8.

Hunter, C. 1991. *Better Trout Habitat: A Guide to Stream Restoration and Management:* edited by T. Palmer. Island Press, Washington D.C.

Hurlbert, S.H. 1984. Pseudoreplication and the design of ecological field experiments. Ecological Monographs, 54(2):187-211.

Hynes, H.B.N. 1970. *The Ecology of Running Waters.* University of Toronto Press. Toronto.

Jaccard, P. 1912. The distribution of flora in an alpine zone. *New Phytol*, 11:37.

Karr, J.R., L. A. and D. R. Dudley. 1981. Ecological perspective on water quality goals. Environ. Manage., 11:249-256.

Karr, J.R., L. A. Toth, and D. R. Dudley. 1985. Fish communities of midwestern rivers; a history of degradation. *BioScience*, 35:90-95.

Karr, J.R. 1987. Biological monitoring and environmental assessment, conceptual framewok. *Environmental Management*, 11:249-256.

Kerri, K. D. et al. 1985. Forecasting pollutant loads from highway runoff. *Transportation Research Record*, 1017:39-46.

Kimmerer, R.W. and T.F.H. Allen. 1982. The role of disturbance in pattern of a riparian bryophyte community. *American Midland Naturalist*, 107:370-383.

Klein, R. D. 1979. Urbanization and stream quality impairment. *Wat. Res. Bull.*, 15:948-963.

Larimore, R. W., and P. W. Smith. 1963. The fishes of Champaign County, Illinois, as affected by 60 years of stream changes. *Ill. Nat. Hist. Surv. Bull.*, 28:299-382.

Layzer, J.B. and R.M. Anderson. 1992. Impacts of the coal industry on rare and endangered aquatic organisms of the upper Cumberland River Basin. Unpublished final report to Kentucky Department of Fish and Wildlife Resources, Frankfort, KY and Tennessee Wildlife Resources Agency, Nashville, TN. 118 pp.

Lenat, D.R. 1993. "A Biotic Index for the Southeastern United States: Derivation and List of Tolerance Values, with Criteria for Assigning Water-Quality Ratings." *Journal of the North American Benthological Society.* 1993. 12(3):279-290.

Lenat, D.R. 1988. "Water Quality Assessment of Streams Using a Qualitative Collection Method for Benthic Macroinvertebrates." *Journal for the North American Benthological Society.* 7(3):222-233.

Lind, O.T. 1979. Handbook of Common Methods in Limnology. C.V. Mosby Company, St. Louis, Missouri.

Lock. M.A., and D.D. Williams. 1981. *Perspectives in Running Water Ecology.* Pelnum Press New York.

Luedtke, R. J., and M. A. Brusven. 1976. Effects of sand sedimentation on colonization of stream insects. *J. Fish. Res.Board Can.*, 33(9):1881-1886.

Maestri, B.; M.E. Dorman and J. Hartigan. 1981 *Managing Pollution from Highway Storm Water Runoff.* Springfield; Annandale: Versar Inc.; Hartigan, Camp, Dresser, and McKee, Inc.

Marking, L.L. and T.D. Bills. 1980. Acute effects of silt and sand sedimentation on freshwater mussels. IN: *Proceedings of the UMRCC Symposium on Upper Mississippi River Bivalve Mollusks,* J.L.Rasmussem. Ed. Upper Mississippi River conservation Committee (Rock Island, Illinois). pp. 204-211.

Matthews, W.J. 1986. Fish faunal structure in an Ozark stream: stability, persistence, and a catastrophic flood. Copeia, 1986(2):388-397.

McCafferty, P.W. 1981 *Aquatic Entomology.* Boston: Jones and Bartlett Publishers. 84-383.

Merritt, R.W., and K.W. Cummins. 1984. An introduction to the aquatic insects of North America, second edition. Kendall/Hunt Publ. Co., Dubuque, Iowa.

Miller, D. L., P. M. Leonard, R. M. Hughes, J. R. Karr, P. B. Moyle, L. H. Schrader, B. A. Thompson, R. A. Daniels, K. D. Fausch, G. A. Fitzhugh. J. R. Gammon, D. B. Halliwell, P. L. Angermeier, and D. J. Orth. 1988. Regional applications of an Index of Biotic Integrity for use in water resource management. *Fisheries*, 13(5):12-20.

Molles, M.C., Jr. 1985. Recovery of a stream invertebrate community from a flash flood in Tesuque Creek, New Mexico. *Southwestern Naturalist*, 30:279-287.

Monongagela River Basin Plan : "Cheat River Basin Section." 1982.

National Technical Advisory Committee. 1968. *Water quality criteria.* Federal Water Pollution Control Administration, Washington, D.C.

Novak, M.A. and R.W. Bode 1992. "Percent Model Affinity; a New Measure of Macroinvertebrate Community Composition." *Journal of the North American Benthological Society.* 11(1):80-85.

Omernik, J. M. 1987. Ecoregions of the conterminous United States. *Ann. Assoc. Am. Geograph.*, 77(1):118-125.

Pearson, W.D. and R.H. Kramer. 1972. *Drift and production of two aquatic insects in a mountain stream.* Ecological Monographs. 24:365-385.

Pearson W.D. and R.H. Kramer. 1969. *A Drift Sampler driven by a waterwheel.* Limnol. Oceanogr. 14:462-465.

Pennak, R.W. 1989. Fresh-water invertebrates of the United States, protozoa to mollusca, 3rd Edition. John Wiley and Sons, NY.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross., and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers, Benthic Macroinvertebrates and Fish. USEPA/440/4-89/001.

Power, M. E. 1992. Top-down and bottom-up forces in food webs: do plants have primacy? *Ecology*, 73(3):733-746.

Power, M. E. and A. J. Stewart. 1987. Disturbance and recovery of an algal assemblage following flooding in an Oklahoma stream. *American Midland Naturalist*, 117:333-345.

Ragan, R. M., and A. J. Dietemann. 1975. Impact of urban stormwater runoff on stream quality. In W. Whipple, Jr. (ed.), *Urbanization and water quality control.* Proc. No. 20. American Water Resources Association, Urbana, IL. pp. 55-61.

Ritter, W. F. 1986. Water quality of agricultural coastal plain watersheds. *Agricultural Wastes*, 16:201-216.

Ritter, W. F. and A. E. M. Chirnside. 1987. Influence of agricultural practices on nitrates in the water table aquifer. Biological Wastes, 19:165-178.

Schindler, D.W. 1987. Detecting ecosystem responses to anthropogenic stress. *Canadien Journal of Fisheries and Aquatic Sciences*, 44(1):6-25.

Schwiebert, E. 1973. Nymphs. New Win Publ., Inc., Clinton, NJ.

Scott, J. B., C. R. Steward, and Q. J. Stober. 1986. Effects of urban development on fish population dynamics in Kelsey Creek., Washington. Trans. Am. Fish. Soc., 115:555-567.

Short,T.M., J.A. Black and W.J. Birge. 1990. "Effects of Acid-Mine Drainage of the Chemical and Biological Character of an Alkaline Headwater Stream." *Archivves of Environmental Contamination and Toxicology* 19(2) 241-248.

Steedman, R. J. 1988. Modification and assessment of an index of Biotic Integrity to quantify stream quality in Southern Ontario. *Can. J. Aquat. Sci.*, 45:492-501.

Swift, B.L. 1984. Status of riparian ecosystems in the United States. *Water Resources Bulletin*, 20:223-228.

SYSTAT Inc. 1992. SYSTAT for Windows: Statistics. Version 5 Edition. Evanston, IL, 750 pp.

Terrell, C.R. and P.B. Perfetti. 1991. Water Quality Indicators Guide: Surface Waters. Soil Conservation Service, SCS-TP-161.

United States Council on Environmental Quality.1981. *Procedures for Interagency Consultation to Avoid or Mitigate Advverse Effects on Rivers in the Nationwide Inventory.*

U.S.D.A., Soil Conservation Service. 1981. Land rresource regions and major land resource areas of the United States. Agricutural Handbook 296, U.S. Govt. Printing Office, Wash., DC.

U.S. Environmental Protection Agency (EPA), 1983. Technical support manual: Waterbody surveys and assessments for conducting use attainability analyses.

United States Department of the Interior, Northeast Region Office Heritage Conservation and Recreation Service. *Nationwide Rivers Inventory/Final List of Rivers.* Philadelphia, PA.: Northeast Regional Office, Heritage Conservation and Recreation Service. 1981.

United States Fish and Wildlife Service. 1994. Potential water quality problems associated with poultry production in the Potoman drainage of West Virginia. WV Field Office Special Project Report 94-05, Elkins, WV.

Virginia Department of Conservation and Historic Resources, Division of Parks and Recreation. *Virginia Scenic Rivers.*

Wallace, B.J. D.S.Vogel and T.F.Cuffiney. 1986. "Recovery of a Headwater Stream from an Insecticide-Induced Community Disturbance." *Journal for the North American Benthological Society.* 5(2):115-126.

Waters, T.F. 1981. "Seasonal Patterns in Production and Drift of *Gammarus pseudolimnaeus* in Valley Creek, Minnesota." *Ecology.* 62 (6):1458-1456.

Water Resources Board, 1990. Title 46, Emergency legislative rules, Requirements governing water qulality standards, Series I. State Water Resources Board, Charleston, WV, 20 pp.

Welsch, D.J. 1991. *Riparian Forest Buffers; Function and Design for Protection and Enhancement of Water Resources.* Randor, Pennsylvania. United States Department of Agriculture.

West Virginia Department of Natural Resources, Division of Water Resources. 1994. *West Virginia Water Quality Status Assessment.*

West Virginia Department of Natural Resources. 1986. *High Quality Streams.*

West Virginia Department of Natural Resources. 1989. *305(b) Report to the E.P.A., West Virginia Water Quality Status Assessment.*

West Virginia Department of Natural Resources. 1989. *Potomac River Basin Plan.*

West Virginia Department of Natural Resources. *West Virginia Stream Code List.* Charleston, WV: Division of Water Resources.

West Virginia Department of Natural Resources. *West Virginia Trout Fishing Guide.* 1989.

Wiggins, G.B.1977. *Larvae of the North American Caddisfly Genera.* University of Toronto Press, Toronto.

Williams, D.D. and G.P. Levins. 1988. "Evidence That Hunger and Limb Loss Can Contribute to Stream Invertebrate drift." *Journal of the North American Benthological Society.* 1988. 7 (3)180-187.

Williams, D.D. *Perspectives in Running Water Ecology.* Edited by M.A. Lock. Pelnum Press New York Date?

Williams, D.D., and H.B.N. Hynes, 1976. "The Recolonization Mechanisms of Stream Benthos." *OIKOS.*: (27)

Wolcott, L.T. and R.J. Neves. 1990. Final report. Impacts of siltation on the mussel fauna of the Powell River, Virginia. Cooperative Agreement No. 14-16-0009-1558, Research Work Order No. 19. Unpublished report submitted to the U.S. Fish and Wildlife Service, Ashville, NC. 116 pp.

Yousef, Yousef A., M.P. Wanielista, H.H. Harper, and J.E. Christopher, *Management of Drainage Systems from Highway Bridges for Pollution Control.* Transportation Research Board National Academy of Sciences. Publication sponsored by the Committee on Hydrology, Hydrologics and Water Quality.

FIGURES AND TABLES

TABLE 1
HABITAT ASSESSMENT PARAMETERS

PARAMETER LEVEL	PARAMETER CHARACTERISTICS	HABITAT ASSESSMENT RANKING*			
		Excellent	Good	Fair	Poor
PRIMARY	Bottom Substrate	16-20	11-15	6-10	0-5
	Embeddedness	16-20	11-15	6-10	0-5
	Stream Flow	16-20	11-15	6-10	0-5
SECONDARY	Channel Alteration	12-15	8-11	4-7	0-3
	Bottom Scour and Deposition	12-15	8-11	4-7	0-3
	Pool:Riffle or Run:Riffle Ratio	12-15	8-11	4-7	0-3
TERTIARY	Bank Stability	9-10	6-8	3-5	0-2
	Bank Vegetative Stability	9-10	6-8	3-5	0-2
	Streamside Cover	9-10	6-8	3-5	0-2

Source: EPA, "Rapid Bioassessment Protocols for Use in Streams and Rivers - Benthic Macroinvertebrates and Fish".

*Note: Parameter levels are numerically weighted whereby Primary parameters are weighted greater than Secondary and Tertiary parameters. The Categorical values (i.e. Excellent, Good, Fair, Poor) reflect these weighted rankings.

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Primary			Secondary			Tertiary		
						Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
B	Tygart Valley River	Leading Creek	1	MT3603	trib. Leading Creek	13	13	11	8	8	5	7	7	4
				MT3600	trib. Wilmoth Creek	4	4	5	5	2	2	6	6	4
				MT3501	trib. Cherry Fork	1	0	7	5	0	2	6	6	9
				MT3500	trib. Leading Creek	1	0	6	3	2	2	3	2	9
				MT1611	trib. Leading Creek	7	10	3	7	6	6	5	4	4
				MT1606	trib. Claylick Run	6	7	7	7	6	7	6	7	6
				MT1604	trib. Leading Creek	11	11	11	8	8	8	8	8	8
				MT1510	trib. Wilmoth Creek	7	7	5	7	8	7	8	8	8
				MT1509	Wilmoth Run	11	10	6	7	10	8	7	8	8
			2	MT3605	trib. Leading Creek	17	17	14	10	13	11	7	7	9
				MT3509	trib. Leading Creek	7	5	7	6	3	3	4	4	4
				MT3503	Pond Lick Run	13	7	13	6	10	3	7	8	9
				MT1511	Wilmoth Run	5	5	5	8	8	7	5	5	5
				MT1607	trib. Leading Creek	4	5	5	8	7	7	8	8	6
				MT1605	Claylick Run	7	6	6	7	7	5	7	7	7
				MT1603	Pearcy Run	11	11	7	8	8	8	8	8	7
				MT1602	Horse Run	4	4	4	5	6	5	5	6	5
				MT1601	Davis Lick	9	8	5	7	8	7	7	7	6
			3	MT3604	Stalnaker Run	16	16	13	10	12	11	7	7	5
				MT3602	Leading Creek	16	15	16	13	10	3	7	7	4
				MT3601	Leading Creek	18	13	16	11	10	9	7	7	4
				MT3502	Cherry Fork	13	10	13	7	7	7	8	7	5
				MT1610	trib. Leading Creek	17	16	17	10	10	11	8	10	9
				MT1609	Leading Creek	17	16	17	10	10	13	7	2	9
				MT1608	Leading Creek	15	17	17	10	10	9	9	9	8
				MT1512	Leading Creek	7	7	10	7	8	8	7	7	6

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Primary			Secondary			Tertiary		
						Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
B	Cheat River	Shavers Fork	1	MC3507	trib. Haddix Run	15	13	13	9	9	9	7	7	8
				MC3508	Haddix Run	13	13	8	10	10	6	7	7	9
				MC3506	trib. Haddix Run	13	13	11	8	9	7	7	7	4
				MC3505	trib. Haddix Run	14	14	12	9	9	5	7	7	4
				MC3504	trib. Leading Creek	17	17	13	10	10	10	7	7	5
				MC3406	Hawk Run	16	13	13	9	9	9	7	7	7
				MC3405	Goodwin Run	18	18	13	10	10	10	7	7	10
				MC3404	Shingle Tree Run	16	13	12	9	9	10	7	9	10
				MC3402	Sugarcamp Run	16	17	13	10	10	13	9	9	8
				MC1507	trib. Pleasant Run	12	12	7	8	9	8	7	8	8
				MC1506	trib. Pleasant Run	12	11	8	12	9	9	8	8	8
				MC1402	trib. Shavers Fork	3	3	3	2	2	3	8	8	5
			2	MC1508	Pleasant Run	12	12	7	8	8	8	8	8	8
				MC1505	Pleasant Run	13	11	11	8	8	10	8	8	7
				MC1504	Slab Camp Run	11	10	12	6	7	10	7	6	6
				MC1503	Pleasant Run	16	16	12	12	11	11	9	9	8
				MC1502	Pleasant Run	16	15	7	9	10	8	8	8	8
			3	MC3403	Haddix Run	16	17	17	12	10	11	9	9	7
				MC3401	Shavers Fork	18	17	18	14	13	13	9	9	8
				MC1501	Shavers Fork	16	15	14	12	12	12	8	8	7
				MC1401	Shavers Fork	17	17	20	14	14	10	10	10	8
				MC1400	Shavers Fork	17	17	20	14	14	10	10	10	8
		Black Fork	1	MC3312	Long Run	16	12	12	7	10	7	7	7	9
				MC3311	trib. Long Run	6	6	7	5	5	5	4	4	9
				MC3310	trib. Snyder Run	13	5	11	5	8	9	5	5	7
				MC3307	trib. Roaring Run	15	17	13	11	11	11	8	8	9

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Primary			Secondary			Tertiary		
						Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
B	Cheat River	Black Fork	1	MC3305	Roaring Run	17	17	16	11	10	13	9	9	9
				MC3304	trib. Slip Hill Mill Run	12	4	6	7	7	10	4	7	9
				MC3303	trib. Slip Hill Mill Run	7	7	7	7	8	10	6	6	8
				MC3302	Slip Hill Mill Run	4	4	8	7	7	7	7	5	7
				MC1317	trib. Roaring Run	7	7	5	6	4	4	6	6	6
				MC1316	trib. Roaring Run	19	13	16	13	12	12	9	9	8
				MC1315	trib. Roaring Run	12	13	8	11	11	7	8	9	8
				MC1314	trib. Roaring Run	15	16	13	12	11	8	8	8	8
				MC1313	trib. Roaring Run	11	12	10	8	8	7	7	8	8
				MC1312	trib. Big Run	10	12	8	12	13	8	10	10	8
				MC1310	Tub Run	16	15	10	12	14	12	9	9	8
				MC1303	trib. N.F. Blackwater River	11	10	16	4	4	7	3	4	5
				MC1301	trib. Beaver Creek	11	10	9	7	8	7	8	7	7
				MC1215	trib. Beaver Creek	11	6	3	7	9	3	7	7	4
				MC1214	trib. Beaver Creek	13	7	14	10	10	6	8	8	4
				MC1213	trib. Pendleton Creek	4	4	4	4	2	2	4	4	4
				MC1211	trib. Pendleton Creek	4	4	3	3	3	3	7	7	4
				MC1210	trib. Beaver Creek	7	3	5	7	7	7	8	8	10
				MC1209	trib. Beaver Creek	7	4	4	7	7	7	7	7	10
				MC1206	trib. Beaver Creek	4	4	5	6	3	3	6	5	5
				MC1205	trib. Beaver Creek	4	4	8	6	6	3	4	4	4
				MC1204	trib. Beaver Creek	7	10	5	6	6	3	5	5	5
				MC1203	trib. Beaver Creek	5	5	8	7	7	3	7	2	5
				MC1202	trib. Beaver Creek	6	7	7	7	5	8	4	3	2
				MC1201	trib. Beaver Creek	12	12	9	10	10	10	7	7	7
				MC1200	trib. Beaver Creek	11	15	14	10	9	10	7	7	7

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

						Primary			Secondary			Tertiary		
Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
B	Cheat River	Black Fork	1	MC1112	trib. Beaver Creek	5	5	0	9	9	0	8	8	5
				MC1111	trib. Beaver Creek	8	8	4	6	6	5	5	5	10
				MC1110	trib. Beaver Creek	13	13	10	10	10	6	11	8	2
				MC1109	trib. Beaver Creek	14	13	14	9	6	10	7	7	8
				MC1108	trib. Beaver Creek	13	7	15	10	10	10	8	8	8
				MC1107	trib. Beaver Creek	6	12	6	6	6	6	4	7	4
				MC1106	trib. Beaver Creek	6	6	10	10	10	8	10	10	5
				MC1105	trib. Beaver Creek	14	14	14	11	11	11	8	8	10
				MC1104	trib. Beaver Creek	14	14	15	15	11	11	8	9	9
				MC1103	trib. Beaver Creek	4	8	10	10	3	5	7	7	9
				MC1102	trib. Beaver Creek	4	7	15	3	5	3	7	7	2
				MC1101	trib. Four Mile Run	13	8	14	8	5	6	7	7	8
				MC1100	Four Mile Run	6	6	10	6	6	8	7	7	6
			2	MC3309	Snyders Run	12	12	12	5	5	8	6	6	4
				MC3308	Roaring Run	19	20	18	14	14	14	9	9	7
				MC3306	Roaring Run	16	18	18	14	14	13	10	10	4
				MC1320	Roaring Run	14	14	14	10	9	9	7	7	5
				MC1318	trib. Black Fork	14	13	6	9	10	8	10	7	5
				MC1311	Big Run	10	10	13	8	12	7	9	8	8
				MC1309	Middle Run	6	6	8	8	8	4	8	5	4
				MC1308	Long Run	10	8	12	8	11	9	8	7	6
				MC1307	Long Run	10	10	13	7	8	8	7	7	4
				MC1306	Long Run	14	11	16	4	4	8	8	5	2
				MC1305	Long Run	10	7	16	4	7	8	3	5	5
				MC1216	trib. Beaver Creek	5	5	5	3	3	3	7	7	4
				MC1212	Pendleton Creek	10	10	15	10	11	10	7	8	5

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

						Primary			Secondary			Tertiary		
Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
B	Cheat River	Black Fork	2	MC1207	trib. Beaver Creek	6	8	7	5	4	5	4	8	8
			3	MC3400	Black Fork River	17	17	17	13	14	14	9	9	7
				MC3301	N.F. Blackwater River	13	11	18	10	13	10	9	4	2
				MC1319	Black Fork River	17	19	20	13	13	14	10	10	7
				MC1304	N.F. Blackwater River	5	3	16	10	8	8	4	6	5
				MC1302	N.F. Blackwater River	16	16	16	7	7	8	5	7	5
				MC1208	Beaver Creek	2	4	20	10	10	2	7	8	5
A	North Branch Potomac River	Patterson Creek	1	PNB2905	trib. N.F. Patterson Creek	16	10	10	4	10	6	6	6	6
				PNB2904	trib. N.F. Patterson Creek	16	11	6	4	1	9	4	4	6
				PNB1008	trib. Elklick Run	15	15	15	15	15	11	10	8	8
				PNB1007	trib. Elklick Run	17	15	15	11	11	11	8	8	5
				PNB908	trib. N.F. Patterson Creek	15	11	8	7	8	8	8	8	4
				PNB903	trib. Elklick Run	15	12	15	13	10	10	7	9	5
				PNB901	trib. M.F. Patterson Creek	8	6	6	5	5	4	4	4	4
				PNB809	trib. Patterson Creek	15	6	5	7	7	7	6	5	6
				PNB808	trib. N.F. Patterson Creek	3	3	7	7	7	5	7	7	5
				PNB806	trib. S.F. Patterson Creek	8	8	8	10	5	5	7	7	4
				PNB805	trib. Patterson Creek	11	11	11	5	7	5	4	8	5
				PNB803	trib. Thorn Run	15	15	10	11	7	7	8	8	5
				PNB800	trib. Patterson Creek	3	3	3	5	6	3	5	4	2
			2	PNB2903	trib. N.F. Patterson Creek	14	13	14	9	9	9	7	7	7
				PNB2802	trib. N.F. Patterson Creek	13	13	9	10	10	5	7	8	5
				PNB2801	N.F. Patterson Creek	18	18	14	11	10	15	8	8	8
				PNB909	trib. N.F. Patterson Creek	17	15	10	12	12	7	7	6	7
				PNB906	Elklick Run	15	15	12	7	10	10	5	9	7
				PNB905	trib. Elklick Run	12	12	13	9	8	7	7	7	4

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Primary			Secondary			Tertiary		
						Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
A	North Branch Potomac River	Patterson Creek	2	PNB904	trib. Elklick Run	12	10	10	10	10	10	4	4	8
				PNB804	trib. Thorn Run	14	12	11	7	5	5	7	6	4
				PNB802	trib. Thorn Run	13	10	5	10	5	4	9	9	9
				PNB801	trib. Patterson Creek	13	13	11	10	10	6	9	9	6
			3	PNB2902	N.F. Patterson Creek	16	14	14	9	9	11	9	9	8
				PNB2901	N.F. Patterson Creek	18	18	18	14	13	13	10	9	8
				PNB2900	N.F. Patterson Creek	18	18	20	14	14	15	10	9	8
				PNB2800	Patterson Creek	17	17	17	12	13	14	9	9	8
				PNB907	M.F. Patterson Creek	13	12	14	10	10	10	8	8	8
				PNB902	N.F. Patterson Creek	18	18	16	12	12	12	7	7	7
				PNB900	M.F. Patterson Creek	16	16	16	11	10	9	6	6	6
				PNB807	Patterson Creek	8	5	8	5	5	4	4	5	4
		Stony River	1	PNB1009	trib. Little Creek	14	10	6	5	10	10	7	7	9
				PNB1005	trib. Stony River	15	12	14	10	11	11	8	8	8
				PNB1004	trib. Abrams Creek	12	11	14	8	6	9	7	7	6
				PNB1003	trib. Abrams Creek	7	7	10	10	7	6	8	8	5
				PNB1002	trib. Abrams Creek	6	3	6	7	7	5	7	7	5
			2	PNB1006	Stony River	18	18	20	14	12	15	10	10	6
				PNB1001	Abrams Creek	4	4	13	5	5	3	7	7	2
				PNB1000	Little Creek	3	4	11	5	5	5	7	7	4
	South Branch Potomac River	Anderson Run	2	PSB2700	Anderson Run	13	3	13	2	10	3	7	8	3
				PSB709	trib. Walnut Bottom	7	7	12	5	5	8	8	8	6
				PSB708	Walnut Bottom	13	7	7	6	6	6	8	7	7
				PSB707	Toombs Hollow Run	14	12	15	8	10	7	7	8	8
				PSB706	trib. Walnut Bottom	18	17	18	13	13	12	9	8	8
				PSB705	trib. Walnut Bottom	11	10	12	8	7	10	6	8	6

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Primary			Secondary			Tertiary		
						Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
A	South Branch Potomac River	Anderson Run	2	PSB704	trib. Walnut Bottom	10	8	11	7	8	7	6	5	5
			3	PSB703	Walnut Bottom	11	11	12	8	8	7	8	8	8
				PSB702	Walnut Bottom	12	11	14	12	12	11	8	8	7
		Clifford Hollow	1	PSB602	trib. Clifford Hollow	13	13	12	8	8	8	8	8	8
				PSB601	trib. Clifford Hollow	8	7	8	8	8	5	7	7	8
		Main Channel	1	PSB2604	trib. Dumpling Run	3	3	7	4	2	2	5	5	1
				PSB701	trib. S.B. Potomac River	6	6	3	7	7	6	6	7	5
				PSB605	trib. S.B. Potomac River	5	5	7	6	8	3	8	8	5
				PSB604	trib. Fort Run	11	11	4	8	8	4	7	7	8
			2	PSB2605	Dumpling Run	5	5	10	7	7	10	6	6	4
				PSB2603	Dumpling Run	3	3	12	5	5	5	5	5	5
				PSB2602	Fort Run	5	5	13	6	3	6	4	6	4
				PSB2601	Dumpling Run	15	12	13	10	10	7	7	7	7
				PSB2600	Fort Run	17	17	16	10	10	12	7	9	6
				PSB603	Clifford Hollow	17	16	16	12	13	12	9	9	8
			3	PSB606	S.B. Potomac River	16	13	18	10	13	12	6	7	6
	Cacapon River	Baker Run	1	PC2502	trib. Long Lick Run	13	13	13	8	10	10	7	7	7
				PC2501	trib. Long Lick Run	7	9	7	6	6	6	4	8	5
				PC505	trib. Long Lick Run	6	6	5	7	7	4	6	7	8
				PC501	trib. Baker Run	7	10	8	7	10	5	6	7	7
			2	PC517	trib. Baker Run	17	17	16	12	12	11	7	9	8
				PC508	Long Lick Run	11	11	12	8	8	7	6	7	6
				PC507	Long Lick Run	8	6	11	7	11	8	7	7	7
				PC506	trib. Long Lick Run	11	10	8	7	7	5	6	6	6
				PC504	Long Lick Run	11	12	12	7	10	8	8	7	5
			3	PC2500	Baker Run	16	17	17	10	10	12	7	7	7

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

						Primary			Secondary			Tertiary		
Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
A	Cacapon River	Baker Run	3	PC503	Baker Run	14	11	15	8	8	9	8	8	8
				PC502	Baker Run	12	12	13	11	11	8	8	7	7
				PC412	Baker Run	16	14	15	9	11	12	8	6	6
		Central Cacapon River	1	PC410	trib. Lost River	10	11	7	4	6	6	7	7	6
				PC409	trib. Lost River	4	4	7	4	11	6	7	7	5
				PC407	trib. Lost River	10	12	12	11	10	7	8	6	8
				PC405	trib. Lost River	5	5	4	8	7	6	7	6	7
				PC404	trib. Lost River	12	13	6	11	8	9	7	7	8
				PC403	trib. Lost River	12	12	10	6	6	7	7	8	8
				PC314	trib. Trout Run	7	5	4	7	8	7	6	6	7
			2	PC2401	trib. Lost River	12	6	11	5	5	5	3	4	4
				PC2400	trib. Lost River	16	16	13	10	11	12	9	9	9
				PC406	trib. Lost River	16	15	12	8	7	11	8	8	8
				PC402	Sauerkraut Run	15	14	17	11	8	12	8	8	8
			3	PC413	Lost River	17	18	18	13	15	11	10	10	8
				PC411	Lost River	17	14	16	8	12	13	6	8	7
				PC408	Lost River	16	14	16	10	11	12	8	8	5
				PC401	Lost River	18	18	3	8	12	13	9	9	7
				PC315	Trout Run	13	12	18	11	11	12	8	7	7
		Skaggs Run	1	PC2504	trib. Skaggs Run	13	13	12	10	10	5	8	8	8
				PC2503	trib. Skaggs Run	13	7	3	5	5	5	7	7	4
				PC516	trib. Skaggs Run	6	6	6	7	7	7	6	6	8
				PC515	trib. Skaggs Run	10	10	9	8	8	8	7	8	7
				PC514	trib. Skaggs Run	6	6	6	10	9	5	7	7	8
				PC512	trib. Skaggs Run	11	11	10	10	10	8	8	7	8
				PC511	trib. Skaggs Run	16	16	15	12	8	12	9	9	8

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Primary			Secondary			Tertiary		
						Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
A	Cacapon RIver	Skaggs Run	1	PC510	trib. Skaggs Run	12	12	5	8	9	7	8	7	8
				PC509	Skaggs Run	6	6	5	5	8	4	6	7	6
			2	PC513	Skaggs Run	11	10	12	9	11	8	8	8	9
		Slate Rock Run	1	PC2301	trib. Slate Rock Run	16	8	13	10	7	10	7	7	7
				PC2300	trib. Slate Rock Run	16	12	12	10	7	10	7	4	8
				PC304	trib. Slate Rock Run	17	17	17	10	11	10	7	7	7
				PC303	trib. Sine Run	13	13	8	9	7	9	6	7	7
				PC302	trib. Sine Run	8	8	15	10	10	10	7	10	7
				PC301	trib. Sine Run	18	8	5	9	3	10	9	9	9
				PC300	trib. Sine Run	13	6	13	11	9	6	7	9	9
			2	PC2302	Slate Rock Run	12	12	15	10	10	10	10	5	5
				PC305	Slate Rock Run	18	18	17	13	13	10	9	9	8
		Waites Run	1	PC312	trib. Waites Run	5	5	4	7	8	6	6	4	7
				PC311	trib. Waites Run	14	12	12	10	8	9	7	8	3
				PC310	trib. Slate Rock Run	3	4	6	4	8	7	7	4	4
				PC309	trib. Waites Run	10	7	11	8	7	8	7	8	8
				PC307	trib. Waites Run	5	5	4	6	7	6	7	9	8
			2	PC313	trib. Waites Run	10	12	14	12	8	12	7	7	8
				PC308	Waites Run	15	16	16	11	12	12	8	8	8
				PC306	Waites Run	18	18	20	13	13	13	10	9	7
			3	PC2303	Waites Run	17	17	17	10	13	13	8	9	8
	Shenandoah River	Cedar Creek	1	PS207	trib. Paddy Run	7	7	4	7	9	3	7	8	9
				PS206	trib. Duck Run	6	6	4	6	6	4	5	5	5
				PS203	trib. Duck Run	7	7	7	5	5	5	4	4	4
				PS111	trib. Mulberry Run	12	2	10	10	7	5	7	9	4
				PS108	trib. Mulberry Run	16	16	14	10	11	10	8	8	8

TABLE 2
HABITAT EVALUATIONS BY ECOREGION, REGIONAL PROJECT WATERSHED, LOCAL PROJECT WATERSHED, AND STREAM ORDER

						Primary			Secondary			Tertiary		
Ecoregion	Regional Project Watershed	Local Project Watershed	Stream Order	Site ID#	Stream Name	Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover
A	Shenandoah River	Cedar Creek	1	PS107	trib. Mulberry Run	16	14	6	6	6	3	5	8	5
				PS105	trib. Mulberry Run	3	3	7	6	6	2	7	7	4
				PS104	trib. Cedar Creek	18	18	3	11	11	13	9	9	9
				PS101	Town Run	8	7	7	5	5	5	5	4	5
			2	PS205	trib. Duck Run	7	6	6	5	5	4	4	4	4
				PS204	trib. Duck Run	7	7	7	5	5	5	4	4	4
				PS202	Duck Run	16	17	15	12	12	12	9	9	10
				PS201	Duck Run	16	17	15	12	12	12	9	9	10
				PS200	Duck Run	16	12	16	10	10	10	7	7	7
				PS113	Turkey Run	16	14	14	9	9	8	7	7	4
				PS112	Mulberry Run	13	13	14	13	10	11	8	9	6
				PS106	Mulberry Run	10	16	6	10	10	10	6	6	9
				PS103	trib. Mulberry Run	14	17	14	10	10	10	9	9	8
				PS102	trib. Mulberry Run	13	15	11	10	9	7	8	8	5
				PS100	Town Run	13	13	7	11	11	11	7	7	8
			3	PS110	Cedar Creek	18	18	18	13	13	8	9	9	8
				PS109	Cedar Creek	18	18	18	13	13	8	9	9	4

TABLE 3
FAMILY BIOTIC INDEX TOLERANCE VALUES - EPA AND VA

Class	Order	Family	Feeding Group	EPA Tolerance	VA Tolerance
Malacostraca	Amphipoda	Talitridae	Shredders	8	8
		Gammaridae	Shredders	4	4
Gastropoda	Basommatophora	Lymnaeidae	Collectors	7	7
		Physidae	Collectors	8	8
		Planorbidae	Collectors	7	7
Insecta	Coleoptera	Chrysomelidae	Shredders	5	5
		Curculionidae	Shredders	5	5
		Dytiscidae	Engulfers	5	5
		Elmidae	Scrapers	4	4
		Gyrinidae	Engulfers	4	4
		Haliplidae	Shredders	5	5
		Helodidae	Collectors	7	7
		Hydrophilidae	Engulfers	5	5
		Noteridae	Engulfers	5	5
		Psephenidae	Scrapers	4	4
Malacostraca	Decapoda	Cambaridae	Engulfers	5	5
Insecta	Diptera	Athericidae	Engulfers	2	2
		Ceratopogonidae	Collectors	6	6
		Chironomidae	Collectors	8	9
		Culicidae	Collectors	8	8
		Dixidae	Collectors	1	1
		Ephydridae	Collectors	7	7
		Ptychopteridae	Collectors	8	8
		Sciomyzidae	Engulfers	10	10
		Simuliidae	Collectors	6	6
		Stratiomyidae	Collectors	7	7
		Tabanidae	Engulfers	6	6
		Tanyderidae	Collectors	6	6
		Tipulidae	Shredders	3	3
Insecta	Ephemeroptera	Baetidae	Collectors	4	4
		Baetiscidae	Collectors	3	3
		Caenidae	Collectors	7	4
		Ephemerellidae	Collectors	1	4
		Ephemeridae	Collectors	4	4
		Heptageniidae	Collectors	4	4
		Leptophlebiidae	Collectors	2	2
		Oligoneuriidae	Collectors	2	2
		Polymitarcyidae	Collectors	2	2
		Potamanthidae	Collectors	4	4
		Siphlonuridae	Collectors	7	7
		Tricorythidae	Collectors	4	4
Hirudinida	Gnathobdellida	Hirudinidae	N/A	7	7
Oligochaeta	Haplotaxida	Haplotaxidae	N/A	8	8
Insecta	Hemiptera	Corixidae	Engulfers	5	5
		Gerridae	Engulfers	8	8
Insecta	Hemiptera	Notonectidae	Engulfers	6	6
Malacostraca	Isopoda	Asellidae	Shredders	8	8

TABLE 3
FAMILY BIOTIC INDEX TOLERANCE VALUES - EPA AND VA

Class	Order	Family	Feeding Group	EPA Tolerance	VA Tolerance
Insecta	Lepidoptera	Pyralidae	Shredders	5	5
Insecta	Megaloptera	Corydalidae	Engulfers	0	5
		Sialidae	Engulfers	4	4
Insecta	Odonata	Aeshnidae	Engulfers	3	3
		Calopterygidae	Engulfers	5	5
		Coenagrionidae	Engulfers	9	9
		Cordulegastridae	Engulfers	3	3
		Corduliidae	Engulfers	5	5
		Gomphidae	Engulfers	1	1
		Libellulidae	Engulfers	9	9
		Macromiidae	Engulfers	3	3
		Petaluridae	Engulfers	5	5
Oligochaeta	Haplotaxida	Enchytraeidae	Collectors	10	10
Insecta	Plecoptera	Capniidae	Shredders	1	1
		Chloroperlidae	Shredders	1	1
		Leuctridae	Shredders	0	0
		Nemouridae	Shredders	2	2
		Peltoperlidae	Shredders	2	2
		Perlidae	Engulfers	1	1
		Perlodidae	Engulfers	2	2
		Taeniopterygidae	Shredders	2	2
		Pteronarcyidae	Shredders	0	0
Bivalvia	Prosobranchia	Hydrobiidae	N/A	3	3
		Pleuroceridae	N/A	4	4
		Viviparidae	N/A	3	3
Gastropoda	Pulmonata	Ancylidae	N/A	6	6
Hirudinea	Rhycholbdellida	Glossiphoniidae	N/A	8	8
Insecta	Trichoptera	Brachycentridae	Collectors	1	1
		Glossosomatidae	Collectors	0	0
		Helicopsychidae	Collectors	3	3
		Hydropsychidae	Collectors	4	6
		Lepidostomatidae	Shredders	1	1
		Leptoceridae	Collectors	4	4
		Limnephilidae	Shredders	4	4
		Molannidae	Collectors	6	6
		Odontoceridae	Shredders	0	0
		Philopotamidae	Collectors	3	3
		Phyganeidae	Shredders	4	4
		Polycentropodidae	Collectors	6	6
		Rhyacophilidae	Engulfers	0	0
		Psychomyiidae	Collectors	2	2
Oligochaeta	Tubificida	Naididae	Collectors	8	8
		Tubificidae	Collectors	10	10
Bivalvia	Paleoheterodonta	Unionidae	Collectors	4	4
Bivalvia	Veneroida	Corbiculidae	Collectors	8	8
		Sphaeriidae	Collectors	8	8

TABLE 4
WATER QUALITY CLASSIFICATION BASED ON FBI

FBI	WATER QUALITY	DEGREE OF ORGANIC POLLUTION
0.0-3.75	Excellent	Pollution Unlikely
3.76-4.25	Very Good	Possible Slight Pollution
4.26-5.00	Good	Some Pollution
5.01-5.75	Fair	Fairly Substantial Pollution
5.76-6.5	Fairly poor	Substantial Pollution
6.51-7.25	Poor	Very Substantial Pollution
7.26-10.00	Very Poor	Severe Organic Pollution

Source: Hilsenhoff, 1988

TABLE 5
REFERENCE STATIONS

METRIC EVALUATION

														Biological Condition Scoring Criteria										
Ecoregion	Stream Order	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Metric 1	Metric 2	Metric 3	Metric 4 - EPT	Metric 4 - Chiron.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Metric 1	Metric 2	Metric 3	Metric 4 - EPT	Metric 4 - Chiron.	Metric 6	Metric 7 - Loss	Metric 7 - Jaccard	Metric Sum	B.I.	B.I. Cat.
A	1	Cacapon River	Slate Rock Run	PC304	trib. Slate Rock Run	1.03	1.06	1.05	1.48	3.00	0.91	0.250	0.600	6	6	6	6	6	6	6	6	36	1.07	A
A	1	Cacapon River	Waites Run	PC311	trib. Waites Run	1.03	1.17	1.22	0.62	1.50	1.04	0.250	0.600	6	6	6	3	6	6	6	6	33	1.00	A
A	1	Cacapon River	Waites Run	PC313	trib. Waites Run	0.94	0.83	0.73	0.90	0.50	1.04	0.273	0.643	6	3	6	6	3	6	6	6	33	0.93	A
A	2	Cacapon River	Waites Run	PC306	Waites Run	1.04	0.74	0.72	0.82	0.42	0.94	0.188	0.632	6	3	6	6	3	6	6	6	33	0.93	A
A	2	Cacapon River	Central Cacapon River	PC402	Sauerkraut Run	0.98	1.12	1.00	1.13	4.50	0.94	0.133	0.765	6	6	6	6	6	6	6	6	36	1.07	A
A	2	Cacapon River	Baker Run	PC517	trib. Baker Run	0.98	1.32	1.28	1.05	2.57	1.13	0.400	0.429	6	6	6	6	6	6	6	3	33	1.00	A
A	3	Shenandoah River	Cedar Creek	PS109	Cedar Creek	0.90	0.97	1.26	0.82	1.44	0.68	0.083	0.692	6	6	6	6	6	0	6	6	30	0.93	A
A	3	Cacapon River	Baker Run	PC412	Lost River	0.98	1.20	0.58	1.39	0.62	1.23	0.077	0.643	6	6	6	6	3	6	6	6	45	1.00	A
B	3	Cheat River	Shavers Fork	MC1501	Shavers Fork	1.13	0.88	1.16	0.79	1.44	1.09	0.067	0.563	6	6	6	6	6	6	6	6	48	1.07	A

TABLE 5
REFERENCE STATIONS

BASIC WATER QUALITY DATA

Ecoregion	Stream Order	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	# Families	# Individuals	Temperature (C)	Dissolved Oxygen mg/l	pH	Family Biotic Index
A	1	Cacapon River	Slate Rock Run	PC304	trib. Slate Rock Run	12	71	14	9	7	3.63
A	1	Cacapon River	Waites Run	PC311	trib. Waites Run	12	35	12.7	10	7.2	3.31
A	1	Cacapon River	Waites Run	PC313	trib. Waites Run	11	54	13.1	8.8	6.8	4.65
A	2	Cacapon River	Waites Run	PC306	Waites Run	16	118	11.1	10	7.3	4.61
A	2	Cacapon River	Central Cacapon River	PC402	Sauerkraut Run	15	105	16	9.2	7.8	3.06
A	2	Cacapon River	Baker Run	PC517	trib. Baker Run	15	102	6	11.1	6	2.59
A	3	Shenandoah River	Cedar Creek	PS109	Cedar Creek	12	102	22	7.2	8	3.62
A	3	Cacapon River	Baker Run	PC412	Lost River	13	138	17.3	9.6	7.5	2.93
B	3	Cheat River	Shavers Fork	MC1501	Shavers Fork	15	84	23.8	7.5	7.9	4.00

HABITAT EVALUATION

						Primary			Secondary			Tertiary			
Ecoregion	Stream Order	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Bottom Substrate	Embeddedness	Streamflow	Channel Alteration	Scour and Deposition	Pool / Run Riffle Ratio	Bank Stability	Bank Vegetation Stability	Streamside Cover	Habitat Assessment Score
A	1	Cacapon River	Slate Rock Run	PC304	trib. Slate Rock Run	17	17	17	10	11	10	7	7	7	103
A	1	Cacapon River	Waites Run	PC311	trib. Waites Run	14	12	12	10	8	9	7	8	3	83
A	1	Cacapon River	Waites Run	PC313	trib. Waites Run	10	12	14	12	8	12	7	7	8	90
A	2	Cacapon River	Waites Run	PC306	Waites Run	18	18	20	13	13	13	10	9	7	121
A	2	Cacapon River	Central Cacapon River	PC402	Sauerkraut Run	15	14	17	11	8	12	8	8	8	101
A	2	Cacapon River	Baker Run	PC517	trib. Baker Run	17	17	16	12	12	11	7	9	8	109
A	3	Shenandoah River	Cedar Creek	PS109	Cedar Creek	18	18	18	13	13	8	9	9	4	110
A	3	Cacapon River	Baker Run	PC412	Lost River	16	14	15	9	11	12	8	6	6	97
B	3	Cheat River	Shavers Fork	MC1501	Shavers Fork	16	15	14	12	12	12	8	8	7	104

TABLE 6
CRITERIA FOR CHARACTERIZATION FOR BIOLOGICAL CONDITION FOR PROTOCOL II

Metric	Biological Condition Scoring Criteria		
	6	3	0
1. Taxa Richness (a)	>80%	40-80%	<40%
2. Family Biotic Index (modified) (b)	>85%	50-85%	<50%
3. Ratio of Scrapers/Filt. Collectors (a,c)	>50%	25-50%	<25%
4. Ratio of EPT and Chironomid Abundances (a)	>75%	25-75%	<25%
6. EPT Index (a)	>90%	70-90%	<70%
7A. Community Loss Index (d)	<0.5	0.5-4.0	>4.0
7B. Jaccard Coefficient of Community (d)	>50%	20-50%	<20

(a) Score is a ratio of study site to reference site x 100.
(b) Score is a ratio of reference site to study site x 100.
(c) Determination of Functional Feeding Group is independent of taxonomic grouping.
(d) Range of values obtained. A comparison to the reference station is incorporated in these indices.

Source: EPA, "Rapid Bioassessment Protocols for Streams and Rivers - Benthic Macroinvertebrates and Fish".

TABLE 7
BIOTIC INTEGRITY

% Comp. to Ref. Score (a)	Biological Condition Category	Attributes
>79%	Non-impaired (A)	Comparable to the best situation to be expected within an ecoregion. Balanced trophic structure. Optimum community structure (composition and dominance) for stream size and habitat quality.
50-79%	Moderately impaired (B)	Fewer families due to loss of most intolerant forms. Reduction in EPT index.
21-49%	Impaired (C)	Fewer families and individuals due to loss of most intolerant forms. Reduction in EPT index.
<21%	Severely impaired (D)	Few families present. If high densities of organisms, then dominated by one or two taxa. Only tolerant organisms present.

(a) Percentage values obtained that are intermediate to the above ranges will require subjective judgement as to the correct placement. Use of the habitat assessment and physicochemical data may be necessary to aid in the decision process.

Source: EPA, "Rapid Bioassessment Protocols for Streams and Rivers - Benthic Macroinvertebrates and Fish".

TABLE 8
WATER QUALITY AND HABITAT ASSESSMENT SCORE

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score
B	Tygart Valley River	Leading Creek	MT3605	trib. Leading Creek	2	7	9.2	6.5	105
B	Tygart Valley River	Leading Creek	MT3604	Stalnaker Run	3	6	9.5	7.5	97
B	Tygart Valley River	Leading Creek	MT3603	trib. Leading Creek	1	6	9.8	6	76
B	Tygart Valley River	Leading Creek	MT3602	Leading Creek	3	6	9.7		91
B	Tygart Valley River	Leading Creek	MT3601	Leading Creek	3	4.5	10.4	6	95
B	Tygart Valley River	Leading Creek	MT3600	trib. Wilmoth Creek	1	6	9	6	38
B	Tygart Valley River	Leading Creek	MT3509	trib. Leading Creek	2	5	11	6.5	43
B	Tygart Valley River	Leading Creek	MC3508	Haddix Run	1	7	10	7.5	83
B	Cheat River	Shavers Fork	MC3507	trib. Haddix Run	1	6	10	6	90
B	Cheat River	Shavers Fork	MC3506	trib. Haddix Run	1	6	9.8	6	79
B	Cheat River	Shavers Fork	MC3505	trib. Haddix Run	1	6	9.4	6.5	81
B	Cheat River	Shavers Fork	MT3504	trib. Leading Creek	1	6.5	9.2	6.5	96
B	Tygart Valley River	Leading Creek	MT3503	Pond Lick Run	2	4	9.7	6.5	76
B	Tygart Valley River	Leading Creek	MT3502	Cherry Fork	3	5	9.3	6	77
B	Tygart Valley River	Leading Creek	MT3501	trib. Cherry Fork	1	4.5	0	6.5	36
B	Tygart Valley River	Leading Creek	MT3500	trib. Leading Creek	1	5	9	6	28
B	Cheat River	Shavers Fork	MC3406	Hawk Run	1	6	12	6	90
B	Cheat River	Shavers Fork	MC3405	Goodwin Run	1	5	18	6	103
B	Cheat River	Shavers Fork	MC3404	Shingle Tree Run	1	4.5	17	6	95
B	Cheat River	Shavers Fork	MC3403	Haddix Run	3	6	12.8	6.5	108
B	Cheat River	Shavers Fork	MC3402	Sugarcamp Run	1	5	14	6	105
B	Cheat River	Shavers Fork	MC3401	Shavers Fork	3	6	14	6	119
B	Cheat River	Black Fork	MC3400	Black Fork River	3	4	15	6	117
B	Cheat River	Black Fork	MC3312	Long Run	1	4	11.4	6.5	87
B	Cheat River	Black Fork	MC3311	trib. Long Run	1	6.5	8	4	51
B	Cheat River	Black Fork	MC3310	trib. Snyder Run	1	4	8	6	68
B	Cheat River	Black Fork	MC3309	Snyders Run	2	4.5	12	5	70
B	Cheat River	Black Fork	MC3308	Roaring Run	2	5	12	7	124
B	Cheat River	Black Fork	MC3307	trib. Roaring Run	1	4	21	6.5	103

TABLE 8
WATER QUALITY AND HABITAT ASSESSMENT SCORE

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score
B	Cheat River	Black Fork	MC3306	Roaring Run	2	3	12	7.5	117
B	Cheat River	Black Fork	MC3305	Roaring Run	1	4	12	7	111
B	Cheat River	Black Fork	MC3304	trib. Slip Hill Mill Run	1	10	12	4	66
B	Cheat River	Black Fork	MC3303	trib. Slip Hill Mill Run	1	5	14	5	66
B	Cheat River	Black Fork	MC3302	Slip Hill Mill Run	1	3	10	6.5	56
B	Cheat River	Black Fork	MC3301	N.F. Blackwater River	3	4	10	6.8	90
A	North Branch Potomac River	Patterson Creek	PNB2905	trib. N.F. Patterson Creek	1	5	10.7	7.5	74
A	North Branch Potomac River	Patterson Creek	PNB2904	trib. N.F. Patterson Creek	1	5	10.6	7.5	61
A	North Branch Potomac River	Patterson Creek	PNB2903	trib. N.F. Patterson Creek	2	3	9	7	89
A	North Branch Potomac River	Patterson Creek	PNB2902	N.F. Patterson Creek	3	5	11	8	99
A	North Branch Potomac River	Patterson Creek	PNB2901	N.F. Patterson Creek	3	3.5	12	8	121
A	North Branch Potomac River	Patterson Creek	PNB2900	N.F. Patterson Creek	3	3.5	12.4	8	126
A	North Branch Potomac River	Patterson Creek	PNB2802	trib. N.F. Patterson Creek	2	3	9.8	8	80
A	North Branch Potomac River	Patterson Creek	PNB2801	N.F. Patterson Creek	2	6.5	11	8	110
A	North Branch Potomac River	Patterson Creek	PNB2800	Patterson Creek	3	5.5	13	8	116
A	South Branch Potomac River	Anderson Run	PSB2700	Anderson Run	2	7	12	8	62
A	South Branch Potomac River	Main Channel	PSB2605	Dumpling Run	2	0.5	10	6.5	60
A	South Branch Potomac River	Main Channel	PSB2604	trib. Dumpling Run	1	0	10	6	32
A	South Branch Potomac River	Main Channel	PSB2603	Dumpling Run	2	0	10	6	48
A	South Branch Potomac River	Main Channel	PSB2602	Fort Run	2	-1	10	7	52
A	South Branch Potomac River	Main Channel	PSB2601	Dumpling Run	2	-1	10	7	88
A	South Branch Potomac River	Main Channel	PSB2600	Fort Run	2	5	12	7	104
A	Cacapon River	Skaggs Run	PC2504	trib. Skaggs Run	1	3	10.2	8	87
A	Cacapon River	Skaggs Run	PC2503	trib. Skaggs Run	1				56
A	Cacapon River	Baker Run	PC2502	trib. Long Lick Run	1	2.5	11	7.5	88
A	Cacapon River	Baker Run	PC2501	trib. Long Lick Run	1	2.5	11	6.5	58
A	Cacapon River	Baker Run	PC2500	Baker Run	3	6	9.8	7.5	103
A	Cacapon River	Central Cacapon River	PC2401	trib. Lost River	2	9		7	55
A	Cacapon River	Central Cacapon River	PC2400	trib. Lost River	2	10	9	7.5	105

TABLE 8
WATER QUALITY AND HABITAT ASSESSMENT SCORE

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score
A	Cacapon River	Waites Run	PC2303	Waites Run	3	7	11	7.5	112
A	Cacapon River	Slate Rock Run	PC2302	Slate Rock Run	2	5	12	7	89
A	Cacapon River	Slate Rock Run	PC2301	trib. Slate Rock Run	1	4	12	7	85
A	Cacapon River	Slate Rock Run	PC2300	trib. Slate Rock Run	1	4	12	7	86
B	Tygart Valley River	Leading Creek	MT1611	trib. Leading Creek	1				52
B	Tygart Valley River	Leading Creek	MT1610	trib. Leading Creek	3	19	7.8	7	108
B	Tygart Valley River	Leading Creek	MT1609	Leading Creek	3				101
B	Tygart Valley River	Leading Creek	MT1608	Leading Creek	3	19	8	7	104
B	Tygart Valley River	Leading Creek	MT1607	trib. Leading Creek	2	20.2	9.3	7.5	58
B	Tygart Valley River	Leading Creek	MT1606	trib. Clay Lick Run	1	19.4	8.7	6.3	59
B	Tygart Valley River	Leading Creek	MT1605	Claylick Run	2	20.2	4.7	7.1	59
B	Tygart Valley River	Leading Creek	MT1604	trib. Leading Creek	1	18	9.2	6.6	81
B	Tygart Valley River	Leading Creek	MT1603	Pearcy Run	2	21.5	6.4	6.9	76
B	Tygart Valley River	Leading Creek	MT1602	Horse Run	2	22.6	4.3	7.1	44
B	Tygart Valley River	Leading Creek	MT1601	Davis Lick	2	23.6	7.6	7.5	64
B	Tygart Valley River	Leading Creek	MT1512	Leading Creek	3	21.8	5.4	7	67
B	Tygart Valley River	Leading Creek	MT1511	Wilmoth Run	2	19.3	4.3	7.3	53
B	Tygart Valley River	Leading Creek	MT1510	trib. Wilmoth Creek	1	17.5	4.2	7.3	65
B	Tygart Valley River	Leading Creek	MT1509	Wilmoth Run	1	20.5	8.7	7.8	75
B	Cheat River	Shavers Fork	MC1508	Pleasant Run	2	12.3	9.6	6.7	79
B	Cheat River	Shavers Fork	MC1507	trib. Pleasant Run	1	17.1	8	6.4	79
B	Cheat River	Shavers Fork	MC1506	trib. Pleasant Run	1	17.4		6.7	85
B	Cheat River	Shavers Fork	MC1505	Pleasant Run	2	19	8.6	7	84
B	Cheat River	Shavers Fork	MC1504	Slab Camp Run	2	19.3	10.5	7.3	75
B	Cheat River	Shavers Fork	MC1503	Pleasant Run	2	18.3	11.1	7	104
B	Cheat River	Shavers Fork	MC1502	Pleasant Run	2	23	9.5	8.5	89
B	Cheat River	Shavers Fork	MC1501	Shavers Fork	3	23.8	7.5	7.9	104
B	Cheat River	Shavers Fork	MC1402	trib. Shavers Fork	1	19	4.1	6	37
B	Cheat River	Shavers Fork	MC1401	Shavers Fork	3	31.5	8	7	120

TABLE 8
WATER QUALITY AND HABITAT ASSESSMENT SCORE

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score
B	Cheat River	Shavers Fork	MC1400	Shavers Fork	3	31.5	8	7	120
B	Cheat River	Black Fork	MC1320	Roaring Run	2	14	8	7.5	89
B	Cheat River	Black Fork	MC1319	Black Fork River	3	19	6.8	7	123
B	Cheat River	Black Fork	MC1318	trib. Black Fork	2	25	6.2	7.5	82
B	Cheat River	Black Fork	MC1317	trib. Roaring Run	1	14.5	6	7	51
B	Cheat River	Black Fork	MC1316	trib. Roaring Run	1	13.4	9.4	7.2	111
B	Cheat River	Black Fork	MC1315	trib. Roaring Run	1	13.6	6.7	6	87
B	Cheat River	Black Fork	MC1314	trib. Roaring Run	1	13.6	8	7.7	99
B	Cheat River	Black Fork	MC1313	trib. Roaring Run	1	13.2	7.8	7.5	79
B	Cheat River	Black Fork	MC1312	trib. Big Run	1	12.8	6.3	4.5	91
B	Cheat River	Black Fork	MC1311	Big Run	2	15	9.9	4.5	85
B	Cheat River	Black Fork	MC1310	Tub Run	1	12.4	7.7	4.1	105
B	Cheat River	Black Fork	MC1309	Middle Run	2	10	7.6	6	57
B	Cheat River	Black Fork	MC1308	Long Run	2	18.3	9.6	6.1	79
B	Cheat River	Black Fork	MC1307	Long Run	2	19.3	9.6	6.2	74
B	Cheat River	Black Fork	MC1306	Long Run	2	15.2	11.3	3.2	72
B	Cheat River	Black Fork	MC1305	Long Run	2	13.9	9.3	2.9	65
B	Cheat River	Black Fork	MC1304	N.F. Blackwater River	3	13.5	10.6	4	65
B	Cheat River	Black Fork	MC1303	trib. N.F. Blackwater River	1	9.1	10.3	2.8	64
B	Cheat River	Black Fork	MC1302	N.F. Blackwater River	3	14.4	10.6	6.9	87
B	Cheat River	Black Fork	MC1301	trib. Beaver Creek	1	13	10.9	5.1	74
B	Cheat River	Black Fork	MC1216	trib. Beaver Creek	2	23	7	5	42
B	Cheat River	Black Fork	MC1215	trib. Beaver Creek	1	21	5.2	5.5	57
B	Cheat River	Black Fork	MC1214	trib. Beaver Creek	1	22	5.2	3	80
B	Cheat River	Black Fork	MC1213	trib. Pendleton Creek	1	26	6.4	7	32
B	Cheat River	Black Fork	MC1212	Pendleton Creek	2	29	7.2	6.5	86
B	Cheat River	Black Fork	MC1211	trib. Pendleton Creek	1	22	6	7	38
B	Cheat River	Black Fork	MC1210	trib. Beaver Creek	1	13	4.4	6.5	62
B	Cheat River	Black Fork	MC1209	trib. Beaver Creek	1	14	3.2	6	60

TABLE 8
WATER QUALITY AND HABITAT ASSESSMENT SCORE

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score
B	Cheat River	Black Fork	MC1208	Beaver Creek	3	18	6.6	4.5	68
B	Cheat River	Black Fork	MC1207	trib. Beaver Creek	2	13	6.8	5	55
B	Cheat River	Black Fork	MC1206	trib. Beaver Creek	1	16	6.8	5	41
B	Cheat River	Black Fork	MC1205	trib. Beaver Creek	1	11	6.2	4.5	43
B	Cheat River	Black Fork	MC1204	trib. Beaver Creek	1	25	5.4	3	52
B	Cheat River	Black Fork	MC1203	trib. Beaver Creek	1	17	5.2	3	49
B	Cheat River	Black Fork	MC1202	trib. Beaver Creek	1	11	4.8	3	49
B	Cheat River	Black Fork	MC1201	trib. Beaver Creek	1	13	8.6	6	84
B	Cheat River	Black Fork	MC1200	trib. Beaver Creek	1	12	8.2	5	90
B	Cheat River	Black Fork	MC1112	trib. Beaver Creek	1	22	4.2	6	49
B	Cheat River	Black Fork	MC1111	trib. Beaver Creek	1	16	6	5.5	57
B	Cheat River	Black Fork	MC1110	trib. Beaver Creek	1	19	6.7	6	83
B	Cheat River	Black Fork	MC1109	trib. Beaver Creek	1	13	6.8	4.5	88
B	Cheat River	Black Fork	MC1108	trib. Beaver Creek	1	15	7.4	5	89
B	Cheat River	Black Fork	MC1107	trib. Beaver Creek	1	15	6.8	4.5	57
B	Cheat River	Black Fork	MC1106	trib. Beaver Creek	1	12	6	4.5	75
B	Cheat River	Black Fork	MC1105	trib. Beaver Creek	1	17		5	101
B	Cheat River	Black Fork	MC1104	trib. Beaver Creek	1	18	6.4	5	106
B	Cheat River	Black Fork	MC1103	trib. Beaver Creek	1	17	7	5	63
B	Cheat River	Black Fork	MC1102	trib. Beaver Creek	1	19	6	6	53
B	Cheat River	Black Fork	MC1101	trib. Four Mile Run	1	17	6	7	76
B	Cheat River	Black Fork	MC1100	Four Mile Run	1	15	6.4	7.5	62
A	North Branch Potomac River	Stony River	PNB1009	trib. Little Creek	1	21	6.5	4	78
A	North Branch Potomac River	Patterson Creek	PNB1008	trib. Elklick Run	1	19	10	7.5	112
A	North Branch Potomac River	Patterson Creek	PNB1007	trib. Elklick Run	1	19	10	7.5	101
A	North Branch Potomac River	Stony River	PNB1006	Stony River	2	26	7	5	123
A	North Branch Potomac River	Stony River	PNB1005	trib. Stony River	1	15	7.6	6.5	97
A	North Branch Potomac River	Stony River	PNB1004	trib. Abrams Creek	1	14	9	4.5	80
A	North Branch Potomac River	Stony River	PNB1003	trib. Abrams Creek	1	14	7	5.5	68

TABLE 8
WATER QUALITY AND HABITAT ASSESSMENT SCORE

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score
A	North Branch Potomac River	Stony River	PNB1002	trib. Abrams Creek	1	14	7.6	7	53
A	North Branch Potomac River	Stony River	PNB1001	Abrams Creek	2	20	5.2	4	50
A	North Branch Potomac River	Stony River	PNB1000	Little Creek	2	25	4.5	3	51
A	North Branch Potomac River	Patterson Creek	PNB909	trib. N.F. Patterson Creek	2	7	10.4	6.5	93
A	North Branch Potomac River	Patterson Creek	PNB908	trib. N.F. Patterson Creek	1	8.5	11.2	8	77
A	North Branch Potomac River	Patterson Creek	PNB907	M.F. Patterson Creek	3		8.2	8	93
A	North Branch Potomac River	Patterson Creek	PNB906	Elklick Run	2	17	7.2	7	90
A	North Branch Potomac River	Patterson Creek	PNB905	trib. Elklick Run	2	19	8	8	79
A	North Branch Potomac River	Patterson Creek	PNB904	trib. Elklick Run	2	16	8.6	8	78
A	North Branch Potomac River	Patterson Creek	PNB903	trib. Elklick Run	1	14	9	8	96
A	North Branch Potomac River	Patterson Creek	PNB902	N.F. Patterson Creek	3	14		8	109
A	North Branch Potomac River	Patterson Creek	PNB901	trib. M.F. Patterson Creek	1	18	7.8	7	46
A	North Branch Potomac River	Patterson Creek	PNB900	M.F. Patterson Creek	3	18	8.2	8	96
A	North Branch Potomac River	Patterson Creek	PNB809	trib. Patterson Creek	1	8.5	9.2	8	64
A	North Branch Potomac River	Patterson Creek	PNB808	trib. N.F. Patterson Creek	1	0.5	12.8	7	51
A	North Branch Potomac River	Patterson Creek	PNB807	Patterson Creek	3	22	1.8	6.5	48
A	North Branch Potomac River	Patterson Creek	PNB806	trib. S.F. Patterson Creek	1	18	7.2	7	62
A	North Branch Potomac River	Patterson Creek	PNB805	trib. Patterson Creek	1	17.5	7.8	7	67
A	North Branch Potomac River	Patterson Creek	PNB804	trib. Thorn Run	2	10	6.2	7	71
A	North Branch Potomac River	Patterson Creek	PNB803	trib. Thorn Run	1	15.5	7.6	6	86
A	North Branch Potomac River	Patterson Creek	PNB802	trib. Thorn Run	2	19	6.5	6	74
A	North Branch Potomac River	Patterson Creek	PNB801	trib. Patterson Creek	2	19	8	8	87
A	North Branch Potomac River	Patterson Creek	PNB800	trib. Patterson Creek	1	27	6.5	8	34
A	South Branch Potomac River	Anderson Run	PSB709	trib. Walnut Bottom	2	21	7.2	7.5	66
A	South Branch Potomac River	Anderson Run	PSB708	Walnut Bottom	2	28	7.2	8	67
A	South Branch Potomac River	Anderson Run	PSB707	Tombs Hollow Run	2	12.3	11.5	8	89
A	South Branch Potomac River	Anderson Run	PSB706	trib. Walnut Bottom	2	14.5	12.4	6.6	116
A	South Branch Potomac River	Anderson Run	PSB705	trib. Walnut Bottom	2	18	10.3	6.3	78
A	South Branch Potomac River	Anderson Run	PSB704	trib. Walnut Bottom	2	19.7	10.8	7	67

TABLE 8
WATER QUALITY AND HABITAT ASSESSMENT SCORE

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score
A	South Branch Potomac River	Anderson Run	PSB703	Walnut Bottom	3	17.9	11	8.3	81
A	South Branch Potomac River	Anderson Run	PSB702	Walnut Bottom	3	16.2	11.2	7.5	95
A	South Branch Potomac River	Main Channel	PSB701	trib. S.B. Potomac River	1	18.6	4.3	7.1	53
A	South Branch Potomac River	Main Channel	PSB606	S.B. Potomac River	3	24.3	13.5	7.4	101
A	South Branch Potomac River	Main Channel	PSB605	trib. S.B. Potomac River	1	23.4	4.9	6.2	55
A	South Branch Potomac River	Main Channel	PSB604	trib. Fort Run	1	17.3	3.9	6.5	68
A	South Branch Potomac River	Main Channel	PSB603	Clifford Hollow	2	13.3	10.1	7	112
A	South Branch Potomac River	Clifford Hollow	PSB602	trib. Clifford Hollow	1	13.3	8.6	7	86
A	South Branch Potomac River	Clifford Hollow	PSB601	trib. Clifford Hollow	1	13.5	8.7	7	66
A	Cacapon River	Baker Run	PC517	trib. Baker Run	2	6	11.1	6	109
A	Cacapon River	Skaggs Run	PC516	trib. Skaggs Run	1	11.5	8.2	6	59
A	Cacapon River	Skaggs Run	PC515	trib. Skaggs Run	1	12.8	9.4	7	75
A	Cacapon River	Skaggs Run	PC514	trib. Skaggs Run	1	12	9.6	6	64
A	Cacapon River	Skaggs Run	PC513	Skaggs Run	2	12.5	9.5	7.5	86
A	Cacapon River	Skaggs Run	PC512	trib. Skaggs Run	1	11.8	10.2	6	83
A	Cacapon River	Skaggs Run	PC511	trib. Skaggs Run	1	11	11.1	7	105
A	Cacapon River	Skaggs Run	PC510	trib. Skaggs Run	1	10.8	10.5	6	76
A	Cacapon River	Skaggs Run	PC509	Skaggs Run	1	11	10.1	6.5	53
A	Cacapon River	Baker Run	PC508	Long Lick Run	2	13.3	9.5	8	76
A	Cacapon River	Baker Run	PC507	Long Lick Run	2	14.5	9.1	7.5	72
A	Cacapon River	Baker Run	PC506	trib. Long Lick Run	2	16	8.3	6.5	66
A	Cacapon River	Baker Run	PC505	trib. Long Lick Run	1	14.3	9	6	56
A	Cacapon River	Baker Run	PC504	Long Lick Run	2	17.8	8.5	7.7	80
A	Cacapon River	Baker Run	PC503	Baker Run	3	17.3	8.5	7.5	89
A	Cacapon River	Baker Run	PC502	Baker Run	3	16.5	8.8	7.5	89
A	Cacapon River	Baker Run	PC501	trib. Baker Run	1	13.3		6.5	67
A	Cacapon River	Central Cacapon River	PC413	Lost River	3	25	7.6	7.5	120
A	Cacapon River	Baker Run	PC412	Baker Run	3	17.3	9.6	7.5	97
A	Cacapon River	Central Cacapon River	PC411	Lost River	3	17	9.8	7.7	101

TABLE 8
WATER QUALITY AND HABITAT ASSESSMENT SCORE

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score
A	Cacapon River	Central Cacapon River	PC410	trib. Lost River	1	14.5	8.8	7.5	64
A	Cacapon River	Central Cacapon River	PC409	trib. Lost River	1	13.5	8.4	7.4	55
A	Cacapon River	Central Cacapon River	PC408	Lost River	3	15.8	9.2	7.7	100
A	Cacapon River	Central Cacapon River	PC407	trib. Lost River	1	11.8	7	6.8	84
A	Cacapon River	Central Cacapon River	PC406	trib. Lost River	2	11.8	5.2	7.1	93
A	Cacapon River	Central Cacapon River	PC405	trib. Lost River	1	11.8	8.2	6.8	55
A	Cacapon River	Central Cacapon River	PC404	trib. Lost River	1	12	5.4	6.6	81
A	Cacapon River	Central Cacapon River	PC403	trib. Lost River	1	12	5.2	6.1	76
A	Cacapon River	Central Cacapon River	PC402	Sauerkraut Run	2	16	9.2	7.8	101
A	Cacapon River	Central Cacapon River	PC401	Lost River	3	20.3	8.2	7.6	97
A	Cacapon River	Central Cacapon River	PC315	Trout Run	3	12.8	10.5	7.6	99
A	Cacapon River	Central Cacapon River	PC314	trib. Trout Run	1	14.5	7.6	7.2	57
A	Cacapon River	Waites Run	PC313	trib. Waites Run	2	13.1	8.8	6.8	90
A	Cacapon River	Waites Run	PC312	trib. Waites Run	1	13	9.6	6.5	52
A	Cacapon River	Waites Run	PC311	trib. Waites Run	1	12.7	10	7.2	83
A	Cacapon River	Waites Run	PC310	trib. Slate Rock Run	1	17.3	7	6.8	47
A	Cacapon River	Waites Run	PC309	trib. Waites Run	1	13.3	7.4	6.8	74
A	Cacapon River	Waites Run	PC308	Waites Run	2	14.7	9.5	7.2	106
A	Cacapon River	Waites Run	PC307	trib. Waites Run	1	15	6.8	6.8	57
A	Cacapon River	Waites Run	PC306	Waites Run	2	11.1	10	7.3	121
A	Cacapon River	Slate Rock Run	PC305	Slate Rock Run	2	15	8.8	7	115
A	Cacapon River	Slate Rock Run	PC304	trib. Slate Rock Run	1	14	9	7	103
A	Cacapon River	Slate Rock Run	PC303	trib. Sine Run	1	14.5	9.2	7	79
A	Cacapon River	Slate Rock Run	PC302	trib. Sine Run	1	12.5	8.9	6.5	85
A	Cacapon River	Slate Rock Run	PC301	trib. Sine Run	1	12	9.1		80
A	Cacapon River	Slate Rock Run	PC300	trib. Sine Run	1	12	10		83
A	Shenandoah River	Cedar Creek	PS207	trib. Paddy Run	1	21	7.8	7	61
A	Shenandoah River	Cedar Creek	PS206	trib. Duck Run	1	21	6.8	7	47
A	Shenandoah River	Cedar Creek	PS205	trib. Duck Run	2	24	5.9	6.5	45

TABLE 8
WATER QUALITY AND HABITAT ASSESSMENT SCORE

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score
A	Shenandoah River	Cedar Creek	PS204	trib. Duck Run	2	29	5.9	6	48
A	Shenandoah River	Cedar Creek	PS203	trib. Duck Run	1	21		7	48
A	Shenandoah River	Cedar Creek	PS202	Duck Run	2	20	7.8	7	112
A	Shenandoah River	Cedar Creek	PS201	Duck Run	2	20	7.8	7	112
A	Shenandoah River	Cedar Creek	PS200	Duck Run	2	21	7	7.5	95
A	Shenandoah River	Cedar Creek	PS113	Turkey Run	2	6.5	9.8	7.5	88
A	Shenandoah River	Cedar Creek	PS112	Mulberry Run	2	24	7.8	8	97
A	Shenandoah River	Cedar Creek	PS111	trib. Mulberry Run	1	23	8	8	66
A	Shenandoah River	Cedar Creek	PS110	Cedar Creek	3	22	7.2	7.5	114
A	Shenandoah River	Cedar Creek	PS109	Cedar Creek	3	22	7.2	8	110
A	Shenandoah River	Cedar Creek	PS108	trib. Mulberry Run	1	23	6	8	101
A	Shenandoah River	Cedar Creek	PS107	trib. Mulberry Run	1	24	7.2	8	69
A	Shenandoah River	Cedar Creek	PS106	Mulberry Run	2	21	7	8	83
A	Shenandoah River	Cedar Creek	PS105	trib. Mulberry Run	1	24	3	7.5	45
A	Shenandoah River	Cedar Creek	PS104	trib. Cedar Creek	1	21	2.8	8	101
A	Shenandoah River	Cedar Creek	PS103	trib. Mulberry Run	2	21	7.8	8	101
A	Shenandoah River	Cedar Creek	PS102	trib. Mulberry Run	2	20	7.2	8	86
A	Shenandoah River	Cedar Creek	PS101	Town Run	1	21	5.4	7	51
A	Shenandoah River	Cedar Creek	PS100	Town Run	2	19	7.8	8	88

