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Prepared For:

Regional Water Authority

South Central Connecticut Regional Water Authority

2009 BENTHIC BIOLOGICAL ASSESSMENT OF THE LOWER MILL RIVER, HAMDEN/NEW HAVEN, CT

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Prepared By:

AECOM

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INTRODUCTION

The purpose of this study is to evaluate biological resources downstream of Lake Whitney in relation to resumption of water withdrawals from Lake Whitney and possible alterations to stream flows in the downstream Mill River. The study provides quantitative and qualitative information about general habitat characteristics and benthic macroinvertebrate community structure at four locations along the lower Mill River in Hamden and New Haven, CT downstream of Lake Whitney. This study summarizes survey results from 2009 and makes comparisons between pre-operation years and post-operation years as it relates to the water treatment plant.

In April 2005 the new water treatment facility which draws water from Lake Whitney went online; this study represents the fifth year of post-operational data collection. Water withdrawals from the facility are governed by a grandfathered diversion registration with the Connecticut Department of Environmental Protection and by a Management Plan developed by the SCCRWA with stakeholder involvement. The water treatment facility was operating mostly in a testing mode in 2005, and withdrawals were generally near the low end of the expected range, averaging 16 percent of the maximum allowed withdrawal. Operations in 2006 consisted of higher but still very moderate withdrawal rates, averaging 31% of the maximum allowed withdrawal. The most significant flow alteration in 2006 occurred as a result of lowering the water level of Lake Whitney for a water supply construction project. This resulted in downstream flows exceeding natural inflow during the drawdown period, followed by a period of minimum downstream releases after the project while the reservoir refilled.

Operations in 2007 consisted of low withdrawal rates, averaging only 28% of the maximum allowed withdrawal. In 2007, Lake Whitney was drawn down for dam inspection and maintenance on two occasions (June and October) for a total of 12 days. Withdrawals in the first month of 2008 were up to 85% of maximum allowed withdrawal due to low reservoir storage system-wide, but were significantly cut back as record rainfall in 2008 (highest in 97 year period of record at Whitney rain gauge) restored system storage to significantly above average levels. From late October 2008 through the end of the year, treatment plant operation was reduced to one day per week. Overall, average withdrawals in 2008 were 30% of the maximum allowed withdrawal. Reduced operation of the treatment plant that began in October 2008 carried through the entire calendar year for 2009. The plant was only operated one day per week for all of 2009, resulting in an average daily withdrawal that was 1.4% of the maximum allowable withdrawal.

While withdrawals were lower than allowable in all years since operation of the new treatment facility commenced, there was variability in flows in the river that facilitates an assessment of influences of changing flow on the macroinvertebrate community of the Mill River.

METHODS

General methods were consistent with previous years, beginning in 2000. Samples were collected on June 24 and August 20, 2009, at the peak of the tidal outflow (low tide). Sampling locations (Figure 1) were the same as in previous years since 2006. Note that in 2006 station 5 was eliminated from the monitoring program due to the tidal influences and to free up budget to facilitate focus on more detailed chironomid analysis at upstream stations. Sampling stations were longitudinal stretches, ranging from 85 to 300 ft in length (~25-90 m). Each sampling station was characterized for general habitat and instream water quality at representative sites. A single sampling location per site was used to determine water quality features on the day of sampling. Flow values were recorded as daily means from SCCRWA flow records from the Whitney Dam.

Aquatic habitat was evaluated in a qualitative to semi-quantitative way. This was a modified version of the USEPA Rapid Bioassessment Protocol (Physical Characterization / Water Quality Assessment) (Barbour et al. 1999). Aquatic habitat characterization included features such as surrounding land use, canopy cover, flow, and substrate composition for each sampling station. Water quality was assessed in a quantitative way with in situ determinations of water temperature, dissolved oxygen content, conductivity, turbidity, and pH at each sampling station.

Timed (two minutes) D-frame dip-net sampling was used to collect macroinvertebrates. This method is commonly used as a multi-habitat rapid bioassessment technique (Barbour et al. 1999). Riffle habitats were sampled at stations where riffle habitat is available, although at higher flows some of these areas could be characterized as run habitats. Macroinvertebrates were captured in the net by dislodging the substrate up to 1 ft (0.3 m) upstream of the dip-net. Two subsamples per sampling station were collected. Each subsample consisted of a two-minute collection, itself comprised of four 30-second collection efforts at four nearby locations within the site. Subsamples were preserved in 70% ethanol for laboratory analysis. Macroinvertebrates were sorted, identified to the lowest practical taxonomic level, and counted. Samples were collected during the period of low tide on both sampling dates.

After a 2005 test run with a subset of the total sample collection, Chironomidae samples were identified in 2006, 2007, 2008 and 2009 to the lowest practical taxonomic division, typically the genus or species level, to facilitate more detailed assessment of this family of flies in relation to flow and related water quality changes. Although the main focus of this monitoring program is on the impacts of changing flows, flow can affect water quality, and pollution tolerance of individual species varies within the Chironomidae family.

The two macroinvertebrate subsamples were analyzed separately, but combined into a single sample per station for data analysis. Variability among subsamples was evident, as is expected for such samples, but was not striking in most cases. Combining four subsamples for each of the two replicate samples helped minimizes variability, which can be naturally very high for macroinvertebrates.

Numerical analysis included relative abundance and dominance patterns for taxonomic and feeding groups, species richness and diversity. Species richness was expressed as number of taxa (S). Species diversity quantifies the degree of dominance (or lack thereof) of taxa within a community; it measures the distribution of individuals among taxa present. When one or a few taxa dominate a community, diversity is low. The Hilsenhoff Biotic Index (HBI), based on a quality value of 0-10 assigned to each taxon multiplied by the abundance of each corresponding taxon and divided by the total number of individuals, was calculated for each station. Modified HBI calculations were completed for all data collected from 2000-2009.   The index was modified to include non-arthropod species (Mandeville 2002). While this report adds the 2009 data to the database, the focus of this report is to examine the entire dataset and determine if there are patterns or correlations between water flow and invertebrate metrics. Additionally, data were lumped together as pre-operational and post-operational to determine if there were differences between the data for these years.

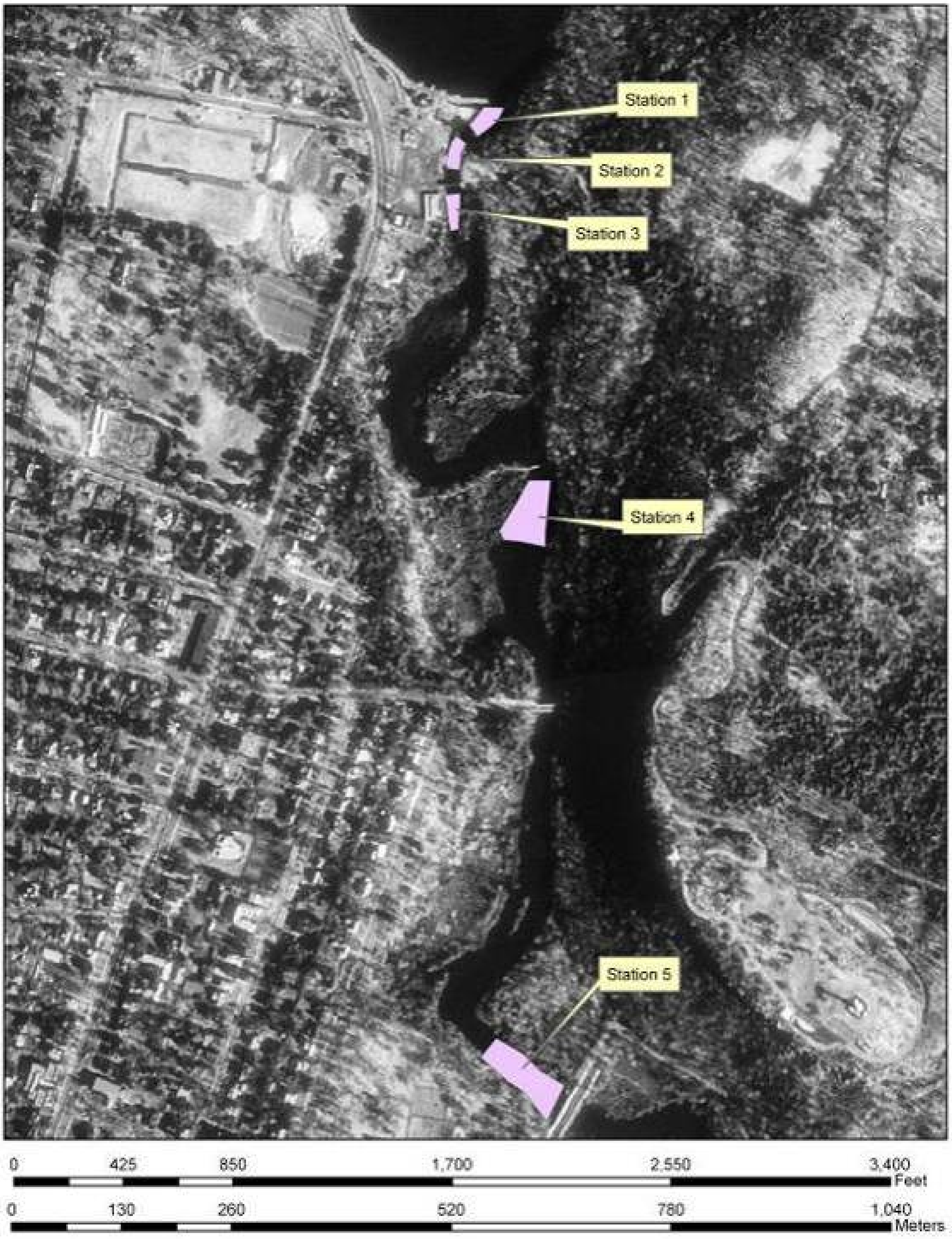

Figure 1. Locations of the five established sampling stations along the Lower Mill River in Hamden (stations 1-4) and New Haven (station 5). Station 5 was eliminated as an active biological sampling station in 2006.

RESULTS

Habitat Characterization

Predominant land use (forest and residential) and sources of pollution (storm pipes discharging at several locations between stations 2 and 4) were the same in 2009 as in all previous surveys (Table 1). Sources of pollution to the lower Mill River include a number of combined sewer overflows (CSOs), the closest to the study area being located at East Rock Road between Stations 4 and 5. CSOs can have strong but intermittent water quality impacts in the tidal areas of the river. Canopy cover reached its maximum at station 3 and its minimum at station 1. Major shore or bank erosion was not observed.

Flow is estimated by the SCCRWA using automated lake level measurements at the Lake Whitney spillway. Flows on the day of the survey are not necessarily an indication of antecedent conditions, however, and SCCRWA flow records were consulted to categorize the hydrological conditions for two and a half months before each sampling (CH2MHILL 2009). Based on factors such as tidal influence and watershed hydrologic characteristics, a wide range of flow conditions might be anticipated at any given time within the study area. Tidal influences are apparent at stations 3 and 4 as water level fluctuations. Variation in flow from Lake Whitney is the more dominant current influence at stations 1 and 2. Under low flow conditions, salinity influences at station 4 are measurable (CH2MHILL 2008). However, while water level changes with tide are evident at station 3, saltwater does not intrude this far upstream. In 2009 the average daily spring flow in the 10-week period preceding the June 24 sampling (107 mgd) was only slightly larger than the average daily summer flow preceding the August 20 sampling (100 mgd) (Table 2), the result of a wet summer.

Considering the period of record, flows in the spring of 2007 were higher than any previously observed average daily 10 week flow preceding sampling since the inception of the study program. April of 2007 was the 2nd wettest April in the 96 year period of record of rainfall measurements at Lake Whitney. Spring flow values increased each year between 2005 and 2007, decreased in 2008 and increased in 2009. Flows during spring 2008 were nearly identical to the 2004 flows. Despite elevated rainfall during the summer resulting in the 2nd wettest summer in the 97-year rain gauge record at Lake Whitney, the 10-week average flow for the period before the August 19th sampling event fell within the range of values recorded from 2005-2007. High rainfall in the summers of 2008 and 2009 kept minimum lake levels well above spillway elevation. This avoided the need to artificially release water from Lake Whitney.

The composition and distribution of aquatic vegetation in 2009 was similar to previous years. The amount of filamentous algae and rooted aquatic plants varied among sampling locations in 2009 and is likely a function of varied flow. In 2009, the abundance of aquatic macrophytes as percent cover at each station was similar at all stations, and similar to previous years. Unlike 2007 (CH2MHILL 2008), station 4 was not influenced by saltwater intrusion in 2008 or 2009 due to high precipitation and freshwater flows throughout the year (J. Hudak, personal communication).

Average stream depth and width were similar to previous years. Stream width and depth were on the higher end of stream width and depth in June 2009 and always varies slightly between sampling events due to variations in flow on the date of sampling. Tide influenced stream depth at Station 4. However, as sampling at station 4 was conducted under low tide conditions, observed fluctuations were minor in comparison with possible changes over the tidal cycle.

Inorganic substrates were generally coarser at the upstream sites (Stations 1 and 2) and progressively decreased in mean particle size in the downstream direction (Table 1). Fine-grained substrate such as silt was observed only at the most downstream station (i.e., Station 4). Data from previous years suggest particle transport is occurring during large storm events, but the amount of transport has not been examined.

Detritus (e.g., logs, wood, leaf litter) was present at relatively low levels, indicating periodic flushing as would be expected in this stream with a large watershed. Most stations had similar percentages of detritus. Station 4 had the greatest amount of detritus, but the relative amount was minimal in comparison with inorganic substrates. However, general amounts of detritus, both fine and coarse, appeared to be sufficient to support abundant populations of macroinvertebrates at all stations.

Vegetation levels in 2009 were similar to those in previous survey years, with increased macrophyte growth at stations 3 and 4, compared to stations 1 and 2. Our experiences from previous years is that species tolerant of high flow such as attached moss and filamentous green algae (Chlorophyta: Chlorophyceae) comprised the majority of the vegetation at the upstream stations (1 and 2), but presence of rooted macrophytes (mostly narrow-leaved pondweeds) was noted in the upstream area during some samplings. Filamentous algal abundance at stations 1 and 2 increased between June and August samplings, the opposite of the pattern observed in 2008. Stations 1 and 2 experienced an overall decrease in macrophyte abundance between June and August related to a narrow river channel under decreased flows, a pattern observed nearly every year.

Waterlilies (*Nymphaea* sp.), a freshwater species that prefers slow-flowing to lentic waters, were observed at the downstream stations. All the taxa of vascular plants encountered in the lower Mill River in 2009 were common taxa, tolerant of conditions such as low light, high nutrients, and salinity gradients (Crow and Hellquist 1980). Total plant coverage at the sites was within the typical ranges observed for temperate lotic systems (Allan 1995), and species present between years are similar.

In general, habitat structure was suitable for macroinvertebrates at all stations in 2009. Substrate structural complexity (i.e., spatial heterogeneity) provides a diverse habitat for invertebrates, creating "niches" dominated by different food resources and hence varied invertebrate species, and providing crevices that protect invertebrates from predation or complete dislodgement by strong currents (Hixon & Menge 1991; Allan 1995). Macrophytes also contribute to increased spatial heterogeneity by providing a substrate rich in food resources (epiphytic algae and detritus covering the plants) (Diehl & Kornijów 1998). Physical substrate (cobble and gravel substrate) and/or macrophyte cover was sufficient to potentially support a rich and diverse macroinvertebrate community at all stations. As seen in previous years, habitat quality at station 4 was not as high as at stations 1-3 in 2009.

Selected water quality parameters were assessed in 2009 during both sampling events (Table 2). Assessed water quality in 2009 was slightly different than previous years for some parameters. The pH of most samples was slightly basic to basic (Table 2). Values for pH in August 2009 were lower than 2008, where all stations had August pH values higher than any value measured previously, except for Station 1. Values for pH in 2009 increased between June and August at all stations, but remained well within the life compatible 4.5 – 9.5 range for most aquatic biota (Wetzel 2001b). Dissolved oxygen levels were above the Connecticut Water Quality Standard of 5 mg/L at all stations during the sampling in June and August, considered adequate to support aquatic life. AECOM did not observed dissolved oxygen levels below 5.0 mg/L in 2009. Weekly summer dissolved oxygen measurements by SCCRWA staff in the study area were all above 5.0 mg/L in 2009 (J. Hudak, personal communication), although monitoring in prior years indicates that summer low flow conditions can lead to values less than 5.0 mg/L at Station 4 (CH2MHILL 2009).

Salinity levels at Station 4 were about 0.1 ppt in both June and August, similar to observations in 2008, and lower than measured salinities from 2005, 2006 and 2007. Water temperature in 2009 was within the range from previous years. Water temperature in August was higher than in June, which is typical.

Specific conductivity was comparable between stations during June and August. Saltwater influence at station 4 has been responsible for increased conductivity in previous years, but high spillway flows in 2009 prevented any saltwater intrusion into the study area (J. Hudak, personal communication) There is evidence of saltwater intrusion at lower flows during dry summers, extending just upstream of Station 4 (CH2MHill 2001).

Turbidity varied among stations and dates to some degree, but was generally low at the time of sampling. Very high turbidity is known from the Mill River system upstream of Lake Whitney, but the lake acts as a detention basin and minimizes downstream transport of particles much of the time.

Table 1. - Lower Mill River habitat characterization. Data are for the June and August sampling events in 2009.

