Physical, Chemical, and Biological Attributes of Moderately Developed Watersheds within Connecticut

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Project Summary

This report provides a summary of a project titled, *Aquatic Life Use Support (ALUS) and Percent Impervious Cover TMDLs in Connecticut*, that was conducted by the Connecticut DEP (CTDEP), Bureau of Water Protection and Land Reuse, from 2006-2008. This project was funded, in part, by a grant to CTDEP from the US Environmental Protection Agency Section 104 (b)(3) of the Clean Water Act.

The CTDEP has modeled the multiple stressors associated with storm water runoff from impervious cover (IC) and ecological degradation of macroinvertebrates and developed a Total Maximum Daily Load (TMDL) using IC as a surrogate measure. This work expands on our initial efforts and evaluates whether sites that are moderately developed (i.e. IC in the upstream watershed 6-14%) chosen *a priori* would fall within an expected range of macroinvertebrate metric scores. These sites are referred to as Mid IC sites in this report. In addition, we evaluated the relationship of IC within the 6-14% range to water temperature, water chemistry, and a provisional measure of a second biological community (fish community).

Important Findings

- **All macroinvertebrate communities were at most mediocre with no Mid-IC site clearly meeting Aquatic Life Use Support (ALUS) goals. Fourteen of the assessments were considered to be ambiguous and 16 clearly did not meet ALUS goals.**
- **The macroinvertebrate multi-metric index (MMI) score and the 7 MMI metrics all decreased slightly across the 6-14 % impervious cover range.**
- **Dominant macroinvertebrate taxa were almost always collector-filtering caddisfly larva. *Cheumatopsyche* was the dominant taxa at 32% of sites, *Hydropsyche bettini* 23 % and *Hydropsyche* 13%.**
- **The traditional Rapid Bioassessment Protocol 3 metrics Taxa Richness and EPT richness decreased across the 6-14% impervious cover range. Density of organisms per m^2 increased slightly and HBI and % dominant taxa were independent of the 6-14% impervious cover range.**
- **We developed a conceptual model for stream classes and management strategies using IC as the stressor of interest. We then used the conceptual model to develop an expected range of macroinvertebrate multi-metric index (MMI) scores using IC as the predictor variable. We found that 80% of the 26 sites sampled had MMI scores that were within the expected range as predicted using IC as a predictor variable.**
- **We also examined the longitudinal effect of urbanization on MMI scores at five locations by sampling upstream and downstream of clusters of urbanization (as measured by %IC). In all five examples, the MMI score showed a decline in stream health below urban clusters.**

- **Highly sensitive taxa were present in two of the longitudinal sites but in both cases absent in the downstream site below an urban cluster. Further, the density of intermediate sensitive taxa was higher at longitudinal sites compared to downstream Mid IC study sites in all five comparisons.**
- **No fish VT MWIBI score (provisional) clearly failed and most were in support of ALUS goals. Eighteen were in support of ALUS goals while 6 were ambiguous.**
- **Fish IBI scores were independent of the 6-14 % impervious cover range.**
- **Fish origin status (native or exotic) were independent of the 6-14 % impervious cover range.**
- **Fish fluvial guild membership were independent of the 6-14 % impervious cover range.**
- **Water chemistry such as specific conductance, chlorides, sulfate, total solids, total nitrogen, and total phosphorous increased slightly across the 6-14 % impervious cover range.**
- **Water chemistry such alkalinity, pH, dissolved oxygen, water temperature, ammonia, turbidity were independent of the 6-14 % impervious cover range.**
- **Summer critical stream temperatures for brook and brown trout were independent of the 6-14 % impervious cover range.**
- **A graduate student at the University of Connecticut is evaluating three different landuse scales (1 mile local contributing scale, 100 ft buffer, 300 buffer) and the effect on the macroinvertebrate metrics and MMI from sites in this study. Preliminary correlation analysis suggests most significant relationships between**

macroinvertebrate metrics and land use/cover were observed at the local contributing area scale. Estimated completion date is January 2009.

Introduction

The negative effect of urbanization on the health of aquatic biota in rivers and streams has been well documented (Coles et al. 2004; Morley and Karr, 2002; Schuler, 1994). The term "urban stream syndrome" (Walsh et al. 2005) has been used to describe the consistent pattern of ecological degradation of streams draining urban lands. Impervious land cover has often been used surrogate measure of the aggregate negative effects of urbanization on hydrology (Galster et al., 2006; Olivera and Defee 2007; Schuster et al. 2005), geomorphology (Cianfrani et al 2006), and biological communities (Miltner et al. 2004; Morse et al. 2002; Stanfield and Kilgour, 2006; Wang et al 2001; Wang and Kanehl 2003). Thus impervious land cover can provide a useful stressor gradient to measure response of biological communities to assess health of aquatic ecosystems.

Recently, the Connecticut Department of Environmental Protection (CTDEP) has modeled the multiple stressors associated with storm water runoff from impervious cover and ecological degradation of macroinvertebrates within the context of the State's Total Maximum Daily Load (TMDL) Program (Bellucci 2007). To support this approach, the percent impervious cover in the upstream catchments and scores of macroinvertebrate health was modeled for catchments less than 50 square miles in Connecticut. These data showed that once impervious cover in the upstream catchment reached approximately 12%, none of the 125 sites analyzed met the state's aquatic life goals set in Connecticut's Water Quality Standards (State of Connecticut 2002).

The modeling work to support the TMDL model has shown that locations with >12 % impervious cover in the upstream catchment are likely to have poor biological communities in watersheds draining < 50 square miles in Connecticut. We believe that the utility of impervious cover as an important variable in water quality management in Connecticut goes beyond the regulatory framework of the TMDL Program. For example, the generalized relationship between stream health and impervious cover characterized broadly by (Schuler 1994) can now be applied more specifically to Connecticut and therefore provides perhaps a more relevant conceptual model that can be used as to communicate as it applies not only to TMDLs, but to general stream quality, and future mitigation through programs such as the MS4 storm water permitting program. In short, these relationships between IC and stream health from Connecticut provides additional local evidence of the importance of implementing storm water best management practices to reduce the effects of IC. This is an important message to communicate to land use decision makers and IC provides a way to group streams into classes (**Figure 1**) to further communicate this message.

Further, we believe that IC provides a valuable tool to frame future research and management strategies for Connecticut (**Figure 1**). For example, a range of impervious cover can be chosen a priori to test assumptions of expected biological condition. Sampling locations that fall within the expected condition (e.g. low numbers of sensitive taxa at 20% impervious cover in the upstream catchment) would be consistent with the Impervious Cover model established in Connecticut (and elsewhere). Perhaps more interesting set of streams to study are those with a mid-range of impervious cover in the upstream catchment. An important management question is whether it is possible to prevent biological degradation as streams in the mid range of imperviousness are faced with increases in imperviousness due to urbanization.

In this study, we selected watershed with impervious cover 6-14% as study watersheds. These watershed are what we are calling “streams of hope” in Connecticut because we feel that streams within this range of IC in the upstream catchment may have the most to gain by future restoration efforts. These are streams that usually have macroinvertebrate communities that result in ambiguous assessments within the context of Clean Water Act Section 303 d listing. We collected macroinvertebrate assemblage data, continuous water temperature, and measured the percent impervious cover in the upstream catchments. We then discuss the relationship of these variables with biological condition of the streams and use these data to fill in gaps to our initial analysis of the relationship of 125 streams (Bellucci 2007).

Several studies have demonstrated a negative impact of impervious cover on fish communities (Morgan and Cushman 2005; Wang et al. 2003). We collected fish community data using the same conceptual model developed for macroinvertebrates **(Figure 1)** to determine if the relationship for these targeted watersheds is consistent for fish communities in Connecticut. To investigate this, we evaluated the fish community and the relationship between levels of IC in the upstream watershed using an Index of Biotic Integrity (IBI) developed in Vermont as well as other ecological measures of fish community. These comparisons should be considered provisional as other efforts are underway to establish an IBI specific to Connecticut and this study only looks at a narrow range of IC.

Methods

Selection of Target Catchments

We targeted catchments that ranged from 6-14% IC for potential study. In order to calculate the IC percent, we used the Impervious cover Analysis Tool (ISAT), an extension used in conjunction with geographic information systems (GIS) software, ESRI Arc Map version 9.2. (all GIS analysis in this study was done with ESRI ArcMap 9.2, and will be referred to as GIS hereafter). ISAT was developed by the Coastal Services Center at the National Oceanic and Atmospheric Administration in collaboration with the Non-point Education for Municipal Officials program at the University of Connecticut (http://www.csc.noaa.gov/crs/cwq/isat.html). ISAT uses land cover coefficients and human population density to calculate the impervious cover for a defined polygon, in our case, upstream catchments. We used coefficients developed for Connecticut based on 2002 Connecticut Land Cover data and population density (Prisloe et al., 2002). A high population density is defined as > 1800 people/square mile, medium is 500 – 1800 people/square mile, and low is <500 people/square mile.

We calculated the percent IC with ISAT for each subregional basin as defined in Thomas (1972). Connecticut has 334 subregional basins **(Figure 2)** that range in size from 0.08 - 176.46 square miles, although 95% are less than 39 square miles (median = 10.45 square miles). Once the subregional basin 6-14% IC were identified, we eliminated catchments with unsuitable riffle habitat for macroinvertebrate sampling (e.g. small coastal basins) or non-wadable (e.g. main stem of large rivers such as the Connecticut River).

A total of 26 catchments met our initial screening criteria. Sampling sites for each of these 26 catchments were chosen by beginning at the pour points and field inspecting access points and suitable habitat for biological sampling. In general, the first location encountered with suitable access and habitat within close proximity to the pour point was selected to represent the watershed to ensure that we stayed with the target range 6-14% IC.

In five of these catchments- Hancock Brook, Muddy River, Steele Brook, East Branch Naugatuck River and West Branch Naugatuck River- we also selected a site in the upper catchment with less IC to provide an upstream comparison of the biological community with a change in impervious cover within the same watershed (longitudinal sites). We also evaluated one sampling site in the Saugatuck River that was located within close proximity to the group of selected sites to provide a relative measure of environmental conditions for the sampling year (benchmark site). The Saugatuck River site was chosen because stream discharge measurements were available through the United States Geological Survey (UGSS gage number 01208990 Saugatuck River near Redding, CT), and there was a 10 year data set of benthic macroinvertebrate samples to characterize the year in which we collected samples for this study.

After initial screening of watershed with GIS and subsequent field checking sites, a total of 31 site locations were selected for this study **(Table 1, Figure 3)**. The latitude and longitude of each study site were recorded with a Garmin Model 76 Global Position System to process further catchment delineation using GIS. The catchments upstream of each sampling location were delineated using the ArcHydro extension of GIS. The delineated catchments were then clipped to the subregional basin boundaries and the percent impervious cover was calculated for each basin using ISAT (as above). Select land use cover attributes of the upstream catchments generated by UConn CLEAR data are presented in **Appendix A**.

Biological Communities

Macroinvertebrates

Benthic macroinvertebrate samples were collected September - October, 2006 using an 800 *u*m-mesh kick net. A total of 2 m^2 of riffle habitat was sampled at each location. Samples were preserved in 70% ethyl alcohol and brought back to the laboratory for subsampling. A 200-organism subsample using a random grid design (Plafkin et al, 1989) was used to represent the benthos from each sampling location. Organisms were identified to the lowest practical taxon, generally species.

A macroinvertebrate multimetric index (MMI) score for each site was calculated using the 200 organism subsample at the genus level (Gerritsen and Jessup 2007). The MMI is composed of 7 metrics: Ephemeroptera taxa (scoring adjusted for watershed size), Plecoptera taxa, percent sensitive EPT (scoring adjusted for watershed size), scraper taxa, biological condition gradient (Davies and Jackson 2006) taxa biotic index, and percent dominant genus. The MMI score is the average score of all seven metrics and ranges from 0 -100 with higher values representing sites least stressed sites. The CTDEP uses the following convention as one of the measures for assessing aquatic life for Clean Water Act 305 (b) reporting and Section 303 (d) impaired water listing - MMI < 44 = fail, MMI range of 45-55 ambiguous, MMI > 56 = pass (Pizzuto personal communication). Ecological attributes for the macroinvertebrates collected during this project are presented in **Appendix B**.

A single habitat assessment following EPA RPB 2 (Plafkin et al 1989) was completed immediately following the macroinvertebrate sampling. This assessment involves subjective rating of 10 different parameters divided into primary (scale 20-0), secondary (scale 15-0), and tertiary categories (scale 10-0). The habitat point total is used to evaluate similarity between the study site and an ecological reference site. Values more than 75% different indicate significant habitat differences and caution interpreting biological results.

Fish

Fish sampling was conducted from June - September 2006 during periods of low streamflow to maximize sampling efficiency. Typically, 150 meters of stream was electrofished using either a back pack unit or a single tow electro fishing unit (Hagstrom et al 1995). At each location a length-frequency consensus was obtained by collecting all fish during a single pass, identifying to species, and total length to nearest centimeter. Current DEP Inland Fisheries Management includes a wild trout program. Several sites (Beacon Hill Brook, Coppermine Brook, Deep Brook, East Branch Naugatuck River (2 sites) and Farm River) fell within these managed stream segments. Fish community data were not collected at the above locations so not to interfere with long-term trout population monitoring.

An index of biological integrity (IBI) using fish has not been calibrated for widespread use in Connecticut. There are several potential candidates each of which are currently being reviewed for accuracy and applicability (Vermont DEC 2004, Jacobson 1994). The Vermont Mixed Water IBI (VT MWIBI) is used for data analysis in this report. Scores are provisional and should not be used for definitive conclusions. Scores for the VT MWIBI are as follows; Excellent = >40, Very Good = 37-39, Good= 33-36, Fair = 27, and Poor = < 28. An additional category called Ambiguous = 29-31 is added due to variability in fish community data sets. For ALUS support assessments scores >32 would meet standards, 29-31 are ambiguous, and those < 28 are not supporting standards.

Ecological attributes for the species collected for this project are presented in **Appendix C**. Each species is classified as to the requirement for flowing water to complete its life cycle (Bain and Meixler 2000). Fluvial Specialists (FS) must have flowing water, Fluvial Dependants (FD) must have flowing water during some part of the life cycle, and Macrohabitat generalists (MG) do not need flowing water.

Physical/Chemical

Water Temperature

Onset brand HOBO Water Temperature Pro programmable water temperature probes were deployed at all sampling locations from May to October, 2006. Probes were pre and post-calibrated in the laboratory by soaking in a water bath at ambient room temperature and checking the recorded temperature for consistency with each other, and with a calibrated thermometer. Each probe was secured into a 2-inch diameter PVC tube and then attached to an anchor assembly- either a steel angle iron (~ 4 lbs) or an 8 x 10 inch steel plate (~ 9 lbs). Prior to deployment, each probe was programmed to record temperature every hour using Box-Car Pro software. The probes and the anchor assembly were set in the stream bottom in a location that would maintain continual flow and then covered with large boulders to prevent downstream movement.

Time-series temperature data can provide insight as to the thermal conditions present in a specific stream segment and thus can be compared against ecological needs of various aquatic species. It can also be used to compare reaches within the same stream. The typical annual temperature profile of streams in Connecticut follows a bell shaped curve with the peak of the curve (i.e. warmest temperatures) usually occurring in July and August. For purposes of this report only data from these 2 months are reported.

Water Chemistry

A single surface grab sample was collected from mid-depth of mid-channel concurrent with the macroinvertebrate community sampling. The sample was placed on ice and delivered to the

University of Connecticut Center Environmental Science and Engineering lab for analysis. Samples were submitted for general chemistry, nutrient series, and heavy metals. Field measurements were obtained on site using a Yellow Springs Instrument Company (YSI) model 6000 multi-parameter water quality meter. Parameters recorded include water temperature, specific conductance, dissolved oxygen, oxygen saturation, and pH. This meter was pre and post calibrated around each sampling date.

Data Analysis

Summary of Work Completed

Macroinvertebrate community, habitat evaluation, grab chemistry, and field measured water quality parameters were collected at each of the 31 sites. Fish community data was collected at 24/31 sites. Six sites were not sampled because some these study streams are managed as Wild Trout Management Area (6) and one was excluded due to high stream flow (1). Water temperature probes were deployed at 28/31 sites. HOBO probes were not deployed at either of the Steele Brook sites or the downstream Hancock Brook due to insufficient number of probes (**Table 2**).

Macroinvertebrates

Species identified

One hundred forty-four unique taxa were identified. The 10 most commonly taxa are listed in **Table 3** by % of all individuals (N=6,407) and by % of sites (N= 31).

Multi-Metric Index-MMI

MMI total scores ranged from a low of 19 to a high of 59. Only a single sample not in the 6-14% IC range clearly met ALUS standards (East Branch Naugatuck River upstream longitudinal site). Of the remaining 14 were ambiguous with a score between 45 and 55 and 16 clearly failed with scores <44 points. MMI scores and individual metric scores are presented in **Table 4** and summary statistics in **Figure 4**.

MMI total score (**Figure 5**) and each of the 7 individual metric scores appear to decrease at least slightly across the 6-14% IC range (**Figure 6**).

Traditional RBP 3 metrics

Attributes of the macroinvertebrate community including; taxa richness, EPT richness, HBI, density, tolerance, density, % dominant taxa, and dominant taxa are presented in **Table 5**. The range of taxa richness was 12 to 39, EPT richness 4 to 24 and HBI 5.25 to 2.19. Of the 9 taxa that were dominant in a sample the dominant taxa at most sites belonged to the family Hydropsychidae (5/9) the remaining samples had dominant organisms belonging to families Philopotamidae (2) and Glossomatidae and Isonyichidae (1 each) (**Table 6 & Figure 7**).

