Technical Memorandum

Connecticut River Watershed 2008 Fish Population Monitoring and Assessment

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Introduction

In September of 2008, fish population surveys were conducted in the Connecticut River Watershed at fourteen stations using techniques similar to Rapid Bioassessment Protocol V as described originally by Plafkin et al. (1989) and later by Barbour et al. (1999) (See Figures 1 and 2). Standard Operating Procedures are described in MassDEP Method CN 075.1 *Fish Collection Procedures for Resident Fish Populations* (MassDEP 2006a). Fish surveys also included a habitat assessment component modified from that described in the aforementioned document (Barbour et al. 1999).

Methods

Fish collections were conducted by electrofishing using a Smith Root Model 12 battery powered backpack electrofisher. A reach of between 70m and 100m was sampled by passing a pole mounted anode ring, side to side through the stream channel and in and around likely fish holding cover. All fish shocked were netted and held in buckets. Sampling proceeded from an obstruction or constriction, upstream to an endpoint at another obstruction or constriction such as a waterfall or shallow riffle. Following completion of a sampling run, all fish were identified to species, a sub-sample were measured and weighed, after which all were released. Results of the fish population surveys can be found in Table 1. It should be noted that young of the year (yoy) fish from most species (with the exception of salmonids) are not targeted for collection. Young of the year fishes that are collected, intentionally or not, are noted in Table 1.

Habitat Assessment

An evaluation of physical habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sample reach during the 2008 Connecticut River watershed fish population surveys, habitat qualities were scored using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the water body and riparian area. Most parameters evaluated are instream physical attributes often related to overall land use and are potential sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follows: instream cover for fish, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and when appropriate compared to a reference station to provide relative habitat ranking (See Table 2).

Fish Sample Processing and Data Analysis

The RBP V protocol (Plafkin et al. 1989 and Barbour et al. 1999) calls for the analysis of the data generated from fish collections using an established Index of Biotic Integrity (IBI) similar to that described by Karr et al. (1986). Since no formal IBI for Massachusetts currently exists, the data provided by this sampling effort were used to qualitatively assess the general condition of the resident fish population as a function of the overall abundance (number of species and individuals) and species composition classifications listed below.

1. Tolerance Classification - Classification of tolerance to environmental stressors similar to that provided in Plafkin et al. (1989), Barbour et al. (1999), and Halliwell et al. (1999). Final tolerance classes are those provided by Halliwell et al. (1999).

2. Macrohabitat Classification – Classification by common macrohabitat use as presented by Bain (1996) modified regionally following discussions between MassDEP and Massachusetts Department of Fish and Game (MA DFG) fishery biologists.

3. Trophic Classes- Classification which utilizes both dominant food items as well as feeding habitat type as presented in Halliwell et al.(1999).

Station Habitat Descriptions and Results

LAMP1, Lampson Brook downstream of George Hannum Street in Belchertown.

Lampson Brook (LAMP1) is a very small third order stream with a drainage area of approximately 3.4 km^2 (USGS 2009). There is a wastewater treatment plant discharge located within the lower one third of the sampled reach. The reach was of moderate gradient with cobble, pebble, gravel, and sand substrates predominating. Five of the seven primary habitat parameters scored in the "optimal" category. Channel alteration and sediment deposition scored suboptimal. For secondary parameters, bank vegetative protection and bank stability scored suboptimal, and riparian vegetative zone width scored optimal and suboptimal in the left and right zones respectively. The final habitat score was 161 out of 200 (See Table 2). The watershed upstream of the sampling station includes a mix of forested, residential (medium and multifamily), agricultural, and commercial landuses.

Fish species captured in order of abundance included eastern blacknose dace *Rhinichthys atratulus*, white sucker *Catostomus commersonii*, and an unidentified cyprinid (See Table 1). Many other eastern blacknose dace were observed but not collected. Sampling efficiency was only rated as being fair. The almost complete dominance by blacknose dace, a moderately tolerant fluvial specialist, suggests a stable flow regime and good water quality. The Massachusetts Department of Fish and Game (MA DFG) sampled a station located a short distance upstream in 2002. They also found a population dominated by eastern blacknose dace, however they also collected 5 brook trout *Salvelinus fontinalis.*

Lampson Brook is on the MA DFG's Coldwater Fishery Resource List,, however, it is listed as Class B Warm Water in the Massachusetts Surface Water Quality Standards (SWQS) (MassDEP 2006 and MA DFG 2007). Collection of additional fish population data is recommended prior to any revision of the SWQS.

WEST1, Weston Brook downstream of Boardman Street in Belchertown.

Weston Brook at Boardman Street is a third order stream with a drainage area of 9.6 km^2 (USGS 2009). The sampling station is located approximately 1.3 km downstream from where Lampson Brook enters the brook. It should be noted that there is a small impoundment located a short distance upstream of WEST1 and Boardman Street. The sampled reach was of moderate gradient. Five of the seven primary habitat parameters scored within the optimal category. Channel alteration and velocity depth combinations scored in the suboptimal category. For secondary parameters, bank stability scored optimal and bank vegetative protection and riparian vegetative zone width scored optimal and suboptimal in the right and left zones, respectively. The final habitat score was 170 out of 200 (See Table 2). The watershed upstream of the sampling station contains a mix of forested, residential (medium and multifamily), agricultural, and commercial landuses.

Fish species captured in order of abundance included brook trout *Salvelinus fontinalis*, eastern blacknose dace *Rhinichthys atratulus*, white sucker *Catostomus commersonii*, fallfish *Semotilus corporalis*, yellow bullhead *Ameiurus natalis*, and pumpkinseed *Lepomis gibbosus* (See Table 1). It should be noted that fish sampling efficiencies were only rated as fair due to high and darkly colored water, as well as a deep side section within the sampled reach. The dominance by brook trout and other fluvial fishes suggests a stable flow regime and good water quality. Weston Brook is listed as Class B Warm Water in the Massachusetts Surface Water Quality Standards (SWQS), however, the brook is on the Massachusetts Department of Fish and Game's (MA DFG) Coldwater Fishery Resource List and they collected brook trout there in 2002 (MassDEP2006 and MA DFG 2007). In light of the presence of reproducing brook trout in Weston Brook, it should be considered for reclassification as Class B Cold Water in the next revision of the SWQS.

