

Wallenpaupack Hydroelectric Project, FERC No. 487

Lackawaxen River Fisheries Survey - Temperature Regulation Program



Prepared For:

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Executive Summary

This study was designed to provide data to assess the trout fishery (specifically the abundance and biomass of trout) within the temperature management zone associated with the Federal Energy Regulatory Commission license for the Wallenpaupack Hydroelectric Project (FERC No. 487) on the Lackawaxen River near Hawley, Pennsylvania. Data were collected from two 500-meter sampling stations that were identical to those sampled in previous surveys using wadeable electrofishing gear. The goal was to collect all trout within each station (each represented approximately 5% of the temperature management zone) to determine the total biomass of trout on a single day. This study occurred on September 28, 2017.

The specific goals of the temperature management program are to maintain a trout fishery with a total trout biomass of 30 kilograms per hectare and 3 kilograms per hectare of sub-legal trout within approximate six miles of the Lackawaxen River downstream of the Wallenpaupack Hydroelectric Project. The temperature of the Lackawaxen River can be reduced via controlled releases of cold water through the turbines of the Wallenpaupack powerhouse to create and maintain suitable habitat for trout.

Data from this study suggest that the biomass of trout within this zone are below the program goals; the estimated total biomass of trout at Stations 1 and 2 were 1.79 and 1.17 kilograms per hectare, respectively.

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1.0 Introduction

The Wallenpaupack Hydroelectric Project (Project) is located near the town of Hawley, PA and consists of a dam on Wallenpaupack Creek with a powerhouse that discharges into the Lackawaxen River. Water from the reservoir flows 3.5 miles through one 14-foot pipe to two turbines located in the 44-megawatt powerhouse (Figure 1).

A temperature regulation program exists as part of the Federal Energy Regulatory Commission (FERC) license issued to PPL Holtwood, LLC in 2005. Brookfield Renewable purchased the Project in 2016 and operates under the current FERC license. The goal of this program was to improve the trout fishery within a target zone downstream of the project by regulating the water temperature of the Lackawaxen River such that it met the following criteria, if feasible: 30 kilograms per hectare (kg/ha) of trout within the target zone and 3 kilograms per hectare of sub-legal (<7 inches or 178 millimeter [mm]) per Pennsylvania Fish and Boat Commission (PFBC) regulations) within the target zone.

The temperature of the Lackawaxen River from river mile 10 to river mile 4 can be regulated via controlled release of water from near the bottom of the reservoir through the turbines such that it does not exceed 75 °F, per the temperature regulation program. This can allow for the maintenance of favorable conditions and habitat in this section of river for trout to occupy during the warm months of summer and early fall (June to September) when ambient river temperatures can exceed those which would be favorable for trout.

As part of this FERC licensing agreement, biological monitoring was to be conducted in years 1, 2, 5, 8 (present study), 11, and 14 following the implementation of this temperature regulation program (2009) to provide fisheries data related to the trout fishery in the target zone. Baseline data were collected in 2008, and biological monitoring occurred in 2011, 2013, and 2014. Although sampling was scheduled to occur in 2010 and 2012, high flows in the Lackawaxen River prevented these sampling events. Sampling at both locations was conducted with wadeable (pram) electrofishing methods in 2013 and 2014, but boat electrofishing methods were utilized in 2011 due to high flows in the Lackawaxen River. For the present study, both pram and backpack electrofishing methods were utilized to increase capture efficiency and obtain more accurate results in September, 2017.

This section of the Lackawaxen River is stocked with catchable trout (both Rainbow *Oncorhynchus mykiss* and Brown Trout *Salmo trutta*) by the PFBC annually in the spring and fall, but the fall stocking did not occur prior to this survey. The PFBC also annually stocks fingerling Rainbow Trout in this section of river in the spring. A private group (Blooming Grove Club) also stocks Blooming Grove Creek, which is located near river mile 8.5, annually with trout (Figure 1).

2.0 Methods

2.1 Electrofishing Sampling Locations

Electrofishing sampling was conducted on September 28, 2017. Two sampling stations on the Lackawaxen River were selected (Figure 1) and were identical to those sampled in previous assessments (2013 and 2014). The Project discharges into the Lackawaxen River near river mile 13 and the two sampling locations were downstream of this discharge within the temperature management zone. Station 1 was located near river mile 4 and Station 2 was located near river mile 7 (Figure 1). Both stations were approximately 500 meters (m) long (representing approximately 5% of the temperature management zone per station) and were delineated with a handheld GPS and rangefinder. The width of the stream along each site was estimated using a rangefinder at 50 m intervals to determine the average width of each station.

