

**SRC-II DEMONSTRATION PROJECT
PHASE ZERO
TASK NUMBER 7**

MASTER

DELIVERABLE NUMBER 14

**ENVIRONMENTAL ANALYSIS
STATUS REPORT**

JULY 31, 1979

**THE PITTSBURG & MIDWAY COAL MINING CO.
DENVER, COLORADO**

PREPARED FOR

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SECTION 1 INTRODUCTION

The Phase Zero portion of the Environmental Analysis consists of subtasks for seasonal and non-seasonal data collection and reporting, EIS (Environmental Impact Statement) liaison, and environmental suitability analysis and reporting. This is the Environmental Analysis Status Report (contract Deliverable Number 14) which presents data collected in the first two subtasks. EIS liaison activities are reported in the subtask entitled Environmental Suitability (contract Deliverable Number 18), Section 2.

Studies contained herein were undertaken to perform the baseline work necessary to evaluate the environmental impact of a proposed coal conversion facility using the Solvent Refined Coal (SRC-II) process. The site, located in the Cass District of Monongalia County, West Virginia, was selected for detailed study from among several sites considered during early planning.

Data presented encompass three sampling periods which represent about 70 percent of the baseline program. Site specific baseline studies and literature searches began in July 1978. To complete the planned twelve (12) month sampling program, final field sampling is scheduled for the summer of 1979.

Stearns-Roger scientific staff has performed baseline field work with the exception of subcontract work awarded for daily operation of the meteorology and air quality system (DeNardo and MacFarland), infiltration and geotechnical studies (D'Appolonia), socioeconomic studies (CONSAD), and the archaeology and historical survey (West Virginia Geological and Economic Survey). Various laboratory analyses performed on air, water, sediments, soils, and aquatic organisms were completed by DeNardo and McFarland, Calgon, NUS, Gulf Science and Technology, CDM/Accu-labs, University of Colorado, and West Virginia University using standard and approved laboratory methods.

The following sections include: Meteorology and Air Quality, summary of three quarters of data; Noise, findings from the winter survey; Surface Water, data from three seasons of sampling; Ground Water, data for three seasons; Aquatic Ecology, three seasons of sampling and one fish survey; Geology, field inspection of the site and literature data; Plant Ecology and Terrestrial Animal Ecology, data on three seasons of field samples; Soils, mapping data from the literature and one field foray; Socioeconomic Analysis, preliminary data from the subcontractor; and Archaeological and Historical Survey, status of work in progress.

SECTION 2

REVIEW OF CRITICAL DATA

Baseline studies completed have identified no environmental concerns which would prevent construction of the proposed SRC-II Demonstration Plant at this site. No critical habitats, and no rare or endangered species were encountered from among the organisms collected at the site, or identified from literature searches to have existed in the area in recent historical time.

The site is typical of the Central Appalachian Plateau where coal has been, and is an important economic resource. Present and past mining of deep mines and surface (strip) mines are in evidence at the site. Subsidence and surface infiltration into the ground aquifers, due to mining activities, can be managed by engineering solutions which are part of the conceptual design (see SITE SUITABILITY REPORT, Deliverable Number 16).

Certain air quality and water quality parameters measured at the site approach or exceed existing or proposed limits. Non-methane hydrocarbons grossly exceed the proposed "guidelines." However, this condition is not unusual for this section of the country. Specifically, at this site hydrocarbon emanations are most likely the combined result of natural vegetation and outgassing from the underground mines in the area. Ozone (O_3) approached the standard in September 1978 and is expected to exceed the standard during June and July 1979.

Mercury (Hg) levels and cadmium (Cd) levels approaching drinking water standards for public water supply were observed in wells serving single family residences. Although further analyses have been undertaken to check for analytical error, these elements are found in local coals. The results of the analytical check are not yet complete.

Several surface water quality parameters exceed existing or proposed state or federal criteria. Existing conditions in excess are summarized as follows: (For comparison of all parameters with regulations for ground water and surface water, see ENVIRONMENTAL SUITABILITY REPORT, Deliverable Number 18.)

Robinson Run/Craft's Run (Stations R-1 and K-1)

pH	Too acidic for State and EPA criteria* during all three sampling periods.
Arsenic	Exceeds State criterion in August and February (Robinson Run only)
Iron	Exceeds EPA criterion during all three sampling periods.
Lead	Exceeds State and EPA criteria in November (Robinson Run only).
Manganese	Exceeds EPA criterion during all three sampling periods.
Fluoride	Exceeds State criterion in February (Robinson Run only).
Phenols	Exceeds State criterion during November in Robinson Run; exceeds EPA criterion in both August and November in Robinson Run. Also exceeds EPA criterion during August in Craft's Run.

Crooked Run/Tributary of Crooked Run (Stations C-1, C-2, and T-1).

Iron Exceeds EPA criterion at all three stations during August and February.

Manganese Occasionally exceeds EPA criterion during all three sampling periods.

Phenols Exceeds EPA criterion at C-1 and T-1 during August; also exceeds EPA criterion at C-2 in November.

Monongahela River (Stations M-1, M-2, and M-3)

Iron Exceeds EPA criterion during all three sampling periods.

Manganese Exceeds EPA criterion during all three sampling periods.

Phenols Occasionally exceeds EPA criterion at M-1 and M-3 during November.

*Reference: 1976, EPA Quality Criteria for Water

SECTION 3

METEOROLOGY AND AIR QUALITY

3.1 INTRODUCTION

The Pittsburgh & Midway Coal Mining Co. is proposing to build a Solvent Refined Coal (SRC-II) demonstration facility near Morgantown, West Virginia. Stearns-Roger Services Inc. was retained to provide intensive environmental baseline studies at the proposed project location. Included in these studies are onsite meteorological and air quality observations.

During the last week of June 1978, a 60-meter (197-foot) meteorological tower was placed in operation onsite to continuously measure wind speed, wind direction, temperature, humidity, and precipitation. At the same time, air quality sensors were installed to monitor sulfur dioxide, nitrogen oxides, carbon monoxide, ozone and non-methane hydrocarbons continuously and 24-hour samples of total suspended particulates every third day.

This report summarizes the observations and provides analyses of the measurements for the first nine months of monitoring through March 1979.

3.2 METHODS

3.2.1 Location

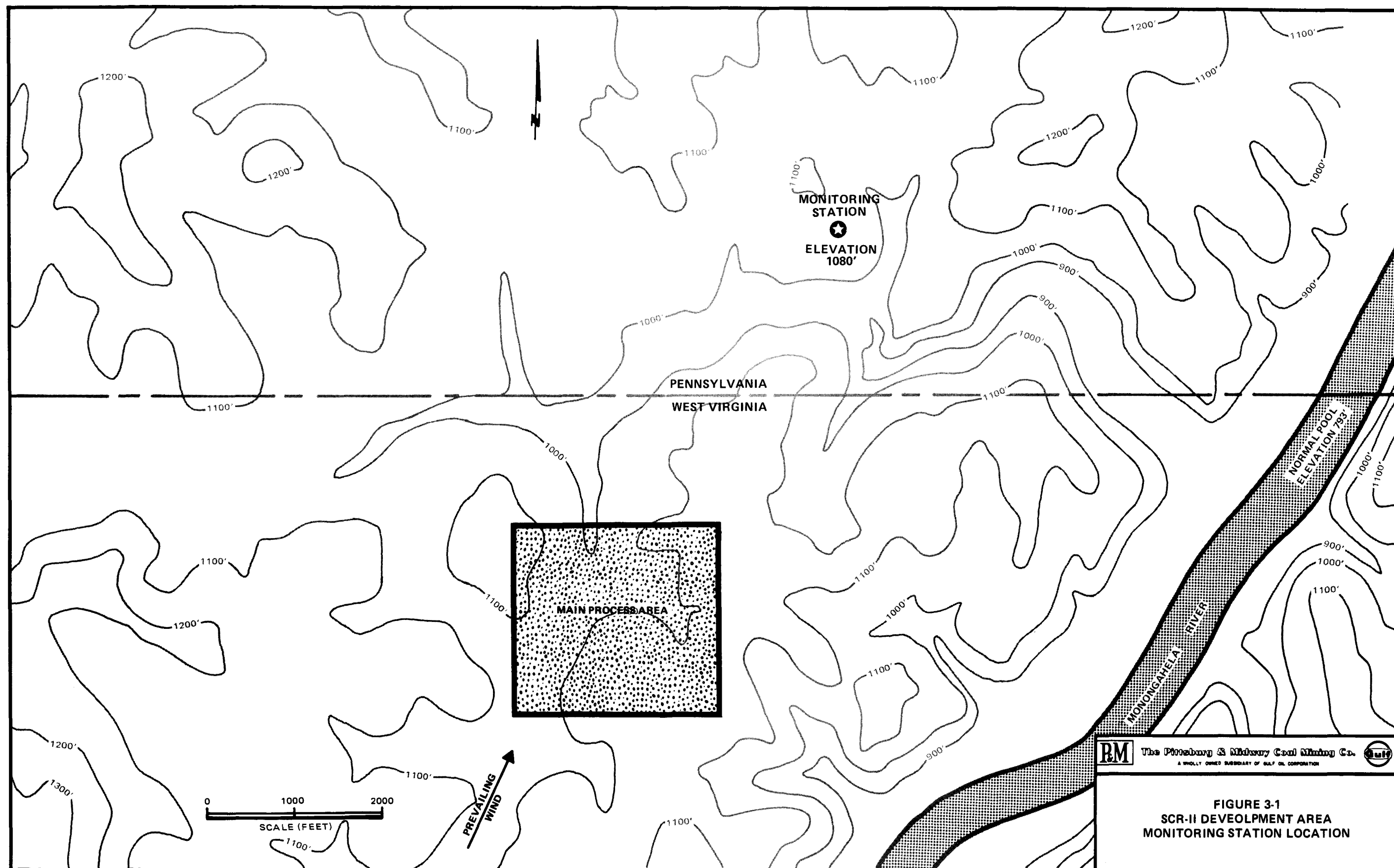
The proposed location of the Solvent Refined Coal (SRC-II) demonstration facility is about 10 kilometers north of Morgantown, West Virginia and five kilometers southwest of Point Marion, Pennsylvania. Figure 3-1 depicts the location of the monitoring station roughly 1.5 kilometer north-northeast of the proposed facility in the prevailing downwind direction. The elevation at the monitoring station is 329 meters (1080 feet) MSL while the graded elevation of the planned facility will be 323 meters (1060 feet) MSL. The general topography of the region shows the proposed facility and monitoring station on a ridge, with elevations around 335 to 365 meters (1100 to 1200 feet), above the Monongahela River at an elevation near 245 meters (800 feet).

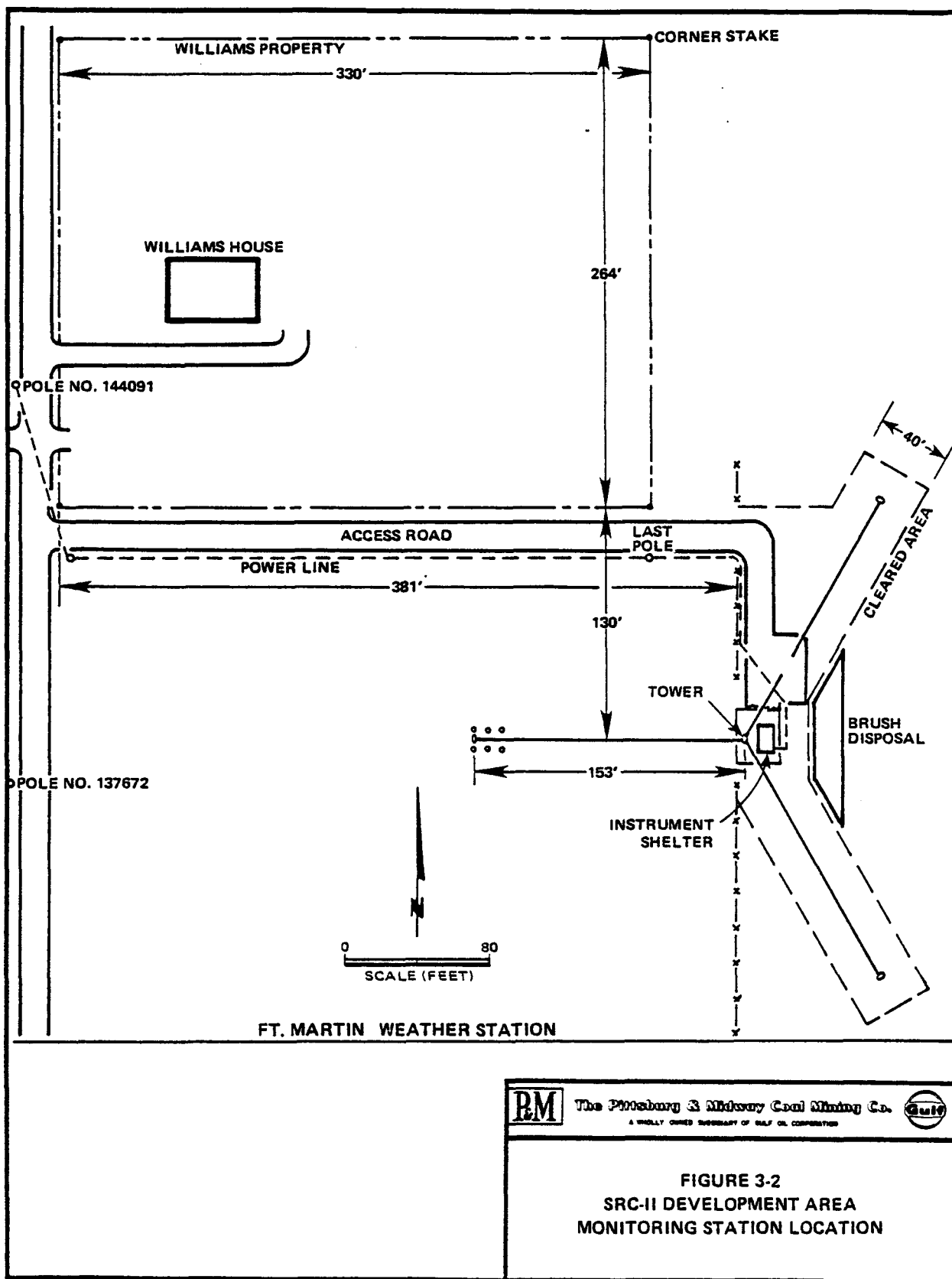
Figure 3-2 shows the general layout of the monitoring station with the 60-meter tower and instrument building. The trees have been removed from the western hemisphere about the site, in the prevailing upwind direction, but the area east of the station is heavily forested. The road to the west is asphalt (bad condition) and lightly traveled.

3.2.2 Equipment and Instrumentation

3.2.2.1 Meteorology

- 1) Rohn Model 55G 60-meter meteorological tower
- 2) Texas Electronics (TE) Model 3010 wind direction sensors at 10 and 60 meters.
- 3) TE Model 3011A wind speed sensors at 10 and 60 meters.
- 4) TE Model 3015 temperature sensors at 10 and 60 meters.
- 5) TE Model 3013 relative humidity sensor at 10 meters
- 6) Livingston-Armadillo 8'x14' molded-fiberglass, temperature-controlled instrument building.
- 7) TE Model 3014 heated, tipping-bucket precipitation gauge mounted on top of the instrument building.





3.2.2.2 Air Quality

- 1) Thermo Electron Corporation Model 43 continuous SO₂ Analyzer (EPA equivalent method).
- 2) Monitor Labs Model 8440 continuous NO_x Analyzer (EPA equivalent method).
- 3) Dasibi Model 1003-AH Continuous O₃ Analyzer (EPA equivalent/reference method).
- 4) Two General Metal Works Model 2310-105 high-volume air samplers (EPA reference method) mounted atop the instrument building.
- 5) Beckman Model 6800 gas chromatograph for continuous measurements of methane, total hydrocarbons, non-methane hydrocarbons (by subtraction), and carbon monoxide.
- 6) Metronics Model 340 dynamic calibrator with NBS-traceable, liquid-phase SO₂ permeation tube (for TECO SO₂ analyzer).
- 7) Monitor Labs Model 8500 3-channel dynamic calibrator for ozone, NBS-traceable liquid-phase NO₂ permeation tube, and NBS-traceable NO span gas.
- 8) Monitor Labs Model 8500 1-channel dynamic calibrator for CO/CH₄ calibration gas (gas chromatograph).
- 9) Dustfall jar and sulfation plates.

3.2.2.3 Data Recording

- 1) Monitor Labs Model 9400 20-channel analog to digital data logger integrated with a Kennedy Model 9832 magnetic tape drive (paper tape backup).
- 2) Five Esterline-Angus dual-channel strip-chart recorders.

3.2.3 Maintenance and Calibration Procedures

3.2.3.1 General

The monitoring systems were initially installed, calibrated, and given a thorough operational checkout by Stearns-Roger environmental engineers and manufacturer's representatives. A full-time instrument technician was hired from DeNardo and McFarland Weather Services Incorporated to perform routine day-by-day operations. Stearns-Roger

environmental engineers visit the site at least monthly for inspection, maintenance, and calibration.

3.2.3.2 Meteorological Instruments

Preventive maintenance and routine inspection are performed daily, five days per week. The instruments are calibrated quarterly by Stearns-Roger environmental engineers.

3.2.3.3 Air Quality Instruments

The continuous sensors are automatically zeroed and spanned daily. Multipoint calibrations, using NBS-traceable materials, are performed monthly by Stearns-Roger environmental engineers. The flow rates of the high-volume samplers are calibrated monthly using an orifice calibrated against an EPA-supplied Roots meter.

3.3. RESULTS AND DISCUSSION

3.3.1 Meteorology

3.3.1.1 60-Meter Meteorological Tower System

1) WIND SPEED AND DIRECTION: Over the nine months, the data recovery rates for the wind direction and wind speed sensors were 92 and 93 percent, respectively.

Table 3-1 gives the wind direction occurrences and average speeds by hour of the day (EST) for the 10-meter level. Discounting the calm winds, a random wind direction distribution would have indicated about 12 occurrences for each of the 16 cardinal wind directions and 24 hours. When occurrences equal to or greater than 24 (twice the random distribution) are outlined on Table 3-1, prevailing windflow patterns can be identified. Winds from the southwest quadrant (south through west) were strongly dominant representing 60 percent of the non-calm winds.

The wind speeds during the nine months averaged 2.42 meters per second (m/s)(5.4 mph) at the 10-meter level with a mean maximum of 3.33 m/s (7.4 mph) at 1300 EST and an average minimum of 1.90 m/s (4.3 mph) at 0200 EST.

The wind direction frequency distribution (for four wind-speed intervals) is shown in the upper portion of Table 3-2 while the wind speed frequency distribution is tabulated in the lower portion. The wind speeds were less than 4.45 m/s (10 mph) for 88.6 percent of the time, equal to or greater than 8.91 m/s (20 mph) on only 0.3 percent of the hourly observations, and with five occurrences of wind speeds of 22.26 m/s (50 mph) or more.

Winds from the southwest quadrant strongly prevailed at 60 meters also as indicated on Table 3-3. These southwesterlies are representative of the broadscale (synoptic) windflow pattern observed over this geographical region.

TABLE 3-1

10-METER LEVEL

WINDROSE FREQUENCY TABULATION - SUMMARY OF ALL DATA

W I N D D I R E C T I O N																			TOTAL AVE	
HR	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	OBS	SPEED	
1	11	6	5	3	4	9	9	4	6	26	17	23	15	7	3	8	83	239	1.93	
2	9	7	2	6	3	7	7	3	12	28	14	27	18	7	6	6	84	246	1.90	
3	11	7	4	4	3	4	9	3	14	30	17	23	15	7	8	7	81	247	1.95	
4	9	9	5	2	1	8	11	2	10	27	24	17	15	12	5	5	81	243	1.98	
5	8	12	4	3	2	14	5	1	6	31	27	20	15	5	8	5	78	245	1.94	
6	12	8	4	4	5	8	9	1	7	25	26	25	15	10	3	2	80	244	2.03	
7	11	7	4	1	5	7	10	2	9	34	24	21	11	8	4	7	80	245	2.02	
8	11	9	4	1	2	8	8	2	12	41	21	13	16	15	3	6	71	243	2.45	
9	12	8	4	2	1	10	9	1	11	42	28	21	17	8	2	4	67	247	2.41	
10	14	13	5	3	2	14	8	0	20	45	32	25	17	4	2	5	44	253	2.62	
11	13	16	5	3	5	11	10	4	16	52	33	25	13	6	3	7	38	260	2.90	
12	16	12	4	2	6	10	12	2	21	49	40	29	13	5	2	7	30	260	3.12	
13	13	13	7	2	4	14	5	4	18	42	50	29	20	4	3	11	20	259	3.33	
14	16	9	7	3	3	13	4	2	17	43	47	28	21	6	8	8	23	258	3.29	
15	17	14	5	2	2	9	5	5	9	38	45	40	22	9	5	8	23	258	3.16	
16	19	18	8	2	4	8	5	2	15	39	40	29	22	10	7	6	17	251	3.09	
17	17	12	8	3	3	11	6	4	16	37	38	30	24	8	7	15	18	257	3.28	
18	22	10	8	4	6	7	4	5	9	34	33	34	23	13	6	5	29	252	2.58	
19	13	15	10	7	8	6	5	3	12	29	27	28	24	8	4	15	43	257	2.19	
20	15	17	7	4	8	10	5	4	18	23	19	23	13	8	12	11	58	255	2.01	
21	12	11	11	3	10	14	10	3	14	22	19	19	12	5	7	9	72	253	1.95	
22	9	15	9	4	8	11	9	0	15	26	16	16	18	9	1	7	81	253	1.94	
23	17	9	4	4	6	11	7	1	14	26	21	16	18	5	2	8	83	252	1.93	
24	14	12	1	5	9	12	7	0	10	27	17	20	17	8	3	6	80	248	1.93	
TOTAL COUNT	321		135		110		179		311		675		415		114		1364			
		269		77		236		58		816		581		185		178		6025	2.42	

*** A WIND SPEED LESS THAN OR EQUAL TO 0.89 M/SEC IS CONSIDERED CALM ***

*** AVERAGE WIND SPEED IS IN METERS PER SECOND (M/SEC) ***

TABLE 3-2

10-METER LEVEL

WIND ROSE TABLE

DIRECTION	LEVEL 1 2.2 M/S	LEVEL 2 4.5 M/S	LEVEL 3 6.7 M/S	LEVEL 4 > 6.7 M/S	TOTAL %
N	3.5	1.8	0.0	0.0	5.3
NNE	3.1	1.3	0.1	0.0	4.5
NE	1.6	0.6	0.0	0.0	2.2
ENE	1.0	0.3	0.0	0.0	1.3
E	1.3	0.4	0.0	0.0	1.8
ESE	1.9	1.8	0.2	0.0	3.9
SE	1.0	1.4	0.5	0.1	3.0
SSE	0.6	0.3	0.0	0.0	1.0
S	2.2	2.5	0.4	0.0	5.2
SSW	3.8	7.0	2.4	0.3	13.5
SW	3.4	5.2	1.9	0.7	11.2
WSW	2.8	4.6	1.8	0.4	9.6
W	2.0	3.2	1.5	0.3	6.9
WNW	1.5	1.3	0.3	0.0	3.1
NW	1.1	0.7	0.1	0.0	1.9
NNW	2.2	0.7	0.0	0.0	3.0
TOTAL %	33.0	33.1	9.4	1.9	77.4

THE WIND WAS CALM 22.6 PERCENT OF THE TIME

A WIND SPEED LESS THAN OR EQUAL TO 0.89 M/SEC IS CONSIDERED CALM ***

WIND SPEED FREQUENCY TABLE - ALL DATA

RANGE	FREQUENCY	ACCUM. %	RANGE	FREQUENCY	ACCUM. %
0.0 - 0.89	1349.0	22.1	11.58-12.46	0.0	99.9
0.90- 1.78	1294.0	43.2	12.47-13.35	2.0	99.9
1.79- 2.67	1284.0	64.2	13.36-14.24	0.0	99.9
2.68- 3.56	825.0	77.7	14.25-15.13	0.0	99.9
3.57- 4.45	669.0	88.6	15.14-16.02	0.0	99.9
4.46- 5.34	334.0	94.1	16.03-16.91	0.0	99.9
5.35- 6.23	170.0	96.9	16.92-17.80	0.0	99.9
6.24- 7.12	114.0	98.7	17.81-18.69	0.0	99.9
7.13- 8.01	41.0	99.4	18.70-19.58	0.0	99.9
8.02- 8.90	20.0	99.7	19.59-20.47	0.0	99.9
8.91- 9.79	8.0	99.9	20.48-21.36	0.0	99.9
9.80-10.68	1.0	99.9	21.37-22.25	0.0	99.9
10.69-11.57	1.0	99.9	22.26-ABOVE	5.0	100.0

TOTAL OCCURRENCES= 6117.0

TABLE 3-3
60-METER LEVEL

WINDROSE FREQUENCY TABULATION - SUMMARY OF ALL DATA

HR	WIND DIRECTION																	TOTAL		AVE SPEED
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	OBS		
1	11	15	3	5	6	5	12	15	18	48	16	16	16	7	5	6	10	214	4.12	
2	12	14	8	4	2	9	11	13	23	48	17	11	14	8	5	6	9	214	4.09	
3	13	12	6	5	3	3	19	10	23	43	24	11	14	10	3	7	8	214	4.15	
4	7	13	10	2	5	3	18	7	19	49	25	14	14	8	7	6	8	215	4.14	
5	8	15	5	2	3	5	16	13	16	42	25	16	18	3	6	4	18	215	3.98	
6	12	12	3	3	7	4	16	11	21	41	23	20	15	5	4	4	14	215	3.97	
7	12	13	4	1	4	3	17	5	21	48	26	11	12	9	6	4	17	213	3.89	
8	5	18	4	2	2	5	16	8	17	45	29	14	12	5	6	6	18	212	3.89	
9	7	20	6	0	7	4	16	8	18	41	35	9	16	6	5	4	10	212	4.15	
10	8	16	4	3	4	5	16	8	18	38	29	14	14	9	4	3	18	211	4.33	
11	11	11	8	2	4	4	21	5	17	34	32	9	17	9	3	6	22	215	4.16	
12	15	15	5	2	1	10	15	5	12	40	34	15	19	4	2	5	15	214	4.38	
13	12	12	7	3	4	4	11	7	7	33	39	17	25	9	3	8	14	215	4.45	
14	14	12	5	2	4	5	10	6	10	35	40	25	25	6	5	7	7	218	4.62	
15	11	13	3	2	5	4	8	6	13	27	39	28	27	9	6	7	10	218	4.61	
16	17	9	5	4	3	4	4	5	14	26	37	26	24	9	5	10	11	213	4.79	
17	19	6	5	4	5	1	9	4	15	30	25	23	27	11	7	11	12	214	4.63	
18	18	16	4	1	4	4	7	2	17	23	31	22	26	13	10	4	11	213	4.31	
19	12	17	9	2	6	7	8	6	10	29	27	19	25	9	11	9	8	214	4.21	
20	9	22	7	4	5	8	13	5	16	31	23	14	20	10	9	10	9	215	4.13	
21	14	11	12	4	5	12	12	7	7	24	30	21	13	18	8	5	6	14	216	4.06
22	13	14	6	7	4	10	14	7	7	26	44	6	16	17	7	6	6	12	215	4.11
23	14	17	4	2	5	5	19	9	15	52	17	11	19	7	3	4	11	214	4.17	
24	16	16	4	3	2	7	14	7	19	46	16	13	22	9	4	4	12	214	4.11	
TOTAL COUNT	290	339	137	69	100	131	322	179	409	923	636	387	456	190	150	147	298	5143	4.23	

*** A WIND SPEED LESS THAN OR EQUAL TO 0.89 M/SEC IS CONSIDERED CALM ***
 *** AVERAGE WIND SPEED IS IN METERS PER SECOND (M/SEC) ***

At 60 meters, the wind speed averaged 4.23 m/s (9.5 mph) with a mean maximum of 4.79 m/s (10.7 mph) at 1600 EST and an average minimum of 3.89 m/s (8.7 mph) at 0700 and 0800 EST.

Table 3-4 shows that the wind speeds were less than 4.45 m/s (10 mph) on 60.3 percent of the hourly records, equal to or greater than 8.91 m/s (20 mph) for 3.6 percent of the time, and with eight occurrences of 22.26 m/s (50 mph) or more.

2) ATMOSPHERIC STABILITY: The temperature difference between 60 and 10 meters was used to compute atmospheric stability as defined by:

<u>Stability Class</u>	<u>$T(60m - 10m)^{\circ}C$</u>
1 - Extremely Unstable	≤ -2.0
2 - Unstable	> -2.0 , but ≤ -1.0
3 - Slightly Unstable	> -1.0 , but ≤ -0.5
4 - Neutral	> -0.5 , but ≤ -0.1
5 - Stable (Inversion)	> -0.1 , but $\leq +2.0$
6 - Very Stable (Inversion)	$\geq +2.0$

The objective stability classification system defined above is patterned after the system used by the Nuclear Regulatory Commission and it differs considerably from the widely-used subjective system developed by Pasquill.

TABLE 3-4

60-METER LEVEL

WIND ROSE TABLE

DIRECTION	LEVEL 1 2.2 M/S	LEVEL 2 4.5 M/S	LEVEL 3 6.7 M/S	LEVEL 4 > 6.7 M/S	TOTAL %
N	1.5	2.8	1.2	0.2	5.6
NNE	2.4	3.2	0.9	0.1	6.6
NE	1.5	1.0	0.1	0.0	2.7
ENE	0.8	0.4	0.2	0.0	1.3
E	0.9	0.8	0.2	0.0	1.9
ESE	0.9	1.0	0.5	0.1	2.5
SE	1.3	2.3	2.0	0.7	6.3
SSE	1.0	1.4	0.8	0.3	3.5
S	2.2	3.5	1.4	0.9	8.0
SSW	2.7	7.5	5.5	2.2	17.9
SW	2.0	4.5	3.5	2.3	12.4
WSW	0.9	2.4	2.5	1.8	7.5
W	0.4	2.6	3.0	2.9	8.9
WNW	0.7	1.1	1.2	0.7	3.7
NW	0.4	1.1	0.7	0.2	2.5
NNW	0.6	1.5	0.7	0.1	2.9
TOTAL %	20.1	37.1	24.4	12.5	94.2

THE WIND WAS CALM 5.8 PERCENT OF THE TIME

A WIND SPEED LESS THAN OR EQUAL TO 0.89 M/SEC IS CONSIDERED CALM ***

WIND SPEED FREQUENCY TABLE - ALL DATA

RANGE	FREQUENCY	ACCUM. %	RANGE	FREQUENCY	ACCUM. %
0.0 - 0.89	287.0	4.9	11.58-12.46	16.0	99.6
0.90- 1.78	645.0	15.8	12.47-13.35	6.0	99.7
1.79- 2.67	836.0	30.0	13.36-14.24	0.0	99.7
2.68- 3.56	896.0	45.2	14.25-15.13	1.0	99.8
3.57- 4.45	892.0	60.3	15.14-16.02	0.0	99.8
4.46- 5.34	691.0	72.0	16.03-16.91	2.0	99.8
5.35- 6.23	612.0	82.4	16.92-17.80	1.0	99.8
6.24- 7.12	424.0	89.6	17.81-18.69	0.0	99.8
7.13- 8.01	248.0	93.8	18.70-19.58	0.0	99.8
8.02- 8.90	154.0	96.4	19.59-20.47	0.0	99.8
8.91- 9.79	81.0	97.8	20.48-21.36	3.0	99.9
9.80-10.68	62.0	98.8	21.37-22.25	0.0	99.9
10.69-11.57	31.0	99.4	22.26-ABOVE	8.0	100.0

TOTAL OCCURRENCES= 5896.0

Tables 3-5 through 3-10 list the 60-meter wind direction frequencies of occurrence for six wind-speed intervals for each of the six stability classes for the six months. The results are summarized below.

<u>Stability Class</u>	<u>Frequency of Occurrence (%)</u>
1	0.2
2	7.5
3	22.8
4	28.8
5	28.1
6	12.7

Over the period, temperature inversions (temperature increasing with height) occurred 40.8 percent of the time for an average of 9.8 hours per day. Such temperature inversions are primarily nighttime phenomena. Nocturnal radiative heat losses from the ground, under light wind speed conditions, result in the air next to the ground being cooled more rapidly than the air at higher levels. (With stronger wind speeds, the air is mixed by mechanical turbulence and such temperature inversions are either destroyed or considerably lessened.) Incoming daytime solar radiation heats the ground and the air above and the nocturnal temperature inversion usually is eliminated.

3) TEMPERATURE AND HUMIDITY: The overall data recovery rates for the temperature and humidity sensors have been 88 and 80 percent, respectively.

TABLE 3-5
STABILITY CLASS 1

ANNUAL RELATIVE FREQUENCY DISTRIBUTION

DIRECTION	SPEED (M/SEC)							TOTAL
	0.0 - 1.7	1.8 - 3.3	3.4 - 5.3	5.4 - 8.4	8.5 - 10.8	GREATER THAN 10.8		
N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
NNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
NE	0.000958	0.0	0.0	0.0	0.0	0.0	0.000958	
ENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ESE	0.000239	0.0	0.0	0.0	0.0	0.0	0.000239	
SE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
SSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
S	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
SSW	0.000072	0.000648	0.000215	0.0	0.0	0.0	0.000934	
SW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
WSW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
WNW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
NW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
NNW	0.000024	0.000215	0.0	0.0	0.0	0.0	0.000239	
TOTAL	0.001293	0.000862	0.000215	0.0	0.0	0.0		

RELATIVE FREQUENCY OF OCCURENCES OF STABILITY CLASS 1=0.002370
RELATIVE FREQUENCY OF CALMS DISTRIBUTED IN (0 - 1.7)
SPEED CLASS ABOVE IN STABILITY CLASS 1=0.000215

TABLE 3-6
STABILITY CLASS 2

ANNUAL RELATIVE FREQUENCY DISTRIBUTION

SPEED(M/SEC)

DIRECTION	0.0 - 1.7	1.8 - 3.3	3.4 - 5.3	5.4 - 8.4	8.5 - 10.8	GREATER THAN 10.8	TOTAL
N	0.004823	0.003448	0.000215	0.0	0.0	0.0	0.008486
NNE	0.008201	0.001724	0.0	0.0	0.0	0.0	0.009925
NE	0.003544	0.0	0.0	0.0	0.0	0.0	0.003544
ENE	0.000493	0.000215	0.0	0.0	0.0	0.0	0.000709
E	0.001029	0.000862	0.0	0.0	0.0	0.0	0.001890
ESE	0.002724	0.001293	0.0	0.0	0.0	0.0	0.004017
SE	0.001995	0.001077	0.0	0.0	0.0	0.0	0.003072
SSE	0.000556	0.000862	0.000215	0.0	0.0	0.0	0.001633
S	0.001564	0.001508	0.0	0.0	0.0	0.0	0.003072
SSW	0.003899	0.003663	0.000431	0.0	0.0	0.0	0.007993
SW	0.006004	0.003448	0.000646	0.0	0.0	0.0	0.010098
WSW	0.001153	0.002155	0.000646	0.0	0.0	0.0	0.003955
W	0.002133	0.004956	0.001077	0.0	0.0	0.0	0.008166
WNW	0.001821	0.001724	0.000215	0.0	0.0	0.0	0.003760
NW	0.000792	0.000862	0.0	0.0	0.0	0.000215	0.001870
NNW	0.001286	0.001077	0.0	0.0	0.0	0.0	0.002363
TOTAL	0.042017	0.028873	0.003448	0.0	0.0	0.000215	

RELATIVE FREQUENCY OF OCCURENCES OF STABILITY CLASS 2=0.074553
RELATIVE FREQUENCY OF CALMS DISTRIBUTED IN (0 - 1.7)
SPEED CLASS ABOVE IN STABILITY CLASS 2=0.006249

TABLE 3-7
STABILITY CLASS 3

ANNUAL RELATIVE FREQUENCY DISTRIBUTION							
SPEED(M/SEC)							
DIRECTION	0.0 - 1.7	1.8 - 3.3	3.4 - 5.3	5.4 - 8.4	8.5 - 10.8	GREATER THAN 10.8	TOTAL
N	0.009920	0.001939	0.000431	0.0	0.0	0.0	0.012290
NNE	0.013073	0.000646	0.0	0.0	0.0	0.0	0.013720
NE	0.003290	0.000431	0.000215	0.0	0.0	0.0	0.003936
ENE	0.001645	0.000215	0.0	0.0	0.0	0.0	0.001860
E	0.002609	0.000646	0.0	0.0	0.0	0.0	0.003255
ESE	0.002660	0.001293	0.0	0.0	0.0	0.0	0.003953
SE	0.003494	0.003017	0.000646	0.000215	0.0	0.0	0.007373
SSE	0.000585	0.001508	0.000646	0.0	0.0	0.0	0.002739
S	0.002848	0.003663	0.000215	0.0	0.0	0.0	0.006726
SSW	0.015475	0.013359	0.001724	0.0	0.0	0.0	0.030558
SW	0.015874	0.021332	0.006033	0.000215	0.0	0.000215	0.043670
WSW	0.010671	0.011420	0.006680	0.0	0.0	0.0	0.028770
W	0.008495	0.019177	0.010127	0.000215	0.0	0.0	0.038014
WNW	0.003706	0.008619	0.002801	0.0	0.0	0.0	0.015125
NW	0.002933	0.004740	0.000646	0.0	0.0	0.0	0.008320
NNW	0.005717	0.001724	0.0	0.0	0.0	0.0	0.007441
TOTAL	0.102995	0.093730	0.030166	0.000646	0.0	0.000215	

RELATIVE FREQUENCY OF OCCURENCES OF STABILITY CLASS 3=0.227753
RELATIVE FREQUENCY OF CALMS DISTRIBUTED IN (0 - 1.7)
SPEED CLASS ABOVE IN STABILITY CLASS 3=0.014437

TABLE 3-8
STABILITY CLASS 4

ANNUAL RELATIVE FREQUENCY DISTRIBUTION

DIRECTION	SPEED(M/SEC)						TOTAL
	0.0 - 1.7	1.8 - 3.3	3.4 - 5.3	5.4 - 8.4	8.5 - 10.8	GREATER THAN 10.8	
N	0.014660	0.007972	0.000215	0.0	0.0	0.0	0.022848
NNE	0.014949	0.003017	0.000215	0.0	0.0	0.0	0.018182
NE	0.004702	0.000431	0.0	0.0	0.0	0.0	0.005133
ENE	0.001094	0.001939	0.000215	0.0	0.0	0.0	0.003249
E	0.002225	0.001508	0.0	0.0	0.0	0.0	0.003733
ESE	0.003570	0.003663	0.000215	0.0	0.0	0.0	0.007449
SE	0.006977	0.010989	0.003017	0.0	0.0	0.0	0.020983
SSE	0.002672	0.004094	0.000862	0.0	0.0	0.0	0.007628
S	0.005777	0.004956	0.001724	0.0	0.0	0.0	0.012457
SSW	0.013039	0.022193	0.005387	0.0	0.0	0.0	0.040619
SW	0.013491	0.013575	0.006464	0.0	0.0	0.0	0.033530
WSW	0.009971	0.018961	0.006464	0.0	0.0	0.0	0.035396
W	0.010007	0.019392	0.011851	0.0	0.0	0.0	0.041250
WNW	0.005633	0.006033	0.002155	0.0	0.0	0.0	0.013821
NW	0.004988	0.003878	0.000431	0.0	0.0	0.0	0.009297
NNW	0.006262	0.005171	0.000646	0.0	0.0	0.0	0.012079
TOTAL	0.120017	0.127774	0.039862	0.0	0.0	0.0	

RELATIVE FREQUENCY OF OCCURENCES OF STABILITY CLASS 4=0.287654
RELATIVE FREQUENCY OF CALMS DISTRIBUTED IN (0 - 1.7)
SPEED CLASS ABOVE IN STABILITY CLASS 4=0.018961

TABLE 3-9
STABILITY CLASS 5

ANNUAL RELATIVE FREQUENCY DISTRIBUTION

SPEED(M/SEC)

DIRECTION	0.0 - 1.7	1.8 - 3.3	3.4 - 5.3	5.4 - 8.4	8.5 - 10.8	GREATER THAN 10.8	TOTAL
N	0.009156	0.003017	0.0	0.0	0.0	0.0	0.012172
NNE	0.018852	0.008834	0.0	0.0	0.0	0.0	0.027686
NE	0.007369	0.001939	0.0	0.0	0.0	0.0	0.009308
ENE	0.004820	0.000431	0.0	0.0	0.0	0.0	0.005251
E	0.002334	0.001724	0.0	0.0	0.0	0.0	0.004057
ESE	0.005506	0.002370	0.0	0.0	0.0	0.0	0.007876
SE	0.012726	0.014006	0.000215	0.0	0.0	0.0	0.026947
SSE	0.009504	0.006249	0.000215	0.0	0.0	0.0	0.015968
S	0.013654	0.007111	0.001293	0.0	0.0	0.0	0.022057
SSW	0.034378	0.035553	0.004309	0.0	0.0	0.0	0.074240
SW	0.014257	0.012713	0.002370	0.0	0.0	0.0	0.029340
WSW	0.006192	0.004309	0.001724	0.000215	0.0	0.0	0.012441
W	0.006955	0.004740	0.0	0.0	0.0	0.0	0.011695
WNW	0.004412	0.001077	0.0	0.0	0.0	0.0	0.005489
NW	0.005151	0.001293	0.000215	0.0	0.0	0.0	0.006660
NNW	0.007631	0.002155	0.0	0.0	0.0	0.0	0.009786
TOTAL	0.162896	0.107520	0.010343	0.000215	0.0	0.0	

RELATIVE FREQUENCY OF OCCURENCES OF STABILITY CLASS 5=0.280974
 RELATIVE FREQUENCY OF CALMS DISTRIBUTED IN (0 - 1.7)
 SPEED CLASS ABOVE IN STABILITY CLASS 5=0.026287

TABLE 3-10
STABILITY CLASS 6

ANNUAL RELATIVE FREQUENCY DISTRIBUTION

SPEED(M/SEC)

DIRECTION	0.0 - 1.7	1.8 - 3.3	3.4 - 5.3	5.4 - 8.4	8.5 - 10.8	GREATER THAN 10.8	TOTAL
N	0.003796	0.000646	0.0	0.0	0.0	0.0	0.004443
NNE	0.006840	0.000215	0.0	0.0	0.0	0.0	0.007056
NE	0.003397	0.0	0.0	0.0	0.0	0.0	0.003397
ENE	0.002352	0.0	0.0	0.0	0.0	0.0	0.002352
E	0.004704	0.0	0.0	0.0	0.0	0.0	0.004704
ESE	0.002875	0.0	0.0	0.0	0.0	0.0	0.002875
SE	0.008977	0.000431	0.0	0.0	0.0	0.0	0.009408
SSE	0.009591	0.000862	0.0	0.0	0.0	0.0	0.010453
S	0.021397	0.001077	0.0	0.0	0.0	0.0	0.022474
SSW	0.035320	0.003878	0.000215	0.0	0.0	0.0	0.039414
SW	0.009036	0.001939	0.0	0.0	0.0	0.0	0.010976
WSW	0.002444	0.000431	0.0	0.0	0.0	0.0	0.002875
W	0.001307	0.0	0.0	0.0	0.0	0.0	0.001307
WNW	0.000784	0.0	0.0	0.0	0.0	0.0	0.000784
NW	0.001660	0.000431	0.0	0.0	0.0	0.0	0.002091
NNW	0.001660	0.000431	0.0	0.0	0.0	0.0	0.002091
TOTAL	0.116138	0.010343	0.000215	0.0	0.0	0.0	

RELATIVE FREQUENCY OF OCCURENCES OF STABILITY CLASS 6=0.126697
RELATIVE FREQUENCY OF CALMS DISTRIBUTED IN (0 - 1.7)
SPEED CLASS ABOVE IN STABILITY CLASS 6=0.022193

The mean monthly and hourly temperatures are listed on Tables 3-11 and 3-12 for the 10- and 60-meter levels. A comparison of the onsite 10-meter temperatures with the Morgantown long-term means is given below:

Month	Mean Temperatures		
	Site (1978/79)		Morgantown (1951-73)*
	°C	°F	°F
July	21.7	71.1	73.2
August	22.7	72.9	71.7
September	20.1	68.2	66.0
October	10.9	51.6	54.9
November	7.6	45.7	43.3
December	2.0	35.6	34.1
January	-3.5	25.7	30.2
February	-5.1	22.8	32.4
March	6.8	44.2	40.6

*Source: Morgantown Airport (FAA).

