# Pennsylvania Department of Environmental Protection
# Response to
# Clean Air Task Force Report: "Impacts On Water Quality From Placement Of Coal Combustion Waste In Pennsylvania Coal Mines"

DEP Bureau of Mining and Reclamation
DEP Bureau of District Mining Operations

November 9, 2007

*In September 2007, the Clean Air Task Force (CATF) released a report entitled "Impacts on Water Quality from Placement of Coal Combustion Waste in Pennsylvania Coal Mines" based on its investigation of Pennsylvania practices of utilizing coal combustion material (coal ash) for beneficial uses throughout the state. The report contains many allegations that beneficial use of coal ash at numerous mine placement sites has caused pollution. The Department has prepared this response to that document.*

## Introduction

Pennsylvania coal fueled this country's industrial revolution. At that time there were no environmental regulations that required the mined land be reclaimed or the water to be protected. This legacy has left 189,000 acres of abandoned mines, over 200 miles of highwalls, thousands of miles of polluted streams, and large areas of contaminated groundwater. There are also over 800 coal refuse piles encompassing more than 8,500 acres. These abandoned mine features are dangerous and deadly. Correction of these problems would cost over 10 billion dollars. Pennsylvania is employing a variety of approaches to address this legacy; among them is the beneficial use of coal ash.[1]

Pennsylvania currently generates more than half its electricity from coal. When coal is burned ash remains and this ash has to go somewhere. There is a special type of power plant that can burn coal refuse. These plants utilize a technology known as fluidized bed combustion (FBC). FBC plants alone burn 10 million tons of coal refuse per year. Power plants that burn coal refuse produce a higher percentage of ash than other types of power plants because much of the fuel is rock that does not burn, plus these plants add limestone to the boiler to prevent air pollution. The limestone adds to the volume of ash, but it also imparts alkalinity to FBC ash.

In the mid-1980s, the Pennsylvania Department of Environmental Protection began to approve coal ash utilization for mine reclamation. Coal ash is used where alternate fill and cover material is either unavailable in adequate volumes or uneconomical. Coal ash is also a low-permeability, high-alkaline material that can be transported in large quanti-

[1] Sources for these figures are: Dalberto, A.D., et al., 2004. Chapter 1. Overview: Coal ash beneficial use and mine land reclamation. In: Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania. PA DEP and Penn State Materials Research Institute; National Abandoned Land Inventory System, 2003. Pennsylvania Department of Environmental Protection, Harrisburg, PA; and EPA, 2001. Coal Remining – Best Management Practices Guidance Manual, EPA-621-8-01-010.

ties. Because coal-fired power plants are often near the coalfields, ash is readily available in the vicinity of the abandoned mine lands. Ash is often returned to the area from which the coal refuse was extracted, thus substituting an alkaline material for an acidic material.

When an applicant proposes to use a source of coal ash for beneficial use in Pennsylvania, extensive chemical testing is required of the ash to determine concentrations of elements that might cause environmental problems. The Department has guidelines for permissible concentration levels. For example, the ash must have a pH value between 7 and 12.5, aluminum must be below 5 mg/l in water passed through the ash (leached) and arsenic must be below 1.25 mg/l. Twenty-one different parameters are used to assess the dry ash composition and the leachate characteristics. If an ash exceeds the limits, it cannot be used beneficially and must be disposed in a lined facility.

To approve a location that can accept ash for beneficial use, the Department reviews the geology and hydrology of the mine site to assure that the ash can be placed in an environmentally safe manner. If the Department determines that placement of ash at a mine would create a problem (either because of the site or the ash quality), the proposal is rejected. This approach has resulted in an effective program in which coal ash has been used to safely reclaim mine sites.

Because the main beneficial use for coal ash has been placement at mine sites for reclamation, it is imperative to understand the environment into which the material is placed. Foremost, one must recognize the historical legacy discussed above. The surface water and groundwater in the coal regions can be severely impacted by acid mine drainage (AMD). AMD renders the local groundwater undrinkable and regional streams hostile to native aquatic life. Common characteristics of mine drainage are low pH (<6.0, frequently as low as 3.0); high concentrations of metals such as iron, manganese, aluminum, lesser concentrations of zinc, nickel, selenium and other metals; and high concentrations of sulfate. Iron, manganese and aluminum can be at concentrations in tens of parts per million, and occasionally over 100 parts per million. The other metals can occur up to a few parts per million. Sulfate is typically hundreds to thousands of parts per million. But, not all mine drainage is acidic and not all has high metals.

The environment for ash placement typically consists of abandoned mine features such as coal refuse (waste rock associated with coal) piles, and mine pits and underground workings – areas that are often polluted by mine drainage. These features provide a means by which precipitation and clean surface waters can become polluted by interacting with acid-producing minerals to generate more AMD. Through the use of coal ash these old mines can be restored to productive land and reduce the amount of pollution coming from the old mines. Many of the sites reclaimed with coal ash would not likely be otherwise reclaimed.

Most of the allegations made by the CATF in its report are a rehash of issues raised by CATF associates in the past. These have been time after time examined through Department investigations and found to be erroneous. The CATF is an advocacy organization that had stated its opposition to the beneficial use of coal ash combustion products repeatedly to the public prior to the investigations documented in their report. This response to the CATF report demonstrates, once again, that the CATF allegations of pollution from ash are seriously flawed. This response will not attempt to address every detail raised in the CATF report, but will point out why there are differences in interpretation and conclusions between the CATF and the Department.

## DEP's Success at Preventing Mine Drainage Pollution

AMD is now largely a historical problem rendered by past mining. Modern laws require reclamation of mined lands and prevention of pollution. Beginning in about 1979, permit applicants began to include scientific data that was used to assess the site potential to generate AMD. The Department's ability to interpret these data has improved dramatically through time. A science-based approach to permitting and an emphasis on preventing AMD has been very effective in minimizing the incidence and severity of new discharges. Figure 1 shows the percentage of mine sites, through time, that resulted in polluted discharges. In comparison to the 1970s and early 1980s, few modern permits are issued that result in a problem. Department studies have shown that even those sites that do have problems are not nearly as severe as what occurred long ago.

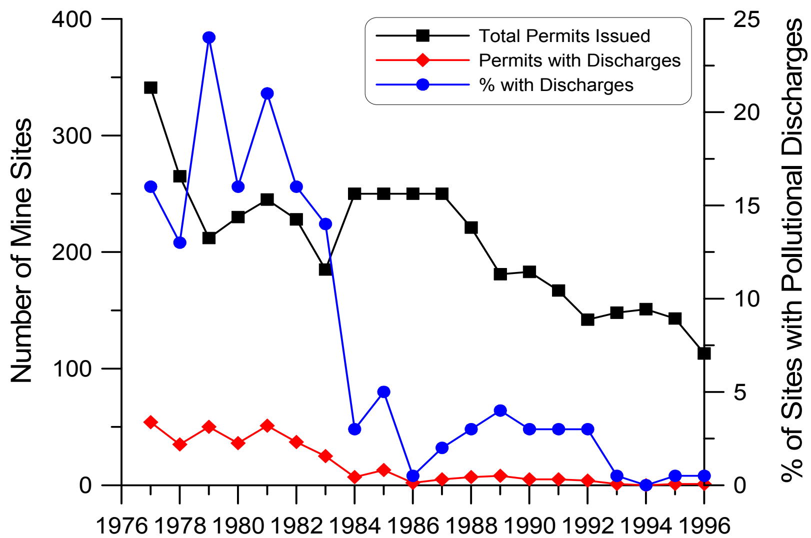


**Figure 1. Graph showing improved permit decision making through time for permitting of surface coal mines. Data from: *Evaluation of Mining Permits Resulting In Acid Mine Drainage 1987-1996: A Post Mortem Study*". [2]**

The Department uses a variety of tools in its decision-making process. These tools are described in the book "*Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania*."[3] It is this toolbox that has resulted in Pennsylvania's ability to successfully predict and prevent post-mining water quality problems.