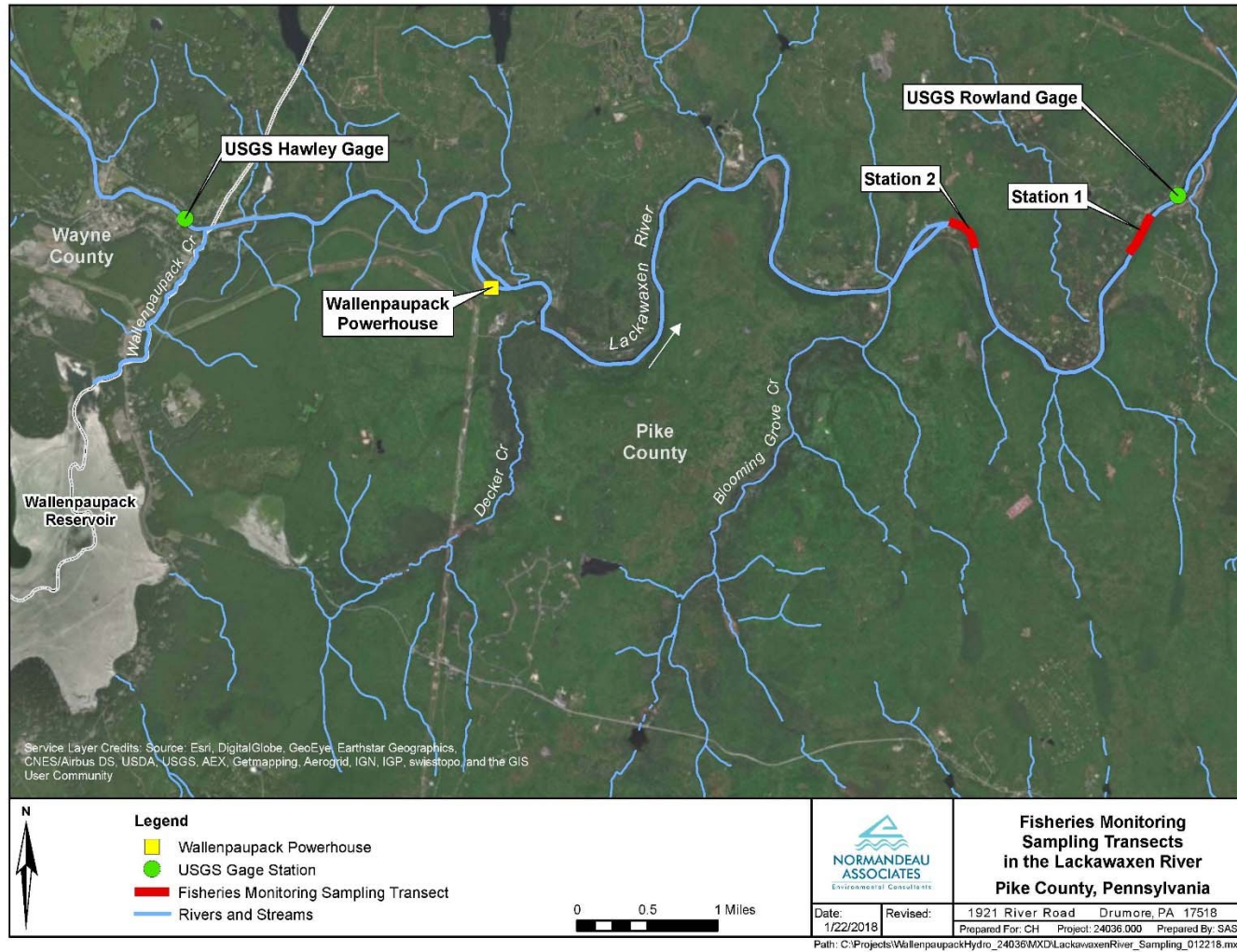


Figure 1: Map showing two electrofishing sampling stations (marked in red), two USGS gages, and the Wallenpaupack powerhouse on the Lackawaxen River, Pennsylvania

