

Permit Review 7

BD MINING (PERMIT # 54850202)

Site Summary

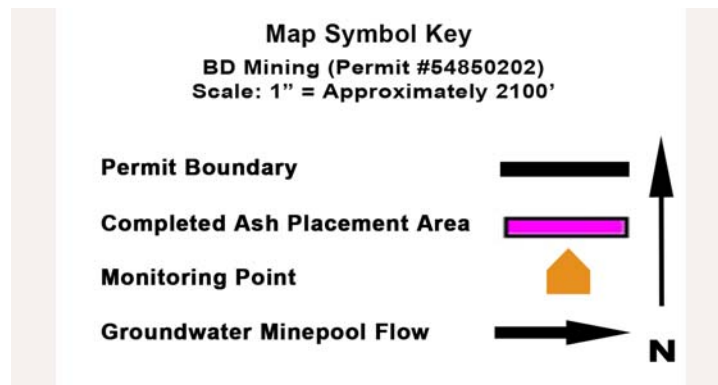
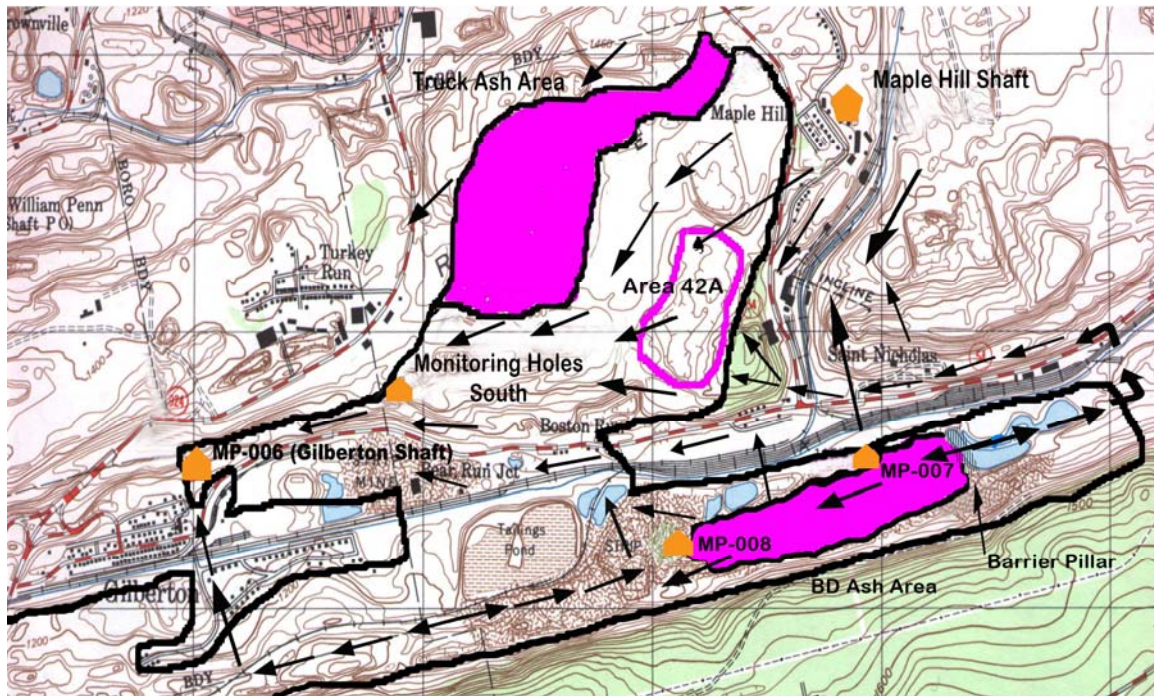
This refuse reprocessing (culm mining) site is located in Gilberton Borough, Mahanoy Township, Schuylkill County. The site lies in the eastern part of the Western Middle Anthracite Field in the Mahanoy-Shamokin Creeks Priority Watershed 6B. This is the southernmost site of a complex of ash disposal areas that include the Knickerbocker Pit Demonstration Project and two other ash disposal areas in the Ellengowan Mine permit area to the north (Permit #54793206, see Permit Review 5). The current on-going ash disposal is filling abandoned strip pits and a former silt dam. The goal of the project is to regrade the contours of the area with the ash reestablishing surface runoff patterns to reduce the inflow of water into existing mine pools, thus making the purpose or “beneficial use” of ash in this case simple placement.

Ash from burning primarily culm is being hauled in from FBC power plants operated by Gilberton Power Company, Panther Creek Partners, UGI Hunlock Creek, and AES Thames Inc., as well as from the Logan Generating Plant. The permit encompasses a total of 1,590 acres of which 809 acres are slated for coal refuse removal and 175 acres are slated for FBC coal ash placement. This is a refuse reprocessing operation where culm removed from the site is burned at the Gilberton cogeneration FBC plant, and then the ash is returned to the site. While there are other ash generators using the BD Mining site, the Gilberton plant has been the primary source of ash deposited there. The 175-acre ash disposal site primarily overlies the Boston Run Colliery (an underground mine complex). The rest of the permit acreage overlies some eight different collieries. The permit authorizing ash placement was approved on December 23, 1987. The Gilberton Plant was in operation undergoing test-firing as early as January 1988, although according to inspection reports, regular shipments of its ash (approximately 120-130 tons/day) were not arriving at the BD Mining site until at least mid-March, 1988. By the end of 2002 some 3.7 million tons of ash had been placed at the site.

Geology

According to the permit the site is honeycombed with deep mines. Several coal beds have been deep mined in the Llewellyn Formation at this site including the Diamond, Orchard, Primrose, Holmes, Mammoth, and Buck Mountain Veins. Several other coal beds in the Lykens Valley coal zone of the Pottsville Formation were also deep mined at the site. This man-made, karst-like underground structure accounts for a hydrologically complex system: an interconnected system of mine pools. Aside from the impact of the ash, the water quality in these mine pools is affected by surface waters that flow into abandoned strip pits and through mine shafts and percolate their way into the mine pools through permeable spoils and culm banks and natural structures such as faults, joints, fractures, and cleavages.

Site Map: BD Mining



Groundwater Monitoring Data: Discussion

Groundwater in the area consists of the mine pools in the abandoned Gilberton, Tunnel Ridge, Saint Nicholas and Boston Run Collieries. These pools are interconnected with at least 11 more upgradient collieries, and the combined water flow of these pools ultimately discharges locally at the Gilberton Shaft pumps. The Gilberton Shaft pumps were installed for the purpose of preventing flooding in the Borough of Gilberton. The flow of water has been documented by the U.S. Bureau of Mines. The RAC disposal area in the northern part of the BD Mining permit has only just begun operating and thus only a few measurements from monitoring points, RAC MP#1 and RAC MP#2, was available for this review. Accordingly, this review focuses on monitoring data from the

ash placement area that has been operating for 18 years in the southeastern portion of the BD permit area.

Unfortunately, according to permit materials, there are no monitoring points that are located upgradient or hydrologically above this ash disposal area, and therefore no monitoring points that are unaffected by the ash. Three BD Mining ash monitoring points assessed in this report are or have been monitoring deep mine pools under the site, and additional more limited review has been undertaken of a fourth monitoring point that was monitoring surface waters also in the refuse remining/ash placement area. According to the permit, MP006 is the downgradient monitoring point located at the Gilberton Shaft pumps. While there is scant information on water levels at these monitoring points in the BD permit files, according to data for the period from 1986 to 2003 from the PADEP Bureau of Abandoned Mine Reclamation, measurements from boreholes nearest to these monitoring points reveal that water level elevations at MP006 are from 15 to 48 feet lower than at MP007 and MP008. Although MP007 and MP008 are labeled as “upgradient” in the permit, they are upgradient relative to the Gilberton Shaft pumps only but clearly downgradient of BD’s ash placement area as PADEP explains in its report, Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania.¹ and as is stated in ATTACHMENT 2, GROUNDWATER MONITORING SUPPLEMENTAL INFORMATION dated May 1990. Therefore, MP007 and MP008 are classified as “downgradient” for the purpose of assessing impacts of ash on minepool water quality in this report.

MP007 was sampled from March 1988 to September 1996. MP007 was displaced when the ash filling operation moved over it. MP008, which replaced MP007 and lies approximately 2,750 feet west-south-west of the older well’s location, was sampled from January 1996 to the present. The latest data available for this report, however, extended to a sampling on July 22, 2004. Both MP007 and MP008 have been monitoring mine pool water not only downgradient of the ash disposal area but in proximity to the ash as its placement has advanced from east to west. ATTACHMENT 2 provides a diagram of their construction and text which indicates they are cased in solid material to 120 feet and extend into the “Top Split Vein Workings” to total depths of approximately 225 feet for MP007 and 250 feet for MP008.

Maps of the permit depict the Gilberton Shaft monitoring point, MP006, as approximately 6000 feet west of MP008, and text indicates this monitoring point is sampling the cumulative discharge from pools of several collieries that converge in the Gilberton Colliery and comprise a very large, albeit unspecified, volume of water, (BD Mining Company, SMP NO. 54850202, MINE POOL LOCATIONS, MODULE 25, EXHIBIT 1, ESTIMATED DIRECTION OF MINE POOL FLOW RVN MAY 1990 and Figure 4.9, Chapt. 4, PADEP, Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania, Dec. 2004). PADEP records indicate that an average of 3,172,249,000 gallons (approximately 16 million cubic yards) of water were pumped annually from the Gilberton Shaft from 1992 through 1997. These volumes were

¹ PADEP, Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania, (Chapter 4, Section 4.3.3: BD Mining – Overall Plant Site and Reading Anthracite – Ellengowan Site), December 2004.

removed by pumps automatically operated to keep mine pools at lower levels than have been allowed subsequently and should therefore be more reflective of the actual volumes of water in the mine pool than more recent figures which reflect smaller volumes removed to maintain the mine pool at a higher level. Thus, while the actual volume of water monitored at MP006 is unknown, it is clear that rising concentrations of pollutants at this monitoring point would reflect the degradation of a lot of water and should be a matter of major concern. It should be noted further that since these collieries also extend extensively under the neighboring Ellengowan mine, MP006 is also downgradient from three other ash placement sites that have received more than 12 million tons of CCW since 1989, most of it also FBC ash from burning culm in the surrounding area. Data has been collected from MP006 from February 1987 to the present although the latest data available for this report also extends only to the July 2004 sampling.

The data assessed and depicted in this report came from a data base (in excel files) of the monitoring data for anthracite coal ash minefills maintained by PADEP's Pottsville District Mining Office staff. Telephone conversations with PADEP staff have divulged that these data reflect total rather than dissolved concentrations. While high total concentrations of pollutants in and of themselves are a matter of concern regardless of the fraction of those concentrations that are dissolved in the water and available for immediate uptake by organisms, the absence of data on dissolved concentrations also does not support any assumption that concentrations discussed in this report are simply suspended but not dissolved in the water. Levels of Total Suspended Solids (TSS) measured at the assessed monitoring points are usually relatively low compared to high levels of Total Dissolved Solids (TDS) suggesting that the larger components of most concentrations in these data are dissolved rather than undissolved fractions. Some 89 percent of all samplings at MP006 had TSS levels below 50 mg/L while 95 percent of the samplings at MP006 had TDS levels more than ten times that high (> 500 mg/L). Some 85 percent of all TSS measurements at MP007 were below 50 mg/L while 98 percent of samplings at this monitoring point had TDS levels more than ten times that high. However at MP008, less than half the measurements, (47.5 percent), had TSS levels below 50 mg/L and less than one third, (30 percent), had TDS levels more than 500 mg/L. Still the large majority of TDS levels measured at MP008 were at least several times the TSS levels measured in the same samplings. In 28 of 40 total samplings at MP008, TDS was at least four times TSS while in only five samplings was TDS less than twice TSS. Average TDS levels at MP008 were approximately 7.95 times greater than average TSS levels.

