HAMMER CREEK

LEBANON AND LANCASTER COUNTIES

WATER QUALITY STANDARDS REVIEW

STREAM REDESIGNATION EVALUATION

Segment: Source to Speedwell Forge Lake Dam
Stream Code: 07664
Drainage List O

WATER QUALITY MONITORING SECTION (TES)
DIVISION OF WATER QUALITY STANDARDS
BUREAU OF WATER STANDARDS AND FACILITY REGULATION
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JUNE 2007
revised
JUNE 2008

GENERAL WATERSHED DESCRIPTION

Hammer Creek is a tributary to Cocalico Creek in the Susquahanna River drainage and is located in Cornwall, South Lebanon, and Heidelberg Townships in Lebanon County and Penn and Elizabeth Townships in Lancaster County. The Hammer Creek basin upstream of the Speedwell Forge Lake Dam is characterized by both freestone and limestone/limestone-influenced streams that drain approximately 24.7mi^2 and flows in a southerly direction. The surrounding area is characterized by relatively hilly topography, which is portrayed on the Lebanon, Richland, and Lititz 7.5-minute series USGS quadrangles.

The Hammer Creek basin upstream of the Speedwell Forge Lake Dam is currently designated High Quality – Cold Water Fishes (HQ-CWF) and was evaluated for a redesignation to Trout Stocking (TSF) in response to a petition submitted by Heidelberg Township to the Environmental Quality Board on March 31, 2003. The petitioner requested redesignation of the Hammer Creek basin from the headwaters to the Speedwell Forge Lake dam alleging that the current water quality, aquatic life, and habitat does not represent HQ-CWF existing use conditions and that the basin was improperly classified when it was designated as a Conservation Area in 1973. Water Quality Standards in effect at the time defined a Conservation Area as "Waters used within and suitable for the maintenance of an area now or in the future to be kept in a relatively primitive condition." Conservation Area use designations were re-labeled as HQ-CWF in the October 8, 1979 revisions to Chapter 93. The Department evaluated the basin of Hammer Creek from the source to the Speedwell Forge Lake dam.

Much of the watershed is dominated by forest and agriculture land uses with some low density residential land use throughout most of the study area. Land ownership is comprised of both private and public areas with most of the forested areas located within State Game Lands 156 while the agricultural area consists of both livestock and crop farming with numerous hay fields (Figure 1). The National Wetlands Inventory maps indicate the presence of forested/shrub wetlands and emergent wetlands.

WATER QUALITY AND USES

Surface Water

A review of DEP files indicates there is one permitted on-lot septic discharge and 10 permitted groundwater withdrawals within the Hammer Creek study area.

Additional DEP file information, other historical information sources, and recent survey data reveals that water quality issues involving pollution incidents and agricultural impacts have existed throughout the upper watershed from as far back as the 1960s and continue to characterize this area to present day.

In 1964, Commonwealth correspondence concerning the construction of Speedwell Forge Lake noted that coliform counts from samples collected in Hammer Creek were

higher than State standards for public bathing places and that the lake could experience algal problems due to the high level of nutrients entering from Hammer Creek (Lyon 1964). Correspondence received in July 1969 by the PA Department of Health expressed concerns about large amounts of floating matter coming from Hammer Creek headwaters (Eitner and Dunlap 1969). A pollution report filed in June 1969 indicated pollution events related to Pennco Distillery occurred within Hammer Creek (Hall and Kulikosky 1969).

Several stream investigations were conducted by DEP during the 1970s. In April 1972, an aquatic biological survey of an unnamed tributary revealed high nitrate and ammonia concentrations and benthic macroinvertebrate samples dominated by pollution-tolerant taxa (Table 1 - 3, Figure 2) (Nichols 1972). A June 1972 survey of an unnamed tributary (locally referred to as Snitzel Creek), conducted in response to a reported oil discharge from the Pennco Distillery, documented that aquatic macroinvertebrates were absent. Additional observations were noted that the underside of many rocks were coated black (Bronner 1972). In March 1973, an investigation was conducted following a complaint that an unnamed tributary (Snitzel Creek) near Pennco Distillery was black in color. No black discharge was observed, however, it was noted that cattle waste was draining into Hammer Creek from lagoons on a nearby farm (Templin 1973). Another March 1973 investigation was conducted on Hammer Creek and several tributaries. The Hammer Creek stations (Figure 2; Stations 1, 5, 7, and 9) were deemed in good condition whereas the tributaries showed a range of good-to-poor conditions. Stations were sampled on the unnamed Pennco Distillery tributary (Figure 2; Stations 2-4). Conditions upstream of the discharge were relatively good. However, anaerobic conditions and temperature violations were evident downstream of the discharge. Samples collected on another tributary revealed poor conditions and were suspected to be related to a landfill located on a nearby pig farm (Tables 1 – 3, Figure 2; Station 8) (Frey 1973). In April 1974, a survey was conducted on an unnamed tributary to Hammer Creek in response to a sewage treatment plant discharge application. Benthic macroinvertebrate collections revealed 11 taxa indicating fair-to-good water quality but noted that less-than optimal diversity was likely related to the agricultural nature of the watershed (Table 1, 4, and 5, Figure 3) (Hughey 1974). A December 1974 investigation conducted on Hammer Creek and several tributaries revealed water quality parameters and benthic macroinvertebrate community conditions ranged from good-to-fair with high nitrate levels (5.94 – 7.56mg/l) for all the sites on Hammer and Mill Creeks (Figure 3; Stations 1 – 7). Snitzel Creek was sampled in relation to the Pennco Distillery discharge revealing excellent conditions upstream of the discharge and bad conditions below (Table 1, 4, and 5, Figure 3; Stations 8 – 9) (Hughey 1975).

In addition to the water quality data discussed above, water quality samples have been collected at several locations on Hammer Creek and Speedwell Forge Lake by several different organizations from 1976-2004 (Table 6, Figure 4). Water quality data collected by the Department (8 locations) and the Pennsylvania Fish and Boat Commission (PFBC) (5 locations) are presented in Tables 7 – 8. The Smithsonian Environmental Research Center (SERC) collected nutrient data on a weekly basis from October 1994 through May 1997 (Table 9, SERC 1999). F.X. Brown, Inc., as part of a Speedwell Forge Lake 319 watershed assessment study, collected water chemistry data from one location on Hammer Creek above Speedwell Forge Lake at both baseflow and stormflow

conditions and on a second unnamed tributary to Speedwell Forge Lake at baseflow conditions (Table 10).

Water quality data had also been collected from Speedwell Forge Lake by Ulanoski et al (1981), Ballaron et al (1996), and F.X. Brown Inc. (2003). Chemical samples were collected on three occasions from two locations within the lake in 1980 and 1995 (Tables 11-12). F.X. Brown, Inc. collected chemistry parameters on four occasions from two locations in 2000 (Table 13). Temperature/dissolved oxygen profiles were also recorded in 1980 and 2000 in conjunction with these chemical sampling events (Figures 5-7) and the Department collected profiles in 1997 (Figure 8). Water quality data collected from Speedwell Forge Lake indicates the lake has high nutrient concentrations. Temperature/dissolved oxygen profiles indicate that the lake stratifies during the summer separating into two distinct layers with dissolved oxygen levels in the hypolimnion often becoming anoxic (0.0mg/l).

The instantaneous nature of water chemistry grab samples does not allow for valid comparisons to water quality criteria. No long-term water chemistry data were available from either Hammer Creek or Speedwell Forge Lake to allow such water quality criteria comparisons. (Data from SERC was extensive but was collected at one location and was limited to several nutrient parameters in Table 9). However, historical water quality data and that collected during recent surveys suggests water chemistry in the upper basin has been generally fair, and that elevated levels of nutrients – particularly nitrates - may be a long-term chronic condition.

Historically, as documented above, Hammer Creek has suffered from non-point source impacts that originate in agricultural areas of the upper basin. Nitrate data has been collected from many varied locations in the upper basin over a long period of time. A review of these data from DEP surveys and other sources revealed that nitrate is routinely present in high concentrations. A compilation of 1972-2004 DEP sample results from the upper basin yields nitrate concentration ranges of 6.7-8.9 mg/l for main stem stations and 2.5-10.9 mg/l for tributary stations (Tables 2, 4, & 7). Another dataset collected at 4HC from October 1994 through May 1997 (SERC 1999) resulted in a nitrate range of 3.5-15.9 mg/l (8.33 mg/l mean) and an ammonia range of .017-3.197 mg/l (.149 mg/l mean). While the only chemistry data presented in this report are from 1972-2004, other file information indicates that water quality conditions typified by the nutrient data above were most likely present in the 1960s and before (Lyon 1964, Eitner and Dunlap 1969). These conditions are chronic and continue to exist.

Grab samples collected during several past surveys indicate the presence of distinct freestone and limestone/limestone-influenced stream reaches (Tables 2, 4, 7, & 8). Except for somewhat higher alkalinity values at some of the limestone/limestone-influenced stations, alkalinity data submitted during the comment period by the Chesapeake Bay Foundation (CBF; 2008) were comparable to data collected from previous surveys. The stations with the lowest alkalinity values were found in the higher gradient, freestone substrate streams while the higher alkalinity values were collected from the flatter, agricultural areas of the upper basin characterized by scattered limestone springs.

Aquatic Biota

Due to the instantaneous nature of water chemistry grab samples, the indigenous aquatic community is a better indicator of long-term water quality conditions and is used as a measure of both water quality and ecological significance. The Department collected habitat and benthic macroinvertebrate data at three sampling locations on May 7, 2003, one location on December 16, 2003, and four locations on April 6, 2004. In addition, the Chesapeake Bay Foundation (CBF 2008) collected habitat and benthic data during an October/November 2007 survey of Hammer Creek.

Habitat. Instream habitat conditions were evaluated at each of the eight stations where benthic macroinvertebrates were sampled (Table 14). The habitat evaluation consists of rating twelve habitat parameters to derive a station habitat score. The habitat scores for Hammer Creek ranged from 134 to 208 - reflecting low-end suboptimal-to-optimal habitat conditions. Habitat scores provided by the Chesapeake Bay Foundation in their Hammer Creek survey report (CBF 2008) ranged from 112 to 222 reflecting marginal-to-optimal conditions. While station habitat scores from both studies were generally comparable, 4HC and 5HC scored noticeably higher in the CBF study.

Benthos. Benthic macroinvertebrate collection efforts were employed using the Department's RBP benthic sampling methodology which is a modification of EPA's Rapid Bioassessment Protocols (RBPs; Plafkin, et al 1989; Barbour et al. 1999). Benthic samples were collected from five stations on the main stem of Hammer Creek and three tributaries. Taxonomic diversity was fair-to-excellent ranging from 12 to 28 taxa (Table 15). Stations with the highest diversity (1, 2, 6, 7, 8) were located in forested areas of the basin while those with lower diversity were in agricultural areas.

Benthic data provided in the CBF report (2008) for the Hammer Creek basin, when compared to DEP data, indicated better metric scores for some stations while other scores were lower. None of the upper agricultural areas met HQ criteria. A combination of variable drought conditions, BMP implementation, other seasonal factors, and natural benthic community dynamics may account for the variability seen between DEP and CBF data.

The stations sampled by the Department in 2003 and 2004, while high in alkalinity, are best described as limestone-influenced sites. The substrates were not characterized by significant growths of aquatic vegetation associated with limestone springs nor, with the exception of a modest occurrence at 3UNT, were crustaceans that commonly dominate the benthos of true limestone springs (amphipods and isopods) present in any noticeable abundance. Freestone metrics were used to evaluate these sites since the limestone protocol was developed from benthic data heavily dominated by amphipods or isopods and this was not the character of the benthos in Hammer Creek.

Fish. The Department collected fish assemblage data on two mainstream sections on Hammer Creek and one station on Kettle Run. The PFBC supplied data for fish collected at five locations (Table 16). Data show that Hammer Creek contains at least 19 species of fishes including cold water fish species such as trout and sculpins. A modest presence of wild trout was documented throughout much of the main stem of Hammer Creek by The PFBC and in Kettle Run by the Department. In 2005, the PFBC stocked

the section of Hammer Creek from the furthest downstream bridge on T536 (Obie Road) to the dam at the pumping station off SR 322 with approximately 1600 catchable sized trout pre-season and similar numbers of catchable sized trout in-season. Anecdotal and other information made known to the Department indicates that trout inhabit various other tributaries of Hammer Creek; particularly in the lower Hammer Creek basin upstream of Speedwell Forge Lake.

The PFBC also supplied fisheries data for Speedwell Forge Lake. The lake fishery contains at least 26 species and has resident populations of several warm water species such as largemouth bass, bluegill, pumpkinseed, green sunfish, black and white crappie, channel and white catfish, brown and yellow bullhead, gizzard shad, and common carp (Table 17). The PFBC manages Speedwell Forge Lake as a warm water fishery through natural reproduction of resident fish and supplemental stocking of channel catfish (Table 18). Cold water salmonids were only captured in the 1999 survey. These fish likely originated from Hammer Creek. Salmonids may use Speedwell Forge Lake during late fall, winter, and early spring, but it is unlikely that they are present in the lake during the summer as temperatures and DO levels often fall outside normal tolerance ranges for these cold water fish.

BIOLOGICAL USE QUALIFICATIONS

The qualifying criterion applied to Hammer Creek was the DEP antidegradation integrated benthic macroinvertebrate score. Selected benthic macroinvertebrate community metrics were compared to one of two reference stations (Table 19). One reference station was located on Segloch Run. Segloch Run is currently designated Exceptional Value (EV) in Chapter 93 and was used to compare with Hammer Creek stations that were freestone with low alkalinities. Elk Creek, an EV limestone-influenced stream, was the second reference station and was used to evaluate Hammer Creek stations that were limestone-influenced as indicated by higher alkalinities. It must be noted that CBF alkalinity values cited for upper Hammer Creek (CBF 2008) are significantly higher than those collected from similar locations during the Department's previous surveys (Tables 2, 4, & 7). Alkalinity values for Elk Creek were not measured during the 2003 survey because historical data had established Elk Creek alkalinity values as comparable to those documented in Hammer Creek. The magnitude difference between the DEP and CBF alkalinity datasets for Hammer Creek and Elk Creek with respect to the resident benthic communities is relatively insignificant. Wide alkalinity concentration ranges may be a factor of variable hydrologic conditions, which are affected by seasonal precipitation events and related groundwater recharge/surface discharge and concentration/dilution dynamics. The alkalinity values measured during DEP surveys also displayed wide spatial/temporal variability (Tables 2, 4, & & 7). Time of year and seasonal drought/extended wet-weather conditions would influence alkalinity variability. Benthic sample data from historical and recent DEP and CBF surveys reflect community structure and taxonomic composition common to freestone streams despite periodic high alkaline concentrations. Further, the sampled Hammer Creek sites were noticeably depauperate in crustacean taxa that normally dominate higher alkaline, true limestone habitat.

The Hammer Creek/Reference Station comparisons were made using metrics that were selected as being indicative of aquatic community health: taxa richness; modified EPT index (total number of intolerant Ephemeroptera, Plecoptera, and Trichoptera taxa); modified Hilsenhoff Biotic Index; percent dominant taxon; and percent modified mayflies.

Based on the application of these five metrics to the Department's data, the Walnut Run station had a biological condition score greater than 92% of the reference station on Segloch Run. This indicates that Walnut Run qualifies for an EV designation under the Department's regulatory criterion (25 Pa. Code §93.4b(b)(1)(v). None of the other DEP stations met the Antidegradation qualifying requirements listed in 25 Pa. Code §93.4b(b). CBF results were comparable to DEP's EV existing use determination for Walnut Run. Metrics analysis results of CBF data for 1HC met the 83% biological condition scoring criterion (25 Pa. Code §93.4b(a)(2)(i)(A)) - indicating that the existing use of this Hammer Creek headwater station matches its current HQ designated use.

PUBLIC RESPONSE AND PARTICIPATION SUMMARY

The Department provided public notice of this aquatic life use evaluation and requested any technical data from the general public through publication in the Pennsylvania Bulletin on June 7, 2003 (33 Pa.B 2712). A similar notice was also published in the Lebanon Daily News on June 6, 2003. In addition, the Heidelberg, South Lebanon, and Elizabeth Townships were notified of the redesignation evaluation in a letter dated June 5, 2003. David Correll from the Smithsonian Environmental Research Center provided water chemistry data for Hammer Creek. The Department received letters from the Hammer Creek Watershed Association, Heidelberg and Warwick Townships, PennEnvironment, and the Pennsylvania Chapter of the Sierra Club in opposition to the changing of designation.

The Hammer Creek report and original recommendations (June 2007) to remove the HQ designation from the Hammer Creek basin and change the designated use of Speedwell Forge Lake to Warm Water Fishes (WWF) were provided to the petitioner and posted on DEP's web page for public review and comment. The Chesapeake Bay Foundation (CBF) submitted a letter opposing the Department's findings and a report with additional data (CBF 2008) summarizing conditions of the Hammer Creek watershed.