Along the same theme, the Department, in cooperation with the Materials Research Institute of the Pennsylvania State University, documented the results of coal ash utilization in a 2004 publication, "*Coal Ash Beneficial Use in Mine Reclamation and Mine*

[2] Available online at http://www.dep.state.pa.us/dep/deputate/minres/districts/AMDPostMortem.htm#Appendice

[3] Available online at: http://www.ott.wrcc.osmre.gov/library/pub/cmdpppp.htm and http://www.dep.state.pa.us/dep/deputate/minres/Districts/CMDP/main.htm

*Drainage Remediation in Pennsylvania*". [4] For this book, the Department and Penn State studied numerous sites (some of which were also examined by CATF) in both anthracite and bituminous coal fields that had conventional ash placement and experimental trials, called demonstration projects.

All beneficial use sites require background data on the ash quality and groundwater quality. The ash is analyzed in a dry state (bulk analysis) and via a leaching procedure. The leaching procedure is to determine what the water contains after it percolates through the ash material, potentially picking up and removing any constituents from the ash. The water from this leachate and at groundwater monitoring sites is analyzed for a wide spectrum of potential contaminants. These data were evaluated using various scientific and statistical methods.

The Department staff in the District Mining Offices looks for trends in the groundwater data to determine if degradation is occurring. A trend is identified when the data set shows a statistically detectable tendency to move in a specific direction, such as a rising concentration over time. If a trend is found, it must then be determined if it is a result of the many variables that play a part in water quality changes in the system or to the placement of the coal ash.

One-time anomalous water quality readings are common. These occur because samples are collected and analyzed by humans. There are many causes for "wacky data" that have nothing to do with pollution. The causes are described below under the discussion on outlier data points. <u>A single value does not constitute a trend</u>. If the data exhibits a genuine trend in a constituent that is attributable to the ash, the Department acknowledges it. Sodium and boron can be hallmarks of ash influences because they are relatively uncommon in background data. The Department has determined that some sites of ash placement have exhibited changes in the groundwater that are likely related to ash placement. Some of these changes are only temporary. None of the changes were determined to constitute a hazardous condition to public health and safety or aquatic life. Again, it must be recognized that the groundwater in these areas is not pristine; it is frequently non-potable and therefore not being used as drinking water. Therefore, if the use of ash to fill mine pits is achieving overall environmental benefit, it is not logical to discontinue the practice if the groundwater shows minor, temporary, essentially harmless effects.

Currently, the coal ash program is undergoing modification based on Department studies and experience, contributions from the Office of Surface Mining and the U.S. Environmental Protection Agency, and suggestions made by the National Research Council – National Academies in a study they completed on coal ash use. Some of the recommendations made by the above named groups appear in the CATF report. Federal regulations for coal ash are in the draft process. In addition, Pennsylvania is in the process of codifying by regulation its policies and procedures and adding language to reflect its improved understanding of coal ash beneficial use.

Therefore, the Department is well on the way to addressing legitimate concerns of CATF such as sample frequency and duration. However, a main purpose of this response document is to clarify, explain and point out the failings and shortcomings of some of the

[4] Available online at
http://www.dep.state.pa.us/dep/deputate/minres/bmr/beneficial_use/Index.htm

CATF's methods and conclusions in its report. Staff from the Department's District Mining Offices and Bureau of Mining and Reclamation, with firsthand knowledge of the sites and data sets, reviewed the CATF's interpretation and conclusions and compiled these comments.

## General comments about the CATF report

Proper interpretation of water monitoring data requires an understanding of the hydrogeologic and geochemical context of the placement site, inherent limitations of water quality data (including common errors), and seasonal factors that influence water chemistry. Although each ash placement site reviewed in the CATF report is addressed individually in the next section, the Department identified some consistent fallacies and misinterpretations of data that appear repeatedly throughout the CATF report. They are as follows:

CATF fails to consider AMD as the source of pollution. The historical legacy of mine drainage has already been addressed above. The effects of coal mining have impacted most mines that receive ash and the water associated with these mines is characteristic of coal mine drainage. CATF routinely jumps to the conclusion that the observed pollution is caused by ash. Most of the constituents that it attributes to the ash are common to coal mine drainage and the Department's observations are that the pollution is a result of the coal mine drainage. Also, as discussed above, the Department's ability to predict mine drainage has improved through time and less and less problems of this type are occurring. However, blame for the pollution must be properly assigned.

CATF gives undue weight to outlier data. Outliers are data points that are numerically distant from typical values. Fortunately they are infrequent events. Most large sets of water quality data contain outliers. CATF routinely assumes that outliers identify pollution events; this is an invalid assumption. Outliers occur for a lot of reasons including improper sample collection, errors in sample analysis, switching of samples (sample was collected somewhere else), reporting error (such as a decimal error or multiplication by 10), and inclusion of large quantities of suspended matter during sample collection. Typically, outliers are visually obvious, but if they are not evident, there are statistical approaches that can identify outliers (see Figure 2). Another flaw in the logic of citing individual sample events as evidence of degradation is that one must then be equally willing to declare the sampling point improved when the very next sampling event reveals lower concentrations, yet such conclusions are not found in the CATF report. From the Department's experience with mine sites, when pollution events occur they (unfortunately) persist. Pollution at mines is not a one time or infrequent event, but a continuing trend.

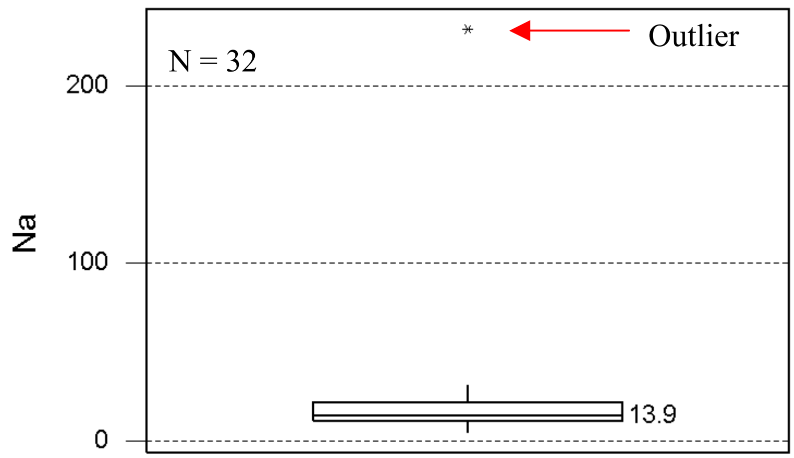


**Figure 2. Boxplot of the sodium data depicted in Figure 8 showing outlier, which is identified by an asterisk (*). The "box" encompasses 50% of the data, the "tails" include all the other data except for the one outlier. All the data, except the outlier, cluster within a tight zone ranging from a low of 4.3 to a high of 31.3; the median is 13.9. The outlier is 232.**

<u>CATF uses statistical trend lines inappropriately.</u> Trend lines are used throughout the report to imply cause-and-effect relationships that often are not otherwise demonstrated nor discussed. Additionally, two CATF interpretation errors are frequently made: (a) Trend lines are placed through data that contains one or two outliers (See example of this in Figure 3). These outlier values, more likely than not being spurious data, are frequently the result of sample collection or analytical error. Placing trend lines through these types of data give outliers undue weight. (b) Trend lines are placed through data that fluctuate widely (Figure 4). These fluctuations are common with mine-impacted waters and are due to seasonal variations and individual precipitation events. Wet times of the year will often result in mine drainage with low concentrations of chemical parameters, or conversely, if a rain event follows a period of drought concentrations can be elevated due to flushing of accumulated pyrite weathering products.

