# 6. DRINKING WATER

AMD pollution affects the availability of clean, affordable drinking water. As described in this section, both public and private drinking water sources in the WBSR watershed have been impacted by AMD. In addition, new industries and large water users may avoid areas in which clean water supplies are not available. While difficult to quantify, AMD remediation is likely to open up cheaper options for future public water supplies and to prevent the need for future waterline extensions.

## 6.1 Impacts on public water supplies

The impact of AMD on public water supplies was researched by conducting interviews of drinking water treatment facility operators within the WBSR watershed. To locate appropriate operators for interviews, a public database of Pennsylvania drinking water systems was queried (PADEP, 2007).[12] Information about all active public water systems was collected; each active system included one or more types of withdrawals.[13] Locations of each withdrawal were then plotted using the provided latitude and longitude using GIS. Only those withdrawals within the boundaries of the WBSR watershed were included in the analysis. As shown in Table 12, active public water systems withdraw from more than 1,000 locations across the watershed.

**Table 12: Withdrawals by active public water systems in the West Branch Susquehanna River watershed**

| Type of system | Permanent | Reserve | Emergency | Seasonal | Interim | Total |
|---|---|---|---|---|---|---|
| Surface | 62 | 6 | 3 | 1 | 0 | 72 |
| Ground | 780 | 51 | 17 | 0 | 3 | 851 |
| Ground under SWI | 48 | 10 | 3 | 9 | 0 | 70 |
| Purchased surface | 10 | 0 | 1 | 0 | 0 | 11 |
| Purchased ground | 9 | 4 | 1 | 0 | 0 | 14 |
| Total | 909 | 71 | 25 | 10 | 3 | 1,018 |

Source: PADEP (2007). SWI=surface water influence.

This database was further refined to include only those permanent withdrawals that were not abandoned. These 747 withdrawals are categorized below in Table 13. A map of these withdrawals was then overlaid onto streams in the WBSR watershed. Streams were characterized as AMD-impaired or non-AMD-impaired, to determine which permanent, non-abandoned public water withdrawals are most likely to be impacted by AMD.

[12] The following 13 counties were included: Cambria, Cameron, Centre, Clearfield, Clinton, Elk, Lycoming, Montour, Northumberland, Potter, Sullivan, Tioga, and Union.
[13] Some active *systems* included abandoned *withdrawals.*

**Table 13: Permanent, not abandoned withdrawals by active public water systems in the West Branch Susquehanna River watershed**

| Type of System | Number |
|---|---|
| Surface | 51 |
| Ground | 639 |
| Ground under SWI | 45 |
| Purchased surface | 7 |
| Purchased ground | 5 |
| Total | 747 |

Source: PADEP (2007). SWI=surface water influence.

Of the 51 surface water withdrawals, we then chose eight located on or very close to AMD-impaired streams. These eight systems were targeted for interviews.

In addition, we identified systems with groundwater withdrawals near AMD-impacted streams and near non-AMD-impacted streams, as well as surface water withdrawals on non-AMD impaired streams. These systems were chosen at random; however, priority was given to municipalities with multiple withdrawals in order to maximize the amount of information attained during the interview process.

Individual systems typically withdraw water from multiple sources. A total of 16 systems with 56 sources were targeted for interviews (Table 14). These sources included abandoned, permanent, and reserve sources, as we wanted to gain information on past, present, and potential future withdrawals.

**Table 14: Public drinking water sources targeted for interviews**

| | Surface | Ground | Total |
|---|---|---|---|
| On or near AMD-impacted streams | 8 | 13 | 21 |
| On or near non-AMD-impacted streams | 9 | 9 | 18 |
| Reserve | 5 | 6 | 11 |
| Abandoned | 0 | 6 | 6 |
| Total | 22 | 34 | 56 |

Introductory letters were sent to all 16 systems. We then called and made appointments for phone interviews. Interviews were conducted with a total of nine of the 16 targeted systems in November 2007. These included all eight systems we believed to be withdrawing surface water from AMD-impacted streams, plus one system with only groundwater withdrawals near AMD-impacted streams. These nine systems had a total of 36 water sources. The systems we spoke with and their corresponding withdrawal sources have been assigned letters A through I to preserve confidentiality. The sources used by these nine systems are listed in Table 15 and have been updated from the original database using information gathered in the interviews.