	Stn 1		Stn 2		Stn 3		Stn 4		Stn 5	
Parameters	**Jun 24**	**Aug 20**	**Jun 24**	**Aug 20**	**Jun 24**	**Aug 20**	**Jun 24**	**Aug 20**	**Jun 24**	**Aug 20**
Length of Segment	85 ft (26 m)		150 ft (46 m)		300 ft (91 m)		300 ft (91 m)		300 ft (91 m)	
Watershed/Bank Features										
predominant surrounding land use	forest/residential		forest/residential		forest/residential		forest/residential		forest/residential	
canopy cover	open		some shade (<40%)		mod. Shade (30-80%)		some shade (<40%)		some shade (<40%)	
dominant riparian vegetation	shrubs		shrubs		trees		trees/shrubs		trees	
bank stability (1)	stable		stable		stable		stable		stable	
other notable features	near dam		near dam		downstream		tidal influence		tidal influence	
In-stream Features										
general habitat type (%)										
riffle	100	100	75	80	80	100	-	-	-	-
run	-	-	25	20	20	-	90	50	-	-
pool	-	-	-		-	-	10	50	-	-
estimated stream width (ft):	85	50	70	40	95	70	125	90	-	-
estimated stream depth (ft):										
riffle	1.5	0.5	1.5	0.75	0.5	0.3	-	-	-	-
run	-	-	1.0	1.0	0.8	-	3.0	2.5	-	-
pool	-	-	-	-	-	-	3.5	3.5	-	-
inorganic substrate composition(2)										
bedrock	-	-	-	-	-	-	-	-	-	-
boulder (>256 mm)	10	10	10	10	0	5	5	5	-	-
cobble (64-256 mm)	75	75	60	60	20	20	10	10	-	-
gravel (2-64 mm)	15	15	30	20	65	65	30	30	-	-
sand (0.06-2 mm)	-	-	-	10	15	15	30	30	-	-
silt (0.004-0.006 mm)	-	-	-	-	-	-	25	25	-	-
clay (<0.004 mm)	-	-	-	-	-	-	-	-	-	-
organic substrate composition(2)										
detritus(3)	0	5	5	10	15	15	25	20	-	-
aquatic macrophytes (total)	35	30	70	65	50	45	50	60	-	-
filamentous algae	100	100	40	70	65	85	20	15	-	-
water lilies (*Nymphaea, Nuphar*)	-	-	-	-	-	5	45	50	-	-
pondweeds (*Potamogeton spp*) (4)	-	-	60	30	25	11	25	25	-	-
moss	-	-				-		-		
waterweed (*Elodea canadensis*)	-	-			10	-	10	5	-	-
tidal influence	No	No	No	No	No	No	Yes	Yes	-	-

(1) stable = minimal evidence of erosion or bank failure

(2) percent coverage

(3) logs, wood, coarse particulate organic matter

(4) narrow-leaved species.

Table 2. Water quality ranges and flows at the sampling locations in 2009. Pre-operation data is also presented as a range of values over all pre-operation years.

	Station 1					
Parameter	**Pre-operation Range**		**Jun 6 2008**		**Aug 19 2008**	
	Jun	Aug				
water temperature (°C)	17.9-23.2	19.8-26.7	18.9		26.1	
dissolved oxygen (mg/L)	8.3-9.7	5.7-9.4	8.9		7.9	
dissolved oxygen (% saturation)	99-112	71-108	95.5		97.2	
specific conductivity (μS/cm)	189-282	194-270	159		277	
turbidity (NTU)	1.0-3.2	1.6-5.6	1.8		2.2	
pH (SU)	7.2-8.5	6.8-8.4	7.5		8.0	
Flow (mgd) (Average daily flow over prior 10 weeks)	88-140	42-97	107		100	
	Station 2					
	Pre-operation Range		**Jun 6 2008**		**Aug 19 2008**	
	Jun	Aug				
water temperature (°C)	17.7-23.2	19.7-26.4	18.8		26.1	
dissolved oxygen (mg/L)	8.0-10.4	7.3-9.0	9.0		7.8	
dissolved oxygen (% saturation)	94-120	86-111	96.5		96.8	
specific conductivity (μS/cm)	190-284	192-268	159		277	
turbidity (NTU)	1.0-7.9	1.2-7.8	1.7		2.2	
pH (SU)	7.2-8.5	7.6-8.8	7.6		8.0	
Flow (mgd) (Average daily flow over prior 10 weeks)	88-140	42-97	107		100	
	Station 3					
	Pre-operation Range		**Jun 6 2008**		**Aug 19 2008**	
	Jun	Aug				
water temperature (°C)	17.6-23.3	19.7-26.7	18.9		26.0	
dissolved oxygen (mg/L)	7.9-10.2	5.9-9.3	8.9		7.4	
dissolved oxygen (% saturation)	93-117	73-109	95.3		90.6	
specific conductivity (μS/cm)	189-290	194-265	159		278	
turbidity (NTU)	1.2-3.8	1.6-4.8	1.6		2.1	
pH (SU)	7.2-8.6	7.6-8.2	7.5		7.9	
Flow (mgd) (Average daily flow over prior 10 weeks)	88-140	42-97	107		100	
	Station 4					
	Pre-operation Range		**Jun 6 2008**		**Aug 6 2008**	
	Jun	Aug	**Surface**	**Bottom**	**Surface**	**Bottom**
water temperature (°C)	17.8-23.5	19.7-30.2	19.0	25.7	19.0	25.4
dissolved oxygen (mg/L)	7.9-11.8	6.1-8.9	8.7	6.4	8.7	6.2
dissolved oxygen (% saturation)	92-134	72-117	94.2	79.0	94.2	76.1
specific conductivity (μS/cm)	189-290	194-7013	161	280	161	281
turbidity (NTU)	1.2-4.6	1.9-8.4	2.0	3.1	1.8	2.8
pH (SU)	7.3-8.8	7.2-8.3	7.4	7.6	7.4	7.5
Salinity (ppt)	-	-	0.11	0.14	0.11	0.14
Flow (mgd) (Average daily flow over prior 10 weeks)	88-140	42-97	107	107	100	100

Macroinvertebrates

This investigation focused on the invertebrate community as an indicator of conditions downstream of Lake Whitney. Invertebrates have long been used as indicators of environmental quality, and will reflect water quantity effects to the extent that water quantity affects water quality (e.g., dilution, runoff). In the extremes, water quantity can also affect invertebrates by altering the substrate (scouring or drying/oxidation), through dislodgment of biota with downstream transport, and through reduced available habitat under dry conditions. Many effects of water quantity are indirect, however, necessitating a considerable database to allow an analysis that accounts for other potentially influential factors. An initial survey of the Mill River downstream of Lake Whitney was conducted in 1998, from which it was determined that invertebrates might provide suitable indication of the impact of changing flow as a consequence of the re-activation of Lake Whitney as a water supply.

The 2009 raw data for benthic macroinvertebrates have been analyzed in several ways relevant to questions of flow impact. Total benthic macroinvertebrate abundance in 2009 (Figure 3) varied within and among stations. The obvious conclusion for previous years is that invertebrates are more abundant at stations 1-3 than at station 4. In 2009, this pattern of decreased abundance in the downstream direction was observed in June, but was not observed in August. In August 2009, station 1 had lower abundance than stations 2, 3 and 4. Station 4 had the highest invertebrate abundance in August 2009, an unusual occurrence for the period of record. There are both physical and chemical habitat changes between stations 3 and 4 that are more likely to be responsible for this difference than any variation in flow. Although not observed on the days of sampling, the primary influence for decreased abundance is likely tidal, with slower water velocities, changing direction of flow, and oscillating salinity at station 4.

In 2009 there was an increase in invertebrate abundance at all stations in June and August compared to 2008, and a nearly 3-fold increase in total abundance of all invertebrates at all stations between 2008 and 2009. Overall, however, values for abundance in 2009 were within the range of variability observed since study inception (Figure 3). Invertebrate abundance in 2009 decreased between June and August for stations 1 and 2, but increased at stations 3 and 4.

Taxonomically, the assemblage of invertebrates in the Mill River downstream of Lake Whitney exhibits mildly variable richness in 2009 (Figure 4), with between 11 and 13 taxa identified at each station for June 2009 and between 9 and 12 taxa for August 2009. The findings in 2009 are within the range encountered in previous years, where the number of taxa present at each station varied between 5 and 28. Richness in 2005-2008, since the treatment facility came online, ranged between 6 and 17 taxa, 10 and 16 taxa, 7 and 21 taxa, and 5 and 12 taxa by year, respectively. This assessment excludes the detailed Chironomidae investigation; chironomids have only been identified below the family level since 2006, and the more detailed data are addressed separately. For the purposes of consistent evaluation over the period or record, Chironomidae are listed only at the family level. Although there are compositional shifts between years, the 2009 data for identified taxa are generally consistent with those of past years. Further comparisons will emphasize the full data base from 2000 through 2009.

A cumulative look at the abundance of invertebrates within the more common taxa encountered at stations 1-3 for all years (Figures 5 and 6), indicates that some combination of the three most common taxa (*Macrostemum, Gammarus and* Chironomidae) is the most abundant each year. Data for stations 1-3 were pooled each year to determine if there were any patterns between flow (previous 10 week average) and abundance of the most common taxa. No discernable patterns exist between flow and the common taxa for June samples (Figure 5) or August samples (Figure 6). Invertebrate abundance has varied to a greater extent than average flow for the preceding 10 weeks for both June and August sampling periods; in some cases average antecedent flows have been nearly identical while invertebrate abundance has varied greatly.

Abundance of the more common taxa versus flow was examined separately for station 4 for all years. Stations 4 and 5 were found to be distinctly different than stations 1-3 in past analyses, and the discontinuation of station 5 after 2005 leaves station 4 to be analyzed over time. June and August data were examined separately to reduce any seasonal variability. At station 4, the three most common taxa over the entire study period are Chironomidae, *Gammurus and Nehelannia,* with only the last of these three taxa representing a different dominant from those at stations 1-3*.* Similar to the results for stations 1-3, no discernable pattern between station 4 dominant invertebrate abundance and flow was observed for all data since study inception (Figures 7 and 8).

In general, the common taxa observed in any one year were also encountered in the other years, although many other taxa are encountered during sampling in any year, and some taxa appear or disappear over time. For example, in 2005 two new taxa were collected: *Donacia* (leaf beetle) and *Neophylax* (caddisfly). *Donacia* has not been observed since 2005, but *Neophylax* has been collected every year since 2005. In 2007, 16 new taxa were collected in the Mill River, but most were present in low numbers. In 2008, members of the family Perlidae (stonefly) were collected for the first time. Individuals were collected in low numbers at stations 1 and 2 in June, and stations 1-3 in August. No members of the family Perlidae were collected in 2009, and no new taxa were in encountered in 2009. In previous years we found that less common taxa were not consistently observed over time or space. Rare taxa tend to be patchily distributed, and patchiness may be exacerbated by spatial habitat heterogeneity. Therefore, absence of such rare taxa in some samples or years may not mean that the taxa were not present in the lower Mill River system. Likewise, presence of some taxa at low levels may not signify a new occurrence, but rather inadequacy of the sampling program to characterize variability at finer scales. At the frequency and intensity of sampling conducted for this program, it is difficult to make projections or provide valid interpretations relating to uncommon species. Rather this effort seeks to discern any major shifts in taxonomic composition and to relate them to flow conditions where such a link is plausible. In general, such links are very weak in this system.

An alternative way to evaluate the macroinvertebrate data is to organize them by feeding groups. These groups have ecological meaning in terms of food resources and energy flow, and may be affected by flow insofar as flow affects food delivery from upstream, the growth of periphyton, and the accumulation of organic detritus. The 2009 feeding group data for stations 1-3 were combined with data from 2000-2008 and graphed against flow (Figures 9-13). General patterns of feeding group abundance between pre-operational and post-operational years appear similar, although slight shifts are present based on specific species occurrences. No discernable patterns related to flow or treatment plant operation are apparent, except that it does appear that there may be more scrapers at lower flows (Figure 12).

Hilsenhoff Biotic Index values at each station were calculated and graphed against the 10-week average flows prior to sampling for each year (Figures 14-17). The graphs do not include the HBI values for the September 2004 sampling event due to the Lake Whitney drawdown for upgrades to the dam related to the new treatment facility, and flows bypassed station 1 through the blowoff pipe. HBI values for 2009 were within the range of values observed previously. Values for all years ranged from 4.6-8.2 at Station 1, 3.7-7.0 at station 2, 4.7-7.2 at station 3, 5.5-9.0 at station 4 and 5.9-7.4 at station 5 (Table 3). Note that lower values indicate more desirable water quality on the 0-10 scale.

Of 92 recorded HBI values, 46% fall into the fair indicator range and 29% fall into the fairly poor range. Just over 14% of values were in the good indicator range, with under 7% very good values and no excellent values recorded. The remaining 4% of values were in the poor to very poor range. HBI values at stations 1-3 were within the good to fair categories for most years while stations 4 and 5 usually corresponded to the fairly poor category (Table 3). There is a consistent trend among stations for lower HBI values to be associated with higher flows; qualitative conditions for invertebrates are apparently enhanced by higher average flows over the range assessed.

To assess the impacts of the water treatment facility on the invertebrate community in the Mill River, pre-operation and post-operation data were grouped separately and graphed against flow for each sampling occasion. Flow was graphed against taxonomic richness, total individuals, evenness and diversity (Figures 18-21). Diversity values are affected by the number of taxa present at each station, while evenness is a normalized measure of diversity that puts all values on a scale of zero (low) to one (high). Pre-operation and post-operation data are similar for taxonomic richness and diversity; evenness between pre and post-operation data is also similar, although post-operational values appear to be slightly higher. Pre-operational data experienced the highest total taxa values. Total number of individuals varies between data sets, with four of the five highest numbers of individuals at any station or date occurring since the water treatment facility went online. Although slight differences in the data may be suggested visually, no trend in flow impacts is apparent.

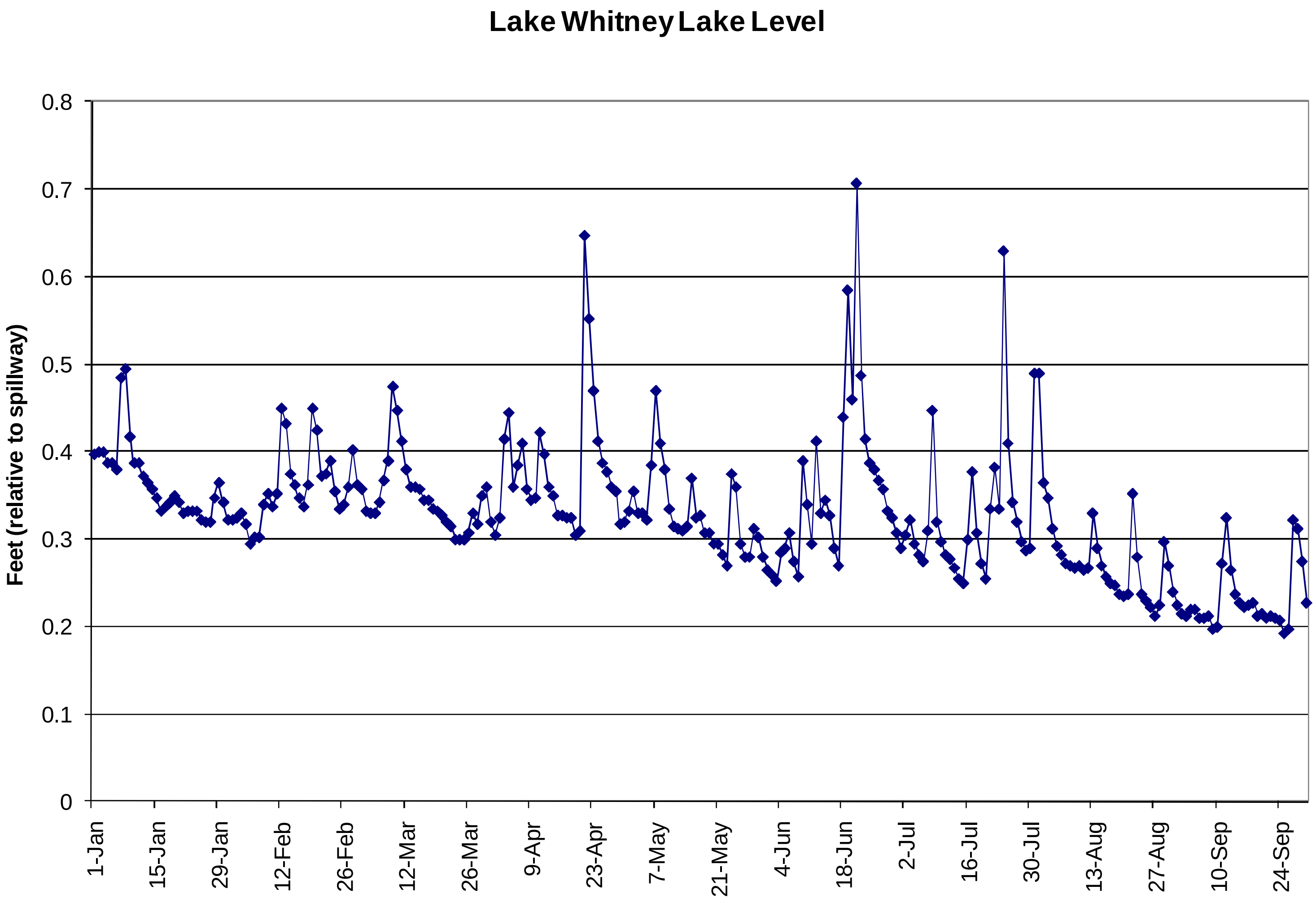

Figure 2. Mill River flows in 2009 measured at the Lake Whitney spillway.

