YEAR ONE (2003) INTERIM REPORT FOR THE WADESVILLE MINE WATER DEMONSTRATION PROJECT

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EXECUTIVE SUMMARY

This interim report presents the first year's (2003) results of the Wadesville Mine Water Demonstration Project. During the Demonstration Project, water pumped from the Wadesville Mine Pool discharged into East Norwegian/Norwegian Creek at Pottsville and flowed into the Schuylkill River for use as consumptive cooling makeup water by Exelon's Limerick Generating Station (LGS) near Pottstown. Since abnormally high ambient flow conditions in the watershed were observed in 2003, the Demonstration Project will be continued in 2004 in order to monitor potential environmental impact during more representative low flow conditions.

The objective of the Demonstration Project is to show that water pumped from the Wadesville Mine Pool can provide an ensured supply of water to the Schuylkill River for consumptive use by LGS, allow a corresponding reduction in the amount of water withdrawn from the Delaware River via the Point Pleasant Diversion, and have no substantial adverse effects.

The Wadesville Mine Pool was identified by Exelon after review of several alternative sources for consumptive cooling makeup water, including reservoirs, quarries, mine waters, and intrabasin or interbasin water transfers. The Wadesville Mine Pool was selected as the water source for the Demonstration Project because no significant capital improvements were necessary; the mine pool water is naturally alkaline, which improves the buffering capacity of the receiving stream; and the mining company (Reading Anthracite Company) would commit resources and contract to supply the water.

The Wadesville Mine Pool essentially is water confined in flooded deep coal mine workings in the state's Southern Anthracite Field. Unlike most mine drainage, which is acidic, Wadesville Mine Pool water contains little acidity, is moderately alkaline, and displays a near-neutral pH.

Reading Anthracite operates deep well pump equipment to lower Wadesville Mine Pool water level to allow surface recovery of coal that otherwise would be submerged. Without pumping, the water would overflow to Mill Creek near St. Clair. However, two vertical turbine pumps installed in the Wadesville mineshaft periodically operate to lower the water surface and can discharge a total of 9,000 to 10,000 gallons per minute to Norwegian Creek at design capacity.

The Demonstration Project was conducted following an Operation and Monitoring Plan approved by the Delaware River Basin Commission (DRBC). This plan, included in this report as Appendix A, provides rules for conducting the Demonstration project, including operational as well as environmental impact monitoring responsibilities. The environmental monitoring focused on water quality and aquatic biological impacts of the Demonstration Project, including reference to baseline monitoring conducted in advance of pumping for the Project.

Several watercourses conveyed water to LGS during the Demonstration Project. East Norwegian/Norwegian Creek and the Schuylkill River conveyed Wadesville Mine Pool water. The East Branch Perkiomen Creek and Perkiomen Creek conveyed Delaware River water via the Point Pleasant Diversion Project, but at reduced volume. In addition, water from Still Creek Reservoir, located near Tamaqua, was conveyed to the Schuylkill River by way of Still Creek and the Little Schuylkill River.

The following environmental monitoring was conducted:

- Wadesville Pool water level, discharge rate, and quality
- East Norwegian Creek and Schuylkill River water quality
- Schuylkill River biological monitoring
- Still Creek Reservoir discharge rate and water quality
- Pottstown Water Treatment Plant intake water quality
- East Branch Perkiomen Creek and Perkiomen Creek water quality

These monitoring efforts consisted of a large suite of parameters performed at differing intervals.

Water was pumped from the Wadesville Mine Pool into East Norwegian/Norwegian Creek from July 11 through October 15, 2003. Daily total volume of water ranged from approximately 2.5 to 11.9 million gallons (MG), with most daily volumes greater than 9 MG. The Wadesville Mine Pool water surface was lowered 86.1 feet through October 7, but it rose rapidly after pumping stopped. A detailed pumping test analysis is present in this report's Appendix B.

Daily measurements of the mine pool water discharged to the receiving stream showed little variation in temperature (range: 13.6 to 15.7° C) and pH (6.6 to 7.19), with greater variation in dissolved oxygen (4.4 to 9.7 mg/l) and specific conductance (638 to 2130 µmhos/cm). Monthly measurements of many other water quality parameters, including NPDES Group 2 metals, were made. No measurements, including those for parameters commonly associated with mine water (iron, manganese, and sulfate) were unusually high. Many measurements, including those for most of the metals, were below laboratory detection limits.

Water quality sampling conducted in East Norwegian Creek and in the Schuylkill River upstream and downstream of the confluence indicated little effect of mixing East Norwegian Creek water with the Schuylkill River. Exceptions include higher downstream measurements of total dissolved solids, specific conductance, total alkalinity, and pH and lower downstream measurements of total and dissolved iron.

Biological resources present in the Schuylkill River upstream and downstream of the Norwegian Creek confluence were monitored approximately monthly from July 1 through October 10. Fish were sampled by electrofishing and benthic macroinvertebrates with a D-frame kicknet. All of the fish samples contained a mixture of warmwater species, with blacknose dace, creek chub, white sucker, and green sunfish most abundant. Small numbers of rainbow, brown, or brook trout were collected downstream – most appeared to be fish previously stocked by the Pennsylvania Fish and Boat Commission. Low numbers of macroinvertebrate taxa were collected at both Schuylkill River locations, and more taxa and more individuals were present downstream than upstream in all collections.

Schuylkill River flow was also augmented by discharges from Still Creek Reservoir during the Demonstration Project. Maximum reservoir drawdown was only 1.1 feet.

Water quality sampling beyond routine monitoring was not required at the Borough of Pottstown's Water Treatment Plant intake because Schuylkill River discharge remained high during the Demonstration Project. Wadesville Pool water did not adversely impact this public water supply.

Monitoring in the Bradshaw Reservoir outfall, East Branch Perkiomen Creek, and Perkiomen Creek along the Delaware River diversion route indicated no adverse impact of reduced water flow from the Point Pleasant Diversion Project during the Demonstration Project.

The first year of the Demonstration Project showed that the Wadesville Mine Pool can be an operationally reliable and environmentally acceptable source of consumptive cooling makeup water for LGS. However, 2003 was a period of unusually high stream flows and no environmental impact data were able to be obtained during normally expected low flow conditions. Therefore, the DRBC authorized an extension to the Demonstration Project to allow it to continue in 2004.

1.0 INTRODUCTION

1.1 Overview of the Demonstration Project

In June 2003, Exelon Generation Company LLC (Exelon) received approval from the Delaware River Basin Commission (DRBC) via a revision to Docket D-69-210 CP (Final) to conduct a demonstration project involving the pumping of water from the Wadesville Mine Pool into the headwaters of the Schuylkill River. The intent of the project was to augment the flow of the Schuylkill River during the yearly season associated with low river flow or high river temperature conditions, and thereby increase the time that Limerick Generating Station (LGS) would be allowed to withdraw consumptive cooling water from the river. This increase in the use of the Schuylkill River for consumptive cooling use at LGS would allow a corresponding reduction in the amount of water diverted for the same purpose from the Delaware River into Perkiomen Creek via the Point Pleasant Pumping Station.

A DRBC-approved Operating and Monitoring Plan was in place to govern the conduct of the demonstration and verify that no environmental harm was being caused as a result of pumping from the Wadesville Mine Pool into the Schuylkill River. The diversion system was maintained in operation during the pumping demonstration, in accordance with the requirements of the approved Operating Plan. In addition, the docket revision allowed for releases from Tamaqua's Still Creek Reservoir (subject to its yield curve limitations) at any time rather than only during emergency conditions.

Initially, the demonstration was scheduled to run over only one (the 2003) pumping season. However, due primarily to abnormally high ambient flow conditions in the watershed which made it difficult if not impossible to definitively determine that no adverse environmental impacts would develop, the demonstration was extended to a second (the 2004) pumping season in order to provide additional assurance that no adverse environmental effects will occur from the use of the mine pool source for augmentation. The first season commenced in July 2003 and was completed in October 2003. This interim report covers the results of the first pumping season.

1.2 Basis for the Project

At full power operation, LGS's per unit consumptive cooling use rates are 17.5 million gallons per day (mgd) average and 21 mgd maximum. This amounts to approximately 24,300 gallons per minute (gpm) average and 29,200 gpm maximum for the two units at LGS. The anticipated mine pool yield was approximately 9,000 to 10,000 gpm, which represents approximately 40 percent of the average consumptive cooling makeup requirement for LGS. The balance of the makeup requirement would be provided from Tamaqua's Still Creek Reservoir and the diversion from the Delaware River. Exelon would operate the mine pool as an underground reservoir with pumping over a 6-month period followed by 6 months of recharge. By using this plan, the pool water would not be mined to depletion.

The primary drivers for identifying one or more additional sources of consumptive cooling makeup were to expand the source water options available to LGS (thus providing increased reliability and operational flexibility), obtain net environmental benefits to the Delaware River Basin, and reduce Exelon's costs associated with the operation and maintenance of the diversion system.

The project is compatible with a Pennsylvania-issued policy that encourages the use of a mine water source for cooling water purposes in the generation of electricity and, as such, was actively supported by the Pennsylvania Department of Environmental Protection (PADEP). The policy is intended to address the problems associated with the release of acid mine drainage from abandoned, inactive, or underutilized coal mines, which has caused severe adverse effects on the water quality and beneficial uses of Pennsylvania's rivers and streams. This pollution limits the ability of the streams to support abundant fish life and recreational activities, and transforms a natural asset into a liability.

1.3 Water Supply Search Rationale

The process of searching for a viable water source within the Schuylkill River Basin began in 2002 and led to Wadesville being selected as the leading candidate. Exelon directed an exhaustive search and screening of potential alternative sources of consumptive cooling makeup water for LGS. The search identified potential water sources that individually or collectively could provide the quantities of water presently supplied by the diversion project. The types of water sources considered included, but were not limited to:

- Existing reservoirs that either appear to have a sizable storage capacity or whose capacity could be increased by capital improvements;
- Existing quarries and quarries whose storage capacity can be increased;
- Siltation basins that could be filled with Schuylkill River water during normal or high-river flow conditions, and released during low flow conditions;
- Mine waters; and
- Other intrabasin or interbasin water transfers.

The search for alternate water sources found that only mine waters were capable of reliably supplying the sizeable quantities of water required. It was reported that approximately 200 billion gallons of water are accumulated in numerous surface and subsurface mine pools in the Anthracite coal mining region. Appropriate agencies were contacted for assistance in obtaining information on the mine pools and mine property owners. Exelon’s consultant identified several mine pools, including Wadesville, located on properties owned by different coal mining companies that currently have stored water or water outflow to local streams feeding the Schuylkill River. Discussions were initiated with the owners about the identified candidate sites. The sites were prioritized with the Wadesville operation identified as the most promising site.

The Wadesville Mine Pool was the most advantageous source of augmentation water for the demonstration project in comparison to other sources considered. Among the reasons that Wadesville was selected were:

- No significant capital improvements were required, which allowed for the demonstration to commence in the upcoming pumping season.
- The mine pool water is naturally high in alkalinity, which improves the buffering capacity of the receiving stream.
- The mining company (Reading Anthracite Company or RAC) was willing to commit resources and enter into a binding contract for the supply of water.

2.0 DESCRIPTION OF THE WADESVILLE MINE SITE

2.1 Project Setting

The productive coal areas in the anthracite region of Pennsylvania are in four distinct fields: Northern, Eastern Middle, Western Middle and Southern. The Southern anthracite field, in which the Wadesville Mine is situated, has an area of about 200 square miles, extending about 70 miles in the east-west direction and 1 to 6 miles wide in Carbon, Schuylkill, Dauphin, and Lebanon Counties from Mauch Chunk (now Jim Thorpe) and the Lehigh River on the east to the Susquehanna River on the west. The Wadesville mining operation is in the Beechwood-Wadesville-Pine Forest Basin of the Southern Middle Anthracite Field in Schuylkill County (near Pottsville), Pennsylvania, and geologically, in the Llewellyn Formation.

The anthracite region has a long history of extensive deep shaft mining since the early 1800s and surface (strip) mining since the 1940s. These past and ongoing mining operations allow surface water to enter the mine workings and accumulate. The water is impounded in underground pools and in abandoned stripping excavations. Barrier pillars separate the mine pools from each other. The impounded water has to be pumped to the surface or overflows by gravity through drainage tunnels or breaches upon reaching an elevation that varies from pool to pool. There are approximately 31 major underground pools in the Southern field, including Wadesville, plus a larger number of surface pools from stripping operations.

2.2 Wadesville Mine Pool Water Quality

Mining operations allow moisture and air to come into contact with sulfur-bearing minerals (iron sulfides, pyrite, and marcasite) that naturally occur in this region. As a result, chemical reactions take place which lead to the formation of sulfuric acid. Most of the water in the deep mine pools becomes highly acidic and, if allowed to drain into surface waters (i.e., becomes acid mine drainage or AMD), becomes an appreciable source of stream pollution. The water in the Wadesville Mine Pool is an exception in that it has a pH in the neutral range (typically 6 to 8) and a moderate level of alkalinity, which made this source of augmentation water ideal in the initial phase of the overall project of identifying several candidate mine pool sources.

Historically, the acidity levels of the water have been negligible [<1 milligrams per liter (mg/l) expressed as calcium carbonate], and the alkalinity levels have been on the order of 300-400 mg/l expressed as calcium carbonate. Specific conductance levels have been on the order of 1,500-1,800 µmhos/cm, sulfate levels on the order of 500-700 mg/l, and water temperatures typically in the range of 55-60°F.

2.3 Wadesville Mine Works History

The deep mine operation at the Wadesville Colliery was discontinued in 1930, and with the cessation of pumping, the mine water level increased to an elevation whereby the overflow discharged into Mill Creek from an abandoned Saint Clair Colliery shaft. In 1949, the now RAC started stripping operations for recovery of coal and installed deep well pump equipment to discharge excess mine water into the Schuylkill River via Norwegian Creek. RAC has continued stripping operations with several interruptions up to the present time period. RAC’s future plans to continue mining at Wadesville are not clearly defined. Without continued pumping, the mine pool elevation would increase until it overflows into Mill Creek. The potential for this overflow is of concern because of development that has occurred in Saint Clair in the vicinity of the overflow site since the last period of overflow.

2.4 Mine Dewatering Facilities

The existing pump house, which is located at the Wadesville vertical borehole shaft approximately ¼-mile from the open pit, contains pumping equipment used for dewatering of the mine to support present-day mining operations. The top of the shaft is at elevation (El) 782 feet above Mean Sea Level (MSL) and its bottom elevation is at 46 feet MSL. The current elevation of the bottom of the pool is at approximately 85 feet MSL. The overflow elevation through an existing pipe at the abandoned Saint Clair shaft is at El 732 feet MSL. A federal government agency estimate of the water volume in the workings in 1953 was 3.4 billion gallons.

Two vertical turbine pumps are presently installed in the Wadesville mineshaft. Prior to the demonstration, the pumps operated periodically to maintain the water level at approximately 450 feet (El 332 feet MSL) below the surface to support active strip mining. The bottoms of the pumps are approximately 500 feet (El 282 feet MSL) below the surface. The pumps are designed to discharge at a rate in the range of 9,000 to 10,000 gpm total, but are currently performing somewhat below the design rate due to needed maintenance on the Peerless Pump which is currently planned for 2004. RAC reports its actual monthly withdrawals from the mine pool to the DRBC on an Annual Water Withdrawal Report.

The discharge path from the pump house to the Schuylkill River is open-channel flow via a dry swale and then to what is locally known as East Norwegian Creek until it reaches the northern end of Pottsville. At this point, a subsurface conduit channels the flow through Pottsville until it daylights on the southern end and immediately discharges to the Schuylkill River.

3.0 THE DEMONSTRATION PROJECT

3.1 Operating Plan

The DRBC and PADEP approved the Demonstration Operation and Monitoring Plan, which was included as Attachment A to Exelon Generating Company, LLC DRBC Docket No. D-69-210 CP, Rev. 11. A copy is provided in Appendix A. The demonstration operating and monitoring plans were designed to take into account the configuration of the Wadesville Mine site and discharge path as described in the previous section of this report.

The operating plan (Part I of the Plan) provides rules for conducting the demonstration of stream flow augmentation by Wadesville Pool and Tamaqua reservoir water. It authorizes a 4 to 6-month demonstration project period during the time when Schuylkill River flow or temperature conditions in the DRBC Docket restrict use of the Schuylkill River for consumptive cooling make-up water for operation of LGS; identifies the responsibilities of Exelon, RAC, and DRBC during the Demonstration Project; and specifies the pumping equipment configuration, evaluation criteria, and reporting schedule.

3.2 Monitoring Plan

The monitoring plan (Part II of the Plan) specifies the parameters to be monitored, the methodologies, the frequency, and locations in order to provide the data necessary to assess the impacts of the mine water and reservoir releases on Norwegian Creek and the Schuylkill River, as well as decreased diversion flows to East Branch Perkiomen Creek and Perkiomen Creek. In short, the monitoring plan was designed to measure water quality and aquatic biological impacts to these water courses, including reference to baseline monitoring performed before demonstration project pumping began.

3.3 Affected Surface Waters

Several watercourses conveyed water to LGS during the Demonstration Project. These include East Norwegian/Norwegian Creek, tributary to the Schuylkill River at Pottsville, and the main stem Schuylkill River. Other surface waters were affected by the Demonstration Project as well. Water from Still Creek Reservoir, a public water supply operated by the Tamaqua Water Authority, was discharged via Still Creek to the Little Schuylkill River, which joins the Schuylkill River at Port Clinton some 15 miles downriver of Pottsville. The East Branch Perkiomen Creek and Perkiomen Creek, components of the Point Pleasant Diversion Project, received reduced amounts of water from Bradshaw Reservoir.

Wadesville Mine Pool water was discharged to a swale that ordinarily would be dry, except when it conveys surface runoff in wet periods. The swale connects to East Norwegian Creek, which mostly flows within a constructed channel to the north part of Pottsville where it enters a long underground conduit. Within this conduit, East Norwegian Creek joins with West Norwegian Creek to form Norwegian Creek, which flows through the conduit to the Schuylkill River in Pottsville (Figure 3.3-1). LGS withdraws cooling water from the Schuylkill River approximately 70 miles downriver of Pottsville.

The East Branch Perkiomen Creek receives water from the Point Pleasant Pumping Station on the Delaware River via the intermediate Bradshaw Reservoir. This water is discharged via pipeline to the headwaters of East Branch and then flows to the Perkiomen Creek. From here, the water continues downstream to the Perkiomen Pumping Station for conveyance by pipeline to LGS. This system for supply of make-up water to LGS is known as the Point Pleasant Diversion Project.

3.4 Monitoring Effort

During operation of the Demonstration Project, the following monitoring was conducted in order to assess any potential environmental impacts:

- Wadesville Pool water level, discharge rate, and quality
- East Norwegian Creek and Schuylkill River water quality
- Schuylkill River biological monitoring
- Still Creek Reservoir discharge rate and water quality
- Pottstown Water Treatment Plant intake water quality
- East Branch Perkiomen Creek and Perkiomen Creek water quality

These programs encompassed measurement of a wide range of parameters at differing frequencies. A description of each program and its results during the demonstration project follow.

3.4.1 Wadesville Pool Water Level, Discharge Rate and Quality

Pumping of Wadesville Pool water into East Norwegian Creek began on July 11, 2003 and continued through October 10. Pumping resumed on October 15, but ended the next day, effectively ending the effort. The daily total volume of water pumped and the resulting change in mine pool water level were measured. In addition, daily measurements of water temperature, dissolved oxygen, pH, and conductivity were made in the discharge outfall near the pumphouse.

The daily total volume of water pumped from the mine pool ranged from 2.48 to 11.85 million gallons (Table 3.4-1 and Figure 3.4-1). From July 12 through September 5, most daily volumes exceeded 9 million gallons. After September 5, daily volumes pumped began to decrease to the end of the demonstration period. The pumping lowered the mine pool water level through October 7, nearly the entire period, for a distance of 86.1 feet (Table 3.4-1 and Figure 3.4-1). The mine pool reached its lowest point on October 7 at 490.1 feet below the level of the pump platform at the surface of the mine shaft. Some recovery of pool elevation was observed toward the end of the demonstration pumping period between October 8 to 10 when a relatively low volume of water is being pumped from the mine pool. Thereafter, while pumping was suspended, recovery occurred rather quickly to 475.3 feet on October 16 and 453 feet on October 28 when RAC resumed pumping in order to continue mining activities. A detailed pumping test analysis is presented in Appendix B of this report.