Of the traditional RBP 3 metrics calculated and reported; Taxa richness and EPT richness decreased across the 6-14% impervious cover gradient, HBI and % dominant taxa were independent, and organisms per m2 increased slightly (**Figure 8**).

Fish

Species occurrence

4,546 individuals representing 28 resident and 4 stocked taxa were collected. The 10 most commonly taxa are listed in **Table 7** by % of all individuals (N=4546) and by % of sites (N= 24). Several notable species observations in this data set are slimy sculpin and tomcod. The total density of individuals per 100 m2 appears to have an increasing trend across the 6-14% IC range (**Figure 9**). The proportion of native to exotic species did not have any noticeable pattern across the 6-14% IC range (**Figure 10**).

Fish Community IBI (provisional)

Fish community IBI scores ranged from a low of 29 to a high of 41 (**Table 8**). IBI scores increased slightly across the 6-16% IC range (**Figure 11**). The majority of sites support preliminary aquatic life standards for fish. Specifically 2 sites were Excellent, 10 Very Good, 6 good, 6 ambiguous, 0 fair and 0 poor (**Figure 12**). The highest scoring samples were Belcher Brook in Berlin (41 points) and Misery Brook in Southington (40 points). The lowest scoring samples were Muddy River in North Haven and West Branch Naugatuck River in Torrington (29 points each).

Flow Guilds

As expected in wadeable streams and rivers the fish community was dominated by FS individuals, followed by FD individuals and finally MG individuals (**Figure 13**). The distribution of species within each of the guilds was approximately equal at the majority of the sites sampled (F**igure 13**). In both cases total individuals and taxa by flow guild membership were independent of the 6-14% IC range (**Figure 13**).

Chemical/Physical

Grab Chemistry

The results for each grab chemical sample for each site reported in **Table 9**. The concentration of sulfate, chloride, and total solids increased across the 6-14% IC range. Alkalinity, pH, total suspended solids, and turbidity were independent of the 6-14% IC range (**Figure 14**). Nitrogen series data showed an increasing trend for all except ammonia which was independent of the 6-14% IC range (**Figure 15**). Phosphorous concentration increased across the 6-14% IC range (**Figure 16**).

Field Meter Observations

The result for each field measurement set for each site reported in **Table 10**. Only specific conductance increased across the 6-14% IC range (**Figure 17**).

Water temperature

Between July 1 2006 and August 31 2006, hourly temperature measurements produced 1,488 observations. For the majority of sites the maximum daily temperature was recorded in July. The distribution of the temperature data by station is F**igure 18**. Thompson Brook, Beacon Hill Brook and Willow Brook had very cold temperatures while West Branch Naugatuck and Mill River had very warm temperatures (**Table 11**). Water temperatures were independent across the 6-14% IC range. Neither daily maximum or daily minimum maximum (**Figure 19**), % of observations over 20 degrees C and % of observations over 25 degrees C (critical temperatures for brook trout and brown trout respectively) showed any sort of relationship across the 6-14% IC range (**Figure 20**). For fish communities, summer water temperature regimes may be more limiting of population structure than impervious cover within the 6-14% range.

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Figures and Tables

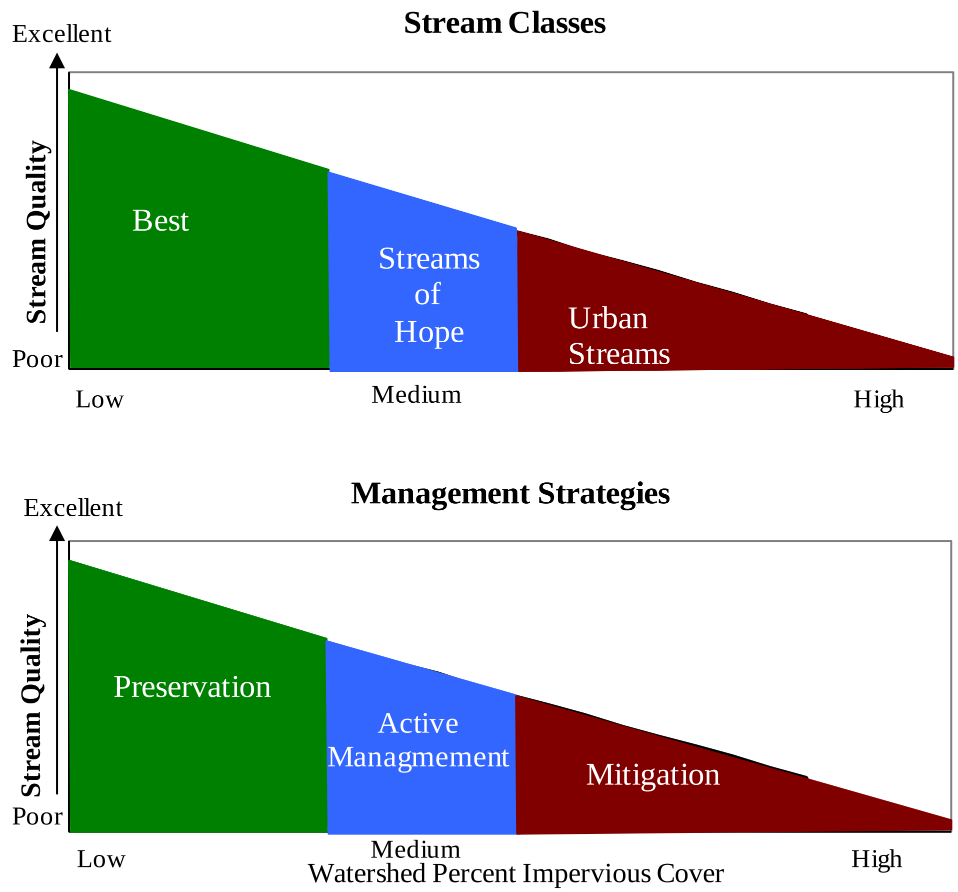


Figure 1. Conceptual Model of the Effect of Impervious Cover on Stream Quality. Watershed percent impervious cover as a conceptual model for stream classes (top) potential management strategies (bottom) for streams.

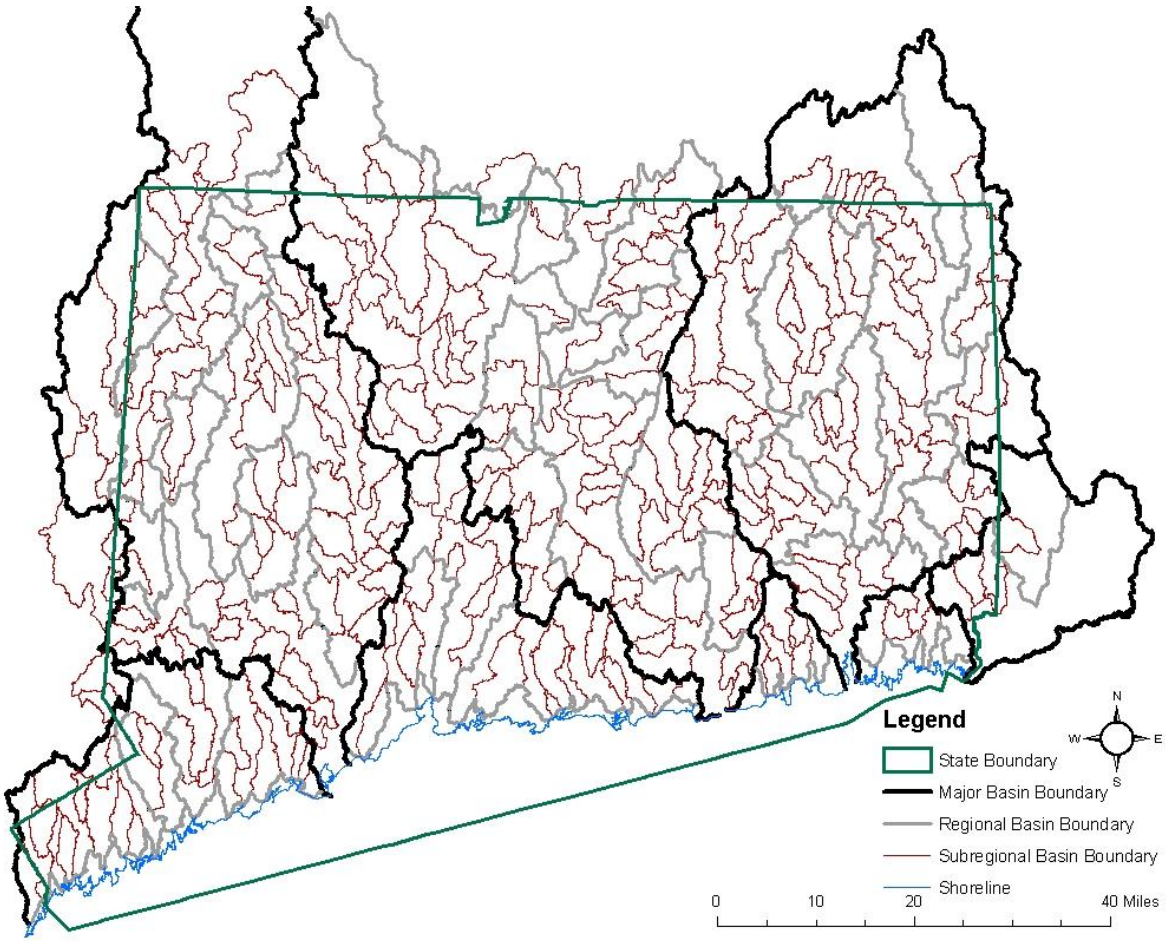


Figure 2. Subregional basins in Connecticut.

Table 1. Attributes of data collection locations sampled as part of the Mid-IC project (6-14%).

StationID	Stream Name	proximity	landmark	basin	Municipality	ylatDD	xlongDD	pctIC	TotAcres	TotICAcr
4	Beacon Hill Brook	upstream	Route 8 on ramp	6918	Naugatuck	41.46841	-73.0519	8.9	6519.963	580.1298
31	Comstock Brook	upstream	wooden footbridge in town park	7300	Wilton	41.19614	-73.4354	7.83	4684.401	366.7721
47	Deep Brook	upstream	Pootatuck River	6019	Newtown	41.41313	-73.2823	8.1	3413.557	276.5162
51	East Branch Naugatuck River	upstream	Route 4	6905	Torrington	41.81224	-73.1221	3.38	6716.926	227.1708
54	East Branch Naugatuck River	downstream	Franklin Street	6905	Torrington	41.79773	-73.1158	9.46	9016.428	853.2328
97	Hancock Brook	near	Mouth upstream RR bridge	6911	Waterbury	41.57988	-73.0497	7.63	9842.385	750.8337
98	Hancock Brook	downstream	Bridge in Waterville Park	6911	Waterbury	41.58855	-73.0503	5.83	8969.139	523.2937
123	Hop Brook	at	RR bridge Naug Glass	6916	Naugatuck	41.49868	-73.0537	10.02	11127	1114.418
347	Ten Mile River	downstream	Route 322	5202	Southington	41.56552	-72.8905	9.03	12919.64	1166.546
357	West Branch Naugatuck River	downstream	Route 4	6904	Torrington	41.81814	-73.1441	3.1	4161.234	128.9676
453	Sawmill Brook	at	Aetna Fitness Trail	4604	Middletown	41.60079	-72.7141	7.85	4448.414	349.4027
514	Steele Brook	under	Route 8 at mouth	6912	Waterbury	41.56869	-73.0574	13.7	10892.62	1492.582
689	Long Meadow Pond Brook	upstream	Elm Street	6917	Naugatuck	41.48636	-73.0556	8.48	5410.041	458.5246
697	Steele Brook	upstream	Route 6 (Culter Street)	6912	Watertown	41.61046	-73.1153	7.65	3321.274	254.1343
894	Coppermine Brook	at	Mouth to Frederick St	4314	Bristol	41.67368	-72.906	12.72	11901.31	1513.971
974	Farm River	at	route 142 crossing	5112	East Haven	41.27908	-72.8673	9.33	12544.54	1169.984
997	Muddy River	at end of	Old Maple Street (DS of RR bridge)	5208	North Haven	41.36679	-72.8543	7.43	13348.68	991.8596
1081	Roaring Brook	upstream footbridge	Lions pool 300 meters US Cottage St.	4312	Farmington	41.75944	-72.8808	8.57	4575.59	392.1486
1243	Nod Brook	DS	Route 10	4317	Avon	41.81584	-72.8294	9.89	3724.152	368.2381
1281	Sasco Brook	at	Wakeman Lane	7109	Fairfield	41.14567	-73.3012	8.35	4997.521	417.2271
1338	Belcher Brook	at	meadow lane	4601	Berlin	41.60498	-72.7577	8.48	2289.631	194.2734
1806	Muddy River	downstream	route 150 (woodhouse ave) in town park	5208	Wallingford	41.41505	-72.8012	5.91	7706.788	455.8321
1807	Willow Brook	at	Willow Road Bridge	5301	Hamden	41.44719	-72.9083	8.77	8220.544	721.0417

1808	Misery Brook	at	South End Road crossing (house # 475-482)	5203	Southington	41.56986	-72.8733	12.89	3500.101	451.234
1809	Mill River	at upper parking lot	Perry Mill Pond River Lab access area	7108	Fairfield	41.15213	-73.2726	10.16	15513.21	1576.585
1810	Cricker Brook	downstream	Nonopoge Road at #93	7107	Fairfield	41.19839	-73.2647	5.97	4471.599	266.8251
1811	Means Brook	upstream	Lane Street	6024	Shelton	41.2931	-73.1442	10.28	6707.973	689.8149
1812	West Branch Naugatuck River	upstream	confluence with East Branch	6904	Torrington	41.798	-73.1177	7.1	5953.409	422.686
1916	Thompson Brook	at	Bike Path Crossing (Old RR grade)	4316	Avon	41.76814	-72.8497	10.11	2113.788	213.6519
1917	Meadow Brook	immediately upstream	confluence with Jeremy River	4703	Colchester	41.58711	-72.3868	8	7111.769	569.1208
1918	Mill Brook	at	Route 75 (#180)	4321	Windsor	41.85689	-72.6501	8.75	3884.614	339.9109

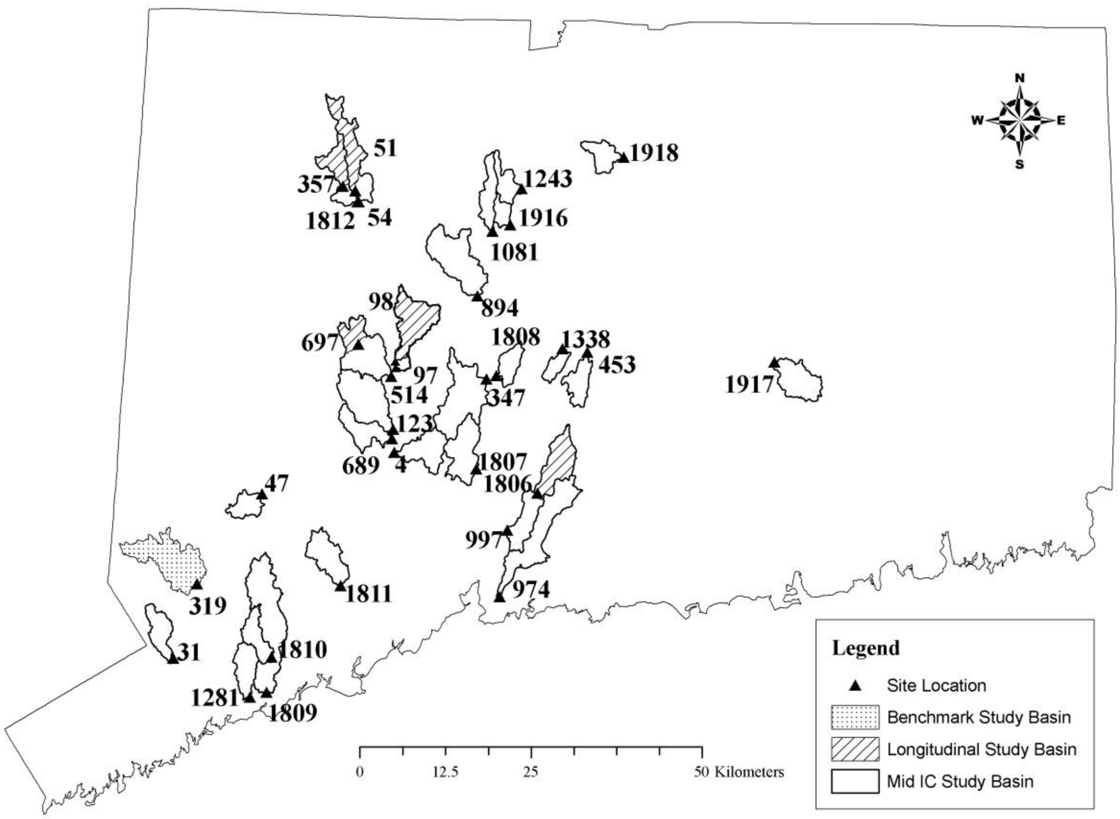


Figure 3. Location of the 31 study catchments selected for data collection as part of the Mid-IC project (6-14%).

Table 2. Samples collected at each of the 31 stations selected for the Mid-IC project (6-14%).

