REDEVELOPMENT OF THE WYOMING STREAM INTEGRITY INDEX (WSII) FOR ASSESSING THE BIOLOGICAL CONDITION OF WADEABLE STREAMS IN WYOMING

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EXECUTIVE SUMMARY

Over the past six years, the Wyoming Department of Environmental Quality – Water Quality Division (WDEQ/WQD) has invested considerable effort in the development of effective indicators for assessment of biological condition of Wyoming streams. Much of the focus has been on developing and refining a statewide multimetric index (MMI) for Wyoming named the Wyoming Stream Integrity Index (WSII). Originally developed in 2000 and later revised in 2002, the WSII is based on macroinvertebrate community-level attributes or metrics designed to assess the degree to which biological communities are different from that expected to occur under reference or baseline conditions. The WSII is one of several tools the WDEQ/WQD uses to understand and quantify both biological impacts on stream ecosystems and the degree to which management practices are effective at rehabilitating them.

Most of the past efforts to refine the WSII concentrated on improving the assessment of biological condition through development of better reference conditions with additional data, the creation of both quantitative and qualitative reference and stressed condition criteria, and better capture of natural variation in macroinvertebrate communities through enhanced site classification. All MMIs including the WSII require an adequate number of reference and stressed sites in a region to estimate natural variation of metrics and biological response to stressors. During development of the original model and subsequent revision, streams identified as reference or stressed in certain regions of Wyoming were few in number and spread over a broad area. This necessitated *ad hoc* development of condition criteria (a commonly used method in MMI development) to select reference and stressed sites from the available dataset. Wyoming is biologically diverse, which much of this diversity attributed to spatial variability in geology, climate and topography. Macroinvertebrate reference conditions are also expected to vary across Wyoming's heterogeneous landscapes. Spatial classification of reference sites allows for the development of reference condition expectations unique to various regions of Wyoming. Site classification increases the chances of identifying truly degraded sites and decreases the chances of erroneously assessing a site as biologically impaired when it is not. At the time the WSII was first

developed, the best classification scheme for Wyoming macroinvertebrates appeared to consist of several bioregions based on level III ecoregions.

While the 2002 revision improved the accuracy and applicability of the WSII, particularly in mountainous regions of Wyoming, it was realized that further improvement was needed to increase the accuracy of biological condition assessments for lowland and foothill streams. To improve biological assessments, another approach to site classification was needed to better capture natural spatial variation in macroinvertebrate communities of these streams. In addition, it was found that the reference and stressed condition criteria assigned many sites a false-positive reference or stressed status. Combined, these issues resulted in inaccurate reference expectations for lowland and foothill streams, leading to over (or under)-estimation of biological condition. This presented the WDEQ/WQD difficulties in ascertaining biological condition and determining aquatic life use support status for many streams in these areas.

Recently, the WDEQ/WQD has made a concerted effort to resolve these problems through a complete recalibration and validation of the WSII. Not only did this redevelopment include the inclusion of additional data, an evaluation and selection of existing and new metrics for inclusion in the index, and a re-evaluation of the performance of the WSII, it also involved changes to two fundamental components of the model. This first involved a refinement of the criteria used to designate reference and stressed sites. Reference and stressed criteria were based on a standardized checklist of reach-wide and watershed-scale characteristics associated with the severity of human disturbance. Re-screening of the existing dataset with these criteria revealed that a sufficient number of reference and stressed sites existed for redevelopment of the WSII without the need to use *ad hoc* condition criteria. The removal of condition criteria allowed for better representation of regional reference and stressed conditions.

The second component change involved the development of a more objective site classification system that reflected the region-specific biological potentials of macroinvertebrate communities in Wyoming.

Sites were classified using a method that combined the use of existing landscape classifications (i.e. ecoregions) with multivariate methods that model the relationships between environmental variables and macroinvertebrate communities at reference sites. Geographic patterns in these relationships are then delineated using multiple landscape classifications such as ecoregions and watershed boundaries. In essence, this allows the "biology" to stratify sites rather than "fitting" macroinvertebrate communties into a pre-existing landscape classification. Compared to the older classification, this approach identified several biologically homogenous classes of streams and better emphasized distinct characteristics of regional macroinvertebrate communities (i.e. lowland versus foothill) that are structured by local and watershed-scale factors. Consequently, by better representing macroinvertebrate communities in Wyoming, expected reference conditions for these communities and the ability of the model to identify biological impairment was also improved.

This report summarizes the methodology, performance, limitations, and applications behind the redevelopment of the WSII. Improvements to the WSII has and will continue to be an iterative process as new ways to improve the model are discovered and better modeling techniques and additional data become available. The redeveloped WSII was a substantial improvement over previous versions in terms of accuracy, precision and better representation of expected reference conditions and represents another important component of the WDEQ/WQD's suite of biological indicators. The redeveloped WSII will help to quantitatively assess the status and trends of aquatic life use support in Wyoming streams and provide another line of evidence in determination of aquatic life use support as it relates to Wyoming's 303(d) and 305(b) requirements under the Clean Water Act.

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INTRODUCTION

For almost three decades, multimetric indices (MMIs) have seen widespread use in the regulatory community as important tools for the assessment of water quality and stream ecosystem integrity (Barbour et al., 1999; Bramblett et al. 2005; Emery et al. 2003; Hughes et al. 2004; Karr 1981; Karr et al. 1986; Karr 1991; Kerans and Karr, 1994; Maxted et al. 2000; McCormick et al. 2001; Mebane et al. 2003; Royer et al. 2001; Weigel et al. 2000; Weigel et al. 2002) MMIs integrate a variety of compositional, structural, and functional attributes of a biotic assemblage (referred to as metrics) into a composite numeric model. Metrics used in an index can be selected one of two ways: *a priori* based on professional expertise (Karr 1981) or an empirical evaluation of candidate metrics and their ability to discriminate between reference and stressed sites (Barbour et al. 1999). Unique metrics that are most responsive to anthropogenic disturbance, least redundant and minimally influenced by natural variation are ultimately incorporated into MMIs (Hughes et al. 1998; Karr and Chu 1999). Sites of unknown biotic condition are compared to an expected reference condition derived from a group of sites that are minimally or least impacted by anthropogenic stressors (Reynoldson et al. 1997).

Stribling et al. (2000) developed an MMI to assess the biological condition of wadeable streams in Wyoming using benthic macroinvertebrate data. This model was called the Wyoming Stream Integrity Index (WSII). Data from 389 samples collected by the Wyoming Department of Environmental Quality-Water Quality Division (WDEQ/WQD) from 1993 to 1997 were used to develop the model. Physical and chemical criteria for characterizing reference and stressed conditions were determined through examination of measured values among seven level III ecoregions (Omernik and Gallant 1987) in the state. From an evaluation of metric distributions for reference sites among the seven ecoregions, four bioregions were recognized: Rockies, Black Hills, Basin, and Plains. The composite WSII consisted of one metric suite for high gradient streams in the Rockies and Black Hills and one metric suite for low gradient streams in the Basin and Plains. Although the index was adequate at the time, the accuracy and applicability of the model was limited in some bioregions due to inadequate numbers of reference or stressed sites.

Additional samples collected by WDEQ/WQD in 1998 and 1999 were combined with the 1993-1997 dataset to increase the total number of samples to 746. The increased sample size, with the addition of more reference and stressed sites, facilitated the redevelopment of the WSII to address known shortcomings (Jessup and Stribling 2002). Criteria used to determine reference and stressed conditions (hereafter referred to as condition criteria) consisted of a combination of both quantitative physical and chemical data and qualitative measures derived from habitat assessments. With the additional data, site classification based on the seven level III ecoregions was re-evaluated and eight bioregions (rather than four) were identified. One metric suite was developed for the five generally high gradient bioregions (Middle Rockies Central-High Elevation, Middle Rockies Central-Low Elevation, Middle Rockies West, Southern Rockies, and Black Hills) and one metric suite for low gradient bioregions (Wyoming Basin, Western High Plains, and Northwestern Great Plains). Indices for each bioregion were assigned unique scoring thresholds based on reference conditions for that bioregion.

Though the WSII was reasonably responsive to anthropogenic impacts on stream biota, application of the model revealed that further improvements were needed to improve performance and applicability. The first concern was the type of condition criteria used for selection of reference and stressed sites. In many instances, the development of an MMI requires the adjustment of condition criteria in order to increase the number of reference and stressed sites from the available dataset for statistical reasons. This aids in site stratification, index development and evaluation (Barbour et al. 1999).

Condition criteria for the WSII were derived, in part, from ranks and scores of qualitative habitat assessments. Though useful in concept, this approach may be subjective and not repeatable due to inconsistent interpretation of the assessment questions by field staff. Furthermore, many of the abiotic quantitative criteria used to define reference and stressed conditions were based on little to no empirical data from the region of interest and therefore may not have reflected natural conditions and led to site being misclassified as reference or stressed. Because of the issues associated with establishing condition criteria for Wyoming, it was decided that reference and stressed conditions would be better represented in a model developed from a sufficient number of *field selected* and validated reference and stressed sites. A reevaluation of reference status for all 1993-1999 sites yielded a sufficient number of reference and stressed sites for a revision of the WSII without the need for condition criteria. It is believed that this approach equates to better representation of regional reference and stressed conditions.

A second concern centered on the use of predefined landscape classifications, such as ecoregions, to stratify sites into biologically “homogeneous” groups. Ecoregions denote areas of general ecological similarity based on geology, landforms, vegetation, soils, and land use (Omernik 1987). This *a priori* framework is based on sound ecological principles (Omernik and Gallant 1987) and is commonly used in building MMIs. However, local and watershed scale factors can influence natural biotic potentials of streams which may differ from expected conditions at the ecoregional scale (Reynoldson et al. 1997; Wang et al. 2003). In some cases, landscape classifications account only for a minor portion of the total variation in regional biotic assemblage structure (Van Sickle and Hughes 2000). An alternative to landscape classification is an *a posteriori* analysis of biological structure to determine bioregions. One approach is the use of cluster analysis followed by discriminant function analysis (DFA) to form a spatially-independent classification. These multivariate techniques are integral to site classification and prediction of faunal assemblages for predictive models (Clarke et al. 2003; Hawkins et al. 2000; Moss et al. 1987; Wright et al. 1993) and have been suggested for use in MMIs alone or in combination with landscape classifications by Barbour et al. (1999) and Van Sickle and Hughes (2000). We are unaware of any efforts to integrate predictive modeling techniques in the development of classifications or bioregions derived from biological data and not solely from landscape classifications. Here, we attempt to follow the suggestions of Barbour et al. (1999) and Van Sickle and Hughes (2000) through implementation of a method that shares some of the continuous classification advantages of multivariate machinery used in predictive models with existing landscape classifications to develop a quasi-spatially independent classification method that retains the spatial framework common to MMIs. We believe this approach may improve bioregion delineation, maximize within-bioregion similarity, and ultimately improve our model's accuracy and precision.

The objective of this study was to redevelop the WSII to enhance its performance in the evaluation of biological condition for wadeable streams in Wyoming. To do this we 1) used the existing WDEQ/WQD 1993-1999 dataset to calibrate the model; 2) eliminated the use of condition criteria for identifying the population of reference and stressed sites for index development and testing; 3) integrated multivariate techniques and predefined landscape classifications to delineate bioregions and stratify sites; 4) assessed robustness of the model to temporal variability through the evaluation of model scores from repeated annual visits to several reference sites; 5) evaluated the responsiveness of the WSII to individual environmental factors influenced by humans as well as a generalized human disturbance gradient; and 6) validated the model performance with an independent dataset.

METHODS AND MATERIALS

Study Area

Unless otherwise noted, the following information was obtained from Knight (1994). The State of Wyoming straddles the continental divide and encompasses 251,489 km^2 (97,100 mi^2). Wyoming is biologically diverse, owing much of this diversity to variability in geology, climate, topography, and other environmental features of the state. Wyoming is characterized by abrupt topographic relief and numerous types of exposed granitic, volcanic, and sedimentary bedrock. Elevation ranges from 939 to 4,207 m (3,081 to 13,802 ft) with a mean of 2,030 m (6,660 ft). Average annual precipitation varies regionally, ranging from 15 to 150 cm (6 to 59 in), which is mostly in the form of rain in the plains regions and snow in the mountain and intermountain basins. Temperature varies widely due to the great topographic relief of the state. For example, mean daily maximum and minimum temperatures for July range from 32°C to <24°C (90 to <75°F) and 13°C to 0°C (55 to 32°F), respectively. Omernik and Gallant (1997) divided Wyoming into seven level III ecoregions: Middle Rockies, Southern Rockies, Snake River Plain, Wasatch/Uinta Mountains, Northwestern Great Plains, Wyoming Basin, and the Western High Plains. The Middle Rockies consist of the Black Hills in northeastern Wyoming, the Bighorn range in north-central Wyoming, and the Teton, Absaroka, Gallatin, Wyoming, Salt River, Wind River, Beartooth, and other ranges of northwestern/western Wyoming. Because of differences in abiotic and biotic characteristics and its extent over several distinct mountain ranges, the Middle Rockies ecoregion can be divided into three sub-regions: Middle Rockies East (Black Hills), Middle Rockies Central (Bighorn mountains), and Middle Rockies West (mountain ranges of northwest and western Wyoming). The Laramie, Medicine Bow, and Sierra Madre ranges of south-central and southeast Wyoming comprise the Southern Rockies. The mountains of Wyoming are characterized by coniferous forest, aspen groves, subalpine meadows, and alpine tundra. The mixed-grass prairie of the Northwestern Great Plains makes up most of the eastern one-third of the state and the short-grass prairie Western High Plains are confined to the southeast corner of Wyoming. Most of the remainder of the state is considered part of the Wyoming Basin, which is an elevated desert plateau that consists of sagebrush, greasewood, and saltbush shrublands. The Snake River Plain and Wasatch/Uinta Mountains occupy small areas of western and southwestern Wyoming, respectively. Adding to the ecological diversity of Wyoming are escarpments of sedimentary and granitic rock scattered throughout the plains and basin regions of the state. Many streams in the mountains are coldwater systems while those in the plains and basin regions are a diverse mixture of cold and warmwater systems.

Site Selection

A total of 931 samples were collected throughout Wyoming by the WDEQ/WQD between 1993 and 2001 (Figure 1). Sites were identified as either reference or stressed based on stringent criteria that evaluated whether water chemistry met numeric in-stream aquatic life criteria (WDEQ 2001), the stability and diversity of bed, bank and instream habitat conditions, and anthropogenic impact on the system (WDEQ 2001b).

From this dataset, 296 samples were identified as reference of which 157 from the 1993-1999 record were used in model development (reference calibration) and 46 from the 2000-2001 dataset were used to validate whether the model could correctly assess sites of known condition (reference validation). An additional 93 samples that were collected at 32 previously sampled reference sites (repeat reference) were used to evaluate temporal variability in reference site index scores. The number of revisits to each of these reference sites ranged from one to eight, with most sites having at least three revisits Of the

635 non-reference samples, 65 were identified as stressed from the 1993-1999 record and were used as part of the model calibration dataset. Many of these sites exceeded one or more numeric in-stream aquatic life criteria, were characterized by unstable bed and banks or habitat degradation, point-source discharges, flow augmentation or depletion, and/or affected by urbanization and stormwater discharges. Most stressed sites were known to be partially or non-supportive of one or more designated uses such as aquatic life or cold-water fisheries (WDEQ 2001). The remaining 570 samples were retained as test samples and evaluated with the model.

Macroinvertebrates

Benthic macroinvertebrates were collected from riffles with a Surber sampler [0.09 m^2 (1 ft^2) and 500-µ mesh]. This habitat was selected because it is considered to have the greatest diversity and density of organisms in the majority of relatively high gradient Wyoming steams (Barbour et al. 1999). In the absence of riffles, samples were collected in runs. Each sample was a composite of eight Surber samples collected randomly along a 30.5 m (100 ft) maximum riffle/run length. Samples were collected from downstream to upstream to avoid habitat disruption, placed in polyethylene bottles and preserved in either 10% Formalin or 99% Isopropanol. Samples were picked, sorted, identified and quality assurance/quality controlled according to approved procedures (WDEQ 2001b). All samples were collected during wadeable baseflow conditions and in habitats that possessed sufficient depth to remain submerged during periods of low flow. Samples in the montane regions were sampled from August 1 to October 31, whereas plains and basin streams were sampled from July 15 to October 31. Repeat samples were generally collected at one year intervals following initial sampling.

Chemical and Physical Habitat Data

Water quality data (pH, temperature, sulfate, total phosphorus, nitrate-nitrogen, hardness, total suspended solids, turbidity, chloride, dissolved oxygen, and conductivity) were collected at one location directly below the base of the riffle or run sampled for macroinvertebrates and prior to macroinvertebrate sampling to minimize contamination from disturbance of the sample area. Samples were collected, preserved and analyzed according to approved procedures (WDEQ 2001b). A digital planimeter or a geographic information system (GIS) was used to calculate watershed area (m^2) and elevation (m) from

1:24,000 United States Geological Survey (USGS) DRG-E topographic maps. Latitude and longitude coordinates were obtained with a handheld global positioning system (GPS) (WGS 1984 datum) and converted to decimal degrees.

Site Classification

Macroinvertebrate data were reported as raw taxa counts and identified to the lowest taxonomic level possible (usually genus). To ensure taxonomic resolution was consistent among reference samples in preparation for site classification, data were aggregated to operational taxonomic units (OTUs) as described in Hawkins et al. (2000). Based on Ostermiller and Hawkins (2004), a subsample of 300 randomly selected individuals from each reference site were used in the site classification. A subsample of 300 randomly selected individuals was used in the predictive modeling methods for site classification. Ostermiller and Hawkins (2004) concluded that the precision, accuracy and sensitivity of predictive models increases with sample size and recommended sub-sample counts of at least 300-350 individuals.

The Sorenson (Bray-Curtis) similarity measure was used to measure the taxonomic similarity between all pairs of reference site samples from OTU raw taxa counts. Rare taxa, defined as those taxa collected at $\leq$10 sites within the reference dataset, were excluded from the classification analysis. The flexible hierarchical unweighted pair-group average (UPGMA) agglomerative clustering method with $\beta = -0.5$ was used to cluster samples based on these similarities.

The hierarchical cluster dendrogram was partitioned into discrete groups that maximized mean similarity within groups and consisted of at least five sites per group. Once cluster groups were identified, we used discriminant function analysis to produce a discriminant model from which a series of equations were used to predict membership probabilities of sites based on watershed and environmental characteristics of streams within each reference group. These discriminant equations were identical to those used in development of the Wyoming RIVPACS predictive model and based on the same reference calibration dataset mentioned previously (Hargett et al. *In Press*; Hargett et al. 2005). Discriminant function equations were used to calculate probabilities of group membership for the remaining test and stressed samples. For purposes of this study, test and stressed sites were assigned to the reference groups to which they had the highest probability of membership. In most cases, the probability exceeded 80% for the group that the site was assigned. The combined reference, test, and stressed site groupings were then evaluated with GIS for bio-geographical patterns. Multiple landscape classifications alone or in combination were used as templates to delineate new bioregions from the spatial assemblage patterns.

To validate whether the new bioregions accurately captured the bio-geographical patterns derived from the discriminat model, the discriminant model was re-run with all reference calibration and test sites from the 1993-1999 dataset grouped by the new bioregions. In addition, the discriminant model was applied to the independent 2000-2001 dataset to further validate the bioregion delineations. The misclassification rate for each bioregion was obtained based on the proportion of sample observations in the bioregion that were misclassified. In addition, mean similarity analyses (Van Sickle 1997) were performed to evaluate the relative classification strength based on the new bioregions, old bioregions and level III ecoregions. The mean between (B) and within-class (W) similarities for each classification were calculated according to Van Sickle (1997) using Sorenson (Bray-Curtis) similarity measures calculated from OTU raw taxa counts. The overall strength of the classification was expressed by the extent to which W exceeds B (Van Sickle and Hughes 2000). In this case, classification strength was measured by the unitless ratio M=B/W (Smith et al. 1990; Van Sickle 1997). Classification strength can also be measured by CS = (W-B)*100. M ratios near 1.0 indicate a weak classification and CS increases as M decreases from 1.0 toward 0 (Van Sickle and Hughes 2000).

NMS using Sorenson (Bray-Curtis) similarities calculated from the OTU raw taxa counts was used to evaluate the new bioregions in ordination space. This test provides a perspective on the strength of within-group similarities and relative dissimilarities among bioregions. Greater distances between bioregions indicate greater dissimilarities in macroinvertebrate assemblages. Similarly, the tighter samples cluster within a bioregion, the greater the within-group similarity. Strong Pearson’s product-moment correlations ($r > 0.6$) of the ordination axes with latitude, longitude, watershed area, or elevation indicated whether bioregions were structured by these geographic variables. The stress value of an NMS analysis indicates how well the clustering patterns match the dissimilarity structure and can be readily interpreted. A stress of < 0.2 is considered acceptable for interpreting results from NMS analysis (Clarke and Warwick 1994).

Metric Selection and Screening

We examined 86 metrics which included those used in previous versions of the WSII (Jessup and Stribling 2002; Stribling et al. 2000) and new metrics developed for this study. Evaluated metrics were grouped into five categories: richness, compositional, life history, functional feeding/habitat preference and tolerance/diversity. Metrics were expressed as enumerations or percentages of species or individuals. The Beck's Biotic Index (BI or Florida Index) metric (Barbour et al. 1996) and the Biotic Condition Index (BCICTQa) (Winget and Mangum 1979) were calculated from published literature. Tolerance values used in the calculation of the Hilsenhoff Biotic Index (HBI) (Hilsenhoff 1987), and number and percentages of tolerant and intolerant taxa metrics were derived from literature (Barbour et al. 1999 and Bob Wisseman (Aquatic Biology Associates), unpublished data). We examined each metric for its discrimination efficiency, responsiveness, and redundancy prior to inclusion in the index (Barbour et al. 1999).

Following suggestions by Barbour et al. (1999), each metric was examined for its discrimination efficiency (DE) or the ability to discriminate between reference and stressed sites among all bioregions. DE was determined as the percent of stressed samples that have metric values below the 25th percentile (or 75th percentile for reverse metrics) of the reference values. Candidate metrics with DE's greater than 50% and a clear consistent mode of response were retained and evaluated for responsiveness to abiotic variables.

In accordance with procedures outlined by Hughes et al. (1998), we used Spearman rank correlations to evaluate the responsiveness of the candidate metrics to physicochemical variables influenced by human disturbance. These parameters included chloride, temperature, total suspended solids, turbidity, specific conductance, total hardness, and sulfate. Metrics were retained if they possessed significant correlations ($r > 0.40$) with the expected mode of response to human disturbance in at least four physicochemical variables. We tested redundancy among the remaining metrics using Pearson product-moment correlations. Metric combinations with r values > 0.75 were considered redundant. One metric of each redundant pair was selected based on professional expertise and whether the metric was one of the best representatives within a metric category.

Metric and Index Scoring

Each bioregion contained a separate suite of metrics deemed suitable for inclusion into the composite WSII. Metrics that were significantly correlated with watershed area were standardized to a watershed area constant. Scoring criteria for each metric were developed using data from reference, test, and stressed samples from the calibration dataset. Metric values were standardized into unitless scores by setting the optimal metric value to a score of 100. This was done by first calculating the 95^{th} percentile of the values for positive metrics and the 5^{th} percentile for reverse metrics. The 5^{th} percentile for a reverse metric represented the optimal condition while the highest non-outlier value constituted the 'worst' condition and thus received a score of 0. Metrics were scored for each sample by calculating the percentage of the 5^{th} or 95^{th} percentile values and multiplied by 100. Multimetric index scores for each sample were calculated by averaging all metric scores to yield a possible range of 0 to 100.

Index Evaluation and Validation

To find the best index alternative, a minimum of 20 metric combinations were considered per bioregion. Scores for each bioregion index were evaluated for their sensitivity to anthropogenic stressors. This was done by evaluating the distribution of index scores for reference and stressed samples with box and whisker plots and by calculating the overall index DE. The precision of each bioregion index was evaluated by performing a random-effects ANOVA on 120 replicate samples collected at 55 sites from 1993-1999. Replicate samples were collected from both reference and test sites. The 90% confidence interval (CI) of each bioregion index was calculated by multiplying the root mean square error by 1.645. Smaller confidence intervals are indicative of more precise index results.

The performance of the WSII was evaluated by examining linear regression relationships between standardized index scores of all sites and selected physicochemical variables affected by human disturbance. To evaluate model bias, we used single-factor analysis of variance (ANOVA) with a Duncan multiple-comparison range test to determine whether bioregional differences existed among reference calibration samples. This same technique was used to look at differences in test site scores among bioregions. We evaluated whether standardized index scores from all sites were related to natural gradients such as elevation and watershed area with linear regression analyses. Two-sample t-tests were used to compare reference site scores between the calibration and independent validation datasets to assess consistency and applicability.

Temporal Variability

We used the root mean square error calculated from a random-effects ANOVA on all repeat reference samples to evaluate temporal variability in WSII scores. A low root mean square error would indicate the WSII was temporally stable.

Data Analysis

All chemical, physical and biological variables were evaluated for normality and either log_{10}, log (X+1) or arcsine-square-root transformed as necessary. All statistical analyses were performed with either PC-ORD (Version 4.0) (McCune and Medford 1999) or STATISTICA (Version 6.0) (StatSoft 2001). All tests were considered significant at the $P < 0.05$ level.

RESULTS

Site Classification

Two-hundred nineteen operational taxonomic units (OTUs) were identified from the reference calibration dataset (Appendix A). Ninety-six of these taxa occurred at 10 or more calibration sites and were included in the cluster analysis. Fifteen reference groups were derived from the cluster analysis of the reference calibration samples (Figure 2). Percent chaining of the cluster analysis was low (0.52). All reference groups contained a minimum of five samples. Stressed and test samples were assigned to one of the fifteen reference groups using the discriminant function equations described previously (Hargett et al., *In Press*; Hargett et al. 2005). In general, the bio-geographical distribution of samples, as defined by the reference groups, conformed to some combination of level III and IV ecoregion boundaries of Wyoming. In several cases, bio-geographical patterns were not adequately captured by ecoregional boundaries alone. Under these circumstances, watershed boundaries and elevation were used to further define the bio-geographical pattern. Using these geographic boundaries and professional expertise, seven bioregions representing areas of biological homogeneity were ultimately delineated: Western Volcanic and Sedimentary Mountains (WVSM), Bighorn and Wind River Mountains (BWM), Bighorn and Wind River Foothills (BWF), Black Hills (BH), Southern Rockies (SR), Wyoming Basin (WB), and the Plains (Figure 3).

The WVSM represented streams in the mid to upper-elevation mountains of western Wyoming, with the exception of the Wind River and Beartooth Mountains. Reference streams in this bioregion occurred in three contiguous reference groups (1, 2 and 3). There appeared to be some regional patterns within the WVSM where streams with watersheds comprised of volcanic or sedimentary materials were marginally unique from the less abundant granitic-dominated watersheds. However, the spatial distributions among these groups were not clear enough to warrant a separation from the WVSM. Together, streams in the Wyoming Range and Uinta/Wasatch mountains appeared biologically similar though were somewhat distinct from the remaining streams in the region. However, these areas could not be delineated as a separate bioregion due to an insufficient number of reference and non-reference sites and were retained in the WVSM.

Streams in the mid to upper-elevation zones of the Bighorn, Wind River, and Beartooth mountains of northcentral and western Wyoming comprised the BWM bioregion. Reference groups 4, 5, 6 and 7 contained the reference streams for this bioregion. Boundaries for the BWM generally paralleled the Dry Mid-Elevation Sedimentary Mountains (17m) and Granitic Subalpine Zone (17k) level IV ecoregions of Wyoming. Although no reference sites were located in the Beartooth mountains, this range was grouped with the BWM based on geologic similarity with the Bighorn and Wind River mountains. Streams with small watershed areas at elevations greater than 9000 feet exhibited some biological differences from the rest of the bioregion. However, they were not partitioned from the BWM due to limited reference site representation.

Regional structuring of the macroinvertebrate assemblages for the Southern Rockies (SR) bioregion was less pronounced compared to the WVSM and BWM. There were indications that biological assemblages located in the Sierra Madre, Laramie mountains and Medicine Bow mountains were each unique. However, these areas could not be identified as separate bioregions due to an insufficient number of reference sites in each of the three mountainous regions. In general, the SR boundaries followed the level III ecoregion (21) of the same name. Reference streams in this bioregion were distributed among reference groups 5, 8, 10, and 11 with over half occurring in groups 8 and 10.

Streams whose origins are in the Bighorn or Wind River mountains, but were situated along the low-elevation foothills of the respective mountain ranges, showed a distinct biogeographic pattern. The spatial patterns of these samples were used to delineate the Bighorn and Wind River Foothills (BWF), where consequently, the boundaries closely paralleled the Foothill Shrublands and Low Mountain (18d) level IV ecoregion surrounding most of the Wind River and Bighorn Mountains. Watershed boundaries were then used to better define the delineation of this bioregion. Many streams located east of the Bighorn Mountains, yet situated along the western portion of the Northwestern Great Plains (43) level III ecoregion, exhibited moderately strong biological associations with foothill streams and were therefore included within the BWF. Reference streams in this bioregion occurred in reference groups 10, 11, 12 and 14

Streams from the Northwestern Great Plains (43) and Western High Plains (25) level III ecoregions were distinct from other streams, but together appeared to possess fairly uniform spatial distributions with no obvious ecoregional separation. The Plains bioregion was created to capture this collective spatial distribution of plains streams. Though located within the Black Hills of northeast Wyoming, the Belle Fourche River showed strong similarities with the Northwestern Great Plains and was therefore was integrated into the Plains bioregion. This made ecological sense, since most of the Belle Fourche River watershed lies within the eastern plains. Subtle differences in assemblage structure were noted between Plains streams with small versus moderate to large watersheds. Reference streams in the Plains bioregion were primarily assigned to group 15.

Streams of the BH bioregion were biologically unique from other streams in the state with most reference streams occurring in group 13. Biogeographical patterns of these streams coincided well with the predefined level IV ecoregions (Black Hills Foothills (17a), Black Hills Plateau (17b), and Black Hills Core Highlands (17c)) that collectively represent the Black Hills.

Streams that were not clearly associated with any of the above bioregions were captured by the WB. Delineation of this bioregion generally followed the boundaries of the Wyoming Basin level III ecoregion. In general, sites within this bioregion exhibited a pattern whereby streams with mountain origins were marginally distinguishable from interior spring-fed streams. Although the transitional foothill nature of streams that originate in the Bighorn and Wind River mountains and flow into the basin are generally captured by the BWF, several of these streams continued to show montane biotic and abiotic characteristics well into the interior of the WB. Conversely, streams that drain the Wyoming Range tend to exhibit interior basin characteristics almost as soon as they enter the WB. Furthermore, streams that drain several of the small isolated mountain ranges within the WB are biologically heterogeneous and may exhibit a montane, interior basin or a combined faunal assemblage. As a consequence, many of these stream segments are not easily classified into the WB or adjacent mountainous or foothill bioregions. In order to account for this natural variability, there is evidence to suggest that the WB could be partitioned into several bioregions. Most apparent would be the separation of streams with mixed montane/basin characteristics from streams with a distinct interior faunal assemblage. Though unique, these interior streams were retained as part of the WB since they were not represented by a sufficient number of reference sites to constitute partitioning into a separate bioregion. Reference streams in the WB were distributed among several reference groups though most occurred in groups 9 and 12.

The discriminant model correctly re-classified 85.5% of the 1993-1999 sites used for model construction and evaluation among all bioregions combined (Table 1). Classification rates varied among bioregions with the WB and the BWF having the lowest classification rates of 71.2% and 77.8%, respectively. When the discriminant model was applied to the independent 2000-2001 dataset, the model correctly classified 90.6% of sites among all bioregions combined (Table 1). With the exception of the BWF, all bioregions had classification rates >90%. The BWF exhibited a low classification rate of 45.5%.

Classification strength as described by CS was larger for a classification based on the new bioregions (16%) rather than the old bioregions (13%) and level III ecoregions (8%) (Table 2). As expected, values of M decreased with increased CS values. The new bioregion classification was only 3% higher than classification based on the old bioregions. The small increase in classification strength was not surprising considering that spatial patterns of sites of the new bioregions was similar (though refined) to the old bioregions.

The NMS ordination (Figure 4) showed that macroinvertebrate assemblages of the Plains bioregion were distinct from the three mountainous bioregions (BWM, WVSM, and SR) with the WB, BWF, and BH sharing some similarities between one or more of these groups. Seventy-three percent of the variation in the assemblage data within the reference calibration dataset was accounted for by three axes: axis 1 (39.9%), axis 2 (20.8%), and axis 3 (12.3%). Final stress for the NMS ordination was 0.18. On a broad scale, the ordination of bioregions corresponded, in part, to their geographic distributions with greater distances separating the western and central mountainous bioregions from the plains. Likewise, there was a west-to-east distribution of bioregions along axis 1 and 2, which was supported by the moderate correlation of longitude ($r \sim 0.5$) (Table 3). Considering axes 1 and 2 together accounted for most of the variability, there was considerable overlap among the BWM, WVSM, and SR bioregions suggesting the assemblages shared similar biological attributes. A handful of streams sites in the SR and BWM plotted together with sites from the BWF, though overall, the BWF was considered relatively distinct from other bioregions. The assemblage structure of the BH was relatively distinct compared to other bioregions, though there were some attributes shared with the Plains. Some reference streams in the BH exhibited natural watershed and environmental characteristics (e.g. fine gravel or sand/silt substrates and naturally elevated physicochemical variables) that are similar to those of Plains streams. These streams were primarily located in ecological transition zones along the northeastern and southern flanks of the BH. The WB possessed the least within-group similarity of all bioregions as evidenced by the large cluster group and wide distribution of sites in the ordination plot, overlapped predominantly with the BWF, SR, BH and Plains. WB sites with similarities to the BWF and SR are moderate gradient streams with watershed origins in the mountains and are located along the periphery (or transitional zone) of the WB that lies adjacent to these bioregions. In contrast, sites that shared similarities with the Plains and BH are located in the interior of the WB characterized by low gradients, spring-fed dominated flow origins and fine-gravel to sand/silt dominant substrates. The overlap among the mountainous bioregions suggested a gradation of biological attributes across these bioregions rather than distinct assemblage classes. Because of their homogeneity, the mountainous bioregions were combined as one group (Rockies) during metric selections, yet were considered separately during the metric scoring and index evaluations to recognize the biological characteristics unique to each bioregion. The BH, WB, BWF, and Plains bioregions were each analyzed separately for metric selection, metric scoring and index evaluation.