Figure 1
Comparison of the Habitat Assessment Score by Ecoregion

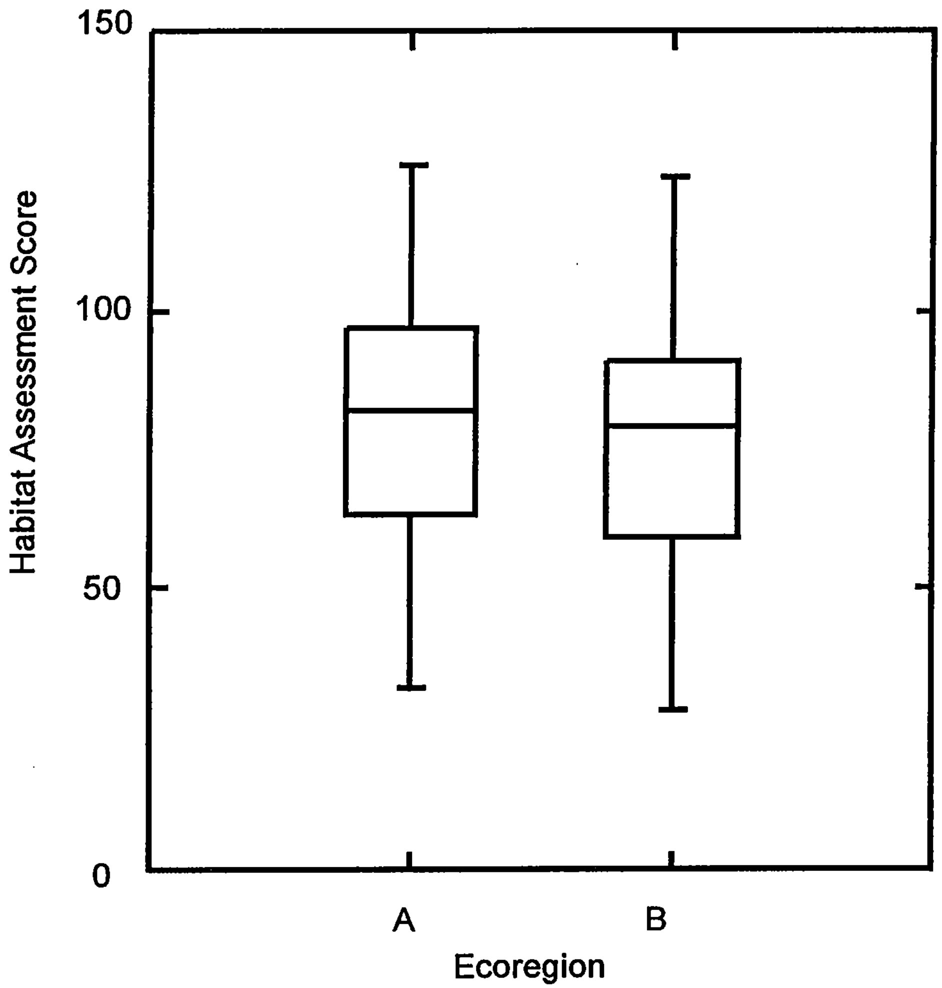


Figure 2
Comparison of the Habitat Assessment Score by Regional Project Watershed

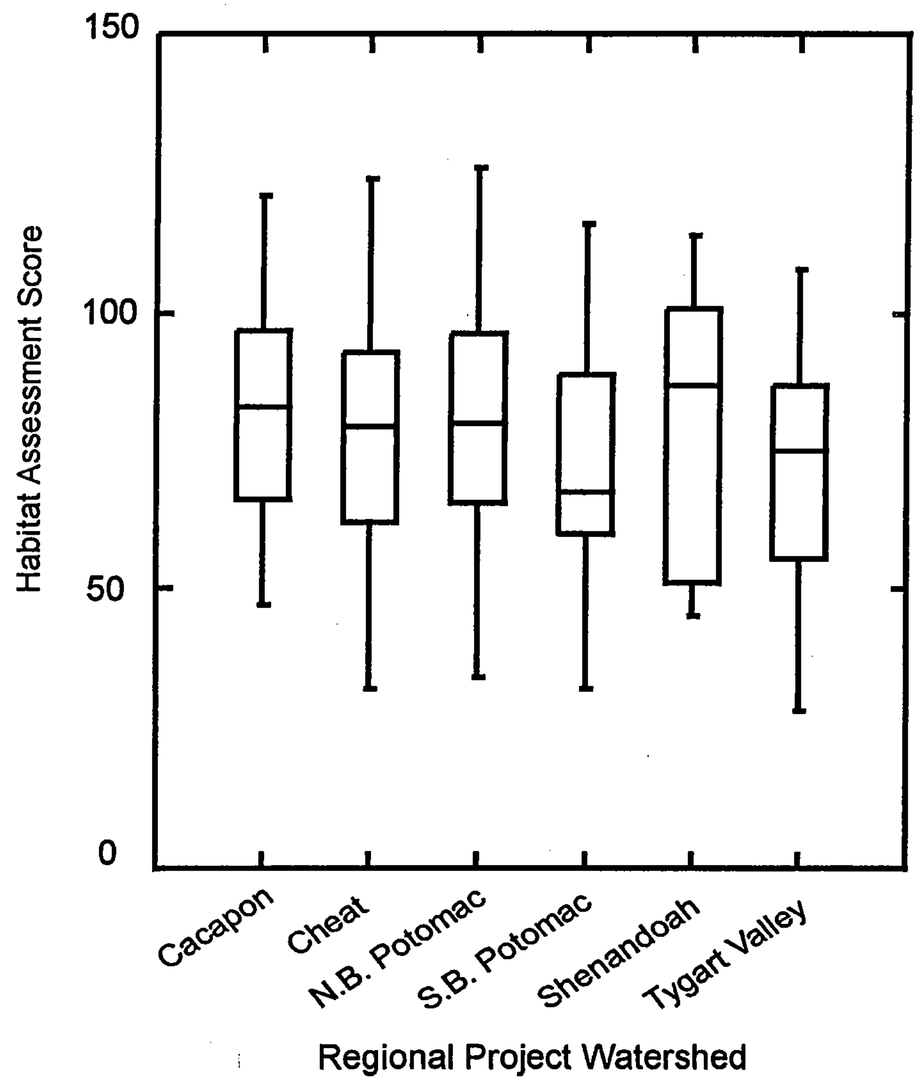


FIGURE 3
CLUSTERING OF HABITAT ASSESSMENT SCORES BY ECOREGION

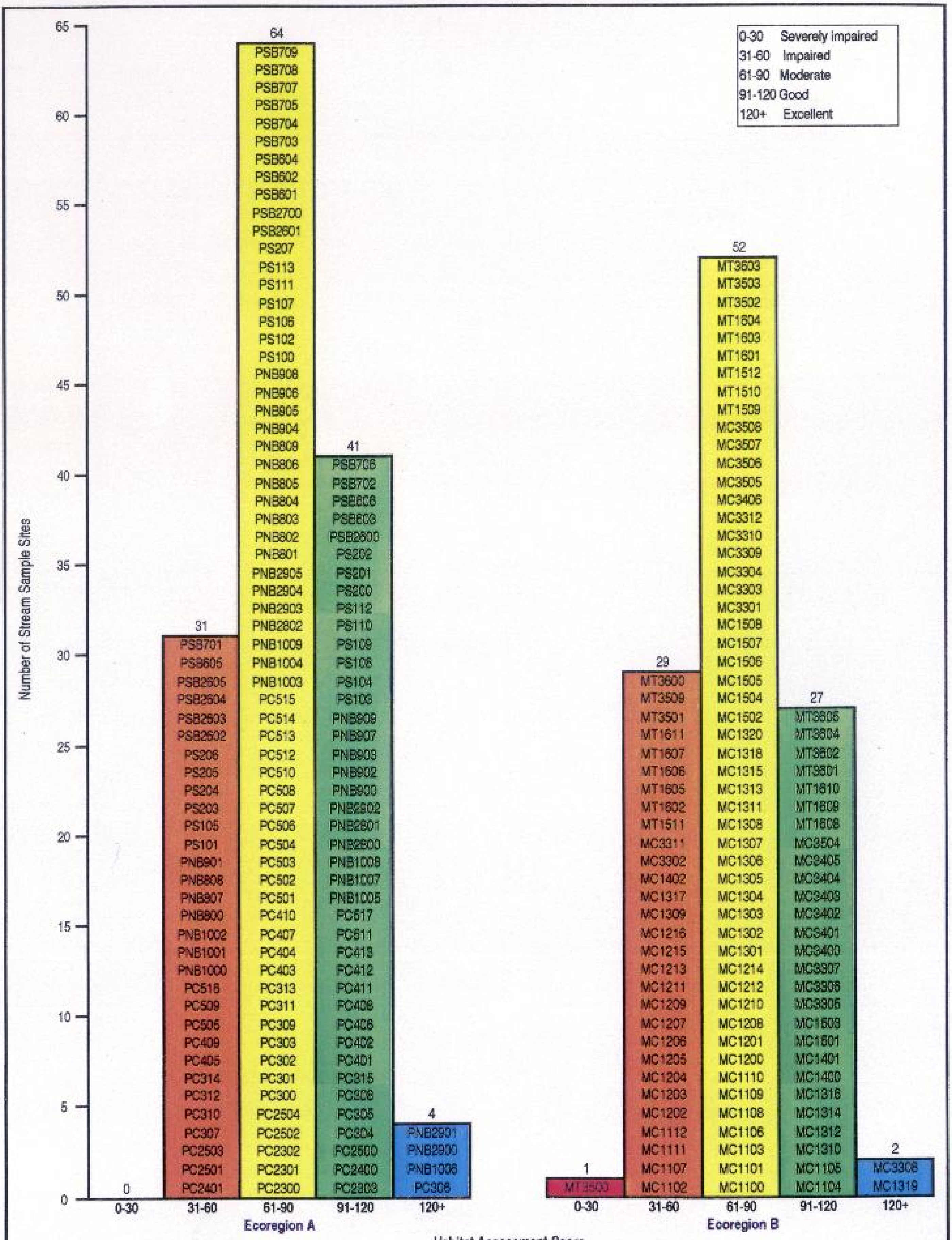


FIGURE 4
CLUSTERING OF HABITAT ASSESSMENT SCORES BY REGIONAL PROJECT WATERSHED

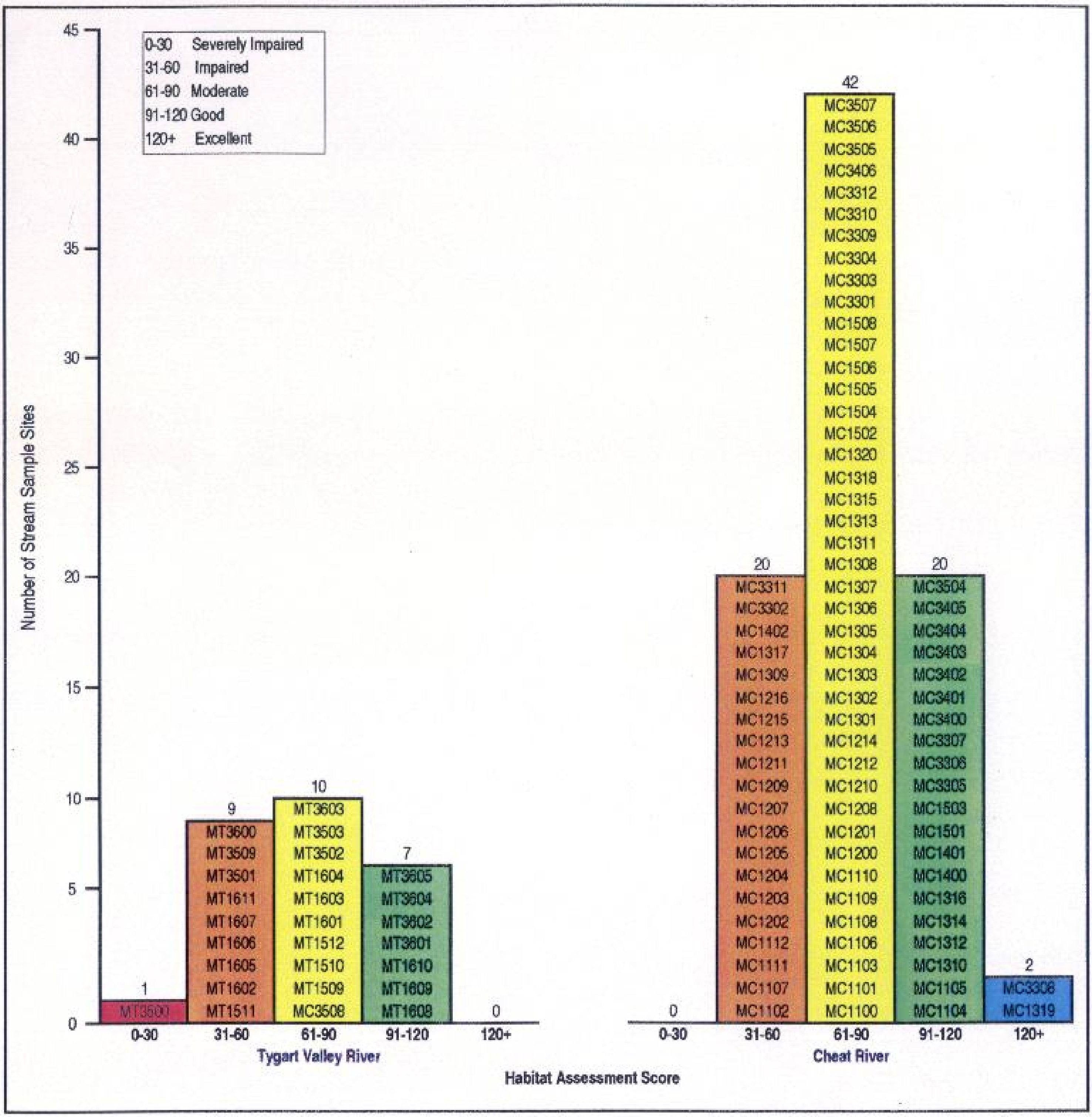


FIGURE 4

CLUSTERING OF HABITAT ASSESSMENT SCORES BY REGIONAL PROJECT WATERSHED

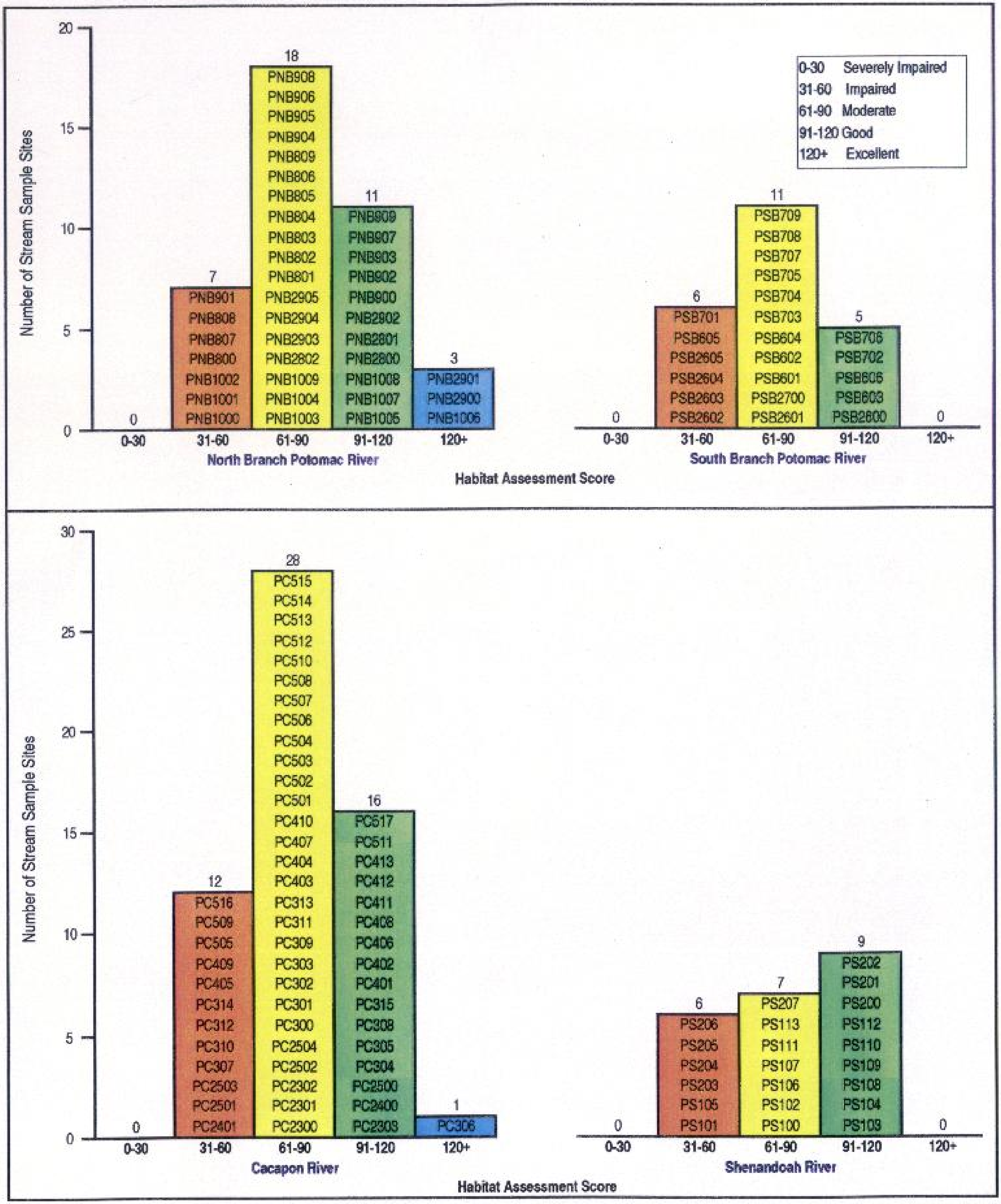


Figure 5
Comparison of the Habitat Assessment Score by Local Project Watershed

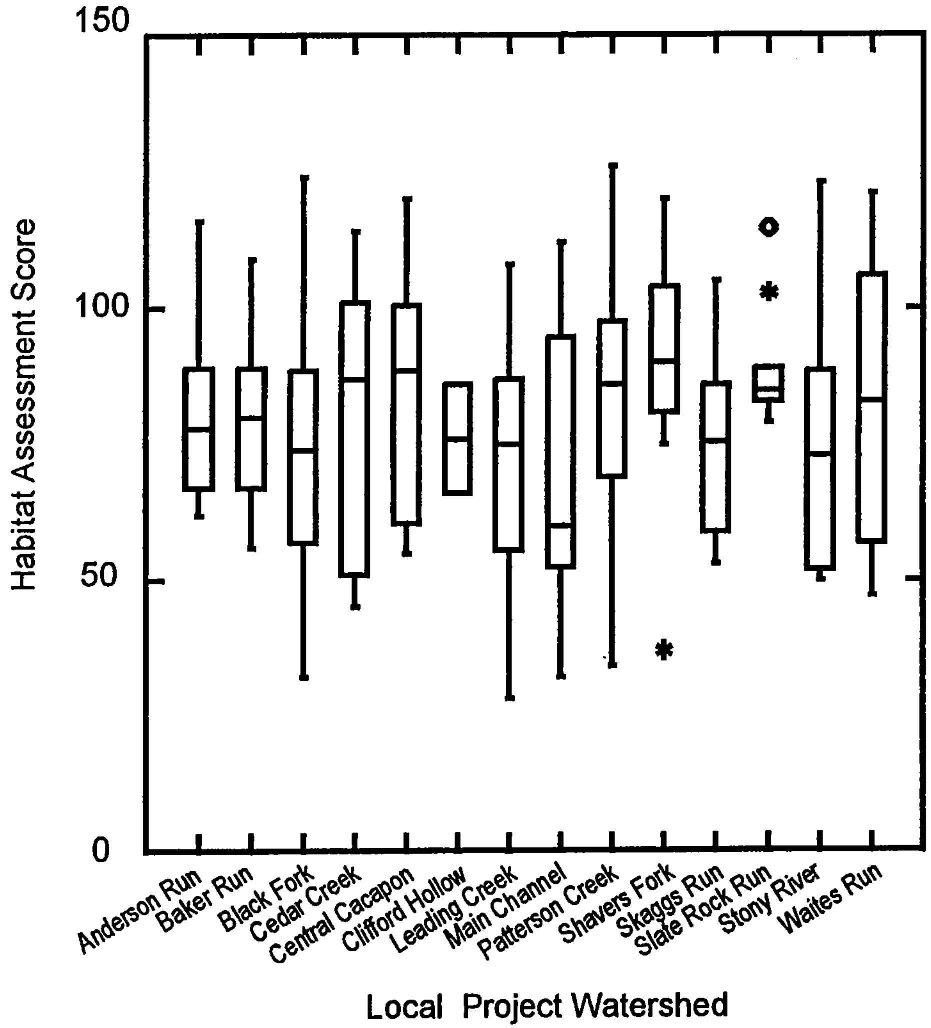


Figure 6
Comparison of the Habitat Assessment Score by Stream Order

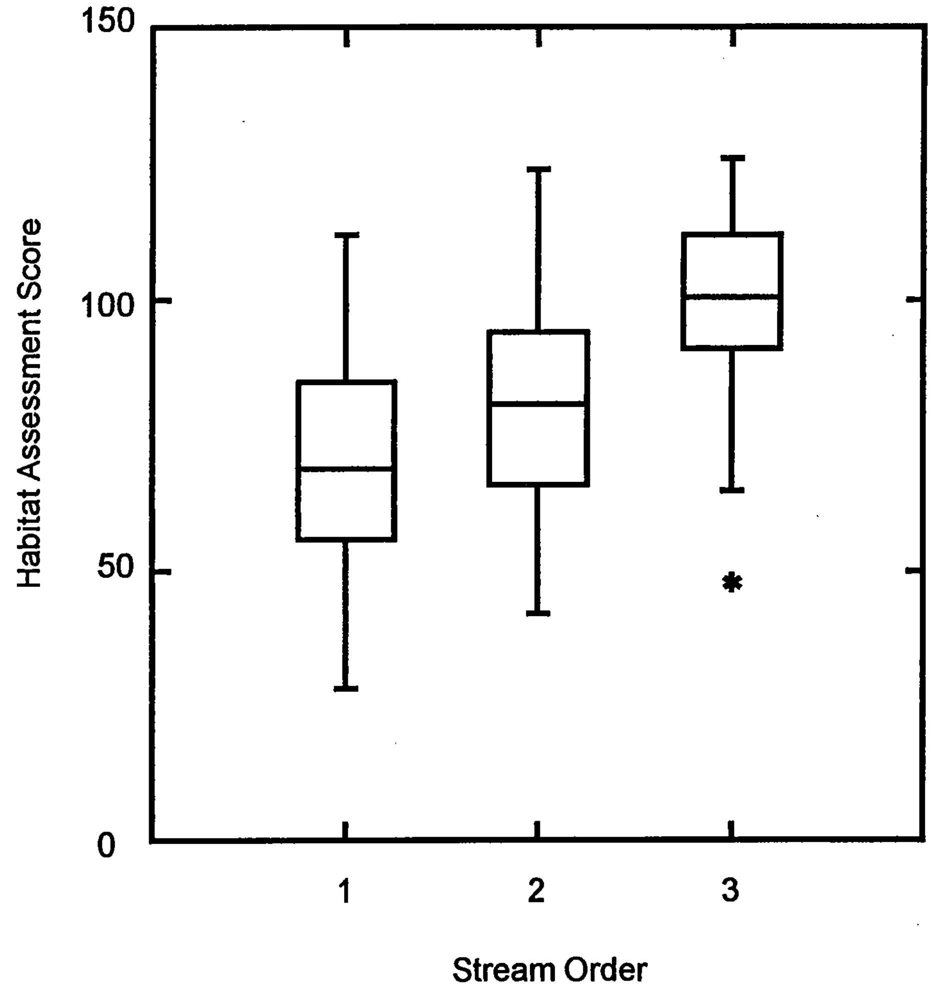


Figure 7
Comparison of the Habitat Assessment Score by Ecoregion for First Order Streams

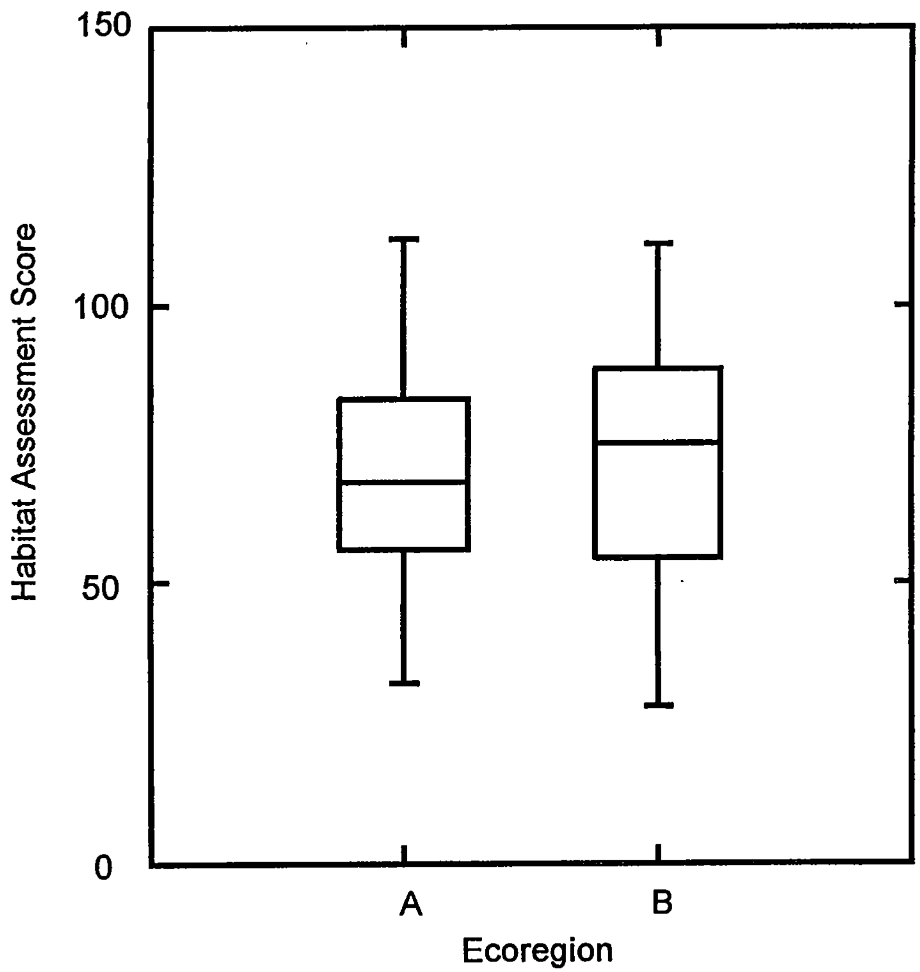


Figure 8
Comparison of Habitat Assessment Score by Ecoregion for Third Order Streams

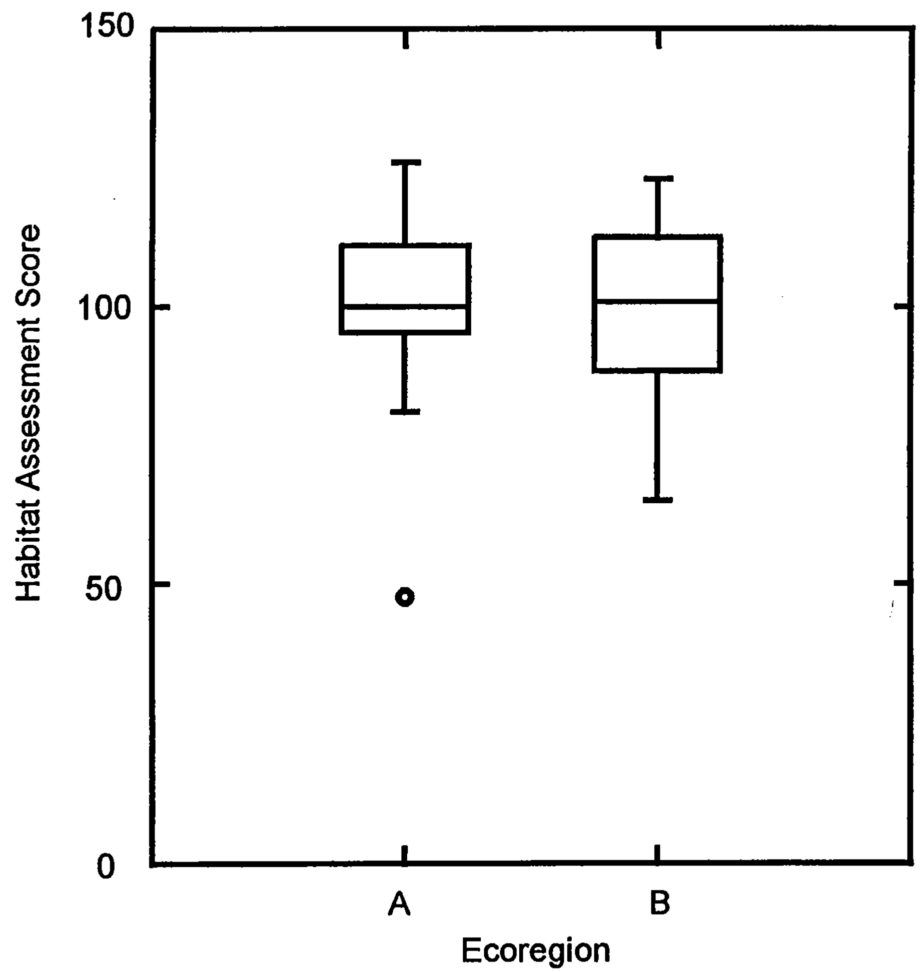


Figure 9
Comparison of Habitat Assessment Score by Ecoregion for Second Order Streams

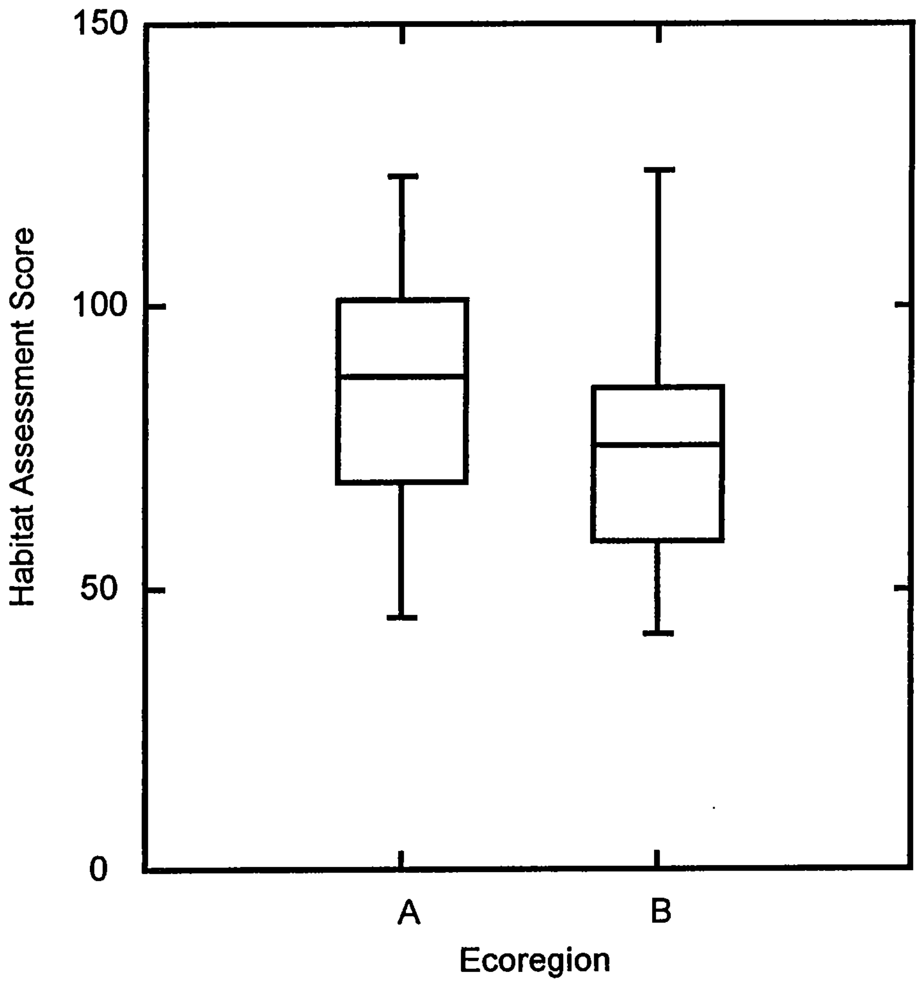


Figure 10
Comparison of Habitat Assessment Score by Regional Project Watershed for First Order Streams

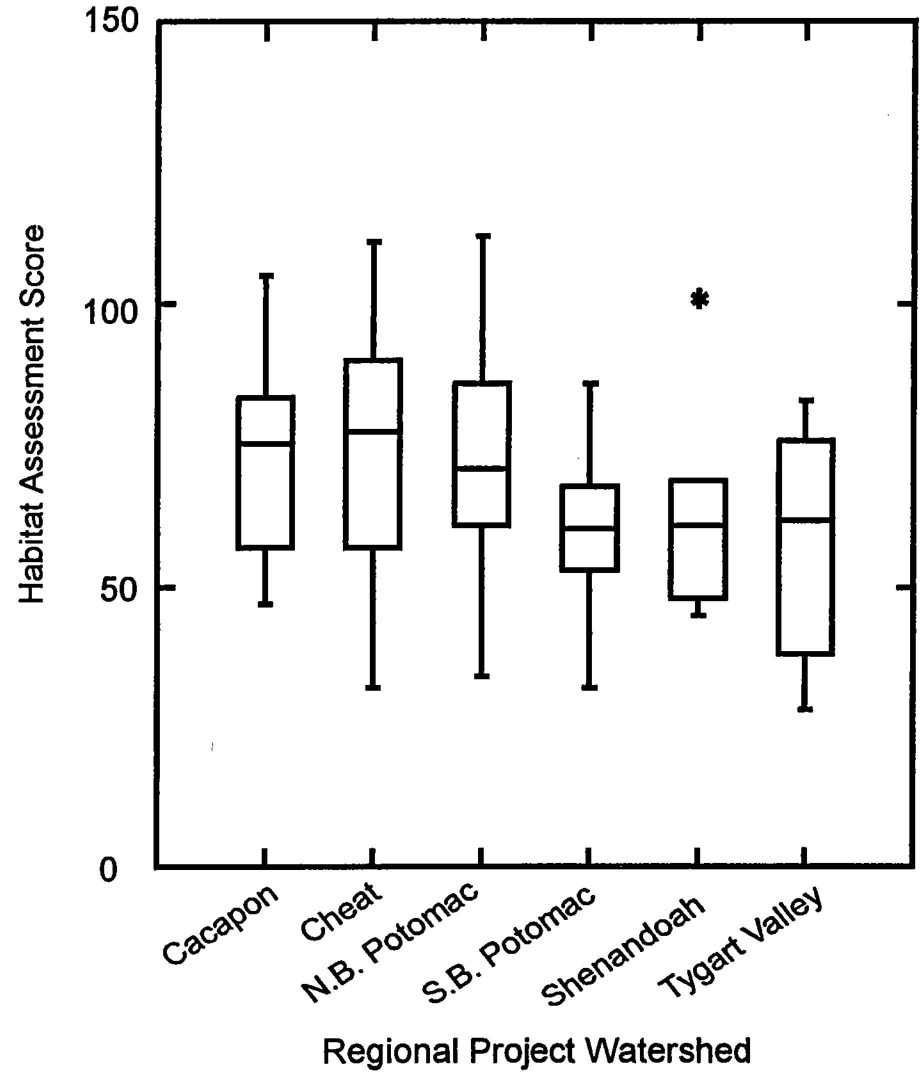


Figure 11
Comparison of Habitat Assessment Score by Regional Project Watershed for Second Order Streams

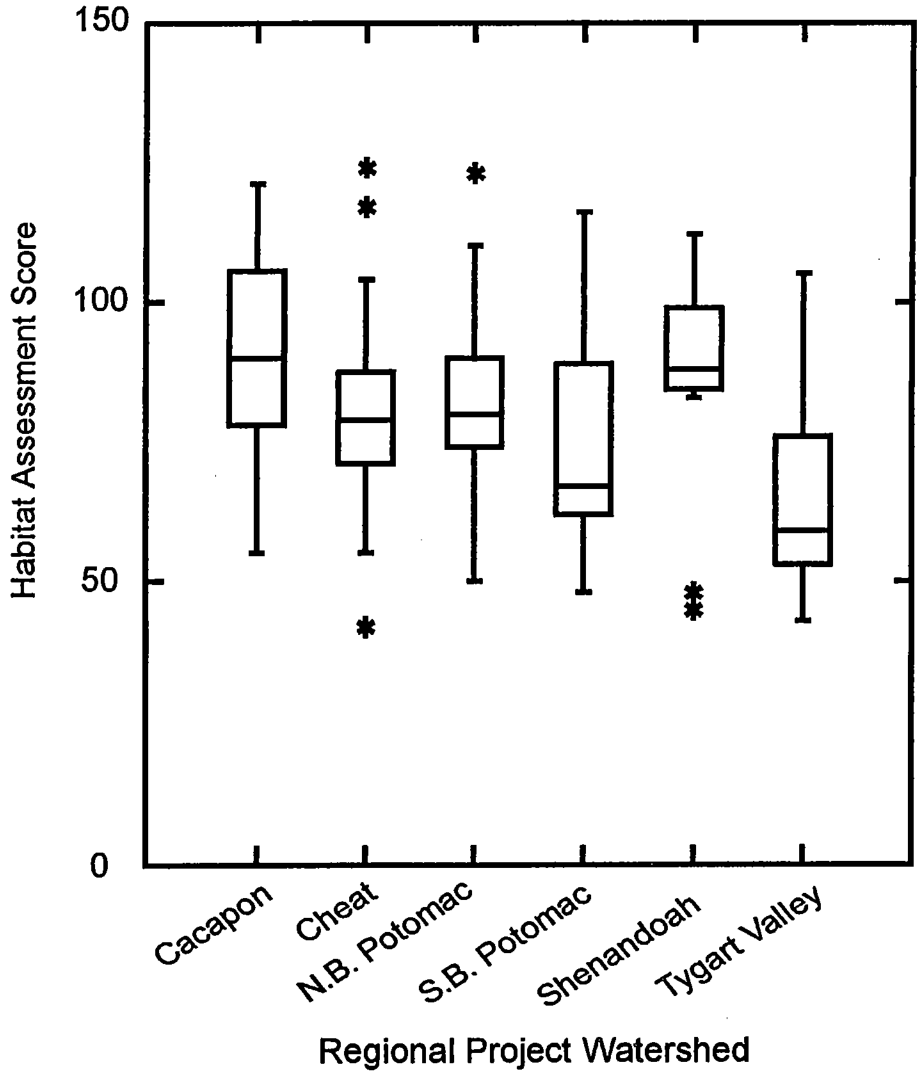


Figure 12
Comparison of Habitat Assessment Score by Regional Project Watershed for Third Order Streams

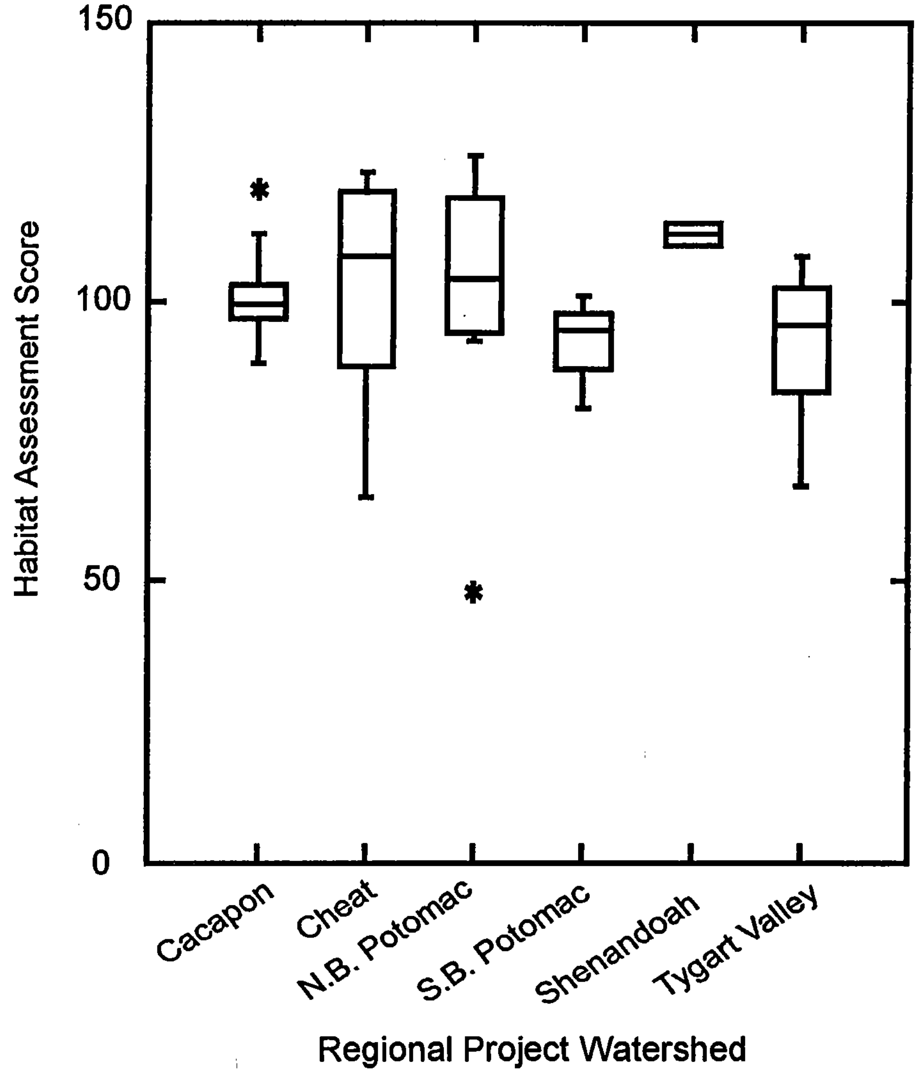


FIGURE 13
CLUSTERING OF HABITAT ASSESSMENT SCORE BY LOCAL PROJECT WATERSHED

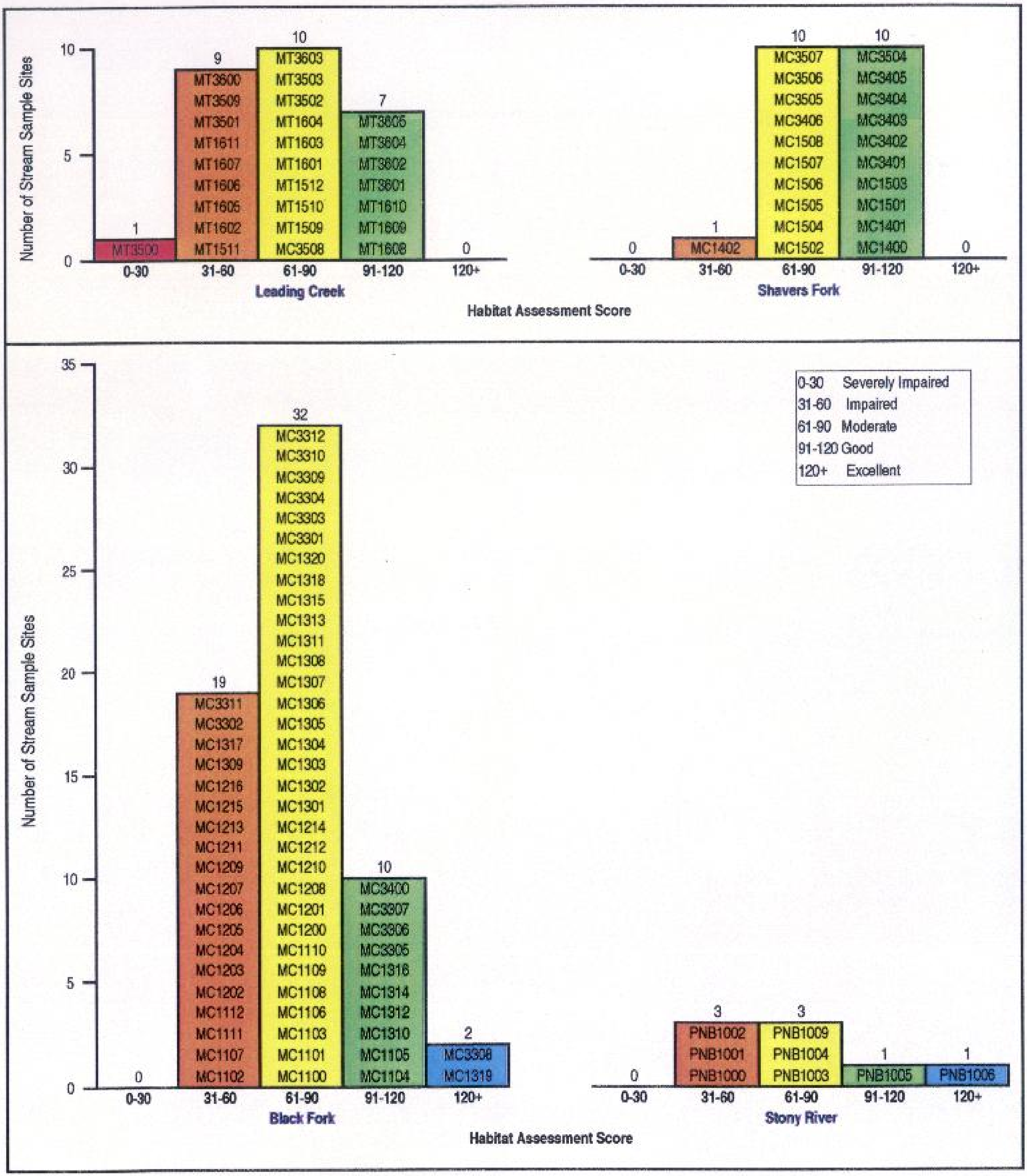


FIGURE 13
CLUSTERING OF HABITAT ASSESSMENT SCORE BY LOCAL PROJECT WATERSHED

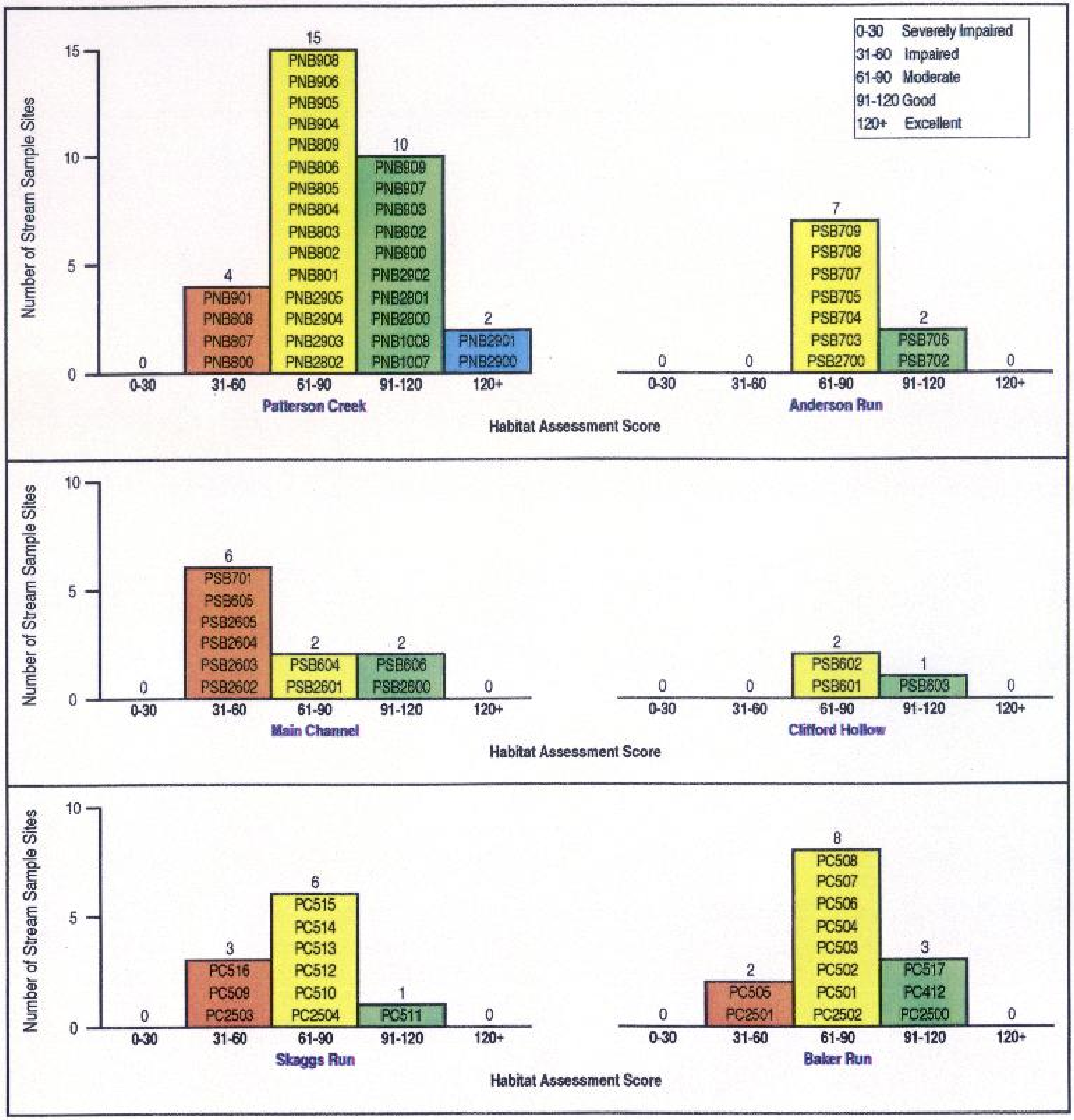


FIGURE 13
CLUSTERING OF HABITAT ASSESSMENT SCORE BY LOCAL PROJECT WATERSHED

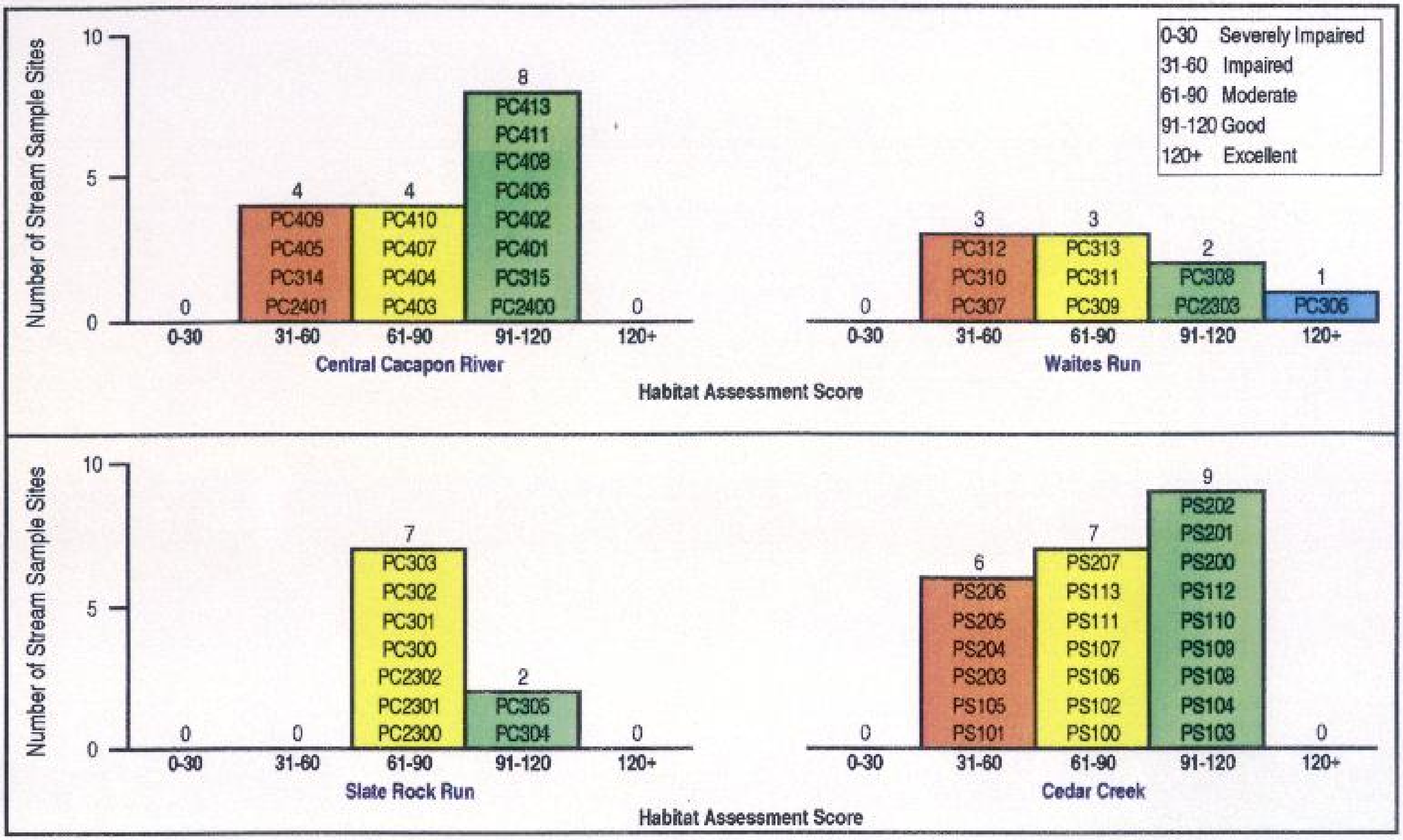


FIGURE 14
CLUSTERING OF HABITAT ASSESSMENT SCORES
BY STREAM ORDER

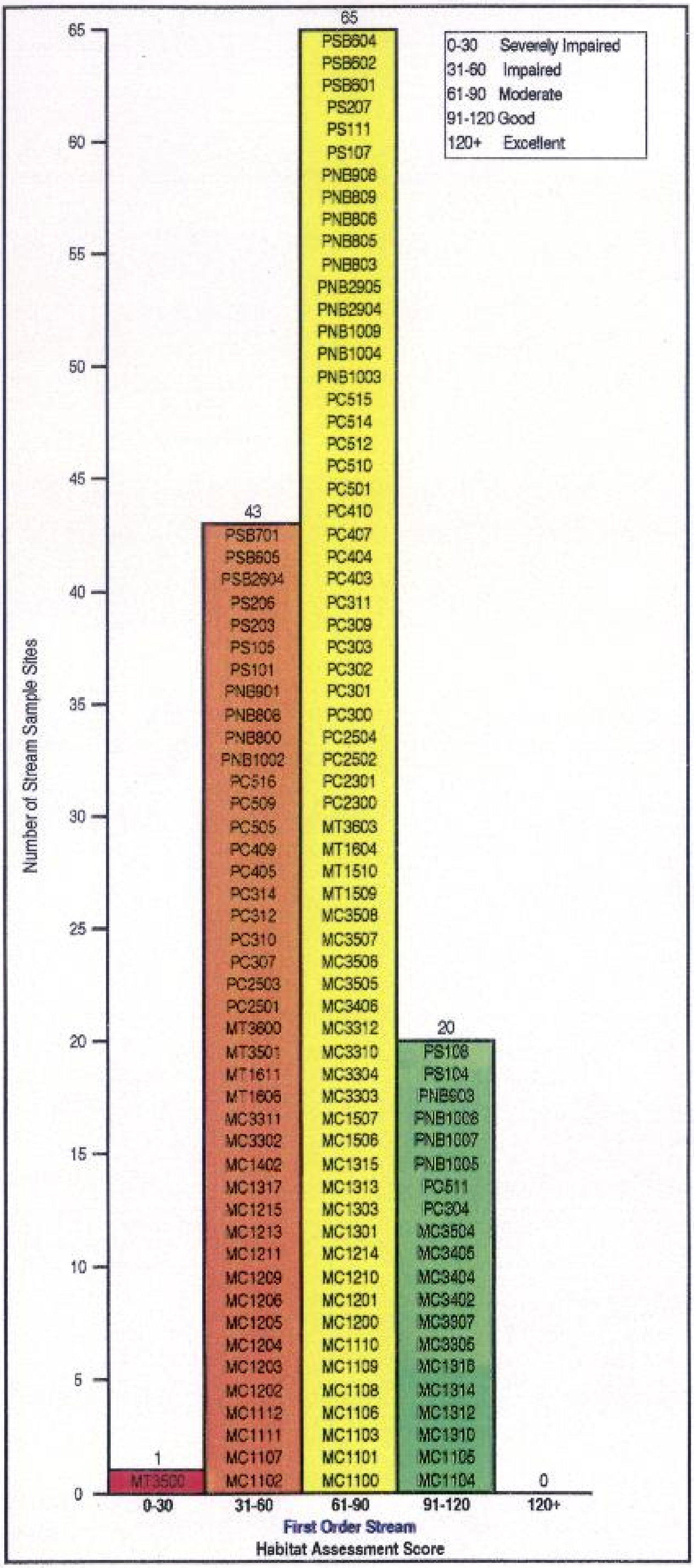


FIGURE 14
CLUSTERING OF HABITAT ASSESSMENT SCORES BY STREAM ORDER

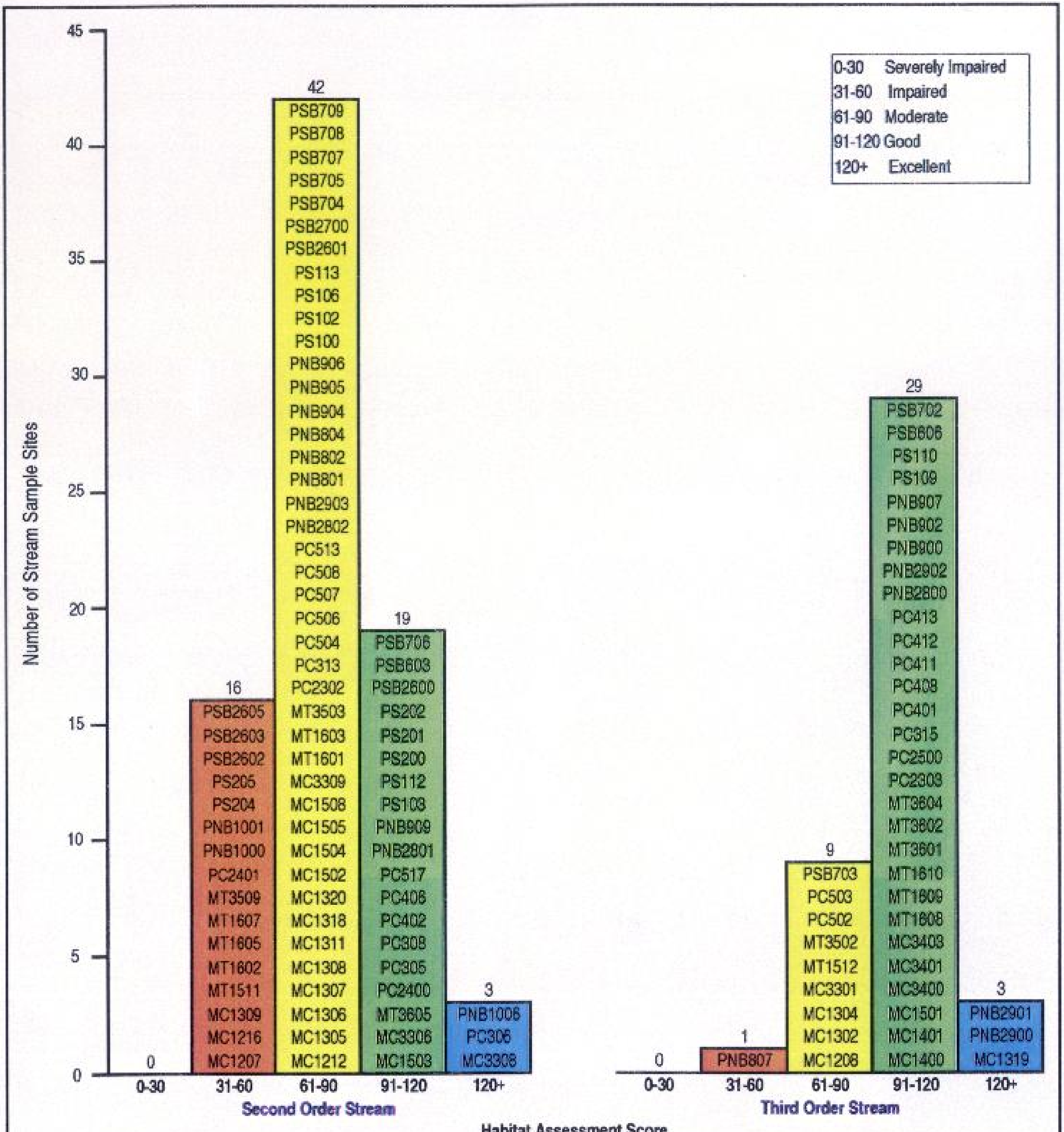
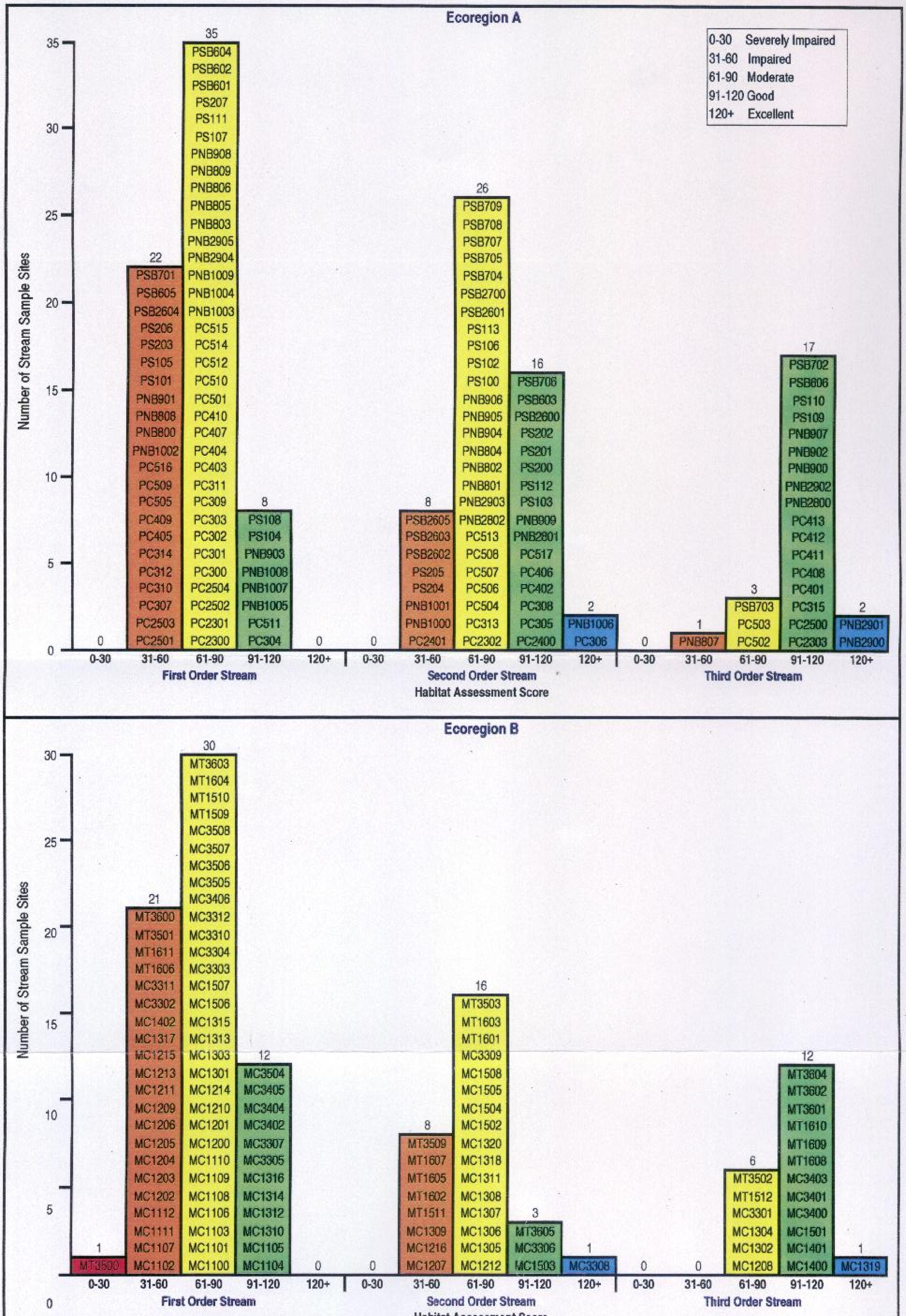


FIGURE 15
CLUSTERING OF HABITAT ASSESSMENT SCORES BY ECOREGION AND STREAM ORDER



FI 16

CLUSTERING OF HABITAT ASSESSMENT SCORES BY REGIONAL PROJECT WATERSHED AND STREAM ORDER

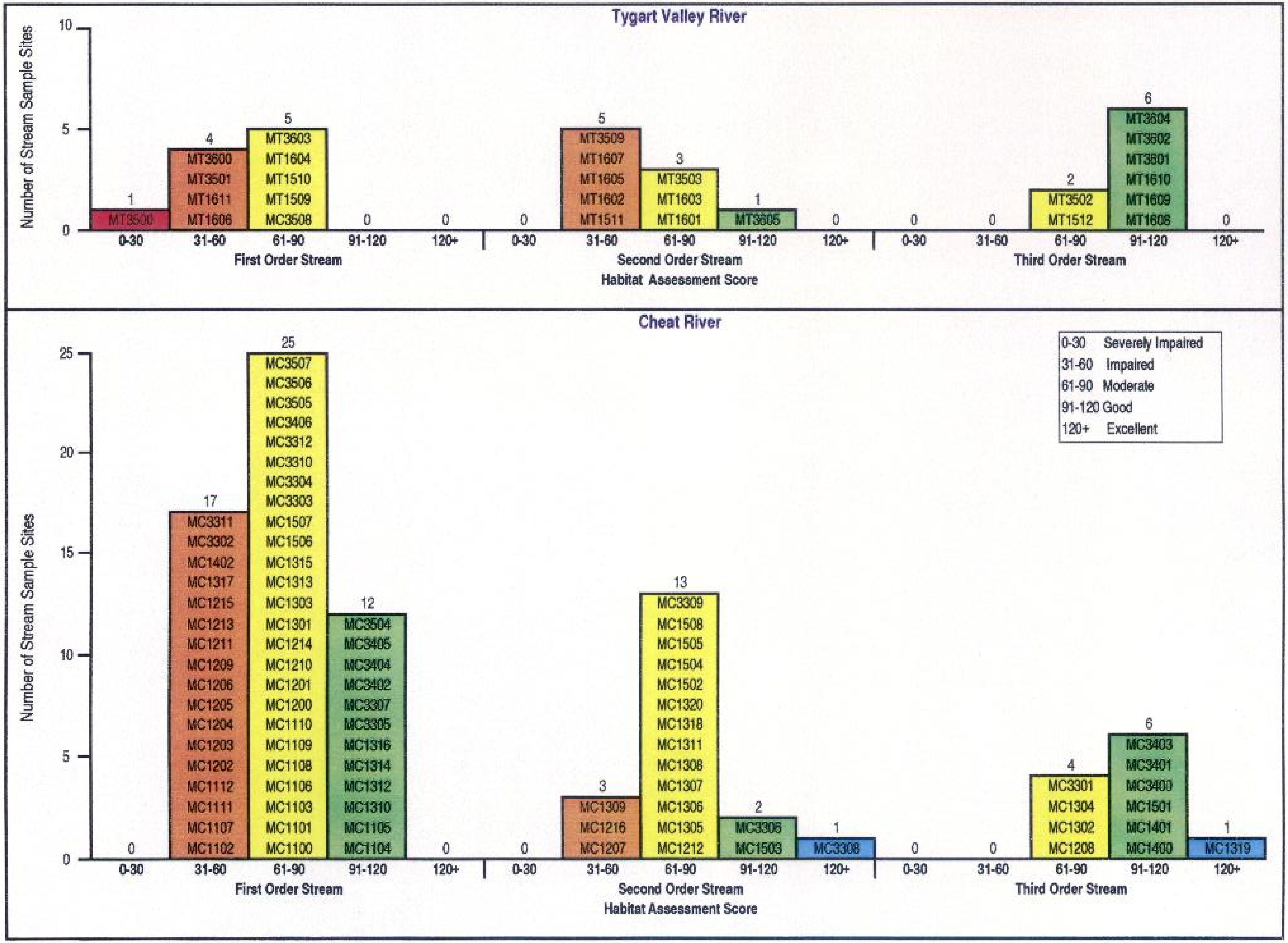


FIGURE 16

CLUSTERING OF HABITAT ASSESSMENT SCORES BY REGIONAL PROJECT WATERSHED AND STREAM ORDER

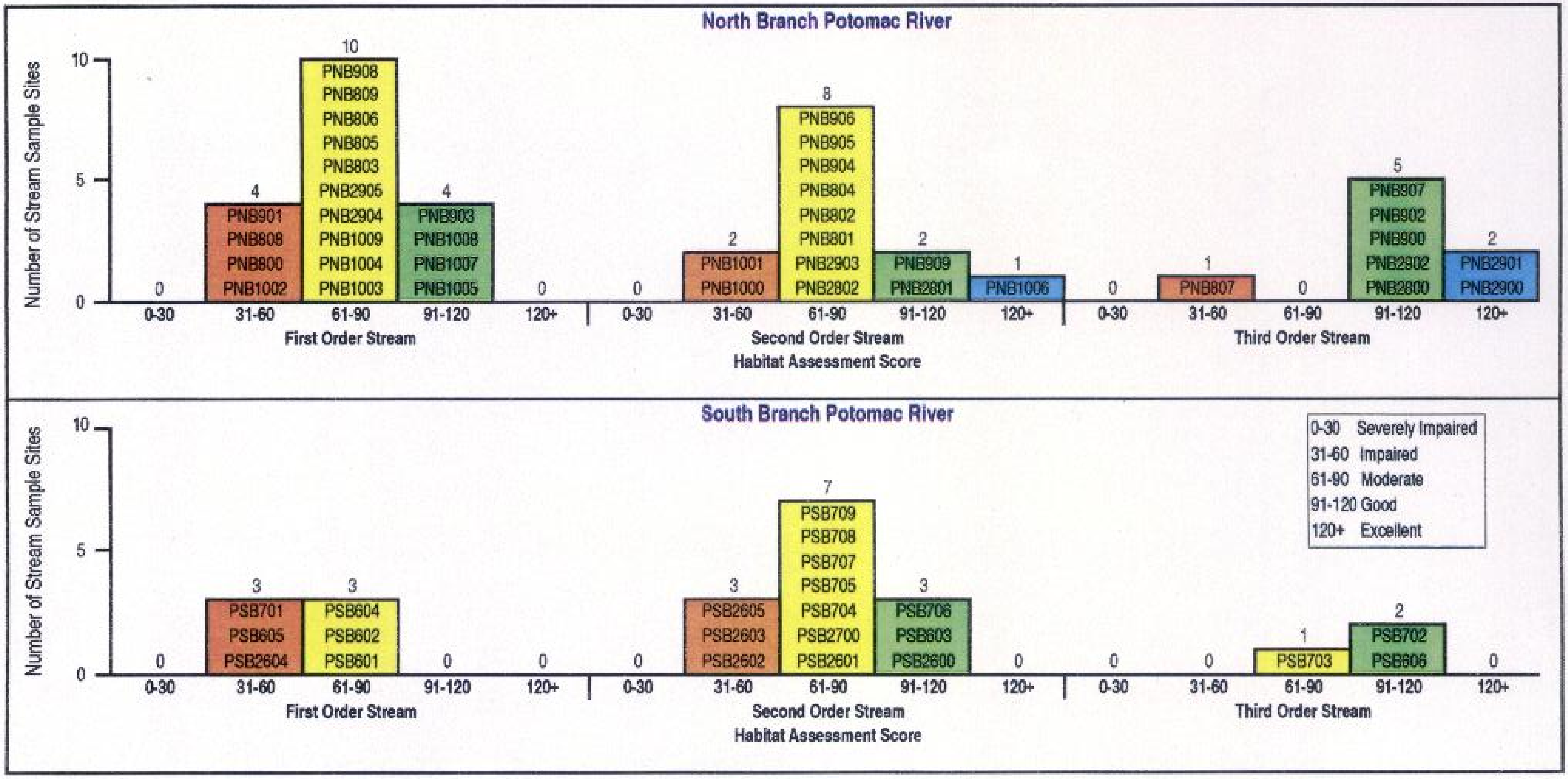


FIGURE 16

CLUSTERING OF HABITAT ASSESSMENT SCORES BY REGIONAL PROJECT WATERSHED AND STREAM ORDER

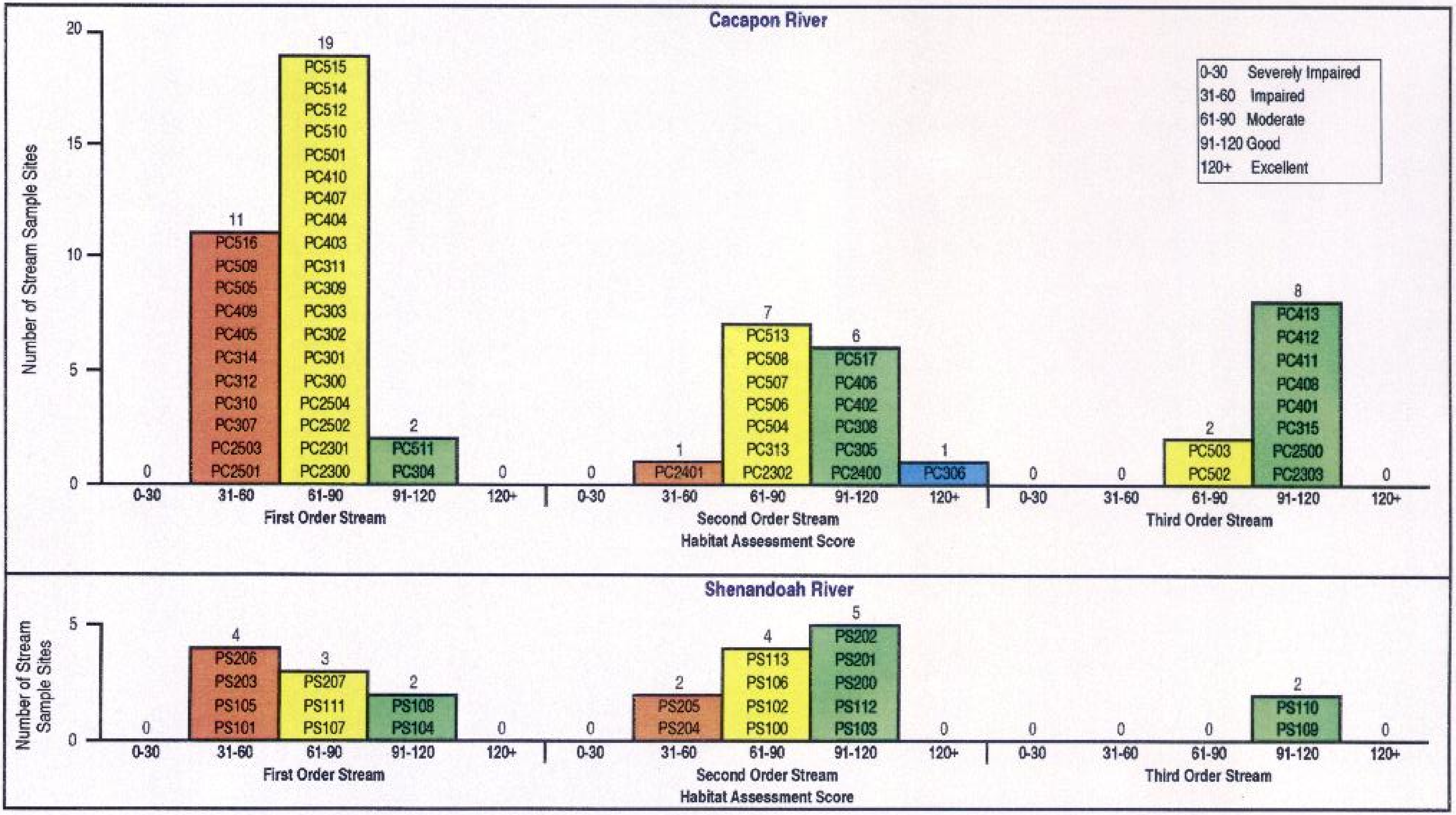


Figure 17
Comparison of the Number of Macroinvertebrate Families by Ecoregion

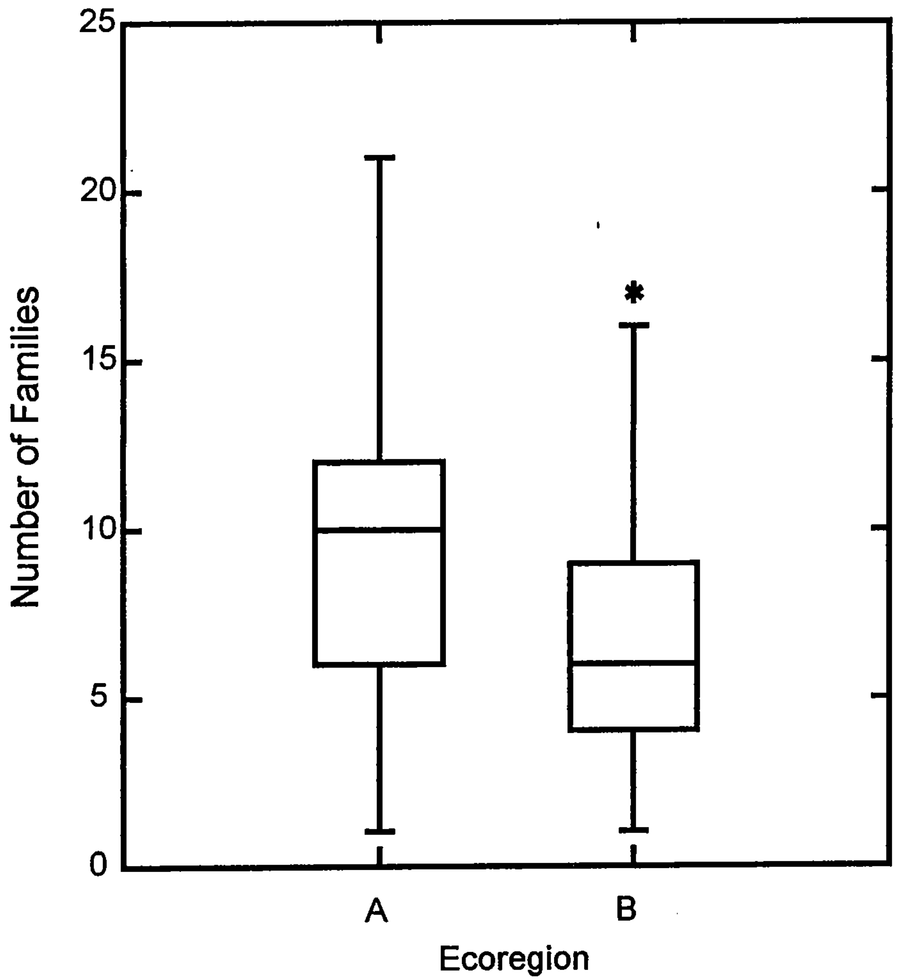


Figure 18
Comparison of the Number of Macroinvertebrate Families by Regional Project Watershed

