CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT FOR AN IOWA COAL MINE [1]

by
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Abstract. Surface Mining Control and Reclamation Act 1977 requires the regulatory authority to assess the probable cumulative impacts of the proposed operation and all anticipated coal mining on the hydrologic balance in the cumulative impact area and to determine if the proposed operation has been designed to prevent material damage to the hydrologic balance outside the permit area.

The coal mining activity in Iowa is in rural areas. The isolated farm houses are sparsely located in the middle of large farms. The main source of water supply is deep aquifer for domestic use and farm ponds for livestock watering. The surficial aquifer and surface water are inter-connected; the groundwater recharges ephemeral streams and farm ponds in dry periods. In the Des Moines River Basin, the Cedar Creek Sub-basin contains the American Coals Corporation surface mines #8, #7 and #5 in the Walnut Creek Sub-sub-basin. The pre-mining water monitoring indicated low pH and excess aluminium, iron and manganese, down stream from previously mined spoil piles in the permit areas.

It was shown in the permit application by HEC1 computer model that the sedimentation ponds reduced the peak flows. The discharge quantity in the receiving stream was estimated by the regression formulas. It was determined by mass balance analysis that the acidic nature of small quantity of water from the permit area was diluted by the large quantity of the ambient water in Walnut Creek, and the net water quality stayed within the allowable standards.

Key words: Iowa, material damage, livestock watering, spoil piles, aluminium, iron, manganese, sulfate, pH, mass balance.

Introduction

The regulatory authority has an obligation to develop the cumulative hydrologic assessment (CHIA) for each coal mining permit per 30 CFR 773.15(c)(5) of the Surface Mining Control and Reclamation Act 1977. The cumulative impact area (CIA) for ACC #8 is the Walnut Creek Sub-sub-basin of the Cedar Creek Sub-basin in the Des Moines River Basin. The existing permits, ACC #7 and #5, in the CIA are considered for cumulative impacts.

In the current CHIA for ACC #8, the status and details of ACC #7 and #5 are also included. The land use, soil, geology, groundwater, surface water and overburden chemistry for the CIA are described and discussed with reference to their hydrologic impact. The material damage standards are delineated for the water use. Finally, the analyses were done to determine if the impact of mining would materially damage the quantity and quality of waters.

Coal Mining Activities

ACC #8

Status. The 250-acre permit was issued on August 7, 1992 for three non-contiguous areas: A-(east), B- (west) and C-series (southwest) pit areas. The coal extraction is in progress only in the A-series pit area.

Geographic Location. The permit area is contained in Sections 29, 30, 31 and 32 of Township 75 North and Range 18 West of the fifth Prime Meridian in the Clay Township in Marion County. The area is bounded by the county road T 17 in the east and the county gravel road G 62 in the north.

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Hydrologic Location. The Walnut Creek passes the permit area from southwest to northeast in the southern portion of the permit area; all coal mining activity is north of the creek. The Walnut Creek is a tributary to the Cedar Creek which empties in the Des Moines River down stream from the Lake Red Rock.

ACC #7

Status. The 401-acre permit was issued on February 23, 1989 for mining in three non-contiguous areas: A- (east), B- (west) and C-series (north) pit areas. The D-series pits in the southwest portion of the permit were approved as an amendment on March 19, 1991. The auger mining in the southwest 6.8 acres outside the original permit boundaries was approved on February 23, 1993 as an incidental boundary revision. The pits have been back filled, except for one pit each in A- and D-series pit areas. Most of the disturbed area has been seeded and reclaimed.

Geographic Location. The permit area is contained in Sections 19, 29 and 30 of Township 75 North and Range 18 West of the fifth Prime Meridian in the Clay Township in Marion County. The area is bounded by the county road T 17 in the east and a county gravel road in the north.

Hydrologic Location. The Willow Creek flowing southwest to northeast crosses the permit area in the southern portion. The Crooked Creek flowing southwest to northeast crosses the permit area in the northwest corner. The Willow Creek joins the Walnut Creek before the confluence of the Crooked Creek and Walnut Creek.

ACC #5

Status. The 121-acre permit was issued on May 9, 1988. The permit area was reduced to 104 acres by an amendment approved on September 9, 1988; the previously mined area in the northeast was eliminated. A 20-acre parcel of land was added east of the county road by an incidental boundary revision which was approved on July 16, 1990. A landfill permit was issued by the Iowa Department of Natural Resources (DNR) on April 12, 1988 for burying the fly ash in the coal mine pits. The landfill permit was revised on October 15, 1991 by DNR for vertical expansion, allowing the final elevations to go 40 feet higher than the approximate original contours (AOC). Subsequently, the permit revision for variation from AOC and changing the final land use as industrial was approved by the Division on August 18, 1992. The CHIA report does not consider the landfill aspect since it was reviewed by another state agency, DNR.

Geographic Location. The permit area is contained in Sections 16 and 21 of Township 75 North and Range 18 West of the fifth Prime Meridian in the Clay Township in Marion County. The area is bounded by the county road T 17 in the west, old state highway 92 in the north and a county gravel road in the east.

Hydrologic Location. The Crooked Creek flowing northwest to southeast passes south of the permit area to join the Walnut Creek before the USGS station 43 of the open-file report 82-1014 of May 1983 for Area 38.