Temperature of the mine pool water varied little, ranging from 13.6 to 15.7°C (Table 3.4-1 and Figure 3.4-2). Dissolved oxygen ranged from 4.4 to 9.7 mg/l, with most measurements exceeding 7.0 mg/l from July 11 through September 13 (Table 3.4-1 and Figure 3.4-2). After September 13, most measurements were less than 6.0 mg/l. It is important to note that the oxygen readings were taken in the energy dissipater immediately after the water daylights from the pump discharge pipe. This reduction in oxygen levels appears to be related to operation of the Peerless pump in that it was out of service most of the time after mid-September. Furthermore, the Peerless pump was subsequently inspected and holes were found in the discharge piping that could have yielded some aeration of the water in the mine shaft while the pump was in service.

The pH varied in the narrow range 6.6 to 7.19, with 5.72 considered to be a spurious value (Table 3.4-1 and Figure 3.4-3). Specific conductance varied in the range 638 to 2130 µmhos/cm and decreased from higher values at the beginning of the Demonstration Project until approximately August 3 (Table 3.4-1 and Figure 3.4-3). After this date, most measurements were in the range 1300 to 1500 µmhos/cm.

Monthly measurements of many other water quality parameters; including NPDES Group 2 metals, total organic carbon, and several inorganic constituents; were made during the demonstration. Although most water samples were collected in the pump discharge, the last sample (October 21) was collected from the Wadesville Pool 600 feet below the pump platform. The objective was to characterize water quality in the pool at a depth approximately 100 feet below the depth of the pump intakes during the 2003 test period in the event that the pump intakes were subsequently lowered in order to optimize use of the mine pool water. This distance (600 feet) corresponds to a point 196 feet below the pool water surface on July 11, the first day of pumping in 2003.

In general, Wadesville Pool water was neutral in pH with low acidity and relatively high alkalinity and was relatively hard and nutrient-free (Tables 3.4-2 to 3.4-4). Note that when a discharge from an area disturbed by mining activity without chemical or biological treatment has a pH greater than 6.0 and a total iron concentration of less than 10.0 mg/l, as is the case with Wadesville, the PADEP manganese limitations (2.0 mg/l 30-day average and 4.0 mg/l daily maximum) do not apply [ref. 25 PA Code §88.9(c)(2)]. Measurements of the parameters commonly associated with mine water (iron, manganese, and sulfate) were not unusually high. Many of the water quality measurements, including most of the metals, were below laboratory detection limits. In addition, measurements made at depth in Wadesville Pool on October 21 were very similar to those made in the pumped discharge on October 10.

3.4.2 <u>East Norwegian Creek and Schuylkill River Water Quality</u>

Limited water quality sampling was conducted in East Norwegian Creek and in the Schuylkill River upstream and downstream of the confluence, coincident with Schuylkill River biological monitoring (see 3.4.3 – Schuylkill River Biological Monitoring). Mixing East Norwegian Creek water with the Schuylkill River seemed to have little effect downstream of the confluence (Table 3.4-5 and Figure 3.4-4). Exceptions include total dissolved solids, specific conductance, total alkalinity, and pH, which were higher downstream, and total and dissolved iron, which were lower downstream.

Daily water temperature measurements were recorded using Onset StowAway Tidbit temperature loggers in East Norwegian Creek and in the Schuylkill River at the same locations where water quality sampling was conducted and where Schuylkill River biological monitoring was conducted (see 3.4.3 Schuylkill River Biological Monitoring). In addition, a temperature logger was placed in the Little Schuylkill River at the PA Route 309 bridge, 1.3 miles north of Tamaqua.

Mean daily water temperature in East Norwegian Creek was equal to or only slightly lower (maximum of 3°F on two dates) than that of the Schuylkill River at Station 107 upstream of the confluence from July 31 through to September 6 (Table 3.4-6 and Figure 3.4-5). After this latter date, the relationship began to reverse and occasional temperature measurements in the Schuylkill River downstream were a degree or two lower than in East Norwegian Creek until September 29, when they were consistently lower through the end of the demonstration project.

Unfortunately, the temperature logger placed at Station 109 in the Schuylkill River approximately 3 miles downstream of the Norwegian Creek confluence malfunctioned from August 22 through September 30. However, the record from July 31 through August 21 indicated that the slightly cooler Norwegian Creek did not reduce the temperature of the Schuylkill River downstream of the confluence from the temperature observed upstream. In fact, the Schuylkill River was consistently warmer downstream during this 22-day period. This relationship of warmer water in the Schuylkill River downstream of the confluence as compared to upstream continued from October 1 through the end of the Demonstration Project.

Water temperature in the Little Schuylkill River was consistently higher, occasionally as much as 12°F higher, than Schuylkill River temperature measured at either location until October 4. After this date, water temperature was equal in both rivers or slightly lower in the Little Schuylkill River.

3.4.3 Schuylkill River Biological Monitoring

Schuylkill River biological monitoring began on July 1, 2003, ten days before Wadesville Pool pumping was initiated, in order to characterize the resident fish and benthic macroinvertebrate communities before any potential impact. The sampling was repeated three times (July 30, August 21, and October 10) during the operational period in order to detect any potential impact. Sampling was not preformed in September due to excessively high Schuylkill River flows during most of the month.

The biological monitoring consisted of sampling fish and benthic macroinvertebrates (aquatic insects and other organisms that live on or in the river bottom) present at single locations in the Schuylkill River upstream and downstream of the Norwegian Creek confluence. On July 1, the samples were collected at Station 107, located immediately upstream of the Norwegian confluence, and at Station 109, located approximately 3 miles downstream of the confluence. During the next three rounds of sampling, Station 107 was abandoned in favor of Station 106, located approximately 0.5 mile upstream of the confluence. This action allowed avoidance of a large stormwater outfall located in the middle of Station 107 and agreed with the sampling location preferred by the Pennsylvania Fish and Boat Commission. Sampling continued at Station 109 throughout the biological monitoring program. Stations 106 and 109 are part of the array of Schuylkill River locations previously sampled by the Pennsylvania Fish and Boat Commission.

Consistent methods were used in the biological monitoring in order to aid in evaluation of the data. Fish were captured by electrofishing in approximately equal lengths of river at both stations. Captured fish were identified, counted, their total length measured, and released live to the river. Benthic macroinvertebrates were sampled by composited collection of single 15-second kick samples in two fast water velocity riffles and two slower water velocity riffle/runs using a D-frame kicknet. The macroinvertebrate samples were preserved with isopropanol for transport to the laboratory where all macroinvertebrates were sorted from sample residue, identified, and counted. Both the fish and benthic macroinvertebrate sampling methods are standard procedures in aquatic biological investigations.

The results of fish sampling are shown in Table 3.4-7 and selected data appear in Figure 3.4-6. With exception of small numbers of trout collected at Station 109 downstream of the Norwegian Creek confluence, all of the fish samples were a mixture of commonly occurring warmwater species with blacknose dace, creek chub, white sucker, and green sunfish most abundant. More species were collected downstream than upstream, largely due to the presence of several trout species at the former location. Conversely, more individuals were collected upstream than downstream.

Small numbers of rainbow, brown, or brook trout were collected downstream on each sampling date. Most of these trout appeared to be fish previously stocked nearby in the Schuylkill River by the Pennsylvania Fish and Boat Commission.

Operation of the demonstration project did not appear to negatively affect the fish community downstream of the Norwegian Creek confluence. There was little difference in species composition and in identity of the most abundant species between the pre-operational period sample collected on July 1 and those samples collected during the operational period. However, although the total numbers of fish collected at both stations increased from July 1 to July 30 and remained relatively constant at the upstream station throughout the rest of the operational period, fewer total fish were collected after July 30 at the downstream station. This reduction in numbers of fish collected at the downstream station is not considered significant because of the variability inherent in the fish species that were most abundant at this station.

The results of the benthic macroinvertebrate sampling are shown in Table 3.4-8 and selected data appear in Figure 3.4-6. Preoperational period samples collected at both stations on July 1 contained very few macroinvertebrates in only a few taxa. However, greater numbers of individuals and taxa were collected in the operational period samples at both stations.

More macroinvertebrates and more taxa consistently were collected downstream than upstream of the East Norwegian Creek confluence. This differential was most pronounced in the numbers of individuals collected.

Taxonomic composition was limited at both stations, but particularly so upstream where relatively few aquatic insect taxa were collected. Of the taxa considered intolerant of environmental disturbance, no mayflies (Ephemeroptera) and only a few individuals of one stonefly (Plecoptera) taxon and two caddisfly (Trichoptera) taxa were collected upstream. Although mayfly and stonefly taxa and numbers were quite low downstream, also, four caddisfly taxa were collected at this location, two (*Cheumatopsyche* and *Hydropsyche*) in relative abundance.

Other macroinvertebrate taxa present at one or both stations included such crustaceans as crayfish (Decapoda), scuds (Amphipoda), and sowbugs (Isopoda) in addition to several groups of worms (Hirudinea, Nematoda, Nemertea, and Oligochaeta). Perhaps noteworthy are the sowbug *Caecidotea* and the oligochaete worms Lumbricidae and Tubificidae, which were present in greatest numbers downstream. These taxa utilize fine particulate organic matter as a food resource and their presence in relative abundance often indicates organic pollutant input to the waterbody.

Mine water pumping did not appear to negatively affect the benthic macroinvertebrate community downstream of the Norwegian Creek confluence. In fact, it may have stimulated this community, noting that many more macroinvertebrate taxa and individuals were collected during the operational period than immediately before it. This enhanced macroinvertebrate community translates to a more abundant food resource for fish.

3.4.4 Still Creek Reservoir Discharge Rate and Water Quality

Discharges from Still Creek Reservoir were used as an augmentation of Schuylkill River water volume, not for water quality enhancement or TDS management. During the demonstration project, daily discharge usually was approximately 8 million gallons (MG) until September 18 when it was reduced to 1.9 MG (Table 3.4-9). Beginning the next day and continuing through October 2, daily discharge was in the range 12.8 to 16.8 MG.

Water discharge from the reservoir had little effect on its water level. Through the entire Demonstration Project, water surface elevation fluctuated a total of only 1.1 feet. Weekly measurements of dissolved oxygen in Still Creek below the reservoir ranged from 6.9 to 9.6 mg/l.

3.4.5 Pottstown Water Treatment Plant Intake Water Quality

Personnel at the Borough of Pottstown's Water Treatment Plant measure pH of Schuylkill River intake water at 2-hour intervals each day. Through the Demonstration Project, intake water pH ranged from 7.0 to 8.2, with the greatest daily range (7.3 to 8.0) observed on August 1 (Table 3.4-10). They also make occasional measurements of intake water specific conductance. Values for this parameter ranged from 170 to 440 µmhos/cm, most of which were in the 300s.

Sampling of additional parameters (i.e., total dissolved solids, iron, manganese, total organic carbon and sulfides) was to take place at the Pottstown water intake once river flows at the U.S. Geological Survey Pottstown gage decreased below 840 cfs. The purpose of the this sampling was to assure that Water Treatment Plant personnel were informed about water quality trends that could result in increased treatment costs or potentially cause a violation of drinking water quality limits. However, Schuylkill River flows did not reach the trigger level for increased monitoring during the 2003 demonstration period. Pottstown was not required to make any changes to public water supply treatment as a result of the implementation of the demonstration project in 2003.

3.4.6 East Branch Perkiomen Creek and Perkiomen Creek Water Quality

Measurements of selected water quality parameters were made in the outfall from Bradshaw Reservoir as well as at three locations in East Branch Perkiomen Creek. The frequency was five times per month immediately before and during the Demonstration Project. Coliforms, both *E coli* and fecal coliforms, were much higher in the East Branch upstream of the Bradshaw Reservoir outfall, compared to downstream (Table 3.4-11). The well-oxygenated outfall water increased dissolved oxygen levels downstream relative to ambient upstream concentrations.

Monthly water quality measurements made in Perkiomen Creek upstream and downstream of the East Branch Perkiomen Creek confluence indicated little difference in the measured parameters between these locations. The relatively high measurements of *E. coli* and fecal coliforms on August 12 at both Perkiomen Creek locations were much higher than observed in the lower East Branch Perkiomen Creek on this date (Table 3.4-11).

Flows from Bradshaw Reservoir were reduced to approximately 27 cfs, or about half the normal discharge rate, during the demonstration period (Figure 3.4-7). The flows in the upper East Branch Perkiomen Creek as monitored by the USGS Dublin gage closely reflect the discharge rate from Bradshaw Reservoir except during precipitation events. We are not aware of any negative effects due to flow reduction.

3.4.7 Schuylkill River Discharge and Local Rainfall

Daily mean discharge of the Schuylkill River is measured by the U.S. Geological Survey at Landingville, Berne, Reading, and Pottstown. These gages are located between the Norwegian Creek confluence and the LGS. In addition, rainfall also is measured at Landingville. Data for these locations are presented in Table 3.4-13. The hydrographs for the Schuylkill River at Landingville (gage located nearest to the Norwegian Creek confluence) and at Pottstown (Figure 3.4-7) document the periods of high river discharge in mid-July, early August, and in much of September. The mean monthly flows (provisional data, in cfs) for July – October 2003 as compared to the monthly averages for the period of record through 2001 at the Landingville and Pottstown gages illustrates the relatively high stream flows experienced during the demonstration period:

Mean Monthly Flow (cfs) of the Schuylkill River

	LANDINGVILLE GAGE		POTTSTOWN GAGE	
MONTH	2003	Period of Record	2003	Period of Record
July	285	170	2356	1243
August	389	133	1967	1030
September	377	153	3349	1064
October	419	176	2764	1136

4.0 STAKEHOLDER COORDINATION

Once a decision was reached that utilization of Wadesville Mine Pool water appeared to be technically, economically, and environmentally feasible, Exelon initiated meetings with numerous governmental and non-governmental stakeholders to explain the mine water project, obtain specific feedback about their concerns, and establish communication pathways. Representatives of the following organizations, as well as interested individuals, participated in one or more informational meetings:

- Pennsylvania Department of Environmental Protection, Bureau of District Mining Operations, Pottsville District Office
- Pennsylvania Department of Environmental Protection, Harrisburg Central Office and Southeast Regional Office
- Pennsylvania Fish and Boat Commission
- Delaware River Basin Commission
- Philadelphia Water Department
- Pottstown Water Department
- Pennsylvania – American Water Company
- Philadelphia Suburban Water Company
- Schuylkill Headwaters Association
- Perkiomen Watershed Conservancy
- Delaware Riverkeeper Network
- Pottsville and Pottstown boroughs
- Numerous Elected Political Representatives

5.0 CONCLUSIONS

In the first year of the Wadesville Mine Water Demonstration Project, the pumped mine pool water was used to augment the flow of the Schuylkill River for consumptive use at LGS from July 11 to October 15. The daily total volume of water pumped varied from approximately 2.5 to 11.9 MG; most daily volumes exceeded 9 MG. Daily pumping lowered the mine pool water level 86.1 feet through October 7. Recovery of the water level took place rapidly after pumping ceased.

Water quality of the Wadesville Pool discharge raised no cause for concern. Acidity was low, alkalinity was relatively high, and the water was relatively hard and nutrient-free. Wadesville Pool mine drainage contaminants (iron, manganese, and sulfate) were not unusually high. Many water quality parameters, including most of the metals, were below laboratory detection limits. No measurements were unusually high and temporal variation in parameter concentrations was minor. Wadesville Pool water quality at approximately 100 feet below the existing pump depth was consistent with the pumped discharge.

Mine water discharged to the Schuylkill River had little effect on water quality. Total dissolved solids, specific conductance, total alkalinity, and pH were somewhat higher downstream, while total and dissolved iron concentrations were lower downstream.

Biological monitoring in the Schuylkill River showed that the mine water discharge did not negatively affect biota living downstream of the Norwegian Creek confluence.

During the demonstration period, additional make-up water for LGS was discharged from Still Creek Reservoir near Tamaqua. Releases were made for volume augmentation, not for water quality enhancement or TDS management. Maximum drawdown of the reservoir was only 1.1 feet.

Additional protective monitoring of influent water quality was not required at the Borough of Pottstown's Water Treatment Plant. Mine water discharge did not adversely impact this public water supply.

The flexibility of sources afforded by the Docket and Operating Plan allowed for consistent Water Diversion System and East Branch Perkiomen Creek flows during the implementation of the Demonstration in 2003. No negative effects of reduced diversion flow in 2003 were identified.

In summary, the first year of the demonstration project has shown that the Wadesville Mine Pool has the potential to be a viable and environmentally acceptable source of a significant quantity of consumptive cooling water for LGS. However, unusually high stream flows occurred during 2003 and the project was not able to demonstrate the efficacy of the mine pool withdrawal and flow augmentation approach under low stream flow conditions. Due to the high degree of public interest in the mine pool project and to ensure that low stream flow conditions are evaluated in the project, the DRBC authorized an extension of Docket No. D-69-210 CP (Revision 11) to allow a second demonstration period to take place in 2004.

Appendix A - Demonstration Operation Plan & Monitoring Plan For the Wadesville Mine Pool Withdrawal & Stream Flow Augmentation Project

Exelon Generating Company, LLP
DRBC Docket No. D-69-210 CP (Final) Revision 11

I. Demonstration Operation Plan

1.0 INTRODUCTION

Exelon will implement a Demonstration Operating Plan that includes a stream flow augmentation strategy that is coordinated with a data collection and analysis program. The plan will enable the applicant to control and account for the amount of minepool water and Tamaqua water to be released.

1.1 Demonstration Project Description

The demonstration will occur over a four to six month period during the remainder of the 2003 season associated with flow and temperature restrictions on the use of Schuylkill River water for consumptive cooling use for LGS.

During the demonstration period while Schuylkill River flow and temperature restrictions are in effect, Exelon will make withdrawals of consumptive cooling makeup water for LGS in this order:

- Withdrawals from the Schuylkill River equivalent to the pumping rate from the Wadesville Mine Pool.
- Withdrawals from the Schuylkill River equivalent to releases from Tamaqua reservoirs subject to yield limitations established for Tamaqua.
- Withdrawals from the Perkiomen Creek subject to sufficient natural creek flow.
- Withdrawals from the Perkiomen Creek augmented by withdrawals from the Delaware River via the diversion project.

Exelon will retain Reading Anthracite Company (RAC), the current owner of the property that includes the Wadesville Mine, to provide operation and maintenance services for the Wadesville pumping and conveyance system. When required, RAC will operate the system in support of the pumping demonstration at a flow rate of up to 10,000 gpm, which represents approximately 40 percent of the average consumptive makeup requirement for LGS.

When Schuylkill River flow or temperature conditions are approaching the limits at which restrictions will be in effect (or if flow or temperature restrictions are already in place at the beginning of the demonstration), pumping from the Wadesville Mine Pool will begin.

When computing the recognized augmentation, LGS will use:

- The actual pumping volumes available from Wadesville;
- A 4 day time allowance for the water to travel from the mine pool to the LGS intake;
- A 3 percent allowance for losses during transit; and
- 2 days of consumptive cooling withdrawals at LGS from mine water augmentation after mine pumping stops at the end of the season.

Flow augmentation will be continuous until the end of the season except for periods when the Schuylkill River is not restricted. At the end of the season, pumping from the mine pool will be discontinued to allow the mine pool water to recover (via recharge from natural precipitation that infiltrates into the mine pool) to an elevation just below where active mining is taking place.

1.2 Responsibilities

The following responsibilities are established for the conduct of this demonstration.

Exelon

Overall management and control of the pumping demonstration.

Specifying flow monitoring equipment.

Specifying, providing, and installing level and water quality monitoring equipment.

Collecting USGS data on local rainfall and Schuylkill River flow.

Biological monitoring and associated water quality monitoring.

Preparing and filing a preliminary and final demonstration report.

Initiating and terminating the demonstration test pumping operations at Wadesville during the pumping season.

Operating in accordance with its LGS Makeup Water System Operating Plan for the duration of demonstration period subject to the provisions of the approved revised docket as reflected in this document, which include the use of Wadesville mine pool water and other changes (e.g., expanded use of Tamaqua).

During the Demonstration Project, Exelon shall arrange to meet with interested parties and stakeholders identified during the DRBC Public Hearing of June 26, 2003, to provide data and findings and accept comments for consideration in future Operating Plan revisions.

Providing monitoring data to DRBC weekly.

Reading Anthracite Company

Procuring and installing flow monitoring equipment.

Operation, inspection, and maintenance of the pumping system and monitoring equipment installed at the Wadesville Mine.

Inspection and maintenance of the discharge channel.

Notifying LGS when conditions occur that have affected or can potentially affect pumping or monitoring (flooding, repairs, etc.).

Monitoring of the Wadesville discharge in accordance with its existing NPDES permit.