Metric Selection and Screening

Forty-seven metrics were selected as candidates for index development based on moderate to high discrimination efficiencies (50-100%) and a consistent mode of response to anthropogenic stressors across most bioregions (Table 4). Nineteen of these 47 metrics were ultimately rejected due to nonsignificant correlations ($P > 0.05$; $r < 0.40$) with four or more physicochemical variables (Table 5). Of the remaining 28 metrics, twelve were rejected because of redundancy with one or more metrics (Table 6). The final 17 metrics selected for index development (Table 7) included six metrics (number of total taxa, percentage of non-insects, percentage of Ephemeroptera (less *Baetidae*) within the community, percentage of collector-gatherers, number of scrapers, and percentage of the five dominant taxa metrics) that did not meet all criteria for inclusion in the index but were retained based on professional expertise. Number of total taxa is an indicator of overall diversity of benthic organisms in the stream and was selected due to it conventional use in many multimetric indices (Barbour et al. 1999; Karr et al. 1986, Kerans et al. 1994). Percentage of non-insects, percentage of collector-gatherers, and number of scrapers were retained since they were found to be sensitive in identifying stressed conditions in several bioregions and may provide extra sensitivity to potential impacts such as sedimentation or nutrient enrichment. Though their initial DE's among bioregions were low to moderate, the percentage of Ephemeroptera (less *Baetidae*) within the community and percentage of the five dominant taxa were retained as they proved to be useful in a previous version of the WSII (Jessup and Stribling 2002) and showed some promise in a few bioregions.

Index Scoring

Metric combinations for each bioregion consisted of at least six metrics from several metric categories. Separate metric suites were developed for the BH, BWF, WB and Plains bioregions. The same metric suite was used for the three mountainous bioregions (BWM, WVSM, and SR) though metric and index scoring was calculated separately for each bioregion. Metric selection and scoring criteria for each of the seven bioregion indices are presented in Table 8.

Index Evaluation and Validation

Index DE's within bioregions were all above 80%, with the WVSM, SR, BWF, and BH exhibiting the greatest discrimination between reference and stressed samples (Figure 5). Estimates of precision varied among bioregions with the SR exhibiting the greatest margin of error of ± 6.4 units for the 90% CI (Figure 5). The bioregion with the best precision was the BH with a CI of ± 2.6 units.

Linear regressions demonstrated that the WSII responded strongly ($P < 0.001$) to human influenced physicochemical variables such as chloride, temperature, total suspended solids, turbidity, alkalinity, specific conductance, total hardness, sulfate, percent coarse substrate, and percent fine substrate (Figure 6). WSII scores were inversely proportional to all physicochemical variables. The amount of variability (r^2) explained in the WSII by the environmental variables ranged from 5% to 39%.

For reference calibration sites, WSII scores were significantly different ($F = 12.93$; $P < 0.001$) among bioregions (Table 9). Reference calibration scores were significantly lower in the Plains bioregion (mean = 46.0) relative to other bioregions according to the Duncan multiple comparison rank test (Table 9). Mountainous bioregions exhibited the highest reference calibration scores while those of the WB and BH were intermediate (Table 9). WSII scores for test sites were significantly different ($F = 22.72$; $P < 0.001$) among bioregions (Table 9). The Duncan test showed that test site scores were highest in the mountainous BWM, WVSM, and SR bioregions (means = 61.2 – 65.6) and lowest in the Plains (mean = 43.3) bioregion (Table 9). Linear regressions verified this pattern as WSII scores generally declined ($P < 0.001$) in response to decreased elevation and increased watershed area, implying that streams in lowland areas were of lower biological condition than elsewhere (Figure 6). Mean WSII scores for the reference calibration and validation datasets were not significantly different from one another ($t = 0.116$; $P = 0.91$) (Figure 7). WSII scores for all 931 samples evaluated in this study are listed in Appendix B.

Temporal Variability

The root mean square error calculated from the random-effects ANOVA performed on the repeat reference dataset was 6.7 suggesting the WSII was temporally stable with minimal inter-annual variation.

DISCUSSION

Classification of Wyoming Streams

Benthic macroinvertebrate assemblages in Wyoming are diverse, owing much of their variability to the environmental heterogeneity of the region. Human activities such as urbanization, intensive agriculture, point-source pollution, hydrologic modifications and timber-harvesting have altered the landscape and consequently the habitat and biota of streams in Wyoming, particularly within the eastern plains and inter-montane basins. Successful evaluation of the biological condition of Wyoming streams requires a multimetric index that is responsive to human disturbance yet accounts for natural variability in stream macroinvertebrate assemblages.

Large natural variability among biological communities within a region requires classification of stream sites into groups with similar habitat and macroinvertebrate community characteristics so that appropriate expected conditions can be developed for test sites (Reynoldson et al. 1997). The conventional approach to site classification for MMIs has been the use of landscape classifications such as ecoregions (Omernik and Gallant 1987). *A posteriori* ordination analyses such as NMS are also commonly used to refine and validate the use of the geographic classification. A geographic classification is preferable in MMIs since it can be readily applied to future test sites and easily mapped. However, trying to 'fit' assemblage structure into a single geographic classification may not adequately aggregate biologically similar assemblages. In addition, local and watershed-scale factors may influence the natural biotic potential of streams which may differ from expected conditions at the landscape classification scale (Wang et al. 2003). Critics of landscape classification propose an alternative continuous approach to classify sites based on an empirical multivariate analysis of macroinvertebrate assemblages to develop classes without prior assumptions on the causes of differences among assemblages (Hawkins et al. 2000). This approach avoids establishing *a priori* bioregions that may not reflect similar benthic communities and creates groups objectively by allowing the biological data to 'structure' site classification (Reynoldson et al. 1997). The downside to full implementation of non-geographic classification in MMIs requires a large consistent dataset derived from a randomized sampling approach where sites are uniformly distributed and capture the environmental heterogeneity of the region. Such an approach would allow for classification and development of reference expectations for entire ecosystems. However, these datasets are rarely available and thus integration of whole-ecosystem spatially-independent classifications in MMIs has yet to be realized.

Considering the absence of such a dataset in Wyoming, we instead redeveloped the WSII using a hybrid site classification that combined the advantages of both spatial (*a priori*) and continuous (*a posteriori*) classifications; namely, modifying the spatial framework using continuous classification output. The continuous component of our site classification aided in identifying biologically similar assemblages and maximizing within-class similarity. Use of multiple landscape classifications to capture the bio-geographical patterns of the continuous output maintained a spatial classification that made ecological sense and better accounted for natural variability in assemblage structure. This approach produced an improved classification that was not radically different than what was used for the previous version of the WSII (Jessup and Stribling 2002) or using only the level III ecoregion classification. However, we found that this marginal improvement in classification resulted in a large proportion of our test sites being categorized into bioregions with appropriate reference expectations. Under the old bioregions, these same test sites were compared to inappropriate reference expectations (e.g., plains and foothill streams compared to mountain reference expectations) which resulted in inaccurate assessments of biological condition. In short, the small improvement in classification strength resulted in significant improvements to accurate assessments of biological condition. Moreover, the classification strength of our new bioregions was better than similar classification strengths of western Oregon streams using ecoregions and/or hydrologic units which ranged from 1% to 13% (Van Sickle and Hughes 2000). Lastly, our new bioregions adequately captured the natural abiotic and biotic variability as described by the discriminant model used to generate the spatial assemblage patterns. Not only can our alternative approach classify sites geographically, but also can provide probabilities of site membership to each of the seven bioregions using the discriminant model. This predictive component of our classification may prove useful for sites located along the boundary of two or more bioregions where overlap in environmental characteristics among bioregions may occur. For example, re-classification of sites in the BWF for the independent validation dataset was low at 45.5%. The reason is that many of these sites were classified geographically into the BWF but were located along the periphery of the bioregion and possessed environmental characteristics that were more similar to streams in neighboring bioregions. Based on these similarities, the discriminant model assigned higher site membership probabilities to the neighboring bioregion(s) than to the BWF, resulting in the low re-classification percentage for the BWF.

The concordance of ecoregions with the spatial distribution of reference groups derived from the cluster analysis indicates that differences in stream macroinvertebrate assemblages in Wyoming are tied to broad-scale abiotic and biotic factors acting upon streams. However, ecoregions alone may not strongly classify any one ecosystem component such as faunal assemblage (Van Sickle and Hughes 2000) which we found to be the case in Wyoming. For this reason, our bioregion boundaries had to be adjusted using other landscape classifications, such as watershed divides and elevation, to better capture local and/or regional environmental factors influencing the biota in Wyoming.

Because a reference site network forms the basis for the development of bioregions, poor or incomplete representation of a unique reference condition in particular regions may result in those areas being combined into biologically similar, yet less representative bioregions. Such homogenization is necessary for practical application of the index, though there is a tradeoff since combining with another bioregion does not recognize the biological uniqueness of some areas and lessens within-group similarity of the bioregion to which it is combined. A case in point is the WB bioregion where within-group similarity was the lowest among all seven bioregions owing to the large variability in this bioregion. For example, macroinvertebrate assemblages of WB streams with montane origins were distinct from interior WB streams with spring-fed origins. Because of their uniqueness, each of these groups could conceivably represent an individual bioregion. Partitioning the WB into separate bioregions was limited, however, by the number of reference sites in our dataset that could adequately describe these diverse biotic assemblages within the WB. Relaxing the criteria used to categorize a stream as reference could be used to artificially increase the number of reference sites for each unique group, though this approach would contradict our efforts to develop a multimetric index where reference criteria are consistent across bioregions. Therefore, the decision was made to retain the WB bioregion for modeling purposes, with the recognition that biologically distinct groups within the WB should be partitioned into separate bioregions in future revisions of the WSII, dependent on the availability of new reference sites that adequately describe attainable biological conditions. The implication of these and similar findings in our study is that site classification is an iterative process which makes use of all relevant information and helps direct future efforts to locate additional reference sites in areas that show potential as unique bioregions.

Metric Selection

In development of the WSII, we considered metrics representing richness, composition, life history, functional feeding, habitat preference, tolerance and diversity attributes of benthic macroinvertebrates assemblages. As recommended by Barbour et al. (1999), our final choice of metrics reflected a balance among different community attributes. In some cases, we modified conventional metrics or those used in previous versions of the WSII to reflect our knowledge of the macroinvertebrate assemblages in Wyoming. Our final index consisted of several richness-based metrics that describe the diversity of the assemblage within each sample. Increasing diversity normally correlates with increasing stream health and suggests that all resource and habitat requirements are adequate to support the community. The total taxa richness metric is a measure of overall macroinvertebrate diversity and has been included as a key metric in several multimetric indices. Ephemeroptera, Plecoptera and Trichoptera richness metrics are key indicators for detecting anthropogenic stress since these groups are sensitive to a range of human stressors (Barbour et al. 1999). Measurements of richness are sensitive to sampling effort and subsampling procedures (Barbour and Gerritsen 1996; Larsen and Herlihy 1998). This concern was addressed by collecting samples from a standard 0.09 m^2 area at eight random locations within a riffle, combining the eight 0.09 m^2 areas into one sample and employing sub-sampling with a fixed-count of 500 organisms during the analysis. The number of semivoltine taxa (less Coleoptera) was the only reproductive strategy metric included in the index. Semivoltine taxa require more than one year to develop, and reflect long-term environmental conditions. Frequent fluctuations in hydrology or instability in the streambed may reduce the number of semivoltine taxa in the assemblage. Semivoltine Coleopterans were excluded from this metric as the vast majority of individuals in our samples were adult forms with a semi-aquatic existence.

Several compositional metrics (relative abundance) were also included in the final index. These metrics provide information on the relative contribution of specific taxonomic groups to the entire assemblage. Ephemeroptera, Plecoptera and Trichoptera are generally intolerant of pollution and a high relative percentage of EPT individuals generally indicates unstressed conditions. Several genera within the families *Baetidae* (Ephemeroptera) and *Hydropsychidae* (Trichoptera) are tolerant to a wide range of environmental conditions (Ward 1992). Because of these tolerances and the possibility of confounding detection of anthropogenic stress when included in an MMI, these families were removed and the percentage of Ephemeroptera (less *Baetidae*) *within the community* and percentage of Trichoptera (less *Hydropsychidae*) *within the community* were used instead. In some bioregions, the percentage of Trichoptera (less *Hydropsychidae*) *within the Trichoptera* group was more sensitive than the entire assemblage or community measure. This was because in many streams, the community measure was not characterized by a sufficient range in values to allow effective detection of anthropogenic stress. *Within community* metrics are calculated as $(((O_n-F_n)/N)*100)$ where O_n are total number of individuals in the Order, F_n are the total number of individuals in the Family an N are the total number of individuals in the sample. Similarly, the *within group* metrics are calculated as $(((O_n-F_n)/N_o)*100)$ where N_o is the total number of individuals within the Order.

The percentage of non-insects was a useful metric in all bioregions with the exception of the Plains and the BH. Many non-insects are pollution tolerant, generally inhabit fine sediments or organic detritus and increase in relative percentage under stressed conditions (Barbour et al. 1999; Ward 1992). This metric was unsuitable in the Plains and BH simply because many non-insects are common members of the assemblages at unimpacted sites. The percentage of the dominant five taxa provided a measure of community redundancy equated with the dominance of a few taxa. An assemblage dominated by few taxa generally indicates degraded conditions, presumably due to the homogeneity of physicochemical conditions that benefit only a few organisms (Barbour et al. 1999).

The reason behind the inclusion of percentage and number of scraper taxa in the WSII was that scrapers are specialist feeders that are sensitive to disturbances because they depend on periphyton for their food resource (Merritt and Cummins 1996). Both metrics were included since they were not redundant and each provided different ecological information on the scraper community of each site. In the absence of human stressors, scrapers are commonly found in moderate to high gradient streams with coarse substrates for periphyton attachment (Merritt and Cummins 1996). Human activities that disturb the substrate and result in a scouring of periphyton or burial of coarse substrate would reduce numbers and/or relative abundances of scraper taxa in the community.

Percent collector-gatherers was included in the WSII to detect disturbances associated with sedimentation in the foothill and lowland bioregions of Wyoming. Collector-gatherers feed predominantly on decomposed fine particulate organic matter on or within fine sediments and can be a common component of the benthic assemblage in some unaltered streams (Merritt and Cummins 1996). However, human activities that appreciably increase the percentage of fine sediment in a stream may result in a community shift that favors the success and dominance of collector-gatherers.

Tolerance/intolerance measures are normally non-specific to the type of stressor, however, the Hilsenhoff Biotic Index (HBI) was developed to detect organic pollution (Hilsenhoff 1987) while the Biotic Condition Index (BCI) and its associated Actual Community Tolerance Quotient (CTQa) was developed to evaluate the effects of sulfate, alkalinity and sedimentation (Winget and Magnum 1979). Values for the HBI are derived from the best available knowledge on tolerances of specific taxa to pollution. BCICTQa values are based on mean tolerance quotients of taxa to alkalinity, sulfate and sediment. A higher HBI or BCICTQa value generally indicates more tolerant taxa are present in the assemblage, presumably due to anthropogenic disturbance.

<u>Model Performance</u>

Overall, the WSII clearly discriminated reference from stressed sites and was accurate and precise enough to detect even modest degradation. However, there appeared to be a small degree of systematic bias associated particularly with the Plains bioregion index and to a lesser extent the WB and BH indices, as reference calibration scores for these bioregions were lower compared to other bioregions. One explanation for the lower reference calibration scores in these bioregions may be associated with their lower overall quality (least disturbed versus minimally disturbed in most other bioregions). Considering that many catchments in these bioregions have been greatly altered from multiple human activities for more than a century, we think it reasonable to use data from least impacted reference sites that embody the best management practices. The use of least impacted rather than minimally impacted reference sites relaxes the objectivity in establishing reference expectations for these bioregions relative to the other bioregions in Wyoming. However, this lower reference condition is necessary simply because minimally impacted reference sites in these areas of Wyoming and neighboring states are virtually absent considering the ubiquitous occurrence of human disturbance.

In addition, the WSII exhibited strong correlations with several physicochemical variables that are commonly influenced by human disturbance. Changes in these physicochemical variables have translated to changes in the macroinvertebrate assemblage. Mean reference validation scores were similar to that of our calibration dataset. Because the validation dataset was not used in any phase of model development, these results are strong evidence that the WSII consistently predicts reference biological condition for new datasets.

Test sites with higher WSII scores were largely distributed among Wyoming's many mountain ranges where human disturbance is generally minimal due to rough terrain and a limited number of population centers. Areas with high densities of test sites with low WSII scores were primarily confined to streams of the eastern plains and inter-montane basins of Wyoming. This was supported by the fact that WSII scores tended to decline with increases in watershed area and declines in elevation. Predominant human activities which have the potential to either directly or indirectly alter the biota of stream ecosystems in these areas include hydrologic modifications, point and non-point source pollutants and stream alterations such as channelization, excessive aggradation or degradation of sediment in the stream channels and urbanization.

Temporal Variability

Not only should a multimetric index be responsive to human disturbance but it should account for natural biotic and environmental variation. Temporal variability in both the diversity and abundance of macroinvertebrate assemblages are associated not only with life history traits such as timing of emergence and dispersal, but also natural variation in environmental variables. Differences in measurement and sample error may also introduce variability into the model. An examination of individual WSII scores for repeat visits to reference sites indicated that biological condition was relatively consistent through time. Our results demonstrate that the WSII is reasonably robust temporally in light of inter-annual changes in macroinvertebrate communities, environmental factors, and crew sampling efficiencies.

Assessment of Anthropogenic Disturbance

Under the authority of the federal Clean Water Act and the oversight and direction of the United States Environmental Protection Agency (USEPA), WDEQ/WQD is responsible for restoring and maintaining the chemical, physical, and biological integrity of waters within the State of Wyoming. Evaluating the biological integrity of waters in Wyoming is based, in part, on the attainment of a designated aquatic life use as defined in state water quality standards (WDEQ 2001). With respect to the WSII and its application in Wyoming, there are three categories of aquatic life use attainment: 'full-support', 'indeterminate', and 'partial/non-support'. When evaluating output from the WSII, it is necessary to first define what scores constitute 'full', 'indeterminate', and 'partial/non-support' status of aquatic life use. The numeric thresholds for these narrative criteria vary across bioregions, though are all developed using the same method. For each bioregion, scores that exceed the 25th percentile of reference scores are identified as 'full-support' of aquatic life uses. Index scores below the 25th percentile of reference scores are trisected into equal portions. Scores in the upper 1/3 of this trisection are identified as 'indeterminate' which technically is not an attainment category in itself, but is rather a designation which would require the use of ancillary information and/or additional data in the decision on a proper narrative assignment. (e.g. full or partial/non-support). Finally, scores that fall within the lower 2/3 of the trisection would be assigned a 'partial/non-support' designation which would indicate substantial anthropogenic perturbations are occurring at and/or upstream of the sample location. Site scores that fall within the 90% CI around narrative thresholds for each bioregion would be treated similar to what is described for 'indeterminate' scores, requiring additional information in a weight-of-evidence approach to arrive at a final aquatic life use support determination. Output from the WSII reveals that the majority of test sites are receiving some degree of anthropogenic disturbance (Table 10, Figure 8). Collectively, these results suggest differing levels of biological degradation within Wyoming for the period of record.

WSII Limitations

The WSII effectively detects human impacts that negatively affect macroinvertebrate assemblages in streams of Wyoming, though, as with all models, there are limitations in the WSII that should be recognized and considered in its application by potential users. These limitations are largely related to representation of reference quality streams in certain regions of Wyoming. Reference conditions are the basis for site assessment and detection of anthropogenic stressors on the aquatic community (Barbour et al. 1999). Poor or incomplete representation of the reference condition for streams in particular regions will result in data gaps in the range of conditions covered by the model, and consequently, less accurate assessments. This concern is strongest for stream segments in the interior of the Wyoming Basin bioregion, which are poorly represented in the reference calibration dataset. Whereas the reference condition of stream segments located along the periphery of the Wyoming Basin bioregion is reasonably well represented in the model, only two reference sites characterize reference conditions of interior Wyoming Basin stream segments, and of those, only systems with relatively small watersheds. These gaps imply that the WSII can reasonably evaluate biological condition for streams along the periphery of this bioregion but may perform marginally for interior Wyoming Basin stream segments which are primarily located in the Bighorn Basin and lower Green River and upper North Platte River drainages.

Large rivers are ecologically unique relative to smaller tributaries that feed into them, particularly with respect to their size and broad spatial scales in distribution of biota and habitats (Emery et al. 2003). Where smaller systems are easily replicated across a particular region, large rivers cross many political boundaries which inhibits the development of similar, multi-state reference conditions (Emery et al. 2003). In addition, defining reference condition for large rivers proves difficult because of the widespread human disturbances that impact these systems. Large rivers, including those in Wyoming, typically have their flow and sediment regimes altered via regulation from diversions and reservoirs and are further influenced by the cumulative effects of land use practices and pollution throughout their watersheds. Thus, locating least impacted large river reference segments in Wyoming has been difficult and has resulted in reliance on data primarily from tributary streams to large rivers and secondarily from the few identified least impacted unregulated river segments (most notably the upper North Platte River). Consequently, the sensitivity and general applicability of the WSII to large rivers is contingent on how appropriate the expected reference condition is to evaluating the biological condition of the river reach. Therefore, it is recommended that use of the WSII to large rivers in Wyoming be considered on a case-by-case basis.

Reference conditions of stream segments with very small watersheds (< 5 mi^2) in addition to those located at upper montane elevations (> 9000 ft) also are minimally represented in our reference calibration dataset and may prove difficult to accurately assess condition with the WSII. Prior to applying the WSII to these streams, it should be determined that the reference condition of the bioregion accurately reflects attributes of the unimpacted macroinvertebrate assemblage of the stream and the response of that assemblage to human activities. The model should not be applied to macroinvertebrate data gathered with dip nets or other less quantitative sampling methods. Lastly, this model should not be applied to assess biological condition on ephemeral or intermittent stream segments or extremely low-gradient lentic-type systems since the WSII was specifically developed to evaluate the biological condition of perennial lotic systems.

Conclusions

The WSII provides another scientifically defensible tool to assess the range of biological condition in Wyoming. Where possible, application of this model in the evaluation of biological condition should be conducted in combination with other pertinent biological assessment tools. Thus, a weight-of-evidence approach in determining biological condition is recommended. Although we advocate the use of the WSII in the determination of aquatic life use support as well as the evaluation of watershed improvement projects as they relate to macroinvertebrate assemblages, we realize that future modifications are needed to enhance the model's performance. The applicability of the WSII can be improved for streams in the

WB bioregion and other regions where the reference condition may not be fully represented. We believe this issue can be addressed through identification of additional reference sites and enhanced delineation of bioregions. The regulated large rivers in Wyoming present a dilemma in applying the WSII to ascertain aquatic life use support. Further work is needed to identify an expected reference condition for these intensively regulated systems and perhaps develop an index specific to these unique systems.

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Table 1 – Classification efficiencies for sites used to build the discriminant model and delineate bioregions (1993-1999 dataset) and validation sites (2000-2001 dataset).

1993-1999 Dataset		Predicted Classifications (number of stations)						
	Percent Correct	Bighorn & Wind River Foothills	Bighorn & Wind River Mountains	Black Hills	Southern Rockies	Plains	Western Volcanic & Sedimentary Mountains	Wyoming Basin
Bighorn & Wind River Foothills	77.8	137	3	0	0	1	10	25
Bighorn & Wind River Mountains	81.3	8	91	0	0	0	13	0
Black Hills	96.2	0	0	25	0	1	0	0
Southern Rockies	100.0	0	0	0	41	0	0	0
Plains	91.1	7	0	0	1	102	0	2
Western Volcanic & Sedimentary Mountains	100.0	0	0	0	0	0	146	0
Wyoming Basin	71.2	0	0	0	14	0	22	89
Total	85.5	152	94	25	56	104	191	116

2000-2001 Dataset		Predicted Classifications (number of stations)						
	Percent Correct	Bighorn & Wind River Foothills	Bighorn & Wind River Mountains	Black Hills	Southern Rockies	Plains	Western Volcanic & Sedimentary Mountains	Wyoming Basin
Bighorn & Wind River Foothills	45.5	15	0	0	0	7	1	10
Bighorn & Wind River Mountains	90.9	4	50	0	0	0	0	1
Black Hills	92.9	0	0	13	0	1	0	0
Southern Rockies	100.0	0	0	0	21	0	0	0
Plains	100.0	0	0	0	0	66	0	0
Western Volcanic & Sedimentary Mountains	100.0	0	0	0	0	0	52	0
Wyoming Basin	91.9	0	0	0	4	0	4	91
Total	90.6	19	50	13	25	74	57	102

Table 2 – Strengths of three stream classifications for benthic macroinvertebrate assemblages from the 157 reference calibration stations. Classification strength is calculated as CS = (W – B)*100 and the corresponding measure M = B/W. Results are given for Sorenson (Bray-Curtis) measures of similarity derived from benthic macroinvertebrate raw taxa counts.

Classification	No. of Classes	CS	B / W
Level III Ecoregions	5	8	0.85
*Old Bioregions	8	13	0.77
New Bioregions	7	16	0.74

*Jessup and Stribling (2002)

Table 3 - Pearson product-moment correlations of latitude, longitude, elevation, and watershed area with NMS axes.

	NMS axes		
	1	2	3
Latitude	-0.198	-0.016	0.09
Longitude	0.514	-0.55	0.003
Elevation	-0.434	0.37	0.319
Watershed area	0.367	0.157	-0.544

Table 4 – Discrimination efficiencies of the initial 86 metrics for each bioregion and the combined Rockies group. The number of reference and stressed sites per bioregion appears in parentheses (reference/stressed). Metrics that responded positively to stress are designated with '+', negative responses are noted with '-' and no trend identified as 'NT'. Metrics retained for index development are italicized.

	Discrimination Efficiency															
	Rockies (89/19)		BWM (25/7)		WVSM (41/8)		SR (23/4)		BWF (27/12)		WB (19/13)		BH (9/3)		Plains (13/20)	
Richness Metrics																
% Ephemeroptera Taxa of EPT Taxa	41.2	+	28.6	+	62.5	-	75.0	+	58.3	+	61.5	+	NT		40.0	+
% Plecoptera Taxa of EPT Taxa	55.9	-	85.7	+	50.0	+	100.0	-	91.7	-	69.2	-	33.3	+	NT	
% Trichoptera Taxa of EPT Taxa	44.1	+	28.6	+	37.5	-	50.0	-	66.7	+	23.1	+	66.7	-	70.0	-
% Trichoptera Taxa of Total Taxa	70.6	-	57.1	-	75.0	-	25.0	-	75.0	-	61.5	-	66.7	-	70.0	-
% Plecoptera Taxa of Total Taxa	67.6	-	28.6	-	37.5	-	100.0	-	100.0	-	69.2	-	33.3	+	NT	
% Ephemeroptera Taxa of Total Taxa	82.4	-	71.4	-	75.0	-	75.0	-	100.0	-	69.2	-	33.3	-	65.0	-
% Chironomidae Taxa of Total Taxa	67.6	+	42.9	+	87.5	+	75.0	+	75.0	+	69.2	+	33.3	-	55.0	+
% Coleoptera Taxa of Total Taxa	35.3	+	28.6	+	12.5	+	25.0	-	41.7	+	69.2	-	33.3	-	40.0	-
% Diptera Taxa of Total Taxa	67.6	+	42.9	+	87.5	+	50.0	+	75.0	+	69.2	+	33.3	-	30.0	+
% Chironomidae Taxa of Diptera Taxa	32.4	+	57.1	+	25.0	+	50.0	+	41.7	+	46.2	+	NT		35.0	+
% Orthocladinae Taxa of Chironomidae Taxa	41.2	-	71.4	-	25.0	+	50.0	-	16.7	-	61.5	-	33.3	-	20.0	+
% Tanytarsini Taxa of Chironomidae Taxa	NT		NT		37.5	+	50.0	-	16.7	-	53.8	+	66.7	+	75.0	-
% Non Insect Taxa of Total Taxa	73.5	+	85.7	+	62.5	+	75.0	+	75.0	+	69.2	+	66.7	+	50.0	+
No. Chironomidae Taxa	47.1	+	42.9	+	50.0	+	50.0	-	58.3	+	46.2	+	33.3	-	45.0	-
No. Coleoptera Taxa	NT		NT		25.0	-	25.0	-	50.0	+	92.3	-	66.7	-	70.0	-
No. Crustacea Mollusca Taxa	70.6	+	71.4	+	37.5	+	NT		16.7	+	30.8	+	NT		75.0	-
No. Diptera Taxa	32.4	+	28.6	+	37.5	+	50.0	-	58.3	+	46.2	+	33.3	-	65.0	-
No. Ephemeroptera Taxa	94.1	-	57.1	-	87.5	-	100.0	-	83.3	-	23.1	-	33.3	-	100.0	-
No. EPT Taxa	88.2	-	85.7	-	75.0	-	100.0	-	100.0	-	69.2	-	66.7	-	95.0	-
No. Oligochaetae Taxa	82.4	+	85.7	+	75.0	+	25.0	+	58.3	+	69.2	+	33.3	+	30.0	+
No. Orthocladinae Taxa	NT		28.6	-	75.0	+	50.0	-	16.7	+	38.5	+	NT		60.0	-
No. Plecoptera Taxa	76.5	-	42.9	-	50.0	-	100.0	-	100.0	-	76.9	-	33.3	-	NT	
No. Tanytarsini Taxa	NT		28.6	+	87.5	+	50.0	-	16.7	-	46.2	+	33.3	+	80.0	-
No. Total Taxa	52.9	-	42.9	-	50.0	-	100.0	-	33.3	-	53.8	-	33.3	-	75.0	-
No. Trichoptera Taxa	88.2	-	57.1	-	75.0	-	100.0	-	66.7	-	53.8	-	33.3	-	90.0	-
No. Non Insect Taxa	70.6	+	71.4	+	62.5	+	25.0	+	66.7	+	53.8	+	33.3	+	30.0	+

Table 4 (cont.) - Discrimination efficiencies of the initial 86 metrics for each bioregion and the combined Rockies group. The number of reference and stressed sites per bioregion appears in parentheses (reference/stressed). Metrics that responded positively to stress are designated with '+', negative responses are noted with '-' and no trend identified as 'NT'. Metrics retained for index development are italicized.

	Discrimination Efficiency															
	Rockies (89/19)		BWM (25/7)		WVSM (41/8)		SR (23/4)		BWF (27/12)		WB (19/13)		BH (9/3)		Plains (13/20)	
Composition Metrics																
% Bivalvia	NT		28.6	+	NT		NT		NT		NT		NT		85.0	-
% Chironomidae	58.8	+	57.1	+	50.0	+	50.0	+	75.0	+	92.3	+	33.3	+	50.0	+
% Coleoptera	44.1	-	28.6	+	NT		50.0	-	41.7	-	61.5	-	100.0	-	65.0	-
% Cricotopus of the Chironomidae	NT		NT		NT		25.0	+	58.3	+	23.1	+	NT		70.0	+
% Crustacea Mollusca	NT		28.6	+	NT		25.0	+	NT		NT		33.3	+	25.0	+
% Diptera	61.8	+	42.9	+	75.0	+	25.0	+	75.0	+	92.3	+	33.3	+	55.0	+
% Ephemeroptera	47.1	-	57.1	-	75.0	-	50.0	+	33.3	-	38.5	-	33.3	-	65.0	-
% EPT	61.8	-	71.4	-	87.5	-	25.0	-	58.3	-	84.6	-	66.7	-	70.0	-
% Gastropoda	NT		NT		12.5	+	50.0	+	33.3	+	15.4	+	33.3	+	50.0	+
% Non Insect	64.7	+	71.4	+	62.5	+	50.0	+	75.0	+	69.2	+	33.3	+	25.0	+
% Odonate	NT		NT		NT		25.0	+	33.3	+	38.5	+	66.7	+	10.0	+
% Oligochaetae	76.5	+	85.7	+	75.0	+	25.0	+	100.0	+	84.6	+	33.3	+	45.0	+
% Orthocladinae of the Chironomidae	41.2	-	57.1	-	12.5	-	50.0	-	41.7	-	61.5	-	66.7	-	35.0	+
% Plecoptera	58.8	-	28.6	-	25.0	-	50.0	-	100.0	-	61.5	-	33.3	-	NT	
% Tanytarsini	41.2	+	42.9	+	62.5	+	75.0	-	16.7	-	84.6	+	33.3	+	60.0	-
% Tanytarsini of the Chironomidae	35.3	+	28.6	+	50.0	+	50.0	-	16.7	-	84.6	+	100.0	+	85.0	-
% Trichoptera	55.9	-	85.7	-	50.0	-	50.0	-	25.0	-	23.1	-	66.7	-	90.0	-
% Trichoptera (less Hydropsychidae) (within the Trichoptera)	50.0	-	14.3	-	NT		50.0	-	91.7	-	69.2	-	100.0	-	60.0	-
% Ephemeroptera (less Baetidae) (within the community)	50.0	-	57.1	-	75.0	-	50.0	-	25.0	+	30.8	+	66.7	-	25.0	-
% Trichoptera (less Hydropsychidae) (within the community)	76.5	-	71.4	-	50.0	-	75.0	-	83.3	-	53.8	-	100.0	-	70.0	-
% Baetidae of the Ephemeroptera	41.2	-	57.1	+	37.5	-	50.0	+	58.3	-	53.8	-	66.7	-	25.0	+
% Hydropsychidae of the EPT	41.2	+	14.3	+	NT		25.0	+	75.0	+	38.5	+	66.7	+	70.0	-
% Hydropsychidae of the Trichoptera	47.1	+	14.3	+	NT		25.0	+	91.7	+	61.5	+	100.0	+	25.0	+
Life History Metrics																
% Multivoltine	41.2	+	71.4	+	62.5	+	25.0	+	16.7	+	69.2	+	66.7	+	35.0	+
% Univoltine	35.3	-	85.7	-	37.5	-	NT		8.3	+	7.7	-	66.7	-	20.0	+
% Semivoltine	50.0	-	57.1	-	62.5	-	50.0	-	41.7	-	76.9	-	100.0	-	65.0	-
% Semivoltine (less semivoltine Coleoptera)	35.3	-	0.0	-	37.5	-	25.0	-	25.0	-	38.5	-	33.3	-	25.0	-
No. Univoltine Taxa	64.7	-	71.4	-	62.5	-	75.0	-	58.3	-	53.8	-	33.3	-	75.0	-
No. Multivoltine Taxa	38.2	+	28.6	+	50.0	+	50.0	-	41.7	+	30.8	+	33.3	-	60.0	-
No. Semivoltine Taxa (less semivoltine Coleoptera)	82.4	-	85.7	-	75.0	-	100.0	-	100.0	-	76.9	-	100.0	-	90.0	-
No. Semivoltine Taxa	67.6	-	71.4	-	87.5	-	100.0	-	33.3	-	100.0	-	66.7	-	70.0	-
No. Multivoltine to Univoltine Taxa	64.7	+	71.4	+	75.0	+	50.0	+	83.3	+	46.2	+	33.3	-	45.0	+

Table 4 (cont.) - Discrimination efficiencies of the initial 86 metrics for each bioregion and the combined Rockies group. The number of reference and stressed sites per bioregion appears in parentheses (reference/stressed). Metrics that responded positively to stress are designated with '+', negative responses are noted with '-' and no trend identified as 'NT'. Metrics retained for index development are italicized.

