Introduction

By Agreement dated June 27, 1969, the Fayette Engineering Company was authorized by the then Pennsylvania Department of Mines and Mineral Industries (now Pennsylvania Department of Environmental Resources) to perform a study of Redstone Creek to determine sources of pollution (mainly mine drainage) and recommend steps to abate or treat the pollution.

The study was to highlight the combined treatment of sanitary sewage and mine drainage.

The mine drainage discharge is from an abandoned mine near the mining community of Phillips, said community and mine drainage is located about two miles north of the City of Uniontown, Fayette County. The sanitary sewage is from the Township of North Union which includes the community of Phillips.

This report sets forth the results of the investigations and studies.

Description of Redstone Creek Drainage Area

Redstone Creek has its source in the mountains of southwestern Pennsylvania, near the Village of Hutchinson, and flows generally 25 miles northwest to empty into the Monongahela River, a few miles below Brownsville, Pennsylvania. It has a total fall of about 500 feet. Coal Lick Run joins Redstone Creek from the west at Uniontown, 19 miles above the mouth. The drainage basin contains 108 square miles of gently rolling terrain, of which 24.1 square miles are above the southeast corporate limit of the City of Uniontown. Normal annual precipitation is 44.7 inches. The average annual snowfall is 38 inches at Uniontown. The largest city in the basin is Uniontown with a population of 16,282 in 1970, who is now, with the passing of the coal mining era, engaged primarily in manufacturing and agriculture. The area is served by three railway systems and major systems of highways-the most recent of which being the Uniontown Bypass.

The population of the entire Redstone Creek Watershed is estimated to be between 50,000-60,000. The land, not covered by refuse piles and old remnants of the active mining years, is now used for residences, light manufacturing, farming and recreation.

The topography of the drainage basin is gently rolling from the mouth of Redstone Creek near Brownsville west to the Village of Hopwood, 3 miles east of the City of Uniontown where the land abruptly rises to the Chestnut Ridge, which has elevations varying from 1300 to 2700 feet above mean sea level. The elevation of Redstone Creek in the heart of Uniontown is approximately 965. The normal pool elevation of the Monongahela River near the mouth of Redstone Creek is 744.

The geology of the basin is described as follows: At the head of the basin above Hopwood, Pennsylvania, the Allegheny, Pottsville, Mauch Chunk, Loyalhanna and Pocono formations of the Carboniferous system form the flanks of the ravines which are floored with the Chemung formation of the Devonian system, brought to the surface by the Chestnut Ridge anticline. The valley downstream from Hopwood has been carved in the Carboniferous shales, sandstones, clays, coals and limestones of the Conemaugh, Monongahela and Dunkard formations. The valley in the vicinity of Uniontown is incised about 200 feet below the general elevation of the Kanawha section of the Allegheny Plateaus. The creek is bordered by flood plains of moderate width. The chief minerals underlying the valley are coal, fire clay, limestone, and natural gas, of which coal is the most important. The several coal seams which have been mined are, in descending stratigraphic order, the Waynesburg, Sewickley, Redstone, Pittsburgh, Upper Freeport, Lower Kittanning, and Brookville-Clarion. The most important and productive seam is the Pittsburgh from which over 90 percent of the coal so far produced in this area, has been mined. With the exception of a few scattered strip mines all coal mining in the Redstone Creek Basin has been completed. Only relatively small amounts of clay, limestone, and gas have been produced in comparison with the large amount of coal.

Mining in Redstone Creek Watershed

Redstone Creek was named for the, outcrop of burned shat..e found in and near the stream by the. earliest settlerss of the region.: The burned shale was caused by the coal seam underlying the shale being exposed by stream erosion and later being ignited, possibly by forest fires, and buring.the overlying shale to form what is commonly called “red dog". The use of coal in this area was noted as early as 1759 but at that time it was treated more, as a curiosity than an important commercial discovery. Coal and then coke were used to fuel the small iron-furnaces to a very limited extent after 1.801, but it, was not until 1855 when a railroad was completed from Connellsville to Pittsburgh that coal from the Connellsville Basin became a valuable commercial asset. When the Civil War increased the demand for pig iron, Pittsburgh built some of the new hot--blast furnaces and fueled them with Connellsville coke. From 1860 to 1875 large quantities of coal were used to produce manufactured gas which was used for illuminating many cities in the east. The number of coke ovens operating in the, county increased from 26 in 1855 to 37,774 in 1913.