**Table 15: Types of sources and volume withdrawn for the systems that participated in drinking water interviews**

| System | Source | Type | Volume withdrawn (million gallons/ year) | AMD impacted? | Other pollutants? | Notes |
|---|---|---|---|---|---|---|
| A | A1 | Ground SWI | 2.6 | No | No | This source will not be available soon, system looking at options |
| A | A2 | Ground SWI | Abandoned | NA | NA | |
| B | B1 | Ground SWI | 4 | No | Yes | Variable pH from acid precipitation, going offline soon |
| B | B2 | Ground | 0 | Yes | No | Will be online in near future, treatment costs will go up |
| B | B3 | Ground | Reserve | No | Unknown | |
| C | C1 | Ground | 9.2 | No | Yes | High iron and manganese due to rock formations |
| C | C2 | Ground SWI | 21 | No | No | High alkalinity and hardness |
| C | C3 | Ground | Reserve | No | Unknown | |
| C | C4 | Ground | Abandoned | NA | NA | Too shallow |
| D | D1 | Surface | 118 | No | No | |
| D | D2 | Ground | 136 | No | No | |
| D | D3 | Ground | 75 | No | Yes | High iron due to rock formation, increased treatment costs |
| D | D4 | Surface | Reserve | Yes | No | Do not use due to AMD |
| D | D5 | Ground | 113 | No | No | |
| D | D6 | Surface | 0 | NA | NA | |
| D | D7 | Surface | Reserve | Yes | No | Do not use due to AMD and water restrictions on creek |
| E | E1 | Surface | 272 | No | No | |
| E | E2 | Surface | 2 | No | No | |
| E | E3 | Ground | 5 | No | No | |
| E | E4 | Ground | Abandoned | NA | NA | |
| E | E5 | Surface | Reserve | Yes | No | Do not use due to AMD |
| E | E6 | Ground | Abandoned | NA | NA | |
| F | F1 | Ground | Abandoned | NA | NA | |
| F | F2 | Surface | 219 | No | Yes | Acidic due to rock formations |
| F | F3 | Surface | Emergency | Yes | No | Do not use due to AMD, becoming more complicated due to drought conditions |
| G | G1 | Surface | Unknown | Yes | No | Drinking water portion of withdrawal is minuscule compared to total withdrawals |
| H | H1 | Surface | 25.6 | Yes | No | Tributaries here are orange, but WBSR is not |
| H | H2 | Surface | 6.4 | Yes | No | Increased treatment requirements and costs |
| H | H3 | Ground | Abandoned | NA | NA | |
| H | H4 | Surface | Reserve | Yes | No | |
| H | H5 | Surface | Reserve | Unknown | Unknown | |
| I | I1 | Ground | 13 | No | No | |
| I | I2 | Ground | 12 | No | No | |
| I | I3 | Ground | 11.5 | No | No | |
| I | I4 | Ground | 10 | No | No | |
| I | I5 | Ground | 15.5 | No | No | |

Note: Sources with reported AMD impacts are highlighted gray. NA=Not applicable.

#### *6.1.1 Systems now affected by AMD*

Of these nine systems, only Systems G and H are actively withdrawing surface water from AMD-impacted streams. System G is described below in Section 6.1.3 because it is not using its water primarily for drinking water.

System H explained that due to the high iron and manganese levels in their surface water, they need to use more potassium permanganate and coagulant to oxidize and then settle out the metals. This increase in oxidants and coagulants along with sludge removal (about 2-3,000 gallons/year) increases treatment costs, especially in the summer when manganese concentrations are higher due to lower flows. System H also explained that they have less water for consumption because they have to backwash their system more frequently due to the build-up of metals on their filters. This reduces the capacity of their plant and increases their costs.