	Discrimination Efficiency															
	Rockies (89/19)		BWM (25/7)		WVSM (41/8)		SR (23/4)		BWF (27/12)		WB (19/13)		BH (9/3)		Plains (13/20)	
Functional Feeding/Habitat Group Metrics																
% Collector-gatherer Taxa of Total Taxa	70.6	+	71.4	+	62.5	+	50.0	+	100.0	+	53.8	+	NT		50.0	+
% Collector-filterer Taxa of Total Taxa	41.2	+	28.6	+	12.5	+	50.0	+	66.7	+	53.8	+	33.3	+	60.0	-
% Predator Taxa of Total Taxa	52.9	-	42.9	-	37.5	-	25.0	+	66.7	-	69.2	-	66.7	+	35.0	+
% Scraper Taxa of Total Taxa	52.9	-	71.4	-	87.5	-	50.0	-	25.0	-	38.5	-	33.3	-	40.0	-
% Shredder Taxa of Total Taxa	50.0	-	42.9	-	25.0	-	50.0	+	91.7	-	61.5	-	33.3	-	NT	
% Collector-filterer Taxa of Collector-gatherer Taxa	26.5	+	57.1	-	50.0	-	50.0	+	25.0	+	38.5	+	33.3	+	65.0	-
% Clinger	70.6	-	71.4	-	87.5	-	75.0	-	33.3	-	53.8	-	66.7	-	65.0	-
% Collector-gatherer	58.8	+	85.7	+	62.5	+	50.0	+	75.0	+	61.5	+	66.7	+	70.0	+
% Collector-filterer	50.0	+	NT		37.5	+	25.0	+	66.7	+	23.1	+	NT		70.0	-
% Predator	67.6	-	71.4	-	62.5	-	50.0	+	83.3	-	46.2	-	33.3	-	35.0	+
% Scraper	82.4	-	85.7	-	75.0	-	50.0	-	83.3	-	76.9	-	100.0	-	60.0	-
% Shredder	61.8	-	42.9	-	50.0	-	75.0	-	100.0	-	61.5	-	66.7	-	NT	
No. Scraper to Collector-gatherer Taxa	67.6	-	85.7	-	75.0	-	50.0	-	50.0	-	38.5	-	NT		40.0	-
No. Clinger Taxa	88.2	-	71.4	-	62.5	-	100.0	-	75.0	-	61.5	-	33.3	-	90.0	-
No. Collector-gatherer Taxa	26.5	+	28.6	+	25.0	+	75.0	-	66.7	+	38.5	+	33.3	-	55.0	-
No. Collector-filterer Taxa	NT		NT		50.0	+	50.0	-	41.7	+	69.2	+	NT		75.0	-
No. Predator Taxa	76.5	-	71.4	-	75.0	-	75.0	-	75.0	-	84.6	-	33.3	+	60.0	-
No. Scraper Taxa	67.6	-	85.7	-	87.5	-	75.0	-	33.3	-	53.8	-	NT		40.0	-
No. Shredder Taxa	64.7	-	28.6	-	50.0	-	25.0	-	83.3	-	76.9	-	33.3	-	NT	
Tolerance Metrics																
No. Tolerant Taxa	64.7	+	71.4	+	75.0	+	50.0	+	83.3	+	53.8	+	66.7	+	40.0	-
No. Intolerant Taxa	82.4	-	71.4	-	62.5	-	100.0	-	100.0	-	69.2	-	100.0	-	NT	
% Intolerant Taxa	85.3	-	71.4	-	87.5	-	100.0	-	100.0	-	61.5	-	100.0	-	NT	
% Tolerant Taxa	76.5	+	71.4	+	100.0	+	25.0	+	91.7	+	69.2	+	33.3	+	70.0	+
BCICTQa	76.5	+	57.1	+	62.5	+	75.0	+	100.0	+	69.2	+	33.3	+	70.0	+
HBI	82.4	+	100.0	+	100.0	+	50.0	+	100.0	+	76.9	+	100.0	+	75.0	+
BeckBI	85.3	-	85.7	-	62.5	-	100.0	-	100.0	-	84.6	-	100.0	-	85.0	-
Diversity Metrics																
% 1 Dominant Taxa	44.1	+	71.4	+	37.5	+	75.0	+	33.3	+	38.5	-	33.3	+	50.0	+
% 5 Dominant Taxa	38.2	+	57.1	+	25.0	+	75.0	+	41.7	+	30.8	-	66.7	+	55.0	+

Table 5 - Spearman rank correlations of metric values with environmental variables. Significant correlations ($P < 0.05$) are in bold. Metrics retained for index development are italicized. Metrics with asterisks are those included in index development based on professional expertise.

	Chloride	Temperature	TSS	Turbidity	Specific Conductance	Total Hardness	Sulfate
Richness Metrics							
% Trichoptera Taxa of Total Taxa	-0.37	-0.16	-0.32	-0.39	-0.39	-0.39	-0.28
% Ephemeroptera Taxa of Total Taxa	**-0.50**	-0.32	**-0.46**	**-0.56**	**-0.65**	**-0.65**	**-0.54**
% Chironomidae Taxa of Total Taxa	**0.40**	0.26	0.32	0.39	0.32	0.32	0.30
% Diptera Taxa of Total Taxa	0.39	0.19	0.31	0.35	0.35	0.36	0.29
% Non Insect Taxa of Total Taxa	0.31	0.24	0.31	**0.43**	**0.48**	**0.48**	0.38
No. Ephemeroptera Taxa	**-0.46**	-0.23	**-0.42**	**-0.43**	**-0.62**	**-0.62**	**-0.52**
No. EPT Taxa	**-0.54**	-0.28	**-0.50**	**-0.57**	**-0.69**	**-0.68**	**-0.58**
No. Oligochaetae Taxa	0.22	0.17	0.28	0.38	0.38	0.39	0.31
No. Plecoptera Taxa	**-0.52**	-0.32	**-0.47**	**-0.56**	**-0.65**	**-0.64**	**-0.60**
**No. Total Taxa*	-0.34	-0.09	-0.30	-0.27	-0.35	-0.33	-0.31
No. Trichoptera Taxa	**-0.44**	-0.17	-0.39	**-0.44**	**-0.48**	**-0.46**	-0.37
No. Non Insect Taxa	0.16	0.19	0.20	0.30	0.34	0.34	0.24
Composition Metrics							
% Chironomidae	0.19	0.16	0.11	0.15	**0.05**	**0.05**	0.03
% Diptera	0.23	0.17	0.12	0.17	0.13	0.13	0.07
% Ephemeroptera	-0.27	-0.19	-0.20	-0.24	-0.30	-0.29	-0.27
% EPT	-0.30	-0.25	-0.19	-0.32	-0.29	-0.28	-0.20
**% Non Insect*	0.19	0.21	0.12	0.25	0.24	0.20	0.11
% Oligochaetae	0.28	0.20	0.30	**0.41**	**0.43**	**0.43**	0.37
% Plecoptera	**-0.46**	-0.31	-0.35	**-0.49**	**-0.55**	**-0.53**	**-0.52**
% Trichoptera	-0.12	-0.03	-0.08	-0.08	-0.01	0.01	0.06
% Trichoptera (less Hydropsychidae) (within the Trichoptera)	**-0.47**	-0.17	**-0.45**	**-0.50**	**-0.65**	**-0.64**	**-0.66**
**% Ephemeroptera (less Baetidae) (within the community)*	-0.17	-0.21	-0.17	-0.21	-0.29	-0.31	-0.23
% Trichoptera (less Hydropsychidae) (within the community)	-0.36	-0.12	**-0.40**	**-0.41**	**-0.44**	**-0.43**	-0.38
Life History Metrics							
% Semivoltine	-0.33	-0.01	-0.21	-0.18	-0.20	-0.16	-0.17
No. Univoltine Taxa	**-0.40**	-0.28	-0.35	-0.35	**-0.40**	-0.39	-0.36
No. Semivoltine Taxa	-0.37	-0.04	-0.27	-0.27	-0.24	-0.17	-0.18
No. Semivoltine Taxa (less semivoltine Coleoptera)	**-0.43**	-0.12	-0.37	**-0.42**	**-0.44**	**-0.41**	-0.39
No. Multivoltine to Univoltine Taxa	0.37	0.33	0.30	0.37	0.30	0.31	0.29

Table 5 (cont.) - Spearman rank correlations of metric values with environmental variables. Significant correlations ($P < 0.05$) are in bold. Metrics retained for index development are italicized. Metrics with asterisks are those included in index development based on professional expertise.

	Chloride	Temperature	TSS	Turbidity	Specific Conductance	Total Hardness	Sulfate
Functional Feeding/Habitat Group Metrics							
% Collector-gatherer Taxa of Total Taxa	0.32	0.23	0.31	**0.41**	**0.40**	**0.40**	0.31
% Scraper Taxa of Total Taxa	**-0.42**	-0.23	-0.34	-0.35	**-0.40**	**-0.40**	-0.28
% Shredder Taxa of Total Taxa	**-0.50**	-0.31	**-0.40**	**-0.47**	**-0.59**	**-0.59**	**-0.55**
No. Scraper to Collector-gatherer Taxa	**-0.44**	-0.25	-0.37	**-0.41**	**-0.44**	**-0.44**	-0.33
**% Collector-gatherer*	0.20	0.13	0.19	0.22	0.25	0.25	0.15
% Scraper	**-0.45**	-0.16	-0.39	-0.39	**-0.48**	**-0.49**	**-0.43**
% Shredder	**-0.48**	-0.24	-0.39	**-0.48**	**-0.55**	**-0.53**	**-0.51**
**No. Scraper Taxa*	**-0.46**	-0.23	-0.39	-0.39	**-0.46**	**-0.45**	-0.34
No. Shredder Taxa	**-0.51**	-0.30	**-0.42**	**-0.49**	**-0.62**	**-0.61**	**-0.57**
No. Clinger Taxa	**-0.49**	-0.20	**-0.48**	**-0.50**	**-0.58**	**-0.55**	**-0.50**
% Clinger	-0.14	-0.10	-0.10	-0.15	-0.14	-0.14	-0.08
Tolerance Metrics							
No. Intolerant Taxa	**-0.58**	-0.27	**-0.54**	**-0.62**	**-0.76**	**-0.74**	**-0.68**
% Tolerant Taxa	**0.51**	0.26	**0.44**	**0.53**	**0.61**	**0.60**	**0.56**
BCICTQa	**0.58**	0.33	**0.53**	**0.63**	**0.72**	**0.71**	**0.64**
HBI	**0.54**	0.28	**0.49**	**0.58**	**0.70**	**0.69**	**0.61**
BeckBI	**-0.58**	-0.27	**-0.54**	**-0.62**	**-0.75**	**-0.72**	**-0.66**
% Intolerant Taxa	**-0.52**	-0.29	**-0.48**	**-0.55**	**-0.71**	**-0.69**	**-0.62**
No. Tolerant Taxa	0.37	0.20	0.37	**0.49**	**0.54**	**0.54**	**0.47**
Diversity Metrics							
**% 5 Dominant Taxa*	0.22	0.03	0.24	0.22	0.30	0.29	0.29

Table 6 - Metrics rejected during the metric screening process by reason.

Failed discrimination efficiency test and/or inconsistent mode of response	Failed responsiveness test	Failed redundancy test
% Ephemeroptera Taxa of EPT Taxa	% Trichoptera Taxa of Total Taxa	% Ephemeroptera Taxa of Total Taxa
% Plecoptera Taxa of EPT Taxa	% Chironomidae Taxa of Total Taxa	% Shredder Taxa of Total Taxa
% Trichoptera Taxa of EPT Taxa	% Diptera Taxa of Total Taxa	No. Scraper to Collector-gatherer Taxa
% Plecoptera Taxa of Total Taxa	No. Oligochaetae Taxa	No. Intolerant Taxa
% Coleoptera Taxa of Total Taxa	No. Non Insect Taxa	% Tolerant Taxa
% Chironomidae Taxa of Diptera Taxa	% Chironomidae	BeckBI
% Orthocladinae Taxa of Chironomidae Taxa	% Diptera	% Intolerant Taxa
% Tanytarsini Taxa of Chironomidae Taxa	% Ephemeroptera	No. Tolerant Taxa
No. Chironomidae Taxa	% EPT	No. Clinger Taxa
No. Coleoptera Taxa	% Oligochaetae	% Shredder
No. Crustacea Mollusca Taxa	% Trichoptera	No. Shredder Taxa
No. Diptera Taxa	% Semivoltine	
No. Orthocladinae Taxa	No. Univoltine Taxa	
No. Tanytarsini Taxa	No. Semivoltine Taxa	
% Bivalvia	No. Multivoltine to Univoltine Taxa	
% Coleoptera	% Collector-gatherer Taxa of Total Taxa	
% Cricotopus of the Chironomidae	% Scraper Taxa of Total Taxa	
% Crustacea Mollusca	% Clinger	
% Gastropoda	% Non Insect Taxa of Total Taxa	
% Odonate		
% Orthocladinae of the Chironomidae		
% Tanytarsini		
% Tanytarsini of the Chironomidae		
% Baetidae of the Ephemeroptera		
% Hydropsychidae of the EPT		
% Hydropsychidae of the Trichoptera		
% Multivoltine		
% Univoltine		
% Semivoltine (less semivoltine Coleoptera)		
No. Multivoltine Taxa		
% Collector-filterer Taxa of Total Taxa		
% Predator Taxa of Total Taxa		
% Collector-filterer Taxa of Collector-gatherer Taxa		
% Collector-filterer		
% Predator		
No. Collector-gatherer Taxa		
No. Collector-filterer Taxa		
No. Predator Taxa		
% 1 Dominant Taxa		

Table 7 – Final metrics included in the Wyoming Stream Integrity Index (WSII).

	Western Volcanic & Sedimentary Mountains	Bighorn & Wind River Moutains	Bighorn & Wind River Foothills	Southern Rockies	Wyoming Basin	Black Hills	Plains
Richness Metrics							
No. Ephemeroptera Taxa	X	X	X	X	X		X
No. EPT Taxa						X	
No. Plecoptera Taxa	X	X	X	X	X		
No. Total Taxa							X
No. Trichoptera Taxa	X	X	X	X	X		X
Composition Metrics							
% Non Insect	X	X	X	X	X		
% Plecoptera			X		X	X	
% Trichoptera (less Hydropsychidae) (within the Trichoptera)			X		X	X	
*% Ephemeroptera (less Baetidae) (within the community)							X
% Trichoptera (less Hydropsychidae) (within the community)	X	X		X			X
Life History Metrics							
No. Semivoltine Taxa (less semivoltine Coleoptera)	X	X	X	X	X	X	
Functional Feeding/Habitat Group Metrics							
% Collector-gatherer			X		X	X	X
% Scraper			X		X	X	
No. Scraper Taxa	X	X		X			
Tolerance Metrics							
BCICTQa	X	X		X			
HBI			X		X	X	X
Diversity Metrics							
% 5 Dominant Taxa						X	

Table 8 – Metrics and scoring criteria for each bioregion.

	Metric Scoring Formulae	5th or 95th %ile (as per formula)
Bighorn Wind River Mountains		
No. Ephemeroptera Taxa	100*X / 95th%ile	10
No. Trichoptera Taxa	100*X / 95th%ile	11
No. Plecoptera Taxa	100*X / 95th%ile	7
% Non Insect	100*(85.2-X) / (85.2-5th%ile)	0.2
% Trichoptera (less *Hydropsychidae*) (% within the community)	100*X / 95th%ile	34.3
No. Scraper Taxa	100*X / 95th%ile	7
BCICTQa	100*(101.2-X) / (101.2-5th%ile)	50.1
No. Semivoltine Taxa (less semivoltine Coleoptera)	100*X / 95th%ile	4
Western Volcanic and Sedimentary Mountains		
No. Ephemeroptera Taxa	100*X / 95th%ile	12
No. Trichoptera Taxa	100*X / 95th%ile	11
No. Plecoptera Taxa	100*X / 95th%ile	8
% Non Insect	100*(41.7-X) / (41.7-5th%ile)	0.4
% Trichoptera (less *Hydropsychidae*) (% within the community)	100*X / 95th%ile	58.1
No. Scraper Taxa	100*X / 95th%ile	8
BCICTQa	100*(95.8-X) / (95.8-5th%ile)	40.3
No. Semivoltine Taxa (less semivoltine Coleoptera)	100*X / 95th%ile	5
Southern Rockies		
No. Ephemeroptera Taxa	100*X / 95th%ile	10
No. Trichoptera Taxa	100*X / 95th%ile	12
No. Plecoptera Taxa	100*X / 95th%ile	9
% Non Insect	100*(55-X) / (55-5th%ile)	0
% Trichoptera (less *Hydropsychidae*) (% within the community)	100*X / 95th%ile	41.5
No. Scraper Taxa	100*X / 95th%ile	8
BCICTQa	100*(102.9-X) / (102.9-5th%ile)	48.1
No. Semivoltine Taxa (less semivoltine Coleoptera)	100*X / 95th%ile	5
Bighorn and Wind River Foothills		
No. Ephemeroptera Taxa	100*X / 95th%ile	9
No. Trichoptera Taxa	100*X / 95th%ile	11
No. Plecoptera Taxa	100*X / 95th%ile	7
% Non Insect	100*(74-X) / (74-5th%ile)	0.3
% Plecoptera	100*X / 95th%ile	19
% Trichoptera (less *Hydropsychidae*) (% within the Trichoptera)	100*X / 95th%ile	100
% Collector-gatherer	100*(91.4-X) / (91.4-5th%ile)	16.5
% Scraper	100*X / 95th%ile	50.3
HBI	100*(8-X) / (8-5th%ile)	1.8
No. Semivoltine Taxa (less semivoltine Coleoptera)	100*X / 95th%ile	5
Wyoming Basin		
No. Ephemeroptera Taxa	100*X / 95th%ile	9
No. Trichoptera Taxa	100*X / 95th%ile	9
No. Plecoptera Taxa	100*X / 95th%ile	6
% Non Insect	100*(64-X) / (64-5th%ile)	0.4
% Plecoptera	100*X / 95th%ile	22.3
% Trichoptera (less *Hydropsychidae*) (% within the Trichoptera)	100*X / 95th%ile	100
% Collector-gatherer	100*(96-X) / (96-5th%ile)	20.3
% Scraper	100*X / 95th%ile	38.6
HBI	100*(8.3-X) / (8.3-5th%ile)	1.9
No. Semivoltine Taxa (less semivoltine Coleoptera)	100*X / 95th%ile	5

Table 8 (cont.) – Metrics and scoring criteria for each bioregion.

	Metric Scoring Formulae	5th or 95th %ile (as per formula)
Plains		
No. Ephemeroptera Taxa	100*X / 95th%ile	8
No. Trichoptera Taxa	100*X / 95th%ile	9
No. Total Taxa	100*X / 95th%ile	42
% Trichoptera (less *Hydropsychidae*) (% within the community)	100*X / 95th%ile	20.7
% Ephemeroptera (less *Baetidae*) (% within the community)	100*X / 95th%ile	54.4
% Collector-gatherer	100*(98.5-X) / (98.5-5th%ile)	12.6
HBI	100*(9.4-X) / (9.4-5th%ile)	4.9
Black Hills		
No. EPT Taxa	100*X / 95th%ile	18
% Plecoptera	100*X / 95th%ile	27.4
% Trichoptera (less *Hydropsychidae*) (% within the Trichoptera)	100*X / 95th%ile	100
% Scraper	100*X / 95th%ile	43.6
% Collector-gatherer	100*(84.3-X) / (84.3-5th%ile)	19.2
HBI	100*(7.8-X) / (7.8-5th%ile)	3.6
No. Semivoltine Taxa (less semivoltine Coleoptera)	100*X / 95th%ile	3
% 5 Dominant Taxa	100*(95.9-X) / (95.9-5th%ile)	53.9

Table 9 – Mean WSII scores and corresponding p-values and F-values for comparisons between bioregions for both reference calibration and test samples. Capitol letters denote homogeneous groups as determined with the Duncan multiple comparison rank test. For example, mean WSII scores for bioregions in the 'A' category are more similar to one another relative to mean WSII scores for bioregions in the 'B' or 'C' categories.

	Bighorn Wind River Mountains	Western Volcanic and Sedimentary Mountains	Southern Rockies	Bighorn Wind River Foothills	Wyoming Basin	Black Hills	Plains	F	P
Reference calibration	71.6	66.9	72.0	69.3	60.6	62.7	46.0	12.93	<0.001
	A	A	A	A	B	B	C	-	-
Test	64.0	61.2	65.6	54.1	51.1	52.3	43.3	22.72	<0.001
	A	A	A	B	B	B	C	-	-

Table 10 – WSII scoring thresholds by narrative criteria for each bioregion for the period of record (1993-2001).

Bioregion	Full-support		Indeterminate		Partial/non-support	
	Scoring Threshold	Percentage of Samples within Bioregion	Scoring Threshold	Percentage of Samples within Bioregion	Scoring Threshold	Percentage of Samples within Bioregion
Bighorn Wind River Mountains	>60.7	54.2% (n = 71)	40.5 - 60.7	38.2% (n = 50)	<40.5	7.6% (n = 10)
Western Volcanic and Sedimentary Mountains	>60.4	60.8% (n = 99)	40.3 - 60.4	33.7% (n = 55)	<40.3	5.5% (n = 9)
Southern Rockies	>68.2	53.5% (n = 31)	45.5 - 68.2	32.8% (n = 19)	<45.5	13.7% (n = 8)
Bighorn Wind River Foothills	>62.1	41.7% (n = 85)	41.4 - 62.1	32.8% (n = 67)	<41.4	25.5% (n = 52)
Wyoming Basin	>51.9	42.8% (n = 78)	34.6 - 51.9	29.7% (n = 54)	<34.6	27.5% (n = 50)
Black Hills	>53.8	46.0% (n = 17)	35.8 - 53.8	37.8% (n = 14)	<35.8	16.2% (n = 6)
Plains	>42.9	42.2% (n = 66)	28.6 - 42.9	28.9% (n = 45)	<28.6	28.9% (n = 45)
Total Samples for all Bioregions		48.0 % (n = 447)		32.7% (n = 304)		19.3% (n = 180)

Figure 1 – Location of reference (solid circles) and test (open circles) sites in relation to major perennial streams in Wyoming.

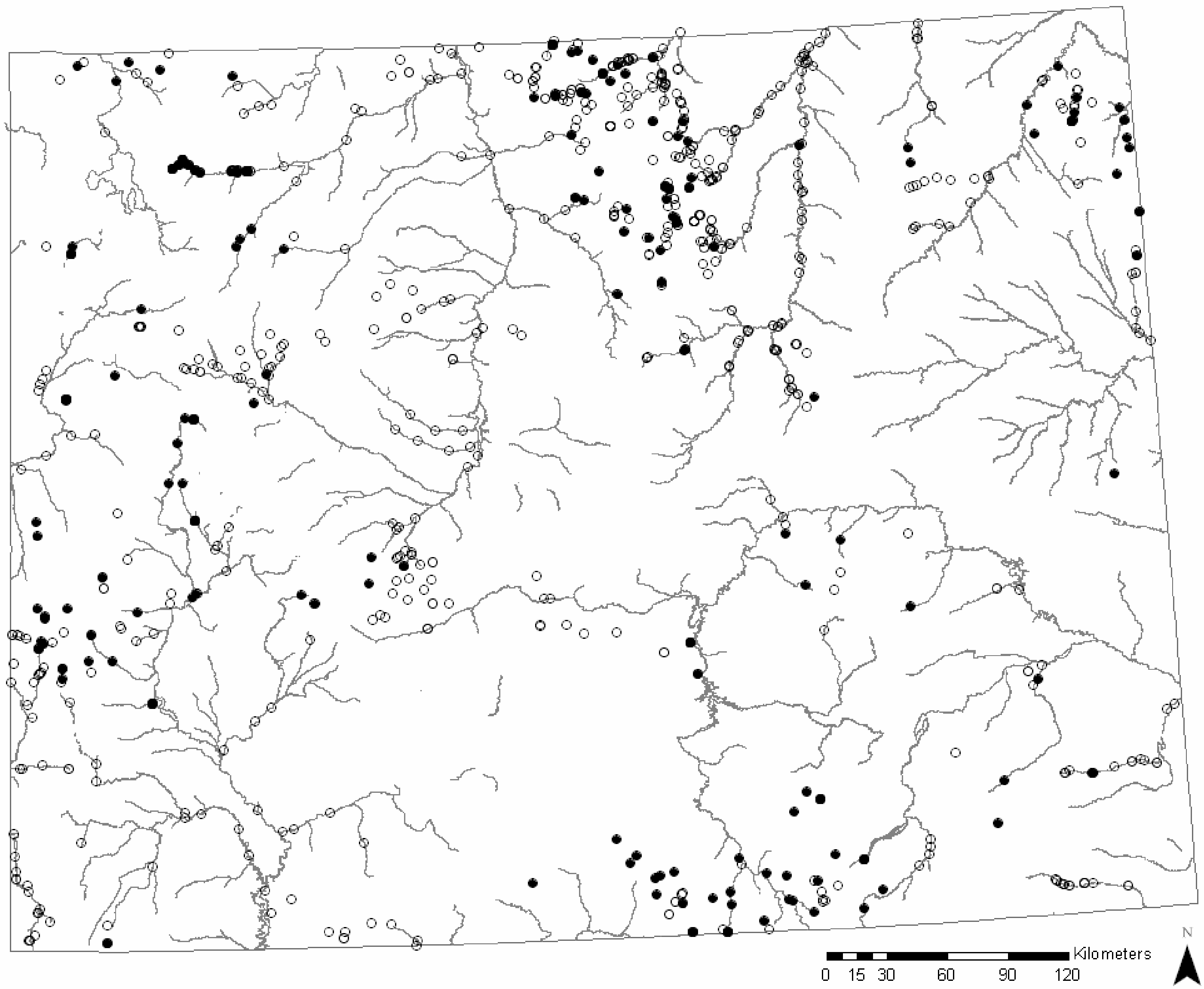


Figure 2 - UPGMA cluster analysis dendrogram that shows the fifteen biologically similar groups derived from the reference calibration dataset.

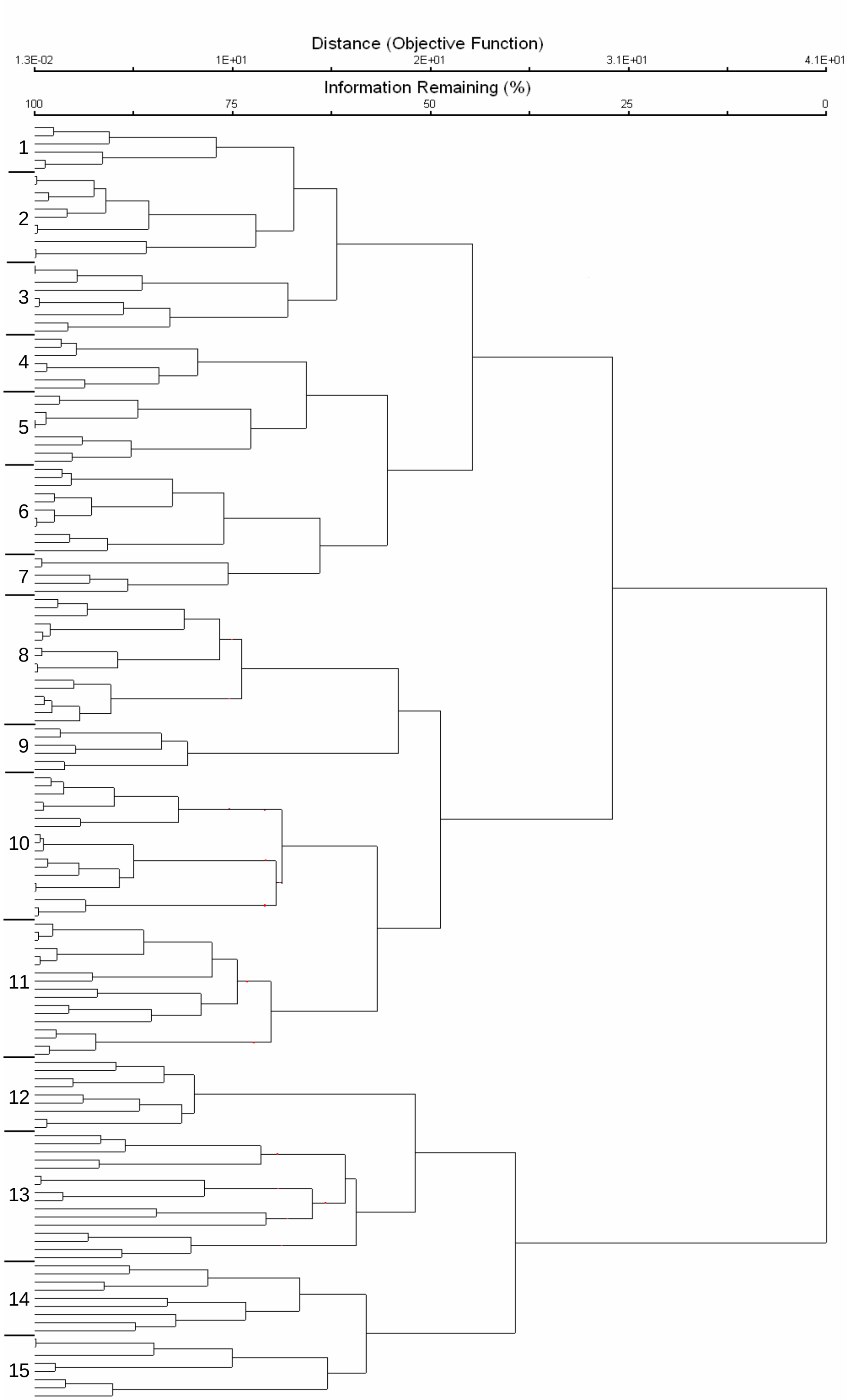


Figure 3 – Reference (solid circles) and test (open circles) sites in relation to the new bioregions of Wyoming.

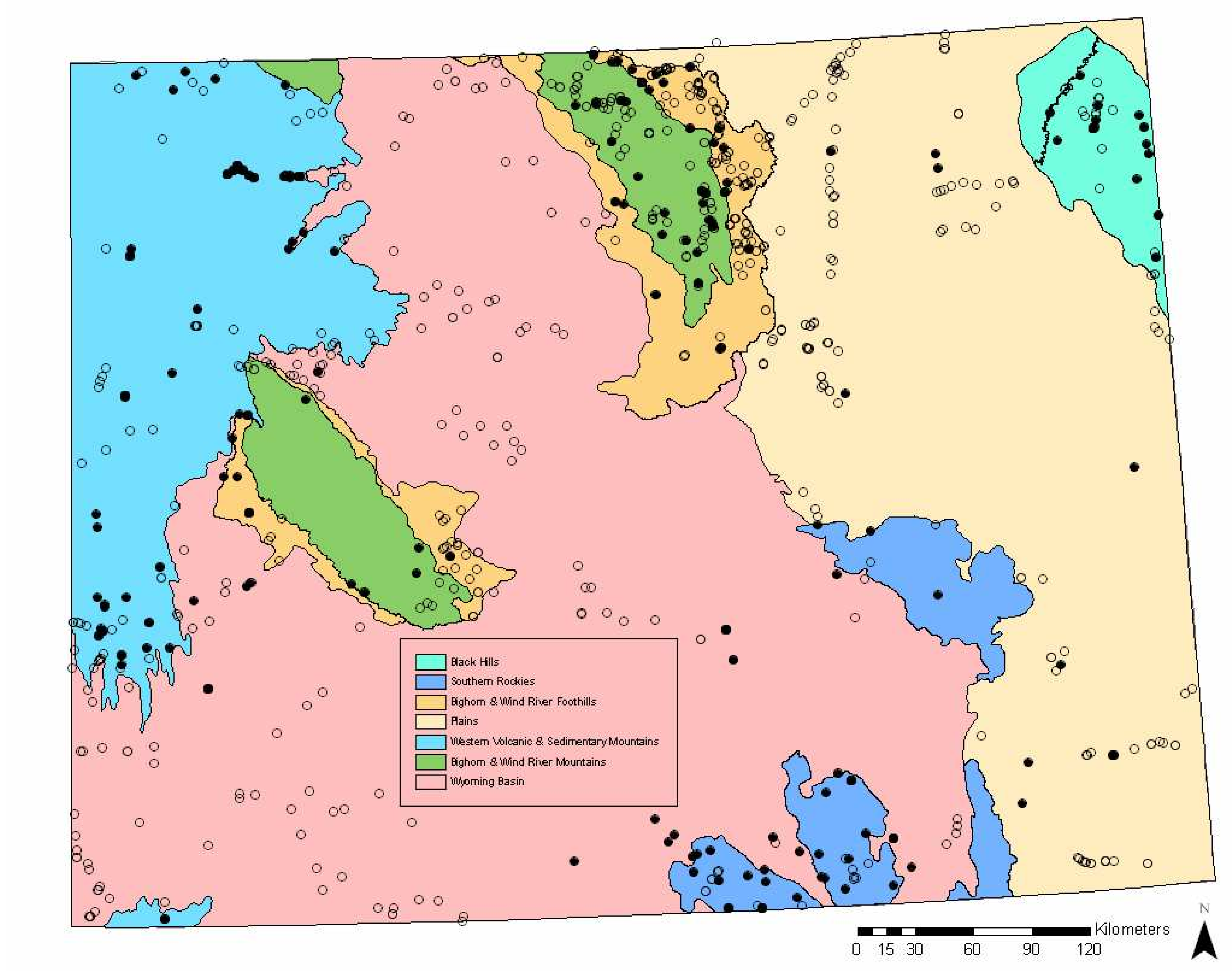


Figure 4 - NMS ordination plot of reference calibration site data showing spatial patterns for seven bioregions along axes 1 and 2. Bioregion 1 = Bighorn and Wind River Foothills; 2 = Bighorn and Wind River Mountains; 3 = Black Hills; 4 = Western Volcanic and Sedimentary Mountains; 5 = Plains; 6 = Southern Rockies; and 7 = Wyoming Basin.

