ACID MINE DRAINAGE IN THE TURTLE CREEK WATERSHED: SOURCES, PROBLEMS, AND ABATEMENT

Compiled by the

TURTLE CREEK WATERSHED ASSOCIATION

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Executive Director
June 30, 1973

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Mr. Clifford H. McConnell
Deputy Secretary
Engineering and Construction
Department of Environmental Resources
P.O. Box 1467
Harrisburg, Pennsylvania 17120

Acid Mine Drainage
in the
Turtle Creek Watershed:
Source, Problems and Abatement

Dear Mr. McConnell:

Enclosed is our report for control and elimination of acid mine drainage affecting stream life in the Turtle Creek watershed. Through contract No. BE 65:1-101.3, the study was limited to areas of the drainage basin and to mining problems heretofore not addressed by other efforts.

Water quality data is included as an integral part of the report to better establish a cost/benefit understanding of abatement efforts.

As a non-profit civic organization, the Turtle Creek Watershed Association is most appreciative of the aid and encouragement we have received from your Department in attempts to rehabilitate our area. It has been a pleasure working with both you and your staff.

Very truly yours,

John M. Mores

John M. Mores
Executive Director

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Enclosure

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about this study

AREA OF CONCERN

The entire 147 square mile area of the Turtle Creek watershed was surveyed in this study to locate, identify and map mining related problems, with the exception of the following sub areas for which studies have already been concluded or are nearly complete.

IRWIN SYNCLINE

This 40 square mile portion of the watershed in Westmareland County was studied during the summer *of* 1972 by TOWA, and resultant mining information and data is on file at TOWA and DER offices. The study does not include information on deep mining in the area. Only surface mining problems were located.

PIERSONS RUN WATERSHED

The area studied includes approximately 1090 areas of land in Boyce Park of Allegheny County and drained by Piersons Run. Completed by General Analytics Inc., consultant engineers officed in Monroeville, Pa., the study was presented to DER September 20, 1971. Full information on Pittsburgh seam and upper Freeport seam mining information is detailed, with alternative abatement procedures and recommendations presented.

CHALFONT RUN

Compiled by Alex Hutchison's Engineers, this study includes the drainage area of Chalfont Run in Allegheny County and is expected to be complete by the Spring season of 1974.

OBJECTIVES

This study was undertaken to locate, identify and map mining problems that relate to the formation, underground conveyance, and eventual outfall of acid mine drainage into Turtle Creek watershed streams.

AU evaluations and assessments are made with the purpose in mind of providing in-depth information required to determine corrective processes for abating these outfalls. According~, a stream testing program is part of the study to determine affects of mine drainage on aquatic life; and to set priorities so that damaged streams can be returned to productivity; and to realize cost/benefits for monies spent in reclaiming streams.

Located during this study were all unreclaimed strip mines, sink holes, strip ponds, abandoned coal tipples and other surface mining problems. Also located were underground mining maps (where available), portals and entryways, and acid mine outfalls.

STUDY MECHANICS

Step 1: Field research was used to provide information on acid mine outfalls, surface problems such as stripping, ponding and sink holes, as well as providing supplemental information from area miners on deep mine conditions. These interviews provided significant amounts of information that complimented survey and deep mine map information.

Step 2: All available deep mining maps were obtained from sources such as Consolidation Coal Company and the Westmoreland Coal Company. Since this area was mined many years ago, and since many of the original mine maps are no longer in existence, underground manways and other tunnel information has been reconstructed within the limitations of existing information.

Step 3: A composite picture of conditions resulting in present acid mine outfalls has been constructed using information from Step 1 and 2. Obviously, it has been necessary to interpolate from areas of available information into areas where deep mine information is lacking. In same regions, where whole areas lack deep mine information, no attempt could be made with any degree of accuracy--and none has been.

Step 4: Summary and conclusions have been made on information that can be of use in accelerating corrective measures. This includes priority abatement areas and possible alternative abatement procedures. This section, by its nature, is limited to the expertise of the author: all other sections of this report are objective presentations of data.

watershed characteristics

GEOLOGY

The geological strata exposed in the watershed is part of the Conemaugh and Monongahela groups. Located on the floor and walls of downstream valleys is the Conemaugh group, with the Monongahela group forming the hilltops. The Pittsburgh coal seam is the first strata in the Monongahela group above the Conemaugh.