Abandoned Mines

The three abandoned mine areas in the CIA are close to the permit areas: one up stream of the ACC #5, one extending down stream from the eastern portion of the ACC #7 which is now being used as the Marion County landfill site, and one residing within the ACC #8 where the mine pits are proposed in the areas undisturbed by the previous mining. None of the three areas have qualified for the inventory in the AML program even though these are close to the county roads which indicates that these are not counted as potentially hazardous areas for health or environment.

Mining Procedures

Operation Plan. The surface mining is conducted by area or strip mining method in sequential pits. The sedimentation ponds and diversions are constructed to control the drainage from the site. The topsoil is scraped from the pit area and hauled to the stockpile location. Then, subsoil is scraped and hauled to a different stockpile location. Next, the consolidated overburden is loosened by blasting if necessary, and removed by dragline or by dozer and truck and stored by the pit in the spoil pile. Lastly, the coal is removed by

blasting or by ripper and trucks and is hauled off the site. Care is taken to see that the fireclay layer underneath the coal seam remains intact to protect the deep aquifers.

Reclamation plan. The pits are then back filled by the consolidated overburden from the spoil piles and by subsoil from the stockpiles and the area is graded. Then, the area is topsoiled from the stockpiles and seeded. One criterion for phase I bond release is erosion control in the permit area. The water quality should be stabilized within the allowable limits for phase II release. After the vegetation is established, the sedimentation ponds may be removed.

Features of the CIA

Climate. The 77% of the total average annual rainfall of 32 inches occurring during the growing season is adequate for the crop growth (USDA report, 1983). The cropland or pasture in the sub-basin does not use irrigation. Because of the severe cold in the winter and 29 inches of annual average snowfall, only one crop is grown in Iowa.

Pre-mining land use. Cropland, pasture and trees along the creek which crosses the permit area in the southeast corners, and spoil piles and ponds from previous mining. One dwelling and other buildings within ACC #8 and also within ACC #5 will stay through mining. Some dwellings and other buildings across the county road north of ACC #7 will stay through mining.

Post-mining land use. Pasture for the disturbed areas and ponds. Undisturbed previously mined areas will not be reclaimed.

Soil. The wind deposited soil or loess in the area is among the most fertile soils in the world. The U.S. Department of Agriculture, Soil Conservation Service has mapped by county the top 60 inches depth of the soil with its properties in the entire state. Protected by vegetative cover, the soil in the area retains water as surficial aquifer. Unprotected soil is prone to be washed away in the ditches in rolling fields. That is the reason why the topsoil is required to be saved properly for redistribution before any disturbance.

Geology. The fireclay, generally encountered below coal seam, is relatively impervious layer which segregates the deep Mississippian aquifer from the surficial aquifers. The overburden above coal seam can be classified in two categories: consolidated overburden which is generally in the form of tight shale and it forms a bedrock for the lower profile of the surficial aquifers, and unconsolidated overburden which generally consists of subsoil and topsoil, it supports the vegetation and holds surficial aquifers.

Overburden Chemistry. Other than spoil piles of previous mining, the overburden comprises of topsoil or clay loam, silty and sandy clay, and shale with paste pH varying from 5.8 to 7.8 at ACC #8, 6.3 to 7.7 at ACC #7 and 6.6 to 7.8 at ACC #5. Other parameters for the overburden and coal characteristics tested were total sulfur, pyritic sulfur, potential acidity and acid-base account. Since the overburden is not acidic, the mining operations shall not contribute to the acidity of the runoff.

Groundwater. No evidence or information is available which suggests that the sub-basin is connected by groundwater to the adjoining sub-basins. Therefore, the sub-sub-basin boundary is the CIA for groundwater.

The main source of domestic water supply is the Mississippian aquifer which is below the lowest coal seam to be mined, and therefore, it shall not be affected by coal mining if the fireclay under the lowest coal seam is protected. The alluvial aquifers are shallow and these are used for livestock watering either by direct pumping or through base flow in the ephemeral streams which recharge the farm ponds.

At ACC #8, the extreme values for pH, total dissolved solids, iron and manganese were 6.3-8.4, 1560, 2.3 and 8.0 respectively in pre-mining monitoring. At ACC #7 and #5, the pre-mining data were not used since at the time of permit issuance for ACC #8, the ACC #7 and #5 were in partial reclamation phase, and the water quality during mining had been within the allowable limits.

Surface Water

Surface Elevations. The relief for the Walnut Creek Sub-Sub-Basin is 250 feet from 940 feet in the west to 690 feet in the east where it meets the Cedar Creek. The general slope is from southwest to northeast except near the down stream end where the terrain droops from northwest to southeast.

The relief for ACC #8 is 125 feet from 875 feet in northwest to 750 feet in the east where the Walnut Creek leaves the permit, it enters the permit at 760 feet elevation in the southwest. The general slope within the permit area is from north to south and west to east.

The relief for ACC #7 is 100 feet from 870 feet in south and west to 770 feet in the east where the Willow Creek leaves the permit, it enters the permit at 805 feet elevation in the southwest. The general slope within the permit area can be described in three parts: from north to south in the north of the Willow Creek for A- and B- series pit areas, and from south to north in the south of the Willow Creek for D-series pit area and also in the C-series pit area which drains to the Crooked Creek.

The relief for ACC #5 is 100 feet from 850 feet in north to 750 feet in the south on the west side of the county road, and 60 feet from 825 feet in the north to 765 feet in the south on the east side for incidental boundary revision area. The general slope within the permit area can be described in three parts: from north to south in the south, and from northeast to southwest in the north and also in the incidental boundary revision area.