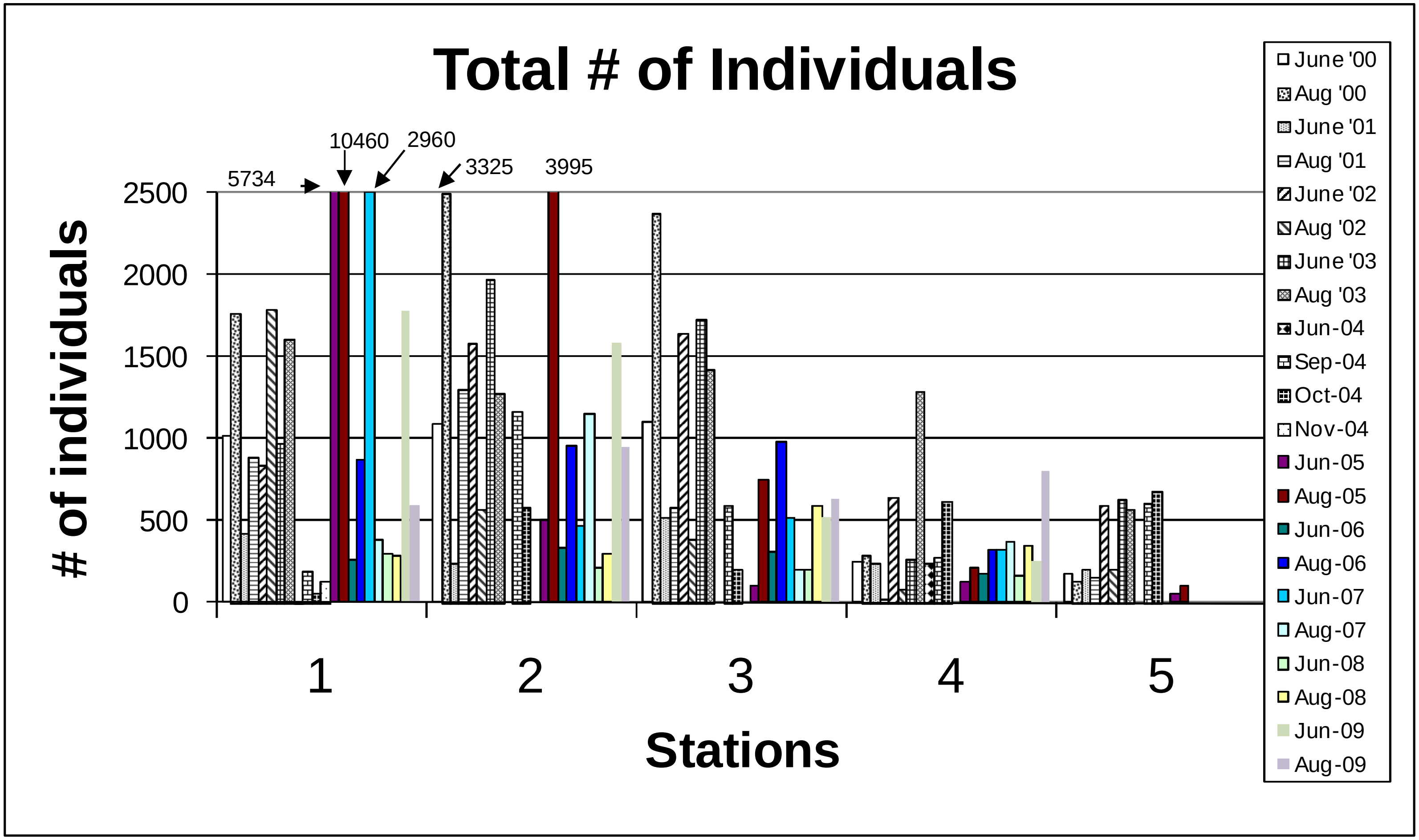

Figure 3. Total number of invertebrates over space and time in the Mill River, downstream of Lake Whitney for all years. These values are based on two timed, two minute D frame net samples.

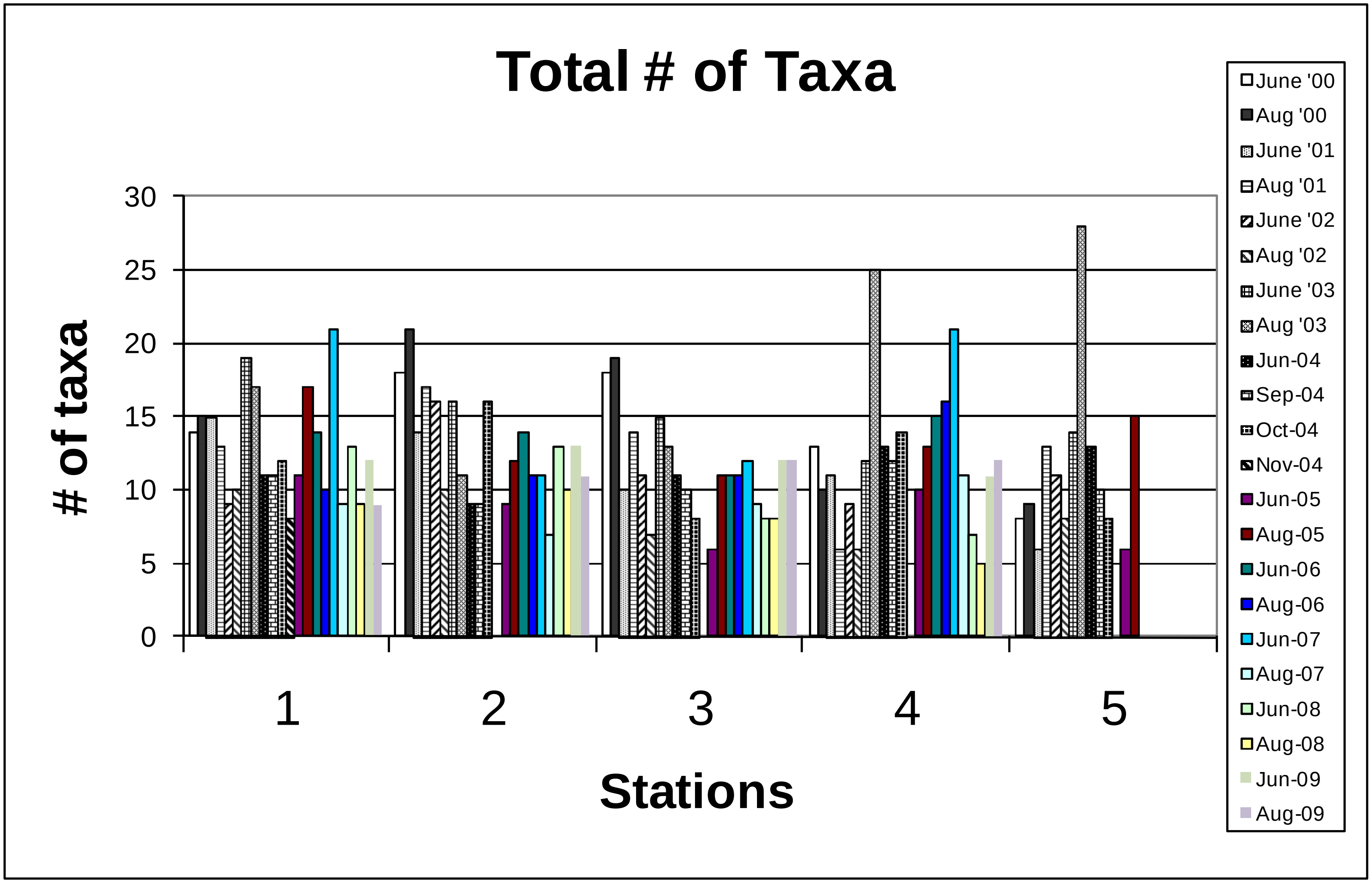

Figure 4. Benthic macroinvertebrate taxa abundance over space and time in the Mill River, downstream of Lake Whitney. Macroinvertebrate abundance is based on two timed, two minute D frame net samples.

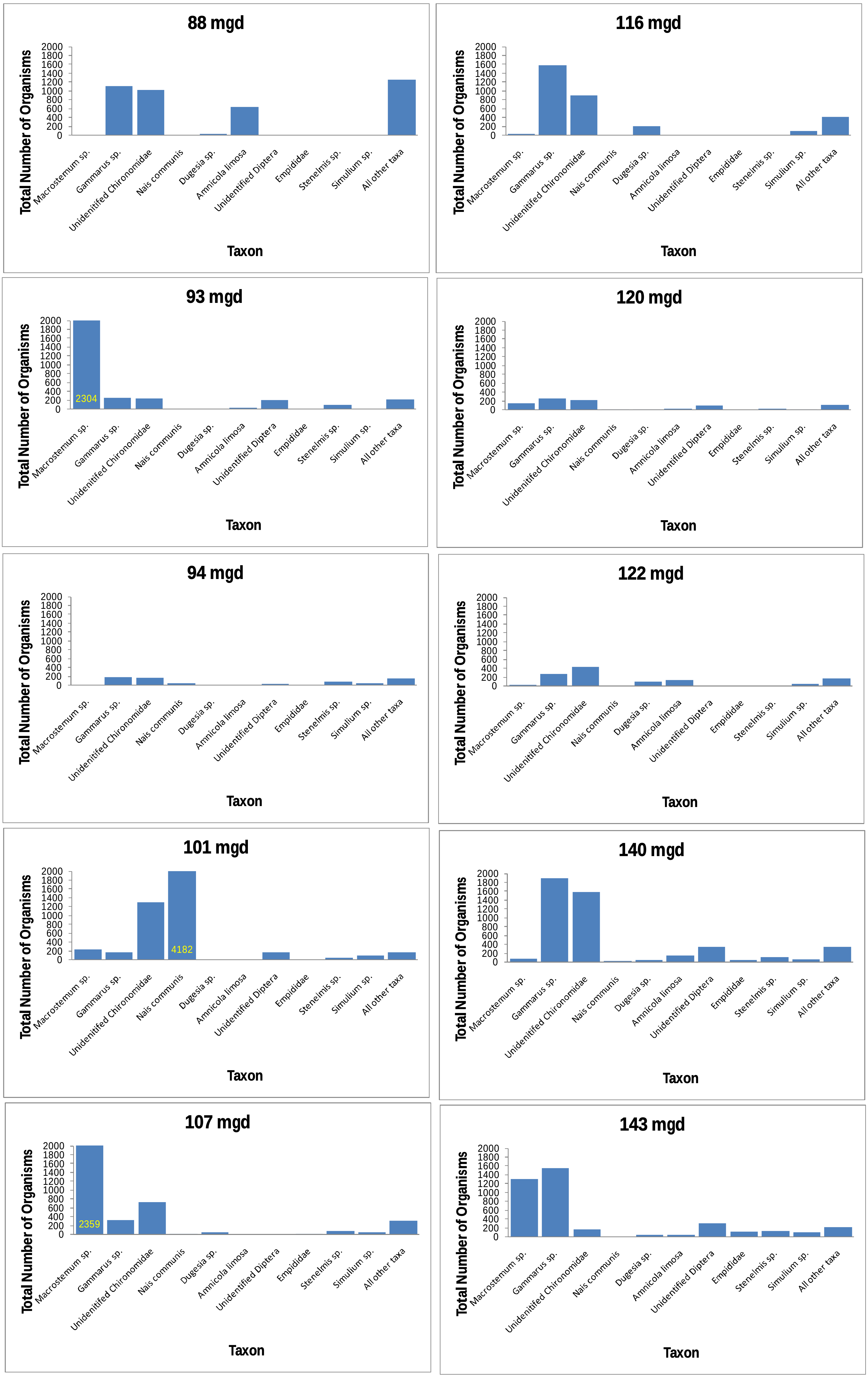

Figure 5. Graphs of the most abundant taxa at stations 1-3 for all June samples. Average flow values 10-weeks prior to sampling for each event are noted at the top.

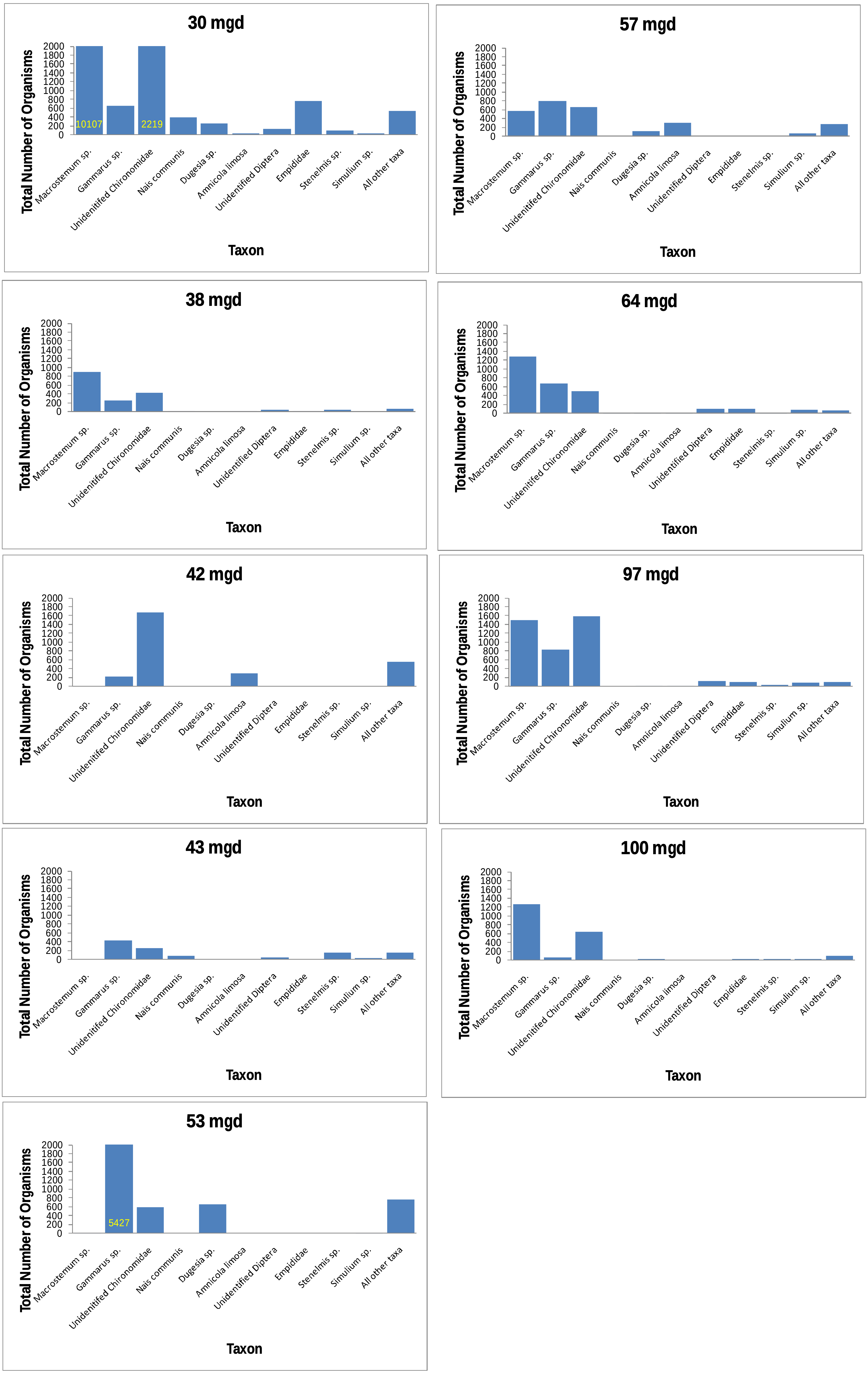

Figure 6. Graphs of the most abundant taxa at stations 1-3 for all August samples. Average flow values 10-weeks prior to sampling for each event are noted at the top.

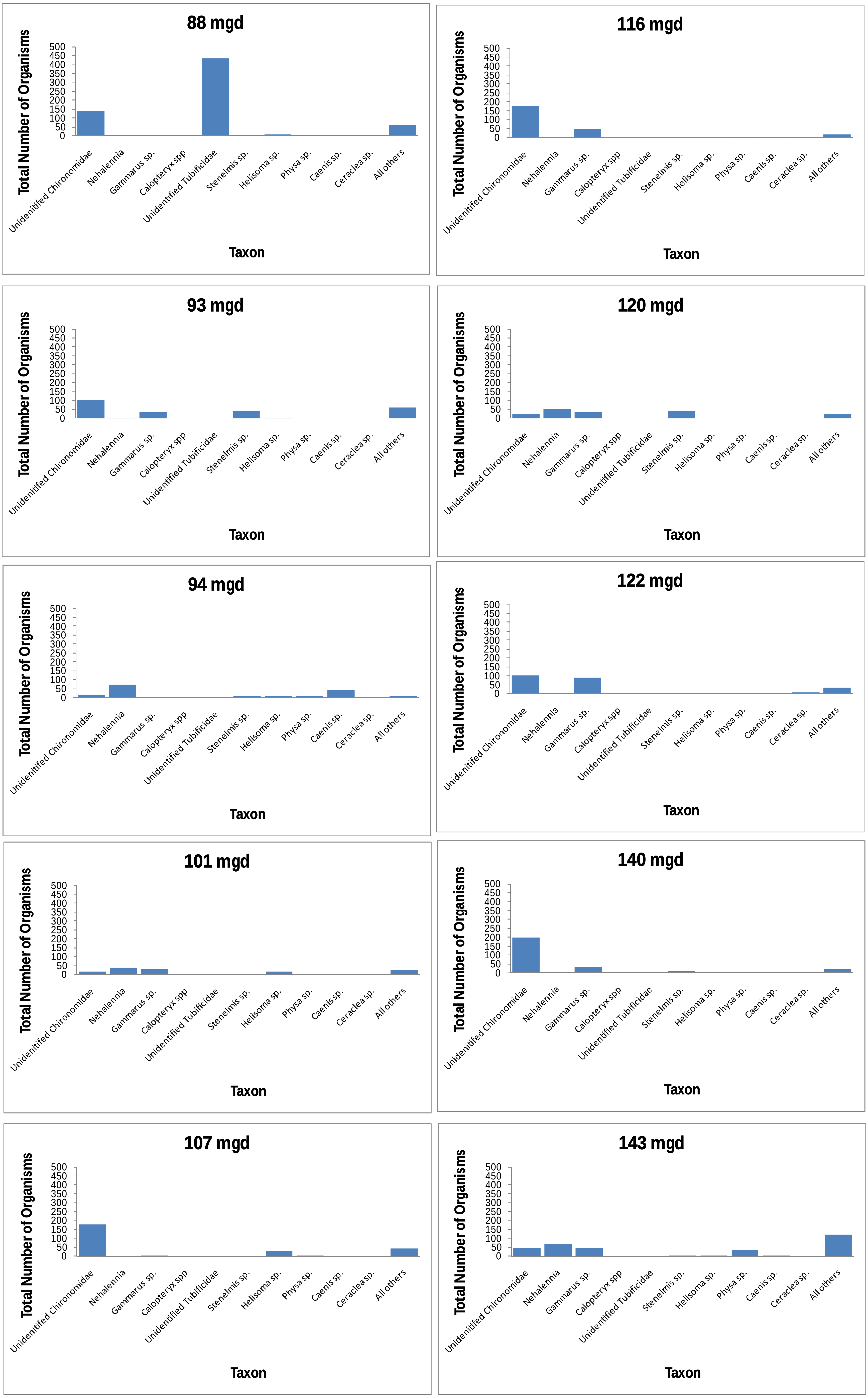

Figure 7. Graphs of the most abundant taxa at station 4 for all June samples. Average flow values 10-weeks prior to sampling for each event are noted at the top.