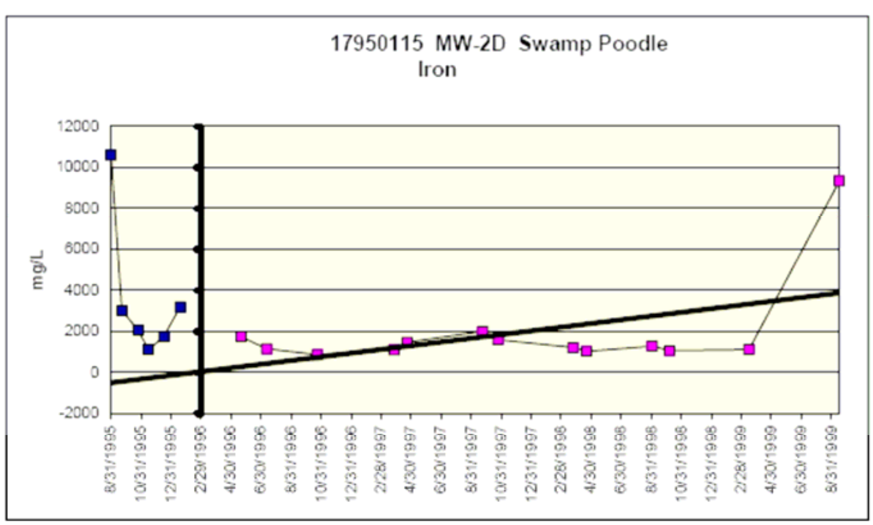


**Figure 3. Example of one outlier (8/1999) skewing the trend line that is generally flat. There is also an outlier in the pre-ash placement data, which is higher than any post-ash placement value. (Fig. 4.10 from CATF report)**

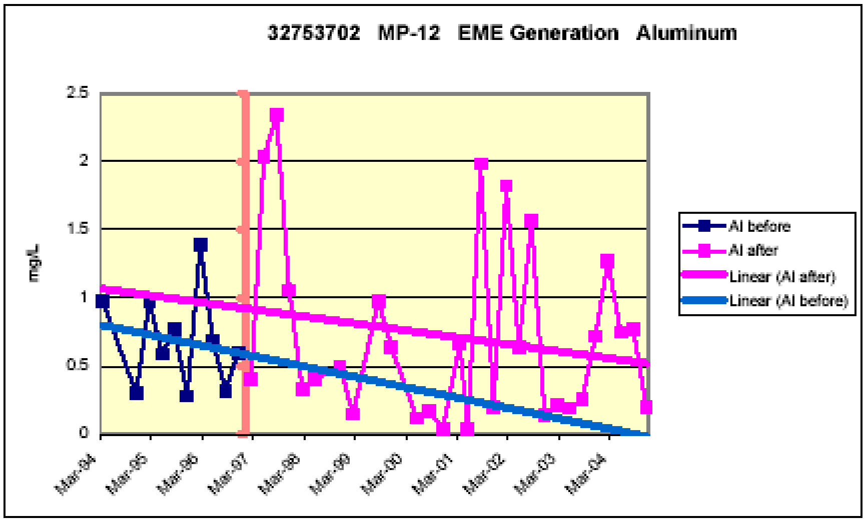


**Figure 4. An example of CATF trend lines put through wildly fluctuating data. These levels of aluminum concentrations are commonly found in coal mine drainage. (Fig 8.20b from CATF report)**

<u>CATF ignores the effects of suspended solids.</u> The CATF fails to recognize the influence of suspended solids on total concentrations of water quality constituents. Suspended solids, as opposed to dissolved solids, is particulate matter that can get dislodged from the sides of monitoring wells or is scooped up during sample collection of discharges. Dissolved solids, on the other hand, are elements that are actually dissolved in the water. Many of the outlier values can be tied to high suspended solids. When samples are collected they are "preserved" in the field with a concentrated acid. This acid will dissolve the suspended particles and if these particles (often just pieces of rock) contain elements being tested, these elements will dissolve into the sample being collected. These elements were not likely to go into solution except under the extreme conditions of the "preserved" sample. Groundwater moves too slowly to contain any appreciable quantity of suspended particles. Thus, high suspended solids in any groundwater sample are a reliable sign that solid material has been dislodged or stirred up during sample collection. The solution to this problem is to require field-filtered samples, which will filter out the suspended particles and give a true reading of the dissolved constituents. The Department is considering making it a requirement to sample ash site for dissolved constituents.

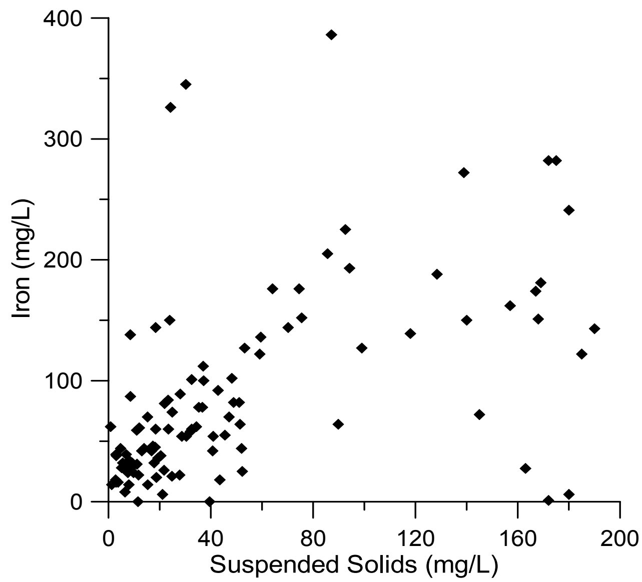


**Figure 5. A plot of iron and suspended solids. There is a tendency for samples with high suspended solids to also have high iron. The sample point used here is the "Monitoring Well South" that is monitored for the Ellengowan-Knickerbocker Mine.**

<u>CATF's definition of success is the generation of alkalinity and water meeting drinking water standards</u>. The CATF defines success of beneficial use as an increase in alkalinity at a mine site. This approach ignores the important benefits of using coal ash to reclaim abandoned mines that are environmental and safety hazards. The lack of alkalinity production from some ashes is evidence that the ash is not leaching pollution. CATF consistently compares the water quality to drinking water standards, even secondary drinking water standards. As has already been discussed, the water at most of the sites did not meet such high standards before ash placement due to impacts from abandoned mines. Drinking water standards are not the effluent standards to which mine sites are typically held. For example, the drinking water standard for iron is 0.3 mg/L. Effluent limits for mining are between 3 and 7 mg/L. Likewise, the manganese drinking water standard is 0.05 mg/L. Effluent limits are between 2 and 5 mg/L. The standards for iron and manganese were developed for aesthetic reasons, not health and safety.

<u>CATF theories attributing degradation to ash do not make sense</u>. The CATF's conjectures linking ash to pollution from mine sites are unreasonable in various respects. Three examples are provided below:

(A) Department studies show ash does not leach contaminants at levels likely to cause environmental degradation. Its low permeability effectively prohibits water flow through ash. The CATF fails to consider that research has shown that the hardening of the ash and sealing of pores will continue to make the elemental constituents of the ash immobile[5].

(B) A comparison of CATF's examination of the Ernest, McDermott and Bender sites (Sites 1, 2 and 3 below) is an example of the CATF's lack of a coherent theory regarding

---

[5] see page 301 of DEP, 2004. Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania. DEP and Penn State Materials Research Institute.

ash effect on groundwater. The allegations of degradation at Ernest include multiple references and claims of trace metal degradation; those at McDermott mention some concerns with trace metal degradation; but rely mostly on other parameters; while at Bender, CATF acknowledges no trends of trace metal contamination and relies almost exclusively on increases in parameters commonly found in AMD to make its case. This raises a question about how such varying water quality conditions can be universally traced back to ash utilization and why the levels of trace metals at the sites differ so much. The obvious answer is that the concentrations have nothing to do with ash placement. The cause of the different water chemistries at these three sites is due to the relative severity of the acid mine drainage (the average acidity at the Ernest ash monitoring seep is 4342 mg/l, the average at MW-2 on McDermott is 273 mg/l, and the average at MD18 at Bender is 64 mg/l). Elevated trace metals are frequently found in severe AMD in Pennsylvania, such as that found on bituminous coal refuse piles (e.g., Ernest), but are much less common in more typical AMD discharges (e.g., McDermott and Bender).