MP006 and MP007/008

Comparing iron concentrations at monitoring point MP006 (figure 7.1) with the iron concentrations at monitoring points MP007/008 shows that the initial concentrations at MP007/008 were higher than at monitoring point MP006. Then in mid 1997 there was an abrupt decline in iron levels at MP008. Although iron concentrations at the further downgradient MP006 stayed relatively constant, iron concentrations at MP008, as the trend line shows, dropped precipitously well below the levels at MP006. Then in 2002

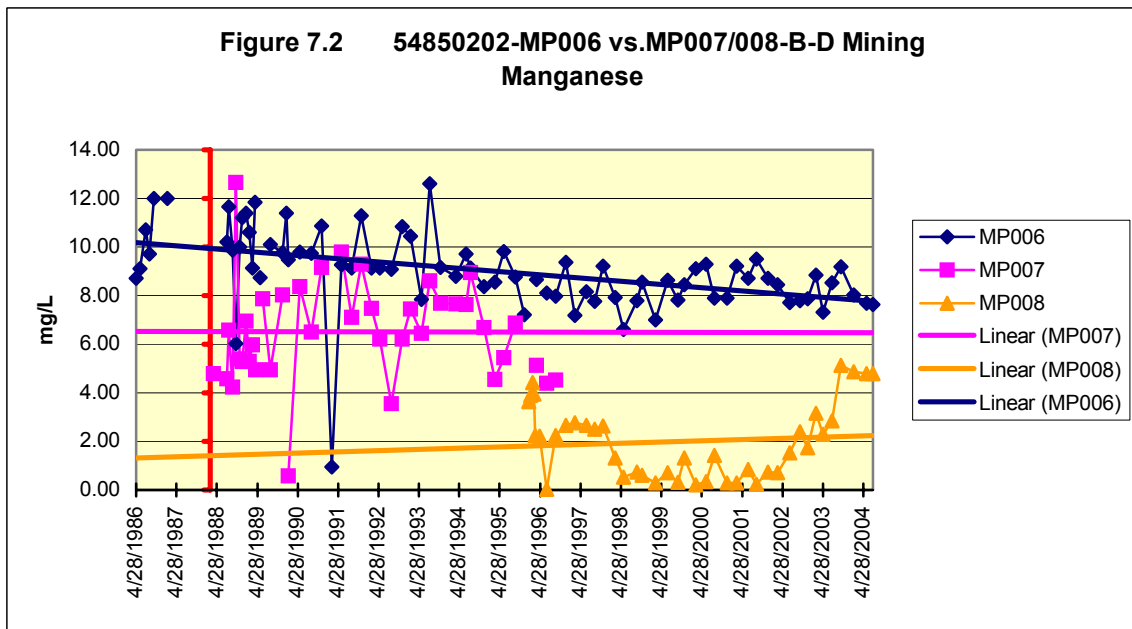
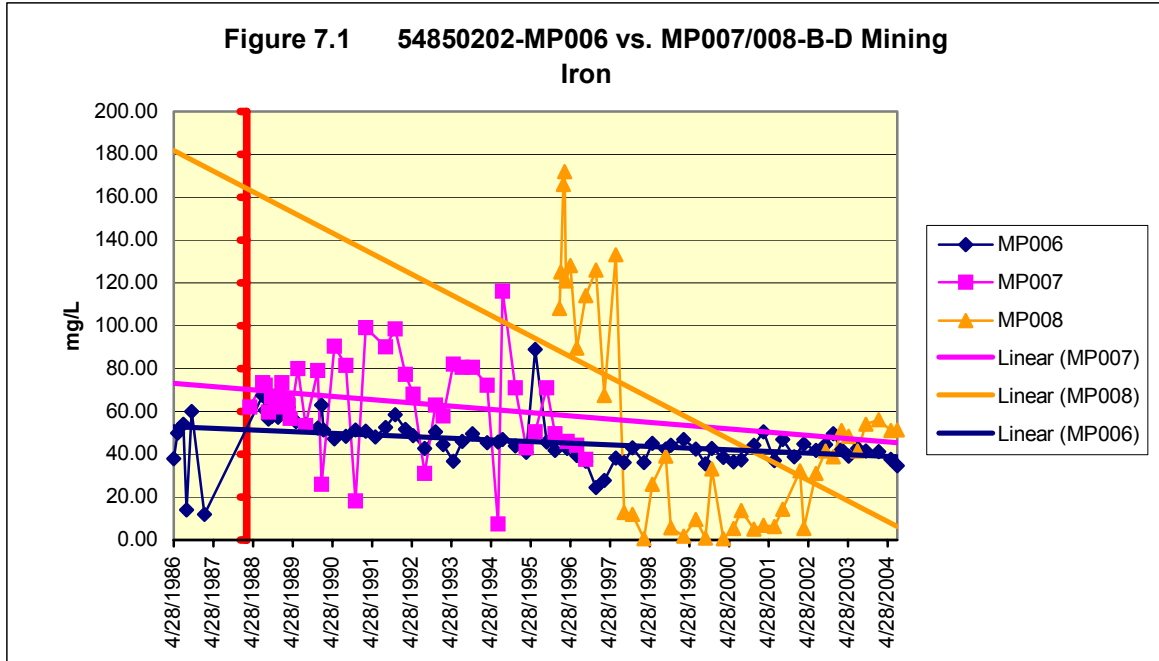
iron levels at MP008 rose back to levels at MP006 and surpassed those levels in 2003 and 2004 to a high of 56 mg/L in February 2004, 187 times the DWS (secondary MCL).

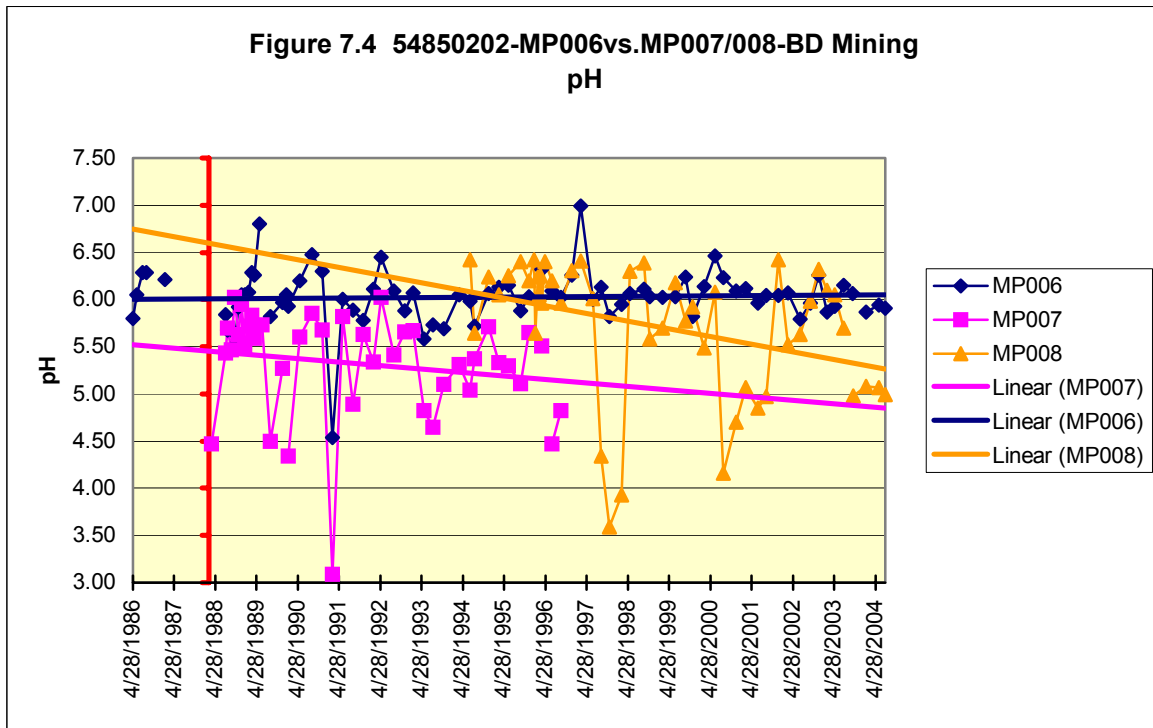
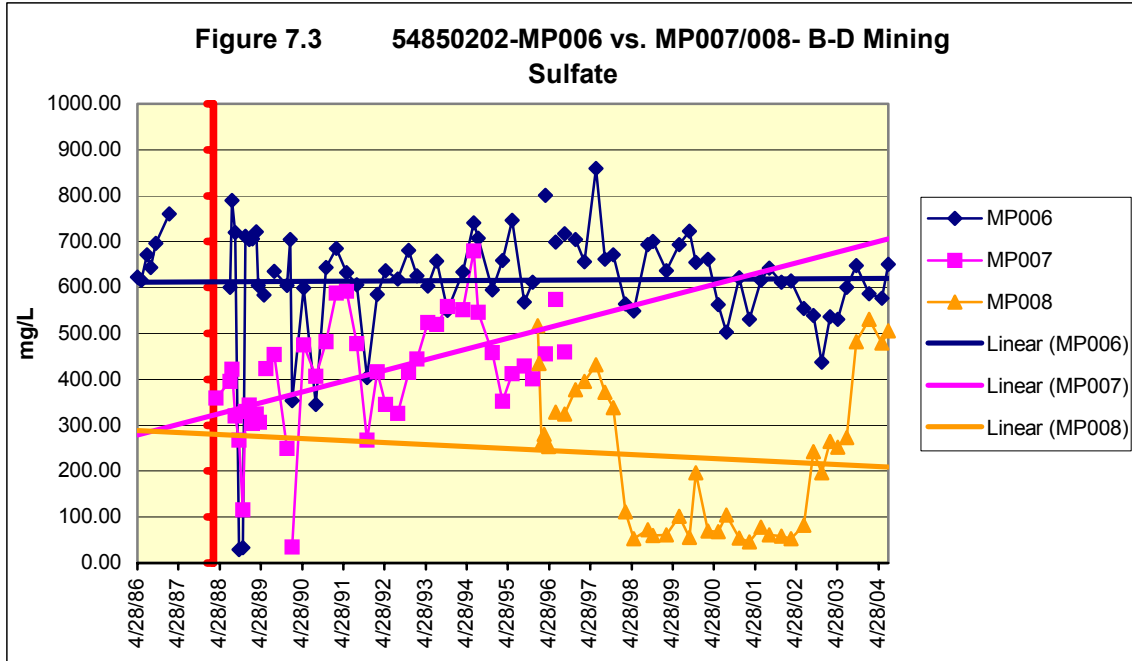
Figure 7.2 compares concentrations of manganese between the monitoring points. Unlike iron, most manganese concentrations are higher at MP006 than at either MP007 or later at MP008. Nonetheless there is a declining trend in manganese levels at MP006 from around 10 mg/L to 8 mg/L, 160 times the DWS (secondary MCL), over the duration of the monitoring period while the overall trends at MP007 and MP008 are rising gradually despite a strong decline in concentrations in the mid 1990s. Manganese concentrations dropped 3-fold in the decline at MP007/008 while concentrations at MP006 dropped off much more slowly. As happened with iron, the decline in manganese concentrations at MP007/008 was followed by a rise in manganese levels from 2002 through 2004 at MP008.