The mean relative humidities and computed wet-bulb temperatures are tabulated on Tables 3-13 and 3-14.

3.3.1.2 Precipitation

The precipitation gauge became operational the latter part of July 1978. The data recovery rate has been 100 percent. A comparison of the observed onsite monthly precipitation with the Morgantown long-term mean is given below:

PRECIPITATION

Months	Site (1978/79)		Morgantown*
	mm	inches	inches
August	80.26	3.16	4.11
September	46.74	1.84	3.19
October	74.17	2.92	2.29
November	58.63	2.31	2.74
December	150.35	5.92	3.10
January	106.13	4.18	2.76
February	50.03	1.97	2.68
March	93.47	3.68	3.61

Monitoring Site:

Max 1-hour: 14.99 mm (0.59 inch), 2100 EST, August 6, 1978

Max 24-hour: 48.76 mm (1.92 inches), March 4/5, 1979

*Source: Morgantown Airport (FAA), 1951-1973.

TABLE 3-11
10-METER LEVEL

AVERAGE AMBIENT AIR TEMPERATURE TABLE													
HOUR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	HOUR AVE.
1	-4.6	-7.8	5.1				19.0	20.7	17.9	8.4	5.9	0.9	6.2
2	-4.4	-7.0	4.5				18.8	20.4	17.5	8.0	6.0	0.2	5.9
3	-4.4	-6.8	4.1				18.4	19.9	16.7	7.6	5.6	0.3	5.7
4	-4.5	-7.3	3.7				18.0	19.7	17.6	7.3	5.8	0.0	5.3
5	-4.6	-7.5	3.2				17.7	19.5	16.4	7.0	5.7	-0.1	5.1
6	-4.6	-8.1	2.7				17.7	19.5	15.9	6.8	5.2	0.0	5.0
7	-4.4	-8.1	2.4				18.2	19.6	15.7	6.4	4.9	0.1	4.9
8	-4.2	-8.3	2.9				19.7	20.1	16.5	7.1	5.0	0.1	5.4
9	-4.2	-7.6	3.6				21.2	19.7	17.2	8.2	5.6	0.6	6.2
10	-4.0	-6.5	5.2				22.4	22.4	19.8	10.0	6.4	1.5	7.5
11	-3.4	-5.1	5.7				23.7	23.3	20.8	11.8	7.7	2.4	8.7
12	-2.8	-3.6	8.5				24.2	24.6	22.7	13.4	9.2	3.2	10.0
13	-2.3	-2.6	9.5				24.9	26.3	24.4	14.8	10.2	3.3	11.0
14	-1.6	-2.5	10.0				25.5	27.1	25.1	15.6	10.7	3.9	11.6
15	-1.7	-1.5	10.8				25.4	26.8	23.0	16.4	11.2	4.6	12.1
16	-1.6	-1.6	11.4				25.5	26.5	25.8	16.6	10.8	4.9	12.1
17	-1.8	-1.7	11.7				25.4	25.7	25.2	16.2	11.2	4.7	11.9
18	-2.5	-2.5	11.6				25.1	25.5	24.4	15.4	9.9	3.6	11.2
19	-3.0	-3.0	10.5				24.6	24.6	22.1	13.2	8.7	3.5	10.3
20	-3.4	-3.7	9.1				22.9	23.2	20.3	11.5	7.9	2.9	9.1
21	-3.7	-4.5	8.0				21.5	22.1	19.6	10.5	7.1	2.3	8.3
22	-4.2	-5.1	6.8				20.8	21.4	18.8	9.8	6.8	2.0	7.6
23	-4.4	-5.5	5.0				19.9	20.7	18.3	9.2	6.3	1.8	7.1
24	-4.7	-5.9	5.7				19.5	20.5	17.9	8.8	6.1	1.6	6.6
MONTH AVE.	-3.5	-5.1	6.8				21.7	22.7	20.1	10.9	7.6	2.0	8.2

TOTAL OBSERVATIONS = 5750.0
ALL TEMPERATURES IN DEGREES CELSIUS

TABLE 3-12
60-METER LEVEL

AVERAGE AMBIENT AIR TEMPERATURE TABLE													
HOUR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	HOUR AVE.
1	-4.1	-5.2	6.3				21.5	20.9	18.3	9.6	6.8	1.8	5.4
2	-4.4	-5.9	5.8				21.2	20.0	17.9	9.2	6.4	1.6	5.0
3	-4.5	-6.1	5.5				21.0	19.6	17.7	8.8	5.8	1.3	4.7
4	-4.6	-6.4	4.9				20.7	19.3	17.4	8.5	5.6	1.3	4.4
5	-4.7	-6.7	4.4				20.8	19.2	17.1	8.2	5.3	1.1	4.1
6	-4.7	-7.0	3.9				20.9	19.3	16.3	7.8	5.2	1.0	3.9
7	-4.4	-7.4	3.8				20.9	19.2	16.6	7.5	5.0	0.9	3.8
8	-4.3	-7.4	3.8				21.3	19.3	16.9	7.5	4.6	0.9	3.8
9	-4.4	-7.3	3.9				21.6	19.7	16.9	8.1	4.9	1.1	4.3
10	-4.4	-6.9	4.7				22.2	20.0	19.3	9.3	5.6	1.5	4.8
11	-4.1	-5.6	5.2				22.7	20.7	20.0	10.9	7.0	2.1	5.9
12	-3.6	-4.3	7.5				24.3	16.6	21.7	12.4	8.4	2.8	7.0
13	-3.1	-3.5	8.7				25.1	23.2	23.4	13.8	9.3	3.2	8.2
14	-2.3	-3.4	9.3				25.7	24.4	24.2	14.6	9.8	3.7	8.8
15	-2.4	-2.3	9.9				25.9	24.6	24.1	15.6	10.5	4.6	9.5
16	-2.2	-2.3	10.7				24.2	24.6	25.0	15.9	10.1	4.8	9.3
17	-2.3	-2.3	10.9				24.3	24.6	24.5	15.6	10.7	4.7	9.4
18	-2.8	-2.8	10.9				24.2	24.4	24.0	15.5	9.9	4.2	9.0
19	-2.1	-2.9	10.3				24.3	23.7	22.4	13.9	9.4	3.9	8.6
20	-3.6	-3.4	9.6				23.8	22.8	21.0	12.9	8.9	3.3	7.7
21	-3.8	-4.0	9.0				23.2	22.0	20.9	11.9	8.3	2.9	7.2
22	-4.2	-4.4	7.9				22.5	21.4	20.1	11.1	7.7	2.8	6.6
23	-4.5	-4.6	7.4				22.0	21.0	19.4	10.5	7.2	2.6	6.1
24	-4.7	-4.8	6.9				21.8	20.8	18.8	9.6	7.0	2.5	5.7
MONTH AVE.	-3.7	-4.9	7.1				22.9	21.4	20.2	11.2	7.5	2.5	6.4

TOTAL OBSERVATIONS = 5221.0
ALL TEMPERATURES IN DEGREES CELSIUS

TABLE 3-13
10-METER LEVEL

AVERAGE RELATIVE HUMIDITY TABLE													HOUR
HOUR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	AVE.
1	84.8	85.0	72.6				98.0	100.0	95.9	85.4	86.4	70.7	84.1
2	87.1	89.5	76.0				98.3	100.0	96.9	85.4	87.0	70.2	85.8
3	87.5	89.5	78.4				98.8	100.0	97.9	86.8	87.2	72.7	86.8
4	88.5	90.0	80.0				99.0	100.0	97.7	87.4	86.7	75.4	87.4
5	89.1	88.4	83.3				99.1	100.0	98.4	88.0	85.9	74.6	87.9
6	89.4	88.6	85.4				99.1	100.0	98.3	88.0	86.6	75.3	88.5
7	89.9	90.1	86.8				98.8	100.0	97.9	89.3	87.0	74.4	89.0
8	90.3	90.4	85.2				96.3	100.0	93.4	88.8	86.2	75.0	88.4
9	90.1	91.2	77.6				94.9	100.0	90.8	82.0	85.5	73.4	85.5
10	87.1	89.5	70.7				92.9	95.7	79.1	72.0	82.0	70.5	80.3
11	84.9	83.3	60.8				89.6	87.5	73.2	59.7	77.0	65.9	74.0
12	81.6	76.3	60.8				86.5	78.7	71.7	52.8	69.9	61.9	69.8
13	80.2	71.7	58.0				84.6	75.0	65.8	49.2	63.5	56.4	66.1
14	77.4	67.6	55.7				81.6	72.3	67.5	45.9	59.3	53.1	63.3
15	78.2	69.7	52.7				80.0	73.6	57.7	45.3	58.2	53.4	61.9
16	76.7	71.8	53.0				78.9	70.8	59.6	44.8	57.1	51.9	61.6
17	79.0	70.9	51.3				78.6	61.9	62.7	45.8	59.5	52.7	62.1
18	80.7	71.1	50.1				80.7	63.9	73.2	47.2	65.3	54.6	64.8
19	82.2	73.8	52.5				85.2	73.9	83.7	56.8	69.7	57.0	69.2
20	83.9	75.7	55.4				91.7	95.5	86.9	67.0	74.3	61.4	73.9
21	83.9	78.2	59.4				95.1	98.3	88.7	73.7	79.6	66.4	77.6
22	84.8	80.9	65.0				96.0	98.3	91.8	76.9	82.4	68.0	80.3
23	84.2	83.2	68.0				96.4	98.3	92.2	79.9	85.2	69.0	81.9
24	85.7	85.3	69.6				96.8	98.3	92.8	81.6	85.5	69.1	83.0
MONTH AVE.	84.4	81.3	67.0				91.6	87.0	33.6	69.5	76.4	65.5	77.0

TOTAL OBSERVATIONS = 5256.0

TABLE 3-14
10-METER LEVEL

AVERAGE WET BULB TEMPERATURE TABLE													
HOUR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	HOUR AVE.
1	-4.6	-7.6	3.7				18.3	0.3	15.5	7.2	5.1	-0.6	4.3
2	-4.4	-6.8	3.4				18.1	10.1	16.1	6.9	5.4	-1.2	3.9
3	-4.3	-6.7	3.1				17.6	10.1	15.1	6.5	4.8	-1.0	3.7
4	-4.4	-7.2	2.8				17.2	10.1	16.4	6.3	5.0	-1.1	3.4
5	-4.5	-7.3	2.6				16.9	10.1	14.8	6.1	4.9	-1.3	3.3
6	-4.6	-7.9	2.0				16.9	10.1	14.3	6.0	4.4	-1.2	3.1
7	-4.5	-7.9	1.7				17.4	10.1	14.0	5.8	4.2	-1.3	3.0
8	-4.2	-8.1	2.2				18.8	0.3	15.2	6.3	4.2	-1.4	3.3
9	-4.2	-7.4	2.6				20.3	12.1	15.4	7.0	4.8	-1.0	4.3
10	-4.0	-6.4	3.7				21.3	14.4	16.9	8.2	5.3	0.4	5.2
11	-3.5	-5.1	3.8				22.6	14.8	18.1	9.2	6.2	1.1	6.0
12	-3.1	-4.0	6.1				22.6	13.1	19.9	10.0	7.2	1.5	6.8
13	-2.7	-3.3	6.8				23.2	6.7	20.5	11.3	7.8	1.2	7.5
14	-1.9	-3.2	7.3				23.5	6.4	21.4	11.6	8.1	1.7	7.8
15	-2.1	-2.2	7.6				23.3	6.9	20.0	12.4	8.5	2.4	8.1
16	-1.9	-2.3	8.2				23.3	10.6	20.0	12.5	8.1	2.4	8.1
17	-2.2	-2.3	8.4				23.3	14.1	19.3	12.3	3.4	2.4	8.1
18	-2.6	-3.0	8.4				23.2	13.4	20.8	11.7	7.6	1.6	7.7
19	-3.0	-3.5	7.4				23.0	13.8	19.8	10.3	6.8	1.4	7.1
20	-3.5	-4.1	6.3				21.7	14.1	18.3	9.4	6.2	1.0	6.3
21	-3.7	-4.9	5.6				20.7	13.1	17.3	8.7	5.7	0.7	5.7
22	-4.2	-5.3	4.8				20.0	12.8	16.8	8.1	5.7	0.4	5.2
23	-4.5	-5.5	4.4				19.1	12.8	16.6	7.6	5.3	0.3	4.9
24	-4.7	-5.9	4.0				18.7	12.4	15.1	7.5	5.1	0.1	4.4
MONTH AVE.	-3.6	-5.3	4.9				20.4	10.6	17.6	8.8	6.1	0.4	5.5

TOTAL OBSERVATIONS = 5256.0
ALL TEMPERATURES IN DEGREES CELSIUS

3.3.2 Air Quality

3.3.2.1 Sulfur Dioxide (SO₂)

The data recovery rate for the TECO SO₂ monitor over the nine months has been a poor-to-fair 74 percent due to initial sensor problems that required return of the instrument to the manufacturer for repairs. After repair, from September 1978 through March 1979, the data recovery rate has been an acceptable 84 percent.

The 3-hour and 24-hour SO₂ concentration frequency distributions are indicated on Table 3-15. The maximum recorded 3-hour SO₂ concentration has been 0.280 parts per million (ppm) by volume, which is 56 percent of the secondary 3-hour National Ambient Air Quality Standard (NAAQS) of 0.500 ppm. The maximum observed 24-hour concentration of 0.095 ppm is 68 percent of the primary NAAQS of 0.140 ppm. The mean SO₂ concentration over the nine months based on the mean of the 24-hour averages was 0.018 ppm, which is 60 percent of the annual primary NAAQS, and 0.015 ppm based on the mean of the 1-hour averages, or 50 percent of the NAAQS.

Mean hourly SO₂ concentrations versus wind direction are shown on Table 3-16. The highest concentrations occurred with winds from the northern quadrant (north-northwest through north-northeast) with a secondary maximum with flow from the southeast. Since the monitoring station parking lot is to the north of the SO₂ monitor manifold intake, the higher concentrations associated with winds from the north may be artificial since sulfur compounds are emitted from the catalytic converter on the technician's car as he comes and goes from work. The Ft. Martin coal-fired power plant is located to the southeast of the monitoring site and is probably the source of the higher SO₂ concentrations correlated with flow from that direction.

TABLE 3-15

POLLUTANT: SULFUR DIOXIDE

24 HOUR DISTRIBUTION OF CONCENTRATIONS (PPB)		3 HOUR DISTRIBUTION OF CONCENTRATIONS (PPB)		MAXIMUM CONCENTRATIONS (PPM)		
RANGE	FREQUENCY	RANGE	FREQUENCY	MONTH	24 HR. AVG.	3 HR. AVG.
ZERO OR LESS	11	ZERO OR LESS	1043	JANUARY	0.06633	0.11079
0.001 - 14.000	102	0.001 - 50.000	3081	FEBRUARY	0.06876	0.13000
14.001 - 28.000	56	50.001 - 100.000	293	MARCH	0.06066	0.24533
28.001 - 42.000	27	100.001 - 150.000	26	APRIL	0.0	0.0
42.001 - 56.000	15	150.001 - 200.000	9	MAY	0.0	0.0
56.001 - 70.000	8	200.001 - 250.000	5	JUNE	0.0	0.0
70.001 - 84.000	0	250.001 - 300.000	2	JULY	0.01186	0.03496
84.001 - 98.000	1	300.001 - 350.000	0	AUGUST	0.00006	0.00083
98.001 - 112.000	0	350.001 - 400.000	0	SEPT.	0.00880	0.03771
112.001 - 126.000	0	400.001 - 450.000	0	OCTOBER	0.04390	0.15208
126.001 - 140.000	0	450.001 - 500.000	0	NOVEMBER	0.09524	0.27979
GREATER THAN 140.000	0	GREATER THAN 500.000	0	DECEMBER	0.03564	0.07754

TOTAL OBSERVATIONS = 220

TOTAL OBSERVATIONS = 4459

Calibrations = 394

Total Valid Data = 4853

ANNUAL AVERAGE CONCENTRATION (PPM) = 0.01784
BASED ON 24 HOUR VALUES.

TABLE 3-16
MEAN HOURLY SO₂ CONCENTRATIONS
VERSUS WIND DIRECTION

Wind Direction	Mean SO ₂ Concentration (Parts per Billion)
N	21.1
NNE	22.3
NE	16.3
ENE	19.6
E	12.0
ESE	10.3
SE	20.2
SSE	18.8
S	13.4
SSW	14.3
SW	13.1
WSW	13.2
W	14.5
WNW	14.6
NW	17.4
NNW	20.8

Mean hourly SO₂ concentrations tabulated on Table 3-17 reveal highest levels during midday and lower values at night. Normally, for concentrations controlled primarily by meteorological conditions, the reverse would have been true: higher concentrations at night when the atmosphere is stable and dispersion poor, and lower values during midday when the air is unstable and dispersion is best. Higher midday concentrations usually indicate localized, nearby emission sources, probably the auto exhaust and the power plant.

3.3.2.2. Nitrogen Oxides (NO_x)

The 9-month data recovery rate for the Monitor Labs instrument has been a good-to-excellent 90 percent.

The only ambient standard for NO_x is an annual arithmetic mean (of the 24-hour averages) of 0.050 ppm. Table 3-18 shows a mean NO_x concentration over the nine-months of 0.018 ppm, which is 36 percent of the annual NAAQS. The maximum recorded 24-hour concentration has been 0.091 ppm with peak 1-hour values as high as 0.192 ppm.

TABLE 3-17

POLLUTANT: SULFUR DIOXIDE

HOURLY AVERAGE CONCENTRATIONS (PPM)

HOUR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	HOUR AVG.
1	0.02478	0.03904	0.01678				0.00205	0.00062	0.00095	0.00627	0.01571	0.01314	0.01326
2	0.02663	0.03677	0.02239				0.00087	0.0	0.00080	0.00644	0.01393	0.01298	0.01342
3	0.02862	0.03845	0.01996				0.00056	0.0	0.00112	0.00804	0.01368	0.00637	0.01298
4	0.0	0.0	0.0				0.00150	0.0	0.00007	0.0	0.02337	0.00572	0.00341
5	0.01935	0.03778	0.03000				0.0	0.0	0.00074	0.00373	0.01288	0.01425	0.01319
6	0.02168	0.03866	0.01728				0.0	0.0	0.00084	0.01416	0.01486	0.01438	0.01354
7	0.01975	0.03577	0.01676				0.00075	0.0	0.00083	0.01496	0.01266	0.01542	0.01299
8	0.02558	0.03568	0.01680				0.00249	0.0	0.00096	0.01387	0.01171	0.02256	0.01440
9	0.02378	0.03857	0.02015				0.00280	0.0	0.00126	0.01137	0.01851	0.01940	0.01509
10	0.02357	0.03826	0.02666				0.00451	0.0	0.00337	0.01105	0.01791	0.01744	0.01586
11	0.02744	0.03408	0.02698				0.00601	0.0	0.00323	0.00917	0.01490	0.01722	0.01545
12	0.02938	0.03344	0.05170				0.00269	0.0	0.00172	0.01489	0.02166	0.01762	0.01923
13	0.02796	0.03915	0.04996				0.00244	0.0	0.00200	0.02010	0.03545	0.01430	0.02126
14	0.02591	0.03546	0.03931				0.00253	0.0	0.00254	0.01660	0.02510	0.01105	0.01761
15	0.02537	0.03727	0.02969				0.00775	0.00062	0.00162	0.01504	0.02217	0.01007	0.01662
16	0.03175	0.03563	0.02527				0.00489	0.0	0.00132	0.01037	0.02473	0.01035	0.01604
17	0.02721	0.03241	0.01792				0.00494	0.0	0.00125	0.01135	0.03058	0.00840	0.01490
18	0.02380	0.03559	0.01702				0.00696	0.0	0.00079	0.01097	0.02854	0.01075	0.01493
19	0.02402	0.03984	0.02170				0.00443	0.0	0.00034	0.01019	0.02735	0.01124	0.01546
20	0.02431	0.04232	0.02191				0.00210	0.00125	0.00010	0.01036	0.02447	0.01148	0.01537
21	0.02536	0.04323	0.02072				0.0	0.0	0.00011	0.00947	0.02217	0.01321	0.01492
22	0.02441	0.04221	0.01960				0.0	0.0	0.00032	0.00810	0.01929	0.01263	0.01406
23	0.02408	0.03866	0.01896				0.0	0.0	0.00081	0.00781	0.01853	0.01356	0.01360
24	0.02333	0.04004	0.02070				0.0	0.0	0.00164	0.00599	0.01757	0.01200	0.01348
MONTH AVG.	0.02409	0.03618	0.02368				0.00251	0.00010	0.00120	0.01043	0.02032	0.01315	0.01463

TABLE 3-18

POLLUTANT: NITROGEN OXIDES

24 HOUR DISTRIBUTION OF CONCENTRATIONS (PPB)			1 HOUR DISTRIBUTION OF CONCENTRATIONS (PPB)			MAXIMUM CONCENTRATIONS (PPM)		
RANGE		FREQUENCY	RANGE		FREQUENCY	MONTH	24 HR. AVG.	1 HR. AVG.
ZERO OR LESS		0	ZERO OR LESS		264	JANUARY	0.05026	0.12400
0.001 - 5.000		20	0.001 - 5.000		613	FEBRUARY	0.08798	0.10300
5.001 - 10.000		60	5.001 - 10.000		1428	MARCH	0.04191	0.17000
10.001 - 15.000		50	10.001 - 15.000		949	APRIL	0.0	0.0
15.001 - 20.000		41	15.001 - 20.000		671	MAY	0.0	0.0
20.001 - 25.000		35	20.001 - 25.000		358	JUNE	0.00536	0.01562
25.001 - 30.000		10	25.001 - 30.000		302	JULY	0.02392	0.04187
30.001 - 35.000		12	30.001 - 35.000		188	AUGUST	0.03045	0.15812
35.001 - 40.000		7	35.001 - 40.000		178	SEPT.	0.02120	0.17212
40.001 - 45.000		10	40.001 - 45.000		119	OCTOBER	0.04079	0.13875
45.001 - 50.000		6	45.001 - 50.000		96	NOVEMBER	0.09123	0.19187
GREATER THAN 50.000		7	GREATER THAN 50.000		354	DECEMBER	0.04726	0.09625
TOTAL OBSERVATIONS = 258			TOTAL OBSERVATIONS = 5520			ANNUAL AVERAGE CONCENTRATION (PPM) = 0.01844		
			Calibrations = 408			BASED ON 24 HOUR VALUES.		
			Total Valid Data = 5928					

Again, the mean hourly NO_x concentrations on Table 3-19 show highest values with winds from the north and the southeast quadrants, with also a high anomaly with east- northeast winds. Auto tail-pipe emissions and burning of coal at the power plant are both major sources of NO_x.

TABLE 3-19

MEAN HOURLY NO_x CONCENTRATIONS
VERSUS WIND DIRECTION

<u>Wind Direction</u>	<u>Mean NO_x Concentration (Parts per Billion)</u>
N	25.5
NNE	26.4
NE	19.9
ENE	26.4
E	18.3
ESE	14.7
SE	20.3
SSE	23.7
S	20.5
SSW	17.1
SW	15.9
WSW	17.0
W	15.4
WNW	20.3
NW	18.0
NNW	20.9

Table 3-20 indicates highest NO_x levels at night and lowest concentrations during mid-afternoon, which is the typical diurnal variation expected when concentration levels are controlled primarily by meteorological conditions.

3.3.2.3 Carbon Monoxide (CO)

The data recovery rate for the CO sensor has been 78 percent. Table 3-21 shows that the maximum recorded 1-hour CO concentration has been 2.35 ppm, which is 7 percent of the NAAQS of 35 ppm. The maximum

TABLE 3-20

POLLUTANT: NITROGEN OXIDES

HOURLY AVERAGE CONCENTRATIONS (PPM)

HOUR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	HOUR AVG.
1	0.01990	0.03273	0.01652				0.01206	0.01310	0.01368	0.02478	0.03976	0.02130	0.01970
2	0.01936	0.03418	0.01976				0.01237	0.01297	0.01300	0.02345	0.03762	0.02220	0.02035
3	0.00450	0.0	0.01620				0.01188	0.00625	0.02873	0.13875	0.05280	0.01493	0.02847
4	0.00500	0.0	0.01020				0.02594	0.00525	0.01311	0.02969	0.05262	0.01337	0.01696
5	0.01863	0.03407	0.02371				0.01328	0.01296	0.01145	0.02298	0.03254	0.02312	0.02053
6	0.01741	0.03239	0.02408				0.00999	0.01180	0.01176	0.02426	0.03245	0.01909	0.01939
7	0.01700	0.03109	0.02546				0.01187	0.01320	0.01399	0.02789	0.03399	0.01975	0.02086
8	0.02014	0.03391	0.02735				0.01168	0.01477	0.01553	0.02573	0.03040	0.02357	0.02175
9	0.01859	0.03376	0.02404				0.01024	0.01542	0.01357	0.02322	0.03095	0.02066	0.02004
10	0.02007	0.03490	0.01948				0.00975	0.01575	0.01216	0.01931	0.03177	0.02036	0.01936
11	0.02086	0.02658	0.01658				0.01006	0.02373	0.01239	0.01380	0.02306	0.01880	0.01659
12	0.02129	0.02239	0.02598				0.00733	0.01494	0.00852	0.01479	0.02582	0.01542	0.01565
13	0.02212	0.02733	0.02890				0.00648	0.00827	0.00912	0.01652	0.02517	0.01360	0.01575
14	0.02127	0.02426	0.02148				0.00745	0.00757	0.00960	0.01356	0.02240	0.01187	0.01395
15	0.01937	0.02580	0.01810				0.00748	0.00760	0.00898	0.01184	0.02193	0.01059	0.01332
16	0.02165	0.02368	0.01521				0.00884	0.00605	0.00699	0.01073	0.02368	0.01117	0.01286
17	0.02109	0.02296	0.01441				0.00932	0.00925	0.00749	0.01124	0.02663	0.01280	0.01381
18	0.02102	0.02348	0.01766				0.00949	0.00712	0.00830	0.01125	0.02543	0.01585	0.01421
19	0.02059	0.02639	0.01638				0.01058	0.00722	0.00950	0.01185	0.02805	0.02079	0.01539
20	0.01945	0.02706	0.01329				0.00955	0.00745	0.01012	0.01365	0.03143	0.02155	0.01554
21	0.02003	0.02741	0.01217				0.00869	0.00916	0.01020	0.01754	0.03316	0.02275	0.01636
22	0.01972	0.02737	0.01312				0.00940	0.01120	0.01281	0.02222	0.03572	0.02138	0.01755
23	0.01978	0.02800	0.01622				0.00989	0.01163	0.01387	0.02408	0.03697	0.01972	0.01828
24	0.02086	0.02987	0.01517				0.01068	0.01216	0.01381	0.02483	0.03892	0.02039	0.01887
MONTH AVG.	0.01874	0.02623	0.01881				0.01060	0.01103	0.01203	0.02408	0.03222	0.01813	0.01773

TABLE 3-21

POLLUTANT: CARBON MONOXIDE

24 HOUR DISTRIBUTION OF CONCENTRATIONS (PPB)		1 HOUR DISTRIBUTION OF CONCENTRATIONS (PPB)		MAXIMUM CONCENTRATIONS (PPM)		
RANGE	FREQUENCY	RANGE	FREQUENCY	MONTH	24 HR. AVG.	1 HR. AVG.
ZERO OR LESS	2	ZERO OR LESS	220	JANUARY	0.58954	2.00000
0.001 - 1000.000	204	0.001 - 3500.000	4501	FEBRUARY	0.53667	1.36000
1000.001 - 2000.000	3	3500.001 - 7000.000	0	MARCH	0.45100	1.07000
2000.001 - 3000.000	0	7000.000 - 10500.000	0	APRIL	0.0	0.0
3000.001 - 4000.000	0	10500.000 - 14000.000	0	MAY	0.0	0.0
4000.001 - 5000.000	0	14000.000 - 17500.000	0	JUNE	0.34323	0.63750
5000.000 - 6000.000	0	17500.000 - 21000.000	0	JULY	0.76302	2.35000
6000.000 - 7000.000	0	21000.000 - 24500.000	0	AUGUST	1.17344	1.65000
7000.000 - 8000.000	0	24500.000 - 28000.000	0	SEPT.	0.37553	0.91500
8000.000 - 9000.000	0	28000.000 - 31500.000	0	OCTOBER	0.21886	0.67667
9000.000 - 10000.000	0	31500.000 - 35000.000	0	NOVEMBER	0.65659	1.61833
GREATER THAN 10000.000	0	GREATER THAN 35000.000	0	DECEMBER	0.56309	1.18250

TOTAL OBSERVATIONS = 209

 TOTAL OBSERVATIONS = 4721
 Calibrations = 354
 Total Valid Data = 5075
ANNUAL AVERAGE CONCENTRATION (PPM) = 0.27750
BASED ON 24 HOUR VALUES.

measured 8-hour level has been 1.37 ppm, which is 15 percent of the NAAQS of 9 ppm.

CO emissions are associated with incomplete combustion of fossil fuels and are normally emitted from autos primarily. The relatively low concentrations recorded at this monitoring station are representative of isolated rural areas far-removed from major CO emission sources.

Table 3-22 again reveals highest CO levels with winds from the northern quadrant, possibly associated with emissions from the technician's car. From the direction of the Fort Martin power plant, the CO levels were at a minimum indicating that the plant is not a major emitter of CO.

TABLE 3-22
MEAN HOURLY CO CONCENTRATIONS
VERSUS WIND DIRECTION

<u>Wind Direction</u>	<u>Mean CO Concentration (Parts per Billion)</u>
N	342
NNE	390
NE	317
ENE	303
E	258
ESE	191
SE	185
SSE	212
S	250
SSW	248
SW	285
WSW	300
W	271
WNW	312
NW	317
NNW	306

Hourly CO concentrations on Table 3-23 show higher levels at night and lower values during the day, which is indicative of concentrations controlled primarily by meteorological conditions.

TABLE 3-23

POLLUTANT: CARBON MONOXIDE

HOURLY AVERAGE CONCENTRATIONS (PPM)

HOUR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	HOUR AVG.
1	0.28222	0.31667	0.25571				0.40400	0.47250	0.16159	0.18620	0.42908	0.32190	0.30465
2	0.28000	0.33325	0.28071				0.36910	0.49110	0.16954	0.16991	0.41125	0.32333	0.31354
3	0.29889	0.34750	0.29143				0.35885	0.47700	0.16987	0.15287	0.37917	0.36737	0.32013
4	0.29222	0.36875	0.32179				0.32250	0.46870	0.09386	0.10738	0.35225	0.31875	0.29570
5	0.28778	0.34000	0.30786				0.34375	0.45640	0.17143	0.16458	0.0	0.31250	0.26843
6	0.24556	0.31208	0.22571				0.32170	0.46500	0.15687	0.13148	0.0	0.28125	0.24230
7	0.43857	0.30958	0.30222				0.43260	0.50573	0.14516	0.14296	0.32050	0.30289	0.32169
8	0.25750	0.31556	0.30333				0.61407	0.56100	0.14607	0.16685	0.34050	0.26776	0.32810
9	0.22714	0.32222	0.29103				0.52458	0.55596	0.13850	0.16788	0.34350	0.33412	0.31549
10	0.14630	0.29080	0.24690				0.47827	0.56018	0.12391	0.10148	0.31190	0.29971	0.27758
11	0.17750	0.25478	0.21074				0.45792	0.62009	0.13058	0.06827	0.27196	0.33633	0.27157
12	0.20333	0.21591	0.18286				0.45890	0.57134	0.13467	0.05893	0.23287	0.32288	0.24985
13	0.18706	0.19542	0.17741				0.47413	0.56971	0.12107	0.05769	0.23426	0.32250	0.24601
14	0.17833	0.20792	0.17407				0.41160	0.56065	0.17819	0.05687	0.21080	0.30100	0.24419
15	0.21187	0.17042	0.19536				0.32450	0.49583	0.10868	0.04983	0.21431	0.29566	0.22498
16	0.25667	0.18208	0.21552				0.29259	0.49961	0.10579	0.05292	0.20422	0.26697	0.22671
17	0.26637	0.17333	0.19276				0.27202	0.49295	0.10190	0.04925	0.20776	0.26012	0.21543
18	0.26769	0.17917	0.20207				0.27963	0.46991	0.11434	0.05942	0.21664	0.25179	0.22781
19	0.28154	0.21417	0.20857				0.30450	0.40926	0.12000	0.06560	0.24975	0.34524	0.24570
20	0.26231	0.22458	0.22929				0.29360	0.46009	0.12841	0.06965	0.25342	0.30119	0.24693
21	0.27615	0.21875	0.23214				0.28320	0.44154	0.13989	0.10431	0.28417	0.30702	0.25413
22	0.28030	0.23500	0.23407				0.31687	0.45440	0.14097	0.17196	0.37717	0.33905	0.28203
23	0.29455	0.24958	0.25593				0.32135	0.46660	0.14316	0.20018	0.38333	0.28429	0.28865
24	0.28600	0.28125	0.25852				0.34808	0.48500	0.15295	0.19546	0.39367	0.31405	0.30150
MONTH AVG.	0.25774	0.26091	0.24150				0.37547	0.50044	0.13739	0.11466	0.27594	0.30824	0.27142

3.3.2.4 Ozone (O_3)

Because of initial instrument problems with the Dasibi monitor, the overall 9-month data recovery rate was only poor-to-fair at 70 percent. From September 1, 1978 through March 31, 1979, the data recovery rate has been excellent at 90 percent.

Table 3-24 shows a maximum 1-hour O_3 concentration of 0.115 ppm, which is within the recently promulgated new NAAQS of 0.120 ppm. There were 16 occurrences of 1-hour O_3 concentrations greater than 0.080 ppm, which is the West Virginia ambient standard (and the old NAAQS).

Mean O_3 concentrations on Table 3-25 reveal highest levels with winds from the southern quadrant indicating that the Morgantown urban area to the south of the monitoring station is probably the primary O_3 source.

As seen on Table 3-26, O_3 levels were 3 to 5 times higher during the afternoon than at night. O_3 is formed through complex photochemical reactions among sunlight (ultraviolet radiation), hydrocarbons, and nitrogen oxides. Airborne chemicals necessary for these reactions are emitted both by natural emanations and by man-made sources.

3.3.2.5 Non-Methane Hydrocarbons (NMHC)

At the present time, there is no EPA reference or equivalent method for measuring NMHC and such observations are not required. NMHC were measured using a Beckman gas chromatograph, a laboratory instrument ill-suited for field use. The sensor has a hydrogen flame that is automatically shut-off in the event of an electrical power interruption. Over the nine months, the NMHC data recovery rate has been 66 percent with most of the data losses due to power failures during the night or on week-ends.

TABLE 3-24

POLLUTANT: OZONE

24 HOUR DISTRIBUTION OF CONCENTRATIONS(PPB)			1 HOUR DISTRIBUTION OF CONCENTRATIONS(PPB)			MAXIMUM CONCENTRATIONS (PPM)		
RANGE		FREQUENCY	RANGE		FREQUENCY	MONTH	24 HR. AVG.	1 HR. AVG.
ZERO OR LESS		8	ZERO OR LESS		929	JANUARY	0.02086	0.02800
0.001 -	8.000	118	0.001 -	8.000	1884	FEBRUARY	0.00730	0.01125
8.001 -	16.000	39	8.001 -	16.000	741	MARCH	0.00927	0.01325
16.001 -	24.000	12	16.001 -	24.000	329	APRIL	0.0	0.0
24.001 -	32.000	2	24.001 -	32.000	127	MAY	0.0	0.0
32.001 -	40.000	3	32.001 -	40.000	44	JUNE	0.0	0.0
40.001 -	48.000	1	40.001 -	48.000	36	JULY	0.0	0.0
48.001 -	56.000	2	48.001 -	56.000	27	AUGUST	0.0	0.0
56.001 -	64.000	1	56.001 -	64.000	13	SEPT.	0.06006	0.11500
64.001 -	72.000	0	64.001 -	72.000	19	OCTOBER	0.01894	0.03625
72.001 -	80.000	0	72.001 -	80.000	13	NOVEMBER	0.01344	0.03575
GREATER THAN	80.000	0	GREATER THAN	80.000	16	DECEMBER	0.01009	0.01575
TOTAL OBSERVATIONS = 186			TOTAL OBSERVATIONS = 4178			ANNUAL AVERAGE CONCENTRATION(PPM)= 0.00827		
			Calibrations = 411			BASED ON 24 HOUR VALUES.		
			Total Valid Data = 4589					

TABLE 3-25
MEAN HOURLY O₃ CONCENTRATIONS
VERSUS WIND DIRECTION

<u>Wind Direction</u>	<u>Mean O₃ Concentration (Parts per Billion)</u>
N	3.5
NNE	2.9
NE	4.4
ENE	3.5
E	4.8
ESE	6.1
SE	7.0
SSE	8.1
S	8.8
SSW	7.9
SW	7.6
WSW	6.8
W	6.2
WNW	5.6
NW	4.3
NNW	3.8

TABLE 3-26

POLLUTANT: OZONE

HOURLY AVERAGE CONCENTRATIONS (PPM)

HOUR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	HOUR AVG.
1	0.00837	0.00202	0.00452						0.01356	0.00457	0.00224	0.00259	0.00541
2	0.00887	0.00214	0.00418						0.0	0.0	0.00303	0.00285	0.00301
3	0.0	0.0	0.0						0.0	0.0	0.0	0.0	0.0
4	0.00907	0.0	0.0						0.01054	0.00295	0.00239	0.00281	0.00396
5	0.01065	0.00242	0.00398						0.01099	0.00326	0.00231	0.00253	0.00516
6	0.01030	0.00239	0.00418						0.01085	0.00322	0.00193	0.00259	0.00506
7	0.00967	0.00233	0.00412						0.01001	0.00298	0.00217	0.00231	0.00480
8	0.00953	0.00237	0.00365						0.01193	0.00391	0.00260	0.00217	0.00516
9	0.01027	0.00375	0.00495						0.01571	0.00523	0.00274	0.00295	0.00652
10	0.01080	0.00476	0.00603						0.02120	0.00769	0.00405	0.00440	0.00842
11	0.01416	0.00530	0.00688						0.02788	0.00936	0.00695	0.00601	0.01094
12	0.01387	0.00570	0.00683						0.03319	0.01172	0.00968	0.00697	0.01257
13	0.01443	0.00562	0.00587						0.03574	0.01352	0.00962	0.00746	0.01318
14	0.01598	0.00544	0.00635						0.03325	0.01506	0.01104	0.00789	0.01357
15	0.01648	0.00562	0.00685						0.04171	0.01475	0.01149	0.00723	0.01487
16	0.01503	0.00539	0.00669						0.04247	0.01462	0.01179	0.00719	0.01474
17	0.01368	0.00477	0.00668						0.03523	0.01288	0.01070	0.00612	0.01287
18	0.01206	0.00389	0.00636						0.02881	0.01061	0.00924	0.00441	0.01077
19	0.01088	0.00342	0.00594						0.02676	0.00876	0.00719	0.00375	0.00953
20	0.01044	0.00340	0.00534						0.02176	0.00722	0.00589	0.00339	0.00820
21	0.01037	0.00322	0.00499						0.01900	0.00566	0.00442	0.00277	0.00721
22	0.01039	0.00284	0.00482						0.01851	0.00454	0.00361	0.00265	0.00677
23	0.00990	0.00258	0.00437						0.01688	0.00391	0.00277	0.00290	0.00619
24	0.00915	0.00253	0.00407						0.01541	0.00377	0.00261	0.00289	0.00578
MONTH AVG.	0.01101	0.00341	0.00490						0.02089	0.00709	0.00544	0.00403	0.00811

EPA's "guideline" for NMHC (to be used in control strategies for photochemical oxidants) is a maximum average of 0.24 ppm between 0600 and 0900 local time. During all hours of the day, Table 3-27 shows that the 3-hour NMHC concentrations were greater than 0.24 ppm on 295 of 4074 observations (7 percent). During the 0600 to 0900 time period, the "guideline" has been exceeded on 13 days.

Table 3-28 indicates that the "guideline" was exceeded on the average with winds from the west-southwest and from the south. The winds from the south with higher levels are most likely due to emissions from Morgantown, but the high concentrations with winds from the west-southwest must be of local origin, possibly outgassing from nearby coal mining.

Table 3-29 reveals highest NMHC concentrations near sunrise and again near sunset, but the mean hourly concentrations really didn't show much diurnal variation. The mean monthly concentrations indicate that the abnormally high levels measured in July 1978 (the first month of operation) may be in error. There may have been an unusually strong NMHC emission source during that month, but this is unlikely.

3.3.2.6 Total Suspended Particulates (TSP)

The 9-month summary of the 24-hour TSP measurements is given below on Table 3-30. The second-highest 24-hour TSP concentration of $107 \mu\text{g}/\text{m}^3$ was well within both the primary and secondary NAAQS of 260 and $150 \mu\text{g}/\text{m}^3$, respectively. The geometric mean of the 85 measurements has been $40 \mu\text{g}/\text{m}^3$, which is also within the primary and secondary annual NAAQS of 75 and $60 \mu\text{g}/\text{m}^3$.

TABLE 3-27

POLLUTANT: THC-CH4

24 HOUR DISTRIBUTION OF CONCENTRATIONS(PPB)			3 HOUR DISTRIBUTION OF CONCENTRATIONS(PPB)			MAXIMUM CONCENTRATIONS (PPM)		
RANGE		FREQUENCY	RANGE		FREQUENCY	MONTH	24 HR. AVG.	3 HR. AVG.
ZERO OR LESS		97	ZERO OR LESS		3088	JANUARY	0.04687	0.16667
0.001 -	10.000	24	0.001 -	24.000	171	FEBRUARY	0.05130	0.39333
10.001 -	20.000	10	24.001 -	48.000	108	MARCH	0.00783	0.11333
20.001 -	30.000	6	48.001 -	72.000	97	APRIL	0.0	0.0
30.001 -	40.000	5	72.001 -	96.000	70	MAY	0.0	0.0
40.001 -	50.000	5	96.001 -	120.000	55	JUNE	0.0	0.0
50.001 -	60.000	6	120.001 -	144.000	31	JULY	3.91062	4.80416
60.001 -	70.000	3	144.001 -	168.000	38	AUGUST	0.48292	1.34750
70.001 -	80.000	2	168.001 -	192.000	40	SEPT.	0.11925	0.31000
80.001 -	90.000	1	192.001 -	216.000	39	OCTOBER	0.00864	0.17000
90.001 -	100.000	1	216.001 -	240.000	42	NOVEMBER	0.07525	0.34500
GREATER THAN	100.000	22	GREATER THAN	240.000	295	DECEMBER	0.10013	1.04250

TOTAL OBSERVATIONS = 182

TOTAL OBSERVATIONS = 4074

ANNUAL AVERAGE CONCENTRATION (PPM) = 0.14383
BASED ON 24 HOUR VALUES.

