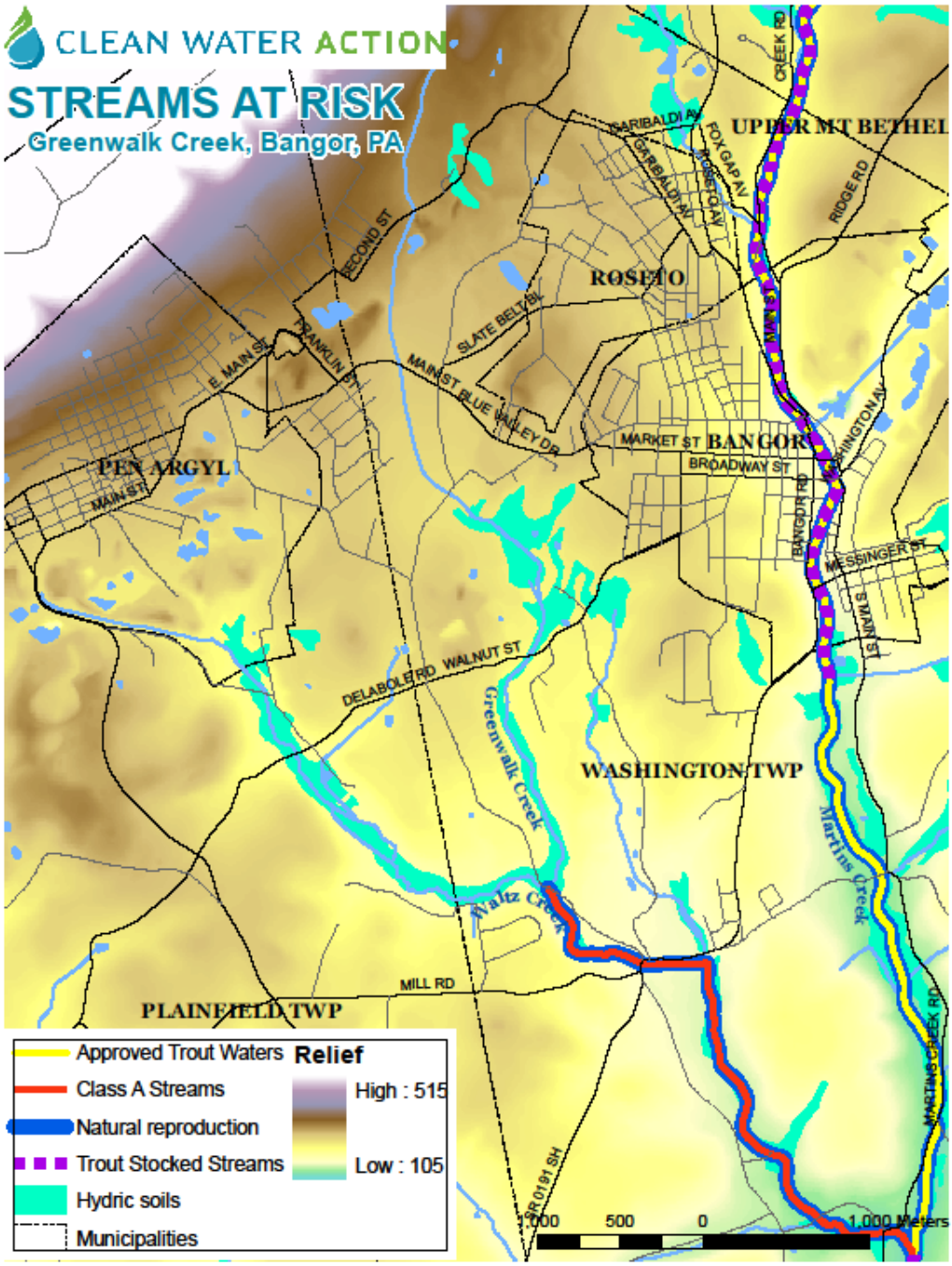
Greenwalk Creek Coldwater Conservation Plan

Location

The Greenwalk originates in the Borough of Pen Argyl in northern Northampton County, Pennsylvania, beginning at the foot of Blue Mountain (the Kittatinny Ridge) and flowing south to confluence with the Waltz Creek in the village of Ackermanville, Washington Township. The Waltz continues on from that point, joining the Martins Creek at the Village of Factoryville in Washington Township. From there, the Martins Creek flows on to the Delaware River at the Village of Martins Creek.



Watershed Description

The Greenwalk Creek is a 2 ½ mile Cold Water Fishery (CWF) that supports a trout population from approximately one mile below it's headwaters to its mouth where it joins the Waltz Creek near Ackermanville in Washington Township, Northampton County, PA. To this point both the Greenwalk and the Waltz are CWF. When they join, however, the combined waters are ranked High Quality (HQ) by the Pennsylvania Department of Environmental Protection (PA DEP), the second highest classification the state offers and one that demands a higher degree of protection that that offered to streams ranked CWF.

This plan for the Greenwalk may be coupled with a plan for the Waltz Creek. The Borough of Pen Argyl has recently completed the reconstruction of the Borough of Pen Argyl Sewage Treatment Plant which discharges into an unnamed tributary of the Waltz. This reconstruction was done in response to federal requirements that were developed following a Total Maximum Daily Load (TMDL) evaluation by the US EPA and the resulting requirements to reduce metals contamination of the Waltz. The results of the work the Borough has undertaken will have a major impact on any plan that is developed for the Waltz.

It is the purpose of this Coldwater Conservation Plan to outline steps that should be taken to preserve the Greenwalk and its benthic community and assure that this stream retains its rural characteristics, continuing to provide opportunities for recreational fishing. The plan has been prepared with the encouragement and help of the Martins-Jacoby Watershed Association. We also acknowledge the help of Nestle Waters Corp., the Green-Walk Trout Hatchery, and Mr. Wayne Butler, all landowners along the Greenwalk.

Watershed Characteristics

The Greenwalk begins as an intermittent stream at the southern foot of Blue Mountain in the Borough of Pen Argyl, Northampton County, PA. It is an area with a large number of abandoned slate quarries, many of which are at least partially filled with water. The Greenwalk flows south to join the Waltz Creek at the Village of Ackermanville. The flow is intermittent for the first mile, running only during wet weather. These intermittent headwaters pass through a strip of commercial and residential properties and through a culvert running under a shopping center parking lot off of PA Route 512 near the border of Pen Argyl Borough and Washington Township. Though this intermittent flow passes through wet areas, the area is not wet enough to provide a year-round flow.
The terrain here is flat with larger trees measuring only a few inches in diameter. Low brush and grass tufts exist throughout the area. The stream is generally difficult to trace when drier conditions prevail.