DESIGNATED USE REVIEW

The petitioners have requested that the designated use of the Hammer Creek basin upstream of the Speedwell Forge Lake Dam be changed from its current HQ-CWF designation to TSF, a less restrictive use. In order to redesignate a stream to a less restrictive use, DEP must conduct a stream redesignation evaluation that satisfies the demonstrations required by 25 Pa. Code §93.4(b) *Less restrictive uses* and *§*93.4(c) *Redesignation of water*.

Section §93.4(b) states that "less restrictive uses than those currently designated for particular waters listed in § § 93.9a—93.9z may be adopted when it is demonstrated that:

- the designated use is more restrictive than the existing use,

- the use cannot be attained by implementing effluent limits required under sections 301(b) and 306 of the Federal Clean Water Act (33 U.S.C.A. § § 1311(b) and 1316) [*pertains to point source discharges*] or implementing cost-effective and reasonable BMPs for nonpoint source control,
- and one or more of the following conditions exist:
  (1) Naturally occurring pollutant concentrations (natural quality) prevent the attainment of the use.
  (2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met.
  (3) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place.
  (4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate the modification in a way that would result in the attainment of the use.
  (5) Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life uses.
  (6) Controls more stringent than those required by sections 301(b) and 306 of the Federal Clean Water Act would result in substantial and widespread economic and social impact."

Further, Section §93.4(c) states that "Waters considered for redesignation may not be redesignated to less restrictive uses than the existing uses."

In order to properly address the petition request for Hammer Creek, DEP has conducted the following stream redesignation evaluation to determine the appropriateness of the original designated use as required by §93.4(b):

- A designated use / existing use comparison to determine if the designated use is more restrictive,
- An evaluation of point sources and nonpoint sources to determine if effluent limits and BMPs will result in attainment of the designated use
- A determination of whether any of the six conditions in the regulations is applicable.

Stream Redesignation Evaluation Summary

HQ-CWF Designated Use. As part of this redesignation evaluation, information known to DEP was reviewed to determine, to the best extent practical, whether the HQ-CWF designated use is supported by "existing use" conditions that may have been present at the time of the original designation. "Existing uses", as defined in 25 Pa. Code §93.1, are "Those uses actually attained in the water body on or after November 28, 1975, whether

or not they are included in the water quality standards." Based on the water quality conditions presented and discussed above in the Water Quality and Uses – Surface Water section, the upper Hammer Creek basin was not in a "primitive" condition at the time of the original Conservation Area designation, and therefore, did not merit the Conservation Area/HQ-CWF conversion made in 1979. The land use conditions, localized stream habitat impacts, and pollution events, which characterized the upper basin area prior to the 1979 redesignation further indicates that HQ-CWF existing uses were not evident at that time.

Designated Use / Existing Use Comparison. Historic and recent data, including benthic data submitted by CBF (2008) for most of the upper basin, show that the HQ "designated use is more restrictive than the existing use" (CWF) – a demonstration required by §93.4(b). To qualify as HQ designated use waters, at least one of following qualifying criteria should be demonstrated: chemistry, biological assessment, or Class A wild trout stream designation.

Chemistry

While no long-term water chemistry data were available from Hammer Creek or Speedwell Forge Lake to allow for HQ-qualifying water quality criteria comparisons, a review of historical and recent water chemistry data collected in the upper basin indicates that if requisite long-term data were available, the chemistry qualifying criterion in §93.4b(a)(1)(i) would not likely be met. (See Tables 2, 4, 7 – 13 and Figures 6 & 7)

Biological Assessment

The benthic communities collected from concurrent sites from 1972 to 2007 are reasonably comparable in that upper Hammer Creek locations were depauperate in sensitive taxa abundance and richness (stoneflies, most mayflies, and some caddisflies) and dominated by more tolerant taxa (particularly Chironomidae) – both situations being counter-indicative of High-Quality existing use conditions.

Class A Wild Trout Designation

Wild trout have been documented in modest quantities in one unnamed tributary (PFBC 0102; Figure 4). While wild trout are also present at other upper basin locations, there is no indication of any significant trout biomass data to compel designation of any Hammer Creek stream reaches as Class A Wild Trout waters.

Point and Nonpoint Source Evaluation. There is only one small permitted point source and it is located in the lower Hammer Creek basin. Because of its location, more restrictive discharge limits would not provide any remedy in attaining HQ conditions in the upper basin. Numerous dam removal and stream bank fencing and stabilization projects (best management practices or BMPs) have been implemented to control nonpoint sources in the study area. While some areas of Hammer Creek have documented improvement, other areas in the upper basin remain impacted by non-point sources.

In order to evaluate the potential of the upper Hammer Creek basin to respond favorably to additional BMP projects and achieve HQ use attainment, sediment and nutrient loading estimates for the upper basin were generated using a reference watershed approach based on the Department's ArcView Generalized Watershed Loading Function (AVGWLF) model.

The Reference Watershed Approach compares two watersheds: one attaining its uses (the reference) and one that is impacted based on biological assessments. Ideally, both watersheds should have similar land use/cover distributions. Other features, such as base geologic formation, are matched to the extent possible; however, most variations can be adjusted for in the model. The objective of the process in this case is to estimate the BMP implementations necessary to reduce the loading rate of pollutants in Hammer Creek to a level equivalent to the loading rate in the reference stream segment (Hay Creek). Implementing these estimated BMPs should reduce loads resulting in conditions favorable for the return of a healthy biological community in Hammer Creek.

Three factors were considered when selecting a suitable reference watershed: 1) The watershed should have been assessed by DEP and determined to be attaining water quality standards; 2) The watershed should be comparable to Hammer Creek in physical properties, such as land cover/land use, physiographic province, and geology/soils; and 3) The size of the reference watershed should be within 20-30 percent of the Hammer Creek watershed area. The search for a reference watershed that would satisfy the above characteristics for the Hammer Creek comparison was conducted by means of a desktop screening using several GIS coverages, including the Multi-Resolution Land Characteristics (MRLC), Landsat-derived land cover/use grid, the Pennsylvania streams database, and geologic rock types. Based on these three reference watershed selection factors, Hay Creek (Berks County) was selected as the reference watershed for comparison because of requisite similarities and EV, HQ-CWF, and CWF designated use attainment. Hay Creek is located south of Birdsboro, in Robeson and Union Townships and New Morgan Borough of Berks County.

The objective of this exercise was to estimate the potential for improvement in Hammer Creek through the implementation of BMPs designed to reduce pollutant-loading rates in the upper basin to rates demonstrated in the non-impaired reference basin, Hay Creek. The AVGWLF model was used to establish existing loading conditions for the Hammer Creek and Hay Creek reference watersheds.

Based on the reconnaissance of Hammer Creek conducted in October 2007, a very small percentage of stream miles in agricultural lands were fenced or had vegetative buffers on banks and riparian areas. In addition, many eroding banks were observed throughout the basin and there were few bank stabilization projects evident. This suggests the sediment loads to Hammer Creek will continue for some time at current, very high rates. It was also observed that the stream bed was buried under fine sediments in many areas and that riffle habitat was lacking.

A review of 2005 color aerial photography (PAMAP, DCNR 2006) for both the Hammer Creek and Hay Creek watersheds and an on-the-ground reconnaissance of Hammer Creek was conducted to determine the presence of agricultural BMPs for each

watershed. In addition, Berks and Lebanon County Conservation Districts were contacted for information on agricultural practices and BMPs to get a better understanding of existing conditions that might influence the AVGWLF model. General observations of the individual watershed characteristics include:

Hammer Creek Watershed

- Local geology co-dominated by carbonate limestone rock and interbedded sandstone.
- Strip cropping and contour plowing on majority of croplands.
- Limited riparian buffer zones in some areas, with residential/commercial and crop/pasture land extending right up to stream banks.

Hay Creek Watershed

- Local geology dominated by interbedded sedimentary rock (shale and sandstone).
- Forest buffers along streams
- Predominately forested watershed

The AVGWLF model produced information on watershed size, land use, and sediment loading. The sediment loads represent an annual average over a 20-year period, from 1975 to 1995 for the Hammer and Hay Creek watersheds. This information was then used to calculate existing unit area loading rates for Hammer Creek and Hay Creek reference watersheds.

The results of the model run estimated the average annual existing loads in pounds per year for the Hammer and Hay Creek modeled areas. The parenthesized values are loads in pounds/acre/year:

	Sediment	**Nitrogen**	**Phosphorus**
Hammer Creek	4,666,000 (502.6)	140,069 (15.09)	5,716.6 (0.62)
Hay Creek	1,927,000 (241.4)	37,240 (4.66)	2,248 (0.28)

These modeling results indicate the estimated existing sediment, nitrogen, and phosphorus loading rates for Hammer Creek would need to be reduced by factors of 2.4, 3.8, and 2.5 to approximate Hay Creek reference conditions.

In order to evaluate potential reductions from implementation of BMPs, the Pollution Reduction Impact Comparison Tool (PredICT) model was used to evaluate BMP scenarios at 75% and 100% of possible agriculture, stream bank fencing and stabilization BMPs for Hammer Creek. The results are presented below in comparison with the previously presented estimated average annual existing loads (pounds/year). Values in parentheses are loads in pounds/acre/year:

	Sediment	Nitrogen	Phosphorus
Hammer Creek:	4,666,000	140,069	5,716.6
existing loading	(502.6)	(15.09)	(0.62)
@ 75% BMP	3,888,251	127,012	4667
implementation	(418.8)	(13.6)	(0.50)
@ 100% BMP	2,716,418	121,013	3,795
implementation	(292.6)	(13.0)	(0.41)
Hay Creek:	1,927,000	37,240	2,248
reference target	(241.4)	(4.66)	(0.28)

When predictive modeling considered BMP implementation levels reaching the maximum possible in Hammer Creek, improvement is indicated but loads still exceeded those of the reference (1.4, 3.2, and 1.7 times higher respectively).

A review of historical aerial photography was conducted in addition to the review of the 2005 PA MAP aerial color photography to examine landuse changes and use of agricultural BMPs over time. Aerial photography from April 29, 1940; July 7, 1970; and the period between 1992 and 1995 showed very little change in land use. Approximately 95% of agricultural lands in 1940 were still present in 2005. Use of BMPs was almost non-existent in 1940. However, in 1970 some farms were using contour plowing/strip cropping and by 1992, nearly every farm with steeper slopes was using contour plowing/strip cropping. Other BMPs in use included terracing and diversions and rotational grazing. In addition to the above BMPs, approximately 10 farms had manure storage facilities, which likely accounted for 80% or more of the farms with animals. Unlike crop lands, pasture lands in the basin had few BMPs and it was common for animals to have free access to streams in pastures. Streams in these areas were over-widened and had numerous point and sand bars, indicative of unstable bank and streambed conditions. On-the-ground reconnaissance of the basin revealed approximately 0.5 mile of stream bank fencing. Most stream miles in the upper basin lacked adequate buffers, and those few areas with adequate buffers were mainly found in the lower portion of the upper basin.

Based upon this review of historic aerial photos and available stream surveys, it is very likely that Hammer Creek had very high sediment, nitrogen and phosphorus loads in the mid to late 1970s. Aquatic habitat scores from various surveys conducted in 1997, 2003 and 2004 were consistently marginal for embeddedness, sediment deposition, channel alteration and riparian vegetation. Embeddedness and sediment deposition scores are very good indications of instream habitat conditions and the marginal scores indicate that habitat for macroinvertebrates and fish was either lacking or of poor quality.

Historical and more recent survey data from upper Hammer Creek indicate that resident aquatic macroinvertebrate communities were impacted by human caused conditions prior to 1970 and that condition persists to the present. The most recent upper basin stations sampled by DEP in 2003 and 2004 (1HC, 2HC, 3UNT, 4HC) reflect these impacts. The three latter stations were characterized by low diversity and taxa richness, while 1HC (located on a completely forested headwater tributary) had a fairly diverse and rich aquatic community.

Modeling results presented above indicate that, while additional BMPs may result in water quality improvements, as the Department has acknowledged, it is very unlikely that Hammer Creek, even with the unlikely scenario of 100% BMP implementation would experience loading rates reduced to a level resulting in HQ designated use attainment. Reaching the HQ designated use level of attainment does not appear to be possible without conversion of agricultural lands to forest and wetlands.

***Less Restrictive Use* Conditions.** The Less Restrictive Use conditions found at 25 Pa. Code §93.4(b) were reviewed in the context of the Hammer Creek redesignation request. Of the six listed, only §93.4(b)(3) is applicable to the upper hammer Creek basin: "*Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place*". Historical and recent data presented in this report clearly document the extent of human impacts on Hammer Creek.

RECOMMENDATIONS

Based on applicable regulations at 25 Pa. Code §93.4(b) and §93.4b, historical file data, comments to date provided to the Department, recent field surveys, and land use reviews the Department makes the following recommendations:

Upper Hammer Creek Basin

The Hammer Creek basin from its source to Rexmont Road (downstream of the two former water supply reservoirs) should retain its current HQ-CWF designated use. The remainder of the upper Hammer Creek basin downstream to the confluence of Unnamed Tributary 07678 (approximately 0.25 miles downstream of the junction of Obie Road and Michters Road) should be changed to CWF. Reasons for this recommendation are listed below:

1) The forested and relatively undisturbed nature of Hammer Creek upstream of the former water supply reservoirs justifies retention of the current HQ-CWF designation;
2) In 1973, Hammer Creek was originally designated as a Conservation Area, which by definition protected waters that were and are in a relatively primitive condition. Since much of Hammer Creek was not in a "relatively primitive condition" anytime between 1940 and the present, the Conservation Area designation was in error for much of the basin. Therefore, the 1979 designated use conversion of Hammer Creek basin from a Conservation Area to HQ-CWF from Rexmont Road downstream to Unnamed Tributary 07678 is also erroneous. Further, water quality evaluations conducted in

the mid-1970s, other historical file information, recent field surveys, and land use reviews do not establish that an HQ existing use was ever realized for this portion of the basin;

3) The current HQ-CWF designated use of this upper basin cannot be attained by implementing effluent limits required under sections 301(b) and 306 of the Federal Clean Water Act (33 U.S.C.A. §§ 1331(b) and 1316);
4) The current HQ-CWF use designation of the upper basin cannot be attained by implementing cost-effective and reasonable best management practices (BMPs) for nonpoint source control; and
5) The human caused conditions that prevent the attainment of the designated use cannot be remedied to the level needed for HQ-CWF use attainment. While BMPs installed to date have led to some water quality improvements and additional BMPs could result in further improvements, modeling indicates those improvements will not result in HQ-CWF use attainment.

Comments received from CBF assert that the Department failed to adequately demonstrate an HQ existing use had not been attained in the upper Hammer Creek basin at any time on or after November 28, 1975, thus invalidating the Department's conclusion that the original HQ designation was a misclassification. A review of land uses, aerial photos (1940-2005), and BMP modeling efforts all indicate that the upper Hammer Creek basin was misclassified. Land use since 1940 has been relatively consistent with agricultural use at comparable levels to those occurring up to 2005. High concentration levels of nitrates in Hammer Creek surface waters (Tables 2, 4, & 7) are relatively constant with a slight increase from 1972-2003; suggesting that water quality has been continuously impacted since the "existing use" definition date of November 28, 1975. There is no evidence to suggest that HQ existing uses were ever attained during this period. Further, if current water quality conditions do not reflect HQ existing uses after BMPs have been in place for several years, it is unreasonable to conclude that such HQ uses would have been evident in an agriculturally active watershed at the time of the original HQ designation when BMPs were even less evident.

Lower Hammer Creek Basin

It is recommended that Walnut Run, a tributary to Hammer Creek be redesignated as EV, based on the biological condition scoring criteria at 25 Pa. Code §93.4b(b)(1)(v).

The remaining, lower portion of the Hammer Creek basin from Unnamed Tributary 07678 downstream to the Inlet of Speedwell Forge Lake, including its northern unnamed tributary, should retain the current HQ-CWF designation. While Department findings indicate that much of the upper Hammer Creek basin does not now and has never displayed HQ existing uses, many sections of the lower basin exhibit improving water quality conditions. The condition of the lower basin, being better than that of the upper portion of Hammer Creek, along with a lack of historical "existing use" information to the contrary on the lower basin, precludes removal of the HQ designation.

Speedwell Forge Lake

A review of available data indicates the existing use for Speedwell Forge Lake is and has always been WWF. The predominance of warm water conditions and warm water fishery found in Speedwell Forge Lake is the consequence of impounding flowing waters. Such conditions are normal and are expected whenever flowing waters are impounded in areas with temperate climates. These warm water conditions are irretrievable since it is not feasible to remove the impoundment or operate other types of hydrologic modifications to restore the water body to its original condition in a way that would result in attainment of the current HQ designated use. Historical data indicate that Speedwell Forge Lake has supported a warm water fish community since it was constructed and has been managed by the PFBC as such.