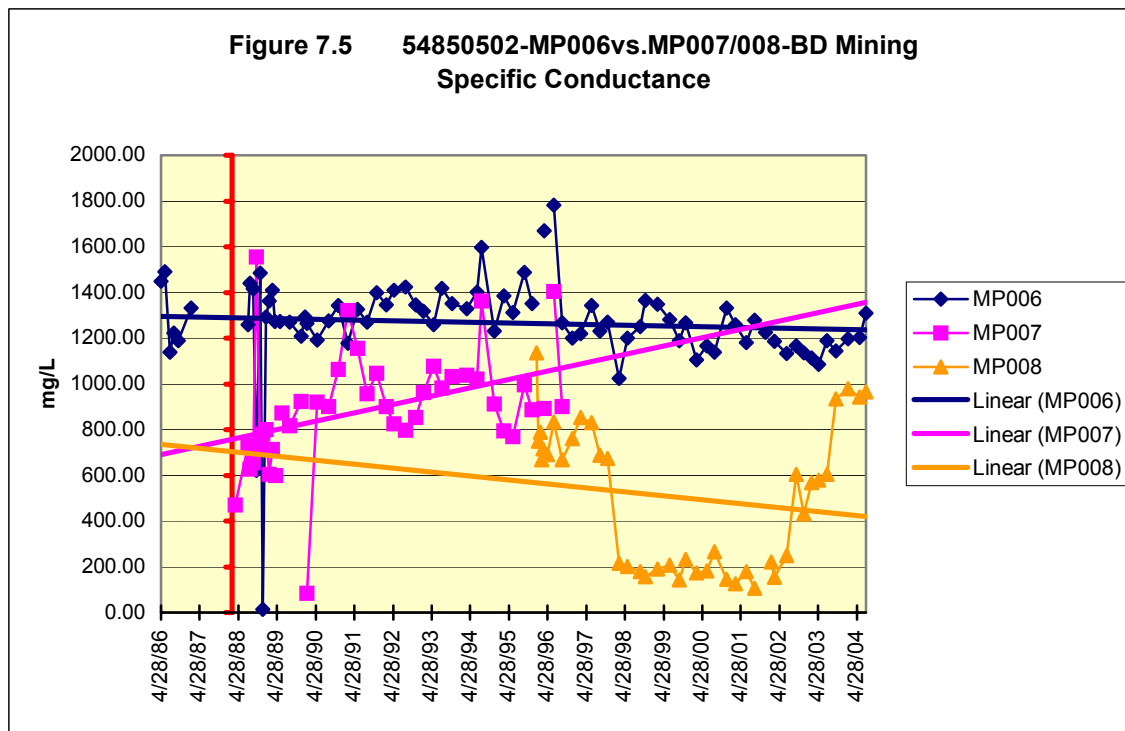
A similar pattern occurred with sulfate (figure 7.3) whose concentrations underwent a reversal in trends and declined markedly in the mid to late 90s at MP007/008 while higher concentrations at MP006 exhibited an almost flat trend line throughout the monitoring period. Nonetheless sulfate concentrations at MP008 also climbed back from levels less than half the DWS (secondary MCL) in 2002 to over 500 mg/L in 2004, twice the DWS.

The pH (figure 7.4) is almost unchanged at MP006 at 6 standard units during the sampling period. Given the large volume of the water body being sampled at MP006, a steady pH would be expected, absent major disruptions in the hydrologic system feeding that monitoring point. The MP007/008 data however show that the pH in groundwater closer to the ash is more varied, spanning levels that both surpass and fall well below the pH at MP006 suggesting more turbulent conditions at MP007/008 from the culm removal and ash placement that may also be diluted by less water. The values in figure 7.4 are of lab rather than field pH as there were several year periods when field pH measurements are not provided in the PADEP data files. Those field pH values that are provided appear to follow the same trends as lab pH although they are in most cases below the lab pH values by approximately one tenth to three fourths of a unit.

The differences in specific conductance (figure 7.5) between MP006 and MP007/008 again demonstrate the pattern described above: a trend reversal in the mid to late 90s at MP007/008, amidst a flat trend line depicting relatively unchanging but higher specific conductance measurements at MP006. After that reversal, the MP006 specific conductance readings were up to 8 times higher than at MP008 where specific conductance dropped precipitously from around 700 micromhos in November 1997 to 200 micromhos in March 1998. Of note however is the rise in specific conductance again in the last three years of monitoring at MP008 to between 400 and 1000 micromhos.



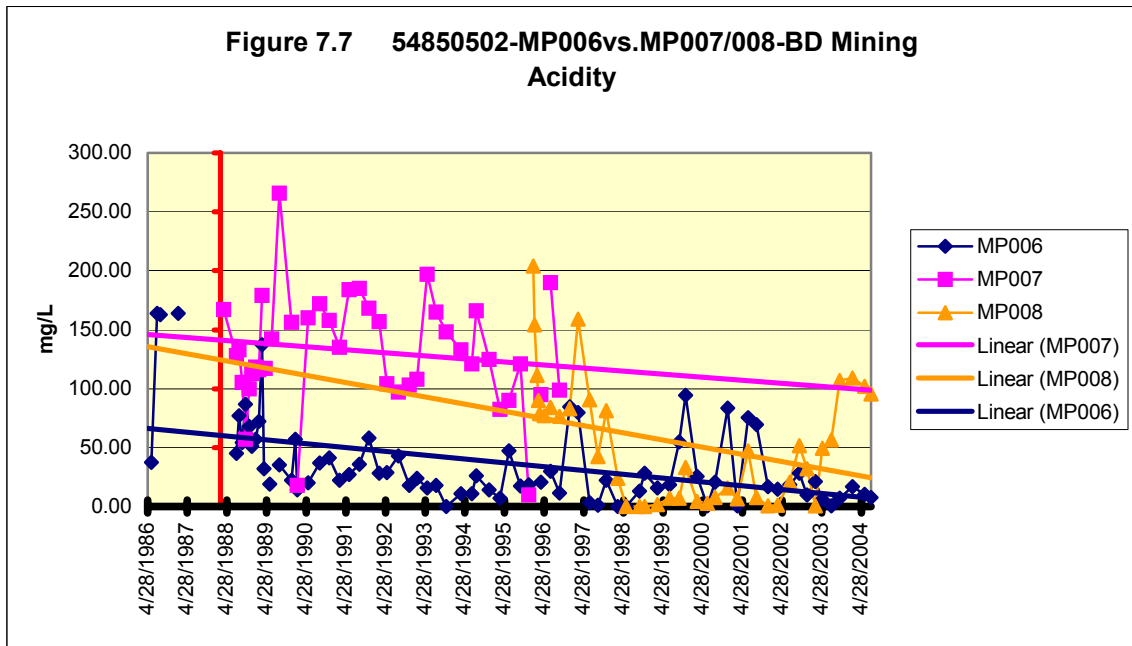
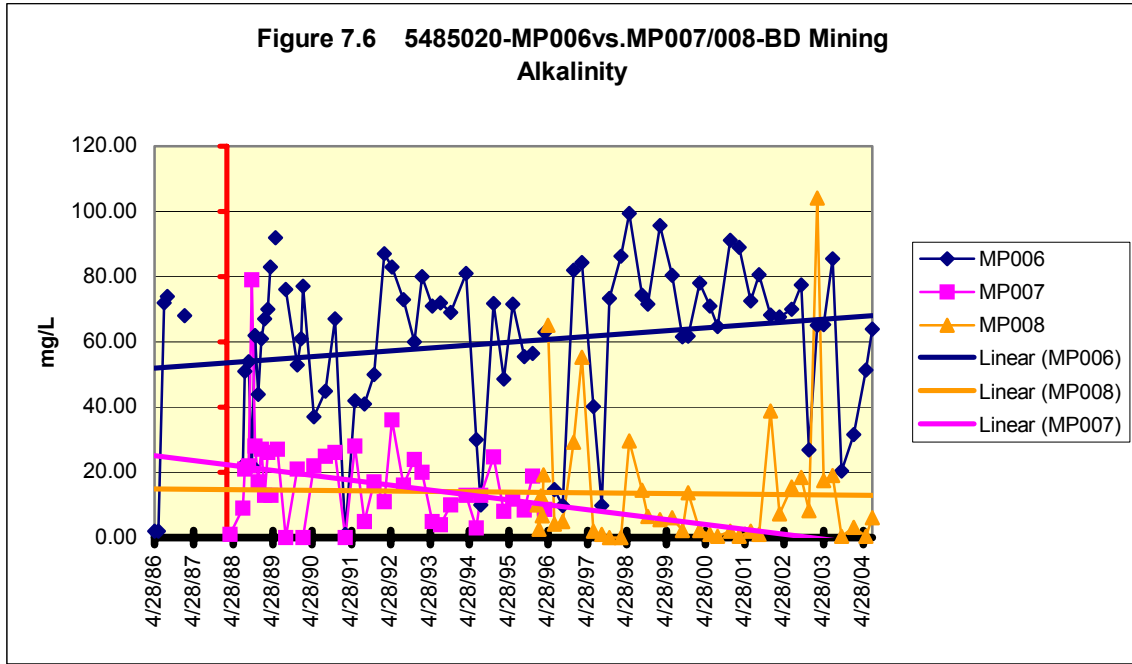