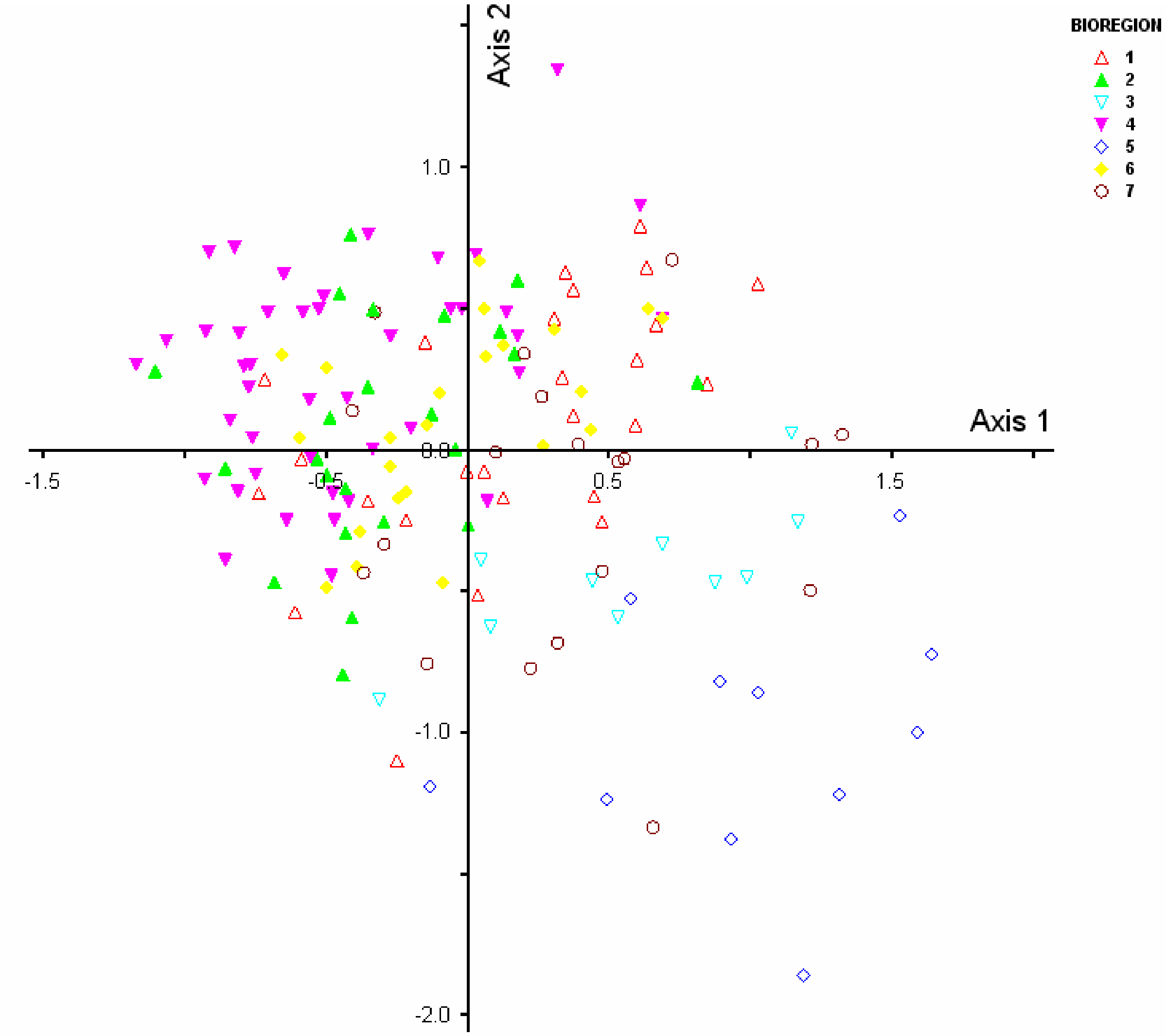
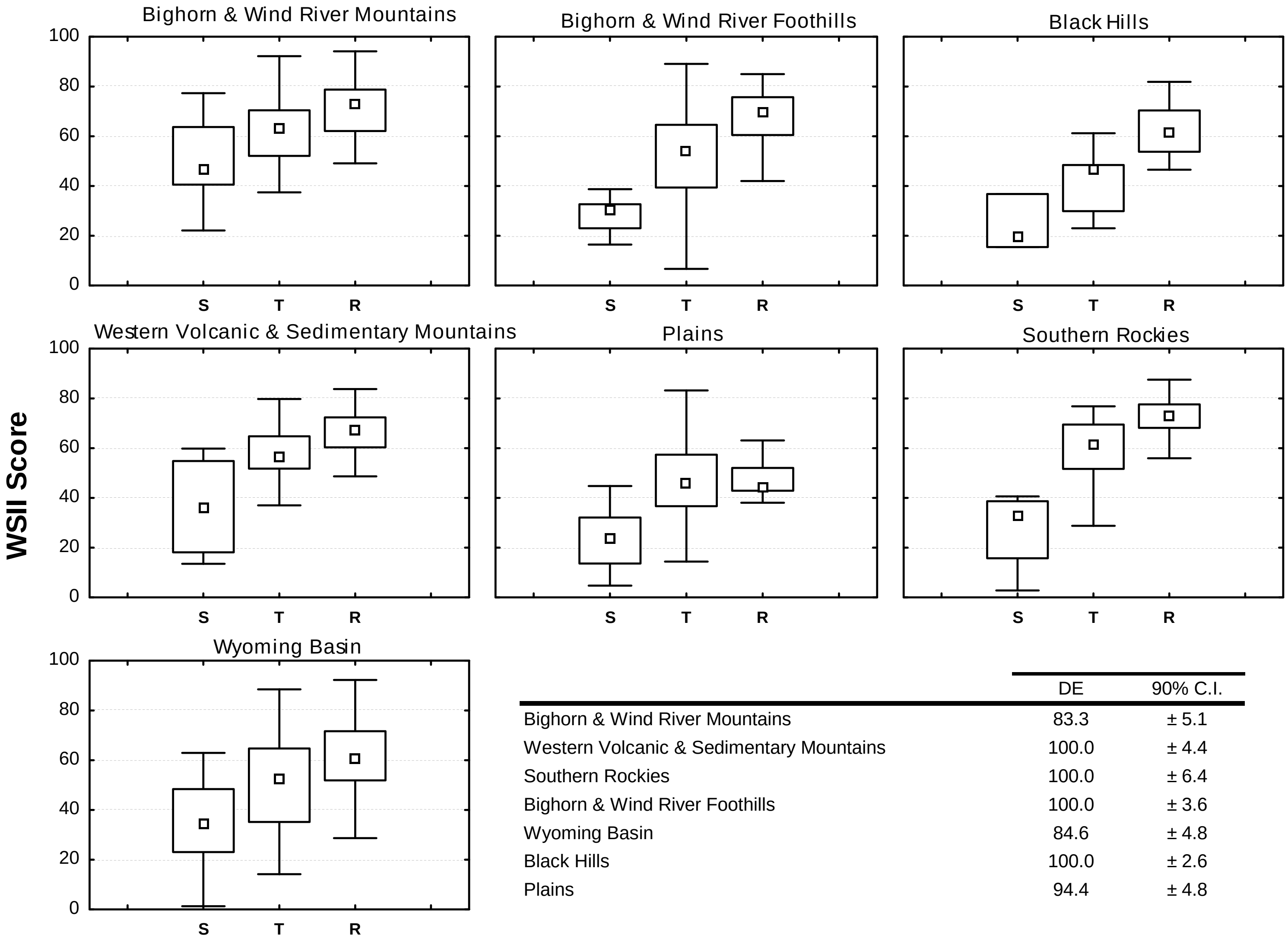


Figure 5 - Distribution of Wyoming Stream Integrity Index (WSII) values for reference (R), stressed (S), and test (T) samples for seven bioregions with associated discrimination efficiencies (DE) and 90% confidence intervals (CI) in the insert table. Boxes represent 25th and 75th percentiles, whiskers represent 5th and 95th percentiles, and squares represent median values.



	DE	90% C.I.
Bighorn & Wind River Mountains	83.3	± 5.1
Western Volcanic & Sedimentary Mountains	100.0	± 4.4
Southern Rockies	100.0	± 6.4
Bighorn & Wind River Foothills	100.0	± 3.6
Wyoming Basin	84.6	± 4.8
Black Hills	100.0	± 2.6
Plains	94.4	± 4.8

Figure 6 - Linear regressions of Wyoming Stream Integrity Index (WSII) scores with physicochemical variables.

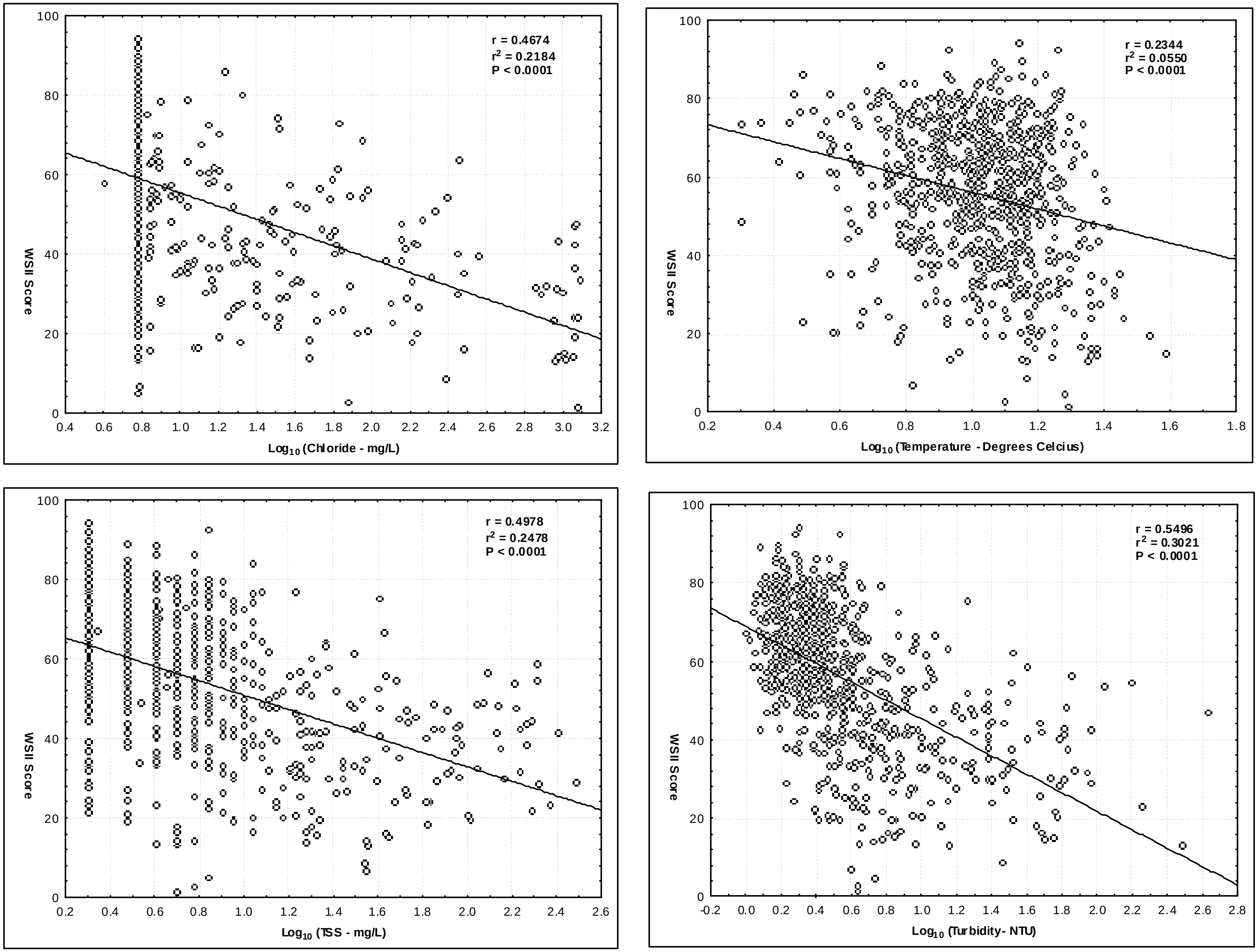


Figure 6 (cont.) – Linear regressions of Wyoming Stream Integrity Index (WSII) scores with physicochemical variables.

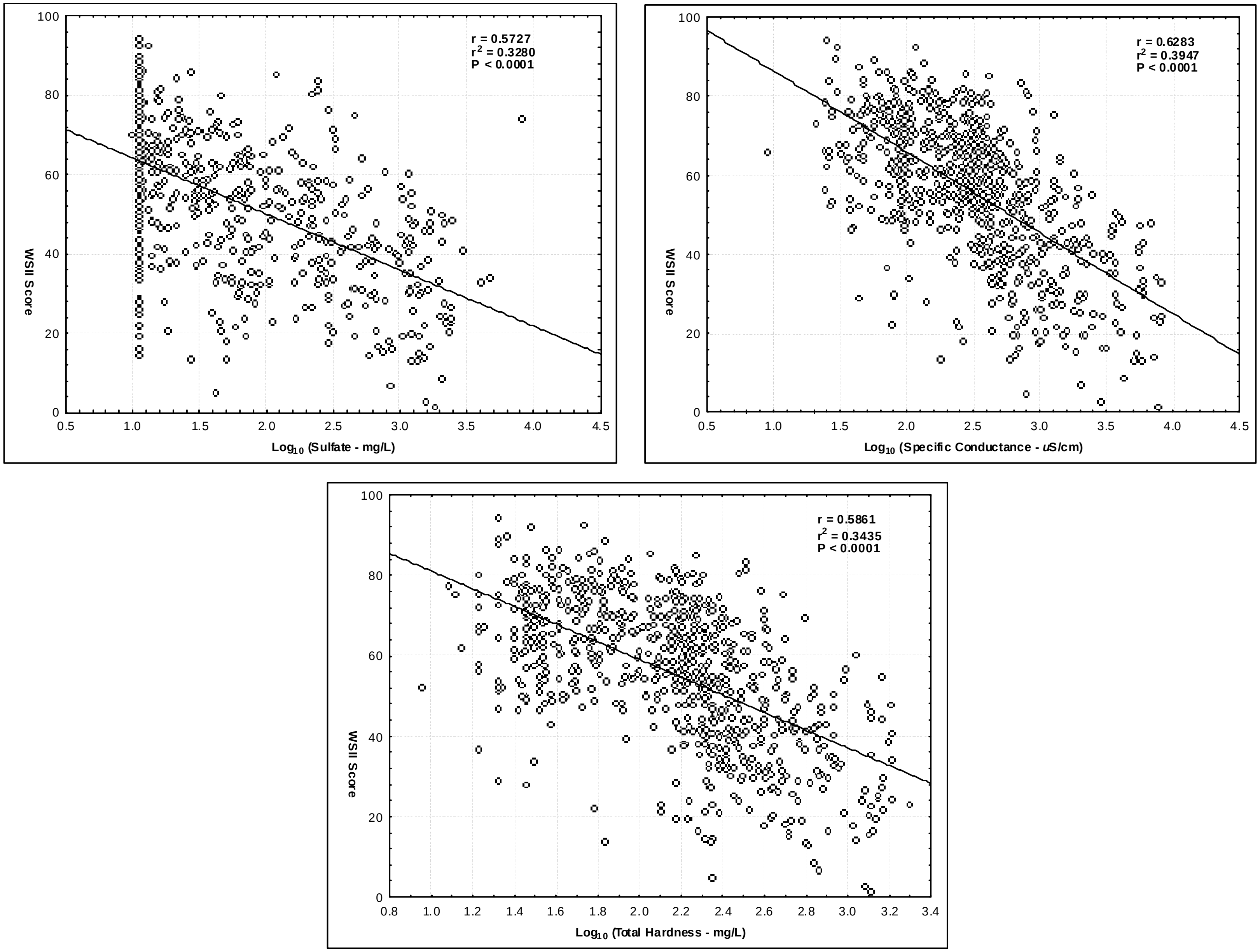
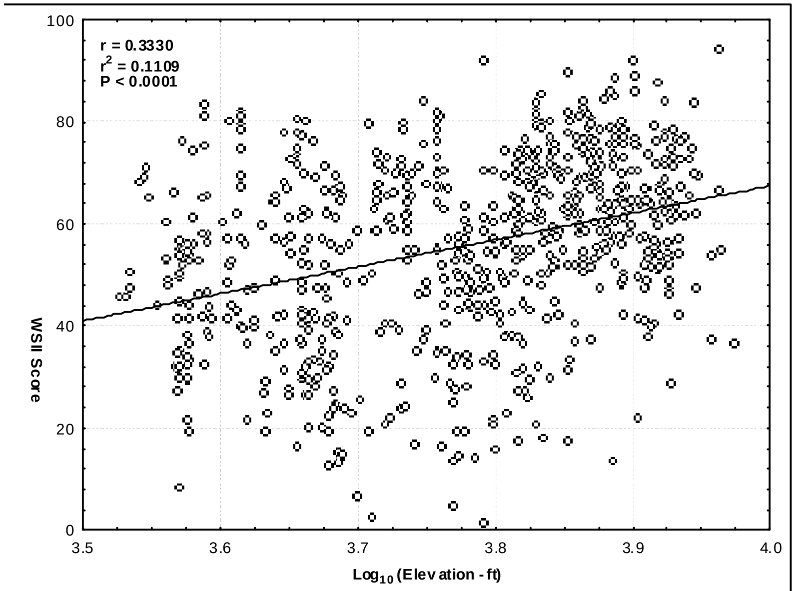


Figure 6 (cont.) – Linear regressions of Wyoming Stream Integrity Index (WSII) scores with physicochemical variables.



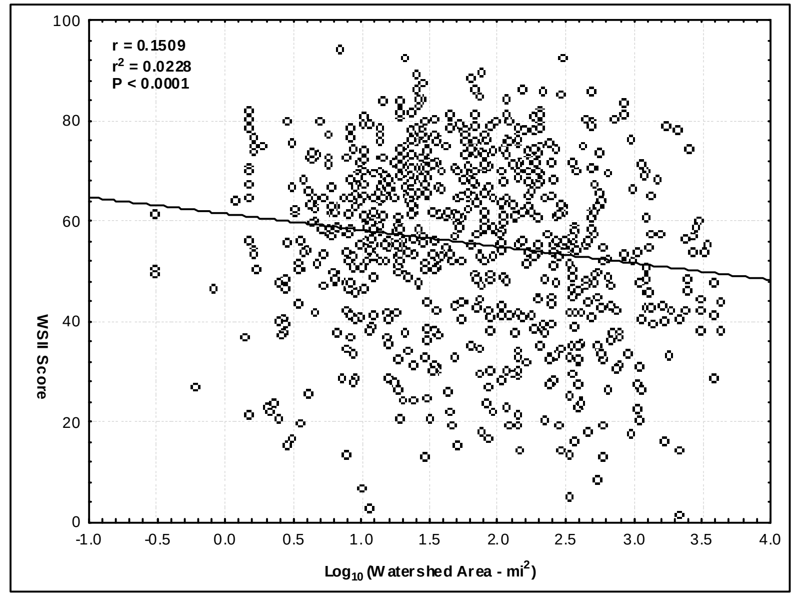


Figure 7 – Box and whisker plot distribution of reference calibration (R) and reference validation (RV) Wyoming Stream Integrity Index (WSII) scores.

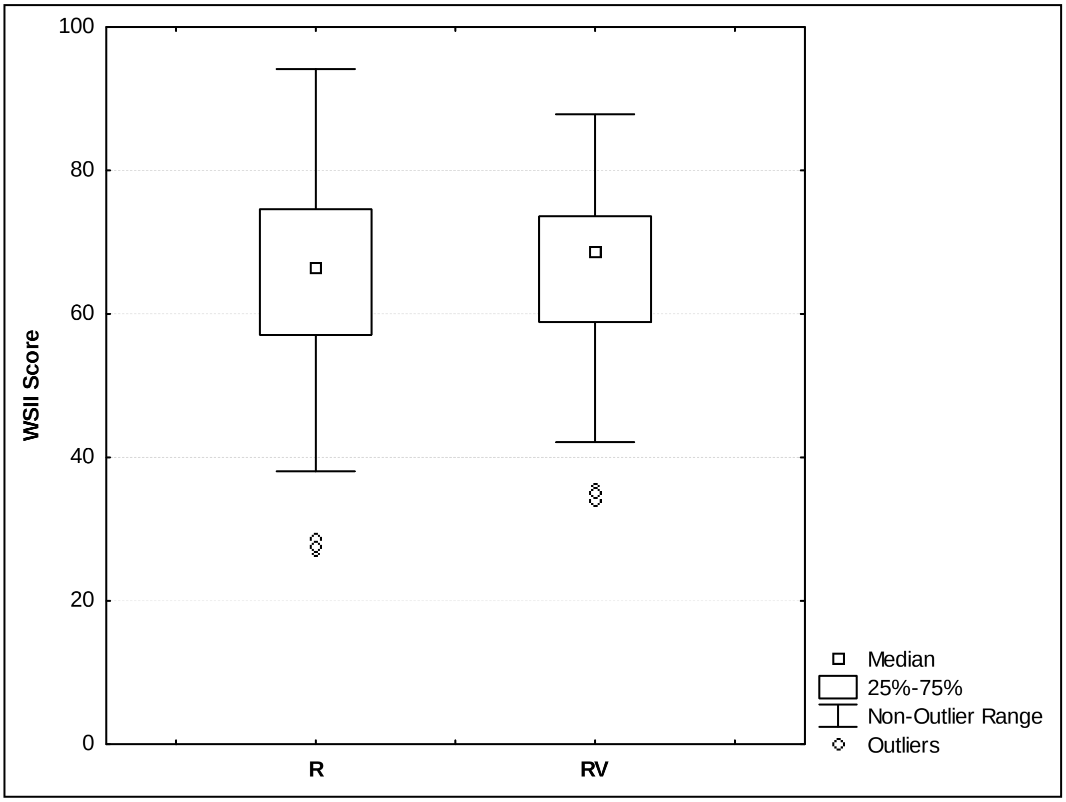
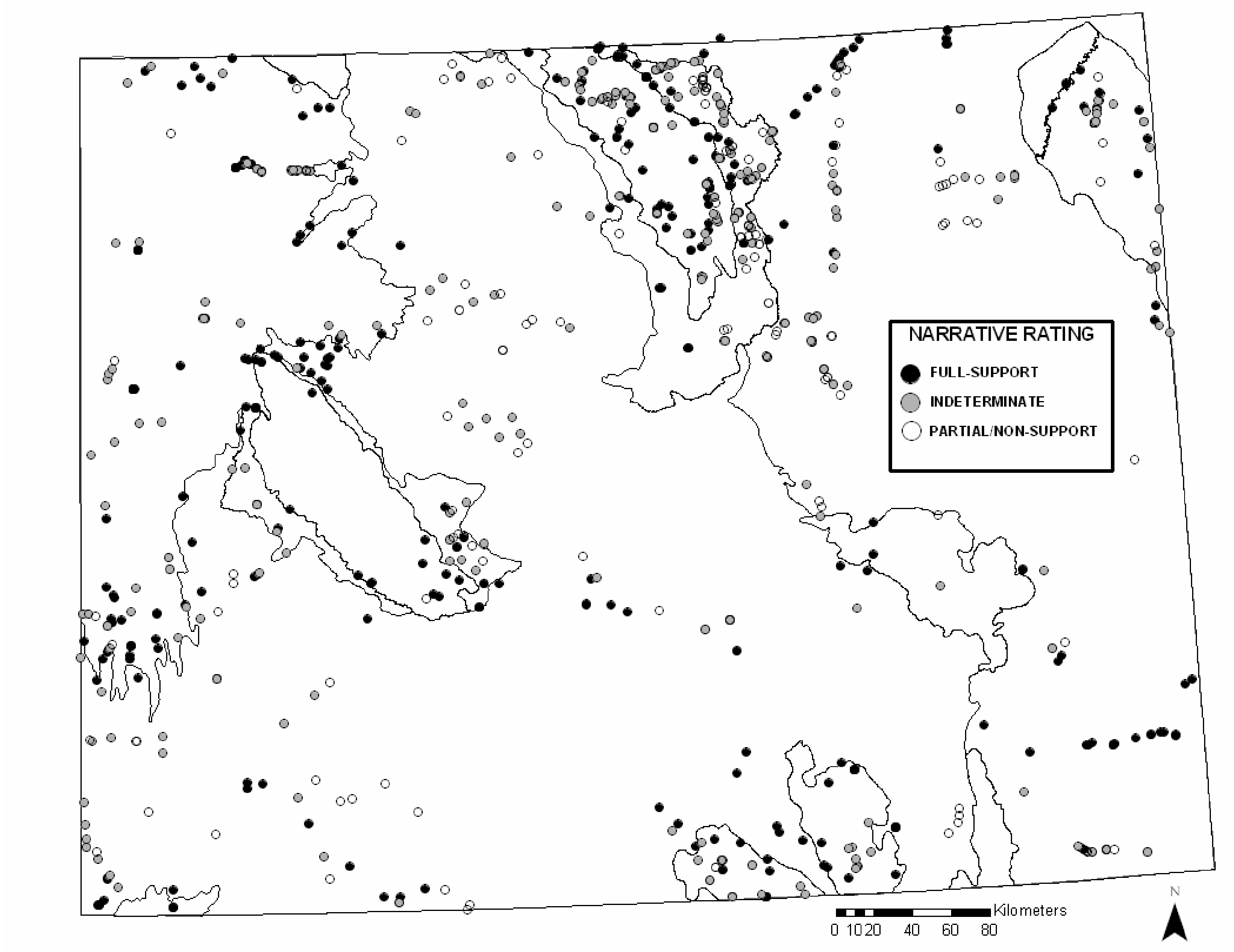


Figure 8 – Distribution of WSII scores by narrative aquatic life use support criteria in relation to the new bioregions for the period of record (1993-2001).



Appendix A – Operational taxonomic units (OTUs) derived from the reference calibration dataset. Asterisks denote OTUs that occurred at 10 or more samples.

Taxa Group	Operational Taxonomic Unit
Acari	**Acari*
Ephemeroptera	**Acentrella insignificans*
Ephemeroptera	**Acentrella turbida*
Ephemeroptera	**Ameletus*
Diptera	**Antocha*
Trichoptera	**Arctopsyche grandis*
Diptera	**Atherix*
Ephemeroptera	**Baetis*
Trichoptera	**Brachycentrus americanus*
Trichoptera	**Brachycentrus occidentalis*
Chironomidae	**Brillia*
Plecoptera	*Capniidae
Diptera	*Ceratopogoninae
Chironomidae	**Chaetocladius*
Diptera	**Chelifera*
Trichoptera	**Cheumatopsyche*
Plecoptera	*Chloroperlidae
Ephemeroptera	**Cinygmula*
Plecoptera	**Claassenia sabulosa*
Coleoptera	**Cleptelmis*
Chironomidae	**Cricotopus*
Chironomidae	**Diamesa*
Diptera	**Dicranota*
Ephemeroptera	**Diphetor hageni*
Trichoptera	**Dolophilodes*
Plecoptera	**Doroneuria*
Ephemeroptera	**Drunella coloradensis/flavilinea*
Ephemeroptera	**Drunella doddsi*
Ephemeroptera	**Drunella grandis/spinifera*
Coleoptera	**Dubiraphia*
Coleoptera	*Dytiscidae
Trichoptera	**Ecclisomyia*
Oligochaeta	*Enchytraeidae
Ephemeroptera	**Epeorus*
Ephemeroptera	**Ephemerella*
Chironomidae	**Eukiefferiella*
Trichoptera	**Glossosoma*
Trichoptera	**Helicopsyche*
Diptera	**Hemerodromia*
Plecoptera	**Hesperoperla*
Coleoptera	**Heterlimnius*
Ephemeroptera	**Hexatoma*
Amphipoda	**Hyalella azteca*
Trichoptera	**Hydropsyche*
Trichoptera	**Hydroptila*
Plecoptera	**Isoperla*
Trichoptera	**Lepidostoma*
Trichoptera	**Limnephilus*
Oligochaeta	*Lumbriculidae
Plecoptera	**Megarcys*
Trichoptera	**Micrasema*
Coleoptera	**Microcylloepus*
Chironomidae	**Micropsectra*
Nematoda	*Nematoda

Appendix A (cont.) – Operational taxonomic units (OTUs) derived from the reference calibration dataset. Asterisks denote OTUs that occurred at 10 or more samples.

Taxa Group	Operational Taxonomic Unit
Trichoptera	**Neothremma*
Trichoptera	**Oecetis*
Trichoptera	**Oligophlebodes*
Oligochaeta	**Ophidonais serpentina*
Coleoptera	**Optioservus*
Chironomidae	**Orthocladius*
Chironomidae	**Pagastia*
Ephemeroptera	**Paraleptophlebia*
Trichoptera	**Parapsyche elsis*
Diptera	**Pericoma*
Gastropoda	**Physella*
Chironomidae	**Polypedilum*
Chironomidae	**Potthastia*
Trichoptera	**Protoptila*
Chironomidae	**Pseudosmittia*
Plecoptera	**Pteronarcella*
Plecoptera	**Pteronarcys*
Chironomidae	**Rheocricotopus*
Chironomidae	**Rheotanytarsus*
Ephemeroptera	**Rhithrogena*
Trichoptera	**Rhyacophila betteni Gr.*
Trichoptera	**Rhyacophila brunnea Gr.*
Trichoptera	**Rhyacophila coloradensis Gr.*
Trichoptera	**Rhyacophila hyalinata Gr.*
Trichoptera	**Rhyacophila pellisa*
Ephemeroptera	**Serratella tibialis*
Diptera	*Simuliidae
Plecoptera	**Skwala*
Bivalvia	*Sphaeriidae
Chironomidae	**Stempellina*
Plecoptera	*Taeniopterygidae
Chironomidae	**Tanytarsus*
Chironomidae	**Thienemanniella*
Diptera	**Tipula*
Ephemeroptera	**Tricorythodes*
Oligochaeta	*Tubificidae
Turbellaria	*Turbellaria
Diptera	**Tvetenia*
Coleoptera	**Zaitzevia*
Plecoptera	**Zapada cinctipes*
Plecoptera	**Zapada columbiana*
Plecoptera	**Zapada oregonensis Gr.*
Trichoptera	*Agapetus*
Trichoptera	*Agraylea*
Hemiptera	*Ambrysus*
Trichoptera	*Amiocentrus aspilus*
Plecoptera	*Amphinemura*
Odonata	*Argia*
Diptera	Blephariceridae
Chironomidae	*Boreoheptagyia*
Coleoptera	*Brychius*
Ephemeroptera	*Caenis*
Ephemeroptera	*Callibaetis*
Chironomidae	*Cardiocladius*

Appendix A (cont.) – Operational taxonomic units (OTUs) derived from the reference calibration dataset. Asterisks denote OTUs that occurred at 10 or more samples.

Taxa Group	**Operational Taxonomic Unit**
Ephemeroptera	*Caudatella*
Diptera	Cecidomyiidae
Ephemeroptera	*Centroptilum*
Trichoptera	*Ceraclea*
Trichoptera	*Chimarra*
Chironomidae	*Chironomus*
Ephemeroptera	*Choroterpes*
Chironomidae	*Cladotanytarsus*
Diptera	*Clinocera*
Chironomidae	*Conchapelopia*
Chironomidae	*Cryptochironomus*
Diptera	*Cryptolabis*
Plecoptera	*Cultus*
Chironomidae	*Demicryptochironomus*
Diptera	*Deuterophlebia*
Trichoptera	*Dicosmoecus atripes*
Trichoptera	*Dicosmoecus gilvipes*
Chironomidae	*Dicrotendipes*
Diptera	*Dixa*
Diptera	*Dixella*
Odonata	*Enallagma/Ischnura*
Chironomidae	*Endochironomus*
Chironomidae	*Euorthocladius*
Ephemeroptera	*Fallceon qulleri*
Gastropoda	*Ferrissia*
Gastropoda	*Fluminicola*
Amphipoda	Gammarus
Diptera	*Glutops*
Odonata	Gomphidae
Coleoptera	*Haliplus*
Oligochaeta	*Haplotaxis*
Chironomidae	*Heleniella*
Coleoptera	*Helichus*
Hirudinea	*Helobdella stagnalis*
Ephemeroptera	*Heptagenia/Nixe*
Diptera	*Hesperoconopa*
Odonata	*Hetaerina*
Chironomidae	*Heterotrissocladius*
Chironomidae	*Hydrobaenus*
Gastropoda	Hydrobiidae
Coleoptera	Hydrophilidae
Plecoptera	*Isogenoides*
Coleoptera	*Lara avara*
Ephemeroptera	*Leptophlebia*
Trichoptera	*Leucotrichia*
Plecoptera	Leuctridae
Diptera	*Limnophora*
Chironomidae	*Limnophyes*
Chironomidae	*Lopescladius*
Oligochaeta	Lumbricidae
Gastropoda	Lymnaeidae
Chironomidae	*Macropelopia*
Plecoptera	*Malenka*
Trichoptera	*Marilia*

Appendix A (cont.) – Operational taxonomic units (OTUs) derived from the reference calibration dataset. Asterisks denote OTUs that occurred at 10 or more samples.