After passing under American Bangor Road in Washington Township however, this illusive stream enters a wetland area identified on US Fish & Wildlife maps as a freshwater forested/shrub wetland. Here the stream encounters a wooded area rich with springs. These are sand springs. Looking into the pools that surround the larger springs, one can see sand bubbling up with the emerging water. The water is abundant and clear. The springs run year-round, producing rivulets which run together through a forested area that has been undisturbed for many decades. Some deciduous trees here may run up to 36 inches in diameter and include beech, oak, maple and birch. Some hemlocks are also present. The ground remains damp and rivulets that form, come together in a marshy area and become the true headwaters of the Greenwalk. Sand springs are evident along the course of the stream from the area 200 yards downstream from American Bangor Road, to the upper section of the Green-Walk Trout Hatchery. (See below for details regarding the Green-Walk Trout Hatchery.)

After exiting the upper hatchery, the Greenwalk continues to receive water as it passes through a swampy area, fed by additional sand springs. The stream splits and rejoins along the way. Another 100 yards downstream and the streambed becomes somewhat rocky. Riffles appear with quieter pools just below them. The trees and brush throughout this area are close to and overshadow the stream banks, keeping off the direct sunlight, maintaining cooler water temperatures. Below the upper hatchery, approximately 1300 yards below American Bangor Road, the Greenwalk flows under Delabole Road. From Delabole Road, the stream banks rise steeply. Here, limited residential use occurs at the top of the banks along with some agricultural use. The flora along the banks keeps erosion to a minimum and shades the stream. The soil on either bank supports a variety of bushes and primarily deciduous trees though some hemlock are also found. Trunk diameters may run up to approximately six inches, with an occasional larger tree. The streambed here continues to evidence sand and gravel along with cobble and larger rocks, some of which may be considered small boulders. As the stream approaches the lower section of the Green-Walk Trout Hatchery, the steep banks recede from the stream edge and the terrain flattens out in the area immediately along the stream.

The lower hatchery runs for approximately 200 yards. Beyond the lower hatchery, steep banks again appear but are set back from the stream edge. The areas near the stream edge are flat and are accessible for another 100 yards. Along the last 300 yards the banks are not accessible due to the thickness of the undergrowth, though the condition of the stream appears to remain similar until it enters the Waltz near the Village of Ackermanville.

Land Use and Human Impacts

Upper section - the beginning – intermittent flow

As indicated above, this intermittent portion of the stream is most influenced by human activities. Parking lots and retail development in the past 40 years have encroached on the Greenwalk to the point of actually forcing the stream underground, piped beneath parking lots. In places it is difficult to determine where the stream actually flowed in the past. Flow here is intermittent, passing through an area of damp soils. Spring thaws and the amount of rain in this area of the watershed affect the flow.

Upper section – springwater sources

Approximately 1200 yards below the parking areas, after passing through a culvert beneath American Bangor Road, the Greenwalk enters an area with multitude sand springs. It is here that the Greenwalk becomes a consistently flowing stream. This area has been largely untouched by human activities for many years. Its marshy character precluded most agricultural uses.

Middle Section - the Upper Trout Hatchery and the springs below

The Green-Walk Trout Hatchery is composed of two parts – an upper and a lower hatchery. The upper section is located just below the confluence of rivulets coming from the sand springs. Below the upper hatchery, the stream continues through forested areas and marshy soils, past occasional residences then on to drier, bonier soils and high stream banks that are held in place by stable flora. Occasional croplands appear near the top of these banks but do not directly impinge on the Creek.

Approaching Delabole Road, the stream begins to run more rapidly and the banks rise more steeply. Shade remains prevalent so cooler temperatures are maintained. Steeper banks channel the stream and the streambed, while continuing to evidence sand, also shows gravel, cobble and boulders. These characteristics continue to the Greenwalk's confluence with the Waltz Creek in the Village of Ackermanville in Washington Township.

The Greenwalk Creek supports a native brown trout population, most in evidence as the stream approaches confluence with the Waltz Creek. Rainbow trout have also been in evidence, though such sightings are rare. The trout found in the middle sections of the Greenwalk tend to be sub-legal in size and may reflect occasional escapees from the upper hatchery operations. Both brown and rainbow trout thrive in cold water. The shade along the stream banks work to effectively protect this habitat.

Lower Section – the Lower Trout Hatchery to the mouth

The high stream banks recede from the Creek nearly 600 yards below the upper hatchery. Fifty more yards along, the lower section of the hatchery operation begins. Another 300 yards and the stream exits the hatchery. Just below this point, a series of residences appear above the stream on high banks that have receded back from the stream. There is evidence here of long-abandoned attempts to channel the stream or to dam a portion of it. Here one finds old pieces of lumber, an old section of corrugated pipe and evidence of some earth disturbance. There does not seem to be any current efforts to affect the course of the stream. From this point, the banks are so overgrown that access is not possible. The stream flows south to where it reaches confluence with the Waltz Creek at the village of Ackermanville. The total length of the stream from the point it flows year round (at the upper hatchery) to its mouth is approximately 1½ miles.

Hatchery details

Both sections of the hatchery are flow-through operations. They straddle the Greenwalk at both locations with the stream passing through the majority of the pens holding brown, brook, rainbow and tiger trout in various states of growth. According to the hatchery owners, this arrangement assures proper aeration of the water and forces the trout in their pens to swim against current, producing a stronger, healthier fish.

This type of operation raises the question of the effect of hatchery operations on the water quality below the facility. Tests of macroinvertebrates above and below the upper hatchery (Baylor, Don, Aquatic Resource Consulting, for the Martins–Jacoby Watershed Association, May of 2008.) showed no appreciable difference in the quality of the water in the Greenwalk between the two test points. In rare instances of severe flooding, the hatchery has lost significant amounts of their stock downstream. This has not seemed to cause any damage to the overall water quality of the stream or its ability to support the native population of brown trout. The general habitat quality was determined to be in the low optimal range, the macrobiotic results showed an imbalance in the benthic population. It was determined that the waters would not qualify for special protection (EV or HQ waters) under PA DEP standards. The only prolific macroinvertibrate found in the Greenwalk was freshwater shrimp (genus *Gammarus*) that tend to inhabit streams like those found in limestone areas. This region, however, is north of the limestone area that is characteristic in southern Lehigh and Northampton Counties in Pennsylvania. Subsequent water conductivity tests conducted by Dr. Joseph Colosi of DeSales University (Center Valley PA.) for the Clean Water Fund did not indicate that the stream had characteristics common to those of a limestone stream.

Additionally, the results of a variety of testing from the mid-1990s to present show the Greenwalk would not qualify as a limestone stream under the Pennsylvania Dept. Of Environmental Resources' (DEP) regulations which provide for a separate set of standards to evaluate limestone streams for protection as High Quality or Exceptional Value waters.

The Hatchery's and Nestle Waters' commitment to the quality of the stream

The Green-Walk Hatchery ownership has made a commitment to the quality of the Greenwalk. In conversations with hatchery management, they have cited (1) their need for clean water to assure healthy fish for their business, (2) their commitment to honor the efforts of the family members who started the operation three generations ago and (3) their appreciation for the natural area in which they live. They

have made a commitment to keep harmful development away from the stream and see their role as guardians of the stream.