BROAD1, Broad Brook downstream and upstream of Hendrick Street in Easthampton.

Broad Brook at Hendrick Street is a large second order stream with a drainage area of approximately 14.65 km^2 (USGS 2009). The brook, (a tributary to the Manhan River), originates just south of Mount Tom and flows parallel to the base of East Mountain before turning to the north and eventually discharging into Nashawannuck Pond in East Hampton. The sampled reach was free flowing and of low to moderate gradient with predominantly sandy substrate. Only three of the seven primary habitat parameters scored within the optimal category. Channel alteration scored suboptimal, embeddedness and sediment deposition scored marginal, and epifaunal substrate scored poor. For secondary parameters, bank stability and bank vegetative protection scored marginal, and riparian vegetative zone width scored optimal and suboptimal in the left and right zones, respectively. The final habitat score was 118 out of 200 (See Table 2). The watershed upstream of the sampling station is primarily forested with some low density residential, and agricultural land use mixed in.

Fish species captured in order of abundance included brook trout *Salvelinus fontinalis*, slimy sculpin *Cottus cognatus*, and white sucker *Catostomus commersonii* (See Table 1). Although the reach seemed to be experiencing recent sedimentation, and despite the fairly low habitat score, the heavy dominance by multiple age classes of brook trout and slimy sculpin (both intolerant cold water species) suggests a stable flow regime and excellent water quality. It appears that spring flooding may have accounted for much of the erosion and sedimentation noted on the field sheet. Broad Brook is classified as Class B Cold Water in the Massachusetts Surface Water Quality Standards (SWQS) and is also on the Massachusetts Department of Fish and Game's (MA DFG's) Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007). Sedimentation issues should be monitored for potential future problems.

MOOSE1, Moose Brook upstream of Moose Brook Road in Southampton.

Moose Brook at Moose Brook Road is a small second order stream with a drainage area of approximately 6.2 km^2 (USGS 2009). The brook originates just to the southwest of Whiteloaf Mountain and flows north to the Manhan River. The sampled reach, located just downstream from the Southampton Country Club, was free flowing and of low to moderate gradient with a predominantly sand and gravel substrate. Only two of the seven primary habitat parameters scored within the optimal category. Channel flow status scored suboptimal, instream cover for fish scored marginal, and epifaunal substrate, embeddedness, and sediment deposition scored poor. For secondary parameters, bank vegetative protection and riparian vegetative zone width scored optimal and bank stability scored poor. The final habitat score was 105 out of 200 (See Table 2). The watershed upstream of the sampling station is primarily forested with some low density residential land use and a golf course.

Fish species captured in order of abundance included slimy sculpin *Cottus cognatus*, eastern blacknose dace *Rhinichthys atratulus*, brook trout *Salvelinus fontinalis*, creek chub *Semotilus atromaculatus*, brown trout *Salmo trutta*, common shiner *Luxilus cornutus*, white sucker *Catostomus commersonii*, longnose dace *Rhinichthys cataractae*, tessellated darter *Etheostoma olmstedi*, and redfin pickerel *Esox americanus americanus* (See Table 1). Although the reach seemed to have experienced recent sedimentation, the diverse fish assemblage, and the heavy dominance by multiple age classes of brook trout and slimy sculpin (both intolerant cold water species), suggests a stable flow regime and excellent water quality. As noted previously for Broad Brook, it appears that spring flooding may have accounted for much of the erosion and sedimentation noted on the field sheet. Moose Brook is classified as Class B Cold Water in the Massachusetts Surface Water Quality Standards (SWQS) and is also on the Massachusetts Department of Fish and Game's (MA DFG) Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007). Sedimentation issues should be monitored for potential future problems.

NBMAN1, North Branch of the Manhan River at Loudville, downstream of Main Road (Westhampton Road) in Northampton.

The North Branch of the Manhan River originates in the hills of Westhampton and flows southeast through Loudville to it's confluence with the Manhan River just west of downtown Easthampton. The North Branch downstream of Main Road is a large third order stream with a drainage area of 38.3 km^2 (USGS 2009). The sampled reach was high gradient within a gorge, and substrates consisted primarily of ledge and boulders. Five of the seven primary habitat parameters scored within the optimal category. Sediment deposition and channel flow status scored in the suboptimal category. For secondary parameters, bank vegetative protection and bank stability scored optimal and riparian vegetative zone width scored optimal and suboptimal in the left and right riparian zones respectively. The final habitat score was 174 out of 200 (See Table 2). The watershed upstream is a mix of forested, cropland, and mining land use. There is very little residential development within the watershed.

Fish species captured in order of abundance included Atlantic salmon *Salmo salar*, longnose dace *Rhinichthys cataractae,* eastern blacknose dace *Rhinichthys atratulus*, and brown trout *Salmo trutta*. (See Table 1). The North Branch of the Manhan River is stocked with salmon fry annually by the Massachusetts Department of Fish and Game (MA DFG). Sampling conducted by MA DFG downstream on the North Branch Manhan River in 2001, 2004, and 2005 resulted in the collections of much more diverse fish assemblages which included large numbers of Atlantic salmon. The disparity between the MassDEP and MA DFG results could be due in part to the turbulent nature of the river at NBMAN1 (downstream of the waterfall and ledges) as well as the relative absence of spawning habitat for trout and cyprinids at this location. North Branch Manhan River is classified as Class B Cold Water in the Massachusetts Surface Water Quality Standards (SWQS) and is also on the Massachusetts Department of Fish and Game (MA DFG) Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007).