The Connellsville Coal Field extends from Latrobe in Westmoreland County on the north to Fairchance in Fayette County on the south, a distance of about 42 miles and averages approximately 32 miles in width. The total area is 147 square miles of which about 88,000 acres was estimated to be recoverable coal. The Uniontown Syncline runs through the center of the field in a north-south direction with the Chestnut Ridge Anticline to the east and the and the Fayette anticline to the west forming a basin. The field is divided by outcrops between Everson and Scottdale to form a north basin and a south basin each consisting of about 44,000 acres. Mine water draining from the south basin which underlies Uniontown is the major source of pollution of Redstone Creek.

As mining progressed in the south basin entries were frequently driven connecting the various mines making it possible for water to flow from one mine to another and creating an almost continuous pool of the entire south basin. It is estimated that this pool presently contains 16 billion gallons of water.

By the time the coal was depleted in early 1961 the last mines operating in the field were pumping 25 million gallons of water a day to the surface. Less than two years after the mines were abandoned and pumping was stopped the mine water discharge north of Uniontown near Phillips appeared, indicating that the pool had filled and was overflowing. Other major discharge points from the south basin have since appeared at Adelaide and Henry Clay mines on the Youghiogheny River.

Underlying the northwestern end of the Redstone Creek Watershed is the main body of the Pittsburgh Coal seam known locally as the Klondike Coal Field. Because of the availability of river transportation the early development of Klondike Field preceeded the development of the Connellsville Basin. After the advent of the railroad in 1855 the subsequent development and depletion of the two field were very similar.

The Lambert Syncline forms the bottom of a basin in this area with the Fayette Anticline lying to the east and the Brownsville

Anticline to the west. One major mine drainage discharge into Redstone Creek from this basin exists on the north side of the creek near Braznell. It is felt that an extensive study of this discharge is beyond the scope of this project.

The coal outcrop, anticlines, synclines, and their relative location to Redstone Creek and its watershed is shown on Plate I.

Stream Flows and Water Quality

No stream-gaging station existed in Redstone Creek prior to November 14, 1942, at which time a chain gage was installed at the Village of Waltersburg, about 6 miles downstream from the City of Uniontown. The station has a tributary drainage area of 73.7 square miles. Readirgs are made twice daily.

Records of stream flows from 1942 to 1968 (as presented in U.S. Geological Survey reports) are presented in Exhibit I

Data presented in Exhibit I is summarized in Table I.

Table 1

Summary of Stream Flows

Redstone Creek

Taken at Waltersburg

	Cubic Feet Per Second	Million Gallons per Day
Yearly Mean	96	62
Minimum	4.2	2.71 (1962)
Maximum	44OO	2842 (Oct. 15, 1954)

The Pennsylvania Department of Environmental Resources maintains a Water Quality Network Station along Redstone Creek,. also located at Waltersburg. Results of analysis of samples taken several times a year are shown on Exhibit II.

Analysis pertinent to the subject of this study are summarized in TABLE 2.

Table 2

Water Quality

Redstone Creek at Waltersburg

Characteristics	ppm	Average Concentrations (1) lbs/day
pH	3.0 to 7.7 (2)	-
Total Iron	54.6	28,200
Acidity to pH 4	7.8	4,030
Acidity to pH	66.2	54,200
Manganese	4.3	2,220
Aluminum	0.5	258
Total Solids	1540	795,000
Coliform Organisms	130 to 24,000,000+ (3)	-
B.O.D.	5.6	2,900

(1) Based on 62 mgd

(2) pH Units

(3) MPN/100 ml

In August and September 1969 a reconnaissance of the main stem of Redstone Creek was made to locate sources of pollution to the stream. The reconnaissance, made in an amphibious vehicle, began near the heart of Uniontown and extended downstream about 20 miles to the streams mouth near Brownsville. Field pH's, points of mine drainage pollution, raw sewage and treated sewage discharges found during the reconnaissance are shown on Plate I.

The field reconnaissance revealed that Redstone Creek and several of its tributaries are heavily polluted with both raw and improperly treated sewage, mine drainage, and some industrial wastes such as oils and heavy concentrations of solids. Stream pollution by raw sewage is from the Townships of North and South Union and virtually all the small mining towns that line the banks of Redstone Creek. Improperly treated sewage is discharged to the stream from the Uniontown sewage treatment plant.. It should be noted however, that South Union Township presently has a comprehensive sewer system under construction with sewage treatment to be provided at the Uniontown City Sewage Treatment Plant, which plant is currently being expanded and upgraded to provide secondary treatment.