Regional Waters: Between Mississippi and Missouri Rivers, the study area is in the Des Moines River Basin. The 14,473 square miles (sm) area of the Des Moines River Basin extends from the state of Minnesota (1,539 sm) to the state of Missouri (64 sm), crossing the state of Iowa (12,870 sm or 23% of the state) from north-west to south-east. After 475 stream miles, Des Moines river empties on the west bank of the Mississippi river at Keokuk, downstream of Lock and Dam #19.

The main stream in the CIA is the 14.8-mile long Walnut Creek with 29 sm or 18560 acres drainage area; it joins the Cedar Creek at 3.7 mile from its mouth. The Walnut Creek is an intermittent stream and its tributaries, the Willow Creek, the Crooked Creeks and other unnamed drainages, are intermittent or ephemeral. The 55.4-mile long Cedar Creek with 423 sm drainage area at the mouth is perennial, and this in turn empties in the 475-mile long Des Moines River at 127.3 mile from its mouth at Keokuk. The drainage area of Des Moines River at a USGS gauging station up stream of the confluence with the Cedar Creek is 12479 sm.

Stream Classification. The Walnut Creek is not classified in its entire length by DNR. The Cedar Creek in the pertinent reach is classified as significant resource, B(WW) - sport fisheries.

Cumulative Impact Area (CIA). The down stream point for the ACC #8 CIA may be taken as the gauging station #43 of the USGS open-file report 82-1014 of May 1983 for Area 38. The station #43 is approximately half a mile down stream of the confluence point of the Crooked and Walnut Creeks; the Willow and Walnut Creeks meet approximately 1100 feet up stream of the Crooked Creek. The station #43 is not a continuous monitoring station, but it has the measurement records for the 1980-81 in the USGS report; it may give some information about the water quality down stream of the abandoned coal mines. The drainage area of Walnut Creek at the USGS station #43 is 23.6 sm.

We do not need to go far up stream of the permit areas to delineate the CIA; it can be demonstrated by computer models that the regulated effluent quantity from the permit areas through sedimentation ponds would not cause the water to back up far enough. The CIA for the ACC #8 is marked in Figure 1, it includes ACC #7 and #5.

Surface Water Inventory. The permits ACC #8 and #7 have some ponds and depressions left by previous mining; these would be used for sedimentation and water control from the permit area and would be retained after mining. One farm pond each in the two permits in B-series pit area would be mined through, and it would be restored after mining. One pond in C-series pit area at ACC #7 would not be disturbed for mining. Two existing ponds would be used to

control sedimentation and water from ACC #5; one pond was constructed to control sedimentation and water in the incidental boundary revision area; all the three ponds would be retained after mining.

Surface Water Use. The numerous farm ponds, which are used throughout the year for livestock, are in the uplands from the three creeks. The water level and quality have remained functional over the years in the farm ponds during drought and flood.

Surface Water Supply Source. Main source of domestic water supply is the private deep wells 250 feet or more below the ground level, it is far below the lowest coal seam to be mined. There is no likelihood of the water supply source to be disrupted by coal mining, and therefore, the alternative supply source has not been discussed. There is no demand of water for irrigation.

Nature takes care of the water supply for the farm ponds in the form of the amount and distribution in the south-central Iowa of the annual average 35 inches of precipitation. The ponds are recharged either from the surface runoff resulting from the rainfall events and snow melts in the up lands, or from the groundwater during low flow or dry periods; the soil type helps retention and flow of groundwater. The ponds, which can be affected by the coal mines, must be down stream of the mines with their bottom elevation below the water table.

The farm ponds do not draw water from the Walnut, Willow or Crooked Creeks directly; some low lying ponds may be getting water from these creeks through groundwater, refer Figure 1. Comparing the elevations, three large ponds near the confluence of the Walnut, Willow and Crooked Creeks have the potential of being recharged from the surficial groundwater connected to the three mines, and therefore, the water quality is analyzed later in this CHIA report to determine if these ponds may be affected by active coal mining.

Pre-mining Surface Water Monitoring Sites. The stations have been marked in Figures 2, 3 and 4 for the permits ACC #8, #7 and #5 respectively. The ACC #8 had five pre-mining stations near the permit boundary: S4 and S5 up stream, and S1, S2 and S3 down stream, and one station on the Walnut Creek down stream from the permit. The ACC #7 had five pre-mining stations: S1 and S2 up stream on Willow Creek and its tributary, S3 in the middle and S4 down stream on Willow Creek, and S5 on Crooked Creek in the north. The ACC #5 had four pre-mining stations: S1 up stream, and S2 and S3 down stream all in the original permit area, and S1A down stream for the incidental boundary revision area.

Continuous Surface Water Monitoring Sites. The stations, which have a potential of being affected by the mining activities, shall continue to be monitored after the permit issuance until phase II bond release. One station S3, which is down stream from the mining activities in A-series pit area at ACC #8, has been monitored after the permit issuance. Two stations S1 and S2 have also been monitored, but until the mining activities start in B- and C-series pit areas, these would be counted for pre-mining monitoring. The monitoring at stations S4 and S5 has been discontinued, since these stations would not reflect any impact of the coal mining because of their hydrologic location being up stream of the mining activities.

Two stations have been monitored at ACC #7 after permit issuance: S4 and S5 which are respectively down stream of the ponds SP1 in the south and SP2 in the north. The monitoring at three stations S1, S2 and S3, where the water does not run off the permit, has been discontinued after the pre-mining monitoring.