WBMILL1, West Branch Mill River, upstream of Rte 143 and adjacent to Rt. 9 in Williamsburg.

The West Branch of the Mill River originates as the outlet of Lower Highland Lake in Goshen and flows southeast into downtown Williamsburg where it meets the East Branch Mill River to form the Mill River. The sampled reach was of moderate to high gradient and contained predominantly rocky substrates. It is a third order stream with a drainage area of 26.4 km^2 at sampling station WBMILL1 (USGS 2009). All seven primary habitat parameters scored within the optimal category. For secondary parameters, bank vegetative protection and bank stability scored optimal. Riparian vegetative zone width scored marginal due to the presence of commercial activity in the right riparian zone and Route 9 in the left riparian zone. The final habitat score was 173 out of 200 (See Table 2). The watershed upstream is mostly forested with some cropland and mining land use interspersed. There is very little residential development within the watershed.

The most dominant fish species were Atlantic salmon *Salmo salar*, longnose dace *Rhinichthys cataractae,* and slimy sculpin *Cottus cognatus.*. Other species present included eastern blacknose dace *Rhinichthys atratulus*, golden shiner *Notemigonus crysoleucas*, common shiner *Luxilus cornutus*, fallfish *Semotilus corporalis*, and yellow perch *Perca flavescens* (See Table 1). It should be noted that this stream is stocked with Atlantic salmon fry annually by the Massachusetts Department of Fish and Game (MA DFG) as part of the Connecticut River anadromous fisheries restoration effort. During the summer of 2004, MA DFG sampled a station on the West Branch Mill River located approximately 1.7 km upstream of WBMILL1 and found a similar assemblage, however, they also found brook trout. The presence and dominance Atlantic salmon and slimy sculpin, both intolerant coldwater fluvial species, suggest a stable flow regime and good water quality. It is unclear if the stocking of Atlantic salmon fry is having a negative effect on brook trout populations at WBMILL1. This segment of the West Branch Mill River is classified as Class B Cold Water in the Massachusetts Surface Water Quality Standards (SWQS) and is also on the Massachusetts Department of Fish and Game (MA DFG) Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007).

EBMR01, East Branch Mill River between Mill Street and Valley View Road in Williamsburg.

The East Branch Mill River originates as Bradford Brook south of Abbott and Sikes hills in Ashfield and Conway, then flows south into downtown Williamsburg where it meets the West Branch Mill River to form the Mill River. The sampled reach is just upstream from the East Branch's confluence with the West Branch and is of moderate gradient containing a diverse mix of substrates from boulder to sand. It is a third order stream with a drainage area of 24.6 km^2 at the sampling location (USGS 2009). Six of the seven primary habitat parameters scored within the optimal category. Sediment deposition scored high in the suboptimal category. For secondary parameters, bank vegetative protection scored suboptimal and marginal on the right and left banks, respectively; bank stability scored optimal and suboptimal on the left and right banks respectively, and riparian vegetative zone width scored suboptimal and marginal in the left and right riparian zones, respectively. The final habitat score was 159 out of 200 (See Table 2). The watershed upstream is mostly forested with a small amount of cropland. There is however a fair amount of medium density residential and commercial development in the immediate area surrounding the sampled reach.

Fish species captured in order of abundance included eastern blacknose dace *Rhinichthys atratulus*, Atlantic salmon *Salmo salar*, slimy sculpin *Cottus cognatus*, longnose dace *Rhinichthys cataractae,* and brook trout *Salvelinus fontinalis*, (See Table 1). It should be noted that this stream is stocked with Atlantic salmon fry annually by the Massachusetts Department of Fish and Game (MA DFG) as part of the Connecticut River anadromous fisheries restoration effort. During the summer of 2005, the MA DFG sampled a station on the East Branch Mill River located approximately 2 km upstream and found a similar assemblage. The presence of Atlantic salmon, slimy sculpin, and brook trout, (all three intolerant coldwater fluvial species), suggests a stable flow regime and excellent water and habitat quality The East Branch Mill River is classified as Class B Cold Water in the Massachusetts Surface Water Quality Standards (SWQS) and is also on the MA DFG's Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007).

WESTB1, West Brook upstream of Chestnut Plain Road in Whately and Hatfield.

Avery and Sinkpot brooks originate in the Conway State Forest. These two brooks (and another unnamed brook) flow into Northampton Reservoir. West Brook begins as the outflow of the reservoir and then flows southeast through Whately to its confluence with the Mill River in Hatfield. The sampled reach is located approximately 0.3 km upstream from West Brook's confluence with the Mill River. The reach was of moderate gradient and contained a diverse mix of substrates ranging from boulder to sand. It is a third order stream with a drainage area of 27.7 km at the sampling location (USGS 2009). Five of the six primary habitat parameters scored within the optimal category (embeddedness was not scored). Sediment deposition scored high in the suboptimal category. For secondary parameters, bank stability scored optimal; bank vegetative protection scored optimal and suboptimal on the right and left banks, respectively; and riparian vegetative zone width scored suboptimal and marginal in the right and left riparian zones, respectively. The final habitat score was 148 out of 180 (See Table 2).