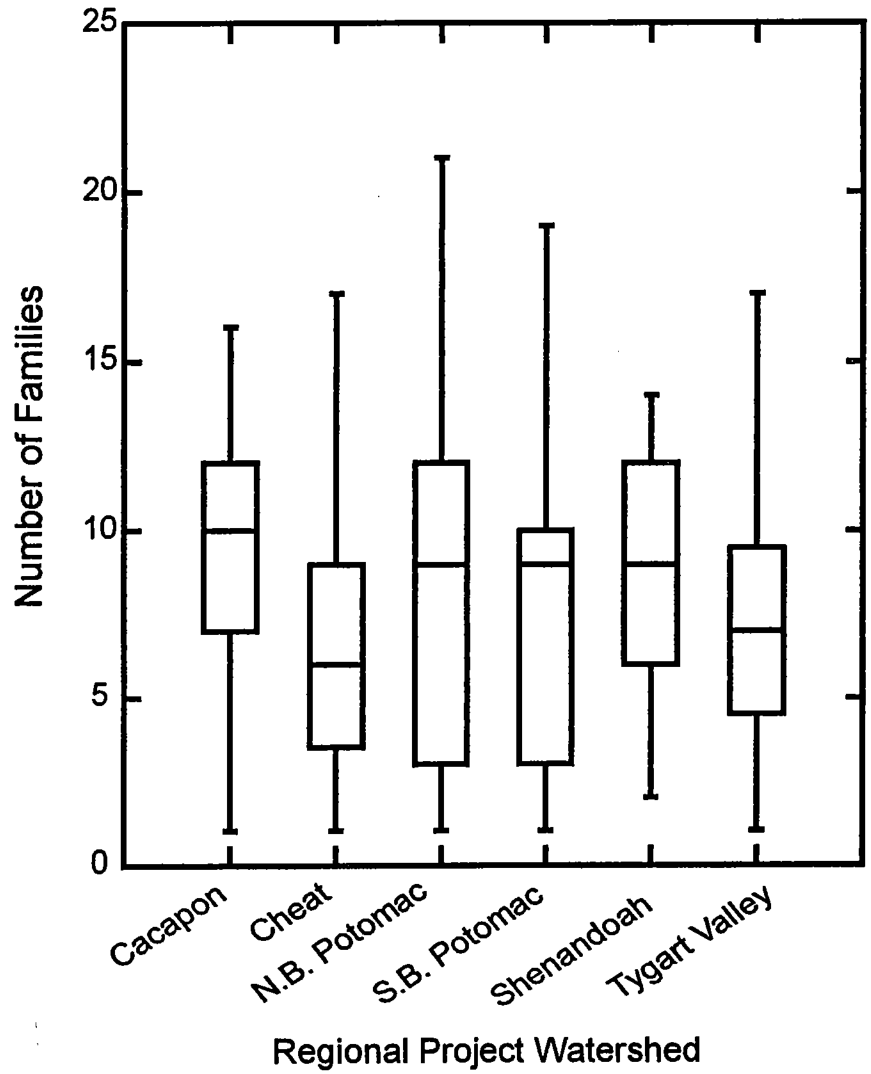


TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC1100	MC1101	MC1102	MC1103	MC1104	MC1105	MC1106	MC1107	MC1108	MC1109	MC1110	MC1111	MC1112	MC1200	MC1201	MC1202	MC1203	MC1204	MC1205	MC1206	MC1207
Amphipoda	Gammaridae	Shredders																					
	Talitridae	Shredders																					
Basommatophora	Lymnaeidae	Collectors																					
	Physidae	Collectors																					
	Planorbidae	Collectors																					
Coleoptera	Chrysomelidae	Shredders																					
	Curculionidae	Shredders	1								1												
	Dytiscidae	Engulfers					1		1						3							1	
	Elmidae	Scrapers																			1		
	Gyrinidae	Engulfers																					
	Haliplidae	Shredders																					
	Helodidae	Collectors																					
	Hydrophilidae	Engulfers																					
	Noteridae	Engulfers																					
	Psephenidae	Scrapers																					
Decapoda	Cambaridae	Engulfers											1										
Diptera	Athericidae	Engulfers																					
	Ceratopogonidae	Collectors												1									
	Chironomidae	Collectors	1	6	105	2		3	47	16	2	5	1	1	1	1					24	1	1
	Culicidae	Collectors																					
	Dixidae	Collectors																					
	Ephydridae	Collectors																					
	Ptychopteridae	Collectors																					
	Sciomyzidae	Engulfers																					
	Simuliidae	Collectors								1	17	4				1							2
	Stratiomyidae	Collectors																					
	Tabanidae	Engulfers																					
	Tanyderidae	Collectors																					
	Tipulidae	Shredders	1						1			2				2						1	
Ephemeroptera	Baetidae	Collectors																					
	Baetiscidae	Collectors																					
	Caenidae	Collectors																					
	Ephemerellidae	Collectors						23															
	Ephemeridae	Collectors																					
	Heptageniidae	Collectors					1	5															
	Leptophlebiidae	Collectors																					
	Oligoneuriidae	Collectors																					
	Polymitarcyidae	Collectors																					
	Potamanthidae	Collectors																					
	Siphlonuridae	Collectors						2			1	4				1							
	Tricorythidae	Collectors																					
Gnathobdellida	Hirudinidae	N/A																					
Haplotaxida	Haplotaxidae	N/A																					
Hemiptera	Corixidae	Engulfers																					
	Gerridae	Engulfers																					
	Notonectidae	Engulfers																					
Isopoda	Asellidae	Shredders																					1

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC1100	MC1101	MC1102	MC1103	MC1104	MC1105	MC1106	MC1107	MC1108	MC1109	MC1110	MC1111	MC1112	MC1200	MC1201	MC1202	MC1203	MC1204	MC1205	MC1206	MC1207
Lepidoptera	Pyralidae	Shredders																					
Megaloptera	Corydalidae	Engulfers																					
	Sialidae	Engulfers							4														
Odonata	Aeshnidae	Engulfers													1								
	Calopterygidae	Engulfers																					
	Coenagrionidae	Engulfers																					
	Cordulegastridae	Engulfers												1									
	Corduliidae	Engulfers																					
	Gomphidae	Engulfers															1						
	Libellulidae	Engulfers																					
	Macromiidae	Engulfers																					
	Petaluridae	Engulfers																					
Oligochaetes	Enchytraeidae	Collectors																					
Plecoptera	Capniidae	Shredders																					
	Chloroperlidae	Shredders					1																
	Leuctridae	Shredders				16	5	11		60	8	1				21	11				14	94	4
	Nemouridae	Shredders	6			24			8	4	63	97				61	11				50		4
	Peltoperlidae	Shredders															46						
	Perlidae	Engulfers																					
	Perlodidae	Engulfers																					
	Pteronarcyidae	Shredders																					
	Taeniopterygidae	Shredders	1					32															
Prosobranchia	Hydrobiidae	N/A																					
	Pleuroceridae	N/A																					
	Viviparidae	N/A																					
Pulmonata	Ancylidae	N/A																					
Rhynchobdellida	Glossiphoniidae	N/A																					
Trichoptera	Brachycentridae	Collectors																					
	Glossosomatidae	Collectors																					
	Helicopsychidae	Collectors																					
	Hydropsychidae	Collectors	1				5	3			1			1		15	6				11		
	Lepidostomatidae	Shredders						8	4			7				8	3				2		
	Leptoceridae	Collectors																					
	Limnephilidae	Shredders														3							
	Molannidae	Collectors																					
	Odontoceridae	Shredders										1				3	3						
	Philopotamidae	Collectors					1										7						
	Phryganeidae	Shredders										1						1					
	Polycentropodidae	Collectors								3	1					3							
	Psycomyiidae	Collectors																					
	Rhyacophilidae	Engulfers												1							2		
Tubificida	Naididae	Collectors																					
	Tubificidae	Collectors																					
Unionida	Unionidae	Collectors																					
Veneroida	Corbiculidae	Collectors																					
	Sphaeriidae	Collectors																					
Grand Total			11	6	105	42	14	87	65	84	94	122	2	5	5	119	88	1			104	97	12

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC1208	MC1209	MC1210	MC1211	MC1212	MC1213	MC1214	MC1215	MC1216	MC1301	MC1302	MC1303	MC1304	MC1305	MC1306	MC1307	MC1308	MC1309	MC1310	MC1311	MC1312
Amphipoda	Gammaridae	Shredders																					
	Talitridae	Shredders																					
Basommatophora	Lymnaeidae	Collectors																					
	Physidae	Collectors																					
	Planorbidae	Collectors					2																
Coleoptera	Chrysomelidae	Shredders																					
	Curculionidae	Shredders																					
	Dytiscidae	Engulfers						5															
	Elmidae	Scrapers																					
	Gyrinidae	Engulfers																					
	Haliplidae	Shredders					1																
	Helodidae	Collectors																1					
	Hydrophilidae	Engulfers				1																	
	Noteridae	Engulfers																			1		1
	Psephenidae	Scrapers																					
Decapoda	Cambaridae	Engulfers																					
Diptera	Athericidae	Engulfers																					
	Ceratopogonidae	Collectors																					
	Chironomidae	Collectors	86		37	21		24	24	1	1				4	1		10	3	18	10		
	Culicidae	Collectors																					
	Dixidae	Collectors																					
	Ephydridae	Collectors																	1				
	Ptychopteridae	Collectors				1																	
	Sciomyzidae	Engulfers																					
	Simuliidae	Collectors			1		91											1		1	3		
	Stratiomyidae	Collectors																					
	Tabanidae	Engulfers																					
	Tanyderidae	Collectors																					
	Tipulidae	Shredders	2																				
Ephemeroptera	Baetidae	Collectors					6	2															
	Baetiscidae	Collectors																					
	Caenidae	Collectors																					
	Ephemerellidae	Collectors																		2			1
	Ephemeridae	Collectors																	15				
	Heptageniidae	Collectors									4												
	Leptophlebiidae	Collectors																					
	Oligoneuriidae	Collectors																					
	Polymitarcyidae	Collectors																					
	Potamanthidae	Collectors																					
	Siphlonuridae	Collectors										1							15	1		1	4
	Tricorythidae	Collectors																					
Gnathobdellida	Hirudinidae	N/A																					
Haplotaxida	Haplotaxidae	N/A																					
Hemiptera	Corixidae	Engulfers						4	28														
	Gerridae	Engulfers																					
	Notonectidae	Engulfers																					
Isopoda	Asellidae	Shredders				6													2	1	1	2	

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC1208	MC1209	MC1210	MC1211	MC1212	MC1213	MC1214	MC1215	MC1216	MC1301	MC1302	MC1303	MC1304	MC1305	MC1306	MC1307	MC1308	MC1309	MC1310	MC1311	MC1312
Lepidoptera	Pyralidae	Shredders																					
Megaloptera	Corydalidae	Engulfers																1		1			
	Sialidae	Engulfers			1		1	1	65		5									1		2	4
Odonata	Aeshnidae	Engulfers									1								3				
	Calopterygidae	Engulfers																					
	Coenagrionidae	Engulfers																					
	Cordulegastridae	Engulfers				5													1			1	
	Corduliidae	Engulfers						2			1												
	Gomphidae	Engulfers																	1	1			
	Libellulidae	Engulfers					1													1			
	Macromiidae	Engulfers																					
	Petaluridae	Engulfers																					
Oligochaetes	Enchytraeidae	Collectors																					
Plecoptera	Capniidae	Shredders																			3	2	2
	Chloroperlidae	Shredders																			1		
	Leuctridae	Shredders	16																				
	Nemouridae	Shredders																3		3			
	Peltoperlidae	Shredders																					
	Perlidae	Engulfers										1											1
	Perlodidae	Engulfers																			1		
	Pteronarcyidae	Shredders																					
	Taeniopterygidae	Shredders																					
Prosobranchia	Hydrobiidae	N/A																					
	Pleuroceridae	N/A																					
	Viviparidae	N/A																					
Pulmonata	Ancylidae	N/A																					
Rhynchobdellida	Glossiphoniidae	N/A																					
Trichoptera	Brachycentridae	Collectors																					
	Glossosomatidae	Collectors																					1
	Helicopsychidae	Collectors																					
	Hydropsychidae	Collectors																		2			
	Lepidostomatidae	Shredders			3							4							1			1	2
	Leptoceridae	Collectors										1										8	1
	Limnephilidae	Shredders										1								3	14	1	3
	Molannidae	Collectors																					1
	Odontoceridae	Shredders																					
	Philopotamidae	Collectors																					
	Phryganeidae	Shredders							1	33													
	Polycentropodidae	Collectors																1		4		1	
	Psycomyiidae	Collectors																					
	Rhyacophilidae	Engulfers																					
Tubificida	Naididae	Collectors																					
	Tubificidae	Collectors																					
Unionida	Unionidae	Collectors						9															
Veneroida	Corbiculidae	Collectors																					
	Sphaeriidae	Collectors			11	5	5			7									2				
Grand Total			104		53	39	107	47	118	41	12	8			4	1		17	44	39	34	19	21

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC1313	MC1314	MC1315	MC1316	MC1317	MC1318	MC1319	MC1320	MC1400	MC1401	MC1402	MC1501	MC1502	MC1503	MC1504	MC1505	MC1506	MC1507	MC1508	MC3301	MC3302
Amphipoda	Gammaridae	Shredders																					
	Talitridae	Shredders		2															1		1		
Basommatophora	Lymnaeidae	Collectors									7			1									
	Physidae	Collectors										5	11				1					22	
	Planorbidae	Collectors																				7	
Coleoptera	Chrysomelidae	Shredders																					
	Curculionidae	Shredders																					
	Dytiscidae	Engulfers																					
	Elmidae	Scrapers		1					4					1									
	Gyrinidae	Engulfers									1												
	Haliplidae	Shredders																					
	Helodidae	Collectors																					
	Hydrophilidae	Engulfers						3															
	Noteridae	Engulfers																					
	Psephenidae	Scrapers						1		2	1			1	4	8		1					
Decapoda	Cambaridae	Engulfers																					
Diptera	Athericidae	Engulfers																					
	Ceratopogonidae	Collectors								1													
	Chironomidae	Collectors						15	10	27	9	7		6		1	2		1		1	102	3
	Culicidae	Collectors				1																	
	Dixidae	Collectors																					
	Ephydridae	Collectors											1										
	Ptychopteridae	Collectors																					
	Sciomyzidae	Engulfers																					
	Simuliidae	Collectors								1													
	Stratiomyidae	Collectors																					
	Tabanidae	Engulfers																					
	Tanyderidae	Collectors										6		3									
	Tipulidae	Shredders	1												1	4							
Ephemeroptera	Baetidae	Collectors							11														
	Baetiscidae	Collectors																					
	Caenidae	Collectors																					
	Ephemerellidae	Collectors		2		1						3				2							
	Ephemeridae	Collectors																		1			
	Heptageniidae	Collectors	9	7		7	1	1		1	15	16		2	1	6	1			1	6		
	Leptophlebiidae	Collectors	4					1								1							
	Oligoneuriidae	Collectors									3												
	Polymitarcyidae	Collectors																					
	Potamanthidae	Collectors																					
	Siphlonuridae	Collectors				2				3				9	3					1			
	Tricorythidae	Collectors																					
Gnathobdellida	Hirudinidae	N/A																					1
Haplotaxida	Haplotaxidae	N/A																					
Hemiptera	Corixidae	Engulfers																					
	Gerridae	Engulfers												3			1		2	2			
	Notonectidae	Engulfers																					
Isopoda	Asellidae	Shredders																					

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC1313	MC1314	MC1315	MC1316	MC1317	MC1318	MC1319	MC1320	MC1400	MC1401	MC1402	MC1501	MC1502	MC1503	MC1504	MC1505	MC1506	MC1507	MC1508	MC3301	MC3302
Lepidoptera	Pyralidae	Shredders																					
Megaloptera	Corydalidae	Engulfers		1								1		2		1							
	Sialidae	Engulfers																					1
Odonata	Aeshnidae	Engulfers						2															
	Calopterygidae	Engulfers																					
	Coenagrionidae	Engulfers																					
	Cordulegastridae	Engulfers						3	1										1				
	Corduliidae	Engulfers																					
	Gomphidae	Engulfers	2	4	1	5													4	6	3		
	Libellulidae	Engulfers																					
	Macromiidae	Engulfers																					
	Petaluridae	Engulfers																					
Oligochaetes	Enchytraeidae	Collectors																					
Plecoptera	Capniidae	Shredders														7							
	Chloroperlidae	Shredders																					
	Leuctridae	Shredders		2																			
	Nemouridae	Shredders						1		2													
	Peltoperlidae	Shredders	5				1																
	Perlidae	Engulfers		1		7	2		4		1			21	4	3		1					
	Perlodidae	Engulfers						6															
	Pteronarcyidae	Shredders						1															
	Taeniopterygidae	Shredders								2													
Prosobranchia	Hydrobiidae	N/A										5											
	Pleuroceridae	N/A																					
	Viviparidae	N/A																					
Pulmonata	Ancylidae	N/A										5											
Rhynchobdellida	Glossiphoniidae	N/A																					
Trichoptera	Brachycentridae	Collectors							3														
	Glossosomatidae	Collectors								3		3											
	Helicopsychidae	Collectors												9	4								
	Hydropsychidae	Collectors	3	3		2	6	7	28	4	5	1		15	36	6	13	2	1			4	
	Lepidostomatidae	Shredders						11				2		2	1			3	1	2			1
	Leptoceridae	Collectors			2	5													1	2	5		
	Limnephilidae	Shredders	8	3	2	10	23	4						2				1	13	22	12		
	Molannidae	Collectors																					
	Odontoceridae	Shredders																					
	Philopotamidae	Collectors								3	26												
	Phryganeidae	Shredders																					
	Polycentropodidae	Collectors	1						1		3			7							1		
	Psycomyiidae	Collectors																					
	Rhyacophilidae	Engulfers													1								
Tubificida	Naididae	Collectors											2									11	
	Tubificidae	Collectors																					
Unionida	Unionidae	Collectors																					
Veneroida	Corbiculidae	Collectors																					
	Sphaeriidae	Collectors											89										1
Grand Total			33	26	5	40	33	56	62	49	71	54	103	84	55	39	18	8	25	37	29	146	7

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC3303	MC3304	MC3305	MC3306	MC3307	MC3308	MC3309	MC3310	MC3311	MC3312	MC3400	MC3401	MC3402	MC3403	MC3404	MC3405	MC3406	MT3504	MC3505	MC3506	MC3507
Amphipoda	Gammaridae	Shredders							3									1					
	Talitridae	Shredders																					
Basommatophora	Lymnaeidae	Collectors																			7		
	Physidae	Collectors																					
	Planorbidae	Collectors																					
Coleoptera	Chrysomelidae	Shredders																					
	Curculionidae	Shredders																					
	Dytiscidae	Engulfers																					
	Elmidae	Scrapers				7		21				5	1	1					4				
	Gyrinidae	Engulfers																					
	Haliplidae	Shredders																					
	Helodidae	Collectors																					
	Hydrophilidae	Engulfers			1																		
	Noteridae	Engulfers																					
	Psephenidae	Scrapers				3	1	1							1	1							3
Decapoda	Cambaridae	Engulfers					1										2						1
Diptera	Athericidae	Engulfers																					
	Ceratopogonidae	Collectors				1										1	1	1	7				1
	Chironomidae	Collectors			1	37	4	14	2						18	1		1	8		16	1	7
	Culicidae	Collectors																					
	Dixidae	Collectors																					
	Ephydridae	Collectors																					
	Ptychopteridae	Collectors																					
	Sciomyzidae	Engulfers			1																		
	Simuliidae	Collectors																					
	Stratiomyidae	Collectors																					
	Tabanidae	Engulfers																					
	Tanyderidae	Collectors																					
	Tipulidae	Shredders	2				9	5								3			6	2	6		4
Ephemeroptera	Baetidae	Collectors																					
	Baetiscidae	Collectors																					
	Caenidae	Collectors																		2			
	Ephemerellidae	Collectors	1																				
	Ephemeridae	Collectors				28		2	4				1										1
	Heptageniidae	Collectors				3		3				13		5		2	1		2				15
	Leptophlebiidae	Collectors				6		5	5						10			3	26	2		1	
	Oligoneuriidae	Collectors						2						7		4							
	Polymitarcyidae	Collectors																					
	Potamanthidae	Collectors																					
	Siphlonuridae	Collectors																					3
	Tricorythidae	Collectors					1		33			18			2				4	2			2
Gnathobdellida	Hirudinidae	N/A															1						
Haplotaxida	Haplotaxidae	N/A																11			1		
Hemiptera	Corixidae	Engulfers																					
	Gerridae	Engulfers																					
	Notonectidae	Engulfers																					
Isopoda	Asellidae	Shredders																					

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC3303	MC3304	MC3305	MC3306	MC3307	MC3308	MC3309	MC3310	MC3311	MC3312	MC3400	MC3401	MC3402	MC3403	MC3404	MC3405	MC3406	MT3504	MC3505	MC3506	MC3507
Lepidoptera	Pyralidae	Shredders																					
Megaloptera	Corydalidae	Engulfers					1		2							1			2				
	Sialidae	Engulfers						1															2
Odonata	Aeshnidae	Engulfers						1															
	Calopterygidae	Engulfers																					
	Coenagrionidae	Engulfers																					
	Cordulegastridae	Engulfers																					
	Corduliidae	Engulfers																					
	Gomphidae	Engulfers							2										1				
	Libellulidae	Engulfers																					
	Macromiidae	Engulfers																					
	Petaluridae	Engulfers																					
Oligochaetes	Enchytraeidae	Collectors																					
Plecoptera	Capniidae	Shredders		4	13		32	7										5	4		8	33	24
	Chloroperlidae	Shredders			1				30								3			7			
	Leuctridae	Shredders													43		25		5				
	Nemouridae	Shredders				9		40								4							
	Peltoperlidae	Shredders			2															1			
	Perlidae	Engulfers					3							4					2				
	Perlodidae	Engulfers					15					1								6	44		13
	Pteronarcyidae	Shredders																					
	Taeniopterygidae	Shredders												8	20								
Prosobranchia	Hydrobiidae	N/A																					
	Pleuroceridae	N/A												10									
	Viviparidae	N/A																					
Pulmonata	Ancylidae	N/A																					
Rhynchobdellida	Glossiphoniidae	N/A																					
Trichoptera	Brachycentridae	Collectors																					
	Glossosomatidae	Collectors																					
	Helicopsychidae	Collectors																					
	Hydropsychidae	Collectors			2	1	3	13	15			5	6	1		11	3		3	8			6
	Lepidostomatidae	Shredders		1										1									3
	Leptoceridae	Collectors																					
	Limnephilidae	Shredders			2		6	1															
	Molannidae	Collectors																					
	Odontoceridae	Shredders																					
	Philopotamidae	Collectors			1												2		1				
	Phryganeidae	Shredders																			1	1	
	Polycentropodidae	Collectors						3					1						6				1
	Psycomyiidae	Collectors																					
	Rhyacophilidae	Engulfers																		1			
Tubificida	Naididae	Collectors		1			5	1												1			13
	Tubificidae	Collectors																	19				
Unionida	Unionidae	Collectors																					
Veneroida	Corbiculidae	Collectors																					
	Sphaeriidae	Collectors				2		1															
Grand Total			**3**	**6**	**24**	**97**	**81**	**121**	**96**			**42**	**9**	**37**	**94**	**28**	**38**	**22**	**100**	**32**	**83**	**36**	**98**

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC3508	MT1509	MT1510	MT1511	MT1512	MT1601	MT1602	MT1603	MT1604	MT1605	MT1606	MT1607	MT1608	MT1609	MT1610	MT1611	MT3500	MT3501	MT3502	MT3503	MT3509
Amphipoda	Gammaridae	Shredders																	4				
	Talitridae	Shredders																					
Basommatophora	Lymnaeidae	Collectors	1									1										1	
	Physidae	Collectors				16														4	3		45
	Planorbidae	Collectors								1		2											
Coleoptera	Chrysomelidae	Shredders																					
	Curculionidae	Shredders																					
	Dytiscidae	Engulfers	1																				
	Elmidae	Scrapers												1	1						11	4	
	Gyrinidae	Engulfers			2												1						
	Haliplidae	Shredders																					
	Helodidae	Collectors																					
	Hydrophilidae	Engulfers																					
	Noteridae	Engulfers										2											
	Psephenidae	Scrapers						1				1			1	3	15						
Decapoda	Cambaridae	Engulfers																			1		
Diptera	Athericidae	Engulfers																			1		
	Ceratopogonidae	Collectors																				15	
	Chironomidae	Collectors	14	1		5	12	21		13	3					3			12	3	26	20	2
	Culicidae	Collectors																					
	Dixidae	Collectors																					
	Ephydridae	Collectors																					
	Ptychopteridae	Collectors																					
	Sciomyzidae	Engulfers																					
	Simuliidae	Collectors																			2		
	Stratiomyidae	Collectors			2																		
	Tabanidae	Engulfers										1											
	Tanyderidae	Collectors																					
	Tipulidae	Shredders	3										1			1			2		2	3	
Ephemeroptera	Baetidae	Collectors																					
	Baetiscidae	Collectors																					
	Caenidae	Collectors						2							1						6		
	Ephemerellidae	Collectors														1							1
	Ephemeridae	Collectors									1												
	Heptageniidae	Collectors					18	6			1				50	27	49				7	1	
	Leptophlebiidae	Collectors																				5	
	Oligoneuriidae	Collectors													10		3				1		
	Polymitarcyidae	Collectors																					
	Potamanthidae	Collectors																					
	Siphlonuridae	Collectors		1								1					3						
	Tricorythidae	Collectors																			3	3	1
Gnathobdellida	Hirudinidae	N/A																					
Haplotaxida	Haplotaxidae	N/A																					
Hemiptera	Corixidae	Engulfers													1								
	Gerridae	Engulfers		3																			
	Notonectidae	Engulfers					4																
Isopoda	Asellidae	Shredders																					

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MC3508	MT1509	MT1510	MT1511	MT1512	MT1601	MT1602	MT1603	MT1604	MT1605	MT1606	MT1607	MT1608	MT1609	MT1610	MT1611	MT3500	MT3501	MT3502	MT3503	MT3509
Lepidoptera	Pyralidae	Shredders																	1				
Megaloptera	Corydalidae	Engulfers													10		2						
	Sialidae	Engulfers								2		1			1	3	3		1		1	1	
Odonata	Aeshnidae	Engulfers					6			2										1			
	Calopterygidae	Engulfers																					
	Coenagrionidae	Engulfers					1								1		7						
	Cordulegastridae	Engulfers									1		1										
	Corduliidae	Engulfers				1																	
	Gomphidae	Engulfers		2													9						
	Libellulidae	Engulfers				1																	
	Macromiidae	Engulfers																					
	Petaluridae	Engulfers										1											
Oligochaetes	Enchytraeidae	Collectors																					
Plecoptera	Capniidae	Shredders																					
	Chloroperlidae	Shredders																					
	Leuctridae	Shredders																					
	Nemouridae	Shredders	1					1											2				
	Peltoperlidae	Shredders	1																				
	Perlidae	Engulfers		2																			
	Perlodidae	Engulfers																			2		
	Pteronarcyidae	Shredders																					
	Taeniopterygidae	Shredders	4																		8		
Prosobranchia	Hydrobiidae	N/A																					
	Pleuroceridae	N/A	1																				
	Viviparidae	N/A																					
Pulmonata	Ancylidae	N/A																					
Rhynchobdellida	Glossiphoniidae	N/A																					
Trichoptera	Brachycentridae	Collectors																					
	Glossosomatidae	Collectors																					
	Helicopsychidae	Collectors																					
	Hydropsychidae	Collectors		1											2		10			1	3		
	Lepidostomatidae	Shredders																					
	Leptoceridae	Collectors																					
	Limnephilidae	Shredders		8							2											1	
	Molannidae	Collectors								2													
	Odontoceridae	Shredders																					
	Philopotamidae	Collectors													7		10						
	Phryganeidae	Shredders																		1			
	Polycentropodidae	Collectors	2				4																
	Psycomyiidae	Collectors																					
	Rhyacophilidae	Engulfers								1											7		
Tubificida	Naididae	Collectors																				33	
	Tubificidae	Collectors																					
Unionida	Unionidae	Collectors													1	1	14						
Veneroida	Corbiculidae	Collectors						2									1						
	Sphaeriidae	Collectors																	11	1	12		19
Grand Total			28	18	4	23	45	33		21	8	10	2	1	86	39	127		33	11	96	87	68

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MT3600	MT3601	MT3602	MT3603	MT3604	MT3605	PC2300	PC2301	PC2302	PC2303	PC2400	PC2401	PC2500	PC2501	PC2502	PC2503	PC2504	PC300	PC301	PC302	PC303	PC304
Amphipoda	Gammaridae	Shredders																						
	Talitridae	Shredders																						
Basommatophora	Lymnaeidae	Collectors					1																	
	Physidae	Collectors	40	1		32		7																
	Planorbidae	Collectors	16																					
Coleoptera	Chrysomelidae	Shredders																						
	Curculionidae	Shredders																						
	Dytiscidae	Engulfers	5			2								2						1				
	Elmidae	Scrapers		4	1		2		1			1												
	Gyrinidae	Engulfers																						
	Haliplidae	Shredders																						
	Helodidae	Collectors																						
	Hydrophilidae	Engulfers														2								
	Noteridae	Engulfers																						
	Psephenidae	Scrapers							7			5												1
Decapoda	Cambaridae	Engulfers		1					1									1						1
Diptera	Athericidae	Engulfers													1									
	Ceratopogonidae	Collectors			2	1				3											1		2	
	Chironomidae	Collectors		18	34	34	11	26		3	6	4		3	16	11	4	10	1	60	21	20	6	2
	Culicidae	Collectors																						
	Dixidae	Collectors																		1				
	Ephydridae	Collectors																						
	Ptychopteridae	Collectors																						
	Sciomyzidae	Engulfers															1							
	Simuliidae	Collectors				1																1	1	2
	Stratiomyidae	Collectors																						
	Tabanidae	Engulfers																						
	Tanyderidae	Collectors																						
	Tipulidae	Shredders					1	1	4			2	1			10	4	1	8	3	3			
Ephemeroptera	Baetidae	Collectors								4														
	Baetiscidae	Collectors																						
	Caenidae	Collectors																						
	Ephemerellidae	Collectors							1		1		83	17	6	4						13		8
	Ephemeridae	Collectors							1								1							
	Heptageniidae	Collectors		21	13				5			13	1		22	12						3		5
	Leptophlebiidae	Collectors		3					6						7	25								
	Oligoneuriidae	Collectors		1			1					7			12									
	Polymitarcyidae	Collectors																						
	Potamanthidae	Collectors																						
	Siphlonuridae	Collectors				1					1													
	Tricorythidae	Collectors	1				2										2	2	1					
Gnathobdellida	Hirudinidae	N/A																						
Haplotaxida	Haplotaxidae	N/A																8						
Hemiptera	Corixidae	Engulfers				1																		
	Gerridae	Engulfers																						
	Notonectidae	Engulfers																						
Isopoda	Asellidae	Shredders														11								

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	MT3600	MT3601	MT3602	MT3603	MT3604	MT3605	PC2300	PC2301	PC2302	PC2303	PC2400	PC2401	PC2500	PC2501	PC2502	PC2503	PC2504	PC300	PC301	PC302	PC303	PC304
Lepidoptera	Pyralidae	Shredders		1																				
Megaloptera	Corydalidae	Engulfers							4							2	2							
	Sialidae	Engulfers		1	1																			
Odonata	Aeshnidae	Engulfers							1															
	Calopterygidae	Engulfers																						
	Coenagrionidae	Engulfers	3			1																		
	Cordulegastridae	Engulfers															1					2		
	Corduliidae	Engulfers																						
	Gomphidae	Engulfers										1			1			1				1		1
	Libellulidae	Engulfers																						
	Macromiidae	Engulfers																						
	Petaluridae	Engulfers																						
Oligochaetes	Enchytraeidae	Collectors																						
Plecoptera	Capniidae	Shredders					3										22							
	Chloroperlidae	Shredders											4										16	
	Leuctridae	Shredders										3				7				3	2		4	
	Nemouridae	Shredders																			7	3	1	3
	Peltoperlidae	Shredders										2								9	13	30		2
	Perlidae	Engulfers							4	1		3	1		3	2	3	1				1		
	Perlodidae	Engulfers											1	11	7							5	15	1
	Pteronarcyidae	Shredders																				1		
	Taeniopterygidae	Shredders		58	7		2				6							5	15				2	
Prosobranchia	Hydrobiidae	N/A																						
	Pleuroceridae	N/A																						
	Viviparidae	N/A										1												
Pulmonata	Ancylidae	N/A					1				2				1									
Rhynchobdellida	Glossiphoniidae	N/A																						
Trichoptera	Brachycentridae	Collectors																						
	Glossosomatidae	Collectors											7											
	Helicopsychidae	Collectors																						
	Hydropsychidae	Collectors	1	5	2		10		5			30		1	48	7	13					1	4	29
	Lepidostomatidae	Shredders										7							2	13	7	1	2	
	Leptoceridae	Collectors																						
	Limnephilidae	Shredders	4						1									2	1	2			3	16
	Molannidae	Collectors																						
	Odontoceridae	Shredders																				1		
	Philopotamidae	Collectors					3					30											9	
	Phryganeidae	Shredders	3																1					
	Polycentropodidae	Collectors		3					4			6	13	1	9	19	1	2	1				1	
	Psycomyiidae	Collectors																						
	Rhyacophilidae	Engulfers				1															6	1	5	
Tubificida	Naididae	Collectors			55						1	4				5								
	Tubificidae	Collectors	2																					
Unionida	Unionidae	Collectors																						
Veneroida	Corbiculidae	Collectors																						
	Sphaeriidae	Collectors			10	32	2	3												29				
Grand Total			75	117	125	106	39	37	45	11	17	119	111	35	133	117	54	33	30	121	60	84	71	71

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PC305	PC306	PC307	PC308	PC309	PC310	PC311	PC312	PC313	PC314	PC315	PC401	PC402	PC403	PC404	PC405	PC406	PC407	PC408	PC409	PC410	PC411	PC412	PC413
Amphipoda	Gammaridae	Shredders																								
	Talitridae	Shredders					1																			
Basommatophora	Lymnaeidae	Collectors			3							12												1		
	Physidae	Collectors																	1							
	Planorbidae	Collectors																								
Coleoptera	Chrysomelidae	Shredders																								
	Curculionidae	Shredders																								
	Dytiscidae	Engulfers			2					9							3									
	Elmidae	Scrapers																					1		1	16
	Gyrinidae	Engulfers																								
	Haliplidae	Shredders																								
	Helodidae	Collectors																								
	Hydrophilidae	Engulfers						3																		
	Noteridae	Engulfers																								
	Psephenidae	Scrapers	1	2		7					2									1	3	1	1		4	3
Decapoda	Cambaridae	Engulfers					3		1						2											
Diptera	Athericidae	Engulfers		1								1														4
	Ceratopogonidae	Collectors	1					1												2			2			
	Chironomidae	Collectors	2	43	5	17	26	35	4	9	12	18	17	80	4		5	1		20	62	11		15	14	5
	Culicidae	Collectors														2										
	Dixidae	Collectors																								
	Ephydridae	Collectors																								
	Ptychopteridae	Collectors																								
	Sciomyzidae	Engulfers																								
	Simuliidae	Collectors	5	4		3	3	4																2		1
	Stratiomyidae	Collectors																								
	Tabanidae	Engulfers			1																					
	Tanyderidae	Collectors																								
	Tipulidae	Shredders	9	2		7	3	3	2			4			1						1					
Ephemeroptera	Baetidae	Collectors		20		29									6						2	2		39	11	
	Baetiscidae	Collectors																								
	Caenidae	Collectors												6												
	Ephemerellidae	Collectors	1	20		16			6		12	37		13						1	10	4	2	6	61	
	Ephemeridae	Collectors	1								1			7												
	Heptageniidae	Collectors	1						2			4		14	3			9			2	2	2	15	23	8
	Leptophlebiidae	Collectors				1	3			8					1			2					1	6	1	
	Oligoneuriidae	Collectors		5								1		4	7						5			3		16
	Polymitarcyidae	Collectors																								
	Potamanthidae	Collectors																								
	Siphlonuridae	Collectors			2				2		14							16			6					
	Tricorythidae	Collectors																								2
Gnathobdellida	Hirudinidae	N/A																								
Haplotaxida	Haplotaxidae	N/A																								
Hemiptera	Corixidae	Engulfers																								
	Gerridae	Engulfers																								
	Notonectidae	Engulfers																								
Isopoda	Asellidae	Shredders			20																					

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PC305	PC306	PC307	PC308	PC309	PC310	PC311	PC312	PC313	PC314	PC315	PC401	PC402	PC403	PC404	PC405	PC406	PC407	PC408	PC409	PC410	PC411	PC412	PC413
Lepidoptera	Pyralidae	Shredders												1			1									
Megaloptera	Corydalidae	Engulfers			1	2		4											1	2	1				1	16
	Sialidae	Engulfers																								
Odonata	Aeshnidae	Engulfers						1																		
	Calopterygidae	Engulfers																								
	Coenagrionidae	Engulfers																								2
	Cordulegastridae	Engulfers			4																					
	Corduliidae	Engulfers																								
	Gomphidae	Engulfers		1		3									1											5
	Libellulidae	Engulfers																								
	Macromiidae	Engulfers																								
	Petaluridae	Engulfers																								
Oligochaetes	Enchytraeidae	Collectors																								
Plecoptera	Capniidae	Shredders																		9						
	Chloroperlidae	Shredders		4							1														1	
	Leuctridae	Shredders								4		6	4					2								
	Nemouridae	Shredders	14	3		1	7				2	1	4		8			1			1	3				
	Peltoperlidae	Shredders	8																							
	Perlidae	Engulfers	11	2		3								1	9						2	4		6	8	
	Perlodidae	Engulfers			19				5		1				15			4				4				
	Pteronarcyidae	Shredders	9		1	2	2																			
	Taeniopterygidae	Shredders							6																	
Prosobranchia	Hydrobiidae	N/A																								
	Pleuroceridae	N/A																								
	Viviparidae	N/A																								
Pulmonata	Ancylidae	N/A							1	25	1				7											
Rhynchobdellida	Glossiphoniidae	N/A						6																		
Trichoptera	Brachycentridae	Collectors																								
	Glossosomatidae	Collectors																								
	Helicopsychidae	Collectors																								
	Hydropsychidae	Collectors	11	1		9	23		3			8		6	9						4	13		6	6	30
	Lepidostomatidae	Shredders	1				21		2		4							6	4	2				1		
	Leptoceridae	Collectors								1																
	Limnephilidae	Shredders	3								4														1	
	Molannidae	Collectors																								
	Odontoceridae	Shredders																								
	Philopotamidae	Collectors		7		9			1			11		1	30							4		1		
	Phryganeidae	Shredders								1								1								
	Polycentropodidae	Collectors		2																					6	
	Psycomyiidae	Collectors															1									
	Rhyacophilidae	Engulfers	5	1											2											
Tubificida	Naididae	Collectors						76																		
	Tubificidae	Collectors																								
Unionida	Unionidae	Collectors																								
Veneroida	Corbiculidae	Collectors																								
	Sphaeriidae	Collectors						2																		
Grand Total			83	118	58	109	92	135	35	57	54	103	25	133	105	2	10	42	6	37	99	48	9	101	138	108

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PC501	PC502	PC503	PC504	PC505	PC506	PC507	PC508	PC509	PC510	PC511	PC512	PC513	PC514	PC515	PC516	PC517	PNB1000	PNB1001	PNB1002	PNB1003	PNB1004
Lepidoptera	Pyralidae	Shredders														1								
Megaloptera	Corydalidae	Engulfers		5	1	3											1							
	Sialidae	Engulfers																						
Odonata	Aeshnidae	Engulfers		2	2																			
	Calopterygidae	Engulfers																						
	Coenagrionidae	Engulfers																						
	Cordulegastridae	Engulfers	1						1				1			2								
	Corduliidae	Engulfers																						
	Gomphidae	Engulfers				1			1														1	
	Libellulidae	Engulfers																						
	Macromiidae	Engulfers																						
	Petaluridae	Engulfers																						
Oligochaetes	Enchytraeidae	Collectors													11									
Plecoptera	Capniidae	Shredders																						
	Chloroperlidae	Shredders				4			1	3							1	1						
	Leuctridae	Shredders					1						1						10				45	24
	Nemouridae	Shredders	5				1						1										1	8
	Peltoperlidae	Shredders															1	1					1	
	Perlidae	Engulfers		3	15				1	3					1		6						1	
	Perlodidae	Engulfers				3				1	5		1		14				4					
	Pteronarcyidae	Shredders				1																		
	Taeniopterygidae	Shredders			8																			4
Prosobranchia	Hydrobiidae	N/A																						
	Pleuroceridae	N/A																						
	Viviparidae	N/A																						
Pulmonata	Ancylidae	N/A																						
Rhynchobdellida	Glossiphoniidae	N/A																						
Trichoptera	Brachycentridae	Collectors																						
	Glossosomatidae	Collectors	2						1	2									2					
	Helicopsychidae	Collectors											6				1							
	Hydropsychidae	Collectors		7	6				5	11			4		7				1			2		20
	Lepidostomatidae	Shredders					7		3	5	1	1		3		1	3						15	25
	Leptoceridae	Collectors		18		2		2		1			3											
	Limnephilidae	Shredders	2			2				7	13		6	20			2	15	2					
	Molannidae	Collectors																						
	Odontoceridae	Shredders				5			1															
	Philopotamidae	Collectors																						5
	Phryganeidae	Shredders																	2					
	Polycentropodidae	Collectors		11	4	10	1		19	1		1			2		1							2
	Psycomyiidae	Collectors																						
	Rhyacophilidae	Engulfers							1					2			2		5					
Tubificida	Naididae	Collectors											3		2	5	1	5						
	Tubificidae	Collectors																						
Unionida	Unionidae	Collectors																						
Veneroida	Corbiculidae	Collectors																						
	Sphaeriidae	Collectors																				22		
Grand Total			21	109	109	50	12	7	45	38	28	3	30	29	97	30	25	25	102			95	98	98

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PNB1005	PNB1006	PNB1007	PNB1008	PNB1009	PNB2800	PNB2801	PNB2802	PNB2900	PNB2901	PNB2902	PNB2903	PNB2904	PNB2905	PNB800	PNB801	PNB802	PNB803
Amphipoda	Gammaridae	Shredders																		
	Talitridae	Shredders																		
Basommatophora	Lymnaeidae	Collectors																		
	Physidae	Collectors						1	1											
	Planorbidae	Collectors						1	1											
Coleoptera	Chrysomelidae	Shredders																		
	Curculionidae	Shredders																		
	Dytiscidae	Engulfers																		
	Elmidae	Scrapers						5		1	1	5	3	2						
	Gyrinidae	Engulfers																		
	Haliplidae	Shredders																		
	Helodidae	Collectors																		
	Hydrophilidae	Engulfers						3												
	Noteridae	Engulfers																		
	Psephenidae	Scrapers			5			3			1		2	3						
Decapoda	Cambaridae	Engulfers							3							4				
Diptera	Athericidae	Engulfers							4		6	3	3							
	Ceratopogonidae	Collectors	1											9		1			4	
	Chironomidae	Collectors	6	2	16	32		32		22	95	26	15	26		2		82		
	Culicidae	Collectors																		
	Dixidae	Collectors																		
	Ephydridae	Collectors																		
	Ptychopteridae	Collectors																		
	Sciomyzidae	Engulfers												1						
	Simuliidae	Collectors												1	1					
	Stratiomyidae	Collectors															1			
	Tabanidae	Engulfers																		
	Tanyderidae	Collectors																		
	Tipulidae	Shredders	1		1				4	1	3	19	43	5						1
Ephemeroptera	Baetidae	Collectors	1	16																
	Baetiscidae	Collectors											1	1						
	Caenidae	Collectors			6			4		29										
	Ephemerellidae	Collectors														28				
	Ephemeridae	Collectors			2						3			2						
	Heptageniidae	Collectors	1					7		31	1	11	3	7		61				
	Leptophlebiidae	Collectors	4		1			5		8				6						
	Oligoneuriidae	Collectors						10		2		12	5							
	Polymitarcyidae	Collectors																		
	Potamanthidae	Collectors																		
	Siphlonuridae	Collectors																		
	Tricorythidae	Collectors						2		19	2	2		3						
Gnathobdellida	Hirudinidae	N/A																		
Haplotaxida	Haplotaxidae	N/A																		
Hemiptera	Corixidae	Engulfers																		
	Gerridae	Engulfers																		
	Notonectidae	Engulfers																		
Isopoda	Asellidae	Shredders													5					

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PNB1005	PNB1006	PNB1007	PNB1008	PNB1009	PNB2800	PNB2801	PNB2802	PNB2900	PNB2901	PNB2902	PNB2903	PNB2904	PNB2905	PNB800	PNB801	PNB802	PNB803
Lepidoptera	Pyralidae	Shredders																		
Megaloptera	Corydalidae	Engulfers						4	7					3						
	Sialidae	Engulfers								1	3			1						
Odonata	Aeshnidae	Engulfers																		
	Calopterygidae	Engulfers																		
	Coenagrionidae	Engulfers								2										
	Cordulegastridae	Engulfers																		
	Corduliidae	Engulfers																		
	Gomphidae	Engulfers	1								1	1	3	14						
	Libellulidae	Engulfers																		
	Macromiidae	Engulfers																		
	Petaluridae	Engulfers																		
Oligochaetes	Enchytraeidae	Collectors																		
Plecoptera	Capniidae	Shredders														2				
	Chloroperlidae	Shredders								2										
	Leuctridae	Shredders	7																	
	Nemouridae	Shredders									14	37						1		
	Peltoperlidae	Shredders																		
	Perlidae	Engulfers	1		2							2	8	8		1				
	Perlodidae	Engulfers	3																1	
	Pteronarcyidae	Shredders														3				
	Taeniopterygidae	Shredders								1				1						
Prosobranchia	Hydrobiidae	N/A																		
	Pleuroceridae	N/A						11	7											
	Viviparidae	N/A						2												
Pulmonata	Ancylidae	N/A									1									
Rhynchobdellida	Glossiphoniidae	N/A																		
Trichoptera	Brachycentridae	Collectors																		
	Glossosomatidae	Collectors																		
	Helicopsychidae	Collectors																		
	Hydropsychidae	Collectors		1	1				99	1	7	12	51	7		9		1		
	Lepidostomatidae	Shredders	6									1								
	Leptoceridae	Collectors																		
	Limnephilidae	Shredders			3	1		1						2				5		
	Molannidae	Collectors																		
	Odontoceridae	Shredders																		
	Philopotamidae	Collectors			1			7						3						
	Phryganeidae	Shredders														8				
	Polycentropodidae	Collectors														3				
	Psycomyiidae	Collectors																		
	Rhyacophilidae	Engulfers									1	1								
Tubificida	Naididae	Collectors													6		9			
	Tubificidae	Collectors																		
Unionida	Unionidae	Collectors																		
Veneroida	Corbiculidae	Collectors																		
	Sphaeriidae	Collectors						1						1						
Grand Total			32	19	38	33		99	126	120	139	132	137	106	12	122	10	89	5	1

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PNB804	PNB805	PNB806	PNB807	PNB808	PNB809	PNB900	PNB901	PNB902	PNB903	PNB904	PNB905	PNB906	PNB907	PNB908	PNB909	PS100	PS101	PS102	PS103	PS104
Amphipoda	Gammaridae	Shredders										90	38	38									
	Talitridae	Shredders																					
Basommatophora	Lymnaeidae	Collectors																					4
	Physidae	Collectors	8			16																	
	Planorbidae	Collectors																					
Coleoptera	Chrysomelidae	Shredders						1															
	Curculionidae	Shredders																					
	Dytiscidae	Engulfers			1	4													1				
	Elmidae	Scrapers				20					1								5		14	20	
	Gyrinidae	Engulfers																					
	Haliplidae	Shredders																					
	Helodidae	Collectors																					
	Hydrophilidae	Engulfers				10	1																
	Noteridae	Engulfers																					
	Psephenidae	Scrapers													2	1							
Decapoda	Cambaridae	Engulfers						1							1		3		1			1	
Diptera	Athericidae	Engulfers																				3	
	Ceratopogonidae	Collectors	1							2													
	Chironomidae	Collectors	19		4	34	1	6	30	2	27	1	1	1	4	48	9	9	3		27	25	5
	Culicidae	Collectors																					
	Dixidae	Collectors																					
	Ephydridae	Collectors												1									
	Ptychopteridae	Collectors																					
	Sciomyzidae	Engulfers																					
	Simuliidae	Collectors				7		2			3						21	43					
	Stratiomyidae	Collectors																					
	Tabanidae	Engulfers	2		1																		
	Tanyderidae	Collectors																					
	Tipulidae	Shredders			1			4	4		3	4		2			7		1		2		
Ephemeroptera	Baetidae	Collectors						1	31					1									
	Baetiscidae	Collectors																					
	Caenidae	Collectors				1																	
	Ephemerellidae	Collectors						1	1		18				1	8					1		
	Ephemeridae	Collectors							2					4									
	Heptageniidae	Collectors							6	5	3	1		3	3	4	13	10	2		14	13	
	Leptophlebiidae	Collectors						3	5		2				2	6	16	2	1				
	Oligoneuridae	Collectors																					
	Polymitarcyidae	Collectors																					
	Potamanthidae	Collectors																					
	Siphlonuridae	Collectors						3			8			23	1	14		28	1				
	Tricorythidae	Collectors																3			2		
Gnathobdellida	Hirudinidae	N/A																					
Haplotaxida	Haplotaxidae	N/A																					
Hemiptera	Corixidae	Engulfers																					
	Gerridae	Engulfers																					
	Notonectidae	Engulfers																					
Isopoda	Asellidae	Shredders																	15	42		3	

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PNB804	PNB805	PNB806	PNB807	PNB808	PNB809	PNB900	PNB901	PNB902	PNB903	PNB904	PNB905	PNB906	PNB907	PNB908	PNB909	PS100	PS101	PS102	PS103	PS104
Lepidoptera	Pyralidae	Shredders										1											
Megaloptera	Corydalidae	Engulfers				1											1	1	2		2		
	Sialidae	Engulfers				1																	
Odonata	Aeshnidae	Engulfers																					
	Calopterygidae	Engulfers																					
	Coenagrionidae	Engulfers																					
	Cordulegastridae	Engulfers																					
	Corduliidae	Engulfers																					
	Gomphidae	Engulfers														4						3	
	Libellulidae	Engulfers				1																	
	Macromiidae	Engulfers																					
	Petaluridae	Engulfers																					
Oligochaetes	Enchytraeidae	Collectors																					
Plecoptera	Capniidae	Shredders								1	15												
	Chloroperlidae	Shredders																10					
	Leuctridae	Shredders																1			3	11	
	Nemouridae	Shredders						1				4	1	9	1		5						
	Peltoperlidae	Shredders								8		6		1				13					
	Perlidae	Engulfers	1						4				1	3	3	4	2	1					
	Perlodidae	Engulfers														1	2	1					
	Pteronarcyidae	Shredders																					
	Taeniopterygidae	Shredders														4							
Prosobranchia	Hydrobiidae	N/A																					
	Pleuroceridae	N/A																					
	Viviparidae	N/A																					
Pulmonata	Ancylidae	N/A																					
Rhynchobdellida	Glossiphoniidae	N/A																					
Trichoptera	Brachycentridae	Collectors																					
	Glossosomatidae	Collectors															3	1	2				
	Helicopsychidae	Collectors																					
	Hydropsychidae	Collectors	12					1	2	2	5			3		2	2		3	1	13	13	
	Lepidostomatidae	Shredders								13													
	Leptoceridae	Collectors																					
	Limnephilidae	Shredders						2						1		2							
	Molannidae	Collectors																					
	Odontoceridae	Shredders																					
	Philopotamidae	Collectors									1				5	5		5					
	Phryganeidae	Shredders																					
	Polycentropodidae	Collectors														2							
	Psycomyiidae	Collectors																					
	Rhyacophilidae	Engulfers														5							
Tubificida	Naididae	Collectors		4														7					
	Tubificidae	Collectors																					
Unionida	Unionidae	Collectors																					
Veneroida	Corbiculidae	Collectors																					
	Sphaeriidae	Collectors				2																	
Grand Total			43	4	7	97	2	26	85	33	86	107	41	90	23	110	84	135	37	43	78	92	9

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PS105	PS106	PS107	PS108	PS109	PS110	PS111	PS112	PS113	PS200	PS201	PS202	PS203	PS204	PS205	PS206	PS207	PSB2600	PSB2601	PSB2602	PSB2603	PSB2604
Amphipoda	Gammaridae	Shredders																						
	Talitridae	Shredders																						
Basommatophora	Lymnaeidae	Collectors		5	3	1	10	2	1		3													
	Physidae	Collectors																						
	Planorbidae	Collectors			2						1													
Coleoptera	Chrysomelidae	Shredders																						
	Curculionidae	Shredders																						
	Dytiscidae	Engulfers				1								1	1			1	1					
	Elmidae	Scrapers	4	3	2		9	2		5	2													
	Gyrinidae	Engulfers					2																	
	Haliplidae	Shredders																						
	Helodidae	Collectors																						
	Hydrophilidae	Engulfers					1							1										
	Noteridae	Engulfers																						
	Psephenidae	Scrapers				1	1		2	3	1		1	2				1						
Decapoda	Cambaridae	Engulfers								1	1													
Diptera	Athericidae	Engulfers																						
	Ceratopogonidae	Collectors																						
	Chironomidae	Collectors	2	4		21	6	4		11	20	2			3	1		3	9	14				
	Culicidae	Collectors																						
	Dixidae	Collectors																						
	Ephydridae	Collectors																	2					
	Ptychopteridae	Collectors																						
	Sciomyzidae	Engulfers																						
	Simuliidae	Collectors																						
	Stratiomyidae	Collectors																						
	Tabanidae	Engulfers								3														
	Tanyderidae	Collectors																						
	Tipulidae	Shredders	1	1						2			2	1	3	2		3	3					
Ephemeroptera	Baetidae	Collectors											4											
	Baetiscidae	Collectors																						
	Caenidae	Collectors								14						1								
	Ephemerellidae	Collectors					3			4					6									
	Ephemeridae	Collectors								18		1				1			3					
	Heptageniidae	Collectors		4		3	3	14		8	4		16	10		8		1	2					
	Leptophlebiidae	Collectors		1											3			4						
	Oligoneuriidae	Collectors						3																
	Polymitarcyidae	Collectors																						
	Potamanthidae	Collectors																						
	Siphlonuridae	Collectors	2											2		1				32				
	Tricorythidae	Collectors								7	6													
Gnathobdellida	Hirudinidae	N/A																						
Haplotaxida	Haplotaxidae	N/A																						
Hemiptera	Corixidae	Engulfers																						
	Gerridae	Engulfers																						
	Notonectidae	Engulfers																						
Isopoda	Asellidae	Shredders	68	11	1				17	5														

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PS105	PS106	PS107	PS108	PS109	PS110	PS111	PS112	PS113	PS200	PS201	PS202	PS203	PS204	PS205	PS206	PS207	PSB2600	PSB2601	PSB2602	PSB2603	PSB2604
Lepidoptera	Pyralidae	Shredders																						
Megaloptera	Corydalidae	Engulfers		1			3			2		2	1	3			1		1					
	Sialidae	Engulfers		1						6														
Odonata	Aeshnidae	Engulfers																						
	Calopterygidae	Engulfers																						
	Coenagrionidae	Engulfers																						
	Cordulegastridae	Engulfers																						
	Corduliidae	Engulfers																						
	Gomphidae	Engulfers									4			3		1								
	Libellulidae	Engulfers																						
	Macromiidae	Engulfers																	1					
	Petaluridae	Engulfers																						
Oligochaetes	Enchytraeidae	Collectors																						
Plecoptera	Capniidae	Shredders																		4				
	Chloroperlidae	Shredders																		30				
	Leuctridae	Shredders		1				4										3		28				
	Nemouridae	Shredders																						
	Peltoperlidae	Shredders										6	9				5	2	2					
	Perlidae	Engulfers					6	1					6	11		3	4	1						
	Perlodidae	Engulfers																						
	Pteronarcyidae	Shredders																						
	Taeniopterygidae	Shredders									4		2											
Prosobranchia	Hydrobiidae	N/A																						
	Pleuroceridae	N/A																						
	Viviparidae	N/A																						
Pulmonata	Ancylidae	N/A																						
Rhynchobdellida	Glossiphoniidae	N/A																						
Trichoptera	Brachycentridae	Collectors																	1					
	Glossosomatidae	Collectors																						
	Helicopsychidae	Collectors																						
	Hydropsychidae	Collectors		5	1	35	3	7			63	5	10	1	4	1	2		9					
	Lepidostomatidae	Shredders		1										13		3	1							
	Leptoceridae	Collectors																						
	Limnephilidae	Shredders				1								16			3							
	Molannidae	Collectors																						
	Odontoceridae	Shredders																						
	Philopotamidae	Collectors		1		1	55	67											1					
	Phryganeidae	Shredders																						
	Polycentropodidae	Collectors									1	3	4						1					
	Psycomyiidae	Collectors																						
	Rhyacophilidae	Engulfers											3	2										
Tubificida	Naididae	Collectors																						
	Tubificidae	Collectors																						
Unionida	Unionidae	Collectors																						
Veneroida	Corbiculidae	Collectors																						
	Sphaeriidae	Collectors	6																					
Grand Total			83	39	9	64	102	104	20	89	110	19	58	66	20	22	16	19	36	108				

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PSB2605	PSB2700	PSB601	PSB602	PSB603	PSB604	PSB605	PSB606	PSB701	PSB702	PSB703	PSB704	PSB705	PSB706	PSB707	PSB708	PSB709	Total
Amphipoda	Gammaridae	Shredders																		174
	Talitridae	Shredders									11				4	100	17			137
Basommatophora	Lymnaeidae	Collectors									17									81
	Physidae	Collectors																		214
	Planorbidae	Collectors																		34
Coleoptera	Chrysomelidae	Shredders																		1
	Curculionidae	Shredders																		2
	Dytiscidae	Engulfers				1														49
	Elmidae	Scrapers		2						2		1			1			18	2	220
	Gyrinidae	Engulfers			1															7
	Haliplidae	Shredders																		1
	Helodidae	Collectors																		1
	Hydrophilidae	Engulfers																1		28
	Noteridae	Engulfers																		4
	Psephenidae	Scrapers		1						3	5							4		139
Decapoda	Cambaridae	Engulfers																		33
Diptera	Athericidae	Engulfers																		27
	Ceratopogonidae	Collectors																		65
	Chironomidae	Collectors		41	6	5	14			37	17	12	60	4	3	6	1	18	4	2655
	Culicidae	Collectors				1						1					2			7
	Dixidae	Collectors																		1
	Ephydridae	Collectors																		8
	Ptychopteridae	Collectors																		1
	Sciomyzidae	Engulfers																		3
	Simuliidae	Collectors														3				247
	Stratiomyidae	Collectors																		3
	Tabanidae	Engulfers																1		10
	Tanyderidae	Collectors																		9
	Tipulidae	Shredders					1			2			3	2		2	4			300
Ephemeroptera	Baetidae	Collectors								2										188
	Baetiscidae	Collectors																		2
	Caenidae	Collectors		78							1							10		161
	Ephemerellidae	Collectors				3	2			4					1		3		7	599
	Ephemeridae	Collectors		1						2		3	1	24	10			7		148
	Heptageniidae	Collectors		3	1	1	6			17	16	14	8	1	4		16	4	5	897
	Leptophlebiidae	Collectors			1	9												1		239
	Oligoneuriidae	Collectors		1														1		130
	Polymitarcyidae	Collectors								14										14
	Potamanthidae	Collectors									1									1
	Siphlonuridae	Collectors			9	6	10	1	1	2							8			297
	Tricorythidae	Collectors		1																127
Gnathobdellida	Hirudinidae	N/A				1														3
Haplotaxida	Haplotaxidae	N/A						1		2										23
Hemiptera	Corixidae	Engulfers																		34
	Gerridae	Engulfers																		11
	Notonectidae	Engulfers																		4
Isopoda	Asellidae	Shredders																		212

TABLE 9
MACROINVERTEBRATE SUMMARY

Order	Family	Feeding Group	PSB2605	PSB2700	PSB601	PSB602	PSB603	PSB604	PSB605	PSB606	PSB701	PSB702	PSB703	PSB704	PSB705	PSB706	PSB707	PSB708	PSB709	Total
Lepidoptera	Pyralidae	Shredders																		6
Megaloptera	Corydalidae	Engulfers					2			3					4			1	5	121
	Sialidae	Engulfers			1								1							118
Odonata	Aeshnidae	Engulfers																		23
	Calopterygidae	Engulfers												4	1					5
	Coenagrionidae	Engulfers								2	3		1							23
	Cordulegastridae	Engulfers																		27
	Corduliidae	Engulfers																		4
	Gomphidae	Engulfers											2		5	3		7		112
	Libellulidae	Engulfers																		4
	Macromiidae	Engulfers																		1
	Petaluridae	Engulfers																		1
Oligochaetes	Enchytraeidae	Collectors																		11
Plecoptera	Capniidae	Shredders			1	28	1					1			1		1		21	254
	Chloroperlidae	Shredders				2	2			5		17			3					150
	Leuctridae	Shredders																		510
	Nemouridae	Shredders																		542
	Peltoperlidae	Shredders				4														179
	Perlidae	Engulfers					6						10	1	1	2				245
	Perlodidae	Engulfers			1															213
	Pteronarcyidae	Shredders																	1	21
	Taeniopterygidae	Shredders																		200
Prosobranchia	Hydrobiidae	N/A																		5
	Pleuroceridae	N/A							3	1										33
	Viviparidae	N/A																		3
Pulmonata	Ancylidae	N/A		1																45
Rhynchobdellida	Glossiphoniidae	N/A							3											9
Trichoptera	Brachycentridae	Collectors																		4
	Glossosomatidae	Collectors								1										28
	Helicopsychidae	Collectors				1														21
	Hydropsychidae	Collectors		10		1	1			3		34	10		6	6	5	7	16	1115
	Lepidostomatidae	Shredders				2														248
	Leptoceridae	Collectors										1			2	1				56
	Limnephilidae	Shredders			1	1		3			1	2				8	2			306
	Molannidae	Collectors																		3
	Odontoceridae	Shredders																		14
	Philopotamidae	Collectors																1		322
	Phryganeidae	Shredders																		55
	Polycentropodidae	Collectors					10						1							188
	Psycomyiidae	Collectors																		1
	Rhyacophilidae	Engulfers																		56
Tubificida	Naididae	Collectors			1		5			3										259
	Tubificidae	Collectors																		21
Unionida	Unionidae	Collectors																		25
Veneroida	Corbiculidae	Collectors																		3
	Sphaeriidae	Collectors								2					2					280
Grand Total				139	23	66	60	5	7	107	72	86	97	36	48	131	59	81	61	13421

TABLE 10
SUMMARY TABLE - BASIC WATER QUALITY

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score	Family Biotic Index	# Individuals	# of Families
B	Tygart Valley River	Leading Creek	MT3605	trib. Leading Creek	2	7	9.2	6.5	105	7.86	37	4
B	Tygart Valley River	Leading Creek	MT3604	Stalnaker Run	3	6	9.5	7.5	97	4.97	39	12
B	Tygart Valley River	Leading Creek	MT3603	trib. Leading Creek	1	6	9.8	6	76	7.80	106	10
B	Tygart Valley River	Leading Creek	MT3602	Leading Creek	3	6	9.7		91	7.09	125	9
B	Tygart Valley River	Leading Creek	MT3601	Leading Creek	3	4.5	10.4	6	95	3.66	117	12
B	Tygart Valley River	Leading Creek	MT3600	trib. Wilmoth Creek	1	6	9	6	38	7.20	75	9
B	Tygart Valley River	Leading Creek	MT3509	trib. Leading Creek	2	5	11	6.5	43	7.84	68	5
B	Tygart Valley River	Leading Creek	MC3508	Haddix Run	1	7	10	7.5	83	5.75	28	9
B	Cheat River	Shavers Fork	MC3507	trib. Haddix Run	1	6	10	6	90	3.83	98	16
B	Cheat River	Shavers Fork	MC3506	trib. Haddix Run	1	6	9.8	6	79	1.31	36	4
B	Cheat River	Shavers Fork	MC3505	trib. Haddix Run	1	6	9.4	6.5	81	3.65	83	7
B	Cheat River	Shavers Fork	MT3504	trib. Leading Creek	1	6.5	9.2	6.5	96	2.91	32	10
B	Tygart Valley River	Leading Creek	MT3503	Pond Lick Run	2	4	9.7	6.5	76	6.67	87	11
B	Tygart Valley River	Leading Creek	MT3502	Cherry Fork	3	5	9.3	6	77	5.39	96	17
B	Tygart Valley River	Leading Creek	MT3501	trib. Cherry Fork	1	4.5	0	6.5	36	6.82	11	6
B	Tygart Valley River	Leading Creek	MT3500	trib. Leading Creek	1	5	9	6	28	6.64	33	7
B	Cheat River	Shavers Fork	MC3406	Hawk Run	1	6	12	6	90	4.64	100	16
B	Cheat River	Shavers Fork	MC3405	Goodwin Run	1	5	18	6	103	5.32	22	6
B	Cheat River	Shavers Fork	MC3404	Shingle Tree Run	1	4.5	17	6	95	1.26	38	8
B	Cheat River	Shavers Fork	MC3403	Haddix Run	3	6	12.8	6.5	108	3.39	28	9
B	Cheat River	Shavers Fork	MC3402	Sugarcamp Run	1	5	14	6	105	2.30	94	6
B	Cheat River	Shavers Fork	MC3401	Shavers Fork	3	6	14	6	119	2.78	37	8
B	Cheat River	Black Fork	MC3400	Black Fork River	3	4	15	6	117	4.22	9	4
B	Cheat River	Black Fork	MC3312	Long Run	1	4	11.4	6.5	87	3.95	42	5
B	Cheat River	Black Fork	MC3311	trib. Long Run	1	6.5	8	4	51	8.00	0	1
B	Cheat River	Black Fork	MC3310	trib. Snyder Run	1	4	8	6	68	8.00	0	1
B	Cheat River	Black Fork	MC3309	Snyders Run	2	4.5	12	5	70	2.90	96	9
B	Cheat River	Black Fork	MC3308	Roaring Run	2	5	12	7	124	3.58	121	17