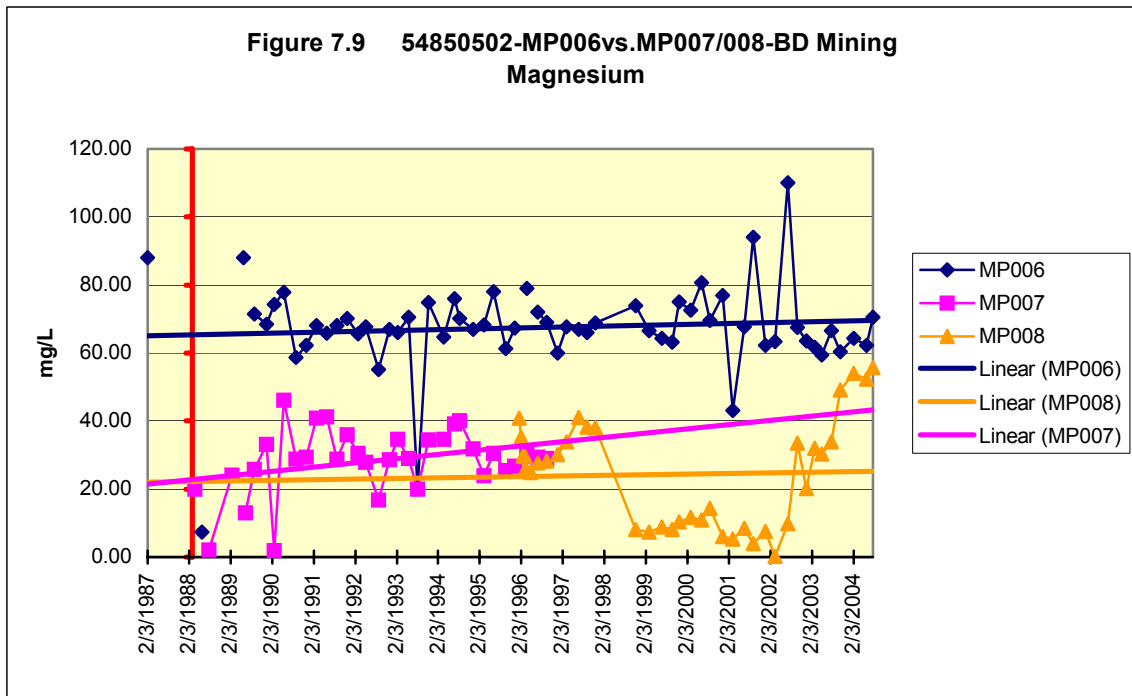
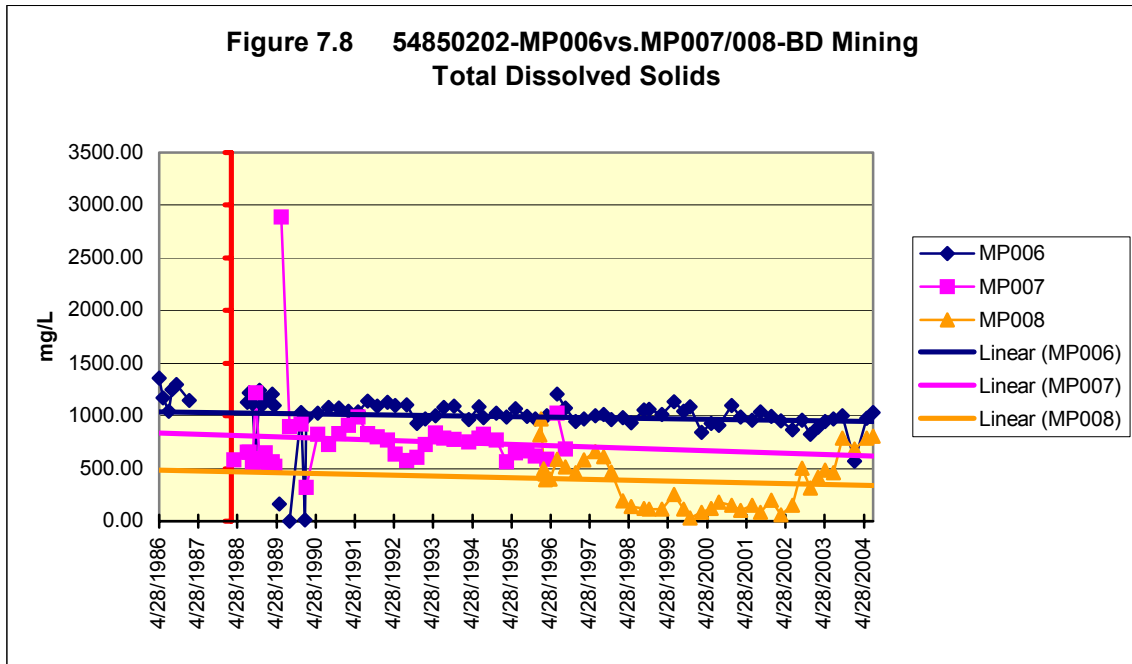


The average alkalinity (figure 7.6) at MP006 was some three times higher than at MP007/008 and was increasing at MP006, decreasing at MP007 and remaining static at MP008. Nonetheless the highest alkalinity was measured at MP008 towards the end of the sampling period in 2003. Acidity (figure 7.7) concentrations decrease at the monitoring points although variations of acidity are more pronounced at MP007/008, probably reflecting their closer proximity to the culm remaining and alkalinity of the ash. The variations in acidity and alkalinity as well as their overall trends at these monitoring points suggest that the ash is having some effect on the water at both MP007/008 and MP006 despite the large volume of water at this more downgradient monitoring point.

TDS (figure 7.8) concentrations displayed the same general pattern: a decline in 1997/98 of concentrations at MP007/008 and only slightly changing higher concentrations at MP006 that remained around 1000 mg/L. Specifically TDS concentrations dropped precipitously at MP008 in March 1998 from concentrations in the range of 400 to 700 mg/L to concentrations between 30 and 250 mg/L. These latter concentrations were one fourth to one tenth the concentrations then measured at MP006. However, in the last four samplings at MP008, TDS concentrations rose sharply to between 600 and 800 mg/l.

Magnesium (figure 7.9) concentrations also display this pattern. A drop in the concentrations sampled at MP007/008 in the mid to late 90s was followed by an abrupt rise in concentrations in the last two to three years of the monitoring data. Higher concentrations of magnesium at MP006, experienced some variations but had a flat overall trend throughout the monitoring period.

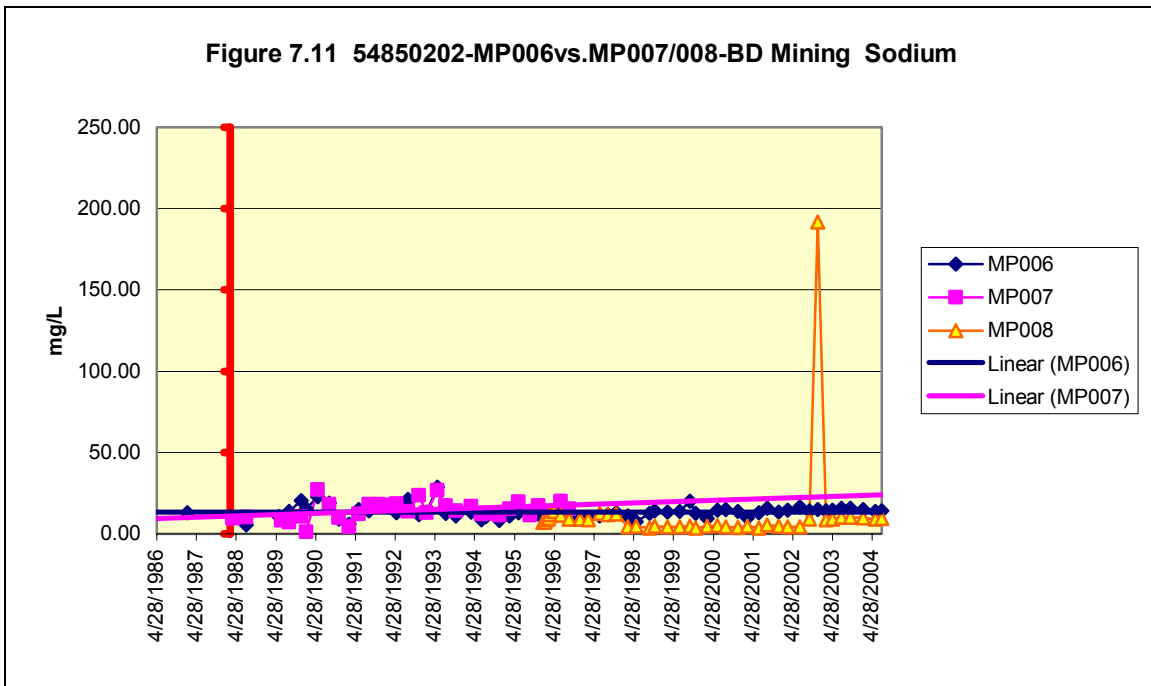
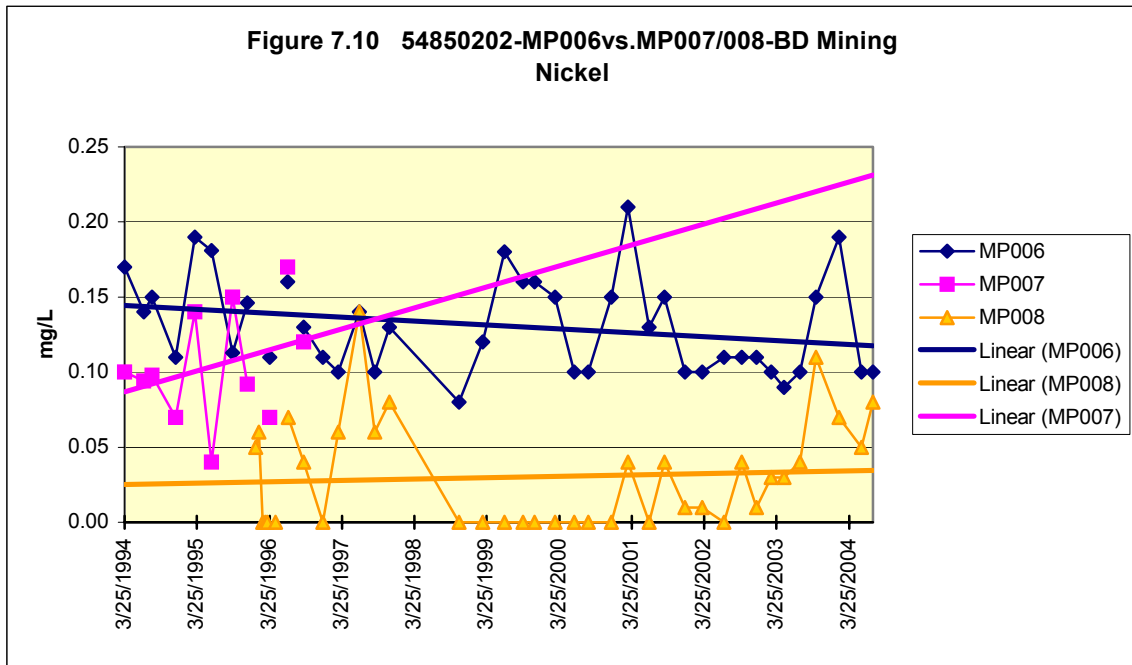