The fish assemblage was heavily dominated by eastern blacknose dace *Rhinichthys atratulus* and brown trout *Salmo trutta.* Other fish species captured in order of abundance included, brook trout *Salvelinus fontinalis*, tessellated darter *Etheostoma olmstedi*, white sucker *Catostomus commersonii*, and yellow perch *Perca flavescens* (See Table 1). During the summer of 2002, the Massachusetts Department of Fish and Game (MA DFG) sampled a station on West Brook located approximately 2 km upstream from WESTB1. At that time, they found a similar fish assemblage; however, they also collected numerous Atlantic salmon and a few brook trout. It should be noted that this stream is stocked by MA DFG with Atlantic salmon fry as part of the Connecticut River anadromous fisheries restoration effort. The presence of multiple age classes of brown trout, brook trout, and Atlantic salmon (all intolerant, coldwater, fluvial species), suggests a stable flow regime and excellent water and habitat quality. The heavy dominance by blacknose dace may be indicative of nutrient enrichment. West Brook is classified as Class B Cold Water in the Massachusetts Surface Water Quality Standards (SWQS) and is also on the MA DFG Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007).

SCANT1.5, Scantic River upstream from Somers Road (Wilbraham Road) in Hampden.

The Scantic River originates in Tray Hollow adjacent to the Shenipsit State Forest in Stafford, Connecticut and flows northwest into Massachusetts. It picks up significant flow from Rockadundee, Temple, and East brooks then turns southwest around Minnechoag Mountain and crosses back into Somers Connecticut, eventually emptying into the Connecticut River. The sampled reach was located downstream from the three aforementioned tributaries in the Town of Hampden. The river here was of moderate gradient containing a mix of substrates ranging from boulder to sand. It is a fourth order stream at this point with a drainage area of 59.5 km^2 (USGS 2009). Six of the seven primary habitat parameters scored within the optimal category. Sediment deposition scored high in the suboptimal category. For secondary parameters, bank stability scored optimal; bank vegetative protection scored optimal and suboptimal in the on the left and right bank, respectively; and riparian vegetative zone width scored optimal and marginal in the left and right riparian zones, respectively. The final habitat score was 175 out of 200 (See Table 2). The watershed upstream is mostly forested on the hills with a mix of cropland, medium density residential and commercial development in the narrow valleys.

The fish assemblage was dominated by eastern blacknose dace *Rhinichthys atratulus*, and fallfish *Semotilus corporalis.* Other fish species present in order of abundance included longnose dace *Rhinichthys cataractae*, common shiner *Luxilus cornutus*, white sucker *Catostomus commersonii*, tessellated darter *Etheostoma olmstedi*, and brown trout *Salmo trutta*. (See Table 1). During the summer of 2002, the Massachusetts Department of Fish and Game (MA DFG) sampled a station on the Scantic River located approximately 2.5 km downstream from SCANT1.5 and found a similar assemblage, however, they collected many more fish including multiple age classes of both brook and brown trout. Although the total dominance by fluvial species suggests good water and habitat quality and a stable flow regime, it is unclear why only two brown trout were collected at SCANT1.5 in 2008. The Scantic River is classified by default (not specifically listed) as Class B Warm Water in the Massachusetts Surface Water Quality Standards (SWQS). It is on the MA DFG Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007). Although DWM collected very few trout in 2008, the Scantic River should be considered for possible re-classification to Class B Cold Water during the next revision of the SWQS. Additional sampling may be warranted prior to re-classification.

SCANT2, Scantic River, Hampden, upstream of Temple Brook.

In addition to SCANT 1.5 described previously, a second reach (upstream) was sampled on the Scantic River in 2008. This reach, also in the Town of Hampden, was just upstream from the confluence of the Scantic River and Temple Brook. The river here was of moderate gradient containing a mix of substrates from boulder to sand. It's a third order stream at SCANT2 with a drainage area of 19.6 km^2 (USGS 2009). The Habitat Assessment Field Scoring Sheet was missing for SCANT2. The watershed upstream is mostly forested on the hills with a mix of cropland, medium density residential and commercial development in the narrow valleys.

The fish assemblage was dominated by eastern blacknose dace *Rhinichthys atratulus*, and tessellated darter *Etheostoma olmstedi.* Other fish species present in order of abundance included brook trout *Salvelinus fontinalis*, white sucker *Catostomus commersonii*, American eel *Anguilla rostrata*, chain pickerel *Esox niger*, longnose dace *Rhinichthys cataractae* and pumpkinseed *Lepomis gibbosus* (See Table 1). During the summer of 2002, the Massachusetts Department of Fish and Game (MA DFG) sampled a station on the Scantic River located approximately 1.8 km upstream of SCANT2 and found a fish assemblage dominated by brook trout.

The dominance by fluvial species suggests good water and habitat quality and a stable flow regime. The Scantic River is classified by default (not specifically identified) as Class B Warm Water in the Massachusetts Surface Water Quality Standards (SWQS). It is on the MA DFG Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007). Although DWM collected very few trout in 2008, the Scantic River should be considered for possible re-classification as Class B Cold Water during the next revision of the SWQS. Additional sampling may be warranted prior to re-classification.

TEMP1, Temple Brook, Hampden, upstream of Scantic Rd.

Temple Brook is a tributary to the Scantic River which originates in and around Moon Mountain, West Hill, and Peaked Mountain in Monson and flows approximately 5 km to its confluence with the Scantic River. The sampled reach was of moderate gradient and contained a diverse mix of substrates from boulder to sand. It is a second order stream with a drainage area of 10.8 km at the sampling location which was located a short distance upstream of its confluence with Scantic Brook (USGS 2009). All seven primary habitat parameters scored within the optimal category. For secondary parameters, bank vegetative protection and bank stability scored optimal. Riparian vegetative zone width scored optimal and marginal in the right and left riparian zones, respectively. The marginal score for the left riparian zone was due to the presence of a residential lawn. The final habitat score was 193 out of 200 (See Table 2). The watershed is a mix of forested and low to medium density residential landuse however there is also some mining, agricultural, and utility right of way landuse interspersed within.