2.2 Electrofishing

In an attempt to increase capture efficiency, obtain more accurate results, and avoid the use of an upstream barrier (block net), a total of four pulsed-DC electrofishing units (two pram units and two backpacks; six anodes total) were used. Crews operating the pram units consisted of three members; one to transport the unit and transfer fish to a livewell, and two that each had an independent anode wand and could also net stunned fish. These pram units were operated at approximately 2-5 amps for an output of 230 volts. Crews operating the backpack units consisted of two members; one to operate the electrofisher and collect stunned fish and another to collect stunned fish and transport them to a livewell. These Smith-Root Model 15 backpacks were operated with an output peak of 400 volts at 50 hertz. Live cages were set up along both stations at approximately 50 m intervals; if crowding of fish in a single livewell was a concern, fish were transferred into these live cages.

At both stations, all four electrofishing crews began sampling parallel to one another along the width of the stream to cover as much area as possible (Figure 2). These crews moved upstream together in unison across the entire width of the stream, unless water depths became too deep for wading. The goal was to maintain an electric barrier and increase capture efficiency as crews moved upstream. As crews neared the end of each station, the two backpack crews advanced ahead to the upstream end to create an electric barrier in an attempt to corral any fish remaining within each station.

All trout and gamefish were netted and held in livewells or live cages, and all other fish species were either netted and held for identification or observed and a count was estimated. Each collected trout was measured (total length) and weighted, and visually inspected to determine whether they were hatchery-reared or wild fish, and scales samples were taken and sent to PFBC staff for age analysis. All other game fish were identified and assessed for length. All non-game fish were identified and counted or a visual count was estimated.



Figure 2: Four electrofishing crews working upstream together with two pram units near mid-channel and two backpack units toward the shorelines on the Lackawaxen River, Pennsylvania.

2.3 Water Temperature

Water temperature data were obtained from two USGS gages on the Lackawaxen River. The Hawley Gage (USGS 01431500) is located at the Church Street Bridge in Hawley, PA and is just upstream of the Project influence. Data from this gage were used to assess ambient river temperatures. The Rowland Gage (USGS 01432110) is located near river mile 4 which is near the end of the temperature management zone and was used to assess the temperature management program (Figure 1). The daily maximum water temperature from both gages were used to assess the efficacy of cold water releases from the Project on maintaining water temperatures below 75 °F within the temperature management zone.

3.0 Results

3.1 Station Data

While sampling Station 1, the Lackawaxen River had an average flow of 90.2 cubic feet per second (cfs; Rowland Gage). The total electrofishing time was 102 minutes and the total area of the sampled station was 2.24 hectares. The substrate consisted mainly of boulders (< 256 mm) and cobble (64-256 mm) and nearly void of any substrate less than 64 mm. At the start of the station and in several other areas, deep pools prevented crews from effectively electrofishing the entire width of the stream (Table 1).

The average flow of the Lackawaxen River while sampling Station 2 was 124 cfs (Rowland Gage). The total electrofishing time was 135 minutes and the total area of the sampled station was 2.03 hectares. The substrate at this station was mainly large boulders, and there were several areas along the left bank with deep pools that were inaccessible to electrofishing crews (Table 1).

Table 1: Habitat data of two stations sampled on the Lackawaxen River, Pennsylvania on September 28, 2017.

	Station 1	Station 2
Station Depth (m)	1	1
Sample Depth (m)	1	1
Station Length (m)	508	488
Average Width (m)	44.1	41.6
Area Sampled (hectare)	2.24	2.03
Sample time (min)	102	135
Weather Code	2 (partly cloudy)	2 (partly cloudy)
Air Temperature (°C)	16.7	15.6
Secchi (m)	0.7	0.9
River Flow (cfs)	90.2	124
River Stage (ft)	3.77	3.89
Water Temperature (°C)	21.3	18.4
DO (mg/l)	8.8	7.8
pH	8.1	7.9
Conductivity (µS/cm)	111	112

3.2 Water Temperature

Maximum ambient water temperature (measured by the Hawley Gage) exceeded the 75 °F threshold on 5 days in June, 23 days in July, 10 days in August and 7 days in September for a total of 45 days during this time period (June to September). Water temperatures measured at

the Rowland Gage, which is located downstream of the Project and is used to assess the temperature management program, exceeded the 75 °F threshold on June 11 and 18 for a total of 9 hours during this same time period (Figure 3).