Taxa Group	Operational Taxonomic Unit
Diptera	*Maruina*
Trichoptera	*Mayatrichia*
Chironomidae	*Microtendipes*
Oligochaeta	*Nais communis*
Oligochaeta	*Nais elinguis*
Oligochaeta	*Nais variabilis*
Chironomidae	*Nanocladius*
Coleoptera	*Narpus*
Trichoptera	*Nectopsyche*
Trichoptera	*Neophylax*
Trichoptera	*Neotrichia*
Chironomidae	*Nilotanypus*
Trichoptera	*Ochrotrichia*
Chironomidae	*Odontomesa*
Coleoptera	*Ordobrevia*
Diptera	*Ormosia*
Trichoptera	*Oxyethira*
Chironomidae	*Parachaetocladius*
Chironomidae	*Parakiefferiella*
Chironomidae	*Paramerina*
Chironomidae	*Parametriocnemus*
Chironomidae	*Paraphaenocladius*
Chironomidae	*Paratanytarsus*
Chironomidae	*Parorthocladius*
Chironomidae	*Pentaneura*
Lepidoptera	*Petrophila*
Chironomidae	*Phaenopsectra*
Gastropoda	Planorbidae
Oligochaeta	*Pristina*
Chironomidae	*Procladius*
Chironomidae	*Prodiamesa*
Plecoptera	*Prostoia*
Chironomidae	*Pseudochironomus*
Chironomidae	*Pseudodiamesa*
Chironomidae	*Pseudorthocladius*
Chironomidae	*Psilometriocnemus*
Trichoptera	*Psychomyia*
Diptera	*Ptychoptera*
Trichoptera	*Rhyacophila angelita Gr.*
Trichoptera	*Rhyacophila cyalinata Gr.*
Trichoptera	*Rhyacophila iranda Gr.*
Trichoptera	*Rhyacophila narvae*
Trichoptera	*Rhyacophila vagrita Gr.*
Trichoptera	*Rhyacophila verrula*
Megaloptera	*Sialis*
Oligochaeta	*Specaria*
Ephemeroptera	*Stenonema*
Chironomidae	*Stictochironomus*
Diptera	Stratiomyiidae
Chironomidae	*Sublettea*
Chironomidae	*Symposiocladius*
Chironomidae	*Synorthocladius*
Diptera	Tabanidae
Oligochaeta	*Uncinais uncinata*
Plecoptera	*Visoka cataractae*
Diptera	*Wiedemannia*
Trichoptera	*Wormaldia*

Appendix B – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

SAMPLE ID	TYPE	STATION ID	WATERBODY NAME	LAT (N)	LONG (W)	COLLECTION DATE	WSII SCORE		NARRATIVE RATING
BIGHORN & WIND RIVER FOOTHILLS									
934	T	WB83	Beason Creek (Day) Above Willow Confluence	42.72676944	-108.70244167	10-27-1999	62.9	*	FULL SUPPORT
873	T	NGP44	Beaver Creek - Lower	43.98680278	-106.68656944	10-27-1999	31.3		PARTIAL/NON SUPPORT
938	T	WB87	Beaver Creek Lower, Confluence	42.51862500	-108.49759167	08-12-1999	73.3		FULL SUPPORT
910	T	NGP81	Beaver Creek on School Section	43.65609722	-106.88446111	09-30-1999	36.0		PARTIAL/NON SUPPORT
202	T	NGPI21	BIG GOOSE CREEK	44.79522222	-106.96559444	10-25-1994	38.2	*	PARTIAL/NON SUPPORT
737	T	NGPI21	BIG GOOSE CREEK	44.79522222	-106.96559444	10-29-1998	49.4		INDETERMINATE
755	T	NGPI47	Big Goose Creek - Beckton	44.74544722	-107.12875000	10-22-1998	61.9	*	INDETERMINATE
678	T	MRCI48	Big Goose Creek - Canyon (T-T Ranch)	44.69918611	-107.18516111	10-22-1998	80.0		FULL SUPPORT
756	T	NGPI49	Big Goose Creek - Normative Services	44.77363056	-107.01981389	10-23-1998	52.7		INDETERMINATE
702	T	NGP15	Billy Creek - Lower	44.12734167	-106.71169722	09-25-1998	38.3	*	PARTIAL/NON SUPPORT
624	T	MRC40	Blue Creek	43.65460833	-106.90920556	08-20-1998	20.8		PARTIAL/NON SUPPORT
703	T	NGP16	Boxelder Creek - Lower	44.56475833	-106.59185556	10-08-1998	21.8		PARTIAL/NON SUPPORT
704	T	NGP17	Boxelder Creek - Upper	44.44059444	-106.69419444	10-08-1998	16.4		PARTIAL/NON SUPPORT
705	T	NGP18	Bull Creek - Lower (Near Buffalo)	44.34747500	-106.67572500	10-09-1998	36.4		PARTIAL/NON SUPPORT
315	T	MRWI19	CHERRY CREEK - YOUNG BASIN	42.62444444	-108.70916667	09-11-1997	50.9		INDETERMINATE
874	T	NGP45	Clear Creek - Above Buffalo WWTP	44.36211111	-106.65299722	10-18-1999	57.9		INDETERMINATE
877	T	NGP48	Clear Creek - Above Piney Creek	44.56335000	-106.52516389	09-29-1999	44.0	*	INDETERMINATE
198	T	NGPI18	CLEAR CREEK - BELOW BUFFALO	44.40208611	-106.60941389	10-24-1995	35.0		PARTIAL/NON SUPPORT
913	T	NGPI18	CLEAR CREEK - BELOW BUFFALO	44.40208611	-106.60941389	09-30-1999	49.1		INDETERMINATE
875	T	NGP46	Clear Creek - Below Buffalo WWTP	44.36378611	-106.65109722	09-28-1999	54.1		INDETERMINATE
46	T	MRCI24	CLEAR CREEK - BUFFALO	44.35190833	-106.69115833	10-01-1996	55.3		INDETERMINATE
837	T	MRCI24	CLEAR CREEK - BUFFALO	44.35190833	-106.69115833	09-27-1999	70.0		FULL SUPPORT
832	T	MRC76	Clear Creek - City Park	44.34523056	-106.70433889	09-22-1999	76.3		FULL SUPPORT
884	T	NGP55	Clear Creek - Texaco	44.52253056	-106.54833056	10-20-1999	47.1		INDETERMINATE
2	R	MRC10	COLUMBUS CREEK	44.91138889	-107.39416667	10-25-1993	65.5	*	FULL SUPPORT
866	T	MRW96	Deep Creek Canyon Mouth	42.63156111	-108.63651944	08-17-1999	47.0		INDETERMINATE
308	R	WB19	DRY MEDICINE LODGE CREEK	44.30111111	-107.54055556	09-04-1997	42.0	*	INDETERMINATE
27	R	MRC27	EAST PASS CREEK	44.94972222	-107.48000000	10-20-1993	67.2		FULL SUPPORT
707	T	NGP20	French Creek - Buffalo	44.35528056	-106.68565833	09-28-1998	61.3	*	INDETERMINATE
637	T	MRC53	French Creek - Goddard Ranch	44.37102778	-106.74716667	09-28-1998	55.2		INDETERMINATE
638	R	MRC54	French Creek - Sanders	44.36444167	-106.81364722	09-28-1998	72.7		FULL SUPPORT
199	T	NGPI19	GOOSE CREEK	44.82686944	-106.96301389	10-26-1994	27.3		PARTIAL/NON SUPPORT
735	T	NGPI19	GOOSE CREEK	44.82686944	-106.96301389	10-30-1998	34.9		PARTIAL/NON SUPPORT
758	T	NGPI50	Goose Creek - Above KOA	44.83426111	-106.96352500	10-26-1998	32.4		PARTIAL/NON SUPPORT
759	T	NGPI51	Goose Creek - Above Sheridan W.W.T.F.	44.82091389	-106.96194167	10-29-1998	32.1		PARTIAL/NON SUPPORT
708	T	NGP21	Goose Creek - Below KOA	44.83533889	-106.96133889	10-26-1998	31.9		PARTIAL/NON SUPPORT
709	T	NGP22	Goose Creek - Lower	44.91205833	-106.98058889	10-29-1998	41.6	*	INDETERMINATE
248	R	WB2	GREEN RIVER - MIDDLE	43.07472222	-110.07805556	10-03-1996	56.1		INDETERMINATE
121	R	MRW50	GREEN RIVER 1 - LOWER	43.25722222	-110.02416667	10-03-1996	85.0		FULL SUPPORT
111	R	MRW4	GREEN RIVER 1 - UPPER	43.36611111	-109.98055556	10-03-1996	77.9		FULL SUPPORT
731	T	NGPI10	JENKS CREEK	44.61743333	-106.84260000	10-06-1998	65.7	*	FULL SUPPORT
49	T	MRCI27	L. N.FK. CRAZY WOMAN CRK.	44.19809167	-106.77617778	10-06-1993	59.1	*	INDETERMINATE
666	T	MRCI27	L. N.FK. CRAZY WOMAN CRK.	44.19809167	-106.77617778	09-24-1998	66.2		FULL SUPPORT
937	T	WB86	Little Beaver Lower (confluence)	42.51672222	-108.49916111	08-12-1999	65.6	*	FULL SUPPORT
9	R	MRC18	LITTLE BIGHORN RIVER	44.98688333	-107.63868056	10-27-1993	74.6		FULL SUPPORT
10	RP	MRC18	LITTLE BIGHORN RIVER	44.98688333	-107.63868056	10-21-1994	80.6		FULL SUPPORT
11	RP	MRC18	LITTLE BIGHORN RIVER	44.98688333	-107.63868056	10-20-1995	78.0		FULL SUPPORT
12	RP	MRC18	LITTLE BIGHORN RIVER	44.98688333	-107.63868056	09-27-1996	74.2		FULL SUPPORT
354	RP	MRC18	LITTLE BIGHORN RIVER	44.98688333	-107.63868056	10-15-1997	78.1		FULL SUPPORT
616	RP	MRC18	LITTLE BIGHORN RIVER	44.98688333	-107.63868056	10-09-1998	71.7		FULL SUPPORT
827	RP	MRC18	LITTLE BIGHORN RIVER	44.98688333	-107.63868056	10-11-1999	65.0	*	FULL SUPPORT
37	RP	MRC38	LITTLE GOOSE CREEK	44.62665556	-107.03036111	10-01-1996	68.2		FULL SUPPORT
622	R	MRC38	LITTLE GOOSE CREEK	44.62665556	-107.03036111	10-27-1998	78.0		FULL SUPPORT
201	T	NGPI20	LITTLE GOOSE CREEK - ABOVE SHERIDAN	44.77080833	-106.95066389	10-24-1994	19.4		PARTIAL/NON SUPPORT
736	T	NGPI20	LITTLE GOOSE CREEK - ABOVE SHERIDAN	44.77080833	-106.95066389	10-26-1998	33.5		PARTIAL/NON SUPPORT
374	T	NGPI36	LITTLE GOOSE CREEK - COFFEEN	44.78533889	-106.94336667	10-08-1997	30.0		PARTIAL/NON SUPPORT
743	T	NGPI36	LITTLE GOOSE CREEK - COFFEEN	44.78533889	-106.94336667	10-27-1998	32.6		PARTIAL/NON SUPPORT
760	T	NGPI52	Little Goose Creek - Highway 87	44.71161111	-106.95876944	10-27-1998	41.2	*	PARTIAL/NON SUPPORT
205	T	NGPI26	LITTLE GOOSE CREEK - SHERIDAN	44.78624444	-106.94205000	10-25-1994	21.4		PARTIAL/NON SUPPORT
369	T	NGPI26	LITTLE GOOSE CREEK - SHERIDAN	44.78624444	-106.94205000	10-08-1997	29.3		PARTIAL/NON SUPPORT
739	T	NGPI26	LITTLE GOOSE CREEK - SHERIDAN	44.78624444	-106.94205000	10-27-1998	34.1		PARTIAL/NON SUPPORT
372	T	NGPI34	LITTLE NORTH FORK SHELL CREEK	44.48222222	-106.83000000	09-24-1997	24.0		PARTIAL/NON SUPPORT
639	R	MRC55	Little Piney Creek - Lower	44.52911667	-106.81895278	10-02-1998	69.4		FULL SUPPORT
640	R	MRC56	Little Piney Creek - Upper	44.55084167	-106.88288333	10-02-1998	68.1		FULL SUPPORT
814	T	WB77	LITTLE POPO AGIE RIVER - DALLAS	42.74747778	-108.61676389	10-14-1998	39.4	*	PARTIAL/NON SUPPORT
815	T	WB78	LITTLE POPO AGIE RIVER - HAMILTON	42.89831389	-108.59018611	10-15-1998	49.0		INDETERMINATE
314	RP	MRW47	LITTLE POPO AGIE RIVER - RED CANYON	42.69141667	-108.66380278	09-11-1997	84.2		FULL SUPPORT
685	R	MRW47	LITTLE POPO AGIE RIVER - RED CANYON	42.69141667	-108.66380278	10-23-1998	75.7		FULL SUPPORT
813	T	WB76	LITTLE POPO AGIE RIVER - YANKEE	42.73644167	-108.61871667	10-15-1998	71.6		FULL SUPPORT
31	R	MRC30	LITTLE TONGUE RIVER	44.80916667	-107.28916667	10-20-1993	72.5		FULL SUPPORT
45	T	MRCI23	LITTLE TONGUE RIVER - LOWER	44.87681111	-107.26584722	10-09-1996	58.2		INDETERMINATE
341	T	MRCI23	LITTLE TONGUE RIVER - LOWER	44.87681111	-107.26584722	10-09-1997	65.6	*	FULL SUPPORT
664	T	MRCI23	LITTLE TONGUE RIVER - LOWER	44.87681111	-107.26584722	10-13-1998	46.9		INDETERMINATE
628	T	MRC44	M.Fk. Powder R. above Hazelton Rd.	43.57614444	-107.14244167	08-18-1998	80.7		FULL SUPPORT
629	T	MRC45	M.Fk. Powder R. below Hazelton Rd.	43.57778611	-107.13679722	08-18-1998	81.1		FULL SUPPORT
706	T	NGP19	Meade Creek	44.70448611	-106.85769167	10-07-1998	41.3	*	PARTIAL/NON SUPPORT
32	R	MRC31	MEDICINE LODGE CREEK - LOWER	44.29972222	-107.53805556	09-28-1993	69.8		FULL SUPPORT
43	T	MRCI21	MIDDLE FK. CRAZY WOMAN CREEK - GREUB	44.05219167	-106.75221389	10-31-1996	64.9	*	FULL SUPPORT
663	T	MRCI21	MIDDLE FK. CRAZY WOMAN CREEK - GREUB	44.05219167	-106.75221389	09-29-1998	67.5		FULL SUPPORT
44	R	NGPI37	MIDDLE FK. CRAZY WOMAN CREEK - HIGH. 87	44.05157778	-106.69582222	10-31-1996	51.8		INDETERMINATE
744	RP	NGPI37	MIDDLE FK. CRAZY WOMAN CREEK - HIGH. 87	44.05157778	-106.69582222	09-29-1998	71.4		FULL SUPPORT
402	T	WBI7	MIDDLE FK. POGO AGIE - LANDER	42.85055556	-108.70166667	09-09-1997	60.9	*	INDETERMINATE

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

357	R	MRC6	MIDDLE FK. POWDER R. - LOWER CANYON A	43.60250000	-106.90500000	10-16-1997	64.7	*	FULL SUPPORT
644	RP	MRC6	MIDDLE FK. POWDER R. - LOWER CANYON A	43.60250000	-106.90500000	09-14-1998	74.2		FULL SUPPORT
359	R	MRC6A	MIDDLE FK. POWDER R. - LOWER CANYON B	43.60138889	-106.90944444	10-16-1997	58.5	*	INDETERMINATE
41	T	MRC8	MIDDLE FORK POWDER RIVER	43.60500000	-106.90111111	10-28-1993	58.4		INDETERMINATE
55	T	MRCI30	MUDDY CREEK - LOWER	44.13237222	-106.71058056	10-05-1993	24.6		PARTIAL/NON SUPPORT
669	T	MRCI30	MUDDY CREEK - LOWER	44.13237222	-106.71058056	09-25-1998	38.7	*	PARTIAL/NON SUPPORT
51	T	MRCI29	MUDDY CREEK - MIDDLE	44.16810833	-106.80583333	10-13-1993	54.9		INDETERMINATE
52	T	MRCI29	MUDDY CREEK - MIDDLE	44.16810833	-106.80583333	09-27-1994	61.0	*	INDETERMINATE
53	T	MRCI29	MUDDY CREEK - MIDDLE	44.16810833	-106.80583333	09-28-1995	52.8		INDETERMINATE
54	T	MRCI29	MUDDY CREEK - MIDDLE	44.16810833	-106.80583333	09-23-1996	62.1	*	FULL SUPPORT
326	T	MRCI29	MUDDY CREEK - MIDDLE	44.16810833	-106.80583333	09-24-1997	69.4		FULL SUPPORT
668	T	MRCI29	MUDDY CREEK - MIDDLE	44.16810833	-106.80583333	09-24-1998	64.5	*	FULL SUPPORT
838	T	MRCI29	MUDDY CREEK - MIDDLE	44.16810833	-106.80583333	09-17-1999	58.4		INDETERMINATE
793	T	WB55	NEW FORK - BELOW EAST FORK CONFLUENCE	42.68228333	-109.74050833	09-30-1998	53.7		INDETERMINATE
792	T	WB54	NEW FORK RIVER - AIRPORT	42.78154722	-109.80220556	09-29-1998	58.6	*	INDETERMINATE
252	R	WB28	NEW FORK RIVER - BULL PASTURE	42.90770556	-109.92388889	10-02-1996	58.2		INDETERMINATE
347	RP	WB28	NEW FORK RIVER - BULL PASTURE	42.90770556	-109.92388889	10-14-1997	62.1	*	FULL SUPPORT
766	RP	WB28	NEW FORK RIVER - BULL PASTURE	42.90770556	-109.92388889	10-01-1998	65.7	*	FULL SUPPORT
928	RP	WB28	NEW FORK RIVER - BULL PASTURE	42.90770556	-109.92388889	10-05-1999	59.9	*	INDETERMINATE
1054	RV	WB28	NEW FORK RIVER - BULL PASTURE	42.90770556	-109.92388889	9/26/2000	68.6		FULL SUPPORT
1229	RV	WB28	NEW FORK RIVER - BULL PASTURE	42.90770556	-109.92388889	9/26/2000	73.0		FULL SUPPORT
1228	RV	WB28	NEW FORK RIVER - BULL PASTURE	42.90770556	-109.92388889	10/3/2001	42.1	*	INDETERMINATE
131	R	MRW63	NEW FORK RIVER - UPPER	43.07833333	-109.99527778	10-02-1996	52.3		INDETERMINATE
730	T	NGP43	North Fork Crazy Woman Creek - Below Muddy Creek	44.12371944	-106.69895833	09-25-1998	41.6	*	INDETERMINATE
57	T	MRCI32	NORTH FORK CRAZY WOMAN CREEK - LOWER	44.17159167	-106.69842222	10-13-1993	40.9	*	PARTIAL/NON SUPPORT
671	T	MRCI32	NORTH FORK CRAZY WOMAN CREEK - LOWER	44.17159167	-106.69842222	09-25-1998	48.6		INDETERMINATE
56	T	MRCI31	NORTH FORK CRAZY WOMAN CREEK - MIDDLE	44.19673056	-106.76899444	10-13-1993	73.3		FULL SUPPORT
670	T	MRCI31	NORTH FORK CRAZY WOMAN CREEK - MIDDLE	44.19673056	-106.76899444	09-24-1998	65.6	*	FULL SUPPORT
710	T	NGP23	North Fork Crazy Woman Creek - Middle Fork Road	44.08656389	-106.67151111	09-28-1998	41.4	*	PARTIAL/NON SUPPORT
387	T	MRW46	NORTH FORK POPO AGIE RIVER - PUBLIC FISHING ACCESS	42.88000000	-108.72694444	10-22-1997	70.1		FULL SUPPORT
206	T	NGPI27	NORTH FORK POWDER RIVER - ABOVE	43.76722222	-106.60972222	10-09-1995	37.7		PARTIAL/NON SUPPORT
207	T	NGPI28	NORTH FORK POWDER RIVER - BELOW	43.76666667	-106.60972222	10-09-1995	20.1		PARTIAL/NON SUPPORT
1061	T	NGP134	North Fork Powder River above Middle Fork Powder R	NC	NC	8/28/2000	38.3	*	PARTIAL/NON SUPPORT
1063	T	NGP133	North Fork Powder River above OT Canal	NC	NC	8/30/2000	46.9		INDETERMINATE
1062	T	NGP132	North Fork Powder River below OT Canal	NC	NC	8/30/2000	41.8	*	INDETERMINATE
649	T	MRC64	North Fork Rock Creek - Upper	44.46629167	-106.90634722	10-19-1998	68.0		FULL SUPPORT
373	T	NGPI35	NORTH FORK SHELL CREEK	44.48929167	-106.80926389	09-24-1997	45.5		INDETERMINATE
742	T	NGPI35	NORTH FORK SHELL CREEK	44.48929167	-106.80926389	10-21-1998	40.3	*	PARTIAL/NON SUPPORT
376	R	MRC34	NORTH OTTER CREEK	43.86277778	-107.29694444	09-05-1997	66.4		FULL SUPPORT
371	T	NGPI33	NORTH PRONG SHELL CREEK	44.50255278	-106.79099444	09-24-1997	32.1		PARTIAL/NON SUPPORT
741	T	NGPI33	NORTH PRONG SHELL CREEK	44.50255278	-106.79099444	10-21-1998	26.3		PARTIAL/NON SUPPORT
1201	T	WB118	Nowood River Bel. Buffalo Ck.	44.12394000	-107.55057000	10/5/2000	32.8		PARTIAL/NON SUPPORT
34	T	MRC33	OTTER CREEK	43.86444444	-107.30972222	10-21-1993	66.7		FULL SUPPORT
14	R	MRC21	PAINTROCK CREEK	44.28833333	-107.48583333	09-28-1993	71.7		FULL SUPPORT
891	T	NGP62	Piney Creek - Clear Creek Confluence	44.56386111	-106.52603611	10-29-1999	52.9		INDETERMINATE
711	T	NGP24	Poison Creek - Johnson	44.07953611	-106.77396667	10-02-1998	19.5		PARTIAL/NON SUPPORT
712	T	NGP25	Poison Creek - Lower	44.08490000	-106.71369444	10-01-1998	24.4		PARTIAL/NON SUPPORT
713	T	NGP26	Poison Creek - Upper	44.07893056	-106.76377222	10-01-1998	25.4		PARTIAL/NON SUPPORT
714	T	NGP27	Pole Creek - Greub Road	43.97700833	-106.76485000	10-01-1998	50.0		INDETERMINATE
939	T	WB88	Pole Creek Lower/191	42.79520833	-109.78832778	10-05-1999	68.6		FULL SUPPORT
865	T	MRW95	Pole Creek Upper/Below Gagin Stn.	42.88075556	-109.71809444	10-06-1999	76.1		FULL SUPPORT
403	T	WBI8	POPO AGIE RIVER - WYPO BRIDGE	42.86361111	-108.68666667	09-09-1997	39.0	*	PARTIAL/NON SUPPORT
1094	T	MRC93	Porcupine Creek above Deer Creek	44.98677000	-108.10095000	8/22/2001	65.2	*	FULL SUPPORT
715	T	NGP28	Prairie Dog Creek - Above Cat Creek	44.84748889	-106.86436111	10-23-1998	49.1		INDETERMINATE
732	R	NGPI11	PRAIRIE DOG CREEK - ABOVE JENKS CR.	44.61900833	-106.84316389	10-06-1998	57.1		INDETERMINATE
734	T	NGPI13	PRAIRIE DOG CREEK - ABOVE MEADE CR.	44.69469722	-106.85270833	10-08-1998	52.0		INDETERMINATE
716	T	NGP29	Prairie Dog Creek - Above Murphy Gulch	44.62999444	-106.83502222	10-07-1998	59.7	*	INDETERMINATE
717	T	NGP30	Prairie Dog Creek - Below Cat Creek	44.85013333	-106.86472500	10-23-1998	48.0		INDETERMINATE
718	T	NGP31	Prairie Dog Creek - Below Highway 14	44.73890833	-106.87871667	10-08-1998	48.3		INDETERMINATE
733	T	NGPI12	PRAIRIE DOG CREEK - BELOW JENKS CR.	44.61991667	-106.84372500	10-06-1998	64.3	*	FULL SUPPORT
719	T	NGP32	Prairie Dog Creek - Below Meade Creek	44.70525278	-106.85844444	10-07-1998	57.1		INDETERMINATE
720	T	NGP33	Prairie Dog Creek - Below Murphy Gulch	44.65965556	-106.83676111	10-07-1998	56.0		INDETERMINATE
94	RP	MRW17	ROARING FORK	43.35821667	-109.92280278	10-03-1996	89.1		FULL SUPPORT
352	RP	MRW17	ROARING FORK	43.35821667	-109.92280278	10-15-1997	76.8		FULL SUPPORT
681	R	MRW17	ROARING FORK	43.35821667	-109.92280278	08-31-1998	76.0		FULL SUPPORT
855	RP	MRW17	ROARING FORK	43.35821667	-109.92280278	10-07-1999	86.1		FULL SUPPORT
1188	RV	MRW17	ROARING FORK	43.35821667	-109.92280278	9/26/2000	87.8		FULL SUPPORT
1189	RV	MRW17	ROARING FORK	43.35821667	-109.92280278	9/25/2001	72.8		FULL SUPPORT
627	T	MRC43	Rock Creek	43.57639722	-107.14254167	08-19-1998	68.4		FULL SUPPORT
721	T	NGP34	Rock Creek - Above Highway 87	44.38450833	-106.70562500	10-22-1998	57.3		INDETERMINATE
722	T	NGP35	Rock Creek - Below Sayles Creek	44.42450278	-106.78526111	10-21-1998	64.6	*	FULL SUPPORT
654	T	MRC69	Rock Creek - USGS Gage	44.45502778	-106.87456111	10-20-1998	70.7		FULL SUPPORT
5	T	MRC13	SHELL CREEK	44.57972222	-107.68833333	09-16-1993	77.4		FULL SUPPORT
217	T	NGPI7	SMITH CREEK - LOWER	44.87805556	-107.26750000	10-09-1996	39.0	*	PARTIAL/NON SUPPORT
342	T	NGPI7	SMITH CREEK - LOWER	44.87805556	-107.26750000	10-09-1997	56.5		INDETERMINATE
892	T	NGP63	Soldier Creek - County Road 330	44.82090278	-107.02638889	09-09-1999	32.7		PARTIAL/NON SUPPORT
893	T	NGP64	Soldier Creek - Sheridan	44.81918333	-106.96322778	09-09-1999	30.0		PARTIAL/NON SUPPORT
834	R	MRC78	Soldier Creek - Upper	44.77768611	-107.17624444	09-08-1999	79.9		FULL SUPPORT
895	T	NGP66	South Fork Crazy Woman Creek - Above Purdy Reservo	44.04223611	-106.64827778	10-26-1999	28.4		PARTIAL/NON SUPPORT
894	T	NGP65	South Fork Crazy Woman Creek - Below Purdy Reservo	44.04223611	-106.64827778	10-26-1999	41.2	*	PARTIAL/NON SUPPORT
896	T	NGP67	South Fork Crazy Woman Creek - Lower	44.06347778	-106.60073611	10-26-1999	37.5		PARTIAL/NON SUPPORT
897	T	NGP68	South Fork Crazy Woman Creek - Plains Upper	43.93318889	-106.74090278	10-28-1999	6.7		PARTIAL/NON SUPPORT
723	T	NGP36	South Fork Shell Creek	44.47359722	-106.80716944	10-21-1998	50.4		INDETERMINATE
33	R	MRC32	SOUTH FORK WEST PASS CREEK	44.94555556	-107.52305556	10-26-1993	79.9		FULL SUPPORT
658	T	MRC73	South Rock Creek	44.45471389	-106.87862222	10-21-1998	61.2	*	INDETERMINATE

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

330	T	WB25	SWEETWATER RIVER - WILSON BAR	42.40638889	-108.53361111	09-26-1997	80.3		FULL SUPPORT
1055	RV	WB25	SWEETWATER RIVER - WILSON BAR	42.40638889	-108.53361111	8/9/2000	66.8		FULL SUPPORT
1227	RV	WB25	SWEETWATER RIVER - WILSON BAR	42.40638889	-108.53361111	9/4/2001	73.1		FULL SUPPORT
724	R	NGP37	Tongue River - Above Dayton WWTF	44.88398889	-107.23905556	10-12-1998	75.5		FULL SUPPORT
725	T	NGP38	Tongue River - Above Ranchester WWTF	44.90493056	-107.14151111	10-13-1998	54.9		INDETERMINATE
726	T	NGP39	Tongue River - Below Dayton WWTF	44.88291944	-107.23481944	10-12-1998	65.1	*	FULL SUPPORT
727	T	NGP40	Tongue River - Below Ranchester WWTF	44.90857778	-107.13948333	10-13-1998	50.2		INDETERMINATE
17	R	MRC24	TONGUE RIVER	44.84662500	-107.33068333	10-19-1993	79.0		FULL SUPPORT
18	RP	MRC24	TONGUE RIVER	44.84662500	-107.33068333	10-20-1994	77.0		FULL SUPPORT
19	RP	MRC24	TONGUE RIVER	44.84662500	-107.33068333	10-16-1995	63.2		FULL SUPPORT
20	RP	MRC24	TONGUE RIVER	44.84662500	-107.33068333	09-26-1996	68.8		FULL SUPPORT
345	RP	MRC24	TONGUE RIVER	44.84662500	-107.33068333	10-13-1997	76.7		FULL SUPPORT
619	RP	MRC24	TONGUE RIVER	44.84662500	-107.33068333	10-13-1998	76.7		FULL SUPPORT
828	RP	MRC24	TONGUE RIVER	44.84662500	-107.33068333	10-12-1999	78.9		FULL SUPPORT
998	RV	MRC24	TONGUE RIVER	44.84662500	-107.33068333	9/20/2000	66.6		FULL SUPPORT
1122	RV	MRC24	TONGUE RIVER	44.84662500	-107.33068333	10/10/2001	85.2		FULL SUPPORT
203	R	NGPI24	TONGUE RIVER - KLEENBURN	44.90649722	-107.01162778	09-12-1995	52.7		INDETERMINATE
738	RP	NGPI24	TONGUE RIVER - KLEENBURN	44.90649722	-107.01162778	10-15-1998	53.2		INDETERMINATE
215	T	NGPI5	TONGUE RIVER - MIDDLE	44.89141944	-107.21133333	10-10-1996	55.9		INDETERMINATE
349	T	NGPI5	TONGUE RIVER - MIDDLE	44.89141944	-107.21133333	10-14-1997	74.3		FULL SUPPORT
757	T	NGPI5	TONGUE RIVER - MIDDLE	44.89141944	-107.21133333	10-15-1998	61.1	*	INDETERMINATE
214	T	NGPI4	TONGUE RIVER - RANCHESTER	44.90364444	-107.16658889	10-11-1996	54.3		INDETERMINATE
350	T	NGPI4	TONGUE RIVER - RANCHESTER	44.90364444	-107.16658889	10-14-1997	55.7		INDETERMINATE
747	T	NGPI4	TONGUE RIVER - RANCHESTER	44.90364444	-107.16658889	10-12-1998	54.7		INDETERMINATE
940	T	WB89	Twin Creek Mckinney/ Derby	42.69276944	-108.56403333	08-24-1999	16.6		PARTIAL/NON SUPPORT
943	T	WB92	Twin Creek Section 36	42.62335000	-108.49770000	08-24-1999	32.7		PARTIAL/NON SUPPORT
942	T	WB91	Twin Creek Upper/ Section 16	42.58000000	-108.55000000	08-24-1999	55.1		INDETERMINATE
941	T	WB90	Twin Creek Taft/ Dallas	42.73629444	-108.61696667	08-24-1999	30.1		PARTIAL/NON SUPPORT
1	T	MRC1	WEST FORK LITTLE BIGHORN RIVER	44.99888889	-107.62777778	10-27-1993	67.0		FULL SUPPORT
989	T	MRC88	West Pass Creek - Low er	44.98778000	-107.48222000	9/21/2000	62.5	*	FULL SUPPORT
990	T	MRC89	West Pass Creek at X-X Ranch	44.95606000	-107.51105000	9/21/2000	70.7		FULL SUPPORT
931	T	WB80	Willow Creek Lower (287)	42.75360833	-108.65374444	10-25-1999	24.0		PARTIAL/NON SUPPORT
932	T	WB81	Willow Creek Upper (Day) Above Beason	42.72215278	-108.70733611	10-27-1999	52.0		INDETERMINATE
933	T	WB82	Willow Creek Middle (Sacher, Blue Hill)	42.73520000	-108.68189444	10-26-1999	37.6		PARTIAL/NON SUPPORT
204	R	NGPI25	WOLF CREEK	44.84250000	-107.18916667	10-25-1995	60.5	*	INDETERMINATE
216	T	NGPI6	WOLF CREEK - LOWER	44.89833333	-107.17166667	10-10-1996	52.7		INDETERMINATE
344	T	NGPI6	WOLF CREEK - LOWER	44.89833333	-107.17166667	10-10-1997	44.2	*	INDETERMINATE
BIGHORN & WIND RIVER MOUNTAINS									
1084	T	MRC95	Battle Creek below headw aters	44.51232000	-107.49489000	9/11/2001	22.9		PARTIAL/NON SUPPORT
831	T	MRC39a	Bear Trap Creek in Bear Trap Meadow	43.90550000	-107.03055556	10-01-1999	60.2	*	INDETERMINATE
42	R	MRC9	BEARTRAP CREEK	43.90777778	-107.03027778	10-22-1993	60.6	*	INDETERMINATE
623	T	MRC39	Beartrap Creek	43.90380556	-107.02985556	08-19-1998	47.4		INDETERMINATE
863	T	MRW93	Beaver Creek Upper (Iron Mtn)	42.56602778	-108.73459722	08-13-1999	69.8		FULL SUPPORT
864	T	MRW94	Beaver Creek middle (Thomsen, Miners Delight)	42.53511111	-108.65072500	08-11-1999	74.5		FULL SUPPORT
181	R	MRWI41	BIG SANDY RIVER	42.57250000	-109.29111111	09-27-1996	82.2		FULL SUPPORT
47	T	MRCI25	BIG WILLOW CREEK	44.76555556	-107.54027778	09-08-1993	46.5		INDETERMINATE
630	T	MRC46	Big Willow Creek - Above Hwy 14A	44.76462778	-107.54130556	09-01-1998	48.8		INDETERMINATE
631	T	MRC47	Big Willow Creek - Upper	44.73092222	-107.56103611	09-01-1998	51.8		INDETERMINATE
48	T	MRCI26	BULL CREEK	44.75993889	-107.58985278	09-09-1993	44.8	*	INDETERMINATE
665	T	MRCI26	BULL CREEK	44.75993889	-107.58985278	08-26-1998	39.4	*	PARTIAL/NON SUPPORT
633	T	MRC49	Bull Creek - Upper	44.73987500	-107.59312778	08-27-1998	46.7		INDETERMINATE
21	RP	MRC25	CLEAR CREEK	44.32327778	-106.82557500	09-24-1993	74.5		FULL SUPPORT
829	R	MRC25	CLEAR CREEK	44.32327778	-106.82557500	09-28-1999	69.0		FULL SUPPORT
1000	RV	MRC25	CLEAR CREEK	44.32327778	-106.82557500	10/6/2000	70.3		FULL SUPPORT
66	T	MRCI44	CONEY CREEK	44.60951944	-107.30264444	09-16-1996	42.9	*	INDETERMINATE
323	T	MRCI44	CONEY CREEK	44.60951944	-107.30264444	09-17-1997	45.5	*	INDETERMINATE
677	T	MRCI44	CONEY CREEK	44.60951944	-107.30264444	09-14-1998	48.2		INDETERMINATE
839	T	MRCI44	CONEY CREEK	44.60951944	-107.30264444	10-28-1999	5.1		PARTIAL/NON SUPPORT
634	T	MRC50	Doyle Creek - Lower	44.07118056	-106.98251111	09-18-1998	53.2		INDETERMINATE
635	R	MRC51	Doyle Creek - Upper	44.04860000	-107.02375833	09-18-1998	62.1	*	FULL SUPPORT
636	T	MRC52	French Creek - Above Paradise Guest Ranch	44.34611667	-106.96205278	09-22-1998	61.2	*	FULL SUPPORT
28	T	MRC28	GRANITE CREEK	44.57694444	-107.54527778	09-27-1993	68.2		FULL SUPPORT
1007	RV	MRC28	GRANITE CREEK	44.57694444	-107.54527778	9/12/2000	71.7		FULL SUPPORT
1006	T	MRC82	Granite Creek Below Antelope Butte Ski Area	44.61075000	-107.52208000	9/12/2000	78.7		FULL SUPPORT
378	T	MRCI37	HALF OUNCE CREEK	44.82500000	-107.77166667	09-18-1997	51.4		INDETERMINATE
1052	T	MRCI37	HALF OUNCE CREEK	44.82500000	-107.77166667	9/14/2000	53.6		INDETERMINATE
331	T	MRCI20	HUNTER CREEK - LOWER	44.32031111	-106.95016944	09-26-1997	75.8		FULL SUPPORT
662	T	MRCI20	HUNTER CREEK - LOWER	44.32031111	-106.95016944	09-18-1998	68.5		FULL SUPPORT
836	T	MRCI20	HUNTER CREEK - LOWER	44.32031111	-106.95016944	09-08-1999	71.8		FULL SUPPORT
1001	T	MRCI20	HUNTER CREEK - LOWER	44.32031111	-106.95016944	9/28/2000	73.1		FULL SUPPORT
1116	T	MRCI20	HUNTER CREEK - LOWER	44.32031111	-106.95016944	9/12/2001	75.2		FULL SUPPORT
329	R	MRCI19	HUNTER CREEK - UPPER	44.33475833	-106.97610000	09-26-1997	46.0		INDETERMINATE
661	RP	MRCI19	HUNTER CREEK - UPPER	44.33475833	-106.97610000	09-18-1998	55.8	*	INDETERMINATE
835	RP	MRCI19	HUNTER CREEK - UPPER	44.33475833	-106.97610000	09-21-1999	44.7	*	INDETERMINATE
1004	RV	MRCI19	HUNTER CREEK - UPPER	44.33475833	-106.97610000	9/28/2000	32.7		PARTIAL/NON SUPPORT
29	T	MRC29	LAKE CREEK	44.19333333	-107.20722222	09-29-1993	71.6		FULL SUPPORT
988	T	MRC87	Little Bighorn Headw aters	44.79872000	-107.76513000	9/18/2000	42.2	*	INDETERMINATE
985	T	MRC83	Little Bighorn River Above Dry Fork	44.93360000	-107.68221000	9/19/2000	63.8	*	FULL SUPPORT
987	T	MRC86	Little Bighorn River Below Dayton Gulch	44.84127000	-107.75404000	9/14/2000	62.2	*	FULL SUPPORT
986	T	MRC84	Little Bighorn River Below Wagon Box Creek	44.88619000	-107.74356000	9/13/2000	67.5		FULL SUPPORT
696	T	MRW87	LITTLE SANDY - UPPER	42.53233056	-109.21099722	09-01-1998	94.7		FULL SUPPORT
134	R	MRW66	LITTLE SANDY CREEK	42.53305556	-109.20555556	09-27-1996	76.0		FULL SUPPORT
641	T	MRC57	Little Sourdough Creek - Elgin Road Crossing	44.24445833	-106.91658333	09-23-1998	22.1		PARTIAL/NON SUPPORT
642	T	MRC58	Little Sourdough Creek - Lower	44.27468333	-106.92172778	09-23-1998	58.1	*	INDETERMINATE
1005	T	MRC81	Mail Creek Above Shell Creek	44.54102000	-107.46438000	9/13/2000	58.3	*	INDETERMINATE