The fish assemblage was dominated by eastern blacknose dace *Rhinichthys atratulus* and brook trout *Salvelinus fontinalis.* Other species present in order of abundance included longnose dace *Rhinichthys cataractae*, common shiner *Luxilus cornutus,* tessellated darter *Etheostoma olmstedi*, white sucker *Catostomus commersonii*, pumpkinseed *Lepomis gibbosus*, and American eel *Anguilla rostrata* (See Table 1). During the summer of 2002, the Massachusetts Department of Fish and Game (MA DFG) sampled the same station on Temple Brook. They found a very similar assemblage at that time, however they found slightly higher numbers of fish and did not document the presence of common shiner.

The large numbers of brook trout and other fluvial fishes suggests a stable flow regime and excellent water and habitat quality. The numerical dominance by eastern blacknose dace may be indicative of slight nutrient enrichment. Temple Brook is classified by default (not specifically identified) as Class B Warm Water in the Massachusetts Surface Water Quality Standards (SWQS), however, the brook is on the MA DFG's Coldwater Fishery Resource List (MassDEP2006 and MA DFG 2007). In light of the presence of reproducing brook trout in Temple Brook, it should be considered for reclassification and listing as Class B Cold Water in the next revision of the SWQS.

KEETS1, Shattuck Brook Bernardston, adjacent to Keets Brook Rd.

Shattuck Brook originates in Bernardston at the confluence of Keats and Beaver Meadow brooks and flows east to the Fall River. The sampled reach was of moderate gradient and contained predominantly rocky and sandy substrates. It is a third order stream with a drainage area of approximately 24 km^2 at the sampling location (USGS 2009). All seven primary habitat parameters scored within the optimal category. For secondary parameters, bank vegetative protection and bank stability scored optimal. Riparian vegetative zone width scored optimal and marginal in the right and left riparian zones respectively due to the presence of Keats Brook Road which runs along the left zone. The final habitat score was 171 out of 200 (See Table 2). The watershed upstream is mostly forested with some cropland in the valleys. There is very little residential development within the watershed.

The fish assemblage was heavily dominated by slimy sculpin *Cottus cognatus.* Other species present in fairly large abundances included Atlantic salmon *Salmo salar*, eastern blacknose dace Rhinichthys atratulus, and longnose dace *Rhinichthys cataractae*. A small number of brook trout *Salvelinus fontinalis* (n=3) were also collected (See Table 1). During the summer of 2004, the Massachusetts Department of Fish and Game (MA DFG) sampled a station very close to KEETS1 and found a very similar fish assemblage. They collected more brook trout but smaller numbers of Atlantic salmon at that time. It should be noted that this stream is stocked with Atlantic salmon fry annually by the MA DFG as part of the Connecticut River anadromous fisheries restoration effort. The presence of Atlantic salmon, brook trout and sculpin along with the other fluvial specialists suggests a stable flow regime and excellent water and habitat quality. Shattuck Brook is classified as Class B Cold Water in the Massachusetts Surface Water Quality Standards (SWQS) and is also on the MA DFG's Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007). It is unclear what effect if any the stocking of Atlantic salmon fry is having on brook trout populations.

FALL1, Fall River, Gill, beginning upstream of Factory Rd.

The Fall River originates in Vermont within the Interstate Highway 91 corridor and flows south through a narrow valley where it picks up flow from tributaries that drain the surrounding hills. The river flows through the towns of Bernardston and Gill before it empties into the Connecticut River just downstream of the dam at Turners Falls.

The sampled reach was of moderate gradient and contained predominantly rocky and sandy substrates. It is a fourth order stream with a drainage area of approximately 86 km^2 at the sampling location (USGS 2009). Five of the seven primary habitat parameters scored within the optimal category. Embeddedness and sediment deposition scored high in the suboptimal category. For secondary parameters, bank vegetative protection scored optimal and bank stability scored optimal and sub-optimal in the right and left zones, respectively. Riparian vegetative zone width scored high in the suboptimal category in both riparian zones due to the presence of paths and roads which parallel the river. The final habitat score was 170 out of 200 (See Table 2). The watershed upstream is mostly forested with some cropland in the valleys. There is a small amount of residential and commercial development within the valleys as well.

The fish assemblage was dominated by slimy sculpin *Cottus cognatus,* eastern blacknose dace *Rhinichthys atratulus*, and longnose dace *Rhinichthys cataractae*. A small number of brook trout *Salvelinus fontinalis* (n=4), Atlantic salmon *Salmo salar* (n=4) and creek chub *Semotilus corporalis* (n=2) were also collected (See Table 1).

During the summers of 2001, 2002, 2004, and 2006 the MA DFG sampled a station on Fall River located approximately 2 km upstream from FALL1. Although they found a very similar fish assemblage, their overall numbers were much higher. The lower numbers of fish encountered by DWM may have been due to electrofishing efficiency issues. The backpack unit used by DWM is small and only marginally effective in some large fourth order streams. The presence of slimy sculpin, Atlantic salmon, and brook trout, along with the other fluvial specialists, suggests a stable flow regime and excellent water and habitat quality. It should be noted that this river is stocked with Atlantic salmon fry annually by the Massachusetts Department of Fish and Game (MA DFG) as part of the Connecticut River anadromous fisheries restoration effort. It is unclear what effect if any the stocking of Atlantic salmon fry is having on brook trout populations.

Fall River is classified as Class B Cold Water in the Massachusetts Surface Water Quality Standards (SWQS) and is also on the Massachusetts Department of Fish and Game (MA DFG) Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007).

MANUP1, Manhan River, Southampton, upstream of Former Rd. and the Tighe Carmody Reservoir.

The Manhan River originates in the towns of Westhampton and Huntington, then flows south through a narrow river valley. It flows through White Reservoir in Southhampton and then into a free flowing segment before flowing through Tighe Carmody Reservoir. Approximately 3 km downstream of Tighe Carmody Reservoir, the river makes an abrupt turn to the north and flows through the town of Northampton before entering the Oxbow (and the Connecticut River).