The Nestle Waters Corp. withdraws ground water from the area where the upper springs are located. Their concern is to prevent contamination of ground water sources that provide up to 390,000 gallons per day when they run at full permitted capacity for their bulk bottled water operation. Nestle has also recently applied for an increase in permitted capacity which would allow maximum average daily withdrawals of up to 550,000 gallons per day. The water from their wells is piped to tank trucks and hauled to bottling operations elsewhere. The PA DEP has approved this operation following studies done by Nestle Waters, which supported the ability of the aquifer to support such withdrawals without lowering the water table or adversely effecting flows in the Greenwalk Creek. Nestle has agreed that, if conditions negatively affect stream flows, they will change their rate of withdrawals to maintain the levels required by the PA Fish and Boat Commission.

These two operations have purchased the majority of the immediate watershed lands serving the Greenwalk, from the upper spring area down through the lower hatchery operation. There are only two other landowners who own streamside property along the lower section of the Greenwalk. Both of these are also committed to protecting the stream, water quality and fish population of the stream.

Recent proposals that can affect water quality in the Greenwalk Creek

There was a proposal in 2008 circulating before regulatory bodies to fill an existing slate quarry located just above the commercial area at the Greenwalk's headwaters. The proposed fill operation would be followed by construction of a large residential development on top of the filled quarry. The fill would consist primarily of the quarry tailings that remained after the quarry was abandoned years ago but would have to be finished with other fill and graded to meet zoning requirements. As of 2011, that proposal has not made any headway.

Findings and Recommended Protection Efforts

The primary deficiency for the Greenwalk, identified through various tests, is an unbalanced macrobiotic population. This imbalance reached its greatest degree around February of 1996 when only 100 different individuals were found in samples taken by the PA DEP and PA Fish and Boat Commission.

While the stream appears at present to be well protected and to have stable banks thanks to strong root systems along streamside, the steep banks along sections of the stream should be monitored periodically to determine if erosion is occurring in the future. If this occurs, interested parties should work with landowners, to stabilize the banks.

Appropriate actions for the future should include:

- Monitoring the steam and conducting stream bank stabilization where appropriate. This should include assuring that the flora along the banks continues to shade the waters, enhancing the habitat for brown and rainbow trout.
- Maintaining awareness of the water levels in the stream during periods of low rainfall to assure that groundwater withdrawals do not adversely affect the ability of the stream to support its current fish and other populations. This would include continuing cooperation and dialogue with hatchery operators, the Nestle Waters Corp. and state agencies in observing and reporting changes in water levels.
- Protection of the water quality in the headwaters of the upper section of the Greenwalk, near the Shopping Center areas, including providing input to state and local agencies when hearings are held on projects that might adversely affect water quality. Though this section of the stream is

intermittent in flow, there is a major concern regarding the effect that runoff from parking areas, roofs and lawns would have on the water quality of the Creek during wet seasons when water does flow.

- Critical examination of any development efforts that could adversely affect the quality of the entire stream to assure that water quality is adequately protected. A concern would also exist around erosion and sedimentation during any grading or construction and around the potential for accidental release of sewage from the completed project .
- The Greenwalk contributes large portion of the water going into the Waltz Creek. From the point that the Greenwalk enters the Waltz, the Waltz becomes a High Quality (HQ) waterway and a Class A Trout Stream. A further discussion of this is below. This fact adds great importance to strong conservation efforts for these streams. Efforts to maintain communications with and the involvement of the sport fishing community to defend these waters should be expanded.

Research and Monitoring

A number of studies have been done on the Waltz / Greenwalk Creeks since the mid-1990s. In 1994, 1997 and 1998 the Pennsylvania Dept. of Environmental Protection (PA DEP) conducted a series of tests on water chemistry, benthos, habitat and, in 1994 and 1999, on fish populations. The latter was done with assistance from the Pennsylvania Fish and Boat Commission (PAFBC.) An additional follow-up was done by the PA DEP in 2001. This was part of the statewide stream classification process required by Pennsylvania regulations. Testing was conducted to determine if the streams, or segments thereof, would qualify for special protection as High Quality-Cold Water Fishes (HQ-CWF) or Exceptional Value (EV) waters. The determination was that the Greenwalk and the upper portion of the Waltz, down to its confluence with the Greenwalk, would only qualify as Cold Water Fishes/Migratory Fishes (CWF-MF.) The lower section of the Waltz between that confluence and the mouth of the Waltz where it meets the Martins Creek, would qualify as HQ-CWF and as a Class A Wild Brown Trout Stream.

In 2004 the US Environment Protection Agency (US EPA) published the results of a Total Maximum Daily Load (TMDL) Report on the Waltz that tangentially touched on the Greenwalk as a tributary to the Waltz. The US EPA relied heavily on the research done in 1998 and 2001 by the PA DEP and PA F&BC.

Another round of tests on the benthos of the Greenwalk was done in 2008 by Don Baylor of Aquatic Resource Consulting of Stroudsburg, Pennsylvania to determine if the trout hatchery operations were adversely affecting the macrobiotic population of the stream. Samples were taken above and below the upper hatchery operation. The results showed that the benthic populations were similar at both sampling locations. The conclusion was that there were no appreciable effects from those operations. Results showed the most prevalent macroinvertibrate to be freshwater shrimp (genus *Gammarus)*, which could indicate that the stream was under the influence of limestone. Subsequent tests (Dr. Joseph Colosi, DeSales University, 2009) on the conductivity of the water, which could confirm such an influence of limestone, showed that the level of conductivity did not indicate an exceptional level of limestone in the water.

APPENDIX A - Monitoring History and Results

Charts on Water Chemistry, Habitat and Macroinvertebrates refer to the upper hatchery operation

Chart 1

GREENWALK CREEK			Water Chemistry				
	2/11/	1998	4/13/	1998	1/23/2009		
	Abv. Htchy	Blw htchy	Abv. Htchy	Blw. Htchy	Blw. Htchy		
Chemical		*		*	*		
Sampler	A	A	A	A	C		
pH	6.3	6.5	6.4	6.6	7.82		
ALK	15.2	19.2	15.4	20			
COND.	216	210	201	217	223		
BOD	<0.3	3.2	1	0.8			
Susp Solids	<2	14	6	26			
Tot Partic	<0.02	0.06	<.02	0.04			
Hardness	61	61	50	55			
CA	19.6	19.6	18.9	19.3	16		
MG	7.68	7.09	6.77	7.01	5.23		
CU	<10	<10	<10	<10			
PB	<1	<1	<1	<1			
ZN	45	105	<10	<10			
F COL	<20	160	20	<20			per 100 mg
Samples by A = DEP		B=PAF&B	C=Loomis& Colosi				
* Samples taken at Delabole Rd.							