The boundary of these two formations is marked by intermittent strip mining, particularly in Westmoreland County, of the Pittsburgh seam at the bottom of the Monongahela group.

Rocks of both formations consist of claystone, shales, sandstones, intermittent coal seams and limestones. The beds have been folded gently with the northeast t113nding Duquesne syncline closely coinciding with the location of Thompson Run, the Murrysville anticline crossing Turtle Creek near Trafford, and the Irwin syncline running on an axis from Export through Irwin.

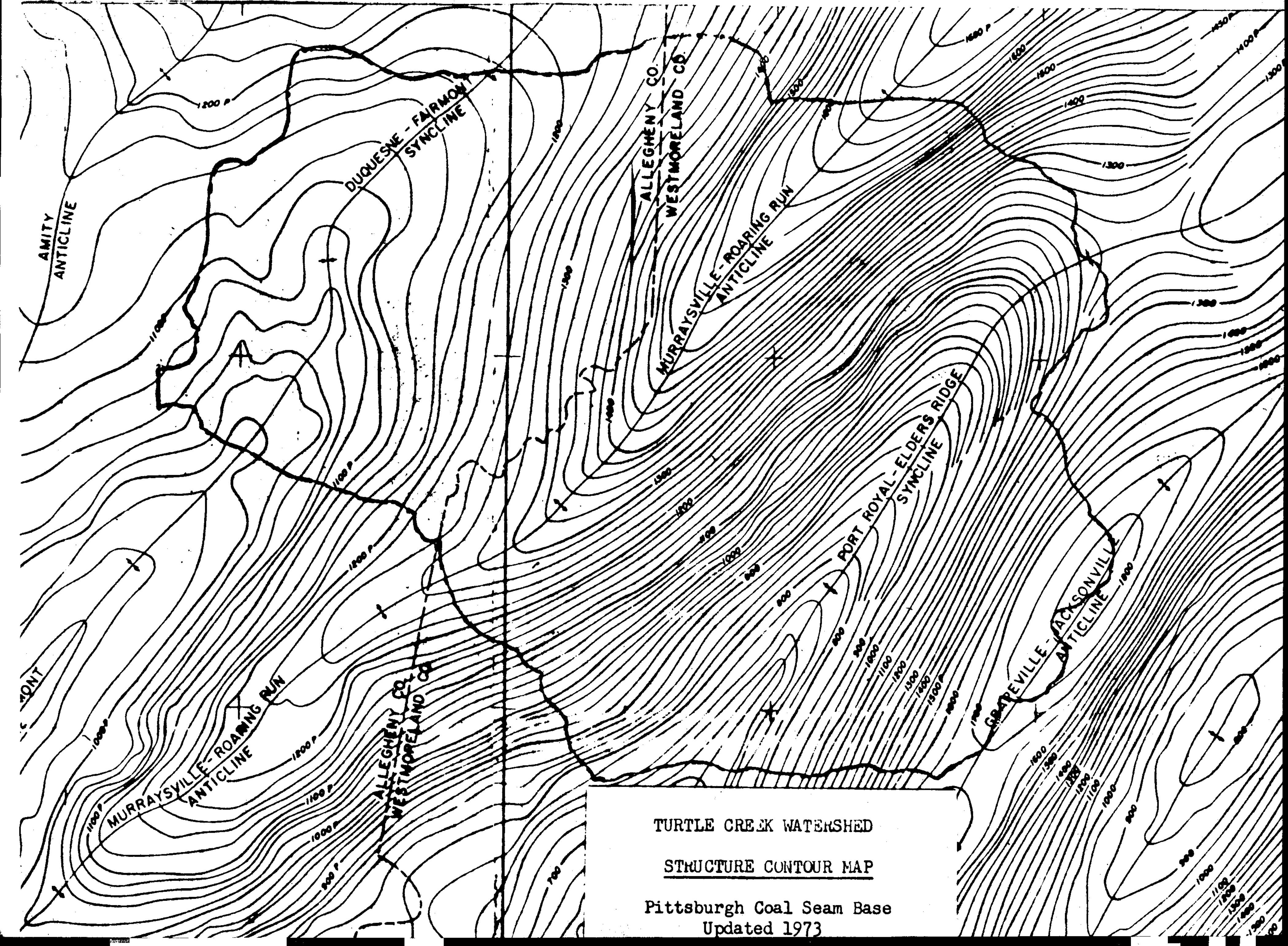
Pittsburgh coal in the Allegheny County portions of the watershed ranges in elevation from 960 feet at the southwestern boundary of the watershed to about 1,220 feet at the north boundary. The coal seam is found high on hill-sides, where it has not been eroded away. The design of the coal is in intermittent "fingers" and "spurs" that generally run off of a main body of coal under the highest ridges. Rarely is the overburden greater than 200 feet.