TABLE 10
SUMMARY TABLE - BASIC WATER QUALITY

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score	Family Biotic Index	# Individuals	# of Families
B	Cheat River	Black Fork	MC3307	trib. Roaring Run	1	4	21	5.5	103	2.63	81	12
B	Cheat River	Black Fork	MC3306	Roaring Run	2	3	12	7.5	117	5.32	97	10
B	Cheat River	Black Fork	MC3305	Roaring Run	1	4	12	7	111	2.50	24	9
B	Cheat River	Black Fork	MC3304	trib. Slip Hill Mill Run	1	10	12	4	66	2.17	6	3
B	Cheat River	Black Fork	MC3303	trib. Slip Hill Mill Run	1	5	14	5	66	2.33	3	2
B	Cheat River	Black Fork	MC3302	Slip Hill Mill Run	1	3	10	6.5	56	6.29	7	5
B	Cheat River	Black Fork	MC3301	N.F. Blackwater River	3	4	10	6.8	90	7.84	146	5
A	North Branch Potomac River	Patterson Creek	PNB2905	trib. N.F. Patterson Creek	1	5	10.7	7.5	74	3.30	122	11
A	North Branch Potomac River	Patterson Creek	PNB2904	trib. N.F. Patterson Creek	1	5	10.6	7.5	61	7.83	12	3
A	North Branch Potomac River	Patterson Creek	PNB2903	trib. N.F. Patterson Creek	2	3	9	7	89	4.31	106	21
A	North Branch Potomac River	Patterson Creek	PNB2902	N.F. Patterson Creek	3	5	11	8	99	3.76	137	11
A	North Branch Potomac River	Patterson Creek	PNB2901	N.F. Patterson Creek	3	3.5	12	8	121	3.73	132	13
A	North Branch Potomac River	Patterson Creek	PNB2900	N.F. Patterson Creek	3	3.5	12.4	8	126	6.39	139	14
A	North Branch Potomac River	Patterson Creek	PNB2802	trib. N.F. Patterson Creek	2	3	9.8	8	80	5.30	120	13
A	North Branch Potomac River	Patterson Creek	PNB2801	N.F. Patterson Creek	2	6.5	11	8	110	3.76	126	8
A	North Branch Potomac River	Patterson Creek	PNB2800	Patterson Creek	3	5.5	13	8	116	5.00	99	17
A	South Branch Potomac River	Anderson Run	PSB2700	Anderson Run	2	7	12	8	62	6.86	139	10
A	South Branch Potomac River	Main Channel	PSB2605	Dumpling Run	2	0.5	10	6.5	60	8.00	0	1
A	South Branch Potomac River	Main Channel	PSB2604	trib. Dumpling Run	1	0	10	6	32	8.00	0	1
A	South Branch Potomac River	Main Channel	PSB2603	Dumpling Run	2	0	10	6	48	8.00	0	1
A	South Branch Potomac River	Main Channel	PSB2602	Fort Run	2	-1	10	7	52	8.00	0	1
A	South Branch Potomac River	Main Channel	PSB2601	Dumpling Run	2	-1	10	7	88	8.00	0	1
A	South Branch Potomac River	Main Channel	PSB2600	Fort Run	2	5	12	7	104	3.43	108	5
A	Cacapon River	Skaggs Run	PC2504	trib. Skaggs Run	1	3	10.2	8	87	2.73	30	8
A	Cacapon River	Skaggs Run	PC2503	trib. Skaggs Run	1				56	5.82	33	10
A	Cacapon River	Baker Run	PC2502	trib. Long Lick Run	1	2.5	11	7.5	88	2.81	54	11
A	Cacapon River	Baker Run	PC2501	trib. Long Lick Run	1	2.5	11	6.5	58	4.29	117	13
A	Cacapon River	Baker Run	PC2500	Baker Run	3	6	9.8	7.5	103	4.00	133	12
A	Cacapon River	Central Cacapon River	PC2401	trib. Lost River	2	9		7	55	2.37	35	6

TABLE 10
SUMMARY TABLE - BASIC WATER QUALITY

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score	Family Biotic Index	# Individuals	# of Families
A	Cacapon River	Central Cacapon River	PC2400	trib. Lost River	2	10	9	7.5	105	1.58	111	8
A	Cacapon River	Waites Run	PC2303	Waites Run	3	7	11	7.5	112	3.56	119	16
A	Cacapon River	Slate Rock Run	PC2302	Slate Rock Run	2	5	12	7	89	5.18	17	6
A	Cacapon River	Slate Rock Run	PC2301	trib. Slate Rock Run	1	4	12	7	85	5.36	11	4
A	Cacapon River	Slate Rock Run	PC2300	trib. Slate Rock Run	1	4	12	7	86	3.13	45	14
B	Tygart Valley River	Leading Creek	MT1611	trib. Leading Creek	1				52	9.00	0	1
B	Tygart Valley River	Leading Creek	MT1610	trib. Leading Creek	3	19	7.8	7	108	3.98	127	13
B	Tygart Valley River	Leading Creek	MT1609	Leading Creek	3				101	4.21	39	7
B	Tygart Valley River	Leading Creek	MT1608	Leading Creek	3	19	8	7	104	3.33	86	12
B	Tygart Valley River	Leading Creek	MT1607	trib. Leading Creek	2	20.2	9.3	7.5	58	4.00	1	1
B	Tygart Valley River	Leading Creek	MT1606	trib. Clay Lick Run	1	19.4	8.7	6.3	59	3.00	2	2
B	Tygart Valley River	Leading Creek	MT1605	Claylick Run	2	20.2	4.7	7.1	59	5.70	10	8
B	Tygart Valley River	Leading Creek	MT1604	trib. Leading Creek	1	18	9.2	6.6	81	5.38	8	5
B	Tygart Valley River	Leading Creek	MT1603	Pearcy Run	2	21.5	6.4	6.9	76	6.52	21	6
B	Tygart Valley River	Leading Creek	MT1602	Horse Run	2	22.6	4.3	7.1	44	9.00	0	1
B	Tygart Valley River	Leading Creek	MT1601	Davis Lick	2	23.6	7.6	7.5	64	6.91	33	6
B	Tygart Valley River	Leading Creek	MT1512	Leading Creek	3	21.8	5.4	7	67	5.40	45	6
B	Tygart Valley River	Leading Creek	MT1511	Wilmoth Run	2	19.3	4.3	7.3	53	7.91	23	4
B	Tygart Valley River	Leading Creek	MT1510	trib. Wilmoth Creek	1	17.5	4.2	7.3	65	5.50	4	2
B	Tygart Valley River	Leading Creek	MT1509	Wilmoth Run	1	20.5	8.7	7.8	75	4.39	18	7
B	Cheat River	Shavers Fork	MC1508	Pleasant Run	2	12.3	9.6	6.7	79	4.03	29	7
B	Cheat River	Shavers Fork	MC1507	trib. Pleasant Run	1	17.1	8	6.4	79	3.65	37	8
B	Cheat River	Shavers Fork	MC1506	trib. Pleasant Run	1	17.4		6.7	85	4.00	25	9
B	Cheat River	Shavers Fork	MC1505	Pleasant Run	2	19	8.6	7	84	2.50	8	5
B	Cheat River	Shavers Fork	MC1504	Slab Camp Run	2	19.3	10.5	7.3	75	4.89	18	5
B	Cheat River	Shavers Fork	MC1503	Pleasant Run	2	18.3	11.1	7	104	2.92	39	10
B	Cheat River	Shavers Fork	MC1502	Pleasant Run	2	23	9.5	8.5	89	3.73	55	9
B	Cheat River	Shavers Fork	MC1501	Shavers Fork	3	23.8	7.5	7.9	104	4.00	84	15
B	Cheat River	Shavers Fork	MC1402	trib. Shavers Fork	1	19	4.1	6	37	7.99	103	4

TABLE 10
SUMMARY TABLE - BASIC WATER QUALITY

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score	Family Biotic Index	# Individuals	# of Families
B	Cheat River	Shavers Fork	MC1401	Shavers Fork	3	31.5	8	7	120	4.63	54	11
B	Cheat River	Shavers Fork	MC1400	Shavers Fork	3	31.5	8	7	120	4.39	71	10
B	Cheat River	Black Fork	MC1320	Roaring Run	2	14	8	7.5	89	6.00	49	11
B	Cheat River	Black Fork	MC1319	Black Fork River	3	19	6.8	7	123	4.32	62	8
B	Cheat River	Black Fork	MC1318	trib. Black Fork	2	25	6.2	7.5	82	4.09	56	13
B	Cheat River	Black Fork	MC1317	trib. Roaring Run	1	14.5	6	7	51	3.76	33	5
B	Cheat River	Black Fork	MC1316	trib. Roaring Run	1	13.4	9.4	7.2	111	3.28	40	9
B	Cheat River	Black Fork	MC1315	trib. Roaring Run	1	13.6	6.7	6	87	3.40	5	3
B	Cheat River	Black Fork	MC1314	trib. Roaring Run	1	13.6	8	7.7	99	3.04	26	10
B	Cheat River	Black Fork	MC1313	trib. Roaring Run	1	13.2	7.8	7.5	79	3.30	33	8
B	Cheat River	Black Fork	MC1312	trib. Big Run	1	12.8	6.3	4.5	91	3.67	21	11
B	Cheat River	Black Fork	MC1311	Big Run	2	15	9.9	4.5	85	4.16	19	9
B	Cheat River	Black Fork	MC1310	Tub Run	1	12.4	7.7	4.1	105	5.09	34	8
B	Cheat River	Black Fork	MC1309	Middle Run	2	10	7.6	6	57	5.92	39	13
B	Cheat River	Black Fork	MC1308	Long Run	2	18.3	9.6	6.1	79	5.50	44	10
B	Cheat River	Black Fork	MC1307	Long Run	2	19.3	9.6	6.2	74	6.18	17	6
B	Cheat River	Black Fork	MC1306	Long Run	2	15.2	11.3	3.2	72	9.00	0	1
B	Cheat River	Black Fork	MC1305	Long Run	2	13.9	9.3	2.9	65	8.00	1	1
B	Cheat River	Black Fork	MC1304	N.F. Blackwater River	3	13.5	10.6	4	65	8.00	4	1
B	Cheat River	Black Fork	MC1303	trib. N.F. Blackwater River	1	9.1	10.3	2.8	64	10.00	0	1
B	Cheat River	Black Fork	MC1302	N.F. Blackwater River	3	14.4	10.6	6.9	87	10.00	0	1
B	Cheat River	Black Fork	MC1301	trib. Beaver Creek	1	13	10.9	5.1	74	2.50	8	6
B	Cheat River	Black Fork	MC1216	trib. Beaver Creek	2	23	7	5	42	4.33	12	5
B	Cheat River	Black Fork	MC1215	trib. Beaver Creek	1	21	5.2	5.5	57	4.78	41	3
B	Cheat River	Black Fork	MC1214	trib. Beaver Creek	1	22	5.2	3	80	5.05	118	4
B	Cheat River	Black Fork	MC1213	trib. Pendleton Creek	1	26	6.4	7	32	6.28	47	7
B	Cheat River	Black Fork	MC1212	Pendleton Creek	2	29	7.2	6.5	86	6.00	107	7
B	Cheat River	Black Fork	MC1211	trib. Pendleton Creek	1	22	6	7	38	7.28	39	6
B	Cheat River	Black Fork	MC1210	trib. Beaver Creek	1	13	4.4	6.5	62	7.49	53	5

TABLE 10
SUMMARY TABLE - BASIC WATER QUALITY

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score	Family Biotic Index	# Individuals	# of Families
B	Cheat River	Black Fork	MC1209	trib. Beaver Creek	1	14	3.2	6	60	8.00	0	1
B	Cheat River	Black Fork	MC1208	Beaver Creek	3	18	6.6	4.5	68	6.67	104	3
B	Cheat River	Black Fork	MC1207	trib. Beaver Creek	2	13	6.8	5	55	3.00	12	5
B	Cheat River	Black Fork	MC1206	trib. Beaver Creek	1	16	6.8	5	41	0.16	97	4
B	Cheat River	Black Fork	MC1205	trib. Beaver Creek	1	11	6.2	4.5	43	3.29	104	7
B	Cheat River	Black Fork	MC1204	trib. Beaver Creek	1	25	5.4	3	52	10.00	0	1
B	Cheat River	Black Fork	MC1203	trib. Beaver Creek	1	17	5.2	3	49	10.00	0	1
B	Cheat River	Black Fork	MC1202	trib. Beaver Creek	1	11	4.8	3	49	4.00	1	1
B	Cheat River	Black Fork	MC1201	trib. Beaver Creek	1	13	8.6	6	84	1.85	88	8
B	Cheat River	Black Fork	MC1200	trib. Beaver Creek	1	12	8.2	5	90	2.08	119	11
B	Cheat River	Black Fork	MC1112	trib. Beaver Creek	1	22	4.2	6	49	5.20	5	3
B	Cheat River	Black Fork	MC1111	trib. Beaver Creek	1	16	6	5.5	57	4.20	5	5
B	Cheat River	Black Fork	MC1110	trib. Beaver Creek	1	19	6.7	6	83	6.50	2	2
B	Cheat River	Black Fork	MC1109	trib. Beaver Creek	1	13	6.8	4.5	88	2.48	122	9
B	Cheat River	Black Fork	MC1108	trib. Beaver Creek	1	15	7.4	5	89	2.83	94	8
B	Cheat River	Black Fork	MC1107	trib. Beaver Creek	1	15	6.8	4.5	57	1.90	84	5
B	Cheat River	Black Fork	MC1106	trib. Beaver Creek	1	12	6	4.5	75	6.46	65	6
B	Cheat River	Black Fork	MC1105	trib. Beaver Creek	1	17		5	101	1.90	87	8
B	Cheat River	Black Fork	MC1104	trib. Beaver Creek	1	18	6.4	5	106	2.36	14	6
B	Cheat River	Black Fork	MC1103	trib. Beaver Creek	1	17	7	5	63	1.52	42	3
B	Cheat River	Black Fork	MC1102	trib. Beaver Creek	1	19	6	6	53	8.00	105	1
B	Cheat River	Black Fork	MC1101	trib. Four Mile Run	1	17	6	7	76	8.00	6	1
B	Cheat River	Black Fork	MC1100	Four Mile Run	1	15	6.4	7.5	62	3.09	11	6
A	North Branch Potomac River	Stony River	PNB1009	trib. Little Creek	1	21	6.5	4	78	8.00	0	1
A	North Branch Potomac River	Patterson Creek	PNB1008	trib. Elklick Run	1	19	10	7.5	112	7.88	33	2
A	North Branch Potomac River	Patterson Creek	PNB1007	trib. Elklick Run	1	19	10	7.5	101	5.89	38	10
A	North Branch Potomac River	Stony River	PNB1006	Stony River	2	26	7	5	123	4.42	19	3
A	North Branch Potomac River	Stony River	PNB1005	trib. Stony River	1	15	7.6	6.5	97	2.72	32	11
A	North Branch Potomac River	Stony River	PNB1004	trib. Abrams Creek	1	14	9	4.5	80	2.20	98	9

TABLE 10
SUMMARY TABLE - BASIC WATER QUALITY

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score	Family Biotic Index	# Individuals	# of Families
A	North Branch Potomac River	Stony River	PNB1003	trib. Abrams Creek	1	14	7	5.5	68	2.45	98	12
A	North Branch Potomac River	Stony River	PNB1002	trib. Abrams Creek	1	14	7.6	7	53	7.34	95	9
A	North Branch Potomac River	Stony River	PNB1001	Abrams Creek	2	20	5.2	4	50	9.00	0	1
A	North Branch Potomac River	Stony River	PNB1000	Little Creek	2	25	4.5	3	51	9.00	0	1
A	North Branch Potomac River	Patterson Creek	PNB909	trib. N.F. Patterson Creek	2	7	10.4	6.5	93	5.13	135	15
A	North Branch Potomac River	Patterson Creek	PNB908	trib. N.F. Patterson Creek	1	8.5	11.2	8	77	4.07	84	13
A	North Branch Potomac River	Patterson Creek	PNB907	M.F. Patterson Creek	3		8.2	8	93	5.30	110	15
A	North Branch Potomac River	Patterson Creek	PNB906	Elklick Run	2	17	7.2	7	90	3.87	23	10
A	North Branch Potomac River	Patterson Creek	PNB905	trib. Elklick Run	2	19	8	8	79	4.50	90	13
A	North Branch Potomac River	Patterson Creek	PNB904	trib. Elklick Run	2	16	8.6	8	78	3.98	41	4
A	North Branch Potomac River	Patterson Creek	PNB903	trib. Elklick Run	1	14	9	8	96	3.82	107	7
A	North Branch Potomac River	Patterson Creek	PNB902	N.F. Patterson Creek	3	14		8	109	4.36	86	11
A	North Branch Potomac River	Patterson Creek	PNB901	trib. M.F. Patterson Creek	1	18	7.8	7	46	2.61	33	7
A	North Branch Potomac River	Patterson Creek	PNB900	M.F. Patterson Creek	3	18	8.2	8	96	5.07	85	9
A	North Branch Potomac River	Patterson Creek	PNB809	trib. Patterson Creek	1	8.5	9.2	8	64	4.92	26	12
A	North Branch Potomac River	Patterson Creek	PNB808	trib. N.F. Patterson Creek	1	0.5	12.8	7	51	6.50	2	2
A	North Branch Potomac River	Patterson Creek	PNB807	Patterson Creek	3	22	1.8	6.5	48	6.47	97	11
A	North Branch Potomac River	Patterson Creek	PNB806	trib. S.F. Patterson Creek	1	18	7.2	7	62	6.57	7	4
A	North Branch Potomac River	Patterson Creek	PNB805	trib. Patterson Creek	1	17.5	7.8	7	67	8.00	4	1
A	North Branch Potomac River	Patterson Creek	PNB804	trib. Thorn Run	2	10	6.2	7	71	6.58	43	6
A	North Branch Potomac River	Patterson Creek	PNB803	trib. Thorn Run	1	15.5	7.6	6	86	3.00	1	1
A	North Branch Potomac River	Patterson Creek	PNB802	trib. Thorn Run	2	19	6.5	6	74	5.20	5	2
A	North Branch Potomac River	Patterson Creek	PNB801	trib. Patterson Creek	2	19	8	8	87	7.66	89	4
A	North Branch Potomac River	Patterson Creek	PNB800	trib. Patterson Creek	1	27	6.5	8	34	7.90	10	2
A	South Branch Potomac River	Anderson Run	PSB709	trib. Walnut Bottom	2	21	7.2	7.5	66	2.49	61	8
A	South Branch Potomac River	Anderson Run	PSB708	Walnut Bottom	2	28	7.2	8	67	4.93	81	14
A	South Branch Potomac River	Anderson Run	PSB707	Tombs Hollow Run	2	12.3	11.5	8	89	5.49	59	10
A	South Branch Potomac River	Anderson Run	PSB706	trib. Walnut Bottom	2	14.5	12.4	6.6	116	7.15	131	9
A	South Branch Potomac River	Anderson Run	PSB705	trib. Walnut Bottom	2	18	10.3	6.3	78	3.75	48	15

TABLE 10
SUMMARY TABLE - BASIC WATER QUALITY

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score	Family Biotic Index	# Individuals	# of Families
A	South Branch Potomac River	Anderson Run	PSB704	trib. Walnut Bottom	2	19.7	10.8	7	67	4.42	36	6
A	South Branch Potomac River	Anderson Run	PSB703	Walnut Bottom	3	17.9	11	8.3	81	6.14	97	10
A	South Branch Potomac River	Anderson Run	PSB702	Walnut Bottom	3	16.2	11.2	7.5	95	3.98	86	10
A	South Branch Potomac River	Main Channel	PSB701	trib. S.B. Potomac River	1	18.6	4.3	7.1	53	6.51	72	9
A	South Branch Potomac River	Main Channel	PSB606	S.B. Potomac River	3	24.3	13.5	7.4	101	5.11	107	19
A	South Branch Potomac River	Main Channel	PSB605	trib. S.B. Potomac River	1	23.4	4.9	6.2	55	6.14	7	3
A	South Branch Potomac River	Main Channel	PSB604	trib. Fort Run	1	17.3	3.9	6.5	68	5.40	5	3
A	South Branch Potomac River	Main Channel	PSB603	Clifford Hollow	2	13.3	10.1	7	112	5.40	60	12
A	South Branch Potomac River	Clifford Hollow	PSB602	trib. Clifford Hollow	1	13.3	8.6	7	86	2.70	66	15
A	South Branch Potomac River	Clifford Hollow	PSB601	trib. Clifford Hollow	1	13.5	8.7	7	66	6.09	23	10
A	Cacapon River	Baker Run	PC517	trib. Baker Run	2	6	11.1	6	109	2.59	102	15
A	Cacapon River	Skaggs Run	PC516	trib. Skaggs Run	1	11.5	8.2	6	59	4.64	25	6
A	Cacapon River	Skaggs Run	PC515	trib. Skaggs Run	1	12.8	9.4	7	75	2.84	25	16
A	Cacapon River	Skaggs Run	PC514	trib. Skaggs Run	1	12	9.6	6	64	5.87	30	8
A	Cacapon River	Skaggs Run	PC513	Skaggs Run	2	12.5	9.5	7.5	86	3.35	97	10
A	Cacapon River	Skaggs Run	PC512	trib. Skaggs Run	1	11.8	10.2	6	83	3.38	29	7
A	Cacapon River	Skaggs Run	PC511	trib. Skaggs Run	1	11	11.1	7	105	4.43	30	10
A	Cacapon River	Skaggs Run	PC510	trib. Skaggs Run	1	10.8	10.5	6	76	3.00	3	3
A	Cacapon River	Skaggs Run	PC509	Skaggs Run	1	11	10.1	6.5	53	4.18	28	7
A	Cacapon River	Baker Run	PC508	Long Lick Run	2	13.3	9.5	8	76	2.71	38	11
A	Cacapon River	Baker Run	PC507	Long Lick Run	2	14.5	9.1	7.5	72	4.33	45	13
A	Cacapon River	Baker Run	PC506	trib. Long Lick Run	2	16	8.3	6.5	66	4.29	7	3
A	Cacapon River	Baker Run	PC505	trib. Long Lick Run	1	14.3	9	6	56	1.83	12	6
A	Cacapon River	Baker Run	PC504	Long Lick Run	2	17.8	8.5	7.7	80	2.74	50	13
A	Cacapon River	Baker Run	PC503	Baker Run	3	17.3	8.5	7.5	89	3.15	109	12
A	Cacapon River	Baker Run	PC502	Baker Run	3	16.5	8.8	7.5	89	3.85	109	12
A	Cacapon River	Baker Run	PC501	trib. Baker Run	1	13.3		6.5	67	4.38	21	9
A	Cacapon River	Central Cacapon River	PC413	Lost River	3	25	7.6	7.5	120	3.19	108	12
A	Cacapon River	Baker Run	PC412	Baker Run	3	17.3	9.6	7.5	97	2.93	138	13

TABLE 10
SUMMARY TABLE - BASIC WATER QUALITY

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score	Family Biotic Index	# Individuals	# of Families
A	Cacapon River	Central Cacapon River	PC411	Lost River	3	17	9.8	7.7	101	4.09	101	12
A	Cacapon River	Central Cacapon River	PC410	trib. Lost River	1	14.5	8.8	7.5	64	3.56	9	6
A	Cacapon River	Central Cacapon River	PC409	trib. Lost River	1	13.5	8.4	7.4	55	4.04	48	10
A	Cacapon River	Central Cacapon River	PC408	Lost River	3	15.8	9.2	7.7	100	6.15	99	12
A	Cacapon River	Central Cacapon River	PC407	trib. Lost River	1	11.8	7	6.8	84	5.08	37	7
A	Cacapon River	Central Cacapon River	PC406	trib. Lost River	2	11.8	5.2	7.1	93	2.00	6	3
A	Cacapon River	Central Cacapon River	PC405	trib. Lost River	1	11.8	8.2	6.8	55	4.29	42	9
A	Cacapon River	Central Cacapon River	PC404	trib. Lost River	1	12	5.4	6.6	81	6.20	10	4
A	Cacapon River	Central Cacapon River	PC403	trib. Lost River	1	12	5.2	6.1	76	8.00	2	1
A	Cacapon River	Central Cacapon River	PC402	Sauerkraut Run	2	16	9.2	7.8	101	3.06	105	15
A	Cacapon River	Central Cacapon River	PC401	Lost River	3	20.3	8.2	7.6	97	6.17	133	10
A	Cacapon River	Central Cacapon River	PC315	Trout Run	3	12.8	10.5	7.6	99	5.76	25	3
A	Cacapon River	Central Cacapon River	PC314	trib. Trout Run	1	14.5	7.6	7.2	57	3.53	103	11
A	Cacapon River	Waites Run	PC313	trib. Waites Run	2	13.1	8.8	6.8	90	4.65	54	11
A	Cacapon River	Waites Run	PC312	trib. Waites Run	1	13	9.6	6.5	52	5.11	57	7
A	Cacapon River	Waites Run	PC311	trib. Waites Run	1	12.7	10	7.2	83	3.31	35	12
A	Cacapon River	Waites Run	PC310	trib. Slate Rock Run	1	17.3	7	6.8	47	7.47	135	11
A	Cacapon River	Waites Run	PC309	trib. Waites Run	1	13.3	7.4	6.8	74	4.25	92	10
A	Cacapon River	Waites Run	PC308	Waites Run	2	14.7	9.5	7.2	106	3.74	109	14
A	Cacapon River	Waites Run	PC307	trib. Waites Run	1	15	6.8	6.8	57	5.19	58	10
A	Cacapon River	Waites Run	PC306	Waites Run	2	11.1	10	7.3	121	4.61	118	16
A	Cacapon River	Slate Rock Run	PC305	Slate Rock Run	2	15	8.8	7	115	2.46	83	16
A	Cacapon River	Slate Rock Run	PC304	trib. Slate Rock Run	1	14	9	7	103	3.63	71	12
A	Cacapon River	Slate Rock Run	PC303	trib. Sine Run	1	14.5	9.2	7	79	2.55	71	14
A	Cacapon River	Slate Rock Run	PC302	trib. Sine Run	1	12.5	8.9	6.5	85	3.33	84	15
A	Cacapon River	Slate Rock Run	PC301	trib. Sine Run	1	12	9.1		80	3.83	60	8
A	Cacapon River	Slate Rock Run	PC300	trib. Sine Run	1	12	10		83	6.33	121	9
A	Shenandoah River	Cedar Creek	PS207	trib. Paddy Run	1	21	7.8	7	61	4.81	36	13
A	Shenandoah River	Cedar Creek	PS206	trib. Duck Run	1	21	6.8	7	47	3.11	19	9

TABLE 10
SUMMARY TABLE - BASIC WATER QUALITY

Ecoregion	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Stream Order	Temperature (C)	Dissolved Oxygen mg/l	pH	Habitat Assessment Score	Family Biotic Index	# Individuals	# of Families
A	Shenandoah River	Cedar Creek	PS205	trib. Duck Run	2	24	5.9	6.5	45	2.19	16	6
A	Shenandoah River	Cedar Creek	PS204	trib. Duck Run	2	29	5.9	6	48	3.41	22	10
A	Shenandoah River	Cedar Creek	PS203	trib. Duck Run	1	21		7	48	3.30	20	6
A	Shenandoah River	Cedar Creek	PS202	Duck Run	2	20	7.8	7	112	2.58	66	13
A	Shenandoah River	Cedar Creek	PS201	Duck Run	2	20	7.8	7	112	3.14	58	11
A	Shenandoah River	Cedar Creek	PS200	Duck Run	2	21	7	7.5	95	3.68	19	6
A	Shenandoah River	Cedar Creek	PS113	Turkey Run	2	6.5	9.8	7.5	88	4.68	110	12
A	Shenandoah River	Cedar Creek	PS112	Mulberry Run	2	24	7.8	8	97	5.02	89	14
A	Shenandoah River	Cedar Creek	PS111	trib. Mulberry Run	1	23	8	8	66	7.55	20	3
A	Shenandoah River	Cedar Creek	PS110	Cedar Creek	3	22	7.2	7.5	114	3.33	104	9
A	Shenandoah River	Cedar Creek	PS109	Cedar Creek	3	22	7.2	8	110	3.62	102	12
A	Shenandoah River	Cedar Creek	PS108	trib. Mulberry Run	1	23	6	8	101	5.36	64	8
A	Shenandoah River	Cedar Creek	PS107	trib. Mulberry Run	1	24	7.2	8	69	6.11	9	5
A	Shenandoah River	Cedar Creek	PS106	Mulberry Run	2	21	7	8	83	5.54	39	13
A	Shenandoah River	Cedar Creek	PS105	trib. Mulberry Run	1	24	3	7.5	45	7.72	83	6
A	Shenandoah River	Cedar Creek	PS104	trib. Cedar Creek	1	21	2.8	8	101	7.56	9	2
A	Shenandoah River	Cedar Creek	PS103	trib. Mulberry Run	2	21	7.8	8	101	4.59	92	9
A	Shenandoah River	Cedar Creek	PS102	trib. Mulberry Run	2	20	7.2	8	86	5.06	78	9
A	Shenandoah River	Cedar Creek	PS101	Town Run	1	21	5.4	7	51	7.91	43	2
A	Shenandoah River	Cedar Creek	PS100	Town Run	2	19	7.8	8	88	5.57	37	12

Figure 19
Comparison of the Number of Macroinvertebrate Families by Local Project Watershed

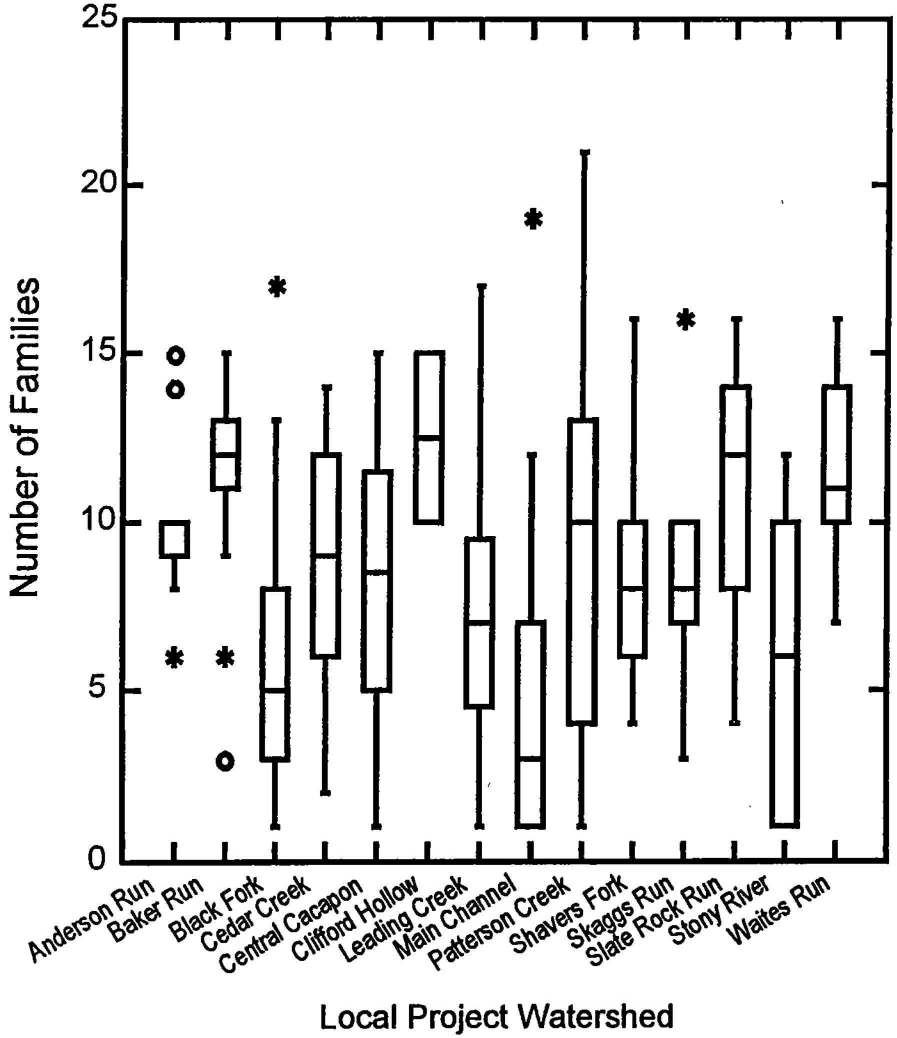


Figure 20
Comparison of the Number of Macroinvertebrate Families by Stream Order

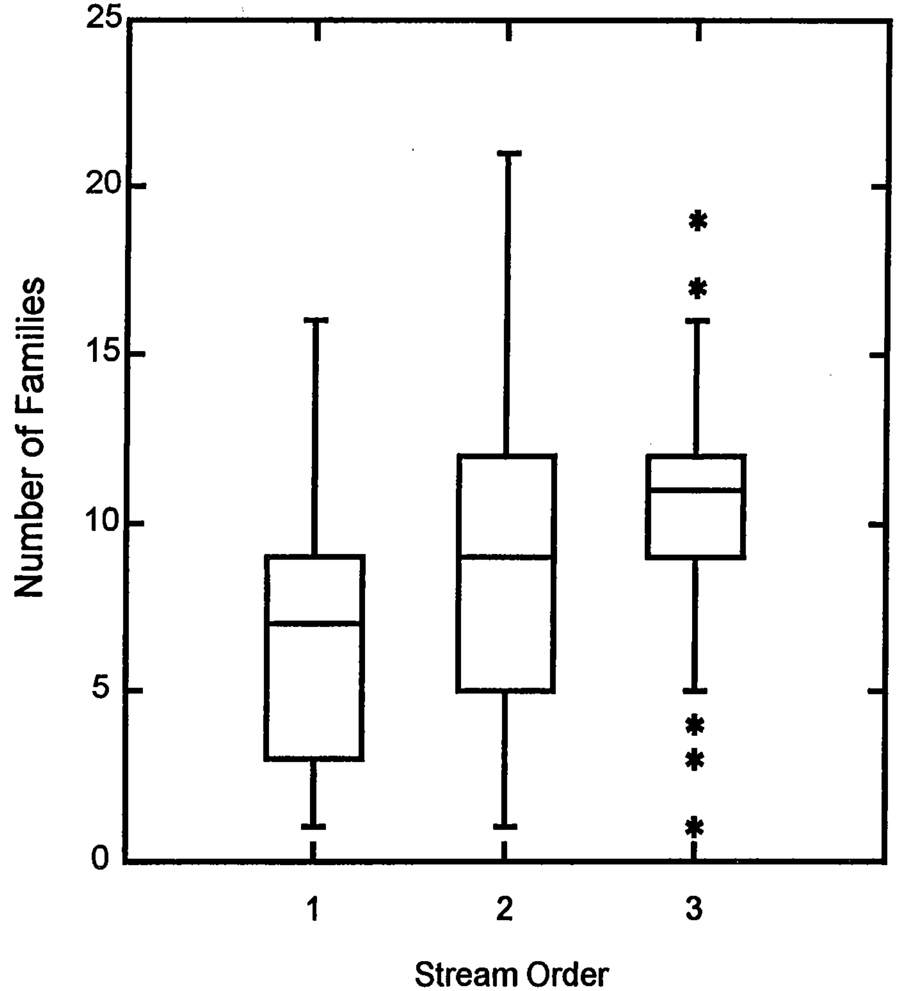


Figure 21
Comparison of the Number of Macroinvertebrate Families by Ecoregion for First Order Streams

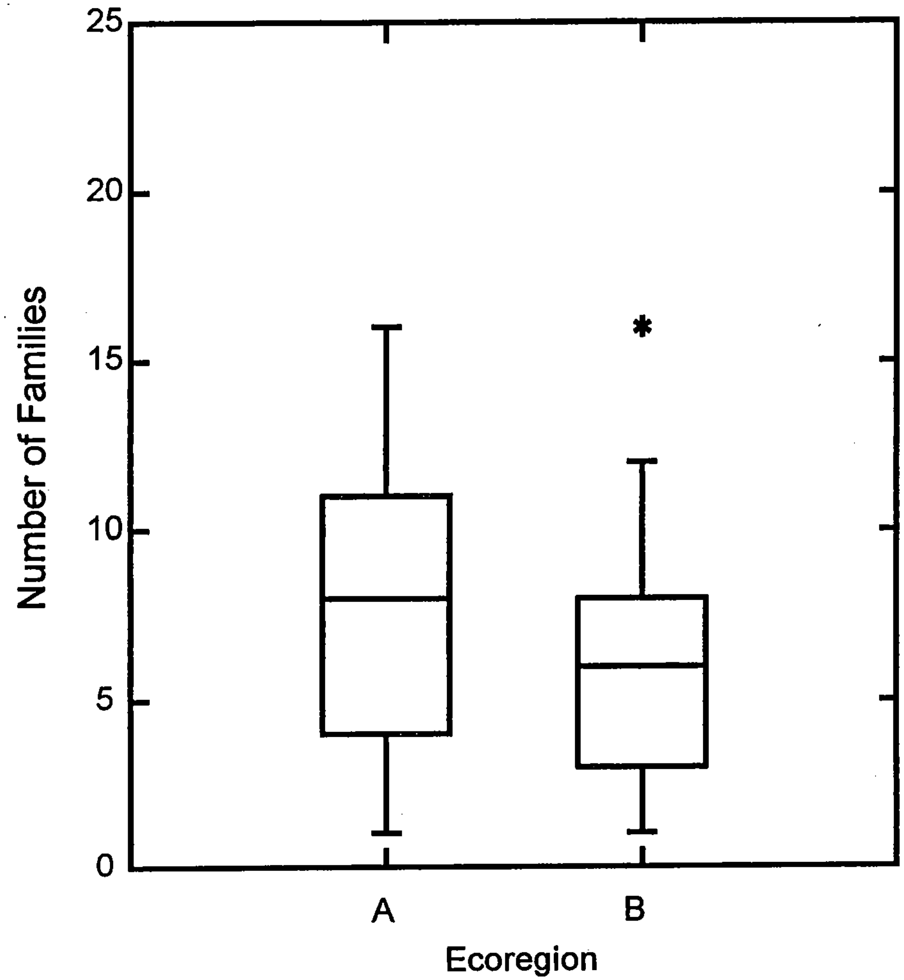


Figure 22
Comparison of the Number of Macroinvertebrate Families by Ecoregion for Second Order Streams

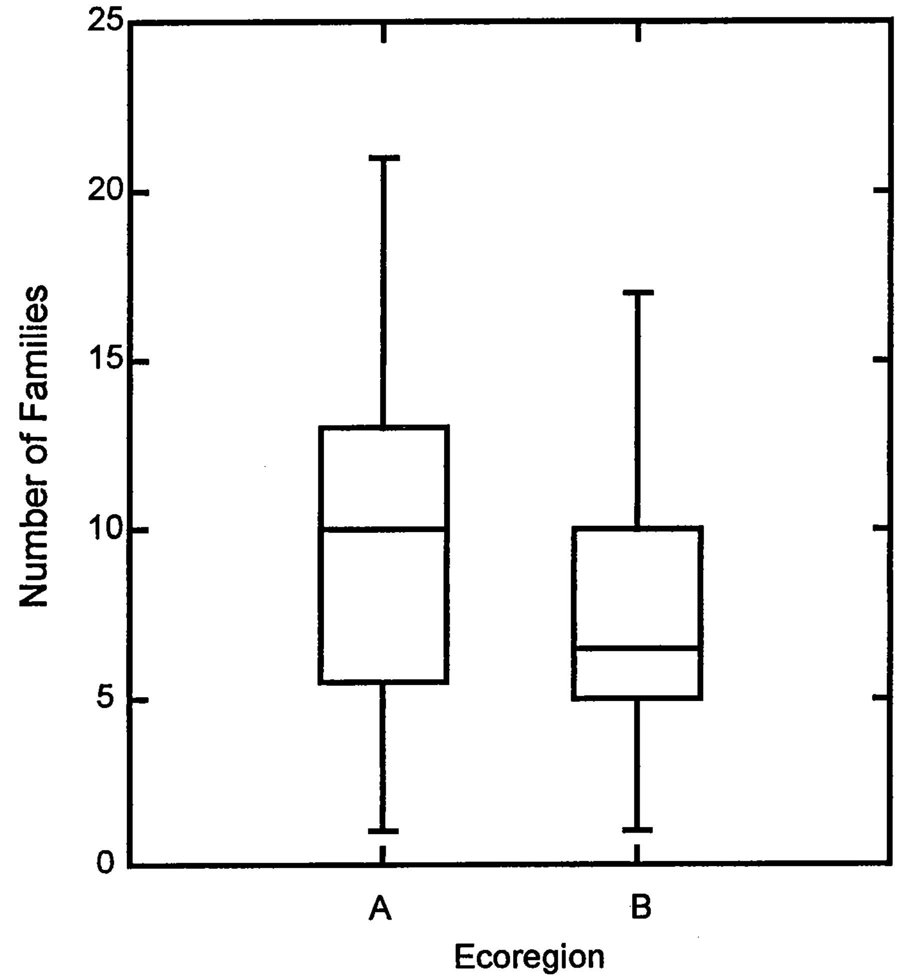


Figure 23
Comparison of the Number of Macroinvertebrate Families by Ecoregion for Third Order Streams

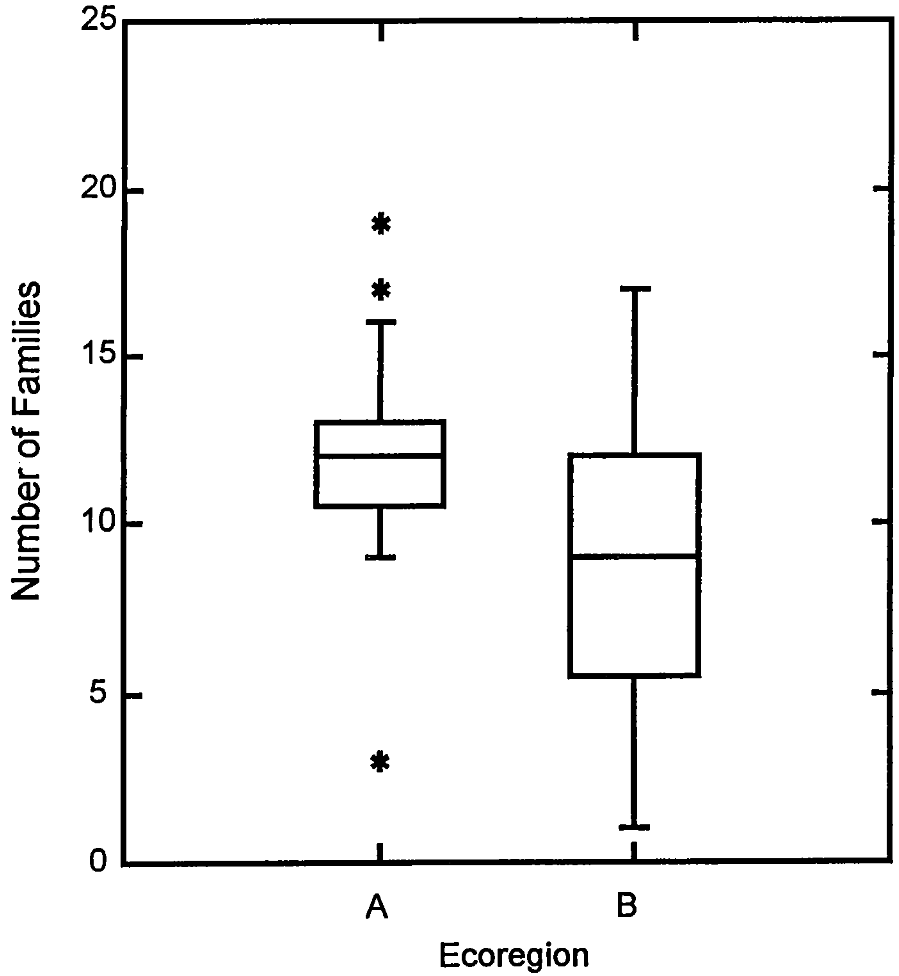


Figure 24
Comparison of the Number of Macroinvertebrate Families by Regional Project Watershed for First Order Streams

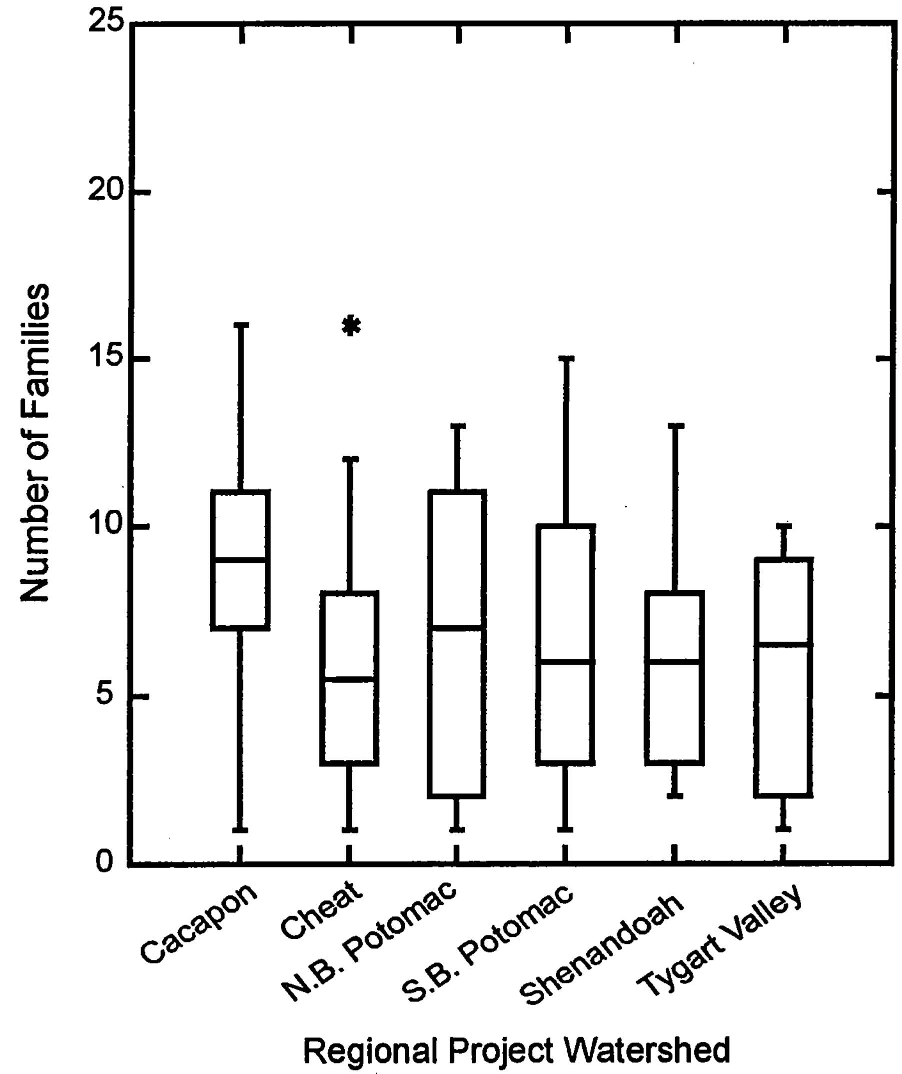


Figure 25
Comparison of the Number of Macroinvertebrate Families by Regional Project Watershed for Second Order Streams

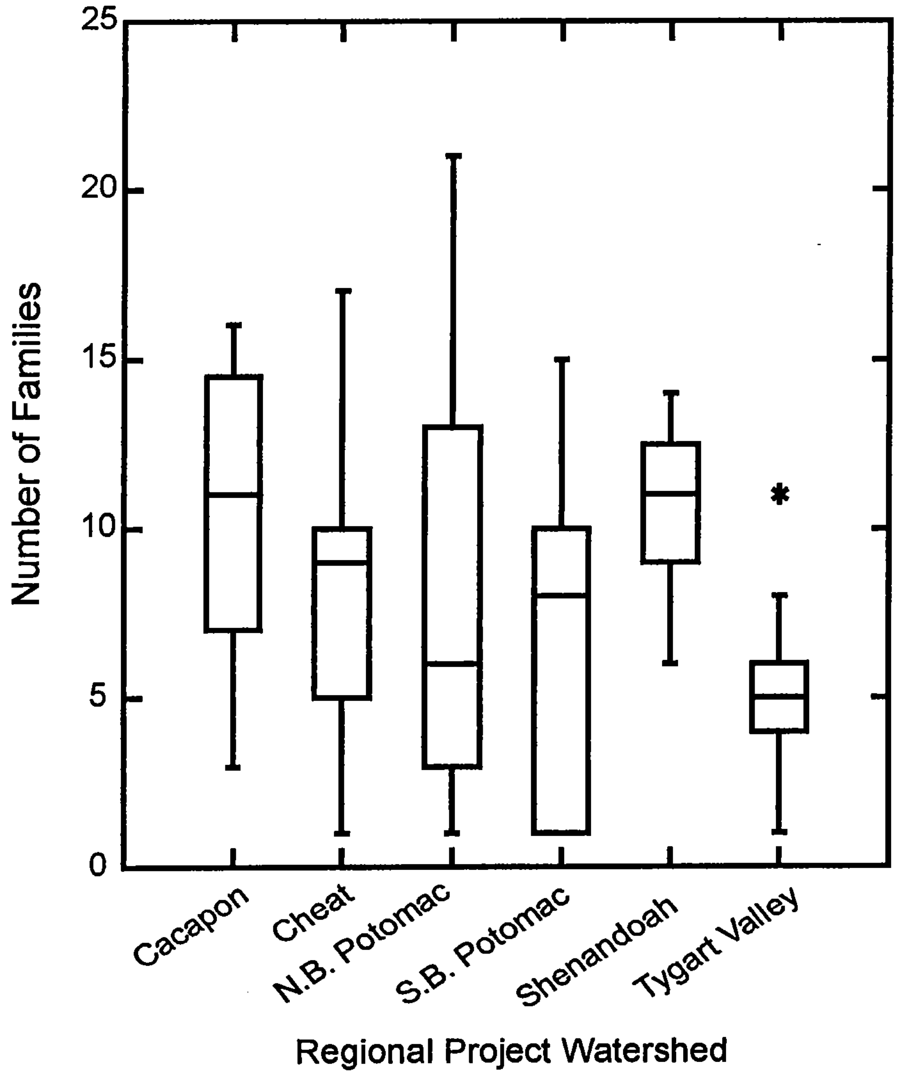


Figure 26
Comparison of the Number of Macroinvertebrate Families by Regional Project Watershed for Third Order Streams