GREENWALK CREEK	HABITAT ASSESSMENTS						
Date of Assessment	Feb. 1998	Feb. 1998	May. 2008	May. 2008	Change	1998-2008	
Station & Tester	Above hatchery	Blw Delabole Rd	Above hatchery	Blw hatchery	Abv. Hatch.	Blw. Hatch.	
	B	B	C	C			
Habitat Parameter							
Instream Cover	15	17	12	13	-3	-4	
Epifaunal Substrate	16	16	16	12	0	-4	
Embeddedness	18	15	17	14	-1	-1	
Velocity/Depth Regimes	11	17	12	14	1	-3	
Channel Alterations	19	16	20	20	1	4	
Sediment Deposition	18	17	17	19	-1	2	
Frequency of Riffles	19	18	16	13	-3	-5	
Channel Flow Status	19	18	15	16	-4	-2	
Condition of Banks	19	18	17	19	-2	1	
Bank Vegetative Protection	19	16	20	20	1	4	
Grazing-Other Disruptive	19	16	20	17	1	1	
Pressurre							
Riparian Vegetative	19	10	19	18	0	8	
Zone Width							
TOTAL SCORE	211	194	201	195	-10	1	
Score Ranges: Optimal-340-192, Suboptimal-180-132, Marginal-120-72, Poor<60							

GREENWALK CREEK - MACROINVERTEBRATE SURVEYS									
Date of Sample	Dec. 1994	Feb. 1996	Feb. 1998	May. 2008	May. 2008		Sensitivity		
							to pollution *		
Station & Tester	Above hatchery	Blw Delabole Rd	Grnwlk. mouth	Above hatchery	Blw hatchery				
	B	B	B	C	C				
Counts & Specimens									
Mayflies							**A**		
Ameletus		1							
Baetis	4		7						
Ephemerella	7			22	16				
Eurylophella		2							
Serratella	3	10	11						
Stenonema	2								
Sub-totals	**16**	**13**	**18**	**22**	**16**				
Stoneflies							**A**		
Paracapnia		19							
Sweltsa		3							
Yugus		1							
Isoperla				1	3				
Amphinemura				1					
Leuctra					2				
Sub-totals		**23**		**2**	**5**				
Caddisflies							**A**		
Cheumatopsyche	275	1							
Hydropsyche	30	1	1						
Palaeagapetus		1							
Chimarra	130	1	33						
Dolophilodes	1				4				
Polycentropus		1							
Rhyacophila	3	1			1				
Agapetus				1					
Diplectrona				1					
Sub-totals	**439**	**6**	**34**	**2**	**5**				
Coleoptera (beetles)							**B**		
Microcylloepus				2	11				
True Flies							**B**		
Chironomidae	60	12	60		2				
Prosimulium	1								
Simulium	1		2						
Tipula	2								
Sub-totals	**64**	**12**	**62**		**2**				
Isopoda (sowbugs)							**B**		
Caecidotea	318		39	2					
Misc. Insect Taxa									
Optioservus	10	1	1						
Gomphidae sp	1								
Arigomphus		1							
Oligochaeta-earthwrms					**1**		**C**		
Non-Insect Taxa									
Gammarus	**148**	**41**		**184**	**210**		**B**		
Sphaerium	4								
Oligochaeta		3							
Cura			3						
TOTAL # Individuals	**1000**	**100**	**157**	**212**	**250**				
Tester Key =	A = PA Fish & Boa	B = DEP	C = Baylor for MJWA						

Aquatic Life Use Attainability Evaluation
Water Quality Standards Review
Waltz Creek
Northampton County
Segment: basin
Drainage list: C
Stream code: 63243

Water Quality Monitoring And Assessment Section (TES)
Division of Water Quality Assessment And Standards
Bureau of Water Supply and Wastewater Management
Department of Environmental Protection
January 2001
Revised October 2002

INTRODUCTION

In 1994, it was determined that during the compilation of Chapter 93, the Waltz Creek basin was not assigned a "designated use". The designated uses listed for the surrounding Martin's Creek drainage segments are either Cold Water Fishes (CWF) or Trout Stocking (TSF) and Migratory Fishes (MF, in part) but they do not include Waltz Creek.

Northeast Regional Office staff conducted a survey on December 20, 1994 and recommended that the Chapter 93 designated use for the Waltz Creek basin be Cold Water Fishes (CWF) because of the presence of well established cold water fauna and Migratory Fishes (MF) because of the presence of the American eel (DEP 1995). However, there was no information offered to consider warmer summer month conditions. Subsequent assessments were conducted in 1997 and 1998. In addition, there was the opportunity to consider newer, more detailed Waltz Creek fishery data collected by the Pennsylvania Fish & Boat Commission (August 1999). The purpose of this report is to review the information and data gathered during these investigations in order to determine the proper Chapter 93 designated use for Waltz Creek.

General Watershed Description

Waltz Creek is a tributary to Martins Creek in the Delaware River drainage. The basin is located in Plainfield and Washington Townships and the Borough of Pen Argyl in Northampton County north of Easton (Figure 1). Waltz Creek is a freestone stream (with some alkaline influences) that drains 11.1 mi2 and flows in a southeastly direction. Relatively flat rural lands with some gently rolling hills of low relief characterize the surrounding area
.
There are significant impacts to the Waltz Creek basin from human activities. Land uses include localized agricultural activities, rural residential development, and the urban areas of Pen Argyl. In addition, Waltz Creek is located in the "slate belt" of northeast Pennsylvania. Thus, the study area is also noted for active and historic slate quarries. It appears that portions of upper Waltz Creek had been relocated in the past to accommodate quarrying activities.

WATER QUALITY AND USES

Surface Water

No long-term water quality data were available to allow a direct comparison to water quality criteria. However, chemical "grab" samples and biological data have been collected from Waltz Creek during recent field surveys conducted by the Department's Northeast Regional Office (NERO) staff and the Pennsylvania Fish & Boat Commission (PFBC).

Department Surveys.
These surveys include a 12/20/94 survey (DEP 1995), 9/10/97 assessments made under the Unassessed Waters (UW) Program, and a 2/11/98 "intensive follow-up" survey (DEP 1998).

The intensive follow-up survey was conducted in response to the UW stream assessment observations. The Department's UW Program assesses the state's surface waters using qualitative biological data to identify impaired waters, sources and causes of these impairments, and to attribute their origin to either "point" or "nonpoint" sources. Another mechanism provided by the UW program, is a more detailed intensive follow-up survey in order to confirm and better define the nature, extent, sources, causes, and discharge origins of the observed impairments.

PFBC IBI Fish Survey.
The PFBC (1999) collected fish at one site on Waltz Creek on 8/25/99. This effort was an intensive "one-pass removal" method for the purpose of collecting fish population data that will be used in developing a fish-based Index of Biotic Integrity (IBI) for small Pennsylvania streams.
Figure 1 shows station locations of these various survey sample points.

Water Quality.
Laboratory analysis results of Waltz Creek surface waters are presented in (Table 1). Grab samples indicated that the overall water quality of Waltz Creek is generally good. However, the instantaneous nature of grab samples precludes comparison to applicable water quality criteria. Despite the limitations of grab samples, observations can be made that provide a generalized overview of Waltz Creek's water quality. The grab sample results were generally better than criteria. Based on hardness, alkalinity, calcium, and magnesium concentrations, grab sample analysis results suggest that Waltz Creek generally exhibits normal buffering capacity. While most metals analyzed were below detection limits and Chapter 93 criteria values, concentrations for copper at 1WC and 2UNT and zinc at 1WC and 3UNT slightly exceeded their hardnessbased criteria. These parameter concentrations were also elevated at other stations but higher hardness levels attenuated their impacts. Except for nutrients, other tested parameters exhibited normal background concentrations. Nutrients were elevated below the Pen Argyl sewage treatment plant at 3UNT and in the lower Waltz Creek mainstem (4WC). Water chemistry information and field observations indicate that Waltz Creek displays fluctuations in water quality often associated with runoff from storm sewers and residential areas (DEP 1998).