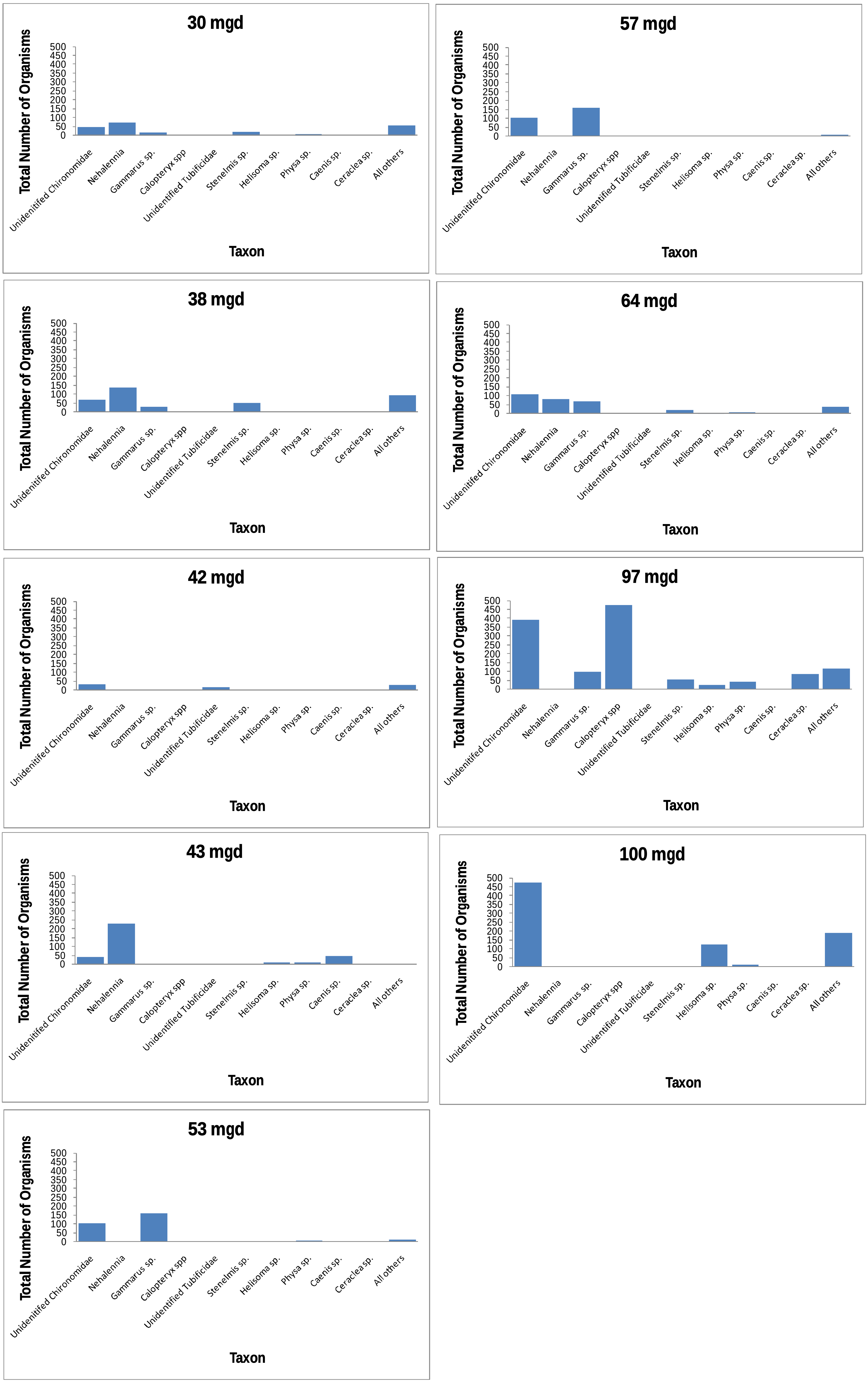

Figure 8. Graphs of the most abundant taxa at station 4 for all August samples. Average flow values 10-weeks prior to sampling for each event are noted at the top.

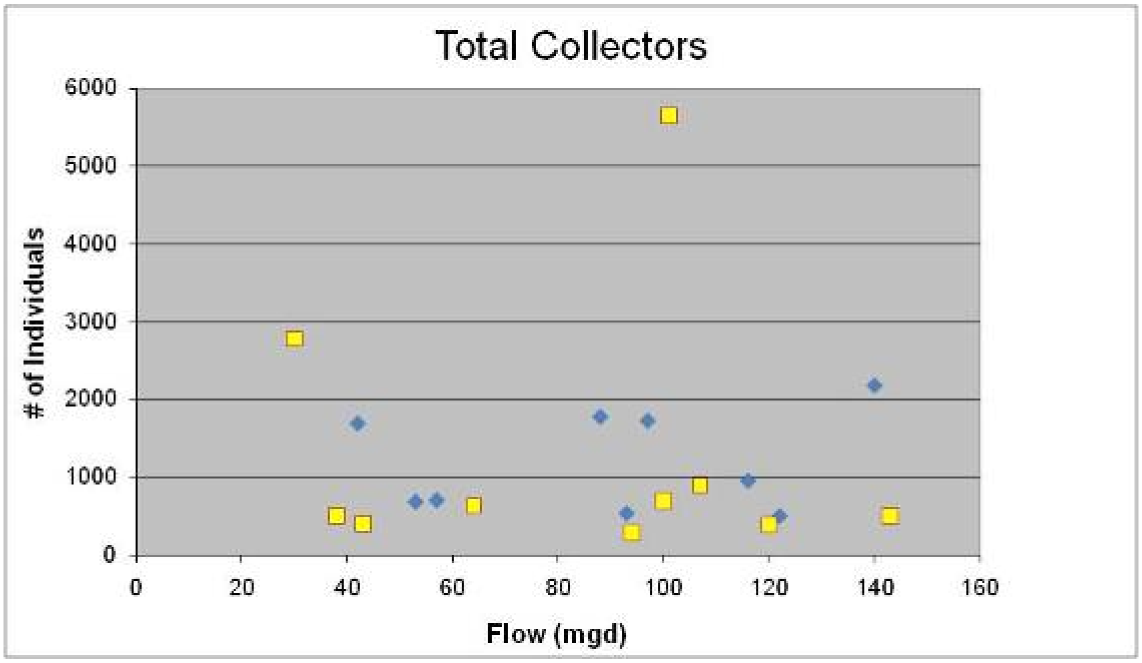

Figure 9. Total Collectors versus flow for all years. Pre-operation years are represented as blue diamonds and post-operation years are represented as yellow squares.

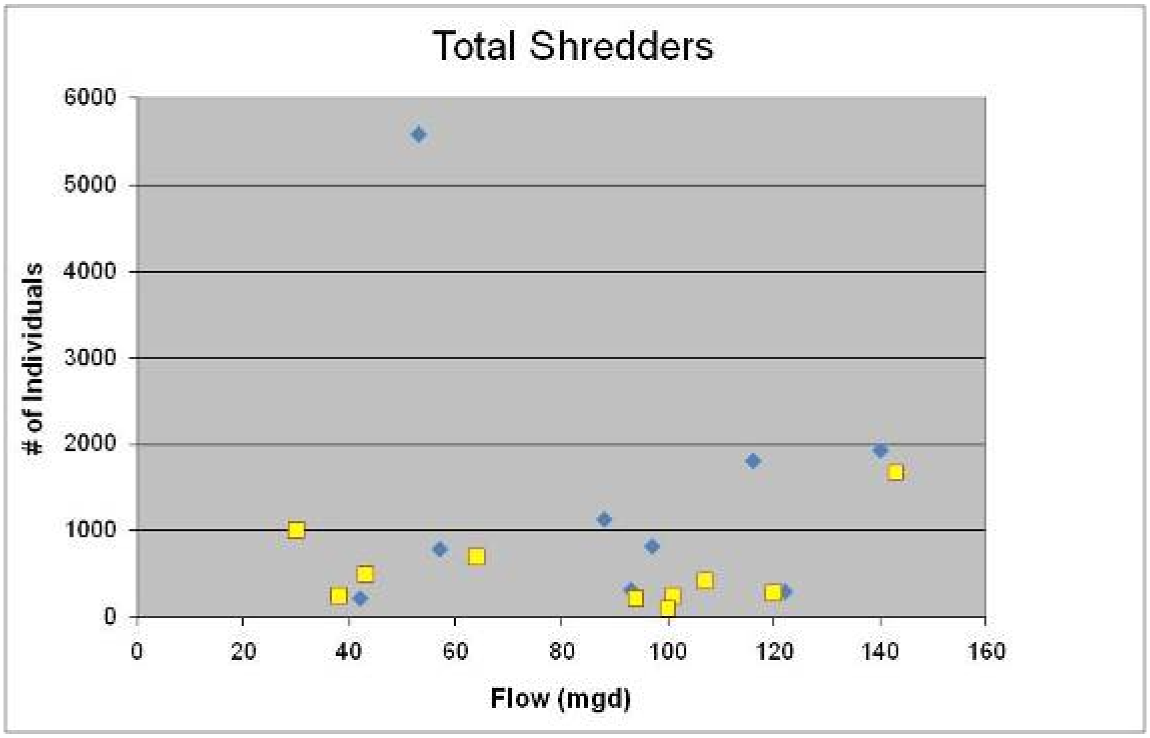

Figure 10. Total Shredders versus flow for all years. Pre-operation years are represented as blue diamonds and post-operation years are represented as yellow squares.

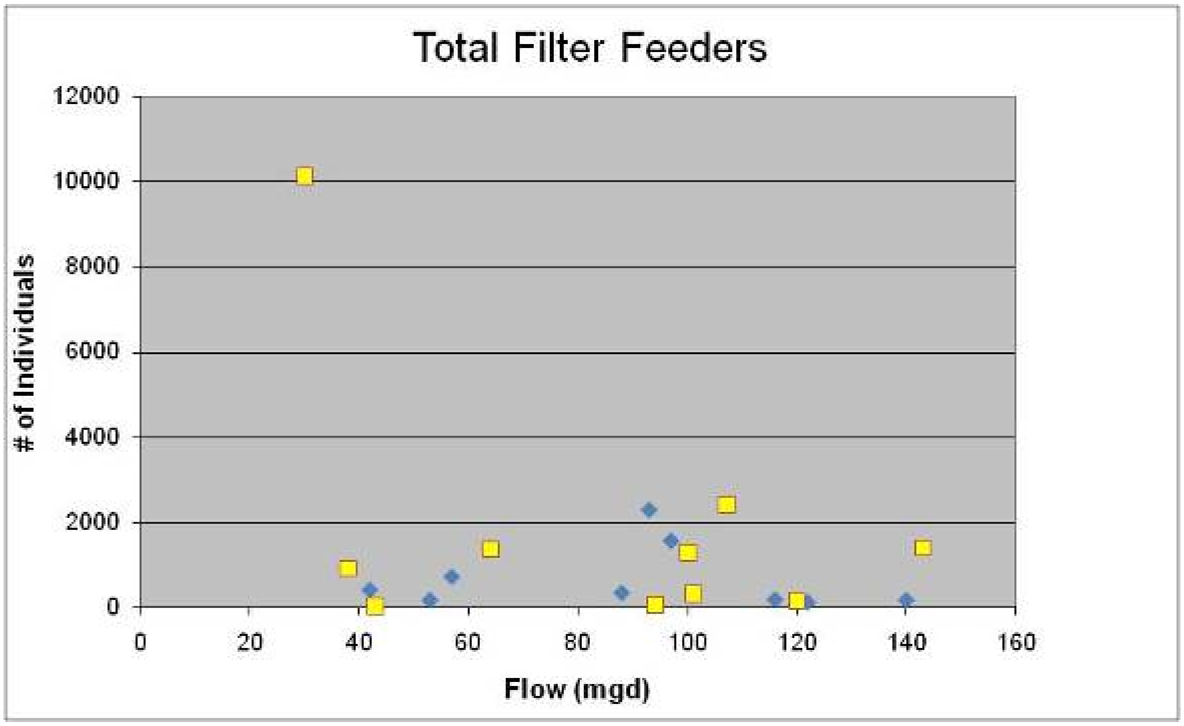

Figure 11. Total Filter Feeders versus flow for all years. Pre-operation years are represented as blue diamonds and post-operation years are represented as yellow squares.

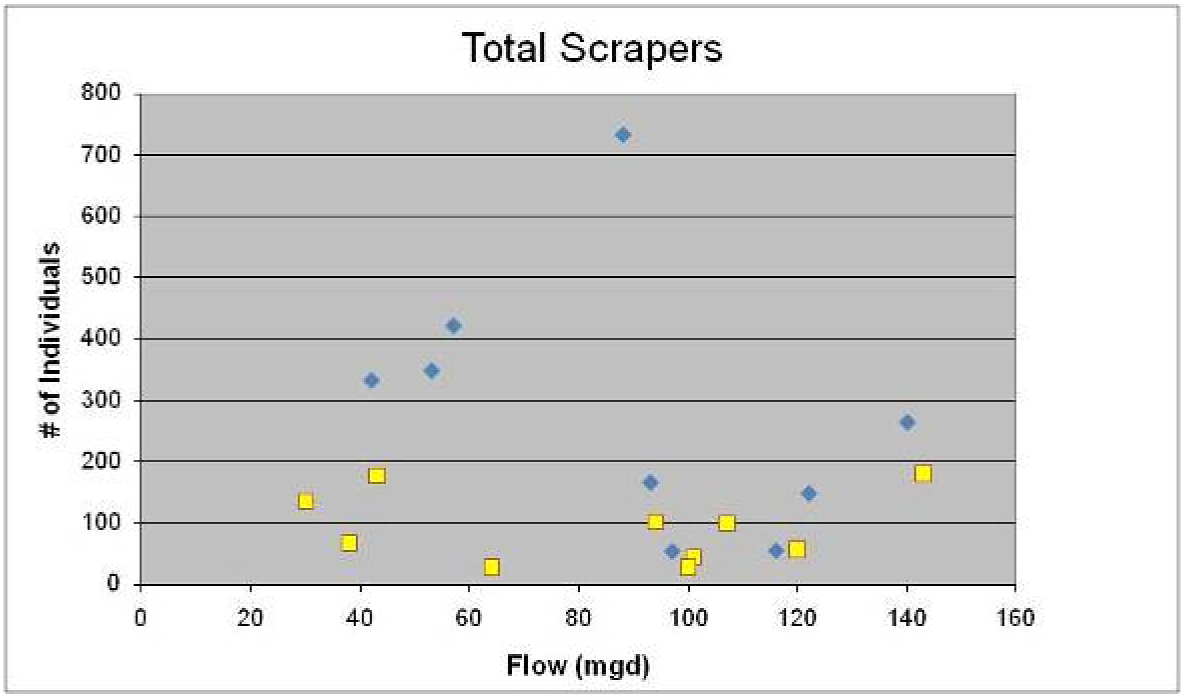

Figure 12. Total Scrapers versus flow for all years. Pre-operation years are represented as blue diamonds and post-operation years are represented as yellow squares.

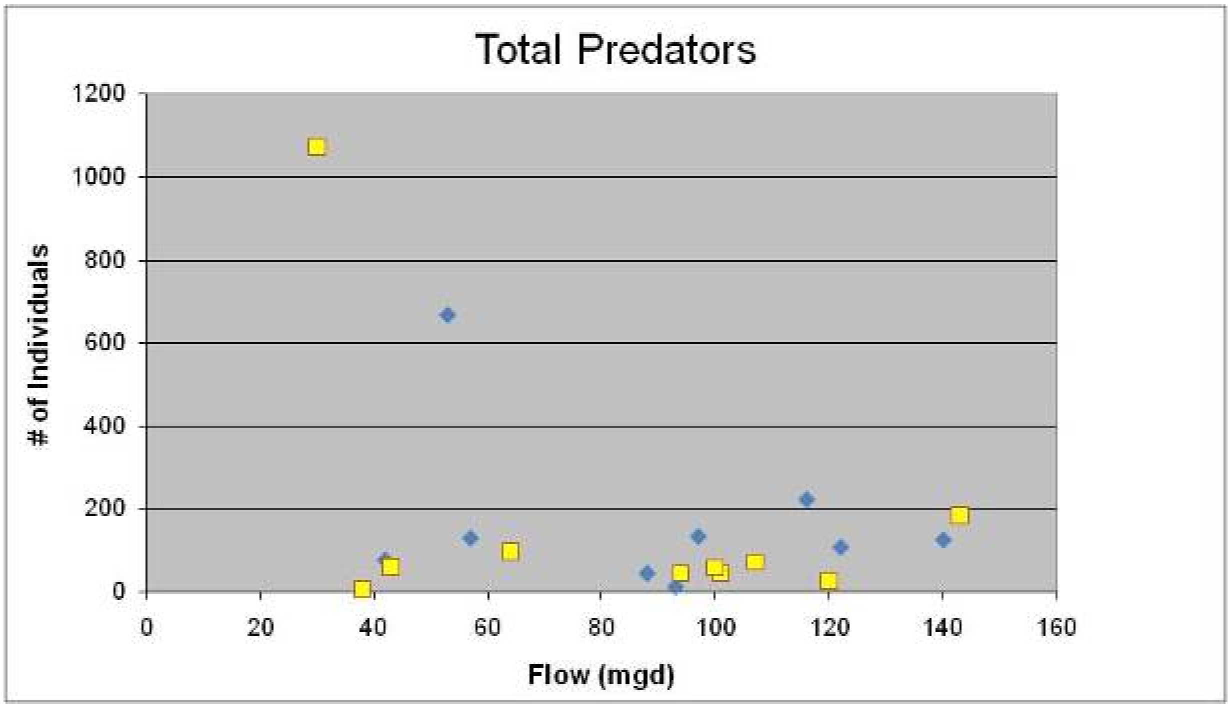

Figure 13. Total Scrapers versus flow for all years. Pre-operation years are represented as blue diamonds and post-operation years are represented as yellow squares.