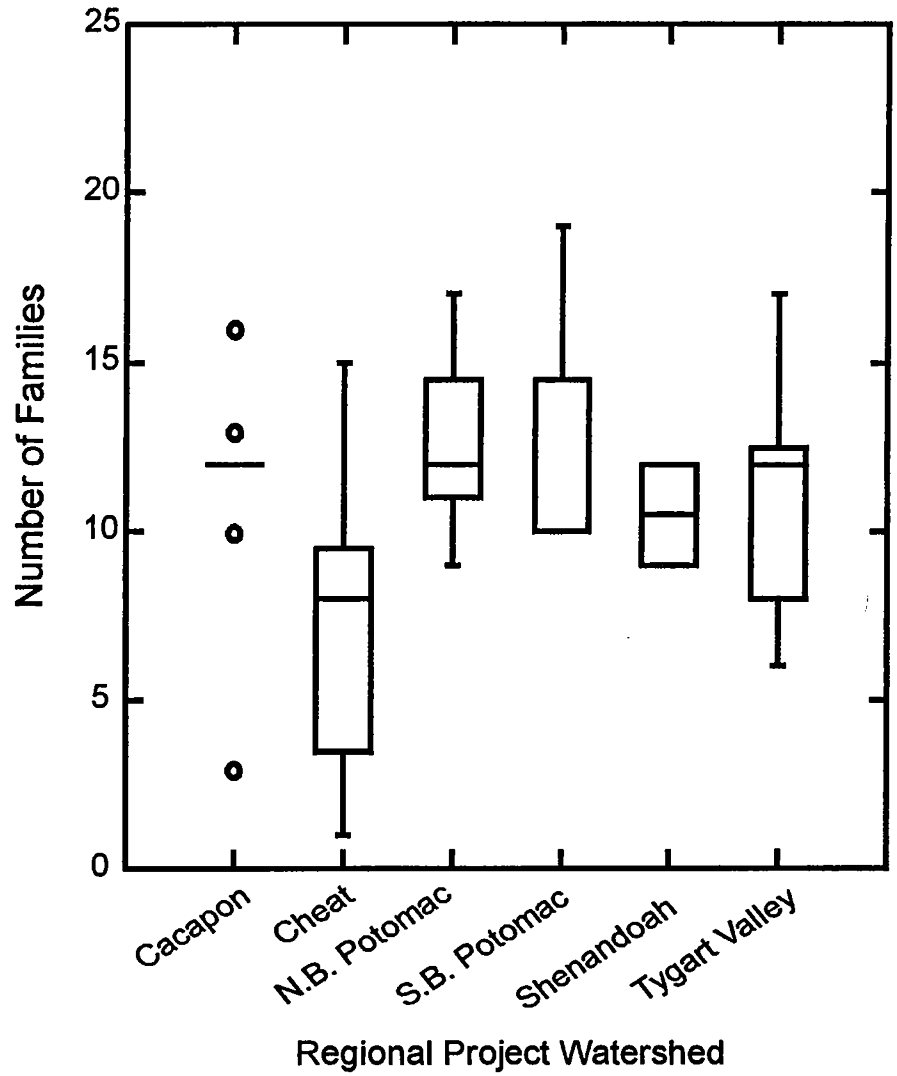


Figure 27
Comparison of Family Biotic Index by Ecoregion

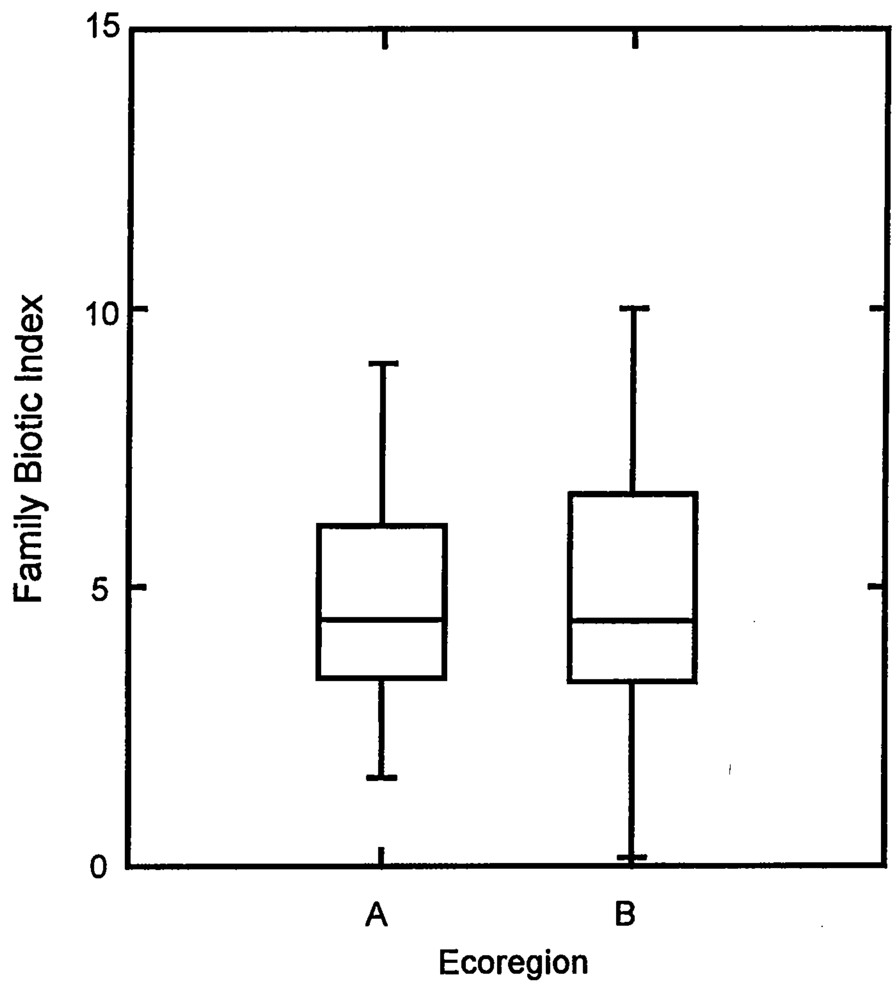


FIGURE 28
CLUSTERING OF FAMILY BIOTIC INDEX BY ECOREGIONS

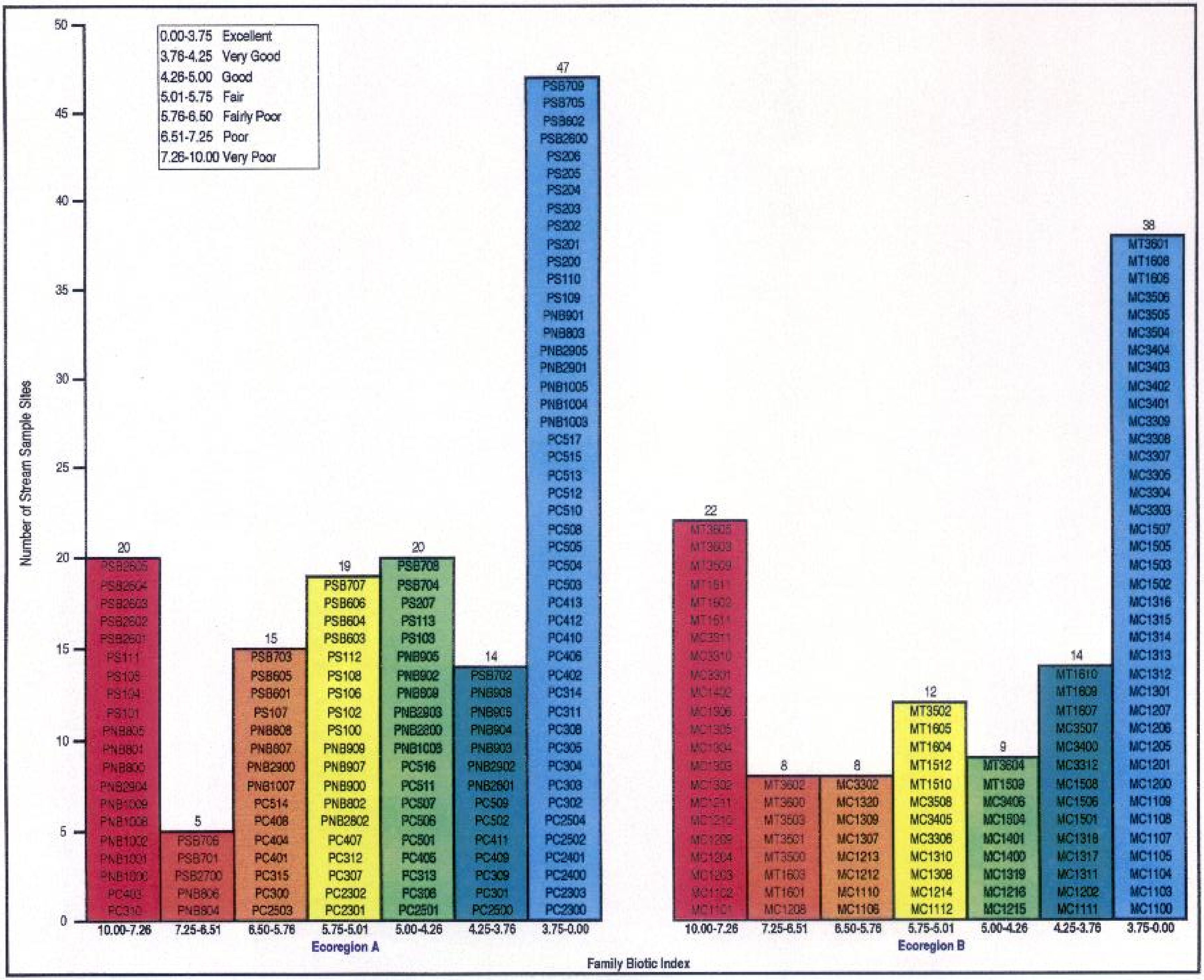


Figure 29
Comparison of Family Biotic Index by Regional Project Watershed

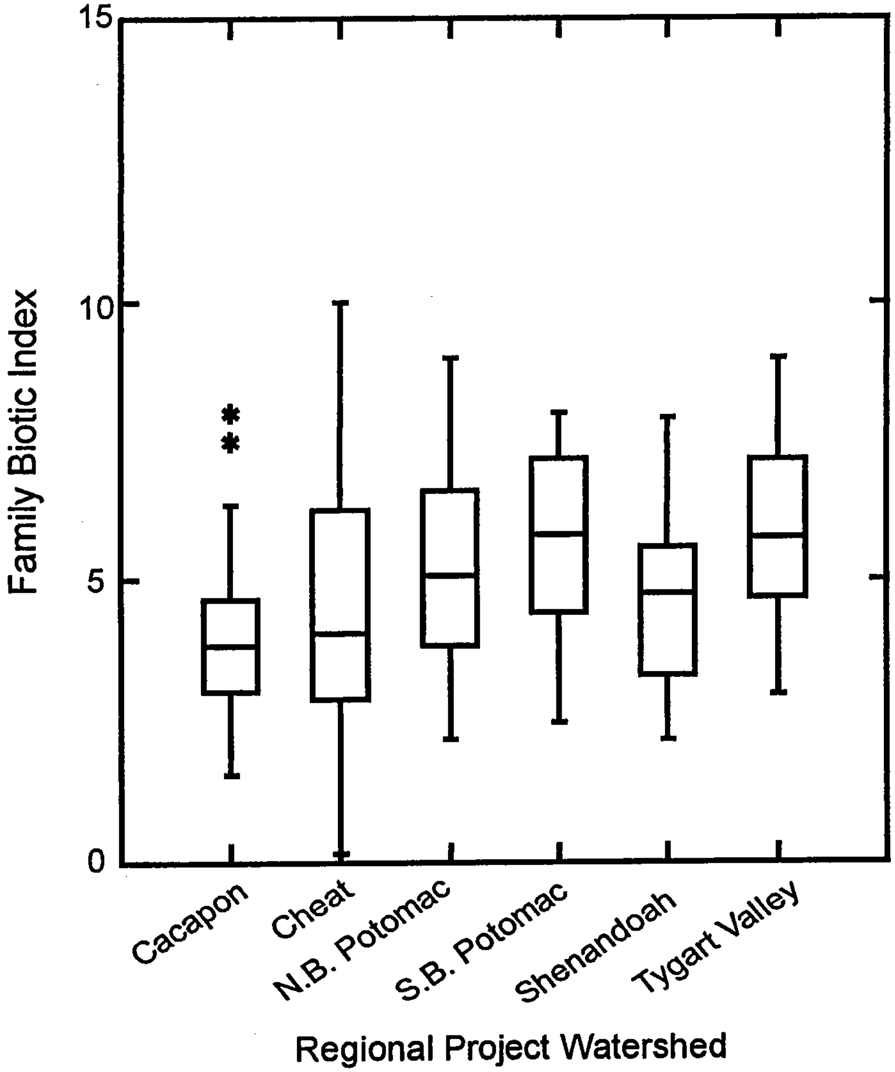


Figure 30
Comparison of Family Biotic Index by Local Project Watershed

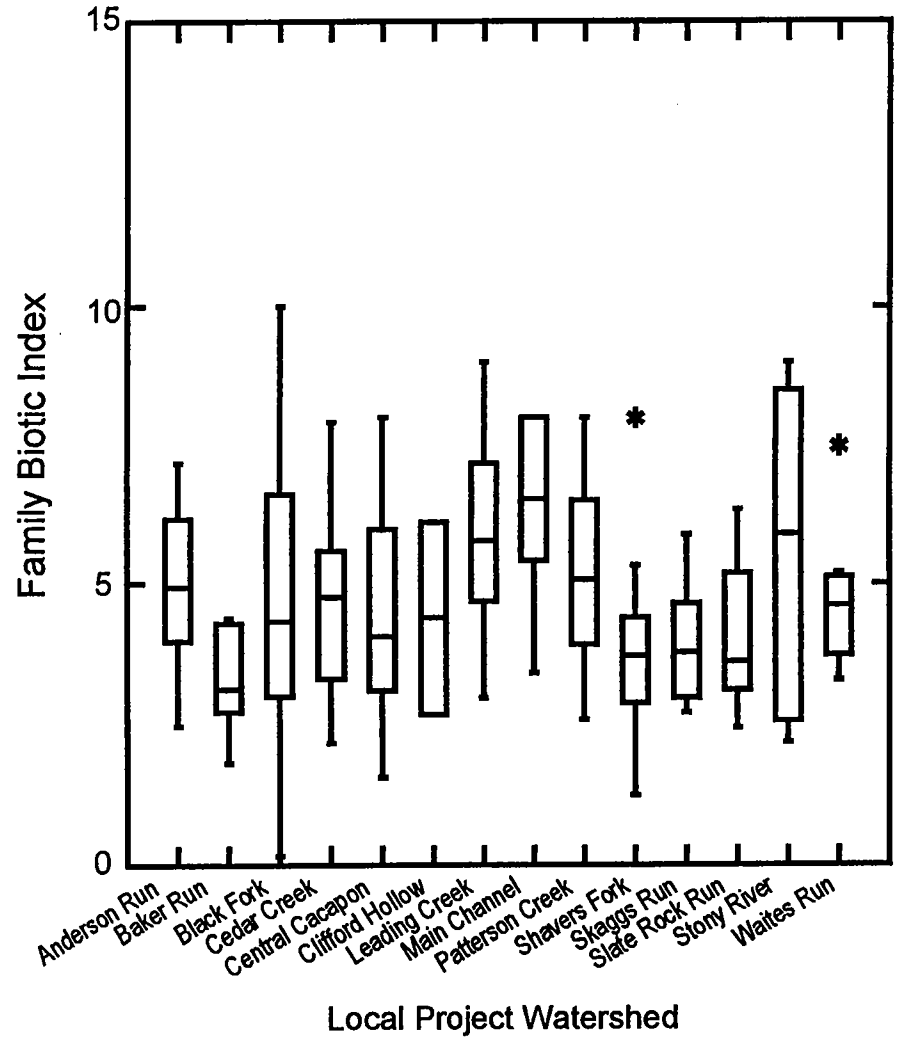


Figure 31
Comparison of Family Biotic Index by Stream Order

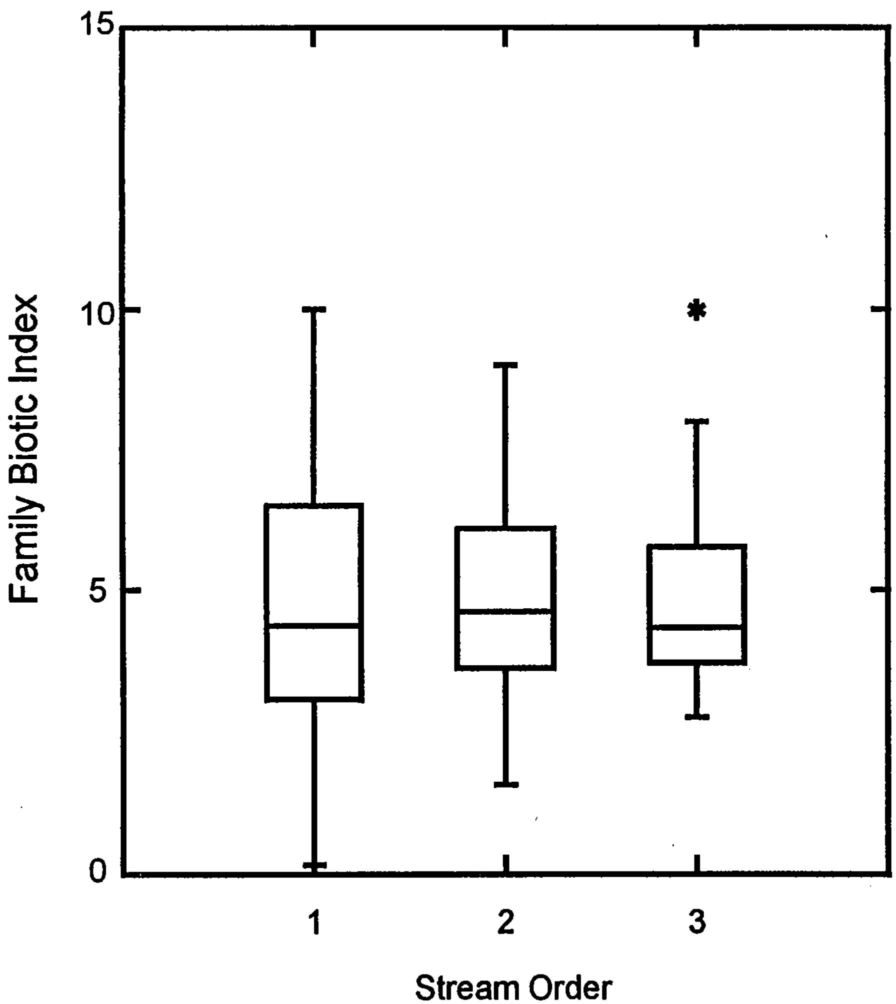


Figure 32
Comparison of Family Biotic Index by Ecoregion for First Order Stream

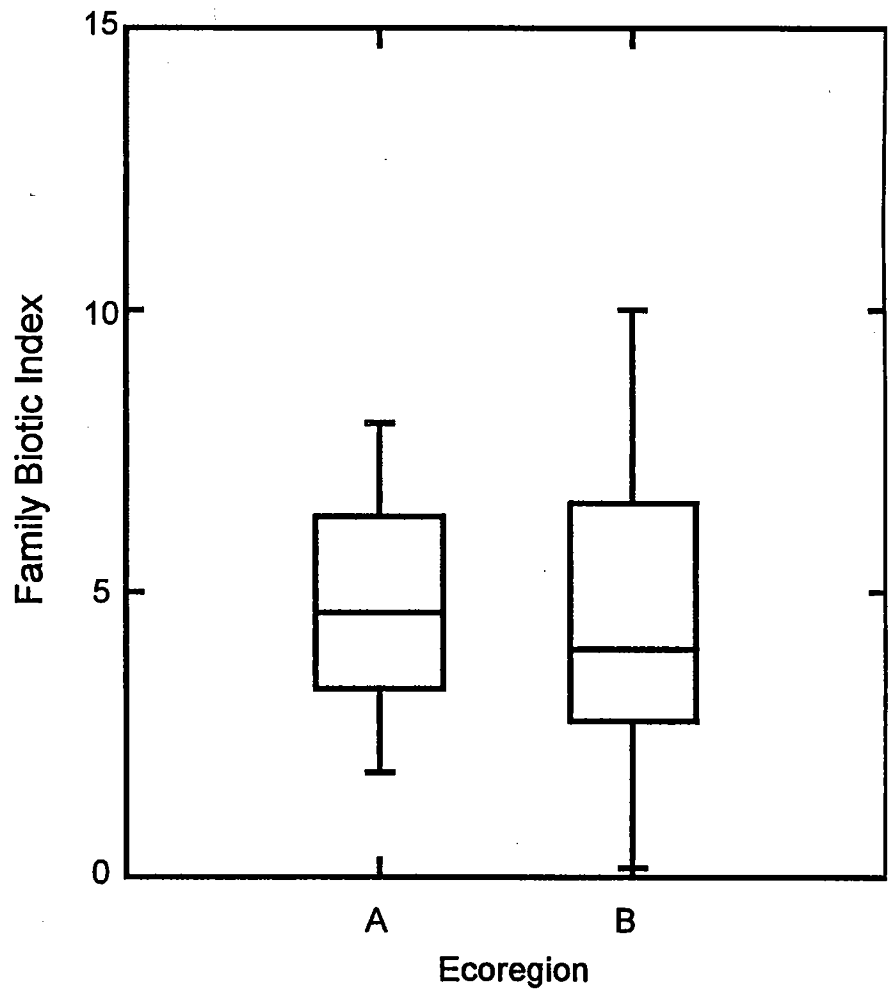


Figure 33
Comparison of Family Biotic Index by Ecoregion for Second Order Stream

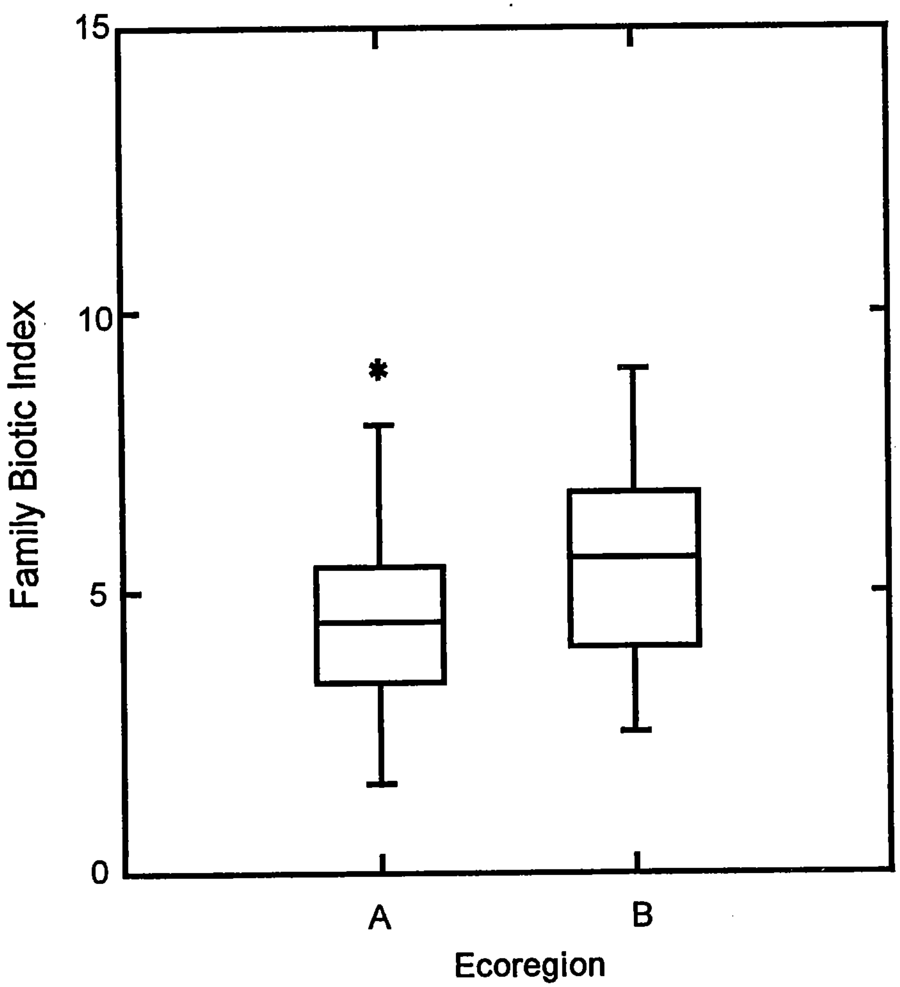


Figure 34
Comparison of Family Biotic Index by Ecoregion for Third Order Stream

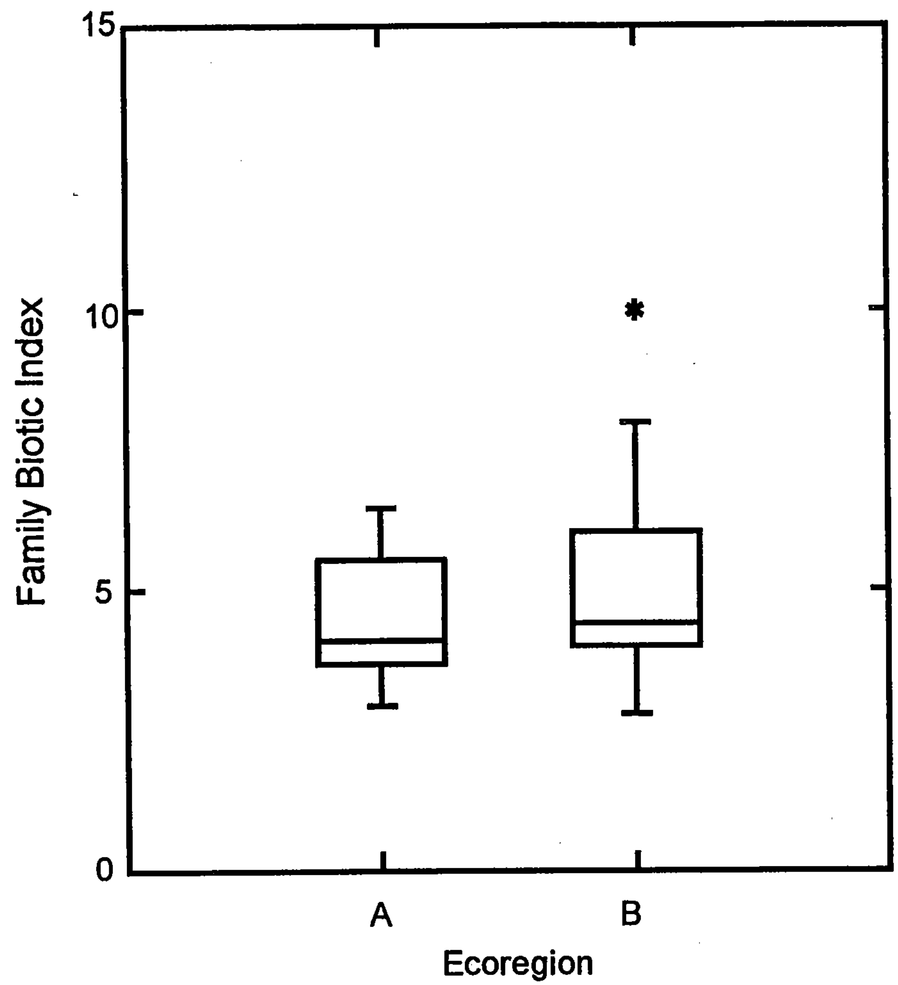


FIGURE 35
CLUSTERING OF FAMILY BIOTIC INDEX BY REGIONAL PROJECT WATERSHED

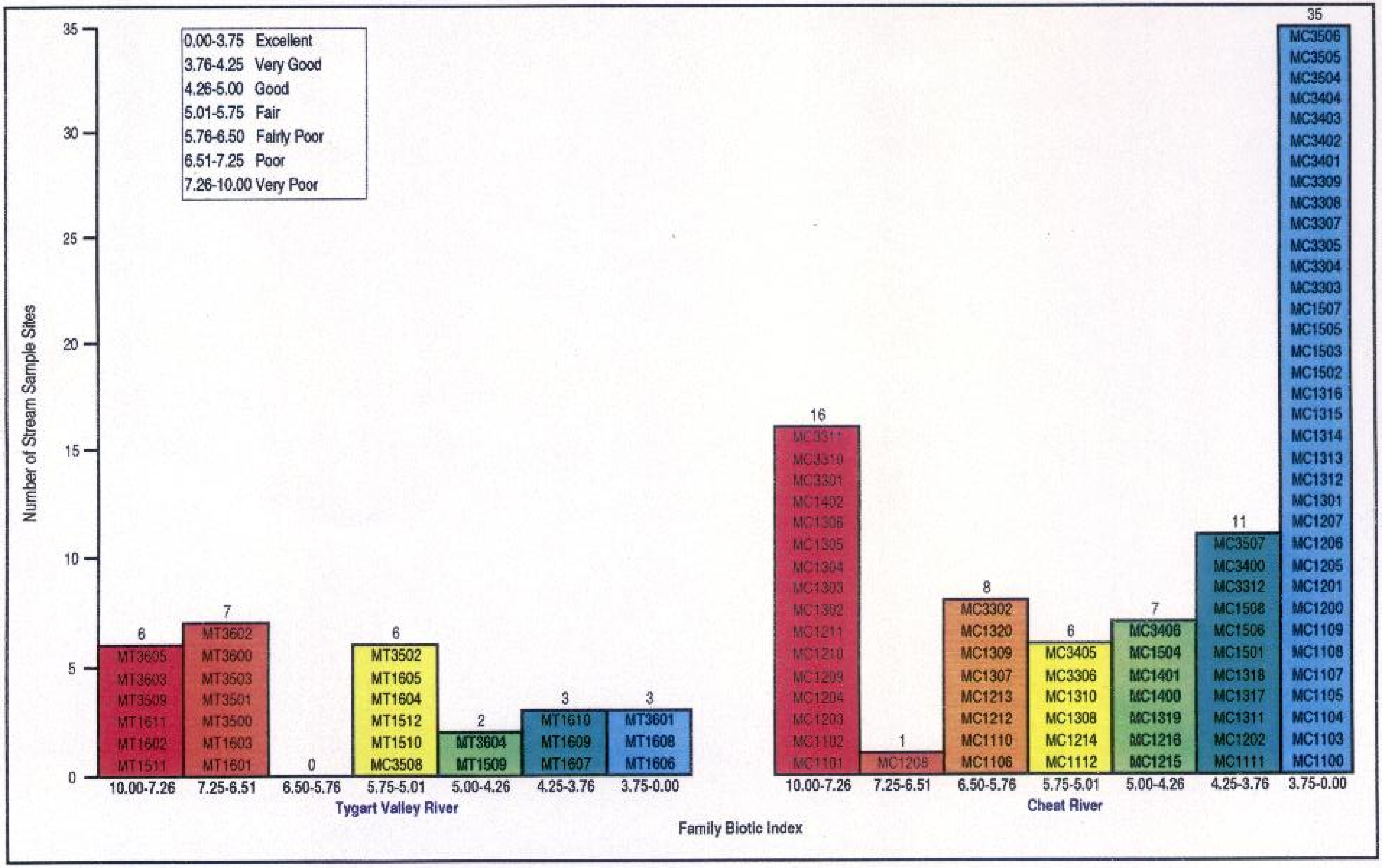


FIGURE 35
CLUSTERING OF FAMILY BIOTIC INDEX BY REGIONAL PROJECT WATERSHED

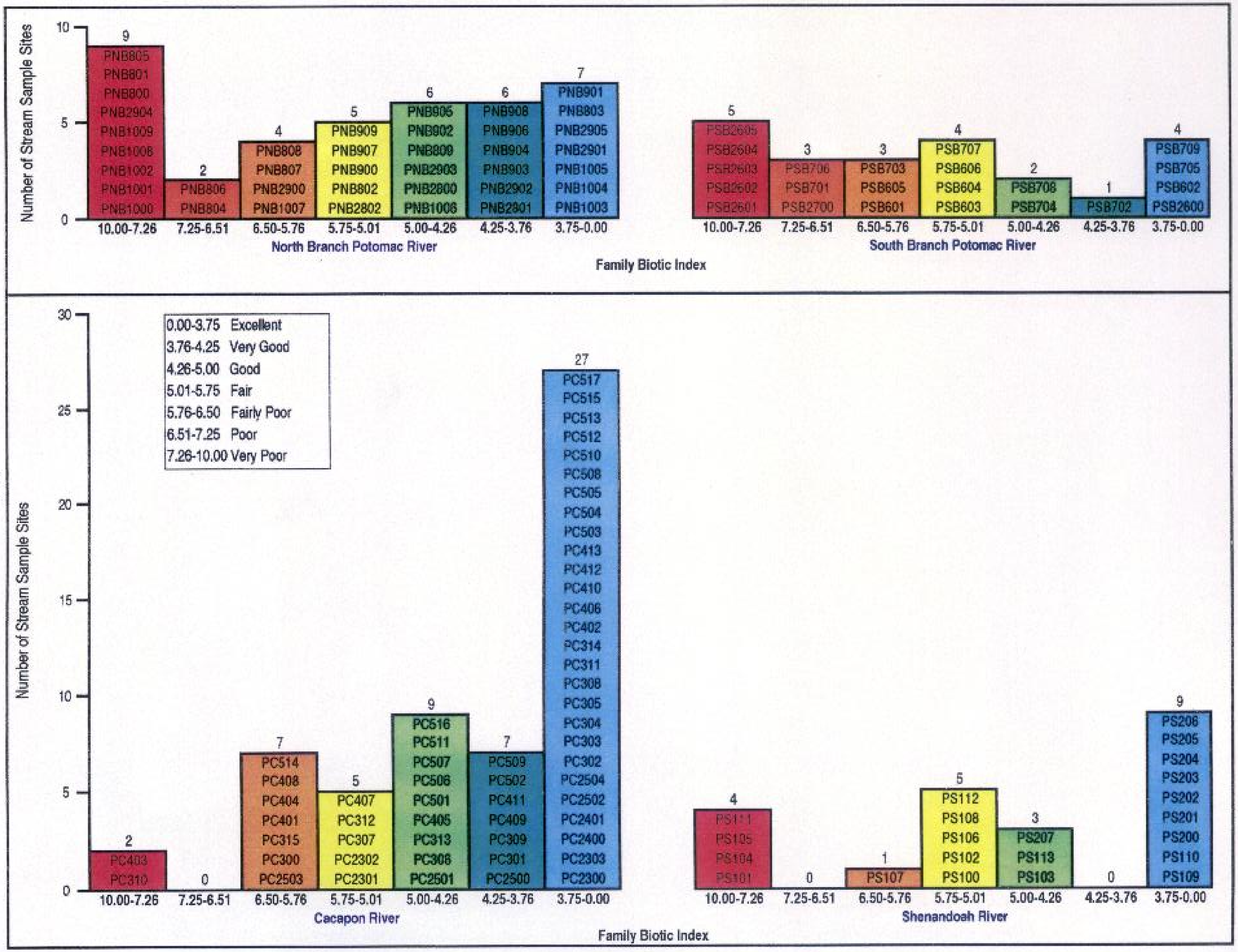


FIGURE 36
CLUSTERING OF FAMILY BIOTIC INDEX BY LOCAL PROJECT WATERSHED

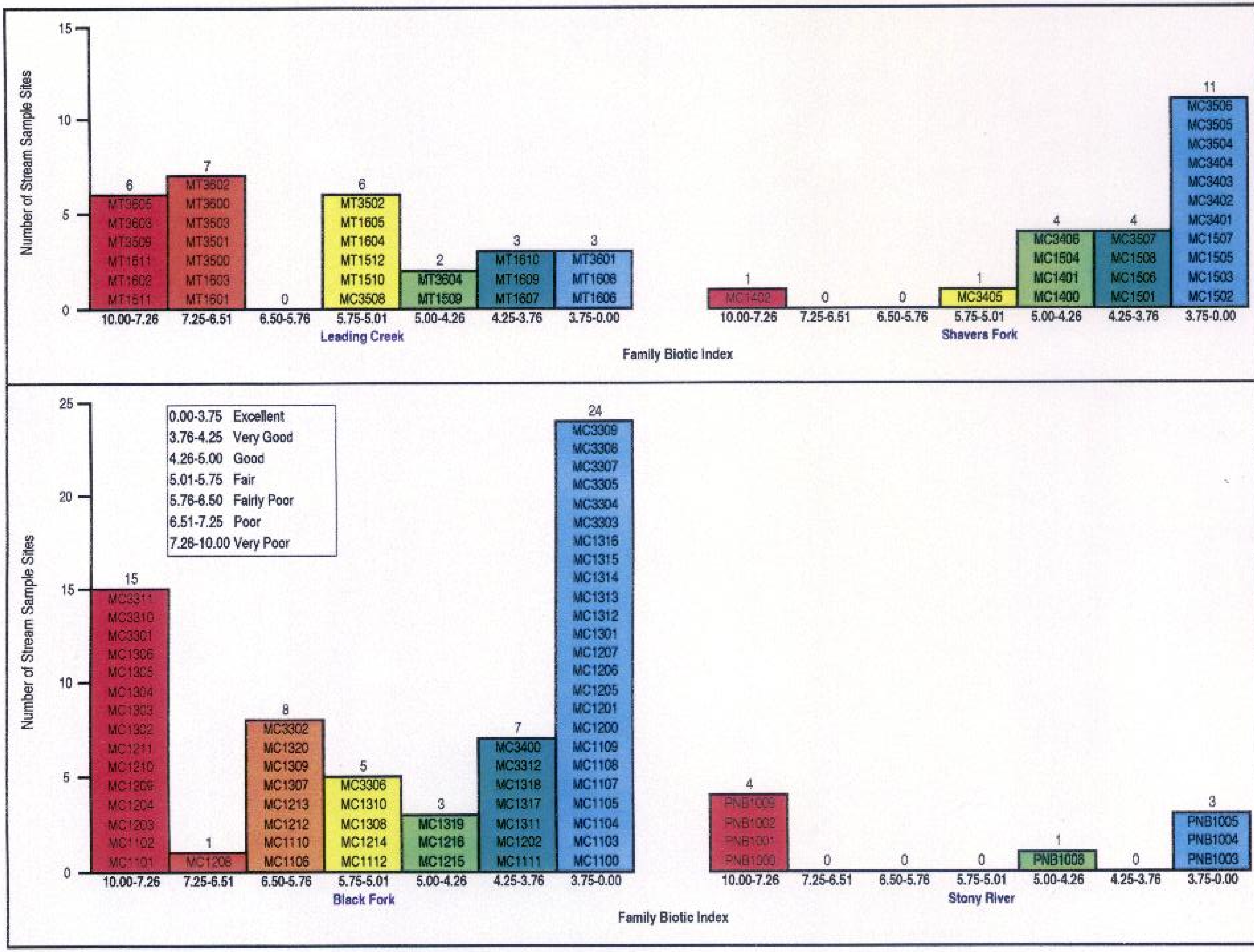


FIGURE 36
CLUSTERING OF FAMILY BIOTIC INDEX BY LOCAL PROJECT WATERSHED

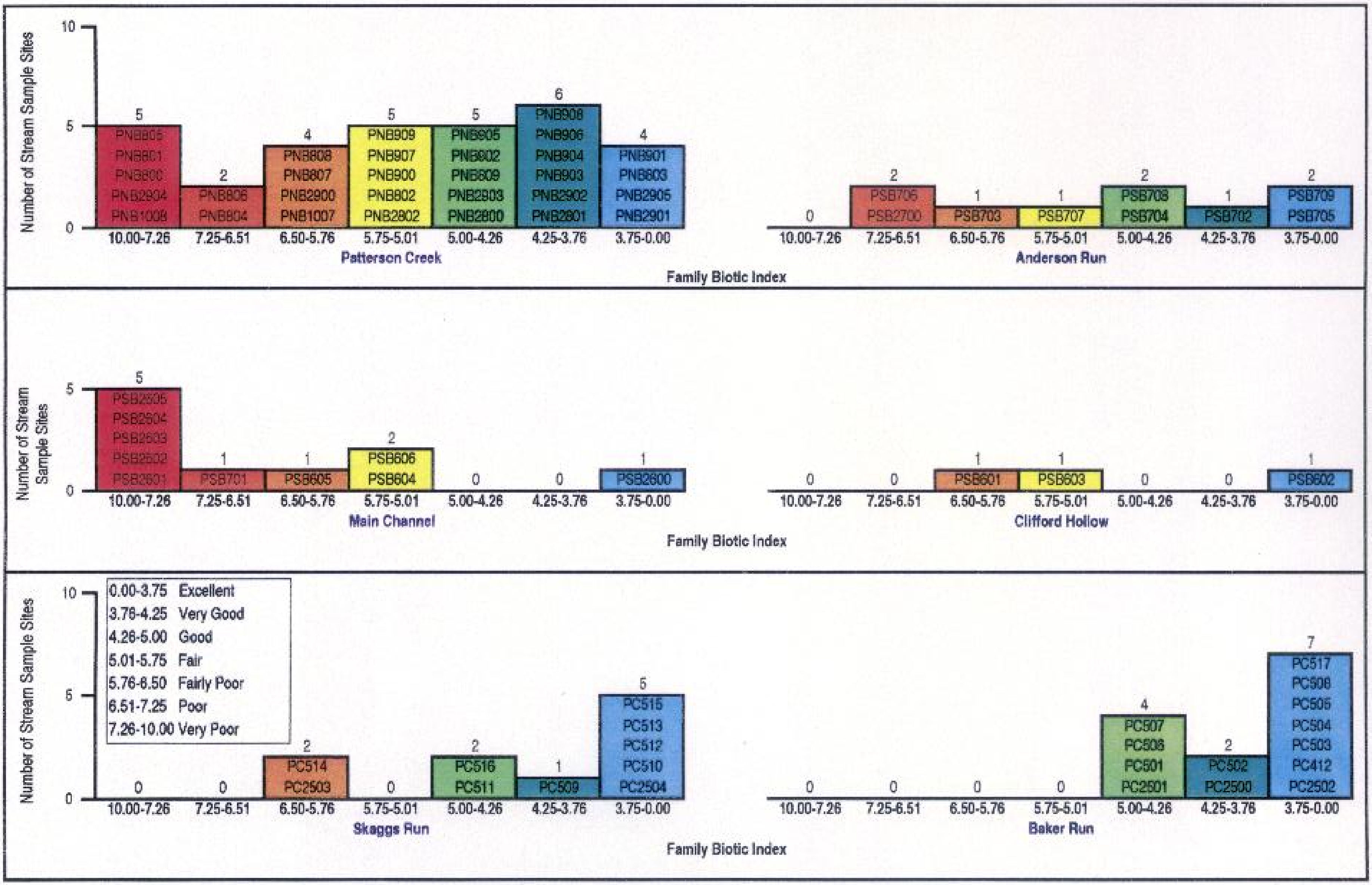


FIGURE 36
CLUSTERING OF FAMILY BIOTIC INDEX BY LOCAL PROJECT WATERSHED

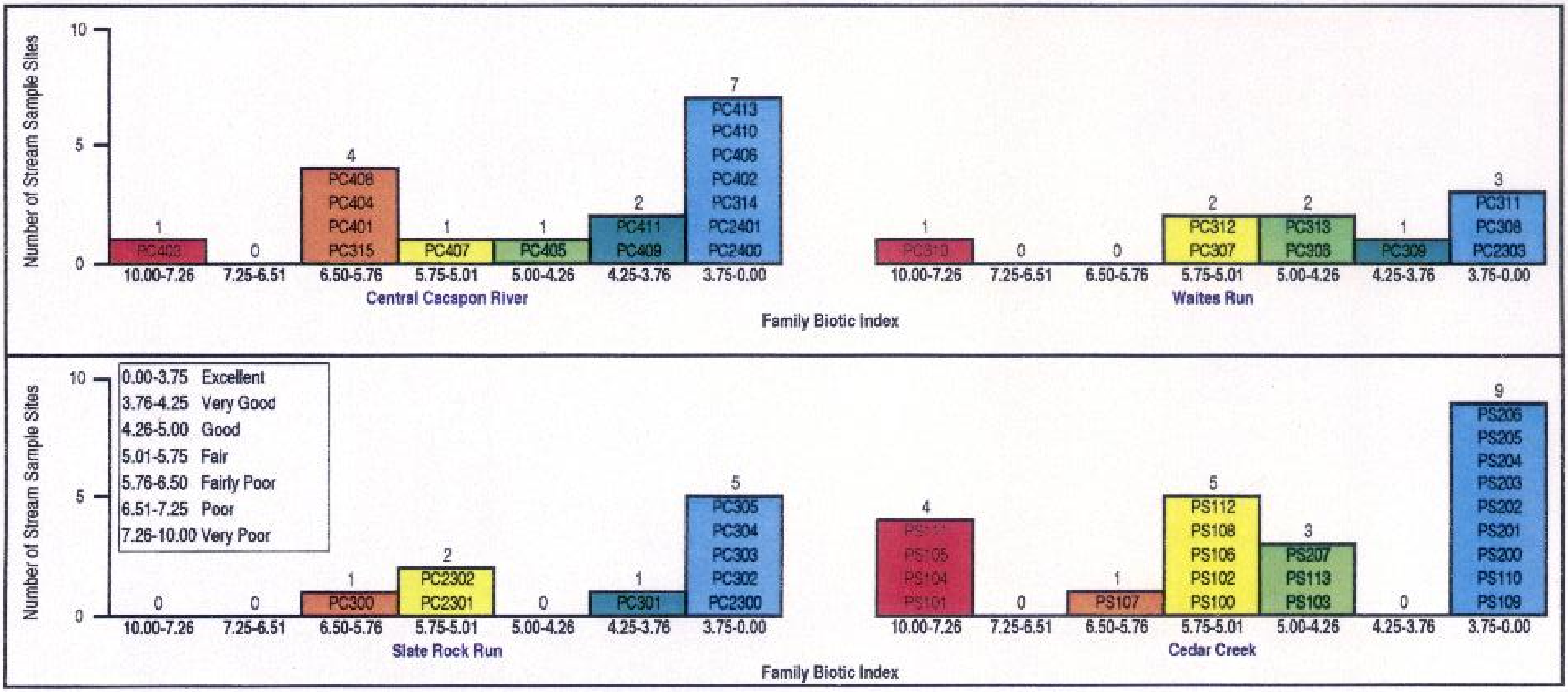


FIGURE 37
CLUSTERING OF FAMILY BIOTIC INDEX BY STREAM ORDER

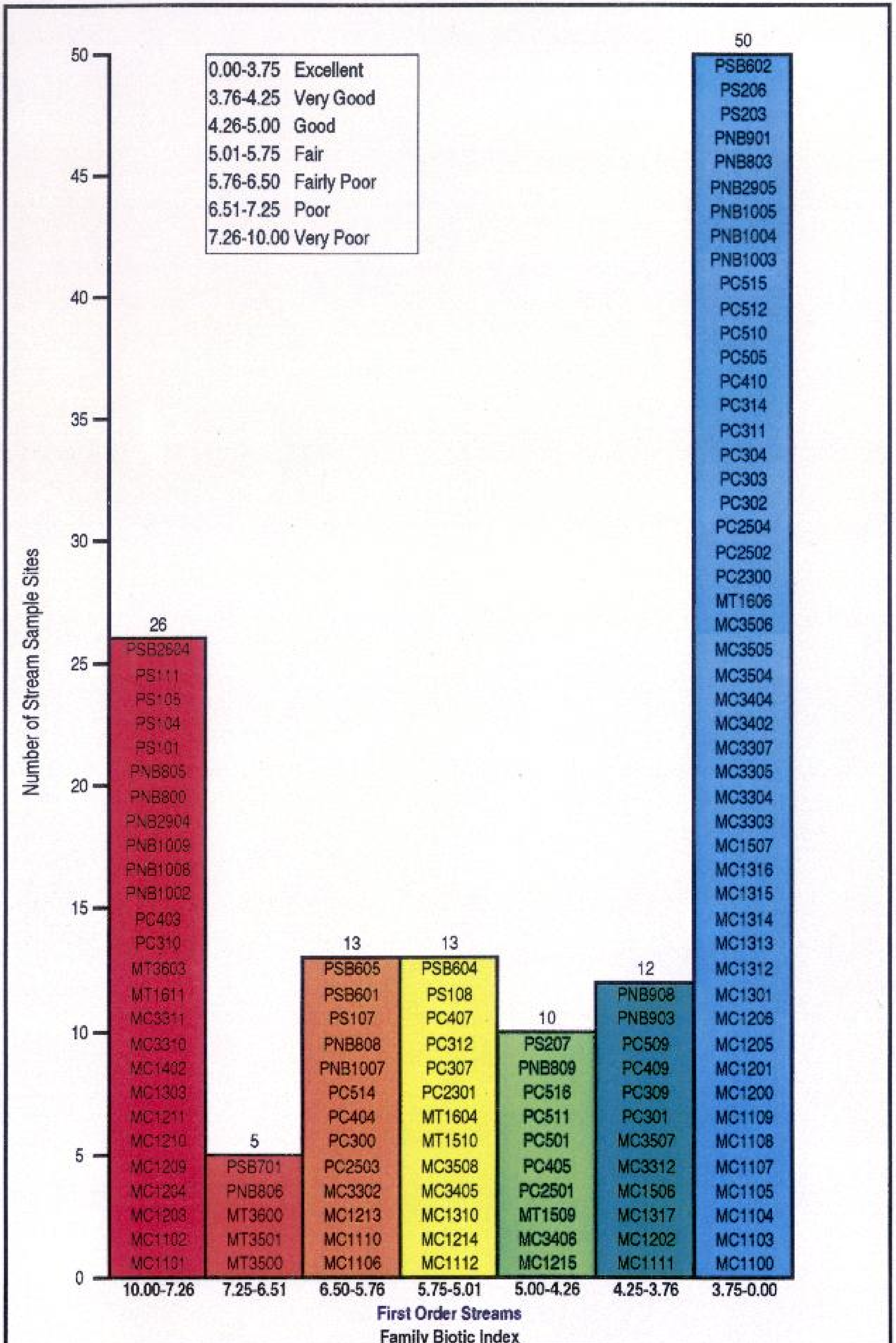


FIGURE 37
CLUSTERING OF FAMILY BIOTIC INDEX BY STREAM ORDER

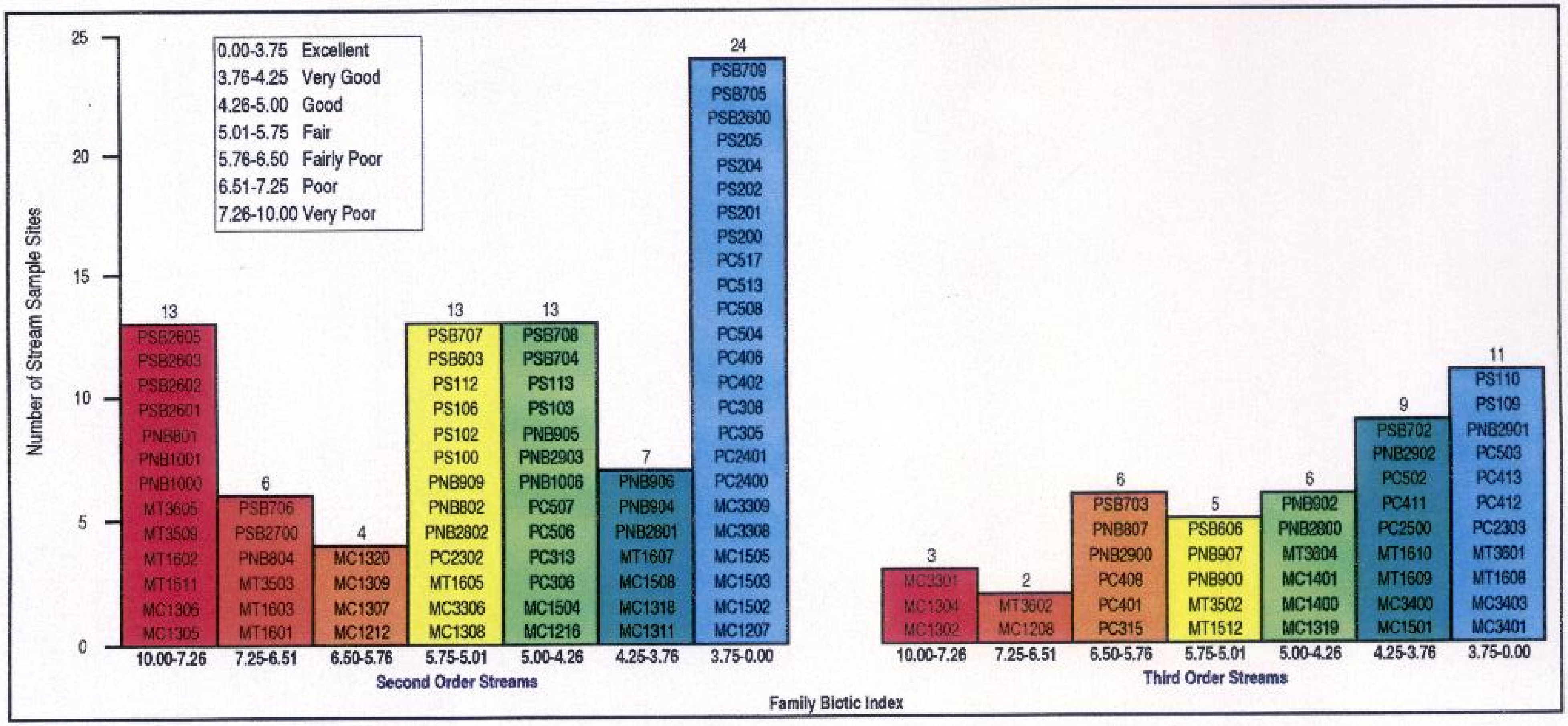


FIGURE 38
CLUSTERING OF FAMILY BIOTIC INDEX BY ECOREGION AND STREAM ORDER

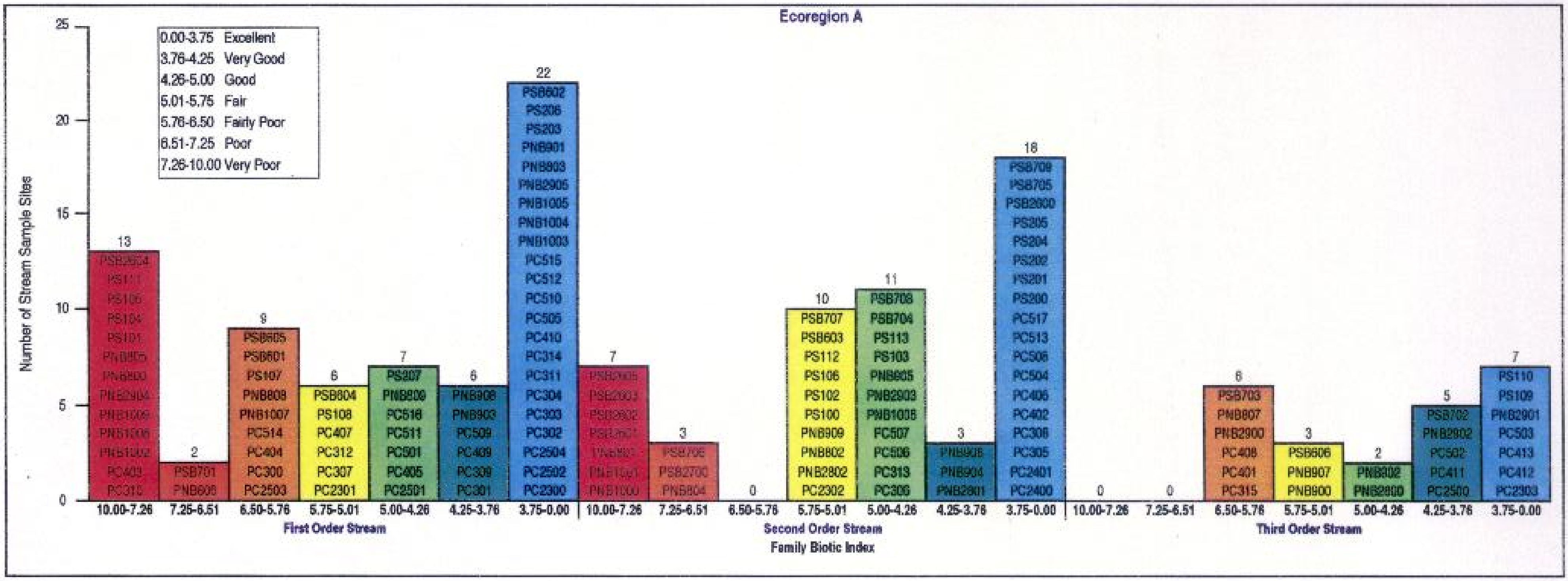


FIGURE 38
CLUSTERING OF FAMILY BIOTIC INDEX BY ECOREGION AND STREAM ORDER

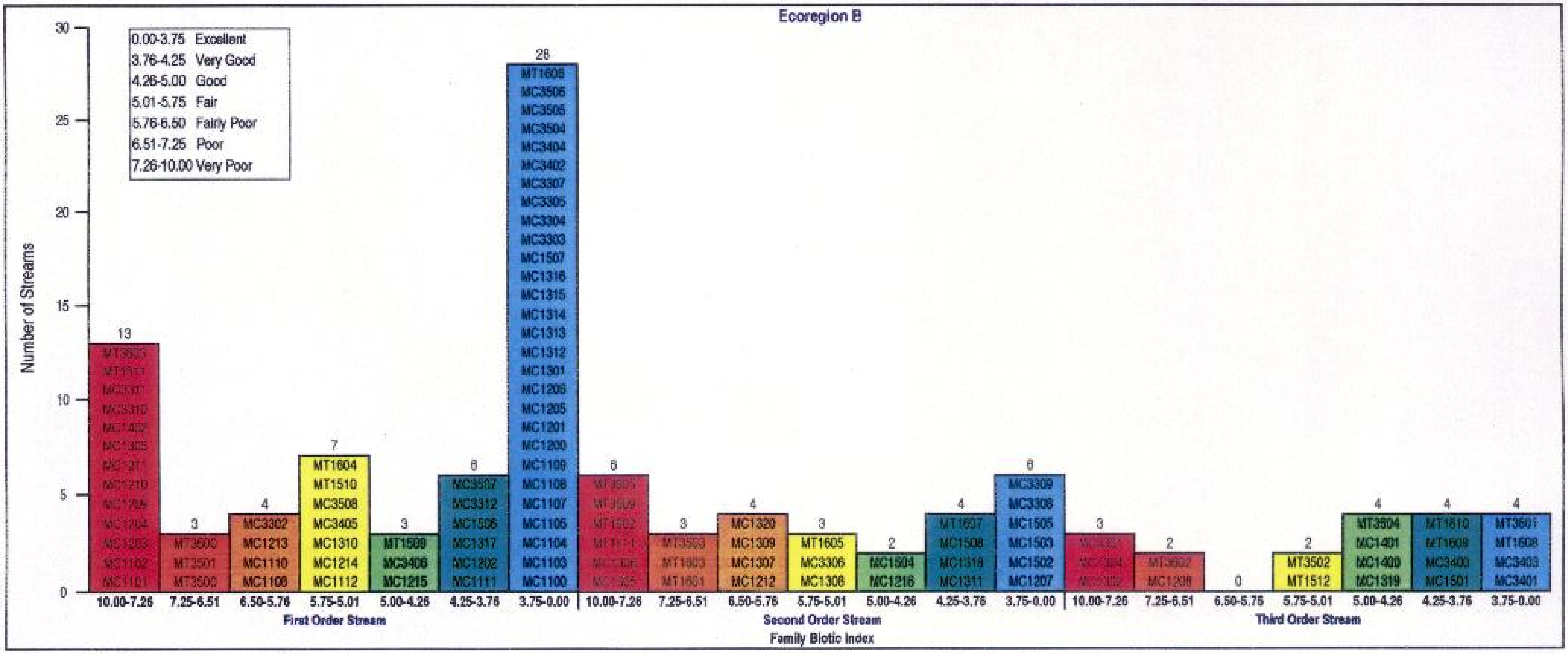


Figure 39
Comparison of Family Biotic Index by Regional Project Watershed for First Order Streams

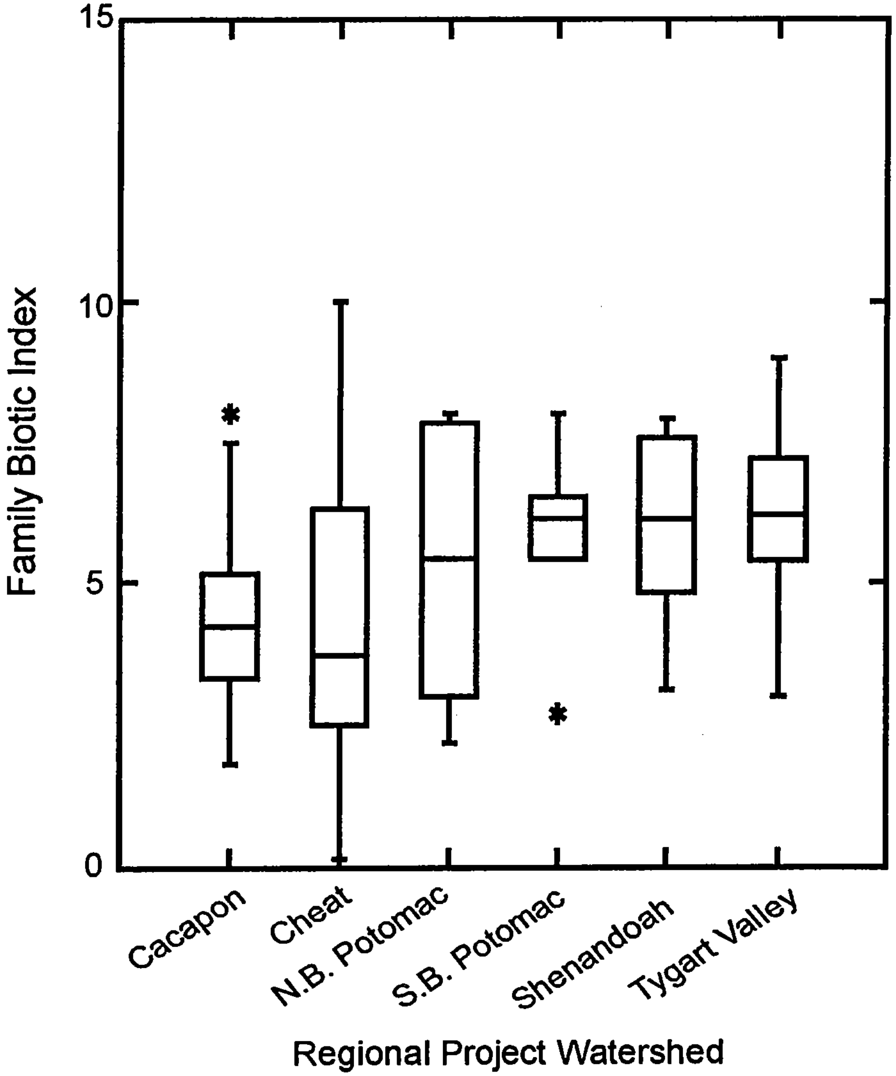


Figure 40
Comparison of Family Biotic Index by Regional Project Watershed for Second Order Streams

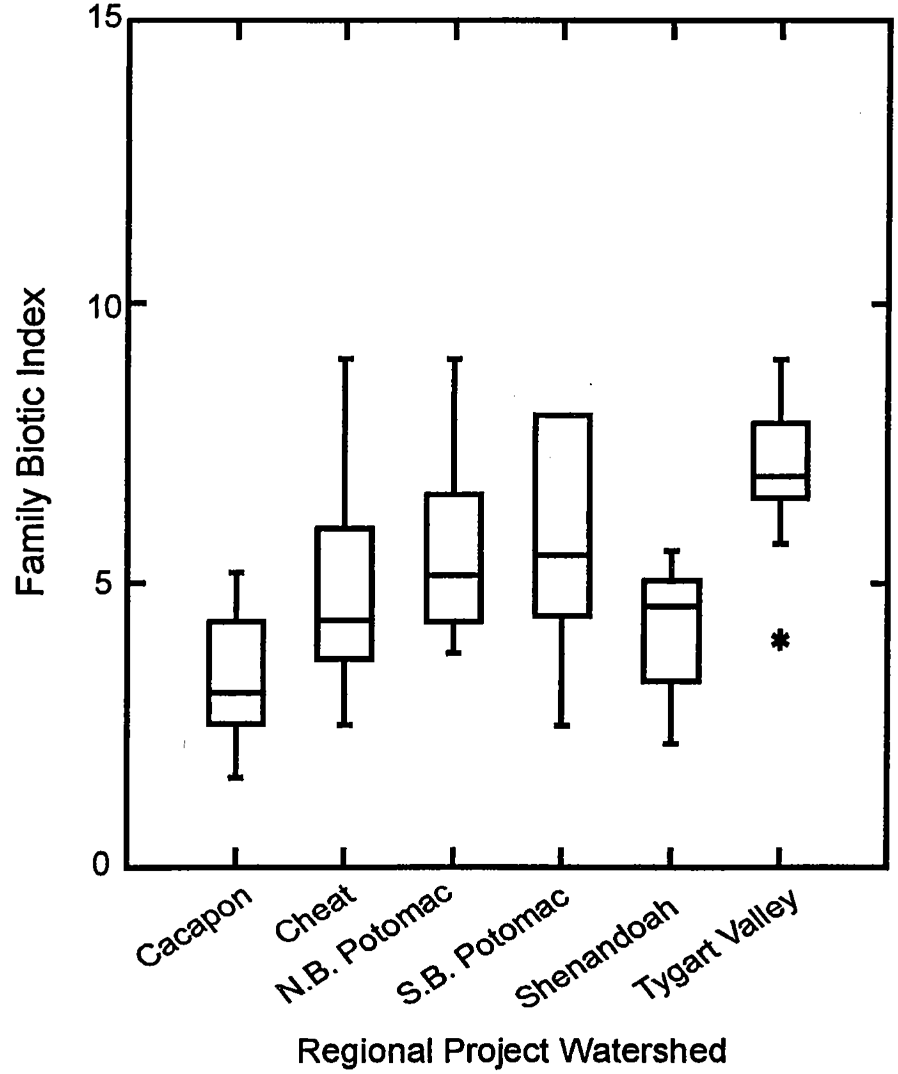


Figure 41
Comparison of Family Biotic Index by Regional Project Watershed for Third Order Streams

