# Watershed Based Plan for West Run of the Monongahela River

Prepared by:

The West Virginia Water Research Institute

and

The West Run Watershed Association

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## Contents

# 1. Introduction

## 1.1 Watershed Management Plan Purpose and Process Used

The purpose of this plan is to document the existing characteristics and conditions within West Run, and identify problem areas for restoration. This was done by first compiling all existing water quality data, and watershed characteristics. This included GIS data such as aerial photography, digital elevation models, and topographic maps. Several sources of water quality data were found to exist as well. These sources included: data collected for masters theses at West Virginia University, data from TMDL development, and data collected by the WV Abandoned Mine Lands program (AML). From this data, it was determined that there are three potential types of problems within the watershed: Acid Mine Drainage (AMD), bacterial contamination, and storm water runoff. The West Virginia Water Research Institute (WV WRI) worked collaboratively with the West Run Watershed Association (WRWA) to complete an intensive field survey of the watershed to verify the existing data and collect additional data. Several types of water quality samples were collected:

- AMD: An intensive inventory was performed to locate previously documented and previously undocumented AMD sources. This was done by consulting digital mine maps collected and mapped by the WV Geological and Economic Survey, speaking with local residents, and walking streams. 15 sources were located and sampled in accordance with EPA standard procedures (appendix A).

- Bacteria: Bacterial contamination in West Run is possible from 3 sources: faulty septic systems, livestock, and wildlife. After looking at the geographic and demographic extent of the watershed, 9 locations were chosen to be sampled for fecal coliform and E. Coli (appendix A). These locations were selected because they are either in the rural headwaters of the watershed where faulty septic systems are the most likely (the more urban downstream portions of the watershed are serviced by city sewer), are downstream of the two livestock farms, or are likely to have large wildlife populations. Samples were collected 5 times at each location within a 30 day time period, in accordance with state regulations.

- Storm Water: Increased development causing an increase in impervious surfaces and decrease in vegetation has increased storm water runoff within the watershed. Without proper storm water management, this can create the potential for increased flooding and sediment load in the stream. There are no gauges on West Run or any of its tributaries to document these phenomena. However, flooding on the Burroughs Run sub-watershed has become such a problem that the city of Morgantown has included Burroughs in its storm water plan. The Morgantown Utility Board (MUB) has implemented a multi-million dollar storm water retention project in this tributary. In order to estimate the increased sediment load originating from developments with improper or no silt fencing or retention ponds, samples were collected upstream and downstream of construction sites with storm water runoff (appendix A). Samples were analyzed for sediment by weight. The increase in sediment load due to each construction site was calculated by subtracting the upstream sample from the downstream sample.

***Watershed Management Team***

This watershed plan was prepared as a joint effort by the project team including:

- Annie Morris: Research Hydrologist, at Hydrogeology Research Center (HRC);
- Brady Gutta: Senior Program Coordinator, West Virginia Water Research Institute (WV WRI)
- Jennifer Fulton: Research Associate, WV WRI;
- Ben Mack: Research Assistant, National Mine Lands Reclamation Center
- Lou Schmidt, Basin Coordinator, West Virginia Department of Environmental Protection (WV DEP).

The project team consulted with the Morgantown Utility board, Morgantown Municipal Airport, Monongalia Planning Commission, WVDEP, and WRWA.

### *Public Participation*

WRWA is a fledgling group of concerned citizens, residents, and stakeholders who have joined together to initiate an active and involved program for the protection, restoration, and promotion of West Run and its tributaries. Future goals for the group include educating the public about acid mine drainage, storm water runoff issues, and sustainable development, as well as restoration of the watershed to provide significant environmental, recreational, and economic value to the area residents, businesses, flora, and fauna.

# 2 Watershed Description

## *2.1 Physical and Natural Features*

West Run is a direct drain to the Monongahela River on the northern edge of Morgantown, WV (Figure 1). This 8.5 $mi^2$ watershed is located partially within Morgantown city limits and entirely in Monongalia County.

### *Hydrology*

West Run is an ungauged direct drain tributary to the Monongahela River.

Because it is ungauged, it is not possible to measure the base flow, storm flow, or flashiness of the creek at this time. However, in recent years, as the watershed has become more developed, flooding has become more common. This is likely due to increased runoff from impervious surfaces throughout the watershed. This is particularly true in the tributary of Burroughs Run.

The mainstem of West Run can be described as a moderately entrenched stream with low channel sinuosity. The upper region has a very well defined floodplain. The channel slope is low, approximately 1.1%. The headwater region and headwater tributaries of West Run display the steepest slopes. As you move downstream the slope decreases to the mouth. The last 0.6 miles only drops 30ft meaning the stream slope has been reduced to less than one percent. Frequently, this very low gradient section of West Run is back flooded by the Monongahela River.

The creek bed is predominately cobbles and sediment. There is one exception to this. Downstream of the VanVoorhis Rd. crossing, West Run becomes more sinuous and has a much steeper gradient. The floodplain also becomes less defined and ultimately disappears entirely before opening up again 0.6 miles before the mouth. This section of creek characteristically has a bedrock channel and is defined by the structural geology.

The Burroughs Run tributary of West Run is the only tributary that has significantly different stream hydrology than that of the mainstem. The upper half of Burroughs Run is underground, either in culverts or sub-pavement gravel channels. The first time it is above ground is at the intersection of VanVoorhis Rd and state route 705. At this location, Burroughs Run is very low gradient with an incised channel and highly erodible banks. There is a very large floodplain along this stretch of creek. However, there are numerous houses, culverts, and bridges in the floodplain. The gradient is so low that in one location, Burroughs Run spreads out to form approximately a 2 acre wetland. The final segment of Burroughs Run is a 0.25 mile stretch of bedrock-bottomed stream. This section of stream is very similar to the bedrock section of the mainstem of West Run.

There are no dams or navigable waterways on West Run or any of its tributaries.

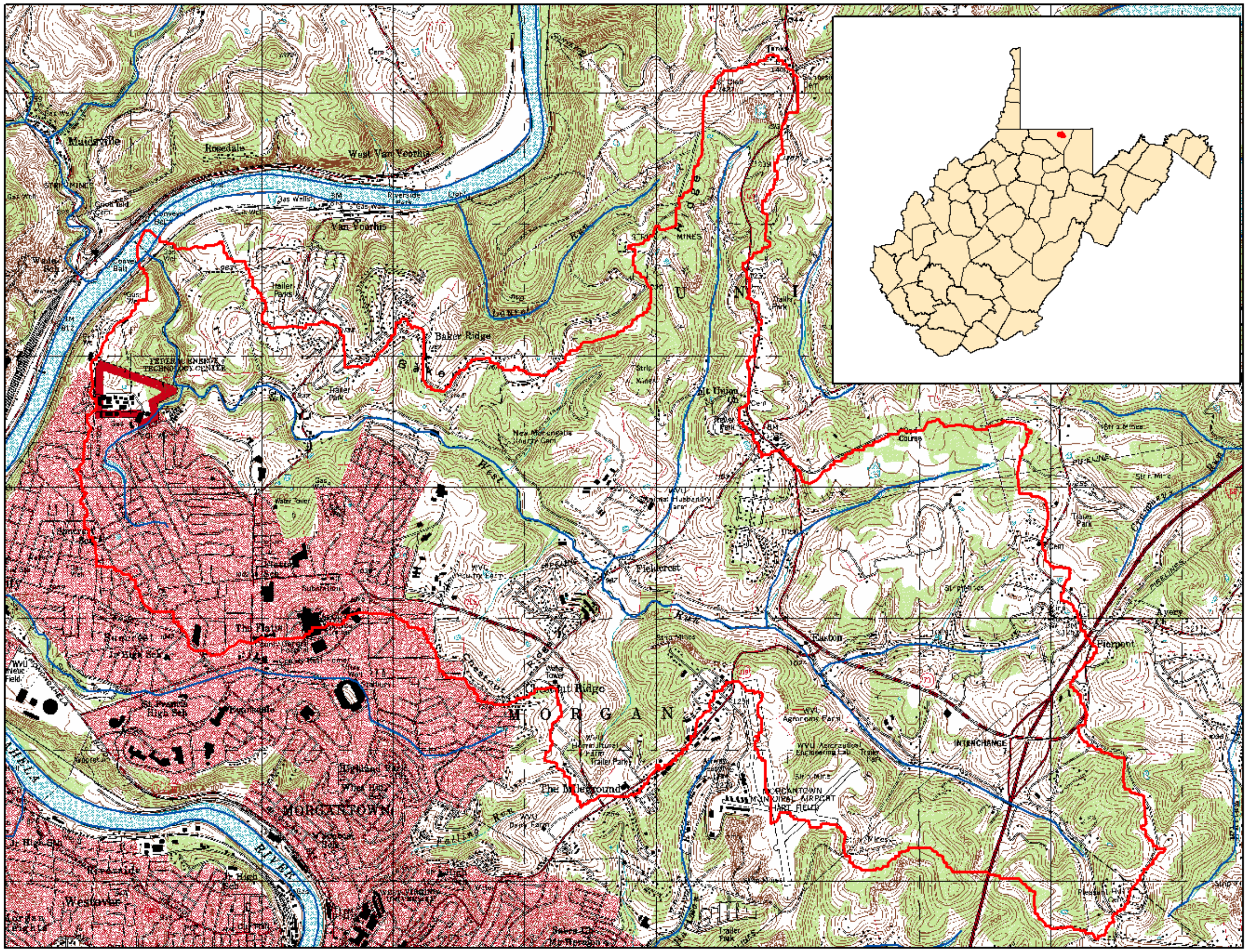


Figure 1.  Location of the West Run watershed.

### *Climate/Precipitation*

Typically, the weather in the north central region of West Virginia has a strongly seasonal pattern. The majority of the precipitation falls between November and March. At this time of year, the weather patterns are dominated by frontal storm systems. In summer months, precipitation is generally orographic or convective. October is generally the driest month of the year.

The West Run watershed receives on average 41 inches per year of precipitation, with the very tip of the watershed receiving an average of 43 inches per year of precipitation. Average high temperatures range, in degrees Fahrenheit, from 85 at low elevation to 83 at high elevation. Average low temperatures range from 21-23 degrees Fahrenheit. And the average temperature in the watershed is 53 degrees Fahrenheit (West Virginia State Climate Center).

### *Surface Water and Groundwater Resources*

At this time, there are no surface water or groundwater intakes in the watershed. City water is not available throughout the entire watershed and many of the homes are on private groundwater wells. There are also no documented springs in the watershed. However, undocumented springs may exist.

### *Flood Plains*

There are three designated flood zones in the West Run watershed (Figure 2). The flood zone along the mainstem and Burroughs run tributary is designated zone A, which is the estimated 100 year floodplain, and has a 26% chance of flooding over the life of a 30-year mortgage. This is considered a special hazard risk area (SFHA). The mouth of West Run is designated Zone AE, which is the calculated 100 year flood plain. Mandatory flood insurance purchase requirements and floodplain management standards apply within this area. Also visible in Figure 2 is a SFHA along the Monongahela River. This is the 500yr floodplain (West Virginia GIS Technical Center, 2008).

### *Topography/Elevation*

West Run originates at an elevation of 1400 ft mean sea level (msl) and drops approximately 600 ft to enter the Monongahela River at an elevation of 800 ft msl (Figure 3). Topography data was obtained from the West Virginia GIS Technical Center (2005).

### *Geology and Soils*

The majority of the rocks that outcrop in West Virginia are Paleozoic in age. In the West Run Watershed, the rocks that outcrop all belong to one subdivision

(Upper Carboniferous). The oldest formation documented in the watershed is the Upper Kittanning coal. The youngest formation documented is the Monongahela series in the headwaters of West Run. It is important to note that the Pittsburgh Coal is present in the upper portions of the watershed. This coal is at least 7 ft thick across the region and is the most valuable mineral resource in Monongalia County (West Virginia Geological and Economic Survey, 1913).

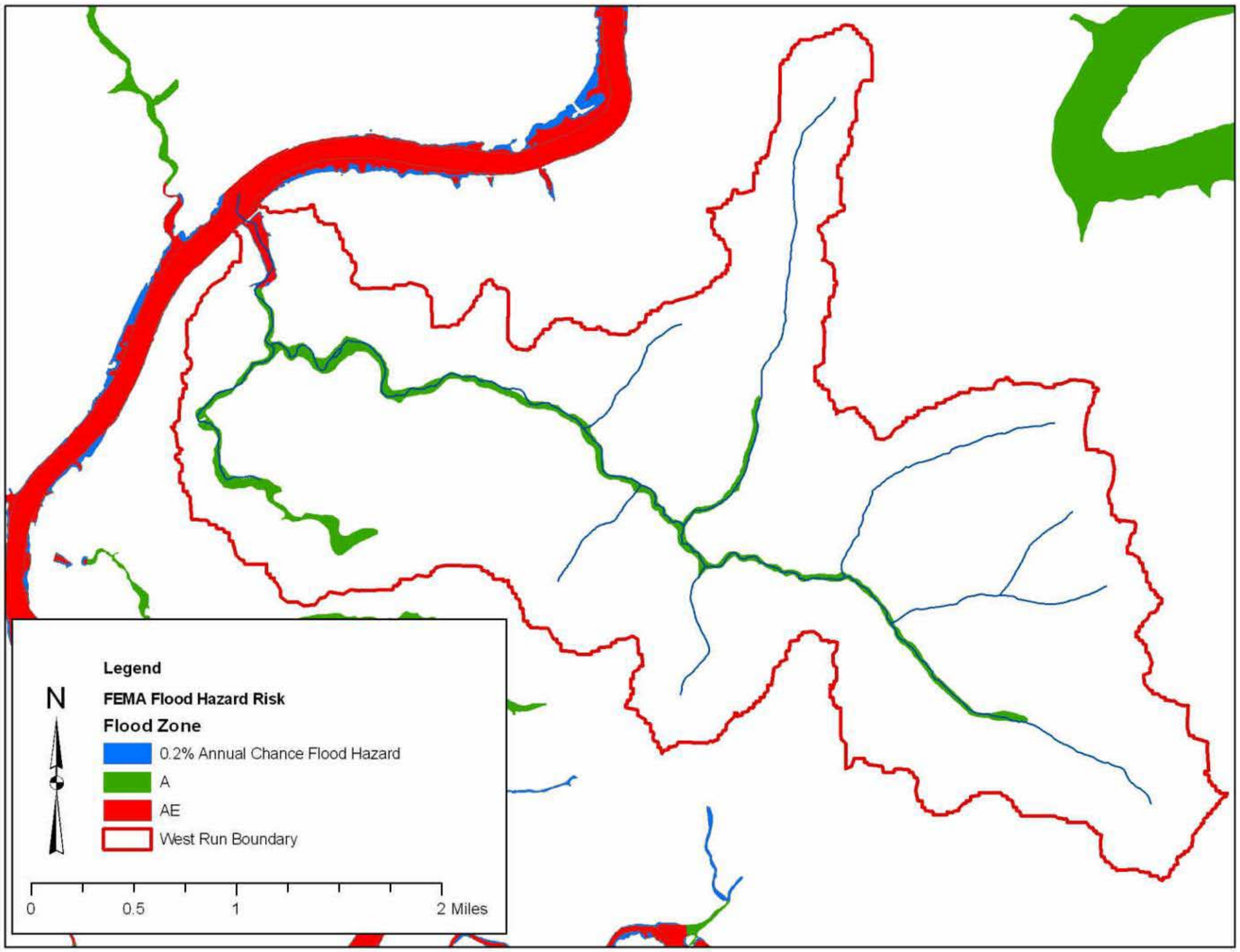


Figure 2. FEMA Flood Hazard Risk in West Run. Areas shaded blue are the 500 year floodplain. Areas shaded green are the estimated100 year flood plane. Areas shown in red are the calculated 100 year floodplain.