It is the Department's conclusion that: 1) the designated use of Speedwell Forge Lake is more restrictive than its existing use; 2) similar to the discussion above in the Upper Hammer Creek Basin Recommendations, the Lake's immediate surrounding area was not in a "relatively primitive condition" at the time of its construction. Thus, the HQ-CWF designation for Speedwell Forge Lake is based on a Conservation Area misclassification; 3) the designated use of HQ-CWF cannot be attained by implementing effluent limits required under sections 301(b) and 306 of the Federal Clean Water Act (33 U.S.C.A. §§ 1331(b) and 1316); 4) its current use designation cannot be attained by implementing cost-effective and reasonable best management practices (BMPs) for nonpoint source control; and 5) the conditions existing in Speedwell Forge Lake are the result of limnological processes that occur naturally in impoundments and it is not feasible to restore this portion of Hammer Creek to its original condition by removing Speedwell Forge Lake or managing the lake in a way that would result in the attainment of its designated use.

These Hammer Creek and Speedwell Forge Lake recommendations are not consistent with the petitioner's request to redesignate the entire Hammer Creek basin as TSF. Redesignation of most of the upper Hammer Creek basin from HQ-CWF to CWF affects approximately 17.5 miles of streams; EV affects approximately 1.6 miles of stream on Walnut Run; and WWF affects approximately 1.5 miles of Hammer Creek represented by Speedwell Forge Lake, which approximates 106 surface acres. Approximately 13.8 stream miles are recommended to retain the current HQ-CWF designation. These recommendations are depicted in Figure 9. These recommendations are depicted in Figure 9.

REFERENCES

Ballaron, P. B., S. W. Bollinger, and D. L. Sitlinger. 1996. Lake Water Quality Assessment: Inventory of Lakes in the Susquehanna River Basin In Pennsylvania and Water Quality Characteristics of Eleven Publicly-Owned Lakes. Susquehanna River Basin Commission. Pub No. 177.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water; Washington, D.C.

Bronner, P. E. 1972. Field Memorandum. Streams 2.14.3 a. Unnamed Tributary to Hammer Creek, Heidelberg Township, Lebanon County. DEP file information.

Chesapeake Bay Foundation. 2008. Collection and Taxonomic Identification and Enumeration of Aquatic Macroinvertebrates in the Hammer Creek Watershed (Lebanon and Lancaster Counties), PA and Appropriate Reference Locations October-November 2007. Bilger, M.D. (auth); EcoAnalysts. 49pp.

Eitner, W. Jr., and R. C. Dunlap. 1969. Speedwell Forge Club Correspondence to Secretary of Health. DEP file information.

Frey, R. F. 1973. Aquatic Biology Investigation. Hammer Creek. Lebanon County. March 21, 22, 1973. DEP file information.

F.X. Brown, Inc. 2003. Speedwell Forge Lake 319 Watershed Assessment Study.

Hall, B. W. and F. A. Kulikosky. 1969. Water Pollution Report. DEP file information.

Hughey, R. E. 1974. Aquatic Biological Survey, Unnamed Tributary to Hammer Creek, Heidelberg Township, Lebanon County. May 2, 1974. DEP file information.

Hughey, R. 1975. Aquatic Biological Investigation. Hammer, Mill, and Snitzel Creeks, Heidelberg Township, Lebanon County. January 14, 1975. DEP file information.

Lyon, W. A. 1964. Commonwealth Correspondence. WDE-Proposed Recreational Dam, Hammer Creek, Elizabeth Township. Lancaster County. DEP file information.

Nichols, T. K. 1972. Aquatic Biological Investigation. Unnamed Tributary to Hammer Creek, Lancaster County, May 4, 1972, DEP file information.

PA Fish and Boat Commission. File information.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates

and Fish. U.S. Environmental Protection Agency, Office of Water Regulation and Standards, Washington, D.C. EPA 440-4-89-001.

Smithsonian Environmental Research Center. 1999. Department of Environmental Protection file information.

Templin, N. D. 1973. Field Investigation. Industrial Waste Complaint, Heidelberg Township, Lebanon County, Kirk Folk Farm. March 8, 1973. DEP file information.

Ulanoski, J. L., R. H. Shertzer, J. L. Barker, and R. L. Hartman. 1981. Trophic classification and characteristics of twenty-six publicly owned Pennsylvania Lakes. Bul. No. 61, Bureau of Water Management, Pennsylvania Department of Environmental Resources. 240 pp.

TABLE 1. HISTORIC STATION LOCATIONS
Hammer Creek, Lebanon and Lancaster Counties

STATION	LOCATION
Nichols 1972	
UNT 1972	UNT to Hammer Creek. Lat: 40.2325 Long: -76.3363 RMI: 0.1
Frey 1973	
1 1973	Hammer Creek, along T-534 in Heidelberg Township, Lebanon County. Lat: 40.2837 Long: -76.3249 RMI: 16.0
2 1973	UNT to UNT Hammer Creek 100 yards upstream T-325 crossing in Heidelberg Township, Lebanon County. Lat: 40.2767 Long: -76.3176 RMI: 0.4
3 1973	UNT to UNT Hammer Creek 100 yards downstream T-325 crossing in Heidelberg Township, Lebanon County. Lat: 40.2777 Long: -76.3208 RMI: 0.1
4 1973	UNT to Hammer Creek 100 yards downstream confluence with UNT. Lat: 40.2781 Long: -76.3227 RMI: 0.1
5 1973	Hammer Creek 30 yards downstream confluence with UNT. Lat: 40.2768 Long: -76.3238 RMI: 15.4
6 1973	UNT Hammer Creek 20 yards downstream T-536 bridge crossing in Heidelberg Township, Lebanon County. Lat: 40.2740 Long: -76.3278 RMI: 0.5
7 1973	Hammer Creek 200 feet downstream confluence with UNT. Lat: 40.2714 Long: -76.3222 RMI: 15.0
8 1973	UNT Hammer Creek. Lat: 40.26.94 Long: -76.3243 RMI: 0.1
9 1973	Hammer Creek along T-325 1000 feet downstream confluence of UNT Heidelberg Township, Lebanon County. Lat: 40.2668 Long: -76.3246 RMI: 13.9

Hughey 1974

UNT 1974 Unnamed tributary to Hammer Creek along T-327, 200 feet upstream from confluence with Hammer Creek
Lat: 40.2863 Long: -76.3154 RMI: 0.7

TABLE 1. (cont.)

STATION	LOCATION

Hughey 1975

1 1974 Hammer Creek.
Lat: 40.2858 Long: -76.3292 RMI: 16.3

2 1974 Hammer Creek, 300 feet upstream confluence with Mill Creek.
Lat: 40.2794 Long: -76.3233 RMI: 15.8

3 1974 Hammer Creek, 200 feet downstream confluence with Mill Creek.
Lat: 40.2768 Long: -76.3238 RMI: 15.4

4 1974 Hammer Creek.
Lat: 40.2699 Long: -76.3219 RMI: 14.9

5 1974 Mill Creek near T-327 bridge.
Lat: 40.2882 Long: -76.3114 RMI: 1.1

6 1974 Mill Creek, 300 feet upstream confluence with Snitzel Creek.
Lat: 40.2789 Long: -76.3214 RMI: 0.3

7 1974 Mill Creek, 300 feet downstream confluence with Snitzel Creek.
Lat: 40.2781 Long: -76.3227 RMI: 0.1

8 1974 Snitzel Creek.
Lat: 40.2767 Long: -76.3176 RMI: 0.4

9 1974 Snitzel Creek.
Lat: 40.2777 Long: -76.3208 RMI: 0.1

TABLE 2.
HAMMER CREEK - WATER CHEMISTRY

DEP (Nichols 1972; Frey 1973)

STATION	UNT Hammer Creek	1	2	3	4	5	6	7	8	9
Date	4/12/1972	3/21-22/1973								
Field Parameters										
Temp (^{o}C)	-	-	7	22.5	10.5	-	-	-	-	-
Laboratory Parameters										
Turbidity (J.C.U.)	5	-	-	-	-	-	-	-	-	-
pH	7.2	8	7.9	7.3	7.9	8	7.2	7.7	6.8	8
Alkalinity (mg/l)	32	140	45	140	150	140	45	140	35	150
Hardness (mg/l)	-	160	55	145	125	32	60	160	35	170
Ammonia Nitrogen (mg/l)	2.1	0	0	0	0	0	0	0	1.2	1.2
Nitrate (mg/l)	10.9	8	2.5	5.3	5.5	7.3	3.4	7.3	1.3	7.1
Nitrite (mg/l)	0.01	0.06	0.07	0.13	0.06	0.06	0.04	0.07	0.06	0.06
Phosphorus (mg/l)	-	0.33	0.22	0.66	0.11	0.11	0.11	0.07	0.22	0.16
T. Susp. Solids (mg/l)	20	5	0	5	0	5	10	0	10	0
B.O.D.	2.1	0.4	0.6	3	1	1	1.8	3.8	2	6.2
Chloride (mg/l)	30	15	10	15	10	15	11	16	11	16
Iron (mg/l)	-	-	0.21	0.18	-	-	0.88	0.14	-	0.26
Copper (mg/l)	-	-	0.03	0.02	-	-	-	-	-	-
Zinc (mg/l)	-	-	0	0.01	-	-	-	-	-	-

TABLE 3.
BENTHIC MACROINVERTEBRATE DATA
Hammer Creek, Lebanon and Lancaster Counties
DEP (Nichols 1972; Frey 1973)

	Station #	UNT Hammer Creek	1	2	3	4	5	6	7	8	9
	Date	4/12/1972	3/21-22/1973								
MAYFLIES											
Baetidae	***Ameletus***	R	A	R	-	VA	A	R	A	R	A
Ephemerellidae	***Ephemerella***	-	A	R	-	A	C	-	C	-	C
Heptageniidae	***Stenonema***	R	C	R	-	-	-	-	-	-	-
STONEFLIES											
Perlidae	***Acroneuria***	-	-	R	-	-	-	-	-	-	-
Perlodidae	***Isoperla***	-	-	R	-	-	-	R	-	-	-
CADDISFLIES											
Hydropsychidae	***Cheumatopsyche***	C	C	C	-	-	-	C	-	-	R
	Hydropsyche	-	C	C	-	C	C	C	C	C	C
Psychomyiidae	***Psychomyia***	-	R	-	-	-	-	-	-	-	-
Uenoidae	***Neophylax***	C	-	-	-	-	-	-	-	-	-
TRUE FLIES											
Chironomidae	***species 1, 1972***	A	-	-	-	-	-	-	-	-	-
	species 2, 1972	A	-	-	-	-	-	-	-	-	-
	species 3, 1972	C	-	-	-	-	-	-	-	-	-
	species 1, 1973	-	C	-	R	C	C	-	A	R	C
	species 2, 1973	-	C	A	-	C	C	C	C	A	-
Simuliidae	***Simulium***	A	-	-	-	-	-	C	R	C	-
Tabanidae	***Chrysops***	-	R	-	-	R	-	R	-	-	-
Tipulidae	***Hexatoma***	-	-	-	-	-	-	-	R	-	-
	Tipula	C	-	R	-	-	R	R	R	-	R
MISC. INSECT TAXA											
Belostomatidae	***Belostoma***	-	-	-	-	-	-	R	-	-	-
Elmidae	***Stenelmis***	-	R	-	-	-	-	-	-	-	-
Dytiscidae	***Hydroporous***	R	-	-	-	-	-	-	-	-	-
Gomphidae	***Hagenius***	-	-	-	-	-	-	R	-	-	-
Libellulidae	***Epicordulia***	-	-	-	-	-	-	R	-	-	-
NON-INSECT TAXA											
Isopoda	***Asellus***	-	C	-	-	-	-	C	R	C	-
	Gammarus	-	A	C	-	R	-	A	-	-	-
Lymnaeidae	***Lymnaea***	-	R	-	-	-	-	-	-	-	-
Physidae	***Physa***	A	-	-	R	R	-	-	-	-	-
Sphaeriidae	***Sphaerium***	-	-	-	-	-	-	R	-	-	-
Oligochaeta		-	-	-	A	R	-	R	-	R	-
Tubificidae		-	-	-	A	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-	R	-
	Total Taxa	11	13	10	4	9	6	15	9	8	6

VA = Very Abundant
A = Abundant
C = Common
R = Rare

TABLE 4.
HAMMER CREEK - WATER CHEMISTRY

DEP (Hughey 1974; 1975)

STATION	UNT Hammer Creek	1	2	3	4	5	6	7	8	9
Date	4/30 1974	12/10 1974	12/5 1974	12/5 1974	12/10 1974	12/10 1974	12/5 1974	12/5 1974	12/5 1974	12/5 1974
Field Parameters										
Temp (^{o}C)	16	6	10	11	6	3	8	13	1	23
pH	8	7.8	7.8	7.8	7.9	8	7.7	7.6	7.4	7.6
Cond (umhos)	280	-	-	-	-	-	-	-	-	-
Diss. O_2 (mg/l)	9.8	-	-	-	-	-	-	-	-	-
Laboratory Parameters										
pH	7.5	7.8	8.1	8.1	7.8	7.9	7.4	7.8	7.7	7.8
Alkalinity (mg/l)	140	88	160	160	48	144	158	160	74	174
Hardness (mg/l)	165	77	210	210	187	165	189	189	-	-
Ammonia Nitrogen (mg/l)	0.1	1.21	0.21	0.23	0.15	0.19	0.18	0.21	0.17	0.04
Nitrate (mg/l)	0.16	7.48	7.56	7.14	7	5.94	6.72	6.72	1.68	7.26
Nitrite (mg/l)	0.04	0.03	0.04	0.05	0.04	0.03	0.04	0.08	0.03	0.05
Phosphorus (mg/l)	-	0.33	0.06	0.08	0.18	0.11	0.04	0.1	0.06	0.09
B.O.D.	2.6	1.2	0.5	0.5	4.4	0.4	0.4	0.5	0.4	6
Chloride (mg/l)	15	12	14	15	13	11	24	18	7	22
Total Solids	280	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	-	378	306	-	348	248	362	310	160	326

TABLE 5.
BENTHIC MACROINVERTEBRATE DATA
Hammer Creek, Lebanon and Lancaster Counties
DEP (Hughey 1974; 1975)

Station #	UNT Hammer Creek	1	2	3	4	5	6	7	8	9
	4/30/1974	12/5 & 10/1974								
MAYFLIES										
Baetidae ***Baetis***	C	-	R	R	-	-	-	R	-	-
Ephemerellidae ***Ephemerella***	A	R	R	-	-	-	C	R	-	-
Heptageniidae ***Stenonema***	-	C	-	-	-	-	R	R	-	-
Tricorythidae ***Tricorythodes***	-	-	R	-	-	-	-	R	-	-
STONEFLIES										
Capniidae ***Allocapnia***	-	-	-	-	-	-	-	-	C	-
CADDISFLIES									-	
Hydropsychidae ***Cheumatopsyche***	R	C	R	R	R	R	R	C	-	-
Hydropsyche	C	A	A	A	A	A	A	C	R	-
TRUE FLIES										
Athericidae ***Atherix***	-	-	-	-	R	-	-	-	-	-
Chironomidae	R	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	R	-	R
Cryptochironomus	-	-	-	-	-	-	R	R	-	-
Dicrotendipes	-	-	R	R	R	-	-	C	-	-
Glypyotoendipes	-	-	-	-	-	-	-	R	-	-
Microtendipes	-	-	A	R	C	C	C	C	-	-
Stictochironomus	-	-	R	R	-	R	C	C	-	-
Diamesinae ***Diamesa***	C	-	R	A	-	R	R	-	-	-
Pseudodiamesa	-	-	C	C	R	-	R	C	C	-
Orthocladiinae ***Cricotopus***	-	-	C	C	C	C	C	C	C	-
Limnophytes	-	-	-	-	R	R	R	-	R	-
Orthocladius	A	-	-	R	-	R	R	R	-	-
Tanypodinae ***Conchapelopia***	-	-	R	R	-	C	R	-	-	-
Muscidae ***Limnophora***	-	-	R	-	-	-	R	-	-	-
Simuliidae ***Simulium***	-	R	C	C	R	-	R	C	-	-
Tabanidae	-	R	-	-	-	-	-	-	-	-
Tipulidae ***Antocha***	-	-	A	-	C	R	R	R	-	-
Hexatoma	R	-	-	-	-	-	-	-	-	-
Limnophila	-	-	-	-	-	-	-	-	-	R
Tipula	-	-	R	R	-	R	R	-	-	-
MISC. INSECT TAXA										
Elmidae	R	-	-	-	-	-	-	-	-	-
Stenelmis	-	R	R	-	R	C	-	-	-	-
Dytiscidae	-	-	R	-	-	-	-	R	-	-
Psephenidae ***Psephenus***	-	-	-	-	-	C	-	-	-	-
Sialidae ***Sialis***	-	-	-	-	R	-	-	-	-	-
NON-INSECT TAXA										
Isopoda ***Asellus***	-	C	-	R	C	C	R	-	-	-
Gammarus	R	A	-	-	R	-	R	R	-	-
Planariidae	-	-	-	R	-	R	R	-	-	-
Physidae ***Physa***	-	R	R	R	-	-	R	R	R	-
Oligochaeta	C	R	C	C	R	R	R	R	-	A
Hirudinea	-	R	-	-	C	-	-	-	-	-
Total Taxa	11	12	20	17	16	16	22	21	6	3