#### *6.1.2 Systems likely to be affected in the future by AMD*

System B will be withdrawing water from AMD-impacted groundwater in the near future, and Systems D, E, and F have reserve or emergency surface water sources that are impacted by AMD. These systems do not currently withdraw from these sources due to the severity of the AMD impairment and associated increases in treatment costs. According to the interviews, these three systems will most likely need to withdraw from these AMD-impaired sources in the future due to drought conditions, failing or contaminated wells, or population expansion.

System B is a small system currently withdrawing from a spring with generally good water quality. This spring's variable pH levels can be low due to acid precipitation, and the spring was recently condemned by PADEP because it is technically a surface water source. System B cannot afford the treatment facility required for treating surface water; therefore, they are being forced to move to a groundwater source that is impacted by AMD. This will raise their annual costs due to an increase in potassium permanganate use, more frequent backwashing, and increased operator hours. They estimate that operator hours will increase from one to six hours and that electricity will increase from $10 to $100 per month. The operator of the system stated that streams in their area are heavily impacted by AMD and that the quality of their surface water is limiting drinking water operations. He also explained that the initial purchase cost for developing a treatment system for surface water withdrawals is high, but in the long run, it is cheaper if the streams are clean. He felt that his system could greatly benefit from AMD remediation in the area.

System D currently has a groundwater source with high levels of iron due to the rock formations from which they withdraw. This operator also stated that this increases their treatment costs due to an increase in the chemicals needed to remove the iron. Due to drought conditions and population expansion, this system is exploring options for withdrawing from their reserve sources. Two of these sources are heavily impacted by AMD. The operator explained that treatment costs would go up to remove the metals from the AMD for these sources, but he could not estimate the cost. Similar to System B, he did state that it is more cost-effective to use surface water to save on electricity costs, but that there are more strict treatment requirements for surface water withdrawals compared with groundwater.

System E also has a reserve surface water source impacted by AMD; however, this system currently has enough clean water to withdraw that they are not looking to use their reserves in the immediate future. This operator did state that there would be increased requirements and costs for treating AMD-impacted water, but that he did not have an estimate for that increase. He is concerned about AMD, iron, and sulfur in the area's waters, but he does not believe that AMD problems are currently impacting expansion plans for his system.

System F is currently withdrawing from a reservoir that is slightly acidic due to the area's rock formations. However, due to current drought conditions, the system is being forced to consider withdrawing from a reserve surface water source heavily impacted by AMD in the near future. The operator stated that this source has a pH of about 5 on a good day, and between 3 and 3.5 on a bad day. He also explained that it is high in iron and manganese. In order to use this source, his system will need to use more potassium permanganate and chlorine, increase their electricity use, and remove more sludge. He estimates that his treatment cost will rise by approximately one-half, from $2.10 per 1,000 gallons to $3.10 per 1,000 gallons. The operator adamantly believes that if AMD were cleaned up, his treatment requirements and costs would be reduced and that AMD is reducing the possibility of his system expanding, especially in times of drought. He further explained that his system tried using wells in the early 1980s and 1990s, but that the elevation was too high. Therefore, they are forced to use surface water sources and he strongly believes that AMD has a big influence on water quality and drinking water treatment costs in his area.

#### *6.1.3 Other systems*

System A is a small system in quite a predicament. They currently withdraw out of a deep mine with excellent water quality through a gravity system. However, due to current drought conditions, fire trucks have brought in water for the last month-and-a-half to supplement their water supply. To further complicate issues, a coal company wants to open a strip mine which will take away this water source. The operator claims that they need an entirely new distribution system, and they are currently exploring options for the future. The options include paying for drinking water from a neighboring system approximately three miles away, getting a new water system, and using nearby streams. However, the operator explained that although nearby surface water sources have more than enough water for the whole town, they cannot afford to treat them because they are heavily impacted by AMD. He was very much aware of the increased treatment requirements and costs for using surface water impacted by AMD. He also stated that a PADEP engineer estimated it would cost about $35,000 per year to treat the iron and manganese from a nearby surface water source.