(C) The CATF considers calcium an acceptable tracer for detecting ash. Calcite - the principle (but not only) mineral that contains calcium - is commonly found on mine sites, with our without ash placement. For more discussion see the Ernest site below.

<u>The CATF report is often equivocal while the summary conclusions are not</u>. The data contained in the report is equivocal, and is often stated to be so, yet the CATF summaries show it as decisively indicating contamination. CATF strongly contends in its report and in past documents that a fundamental flaw with Pennsylvania's CFB beneficial use program, and with the specific sites reviewed, is that inadequate data are collected to characterize the sites. Yet, CATF generates none of its own data, but relies completely on the very data it deems as flawed to reach its conclusions. CATF's arguments are therefore mutually exclusive and in conflict with one another. CATF's conclusions do not withstand scientific scrutiny.

## Assessment of Individual Mine Sites Utilized for Ash Placement

### 1. Ernest Mine, SMP No. 32950201, Indiana County

This site remains a work-in-progress and any claim that it has been either a failure or a success is premature and not supported by existing data. It is a large abandoned coal refuse pile that is being reprocessed for fuel for a fluidized bed combustor (FBC) power plant. Alkaline ash from the plant is being used to reclaim the site. The abandoned coal refuse is a significant source of pollution in the form of both AMD parameters and trace metals at levels that exceed those found in most mine drainage. Because the abandoned coal refuse at the site leaches relatively high levels of trace metals, this site has been a favorite target of CATF in the past. However, the background data clearly establish that elevated trace metals were present prior to any ash placement.

Very little area has been completely reclaimed as yet. Large areas of exposed coal refuse are still being disturbed and remain a source of mine drainage. That has likely led to some fluctuations in data, and the operator has tripped triggers for the Subchapter F (remining) monitoring point mostly due to increases in flow. Such results are not unusual at refuse pile remining sites during active operations with or without ash utilization.

The site data have significant fluctuations, and very little in the way of clear trends, negative or positive. The strongest trends of increase for most parameters, show up in the background data (before ash placement), which complicates the interpretation but suggests it is not attributable to the ash. Most of the CATF claims of increasing trace metals are based on spikes from individual sampling events not trends in the data.

The CATF report claims that <u>decreasing</u> acidity at some points (e.g., MW-1) is attributable to ash placement (page 56) while <u>increasing</u> acidity at at least one other point down gradient of the same ash placement area (e.g., E-70) is due to the operation (pages 99-100). This contradiction is an example of the CATF's lack of a coherent theory about how ash may affect groundwater that is evident throughout the report. It also demonstrates how one may reach contradictory conclusions if not careful in assuming cause-and-effect relationships that do not actually exist. Further, the FBC ash placed on the Ernest site is highly alkaline and is incapable of generating acidity.

The Department will further evaluate the claims regarding the abandoned discharge, E70. That is not an ash monitoring point.

An example of how the CATF and the Department look at the same data and reach different conclusions is illustrated by considering total lead concentrations at monitoring well MW-1 at the Ernest site. On page 57 of its report CATF includes several statements that imply a significant increase in lead at MW-1 over time and state that it "may" be due to ash. On page 65 of the report this alleged increase is characterized as "degradation." The available lead data from MW-1 are graphed in Figure 6. The Department's conclusions regarding the data in Figure 1 include: 1) the abandoned coal refuse at the Ernest site is capable of leaching detectable levels of lead based on the pre-remining (pre-October 1996) data; 2) the high detection limits of 0.40 mg/l reported by the company in the 9-23-99 and 6-16-00 results and of 0.05 mg/l on 6-12-96 and 6-29-04 may not be appropriate, but do not represent actual lead levels; 3) there are detectable lead concentrations scattered through the data set; 4) there is no discernible trend in the data that can be accurately characterized as a trend or "degradation."

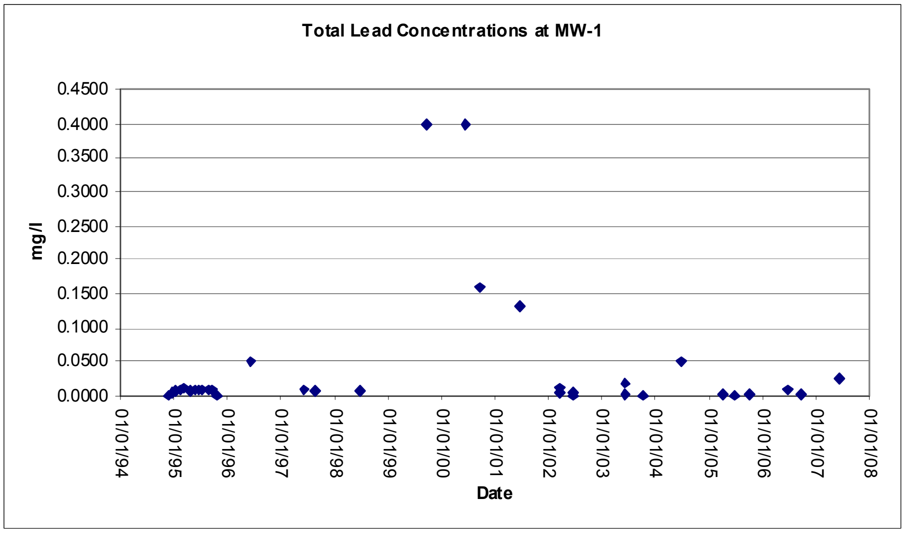


**Figure 6. A plot of lead concentration through time at the Ernest site.**

An examination of the data at the Ernest monitoring point E-5 helps demonstrate with specific data why CATF's conclusions that calcium is unlikely to be elevated on mine sites where acid-base accounting overburden shows low neutralization potential are incorrect. Monitoring point E-5 is leachate from abandoned coal refuse, which is reject rock from a deep mine. Material from such rock piles typically exhibits almost no neutralization potential. Yet the average calcium concentration in the E-5 leachate background data, prior to any ash placement on that site was 299.5 mg/l; the average calcium concentrations in the Bender discharge point 18 is 114 mg/l including the data collected after both coal ash and limestone were added to the Bender site. Average magnesium concentrations in E-5 background data and Bender point 18 data are 70 and 50 mg/l respectively. In this comparison the site comprised solely of mine waste material leaches higher levels of both Ca and Mg than does the mine site where both coal ash and limestone have been added to the site overburden. Obviously, CATF's premise that calcium and magnesium are not available for leaching in mine rock with low neutralization potential and that Ca and Mg are therefore reliable ash tracer parameters is seriously flawed. Conclusions made throughout the CATF report based on that premise therefore must be rejected as flawed.

The Department believes that the current remining operation and ash utilization will ultimately result in significant improvements in water quality at the Ernest site and has concluded that none of the data reveal pollution from ash placement. As already noted, very little of this site has been completed.

## 2. McDermott Mine, SMP No. 11950102, Cambria County

Highly alkaline FBC ash was used for alkaline addition at this site because it was known that the rock above the coal would produce acidity if not treated. Unfortunately, the ash did not produce the needed alkalinity to offset the acidity and the site is producing acid mine drainage. However, it does not logically follow that the alkaline ash is producing the acid mine drainage or is the source of all elevated parameters at the site. Such a conclusion would be exactly parallel to claiming that limestone is the source of AMD on sites where alkaline addition using limestone has not prevented AMD formation. All the parameters that have increased, with the exception of sodium and chloride, are common to mine drainage. Some abandoned mines (pre-1966) were producing elevated lead concentrations before the more recent mining at McDermott; again consistent with the problem being acid mine drainage, not ash-related.

Sodium and chloride have increased modestly and the Department attributes this in part to the ash. However, the concentrations are hardly of concern and are well below 250 mg/L, the recommended drinking water standard for chloride. This combination of ions, in the form of salt, is routinely kept on the dining room table at far higher concentrations. Investigators should also be aware that some of the McDermott monitoring points, especially those around the southern end of the site, are influenced by heavy road salting on US Route 22.