There are four main discharges of mine drainage to Redstone Creek. These are located as follows:

(1) Immediately north of the Village of Phillips. (hereinafter called Phillips Discharge)

(2) Directly across the creek from the Phillips Discharge.

(3) Along Rankin Run approximately one mile upstream from its confluence with Redstone Creek.

(4) At Braznell, near the mouth of Redstone Creek.

Based on an examination of mine maps we feel Discharges (1), (2) and (3) are from interconnecting mines. It should therefore be possible to consolidate all three of these discharges at the lower discharge (Phillips Discharge) by pumping. This fact was borne out when a ditch 3 feet x 5 feet x 5 feet deep was dug at the Phillips Discharge.. Ditching in this area completely eliminated discharge No. .2..

The mine drainage discharge at Braznell did have a low pH. and appeared to contain a relatively high iron concentration. Based on a very rough estimate, there appeared to be about 1000 gpm of mine drainage discharging to Redstone Creek at the point. Due to the relative location of the Phillips Discharge and the Braznell Discharge-a distance of 18 miles apart-no effort was made, as part of this study to consolidate or study both the discharges. The Phillips Discharge, being the largest and closest to the source of raw sewage, was chosen as the mine discharge to be studied for this report. Perhaps the discharge at Braznell can be the subject of a future study.

It appears that when the above mentioned sewerage construction programs are completed, and when North Union Township sewage and the mine drainage at Phillips and Braznell are either abated or treated, the pollution of Redstone Creek will be virtually eliminated.

Mine Drainage Flows and Quality

The discharge of mine drainage from the Phillips Discharge to Redstone Creek was measured and sampled over a 10-month period, beginning in December, 1969 and extending to September, 1970. In order to consolidate the mine drainage, which was discharging to the surface at several locations, a ditch 3 x 5 x 5 feet deep, having a total length of approximately 75 feet, was dug from Redstone Creek to the point where the greatest concentration of mine drainage was discharging. Following the construction of the ditch, a rectangular weir, having a crest width of 5 feet, was constructed and placed in the ditch. Measurements of the head of flow over the weir and samples were then taken. Photographs of the Phillips Discharge and the weir installation are shown in Exhibit III.

The results of the flow measurements are shown in Exhibit IV and are summarized in Table 31I The flow was calculated using the Francis Formula, which is: $Q = 3.33\ H^{3/2}\ (L-0..2H)$ where Q = Discharge in cubic feet per second; L = Length of weir crest in feet; and H = Head on weir in feet.

TABLE 3

Summary of Mine Drainage Flows

Phillips Discharge

	Flow		
	Cubic Feet Per Second	Gallons Per Minute	Million Gallons Per Day
Average	8.44	3880	5.45
Minimum	6.96	3120	4.50
Maximum	9.66	4350	6.25

Periodic surges in the flow occurred. These surges are attributed to sudden pressure releases in the mine due to apparent fractures or wall collapses. During these surges the flow to approximately 8 to 10 mgd.

Typical chemical and bacteriological analyses of the drainage are shown in Exhibit V. Table 4 is a summary of these results.

TABLE 4

Chemical and Bacteriological Characteristics of Mine Drainage

Phillips Discharge

Characteristics	Average Concentration ppm	#/day[1]
ph[2]	4.4 to 6.05	-
Total Iron	327	14,850
Acidity (to pH 8.3)	293	13,300
Manganese	9.22	418
Aluminum	0.44	20
Coliform Organisms	Less than 2.2[3]	-

(1) Based on 5.45 mgd

(2) pH Units

(3) MPN/100 ml

Table 4 shows the results of analyses of grab samples. Al^t^hough there are several raw sewage discharges into the mine it A interesting to note that the E Coli concentration is zero.

Sanitary Sewage Flows

The sanitary sewage flow from a portion of the Township of North Union could, from an engineering standpoint, be conveyed by gravity to the site of Phillips Discharge for treatment. The Phillips Discharge is located in North Union Township near the northern section of the township at the farthest point downstream in Redstone Creek. North Union Township is a second class township which had a total population of 13,561 in 1970. There are five main drainage areas in the township. They are designated as Redstone Creek, Cove Run, Bennington Spring Run, Rankin Run and Gist Run. Gist Run flows to the north to the Youghiogheny River and the other four drainage areas flow northwesterly to the Monongahela River.