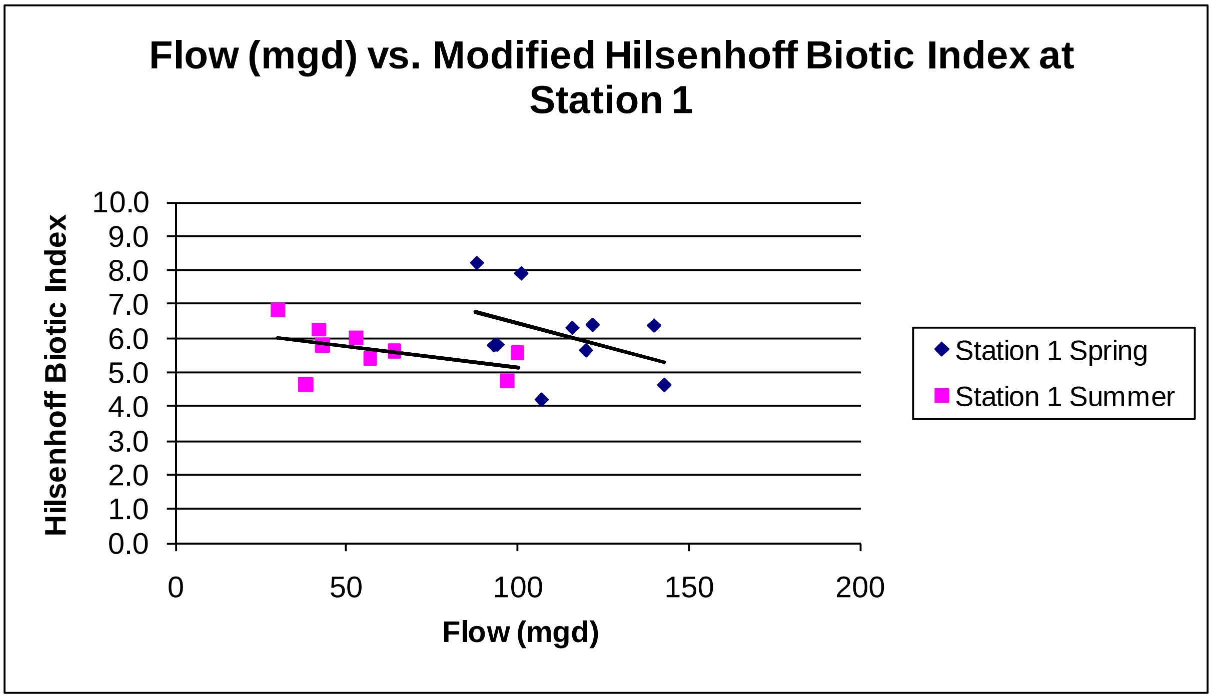

Figure 14. A graph of HBI values vs. average flow for 10 weeks prior to macroinvertebrate sampling for 2000-2009 at station 1. Flow values are based on water flow over the dam, downstream releases and blowoff.

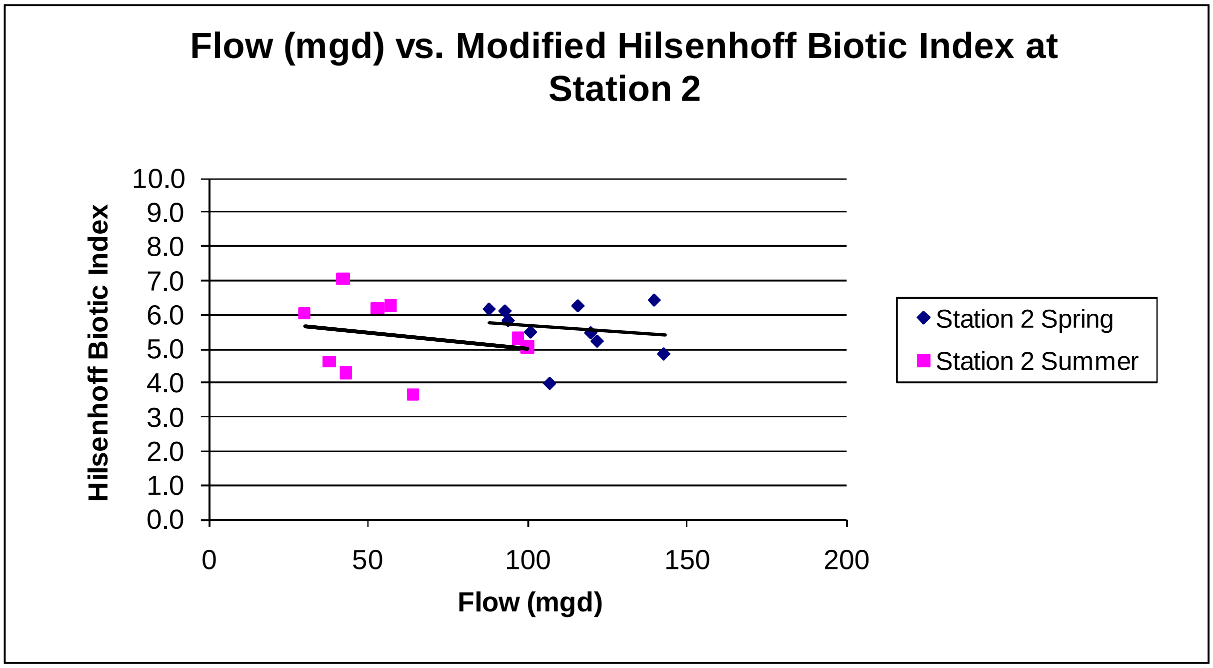

Figure 15. A graph of HBI values vs. average flow for 10 weeks prior to macroinvertebrate sampling for 2000-2009 at station 2. Flow values are based on water flow over the dam, downstream releases and blowoff.

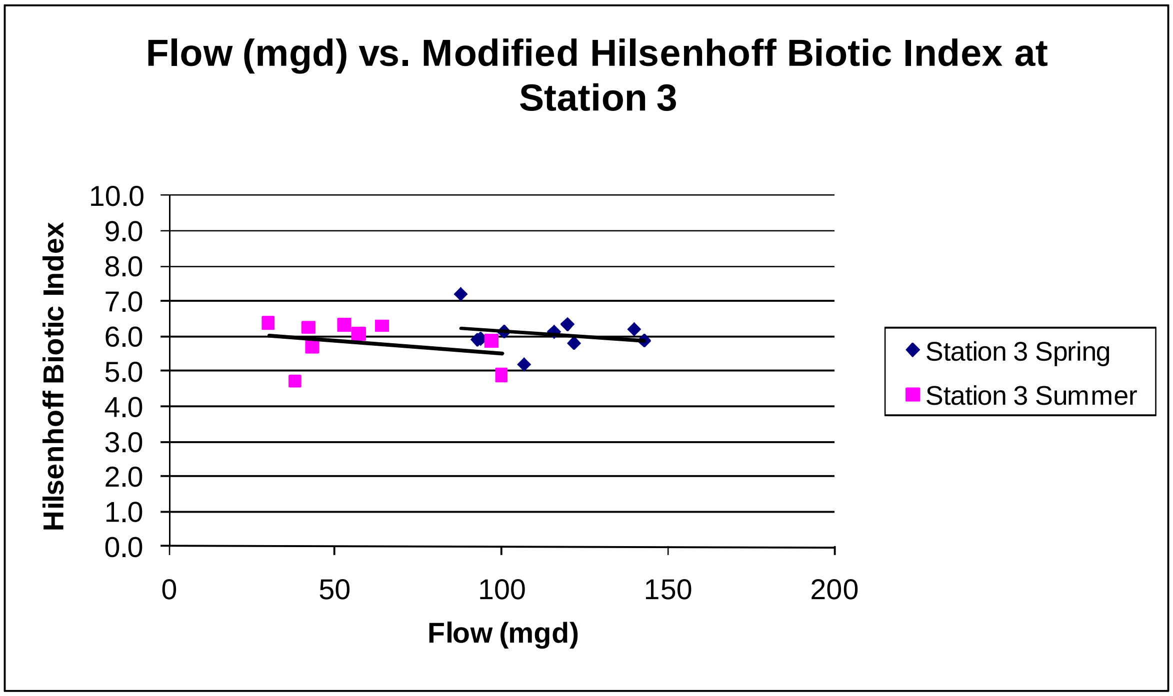

Figure 16. A graph of HBI values vs. average flow for 10 weeks prior to macroinvertebrate sampling for 2000-2009 at station 3. Flow values are based on water flow over the dam, downstream releases and blowoff.

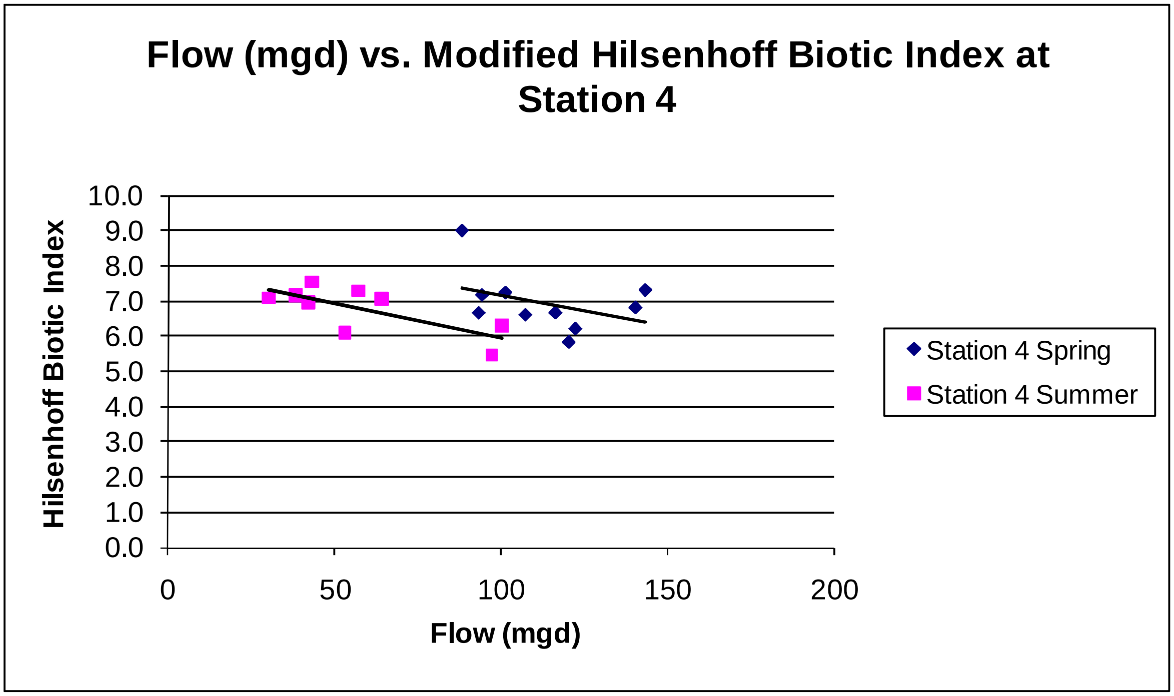

Figure 17. A graph of HBI values vs. average flow for 10 weeks prior to macroinvertebrate sampling for 2000-2009 at station 4. Flow values are based on water flow over the dam, downstream releases and blowoff.

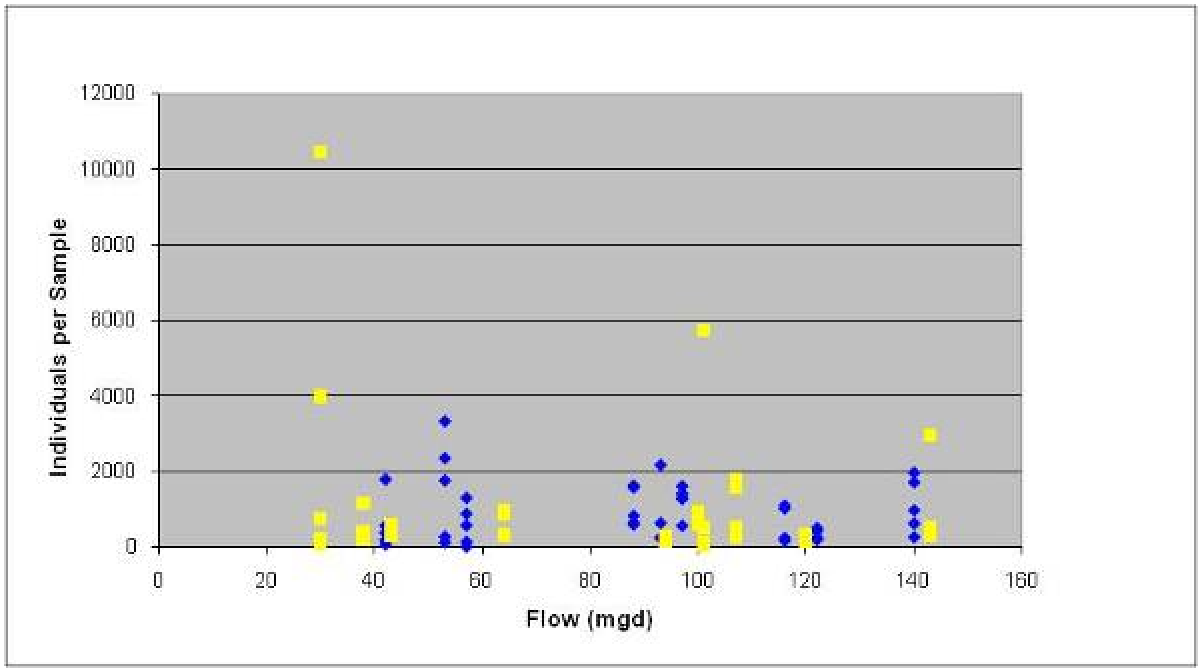

Figure 18. A graph of average flow for 10 weeks prior to macroinvertebrate sampling vs. total number of individuals for 2000-2009 invertebrate data. Pre-operation data are represented by blue diamonds while post-operation data are represented by yellow squares.

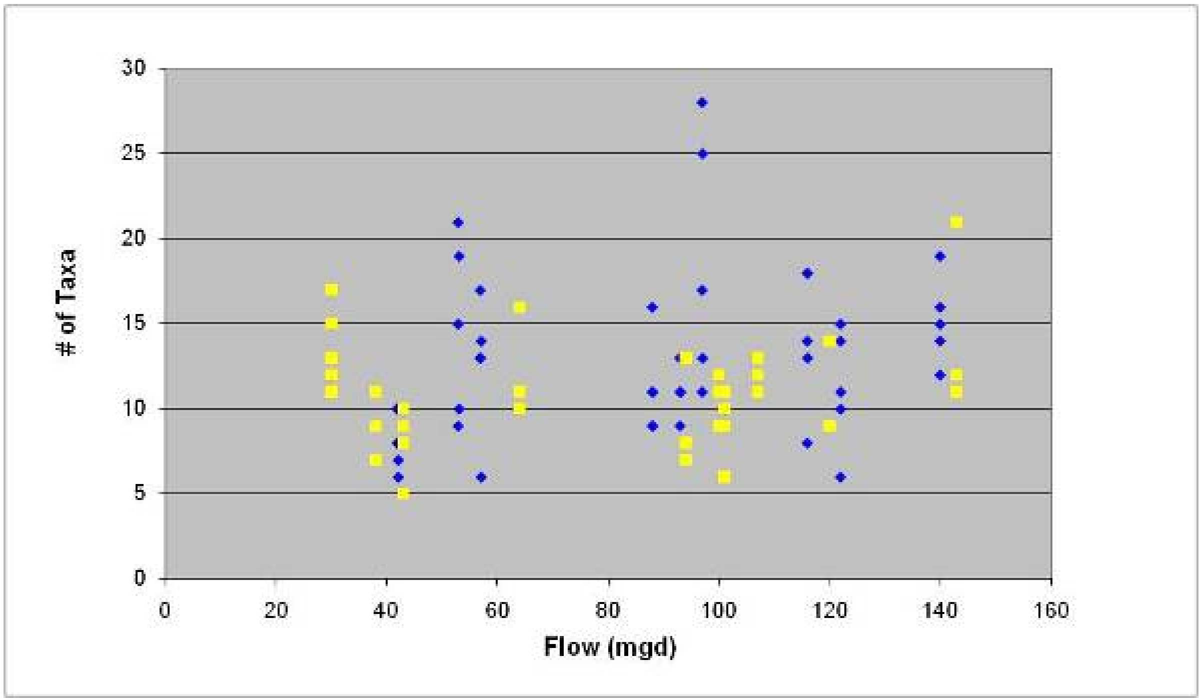

Figure 19. A graph of average flow for 10 weeks prior to macroinvertebrate sampling vs. number of taxa for 2000-2008 invertebrate data. Pre-operation data are represented by blue diamonds while post-operation data are represented by yellow squares.