There are two active NPDES permitted point source discharges in the study area. One is a municipal sewage treatment plant discharge located on an unnamed tributary of Waltz Creek (Figure 1) (Table 1) in the Borough of Pen Argyl permitted to the Pen Argyl Municipal Authority. The second discharge is a non-municipal sewage treatment discharge located in Plainfield Township and permitted to H.A. Berkheimer, Inc.
There is one permitted surface water withdrawal permit in the study area – an instream diversion for the Citizens Utility Water Company for 0.149 MGD.

Aquatic Biota
The indigenous aquatic community is an excellent indicator of long-term conditions and is used as a measure of both water quality and ecological significance. NERO staff collected habitat and benthic macroinvertebrate data during their 1994 & 1998 surveys. Fish data were collected by NERO in 1994 and by the PFBC in 1999.

Habitat.
For simplicity, the most current habitat data (DEP 1998) is reported in (Table 2). Instream habitat conditions were evaluated at each station where benthic macroinvertebrates were sampled. The habitat evaluation consists of rating twelve habitat parameters to derive a station habitat score. The range of habitat score totals for

Waltz Creek stations was 156-211 – generally considered to reflect sub-optimal to optimal habitat conditions.

Benthos.
NERO's benthic macroinvertebrate collection efforts employed the Department's PA-DEP RBPIII benthic sampling methodology. The PA-DEP RBPIII method is a modification of EPA's Rapid Bioassessment Protocols (RBPs; Plafkin, et al 1989). The collected and processed benthic samples serve as the basis for benthic metric analysis and allows comparisons of Waltz Creek metrics scores to generally accepted water quality predictive scoring ranges (e.g. Shannon diversity index range of <1-3+, where low scores are indicative of poor quality and higher scores better quality).
Waltz Creek supports widely varied benthic macroinvertebrate populations.

Macroinvertebrates collected in the Waltz Creek basin (Table 3) revealed taxa richness (total # of taxa) values ranging 7-31 in December 1994 and 4-19 in February 1998. Modified EPT index scores were also widely variable with ranges of 2-12 (1994) and 0-19 (1998). It must be noted that both surveys were conducted during winter conditions, so there should not be very much variablility attributed to seasonality. However, the older survey data from 1994 reflects total sample identifications while only portions of the 1998 collections were identified (100+ sub-samples). This difference in sample processing accounts for the variation between the two NERO surveys.

Despite the different sample sizes between the two NERO surveys, pollution sensitive benthic metric values were comparable. The benthic collections of both surveys were consistent with each other and reflect the water quality conditions of their respective station. The macroinvertebrate communities were quite varied in condition, "health", and diversity, and contained a number of pollution-tolerant genera. For example, when considering the 1998 data, Waltz Creek's upper stations (1- & 4WC) and headwater tributaries (2- & 3UNT) scored poorly. The "Shannon" diversity index, a traditional benthic metric where low scores indicate poor conditions, scored low – ranging from .47 to 1.59. (Normally, in the spectrum of typical diversity index scores, <1 represent "very poor" water quality conditions and 3+ represent "excellent" conditions). The HBI scores (Hilsenhoff Biotic Index; high values indicating poorer water quality conditions) for 2- & 3UNT were among the highest found in the study area (6.25 & 5.88, respectively). With the exception of the lower-most station (8WC), the other stations scored poorly with the %Dominant Taxon metric (Higher percentages indicating benthic community imbalance). The poor performances of these three metrics indicate that the stream has been subjected to varying degrees of chronic or acute degradation. These stations receive the discharge from the Pen Argyl STP and runoff from residential areas.

The best benthic conditions found in Waltz Creek appear at 8WC and at the headwaters of Greenwalk Creek (5GC). Relative to the rest of the study area, these stations had the best scores for taxa richness (19, 17), HBI (3.85, 3.46), and Shannon diversity (2.45, 1.91). Conditions at Station 8WC may reflect improved water quality as a result of dilution of runoff emanating from Pen Argyl in the headwaters of Waltz Creek. Greenwalk Creek headwaters (5GC) don't receive direct urban runoff like Waltz Creek does.

Fish.
Waltz Creek fish populations were sampled by NERO staff in 1994 and with the assistance of PFBC biologists in August 1999. The presence of coldwater fishes, particularly brown trout, was the basis for the Department's original use-attainability recommendations (1995). The PFBC's IBI survey provided valuable warm weather data concerning the Waltz Creek fishery.

Seven species of fish were captured in Waltz Creek during the Department's December 1994 survey (Table 4). The PFBC quantitative IBI survey documented the same species plus one – the shield darter (*Percina peltata*). Forty-six brown trout (85-288mm in size)

and 3 rainbow trout (155-323) were captured during the PFBC survey. These species were also collected in 1994. Brown and rainbow trout are cold water species and the rest, while commonly found in cold water streams, are more widely adaptive and temperature tolerant "coolwater fishes". The size of captured trout (sub-legal sizes of <175mm) suggest natural reproduction. However, Greenwalk Creek supports a trout hatchery, which raises the possibility of sub-legal sized "escapees" (especially the observed rainbows). Overall, the Waltz Creek fishery is dominated by blacknose dace with low-to-moderate density brown trout populations being present.

PUBLIC RESPONSE AND PARTICIPATION SUMMARY

The Department provided public notice of this redesignation evaluation and requested any technical data from the general public through publication in the Pennsylvania Bulletin on April 22, 2000 (30 Pa.B 2071). A similar notice was also published in The Express Times newspaper (Easton, PA) on April 21, 2000. In addition, Plainfield and Washington Townships, Pen Argyl Borough, and Lehigh Valley Planning Commission were notified of the redesignation evaluation in a letter dated April 19, 2000. No data on water chemistry, in-stream habitat, or the aquatic community were received in response to these notices.

A draft of this report was submitted to the above stakeholders, along with a request for comments, on September 20, 2002. No comments were received in response to this request.

The Department's initial recommendation as a result of this evaluation was to designate the entire Waltz Creek basin Cold Water Fishes, Migratory Fishes (CWF, MF). This recommendation was approved by the Environmental Quality Board and published as proposed rulemaking (33 Pa.B 4165). During the public comment period, the PFBC advised the Department that its assessment work at two sites on Waltz Creek in August 2002 developed data to support the inclusion of Waltz Creek on the Class A Wild Trout Streams list. The Commission published notice in the *Pennsylvania Bulletin* on March 20, 2004 (34 Pa.B 1643) that it proposed to add portions of Waltz Creek to its list of Class A Wild Trout Streams. Formal action to designate a portion of Waltz Creek as a Class A Wild Trout stream was taken at the Commission meeting on April 19 - 20, 2004, following the public comment period. The Department obtained the PFBC inventory report for the lower reach of Waltz Creek and its independent review confirmed that the Class A wild brown trout criterion for a High Quality Cold Water Fishes water is met. As a result, the portion of Waltz Creek downstream from the confluence of Greenwalk Creek is now recommended for designation as High Quality-Cold Water Fishes, Migratory Fishes (HQ-CWF, MF).