Station ID	Stream	landmark	Impervious cover %	Macro-invertebrates	Fish	HOBO	Grab Chemistry	Field Observations	Habitat
4	Beacon Hill Brook	Route 8 on ramp	8.9	X		X	X	X	X
1338	Belcher Brook	meadow lane	8.48	X	X	X	X	X	X
31	Comstock Brook	wooden footbridge in town park	7.83	X	X	X	X	X	X
894	Coppermine Brook	Mouth to Frederick St	12.72	X		X	X	X	X
1810	Cricker Brook	Nonopoge Road at #93	5.97	X	X	X	X	X	X
47	Deep Brook	Pootatuck River	8.1	X		X	X	X	X
51	East Branch Naugatuck River	Route 4	3.38	X		X	X	X	X
54	East Branch Naugatuck River	Franklin Street	9.46	X		X	X	X	X
974	Farm River	route 142 crossing	9.33	X		X	X	X	X
98	Hancock Brook	Bridge in Waterville Park	5.83	X	X	X	X	X	X
97	Hancock Brook	Mouth upstream RR bridge	7.63	X			X	X	X
123	Hop Brook	RR bridge Naug Glass	10.02	X	X	X	X	X	X
689	Long Meadow Pond Brook	Elm Street	8.48	X	X	X	X	X	X
1917	Meadow Brook	confluence with Jeremy River	8	X	X	X	X	X	X
1811	Means Brook	Lane Street	10.28	X	X	X	X	X	X
1918	Mill Brook	Route 75 (#180)	8.75	X	X	X	X	X	X
1809	Mill River	Perry Mill Pond River Lab access area	10.16	X	X	X	X	X	X
1808	Misery Brook	South End Road crossing (house # 475-482)	12.89	X	X	X	X	X	X
1806	Muddy River	route 150 (woodhouse ave) in town park	5.91	X	X	X	X	X	X
997	Muddy River	Old Maple Street (DS of RR bridge)	7.43	X	X	X	X	X	X
1243	Nod Brook	Route 10	9.89	X	X	X	X	X	X
1081	Roaring Brook	Lions pool 300 meters US Cottage St.	8.57	X	X	X	X	X	X
1281	Sasco Brook	Wakeman Lane	8.35	X	X	X	X	X	X
453	Sawmill Brook	Aetna Fitness Trail	7.85	X	X	X	X	X	X
697	Steele Brook	Route 6 (Culter Street)	7.65	X	X		X	X	X
514	Steele Brook	Route 8 at mouth	13.7	X	X		X	X	X
347	Ten Mile River	Route 322	9.03	X	X	X	X	X	X
1916	Thompson Brook	Bike Path Crossing (Old RR grade)	10.11	X	X	X	X	X	X
357	West Branch Naugatuck River	Route 4	3.1	X	X	X	X	X	X

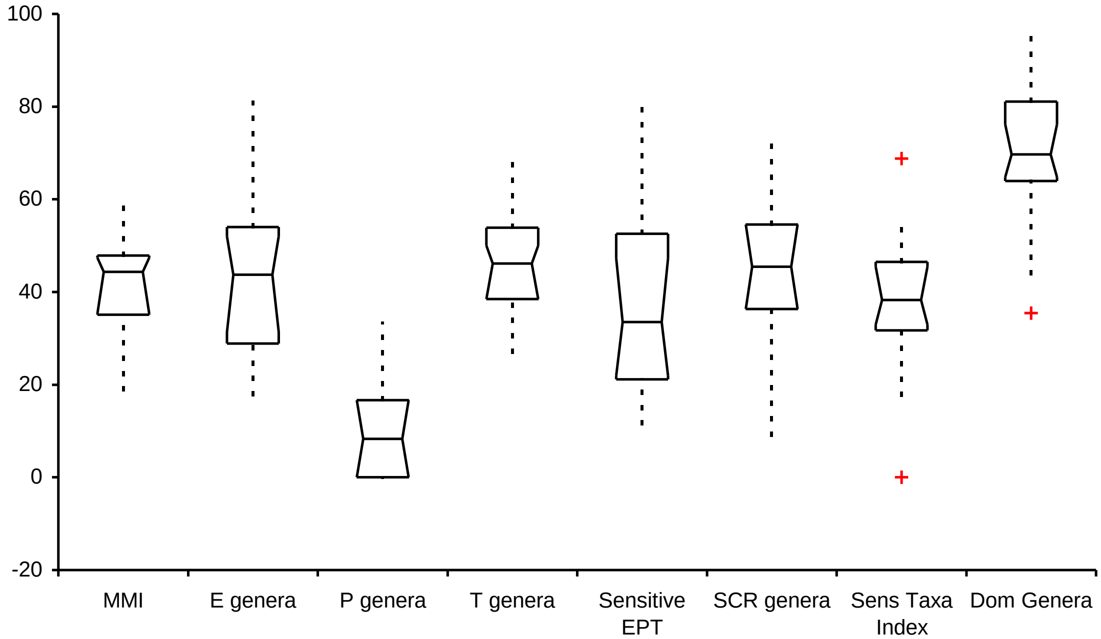
1812	West Branch Naugatuck River	confluence with East Branch	7.1	X	X	X	X	X	X
1807	Willow Brook	Willow Road Bridge	8.77	X	X	X	X	X	X

Table 3. Top 10 macroinvertebrate taxa as % of individuals identified (N=6407) and as % of sites present (N=31) for samples collected during fall 2006 in support of the Mid-IC project (6-14%).

Taxa	% of individuals identified		Taxa	% of sites sampled
Cheumatopsyche	21		Cheumatopsyche	100
Hydropsyche betteni	15		Hydropsyche betteni	100
Hydropsyche	10		Hydropsyche	97
Chimarra aterrima	7		Glossosoma	94
Glossosoma	5		Ceratopsyche sparna	74
Ceratopsyche sparna	3		Chimarra aterrima	71
Maccaffertium modestum group	3		Maccaffertium modestum group	68
Hydropsyche bronta	3		Antocha	68
Psephenus herricki	2		Psephenus herricki	61
Acentrella turbida	2		Hydropsyche bronta	58

Table 4. Macroinvertebrate MMI value and individual metric values for each of the 31 sites sampled during fall 2006 in support of the Mid-IC project (6-14%). The MMI value is calculated as the arthimetic mean of the 7 individual MMI metric values.

Station ID	date	% IC	MMI	E genera taxa	P genera taxa	T genera taxa	Sensitive EPT %	SCR genera Taxa	Sensitive Taxa Index	Dominant Genera %
4	10/6/06	8.9	54	58	33	54	70	27	51	81
31	9/20/06	7.83	46	69	0	46	79	36	27	64
47	10/11/06	8.1	53	65	17	46	57	64	33	91
51	10/5/06	3.38	59	81	33	62	31	73	55	73
54	10/5/06	9.46	41	56	0	46	12	55	50	70
97	10/6/06	7.63	35	32	17	46	19	36	28	68
98	10/6/06	5.83	44	44	33	46	20	55	28	81
123	10/6/06	10.02	45	78	8	42	22	64	38	64
347	9/27/06	9.03	19	19	0	31	19	18	0	44
357	10/5/06	3.1	54	76	17	46	65	55	32	88
453	9/21/06	7.85	48	35	17	46	59	55	40	85
514	10/19/06	13.7	30	31	0	38	15	36	21	68
689	10/6/06	8.48	29	24	17	54	22	18	33	35
697	10/19/06	7.65	44	52	0	54	45	45	48	66
894	10/11/06	12.72	25	19	0	35	22	27	18	56
974	9/27/06	9.33	27	18	0	31	15	27	31	65
997	9/27/06	7.43	47	42	8	42	59	64	45	70
1081	10/5/06	8.57	35	26	17	38	34	45	33	54
1243	10/11/06	9.89	47	51	0	62	48	45	43	82
1281	9/20/06	8.35	36	30	0	50	29	41	43	60
1338	9/21/06	8.48	50	47	0	62	72	45	38	89
1806	9/27/06	5.91	50	57	33	54	30	64	52	62
1807	9/27/06	8.77	45	33	17	38	39	73	44	74
1808	10/11/06	12.89	43	39	0	38	47	55	42	76
1809	9/20/06	10.16	33	24	0	27	38	9	69	61
1810	9/20/06	5.97	44	27	0	42	80	45	46	69
1811	10/11/06	10.28	44	46	0	46	29	55	37	96
1812	10/5/06	7.1	35	52	17	38	12	36	19	71
1916	10/11/06	10.11	48	48	17	69	41	45	46	67
1917	9/21/06	8	54	46	17	62	40	73	52	89
1918	9/21/06	8.75	31	27	0	38	20	27	35	70



	MMI Score	E genera taxa	P genera taxa	T genera taxa	Sensitive EPT %	SCR genera taxa	Sensitive Taxa Index	Dominant genera %
Min	19	18	0	27	12	9	0	35
25th	35	29	0	38	21	36	32	64
Mean	42	44	10	46	38	46	38	71
Median	44	44	8	46	34	45	38	70
75th	47	52	17	54	45	55	46	77
Max	59	81	33	69	80	73	69	96

Figure 5. Box plots and distribution statistics of MMI value and MMI metric scores for each of the 31 macroinvertebrate samples collected during fall 2006 in support of the Mid-IC project (6-14%).

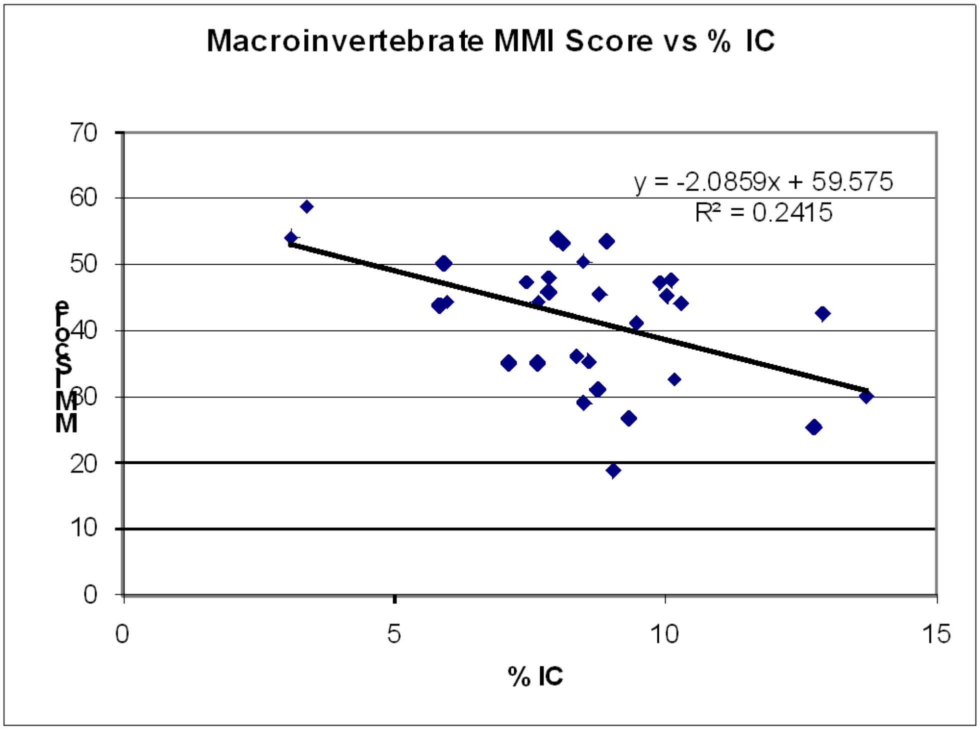
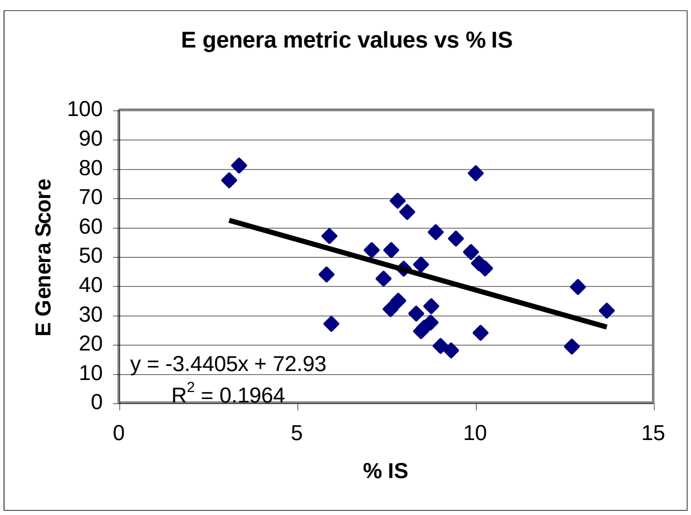
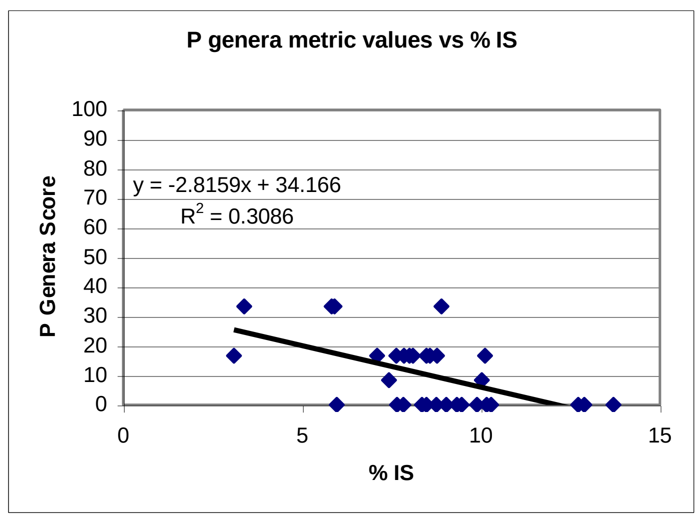
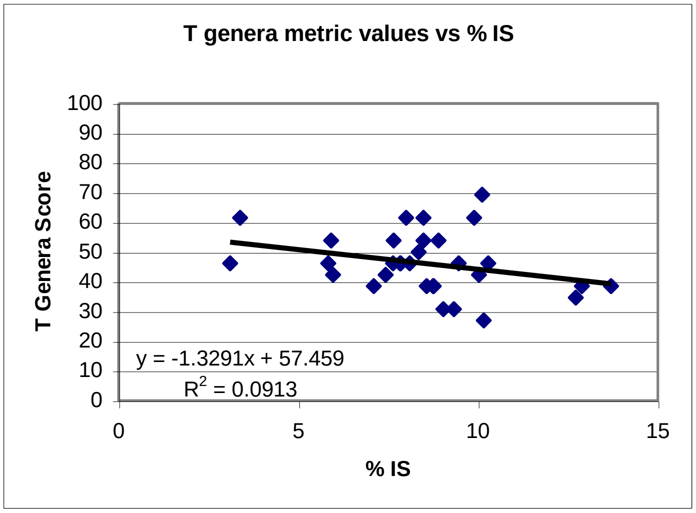
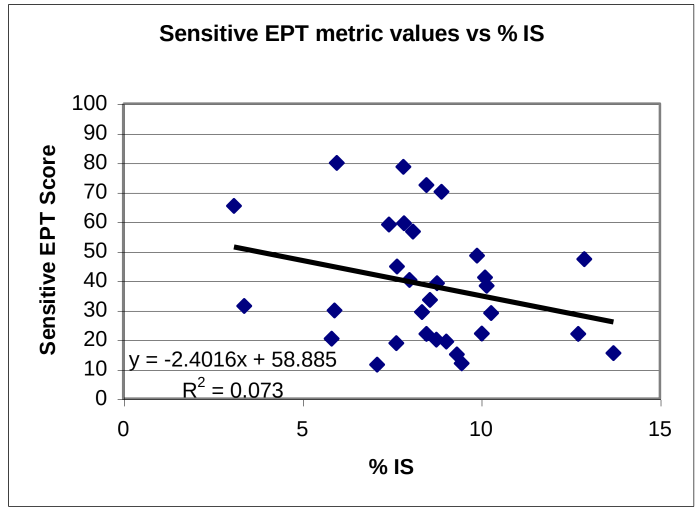


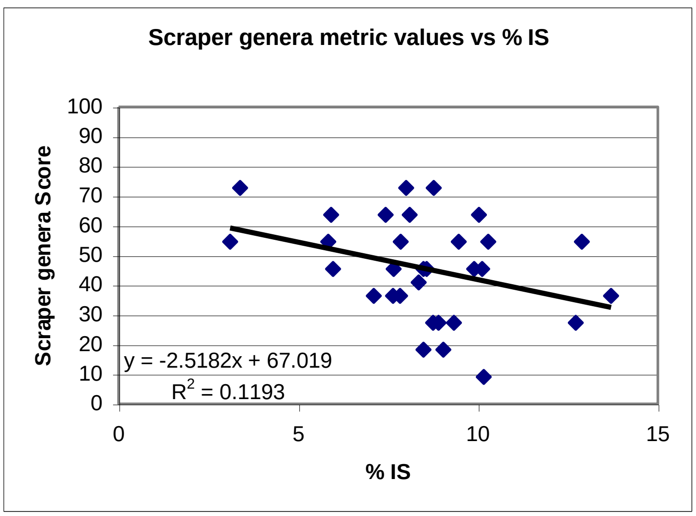
Figure 6. MMI total score versus % impervious cover upstream of sample location for data collected at part of the Mid-IC project (6-14%).