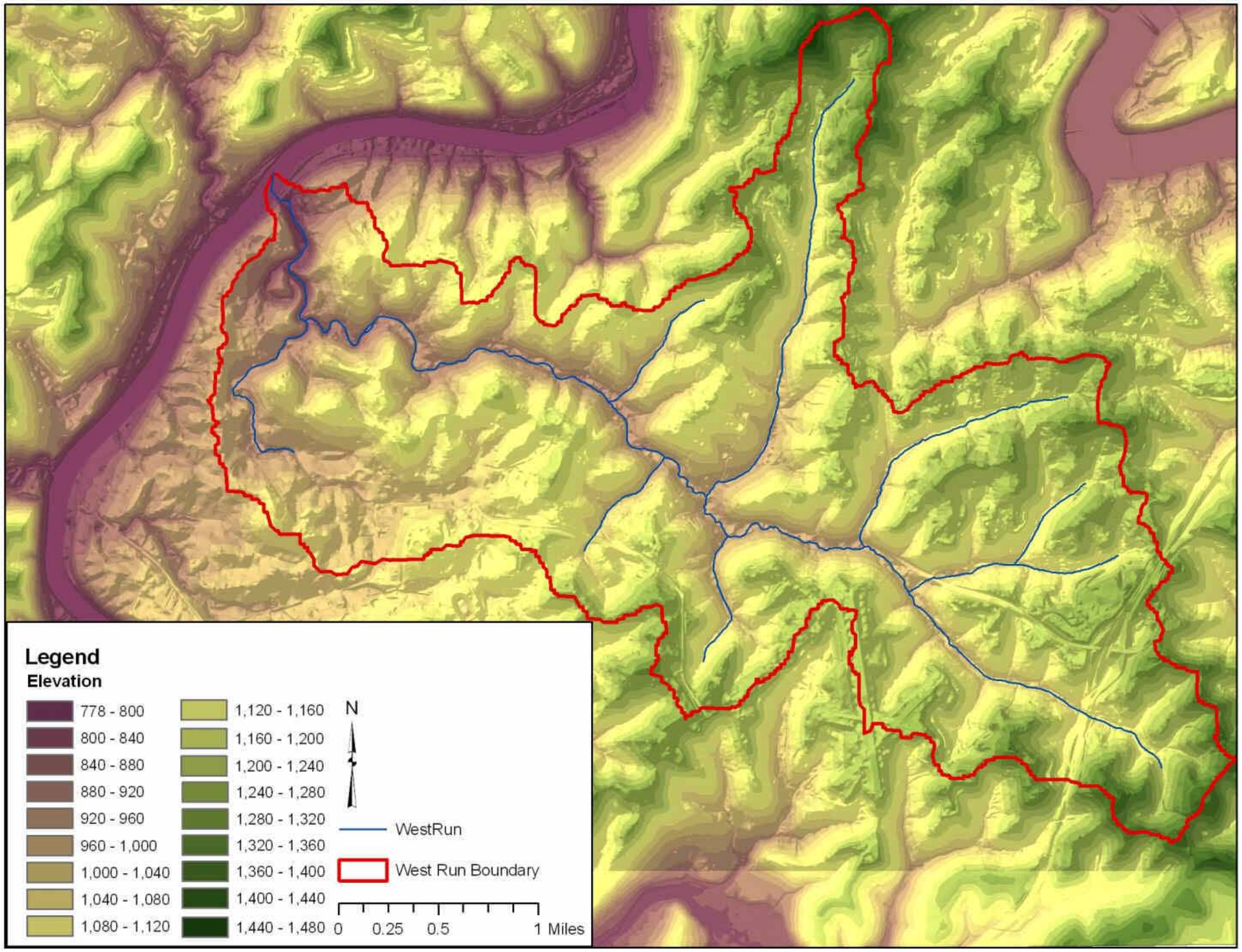


Figure 3. Digital Elevation model of the West Run watershed. High elevations are shown in green and low elevations are shown in purple

### *Wildlife*

According to an unpublished report prepared by the National Resources Conservation Service in 2000, the West Run watershed provides habitat for whitetail deer, wild turkey, cottontail rabbits, gray fox, squirrels, and grouse. The whitetail deer population in Monongalia County was approximately 66 deer per square mile, which exceeds the WVDNR's population management objective. The wild turkey population was above average for the state at that time (Natural Resources Conservation Service, 2000).

### *Protected Species*

West Virginia does not have state threatened or endangered species legislation, therefore all species listed as either threatened or endangered are those found on the US Fish and Wildlife Service's list of federally threatened and endangered species. In West Virginia, there are eleven species of animals and four species of plants that appear on the federal threatened or endangered species list. According to an unpublished report prepared by the National Resources Conservation Service in 2000, the summer range for the Indiana Bat (*Myotis sodalis*) may be found in the watershed. Species of concern (SOC) include the flat-spired three toothed land snail (*Triodopsis platysayoides*), and the Northern Virginia flying squirrels (*Glaucomys sabrinus fuscus)*. Listed in species of concern (SOC), there are only two known plants, Barbara's buttons (*Marshallia grandiflora*), and Bachman's sparrow (*Aimophila aestivalis*) in the West Run watershed (Natural Resources Conservation Service, 2000).

### *Cultural Resources*

West Virginia University (WVU) is the largest landowner in the West Run Watershed. All West Virginia University land is considered public land. The WVU hospital, woodlot, animal husbandry farm, and organic farm are all at least partially within the watershed. In addition to WVU, there are four elementary schools in the watershed: Morgantown Learning Academy, North Elementary, Suncrest Flatts Elementary, and Easton Elementary. Easton Elementary is located on the floodplain of West Run.

Both of Monongalia County's hospitals are located within or partially within the West Run Watershed. The Hazel Ruby McQuain Memorial Hospital, or WVU research hospital, sits on the drainage divide between Burroughs Run and Pompanoe Run. Monongalia General Hospital is completely within the Burroughs Run subwatershed.

## 2.2 Land Use and Land Cover

Land Use and Land Cover data were obtained from the West Virginia Gap Analysis Project. 30m satellite imagery obtained between 1992 and 1994 were analyzed and categorized for land use and land cover types. The primary vegetation type in the West Run watershed (Table 1) is deciduous forest, primarily oak dominated forest. At the time of the study, only 33.5% of the watershed was developed (Strager et. al, 2000).

| **% type** | **Land Use/Land Cover Type** |
|---|---|
| 4.20 | Shrubland |
| 0.03 | Woodland |
| 0.11 | Surface water |
| 0.28 | Major roads |
| 1.00 | Major power lines |
| 14.12 | Populated areas |
| 12.67 | Light intensity urban |
| 5.74 | Moderate intensity urban |
| 0.85 | Intensive urban |
| 17.46 | Pastrue/grassland |
| 0.15 | Barren land-mining, construction |
| 0.32 | Planted grassland |
| 0.20 | Conifer plantation |
| 0.30 | Floodplain forest |
| 0.06 | Herbaceous wetland |
| 0.33 | Surface water |
| 10.71 | Diverse/mesophytic hardwood forest |
| 0.97 | Hardwood/conifer forest |
| 30.48 | Oak dominant forest |

Table 1. Summary of land use types in West Run

### *Vegetation*

The primary vegetation type in the West Run watershed is oak dominated deciduous forest. There is also substantial acreage of shrub/grassland.

### *Exotic/Invasive Species*

Several non-native invasive species are found in West Virginia. These include garlic mustard, Japanese honeysuckle, kudzu, purple loosestrife, mile-a-minute, Japanese knotweed, sachaline knotweed, spotted knapweed, barren brome, and tree of heaven. According to the West Virginia Department of Natural

Resources, the number of non-native invasive species in the state is rising. Every year, new varieties of non-native invasive species are documented (West Virginia Department of Natural Resources, 2009).

### ***Open Space***

The West Run watershed is one of the most rapidly developing areas in Monongalia County. However, there are still areas that remain undeveloped. The majority of open space is West Virginia University land including; WVU organic farm, WVU animal husbandry farm, WVU agronomy farm, and WVU woodlot. The WVU woodlot contains trails that are utilized for WVU classes as well as hiking, trail running, and mountain biking by local residents.

### ***Agricultural Lands***

West Virginia University is the largest agricultural presence in the West Run watershed. The WVU agronomy farm, WVU organic farm, and WVU animal husbandry farm make up the majority of the agriculture in the watershed. There is only one additional farm to the WVU farms. It is a small private cattle farm in the upper reaches of the watershed.

### ***Mining***

The Pittsburgh Coal is the only economic mineral that has been mined in the West Run watershed. Typically, underground mining took place between 1930 and 1950 (West Virginia Geological and Economic Survey, 2009). The headwaters of West Run have been mined extensively (Figure 4).

### ***Developed Areas***

The West Run watershed is one of the most rapidly developing regions in the greater Morgantown area. The Monongalia Planning Commission has mapped the existing land use in the West Run planning district (Figure 5). The majority of the developed areas are in the lower reaches of the watershed; however, development is rapidly spreading to the headwaters.

### ***Future Land Use Considerations***

The Monongalia County Planning Commission has proposed zoning to control the rampant development in West Run. Figure 6 shows the proposed zoning. Zoning approval is expected in 2008.

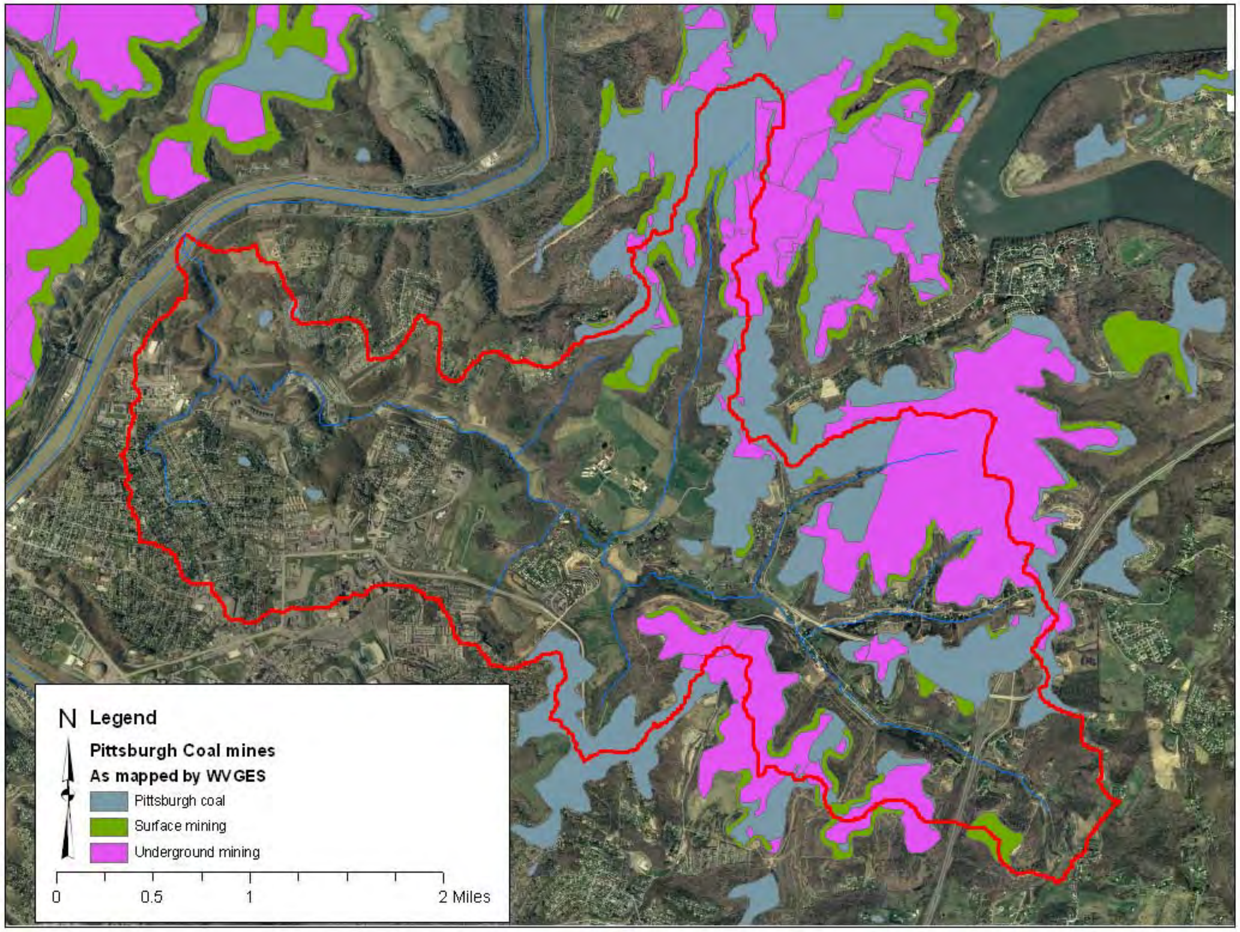


Figure 4: Figure 4 shows the presence of the Pittsburgh coal in the West Run Watershed (Blue). Known underground mining is shown in pink while surface mining is shown in green.