RECOMMENDATIONS

The biological data indicate that Waltz Creek supports cold water and migratory fish. Two species of trout were collected from Waltz Creek during both cold and warm months. American eels were also collected in the mainstem. These species were found in both 1995 and 1999. In addition, PFBC data indicate the presence of a Class A brown trout population in the lower reaches of Waltz Creek.

Based on applicable regulatory criteria and the PFBC fishery data obtained during the public comment period on the proposed rulemaking, the Department recommends the following use designations for the Waltz Creek basin:

Waltz Creek - Basin, Source to confluence of Greenwalk Creek: Cold Water Fishes, Migratory Fishes (CWF, MF), based on the presence of a reproducing brown trout Population

Greenwalk Creek - Basin: Cold Water Fishes, Migratory Fishes (CWF, MF), based on the presence of reproducing trout populations

Waltz Creek, Basin - Greenwalk Creek to mouth: High Quality-Cold Water Fishes (HQCWF), based on the presence of a Class A wild brown trout population documented by PFBC and formally designated as such
This recommendation adds approximately 14.6 stream miles of CWF waters to Chapter 93.

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Pennsylvania Fish & Boat Commission (1999). File information, 8/25/99 IBI Survey of Martins Creek basin.

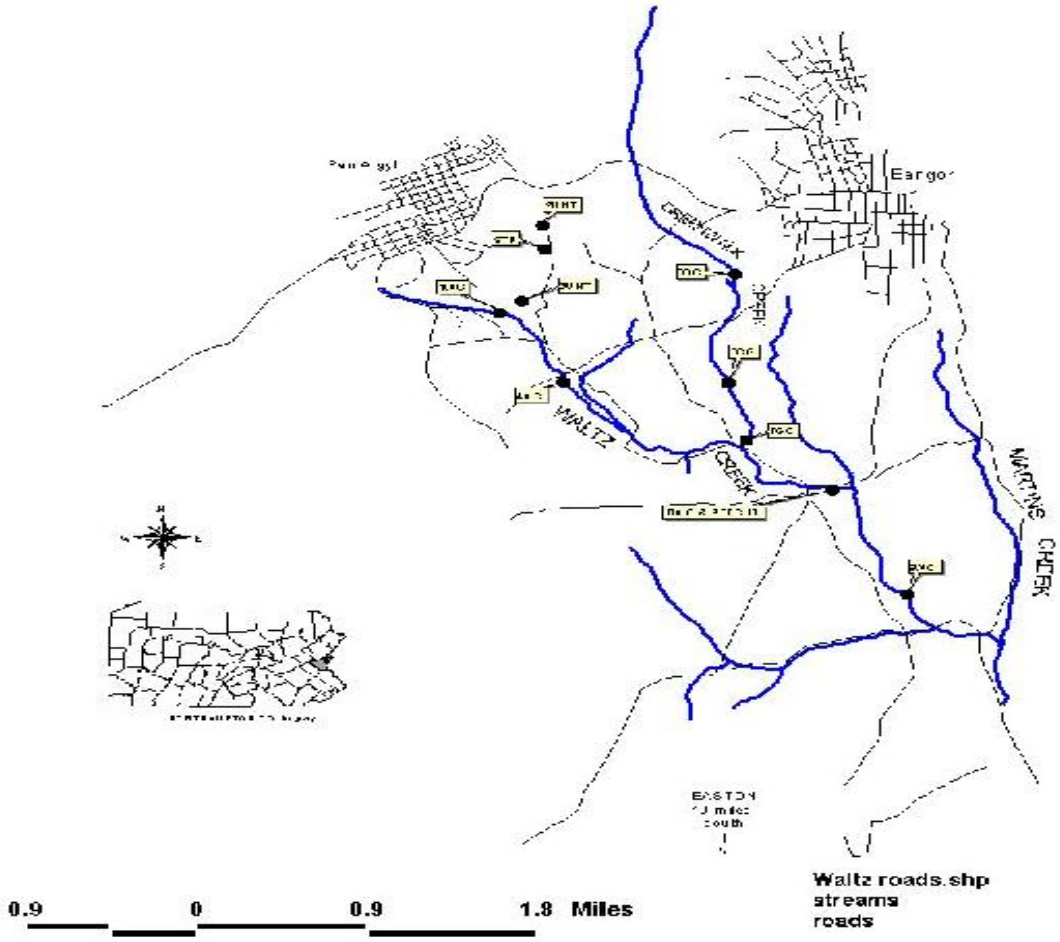
Tables and Figures*

* All Tables and Figures require Adobe Acrobat Reader (it's free) to view or print. Follow Site Plug-Ins/Viewers at bottom of page for more information.

Figure 1 - Stream Map Image
Table 1 - Water Chemistry
Table 2 - Habitat Evaluation
Table 3 - Macroinvertebrates
Table 4 - Fishes

Map - PA DEP test sites along the Waltz and Greenwalk Creeks

FIGURE 1. WALTZ CREEK WATERSHED
NORTHAMPTON CO.



BENTHIC MACROINVERTEBRATES OF GREENWALK AND JACOBY CREEKS

MAY 20, 2008

FOR

MARTINS–JACOBY WATERSHED ASSOCIATION

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BENTHIC MACROINVERTEBRATES OF GREENWALK AND JACOBY CREEKS, MAY 20, 2008

BACKGROUND

On May 20 2008, at the request of the Martin –Jacoby Watershed Association, Aquatic Resource Consulting biologist Don Baylor sampled benthic macroinvertebrates at two stations on Greenwalk Creek and one station on Jacoby Creek . Assistance was provided by Rich Budihas and Brian Kress. The purpose of the study was to establish baseline water quality data to be able to evaluate potential impacts and to determine how the sites compared to designated use criteria for Pennsylvania streams established by Pennsylvania Department of Environmental Protection (DEP). Greenwalk Creek is designated Cold Water Fishery with Migratory Fishes (CWF, MF), and Jacoby Creek is designated CWF.

Aquatic macroinvertebrates are preferred indicators of stream water quality because of their limited mobility, one to three year life cycles, and specific sensitivities to pollutants. Clean streams usually support numerous species of invertebrates, theoretically evenly represented numerically. Impairment may be indicated by low taxa richness, shifts in community balance toward dominance of pollution-tolerant forms, or overall scarcity of invertebrates (Plafkin, et al. 1989). In order to assure an accurate assessment, recent work in bio-monitoring stresses the use of several parameters, or metrics, to measure different components of the community structure.