Bennington Spring Run, Rankin Run and Cove Run are all tributaries of Redstone Creek. Sewage flow from the Bennington Spring Run drainage area and the Cove Run drainage area will be treated at the Uniontown Waste Water Treatment Plant, which discharges its treated effluent to Redstone Creek. The sewage flow originating in the area along Redstone Creek downstream from the Uniontown Waste Water Treatment Plant and the sewage flow from the Rankin Run Drainage Area could be conveyed to the area of the Phillips Discharge for treatment, along with the mine drainage. The alternative for the treatment of North Union Township sewage would be to construct separate waste water treatment plants-one along Rankin Run and one along Redstone Creek. It is estimated that the ultimate sewage flow that could be obtained from North Union

Township and conveyed to a joint mine drainage sewage treatment plant would be 1 million gallons per day.

Since most of the area of North Union Township to be sewered in a joint treatment plant would be mostly residential in nature, normal concentrations of B.O.D. and suspended solids - 205 ppm and 240 ppm respectively - should be used for design purposes.

Treatment Requirements

The Pennsylvania Department of Environmental Resources in accordance with its powers under the Clean Streams Law conducted a hearing in Uniontown in August 1, 1972 during which hearing water quality standards for Redstone Creek and its tributaries were presented. The standards recommended for discharges to Redstone Creek consist of the following:

1. The total biochemical oxygen demand shall not exceed 20 mg/l
2. Ammonia nitrogen shall not exceed 1.5 mg/l as N
3. Total suspended solids shall not exceed 25 mg/l
4. Dissolved oxygen shall equal or exceed 5.0 mg/l

It is to be noted that these standards make no reference to mine drainage constituents such as iron, acidity, manganese, dissolved solids, hardness, etc. Based upon discussions with engineers of the Bureau of Sanitary Engineering, Pennsylvania Department of Environmental Resources standards pertaining to mine drainage discharges limit the total iron content in the treated discharge to 7 ppm and the pH to 6 to 9. If limitations are placed on the other constituents at a later date, the design basis of the facilities proposed herein will have to be re-evaluated to ascertain that any new standards can be met.

The standards reported above have been used as a basis for developing engineering solutions to the mine drainage and sanitary sewage investigated, studied, and reported herein.

North Union Township was ordered by the Pennsylvania Sanitary Water Board in December, 1966 to discontinue its sewage discharges to Bennington Spring Run, Cove Run, and Redstone Creek within two years. In 1967, a sewage feasibility report was prepared for the township and in 1969 preliminary plans of sewerage facilities were completed. Since that time, the township has been ordered by the Pennsylvania Department of Environmental Resources to have final plans completed by March 1, 1973, and, at the same time, enter into negotiations with the City of Uniontown providing for joint treatment facilities. The steps which North Union Township ultimately takes to comply with the recent orders depends, to a great extent, on the feasibility of the township joining in the project which is the subject of this report.

Preliminary Basis of Design

Utilizing data obtained in the laboratory and design requirements established by the Pennsylvania Department of Environmental Resources, a preliminary basis of design has been formulated for both the mine drainage and sanitary sewage treatment and solids disposal facilities. These basis of designs are presented in Table 5.

TABLE 5

Preliminary Basis of Design

Mine Drainage

Flows	mgd		gpm
Minimum	4.5		3120
Average	5.5		3800
Peak	10.0		6950
Iron - Lbs/day			
Ferrous			9650
Ferric			5350
		Total	15000
Acidity - Lbs/day			13500
Lime Requirements - Lbs/day			14000
Oxygen Requirements - Lbs/day			360

Sludge Resulting from Treatment

Dry Solids	
Percent	1.2
Lbs/day	30,000
Volume - millions gallons per day	0.35

Sanitary Sewage

Population

1970		6,000
1985		10,000
2010		15,000
Flow	**mgd**	**gpm**
Average	1.0	695
Minimum	0.4	275
Peak	2.5	1750
Biochemical Oxygen Demand		
Parts per million		205
Pounds per capita		0.17
Lbs per day		1700
Suspended Solids		
PPM		240
Pounds per capita		6.2
Total pounds per day		2000
Sludge Resulting from Treatment		
Per Cent (%)		0.9
Dry Solids - Lbs/day		2100
Volume - mgd		0.028

The design basis presented above, has been used to design treatment facilities proposed herein.