System C withdraws groundwater only and is located near the headwaters of the WBSR watershed. They deal with high iron and manganese levels from one of their sources; however, this is due to the rock formations from which they withdraw. The treatment requirements for this water are similar to that for AMD-impacted waters in that they must increase the amount of oxidants and coagulants used, increase the backwash rates, and increase ozone rates. The operator explained that an AMD-impaired stream runs through town, but that there is not enough water in the stream to use it as a surface water withdrawal. He further explained that because they are located in the headwaters, AMD is not much of an issue, but that it may be a problem further downstream in the watershed.

System G withdraws directly from the WBSR. The person we spoke with stated that the river here is impacted by AMD. While the mainstem is not orange, several nearby tributaries are. She explained that the amount of water they withdraw for drinking water is miniscule compared to the amount they withdraw for industrial purposes. The water is treated before use at the facility, and is therefore treated for consumption, but she could not separate the two and was not aware of different treatment requirements for treating clean water versus AMD-impacted water.

System I uses five groundwater sources of excellent quality. The only issue they deal with is the hardness of their water. They disinfect with chlorine and use a softener. The operator explained that the streams in their area are impacted by AMD, but that their flows are too small to be used as drinking water withdrawals, especially with the current drought conditions. In fact, he stated that three of his groundwater sources have slowed 80% due to the current drought. All in all, he explained that his system is not impacted by pollution in general or AMD specifically.

#### *6.1.4 Summary*

Results from this interview process indicate that there are increased treatment requirements and costs associated with using AMD-impacted water for drinking water. Increased costs result from using more chemicals (potassium permanganate) to oxidize iron and manganese, using more coagulants, backwashing filters more frequently, and disposing of larger quantities of sludge. Labor costs also increase. Due to current drought conditions and expanding populations, several systems in the WBSR watershed are entertaining the idea of using reserve and emergency sources that are impacted by AMD. These systems would benefit from nearby AMD remediation projects.

Unfortunately, we were not able to ascertain the actual costs associated with using clean surface water versus AMD-impacted surface water. We did, however, compile information on treatment costs, when such information was provided during the interview process (Table 16). It is important to note that not all systems reported costs in the same manner. Some systems reported costs for chemicals only, some for the entire plant operation, and some for combinations of costs in between. Also, three systems were not able to estimate treatment costs for any aspect of their systems.

**Table 16: Total volume withdrawn and treatment costs for the systems that participated in drinking water interviews**

| System | Volume withdrawn (million gallons/ year) | Treatment cost | | Current pollutants | Source of pollutants | Cost estimate |
|---|---|---|---|---|---|---|
| | | $/million gallons | $/year | | | |
| A | 2.6 | Not calculated | 35,000 | N/A | AMD | PADEP estimate to treat AMD |
| B | 4 | 3,000 | 12,000 | Low pH | Acid precip. | Chemicals only |
| D | 443 | 87 | 38,541 | Iron | Rock form. | Chemicals only |
| E | 279 | 1,390 | 387,810 | None | N/A | Total treatment |
| F | 219 | 2,100 | 459,900 | Low pH | Rock form. | Staff, utilities, chemicals |
| H | 32 | 2,500 | 80,000 | Yes | AMD | Entire facility |

Note: For System A, treatment cost/million gallons not calculated because cost estimate from PADEP does not reflect current treatment costs. System B operator stated that treatment cost was a little high. System C is not included in this table because cost data provided by operator is not considered to be reliable. System D volume withdrawn differs from sum of sources due to rounding. For System H, cost estimate includes chemicals, wages, utilities, repairs, lab fees, and insurance. No cost data were received from Systems G and I.