METHODS

Macroinvertebrate sampling methods followed those recommended by the US Environmental Protection Agency Protocol III (Plafkin, et al., 1989) with the latest modifications adopted by the PA Department of Environmental Protection (PA DEP, 2007). At each station, two samples were taken from a riffle/run area with a D-frame kick net (Wildlife Supply Company #425-D5) of 500u nitex. Samples were taken by placing the net against the substrate and disturbing approximately one square meter above the net by foot. Organisms and debris were composited for each station in a plastic container and preserved in alcohol for transport to the laboratory. Habitat was evaluated at each station using DEP's Water Quality Network Habitat Assessment forms for streams with riffle/run prevalence. Twelve habitat parameters were ranked on a scale of 1-20 and combined for a total habitat score. In the laboratory, organisms were removed from the debris and placed in a white pan marked with a grid to delineate 21 squares measuring two inches on a side. Organisms were then picked from randomly selected grids until over 200 organisms were obtained. Organisms were identified to the genus for most taxa, enumerated, and assigned a pollution tolerance value (PA DEP, 2007). Metrics for riffle/run freestone streams were calculated for each subsample, including Modified Beck's Index, Ephemeroptera + Plecoptera + Trichoptera taxa richness (EPT),

total taxa richness, Shannon diversity index, Hilsenhoff biotic index, percent dominant taxon, and percent intolerant individuals. A description and brief rationale for each of the metrics follow:

1. **Modified Beck's Index** is a weighted count of taxa with pollution tolerance values of 0, 1, or 2. This metric is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting the loss of pollution sensitive taxa.
It is calculated by multiplying by 3 the number of taxa with a pollution tolerance value of 0, multiplying by 2 the number of taxa with a pollution tolerance value of 1, and multiplying by 1 the number of taxa with a pollution tolerance value of 2.
The three values are added to yield the Modified Beck's Index score.

2. **Ephemeroptera, Plecoptera, and Trichoptera** (mayflies, stoneflies, and caddisflies), collectively referred to as EPT, are generally considered pollution sensitive (Plafkin et al. 1989). Thus, the total number of taxa within the EPT insect groups is used to evaluate community balance. Healthy biotic conditions are reflected when these taxa are well represented in the benthic community.

3.**Total Taxa Richness** – is an index of diversity. The number of taxa (kinds) of invertebrates indicates the health of the benthic community through measurement of the variety of species present. Generally, number of species increases with increased water quality. However, variability in natural habitat (stream order and size, substrate composition, current velocity) also affects this number.

4. **Shannon Diversity Index** measures taxonomic richness and evenness of numbers of individuals across the taxa of a subsample. This metric is expected to decrease in values with increased anthropogenic stress to a stream ecosystem, reflecting loss of pollution-sensitive taxa and predominance of a few pollution-tolerant taxa.

5. **Hilsenhoff Biotic Index** – is a direct measure of organic pollution in streams. The biotic index value is the mean tolerance value of all organisms in a sample. Tolerance values range from 0.00 to 10.00; the higher the value, the greater the level of pollution indicated.

Table 1. Evaluation of water quality using biotic index values (Hilsenhoff, 1987)		
BIOTIC INDEX	**WATER QUALITY**	**DEGREE OF ORGANIC POLLUTION**
0.00-3.50	Excellent	None Apparent
3.51-4.50	Very Good	Possible Slight
4.51-5.50	Good	Some
5.51-6.50	Fair	Fairly Significant
6.51-7.50	Fairly Poor	Significant
7.51-8.50	Poor	Very Significant
8.51-10.00	Very Poor	Severe

6. **Percent Intolerant Individuals** is the percentage of individuals in the subsample with pollution tolerance values of five or less. It is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem.

Index Calculation

An overall index is used to integrate information from these various metrics and standardize them into one score for a subsample. The values for any standardized core metric are set to a maximum value of 1.00, with values closer to zero corresponding to increasing deviation from the expected reference condition and progressively higher values corresponding more closely to the biological reference condition. The adjusted standardized metric values for the six core metrics are averaged and multiplied by 100 to produce an index score ranging from 0-100. This number represents the index of biotic integrity (IBI) score for a sample. The following table shows metric standardization equations and index calculations for the sub-sample from Station 3 on Jacoby Creek:

Table 2. Metric standardization and index of biotic integrity calculations for the benthic macroinvertebrate sample from Station 3 on Jacoby Creek.				
Metric	**Standardization Equation**	**Observed Metric Value**	**Standardized Metric Score**	**Adjusted Standardized Metric Score** Maximum =1.00
Modified Beck's Index	Observed value/39	18	0.462	0.462
EPT Taxa Richness	Observed Value/23	19	0.826	0.826
Total Taxa Richness	Observed value/35	25	0.714	0.714
Shannon Diversity Index	Observed Value/2.90	3.72	1.283	1.00
Hilsenhoff Biotic Index	10-observed value/ (10-1.78)	3.56	0.783	0.783
Percent Intolerant Individuals	Observed value/92.5	52.31	0.566	0.566
Average of adjusted standardized core metric scores x 100 = IBI score				**72.50**

Pennsylvania DEP Index of Biotic Integrity scoring benchmarks require a score of 80.0 or better to qualify for High Quality and Exceptional Value Waters.

Sampling Stations

Three stations were sampled for benthic macroinvertebrates on May 20, 2008. Two were on Greenwalk Creek – one above and one below Greenwalk Trout hatchery , and one was on Jacoby Creek (Figures 1-5).

Station 1 Greenwalk Creek above Greenwalk Trout Hatchery with site latitude/longitude of 40.51711/75.13609.

Station 2 –Greenwalk Creek below Greenwalk Trout Hatchery with site latitude/longitude of 40. 51582/75.13550.

Station 3 –Jacoby Creek with site latitude/longitude of 40.54609/75.07635.

PHOTO NOT AVAILABLE

Figure 1. Station sampled for benthic macroinvertebrates on Greenwalk Creek on May 20, 2008.

PHOTO NOT AVAILABLE

Figure 2. Station sampled for benthic macroinvertebrates on Jacoby Creek on May 20, 2008.

Figure 3. Benthic macroinvertebrate Station 1 on Greenwalk Creek above the trout hatchery sampled on May 20, 2008.

Figure 4. Benthic macroinvertebrate Station 2 on Greenwalk Creek below the trout hatchery sampled on May 20, 2008.

Figure 5. Benthic macroinvertebrate Station 3 on Jacoby Creek sampled on May 20, 2008.

RESULTS AND DISCUSSION

Habitat

All three stations scored in the low optimal range for habitat quality (Table 3). Each station had minimal erosion, with a good riparian vegetative zone. Disruptive pressure was caused only by the hatchery above Station 2 and a road crossing above Station 3. However, each station was in a relatively shallow stream section lacking the full diversity of velocity and depth regimes (Figures 3-5). Although Station 2 on Greenwalk Creek had good diversity of substrate, including a variety of cobble and boulder, the stream immediately below Station 2 had substrate consisting mainly of sand and fine gravel.

Table 3. Habitat assessment of sampling stations on Greenwalk and Jacoby Creeks, May 20, 2008.