Calibrations = 271

Total Valid Data = 4345

TABLE 3-28
MEAN HOURLY NMHC CONCENTRATIONS
VERSUS WIND DIRECTION

<u>Wind Direction</u>	<u>Mean NMHC Concentration (Parts per Billion)</u>
N	65
NNE	150
NE	115
ENE	198
E	111
ESE	41
SE	181
SSE	142
S	375
SSW	171
SW	147
WSW	510
W	100
WNW	138
NW	104
NNW	118

TABLE 3-29

POLLUTANT: THC-CH4

HOURLY AVERAGE CONCENTRATIONS (PPM)

HOUR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	HOUR AVG.
1	0.01656	0.00208	0.0				2.27027	0.16270	0.03523	0.00130	0.03108	0.04024	0.28438
2	0.01625	0.0	0.0				2.31333	0.19740	0.03409	0.0	0.03933	0.04048	0.29343
3	0.04687	0.00875	0.0				2.32777	0.12840	0.03500	0.0	0.03083	0.03150	0.28990
4	0.04531	0.0	0.0				2.27916	0.13620	0.11250	0.00179	0.01717	0.00600	0.28868
5	0.02312	0.0	0.0				2.30750	0.14900	0.05705	0.0	0.0	0.00316	0.28220
6	0.01219	0.0	0.04857				2.49833	0.15180	0.06050	0.01135	0.0	0.0	0.30919
7	0.00550	0.00522	0.0				2.35138	0.13625	0.0	0.00657	0.01667	0.01000	0.28129
8	0.03250	0.0	0.0				1.91125	0.23896	0.01250	0.00071	0.00908	0.00934	0.24604
9	0.01042	0.0	0.0				1.72805	0.10380	0.0	0.0	0.01475	0.01338	0.20782
10	0.02000	0.0	0.0				1.90861	0.09679	0.01875	0.00020	0.00828	0.01044	0.22923
11	0.00786	0.05130	0.0				2.09093	0.08259	0.01000	0.0	0.00205	0.02232	0.25190
12	0.01033	0.00708	0.0				2.00825	0.06889	0.01281	0.0	0.00089	0.00482	0.23479
13	0.01900	0.0	0.0				2.08159	0.07210	0.0	0.0	0.0	0.0	0.24141
14	0.03383	0.0	0.0				2.44694	0.05824	0.00455	0.0	0.00214	0.0	0.28286
15	0.02981	0.00792	0.0				2.48166	0.06074	0.00023	0.0	0.00233	0.0	0.28696
16	0.02750	0.0	0.0				2.43024	0.06683	0.00068	0.0	0.00078	0.0	0.28067
17	0.03942	0.00583	0.0				2.57999	0.06954	0.0	0.0	0.00009	0.01631	0.30124
18	0.03227	0.0	0.0				2.68318	0.10982	0.01437	0.0	0.0	0.05750	0.32190
19	0.03068	0.03667	0.0				2.45350	0.16125	0.00979	0.0	0.00033	0.00036	0.29917
20	0.02591	0.0	0.0				2.09800	0.15843	0.01250	0.0	0.0	0.00131	0.25513
21	0.03000	0.0	0.0				2.00249	0.20423	0.01646	0.0	0.00592	0.08929	0.26093
22	0.05425	0.0	0.00600				2.06425	0.14700	0.02583	0.00018	0.02758	0.00655	0.25907
23	0.03417	0.0	0.0				2.10025	0.17990	0.02364	0.0	0.03125	0.07762	0.27187
24	0.04000	0.0	0.0				2.06349	0.15210	0.02409	0.00185	0.03708	0.01083	0.25883
MONTH AVG.	0.02682	0.00520	0.00227				2.22834	0.12887	0.02169	0.00100	0.01157	0.01881	0.27162

TABLE 3-30

TOTAL SUSPENDED PARTICULATES
(micrograms per cubic meter)

Number Samples	Concentrations		
	Maximum	Second Highest	Geometric Mean
85	114	107	40

Analyses: Stearns-Roger Services, Inc.

3.3.2.7 Trace Elements

Three composites of the particulate material have been analyzed for trace elements as listed on Table 3-31. West Virginia has no ambient standards for trace elements. EPA has only a standard for lead of $1.5 \mu\text{g}/\text{m}^3$, 3-month average. Pennsylvania has the following ambient standards for trace elements:

<u>Element</u>	<u>Allowable Concentration</u>
Beryllium	$0.01 \mu\text{g}/\text{m}^3$, 30-day mean
Fluoride	5 $\mu\text{g}/\text{m}^3$, 24-hour mean
Lead	5 $\mu\text{g}/\text{m}^3$, 30-day mean
Sulfate	10 $\mu\text{g}/\text{m}^3$, 30-day mean

The measured beryllium, fluoride, and lead concentrations have all been within these standards. The sulfate standard was exceeded on two of the three composite samples.

TABLE 3-31
TRACE ELEMENTS

Element	Concentration ($\mu\text{g}/\text{m}^3$)			Element	Concentration ($\mu\text{g}/\text{m}^3$)			Element	Concentration ($\mu\text{g}/\text{m}^3$)		
ALUMINUM	1.26	0.91	1.54	INDIUM	(Standard)			SAMARIUM	*	*	*
ANTIMONY	*	*	*	IODINE	*	*	*	SCANDIUM	*	*	*
ARSENIC	*	*	*	IRIDIUM	*	*	*	SELENIUM	*	*	*
BARIUM	*	*	*	IRON	0.30	0.59	0.52	SILICON	2.06	1.82	0.32
BERYLLIUM	*	*	*	LANTHANUM	*	*	*	SILVER	*	*	*
BISMUTH	*	*	*	LEAD	0.09	0.11	0.14	SODIUM	0.11	0.27	0.50
BORON	--	*	0.02	LITHIUM	*	0.02	*	STRONTIUM	*	*	*
BROMINE	0.01	0.02	0.01	LUTECIUM	*	*	*	SULFATE**	13.97	12.08	7.72
CADMIUM	*	*	*	MAGNESIUM	0.25	0.18	0.13	SULFUR	0.25	0.23	0.36
CALCIUM	0.46	1.66	0.32	MANGANESE	0.02	0.03	0.03	TANTALUM	*	*	*
CERIUM	*	*	*	MERCURY	0.0002	0.0002	0.0002	TELLURIUM	*	*	*
CESIUM	*	*	*	MOLYBDENUM	*	*	*	TERBIUM	*	*	*
CHLORINE	*	*	*	NEODYMIUM	*	*	*	THALLIUM	*	*	*
CHROMIUM	*	0.04	0.01	NICKEL	*	0.01	*	THORIUM	*	*	*
COBALT	*	*	*	NIObIUM	*	*	*	THULLIUM	*	*	*
COPPER	0.59	0.39	0.07	OSMIUM	*	*	*	TIN	0.01	*	*
DYSPROSIUM	*	*	*	PALLADIUM	*	*	*	TITANIUM	0.05	0.07	0.11
ERBIUM	*	*	*	PHOSPHOROUS	0.16	0.08	0.07	TUNGSTEN	*	*	*
EUROPIUM	*	*	*	PLATINUM	*	*	*	URANIUM	*	*	*
FLUORINE	*	0.05	0.05	POTASSIUM	0.39	0.39	0.20	VANADIUM	*	*	*
GADOLINIUM	*	*	*	PRASEODYMIUM	*	*	*	YTTERBIUM	*	*	*
GALLIUM	*	*	*	RHENIUM	(Standard)			YTTRIUM	*	*	*
GERMANIUM	*	*	*	RHODIUM	*	*	*	ZINC	0.08	0.03	0.08
GOLD	*	*	*	RUBIDIUM	*	*	*	ZIRCONIUM	*	*	*
HAFNIUM	*	*	*	RUTHENIUM	*	*	*				
HOLMIUM	*	*	*								

Analyses: CDM Accu-Labs

* = less than 0.01 micrograms per cubic meter.

** = sulfate ion ($\text{SO}_4^{=}$)

3.3.2.8 Dustfall

TABLE 3-32

DUSTFALL (MILLIGRAMS PER SQUARE CENTIMETER PER MONTH)

<u>Exposure Dates</u>	<u>Total Dustfall</u>	<u>Water Soluble</u>	<u>Water Insoluble</u>	<u>Combustible</u>	<u>Benzene Soluble</u>
06/30/78- 08/04/78	--*	0.337	--*	0.324	0.0039
08/04/78- 09/02/78	0.333	0.174	0.159	0.190	0.0039
09/02/78- 10/04/78	0.252	0.189	0.063	0.065	ND
10/04/78- 11/07/78	0.568	0.238	0.330	0.242	ND
11/07/78- 12/04/78	0.282	0.089	0.193	0.094	ND
12/04/78- 01/03/79	0.293	0.220	0.073	0.174	0.0197
01/03/79- 02/02/79	0.797	0.150	0.647	0.134	0.0280
02/02/79- 03/02/79	0.600	0.409	0.191	0.364	0.0358
03/02/79- 05/04/79	0.195	0.148	0.047	0.089	0.0085

*Insoluble portion of sample lost due to lab accident.

ND = Not Detectible

Analyses: DeNardo and McFarland Weather Services, Inc.

EPA and West Virginia have no dustfall standards. The Pennsylvania standard is 1.5 milligrams per square centimeter per month. The observed dustfall rates were well within this standard.

3.3.2.9 Sulfation Rate

TABLE 3-33
SULFATION RATE

<u>Exposure Dates</u>	<u>Micrograms SO₃ per cm² per day</u>	<u>Average SO₂ ppm*</u>
06/30/78- 08/04/78	2.9	0.010
08/04/78- 09/01/78	2.1	0.007
09/01/78- 10/04/78	3.1	0.011
10/04/78- 11/09/78	9.1	0.032
11/09/78- 12/04/78	6.0	0.021
12/04/78- 01/03/79	5.9	0.021
01/03/79- 02/02/79	6.6	0.023
02/02/79 03/02/79	5.3	0.019

Analyses: Corning Laboratories, Inc.

* Using a conversion factor of 0.0035

EPA, West Virginia, and Pennsylvania have no standards for sulfation rate.

3.3.2.10 Polynuclear Aromatics (PNA)

Three 5-filter composites of the particulate matter from the hi-vol samplers were analyzed for PNA's as given in the table below:

TABLE 3-34
Polynuclear Aromatics (PNA)

<u>Compound</u>	<u>Concentrations ($\mu\text{g}/\text{m}^3$)</u>		
BENZ (A) ANTHRACENE	0.000458	0.001369	0.004288
BENZ (A) PYRENE	0.001044	0.002749	0.003361
BENZ (E) PYRENE	0.000027	0.000566	0.000869
BENZ (G,H,I) PERYLENE	(none found)	0.002053	0.000313
PYRENE	0.000516	(not analyzed)	(not analyzed)

Analyses: Gulf Research and Development Company

There are presently no federal or state ambient standards for PNA's.

SECTION 4

NOISE

4.1 INTRODUCTION

This section presents the results of the baseline noise survey performed during winter 1979 at The Pittsburgh & Midway Coal Mining Co., SRC-II site, located near Fort Martin, West Virginia. The survey was conducted by Stearns-Roger Engineering Corporation from February 15 through February 20.

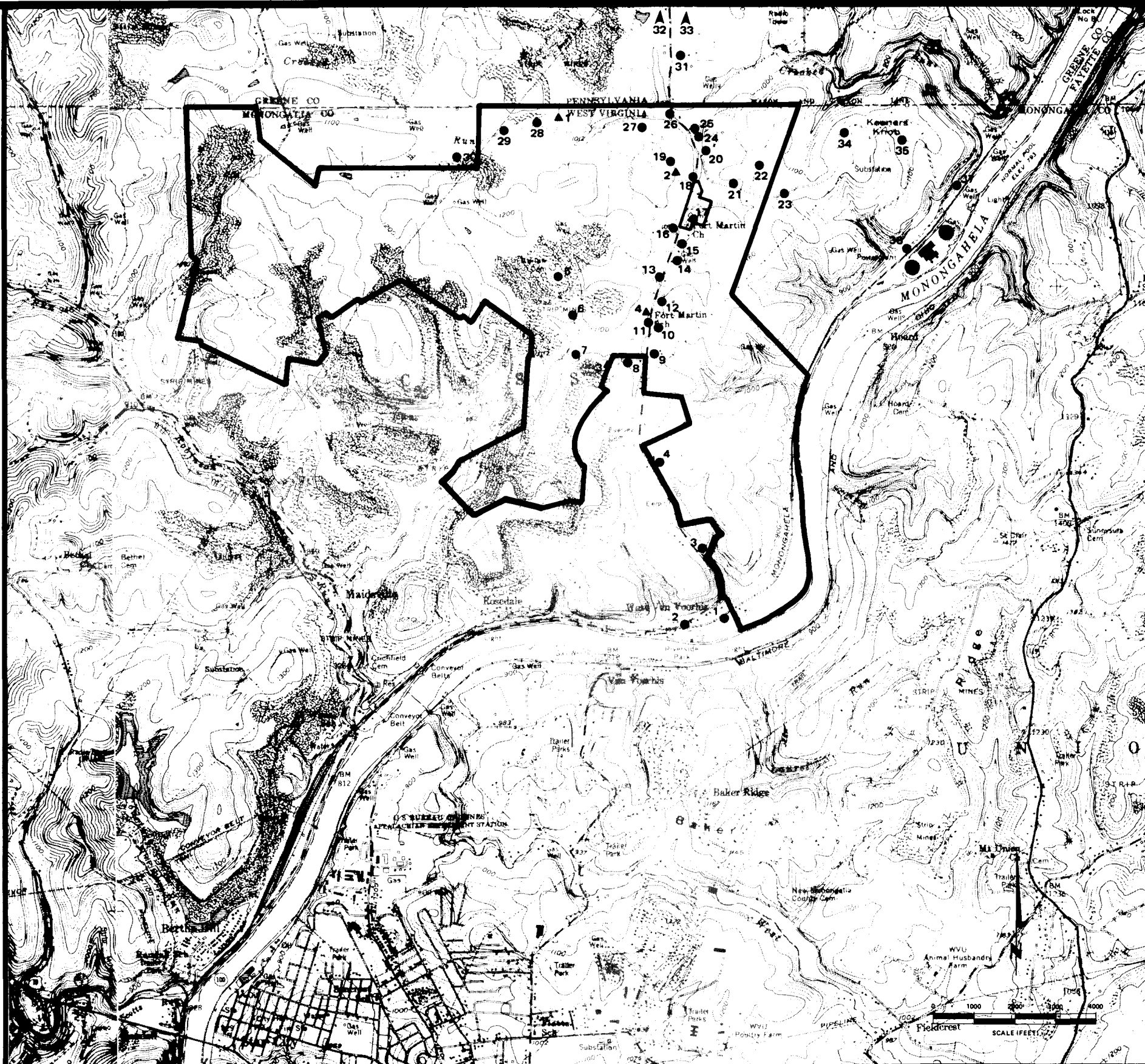
The objective of the noise survey was to document and provide complete baseline noise information in order to assess existing conditions of the surrounding area. Equipment used during this survey consisted of three discrete systems which were the standard Field Measurement System, Statistical Distribution System, and Meteorological Measurement System. Each system was calibrated per recommended standards and specifications and is further described in the following pages.

4.1.1. Methods and Procedures

Surveys were conducted both during the week and on weekends to gather information covering all extremes of activity (high, medium, and low). Field data were collected at 37 monitoring locations in the Fort Martin area (see Figure 4-1), and are shown in Exhibits 4-1 to 4-37.

Monitoring points were located to measure the nature of the outdoor noise environment on the adjacent community. Using the Standard Field Measurement System (Type 1 Precision sound-level meter and analyzer), noise was sampled on the "A-weighted" and "C-weighted" networks over a twenty minute period at each monitoring location during the daytime hours and ten minutes at selected monitoring locations during the nighttime hours.

In addition to the single point noise monitoring, continuous 24-hour statistical baseline community noise levels dB(A) were



LEGEND

- SINGLE EVENT NOISE MONITORING
- ▲ CONTINUOUS 24-HR NOISE MONITORING

RM The Pittsburgh & Allegheny Coal Mining Co. **Gulf**
A WHOLLY OWNED SUBSIDIARY OF GULF OIL CORPORATION

FIGURE 4-1
SRC-II DEVELOPMENT AREA
INDIVIDUAL SOUND LEVEL READINGS

recorded using the Metrosonics dB 602 Sound Level Analyzer. Seven 24-hour statistical community noise surveys were conducted.

Statistical exceedance level results are summarized in Table 4-1. Statistical exceedance levels are defined as the sound level in decibels exceeded x percent of the time. This exceedance is usually symbolized as L_x . For example, " $L_{50} = 28 \text{ dB(A)}$ " means 50 percent of the time the sound exceeds a level of 28 dB measured with the A-weighting network. The measures of L_{dn} (day/night) and L_{eq} (equivalent sound level) are provided as measures of the outdoor noise environment for the purpose of correlating noise and community reaction.

An L_{dn} level is defined as the "day/night" level assuming that noise disturbance is more critical during the night than the day. L_{dn} is a 24-hour equivalent continuous level calculation with a 10 decibel penalty added to every sample taken during the nine "night" hours of 10:00 p.m. to 7:00 a.m.

The equivalent sound level (L_{eq}) is regarded as the most objective single number descriptor. L_{eq} is the continuous equivalent sound level which would generate the same total energy as does the measured varying sound. In the table, statistical exceedance levels including L_{dn} and L_{eq} , are presented as a function of measurement time and location.

4.1.2 Results and Discussion

Throughout the winter survey, the outdoor atmosphere was in constant motion. Turbulence, wind gradients and temperatures, atmospheric absorption, and the land contours contributed to fluctuations in the received sound levels and in the measured amplitude.

TABLE 4-1
24-HOUR COMMUNITY NOISE ANALYSES
STATISTICAL EXCEEDANCE LEVEL RESULTS
P&M/SRC-II SITE
WINTER PERIOD

Date:	2/15-2/16	2/16-2/17	2/17-2/18	2/19-2/20
Time:	0200-1230	1300-1445	1520-1540	0800-0910
<u>Exceedance Levels dB(A)</u>	<u>Run #01</u>	<u>Run #02</u>	<u>Run #03</u>	<u>Run #04</u>
L _{max}	49	54	67	70
L ₁	41	40	45	49
L ₂	38	37	42	46
L ₅	34	34	38	41
L ₁₀	32	31	36	37
L ₂₀	30	28	33	31
L ₅₀	25	24	29	25
L ₉₀	20	20	23	20
L ₉₉	20	20	20	20
L _{min}	20	20	20	20
L _{dn}	34	33	40	41
L _{eq}	31	30	36	39

Notes for Table 4-1:

Exceedance levels are defined as the sound-level in decibels exceeded x percent of the time.

L_{dn} is a 24-hour equivalent level calculation with a 10-dB penalty added to every sample taken during the nine "night" hours of 10:00 p.m. to 7:00 a.m.

L_{eq} is the equivalent continuous sound that generates the same total energy (acting for the duration of the measurement run) as does the measured (varying) sound.

Meteorological conditions varied throughout the winter survey period from continuous to intermittent rain/snow flurries to clear, sunny days. Temperature ranged from 10 degrees to minus 21 degrees Celsius, with varying ambient wind velocities of 0 to 13 km/hr (0-8 mph).

The residual noise levels throughout the winter noise survey were apparently governed by the continuous noise from the Ft. Martin power plant, and the strip mining operations. The residual noise levels appeared to have random fluctuations during any given time period due to the environmental factors described earlier. Distinguishable single event intruding noises were propagated from propeller and jet aircraft overflights, coal truck traffic, car, pick-up truck, and triaxle transport trucks, dogs barking, and birds chirping.

Sound pressure levels measured during the winter were generally low. No long-term noise problems were identified which would prevent construction of the SRC-II Demonstration Plant.

EXHIBIT 4-1

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #01 WINTER PERIOD

Measurements were taken near the Monongahela River approximately 304 meters east of the Fort Martin Road and railroad track intersection.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1300-1310	45-50	50-54
	<u>Noise Environment:</u> Cloudy, freezing drizzle rain and snow, slight breeze, temperature -1.0°C. The major intruding single event noise sources included car passbys (Fort Martin Road) 53-56 dB(A), tug boat (no load) headed down river 57-60 dB(A).		
2/16/79	0241-0249	29-35	50-54
	<u>Noise Environment:</u> quiet, calm.		
2/16/79	0530-0548	35-37	48-52
	<u>Noise Environment:</u> Cloudy, freezing drizzle rain calm, temperature 2°C. Single event intruding noise source dog barking nearby 49-52 dB(A), otherwise quiet.		
2/17/79	0246-0254	29-31	40-42
	<u>Noise Environment:</u> Calm, temperature -18°C, no movement, quiet.		
2/17/79	0515-0533	29-33	39-44
	<u>Noise Environment:</u> Calm, temperature -20°C, quiet.		
2/18/79	0217-0225	26-30	46-48
	<u>Noise Environment:</u> Calm - slight breeze, -13°C.		
2/18/79	0520-0538	28-33	42-48
	<u>Noise Environment:</u> Calm - slight breeze, temperature -13°C, relatively quiet.		
2/19/79	0500-0518	26-30	43-50
	<u>Noise Environment:</u> Calm, temperature -7°C, quiet.		
2/20/79	0227-0235	26-29	40-44
	<u>Noise Environment:</u> Calm, temperature -14°C.		

EXHIBIT 4-2

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #02 WINTER PERIOD

Measurements were taken in the parking lot of the Full Gospel Mission Church approximately 7 meters from the edge of the Fort Martin Road.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1315-1323	31-34	56-61
	<u>Noise Environment:</u> Intermittent freezing drizzle rain, temperature -1°C, single event noise intrusions included three car passbys ranging 39-45 dB(A), loaded 3-axle coal truck coming downhill 74-87 dB(A), birds chirping and ice crackling.		
2/16/79	0228-0236	26-30	39-40
	<u>Noise Environment:</u> Calm, temperature 0°C, quiet.		
2/16/79	0554-0612	28-31	40-45
	<u>Noise Environment:</u> Calm, temperature -1°C, quiet.		
2/17/79	0234-0242	29-33	42-47
	<u>Noise Environment:</u> Breeze 2-3 mph, temperature -17°C.		
2/17/79	0539-0557	28-31	39-47
	<u>Noise Environment:</u> Slight breeze, temperature -19°C.		
2/18/79	0201-0209	25-28	39-47
	<u>Noise Environment:</u> Breeze 3-4 mph, temperature -13°C, ice crackling.		
2/18/79	0543-0601	27-33	49-61
	<u>Noise Environment:</u> Intermittent breeze 3-4 mph, temperature -12°C.		
2/19/79	0523-0541	29-35	42-47
	<u>Noise Environment:</u> Calm, temperature -7°C, snowing lightly, quiet.		
2/20/79	0210-0218	26-28	41-43
	<u>Noise Environment:</u> Calm, temperature -14°C.		

EXHIBIT 4-3

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #03 WINTER PERIOD

Measurements were taken approximately 805 meters (1/2 mile) north on Fort Martin road, 7.6 meters (25 ft) into the private driveway midway up the hill (Pink cement block house).

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1329-1337	28-30	43-46
<u>Noise Environment:</u> Calm, intermittent freezing rain, temperature -1°C, fluctuations of the wind currents made the power plant noise audible with no noticeable increase in decibels.			
2/16/79	0210-0218	29-32	39-41
<u>Noise Environment:</u> Slight breeze, temperature 0°C.			
2/16/79	0619-0637	25-29	38-45
<u>Noise Environment:</u> Cloudy, calm, temperature -1°C.			
2/17/79	0220-0228	28-30	39-42
<u>Noise Environment:</u> Calm, temperature -18°C, quiet.			
2/17/79	0606-0624	28-32	43-50
<u>Noise Environment:</u> Partly cloudy, slight breeze, temperature -19°C, single event noise sources one car passby 54-59 dB(A), cows could be heard from the farm on the west side of the road with no increase in decibel reading.			
2/18/79	0145-0153	25-27	38-43
<u>Noise Environment:</u> Calm, temperature -14°C.			
2/18/79	0607-0625	25-31	40-46
<u>Noise Environment:</u> Slight breeze, temperature -14°C, quiet, dog barking - no influence in decibels.			
2/19/79	0548-0606	27-31	38-45
<u>Noise Environment:</u> Calm, temperature -7°C, cloudy, quiet.			
2/20/79	0151-0159	26-29	38-43
<u>Noise Environment:</u> Calm, temperature -14°C.			

EXHIBIT 4-4

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #04 WINTER PERIOD

Measurements were taken approximately 7.6 meters (25 ft) from Fort Martin road into the driveway of I.R. Van Voorhis, P.O. #207.

Site Description: Main house two story red brick, detached four car garage with converted loft living quarters. Two evergreen trees in front yard and hedges around the perimeter. Directly across the road: two story red brick house, detached medium sized barn and small shed.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(B)</u>
2/15/79	1345-1353	32-35	45-49
	<u>Noise Environment:</u> Freezing rain (drizzle), calm, temperature -1°C, could hear noise from power plant with fluctuations in atmospheric wind conditions.		
2/16/79	0152-0200	31-33	40-42
	<u>Noise Environment:</u> Calm, temperature 1°C.		
2/16/79	0645-0703	34-40	45-48
	<u>Noise Environment:</u> Cloudy, intermittent rain and snow, breeze 5-8 mph, temperature -1°C, could hear noise from power plant.		
2/17/79	0200-0208	30-35	41-53
	<u>Noise Environment:</u> Strong breeze 2-3 mph, temperature -17°C.		
2/17/78	0633-0651	28-31	38-45
	<u>Noise Environment:</u> Calm, temperature -12°C, quiet.		
2/18/79	0127-0135	27-30	38-43
	<u>Noise Environment:</u> Slight breeze 2-3 mph, temperature -16°C, quiet.		
2/18/79	0632-0650	29-35	42-53
	<u>Noise Environment:</u> Breeze 3-4 mph, temperature -12°C.		
2/19/79	0614-0632	26-31	38-46
	<u>Noise Environment:</u> Calm, temperature 7°C, snowing.		
2/20/79	0136-0144	26-28	39-43
	<u>Noise Environment:</u> Calm, temperature -13°C.		

EXHIBIT 4-5

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #05 WINTER PERIOD

Measurements were taken near the Garlow Cemetery.

Site Description: Monitoring point was approximately 92 meters (100 yards) east of the coal stripping operation. Dominant intrusive noise sources included the dredge shovel and bulldozer which were operated continuously through the monitoring period. A large coal pile acted as a noise barrier as it was situated between the equipment and sound level meter instrumentation.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1404-1412	47-50	50-52
	<u>Noise Environment:</u> Cloudy, freezing (drizzle) rain, breeze 5-8 mph, bulldozer back-up signal (beeping) 47-48 dB(A), crane releasing dredged coal product from bucket onto coal pile 47-66 dB(A), crane engine noise 66-75 dB(A).		
2/16/79	0715-0733	37-41	47-61
	<u>Noise Environment:</u> Cloudy, intermittent freezing rain and snow, breeze 3-5 mph, temperature 1°C, no strip mining occurred during monitoring.		
2/17/79	0705-0723	33-37	46-53
	<u>Noise Environment:</u> Partly cloudy, slight breeze 2-3 mph, temperature -20°C, no strip mining occurred during monitoring, quiet.		
2/18/79	0708-0726	29-35	49-63
	<u>Noise Environment:</u> Cloudy, snowing, breeze 4-5 mph, temperature -12°C, quiet.		
2/19/79	0646-0704	29-38	41-53
	<u>Noise Environment:</u> Partly cloudy, intermittent rain and snow showers, breeze 3-5 mph, temperature -6°C.		

EXHIBIT 4-6

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #06 WINTER PERIOD

Measurements were taken approximately 300 meters (900 ft) south of point #05.

Site Description: Monitoring point was due east of the strip mining operation in open pasture type field.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1417-1425	43-50	53-56
	<u>Noise Environment:</u> Calm, intermittent rain and snow, temperature -1°C , car passby on Fort Martin Road (approx. 1/2 mi. east) 48-50 dB(A) noise source was produced by the car tire on icy roads. Strip mining was in operation.		
2/16/79	0740-0758	38-45	48-52
	<u>Noise Environment:</u> Windy 5-6 mph, temperature 1°C , intermittent rain (drizzle). Two southbound cars on Fort Martin road produced 52-63 decibels primarily from tire noise-icy road conditions, front end loader idling produced noise in the 42-45 decibel range.		
2/17/79	0729-0747	35-39	45-50
	<u>Noise Environment:</u> Breeze 3-5 mph, partly cloudy, temperature -21°C . Strip mining operations can be heard.		
2/18/79	0732-0750	29-34	50-65
	<u>Noise Environment:</u> Cloudy, 4-5 mph wind, temperature -12°C , quiet.		
2/19/79	0710-0728	28-33	48-56
	<u>Noise Environment:</u> Cloudy, intermittent rain, calm, temperature -7°C .		

EXHIBIT 4-7

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #07 WINTER PERIOD

Measurements were taken at the entrance to the strip mining area approximately 15 meters (50 feet) east of the abandoned barn structures.

Site Description: Open pasture type field with deciduous tree stands to the west and south.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
	<u>Noise Environment:</u> Cloudy, freezing rain and snow, strong breeze 5-8 mph, temperature -1°C. Can hear power plant noise when windy... does not influence sound level measurements.		
2/16/79	0805-0823	34-38	40-50
	<u>Noise Environment:</u> Cloudy, intermittent rain, 4-7 mph wind, temperature -3°C. Noise contributors are the strip mining operation and power plant.		
2/17/79	0753-0811	29-35	39-46
	<u>Noise Environment:</u> Clear skies, 2-4 mph breeze, temperature -20°C. Strip mining operations can be heard, otherwise quiet.		
2/18/79	0756-0814	29-33	50-58
	<u>Noise Environment:</u> Cloudy, intermittent snow, 2-4 mph breeze, temperature -12°C, quiet.		
2/19/79	0733-0751	31-35	48-55
	<u>Noise Environment:</u> Calm, temperature -7°C, strip mining operations can be heard.		

EXHIBIT 4-8

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #08 WINTER PERIOD

Measurements were taken approximately 402 meters (1/4 mile) east of point #07.

Site Description: Monitoring was conducted in the driveway of Mr. S. Slavensky residence, P.O. Box 104, Maidsville, W. Virginia, two story blond brick and veneer construction, evergreen trees in front of house alongside the road with deciduous trees around perimeter of yard.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1443-1451	34-38	42-48
	<u>Noise Environment:</u> Cloudy, calm, temperature -10°C. Noise intrusions include strip mining operation (west), powerplant noise fluctuations with the wind currents increases sound pressure level 1-2 decibels. Jet passover 39-41 decibels.		
2/16/79	0206-0216	29-32	39-42
	<u>Noise Environment:</u> Calm, temperature 10°C, snowing moderately.		
2/16/79	0840-0858	37-44	51-67
	<u>Noise Environment:</u> Cloudy, intermittent rain, 6-9 mph wind, temperature -30°C, noise intrusions include strip mining operation (west), power plant (east), car and truck traffic on Fort Martin road.		
2/17/79	0140-0148	29-33	39-42
	<u>Noise Environment:</u> Calm, temperature 10°C, snowing.		
2/17/79	0816-0836	27-32	35-43
	<u>Noise Environment:</u> Clear skies, temperature -190°C, cat meowing, birds chirping.		
2/18/79	0819-0837	33-36	51-69
	<u>Noise Environment:</u> Cloudy, 2-4 mph breeze, temperature -120°C, quiet.		
2/19/79	0757-0815	32-36	48-65
	<u>Noise Environment:</u> Cloudy, temperature -70°C, snowing.		
2/20/79	0115-0125	29-31	46-53
	<u>Noise Environment:</u> Slight breeze, temperature -140°C.		

EXHIBIT 4-9

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #09 WINTER PERIOD

Measurements were taken approximately 402 meters (1/4 mile) east of point #08.

Site Description: Monitoring point was located approximately 7.6 meters (25 feet) into the driveway of Lemuel Hunt residence (two story house). Evergreen trees surround the outer perimeter (near Fort Martin Road) of the yard including some deciduous bushes. Large open field due west, in the direction of the strip mining operation.

Date	Time	dB(A)	dB(C)
2/15/79	1458-1506	36-40	46-52
	<u>Noise Environment:</u> Cloudy, freezing rain and snow, 2-4 mph breeze, temperature -1°C, noise intrusions include power plant and strip mining operations due west.		
2/16/79	0150-0158	29-31	39-43
	<u>Noise Environment:</u> Snowing, calm, temperature 1°C.		
2/16/79	0906-0924	32-37	38-53
	<u>Noise Environment:</u> Cloudy, 4-6 mph wind gusts, temperature -6°C, intrusive noises include power plant and strip mining operations, vehicle traffic on Fort Martin road.		
2/17/79	0054-0104	30-33	39-43
	<u>Noise Environment:</u> 1-3 mph breeze, temperature -16°C, quiet.		
2/17/79	0843-0901	29-33	42-63
	<u>Noise Environment:</u> Clear skies, breeze 4-6 mph temperature -20°C, noise from power plant and car passby 52-58 dB(A).		
2/18/79	0843-0901	30-36	46-55
	<u>Noise Environment:</u> Cloudy, 2-4 mph breeze, temperature -12°C, quiet.		
2/19/79	0821-0839	32-42	43-52
	<u>Noise Environment:</u> Cloudy, calm-slight breeze, temperature -7°C, power plant noise and strip mining activity due west, car passby 48-54 decibels.		
2/20/79	0100-0110	27-30	42-50
	<u>Noise Environment:</u> snowing, 2-3 mph wind. Temperature -8°C, power plant noise.		

EXHIBIT 4-10

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #10 WINTER PERIOD

Measurements were taken approximately 152 meters (500 feet) north of point #09.

Site Description: Monitoring point was located approximately 7.6 meters (25 feet) east of Fort Martin road into a long driveway leading to a large two story red brick house. Power plant is located approximately 1 mile due east and mining operations approximately 402 meters (1/4 mile) west.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1511-1519	35-36	54-60
<u>Noise Environment:</u> freezing rain, 2-4 mph wind, temperature -1°C , mining operations to the west and north, two car passbys 50-55 decibels.			
2/16/79	0928-0946	33-35	46-51
<u>Noise Environment:</u> Cloudy, 2-4 mph wind, temperature -6°C , strip mining operations from the west and north, beeping sounds from the west site (approximately 1/4 mile away).			
2/17/79	0906-0924	36-40	48-57
<u>Noise Environment:</u> Clear skies, 4-6 mph breeze, temperature -19°C , rustle of leaves on large oak tree across Fort Martin Road in community center yard. 53-56 dB(C), quiet.			
2/18/79	0906-0924	34-38	45-53
<u>Noise Environment:</u> Cloudy, slight breeze, temperature -11°C , car passby 56-68 dB(A).			
2/19/79	0844-0902	33-39	46-54
<u>Noise Environment:</u> Cloudy, intermittent rain, temperature -5°C , power plant noise and beeping sounds from the strip mining operations due west.			

EXHIBIT 4-11

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #11 WINTER PERIOD

Measurements were taken approximately 31 meters (100 feet) northwest of point #10.

Site Description: Monitoring point was located in the Community Center lot approximately 9 meters (30 feet) west of Fort Martin road and 12 meters (40 feet) south of the Community Center building. Evergreen trees, deciduous bushes and trees lined the bordering fence line (south and west).

Date	Time	dB(A)	dB(C)
2/15/79	1523-1531	38-42	60-68
<u>Noise Environment:</u> freezing rain, strong wind 6-8 mph, temperature -1°C, mining operations to the west and north.			
2/16/79	0134-0142	31-33	40-43
<u>Noise Environment:</u> Calm, snowing, temperature 1°C.			
2/16/79	0951-1009	33-35	45-49
<u>Noise Environment:</u> Freezing rain and snow, 1-3 mph breeze, temperature -7°C, beeping sounds from west strip mining operation.			
2/17/79	0112-0120	29-31	40-46
<u>Noise Environment:</u> Calm, 1-2 mph breeze, temperature -16°C.			
2/17/79	0929-0947	33-36	53-62
<u>Noise Environment:</u> Wind gusts 4-7 mph, temperature -18°C, noise intrusions include power plant, strip mining operations, and vehicle traffic on Fort Martin road.			
2/18/79	0038-0048	31-32	45-49
<u>Noise Environment:</u> Slight breeze, temperature -16°C.			
2/18/79	0929-0947	29-34	49-57
<u>Noise Environment:</u> Cloudy, 2-3 mph breeze, temperature -11°C, relatively quiet.			
2/19/79	0907-0925	33-38	48-54
<u>Noise Environment:</u> Light rain, 2-3 mph breeze, temperature -5°C, power plant noise and strip mining operation noise. Airplane fly over (single engine prop.) 49-50 dB(A).			
2/20/79	0044-0052	28-30	45-49
<u>Noise Environment:</u> Calm, temperature -12°C.			

EXHIBIT 4-12

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #12 WINTER PERIOD

Measurements were taken approximately 152 meters (500 feet) north of point #11 on the east side of Fort Martin road.

Site Description: Monitoring was conducted approximately 7 meters (20 feet) into the driveway of the Gilgrich residence (P.O. Box 109). A two story house constructed of wood approximately 21 meters (70 feet) from Fort Martin Road.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1536-1544	35-37	53-56
	<u>Noise Environment:</u> Freezing rain, temperature -10°C, could hear people talking - car door shut 48 dB(A), relatively quiet.		
2/16/79	1014-1032	34-38	45-56
	<u>Noise Environment:</u> Cloudy, temperature -7°C, leaves rustling on trees, 3-5 mph breeze, car passby 56-74 decibels.		
2/17/79	0953-1011	30-33	42-47
	<u>Noise Environment:</u> Sunshine, temperature -15°C, birds chirping, person operating a 6 Hp. garden tractor with snow plow blade 52-62 decibels.		
2/18/79	0952-1010	31-35	43-56
	<u>Noise Environment:</u> Cloudy, temperature -11°C, 2-3 mph wind, truck passby 52-76 decibels.		
2/19/79	0931-0949	32-36	48-55
	<u>Noise Environment:</u> Intermittent rain/snow, temperature -4°C, 2-3 mph breeze, birds chirping, airplane fly over 47 decibels.		

EXHIBIT 4-13

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #13 WINTER PERIOD

Measurements were taken approximately 152 meters (500 feet) north of point #12 on Fort Martin road.

Site Description: Monitoring was conducted in the driveway (P.O. Box 184) approximately 7.6 m (25 feet) from Fort Martin road.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1549-1557	35-36	44-47
<u>Noise Environment:</u> Slight breeze, intermittent rain, temperature -1°C, power plant noise can be heard from the east.			
2/16/79	0119-0129	29-33	40-45
<u>Noise Environment:</u> Slight breeze, temperature 0°C, quiet.			
2/16/79	1039-1057	36-40	45-52
<u>Noise Environment:</u> 2-3 mph breeze, temperature -6°C, power plant noise, dog barking from residence across Fort Martin road 39-40 decibels.			
2/17/79	0100-0107	29-32	40-43
<u>Noise Environment:</u> Calm, temperature -16°C.			
2/17/79	1016-1034	35-40	47-56
<u>Noise Environment:</u> Clear skies, temperature -15°C, 7 triaxle coal trucks 72-84 dB(A), 2 pick-up trucks 64-78 dB(A), low flying single-engine airplane 54-56 dB(A), neighbors tractor with snowplow can be heard.			
2/18/79	0022-0030	29-31	42-47
<u>Noise Environment:</u> 1-2 mph breeze, temperature -15°C, quiet.			
2/18/79	1016-1034	35-40	53-65
<u>Noise Environment:</u> Cloudy, strong wind 4-7 mph, temperature -15°C, leaves rustling on the trees, car passby 56-62 dB(A).			
2/19/79	0954-1012	30-36	46-53
<u>Noise Environment:</u> Cloudy, light breeze 2-4 mph, temperature -4°C.			
2/20/79	0026-0034	27-30	42-48
<u>Noise Environment:</u> Calm, temperature -13°C, quiet.			

EXHIBIT 4-14

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #14 WINTER PERIOD

Measurements were taken approximately 152 meters (500 feet) north of point #13.

Site Description: Monitoring was conducted approximately 7.6 m (25 ft) into the driveway (Box 190) of the Darlings residence. Ranch style house located approximately 15 m (50 ft) east of Fort Martin road.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1602-1610	35-37	45-47
	<u>Noise Environment:</u> Freezing rain/snow, calm, temperature -1°C, power plant noise (east), strip mining operation (west).		
2/16/79	1102-1120	29-33	43-50
	<u>Noise Environment:</u> Cloudy, wind gusts 3-5 mph, temperature -8°C, car passby 56-62 decibels, power plant (east), strip mining operation (west).		
2/17/79	1039-1057	29-35	47-65
	<u>Noise Environment:</u> Clear skies, wind 5-6 mph, temperature -15°C, dog barking, power plant (east).		
2/18/79	1100-1118	33-40	50-69
	<u>Noise Environment:</u> Cloudy, intermittent rain/snow, temperature -10°C, wind gusts 8-10 mph.		
2/19/79	1018-1036	30-36	58-66
	<u>Noise Environment:</u> Cloudy, windy 5-7 mph, temperature -3°C, car passby 56-68 decibels, people talking next door.		

EXHIBIT 4-15

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #15 WINTER PERIOD

Measurements were made approximately 152 meters (500 feet) north of point #14.

Site Description: Monitoring was conducted approximately 15 m (50 ft) west of the Fort Martin road in an open field surrounded by deciduous type trees and bushes.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1615-1623	32-34	43-47
	<u>Noise Environment:</u> Freezing rain/snow, breeze 2-3 mph north northwest, temperature 0°C, power plant noise (east), mining operations to the west.		
2/16/79	0103-0113	28-31	40-45
	<u>Noise Environment:</u> Calm, temperature -3°C.		
2/16/79	1125-1143	30-34	43-58
	<u>Noise Environment:</u> Cloudy, breeze 2-3 mph northwest, temperature -7°C, birds chirping, mining operations to the west.		
2/17/79	0047-0055	29-31	39-43
	<u>Noise Environment:</u> Calm, temperature -16°C.		
2/17/79	1102-1120	33-37	47-55
	<u>Noise Environment:</u> Clear skies, 2-3 mph breeze, power plant (east), strip mining operations (west).		
2/18/79	0007-0015	30-32	44-48
	<u>Noise Environment:</u> Raining, temperature -14°C, slight breeze 2-3 mph, power plant noise (east).		
2/18/79	1125-1143	32-38	45-63
	<u>Noise Environment:</u> Cloudy, raining, temperature -10°C, windy 9-11 mph, two cars passby 58-64 decibels, power plant noise.		
2/19/79	1041-1059	33-43	53-61
	<u>Noise Environment:</u> Cloudy, strong breeze 2-4 mph, temperature -4°C.		
2/20/79	0011-0019	28-29	49-53
	<u>Noise Environment:</u> 1-2 mph breeze, temperature -13°C.		

EXHIBIT 4-16

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #16 WINTER PERIOD

Measurements were taken approximately 15 meters (50 ft) north of point #15.

Site Description: Monitoring was conducted approximately 7 meters (2.5 ft) into the driveway of R.C. Beach residence.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1628-1636	34-38	50-54
	<u>Noise Environment:</u> Drizzle rain, temperature -1°C, vehicle traffic on Fort Martin road, power plant noise, and strip mining operations.		
2/16/79	0043-0051	30-31	41-45
	<u>Noise Environment:</u> Calm, temperature 0°C, quiet.		
2/16/79	1148-1206	29-33	44-51
	<u>Noise Environment:</u> Cloudy, 2-3 mph breeze, power plant noise, mining operations.		
2/17/79	0034-0042	28-31	40-45
	<u>Noise Environment:</u> Calm, temperature -16°C.		
2/17/79	1125-1143	33-38	43-53
	<u>Noise Environment:</u> Partly cloudy, temperature -14°C.		
2/18/79	2353-0001	29-32	46-49
	<u>Noise Environment:</u> Raining, 2-3 mph breeze, temperature -15°C, quiet.		
2/18/79	1148-1206	34-37	42-56
	<u>Noise Environment:</u> Cloudy, 6-7 mph wind gusts, temperature -10°C.		
2/19/79	1104-1122	36-40	49-68
	<u>Noise Environment:</u> Wind gusts 6-8 mph, temperature -4°C, mining operations and power plant noise.		