## 6.2 Impacts on water supplies for homes and businesses

Private water supplies are also impacted by AMD. In this section we investigate these impacts by cataloging publicly-financed water line extensions for private water supplies in the WBSR watershed.

The Title IV Abandoned Mine Land Fund collects fees on each ton of coal mined and allocates funds back to states to remediate coal mines abandoned before 1977. Among other things, these funds are used to pay for waterline extensions when drinking water has been polluted. As shown in Table 17, 18 such projects have been completed or were under construction as of May 2007. These projects cost over $11 million, and provided clean drinking water to 689 residences and 4 businesses. Over 320,000 feet of waterline extensions were involved in these projects. Water pollution from coal mines justified 16 of these projects. In at least 11 of these projects, a reduction in water quantity was also recorded.

In all but two of the projects, private wells were replaced with public waterline extensions. In one project, the well was replaced with another well, but was subsequently replaced with an extension to a public water supply after this effort failed. In the final project, a public water supply threatened by contamination via subsidence was restored. In many cases, the financial responsibility of connecting to the public water line extension was left up to individual residents, although public funds were used for the actual extension project.

**Table 17: Water supply replacements projects in the West Branch Susquehanna River watershed funded by Title IV Abandoned Mine Land Fund**

| Project name | Project number | Cost ($) | Water quality impact? | Water quantity impact? | No. resi-dences | No. busi-nesses | Waterline distance (feet) |
|---|---|---|---|---|---|---|---|
| **Public waterlines** | | | | | | | |
| Needful West | OSM 17 (0084)103.1 | 367,482 | Yes | Yes | 4 | 0 | 6,000 |
| Scotch Hollow Southeast | OSM 17 (0091)101.1 | 30,865 | Yes | No | 2 | 0 | 4,150 |
| Muddy Run West (Glendale Cont) | BF 354-102.1 | 78,395 | Yes | No | 2 | 0 | 1,700 |
| Cherry Run | OSM 24 (0512)101.1 | 62,196 | Yes | No | 8 | 0 | 1,781 |
| Belsena Mills | OSM 17 (1405)101.1 | 345,768 | Yes | No | 13 | 0 | 12,148 |
| Mock Hill (Refund) | OSM 17 (1417)101.1 | 109,376 | Yes | Yes | 26 | 1 | 13,450 |
| Spring Valley/Salem-1 | OSM 17 (1941)101.1 | 1,329,747 | Yes | Yes | 135 | 0 | 30,190 |
| Spring Valley/Salem-2,3 & 4 | OSM 17 (1941)102.1 | 1,952,795 | Yes | Yes | 163 | 0 | 66,779 |
| Sanbourn | OSM 17 (1942)101.1 | 1,939,674 | Yes | Unknown | 83 | 0 | 69,500 |
| Drane | OSM 17 (1946)101.1 | 3,482,229 | Yes | Yes | 133 | 0 | 65,000 |
| Madera West | OSM 17 (2570)101.1 | 90,072 | Yes | No | 1 | 0 | 3,300 |
| Barr Twp. | OSM 17 (2813)101.1 | 41,212 | No | Yes | 70 | 0 | N/A |
| Kettle Spring Run (Pinchy Road) | OSM 17 (6404)101.1 | 102,081 | Yes | Yes | 10 | 0 | 3,750 |
| Bigler Northeast | OSM 17 (7072)101.1 | 65,455 | Yes | Yes | 4 | 0 | 2,600 |
| Blue Ball East | OSM 17 (7085/7086)101.1 | 1,100,000 | Yes | Yes | 13 | 0 | 22,000 |
| McDowell Mountain South | OSM 17 (7163)102.1 | 189,786 | No | Yes | 3 | 0 | 4,568 |
| Graham West | OSM 17 (7500)101.1 | 243,474 | Yes | Yes | 18 | 3 | 13,600 |
| **Well** | | | | | | | |
| Needful West | OSM 17 (0084)101.1 | 15,646 | Yes | No | 1 | 0 | N/A |
| Total | | 11,546,253 | | | 689 | 4 | 320,516 |

Note: Information gathered from problem area descriptions, general environmental assessments, and other project information sources. Projects are as of as of May 2007. Growing Greener paid $941,235 toward Spring Valley/Salem-1 and $877,151 toward Spring Valley/Salem-2,3 & 4. Blue Ball East is in design phase, cost and extension distance is an estimate.