The McDermott site data suggest that one of the shortcomings of the mining plan, is that the ash was not as reactive as believed and thus did not generate sufficient alkalinity to offset the acid producing potential of the overburden. The premise for ash use at this site was to derive alkalinity from the ash and this has not occurred. This strongly suggests that other chemical constituents that are present in far smaller concentrations are likewise not leaching.

CATF's conclusions that there have been increases in trace metals at the site are not based on any clearly defined trends, but simply point out individual sampling events where concentrations exceeded baseline concentrations and conclude those results are due to ash; no cause-and-effect link is established and no explanation is given when further sampling shows the concentrations to have returned to baseline conditions or less. Because more data were collected after ash placement as compared to before ash placement, one would expect some higher individual concentration results in the larger post-mining data sets, even if the data were purely random and the site had never been mined. Another flaw in CATF's logic of citing individual sample events as evidence of degradation is that one must then be equally willing to declare the sampling point improved when the very next sampling event reveals lower concentrations, yet such conclusions are not found in the CATF report.

The Department has concluded that: 1) The mining on the McDermott site produced acid mine drainage and convincingly degraded some down-gradient monitoring points with AMD; 2) The alkaline addition plan for the site did not work and the amount of ash used was either inadequate or the alkalinity in the ash was not as chemically available as was predicted; 3) Trace metal data, other than lead, remain essentially unchanged throughout the life of the monitoring plan; 4) Lead concentrations were elevated on the northern end of the site prior to activation of the McDermott site and increased when the northern area was mined; however, lead concentrations on the southern end of the site were low prior to site activation and remained low after mining and ash placement, <u>despite ash placement rates being generally higher on the southern end of the site</u>—this clearly demonstrates a lead source in the overburden.

The mine company was properly cited by the Department for causing increases in mine drainage pollution at the McDermott site. Unfortunately, the company went out of business and abandoned the site rather than correcting the problems.

The department's study of this site is available in:

> Kania, T.C. and J.M. Tarantino, 2004. Chapter 5. Coal ash beneficial use on bituminous mine sites. In: Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania. Department of Environmental Protection and Penn State Material Research Institute, pp.135-145.

**3. EP Bender Mine, SMP No. 11930102, Cambria County**

This was a Subchapter F (remining) site initially issued without ash placement. When the two primary monitoring points started to degrade, the permit was modified to allow ash placement as part of an attempt at abating a developing problem. The abatement did not work and the company eventually commenced treatment. The company has accepted its responsibility for increased AMD at the site and is currently successfully treating the degraded water using passive treatment methods.

A critical point regarding this site is that ash placement was proposed as abatement after the Department and the company recognized that mining on the site had started to degrade abandoned mine discharges. This fact is clearly established in Department files for the site. Yet throughout its discussion on this site CATF includes statements that imply AMD parameters began to increase after ash placement began. Since the established purpose of ash placement at this site was to try to abate an already recognized trend of degradation, these types of statements clearly imply a relationship between ash placement and the onset of AMD increases that is not supported by fact. As mining on the site continued so did the increases in some AMD parameters at some monitoring points. So it would be accurate to conclude that the abatement plan using ash (and limestone) as an alkaline addition agent was not successful, but it is equally inaccurate to state that the use of ash created the increase in AMD parameters on the site.

All the parameters that have increased at the Bender site are common to AMD and it is proven fact that the onset of increased AMD predated ash placement at this site. CATF acknowledges that "there were no substantial upward trends found in trace metals at this site aside from nickel…" on page 201 of its report, but goes on to cite individual sampling events with detectable levels of some trace metals. The Department concurs that trace metal levels have not increased at the site and point out that nickel at detectable levels is quite typical in acid mine drainage and usually increases with an increase in acidity. Because the alkaline addition plan at this site did not seem to be working, the company abandoned the use of ash in favor of limestone. The amount of ash used on the Bender site was therefore less than 75,000 tons, an amount dwarfed by the millions of tons of rock overburden on the site. It is not surprising that the ash placement on the site did not neutralize the mine drainage or otherwise affect the discharge quality.

The CATF seems to think that increased calcium concentrations are attributable to the ash because of the low neutralization potential of the overburden strata. That does not necessarily follow in that the rocks can still contain small amounts of calcite and other calcium-bearing minerals. In fact, calcium levels almost universally increase with increasing levels of AMD pollution. The same is true of magnesium. Manganese and aluminum are also quite common components of mine drainage. Therefore, it is generally not appropriate to attempt to use these parameters to define an influence from ash on mine sites as CATF does throughout its report. CATF cites an increase in chloride levels at the Bender site. The chloride levels at the Bender site are well within what would be expected for shallow groundwater in that part of Pennsylvania.

**4. Reading Anthracite Company, Ellengowan/Knickerbocker Mine, SMP No. 54793206, Schuylkill County**

This demonstration site (along with the NEPCO/Silverbrook/Big Gorilla site) has been extensively studied by the Department and the Penn State Materials Research Institute. Published studies include:

Loop, C.M., W.B. White and B.E. Scheetz, 2004. Chapter 8. The Knickerbocker demonstration project. In: Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania. Department of Environmental Protection and Penn State Material Research Institute, pp. 229-245.

Loop, Caroline M. 2000. The Impact of Ash Placement in a Surface Mine Pool on the chemistry of the Silverbrook Basin. MS Thesis, PSU

Loop, Caroline M. 2003. Aqueous and Precipitate Chemistry of Coal Mine Drainage Water in Alkaline Environments. PhD Dissertation, PSU.

None of the above studies found pollution attributable to the placement of ash at these sites.

The CATF relies on extreme outlier values that are not statistically significant. Extreme outliers are more likely to be caused by poor sample collection techniques, laboratory error, sample contamination, or a spurious rare event than actual pollution.

There is a lack of actual trends. If pollution is occurring, it would not be a one-time or infrequent event; it would be an upward trend or at least a constant problem. An absence of a trend is most likely an absence of pollution.

The CATF fails to recognize the normal characteristics of mine drainage pollution. Mine drainage contains nearly all of the constituents they are attributing to ash. Mine drainage chemistry often varies through time due to precipitation events and seasonal influences. Variations in concentrations are natural, not abnormal.

The CATF overemphasizes that parameter ‘a’ increased ‘x’ times when in fact the data show concentrations for the element are still quite low. For example, sodium and calcium at Maple Hill & Holes South site (Figure 6) increased over time but remained well below levels routinely consumed in food and drink. There was an increase, but it is inconsequential.

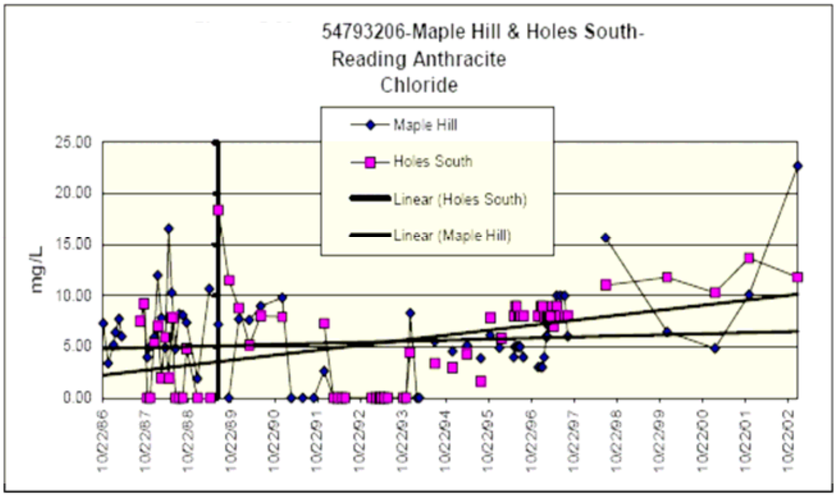


**Figure 6. Chloride values appear to have increased but values are still far below drinking water secondary MCL values of 250 mg/l. (Figure 5.22a from CATF report)**

Mr. Gadinski, an author for the CATF report, filed a complaint with the Pottsville District Mining Office in February 2007 regarding this ash site. The Department completed an investigative report in response to the complaint, dated August 8, 2007. Many of the same allegations were made by Mr. Gadinski as are in the CATF report. Upon close inspection, the Department found that compared to published data on anthracite mine pools, the mine pool water at this site was not unusual. The monitoring points did not show increasing trends as was alleged. The claim that “severe mine pool contamination” was occurring is unsubstantiated.