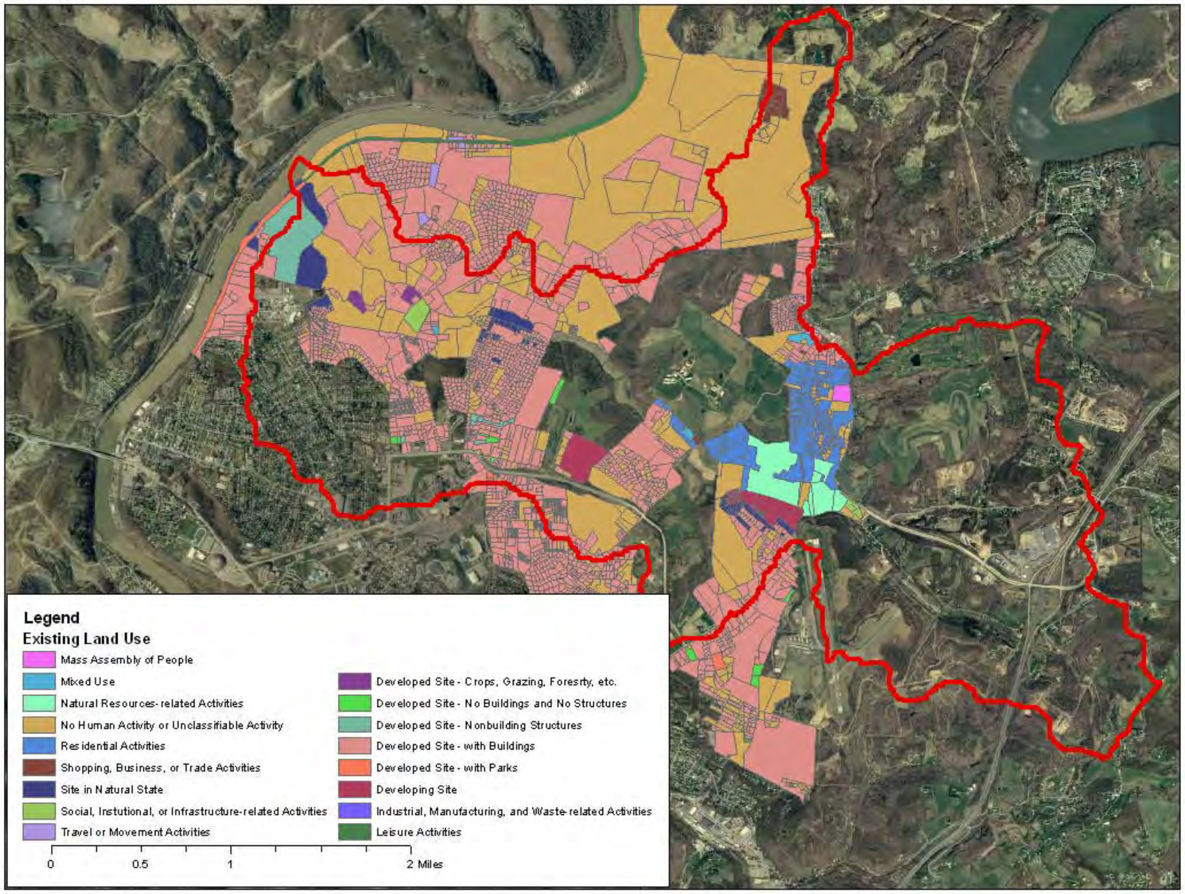


Figure 5: Current land use as mapped by the Monongalia County Planning Commission.

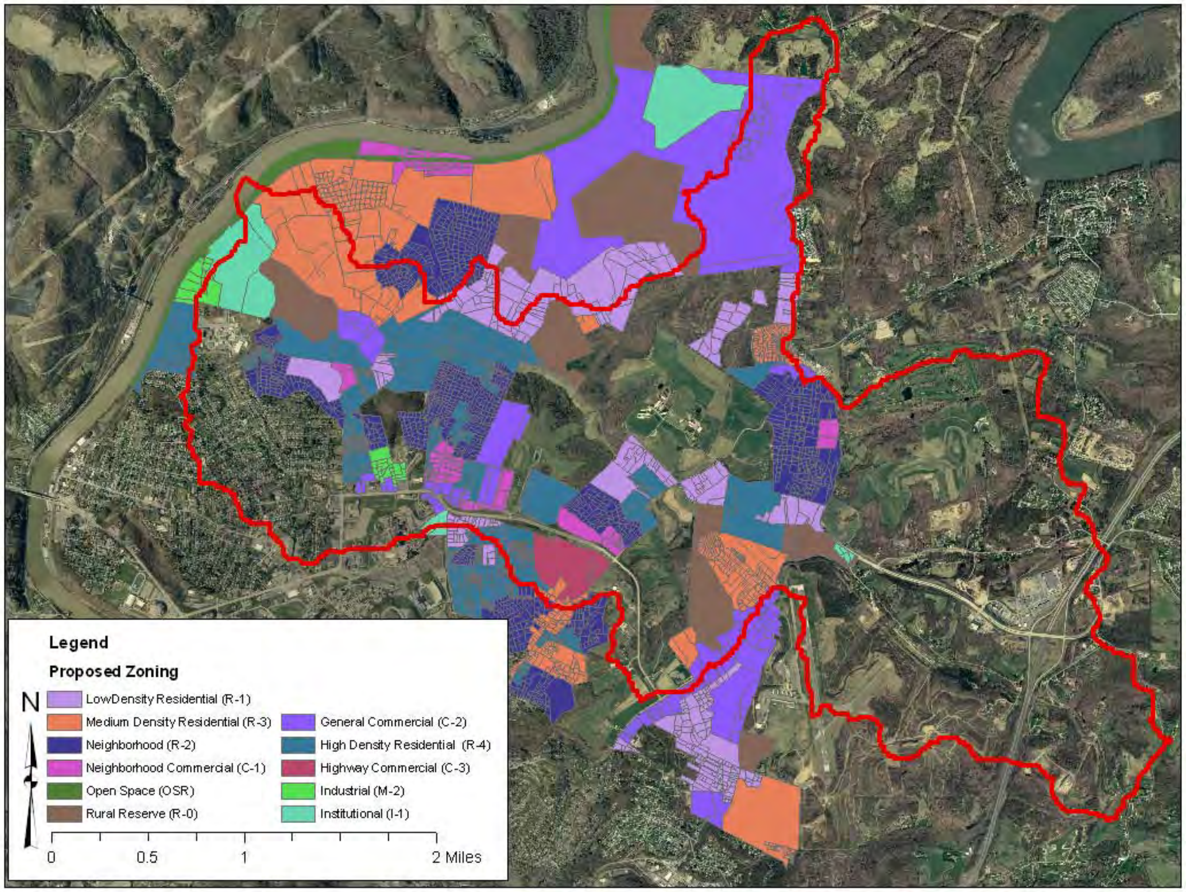


Figure 6: Proposed Zoning for the West Run planning district as mapped by the Monongalia County Planning Commission.

### *2.3 Demographic Characteristics*

The US Census Bureau collects demographics data based on political boundaries, such as city limits and county lines. West Run is completely in Monongalia County and partially within the Morgantown city limits. Therefore, the demographic data presented will be for Monongalia County and the city of Morgantown. All census data was obtained from the US Census Bureau's website and can be found at http://quickfacts.census.gov.

In 1900, Monongalia County had a population of 19,049 of which 18,474 were white persons. By 1910, the population had increased almost 27%. Morgantown accounted for close to 50% of Monongalia County's population in 1910 (West Virginia Geological and Economic Survey, 1913). Since then, the population of Monongalia County has increased by 233% to 81,866 people. The US Census Bureau estimates that by 2006, the population had increased to 84,752 with 92.4% of the population being white.

## 3 Watershed Conditions

### *3.1 Water Quality Standards*

#### *3.1.1 Designated and Desired Usages*

According to the West Virginia Legislative Rules for the Department of Environmental Protection, Office of Surface Water Quality, the Water Quality Standards Rule 47 CSR2 requires at a minimum all waters of the State of West Virginia are designated for the Propagation and Maintenance of Fish and Other Aquatic Life (Category B) and for Water Contact Recreation (Category C). Category B waters include warm water fishery streams, trout waters, and wetlands. Category C includes swimming, fishing, water skiing, and certain types of pleasure boating such as sailing in very small craft and outboard motor boats. West Run is not category B2 trout water.

#### *3.1.2 Numeric and Narrative Criteria*

***Metals***

| Parameter | Criteria | | |
|---|---|---|---|
| | Acute | Chronic | Human Health |
| Iron | | 1.5mg/L | |
| Aluminum | 0.75mg/L | 0.75mg/L | |
| Manganese | | | 1.0mg/L |

### *Bacteria*

Fecal Coliform: The maximum allowable level of fecal coliform content for Primary Water Contact Recreation shall not exceed 200 colonies/100 ml as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 ml in more than ten percent of all samples taken during the month.

### *3.1.3 Antidegradation Policies*

The State of West Virginia's antidegredation policies can be found in the legislative rule for the Department of Environmental Protection Secretary's office (60 CSR5). This rule divides the state waters into Tier 1 and Tier 2 waters. West Run is a Tier 1 watershed. All waters of the state receive Tier 1 protection. Tier 1 protection states "existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected" (60 CSR5). Tier 1 watershed are waters of the state where the "water quality is not sufficient to support recreation and wildlife and the propagation and maintenance of fish and other aquatic life or where the water quality meets but does not exceed levels necessary to support recreation" (60 CSR5).

## *3.2 Available Monitoring/Resource Data*

### *AMD*

Nearly all of the West Run drainage basin is affected by Acid Mine Drainage (AMD). The main stem of West Run is on the 1998 EPA 303(d) list for pH and metals, and has a 2002 TMDL for metals. It is slated for TMDL redevelopment in 2012.

Water quality data has been collected by several organizations and groups:

- EPA: Sample data from the 2002 TMDL (Appendix A) shows that pre-law mining in sub-watershed 94 is the primary source of AMD in the watershed.
- WVDEP: In 1984, the Abandoned Mine Lands (AML) program of the WV DEP did a very thorough inventory of West Run. This inventory cataloged 24 abandoned mining related problem areas (Vukovich, Shelia, personal communication). Appendix A shows the approximate sample locations.
- Students at WVU: Between 1973 and 1974, David Akers (1976) sampled the water chemistry at nine locations in subwatershed 94 as part of his master's thesis at WVU (Appendix A). At that time, the pH was very low and iron, aluminum, and manganese were very high in the upper portion of the watershed. In 1979, (Smith, 1979) and again in 1999 (McCoy, 1999), three sites in the watershed were sampled by students in the Geology department at WVU (Appendix A). These data show that water quality in West Run did not improve between 1979 and 1999.

- WRWA/WRI: During the fall of 2007 and spring of 2008, a very thorough inventory of AMD sources was completed by NMLRC and WRWA. Sources of AMD were located, documented, and sampled for standard AMD parameters. These data (Appendix A) show that the water quality in West Run has not improved enough since 1999 to be de-listed

### *Bacteria*

In accordance with the numeric water quality standards for West Virginia, 9 locations were sampled for fecal coliform and E. coli within 30 days in December/January 2007/2008, and again in July2008. These data can be found in Appendix A.

### *Biological Data*

A benthic macroinvertebrate survey was completed in 2008 at six locations in the watershed (Figure 7). The detailed results of the survey can be found in Appendix A. These indicate that West Run has some of the most impaired communities in the state. This includes Burroughs Run, which is not impacted by AMD, illustrating the effects of poorly managed development. West Run is impacted by AMD and development producing extremely poor conditions for macroinvertebrate life.

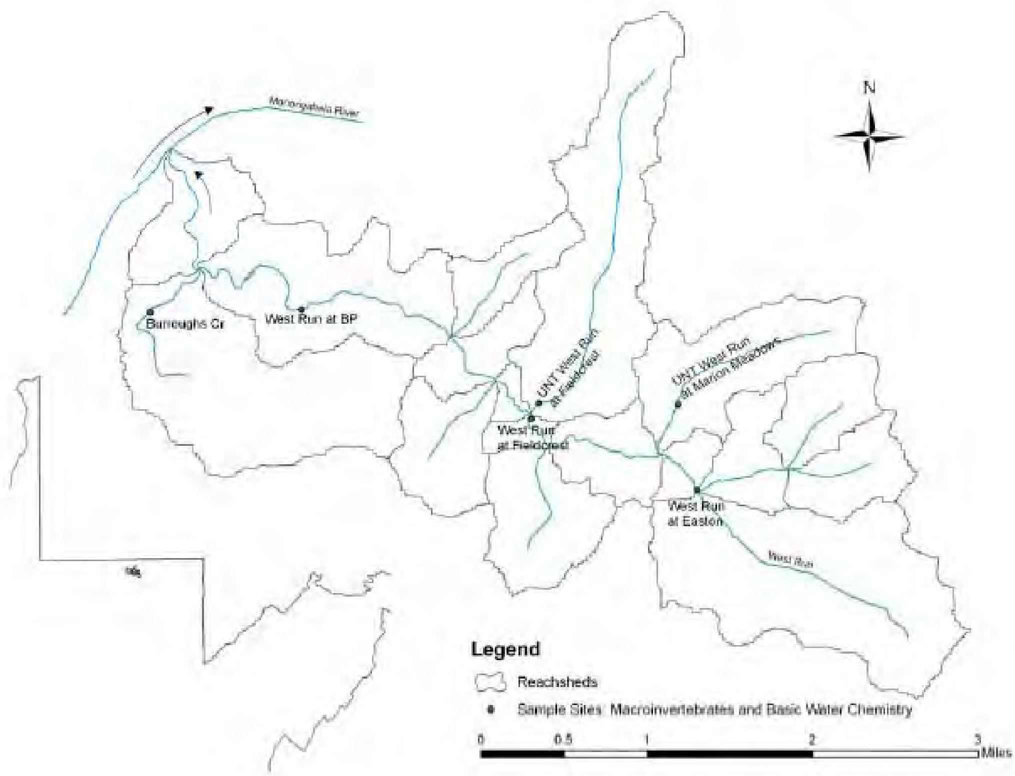


Figure 7. Water chemistry and macroinvertebrate sampling points in the West Run watershed.