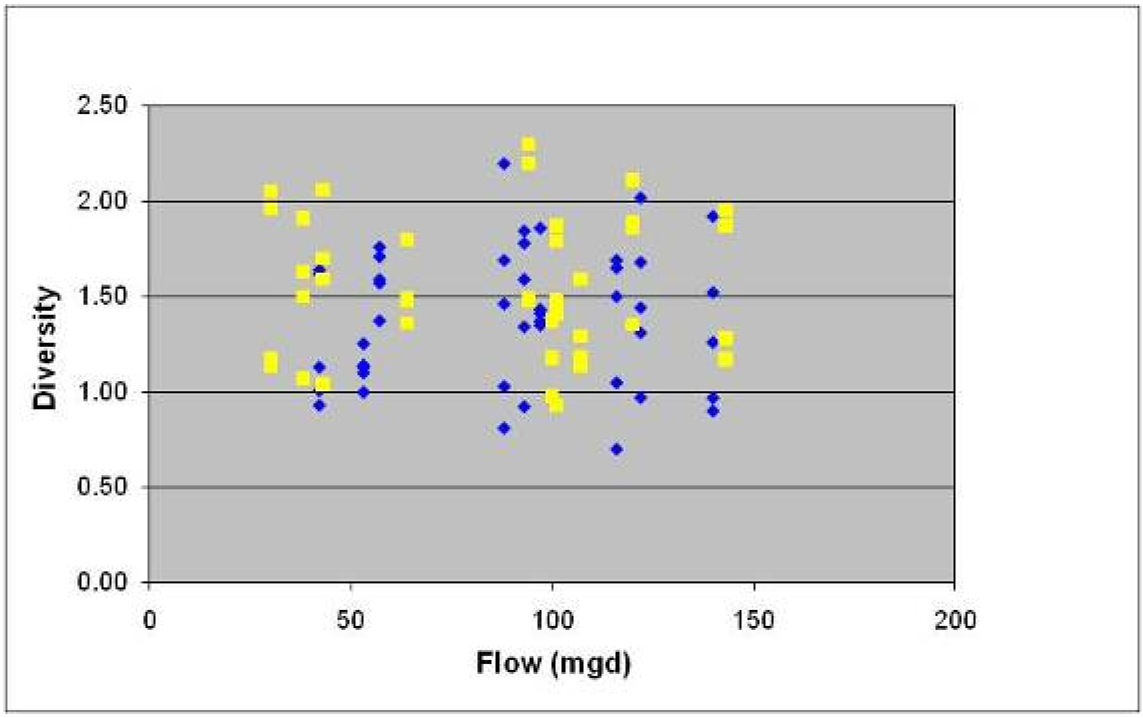

Figure 20. **A graph of average flow for 10 weeks prior to macroinvertebrate sampling vs. diversity for 2000-2009 invertebrate data. Pre-operation data are represented by blue diamonds while post-operation data are represented by yellow squares.**

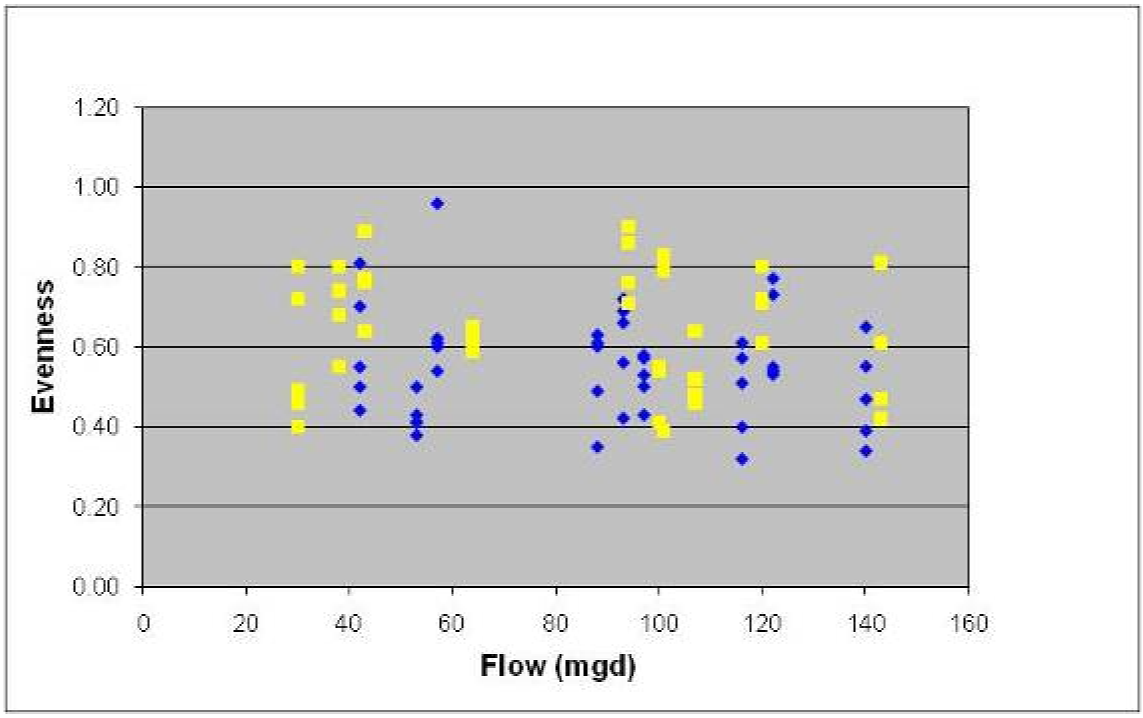

Figure 21. **A graph of average flow for 10 weeks prior to macroinvertebrate sampling vs. evenness for 2000-2009 invertebrate data. Pre-operation data are represented by blue diamonds while post-operation data are represented by yellow squares.**

Table 3. Tabular results of the Modified Hilsenhoff Biotic Index values for 2000-2009 at each station and the corresponding flows. Flow data for September 2004 are not available due to the Lake Whitney drawdown for maintenance. Modified HBI values with suggested water quality designation and degree of organic pollution. Table taken from Mandeville 2002.

	2000		2001		2002		2003		2004	
	June	August	June	August	June	August	June	August	June	September
Station 1	6.3	6.0	6.4	5.4	8.2	6.3	6.4	4.8	5.8	6.8
Station 2	6.3	6.2	5.2	6.3	6.2	7.0	6.4	5.3	6.1	6.0
Station 3	6.1	6.3	5.8	6.1	7.2	6.3	6.2	5.9	5.9	5.6
Station 4	6.7	6.1	6.2	7.3	9.0	6.9	6.8	5.5	6.7	6.8
Station 5	7.2	6.6	6.7	5.9	7.1	6.8	7.1	6.8	7.1	7.4
Flow (mgd)	116	53	122	57	88	42	140	97	93	

	2005		2006		2007		2008		2009	
	June	August	June	August	June	August	June	August	June	August
Station 1	7.9	5.6	5.7	4.6	4.6	5.8	5.8	5.6	4.2	4.5
Station 2	5.5	3.7	5.5	4.6	4.9	4.3	5.8	5.1	4.0	4.1
Station 3	6.1	6.4	6.3	6.3	5.9	4.7	5.9	5.7	5.2	4.9
Station 4	7.2	7.1	5.8	7.1	7.3	7.2	7.2	7.5	6.6	6.3
Station 5	6.9	6.9	*	*	*	*	*	*	*	*
Flow (mgd)	101	30	120	64	143	38	94	43	107	100

Biotic Index	**Water Quality**	**Degree of Organic Pollution**
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very Good	Possible slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly Poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.00	Very Poor	Severe organic pollution

2009 Lower Mill River Chironomid Taxonomic Study

Analysis of Mill River chironomids from all 2009 samples collected at stations 1-4 during June and August was conducted to assess variability in responses to hydrologic changes among subclassifications of chironomids beyond family level. Further identification of chironomids involves additional sample preparation and examination at higher magnification, which was performed on a subset of previous samples in 2005 to assess potential richness increases. On the advice of the Whitney Environmental Study Team (EST) that provides oversight for the overall environmental monitoring program, the SCCRWA agreed to expand sample analysis going forward to include this more detailed assessment of chironomids, although there is no pre-operational data to which these new data can be compared. Identifications followed Epler (2001), with consideration of Simpson and Bode (1980), an older but regionally appropriate text. Although operation of the Whitney treatment facility was feasible in 2009, wet conditions limited the need for water from this system, and the results from 2009 are more indicative of a non-operational period.

The results presented in Table 4 demonstrate moderate taxonomic richness and fairly consistent composition between stations and dates. There were a total of thirteen (13) taxa identified in 2009, representing four sub-families of the Chironomidae. This represents an increase from 10 taxa from three sub-families in 2008. Four species have occurred in a majority of samples from 2006-2009. One new group of chironomids was identified in 2009, the Thienemannimyia group. The dominant taxon varied slightly between stations and sampling dates. The four common chironomids in the June 2009 samples, in order of abundance were *Dicrotendipes neomodestus, Cricotopus trifascia, Polypedilum flavum*, and members from the Thienemannimyia group. All but the Thienemannimyia group have been common in previous samples. In August, these taxa were present but there was a slight shift in abundance. In August, the most common taxon present was *Cricotopus trifascia*, followed by *Polypedilum flavum*, members of the group Thienemannimyia, and *Dicrotendipes neomodestus.* Remaining chironomid taxa were found at low densities or in just a few samples. The number of taxa present in the 2009 samples is within the range of taxa encountered in previous years. The total number of individuals increased in 2009 compared to previous years (2006-2007). It is important to note however, that dominant species are similar over all four years

The ecological indications of virtually all encountered species demonstrate minimal water quality preference (found in a wide range of chemical conditions), high tolerance for elevated nutrients and organic matter (eutrophic conditions), and wide tolerance of current speed with a general preference for moderate to high velocities. The ecological indications of the chironomid species present in the Mill River downstream of the Lake Whitney dam are entirely consistent with observed conditions.

Table 4. Tabular results of the Chironomid analysis from 2006-2009.

	1-Jun-06				17-Aug-06				19-Jun-07				15-Aug-07				6-Jun-08				19-Aug-08				24-Jun-09				20-Aug-09			
	Stations				Stations				Stations				Stations				Stations				Stations				Stations				Stations			
Taxon	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Chironominae																																
Chironomini																																
Chironomus riparius					2																				3				1	1	1	
Dicrotendipes neomodestus				1	28	80	15	18	42	1	11		12	5	6	5		3	21	1	10	1			3	15	12	11	2	11		12
Glyptotendipes lobiferus			5	2	3	6	10	14		3			8	10			1	4	1	1		3		6		1		7	7	6	5	3
Paratendipes albimanus					6	8																										
Polypedilum flavum	30	40	55	8	52	48	24	30	8	11	1		6	31	5	7	9	6		3		5	13	5	6	8	12	1	5		23	12
Polypedilum braseniae				1																		1										3
Polypedilum sp.							1																					1		9		
Tanytarsini																																
Paratanytarsus sp.							1																		5		2	2				11
Rheotanytarsus exiguus group				3		3	4		13					5		1									1			1	2			
Orthocladiinae																																
Cardiocladius obscurum												12	2	2	2			4		2	2				2	1			5	2	1	3
Cricotopus trifascia	5	3	17	2	10		30	22				23	10	14	9	7	3	1		3	9	5	3	4	14	4	5	6	5	9	26	64
Cricotopus intersectus		5		2	4	6	12		2	3			1	4			6						4	2								
Cricotopus tibialis		1																														
Cricotopus sylvestris		3	1														1									1		5	1	1	1	
Eukiefferiella tirolensis	8																				7	5	3	1			4	1	1			
Tanypodinae																																
Procladius sp.											2								1													
Thienemannimyia group																									4	3	1	7	14		13	2

DISCUSSION

Hydrologic conditions in 2009 varied, with more high flows than in most years of study, and average flow for the 10 weeks preceding sampling events was more similar for June and August samplings than in preceding years. Average spring flow in 2009 was within the range encountered to date, while the average summer flow in 2009 was the highest recorded so far in this study. Channel width and depth at each station were comparable to the range of values measured previously, but both decreased slightly between June and August as expected with decreased summer flows. However, increased rainfall totals during the summer of 2009 resulted in higher than average flows leading up to the August 2009 sampling event; the spring to summer decrease was not substantial in 2009. Elevated flows ensured that a substantial amount of suitable benthic habitat was available for macroinvertebrates and other organisms in 2009, but high flows can have direct impacts through wash-out related to elevated velocities. Data for 2009 added the fifth year of post-operational data to go with five years of pre-operational data, and facilitated an analysis of the overall dataset to date.

Differences in macroinvertebrate taxonomic composition between upstream (stations 1 through 3) and downstream (station 4) areas may be ascribed mostly to differences in physical habitat and salinity exposure. Keeping station 4 separate from other stations in the overall analysis of changes in response to flow or treatment facility operation is considered justified and minimizes potentially confounding variability. In both 2008 and 2009, the August sampling deviated from observations in previous years as station 4 invertebrate abundance was higher than at stations 1 and 2; this appears related to reduced exposure to salinity in 2008 and 2009 compared to previous years.

Flow is a potentially important factor in shaping the invertebrate community of the lower Mill river, and specific changes in the invertebrate community may be explained by key flow events. The strikingly high invertebrate abundance at Stations 1 and 2 in 2005 after a prolonged period of flow diversion around these stations was followed by a return to more typical densities in 2006. Initial recolonization of new substrates at station 1 in 2005, along with favorable flows and velocities, likely resulted in the observed increases in abundance. The return to lower densities may be related to a combination of normal successional forces and elevated water velocities as experienced during multiple large storms and elevated summer downstream flows associated with a drawdown of the reservoir in 2006.

Some relationships are not so obvious, however. There does appear to be a pattern of alternating years of decreased and increased invertebrate abundance at station 1, with higher values in odd years; June 2009 invertebrate abundance at station 1 was nearly 6 times greater than observed abundance in 2008, and 2 times greater between August samples for those years. This instability has not been adequately explained by any factors we have examined. In most cases, however, increased abundance is related to increases in just a few taxa, suggesting opportunistic activity when resources (space or food under favorable water quality) are available and substantial fluctuations in that availability. Lack of stability may be a function of varying flows, but the influence of the water treatment facility withdrawal is very minor in that regard.

Abundance of the most common taxa observed over all years does not appear to be related to flow (Figures 5-8). The three most common taxa at stations 1-3 for all years did not increase in abundance with increased flows. Invertebrate abundance at stations 1-3 was highest under the lowest flow observed since study inception (30 mgd), but similar flow values did not necessarily result in high abundance of these species. The most common taxa were present at stations 1-3 under moderate and high flows as well. At station 4, the highest invertebrate abundances appear to occur under moderate flows, but increased abundances of some taxa have occurred under both lower and higher flows. Flow itself may be influential in setting habitat, affecting water quality, and washing invertebrates downstream, but is not the sole factor affecting abundance or composition of the invertebrate community, and may not be the primary factor.

No clear patterns are apparent in the analysis of feeding guild versus flow. Increased flow did not result in increased presence of any one particular feeding group (Figures 9-13), although decreased flow may favor the scraper group. This is consistent with the ecology of that group, which scrapes attached algae and related organic matter off of rocks and other substrates. Such accumulations will be higher with low flows, while the quantity and quality of suspended particles may be reduced at low flows. However, there was not a clear increase in suspended particulate feeders at high flows, perhaps indicating a confining influence of flow (more specifically velocity) on abundance.

High values for any one feeding group are usually related to increased abundance of one or two particular taxa. Grouping the data as pre-operation and post-operation sets as relates to the water treatment facility does not suggest any patterns in feeding group abundance or indicate any shifts between feeding groups as a result of the treatment facility operation. A range of flows have been experienced in pre-operation and post-operation years, and the abundance of any one feeding group for a particular range of flows is variable.

In general, the macroinvertebrate assemblages observed in the Mill River since 2000 are indicative of intermediate stream community health. The taxa collected in the Mill River may be commonly found in a range of environments (e.g., worms, scuds, prosobranch snails, caddisflies, mayflies). Most taxa found were typical of urban freshwater habitats (Walsh et al. 2001), where water quality impacts are common. Midges (Diptera, Chironomidae) which were common invertebrates, can be found in a variety of freshwater habitats (Wetzel 2001c), but their dominance in a community is often regarded as a sign of degraded conditions. More detailed assessment of chironomid species supports this assessment. There is no indication of any strong pattern over time, independent of possible causative agents. As this analysis is primarily focused on flow-induced impacts, we have not examined other possible influences in great detail. While there are spatial patterns that may be linked to tidal influences and CSO inputs, the temporal pattern is not indicative of any longer term directional shift in the invertebrate community.

Overall, and fairly consistently at each assessed station, the HBI value declined, suggesting better water quality, with increasing average flows for the preceding 10-week period. While storm water runoff is a concern in the contributory watershed, water quality features of primary importance to invertebrates are apparently positively influenced by higher flows. This may include temperature and oxygen, and possibly pH, all of which can be altered by detention in upstream Lake Whitney. However, as the quality indications of the HBI are moderate overall, it is apparent that water quality in the lower Mill River is suboptimal at all flow levels assessed.

Reduced flow may decrease invertebrate density and diversity (Gørtz 1998; Brunke et al. 2001), but high flow may directly remove invertebrates and interacts with the physical structure of the habitat in ways that affect future support of invertebrate populations. Streams with relatively low flow but a high degree of habitat heterogeneity (coarse detritus, rocks, submerged vegetation) may still support high invertebrate density, taxonomic richness and diversity (Brunke et al. 2001). Increased vegetation cover may be expected at lower flow regimes, thus counterbalancing the potentially negative effects of decreased flow by increasing substrate heterogeneity. Shifts in composition may reflect changes in habitat features, while abundance remains less altered. Decreases in abundance, with limited changes in composition, may reflect direct impacts of high flows. Relatively rapid response of invertebrate communities suggests that recovery will occur within months after any flood or drought period. In the Mill River, macroinvertebrate density tends to increase slightly with decreasing flow, but absolute abundance over the stream channel may decrease as a function of decreased stream area.

Effects of changing salinity on the lower Mill River invertebrate assemblages are difficult to predict, but may be more severe than direct effects of changing flow. However, both influences are linked in this system. Reduced freshwater flow increases salinity effects. Most of the taxa found in this survey may withstand small increases in salinity, with invertebrate communities expected to be shaped more by physical habitat characteristics than fluctuations in salinity (Alcocer et al. 1998). However, effects of possible tide-related bursts in salinity, exacerbated by lower flow or removal of tide gates, could shift the community to a taxa-poor, low-diversity assemblage dominated by high salinity tolerant taxa (Wolfram et al. 1999). The current community at station 4, where salinity exposure is periodically elevated, already exhibits this condition. Due to its higher elevation, the upstream portion of the lower Mill River (stations 1 through 3) is isolated from saltwater intrusion and thus appears unlikely to be affected by tide-driven salinity bursts.

As noted in the summary report for the 2000-2004 pre-operational monitoring program, changes in the invertebrate community over time may be a consequence of many environmental factors, including the desiccation of the stream during the dry summer months, changes in water quality, altered food abundance and quality, and predation effects. Flow is only one factor, and is likely to have more indirect effects at low levels. Variability in flow, inducing instability, may be a potent factor in structuring the benthic macroinvertebrate community of the lower Mill River, and is linked to water quality issues (including dilution of contaminants from upstream and salinity from downstream), altered physical habitat, and available food resources. Post-operational data support that conclusion and suggest no detectable influence by the water withdrawal since operation of the treatment facility commenced.

This study represents the fifth year of post-operational macroinvertebrate data related to the withdrawal of water in Lake Whitney, following five years of pre-operational monitoring. Comparisons of pre- and post-operational data available thus far do not suggest any impacts of the water treatment facility going online, and consideration of the range of flows encountered over the period of record do not suggest much likelihood for impact by water withdrawals within the terms of the SCCRWA's Management Plan under the flow regime observed. Yet operation has not been at full potential or even expected average levels through the post-operational period to date. With 2005 as a start-up and testing year, and the treatment plant operating for 8 hours per week since October 2008 (due to decreased water demands related to high rainfall), the influence of withdrawals on flow has been very limited.

Given the wide variability of river flows occurring under non-operating conditions, it appears unlikely that operation of the treatment facility in accordance with the Management Plan has significant potential to result in measurable changes to the invertebrate community. To this point, however, monitoring opportunities during extended dry, low flow periods have been limited. Additional data under both operating and non-operating conditions during these dry weather events should provide more conclusive evidence as to the adequacy of the Management Plan to minimize water withdrawal impacts.