Reporting in accordance with current DRBC requirements.

Notifying Exelon of regulatory actions, citizen complaints, water quality issues (e.g., strong odor in discharge).

Collecting water samples as required, arranging for sample analyses, and reporting analytical results.

DRBC

Reviewing, evaluating, and distributing monitoring data.

Developing water quality values relative to flow conditions; establishing appropriate monitoring parameters and operating plan conditions for the augmentation with mine pool water.

1.3 Equipment Configuration

The Wadesville Mine shaft is the conduit through which water from the mine pool will be withdrawn. The top of the mine shaft is at approximately elevation 782 feet mean sea level (MSL) and its bottom elevation is at 46 feet MSL. A pump house at the shaft contains the equipment necessary for mine pool dewatering to support the demonstration and coal mining operations.

Two vertical turbine pumps are presently installed in the shaft with the casings at approximately 500 feet below the surface (at elevation 282 feet MSL). The pumps are rated to discharge at a rate in the range of 9,000 to 10,000 gpm total. Two discharge pipes (one from each pump) emerge from the mine shaft and run separately through pump house wall penetrations into a concrete energy dissipation chamber located adjacent to the pump house.

The discharge path from the chamber to the Schuylkill River consists of, in order:

- Metal and concrete sluiceways leading to a dry swale to East Norwegian Creek.
- East and West Norwegian Creeks combining into Norwegian Creek, running to the northern end of Pottsville.
- An underground conduit channeling the flow through Pottsville until it daylights on the southern end of the borough and discharges into the Schuylkill River (East Branch).

To measure the rate of discharge flow and record total gallons pumped, RAC initially may utilize its existing method, which provides the basis for past reporting of withdrawals to the DRBC. To take daily measurements of the water level in the mine shaft, RAC initially may utilize its existing float and line method. RAC will utilize an alternate equivalent method to be specified and provided by Exelon for level measurements for the balance of the demonstration. RAC will procure and install new open-channel flow metering specified by Exelon for use during the balance of the demonstration.

2.0 PLAN OF OPERATION

2.1 Prerequisites

Prior to beginning of the Demonstration, these two prerequisites must be satisfied:

- Exelon has started to implement the monitoring specified in the Monitoring Plan (Attachment A) as required.
- Exelon has provided DRBC with at least 24-hour prior notification of the intended start of the Demonstration.

2.2 Pumping and Monitoring

RAC is subject to monitoring and reporting requirements of its applicable NPDES permit and reporting of discharge quantities to the DRBC on its Annual Water Withdrawal Report.

Prior to the start of pumping at Wadesville, in support of the demonstration project, Exelon will verify that the prerequisites contained in Section 2.1 are satisfied.

2.2.1 Initiation of Pumping

When Schuylkill River flow or temperature conditions are approaching the limits at which restrictions will be in effect (or if flow or temperature restrictions are already in place at the time of startup), LGS will notify RAC to start both pumps and maintain a steady discharge flow at the maximum rate achievable, but no higher than 10,000 gpm. RAC will report to LGS the date and time of starting of the pumps, and the steady-state discharge flow rate achieved.

RAC will collect water samples for analysis of parameters specified in the Monitoring Plan (Appendix A) to be monitored at startup. Exelon will compile the monitoring data for submittal to the DRBC within one week after receipt of analytical results.

2.2.2 During Pumping Demonstration

During the pumping demonstration, LGS will operate in accordance with its existing approved Operating Plan subject to the provisions of the approved revised docket as reflected in this document, which include the use of mine pool water and other changes (e.g., expanded use of Tamaqua).

Normally, RAC will continue pumping for the duration of the demonstration period for 24-hour per day, 7-days per week operation with the discharge flow at the specified demonstration pumping rate (9,000-10,000 gpm). RAC will be responsible to perform preventive and corrective maintenance to maximize reliable pumping system operation.

If Schuylkill River flow and temperature restrictions are not in effect for any period during the pumping season, then LGS may elect to reduce or suspend pumping from the mine pool.

Monitoring of parameters and conditions will be performed throughout the pumping demonstration period in accordance with the Monitoring Plan. Exelon will compile the monitoring data and submit to the DRBC within one week after receipt of analytical results.

LGS will allow for:

- A 4 day travel time for the water augmentation to reach its intake structure at the Schuylkill River Pump House; and
- A 3 percent in-transit loss in the flow quantity.
- 2 days of consumptive cooling withdrawals at LGS from mine water augmentation after mine pumping stops at the end of the season.

LGS may then increase its makeup water pumping rate from the Schuylkill River to include the time and loss-adjusted mine water augmentation flow for consumptive cooling.

At any time from DRBC's approval of this Demonstration Plan, LGS may elect to request releases from Tamaqua, subject to established yield limitations on the Tamaqua reservoirs. The Schuylkill River augmentation from the Tamaqua source would be additive to that from Wadesville. Tamaqua will report to LGS the quantity of its daily releases made on behalf of LGS. During the demonstration, monitoring requirements for Tamaqua releases will be in accordance with the Monitoring Plan associated with this demonstration Operating Plan.

For the balance of its consumptive cooling needs, LGS will withdraw water from Perkiomen Creek, augmented if necessary by water from the diversion project, and collect daily data on withdrawals in accordance with the existing LGS Operating Plan.

LGS will collect data of its consumptive water use as well as releases from each source. LGS will tally and average the data over a calendar month. Overages of water from the combined consumptive cooling makeup sources will be carried over into the next calendar month and adjustments made in the releases as appropriate.

Off-normal conditions will trigger certain actions as detailed in Section 2.3.

If, at any time during the demonstration period, the DRBC requires Exelon to shut down pumping from the mine pool, DRBC will contact:

- (during normal business hours and non-emergency conditions) Craig Wyler, LGS Makeup Water System Manager (phone number provided to DRBC)
- (during non-business hours and emergency conditions) the LGS Control Room Supervisor (phone number provided to DRBC)

The above LGS personnel will be responsible to notify RAC of the required shutdown.

The following agencies have authority to contact the LGS Control Room Supervisor and temporarily suspend pumping operations at Wadesville:

- PADEP Pottstown Mining Office
- PADEP Harrisburg
- PADEP Wilkes-Barre
- PADEP Conshohocken
- Pottstown Water Department
- Philadelphia Water Department
- DRBC

The DRBC will authorize resumption of pumping operations.

2.2.3 Termination of Pumping

When seasonal flow augmentation requirements have been completed, LGS will notify RAC to shut down both pumps, which will allow the water table in the mine pool to recover.

2.3 Off-Normal Conditions and Required Actions

In the event that any of the conditions identified below occur, Exelon will require that the action associated with each condition be performed. If needed, DRBC will develop additional conditions after the first two weeks of monitoring data is analyzed. These conditions may include trigger values that could require modifications to monitoring and/or mine water augmentation.

Condition 1: Pumping from the mine pool is interrupted or significantly reduced (e.g., one pump off or low water level).

Action 1: RAC will notify LGS and perform corrective maintenance as necessary. LGS will notify the DRBC (during the next business day if condition occurs after normal working hours) and make adjustments to the consumptive cooling makeup flow from Perkiomen Creek or Tamaqua as required by the LGS Operating Plan during the time lag period when the water from the mine pool is in transit. Exelon will report pumping outages of less than a 12-hour duration weekly to the DRBC.

Condition 2: Monitoring results indicate significant water quality or related issues.

Action 2: Exelon will notify DRBC in a timely manner and recommend specific actions depending on the nature of the issue.

Condition 3: Adverse effects are identified by the public.

Action 3: Upon notification, Exelon will notify DRBC in a timely manner and recommend specific actions depending on the nature of the conditions.

3.0 RESTORATION PERIOD

3.1 Monitoring

Collection of data after termination of pumping will be limited to water levels in the mine shaft and rainfall data.

RAC will continue with monitoring of mine pool level, and may resume pumping after the pool recovers to pre-demonstration levels, as necessary to support active mining.

3.2 Evaluation Criteria

The following criteria will be used to evaluate the demonstration of the capability to augment Schuylkill River flow with water contained in the Wadesville Mine pool and Tamaqua reservoirs:

- Water quality is maintained to the satisfaction of the DEP and DRBC.
- Mine pool and reservoir water elevations are managed within a satisfactory range.
- During flow and temperature restrictions in the Schuylkill River, LGS demonstrates operational flexibility to use the various augmentation sources.
- If any adverse effects of the demonstration are identified, means to mitigate the effects have been identified.

3.3 Evaluation and Reporting

Exelon will file a draft report with DRBC presenting and discussing the results of the Demonstration by February 29, 2004, and a final report by April 30, 2004.

II. Demonstration Monitoring Plan

This monitoring plan will provide the data necessary to assess the impacts of this project to the water resources related environment of the Schuylkill River, the East Branch Perkiomen Creek, Perkiomen Creek, and Norwegian Creek as required by the above-referenced docket. The flow augmentation project involves withdrawal of up to 10,000 gpm from the Wadesville Mine pool for discharge to the Schuylkill River Basin in order to provide consumptive loss makeup and thermal impact control at the Limerick Generating Station. This plan is based on direction obtained during an inter-agency/applicant meeting held on June 9, 2003 and the DRBC meeting on June 26, 2003.

The parameters to be monitored, the frequency at which they will be evaluated, and the locations at which the monitoring will be conducted are provided below. After two weeks of baseline monitoring, the DRBC may review and adjust this monitoring plan to reflect monitoring results. Additionally, the DRBC may develop trigger levels for additional monitoring and/or modification of pumping. These changes will be added to the Demonstration Operating Plan.

Parameters	**Frequency***	**Locations****
TDS	Wkly (1st Month), Monthly (thereafter)	1
TDS	Monthly (Wkly when flow at Pottstown gage < 560 CFS)	4
Conductivity, Temp., pH, Dissolved Oxygen	Daily or In Accordance with Early Warning System	1
Conductivity, Temp., pH, Dissolved Oxygen	As provided by PA American or if available from the Early Warning System	4
Flow	Daily	1,2
Stream Flow	Daily	Four USGS gage stations
Temperature	Daily, Continuous in Still Creek below Reservoir	1,2
Rainfall	Daily	Pottsville USGS gage
Dissolved Oxygen	At startup, Monthly (prior to entering E. Norwegian Creek)	1
Dissolved Oxygen	Weekly during times of use , Still Creek below Reservoir	2
Reservoir Level	Daily, during times of use	2
TOC	At startup, Monthly	1
Anions***	At startup, Monthly	1
Parameters	**Frequency***	
Cations****	At startup, Monthly	1
Acidity	Monthly	1
Alkalinity	Monthly	1
TSS	Monthly (per NPDES Permit No. PA0593508)	1
PH	Monthly (per NPDES Permit No. PA0593508)	1
Manganese, Total	Monthly (per NPDES Permit No. PA0593508)	1
Iron, Total	Monthly (per NPDES Permit No. PA0593508)	1
Priority Pollutants	Once prior to full monitoring study	1
Group 2 Metals	Once prior to full monitoring study, Monthly	1
Gross Alpha	Once prior to full monitoring study	1
Gross Beta	Once prior to full monitoring study	1
Conductivity	Twice/Weekly by Pottstown	3
PH	2 hour intervals by Pottstown	3

TDS	Twice/Weekly for the first two weeks (when flow at Pottstown gage < 840 CFS)	3
Iron, Total	Twice/Weekly for the first two weeks (when flow at Pottstown gage < 840 CFS)	3
Manganese, Total	Twice/Weekly for the first two weeks (when flow at Pottstown gage < 840 CFS)	3
TOC	Twice/Weekly for the first two weeks (when flow at Pottstown gage < 840 CFS)	3
Sulfides	Twice/Weekly for the first two weeks (when flow at Pottstown gage < 840 CFS)	3
Biological Assay	At the beginning and the last month of the pumping demonstration at same time as Schuylkill River biological monitoring	Pool Area in East Norwegian Creek
Biological (fish & benthic invertebrates)	Prior to pumping or during first week of pumping and monthly thereafter (conditions permitting)	Schuylkill River (upstream and downstream of confluence w/ Norwegian Creek)
pH, Dissolved Oxygen, Temp., Conductivity, Alkalinity	Field measurements with biological sampling	Schuylkill River (upstream and downstream of confluence w/ Norwegian Creek), Norwegian Creek at the confluence w/ Schuylkill River
Parameters	**Frequency***	
Temperature	Continuously recorded	Norwegian Creek at the confluence w/ Schuylkill River, Schuylkill River (upstream and downstream of confluence w/ Norwegian Creek)
TSS, TDS, Osmotic Pressure, Total Iron, Dissolved Iron	Field measurements with biological sampling	Norwegian Creek at the confluence w/ Schuylkill River, Schuylkill River (upstream and downstream of confluence w/ Norwegian Creek)
Mine Pool Level	Daily (to continue after demonstration during mine pool recovery period)	1
Dissolved Oxygen, Temp., E. coli, fecal coliforms	Five times per month	5

Dissolved Oxygen, Temp., E. coli, fecal coliform	Monthly	6
Erosion/sedimentation monitoring	At the end of this pumping season	Selected historical locations on the East branch of Perkiomen Creek
Use survey	To be determined by Exelon in conjunction with the Perkiomen Watershed Conservancy	Perkiomen watershed

* Daily monitoring will be based on business days (five days per week excluding holidays).

** The water quality monitoring locations are as follows: Wadesville Pumphouse (1), Still Creek during reservoir releases for Exelon (2), Pottstown Water Department (3), PA American (4), East Branch Perkiomen Creek (5), and Perkiomen Creek (6). Biological monitoring locations are PA Fish & Boat Commission historic sampling site 106 just upstream of the Rt. 61 Bridge and Norwegian Creek confluence at Pottsville (Schuylkill River mile 123.6) and site 109 approximately 32 yards upstream of the Cressona Mall Bridge off Rt. 63 (River mile 120.1).

*** Anions will include chloride, bromide, nitrate, nitrite, orthophosphate, and sulfate.

**** Cations will include sodium, potassium, calcium, and magnesium.

Water quality sampling and analysis will be performed according to PADEP or EPA-approved methods. Sampling will consider the approximately 3 to 4-day time-of-travel from Pottsville to Pottstown under low flow conditions. Biological sampling will employ methods used previously by the PA Fish and Boat Commission. Fish will be sampled by electrofishing; a D-frame net will be used to collect kick samples of macroinvertebrates. Biological sampling and associated water quality monitoring will be performed when flow conditions permit sampling.

Reports about the water quality results and the projected correlation of those results to low Schuylkill River flow (e.g., Q_{7-10}) conditions will be provided in the final report.

Specific Requirements for the Pottstown Intake Monitoring

1. Testing at the Pottstown Intake will not occur if the flow in the Schuylkill River is above 840 CFS.
2. Tests that are twice per week will be analyzed with a 48-hour turnaround.
3. After two weeks of test results, the Pottstown Borough Authority and Exelon will evaluate the test results and make an informed decision on whether or not to adjust the testing requirements.
4. Exelon will analyze for priority pollutants at the startup of mine pool discharge. The results will be evaluated by the Pottstown Borough Authority. Based on the analysis of this testing, Exelon and the Borough Authority will determine the need for additional testing at either the Water Plant intake or the mine pool discharge.

Data Distribution

Exelon will transmit monitoring data to DRBC on a weekly basis. Exelon or its laboratory contractor will provide Pottstown intake monitoring data to Pottstown Water Department upon receipt.

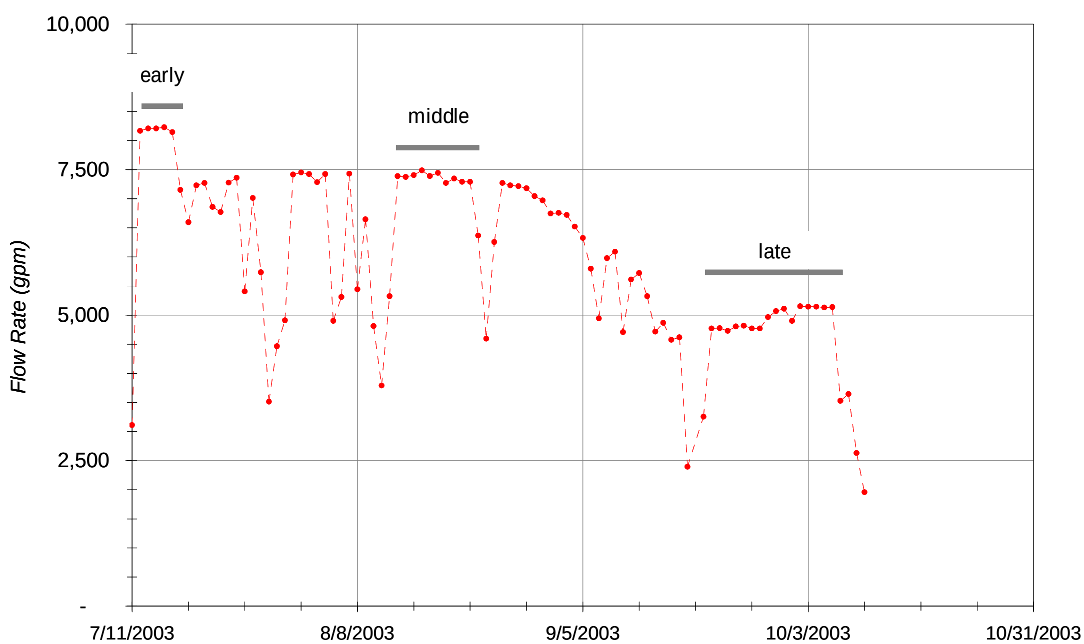
Appendix B - Pumping Test Analysis

The objective of the pumping test analysis presented in this report is to predict, within the limits of confidence afforded by the data, a sustainable rate of water withdrawal from the Wadesville Mine Pool over a period of up to 6 months. For the purpose of this study, the definition of 'sustainable water withdrawal' is to achieve maximum constant-rate water withdrawal over the indicated time period while not lowering the mine pool level to more than 600 feet below the surface measuring point.

1.0 Data Collection and Observations

Between July 11, 2003 and October 10, 2003, water was pumped from the Wadesville Mine Pool at daily rates ranging from 2.82 million gallons per day (mgd) to 11.85 mgd, corresponding to pumping rates of 1,958 gallons per minute (gpm) to 8,230 gpm. The estimated pumping rates varied over time as follows:

Figure 1: Water Withdrawal Rates (July – October 2003)



There were only a few time intervals during the pumping test when water withdrawal rates were approximately constant. As shown in the graph above, these were (a) 'early' phase withdrawal at approximately 8,200 gpm, (b) 'middle' phase withdrawal at approximately 6,400 gpm, and (c) 'late' phase withdrawal at approximately 5,000 gpm.