### *Impaired Uses and/or Water Quality Threats*

West Run is designated as a Tier 1 watershed and is to be protected for Primary Water Contact Recreation. This use is impaired by metals, pH, and in some locations bacteria. It is possible that water impaired by AMD is masking problems with bacteria. The low pH water may be killing the bacteria. Once the AMD is neutralized there may be an increase in bacteria in the watershed.

# 4 Pollutant Source Assessment

## *4.1 Nonpoint Sources*

### *4.1.1 Mining*

As previously noted, all of the mining in the West Run watershed is in the Pittsburgh Coal seam and most was mined between 1930 and 1950. All of the underground mining in the watershed was completed before the 1977 Surface Mine Control and Reclamation Act (SMCRA). In 1984, AML completed a thorough inventory of the mining related problems in the watershed. The result of this inventory was 24 Problem Area Descriptions (PAD) that involve mine water (Appendix B, Figure 8). The inventory completed by WRWA and WRI located 11 of these and found three additional AMD discharges entering West Run or its tributaries from underground or surface mines. The remaining AML PAD locations were either not found, no longer discharging AMD, or have been buried by development. The full data set collected at each of these sites sampled by WRWA/WRI is located in Appendix D. Table 2 contains the average data for each of the sites.

Overall, mining has impaired roughly 7 miles of the West Run mainstem and 6 miles of West Run’s tributaries. Table 3 details impaired stream miles, pollutant type, and pollutant sources for each of the tributaries sampled in Figure 7, as well as for the mainstem itself.

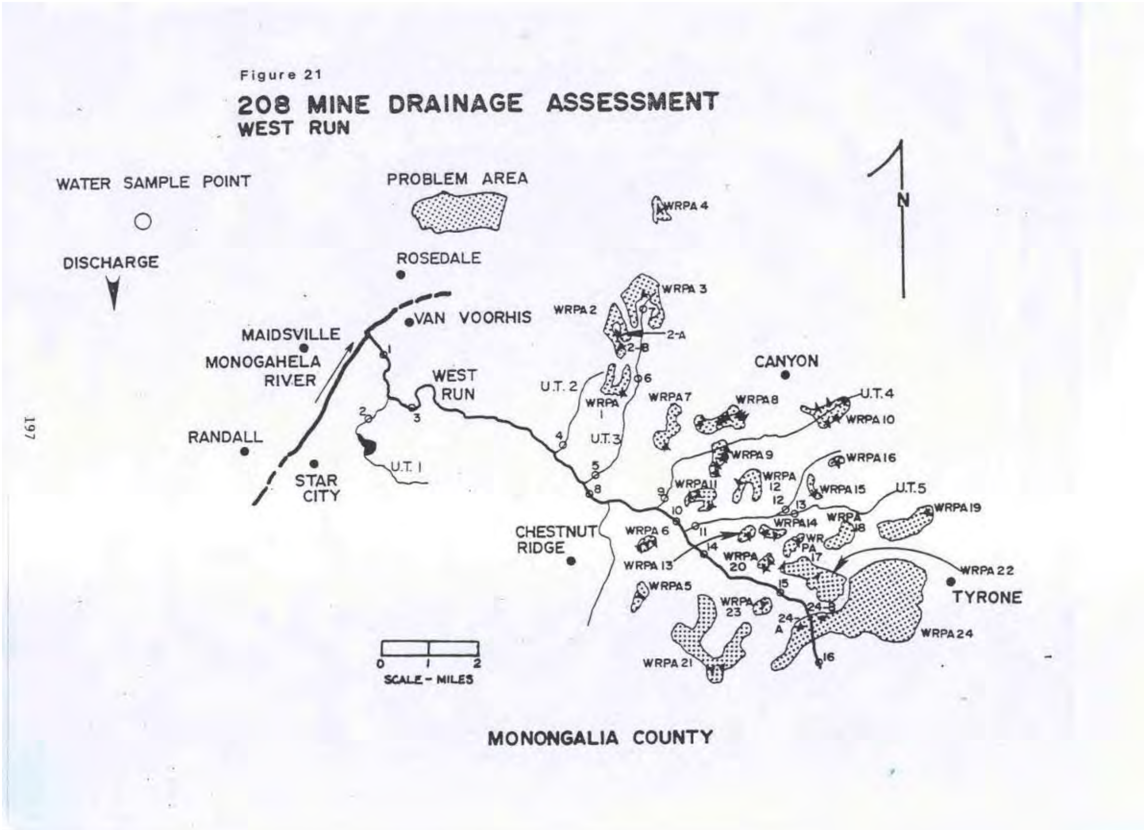


Figure 8: Map of Problem Area Descriptions (PAD) in West Run inventoried by the West Virginia Abandoned Mine Lands (AML) program in 1984.

| Sample Site | GPM | Temp | Field Conductivity | Field pH | acidity | alkalinity | SO4 | Dissolved Fe | Dissolved Al | Dissolved Mn |
|---|---|---|---|---|---|---|---|---|---|---|
| Walls | 153 | 11.8 | 3096 | 2.62 | 690.31 | 0 | 1259 | 61.7 | 47.0 | 4.3 |
| St Thomas | 20 | 10.9 | 2898 | 2.51 | 1464.06 | 0 | 1471 | 306.3 | 72.9 | 3.4 |
| Rainbow Run Aluminum | 165 | 12.0 | 793 | 4.89 | 165.43 | 10 | 359 | 0.9 | 9.9 | 3.2 |
| Rainbow Run Middle | 745 | 12.0 | 229 | 6.20 | 10.53 | 61 | 31 | 0.1 | 0.1 | 0.1 |
| Rainbow Run Iron | 165 | 12.3 | 1298 | 6.30 | 28.27 | 80 | 418 | 6.4 | 0.3 | 8.7 |
| Pierpont | 35 | 12.7 | 1417 | 3.08 | 460.65 | 0 | 845 | 16.5 | 36.3 | 11.1 |
| Mouth | 7350 | 9.2 | 654 | 6.46 | 17.54 | 17 | 188 | 0.5 | 1.2 | 1.2 |
| Airport | 200 | 11.6 | 1567 | 3.14 | 321.88 | 0 | 739 | 33.2 | 22.0 | 9.1 |
| Easton R | 176 | 13.0 | 860 | 3.00 | 245.72 | 0 | 440 | 5.4 | 13.7 | 1.8 |
| Easton L | 205 | 13.4 | 1164 | 3.04 | 204.57 | 3 | 342 | 4.6 | 12.1 | 1.8 |
| Marion Meadows | 146 | 13.5 | 1514 | 2.84 | 282.52 | 0 | 457 | 43.4 | 12.8 | 2.4 |
| Pines | 1 | 16.5 | 1624 | 2.88 | 371.81 | 0 | 515 | 42.9 | 17.6 | 3.3 |
| Alcon | 32 | 11.9 | 2996 | 2.88 | 647.36 | 0 | 1311 | 76.2 | 46.9 | 12.0 |
| Baker's Highwall | 15 | 13.9 | 920 | 3.67 | 193.86 | 0 | 348 | 30.6 | 4.7 | 2.7 |
| Agronomy 1 | 66 | 11.3 | 1897 | 2.93 | 756.07 | 0 | 742 | 107.9 | 41.2 | 4.7 |
| Agronomy 2 | 39 | 12.7 | 1872 | 2.76 | 834.11 | 0 | 850 | 109.8 | 46.6 | 3.5 |

Table 2. Average water chemistry values for AMD samples taken in West Run watershed.

| Sample point | Impacted stream miles | Pollutant type | Pollutant source |
|---|---|---|---|
| Mainstem West Run | 6.6 | Fe, Al, pH | Abandoned coal mines throughout the watershed |
| UNT @ Easton | 1.65 | Fe, Al, pH | 9 abandoned coal mines |
| UNT @ Marion Meadows | 1.74 | Fe, Al, pH | 4 abandoned coal mines |
| UNT@ Fieldcrest | 2.82 | Fe, Al, pH | 1 abandoned coal mine |

Table 3. Description of mining impacted tributaries of West Run.

### ***Baker's Ridge Highwall***

The Baker's Ridge Highwall is an un-reclaimed highwall with a 731 square meter AMD pond below it. This site is AMD PAD WR2. At the time the AML PAD was written the area was being surface mined and there were several individual seeps starting at the top of the highwall and flowing into the unnamed tributary of West Run. Presently, the seeps flow into the pond before discharging to the tributary of West Run. The average discharge from samples taken at this site between July 2007 and May 2008 is 14.5 gpm, has a pH of 3.1, and a conductivity of >1000 µS/sec. The metals in this discharge are high and there is no alkalinity.

Figure 9: AMD pond that the base of the Baker's Ridge Highwall. This location discharges 14.5gpm, of pH 3.1 water.

### ***Baker's Ridge Gob Pile***

At this site, UNT 3 flows through a large exposed refuse pile that is both in and adjacent to the stream. This site was previously documented as AML PAD WR3. At the time of the AML inventory there was active surface mining adjacent to this site, as well as open refuse beside the stream. There is no longer any surface mining, but there is still open refuse beside the stream. The area has re-vegetated with the exception of the refuse pile. After flowing through the refuse, UNT has a pH of 3.32 and a conductivity of 714 µS/sec.

### ***Marion Meadows/Hughart Portal***

The "Marion Meadows" site is a large discharge from an unmapped underground mine in the Marion Meadows neighborhood. This site was mapped as AML PAD WR7. At the time of the AML inventory there was a dangerous open portal with a discharge. The site was previously known as the Hughart Portal. AML constructed a wet seal according to state law, removed abandoned structures, and reclaimed the surface in 1984. Currently the wet seal discharges an average of 146gpm, has an average pH of 2.9, and an average conductivity of 1513 µS/sec.

Figure 10: This photograph shows the Marion Meadows/Hughart portal discharge.

### ***Pines***

This site corresponds with AML PAD WR10. There are various punch holes and portals into the Canyon Coal and Coke mine. This mine also discharges into Canyon Run which is a direct drain to Cheat Lake. This is a very small discharge that appears with the first water in the stream bed. The location of AML PAD WR8, and WR9 were found along the tributary but were dry. Downstream of the initial source of AMD, there is a large impoundment. Further downstream, there is an old dilapidated dam which was likely constructed to divert water away from the farmhouse below. The initial water sample was taken at the first place the flow was large enough to measure. This sample (Pines) was 0.5gpm, had a pH of 2.88, and a conductivity of >1400 µS/sec. Subsequent samples (DS Pines) were taken in the same location that was sampled by AML. This location has a flow of 77gpm, a pH of 4.5, and a conductivity of 357 µS/sec.

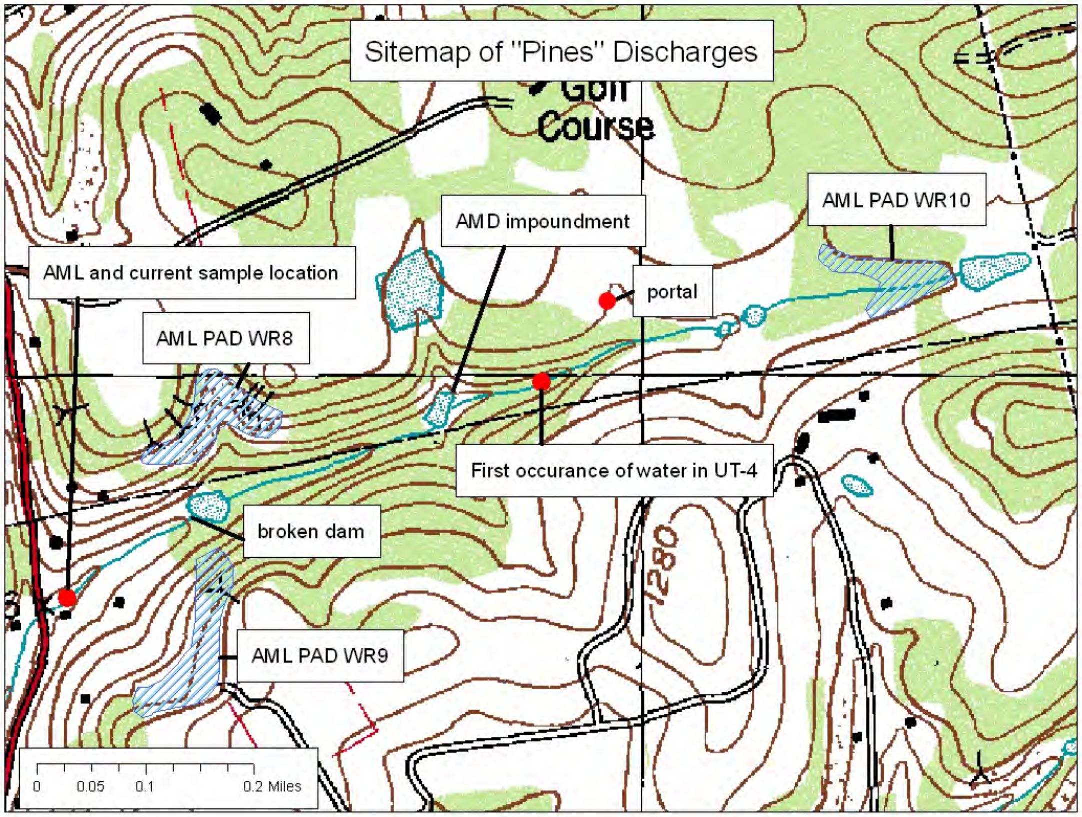


Figure 11: The headwater of UT-4 has 3 AML PAD locations. Today there is no water at PAD WR10, PAD WR9 or PAD WR8. The portal located on the north side of UT-5 is also dry. However the first occurrence of water in UT-4 has a pH of 2.88, a conductivity of >1400 µS/sec, and is clearly mining impaired. Downstream of this location, there is a large AMD impoundment. Further downstream is a broken dam that was likely built to divert flood water from the farm immediately downstream.