**5. Northeastern Power Company, Silverbrook/Big Gorilla Site, SMP No. 54920201, Schuylkill & Carbon Counties**

The CATF report contains inappropriate trend lines that project into the past or future where there is no data. Obviously, this is a misleading practice. In the sodium graph, the trend line is highly skewed by one errant sample and becomes a clearly false representation of the data since most of the measured values are contained below it (Figure 8). This errant point is an excellent example of a statistical outlier.

In some cases, the scale is inflated, the values are very small thus portraying the trend as significant where it is not. That is a hallmark of using a graph to lead the viewer towards a conclusion that is, in essence, not self-evident or significant.

This site was also part of the Penn State Materials Research Institute studies that resulted in the second two publications cited under site 4 above. It is also discussed in:

Loop, C.M., B.E. Scheetz, and W.B. White, 2004. Chapter 9. The Big Gorilla demonstration project. In: Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania. Department of Environmental Protection and Penn State Material Research Institute, pp. 246-301.

The CATF review is far, far less rigorous than the studies performed by the Penn State Materials Research Institute. It is not even comparable considering the degree of testing, analysis and interpretation on all aspects of this project performed by Penn State experts. The CATF review is superficial and unsupported in its conclusions that are contradictory to the Department's and PSU's findings.

Penn State found that the supply of minerals contributing to alkalinity is either consumed quickly or is only available in the top layers of ash.[6] The ash essentially forms an impermeable plug. The metals are held, not leached in appreciable concentrations as the CATF alleges. This project did not cause pollution.

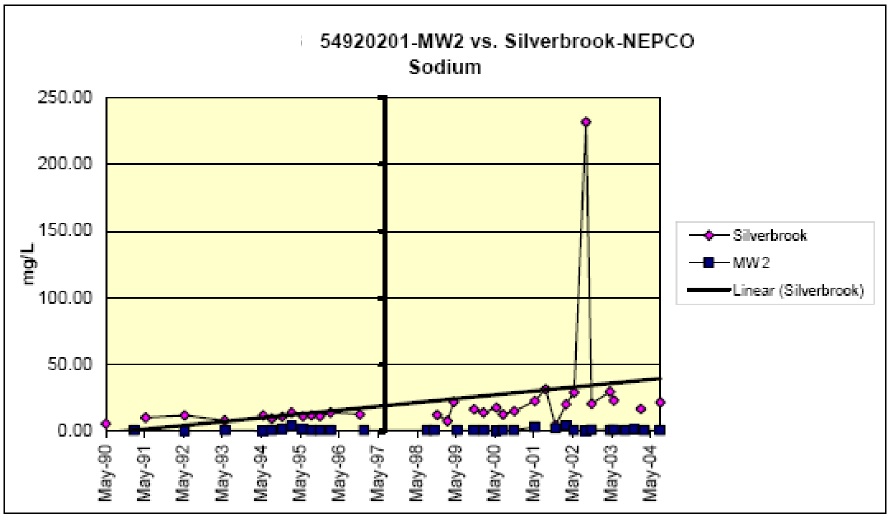


**Figure 8. One value causes a clear misrepresentation of a trend. The post-ash data fall mostly below the trend line. Again, the concentrations are inconsequentially low. (Fig. 6.13 from CATF report).**

## 6. BD Mining Company Mine, SMP No. 54850202, Schuylkill County

Again, here is an example of the CATF using the trend lines to misrepresent the data as showing contamination. Lines purported to represent trends in pH are inaccurate, because values are fluctuating as a result of seasonal influences and precipitation events. Linear trend lines are actually not the best fit for the data. Trend lines are shown as projecting past the point where regular sampling has taken place. That is not justifiable due to the variation in the data.

Alkalinity spikes can be indicative of water quality improvements, not contamination, based on less inflow to the mine pool. The metals concentrations do not signal a trend when most of the results are still below detectable levels. The Department does not agree that the comparisons of lead values in watersheds is appropriate since there are differences in rock chemistry between watersheds, and comparisons are made between undisturbed and mined areas. In any event, the data here is complex and variation may well be attributable to interacting factors, not one simple cause and effect.

[6] Loop, C.M. et al., 2004. Chapter 9. The Big Gorilla demonstration project. In: Coal Ash Beneficial Use in Mine Reclamation and Mine Drainage Remediation in Pennsylvania. PA DEP and Penn State Materials Research Institute, pp. 246-301.

CATF concludes that there is not enough data to effectively assess the causes for metals in the mine pool (p. 374) yet the CATF summary sheet states the ash is responsible.

**7. Russelton Mine, SMP No. 02930201, Allegheny County**
No WQ problem stated

**8. Wildwood Mine, SMP No. 02940201, Allegheny County**
No WQ problem stated

Both of these sites have improved water quality. CATF would like to see more monitoring at both sites to try and explain data outliers and confirm that the trends are long term.

It is not reasonable to assume, as the CATF does, that the conditions at the sites will 'use up' the alkalinity and that the resulting acid condition will leach the metals from the refuse and the ash. In both cases 90% of the refuse was burned and came back as ash, leaving both sites overwhelmingly alkaline.

**9. Larson Enterprises, Swamp Poodle Site, SMP No. 17950115, Clearfield County**

As with the other sites, no rigorous statistical analyses was conducted to support the strong conclusions made by CATF: there were no tests to determine significant changes between premining and postmining data; trend lines are placed upon the various charts, but no statistical tests for trend significance were conducted; the correlation coefficients for the various trend lines are not given. And again, as at other sites, some trend lines may have some meaning, but outliers skew many and/or the correlation coefficient is probably very low due to randomness in the data.

CATF made no attempt to place the monitoring of the wells within the context of the hydrology of the site and the various stages of mining. The CATF often concludes that certain trace elements (arsenic, cadmium, lead, and selenium) had increased due to the mining and ash placement, but they do not consider when ash was placed where at a mine. Some elevated concentrations are outliers and may be an artifact of improper sampling methods and/or equipment contamination.

Within the narrative, most remarks, interpretations, and conclusions are based upon the visual display of the plots. As mentioned above, visually observing the data in plots that have "trend lines" superimposed without considering correlation coefficients, outliers, and trend analysis can be misleading. Furthermore, the CATF portrays the water quality concentrations as being "x times" higher than the EPA drinking water standards. The water failed to meet drinking water standards prior to ash placement and the incidents of measurements above this level are inconsistent, sometimes returning to below the maximum contaminant level. This is not a trend.

Some monitoring points have mine drainage parameters, such as manganese and sulfate, with increasing trends (primarily MW-3D and, to a lesser extent, MW-4D). Again, these changes are typical of mine water chemistry, which is the more likely explanation of their existence.

## 10. EME Generation Mine, SMP No. 32753702, Indiana County

The site is a “no discharge” ash/coal refuse disposal facility. The entire ash/coal refuse disposal footprint is underlain by a 50 mil HDPE liner. (Note that a liner does not underlie some of the previous coal refuse disposal area.) The leachate and all surface runoff is collected and pumped to the power plant for treatment and make-up water. An under-drain collects any groundwater below the liner system, sampled at MP-15, which shows no evidence of liner failure. The water quality is typical of shallow groundwater. The leachate water quality is sampled at MP-14 and is completely different from that of MP-15. The MP-14 water quality is typical of coal refuse leachate, with highly elevated AMD parameters and low pH.

As the Department has repeatedly observed in the CATF report, the graphs and trend analysis are very misleading. Projecting trends on limited data is speculative. Even though the trend lines of most chemical parameters are declining post ash/refuse disposal, the CATF highlights peak data values. Trend line generation is a function of the complete data set where high and low points are weighted equally.