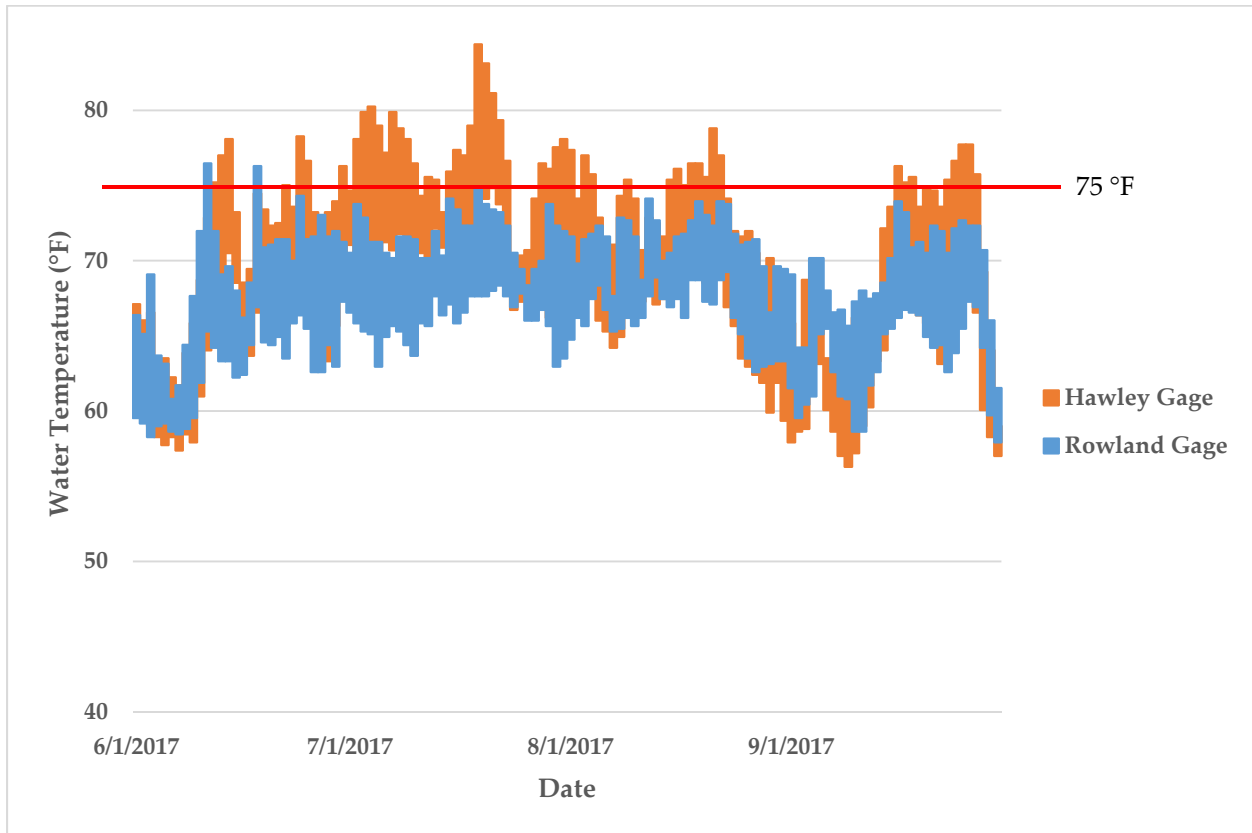


Figure 3: Daily water temperature ranges recorded at the upstream Hawley Gage (ambient) and the downstream Rowland Gage on the Lackawaxen River, Pennsylvania from June-September 2017.

3.3 Fisheries Data

There were 15 species of fish collected and/or observed at Station 1, five of which were game species (Rainbow Trout, Brown Trout, Smallmouth Bass *Micropterus dolomieu*, Rock Bass *Ambloplites rupestris*, and Pumpkinseed *Lepomis gibbosus*). The most abundant game fish collected at this station was Smallmouth Bass. The most abundant species overall was American Eel *Anguilla rostrata* with approximately 1,000 observed, followed by Cutlips Minnow *Exoglossum maxillingua*, and Shield Darter *Percina peltata*.

There were 22 species of fish collected and/or observed at Station 2, nine of which were game species. The most abundant game fish were Smallmouth Bass and Rock Bass, and the most abundant species observed was American Eel followed by the Shield Darter. There were more fish collected overall at Station 2 compared to Station 1 (29 fish versus 104 fish, respectively) as well as substantially more fish observed at Station 2 (Table 2).