### *St Thomas*

This site is located behind the St Thomas of Becket Church and corresponds to AML PAD WR 12. In 1984 AML documented several collapsed openings and one portal discharging a “significant” volume of AMD at this site which discharges into UT-5. The site was also strip mined, but has re-vegetated and been re-graded since the 1984 survey. The current location of the discharge is just below a new home and the old high wall and collapsed portals are not evident. The main discharge emerges from a pipe, which may be an AML wet seal. There are several ephemeral wet areas adjacent to the large discharge that may contribute additional acid and metals loads to UT-5. This discharge likely originates from a partially flooded portion of the Canyon Coal and Coke mine. Currently this mine is discharging an average flow of 20gpm, an average pH of 2.5, and an average conductivity of 2898 µS/sec.

### *Wall's Portal*

The "Wall's Portal" site corresponds with AML PAD WR14. This site consists of mine drainage flowing out of two collapsed openings and several smaller seepages at lower elevation. The AMD flows into a wetland with a vertical drain at the far end. Combined samples were collected from the downstream end of the vertical drain. Currently, this site discharges 153gpm, with an average pH of 2.62, and an average conductivity of 3095 µS/sec.

### *Agronomy*

The two "Agronomy" discharges correspond to AML PAD WR16. When the PAD was written in 1984, there was discharge that was piped from a backfilled portal in to the left brand of UT-5. Today, there are three piped discharges. All three flow into open limestone channels before entering UT-5. Discharge three is too small to measure. Adjacent to these discharges is a clarification pond for a water treatment plant for the Whipkey subdivision, (NPDES 350739). The Agronomy 1 discharge has an average flow of 67gpm, with an average pH of 2.9, and an average conductivity of 1897 µS/sec. The Agronomy 2 discharge has an average flow of 39gpm, with an average pH of 2.8, and an average conductivity of 1872 µS/sec.

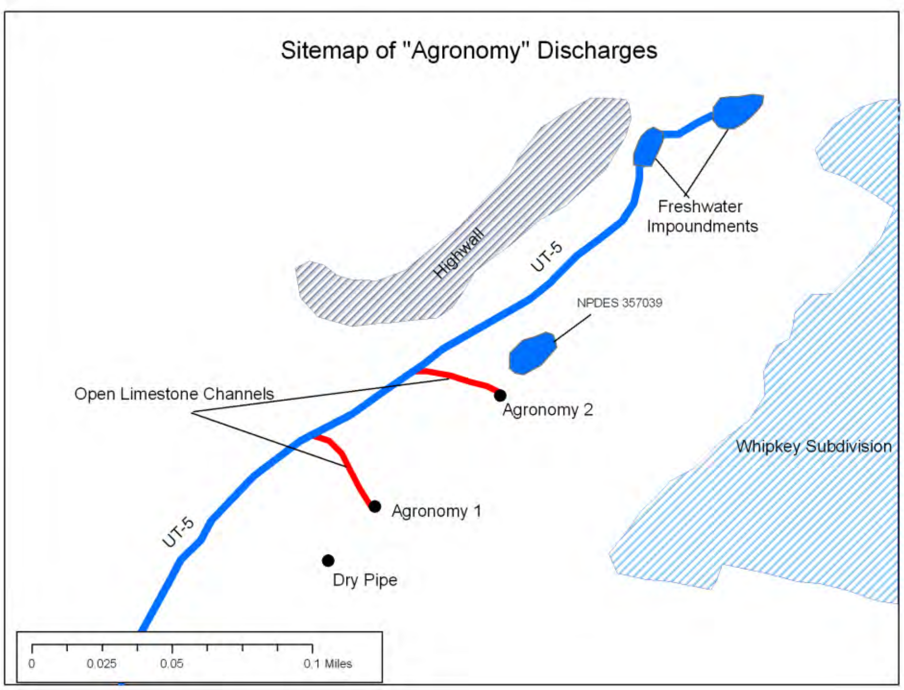


Figure 12: The "Agronomy" site has two discharges that have been piped from backfilled portals. On the north side of UT-5 is an un-reclaimed highwall.

Upstream of the Agronomy discharges are several freshwater impoundments which are part of the Whipkey subdivisions wastewater treatment plan.

Figure 13: This photograph shows the Agronomy 1 discharge.

Figure 14: This photograph shows the Agronomy 2 discharge.

## ***Alcon***

This site corresponds with AML PAD WR19. The PAD description is of a two acre landslide from downslope spoil, as well as a 30 ft tall highwall that was 1000 ftl long with three caved dog holes. AML diverted subsurface and surface drainage, backfilled the highwall, removed the slide and re-vegetated. Currently there is one discharge leaving the site. First it collects in a constructed wetland then runs down an OLC to UT-5. The water leaving the wetland averages 32gpm, and has a pH and conductivities of 2.88, and 2995 µS/sec respectively. This is very similar to the raw AMD chemistry documented by AML in 1984.

Figure 15: This figure shows the wetland which collects AMD at the "Alcon" discharge. The discharge leaves the wetland and flows down a limestone channel to UT-5.

### *Pierpont*

The Pierpont discharge was not documented by AML. The AMD discharge at this site consists of drainage running along a highwall. It collects in a gully and runs along Rt. 857 before entering the very headwaters of West Run. The average flow is 35 gpm with a pH of 3.1 and a conductivity of 1400 µS/sec.

Figure 16: This photograph shows the Pierpont discharge in winter. Part of discharge has frozen into icicles on its way to the collection ditch.

### *Airport*

The “Airport” discharge corresponds to AML PAD WR21. The AML PAD describes the discharge as draining from a wet sealed portal and collapsed opening. This area has been extensively deep and surface mined. The Morgantown Municipal Airport surface mined this area while obtaining fill material for their runway expansion project. In November 2007 there was open refuse at the headwaters of this un-named tributary. There were also several open portals with minimal drainage and one collapsed entry with substantial drainage. No additional AMD sources enter the tributary before its confluence with West Run. Recent samples have been collected at the bottom of the tributary before it enters West Run. The average flow is 200 gpm, with a pH and conductivity of 3.1 and 1566 µS/sec respectively.

Figure 17: This photograph shows Ben Mack of the West Virginia Water Research Institute taking field measurements of the Airport discharge.

### *Rainbow Run*

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Figure 18: This photograph shows the confluence of three tributaries at "Rainbow Run". The discharge to the left has high dissolved iron content, while the discharge to the right has high aluminum content. The tributary in the middle has a high pH, low conductivity, and low dissolved metals

The two "Rainbow Run" discharges are both directly adjacent to the I-68 highway fill. These were documented in the 1984 AML inventory as PAD WR24 A and B. The inventory says "Several seeps occur due to deep mine workings which were intercepted by highway construction" (Kelly, 1984). There is local anecdotal information to the effect that the aluminum discharge was not present prior to the construction of I-68.

### *Rainbow Run Iron*

The "Rainbow Run Iron" site corresponds to AML PAD WR24B. This site is a collection of mine drainages from collapsed mine openings that are piped into the stream (UNT5). Seeps also infiltrate directly into the stream. Samples for this site collected by WRWA and WRI were combined samples take downstream of the last AMD source. Currently the average flow is 165 gpm with a pH of 6.3 and a conductivity of 1297 µS/sec. The current water chemistry at this site is very similar to the chemistry sampled in 1884.

### *Rainbow Run Aluminum*

The "Rainbow Run Aluminum" site corresponds to AML PAD WR24A. This site is an approximately 200ft stream reach that has high concentrations of aluminum seeping into it from the adjacent highway fill. It is unknown as to whether the source of aluminum is from the highway fill itself, or deep mining that has been buried by the fill. Currently the average flow is 165 gpm, and has an average pH of 4.9. The average conductivity is 790 µS/sec and the average aluminum concentration is 9.9mg/l.

### *Easton Portals*

There are two large portal discharges originating from under the Morgantown Municipal Airport Runway. Neither of these discharges was documented by the 1984 AML sweep. Both discharges emanate from the Metro Coal/Morris/No25 mine complex. These are two very large discharges that flow down limestone riprap channels before entering a concrete drainage ditch that carries them to West Run. Easton Left has an average discharge of 205gpm, with a pH of 3.0 and a conductivity of 1164 µS/sec. Easton Right has an average discharge of 176gpm, with a pH of 3.0 and a conductivity of 1194 µS/sec.

Figure 19: This photograph shows the Easton Left Portal discharge.

Figure 20: This photograph shows the Easton Right Portal discharge.

### *Septic Systems*

City sewer is available to part of the west run watershed, but not all. The rest of the watershed either has private sewage treatment plants that have NPDES permits or septic systems. The septic systems are primarily in the mor rual headwater areas. It is likely that some of these septic systems are faulty and are contributing bacteria to West Run. Fecal Coliform and Ecoli samples were taken at 9 locations in West Run in December 2007 and January 2008. Five samples were taken at each location in accordance with EPA regulations. Table 3 shows the average of the five samples at each location. The complete dataset can be found in Appendix E. Figure 21 shows the locations of these samples and the average sample value for each site. Figure 21: Location of bacteria samples collected in West Run

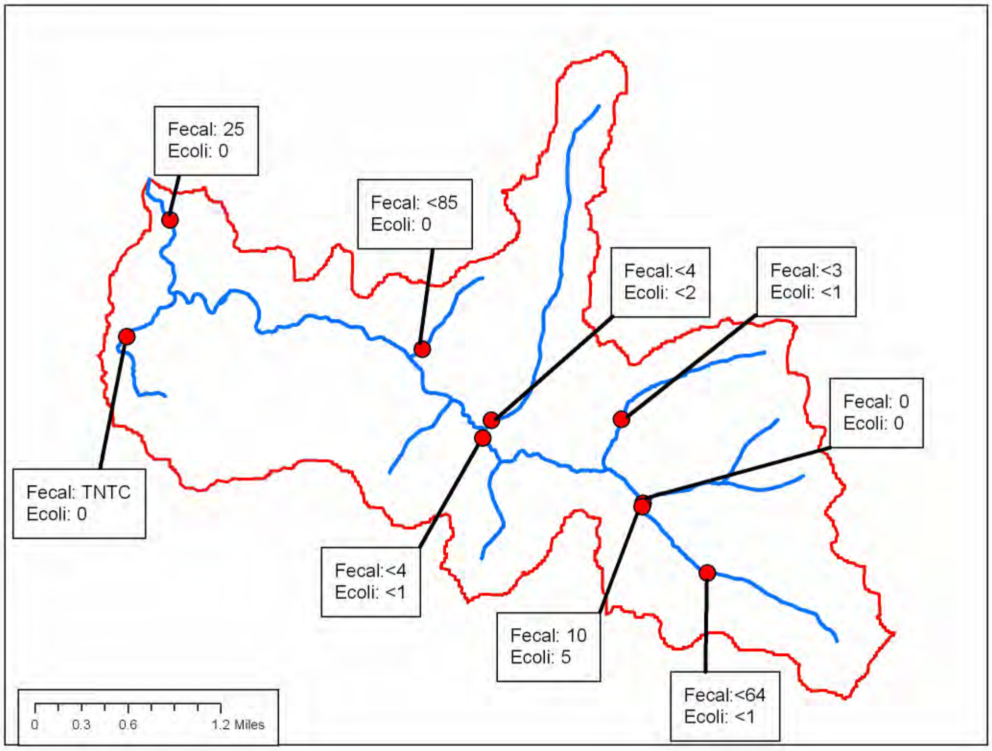


Figure 21: Location of bacteria samples collected in West Run

The samples were collected during a period of high precipitation. This could have increase overland flow and increase the bacteria counts in water due to wild life. Three of the sample locations, X, Y, and Z, did not have any Fecal Coliform values over the water quality standard. Four sample locations, A, B, C, and D, had one sample value over water quality standard. The XX location had 2 samples with bacteria counts over water quality standards. The only location that repeatedly shows bacteria counts over water quality standards is the Boroughs run site. This site is the only location sampled that is not impaired by AMD, and it is the only site that the entire upstream area is serviced by city sewer.

The rural regions of West Run are the areas most likely to have individual septic tanks at homes and the areas most likely to have high bacteria counts in the surface water. In this watershed, all of the AMD contamination is in the same rural regions as the septic tanks. The low occurrence of bacteria in the water in these areas may be due to the AMD killing off the bacteria. This needs to be re-evaluated after the AMD has been remediated.

### *4.1.2 Urban/Suburban Runoff*

West Run is being developed at a phenomenal rate. Urban/Suburban runoff has the potential to impair the entire watershed if the development continues unchecked. Currently the Boroughs run sub-watershed is currently the only truly impaired section of stream. Flooding and related water quality problems have been an issue in this sub-watershed since the 1970s when a large highway (Rt. 705) was constructed in the upper half of the watershed. The advent of Rt. 705 generated large commercial, institutional, and residential development. The huge increase of impervious surface with no stream improvements has caused numerous flooding events, and stream bank erosion in the downstream residential district.

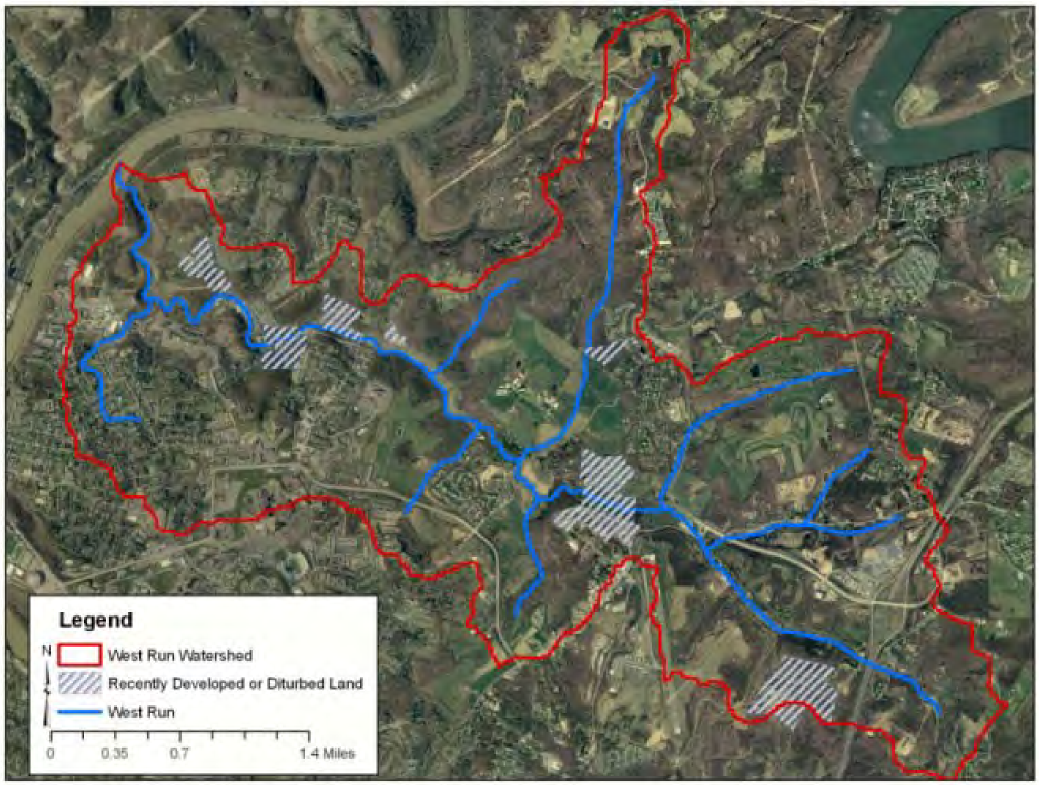


Figure 22: Recently disturbed land in the West Run watershed.