Three stations have been monitored at ACC #5 after permit issuance: down stream from the ponds SP1, SP2 and SP1A. The monitoring at station S1 has been discontinued, since this station would not reflect any impact of the coal mining because of its hydrologic location being up stream of the mining activities.

Pre-mining Surface Water Quality. The water quality at the two monitoring stations S1 and S2 of ACC #8 suggested excessive iron, manganese, aluminium and sulfate as compared with the allowable limits, perhaps because the stations were getting the discharge from the exposed spoil piles of the previously

mined area. The station S3 was also draining the previously mined area, but a major portion of its drainage area was not disturbed by the coal mining. Therefore, the water quality at station S3 was not reflecting the impact of abandoned coal mine as pronouncedly as at stations S1 and S2. The stations S4 and S5 were up stream of the previously mined area, and there the water quality was within allowable limits.

The water quality at all the five monitoring stations of ACC #7 and at all the three stations of ACC #5 were within the allowable limits, except one sample in June 1984 at S2 of ACC #5 which was down stream of the exposed spoil piles in the previously mined area where the pH was 5.5, total iron 1.8 milligram per liter (mg/l) and total manganese 10.0 mg/l.

Continuous Surface Water Monitoring. The rules require that the permittee shall continue until phase II bond release monitoring of all surface water leaving the permit boundaries according to the NPDES permit requirements.

The water quality has been within the allowable limits at all the three mines except one aberration at SP1 of ACC #7 in January 1992: the pH was 8.5, but the total iron contents were 8.1 milligram per liter against the NPDES limit of 6.0. The plausible explanation for the improvement in water quality after starting the mining operations can be 'dilution is the solution to pollution': the pond SP1 which was getting the runoff primarily from the exposed spoil piles of the previous mining was discharging right away. After the mining operations were started, the runoff was diverted from other areas of the permit into the pond, the diverted runoff did not have any reason to be acidic, and a dam was constructed across the pond with a principal spillway and an emergency spillway, which allowed the mixing of the pre-mining acidic water of the pond with the diverted non-acidic water. The quarterly surface water monitoring reports for ACC #8 also indicate similar effect at the station S3 in A-series pit area where the mining operations have started. It is evident from the preceding discussion that the operation plans have been effective in controlling the quality of surface waters leaving the permit areas through sedimentation ponds.

Material Damage

Material Damage Criteria

The surface water quantity down stream of the permit area and CIA should not be reduced below the minimum demand quantity, nor should it be increased above the carrying capacity of the receiving stream to cause damage to the persons or property because of the coal mining activities in the CIA.

The surface water quality should not be affected by the coal mining activities to the extent that the regulated standards for the current or potential use of the surface water are violated. In the CIA, the current and potential use of the surface water is for livestock watering. The topography and the soil type in the CIA are such that the groundwater and surface water are inter-connected. There are few ponds which have the potential of being affected by the coal mining activities in the CIA.

The general characteristic of the surface water is regulated by the NPDES permit requirements, the parameters of concern are the settleable solids for the 10-year, 24-hour precipitation event, and pH, total iron (Fe), total manganese (Mn) and total suspended solids.

The parameters that shall be analyzed are aluminium (Al), Fe, Mn, sulfate and pH. The applicable Iowa standards for livestock and the NPDES standards are listed in Table 1.

Table 1
Water Quality Standards

Parameter	Unit	Allowable Limit
Iowa Standards for Livestock:		
Total Aluminium	mg/l	5
Total Sulfates	mg/l	1000
Total Dissolved Solids	mg/l	3000
NPDES Standards:		
Total Iron	mg/l	6
Total Manganese	mg/l	4
pH		6-9

Material Damage Determination

Surface Water Quantity. The surface water quantity shall be estimated in the form of peak discharges at a significant point in the CIA in pre-mining and post-mining scenarios. The difference in the two scenarios would be caused by the sedimentation ponds; the post-mining peak discharges would be less. The farm ponds in the watersheds would hold some runoff resulting in the reduction of the peak discharges, the effect on the estimated discharge will be ignored, the consistent application of the assumption should not significantly alter the resulting comparison.

The drainage area of Walnut Creek at the USGS station #43 is 23.6 sm. The watershed areas of the drainages passing through ACC #8, #7 and #5 are 0.84, 0.83 and 0.72 sm. The net drainage area remains 21.2 sm. Using the regression formula: $Q=CA^xS^y$, refer Lara 1973, the ratio of post-mining to pre-mining peak discharges at the USGS station #43 for 2-, 10- and 50-year frequency would be 0.93, 0.94 and 0.95. In the regression formula, the symbol 'Q' is the discharge in cubic feet per second (cfs) at a point, 'A' is the drainage area in sm at the given point, 'C' is a regression coefficient, and 'x' and 'y' are the regression exponents. The values of 'C', 'x' and 'y' vary with the frequency of the storm event. The results indicate that because of the mining, the peak discharge in Walnut Creek would decrease by less than 7 percent.

The 7-day, 10-year low-flows would be less than 0.1 cfs for drainage areas less than 100 sm, and the 7-day, 2-year low-flows would be zero for drainage areas less than 50 sm, refer Cagle 1978. The reference indicates that the coal mining will not affect any perceptible change in the low-flows for the 23.6 sm CIA.