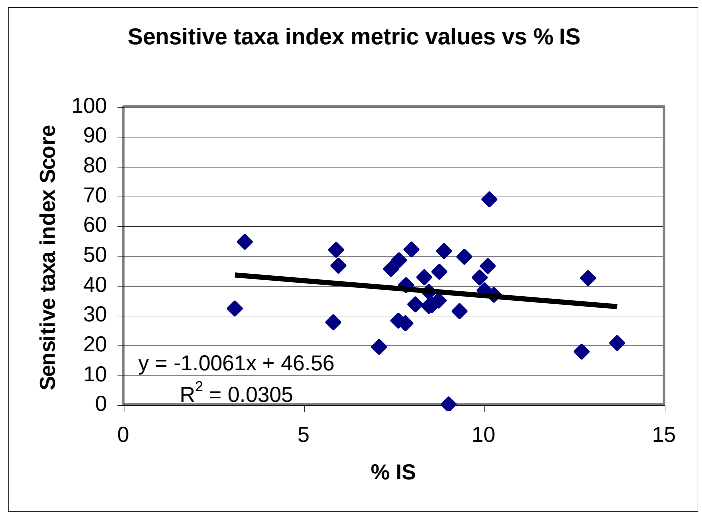


Figure 7. Scatter plot of the 7 individual metric scores that make-up the MMI versus % impervious cover upstream of sample location for data collected at part of the Mid-IC project (6-14%).

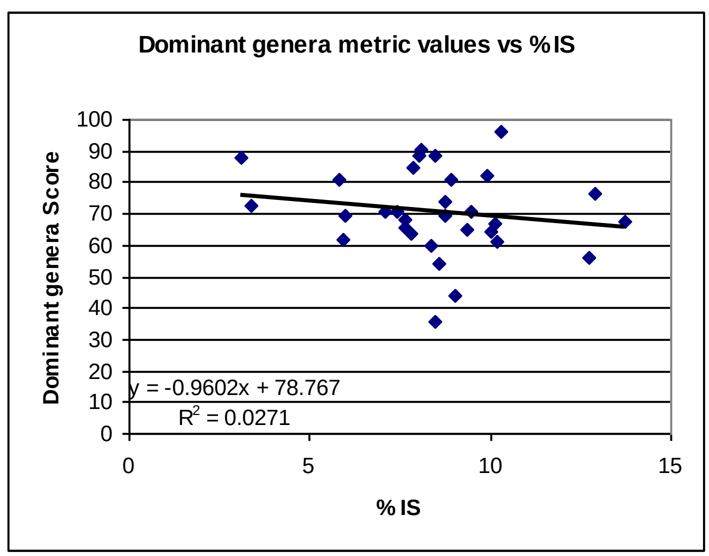


Table 5. Select traditional RBP3 metrics for data collected during fall 2006 in support of the Mid-IC project (6-14%).

StationID	Stream	% IC	Trip date	organisms per m2	Taxa Richness	EPT Richness	HBI	% dominant taxa	dominant taxa name
4	Beacon Hill Brook	8.9	10/6/2006	872	25	18	2.19	26	Dolophilodes
31	Comstock Brook	7.8	9/20/2006	485	25	12	4.32	38	Chimarra aterrima
47	Deep Brook	8.1	10/11/2006	812	35	12	3.70	19	Glossosoma
51	East Branch Naugatuck River	3.38	10/5/2006	574	29	24	4.16	18	Hydropsyche betteni
54	East Branch Naugatuck River	9.46	10/5/2006	936	24	11	4.53	31	Hydropsyche bronta
97	Hancock Brook	7.63	10/6/2006	343	25	12	4.28	28	Hydropsyche betteni
98	Hancock Brook	5.83	10/6/2006	804	28	13	4.50	21	Cheumatopsyche
123	Hop Brook	10.02	10/6/2006	2035	20	13	4.48	39	Cheumatopsyche
347	Ten Mile River	9.03	9/27/2006	375	14	5	5.25	42	Hydropsyche betteni
357	West Branch Naugatuck River	3.1	10/5/2006	563	31	16	3.60	21	Isonychia
453	Sawmill Brook	7.85	9/21/2006	961	24	10	4.03	23	Chimarra aterrima
514	Steele Brook	13.7	10/19/2006	653	21	9	3.36	31	Ceratopsyche sparna
689	Long Meadow Pond Brook	8.48	10/6/2006	485	16	10	4.57	59	Cheumatopsyche
697	Steele Brook	7.65	10/6/2006	1435	22	11	3.98	37	Cheumatopsyche
894	Coppermine Brook	12.72	10/11/2006	2100	13	7	4.31	34	Cheumatopsyche
974	Farm River	9.33	9/27/2006	980	21	6	5.06	31	Hydropsyche betteni
997	Muddy River	7.43	9/27/2006	2100	28	9	4.54	33	Chimarra aterrima
1081	Roaring Brook	8.57	10/5/2006	776	19	8	4.61	45	Cheumatopsyche
1243	Nod Brook	9.89	10/11/2006	739	22	12	3.90	19	Chimarra aterrima
1281	Sasco Brook	8.35	9/20/2006	856	22	9	3.99	46	Hydropsyche betteni
1338	Belcher Brook	8.48	9/21/2006	299	25	12	4.00	15	Hydropsyche betteni
1806	Muddy River	5.91	9/27/2006	1470	25	13	4.33	40	Cheumatopsyche

1807	Willow Brook	8.77	9/27/2006	1435	27	8	4.30	21	Hydropsyche
1808	Misery Brook	12.89	10/11/2006	1484	19	7	4.27	24	Cheumatopsyche
1809	Mill River	10.16	9/20/2006	2954	17	4	4.70	28	Hydropsyche
1810	Cricker Brook	5.97	9/20/2006	1120	15	5	4.31	31	Chimarra aterrima
1811	Means Brook	10.28	10/11/2006	591	39	9	5.20	11	Hydropsyche betteni
1812	West Branch Naugatuck River	7.1	10/5/2006	1442	27	13	4.50	33	Cheumatopsyche
1916	Thompson Brook	10.11	10/11/2006	1589	26	13	3.94	23	Hydropsyche
1917	Meadow Brook	8	9/21/2006	732	38	14	3.65	15	Hydropsyche
1918	Mill Brook	8.75	9/21/2006	1022	12	7	4.78	34	Cheumatopsyche

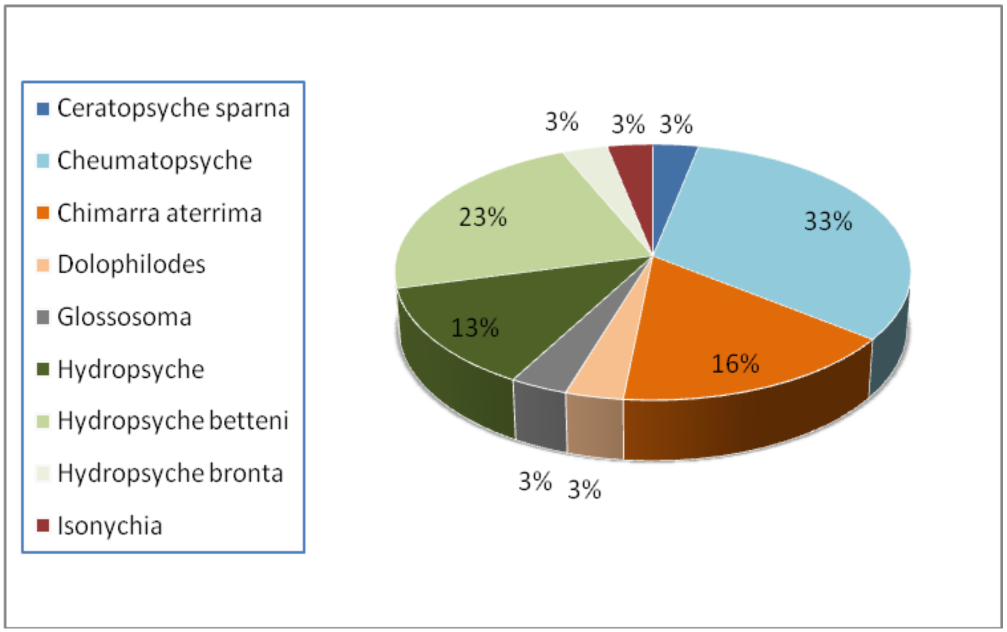
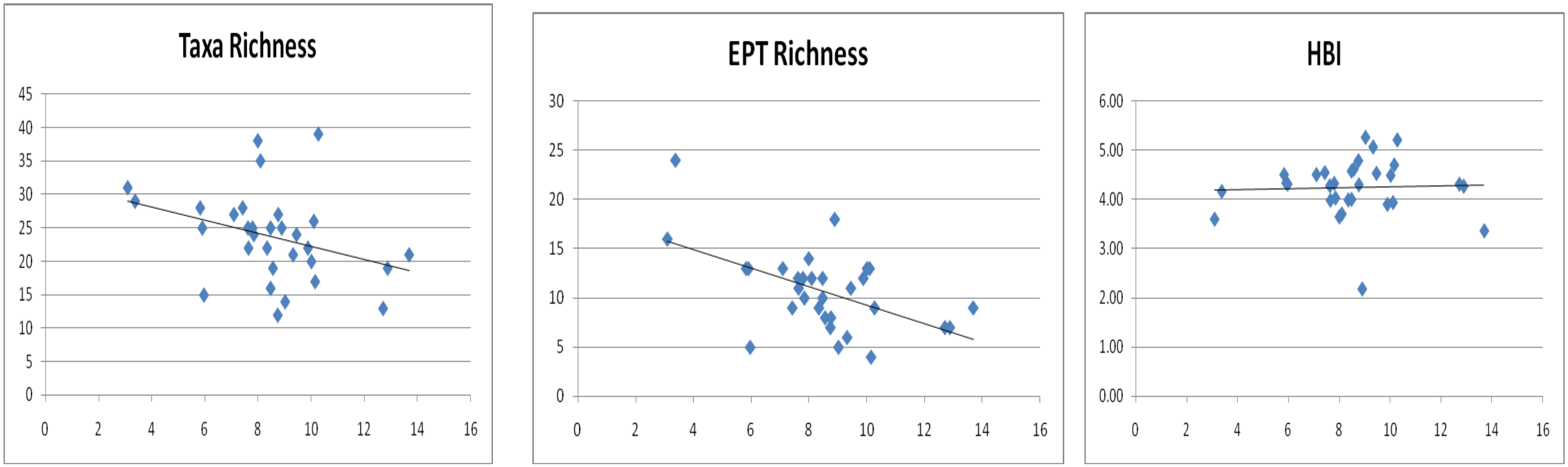


Table 6. Dominant macroinvertebrate taxa statistics for samples collected to support the Mid-IC project (6-14%).

Name	sites	percent sites
Ceratopsyche sparna	1	3
Cheumatopsyche	10	32
Chimarra aterrima	5	16
Dolophilodes	1	3
Glossosoma	1	3
Hydropsyche	4	13
Hydropsyche betteni	7	23
Hydropsyche bronta	1	3
Isonychia	1	3

Figure 7. Macroninvertebrate taxa and the percent of samples each were dominant for data supporting the Mid-IC project (6-14%).



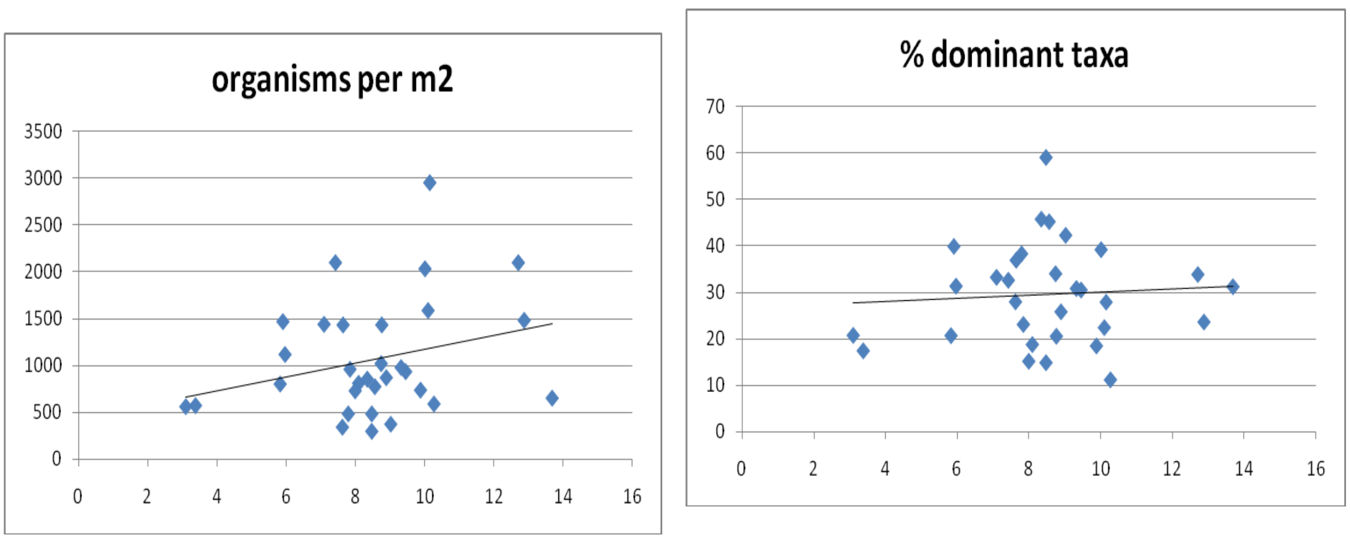


Figure 8. Select traditional RBP 3 metrics versus % IC for data collected to support the Mid-IC project (6-14%).

Table 7. Top 10 fish taxa as % of total individuals identified (N=4546) and as % of sites present (N=24). Fish community data collected at part of the Mid-IC project (6-14%).

Species Abbrev	Species	% of individuals		Species Abbrev	Species	% of sites
BL	Rhinichthys atratulus	23		AE	Anguilla rostrata	92
AE	Anguilla rostrata	19		BL	Rhinichthys atratulus	88
WS	Catostomus commersoni	12		TD	Etheostoma olmstedi	83
LD	Rhinichthys cataractae	10		WS	Catostomus commersoni	79
FF	Semotilus corporalis	5		LD	Rhinichthys cataractae	71
TD	Etheostoma olmstedi	4		LM	Micropterus salmoides	63
CS	Luxilus cornutus	3		BG	Lepomis macrochirus	58
WBN	Salmo trutta	3		PS	Lepomis gibbosus	54
CM	Exoglossum maxillingua	3		CS	Luxilus cornutus	46
BN	Salmo trutta hatcheryis	3		WBN	Salmo trutta	38

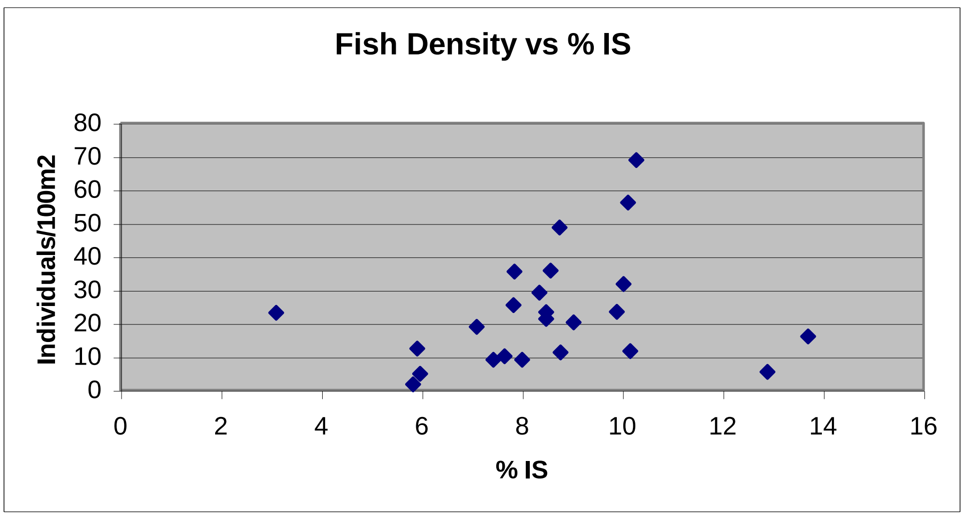


Figure 9. Density of fish versus % impervious cover upstream of sample location for data collected at part of the Mid-IC project (6-14%).

Figure 10. Proportion of native and exotic species per sample for data collected at part of the Mid-IC project (6-14%).