The CATF ignored key data regarding sulfate in the stream. Monitoring points, MP-3, 4, 16, 17 and 18, were not included in the evaluation. These data are available in Department files and the CATF was notified in 2005 that in order to have a complete hydrologic assessment, these points must be considered. Still, the CATF chose to ignore this data set. Monitoring points MP-3 (upstream) and MP-4 (mid-stream) are sample locations on an unnamed tributary to Cherry Run. CATF included only MP-13 in their evaluation, which is at the mouth of this unnamed tributary. The CATF relies heavily on MP-11 (upstream Cherry Run), MP-12 (downstream Cherry Run), and MP-13 to conclude that ash disposal is the sole source of rising sulfate levels in Cherry Run downstream, and that Cherry Run has been significantly degraded to a level which renders the stream non-potable.

Sulfate is the only chemical parameter at MP-12 that shows an increasing trend. One would logically expect that other typical AMD parameters would trend similarly to sulfate concentrations if contamination from an ash/coal refuse facility was indeed occurring. However, the data here indicates otherwise. The trend for iron and manganese is decreasing and pH is increasing. The same trends are noticed at MP-13. Had CATF considered the upstream monitoring points MP- 3 and MP-4 in the evaluation, it would have observed an elevated sulfate trail that can be followed upstream to the Helvetia mine drainage treatment plant. The plant treats water pumped from the Lucerne #6 deep mine and leachate from the Lucerne #6 coal refuse disposal area. The observed sulfate levels are typical of treated acid mine drainage.

Contrary to the CATF summary on EME ash disposal, the Department finds no evidence of sulfate contamination to Cherry Run related to the beneficial ash disposal and concludes, instead, the obvious source of sulfate is the upstream treatment plant, not the ash.

Based on the evidence, the facts do not support the CATF allegation that the ash is not only contaminating the groundwater at this location, but managing to circumvent the liner system to do so. It is difficult to imagine a clearer example of how the CATF selectively chose the data to show the intended conclusion.

## 11. Lawrence Coal Company, Hartley Strip Mine, SMP No. 30713008, Greene County

The CATF report does not hesitate to use a lack of data to draw hard conclusions where no data exists. Trend lines are drawn and conclusions are made even though there are wide variations in data or missing data points (see Figure 9). The CATF does not hesitate to use outliers to see problems. The CATF has built its arguments for pollution by making unsupported assumptions and theorized hydrologic connections.

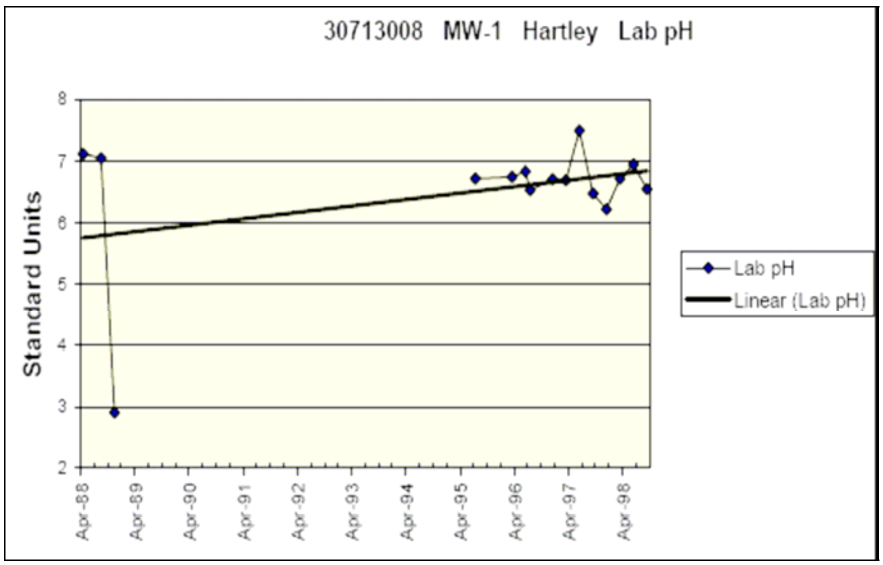


**Figure 9. The trend line does not realistically represent the behavior of the data. (Fig. 9.3A from CATF report)**

## 12. Sky Haven Coal Company, Bloom #1 Site, SMP No. 17950110 Clearfield County

The CATF selectively used data for this site to suggest that ash placement was responsible for contamination. It is not clear that contamination has occurred.

Mining up-gradient of monitoring point FA-30 did not commence until the spring of 1999. All spikes in parameters occur during the spring of 2003 when mining was taking place up-gradient of FA-30. Manganese spiked due to mining in the area above FA-30. Sulfate levels are at the highest levels during fall of 2002 and spring of 2003. The average manganese value of 3.8 mg/l falls within the range of background samples. If the two outliers are thrown out, the average concentration is 3.11 mg/l, lower than the background average.

Spikes in sulfate and total dissolved solids correspond to those in manganese due to mining in the immediate area of FA-30. The levels of sulfate, manganese and dissolved solids otherwise remain at background levels for this monitoring point. The elevated magnesium and calcium might also be attributed to mining in the immediate area of FA-30.

Monitoring point FA-30 was net acidic prior to mining and is now neutral. Acidity and pH have decreased in concentration and alkalinity has shown a slight increase in concentration.

Monitoring point FA-19 is affected by acid mine drainage from the mine site. Increases in concentrations of iron, manganese, sulfate, acidity and TDS are evident. In addition, the alkalinity and pH have decreased. The water chemistry is indicative of coal mine drainage and there is no evidence of impacts on water quality from the ash at this monitoring point.

Monitoring point FA-32 is a dug well that extends below the Middle Kittanning coal elevation and is located just down-gradient of the mine site and is affected by acid mine drainage from the mine site. Again, there is no evidence of impacts on water quality from the ash at this monitoring point.

Monitoring point FA-20 sampling data shows degradation from acid mine drainage. Mining of the initial phase resulted in the flows increasing up to two times the background rates. The mining, along with the increase in flow, has led to increases in loadings for iron and manganese.

MW-3 is a monitoring well drilled into the backfill of the mine site down to the Middle Kittanning coal seam. The bottom of the well is located 5 feet below the pit floor. The well is cased through the spoil and fly ash so that samples of groundwater within the spoil can be collected. Only one sample has been collected from this monitoring point that included the ash parameters. The elevated parameters are most likely due to high suspended solids within the sample (418 mg/L). High suspended solids at this sample point has been a routine problem at this monitoring point with other samples (samples collected for mine drainage parameters) having 89 mg/L suspended solids or higher for every sample. The data show increasing alkalinity and decreasing acidity, which is attributed to the ash. The elevated sulfate is probably attributable to both the mining and ash placement. Figure 9 shows the increase in sulfate. For those who are unfamiliar with water chemistry, this graph is deceptive: all three parameters plotted on the graph essentially depict the same thing and should look the same. Sulfate is a dominant anion and its concentration would be directly related to total dissolved solids (TDS). Specific conductivity (SC) is simply a way to estimate TDS using an electrode. All three measure the same property.

Elevated concentrations of many constituents are probably due to suspended matter that entered the water during collection and not due to dissolved ions in the water. More samples and filtered samples would resolve the issue of the source of elevated ions.