The main corridor of West Run has been subject to intense development in recent years. Figure 22 shows areas that have been cleared for development since 2003. In some cases these sites do not have proper stormwater retention or silt fences, and riparian buffers are not being left along the stream. Figure 23 shows a location where a developer is using a tree as a silt fence. Figure 24 shows a location where instead of a riparian buffer, a condominium is being cantilevered over West Run. Figure 25 shows a large retaining wall that was over vertical in places at the time of construction. Above this retaining wall is a large apartment complex and a housing development (Figure 26).

Figure 23:  This photograph shows a tree being used as a silt fence.

Figure 24:  This photograph shows condominiums being built cantilevered over West Run.

Figure 25:  This photograph shows a poorly constructed retaining wall along West Run.

Figure 26:  Development above the poorly constructed retaining wall.

Samples were collected and analyzed for total suspended solids (TSS) in 2008 at 12 locations at low flow and during a storm event. At every location, there was at least a 200% increase in TSS during the storm flow (Appendix A).

### *4.2 Point Sources*

## *NPDES Permits*

There are seventy-one NPDES permits that discharge into West Run. These can be categorized into seven types (Figure 27):

- Car Wash:1
- Home Aeration:14
- Sewage:7
- Storm Water Construction:23
- Storm Water Construction (Notice Of Intent):17
- Storm Water Industrial:3
- Mining: 6.

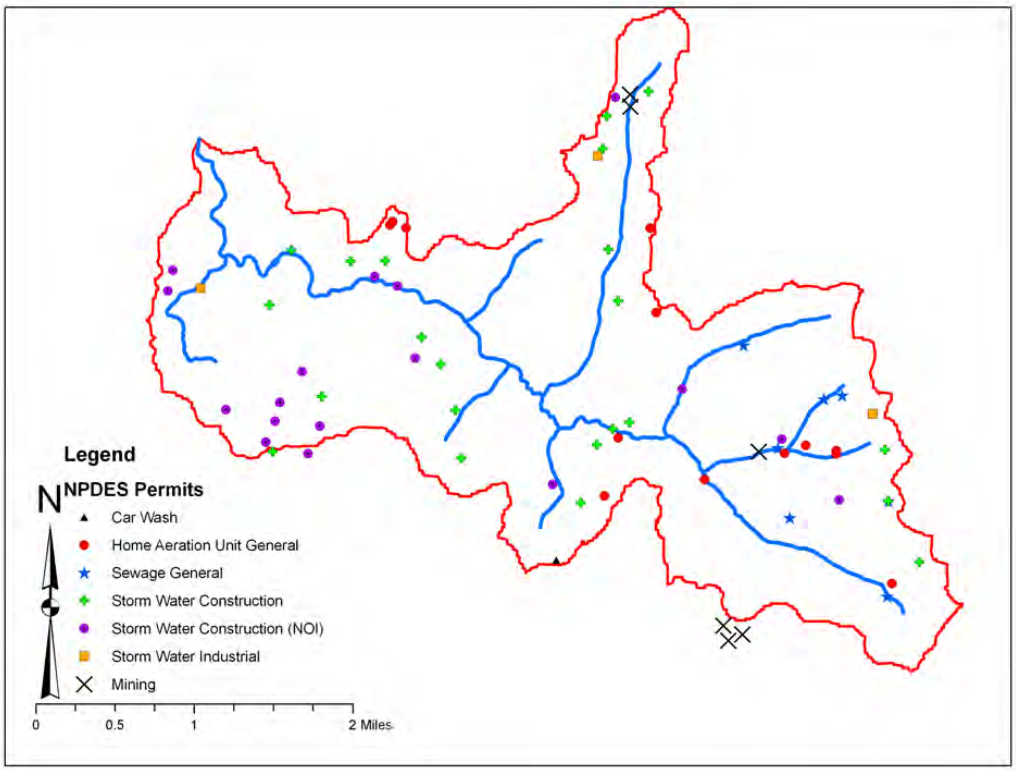


Figure 27: Locations and types of NPDES permits that discharge to West Run.

## *4.3 Hazardous Waste*

There are no CERCLA, RCRA or Brownfields sites in West Run. There are several locations with underground storage tanks in the watershed. These are all fuel stations.

# 5 Linkage of Pollutant Loads to Water Quality

## 5.1 Estimation of Pollutant Loads

### 5.1.1 Existing Conditions and Pollutant Load Estimation

#### Acid Mine Drainage

As discussed previously, fourteen AMD sources have been located in West Run. The annual pollutant loadings for these sites are shown in Table 4.

| Sample Site | Acidity (tons/yr) | Alkalinity (tons/yr) | SO4 (tons/yr) | Dissolved Fe (tons/yr) | Dissolved Al (tons/yr) | Dissolved Mn (tons/yr) |
|---|---|---|---|---|---|---|
| Walls | 232 | 0.00 | 422 | 21 | 15.8 | 1.4 |
| St Thomas | 65 | 0.00 | 65 | 14 | 3.2 | 0.2 |
| Rainbow Run Aluminum | 60 | 3.60 | 130 | 0 | 3.6 | 1.2 |
| Rainbow Run Iron | 10 | 28.99 | 151 | 2 | 0.1 | 3.2 |
| Pierpont | 35 | 0.00 | 64 | 1 | 2.8 | 0.8 |
| Airport | 141 | 0.00 | 324 | 15 | 9.6 | 4.0 |
| Easton R | 95 | 0.00 | 170 | 2 | 5.3 | 0.7 |
| Easton L | 92 | 1.51 | 154 | 2 | 5.4 | 0.8 |
| Marion Meadows | 91 | 0.00 | 146 | 14 | 4.1 | 0.8 |
| Pines | 0 | 0.00 | 1 | 0 | 0.0 | 0.0 |
| Alcon | 46 | 0.00 | 93 | 5 | 3.3 | 0.8 |
| Baker's Highwall | 6 | 0.00 | 11 | 1 | 0.2 | 0.1 |
| Agronomy 1 | 110 | 0.00 | 108 | 16 | 6.0 | 0.7 |
| Agronomy 2 | 71 | 0.00 | 72 | 9 | 4.0 | 0.3 |

Table 4. Annual pollutant loadings for 14 sampling points in the West Run watershed.

#### Bacteria

Currently, West Run does not have a TMDL and is not on the 303(d) list for bacteria. Therefore, load reductions are not calculated for the watershed. The need for bacteria load reduction needs to be re-evaluated after the AMD sources in the watershed are remediated.

# 6 Watershed Goals and Objectives

## 6.1 Management Objectives

The main goal of WRWA is to restore the West Run watershed to contact recreation standards. This will be accomplished by meeting the following objectives:

- AMD remediation;
- Enforcement of storm water regulations;
- Employment of storm water sediment reduction strategies;
- Further testing to see if additional control measures need to be put inplace to reduce the fecal coliform in West Run.

## *6.2 Load Reduction Targets*

### *6.2.1 AMD*

- Metals: Achieve load reduction in iron and aluminum in accordance with the West Run TMDL in order to achieve 100% compliance with the West Virginia state water quality standards. The allocated loads, current loads and target load reductions for iron and aluminum are shown in table 5. West Run also has a TMDL load reduction required for manganese. However, in 2005, the manganese criterion was revised to only apply within 5 miles of a public water intake. There are no public water intakes in the West Run Watershed.

- pH: Reduce loads and/or mitigate to 100% compliance with state criterion (pH 6-9) in all streams in watershed.

### *6.2.2 Fecal Coliform Bacteria*

West Run does not have a TMDL, and is not on the 303(d) list for fecal coliform bacteria. Recent water samples show minimum bacteriological impairment. This must be re-evaluated after metals and pH load reduction targets have been met. If fecal coliform bacteria do not meet state criterion, target reduction of 100% compliance will be employed.

### *6.2.3 Sediment:*

There is no state criterion for sediment, and currently there is little to no water quality data existing for sediment. However, sediment sources can, and have been, identified. Sampling for sediment will be conducted summer of 2008 by WRWA. Our goal is that no sediment source shall increase the background sediment load by more than 10%.

| | | |
|---|---|---|
| Aluminum | Baseline Load (lb/yr) | 22,589 |
| | Allocated Load (lb/yr) | 11,165 |
| | Reduction Required (lb/yr) | 11,424 |
| Iron | Baseline Load (lb/yr) | 92,496 |
| | Allocated Load (lb/yr) | 21,165 |
| | Reduction Required (lb/yr) | 71,331 |
| Manganese | Baseline Load (lb/yr) | 29,410 |
| | Allocated Load (lb/yr) | 7,525 |
| | Reduction Required (lb/yr) | 21,885 |

Table 5: Baseline loads, allocated loads, and targeted load reductions from the 2002 TMDL.

# 7 Identification of Management Strategies

## *7.1 Existing Management Strategies*

### *7.1.1 Acid Mine Drainage*

The only existing management strategy for AMD in West Run is at the Agronomy site. At this location, the AMD is piped out of two backfilled portals into limestone riprap channels. This is not sufficient treatment to meet water quality standards.

### *7.1.2 Sediment/Storm water*

The Morgantown Utility Board (MUB) has completed a large storm water project in the Burroughs Run sub-watershed. This project included armoring stream banks, enlarging bridges, and creating storm water retention cells. Details of this project can be found at http://www.mub.org/BRPRList-04192007.htm.

Increased sediment from storm water runoff due to disturbed soils is controlled in many locations in the watershed by silt fences and sedimentation ponds.

A watershed plan was written for the Burroughs Run sub-watershed and can be found in appendix B.

## *7.2 Additional Strategies Needed to Achieve Goals*

### *7.2.1 Acid Mine Drainage*

The primary method of abatement of mine drainage in West Run will be passive treatment. Passive treatment in West Run will utilize combinations of passive treatment modules in succession to neutralize the acid sources while the sources of alkaline mine drainage will be oxidized. Precipitation of metals through the use of passive treatment will accomplish both of these goals.

Several of the potential project sites in the West Run watershed are located in areas with many residential and commercial buildings. The terrain is also sometimes too steep for passive treatment to be effective. Both of these factors limit the amount of land available for passive treatment modules. However, it is possible that other treatment methods such as active or in-situ treatment may be employed in order to adequately treat the mine discharges.

Some examples of passive treatment technologies include but are not limited to:

*Open Limestone Channels* (OLCs) - Open limestone channels are treatment modules that will be installed to convey the effluent through and to the systems. In addition to conveyance, the OLCs will also help to neutralize acidity and precipitate metals. The OLCs are generally constructed with a limestone sand and/or steel slag base with rip- rap sized limestone above.

Open limestone channels will also be used where alkaline mine drainage is present. In this instance, the OLC's will oxidize and allow for the collection of precipitated metals.

*Limestone Leach Beds* (LLB) – Limestone leach beds are another treatment module which utilizes limestone to neutralize acidity and precipitate metals. Leach beds are used in very low pH environments, are generally rectangular in shape, and designed for retention times of approximately 1.5 hours. The effluent enters the bed from the top and exits through a manifold system situated in the bottom of the bed.

*Steel Slag Leach Beds* (SSLB) – Steel slag leach beds are used in areas where there is a source of water that is relatively free of metals and a near neutral pH (generally surface flow). The slag beds generate excess alkalinity which in turn is used to neutralize the AMD.

*Anoxic Limestone Drain* (ALD) – ALDs consist of buried trenches of limestone which allow for neutralization of AMD without the presence of oxygen and without iron oxidation/precipitation. ALDs are used in situations where there is little to no dissolved oxygen and very little to no aluminum. Additionally, the iron in the effluent entering the bed should be ferrous (in a reduced state).

*Vertical Flow Reactors* (VFR) - Vertical flow reactors combine two passive technologies into one module. A VFR is constructed with a layer of organic material on top of a limestone bed. The effluent enters the bed from the top and flows down through the organic material where oxygen is removed and sulfates are reduced. The water then enters the limestone where neutralization occurs. The effluent leaves the reactor, at which point oxidation occurs and the metals precipitate from solution.

*Aerobic Wetlands* – Aerobic wetlands are utilized in passive treatment as more of a polishing feature where precipitates can be gathered and any metals still in solution can be collected.  An aerobic wetland generally has an organic rich substrate that will produce a variety of wetland species. These wetlands can be used for both acidic and alkaline discharges.

#### *7.2.1.1 Treatment Scenarios*

The locations of the sources of AMD in the West Run watershed have been grouped into their respective sub-watersheds. These three sub-watersheds are labeled Old Cheat Rd., Stewartstown, and Main Stem.

The following conceptual designs are based on preliminary data that we have collected for the following proposed project locations and are subject to change as additional samples are collected. These systems will utilize combinations of passive treatment modules mentioned above in an effort to neutralize the acidity, precipitate metals, and raise the pH.  The goal of these projects is to achieve 80% acid load reduction.

The estimated costs for these projects were determined using the following formula: Acid load*cost of neutralization of 1 ton of acid load*expected life of treatment system. The acid load is determined by multiplying flow*acidity*0.0022. The unit of acid load is tons of acid/year. The cost of neutralization of 1 ton of acid load had an assumed value of $125 and the expected life of the treatment system was 20 years for all sites. This formula was modified if the water was already alkaline. The cost of neutralization of 1 ton/year of acid load was determined to be $50 per ton in this case.