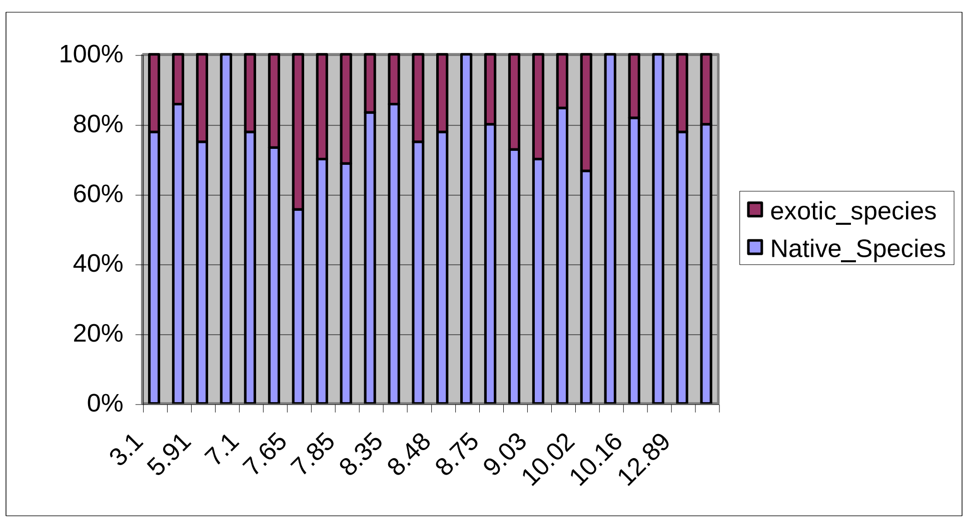


Table 8. Fish Community IBI score and individual metric scores for each of the samples collected as part of the Mid-IC project (6-14%). Samples were collected during summer 2006.

station id	Stream	% IC	basin	date	sample id	Municipality	**VT MWIBI**	order	Area Mi2	1	2	3	4	5	6	7	8
31	Comstock Brook	7.83	7301	7/19/2006	8677	Wilton	**37**	2	4	5	3	5	3	3	3	5	5
98	Hancock Brook	5.83	6911	6/12/2006	8173	Waterbury	**33**	3	15	3	1	5	3	5	5	3	3
123	Hop Brook	10	6916	7/26/2006	8757	Naugatuck	**33**	3	17	3	1	5	3	3	5	3	5
347	Ten Mile River	9	5202	7/12/2006	8563	Southington	**39**	3	18	3	5	5	5	5	3	5	3
357	West Branch Naugatuck River	3.1	6904	6/23/2006	8365	Torrington	**29**	3	31	3	1	5	5	1	3	1	5
453	Sawmill Brook	7.85	4604	6/19/2006	8275	Middletown	**37**	2	4	5	3	5	3	3	3	5	5
514	Steele Brook	13.7	6912	9/8/2006	9627	Waterbury	**31**	3	17	5	1	5	3	1	3	3	5
689	Long Meadow Pond Brook	8.48	6917	6/16/2006	8271	Naugatuck	**33**	2	8	5	1	5	3	3	5	1	5
697	Steele Brook	7.65	6912	9/8/2006	9629	Watertown	**31**	2	6	3	1	5	1	3	3	5	5
997	Muddy River	7.43	5208	7/11/2006	8511	North Haven	**29**	3	20	5	1	5	1	1	1	5	5
1081	Roaring Brook	8.57	4312	7/21/2006	8694	Farmington	**31**	2	8	3	1	5	5	1	3	3	5
1243	Nod Brook	9.89	4317	7/21/2006	8692	Avon	**35**	2	6	5	5	5	3	1	3	3	5
1281	Sasco Brook	8.35	7109	7/10/2006	8499	Fairfield	**35**	3	8	3	3	1	5	5	3	5	5
1338	Belcher Brook	8.48	4601	6/19/2006	8274	Berlin	**41**	1	4	5	3	5	5	5	3	5	5
1806	Muddy River	5.91	5208	7/11/2006	8512	Wallingford	**34**	3	12	4	3	5	1	3	3	5	5
1807	Willow Brook	8.77	5301	7/11/2006	8513	Hamden	**35**	3	13	3	5	5	3	3	1	5	5
1808	Misery Brook	12.9	5203	7/12/2006	8564	Southington	**40**	2	6	4	3	5	5	5	5	3	5
1809	Mill River	10.2	7108	7/10/2006	8498	Fairfield	**37**	3	24	3	3	5	5	5	1	5	5
1810	Cricker Brook	5.97	7107	7/10/2006	8500	Fairfield	**31**	1	7	3	1	5	3	5	1	3	5
1811	Means Brook	10.3	6024	7/7/2006	8495	Shelton	**35**	2	11	3	1	5	5	5	5	1	5
1812	West Branch Naugatuck River	7.1	6904	6/23/2006	8364	Torrington	**39**	3	34	3	5	5	5	5	5	1	5
1916	Thompson Brook	10.1	4316	7/21/2006	8693	Avon	**39**	2	4	5	5	5	3	5	1	5	5
1917	Meadow Brook	8	4703	6/19/2006	8276	Colchester	**35**	2	11	5	3	5	5	1	3	3	5
1918	Mill Brook	8.75	4321	7/14/2006	8606	Windsor	**39**	2	6	5	1	5	5	5	3	5	5

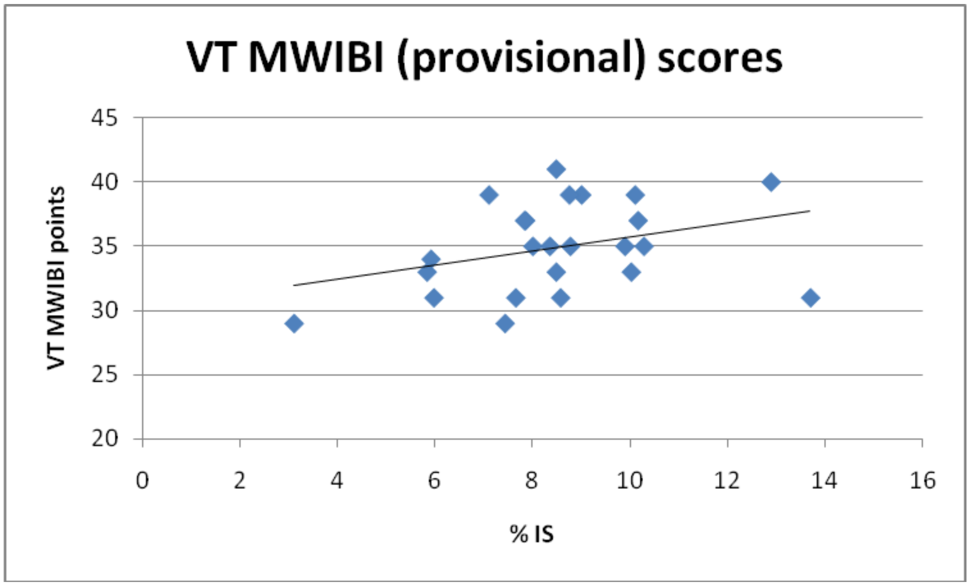


Figure 11. Scatter plot of VT MWIBI scores versus percent impervious cover upstream of sample location for fish community data collected at part of the Mid-IC project (6-14%).

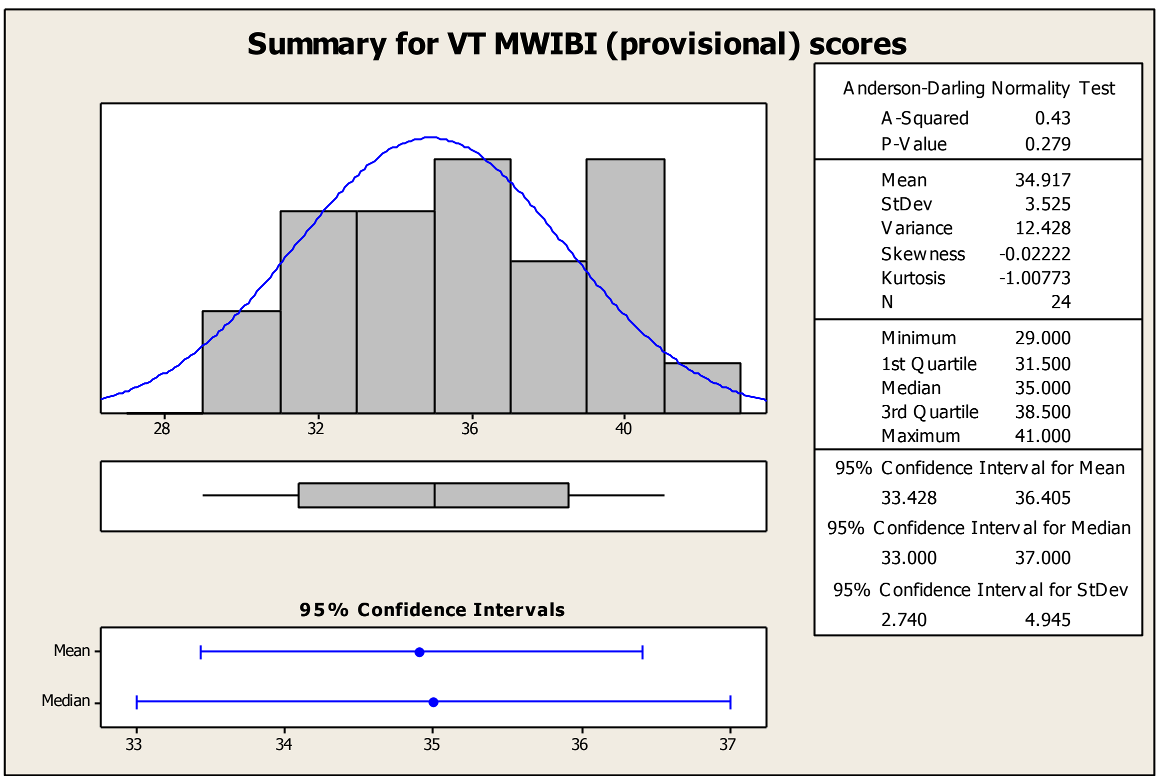
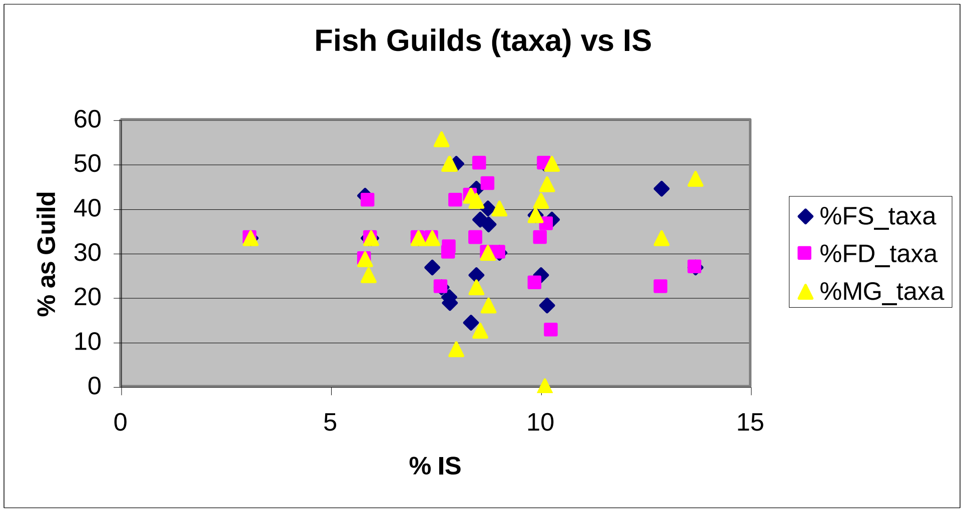
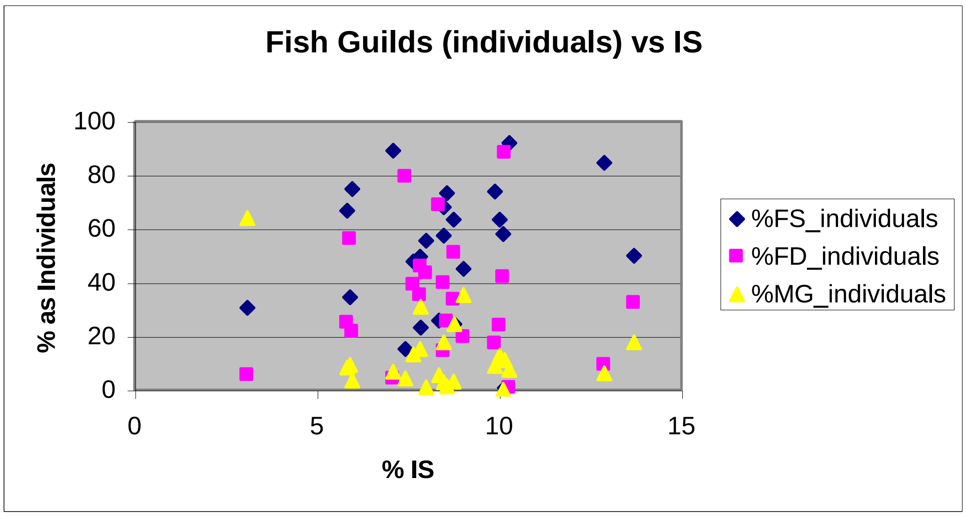


Figure 12. Distribution of VT MWIBI scores for fish community data collected at part of the Mid-IC project (6-14%).





Figures 13. Scatter plot flow guild taxa and flow guild % individuals versus % impervious cover for data collected at part of the Mid-IC project (6-14%).

Table 9. Grab chemistry results for grab samples collected concurrent with macroinvertebrate community samples.

			Alkalinity	Ammonia N	Chloride	Nitrate as N	Nitrite as N	Nitrogen, Total	Ortho phosphate	Phosphate, Total	pH lab	Solids, Total	Solids, Total Suspended	Sulfate	Turbidity
			1	2	0.2	2	4	16	2	2		5	2	0.2	0.1
Station ID	tripdate	% IC	ppm	PPB	ppm	PPB	PPB	PPB	PPB	PPB	units	ppm	ppm	ppm	NTU
4	10/6/06	8.9	19	5	25.9	1087	4	1094	8	12	7.39	122	2	19.64	0.31
31	10/26/06	7.83	45	3	MISSING	208	4	477	9	21	7.22	124	2	MISSING	1.01
47	10/11/06	8.1	70	5	33.39	394	4	543	25	32	7.51	186	2	13	1.29
51	10/5/06	3.38	26	17	16.07	42	4	740	4	15	7.52	82	2	7.52	0.99
54	10/5/06	9.46	33	7	34.99	265	6	428	6	13	7.66	116	2	9.14	0.69
97	10/6/06	7.63	12	17	20.47	86	4	259	8	16	7.13	100	2	8.89	0.98
98	10/6/06	5.83	12	7	18.91	52	4	232	3	5	7.32	68	4	8.66	0.8
123	10/6/06	10.02	5	26	34.04	373	10	620	13	26	6.84	126	2	11.62	1.62
347	9/27/06	9.03	73	23	31.53	1289	11	1300	12	31	8.22	170	7	12.38	3.74
357	10/5/06	3.1	26	11	9.71	12	4	269	4	22	6.97	64	5	6.81	1.44
453	9/21/06	7.85	89	2	25.16	264	4	399	13	12	7.69	184	10	13.13	2.84
514	10/19/06	13.7	25	7	36.71	673	4	890	12	23	7.01	132	3	15.01	1.17
689	10/6/06	8.48	29	8	25.93	457	4	584	9	23	7.73	108	3	13.02	1.51
697	10/19/06	7.65	24	7	23.54	513	4	808	10	17	6.89	104	4	11.81	0.93
894	10/11/06	12.72	41	5	29.29	834	6	931	10	20	7.6	140	2	10.3	0.78
974	9/27/06	9.33	108	9	28.92	2482	8	2380	19	31	8.03	234	2	23.71	4.13
997	9/27/06	7.43	80	6	20.91	1694	6	1834	18	30	7.94	176	6	16.64	2.5
1081	10/5/06	8.57	28	8	32.29	275	5	575	7	24	7.68	116	2	9.03	1.11
1243	10/11/06	9.89	69	2	64.36	638	6	873	9	21	7.49	274	2	11.1	1.04
1281	9/20/06	8.35	33	5	21.95	1111	4	1430	17	18	7.74	144	2	15.77	0.55
1338	9/21/06	8.48	96	8	33.46	MISSING	5	1189	20	27	7.8	222	20	10.31	8.89
1806	9/27/06	5.91	86	2	18.91	410	4	638	2	26	7.87	150	3	15.46	2.41
1807	9/27/06	8.77	73	11	19.07	1315	5	1328	14	28	7.98	150	3	10.49	3.35
1808	10/11/06	12.89	107	14	26.61	1035	5	1148	34	52	7.74	224	12	13.9	2.58
1809	9/20/06	10.16	22	25	23.45	MISSING	5	892	12	33	7.06	112	4	15.08	1.42
1810	9/20/06	5.97	28	25	26.37	MISSING	5	632	5	14	7.26	120	2	14.63	1.36
1811	10/11/06	10.28	37	22	39.01	932	8	1062	6	17	7.26	164	2	19.65	0.61
1812	10/5/06	7.1	33	6	15.06	76	4	311	3	20	7.51	76	2	7.52	1.42
1916	10/11/06	10.11	49	3	36.2	2354	6	2338	7	11	7.56	182	2	12.05	0.41
1917	9/21/06	8	11	2	31.88	153	4	331	2	5	6.86	108	6	12.44	1.08
1918	9/21/06	8.75	MISSING	3	72.78	1168	4	1365	0	37	8.04	300	12	20.15	2.46

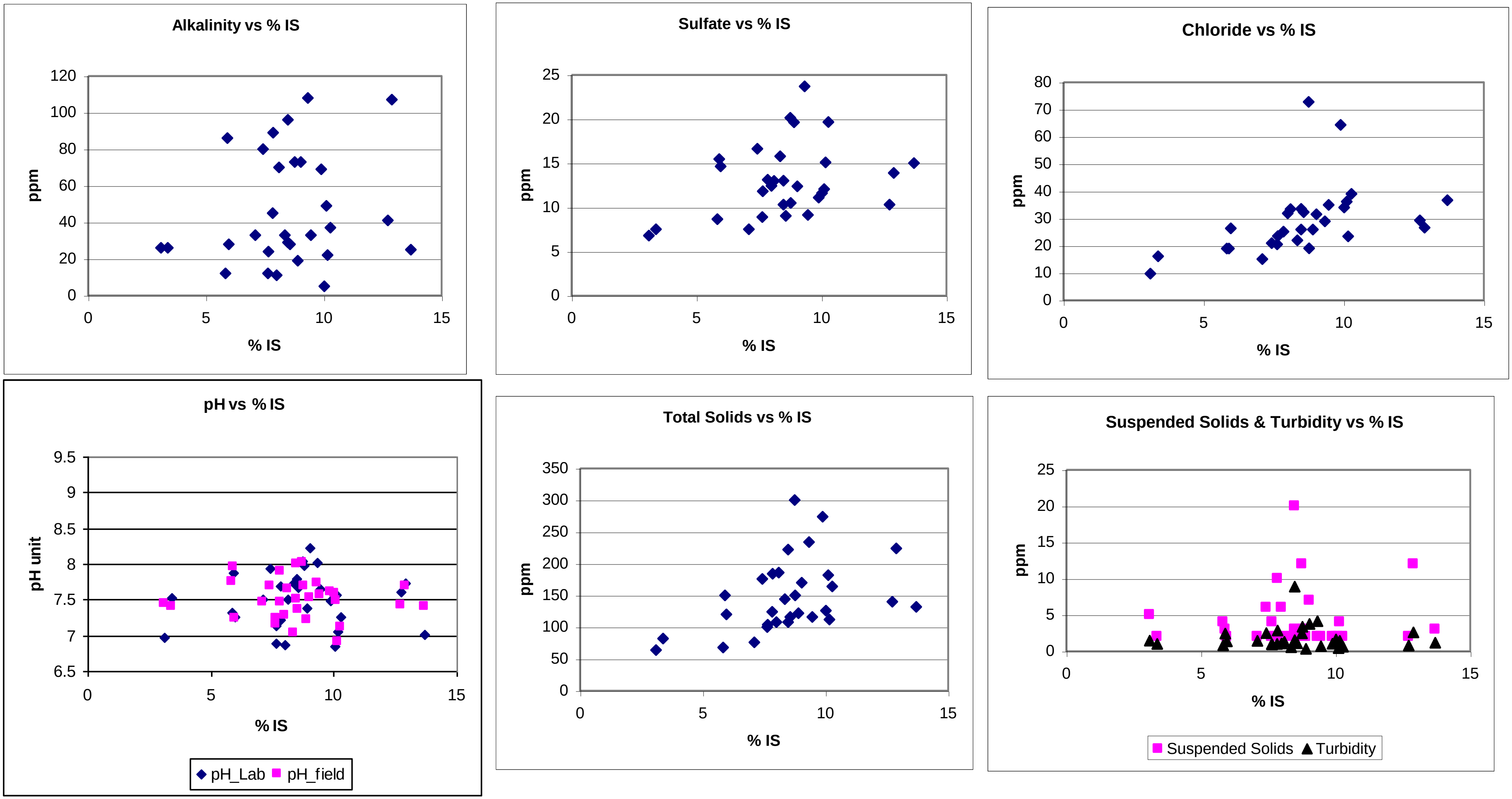


Figure 14. Non-nutrient grab chemistry parameters versus % impervious cover for data collected at part of the Mid-IC project (6-14%).