EXHIBIT 4-17

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #17 WINTER PERIOD

Measurements were taken approximately 152 meters (500 ft) east of point #16.

Site Description: Monitoring was conducted near the Fort Martin Church in the courtyard area.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2/15/79	1642-1650	39-42	53-55
	<u>Noise Environment:</u> Drizzle rain, calm, temperature -10°C, four coal trucks passby 86-97 decibels.		
1/16/79	1213-1231	29-33	40-53
	<u>Noise Environment:</u> Cloudy, temperature -8°C, wind speed 2-3 mph northwest.		
2/17/79	1131-1149	30-35	47-53
	<u>Noise Environment:</u> Partly cloudy, temperature -13°C, 2-3 mph breeze, mining operations and power plant noise.		
2/18/79	1214-1232	30-33	45-65
	<u>Noise Environment:</u> Snowing, wind gusts 6-8 mph, temperature -10°C.		
2/19/79	1131-1149	35-37	48-62
	<u>Noise Environment:</u> Cloudy, windy 6-7 mph, temperature -3°C, power plant noise and mining operations noise.		

EXHIBIT 4-18

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #18 WINTER PERIOD

Measurements were taken approximately 304 meters (1000 ft) north of point #17.

Site Description: Monitoring was conducted approximately 7.6 meters (25 ft) into the driveway of the residence near the bottom of the hill. Residence is a two-story white wood house with walk out garage.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1651-1659	34-41	47-53
	<u>Noise Environment:</u> Freezing drizzle rain, 2-3 mph breeze, temperature -1°C, mining operations (North).		
2-16-79	0028-0036	28-30	40-42
	<u>Noise Environment:</u> Calm, temperature 0°C		
2-16-79	1236-1254	29-35	42-51
	<u>Noise Environment:</u> Cloudy, 2-4 mph breeze, temperature -7°C, quiet, woman shoveling her car out of a snow bank.		
2-17-79	0021-0029	27-29	42-48
	<u>Noise Environment:</u> Calm, slight breeze, temperature -16°C.		
2-17-79	1155-1213	29-35	45-56
	<u>Noise Environment:</u> Partly cloudy, 4-5 mph wind, temperature -13°C, 2 cars passby 52-58 decibels.		
2-17-79	2338-2348	28-30	39-42
	<u>Noise Environment:</u> Calm, temperature -16°C.		
2-18-79	1242-1300	31-33	46-57
	<u>Noise Environment:</u> Freezing rain/snow, 5-7 mph breeze, temperature -9°C, no activity, quiet.		
2-19-79	1200-1218	31-35	46-59
	<u>Noise Environment:</u> Cloudy, wind gusts 3-5 mph, temperature -3°C, 2 cars proceeding uphill 54 decibels (tire noise).		
2-19-79	2336-2344	27-29	39-42
	<u>Noise Environment:</u> Calm, temperature -11°C, quiet.		

EXHIBIT 4-19

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #19 WINTER PERIOD

Measurements were taken approximately 45 meters (150 ft) northwest of point #18.

Site Description: Monitoring was conducted on the hillside approximately 152 meters (500 ft) above the Fort Martin Road. Hillside terrain consisted of tall legumes and bushes.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1710-1718	31-35	45-53
	<u>Noise Environment:</u> Freezing drizzle rain, temperature 0°C, power plant noise (east), and strip mining noises (West-Northwest).		
2-16-79	1305-1323	30-41	44-58
	<u>Noise Environment:</u> Cloudy, temperature -8°C, 2-3 mph breeze-NNW, three triaxle coal trucks southbound on Fort Martin road 88-92 decibels, powerplant noise and strip mining noises.		
2-17-79	1225-1243	29-35	46-56
	<u>Noise Environment:</u> Sunny-partly cloudy, 7-8 mph wind gusts, temperature -13°C, birds chirping, southbound car on Fort Martin road 38-41 decibels, powerplant noise, strip mining noise, otherwise quiet.		
2-18-79	1307-1325	29-33	48-55
	<u>Noise Environment:</u> Snowing lightly, 4-6 mph wind gusts, temperature -9°C, quiet.		
2-19-79	1224-1242	32-40	42-67
	<u>Noise Environment:</u> Cloudy, strong breeze 6-8 mph, temperature -3°C, strip mining noises.		

EXHIBIT 4-20

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #20 WINTER PERIOD

Measurements were taken approximately 183 meters north of point #18 on Fort Martin road.

Site Description: Monitoring was conducted at the intersection of Fort Martin road and the access road to the power plant facility.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1732-1740	30-32	51-60
	<u>Noise Environment:</u> Slight breeze from the North, temperature -1°C, intermittent rain/snow, quiet.		
2-15-79	2301-2309	28-30	40-43
	<u>Noise Environment:</u> Snowing, calm, temp. -1°C.		
2-16-79	1338-1356	32-39	50-63
	<u>Noise Environment:</u> Cloudy, temperature -7°C, 3-4 mph breeze, relatively quiet, car-passby 38-41 dB(A).		
2-16-79	2305-2313	26-29	38-42
	<u>Noise Environment:</u> 4-5 mph breeze, temperature -15°C.		
2-17-79	1258-1316	30-33	48-51
	<u>Noise Environment:</u> Partly cloudy, temperature -12°C, dog barking nearby, relatively quiet.		
2-17-79	2215-2223	29-31	38-40
	<u>Noise Environment:</u> Calm, temperature -16°C, quiet.		
2-18-79	1334-1352	29-33	49-59
	<u>Noise Environment:</u> Cloudy, intermittent rain, 4-5 mph breeze, temperature -9°C, no activity, quiet.		
2-19-79	1252-1310	33-36	51-63
	<u>Noise Environment:</u> Partly cloudy, temperature -3°C, 5-8 mph breeze, car-passby 39-42 decibels, truck proceeding south on Fort Martin road 72-87 decibels.		
2-19-79	2215-2223	26-30	36-40
	<u>Noise Environment:</u> Calm, temperature -10°C, quiet.		

EXHIBIT 4-21

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #21 WINTER PERIOD

Measurements were taken approximately 304 meters east of point #20 on power plant access road.

Site Description: Monitoring was conducted at a point on the power plant access road near the top of the hill at approximately the same elevation as point #19.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1748-1756 <u>Noise Environment:</u> Intermittent rain/snow, 1-2 mph breeze, temperature -0°C, quiet.	32-34	50-57
2-15-79	2248-2256 <u>Noise Environment:</u> Snowing, temperature 1°C, calm, quiet.	30-33	42-45
2-16-79	1408-1426 <u>Noise Environment:</u> Cloudy, 3-4 mph breeze, temperature -7°C, power plant noise and strip mining noise from West and Northwest.	33-37	48-51
2-16-79	2252-2300 <u>Noise Environment:</u> Temperature -14°C, calm.	26-30	39-41
2-17-79	1328-1346 <u>Noise Environment:</u> Partly cloudy, 5-6 mph breeze, temperature -11°C, quiet, car passby on Fort Martin road 54-60 decibels, power plant noise.	30-34	42-58
2-17-79	2150-2158 <u>Noise Environment:</u> Calm, temperature -16°C, quiet.	29-32	38-40
2-18-79	1400-1418 <u>Noise Environment:</u> Temperature -10°C, 3-5 mph breeze, two cars passby on Fort Martin road 42-49 decibels primarily tire noise.	32-35	50-60
2-19-79	1318-1336 <u>Noise Environment:</u> Cloudy, temperature -3°C, 5-8 mph wind gusts, two triaxle coal trucks northbound on Fort Martin road, power plant noise and strip mining operations noise.	34-42	51-65
2-19-79	2200-2210 <u>Noise Environment:</u> Calm, temperature -10°C, quiet.	30-31	38-40

EXHIBIT 4-22

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #22 WINTER PERIOD

Measurements were taken approximately 304 meters east of point #21.

Site Description: Monitoring was conducted 62 meters (200 ft) north of the power plant access road near a wooden barn. The area is an open field on top of a hill.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1808-1816	30-33	46-49
	<u>Noise Environment:</u> Calm, 0°C, freezing rain/snow, power plant noise, strip mining operations.		
2-16-79	1439-1457	32-36	50-63
	<u>Noise Environment:</u> Cloudy, 6-7 mph breeze, temperature -8°C, power plant noise and intermittent noise from strip mining operations.		
2-17-79	1358-1416	30-35	49-62
	<u>Noise Environment:</u> Partly cloudy, temperature -11°C, 5-6 mph breeze, power plant noise and strip mining operations, birds chirping.		
2-18-79	1430-1448	32-34	50-60
	<u>Noise Environment:</u> Intermittent rain/snow, temperature -10°C, 3-5 mph breeze.		
2-19-79	1349-1407	33-35	49-56
	<u>Noise Environment:</u> Cloudy, 2-4 mph breeze, temperature -4°C, power plant noise, quiet.		

EXHIBIT 4-23

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #23 WINTER PERIOD

Measurements were taken approximately 304 meters east of point #22.

Site Description: Monitoring was conducted on the power plant access road approximately 760 meters west of the existing substation. Area is surrounded by open fields, mostly legumes and small bushes some deciduous tree stands.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1830-1838	31-33	46-51
	<u>Noise Environment:</u>	Drizzle rain, calm, 0°C.	
2-16-79	1511-1529	31-42	49-60
	<u>Noise Environment:</u>	Cloudy, temperature -7°C, 6-7 mph breeze, power plant noise and intermittent strip mining noise, three cars passby 38-52 decibels.	
2-17-79	1430-1448	33-52	56-72
	<u>Noise Environment:</u>	Partly cloudy, temperature -10°C, 6-9 mph wind gusts, car passby 62-70 decibels, power plant noise.	
2-18-79	1500-1518	30-33	49-56
	<u>Noise Environment:</u>	Intermittent rain/snow, temperature -10°C, 3-6 mph breeze, power plant noise.	
2-19-79	1419-1437	32-34	49-56
	<u>Noise Environment:</u>	Partly cloudy, temperature -4°C, 3-5 mph breeze, relatively quiet.	

EXHIBIT 4-24

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #24 WINTER PERIOD

Measurements were taken approximately 62 meters north of point #20 on Fort Martin road.

Site Description: Monitoring was conducted approximately 7.6 meters (25 ft) east of Fort Martin road in the driveway of P.O. Box 122. Nearby residence ranch style white wood house.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1852-1900	38-42	56-59
	<u>Noise Environment:</u> Cloudy, 3-5 mph breeze, temperature -10°, trickle of water in creek, quiet, car passby 40-48 decibels.		
2-15-79	2314-2322	30-31	42-47
	<u>Noise Environment:</u> Snowing, temperature 10°C, calm, trickle of water in creek.		
2-16-79	1541-1559	40-42	51-66
	<u>Noise Environment:</u> Cloudy, 6-7 mph breeze, temperature -8°C, strip mining operations, car passby 66-76 decibels, jet plane pass over 61-66 decibels.		
2-16-79	2318-2326	26-29	38-40
	<u>Noise Environment:</u> Calm, temperature -14°C, quiet, trickle of water in creek.		
2-17-79	1458-1516	32-38	46-73
	<u>Noise Environment:</u> Partly cloudy, temperature -11°C, 6-7 mph breeze, three cars and 1 pickup truck passby 49-68 decibels.		
2-17-79	2231-2239	30-32	39-42
	<u>Noise Environment:</u> 2-3 mph breeze, temperature -16°C.		
2-18-79	1528-1546	30-34	42-55
	<u>Noise Environment:</u> Snowing, temperature -9°C, 3-6 mph breeze.		
2-19-79	1449-1507	32-35	49-56
	<u>Noise Environment:</u> Cloudy, 4-6 mph breeze, temperature -5°C, trickle of water in creek, dog barking.		
2-19-79	2230-2238	28-30	39-42
	<u>Noise Environment:</u> Calm, temperature -11°C, quiet.		

EXHIBIT 4-25

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #25 WINTER PERIOD

Measurements were taken approximately 62 meters north of point 24.

Site Description: Monitoring was conducted approximately 7.6 meters (25 ft) into the driveway of Rt 1, Box 202 near Fort Martin road. Residence is a two story white wooden house.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1906-1914	32-33	45-47
	<u>Noise Environment:</u> Snowing, temperature 0°C, dog barking 38-40 decibels, trickle of water in creek.		
2-16-79	1605-1623	36-43	52-71
	<u>Noise Environment:</u> Cloudy, 6-7 mph wind, two pickup trucks passby 68-76 decibels.		
2-17-79	1522-1540	34-48	50-63
	<u>Noise Environment:</u> Partly cloudy, 5-6 mph breeze, temperature -11°C, single engine airplane pass over 58-66 decibels, coal trucks passby 82-93 decibels, strip mining operations from Northwest.		
2-18-79	1551-1609	31-33	42-56
	<u>Noise Environment:</u> Snowing, temperature -10°C, 3-5 mph breeze, quiet.		
2-19-79	1512-1530	31-34	42-52
	<u>Noise Environment:</u> 2-3 mph breeze, temperature -4°C, quiet.		

EXHIBIT 4-26

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #26 WINTER PERIOD

Measurements were taken approximately 183 meters north and west of point #25.

Site Description: Monitoring was conducted at a point near the gate to the Explosives Mixing Plant. Approximately 7.6 meters (25 ft) west of Fort Martin road:

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1920-1928	33-36	40-48
	<u>Noise Environment:</u> Snowing lightly, slight breeze, temperature 0°C, strip mining operations.		
2-15-79	2332-2340	29-31	39-42
	<u>Noise Environment:</u> Snowing, calm, temperature 1°C.		
2-16-79	1630-1648	42-48	53-63
	<u>Noise Environment:</u> Cloudy, 5-7 mph breeze, temperature -9°C, Seven cars passby 56-76 decibels, three coal trucks passby 79-91 decibels.		
2-16-79	2331-2339	27-30	37-40
	<u>Noise Environment:</u> Calm, quiet, temperature -15°C.		
2-17-79	1547-1605	37-43	45-56
	<u>Noise Environment:</u> Partly cloudy, 4-6 mph breeze, temperature -11°C, three cars passby 48-66 decibels.		
2-17-79	2246-2254	29-31	39-41
	<u>Noise Environment:</u> Calm, temperature -16°C, one car pasby 52-60 decibels.		
2-18-79	1615-1633	31-34	42-54
	<u>Noise Environment:</u> Snowing, 3-6 mph breeze, temperature -9°C.		
2-19-79	1536-1554	29-33	39-53
	<u>Noise Environment:</u> 2-3 mph breeze, temperature -4°C, strip mining operations, one pickup truck 49-56 decibels.		
2-19-79	2246-2254	29-31	39-42
	<u>Noise Environment:</u> Calm, temperature -11°C.		

EXHIBIT 4-27

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #27 WINTER PERIOD

Measurements were taken approximately 300 meters West of point #26.

Site Description: Monitoring was conducted approximately 15 meters (50 ft) north of the blasting cap storage trailer.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1935-1943	33-38	46-53
	<u>Noise Environment:</u> Snowing lightly, calm, temperature -10°C, strip mining operations noise from the north.		
2-16-79	1658-1716	30-41	51-73
	<u>Noise Environment:</u> Cloudy, temperature -9°C, 5-8 mph breeze, birds chirping, one truck, two cars passed by, mining operations to the north.		
2-17-79	1614-1632	29-39	44-72
	<u>Noise Environment:</u> Partly cloudy, temperature -11°C, 4-7 mph breeze, mining operations to the north.		
2-18-79	1639-1657	30-33	44-59
	<u>Noise Environment:</u> Cloudy, snowing, temperature -9°C, 3-5 mph breeze, mining operations.		
2-19-79	1600-1618	29-33	46-55
	<u>Noise Environment:</u> Calm, temperature -4°C, mining operations to the north.		

EXHIBIT 4-28

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #28 WINTER PERIOD

Measurements were taken approximately 152 meters west of point #27.

Site Description: Monitoring was conducted alongside the access road to the Explosives Mixing Plant in a low sloping open field area.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	1950-1958	30-32	44-48
	<u>Noise Environment:</u> Snowing, slight breeze, temperature 0°C, strip mining operations to the north.		
2-16-79	1726-1744	33-39	49-66
	<u>Noise Environment:</u> Cloudy, temperature -9°C, 5-6 mph breeze, mining operations to the north, ammonium sulfate plant due west.		
2-17-79	1639-1657	33-39	47-63
	<u>Noise Environment:</u> Partly cloudy, temperature -12°C, 4-6 mph breeze, mining operations noise and ammonium sulfate process plant noise.		
2-18-79	1704-1722	29-33	38-46
	<u>Noise Environment:</u> Snowing hard, temperature -9°C, 4-6 mph breeze.		
2-19-79	1624-1642	29-31	42-47
	<u>Noise Environment:</u> Calm, temperature -4°C, mining operations to the north, birds chirping.		

EXHIBIT 4-29

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #29 WINTER PERIOD

Measurements were taken approximately 304 meters west of point #28.

Site Description: Monitoring was conducted approximately 30 meters north of the access road to the Explosives Mixing Plant.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	2010-2018	29-32	42-49
	<u>Noise Environment:</u> Freezing rain/snow, calm, temperature 0°C, quiet.		
2-16-79	1754-1812	33-36	47-53
	<u>Noise Environment:</u> Cloudy, temperature -10°C, 3-5 mph breeze, mining operations to the north.		
2-17-79	1707-1725	33-39	49-73
	<u>Noise Environment:</u> Partly cloudy, temperature -13°C, 5-7 mph breeze, birds chirping, mallard ducks in swamp area, mining operations to the north.		
2-18-79	Noise monitoring aborted due to excess snow.		
2-19-79	1650-1708	29-31	42-47
	<u>Noise Environment:</u> Calm, temperature -6°C, three cars and one pickup truck passby from process plant.		

EXHIBIT 4-30

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #30 WINTER PERIOD

Measurements were taken approximately 800 meters west of point #29.

Site Description: Monitoring was conducted approximately 23 meters west of the Explosives Mixing Plant.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	Noise measurements were not taken due to locked gate to plant area.		
2-16-79	1822-1840	33-41	48-51
	<u>Noise Environment:</u> 4-6 mph breeze, temperature -10°C, process plant operation shut down at 1830 hours, cows mooing in nearby field.		
2-17-79	1738-1756	32-36	46-53
	<u>Noise Environment:</u> 4-6 mph breeze, temperature -14°C, birds chirping, cows mooing, mining operations noise.		
2-18-79	Noise measurement survey aborted due to snow.		
2-19-79	1718-1736	32-36	42-46
	<u>Noise Environment:</u> 2-3 mph breeze, temperature -4°C, birds chirping, process plant operation shut down at 1730 hrs, mining operations noise.		

EXHIBIT 4-31

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #31 WINTER PERIOD

Measurements were taken approximately 460 meters north of point #26.

Site Description: Monitoring was conducted in the State of Pennsylvania, approximately 15 meters (50 ft) into the driveway of P.O. Box 63.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	2038-2046 <u>Noise Environment:</u> 2-3 mph breeze, temperature 0°C, dogs barking	33-36 34-42 decibels.	55-63
2-15-79	2348-2358 <u>Noise Environment:</u> Snowing, 2-3 mph breeze, temperature 1°C, quiet.	30-33	40-47
2-16-79	1908-1926 <u>Noise Environment:</u> 4-6 mph breeze, temperature -11°C, two cars passby	33-36 56-72 decibels, three dogs barking simultaneously 58-65 dB(A), strip mining operations and power plant noise.	55-60
2-17-79	1818-1836 <u>Noise Environment:</u> 5-8 mph breeze, temperature -14°C, birds chirping, crows cawing, dogs barking, mining operations due west and power plant noise southeast.	35-46	54-70
2-17-79	2302-2310 <u>Noise Environment:</u> Slight breeze, temperature -16°C quiet.	30-31	42-46
2-18-79	Noise measurement survey aborted due to snow.		
2-19-79	1756-1814 <u>Noise Environment:</u> Calm, temperature -5°C, four trucks - two cars passby	33-35 56-78 decibels.	42-47
2-19-79	2304-2314 <u>Noise Environment:</u> Calm, temperature -11°C.	29-31	40-44

EXHIBIT 4-32

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #32 WINTER PERIOD

Measurements were taken approximately 608 meters north and west of point #31.

Site Description: Monitoring was conducted in the State of Pennsylvania near the Fort Martin mining company offices.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	2058-2106 <u>Noise Environment:</u> Calm, temperature 0°C, light rain, strip mining operation, backup signal of bulldozer.	44-48	50-56
2-15-79	2352-Midnight <u>Noise Environment:</u> 2-3 mph breeze, temperature 0°C, quiet, raining.	29-30	42-44
2-16-79	1944-2002 <u>Noise Environment:</u> 4-5 mph breeze, temperature -10°C, strip mining operation, dog barking in distance not influencing SLM measurements.	36-42	49-55
2-16-79	0003-0011 <u>Noise Environment:</u> Calm, temperature -16°C, quiet.	26-29	35-47
2-17-79	1851-1909 <u>Noise Environment:</u> Temperature -14°C, 3-4 mph breeze, mining operations noise, pickup truck riding 49 decibels.	33-41	46-56
2-17-79	2317-2325 <u>Noise Environment:</u> 2-3 mph breeze, temperature -16°C.	31-32	42-45
2-18-79	Noise measurement survey aborted due to excess snow.		
2-19-79	1828-1846 <u>Noise Environment:</u> Temperature -5°C, 3-5 mph breeze, shift change activity near trailer house (door slamming shut), trucks and cars accelerating 56-68 decibels.	33-41	46-58
2-19-79	2321-2329 <u>Noise Environment:</u> Temperature -12°C, calm.	31-33	42-46

EXHIBIT 4-33

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #33 WINTER PERIOD

Measurements were taken approximately 2000 meters north of the Pennsylvania State line and approximately 402 meters north of point #32.

Site Description: Monitoring was conducted in an open field alongside the Fort Martin road.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	2116-2124	35-37	45-46
	<u>Noise Environment:</u> Calm, temperature 0°C, three cars passby 56-71 decibels.		
2-16-79	2015-2033	33-37	42-51
	<u>Noise Environment:</u> Temperature -12°C, 3-4 mph breeze, dogs barking otherwise quiet.		
2-17-79	1919-1937	33-42	51-68
	<u>Noise Environment:</u> Temperature -14°C, 5-7 mph breeze, two cars passby 56-74 decibels.		
2-18-79	Noise measurements were aborted due to snow.		
2-19-79	1856-1914	33-35	40-47
	<u>Noise Environment:</u> Temperature -6°C, 3-4 mph breeze, mining operations to the south and west.		

EXHIBIT 4-34

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #34 WINTER PERIOD

Measurements were taken approximately 612 meters east and north of point #23.

Site Description: Monitoring was conducted west of Keeners Knob and the substation located near the power plant access road.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	2144-2152	37-39	50-53
	<u>Noise Environment:</u> Snowing, temperature 0°C, continuous popping and cracking sounds from substation power lines, power plant noise.		
2-16-79	2045-2103	37-42	50-52
	<u>Noise Environment:</u> Temperature -13°C, 4-5 mph breeze, continuous popping and cracking from power lines, power plant noise.		
2-17-79	1957-2015	38-41	50-56
	<u>Noise Environment:</u> Temperature -15°C, 3-4 mph breeze, continuous popping and cracking of power lines from substation, power plant noise, intermittent mining operations noise.		
2-18-79	Noise survey measurements aborted due to snow.		
2-19-79	1934-1952	35-38	48-52
	<u>Noise Environment:</u> Temperature -7°C, 2-3 mph breeze popping and cracking of power lines, power plant noise, 2 cars passby.		

EXHIBIT 4-35

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #35 WINTER PERIOD

Measurements were taken approximately 608 meters east of point #34.

Site Description: Monitoring was conducted approximately 107 meters east of the existing substation located on Keeners Knob.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	2200-2208 <u>Noise Environment:</u> Temperature 0°C, 2-3 mph breeze, power plant noise and popping - humming of substation.	37-39	51-52
2-16-79	2111-2129 <u>Noise Environment:</u> Temperature -13°C, 4-5 mph breeze, power plant noise, popping and cracking from substation.	33-39	48-53
2-17-79	2021-2039 <u>Noise Environment:</u> Temperature -15°C, 4-5 mph breeze, power plant noise, cracking and popping from substation.	34-39	48-53
2-18-79	Noise survey measurements aborted due to snow.		
2-19-79	1957-2015 <u>Noise Environment:</u> Temperature -7°C, 2-3 mph breeze, power plant noise, substation noise.	33-37	43-52

EXHIBIT 4-36

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #36 WINTER PERIOD

Measurements were taken approximately 912 meters south and east of point #35.

Site Description: Monitoring was conducted approximately 152 meters west of the power plant facility on the access road.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	2216-2224	67-69	77-79
	<u>Noise Environment:</u> Temperature 1°C, calm, raining, dominant noise source - power plant.		
2-16-79	2141-2159	66-69	77-79
	<u>Noise Environment:</u> Temperature -12°C, 4-5 mph wind, power plant noise.		
2-17-79	2047-2105	66-69	76-79
	<u>Noise Environment:</u> Temperature -14°C, 2-3 mph breeze, power plant noise.		
2-18-79	Noise survey measurements were aborted due to snow.		
2-19-79	2025-2043	66-70	76-79
	<u>Noise Environment:</u> Temperature -10°C, 2-3 mph breeze, power plant noise.		

EXHIBIT 4-37

INDIVIDUAL SOUND LEVEL READINGS TAKEN IN THE VICINITY OF THE SITE P&M/SRC-II SITE LOCATION POINT #37 WINTER PERIOD

Measurements were taken approximately 304 meters north and east of point #36.

Site Description: Monitoring was conducted approximately 304 meters north and east of the power plant superstructure near a coal storage pile. Large cooling towers reflects and shields the power plant noise.

<u>Date</u>	<u>Time</u>	<u>dB(A)</u>	<u>dB(C)</u>
2-15-79	2230-2238	49-52	60-62
	<u>Noise Environment:</u> Temperature 1°C, calm, raining, noise source - power plant operation.		
2-16-79	2222-2240	50-57	59-63
	<u>Noise Environment:</u> Temperature -13°C, 4-5 mph breeze, power plant noise and one single event noise source frontend loader 82-91 decibels.		
2-17-79	2113-2131	52-60	60-63
	<u>Noise Environment:</u> Temperature -15°C, 2-3 mph breeze, power plant noise and cooling tower noise.		
2-18-79	Noise survey measurements aborted due to snow.		
2-19-79	2048-2106	54-60	60-62
	<u>Noise Environment:</u> Temperature -11°C, 2-3 mph breeze, power plant noise.		

SECTION 5

GEOLOGY

5.1 DESCRIPTION

The general and specific geologic conditions of the SRC-II site to be considered in this section include stratigraphy and lithology, structure, hazards, seismic history and risk, and mineral resources.

North-central West Virginia is in the Appalachian Plateau physiographic province of eastern United States and the Northern Coal Basin of West Virginia. The geologic structure of the Appalachian Plateau is characterized by flatter beds and less folding in comparison to the strongly folded and faulted beds of the Appalachian Mountain region in southeastern West Virginia. These structural features were caused by a major mountain-building sequence during the Permian Period (225-270 million years ago) known as the Appalachian Orogeny.

Prior to the Appalachian Orogeny, what is now known as the Appalachian region comprised a portion of a major subsidence trough or geosyncline. The trough was the focal point of a tremendous accumulation of marine and continental sediments that occurred almost continuously for a period of 500 million years. During the 200 million years following the Appalachian Orogeny (Mesozoic and Cenozoic eras), the Appalachian region has been worn down by erosion, has never again submerged beneath the sea, and has had no further extensive accumulation of sediments (Cardwell 1975). Consequently, the youngest rock formations in the project vicinity are comprised of sediments deposited during the Pennsylvania and Permian Periods (about 225 to 255 million years ago). Only a relatively minor accumulation of unconsolidated sediments has occurred in recent time. These sediments are predominantly alluvial deposits which have accumulated in and along existing watercourses.

5.2 METHODS AND MATERIALS

A combination of literature review, field reconnaissance, and geotechnical exploration was conducted to characterize the geologic conditions. State and federal publications comprised the majority of the literature surveyed. In addition, the U.S. Bureau of Mines was contacted to review available mine records and maps, and the National Geophysical and Solar-terrestrial Data Center in Boulder, Colorado, provided earthquake history data. The operator of the Morgantown Seismograph Station verified the local earthquake history.

Six reconnaissance surveys were conducted in and around the project area in conjunction with the baseline study of ground water initiated in August 1978. The objectives of the field reconnaissance were to verify local geologic conditions described in the literature, note local lithologic variations, identify and delineate natural and man-induced hazardous geologic conditions, and verify the extent and conditions of surface-mined lands.

D'Appolonia Consulting Engineers, Inc. (D'Appolonia) was given a contract to perform an infiltration and geotechnical study in the vicinity of the proposed raw coal stockpile and slag disposal areas of the SRC-II Demonstration Plant. The objectives of the investigation were: 1) identify and describe the lithology of underlying strata, 2) identify and delineate clays suitable for use as liner material to seal the disposal basin, 3) determine site suitability for the disposal-basin retention dam, 4) verify the extent and condition of abandoned deep mines, 5) identify and describe aquifers encountered in exploratory borings, and 6) determine hydraulic properties of various rock strata. Piezometers were installed in four of the exploratory borings to facilitate recording water tables and collecting future samples for water quality analysis. The investigation was initiated in April 1979 and the final report will be completed during July 1979. Some preliminary data and conclusions reported by D'Appolonia are included in this section.

5.3 STRATIGRAPHY AND LITHOLOGY

Sedimentary beds of the Late Pennsylvanian Conemaugh and Monongahela Groups are the principal bedrock strata exposed in the project area. Basal strata of the Permian Dunkard Group, which overlies Monongahela strata, form the cap rock on the two hills located in the extreme western portion of the project site. Accumulations of unconsolidated, recent alluvial deposits occur in and along tributary streams and the Monongahela River. A partial stratigraphic column is presented in Table 5-1. Figure 5-1 is a general surficial geologic map of the project area and Figure 5-2 is an east-west cross section through the site. The geotechnical report being prepared by D'Appolonia will include a detailed site geologic map with cross-sections.

5.3.1 Conemaugh Group (Late Pennsylvanian)

The upper portion (Casselman Formation) of the Conemaugh Group surfaces on the eastern portion of the site and underlies the Monongahela Group in the western portion. Its total thickness is expected to be 180 meters (600 ft.). Generally, the Conemaugh Group consists of a repetitive sequence (cyclothems) of thick to thin lenticular sandstones, gray, green, and red shales, claystone, thin limestones, thin coal beds, and thin, low-grade fire clays (Simms 1960, and Friel et al 1967).

5.3.2 Monongahela Group (Late Pennsylvanian)

The Monongahela Group outcrops in the central and western portions of the project area. It includes all strata between the bottom of the Pittsburgh coal and the bottom of the overlying Waynesburg coal. Its total thickness ranges from 105 to 120 meters (350 to 400 ft.). The sequence of the deposition was similar to that of the Conemaugh Group except it included vast deposits of limestone and peat. Peat deposits were subsequently altered to form extensive coal beds.

In descending order, the Monongahela Group is subdivided into the Uniontown and Pittsburgh Formations. The lower section of the

TABLE 5-1
PARTIAL STRATIGRAPHIC COLUMN
P&M/SRC-II SITE

ERA	PERIOD	GROUP	FORMATION	IMPORTANT BEDS
Cenozoic	Quaternary		(Alluvium)	
Mesozoic		Absent		
Paleozoic	Permian	Dunkard	Waynesburg	Waynesburg coal
	Pennsylvanian	Monongahela	Uniontown Pittsburgh	Sewickley coal Redstone coal Pittsburgh coal (aquifers drained)
		Conemaugh ^a	Casselman	Freshwater sands
		Allegheny		Upper Freeport coal Freshwater sands
		Pottsville	Kanawha New River Pocahontas	Salt sands
	Mississippian	Mauch Chunk Greenbrier Pocono		Maxton sand Big Lime Big Injun sand (gas sand)

a None of the rock strata below the middle part of the Conemaugh Group are exposed in the SRC-II site.

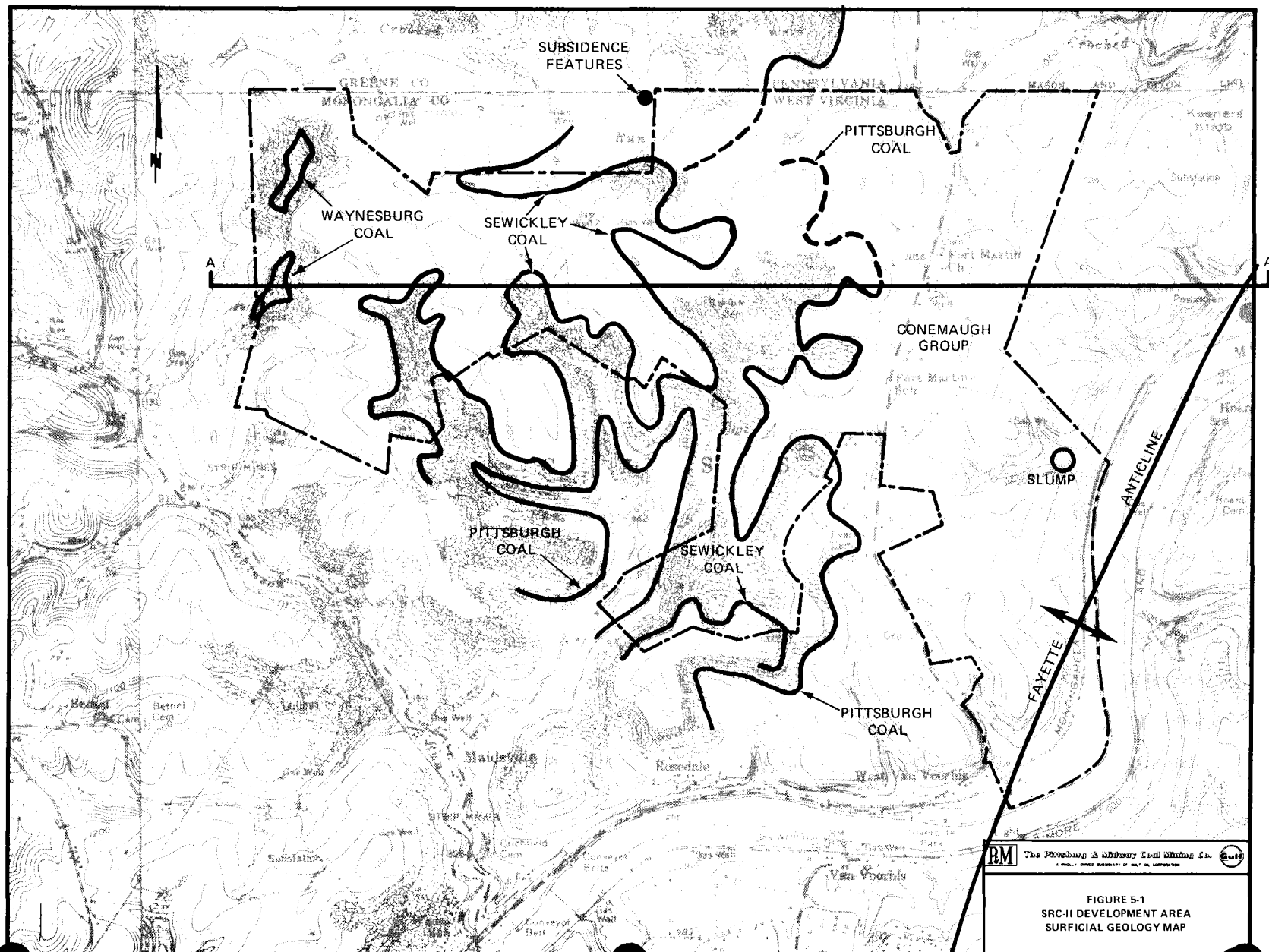
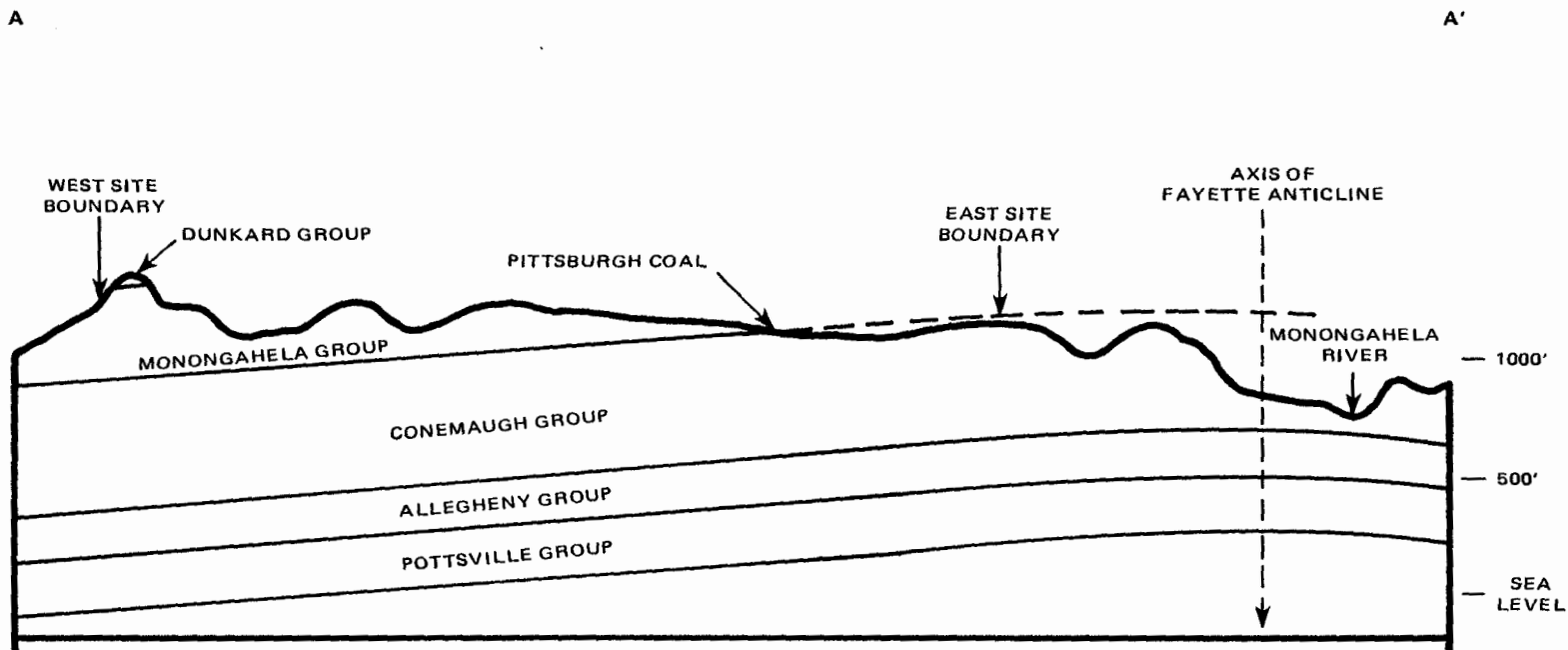


FIGURE 5-1
SRC-II DEVELOPMENT AREA
SURFICIAL GEOLOGY MAP



0 2000 4000
HORIZONTAL SCALE (FEET)
VERTICAL EXAGGERATION 3.5X

PM The Pittsburg & Midway Coal Mining Co. **Gulf**
A WHOLLY OWNED SUBSIDIARY OF GULF OIL CORPORATION

FIGURE 5-2
SRC-II DEVELOPMENT AREA
EAST-WEST GEOLOGIC CROSS SECTION

Pittsburgh Formation is comprised of three important coal beds separated by interbedded claystone, shale, carbonaceous shale, siltstone, sandstone, and some limestone. The Pittsburgh coal is the basal unit of the Monongahela Group and consists of two or three coal benches separated by thin partings. The main coal bench is about 2.1 meters (7 ft.) thick. The Redstone coal occurs about 7.5 meters (25 ft.) above the Pittsburgh coal (D'Appolonia, verbal communication June 1979), and although it may reach a thickness up to 1.5 meters (5 ft.) locally, a thickness of 0.6 to 1.2 meters (2-4 ft.) is typical. The Sewickley coal is about five feet thick and occurs from 10 to 18.5 meters (35 to 60 ft.) above the Redstone coal.

The Benwood limestone comprises the middle section of the Pittsburgh Formation. It is composed of limestone beds up to 1.5 meters (5 ft.) thick, interbedded with thin to thick beds of shale and sandstone (Simms 1960). A claystone unit occurs between the Benwood limestone and the underlying Sewickley coal bed. The upper section of the Pittsburgh Formation consists of three or four argillaceous limestone beds from 0.6 to 6 meters (2 to 20 ft.) thick, separated by shale, siltstone, and sandstone (Kent 1973).

The Uniontown Formation ranges up to 30 meters (100 ft.) in thickness and consists of cyclic sequences of claystone, shale, carbonaceous shale, siltstone, thin to massive sandstone, limestone, and a thin basal coal bed. The top of the formation underlies the Waynesburg coal (Dunkard Group) and the thin Uniontown coal bed represents the basal unit. The Uniontown coal is impure and locally grades abruptly to shale (Kent 1973).

5.3.3 Dunkard Group (Lower Permian)

The Dunkard Group represents the youngest rocks in the Appalachian region and the only ones of Permian age in West Virginia. The maximum thickness of the Dunkard Group present in West Virginia is about 365 meters (1,200 ft.) (Cardwell 1975). With the exception of about 12 meters (40 ft.) of the lower section that originally capped

hilltops in the extreme western portion, the Dunkard Group has been completely eroded from the project area. Kent (1973) reports that the Waynesburg coal forms the basal unit and ranges in thickness from 1.5 to 2.1 meters (5 to 7 ft.). In the project area, strip-mining of the Waynesburg coal has completely disturbed remnant strata of the Dunkard Group.

5.3.4 Alluvium (Quaternary - Holocene)

Unconsolidated alluvium of Holocene age (recent) represents the youngest deposits of sediments in the project area and the only ones which have accumulated over the last 200 million years. In West Virginia there are no known sedimentary rocks of Mesozoic or Tertiary (Cenozoic) age (Cardwell 1975).

In the project area, alluvial deposits are primarily unconsolidated clays, silts, sands, and gravels, deposited by and along Crooked Run, Crafts Run, Robinson Run, and the Monongahela River. The thickness of alluvium is estimated to be less than 3 meters (10 ft.) along tributary streams and less than 15 meters (50 ft.) in the Monongahela River valley.

5.4 STRUCTURE

As described above, the geologic structure of the project area can be characterized as gently folded beds. There are no known faults in the vicinity. The main structural feature of the region is the northeast-southwest trending Fayette anticline, the axis of which extends through the extreme southeastern portion of the site. Strata are nearly horizontal on the axis of the anticline, but dip gently (up to 5 degrees northwest) on the western limb of the fold.

Joint fractures are the principal secondary structures associated with the fold. Simms (1960) and Bench et al (1977) provide rose diagrams of joint orientations for the Morgantown North Topographic Quadrangle. Their studies show that major joint sets are oriented from North 20 to 30 degrees East (primary set) and North 70 to 75 degrees West (secondary set). Major joint sets in the site were confirmed to have the same range of attitudes. The joint sets are generally parallel and perpendicular to the strike of beds, which indicates an origin contemporaneous with the formation of the Fayette anticline.

5.5 GEOLOGIC HAZARDS

No natural, hazardous geologic conditions which will preclude development were observed in the project area. Undisturbed rock strata are not susceptible to major sliding, although weak Conemaugh shales and unconsolidated deposits which veneer steep slopes are susceptible to small, localized failures. A small slump feature was observed in the tributary drainage in the extreme east-central part of the site (Figure 5-1).