VA = Very Abundant
A = Abundant
C = Common
R = Rare

TABLE 6. STATION LOCATIONS
Hammer Creek and Segloch Run, Lebanon and Lancaster Counties
Elk Creek, Centre County

STATION	LOCATION
1HC	Hammer Creek upstream of breached Lebanon Reservoir near T349 Lebanon Township, Lebanon County. Lat: 40.2731 Long: -76.3579 RMI: 19.1
2HC	Hammer Creek at T536 bridge crossing in South Lebanon Township, Lebanon County. Lat: 40.2887 Long: -76.3458 RMI: 17.5
PFBC 0101	Hammer Creek along T534 in Heidelberg Township, Lebanon County. Lat: 40.2860 Long: -76.2398 RMI: 16.5
3 UNT PFBC 0102	Unnamed tributary to Hammer Creek along T327 in Heidelberg Township, Lebanon County. Lat: 40.2822 Long: -76.3197 RMI: 0.4
4HC SERC	Hammer Creek at T536 bridge crossing in Heidelberg Township, Lebanon County. Lat: 40.2707 Long: -76.3214 RMI: 14.9
PFBC 0201	Hammer Creek along T325 in Heidelberg Township, Lebanon County. Lat: 40.2703 Long: -76.3227 RMI: 14.4
5HC PFBC 0202	Hammer Creek along T560 in Elizabeth Township, Lancaster County. Lat: 40.2480 Long: -76.3327 RMI: 13.0
6WR	Walnut Run along SR322 in Elizabeth Township, Lancaster County. Lat: 40.2470 Long: -76.3399 RMI: 0.4
7KR	Kettle Run at SGL 156 boundary in Penn Township, Lancaster County. Lat: 40.2373 Long: -76.34.91 RMI: 0.9
8HC PFBC 0301 319-1	Hammer Creek along SR1037 in Elizabeth Township, Lancaster County Lat: 40.2283 Long: -76.3352 RMI: 11.4
319-2	Unnamed tributary to Speedwell Forge Lake in Elizabeth Township, Lancaster County. Lat: 40.2147 Long: -76.3158 RMI: 0.2
Ref1	Segloch Run at SGL 46 boundary along T596 in Clay Township, Lancaster County. Lat: 40.2467 Long: -76.2823 RMI: 1.7
Ref2	Elk Creek along T863 in Miles Township, Centre County. Lat: 40.9209 Long: -77.4803 RMI: 4.7

TABLE 7.
HAMMER CREEK - WATER CHEMISTRY
DEP

STATION	1HC	2HC	3UNT		4HC		4.5HC	5HC		6WR	7KR	8HC
Date	4/6/2004	4/6/2004	4/16/2003	4/6/2004	4/16/2003	5/7/2003	4/16/2003	4/16/2003	5/7/2003	5/7/2003	4/6/2004	5/7/2003
Field Parameters												
Temp (^{o}C)	-	-	-	-	-	17.54	-	-	13.69	15.46	-	12.43
pH	-	-	-	-	-	8.35	-	-	7.9	7.61	-	7.4
Cond (umhos)	-	-	-	-	-	495	-	-	446	90	-	381
Diss. O_2 (mg/l)	-	-	-	-	-	13.27	-	-	11.78	9.9	-	10.5
Alkalinity (mg/l)	20	30	-	180	-	-	-	-	-	-	10	-
Laboratory Parameters												
pH	-	-	7.7	-	8	-	7.9	7.8	-	-	-	-
Alkalinity (mg/l)	-	-	160.4	-	151.4	-	138	120.8	-	-	-	-
Nitrite (mg/l)	-	-	0.01	-	0.01	-	0.02	0.01	-	-	-	-
Nitrate (mg/l)	-	-	9.38	-	8.9	-	8.14	6.73	-	-	-	-
T. Susp. Solids (mg/l)	-	-	6	-	22	-	4	10	-	-	-	-
Phosphorus (mg/l)	-	-	<0.01	-	<0.01	-	0.012	0.026	-	-	-	-
Chloride (mg/l)	-	-	27.8	-	19.6	-	-	15.2	-	-	-	-

TABLE 8.
HAMMER CREEK - WATER CHEMISTRY
PFBC

STATION	0101	0101	0102	0201	0202	0202	0301
Date	9/8/1983	9/12/2003	10/30/2003	6/29/1976	6/30/1976	9/11/2003	9/11/2003
Field Parameters							
Temp (^{o}C)	20.8	14	13.3	22	19.5	15.9	14
pH	8.2	7.8	7.6	7.4	7.4	8	7.5
Specific Conductance	399	415	461	320	260	421	370
Hardness	192	294	312	112	83	260	238
Alkalinity (mg/l)	158	196	194	96	80	182	165
Diss. O_2 (mg/l)	9.3	-	-	-	-	-	-

TABLE 9.
HAMMER CREEK - WATER CHEMISTRY
Smithsonian Environmental Research Center
Station Location SERC, Figure 4

Date	Phosphorus	Orthophosphate	Nitrate + Nitrite	Ammonia	Kjeldahl Nitrogen	Organic Matter
Units	ug/l	ug/l	ug/l	ug/l	ug/l	g-4/l
10/4/1994	58	34	9415	87	264	13
10/12/1994	70	30	9184	95	354	51
10/18/1994	76	49	9665	220	400	36
10/25/1994	58	33	5269	334	297	18
11/1/1994	495	257	7962	301	1034	63
11/8/1994	81	40	9282	210	433	13
11/15/1994	345	166	8280	159	988	62
11/22/1994	107	61	7183	122	438	26
11/29/1994	269	191	7417	127	788	42
12/6/1994	205	109	9617	60	703	38
12/13/1994	64	33	8192	40	207	20
12/20/1994	52	17	8729	32	154	11
12/28/1994	200	77	9628	42	640	23
1/4/1995	86	41	8106	52	275	35
1/10/1995	76	25	8040	57	329	30
1/18/1995	130	61	9316	53	374	19
1/18/1995	111	62	9576	51	383	29
1/18/1995	70	66	8527	55	332	30
1/24/1995	143	63	8484	54	575	2
1/31/1995	111	62	9125	44	342	42
2/7/1995	84	22	8116	17	144	21
2/14/1995	105	33	8303	120	411	11
2/22/1995	453	255	5631	411	1527	69
2/28/1995	42	17	8485	44	162	17
3/7/1995	327	138	7649	152	971	69
3/14/1995	88	45	7955	39	304	13
3/21/1995	45	17	9006	19	174	23
3/28/1995	39	16	8847	34	188	26
4/4/1995	85	32	7799	106	603	26
4/11/1995	85	47	9475	72	434	25
4/18/1995	105	86	8639	125	397	32
4/25/1995	77	29	8516	84	333	41
5/2/1995	122	54	7481	128	515	38
5/9/1995	111	70	9021	148	366	31
5/16/1995	77	48	6984	107	413	17
5/23/1995	138	72	8342	142	504	91
5/31/1995	101	39	6436	130	516	18
5/31/1995	90	38	5949	130	508	28
5/31/1995	99	46	5845	127	440	35
6/6/1995	81	61	9969	152	341	40
6/13/1995	116	61	8732	150	263	34
6/20/1995	102	68	8384	147	364	28
6/27/1995	97	73	8078	97	412	38
7/5/1995	171	108	8102	126	657	40
7/11/1995	273	191	9335	190	1216	49
7/18/1995	164	114	8012	127	679	36
7/25/1995	558	240	6444	122	1324	78
8/1/1995	140	83	9102	151	568	51

TABLE 9. (cont.)

Date	Phosphorus	Orthophosphate	Nitrate + Nitrite	Ammonia	Kjeldahl Nitrogen	Organic Matter
Units	ug/l	ug/l	ug/l	ug/l	ug/l	g-4/l
8/8/1995	77	51	8958	96	520	31
8/15/1995	119	81	11212	181	640	48
8/22/1995	104	62	10513	94	421	41
8/29/1995	122	68	9001	78	515	49
8/29/1995	123	64	9071	78	422	56
8/29/1995	127	65	9141	75	632	55
9/9/1995	101	61	10517	89	426	29
9/12/1995	129	90	9498	152	671	49
9/19/1995	151	87	9098	113	504	12
9/26/1995	114	77	9409	112	453	16
10/3/1995	165	112	8633	103	618	35
10/11/1995	204	125	8284	133	651	53
10/11/1995	182	120	8449	132	665	33
10/11/1995	194	119	8251	131	704	42
10/17/1995	446	195	6328	190	1305	59
10/24/1995	250	149	8646	132	699	44
10/31/1995	355	242	8396	215	1002	76
11/7/1995	852	530	8053	524	2352	145
11/14/1995	2004	979	9935	515	4920	574
11/21/1995	44	38	15857	31	162	21
11/28/1995	57	35	9011	30	209	24
12/5/1995	1888	1123	7515	716	4796	483
12/12/1995	4064	1674	8731	438	9884	743
12/19/1995	20308	10840	5340	3197	52822	4622
12/28/1995	2313	1180	6829	612	6592	479
1/3/1995	86	46	9254	70	274	16
1/17/1995	92	58	8902	84	325	43
1/23/1995	686	346	8351	321	1631	108
1/30/1996	117	49	10172	41	357	20
2/6/1996	289	176	8748	191	846	51
2/13/1996	507	276	8303	317	1693	83
2/21/1996	117	91	7525	89	536	25
2/27/1996	82	39	9409	35	363	40
3/5/1996	220	137	9140	128	813	32
3/12/1996	141	56	8514	61	478	27
3/19/1996	519	262	7792	188	1436	86
3/26/1996	220	121	7548	137	611	32
4/2/1996	53	31	8072	36	189	20
4/9/1996	449	223	5677	158	1799	13
4/16/1996	61	32	7918	50	442	18
4/16/1996	53	31	7950	50	348	23
4/16/1996	56	31	7982	51	426	28
4/23/1996	84	42	7444	73	577	21
4/30/1996	130	67	7472	101	599	18
5/7/1996	234	127	6234	146	1043	47
5/14/1996	170	89	6614	84	655	36
5/20/1996	166	85	8766	110	850	43
5/28/1996	210	92	8291	83	542	29
6/3/1996	608	330	8578	157	1433	65
6/10/1996	3578	1628	4742	274	7802	385
6/17/1996	1395	742	5978	212	3565	191
6/24/1996	121	114	8927	60	723	20

TABLE 9. (cont.)

Date	Phosphorus	Orthophosphate	Nitrate + Nitrite	Ammonia	Kjeldahl Nitrogen	Organic Matter
Units	ug/l	ug/l	ug/l	ug/l	ug/l	g-4/l
7/1/1996	75	60	9730	62	424	37
7/8/1996	379	230	7168	243	1561	73
7/15/1996	869	424	5991	195	3153	225
7/22/1996	95	58	8038	81	391	38
7/29/1996	91	65	7841	79	399	25
8/5/1996	114	62	9764	99	426	28
8/12/1996	82	54	8255	86	510	37
8/19/1996	88	65	9138	67	347	28
8/23/1996	666	555	9936	224	1343	84
9/3/1996	174	79	9165	180	733	105
9/9/1996	68	52	7703	76	406	18
9/16/1996	152	93	9081	101	564	10
9/23/1996	120	82	9400	103	418	26
9/30/1996	68	48	10213	67	263	29
10/7/1996	221	190	8727	182	1014	41
10/15/1996	1450	664	3558	236	3338	13
10/21/1996	141	91	8519	57	396	18
10/28/1996	84	5	9433	46	287	17
11/4/1996	1167	701	4045	338	2962	99
11/12/1996	221	51	8600	120	475	26
11/18/1996	424	391	6998	151	1106	66
11/25/1996	840	633	5548	328	2532	99
12/2/1996	326	196	8060	115	837	87
12/9/1996	584	287	6441	149	635	63
12/16/1996	129	81	7939	66	-	26
12/30/1996	68	40	9282	37	-	23
1/6/1997	111	41	9639	40	-	22
1/13/1997	123	37	9918	50	-	7
1/21/1997	98	42	10171	46	-	19
1/27/1997	56	33	9537	83	-	21
2/3/1997	108	51	8751	38	-	28
2/10/1997	103	61	7878	86	-	22
2/10/1997	110	66	7844	90	-	25
2/10/1997	92	75	7878	91	-	-
2/18/1997	29	10	8695	35	-	24
2/24/1997	52	22	8882	29	-	59
3/3/1997	71	51	8818	75	-	60
3/10/1997	329	183	7827	188	-	62
3/17/1997	52	25	8745	55	-	66
3/27/1997	79	41	7653	69	-	46
3/31/1997	61	51	8859	42	-	7
4/7/1997	33	21	9694	35	-	46
4/14/1997	71	4	8819	38	-	19
4/21/1997	25	25	8893	48	-	18
4/28/1997	47	28	7076	50	-	29
5/5/1997	39	19	7233	77	-	26
5/12/1997	60	24	9390	70	-	15
5/19/1997	220	122	7446	192	-	68
5/25/1997	156	82	8069	172	-	50

TABLE 10.
WATER CHEMISTRY

Hammer Creek (391-1) and Unnamed Tributary to Speedwell Forge Lake (319-2)

F.X.. Brown, Inc.

STATION	319-1								
Date	7/10 2000	10/2 2000	2/9 2001	5/10 2001	1/25 2002	3/3 2002	3/21 2002	3/28 2002	5/14 2002
Laboratory Parameters	Baseflow				Stormflow				
Total Phosphorus	0.037	0.037	0.064	0.046	0.17	0.2	0.44	0.26	1.3
Nitrite/nitrate nitrogen	7.4	6.43	6.08	1.42	4.05	4.08	3.5	3.55	3
Total Kjeldahl Nitrogen	<.1	<.1	<.1	<.1	0.77	1.4	2.1	4.55	2.7
Total suspended solids	<.1	<.1	32	8.8	50	72	150	270	310
pH	8.4	8.2	8.5	8.3	7.8	7.8	7.7	7.6	7.6

STATION	319-2			
Date	7/10 2000	10/2 2000	2/9 2001	5/10 2001
Laboratory Parameters	Baseflow			
Total Phosphorus	0.063	0.065	0.21	0.062
Nitrite/nitrate nitrogen	6.43	4.65	6.08	1.17
Total Kjeldahl Nitrogen	<.1	0.37	<.1	<.1
Total suspended solids	<.1	1.6	28	3.6
pH	7.7	7.7	8.6	7.7