HABAITAT PARAMETER	STA. 1 Greenwalk	STA. 2 Greenwalk	STA. 3 Jacoby
1. Instream Cover	12	13	14
2. Epifaunal Substrate	16	12	17
3. Embeddedness	17	14	18
4. Velocity/Depth Regimes	12	14	15
5. Channel Alteration	20	20	18
6. Sediment Deposition	17	19	19
7. Frequency of Riffles	16	13	19
8. Channel Flow Status	15	16	19
9. Condition of Banks	17	19	17
10. Bank Vegetative Protection	20	20	18
11. Grazing or Other Disruptive Pressure	20	17	18
12. Riparian Vegetative Zone Width	19	18	17
TOTAL SCORE	**201**	**195**	**209**
Score ranges: Optimal 340-192, Suboptimal 180-132, Marginal 120-72, Poor <60			

Benthic Macroinvertebrates

Appendix A shows the taxa, numbers, biotic index value (BI) and functional feeding group (FG) for the benthic macroinvertebrates from Greenwalk and Jacoby Creeks on May 20, 2008. Table 4 shows the raw metric values, and Table 5 shows the adjusted standardized metric scores and IBI scores for each sample.

None of the stations had an IBI score equal to or higher than the 80.0 threshold required By PA DEP to qualify for High Quality or Exceptional Value Waters (Table 5). Jacoby Creek Satation 3 had the highest IBI score of 72.50. Stations 1 and 2 on Greenwalk Creek had very similar benthic communities, and their IBI scores were very similar – 45.87 and 48.43, respectively. Station 3 on Jacoby Creek had considerably more taxa and EPT taxa and a much higher diversity value than Stations 1 and 2 on Greenwalk Creek (Table 4). The only metric for which the Greenwalk Creek stations were superior to the Jacoby Creek station was the percentage of intolerant individuals. Benthic macroinvertebrates were abundant at all stations. However, the population balance was relatively poor at both Greenwalk Creek stations.

Table 4. Metric scores for benthic macroinvertebrate samples from Greenwalk and Jacoby Creeks on May 21, 2008.

METRIC	STA.1 Greenwalk	STA.2 Greenwalk	STA.3 Jacoby
Number of Organisms	**214**	**250**	**216**
Modified Beck's Index	**10**	**12**	**18**
EPT Taxa Richness	**5**	**5**	**19**
Total Taxa Richness	**8**	**9**	**25**
Shannon Diversity Index	**0.80**	**1.01**	**3.72**
Hilsenhoff biotic Index	**3.64**	**3.62**	**3.56**
Percent Intolerant Individuals	**99.07**	**98.80**	**52.31**

Table 5. Adjusted standardized metric scores and Index of Biotic Integrity scores for benthic macroinvertebrate samples from Greenwalk and Jacoby Creeks, May 20, 2008.							
Station	**Mod. Beck's Index – observed value/39**	**EPT Taxa Richness-observed value/23**	**Total Taxa Richness-observed value/35**	**Shannon Diversity-observed value/2.90**	**Hilsenhoff Biotic Index – (10-value)/ (10-1.78)**	**Percent Intolerant Individuals-observed value/92.5**	**IBI Score**
STA.1 Green-walk	0.256	0.217	0.229	0.276	0.774	1.071 (1.00)	**45.87**
STA. 2 Green-walk	0.308	0.217	0.257	0.348	0.776	1.068 (1.00)	**48.43**
STA. 3 Jacoby	0.462	0.826	0.714	1.283 (1.00)	0.783	0.566	**72.50**

Samples from above and below the hatchery on Greenwalk Creek had very similar values for all metrics, indicating no impact to water quality from the hatchery. Both Greenwalk stations had poorly balanced macroinvertebrate populations with freshwater shrimp (scuds) of the genus *Gammarus* dominating samples from both stations. *Gammarus* were very prolific and constituted 85% and 84% of the macroinvertebrates at Stations 1 and 2, respectively (appendix A). This imbalance in the benthic population of Greenwalk Creek accounted for the relatively poor values for Shannon Diversity (Table 4).

Gammarus spp. are typically abundant in highly alkaline limestone streams. PA DEP has recognized that true limestone streams are not as diverse as freestone streams and has developed separate protocols for them. To qualify as a true limestone stream, PA DEP requires that the stream maintain minimum alkalinity of 140 milligrams per liter (mg/l). A study by PA DEP conducted in February and April of 1998 and 1999 measured alkalinity in Greenwalk Creek ranging from 15.2 to 20 mg/l (PA DEP 2001, revised 2002). According to the water chemistry results from that study, Greenwalk Creek did not qualify under DEP protocols as a true limestone stream. Thus, DEP protocols for freestone streams were applied to samples from Greenwalk Creek. Greenwalk Creek is evidently sufficiently rich in calcium to support an abundant population of crustaceans (*Gammarus*), which require calcium for their exoskeletons.

Appendix A. Taxa, numbers, pollution tolerance value (BI), and functional feeding Group (FG*) for benthic macroinvertebrate subsamples from Greenwalk and Jacoby Creeks, May 20, 2008.					
TAXA	**STA 1 Greenwalk**	**STA 2 Greenwalk**	**STA 3 Jacoby**	**BI**	**FG**
Ephemeroptera (mayflies)					
Ephemerella	22	16	18	1	Cg
Drunella	-	-	3	1	Sc
Seratella	-	-	21	2	Cg
Isonychia	-	-	8	3	Cg
Caenis	-	-	2	7	Cg
Baetis	-	-	59	6	Cg
Acentrella	-	-	1	4	Sc
Stenonema	-	-	16	3	Sc
Epeorus	-	-	1	0	Sc
Nixe	-	-	4	2	Sc
Trichoptera (caddisflies)					
Rhyacophila	-	1	-	1	Pr
Agapetus	1	-	-	0	Sc
Dolophilodes	-	4	7	0	Fc
Chimarra	-	-	3	4	Fc
Lepidostoma	-	-	1	1	Sh
Diplectrona	1	-	-	0	Fc
Hydropsyche	-	-	3	5	Fc
Ceratopsyche	-	-	1	5	Fc
Cheumatopsyche	-	-	5	6	Fc
Plecoptera (stoneflies)					
Acroneuria	-	-	5	0	Pr
Isoperla	1	3	3	2	Pr
Leuctra	-	2	-	0	Sh
Amphinemura	1	-	2	3	Sh

Appendix A. Continued					
TAXA	**STA 1 Greenwalk**	**STA 2 Greenwalk**	**STA 3 Jacoby**	**BI**	**FG**
Coleoptera (beetles)					
Psephenus	-	-	4	4	Sc
Stenelmis	-	-	8	5	Sc
Microcylloepus	2	11	-	2	Sc
Diptera (true flies)					
Chironomidae	-	2	19	6	Cg
Simulium	-	-	19	6	Fc
Megaloptera (hellgrammites)					
Corydalus	-	-	2	4	Pr
Amphipod (freshwater shrimp)					
Gammarus	184	210	-	4	Cg
Isopoda (sowbugs)					
Caecidotea	2	-	-	6	Cg
Turbellaria (flatworms)					
Macrostomum	-	-	1	8	Pr
Oligochaeta (earthworms)					
Lumbriculidae	-	1	-	8	Cg
* Cg = collector-gatherer, Sc = scraper, Pr = predator, Fc = filtering collector, Sh = shredder					

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The Watershed at a Glimpse – Pictures of the Greenwalk