### *Alcon-*

The Alcon site, which is located on the southern side of Old Cheat Road (C.R. 73/12), is a seep that discharges from the ground and flows through a wetland before emptying into the headwaters of a tributary of West Run. This site is the most upstream AMD source on this tributary. Similar to the Walls Portal site, there is a limited amount of space to passively treat this discharge. A limestone leach bed would be placed in the footprint of the current wetland to begin to raise the pH. The leach bed would discharge into an OLC, which would convey the water to a settling pond that would be constructed below the leach bed. From the settling pond, the water would discharge into the tributary of West Run. The estimated cost for these modules would be $98,079. Currently, the Alcon site adds 10,000 lbs/yr of iron and 6,600 lbs/yr of aluminum to West Run. The remediation project described above will remove an estimated 8,000 lbs/yr of iron and 5,280 lbs/yr of aluminum. The implementation of a remediation project at the Alcon site will help meet the load reduction goals listed in the Monongahela River TMDL.

### *Walls Portal –*

The Walls portal project, located on the southern side of Old Cheat Rd (C.R. 73/12), has two portals that have been backfilled and pipes placed to allow the AMD to drain. There is limited space with which to install a traditional passive treatment system. However, a terraced system could be applicable at this site. First, the AMD would be conveyed from the pipes via an open limestone channel to the first of three limestone leach beds. The first leach bed would be constructed at the site of a breached pond. The second and third leach beds would be situated down slope from the first leach bed. Each of the final two leach beds would be situated on their own terrace and connected to the previous leach bed by an open limestone channel. The water will also be conveyed by an open limestone channel from the final bed to the receiving stream. The estimated cost of this system is $467,613. Currently, the Walls Portal site adds 42,000 lbs/yr of iron and 31,600 lbs/yr of aluminum to West Run. The remediation project described above will remove an estimated 33,600 lbs/yr of iron and 25,280 lbs/yr of aluminum. The implementation of a remediation project at the Walls Portal site will help meet the load reduction goals listed in the Monongahela River TMDL.

### *Agronomy Farm 1-*

Agronomy Farm 1 is located on the eastern side of Agronomy Farm Road (C.R. 73/11). This is a former Department of Abandoned Mine Lands (AML) project that drains an abandoned mine into a tributary of West Run. AML installed a wet seal and OLC to convey the water to the tributary of West Run. The mine water discharges from a pipe on an old strip mining bench before flowing down the OLC to an old logging road. From here, the mine water continues down slope to the tributary of West Run. Treatment would consist of a limestone leach bed on the old mining bench where the wet seal is. Water would discharge from the bed and into a settling pond to keep the precipitating metals out of the receiving stream. The existing OLC would be refurbished with new limestone and used to convey water from the wet seal to the receiving stream, as well as between each module. The estimated cost of treatment for Agronomy Farm 1 is $212,873. Currently, the Agronomy Farm 1 site adds 32,000 lbs/yr of iron and 12,000 lbs/yr of aluminum to West Run. The remediation project described above will remove an estimated 25,600 lbs/yr of iron and 9,600 lbs/yr of aluminum. The implementation of a remediation project at the Agronomy Farm 1 site will help meet the load reduction goals listed in the Monongahela River TMDL.

### *Agronomy Farm 2-*

Agronomy Farm 2 is located ~100 yards upstream of Agronomy Farm 1 on the same tributary of West Run. West Virginia's AML program installed a wet seal and an OLC for this discharge as well. Due to the similarity between Agronomy Farm 2 and Agronomy Farm 1 in both chemical and physical characteristics, they can be remediated in a similar fashion. A limestone leach bed just below the wet seal followed by an OLC should adequately treat this discharge. The estimated cost of treatment for Agronomy Farm 2 is $137,937. Currently, the Agronomy Farm 2 site adds 18,000 lbs/yr of iron and 8,000 lbs/yr of aluminum to West Run. The remediation project described above will remove an estimated 14,400 lbs/yr of iron and 6,400 lbs/yr of aluminum. The implementation of a remediation project at the Agronomy Farm 2 site will help meet the load reduction goals listed in the Monongahela River TMDL.

### *St Thomas Seep-*

On the northern side of Old Cheat Rd (CR 73/12), there is a small discharge adjacent to the St. Thomas A. Beckett Episcopal Church. This source emanates from an abandoned deep mine and contributes approximately 61.4 tons per year of acidity to West Run. There are several residences and businesses adjacent to the source which will make installing an adequately sized passive treatment system difficult. However, an OLC could be effective in treating this discharge. According to topographic maps of the area, there is approximately 762 feet available for the installation of an OLC. A channel that is 4 feet wide and 3 feet deep (2 feet of limestone) would treat 99% of the acidity of this discharge. The estimated cost of treatment for the St. Thomas Seep discharge is $153,584. Currently, the St. Thomas Seep site adds 28,000 lbs/yr of iron and 6,400 lbs/yr of aluminum to West Run. The remediation project described above will remove an estimated 22,400 lbs/yr of iron and 5,120 lbs/yr of aluminum. The implementation of a remediation project at the St. Thomas Seep site will help meet the load reduction goals listed in the Monongahela River TMDL.

### *Pines Country Club-*

South of the Pines Country Club, there is a small discharge that runs through a forested area into a clearing before it discharges into the Stewartstown Road tributary of West Run. The water chemistry of this discharge is very conducive to AMD treatment by OLC. Limestone would be added to the existing water channel for 141 feet. This would eliminate 80% of the existing acid load of the discharge. The estimated cost of treatment for the Pines Country Club discharge is $782. Currently, the Pines Country Club site adds a negligible amount of iron and aluminum to West Run. Because of this, load reductions cannot be estimated with any degree of accuracy.

### *Marion Meadows Seep-*

The Marion Meadows seep pops up from underground just below the Marion Meadows housing development off of Route 119. Currently, this seep runs downhill through a channel and discharges into West Run ~1500 feet from its source. This discharge could be treated by installing a limestone channel into the current channel. The bottom of the OLC would discharge into a settling pond with berms built into it to increase retention time. The goal of this pond is to provide a place for the precipitated metals to settle out of solution, which will decrease the acid load entering West Run. The estimated cost of treatment for the Marion Meadows seep is $212,507. Currently, the Marion Meadows Seep site adds 28,000 lbs/yr of iron and 8,200 lbs/yr of aluminum to West Run. The remediation project described above will remove an estimated 22,400 lbs/yr of iron and 6,560 lbs/yr of aluminum. The implementation of a remediation project at the Marion Meadows Seep site will help meet the load reduction goals listed in the Monongahela River TMDL.

### *Bakers Ridge Highwall-*

The Bakers Ridge Highwall site consists of a small pit lake adjacent to an abandoned highwall. This site contributes approximately 4 tons per year of acidity to West Run. The effluent from the pit lake exits down a small channel and into a tributary of West Run. Proposed construction for this project will consist of turning the impoundment into a anoxic limestone bed (ALD) and utilizing the existing stream bed as an open limestone channel. According to preliminary estimates, the approximate cost for this project is $80,000. Currently, the Bakers Ridge Highwall site adds 2,000 lbs/yr of iron and 400 lbs/yr of aluminum to West Run. The remediation project described above will remove an estimated 1,600 lbs/yr of iron and 320 lbs/yr of aluminum. The implementation of a remediation project at the Bakers Ridge Highwall site will help meet the load reduction goals listed in the Monongahela River TMDL.

### ***Pierpont Road discharge-***

The Pierpont Road discharge enters West Run at the headwaters of the mainstem of West Run. This discharge seeps from an old mining bench right along the southern side of Pierpont Road. Similar to other sources within the West Run watershed, the Pierpont Road discharge has low pH (3.0) and large metal concentrations, particularly aluminum (Al=36 mg/l). Because of this chemistry, a limestone leach bed could be effective for this discharge. However, there is only a small amount of space to install a system in this location due to the proximity of the discharge to a major road. A small leach bed that empties into an OLC would provide treatment for this discharge. The OLC could be as long as ~2500 feet in order to provide the maximum amount of treatment for the available land area. The estimated cost of treatment for the Pierpont Road discharge is $58,585. Currently, the Pierpont Road site adds 2,000 lbs/yr of iron and 5,600 lbs/yr of aluminum to West Run. The remediation project described above will remove an estimated 1,600 lbs/yr of iron and 4,480 lbs/yr of aluminum. The implementation of a remediation project at the Pierpont Road site will help meet the load reduction goals listed in the Monongahela River TMDL.

### ***Rainbow Run-***

Rainbow Run, located near the top of the watershed adjacent to County Route 119/32, has three sources of impairment; one source enters West Run from the west and emanates from fill used to construct Interstate 68. This source is acidic in nature and contributes 19.7 tons per year of acidity, mostly from aluminum. The second source comes from the headwaters above this site, is alkaline in nature, and contributes approximately 97.4 tons per year of alkalinity. The third source emanates from abandoned strip operations to the east of West Run and is also alkaline in nature with a contribution of 16.5 tons per year of alkalinity. Each of the three sources will have different treatment modules installed to remediate them.

The proposed conceptual design for the alkaline discharge entering West Run from the east will utilize a series of in-stream leach beds. Two small leach beds, with berms at the discharge end, will be constructed to remove the metals in the water. The leach beds will also be connected by an open limestone channel. Although this discharge is slightly acidic, the pH is high enough that no further alkaline amendments should be needed to treat the water to an acceptable level. The estimated cost for this module is $16,525. Currently, the eastern Rainbow Run site adds 4,000 lbs/yr of iron and 200 lbs/yr of aluminum to West Run. The remediation project described above will remove an estimated 3,200 lbs/yr of iron and 160 lbs/yr of aluminum. The implementation of a remediation project at the eastern Rainbow Run site will help meet the load reduction goals listed in the Monongahela River TMDL.

The second source of water, which is alkaline with very low metal concentrations, will not be treated before it intersects the discharges that enter from the east and west. Instead, a wetland will be constructed in the stream channel as a final polishing step for the water. The passive treatment systems on the east and west channels will have removed the large majority of metals and acidity. The water from the east and west tributaries will mix with the alkaline second source and will be conveyed to the in-stream wetland. The estimated cost for the wetland module will be $97,384.

The discharge that enters from the west is the only net acidic water of the three discharges. The majority of this acidity comes from the high concentration of aluminum that is dissolved in the water. Currently, the water source is ~50 yards from where the channel discharges into West Run. To treat this water, a limestone leach bed will be constructed at the water source. The water will then be conveyed to West Run by an open limestone channel. The estimated cost for this treatment system is $49,341. The total cost for all modules for the Rainbow Run site is $163,250. Currently, the western Rainbow Run site adds a negligible iron load and 7,200 lbs/yr of aluminum to West Run. The remediation project described above will remove all of the iron load and 5,760 lbs/yr of aluminum. The implementation of a remediation project at the western Rainbow Run site will help meet the load reduction goals listed in the Monongahela River TMDL.

***Airport discharge-***

The Morgantown Airport is currently undergoing a runway extension. Near the end of the new runway are two portals that discharge AMD. The combined discharge of the two portals is 200 gpm. The area immediately below the discharge is a natural impoundment. This area would be turned into a limestone leach bed. From here, the discharge would flow through a culvert via an OLC and into a settling pond. The water would then be discharged down another OLC and into a wetland. The wetland will catch any remaining metal precipitates before the water is discharged into West Run. The estimated cost of treatment for the Airport discharge is $290,212. Currently, the Airport site adds 30,000 lbs/yr of iron and 19,200 lbs/yr of aluminum to West Run. The remediation project described above will remove 24,000 lbs/yr of the iron load and 15,360 lbs/yr of aluminum. The implementation of a remediation project at the Airport site will help meet the load reduction goals listed in the Monongahela River TMDL.

***Easton Hill Portals Right and Left-***

The Easton Hill Portals are located along Rt. 119 before its intersection with Pierpont Road. These two portals had wet seals installed in order to control the direction of flow from the portals. The portals are ~30 feet from one another and they have very similar water chemistry. The initial discharge from these portals is only about 50 feet from a major road. From each portal, the water flows down a grouted channel and then into a concrete ditch that conveys the water parallel to the road and into West Run. Since these sources are so close to the road, there are few options available to treat this water passively. One option could be *in situ* treatment. However, the hydrology of the mine has not been extensively studied. More research on the mine would have to occur to determine if *in situ* treatment is viable. Another technology that could work at this site is an OLC.

The concrete ditch that the water currently runs through could be remade into an OLC, decreasing acidity in the discharge before it enters West Run. The total estimated cost for the treatment of the Easton Hill portals Right and Left site would be $141,107. Currently, the Easton Hill Portals add a combined 8,000 lbs/yr of iron and 21,400 lbs/yr of aluminum to West Run. The remediation project described above will remove 6,400 lbs/yr of the iron load and 17,120 lbs/yr of aluminum. The implementation of a remediation project at the Airport site will help meet the load reduction goals listed in the Monongahela River TMDL.

When combined, the total load reduction that will be achieved by implementing all of the above remediation projects equals 163,200 lbs/yr of iron reduced and 101,440 lbs/yr of aluminum reduced. These reductions exceed the goals set forth in the Monongahela River TMDL, which were 71,331 lbs/yr of iron and 11,424 lbs/yr of aluminum.

In conclusion, these module designs and their costs were estimated using AMDTreat software from Office of Surface Mining. The designs and costs were constructed using the most recent water quality data. However, these designs/costs are merely preliminary attempts to mitigate the AMD in the West Run watershed. As such, both the costs and the designs could change before any project construction commences.

### *7.2.2 Sediment/Storm water*

Morgantown is a MS4 community meaning that within city limits there are regulations in place to detect and eliminate elicit discharges, control construction site runoff, and post construction storm water management in new development and redevelopment. Additionally there are requirements for public involvement, and education and outreach. WRWA volunteers will push for enforcement of the existing regulations and work to increase public involvement, and education and outreach. Currently WRWA is working with the Morgantown Utility Board, WV DEP, and the NRCS, to install a demonstrative rain garden in a small city park in the Burroughs watershed.

All of the sediment and storm water related issues in West Run that have not been addressed by the MUB Burroughs Run storm water project are issues created by disturbed soils due to development. The increase in sediment and storm water runoff can be reduced or eliminated by:

- Establishment of riparian buffer between development and streams;
- Re-vegetation of slopes exposed during construction,
- Construction of rain gardens to reduce runoff;
- Implementation of silt fencing;
- Implementation of properly sized sedimentation ponds;
- Enforcement of state storm water regulations.