However, the average discharge may be a better measure of impact. Using the regression formula for the region: $Qav=0.77Aexp(0.94)$, refer Cagle 1978, the average discharge will decrease by 9.6% if no discharge is assumed from the drainages passing through the three permits. In the real world, the discharge will not be shut off entirely through the permit areas, and the reduction in average discharge will be far less than 9.6 percent. Further, the farm ponds at lower end of the sub-sub-basin are recharged mainly by ephemeral drainages in the up lands and partly by groundwater which is recharged partly by Walnut Creek. Thus, the reduction in discharge in Walnut Creek because of coal mining will reduce the pond storage for livestock watering by only a negligibly small fraction.

Surface Water Quality. The mass balance analysis will be performed to compute the net quality of surface water for the 10-year, 24-hour design event at the USGS station #43 which is down stream of the coal mining activity. The discharge in Walnut Creek is estimated by the USGS regression formula $Q=CA^x$, refer Lara (1973), the symbols 'Q', 'A', 'C' and 'x' are explained earlier for peak flows. The cumulative area of the drainages, which are passing through the three coal mines and which are controlled by the sedimentation ponds, was measured as 2.4 sm. Therefore, the net drainage area contributing the ambient flow is reduced from 23.6 sm to 21.2 sm. The values of the quality parameters of the ambient flow will be taken same as the pre-mining values at the station S4 which is up stream of the previous mining for a flow which is closest to the design event.

For the discharge points from the permit areas, the discharges will be taken in cfs from the pond routing at ACC #8 available in the permit and from the measurements in gallons per minute (gpm) at ACC #7 and ACC #5 in quarterly monitoring reports. Those values of the quality parameters will be used which correspond to the flow closest to the design event.

It may be noted here that the inflow rates for the design event are several times higher than those for which the quality analysis is available: 47 cfs (21103 gpm) combined for ponds SP2, SP3 and I-1 versus 60 gpm at station 1, and 36 cfs (16164 gpm) for pond SP1 versus 300 gpm at station S3. There is no mining activity in the operation plans of ACC #8 in the watershed of station S2. It is also known and the pre-mining data also indicate that the metal concentrations are high for low discharges. Using the higher values of discharges, the corresponding metal concentrations is expected further lower but these were not adjusted in the

analysis. Thus, the error is introduced in the mass balance analysis result toward conservative side as compared to the scenario when the water quantity with the routed discharge could be sampled for metal concentration.

The following mass balance formula is used:

$$Vn = (Qa*Va+Q8*V8+Q7*V7+Q5*V5)/(Qa+Q8+Q7+Q5)$$

The symbol 'Q' is used for discharges in cfs, and 'V' for quality parameter Al, Fe, Mn or sulfate in milligram per liter (mg/l) or for pH. The subscript 'a' is used for ambient values, 'n' for net values, and '8', '7' and '5' for ACC #8, ACC #7 and ACC #5. The Al, Fe and Mn in quarterly monitoring report were 0.0, 0.1 and 1.4 at ACC #7 for 500 gpm, and 0.0, 0.1 and 1.9 at ACC #5 for 12 gpm. The discharges and metal content at ACC #7 and ACC #5 were so low that these records can be ignored in the analysis; the error will be toward conservative side. Instead the data for stations S1, S2 and S3 at ACC #8 will be used in the mass balance equation for ACC #8, ACC #7 and ACC #5 to be more precise and specific. The net discharge would be 848 cfs.

Aluminum:
Vn=(798*.04+17*27.5+30*1.2+3*.01)/848=.6

Iron:
Vn=(798*.1+17*8.0+30*1.24+3*.05)/848=.3

Manganese:
Vn=(798*.6+17*15.25+30*4.5+3*.05)/848=1

Sulfate:
Vn=(798*45+17*300+30*300+3*410)/848=60

pH:
Vn=(798*7.9+17*3.1+30*5.1+3*7.0)/848=7.7

The net values of Al, Fe, Mn, sulfate and pH are within the allowable limits of 5, 6, 4, and 3000 mg/l and 6-9. The data for total dissolved solids were not available. Thus, it is clear from the analysis that no material damage is done.

Conclusion and Recommendations

Conclusion. It has been shown in the analysis above that the proposed operations at ACC #8 and other mining activities will neither materially diminish the quantity nor materially affect the quality of the waters in the cumulative impact area. Therefore, the permit issuance for ACC #8 will allow the recovery of coal resources and will still protect the waters.

Recommendations. The cumulative hydrologic impact assessment should be verified by continually monitoring the surface water and groundwater at significant points during and after mining for those parameters which may have adverse impact.