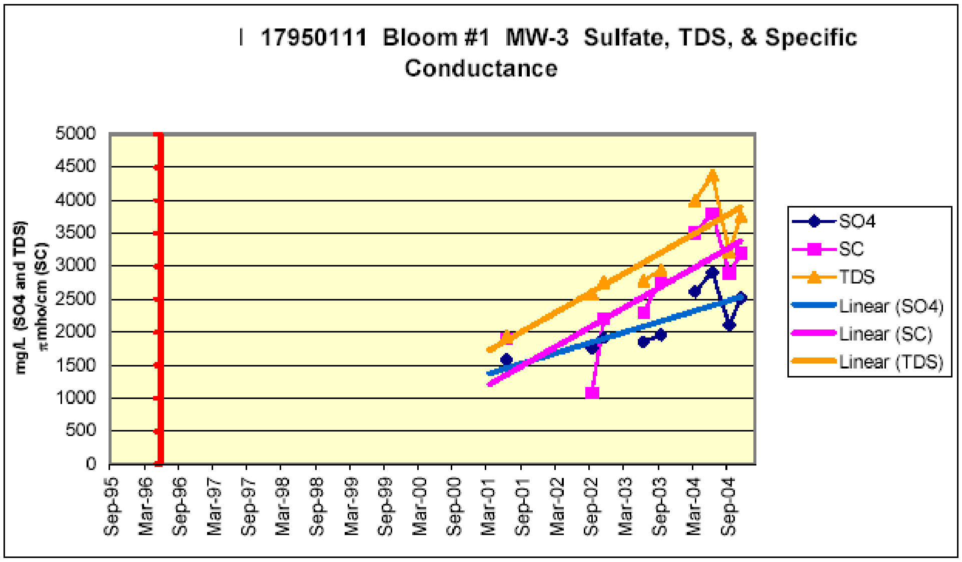


**Figure 10. This graph could be interpreted as being three separate parameters increasing through time. However, they essentially measure the same property of the water. (Figure 10.51 of CATF report)**

## 13. TDK Sandy Hollow Mine, SMP No. 16910104, Clarion County

CATF's conclusion that there is "… a definite degradation of groundwater at the Sandy Hollow Mine…" contradicts statements in the body of its report. The last sentence of page 507 states, "*If* chloride and sodium are ash indicator parameters at MW-3, then ash placement has had little effect on groundwater." The last sentence on page 508 states "…it is not possible to determine the ash's effect on trace element concentrations in down-gradient waters."

Calcium and magnesium rose after ash placement in down-gradient monitoring well MW-3. This is expected with the placement of FBC ash. Manganese and iron also were elevated during mining but fell to pre-mining levels. Sulfates are elevated from the 100 plus range to between 300 and 400 mg/l.

The CATF considers any rise of any parameter degradation. The CATF also states in the conclusion that "However, it is difficult to determine the degree to which ash placement or AMD from mining activity is contributing to this increasing degradation with the information at hand".

Monitoring data shows that there was an increase in mining-related groundwater parameters that. with the exception of sulfate, returned to pre-mining levels. Chloride and sodium are indicator parameters for FBC ash. The flat lying trend with these parameters (Figure 11) does indicate that there has been no degradation as a result of ash placement on the Sandy Hollow site.

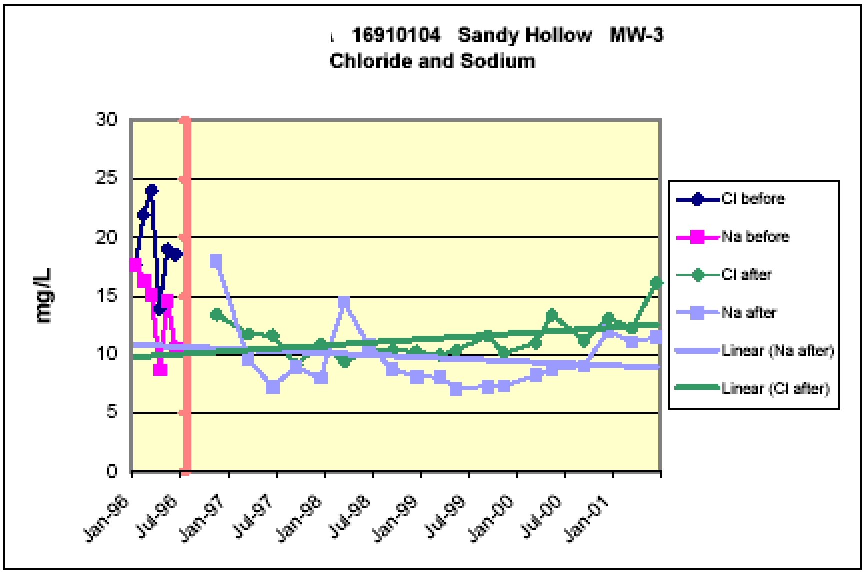


**Figure 11. Chloride and sodium concentrations before and after ash placement. Note that pre-placement values are as high or higher than post-ash placement. All concentrations are low and inconsequential. (Figure 11.11A of CATF report).**

## 14. C&K Coal Mine, SMP No. 16703006, Clarion County

The CATF concluded that a rise in calcium, magnesium, chloride, alkalinity and pH is an impact on groundwater from ash placement. This was anticipated and, for the most part, is a beneficial impact on groundwater. The CATF summarizes that there has been buffering and neutralization of acid mine drainage from coal ash over time. The CATF concludes that the rise of these constituents can result from mining, mine drainage, ash placement or any combination of these activities.

It is not clear what the CATF was implying when it stated: "Higher major and trace element concentrations in the spoil aquifer can result from mining activity and the placement of the ash and coal waste directly into spoil water." If the CATF thinks that the rise in the concentrations of the above noted parameters is contamination and it expects this to continue into the future, there is no data that confirms this assertion.

The CATF does not conclude that placement of coal ash has degraded the groundwater at this site.

## 15. Forcey Coal Company, Buterbaugh Mine, SMP No. 17990112 Clearfield County

The CATF report states that the placement area covered 72 acres. The actual placement area was much smaller than 72 acres. The ash source, Westvaco's Tyrone Paper Mill was closed from October 2001 through November 2003. There was no fly ash delivered to the Buterbaugh Mine during this time period because the mill did not generate ash. The total volume of ash disposed of during the four-year period was 24,538 tons. Two water-monitoring points (BC-3 & BC-14) were addressed in the CATF narrative.

The CATF report alleges that both points were impacted/degraded by ash placement. CATF incorrectly assessed the data relative to these two monitoring points.

BC-3 emerges as a toe of spoil discharge from the pre-law surface mine down slope from the Buterbaugh Mine. There is a clear degradation trend at BC-3 from acid mine drainage. The Department completed a hydrologic investigation in May 2007. Beneficial use of coal ash was approved in December 2000 and occurred after degradation had first appeared at BC-3. The Department's position is that the trend reflects degradation from surface mining activity not ash placement. The hydrologic investigation of BC-3 concluded that surface mining was initiated in the recharge area of BC-3 in April 2000 and preceded approval of ash disposal.

BC-14 is the upstream water sampling point for an intermittent unnamed tributary to Banian Run. The CATF report identifies what, at first blush, appears to be an increasing trend in iron concentrations at BC-14. A closer look at the water data for BC-14 clearly indicates that the iron trend is linked to increased total suspended solids (TSS). Total suspended solids were not considered as a parameter of interest in the report. The increased suspended solids evident in the sampling analysis explain the elevated iron concentration reported in June 2004. Steep gradient streams often have elevated suspended solids from bed load transport. BC-14 sampling frequently exhibits elevated suspended solids in the sampling coupled to elevated metal concentrations. For example, BC-14 baseline metal concentrations for iron and manganese were recorded at 10.56 mg/L and 7.69 mg/L, respectively with a high total suspended solids sample (108.5 mg/L) collected in February 2000 before ash disposal approval. If one removes the "outlier" values contributable to elevated total suspended solids, there is no degradation trend at BC-14 for any of the parameters mentioned in the CATF report.

The source of pollution at BC-3 is acid mine drainage generated by the Forcey Coal, Inc. Buterbaugh Mine. The source of pollution is primarily from the pyritic shale units in the lower geologic section of the Middle Kittanning coal formation that were disturbed during the surface mining process. On-site alkaline strata was not spread adequately to offset acid mine drainage production from low-cover mining areas. On Phases I and II of this mine, Forcey Coal spoiled approximately 7,332,000 tons of overburden through the surface mining process. The total ash used on this mine was 24,538 tons, which equates to 0.3% of the material within the backfill of this mine. The data analyzed do not support the claim that ash contributed to the contamination of the water in the mining operation, because the contamination at BC-3 preceded approval of ash placement and the quantity of ash placed within the mine is minuscule relative to the overall material spoiled and reclaimed through the surface mining process.

There is no degradation evident at monitoring point BC-14.