Within the sampled reach, the river is second order, of moderate gradient, and has a drainage area of approximately 13.5 km^2 (USGS 2009). Six of the seven primary habitat parameters scored within the optimal category. Sediment deposition scored high in the suboptimal category due to the presence of some sand noted “in eddies behind rocks” . All secondary parameters scored optimal. The final habitat score was 178 out of 200 (See Table 2). The watershed upstream is mostly forested with some wetlands.

Fish species captured in order of abundance included bluegill *Lepomis macrochirus*, white sucker *Catostomus commersonii*, fallfish *Semotilus corporalis*, brown bullhead *Ameiurus nebulosus*, eastern blacknose dace *Rhinichthys atratulus*, pumpkinseed *Lepomis gibbosus*, brown trout *Salmo trutta*, and brook trout *Salvelinus fontinalis*, (See Table 1). During the summer of 2002, the Massachusetts

Department of Fish and Game (MA DFG) sampled a station on the Manhan River located approximately 2 km downstream from MANUP1. They found an assemblage heavily dominated by blacknose dace and common shiner *Luxilus cornutus.* White sucker were also plentiful in the MA DFG sample. Although the presence of wild trout and other fluvial specialist/dependants are indicative of a stable flow regime and good water quality, the dominance by bluegill, a macrohabitat generalist, is less than desirable. Impoundments located both upstream and downstream of MANUP1 are the most likely sources of bluegill.

The Manhan River upstream of Tighe Carmody Reservoir is classified (by default) as a Class A Public Water Supply in the Massachusetts Surface Water Quality Standards (SWQS) and it is on the MA DFG's Coldwater Fishery Resource List (MassDEP 2006 and MA DFG 2007). In light of the presence of reproducing brook trout in the Manhan River, it should be considered for reclassification, if appropriate, as a Class A Public Water Supply and Cold Water in the next revision of the SWQS.

References

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Figure 1.
Location of sampling stations
Connecticut River North Watershed
Fish Population Survey 2008

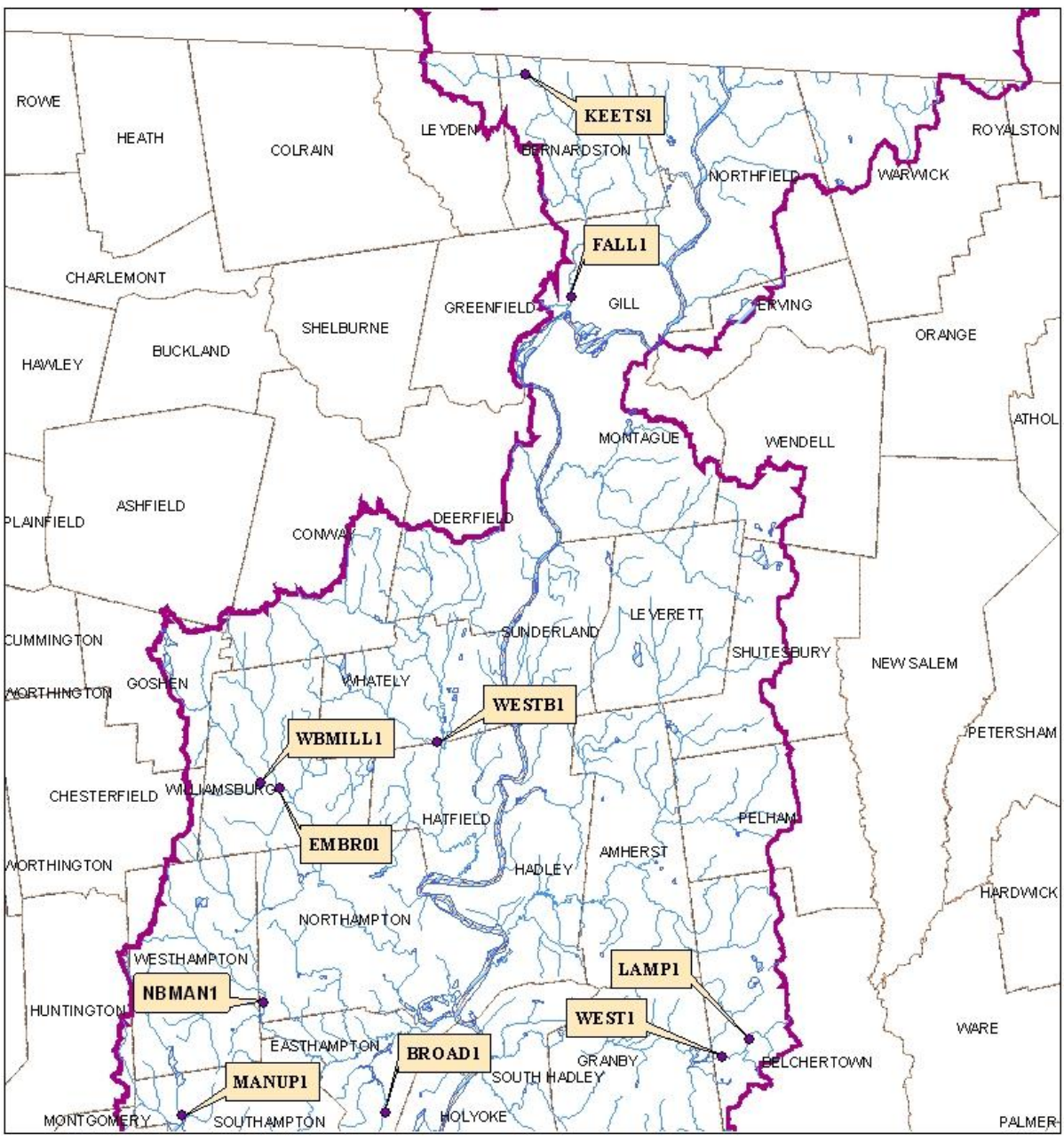

Figure 2.
Location of sampling stations
Connecticut River South Watershed
Fish Population Survey 2008