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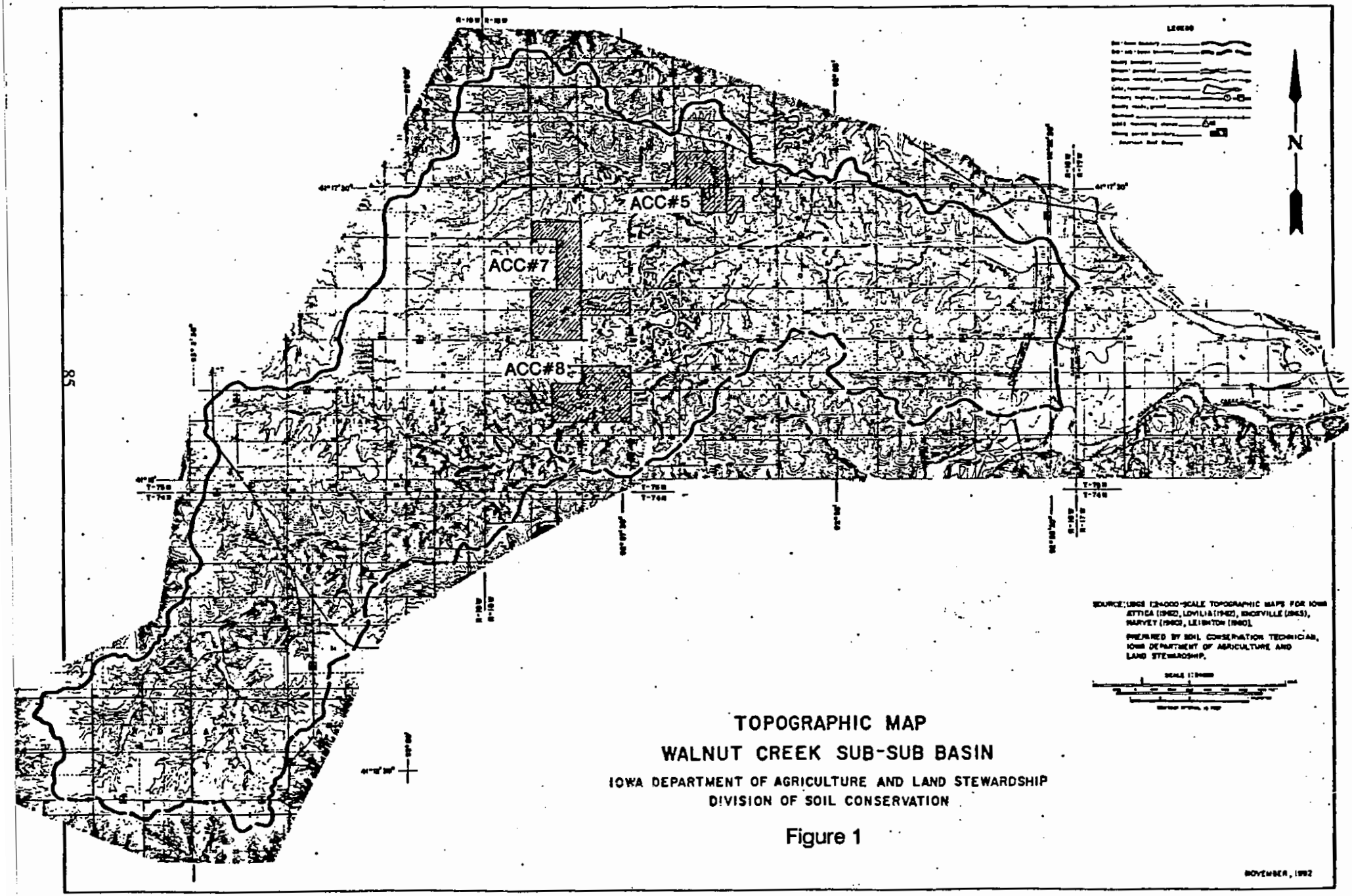

TOPOGRAPHIC MAP

WALNUT CREEK SUB-SUB BASIN

IOWA DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP
DIVISION OF SOIL CONSERVATION