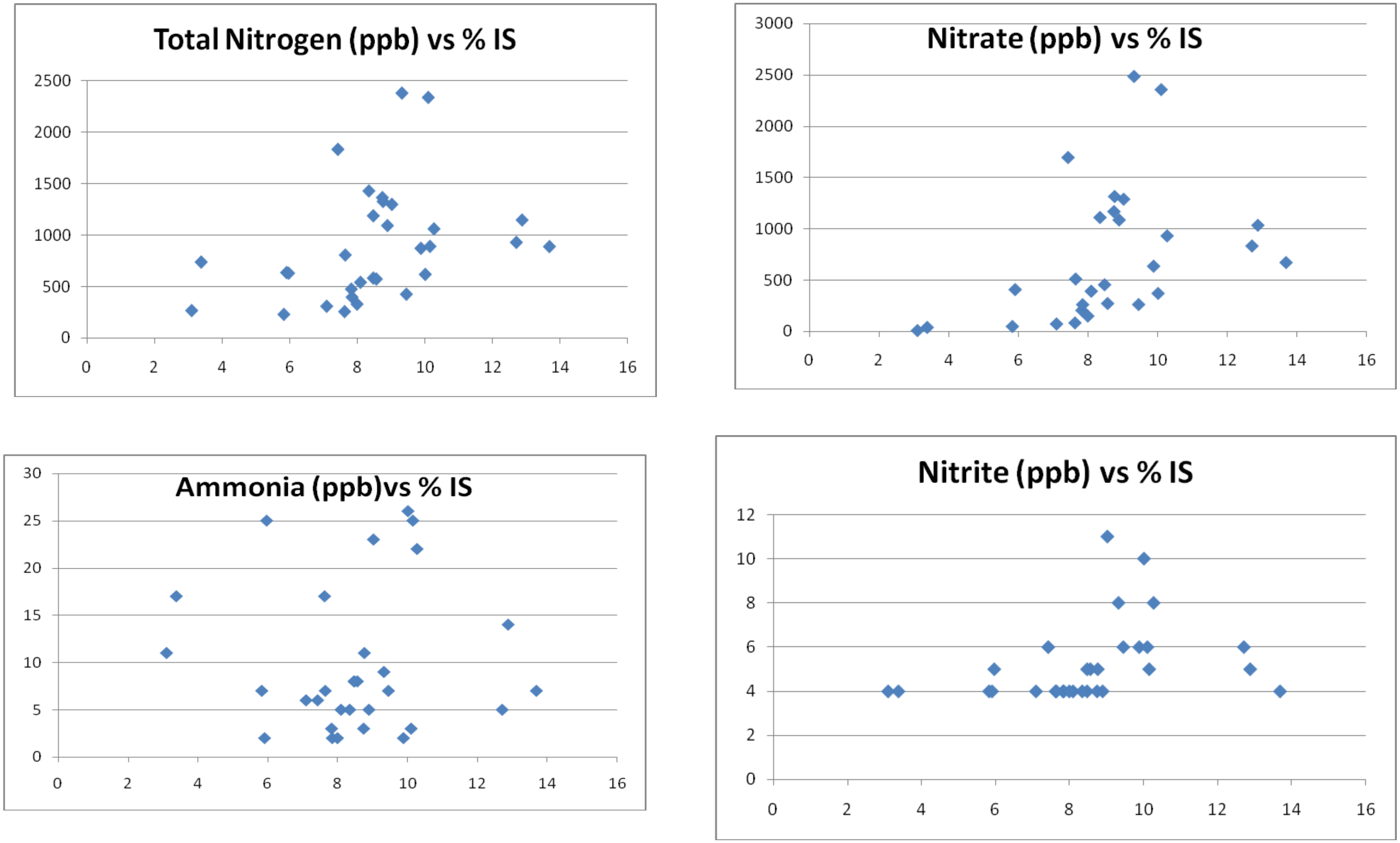
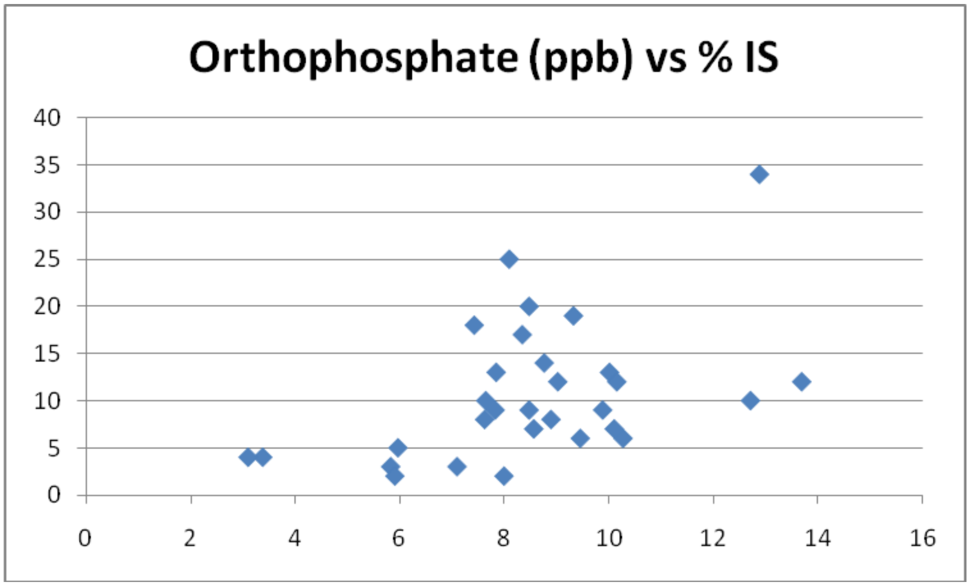


Figure 15. Scatter plots of nitrogen series grab sample data versus % impervious cover upstream of sample location for data collected at part of the Mid-IC project (6-14%).



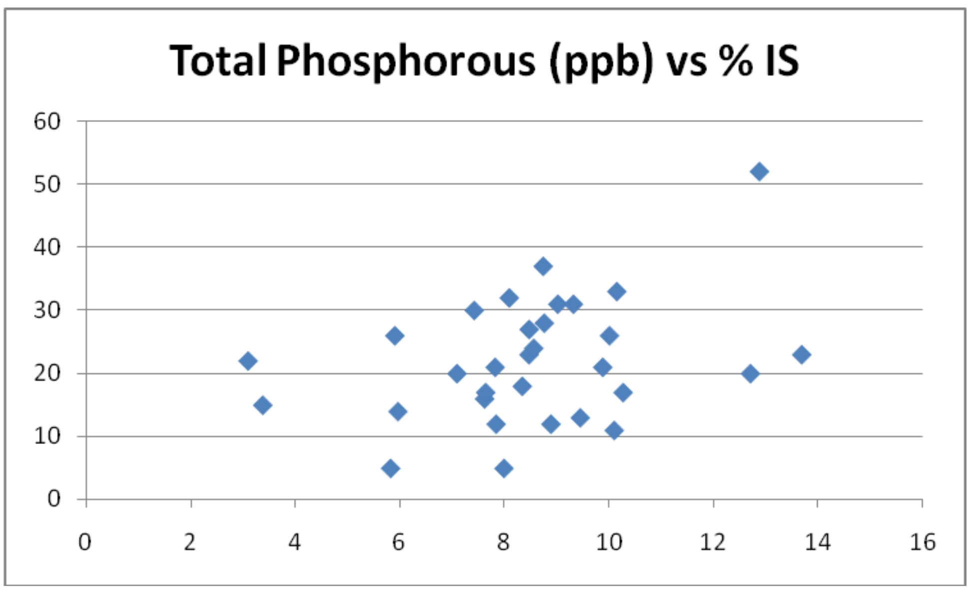


Figure 16. Scatter plots of phosphorous series grab sample data versus % impervious cover upstream of sample location for data collected at part of the Mid-IC project (6-14%).

Table 10. Field water quality parameters measured at stations to support the Mid-IC project (6-14%). Values were recorded concurrent with macroinvertebrate sample collection.

			dissolved oxygen	oxygen saturation	pH	specific conductance	total dissolved solids	water temperature
StationID	tripdate	% IC	mg/l	percent	s.u.	ms/cm	g/l	degrees C
4	10/6/06	8.9	11.94	110.6	7.21	0.271	0.176	11.92
31	10/26/06	7.83	13.33	111	7.89	0.19	0.123	7.43
47	10/11/06	8.1	10.36	98.7	7.66	0.349	0.227	13.09
51	10/5/06	3.38	11.12	107	7.4	0.179	0.116	13.6
54	10/5/06	9.46	10.84	104.4	7.57	0.267	0.173	13.62
97	10/6/06	7.63	11.01	105.8	7.24	0.204	0.133	13.55
98	10/6/06	5.83	11.12	107.5	7.75	0.195	0.127	13.79
123	10/6/06	10.02	11.05	107.8	7.59	0.284	0.185	14.21
347	9/27/06	9.03	9.22	89.6	7.52	0.331	0.215	14.04
357	10/5/06	3.1	10.95	108.2	7.45	0.162	0.105	14.81
453	9/21/06	7.85	9.81	97.1	7.46	0.333	0.216	14.92
514	10/19/06	13.7	11.01	104.8	7.4	0.216	0.14	13.13
689	10/6/06	8.48	11.35	108.3	7.5	0.265	0.172	13.21
697	10/19/06	7.65	10.91	102.8	7.15	0.161	0.105	12.66
894	10/11/06	12.72	10.01	96.7	7.43	0.279	0.182	13.76
974	9/27/06	9.33	9.3	90.5	7.73	0.414	0.269	14.1
997	9/27/06	7.43	9.87	95	7.69	0.323	0.21	13.61
1081	10/5/06	8.57	10.08	102.3	7.37	0.245	0.159	16.01
1243	10/11/06	9.89	10.05	98.6	7.61	0.434	0.282	14.48
1281	9/20/06	8.35	9.36	97.2	7.04	0.218	0.142	17.14
1338	9/21/06	8.48	9.94	101.4	8.01	0.381	0.248	16.27
1806	9/27/06	5.91	10.1	98.9	7.95	0.312	0.203	14.37
1807	9/27/06	8.77	10.03	96	7.69	0.284	0.185	13.38
1808	10/11/06	12.89	10.07	96.5	7.69	0.397	0.258	13.36
1809	9/20/06	10.16	7.07	77.2	6.91	0.205	0.133	19.64
1810	9/20/06	5.97	8.35	87.2	7.23	0.217	0.141	17.43
1811	10/11/06	10.28	9.3	90.3	7.11	0.325	0.211	13.99
1812	10/5/06	7.1	10.58	105	7.46	0.189	0.123	15.02
1916	10/11/06	10.11	10.97	104.3	7.49	0.332	0.216	13.04
1917	9/21/06	8	9.45	94.6	7.28	0.203	0.132	15.39
1918	9/21/06	8.75	10.33	105.4	8.03	0.489	0.318	16.31

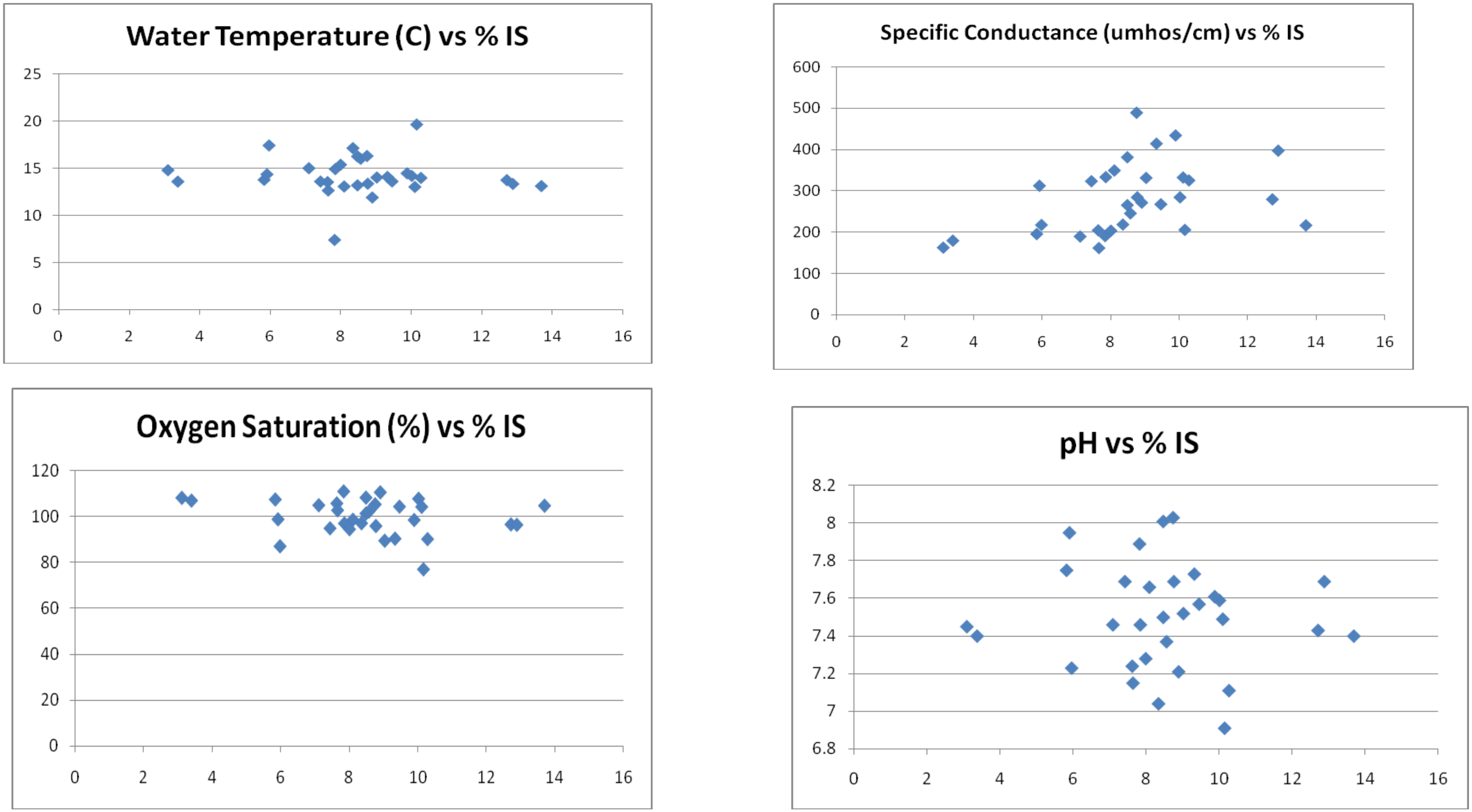


Figure 17. Field measured water quality parameters versus percent impervious cover upstream of the sample location for data collected at part of the Mid-IC project (6-14%).