In Westmoreland County, where the steep sided Irwin Syncline has plunged the coal to depths of 700 MSL in the watershed, coal can also be found as high as 1,260 feet in the outcroppings.

Upper Freeport coal is found approximately 600 feet beneath the Pitts-burgh seam and mineable quantities have been confirmed only in the north-western quadrant of the watershed.

CLIMATE

The Turtle Creek Basin has a temperate climate with normal monthly temperatures varying between 75 degrees F in July and 30 degrees F in January; mean average temperature is 52 degrees F.



TURTLE CREEK WATERSHED

STRUCTURE CONTOUR MAP

Pittsburgh Coal Seam Base
Updated 1973

Precipitation over the watershed is uniformly distributed with annual norms about 40 inches. June is the wettest month with an average of 3.95 inches, and October the driest month with an average 2.30 inches of precipitation.

However, "high flow" months are March, April, and May, with low flows occurring during August, September and October.

Because of the nature of development and vegetation over the watershed, there is a significant difference in run-off from east to west in the watershed.

Using the Allegheny-Westmoreland County boundary as a dividing line, the eastern portion which is comprised of low hills experiences from 50% in the growing season (transpiration) to 65% in the winter of precipitation runoff.

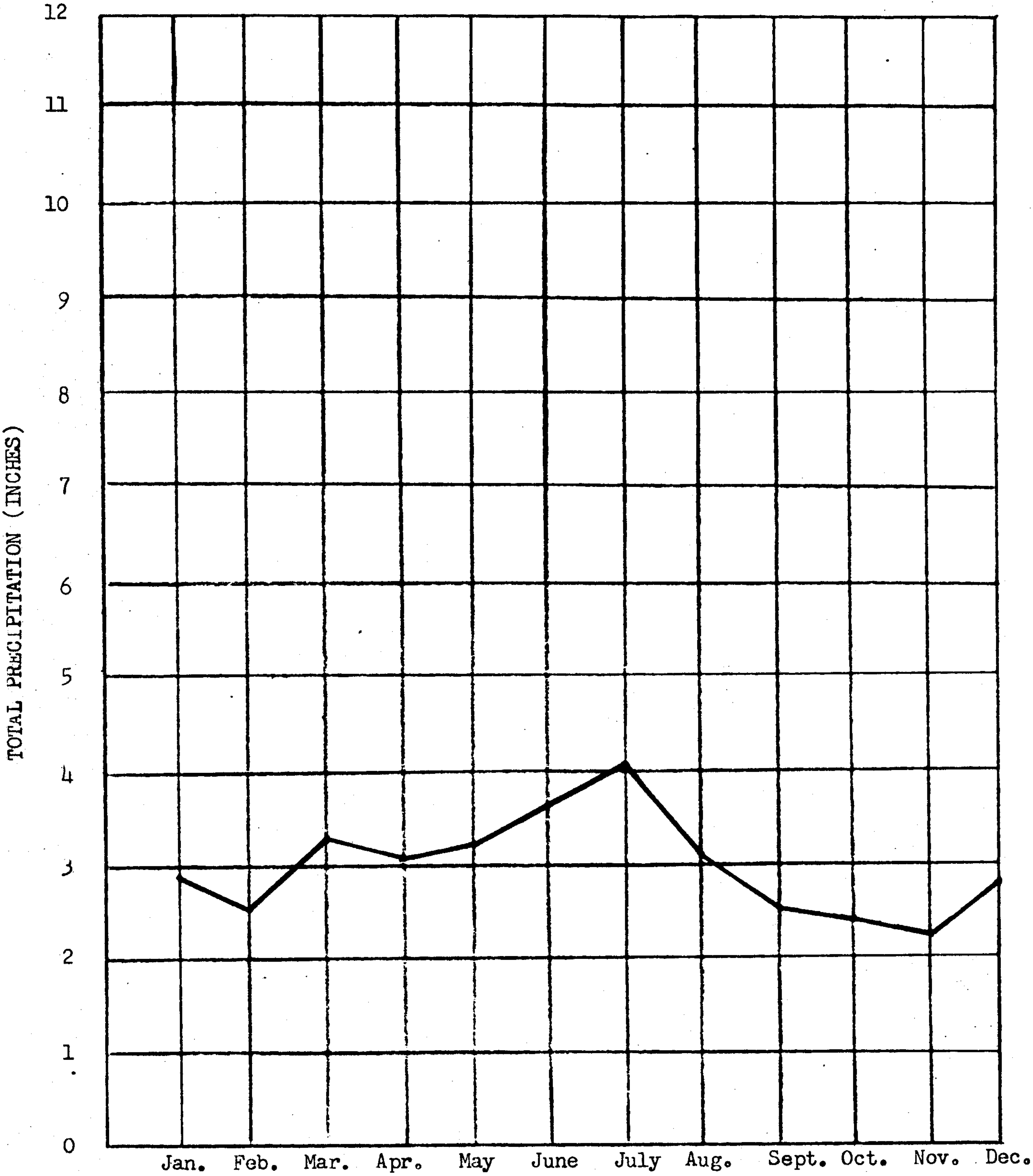
In the west area, due to its hilly nature and extensive urban development, runoff is in excess of 70% of rainfall the entire year.

DRAINAGE PATTERNS

The watershed has a typical dendritic drainage pattern with steep valley walls in the lower reaches and gently rising hills in the upper watershed. The formation of the system with significant drainage tributaries is shown below.

Stream/Tributaries	Drainage Area In Square Miles		Affects of Acid Mine Drainage/Sewage
Brush Creek	57.2		highly acid
Bushy Run		18.1	slightly basic
Turtle Creek Branch (above Trafford)	55.8		highly acid
Haymaker Run		11.0	neutral
Abers Run		8.8	neutral
Lyons Run		8.8	slightly acid
Steels Run		4.6	highly acid
Thompson Run	17.8		acid/basic
Chalfont Run		6.4	slightly acid
Sawmill Run		4.3	slightly basic
Boundary Run		2.1	highly acid