Treatability Studies

Laboratory investigations and studies were conducted both separately and together on samples of mine drainage and sewage in the summer of 1970. Samples of mine drainage were taken daily and delivered to the McKeesport Sewage Treatment Plant, where the samples were analyzed along with samples taken of the raw sewage influent to the plant. All samples were analyzed and treatability studies were performed in the McKeesport Sewage Treatment Plant laboratory. The results of the analyses performed on McKeesport sewage are shown in Exhibit IV, and,. as previously discussed, the mine drainage analyses are shown in Exhibit V.

Since the actual ratio of raw sewage to the mine drainage is estimated to be about 1 to 6 (1 mgd North Union Sewage to 5.5 mgd mine drainage sewage), tests were performed on 1000 ml samples using 850 ml of mine drainage to 150 ml of McKeesport raw sewage.

Varying concentrations of lime, anionic polyelectric and chlorine were added to six 1000 ml beakers. These beakers were then mixed by a gang stirrer which mixed all six solutions evenly. Each solution was mixed at 80-100 revolutions per minute, at 50 revolutions per minute for 5 minutes and at 20 revolutions per minute for 10 minutes. Following mixing, the contents of the beaker was permitted to settle for predetermined periods of time to assimilate conditions that would be experienced in a waste water treatment plant. After settling, 100 ml of supernatant was pipetted off each beaker into which one drop of ferrocyanate was added. This procedure was used as a qualitative means of determining the ferrous iron concentration in the beakers. The color which developed was compared to untreated mine drainage which developed a very dark blue-green color when a drop of ferrocyanate was added to it. A completely negative test (no ferrous iron present) was indicated when the supernatant into which the ferrocyanate was added turned yellow.

The treated beakers were also inspected for turbidity, volume, texture and color of sludge, and floating particles and scum. Conclusions were then drawn using these parameters.

The results of the treatability studies are presented in Exhibit VII (Tests 1 through 23). We theorized that which the chloride, iodide, nitrate, sulfate and the oxides of ferrous iron (Fe^{++}) are very soluble in water, and the carbonates, hydroxides, oxalates, phosphates and sulfides of the ferrous iron are only slightly soluble, ferric iron (Fe+3) compounded with these ions are very insoluble in water. We therefore tested, as the first step in our treatability studies, the oxidation of the ferrous iron to ferric iron. Considering the economics and results of tests using various oxidizing agents, we concluded that oxidation with air would produce the best overall results.

In view of the above, the addition of sewage to the mine drainage with the iron in the ferric state should result in the reduction of sulfide chlorides and phosphates present in the sewage. The sewage also served to raise, to a small degree, the pH of the mine drainage. This adjustment proved insignificant, mainly because the pH of the mine drainage during the sampling period was 6.5 to 6.8, and the dilution factor is 6 to 1, mine drainage to sewage, respectively.

It was interesting to Note however, that the pH of the mine drainage sample decreased and the ferric iron increased as the time the sample was exposed to the atmosphere increased. This is believed to be caused by the sample absorbing CO_2 and oxygen from the air forming carbonic acid and causing the ferrous iron to be oxidized.

It was found that lime in concentration of 2-00 to 300 ppm followed by a 2 hour aeration and 2 hour settling period produced the best results. At these lime concentrations a scum developed which when aerated and chlorinated disappeared. The scum is thought to be residual ferrous iron.

Anionic polymers added in concentration varying from 0.3 to 0.5 ppm did produce the best results but the results were riot that significant to warrant their use.

Oxygen added by air appeared to be the most effective oxidizing agent for the mine drainage. According to studies performed by others in order to increase the oxidation of ferrous iron in concentrations greater than 150 ppm the water must be kept saturated with oxygen. Furthermore it has been shown that 0.14 ppm of oxygen is required to completely oxidize 1 ppm of ferrous iron. These conditions are met using conventional aeration practices available today.

An aeration time of 2 - 3 hours was found to be optimum in oxidizing the iron to the ferric state. Aeration periods lasting longer than 3 hours tends to break up the ferric precipitates which are formed during the first 2 to 3 hours of aeration. Although the mine drainage and sewage are both amenable to treatment by aeration the detention periods required to satisfy the B.O.D. of the sewage are several times those periods required for ferrous oxidation.