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

38	R	MRC4	MEDICINE LODGE CREEK - UPPER	44.41500000	-107.38416667	09-27-1993	65.9	FULL SUPPORT
643	T	MRC59	Middle Fork Crazy Woman Creek - Upper	44.10677222	-106.99445278	09-29-1998	51.0	INDETERMINATE
312	R	MRW48	MIDDLE POPO AGIE RIVER - BRUCE'S BRIDGE	42.72972222	-108.85888889	09-10-1997	91.7	FULL SUPPORT
50	T	MRCI28	MUDDY CREEK - UPPER	44.15870000	-106.90964722	10-06-1993	44.8 *	INDETERMINATE
667	T	MRCI28	MUDDY CREEK - UPPER	44.15870000	-106.90964722	09-16-1998	42.5 *	INDETERMINATE
645	R	MRC60	North Clear Creek - Above Hunter Creek	44.32090833	-106.95058611	09-18-1998	84.1	FULL SUPPORT
646	R	MRC61	North Clear Creek - Below Hunter Creek	44.32104722	-106.95060278	09-18-1998	79.3	FULL SUPPORT
1048	T	MRC61	North Clear Creek - Below Hunter Creek	44.32104722	-106.95060278	9/28/2000	81.1	FULL SUPPORT
648	T	MRC63	North Fork Crazy Woman Creek - Pole Creek Road	44.15616944	-106.97225833	09-17-1998	74.8	FULL SUPPORT
23	R	MRC26	NORTH FORK CRAZY WOMAN CREEK - UPPER	44.16877500	-106.91521667	10-06-1993	71.8	FULL SUPPORT
24	RP	MRC26	NORTH FORK CRAZY WOMAN CREEK - UPPER	44.16877500	-106.91521667	09-28-1994	60.8 *	FULL SUPPORT
25	RP	MRC26	NORTH FORK CRAZY WOMAN CREEK - UPPER	44.16877500	-106.91521667	09-26-1995	55.4	INDETERMINATE
26	RP	MRC26	NORTH FORK CRAZY WOMAN CREEK - UPPER	44.16877500	-106.91521667	09-24-1996	61.0 *	FULL SUPPORT
327	RP	MRC26	NORTH FORK CRAZY WOMAN CREEK - UPPER	44.16877500	-106.91521667	09-25-1997	71.0	FULL SUPPORT
620	RP	MRC26	NORTH FORK CRAZY WOMAN CREEK - UPPER	44.16877500	-106.91521667	09-17-1998	71.5	FULL SUPPORT
830	RP	MRC26	NORTH FORK CRAZY WOMAN CREEK - UPPER	44.16877500	-106.91521667	09-16-1999	71.3	FULL SUPPORT
1074	RV	MRC26	NORTH FORK CRAZY WOMAN CREEK - UPPER	44.16877500	-106.91521667	9/7/2000	75.7	FULL SUPPORT
1072	RV	MRC26	NORTH FORK CRAZY WOMAN CREEK - UPPER	44.16877500	-106.91521667	9/10/2001	60.2 *	INDETERMINATE
317	R	MRCI35	NORTH FORK POWDER RIVER - CROSSING	44.10694444	-107.09000000	09-12-1997	70.8	FULL SUPPORT
40	T	MRC7	NORTH FORK POWDER RIVER - LOWER	44.03083333	-107.09444444	09-29-1994	65.4 *	FULL SUPPORT
35	T	MRC35	NORTH FORK POWDER RIVER - UPPER	44.03416667	-107.09444444	09-29-1994	71.8	FULL SUPPORT
375	R	MRC22	NORTH TONGUE RIVER - HIDEOUT	44.75550278	-107.63309444	09-18-1997	60.1 *	INDETERMINATE
617	RP	MRC22	NORTH TONGUE RIVER - HIDEOUT	44.75550278	-107.63309444	09-10-1998	56.7 *	INDETERMINATE
650	T	MRC65	North Tongue River - Highway 14A Crossing	44.75953333	-107.62000000	09-10-1998	53.6	INDETERMINATE
4	T	MRC12	NORTH TONGUE RIVER - LOWER	44.78192222	-107.53440278	09-15-1993	40.8 *	INDETERMINATE
615	T	MRC12	NORTH TONGUE RIVER - LOWER	44.78192222	-107.53440278	09-10-1998	63.9 *	FULL SUPPORT
3	T	MRC11	NORTH TONGUE RIVER - UPPER	44.74600833	-107.69480833	09-14-1993	43.2 *	INDETERMINATE
614	T	MRC11	NORTH TONGUE RIVER - UPPER	44.74600833	-107.69480833	09-10-1998	57.5 *	INDETERMINATE
1194	T	MRW97	Pine Creek Above Highway 28	42.45132000	-108.86040000	8/17/2000	18.7	PARTIAL/NON SUPPORT
651	T	MRC66	Poison Creek - Dam	44.12352500	-106.97546111	09-16-1998	59.0 *	INDETERMINATE
652	R	MRC67	Pole Creek - Lower	44.18931389	-106.92474167	09-15-1998	53.5	INDETERMINATE
653	R	MRC68	Pole Creek - Upper	44.19956667	-106.94156944	09-15-1998	57.1 *	INDETERMINATE
8	T	MRC17	PORCUPINE CREEK	44.83944444	-107.86861111	09-15-1993	56.6 *	INDETERMINATE
1068	T	MRC17	PORCUPINE CREEK	44.83944444	-107.86861111	8/22/2001	62.3 *	FULL SUPPORT
1095	T	MRC94	Porcupine Creek below Porcupine Falls	44.85831000	-107.91772000	8/23/2001	70.1	FULL SUPPORT
30	T	MRC3	PROSPECT CREEK	44.64277778	-107.50861111	09-16-1993	37.4 *	PARTIAL/NON SUPPORT
632	R	MRC48	Prune Creek - Above Sibley Lake	44.75787222	-107.43633056	08-05-1998	68.5	FULL SUPPORT
61	T	MRCI39	PRUNE CREEK - PRUNE CAMPGROUND	44.76888889	-107.46722222	08-24-1995	70.4	FULL SUPPORT
673	T	MRCI39	PRUNE CREEK - PRUNE CAMPGROUND	44.76888889	-107.46722222	08-06-1998	70.2	FULL SUPPORT
60	T	MRCI38	PRUNE CREEK - SIBLEY LAKE	44.76028333	-107.44562778	08-24-1995	62.2 *	FULL SUPPORT
672	T	MRCI38	PRUNE CREEK - SIBLEY LAKE	44.76028333	-107.44562778	08-06-1998	62.5 *	FULL SUPPORT
59	T	MRCI36	RAPID CREEK	44.61666667	-107.18166667	10-07-1996	48.9	INDETERMINATE
626	T	MRC42	Sawmill Creek	43.89464167	-107.03122500	08-20-1998	47.7	INDETERMINATE
382	R	MRW20	SILAS CREEK - SHOSHONE NATL. FOREST	42.61611111	-108.87888889	09-10-1997	92.1	FULL SUPPORT
1180	T	MRC79	Soldier Creek Buck	44.25348000	-107.27258000	9/19/2000	70.7	FULL SUPPORT
1181	T	MRC80	Soldier Creek Camp	44.23352000	-107.29973000	9/19/2000	82.5	FULL SUPPORT
833	T	MRC77	Soldier Creek - PK Ranch	44.73435278	-107.21830278	09-07-1999	66.9	FULL SUPPORT
655	T	MRC70	Sourdough Creek - Lower	44.27500556	-106.92260833	09-23-1998	55.1	INDETERMINATE
656	T	MRC71	Sourdough Creek - Upper	44.24016111	-106.96542778	09-23-1998	64.0 *	FULL SUPPORT
13	R	MRC2	SOUTH BEAVER CREEK	44.75111111	-107.76694444	09-15-1993	67.2	FULL SUPPORT
39	R	MRC5	SOUTH FORK CLEAR CREEK	44.27388889	-106.96833333	09-20-1993	64.2 *	FULL SUPPORT
36	T	MRC37	SOUTH FORK PINEY CREEK	44.55433333	-106.94287222	09-30-1996	68.5	FULL SUPPORT
621	T	MRC37	SOUTH FORK PINEY CREEK	44.55433333	-106.94287222	09-30-1998	78.1	FULL SUPPORT
58	T	MRCI33	SOUTH PAINTROCK CREEK	44.21444444	-107.30555556	09-29-1993	36.1 *	PARTIAL/NON SUPPORT
1182	T	MRCI33	SOUTH PAINTROCK CREEK	44.21444444	-107.30555556	9/19/2000	49.6	INDETERMINATE
377	T	MRCI34	SOUTH PAINTROCK CREEK - UPPER	44.21222222	-107.30333333	09-11-1997	40.4 *	PARTIAL/NON SUPPORT
1183	T	MRCI34	SOUTH PAINTROCK CREEK - UPPER	44.21222222	-107.30333333	9/19/2000	61.2 *	FULL SUPPORT
657	R	MRC72	South Piney Creek - Above Willow Park Reservoir	44.45150556	-107.04796667	09-30-1998	70.4	FULL SUPPORT
15	RP	MRC23	SOUTH TONGUE RIVER	44.76693611	-107.47208333	09-14-1993	73.4	FULL SUPPORT
16	R	MRC23	SOUTH TONGUE RIVER	44.76693611	-107.47208333	08-25-1995	79.0	FULL SUPPORT
618	RP	MRC23	SOUTH TONGUE RIVER	44.76693611	-107.47208333	09-09-1998	77.0	FULL SUPPORT
63	T	MRCI41	SOUTH TONGUE RIVER - LOWER	44.78247222	-107.47566389	08-25-1995	64.6 *	FULL SUPPORT
674	T	MRCI41	SOUTH TONGUE RIVER - LOWER	44.78247222	-107.47566389	09-09-1998	54.6	INDETERMINATE
62	T	MRCI40	SOUTH TONGUE RIVER - MIDDLE	44.76916667	-107.46888889	08-24-1995	66.7	FULL SUPPORT
647	T	MRC62	South Tongue River - Upper	44.68644444	-107.44615000	09-08-1998	68.6	FULL SUPPORT
659	T	MRC74	Sucker Creek - Lower	44.72298889	-107.44583056	09-08-1998	52.1	INDETERMINATE
660	T	MRC75	Sucker Creek - Upper	44.70938889	-107.41121944	09-02-1998	57.9 *	INDETERMINATE
6	R	MRC15	TENSLEEP CREEK	44.14055556	-107.24638889	10-12-1993	67.3	FULL SUPPORT
319	R	MRW19	TORREY CREEK - WHISKEY MOUNTAIN	43.42777778	-109.55833333	09-15-1997	77.7	FULL SUPPORT
849	T	MRW107	Trappers Creek Lower/ Above Warm Springs Confluence	43.57345000	-109.88067778	09-09-1999	68.4	FULL SUPPORT
1057	T	MRC92	Unnamed Tributary to Little Bighorn River	44.84333000	-107.75722000	9/13/2000	24.7	PARTIAL/NON SUPPORT
984	T	MRC85	Wagon Box Creek Above Little Bighorn River	44.88514000	-107.75177000	9/14/2000	58.8 *	INDETERMINATE
852	T	MRW110	Warm Springs Creek Green	43.58450278	-109.91686667	09-10-1999	69.1	FULL SUPPORT
854	T	MRW112	Warm Springs Creek Lower/ Above Trappers Creek	43.57235833	-109.88076389	09-09-1999	73.8	FULL SUPPORT
625	T	MRC41	Webb Creek	44.10951389	-107.11024722	09-16-1998	47.1	INDETERMINATE
64	T	MRCI42	WEST FORK BIG GOOSE CREEK - LOWER	44.61198056	-107.29875556	09-16-1996	54.8	INDETERMINATE
297	T	MRCI42	WEST FORK BIG GOOSE CREEK - LOWER	44.61198056	-107.29875556	10-06-1997	55.2	INDETERMINATE
675	T	MRCI42	WEST FORK BIG GOOSE CREEK - LOWER	44.61198056	-107.29875556	09-11-1998	50.8	INDETERMINATE
65	T	MRCI43	WEST FORK BIG GOOSE CREEK - UPPER	44.61081111	-107.30042222	09-16-1996	52.3	INDETERMINATE
298	T	MRCI43	WEST FORK BIG GOOSE CREEK - UPPER	44.61081111	-107.30042222	09-17-1997	59.1 *	INDETERMINATE
676	T	MRCI43	WEST FORK BIG GOOSE CREEK - UPPER	44.61081111	-107.30042222	09-11-1998	59.3 *	INDETERMINATE
7	R	MRC16	WEST TENSLEEP CREEK	44.23861111	-107.22444444	10-12-1993	80.7	FULL SUPPORT
844	T	MRW102	Willow Creek Upper (RR Crossing)	42.47286111	-108.81522222	08-04-1999	63.2 *	FULL SUPPORT
845	T	MRW103	Willow Creek Middle -Shields Mine	42.46330278	-108.78414722	08-05-1999	68.1	FULL SUPPORT

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

BLACK HILLS									
83	T	MREI5	BEAVER CREEK	44.57250000	-104.40666667	10-03-1996	61.2		FULL SUPPORT
1034	T	MRE14	Beaver Creek - Above Cook Lake	44.56232000	-104.40585000	10/18/2000	42.3		INDETERMINATE
1033	T	MRE15	Beaver Creek - Above Fawn Creek	44.64112000	-104.38391000	10/18/2000	61.2		FULL SUPPORT
1032	T	MRE16	Beaver Creek - Above Little Creek	44.60758000	-104.39847000	8/31/2000	48.3		INDETERMINATE
365	T	MRE6	BEAVERDAM CREEK	44.71500000	-104.38638889	10-22-1997	23.0		PARTIAL/NON SUPPORT
76	T	MRE8	BLACKTAIL CREEK	44.56027778	-104.47694444	10-04-1996	47.6		INDETERMINATE
1046	T	MRE19	Blacktail Creek - Below Hershey Creek	44.58301000	-104.49026000	10/25/2000	71.4		FULL SUPPORT
379	R	MRE11	COLD SPRINGS CREEK	44.25277778	-104.17833333	10-02-1997	61.5		FULL SUPPORT
1045	T	MRE17	Fawn Creek - Above F.S. Boundary	44.63751000	-104.37569000	10/17/2000	33.5	*	PARTIAL/NON SUPPORT
336	T	MRE10	INYAN KARA CREEK	44.22583333	-104.42500000	10-02-1997	29.9		PARTIAL/NON SUPPORT
1031	RV	MRE18	Little Creek - F.S. Boundary	44.60747000	-104.39073000	8/30/2000	67.2		FULL SUPPORT
380	T	MRE5	NORTH FORK SUNDANCE CREEK	44.40638889	-104.38805556	10-22-1997	15.4		PARTIAL/NON SUPPORT
82	T	MREI4	NORTH REDWATER CREEK	44.58222222	-104.29777778	10-18-1995	36.8	*	INDETERMINATE
364	R	MRE13	SAND CREEK - CROSSING	44.41305556	-104.09583333	10-21-1997	58.4		FULL SUPPORT
73	R	MRE3	SAND CREEK - LOWER	44.49222222	-104.10861111	09-20-1994	55.0	*	FULL SUPPORT
72	R	MRE2	SAND CREEK - UPPER	44.49027778	-104.10694444	09-20-1994	53.7	*	INDETERMINATE
381	R	MREI3	SPOTTED TAIL CREEK	44.36861111	-104.08694444	10-15-1997	46.5		INDETERMINATE
81	T	MREI2	STOCKADE BEAVER CREEK - LOWER	43.81250000	-104.11250000	10-06-1994	19.4		PARTIAL/NON SUPPORT
1078	T	MREI2	STOCKADE BEAVER CREEK - LOWER	43.81250000	-104.11250000	9/19/2001	46.4		INDETERMINATE
334	R	MRE12	STOCKADE BEAVER CREEK - MALLO CAMP	44.08166667	-104.05888889	10-01-1997	46.7		INDETERMINATE
1076	RV	MRE12	STOCKADE BEAVER CREEK - MALLO CAMP	44.08166667	-104.05888889	9/17/2001	46.9		INDETERMINATE
74	R	MRE4	STOCKADE BEAVER CREEK - UPPER	43.88722222	-104.09722222	10-19-1995	55.1	*	FULL SUPPORT
1077	RV	MRE4	STOCKADE BEAVER CREEK - UPPER	43.88722222	-104.09722222	9/18/2001	43.9		INDETERMINATE
1089	T	NGP137	Stockade Beaver Creek above Kinney Canyon	43.91117000	-104.10676000	9/18/2001	26.2		PARTIAL/NON SUPPORT
75	R	MRE7	TOGUS CREEK	44.54416667	-104.41277778	10-03-1996	50.4		INDETERMINATE
78	T	MREI1	WHITELAW CREEK - LOWER	44.50722222	-104.42055556	09-22-1993	39.3		INDETERMINATE
79	T	MREI1	WHITELAW CREEK - LOWER	44.50722222	-104.42055556	09-02-1994	46.6		INDETERMINATE
80	T	MREI1	WHITELAW CREEK - LOWER	44.50722222	-104.42055556	10-03-1996	48.4		INDETERMINATE
68	R	MRE1	WHITELAW CREEK - UPPER	44.50500000	-104.43241111	09-23-1993	70.4		FULL SUPPORT
69	RP	MRE1	WHITELAW CREEK - UPPER	44.50500000	-104.43241111	09-23-1994	64.4		FULL SUPPORT
70	RP	MRE1	WHITELAW CREEK - UPPER	44.50500000	-104.43241111	10-18-1995	70.2		FULL SUPPORT
71	RP	MRE1	WHITELAW CREEK - UPPER	44.50500000	-104.43241111	10-03-1996	67.3		FULL SUPPORT
333	RP	MRE1	WHITELAW CREEK - UPPER	44.50500000	-104.43241111	10-01-1997	78.4		FULL SUPPORT
679	RP	MRE1	WHITELAW CREEK - UPPER	44.50500000	-104.43241111	09-10-1998	81.9		FULL SUPPORT
840	RP	MRE1	WHITELAW CREEK - UPPER	44.50500000	-104.43241111	10-08-1999	80.2		FULL SUPPORT
1030	RV	MRE1	WHITELAW CREEK - UPPER	44.50500000	-104.43241111	10/19/2000	69.5		FULL SUPPORT
1067	RV	MRE1	WHITELAW CREEK - UPPER	44.50500000	-104.43241111	10/2/2001	58.9		FULL SUPPORT
WESTERN VOLCANIC & SEDIMENTARY MOUNTAINS									
1186	T	MRW113	Alice Creek White Saddle	42.41389000	-110.72361000	9/6/2000	53.0		INDETERMINATE
126	R	MRW58	ANTELOPE CREEK	44.86944444	-110.38361111	09-14-1994	66.5		FULL SUPPORT
861	T	MRW91	Bear Creek (Upper) Bear Basin	43.73471389	-109.44759722	09-13-1999	56.4	*	INDETERMINATE
164	T	MRWI25	BLACKTAIL DEER CREEK	44.95694444	-110.58611111	09-09-1994	54.9		INDETERMINATE
147	R	MRW9	BUFFALO FORK RIVER	43.85472222	-110.23833333	08-31-1994	57.2	*	INDETERMINATE
130	R	MRW61	CABIN CREEK	44.12750000	-109.64388889	09-17-1996	72.3		FULL SUPPORT
84	R	MRW1	CACHE CREEK - LOWER - USGS STREAM GAGE	43.45244722	-110.70362778	08-27-1993	60.4	*	FULL SUPPORT
85	RP	MRW1	CACHE CREEK - LOWER - USGS STREAM GAGE	43.45244722	-110.70362778	09-01-1994	67.3		FULL SUPPORT
86	RP	MRW1	CACHE CREEK - LOWER - USGS STREAM GAGE	43.45244722	-110.70362778	09-07-1995	67.2		FULL SUPPORT
87	RP	MRW1	CACHE CREEK - LOWER - USGS STREAM GAGE	43.45244722	-110.70362778	09-04-1996	79.2		FULL SUPPORT
320	RP	MRW1	CACHE CREEK - LOWER - USGS STREAM GAGE	43.45244722	-110.70362778	09-16-1997	80.5		FULL SUPPORT
680	RP	MRW1	CACHE CREEK - LOWER - USGS STREAM GAGE	43.45244722	-110.70362778	10-06-1998	72.1		FULL SUPPORT
841	RP	MRW1	CACHE CREEK - LOWER - USGS STREAM GAGE	43.45244722	-110.70362778	09-01-1999	74.2		FULL SUPPORT
1184	RV	MRW1	CACHE CREEK - LOWER - USGS STREAM GAGE	43.45244722	-110.70362778	8/30/2000	80.2		FULL SUPPORT
1185	RV	MRW1	CACHE CREEK - LOWER - USGS STREAM GAGE	43.45244722	-110.70362778	9/5/2001	74.2		FULL SUPPORT
90	R	MRW12	CACHE CREEK - UPPER	43.45083333	-110.70083333	09-01-1994	64.8	*	FULL SUPPORT
862	T	MRW92	Castle Creek (culvert)	43.67677222	-109.37787222	09-14-1999	62.4	*	FULL SUPPORT
303	T	MRW29	CLARKS FORK RIVER - HUNTER PEAK	44.88638889	-109.65555556	08-27-1997	68.2		FULL SUPPORT
145	R	MRW76	CLEARWATER CREEK (ABOVE)	44.46305556	-109.67083333	09-20-1996	52.7		INDETERMINATE
278	RP	MRW76	CLEARWATER CREEK (ABOVE)	44.46305556	-109.67083333	09-10-1997	59.2	*	INDETERMINATE
150	T	MRWI11	CLEARWATER CREEK (BELOW)	44.46416667	-109.67194444	09-20-1996	60.6	*	FULL SUPPORT
277	T	MRWI11	CLEARWATER CREEK (BELOW)	44.46416667	-109.67194444	09-10-1997	49.8		INDETERMINATE
141	R	MRW72	CLOCKTOWER CREEK (ABOVE)	44.46027778	-109.57500000	09-20-1996	50.7		INDETERMINATE
280	RP	MRW72	CLOCKTOWER CREEK (ABOVE)	44.46027778	-109.57500000	09-10-1997	33.8		PARTIAL/NON SUPPORT
184	T	MRWI7	CLOCKTOWER CREEK (BELOW)	44.46222222	-109.57388889	09-20-1996	52.8		INDETERMINATE
279	T	MRWI7	CLOCKTOWER CREEK (BELOW)	44.46222222	-109.57388889	09-10-1997	27.9		PARTIAL/NON SUPPORT
177	T	MRWI38	COAL CREEK	42.39000000	-110.95194444	10-03-1995	38.2	*	PARTIAL/NON SUPPORT
154	T	MRWI15	COAL CREEK	42.24055556	-110.85861111	09-25-1996	43.3	*	INDETERMINATE
688	T	MRW79	COAL CREEK - UPPER	42.25938056	-110.84340000	09-22-1998	37.1	*	PARTIAL/NON SUPPORT
690	T	MRW81	COANTAG CREEK - BRIDGE (BEAR RIVER)	42.37116111	-110.78874722	09-24-1998	62.0	*	FULL SUPPORT
96	R	MRW18	CROW CREEK	44.51313889	-109.97328056	09-02-1993	69.2		FULL SUPPORT
97	RP	MRW18	CROW CREEK	44.51313889	-109.97328056	09-07-1994	83.8		FULL SUPPORT
98	RP	MRW18	CROW CREEK	44.51313889	-109.97328056	09-22-1995	80.9		FULL SUPPORT
99	RP	MRW18	CROW CREEK	44.51313889	-109.97328056	09-18-1996	82.2		FULL SUPPORT
301	RP	MRW18	CROW CREEK	44.51313889	-109.97328056	08-26-1997	74.6		FULL SUPPORT
682	RP	MRW18	CROW CREEK	44.51313889	-109.97328056	09-04-1998	81.7		FULL SUPPORT
856	RP	MRW18	CROW CREEK	44.51313889	-109.97328056	08-31-1999	70.8		FULL SUPPORT
1003	RV	MRW18	CROW CREEK	44.51313889	-109.97328056	9/6/2000	73.6		FULL SUPPORT
1111	RV	MRW18	CROW CREEK	44.51313889	-109.97328056	8/27/2001	84.0		FULL SUPPORT
88	R	MRW10	CRYSTAL CREEK	43.55833333	-110.40555556	09-05-1996	64.4	*	FULL SUPPORT
1083	T	MRW117	Dead Indian Creek below Dead Indian Campground	44.75567000	-109.41618000	8/29/2001	66.3		FULL SUPPORT
129	R	MRW60	DEER CREEK	44.16055556	-109.62083333	09-17-1996	65.5		FULL SUPPORT
868	T	MRW99	East Fork Wind River Upper/ Below Lean-to Creek	43.69077222	-109.36136111	09-14-1999	53.3		INDETERMINATE
142	RP	MRW73	ELK FORK CREEK (ABOVE)	44.46472222	-109.62777778	09-20-1996	54.1		INDETERMINATE
282	R	MRW73	ELK FORK CREEK (ABOVE)	44.46472222	-109.62777778	09-10-1997	57.7	*	INDETERMINATE
185	T	MRWI8	ELK FORK CREEK (BELOW)	44.46611111	-109.62722222	09-20-1996	43.0	*	INDETERMINATE
281	T	MRWI8	ELK FORK CREEK (BELOW)	44.46611111	-109.62722222	09-10-1997	55.8		INDETERMINATE

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

106	R	MRW31	ELK FORK RIVER	44.45777778	-109.63250000	09-07-1994	63.4	*	FULL SUPPORT
113	T	MRW42	FALLS RIVER	44.13472222	-110.82083333	08-31-1993	52.1		INDETERMINATE
172	T	MRWI33	FISH CREEK - STATION 1	43.49277778	-110.87277778	09-07-1995	47.1		INDETERMINATE
173	T	MRWI34	FISH CREEK - STATION 2	43.52194444	-110.86333333	09-06-1995	49.3		INDETERMINATE
174	T	MRWI35	FISH CREEK - STATION 3	43.54555556	-110.84583333	09-06-1995	50.5		INDETERMINATE
175	T	MRWI36	FISH CREEK - STATION 4	43.58527778	-110.82555556	09-06-1995	21.4		PARTIAL/NON SUPPORT
127	R	MRW59	FONTENELLE CREEK - UPPER	42.28777778	-110.57472222	09-26-1996	62.9	*	FULL SUPPORT
695	T	MRW86	FONTENELLE CREEK - UPPER (GREEN RIVER)	42.24008333	-110.55520556	09-01-1998	62.0	*	FULL SUPPORT
692	T	MRW83	GIRAFFE CREEK - BAUMAN	42.40370833	-110.99915833	10-08-1998	54.0		INDETERMINATE
383	R	MRW21	GREYBULL RIVER - JACK CREEK	44.11111111	-109.35333333	08-28-1997	60.4	*	FULL SUPPORT
101	T	MRW23	GREYS RIVER	43.14305556	-110.97611111	09-01-1993	55.4		INDETERMINATE
135	RP	MRW67	GRINNEL CREEK (ABOVE)	44.49500000	-109.93305556	09-19-1996	68.5		FULL SUPPORT
284	R	MRW67	GRINNEL CREEK (ABOVE)	44.49500000	-109.93305556	09-09-1997	70.5		FULL SUPPORT
156	T	MRWI2	GRINNEL CREEK (BELOW)	44.49500000	-109.93305556	09-19-1996	74.6		FULL SUPPORT
283	T	MRWI2	GRINNEL CREEK (BELOW)	44.49500000	-109.93305556	09-09-1997	64.8	*	FULL SUPPORT
697	T	MRW88	HAMS FORK - FOREST	42.19278056	-110.73752778	09-17-1998	62.5	*	FULL SUPPORT
146	R	MRW8	HAMS FORK RIVER - BELOW	42.20944444	-110.73222222	10-05-1995	79.4		FULL SUPPORT
123	R	MRW53	HAMS FORK RIVER - CAMPGROUND	42.25416667	-110.72972222	10-05-1995	70.4		FULL SUPPORT
1053	RV	MRW53	HAMS FORK RIVER - CAMPGROUND	42.25416667	-110.72972222	9/25/2000	65.9		FULL SUPPORT
1193	RV	MRW53	HAMS FORK RIVER - CAMPGROUND	42.25416667	-110.72972222	9/25/2000	66.0		FULL SUPPORT
1192	RV	MRW53	HAMS FORK RIVER - CAMPGROUND	42.25416667	-110.72972222	10/2/2001	63.8	*	FULL SUPPORT
92	R	MRW15	HOBBLE CREEK	42.36500000	-110.84527778	09-25-1996	73.1		FULL SUPPORT
367	R	MRW52	LABARGE CREEK	42.40638889	-110.56083333	09-17-1997	70.0		FULL SUPPORT
138	R	MRW7	LABARGE CREEK - LOWER	42.40305556	-110.56055556	09-28-1996	64.7	*	FULL SUPPORT
100	R	MRW22	LABARGE CREEK - UPPER	42.52111111	-110.69888889	09-28-1996	54.3		INDETERMINATE
163	T	MRWI24	LAMAR RIVER - LOWER	44.90083333	-110.25555556	09-13-1994	69.8		FULL SUPPORT
112	T	MRW41	LAMAR RIVER - UPPER	44.86083333	-110.18638889	09-13-1994	61.8	*	FULL SUPPORT
114	R	MRW44	LAVA CREEK	44.93555556	-110.62416667	09-14-1994	76.9		FULL SUPPORT
136	R	MRW68	LIBBY CREEK (ABOVE)	44.46055556	-109.86166667	09-19-1996	50.2		INDETERMINATE
286	RP	MRW68	LIBBY CREEK (ABOVE)	44.46055556	-109.86166667	09-09-1997	50.3		INDETERMINATE
168	T	MRWI3	LIBBY CREEK (BELOW)	44.45972222	-109.86416667	09-01-1996	15.6		PARTIAL/NON SUPPORT
285	T	MRWI3	LIBBY CREEK (BELOW)	44.45972222	-109.86416667	09-09-1997	56.2	*	INDETERMINATE
89	T	MRW11	LITTLE GRANITE CREEK	43.29888889	-110.52583333	09-01-1993	49.5		INDETERMINATE
140	RP	MRW71	M.FK. SHOSHONE RIVER (ABOVE)	44.49222222	-109.99583333	09-19-1996	77.0		FULL SUPPORT
290	R	MRW71	M.FK. SHOSHONE RIVER (ABOVE)	44.49222222	-109.99583333	09-09-1997	80.1		FULL SUPPORT
183	RP	MRWI6	M.FK. SHOSHONE RIVER (BELOW)	44.49277778	-109.99333333	09-19-1996	71.6		FULL SUPPORT
289	R	MRWI6	M.FK. SHOSHONE RIVER (BELOW)	44.49277778	-109.99333333	09-09-1997	75.7		FULL SUPPORT
116	RP	MRW45	MIDDLE CREEK	44.47776667	-110.03559167	09-02-1993	61.9	*	FULL SUPPORT
117	R	MRW45	MIDDLE CREEK	44.47776667	-110.03559167	09-07-1994	81.8		FULL SUPPORT
118	RP	MRW45	MIDDLE CREEK	44.47776667	-110.03559167	09-21-1995	77.9		FULL SUPPORT
119	RP	MRW45	MIDDLE CREEK	44.47776667	-110.03559167	09-18-1996	70.4		FULL SUPPORT
386	RP	MRW45	MIDDLE CREEK	44.47776667	-110.03559167	08-25-1997	65.6		FULL SUPPORT
684	RP	MRW45	MIDDLE CREEK	44.47776667	-110.03559167	09-03-1998	62.7	*	FULL SUPPORT
858	RP	MRW45	MIDDLE CREEK	44.47776667	-110.03559167	09-01-1999	63.3	*	FULL SUPPORT
999	RV	MRW45	MIDDLE CREEK	44.47776667	-110.03559167	9/7/2000	72.3		FULL SUPPORT
1070	RV	MRW45	MIDDLE CREEK	44.47776667	-110.03559167	8/30/2001	79.6		FULL SUPPORT
132	T	MRW64	MIDDLE PINEY CREEK	42.60833333	-110.48166667	10-01-1996	57.7	*	INDETERMINATE
325	T	MRW64	MIDDLE PINEY CREEK	42.60833333	-110.48166667	09-18-1997	51.8		INDETERMINATE
137	R	MRW69	MORMON CREEK (ABOVE)	44.47305556	-109.89638889	09-19-1996	59.8	*	INDETERMINATE
288	RP	MRW69	MORMON CREEK (ABOVE)	44.47305556	-109.89638889	09-09-1997	72.4		FULL SUPPORT
179	T	MRWI4	MORMON CREEK (BELOW)	44.47277778	-109.89888889	09-19-1996	62.8	*	FULL SUPPORT
287	T	MRWI4	MORMON CREEK (BELOW)	44.47277778	-109.89888889	09-09-1997	62.2	*	FULL SUPPORT
144	T	MRW75	N.FK. SHOSHONE RIVER (SITE 1) (ABOVE)	44.46111111	-109.66388889	09-20-1996	54.8		INDETERMINATE
292	T	MRW75	N.FK. SHOSHONE RIVER (SITE 1) (ABOVE)	44.46111111	-109.66388889	09-10-1997	57.1	*	INDETERMINATE
149	T	MRWI10	N.FK. SHOSHONE RIVER (SITE 1) (BELOW)	44.46722222	-109.65916667	09-20-1996	46.6		INDETERMINATE
291	T	MRWI10	N.FK. SHOSHONE RIVER (SITE 1) (BELOW)	44.46722222	-109.65916667	09-10-1997	49.8		INDETERMINATE
139	R	MRW70	N.FK. SHOSHONE RIVER (SITE 2) (ABOVE)	44.50305556	-109.96055556	09-19-1996	57.5	*	INDETERMINATE
294	RP	MRW70	N.FK. SHOSHONE RIVER (SITE 2) (ABOVE)	44.50305556	-109.96055556	09-09-1997	61.2	*	FULL SUPPORT
182	T	MRWI5	N.FK. SHOSHONE RIVER (SITE 2) (BELOW)	44.50000000	-109.95444444	09-19-1996	48.7		INDETERMINATE
293	T	MRWI5	N.FK. SHOSHONE RIVER (SITE 2) (BELOW)	44.50000000	-109.95444444	09-09-1997	74.3		FULL SUPPORT
143	T	MRW74	N.FK. SHOSHONE RIVER (SITE 3) (ABOVE)	44.45972222	-109.56694444	09-20-1996	67.6		FULL SUPPORT
296	T	MRW74	N.FK. SHOSHONE RIVER (SITE 3) (ABOVE)	44.45972222	-109.56694444	09-10-1997	67.1		FULL SUPPORT
186	T	MRWI9	N.FK. SHOSHONE RIVER (SITE 3) (BELOW)	44.46055556	-109.55305556	09-20-1996	70.5		FULL SUPPORT
295	T	MRWI9	N.FK. SHOSHONE RIVER (SITE 3) (BELOW)	44.46055556	-109.55305556	09-10-1997	49.2		INDETERMINATE
122	T	MRW51	NORTH FORK SHOSHONE RIVER - SCOUT CAMP	44.45750000	-109.86277778	09-03-1993	48.3		INDETERMINATE
178	R	MRWI39	NORTH FORK SMITHS FORK RIVER	42.48722222	-110.83583333	10-04-1995	66.6		FULL SUPPORT
161	T	MRWI22	NORTH FORK SPREAD CREEK - LOWER	43.77750000	-110.25527778	08-30-1994	54.6		INDETERMINATE
162	T	MRWI22	NORTH FORK SPREAD CREEK - LOWER	43.77750000	-110.25527778	09-04-1996	55.9		INDETERMINATE
159	T	MRWI21	NORTH FORK SPREAD CREEK - MIDDLE	43.77722222	-110.24972222	08-30-1994	51.3		INDETERMINATE
160	T	MRWI21	NORTH FORK SPREAD CREEK - MIDDLE	43.77722222	-110.24972222	09-04-1996	59.8	*	INDETERMINATE
157	T	MRWI20	NORTH FORK SPREAD CREEK - UPPER	43.77611111	-110.24250000	08-31-1994	67.3		FULL SUPPORT
158	T	MRWI20	NORTH FORK SPREAD CREEK - UPPER	43.77611111	-110.24250000	09-04-1996	66.4		FULL SUPPORT
1187	T	MRW121	North Horse Creek- Merna Butte	42.94663000	-110.39611000	9/26/2001	67.5		FULL SUPPORT
128	R	MRW6	NORTH PINEY CREEK #1	42.66166667	-110.49055556	10-01-1996	48.7		INDETERMINATE
93	R	MRW16	NORTH PINEY CREEK #2	42.66138889	-110.49000000	10-01-1996	65.0		FULL SUPPORT
108	T	MRW37	OBSIDIAN CREEK	44.87944444	-110.73666667	09-15-1994	54.5		INDETERMINATE
302	T	MRWI26	OLIVER GULCH CREEK	44.84361111	-109.62555556	08-27-1997	20.7		PARTIAL/NON SUPPORT
368	R	MRW62	PEBBLE CREEK	44.91777778	-110.11055556	08-26-1997	50.4		INDETERMINATE
107	T	MRW36	RAYMOND CREEK	42.27666667	-111.02138889	09-24-1996	61.1	*	FULL SUPPORT
322	R	MRW35	ROCK CREEK	42.28861111	-110.42861111	09-17-1997	58.8	*	INDETERMINATE
306	T	MRW77	ROCK CREEK - LOWER	43.69472222	-109.10861111	09-03-1997	72.6		FULL SUPPORT
305	T	MRWI42	ROCK CREEK - UPPER	43.73055556	-109.13944444	09-03-1997	55.1		INDETERMINATE
691	T	MRW82	SALT CREEK - 89 CANYON	42.40358056	-111.03118889	10-08-1998	63.5	*	FULL SUPPORT
155	T	MRWI16	SALT CREEK - LOWER	42.40388889	-111.02916667	10-03-1995	54.1		INDETERMINATE
176	T	MRWI37	SALT CREEK - UPPER	42.40194444	-110.99027778	08-03-1995	50.7		INDETERMINATE