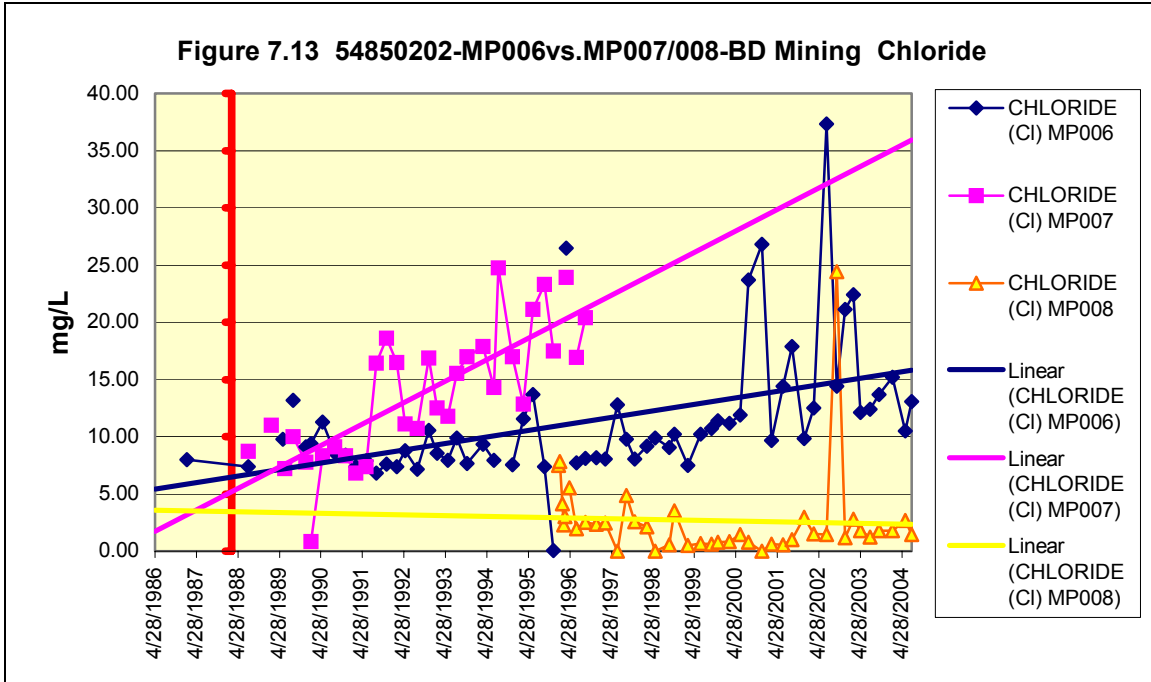
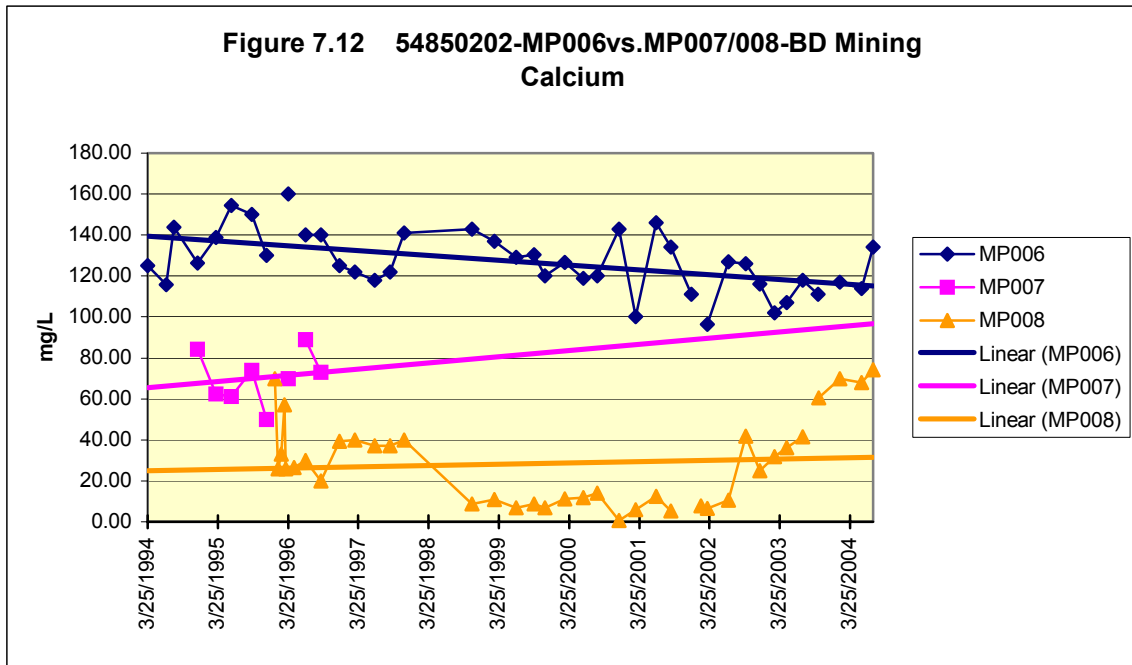


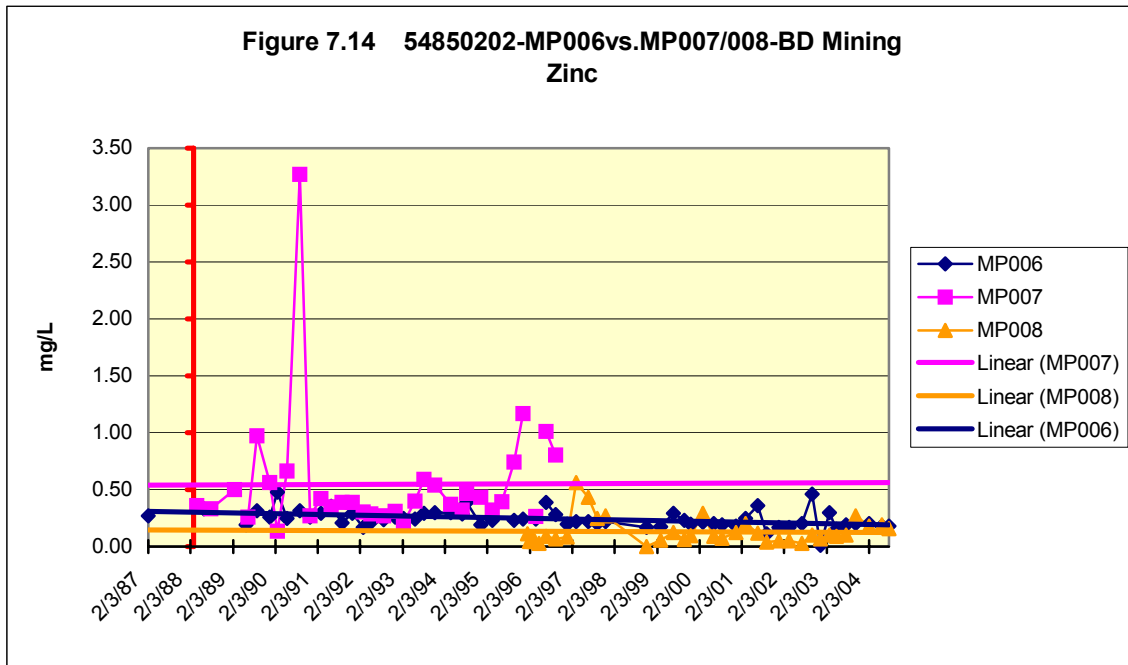
However while magnesium levels at MP006 were on average twice as high (around 70 mg/L) as at MP007 (around 35 mg/L), their last four measurements at MP006 were only 10 mg/L higher than magnesium concentrations at MP008 which rose from around 10 mg/L from 1999-2002 to over 50 mg/L in 2004.

The same drop in concentrations in 1998 followed by a rise in 2002 to previous if not higher concentrations occurred at MP008 for nickel (figure 7.10), sodium (figure 7.11), and calcium (figure 7.12). In the case of sodium, an anomalously high value of 192 mg/L in December 2002 was 6.7 times higher than the next highest values that occurred at any of the three monitoring points and thus nearly hides the smaller but definite increase in other concentrations of sodium in figure 7.11 that occurred at MP008 in 2002. Both sodium and chloride (figure 7.13) concentrations were usually a little higher at MP007 than at MP006 while being lower in most instances at MP008 than at MP006. Zinc concentrations (figure 7.14) were substantially higher at MP007 than at MP006 and also dropped in 1998 at MP008 but did not rise as noticeably as other constituents at MP008 at the end of the monitoring period.

The drop in concentrations of so many constituents at MP007 in 1996 and at MP008 in 1997 and 1998 followed by rises at MP008 after 2001 back to levels that mirror earlier concentrations at MP007 suggests a response to the culm remining and ash as its placement advanced gradually toward MP008 from the east. The changing concentrations could have also resulted from changing conditions in the minepool underneath the remining and ash placement that could have temporarily changed the directions of water flow at MP007 and MP008. Water level data maintained by PADEP indicate that from 2000 through 2003 annual water level elevations changed by as much as nine feet between boreholes closest to MP007 and the Maple Hill Shaft monitoring point in the adjacent Ellengowan Mine to the north, with the Maple Hill Shaft water levels rising from five feet below levels at MP007 in 2000 and 2001 to a level four feet above the level at MP007 in 2003 (see the section, Groundwater (Mine Pool) Monitoring in Truck and Conveyor Ash Sites in Permit Review 5, Reading Anthracite Company, Ellengowan Mine). While these boreholes are as much as 1000 feet from the monitoring locations, and “annual measurements” of instantaneous levels are clearly too few in number to characterize minepool levels with much accuracy, the changes in water elevations at them suggests that flow directions might have been changing in the minepool at MP007. Nonetheless without more detailed information such as records of the continuous pumping rates at the Gilberton Shaft or at least monthly water levels measured at these monitoring points from 1996 to the present, the authors of this report can only speculate on causes for this pattern of changing concentrations.







RCRA Trace Elements

The pattern of declining concentrations in the 1990s is not reflected in data on other trace elements which reached high concentrations at these monitoring points in multiple samplings during ash placement. In many instances these concentrations are far beyond the DWS.

However the absence of a monitoring point upgradient of the ash placement area as well as the existence of only one data point reflecting a concentration measured by the mining operation during the baseline period (in February 1987 - one year before the start of regular ash placement in March, 1988) fundamentally hinder assessment of whether the ash is the source of these metals. The authors have added data from three measurements of trace elements taken from the “Gilberton Shaft Pump” in the monitoring performed for the Turkey Run Landfill to the following figures to assist in the evaluation of baseline concentrations for trace elements. This solid waste landfill, closed in the 1990s, is approximately 2000 feet east-north-east of the Gilberton Shaft (Permit I.D. # 100799, West Mahanoy Township, Turkey Run Landfill Site Map, Exhibit 4 Monitoring Points, EDWARD J. GAYDOS, INC., Consulting Engineer & Surveyor, Orwigsburg, PA). The Turkey Run measurements are depicted as data points for MP006 (also identified as the Gilberton Shaft Pump in the BD Mining Permit) although it is not known if they were taken at the exact location at which MP006 is sampled. Even with these additional measurements however, the amount of baseline data is deficient for making definitive comparisons to post ash placement concentrations. Nonetheless in every

instance, the four baseline concentrations measured at the Gilberton Shaft or MP006 (one by BD Mining and three by the North Schuylkill Landfill Association for the Turkey Run Landfill) are well below the high concentrations that occur during ash placement at MP006. In the cases of lead and cadmium, the highest concentrations were measured several years after ash placement was underway.

It should be noted also that in multiple instances detection limit values that were equal to or up to many times over the DWS for trace elements have been accepted by PADEP in this monitoring data. To present a less confusing picture of actual concentrations measured, all of these detection limit values are portrayed on the x axis (as 0.00 mg/L) in the figures below.

Lead concentration increases present evidence of serious degradation of water quality at this site (figure 7.15). At all three minepool monitoring points MP006, MP007, and MP008, lead was measured at levels many times DWS during ash placement. Starting at MP007, the monitoring point closest to the ash, lead was measured at 0.220 mg/L, more than 14 times over the DWS in June 1989, 15 months after regular shipments of ash to the site had gotten underway. Three subsequent measurements at MP007 measured between 0.120 mg/L and 0.160 mg/L, 8 to 11 times the DWS through November 1991. These high lead levels then began to show up at MP006 with four measurements from November 1991 through May 1993 between 0.100 mg/L and 0.140 mg/L. The next high lead level measured was 0.100 mg/L at MP008 in April 1996. Lead was measured again at MP008 at 0.100 mg/L and at MP006 at 0.120 mg/L, 6.7 and 8 times over the DWS, respectively, in March of 1999. Lead rose further at MP008 to 0.180 mg/L in June 1999, 12 times the DWS. It was then measured at 0.580 mg/L at MP008 in September 2001, 39 times the DWS. Additional high lead concentrations were measured at MP006 in June 1999 (0.160 mg/L) and in September 2001 (0.150 mg/L). Many other measurements at the three monitoring points were below limits of detection which ranged from 0.030 to as high as 0.500 mg/L and thus are depicted in the figure as dots on the x axis or as 0.000 mg/L. Detection levels like these that are twice and more than 30 times over the DWS respectively do not allow reviewers to discern whether harmful lead levels are in the water in those samplings.

However, lead was also actually measured at least four times from February 1990 to May 1993 at 0.120 mg/L to 0.180 mg/L at another downgradient monitoring point, MP005. According to the PADEP monitoring data base, MP005 was monitoring waters in a strip pit in the ash placement area. According to the engineer for BD Mining (WJP Engineers, Pottsville PA), MP005 sampled ponded surface waters in a strip pit between MP007 and MP008 where coal refuse reject material from the Gilberton Cogen Plant was placed until the pit was eliminated by ash backfilling operations. Monitoring of MP005 did not take place while ash was being placed in the pit as there was no water left to sample at this location at that time (WJP Engineers, August 29, 2006 telephone conversation). Nonetheless, MP005 is identified by PADEP in its monitoring data base as a downgradient monitoring point and presumably water in this pit would have had ample contact with water moving through ash being deposited at the site. There are no

baseline measurements from MP005. According to the PADEP monitoring database, monitoring at MP005 took place from August 28, 1989 through May 17, 1993.