Mine pool drawdown in response to water withdrawal was monitored using a pressure transducer and data logger (with a manual depth to water meter as a backup). From an initial depth to mine pool of 400 feet, the daily readings of the mine pool level were as follows:

Figure 2: Observed Mine Pool Level and Water Withdrawal Rates (July – October 2003)

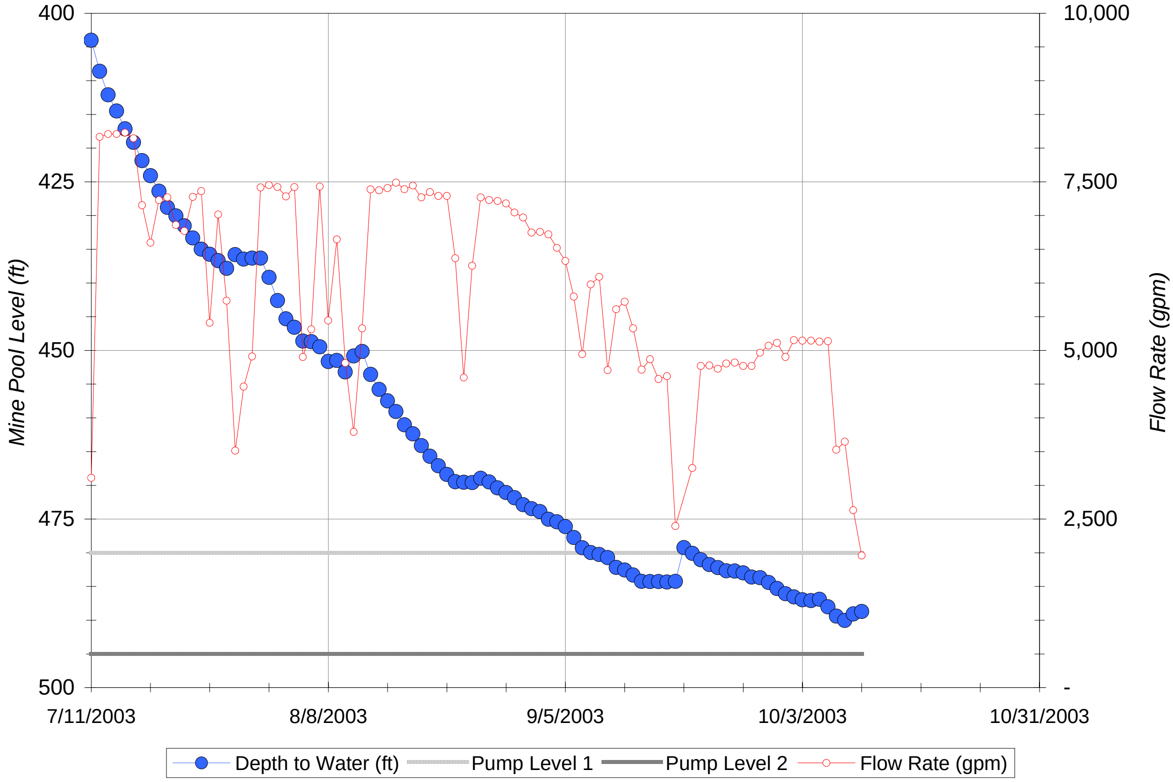
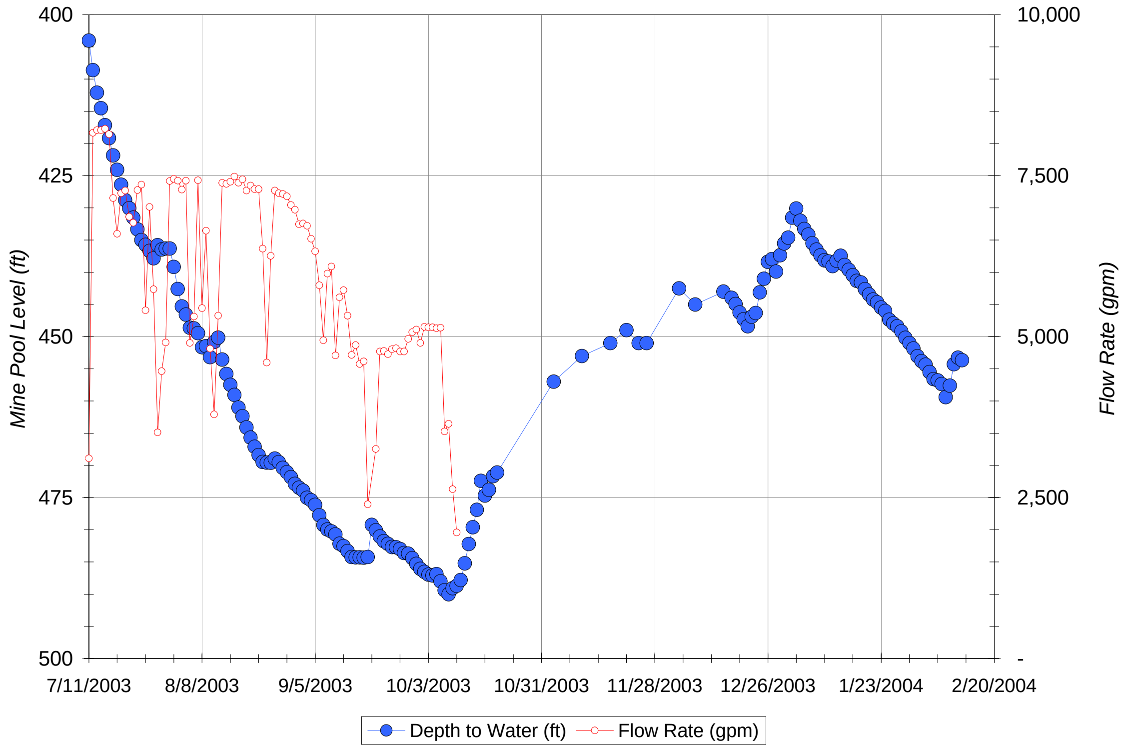


Figure 2 also shows the approximate depth position of the two pump systems that were utilized during the water withdrawal test. Pump 1 was positioned at approximately 480 feet depth and Pump 2 was positioned at approximately 495 feet depth. The decreased water withdrawal rates in September and October 2003 were probably due to dewatering of the mine pool below the upper pump position, which resulted in only Pump 2 being available for water withdrawal.

It is immediately clear from Figure 2 that periods of approximately constant water withdrawal rates correspond to approximately linear decreases in the mine pool level (in other words, the rate of drawdown is constant for a given rate of water withdrawal). Note also that brief periods of much lower withdrawal rates resulted in much lesser rates of drawdown or even no change in mine pool level (marked with the circle in Figure 2), representing long-term (truly) sustainable water withdrawal conditions. It is also apparent from Figure 2 that the slope of decreasing mine pool levels (i.e., the actual rate of drawdown) is related to the water withdrawal rate. This relationship will be explored in detail in Section 2.0 (Derivation of Sustainable Withdrawal Rates).

From October 11 through October 20, 2003, water withdrawal ceased and daily readings of the recovered mine pool level were made (see Figure 3). The recovery phase observations are intermittent, and between November 2003 and February 2004 Reading Anthracite again pumped water intermittently from the Wadesville Mine Pool. The complete mine pool level measurements, including recovery phase (October 2003) and intermittent pumping phase (November 2003 to February 2004) are shown in Figure 3.

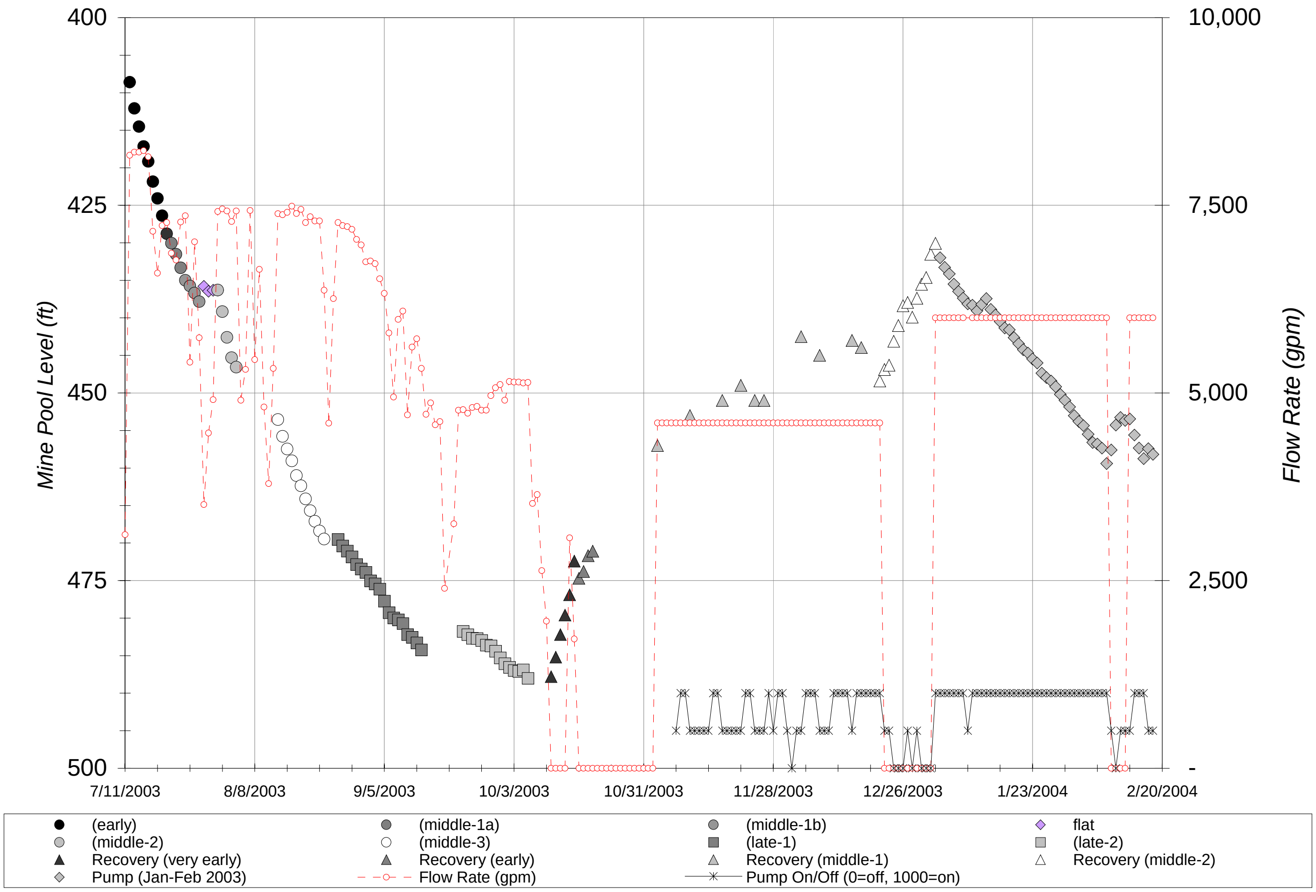
Figure 3: Mine Pool Level and Water Withdrawal Rate (July 2003 through February 2004)



2.0 Estimation of Sustainable Withdrawal Rates

This section analyzes the relationship of linear drawdown in mine pool level and corresponding water withdrawal rates in greater detail. Figure 4 presents the interpreted periods of 'linear' behavior of mine pool level drawdown.

Figure 4: Interpreted Linear Periods of Mine Pool Level Drawdown

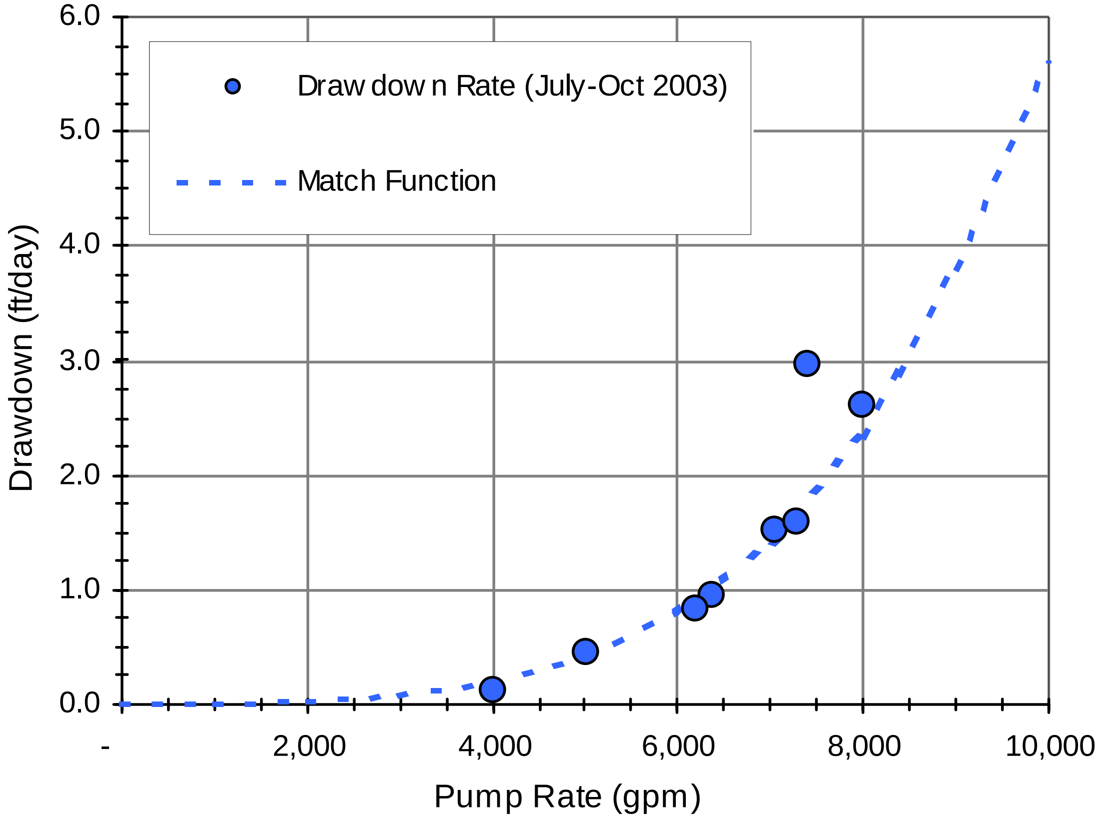


Each linear segment (labeled accordingly) was used to fit a regression line. The estimated rate of drawdown (the slope of a regression line) and approximate pumping rates are:

Phase	Sub-Phase	Pump Rate (gpm)	Rate of Drawdown (ft/day)	r^2
Drawdown	Early	8,000	2.6	0.99
Drawdown	Middle-1a	7,045	1.5	0.99
Drawdown	Middle-1b	6,380	0.94	0.99
Drawdown	Flat	4,000	0.13	0.75
Drawdown	Middle-2	7,400	3.0	0.98
Drawdown	Middle-3	7,300	1.6	0.99
Drawdown	Late-1	6,200	0.83	0.99
Drawdown	Late-2	5,000	0.46	0.97

The relationship between rate of drawdown and water withdrawal rate was explored graphically and a best-fit (exponential) match function was estimated (Figure 5A):

Figure 5A: Relationship of Estimated Mine Pool Drawdown Rate and Withdrawal Rate



The empirical match function has the following term: $y = 10^{-14} * 0.95 * X^{3.95}$

Where ‘y’ is drawdown rate and ‘x’ is pump rate.

Using this function, the approximate rates of water replenishment during recovery (gray symbols in Figure 5A) and the approximate rates of water withdrawal between November 2003 and February 2004 were calculated.

Phase	Sub-Phase	Pump Rate (gpm)	Rate of Drawdown (ft/day)	r^2
Drawdown	Early	8,000	2.6	0.99
Drawdown	Middle-1a	7,045	1.5	0.99
Drawdown	Middle-1b	6,380	0.94	0.99
Drawdown	Flat	4,000	0.13	0.75
Drawdown	Middle-2	7,400	3.0	0.98
Drawdown	Middle-3	7,300	1.6	0.99
Drawdown	Late-1	6,200	0.83	0.99
Drawdown	Late-2	5,000	0.46	0.97
Drawdown *	Feburary	6,000	0.80	0.99
Recovery **	Very early	8,370	2.9	0.99
Recovery **	Early	6,820	1.3	0.95
Recovery **	Middle-1	4,620	0.31	0.86
Recovery **	Middle-2	7,000	1.4	0.95

* = estimated pumping rate

** = estimated recovery rate

The graph in Figure 5B suggests strongly that, for any similar set of conditions, withdrawal rates of 4,000 gpm or less will result in very low rates of drawdown. As the water withdrawal rate increases, the rate of drawdown increases exponentially. Between 7,000 and 8,000 gpm small further increases in pumping rate will likely cause accelerated increases in the rate of drawdown.

Figure 5B: Relationship of Estimated Mine Pool Drawdown Rate and Withdrawal/Recovery Rate

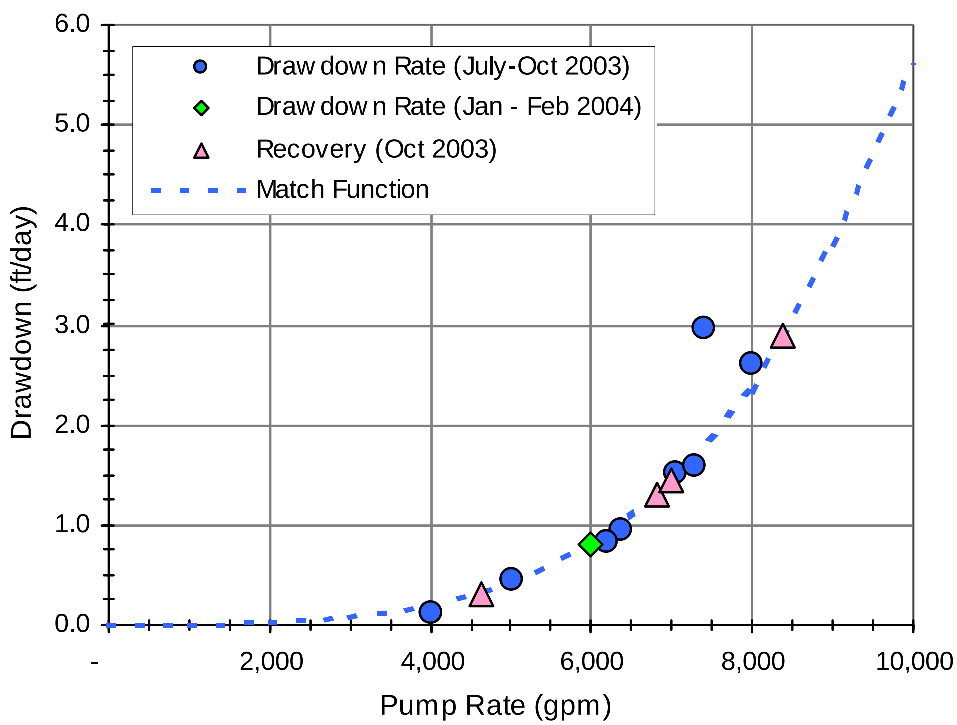
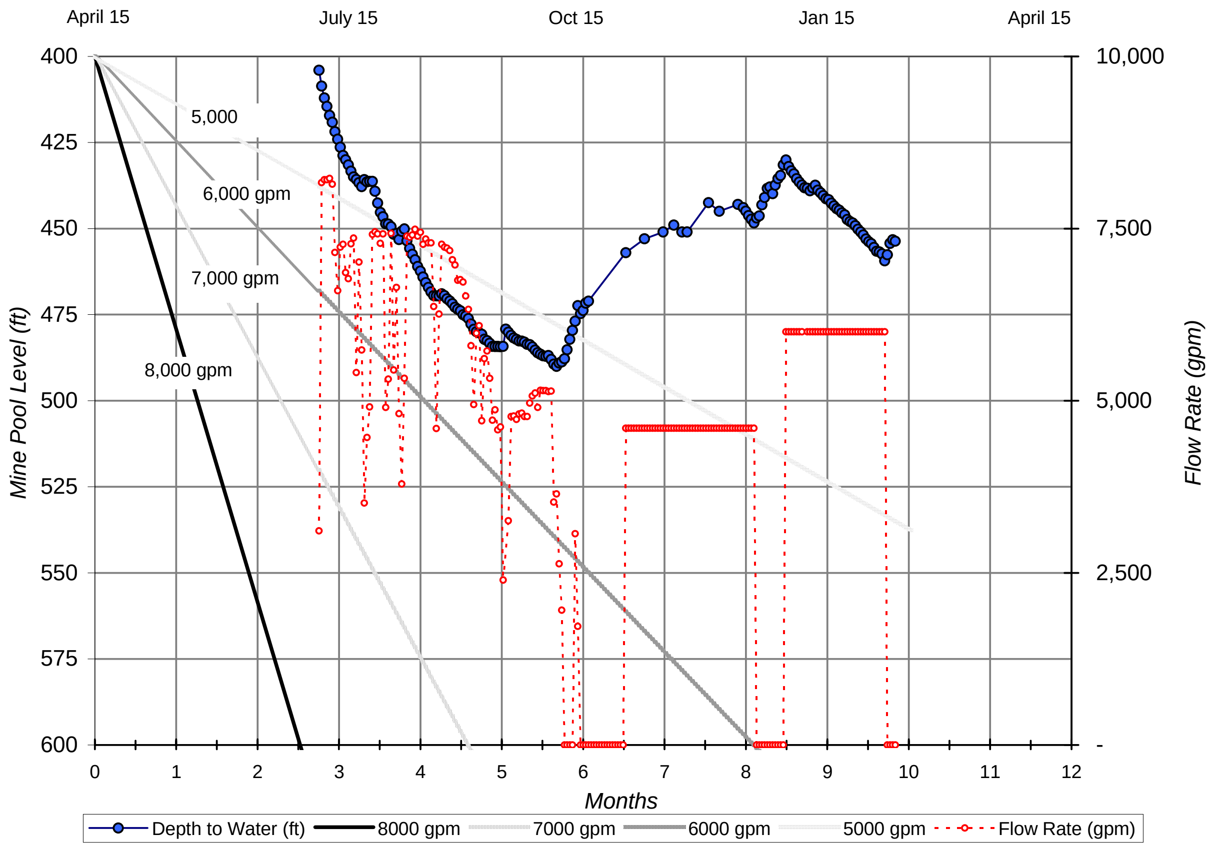


Figure 6 presents the predicted linear drawdown for pumping rates of 5,000 to 8,000 gpm, with the x-axis re-scaled in months to recognize whether a given pumping rate is sustainable (to a maximum mine pool level of 600 ft depth) over a period of 6 months. Figure 6 also shows the Wadesville pumping data for comparison.