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

384	R	MRW25	SALT RIVER	42.52500000	-110.88194444	10-16-1997	70.6		FULL SUPPORT
109	R	MRW38	SLOUGH CREEK	44.95333333	-110.29944444	09-13-1994	70.3		FULL SUPPORT
120	R	MRW5	SMITHS FORK RIVER	42.47722222	-110.83361111	09-25-1996	69.1		FULL SUPPORT
153	T	MRWI14	SMITHS FORK RIVER - LOWER	42.34611111	-110.87250000	10-12-1994	56.2	*	INDETERMINATE
124	R	MRW55	SMITHS FORK RIVER - LOWER	42.34569444	-110.87277500	09-25-1996	70.1		FULL SUPPORT
686	RP	MRW55	SMITHS FORK RIVER - LOWER	42.34569444	-110.87277500	09-22-1998	57.4	*	INDETERMINATE
171	R	MRWI32	SMITHS FORK RIVER - UPPER	42.37944444	-110.85527778	10-12-1994	70.8		FULL SUPPORT
125	T	MRW57	SNAKE RIVER - ALPINE	43.20416667	-110.83000000	09-01-1994	55.2		INDETERMINATE
102	RP	MRW3	SNAKE RIVER - FLAGG RANCH	44.10078333	-110.66946111	08-31-1993	85.6		FULL SUPPORT
103	RP	MRW3	SNAKE RIVER - FLAGG RANCH	44.10078333	-110.66946111	08-31-1994	79.8		FULL SUPPORT
104	R	MRW3	SNAKE RIVER - FLAGG RANCH	44.10078333	-110.66946111	09-08-1995	62.0	*	FULL SUPPORT
105	RP	MRW3	SNAKE RIVER - FLAGG RANCH	44.10078333	-110.66946111	09-05-1996	60.8	*	FULL SUPPORT
321	RP	MRW3	SNAKE RIVER - FLAGG RANCH	44.10078333	-110.66946111	09-16-1997	78.7		FULL SUPPORT
683	RP	MRW3	SNAKE RIVER - FLAGG RANCH	44.10078333	-110.66946111	10-07-1998	70.4		FULL SUPPORT
857	RP	MRW3	SNAKE RIVER - FLAGG RANCH	44.10078333	-110.66946111	09-01-1999	60.6	*	FULL SUPPORT
1190	RV	MRW3	SNAKE RIVER - FLAGG RANCH	44.10078333	-110.66946111	8/30/2000	35.1		PARTIAL/NON SUPPORT
1191	RV	MRW3	SNAKE RIVER - FLAGG RANCH	44.10078333	-110.66946111	9/5/2001	64.3	*	FULL SUPPORT
110	R	MRW39	SNAKE RIVER - YELLOWSTONE	44.13666667	-110.66416667	09-08-1995	58.2	*	INDETERMINATE
169	T	MRWI30	SODA BUTTE CREEK	44.99277778	-110.05194444	09-13-1994	66.3		FULL SUPPORT
385	R	MRW28	STRAWBERRY CREEK	42.90666667	-110.88666667	10-15-1997	58.2	*	INDETERMINATE
1082	T	MRW118	Sunlight Creek above Little Sunlight Creek	44.71605000	-109.58838000	8/28/2001	60.6	*	FULL SUPPORT
1081	T	MRW119	Sunlight Creek at White Mountain	44.75228000	-109.49077000	8/28/2001	82.0		FULL SUPPORT
170	T	MRWI31	TROUT CREEK	44.64138889	-110.45750000	09-14-1994	13.6		PARTIAL/NON SUPPORT
850	T	MRW108	Unnamed Tributary to Brooks Lake	43.75533611	-110.01166667	09-02-1999	53.6		INDETERMINATE
851	T	MRW109	Warm Springs Creek Upper/ Above Coyote Creek	43.59199722	-109.98405556	09-08-1999	79.4		FULL SUPPORT
853	T	MRW111	Warm Springs Creek Fish	43.58584722	-109.96773611	09-08-1999	69.9		FULL SUPPORT
360	RP	MRW56	WEST FORK SMITHS FORK	41.03005000	-110.47426389	10-22-1997	73.1		FULL SUPPORT
687	RP	MRW56	WEST FORK SMITHS FORK	41.03005000	-110.47426389	10-08-1998	61.0	*	FULL SUPPORT
859	R	MRW56	WEST FORK SMITHS FORK	41.03005000	-110.47426389	10-18-1999	74.8		FULL SUPPORT
91	T	MRW13	WILLOW CREEK	43.29138889	-110.67166667	09-01-1994	53.3		INDETERMINATE
355	R	MRW26	WILLOW CREEK	42.84500000	-110.87888889	10-16-1997	64.5	*	FULL SUPPORT
PLAINS									
958	T	WHP18	BEAR CREEK - ABOVE DATER CREEK (BC5)	41.65210278	-104.37569444	10-14-1999	55.8		FULL SUPPORT
1107	T	WHP18	BEAR CREEK - ABOVE DATER CREEK (BC5)	41.65210278	-104.37569444	10/17/2001	45.8	*	FULL SUPPORT
957	T	WHP17	BEAR CREEK - ABOVE FOX CREEK (BC4)	41.65861389	-104.32133889	10-15-1999	57.1		FULL SUPPORT
961	R	WHP21	BEAR CREEK - ABOVE LITTLE BEAR CREEK (BC8)	41.61624167	-104.61689167	10-20-1999	65.9		FULL SUPPORT
1108	T	WHP21	BEAR CREEK - ABOVE LITTLE BEAR CREEK (BC8)	41.61624167	-104.61689167	10/25/2001	67.4		FULL SUPPORT
956	T	WHP16	BEAR CREEK - BELOW FOX CREEK (BC3)	41.65443056	-104.29721111	10-15-1999	47.7	*	FULL SUPPORT
960	R	WHP20	BEAR CREEK - BELOW LITTLE BEAR CREEK (BC7)	41.61605556	-104.60957500	10-19-1999	63.1		FULL SUPPORT
1109	RV	WHP20	BEAR CREEK - BELOW LITTLE BEAR CREEK (BC7)	41.61605556	-104.60957500	10/18/2001	58.0		FULL SUPPORT
955	T	WHP15	BEAR CREEK - BELOW LOVERCHECK DIVERSION DITCH (BC2	41.63886111	-104.22800556	10-13-1999	61.9		FULL SUPPORT
959	T	WHP19	BEAR CREEK - BELOW SPRING RUN (BC6)	41.63595278	-104.47532500	10-19-1999	56.0		FULL SUPPORT
962	T	WHP22	BEAR CREEK - HEADWATER (BC9)	41.63225278	-104.74628056	10-21-1999	78.3		FULL SUPPORT
954	T	WHP14	BEAR CREEK - NEAR MOUTH (BC1)	41.63653333	-104.22511389	10-12-1999	62.9		FULL SUPPORT
1092	T	NGP141	Beaver Creek below Stockade Beaver Creek	43.54044000	-104.12263000	9/26/2001	42.8	*	INDETERMINATE
1091	T	NGP140	Beaver Creek near South Dakota state line	43.50334000	-104.05908000	9/27/2001	36.5		INDETERMINATE
189	R	NGP3	BELLE FOURCHE RIVER - BLM	44.75277778	-104.49055556	10-05-1994	60.2		FULL SUPPORT
197	R	NGPI17	BELLE FOURCHE RIVER - DEVILS TOWER	44.58916667	-104.70055556	09-21-1994	46.2	*	FULL SUPPORT
745	T	NGPI38	BELLE FOURCHE RIVER - DOWNSTREAM OF DONKEY CREEK	44.29051111	-104.97133333	10-01-1998	39.9	*	INDETERMINATE
748	T	NGPI40	BELLE FOURCHE RIVER - DOWNSTREAM OF HULETT WWTF	44.69906944	-104.59213889	09-02-1998	56.8		FULL SUPPORT
746	T	NGPI39	BELLE FOURCHE RIVER - DOWNSTREAM OF RUSH CREEK	44.27652500	-104.97213889	09-23-1998	39.5	*	INDETERMINATE
749	T	NGPI41	BELLE FOURCHE RIVER - UPSTREAM OF HULETT WWTF	44.69428611	-104.59465833	09-02-1998	53.9		FULL SUPPORT
699	T	NGP12	BELLE FOURCHE RIVER - UPSTREAM OF RAVEN CREEK	44.18029444	-105.09141944	09-24-1998	40.2	*	INDETERMINATE
994	T	NGP116	Belle Fourche River Below Caballo Creek	44.07906000	-105.23782000	8/24/2000	28.0	*	PARTIAL/NON SUPPORT
1060	T	NGP118	Black Thunder Creek above Little Thunder Creek	NC	NC	9/23/2000	15.6		PARTIAL/NON SUPPORT
1065	T	NGP121	Black Thunder Creek at gage	NC	NC	9/19/2000	22.3		PARTIAL/NON SUPPORT
997	T	NGP105	Caballo Creek Below Belle Ayr Mine	44.09231000	-105.29985000	8/23/2000	22.3		PARTIAL/NON SUPPORT
996	T	NGP106	Caballo Creek Below Bone Pile Creek	44.08970000	-105.44541000	8/23/2000	19.3		PARTIAL/NON SUPPORT
995	T	NGP107	Caballo Creek Below Hwy 59	44.08027000	-105.46274000	8/23/2000	17.5		PARTIAL/NON SUPPORT
190	T	NGP7	CASPER CREEK	42.91666667	-106.43027778	10-10-1995	40.7	*	INDETERMINATE
911	T	NGP82	Castle Creek above Salt Creek	43.39738611	-106.27962778	07-27-1999	14.4		PARTIAL/NON SUPPORT
266	R	WHP5	CHUGWATER CREEK	42.04500000	-104.89611111	10-09-1996	42.9	*	FULL SUPPORT
405	R	WHPI7	CHUGWATER CREEK	41.61000000	-105.13333333	10-22-1997	44.4	*	FULL SUPPORT
820	T	WHP10	CHUGWATER CREEK - LOWER	42.10578889	-104.86513611	10-22-1998	26.3	*	PARTIAL/NON SUPPORT
819	T	WHP09	CHUGWATER CREEK - UPPER	42.02167222	-104.92333333	10-23-1998	51.8		FULL SUPPORT
876	T	NGP47	Clear Creek - Above Clearmont WWTF	44.63513056	-106.37624722	10-15-1999	83.2		FULL SUPPORT
878	T	NGP49	Clear Creek - Below Clearmont WWTP	44.64153889	-106.37142222	10-15-1999	81.3		FULL SUPPORT
879	T	NGP50	Clear Creek - Below Piney Creek Confluence	44.56547500	-106.52126389	09-29-1999	80.4		FULL SUPPORT
880	T	NGP51	Clear Creek - County 70 Bridge	44.75009167	-106.22308889	10-14-1999	66.2		FULL SUPPORT
881	T	NGP52	Clear Creek - Foate	44.85438889	-106.09777778	10-13-1999	71.1		FULL SUPPORT
882	T	NGP53	Clear Creek - Leiter (14/16 Bridge)	44.71565278	-106.28318889	10-14-1999	76.1		FULL SUPPORT
883	T	NGP54	Clear Creek - Rowley's	44.87215278	-106.08090556	10-13-1999	69.1		FULL SUPPORT
1008	T	NGP104	Clear Creek Above Powder River	44.87863000	-106.06968000	10/9/2000	66.4		FULL SUPPORT
218	T	NGPI8	COLUMBUS CREEK - LOWER	44.89305556	-107.23611111	10-08-1996	41.7	*	INDETERMINATE
346	T	NGPI8	COLUMBUS CREEK - LOWER	44.89305556	-107.23611111	10-14-1997	58.0		FULL SUPPORT
191	R	NGP8	CRAZY WOMAN CREEK	44.48611111	-106.13416667	10-26-1995	52.1		FULL SUPPORT
885	T	NGP56	Crazy Woman Creek - State Section	44.12973333	-106.48351111	10-25-1999	64.2		FULL SUPPORT
886	T	NGP57	Crazy Woman Creek - Upper	44.06397222	-106.59203056	10-26-1999	75.1		FULL SUPPORT
967	T	WHP27	CROW CREEK - ARCOLA	41.10328056	-104.45371667	10-26-1999	46.4	*	FULL SUPPORT
824	T	WHPI08	CROW CREEK - DOWNSTREAM OF DRY CREEK	41.12920000	-104.70496667	09-28-1998	4.8		PARTIAL/NON SUPPORT
972	T	WHPI11	CROW CREEK - DOWNSTREAM OF DRY CREEK	41.12920000	-104.70496667	10-27-1999	13.6		PARTIAL/NON SUPPORT
968	T	WHP28	CROW CREEK - FAMCAMP	41.15613056	-104.87467500	10-29-1999	41.7	*	INDETERMINATE
823	T	WHP13	CROW CREEK - HAPPY JACK ROAD	41.13576944	-104.84286111	09-28-1998	51.0		FULL SUPPORT
822	T	WHP12	CROW CREEK - MORRIE AVENUE	41.12262500	-104.79537778	09-28-1998	34.4		INDETERMINATE
269	T	WHPI1	CROW CREEK - STATION 1	41.10361111	-104.45416667	08-03-1994	35.3		INDETERMINATE

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

270	T	WHPI2	CROW CREEK - STATION 2	41.12638889	-104.65861111	08-04-1994	16.3		PARTIAL/NON SUPPORT
272	T	WHPI4	CROW CREEK - STATION 4	41.12222222	-104.79694444	08-04-1994	14.4		PARTIAL/NON SUPPORT
273	T	WHPI4B	CROW CREEK - STATION 4B	41.12666667	-104.82361111	08-04-1994	19.5		PARTIAL/NON SUPPORT
275	T	WHPI5	CROW CREEK - STATION 5	41.13194444	-104.82916667	08-04-1994	28.2	*	PARTIAL/NON SUPPORT
276	R	WHPI6	CROW CREEK - STATION 6	41.14916667	-104.86333333	08-05-1994	43.6	*	FULL SUPPORT
821	T	WHP11	CROW CREEK - UPSTREAM OF DRY CREEK	41.12723889	-104.70533056	09-29-1998	25.2	*	PARTIAL/NON SUPPORT
953	T	WHP11	CROW CREEK - UPSTREAM OF DRY CREEK	41.12723889	-104.70533056	10-27-1999	32.6	*	INDETERMINATE
974	T	NGP109	Donkey Creek - State Section	44.29697000	-105.29127000	8/29/2000	29.0	*	INDETERMINATE
978	T	NGP110	Donkey Creek Above Adon Rd.	44.28454000	-105.20598000	8/29/2000	19.6		PARTIAL/NON SUPPORT
980	T	NGP112	Donkey Creek Above Stonepile Creek	44.26267000	-105.46320000	8/29/2000	18.1		PARTIAL/NON SUPPORT
979	T	NGP115	Donkey Creek Above Wyodak	44.27000000	-105.42000000	8/30/2000	24.7	*	PARTIAL/NON SUPPORT
975	T	NGP114	Donkey Creek at Belle Fourche Confluence	44.28593000	-104.97417000	8/31/2000	32.9	*	INDETERMINATE
976	T	NGP113	Donkey Creek Below Well Creek	44.28302000	-105.06368000	8/31/2000	28.9	*	INDETERMINATE
977	T	NGP111	Donkey Creek Below Wyodak	44.28927000	-105.37454000	8/30/2000	15.7		PARTIAL/NON SUPPORT
219	T	NGPI9	FIVE MILE CREEK	44.90638889	-107.16888889	10-08-1996	36.7		INDETERMINATE
343	T	NGPI9	FIVE MILE CREEK	44.90638889	-107.16888889	10-10-1997	41.6	*	INDETERMINATE
267	R	WHP6	HORSE CREEK	41.42250000	-105.18666667	10-11-1996	38.1	*	INDETERMINATE
966	T	WHP26	HORSE CREEK - BELOW DRY CREEK (HC2)	41.87311944	-104.13921389	10-07-1999	57.4		FULL SUPPORT
965	T	WHP25	HORSE CREEK - BELOW SO. HORSE CK. LATERAL CANAL (H	41.89321389	-104.09701111	10-06-1999	43.2	*	FULL SUPPORT
970	T	WHP30	Horse Shoe Creek above North Platte	42.44722222	-104.96591111	09-08-1999	39.3	*	INDETERMINATE
969	T	WHP29	Horse Shoe Creek above Pipeline	42.45833333	-105.10222222	09-07-1999	62.6		FULL SUPPORT
971	T	WHP31	Horse Shoe Creek below Pipeline	42.45833333	-105.10222222	09-07-1999	62.0		FULL SUPPORT
187	R	NGP1	LITTLE POWDER RIVER	44.43888889	-105.45916667	10-17-1995	42.9	*	FULL SUPPORT
208	T	NGPI29	LITTLE POWDER RIVER - ABOVE	44.61555556	-105.29000000	10-17-1995	49.7		FULL SUPPORT
370	T	NGPI29	LITTLE POWDER RIVER - ABOVE	44.61555556	-105.29000000	10-29-1997	35.2		INDETERMINATE
887	T	NGP58	Little Powder River - Above Dry Creek	44.95077500	-105.35013611	10-06-1999	45.9	*	FULL SUPPORT
888	T	NGP59	Little Powder River - Above Olmstead Creek	44.92005833	-105.35407778	10-05-1999	47.5	*	FULL SUPPORT
210	T	NGPI30	LITTLE POWDER RIVER - BELOW	44.61583333	-105.29000000	10-17-1995	8.4		PARTIAL/NON SUPPORT
362	T	NGPI30	LITTLE POWDER RIVER - BELOW	44.61583333	-105.29000000	10-20-1997	44.8	*	FULL SUPPORT
890	T	NGP61	Little Powder River - Below 85 Creek	44.92292222	-105.34710278	10-04-1999	50.7		FULL SUPPORT
889	T	NGP60	Little Powder River - Below Dry Trail Creek	44.98878889	-105.34000000	10-06-1999	45.9	*	FULL SUPPORT
1059	T	NGP117	Little Thunder Creek at gage	NC	NC	9/20/2000	23.0		PARTIAL/NON SUPPORT
1066	T	NGP122	Little Thunder Creek below LT Reservoir	NC	NC	9/21/2000	35.5		INDETERMINATE
1058	T	NGP120	Little Thunder Creek below School Creek	NC	NC	9/20/2000	28.4	*	PARTIAL/NON SUPPORT
213	T	NGPI32	MEADOW CREEK - OIL TREATER	43.59888889	-106.21555556	10-14-1996	13.1		PARTIAL/NON SUPPORT
701	T	NGP14	Meadow Creek above Salt Creek	43.57903056	-106.34678611	10-14-1998	29.9	*	INDETERMINATE
870	T	NGP14	Meadow Creek above Salt Creek	43.57903056	-106.34678611	09-01-1999	30.9	*	INDETERMINATE
912	T	NGP83	Meadow Creek below Linch	43.60098333	-106.22516111	09-13-1999	15.0		PARTIAL/NON SUPPORT
904	T	NGP75	Middle Fork Powder River above South Fork	43.67000000	-106.51337222	10-06-1999	52.3		FULL SUPPORT
188	R	NGP2	MOYER SPRING	44.37638889	-105.44527778	09-13-1995	27.1	*	PARTIAL/NON SUPPORT
963	T	WHP23	NORTH BEAR CREEK - LOWER CANTLER (NBC1)	41.62488333	-104.77940833	10-21-1999	55.2		FULL SUPPORT
351	T	SRI1	NORTH SYBILLE CREEK	41.74611111	-105.41055556	10-15-1997	60.4		FULL SUPPORT
899	T	NGP70	Posey Creek above South Fork Powder River	43.51705000	-106.63971111	10-14-1999	34.2		INDETERMINATE
1025	T	NGP90	Powder River - BLM Land	44.97118000	-105.92261000	10/11/2000	52.9		FULL SUPPORT
1013	T	NGP88	Powder River Above Barber Creek	44.29879000	-106.15624000	10/17/2000	31.3	*	INDETERMINATE
908	T	NGP79	Powder River above Burger Draw	44.14721944	-106.14250278	10-21-1999	38.0		INDETERMINATE
1017	T	NGP93	Powder River Above Crazy Woman Creek	44.48241000	-106.13182000	10/23/2000	22.6		PARTIAL/NON SUPPORT
1015	T	NGP95	Powder River Above Flying E Creek	44.27093000	-106.13058000	10/16/2000	27.9	*	PARTIAL/NON SUPPORT
1019	T	NGP98	Powder River Above Ivy Creek	44.80898000	-106.08681000	10/11/2000	20.5		PARTIAL/NON SUPPORT
1024	T	NGP100	Powder River Above LX Bar Creek	44.91338000	-106.03099000	10/10/2000	55.8		FULL SUPPORT
700	T	NGP13	Powder River above Salt Creek	43.69094444	-106.35653889	10-13-1998	42.0	*	INDETERMINATE
869	T	NGP13a	Powder River above Salt Creek	43.69077500	-106.35583056	10-15-1999	56.4		FULL SUPPORT
906	T	NGP77	Powder River at Falxa Homestead	43.97460556	-106.16154722	10-25-1999	41.2	*	INDETERMINATE
907	T	NGP78	Powder River at Red Draw	43.98698333	-106.17577222	10-22-1999	47.5	*	FULL SUPPORT
919	T	NGPi48	Powder River at School Section Draw	43.91451667	-106.18020556	10-26-1999	28.9	*	INDETERMINATE
1023	T	NGP87	Powder River Below Arvada	44.73288000	-106.10177000	8/4/2000	35.8		INDETERMINATE
1012	T	NGP89	Powder River Below Barber Creek	44.35249000	-106.14953000	10/18/2000	32.0	*	INDETERMINATE
909	T	NGP80	Powder River below Burger Draw	44.14731944	-106.14390556	10-21-1999	43.8	*	FULL SUPPORT
1021	T	NGP91	Powder River Below Clear Creek	44.88999000	-106.06514000	10/4/2000	56.1		FULL SUPPORT
1011	T	NGP92	Powder River Below Cottonwood Creek	44.58481000	-106.08867000	10/24/2000	11.1		PARTIAL/NON SUPPORT
1018	T	NGP94	Powder River Below Crazy Woman Creek	44.48588000	-106.11681000	10/23/2000	15.5		PARTIAL/NON SUPPORT
1014	T	NGP96	Powder River Below Flying E Creek	44.27627000	-106.12615000	10/17/2000	35.7		INDETERMINATE
1010	T	NGP97	Powder River Below Indian Creek	44.18552000	-106.14245000	10/16/2000	32.2	*	INDETERMINATE
1016	T	NGP99	Powder River Below Ivy Creek	44.84562000	-106.06354000	10/3/2000	49.3		FULL SUPPORT
1022	T	NGP101	Powder River Below LX Bar Creek	44.93500000	-105.96548000	10/10/2000	56.6		FULL SUPPORT
754	T	NGPI46	Powder River below Salt Creek	43.69715833	-106.30540556	10-15-1998	38.3	*	INDETERMINATE
918	T	NGPi46a	Powder River below Salt Creek	43.69350556	-106.30601944	10-15-1999	42.2	*	INDETERMINATE
905	T	NGP76	Powder River below South Fork Powder River	43.67154444	-106.51265556	10-06-1999	40.3	*	INDETERMINATE
1020	T	NGP102	Powder River Below Spotted Horse Creek	44.86010000	-106.05667000	10/4/2000	35.8		INDETERMINATE
1009	T	NGP103	Powder River Near Taylor Draw	44.40582000	-106.14906000	10/19/2000	27.4	*	PARTIAL/NON SUPPORT
337	R	NGPI22	REDWATER CREEK	44.54833333	-104.13138889	10-03-1997	44.1	*	FULL SUPPORT
404	R	WHP8	SAGE CREEK - HAT CREEK STATION	42.93000000	-104.34500000	10-16-1997	27.6	*	PARTIAL/NON SUPPORT
200	T	NGPI2	SALT CREEK - MIDDLE	43.40583333	-106.26277778	10-17-1996	24.2	*	PARTIAL/NON SUPPORT
914	T	NGPI2	SALT CREEK - MIDDLE	43.40583333	-106.26277778	09-09-1999	23.9	*	PARTIAL/NON SUPPORT
192	T	NGPI1	SALT CREEK - UPPER	43.32111111	-106.18361111	10-23-1996	23.0		PARTIAL/NON SUPPORT
753	T	NGPI45	Salt Creek above Cottonwood	43.37459722	-106.22563611	08-26-1998	33.1	*	INDETERMINATE
917	T	NGPi45a	Salt Creek above Cottonwood Creek	43.37475833	-106.22555278	09-13-1999	47.7	*	FULL SUPPORT
752	T	NGPI44	Salt Creek above Meadow Creek	43.57822222	-106.34775278	10-14-1998	43.0	*	FULL SUPPORT
916	T	NGPI44	Salt Creek above Meadow Creek	43.57822222	-106.34775278	08-31-1999	47.3	*	FULL SUPPORT
751	T	NGPI43	Salt Creek below Meadow Creek	43.58328056	-106.35564167	10-14-1998	30.4	*	INDETERMINATE
872	T	NGPI43	Salt Creek below Meadow Creek	43.58328056	-106.35564167	08-30-1999	42.1	*	INDETERMINATE
209	T	NGPI3	Salt Creek below Midwest	43.44474722	-106.28000278	10-17-1996	32.1	*	INDETERMINATE
740	T	NGPI3	Salt Creek below Midwest	43.44474722	-106.28000278	10-15-1998	12.9		PARTIAL/NON SUPPORT
915	T	NGPI3	Salt Creek below Midwest	43.44474722	-106.28000278	09-09-1999	19.2		PARTIAL/NON SUPPORT
750	T	NGPI42	Salt Creek lower - Above Powder River	43.68452500	-106.32767778	10-13-1998	31.4	*	INDETERMINATE