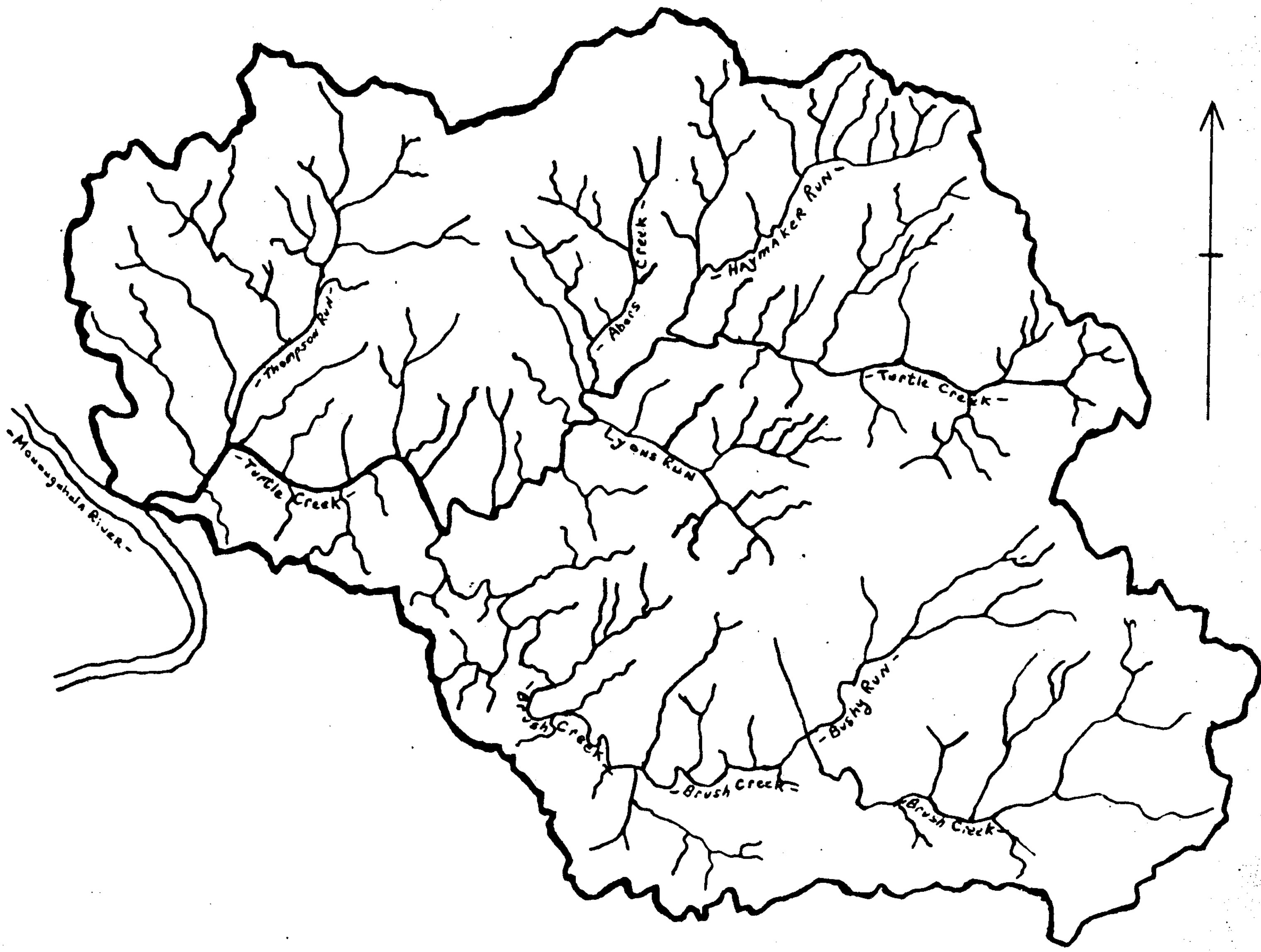
TOTAL MONTHLY PRECIPITATION - RECORD MEAN 1872-1971
Pittsburgh, Pa. *



(*Source: Local Climatological Data, Annual Summary with Comparative Data, Pittsburgh, Pa.; U.S. Dept. of Commerce, 1971)

Stream/Tributaries	Drainage Area In Square Miles	Affects of Acid Mine Drainage/Sewage
Main Watercourse (below Trafford)	16.2	
Dirty Camp Run	6.7	acid/basic
Lynn Avenue Run	2.8	highly acid
Wall Run	2.3	highly acid
Coal Run	1.2	highly acid
Total	147.0	

DRAINAGE SYSTEM
TURTLE CREEK WATERSHED



Major Sub-Watershed Areas

Sub-Watershed	Drainage Area (in square miles)
Brush Creek	57.2
Turtle Creek Branch (above Trafford)	55.8
Thompson Run	17.8
Main Watercourse (below Trafford)	16.2
Total	147.0

important mining considerations

HISTORY OF LOCAL MINING

A. Allegheny County

Portions of the watershed in Allegheny County were some of the first areas mined in the Pittsburgh region. The New York and Cleveland Gas Coal Company began large mining operations about 1868 in the Oak Hill Nos. 1,2, 3 and 4 mines.