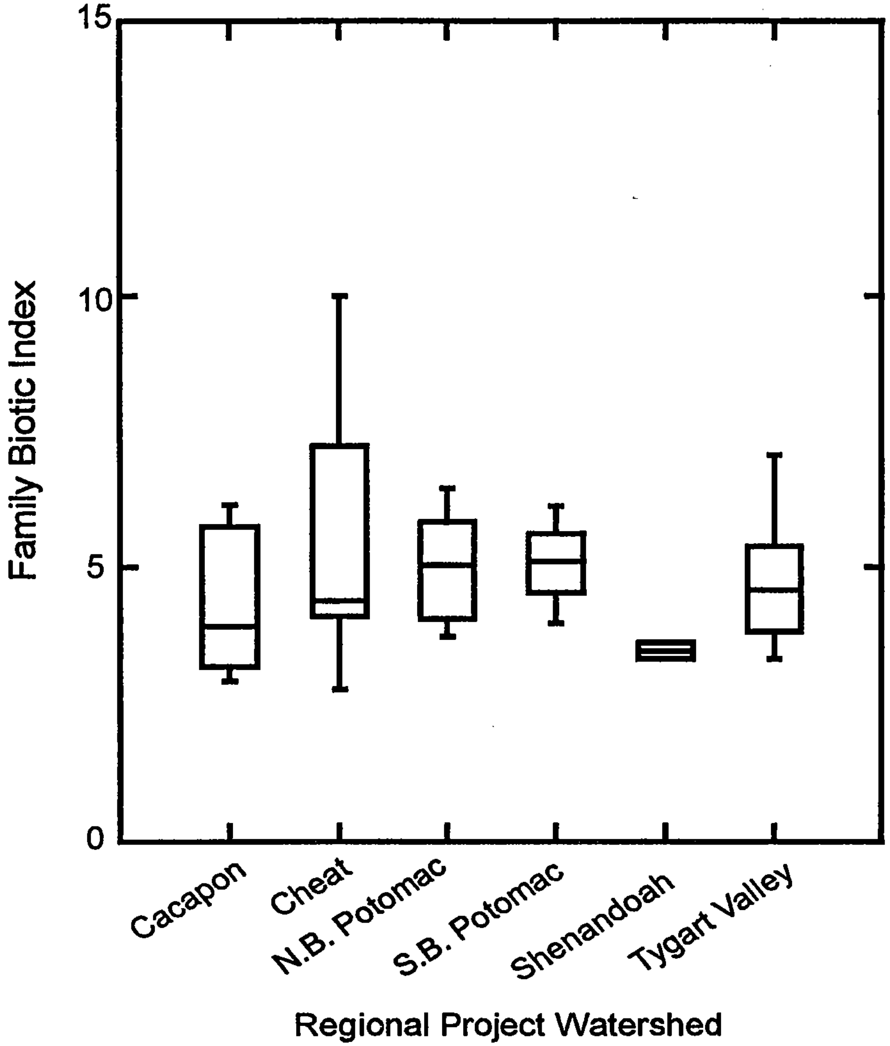


FIGURE 42

CLUSTERING OF FAMILY BIOTIC INDEX BY REGIONAL PROJECT WATERSHED AND STREAM ORDER

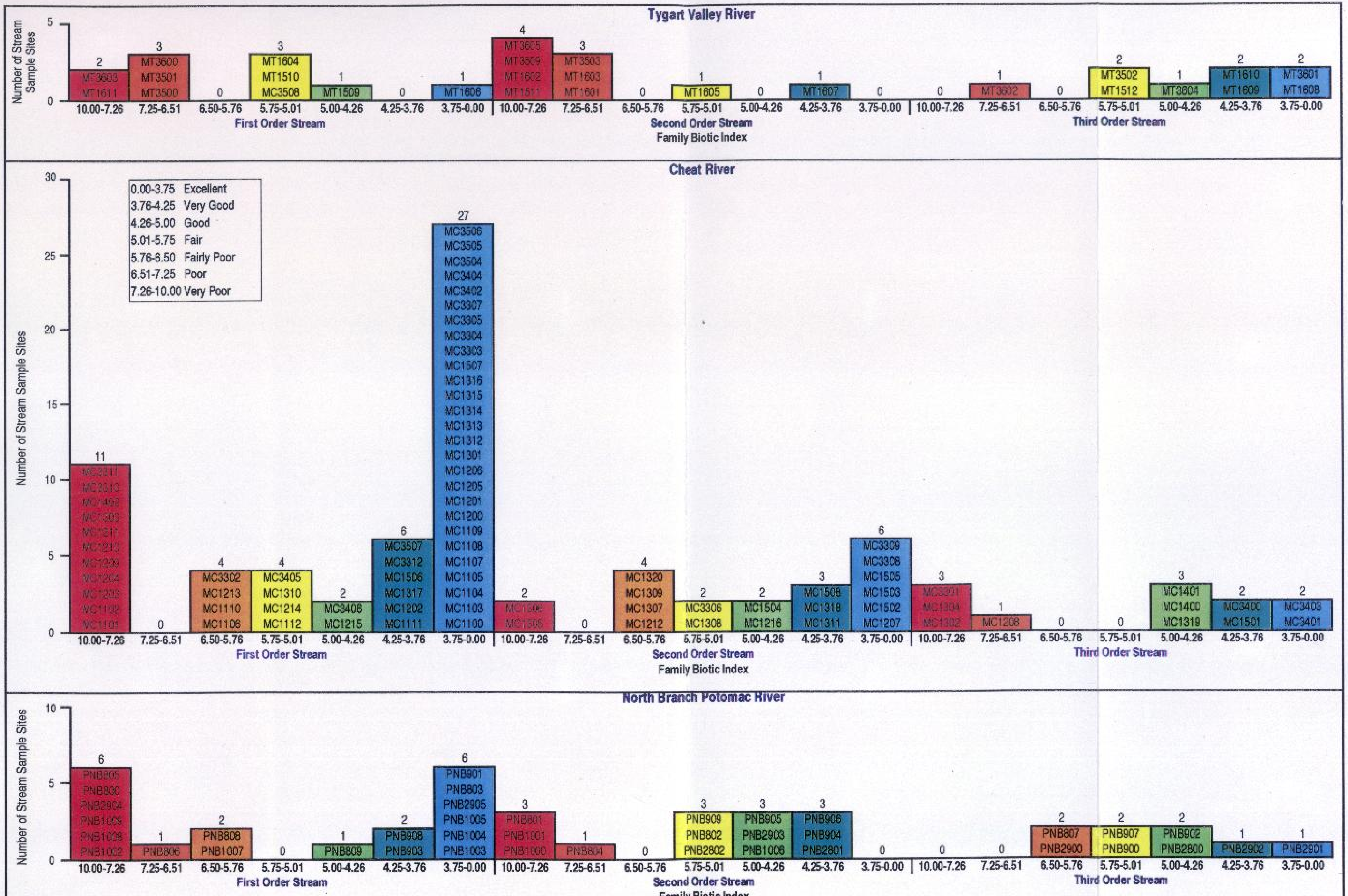


FIGURE 42
CLUSTERING OF FAMILY BIOTIC INDEX BY REGIONAL PROJECT WATERSHED AND STREAM ORDER

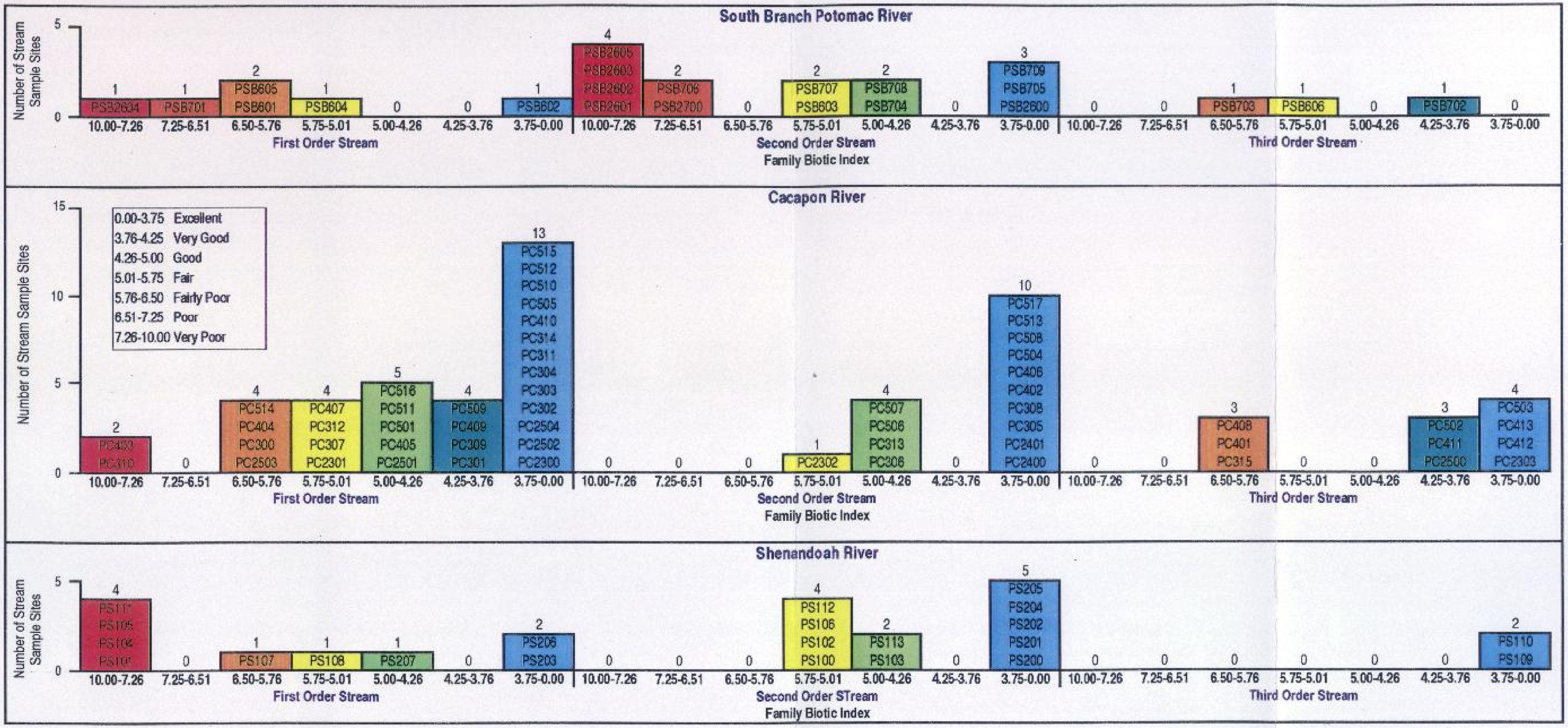


Figure 43
Comparison of Biotic Integrity by Ecoregion

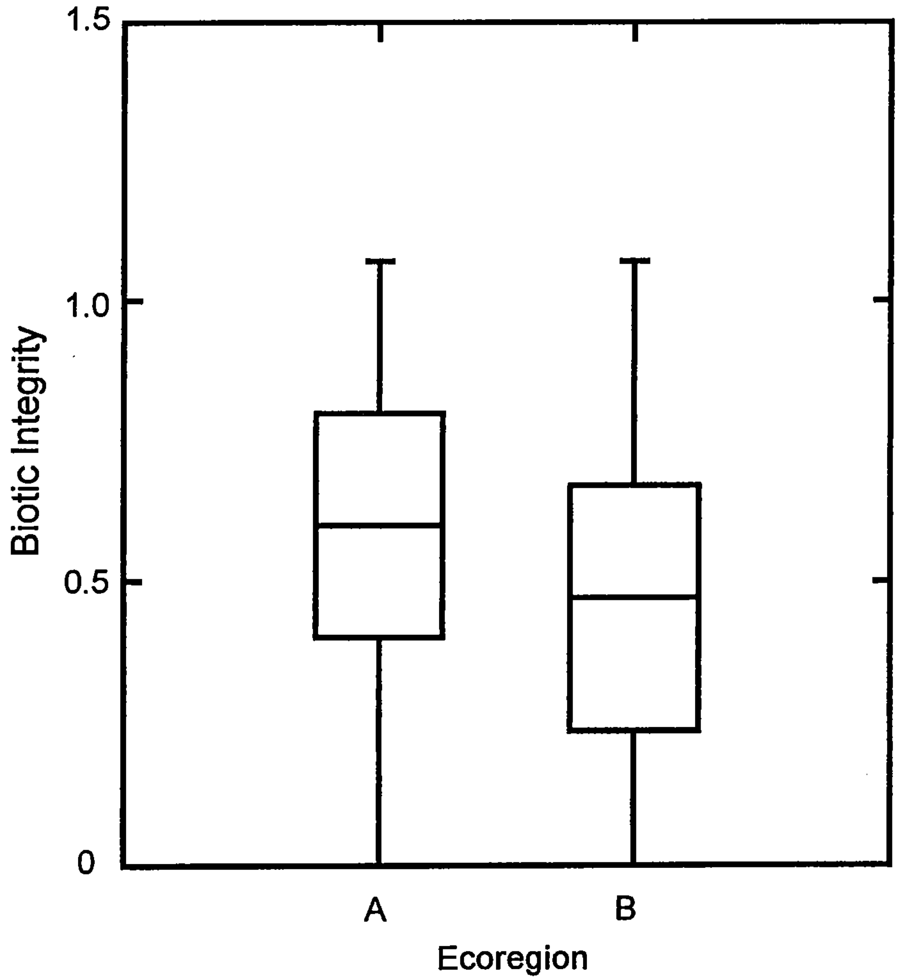


Figure 44
Comparison of Biotic Integrity by Regional Project Watershed

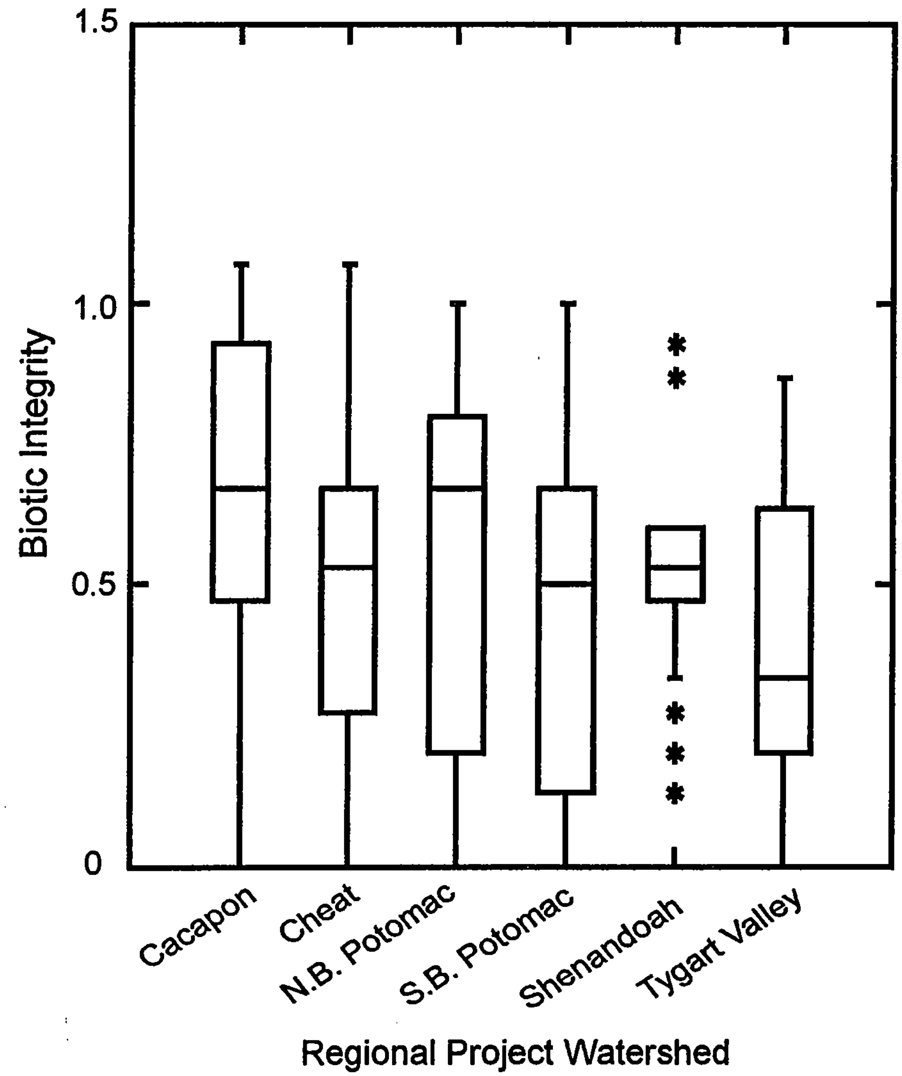


Figure 45
Comparison of Biotic Integrity by Local Project Watershed

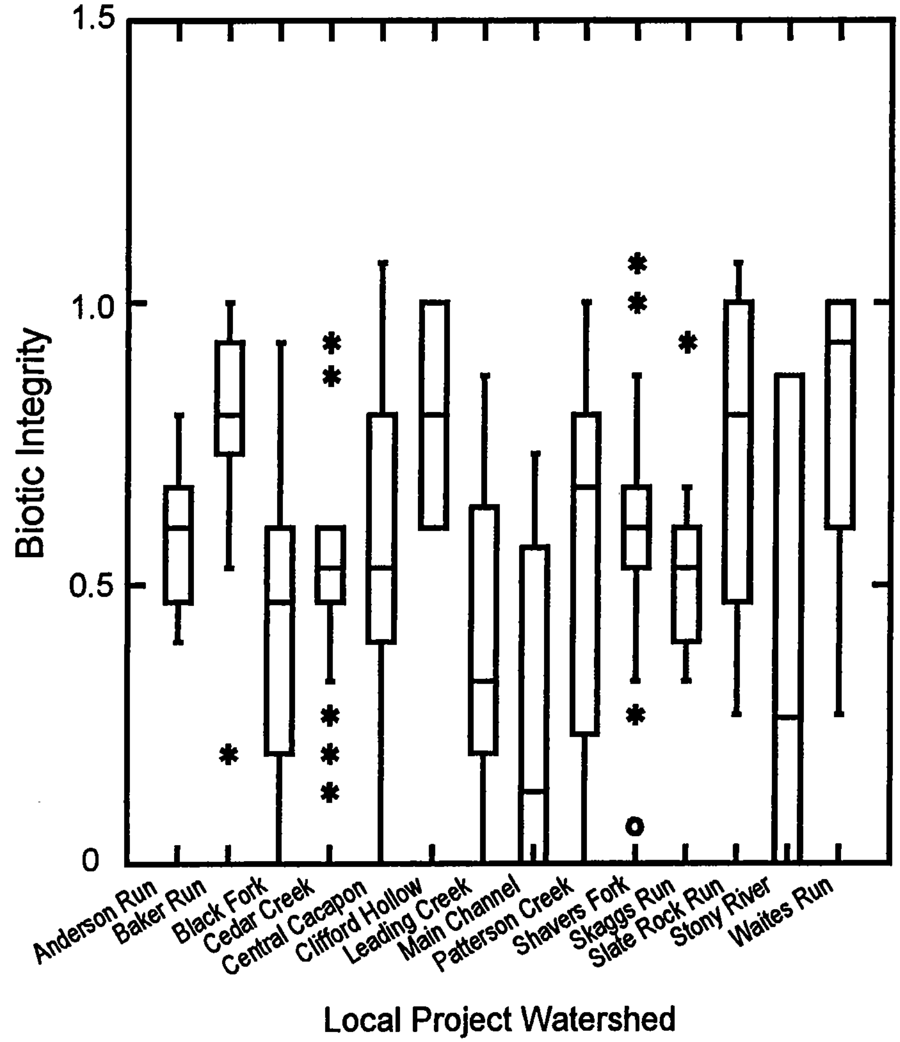


FIGURE 46
CLUSTERING OF BIOTIC INTEGRITY RANKS BY ECOREGION

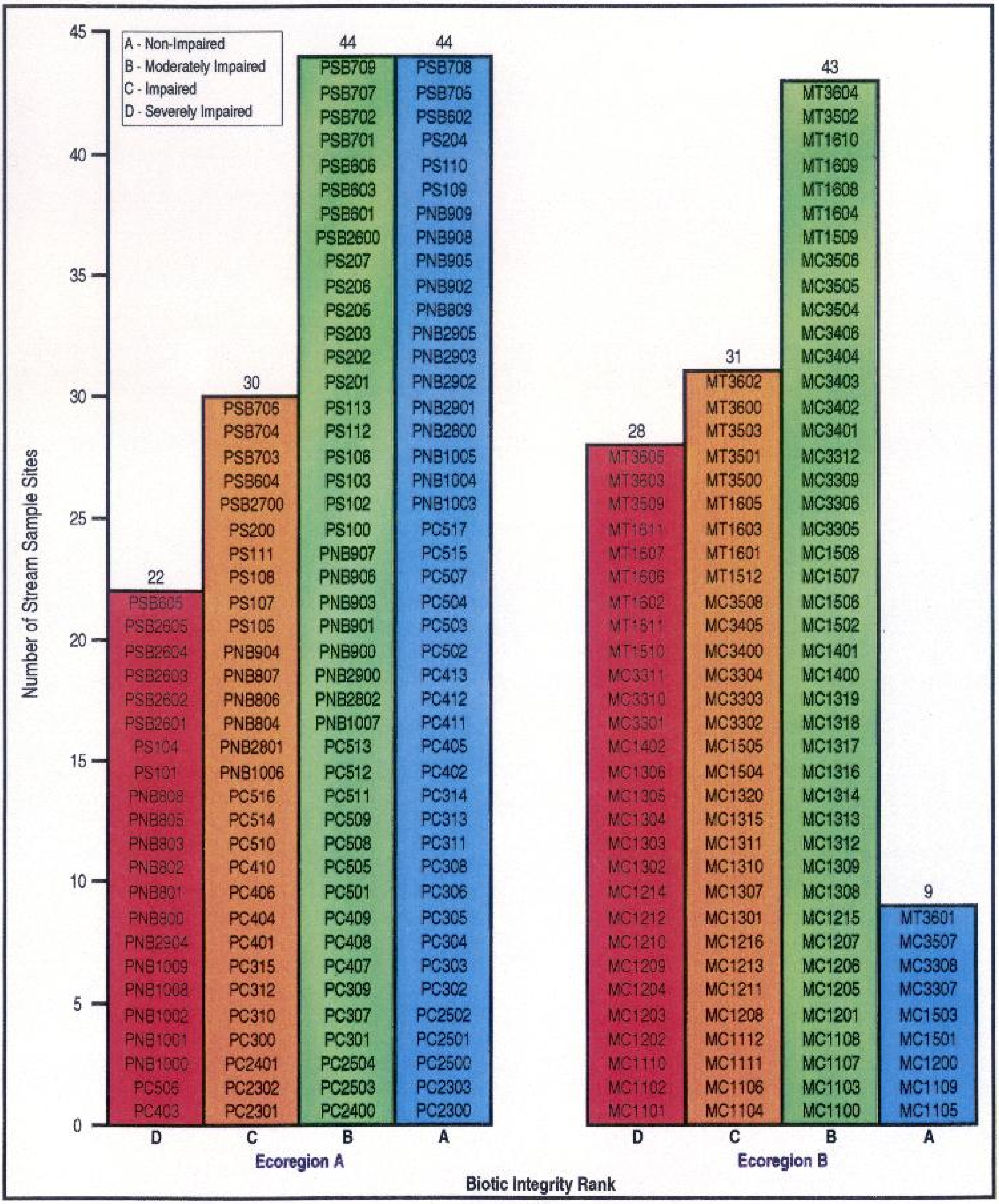


FIGURE 47
CLUSTERING OF BIOTIC INTEGRITY RANKS BY REGIONAL PROJECT WATERSHED

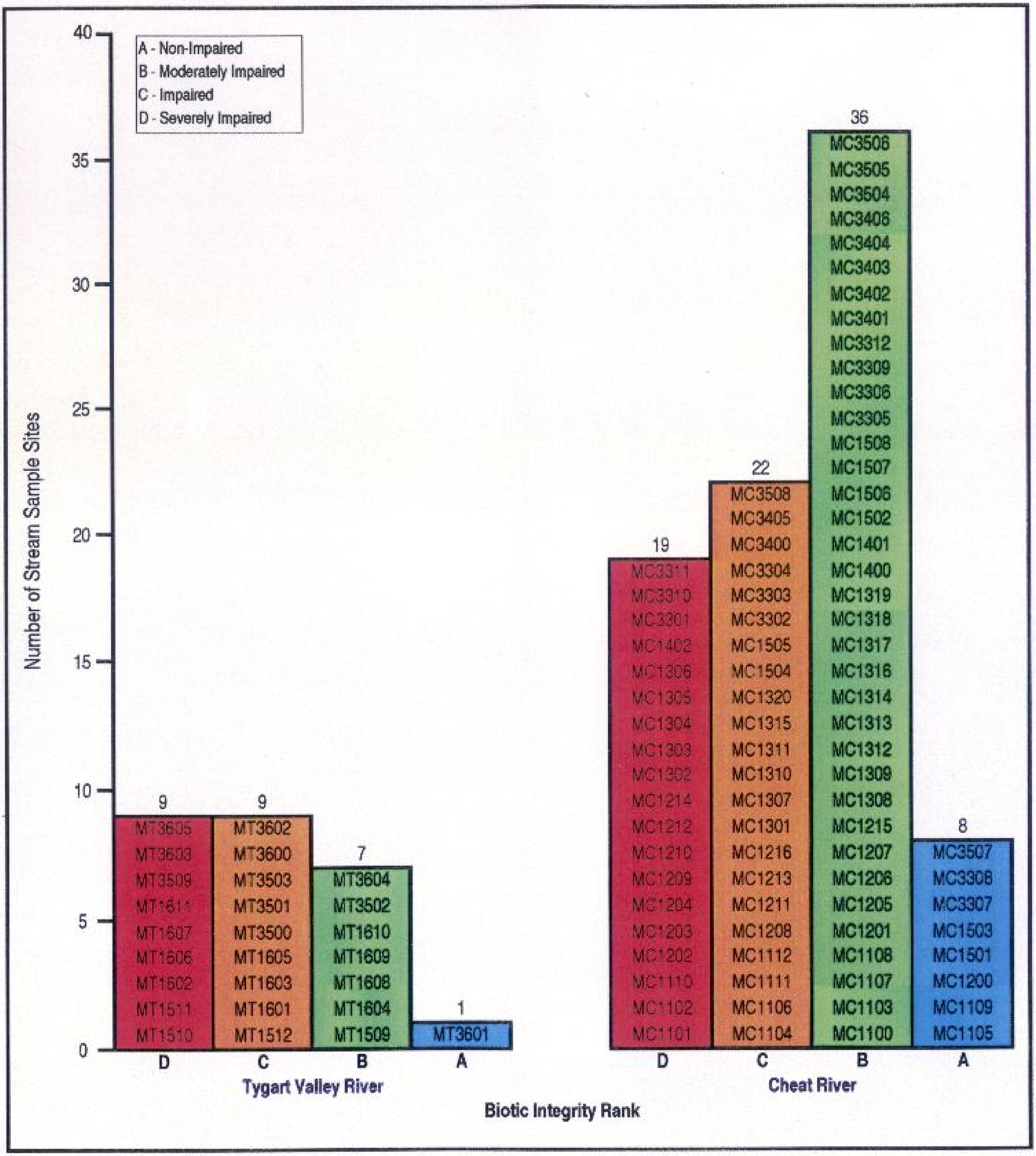


FIGURE 47
CLUSTERING OF BIOTIC INTEGRITY RANKS BY REGIONAL PROJECT WATERSHED

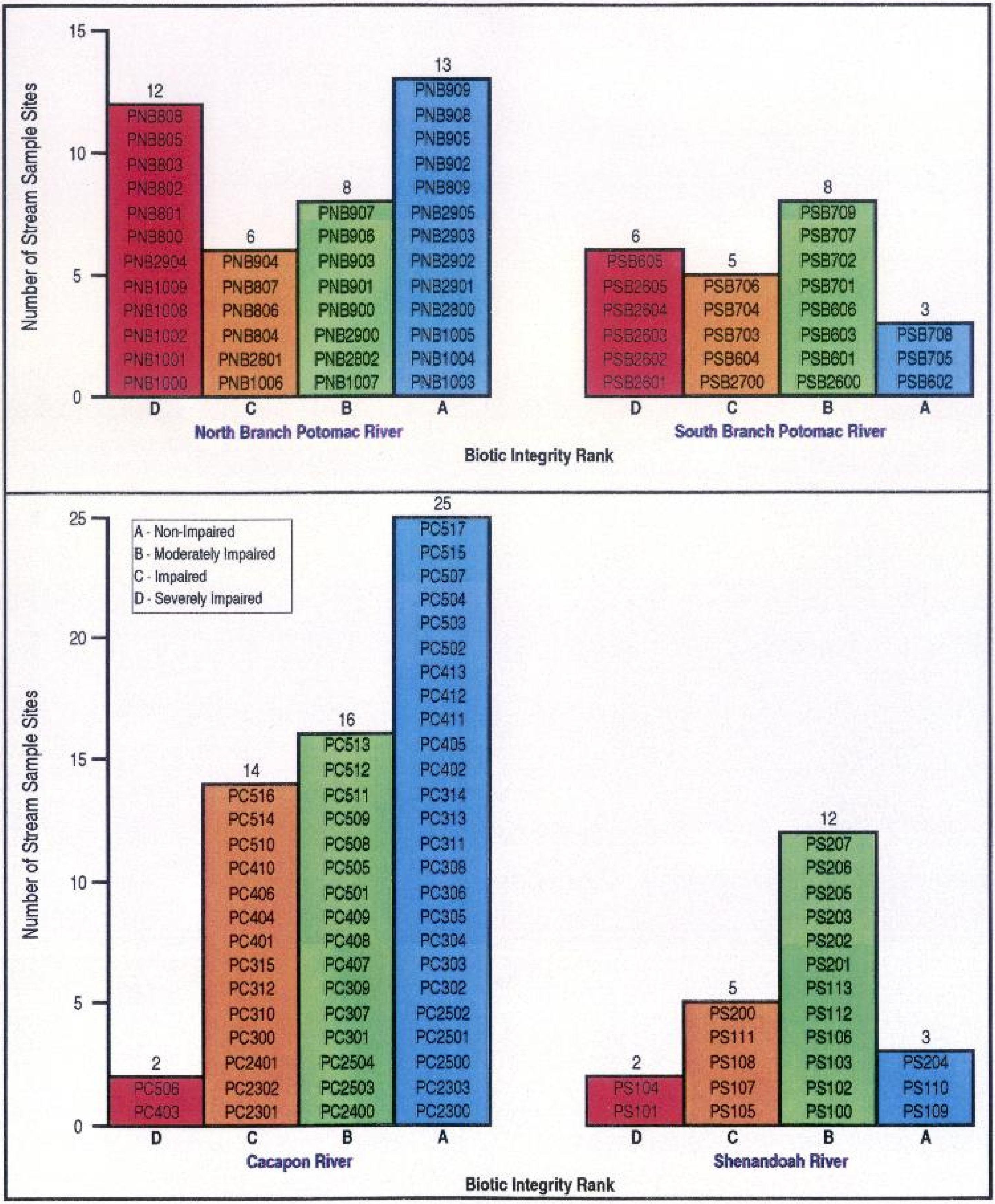


FIGURE 48
CLUSERING OF BIOTIC INTEGRITY RANKS BY LOCAL PROJECT WATERSHED

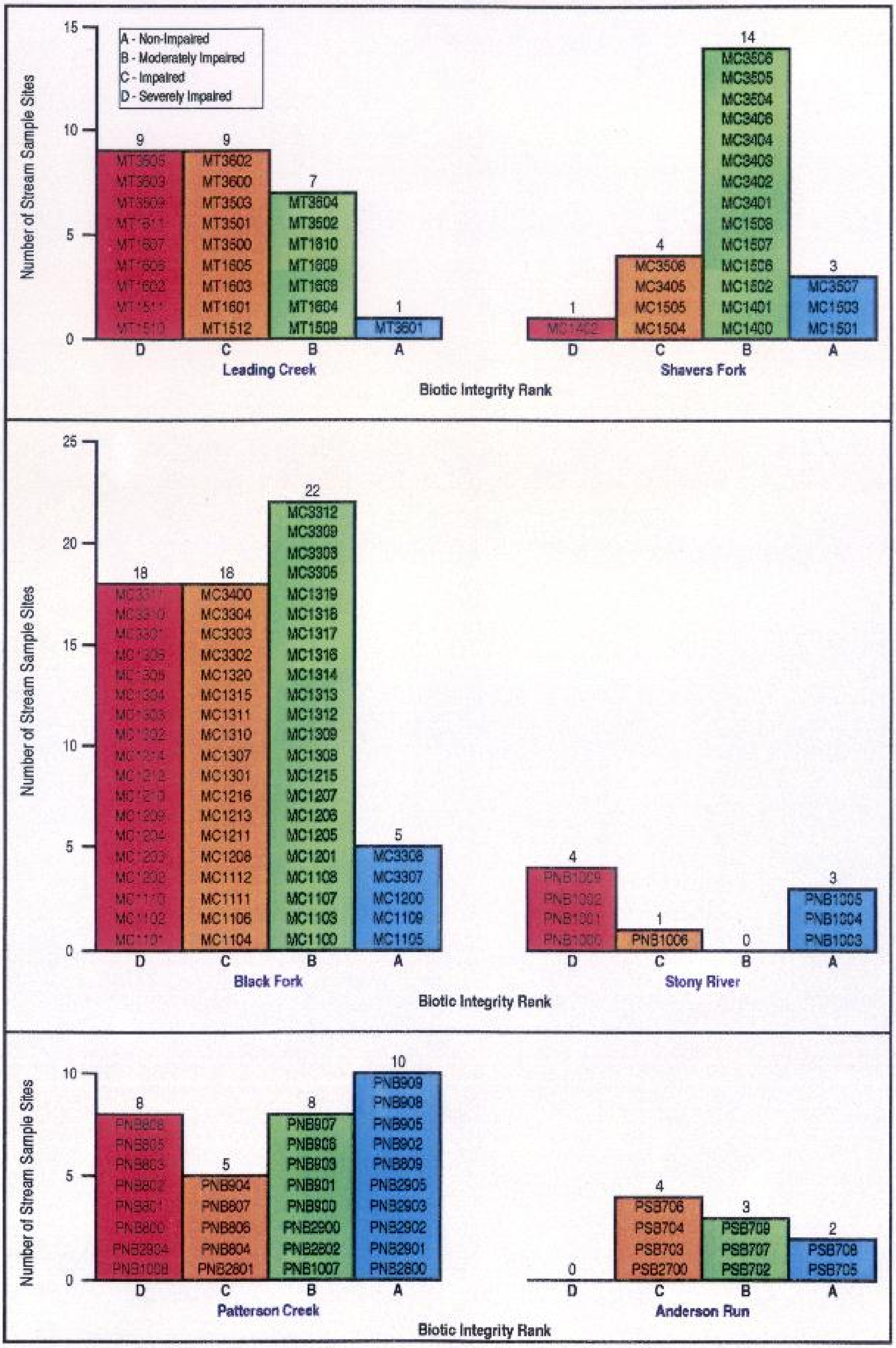


FIGURE 48
CLUSERING OF BIOTIC INTEGRITY RANKS BY LOCAL PROJECT WATERSHED

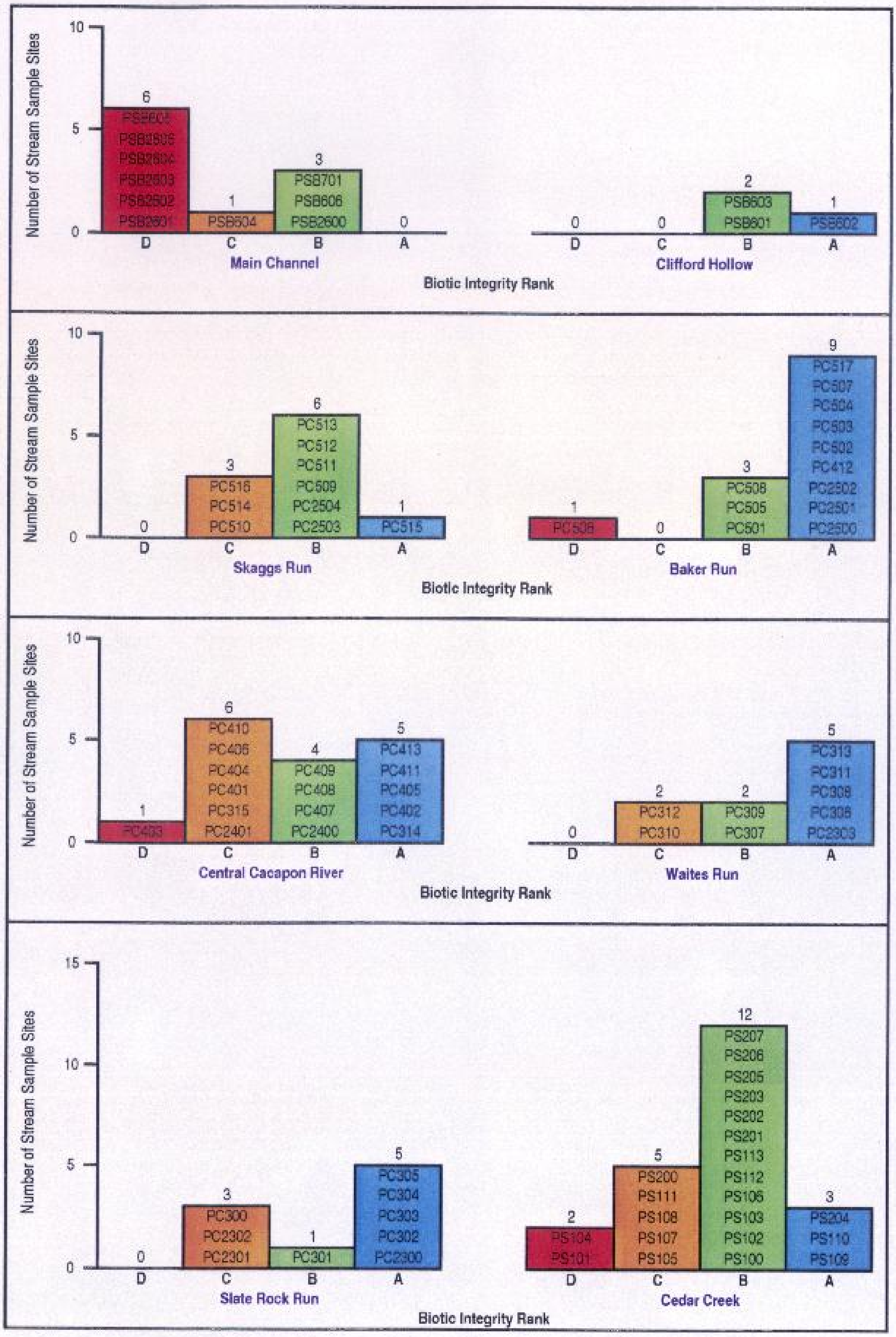


TABLE 11
RAPID BIOASSESSMENT PROTOCOL II - RESULT SUMMARY

														Biological Condition Scoring										
Ecoregion	Stream Order	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chrin.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chrin.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Sum*	B.I.	B.I. Cat.
B	1	Cheat River	Black Fork	MC1100	Four Mile Run	0.39	1.11	29.99	0.10	18.00	0.28	1.83	0.24	0	6	6	0	6	0	3	3	24	0.53	B
B	1	Cheat River	Black Fork	MC1101	trib. Four Mile Run	0.09	0.48	0.00	0.00	1.00	0.00	11.00	0.08	0	0	0	0	6	0	0	0	6	0.13	D
B	1	Cheat River	Black Fork	MC1102	trib. Beaver Creek	0.08	0.44	0.00	0.00	0.08	0.00	9.00	0.10	0	0	0	0	0	0	0	0	0	0.00	D
B	1	Cheat River	Black Fork	MC1103	trib. Beaver Creek	0.26	2.54	43.89	0.92	3.00	0.26	3.33	0.15	0	6	6	6	6	0	3	0	27	0.60	B
B	1	Cheat River	Black Fork	MC1104	trib. Beaver Creek	0.51	1.64	1.88	0.30	0.00	0.65	1.67	0.13	3	6	6	3	0	0	3	0	21	0.47	C
B	1	Cheat River	Black Fork	MC1105	trib. Beaver Creek	0.69	2.03	3.11	1.94	2.00	0.91	0.75	0.43	3	6	6	6	6	6	3	3	39	0.87	A
B	1	Cheat River	Black Fork	MC1106	trib. Beaver Creek	0.51	0.60	0.61	0.28	0.13	0.26	1.50	0.20	3	3	6	3	0	0	3	3	21	0.47	C
B	1	Cheat River	Black Fork	MC1107	trib. Beaver Creek	0.43	2.03	7.02	1.55	0.38	0.39	2.00	0.13	3	6	6	6	3	0	3	0	27	0.60	B
B	1	Cheat River	Black Fork	MC1108	trib. Beaver Creek	0.69	1.37	7.18	1.71	3.00	0.65	1.00	0.25	3	6	6	6	6	0	3	3	33	0.73	B
B	1	Cheat River	Black Fork	MC1109	trib. Beaver Creek	0.77	1.56	18.40	2.56	1.20	0.78	0.89	0.24	3	6	6	6	6	3	3	3	36	0.80	A
B	1	Cheat River	Black Fork	MC1110	trib. Beaver Creek	0.17	0.59	0.00	0.00	6.00	0.00	5.00	0.17	0	3	0	0	6	0	0	0	9	0.20	D
B	1	Cheat River	Black Fork	MC1111	trib. Beaver Creek	0.43	0.92	0.00	0.05	6.00	0.26	2.00	0.13	3	6	0	0	6	0	3	0	18	0.40	C
B	1	Cheat River	Black Fork	MC1112	trib. Beaver Creek	0.26	0.74	0.00	0.00	6.00	0.00	3.67	0.07	0	3	0	0	6	0	3	0	12	0.27	C
B	1	Cheat River	Black Fork	MC1200	trib. Beaver Creek	0.94	1.86	10.24	2.65	6.00	1.04	0.55	0.35	6	6	6	6	6	6	3	3	42	0.93	A
B	1	Cheat River	Black Fork	MC1201	trib. Beaver Creek	0.69	2.09	12.49	2.01	0.00	0.91	1.13	0.18	3	6	6	6	0	6	3	0	30	0.67	B
B	1	Cheat River	Black Fork	MC1202	trib. Beaver Creek	0.09	0.97	0.00	0.02	0.00	0.13	12.00	0.00	0	6	0	0	0	0	0	0	6	0.13	D
B	1	Cheat River	Black Fork	MC1203	trib. Beaver Creek	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	1	Cheat River	Black Fork	MC1204	trib. Beaver Creek	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	1	Cheat River	Black Fork	MC1205	trib. Beaver Creek	0.60	1.18	4.20	1.82	0.25	0.65	1.14	0.27	3	6	6	6	3	0	3	3	30	0.67	B
B	1	Cheat River	Black Fork	MC1206	trib. Beaver Creek	0.34	23.43	208.46	2.17	6.00	0.13	2.75	0.07	0	6	6	6	6	0	3	0	27	0.60	B
B	2	Cheat River	Black Fork	MC1207	trib. Beaver Creek	0.43	1.29	6.58	0.18	6.00	0.26	2.00	0.13	3	6	6	0	6	0	3	0	24	0.53	B
B	3	Cheat River	Black Fork	MC1208	Beaver Creek	0.23	0.53	2.11	0.19	0.10	0.14	3.00	0.08	0	3	6	0	0	0	3	0	12	0.27	C
B	1	Cheat River	Black Fork	MC1209	trib. Beaver Creek	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	1	Cheat River	Black Fork	MC1210	trib. Beaver Creek	0.43	0.52	0.13	0.07	0.16	0.13	2.00	0.13	3	3	0	0	0	0	3	0	9	0.20	D
B	1	Cheat River	Black Fork	MC1211	trib. Pendleton Creek	0.39	0.47	1.48	0.00	0.86	0.00	2.33	0.05	0	0	6	0	6	0	3	0	15	0.33	C
B	2	Cheat River	Black Fork	MC1212	Pendleton Creek	0.46	0.57	0.06	0.08	0.00	0.09	1.86	0.10	3	3	0	0	0	0	3	0	9	0.20	D
B	1	Cheat River	Black Fork	MC1213	trib. Pendleton Creek	0.60	0.62	0.00	0.05	0.25	0.13	1.57	0.06	3	3	0	0	3	0	3	0	12	0.27	C
B	1	Cheat River	Black Fork	MC1214	trib. Beaver Creek	0.34	0.77	0.09	0.02	0.25	0.13	2.75	0.07	0	3	0	0	3	0	3	0	9	0.20	D
B	1	Cheat River	Black Fork	MC1215	trib. Beaver Creek	0.26	0.81	9.05	0.76	6.00	0.13	3.67	0.07	0	3	6	6	6	0	3	0	24	0.53	B
B	2	Cheat River	Black Fork	MC1216	trib. Beaver Creek	0.43	0.89	0.00	0.09	6.00	0.13	2.00	0.13	3	6	0	0	6	0	3	0	18	0.40	C
B	1	Cheat River	Black Fork	MC1301	trib. Beaver Creek	0.43	1.55	5.49	0.18	0.00	0.65	1.80	0.21	3	6	6	0	0	0	3	3	21	0.47	C
B	3	Cheat River	Black Fork	MC1302	N.F. Blackwater River	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	1	Cheat River	Black Fork	MC1303	trib. N.F. Blackwater River	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	3	Cheat River	Black Fork	MC1304	N.F. Blackwater River	0.08	0.44	0.00	0.00	2.17	0.00	9.00	0.10	0	0	0	0	6	0	0	0	6	0.13	D
B	2	Cheat River	Black Fork	MC1305	Long Run	0.07	0.43	0.00	0.00	18.00	0.00	14.00	0.07	0	0	0	0	6	0	0	0	6	0.13	D
B	2	Cheat River	Black Fork	MC1306	Long Run	0.07	0.00		0.00	0.00	0.00	15.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	2	Cheat River	Black Fork	MC1307	Long Run	0.39	0.55	1.54	0.05	1.80	0.19	2.00	0.17	0	3	6	0	6	0	3	0	18	0.40	C
B	2	Cheat River	Black Fork	MC1308	Long Run	0.65	0.62	0.56	0.39	6.00	0.28	1.30	0.09	3	3	6	3	6	0	3	0	24	0.53	B
B	2	Cheat River	Black Fork	MC1309	Middle Run	0.85	0.58	1.67	0.19	1.00	0.56	0.69	0.27	6	3	6	0	6	0	3	3	27	0.60	B
B	1	Cheat River	Black Fork	MC1310	Tub Run	0.52	0.67	9.74	0.24	1.80	0.38	1.50	0.15	3	3	6	0	6	0	3	0	21	0.47	C
B	2	Cheat River	Black Fork	MC1311	Big Run	0.59	0.82	4.00	0.18	0.00	0.56	1.67	0.00	3	3	6	0	0	0	3	0	15	0.33	C
B	1	Cheat River	Black Fork	MC1312	trib. Big Run	0.94	1.05	1.92	0.37	0.00	1.17	0.73	0.21	6	6	6	3	0	6	3	3	33	0.73	B
B	1	Cheat River	Black Fork	MC1313	trib. Roaring Run	0.69	1.17	1.81	0.69	0.00	0.78	1.13	0.18	3	6	6	3	0	3	3	0	24	0.53	B
B	1	Cheat River	Black Fork	MC1314	trib. Roaring Run	0.86	1.27	1.46	0.42	0.00	0.78	0.80	0.22	6	6	6	3	0	3	3	3	30	0.67	B
B	1	Cheat River	Black Fork	MC1315	unnamed	0.26	1.14	2.19	0.09	0.00	0.26	3.67	0.07	0	6	6	0	0	0	3	0	15	0.33	C
B	1	Cheat River	Black Fork	MC1316	trib. Roaring Run	0.77	1.18	1.22	0.78	0.00	0.91	0.78	0.31	3	6	6	6	0	6	3	3	33	0.73	B
B	1	Cheat River	Black Fork	MC1317	trib. Roaring Run	0.43	1.03	7.52	0.76	0.00	0.65	1.80	0.21	3	6	6	6	0	0	3	3	27	0.60	B

TABLE 11
RAPID BIOASSESSMENT PROTOCOL II - RESULT SUMMARY

														Biological Condition Scoring										
Ecoregion	Stream Order	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chirn.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chirn.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Sum*	B.I.	B.I. Cat.
B	2	Cheat River	Black Fork	MC1318	trib. Black Fork	0.85	0.84	5.00	0.40	1.20	0.75	0.69	0.27	6	3	6	3	6	3	3	3	33	0.73	B
B	3	Cheat River	Black Fork	MC1319	Black Fork River	0.60	0.81	0.76	0.55	0.87	0.68	0.63	0.36	3	3	6	3	6	0	3	3	27	0.60	B
B	2	Cheat River	Black Fork	MC1320	Roaring Run	0.72	0.57	0.93	0.23	0.67	0.66	0.82	0.30	3	3	6	0	3	0	3	3	21	0.47	C
B	3	Cheat River	Shavers Fork	MC1400	Shavers Fork	0.75	0.80	0.15	0.62	0.96	0.82	0.30	0.54	3	3	0	3	6	3	6	6	30	0.67	B
B	3	Cheat River	Shavers Fork	MC1401	Shavers Fork	0.83	0.76	0.49	0.29	1.24	0.68	0.45	0.31	6	3	3	3	6	0	6	3	30	0.67	B
B	1	Cheat River	Shavers Fork	MC1402	trib. Shavers Fork	0.34	0.48	0.00	0.00	0.00	0.00	3.00	0.00	0	0	0	0	0	0	3	0	3	0.07	D
B	3	Cheat River	Shavers Fork	MC1501	Shavers Fork	1.13	0.88	1.16	0.79	1.44	1.09	0.07	0.56	6	6	6	6	6	6	6	6	48	1.07	A
B	2	Cheat River	Shavers Fork	MC1502	Pleasant Run	0.68	0.94	1.37	0.59	0.00	0.95	0.67	0.27	3	6	6	3	0	6	3	3	30	0.67	B
B	2	Cheat River	Shavers Fork	MC1503	Pleasant Run	0.75	1.20	11.96	0.29	8.67	0.82	0.30	0.54	3	6	6	3	6	3	6	6	39	0.87	A
B	2	Cheat River	Shavers Fork	MC1504	Slab Camp Run	0.33	0.70	0.00	0.18	9.00	0.19	2.40	0.18	0	3	0	0	6	0	3	0	12	0.27	C
B	2	Cheat River	Shavers Fork	MC1505	Pleasant Run	0.33	1.37	16.66	0.09	0.00	0.38	2.60	0.11	0	6	6	0	0	0	3	0	15	0.33	C
B	1	Cheat River	Shavers Fork	MC1506	trib. Pleasant Run	0.77	0.97	10.97	0.37	6.00	0.52	0.89	0.24	3	6	6	3	6	0	3	3	30	0.67	B
B	1	Cheat River	Shavers Fork	MC1507	trib. Pleasant Run	0.69	1.06	10.53	0.67	0.00	0.78	1.00	0.25	3	6	6	3	0	3	3	3	27	0.60	B
B	2	Cheat River	Shavers Fork	MC1508	Pleasant Run	0.46	0.85	6.66	0.30	18.00	0.38	1.71	0.16	3	3	6	3	6	0	3	0	24	0.53	B
B	3	Cheat River	Black Fork	MC3301	N.F. Blackwater River	0.38	0.45	0.00	0.05	0.08	0.14	1.60	0.15	0	0	0	0	0	0	3	0	3	0.07	D
B	1	Cheat River	Black Fork	MC3302	Slip Hill Mill Run	0.43	0.61	0.55	0.02	2.00	0.13	2.00	0.13	3	3	6	0	6	0	3	0	21	0.47	C
B	1	Cheat River	Black Fork	MC3303	trib. Slip Hill Mill Run	0.17	1.66	4.39	0.02	0.00	0.13	5.50	0.08	0	6	6	0	0	0	0	0	12	0.27	C
B	1	Cheat River	Black Fork	MC3304	trib. Slip Hill Mill Run	0.26	1.78	10.97	0.12	0.00	0.26	3.67	0.07	0	6	6	0	0	0	3	0	15	0.33	C
B	1	Cheat River	Black Fork	MC3305	Roaring Run	0.77	1.55	9.87	0.48	6.00	0.78	1.00	0.17	3	6	6	3	6	3	3	0	30	0.67	B
B	2	Cheat River	Black Fork	MC3306	Roaring Run	0.65	0.64	1.62	0.59	0.49	0.47	1.00	0.25	3	3	6	3	3	0	3	3	24	0.53	B
B	1	Cheat River	Black Fork	MC3307	trib. Roaring Run	1.03	1.47	8.10	1.38	1.50	0.78	0.50	0.33	6	6	6	6	6	3	3	3	39	0.87	A
B	2	Cheat River	Black Fork	MC3308	Roaring Run	1.11	0.96	11.36	0.95	1.29	0.84	0.47	0.28	6	6	6	6	6	3	6	3	42	0.93	A
B	2	Cheat River	Black Fork	MC3309	Snyders Run	0.68	1.21	5.64	1.02	4.33	0.68	0.78	0.19	3	6	6	6	6	0	3	0	30	0.67	B
B	1	Cheat River	Black Fork	MC3310	trib. Snyder Run	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	1	Cheat River	Black Fork	MC3311	trib. Long Run	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	1	Cheat River	Black Fork	MC3312	Long Run	0.43	0.98	0.30	0.85	0.00	0.52	1.80	0.21	3	6	3	6	0	0	3	3	24	0.53	B
B	3	Cheat River	Black Fork	MC3400	Black Fork River	0.30	0.83	1.26	0.09	0.00	0.41	1.75	0.27	0	3	6	0	0	0	3	3	15	0.33	C
B	3	Cheat River	Shavers Fork	MC3401	Shavers Fork	0.60	1.26	7.75	0.31	0.00	0.82	0.75	0.29	3	6	6	3	0	3	3	3	27	0.60	B
B	1	Cheat River	Shavers Fork	MC3402	Sugarcamp Run	0.39	1.49	14.22	0.94	1.00	0.38	2.17	0.11	0	6	6	6	6	0	3	0	27	0.60	B
B	3	Cheat River	Shavers Fork	MC3403	Haddix Run	0.68	1.04	4.24	0.25	8.67	0.55	0.56	0.36	3	6	6	0	6	0	3	3	27	0.60	B
B	1	Cheat River	Shavers Fork	MC3404	Shingle Tree Run	0.69	3.07	8.78	0.78	0.00	0.65	1.13	0.18	3	6	6	6	0	0	3	0	24	0.53	B
B	1	Cheat River	Shavers Fork	MC3405	Goodwin Run	0.39	0.64	8.00	0.10	18.00	0.19	2.17	0.11	0	3	6	0	6	0	3	0	18	0.40	C
B	1	Cheat River	Shavers Fork	MC3406	Hawk Run	1.37	0.83	0.55	1.22	0.75	1.17	0.56	0.12	6	3	6	6	3	6	3	0	33	0.73	B
B	1	Tygart Valley River	Leading Creek	MT3504	trib. Leading Creek	0.86	1.33	1.46	0.67	0.00	1.04	1.00	0.10	6	6	6	3	0	6	3	0	30	0.67	B
B	1	Cheat River	Shavers Fork	MC3505	trib. Haddix Run	0.60	1.06	1.43	1.22	0.38	0.39	1.43	0.12	3	6	6	6	3	0	3	0	27	0.60	B
B	1	Cheat River	Shavers Fork	MC3506	trib. Haddix Run	0.34	2.96	37.30	0.81	6.00	0.39	2.75	0.07	0	6	6	6	6	0	3	0	27	0.60	B
B	1	Cheat River	Shavers Fork	MC3507	trib. Haddix Run	1.37	1.01	1.55	1.55	0.86	1.17	0.25	0.40	6	6	6	6	6	6	6	3	45	1.00	A
B	1	Cheat River	Shavers Fork	MC3508	Haddix Run	0.77	0.67	1.16	0.18	0.43	0.52	1.11	0.11	3	3	6	0	3	0	3	0	18	0.40	C
B	1	Tygart Valley River	Leading Creek	MT1509	Wilmoth Run	0.60	0.88	5.85	0.28	6.00	0.52	1.14	0.27	3	6	6	3	6	0	3	3	30	0.67	B
B	1	Tygart Valley River	Leading Creek	MT1510	trib. Wilmoth Run	0.17	0.70	0.00	0.00	0.00	0.00	6.00	0.00	0	3	0	0	0	0	0	0	3	0.07	D
B	2	Tygart Valley River	Leading Creek	MT1511	Wilmoth Run	0.26	0.43	0.00	0.00	3.60	0.00	3.50	0.06	0	0	0	0	6	0	3	0	9	0.20	D
B	3	Tygart Valley River	Leading Creek	MT1512	Leading Creek	0.45	0.65	0.00	0.26	0.72	0.27	1.17	0.23	3	3	0	3	3	0	3	3	18	0.40	C
B	2	Tygart Valley River	Leading Creek	MT1601	Davis Lick	0.39	0.49	0.43	0.11	0.86	0.28	2.00	0.17	0	0	3	0	6	0	3	0	12	0.27	C
B	2	Tygart Valley River	Leading Creek	MT1602	Horse Run	0.07	0.00		0.00	0.00	0.00	15.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	2	Tygart Valley River	Leading Creek	MT1603	Pearcy Run	0.39	0.52	0.00	0.04	1.38	0.19	2.17	0.11	0	3	0	0	6	0	3	0	12	0.27	C
B	1	Tygart Valley River	Leading Creek	MT1604	trib. Leading Creek	0.43	0.72	0.88	0.09	2.00	0.39	1.80	0.21	3	3	6	0	6	0	3	3	24	0.53	B
B	2	Tygart Valley River	Leading Creek	MT1605	Clay Lick Run	0.52	0.60	1.67	0.01	0.00	0.09	1.88	0.00	3	3	6	0	0	0	3	0	15	0.33	C

TABLE 11
RAPID BIOASSESSMENT PROTOCOL II - RESULT SUMMARY

														Biological Condition Scoring										
Ecoregion	Stream Order	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chirn.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chirn.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Sum*	B.I.	B.I. Cat.
B	1	Tygart Valley River	Leading Creek	MT1606	trib. Clay Lick Run	0.17	1.29	0.00	0.00	0.00	0.00	6.00	0.00	0	6	0	0	0	0	0	0	6	0.13	D
B	2	Tygart Valley River	Leading Creek	MT1607	trib. Leading Creek	0.07	0.85	0.00	0.00	0.00	0.00	15.00	0.00	0	6	0	0	0	0	0	0	6	0.13	D
B	3	Tygart Valley River	Leading Creek	MT1608	Leading Creek	0.90	1.06	0.28	0.82	0.00	0.68	0.42	0.29	6	6	3	6	0	0	6	3	30	0.67	B
B	3	Tygart Valley River	Leading Creek	MT1609	Leading Creek	0.53	0.84	1.26	0.33	2.89	0.27	0.86	0.31	3	3	6	3	6	0	3	3	27	0.60	B
B	3	Tygart Valley River	Leading Creek	MT1610	trib. Leading Creek	0.98	0.88	1.68	0.88	0.00	0.68	0.46	0.21	6	6	6	6	0	0	6	3	33	0.73	B
B	1	Tygart Valley River	Leading Creek	MT1611	trib. Leading Creek	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
B	1	Tygart Valley River	Leading Creek	MT3500	trib. Leading Creek	0.46	0.52	2.61	0.03	1.50	0.09	1.71	0.16	3	3	6	0	6	0	3	0	21	0.47	C
B	1	Tygart Valley River	Leading Creek	MT3501	trib. Cherry Fork	0.51	0.57	0.24	0.05	2.00	0.26	1.67	0.13	3	3	0	0	6	0	3	0	15	0.33	C
B	3	Tygart Valley River	Leading Creek	MT3502	Cherry Fork	1.28	0.65	3.36	0.44	0.33	1.09	0.35	0.17	6	3	6	3	3	6	6	0	33	0.73	B
B	2	Tygart Valley River	Leading Creek	MT3503	Pond Lick Run	0.72	0.51	0.68	0.13	0.90	0.38	1.00	0.18	3	3	6	0	6	0	3	0	21	0.47	C
B	2	Tygart Valley River	Leading Creek	MT3509	trib. Leading Creek	0.33	0.44	0.00	0.03	9.00	0.19	2.60	0.11	0	0	0	0	6	0	3	0	9	0.20	D
B	1	Tygart Valley River	Leading Creek	MT3600	trib. Wilmoth Run	0.77	0.54	0.26	0.21	0.00	0.52	1.11	0.11	3	3	3	0	0	0	3	0	12	0.27	C
B	3	Tygart Valley River	Leading Creek	MT3601	Leading Creek	0.90	0.96	12.21	1.07	0.48	0.82	0.42	0.29	6	6	6	6	3	3	6	3	39	0.87	A
B	3	Tygart Valley River	Leading Creek	MT3602	Leading Creek	0.68	0.50	0.69	0.26	0.25	0.41	0.67	0.27	3	0	6	3	3	0	3	3	21	0.47	C
B	1	Tygart Valley River	Leading Creek	MT3603	trib. Leading Creek	0.86	0.50	0.00	0.05	0.18	0.26	1.00	0.10	6	0	0	0	0	0	3	0	9	0.20	D
B	3	Tygart Valley River	Leading Creek	MT3604	Stalnaker Run	0.90	0.71	2.69	0.25	0.79	0.82	0.50	0.22	6	3	6	0	6	3	3	3	30	0.67	B
B	2	Tygart Valley River	Leading Creek	MT3605	trib. Leading Creek	0.26	0.43	0.19	0.00	0.69	0.00	3.25	0.12	0	0	0	0	3	0	3	0	6	0.13	D
A	1	Cacapon River	Slate Rock Run	PC2300	trib. Slate Rock Run	1.20	1.23	1.30	0.62	0.00	1.04	0.43	0.30	6	6	6	3	0	6	6	3	36	0.80	A
A	1	Cacapon River	Slate Rock Run	PC2301	trib. Slate Rock Run	0.34	0.72	0.00	0.12	2.00	0.26	2.75	0.07	0	3	0	0	6	0	3	0	12	0.27	C
A	2	Cacapon River	Slate Rock Run	PC2302	Slate Rock Run	0.45	0.68	6.72	0.09	1.44	0.41	1.33	0.14	3	3	6	0	6	0	3	0	21	0.47	C
A	3	Cacapon River	Waites Run	PC2303	Waites Run	1.20	0.99	2.14	1.19	2.17	1.23	0.19	0.37	6	6	6	6	6	6	6	3	45	1.00	A
A	2	Cacapon River	Central Cacapon River	PC2400	trib. Lost River	0.52	2.16	0.32	1.38	0.00	0.66	1.25	0.28	3	6	3	6	0	0	3	3	24	0.53	B
A	2	Cacapon River	Central Cacapon River	PC2401	trib. Lost River	0.39	1.44	0.00	0.38	6.00	0.38	1.83	0.24	0	6	0	3	6	0	3	3	21	0.47	C
A	3	Cacapon River	Baker Run	PC2500	Baker Run	0.90	0.88	0.00	1.34	0.54	1.09	0.33	0.38	6	6	0	6	3	6	6	3	36	0.80	A
A	1	Cacapon River	Baker Run	PC2501	trib. Long Lick Run	1.11	0.90	0.74	1.75	0.55	0.91	0.62	0.19	6	6	6	6	3	6	3	0	36	0.80	A
A	1	Cacapon River	Baker Run	PC2502	trib. Long Lick Run	0.94	1.37	2.72	0.97	1.50	0.78	0.91	0.10	6	6	6	6	6	3	3	0	36	0.80	A
A	1	Cacapon River	Skaggs Run	PC2503	trib. Skaggs Run	0.86	0.66	1.25	0.28	0.60	0.65	0.90	0.16	6	3	6	3	3	0	3	0	24	0.53	B
A	1	Cacapon River	Skaggs Run	PC2504	trib. Skaggs Run	0.69	1.41	19.75	0.48	6.00	0.78	1.13	0.18	3	6	6	3	6	3	3	0	30	0.67	B
A	1	Cacapon River	Slate Rock Run	PC300	trib. Sine Run	0.77	0.61	0.73	0.62	0.10	0.52	1.00	0.17	3	3	6	3	0	0	3	0	18	0.40	C
A	1	Cacapon River	Slate Rock Run	PC301	trib. Sine Run	0.69	1.01	3.19	0.81	0.29	0.65	1.13	0.18	3	6	6	6	3	0	3	0	27	0.60	B
A	1	Cacapon River	Slate Rock Run	PC302	trib. Sine Run	1.29	1.16	2.08	1.38	0.30	1.43	0.33	0.35	6	6	6	6	3	6	6	3	42	0.93	A
A	1	Cacapon River	Slate Rock Run	PC303	trib. Sine Run	1.20	1.52	2.67	1.43	1.00	1.43	0.43	0.30	6	6	6	6	6	6	6	3	45	1.00	A
A	1	Cacapon River	Slate Rock Run	PC304	trib. Slate Rock Run	1.03	1.06	1.05	1.48	3.00	0.91	0.25	0.60	6	6	6	6	6	6	6	6	48	1.07	A
A	2	Cacapon River	Slate Rock Run	PC305	Slate Rock Run	1.20	1.43	20.61	0.76	4.33	1.50	0.25	0.30	6	6	6	6	6	6	6	3	45	1.00	A
A	2	Cacapon River	Waites Run	PC306	Waites Run	1.04	0.74	0.72	0.82	0.42	0.94	0.19	0.63	6	3	6	6	3	6	6	6	42	0.93	A
A	1	Cacapon River	Waites Run	PC307	trib. Waites Run	0.86	0.74	4.61	0.51	1.20	0.39	0.90	0.16	6	3	6	3	6	0	3	0	27	0.60	B
A	2	Cacapon River	Waites Run	PC308	Waites Run	0.91	0.91	1.35	0.88	1.06	0.75	0.29	0.61	6	6	6	6	6	3	6	6	45	1.00	A
A	1	Cacapon River	Waites Run	PC309	trib. Waites Run	0.86	0.91	1.36	1.29	0.23	0.65	0.70	0.29	6	6	6	6	0	0	3	3	30	0.67	B
A	1	Cacapon River	Waites Run	PC310	trib. Waites Run	0.94	0.52	0.06	0.00	0.17	0.00	1.00	0.05	6	3	0	0	0	0	3	0	12	0.27	C
A	1	Cacapon River	Waites Run	PC311	trib. Waites Run	1.03	1.17	1.22	0.62	1.50	1.04	0.25	0.60	6	6	6	3	6	6	6	6	45	1.00	A
A	1	Cacapon River	Waites Run	PC312	trib. Waites Run	0.60	0.76	0.61	0.32	0.67	0.52	1.43	0.12	3	3	6	3	3	0	3	0	21	0.47	C
A	2	Cacapon River	Waites Run	PC313	trib. Waites Run	0.94	0.83	0.73	0.90	0.50	1.04	0.27	0.64	6	3	6	6	3	6	6	6	42	0.93	A
A	1	Cacapon River	Central Cacapon River	PC314	trib. Trout Run	0.94	1.09	0.27	1.57	0.33	0.91	0.64	0.28	6	6	3	6	3	6	3	3	36	0.80	A
A	3	Cacapon River	Central Cacapon River	PC315	Trout Run	0.23	0.61	4.74	0.09	0.51	0.27	3.00	0.08	0	3	6	0	3	0	3	0	15	0.33	C
A	3	Cacapon River	Central Cacapon River	PC401	Lost River	0.75	0.57	0.08	0.61	0.11	1.09	0.50	0.33	3	3	0	3	0	6	3	3	21	0.47	C
A	2	Cacapon River	Central Cacapon River	PC402	Sauerkraut Run	0.98	1.12	1.00	1.13	4.50	0.94	0.13	0.76	6	6	6	6	6	6	6	6	48	1.07	A
A	1	Cacapon River	Central Cacapon River	PC403	trib. Lost River	0.09	0.48	0.00	0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D

TABLE 11
RAPID BIOASSESSMENT PROTOCOL II - RESULT SUMMARY

Ecoregion	Stream Order	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chirn.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Biological Condition Scoring: Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chirn.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Sum*	B.I.	B.I. Cat.
A	1	Cacapon River	Central Cacapon River	PC404	trib. Lost River	0.34	0.62	0.37	0.02	1.20	0.13	2.75	0.07	0	3	3	0	6	0	3	0	15	0.33	C
A	1	Cacapon River	Central Cacapon River	PC405	trib. Lost River	0.77	0.90	0.78	0.95	6.00	1.04	0.67	0.40	3	6	6	6	6	6	3	3	39	0.87	A
A	2	Cacapon River	Central Cacapon River	PC406	trib. Lost River	0.20	1.71	26.66	0.05	0.00	0.09	5.00	0.00	0	6	6	0	0	0	0	0	12	0.27	C
A	1	Cacapon River	Central Cacapon River	PC407	trib. Lost River	0.60	0.76	1.14	0.28	0.30	0.39	1.14	0.27	3	3	6	3	3	0	3	3	24	0.53	B
A	3	Cacapon River	Central Cacapon River	PC408	Lost River	0.90	0.57	0.55	0.38	0.14	1.09	0.25	0.47	6	3	6	3	0	6	6	3	33	0.73	B
A	1	Cacapon River	Central Cacapon River	PC409	trib. Lost River	0.86	0.96	0.24	0.83	0.55	1.04	0.50	0.47	6	6	0	6	3	6	3	3	33	0.73	B
A	1	Cacapon River	Central Cacapon River	PC410	trib. Lost River	0.51	1.09	0.63	0.12	0.00	0.39	1.50	0.20	3	6	6	0	0	0	3	3	21	0.47	C
A	3	Cacapon River	Central Cacapon River	PC411	Lost River	0.90	0.86	0.11	0.98	0.58	1.23	0.33	0.38	6	6	0	6	3	6	6	3	36	0.80	A
A	3	Cacapon River	Baker Run	PC412	Lost River	0.98	1.20	0.58	1.39	0.62	1.23	0.08	0.64	6	6	6	6	3	6	6	6	45	1.00	A
A	3	Cacapon River	Central Cacapon River	PC413	Lost River	0.90	1.10	3.09	0.66	1.73	0.55	0.33	0.38	6	6	6	3	6	0	6	3	36	0.80	A
A	1	Cacapon River	Baker Run	PC501	trib. Baker Run	0.77	0.88	1.18	0.37	2.00	0.78	0.67	0.40	3	6	6	3	6	3	3	3	33	0.73	B
A	3	Cacapon River	Baker Run	PC502	Baker Run	0.90	0.91	1.39	0.91	0.72	0.82	0.17	0.57	6	6	6	6	3	3	6	6	42	0.93	A
A	3	Cacapon River	Baker Run	PC503	Baker Run	0.90	1.12	1.11	1.08	0.67	1.09	0.25	0.47	6	6	6	6	3	6	6	3	42	0.93	A
A	2	Cacapon River	Baker Run	PC504	Long Lick Run	0.85	1.25	2.67	0.54	9.00	0.84	0.77	0.22	6	6	6	3	6	3	3	3	36	0.80	A
A	1	Cacapon River	Baker Run	PC505	trib. Long Lick Run	0.51	2.11	10.97	0.25	0.00	0.65	1.50	0.20	3	6	6	3	0	0	3	3	24	0.53	B
A	2	Cacapon River	Baker Run	PC506	trib. Long Lick Run	0.20	0.80	0.00	0.06	9.00	0.19	4.33	0.13	0	3	0	0	6	0	0	0	9	0.20	D
A	2	Cacapon River	Baker Run	PC507	Long Lick Run	0.85	0.79	0.93	0.48	3.60	0.94	0.69	0.27	6	3	6	3	6	6	3	3	36	0.80	A
A	2	Cacapon River	Baker Run	PC508	Long Lick Run	0.72	1.26	6.66	0.45	0.00	0.94	0.91	0.24	3	6	6	3	0	6	3	3	30	0.67	B
A	1	Cacapon River	Skaggs Run	PC509	unnamed	0.60	0.92	5.02	0.60	0.00	0.65	1.00	0.36	3	6	6	3	0	0	3	3	24	0.53	B
A	1	Cacapon River	Skaggs Run	PC510	trib. Skaggs Run	0.26	1.29	1.10	0.07	0.00	0.39	3.67	0.07	0	6	6	0	0	0	3	0	15	0.33	C
A	1	Cacapon River	Skaggs Run	PC511	trib. Skaggs Run	0.65	0.77	2.67	0.28	4.50	0.66	1.10	0.19	3	3	6	3	6	0	3	0	24	0.53	B
A	1	Cacapon River	Skaggs Run	PC512	trib. Skaggs Run	0.60	1.14	17.55	0.62	0.00	0.65	1.14	0.27	3	6	6	3	0	0	3	3	24	0.53	B
A	2	Cacapon River	Skaggs Run	PC513	Skaggs Run	0.65	1.02	0.00	1.04	18.00	0.66	0.90	0.32	3	6	0	6	6	0	3	3	27	0.60	B
A	1	Cacapon River	Skaggs Run	PC514	trib. Skaggs Run	0.69	0.66	0.48	0.44	0.00	0.52	1.13	0.18	3	3	3	3	0	0	3	0	15	0.33	C
A	1	Cacapon River	Skaggs Run	PC515	unnamed	1.37	1.36	2.51	0.44	6.00	1.30	0.44	0.22	6	6	6	3	6	6	6	3	42	0.93	A
A	1	Cacapon River	Skaggs Run	PC516	trib. Skaggs Run	0.51	0.63	6.95	0.42	0.00	0.52	1.67	0.13	3	3	6	3	0	0	3	0	18	0.40	C
A	2	Cacapon River	Baker Run	PC517	trib. Baker Run	0.98	1.32	1.28	1.05	2.57	1.13	0.40	0.43	6	6	6	6	6	6	6	3	45	1.00	A
A	2	North Branch Potomac River	Stony River	PNB1000	Little Creek	0.07	0.00		0.00	0.00	0.00	15.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
A	2	North Branch Potomac River	Stony River	PNB1001	Abrams Creek	0.07	0.00		0.00	0.00	0.00	15.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
A	1	North Branch Potomac River	Stony River	PNB1002	trib. Abrams Creek	0.77	0.53	0.21	0.05	0.11	0.13	1.00	0.17	3	3	0	0	0	0	3	0	9	0.20	D
A	1	North Branch Potomac River	Stony River	PNB1003	trib. Abrams Creek	1.03	1.58	5.07	1.55	0.26	0.91	0.50	0.33	6	6	6	6	3	6	3	3	39	0.87	A
A	1	North Branch Potomac River	Stony River	PNB1004	trib. Abrams Creek	0.77	1.75	3.62	2.15	1.20	1.04	0.78	0.31	3	6	6	6	6	6	3	3	39	0.87	A
A	1	North Branch Potomac River	Stony River	PNB1005	trib. Stony River	0.94	1.42	2.36	0.53	1.00	0.91	0.73	0.21	6	6	6	3	6	6	3	3	39	0.87	A
A	2	North Branch Potomac River	Stony River	PNB1006	Stony River	0.20	0.77	0.00	0.21	9.00	0.19	4.00	0.20	0	3	0	0	6	0	3	3	15	0.33	C
A	1	North Branch Potomac River	Patterson Creek	PNB1007	trib. Elklick Run	0.86	0.66	0.73	0.37	0.38	0.91	0.80	0.22	6	3	6	3	3	6	3	3	33	0.73	B
A	1	North Branch Potomac River	Patterson Creek	PNB1008	trib. Elklick Run	0.17	0.49	0.07	0.02	0.19	0.13	5.00	0.17	0	0	0	0	0	0	0	0	0	0.00	D
A	1	North Branch Potomac River	Stony River	PNB1009	trib. Little Creek	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
A	3	North Branch Potomac River	Patterson Creek	PNB2800	Patterson Creek	1.28	0.70	1.30	0.42	0.27	0.95	0.29	0.23	6	3	6	3	3	6	6	3	36	0.80	A
A	2	North Branch Potomac River	Patterson Creek	PNB2801	N.F. Patterson Creek	0.60	0.93	0.40	1.16	0.00	0.14	1.00	0.13	3	6	3	6	0	0	3	0	21	0.47	C
A	2	North Branch Potomac River	Patterson Creek	PNB2802	trib. N.F. Patterson Creek	0.85	0.65	0.30	1.17	0.82	0.75	0.69	0.27	6	3	3	6	6	3	3	3	33	0.73	B
A	3	North Branch Potomac River	Patterson Creek	PNB2900	N.F. Patterson Creek	1.05	0.55	1.77	0.33	0.09	0.82	0.36	0.26	6	3	6	3	0	3	6	3	30	0.67	B
A	3	North Branch Potomac River	Patterson Creek	PNB2901	N.F. Patterson Creek	0.98	0.94	9.92	0.92	0.33	1.09	0.38	0.28	6	6	6	6	3	6	6	3	42	0.93	A
A	3	North Branch Potomac River	Patterson Creek	PNB2902	N.F. Patterson Creek	0.83	0.94	6.45	0.80	0.58	0.68	0.36	0.40	6	6	6	6	3	0	6	3	36	0.80	A
A	2	North Branch Potomac River	Patterson Creek	PNB2903	trib. N.F. Patterson Creek	1.37	0.79	1.31	0.50	0.69	0.94	0.29	0.33	6	3	6	3	3	6	6	3	36	0.80	A
A	1	North Branch Potomac River	Patterson Creek	PNB2904	trib. N.F. Patterson Creek	0.26	0.49	1.57	0.00	0.00	0.00	4.00	0.00	0	0	6	0	0	0	3	0	9	0.20	D
A	1	North Branch Potomac River	Patterson Creek	PNB2905	trib. N.F. Patterson Creek	0.94	1.17	0.27	2.65	3.00	1.04	0.64	0.28	6	6	3	6	6	6	3	3	39	0.87	A
A	1	North Branch Potomac River	Patterson Creek	PNB800	trib. Patterson Creek	0.17	0.49	0.00	0.00	0.00	0.00	6.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D

TABLE 11
RAPID BIOASSESSMENT PROTOCOL II - RESULT SUMMARY

														Biological Condition Scoring										
Ecoregion	Stream Order	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chirn.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chirn.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Sum*	B.I.	B.I. Cat.
A	2	North Branch Potomac River	Patterson Creek	PNB801	trib. Patterson Creek	0.26	0.45	0.48	0.09	0.22	0.28	3.00	0.19	0	0	3	0	0	0	3	0	6	0.13	D
A	2	North Branch Potomac River	Patterson Creek	PNB802	trib. Thorn Run	0.13	0.66	0.00	0.01	0.00	0.09	7.00	0.06	0	3	0	0	0	0	0	0	3	0.07	D
A	1	North Branch Potomac River	Patterson Creek	PNB803	trib. Thorn Run	0.09	1.29	0.00	0.00	0.00	0.00	12.00	0.00	0	6	0	0	0	0	0	0	6	0.13	D
A	2	North Branch Potomac River	Patterson Creek	PNB804	trib. Thorn Run	0.39	0.52	0.00	0.16	0.95	0.19	2.00	0.17	0	3	0	0	6	0	3	0	12	0.27	C
A	1	North Branch Potomac River	Patterson Creek	PNB805	trib. Patterson Creek	0.09	0.48	0.00	0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
A	1	North Branch Potomac River	Patterson Creek	PNB806	trib. S.F. Patterson Creek	0.34	0.59	0.55	0.00	1.50	0.00	2.75	0.07	0	3	6	0	6	0	3	0	18	0.40	C
A	3	North Branch Potomac River	Patterson Creek	PNB807	Patterson Creek	0.83	0.54	3.36	0.01	0.25	0.14	0.64	0.17	6	3	6	0	3	0	3	0	21	0.47	C
A	1	North Branch Potomac River	Patterson Creek	PNB808	trib. N.F. Patterson Creek	0.17	0.59	0.00	0.00	6.00	0.00	5.50	0.08	0	3	0	0	6	0	0	0	9	0.20	D
A	1	North Branch Potomac River	Patterson Creek	PNB809	trib. Patterson Creek	1.03	0.79	1.03	0.28	1.00	0.91	0.42	0.41	6	3	6	3	6	6	6	3	39	0.87	A
A	3	North Branch Potomac River	Patterson Creek	PNB900	M.F. Patterson Creek	0.68	0.69	0.52	0.60	0.29	0.95	0.56	0.36	3	3	6	3	3	6	3	3	30	0.67	B
A	1	North Branch Potomac River	Patterson Creek	PNB901	trib. M.F. Patterson Creek	0.60	1.48	4.39	0.67	3.00	0.65	1.14	0.27	3	6	6	3	6	0	3	3	30	0.67	B
A	3	North Branch Potomac River	Patterson Creek	PNB902	N.F. Patterson Creek	0.83	0.81	2.86	0.61	0.32	0.95	0.45	0.31	6	3	6	3	3	6	6	3	36	0.80	A
A	1	North Branch Potomac River	Patterson Creek	PNB903	trib. Elklick Run	0.60	1.01	115.20	0.25	6.00	0.39	1.29	0.19	3	6	6	3	6	0	3	0	27	0.60	B
A	2	North Branch Potomac River	Patterson Creek	PNB904	trib. Elklick Run	0.26	0.86	259.91	0.03	18.00	0.19	3.00	0.19	0	6	6	0	6	0	3	0	21	0.47	C
A	2	North Branch Potomac River	Patterson Creek	PNB905	trib. Elklick Run	1.11	0.86	3.11	1.11	6.00	1.17	0.46	0.32	6	6	6	6	6	6	6	3	45	1.00	A
A	2	North Branch Potomac River	Patterson Creek	PNB906	Elklick Run	0.75	0.91	1.89	0.19	2.17	0.95	0.50	0.33	3	6	6	0	6	6	3	3	33	0.73	B
A	3	North Branch Potomac River	Patterson Creek	PNB907	M.F. Patterson Creek	1.13	0.66	0.79	0.67	0.18	1.64	0.20	0.39	6	3	6	3	0	6	6	3	33	0.73	B
A	1	North Branch Potomac River	Patterson Creek	PNB908	trib. N.F. Patterson Creek	1.11	0.95	0.41	0.99	0.67	0.91	0.46	0.32	6	6	3	6	3	6	6	3	39	0.87	A
A	2	North Branch Potomac River	Patterson Creek	PNB909	trib. N.F. Patterson Creek	0.98	0.67	1.48	0.94	2.00	1.03	0.53	0.30	6	3	6	6	6	6	3	3	39	0.87	A
A	2	Shenandoah River	Cedar Creek	PS100	Town Run	0.78	0.61	11.66	0.11	6.00	0.47	0.83	0.23	3	3	6	0	6	0	3	3	24	0.53	B
A	1	Shenandoah River	Cedar Creek	PS101	Town Run	0.17	0.49	92.16	0.02	0.00	0.13	5.50	0.08	0	0	6	0	0	0	0	0	6	0.13	D
A	2	Shenandoah River	Cedar Creek	PS102	trib. Mulberry Run	0.59	0.68	2.22	0.41	0.67	0.47	1.11	0.26	3	3	6	3	3	0	3	3	24	0.53	B
A	2	Shenandoah River	Cedar Creek	PS103	trib. Mulberry Run	0.59	0.75	4.44	0.46	0.72	0.28	1.22	0.20	3	3	6	3	3	0	3	3	24	0.53	B
A	1	Shenandoah River	Cedar Creek	PS104	trib. Cedar Creek	0.17	0.51	0.00	0.00	1.20	0.00	5.50	0.08	0	3	0	0	6	0	0	0	9	0.20	D
A	1	Shenandoah River	Cedar Creek	PS105	trib. Mulberry Run	0.51	0.50	16.02	0.05	3.00	0.13	1.67	0.13	3	3	6	0	6	0	3	0	21	0.47	C
A	2	Shenandoah River	Cedar Creek	PS106	Mulberry Run	0.85	0.62	5.66	0.16	4.50	0.56	0.69	0.27	6	3	6	0	6	0	3	3	27	0.60	B
A	1	Shenandoah River	Cedar Creek	PS107	trib. Mulberry Run	0.43	0.63	1.10	0.02	0.00	0.13	2.20	0.06	3	3	6	0	0	0	3	0	15	0.33	C
A	1	Shenandoah River	Cedar Creek	PS108	trib. Mulberry Run	0.69	0.72	0.07	0.92	0.29	0.52	0.88	0.33	3	3	0	6	3	0	3	3	21	0.47	C
A	3	Shenandoah River	Cedar Creek	PS109	Cedar Creek	0.90	0.97	1.26	0.82	1.44	0.68	0.08	0.69	6	6	6	6	6	0	6	6	42	0.93	A
A	3	Shenandoah River	Cedar Creek	PS110	Cedar Creek	0.68	1.06	0.62	1.13	2.17	0.82	0.44	0.46	3	6	6	6	6	3	6	3	39	0.87	A
A	1	Shenandoah River	Cedar Creek	PS111	trib. Cedar Creek	0.26	0.51	41.69	0.00	0.00	0.00	3.67	0.07	0	3	6	0	0	0	3	0	12	0.27	C
A	2	Shenandoah River	Cedar Creek	PS112	Mulberry Run	0.91	0.68	1.61	0.64	1.64	0.47	0.79	0.16	6	3	6	3	6	0	3	0	27	0.60	B
A	2	Shenandoah River	Cedar Creek	PS113	Turkey Run	0.78	0.73	0.48	0.98	0.90	0.47	0.92	0.17	3	3	3	6	6	0	3	0	24	0.53	B
A	2	Shenandoah River	Cedar Creek	PS200	Duck Run	0.39	0.93	3.64	0.19	9.00	0.38	2.17	0.11	0	6	6	0	6	0	3	0	21	0.47	C
A	2	Shenandoah River	Cedar Creek	PS201	Duck Run	0.72	1.09	2.74	0.68	0.00	0.75	0.82	0.30	3	6	6	3	0	3	3	3	27	0.60	B
A	2	Shenandoah River	Cedar Creek	PS202	Duck Run	0.85	1.33	16.40	0.69	0.00	0.66	0.69	0.27	6	6	6	3	0	0	3	3	27	0.60	B
A	1	Shenandoah River	Cedar Creek	PS203	trib. Duck Run	0.51	1.17	0.41	0.30	2.00	0.39	1.50	0.20	3	6	3	3	6	0	3	3	27	0.60	B
A	2	Shenandoah River	Cedar Creek	PS204	trib. Duck Run	0.86	1.13	0.84	0.42	6.00	0.91	0.70	0.29	6	6	6	3	6	6	3	3	39	0.87	A
A	2	Shenandoah River	Cedar Creek	PS205	trib. Duck Run	0.51	1.77	9.87	0.35	0.00	0.65	1.50	0.20	3	6	6	3	0	0	3	3	24	0.53	B
A	1	Shenandoah River	Cedar Creek	PS206	trib. Duck Run	0.77	1.24	2.47	0.25	2.00	0.65	1.00	0.17	3	6	6	3	6	0	3	0	27	0.60	B
A	1	Shenandoah River	Cedar Creek	PS207	trib. Paddy Run	1.11	0.80	0.39	0.44	0.67	0.91	0.69	0.14	6	3	3	3	3	6	3	0	27	0.60	B
A	2	South Branch Potomac River	Main Channel	PSB2600	Fort Run	0.33	1.00	8.98	1.18	1.29	0.38	2.80	0.05	0	6	6	6	6	0	3	0	27	0.60	B
A	2	South Branch Potomac River	Main Channel	PSB2601	Dumpling Run	0.07	0.00		0.00	0.00	0.00	15.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
A	2	South Branch Potomac River	Main Channel	PSB2602	Fort Run	0.07	0.00		0.00	0.00	0.00	15.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
A	2	South Branch Potomac River	Main Channel	PSB2603	Dumpling Run	0.07	0.00		0.00	0.00	0.00	15.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
A	1	South Branch Potomac River	Main Channel	PSB2604	trib. Dumpling Run	0.09	0.00		0.00	0.00	0.00	12.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D
A	2	South Branch Potomac River	Main Channel	PSB2605	Dumpling Run	0.07	0.00		0.00	0.00	0.00	15.00	0.00	0	0	0	0	0	0	0	0	0	0.00	D

TABLE 11
RAPID BIOASSESSMENT PROTOCOL II - RESULT SUMMARY

Ecoregion	Stream Order	Regional Project Watershed	Local Project Watershed	Site ID#	Stream Name	Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chrin.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Biological Condition Scoring: Metric 1	Metric 2	Metric 3	Metric 4 EPT	Metric 4 Chrin.	Metric 6	Metric 7 - Community Loss	Metric 7 - Jaccard Coefficient	Sum*	B.I.	B.I. Cat.
A	2	South Branch Potomac River	Anderson Run	PSB2700	Anderson Run	0.75	0.51	0.22	1.11	0.21	0.82	0.50	0.33	3	3	0	6	0	3	3	3	21	0.47	C
A	1	South Branch Potomac River	Clifford Hollow	PSB601	trib. Clifford Hollow	0.86	0.64	0.24	0.32	1.00	0.78	0.70	0.29	6	3	0	3	6	3	3	3	27	0.60	B
A	1	South Branch Potomac River	Clifford Hollow	PSB602	trib. Clifford Hollow	1.29	1.43	3.01	1.34	1.20	1.43	0.33	0.35	6	6	6	6	6	6	6	3	45	1.00	A
A	2	South Branch Potomac River	Main Channel	PSB603	Clifford Hollow	0.78	0.63	0.56	0.48	1.29	0.75	0.75	0.29	3	3	6	3	6	3	3	3	30	0.67	B
A	1	South Branch Potomac River	Main Channel	PSB604	trib. Fort Run	0.26	0.72	6.58	0.09	0.00	0.26	3.33	0.15	0	3	6	0	0	0	3	0	12	0.27	C
A	1	South Branch Potomac River	Main Channel	PSB605	trib. S.B. Potomac River	0.26	0.63	0.00	0.02	0.00	0.13	3.67	0.07	0	3	0	0	0	0	3	0	6	0.13	D
A	3	South Branch Potomac River	Main Channel	PSB606	S.B. Potomac River	1.43	0.69	1.39	0.59	0.23	1.23	0.16	0.32	6	3	6	3	0	6	6	3	33	0.73	B
A	1	South Branch Potomac River	Main Channel	PSB701	trib. S.B. Potomac River	0.77	0.59	0.72	0.44	0.35	0.52	0.89	0.24	3	3	6	3	3	0	3	3	24	0.53	B
A	3	South Branch Potomac River	Anderson Run	PSB702	Walnut Bottom	0.65	0.86	2.15	0.90	1.50	0.66	1.20	0.14	3	6	6	6	6	0	3	0	30	0.67	B
A	3	South Branch Potomac River	Anderson Run	PSB703	Walnut Bottom	0.65	0.56	0.25	0.38	0.30	0.47	0.90	0.32	3	3	0	3	3	0	3	3	18	0.40	C
A	2	South Branch Potomac River	Anderson Run	PSB704	trib. Walnut Bottom	0.51	0.88	0.15	0.60	1.50	0.39	1.67	0.13	3	6	0	3	6	0	3	0	21	0.47	C
A	2	South Branch Potomac River	Anderson Run	PSB705	trib. Walnut Bottom	0.98	0.91	2.14	0.35	6.00	0.75	0.60	0.25	6	6	6	3	6	3	3	3	36	0.80	A
A	2	South Branch Potomac River	Anderson Run	PSB706	unnamed	0.59	0.48	45.82	0.21	3.00	0.38	1.00	0.33	3	0	6	0	6	0	3	3	21	0.47	C
A	2	South Branch Potomac River	Anderson Run	PSB707	Tombs Hollow Run	0.65	0.62	4.57	0.44	18.00	0.56	1.00	0.25	3	3	6	3	6	0	3	3	27	0.60	B
A	2	South Branch Potomac River	Anderson Run	PSB708	Walnut Bottom	1.05	0.71	4.52	0.36	0.48	0.95	0.29	0.33	6	3	6	3	3	6	6	3	36	0.80	A
A	2	South Branch Potomac River	Anderson Run	PSB709	trib. Walnut Bottom	0.52	1.37	5.00	0.63	4.50	0.47	1.38	0.21	3	6	6	3	6	0	3	3	30	0.67	B

Figure 49
Comparison of Biotic Integrity by Stream Order

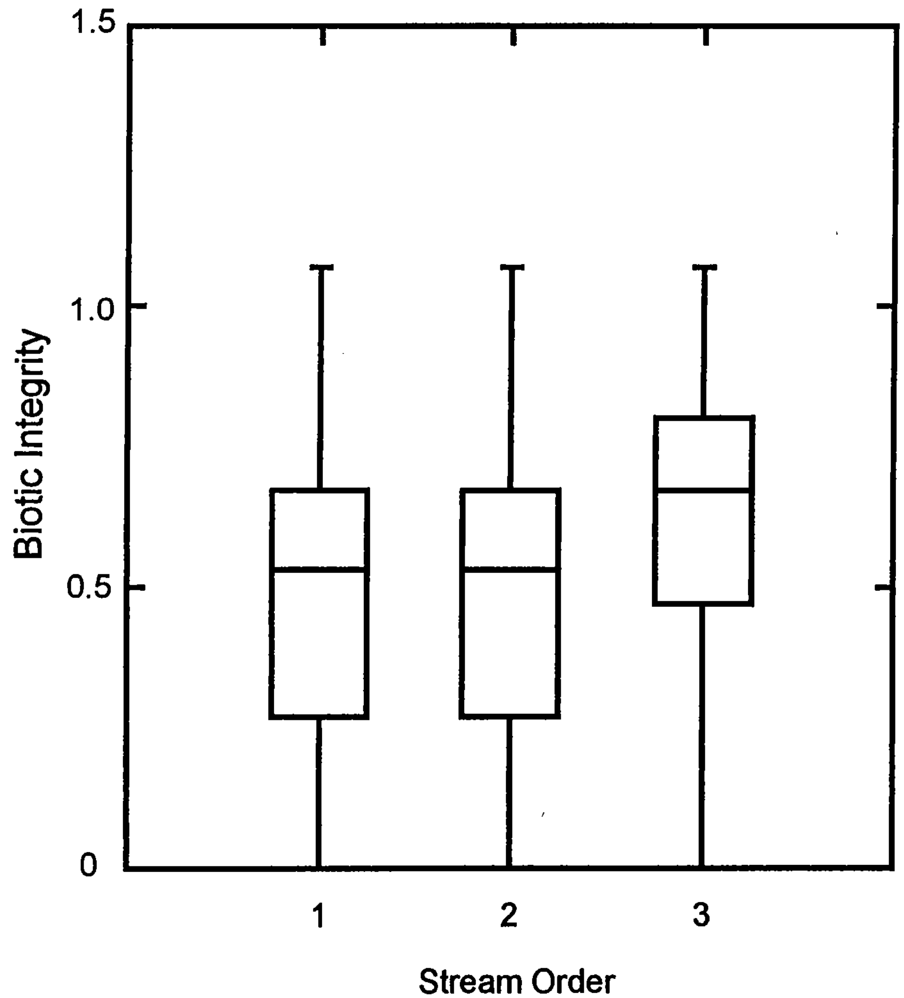


Figure 50
Comparison of Biotic Integrity by Ecoregion for First Order Streams

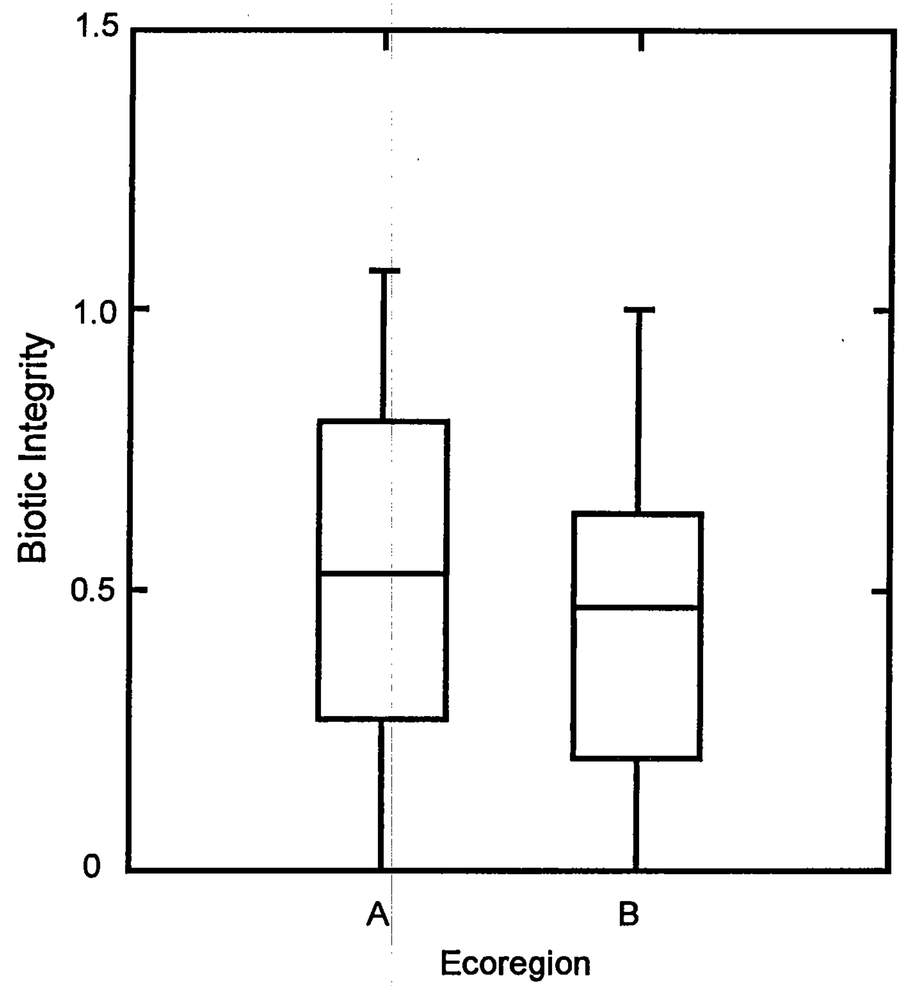


Figure 51
Comparison of Biotic Integrity by Ecoregion for Second Order Streams

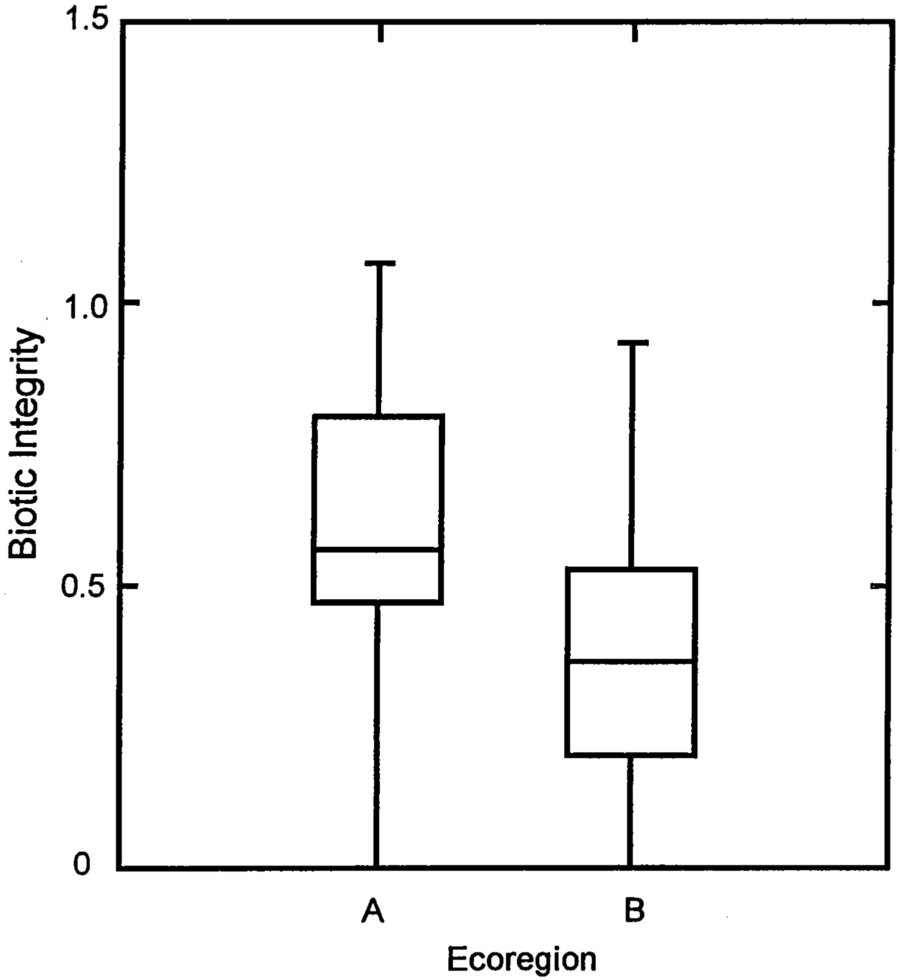


Figure 52
Comparison of Biotic Integrity by Ecoregion for Third Order Streams

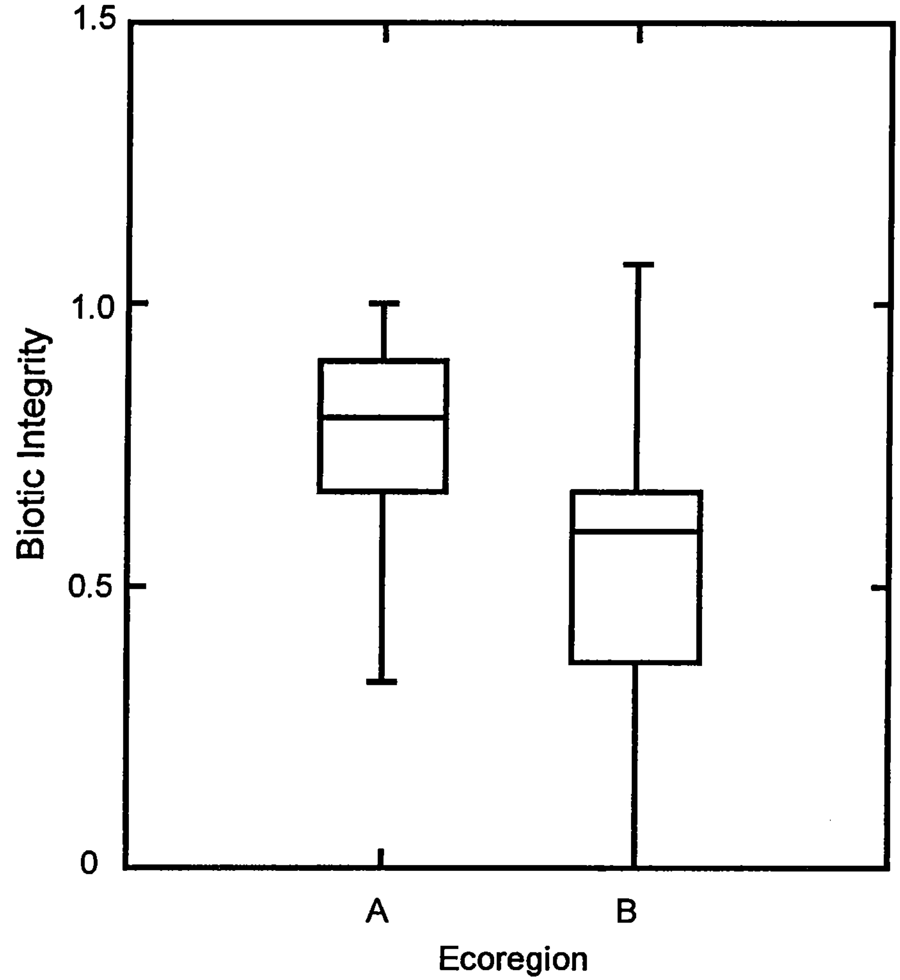


Figure 53
Comparison of Biotic Integrity by Regional Project Watershed for First Order Streams