TABLE 11.
SPEEDWELL FORGE LAKE - WATER CHEMISTRY

Ulanoski and Shertzer 1981

	Location	Dam						Mid-lake		
		April 17, 1980		June 25, 1980		August 5, 1980		April 17, 1980	June 25, 1980	August 5, 1980
Parameter	Units	1 meters	8 meters	1 meters	6 meters	1 meters	6 meters	1 meter	1 meter	1 meter
Field Parameters										
pH		7.5	-	8.4	6.9	8.6	6.7	7.7	8.2	8.8
Conductance	µmhos/cm	290	-	279	280	255	385	295	297	248
Diss. O_2	mg/l	9	7.2	9.5	0.3	14.2	0.5	10.1	10.3	16.2
Temp.	^oC	13.5	12.5	23.8	15.8	28	19	10.5	23.2	27.4
Secchi	meters	-	-	2.65	-	0.6	-	-	1.36	0.57
Laboratory Parameters										
Color	Pt/c	-	-	5	5	<5	10	-	<5	15
Chlorophyll a	µg/l	12.317	-	-	-	57.127	-	-	-	69.274
Carbon, organic-total	mg/l	3	-	1	-	-	-	3	3	-
Alkalinity	mg/l	-	-	112	110	74	134	-	112	74
Hardness-total	mg/l	20	<20	116	118	83	135	<20	125	84
Diss. Solids	mg/l	170	170	238	216	190	270	192	238	190
NH_3-N	mg/l	0.07	0.08	0.05	0.26	0.1	0.9	0.1	0.01	0.09
NO_2-N	mg/l	0.018	0.024	0.01	0.054	0.064	0.02	0.016	0.064	0.066
NO_3-N	mg/l	3.28	3.28	3	1.08	2.36	1.22	3.72	>2.0	2.13
N-organic	mg/l	0.5	0.8	0.5	0.8	-	0.04	0.4	0.29	-
N-Kjeldahl	mg/l	0.6	0.9	0.6	0.9	1.4	-	0.5	0.3	1.75
P-total	mg/l	0.12	0.37	0.02	0.03	0.04	0.05	0.09	0.04	0.06
Ortho-P-total	mg/l	0.03	0.04	0.03	0.04	0.002	0.002	0.02	<0.01	0.004
Ortho-P-diss.	mg/l	0.02	0.01	0.02	0.01	0.002	0.002	0.01	<0.01	0.004
Ca-diss.	mg/l	34.3	33.7	34.4	35.4	17.9	39.3	33.8	36.9	19.2
Mg-diss.	mg/l	23.4	33.7	9.4	8.5	10.3	9.9	33.8	9.6	10.4
Cl-diss.	mg/l	12	12	12	12	13	13	12	13	14
SO_4-diss.	mg/l	30	30	15	15	29	26	25	15	25
Fe-diss.	µg/l	70	50	40	30	50	40	60	30	50
Mn-diss.	µg/l	90	130	10	710	10	1130	60	40	10
Si-diss.	mg/l	<20	<20	<20	<20	8.69	11.24	<20	<20	8.18
Na-diss.	mg/l	1.78	1.98	4.86	4.62	4.98	4.74	1.82	4.68	4.98
K-diss.	mg/l	3.19	5.17	2.08	2.24	2.58	3.08	5.06	2.1	2.7
Floride-diss.	mg/l	<0.10	<0.11	<0.10	<0.10	<0.10	<0.10	<10	<0.10	<0.10

TABLE 12.
SPEEDWELL FORGE LAKE - WATER CHEMISTRY
SRBC (Ballaron et al. 1996)

	Location	Dam						Mid-lake		
		April 19, 1995		June 21, 1995		September 7, 1995		April 19, 1995	June 21, 1995	September 7, 1995
Parameter	Units	1 meters	5 meters	1 meters	5 meters	1 meters	5 meters	1 meter	1 meter	1 meter
Field Parameters										
pH		8.8	8.1	8.7	7.55	7.85	7.15	8.25	7.98	8.55
Conductance	µmhos/cm	307	329	284	380	336	379	326	309	333
Diss. O_2	mg/l	10.4	9.4	10.01	1.2	8.68	1.19	12.65	11.31	11.55
Temp.	^oC	12.5	9.5	24.8	17.1	23.9	22.5	12.9	25.3	23.8
Secchi	meters	1	-	0.7	-	1.09	-	1	1.95	0.48
Laboratory Parameters										
Color	Pt/c	25	25	20	40	15	10	20	15	12.5
Chlorophyll a	µg/l	0.0481	-	0.0993	-	0.0449	-	-	-	-
Carbon, organic-total	mg/l	3.9	3.7	5.9	5.3	4	3.9	2.8	5.2	4.8
Alkalinity	mg/l	100	110	88	152	114	138	108	96	110
Hardness-total	mg/l	141	151	149	78	141	160	151	109	139
Diss. Solids	mg/l	254	544	192	244	218	232	274	248	435
NH_3-N	mg/l	0.03	0.11	0.02	1.55	0.16	0.68	0.03	0.03	0.215
NO_2-N	mg/l	0.032	0.036	0.054	0.044	0.042	0.024	0.03	0.068	0.068
NO_3-N	mg/l	1.69	4.71	2.68	0.16	3.17	2.71	4.85	3.23	3.87
N-organic	mg/l	5.45	5.63	3.87	2.38	4.05	4.05	6.69	4.93	4.81
P-total	mg/l	0.08	0.1	0.16	0.13	0.09	0.11	0.07	0.17	0.14
Ortho-P-total	mg/l	0.005	0.015	0.035	0.021	0.022	0.031	0.009	0.03	0.051
Ortho-P-diss.	mg/l	<.002	<.002	0.013	0.014	0.01	0.005	<.002	<.002	0.039
Ca-diss.	mg/l	38.2	40.8	30.3	49.5	34.4	41.4	39.7	34.1	3.31
Mg-diss.	mg/l	13	12.9	12.5	12.9	12.9	13.4	12.6	13.5	13.45
SO_4-diss.	mg/l	20.8	20.9	19.5	14.5	21.1	20.9	20.8	18.6	21.65
Fe-diss.	µg/l	23	24	<10	960	74	89	32	<10	69
Mn-diss.	µg/l	<10	23	<10	1790	37	514	15	<10	30.5
Si-diss.	mg/l	4.1516	5.3928	7.49	11.3634	7.6184	8.8382	7.04	9.39	7.97
Na-diss.	mg/l	6.39	6.18	6.95	7.23	6.5	6.61	6.33	7.36	6.65
K-diss.	mg/l	2.52	2.49	2.68	3.94	3.03	3.02	3.17	2.7	2.94
Floride-diss.	mg/l	<.2	<.2	<.2	<.2	<.2	<.2	<0.2	<.2	<.2

Table 13.
SPEEDWELL FORGE LAKE - CHEMISTRY
F.X.. Brown, Inc.

Station 1	Surface				Bottom			
Parameter / Date	6/13/2000	7/10/2000	8/31/2000	10/2/2000	6/13/2000	7/10/2000	8/31/2000	10/2/2000
Total Phosphorus	0.09	0.071	0.022	0.062	0.078	0.052	0.268	0.08
Dissolved Reactive Phosphorus	0.014	0.016	0.02	0.01	0.02	0.007	0.016	0.012
Nitrite/Nitrate Nitrogen	3.95	5.31	3.18	2.96	4.16	2.92	0.22	3.78
Ammonia Nitrogen	<.1	0.5	<.1	<.1	0.66	0.76	2.45	0.14
Total Kjedahl Nitrogen	0.65	1.33	1	1.4	1.22	1.58	3.37	0.59
Organic Nitrogen	0.55	0.83	0.9	1.3	0.56	0.82	0.92	0.45
Total Suspended Solids	9	9.5	11.2	11.7	5.8	18	60	17.1
pH	8.4	8.9	8.1	8.5	7.5	7.5	0.75	7.8
Secchi Disk	1	0.8	0.8	0.9	-	-	-	-
Chlorophyll a	26.7	31.4	29.1	63.2	-	-	-	-
Pheophytin a	5.4	3.1	7.7	<.1	-	-	-	-

Station 2	Surface			
Parameter / Date	6/13/2000	7/10/2000	8/31/2000	10/2/2000
Total Phosphorus	0.096	0.104	0.17	0.139
Dissolved Reactive Phosphorus	0.025	0.018	0.023	0.019
Nitrite/Nitrate Nitrogen	4.3	6.08	4	3.39
Ammonia Nitrogen	<.1	<.1	<.1	<.1
Total Kjedahl Nitrogen	0.72	0.76	1.61	2.08
Organic Nitrogen	0.62	0.66	1.51	1.98
Total Suspended Solids	11	13	11.3	17.5
pH	8.3	8.8	8.1	8.6
Secchi Disk	0.6	0.6	0.4	0.5
Chlorophyll a	41.1	28.8	118	78.7
Pheophytin a	10.8	6.8	<.1	1.5

TABLE 14.
HABITAT ASSESSMENT SUMMARY
Hammer Creek and Segloch Run, Lebanon and Lancaster Counties
Elk Creek, Centre County

HABITAT PARAMETER	scoring range	Candidate Stations								Reference Stations			
		1HC	2HC	3UNT	4HC	5HC	6WR	7KR	8HC	R1 12/16/2003	R1 4/6/2004	R2 5/8/2003	R2 4/21/2004
1. instream cover	0 - 20	16	7	15	16	6	17	16	18	16	16	18	16
2. epifaunal substrate	0 - 20	16	16	17	6	7	18	18	14	18	18	18	18
3. embeddedness	0 - 20	17	10	15	5	6	14	16	8	12	16	14	16
4. velocity/depth	0 - 20	10	8	16	16	14	12	10	16	13	16	15	16
5. channel alterations	0 - 20	19	6	15	16	16	18	19	16	18	15	18	19
6. sediment deposition	0 - 20	16	9	15	6	7	14	16	10	14	16	16	18
7. riffle frequency	0 - 20	17	12	16	10	8	19	18	13	17	18	18	17
8. channel flow status	0 - 20	18	16	19	15	16	19	19	16	17	19	18	18
9. bank condition	0 - 20	18	13	15	10	12	19	19	13	18	18	18	18
10. bank vegetation protection	0 - 20	19	15	16	8	13	18	19	16	17	18	18	18
11. grazing/disruptive pressures	0 - 20	19	17	10	10	15	18	19	15	18	18	15	18
12. riparian vegetation zone width	0 - 20	19	5	10	8	15	18	19	15	14	16	18	19
Total Score	0 - 240	204	134	179	126	135	204	208	170	192	204	204	211
Rating		Optimal	Suboptimal	Suboptimal	Suboptimal/ Marginal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal

TABLE 15.
SEMI-QUANTITATIVE BENTHIC MACROINVERTEBRATE DATA
Hammer Creek and Segloch Run, Lebanon and Lancaster Counties
Elk Creek, Centre County

		Candidate			Reference	Candidate	Reference	Candidate	Reference	Candidate			Reference
Station #		1HC	2HC	7KR	R1	6WR	R1	3UNT	R2	4HC	5HC	8HC	R2
		4/6/2004	4/6/2004	4/6/2004	4/6/2004	12/16/2003	12/16/2003	4/6/2004	4/21/2004	5/7/2003	5/7/2003	5/7/2003	5/8/2003
MAYFLIES													
Baetidae	***Acerpenna***	-	8	-	-	-	1	-	-	-	-	-	-
	Baetis	41	32	-	13	4	1	12	22	-	-	-	8
	Centroptilum	-	1	-	-	-	-	-	-	-	-	-	-
Ephemeridae	***Ephemera***	-	-	-	-	-	-	-	-	1	-	-	-
Ephemerellidae		-	-	-	-	1	-	-	-	-	-	-	-
	Drunella	-	1	-	-	-	-	-	5	-	-	-	19
	Ephemerella	30	1	4	127	37	61	-	114	-	11	42	87
	Eurylophella	-	-	-	-	-	1	-	-	-	-	-	-
	Serratella	-	-	-	-	-	15	-	1	-	-	-	1
Heptageniidae		-	-	-	-	1	-	-	-	-	-	-	-
	Cinygmula	-	-	-	10	-	-	-	-	-	-	-	-
	Epeorus	2	-	-	6	27	4	-	2	-	-	-	1
	Stenacron	-	-	-	-	-	-	-	-	-	-	2	1
	Stenonema	-	1	-	-	-	2	-	-	-	-	-	-
Isonychidae	***Isonychia***	-	-	-	-	-	-	-	-	-	-	1	-
Leptophlebiidae		1	-	-	-	-	1	-	-	-	-	-	-
	Paraleptophlebia	-	-	-	-	-	-	-	6	-	-	-	5
STONEFLIES													
Capniidae	***Allocapnia***	-	-	-	-	11	5	-	-	-	-	-	-
Chloroperlidae		-	-	1	3	-	-	-	-	-	-	-	-
	Alloperla	-	-	-	-	1	-	-	-	-	-	-	-
Leuctridae	***Leuctra***	6	-	22	-	-	1	-	-	-	-	-	1
Nemouridae	***Amphinemura***	67	2	69	5	-	-	-	3	-	-	-	-
	Prostoia	-	-	-	-	14	-	-	-	-	-	-	-
Peltoperlidae	***Tallaperla***	10	-	-	-	-	-	-	-	-	-	-	-
Perlidae	***Acroneuria***	-	-	-	1	4	2	-	-	-	-	2	-
	Eccoptura	-	-	1	-	-	-	-	-	-	-	-	-
	Perlesta	-	-	-	-	-	-	-	-	-	-	1	-
Perlodidae	***Isoperla***	1	-	-	4	2	7	-	1	-	-	2	1
Pteronarcyidae	***Pteronarcys***	2	-	-	-	4	-	-	-	-	-	-	-
Taeniopterygidae	***Taeniopteryx***	-	-	-	-	1	6	-	-	-	-	-	-

TABLE 15. (cont.)

Station #		1HC	2HC	7KR	R1	6WR	R1	3UNT	R2	4HC	5HC	8HC	R2
CADDISFLIES													
Brachycentridae	***Micrasema***	-	-	-	-	-	-	-	2	-	-	-	3
Glossosomatidae	***Glossosoma***	-	-	-	-	2	-	-	-	-	-	-	-
Hydroptilidae	***Palaeagapetus***	-	-	2	-	-	-	-	-	-	-	-	-
Goeridae	***Goera***	-	-	-	-	-	-	-	-	-	1	-	-
Hydropsychidae	***Cheumatopsyche***	-	18	-	-	-	-	-	5	4	2	11	-
	Diplectrona	-	-	23	-	2	4	-	-	-	-	-	-
	Hydropsyche	-	19	2	1	2	-	8	16	4	9	5	3
Lepidostomatidae	***Lepidostoma***	-	-	2	-	-	-	-	-	-	-	-	-
Limnephilidae	***Pycnopsyche***	1	-	-	-	1	-	-	-	-	-	-	-
Odontoceridae	***Psilotreta***	-	-	-	-	-	-	-	1	-	-	-	3
Philopotamidae	***Chimarra***	-	-	-	-	-	-	-	-	-	-	7	-
	Dolophilodes	-	-	-	-	4	1	-	-	-	-	-	-
	Wormaldia	-	-	-	-	-	1	-	-	-	-	-	-
Polycentropodidae	***Polycentropus***	-	-	1	-	-	-	-	-	-	-	-	-
Rhyacophilidae	***Rhyacophila***	5	-	5	5	3	-	-	1	-	-	1	5
Uenoidae	***Neophylax***	3	-	-	4	1	6	-	-	-	-	-	-
TRUE FLIES													
Ceratopogonidae		-	-	4	2	-	-	-	-	4	-	-	-
	Bezzia	1	2	-	-	-	-	-	-	-	-	-	-
Chironomidae		3	109	71	26	19	41	79	8	178	34	60	50
Empididae	***Chelifera***	3	-	3	4	-	-	6	-	-	-	-	-
	Hemerodromia	-	6	-	-	-	-	8	-	-	12	1	-
Psychodidae		-	-	1	-	-	-	-	-	-	-	-	-
Simuliidae	***Cnephia***	-	3	-	-	-	-	-	-	-	-	-	-
	Prosimulium	4	7	-	14	3	2	-	-	-	-	-	11
	Simulium	1	-	-	2	-	-	1	1	2	-	1	3
Stratiomyidae		-	1	-	-	-	-	-	-	-	-	-	-
Tabanidae	***Chrysops***	-	-	-	-	-	-	-	-	-	2	-	-
Tipulidae	***Antocha***	-	3	1	-	1	-	6	-	6	-	8	1
	Dicranota	1	-	1	1	-	2	-	-	-	-	-	-
	Hexatoma	-	-	2	1	1	-	-	-	1	3	-	1
	Limnophila	-	-	-	-	-	-	-	-	-	1	-	-
	Pedicia	-	-	-	1	-	-	-	-	-	-	-	-
	Pseudolimnophila	-	-	-	1	-	-	-	-	-	-	-	-
	Tipula	-	-	-	-	-	1	-	-	-	1	2	-

TABLE 15. (cont.)

Station #	1HC	2HC	7KR	R1	6WR	R1	3UNT	R2	4HC	5HC	8HC	R2
MISC. INSECT TAXA												
Corydalidae ***Nigronia***	-	-	-	-	-	1	-	-	-	-	-	-
Elmidae ***Dubiraphia***	-	-	-	-	-	-	-	-	-	4	-	-
Macronychus	-	-	-	-	-	-	-	-	-	1	-	-
Optioservus	23	5	8	7	3	3	2	3	3	58	14	1
Oulimnius	3	-	1	5	13	34	-	-	-	-	2	-
Promoresia	-	-	-	9	1	5	-	6	-	-	-	8
Stenelmis	-	3	-	-	-	-	5	-	3	48	35	-
Psephenidae ***Psephenus***	-	-	-	-	1	-	-	-	-	-	8	-
Cordulegasteridae ***Cordulegaster***	-	-	1	-	-	-	-	-	-	-	-	-
Gomphidae	2	-	-	-	-	-	-	-	-	-	-	-
Lanthus	-	-	2	1	-	-	-	-	-	-	-	-
Ophiogomphus	-	-	1	-	-	1	-	-	1	-	-	-
NON-INSECT TAXA												
Cambaridae ***Cambarus***	-	-	-	1	1	-	-	-	-	-	-	-
Isopoda ***Caecidotea***	-	-	-	-	-	-	1	-	-	-	-	-
Crangonyx	-	1	-	-	-	-	-	-	-	-	-	-
Gammarus	-	1	-	-	-	-	47	1	4	-	-	3
Turbellaria	-	-	1	-	-	-	-	-	-	-	-	-
Sphaeriidae	-	2	-	-	-	1	-	-	-	7	-	-
Nematoda	-	-	-	-	-	-	-	-	1	1	-	-
Oligochaeta	-	3	-	-	-	-	2	-	2	-	1	-
Hydracarina	-	-	-	-	-	-	-	2	-	-	-	-
Total Taxa	21	22	24	25	11	27	12	19	14	16	14	21

TABLE 16.