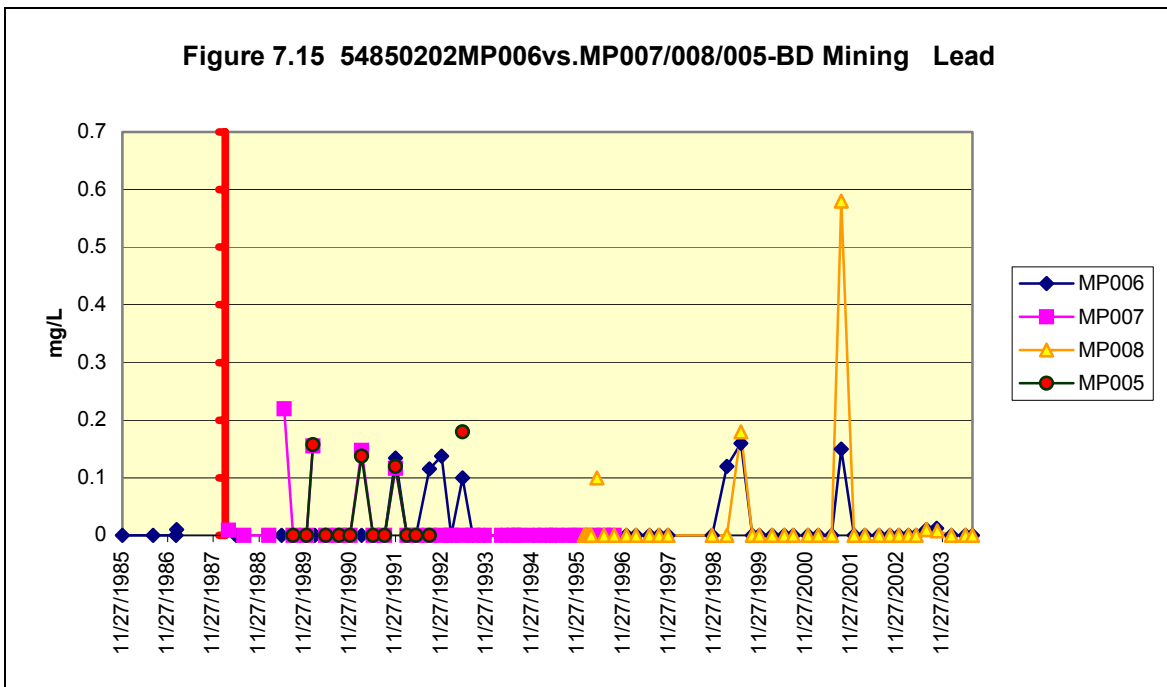
Chromium concentrations (figure 7.16) at MP006 and MP007 measured 0.239 mg/L and 0.232 mg/L respectively in November 1991, more than twice the DWS for Total Chromium (0.100 mg/L). The highest measurement of chromium at MP005 also occurred in that sampling at 0.061 mg/L. Chromium was measured at 0.099 mg/L at MP007 in September 1995 and at 0.09 mg/L at MP006 in September 1997. Chromium values at MP008 however were usually measured below instrument detection limits of 0.05 mg/L (from March 1999 through September 2001) or 0.01 mg/L (from February 2002 through July 2004). Exceptions included actual measurements at MP008 of chromium at 0.06 mg/L in June 1997 and September 1999, 0.01 mg/L in July 2002 and February 2004, and 0.02 mg/L in May 2004. The first baseline measurement of chromium applicable to MP006 from Turkey Run Landfill data was 0.06 mg/L in November 1985 but subsequent baseline values were below instrument detection limits. A very high chromium measurement of 0.78 mg/L was recorded also in November 1985 from the Turkey Run Landfill's monitoring point at a deep mine discharge in Girardville approximately two miles west of MP006. However this monitoring point would appear to be more affected by a commercial hazardous waste facility waste impoundment (the Keystone Chemical Company), immediately upgradient of the discharge. This facility had a monitoring program for chromium and other trace metals.

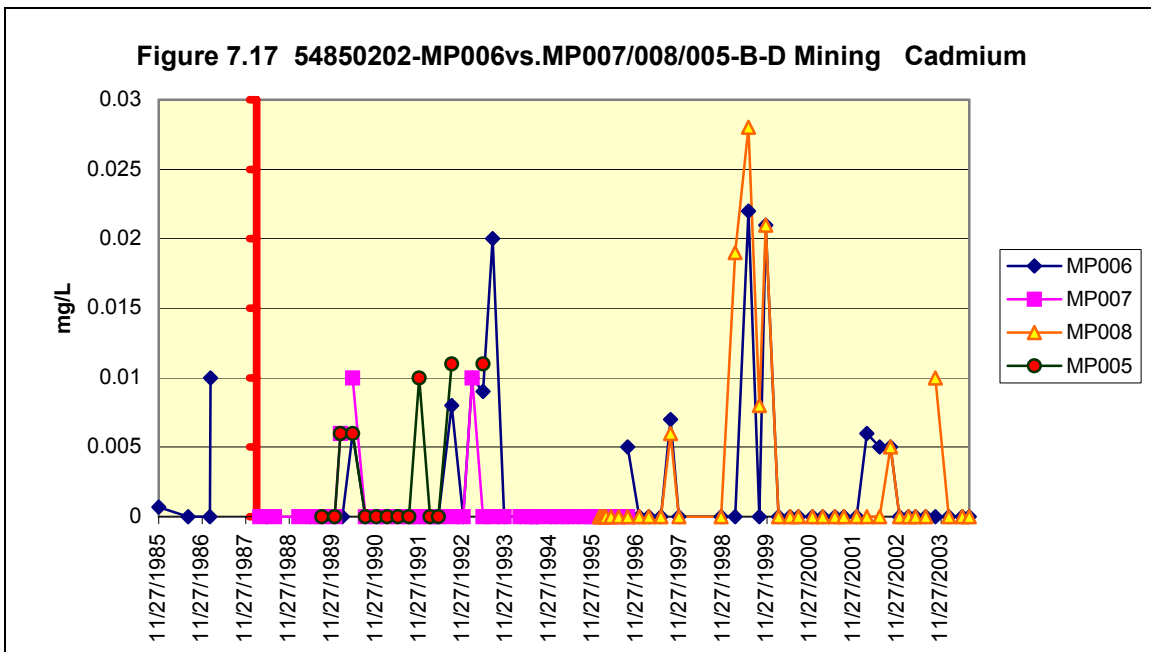
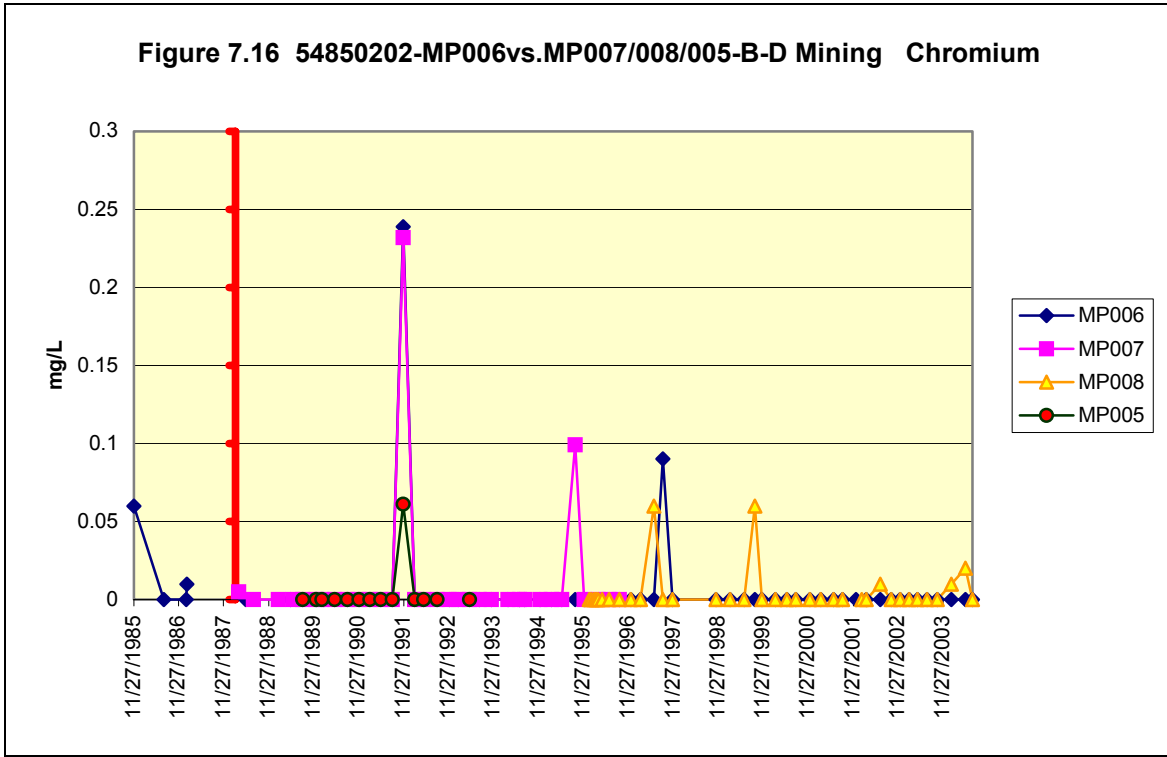
Cadmium concentrations (figure 7.17) also reached unacceptable levels after ash placement with maximum concentrations in June 1999 more than 5 times the DWS at MP008 (0.028 mg/L) and more than four times the DWS at MP006 (0.022 mg/L). Many cadmium measurements at these monitoring points were below a detection limit of 0.01 mg/L (twice the DWS of 0.005 mg/L). It should also be noted however that the single baseline measurement of cadmium collected under the mining permit at MP006 was also an actual concentration of 0.010 mg/L in February 1987, approximately one year before regular ash shipments arrived at the site. Actual concentrations of cadmium at MP007 were first measured at 0.006 mg/L and 0.01 mg/L in February and May of 1990, respectively and again at 0.01 mg/L in February 1993. Five nearly identical measurements (ranging from 0.006 mg/L to 0.011 mg/L) occurred at MP005 during this same period. Even the lowest of these measurements, 0.006 mg/L, is three times the federal water quality standard for acute toxicity of cadmium to aquatic life (CMC) of 0.002 mg/L and 24 times the federal water quality standard for chronic toxicity of cadmium to aquatic life (CCC) of 0.00025 mg/L (National Recommended Water Quality, USEPA, published pursuant to Section 304(a) of the Clean Water Act). Whether the surface waters at MP005 were discharging entirely to the minepool or offsite to other surface waters is not known. The levels of cadmium recorded substantially further beyond these water quality standards at MP006 would also be a concern given the discharge of these waters to Mahanoy Creek at this sampling point.