Two additional waterline extension projects are in the early stages of planning, and no designs or cost estimates are yet available. These projects are not included in Table 17.

A standard justification for funding for these projects is exhibited by the following excerpt from the General Environmental Assessment report for one of the sites:

> "These past coal mining operations have interrupted or adversely affect the quality of the local aquifers resulting in a lack of potable water for many of the local residences and businesses. The lack of a potable water source adversely affects the quality of life for the local residents and could have potential adverse health effects for persons who are presently consuming the degraded water. Individual water supplies were sampled and analyzed and do not meet safe drinking water standards. Most water supplies have elevated levels of iron, manganese and sulfates along with low pH values." (PADEP, 1994a, p. 1)

Many residents have experienced years or even decades of hardship in dealing with water supply issues related to abandoned mining activities, such as the following resident who waited from an initial investigation in 1981 until 1994 before any assistance was received in restoring his water supply:

> "BMR investigated the water supply problem in 1981 and 1982 in response to a complaint by Mr. [W.]. Department hydrogeologist, [J.], found Benjamin Coal Company

responsible for the spring degradation in his October 19, 1982 report. Benjamin was issued a Departmental order for a water supply replacement, which Benjamin subsequently appealed. Benjamin Coal Company became insolvent in 1989 and the [W.] water supply was never replaced." (PADEP, 1994b, No page number)

"Mr. [W.] utilizes a dug well for his bulk water needs, and hauls potable water from his son's house in Madera which is served by municipal water. Although his well supplies water of generally good quality, it is not a reliable supply due to insufficient quantity during the summer months. The Madera Fire Company has filled his well several times as a courtesy for which Mr. [W.] has made contributions. He also collects rain water in a cistern to supplement his supply. He doesn't know how long the fire company will be able to supply him bulk water. He does not feel that he can rely on them for a permanent water supply" (PADEP, 1994b, No page number)

Several water supply or water well replacement projects have also been funded in the WBSR watershed using coal mining company bonds forfeited to PADEP upon inadequate closure of mining operations. Details of these projects are listed in Table 18.

**Table 18: Water supply replacement projects in the West Branch Susquehanna River watershed funded by forfeited bonds**

| Project number | Cost ($) | Water quality impact? | Water quantity impact? | No. residences | No. businesses |
|---|---|---|---|---|---|
| **Water supply** | | | | | |
| BF 217-101.1 | $42,224 | No | Yes | 1 | 1 |
| BF 261-102.1 | $51,870 | Yes | No | 4 | 0 |
| BF 34-202.1 | $13,681 | Yes | No | 1 | 0 |
| **Well** | | | | | |
| BF 217-103.1 | $17,859 | No | Yes | 1 | 0 |
| Total | $125,635 | | | 7 | 1 |

Note: Information gathered from water supply investigation reports, scopes of work, and other project information sources. Replacements as of May 2007.

## 6.3 Summary

Both public and private drinking water systems have been affected by AMD in the WBSR watershed. Public systems face increased treatment requirements and costs when source water is impacted by AMD. Several systems in the watershed are considering using reserve and emergency sources that are impacted by AMD; these systems would benefit from nearby AMD remediation projects. Private systems have also been impacted by AMD. More than $11 million has been spent on waterline extensions to bring clean water to 696 residences and five businesses within the WBSR watershed.

Remediating AMD across the watershed would open up more plentiful and cheaper source water options for public water systems, and would minimize the need for additional spending on waterline extensions for private residences and businesses.