The Sandy Creek Mine, Oak Hill No. 5, the Duquesne Mine, the Plum Creek Mine and the Stuart Dickson Mine started mining operations between 1854 and 1890. All coal removal was by pick and shovel, and the early mining methods often left significant "support" coal in place.

Nearly all area mining property and map information was purchased by the Pittsburgh Coal Company (now Consolidation Coal Company) around 1910. Most of the Pittsburgh seam of coal that remained was removed by retreat mining after this period. Mining continued into the 1930's.

Stripping was not done extensively in the Allegheny County portions of the watershed, with only limited areas near Turtle Creek Borough, Boyce Park and several areas in eastern Penn Hills being so affected in the 1940's. Few signs of stripping are in evidence today because of urban development.

One major characteristic of this region is the extremely large number of "country pits" in addition to the several large mines. Every homeowner had his "dog hole" supplying coal for his stove; and many small mining concerns operated limited facilities.

Today, the only active mine in the area is the Renton Mine of Consolidation Coal Company mining the upper Freeport seam. This coal is nowhere in the watershed less than 500 feet below surface streams (proved quantities of mineable coal).

B. Westmoreland County

In Westmoreland County, and excluding coal in the main portion of the Irwin Suncline, mining activities can be divided into two groups with Turtle Creek as the divider line.

South of Turtle Creek, Pittsburgh coal was found near the top of several hills at the headwaters of Byers Run and Lyons Run. The overburden was 1 to 150 feet thick. During the early 1940's all of this coal was stripped out. Most of the stripped area has been reclaimed to some extent.

North of Turtle Creek, above Export, two deep mines removed coal from limited deposits along Steels Run. The Skelly Mines were in operation, it is reported by local residents, between 1920-1935.

All of the outcropping in this region was removed during the early 1940's and no reclamation has taken place. The combination of deep mines and unreclaimed strip pits has led to the formulation of large quantities of mine acid.

There is one active strip mine in the area owned by Mr. Frank Kowalski. His property and a section owned by Mr. William Benson of Delmont are the sources of most of the acid mine drainage affecting Steels Run.

MINING METHODS USED (ALLEGHENY COUNTY SECTION)

It is extremely important in the determination of underground water flows to recognize the local mining methods used in removing coal (from the Pittsburgh seam).

Several vital considerations must be known

*coal ownership
*direction of main entries and lateral entries.

A. Coal Ownership

Around 1895, there were eight to ten large mining companies who owned coal and were operating in the Allegheny County portions of the Turtle Creek watershed.

From all information obtained, these companies worked to the limits of their property lines. Thus, the major coal mines left few barriers in place; it was not necessary to do so because mine water accumulations were not a major problem.

Therefore, the area mines are all interconnected and water flows are not inhibited by flow control barriers left in place.

Note: Near the end of the 1900's, the New York and Cleveland Gas Coal Company consolidated nearly all of the smaller companies into one large corporation; it eventually evolved into Consolidation Coal Company.

During this time, many "country pits" were being operated by five or less miners. The State did not require plans to be recorded if a mine had less than six miners. Therefore, there are no maps available of these small mines that usually ranged from 1 to 100 acres in size. Their locations are at this time unknown.

They are important because these small mines worked the outcrop line and often broke through into the workings of the large mining companies. The result is that the line of outcrop coal is porous in the area, and there are many places where mine drainage from the large mines can easily reach the surface.

B. Direction of Mine Entries and Lateral Entries

The Pittsburgh coal has a natural weakness which causes it to break under pressure in a certain fashion. The weak points of the coal are perpendicular to one another and when mined correctly causes the coal seam to break down into nearly rectangular or square blocks of coal.

This geological characteristic has resulted in "butt" and "face" mining where the coal is mined along its natural "fracture lines". If it were not, the coal would shatter into "slack" or dust.

These natural fracture lines are consistent in direction throughout the coal seam in the watershed. They determine the direction of entryways.

One shear line is 15 degrees while the other is 105 degrees from true north. Virtually all of the main entries and lateral entries lie on a line of either 15 degrees or 105 degrees.