FISH - Species Occurrence[1]

Hammer Creek, Lebanon and Lancaster Counties

DEP and PFBC

		Station									
		Hammer Creek 1HC 4/6/2004	Hammer Creek 2HC 4/6/2004	PFBC 0101 9/8/1983	PFBC 0101 9/12/2003	PFBC 0102 9/12/2003	PFBC 0201 6/29/1976	PFBC 0202 6/30/1976	PFBC 0202 9/11/2003	Kettle Run 7KR 4/6/2004	PFBC 0301 9/11/2003
Salvelinus fontinalis	brook trout (wild)[2]	-	-	-	0/3	3/0	-	-	11/3	A	7/4
Salmo trutta	brown trout (wild)[2]	-	-	-	-	-	-	-	0/1	-	0/2
S. trutta	brown trout (stocked)[2]	-	-	-	0/7	-	0/3	0/1	0/2	-	0/11
Oncorhynchus mykiss	rainbow trout (stocked)[2]	-	-	-	0/4	-	1/0	0/3	-	-	-
Cottus cognatus	slimy sculpin	-	-	-	A	C	-	-	-	-	-
Dorosoma cepedianum	gizzard shad	-	-	-	-	-	-	-	-	-	P
Cyprinus carpio	common carp	-	-	-	-	-	-	-	-	-	P
Rhinichythys atratulus	blacknose dace	-	C	X	A	P	X	X	A	-	A
R. cataractae	longnose dace	-	-	X	C	R	X	X	C	-	C
Margariscus margarita	pearl dace	-	-	-	P	P	-	-	-	-	-
Semotilus atromaculatus	creek chub	-	R	X	P	P	X	X	P	-	R
Exoglossum maxillingua	cutlips minnow	-	-	-	-	-	-	-	P	-	P
Pimephales notatus	bluntnose minnow	-	-	X	-	-	-	X	-	-	-
Hypentelium nigricans	northern hogsucker	-	-	-	-	-	-	-	R	-	P
Catastomus commersoni	white sucker	-	C	X	C	C	X	X	C	-	A
Ameiurus natalis	yellow bullhead	-	-	-	-	-	-	-	-	-	R
Lepomis macrochirus	bluegill	-	-	-	R	P	X	-	-	-	P
L. cyanellus	green sunfish	-	-	-	-	R	X	X	P	-	R
L. gibbosus	pumpkinseed	-	-	-	R	R	X	-	P	-	P
Etheostoma olmstedi	tessellated darter	-	C	X	P	P	X	X	C	-	P
	TOTAL TAXA	0	4	6	12	11	10	9	12	1	16

[1] - Occurrence: R - rare (<3), P - present (3-9), C - common (10-24), A - abundant (25-100), X - present

[2] - PFBC trout information :xx/yy = # of sublegal/legal sized (<175mm/?175mm)

TABLE 17.
FISH - Species Occurrence
Speedwell Forge Lake, Lancaster County
PFBC
Various sampling gears from 1988-1999

Scientific name	Common name	1988	1995	1996	1997	1999
Dorosoma cepedianum	Gizzard shad	X	X	X	X	X
Esox lucius	Northern pike	X	-	-	-	-
E. lucius x masquinongy	Tiger muskellunge	X	-	-	-	-
Cyprinus carpio	Common carp	X	X	-	-	X
Notemigonus crysoleucas	Golden shiner	X	X	-	-	X
Cyprinella analostana	Satinfin shiner	-	-	-	X	-
Cyprinella spiloptera	Spotfin shiner	-	-	X	-	-
Notropis hudsonius	Spottail shiner	X	-	X	X	-
Pimephales notatus	Bluntnose minnow	X	-	X	X	-
Catostomus commersoni	White sucker	X	-	X	X	X
Ictalurus punctatus	Channel Catfish	X	-	-	-	X
Ameiurus catus	White catfish	X	-	-	-	X
Ameiurus natalis	Yellow bullhead	X	X	-	-	X
Ameiurus nebulosus	Brown bullhead	X	X	X	-	X
Salvelinus fontinalis	Brook trout (hatchery)	-	-	-	-	X
Salmo trutta	Brown trout (hatchery)	-	-	-	-	X
Oncorhynchus mykiss	Rainbow trout (hatchery)	-	-	-	-	X
Pomoxis nigromaculatus	Black crappie	X	X	-	-	X
Pomoxis annularis	White crappie	X	X	X	-	X
Micropterus dolomieu	Smallmouth bass	-	-	X	X	-
Micropterus salmoides	Largemouth bass	X	X	X	X	X
Lepomis cyanellus	Green sunfish	X	X	X	-	X
Lepomis gibbosus	Pumpkinseed	X	X	X	X	X
Lepomis macrochirus	Bluegill	X	X	X	X	X
Sander vitreus	Walleye	X	X	-	-	-
Etheostoma olmstedi	Tesselated darter	-	-	-	X	-
	Total Species:	19	12	12	10	17

TABLE 18.
FISH STOCKING HISTORY - SPEEDWELL FORGE LAKE
WARMWATER/COOLWATER SPECIES

PFBC

2004	Channel Catfish	Fingerling	4,200
2003	Channel Catfish	Fingerling	4,200
2002	Channel Catfish	Fingerling	1,739
2001	Channel Catfish	Fingerling	3,150
2000	Channel Catfish	Fingerling	1,050
1999	Channel Catfish	Fingerling	2,100
1998	Channel Catfish	Fingerling	2,100
1996	Channel Catfish	Fingerling	1,050
1995	Channel Catfish	Fingerling	2,100
1995	Spotfin Shiner	Adult	5,500
1994	Walleye	Fingerling	3,150
1993	Walleye	Fingerling	3,150
1993	Channel Catfish	Fingerling	1,050
1992	Walleye	Fingerling	3,150
1991	Walleye	Fingerling	3,150
1990	Walleye	Fingerling	2,150
1990	Channel Catfish	Fingerling	1,600
1989	Walleye	Fingerling	2,100
1989	Channel Catfish	Fingerling	5,300
1988	Walleye	Fingerling	2,100
1988	Channel Catfish	Fingerling	5,300
1987	Walleye	Fingerling	3,200
1987	Tiger Muskellunge	Fingerling	550
1987	White Catfish	Fingerling	5,300
1987	Channel Catfish	Fingerling	5,300
1986	Tiger Muskellunge	Fingerling	200
1986	Gizzard Shad	Adult	220
1985	Walleye	Fingerling	2,650
1985	White Catfish	Fingerling	2,100
1984	Walleye	Fingerling	2,100
1984	Tiger Muskellunge	Fingerling	200
1984	White Catfish	Fingerling	5,300
1984	Channel Catfish	Fingerling	5,300
1983	Channel Catfish	Fingerling	5,300
1982	Walleye	Fingerling	2,100
1982	Tiger Muskellunge	Fingerling	200
1982	Alewife	Adult	5,000
1981	Walleye	Fingerling	1,050
1981	Channel Catfish	Fingerling	5,300
1980	Tiger Muskellunge	Fingerling	500
1980	Channel Catfish	Fingerling	2,100
1979	Tiger Muskellunge	Fingerling	550
1979	Walleye	Adult	400
1978	Walleye	Adult	300
1978	Tiger Muskellunge	Fingerling	500
1977	Walleye	Adult	300
1975	Tiger Muskellunge	Fingerling	700
1973	Walleye	Adult	200
1971	Walleye	Adult	200
1969	Largemouth Bass	Fingerling	74
1969	Largemouth Bass	Adult	53
1969	Northern Pike	Fingerling	1,159
1968	Largemouth Bass	Fingerling	1,000
1968	Walleye	Fry	265,000
1967	Largemouth Bass	Fingerling	1,000
1967	Largemouth Bass	Fry	52,000
1967	Black Crappie	Fingerling	8,000
1967	Channel Catfish	Fingerling	2,000
1967	Walleye	Fry	265,000
1967	Northern Pike	Fry	10,600
1966	Largemouth Bass	Fingerling	10,600
1966	Black Crappie	Fingerling	8,000
1966	Channel Catfish	Fingerling	5,000

TABLE 19.
RBP METRIC COMPARISON
Hammer and Segloch Creeks, Lebanon and Lancaster Counties
Elk Creek, Centre County

METRIC	CANDIDATE			REFERENCE	CANDIDATE	REFERENCE	CANDIDATE	REFERENCE	CANDIDATE			REFERENCE
	Hammer Creek 4/6/2004	Hammer Creek 4/6/2004	Kettle Run 4/6/2004	Segloch Run 4/6/2004	Walnut Run 12/16/2003	Segloch Run 12/16/2003	Unt Hammer Creek 4/6/2004	Elk Creek 4/21/2004	Hammer Creek 5/7/2003	Hammer Creek 5/7/2003	Hammer Creek 5/7/2003	Elk Creek 5/8/2003
Station #	1HC	2HC	7KR	R1	6WR	R1	3UNT	R2	4HC	5HC	8HC	R2
1. TAXA RICHNESS	21	22	25	25	28	27	12	19	14	16	20	21
Candidate/Reference (%)	84.0%	88.0%	100.0%	--	103.7%	--	63.2%	--	66.7%	76.2%	95.2%	--
Biological Condition Score	8	8	8	--	8	--	2	--	3	6	8	--
2. MODIFIED EPT INDEX	11	5	10	9	17	15	0	10	1	2	8	11
Candidate/Reference (%)	122.2%	55.6%	111.1%	--	113.3%	--	0.0%	--	9.1%	18.2%	72.7%	--
Biological Condition Score	8	2	8	--	8	--	0	--	0	0	6	--
3. MODIFIED HBI	3.21	5.63	3.43	2.31	2.22	3.04	5.32	2.41	5.81	4.79	4.21	2.64
Candidate - Reference	0.9	3.32	1.12	--	-0.82	--	2.91	--	3.17	2.15	1.57	--
Biological Condition Score	5	0	3	--	8	--	0	--	0	0	0	--
4. % DOMINANT TAXA	31.9	47.6	30.9	50	22.4	29	44.6	57	83.2	29.7	29.1	40.3
Candidate - Reference	-18.1	-2.4	-19.1	--	-6.6	--	-12.4	--	42.9	-10.6	-11.2	--
Biological Condition Score	8	8	8	--	8	--	8	--	0	8	8	--
5. % MODIFIED MAYFLIES	15.7	1.75	2.17	56.3	40	40	0	64	0.5	5.6	21.8	52.8
Reference - Candidate	40.6	54.55	54.13	--	0	--	64	--	52.3	47.2	31	--
Biological Condition Score	0	0	0	--	8	--	0	--	0	0	3	--
TOTAL BIOLOGICAL CONDITION SCORE	29	18	27	--	40	--	10	--	3	14	25	--
% COMPARABILITY TO REFERENCE	73%	45%	68%	--	100%	--	25%	--	8%	35%	63%	--