Potentially hazardous conditions caused by mining activities in the site are important. Deep mining may have created a potential mine subsidence hazard. D'Appolonia (verbal communication, June 1979) has estimated that a maximum of 3.5 meters (12 ft.) of subsidence could occur in the western portion of the site where the Sewickley, Redstone, and Pittsburgh coals have been deep-mined. The variables which control the actual magnitude of potential future subsidence include, in part, extent of mining, presence and condition of pillars, magnitude of subsidence that already may have occurred, strength and total thickness of overlying rock strata, and surcharge. Subsidence features have been identified adjacent to the north-central site boundary (Figure 5-1).

In addition to mine subsidence, spoil piles created by highwall mining and reclaimed spoils used to backfill strip mines on the site are susceptible to differential settlements upon loading. Highwall spoils were placed with minimal compactive effort. Although a degree of compactive effort was made during placement, it is doubtful that strip-mine backfills will support moderate to heavy foundation loads without settlement. The suitability of these materials to support foundations will be determined by D'Appolonia.

5.6 SEISMIC HISTORY AND RISK

West Virginia is classified seismic risk Zone 1 and 2; the higher risk in the extreme eastern and southern parts of the state is caused primarily by numerous earthquakes in the Blue Ridge Mountains (Lessing 1974) (Figure 5-3). The risk zone classification is based on earthquake intensity, which is a measure of violence based on the observed effects on people, objects, and structures. The zones depict the probability or risk of damage, but not the probability of future earthquake occurrences. Earthquakes occurring in Zone 1 are expected to have a maximum intensity of V or VI of Modified Mercalli (M.M.) Intensity Scale (Table 5-2) and cause only slight damage. Zone 2 earthquakes are expected to have a maximum intensity of VII of M.M. Scale and slight to moderate damage in well-built ordinary structures, and negligible damage in buildings of good design and construction. Zone 1 earthquakes will produce a ground acceleration of 0.05g or less, and Zone 2 earthquakes, 0.06 g to 0.17 g.

Although northern West Virginia is not in an active seismic area, at least 150 known earthquakes have occurred in the Central Appalachian region. Lessing (1974) reported that 97 earthquakes of intensity V and greater occurred in West Virginia and contiguous states from 1758 to 1970. All 97 earthquakes are shown on Figure 5-3, as well as most of the 54 additional shocks of intensity less than V from 1928 to 1970.

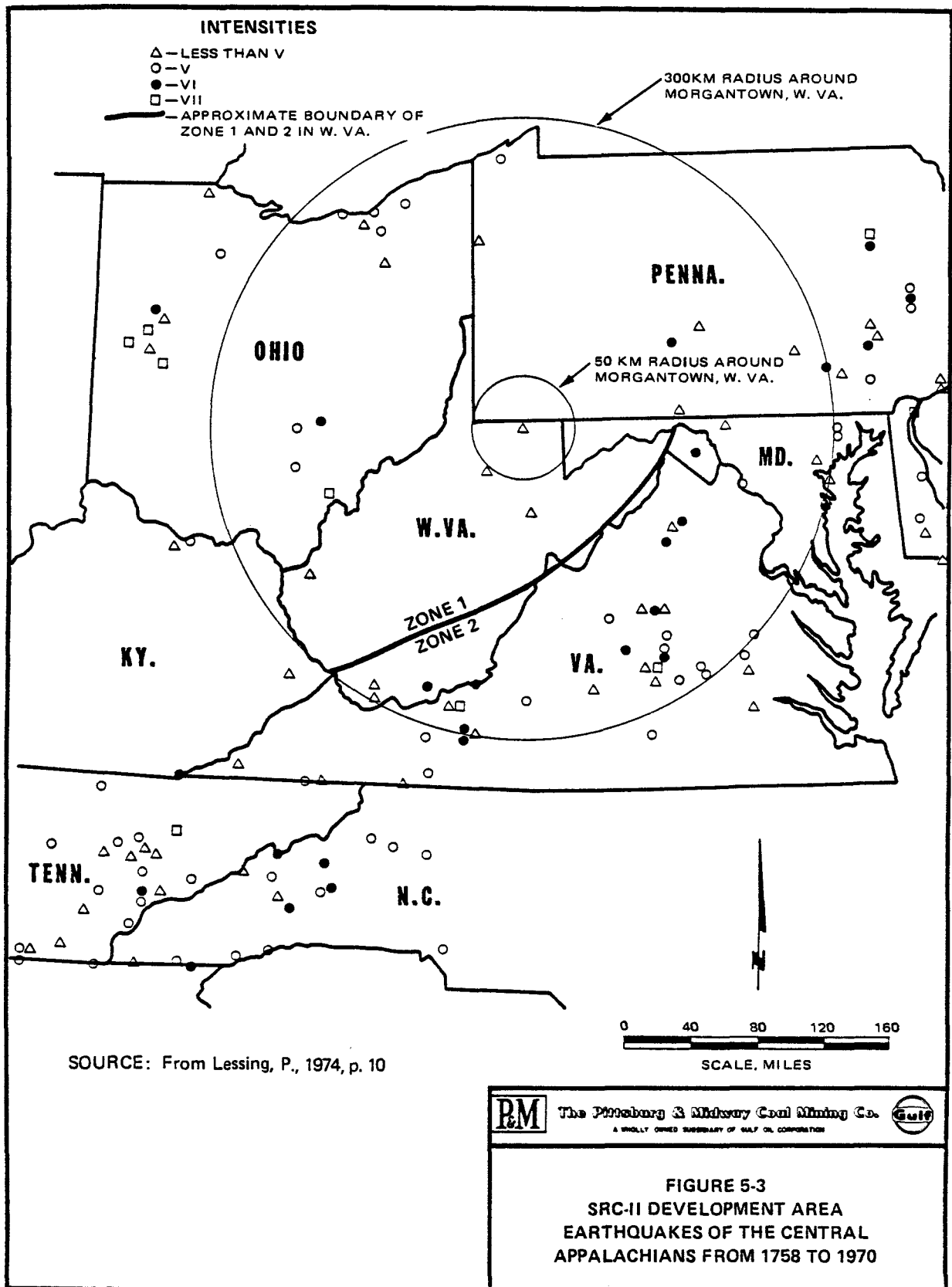


TABLE 5-2

MODIFIED MERCALLI INTENSITY SCALE OF 1931 (ABRIDGED)

<u>Intensity</u>	<u>Description</u>
I	Not felt except by a very few under specially favorable circumstances. (I Rossi-Forel Scale).
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel Scale).
III	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated. (III Rossi-Forel Scale).
IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel Scale).
V	Felt by nearly everyone, many awakened. Some dishes, windows, etc. broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel Scale).
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel Scale).
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars. (VIII Rossi-Forel Scale).

TABLE 5-2 Continued

MODIFIED MERCALLI INTENSITY SCALE OF 1931 (ABRIDGED)

<u>Intensity</u>	<u>Description</u>
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amount. Changes in well water. Persons driving motorcars disturbed. (VIII + to IX Rossi-Forel Scale.)
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX + Rossi-Forel Scale).
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped over banks). (X Rossi-Forel Scale).
XI	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII	Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

A list of earthquakes that caused damage or were felt within a radius of 50 kilometers and 300 kilometers of Morgantown, West Virginia is presented in Tables 5-3 and 5-4. Only earthquakes of intensity IV and greater are listed for the 300-kilometers radius around Morgantown. Blanks in the "Intensity" column indicate the residents of the nearest city were included in a questionnaire canvas, but they reported "not felt" or failed to report. Lessing (1974) reported that two earthquakes of intensity less than V were centered in the Morgantown area on 7 and 13 March 1957. The Morgantown seismograph station recorded both events, however, the magnitude was only about 1.5 on the Richter Scale. Few people in the Morgantown area reported feeling the 7 March earthquake, and there were no "felt" reports for the 13 March earthquake (R. W. Laird, written communication, May 1979).

The historic earthquake data for West Virginia and contiguous states indicate there is a very low probability that future earthquakes will be centered in the Morgantown area. In addition, there is a low probability that earthquakes centered elsewhere will be felt with an intensity V or greater in the Morgantown area. Only two, very small historic earthquakes have centered in the Morgantown area, and no historic earthquakes centered elsewhere have produced a reported intensity V or greater within 50 km of Morgantown. For these reasons, the seismic risk in northern West Virginia is considered to be very low, and earthquakes that may occur in the region are expected to cause negligible, if any, damage in industrial facilities of good design and construction.

TABLE 5-3
SEISMIC HISTORY - EARTHQUAKES FELT/CENTERED
50 KM RADIUS AROUND MORGANTOWN, WEST VIRGINIA

Source*	Date m/d/yr	Earthquake Coordinates		Epicenter Locality	Epicenter Distance From Morgantown (km)	Locality Felt		
		North Latitude	West Longitude			City	State	Intensity
GSTDC	11/1/35	46.8	79.1	Timiskaming, Canada	800	Connellsville	Pa.	III
						Masontown	Pa.	III
						McClellandtown	Pa.	IV
						Fairmont	W. Va.	III
						Grafton	W. Va.	-
EHWV	3/7/57	39.7	79.9	Morgantown, W.Va. area	0+	Morgantown	W. Va.	II
EHWV	3/13/57	39.7	79.9	Morgantown, W.Va. area	0+			-
GSTDC	11/10/69	37.4	81.0	Southern W. Va.	270+	Grafton	W. Va.	IV

* GSTDC - National Geophysical and Solar-Terrestrial Data Center

EHWV - Earthquake History of West Virginia (Lessing, 1974); verified by Morgantown Seismograph Station records

TABLE 5-4

SEISMIC HISTORY - EARTHQUAKE EPICENTERS
300 KM RADIUS AROUND MORGANTOWN, WEST VIRGINIA
INTENSITY IV AND GREATER*

Source**	Date			Geographic Coordinates		Locality	Maximum Intensity	Epicenter Distance From Morgantown (Km)
	Year	Mo.	Day	N. Latitude	W. Longitude			
CGS	1962	9	7	39.7	78.2	South-central Pa.	-	146
CGS	1963	10	10	39.8	78.2	South-central Pa.	-	147
GS	1976	1	30	39.7	78.1	Western W. Va.	-	149
USE	1938	7	15	40.4	78.2	Blair County, Pa.	VI	163
EQH	1909	4	2	39.4	78.0	Charlestown, W. Va.	VI	167
EQH	1918	4	10	38.7	78.4	Northeastern Va.	VI	169
EQH	1919	9	6	38.8	78.2	Northeastern Va.	VI	176
CGS	1964	2	13	40.5	77.9	Eastern Pa.	-	195
EQH	1926	11	5	39.1	82.1	Southeastern Ohio	VII	198
USE	1952	6	20	39.8	82.3	Southeastern Ohio	VI	200
EQH	1927	6	10	38.0	79.0	Near Charlottesville, Va.	V	202
GS	1974	3	23	38.9	77.8	Northeastern Va.	-	202
USE	1929	12	27	38.1	78.5	Central Va.	VI	213
EQH	1885	1	3	39.2	77.5	Md.-Va. border	V	214
CGS	1967	4	8	39.6	82.5	Columbus, Ohio	V	221
EQH	1901	5	17	39.3	82.5	Southeastern Ohio	V	225
GS	1975	2	16	39.1	82.4	Southeastern Ohio	-	226
GS	1977	2	27	37.9	78.6	Central Va.	V	226
EQH	1885	10	10	37.7	78.8	Central Va.	VI	239
EQH	1906	6	27	41.4	81.6	Fairport, Ohio	V	240
CGS	1946	3	9	41.6	81.3	Lake Erie area	V	245
EQH	1921	8	7	37.8	78.4	New Canton, Va. area	V	246
USE	1959	4	23	37.5	80.5	W. Va. - Va. border	VI	246
USE	1970	8	11	38.4	82.3	Near Huntington, W. Va.	IV	249
EQH	1907	2	11	37.7	78.4	Arvon, Va.	VI	255

TABLE 5-4 (Continued)

SEISMIC HISTORY - EARTHQUAKE EPICENTERS
300 KM RADIUS AROUND MORGANTOWN, WEST VIRGINIA
INTENSITY IV AND GREATER*

Source**	Date			Geographic Coordinates		Locality	Maximum Intensity	Epicenter Distance From Morgantown (Km)
	Year	Mo.	Day	N. Latitude	W. Longitude			
EQH	1910	5	8	37.7	78.4	Arvonias, Va.	V	255
GS	1974	5	30	37.4	80.4	Eastern Va.	V	258
EQH	1875	12	23	37.6	78.5	Arvonias, Va. area	VII	261
EQH	1924	12	26	37.3	79.9	Roanoke, Va.	V	263
USE	1969	11	20	37.4	81.0	Southern W. Va.	VI	269
USE	1928	9	9	41.5	82.0	Cleveland, Ohio	V	269
EQH	1897	5	31	37.3	80.7	Giles County, Va.	VIII	272
BLA	1968	3	8	37.3	80.8	Giles County, Va.	IV	277
ERL	1971	9	12	38.1	77.4	Eastern Va.	V	278
CGS	1966	5	31	37.6	78.0	West of Richmond, Va.	V	284
GS	1975	11	11	37.2	80.8	West-central Va.	IV	286
GS	1976	7	3	37.2	81.1	West-central Va.	-	291
CGS	1967	12	16	37.4	81.6	West-central Va.	-	291
EQH	1897	5	3	37.1	80.7	Pulaski, Va.	VI	293
USE	1943	3	9	42.2	80.9	Lake Erie area	V	294
GS	1976	6	19	37.4	81.6	McDowell County, W. Va.	-	296
CGS	1964	5	12	40.2	76.5	Cornwall, Pa.	VI	297
EQH	1908	8	23	37.5	77.9	Powhatan, Va.	V	298
USE	1930	11	1	39.2	76.5	Central Md.	-	298

* From Earthquake Data File, prepared by the National Geophysical and Solar-Terrestrial Data Center (April 1979)

** CGS U.S. Coast and Geodetic Survey

GS U. S. Geological Survey

USE United States Earthquakes Reports (prepared by CGS 1928-1929 and NOAA/USGS thereafter)

EQH Earthquake History of the United States (through 1970) (Coffman and von Hake, 1973)

BLA Blacksburg, Va. Seismograph Station

5.7 MINERAL RESOURCES

5.7.1 Coal

Coal is the principal mineral resource in this area of Monongalia County. The bulk of the coal is high-quality bituminous with 60 to 65 percent fixed carbon (dry ash-free), 1.5 to 3 percent sulfur content, and over 12 percent ash content (Barlow 1974). The coal is ranked high-volatile bituminous and classified a medium-sulfur coal.

As previously discussed, four mineable coal beds underlie the SRC-II site. In descending order these are the Waynesburg, Sewickley, Redstone, and Pittsburgh coals. Coal has been extensively mined in the site by deep and surface mining (contour and strip-mining). Although there are no active contour mining operations in the site, there are active deep and strip pit operations in the western portion.

The Waynesburg coal has been strip-mined from the hilltops in the extreme western portion of the property (Figure 5-1). The nature and thickness of the Waynesburg prior to mining is unknown.

The Sewickley coal outcrops in the central portion of the site. It was originally mined by both contour and deep (room-and-pillar) mine methods. Present mining is by deep and strip pit methods. The percent of Sewickley coal remaining and tonnage previously mined are unknown.

The Redstone coal outcrops in the central portion of the site between the Sewickley and Pittsburgh crop lines. Little is known about the extent of Redstone coal deep mining. Due to its lenticular nature, with an average thickness of about 1 meter (3 ft.), mining of the Redstone by small operators is believed to have been sporadic. It is difficult to determine the extent of mining since few records are available (D'Appolonia, verbal communication, June 1979). Presently, Redstone and Sewickley coal is mined by strip pit.

The Pittsburgh coal is the most important coal bed in Monongalia County in extent, thickness, and regularity of occurrence (Morris 1932). It is estimated that as much as 80 percent of the Pittsburgh coal has been mined from the site, primarily by the room-and-pillar method, but also by contour mining along the crop line. It is difficult to predict the condition of the abandoned workings. Voids up to about 3 meters (9 ft.) thick were encountered in geotechnical exploratory borings in the central portion of the site where the seam occurred at a depth of less than 30 meters (100 ft.). No deep exploratory bore holes have been drilled in the western portion where the seam occurred at a depth of about 90 meters (300 ft.).

5.7.1.1 Oil and Gas

Oil is an important resource in the western part of Monongalia County and in the northwestern part of the Cass District. However, there are no oil sands underlying the SRC-II site. According to Haught (1956) the production of oil and gas is under structural control, and almost all production has derived from the Big Injun sand (Table 5-1). Oil production in the Cass District is confined to the northwestern part. Down dip (1 to 2 degrees northwest) of the oil the Big Injun sand is full of salt water and up dip (southeast toward the SRC-II site) the sand was originally full of gas (Haught 1956). Since the early 1900's many gas wells have been drilled throughout the district, and several were drilled in and adjacent to the SRC-II site, where the Big Injun sand is at a depth of about 400 to 450 meters (1350 to 1500 ft.) below the top of the Pittsburgh coal. Gas production has been exhausted from many of these wells, and only one active producing well is in the site (adjacent to the east side of the demonstration disposal basin). The Keystone Gas Company owns this well and three other active producing wells located east of the site. The existing gathering pipeline system for these wells crosses the eastern portion of the site parallel to the Highway 53.

5.7.1.2 Other Mineral Resources

Other mineral resources of commercial value are not known to occur in the site. However, some of the clays and claystones are

expected to be suitable for site construction materials. One of the objectives of the D'Appolonia investigation is to evaluate the suitability of the various clays and claystones for use in constructing the disposal-basin earthen embankment and liner.

5.8 CONCLUSIONS

With respect to regional geologic conditions, the SRC-II site is located in a very stable area. Geologic conditions have changed little in the past 200 million years. The site is in a seismically inactive area of the Appalachian region, thereby making the seismic risk very low. Earthquakes, based on historic events "felt" at the site, are expected to generate a maximum ground acceleration of 0.05g, therefore, structures should be designed for ground accelerations in excess of 0.05g.

The site is not susceptible to any major, natural occurrences of mass land movement or failure. However, the land in the central and western parts of the site is susceptible to subsidence, due to collapse and/or fracturing of rock strata overlying deep coal mines. In addition, unreclaimed contour mine spoils and reclaimed strip pit spoils are susceptible to settlement upon loading.

High-quality coal is the only valuable mineral resource in the site. The mining of coal has been extensive in the past and surface mining continues in the Redstone and Sewickley seams. Coal remaining in the abandoned deep mines is considered a nonrecoverable resource because there is no existing mining method that makes it feasible to re-enter these mines. Gas production is nearly exhausted in this part of Monongalia County, and production from sands below the Big Injun has generally been scanty. Therefore, it is highly unlikely that gas production will again be important in this area.

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SECTION 6

GROUND WATER

6.1 INTRODUCTION

The purpose of this section is to describe the occurrence, hydraulic characteristics and water quality of the ground waters in the vicinity of the SRC-II site. Physical and chemical data pertaining to local ground waters were collected in baseline field studies conducted during 1978 and 1979. Ground water hydrology of the Monongahela River basin is fairly well documented, from which some of the information was used to supplement site specific investigations.

Ground water is the primary source of domestic water where public water is unavailable. Continued use of domestic wells to supplement public water is not uncommon, particularly where the ground water is softer. In addition, a few springs are used for domestic water and limited stock watering. There are no commercial wells in the site. Shallow well and spring yields are only sufficient for domestic stock and possibly light industrial or commercial usage. Deep wells may yield as much as 400 gallons per minute locally, however, the deeper aquifers west of the Monongahela River produce saline water.

All of the existing wells that supply water to residences in the site are less than 60 meters (200 ft.) deep and tap Conemaugh Group aquifers. Residences in the site are all located along Highway 58 and east of the Pittsburgh coal crop line, which marks the bottom of the Monongahela group. The majority of the wells west and northwest of the site tap aquifers in the upper section of the Monongahela Group above the Sewickley coal seam. Sandstone strata between the coal seams may have originally been important aquifers, but surface and underground mining has since drained these units by altering the ground water hydrologic regime. Mining has enhanced secondary porosity, by causing additional fracturing in overlying strata and creating mine voids, to the extent that ground water discharge now exceeds local recharge.

6.2 METHODS AND MATERIALS

Several methodologies were pursued to survey the ground water hydrologic regime in and adjacent to the SRC-II site. These included a review of published and unpublished literature, aerial photographs, and topographic maps, an infiltration study, and collection of water samples from existing wells and springs for water quality analysis.

6.2.1 Infiltration Study

D'Appolonia Consulting Engineers, Inc. (D'Appolonia) was retained by Stearns-Roger to conduct an infiltration study to evaluate the potential migration of any subsurface drainage originating from the raw coal storage area and slag disposal area. The infiltration study field program was implemented in April 1979 and consisted of a site reconnaissance, subsurface exploration, and field permeability testing and piezometer installation for assessment of the hydrologic regime. The analysis of that data will be performed by a team of D'Appolonia environmental engineers, geologists, hydrogeologists, and geotechnical engineers.

D'Appolonia has provided Stearns-Roger with preliminary information pertaining to bedrock lithologies, field permeabilities and occurrence of shallow aquifers. Some of the preliminary information is presented in the following sections.

6.2.2 Water Quality

Water quality samples were collected one time from two locations and on a quarterly basis from four locations. Collections were made on the following dates: August 30 - September 1, 1978 (summer season); November 7-8, 1978 (fall season); February 13-15, 1979 (winter season); and April 19-20, 1979 (spring season). The locations of all sampling stations are shown on Figure 6-1.

The sampling stations included three springs and three wells. Sampling from springs and existing wells made it possible to sample known producing aquifers considered to be representative of local

ground water conditions. Spring No. 1 is used for stock watering, Spring No. 2 is not presently being used, and Spring No. 4 is a domestic supply. The wells are domestic, although Well No. 2 is not presently being used. Spring No. 2 was dropped after summer sampling because it is believed to be hydrologically independent of the project site. Well No. 2 was also dropped from the sampling program because it was without a pump. Well No. 3 and Spring No. 4 were subsequently substituted for Spring No. 2 and Well No. 2.

During each sampling period, measurements of water temperature, pH, and specific conductance were made in situ. Dissolved oxygen of the spring waters was also measured. Prior to sampling, Well No's. 1 and 3 were pumped continuously until pH and specific conductance measurements stabilized. Well No. 2 had to be bailed. Samples for inorganic constituent analysis were collected by the following methods:

Well No. 1 - Kemmerer

Well No. 2 - Kemmerer

Well No. 3 - House tap

Spring No. 1 - at point of discharge

Spring No. 2 - at point of discharge

Spring No. 3 - from cistern fed directly by source discharge

Samples for organic constituent analysis were collected at a tap from Wells No. 1 and 3 and with a metal bucket from Well No. 2. The methodology for collecting organic samples from the springs was the same as the inorganic sampling. All samples were collected, preserved, and delivered for laboratory analysis in accordance with Environmental Protection Agency (EPA) standards (1976).

In addition to collecting samples for routine organic constituent analysis, quarterly samples were also collected for analysis of polynuclear aromatic hydrocarbon (PNA) concentrations. Specific PNA's of interest included benz(a)anthracene, benzo(a)pyrene,

benzo(e)pyrene, and benzo(g,h,i)perylene. Samples were also taken for phenols and benzene soluble fraction measurements. PNA and benzene soluble fraction samples were collected in one-gallon glass bottles fitted with teflon-lined caps. The bottles had been washed with methylene chloride. Phenol samples were taken in one liter amber glass bottles containing a copper sulfate preservative. After collection, phenol samples were acidified to a pH of 3-4 with phosphoric acid and placed on ice.

Summer samples were obtained from Well No. 1 and Spring No. 2 for analysis of hydrocarbons according to procedures outlined in the Level I Environmental Assessment Program (EPA, 1976). The samples were collected in methylene chloride-washed amber bottles fitted with teflon-lined caps and immediately placed on ice.

Analysis of water samples for inorganic and routine organic constituents collected in August 1978, was conducted by Calgon Corporation Labs., Pittsburgh, Pennsylvania. During subsequent sampling periods, the analyses were conducted by NUS Corporation, Pittsburgh. Samples were also analyzed by Calgon in April 1979 for quality assurance. All Level I hydrocarbon samples, trace organics (PNA's, benzene soluble fraction), and phenol samples were analyzed by Gulf Science and Technology Co., Pittsburgh. The methods used for inorganic and organic constituent analysis are listed in Table 6-1. Figure 6-2 shows diagrammatically the analytical techniques for PNA analysis.

TABLE 6-1
METHODS FOR GROUND WATER ANALYSIS
P&M/SRC-II SITE

<u>PARAMETER</u>	<u>METHOD OR REFERENCE</u>
<u>General</u>	
Water Temp.	Mark IV Water Quality Analyzer
Spec. Conductance	HSI Model 33
pH	Corning 610A
Dissolved Oxygen	YSI Model
Acidity	APHA Potentiometric
Alkalinity, Total and Pht.	APHA
Color	APHA
Dissolved Solids, Total	EPA
Suspended Solids, Total	a C - APHA b N - EPA
Calcium	Atomic Absorption
Fluoride	Orion Specific Ion Electrode
Magnesium	Atomic Absorption
Organic Carbon, Total	Beckman Analyzer
Potassium	Atomic Absorption
Silica	C - ASTM N - APHA
Sodium	Atomic Absorption
Sulfate	Gravimetric with Separation
<u>Nutrients</u>	
Ammonia Nitrogen	EPA - Electrode
Kjeldahl Nitrogen	EPA - Electrode
Nitrate Nitrogen	APHJA, brucine method
Nitrite Nitrogen	C - EPA N - APHA
Phosphate, Total	EPA

TABLE 6-1 (Continued)
METHODS FOR GROUND WATER ANALYSIS
P&M/SRC-II SITE

<u>PARAMETER</u>	<u>METHOD OR REFERENCE</u>
<u>Indicators of Industrial & Municipal Contaminants</u>	
COD	APHA
Chloride	APHA
Cyanide	C - ASTM N - ASTM, APHA, EPA
Oil and Grease	C - EPA N - APHA, EPA
Phenols	APHA; 4 aminoantipyrine method with distillation/chloroform extraction
Sulfide	APHA
Thiocyanate	Atomic Absorption
<u>Trace Elements</u>	
Aluminum	Atomic Absorption
Antimony	Atomic Absorption
Arsenic	Atomic Absorption
Barium	Atomic Absorption
Beryllium	Atomic Absorption
Boron	APHA
Cadmium	Atomic Absorption
Chromium, Hexavalent	APHA
Chromium, Total	Atomic Absorption
Copper	Atomic Absorption
Iron	Atomic Absorption
Lead	Atomic Absorption
Manganese	Atomic Absorption
Mercury	C - Cold Vapor Hg Analyzer N - Atomic Absorption, Flameless
Molybdenum	Atomic Absorption
Nickel	Atomic Absorption
Selenium	Atomic Absorption
Silver	Atomic Absorption
Uranium	Colorimetric, PADAP (Anal.Chem., 1970. 42:271.)
Vanadium	Atomic Absorption
Zinc	Atomic Absorption

TABLE 6-1 (Continued)
METHODS FOR GROUND WATER ANALYSIS
P&M/SRC-II SITE

<u>PARAMETER</u>	<u>METHOD OR REFERENCE</u>
<u>Trace Organics</u>	
Benz (a) anthracene	See PNA Analysis Flow Chart
Benzo (a) pyrene	See PNA Analysis Flow Chart
Benzo (e) pyrene	See PNA Analysis Flow Chart
Benzo (g, h, i) perylene	See PNA Analysis Flow Chart
Benzene Soluble Fraction	1 gallon water, extract with benzene, evaporate benzene to dryness, weigh residue
Level I Analysis for Hydrocarbons	IERL-RTP Procedures Manual: Level I Environmental Assessment, EPA - 600/2-76-160a. June 1976.

^a C = analyzed by Calgon Corp. Labs., Pittsburgh, PA

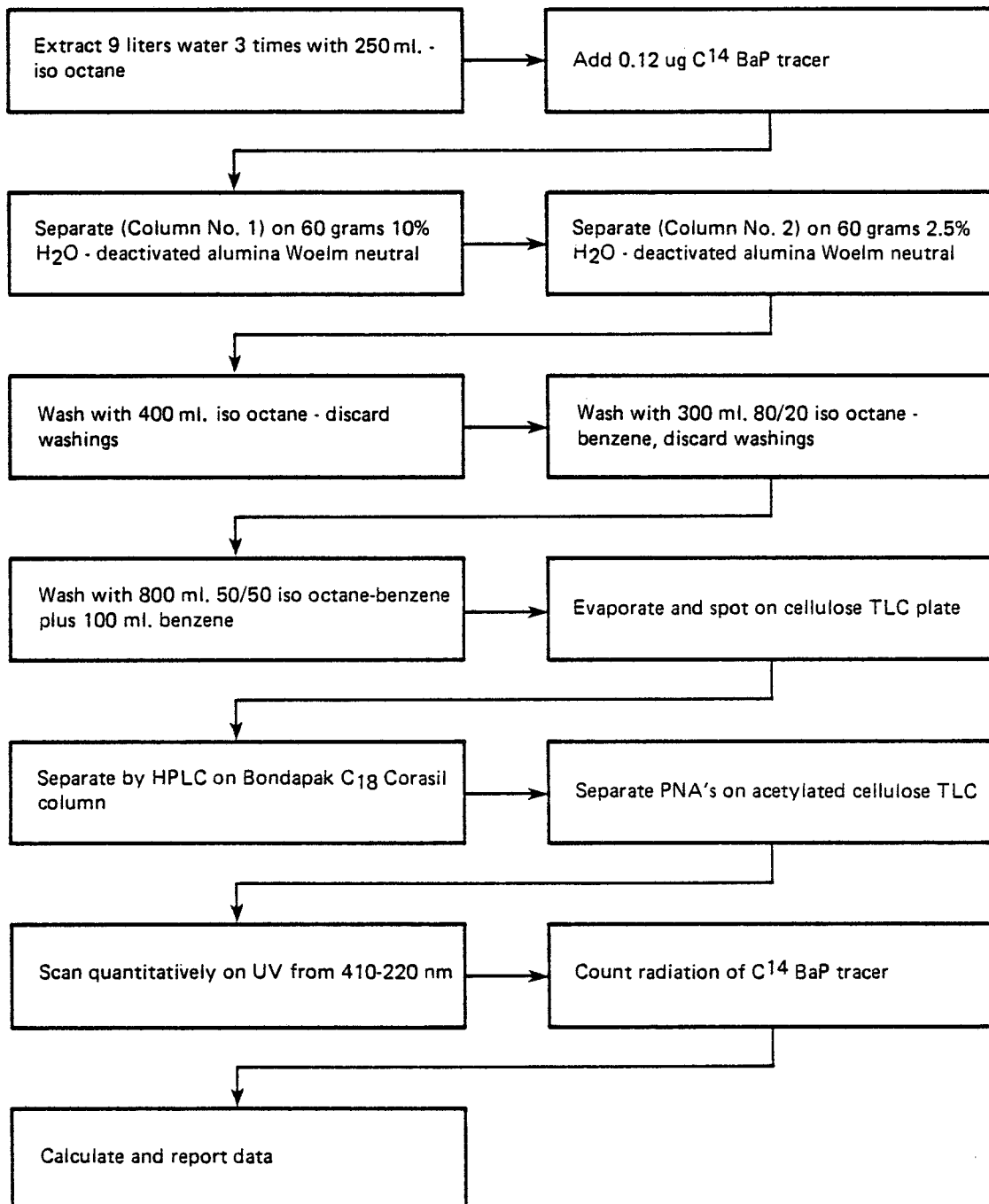
^b N = analyzed by NUS Corp. Labs., Pittsburgh, PA

APHA - American Public Health Association

ASTM - American Society for Testing Materials

EPA - Environmental Protection Agency

FIGURE 6-2
FLOW CHART - PNA ANALYSIS FOR WATER



6.3 RESULTS AND DISCUSSION

6.3.1 General

Ground water occurs in both unconsolidated (i.e., alluvium, soils, and mine spoils) and consolidated (bedrock) units. Local deposits of unconsolidated material are too limited in extent and thickness, or are not permeable enough to be an important source of ground water. Sandstone units in the Conemaugh Group are the principle sources of ground water in the SRC-II site. Northeast of the site, sandstone, and some limestone above the Sewickley coal seam are the primary sources of ground water. Conemaugh sandstone aquifers supply Well No. 1, Well No. 2, Spring No. 1, and Spring No. 4. Spring No. 4 discharges from, and Well No. 3 is completed in, limestone and/or possibly calcareous sandstone units in the upper section of the Monongahela Group above the Sewickley coal seam. There are no well completion records available for the wells sampled. However, the following information was supplied, in part, by individual well owners. The water levels listed are the average for the summer, fall, and winter sampling periods.

	<u>Water Level</u>	<u>Total Depth</u>	<u>Diameter</u>	<u>Construction Method</u>	<u>Probable Source</u>
Well No. 1	18.2'	23.8'	36"	Dug	Sandstone
Well No. 2	34.2'	36.5'	24"	Dug	Sandstone
Well No. 3	7'	32'	-	Drilled	Limestone

As previously discussed, the site is located on the west flank of the Fayette anticline. The local ground water hydrologic regime is clearly controlled by both lithology and structure. The principle sources of ground water are relatively shallow sandstones and limestones, locally discontinuous in nature, with secondary permeability associated with fracturing providing the major ground water pathways (D'Appolonia, verbal communication). Yields from springs and shallow wells (less than 60 m. or 200 ft. in depth) commonly yield less than 2.5 gallons per minute (gpm) (Carlston 1958). Spring No's. 1 and 2 yield less than 3 gpm and Well No. 3

reportedly yields 10 gpm. The yields of Spring No. 4 and Well No's. 1 and 2 were undetermined.

No site-specific information is available for the water-bearing properties of the deeper Allegheny and Pottsville aquifers. Carlston (1958) reported that the Allegheny is a relatively unimportant aquifer because yields are commonly less than 2.5 gpm. Ward and Wilmoth (1968) state that Allegheny aquifer yields are sufficient for small to moderate industrial and public water in central and northeastern Monongalia County; however, the aquifer is untested in the project area. The Pottsville is the most important aquifer in the central and northeastern parts of Monongalia County (Carlston 1958, Ward and Wilmoth 1968) where well yields range from less than one to 250 gpm and average about 45 gpm. Of particular interest, the Pottsville west of the Monongahela River is referred to as "salt sandstones" by drillers because it contains saline water (Carlston 1958; Ward and Wilmoth 1968). Although the Pottsville is untested in the site area, it appears unsuitable for use without treatment and yields are expected to be insufficient for heavy industrial supplies.

6.3.2 Infiltration Study

As discussed above, a site-specific infiltration study was conducted by D'Appolonia. Although the final report is yet to be completed, Stearns-Roger has been provided some preliminary information. Exploratory drilling and field permeability tests revealed that the most important shallow aquifer occurs within a fractured sandstone 21-24 meters (70-80 ft.) below the Pittsburgh seam. The thickness of the fracture zones are generally less than one meter (3 ft.). Aquifer permeabilities, determined from pressure testing, range from 10^{-3} cm/sec to 10^{-4} cm/sec. Permeabilities in impervious and low productivity units (fine-grained units) are less than 10^{-6} cm/sec.

Piezometer water level data indicate that the principle sandstone aquifer is unconfined in the coal storage area and partially confined

in the demonstration slag disposal area where the overburden thickness is greater. Recharge to the sandstone aquifer is by surface water infiltration via fracture pathways. In addition, the aquifer is the source of several seeps and springs in the site.

Low water levels measured in the piezometers installed in mine voids of the Pittsburgh seam indicate that little water exists within the mine and that ground water exits the mined area at a rate greater than it is recharged. Recharge to the Pittsburgh mine occurs along the crop line on the east flank of hillsides and by surface water infiltration via fractures in the overburden. Water moving through the Pittsburgh mine void discharges as acid mine drainage seeps in the Crafts Run valley west of the site.

6.3.3 Water Quality

A summary of existing ground water quality data for aquifers in the Monongahela River Basin in West Virginia (Ward and Wilmoth 1968) is presented in Table 6-2. The data is in general agreement with samples collected in and near the site.

The aquifers included in Table 6-2 were the Monongahela, Conemaugh, Allegheny, and Pottsville Groups. Of these, the Conemaugh aquifer is the most important source of domestic water in the project area. The Conemaugh Group showed a median hydrogen ion concentration (pH) of 7.0, a moderate hardness of 102 ppm (median) and low (median) concentrations of iron (0.1 ppm) and chloride (5 ppm) (Ward and Wilmoth 1968). The data suggests that the dominate cation is calcium (Ca^{++}) while the most likely anion, given a neutral pH, is bicarbonate (HCO_3^{--}).

Other aquifers discussed by Ward and Wilmoth (1968) had similar water quality characteristics. Generally higher iron concentrations and lower pH's occurred in all, except in the Monongahela Group. The hardness concentrations were generally lower in the Allegheny and Pottsville Groups and higher in the Monongahela Group. Additional

TABLE 6-2
SUMMARY OF CHLORIDE, IRON, HARDNESS, AND pH
OF GROUND WATER, MONONGAHELA RIVER BASIN
WEST VIRGINIA^a

<u>Water-bearing unit</u>	<u>Number of samples analyzed</u>	<u>Chloride (ppm)</u>		<u>Iron (ppm)</u>		<u>Hardness (ppm)</u>		<u>Hydrogen ion concentration (pH)</u>	
		<u>Range</u>	<u>Median concentration</u>	<u>Range</u>	<u>Median concentration</u>	<u>Range</u>	<u>Median concentration</u>	<u>Range</u>	<u>Median concentration</u>
Monongahela Group	42	0- 105	6	0-18	.2	0.5-1,212	124	5.8-8.8	7.1
Conemaugh Group	161	0-1,700	5	0-24	.1	0-1,479	102	4.8-9.0	7.0
Allegheny Formation	38	0- 237	4	0-12	1.0	1-1,650	81	5.0-8.4	6.7
Pottsville Group	49	0- 688	4	0-20	1.5	5- 242	46	4.3-8.1	6.6

^a Source: Ward and Wilmoth, 1968

observations on the Pottsville Group show very high dissolved solids west of the Monongahela River and, therefore, probably at the plant site (Carlston 1958; Ward and Wilmoth 1968).

The aquifers analyzed in and near the project site included the Conemaugh (Well No's. 1 and 2, Spring No's. 1 and 4) and the Monongahela (Well No. 3 and Spring No. 2). The analyses are in agreement with those presented in Table 6-2. Refer to Exhibits 6-1 through 6-4 for a complete listing of analysis results.

The dominate cations in the ground waters analyzed were calcium and magnesium, while the monovalent cations of sodium and potassium were present but less important. The trace elements are cations, but will be discussed separately due to their importance in low concentrations as nutrients and toxicants. The dominant anion found was bicarbonate, with sulfate and chloride of secondary importance.

Nutrients were characterized by moderate to low nitrogen concentrations. Nitrogen was found in the fully oxidized state as nitrate. The reduced forms of nitrogen (ammonia, organic N, and nitrite) had low concentrations or were absent. Phosphate concentrations were low while silica, often considered a nutrient, was relatively high.

Parameters used as indicators of anthropogenic activity were acceptable except for phenols, which exceeded federal drinking water standards in most samples. Oil and grease, and thiocyanates were also often high. Other parameters were at low or acceptable concentrations and posed no drinking water problems. The source of high phenols and thiocyanates is not known, but the relatively high solubility of phenol due to its polar nature suggests it could be leached from coal. The oil and grease may be an artifact of pump contamination, along with some coal leaching.

The trace organic parameters measured were an important part of the ground water baseline study. The specific organic compounds measured were polynuclear aromatics (PNA) traditionally used as carcinogenic indicators; pyrene and the benzene soluble fraction were also measured. PNA's are often related to the oil shale, coal, and oil processing industries, as well as to domestic sewage (Adelman and Suess 1970).

The presence of coal between some of the aquifers in the study area suggests a possible source of PNA. However, PNA concentrations in ground water were found to be very low in the U.S. and Germany by Borneff and Kunte 1964, Siddiqi and Wagner 1972, and Basu and Saxena 1978, but very high concentrations in some U.S. samples were reported by Grigoropoulos and Smith (1971). The World Health Organization set drinking water standards at 0.2 $\mu\text{g/l}$ PNA (World Health Organization 1971). The Organization standards further state that routine examination of ground waters for PNA is not needed due to the low concentrations typically found in ground water.

PNA in the wells and springs sampled on the P&M SRC-II site were uniformly low or absent. Only Benzo(a)pyrene had trace amounts present in summer 1978 at each station. Pyrene was also present in August 1978 at Spring No. 2 and Well No. 1. The highest concentration of Benzo(a)pyrene was 15 ppt from Well No. 2 in September 1978 (Exhibit 6-2). The 0.9 ppt to 15 ppt range of concentrations for benzo(a)pyrene are slightly higher than concentrations found in Endicott, New York, ground water by Basu and Saxena (1978) and in Germany by Borneff (1964).

The benzene soluble fraction ranged from 0.07 to 7.18 mg/kg. The 7.18 mg/kg value was recorded at Spring No. 1 in November 1978 and seemed unrelated to concentrations of other organic compounds.

Level I analysis could be done on two samples and neither would show any marked partitioning of organics by carbon content.

Trace metals were generally at or below detection limits for the methods used. Aluminum, cadmium, copper, iron, lead, manganese, mercury, and zinc were found in ground water samples from the site. Cadmium and mercury exceeded EPA (1976) criteria for domestic water supplies at all stations in August 1978, and iron exceeded the criteria at Well No. 1 and No. 2 for August 1978. Manganese exceeded the criteria once at Well No. 2 in August 1978. All other trace metals found at concentrations above the detection limits of the methods used were at low concentrations.

The ground water quality at the P&M SRC-II site was generally good with the few trace metals noted. The rather sparse data available for the area, limited depth of wells, and small number of wells and springs sampled gives only a brief overview of water quality, primarily from the Conemaugh group.