Figure 1

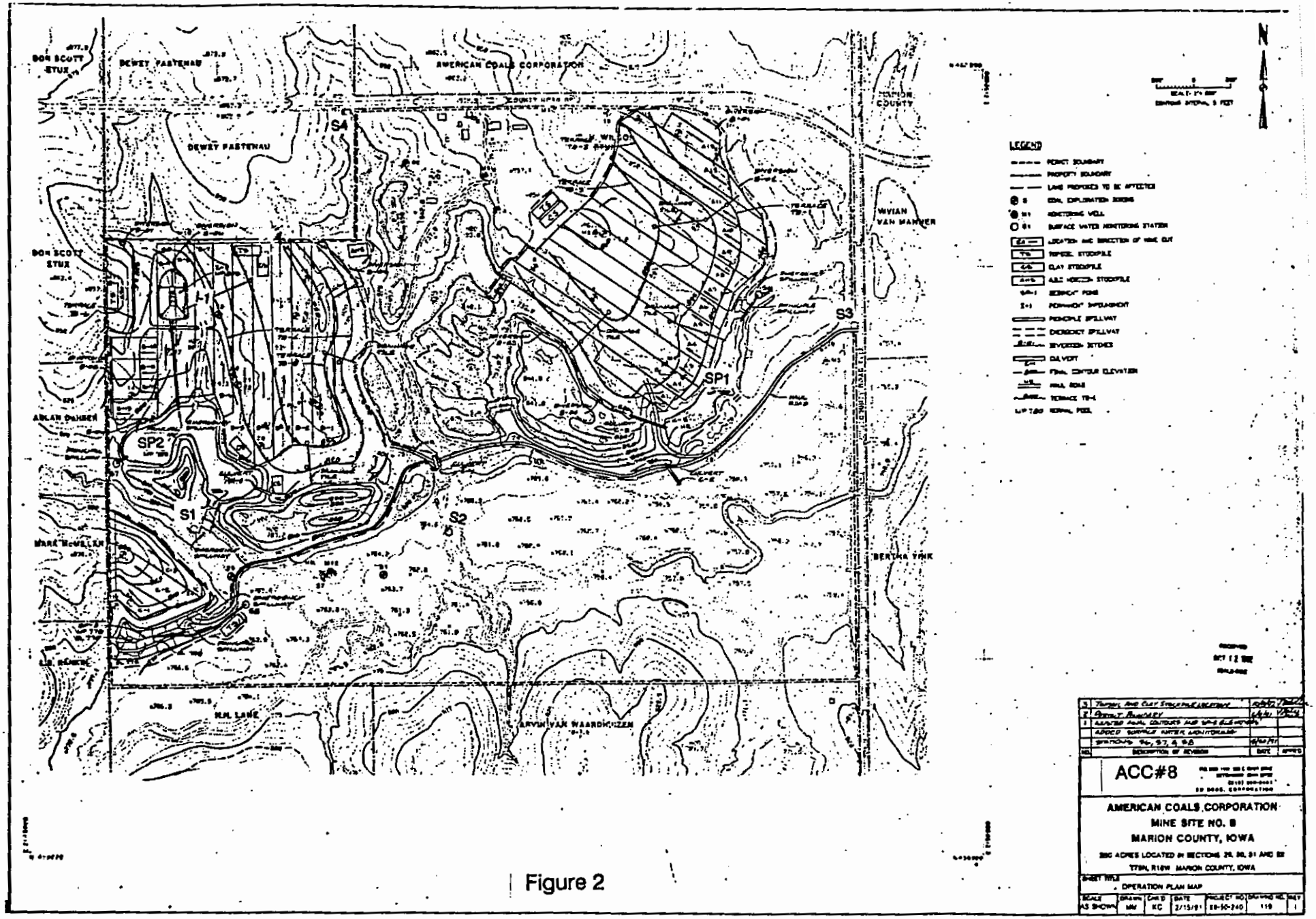
DON SCOTT ETUX
DEWEY PASTENAU
AMERICAN COALS CORPORATION
MARION COUNTY
VIVIAN VAN MANNER
S4
S3
SP1
SP2
S1
S2
I-1
ADLAN DAHSER
MARK MUELLER
BERTHA YINK
R.H. LANE
ARVIN VAN WAARDHUIZEN
LEGEND
PERMIT BOUNDARY
PROPERTY BOUNDARY
LAND PROPOSED TO BE AFFECTED
COAL EXPLORATION BORING
MONITORING WELL
SURFACE WATER MONITORING STATION
LOCATION AND DIRECTION OF MINE CUT
TOPSOIL STOCKPILE
CLAY STOCKPILE
SCRUBBER POND
PERMANENT IMPOUNDMENT
PRINCIPLE SPILLWAY
EMERGENCY SPILLWAY
DIVERSION DITCHES
CULVERT
FINAL CONTOUR ELEVATION
HAUL ROAD
TERRACE TIE-IN
NORMAL POOL
ACC#8
AMERICAN COALS CORPORATION
MINE SITE NO. 8
MARION COUNTY, IOWA
SHEET TITLE
OPERATION PLAN MAP

Figure 2

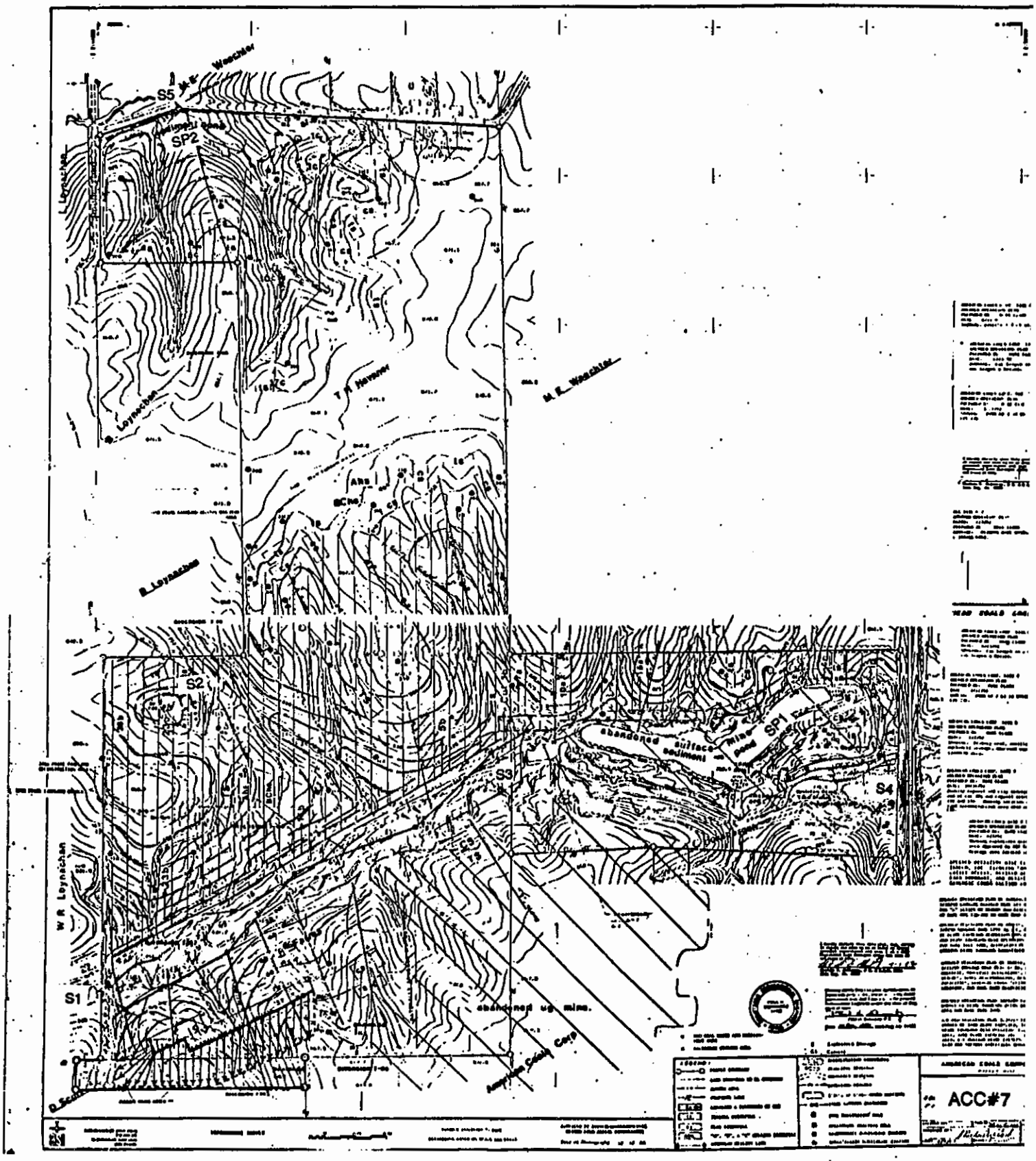
S5
SP2
S2
S3
S4
SP1
S1
abandoned surface mine pond
abandoned u/g mine.
ACC#7