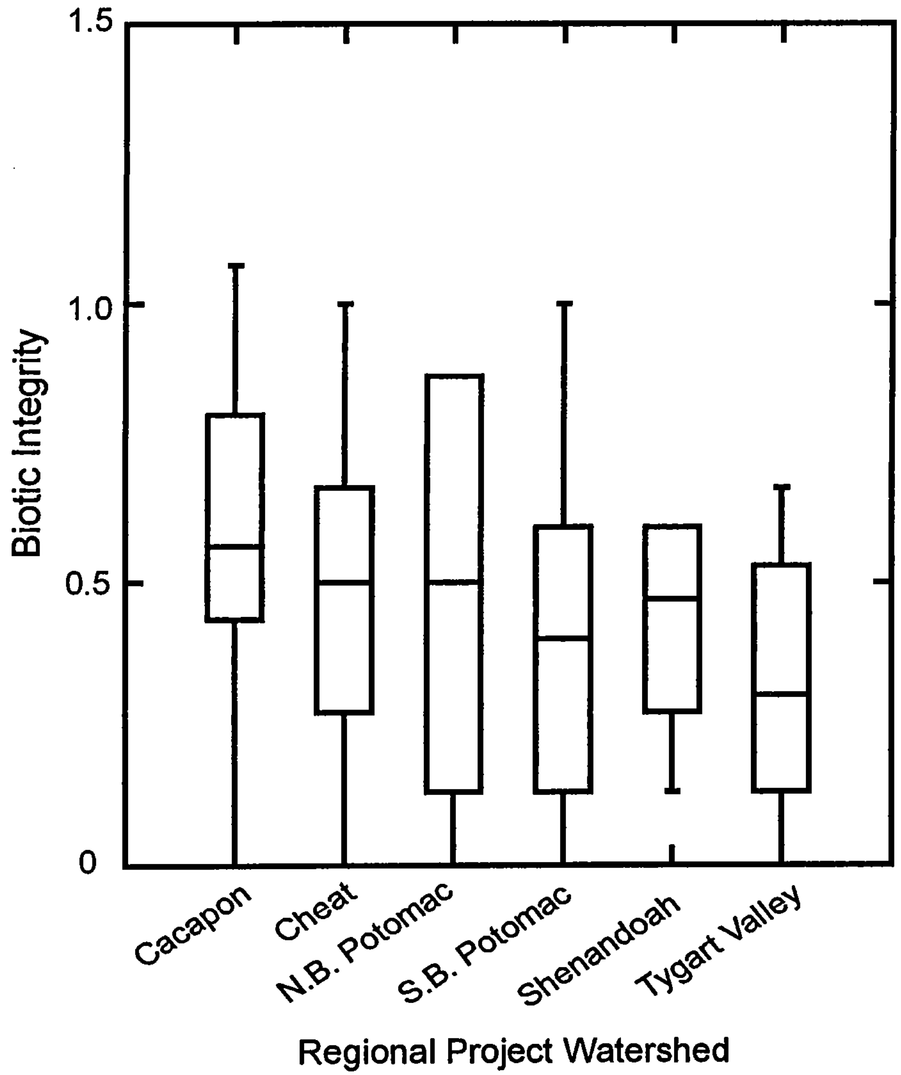


Figure 54
Comparison of Biotic Integrity by Regional Project Watershed for Second Order Streams

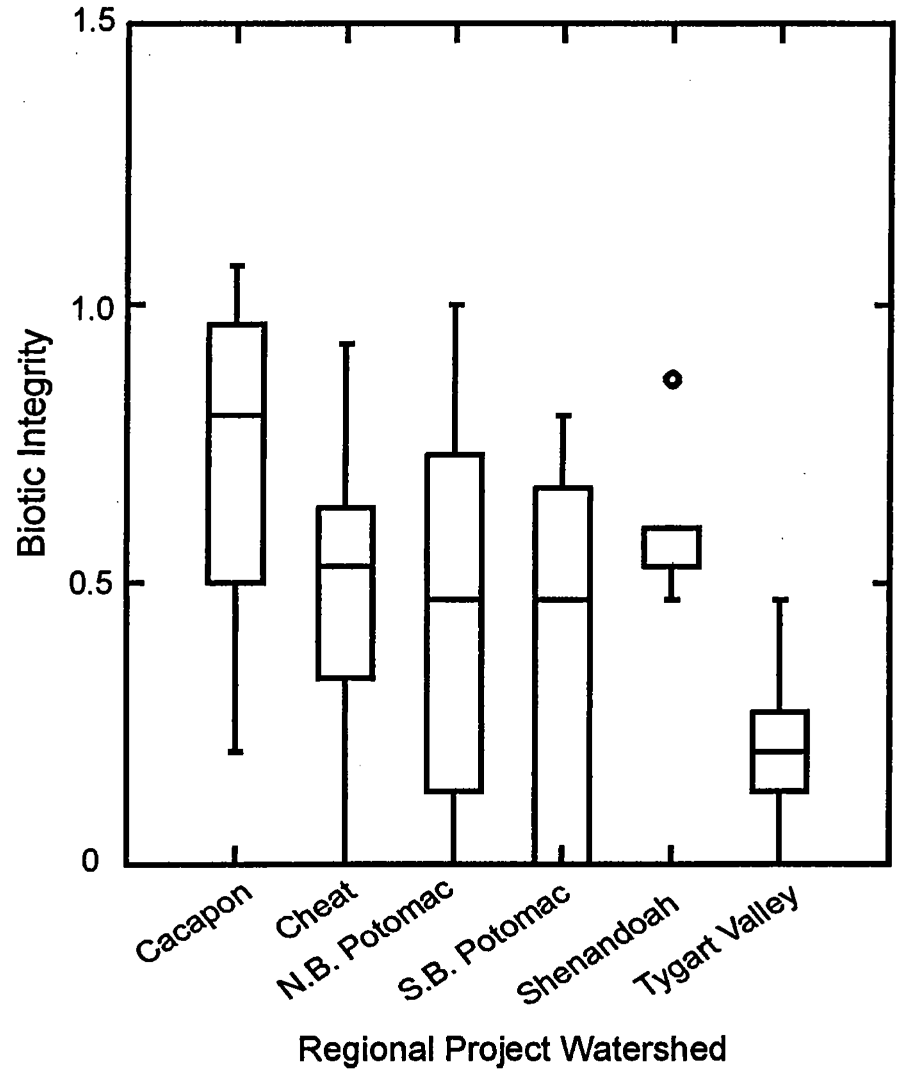


Figure 55
Comparison of Biotic Integrity by Regional Project Watershed for Third Order Streams

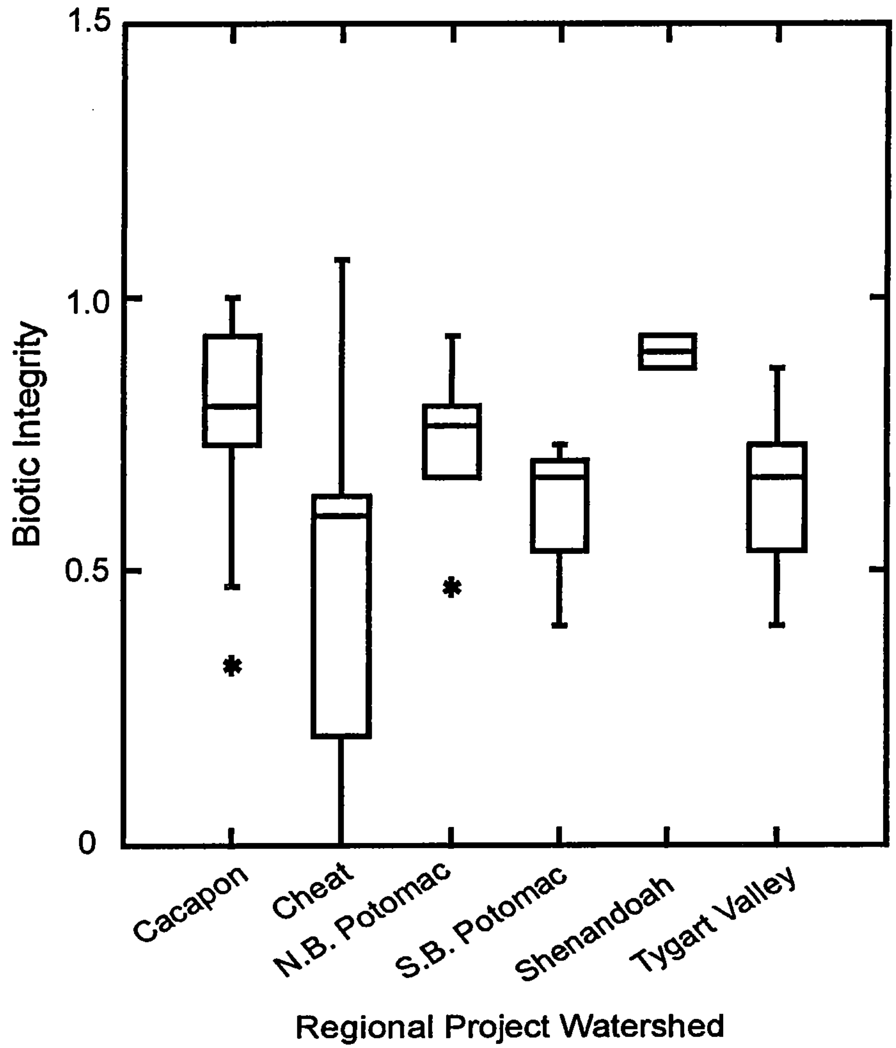


FIGURE 56
CLUSTERING OF BIOTIC INTEGRITY RANK BY STREAM ORDER

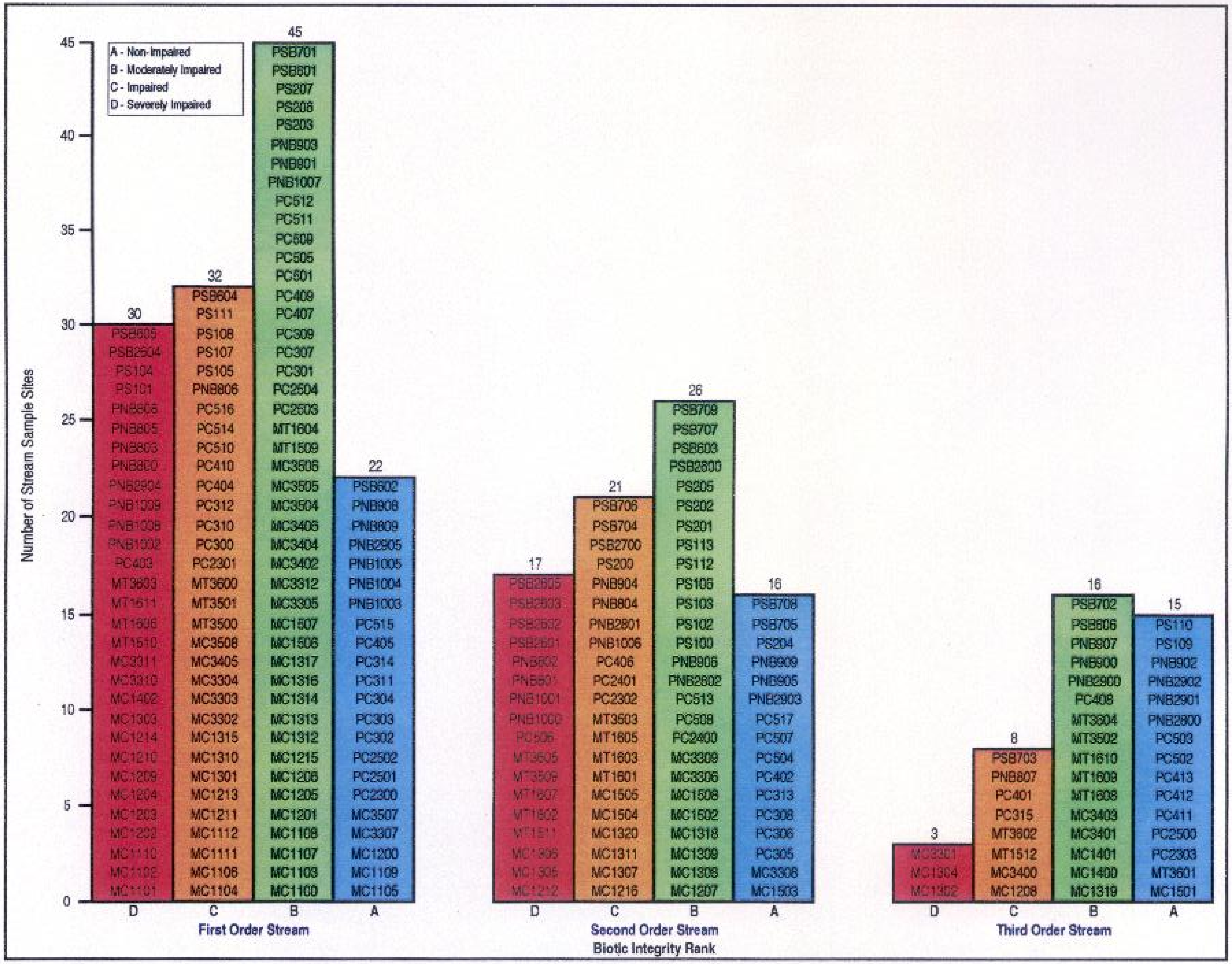


FIGURE 57
CLUSTERING OF BIOTIC INTEGRITY RANKS BY ECOREGION AND STREAM ORDER

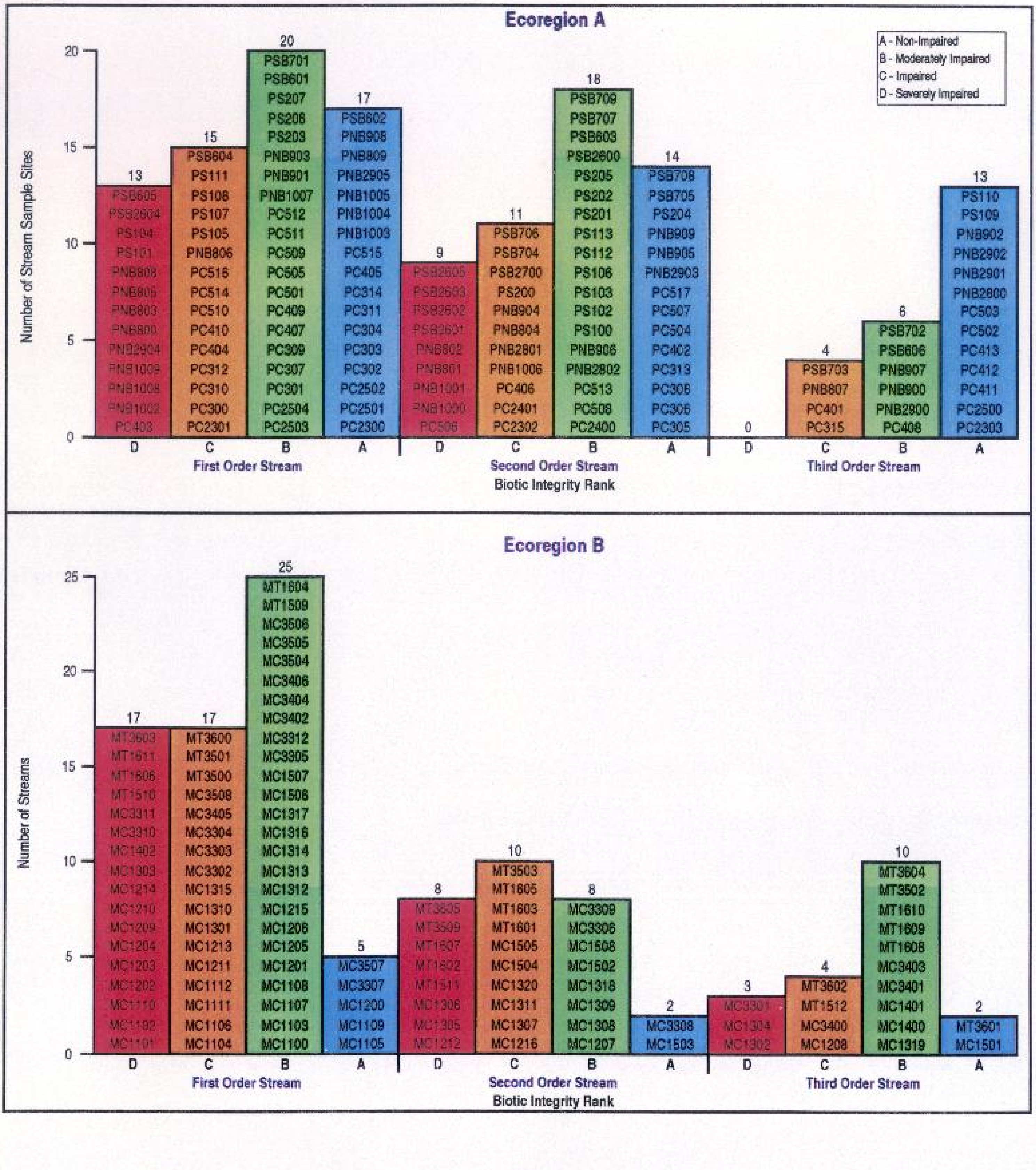


FIGURE 58
CLUSTERING OF BIOTIC INTEGRITY RANKS BY REGIONAL PROJECT WATERSHED AND STREAM ORDER

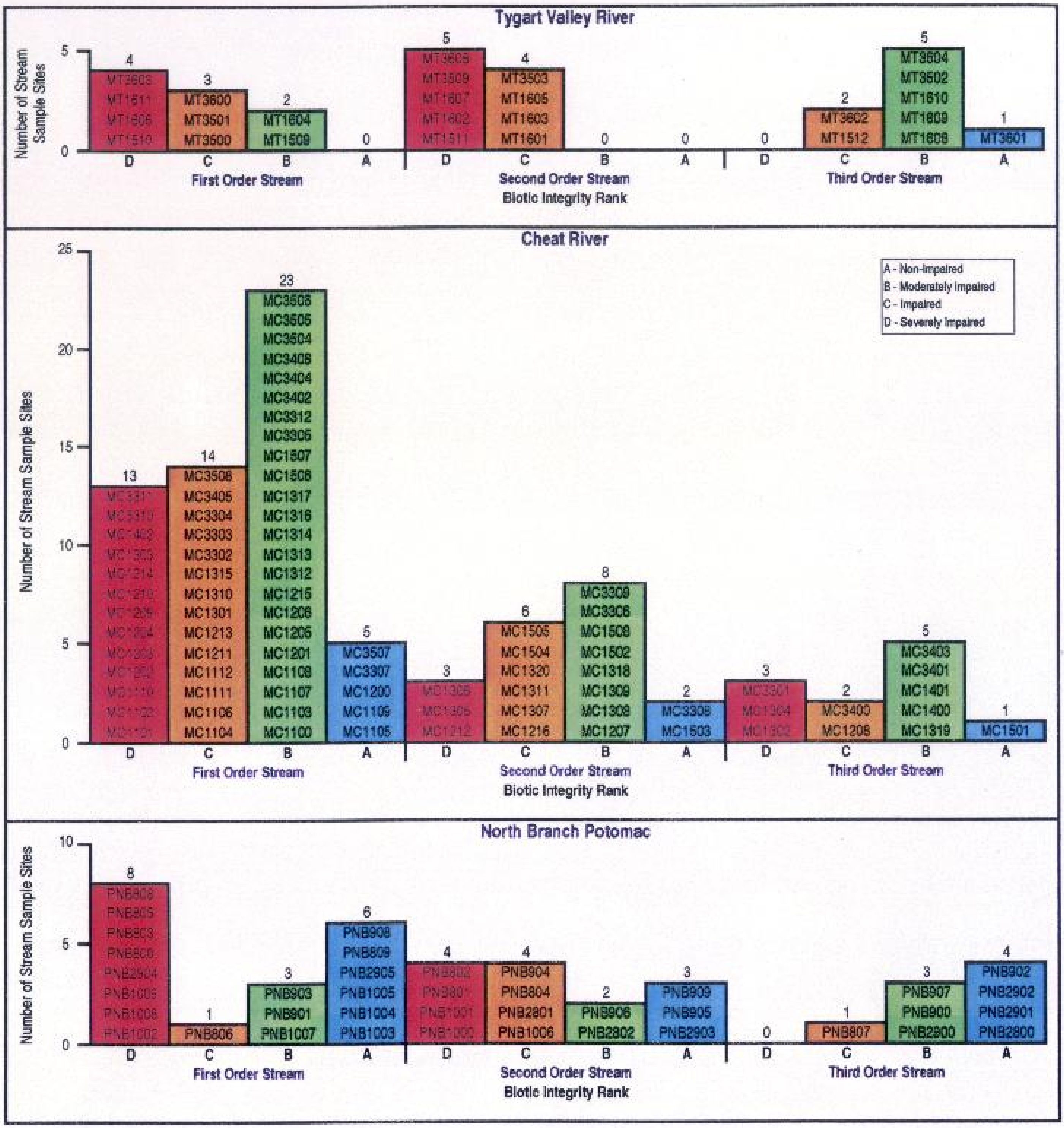


FIGURE 58
CLUSTERING OF BIOTIC INTEGRITY RANKS BY REGIONAL PROJECT WATERSHED AND STREAM ORDER

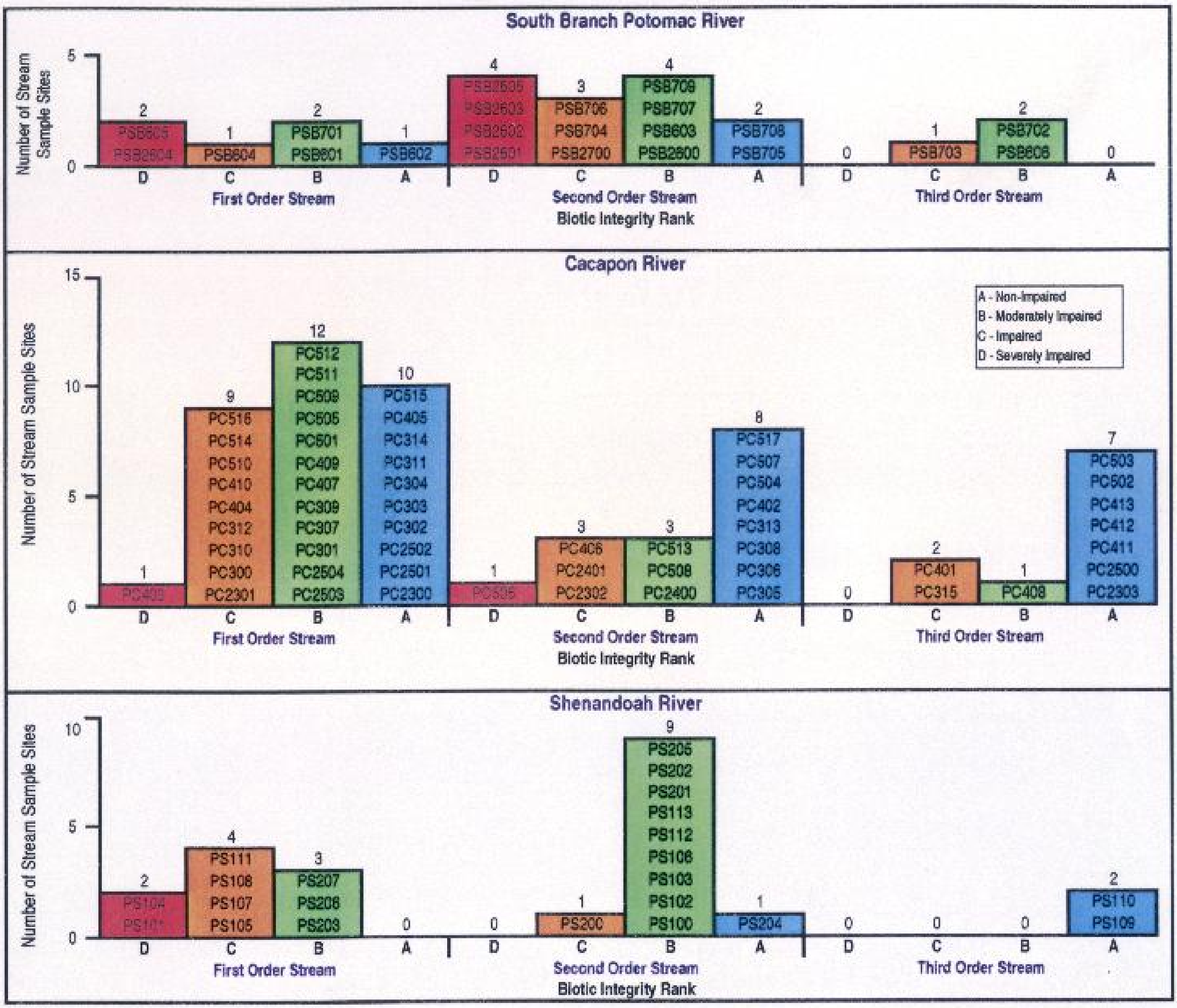


TABLE 12
PERENNIAL STREAM CLASSIFICATION TABLE

Local Project Watershed	Stream ID	Stream Name	Native Trout	Stocked Trout	State High Quality	WV National Resource Waters	Nationwide Rivers Inventory
Leading Creek	MT1509	Wilmoth Run	No	No	No	No	No
Leading Creek	MT1510	trib. Wilmoth Creek	No	No	No	No	No
Leading Creek	MT1511	Wilmoth Creek	No	No	No	No	No
Leading Creek	MT1512	Leading Creek	No	No	Yes	No	No
Leading Creek	MT1601	Davis Lick	No	No	No	No	No
Leading Creek	MT1602	Horse Run	No	No	No	No	No
Leading Creek	MT1603	Pearcy Run	No	No	No	No	No
Leading Creek	MT1604	trib. Leading Creek	No	No	No	No	No
Leading Creek	MT1605	Clay Lick Run	No	No	No	No	No
Leading Creek	MT1606	trib. Claylick Run	No	No	No	No	No
Leading Creek	MT1607	trib. Leading Creek	No	No	No	No	No
Leading Creek	MT1608	Leading Creek	No	No	Yes	No	No
Leading Creek	MT1609	Leading Creek	No	No	Yes	No	No
Leading Creek	MT1610	trib. Leading Creek	No	No	No	No	No
Leading Creek	MT1611	trib. Leading Creek	No	No	No	No	No
Leading Creek	MT3500	trib. Leading Creek	No	No	No	No	No
Leading Creek	MT3501	trib. Cherry Fork	No	No	No	No	No
Leading Creek	MT3502	Cherry Fork	No	No	No	No	No
Leading Creek	MT3503	Long Lick Run	No	No	No	No	No
Leading Creek	MT3504	trib. Leading Creek	No	No	No	No	No
Leading Creek	MT3509	trib. Leading Creek	No	No	No	No	No
Leading Creek	MT3600	trib. Wilmoth Creek	No	No	No	No	No
Leading Creek	MT3601	Leading Creek	No	No	Yes	No	No
Leading Creek	MT3602	Leading Creek	No	No	No	No	No
Leading Creek	MT3603	trib. Leading Creek	No	No	No	No	No
Leading Creek	MT3604	Stalnaker Run	No	No	No	No	No
Leading Creek	MT3605	trib. Leading Creek	No	No	No	No	No
Shavers Fork	MC1400	Shavers Fork	No	No	Yes	Yes	Yes
Shavers Fork	MC1401	Shavers Fork	No	No	Yes	Yes	Yes
Shavers Fork	MC1402	trib. Shavers Fork	No	No	No	No	No
Shavers Fork	MC1501	Shavers Fork	No	No	Yes	Yes	Yes
Shavers Fork	MC1502	Pleasant Run	Yes	No	No	Yes	No
Shavers Fork	MC1503	Pleasant Run	Yes	No	No	Yes	No
Shavers Fork	MC1504	Slab Camp Run	No	No	No	No	No
Shavers Fork	MC1505	Pleasant Run	Yes	No	No	Yes	No
Shavers Fork	MC1506	trib. Pleasant Run	No	No	No	No	No
Shavers Fork	MC1507	trib. Pleasant Run	No	No	No	No	No
Shavers Fork	MC1508	Pleasant Run	No	No	No	No	No
Shavers Fork	MC3401	Shaver Fork	No	No	Yes	Yes	Yes
Shavers Fork	MC3402	Sugarcamp Run	No	No	No	No	No
Shavers Fork	MC3403	Haddix Run	No	No	No	No	No
Shavers Fork	MC3404	Shingle Tree Run	No	No	No	No	No
Shavers Fork	MC3405	Goodwin Run	No	No	No	No	No
Shavers Fork	MC3406	Hawk Run	No	No	No	No	No
Black Fork	MC1100	Four Mile Run	No	No	No	No	No
Black Fork	MC1101	trib. Four Mile Run	No	No	No	No	No
Black Fork	MC1102	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1103	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1104	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1105	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1106	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1107	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1108	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1109	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1110	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1111	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1112	trib. Beaver Creek	No	No	No	No	No

TABLE 12
PERENNIAL STREAM CLASSIFICATION TABLE

Local Project Watershed	Stream ID	Stream Name	Native Trout	Stocked Trout	State High Quality	WV National Resource Waters	Nationwide Rivers Inventory
Black Fork	MC1200	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1201	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1202	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1203	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1204	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1205	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1206	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1207	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1208	Beaver Creek	No	No	Yes	No	No
Black Fork	MC1209	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1210	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1211	trib. Pendleton Creek	No	No	No	No	No
Black Fork	MC1212	Pendleton Creek	No	No	Yes	No	No
Black Fork	MC1213	trib. Pendleton Creek	No	No	No	No	No
Black Fork	MC1214	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1215	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1216	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1301	trib. Beaver Creek	No	No	No	No	No
Black Fork	MC1302	North Fork	No	No	No	No	No
Black Fork	MC1303	trib. N.F. Blackwater	No	No	No	No	No
Black Fork	MC1304	N.F. Blackwater River	No	No	No	No	No
Black Fork	MC1305	Long Run	No	No	No	No	No
Black Fork	MC1306	Long Run	No	No	No	No	No
Black Fork	MC1307	Long Run	No	No	No	No	No
Black Fork	MC1308	Long Run	No	No	No	No	No
Black Fork	MC1309	Middle Run	No	No	No	No	No
Black Fork	MC1310	Tub Run	No	No	No	No	No
Black Fork	MC1311	Big Run	No	No	No	No	No
Black Fork	MC1312	trib. Big Run	No	No	No	No	No
Black Fork	MC1313	trib. Roaring Run	No	No	No	No	No
Black Fork	MC1314	trib. Roaring Run	No	No	No	No	No
Black Fork	MC1315	trib. Roaring Run	No	No	No	No	No
Black Fork	MC1316	trib. Roaring Run	No	No	No	No	No
Black Fork	MC1317	trib. Roaring Run	No	No	No	No	No
Black Fork	MC1318	trib. Black Fork	No	No	No	No	No
Black Fork	MC1319	Black Fork	No	No	No	No	No
Black Fork	MC1320	Roaring Run	Yes	No	Yes	Yes	No
Black Fork	MC3301	N.F. Blackwater	No	No	Yes	No	No
Black Fork	MC3302	Slip Mill Run	Yes	No	Yes	Yes	No
Black Fork	MC3303	trib. Slip Mill Run	No	No	No	No	No
Black Fork	MC3304	trib. Slip Mill Run	No	No	No	No	No
Black Fork	MC3305	Roaring Run	Yes	No	Yes	Yes	No
Black Fork	MC3306	Roaring Run	Yes	No	Yes	Yes	No
Black Fork	MC3307	trib. Roaring Run	No	No	No	No	No
Black Fork	MC3308	Roaring Run	Yes	No	Yes	Yes	No
Black Fork	MC3309	Snyders Run	No	No	No	No	No
Black Fork	MC3310	trib. Snyder Run	No	No	No	No	No
Black Fork	MC3311	trib. Long Run	No	No	No	No	No
Black Fork	MC3312	Long Run	No	No	No	No	No
Black Fork	MC3400	Black Fork	No	No	Yes	No	No
Black Fork	MC3505	trib. Haddix Run	No	No	No	No	No
Black Fork	MC3506	trib. Haddix Run	No	No	No	No	No
Black Fork	MC3507	trib. Haddix Run	No	No	No	No	No
Black Fork	MC3508	Headwater Haddix Run	No	No	No	No	No
Stony River	PNB1000	Little Creek	No	No	No	No	No
Stony River	PNB1001	Abrams Creek	No	No	No	No	No
Stony River	PNB1002	trib. Abrams Creek	No	No	No	No	No

TABLE 12
PERENNIAL STREAM CLASSIFICATION TABLE

Local Project Watershed	Stream ID	Stream Name	Native Trout	Stocked Trout	State High Quality	WV National Resource Waters	Nationwide Rivers Inventory
Stony River	PNB1003	trib. Abrams Creek	No	No	No	No	No
Stony River	PNB1004	trib. Abrams Creek	No	No	No	No	No
Stony River	PNB1005	trib. Stony River	No	No	No	No	No
Stony River	PNB1006	Stony River	No	No	No	No	No
Stony River	PNB1009	trib. Little Creek	No	No	No	No	No
Patterson Creek	PNB1007	trib. Elklick Run	Yes	No	No	Yes	No
Patterson Creek	PNB1008	trib. Elklick Run	No	Yes	No	No	No
Patterson Creek	PNB2800	Patterson Creek	No	No	Yes	No	No
Patterson Creek	PNB2801	N.F. of Patterson Creek	No	Yes	Yes	No	No
Patterson Creek	PNB2802	trib. N.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB2900	N.F. Patterson Creek	No	Yes	Yes	No	No
Patterson Creek	PNB2901	N.F. Patterson Creek	No	Yes	Yes	No	No
Patterson Creek	PNB2902	N.F. Patterson Creek	No	Yes	Yes	No	No
Patterson Creek	PNB2903	trib. N.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB2904	trib. N.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB2905	trib. N.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB800	trib. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB801	trib. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB802	trib. Thorn Run	No	No	No	No	No
Patterson Creek	PNB803	trib. Thorn Run	No	No	No	No	No
Patterson Creek	PNB804	trib. Thorn Run	No	No	No	No	No
Patterson Creek	PNB805	trib. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB806	trib. S.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB807	Patterson Creek	No	No	Yes	No	No
Patterson Creek	PNB808	trib. N.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB809	trib. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB900	M.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB901	trib. M.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB902	N.F. Patterson Creek	No	Yes	Yes	No	No
Patterson Creek	PNB903	trib. Elklick Run	No	No	No	No	No
Patterson Creek	PNB904	trib. Elklick Run	No	No	No	No	No
Patterson Creek	PNB905	trib. Elklick Run	No	No	No	No	No
Patterson Creek	PNB906	Elklick Run	Yes	No	Yes	Tes	No
Patterson Creek	PNB907	M.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB908	trib. N.F. Patterson Creek	No	No	No	No	No
Patterson Creek	PNB909	trib. N.F. Patterson Creek	No	No	No	No	No
Anderson Run	PSB702	Walnut Bottom Run	No	No	No	No	No
Anderson Run	PSB703	Walnut Bottom Run	No	No	No	No	No
Anderson Run	PSB704	trib. Walnut Bottom Run	No	No	No	No	No
Anderson Run	PSB705	trib. Walnut Bottom Run	No	No	No	No	No
Anderson Run	PSB706	trib. Walnut Bottom Run	No	No	No	No	No
Anderson Run	PSB707	Tombs Hollow Run	No	No	No	No	No
Anderson Run	PSB708	Walnut Bottom Run	No	No	No	No	No
Anderson Run	PSB709	trib. Walnut Bottom Run	No	No	No	No	No
Anderson Run	PSB2700	Anderson Run	No	No	No	No	No
South Branch	PSB603	Clifford Hollow	No	No	No	No	No
South Branch	PSB604	trib. Fort Run	No	No	No	No	No
South Branch	PSB605	trib. S.B. Potomac River	No	No	No	No	No
South Branch	PSB606	S.B. Potomac River	No	No	Yes	Yes	Yes
South Branch	PSB701	trib. S.B. Potomac River	No	No	No	No	No
Main Channel	PSB2600	Fort Run	No	No	No	No	No
Main Channel	PSB2601	Dumpling Run	No	No	No	No	No
Main Channel	PSB2602	Fort Run	No	No	No	No	No
South Branch	PSB2603	Dumpling Run	No	No	No	No	No
South Branch	PSB2604	trib. Dumpling Run	No	No	No	No	No
South Branch	PSB2605	Dumpling Run	No	No	No	No	No
Clifford Hollow	PSB601	trib. Clifford Hollow	No	No	No	No	No

TABLE 12
PERENNIAL STREAM CLASSIFICATION TABLE

Local Project Watershed	Stream ID	Stream Name	Native Trout	Stocked Trout	State High Quality	WV National Resource Waters	Nationwide Rivers Inventory
Clifford Hollow	PSB602	trib. Clifford Hollow	No	No	No	No	No
Skaggs Run	PC509	trib. Skaggs Run	No	No	No	No	No
Skaggs Run	PC510	trib. Skaggs Run	No	No	No	No	No
Skaggs Run	PC511	trib. Skaggs Run	No	No	No	No	No
Skaggs Run	PC512	trib. Skaggs Run	No	No	No	No	No
Skaggs Run	PC513	Skaggs Run	No	No	No	No	No
Skaggs Run	PC514	trib. Skaggs Run	No	No	No	No	No
Skaggs Run	PC515	trib. Skaggs Run	No	No	No	No	No
Skaggs Run	PC516	trib. Skaggs Run	No	No	No	No	No
Skaggs Run	PC517	trib. Baker Run	No	No	No	No	No
Skaggs Run	PC2503	trib. Skaggs Run	No	No	No	No	No
Skaggs Run	PC2504	trib. Skaggs Run	No	No	No	No	No
Baker Run	PC412	Baker Run	No	No	No	No	No
Baker Run	PC501	trib. Baker Run	No	No	No	No	No
Baker Run	PC502	Baker Run	No	No	No	No	No
Baker Run	PC503	Baker Run	No	No	No	No	No
Baker Run	PC504	Long Lick Run	No	No	No	No	No
Baker Run	PC505	trib. Long Lick Run	No	No	No	No	No
Baker Run	PC506	trib. Long Lick Run	No	No	No	No	No
Baker Run	PC507	Long Lick Run	No	No	No	No	No
Baker Run	PC508	Long Lick Run	No	No	No	No	No
Baker Run	PC2500	Baker Run	No	No	No	No	No
Central Cacapon	PC314	trib. Trout Run	No	No	No	No	No
Central Cacapon	PC315	Trout Run	Yes	Yes	Yes	Yes	No
Central Cacapon	PC401	Lost River	No	Yes	Yes	Yes	Yes
Central Cacapon	PC402	Sauerkraut Run	No	No	No	No	No
Central Cacapon	PC403	trib. Lost River	No	No	No	No	No
Central Cacapon	PC404	trib. Lost River	No	No	No	No	No
Central Cacapon	PC405	trib. Lost River	No	No	No	No	No
Central Cacapon	PC406	trib. Lost River	No	No	No	No	No
Central Cacapon	PC407	trib. Lost River	No	No	No	No	No
Central Cacapon	PC408	Lost River	No	Yes	Yes	Yes	Yes
Central Cacapon	PC409	trib. Lost River	No	No	No	No	No
Central Cacapon	PC410	trib. Lost River	No	No	No	No	No
Central Cacapon	PC411	Lost River	No	Yes	Yes	Yes	Yes
Central Cacapon	PC413	Lost River	No	Yes	Yes	Yes	Yes
Central Cacapon	PC2400	trib. Lost River	No	No	No	No	No
Central Cacapon	PC2401	trib. Lost River	No	No	No	No	No
Central Cacapon	PC2501	trib. Long Lick Run	No	No	No	No	No
Central Cacapon	PC2502	trib. Long Lick Run	No	No	No	No	No
Waites Run	PC306	Waites Run	No	Yes	Yes	No	No
Waites Run	PC307	trib. Waites Run	No	No	No	No	No
Waites Run	PC308	Waites Run	No	Yes	Yes	No	No
Waites Run	PC309	trib. Waites Run	No	No	No	No	No
Waites Run	PC310	trib. Waites Run	No	No	No	No	No
Waites Run	PC311	trib. Waites Run	No	No	No	No	No
Waites Run	PC312	trib. Waites Run	No	No	No	No	No
Waites Run	PC313	trib. Waites Run	No	No	No	No	No
Waites Run	PC2303	Waites Run	No	Yes	Yes	No	No
Slate Rock Run	PC300	trib. Sine Run	No	No	No	No	No
Slate Rock Run	PC301	trib. Sine Run	No	No	No	No	No
Slate Rock Run	PC302	trib. Sine Run	No	No	No	No	No
Slate Rock Run	PC303	trib. Sine Run	No	No	No	No	No
Slate Rock Run	PC304	trib. Slate Rock Run	No	No	No	No	No
Slate Rock Run	PC305	Slate Rock Run	No	No	No	No	No
Slate Rock Run	PC2300	trib. Slate Rock Run	No	No	No	No	No
Slate Rock Run	PC2301	trib. Slate Rock Run	No	No	No	No	No

TABLE 12
PERENNIAL STREAM CLASSIFICATION TABLE

Local Project Watershed	Stream ID	Stream Name	Native Trout	Stocked Trout	State High Quality	WV National Resource Waters	Nationwide Rivers Inventory
Slate Rock Run	PC2302	Slate Rock Run	No	No	No	No	No
Cedar Creek	PS100	Town Run	No	No	No	No	No
Cedar Creek	PS101	Town Run	No	No	No	No	No
Cedar Creek	PS102	trib. Mulberry Run	No	No	No	No	No
Cedar Creek	PS103	trib. Mulberry Run	No	No	No	No	No
Cedar Creek	PS104	trib. Cedar Creek	No	No	No	No	No
Cedar Creek	PS105	trib. Mulberry Run	No	No	No	No	No
Cedar Creek	PS106	Mulberry Run	No	No	No	No	No
Cedar Creek	PS107	trib. Mulberry Run	No	No	No	No	No
Cedar Creek	PS108	trib. Mulberry Run	No	No	No	No	No
Cedar Creek	PS109	Cedar Creek	No	Yes	No	Yes	Yes
Cedar Creek	PS110	Cedar Creek	No	Yes	No	Yes	Yes
Cedar Creek	PS111	trib. Cedar Creek	No	No	No	No	No
Cedar Creek	PS112	Mulberry Run	No	No	No	No	No
Cedar Creek	PS113	Turkey Run	No	No	No	No	No
Cedar Creek	PS200	Duck Run	Yes	No	Yes	Yes	No
Cedar Creek	PS201	Duck Run	Yes	No	Yes	Yes	No
Cedar Creek	PS202	Duck Run	Yes	No	Yes	Yes	No
Cedar Creek	PS203	trib. Duck Run	Yes	No	Yes	Yes	No
Cedar Creek	PS204	trib. Duck Run	Yes	No	Yes	Yes	No
Cedar Creek	PS205	trib. Duck Run	Yes	No	Yes	Yes	No
Cedar Creek	PS206	trib. Duck Run	Yes	No	Yes	Yes	No
Cedar Creek	PS207	trib. Paddy Run	Yes	No	No	Yes	No

Note: State High Quality Streams

In West Virginia = High Quality Streams as defined by WVDBR

Virginia = Outstanding State Resource Waters as defined by VADEQ

FIGURE 59

BIOTIC INTEGRITY CLUSTER - REGIONAL PROJECT WATERSHED AND STREAM ORDER

TYGART VALLEY RIVER

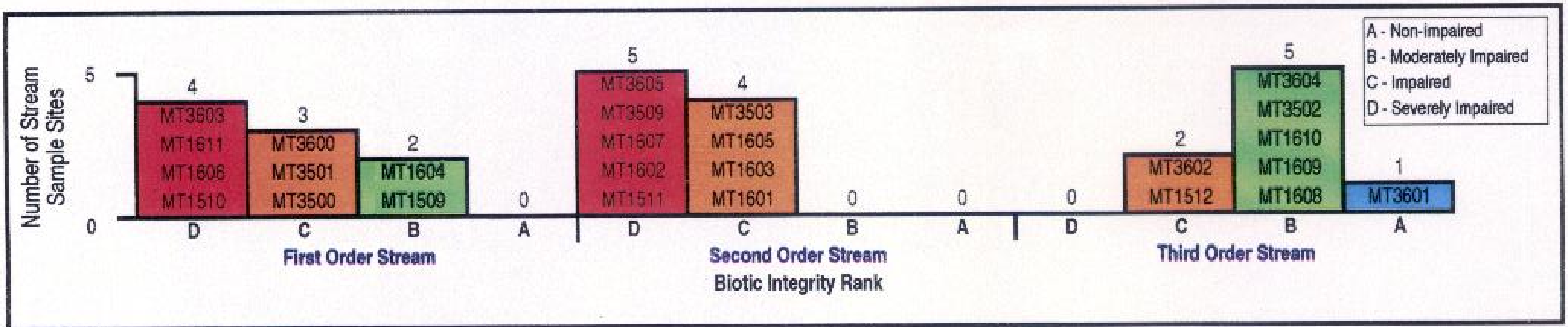


FIGURE 60
BIOTIC INTEGRITY CLUSTER - REGIONAL PROJECT WATERSHED AND STREAM ORDER
CHEAT RIVER

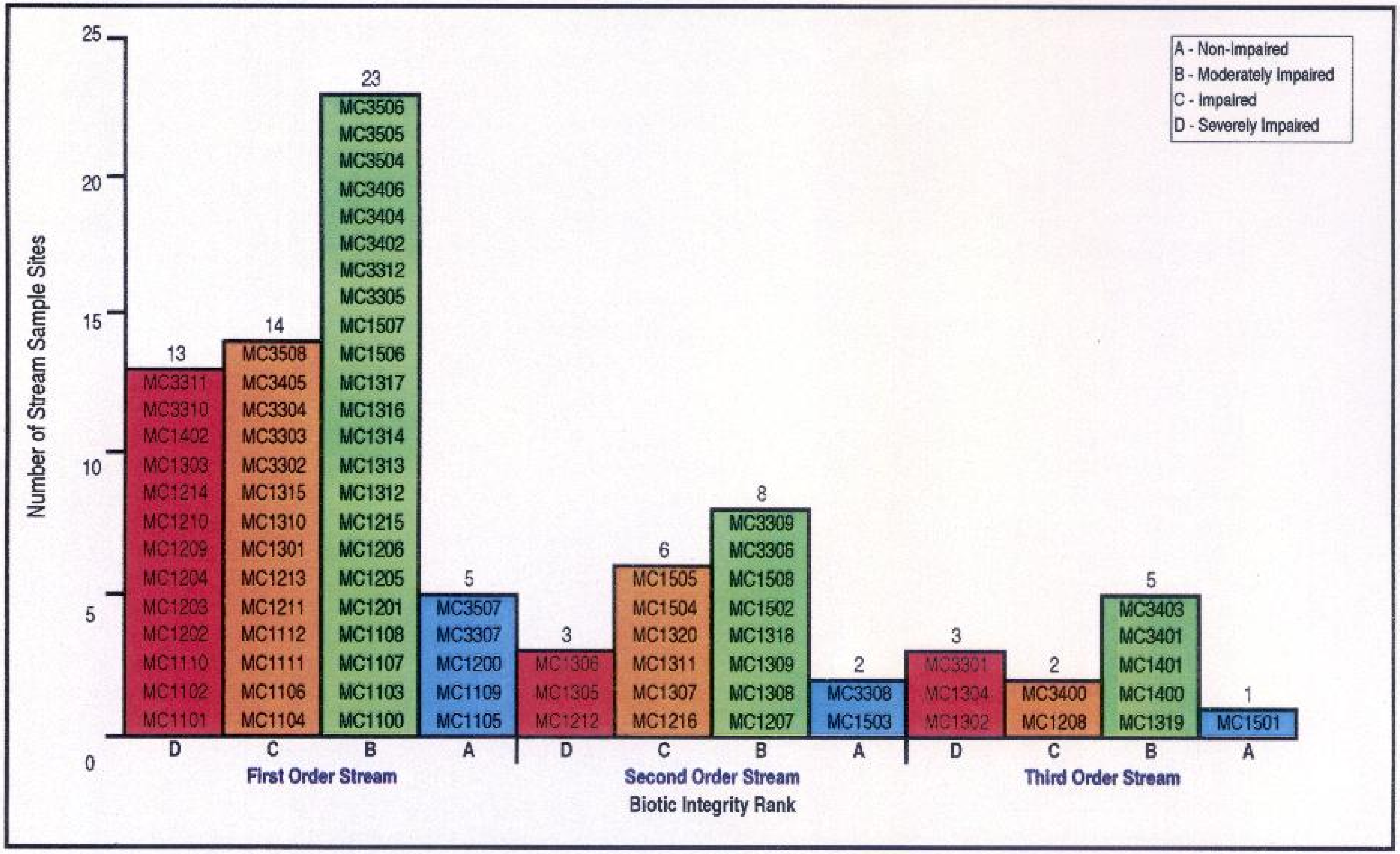


FIGURE 61
BIOTIC INTEGRITY CLUSTER - REGIONAL PROJECT WATERSHED AND STREAM ORDER
NORTH BRANCH POTOMAC RIVER

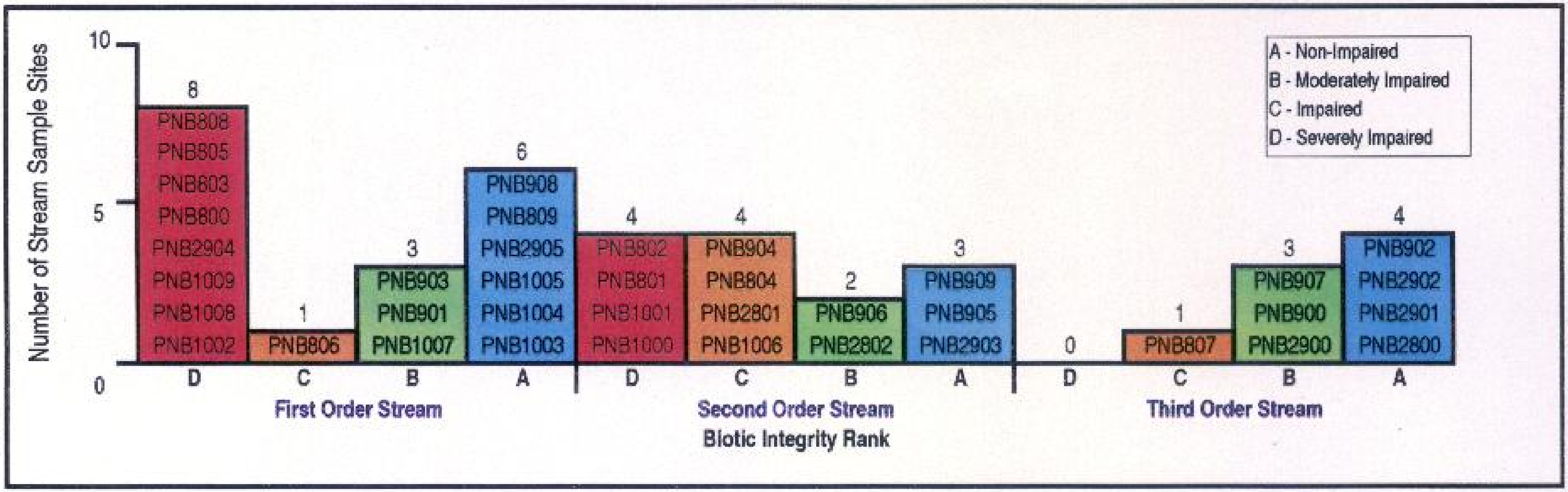


FIGURE 62
BIOTIC INTEGRITY CLUSTER - REGIONAL PROJECT WATERSHED AND STREAM ORDER
SOUTH BRANCH POTOMAC RIVER

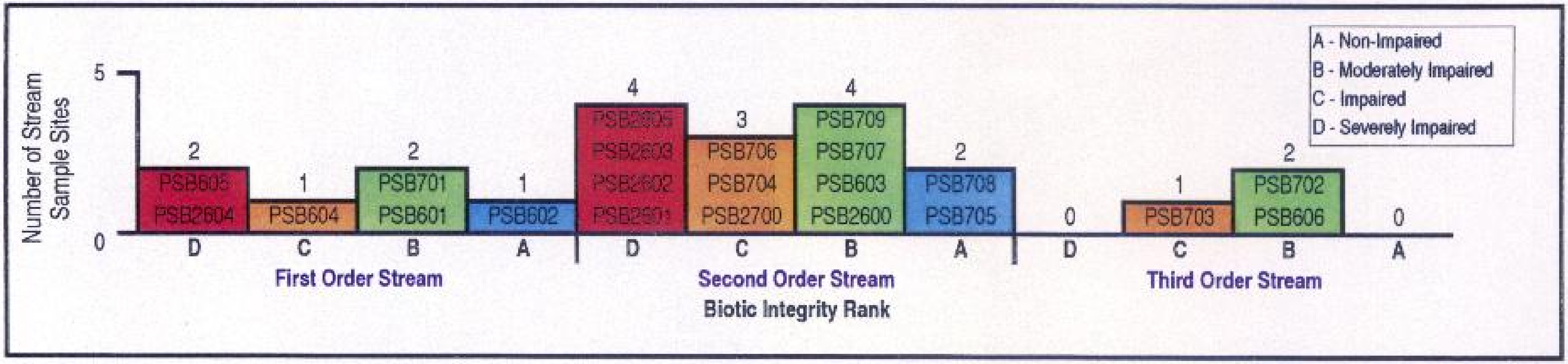


FIGURE 63

BIOTIC INTEGRITY CLUSTER - REGIONAL PROJECT WATERSHED AND STREAM ORDER

CACAPON RIVER

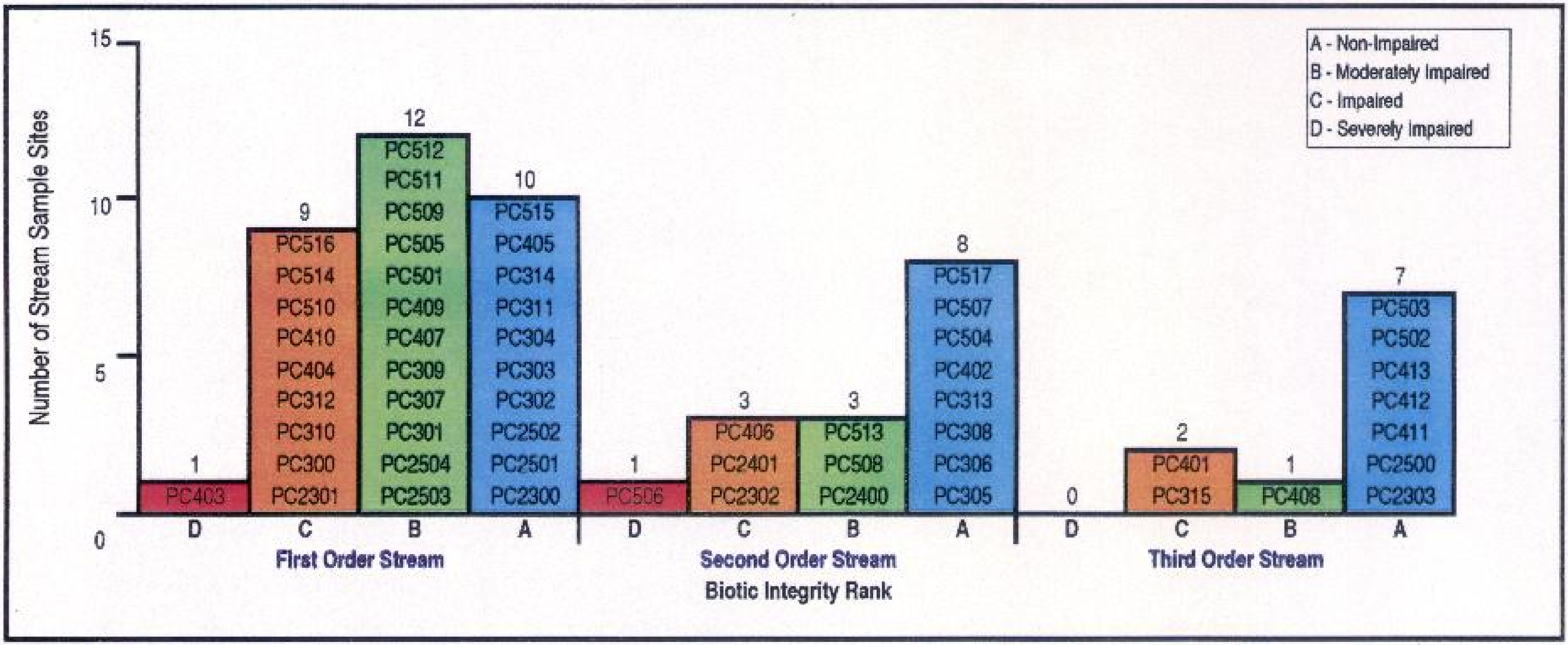


FIGURE 64
BIOTIC INTEGRITY CLUSTER - REGIONAL PROJECT WATERSHED AND STREAM ORDER
SHENANDOAH RIVER

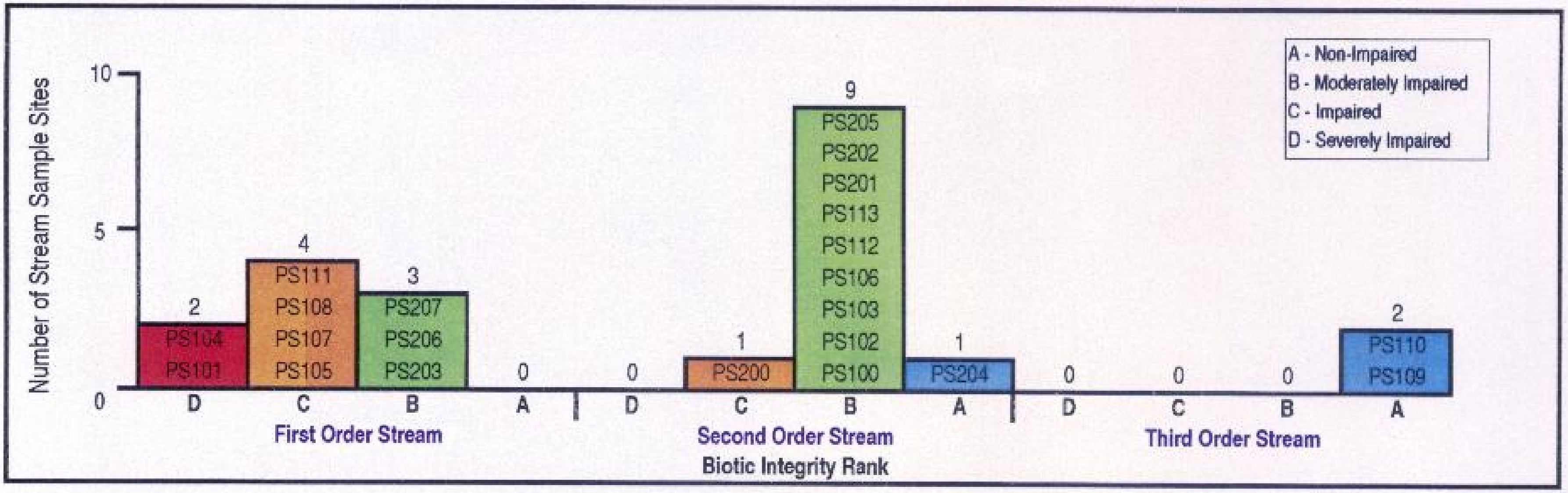


TABLE 13
STREAM CROSSING CLUSTER BY LOCAL PROJECT WATERSHED, STREAM ORDER, AND DRAINAGE STRUCTURE
IRA & Build - Line A

											Build - Line A						
Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet
Leading Creek	1	Pipe	MC3504	96	32	10	2.9	0.67	30	100							
			MT1604	81	8	5	5.4	0.53	30	100	81	8	5	5.4	0.53	122	400
			MT1606	59	2	2	3.0	0.13	198	650	59	2	2	3.0	0.13	229	750
			MT3500	28	33	7	6.6	0.47	46	150							
			MT3501	36	11	6	6.8	0.33	30	100							
			MT3600	38	75	9	7.2	0.27	24	80							
			MT3603	76	106	10	7.8	0.20	38	125	76	106	10	7.8	0.20	15	50
		Pipe Total		**59**	**38**	**7**	**5.7**	**0.37**	**398**	**1305**	**72**	**39**	**6**	**5.4**	**0.29**	**366**	**1200**
	2	Box Culvert	MT1602								44		1	9.0		104	340
			MT1607	58	1	1	4.0	0.13	84	275	58	1	1	4.0	0.13	122	400
			MT3605	105	37	4	7.9	0.13	46	150							
		Box Culvert Total		**82**	**19**	**3**	**5.9**	**0.13**	**130**	**425**	**51**	**1**	**1**	**6.5**	**0.07**	**226**	**740**
		Pipe	MT1511	53	23	4	7.9	0.20	23	75							
			MT3503	76	87	11	6.7	0.47	24	80							
			MT3509	43	68	5	7.8	0.20	24	80							
		Pipe Total		**57**	**59**	**7**	**7.5**	**0.29**	**72**	**235**							
Leading Creek Total				**62**	**40**	**6**	**6.2**	**0.31**	**599**	**1965**	**64**	**23**	**4**	**5.8**	**0.20**	**591**	**1940**
Shavers Fork	1	Pipe	MC1506								85	25	9	4.0	0.67	280	920
			MC3404	95	38	8	1.3	0.53	37	120							
			MC3405	103	22	6	5.3	0.40	24	80							
			MC3406	90	100	16	4.6	0.73	34	110							
			MC3505	81	83	7	3.7	0.60	30	100							
			MC3506	79	36	4	1.3	0.60	24	80							
			MC3507	90	98	16	3.8	1.00	30	100							
		Pipe Total		**90**	**63**	**10**	**3.3**	**0.64**	**180**	**590**	**85**	**25**	**9**	**4.0**	**0.67**	**280**	**920**
Shavers Fork Total				**90**	**63**	**10**	**3.3**	**0.64**	**180**	**590**	**85**	**25**	**9**	**4.0**	**0.67**	**280**	**920**
Black Fork	1	Box Culvert	MC1102	53	105	1	8.0		30	100							
			MC1104								106	14	6	2.4	0.47	94	310
			MC1105	101	87	8	1.9	0.87	61	200	101	87	8	1.9	0.87	55	180
			MC1112	49	5	3	5.2	0.27	30	100	49	5	3	5.2	0.27	49	160
			MC1206								41	97	4	0.2	0.60	23	75
			MC1312								91	21	11	3.7	0.73	61	200
			MC1314								99	26	10	3.0	0.67	274	900
		Box Culvert Total		**68**	**66**	**4**	**5.0**	**0.38**	**122**	**400**	**81**	**42**	**7**	**2.7**	**0.60**	**556**	**1825**

TABLE 13
STREAM CROSSING CLUSTER BY LOCAL PROJECT WATERSHED, STREAM ORDER, AND DRAINAGE STRUCTURE
IRA & Build - Line A

Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Build - Line A Average Habitat Score	Build - Line A Average #Ind.	Build - Line A Average #Families	Build - Line A Average FBI	Build - Line A Average B.I.	Build - Line A Sum Length meters	Build - Line A Sum Length feet
Black Fork (cont.)	1	Pipe	MC1100								62	11	6	3.1	0.53	137	450
			MC1103	63	42	3	1.5	0.60	24	80							
			MC1106	75	65	6	6.5	0.47	30	100	75	65	6	6.5	0.47	40	130
			MC1107	57	84	5	1.9	0.60	24	80	57	84	5	1.9	0.60	46	150
			MC1108	89	94	8	2.8	0.73	37	120	89	94	8	2.8	0.73	61	200
			MC1110	83	2	2	6.5	0.20	30	100	83	2	2	6.5	0.20	58	190
			MC1111	57	5	5	4.2	0.40	24	80	57	5	5	4.2	0.40	137	450
			MC1200	90	119	11	2.1	0.93	24	80	90	119	11	2.1	0.93	23	75
			MC1201	84	88	8	1.9	0.67	24	80							
			MC1203	49		1	10.0		24	80	49		1	10.0		23	75
			MC1204								52		1	10.0		23	75
			MC1205								43	104	7	3.3	0.67	23	75
			MC1209	60		1	8.0		24	80	60		1	8.0		23	75
			MC1210	62	53	5	7.5	0.20	24	80	62	53	5	7.5	0.20	23	75
			MC1211	38	39	6	7.3	0.33	24	80							
			MC1213								32	47	7	6.3	0.27	183	600
			MC1214	80	118	4	5.1	0.20	24	80							
			MC1215	57	41	3	4.8	0.53	24	80	57	41	3	4.8	0.53	61	200
			MC1316								111	40	9	3.3	0.73	271	890
			MC1317								51	33	5	3.8	0.60	323	1060
			MC3302	56	7	5	6.3	0.47	165	540							
			MC3303	66	3	2	2.3	0.27	91	300							
			MC3304	66	6	3	2.2	0.33	55	180	66	6	3	2.2	0.33	125	410
			MC3305	111	24	9	2.5	0.67	244	800							
			MC3307	103	81	12	2.6	0.87	61	200							
			MC3310	68		1	8.0		61	200							
			MC3311	51		1	8.0		24	80							
			MC3312	87	42	5	4.0	0.53	61	200							
		Pipe Total		**71**	**42**	**5**	**4.8**	**0.41**	**1128**	**3700**	**64**	**41**	**5**	**5.1**	**0.42**	**1579**	**5180**
	2	Box Culvert	MC1212								86	107	7	6.0	0.20	61	200
			MC1308								79	44	10	5.5	0.53	183	600
			MC1309								57	39	13	5.9	0.60	49	160
			MC1318								82	56	13	4.1	0.73	198	650
		Box Culvert Total									**76**	**62**	**11**	**5.4**	**0.52**	**491**	**1610**
		Pipe	MC1212	86	107	7	6.0	0.20	24	80							
			MC1216	42	12	5	4.3	0.40	24	80	42	12	5	4.3	0.40	30	100
		Pipe Total		**64**	**60**	**6**	**5.2**	**0.30**	**49**	**160**	**42**	**12**	**5**	**4.3**	**0.40**	**30**	**100**
Black Fork Total				**70**	**46**	**5**	**4.9**	**0.40**	**1298**	**4260**	**69**	**43**	**6**	**4.6**	**0.47**	**2656**	**8715**

TABLE 13
STREAM CROSSING CLUSTER BY LOCAL PROJECT WATERSHED, STREAM ORDER, AND DRAINAGE STRUCTURE
IRA & Build - Line A

Local Project Watershed	Stream Order	Structure	Stream ID								Build - Line A						
				Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet
Stony River	1	Pipe	PNB1003	68	98	12	2.5	0.87	30	100							
			PNB1005								97	32	11	2.7	0.87	91	300
			PNB1009	78		1	8.0		122	400							
		Pipe Total		73	49	7	5.2	0.44	152	500	97	32	11	2.7	0.87	91	300
	2	Box Culvert	PNB1000								51		1	9.0		76	250
			PNB1001								50		1	9.0		137	450
		Box Culvert Total									51		1	9.0		213	700
		Pipe	PNB1000	51		1	9.0		189	620							
			PNB1001	50		1	9.0		52	170							
		Pipe Total		51		1	9.0		241	790							
Stony River Total				62	25	4	7.1	0.22	393	1290	66	11	4	6.9	0.29	305	1000
Patterson Creek	1	Box Culvert	PNB2905	74	122	11	3.3	0.87	46	150							
		Box Culvert Total		74	122	11	3.3	0.87	46	150							
		Pipe	PNB800								34	10	2	7.9		116	380
			PNB803								86	1	1	3.0	0.13	82	270
			PNB806								62	7	4	6.6	0.40	101	330
		Pipe Total									61	6	2	5.8	0.18	299	980
	2	Box Culvert	PNB2903	89	106	21	4.3	0.80	49	160							
			PNB804								71	43	6	6.6	0.27	137	450
		Box Culvert Total		89	106	21	4.3	0.80	49	160	71	43	6	6.6	0.27	137	450
		Pipe	PNB2802	80	120	13	5.3	0.73	67	220							
			PNB801								87	89	4	7.7	0.13	244	800
			PNB802								74	5	2	5.2	0.07	128	420
		Pipe Total		80	120	13	5.3	0.73	67	220	81	47	3	6.4	0.10	372	1220
	3	Box Culvert	PNB807								48	97	11	6.5	0.47	152	500
		Box Culvert Total									48	97	11	6.5	0.47	152	500
Patterson Creek Total				81	116	15	4.3	0.80	162	530	66	36	4	6.2	0.21	960	3150
Anderson Run	2	Box Culvert	PSB709								66	61	8	2.5	0.67	198	650
		Box Culvert Total									66	61	8	2.5	0.67	198	650
Anderson Run Total											66	61	8	2.5	0.67	198	650
Main Channel	2	Pipe	PSB2600	104	108	5	3.4	0.60	70	230							
		Pipe Total		104	108	5	3.4	0.60	70	230							
Main Channel Total				104	108	5	3.4	0.60	70	230							

TABLE 13
STREAM CROSSING CLUSTER BY LOCAL PROJECT WATERSHED, STREAM ORDER, AND DRAINAGE STRUCTURE
IRA & Build - Line A

Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Build - Line A Average Habitat Score	Build - Line A Average #Ind.	Build - Line A Average #Families	Build - Line A Average FBI	Build - Line A Average B.I.	Build - Line A Sum Length meters	Build - Line A Sum Length feet
Skaggs Run	1	Box Culvert	PC511								105	30	10	4.4	0.53	186	610
		Box Culvert Total									**105**	**30**	**10**	**4.4**	**0.53**	**186**	**610**
		Pipe	PC2503	56	33	10	5.8	0.53	61	200							
			PC2504	87	30	8	2.7	0.67	191	625							
			PC509								53	28	7	4.2	0.53	189	620
			PC512								83	29	7	3.4	0.53	131	430
			PC514								64	30	8	5.9	0.33	116	380
			PC516								59	25	6	4.6	0.40	76	250
		Pipe Total		**79**	**31**	**9**	**3.5**	**0.64**	**251**	**825**	**65**	**28**	**7**	**4.5**	**0.45**	**512**	**1680**
	2	Box Culvert	PC513								86	97	10	3.4	0.60	91	300
		Box Culvert Total									**86**	**97**	**10**	**3.4**	**0.60**	**91**	**300**
Skaggs Run Total				**79**	**31**	**9**	**3.5**	**0.64**	**251**	**825**	**75**	**40**	**8**	**4.3**	**0.49**	**789**	**2590**
Baker Run	1	Pipe	PC2501	58	117	13	4.3	0.80	24	80							
			PC2502	88	54	11	2.8	0.80	137	450							
			PC501	67	21	9	4.4	0.73	137	450	67	21	9	4.4	0.73	94	310
			PC505								56	12	6	1.8	0.53	107	350
		Pipe Total		**71**	**64**	**11**	**3.8**	**0.78**	**299**	**980**	**62**	**17**	**8**	**3.1**	**0.63**	**201**	**660**
	2	Box Culvert	PC507								72	45	13	4.3	0.80	107	350
		Box Culvert Total									**72**	**45**	**13**	**4.3**	**0.80**	**107**	**350**
		Pipe	PC506	66	7	3	4.3	0.20	24	80	66	7	3	4.3	0.20	64	210
			PC508	76	38	11	2.7	0.67	30	100							
		Pipe Total		**71**	**23**	**7**	**3.5**	**0.44**	**55**	**180**	**66**	**7**	**3**	**4.3**	**0.20**	**64**	**210**
Baker Run Total				**71**	**47**	**9**	**3.7**	**0.64**	**354**	**1160**	**65**	**21**	**8**	**3.7**	**0.57**	**372**	**1220**