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EXHIBIT 6-1

GROUND WATER QUALITY DATA
P&M/SRC-II SITE
WELL #1

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATES</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
<u>General</u>			
Water Temperature (°C) ^a	14	13	10
Specific Conductance (μmhos/cm) ^a	360	295	338
pH (Units) ^a	6.8	6.5	7.1
Dissolved Oxygen ^a	8.6	3.9	5.7
Acidity Free (CaCO ₃)	-	0	0
Acidity Total (CaCO ₃)	-	21	5
Alkalinity Pht. (CaCO ₃)	-	0	0
Alkalinity Total (CaCO ₃)	152	170	149
Bicarbonate (CaCO ₃)	-	170	-
Calcium	10.5	55	56
Carbon Inorganic	-	-	46
Carbon Organic	4	<1	<1
Carbon Total	-	-	46
Carbonate (CO ₃)	-	0	0
Color (Platinum-Cobalt units)	<5	-	5-10
Fluoride	0.1	0.20	0.10
Magnesium	50	13	12
Potassium	1.4	1.4	1.1
Silica (as SiO ₂)	10	6.4	4.3
Sodium	3.7	3.4	2.7
Solids Dissolved (Total)	230	260	195
Solids Suspended (Total)	5	-	3
Sulfate (as SO ₄)	35	30	29
<u>Nutrients</u>			
Ammonia Nitrogen as N	<0.05	<0.1	<0.1
Kjeldahl Nitrogen as N	0.15	-	<0.1
Nitrate Nitrogen as N	1.8	0.6	0.6
Nitrite Nitrogen as N	<0.01	<0.01	0.01
Phosphate Total as P	0.05	0.03	0.02

EXHIBIT 6-1 (Continued)

GROUND WATER QUALITY DATA
P&M/SRC-II SITE
WELL #1

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATES</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
<u>Indicators of Industrial and Municipal Contaminants</u>			
COD	< 10	< 5	< 5
Chloride	2	4	2
Cyanide	< 0.01	< 0.001	< 0.001
Oil and Grease	< 5	8	< 1
Phenols (ppb)	.002	2.5	6.8
Sulfide (as S)	< 0.1	< 0.02	< 0.02
Thiocyanate	< 1	-	< 0.4
<u>Trace Elements (Total Conc.)</u>			
Aluminum	0.4	< 0.1	< 0.1
Antimony	< 0.5	-	< 0.1
Arsenic	< 0.010	< 0.01	< 0.01
Barium	-	< 0.1	< 0.1
Beryllium	< 0.01	-	< 0.02
Boron	< 0.10	-	< 0.5
Cadmium	0.03	0.01	< 0.01
Chromium, Hexavalent	-	< 0.002	< 0.002
Chromium, Total	< 0.05	< 0.03	< 0.03
Copper	< 0.05	0.02	0.03
Iron	0.35	0.06	0.05
Lead	0.010	< 0.05	< 0.05
Manganese	< 0.05	0.03	< 0.02
Mercury	0.009	< 0.0002	< 0.0002
Molybdenum	< 0.1	< 0.05	< 0.05
Nickel	< 0.05	< 0.02	< 0.02
Selenium	< 0.002	< 0.01	< 0.01
Silver	-	< 0.02	< 0.02
Uranium	-	-	< 0.1
Vanadium	< 0.2	-	< 0.1
Zinc	0.55	0.02	0.02

EXHIBIT 6-1 (Continued)

GROUND WATER QUALITY DATA
P&M/SRC-II SITE
WELL #1

<u>PARAMETERS (units as indicated)</u>	<u>SAMPLING DATES</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	0.0	0.0	< 40
Benzo(a)pyrene	8	0.0	< 10
Benzo(e)pyrene	0.0	0.0	< 40
Benzo(g,h,i)perylene	0.0	0.0	< 10
Benzene Soluble Fraction (mg/kg)	0.086	0.65	0.31
Pyrene	0.2	-	-
<u>Level I Analysis for Hydrocarbons (mg/l)</u>			
C-1	< 1	-	-
C-2	< 1	-	-
C-3	< 1	-	-
C-4	< 1	-	-
C-5	< 1	-	-
C-6	< 1	-	-
C-7	< 0.1	-	-
C-8	0.5	-	-
C-9	< 0.1	-	-
C-10	< 0.1	-	-
C-11	< 0.1	-	-
C-12	< 0.1	-	-
Methylene Chloride			
Extract (mg/10 liters)	1.8	-	-
Infrared Analysis for			
Functional Groups	Trace HC	-	-

NOTE: a = field measurements

EXHIBIT 6-2

GROUND WATER QUALITY DATA
P&M/SRC-II SITE
WELL #2^a - SPRING #4^b

PARAMETERS (mg/l except as indicated)	SAMPLING DATES		
	Sep. 78	Nov. 78	Feb. 78
	Well #2	Spr. #4	Spr. #4
<u>General</u>			
Water Temperature (°C) ^c	14	13.9	8
Specific Conductance (μmhos/cm) ^c	660	311	220
pH (Units) ^c	7.2	6.9	6.5
Dissolved Oxygen ^c	10.3	7.8	8.2
Acidity Free (CaCO ₃)	-	0	0
Acidity Total (CaCO ₃)	-	17	18
Alkalinity Pht. (CaCO ₃)	-	0	0
Alkalinity Total (CaCO ₃)	234	154	127
Bicarbonate (CaCO ₃)	-	154	-
Calcium	150	55	49
Carbon Inorganic	-	-	41
Carbon Organic	6	< 1	2
Carbon, Total	-	-	43
Carbonate (CO ₃)	-	0	0
Color (Platinum-Cobalt units)	< 5	-	5-10
Fluoride	0.3	0.18	0.17
Magnesium	9.0	0.02	9.2
Potassium	5.1	1.1	0.8
Silica (as SiO ₂)	10	5.2	4.3
Sodium	8.9	3.3	2.8
Solids Dissolved (Total)	430	202	167
Solids Suspended (Total)	5	-	3
Sulfate (as SO ₄)	125	30	32
<u>Nutrients</u>			
Ammonia Nitrogen as N	< 0.05	< 0.1	< 0.1
Kjeldahl Nitrogen as N	0.15	-	< 0.1
Nitrate Nitrogen as N	2.4	0.2	< 0.2
Nitrite Nitrogen as N	< 0.01	< 0.01	< 0.01
Phosphate Total as P	0.10	< 0.02	0.01

EXHIBIT 6-2 (Continued)

GROUND WATER QUALITY DATA
P&M/SRC-II SITE
WELL #2^a - SPRING #4^b

<u>PARAMETERS (units as indicated)</u>	<u>SAMPLING DATES</u>		
	<u>Sep. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
	<u>Well #2</u>	<u>Spr. #4</u>	<u>Spr. 4</u>
<u>Indicators of Industrial and Municipal Contaminants</u>			
COD	< 10	< 5	< 5
Chloride	13	< 0.2	0.98
Cyanide	< 0.01	< 0.001	< 0.001
Oil and Grease	< 5	7	3
Phenols (ppb)	2.0	2.8	1.8
Sulfide (as S)	< 0.1	< 0.02	< 0.02
Thiocyanate	< 1	-	< 0.4
<u>Trace Elements (Total Conc.)</u>			
Aluminum	0.8	< 0.1	< 0.1
Antimony	< 0.5	-	< 0.1
Arsenic	< 0.010	< 0.01	< 0.01
Barium	-	< 0.1	< 0.1
Beryllium	< 0.01	-	< 0.02
Boron	< 0.10	-	< 0.5
Cadmium	0.01	< 0.01	< 0.01
Chromium, Hexavalent	-	< 0.002	0.003
Chromium, Total	< 0.05	< 0.03	< 0.03
Copper	0.05	0.02	< 0.02
Iron	1.65	0.06	0.08
Lead	0.016	< 0.05	< 0.05
Manganese	0.15	0.02	< 0.02
Mercury	0.0045	< 0.0002	< 0.0002
Molybdenum	< 0.1	< 0.05	< 0.05
Nickel	< 0.05	< 0.02	< 0.02
Selenium	< 0.002	< 0.01	< 0.01
Silver	-	-	< 0.02
Uranium	-	-	< 0.1
Vanadium	< 0.2	-	< 0.1
Zinc	1.30	0.02	< 0.03

EXHIBIT 6-2 (Continued)

GROUND WATER QUALITY DATA
P&M/SRC-II SITE
WELL #2^a - SPRING #4^b

<u>PARAMETERS (units as indicated)</u>	<u>SAMPLING DATES</u>		
	<u>Sept. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
	<u>Well #2</u>	<u>Spr. #4</u>	<u>Spr. #4</u>
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	0.0	0.0	< 40
Benzo(a)pyrene	15	0.0	< 10
Benzo(e)pyrene	0.0	0.0	< 40
Benzo(g,h,i)perylene	0.0	0.0	< 10
Benzene Soluble Fraction (mg/kg)	0.808	0.26	0.07
Pyrene	0.0	-	-
<u>Level I Analysis for Hydrocarbons (mg/l)</u>			
C-1	-	-	-
C-2	-	-	-
C-3	-	-	-
C-4	-	-	-
C-5	-	-	-
C-6	-	-	-
C-7	-	-	-
C-8	-	-	-
C-9	-	-	-
C-10	-	-	-
C-11	-	-	-
C-12	-	-	-
Methylene Chloride Extract (mg/10 liters)	-	-	-
Infrared Analysis for Functional Groups	-	-	-

NOTE: a = Well on Hunt property
b = Spring on Hunt property
c = Field measurements

EXHIBIT 6-3
GROUND WATER QUALITY DATA
P&M/SRC II SITE
SPRING #1

PARAMETERS (mg/l except as indicated)	SAMPLING DATES		
	Aug. 78	Nov. 78	Feb. 79
<u>General</u>			
Water Temperature (°C) ^a	14.7	11.9	6.3
Specific Conductance (μmhos/cm) ^a	180	159	119
pH (Units) ^a	6.5	6.7	6.9
Dissolved Oxygen ^a	10.2	10.6	12.1
Acidity Free (CaCO ₃)	-	0	0
Acidity Total (CaCO ₃)	-	4	5
Alkalinity Pht. (CaCO ₃)	-	0	0
Alkalinity Total (CaCO ₃)	60	49	42
Bicarbonate (CaCO ₃)	-	49	-
Calcium	23	25	22
Carbon Inorganic	-	-	10
Carbon Organic	6	1	< 1
Carbon Total	-	-	10
Carbonate (CO ₃)	-	0	0
Color (Platinum - Cobalt units)	< 5	-	0-5
Fluoride	0.2	0.08	0.07
Magnesium	4.5	4.9	3.7
Potassium	1.2	1.1	1.0
Silica (as SiO ₂)	12	8.5	6.3
Sodium	3.8	2.5	2.4
Solids Dissolved (Total)	120	110	92
Solids Suspended (Total)	5	-	< 1
Sulfate (as SO ₄)	25	27	30
<u>Nutrients</u>			
Ammonia Nitrogen as N	< 0.05	< 0.1	< 0.1
Kjeldahl Nitrogen as N	< 0.15	-	< 0.1
Nitrate Nitrogen as N	1.8	1.8	1.9
Nitrite Nitrogen as N	< 0.01	< 0.01	< 0.01
Phosphate Total as P	< 0.05	0.09	0.02

EXHIBIT 6-3 (Continued)

GROUND WATER QUALITY DATA
P&M/SRC II SITE
SPRING #1

PARAMETERS (mg/l except as indicated)	SAMPLING DATES		
	Aug. 78	Nov. 78	Feb. 79
<u>Indicators of Industrial and Municipal Contaminants</u>			
COD	< 10	< 5	< 5
Chloride	3	4	2
Cyanide	< 0.01	< 0.001	< 0.001
Oil and Grease	< 5	7	2
Phenols (ppb)	2.0	3.0	4.5
Sulfide (as S)	< 0.1	< 0.02	< 0.02
Thiocyanate	1	-	< 0.4
<u>Trace Elements (Total conc.)</u>			
Aluminum	0.2	0.2	< 0.1
Antimony	< 0.5	-	< 0.1
Arsenic	< 0.010	< 0.01	< 0.01
Barium	-	< 0.1	< 0.1
Beryllium	< 0.01	-	< 0.02
Boron	< 0.10	-	< 0.5
Cadmium	0.02	< 0.01	< 0.01
Chromium, Hexavalent	-	< 0.002	0.002
Chromium, Total	< 0.05	< 0.03	< 0.03
Copper	< 0.05	< 0.02	< 0.02
Iron	0.15	0.24	0.07
Lead	< 0.010	< 0.05	< 0.05
Manganese	< 0.05	0.05	< 0.02
Mercury	0.011	< 0.0002	< 0.0002
Molybdenum	< 0.1	< 0.05	< 0.05
Nickel	< 0.05	< 0.02	< 0.02
Selenium	< 0.002	< 0.01	< 0.01
Silver	-	< 0.02	< 0.02
Uranium	-	-	< 0.1
Vanadium	< 0.2	-	< 0.1
Zinc	0.90	< 0.02	0.02

EXHIBIT 6-3 (Continued)

GROUND WATER QUALITY DATA
P&M/SRC II SITE
SPRING #1

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATES</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	0.0	0.0	< 40
Benzo(a)pyrene	0.9	0.0	< 10
Benzo(e)pyrene	0.0	0.0	< 40
Benzo(g,h,i)perylene	0.0	0.0	< 10
Benzene Soluble Fraction (mg/kg)	0.173	7.18	0.10
Pyrene	0.0	-	-
<u>Level I Analysis for Hydrocarbons (mg/l)</u>			
C-1	-	-	-
C-2	-	-	-
C-3	-	-	-
C-4	-	-	-
C-5	-	-	-
C-6	-	-	-
C-7	-	-	-
C-8	-	-	-
C-9	-	-	-
C-10	-	-	-
C-11	-	-	-
C-12	-	-	-
Methylene Chloride Extract (mg/10 liters)	-	-	-
Infrared Analysis for Functional Groups	-	-	-

NOTE: a = field measurements

EXHIBIT 6-4

GROUND WATER QUALITY DATA
P&M/SRC-II SITE
SPRING #2^a - WELL #3^b

PARAMETERS (mg/l except as indicated)	SAMPLING DATES		
	Aug. 78	Nov. 78	Feb. 79
	Spr. #2	Well #3	Well #3
<u>General</u>			
Water Temperature (°C) ^c	11.8	15.5	10.8
Specific Conductance (μmhos/cm) ^c	950	430	330
pH (Units) ^c	6.9	7.2	7.2
Dissolved Oxygen ^c	9.2	-	-
Acidity Free (CaCO ₃)	-	0	0
Acidity Total (CaCO ₃)	-	15	13
Alkalinity Pht. (CaCO ₃)	-	0	0
Alkalinity Total (CaCO ₃)	315	275	275
Bicarbonate (CaCO ₃)	-	298	-
Calcium	130	72	59
Carbon Inorganic	-	-	56
Carbon Organic	4	< 1	< 1
Carbon Total	-	-	56
Carbonate (CO ₃)	-	0	0
Color (Platinum-Cobalt Units)	< 5	-	0-5
Fluoride	0.3	0.12	0.14
Magnesium	34	36	36
Potassium	1.6	2.4	2.1
Silica (as SiO ₂)	11	3.9	3.3
Sodium	66	27	18
Solids Dissolved (Total)	700	390	354
Solids Suspended (Total)	10	-	< 1
Sulfate (as SO ₄)	270	75	58
<u>Nutrients</u>			
Ammonia Nitrogen as N	< 0.05	< 0.1	< 0.1
Kjeldahl Nitrogen as N	< 0.05	-	0.17
Nitrate Nitrogen as N	0.25	< 0.2	0.2
Nitrite Nitrogen as N	< 0.01	< 0.01	< 0.01
Phosphate Total as P	< 0.05	< 0.01	< 0.01

EXHIBIT 6-4 (Continued)

GROUND WATER QUALITY DATA
P&M/SRC-II SITE
SPRING #2^a - WELL #3^b

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATES</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
	<u>Spr. #2</u>	<u>Well #3</u>	<u>Well #3</u>
<u>Indicators of Industrial and Municipal Contaminants</u>			
COD	<10	<5	<5
Chloride	4	5	2
Cyanide	<0.01	<0.001	<0.001
Oil and Grease	<5	4	1
Phenols (ppb)	2.0	0.3	2.0
Sulfide (as S)	<0.1	<0.02	<0.02
Thiocyanate	<1	-	<0.4
<u>Trace Elements (Total Conc.)</u>			
Aluminum	0.2	0.2	<0.1
Antimony	<0.5	-	<0.1
Arsenic	<0.010	<0.01	<0.01
Barium	-	<0.1	<0.1
Beryllium	<0.01	-	<0.02
Boron	<0.10	-	<0.5
Cadmium	0.02	<0.01	<0.01
Chromium, Hexavalent	-	<0.002	<0.002
Chromium, Total	<0.05	<0.03	<0.03
Copper	<0.05	<0.02	<0.02
Iron	0.35	0.07	0.10
Lead	0.010	<0.05	<0.05
Manganese	<0.05	0.04	<0.02
Mercury	0.008	<0.0002	<0.0002
Molybdenum	<0.1	<0.05	<0.05
Nickel	<0.05	<0.02	<0.02
Selenium	<0.002	<0.01	<0.01
Silver	-	<0.02	<0.02
Uranium	-	-	<0.1
Vanadium	<0.2	-	<0.1
Zinc	0.75	0.03	0.10

EXHIBIT 6-4 (Continued)

GROUND WATER QUALITY DATA
P&M/SRC-II SITE
SPRING #2^a - WELL #3^b

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATES</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
	<u>Spr. #2</u>	<u>Well #3</u>	<u>Well #3</u>
Trace Organic (ppt)			
Benz(a)anthracene	0.0	0.0	<40
Benzo(a)pyrene	13	0.0	<10
Benzo(e)pyrene	0.0	0.0	<40
Benzo(g,h,i)perylene	0.0	0.0	<10
Benzene Soluble Fraction (mg/kg)	0.093	0.31	0.31
Pyrene	32	-	-
<u>Level I Analysis For Hydrocarbons (mg/l)</u>			
C-1	<1	-	-
C-2	<1	-	-
C-3	<1	-	-
C-4	<1	-	-
C-5	<1	-	-
C-6	<1	-	-
C-7	<0.1	-	-
C-8	0.2	-	-
C-9	<0.1	-	-
C-10	<0.1	-	-
C-11	<0.1	-	-
C-12	<0.1	-	-
Methylene Chloride Extract (mg/10 liters)	2.7	-	-
Infrared Analysis for Functional Groups	Trace HC	-	-

NOTE: a = Rauber Spring - see text
b = Mathew Well - see text
c = Field measurement

SECTION 7 SURFACE WATER

7.1 BACKGROUND

This section will provide a history and description of the water quality and hydrologic characteristics of the principal water bodies in the P&M SRC-II site vicinity. Included is the Monongahela River, Robinson Run, Crafts Run, Crooked Run, and an unnamed tributary of Crooked Run.

Physical and chemical data pertaining to these perennial waters were collected in baseline field studies conducted from 1978 to 1979. Existing literature was also used to supplement the field investigations.

The Monongahela River is formed at Fairmont, West Virginia, at the confluence of the Tygart and West Fork Rivers. The river flows generally northward from this point and finally contributes to the Ohio River at Pittsburgh, Pennsylvania. Within West Virginia, the Monongahela River drains an area of about 2900 square miles. Throughout its 129 mile length, several navigation locks and dams interrupt the free flow of water in the river. This network of locks and dams is used primarily for the transport of coal via barges to the Pittsburgh industrial area.

All of the locks and dams within Monongalia County are strictly navigation structures, having no flood control capability. The main flood season in the river basin is generally from December through March, with most floods resulting from heavy rain and snow melt (U.S. Army Corps. of Engineers 1975), however, large scale floods may occur at any time.

During the 1960's the Monongahela River achieved notoriety as one of the most severely polluted rivers in the United States. This was

due primarily to large quantities of acid mine drainage entering the river from its many tributaries, in addition to direct industrial and municipal waste discharges. Since that time, however, the water quality of the basin has generally improved, partially because many industries and municipalities within the basin have implemented effective water pollution control programs.

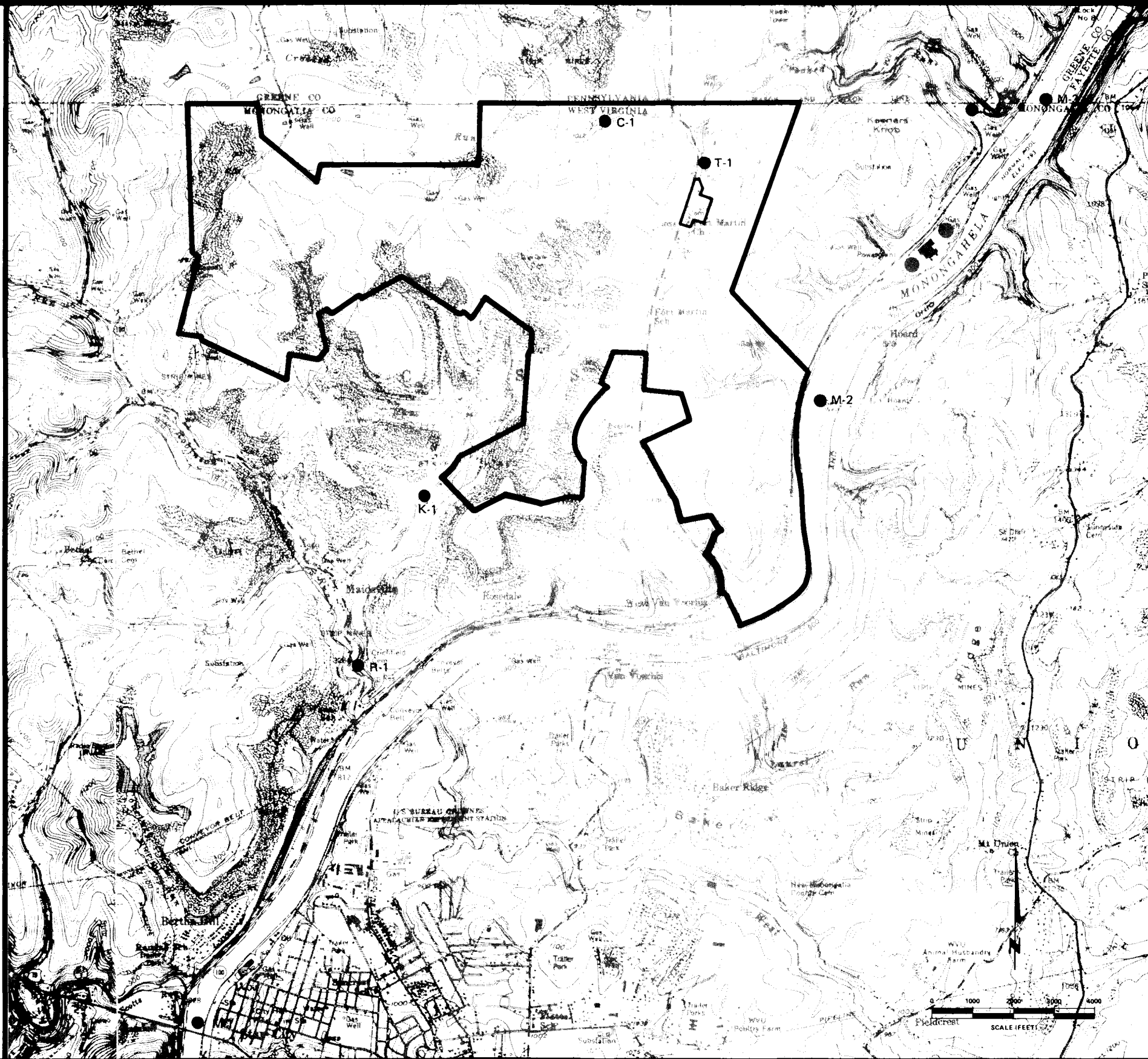
7.2 METHODS AND MATERIALS

Water quality samples were collected on a quarterly basis. Collections were made on the following dates: August 15 to 17, 1978 (summer season); November 7 to 8, 1978 (fall season); January 23 and February 13 to 14, 1979 (winter season) and April 24 to 26, 1979 (spring season). The locations of all sampling stations are shown on Figure 7-1.

During each sampling period, in situ measurements were made for water temperature, dissolved oxygen, pH, specific conductance, and discharge. At Station M-2 (proposed water intake station) a dissolved oxygen and pH depth profile was also conducted each quarter. Samples obtained for laboratory analyses of inorganic and organic constituents were collected near mid-stream, below the water surface, following standard procedures. Following collection, those samples requiring refrigeration were placed on ice in styrofoam coolers.

In addition to samples obtained for extensive inorganic and routine organic analyses, water samples were also collected during each sampling period for analysis of polynuclear aromatic hydrocarbon (PNA or PAH) concentrations. The specific PNA's of interest during this study included benz(a)anthracene; benzo(a)pyrene, benzo(e)pyrene, and benzo(g,h,i)perylene. Samples were also taken concurrently for phenols and benzene soluble fraction measurements. PNA samples were collected in three one-gallon amber glass bottles at each station. All caps used were teflon-lined and all bottles had previously been washed with methylene chloride.

Water samples obtained for the benzene soluble fraction were also collected in one-gallon amber glass bottles with teflon-lined screw caps. Phenol samples were taken in one-liter amber glass bottles containing a copper sulfate preservative. After collection, phenol samples were acidified to a pH of 3 to 4 with phosphoric acid, and placed on ice.



M-1	Monongahela River
M-2	Monongahela River
M-3	Monongahela River
R-1	Robinson Run
K-1	Crafts Run
C-1	Crooked Run
C-2	Crooked Run
T-1	Tributary of Crooked Run


The Pinesburg & Maidsville Coal Mining Co.

A WHOLLY OWNED SUBSIDIARY OF GULF OIL CORPORATION

FIGURE 7-1
SRC-II DEVELOPMENT AREA
SURFACE WATER QUALITY
SAMPLING STATIONS

During the summer sampling period, samples were obtained from two Monongahela River stations for analysis of hydrocarbons, according to procedures outlined in the Level I Environmental Assessment program (EPA 1976a). These samples were also collected in Methylene chloride-washed amber glass bottles with teflon-lined screw caps. A total of four gallons of water per station was collected, with all samples placed on ice immediately following collection.

Analysis of water samples for inorganic and routine organic constituents collected in the summer period was conducted by Calgon Corporation Labs., Pittsburgh, Pennsylvania. During subsequent sampling periods, these parameters were analyzed by NUS Corporation, Pittsburgh. All Level I hydrocarbon samples, trace organics (PNA's, benzene soluble fraction) and phenol samples were analyzed by Gulf Science and Technology Co., Pittsburgh. The methods used for analysis of all parameters are found on Table 7-1. Figure 7-2 shows diagrammatically the analytical technique employed for PNA analysis.

During the winter sampling phase (February 13 to 14, 1979), sediment samples were also collected from four water quality stations; two from the Monongahela River, and one each from Robinson Run and Crooked Run. Samples obtained for inorganic analyses were collected by use of a hand operated core sampler with a plastic tube. A total of three separate samples were taken at each station for inorganics; two samples were replicates while a third was a composite sample. The composite was obtained by collecting three or four core samples and placing them in one container.

PNA sediment samples were collected with a petite Ponar grab sampler. The sediment obtained was placed in a five-gallon metal can previously washed with methylene chloride. The can was sealed with a metal lid and transported to the laboratory.

TABLE 7-1
METHODS FOR SURFACE WATER ANALYSIS
P&M/SRC-II SITE

<u>Parameter</u>	<u>METHOD or REFERENCE</u>
<u>General</u>	
Water Temp.	Mark IV Water Quality Analyzer
Discharge	Gurley Pygmy Current Meter
Secchi Disc	Standard Secchi Disc
Spec. Conductance	Mark IV Water Quality Analyzer
pH	Mark IV Water Quality Analyzer
Dissolved Oxygen	Mark IV Water Quality Analyzer
Acidity	APHA Potentiometric
Alkalinity, Total	APHA Potentiometric
Color	APHA
Dissolved Solids, Total	EPA
Suspended Solids, Total	a C - APHA b N - EPA
Calcium	Atomic Absorption
Fluoride	Orion Specific Ion Electrode
Magnesium	Atomic Absorption
Organic Carbon, Total	Beckman Analyzer
Potassium	Atomic Absorption
Silica	C - ASTM N - APHA
Sodium	Atomic Absorption
Sulfate	Gravimetric with Separation
<u>Nutrients</u>	
Ammonia Nitrogen	EPA - Electrode
Kjeldahl Nitrogen	EPA - Electrode
Nitrate Nitrogen	APHA, brucine method
Nitrite Nitrogen	C - EPA N - APHA
Phosphate, Total	EPA
Ortho-Phosphate	EPA
<u>Indicators of Industrial & Municipal Contaminants</u>	
BOD, 5 day	APHA
COD	APHA
Chloride	APHA
Cyanide	C - ASTM N - ASTM, APHA, EPA
Oil and Grease	C - EPA N - APHA, EPA

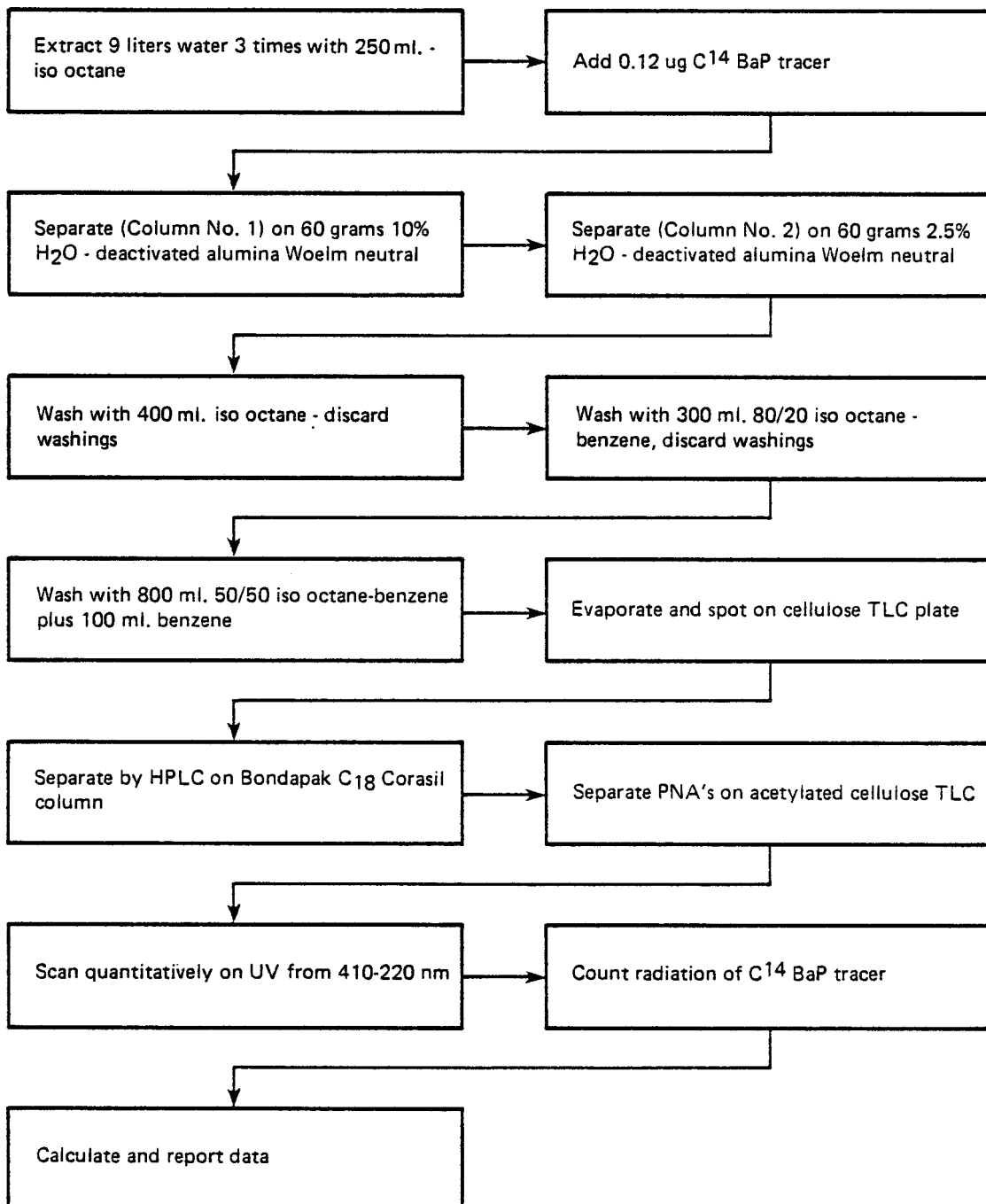
TABLE 1 (Continued)
METHODS FOR SURFACE WATER ANALYSIS
P&M/SRC-II SITE

<u>PARAMETER</u>	<u>METHOD or REFERENCE</u>
Phenols	APHA; 4 aminoantipyrine method with distillation/chloroform extraction
Sulfide	APHA
Surfactants	APHA
Thiocyanate	Atomic Absorption
<u>Trace Elements</u>	
Aluminum	Atomic Absorption
Antimony	Atomic Absorption
Arsenic	Atomic Absorption
Barium	Atomic Absorption
Beryllium	Atomic Absorption
Boron	APHA
Cadmium	Atomic Absorption
Chromium, Total	Atomic Absorption
Chromium, Hexavalent	APHA
Copper	Atomic Absorption
Iron	Atomic Absorption
Lead	Atomic Absorption
Manganese	Atomic Absorption
Mercury	C - Cold Vapor Hg Analyzer N - Atomic Absorption, Flameless
Molybdenum	Atomic Absorption
Nickel	Atomic Absorption
Selenium	Atomic Absorption
Silver	Atomic Absorption
Uranium	Colorimetric, PADAP (Anal.Chem., 1970. 42:271.)
Vanadium	Atomic Absorption
Zinc	Atomic Absorption
<u>Trace Organics</u>	
Benz(a)anthracene	See PNA Analysis Flow Chart
Benzo(a)pyrene	See PNA Analysis Flow Chart
Benzo(e)pyrene	See PNA Analysis Flow Chart
Benzo(g,h,i)perylene	See PNA Analysis Flow Chart
Benzene Soluble Fraction	1 gallon water, extract with benzene, evaporate benzene to dryness, weigh residue
Level I Analysis for Hydrocarbons	IERL-RTP Procedures Manual: Level I Environmental Assessment, EPA - 600/2-76-160a. June 1976.

^a C = analyzed by Calgon Corp. Labs., Pittsburgh, PA

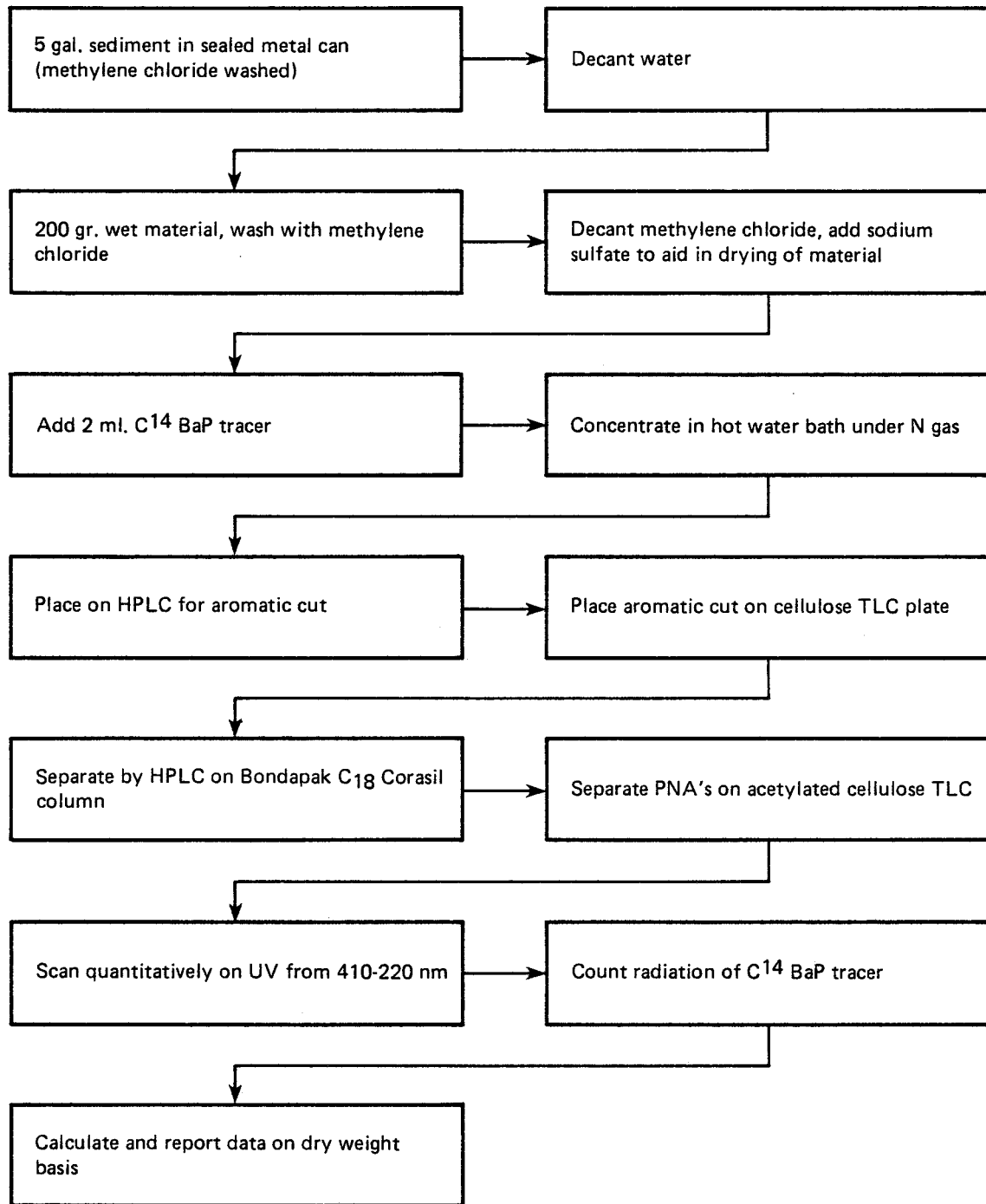
^b N = analyzed by NUS Corp. Labs., Pittsburgh, PA

FIGURE 7-2
FLOW CHART - PNA ANALYSIS FOR WATER



All sediment samples were collected from the upper 2-4 inch layer (5-10 cm.) of sediment. Analytical procedures employed by NUS Corporation, Pittsburgh, for analysis of inorganic parameters, consisted primarily of atomic absorption techniques using methods recommended in APHA (1975) and EPA (1974). Physical characteristics of the sediment, such as percent silt, clay, and organic matter, were determined according to methods in the IBP Handbook No. 16 (1971). PNA analyses were conducted by Gulf Science and Technology Co., Pittsburgh, in a manner similar to the water samples, as shown in Figure 7-3.

FIGURE 7-3
FLOW CHART - PNA ANALYSIS FOR SEDIMENT



7.3 RESULTS AND DISCUSSION

7.3.1 Monongahela River

Exhibits 7-1 through 7-10 show the gradual progression of overall improved water quality of the Monongahela River in the site vicinity. Some of the most noticeable improvements include reduction in acidity, slight improvements in dissolved oxygen concentrations, and generally decreased sulfate levels. These historical data and data collected during the Stearns-Roger field investigation reveal the seasonal and spatial variability in various parameters.

Water quality data collected during the Stearns-Roger field study (Exhibits 7-11 through 7-13) indicates that near the SRC-II site, Monongahela River water has low alkalinity, moderately high total dissolved solids levels, generally high mineralization, and high concentrations of nutrients.

On a seasonal basis, many of the parameters measured in situ display normal, variability. For example, the highest water temperatures and lowest dissolved oxygen levels were found during the summer season when dissolved oxygen values ranged from 6.7 to 7.1 mg/l. Specific conductance and total dissolved solids levels also displayed expected seasonal variability with the river flow. The highest conductance readings and total dissolved solids concentrations occurred during the fall period, concurrent with the lowest flow measurements.

Variability among many of the parameters measured in situ as well as other inorganic parameters, is relatively slight between stations during a given season. Exceptions include total phosphate, ortho-phosphate, and chemical oxygen demand (COD) levels which decrease in concentration from upstream to downstream. This can probably be attributed to gradual (decay/laydown) waste discharges from the Morgantown sewage treatment plant which enter the river near Star City, above Station M-1.

As shown in Exhibit 7-14, the diurnal fluctuations in pH, conductivity, temperature, and dissolved oxygen of the Monongahela River below Morgantown are relatively minor. The dissolved oxygen concentrations recorded during the two diurnal studies followed the expected pattern with higher dissolved oxygen levels during the daylight hours and lower concentrations during the dark hours. This rise and fall of dissolved oxygen levels is due primarily to the processes of photosynthesis during the day and respiration at night.

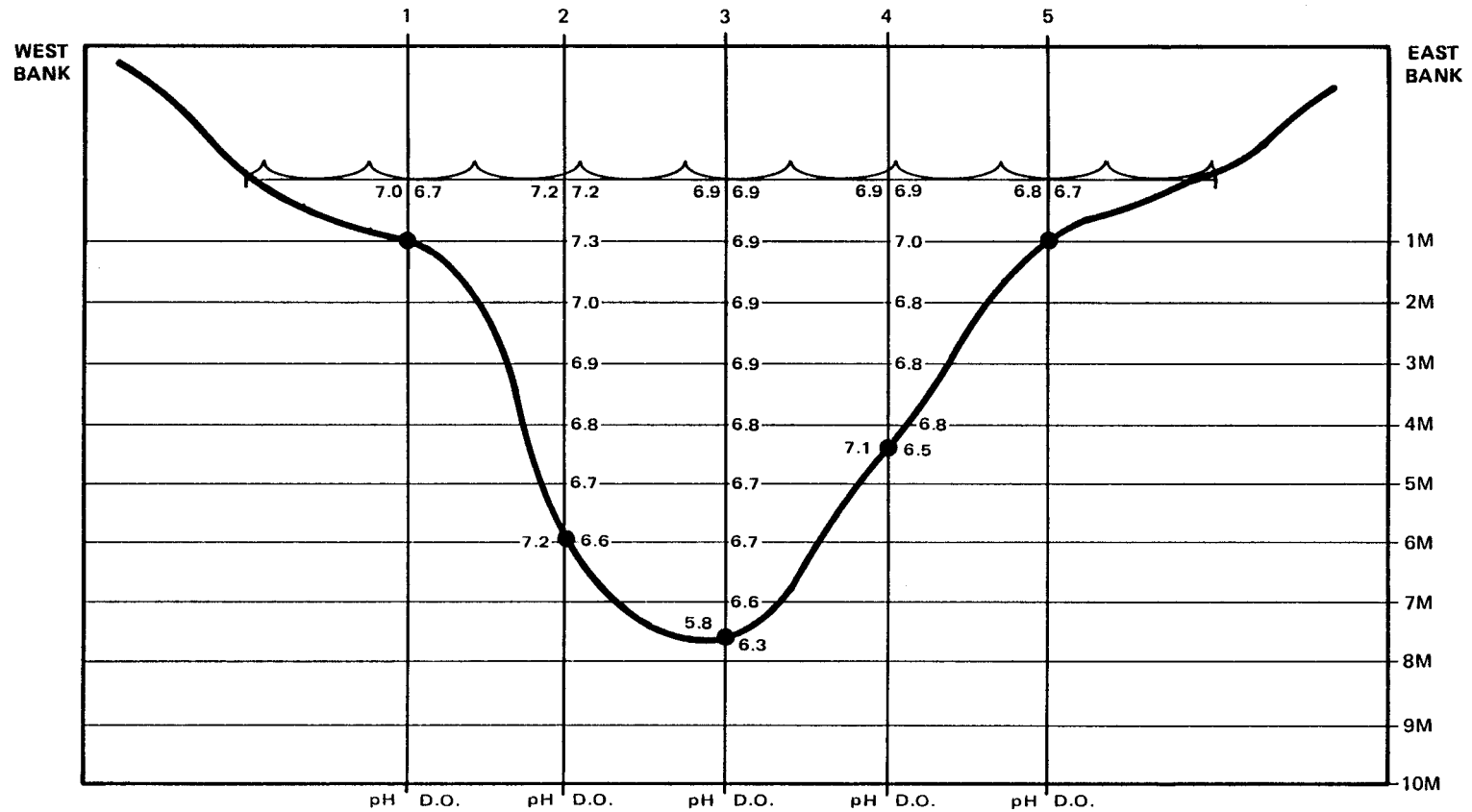
Figures 7-4 to 7-6 illustrate the values of dissolved oxygen and pH obtained from the depth profiles conducted each quarter at Station M-2. These profiles suggest only minor tendencies toward stratification, with generally decreasing dissolved oxygen and pH values found at increasing depth. The lack of pronounced stratification is due mainly to the relative shallowness of the river (about eight meters maximum in the middle) and the frequent mixing which occurs in conjunction with barge traffic.

With respect to trace element concentrations, all three sampling stations on the river far exceed EPA Criteria (1976b) for iron and manganese, which are 0.3 and 0.05 mg/l, respectively. Iron concentrations during this study ranged from 0.45 to 4.2 mg/l while manganese levels varied from 0.30 to 0.47 mg/l. Historical data also indicate high concentrations of these elements.