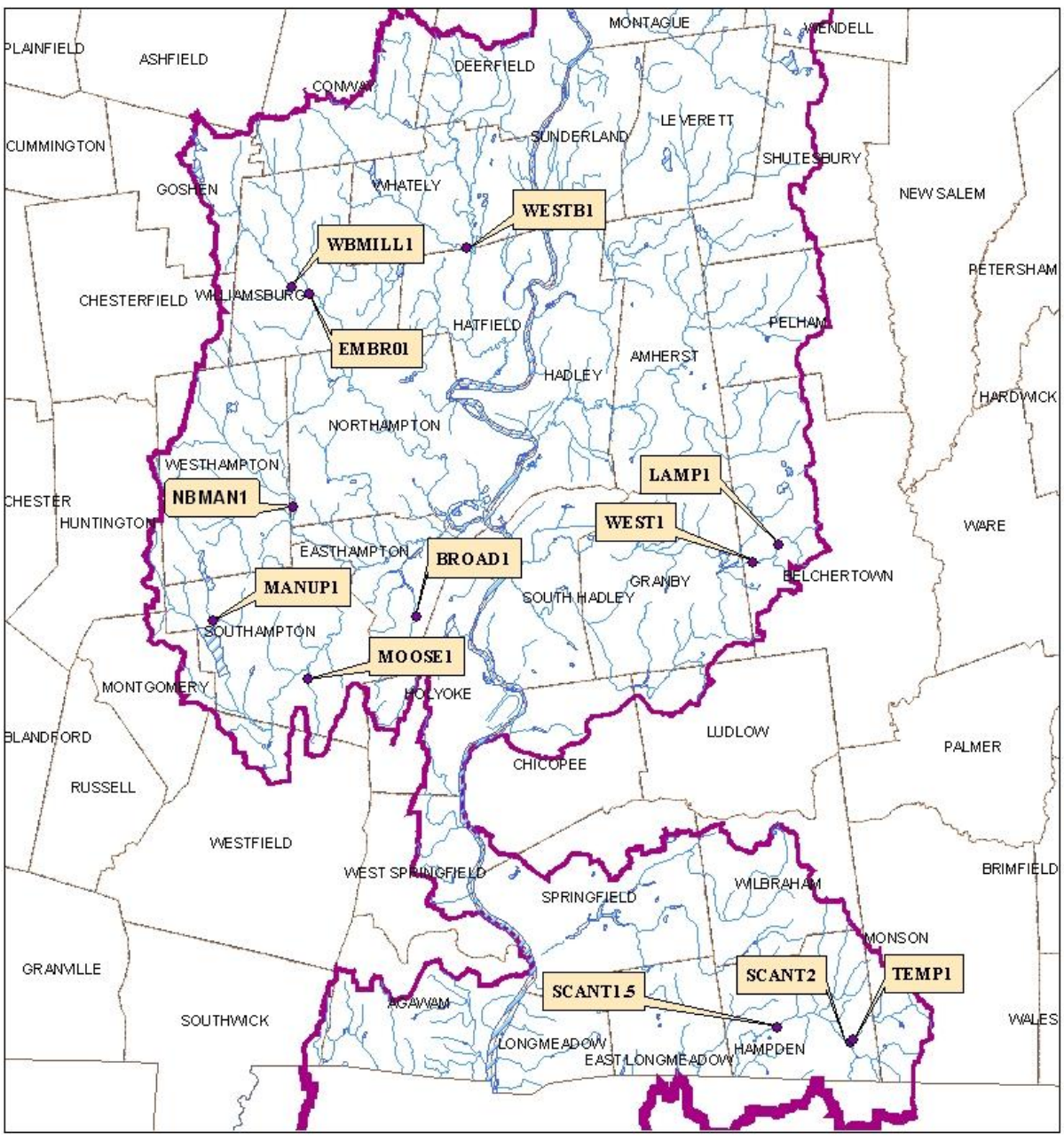

Table 1. List of fish population survey station locations and results from the 2008 Connecticut River Watershed survey.

Station Description	Date	Species Code[1]																			
		FF	YP	CRC	RFP	SC	AE	BG	CP	BB	CS	WS	EBT	LND	TD	AS	YB	BT	GS	P	BND	Comments
LAMP1, Lampson Brook downstream of George Hannum Street in Belchertown.	15 Sept. 2008	-	-	-	-	-	-	-	-	-	-	2(1)	-	-	-	-	-	-	-	-	108(2)	BND <35mm considered YOY. WS <50mm considered YOY
WEST1, Weston Brook, downstream of Boardman Street in Belchertown.	15 Sept. 2008	5	-	-	-	-	-	-	-	-	-	7	13	-	-	-	4	-	-	1	13	
BROAD1, Broad Brook, downstream and upstream of Hendrick Street in Easthampton.	16 Sept. 2008	-	-	-	-	19	-	-	-	-	-	5	62(3)	-	-	-	-	-	-	-	-	EBT< 70 mm considered YOY
MOOSE1, Moose Brook, upstream of Moose Brook Road in Southampton .	16 Sept. 2008	-	-	15	1	45(2)	-	-	-	-	8	7	22(2)	6	4	-	-	11	-	-	35	SS <33mm considered YOY. EBT <80mm considered YOY
NBMAN1, North Branch of Manhan River at Loudville, downstream of Main Road (Westhampton Road) in Northampton	16 Sept. 2008	-	-	-	-	-	-	-	-	-	-	-	-	22	-	36	-	2	-	-	5(1)	
WBMILL1, West Branch, Mill River, upstream of Route 143 and adjacent to Route 9 in Willamsburg.	17 Sept. 2008	2	1	-	-	21	-	-	-	-	2	-	-	22	-	36(1)	-	-	3	-	6	AS< 65 mm considered YOY
WESTB1, West Brook upstream of Chestnut Plain Road in Whately and Hatfield.	17 Sept. 2008	-	1	-	-	-	-	-	-	-	-	2	11	-	4	-	-	41(2)	-	-	77	BT< 75 mm considered YOY
EBMR01, East Branch, Mill River between Mill Street and Valley View Road in Williamsburg.	17 Sept. 2008	-	-	-	-	22	-	-	-	-	-	-	9	13	-	29	-	-	-	-	34(1)	BND< 35 mm considered YOY
SCANT2, Scantic River, Hampden, upstream of Temple Brook.	24 Sept. 2008	-	-	-	-	-	5	-	4	-	-	5	7	4	12	-	-	-	-	1	29	
SCANT1.5, Scantic River, upstream from Somers Road (Wilbraham Road) in Hampden.	24 Sept. 2008	18	-	-	-	-	-	-	-	-	5	5	-	10(1)	3	-	-	2	-	-	29(3)	BND <30 mm considered YOY LND< 40 mm considered YOY