Figure 1. Hammer Creek Watershed

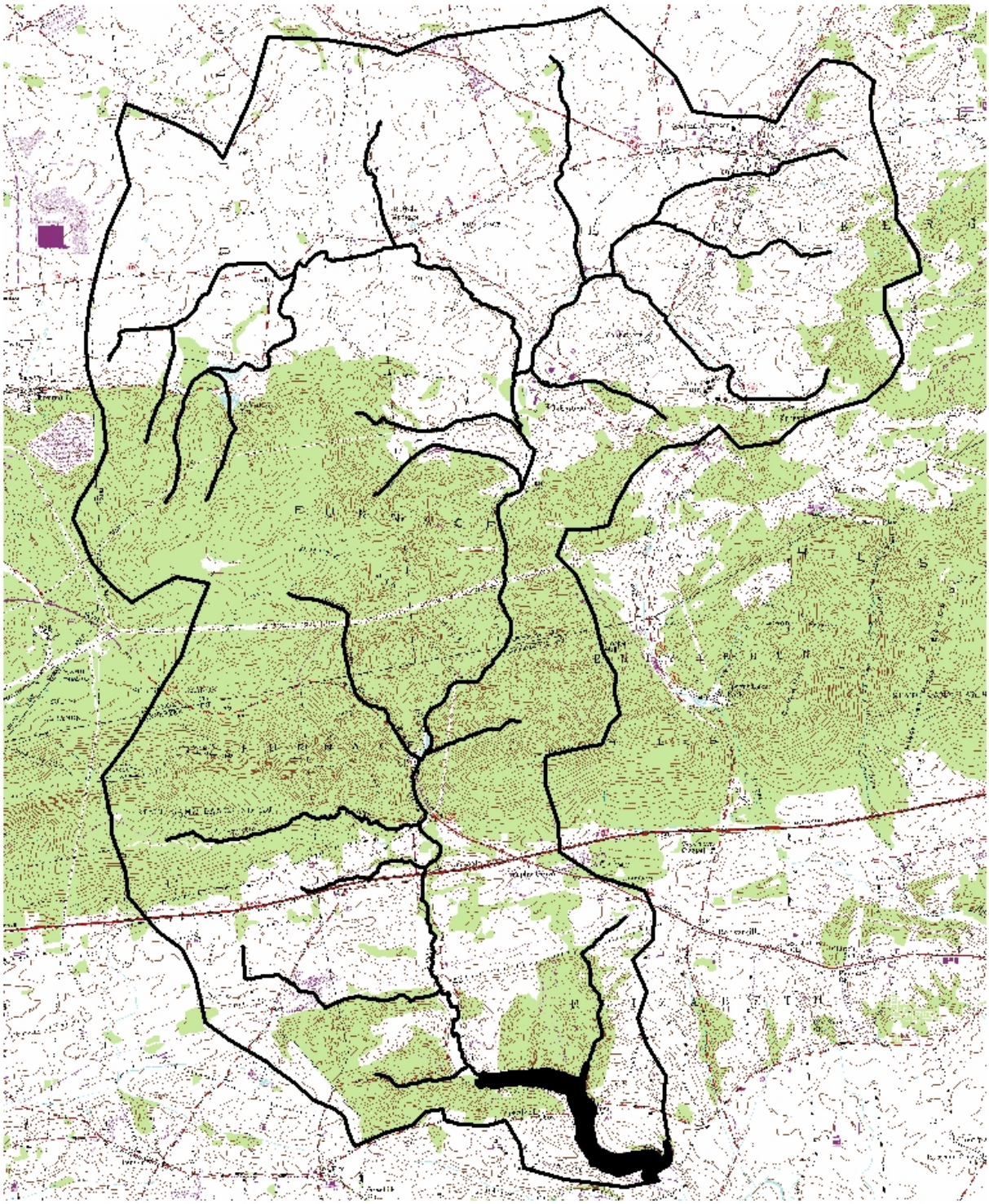


Figure 2. Historical Hammer Creek Sampling Locations, 1972 - 1973

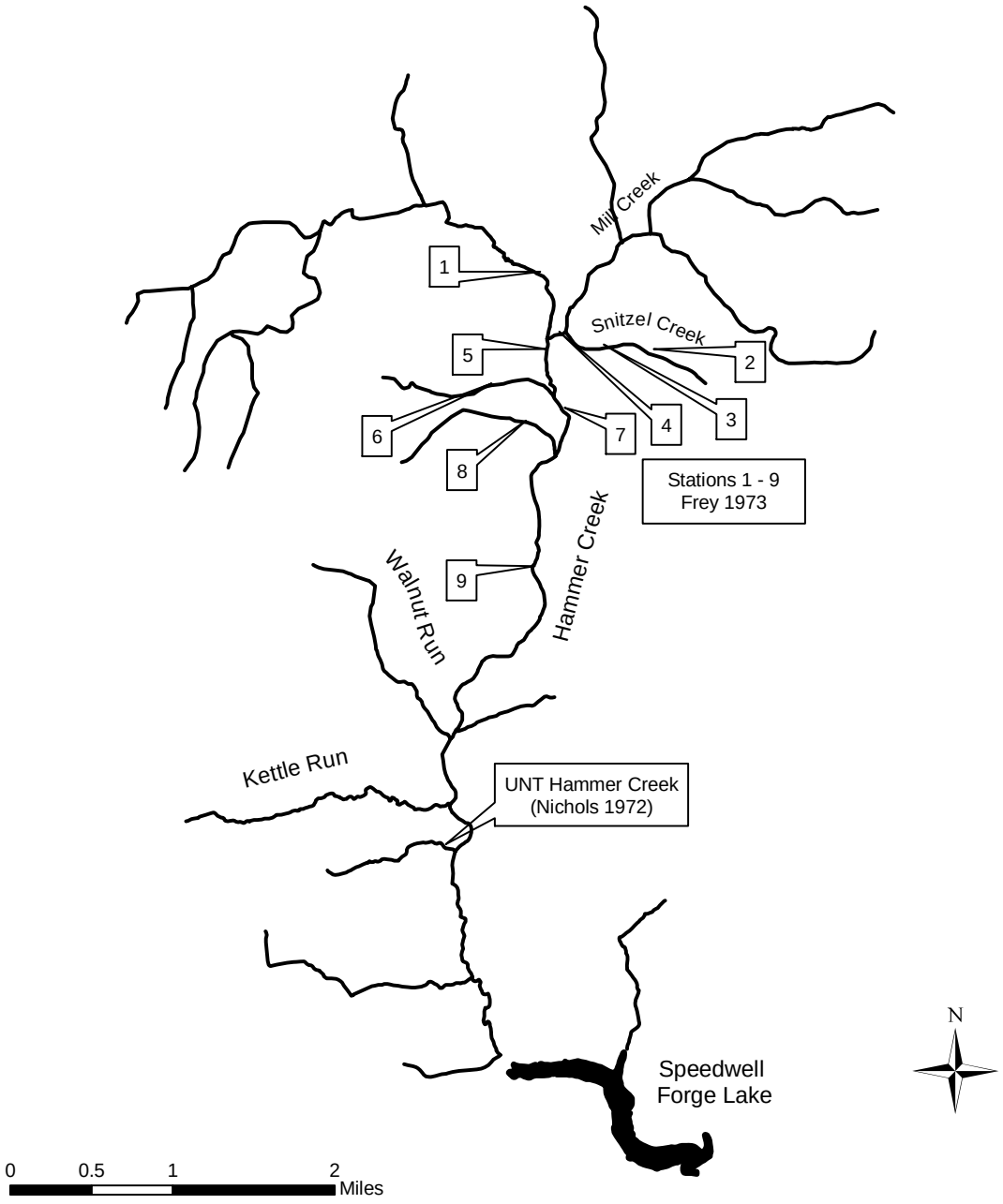


Figure 3. Historical Hammer Creek Sampling Locations, 1974

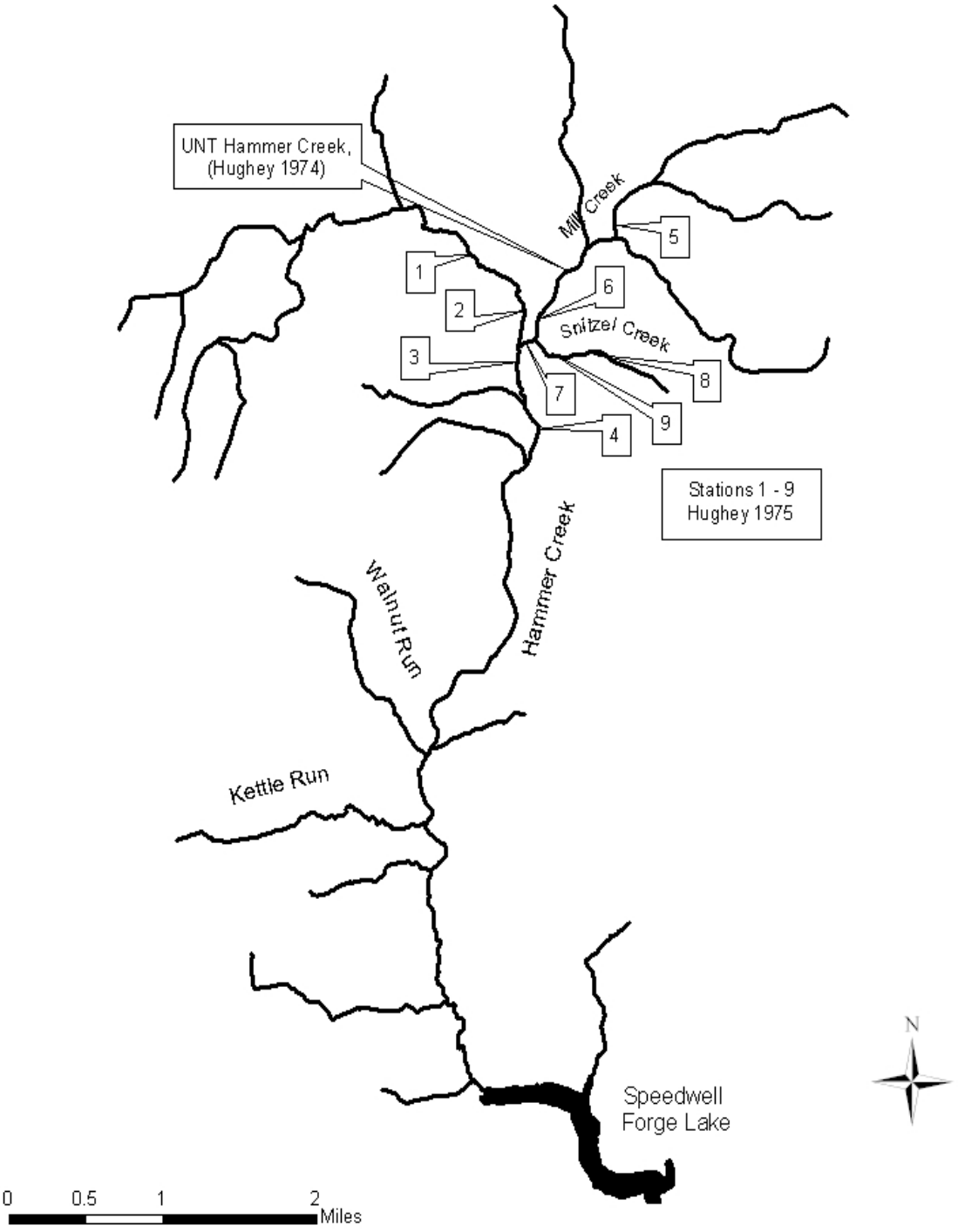


Figure 4. Hammer Creek Sampling Locations
1976-2004

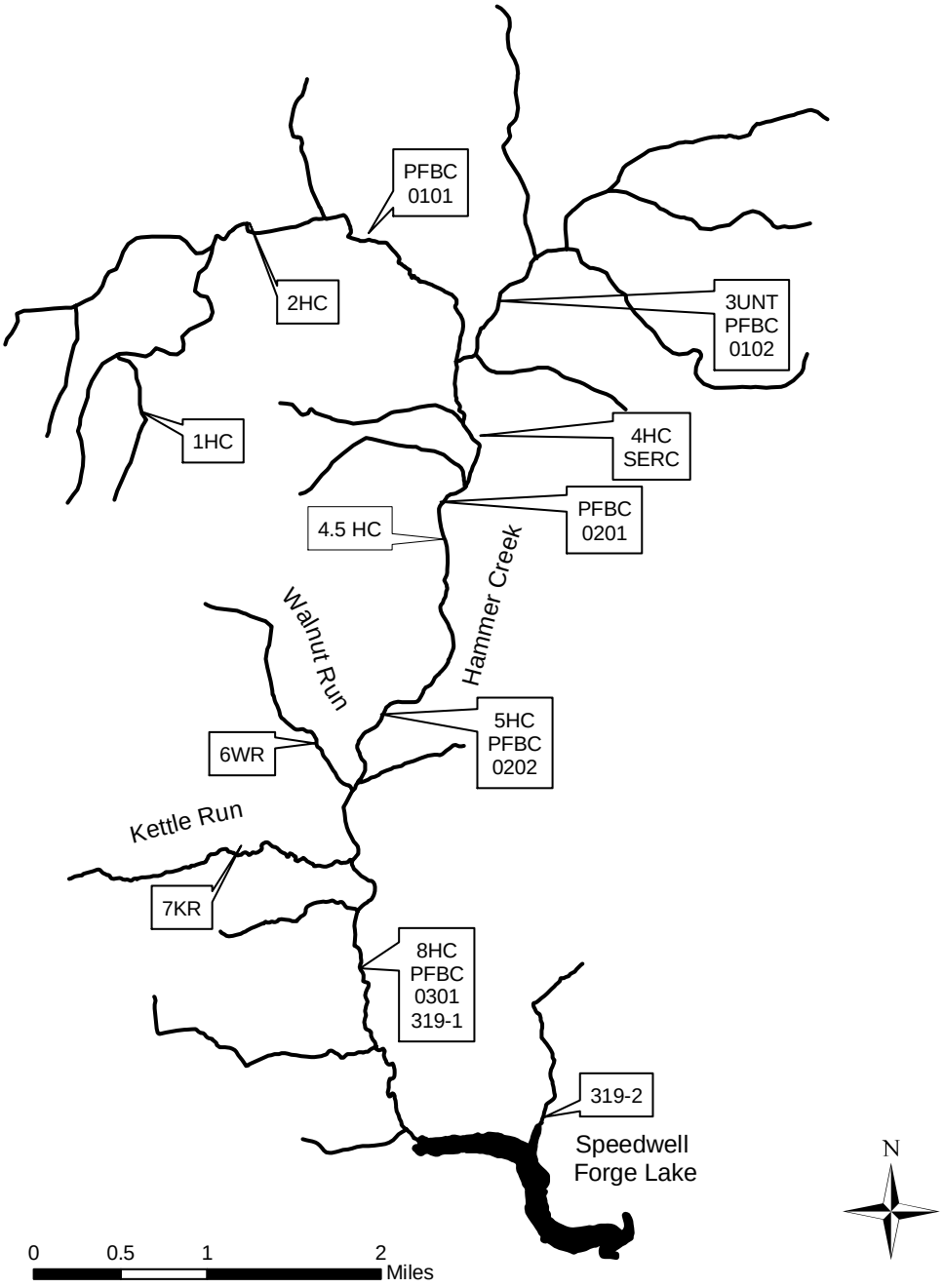
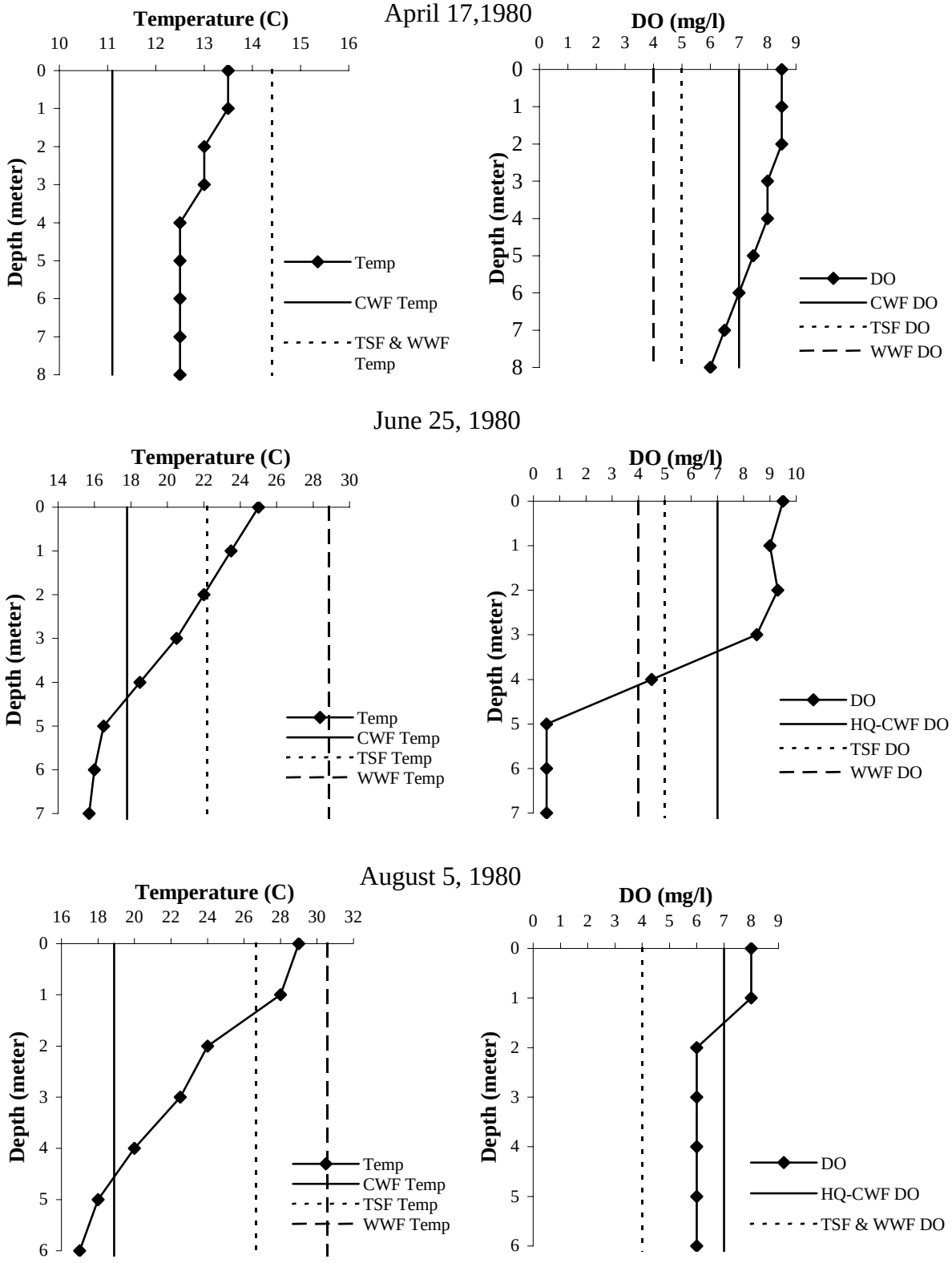


FIGURE 5.

SPEEDWELL FORGE LAKE - WATER CHEMISTRY[1]

Temperature and Dissolved Oxygen Profiles

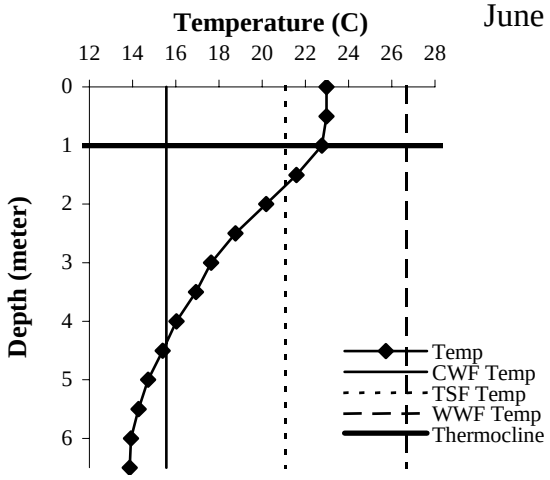
Ulanoski and Shertzer 1981

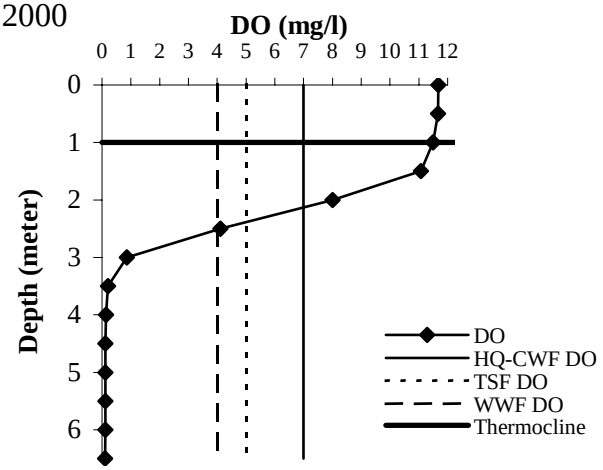


[1]Vertical lines depict parameter criteria. Depth measurements prevent the labeling of a thermocline.

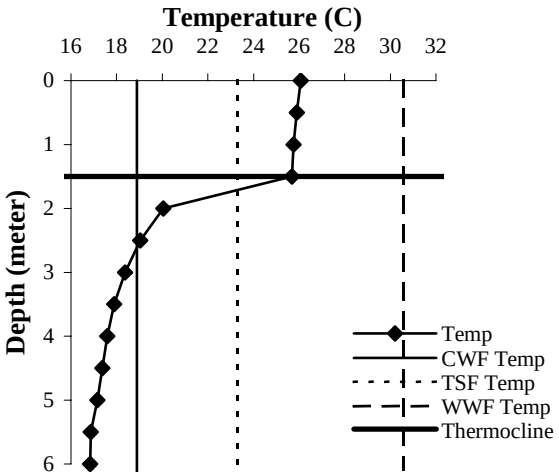
FIGURE 6.
SPEEDWELL FORGE LAKE - WATER CHEMISTRY
Temperature and Dissolved Oxygen Profiles
Dam Location - F.X.. Brown, Inc.
Vertical lines depict parameter criteria.