Concentrations of other trace elements were below both EPA Criteria (1976b) and West Virginia Water Quality Criteria (1977), and most were within ranges reported for other U.S. waters in previous investigations (Kopp and Kroner 1970; APHA 1975; EPA 1976b). An exception to this was the aluminum level found in this study. Concentrations of aluminum in the river ranged from 0.3 to 3.6 mg/l. Kopp and Kroner (1970) reported a mean concentration of 0.022 mg/l of aluminum in rivers of northern Appalachia. The relatively high values of aluminum present may be due in part to the geology of the area, especially the high percentage of aluminum found in coals of the region.

FIGURE 7-4
DISSOLVED OXYGEN/pH DEPTH PROFILE OF
MONONGAHELA RIVER AT STATION M-2

SAMPLING DATE: AUGUST 17, 1978



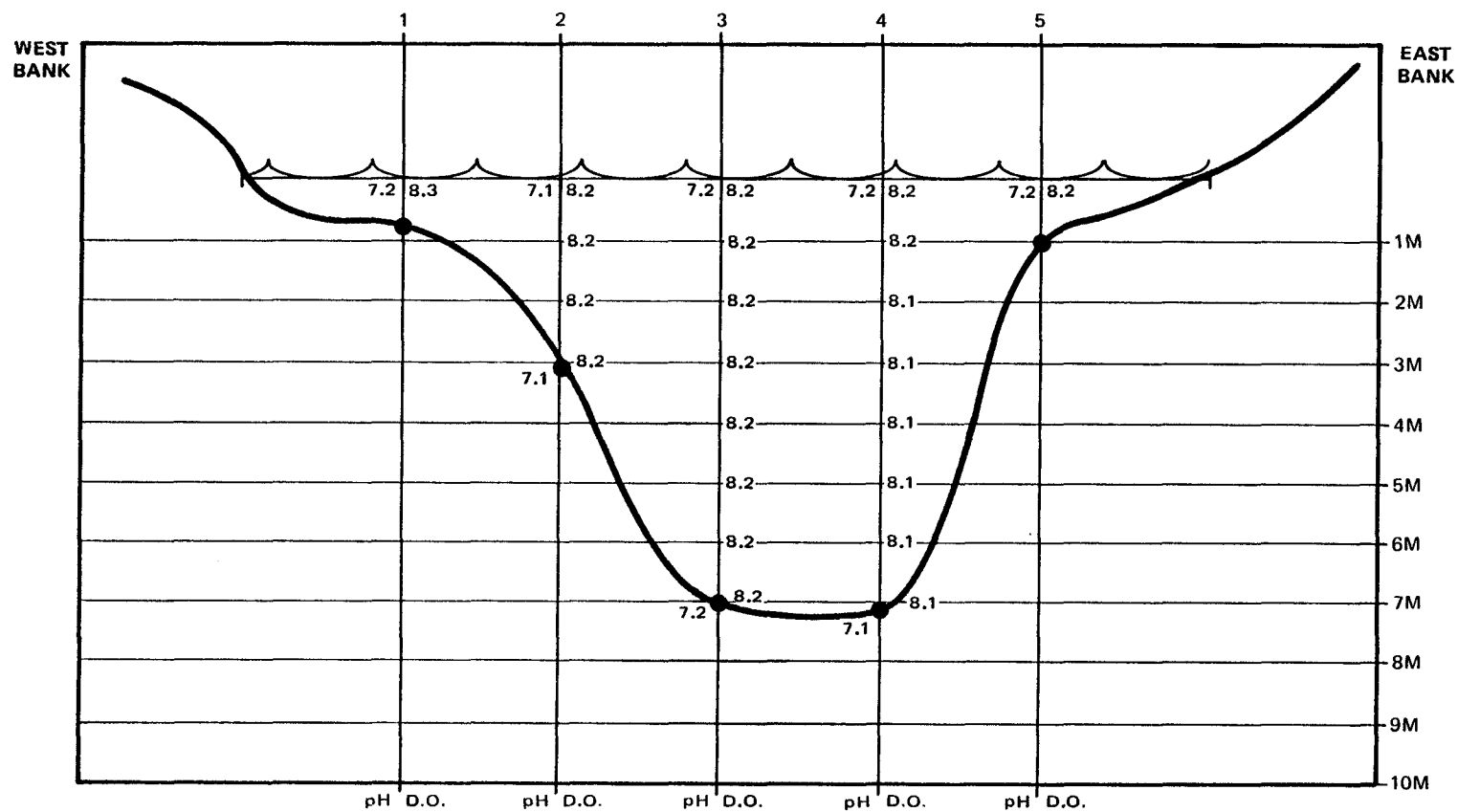
SCALE

1" = 20 METERS x AXIS = ENGINEER SCALE 20
1" = 3 METERS y AXIS = ENGINEER SCALE 30

SURFACE WATER TEMPERATURE 13.1°C

FIGURE 7-5
DISSOLVED OXYGEN/pH DEPTH PROFILE OF
MONONGAHELA RIVER AT STATION M-2

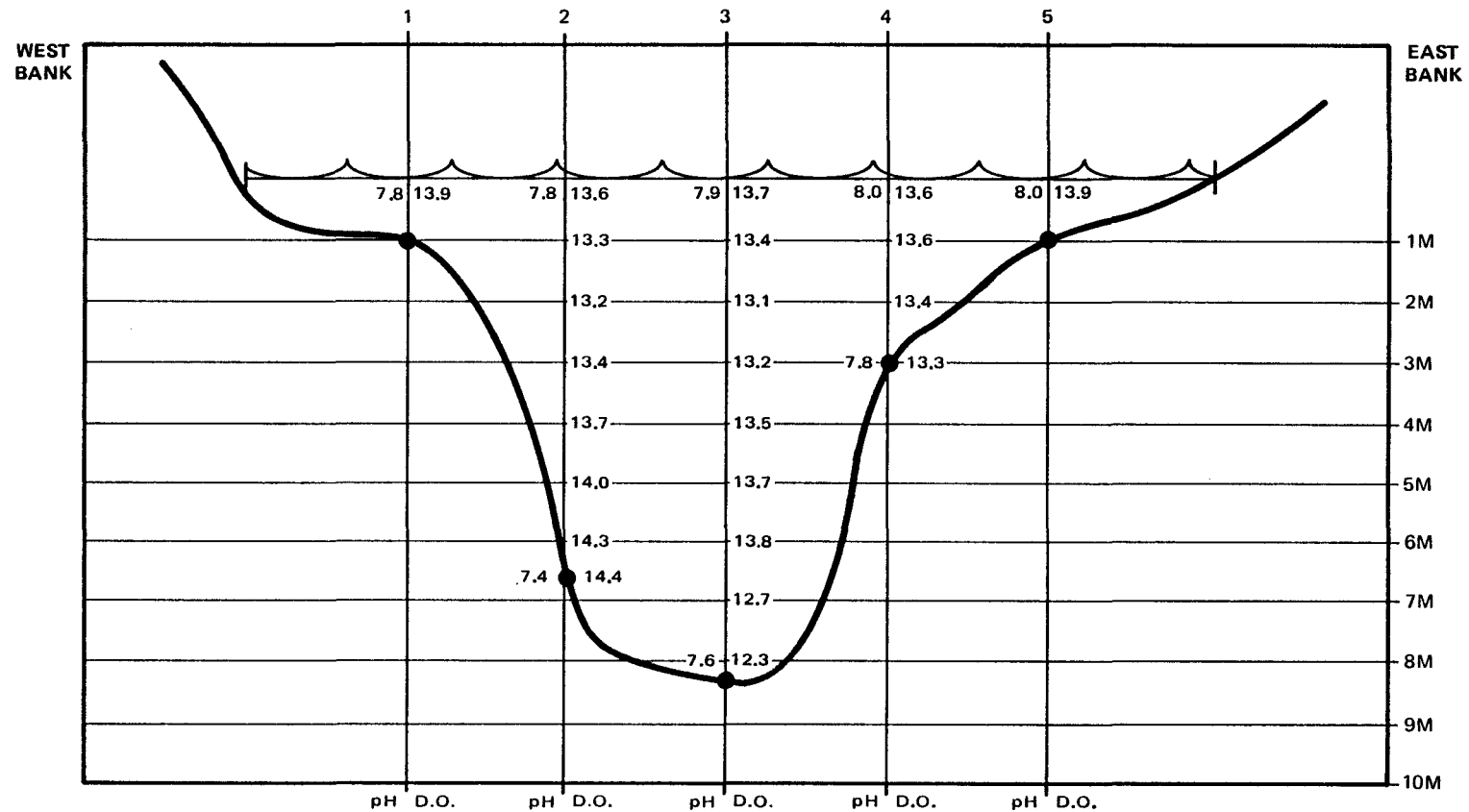
SAMPLING DATE: NOVEMBER 7, 1978



SURFACE WATER TEMPERATURE 12.0°C

FIGURE 7-6
DISSOLVED OXYGEN/pH DEPTH PROFILE OF
MONONGAHELA RIVER AT STATION M-2

SAMPLING DATE: JANUARY 23, 1979



SURFACE WATER TEMPERATURE 2.1 °C

NOTE: BARGE PASSED THROUGH AREA DURING PROFILE.

Phenol concentrations during the baseline survey ranged from less than 1.0 ppb in the summer to 4.8 ppb in the winter sampling period. Concentrations during the fall and winter decreased from upstream to downstream stations. This may be due to the proximity of the stations to industrial and sewage waste discharges. The levels of phenol found in the fall and winter exceeded the EPA Criteria (1976b) of 1.0 ppb, but not the State Criteria (1977) of 5.0 ppb. Historical data indicates that phenol concentrations as high as 38 ppb have been recorded at the upstream Star City location.

The results of analyses for PNA concentrations are shown in Exhibits 7-11, 7-12, and 7-13. The potential sources of these materials, which have traditionally been used as "indicators" of potential carcinogenic activity in the aquatic environment, are varied and complex. PNA's are formed by many processes, including the pyrolytic processing of organic raw materials such as coal and petroleum, carried out at high temperatures. Thus, effluents from such industries as oil and shale refineries, coal liquefaction and gasification plants, coal-fired power plants, coking operations, and plastics manufacturing may contain PNA's. The consumption of these products (coal tar, coal tar pitch and gasoline) also produces PNA's (Andelman and Snodgrass 1974). In addition, urban and domestic sewage effluents frequently contain PNA's (Andelman and Suess 1970). Other possible sources include carbon black which is used in the manufacturing of automobile tires. This substance contains PNA's and, consequently, the wear of tires on the road can be a source of these carcinogens. Bituminous road surfaces can also contribute PNA's during periods of road runoff whereby vehicle exhaust emissions are deposited on roads and nearby soils where they can be washed into waterways (Harrison et al 1975). PNA's have also been recovered from rain and freshly fallen snow (Andelman and Suess 1970).

The presence of PNA's, however, in remote nonindustrialized regions of the world indicates their ubiquitous nature and suggests the endogenous formation of these compounds by plants and microorganisms. Indeed, strong evidence has been gathered which

indicates that PNA's may be produced by bacteria and plants (Knorr and Schenk 1968; Hancock et al 1970). For example, laboratory culture studies of the fresh water alga, Chlorella vulgaris, have shown that this organism synthesizes several PNA's (Borneff 1964; Borneff et al 1968).

The high molecular weight and lack of polar substituent groups cause PNA's to be insoluble in water. The presence of synthetic detergents and mineral oils can increase the solubility of PNA's; however, surfactant concentrations in the range of 0.1 to 1.0 mg/l do not show any effect on benzo(a)pyrene solubility (Andelman and Snodgrass 1974). Due to their low solubilities, a large proportion of the PNA content of surface waters is adsorbed on suspended solids.

According to Searle (1976), most surface waters contain an average PNA concentration of 0.025 to 0.100 $\mu\text{g/l}$ (ppb). Higher concentrations (up to 1.0 $\mu\text{g/l}$) are found in strongly polluted waters. The results obtained in this study are far below the above ranges, as benz(a)anthracene and benzo(e)pyrene levels varied from 0.0 ppt (ng/l) to less than 40.0 ppt. Benzo(a)pyrene concentrations ranged from 0.0 ppt to 36.0 ppt. Concentrations of benzo(g,h,i)perylene varied from 0.0 ppt to less than 10.0 ppt.

Concentrations found in the Monongahela River are also below the World Health Organization International Standards for Drinking Water (1971), which recommends that PNA levels should not exceed 0.2 $\mu\text{g/l}$. The low concentrations of benzo(a)pyrene found in this investigation compare favorably with those found in German rivers such as the Danube, Rhine, and Schussen, according to studies by Borneff and Kunte (1964 and 1965). Levels of benzo(a)pyrene found in the Monongahela River were less than the range of 78 to 150 ppt reported by Keegan (1971) for the Oyster River in New Hampshire, and Onondaga Lake in New York (74.5 ppt), reported by Basu and Saxena (1978a).

In a 1977 study, Basu and Saxena (1978b) reported benzo(a)pyrene concentrations of 42.1 and 77.1 ppt for samples collected from the Monongahela River at Pittsburgh. They also found benzo(g,h,i)perylene concentrations of 34.4 and 49.8 ppt in the Monongahela River. These investigators also reported a benzo(a)pyrene concentration of 5.6 ppt in samples taken from the Ohio River at Huntington, West Virginia, as well as a benzo(g,h,i)perylene concentration of 10.7 ppt. Thus, the findings of the current study correlate well with other recent investigations of ambient PNA levels present in Appalachian rivers.

Benzene soluble fraction measurements ranged from 0.038 mg/kg (ppm) in the summer to 2.30 mg/kg in the fall. This seasonal variability was inconclusive, however, as measurements did not necessarily correlate with total organic carbon values, oil and grease concentrations, or amounts of suspended matter in the water column. No distinct trends between upstream and downstream stations were evident.

The results of the Level I analysis for organic compounds are shown in Exhibits 7-11 and 7-13. Concentrations of hydrocarbons recovered following the extraction step were below the 8 mg desired for further detailed analysis using mass spectrometry or infrared. The upstream Station M-1, however, did show higher concentrations of organics than did the downstream Station M-3. Hydrocarbons found in the highest concentrations at M-1 and M-3 during the summer were of the butane (C-4), octane (C-8), and nonane (C-9) series.

7.3.2 Robinson Run

Surface water quality data obtained during this study pertinent to the Robinson Run station are presented in Exhibit 7-15. These data indicate that this tributary is highly polluted by acid mine drainage. Values of pH were very low, ranging from 2.8 to 3.27 over the course of the investigation. These values are much below those given in the West Virginia Water Quality Criteria (1977) of 6.0 to 8.5 for Monongahela River tributaries. Sulfate concentrations were very

high, ranging from 1650 to 2630 mg/l, as were iron levels, varying from 112 to 350 mg/l. Manganese concentrations also exceeded EPA Criteria (EPA 1976b).

Several other constituent concentrations measured from Robinson Run samples exceed either EPA or State Water Quality Criteria. Levels of arsenic (0.02 and 0.03 mg/l) exceeded the State Criteria of 0.01 mg/l during two sampling periods. The concentration of lead during the fall (0.08 mg/l) exceeded the EPA and State Criteria of 0.05 mg/l. During the winter season, the concentration of fluoride (1.7 mg/l) was greater than the State Criteria of 1.0 mg/l. As in the case of the Monongahela River, aluminum values for Robinson Run seemed abnormally high for streams in this region. Concentrations of this element ranged from 66 to 86 mg/l.

In addition to containing high levels of many trace elements, this tributary is also nutrient rich, as suggested by the nitrogen and phosphorus values. This stream also experiences periodic high loadings of biodegradable organic wastes, as indicated by the BOD values.

Phenol concentrations varied from 0.3 to 12.6 ppb. The latter concentration, found in November, exceeds both the EPA (1.0 ppb) and State Criteria (5.0 ppb) for phenols. A concentration of 2.5 ppb, found in the summer, also exceeded the EPA Criteria (1976b) of 1.0 ppb.

Quarterly samples collected for PNA analysis indicated very low levels of these compounds, with benz(a)anthracene and benzo(e)pyrene concentrations ranging from 0.0 to less than 40 ppt. Benzo(a)pyrene and benzo(g,h,i)perylene concentration ranges were 0.0 to less than 10.0 ppt. A relatively high benzene soluble fraction measurement in the fall (3.76 mg/kg) suggests the presence of organic compounds other than the PNA's studied, such as other aromatic hydrocarbons and phenols.

7.3.3 Crafts Run

As in the case of Robinson Run, Crafts Run also receives acid mine drainage, thereby producing similar water quality characteristics. Acidic pH values and high concentrations of sulfate, iron, and manganese also characterize this small stream (Exhibit 7-16). Nutrient and organic waste loadings, however, do not appear to be as great as those in Robinson Run.

In addition to high iron and manganese levels, aluminum concentrations were high in this stream, varying from 25 to 31 mg/l. Concentrations of the remaining trace elements appear to be within normal ranges reported for other U.S. waters.

The concentration of phenols in Crafts Run during August was 2.8 ppb, a level similar to that found in Robinson run. PNA concentrations were very low during this period.

7.3.4 Crooked Run

Water quality data collected from this study shows Crooked Run to have higher water quality compared to other streams that drain the proposed project site. Values for pH were within the slightly alkaline range, varying from 6.9 to 8.6, with most readings slightly above pH 7.0 (Exhibits 7-17 and 7-18). Concentrations of nutrients were generally low, although higher concentrations were found upstream near Station C-1. These higher upstream concentrations can probably be attributed to agricultural and pastureland drainage in the upper reaches of the stream. Lowest flows in this stream were found in November, concurrent with the highest specific conductance measurements. As one moves from upstream to downstream, the flow of the stream increases while total dissolved solids and alkalinity levels decrease.

As in the case of other streams investigated, iron and manganese levels were generally high in Crooked Run. Iron concentrations varied from 0.09 to 2.9 mg/l, often exceeding the EPA Criteria (1976b)

of 0.3 mg/l. Manganese concentrations ranged from 0.05 to 2.3 mg/l, with all values either meeting or exceeding the EPA Criteria (1976b) of 0.05 mg/l. Concentrations of other trace elements were considered to be within expected ranges.

Phenol measurements in Crooked Run were within State Criteria (5.0 ppb), ranging from 1.0 to 4.7 ppb. During the summer and winter periods the upstream station contained considerably higher levels of phenols than did the lower station. Reasons for this are unclear at this time. Similarly, concentrations of organic compounds soluble in benzene were higher at the upstream than the downstream station. Concentrations of PNA's were uniformly low throughout the study, with benz(a)anthracene and benzo(e)pyrene ranging from 0.0 to less than 40.0 ppt. Benzo(a)pyrene and benzo(g,h,i)perylene measurements ranged from 0.0 to less than 10.0 ppt.

7.3.5 Tributary of Crooked Run

This unnamed tributary of Crooked Run also contains water of generally good quality, with low to moderate alkalinity, low total dissolved solids, and low sulfate concentrations. Dissolved oxygen and percent dissolved oxygen saturation measurements were among the highest of all stations sampled during any particular season (Exhibit 7-19). Like Crooked Run, the lowest flow readings were recorded in the fall, concurrent with the highest specific conductance measurements. Higher flows occurred during the summer when slightly more than 1 cfs was measured. Nutrient concentrations were generally low and were similar to those in Crooked Run.

Only concentrations of iron and manganese exceeded either State or EPA water quality criteria, with iron ranging from 0.19 to 3.8 mg/l and manganese varying from 0.08 to 0.25 mg/l. Levels of other trace elements were generally within expected ranges when compared to values given by Kopp and Kroner (1970) for northern Appalachian streams.

The concentration of phenols found during August (2.8 ppb) exceeds the EPA Criteria (1976b) of 1.0 ppb but, PNA and benzene soluble fraction levels were low at this time.

7.3.6 Sediments

Exhibits 7-20 to 7-23 display the results of chemical analyses performed on sediment samples collected during February 1979. Monongahela River samples were composed of primarily silt and clay particles at both Stations M-1 and M-3. Overall differences in concentrations of inorganic parameters between replicate and composite samples are generally small, thus suggesting relatively even distribution of the constituents measured.

Major inorganic constituents present in the Monongahela River sediments included fluoride, sulfate, sulfide, barium, iron, manganese, and zinc. This was expected, since most of these parameters are also commonly found in regional coals.

Concentrations of all trace elements measured were greater than those of the overlying water. This is common due to the tendency of many trace elements to sorb to a variety of stream substrates, thereby reducing levels that would otherwise remain in solution.

Levels of cyanide, sulfide, arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc were higher at the upstream Station M-1 than at M-3. This can probably be attributed to three factors: the close proximity of M-1 to the Morgantown sewage treatment plant outfall, other discharges to the river from industries a short distance upstream of Station M-1, and the influence of tributaries containing acid mine wastes.

Concentrations of most trace elements in sediment collections were generally within ranges reported in the literature for other urban regions. A few exceptions include lead, copper, and zinc. Lead levels measured in this study (33 to 130 ppm) were higher than those

found in the Illinois River (28 ppm) by Mathis and Cummings (1973) and in the Willamette River, Oregon (5 to 100 ppm), by Rickert et al (1977).

Copper concentrations of 40 to 57 ppm found in the Monongahela River were greater than levels of 19 ppm reported present in the Illinois River by Mathis and Cummings (1973), in the Willamette River (5 to 30 ppm), reported by Rickert et al (1977), and in Lake Superior (19 to 36 ppm) as found by Helmke (1977).

Concentrations of zinc found in this study (280 to 540 ppm) were higher than those present in the Illinois River (81 ppm), reported by Mathis and Cummings (1973), in the Willamette River (60 to 225 ppm), reported by Rickert et al (1977), in Lake Washington (192 ppm), found by Spyridakis and Barnes (1976), and in Lake Superior (64 to 91 ppm), reported by Helmke (1977).

PNA concentrations in Monongahela River sediment were measured in the ppb range, which were higher concentrations than in the overlying water. This is presumably due to the relative insolubility of PNA's in water and their tendency to sorb onto suspended and settled particles in natural waters. Benzo(a)pyrene was present in the highest concentration (over 550 ppb) at both Stations M-1 and M-3.

There is a paucity of literature pertaining to world-wide PNA sediment levels, hence, little comparison can be made. However, concentrations found during this study do not appear to be extraordinarily high. For example, Searle (1976) reports that the PNA concentration of the seabed near heavily industrialized regions such as France may reach 1500 ppb. The following PNA concentrations in sediments collected from mildly polluted Buzzard's Bay, Massachusetts, included (Giger and Blumer 1974): Benz(a)anthracene - 41 to 330 ppb; benzo(a)pyrene - 75 to 370 ppb, benzo(e)pyrene - 59 to 310 ppb, and benzo(g,h,i) perylene - 66 to 280 ppb. The River Seine below Paris contained concentrations of benzo(a)pyrene ranging from 4 to over

3000 ppb, according to Mallet (1966), while sediments collected from a remote area near Greenland contained only 5 ppb of benzo(a)pyrene (Mallet et al 1963). The Bay of Naples near Italy was also shown to display wide ranges of benzo(a)pyrene concentrations, with values varying from less than 10 to over 2000 ppb (Bourcart and Mallet 1965). Finally, Samoilovich and Red'kin (1968) report benzo(a)pyrene values of 9.2 to 19.0 ppb in sediments collected from the Sunzha River in the Soviet Union. These samples were taken approximately 3 to 4 kilometers downstream from a refinery discharge point.

In the present study, Robinson Run sediment samples (Exhibit 7-22) contained considerably lower percentages of silt, clay, and organic matter than did Monongahela River samples, thus reflecting the stone and gravel substrate of Robinson Run. Similar to the river, the major inorganic constituents found in Robinson Run sediments were fluoride, sulfide, barium, manganese, iron, and zinc. Sediment samples from Robinson Run also contained higher levels of trace elements than did the water samples.

Compared to samples collected from the Monongahela River, concentrations of sulfate, cyanide, sulfide, barium, lead, manganese, and zinc were lower in Robinson Run sediments than in the river. Arsenic, chromium, iron, and vanadium, however, were present in greater concentrations. These differences may reflect variations either in local geology, composition of waste discharges, sediment geochemistry, or combinations of these factors.

PNA concentrations in Robinson Run sediment samples were less than 0.10 ppb. The low sediment values can probably be attributed to low levels of PNA's in the water column and the substrate composition of Robinson Run. With respect to substrate compositions, sand and gravel is plentiful, but silt, clay, and mud particles are relatively scarce. Thus, PNA's in solution are not readily deposited in the substrate.

The results of analyses performed on sediments collected from the lowest Crooked Run station are shown in Exhibit 7-23. These data suggest that sediments in this area also contain fluoride, sulfate, barium, and manganese as the major inorganic constituents. Replicate and composite samples were similar in overall chemical characteristics. Concentrations of cyanide, chromium, iron, lead, mercury, and zinc were the lowest found among all sediment sampling stations. Thus, these findings partially reflect the generally good water quality of this stream.

In February, total concentrations of PNA's present at Station C-2 were the highest of any stations sampled, with the concentration of the four PNA's analyzed collectively exceeding 1900 ppb. Benzo(g,h,i)perylene was found at a concentration of 790 ppb while the benzo(a)pyrene concentration was 468 ppb. Several factors may account for these values at this particular station. First, sediment collected at C-2 contained relatively high levels of silt, clay, organic matter, and solids, thus allowing for any PNA's present to have many possible adsorption sites. Second, the location of this station favors high PNA levels. Sediments were collected downstream of a bridge crossed numerous times each day by uncovered diesel trucks transporting coal and fly ash to and from the Ft. Martin power plant. Thus, there is the potential for many of these coal dust and fly ash particles to be deposited in-or-near the stream bed. These factors, in addition to this station's close proximity to a coal-fired electrical generating plant and a frequently traveled roadway, may combine to cause the elevated PNA levels.

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EXHIBIT 7-1

WATER QUALITY PARAMETER RANGES OF THE MONONGAHELA RIVER NEAR MORGANTOWN, 1965-1966 P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)

<u>Sampling Periods</u>	<u>Water Temperature (°C) (Mean)</u>	<u>pH (Units)</u>	<u>Acidity, Total (as CaCO₃)</u>	<u>Iron</u>	<u>Hardness (as CaCO₃)</u>
July 1965	26	3.5-3.4	90-83	2.6-1.6	360-310
August 1965	25	3.5-3.4	126-85	2.1-1.1	380-270
September 1965	23	3.5-3.4	73-59	1.5-1.0	270-230
October 1965	16	3.6-3.5	66-53	2.3-1.2	260-190
November 1965	9	3.8-3.7	67-51	3.5-3.1	270-170
December 1965	7	3.8-3.8	44-44	3.1-3.1	140-140
March 1966	9	4.0-4.0	46-45	3.5-3.5	110-100
April 1966	10	6.3-4.8	30-7	3.1-0.9	160-50
May 1966	16	5.5-3.8	64-8	3.4-1.5	220-50
June 1966	22	3.8-3.4	80-42	1.1-0.6	210-140
July 1966	27	3.8-3.4	109-68	2.0-0.5	290-200
August 1966	27	3.5-3.4	91-66	2.2-0.9	230-210
September 1966	22	3.7-3.3	70-42	1.0-0.5	290-130
October 1966	-	4.1-4.1	19-17	-	70-70
November 1966	11	4.2-4.2	43-38	2.5-2.5	140-130

Source: Sotak, M. J., 1968.

EXHIBIT 7-2

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE STAR CITY BRIDGE, 1973
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES							
	Jan. 16	Mar. 6	Apr. 23	Jul. 17	Jul. 24	Aug. 21	Oct. 16	Nov. 27
Water Temperature (°C)	2.0	8.0	12.0	26.0	26.0	22.0	18.0	11.0
Specific Conductance (μmhos/cm)	340	270	245	440	620	440	310	200
pH (Units)	6.2	6.7	6.8	6.9	7.0	7.0	7.1	7.1
Dissolved Oxygen	13.1	11.1	8.4	6.8	6.2	7.8	6.8	7.9
% D.O. Saturation	95.2	94.5	81.7	82.0	74.8	87.8	71.8	70.3
Acidity Total (as CaCO ₃)	3	2	2	3	3	4	2	1
Alkalinity, Total (as CaCO ₃)	15	16	14	19	29	37	21	14
Color (Platinum-Cobalt Units)	<5	5	<5	6	5	-	5	5
Dissolved Solids, Total	230	210	173	363	478	289	228	146
Suspended Solids, Total	6	16	13	13	17	5	1	13
Organic Carbon, Total	-	-	-	-	-	-	-	-
Nitrate Nitrogen as N	0.43	0.40	0.50	0.40	0.42	0.77	0.75	0.10
Kjeldahl Nitrogen as N	-	-	-	-	-	-	-	-
Phosphorus, Total (as P)	-	-	-	-	-	-	-	-
Phosphorus (Ortho) (as P)	-	-	-	-	-	-	-	-
BOD, 5 day	1.2	0.5	0.3	1.1	0.7	1.0	0.8	0.6
COD	-	-	-	-	-	-	-	-
Chloride	19	9	9	29	20	16	15	10
Oil and Grease (Severity)	0	1	0	0	0	0	0	0
Phenols (ppb)	38	9	7	<1	<1	3	2	4
Sulfate (as SO ₄)	130	130	103	193	282	175	130	66
Iron (μg/l)	90	500	330	130	210	450	440	180
Manganese (μg/l)	590	400	290	410	660	390	280	360

Source: West Virginia Division of Water Resources, 1973.

EXHIBIT 7-3

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE STAR CITY BRIDGE, 1974
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES							
	Jan. 15	Feb. 26	Apr. 16	Jun. 4	Jul. 16	Sept. 3	Oct. 29	Dec. 3
Water Temperature (°C)	4.0	4.0	12.0	18.0	24.0	22.0	11.0	16.0
Specific Conductance (μmhos/cm)	200	290	240	140	490	460	350	180
pH (Units) ^a	6.4	6.8	7.0	6.9	6.8	6.0	7.1	7.1
Dissolved Oxygen	8.6	11.7	10.6	9.4	7.4	8.0	7.6	11.2
% D.O. Saturation	66.0	90.0	98.0	98.1	86.7	88.7	-	-
Acidity, Total (as CaCO ₃)	3	3	5	3	4	8	5	4
Alkalinity, Total (as CaCO ₃)	9	22	21	20	23	8	22	20
Color (Platinum-Cobalt Units)	5	<5	5	7	7	7	5	<5
Dissolved Solids, Total	133	211	163	89	346	325	240	115
Suspended Solids, Total	53	14	29	134	30	92	8	15
Organic Carbon, Total	-	-	-	-	-	-	-	-
Nitrate Nitrogen as N	0.12	0.20	< 0.05	0.10	0.47	0.57	0.22	-
Kjeldahl Nitrogen as N	-	-	-	-	0.41	0.31	0.21	0.41
Phosphorus, Total (as P)	-	-	-	-	0.042	0.057	0.023	0.038
Phosphorus, Ortho (as P)	-	-	-	-	-	-	-	-
BOD, 5 day	0.4	0.4	0.4	-	1.3	0.7	1.3	0.9
COD	-	-	-	-	-	-	-	-
Chloride	11	17	12	8	18	29	16	9
Oil and Grease (Severity)	1	0	0	0	0	0	0	0
Phenols (ppb)	< 1	< 1	< 1	1	1	< 1	< 1	< 1
Sulfate (as SO ₄)	80	78	92	50	208	193	139	62
Iron (μg/l)	520	170	150	360	1020	3200	40	1160
Manganese (μg/l)	350	20	21	12	650	550	360	220

^a - Laboratory measurement

Source: West Virginia Division of Water Resources, 1974.

EXHIBIT 7-4

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER AT THE STAR CITY BRIDGE, 1975 P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES						
	Feb. 25	Apr. 15	Jun. 2	Jul. 29	Sept. 9	Oct. 28	Dec. 2
Water temperature (°C)	8.0	9.0	19.0	27.0	23.0	16.0	6.0
Specific Conductance ^a (μmhos/cm)	265	280	225	560	350	220	210
pH (Units) ^a	7.0	6.2	7.0	5.7	6.9	6.8	7.2
Dissolved Oxygen	10.0	-	8.0	6.7	7.6	9.0	-
% D.O. Saturation	87.2	-	86.4	82.5	87.4	89.6	-
Acidity, Total (as CaCO ₃)	3	6	3	6	7	5	3
Alkalinity, Total (as CaCO ₃)	34	35	24	7	23	21	21
Color (Platinum-Cobalt Units)	5	5	5	5	< 5	6	5
Dissolved Solids, Total	144	224	133	379	238	164	168
Suspended Solids, Total	33	19	18	31	25	9	8
Organic Carbon Total	-	-	-	-	-	-	-
Nitrate Nitrogen as N	-	-	-	-	-	-	-
Kjeldahl Nitrogen as N	0.35	0.35	0.23	0.40	0.37	0.60	0.44
Phosphorus, Total (as P)	0.048	0.028	0.027	0.283	0.100	0.063	0.037
Phosphorus, Ortho (as P)	0.033	0.005	0.020	0.150	0.053	0.063	0.019
BOD, 5-day	0.9	0.3	0.5	0.5	1.1	0.9	-
COD	-	-	-	-	-	-	-
Chloride	8	8	5	15	12	19	8
Oil and Grease (Severity)	0	0	0	0	0	0	0
Phenols (ppb)	1	< 1	< 1	3	2	1	< 1
Sulfate (as SO ₄)	60	132	80	256	126	68	88
Iron (μg/l)	2000	1600	820	840	1280	1560	660
Manganese (μg/l)	450	430	280	550	450	348	280

^aLaboratory measurements

Source: West Virginia Division of Water Resources, 1975.

EXHIBIT 7-5

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE STAR CITY BRIDGE, 1976
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES					
	Jan. 13	Mar. 9	Apr. 13	May 11	Jun. 15	Jul. 13
Water Temperature (°C)	2.0	-	10.0	16.0	25.0	23.0
Specific Conductance ^a (μmhos/cm)	200	250	200	500	400	400
pH ^a (Units)	7.1	6.8	7.2	6.8	6.9	7.2
Dissolved Oxygen ^a	11.8	10.4	10.0	8.7	7.4	7.6
% D.O. Saturation	85.1	-	89.4	88.1	87.5	87.0
Acidity, Total (as CaCO ₃)	5	4	4	5	11	4
Alkalinity, Total (as CaCO ₃)	23	12	15	29	26	27
Color (Platinum-Cobalt Units)	5	5	5	5	10	-
Dissolved Solids, Total	158	190	123	382	241	309
Suspended Solids, Total	93	16	13	23	29	13
Organic Carbon, Total	-	4	-	6	11	6
Nitrate Nitrogen as N	-	-	-	-	-	-
Kjeldahl Nitrogen as N	0.26	0.70	0.35	0.75	0.93	1.12
Phosphorus, Total (as P)	0.043	0.105	0.028	0.070	0.364	0.024
Phosphorus, Ortho (as P)	0.032	0.045	0.020	0.035	0.303	0.015
BOD, 5-day	1.1	0.5	2.6	1.2	0.7	0.9
COD	-	-	-	-	-	-
Chloride	10	13	9	18	16	16
Oil and Grease (Severity)	0	-	0	0	-	0
Phenols (ppb)	3	< 1	7	< 1	< 1	5
Sulfate (as SO ₄)	103	121	63	260	130	208
Iron (μg/l)	1040	800	700	1040	520	720
Manganese (μg/l)	320	480	252	600	280	580

^aLaboratory measurements

Source: West Virginia Division of Water Resources, 1976.

EXHIBIT 7-5 (Continued)

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE STAR CITY BRIDGE, 1976
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES				
	Aug. 10	Sep. 14	Oct. 12	Nov. 9	Dec. 7
Water Temperature (°C)	22.0	26.0	12.0	6.0	2.0
Specific Conductance ^a (μmhos/cm)	220	600	190	200	250
pH ^a (Units)	7.2	7.2	7.0	7.1	7.7
Dissolved Oxygen ^a	7.3	6.2	10.0	9.8	12.7
% D.O. Saturation	83.0	75.6	92.8	78.3	91.6
Acidity, Total (as CaCO ₃)	4	3	7	4	7
Alkalinity, Total (as CaCO ₃)	19	17	18	18	20
Color (Platinum-Cobalt Units)	5	10	10	10	10
Dissolved Solids, Total	144	355	118	141	156
Suspended Solids, Total	12	7	92	19	123
Organic Carbon, Total	<1	9	9	-	5
Nitrate Nitrogen as N	-	-	-	-	-
Kjeldahl Nitrogen as N	0.88	0.93	0.78	-	0.49
Phosphorus, Total (as P)	0.048	0.050	0.127	-	0.095
Phosphorus, Ortho (as P)	0.020	0.039	0.069	-	0.089
BOD, 5-day	-	-	-	-	1.1
COD	-	-	-	-	-
Chloride	8	17	6	13	14
Oil and Grease (Severity)	1	-	0	1	1
Phenols (ppb)	<1	<1	<1	<1	<1
Sulfate (as SO ₄)	58	230	49	54	88
Iron (μg/l)	400	440	4280	620	4000
Manganese (μg/l)	220	328	376	218	408

^aLaboratory measurements

Source: West Virginia Division of Water Resources, 1976.

EXHIBIT 7-6

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE STAR CITY BRIDGE 1977
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES					
	Feb. 8	Mar. 15	Apr. 12	May 10	Jun. 14	Jul. 12
Water Temperature (°C)	2.0	10.0	11.0	14.0	22.0	26.0
Specific Conductance ^a (μmhos/cm)	350	260	250	300	500	350
pH (Units) ^a	7.2	7.6	7.1	7.3	7.5	7.2
Dissolved Oxygen ^a	13.4	10.6	11.5	10.2	7.5	9.1
% D.O. Saturation	95.2	94.8	104.2	98.2	84.5	111.0
Acidity Total (as CaCO ₃)	6	2	4	12	3	2
Alkalinity, Total (as CaCO ₃)	38	33	15	30	29	20
Color (Platinum-Cobalt Units)	10	10	10	10	10	10
Dissolved Solids, Total	282	180	143	204	345	196
Suspended Solids, Total	12	103	25	22	16	22
Organic Carbon, Total	18	7	8	17	4	7
Nitrate Nitrogen as N	-	-	-	-	-	-
Kjeldahl Nitrogen as N	0.92	0.18	0.17	0.47	1.08	0.30
Phosphorus, Total (as P)	0.170	0.203	0.085	0.052	0.174	0.050
Phosphorus, Ortho (as P)	0.078	0.152	0.022	0.028	-	-
BOD, 5-day	-	-	-	-	3.6	0.4 ^b
COD	-	-	-	-	-	-
Chloride	21	8	15	9	14	11
Oil and Grease (Severity)	0	2	0	0	1	0
Phenols (ppb)	< 1	< 1	< 1	< 1	1.0	< 1
Sulfate (as SO ₄)	165	120	68	103	206	146
Iron (μg/l)	1280	2760	1160	1160	420	600
Manganese (μg/l)	540	262	252	292	340	216

^aLaboratory measurement^bA 48-hour-old sample used for analysis

Source: West Virginia Division of Water Resources, 1977.

EXHIBIT 7-6 (Continued)

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE STAR CITY BRIDGE 1977
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES				
	Aug. 9	Sep. 13	Oct. 11	Nov. 15	Dec. 13
Water Temperature (°C)	25.0	24.0	15.0	10.0	3.0
Specific Conductance ^a (μmhos/cm)	250	400	350	300	200
pH (Units) ^a	7.2	7.4	8.2	7.4	8.5
Dissolved Oxygen ^a	7.9	6.9	10.2	9.3	14.0
% D.O. Saturation	94.4	80.8	100.5	82.2	103.9
Acidity Total (as CaCO ₃)	2	4	1	3	-
Alkalinity, Total (as CaCO ₃)	15	31	34	34	17
Color (Platinum-Cobalt Units)	10	10	10	10	10
Dissolved Solids, Total	137	261	231	202	132
Suspended Solids, Total	12	6	32	8	45
Organic Carbon, Total	9	13	15	22	4
Nitrate Nitrogen as N	-	-	-	-	-
Kjeldahl Nitrogen as N	0.27	0.41	0.47	0.45	0.28
Phosphorus, Total (as P)	0.048	0.055	0.073	0.063	0.048
Phosphorus, Ortho (as P)	-	-	-	-	-
BOD, 5-day	0.2	0.9	0.3 ^b	-	2.8
COD	-	-	-	-	-
Chloride	8	< 1	11	11	9
Oil and Grease (Severity)	0	-	0	0	0
Phenols (ppb)	< 1	< 1	< 1	1	1
Sulfate (as SO ₄)	-	-	200	-	78
Iron (μg/l)	400	520	1200	600	440
Manganese (μg/l)	268	156	27	224	232

^aLaboratory measurement

^bA 48-hour-old sample used for analysis

Source: West Virginia Division of Water Resources, 1977.

EXHIBIT 7-7

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE STAR CITY BRIDGE, 1978
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES					
	Jan. 17	Feb. 15	Mar. 14	Apr. 11	May 10	Jun. 14
Water Temperature ($^{\circ}\text{C}$)	1.0	1.0	5.0	16.0	12.0	-
Specific Conductance ^a ($\mu\text{mhos/cm}$)	210	240	200	300	200	300
pH (Units) ^a	7.3	6.8	7.3	7.7	6.9	7.4
Dissolved Oxygen ^a	15.4	15.8	13.8	10.8	9.5	9.0
% D.O. Saturation	106.9	111.0	107.8	107.8	87.8	-
Acidity, Total (as CaCO_3)	10	5	3	2	7	4
Alkalinity, Total (as CaCO_3)	18	14	24	32	22	26
Color (Platinum-Cobalt Units)	5	5	5	5	5	5
Dissolved Solids, Total	142	205	-	276	162	235
Suspended Solids, Total	10	29	532	23	51	14
Organic Carbon, Total	9	9	12	18	6	13
Nitrate Nitrogen as N	-	-	-	-	-	-
Kjeldahl Nitrogen as N	0.55	0.56	0.36	0.52	0.25	0.96
Phosphorus, Total (as P)	0.058	0.102	0.207	0.387	0.128	0.053
Phosphorus, Ortho (as P)	-	-	-	-	-	-
BOD, 5-day	< 0.1	2.5	2.0	1.7	0.6	0.3
COD	-	-	-	-	8	-
Chloride	8	8	8	7	6	8
Oil and Grease (Severity)	0	0	3	0	0	0
Phenols (ppb)	2	< 1	< 1	1	< 1	< 1
Sulfate (as SO_4)	80	130	61	150	90	135
Iron ($\mu\text{g/l}$)	640	1560	24000	800	1400	460
Manganese ($\mu\text{g/l}$)	276	580	720	460	296	328

^a Laboratory measurements.

Source: West Virginia Division of Water Resources, 1978.

EXHIBIT 7-7 (Continued)

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE STAR CITY BRIDGE, 1978
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES					
	Jul. 12	Aug. 16	Sep. 13	Oct. 11	Nov. 15	Dec. 12
Water Temperature ($^{\circ}\text{C}$)	19.0	25.0	24.0	16.0	11.0	5.0
Specific Conductance ^a ($\mu\text{mhos/cm}$)	-	250	200	300	440	140
pH (Units) ^a	7.3	7.1	7.4	6.7	7.0	7.0
Dissolved Oxygen ^a	8.2	8.4	7.6	7.8	7.4	12.5
% D.O. Saturation	86.9	99.4	89.1	71.3	66.1	97.7
Acidity, Total (as CaCO_3)	2	7	4	5	7	6
Alkalinity, Total (as CaCO_3)	24	<1	28	36	44	23
Color (Platinum-Cobalt Units)	5	5	5	5	5	5
Dissolved Solids, Total	157	175	139	237	336	110
Suspended Solids, Total	21	5	6	18	13	78
Organic Carbon, Total	7	11	7	-	-	3
Nitrate Nitrogen as N	-	-	-	-	-	-
Kjeldahl Nitrogen as N	0.20	0.93	0.43	0.36	0.83	0.34
Phosphorus, Total (as P)	0.251	0.075	0.044	0.013	0.117	0.021
Phosphorus, Ortho (as P)	-	-	-	-	-	-
BOD, 5-day	0.7	1.2	3.0	0.8	0.7	2.1
COD	20	-	-	8	20	-
Chloride	6	5	8	10	16	7
Oil and Grease (Severity)	0	0	0	0	0	0
Phenols (ppb)	<1	1	2	<1	<1	2
Sulfate (as SO_4)	88	150	61	148	250	72
Iron ($\mu\text{g/l}$)	980	640	360	-	-	2800
Manganese ($\mu\text{g/l}$)	274	278	172	-	-	308

^a Laboratory measurements.