Table 2: Number of fish collected or observed at Stations 1 and 2 on the Lackawaxen River, Pennsylvania on September 28, 2017. Catch per unit effort (CPUE) values are reported as the number of fish collected and observed per hour of sampling effort.

Species	Station 1			Station 2		
	Collected	Approximate No. Observed	CPUE	Collected	Approximate No. Observed	CPUE
Rainbow Trout	2	0	1.18	6	2	3.56
Brown Trout	8	0	4.71	4	1	2.22
Walleye	-	-	-	5	0	2.22
Smallmouth Bass	15	1	9.41	39	1	17.78
Black Crappie	-	-	-	1	0	0.44
Rock Bass	3	5	4.71	39	2	18.22
Redbreast Sunfish	-	-	-	7	3	4.44
Green Sunfish	-	-	-	2	1	1.33
Bluegill	-	-	-	0	1	0.44
Pumpkinseed	1	0	0.59	-	-	-
Chain Pickerel	-	-	-	1	1	0.89
American Eel	0	1,000+	-	0	1,500+	-
Cutlips Minnow	5	80+	-	4	180+	-
Blacknose Dace	0	5	-	1	130+	-
Longnose Dace	3	30+	-	2	20+	-
Fallfish	2	30+	-	7	90+	-
White Sucker	0	20+	-	0	170+	-
Northern Hogsucker	0	1	-	0	13	-
Margined Madtom	2	15	-	9	30+	-
Tesselated Darter	1	17	-	1	100+	-
Shield Darter	4	50+	-	6	200+	-
Sea Lamprey (transformed)	-	-	-	0	2	-

3.4 Trout

There were 10 individual trout collected from each station; 2 Rainbow Trout and 8 Brown Trout at Station 1, and 6 Rainbow Trout and 4 Brown Trout at Station 2. There were also three other trout observed at Station 2 that were not captured. None of these fish were sub-legal in size (>7 inches or 178 mm). The CPUE values of trout collected at Stations 1 and 2 were 5.99 and 5.78, respectively (including trout that were observed, Table 2).

Rainbow Trout collected from Station 1 were 360 mm and 368 mm in total length, with respective weights of 510 grams (g) and 555 g. Rainbow Trout from Station 2 ranged from 278 to 367 mm in total length and weights ranged from 230 to 570 g. Brown Trout collected at Station 1 ranged from 257 to 517 mm in length and weights ranged from 210 to 900 g. Brown Trout from Station 2 were 267 to 314 mm in total length, and weights ranged from 190 to 360 g (Table 3).

All of the Rainbow Trout that were captured at both stations were determined to be hatchery-reared fish. Of the eight Rainbow Trout collected, only one had an adipose fin clip. Most of the Brown Trout (9 out of 12) that were collected from both stations were considered wild fish (Table 3). All trout collected from both stations were analyzed for age. The two Rainbow Trout collected at Station 1 were determined to be in the 3+ age class. Of the Brown Trout collected at Station 1, one was classified as 5+, one was 3+, and the remaining six were classified as 2+. All six Rainbow Trout and four Brown Trout collected from Station 2 were classified as age 2+ fish (Table 3).

At Station 1, the biomass estimates of Rainbow and Brown Trout were 0.48 and 1.31 kg/ha, respectively, for a total trout biomass estimate of 1.79 kg/ha. At Station 2, biomass estimates of Rainbow and Brown trout were 1.13 and 0.58 kg/ha, respectively, for a total trout biomass estimate of 1.71 kg/ha.

Table 3: Biological data on trout collected at both stations on the Lackawaxen River, Pennsylvania on September 28, 2017. Trout were visually inspected to determine whether they were hatchery-reared or wild fish.