Figure 3

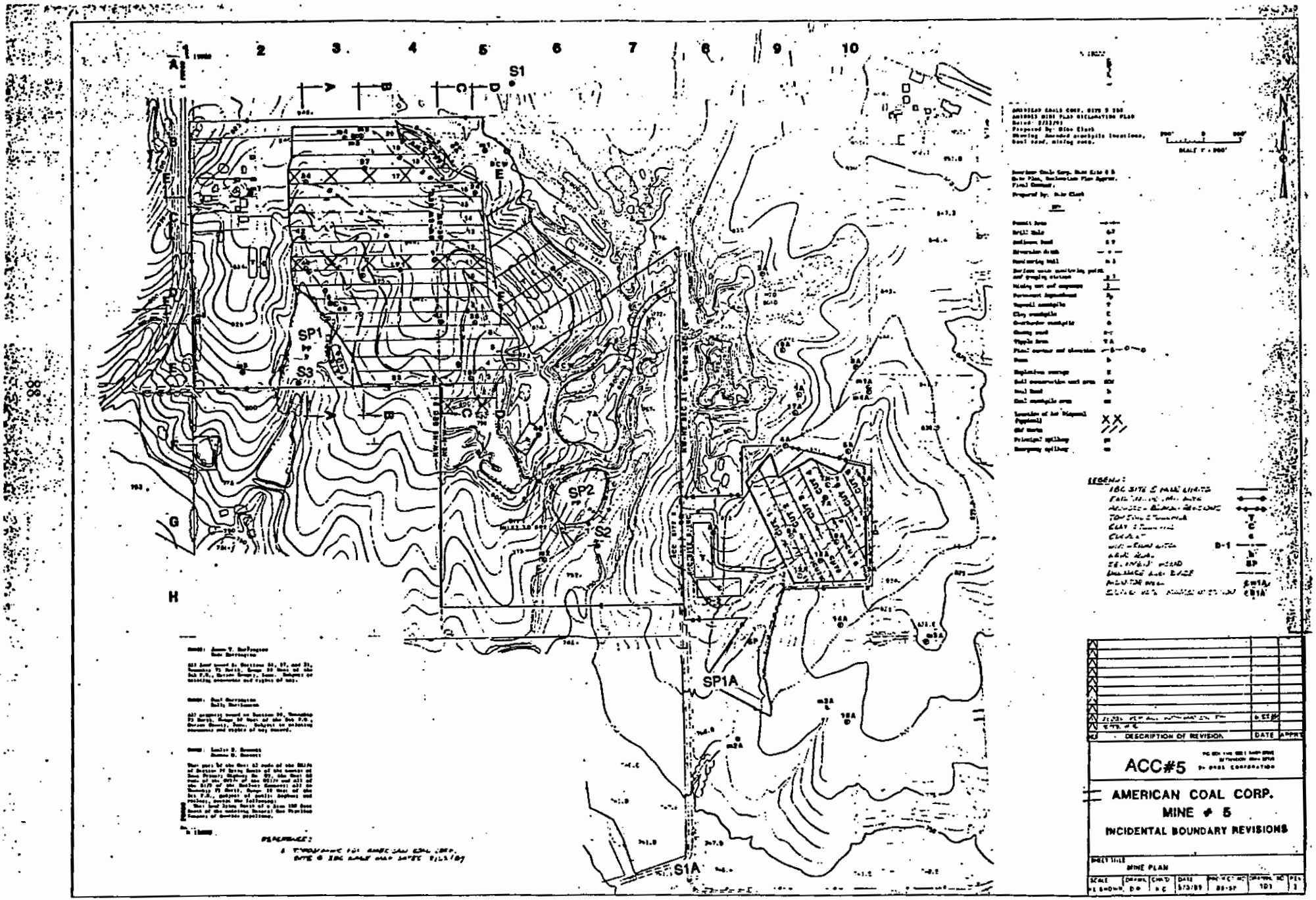
S1
SP1
S3
SP2
S2
SP1A
S1A
ACC#5
AMERICAN COAL CORP.
MINE # 5
INCIDENTAL BOUNDARY REVISIONS
MINE PLAN

Figure 4