This characteristic has allowed an "educated guess" to be made concerning entryways where no mine maps are presently available but where the pit mouth or drain hole is known or where only portions of mine maps can be found.

MINE MAPS AVAILABLE

Mining maps were located for approximately 50 percent of the mined portions of the watershed studied. Nearly all of the maps located were compiled for the now defunct New York and Cleveland Gas Coal Company for holdings which they had consolidated.

Since these maps were produced between 1890 and 1910 by a company no longer in existence, there can be no attesting to their accuracy.

The maps cover all or portions of the following mines (in the watershed):

Mine	Percent Area Covered
Oak Hill No.2	100%
Oak Hill No.3	100%
Oak Hill No.4	40%
Oak Hill No.5	100%
Sandy Creek Mine	20%
Plum Creek Mine	50%
Hampton Mines	0%
Duquesne Mine	50%
Stuart Dickson Mine	0%
Taylor Mine	0%

mine drainage abatement methods

This section identifies pollution abatement methods in light of the constraints found in the study area. Alternative abatement processes will then be recommended for each mine complex identified in the ANALYSIS SECTION that follows. No costs for abatement facilities will be attempted, they are beyond the scope of this research, only the processes most compatible with the discharge problem, the area, and the information on deep mining will be presented.

Contemporary efforts to eliminate or decrease flows of acid mine drainage are still primarily in the experimental stage. However, certain portions of the Turtle Creek watershed in Allegheny County appear to lend themselves to experiment.

This is because the discharge flows are generally small, several of the most important are on publicly owned land, because the discharges flow through urban areas many people are exposed to the deleterious affects, and several important experimental stations such as Bituminous Coal Research, Inc. (sponsored by the National Coal Association) are located in the study area.

Following is a discussion of both proven methods and those experimental in nature.

Treatment Plants - Traditionally, treatment facilities using lime as a neutralizer have been the primary effort to clear mine drainage from streams. Properly administered, they have proven effective.

The disadvantages of. this method are notorious. High initial costs, continuous maintenance, high cost of neutralizing agents, problems of precipitate removal, and unsightleness make this method unsatisfactory. It is recommended in this study only as a last resort.

Strip Mining - Stripping, with proper backfilling, soil treatment, planting and runoff water control is an excellent method of abating deep mine problems. It is recommended for all of the Westmoreland County source areas of mine drainage considered in this study.

In-Stream Neutralization - This process includes several methods of "sweetening" streams by adding lime directly into the polluted stream. A demonstration project at Penn State University is on-going using small dams of limestone to raise the pH of mine acid affected streams. This method can be used only where mine discharges are high in acid concentration and low in unstable iron compounds.

Hydrated lime can be added directly to stream flow for small discharges high in acidity, also.

Lime Slurry and Fly Ash Injection - Both of these methods attempt to trap mine water in the mine by sealing seepage points and slowing water flows in the mine. Lime slurry forms an insoluable compound on reacting with unstable iron compounds and, like fly ash, plugs the drain holes and underground flow corridors.

Because of the nature of the geological structure in the study area and the mining methods used, this alternative may be the most advisable for many discharges (on an experimental basis).

Grouting - Placing a barrier of concrete in the mine tunnels and along outcrop lines to slow flows and prevent seepage is not feasible in this area. The outcrops throughout the area are perforated by "county pit" mines and mine fires. To prevent blowouts and new seepage points, virtually all of the outcrop line would require grouting.

Mine Seals - These seals placed in entries and pit mouths to flood reactive coal refuse are usually constructed of two concrete block walls sandwiching a one foot grouting of reinforced concrete poured between the walls.

In the area studied, mine seals can be used to concentrate mine acid at a fewer number of discharge points. However, they must be used judiciously and further investigation beyond this study is required to determine if the underground flows and outcrop line are correct for a proper use of these seals.

Surface Mine Control - A significant percentage of the water entering the Stuart Dickson complex and Oak Hill complex of mines is the result of illegal taps of domestic sewage and storm water into the old mine workings. Removal of these taps combined with other abatement procedures could lead to significant reductions in acid mine drainage to area streams.