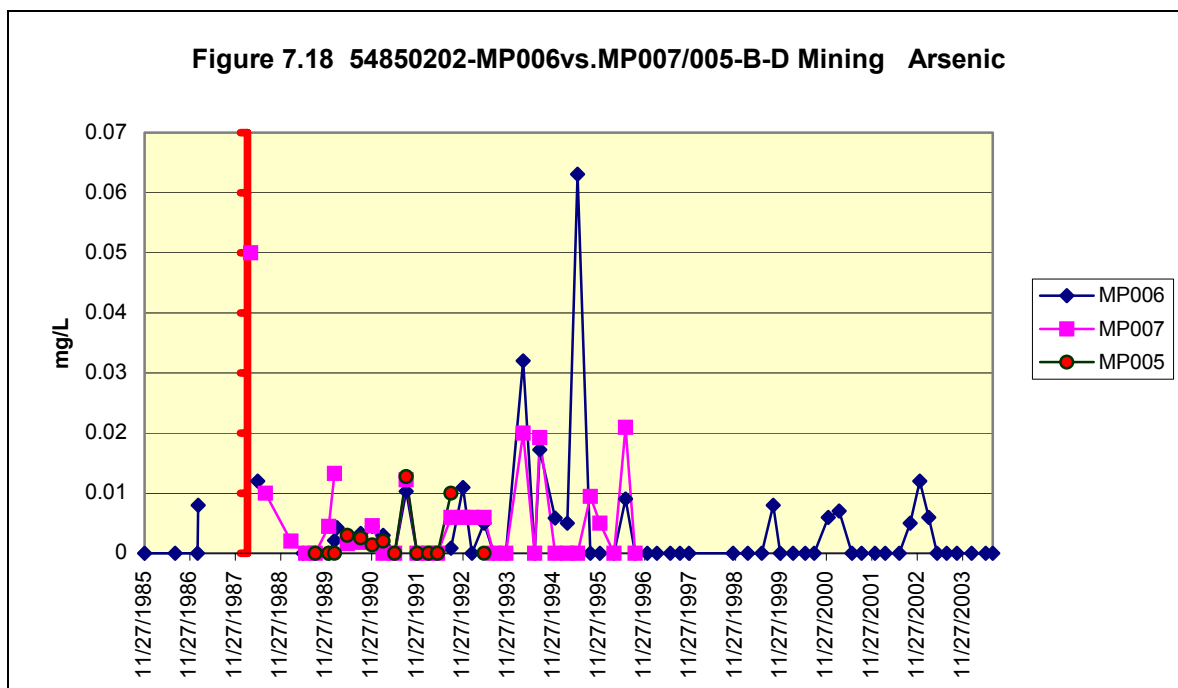
Figure 7.18 shows appreciable levels of arsenic at MP006, MP007 and MP005. A measurement of 0.0631 mg/L in June 1995 at MP006 exceeded the old DWS (0.05 mg/L) and exceeded the new DWS (0.01 mg/L) by more than six times. The second

highest concentration of arsenic at MP006 was 0.032 mg/L in March 1994. The highest arsenic at MP007 was 0.05 mg/L measured in a March 27, 1988 sampling during the first month of regular ash placement at the site. The second highest arsenic concentration at MP007 was 0.021 mg/L in June 1996 the second to last measurement at this monitoring point. The highest arsenic at MP005 exceeded the new DWS at 0.01281 in August 1991. Arsenic concentrations at MP008 were measured at zero or below instrument detection levels equal to the new DWS in all but one instance when an actual value of 0.007 mg/L was measured in April 1996 and hence were not graphed.

Selenium concentrations, (ungraphed) were less noticeable, usually below a detection limit of 0.010 mg/L or close to 0.00 mg/L at all monitoring points. However there were several higher selenium concentrations measured including 0.041 mg/L in MP008 and 0.017 mg/L in MP006 in June 1999. The DWS for selenium is 0.05 mg/L and the water quality standard (federal standard for chronic exposure of aquatic life) is 0.005 mg/L. Selenium exceeded this water quality standard also in the August 28, 1991 measurement at MP005 which was 0.00832 mg/L.







High Lead Levels

The lead levels found after ash placement began at the BD Mining monitoring points (figure 7.15) are not found naturally in Pennsylvania groundwater and do not appear to be an artifact of anthracite mining in eastern Pennsylvania. Out of 144 measurements at BD Mining’s ash monitoring points for total lead, 18 measurements, 12.5 %, exceeded the DWS (federal Action Level of 0.015 mg/L). These exceedances ranged from 0.10 mg/L (6.7 times the DWS) to 0.58 mg/L, (38.7 times the DWS). This compares to 210 out of 6762 measurements or 3.1% of all measurements for total lead exceeding the DWS in Summary of Groundwater Quality Monitoring Data (1985-1997) from Pennsylvania’s Ambient and Fixed Station Network (FSN) Monitoring Program, Selected Groundwater Basins in Southwestern, Southcentral and Southeastern Pennsylvania, (PADEP, June 1998). This survey of ambient groundwater quality examined concentrations of 27 analytes from 1089 monitoring points over a twelve year period in 46 designated higher priority Groundwater Basins in southern Pennsylvania. Table 7 (page 14) in this Report identifies lead as a constituent of “potential ecological concern,” under the Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 (also called Act 2) and states, “Natural water seldom has values >5 ug/L (0.005 mg/L of lead).” (details in parentheses added)

Total lead levels measured in the water under the ash at BD Mining have repeatedly reached levels well beyond total lead levels observed in the four Groundwater Basins studied in this Report that are closest to the BD Mining Site. The closest Basin is

Groundwater Basin #49 in Berks County approximately 15 miles south of the BD site. According to Appendix 2 of the Report, 41 monitoring points generated 78 samples assessed for analytes including total lead in this Basin. Box plot graphs of the data in Appendix 3 of the Report indicate that the highest total lead value was approximately 0.023 mg/L, one of four values exceeding the DWS in this Basin. Whether the dots in these graphs represent just one measurement or more than one measurement is not explicitly spelled out in the Report. Nonetheless the box plot reveals very little variation in the data with the median data point at 0.004 mg/L and the 90th percentile data point being <0.010 mg/L.

The next closest Basin, Groundwater Basin #36 further east in Berks and Lehigh Counties, contains 41 monitoring points that generated 881 samples. Nine lead values exceeded the DWS and the highest of these according to the graphs in Appendix 3 was approximately 0.050 mg/L. The entire range of data up to the 75th percentile value was below the median data value of 0.004 mg/L and the 90th percentile value was below the DWS.

Bordering this Basin to the north in Lehigh and Northampton Counties is Groundwater Basin #35. It contains 35 monitoring points that generated 710 samples. Three lead values exceeded the DWS. The highest of these was approximately 0.0375 mg/L. Again there was little variation in the data with 75 percent of the concentrations being below the median data value of 0.004 mg/L and the 90th percentile value below the DWS.

The fourth closest Basin, Groundwater Basin #53, is about 20 miles due south of the BD Mining site in Lebanon and Berks Counties. Nineteen monitoring points in this Basin generated 23 samples assessed in the Report. The highest lead concentration at 0.040 mg/L, was the only value that exceeded the DWS in this Basin. The box plot graph indicates there was virtually no variation in the data with the 90th percentile value being <0.005 mg/L and the median value at approximately 0.001 mg/L.

In summary, out of the 1692 samples surveyed in this Report from Groundwater Basins closest to the BD Mining ash site, the highest total lead concentration found was half the lowest of eighteen concentrations of total lead measured from the BD ash monitoring points that exceeded the DWS. Furthermore, the PADEP Report indicates that values below detection limits were used to discern median values and perform other calculations with the data, so it is not even clear whether the highest lead concentration graphed in Appendix 3 from these four Groundwater Basins was an actual value or a detection limit artifact.

A survey of data from other sites in eastern Pennsylvania reveals that the lead concentrations from the BD wells in excess of the DWS are generally an order of magnitude above lead concentrations measured from wells in minepools from other mines and around other waste management facilities in the anthracite coal fields. For example at the CES Landfill, (Permit I.D. #101615), in Schuylkill County, Foster Township in the southern anthracite field close to its border with the central anthracite

field (which includes the Western Middle Field in which the BD Mining operation is located), the highest total lead level found in a monitoring well located in the minepool under this site in a seven year period (from 9/1/1998 to 6/2/2005) was 0.003 mg/L. At the John Fry Landfill Tract 2, (Permit I.D. #101400) also in Schuylkill County, Foster and Reilly Townships, (adjacent to the CES Landfill) the highest total lead found in a recent two year period (2001-2003) was 0.007 mg/L in a monitoring well and 0.014 mg/L in a stream downgradient of the site.

A review of data in a Regional Groundwater Database analyzed in the cleanup of lead contamination from the Marjol Battery Superfund site in Lackawanna County also documents substantially lower lead levels in the vast Scranton Mine Pool in the northern anthracite field (see Appendix E, SUPPLEMENTARY RFI ACTIVITIES REPORT, MARJOL BATTERY SITE, Advanced GeoServices Corp., Project Number 92-002-AP, July 17, 1995). The Scranton Mine pool was created from deep mining coals in the Llewellyn Formation that was also mined predominantly under the BD site. The highest lead in this data base from monitoring points at the Coalbrook Mine, Gravity Slope Mine, Old Forge Bore, and Duryea Breach is 0.0920 mg/L of dissolved lead (total lead for this sampling is listed as 0.0000 mg/L) at the Duryea Breach in April 1987. The next highest lead levels are 0.0200 mg/L at the Old Forge Bore and Gravity Slope Mine in October 1969 and April 1971. Exceptions to these lower lead concentrations in this Regional Database are total lead levels in minepool monitoring wells at the Lackawanna Refuse site (Old Forge Borough, Lackawanna County) and Keystone Landfill (Dunmore Borough, Lackawanna County) which are in the same range (0.100-0.600 mg/L) as levels in the BD wells. However discussions with staff who oversee these facilities in the PADEP's Waste Management Program (Wilkes Barre Regional PADEP Office) indicate that Lackawanna Refuse is a major superfund site where some 15,000 drums, much of it hazardous waste containing high levels of heavy metals, were buried in an abandoned strip mine pit. These drums are reportedly the source of the high lead levels in this site's minepool monitoring wells. These staff also state that a battery manufacturing plant (Gould Battery) upgradient of the Keystone Landfill is the source of the lead contamination in its minepool wells. PADEP Waste Management staff in the Wilkes Barre and Bethlehem District Offices stated in multiple discussions with the authors of this report in November and December 2005 and in the first half of 2006, that they do not normally see high lead levels (at or exceeding the DWS of 0.015 mg/L) in acid mine drainage from anthracite mines and therefore would expect the lead levels in the BD Mining wells to be coming from other human activity.

Yet the PADEP has no knowledge of the existence of industrial plants, waste disposal facilities or illegal dumps draining into the Boston Run, St. Nicholas or Gilberton Minepools that are sources of lead pollution. Several inquiries to PADEP's waste management program staff turned up two facilities closer to the BD Mining site in the Mahonoy Creek watershed of northern Schuylkill County that could have been sources of high lead levels in minepools. One of these facilities, the Keystone Chemical Company's property, is approximately 2 miles west of the Gilberton Shaft monitoring point (MPOO6). The facility was closed in the early 1990s. According to information in the archived files of that facility (PAD # 000647735, Butler Township) the

groundwaters under this facility are draining into minepools that are discharging toward the west into the Girardville area, not flowing east to MP006. Nonetheless this commercial hazardous waste facility contains a waste disposal impoundment that was required to be monitored for lead and other trace metals. The highest lead found in five quarters of monitoring data reviewed between December 1987 and April 1992 was 0.017 mg/L (a dissolved value) at two monitoring points. One monitoring report indicates a background concentration of 0.036 mg/L was found in January 1988 at an upgradient monitoring point (MW-1).