# 8 Implementation Program Design

## 8.1 Management Strategies

AMD is currently the limiting factor for life in West Run. Therefore, reclamation will focus on AMD first. Once load reductions have been achieved to allow life, fecal coliform bacteria and sediment loadings will be re-assessed. Concurrent with the AMD reclamation, the WRWA will educate community members about AMD and storm water related issues. They will also request that the West Virginia Department of Environmental Protection use Environmental Enforcement officers to check that current and future development complies with storm water regulations. Table 6 gives estimation of costs for the AMD remediation projects in the watershed.

### 8.1.1 Cost Estimates

| Site | Cost |
|---|---|
| Alcon | $98,079 |
| Walls Portal | $467,613 |
| Agronomy Farm 1 | $212,873 |
| Agronomy Farm 2 | $137,937 |
| St Thomas Seep | $153,584 |
| Pines Country Club | $782 |
| Marion Meadows Seep | $212,507 |
| Bakers Ridge Highwall | $80,000 |
| Pierpont Road discharge | $58,585 |
| Rainbow Run | $163,250 |
| Airport | $290,212 |
| Easton Hill Portals Right and Left | $141,107 |
| **Total** | **$3,573,659** |

Table 6: Cost estimates for AMD remediation

### 8.1.2 Funding Sources

#### Section 319 funds

Clean Water Act Section 319 funds may be provided by USEPA to WVDEP to be used for reclamation of nonpoint source AMD sources. This Watershed Based Plan is being developed so that these funds in fiscal year 2007 and beyond can be allocated to the West Run watershed. WVDEP's Division of Water Resources sets priorities and administers the state Section 319 program.

#### Watershed Cooperative Agreement Program

Grants specifically for AMD remediation projects on AMLs are available through

OSM's Watershed Cooperative Agreement Program (WCAP). The WCAP is part of the Appalachian Clean Streams Initiative. Grants of up to $100,000 are awarded to not-for-profit organizations that have developed cooperative agreements with other entities to reclaim AML sites.

### *8.1.3 Technical Assistance*

#### *West Virginia Department of Environmental Protection*

The Division of Water and Waste Management will provide technical assistance in the implementation of the watershed based plan through the Nonpoint Source Program (NPS). The NPS Program is funded primarily by the Clean Water Act Section 319 Grants in order to:

- Educate the public and land users on non-point source issues,
- Support citizen based watershed organizations,
- Support enforcement of non-point source water quality laws, and
- Restore impaired watersheds

Another technical assistance program within the WVDEP is the WV Save Our Streams program. This is a volunteer monitoring program that trains West Virginia citizens of all ages how to monitor and to become watchdogs over their local wadeable streams and rivers. This program has proven to be an invaluable asset in educating members of watershed groups as well as the general public.

#### *West Virginia University*

The primary organization housed within West Virginia University that provides technical assistance for watershed groups is the National Mine Land Reclamation Center (NMLRC). This organization can provide conceptual site designs for reclamation of AMD, as well as oversee the installation of the project site, and monitor the pre- and post - construction water quality. The NMLRC also provides support to DEP in developing watershed plans and training for watershed organizations. NMLRC can draw upon the expertise of the numerous university colleges at WVU to address other types of nonpoint source pollutants.

#### *West Virginia Conservation Agency*

The West Virginia Conservation Agency will provide technical assistance in the proper installation and maintenance of best management practices (BMPs), as well as offer support for education and outreach efforts.

### *8.2 Schedule of Activities Interim Milestones and Indicators to Measure Progress*

As described in the management strategy, the first activities will be AMD remediation as it is currently the limiting factor in West Run. As remediation progresses this should be re-evaluated in 2015. Once all AMD remediation is complete in 2020, the West Run should be re-evaluated for impairment from biological sources.

| Project | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Airport | Pre-construction data collection | | Apply for 2010 grant | Construction | | Post-construction monitoring | | | | | | | | |
| Bakers Ridge Highwall | Pre-construction data collection | | | Apply for 2011 grant | Construction | | Post-construction monitoring | | | | | | | |
| Pines Country Club | Pre-construction data collection | | | Apply for 2011 grant | Construction | | Post-construction monitoring | | | | | | | |
| Easton Hill Portals Right and Left | Pre-construction data collection | | | | Apply for 2012 grant | Construction | | Post-construction monitoring | | | | | | |
| Marion Meadows Seep | Pre-construction data collection | | | | | Apply for 2013 grant | Construction | | Post-construction monitoring | | | | | |
| St Thomas Seep | Pre-construction data collection | | | | | | Apply for 2014 grant | Construction | | Post-construction monitoring | | | | |
| Walls Portal | Pre-construction data collection | | | | | | | Apply for 2015 grant | Construction | | Post-construction monitoring | | | |
| Agronomy Farm 1 | Pre-construction data collection | | | | | | | | Apply for 2016 grant | Construction | | Post-construction monitoring | | |
| Agronomy Farm 2 | Pre-construction data collection | | | | | | | | Apply for 2016 grant | Construction | | Post-construction monitoring | | |
| Alcon | Pre-construction data collection | | | | | | | | | Apply for 2016 grant | Construction | | Post-construction monitoring | |
| Rainbow Run | Pre-construction data collection | | | | | | | | | | Apply for 2016 grant | Construction | | monitoring |
| Pierpont Road discharge | Pre-construction data collection | | | | | | | | | | | Apply for 2016 grant | Construction | |
| Education and Outreach | Education and Outreach about AMD and storm water issues | | | | | | | | | | | | | |

Table 7: Schedule of proposed activities

Interim milestones will be met for each tributary of West Run. These milestones include metal load reductions of 50-80% of the original load of the tributary. These load reductions are anticipated to occur within one year after project construction. As each project within a subwatershed is completed, loading at the mouth of that tributary will be determined and compared to the initial loading. This will detail the removal of AMD pollution in West Run in a scientifically rigorous manner. Table 8 shows the initial loadings from all AMD sources for each tributary section, as well as the anticipated load reductions for iron and aluminum.

| Subwatershed | Initial Fe load | Expected Fe Reduction | Initial Al load | Expected Al Reduction |
|---|---|---|---|---|
| | lbs/yr | lbs/yr | lbs/yr | lbs/yr |
| Old Cheat Rd. | 130,000 | 65,000-104,000 | 58,000 | 29,000-46,400 |
| Stewartstown | 30,000 | 15,000-24,000 | 6,880 | 3,440-5,504 |
| Mainstem | 44,000 | 22,000-35,200 | 52,160 | 26,080-41,728 |

Table 8. Initial metal loads and anticipated load reductions for three subwatersheds of West Run.

Load reductions for each site will also be included in the 319 requests for each site. The efficacy of these projects will be determined by routine pre and post-construction sampling. Sampling will also take place in 2015 to determine if AMD is still the limiting factor of life in West Run.

## *8.3 Information/Education Component*

A prominent portion of WRWA's mission statement is to publicize the status of the watershed, and encourage education of environmental issues within the watershed. WRWA has and will educate stakeholders and members of the community about AMD through:

- maintaining an informative website (www.westrun.org);
- public meetings;
- educational displays at regional and local festivals, and other public events.

In the future, WRWA may:

- organize volunteer citizen monitoring;
- implement a permanent educational display along the Monongahela River rail trail at the mouth of West Run;
- work with local parks, schools, and community members to build rain gardens with associated educational displays.

## *8.4 Monitoring Component*

Monitoring is an essential component of a watershed-based implementation plan because it allows stakeholders to see what progress is being made and when goals are achieved. Monitoring will be a key component of each of the projects described in section 7.2.1 above. In general, at least one year of chemical monitoring (sampled once a month) will be conducted before and after each project within the project's subwatershed. Monitoring will also take place at the mouth of the completed project's subwatershed in order to quantify the effect of AMD treatment at each project site. AMD monitoring will include pre and post-construction sampling for 14 project sites as well as the mouth of each subwwatershed and the mouth of West Run, for a total of 19 sample points. This number and frequency of samples was deemed appropriate for a watershed this size because all AMD sources would be sampled several times and both initial metal loads and metal load reductions could be accurately calculated with this number of samples. A sampling regime of this size and frequency has also been previously used on other AMD remediation projects and has been found to effectively represent water quality conditions.  Figure 28 shows the location of the 14 AMD project sampling points and the sampling point at the mouth of West Run.

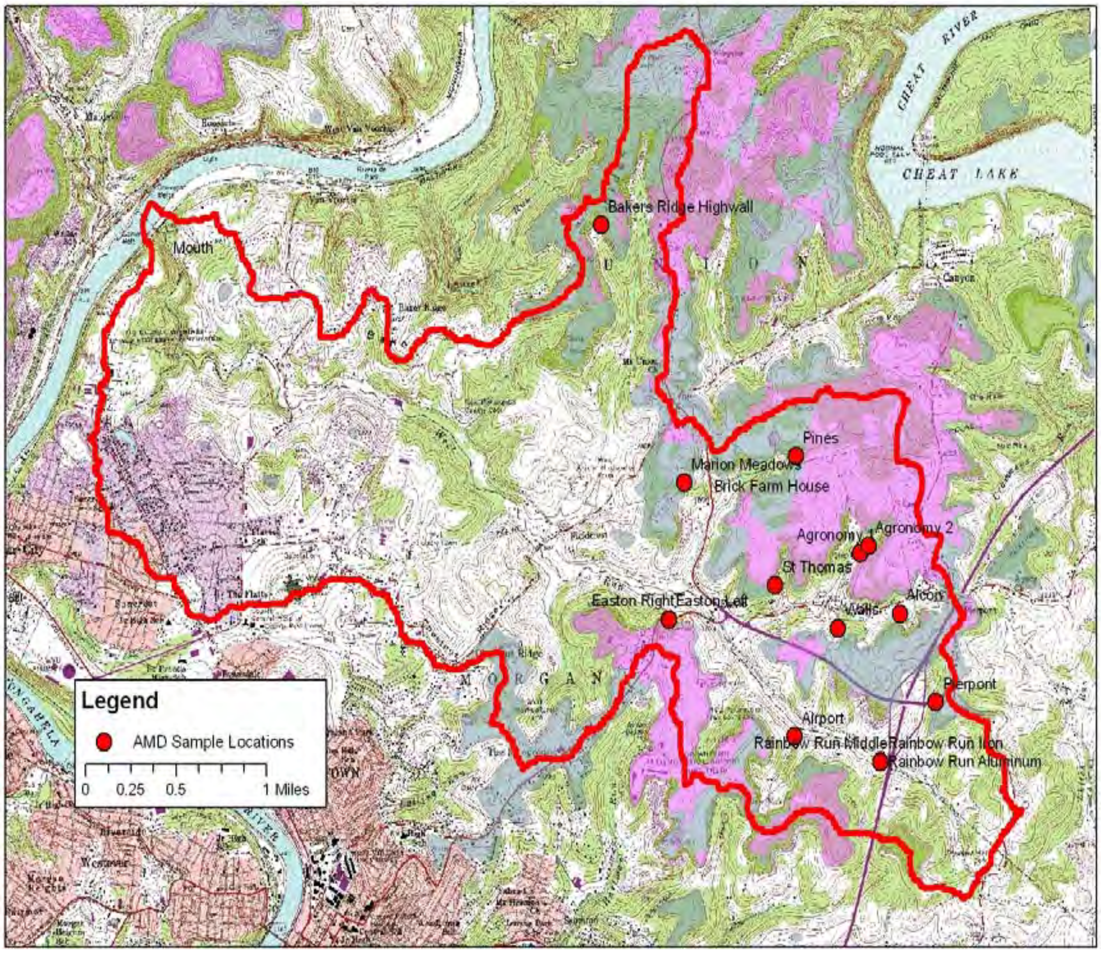


Figure 28. AMD sampling points in West Run.

Chemical sampling will be the responsibility of the organization that is conducting the reclamation. In addition to localized, project-related monitoring, WRWA has applied for funding to complete watershed-wide surveys of AMD related water quality quarterly in 2008-2009. WRWA plans to continue these surveys as funding allows.

The above monitoring plan will effectively address the evaluation criteria in Section 7.2.1 of this plan by comparing existing monitoring data with data collected in the future.  These data will be linked through the parameter of metal loads.  Iron and aluminum loads will be calculated for future samples and compared to previous samples to determine load reductions.  Metal load reductions will also be used to establish the extent to which the West Run TMDL is being implemented.  The data comparison will allow the WVDEP to determine the amount of progress made the ultimate goal of removing West Run from the WV 303(d) list of impacted streams.  The progress toward these goals will be continually reassessed by the WVDEP as reclamation is completed.

## *8.5 Criteria to Be Used for Evaluation*

### *AMD*

Concentrations and loads of iron, aluminum, and pH will be used as the quantitative criterion.  WV state water quality standards for total iron are 0.5 and 0.75mg/L respectively.  The load limits for iron and aluminum are established in the 2002 TMDL report (Appendix A).  State regulations for pH require it to be between 6 and 9.

### *Bacteria*

Fecal coliform concentrations will be used as the criterion for fecal bacteria assessment. The state water quality standard for fecal coliform for C waters is 200 CFU per 100 mL as a monthly geometric mean based on not less than 5 samples per month or 400 CFU per 100 mL in more than ten percent of all samples taken during the month.

### *Sediment*

There are no state regulations for sediment.  Sediment will be evaluated by sampling above and below a sediment source. Sediment must not increase more than 10% greater than its background level.

The qualitative criterion used to evaluate success can apply to all three of the previously mentioned pollutants.  The first criterion will include more recreational opportunities for users of the streams.  Removal of the pollutants in the stream will allow benthic macroinvertebrate and fish populations to grow, presenting the general public with an increased ability to use and enjoy this resource.  A stream free of pollutants will also allow increased opportunities for contact recreation, such as swimming and wading.  If the general populace within the watershed begins to see benefits from pollution control practices, they will likely become more involved as caretakers of the watershed.  They will also encourage other community members to use the resource in a responsible manner.

A second qualitative criterion is the increased education opportunities that a cleaner stream will provide.  The schools in the watershed could use West Run as a “living laboratory” to further environmental education within their classrooms. If students see the environmental and recreational benefits of a clean stream, they will be more likely to encourage continued stewardship of the resource.

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