Figure 6: Predicted Linear Drawdown at Various Pumping Rates



For a maximum pump depth of 600 feet, the linear extrapolation for 8,000 gpm indicates exhaustion of the mine pool reservoir within 2.5 months. The linear extrapolation for 7,000 gpm indicates exhaustion of the reservoir within 4.5 months. The linear extrapolation for 6,000 gpm indicates extrapolation of the reservoir by about 8 months. The maximum rate of drawdown Y and the corresponding pumping rate X that (over a six months period) may result in a sustainable mine pool level to no deeper than 600 feet can be calculated as follows:

$$Y = 200 \text{ ft} / 180 \text{ day} = 1.09 \text{ ft/day}$$

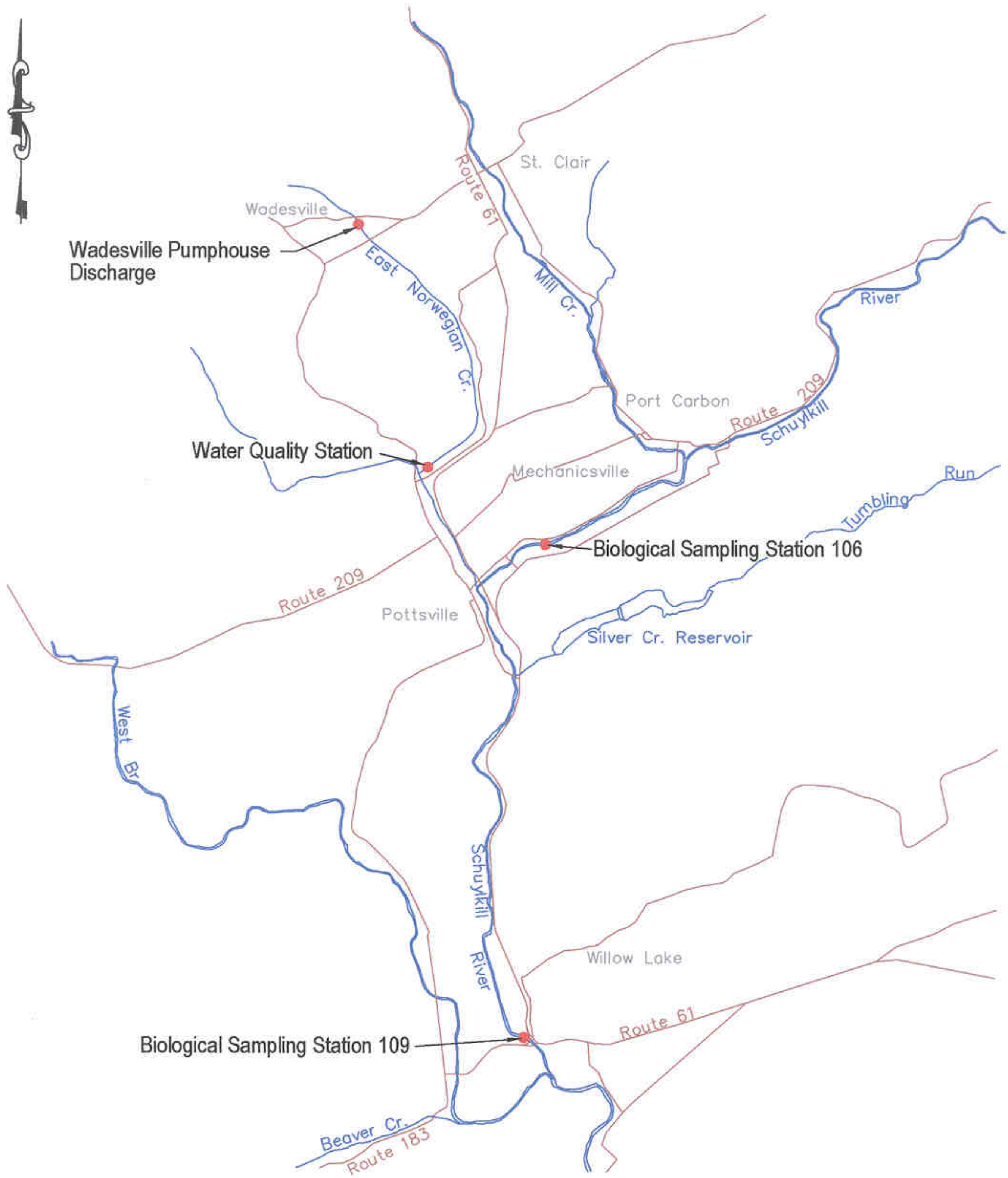
$$Y = 10^{-14} * 0.95 * X^{3.95}$$

$$1.09 = 10^{-14} * 0.95 * X^{3.95}$$

$$X = 6{,}500 \text{ gpm}$$

The predictive analysis presented herein depends on several limiting assumptions: (1) the water withdrawal rates reported from the Wadesville mine shaft were constant rather than averages (e.g., 18 hours on and 6 hours off per day); (2) the linear relationship of drawdown at a given withdrawal rate applies over longer periods of time and throughout the extent of the mine and its shaft (the test data show linearity over 25-40 foot intervals and over a period of about 3 months, both of which are less than what is proposed); (3) the rate of replenishment applies to periods longer than the 3-months withdrawal test (July-October 2003); (4) pumps placed at 600-ft depth can generate a constant flow; and (5) the volume geometry of the mine is reasonably uniform.

Figure 3.3-1. Location of sampling stations for the Wadesville Mine Demonstration Project during 2003



NORMANDEAU ASSOCIATES ENVIRONMENTAL CONSULTANTS 3450 Schuylkill Road Spring City, PA 19475-1124	Source: Basemap digitized from USGS Pottsville, PA Quad	DRAWN BY:	SGS	DATE:	02-05-04	FIGURE
		CHECKED BY:	CDD/BJS	DETAIL NO.:	19288002	
		JOB NO.:	19288.001	SCALE:	1" = 5000'	

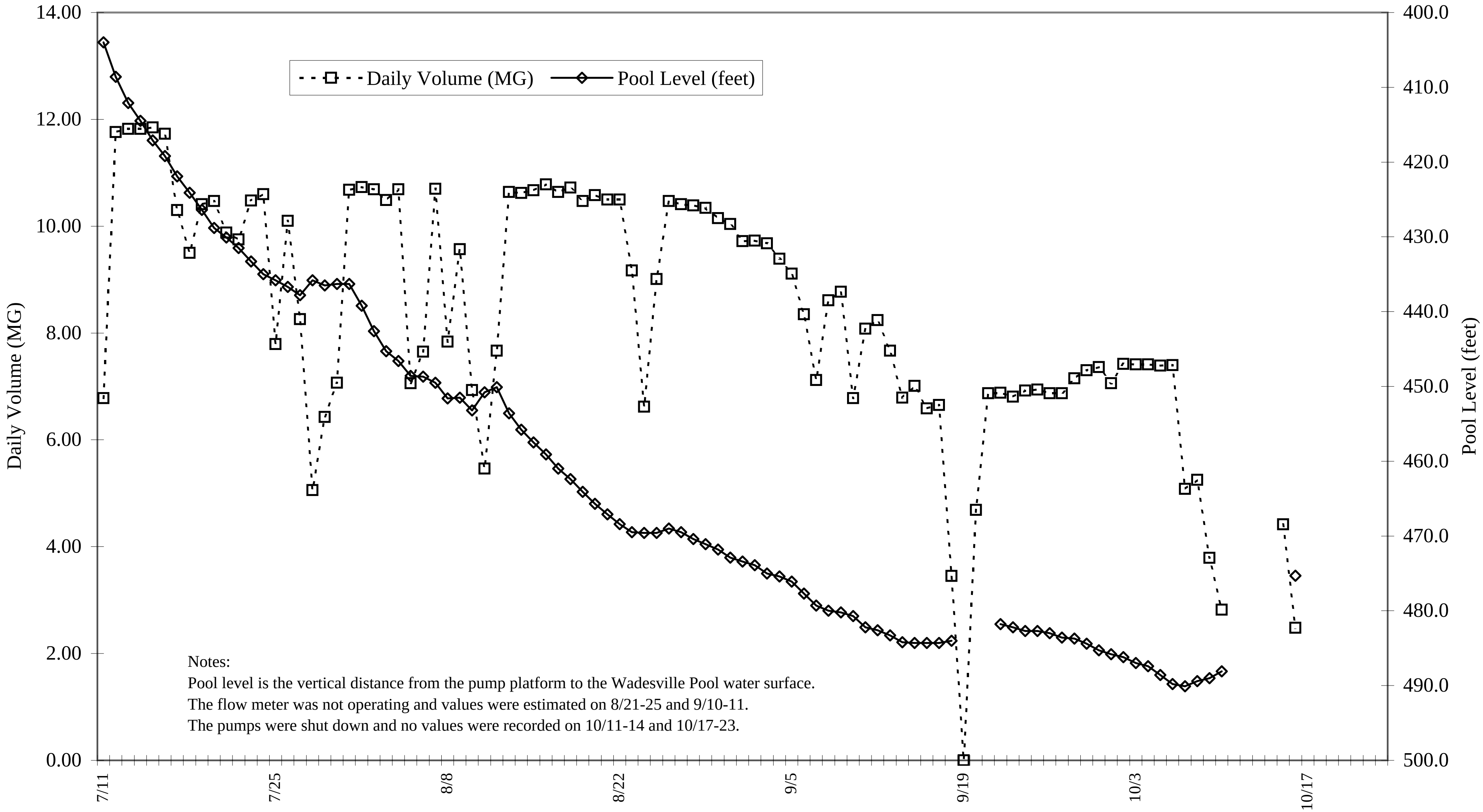


Figure 3.4-1. Daily volume of water pumped from the Wadesville Pool near Pottsville, Pennsylvania and pool water level during the Wadesville Mine Water Demonstration Project, July-October 2003.

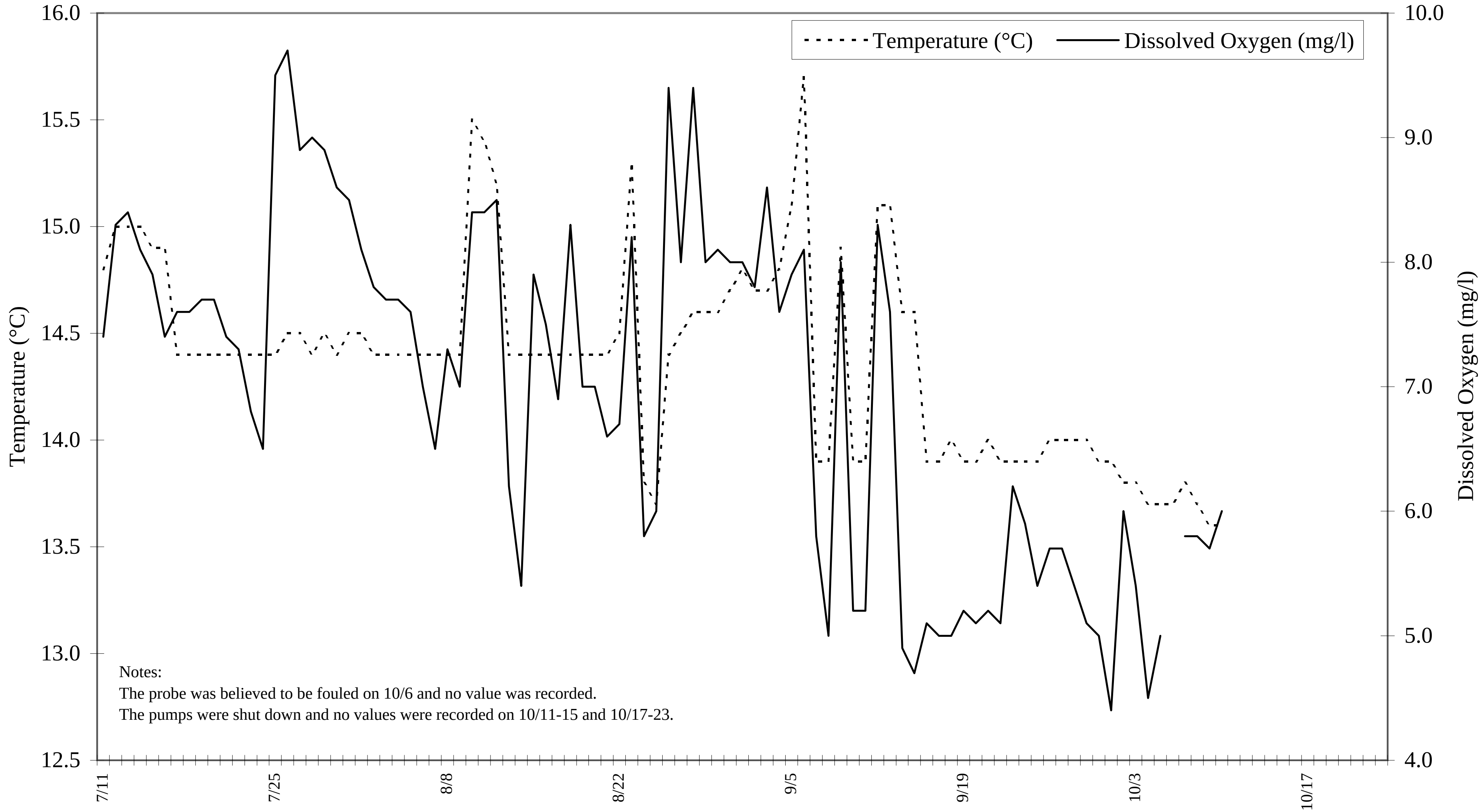


Figure 3.4-2. Temperature and dissolved oxygen measured in water pumped from the Wadesville Pool near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

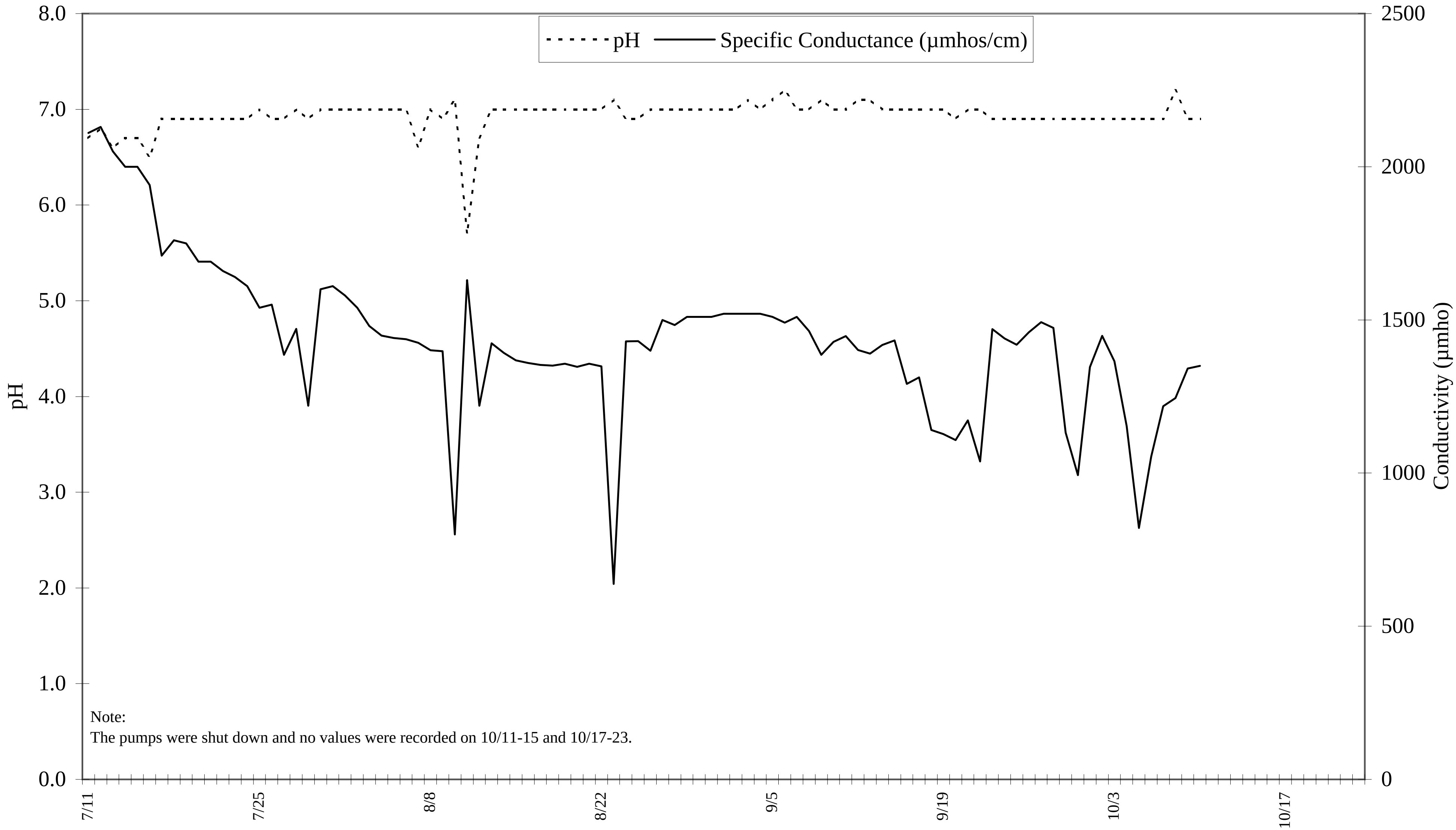


Figure 3.4-3. pH and specific conductance measured in water pumped from the Wadesville Pool near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

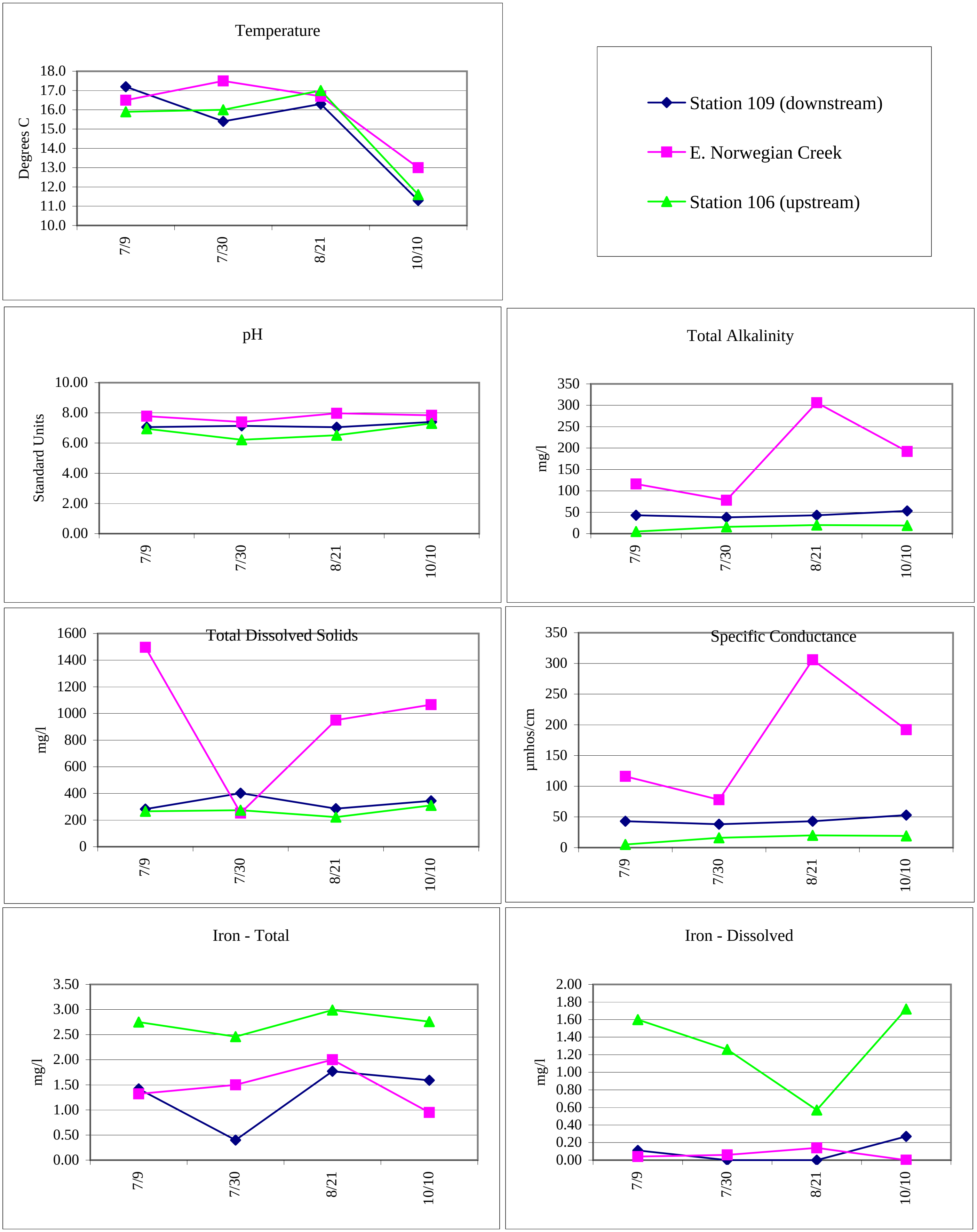


Figure 3.4-4. Water quality measured at Stations 106 and 109 in the Schuylkill River and in East Norwegian Creek near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