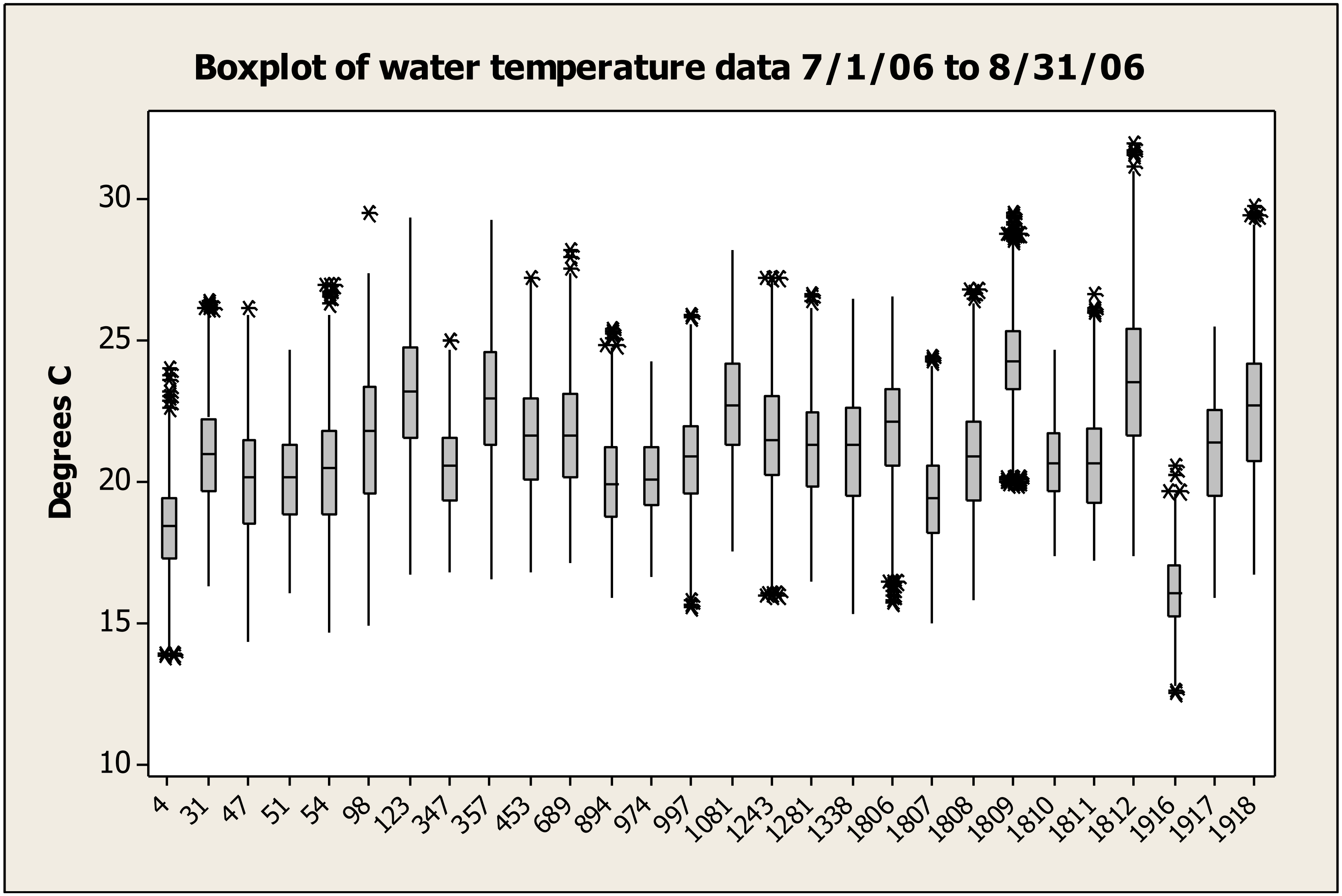
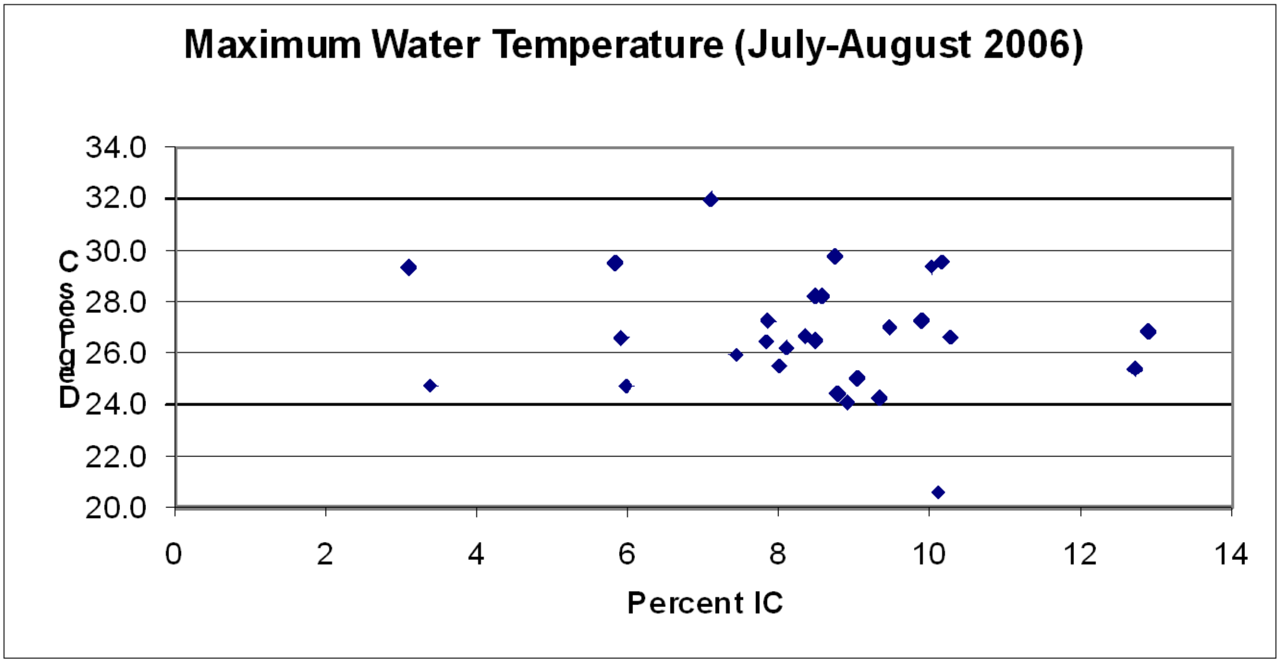


Figure 18. Box plot of water temperature data at Mid-IC stations recorded once an hour from 7/1/06 to 8/31/06 for data collected at part of the Mid-IC project (6-16%).

Table 11. Water temperature summary statistics (7/1/06 to 8/31/06) for sites selected for the Mid-IC project (6-14%).

Station id	Mean	Minimum	25%	Median	75%	Maximum	Range	IQR
4	18.4	13.8	17.3	18.5	19.4	24.1	10.2	2.1
31	21.0	16.3	19.7	21.0	22.3	26.5	10.1	2.6
47	20.1	14.4	18.5	20.2	21.5	26.2	11.8	3.0
51	20.1	16.1	18.9	20.2	21.4	24.7	8.6	2.5
54	20.5	14.7	18.9	20.5	21.8	27.0	12.3	2.9
98	21.5	14.9	19.6	21.8	23.4	29.5	14.6	3.8
123	23.2	16.7	21.6	23.2	24.8	29.4	12.6	3.2
347	20.5	16.8	19.3	20.6	21.6	25.0	8.2	2.2
357	23.0	16.6	21.3	23.0	24.6	29.3	12.7	3.3
453	21.5	16.8	20.1	21.7	22.9	27.3	10.5	2.8
689	21.7	17.2	20.2	21.7	23.1	28.2	11.0	2.9
894	20.1	16.0	18.8	20.0	21.2	25.4	9.4	2.4
974	20.2	16.7	19.2	20.1	21.2	24.3	7.6	2.1
997	20.8	15.6	19.6	20.9	22.0	25.9	10.4	2.4
1081	22.8	17.6	21.4	22.8	24.2	28.2	10.7	2.8
1243	21.5	16.0	20.3	21.5	23.0	27.3	11.2	2.8
1281	21.2	16.5	19.9	21.3	22.5	26.7	10.2	2.6
1338	21.2	15.3	19.6	21.4	22.6	26.5	11.1	3.1



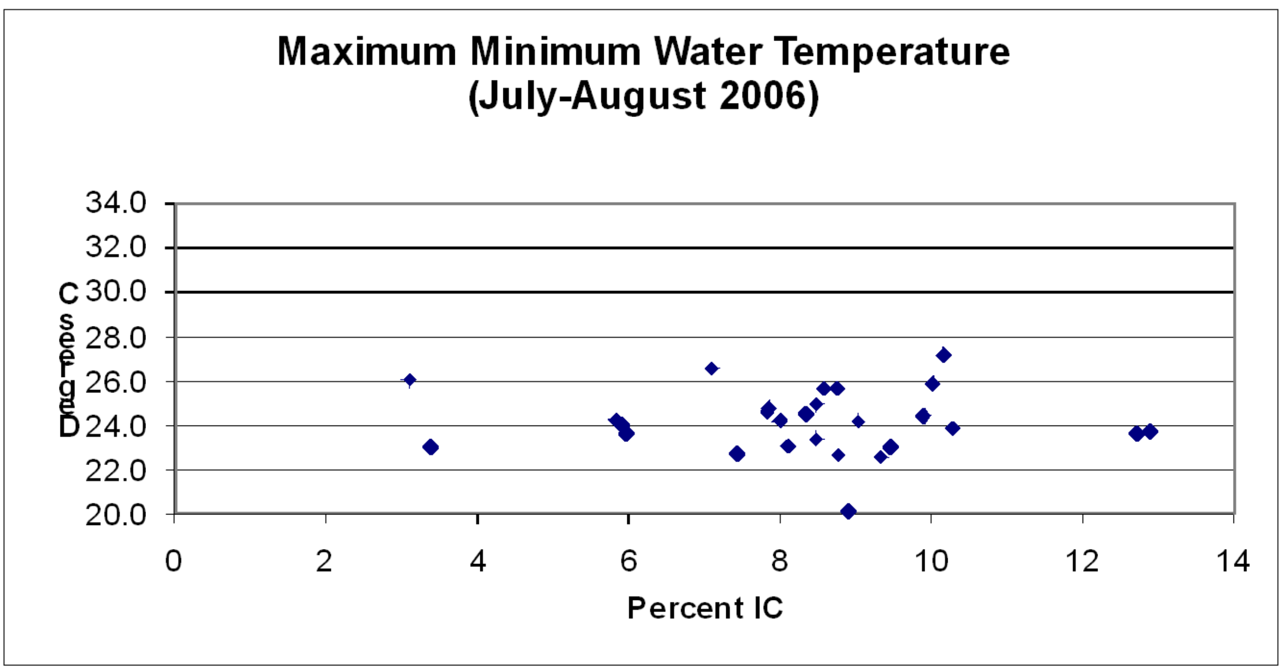
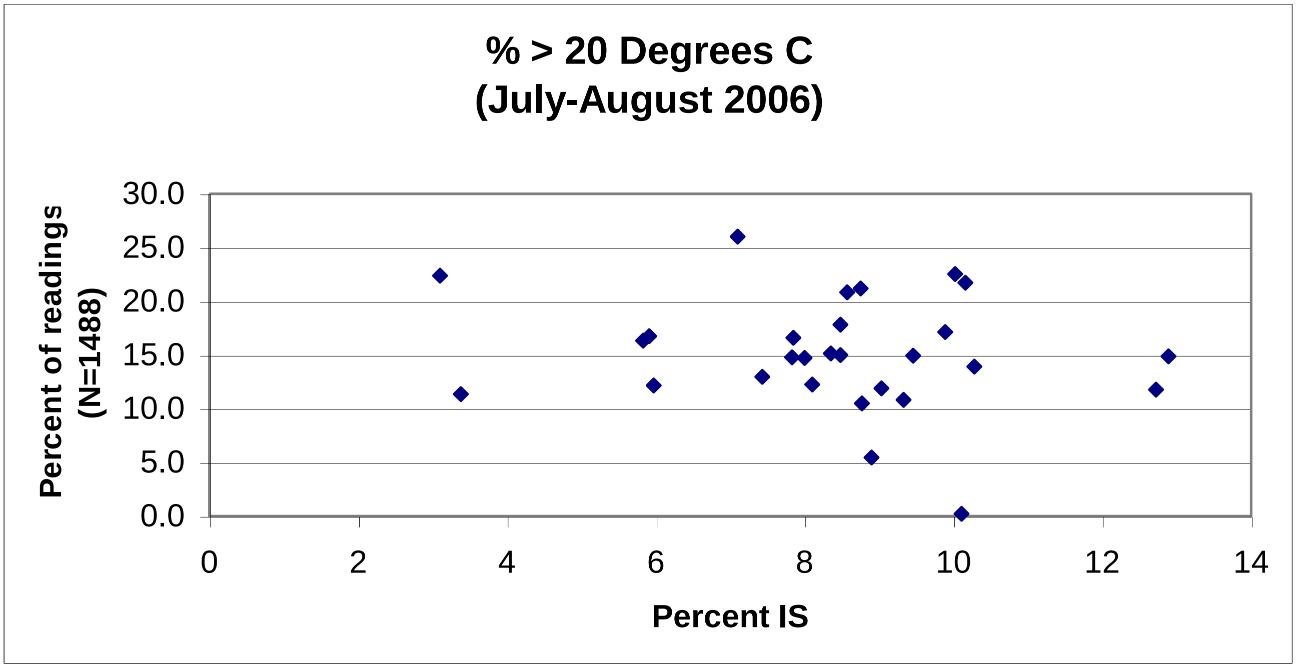


Figure 19. Maximum water temperature (top) and highest minimum water temperature (bottom) 7/1/06 to 8/31/06 for data collected at part of the Mid-IC project (6-14%).



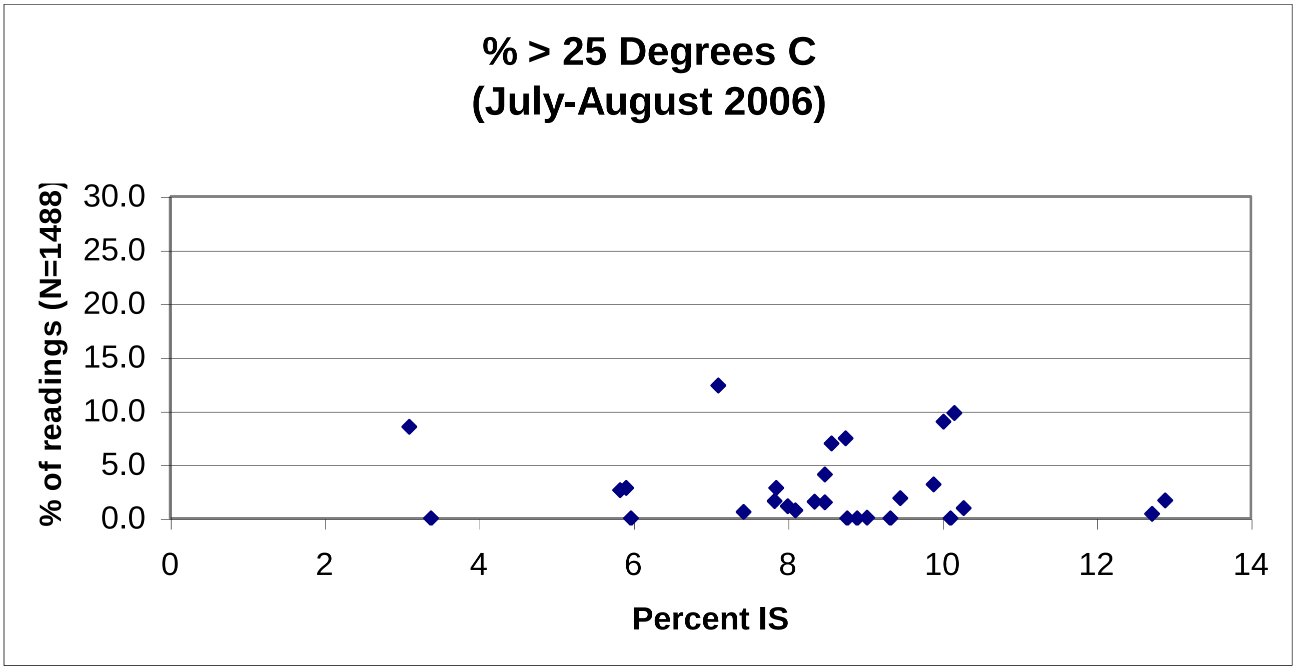


Figure 20. Critical stream temperature values for salmonid fish species. The percentage of temperature observations over 20 degrees C vs % IC (top) and percentage of temperature observations over 25 degrees C vs % IC (bottom) data collected at part of the Mid-IC project (6-14%).

Appendix A. Selected land use attributes of catchments upstream of each sampling point selected for the Mid-IC project (6-14%). The values are determined from data supplied by UConn CLEAR.