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

871	T	NGPI42	Salt Creek lower - Above Powder River	43.68452500	-106.32767778	09-01-1999	36.7		INDETERMINATE
964	T	WHP24	SOUTH FORK BEAR CREEK - VOWER RANCH (SBC1)	41.62373056	-104.77034722	10-28-1999	69.9		FULL SUPPORT
901	T	NGP72	South Fork Powder River above I-25	43.61820556	-106.57725278	10-11-1999	20.1		PARTIAL/NON SUPPORT
903	T	NGP74	South Fork Powder River above Middle Fork Powder R	43.67264444	-106.51668333	10-07-1999	48.4		FULL SUPPORT
898	T	NGP69	South Fork Powder River above Posey Creek	43.51691667	-106.63911111	10-14-1999	27.5	*	PARTIAL/NON SUPPORT
902	T	NGP73	South Fork Powder River below I-25	43.63245556	-106.57050278	10-11-1999	26.5	*	PARTIAL/NON SUPPORT
900	T	NGP71	South Fork Powder River below Posey Creek	43.52010556	-106.64038611	10-13-1999	22.6		PARTIAL/NON SUPPORT
992	T	NGP85	Spotted Horse Creek - Cresw ell State	44.83186000	-106.01752000	9/27/2000	23.0		PARTIAL/NON SUPPORT
991	T	NGP84	Spotted Horse Creek Above Cresw ell's Diversion	44.84644000	-106.04984000	9/27/2000	17.3		PARTIAL/NON SUPPORT
1064	T	NGP126	Spring Creek on Reno	NC	NC	10/12/2000	15.5		PARTIAL/NON SUPPORT
1087	T	NGP135	Stockade Beaver Creek above Beaver Creek	43.56741000	-104.14640000	9/25/2001	49.7		FULL SUPPORT
1088	T	NGP136	Stockade Beaver Creek below Salt Creek	43.80696000	-104.13942000	9/19/2001	34.2		INDETERMINATE
1090	T	NGP139	Stockade Beaver Creek below Whoopup Creek	43.63672000	-104.13306000	9/26/2001	44.6	*	FULL SUPPORT
981	T	NGP108	Stonepile Creek Below Gillette WWTP	44.26811000	-105.44114000	8/25/2000	13.3		PARTIAL/NON SUPPORT
728	T	NGP41	Tongue River - Decker Highway	44.94245833	-106.95067778	10-15-1998	65.0		FULL SUPPORT
729	T	NGP42	Tongue River - State Line	45.01078611	-106.83659167	10-15-1998	68.1		FULL SUPPORT
825	T	WHPI09	WHEATLAND CREEK - ABOVE WHEATLAND WWTF	42.08313056	-104.95088333	10-21-1998	42.6	*	INDETERMINATE
826	T	WHPI10	WHEATLAND CREEK - BELOW WHEATLAND WWTF	42.08466667	-104.95049167	10-20-1998	33.4	*	INDETERMINATE
SOUTHERN ROCKIES									
1039	RV	SR28	Bear Creek - Above F.S. Road 543	41.21391000	-106.27057000	9/27/2000	61.3		INDETERMINATE
1040	T	SR29	Bear Creek - Below F.S. Road 500E	41.21300000	-106.29192000	9/27/2000	53.4		INDETERMINATE
225	R	SR17	DEEP CREEK	41.19083333	-107.22444444	08-22-1996	57.6		INDETERMINATE
229	R	SR22	DEER CREEK - LOWER	42.72250000	-106.02555556	10-16-1996	71.4	*	FULL SUPPORT
389	T	SR18	DEER CREEK - MIDDLE	42.57444444	-106.03666667	10-07-1997	69.5	*	FULL SUPPORT
356	T	SRI13	DOUGLAS CREEK - DREDGE	41.12750000	-106.24611111	10-16-1997	61.5		INDETERMINATE
393	T	SRI12	DOUGLAS CREEK - JIM CREEK	41.16111111	-106.25500000	10-15-1997	65.5	*	INDETERMINATE
358	R	SRI14	DOUGLAS CREEK - PELTON	41.07583333	-106.30222222	10-16-1997	76.4		FULL SUPPORT
353	R	SRI11	DOUGLAS CREEK - WILDERNESS	41.13055556	-106.42527778	10-15-1997	86.1		FULL SUPPORT
299	R	SR26	EAST FORK SAVERY CREEK - CARRICO	41.26972222	-107.19916667	08-14-1997	56.1		INDETERMINATE
230	R	SR23	ENCAMPMENT RIVER - IOOF	41.18277778	-106.79388889	08-29-1996	75.4		FULL SUPPORT
220	R	SR1	ENCAMPMENT RIVER - STATELINE	41.00472222	-106.81472222	09-04-1996	78.0		FULL SUPPORT
238	R	SR9	ENCAMPMENT RIVER - WATER VALLEY	41.12638889	-106.78722222	08-28-1996	69.8	*	FULL SUPPORT
223	RP	SR15	ENCAMPMENT RIVER - WILDERNESS	41.00703056	-106.81600000	09-05-1996	84.3		FULL SUPPORT
309	RP	SR15	ENCAMPMENT RIVER - WILDERNESS	41.00703056	-106.81600000	09-09-1997	68.8	*	FULL SUPPORT
761	RP	SR15	ENCAMPMENT RIVER - WILDERNESS	41.00703056	-106.81600000	09-17-1998	72.7	*	FULL SUPPORT
920	R	SR15	ENCAMPMENT RIVER - WILDERNESS	41.00703056	-106.81600000	09-24-1999	77.2		FULL SUPPORT
1027	RV	SR15	ENCAMPMENT RIVER - WILDERNESS	41.00703056	-106.81600000	9/14/2000	70.2	*	FULL SUPPORT
1113	RV	SR15	ENCAMPMENT RIVER - WILDERNESS	41.00703056	-106.81600000	9/6/2001	72.9	*	FULL SUPPORT
245	T	SRI7	GARDEN CREEK - 13TH STREET	42.83722222	-106.35916667	10-15-1996	2.8		PARTIAL/NON SUPPORT
244	T	SRI6	GARDEN CREEK - WYOMING BOULEVARD	42.80444444	-106.34722222	10-15-1996	28.8		PARTIAL/NON SUPPORT
242	T	SRI4	HAGGARTY CREEK - LOWER	41.15166667	-107.11805556	08-21-1996	28.7		PARTIAL/NON SUPPORT
1114	T	SRI4	HAGGARTY CREEK - LOWER	41.15166667	-107.11805556	9/26/2001	38.3		PARTIAL/NON SUPPORT
1125	T	SR35	Haggarty Creek - Rudefeha	41.18819000	-107.07174000	9/25/2001	61.1		INDETERMINATE
241	T	SRI3	HAGGARTY CREEK - UPPER	41.18305556	-107.07694444	08-21-1996	36.7		PARTIAL/NON SUPPORT
1115	T	SRI3	HAGGARTY CREEK - UPPER	41.18305556	-107.07694444	9/26/2001	7.1		PARTIAL/NON SUPPORT
234	R	SR5	JACK CREEK	41.28444444	-107.11916667	08-27-1996	71.7	*	FULL SUPPORT
390	R	SR19	LA BONTE CREEK - CURTIS GULCH	42.40694444	-105.62416667	10-08-1997	60.8		INDETERMINATE
239	T	SRI10	LA PRELE CREEK - LOWER	42.73361111	-105.61444444	10-16-1996	40.7	*	PARTIAL/NON SUPPORT
316	R	SR14	LARAMIE RIVER - JELM	41.07972222	-106.01194444	09-12-1997	71.6	*	FULL SUPPORT
246	R	SRI8	LOST CREEK - CAMPGROUND	41.14222222	-107.07444444	08-22-1996	75.0		FULL SUPPORT
1118	RV	SRI8	LOST CREEK - CAMPGROUND	41.14222222	-107.07444444	9/27/2001	68.6	*	FULL SUPPORT
235	R	SR6	MEDICINE BOW RIVER	41.52555556	-106.39111111	09-11-1996	87.5		FULL SUPPORT
228	T	SR21	MIDDLE FORK BIG CREEK	41.00833333	-106.57194444	09-04-1996	51.6	*	INDETERMINATE
1035	RV	SR33	Middle Fork Mill Creek - Above F.S. Road 397A	43.36424000	-106.13204000	9/8/2000	55.9		INDETERMINATE
763	T	SR27	MUDDY CREEK - DELTA CLAIM	41.12500278	-106.23720000	07-29-1998	76.8		FULL SUPPORT
227	R	SR20	NORTH FORK BIG CREEK	41.04666667	-106.59805556	09-04-1996	48.8	*	INDETERMINATE
236	R	SR7	NORTH FORK ENCAMPMENT RIVER - UPPER	41.15944444	-106.89222222	08-28-1996	64.7	*	INDETERMINATE
226	R	SR2	NORTH FORK LITTLE LARAMIE RIVER	41.32916667	-106.16138889	09-12-1996	67.6	*	INDETERMINATE
224	R	SR16	NORTH FORK LITTLE SNAKE RIVER	41.01541667	-107.02159167	08-23-1996	72.2	*	FULL SUPPORT
310	RP	SR16	NORTH FORK LITTLE SNAKE RIVER	41.01541667	-107.02159167	09-09-1997	76.7		FULL SUPPORT
762	RP	SR16	NORTH FORK LITTLE SNAKE RIVER	41.01541667	-107.02159167	09-17-1998	67.1	*	INDETERMINATE
921	RP	SR16	NORTH FORK LITTLE SNAKE RIVER	41.01541667	-107.02159167	09-16-1999	80.0		FULL SUPPORT
348	R	SR12	NORTH PLATTE RIVER - PIKE POLE	41.14000000	-106.44583333	10-14-1997	78.8		FULL SUPPORT
232	RP	SR3	ROCK CREEK	41.57673889	-106.22973611	09-12-1996	73.0	*	FULL SUPPORT
392	R	SR3	ROCK CREEK	41.57673889	-106.22973611	09-11-1997	75.7		FULL SUPPORT
764	RP	SR3	ROCK CREEK	41.57673889	-106.22973611	10-07-1998	78.3		FULL SUPPORT
922	RP	SR3	ROCK CREEK	41.57673889	-106.22973611	09-27-1999	77.0		FULL SUPPORT
1026	RV	SR3	ROCK CREEK	41.57673889	-106.22973611	9/19/2000	80.6		FULL SUPPORT
1119	RV	SR3	ROCK CREEK	41.57673889	-106.22973611	9/13/2001	74.4	*	FULL SUPPORT
1036	T	SR32	Smith/North Creek - Below Mouth of Canyon	41.11839000	-106.25194000	9/12/2000	58.6		INDETERMINATE
1041	T	SR34	So. Fk. Little Laramie River-Below FS Road 500Xing	41.18701000	-106.15326000	9/29/2000	68.1	*	INDETERMINATE
1038	T	SR31	South Fork Hog Park Creek-Revetments-Below FS 496	41.01983000	-106.84406000	9/14/2000	66.0	*	INDETERMINATE
237	R	SR8	SOUTH FRENCH CREEK	41.24250000	-106.45388889	08-29-1996	70.5	*	FULL SUPPORT
222	R	SR11	SOUTH SPRING CREEK	41.26305556	-106.95638889	09-05-1996	78.6		FULL SUPPORT
247	T	SRI9	WEST FORK BATTLE CREEK	41.09527778	-107.15638889	08-22-1996	53.2		INDETERMINATE
1124	T	SRI9	WEST FORK BATTLE CREEK	41.09527778	-107.15638889	9/27/2001	28.8		PARTIAL/NON SUPPORT
243	R	SRI5	WEST FORK GARDEN CREEK	42.76333333	-106.35444444	10-15-1996	56.0		INDETERMINATE
WYOMING BASIN									
804	T	WB66	ALBERT CREEK - UPPER	41.47652500	-110.62250833	10-07-1998	31.8	*	PARTIAL/NON SUPPORT
773	T	WB35	ALKALI CREEK - LOWER (GREEN RIVER)	41.61753333	-109.57735278	10-14-1998	32.9	*	PARTIAL/NON SUPPORT
1103	T	WB134	Alkali Creek above Rd. 16	44.73061000	-108.89168000	10/24/2001	47.4	*	INDETERMINATE
1102	T	WB133	Alkali Creek above Shoshone	44.71514000	-108.84962000	10/24/2001	36.2	*	INDETERMINATE
391	R	SR25	BATES CREEK	42.52916667	-106.24722222	10-06-1997	52.9	*	FULL SUPPORT
935	T	WB84	Bear Creek Lower (Bearpole)	43.58562778	-109.45646667	09-15-1999	74.6		FULL SUPPORT
860	T	MRW90	Bear Creek Middle (Campground)	43.64443056	-109.49986944	09-14-1999	58.6		FULL SUPPORT

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

780	T	WB42	BEAR RIVER - BURTON	41.04343889	-110.93235556	10-21-1998	73.7		FULL SUPPORT
781	T	WB43	BEAR RIVER - FIELD	41.16600278	-110.88062778	10-21-1998	62.9		FULL SUPPORT
783	T	WB45	BEAR RIVER - MARTIN RANCH	41.41576389	-111.01650556	10-21-1998	37.8	*	INDETERMINATE
782	T	WB44	BEAR RIVER - State PARK	41.26036944	-110.93524444	10-20-1998	48.0	*	INDETERMINATE
1195	T	WB104	Bear River Woodruff	41.52036000	-111.02234000	8/29/2000	42.7		INDETERMINATE
259	T	WBI17	BEAR RIVER 1 - LOWER	41.16777778	-110.87916667	10-11-1994	55.1	*	FULL SUPPORT
256	T	WBI16	BEAR RIVER 1 - UPPER	41.04361111	-110.93166667	10-11-1994	69.9		FULL SUPPORT
257	T	WBI16	BEAR RIVER 1 - UPPER	41.04361111	-110.93166667	10-05-1995	60.5		FULL SUPPORT
258	T	WBI16	BEAR RIVER 1 - UPPER	41.04361111	-110.93166667	09-24-1996	67.2		FULL SUPPORT
260	T	WBI18	BEAR RIVER 2 - LOWER	41.35277778	-111.00972222	10-13-1994	37.9	*	INDETERMINATE
254	T	WBI1	BEAR RIVER 2 - UPPER (Nixon)	41.31480833	-111.00919722	10-11-1994	36.7	*	INDETERMINATE
816	T	WBI1	BEAR RIVER 2 - UPPER (Nixon)	41.31480833	-111.00919722	10-21-1998	36.4	*	INDETERMINATE
930	T	WB79	Bear River Border	42.19583333	-111.04194444	10-21-1999	48.4	*	INDETERMINATE
328	T	WBI9	BEAVER CREEK - WOOLERY RANCH	42.51694444	-108.40000000	09-26-1997	65.0		FULL SUPPORT
797	T	WB59	BIG SANDY RIVER - LOWER	41.88551667	-109.77166111	09-10-1998	42.3		INDETERMINATE
796	T	WB58	BIG SANDY RIVER - MIDDLE	42.01117778	-109.58005833	09-09-1998	42.8		INDETERMINATE
795	T	WB57	BIG SANDY RIVER - UPPER	42.07258056	-109.48381944	09-10-1998	30.7	*	PARTIAL/NON SUPPORT
771	T	WB33	BITTER CREEK - KANDA (MIDDLE)	41.52653056	-109.35785833	08-19-1998	1.3		PARTIAL/NON SUPPORT
770	T	WB32	BITTER CREEK - LOWER	41.51741389	-109.42852500	08-18-1998	14.1		PARTIAL/NON SUPPORT
772	T	WB34	BITTER CREEK - UPPER	41.59638889	-109.14615278	08-19-1998	16.0		PARTIAL/NON SUPPORT
810	T	WB73	BLACKS FORK - BELOW GRANGER (GREEN RIVER)	41.60287222	-109.91109444	10-27-1998	58.7		FULL SUPPORT
812	T	WB75	BLACKS FORK - FLAMING GORGE (GREEN RIVER)	41.41334444	-109.62971111	10-27-1998	53.8	*	FULL SUPPORT
809	T	WB72	BLACKS FORK - VERNE (GREEN RIVER)	41.58382778	-110.00424444	10-28-1998	54.6	*	FULL SUPPORT
811	T	WB74	BLACKS FORK -INTERState (GREEN RIVER)	41.53456111	-109.68764444	10-27-1998	44.3		INDETERMINATE
689	T	MRW80	COAL CREEK - LOWER	42.23439444	-110.86624722	09-23-1998	72.7		FULL SUPPORT
1196	T	WB105	Cottonw ood Creek 2411 Crossing	42.40022000	-107.69980000	8/22/2000	56.0	*	FULL SUPPORT
778	T	WB40	COTTONWOOD CREEK - BAIRD (MIDDLE)	43.85963611	-108.37281667	08-13-1998	35.1	*	INDETERMINATE
777	T	WB39	COTTONWOOD CREEK - LEGEND ROCK (UPPER)	43.79353056	-108.60567500	08-12-1998	23.8		PARTIAL/NON SUPPORT
1230	T	WB39	COTTONWOOD CREEK - LEGEND ROCK (UPPER)	43.79353056	-108.60567500	8/21/2001	17.6		PARTIAL/NON SUPPORT
779	T	WB41	COTTONWOOD CREEK - LOWER	43.86739722	-108.33338889	08-13-1998	29.7		PARTIAL/NON SUPPORT
1212	T	WB151	Cottonw ood Creek - Putney	43.74880000	-108.81085000	8/21/2001	31.4	*	PARTIAL/NON SUPPORT
1211	T	WB150	Cottonw ood Creek - Rd 10 crossing	43.82822000	-108.51068000	8/22/2001	35.6	*	INDETERMINATE
1086	T	WB131	Crooked Creek above Crooked Creek Bay	44.96344000	-108.27924000	8/21/2001	32.5	*	PARTIAL/NON SUPPORT
1085	T	WB132	Crooked Creek below Montana state line	44.98426000	-108.34983000	8/21/2001	36.4	*	INDETERMINATE
400	T	WBI22	CROOKS CREEK - LOWER	42.40722222	-107.85444444	10-07-1997	53.0	*	FULL SUPPORT
340	T	WBI23	CROOKS CREEK - UPPER	42.40055556	-107.85638889	10-08-1997	58.7		FULL SUPPORT
1198	T	WB107	Currant Creek Gorge	41.25753000	-109.53789000	9/12/2000	43.2		INDETERMINATE
1197	T	WB106	Currant Creek Big Ridge	41.21569000	-109.38011000	9/12/2000	54.9	*	FULL SUPPORT
388	T	SR13	DEER CREEK - UPPER	42.49916667	-106.07972222	10-06-1997	74.2		FULL SUPPORT
401	R	WBI4	DEWEESE CREEK	42.30210833	-106.96081389	10-01-1997	28.7		PARTIAL/NON SUPPORT
818	R	WBI4A	DEWEESE CREEK	42.30210833	-106.96081389	10-08-1998	40.4		INDETERMINATE
952	RP	WBI4A	DEWEESE CREEK	42.30210833	-106.96081389	09-14-1999	35.4	*	INDETERMINATE
1029	RV	WBI4A	DEWEESE CREEK	42.30210833	-106.96081389	10/3/2000	35.6	*	INDETERMINATE
1112	RV	WBI4A	DEWEESE CREEK	42.30210833	-106.96081389	9/12/2001	34.0	*	PARTIAL/NON SUPPORT
221	R	SR10	DIRTYMAN FORK	41.25916667	-107.23250000	08-27-1996	68.3		FULL SUPPORT
1098	T	WB144	Dry Creek above Bighorn River	44.50632000	-108.05737000	10/2/2001	7.0		PARTIAL/NON SUPPORT
1099	T	WB145	Dry Creek below Emblem Bench	44.50213000	-108.23568000	10/2/2001	37.0	*	INDETERMINATE
791	T	WB53	DRY PINEY CREEK - LOWER (GREEN RIVER)	42.40741389	-110.18052500	10-02-1998	18.1		PARTIAL/NON SUPPORT
790	T	WB52	DRY PINEY CREEK - UPPER (GREEN RIVER)	42.37699722	-110.28743333	10-01-1998	37.4	*	INDETERMINATE
843	T	MRW101	East Fork Wind River Alkali Confluence	43.63082500	-109.38665833	09-16-1999	78.9		FULL SUPPORT
842	T	MRW100	East Fork Wind River Bluff	43.59073333	-109.44307778	09-16-1999	57.6		FULL SUPPORT
923	T	WB100	East Fork Wind River Lower (State) Above Harvey Dr	43.54801944	-109.45789722	09-15-1999	74.5		FULL SUPPORT
1037	T	WB127	Encampment River - Above USGS Station 06625000	41.30321000	-106.71459000	9/13/2000	69.2		FULL SUPPORT
1218	T	WB157	Five Mile Creek - Lost Wells Butte	43.19407000	-108.36850000	8/30/2001	43.4		INDETERMINATE
1219	T	WB158	Fivemile Creek - S7T3R3	43.24710000	-108.56293000	8/28/2001	36.2	*	INDETERMINATE
1220	T	WB159	Fivemile Creek - Wyoming Canal Crossing	43.29892000	-108.69787000	8/28/2001	22.8		PARTIAL/NON SUPPORT
1217	T	WB156	Fivemile Creek- Boysen	43.20844000	-108.23720000	8/31/2001	38.2	*	INDETERMINATE
249	RP	WB23	FONTENELLE CREEK - LOWER	42.09743056	-110.19126667	09-27-1996	44.9		INDETERMINATE
396	RP	WB23	FONTENELLE CREEK - LOWER	42.09743056	-110.19126667	10-14-1997	53.7	*	FULL SUPPORT
765	R	WB23	FONTENELLE CREEK - LOWER	42.09743056	-110.19126667	09-01-1998	44.5		INDETERMINATE
927	RP	WB23	FONTENELLE CREEK - LOWER	42.09743056	-110.19126667	10-07-1999	55.1	*	FULL SUPPORT
1051	RV	WB23	FONTENELLE CREEK - LOWER	42.09743056	-110.19126667	9/27/2000	52.5	*	FULL SUPPORT
1226	RV	WB23	FONTENELLE CREEK - LOWER	42.09743056	-110.19126667	9/24/2001	52.1	*	FULL SUPPORT
774	T	WB36	GRASS CREEK - LOWER (BIGHORN)	43.91300278	-108.56123611	08-12-1998	21.8		PARTIAL/NON SUPPORT
775	T	WB37	GRASS CREEK - MIDDLE (BIGHORN)	43.94713611	-108.70234722	08-11-1998	44.2		INDETERMINATE
776	T	WB38	GRASS CREEK - UPPER (BIGHORN)	43.89175278	-108.78619722	08-11-1998	47.6	*	INDETERMINATE
250	R	WB26	GREEN RIVER - NEAR NEW FORK RIVER	42.57055556	-109.94833333	09-30-1996	60.6		FULL SUPPORT
307	T	MRW32	GREYBULL RIVER - MIDDLE	44.10583333	-108.97333333	09-04-1997	54.8	*	FULL SUPPORT
698	T	MRW89	HAMS FORK - DITCH	42.10602778	-110.68584444	09-17-1998	71.1		FULL SUPPORT
803	T	WB65	HAMS FORK - GRANGER (GREEN RIVER)	41.60952222	-110.00822500	09-16-1998	54.5	*	FULL SUPPORT
802	T	WB64	HAMS FORK - LIONS PARK	41.82815833	-110.53085000	09-15-1998	44.8		INDETERMINATE
817	T	WBI25	HAMS FORK - LOWER BRIDGE (HWY 30)	41.74995000	-110.53361944	09-16-1998	41.6		INDETERMINATE
926	T	WB103	Horse Creek Middle/ S. 20	43.58929722	-109.60785000	10-13-1999	77.2		FULL SUPPORT
950	T	WB99	Horse Creek Lower/ Dubois	43.54178056	-109.63209167	10-13-1999	75.8		FULL SUPPORT
867	T	MRW98	Horse Creek Upper/ Below Burroughs Confluence	43.66446667	-109.63343056	09-21-1999	88.5		FULL SUPPORT
1222	T	WB161	Kirby Creek- Blue Springs	43.72604000	-107.95726000	9/11/2001	0.0		PARTIAL/NON SUPPORT
1221	T	WB160	Kirby Creek- Kirby Ditch	43.73839000	-108.13903000	9/11/2001	20.8		PARTIAL/NON SUPPORT
255	T	WBI15	LARAMIE RIVER - ABOVE	41.30111111	-105.60805556	09-13-1996	33.6	*	PARTIAL/NON SUPPORT
263	T	WBI20	LARAMIE RIVER - BELOW	41.33611111	-105.59611111	09-13-1996	17.7		PARTIAL/NON SUPPORT
1043	T	WB126	Laramie River - Below Laramie WWTF	41.36826000	-105.59404000	10/12/2000	12.8		PARTIAL/NON SUPPORT
1044	T	WB125	Laramie River - Monolith	41.25694000	-105.66710000	10/13/2000	32.4	*	PARTIAL/NON SUPPORT
253	RP	WB3	LITTLE LARAMIE RIVER	41.29971944	-105.99415556	09-12-1996	65.1		FULL SUPPORT
313	RP	WB3	LITTLE LARAMIE RIVER	41.29971944	-105.99415556	09-11-1997	54.0	*	FULL SUPPORT
767	RP	WB3	LITTLE LARAMIE RIVER	41.29971944	-105.99415556	09-16-1998	74.0		FULL SUPPORT
929	R	WB3	LITTLE LARAMIE RIVER	41.29971944	-105.99415556	09-23-1999	67.9		FULL SUPPORT

Appendix B (cont.) – WSII scores and narrative ratings for samples by bioregion. Samples marked with an asterisk are within the 90% confidence interval of a narrative threshold. Under Type, R = Reference Calibration, RV = Reference Validation, RP = Repeat Reference and T = Test. NC = not collected.

1028	RV	WB3	LITTLE LARAMIE RIVER	41.29971944	-105.99415556	10/4/2000	73.8		FULL SUPPORT
1117	RV	WB3	LITTLE LARAMIE RIVER	41.29971944	-105.99415556	9/13/2001	70.8		FULL SUPPORT
398	T	WBI14	LITTLE MEDICINE BOW RIVER	42.32722222	-106.15361111	10-06-1997	51.5	*	INDETERMINATE
798	T	WB60	LITTLE SANDY - LOWER	42.36778889	-109.23714167	09-02-1998	59.7		FULL SUPPORT
311	R	WB13	LITTLE SAVERY CREEK - GRIZZLY RANCH	41.33222222	-107.37694444	09-10-1997	51.8	*	INDETERMINATE
300	R	WBI24	LITTLEFIELD CREEK - MAC-02	41.44277778	-107.44833333	08-13-1997	51.9	*	FULL SUPPORT
395	R	WB14	MCCARTY CREEK	41.36722222	-107.33611111	09-10-1997	55.5	*	FULL SUPPORT
1207	T	WB124	Medicine Lodge Creek - School	44.24655000	-107.60536000	9/20/2000	61.4		FULL SUPPORT
785	T	WB47	MILL CREEK - ABOVE CULVERT (BEAR RIVER)	42.19163333	-110.90787222	09-22-1998	62.9		FULL SUPPORT
694	T	MRW85	MILL CREEK - State (BEAR RIVER)	41.06551111	-110.89613889	10-22-1998	73.9		FULL SUPPORT
332	R	WB15	MORGAN CREEK	42.16111111	-106.92027778	10-01-1997	74.3		FULL SUPPORT
1210	RV	WB15	MORGAN CREEK	42.16111111	-106.92027778	10/30/2001	72.1		FULL SUPPORT
1215	T	WB154	Muddy Creek - blw 431 crossing	43.28666000	-108.44958000	8/29/2001	36.3	*	INDETERMINATE
1214	T	WB153	Muddy Creek - Boysen	43.28438000	-108.28534000	8/30/2001	43.0		INDETERMINATE
801	T	WB63	MUDDY CREEK - LOWER (GREEN RIVER)	42.53967222	-110.07949444	09-30-1998	32.4	*	PARTIAL/NON SUPPORT
800	T	WB62	MUDDY CREEK - MIDDLE (GREEN RIVER)	42.58702778	-110.07671111	09-30-1998	29.8	*	PARTIAL/NON SUPPORT
799	T	WB61	MUDDY CREEK - UPPER (GREEN RIVER)	42.73681667	-110.33405000	09-30-1998	55.0	*	FULL SUPPORT
1216	T	WB155	Muddy Creek -Wyoming Canal Crossing	43.36153000	-108.60171000	8/29/2001	44.0		INDETERMINATE
794	T	WB56	NEW FORK - ROSS BUTTE	42.58597778	-109.91810833	09-30-1998	50.1	*	INDETERMINATE
251	R	WB27	NEW FORK RIVER	42.58444444	-109.92027778	09-30-1996	70.0		FULL SUPPORT
233	R	SR4	NORTH FORK ENCAMPMENT RIVER - LOWER	41.15972222	-106.89055556	08-28-1996	71.6		FULL SUPPORT
808	T	WB71	NORTH FORK VERMILLION CREEK - LOWER	41.09373333	-108.79495556	08-27-1998	31.3	*	PARTIAL/NON SUPPORT
807	T	WB70	NORTH FORK VERMILLION CREEK - UPPER	41.10039167	-108.91217222	08-27-1998	62.8		FULL SUPPORT
361	R	WB29	NORTH PLATTE RIVER - ABOVE SAGE CREEK	41.58888889	-106.95944444	10-20-1997	64.5		FULL SUPPORT
231	R	SR24	NORTH PLATTE RIVER - CORRAL CREEK	41.25944444	-106.57361111	08-29-1996	77.9		FULL SUPPORT
399	T	WBI21	NORTH PLATTE RIVER - SAVAGE MEADOWS	41.68638889	-106.89166667	10-20-1997	61.9		FULL SUPPORT
397	R	WB5	NORTH PLATTE RIVER - TREASURE ISLAND	41.33222222	-106.72694444	10-14-1997	74.6		FULL SUPPORT
1199	T	WB116	Nowood River Bluff	44.21079000	-107.73752000	10/4/2000	51.5	*	INDETERMINATE
1200	T	WB117	Nowood River Manderson	44.26450000	-107.94917000	10/4/2000	39.8		INDETERMINATE
1213	T	WB152	Owl Creek - Hwy 20 crossing	43.71579000	-108.17860000	8/22/2001	23.2		PARTIAL/NON SUPPORT
304	T	MRW33	PICKETT CREEK	44.16722222	-109.28638889	08-29-1997	64.0		FULL SUPPORT
324	T	MRW78	PINE GROVE CREEK	42.43305556	-110.37555556	09-18-1997	41.5		INDETERMINATE
769	T	WB31	PLEASANT VALLEY CREEK - CROMPTON	41.29153056	-110.94510833	10-20-1998	20.5		PARTIAL/NON SUPPORT
1105	T	WB136	Polecat Creek above Sage Creek	44.88263000	-108.54868000	10/16/2001	27.2		PARTIAL/NON SUPPORT
1104	T	WB135	Polecat Creek above WAW Road	44.87296000	-108.65978000	10/16/2001	34.1	*	PARTIAL/NON SUPPORT
1209	T	WB149	Red Canyon Creek - Bison Ranch	43.60053000	-108.33244000	8/13/2001	26.8		PARTIAL/NON SUPPORT
1208	T	WB143	Red Canyon Creek - Bison Ranch	43.60053000	-108.33244000	8/13/2001	26.8		PARTIAL/NON SUPPORT
1101	T	WB143	Red Canyon Creek - Bison Ranch	43.60053000	-108.33244000	10/15/2001	28.4		PARTIAL/NON SUPPORT
1202	T	WB119	Red Creek Beef Steer	41.06943000	-109.16884000	9/13/2000	52.3	*	FULL SUPPORT
1204	T	WB121	Red Creek Pine Mountain	41.06851000	-109.07088000	9/14/2000	59.2		FULL SUPPORT
1203	T	WB120	Red Creek Richards Gap	41.04148000	-109.07930000	9/13/2000	39.3	*	INDETERMINATE
1042	T	WB120	Red Creek Richards Gap	41.04148000	-109.07930000	10/13/2000	13.4		PARTIAL/NON SUPPORT
1097	T	WB140	Sage Creek above Shoshone River	44.84604000	-108.41106000	10/17/2001	37.6	*	INDETERMINATE
1096	T	WB139	Sage Creek below Frannie	44.94044000	-108.59924000	10/18/2001	28.4		PARTIAL/NON SUPPORT
1100	T	WB141	Sage Creek below Polecat Creek	44.88621000	-108.54861000	10/17/2001	35.7	*	INDETERMINATE
363	T	WB1	SALT WELLS CREEK	41.45916667	-108.94638889	10-21-1997	17.8		PARTIAL/NON SUPPORT
335	T	WBI12	SAND CREEK	42.26416667	-107.11694444	10-02-1997	40.7		INDETERMINATE
1231	T	WBI12	SAND CREEK	42.26416667	-107.11694444	10/30/2001	42.6		INDETERMINATE
936	T	WB85	Shoshone River (Corbett)	44.59247222	-108.94791667	10-21-1999	33.1	*	PARTIAL/NON SUPPORT
1093	T	WB138	Shoshone River above Sand Draw	44.85377000	-108.36824000	10/23/2001	31.2	*	PARTIAL/NON SUPPORT
1106	T	WB137	Shoshone River above Yellowtail Reservoir	44.86928000	-108.21741000	10/23/2001	32.1	*	PARTIAL/NON SUPPORT
768	T	WB30	SMITHS FORK - BRIDGE/HWY 80 (GREEN RIVER)	41.37297778	-110.20428056	10-27-1998	23.1		PARTIAL/NON SUPPORT
693	T	MRW84	SMITHS FORK - CLARKS (BEAR RIVER)	42.22642778	-110.87692778	09-23-1998	71.8		FULL SUPPORT
784	T	WB46	SMITHS FORK - ROCKY (BEAR RIVER)	42.09594167	-110.94309444	09-23-1998	61.2		FULL SUPPORT
133	T	MRW65	SOUTH FORK BEAVER CREEK	42.44583333	-110.38305556	09-30-1996	58.4		FULL SUPPORT
166	T	MRWI28	SOUTH FORK SHOSHONE RIVER - LOWER	44.41000000	-109.26777778	09-19-1996	65.5		FULL SUPPORT
165	R	MRWI27	SOUTH FORK SHOSHONE RIVER - UPPER	44.20722222	-109.55527778	09-19-1996	92.3		FULL SUPPORT
261	T	WBI19	SOUTH FORK TWIN CREEK	41.80833333	-110.69555556	10-04-1995	25.8		PARTIAL/NON SUPPORT
180	R	MRWI40	SOUTH PINEY CREEK	42.50611111	-110.27777778	10-01-1996	63.1		FULL SUPPORT
789	T	WB51	SUBLETTE CREEK - THOMPSON RANCH	42.03605000	-110.91541111	10-14-1998	44.1		INDETERMINATE
949	T	WB98	Sulphur Creek Cornelison S. 20 T14N R119W	41.18322500	-110.86587222	10-20-1999	42.2		INDETERMINATE
948	T	WB97	Sulphur Creek Upper/La Chapelle	41.12841111	-110.80844722	10-19-1999	40.4		INDETERMINATE
925	T	WB102	Sweetwater River Lower/Haul Road	42.52488333	-107.78446667	10-19-1999	42.6		INDETERMINATE
924	T	WB101	Sweetwater River Upper/Emigrant	42.52128611	-107.82255556	10-19-1999	57.3		FULL SUPPORT
1205	T	WB122	Tin Cup Creek Canyon	42.62733000	-107.86494000	8/21/2000	21.1		PARTIAL/NON SUPPORT
167	T	MRWI29	TROUT CREEK	44.48055556	-109.34361111	09-18-1996	60.3		FULL SUPPORT
262	T	WBI2	TWIN CREEK	41.80944444	-110.96833333	10-13-1994	44.8		INDETERMINATE
265	T	WBI6	TWIN CREEK	42.70055556	-108.49111111	09-17-1996	35.0	*	INDETERMINATE
786	T	WB48	TWIN CREEK - LOWER (BEAR RIVER)	41.81057500	-110.98946389	09-16-1998	32.7	*	PARTIAL/NON SUPPORT
787	T	WB49	TWIN CREEK - NUGGET (BEAR RIVER)	41.82366111	-110.85387778	09-16-1998	38.4	*	INDETERMINATE
951	T	WBI06	Twin Creek Old 287 Crossing	42.70136944	-108.49290000	08-25-1999	34.7	*	INDETERMINATE
788	T	WB50	TWIN CREEK S.FORK - UPPER (BEAR RIVER)	41.80832500	-110.69616389	09-16-1998	29.5		PARTIAL/NON SUPPORT
394	T	WB10	UPPER MARSH CREEK	41.15750000	-109.50194444	10-21-1997	19.2		PARTIAL/NON SUPPORT
806	T	WB69	VERMILLION CREEK - LOWER	41.00021389	-108.65420556	08-28-1998	27.5		PARTIAL/NON SUPPORT
805	T	WB68	VERMILLION CREEK (UPPER)	41.02169444	-108.64267222	08-28-1998	27.1		PARTIAL/NON SUPPORT
240	R	SRI2	WAGONHOUND CREEK	41.61305556	-106.30944444	09-11-1996	56.6	*	FULL SUPPORT
1223	T	WB162	West Fork Kirby Creek - Monument Hill	43.69625000	-107.89948000	9/11/2001	40.2		INDETERMINATE
264	T	WBI3	WHISKEY CREEK	42.36027778	-107.40000000	09-17-1996	34.3	*	PARTIAL/NON SUPPORT
318	R	MRW49	WIGGINS FORK - THUNDERHEAD	43.55638889	-109.47666667	09-15-1997	85.6		FULL SUPPORT
366	T	MRW54	WILLOW CREEK	41.11222222	-110.46694444	10-22-1997	67.4		FULL SUPPORT
1206	T	WB123	Willow Creek Henry Peak	42.36150000	-107.59635000	8/22/2000	62.5		FULL SUPPORT
848	T	MRW106	Wind River BLM	43.60637500	-109.80206389	09-22-1999	81.4		FULL SUPPORT
1224	T	WB163	Wind River - Boysen	43.16652000	-108.19497000	9/18/2001	30.1	*	PARTIAL/NON SUPPORT
945	T	WB94	Wind River Dubois	43.53974444	-109.65515833	09-23-1999	51.6	*	INDETERMINATE
946	T	WB95	Wind River Fish Access	43.48119444	-109.49869444	09-30-1999	73.6		FULL SUPPORT
944	T	WB93	Wind River Jakey's Fork	43.51920000	-109.56702778	09-29-1999	62.7		FULL SUPPORT
947	T	WB96	Wind River Schwinn/287 Crossing	43.44198333	-109.46164167	10-01-1999	69.7		FULL SUPPORT
847	T	MRW105	Wind River Stoney Point	43.59121667	-109.77480833	09-23-1999	64.7		FULL SUPPORT
1225	T	WB164	Wind River- Neble Hill	43.12151000	-108.25588000	9/19/2001	28.3		PARTIAL/NON SUPPORT
846	T	MRW104	Wind River USFS	43.62967778	-109.88528889	09-24-1999	84.6		FULL SUPPORT