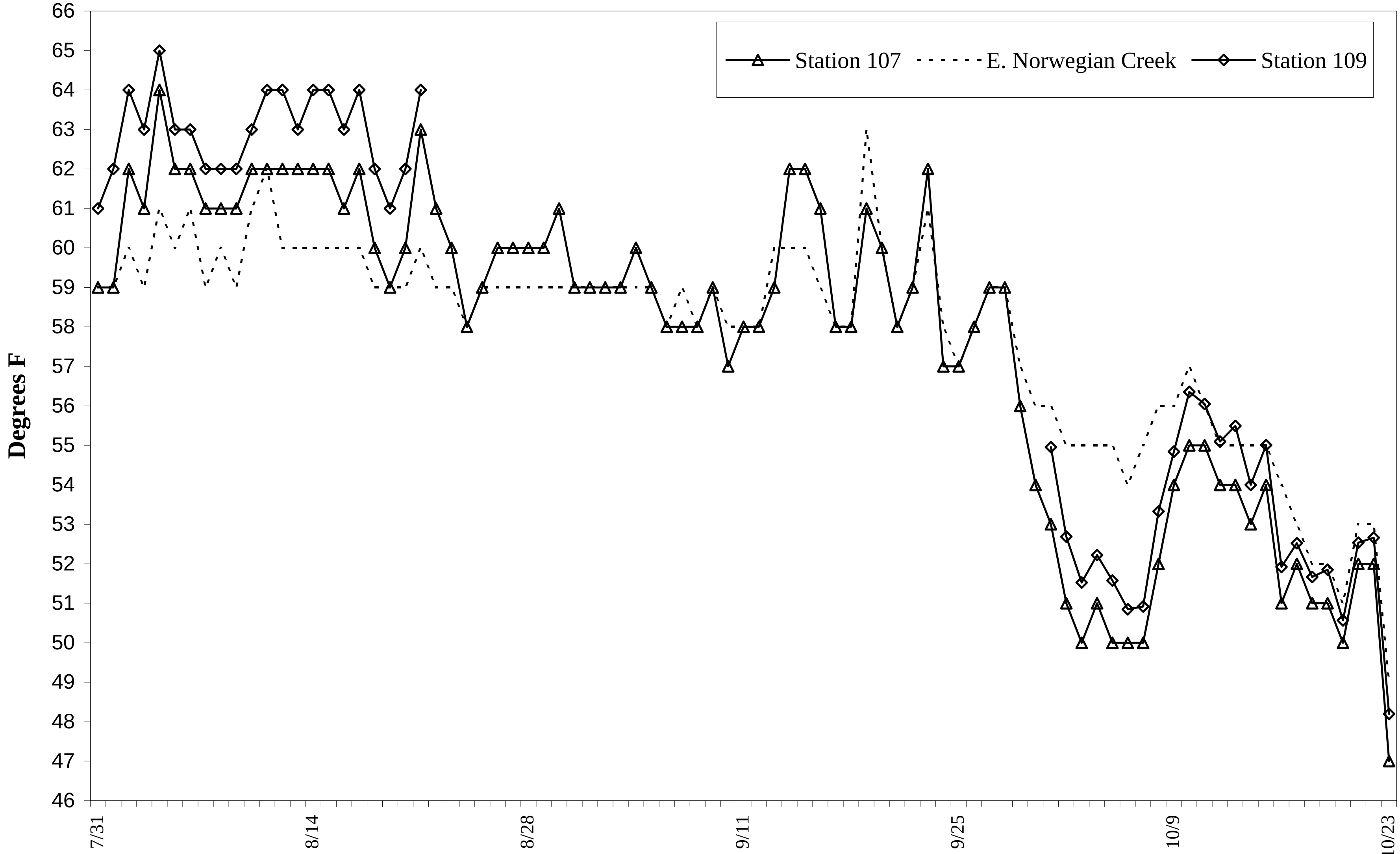


Figure 3.4-5. Mean daily water temperature measured at Stations 107 and 109 in the Schuylkill River and in East Norwegian Creek near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

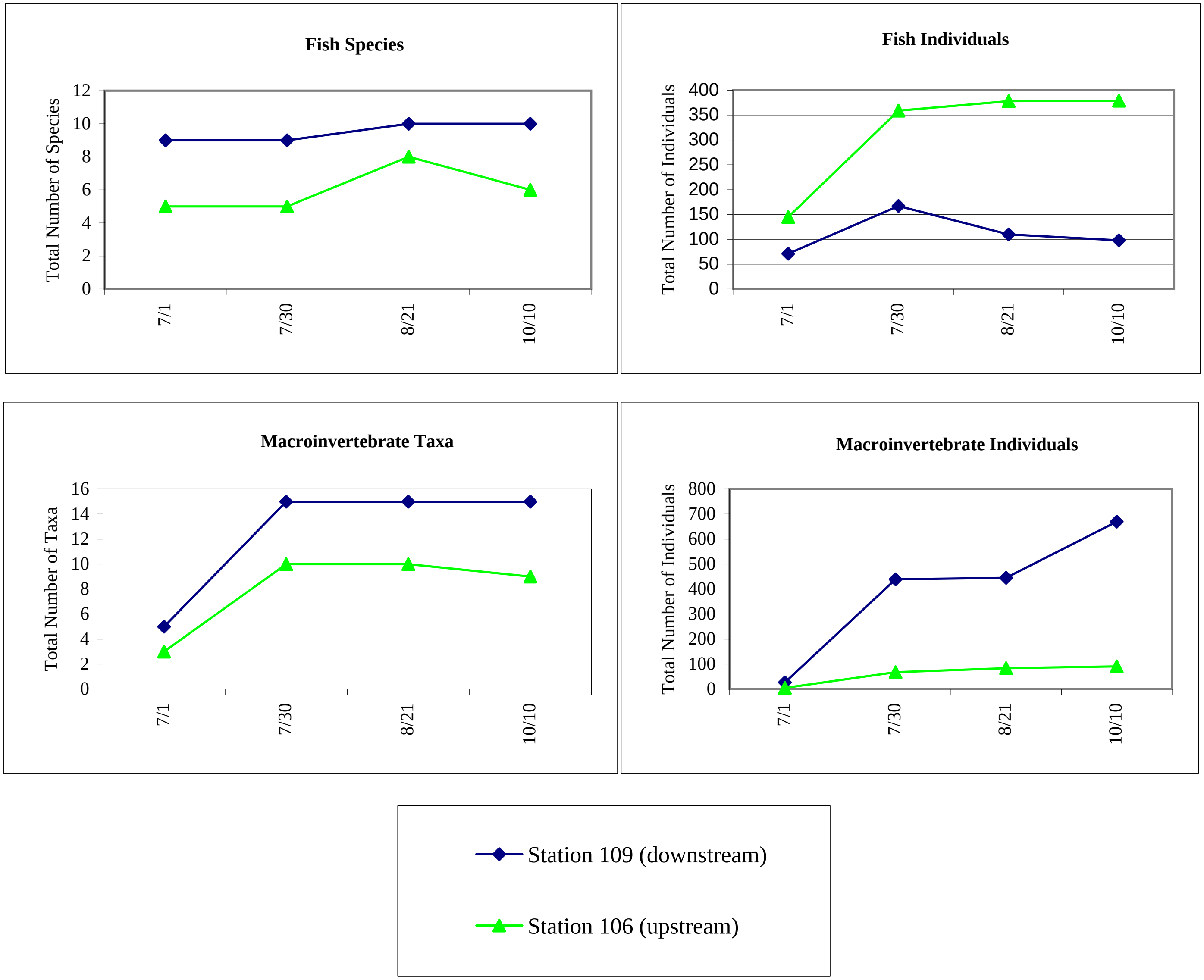


Figure 3.4-6. Selected fish and benthic macroinvertebrate data obtained at two stations in the Schuylkill River near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

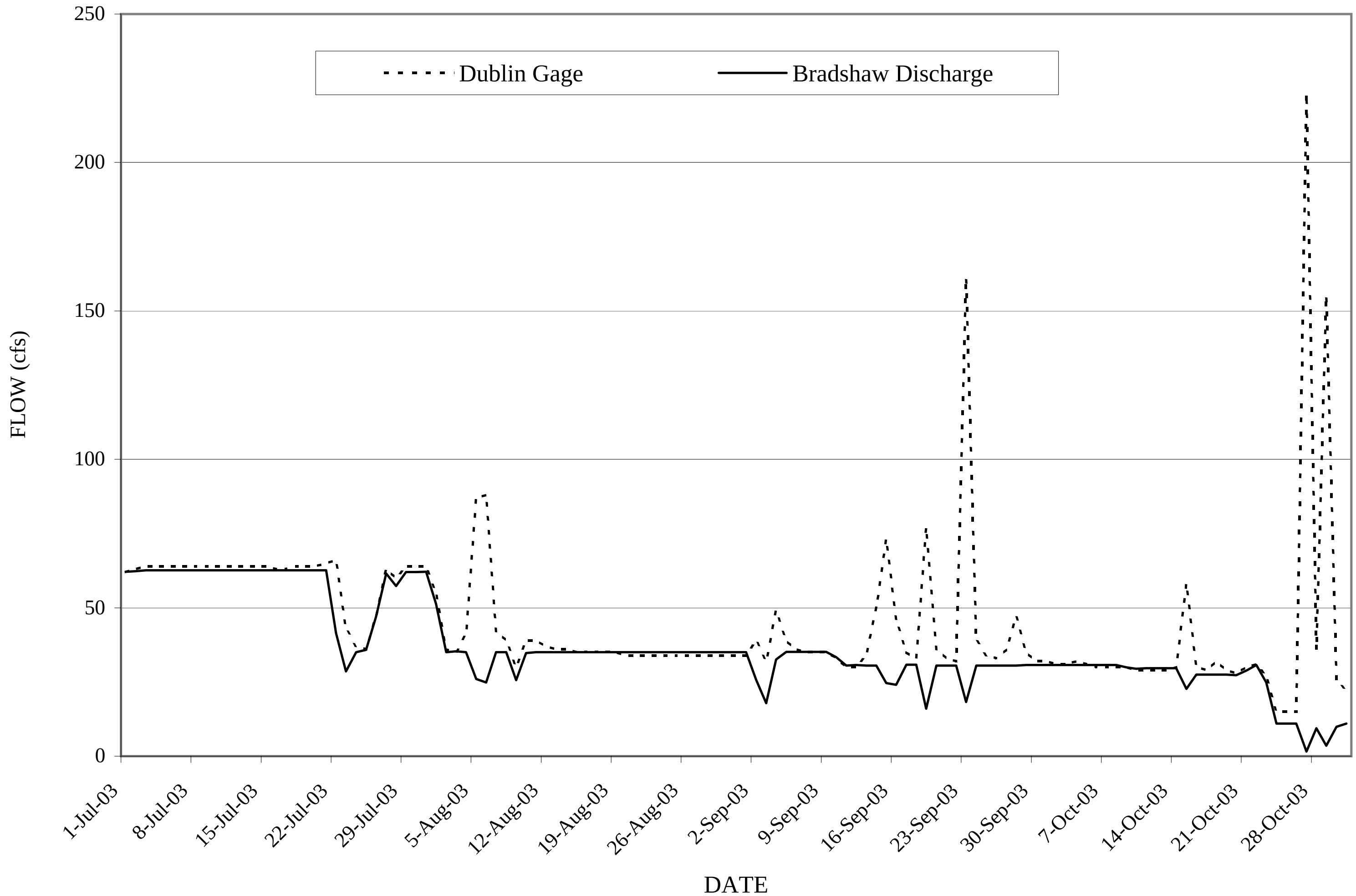


Figure 3.4-7. Flow rate of the Bradshaw Reservoir discharge and the East Branch Perkiomen Creek at the Dublin USGS gage, July - October 2003.

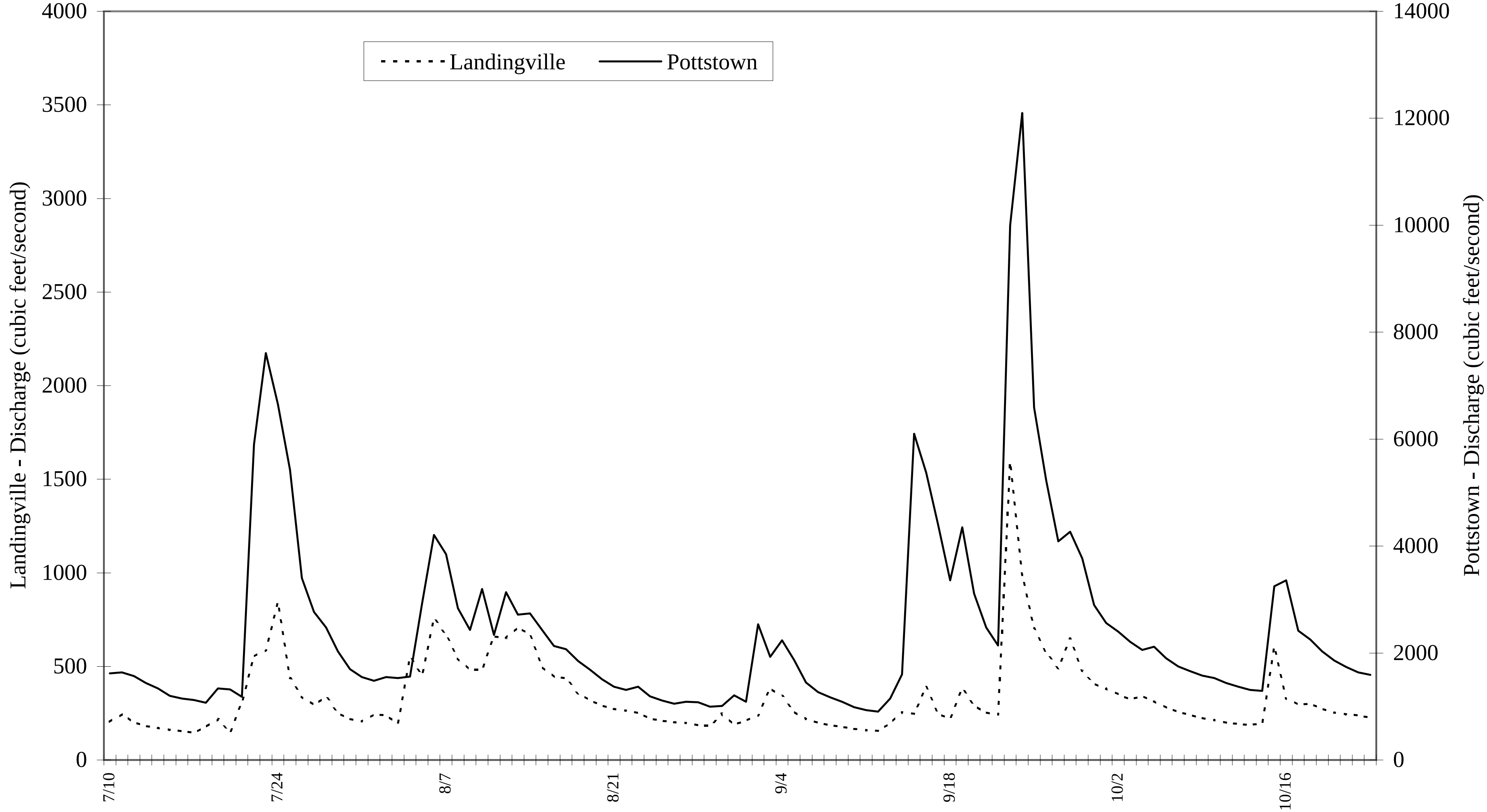


Figure 3.4-8. Daily mean discharge of the Schuylkill River measured at Landingville and at Pottstown, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

Table 3.4-1 Daily water quality measurements made in the Wadesville Pool near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

Date	Daily Volume (MG)	Temp. (ºC)	Dissolved Oxygen (mg/l)	pH	Specific Conductance (µmhos/cm)	Pool Level[1] (feet)
7/11/2003	6.78	14.8	7.4	6.7	2110	404.0
7/12/2003	11.76	15.0	8.3	6.8	2130	408.6
7/13/2003	11.82	15.0	8.4	6.6	2050	412.1
7/14/2003	11.82	15.0	8.1	6.7	2000	414.5
7/15/2003	11.85	14.9	7.9	6.7	2000	417.1
7/16/2003	11.73	14.9	7.4	6.5	1940	419.2
7/17/2003	10.30	14.4	7.6	6.9	1710	421.9
7/18/2003	9.50	14.4	7.6	6.9	1760	424.1
7/19/2003	10.41	14.4	7.7	6.9	1750	426.4
7/20/2003	10.47	14.4	7.7	6.9	1690	428.8
7/21/2003	9.88	14.4	7.4	6.9	1690	430.1
7/22/2003	9.75	14.4	7.3	6.9	1660	431.5
7/23/2003	10.48	14.4	6.8	6.9	1640	433.3
7/24/2003	10.60	14.4	6.5	6.9	1610	435.0
7/25/2003	7.79	14.4	9.5	7.0	1540	435.8
7/26/2003	10.10	14.5	9.7	6.9	1550	436.7
7/27/2003	8.26	14.5	8.9	6.9	1386	437.8
7/28/2003	5.06	14.4	9.0	7.0	1471	435.8
7/29/2003	6.43	14.5	8.9	6.9	1220	436.5
7/30/2003	7.07	14.4	8.6	7.0	1600	436.3
7/31/2003	10.68	14.5	8.5	7.0	1610	436.3
8/1/2003	10.73	14.5	8.1	7.0	1580	439.2
8/2/2003	10.69	14.4	7.8	7.0	1540	442.6
8/3/2003	10.49	14.4	7.7	7.0	1480	445.3
8/4/2003	10.69	14.4	7.7	7.0	1449	446.6
8/5/2003	7.06	14.4	7.6	7.0	1441	448.6
8/6/2003	7.65	14.4	7.0	7.0	1437	448.7
8/7/2003	10.70	14.4	6.5	6.6	1425	449.5
8/8/2003	7.84	14.4	7.3	7.0	1401	451.6
8/9/2003	9.57	14.4	7.0	6.9	1398	451.5
8/10/2003	6.93	15.5	8.4	7.1	800	453.2
8/11/2003	5.46	15.4	8.4	5.7	1630	450.8
8/12/2003	7.67	15.2	8.5	6.7	1220	450.1
8/13/2003	10.64	14.4	6.2	7.0	1424	453.6
8/14/2003	10.62	14.4	5.4	7.0	1392	455.8
8/15/2003	10.67	14.4	7.9	7.0	1368	457.5

Table 3.4-1. (Continued.)