Based on the results over a decade of monitoring, it has been suggested by the EST that Station 4 (footbridge) be dropped, as was the case for Station 5 (Orange Street bridge) a few years ago, as it is influenced by factors other than flow to an extent that compromises any flow impact indications. Stations 1, 2 and 3 are similar and mainly influenced by the outflow from Lake Whitney, providing adequate data to facilitate analysis of any flow impacts. Additionally, it has been recommended that assessment of spring conditions, typically with high flows, be eliminated. While the spring data for the last decade has been useful in characterizing the range of conditions experienced in the stream and supporting analysis of flow-invertebrate relationships, further assessment provides little information of use in assessing the key conditions of interest, namely low flows. Future monitoring could focus on Stations 1-3 during August only.

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APPENDIX A

2005-2009 Benthic Macroinvertebrate Data

					13-Jun-05					23-Aug-05				
					Stations					Stations				
					1	2	3	4	5	1	2	3	4	5
Class	**Order**	**Family**	**Genus/Species**	**Feeding Group**										
Annelida	Hirudinea	Glossiphoniidae	Glossiphonia complanata	Parasite										
Annelida	Hirudinea	Glossiphoniidae	Placobdella sp.	Parasite										
Annelida	Hirudinea		Hirudinia	Parasite	30					53	10			
Annelida	Oligochaeta	Lumbriculidae	Unidentified Lumbriculidae	Collector										
Annelida	Oligochaeta	Naididae	Nais communis	Collector	4127	55		17		367	7	13		
Annelida	Oligochaeta	Oligochaeta	Unidentified Oligochaeta	Collector						20				
Annelida	Oligochaeta	Tubificidae	Limnodrilus hoffmeisteri	Collector										
Annelida	Oligochaeta	Tubificidae	Unidentified Tubificidae	Collector										
Annelida	Polychaeta	Ampherididae	Unidentified Ampherididae	Detritivore										
Annelida	Polychaeta	Capitellidae	Heteromastus filiformis	Detritivore										
Annelida	Polychaeta	Spionidae	Marenzellaria viridis	Filter Feeder										
Annelida	Polychaeta	Spionidae	Polydora sp.	Detritivore										
Arachnida	Trombidiformes	Lebertiidae	Lebertia sp.	Predator								1	3	
Arachnoidea	Hydracarina	Arrenuridae	Unidentified Arrenuridae	Parasite				2					3	
Bivalvia	Veneorida	Pisidiidae	Pisidium sp.	Filter Feeder										
Branchiopoda	Cladocera		cladocera	Collector										
Crustacea	Amphipoda	Corophiidae	Corophium sp. (juvenile)	Filter Feeder										
Crustacea	Amphipoda	Crangonyctidae	Crangonyx sp.	Shredder	77	18				67				
Crustacea	Amphipoda	Gammaridae	Gammarus sp.	Shredder	50	82	30	30	12	247	137	264	15	14
Crustacea	Cumacea	Nannasticidae	Almyracuma proximoculi	Shredder										
Crustacea	Decapoda	Palaemonidae	Paleomonetes vulgaris	Shredder										8
Crustacea	Decapoda	Palaemonidae	Paleomonetes paludosus	Shredder										
Crustacea	Decapoda	Portunidae	Carcinus maenus	Shredder										1
Crustacea	Isopoda	Asellidae	Caecidotea communis	Collector										
Crustacea	Isopoda	Asellidae	Lirceus/Acellus sp. (communis)	Shredder										
Hydrozoa	Hydroida	Hydridae	Hydra sp.	Predator										
Insecta	Coleoptera	Brachyceridae	Brachycerus sp.	Collector					2			1		
Insecta	Coleoptera	Chrysomelidae	Donacia	Shredder									7	2
Insecta	Coleoptera	Coleoptera	Unidentified Coleoptera	Predator										
Insecta	Coleoptera	Curculionidae	Unidentifed Curculionidae	Shredder										
Insecta	Coleoptera	Dryopidae	Helichus sp.	Predator										
Insecta	Coleoptera	Elmidae	Stenelmis sp.	Scraper	10	16	18	3		20	24	48	20	1
Insecta	Coleoptera	Haliplidae	Peltodytes	Shredder										
Insecta	Coleoptera	Hydrophilidae	Berosus sp.	Predator		2		2		20			3	1
Insecta	Coleoptera	Psephenidae	Unidentified Psephenidae	Predator										
Insecta	Diptera	Atrichopogon	Atrichopogon	Predator	10			3						1
Insecta	Diptera	Ceratopognidae	Unidentified Ceratopognidae	Predator										
Insecta	Diptera	Chironomidae	Unidenitifed Chironomidae	Collector	1130	139	35	14	22	747	1087	385	48	23
Insecta	Diptera	Diptera	Unidentified Diptera	Collector	127	15	21			40	80	4	7	1
Insecta	Diptera	Empididae	Empididae	Predator						533	227			
Insecta	Diptera	Empididae	Hemerodromia sp.	Filter Feeder										
Insecta	Diptera	Simuliidae	Simulium sp.	Filter Feeder	50	39				33				
Insecta	Diptera	Tabanidae	tabanidae	Predator	33									
Insecta	Diptera	Tachinidae	Ceracia	Parasite										
Insecta	Diptera	Tipulidae	Unidentified Tipulidae	Shredder						287	7	1		
Insecta	Ephemeroptera	Baetidae	Baetis sp	Collector					2				6	6
Insecta	Ephemeroptera	Caenidae	Caenis sp.	Collector										
Insecta	Ephemeroptera	Ephemerellidae	Unidentified Ephemerellidae	Collector										
Insecta	Ephemeroptera	Heptageniidae	Stenonema sp.	Scraper										
Insecta	Ephemeroptera	Oligoneuridae	Isonychia sp.	Collector										
Insecta	Hemiptera	Aphididae	aphididae	Predator									133	
Insecta	Hemiptera	Hemiptera	Unidentified Hemiptera	Predator										
Insecta	Heteroptera	Gerridae	Unidentified Gerridae	Predator										
Insecta	Heteroptera	Gerridae	Rheumatobates sp.	Predator										1
Insecta	Heteroptera	Mesoveliidae	Mesovelia sp.	Predator										
Insecta	Heteroptera	Veliidae	Microvelia	Predator										
Insecta	Neuroptera	Sisyridae	Sisyira sp.	Predator										
Insecta	Odonata	Calopterygidae	Calopteryx spp	Predator										
Insecta	Odonata	Coenagrionidae	Argia sp.	Predator										
Insecta	Odonata	Coenagrionidae	Ischnura/Enallagma sp.	Predator										
Insecta	Odonata	Coenagrionidae	Nehalennia	Predator				36	16				73	34
Insecta	Odonata	Cordulegastridae	Epitheca	Predator										
Insecta	Odonata	Corduliidae	Didymops sp.	Predator										
Insecta	Odonata	Corduliidae	Somatochlora sp.	Predator										
Insecta	Odonata		Anisoptera (juvenile)	Predator										
Insecta	Odonata		zygoptera fragments	Predator										
Insecta	Trichoptera	Brachycentridae	Brachycentrus sp.	Filter Feeder										
Insecta	Trichoptera	Brachycentridae	Micrasema sp.	Filter Feeder										
Insecta	Trichoptera	Glossosomatidae	Glossosoma	Scraper										
Insecta	Trichoptera	Hydropsychidae	Hydropsyche sp.	Filter Feeder										
Insecta	Trichoptera	Hydropsychidae	Macrostemum sp.	Filter Feeder	90	145	3			7707	2376	24		3
Insecta	Trichoptera	Hydropsychidae	Parapsyche sp.	Filter Feeder										
Insecta	Trichoptera	Hydroptilidae	Agraylea sp.	Parasite						20	10	1	13	
Insecta	Trichoptera	Hydroptilidae	Orthotrichia sp.	Predator										
Insecta	Trichoptera	Hydroptilidae	Oxyethira sp.	Predator										
Insecta	Trichoptera	Leptoceridae	Ceraclea sp.	Collector										
Insecta	Trichoptera	Leptoceridae	Mystacides sp.	Collector										
Insecta	Trichoptera	Leptoceridae	Triaenodes sp.	Shredder										
Insecta	Trichoptera	Limnephilidae	Rossiana sp.	Scraper										
Insecta	Trichoptera	Limnephilidae	Unidentified Limnephilidae	Scraper										
Insecta	Trichoptera	Philopotamidae	Chimarra spp	Filter Feeder										
Insecta	Trichoptera	Psychomyiidae	Psychomyia sp.	Collector										
Insecta	Trichoptera	Uenoidae	Neophylax	Shredder										1
Malacostraca	Amphipoda	Hyalellidae	Hyalella azteca	Collector										
Malacostraca	Decapoda	Cambaridae	Orconectes limosus	Shredder										
Malacostraca	Decapoda	Cambaridae	Unidentified Cambaridae	Shredder			1		2					
Maxillopoda	Sessilia	Balanidae	Balanus improvisus	Filter Feeder										
Mollusca	Bivalvia	Sphaeriidae	Unidentified Sphaeriidae	Scraper										
Mollusca	Gastropoda	Ancylidae	Ferrissia rivularis	Scraper										
Mollusca	Gastropoda	Gastropoda	Unidentified Gastropoda	Scraper										
Mollusca	Gastropoda	Hydrobiidae	Amnicola limosa/Bithynia tentaulata	Scraper						33			13	
Mollusca	Gastropoda	Hydrobiidae	Pomatiopsis sp.	Scraper										
Mollusca	Gastropoda	Lymnaeidae	Lymnaea columella	Scraper										
Mollusca	Gastropoda	Physidae	Physa sp.	Scraper				3					8	3
Mollusca	Gastropoda	Planorbidae	Gyraulus circumstriatus	Scraper										
Mollusca	Gastropoda	Planorbidae	Gyraulus deflectus	Scraper										
Mollusca	Gastropoda	Planorbidae	Gyraulus parvus	Scraper										
Mollusca	Gastropoda	Planorbidae	Helisoma sp.	Scraper				15			10			
Mollusca	Gastropoda	Pleuroceridae	Pleurocera sp.	Scraper										
Mollusca	Gastropoda	Valvatidae	Valvata tricarinata	Scraper										
Nemertea	Nemertea	Nemertea	Unidentified Nemertea	Predator						33				
Turbellaria	Tricladida	Dugesiidae	Dugesia sp.	Predator						233	20	7		
				Total Individuals	5734	511	108	125	56	10460	3995	749	352	100
				Total Taxa	11	9	6	10	6	17	12	11	14	15

					1-Jun-06				1-Aug-06			
					Stations				Stations			
					1	2	3	4	1	2	3	4
Class	**Order**	**Family**	**Genus/Species**	**Feeding Group**								
Annelida	Hirudinea	Glossiphoniidae	Glossiphonia complanata	Parasite								
Annelida	Hirudinea	Glossiphoniidae	Placobdella sp.	Parasite								
Annelida	Hirudinea		Hirudinia	Parasite								
Annelida	Oligochaeta	Lumbriculidae	Unidentified Lumbriculidae	Collector								
Annelida	Oligochaeta	Naididae	Nais communis	Collector	14	2			5			
Annelida	Oligochaeta	Oligochaeta	Unidentified Oligochaeta	Collector				4				
Annelida	Oligochaeta	Tubificidae	Unidentified Tubificidae	Collector								
Annelida	Oligochaeta	Tubificidae	Limnodrilus hoffmeisteri	Collector								
Annelida	Polychaeta	Ampherididae	Unidentified Ampherididae	Detritivore								
Annelida	Polychaeta	Capitellidae	Heteromastus filiformis	Detritivore								
Annelida	Polychaeta	Spionidae	Marenzellaria viridis	Filter Feeder								
Annelida	Polychaeta	Spionidae	Polydora sp.	Detritivore								
Arachnida	Trombidiformes	Lebertiidae	Lebertia sp.	Predator							5	
Arachnoidea	Hydracarina	Arrenuridae	Unidentified Arrenuridae	Parasite								
Bivalvia	Veneorida	Pisidiidae	Pisidium sp.	Filter Feeder								2
Branchiopoda	Cladocera		cladocera	Collector								
Crustacea	Amphipoda	Corophiidae	Corophium sp. (juvenile)	Filter Feeder								
Crustacea	Amphipoda	Crangonyctidae	Crangonyx sp.	Shredder	4	5	6	1				
Crustacea	Amphipoda	Gammaridae	Gammarus sp.	Shredder	10	83	161	31	241	117	316	70
Crustacea	Cumacea	Nannasticidae	Almyracuma proximoculi	Shredder								
Crustacea	Decapoda	Palaemonidae	Paleomonetes vulgaris	Shredder								
Crustacea	Decapoda	Palaemonidae	Paleomonetes paludosus	Shredder								
Crustacea	Decapoda	Portunidae	Carcinus maenus	Shredder								
Crustacea	Isopoda	Asellidae	Caecidotea communis	Collector	34	36	0	1	4	0	4	6
Crustacea	Isopoda	Asellidae	Lirceus/Acellus sp. (communis)	Shredder								
Hydrozoa	Hydroida	Hydridae	Hydra sp.	Predator								
Insecta	Coleoptera	Brachyceridae	Brachycerus sp.	Collector								8
Insecta	Coleoptera	Chrysomelidae	Donacia	Shredder								
Insecta	Coleoptera	Coleoptera	Unidentified Coleoptera	Predator								
Insecta	Coleoptera	Curculionidae	Unidentifed Curculionidae	Shredder								
Insecta	Coleoptera	Dryopidae	Helichus sp.	Predator								
Insecta	Coleoptera	Elmidae	Stenelmis sp.	Scraper	8	2	20	44	5	4	8	18
Insecta	Coleoptera	Haliplidae	Peltodytes	Shredder								
Insecta	Coleoptera	Hydrophilidae	Berosus sp.	Predator	7	1	7		1			
Insecta	Coleoptera	Psephenidae	Unidentified Psephenidae	Predator								
Insecta	Diptera	Atrichopogon	Atrichopogon	Predator								
Insecta	Diptera	Ceratopogonidae	Probezzia	Predator				1				
Insecta	Diptera	Ceratopognidae	Unidentified Ceratopognidae	Predator								
Insecta	Diptera	Chironomidae	Unidenitifed Chironomidae	Collector	61	66	86	24	134	216	142	107
Insecta	Diptera	Diptera	Unidentified Diptera	Collector	50	15	24	5	22	51	30	4
Insecta	Diptera	Empididae	Empididae	Predator						49	42	
Insecta	Diptera	Empididae	Hemerodromia sp.	Filter Feeder								
Insecta	Diptera	Simuliidae	Simulium sp.	Filter Feeder	6	1	1		44	37		
Insecta	Diptera	Tabanidae	tabanidae	Predator								
Insecta	Diptera	Tachinidae	Ceracia	Parasite								
Insecta	Diptera	Tipulidae	Unidentified Tipulidae	Shredder	3	3	0	0	4	17	4	
Insecta	Ephemeroptera	Baetidae	Baetis sp	Collector				1				2
Insecta	Ephemeroptera	Caenidae	Caenis sp.	Collector								
Insecta	Ephemeroptera	Ephemerellidae	Unidentified Ephemerellidae	Collector								
Insecta	Ephemeroptera	Heptageniidae	Stenonema sp.	Scraper								
Insecta	Ephemeroptera	Oligoneuridae	Isonychia sp.	Collector								
Insecta	Hemiptera	Aphididae	aphididae	Predator	1						1	
Insecta	Hemiptera	Gelastocoridae	Gelastocoris	Predator								1
Insecta	Hemiptera	Hemiptera	Unidentified Hemiptera	Predator								
Insecta	Heteroptera	Gerridae	Rheumatobates sp.	Predator								1
Insecta	Heteroptera	Gerridae	Unidentified Gerridae	Predator								
Insecta	Heteroptera	Mesoveliidae	Mesovelia sp.	Predator								
Insecta	Heteroptera	Veliidae	Microvelia	Predator								
Insecta	Neuroptera	Sisyridae	Sisyira sp.	Predator								
Insecta	Odonata	Calopterygidae	Calopteryx spp	Predator								
Insecta	Odonata	Coenagrionidae	Nehalennia	Predator				50				80
Insecta	Odonata	Coenagrionidae	Ischnura/Enallagma sp.	Predator								
Insecta	Odonata	Coenagrionidae	Argia sp.	Predator		2		3				2
Insecta	Odonata	Cordulegastridae	Epitheca	Predator								
Insecta	Odonata	Corduliidae	Epicordulia	Predator				5				6
Insecta	Odonata	Corduliidae	Somatochlora sp.	Predator								
Insecta	Odonata	Corduliidae	Didymops sp.	Predator								
Insecta	Odonata		Anisoptera (juvenile)	Predator								
Insecta	Odonata		zygoptera fragments	Predator								
Insecta	Trichoptera	Brachycentridae	Brachycentrus sp.	Filter Feeder								
Insecta	Trichoptera	Brachycentridae	Micrasema sp.	Filter Feeder								
Insecta	Trichoptera	Glossosomatidae	Glossosoma	Scraper								
Insecta	Trichoptera	Hydropsychidae	Macrostemum sp.	Filter Feeder	56	92	1		416	468	401	
Insecta	Trichoptera	Hydropsychidae	Hydropsyche sp.	Filter Feeder								
Insecta	Trichoptera	Hydropsychidae	Parapsyche sp.	Filter Feeder								
Insecta	Trichoptera	Hydroptilidae	Agraylea sp.	Parasite						1	22	2
Insecta	Trichoptera	Hydroptilidae	Oxyethira sp.	Predator								
Insecta	Trichoptera	Hydroptilidae	Orthotrichia sp.	Predator								
Insecta	Trichoptera	Leptoceridae	Ceraclea sp.	Collector								
Insecta	Trichoptera	Leptoceridae	Mystacides sp.	Collector								
Insecta	Trichoptera	Leptoceridae	Triaenodes sp.	Shredder								
Insecta	Trichoptera	Limnephilidae	Rossiana sp.	Scraper								
Insecta	Trichoptera	Limnephilidae	Unidentified Limnephilidae	Scraper				1				
Insecta	Trichoptera	Philopotamidae	Chimarra spp	Filter Feeder								
Insecta	Trichoptera	Psychomyiidae	Psychomyia sp.	Collector								
Insecta	Trichoptera	Uenoidae	Neophylax	Shredder	11			1				
Malacostraca	Amphipoda	Hyalellidae	Hyalella azteca	Collector								
Malacostraca	Decapoda	Cambaridae	Orconectes limosus	Shredder								
Malacostraca	Decapoda	Cambaridae	Unidentified Cambaridae	Shredder								
Maxillopoda	Sessilia	Balanidae	Balanus improvisus	Filter Feeder								
Mollusca	Bivalvia	Sphaeriidae	Unidentified Sphaeriidae	Scraper								
Mollusca	Gastropoda	Ancylidae	Ferrissia rivularis	Scraper								
Mollusca	Gastropoda	Gastropoda	Unidentified Gastropoda	Scraper								
Mollusca	Gastropoda	Hydrobiidae	Amnicola limosa/Bithynia tentaulata	Scraper	1	18	7				10	
Mollusca	Gastropoda	Hydrobiidae	Pomatiopsis sp.	Scraper								
Mollusca	Gastropoda	Lymnaeidae	Lymnaea columella	Scraper								
Mollusca	Gastropoda	Physidae	Physa sp.	Scraper								5
Mollusca	Gastropoda	Planorbidae	Gyraulus parvus	Scraper								
Mollusca	Gastropoda	Planorbidae	Helisoma sp.	Scraper								2
Mollusca	Gastropoda	Planorbidae	Gyraulus deflectus	Scraper								
Mollusca	Gastropoda	Planorbidae	Gyraulus circumstriatus	Scraper								
Mollusca	Gastropoda	Pleuroceridae	Pleurocera sp.	Scraper								
Mollusca	Gastropoda	Valvatidae	Valvata tricarinata	Scraper								
Nemertea	Nemertea	Nemertea	Unidentified Nemertea	Predator								
Turbellaria	Tricladida	Dugesiidae	Dugesia sp.	Predator	3	7				1		