StationID	Stream Name	Total acres	square miles	Stream order	% IC	Developed acres	Grass acres	Deciduous acres	Coniferous acres	Water acres	Wetland acres
4	Beacon Hill Brook	6538	10	2	8.9	1124	272	4240	226	176	77
31	Comstock Brook	2729	4	2	7.83	473	233	1413	61	15	125
47	Deep Brook	3422	5	2	8.1	809	330	1207	168	1	159
51	East Branch Naugatuck River	7201	11	2	3.38	973	101	2369	2424	385	232
54	East Branch Naugatuck River	9041	14	2	9.46	2011	226	2726	2635	392	247
97	Hancock Brook	9851	15	3	7.63	1689	224	6194	684	188	145
98	Hancock Brook	9851	15	3	5.83	1689	224	6194	684	188	145
123	Hop Brook	11136	17	3	10.02	2484	837	5561	117	101	389
347	Ten Mile River	11603	18	3	9.03	2735	684	6210	61	81	488
357	West Branch Naugatuck River	19886	31	3	3.1	1014	52	9300	6395	593	769
453	Sawmill Brook	2589	4	2	7.85	220	27	1349	298	2	64
514	Steele Brook	10906	17	3	13.7	3681	1222	3618	194	231	104
689	Long Meadow Pond Brook	5421	8	2	8.48	1118	153	2908	162	132	188
697	Steele Brook	3748	6	2	7.65	722	618	1293	145	71	17
894	Coppermine Brook	11916	19	3	12.72	3305	744	6491	299	38	245
974	Farm River	15108	24	2	9.33	3913	838	5737	364	217	429
997	Muddy River	12913	20	3	7.43	2769	730	4408	465	319	379
1081	Roaring Brook	4835	8	2	8.57	1157	445	2189	559	64	238
1243	Nod Brook	3937	6	2	9.89	1144	210	1198	996	29	168
1281	Sasco Brook	5354	8	3	8.35	1348	929	1892	217	19	209
1338	Belcher Brook	2514	4	1	8.48	724	205	1016	38	197	77
1806	Muddy River	7848	12	3	5.91	1237	288	2890	382	279	278
1807	Willow Brook	8299	13	3	8.77	1736	768	4661	250	37	324
1808	Misery Brook	3993	6	2	12.89	1173	608	1126	395	32	222
1809	Mill River	15508	24	3	10.16	3954	1751	7038	371	630	369
1810	Cricker Brook	4251	7	1	5.97	630	213	2241	108	457	124
1811	Means Brook	7008	11	2	10.28	1733	894	2945	111	40	108
1812	West Branch Naugatuck River	21743	34	3	7.1	1838	154	9964	6488	600	790
1916	Thompson Brook	2471	4	2	10.11	550	361	750	473	6	94

1917	Meadow Brook	7118	11	2	8	1903	145	3394	169	42	394
1918	Mill Brook	4118	6	2	8.75	1136	375	1301	57	26	161

Appendix B. Ecological attributes for macroinvertebrate species identified from samples collected to support the Mid-IC project (6-14%). Attributes are from the CT DEP 2008 master macroinvertebrate taxa list. Species are sorted alphabetically by Family then Genus species. Tol= modified Hilsenhoff Scale where the range is 0-10. 0 is not tolerant and 10 is most tolerant. FFG= Functional Feeding Group. PRD= predator, SCR= scraper, C-G= collector-gatherer, SHR= shredder, and C-F= collector-filterer. BCG= an attribute assigned via BPJ by consensus of regional biologists. The scale is 2 through 6. Taxa with attribute 2 are considered to be sensitive and 6 tolerant.

Class	Order	Family	Genus	Final ID	Tol	FFG	BCG
Arachnida	Trombidiformes	Sperchonidae	Sperchon	Sperchon	4	PRD	4
Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Prostoma	8	PRD	4
Gastropoda	Basommatophora	Ancylidae		Ancylidae	6	SCR	4
Gastropoda	Basommatophora	Ancylidae	Laevapex	Laevapex fuscus	5	SCR	4
Gastropoda	Basommatophora	Physidae	Physa	Physa	8	C-G	4
Gastropoda	Basommatophora	Planorbidae	Micromenetus	Micromenetus dilatatus	5	SCR	4
Gastropoda	Mesogastropoda	Hydrobiidae		Hydrobiidae	8	SCR	4
Insecta	Coleoptera	Elmidae	Ancyronyx	Ancyronyx variegatus	6	C-G	4
Insecta	Coleoptera	Elmidae	Macronychus	Macronychus glabratus	4	SHR	4
Insecta	Coleoptera	Elmidae	Microcylloepus	Microcylloepus	3	C-G	4
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	4	SCR	4
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus ovalis	3	SCR	4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	2	SCR	3
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius latiusculus	4	C-G	3
Insecta	Coleoptera	Elmidae	Promoresia	Promoresia tardella	3	SCR	3
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	5	SCR	4
Insecta	Coleoptera	Psephenidae	Ectopria	Ectopria	5	SCR	3
Insecta	Coleoptera	Psephenidae	Psephenus	Psephenus herricki	4	SCR	3
Insecta	Diptera	Athericidae	Atherix	Atherix	2	PRD	3
Insecta	Diptera	Chironomidae	Brillia	Brillia	5	SHR	4
Insecta	Diptera	Chironomidae	Cardiocladius	Cardiocladius obscurus	5	PRD	6
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	6	C-G	
Insecta	Diptera	Chironomidae	Cladotanytarsus	Cladotanytarsus	7	C-F	5
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	7	C-G	3
Insecta	Diptera	Chironomidae	Cricotopus	Cricotopus	7	SHR	6
Insecta	Diptera	Chironomidae	Cricotopus	Cricotopus bicinctus	7	SHR	6
Insecta	Diptera	Chironomidae	Cricotopus	Cricotopus trifascia group	7	SHR	6
Insecta	Diptera	Chironomidae	Diamesa	Diamesa	5	C-G	4
Insecta	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella claripennis group	8	C-G	3
Insecta	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella devonica group	8	C-G	3
Insecta	Diptera	Chironomidae	Limnophyes	Limnophyes	8	C-G	5
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	7	C-G	3

Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes pedellus group	6	C-F	4
Insecta	Diptera	Chironomidae	Nanocladius	Nanocladius	3	C-G	3
Insecta	Diptera	Chironomidae	Orthocladius	Orthocladius	6	C-G	4
Insecta	Diptera	Chironomidae	Orthocladius	Orthocladius (Euorthocladius)	6	C-G	4
Insecta	Diptera	Chironomidae	Orthocladius	Orthocladius (Euorthocladius) rivicola	6	C-G	4
Insecta	Diptera	Chironomidae	Orthocladius	Orthocladius Complex	6	C-G	4
Insecta	Diptera	Chironomidae	Parachaetocladius	Parachaetocladius	2	C-G	3
Insecta	Diptera	Chironomidae	Paracricotopus	Paracricotopus	6	C-G	
Insecta	Diptera	Chironomidae	Parakiefferiella	Parakiefferiella	7	C-G	4
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	5	C-G	4
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	6	C-F	4
Insecta	Diptera	Chironomidae	Phaenopsectra	Phaenopsectra	7	SCR	4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	6	SHR	4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum aviceps	6	SHR	4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum flavum	6	SHR	4
Insecta	Diptera	Chironomidae	Potthastia	Potthastia longimana group	2	C-G	4
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	6	C-G	3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus exiguus group	6	C-F	4
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus pellucidus group	6	C-F	4
Insecta	Diptera	Chironomidae	Stenochironomus	Stenochironomus	5	C-G	3
Insecta	Diptera	Chironomidae	Stilocladius	Stilocladius	6	C-G	3
Insecta	Diptera	Chironomidae	Sublettea	Sublettea	6	C-F	4
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	6	C-F	4
Insecta	Diptera	Chironomidae	Thienemanniella	Thienemanniella	6	C-G	4
Insecta	Diptera	Chironomidae	Thienemannimyia	Thienemannimyia group	7	PRD	4
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia bavarica group	5	C-G	4
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia vitracies group	5	C-G	4
Insecta	Diptera	Chironomidae	Xenochironomus	Xenochironomus xenolabis	0	PRD	2
Insecta	Diptera	Empididae		Empididae	6	PRD	4
Insecta	Diptera	Empididae	Hemerodromia	Hemerodromia	6	PRD	5
Insecta	Diptera	Simuliidae	Simulium	Simulium	5	C-F	5
Insecta	Diptera	Tipulidae	Antocha	Antocha	3	C-G	5
Insecta	Diptera	Tipulidae	Tipula	Tipula	4	SHR	4
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella turbida	4	SCR	4
Insecta	Ephemeroptera	Baetidae	Baetis	Baetis	5	C-G	4
Insecta	Ephemeroptera	Baetidae	Baetis	Baetis flavistriga	4	C-G	4
Insecta	Ephemeroptera	Baetidae	Baetis	Baetis intercalaris	6	C-G	4

Insecta	Ephemeroptera	Baetidae	Baetis	Baetis pluto	4	C-G	4
Insecta	Ephemeroptera	Baetidae	Baetis	Baetis tricaudatus	2	C-G	4
Insecta	Ephemeroptera	Baetidae	Heterocloeon	Heterocloeon	2	SCR	
Insecta	Ephemeroptera	Baetidae	Baetis	Plauditus	4	C-G	3
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	1	C-G	3
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella subvaria	1	C-G	3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	4	C-G	4
Insecta	Ephemeroptera	Ephemerellidae	Serratella	Serratella deficiens	2	C-G	3
Insecta	Ephemeroptera	Heptageniidae	Epeorus	Epeorus	0	SCR	2
Insecta	Ephemeroptera	Heptageniidae	Heptageniidae	Heptageniidae	4	C-G	
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	3	SCR	4
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium modestum group	4	SCR	4
Insecta	Ephemeroptera	Isonychiidae	Isonychia	Isonychia	2	C-G	3
Insecta	Ephemeroptera	Leptophlebiidae		Leptophlebiidae	2	C-G	2
Insecta	Lepidoptera	Pyralidae	Petrophila	Petrophila	5	SCR	
Insecta	Megaloptera	Corydalidae	Corydalus	Corydalus cornutus	6	PRD	3
Insecta	Megaloptera	Corydalidae	Nigronia	Nigronia serricornis	4	PRD	3
Insecta	Odonata	Aeshnidae	Boyeria	Boyeria grafiana	2	PRD	4
Insecta	Odonata	Aeshnidae	Boyeria	Boyeria vinosa	2	PRD	4
Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx	5	PRD	4
Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx maculata	5	PRD	4
Insecta	Odonata	Coenagrionidae	Argia	Argia	7	PRD	4
Insecta	Odonata	Gomphidae		Gomphidae	1	PRD	3
Insecta	Odonata	Gomphidae	Ophiogomphus	Ophiogomphus	1	PRD	2
Insecta	Odonata	Gomphidae	Stylogomphus	Stylogomphus albistylus	0	PRD	3
Insecta	Plecoptera	Chloroperlidae		Chloroperlidae	1	PRD	3
Insecta	Plecoptera	Chloroperlidae	Sweltsa	Sweltsa	0	PRD	3
Insecta	Plecoptera	Perlidae	Acroneuria	Acroneuria abnormis	0	PRD	3
Insecta	Plecoptera	Perlidae	Paragnetina	Paragnetina	1	PRD	3
Insecta	Plecoptera	Perlidae	Paragnetina	Paragnetina media	1	PRD	3
Insecta	Plecoptera	Pteronarcyidae	Pteronarcys	Pteronarcys	0	SHR	2
Insecta	Plecoptera	Taeniopterygidae	Taeniopteryx	Taeniopteryx	2	SHR	3
Insecta	Trichoptera	Apataniidae	Apatania	Apatania	3	SCR	3
Insecta	Trichoptera	Brachycentridae	Brachycentrus	Brachycentrus appalachia	0	C-F	3
Insecta	Trichoptera	Brachycentridae	Micrasema	Micrasema	2	SHR	3
Insecta	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	0	SCR	4
Insecta	Trichoptera	Glossosomatidae		Glossosomatidae	0	SCR	4
Insecta	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche bifida group	4	C-F	5
Insecta	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche sparna	1	C-F	5
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	5	C-F	5
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	0	C-F	3
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	4	C-F	5
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche betteni	6	C-F	5

Insecta	Trichoptera	Hydropsychidae	Ceratopsyche	Hydropsyche bronta	4	C-F	5
Insecta	Trichoptera	Hydropsychidae	Ceratopsyche	Hydropsyche morosa	4	C-F	5
Insecta	Trichoptera	Hydropsychidae		Hydropsychidae	4	C-F	
Insecta	Trichoptera	Hydropsychidae	Macrostemum	Macrostemum	3	C-F	4
Insecta	Trichoptera	Hydroptilidae	Hydroptila	Hydroptila	6	SCR	4
Insecta	Trichoptera	Hydroptilidae		Hydroptilidae	4	SCR	4
Insecta	Trichoptera	Hydroptilidae	Leucotrichia	Leucotrichia pictipes	4	SCR	6
Insecta	Trichoptera	Lepidostomatidae	Lepidostoma	Lepidostoma	1	SHR	2
Insecta	Trichoptera	Leptoceridae	Mystacides	Mystacides sepulchralis	4	C-G	0
Insecta	Trichoptera	Leptoceridae	Oecetis	Oecetis	8	PRD	4
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra aterrima	4	C-F	4
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra obscura	4	C-F	4
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	0	C-F	3
Insecta	Trichoptera	Philopotamidae		Philopotamidae	3	C-F	
Insecta	Trichoptera	Psychomyiidae	Lype	Lype diversa	2	SCR	4
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila	0	PRD	3
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila fuscula	0	PRD	3
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila manistee	0	PRD	3
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila minora	0	PRD	3
Malacostraca	Amphipoda	Gammaridae	Gammarus	Gammarus	6	C-G	6
Malacostraca	Isopoda	Asellidae	Caecidotea	Caecidotea	8	C-G	4
Oligochaeta	Lumbricina	Lumbricina	Lumbricina	Lumbricina	8	C-G	4
Oligochaeta	Lumbriculida	Lumbriculidae		Lumbriculidae	8	C-G	4
Oligochaeta	Tubificida	Naididae		Naididae	8	C-G	4
Oligochaeta	Tubificida	Naididae	Nais	Nais behningi	6	C-G	4
Oligochaeta	Tubificida	Naididae	Nais	Nais bretscheri	6	C-G	4
Oligochaeta	Tubificida	Naididae	Nais	Nais communis	8	C-G	4
Pelecypoda	Veneroida	Corbiculidae	Corbicula	Corbicula fluminea	8	C-F	6
Pelecypoda	Veneroida	Pisidiidae	Pisidium	Pisidium	8	C-F	4
Pelecypoda	Veneroida	Pisidiidae	Sphaerium	Sphaerium	8	C-F	4
Pelecypoda	Veneroida	Sphaeriidae (Mollusca)		Sphaeriidae	8	C-F	4
Turbellaria				Turbellaria	4	PRD	4

Appendix C. Ecological attributes for fish species identified in samples collected to support the Mid-IC project (6-14%). Species are sorted alphabetically by Family then Genus species. Trophic guild are TC= top carnivore, GF= generalist feeder, BI= benthic invertivore, WC= Water column invertivore, PF= parasitic feeder. Flow guild are FD= fluvial dependant, MG= macrohabitat generalist, and FS= fluvial specialist. Pollution tolerance are T= tolerant, M= moderately tolerant, I= Intolerant.

Family	Genus species	Common name	Species code	Origin	Trophic guild	Flow guild	Pollution tollerance
Anguillidae	Anguilla rostrata	American eel	AE	Native	TC	FD	T
Catostomidae	Catostomus commersoni	White sucker	WS	native	GF	FD	T
Centrarchidae	Ambloplites rupestris	Rock bass	RB	exotic	TC	MG	M
Centrarchidae	Lepomis auritus	Redbreast sunfish	RS	native	GF	MG	M
Centrarchidae	Lepomis cyanellus	Green sunfish	GR	exotic	GF	FD	T
Centrarchidae	Lepomis gibbosus	Pumpkinseed sunfish	PS	Native	GF	MG	M
Centrarchidae	Lepomis macrochirus	Bluegill sunfish	BG	exotic	GF	MG	T
Centrarchidae	Micropterus dolomieu	Smallmouth bass	SM	exotic	TC	MG	M
Centrarchidae	Micropterus salmoides	Largemouth bass	LM	exotic	TC	MG	M
Centrarchidae	Pomoxis nigromaculatus	Black crappie	BC	exotic	TC	MG	M
Cottidae	Cottus cognathus	Slimy sculpin	SC	native	BI	FS	I
Cyprinidae	Cyprinidae		UCY		GF		
Cyprinidae	Exoglossum maxillingua	Cutlip minnow	CM	native	BI	FS	I
Cyprinidae	Luxilus cornutus	Common shiner	CS	native	GF	FD	M
Cyprinidae	Notemigonus crysoleucas	Golden shiner	GS	native	GF	MG	T
Cyprinidae	Notropis hudsonius	Spottail shiner	SS	native	WC	MG	M
Cyprinidae	Rhinichthys atratulus	Blacknose dace	BL	native	GF	FS	T
Cyprinidae	Rhinichthys cataractae	Longnose dace	LD	native	BI	FS	M
Cyprinidae	Semotilus atromaculatus	Creek chub	CR	native	GF	MG	T
Cyprinidae	Semotilus corporalis	Fall fish	FF	native	GF	FS	M
Esocidae	Esox niger	Chain pickerel	CP	native	TC	MG	M
Gadidae	Microgadus tomcod	Tomcod	TO	Native	BI	FD	
Ictaluridae	Ameiurus natalis	Yellow bullhead	YB	exotic	GF	MG	T
Ictaluridae	Ameiurus nebulosus	Brown bullhead	BB	Native	GF	MG	T
Percidae	Etheostoma olmstedi	Tessellated darter	TD	Native	BI	FS	M
Percidae	Perca flavescens	Yellow perch	YP	native	TC	MG	M
Petromyzontidae	Petromyzon marinus	Sea lamprey	SL	native	PF	FD	M
Salmonidae	Oncoricus mykiss hatcheryis	Ranbow trout stocked	RW	exotic	TC	FD	I
Salmonidae	Salmo salar hatcheryis	Altlantic salmon stocked	SA	native	TC	FS	I
Salmonidae	Salmo trutta	Brown trout	WBN	native	TC	FD	I
Salmonidae	Salmo trutta hatcheryis	Brown trout stocked	BN	exotic	TC	FD	I
Salmonidae	Salvelinus fontinalis	Brook trout	WBK	native	TC	FS	I
Salmonidae	Salvelinus fontinalis hatcheryis	Brook trout stocked	BK	native	TC	FS	I