Date	Daily Volume (MG)	Temp. (ºC)	Dissolved Oxygen (mg/l)	pH	Specific Conductance (µmhos/cm)	Pool Level[1] (feet)
8/16/2003	10.78	14.4	7.5	7.0	1359	459.1
8/17/2003	10.64	14.4	6.9	7.0	1353	461.0
8/18/2003	10.72	14.4	8.3	7.0	1351	462.4
8/19/2003	10.47	14.4	7.0	7.0	1357	464.1
8/20/2003	10.58	14.4	7.0	7.0	1347	465.7
8/21/2003	10.5*	14.4	6.6	7.0	1357	467.1
8/22/2003	10.5*	14.5	6.7	7.0	1348	468.4
8/23/2003	9.17*	15.3	8.2	7.1	638	469.5
8/24/2003	6.62*	13.8	5.8	6.9	1430	469.6
8/25/2003	9.01*	13.7	6.0	6.9	1431	469.6
8/26/2003	10.47	14.4	9.4	7.0	1399	469.0
8/27/2003	10.41	14.5	8.0	7.0	1500	469.5
8/28/2003	10.39	14.6	9.4	7.0	1483	470.4
8/29/2003	10.34	14.6	8.0	7.0	1510	471.1
8/30/2003	10.15	14.6	8.1	7.0	1510	471.8
8/31/2003	10.04	14.7	8.0	7.0	1510	472.9
9/1/2003	9.72	14.8	8.0	7.0	1520	473.4
9/2/2003	9.73	14.7	7.8	7.0	1520	473.9
9/3/2003	9.68	14.7	8.6	7.1	1520	475.0
9/4/2003	9.39	14.8	7.6	7.0	1520	475.4
9/5/2003	9.11	15.1	7.9	7.1	1510	476.1
9/6/2003	8.35	15.7	8.1	7.2	1491	477.7
9/7/2003	7.12	13.9	5.8	7.0	1510	479.3
9/8/2003	8.61	13.9	5.0	7.0	1464	480.0
9/9/2003	8.77	14.9	8.0	7.1	1386	480.2
9/10/2003	6.78*	13.9	5.2	7.0	1428	480.7
9/11/2003	8.08*	13.9	5.2	7.0	1447	482.2
9/12/2003	8.24	15.1	8.3	7.1	1402	482.6
9/13/2003	7.67	15.1	7.6	7.1	1390	483.3
9/14/2003	6.79	14.6	4.9	7.0	1418	484.2
9/15/2003	7.01	14.6	4.7	7.0	1433	484.3
9/16/2003	6.59	13.9	5.1	7.0	1291	484.3
9/17/2003	6.65	13.9	5.0	7.0	1312	484.3
9/18/2003	3.45	14.0	5.0	7.0	1141	484.2
9/19/2003	0.00	13.9	5.2	7.0	1127	N/A
9/20/2003	4.69	13.9	5.1	6.9	1108	N/A

Table 3.4-1. (Continued.)

Date	Daily Volume (MG)	Temp. (ºC)	Dissolved Oxygen (mg/l)	pH	Specific Conductance (µmhos/cm)	Pool Level (feet)
9/21/2003	6.87	14.0	5.2	7.0	1172	N/A
9/22/2003	6.88	13.9	5.1	7.0	1038	481.8
9/23/2003	6.81	13.9	6.2	6.9	1470	482.2
9/24/2003	6.92	13.9	5.9	6.9	1439	482.7
9/25/2003	6.94	13.9	5.4	6.9	1419	482.7
9/26/2003	6.87	14.0	5.7	6.9	1460	483.0
9/27/2003	6.87	14.0	5.7	6.9	1493	483.6
9/28/2003	7.15	14.0	5.4	6.9	1474	483.7
9/29/2003	7.30	14.0	5.1	6.9	1132	484.4
9/30/2003	7.36	13.9	5.0	6.9	993	485.3
10/1/2003	7.06	13.9	4.4	6.9	1346	485.8
10/2/2003	7.42	13.8	6.0	6.9	1448	486.2
10/3/2003	7.41	13.8	5.4	6.9	1365	487.0
10/4/2003	7.41	13.7	4.5	6.9	1153	487.4
10/5/2003	7.39	13.7	5.0	6.9	821	488.6
10/6/2003	7.40	13.7	##	6.9	1054	489.8
10/7/2003	5.08	13.8	5.8	6.9	1218	490.1
10/8/2003	5.25	13.7	5.8	7.2	1245	489.4
10/9/2003	3.79	13.6	5.7	6.9	1341	489.0
10/10/2003	2.82	13.6	6.0	6.9	1350	488.1
10/11/2003	**	**	**	**	**	**
10/12/2003	**	**	**	**	**	**
10/13/2003	**	**	**	**	**	**
10/14/2003	**	**	**	**	**	**
10/15/2003	4.42	**	**	**	**	**
10/16/2003	2.48	13.6	4.5	7.0	1265	475.3
10/17/2003	**	**	**	**	**	**
10/18/2003	**	**	**	**	**	**
10/19/2003	**	**	**	**	**	**
10/20/2003	**	**	**	**	**	**
10/21/2003	**	**	**	**	**	**
10/22/2003	**	**	**	**	**	**
10/23/2003	**	**	**	**	**	**

[1] Pool level is the vertical distance from the pump platform to the Wadesville Pool water surface.

*flow meter down; estimated values
Probe believed to be fouled
**pumps shutdown

Table 3.4-2. Monthly water quality measurements (NPDES Group 2 Metals) made in the Wadesville Pool near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

Sample Date	6/2/2003	7/24/2003	8/14/2003	9/11/2003	10/10/2003	10/21/2003
Parameter / Depth	Discharge	Discharge	Discharge	Discharge	Discharge	600 ft
Antimony	<0.075	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.005	<0.001	0.002	0.001	<0.001	<0.001
Beryllium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium, Hexavalent	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	<0.005	<0.005	<0.005	0.014	<0.005	<0.005
Lead	<0.001	<0.05	<0.05	<0.001	<0.05	<0.05
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002
Nickel	0.010	0.023	<0.005	0.019	0.010	0.009
Selenium	0.005	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	0.02	0.084	<0.005	0.054	0.025	0.033
Cyanide	<0.01	<0.005	<0.005	<0.005	0.006	0.005
Cyanide, Free	<0.01	<0.005	<0.005	0.006	<0.005	<0.005
Phenolics	<0.05	<0.01	0.024	0.028	<0.01	<0.01
Aluminum	<0.020	<0.02	<0.02	0.06	<0.02	0.04
Barium	0.03	0.040	0.044	0.041	0.036	0.034
Boron	0.02	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	<0.020	<0.005	0.006	0.008	0.005	<0.005
Iron	1.45	2.31	3.94	3.09	2.74	2.19
Iron, Dissolved	0.12	<0.02	3.23	1.42	2.09	1.36
Magnesium	117	122	100	126	115	129
Molybdenum	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese	2.67	2.77	2.87	2.17	2.71	2.24
Tin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	<0.1	<0.025	<0.025	<0.025	<0.025	<0.025

Total concentration in mg/l unless otherwise indicated

Table 3.4-3. Monthly water quality measurements (total organic carbon and inorganics) made in the Wadesville Pool near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

Parameter / Sample Date / Depth	6/27/2003 Discharge	7/16/2003 Discharge	7/24/2003 Discharge	7/29/2003 Discharge	8/6/2003 Discharge	8/14/2003 Discharge	9/11/2003 Discharge	10/10/2003 Discharge	10/21/2003 600 ft.
Total Organic Carbon	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	0.8
Chloride	21	-	17	-	-	17	16	16	14
Bromide	<1	-	<1	-	-	<1	<1	<1	<1
Nitrate Nitrogen	<1	-	<1	-	-	<1	<1	<1	<1
Nitrite Nitrogen	<0.1	-	<0.1	-	-	<0.1	<0.1	<0.1	<0.1
Ammonia	-	-	-	-	-	0.8	0.6	0.5	0.5
Phosphorous, Ortho	<0.05	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05
Sulfate	800	-	700	-	-	530	670	640	760
Sodium	72	-	61	-	-	62	74	58	61
Potassium	2.3	-	1.9	-	-	1.8	2.0	1.9	2.0
Calcium	200	-	220	-	-	230	250	240	240
Magnesium	140	-	122	-	-	100	126	115	129
Acidity	33	-	32	-	-	13	27	30	46
Alkalinity	250	-	306	-	-	336	340	296	298
Hardness	990	-	796	-	-	816	888	836	990
Total Dissolved Solids	-	1520	1306	1326	1138	1190	1330	1308	1384

Total concentration in mg/l unless otherwise indicated

Table 3.4-4. Monthly water quality measurements (NPDES Permit parameters) made in the Wadesville Pool near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

Parameter	Sample Date 7/11/2003	8/1/2003	9/2/2003	10/7/2003
pH (SU)	7.03	7.40	7.42	7.15
Specific Conductance (µmhos/cm)	2109	1649	1829	1274
Iron, Total	1.18	0.94	1.96	2.46
Manganese, Total	2.63	2.13	5.10	1.96
Sulfate	1170	791	648	404
Acidity	<0.40	<0.40	<0.40	<0.40
Alkalinity	202	321	337	268
Total Suspended Solids	8	8	7	9

Total concentration in mg/l unless otherwise indicated

Table 3.4-5. Water quality measurements made in East Norwegian Creek and in the Schuylkill River near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

Sample Date/Parameters	Schuylkill River at Station 106[1] (upstream)	East Norwegian Creek[2]	Schuylkill River at Station 109[3] (downstream)
7/9/2003			
Total Suspended Solids	9	11	7
Total Dissolved Solids	266	1496	282
Osmotic Pressure (milliosmoles/kg)	<10	22	<10
Iron, Dissolved	1.60	0.04	0.11
Iron, Total	2.75	1.32	1.42
Total Alkalinity	5	116	43
Dissolved Oxygen	8.7	9.2	8.6
Spec. Cond. (µmhos/cm)	353	1660	498
pH (SU)	6.95	7.78	7.06
Temp (°C)	15.9	16.5	17.2
7/30/2003			
Total Suspended Solids	6	11	16
Total Dissolved Solids	274	252	402
Osmotic Pressure (milliosmoles/kg)	<10	<10	<10
Iron, Dissolved	1.26	0.06	<0.02
Iron, Total	2.46	1.50	0.40
Total Alkalinity	16	78	38
Dissolved Oxygen	8.9	8.5	9.0
Spec. Cond. (µmhos/cm)	300	494	437
pH (SU)	6.22	7.40	7.14
Temp (°C)	16.0	17.5	15.4
8/21/2003			
Total Suspended Solids	14	6	7
Total Dissolved Solids	222	950	286
Osmotic Pressure (milliosmoles/kg)	<10	16	<10
Iron, Dissolved	0.57	0.14	<0.02
Iron, Total	2.99	2.00	1.77
Total Alkalinity	20	306	43

Table 3.4-5. (Continued.)

Sample Date/Parameters	Schuylkill River at Station 106[1] (upstream)	East Norwegian Creek[2]	Schuylkill River at Station 109[3] (downstream)
Dissolved Oxygen	9.1	8.7	9.0
Spec. Cond. (µmhos/cm)	298	1310	383
pH (SU)	6.52	7.97	7.05
Temp (°C)	17.0	16.7	16.3
10/10/2003			
Total Suspended Solids	12	5	10
Total Dissolved Solids	310	1066	344
Osmotic Pressure (milliosmoles/kg)	<10	14	<10
Iron, Dissolved	1.72	<0.02	0.27
Iron, Total	2.76	0.95	1.59
Total Alkalinity	19	192	53
Dissolved Oxygen	10.3	10.0	10.3
Spec. Cond. (µmhos/cm)	329	1278	437
pH (SU)	7.30	7.84	7.40
Temp (°C)	11.6	13.0	11.3

Concentration in mg/l unless otherwise indicated

[1] Station 106 is located in the Schuylkill River approximately 0.5 mile upstream of the Norwegian Creek confluence.

[2] Sample station is located in East Norwegian Creek immediately upstream of the long culvert which conveys the stream under Pottsville.

[3] Station 109 is located in the Schuylkill River approximately 3 miles downstream of the Norwegian Creek confluence.

Table 3.4-6. Mean daily water temperature measurements[1] (°F) made in East Norwegian Creek and the Schuylkill River near Pottsville, Pennsylvania and the Little Schuylkill River near Tamaqua, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

DATE	Schuylkill River[2] at Station 107 (upstream)	East Norwegian Creek[3]	Schuylkill River[4] at Station 109 (downstream)	Little Schuylkill[5] River
7/31/2003	59	59	61	64
8/1/2003	59	59	62	63
8/2/2003	62	60	64	65
8/3/2003	61	59	63	66
8/4/2003	64	61	65	67
8/5/2003	62	60	63	69
8/6/2003	62	61	63	67
8/7/2003	61	59	62	65
8/8/2003	61	60	62	66
8/9/2003	61	59	62	65
8/10/2003	62	61	63	66
8/11/2003	62	62	64	65
8/12/2003	62	60	64	66
8/13/2003	62	60	63	67
8/14/2003	62	60	64	67
8/15/2003	62	60	64	67
8/16/2003	61	60	63	67
8/17/2003	62	60	64	66
8/18/2003	60	59	62	65
8/19/2003	59	59	61	65
8/20/2003	60	59	62	66
8/21/2003	63	60	64	67
8/22/2003	61	59	**	68
8/23/2003	60	59		72
8/24/2003	58	58		63
8/25/2003	59	59		64
8/26/2003	60	59		65
8/27/2003	60	59		65
8/28/2003	60	59		65
8/29/2003	60	59		64
8/30/2003	61	59		65
8/31/2003	59	59		62
9/1/2003	59	59		62
9/2/2003	59	59		62
9/3/2003	59	59		61
9/4/2003	60	59		62
9/5/2003	59	59		62

Table 3.4-6. (Continued.)

DATE	Schuylkill River[2] at Station 107 (upstream)	East Norwegian Creek[3]	Schuylkill River[4] at Station 109 (downstream)	Little Schuylkill[5] River
9/6/2003	58	58		60
9/7/2003	58	59		60
9/8/2003	58	58		61
9/9/2003	59	59		61
9/10/2003	57	58		59
9/11/2003	58	58		60
9/12/2003	58	58		60
9/13/2003	59	60		61
9/14/2003	62	60		64
9/15/2003	62	60		64
9/16/2003	61	59		64
9/17/2003	58	58		62
9/18/2003	58	58		61
9/19/2003	61	63		62
9/20/2003	60	60		63
9/21/2003	58	58		61
9/22/2003	59	59		62
9/23/2003	62	61		63
9/24/2003	57	58		61
9/25/2003	57	57		60
9/26/2003	58	58		60
9/27/2003	59	59		62
9/28/2003	59	59		61
9/29/2003	56	57		59
9/30/2003	54	56		57
10/1/2003	53	56	55	56
10/2/2003	51	55	53	54
10/3/2003	50	55	52	53
10/4/2003	51	55	52	52
10/5/2003	50	55	52	51
10/6/2003	50	54	51	50
10/7/2003	50	55	51	50
10/8/2003	52	56	53	53
10/9/2003	54	56	55	54
10/10/2003	55	57	56	55
10/11/2003	55	56	56	55
10/12/2003	54	55	55	55

Table 3.4-6. (Continued.)

DATE	Schuylkill River[2] at Station 107 (upstream)	East Norwegian Creek[3]	Schuylkill River[4] at Station 109 (downstream)	Little Schuylkill[5] River
10/13/2003	54	55	55	55
10/14/2003	53	55	54	54
10/15/2003	54	55	55	55
10/16/2003	51	54	52	52
10/17/2003	52	53	53	52
10/18/2003	51	52	52	51
10/19/2003	51	52	52	51
10/20/2003	50	51	51	50
10/21/2003	52	53	53	52
10/22/2003	52	53	53	52
10/23/2003	47	49	48	47

** Recorder malfunction after upload

[1] Measurements made using Tidbit temperature loggers.

[2] Station 107 is located in the Schuylkill River immediately upstream of the Norwegian Creek confluence.

[3] Measurements made in East Norwegian Creek immediately upstream of the long culvert which conveys the stream under Pottsville.

[4] Station 109 is located in the Schuylkill River approximately 3 miles downstream of the Norwegian Creek confluence.

[5] Measurements made at the PA Route 309 bridge, 1.3 miles north of Tamaqua, Pennsylvania.

Table 3.4-7. Fish collected by electrofishing at Stations 106[1] and 109[2] in the Schuylkill River near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July - October 2003.

	Sample Date:	July 1				July 30			
	Sample Station:	106[3]		109		106		109	
		Upstream		Downstream		Upstream		Downstream	
Scientific Name	Common Name	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)
Onchorynchus mykiss	rainbow trout								
Salmo trutta	brown trout (wild)			3	220-226				
Salmo trutta	brown trout (stock carryover)							5	240-301
Salmo trutta	brown trout (stocked fingerling)							3	69-100
Salvelinus fontinalis	brook trout (wild)			1	199			2	100-105
Carassius auratus	goldfish								
Cyprinus carpio	carp								
Rhinichthys atratulus	blacknose dace	61	36-83	16	34-88	149	30-95	76	35-90
Semotilus atromaculatus	creek chub	50	42-167	3	62-134	94	40-186	8	55-95
Catostomus commersoni	white sucker	16	78-326	29	78-375	83	72-372	61	63-369
Ictalurus punctatus	channel catfish							1	405
Ameiurus natalis	yellow bullhead	1	158						
Lepomis cyanellus	green sunfish	17	31-120	7	58-112	29	40-105	7	44-119
Lepomis gibbosus	pumpkinseed			4	55-70	4	33-64		
Lepomis machrochirus	bluegill			7	35-115			3	45-69
Micropterus salmoides	largemouth bass			1	74			1	45
	Total Species:	5		9		5		9	
	Total Individuals:	145		71		359		167	
Physicochemical data:									
	Time:	1515		0930		1555		0800	
	Water Temp (C):	16.2		14.8		17.5		15.4	
	DO (mg/l):	8.19		9.64		8.50		9.01	
	pH:	6.32		6.68		7.40		7.14	
	Conductivity (µmhos/cm):	324		324		494		437	
	Total Alkalinity (mg/l):	15		34		78		38	

[1] Station 106 is located in the Schuylkill River approximately 0.5 mile upstream of the Norwegian Creek confluence.
[2] Station 109 is located in the Schuylkill River approximately 3 miles downstream of the Norwegian Creek confluence.
[3] Station 107, located in the Schuylkill River immediately upstream of the Norwegian Creek confluence, was sampled on this date, only.

Table 3.4-7. (Continued)

	Sample Date:	August 21				October 10			
	Sample Station:	106		109		106		109	
		Upstream		Downstream		Upstream		Downstream	
Scientific Name	Common Name	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)
Onchorynchus mykiss	rainbow trout			1	276			2	315-335
Salmo trutta	brown trout (wild)								
Salmo trutta	brown trout (stock carryover)			2	244-262			3	305-325
Salmo trutta	brown trout (stocked fingerling)			2	88-101			1	135
Salvelinus fontinalis	brook trout (wild)	1	248	1	218			1	125
Carassius auratus	goldfish							1	100
Cyprinus carpio	carp	1	55						
Rhinichthys atratulus	blacknose dace	118	38-91	52	45-94	116	38-82	33	35-90
Semotilus atromaculatus	creek chub	106	53-155	7	58-114	118	50-186	5	64-84
Catostomus commersoni	white sucker	107	23-340	27	81-310	78	62-346	40	52-388
Ictalurus punctatus	channel catfish								
Ameiurus natalis	yellow bullhead							1	44
Lepomis cyanellus	green sunfish	42	21-92	9	28-102	60	32-110	10	35-86
Lepomis gibbosus	pumpkinseed	1	6	2	62-64	6	46-83		
Lepomis machrochirus	bluegill	2	46-71	6	44-92	1	45	1	70
Micropterus salmoides	largemouth bass			1	75				
	Total Species:	8		10		6		10	
	Total Individuals:	378		110		379		98	
Physicochemical data:									
	Time:	1230		0820		1230		0925	
	Water Temp (C):	17.0		16.5		13.0		12.5	
	DO (mg/l):	9.10		8.95		9.5		10.2	
	pH:	6.52		7.05		6.4		7.6	
	Conductivity (µmhos/cm):	298		383		292		387	
	Total Alkalinity (mg/l):	20		43		19		53	

Table 3.4-8. Benthic macroinvertebrates collected at Stations 106[1] and 109[2] in the Schuylkill River near Pottsville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

Sample Date:	July 1		July 30		August 21		October 10	
	Station No.		Station No.		Station No.		Station No.	
Taxon	106[3] Upstream	109 Downstream	106 Upstream	109 Downstream	106 Upstream	109 Downstream	106 Upstream	109 Downstream
Amphipoda (scuds)								
Crangonyx		2		14		14		8
Stygobromis	1		8				1	
Coleoptera (beetles)								
Hydrophilidae	2							
Psephenus		1						
Decapoda (crayfish)								
Cambarus			1					1
Diptera (true flies)								
Chironomidae	2	15	50	265	69	180	62	288
Chelifera						6		
Dicranota			1		1	1		
Hemerodromia						16		3
Ormosia			2		1			
Palpomyia gr.				1			1	
Pseudolimnophila								1
Psychoda				2		2		
Tipula			1		1		19	
Ephemeroptera (mayflies)								
Baetis				1				1
Hirudinea (leeches)								
Mooreobdella				1				
Isopoda (sowbugs)								
Caecidotea				21	1	19	1	43
Megaloptera (dobsonflies)								
Nigronia					2	1		
Sialis					3	4	1	1
Mollusca (clams)								
Pisidium				1				
Nematoda (round worms)								1
Nemertea (proboscis worms)								
Prostoma							1	1
Oligochaeta (worms)								
Enchytraeidae			1	3			2	1
Lumbricidae		7		56		92	3	17
Tubificidae			2	16	1	5		

Table 3.4-8. (Continued)

Sample Date:	July 1		July 30		August 21		October 10	
	Station No.		Station No.		Station No.		Station No.	
Taxon	106[3] Upstream	109 Downstream	106 Upstream	109 Downstream	106 Upstream	109 Downstream	106 Upstream	109 Downstream
Plecoptera (stoneflies)								
Allocapnia					2	1		
Leuctra			1					
Trichoptera (caddisflies)								
Ceratopsyche				12		22		4
Cheumatopsyche				41	3	66		132
Hydropsyche		2	1	4		16		168
Hydroptila				1				
Total Taxa	**3**	**5**	**10**	**15**	**10**	**15**	**9**	**15**
Total Individuals	**5**	**27**	**68**	**439**	**84**	**445**	**91**	**670**

[1] Station 106 is located in the Schuylkill River approximately 0.5 mile upstream of the Norwegian Creek confluence.
[2] Station 109 is located in the Schuylkill River approximately 3 miles downstream of the Norwegian Creek confluence.
[3] Station 107, located in the Schuylkill River immediately upstream of the Norwegian Creek confluence, was sampled on this date, only.