The mine drainage to sewage ratio would require a larger aeration basin to satisfy the B.O.D. thus resulting in increased costs for "tankage" which is not needed. These two points indicate that more suitable results would be obtained if the two waste streams were aerated separately. It was found however that the dilution afforded the sewage by the mine drainage did reduce the B.O.D. to where aeration periods required to satisfy ferrous iron oxidation coupled with chemical treatment and sedimentation should provide the degree of treatment required for discharge to Redstone Creek.

Conventional settling times of 2 to 3 hours were found to produce satisfactory results. Surface settling rates could not be examined in the laboratory but it is recommended that the rate at peak design flow should not be greater than 1000 gallons per square foot per day.

PROPOSED FACILITIES

The following treatment processes are necessary to treat the mine drainage and sewage:

Suspended BOD Removal

Dissolved BOD Removal

Lime and/or Limestone

Neutralization pH Adjustments

Ferrous Iron Oxidization

Ferric Iron and Settable Solids Removal

Dissolved Solids Removal

Suspended Solids Removal

Sludge Pumping Thickening and Disposal

Final Effluent Chlorination

Various flow sheets were developed. These consisted of treating, the flows as a single waste stream to completely separate waste streams. Combinations of processes were also developed. Plate II shows the most acceptable process developed.

Although considerable research is currently being conducted in the treatment of mine drainage using different. techniques; ie, reverse osmosis, ion exchange, electrochemical oxidation etc., neutralization with lime and a combination of lime and limestone in combination with ferrous oxidation with air has been proven by actual field application and laboratory studies to still be the most practical treatment method. We have therefore used aeration and the lime and/or limestone neutralization method in our flow sheet. Table 6 is the preliminary design basis for the units that
comprise the process. The proposed sewers described in the design

basis are required to convey the sewage from North Union Township to the site of the mine drainage for treatment, and the raw sewage pumps are required to lift the raw sewage to the treatment units.

TABLE 6

Combined Sewage and Mine Drainage

Treatment Plant

Preliminary Design Basis

Proposed Sewers	
Rankin Run Interceptor	
Design Population	1,500
Design Flow - Gal/Day	375,000
Size of Sewer - Inches	8
Length of Sewer - Feet	8,000
Capacity of Sewer @ Min. Slope - Gal/Day	450,000
Redstone Creek Interceptor	
Design Population	8,500
Design Flow - mgd	2.12
Size of Sewer - Inches	18
Length of Sewer - Feet	4,000
Capacity of Sewer @ Min. Slope - mgd	2.3
Proposed Raw Sewage Pumps	
Design Population	10,000
Design Flow - mgd	2.5
- gpm	1,750
Number of Pumps	3
Capacity of Each - gpm	900
Total Dynamic Head - Feet	35

Aeration Tank - (Sewage Only)

Design Flow - mgd	1
gpm	695
Number	2
Size - Each	34 x 34 x 15 SWD
Capacity - Gallons	258,000
Detention Time - Hours	6.2
Air Requirement - Ft.^{3}/lb. BOD	1,500
Aerator Capacity - cfm	2,080

Settling Tank (Sewage Only)

Design Flow - mgd	1
- gpm	695
Number	1
Size - Each - Ft.	40 dia x 7 SWD
Overflow Rate - gpd/ft.^{2}	795
Detention Time - hrs. - Total	1.57
Return Sludge - gpm	695

Flash Mixer and Lime Reactor - Mine Drainage (MD) and Sewage (Sew)

Design Flow - mgd	6.5
- gpm	4,500
Number	2
Size - Feet - Each	17.5 x 17.5 x 10 SWD
Capacity - gallons - (Total)	45,500
Detention Time - Minutes	10.2

Oxidation Tank (MD and Sew)

Design Flow - mgd	6.5
- gpm	4,500
Number	2
Size - Feet (each)	50 x 50 x 15 SWD
Detention Time - Hrs.	2
Air Requirement - SCFM	3,000

Settling Tank (MD and Sew)

Design Flow - mgd	
Mine Drainage	5.5
Sewage	1.0
Return Sludge	2.5
Total	9.0
Design Flow - gpm	6,250
Number	2
Size - Feet (each)	90 Dia. x 10 SWD
Detention Time - Hours	
@ 9.0 mgd	2.51
@ 6.5 mgd	3.45
Overflow Rate - gpd/ft.^{2}	
@ 9.0 mgd	710
@ 6.5 mgd	585
Return Sludge - gpm	6,250