				15-Jun-07				**17-Aug-07**			
				Stations				**Stations**			
				1	2	3	4	1	2	3	4
Class	**Order**	**Family**	**Genus/Species**								
Annelida	Hirudinea	Glossiphoniidae	Glossiphonia complanata								
Annelida	Hirudinea	Glossiphoniidae	Placobdella sp.								
Annelida	Hirudinea		Hirudinia								
Annelida	Oligochaeta	Lumbriculidae	Unidentified Lumbriculidae								
Annelida	Oligochaeta	Naididae	Nais communis	8			36	4			17
Annelida	Oligochaeta	Oligochaeta	Unidentified Oligochaeta				9				
Annelida	Oligochaeta	Tubificidae	Unidentified Tubificidae	2							
Annelida	Oligochaeta	Tubificidae	Limnodrilus hoffmeisteri								
Annelida	Polychaeta	Ampherididae	Unidentified Ampherididae								
Annelida	Polychaeta	Capitellidae	Heteromastus filiformis								
Annelida	Polychaeta	Spionidae	Marenzellaria viridis								
Annelida	Polychaeta	Spionidae	Polydora sp.				1				
Arachnida	Trombidiformes	Lebertiidae	Lebertia sp.		2						
Arachnoidea	Hydracarina	Arrenuridae	Unidentified Arrenuridae								
Bivalvia	Veneorida	Pisidiidae	Pisidium sp.			8					
Branchiopoda	Cladocera		cladocera								10
Crustacea	Amphipoda	Corophiidae	Corophium sp. (juvenile)								
Crustacea	Amphipoda	Crangonyctidae	Crangonyx sp.	20		3					
Crustacea	Amphipoda	Gammaridae	Gammarus sp.	1165	11	370	45	80	117	54	27
Crustacea	Cumacea	Nannasticidae	Almyracuma proximoculi	2							
Crustacea	Decapoda	Palaemonidae	Paleomonetes vulgaris								
Crustacea	Decapoda	Palaemonidae	Paleomonetes paludosus								
Crustacea	Decapoda	Portunidae	Carcinus maenus								
Crustacea	Isopoda	Asellidae	Caecidotea communis	2		1	3		30		
Crustacea	Isopoda	Asellidae	Lirceus/Acellus sp. (communis)								
Hydrozoa	Hydroida	Hydridae	Hydra sp.								
Insecta	Coleoptera	Brachyceridae	Brachycerus sp.								
Insecta	Coleoptera	Chrysomelidae	Donacia								
Insecta	Coleoptera	Coleoptera	Unidentified Coleoptera								
Insecta	Coleoptera	Curculionidae	Unidentifed Curculionidae								
Insecta	Coleoptera	Dryopidae	Helichus sp.								
Insecta	Coleoptera	Elmidae	Stenelmis sp.	55	33	49	1	24	3	17	50
Insecta	Coleoptera	Haliplidae	Peltodytes								7
Insecta	Coleoptera	Hydrophilidae	Berosus sp.	2	24	1	1				
Insecta	Coleoptera	Psephenidae	Unidentified Psephenidae								
Insecta	Diptera	Atrichopogon	Atrichopogon								
Insecta	Diptera	Ceratopogonidae	Probezzia								
Insecta	Diptera	Ceratopognidae	Unidentified Ceratopognidae								
Insecta	Diptera	Chironomidae	Unidenitifed Chironomidae	108	40	18	47	156	237	31	67
Insecta	Diptera	Diptera	Unidentified Diptera	137	144	25	9	28	13	6	10
Insecta	Diptera	Empididae	Empididae		89	19				1	
Insecta	Diptera	Empididae	Hemerodromia sp.								
Insecta	Diptera	Simuliidae	Simulium sp.	87	9						
Insecta	Diptera	Tabanidae	tabanidae								
Insecta	Diptera	Tachinidae	Ceracia	8							
Insecta	Diptera	Tipulidae	Unidentified Tipulidae	2							
Insecta	Ephemeroptera	Baetidae	Baetis sp								
Insecta	Ephemeroptera	Caenidae	Caenis sp.	5			4				
Insecta	Ephemeroptera	Ephemerellidae	Unidentified Ephemerellidae								
Insecta	Ephemeroptera	Heptageniidae	Stenonema sp.				1				
Insecta	Ephemeroptera	Oligoneuridae	Isonychia sp.								
Insecta	Hemiptera	Gelastocoridae	Gelastocoris								
Insecta	Hemiptera	Hemiptera	Unidentified Hemiptera								
Insecta	Heteroptera	Gerridae	Rheumatobates sp.							3	
Insecta	Heteroptera	Gerridae	Unidentified Gerridae								
Insecta	Heteroptera	Mesoveliidae	Mesovelia sp.				4				
Insecta	Heteroptera	Veliidae	Microvelia	2			4			1	
Insecta	Neuroptera	Sisyridae	Sisyira sp.	3							
Insecta	Odonata	Calopterygidae	Calopteryx spp								
Insecta	Odonata	Coenagrionidae	Nehalennia				67				140
Insecta	Odonata	Coenagrionidae	Ischnura/Enallagma sp.								
Insecta	Odonata	Coenagrionidae	Argia sp.								
Insecta	Odonata	Cordulegastridae	Epitheca								
Insecta	Odonata	Corduliidae	Epicordulia								
Insecta	Odonata	Corduliidae	Somatochlora sp.								
Insecta	Odonata	Corduliidae	Didymops sp.								
Insecta	Odonata		Anisoptera (juvenile)								
Insecta	Odonata		zygoptera fragments								
Insecta	Trichoptera	Brachycentridae	Brachycentrus sp.								
Insecta	Trichoptera	Brachycentridae	Micrasema sp.								
Insecta	Trichoptera	Glossosomatidae	Glossosoma								
Insecta	Trichoptera	Hydropsychidae	Macrostemum sp.	1248	47			76	740	87	3
Insecta	Trichoptera	Hydropsychidae	Hydropsyche sp.						17		
Insecta	Trichoptera	Hydropsychidae	Parapsyche sp.								
Insecta	Trichoptera	Hydroptilidae	Agraylea sp.	13			1				30
Insecta	Trichoptera	Hydroptilidae	Oxyethira sp.								
Insecta	Trichoptera	Hydroptilidae	Orthotrichia sp.								
Insecta	Trichoptera	Leptoceridae	Ceraclea sp.								
Insecta	Trichoptera	Leptoceridae	Mystacides sp.								
Insecta	Trichoptera	Leptoceridae	Triaenodes sp.								
Insecta	Trichoptera	Limnephilidae	Rossiana sp.								
Insecta	Trichoptera	Limnephilidae	Unidentified Limnephilidae								
Insecta	Trichoptera	Philopotamidae	Chimarra spp								
Insecta	Trichoptera	Psychomyiidae	Psychomyia sp.								
Insecta	Trichoptera	Uenoidae	Neophylax	38	67	3					
Malacostraca	Amphipoda	Hyalellidae	Hyalella azteca				23				17
Malacostraca	Decapoda	Cambaridae	Orconectes limosus								
Malacostraca	Decapoda	Cambaridae	Unidentified Cambaridae								
Maxillopoda	Sessilia	Balanidae	Balanus improvisus								
Mollusca	Bivalvia	Sphaeriidae	Unidentified Sphaeriidae								
Mollusca	Gastropoda	Ancylidae	Ferrissia rivularis				1				
Mollusca	Gastropoda	Gastropoda	Unidentified Gastropoda								
Mollusca	Gastropoda	Hydrobiidae	Amnicola limosa/Bithynia tentaulata	12	2	24	3	8		3	
Mollusca	Gastropoda	Hydrobiidae	Pomatiopsis sp.								
Mollusca	Gastropoda	Lymnaeidae	Lymnaea columella								
Mollusca	Gastropoda	Physidae	Physa sp.				32	8			
Mollusca	Gastropoda	Planorbidae	Gyraulus parvus				24				
Mollusca	Gastropoda	Planorbidae	Helisoma sp.			5	1				
Mollusca	Gastropoda	Planorbidae	Gyraulus deflectus					4			
Mollusca	Gastropoda	Planorbidae	Gyraulus circumstriatus								
Mollusca	Gastropoda	Pleuroceridae	Pleurocera sp.								
Mollusca	Gastropoda	Valvatidae	Valvata tricarinata								
Nemertea	Nemertea	Nemertea	Unidentified Nemertea								
Turbellaria	Tricladida	Dugesiidae	Dugesia sp.	42							

				6-Jun-08				19-Aug-08			
				Stations				Stations			
				1	2	3	4	1	2	3	4
Class	**Order**	**Family**	**Genus/Species**								
Annelida	Hirudinea	Glossiphoniidae	Glossiphonia complanata								
Annelida	Hirudinea	Glossiphoniidae	Placobdella sp.								
Annelida	Hirudinea		Hirudinia								
Annelida	Oligochaeta	Lumbriculidae	Unidentified Lumbriculidae								
Annelida	Oligochaeta	Naididae	Nais communis	30	14			17	45	25	
Annelida	Oligochaeta	Oligochaeta	Unidentified Oligochaeta								
Annelida	Oligochaeta	Tubificidae	Unidentified Tubificidae								
Annelida	Oligochaeta	Tubificidae	Limnodrilus hoffmeisteri								
Annelida	Polychaeta	Ampherididae	Unidentified Ampherididae								
Annelida	Polychaeta	Capitellidae	Heteromastus filiformis								
Annelida	Polychaeta	Spionidae	Marenzellaria viridis								
Annelida	Polychaeta	Spionidae	Polydora sp.								
Arachnida	Trombidiformes	Lebertiidae	Lebertia sp.								
Arachnoidea	Hydracarina	Arrenuridae	Unidentified Arrenuridae								
Bivalvia	Veneorida	Pisidiidae	Pisidium sp.								
Branchiopoda	Cladocera		cladocera								
Crustacea	Amphipoda	Corophiidae	Corophium sp. (juvenile)								
Crustacea	Amphipoda	Crangonyctidae	Crangonyx sp.								
Crustacea	Amphipoda	Gammaridae	Gammarus sp.	50	54	83		108	82	242	
Crustacea	Cumacea	Nannasticidae	Almyracuma proximoculi								
Crustacea	Decapoda	Palaemonidae	Paleomonetes vulgaris								
Crustacea	Decapoda	Palaemonidae	Paleomonetes paludosus								
Crustacea	Decapoda	Portunidae	Carcinus maenus								
Crustacea	Isopoda	Asellidae	Caecidotea communis	30	11		5				
Crustacea	Isopoda	Asellidae	Lirceus/Acellus sp. (communis)								
Hydrozoa	Hydroida	Hydridae	Hydra sp.								
Insecta	Coleoptera	Brachyceridae	Brachycerus sp.		4				9		
Insecta	Coleoptera	Chrysomelidae	Donacia								
Insecta	Coleoptera	Coleoptera	Unidentified Coleoptera								
Insecta	Coleoptera	Curculionidae	Unidentifed Curculionidae								
Insecta	Coleoptera	Dryopidae	Helichus sp.								
Insecta	Coleoptera	Elmidae	Stenelmis sp.	10	29	38	5	8	36	108	
Insecta	Coleoptera	Haliplidae	Peltodytes								
Insecta	Coleoptera	Hydrophilidae	Berosus sp.			4					
Insecta	Coleoptera	Psephenidae	Unidentified Psephenidae								
Insecta	Diptera	Atrichopogon	Atrichopogon								
Insecta	Diptera	Ceratopogonidae	Probezzia								
Insecta	Diptera	Ceratopognidae	Unidentified Ceratopognidae								
Insecta	Diptera	Chironomidae	Unidenitifed Chironomidae	72	44	53	17	88	38	128	44
Insecta	Diptera	Diptera	Unidentified Diptera	20				17	36		
Insecta	Diptera	Empididae	Empididae	10							
Insecta	Diptera	Empididae	Hemerodromia sp.								
Insecta	Diptera	Simuliidae	Simulium sp.	30	11			8	18		
Insecta	Diptera	Tabanidae	tabanidae								
Insecta	Diptera	Tachinidae	Ceracia								
Insecta	Diptera	Tipulidae	Unidentified Tipulidae	10	4	4			9		
Insecta	Ephemeroptera	Baetidae	Baetis sp		11						
Insecta	Ephemeroptera	Caenidae	Caenis sp.				41				47
Insecta	Ephemeroptera	Ephemerellidae	Unidentified Ephemerellidae								
Insecta	Ephemeroptera	Heptageniidae	Stenonema sp.								
Insecta	Ephemeroptera	Oligoneuridae	Isonychia sp.								
Insecta	Hemiptera	Gelastocoridae	Gelastocoris								
Insecta	Hemiptera	Hemiptera	Unidentified Hemiptera								
Insecta	Heteroptera	Gerridae	Rheumatobates sp.								
Insecta	Heteroptera	Gerridae	Unidentified Gerridae								
Insecta	Heteroptera	Mesoveliidae	Mesovelia sp.								
Insecta	Heteroptera	Veliidae	Microvelia	10							
Insecta	Neuroptera	Sisyridae	Sisyira sp.								
Insecta	Odonata	Calopterygidae	Calopteryx spp								
Insecta	Odonata	Coenagrionidae	Nehalennia				73				229
Insecta	Odonata	Coenagrionidae	Ischnura/Enallagma sp.								
Insecta	Odonata	Coenagrionidae	Argia sp.			4				8	
Insecta	Odonata	Cordulegastridae	Epitheca								
Insecta	Odonata	Corduliidae	Epicordulia								
Insecta	Odonata	Corduliidae	Somatochlora sp.								
Insecta	Odonata	Corduliidae	Didymops sp.								
Insecta	Odonata		Anisoptera (juvenile)								
Insecta	Odonata		zygoptera fragments								
Insecta	Plecoptera	Perlidae	Perlidae sp.	10	7			17	18	17	
Insecta	Trichoptera	Brachycentridae	Brachycentrus sp.								
Insecta	Trichoptera	Brachycentridae	Micrasema sp.								
Insecta	Trichoptera	Glossosomatidae	Glossosoma								
Insecta	Trichoptera	Hydropsychidae	Macrostemum sp.	10					9		
Insecta	Trichoptera	Hydropsychidae	Hydropsyche sp.								
Insecta	Trichoptera	Hydropsychidae	Parapsyche sp.								
Insecta	Trichoptera	Hydroptilidae	Agraylea sp.								
Insecta	Trichoptera	Hydroptilidae	Oxyethira sp.								
Insecta	Trichoptera	Hydroptilidae	Orthotrichia sp.								
Insecta	Trichoptera	Leptoceridae	Ceraclea sp.								
Insecta	Trichoptera	Leptoceridae	Mystacides sp.								
Insecta	Trichoptera	Leptoceridae	Triaenodes sp.								
Insecta	Trichoptera	Limnephilidae	Rossiana sp.								
Insecta	Trichoptera	Limnephilidae	Unidentified Limnephilidae								
Insecta	Trichoptera	Philopotamidae	Chimarra spp								
Insecta	Trichoptera	Psychomyiidae	Psychomyia sp.								
Insecta	Trichoptera	Uenoidae	Neophylax		11	8		17		42	
Malacostraca	Amphipoda	Hyalellidae	Hyalella azteca								
Malacostraca	Decapoda	Cambaridae	Orconectes limosus								
Malacostraca	Decapoda	Cambaridae	Unidentified Cambaridae								
Maxillopoda	Sessilia	Balanidae	Balanus improvisus								
Mollusca	Bivalvia	Sphaeriidae	Unidentified Sphaeriidae								
Mollusca	Gastropoda	Ancylidae	Ferrissia rivularis								
Mollusca	Gastropoda	Gastropoda	Unidentified Gastropoda	10				8			
Mollusca	Gastropoda	Hydrobiidae	Amnicola limosa/Bithynia tentaulata		7					17	
Mollusca	Gastropoda	Hydrobiidae	Pomatiopsis sp.								
Mollusca	Gastropoda	Lymnaeidae	Lymnaea columella								
Mollusca	Gastropoda	Physidae	Physa sp.			4	9				12
Mollusca	Gastropoda	Planorbidae	Gyraulus parvus								
Mollusca	Gastropoda	Planorbidae	Helisoma sp.		4		9				12
Mollusca	Gastropoda	Planorbidae	Gyraulus deflectus								
Mollusca	Gastropoda	Planorbidae	Gyraulus circumstriatus								
Mollusca	Gastropoda	Pleuroceridae	Pleurocera sp.								
Mollusca	Gastropoda	Valvatidae	Valvata tricarinata								
Nemertea	Nemertea	Nemertea	Unidentified Nemertea								
Turbellaria	Tricladida	Dugesiidae	Dugesia sp.								