Perhaps more relevant data comes from the other of these facilities, the Turkey Run Landfill given its location 2000 feet east-north-east of MP006 in the BD Mining site, its use of the Gilberton Shaft Pump also as a monitoring point and its history as an abandoned anthracite strip mine pit labeled by the PADEP and the USEPA in an assesment as a “mine acid drainage area.” The Turkey Run Landfill (Permit I.D. # 100799, West Mahanoy Township) was operated by the North Schuylkill Landfill Association as an unlined “natural renovation site” that received mainly commercial and municipal wastes including industrial waste water sludges such as aluminum hydroxide sludges, spent acids and other plating wastes. An examination of archived files for the Turkey Run Landfill located a one page PADEP (at that time the Pennsylvania Department of Environmental Resources) approval dated March 28, 1978, of Application 5477201 from the “Reynolds Plant” of Atlas Powder Company in Walker Township, Schuylkill County to dispose “Solid waste material generated from a lime neutralization facility producing settleable floc containing ferric hydroxide and fly ash” at the Turkey Run Landfill. No other information identifying the fuel source of the “fly ash” or documenting the extent of ash disposal at the Landfill could be found.

The highest lead measured in six quarters of data from Turkey Run monitoring points spanning from November 1985 to March 1994 was 0.00508 mg/L in Total Recoverable Lead from an undisclosed location in March 1994 at the “Turkey Run Landfill/Transfer Station.” The next highest lead measurement was measured at the Gilberton Shaft at <0.05 mg/L in November 1985 which level was also recorded at the other two monitoring points at this facility. The rest of the lead measurements in this data are below detection limits usually set at <0.005 mg/L or less. The Turkey Run data provides three additional recorded concentrations of total lead from the Gilberton Mine shaft before ash placement started at the BD Mining site which are assessed as baseline data in this report reflecting pre-ash conditions in the Gilberton Mine Pool. Under the PADEP mine ash placement permit, only one baseline measurement was recorded for lead at MP006 (the Gilberton Shaft) of 0.01 mg/L in February 1987. In addition to the <0.05 mg/L measured in November 1985, the additional measurements at the Gilberton Shaft from the Landfill include <0.005 mg/L in July 1986 and <0.005 mg/L in January 1987. Thus the Turkey Run data gives additional weight to the concern that the high lead seen at the BD Mining ash monitoring points was not being contributed by AMD from anthracite mining and not in the minepools under the BD Mining site before large scale ash placement started under the mining permit.

Conclusion

Data generated by the ash monitoring points at this site demonstrates unquestionably that the large mine pool downgradient of the BD ash placement area is being substantively contaminated with toxic levels of lead. Concentrations of cadmium, chromium and arsenic have also been measured above DWS in the mine pool after ash placement although their levels have not reached the magnitude or frequency of exceedances of the DWS measured for lead.

However there are basic defects in the monitoring system at this site that are of serious concern given the size of the ash disposal operation it contains and the high levels of toxic metals that are being exhibited in the underlying mine pools. The approved disposal in areas 1 and 2 at the BD Mining site totaled 3,551,429 cubic yards of coal ash. For the past 10 years, this large mass of ash has only been monitored by monitoring points MP006 and MP008. MP007, a well on the western perimeter of the ash placement area, was monitored for the first eight and a half years after ash placement started before it was buried by the ash and replaced by MP008. MP005 was a surface water point monitored for less than four years in the strip pit before this pit was filled with ash.

Even worse, there are no monitoring points upgradient of the ash placement area which is located above the mine pool that subsequently drains into monitoring points MP008 and MP006. Therefore, the monitoring system at this site has never been capable of assessing mine pool water quality unaffected by ash. This deficiency is exacerbated by the extremely limited baseline monitoring that produced only 1 data point at MP006 that reliably reflects pre-ash placement conditions for many trace elements and other Module 25 ash parameters prior to the beginning of ash placement at this site. Not a single concentration of these constituents is recorded in the PADEP's data base for the monitoring results at this site or accessible in the public files of the BD Mining Permit for any of the monitoring points near the ash at this site (MP007, MP005, and MP008). Three additional measurements for total concentrations of lead, chromium, cadmium and arsenic at the Gilberton Shaft pump (presumably adjacent to or directly from MP006) as part of the monitoring for the Turkey Run Landfill from 1985 through 1987 have been included in the assessment of baseline water quality in this Report, but even four measurements is an inadequate number for characterizing baseline concentrations of these trace elements. There were also no monitoring points established to measure water quality in the pore water in the ash to help differentiate impacts of ash on water quality from impacts of culm and coal silt. While reviewers can speculate about the sources of high trace metals and other pollutants, these deficiencies do not allow the causes for the degradation of mine pool water quality occurring under this site to be definitively identified.

Given the position of MP006 in the Gilberton mine pool which receives flow from a several other mine pools and more than one mile downgradient of MP007 and MP008, there is presumably a significantly greater quantity of water being monitored at

MP006 than at MP007/008. This accounts for why there is greater variability in concentrations at MP007/008 and why constituents at MP007/MP008 fell to levels below MP006 as their measurements appear to have been reflecting more concentrated pulses that go past their sampling points. A spike in alkalinity to 105 mg/L in the spring of 2003 suggests an ash influence at MP008. Rising levels of other ash indicator parameters such as calcium, magnesium and trace metals and parameters indicative of both mining and ash placement, such as manganese, sulfates, TDS and specific conductance in the last three years of monitoring at MP008 also suggest the advance of the ash filling operation closer to this monitoring point.

The numerous high levels of lead exceeding the DWS by several times (at the minimum) at the monitoring points beginning about one year after ash placement should be of serious concern to PADEP. High lead levels were first measured at MP007 and MP005 some two and a half years and two years respectively prior to high lead levels being measured at MP006. Lead also reached higher levels at MP007, MP005 and MP008 (as high as 0.22 mg/L in June 1989 at MP007 and 0.58 mg/L in September 2001 at MP008) than at MP006. These results would be expected given the greater distance between the ash and MP006 and the greater volume of water and dilution of pollutant levels that MP006 should be monitoring. Nevertheless at MP006, total lead reached 0.16 mg/L on June 23, 2001, more than 10 times the DWS (federal action level), and 0.15 mg/L on September 4, 2001, 10 times the DWS. These levels are particularly disconcerting because MP006 is monitoring a very large mine pool more than one mile downgradient from the ash. This mine pool is either the regional water table for the entire area or likely to be hydraulically connected to it. Furthermore assuming hypothetically that 0.16 mg/L was measured throughout the year on a sustained basis in a mine pool discharge of at least 3 billion gallons (less than the average amount of water withdrawn annually from the Gilberton Shaft during most of the 1990s), more than 4,000 pounds of lead would have been discharged annually from this pump into Mahanoy Creek and the surrounding watershed. The impact of lead discharges from the Gilberton Shaft pump on water quality standards and aquatic life in Mahanoy Creek is not being documented or assessed in the permit files for the BD Mining site and has yet to be acknowledged as even a potential problem publicly by PADEP.

The authors of this report know of no data either from monitoring points or other characterizations of mine drainage in the anthracite coal basins that indicates these lead levels are coming from anthropogenic sources such as waste disposal sites, industrial plants or anthracite mining practices in the Mahanoy Creek Watershed.

On the other hand, data from the permit leach tests on the primary ash being placed at the BD Mining site, FBC ash from the Gilberton Cogen Plant, definitely suggests a likelihood that this ash is one source if not the source of the lead in the mine pool. While laboratory leach tests like the SPLP should never be considered reliable predictors of what coal ash will do in different placement settings absent other site information, the SPLP leach test is the only means PADEP uses to assess the potential for an ash to cause water quality problems prior to its placement in a mine site. According to a data base of results from 83 leach tests on ashes compiled from PADEP minefill

permits in 2000 by the US Department of Energy, the Gilberton Cogen ash leaches a high level of lead. In fact, data indicate that the Gilberton Cogen ash leaches more lead than any of the other coal ashes whose tests results are in this database. The average lead concentration leached in 12 tests on the Gilberton ash was 0.271 mg/L compared to an average lead concentration of 0.14 mg/L leached in 71 tests on other Module 25 ashes. Perhaps more telling than average leaching concentrations, the range of lead concentrations leached from the Gilberton ash was 0.128 mg/L to 0.520 mg/L compared to a range of 0.001 mg/L to 0.49 mg/L of lead leached from all of the other ashes in this data base.²

After ash placement began at the BD site, chromium concentrations rose also to more than twice the drinking water standard near the ash and in the mine pool further downgradient of the ash. Cadmium concentrations rose to levels 4 times higher than its DWS in MP006 and nearly 6 times higher than the DWS in MP008 in 1999. Arsenic exceeded the current DWS at three of the four monitoring points (MP005, MP007 and MP006). Arsenic levels exceeded 0.020 mg/L, more than twice the DWS, at MP007 and MP006, and arsenic was measured at 0.0631 mg/L, more than six times the DWS, at MP006 in a June 1995 sample.

These high trace element levels have occurred in water that is slightly to moderately acidic (pH of 5-6) although acidity has been declining at all three of the groundwater monitoring wells studied and alkalinity increasing or remaining static at two of these three wells. Over seventeen years since ash placement started, average lab pH remained steadily at 6 units at MP006 but has decreased from 5.4 to 4.9 units from the start of monitoring at MP007 to the latest monitoring available from MP008. The rising alkalinity and declining acidity to average concentrations below 10.0 mg/L at MP006 as well as the spikes in alkalinity at MP007 and more recently at MP008 suggest an impact to the minepool water from the FBC ash. Rises in calcium and magnesium, two well known markers for PA FBC waste coal ashes, to their highest levels at MP008 in the last two years of monitoring are further evidence of this impact. These changes in water chemistry along with the high solubility of lead in the SPLP test on the Gilberton ash and the absence of data indicating high levels of lead as a normal occurrence in anthracite mine drainage or high levels of lead coming from other human activities in the Mahanoy Creek Watershed together provide a credible basis for suspecting the lead in the mine pool under this site has come from the large volume of ash placed here.

However, without more baseline data, data from points monitoring only disturbance of culm and the coal silt on the site, and/or substantive pore water data collected from within the ash, site materials independent of the ash (if not affected by it) cannot be dismissed as a potential source of the lead in the mine pool. Indeed, most of

² Cardone, Carol R. and Ann G. Kim, 2000, Assessment of Coal Combustion By-Products and Water Quality Variations at Mine Sites, U.S. Department of Energy, National Energy Technology Laboratory, Pittsburgh, PA in Proceedings of the Use and Disposal of Coal Combustion By-Products at Coal Mines: A Technical Interactive Forum. Ed. Vories, Kimery C. and Dianne Throgmorton, U.S. Department of the Interior, Office of Surface Mining, April 10-13, 2000, Morgantown WV. www.ott.wrcc.osmre.gov/library/proceed/ccb2000/back.pdf.

the ash placed at the BD Mining site has come from culm and coal silt generated at this site from previous mining. Aside from the limestone added during combustion, the parent material for these three materials is the same anthracite coal from this area.

At the least, the high concentrations of total lead at downgradient ash monitoring points establish that the culm re-mining and FBC ash from burning this culm and other culm in the surrounding region is having a significant toxic impact on water quality that is reaching well beyond the boundary of the ash placement area at the BD Mining site. As at other sites, an enhanced program that monitors from more points, upgradient, downgradient and in the ash, and from points on surface waters for trace elements and other ash parameters is needed to more effectively assess the causes for toxic metal contamination in the mine pool and develop corrective remedial responses.