Table 3.4-9. Measurements of daily total discharge, daily water surface elevation, and weekly dissolved oxygen made at the Tamaqua Water Authority's Still Creek Reservoir during the Wadesville Mine Water Demonstration Project, July-October 2003.

Date	Reservoir Release, Daily Discharge (MG)	Reservoir Water Surface Elevation[1] (feet)	Weekly Dissolved Oxygen (mg/l)
7/29/2003	5.70	1182.1	-
7/30/2003	8.20	1182.1	-
7/31/2003	8.00	1182.0	-
8/1/2003	8.00	1182.0	7.6
8/2/2003	7.90	1181.9	-
8/3/2003	8.20	1181.9	-
8/4/2003	8.20	1182.3	-
8/5/2003	8.00	1182.3	-
8/6/2003	8.00	1182.3	-
8/7/2000	8.00	1182.2	-
8/8/2003	8.00	1182.2	7.0
8/9/2003	8.30	1182.2	-
8/10/2003	8.00	1182.2	-
8/11/2003	8.00	1182.2	-
8/12/2003	8.10	1182.3	-
8/13/2003	8.20	1182.2	-
8/14/2003	8.00	1182.1	-
8/15/2003	8.00	1182.1	6.9
8/16/2003	8.20	1182.1	-
8/17/2003	8.10	1182.1	-
8/18/2003	8.00	1182.1	-
8/19/2003	-	1182.1	-
8/20/2003	-	-	-
8/21/2003	-	-	-
8/22/2003	-	-	-
8/23/2003	-	-	-
8/24/2003	-	-	-
8/25/2003	-	-	-
8/26/2003	-	-	-
8/27/2003	-	-	-
8/28/2003	-	-	-
8/29/2003	8.00	1182.1	-
8/30/2003	8.10	1182.1	-
8/31/2003	7.80	1182.1	-
9/1/2003	8.20	1182.0	-
9/2/2003	8.10	1182.0	-

Table 3.4-9. (Continued.)

Date	Reservoir Release, Daily Discharge (MG)	Reservoir Water Surface Elevation[1] (feet)	Weekly Dissolved Oxygen (mg/l)
9/3/2003	8.00	1182.0	-
9/4/2003	8.10	1182.0	-
9/5/2003	8.10	1182.0	7.10
9/6/2003	8.20	1182.0	-
9/7/2003	8.10	1182.0	-
9/8/2003	8.10	1181.9	-
9/9/2003	7.80	1181.8	-
9/10/2003	8.00	1181.8	-
9/11/2003	8.00	1181.8	-
9/12/2003	8.00	1181.7	7.60
9/13/2003	8.10	1181.6	-
9/14/2003	8.20	1181.5	-
9/15/2003	8.20	1181.5	-
9/16/2003	8.20	1181.5	-
9/17/2003	8.00	1181.4	-
9/18/2003	1.90	1181.4	-
9/19/2003	12.80	1181.5	-
9/20/2003	15.60	1181.4	7.40
9/21/2003	16.10	1181.4	-
9/22/2003	16.00	1181.2	-
9/23/2003	16.80	1181.5	-
9/24/2003	16.00	1181.8	-
9/25/2003	16.10	1181.9	-
9/26/2003	16.00	1181.9	7.40
9/27/2003	16.00	1181.8	-
9/28/2003	16.00	1181.8	-
9/29/2003	16.00	1181.7	-
9/30/2003	16.00	1181.7	-
10/1/2003	16.20	1181.6	-
10/2/2003	15.90	1181.6	-
10/3/2003	-	1181.6	9.60
10/4/2003	-	-	-
10/5/2003	-	-	-
10/6/2003	-	-	-
10/7/2003	-	-	-
10/8/2003	-	-	-

Table 3.4-9. (Continued.)

Date	Reservoir Release, Daily Discharge (MG)	Reservoir Water Surface Elevation[1] (feet)	Weekly Dissolved Oxygen (mg/l)
10/9/2003	-	-	-
10/10/2003	-	-	-
10/11/2003	-	-	-
10/12/2003	-	-	-
10/13/2003	-	-	-
10/14/2003	-	-	-
10/15/2003	-	-	-
10/16/2003	-	-	-
10/17/2003	-	-	-
10/18/2003	-	-	-
10/19/2003	-	-	-
10/20/2003	-	-	-
10/21/2003	-	-	-
10/22/2003	-	-	-
10/23/2003	-	-	-

[1] Elevation above mean sea level.

Table 3.4-10. Measurements of pH and specific conductance made in Schuylkill River intake water at the Borough of Pottstown's Water Treatment Plant during the Wadesville Mine Water Demonstration Project, July-October 2003.

Date	pH Range[1] (standard units) Min	Max	Specific Conductance µmhos/cm
7/11/2003	7.4	7.5	
7/12/2003	7.3	7.6	
7/13/2003	7.4	7.6	
7/14/2003	7.4	7.8	
7/15/2003	7.4	7.9	370
7/16/2003	7.5	7.9	
7/17/2003	7.4	7.8	
7/18/2003	7.4	7.7	
7/19/2003	7.3	7.6	
7/20/2003	7.4	7.7	
7/21/2003	7.4	7.7	
7/22/2003	7.2	7.4	
7/23/2003	7.3	7.5	
7/24/2003	7.3	7.5	
7/25/2003	7.4	7.5	
7/26/2003	7.3	7.5	
7/27/2003	7.3	7.5	
7/28/2003	7.1	7.5	
7/29/2003	7.2	7.6	330
7/30/2003	7.3	7.5	360
7/31/2003	7.4	7.5	
8/1/2003	7.3	8.0	370
8/2/2003	7.4	7.5	
8/3/2003	7.3	7.6	
8/4/2003	7.4	7.5	
8/5/2003	7.4	7.6	370
8/6/2003	7.2	7.4	
8/7/2003	7.4	7.6	
8/8/2003	7.3	7.5	
8/9/2003	7.2	7.4	
8/10/2003	7.2	7.4	
8/11/2003	7.2	7.4	320
8/12/2003	7.2	7.5	
8/13/2003	7.2	7.3	310
8/14/2003	7.1	7.4	
8/15/2003	7.2	7.3	

Table 3.4-10. (Continued.)

Date	pH Range[1] (standard units) Min	Max	Specific Conductance µmhos/cm
8/16/2003	7.4	7.5	
8/17/2003	7.3	7.6	
8/18/2003	7.2	7.5	310
8/19/2003	7.4	7.6	300
8/20/2003	7.4	7.5	
8/21/2003	7.4	7.7	
8/22/2003	7.5	7.7	370
8/23/2003	7.4	7.8	
8/24/2003	7.4	7.6	
8/25/2003	7.5	7.9	
8/26/2003	7.5	8.2	420
8/27/2003	7.6	8.0	
8/28/2003	7.6	8.1	
8/29/2003	7.7	8.2	440
8/30/2003	7.5	8.0	
8/31/2003	7.5	7.8	
9/1/2003	7.5	7.9	
9/2/2003	7.4	7.7	
9/3/2003	7.4	7.6	
9/4/2003	7.5	7.7	
9/5/2003	7.4	7.5	360
9/6/2003	7.4	7.6	
9/7/2003	7.5	7.6	
9/8/2003	7.4	7.6	
9/9/2003	7.5	7.7	400
9/10/2003	7.6	7.7	
9/11/2003	7.6	7.7	
9/12/2003	7.5	7.7	
9/13/2003	7.4	7.7	
9/14/2003	7.4	7.5	
9/15/2003	7.1	7.5	170
9/16/2003	7.1	7.6	
9/17/2003	7.4	7.7	
9/18/2003	7.5	7.7	330
9/19/2003	7.3	7.6	
9/20/2003	7.3	7.5	

Table 3.4-10. (Continued.)

Date	pH Range[1] (standard units) Min	Max	Specific Conductance µmhos/cm
9/21/2003	7.3	7.5	
9/22/2003	7.3	7.5	
9/23/2003	7.2	7.5	
9/24/2003	7.1	7.3	
9/25/2003	7.0	7.4	
9/26/2003	7.1	7.4	250
9/27/2003	7.3	7.4	
9/28/2003	7.1	7.4	
9/29/2003	7.2	7.6	
9/30/2003	7.2	7.6	300
10/1/2003	7.2	7.8	
10/2/2003	7.2	7.6	
10/3/2003	7.3	7.7	330
10/4/2003	7.3	7.5	
10/5/2003	7.4	7.5	
10/6/2003	7.3	7.6	
10/7/2003	7.2	7.6	
10/8/2003	7.4	7.6	
10/9/2003	7.4	7.6	380
10/10/2003	7.3	7.5	390
10/11/2003	7.2	7.7	
10/12/2003	7.4	7.9	
10/13/2003	7.4	7.7	
10/14/2003	7.6	8.1	
10/15/2003	7.2	7.6	
10/16/2003	7.0	7.4	
10/17/2003	7.3	7.6	330
10/18/2003	7.2	7.5	
10/19/2003	7.1	7.3	
10/20/2003	7.2	7.4	
10/21/2003	7.2	7.8	
10/22/2003	7.1	7.4	
10/23/2003	7.2	7.7	380

[1] pH is measured every 2 hours during the day.

Table 3.4-11. Water quality measurements[1] made in the Bradshaw Reservoir outfall to the East Branch Perkiomen Creek and at three locations in East Branch Perkiomen Creek during the Wadesville Mine Water Demonstration Project, July-October 2003.

	200 ft. Upstream of Bradshaw Outfall				Outfall from Bradshaw Reservoir				Downstream at Bucks Rd. USGS gage				Downstream at Rt. 73 Bridge			
Date	Diss. Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)	Diss. Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)	Diss. Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)	Diss. Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)
7/1/2003	8.9	22.4	330	400	13.2	21.6	1	2	12.4	22.0	6	10				
7/7/2003	9.7	25.6	39	60	12.2	25.0	2	9	10.8	24.6	39	40				
7/17/2003	6.5	20.7	1000	1100	11.9	23.7	1	2	9.0	24.0	7	7	9.6	26.0	17	44
7/22/2003	6.7	22.3	2400	6000	11.3	23.4	50	90	10.4	22.4	920	1800				
7/28/2003	9.1	23.5	730	1100	12.6	25	10	13	9.9	25.3	19	20				
8/5/2003	7.9	22.9	2000	2700	8.9	24.9	200	340	8.5	24.9	120	120				
8/12/2003	8.7	22.1	340	400	9.7	23.8	130	230	9.4	24.0	74	200	9.4	25.2	150	200
8/18/2003	11.0	21.2	290	300	11.4	23.6	19	19	9.1	24.2	36	40	9.7	24.9	130	200
8/19/2003	10.6	21.2	250	320	10.6	23.3	22	50	9.7	23.6	28	40	8.5	25.3	18	80
8/21/2003	7.3	22.2	180	330	9.3	24.1	10	16	8.9	24.7	28	50	9.3	26	17	62
9/8/2003	10.2	19.0	200	260	10.6	19.5	21	45	10.2	20.1	46	46	9.8	20.9	43	94
9/9/2003	9.0	18.8	160	170	9.9	20.1	9	27	9.4	20.5	19	20	9.8	21.9	30	90
9/10/2003	9.5	17.2	180	370	10.1	20.1	5	14	9.7	20.6	22	22	9.7	180	22	64
9/17/2003	9.1	16.6	1200	2000	9.6	21.3	120	240	9.0	20.9	120	200	9.2	18.8	260	400
9/18/2003	9.1	16.7	260	350	9.6	20.7	69	80	8.7	20.3	47	66	9.0	18.4	160	200
10/6/2003	12.7	9.0	130	300	11.6	12.7	40	64	12.0	12.8	44	60	10.4	12.3	64	120
10/9/2003	11.1	13.0	93	400	10.2	13.3	40	40	10.9	14.0	31	56	12.5	14.0	53	80
10/20/2003	11.0	9.5	180	180	10.8	12.3	88	90	11.3	12.4	70	70	11.9	11.0	80	80
10/22/2003	10.5	12.5	70	66	10.8	12.5	80	80	11.6	12.7	54	70	11.8	12.6	65	88
10/23/2003	9.3	8.6	114	250	9.2	11.6	64	80	9.7	11.3	66	100	11.3	9.5	66	90

[1] Sample collection frequency - 5 dates per month.

Table 3.4-12. Monthly water quality measurements made in the Perkiomen Creek near the East Branch Perkiomen Creek confluence during the Wadesville Mine Water Demonstration Project, July-October 2003.

Date	Dissolved Oxygen (mg/l)	Temperature (°C)	*E. coli* (mpn/100ml)	Fecal Coliforms (no./100ml)
Perkiomen Creek upstream of the East Branch Perkiomen Creek confluence, Rt 73 Bridge Schwenksville				
July 17	8.7	26.4	18	60
August 12	8.7	24.8	1100	2000
September 10	9.8	22.0	110	120
October 9	11.8	15.4	48	56
Perkiomen Creek downstream of the East Branch Perkiomen Creek confluence, Grateford Intake Pumphouse				
July 17	9.4	25.9	21	60
August 12	8.1	24.6	1100	1500
September 10	9.8	21.1	39	100
October 9	12.7	15.3	59	80

Table 3.4-13. Daily mean discharge of the Schuylkill River measured at four locations and total daily rainfall measured at Landingville, Pennsylvania during the Wadesville Mine Water Demonstration Project, July-October 2003.

Date	Daily Mean Discharge (cubic feet/second)				Rainfall (in.)
	Landingville	Berne	Reading	Pottstown	Landingville
7/10/2003	204	475	1250	1620	0.17
7/11/2003	245	507	1240	1640	0.14
7/12/2003	201	468	1200	1570	0.00
7/13/2003	182	410	1080	1440	0.00
7/14/2003	172	379	975	1340	0.00
7/15/2003	161	361	868	1200	0.00
7/16/2003	154	344	837	1150	0.03
7/17/2003	145	323	830	1120	0.00
7/18/2003	177	330	818	1070	0.41
7/19/2003	217	514	1130	1340	0.00
7/20/2003	146	347	946	1320	0.00
7/21/2003	307	427	912	1180	1.66
7/22/2003	552	2030	6210	5900	0.43
7/23/2003	587	1210	5110	7610	1.65
7/24/2003	841	2859	6450	6650	0.02
7/25/2003	437	1490	4300	5420	0.00
7/26/2003	339	1019	2890	3400	0.00
7/27/2003	294	820	2410	2770	0.41
7/28/2003	337	848	2150	2480	0.01
7/29/2003	251	663	1660	2030	0.00
7/30/2003	219	565	1419	1700	0.00
7/31/2003	206	512	1280	1550	0.00
8/1/2003	243	537	1230	1480	0.33
8/2/2003	238	585	1350	1550	0.16
8/3/2003	197	486	1210	1530	0.00
8/4/2003	549	1130	1340	1560	1.32
8/5/2003	454	1800	2849	2930	0.15
8/6/2003	755	1890	3410	4210	0.34
8/7/2003	668	1719	3120	3850	0.00
8/8/2003	543	1390	2400	2839	0.00
8/9/2003	481	1150	2090	2430	0.19
8/10/2003	484	1100	1980	3200	0.66
8/11/2003	660	1290	1960	2340	0.22
8/12/2003	651	1840	2930	3140	0.00
8/13/2003	709	1429	2230	2720	0.43
8/14/2003	670	1810	2580	2740	0.00
8/15/2003	498	1260	2039	2430	0.00

Table 3.4-13. (Continued.)

Date	Daily Mean Discharge (cubic feet/second)				Rainfall (in.)
	Landingville	Berne	Reading	Pottstown	Landingville
8/16/2003	444	1050	1800	2130	0.13
8/17/2003	437	1040	1750	2070	0.07
8/18/2003	356	836	1550	1850	0.00
8/19/2003	319	718	1409	1690	0.00
8/20/2003	292	634	1250	1510	0.00
8/21/2003	273	582	1140	1370	0.00
8/22/2003	264	548	1100	1310	0.06
8/23/2003	250	534	1060	1370	0.00
8/24/2003	222	472	949	1190	0.00
8/25/2003	209	440	886	1110	0.00
8/26/2003	202	418	850	1050	0.04
8/27/2003	198	414	881	1090	0.03
8/28/2003	186	396	835	1080	0.00
8/29/2003	182	368	781	997	0.46
8/30/2003	246	489	892	1010	0.47
8/31/2003	188	439	971	1210	0.00
9/1/2003	209	404	912	1090	0.42
9/2/2003	239	527	1310	2540	0.25
9/3/2003	383	788	1429	1930	1.35
9/4/2003	341	775	1620	2240	0.05
9/5/2003	258	618	1360	1870	0.00
9/6/2003	219	515	1100	1450	0.00
9/7/2003	199	456	969	1270	0.00
9/8/2003	186	420	886	1170	0.00
9/9/2003	178	395	821	1090	0.00
9/10/2003	166	370	722	989	0.00
9/11/2003	159	350	684	930	0.00
9/12/2003	156	340	663	904	0.00
9/13/2003	197	363	709	1150	0.86
9/14/2003	256	584	1090	1600	0.19
9/15/2003	247	639	2140	6100	1.22
9/16/2003	392	1300	3980	5370	0.00
9/17/2003	247	844	3469	4400	0.00
9/18/2003	222	671	2470	3360	0.08
9/19/2003	381	997	2440	4350	0.81
9/20/2003	291	860	2210	3110	0.01
9/21/2003	253	723	1870	2480	0.00

Table 3.4-13. (Continued.)

Date	Daily Mean Discharge (cubic feet/second)				Rainfall (in.)
	Landingville	Berne	Reading	Pottstown	Landingville
9/22/2003	242	656	1570	2140	0.48
9/23/2003	1590	4470	8990	10000	2.09
9/24/2003	987	3420	8800	12100	0.00
9/25/2003	704	2270	5260	6590	0.01
9/26/2003	572	1770	4200	5230	0.02
9/27/2003	491	1429	3360	4089	0.01
9/28/2003	649	1600	3310	4270	0.61
9/29/2003	474	1270	2910	3770	0.02
9/30/2003	407	1030	2370	2900	0.00
10/1/2003	381	931	2140	2560	0.11
10/2/2003	351	861	2020	2400	0.00
10/3/2003	323	775	1820	2210	0.00
10/4/2003	342	772	1729	2060	0.38
10/5/2003	314	746	1760	2120	0.01
10/6/2003	280	646	1560	1900	0.00
10/7/2003	257	583	1460	1750	0.00
10/8/2003	240	547	1380	1660	0.00
10/9/2003	224	520	1320	1580	0.00
10/10/2003	214	495	1270	1530	0.00
10/11/2003	199	465	1180	1440	0.00
10/12/2003	192	441	1130	1370	0.00
10/13/2003	187	417	1100	1310	0.00
10/14/2003	195	409	1150	1290	1.34
10/15/2003	604	1400	2890	3250	0.21
10/16/2003	329	897	2630	3360	0.00
10/17/2003	296	737	2000	2420	0.27
10/18/2003	301	748	1840	2250	0.01
10/19/2003	274	659	1690	2030	0.00
10/20/2003	253	602	1590	1860	0.00
10/21/2003	244	577	1470	1739	0.00
10/22/2003	238	566	1360	1640	0.02
10/23/2003	225	535	1270	1590	0.00