Species	Station 1				Station 2			
	Length (mm)	Weight (g)	Age (years)	Source	Length (mm)	Weight (g)	Age (years)	Source
Rainbow Trout	368	555	3+	Hatchery	352	380	2+	Hatchery
Rainbow Trout	360	510	3+	Hatchery	346	425	2+	Hatchery
Rainbow Trout	-	-	-	-	367	570	2+	Hatchery
Rainbow Trout	-	-	-	-	295	330	2+	Hatchery
Rainbow Trout	-	-	-	-	318	350	2+	Hatchery
Rainbow Trout	-	-	-	-	278	230	2+	Hatchery ¹
Average	364	532.5			326	380.8		
Brown Trout	517	900	5+	Wild	294	360	2+	Wild
Brown Trout	348	460	3+	Wild	314	337	2+	Wild
Brown Trout	322	350	2+	Wild	267	190	2+	Wild
Brown Trout	283	235	2+	Wild	304	300	2+	Wild
Brown Trout	289	290	2+	Hatchery	-	-	-	-
Brown Trout	257	210	2+	Hatchery	-	-	-	-
Brown Trout	269	215	2+	Wild	-	-	-	-
Brown Trout	303	280	2+	Hatchery	-	-	-	-
Average	323.5	367.5			294.8	296.8		

¹ Adipose fin-clipped

Table 4: Calculated biomass of Rainbow Trout (upper) and Brown Trout (lower) collected from both stations on the Lackawaxen River, Pennsylvania on September 28, 2017.

	Station 1	Station 2	
Station Area (ha)	2.24	2.03	Rainbow Trout
Trout Collected (#)	2	6	
Density (fish/ha)	0.89	2.96	
Trout Average Weight (g)	532.5	380.8	
Biomass (kg/ha)	0.48	1.13	
Station Area (ha)	2.24	2.03	Brown Trout
Trout Collected (#)	8	4	
Density (fish/ha)	3.57	1.97	
Trout Average Weight (g)	367.5	296.8	
Biomass (kg/ha)	1.31	0.58	
Combined Trout Biomass (kg/ha)	1.79	1.71	

4.0 Discussion

The management of the water temperature zone via controlled releases of colder water from the Project appears to be effective at maintaining water temperatures in this zone below 75 °F. While the ambient river temperatures exceeded this threshold fairly often in Hawley from June to September, the threshold was only exceeded twice at the Rowland Gage, which occurred on June 11 and June 18.

The results of this study suggest that the biomass of trout in the temperature management zone fall below the target of 30 kg/ha of trout with 3 kg/ha of sub-legal trout. Previous assessments (Kleinschmidt 2014) showed a steady increase in the biomass of trout from 2011 to 2014, while the results of the present assessment show a reduction in the overall biomass of trout. However, comparing the results from 2011, 2013, and 2014 with this dataset is difficult as the amount of effort and methods have varied (boat electrofishing in 2011; pram electrofishing in 2013 and 2014; backpack electrofishing combined with pram electrofishing in 2017).

There are forage fish present within the temperature management zone, but there are also abundant predatory fish (American Eel, Smallmouth Bass), which may present significant competition and predation for trout throughout their life cycles. The angling pressure is unknown during the year, but two anglers were observed while the sampling crews were at Station 1.

The two stations contained mostly boulders with large cobble but very little smaller substrate for spawning habitat (Figure 4), however, this type of habitat may exist elsewhere within the temperature management zone. This study did not assess the spawning success of trout within the temperature management zone, but there were no juvenile trout collected at either sampling station.

These stations on the Lackawaxen River are difficult to sample with electrofishing gear, as the width of the river exceeds 50 meters in some locations. There are many deep pools with large boulders and other refugia where fish can avoid coming into contact with the electrical field, especially Station 1. These factors could have potentially reduced catch efficiency. Also, Station 1 was sampled in the latter part of the day which resulted in reduced visibility due to higher winds and glare from the setting sun.

These stations can be sampled with boat electrofishing gear when river flows permit, as was done for the 2011 survey. The present study attempted to obtain more accurate results by maintaining an electric barrier as crews moved upstream, however, the river morphology made those attempts difficult. Two-pass depletion electrofishing may provide a more accurate assessment of the biomass of trout in the temperature management zone.

There are numerous environmental conditions that aren't assessed in this study that may affect the growth and reproduction of trout within the temperature management zone. This study only attempted to quantify the prevailing biomass of trout within this zone on a single day. The temperature regulation program has been in place for eight years, and the estimated biomass of trout in this zone has not improved and is currently below 7% of the program goal of 30 kg/ha of trout. This suggests that modifying only the water temperatures within this zone may not be the singular method for achieving such a trout fishery.



Figure 4: Example of substrate present within the sampling stations on the Lackawaxen River, Pennsylvania.

Literature Cited

Kleinschmidt. 2014. Lackawaxen River Fishery Survey, Wallenpaupack Hydroelectric Station, FERC No. 487. Report prepared for PPL.