TABLE 13
STREAM CROSSING CLUSTER BY LOCAL PROJECT WATERSHED, STREAM ORDER, AND DRAINAGE STRUCTURE
IRA & Build - Line A

Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Build - Line A Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet
Central Cacapon River	1	Pipe	PC314	57	103	11	3.5	0.80	24	80	57	103	11	3.5	0.80	67	220
			PC403	76	2	1	8.0		46	150	76	2	1	8.0		137	450
			PC404	81	10	4	6.2	0.33	61	200	81	10	4	6.2	0.33	146	480
			PC405	55	42	9	4.3	0.87	24	80	55	42	9	4.3	0.87	130	425
			PC407	84	37	7	5.1	0.53	34	110							
		Pipe Total		**71**	**39**	**6**	**5.4**	**0.51**	**189**	**620**	**67**	**39**	**6**	**5.5**	**0.50**	**480**	**1575**
	2	Box Culvert	PC2401	55	35	6	2.4	0.47	27	90							
			PC402	101	105	15	3.1	1.07	24	80							
			PC406								93	6	3	2.0	0.27	247	810
		Box Culvert Total		**78**	**70**	**11**	**2.7**	**0.77**	**52**	**170**	**93**	**6**	**3**	**2.0**	**0.27**	**247**	**810**
		Pipe	PC2400	105	111	8	1.6	0.53	49	160							
			PC406	93	6	3	2.0	0.27	238	780							
		Pipe Total		**99**	**59**	**6**	**1.8**	**0.40**	**287**	**940**							
Central Cacapon River Total				**79**	**50**	**7**	**4.0**	**0.54**	**527**	**1730**	**72**	**33**	**6**	**4.8**	**0.45**	**727**	**2385**
Waites Run	1	Box Culvert	PC311								83	35	12	3.3	1.00	137	450
		Box Culvert Total									**83**	**35**	**12**	**3.3**	**1.00**	**137**	**450**
		Pipe	PC307								57	58	10	5.2	0.60	76	250
		Pipe Total									**57**	**58**	**10**	**5.2**	**0.60**	**76**	**250**
Waites Run Total											**70**	**47**	**11**	**4.3**	**0.80**	**213**	**700**
Slate Rock Run	1	Box Culvert	PC302								85	84	15	3.3	0.93	198	650
		Box Culvert Total									**85**	**84**	**15**	**3.3**	**0.93**	**198**	**650**
		Pipe	PC2301	85	11	4	5.4	0.27	49	160							
			PC300	83	121	9	6.3	0.40	67	220	83	121	9	6.3	0.40	114	375
			PC301	80	60	8	3.8	0.60	73	240	80	60	8	3.8	0.60	79	260
			PC302	85	84	15	3.3	0.93	85	280							
			PC303	79	71	14	2.6	1.00	201	660	79	71	14	2.6	1.00	122	400
			PC304								103	71	12	3.6	1.07	168	550
		Pipe Total		**82**	**70**	**11**	**4.0**	**0.70**	**475**	**1560**	**86**	**81**	**11**	**4.1**	**0.77**	**483**	**1585**
	2	Box Culvert	PC305								115	83	16	2.5	1.00	131	430
		Box Culvert Total									**115**	**83**	**16**	**2.5**	**1.00**	**131**	**430**
Slate Rock Run Total				**82**	**70**	**11**	**4.0**	**0.70**	**475**	**1560**	**91**	**82**	**12**	**3.7**	**0.83**	**812**	**2665**

TABLE 13
STREAM CROSSING CLUSTER BY LOCAL PROJECT WATERSHED, STREAM ORDER, AND DRAINAGE STRUCTURE
IRA & Build - Line A

											Build - Line A						
Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	feet	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	feet
Cedar Creek	1	Box Culvert	PS105								45	83	6	7.7	0.47	113	370
			PS207								61	36	13	4.8	0.60	137	450
		Box Culvert Total									**53**	**60**	**10**	**6.3**	**0.54**	**250**	**820**
		Pipe	PS104								101	9	2	7.6	0.20	107	350
			PS105	45	83	6	7.7	0.47	46	150							
			PS108								101	64	8	5.4	0.47	61	200
			PS203	48	20	6	3.3	0.60	24	80							
			PS206	47	19	9	3.1	0.60	30	100							
		Pipe Total		**47**	**41**	**7**	**4.7**	**0.56**	**101**	**330**	**101**	**37**	**5**	**6.5**	**0.34**	**168**	**550**
	2	Box Culvert	PS106								83	39	13	5.5	0.60	76	250
		Box Culvert Total									**83**	**39**	**13**	**5.5**	**0.60**	**76**	**250**
		Pipe	PS100	88	37	12	5.6	0.53	107	350	88	37	12	5.6	0.53	101	330
			PS201	112	58	11	3.1	0.60	24	80							
			PS202	112	66	13	2.6	0.60	40	130							
		Pipe Total		**104**	**54**	**12**	**3.8**	**0.58**	**171**	**560**	**88**	**37**	**12**	**5.6**	**0.53**	**101**	**330**
Cedar Creek Total				**75**	**47**	**10**	**4.2**	**0.57**	**271**	**890**	**80**	**45**	**9**	**6.1**	**0.48**	**594**	**1950**
			Grand Total	**73**	**50**	**7**	**4.7**	**0.49**	**4581**	**15030**	**72**	**41**	**7**	**4.9**	**0.47**	**8499**	**27885**

TABLE 13
STREAM CROSSING CLUSTER BY STREAM ORDER AND DRAINAGE STRUCTURE

INTERCHANGE OPTION AREA COMPARISON

				Line I							Line A						
Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet
Leading Creek	1	Pipe	MT1604	81	8	5	5.4	0.53	107	350	81	8	5	5.4	0.53	122	400
			MT1606	59	2	2	3.0	0.13	229	750	59	2	2	3.0	0.13	229	750
		Pipe Total		**70**	**5**	**3.5**	**4.2**	**0.33**	**335**	**1100**	**70**	**5**	**3.5**	**4.2**	**0.33**	**351**	**1150**
			Grand Total	**70**	**5**	**3.5**	**4.2**	**0.33**	**335**	**1100**	**70**	**5**	**3.5**	**4.2**	**0.33**	**351**	**1150**

PATTERSON CREEK OPTION AREA COMPARISON

				Line P							Line A						
Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet
Patterson Creek	1	Pipe	PNB803	86	1	1	3.0	0.13	119	390	86	1	1	3.0	0.13	82	270
			PNB805	67	4	1	8.0		110	360							
			PNB806	62	7	4	6.6	0.40	99	325	62	7	4	6.6	0.40	101	330
			PNB908	77	84	13	4.1	0.87	137	450							
		Pipe Total		**73**	**24**	**5**	**5.4**	**0.35**	**465**	**1525**	**74**	**4**	**3**	**4.8**	**0.27**	**183**	**600**
	2	Box Culvert	PNB804	71	43	6	6.6	0.27	137	450	71	43	6	6.6	0.27	137	450
		Box Culvert Total		**71**	**43**	**6**	**6.6**	**0.27**	**137**	**450**	**71**	**43**	**6**	**6.6**	**0.27**	**137**	**450**
		Pipe	PNB909	93	135	15	5.1	0.87	168	550							
		Pipe Total		**93**	**135**	**15**	**5.1**	**0.87**	**168**	**550**							
	3	Box Culvert	PNB907	93	110	15	5.3	0.73	213	700							
		Box Culvert Total		**93**	**110**	**15**	**5.3**	**0.73**	**213**	**700**							
			Grand Total	**78**	**55**	**8**	**5.5**	**0.47**	**983**	**3225**	**73**	**17**	**4**	**5.4**	**0.27**	**320**	**1050**

TABLE 13
STREAM CROSSING CLUSTER BY STREAM ORDER AND DRAINAGE STRUCTURE

INTERCHANGE OPTION AREA COMPARISON

				Line F							Line A						
Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet
Patterson Creek	1	Pipe	PNB800	34	10	2	7.9		137	450	34	10	2	7.9		116	380
		Pipe Total		**34**	**10**	**2**	**7.9**		**137**	**450**	**34**	**10**	**2**	**7.9**		**116**	**380**
	2	Pipe	PNB801	87	89	4	7.7	0.13	244	800	87	89	4	7.7	0.13	244	800
		Pipe Total		**87**	**89**	**4**	**7.7**	**0.13**	**244**	**800**	**87**	**89**	**4**	**7.7**	**0.13**	**244**	**800**
	3	Box Culvert	PNB807	48	97	11	6.5	0.47	152	500	48	97	11	6.5	0.47	152	500
		Box Culvert Total		**48**	**97**	**11**	**6.5**	**0.47**	**152**	**500**	**48**	**97**	**11**	**6.5**	**0.47**	**152**	**500**
			Grand Total	**56**	**65**	**6**	**7.3**	**0.20**	**533**	**1750**	**56**	**65**	**6**	**7.3**	**0.20**	**512**	**1680**

BAKER OPTION AREA COMPARISON

				Line B							Line A						
Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet
Baker Run	1	Pipe	PC501								67	21	9	4.4	0.73	94	310
		Pipe Total									**67**	**21**	**9**	**4.4**	**0.73**	**94**	**310**
	2	Box Culvert	PC517	109	102	15	2.6	1.00	198	650							
		Box Culvert Total		**109**	**102**	**15**	**2.6**	**1.00**	**198**	**650**							
			Grand Total	**109**	**102**	**15**	**2.6**	**1.00**	**198**	**650**	**67**	**21**	**9**	**4.4**	**0.73**	**94**	**310**

TABLE 13
STREAM CROSSING CLUSTER BY STREAM ORDER AND DRAINAGE STRUCTURE

DUCK RUN OPTION AREA COMPARISON

				Line D2							Line A						
Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet
Cedar Creek	1	Box Culvert	PS207	61	36	13	4.8	0.60	137	450	61	36	13	4.8	0.60	137	450
		Box Culvert Total		61	36	13	4.8	0.60	137	450	61	36	13	4.8	0.60	137	450
			Grand Total	61	36	13	4.8	0.60	137	450	61	36	13	4.8	0.60	137	450

LEBANON CHURCH OPTION AREA COMPARISON

				Line L							Line A						
Local Project Watershed	Stream Order	Structure	Stream ID	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet	Average Habitat Score	Average #Ind.	Average #Families	Average FBI	Average B.I.	Sum Length meters	Sum Length feet
Cedar Creek	1	Box Culvert	PS105								45	83	6	7.7	0.47	113	370
		Box Culvert Total									45	83	6	7.7	0.47	113	370
		Pipe	PS108								101	64	8	5.4	0.47	61	200
			PS111	66	20	3	7.6	0.27	107	350							
		Pipe Total		66	20	3	7.6	0.27	107	350	101	64	8	5.4	0.47	61	200
	2	Box Culvert	PS106								83	39	13	5.5	0.60	76	250
		Box Culvert Total									83	39	13	5.5	0.60	76	250
		Pipe	PS100								88	37	12	5.6	0.53	101	330
		Pipe Total									88	37	12	5.6	0.53	101	330
			Grand Total	66	20	3	7.6	0.27	107	350	79	56	10	6.0	0.52	351	1150

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Leading Creek	Box Culvert	D	Count	2	2
			Average Habitat Assessment Score	82	51
			Sum of Length in meters	130	226
			Sum of Length in feet	425	740
			% Differecne of Line A to IRA		74%
			% column	2.8%	2.7%
	Pipe	B	Count	2	1
			Average Habitat Assessment Score	89	81
			Sum of Length in meters	61	122
			Sum of Length in feet	200	400
			% Differecne of Line A to IRA		100%
			% column	1.3%	1.4%
		C	Count	4	
			Average Habitat Assessment Score	45	
			Sum of Length in meters	125	
			Sum of Length in feet	410	
			% Differecne of Line A to IRA		-100%
			% column	2.7%	
		D	Count	4	2
			Average Habitat Assessment Score	58	68
			Sum of Length in meters	283	244
			Sum of Length in feet	930	800
			% Differecne of Line A to IRA		-14%
			% column	6.2%	2.9%
Leading Creek Count				12	5
Leading Creek Average Habitat Assessment Score				62	64
Leading Creek Sum of Length in meters				599	591
Leading Creek Sum of Length in feet				1965	1940
Leading Creek % Differecne of Line A to IRA					-1%
Leading Creek % column				13.1%	7.0%

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Shavers Fork	Pipe	A	Count	1	
			Average Habitat Assessment Score	90	
			Sum of Length in meters	30	
			Sum of Length in feet	100	
			% Differecne of Line A to IRA		-100%
			% column	0.7%	
		B	Count	4	1
			Average Habitat Assessment Score	86	85
			Sum of Length in meters	125	280
			Sum of Length in feet	410	920
			% Differecne of Line A to IRA		124%
			% column	2.7%	3.3%
		C	Count	1	
			Average Habitat Assessment Score	103	
			Sum of Length in meters	24	
			Sum of Length in feet	80	
			% Differecne of Line A to IRA		-100%
			% column	0.5%	
Shavers Fork Count				6	1
Shavers Fork Average Habitat Assessment Score				90	85
Shavers Fork Sum of Length in meters				180	280
Shavers Fork Sum of Length in feet				590	920
Shavers Fork % Differecne of Line A to IRA					56%
Shavers Fork % column				3.9%	3.3%
Black Fork	Box Culvert	A	Count	1	1
			Average Habitat Assessment Score	101	101
			Sum of Length in meters	61	55
			Sum of Length in feet	200	180
			% Differecne of Line A to IRA		-10%
			% column	1.3%	0.6%
		B	Count		6
			Average Habitat Assessment Score		75
			Sum of Length in meters		788
			Sum of Length in feet		2585
			% Differecne of Line A to IRA		
			% column		9.3%
		C	Count	1	2
			Average Habitat Assessment Score	49	78
			Sum of Length in meters	30	143
			Sum of Length in feet	100	470
			% Differecne of Line A to IRA		370%
			% column	0.7%	1.7%
		D	Count	1	1
			Average Habitat Assessment Score	53	86
			Sum of Length in meters	30	61
			Sum of Length in feet	100	200
			% Differecne of Line A to IRA		100%
			% column	0.7%	0.7%

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Black Fork	Pipe	A	Count	2	1
			Average Habitat Assessment Score	97	90
			Sum of Length in meters	85	23
			Sum of Length in feet	280	75
			% Differecne of Line A to IRA		-73%
			% column	1.9%	0.3%
		B	Count	7	7
			Average Habitat Assessment Score	78	67
			Sum of Length in meters	439	922
			Sum of Length in feet	1440	3025
			% Differecne of Line A to IRA		110%
			% column	9.6%	10.8%
		C	Count	7	5
			Average Habitat Assessment Score	57	54
			Sum of Length in meters	415	515
			Sum of Length in feet	1360	1690
			% Differecne of Line A to IRA		24%
			% column	9.0%	6.1%
		D	Count	8	5
			Average Habitat Assessment Score	67	61
			Sum of Length in meters	238	149
			Sum of Length in feet	780	490
			% Differecne of Line A to IRA		-37%
			% column	5.2%	1.8%
Black Fork Count				27	28
Black Fork Average Habitat Assessment Score				70	69
Black Fork Sum of Length in meters				1298	2656
Black Fork Sum of Length in feet				4260	8715
Black Fork % Differecne of Line A to IRA					105%
Black Fork % column				28.3%	31.3%

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Stony River	Box Culvert	D	Count		2
			Average Habitat Assessment Score		51
			Sum of Length in meters		213
			Sum of Length in feet		700
			% Differecne of Line A to IRA		
			% column		2.5%
	Pipe	A	Count	1	1
			Average Habitat Assessment Score	68	97
			Sum of Length in meters	30	91
			Sum of Length in feet	100	300
			% Differecne of Line A to IRA		200%
			% column	0.7%	1.1%
		D	Count	3	
			Average Habitat Assessment Score	60	
			Sum of Length in meters	363	
			Sum of Length in feet	1190	
			% Differecne of Line A to IRA		-100%
			% column	7.9%	
Stony River Count				4	3
Stony River Average Habitat Assessment Score				62	66
Stony River Sum of Length in meters				393	305
Stony River Sum of Length in feet				1290	1000
Stony River % Differecne of Line A to IRA					-22%
Stony River % column				8.6%	3.6%

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Patterson Creek	Box Culvert	A	Count	2	
			Average Habitat Assessment Score	82	
			Sum of Length in meters	94	
			Sum of Length in feet	310	
			% Differecne of Line A to IRA		-100%
			% column	2.1%	
		C	Count		2
			Average Habitat Assessment Score		60
			Sum of Length in meters		290
			Sum of Length in feet		950
			% Differecne of Line A to IRA		
			% column		3.4%
	Pipe	B	Count	1	
			Average Habitat Assessment Score	80	
			Sum of Length in meters	67	
			Sum of Length in feet	220	
			% Differecne of Line A to IRA		-100%
			% column	1.5%	
		C	Count		1
			Average Habitat Assessment Score		62
			Sum of Length in meters		101
			Sum of Length in feet		330
			% Differecne of Line A to IRA		
			% column		1.2%
		D	Count		4
			Average Habitat Assessment Score		70
			Sum of Length in meters		570
			Sum of Length in feet		1870
			% Differecne of Line A to IRA		
			% column		6.7%
Patterson Creek Count				3	7
Patterson Creek Average Habitat Assessment Score				81	66
Patterson Creek Sum of Length in meters				162	960
Patterson Creek Sum of Length in feet				530	3150
Patterson Creek % Differecne of Line A to IRA					494%
Patterson Creek % column				3.5%	11.3%
Anderson Run	Box Culvert	B	Count		1
			Average Habitat Assessment Score		66
			Sum of Length in meters		198
			Sum of Length in feet		650
			% Differecne of Line A to IRA		
			% column		2.3%
Anderson Run Count					1
Anderson Run Average Habitat Assessment Score					66
Anderson Run Sum of Length in meters					198
Anderson Run Sum of Length in feet					650
Anderson Run % Differecne of Line A to IRA					
Anderson Run % column					2.3%

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES
BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Main Channel	Pipe	B	Count	1	
			Average Habitat Assessment Score	104	
			Sum of Length in meters	70	
			Sum of Length in feet	230	
			% Differecne of Line A to IRA		-100%
			% column	1.5%	
Main Channel Count				1	
Main Channel Average Habitat Assessment Score				104	
Main Channel Sum of Length in meters				70	
Main Channel Sum of Length in feet				230	
Main Channel % Differecne of Line A to IRA					-100%
Main Channel % column				1.5%	
Skaggs Run	Box Culvert	B	Count		2
			Average Habitat Assessment Score		96
			Sum of Length in meters		277
			Sum of Length in feet		910
			% Differecne of Line A to IRA		
			% column		3.3%
	Pipe	B	Count	4	2
			Average Habitat Assessment Score	79	68
			Sum of Length in meters	251	320
			Sum of Length in feet	825	1050
			% Differecne of Line A to IRA		27%
			% column	5.5%	3.8%
		C	Count		2
			Average Habitat Assessment Score		62
			Sum of Length in meters		192
			Sum of Length in feet		630
			% Differecne of Line A to IRA		
			% column		2.3%
Skaggs Run Count				4	6
Skaggs Run Average Habitat Assessment Score				79	75
Skaggs Run Sum of Length in meters				251	789
Skaggs Run Sum of Length in feet				825	2590
Skaggs Run % Differecne of Line A to IRA					214%
Skaggs Run % column				5.5%	9.3%

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES
BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Baker Run	Box Culvert	A	Count		1
			Average Habitat Assessment Score		72
			Sum of Length in meters		107
			Sum of Length in feet		350
			% Differecne of Line A to IRA		
			% column		1.3%
	Pipe	A	Count	2	
			Average Habitat Assessment Score	73	
			Sum of Length in meters	162	
			Sum of Length in feet	530	
			% Differecne of Line A to IRA		-100%
			% column	3.5%	
		B	Count	2	2
			Average Habitat Assessment Score	72	62
			Sum of Length in meters	168	201
			Sum of Length in feet	550	660
			% Differecne of Line A to IRA		20%
			% column	3.7%	2.4%
		D	Count	1	1
			Average Habitat Assessment Score	66	66
			Sum of Length in meters	24	64
			Sum of Length in feet	80	210
			% Differecne of Line A to IRA		163%
			% column	0.5%	0.8%
Baker Run Count				5	4
Baker Run Average Habitat Assessment Score				71	65
Baker Run Sum of Length in meters				354	372
Baker Run Sum of Length in feet				1160	1220
Baker Run % Differecne of Line A to IRA					5%
Baker Run % column				7.7%	4.4%

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Central Cacapon River	Box Culvert	A	Count	1	
			Average Habitat Assessment Score	101	
			Sum of Length in meters	24	
			Sum of Length in feet	80	
			% Differecne of Line A to IRA		-100%
			% column	0.5%	
		C	Count	1	1
			Average Habitat Assessment Score	55	93
			Sum of Length in meters	27	247
			Sum of Length in feet	90	810
			% Differecne of Line A to IRA		800%
			% column	0.6%	2.9%
	Pipe	A	Count	2	2
			Average Habitat Assessment Score	56	56
			Sum of Length in meters	49	197
			Sum of Length in feet	160	645
			% Differecne of Line A to IRA		303%
			% column	1.1%	2.3%
		B	Count	2	
			Average Habitat Assessment Score	95	
			Sum of Length in meters	82	
			Sum of Length in feet	270	
			% Differecne of Line A to IRA		-100%
			% column	1.8%	
		C	Count	2	1
			Average Habitat Assessment Score	87	81
			Sum of Length in meters	299	146
			Sum of Length in feet	980	480
			% Differecne of Line A to IRA		-51%
			% column	6.5%	1.7%
		D	Count	1	1
			Average Habitat Assessment Score	76	76
			Sum of Length in meters	46	137
			Sum of Length in feet	150	450
			% Differecne of Line A to IRA		200%
			% column	1.0%	1.6%
Central Cacapon River Count				9	5
Central Cacapon River Average Habitat Assessment Score				79	72
Central Cacapon River Sum of Length in meters				527	727
Central Cacapon River Sum of Length in feet				1730	2385
Central Cacapon River % Differecne of Line A to IRA					38%
Central Cacapon River % column				11.5%	8.6%

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Waites Run	Box Culvert	A	Count		1
			Average Habitat Assessment Score		83
			Sum of Length in meters		137
			Sum of Length in feet		450
			% Differecne of Line A to IRA		
			% column		1.6%
	Pipe	B	Count		1
			Average Habitat Assessment Score		57
			Sum of Length in meters		76
			Sum of Length in feet		250
			% Differecne of Line A to IRA		
			% column		0.9%
Waites Run Count					2
Waites Run Average Habitat Assessment Score					70
Waites Run Sum of Length in meters					213
Waites Run Sum of Length in feet					700
Waites Run % Differecne of Line A to IRA					
Waites Run % column					2.5%
Slate Rock Run	Box Culvert	A	Count		2
			Average Habitat Assessment Score		100
			Sum of Length in meters		329
			Sum of Length in feet		1080
			% Differecne of Line A to IRA		
			% column		3.9%
	Pipe	A	Count	3	2
			Average Habitat Assessment Score	81	91
			Sum of Length in meters	287	290
			Sum of Length in feet	940	950
			% Differecne of Line A to IRA		1%
			% column	6.3%	3.4%
		B	Count	1	1
			Average Habitat Assessment Score	80	80
			Sum of Length in meters	73	79
			Sum of Length in feet	240	260
			% Differecne of Line A to IRA		8%
			% column	1.6%	0.9%
		C	Count	2	1
			Average Habitat Assessment Score	84	83
			Sum of Length in meters	116	114
			Sum of Length in feet	380	375
			% Differecne of Line A to IRA		-1%
			% column	2.5%	1.3%
Slate Rock Run Count				6	6
Slate Rock Run Average Habitat Assessment Score				82	91
Slate Rock Run Sum of Length in meters				475	812
Slate Rock Run Sum of Length in feet				1560	2665
Slate Rock Run % Differecne of Line A to IRA					71%
Slate Rock Run % column				10.4%	9.6%

TABLE 14
CLUSTERING OF BIOTIC INTEGRITY RANK ASSOCIATED WITH DRAINAGE STRUCTURES
BY LOCAL PROJECT WATERSHED

Watershed	Drainage Structure	Biotic Integrity Rank	Data	IRA	Line A
Cedar Creek	Box Culvert	B	Count		2
			Average Habitat Assessment Score		72
			Sum of Length in meters		213
			Sum of Length in feet		700
			% Differecne of Line A to IRA		
			% column		2.5%
		C	Count		1
			Average Habitat Assessment Score		45
			Sum of Length in meters		113
			Sum of Length in feet		370
			% Differecne of Line A to IRA		
			% column		1.3%
	Pipe	B	Count	5	1
			Average Habitat Assessment Score	81	88
			Sum of Length in meters	226	101
			Sum of Length in feet	740	330
			% Differecne of Line A to IRA		-55%
			% column	4.9%	1.2%
		C	Count	1	1
			Average Habitat Assessment Score	45	101
			Sum of Length in meters	46	61
			Sum of Length in feet	150	200
			% Differecne of Line A to IRA		33%
			% column	1.0%	0.7%
		D	Count		1
			Average Habitat Assessment Score		101
			Sum of Length in meters		107
			Sum of Length in feet		350
			% Differecne of Line A to IRA		
			% column		1.3%
Cedar Creek Count				6	6
Cedar Creek Average Habitat Assessment Score				75	80
Cedar Creek Sum of Length in meters				271	594
Cedar Creek Sum of Length in feet				890	1950
Cedar Creek % Differecne of Line A to IRA					119%
Cedar Creek % column				5.9%	7.0%
Total Count				83	74
Total Average Habitat Assessment Score				73	72
Total Sum of Length in meters				4581	8499
Total Sum of Length in feet				15030	27885
Total % Differecne of Line A to IRA					86%
Total % column				100.0%	100.0%

TABLE 15
SUMMARY OF STREAM IMPACTS BY WATERSHED - IRA

AREA OF IMPACT	Tygart Valley River		Cheat River		North Branch of Potomac		South Branch of Potomac		Cacapon River		Shenandoah River		Total	
	Metric	English	Metric	English	Metric	English	Metric	English	Metric	English	Metric	English	Metric	English
Total Perennial Streams in Watershed (kilometers/miles)	93	58	293	183	163	102	101	63	154	96	205	128	1,009	630
Length of Enclosures (meters/feet)	599	1,965	1,478	4,850	555	1,820	70	230	1,608	5,275	271	890	4,581	15,030
Length of Relocations (meters/feet)	122	400	389	1,275	38	125	35	115	305	1,000	38	125	927	3,040
Enclosures and Relocations as a Percentage of Total Streams		0.8%		0.6%		0.4%		0.1%		1.2%		0.2%		0.5%

FIGURE 65
CLUSTERING OF IRA
STREAM CROSSINGS - BIOTIC INTEGRITY RANK
BY REGIONAL PROJECT WATERSHED

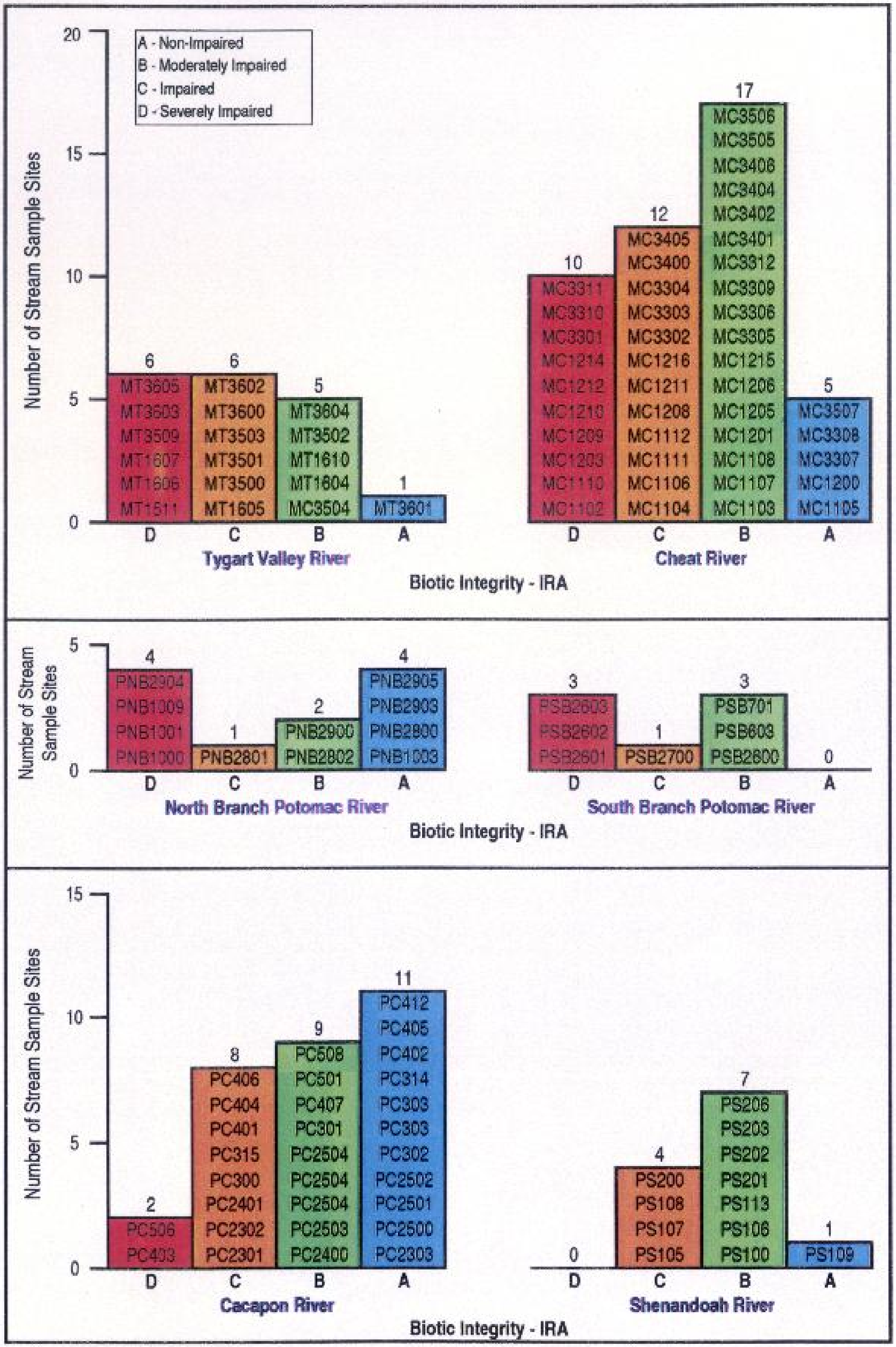


FIGURE 66
CLUSTERING OF IRA
STREAM CROSSINGS - HABITAT ASSESSMENT SCORE
BY REGIONAL PROJECT WATERSHED

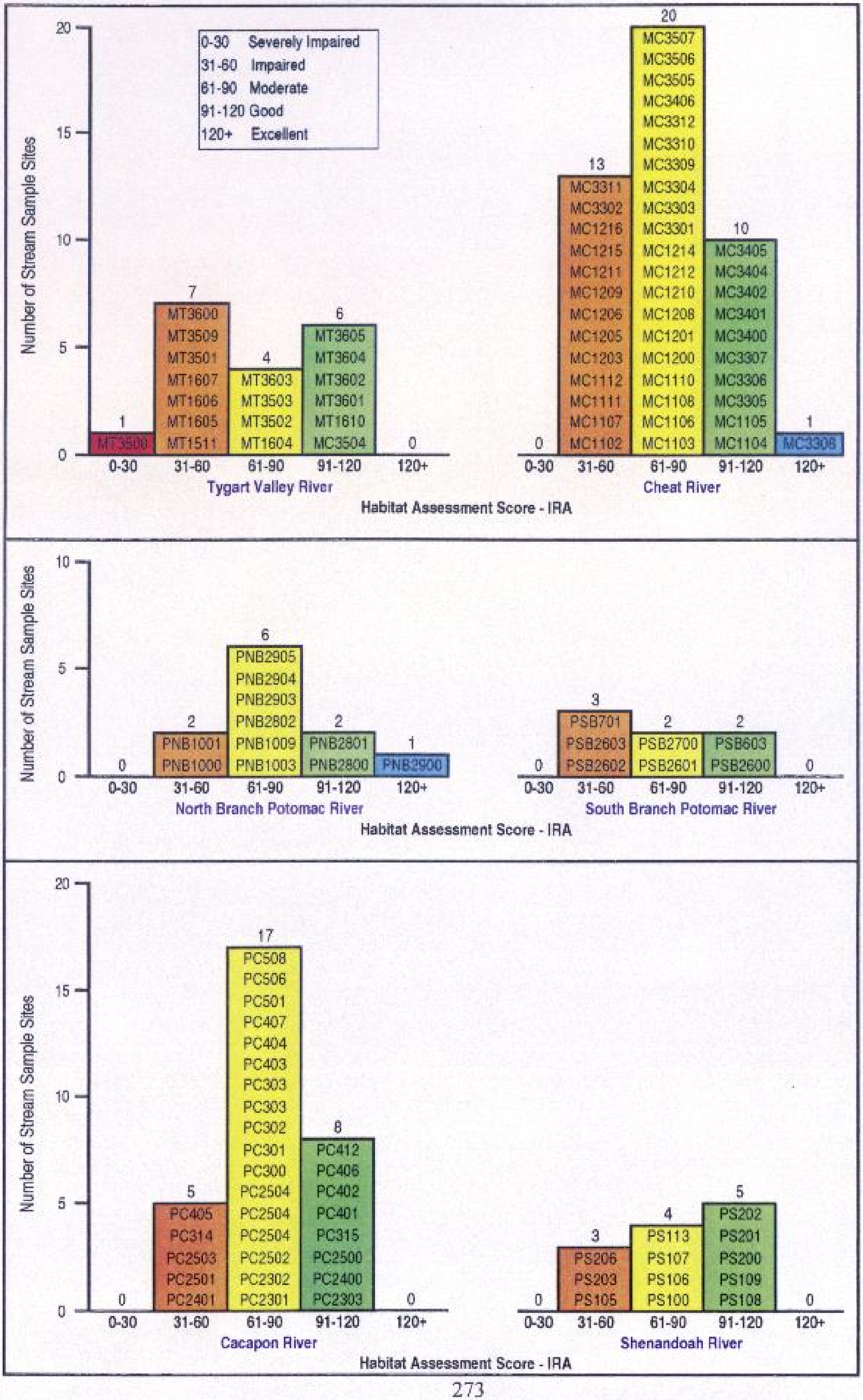


Table 16
SUMMARY OF STREAM IMPACTS BY WATERSHED - Line A

AREA OF IMPACT	Tygart Valley River		Cheat River		North Branch of Potomac		South Branch of Potomac		Cacapon River		Shenandoah River		Total	
	Metric	English	Metric	English	Metric	English	Metric	English	Metric	English	Metric	English	Metric	English
Total Perennial Streams in Watershed (kilometers/miles)	93	58	293	183	163	102	101	63	154	96	205	128	1,009	630
Length of Enclosures (meters/feet)	591	1,940	2,937	9,635	1,265	4,150	198	650	2,914	9,560	594	1,950	8,499	27,885
Length of Relocations (meters/feet)	366	1,200	884	2,900	1,119	3,670	335	1,100	411	1,350	30	100	3,145	10,320
Enclosures and Relocations as a Percentage of Total Per. Streams		1.0%		1.3%		1.5%		0.5%		2.2%		0.3%		1.1%

FIGURE 67
CLUSTERING OF LINE A
STREAM CROSSINGS - BIOTIC INTEGRITY RANK
BY REGIONAL PROJECT WATERSHED

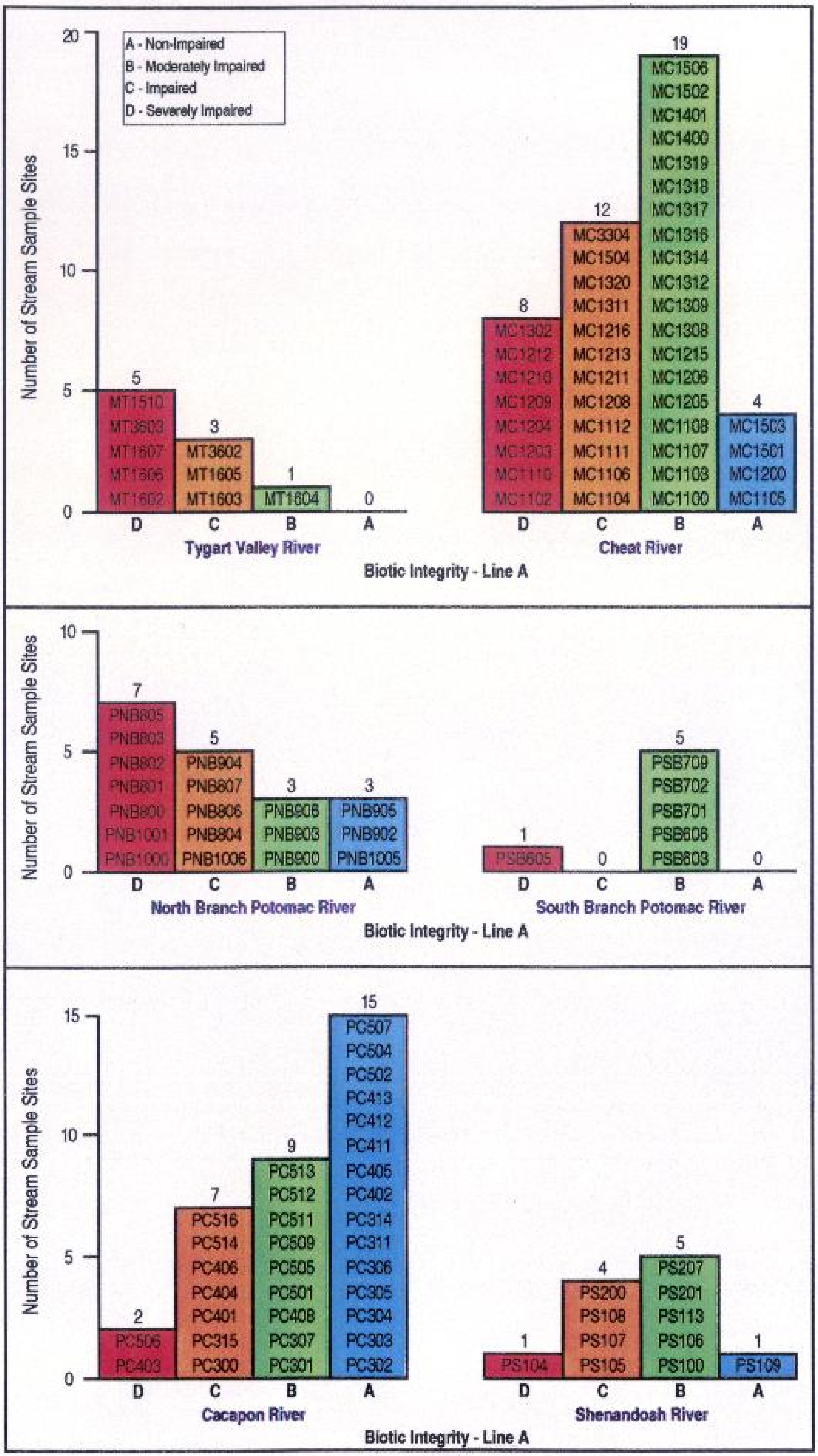


FIGURE 68
CLUSTERING OF LINE A
STREAM CROSSINGS - HABITAT ASSESSMENT SCORE
BY REGIONAL PROJECT WATERSHED

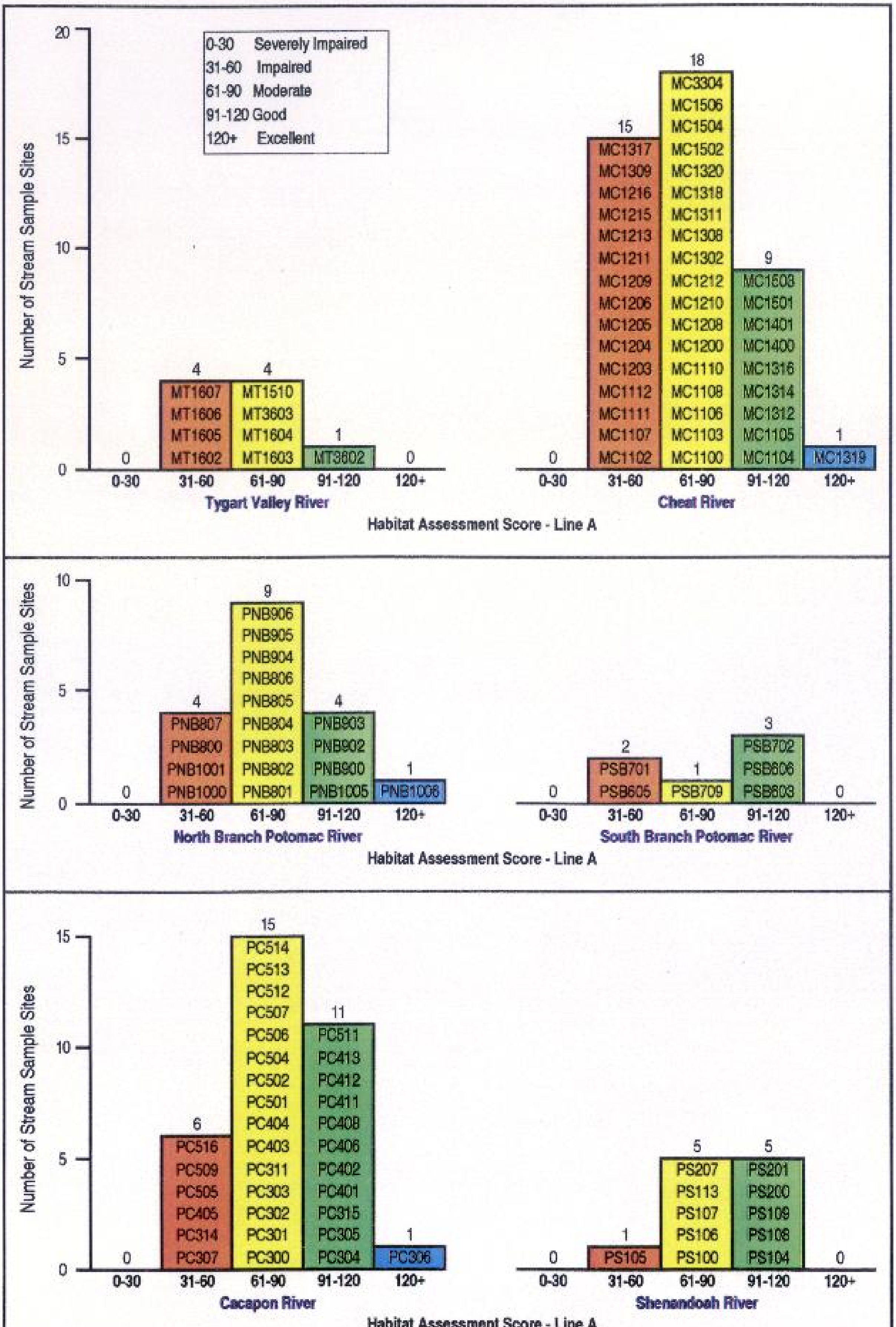


TABLE 17
OPTION AREA COMPARISON - WEST VIRGINIA

AREA OF IMPACT	TOTAL LINE A (WV)		Option Area Comparisons in West Virginia																								
			Interchange				Shavers Fork				Patterson Creek				Forman				Baker				Hanging Rock			
			Line I		Line A		Line S		Line A		Line P		Line A		Line F		Line A		Line B		Line A		Line R		Line A	
	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet
Number of Box Culverts		21		0		0		0		0		2		1		1		1		1		0		0		0
Length of Box Culverts	2,681	8,795	0	0	0	0	0	0	0	0	351	1,150	137	450	152	500	152	500	198	650	0	0	0	0	0	0
Number of Open Bottom Culverts		3		0		0		0		0		0		0		0		0		0		0		0		0
Length of Open Bottom Culverts	390	1,280	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Pipes		43		2		2		0		0		5		2		2		2		0		1		0		0
Length of Pipes	4,811	15,785	335	1,100	351	1,150	0	0	0	0	632	2,075	183	600	381	1,250	360	1,180	0	0	94	310	0	0	0	0
Total Number of Enclosures		67		2		2		0		0		7		3		3		3		1		1		0		0
Total Length of Enclosures	7,882	25,860	335	1,100	351	1,150	0	0	0	0	983	3,225	320	1,050	533	1,750	512	1,680	198	650	94	310	0	0	0	0
Number of Relocations		19		2		2		1		1		1		1		2		2		0		0		0		0
Length of Relocations	3,115	10,220	305	1,000	305	1,000		600		600	116	380	116	380	625	2,050	351	1,150	0	0	0	0	0	0	0	0
Length of Perennial Streams	12,500	41,009	741	2,431	807	2,646	77	254	94	307	1,392	4,568	472	1,549	1,292	4,239	1,304	4,277	191	627	94	310	0	0	0	0
Length of Intermittant Streams	26,294	86,267	269	884	265	869	1,755	5,757	1,650	5,414	696	2,284	869	2,850	1,539	5,050	1,686	5,531	346	1,135	639	2,095	457	1,499	467	1,532

TABLE 18
OPTION AREA COMPARISON - VIRGINIA

AREA OF IMPACT	TOTAL LINE A (VA)		Option Area Comparisons in Virginia									
			Duck Run						Lebanon Church			
			Line D1		Line D2		Line A		Line L		Line A	
	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet
Number of Box Culverts		2		0		0		0		0		2
Length of Box Culverts	189	620	0	0	0	0	0	0	0	0	158	520
Number of Open Bottom Culverts		1		0		1		1		0		0
Length of Open Bottom Culverts	137	450	0	0	137	450	137	450	0	0	0	0
Number of Pipes		3		0		0		0		1		2
Length of Pipes	268	880	0	0	0	0	0	0	107	350	189	620
Total Number of Enclosures		6		0		1		1		1		4
Total Length of Enclosures	594	1,950	0	0	137	450	137	450	107	350	347	1,140
Number of Relocations		1		0		0		0		0		1
Length of Relocations	30	100	0	0	0	0	0	0	0	0	30	100
Length of Perennial Streams	658	2,159	0	0	137	448	137	448	109	359	405	1,330
Length of Intermittant Streams	2,843	9,328	1,358	4,456	1,332	4,371	1,148	3,766	863	2,830	400	1,313

TABLE 19

MEASURES TAKEN TO AVOID STREAM RELOCATIONS

Regional Project Watershed	Stream Avoided	Measure Taken	Station	Impact Avoided meters / feet		Comments
Tygart River	Leading Creek	Retaining Wall	573	122	400	WVHQ
Tygart River	Leading Creek	Increased Slopes	620	152	500	WVHQ
Cheat River	Trib. to Roaring Run	Increased Slopes	3725	335	1,100	
North Branch of Potomac	Trib. to Elklick Run	Shifted construction limits	5230	335	1,100	
North Branch of Potomac	MF of Patterson Creek	Retaining Wall	5565	320	1,050	
North Branch of Potomac	Thorn Run	Increased Slopes	5650	305	1,000	
North Branch of Potomac	Toombs Hollow	Retaining Wall	5950	137	450	
North Branch of Potomac	Williams Hollow	Increased Slopes	6340	366	1,200	
Cacapon River	Trib. to Long Lick	Increased Slopes	6830	85	280	
Cacapon River	Baker Run	Changed vertical grade	6950	427	1,400	
		TOTAL		**2,584**	**8,480**	

AMD= Acid Mine Drainage

NRI = Nationwide Rivers Inventory; WVHQ = WVa. High Quality Stream; OSRW = Va. Outstanding State Resource Waters

TABLE 20

BRIDGES - Line A

Regional Project Watershed	Stream Name	Station	Structure Length meters / feet		Comments
Tygart Valley River	Clay Lick Run	451	213	700	
Tygart Valley River	Pearcy Run	568	137	450	
Tygart Valley River	Leading Creek	646	137	450	WV HQ
Tygart Valley River	Trib. to Wilmoth Creek	805	122	400	
Cheat River	Slabcamp Run	3224	114	375	
Cheat River	Pleasant Run	3300	61	200	Native Trout
Cheat River	Shavers Fork	3338	518	1,700	NRI, WVHQ
Cheat River	Shavers Fork	3460	137	450	NRI, WVHQ
Cheat River	Shavers Fork	3476	195	640	NRI, WVHQ
Cheat River	Black Fork	3621	366	1,200	
Cheat River	Roaring Run	3627	38	125	Native Trout
Cheat River	Big Run*	3922	113	370	
Cheat River	NF Blackwater River	4091	320	1,050	AMD
Cheat River	Trib. to Pendleton Creek	4185	46	150	
Cheat River	Beaver Creek	4325	38	125	AMD, WVHQ
Cheat River	Trib. to Beaver Creek	4742	107	350	Includes MC1103
North Branch of Potomac	Stoney River	4912	262	860	AMD
North Branch of Potomac	Elklick Run	5265	198	650	Native Trout, WVHQ
North Branch of Potomac	Trib. to Elklick Run*	5293	198	650	
North Branch of Potomac	NF Patterson Creek	5415	137	450	Stocked Trout, WVHQ
North Branch of Potomac	MF Patterson Creek*	5534	366	1,200	
North Branch of Potomac	Trib. to MF Patterson Creek	5597	131	430	
South Branch of Potomac	Walnut Bottom Run	6142	91	300	
South Branch of Potomac	SB Potomac River and tribs	6243	732	2,400	NRI, WVHQ
South Branch of Potomac	Clifford Hollow*	6515	366	1,200	
Cacapon River	Long Lick Run	6925	122	400	
Cacapon River	Baker Run	7000	171	560	
Cacapon River	Baker Run	7068	43	140	
Cacapon River	Lost River	7087	128	420	Stocked Trout, WVHQ, NRI
Cacapon River	Lost River	7170	265	870	Stocked Trout, WVHQ, NRI
Cacapon River	Sauerkraut Run	7327	152	500	
Cacapon River	Lost River	7352	168	550	Stocked Trout, WVHQ, NRI
Cacapon River	Trout Run	7498	91	300	Native Trout, Stocked Trout, WVHQ
Cacapon River	Waites Run	7585	76	250	Stocked Trout, WVHQ
Shenandoah River	Duck Run	7948	137	450	Native Trout, OSRW
Shenandoah River	Duck Run	8028	82	270	Native Trout, OSRW
Shenandoah River	Cedar Creek	8111	137	450	NRI, Stocked Trout
Shenandoah River	Turkey Run	8259	183	600	
Shenandoah River	Trib. to Mulberry Run	8403	46	150	
	Total Bridge Length		6,944	22,785	

* Bridges substituted for box culverts after field reviews

AMD= Acid Mine Drainage

NRI = Nationwide Rivers Inventory; WVHQ = WVa. High Quality Stream; OSRW = Va. Outstanding State Resource Waters

TABLE 21

ADDITIONAL AVOIDANCE AND MINIMZATION MEASURES

DEVELOPED FOLLOWING FIELD REVIEWS

Regional Project Watershed	Stream	Measure Taken	Station	Stream Impact Reductior meters / feet		Comments
Cheat River	Trib. to Roaring Run	Steepen slopes to reduce length of pipe	3731	76	250	
Cheat River	Big Run	Replace box culvert with 350 ft. bridge	3925	274	900	
Cheat River	Middle Run	Change in grade reduces culvert length	4055	8	25	
North Branch of Potomac	Abrams Creek	Increase slope to reduce length of culvert	5029	15	50	AMD
North Branch of Potomac	Trib. to Elklick Run	Replace box culvert with 650 ft. bridge	5293	137	450	
North Branch of Potomac	MF of Patterson Creek	Replace box culvert with a 1,200 ft. bridge	5534	427	1,400	
North Branch of Potomac	Trib. to Patterson Creek	Shifted line and reduced length of box culvert	5850	76	250	
South Branch of Potomac	Clifford Hollow	Replace box culvert with a 1,200 ft. bridge	6515	308	1,010	
		TOTAL		1,321	4,335	

AMD= Acid Mine Drainage

NRI = Nationwide Rivers Inventory; WVHQ = WVa. High Quality Stream; OSRW = Va. Outstanding State Resource Waters

Table 22
STREAMS PROPOSED FOR OPEN BOX CULVERTS AND BURIED INVERTS BASED ON TOTAL HABITAT ASSESSMENT SCORE (>90) AND BI (>=B)

Str Ord	Regional Project Watershed	Local Project Watershed	B.I. Cat.	FBI	Habitat Score	#Ind.	#Families	Alternative	Drainage Structure	Stream Name	Streams ID	Station	Length meters	Length feet
A	Cheat River	Black Fork	A	1.90	101	87	8	IRA	Box Culvert	Trib. Beaver Creek	MC1105	4812	61	200
A	Cheat River	Black Fork	A	2.63	103	81	12	IRA	Pipe	Trib. Roaring Run	MC3307	2325	61	200
A	Cheat River	Black Fork	B	2.50	111	24	9	IRA	Pipe	Roaring Run	MC3305	2431	244	800
A	Cheat River	Shavers Fork	B	1.26	95	38	8	IRA	Pipe	Shingle Tree Run	MC3404	2063	37	120
A	Tygart Valley River	Leading Creek	B	2.91	96	32	10	IRA	Pipe	Trib. Haddix Run	MC3504	1845	30	100
B	Cacapon River	Central Cacapon River	A	3.06	101	105	15	IRA	Box Culvert	Sauerkraut Run	PC402	6472	24	80
B	Cacapon River	Central Cacapon River	B	1.58	105	111	8	IRA	Pipe	Trib. Lost River	PC2400	6251	49	160
B	Shenandoah River	Cedar Creek	B	3.14	112	58	11	IRA	Pipe	Duck Run	PS201	126	24	80
B	Shenandoah River	Cedar Creek	B	2.58	112	66	13	IRA	Pipe	Duck Run	PS202	93	40	130
B	South Branch Potomac River	Main Channel	B	3.43	104	108	5	IRA	Pipe	Fort Run	PSB2600	5396	70	230
A	Cheat River	Black Fork	A	1.90	101	87	8	Line A	Box Culvert	Trib. Beaver Creek	MC1105	4668	55	180
A	Cacapon River	Slate Rock Run	A	3.63	103	71	12	Line A	Pipe	Trib. Slate Rock Run	PC304	7702	168	550
A	North Branch Potomac River	Stony River	A	2.72	97	32	11	Line A	Pipe	Trib. Stony River	PNB1005	4893	91	300
A	Cheat River	Black Fork	B	3.67	91	21	11	Line A	Box Culvert	Trib. Big Run	MC1312	3900	61	200
A	Cheat River	Black Fork	B	3.04	99	26	10	Line A	Box Culvert	Trib. Roaring Run	MC1314	3757	274	900
A	Cheat River	Black Fork	B	3.28	111	40	9	Line A	Pipe	Trib. Roaring Run	MC1316	3731	271	890
A	Cacapon River	Skaggs Run	B	4.43	105	30	10	Line A	Box Culvert	Trib. Skaggs Run	PC511	6731	186	610
B	Cacapon River	Slate Rock Run	A	2.46	115	83	16	Line A	Box Culvert	Slate Rock Run	PC305	7681	131	430
B	Cacapon River	Baker Run	A	2.59	109	102	15	Line B	Box Culvert	Trib. Baker Run	PC517	6980	198	650
B	North Branch Potomac River	Patterson Creek	A	5.13	93	135	15	Line P	Pipe	Trib. M.F. Patterson Creek	PNB909	5532	168	550
C	North Branch Potomac River	Patterson Creek	B	5.30	93	110	15	Line P	Box Culvert	M.F. Patterson Creek	PNB907	5582	213	700

Table 23

COMMON HIGHWAY RUNOFF CONSTITUENTS AND THEIR PRIMARY SOURCES

Constituent	Primary Sources*
Particulates	Pavement wear, vehicles, atmosphere, maintenance
Nitrogen, Phosphorus	Atmosphere, roadside fertilizer application
Lead	Leaded gasoline (auto exhaust), tire wear (lead oxide filler material), lubricating oil and grease, bearing wear
Zinc	Tire wear (filler material), motor oil (stabilizing additive), grease
Iron	Auto body rust, steel highway structures (guardrails, etc.), moving engine parts
Copper	Metal plating, bearing and bushing wear, moving engine parts, brake lining wear, fugicides and insecticides applied by maintenance operations
Cadmium	Tire wear (filler material), insecticide application
Chromium	Metal plating, moving engine parts, brake lining wear
Nickel	Diesel fuel and gasoline (exhaust) lubricating oil, metal plating, bushing wear, brake lining wear, asphalt paving
Manganese	Moving engine parts
Bromide	Exhaust
Cyanide	Anticake compound (ferric ferrocyanide, Prussian Blue or sodium ferrocyanide, Yellow Prussiate of Soda) used to keep deicing salt granular
Sodium, Calcium	Deicing salts, grease
Chloride	Deicing salts
Sulphate	Roadway blends, fuel, deicing salts
Petroleum	Spills, leaks or blow-by of motor lubricants, antifreeze and hydraulic fluids, asphalt surface leachate
Polychlorinated Biphenyls	Spraying of highway right-of-ways, background atmospheric deposition, PCB catalyst in synthetic tires
Pesticides Pathogenic bacteria (indicators)	Soil, litter, bird droppings and trucks hauling livestock and stockyard waste
Rubber	Tire wear
Asbestos	Clutch and brake lining wear

* Source: Kobriger, 1984

TABLE 24
EFFECTIVENESS OF STORMWATER MITIGATION MEASURES

POLLUTANT	WET DETENTION BASIN	GRASS SWALES AND BUFFER STRIPS
Suspended Sediment	80-90%	50-60%
Phosphorus	50-60%	10-15%
Nitrogen	30-40%	5-10%
Lead	70-80%	45-55%
Zinc	40-50%	25-30%
Copper	40-50%	30-35%

Source: Virginia Stormwater Management Regulations (1993)

TABLE 25
SUMMARY OF IMPACTS TO RIPARIAN BUFFER ZONES: IRA

Regional Project Watershed	Local Project Watershed	Perennial Streams	Stream Order	Length of Parallel Construction Within 23 m (75') of Stream*		Number of Riparian Buffers Impacted
				Meters	Feet	
Tygart Valley River	Leading Creek	trib. Leading Creek	1	27	89	1
		Wilmoth Run	2	142	466	3
		Leading Creek	3	197	643	6
Cheat River	Shavers Fork	Haddix Run	1	472	1,548	2
		trib. Shavers Fork	1	113	372	1
		Haddix Run	2	1,252	4,106	8
		Haddix Run	3	1,049	3,441	8
	Black Fork	Roaring Run	1	203	666	1
		trib. Beaver Creek	1	309	1,015	2
		trib. Slip Hill Mill Run	1	216	710	1
		Roaring Run	2	422	1,386	4
		Beaver Creek	3	36	119	1
S. Branch Potomac	Main Channel	Dumpling Run	2	404	1,324	1
		Fort Run	2	362	1,187	1
Cacapon River	Skaggs Run	trib. Skaggs Run	1	174	572	2
	Baker Run	trib. Long Lick Run	1	155	507	1
		trib. Baker Run	1	197	646	1
		Baker Run	3	650	2,131	4
	Central Cacapon	Lost River	3	772	2,533	4
	Slate Rock Run	trib. Sine Run	1	230	756	1
		trib. Slate Rock Run	1	1,280	4,201	2
Shenandoah River	Cedar Creek	Duck Run	2	801	2,627	4
Total				**9,463**	**31,045**	**59**

* Based on Proposed Limits of Construction

TABLE 26
RESULTANT RIPARIAN BUFFER ZONE < 23 METERS (75')[1]
IRA

Associated Reference Station	Regional Project Watershed	Local Watershed	Stream Name	Stream Order	Stream Length		Riparian Buffer Land Use	Biotic Integrity (%)	Biotic Rank[2]	Habitat Score
					Meters	Feet				
PS201	Shenandoah	Cedar Creek	Duck Run	2	22	73	Forest	60	B	112
PS202	Shenandoah	Cedar Creek	Duck Run	2	214	703	Forest	60	B	112
PS204	Shenandoah	Cedar Creek	Duck Run	2	243	796	Forest	87	A	48
PS204	Shenandoah	Cedar Creek	Duck Run	2	322	1055	Forest	87	A	48
PC303	Cacapon	Slate Rock Run	trib. Sine Run	1	230	756	Forest	100	A	79
PC2300	Cacapon	Slate Rock Run	trib. Slate Rock RUn	1	959	3146	Forest/Agriculture	80	A	86
PC2300	Cacapon	Slate Rock Run	trib. Slate Rock RUn	1	322	1055	Forest/Agriculture	80	A	86
PC413	Cacapon	Central Cacapon River	Lost River	3	15	50	Rangeland	80	A	120
PC413	Cacapon	Central Cacapon River	Lost River	3	676	2218	Rangeland	80	A	120
PC401	Cacapon	Central Cacapon River	Lost River	3	40	130	Forest	47	C	97
PC401	Cacapon	Central Cacapon River	Lost River	3	41	135	Forest	47	C	97
PC501	Cacapon	Baker Run	trib. Baker Run	1	197	646	Forest/Agriculture	73	B	67
PC503	Cacapon	Baker Run	Baker Run	3	194	637	Forest/Agriculture	93	A	89
PC2500	Cacapon	Baker Run	Baker Run	3	46	150	Agriculture	80	A	103
PC2500	Cacapon	Baker Run	Baker Run	3	152	500	Agriculture	80	A	103
PC2500	Cacapon	Baker Run	Baker Run	3	257	844	Agriculture	80	A	103
PC2502	Cacapon	Baker Run	trib. Long Lick Run	1	155	507	Forest	80	A	88
PC2504	Cacapon	Skaggs Run	trib. Skaggs Run	1	139	456	Forest/Rangeland	67	B	87
PC2504	Cacapon	Skaggs Run	trib. Skaggs Run	1	35	116	Forest/Rangeland	67	B	87
PSB2605	SBPR	Main Channel	Dumpling Run	2	404	1324	Agriculture	0	D	60
PSB2602	SBPR	Main Channel	Fort Run	2	362	1187	Agriculture	0	D	52
MC1103	Cheat	Black Fork	trib. Beaver Creek	1	172	563	Forest/Wetland	60	B	63
MC1208	Cheat	Black Fork	Beaver Creek	3	36	119	Forest	27	C	68
MC1111	Cheat	Black Fork	trib. Beaver Creek	1	138	452	Forest/Wetland	40	C	57
MC3303	Cheat	Black Fork	trib. Slip Hill Mill Run	1	216	710	Forest	27	C	66
MC3306	Cheat	Black Fork	Roaring Run	2	75	246	Forest	53	B	117
MC3305	Cheat	Black Fork	Roaring Run	1	203	666	Forest	67	B	111
MC3308	Cheat	Black Fork	Roaring Run	2	258	849	Forest	93	A	124
MC3308	Cheat	Black Fork	Roaring Run	2	55	179	Forest	93	A	124
MC3308	Cheat	Black Fork	Roaring Run	2	34	112	Forest	93	A	124
MC1400	Cheat	Shavers Fork	trib. Shavers Fork	1	113	372	Forest/Shrub	67	B	120
MC3403	Cheat	Shavers Fork	Haddix Run	3	119	389	Forest/Shrub/Agriculture	60	B	108
MT3504	Cheat	Shavers Fork	Haddix Run	3	199	652	Forest/Shrub/Agriculture	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	3	155	508	Forest/Shrub/Agriculture	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	3	73	241	Forest/Shrub/Agriculture	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	3	261	857	Shrub/Wetland	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	3	80	264	Shrub/Wetland	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	3	101	330	Shrub/Wetland	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	3	61	200	Shrub/Wetland	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	2	166	547	Shrub/Wetland	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	2	157	516	Forest/Shrub	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	2	154	505	Forest/Shrub	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	2	47	154	Forest/Shrub	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	2	21	68	Forest/Shrub	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	2	43	140	Forest/Shrub	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	2	13	42	Forest/Shrub	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	2	650	2134	Forest/Shrub	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	1	459	1506	Forest/Shrub	67	B	96
MT3504	Cheat	Shavers Fork	Haddix Run	1	13	42	Forest/Shrub	67	B	96
MT3503	Tygart	Leading Creek	Leading Creek	3	58	189	Forest/Agriculture	47	C	76
MT3503	Tygart	Leading Creek	Leading Creek	3	30	97	Forest/Agriculture	47	C	76
MT3503	Tygart	Leading Creek	Leading Creek	3	38	125	Forest/Agriculture	47	C	76
MT3503	Tygart	Leading Creek	Leading Creek	3	15	48	Forest/Agriculture	47	C	76
MT3503	Tygart	Leading Creek	Leading Creek	3	19	61	Forest/Agriculture	47	C	76
MT3502	Tygart	Leading Creek	Leading Creek	3	37	123	Agriculture	73	B	77
MT1511	Tygart	Leading Creek	Wilmoth Run	2	71	232	Shrub/Brush	20	D	53
MT1511	Tygart	Leading Creek	Wilmoth Run	2	15	50	Shrub/Brush	20	D	53
MT1511	Tygart	Leading Creek	Wilmoth Run	2	56	184	Shrub/Brush	20	D	53
MT3603	Tygart	Leading Creek	trib. Leading Creek	1	27	89	Agriculture/Wetland	20	D	76
Total					9,463	31,045				

1 Based on Welsch, 1991, Croonquist and Brooks, 1993

2 Biotic Rank Determined from Biotic Integrity Scores:

A = > 79%
B = 50-79%
C = 21-49%
D = < 21%

TABLE 27
SUMMARY OF IMPACTS TO RIPARIAN BUFFER ZONES: Line A

Regional Project Watershed	Local Project Watershed	Perennial Streams	Stream Order	Length of Parallel Construction Within 23 m (75') of Stream*		Number of Riparian Buffers Impacted
				Meters	Feet	
Tygart Valley River	Leading Creek	Pearcy Run	2	46	153	1
		Leading Creek	3	123	411	4
Cheat River	Black Fork	trib. Beaver Creek	1	29	95	1
		Pendleton Creek	2	172	573	1
	Shavers Fork	trib. Shavers Fork	1	123	411	1
		Pleasant Run	2	15	51	1
		Pleasant Run	3	59	195	1
		Shavers Fork	3	48	160	1
N. Branch Potomac	Patterson Creek	trib. Patterson Creek	1	84	279	1
		trib. N.B. Patterson Creek	1	227	756	2
		M.F. Patterson Creek	3	146	485	1
S. Branch Potomac	Anderson Run	Toombs Hollow Run	2	515	1,715	2
Cacapon River	Skaggs Run	Skaggs Run	2	152	508	2
Total				**1,739**	**5,792**	**19**

TABLE 28
RESULTANT RIPARIAN BUFFER ZONES < 23 METERS (75')[1]
Line A

Associated Reference Station	Regional Project Watershed	Local Watershed	Stream Name	Stream Order	Stream Length		Riparian Buffer Land Use	Biotic Integrity (%)	Biotic Rank[2]	Habitat Score
					Meters	Feet				
PNB800	NBPR	Patterson Creek	trib. Patterson Creek	1	84	279	Forest	0	D	34
PNB808	NBPR	Patterson Creek	trib. N.B. Patterson Creek	1	150	500	Agriculture	20	D	51
PNB808	NBPR	Patterson Creek	trib. N.B. Patterson Creek	1	77	256	Shrub/Brush	20	D	51
MC1111	Cheat	Black Fork	trib. Beaver Creek	1	29	95	Forest	40	C	57
MC1402	Cheat	Shavers Fork	trib. Shavers Fork	1	123	411	Agriculture	7	D	37
PC513	Cacapon	Skaggs Run	Skaggs Run	2	82	274	Shrub/Brush	60	B	86
PC513	Cacapon	Skaggs Run	Skaggs Run	2	70	234	Shrub/Brush	60	B	86
PSB707	SBPR	Anderson Run	Toombs Hollow Run	2	419	1,398	Forest	60	B	89
PSB708	SBPR	Anderson Run	Toombs Hollow Run	2	95	317	Forest	60	B	89
MC1212	Cheat	Black Fork	Pendleton Creek	2	172	573	Wetland	20	D	86
MC1505	Cheat	Shavers Fork	Pleasant Run	2	15	51	Agriculture	33	C	84
MT1603	Tygart	Leading Creek	Pearcy Run	2	46	153	Agriculture	27	C	76
PNB907	NBPR	Patterson Creek	M.F. Patterson Creek	3	146	485	Forest	73	B	93
MC1400	Cheat	Shavers Fork	Shavers Fork	3	48	160	Shrub/Brush	67	B	120
MC1503	Cheat	Shavers Fork	Pleasant Run	3	59	195	Forest	87	A	104
MT3602	Tygart	Leading Creek	Leading Creek	3	21	69	Forest	47	C	91
MT3602	Tygart	Leading Creek	Leading Creek	3	25	83	Forest	47	C	91
MT3602	Tygart	Leading Creek	Leading Creek	3	56	185	Forest	47	C	91
MT3602	Tygart	Leading Creek	Leading Creek	3	22	74	Forest	47	C	91
Total					1,739	5,792				

1 Based on Welsch, 1991, Croonquist and Brooks, 1993

2 Biotic Rank Determined from Biotic Integrity Scores: A = > 79%
B = 50-79%
C = 21-49%
D = < 21%

Figure 69
RIPARIAN BUFFER ZONE ENCROACHMENT
IRA & Line A COMPARISON
Riparian Buffer Zone < 23 meters (75')

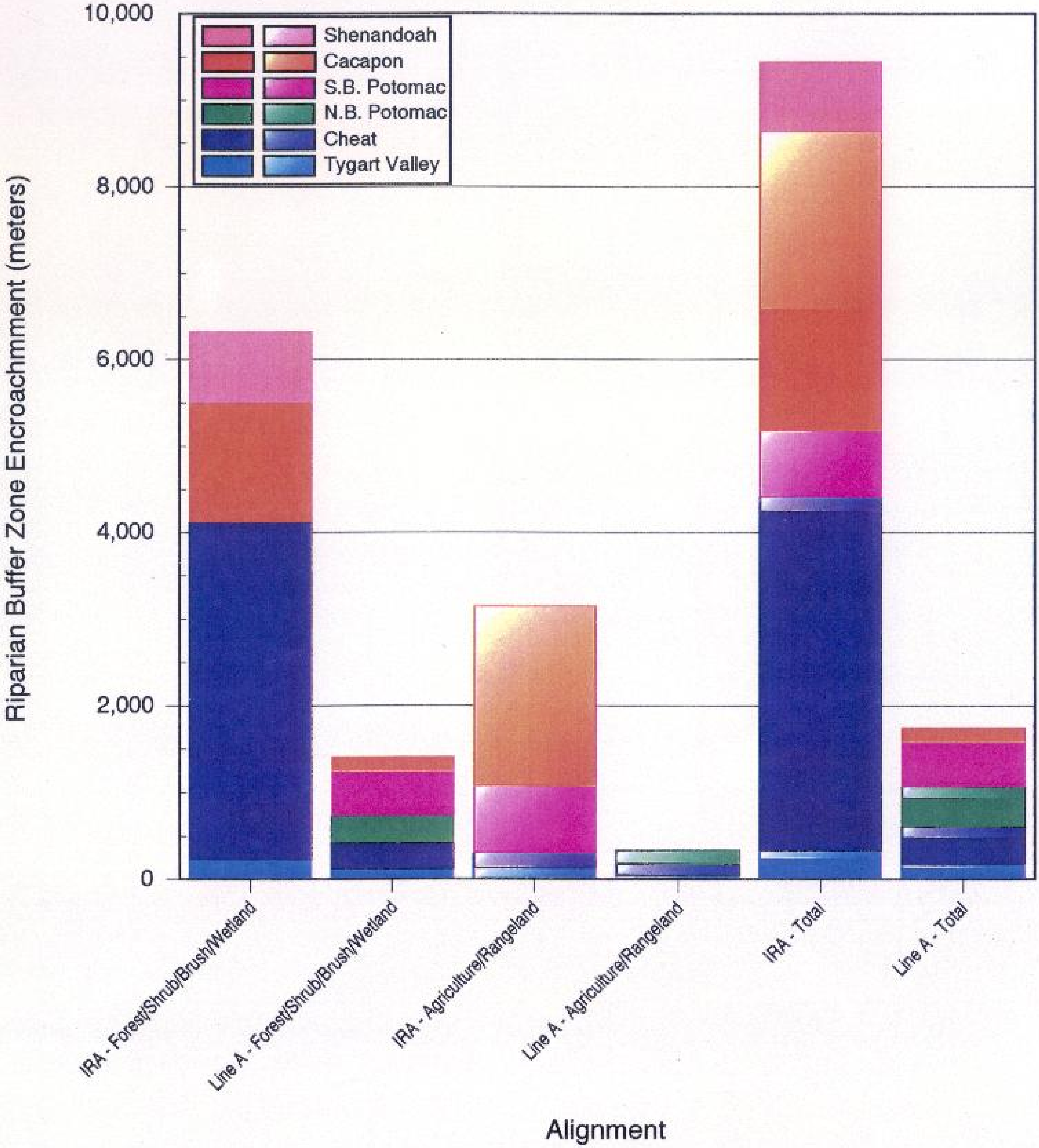


TABLE 29
SUMMARY OF RIPARIAN IMPACTS BY WATERSHED: IRA AND Line A

Regional Project Watershed	Number of Riparian Impacts in Each Biotic Rank Category								Length of Riparian Impacts in Each Biotic Rank Category (Meters)							
	IRA				Line A				IRA				Line A			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Tygart Valley River	0	1	5	4	0	0	5	0	0	37	160	169	0	0	170	0
Cheat River	3	22	3	0	1	1	2	2	347	3,335	390	0	59	48	44	295
N. Branch Potomac	0	0	0	0	0	1	0	3	0	0	0	0	0	146	0	311
S. Branch Potomac	0	0	0	2	0	2	0	0	0	0	0	766	0	514	0	0
Cacapon River	10	3	2	0	0	2	0	0	3,006	371	81	0	0	152	0	0
Shenandoah	2	2	0	0	0	0	0	0	565	236	0	0	0	0	0	0
Total	15	28	10	6	1	6	7	5	3,918	3,979	631	935	59	860	214	606