Table 1. (continued)

Station Description	Date	Species Code[1]																				
		FF	YP	CRC	RFP	SC	AE	BG	CP	BB	CS	WS	EBT	LND	TD	AS	YB	BT	GS	P	BND	Comments
TEMP1, Temple Brook, Hampden, upstream of Scantic Road.	24 Sept. 2008	-	-	-	-	-	1	-	-	-	11	3	35(2)	11	4	-	-	-	-	2	60(1)	EBT< 65 mm considered YOY BND< 35 mm considered YOY
KEETS1, Shattuck Brook, Bernardston, adjacent to Keets Brook Road.	25 Sept. 2008	-	-	-	-	83(2)	-	-	-	-	-	-	3	26	-	32	-	-	-	-	27(6)	SC< 34 mm considered YOY BND< 35 mm considered YOY
FALL1, Fall River, Gill, beginning upstream of Factory Road.	25 Sept. 2008	-	-	2	-	49	-	-	-	-	-	-	4	25	-	4	-	-	-	-	39	
MANUP1, Manhan River, Southampton, upstream of Former Road. and the Tighe Carmody Reservoir.	25 Sept. 2008	17	-	-	-	-		28	-	15	-	36	1	-	-	-	-	5	-	7	11	

[1]SPECIES CODE	COMMON NAME	SCIENTIFIC NAME
FF	fallfish	*Semotilis corporalis*
YP	yellow perch	*Perca flavescens*
CRC	creek chub	*Semotilus atromaculatus*
RFP	redfin pickerel	*Esox americanus americanus*
SC	slimy sculpin	*Cottus cognatus*
AE	American eel	*Anguilla rostrata*
BG	bluegill	*Lepomis macrochirus*
CP	chain pickerel	*Esox niger*
BB	brown bullhead	*Ameiurus nebulosus*
CS	common shiner	*Luxilus cornutus*
WS	white sucker	*Catostomus commersoni*
EBT	brook trout	*Salvelinus fontinalis*
LND	longnose dace	*Rhinichthys cataractae*
TD	tessellated darter	*Etheostoma olmstedi*
AS	Atlantic salmon	*Salmo salar*
YB	yellow bullhead	*Ameiurus natalis*
BT	brown trout	*Salmo trutta*
GS	golden shiner	*Notemigonus crysoleucas*
P	pumpkinseed	*Lepomis gibbosus*
BND	blacknose dace	*Rhinichthys atratulus*

[2] number in parentheses indicate young-of-the-year and is in addition to the non-yoy number noted.

Table 2. Habitat assessment summary for fish population stations sampled during the 2008 Connecticut River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a listing and description of sampling stations.

Stations	Lampson Brook LAMP1	Weston Brook WEST1	Broad Brook BROAD1	Moose Brook MOOSE1	North Branch of Manhan River NBMAN1	West Branch of Mill River WBMILL1	West Brook WESTB1	East Branch of Mill River EBMR01	Scantic River at Hampden SCANT1.5	Temple Brook TEMP1	Shattuck Brook KEETS1	Fall River FALL1	Manhan River MANUP1
Primary Habitat Parameters	**Score (0-20)**												
INSTREAM COVER (for Fish)	17	16	17	7	18	19	18	19	18	20	16	18	19
EPIFAUNAL SUBSTRATE	17	16	5	3	18	19	18	18	17	20	18	19	19
EMBEDDEDNESS	18	18	7	1	18	19	NA	16	18	20	19	15	16
CHANNEL ALTERATION	14	15	15	20	18	16	19	18	19	20	19	19	18
SEDIMENT DEPOSITION	15	17	6	1	12	19	14	15	15	19	19	15	15
VELOCITY-DEPTH COMBINATIONS	16	15	16	16	19	19	17	17	20	20	16	16	16
CHANNEL FLOW STATUS	18	20	17	15	15	18	16	17	20	20	16	17	18
Secondary Habitat Parameters	**Score (0-10)**												
BANK VEGETATIVE PROTECTION left	8	8	5	9	9	10	8	4	9	10	9	10	9
BANK VEGETATIVE PROTECTION right	7	10	4	9	9	9	9	7	7	10	9	10	9
BANK STABILITY left	7	9	5	2	10	10	9	9	9	10	9	6	10
BANK STABILITY right	7	10	4	2	10	9	9	8	9	10	9	9	10
RIPARIAN VEGETATIVE ZONE WIDTH left	10	6	9	10	10	3	5	7	9	5	3	8	10
RIPARIAN VEGETATIVE ZONE WIDTH right	7	10	8	10	8	3	6	4	5	9	9	8	9
Total Score (of a possible 200 unless noted)	**161**	**170**	**118**	**105**	**174**	**173**	**148 ***	**159**	**175**	**193**	**171**	**170**	**178**

N/A not assessed
* of a possible 180