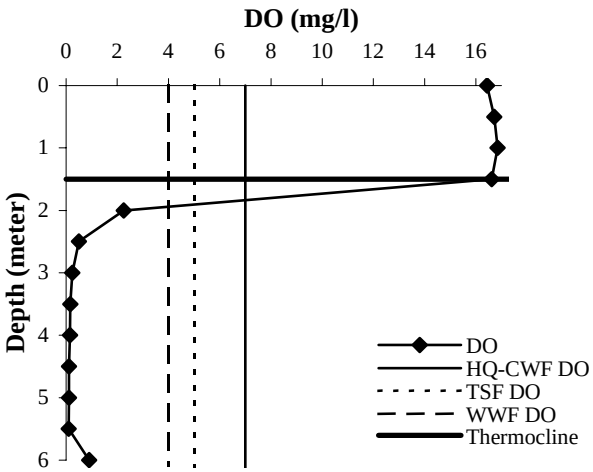
June 13,2000



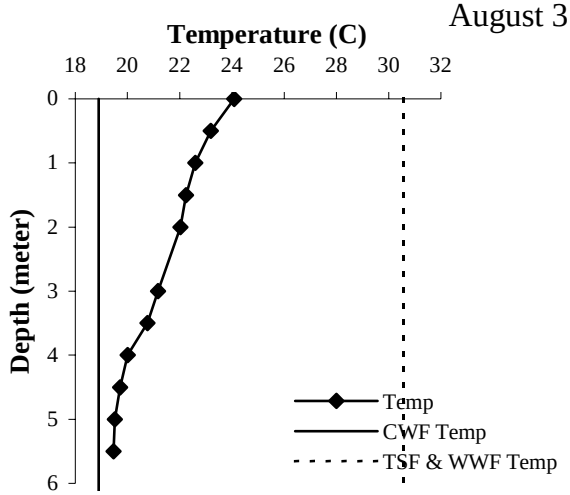


July 10, 2000





August 31, 2000



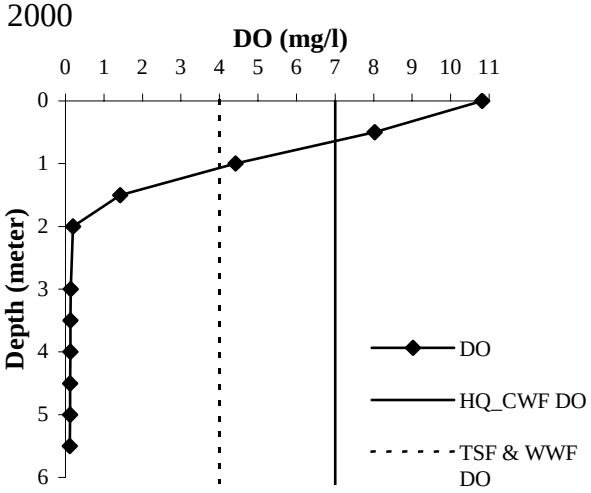


FIGURE 6. (cont.)
WATER CHEMISTRY - Temperature and Dissolved Oxygen Profiles
October 2, 2000

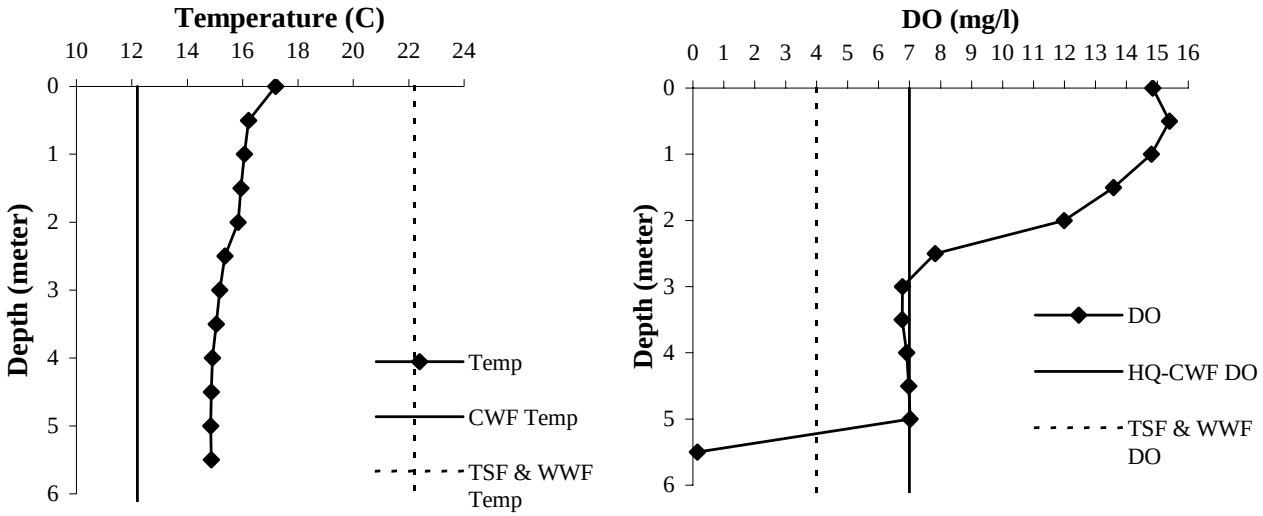
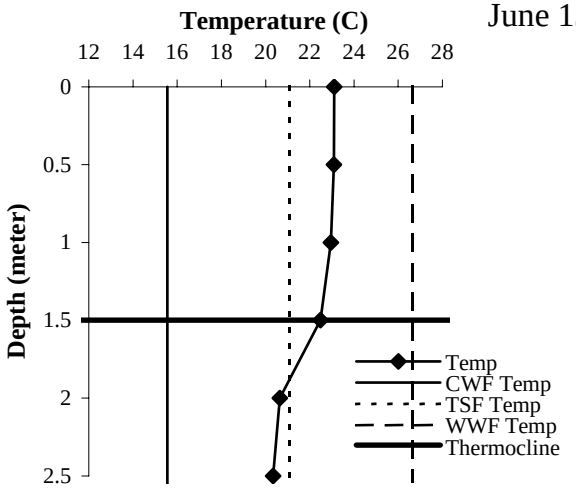
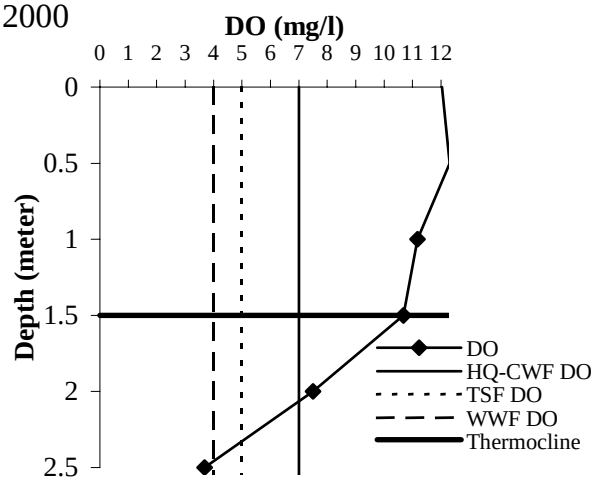


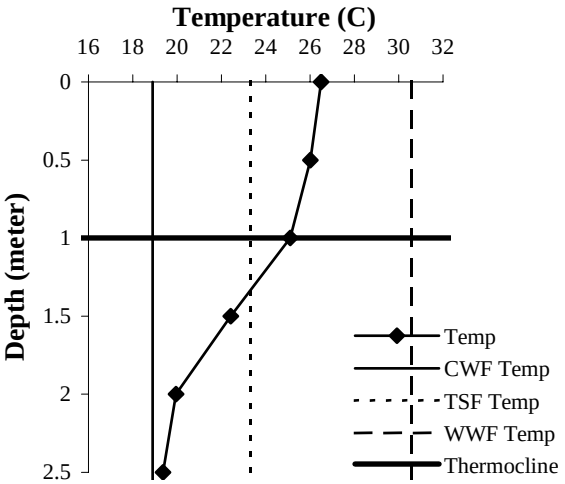
FIGURE 7.
SPEEDWELL FORGE LAKE - WATER CHEMISTRY
Temperature and Dissolved Oxygen Profiles
Uplake Location - FX Brown
Vertical lines depict parameter criteria.

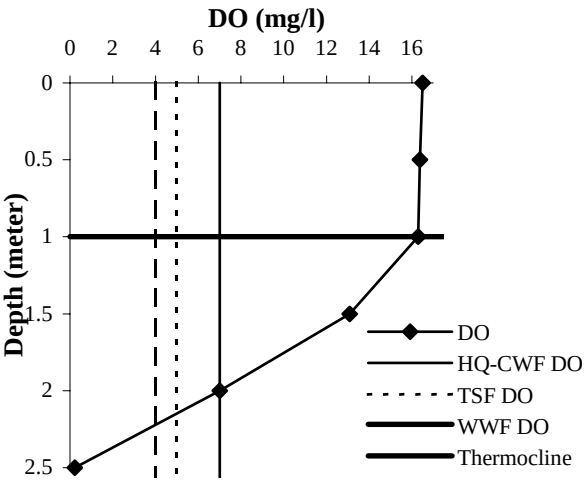
June 13, 2000



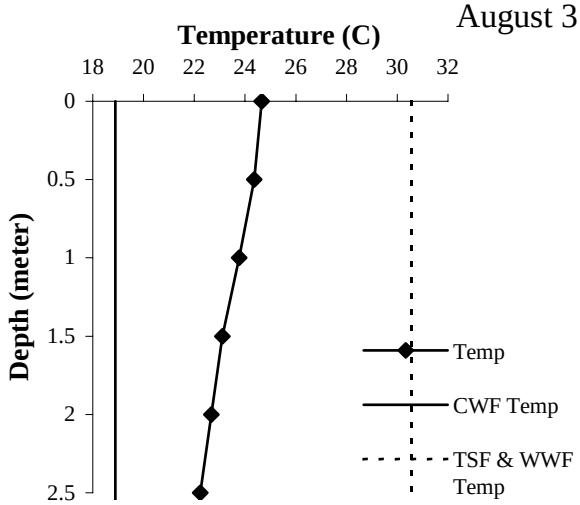


July 10, 2000





August 31, 2000



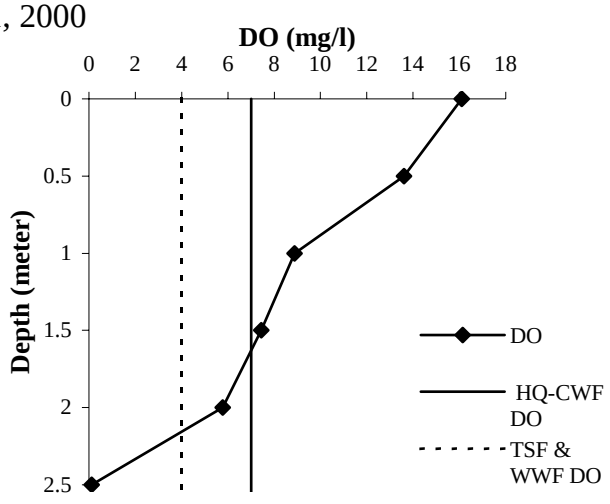


FIGURE 7. (cont.)
WATER CHEMISTRY - Temperature and Dissolved Oxygen Profiles

October 2, 2000

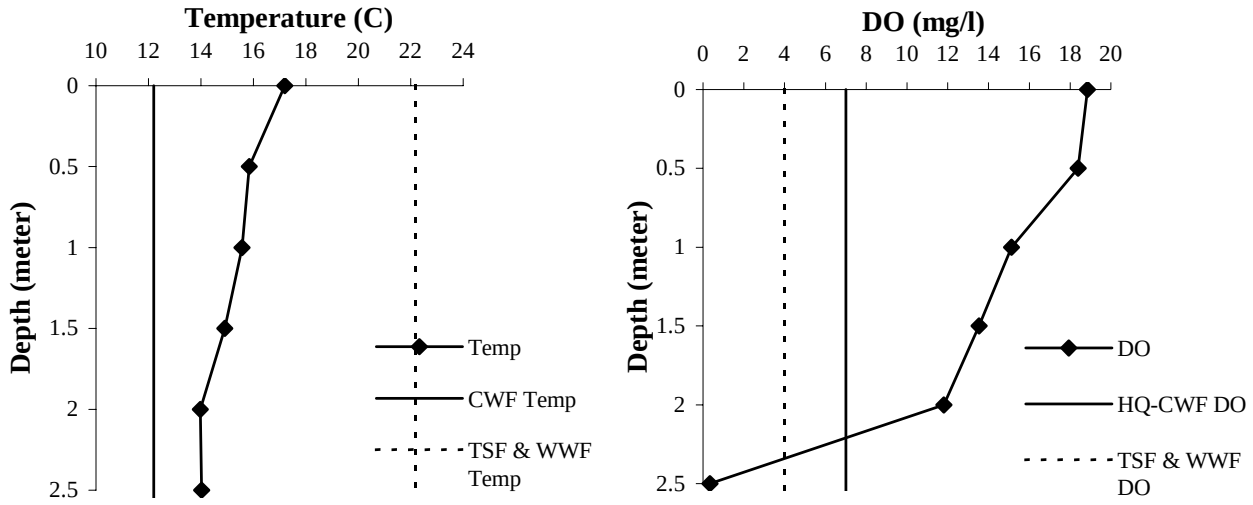


FIGURE 8.
SPEEDWELL FORGE LAKE - WATER CHEMISTRY
Temperature and Dissolved Oxygen Profiles - Dam

DEP

August 29, 1997

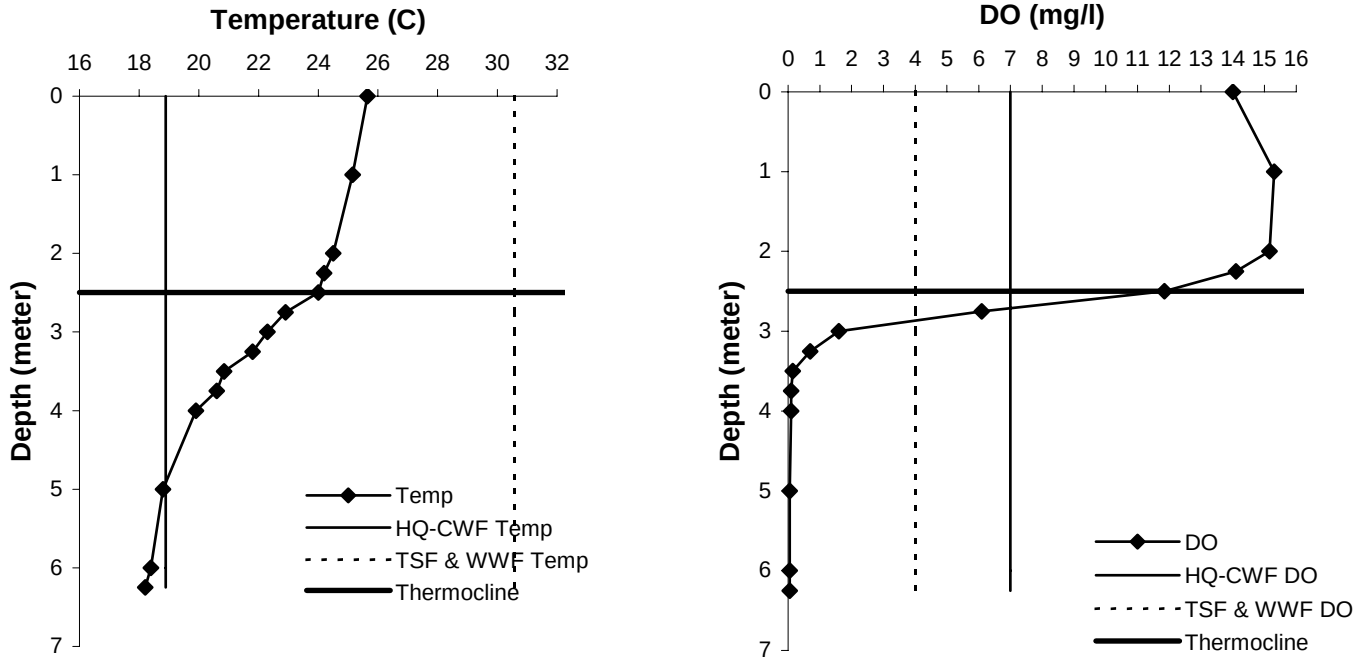


Figure 9. Hammer Creek Watershed