Sludge Drying Lagoon

Dry Solids - lbs/day		
Lime - 40% Recovery		6,600
Sewage Solids		1,800
Ferric Sludge		13,500
	Total	21,900
Moisture Content - %		90
Number		2
Size - each - feet		100 x 100 x 5 SWD
Sludge Holding Capacity - 2' depth-days		180

Chlorine Contact Tank

Design Flow - mgd	12.5
Number	2
Size - Feet - each	30 x 30 x 10
Detention Time - Minutes	15

Control and Chemical Feed Building

Building to house chemical feed equipment, sludge pumps, chemical storage, chlorination, laboratory, raw sewage pumps, blowers.

It is estimated that approximately 3 to 5 acres will be required to construct the proposed facilities presented in Table 6.

Cost Estimates

Preliminary construction and operating cost of the facilities proposed herein are estimated to be $2,850;000 and S205,000 respectively. A detailed breakdown of these costs are presented in Exhibits IX and X. If a project is undertaken to treat only the mine drainage the construction costs are estimated to be 52,000,000.

Financing

Financing the proposed facilities with the Pennsylvania Department of Environmental Resources and/or other Federal or State agency assuming the total initial construction costs and the Township of North Union assuming the annual operating cost does not appear to be favorable so far as the township is concerned, especially in view of the fact that a sewage treatment plant to serve the township alone would probably be eligible for a combined State-Federal construction grant amounting to about 70% of the construction costs.

Annual costs to the township to construct and operate separate sewage treatment facilities are estimated to be approximately 3125,000 (includes debt service and coverage in the initial construction investment).

We have therefore concluded that it is not economically feasible for the Township of North Union to participate in a joint treatment plant under the conditions stipulated above. However, in view of the emphasis being placed on regional systems every effort should be pursued to arrange financing so a combined treatment project could be undertaken.

Summary of Conclusions

The following conclusions are made as a result of the investigations and studies reported herein.

1. Pollution of Redstone Creek is the result of mine drainage and untreated and improperly treated sewage. The stream has no known uses. By treating both the mine drainage discharging to the creek at Phillips and the sewage from North Union Township discharging to the creek and following the completion of sewerage projects currently under construction, the major pollutional sources of Redstone Creek will be eliminated.

2. Average concentrations of total iron and acidity in the mine drainage are 327 ppm and 293 ppm respectively. Flow measurements revealed an average discharge of 5.x-5 million gallons per day. Redstone Creek at Waltersburg about 3.5 miles downstream from Phillips has a flow of 62 mgd and average total iron and acidity concentrations of 54.6 ppm and 73 ppm respectively.

3. Raw sewage flows that could be treated at the Phillips site originate in the portion of North Union Township downstream from the Uniontown sewage treatment plant. An ultimate average sewage flow of I millibn gallons per day is estimated.

4. It is possible to treat the mine drainage at Phillips and the sewage from a portion of North Union Township in a combined waste water treatment plant which plant can be constructed in the vicinity of the Phillips discharge.

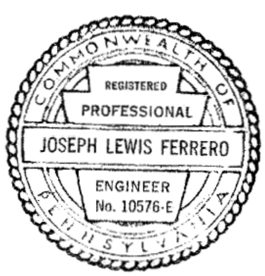
5. Although the combined waste streams of the sewage and mine drainage would be amenable to treatment by the processes proposed, financial feasibility precludes this from being done at the sewage to mine drainage volumes (I to 6 respectively) we are dealing with in this study. Combining the waste streams prior to treatment would probably be feasible when the sewage volume is at least double the mine drainage volume.

6. Proposed treatment facilities should be designed for an average of 1 mgd Sewage and 5.5 mgd Mine Drainage.

7. A treatment plant employing separate chemical neutralization for the mine drainage and separate biological treatment for the sewage followed by combined settling and sludge handling facilities is proposed.

8. Construction costs of a sewage - mine drainage treatment plant are estimated to be $2,850,000 and operating costs are estimated to be $205,000 per year.

9. Financing the proposed treatment facilities with the Federal and/or State agencies assuming the initial construction costs and the township assuming the annual operating cost is not feasible for the township. Alternate means of financing should be pursued.



Respectfully submitted,
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