Source: West Virginia Division of Water Resources, 1978.

EXHIBIT 7-8

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
 AT THE FORT MARTIN POWER PLANT, 1976-1978
 P&M/SRC-II Site

<u>SAMPLING DATES</u>	<u>PARAMETERS (mg/l except as indicated)</u>				
	<u>Dissolved Solids, Total</u>	<u>Suspended Solids, Total</u>	<u>Organic Carbon, Total</u>	<u>Nitrate, Nitrogen</u>	<u>Phosphate, Total</u>
<u>1976</u>					
Sep. 7	380	< 5	4	0.55	-
Oct. 10	-	< 5	-	-	0.02
Dec. 7	-	5	-	-	0.02
Dec. 23	-	< 5	-	-	-
<u>1977</u>					
Jan. 5	-	15	-	-	0.04
Jan. 18	-	10	-	-	-
Feb. 14	-	40	-	-	0.12
Feb. 24	-	25	-	-	-
Mar. 2	-	< 5	-	-	0.04
Mar. 21	-	20	-	-	-
Apr. 5	220	10	-	-	0.02
Apr. 19	-	10	-	-	-
May 5	270	< 5	-	-	0.02
May 18	-	< 5	-	-	-
Jun. 2	870	25	-	-	-
Jun. 16	400	< 5	-	-	-

EXHIBIT 7-8 (Continued)

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
 AT THE FORT MARTIN POWER PLANT, 1976-1978
 P&M/SRC-II Site

SAMPLING DATES	PARAMETERS (mg/l except as indicated)				
	Dissolved Solids, Total	Suspended Solids, Total	Organic Carbon, Total	Nitrate, Nitrogen	Phosphate, Total
<u>1977</u>					
Jul. 12	360	5	-	-	-
Jul. 20	250	10	-	-	-
Aug. 2	400	5	-	-	-
Aug. 23	195	5	-	-	-
Sep. 7	240	<5	-	-	-
Sep. 22	330	<5	-	-	-
Oct. 5	300	<5	-	-	-
Oct. 26	115	<5	-	-	-
Nov. 3	120	5	-	-	-
Nov. 23	180	5	-	-	-
Dec. 13	130	<5	-	-	-
Dec. 21	120	<5	-	-	-
<u>1978</u>					
Jan. 5	140	<5	-	-	-
Jan. 19	180	<5	-	-	-
Feb. 9	220	5	-	-	-
Feb. 22	380	10	-	-	-
Mar. 8	315	<5	-	-	-
Mar. 21	100	15	-	-	-

EXHIBIT 7-8 (Continued)

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE FORT MARTIN POWER PLANT, 1976-1978
P&M/SRC-II Site

SAMPLING DATES	PARAMETERS (mg/l except as indicated)				
	<u>Dissolved Solids, Total</u>	<u>Suspended Solids, Total</u>	<u>Organic Carbon, Total</u>	<u>Nitrate, Nitrogen</u>	<u>Phosphate, Total</u>
<u>1978</u>					
Apr. 6	140	<5	-	-	-
Apr. 18	235	5	-	-	-
May 9	320	<5	-	-	-
May 18	170	5	-	-	-
Jun. 13	560	45	-	-	-
Jun. 14	185	<5	-	-	-
Jun. 21	310	<5	-	-	-
Jul. 6	160	20	-	-	-
Jul. 26	225	<5	-	-	-
Aug. 2	160	25	-	-	-
Aug. 17	190	<5	-	-	-

EXHIBIT 7-8 (Continued)

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
 AT THE FORT MARTIN POWER PLANT, 1976-1978
 P&M/SRC-II Site

<u>SAMPLING DATES</u>	<u>PARAMETERS (mg/l except as indicated)</u>					
	<u>COD</u>	<u>Oil and Grease</u>	<u>Phenols (ppb)</u>	<u>Sulfate</u>	<u>Iron</u>	<u>Manganese</u>
<u>1976</u>						
Sep. 7	< 10	< 5	0.005	215	0.65	-
Oct. 10	-	< 5	-	75	0.55	-
Dec. 7	-	< 5	-	190	1.05	-
Dec. 23	-	< 5	-	-	-	-
<u>1977</u>						
Jan. 5	-	< 5	-	145	0.95	-
Jan. 18	-	< 5	-	-	-	-
Feb. 14	-	< 5	8	115	2.6	-
Feb. 24	-	< 5	-	-	-	-
Mar. 2	-	< 5	-	50	0.90	-
Mar. 21	-	< 5	-	-	-	-
Apr. 5	-	< 5	-	150	1.35	-
Apr. 19	-	< 5	-	-	-	-
May 5	-	< 5	-	180	1.10	-
May 18	-	< 5	-	-	-	-
Jun. 2	-	< 5	-	-	0.80	-
Jun. 16	-	< 5	-	-	-	-

EXHIBIT 7-8 (Continued)

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
 AT THE FORT MARTIN POWER PLANT, 1976-1978
 P&M/SRC-II Site

<u>SAMPLING DATES</u>	<u>PARAMETERS (mg/l except as indicated)</u>					
	<u>COD</u>	<u>Oil and Grease</u>	<u>Phenols (ppb)</u>	<u>Sulfate</u>	<u>Iron</u>	<u>Manganese</u>
<u>1977</u>						
Jul. 12	-	<5	-	-	0.35	-
Jul. 20	-	<5	-	-	-	-
Aug. 2	-	<5	-	-	0.15	-
Aug. 23	-	<5	-	-	-	-
Sep. 7	-	<5	-	-	0.25	-
Sep. 22	-	<5	-	-	-	-
Oct. 5	-	<5	-	-	0.30	0.20
Oct. 26	-	<5	-	-	0.45	-
Nov. 3	-	<5	-	-	-	-
Nov. 23	-	<5	-	-	0.70	-
Dec. 13	-	<5	-	-	0.40	-
Dec. 21	-	<5	-	-	-	-
<u>1978</u>						
Jan. 5	-	5	-	-	0.55	-
Jan. 19	-	<5	-	-	-	-
Feb. 9	-	<5	-	-	1.20	0.50
Feb. 22	-	<5	-	-	-	-
Mar. 8	-	<5	-	-	1.50	0.85
Mar. 21	-	<5	-	-	-	-

EXHIBIT 7-8 (Continued)

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT THE FORT MARTIN POWER PLANT, 1976-1978
P&M/SRC-II Site

PARAMETERS (mg/l except as indicated)

<u>SAMPLING DATES</u>	<u>COD</u>	<u>Oil and Grease</u>	<u>Phenols (ppb)</u>	<u>Sulfate</u>	<u>Iron</u>	<u>Manganese</u>
Apr. 6	-	< 5	-	-	0.65	-
Apr. 18	-	< 5	-	-	-	-
May 9	-	< 5	-	-	0.80	-
May 18	-	< 5	-	-	-	-
Jun. 13	-	< 5	-	-	0.60	-
Jun. 14	-	< 5	-	-	0.65	-
Jun. 21	-	< 5	-	-	-	-
Jul. 6	-	< 5	-	-	1.00	-
Jul. 26	-	< 5	-	-	-	-
Aug. 2	-	< 5	-	-	1.80	-
Aug. 17	-	< 5	-	-	-	-

Source: Allegheny Power System, 1978.

EXHIBIT 7-9

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT LOCK AND DAM #8, 1973
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES					
	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	Jun. 1
Water Temperature (°C)	1.0	2.0	11.5	10.0	15.5	26.0
Specific Conductance ^a (μmhos/cm at 25°C)	342	291	323	236	350	520
pH (Units) ^b	6.6	6.9	6.4	6.5	5.5	4.9
Dissolved Oxygen	17.8	13.8	10.6	11.4	9.4	7.8
% D. O. Saturation	-	-	-	-	-	-
Acidity, Total (as CaCO ₃)	7	-	-	-	-	11
Alkalinity, Total (as CaCO ₃)	2	3	7	8	-	-
Color (Platinum-Cobalt Units)	-	-	0	-	-	-
Dissolved Solids, Total	-	-	-	-	-	-
Suspended Solids, Total	-	-	-	-	-	-
Organic Carbon, Total	2	2	3	2	2	-
Nitrate Nitrogen as N	-	-	0.27	-	0.41	-
Kjeldahl Nitrogen as N	-	-	-	-	-	-
Phosphorus, Total (as P)	-	-	-	-	0.018	-
Phosphorus, Ortho (as P)	-	-	0.007	-	0.007	-
BOD, 5-day	-	-	-	-	-	-
COD	-	-	-	-	-	-
Chloride	-	-	9	-	-	14
Oil and Grease (Severity)	-	-	-	-	-	-
Phenols (ppb)	-	-	-	-	-	-
Sulfate (as SO ₄)	-	-	124	-	-	170
Iron (μg/l)	-	-	-	-	-	480
Manganese (μg/l)	-	-	-	-	-	-

^aLaboratory measurement^bField measurements

Source: U.S. EPA STORET, 1977.

EXHIBIT 7-9 (Continued)

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT LOCK AND DAM #8, 1973
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES					
	Jul. 1	Aug. 1	Sep. 1	Oct. 1	Nov. 1	Dec. 1
Water Temperature (°C)	26.0	27.0	22.5	16.0	10.0	2.5
Specific Conductance ^a (μmhos/cm at 25°C)	490	660	526	310	280	185
pH (Units) ^b	-	5.7	6.5	6.2	6.7	6.7
Dissolved Oxygen	-	7.4	7.8	9.0	10.2	13.9
% D. O. Saturation	-	-	-	-	-	-
Acidity, Total (as CaCO ₃)	-	3	-	2	1	5
Alkalinity, Total (as CaCO ₃)	2	2	11	4	15	5
Color (Platinum-Cobalt Units)	-	-	-	-	-	-
Dissolved Solids, Total	-	-	-	-	-	-
Suspended Solids, Total	-	-	-	-	-	-
Organic Carbon, Total	-	0	7	-	-	2
Nitrate Nitrogen as N	-	-	0.43	-	-	0.13
Kjeldahl Nitrogen as N	-	-	0.51	-	-	0.38
Phosphorus, Total (as P)	-	-	0.033	-	-	8.500
Phosphorus, Ortho (as P)	-	-	0.011	-	-	8.399
BOD, 5-day	-	0.8	0.4	1.0	0.6	0.4
COD	-	-	-	-	-	-
Chloride	-	-	-	-	-	6
Oil and Grease (Severity)	-	-	-	-	-	-
Phenols (ppb)	-	-	0	-	-	14
Sulfate (as SO ₄)	-	-	230	-	-	55
Iron (μg/l)	320	360	460	650	950	-
Manganese (μg/l)	890	1200	760	430	460	-

^aLaboratory measurement

^bField measurements

Source: U.S. EPA STORET, 1977.

EXHIBIT 7-10

WATER QUALITY PARAMETERS OF THE MONONGAHELA RIVER
AT LOCK AND DAM #8, 1975-1976
P&M/SRC-II SITE

PARAMETERS (mg/l except as indicated)	SAMPLING DATES									
	1975					1976				
	Nov. 1	Dec. 1	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	Jun. 1	Jul. 1	Aug 1
Water Temperature (°C)	14.0	5.0	5.0	8.0	10.0	14.0	18.0	-	19.0	-
Specific Conductance ^a (μmhos/cm at 25°C)	315	285	315	295	180	400	340	500	170	370
pH (Units) ^b	-	7.1	-	5.6	7.0	7.6	-	-	-	-
Dissolved Oxygen	-	10.5	13.0	-	13.4	-	11.2	-	-	-
% D.O. Saturation	-	-	-	-	-	-	-	-	-	-
Acidity, Total (as CaCO ₃)	-	-	-	-	-	-	-	-	-	-
Alkalinity, Total (as CaCO ₃)	12	16	17	12	20	30	20	22	24	12
Color (Platinum-Cobalt Units)	-	-	-	-	-	-	-	-	-	-
Dissolved Solids, Total	-	-	-	-	-	-	-	-	-	-
Suspended Solids, Total	-	-	-	-	-	-	-	-	-	-
Organic Carbon, Total	-	-	-	-	-	-	-	-	-	-
Nitrate Nitrogen as N	-	-	1.32	-	1.18	1.02	0.87	0.92	0.86	0.99
Kjeldahl Nitrogen as N	-	-	-	-	-	-	-	-	-	-
Phosphorus, Total (as P)	0.200	0.200	0.200	0.200	0.040	0.120	0.080	0.060	0.130	0.060
Phosphorus, Ortho (as P)	-	-	-	-	-	-	-	-	-	-
BOD, 5-day	-	-	-	-	-	-	-	-	-	-
COD	-	-	-	-	-	-	-	-	-	-
Chloride	5	6	11	8	7	11	8	13	6	13
Oil and Grease (Severity)	-	-	-	-	-	-	-	-	-	-
Phenols (ppb)	-	-	-	-	-	10	10	-	-	-
Sulfate (as SO ₄)	105	110	125	110	20	194	106	180	44	144
Iron (μg/l)	800	750	3,300	700	920	2,870	510	320	2,440	970
Manganese (μg/l)	-	-	-	-	-	-	-	-	420	-

a = Laboratory measurement

b = Field measurement

Source: U.S. EPA STORET, 1977.

EXHIBIT 7-11

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
MONONGAHELA RIVER (M-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Jan. 79
<u>General</u>			
Water Temperature (°C) ^a	25.5	11.8	2.0
Discharge (cfs) ^a	-	-	-
Secchi Disc (m) ^a	-	0.70	0.25
Specific Conductance (µmhos/cm) ^a	-	730.0	238.0
pH (Units) ^a	6.8	7.4	7.9
Dissolved Oxygen ^a	6.7	8.9	14.0
% D.O. Saturation	85.0	87.6	106.0
Acidity (as CaCO ₃)	0.0	-	16.0
Alkalinity Total (CaCO ₃)	33.0	42.0	3.0
Color (Platinum - Cobalt units)	5.0	5.0-10.0	20.0-30.0
Dissolved Solids, Total	210.0	420.0	162.0
Suspended Solids, Total	<5.0	5.0	81.0
Calcium	31.0	80.0	51.0
Fluoride	<0.1	0.26	0.07
Magnesium	7.5	17.0	6.8
Organic Carbon, Total	5.0	5.0	4.0
Potassium	1.8	4.1	2.7
Silica (as SiO ₂)	5.0	3.4	22.0
Sodium	12.0	41.0	8.4
Sulfate (as SO ₄)	90.0	276.0	74.0
<u>Nutrients</u>			
Ammonia Nitrogen as N	0.10	0.56	0.12
Kjeldahl Nitrogen as N	0.25	1.0	0.23
Nitrate Nitrogen as N	0.40	0.8	0.50
Nitrite Nitrogen as N	<0.01	<0.02	<0.01
Phosphate Total as P	0.07	0.13	0.10
Ortho-Phosphate as P	-	0.07	0.09

EXHIBIT 7-11 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
MONONGAHELA RIVER (M-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Jan. 79
<u>Indicators of Industrial and Municipal Contaminants</u>			
BOD, 5 day	<5.0	<1.0	<1.0
COD	<10.0	11.0	10.0
Chloride	8.0	17.0	8.0
Cyanide	<0.01	0.001	0.002
Oil and Grease	<5.0	6.0	<1.0
Phenols (ppb)	<1.0	1.3	4.8
Sulfide (as S)	<0.1	-	0.02
Surfactant (as MBAS)	-	0.04	0.01
Thiocyanate	<1.0	-	<0.1
<u>Trace Elements (Total conc.)</u>			
Aluminum	0.3	-	3.6
Antimony	0.2	-	<0.1
Arsenic	<0.01	<0.01	0.01
Barium	-	0.2 ^b	<0.1
Beryllium	<0.01	-	<0.02
Boron	<0.1	-	<0.5
Cadmium	<0.01	<0.01	<0.01
Chromium, Total	<0.05	<0.03	<0.03
Chromium, Hexavalent	-	<0.002	0.004
Copper	<0.05	-	<0.02
Iron	0.45	0.66	4.2
Lead	<0.01	<0.05	<0.05
Manganese	0.30	<0.47	0.33
Mercury	<0.0005	0.0002	<0.0001
Molybdenum	<0.1	-	<0.05
Nickel	<0.05	-	<0.02
Selenium	<0.001	<0.01	<0.01
Silver	-	<0.02	<0.02
Uranium	-	-	0.10
Vanadium	<0.1	-	<0.10
Zinc	0.10	-	0.15

EXHIBIT 7-11 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
MONONGAHELA RIVER (M-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Jan. 79
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	0.0	0.0	< 40.0
Benzo(a)pyrene	< 10.0	0.0	36.0
Benzo(e)pyrene	0.0	0.0	< 40.0
Benzo(g,h,i)perylene	0.0	0.0	< 10.0
Benzene Soluble Fraction (mg/kg)	0.143	0.51	0.70
 Level I Analysis for Hydrocarbons (mg/l)			
C-1	< 1.0	-	-
C-2	< 1.0	-	-
C-3	< 1.0	-	-
C-4	6.0	-	-
C-5	< 1.0	-	-
C-6	< 1.0	-	-
C-7	< 0.1	-	-
C-8	9.6	-	-
C-9	3.3	-	-
C-10	1.0	-	-
C-11	< 0.1	-	-
C-12	< 0.1	-	-
Methylene Chloride Extract (mg/10 liters)	4.6 ^c	-	-
Infrared Analysis for Functional Groups	None	-	-

NOTE: a = field measurements
b = possible analytical interference
c = recovery was less than 8 mg; thus no column chromatography, mass spectrometry, or further infrared analysis possible or required.

EXHIBIT 7-12

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
MONONGAHELA RIVER (M-2)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Jan. 79
<u>General</u>			
Water Temperature (°C) ^a	-	12.0	2.1
Discharge (cfs) ^a	-	-	-
Secchi Disc (m) ^a	-	1.50	0.4
Specific Conductance (μmhos/cm) ^a	-	-	248.0
pH (Units) ^a	-	7.2	7.9
Dissolved Oxygen ^a	-	8.2	13.9
% D.O. Saturation	-	81.4	107.0
Acidity (as CaCO ₃)	-	-	9.0
Alkalinity Total (CaCO ₃)	-	36.0	3.0
Color (Platinum - Cobalt units)	-	5.0-10.0	10.0-20.0
Dissolved Solids, Total	-	500.0	164.0
Suspended Solids, Total	-	6.0	61.0
Calcium	-	64.0	53.0
Fluoride	-	0.22	0.06
Magnesium	-	15.0	7.3
Organic Carbon, Total	-	3.0	4.0
Potassium	-	3.6	2.5
Silica (as SiO ₂)	-	3.2	17.0
Sodium	-	37.0	8.6
Sulfate (as SO ₄)	-	222.0	78.0
<u>Nutrients</u>			
Ammonia Nitrogen as N	-	0.67	0.14
Kjeldahl Nitrogen as N	-	1.1	0.23
Nitrate Nitrogen as N	-	0.5	0.40
Nitrite Nitrogen as N	-	0.02	<0.01
Phosphate Total as P	-	0.05	0.07
Ortho-Phosphate as P	-	0.03	0.06

EXHIBIT 7-12 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
MONONGAHELA RIVER (M-2)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Jan. 79
<u>Indicators of Industrial and Municipal Contaminants</u>			
BOD, 5 day	-	<1.0	<1.0
COD	-	8.0	9.0
Chloride	-	17.0	8.0
Cyanide	-	0.002	0.002
Oil and Grease	-	7.0	2.0
Phenols (ppb)	-	-	-
Sulfide (as S)	-	-	<0.02
Surfactant (as MBAS)	-	0.04	0.01
Thiocyanate	-	-	<0.1
<u>Trace Elements (Total conc.)</u>			
Aluminum	-	-	2.3
Antimony	-	-	<0.1
Arsenic	-	< 0.01	<0.01
Barium	-	0.1 ^b	<0.1
Beryllium	-	-	<0.02
Boron	-	-	<0.5
Cadmium	-	< 0.01	<0.01
Chromium, Total	-	< 0.03	<0.03
Chromium, Hexavalent	-	< 0.002	<0.002
Copper	-	-	<0.02
Iron	-	0.61	3.8
Lead	-	< 0.05	<0.05
Manganese	-	0.43	0.32
Mercury	-	< 0.0002	<0.0001
Molybdenum	-	-	<0.05
Nickel	-	-	<0.02
Selenium	-	< 0.01	<0.01
Silver	-	< 0.02	<0.02
Uranium	-	-	0.09
Vanadium	-	-	<0.10
Zinc	-	-	0.10

EXHIBIT 7-12 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
MONONGAHELA RIVER (M-2)

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATE</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Jan. 79</u>
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	-	-	-
Benzo(a)pyrene	-	-	-
Benzo(e)pyrene	-	-	-
Benzo(g,h,i)perylene	-	-	-
Benzene Soluble Fraction (mg/kg)	-	-	-
<u>Level I Analysis for Hydrocarbons (mg/l)</u>			
C-1	-		
C-2	-		
C-3	-		
C-4	-		
C-5	-		
C-6	-		
C-7	-		
C-8	-		
C-9	-		
C-10	-		
C-11	-		
C-12	-		
Methylene Chloride Extract (mg/10 liters)	-		
Infrared Analysis for Functional Groups	-		

NOTE: a = field measurements
b = possible analytical interference

EXHIBIT 7-13

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
MONONGAHELA RIVER (M-3)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Jan. 79
<u>General</u>			
Water Temperature (°C) ^a	26.5	12.2	2.3
Discharge (cfs) ^a	3,864.0 ^c	946.0 ^c	24,040.0 ^c
Secchi Disc (m) ^a	0.65	1.25	0.35
Specific Conductance (μmhos/cm) ^a	-	614.0	247.0
pH (Units) ^a	7.0	7.1	8.0
Dissolved Oxygen ^a	7.1	8.6	13.9
% D.O. Saturation	91.0	88.6	107.0
Acidity (as CaCO ₃)	0.0	-	9.0
Alkalinity Total (CaCO ₃)	29.0	33.0	2.0
Color (Platinum - Cobalt units)	<5.0	5.0-10.0	20.0-30.0
Dissolved Solids, Total	190.0	400.0	174.0
Suspended Solids, Total	50.0	8.0	61.0
Calcium	31.0	54.0	53.0
Fluoride	0.1	0.19	0.06
Magnesium	7.0	14.0	7.1
Organic Carbon, Total	5.0	2.0	1.0
Potassium	1.8	3.6	2.5
Silica (as SiO ₂)	5.0	3.5	17.0
Sodium	10.2	35.0	8.5
Sulfate (as SO ₄)	90.0	225.0	75.0
<u>Nutrients</u>			
Ammonia Nitrogen as N	0.15	0.59	<0.10
Kjeldahl Nitrogen as N	0.35	1.0	0.30
Nitrate Nitrogen as N	0.40	0.7	0.70
Nitrite Nitrogen as N	0.01	0.02	<0.01
Phosphate Total as P	0.08	0.04	0.08
Ortho-Phosphate as P	-	0.02	0.06

EXHIBIT 7-13 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
MONONGAHELA RIVER (M-3)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Jan. 79
<u>Indicators of Industrial and Municipal Contaminants</u>			
BOD, 5 day	< 5.0	< 1.0	< 1.0
COD	< 10.0	7.0	8.0
Chloride	7.0	17.0	8.0
Cyanide	< 0.01	0.001	0.001
Oil and Grease	< 5.0	5.0	< 1.0
Phenols (ppb)	< 1.0	1.0	2.5
Sulfide (as S)	< 0.1	-	< 0.02
Surfactant (as MBAS)	-	0.04	< 0.01
Thiocyanate	< 1.0	-	< 0.1
<u>Trace Elements (Total conc.)</u>			
Aluminum	0.3	-	2.2
Antimony	0.4	-	< 0.1
Arsenic	< 0.01	0.01	< 0.01
Barium	-	0.1	< 0.1
Beryllium	< 0.01	-	< 0.02
Boron	< 0.1	-	< 0.5
Cadmium	< 0.01	0.01	0.01
Chromium, Total	< 0.05	0.03	< 0.03
Chromium, Hexavalent	-	0.002	< 0.002
Copper	< 0.05	-	< 0.02
Iron	0.65	0.57	3.8
Lead	0.01	0.05	< 0.05
Manganese	0.30	0.39	0.31
Mercury	< 0.0005	0.0002	< 0.0001
Molybdenum	< 0.1	-	< 0.05
Nickel	< 0.05	-	< 0.02
Selenium	< 0.001	0.01	< 0.01
Silver	-	0.02	< 0.02
Uranium	-	-	0.08 ^a
Vanadium	< 0.1	-	< 0.10
Zinc	< 0.05	-	0.11

EXHIBIT 7-13 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
MONONGAHELA RIVER (M-3)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Jan. 79
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	0.0	0.0	< 40.0
Benzo(a)pyrene	14.0	0.0	17.0
Benzo(e)pyrene	0.0	0.0	< 40.0
Benzo(g,h,i)perylene	0.0	0.0	< 10.0
Benzene Soluble Fraction (mg/kg)	0.038	2.30	0.94
 Level I Analysis for Hydrocarbons (mg/l)			
C-1	< 1.0	-	-
C-2	< 1.0	-	-
C-3	< 1.0	-	-
C-4	< 1.0	-	-
C-5	< 1.0	-	-
C-6	< 1.0	-	-
C-7	< 0.1	-	-
C-8	< 4.7	-	-
C-9	1.5	-	-
C-10	< 0.1	-	-
C-11	< 0.1	-	-
C-12	< 0.1	-	-
Methylene Chloride Extract (mg/10 liters)	1.7 ^b	-	-
Infrared Analysis for Functional Groups	Trace	-	-
	Hydrocarbons		

NOTE: a = field measurements
b = recovery was less than 8 mg; thus no column chromatography, mass spectrometry, or further infrared analysis possible or required.
c = calculated

EXHIBIT 7-14

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
24-HOUR STUDY - BETWEEN M-1 AND M-2

<u>Sampling Date</u>	<u>Time</u>	<u>pH</u>	<u>Conductivity (μmhos/cm)</u>	<u>Temp. °C</u>	<u>Diss.Oxygen (mg/l)</u>	<u>% O₂ Satura- tion</u>
Nov. 7, 1978	1315	7.24	690	11.6	7.91	77.3
Nov. 7, 1978	1712	7.17	638	11.1	7.82	75.2
Nov. 7, 1978	2120	7.19	632	11.0	7.72	76.2
Nov. 8, 1978	0100	7.11	628	10.9	7.66	73.0
Nov. 8, 1978	0505	7.20	668	11.1	7.67	74.2
Nov. 8, 1978	0910	7.17	709	11.3	7.79	76.2
Apr.25, 1979	0815	6.4	367	12.9	14.6	146.3
Apr.25, 1979	1235	6.0	375	14.5	15.2	154.5
Apr.25, 1979	1600	6.0	391	17.0	14.6	151.4
Apr.25, 1979	2020	6.2	382	13.5	13.9	139.1
Apr.26, 1979	0015	6.2	385	13.3	11.7	117.4
Apr.26, 1979	0415	6.2	392	13.2	11.0	110.2

EXHIBIT 7-15

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
ROBINSON RUN (R-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
<u>General</u>			
Water Temperature (°C) ^a	19.7	8.8	5.9
Discharge (cfs) ^a	18.0	7.6	11.8
Secchi Disc (m) ^a		-	-
Specific Conductance (μmhos/cm) ^a	2,900.0	3,330.0	3,542.0
pH (Units) ^a	2.95	3.27	2.8
Dissolved Oxygen ^a	7.5	10.98	11.5
% D.O. Saturation	88.0	99.9	98.0
Acidity (as CaCO ₃)	660.0	477.0	1,110.0
Alkalinity Total (CaCO ₃)	0.0	0.0	0.0
Color (Platinum - Cobalt units) ^a	20.0	5.0-10.0	30.0-40.0
Dissolved Solids, Total	3,250.0	3,100.0	4,078.0
Suspended Solids, Total	165.0	150.0	50.0
Calcium	180.0	530.0	450.0
Fluoride	1.0	0.52	1.7
Magnesium	83.0	88.0	110.0
Organic Carbon, Total	2.0	2.0	3.0
Potassium	5.0	7.3	7.7
Silica (as SiO ₂)	28.0	14.0	17.0
Sodium	53.0	82.0	70.0
Sulfate (as SO ₄)	1,650.0	2,136.0	2,620.0

EXHIBIT 7-15 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
ROBINSON RUN (R-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
<u>Nutrients</u>			
Ammonia Nitrogen as N	1.0	0.62	1.6
Kjeldahl Nitrogen as N	2.0	1.1	2.5
Nitrate Nitrogen as N	2.1	2.1	1.0
Nitrite Nitrogen as N	0.08	0.07	0.03
Phosphate Total as P	0.55	1.0	0.54
Ortho-Phosphate as P	-	< 0.01	0.05
<u>Indicators of Industrial and Municipal Contaminants</u>			
BOD, 5 day	15.0	8.0	<1.0
COD	23.0	22.0	26.0
Chloride	4.0	6.0	3.0
Cyanide	<0.01	0.001	<0.001
Oil and Grease	<5.0	3.0	1.0
Phenols (ppb)	2.5	12.6 ^b	0.3
Sulfide (as S)	<0.1	-	<0.02
Surfactant (as MBAS)	-	<0.01	0.01
Thiocyanate	<1.0	-	0.4
<u>Trace Elements (Total conc.)</u>			
Aluminum	66.0	-	86.0
Antimony	0.3	-	<0.1
Arsenic	0.03	<0.01	0.02
Barium	-	0.1 ^c	<0.1
Beryllium	0.01	-	<0.02
Boron	0.4	-	<0.5
Cadmium	<0.01	0.01	0.01
Chromium, Total	<0.05	0.003	<0.03

EXHIBIT 7-15 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC- II SITE
ROBINSON RUN (R-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
Chromium, Hexavalent	-	< 0.002	< 0.002
Copper	0.10	-	0.09
Iron	170.0	112.0	350.0
Lead	< 0.01	0.08	< 0.05
Manganese	4.2	2.7	4.6
Mercury	< 0.0005	< 0.0002	< 0.0002
Molybdenum	< 0.1	-	< 0.05
Nickel	0.50	-	0.75
Selenium	< 0.010	< 0.01	< 0.01
Silver	-	< 0.02	< 0.02
Uranium	-	-	< 0.10
Vanadium	< 0.1	-	< 0.10
Zinc	1.05	-	1.8
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	0.0	0.0	< 40.0
Benzo(a)pyrene	< 10.0	0.0	< 10.0
Benzo(e)pyrene	0.0	0.0	< 40.0
Benzo(g,h,i)perylene	0.0	0.0	< 10.0
Benzene Soluble Fraction (mg/kg)	0.005	3.76	0.10

NOTE: a = field measurements
b = sample contained some sediment
c = possible analytical interference

EXHIBIT 7-16

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
CRAFTS RUN (K-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
<u>General</u>			
Water Temperature (°C) ^a	22.4	7.6	0.1
Discharge (cfs) ^a	0.8	0.13	c
Secchi Disc (m) ^a	-	-	-
Specific Conductance (μmhos/cm) ^a	1,600.0	935.0	1,569.0
pH (Units) ^a	4.0	4.86	4.3
Dissolved Oxygen ^a	6.7	11.6	15.0
% D.O. Saturation	81.0	104.0	111.0
Acidity (as CaCO ₃)	92.0	141.0	154.0
Alkalinity, Total (CaCO ₃)	11.0	0.0	4.0
Color (Platinum - Cobalt Units)	5.0	10.0-20.0	0.0-5.0
Dissolved Solids, Total	1,550.0	1,700.0	1,508.0
Suspended Solids, Total	55.0	72.0	116.0
Calcium	240.0	340.0	240.0
Fluoride	0.4	0.62	0.53
Magnesium	58.0	61.0	55.0
Organic Carbon, Total	4.0	3.0	3.0
Potassium	3.6	4.8	4.7
Silica (as SiO ₂)	27.0	26.0	28.0
Sodium	6.3	7.2	6.0
Sulfate (as SO ₄)	850.0	1,140.0	949.0

EXHIBIT 7-16 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
CRAFTS RUN (K-1)

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATE</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
<u>Nutrients</u>			
Ammonia Nitrogen as N	<0.05	0.37	0.45
Kjeldahl Nitrogen as N	1.30	0.74	0.57
Nitrate Nitrogen as N	0.45	0.6	0.80
Nitrite Nitrogen as N	0.01	<0.01	< 0.01
Phosphate, Total as P	0.05	0.02	0.01
Ortho-Phosphate as P	-	< 0.01	< 0.01
<u>Indicators of Industrial and Municipal Contaminants</u>			
BOD, 5 day	<5.0	<1.0	<1.0
COD	18.0	10.0	9.0
Chloride	3.0	5.0	2.0
Cyanide	< 0.01	0.001	<0.001
Oil and Grease	< 5.0	4.0	2.0
Phenols (ppb)	2.8	-	-
Sulfide (as S)	< 0.1	-	<0.02
Surfactant (as MBAS)	-	0.01	0.01
Thiocyanate	< 1.0	-	<0.4
<u>Trace Elements (Total conc.)</u>			
Aluminum	25.0	-	31.0
Antimony	0.2	-	<0.1
Arsenic	<0.01	<0.01	<0.01
Barium	-	0.1 ^b	<0.1
Beryllium	<0.01	-	<0.02
Boron	0.3	-	<0.5
Cadmium	0.01	<0.01	0.01
Chromium, Total	<0.05	<0.03	<0.03

EXHIBIT 7-16 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
CRAFTS RUN (K-1)

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATE</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
Chromium, Hexavalent	-	< 0.002	< 0.002
Copper	0.15	-	0.10
Iron	10.0	16.0	26.0
Lead	0.01	< 0.05	0.05
Manganese	8.8	10.0	8.6
Mercury	< 0.0005	< 0.0002	0.0002
Molybdenum	< 0.1	-	< 0.05
Nickel	0.25	-	0.18
Selenium	< 0.010	< 0.01	< 0.01
Silver	-	< 0.02	< 0.02
Uranium	-	-	< 0.10
Vanadium	< 0.1	-	< 0.10
Zinc	0.35	-	0.48
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	< 40.0	-	-
Benzo(a)pyrene	< 10.0	-	-
Benzo(e)pyrene	0.0	-	-
Benzo(g,h,i)perylene	0.0	-	-
Benzene Soluble Fraction (mg/kg)	0.654	-	-

NOTE: a = Field measurements
b = Possible analytical interference
c = Not measurable

EXHIBIT 7-17

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
CROOKED RUN (C-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
<u>General</u>			
Water Temperature (°C) ^a	21.6	7.8	0.1
Discharge (cfs) ^a	0.9	0.59	0.76
Secchi Disc (m) ^a	-	-	-
Specific Conductance (μmhos/cm) ^a	690.0	788.0	786.0
pH (Units) ^a	7.6	7.7	6.9
Dissolved Oxygen ^a	7.5	11.98	16.0
% D.O. Saturation	90.0	107.1	117.0
Acidity (as CaCO ₃)	0.0	-	5.0
Alkalinity Total (CaCO ₃)	160.0	112.0	131.0
Color (Platinum - Cobalt units)	15.0	5.0-10.0	5.0-10.0
Dissolved Solids, Total	475.0	510.0	599.0
Suspended Solids, Total	5.0	6.0	54.0
Calcium	80.0	93.0	100.0
Fluoride	0.2	0.19	0.23
Magnesium	29.0	30.0	36.0
Organic Carbon, Total	4.0	2.0	< 1.0
Potassium	2.3	3.0	2.9
Silica (as SiO ₂)	7.0	4.6	5.1
Sodium	19.0	19.0	19.0
Sulfate (as SO ₄)	220.0	261.0	283.0

EXHIBIT 7-17 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
CROOKED RUN (C-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
<u>Nutrients</u>			
Ammonia Nitrogen as N	< 0.05	0.27	0.14
Kjeldahl Nitrogen as N	0.80	0.61	0.71
Nitrate Nitrogen as N	< 0.05	0.3	0.20
Nitrite Nitrogen as N	< 0.01	0.02	< 0.01
Phosphate Total as P	0.05	0.02	0.04
Ortho-Phosphate as P	-	< 0.01	0.02
<u>Indicators of Industrial and Municipal Contaminants</u>			
BOD, 5 day	< 5.0	< 1.0	1.0
COD	< 10.0	6.0	10.0
Chloride	4.0	5.0	2.0
Cyanide	< 0.01	0.001	0.001
Oil and Grease	< 5.0	8.0	1.0
Phenols (ppb)	4.7	-	4.3
Sulfide (as S)	< 0.1	-	< 0.02
Surfactant (as MBAS)	-	< 0.01	< 0.01
Thiocyanate	< 1.0	-	< 0.4
<u>Trace Elements (Total conc.)</u>			
Aluminum	0.5	-	1.7
Antimony	< 0.1	-	< 0.1
Arsenic	< 0.01	< 0.01	< 0.01
Barium	-	0.1 ^b	< 0.1
Beryllium	< 0.01	-	< 0.02
Boron	0.1	-	< 0.5
Cadmium	< 0.01	< 0.01	< 0.01
Chromium, Total	0.05	< 0.03	< 0.03

EXHIBIT 7-17 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
CROOKED RUN (C-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
Chromium, Hexavalent	-	<0.002	<0.002
Copper	<0.05	-	<0.02
Iron	1.35	0.98	2.9
Lead	0.01	<0.05	<0.05
Manganese	0.60	2.1	2.3
Mercury	<0.0005	0.0002	<0.0002
Molybdenum	<0.1	-	<0.05
Nickel	<0.05	-	0.02
Selenium	<0.002	<0.01	<0.01
Silver	-	<0.02	<0.02
Uranium	-	-	<0.10
Vanadium	<0.1	-	<0.10
Zinc	<0.05	-	0.15
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	<40.0	-	<40.0
Benzo(a)pyrene	<10.0	-	<10.0
Benzo(e)pyrene	0.0	-	<40.0
Benzo(g,h,i)perylene	0.0	-	<10.0
Benzene Soluble Fraction (mg/kg)	0.587	-	1.39

NOTE: a = Field measurements
b = Possible analytical interference

EXHIBIT 7-18

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
CROOKED RUN (C-2)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
<u>General</u>			
Water Temperature (°C) ^a	21.4	8.2	0.1
Discharge (cfs) ^a	3.4	2.0	4.13
Secchi Disc (m) ^a	-	-	-
Specific Conductance (μmhos/cm) ^a	500.0	746.0	668.0
pH (Units) ^a	7.6	8.6	7.1
Dissolved Oxygen ^a	6.9 ^b	12.8	15.8
% D.O. Saturation	82.0 ^b	114.3	115.0
Acidity (as CaCO ₃)	0.0	-	5.0
Alkalinity Total (CaCO ₃)	85.0	58.0	60.0
Color (Platinum - Cobalt units)	5.0	5.0-10.0	5.0-10.0
Dissolved Solids, Total	350.0	500.0	462.0
Suspended Solids, Total	10.0	<1.0	16.0
Calcium	65.0	83.0	78.0
Fluoride	0.2	0.18	0.18
Magnesium	17.5	20.0	24.0
Organic Carbon, Total	5.0	<1.0	<1.0
Potassium	5.4	12.0	6.4
Silica (as SiO ₂)	8.0	3.4	6.4
Sodium	16.0	33.0	23.0
Sulfate (as SO ₄)	170.0	288.0	255.0

EXHIBIT 7-18 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
CROOKED RUN (C-2)

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATE</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
<u>Nutrients</u>			
Ammonia Nitrogen as N	0.10	< 0.1	0.10
Kjeldahl Nitrogen as N	0.65	0.37	0.10
Nitrate Nitrogen as N	0.20	0.2	0.20
Nitrite Nitrogen as N	< 0.01	< 0.01	< 0.01
Phosphate Total as P	0.10	0.01	0.02
Ortho-Phosphate as P	-	< 0.01	0.02
<u>Indicators of Industrial and Municipal Contaminants</u>			
BOD, 5 day	< 5.0	< 1.0	< 1.0
COD	< 10.0	5.0	5.0
Chloride	6.0	15.0	6.0
Cyanide	< 0.01	< 0.001	< 0.001
Oil and Grease	< 5.0	6.0	2.0
Phenols (ppb)	1.0	4.5	1.0
Sulfide (as S)	< 0.1	-	< 0.02
Surfactant (as MBAS)	-	0.02	< 0.01
Thiocyanate	< 1.0	-	1.4
<u>Trace Elements (Total conc.)</u>			
Aluminum	1.5	-	1.0
Antimony	0.2	-	< 0.1
Arsenic	< 0.01	< 0.01	< 0.01
Barium	-	< 0.1	< 0.1
Beryllium	< 0.01	-	< 0.02
Boron	0.3	-	0.5
Cadmium	< 0.01	< 0.01	< 0.01
Chromium, Total	< 0.05	< 0.03	< 0.03

EXHIBIT 7-18 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
CROOKED RUN (C-2)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
Chromium, Hexavalent	-	<0.002	<0.002
Copper	<0.05	-	<0.02
Iron	1.80	0.09	0.44
Lead	0.01	<0.05	<0.05
Manganese	0.20	0.05	1.4
Mercury	<0.0005	<0.0002	<0.0002
Molybdenum	<0.1	-	<0.05
Nickel	<0.05	-	<0.02
Selenium	0.004	<0.01	<0.01
Silver	-	<0.02	<0.02
Uranium	-	-	<0.02
Vanadium	<0.1	-	<0.10
Zinc	<0.05	-	<0.05
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	0.0	0.0	<40.0
Benzo(a)pyrene	0.0	0.0	<10.0
Benzo(e)pyrene	0.0	0.0	<40.0
Benzo(g,h,i)perylene	0.0	0.0	<10.0
Benzene Soluble Fraction (mg/kg)	0.131	0.26	0.51

NOTE: a = field measurements
b = average of pool and riffle measurements

EXHIBIT 7-19

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
TRIBUTARY OF CROOKED RUN (T-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
<u>General</u>			
Water Temperature (°C) ^a	24.5	8.0	0.4
Discharge (cfs) ^a	1.1	0.13	0.32
Secchi Disc (m) ^a	-	-	-
Specific Conductance (µmhos/cm)	290.0	363.0	299.0
pH (Units) ^a	7.6	8.0	6.9
Dissolved Oxygen ^a	7.0	11.6	16.0
% D.O. Saturation	90.0	105.1	116.0
Acidity (as CaCO ₃)	0.0	-	5.0
Alkalinity Total (CaCO ₃)	102.0	7.0	56.0
Color (Platinum - Cobalt units)	25.0	5.0-10.0	0.0-5.0
Dissolved Solids, Total	170.0	190.0	169.0
Suspended Solids, Total	90.0	< 2.0	33.0
Calcium	43.0	57.0	42.0
Fluoride	0.14	0.09	0.10
Magnesium	5.5	7.3	5.7
Organic Carbon, Total	6.0	2.0	< 1.0
Potassium	2.9	3.1	2.1
Silica (as SiO ₂)	7.0	3.8	6.2
Sodium	4.0	6.0	6.0
Sulfate (as SO ₄)	50.0	93.0	64.0

EXHIBIT 7-19 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
TRIBUTARY OF CROOKED RUN (T-1)

PARAMETERS (mg/l except as indicated)	SAMPLING DATE		
	Aug. 78	Nov. 78	Feb. 79
<u>Nutrients</u>			
Ammonia Nitrogen as N	0.10	< 0.1	0.13
Kjeldahl Nitrogen as N	1.35	0.26	0.21
Nitrate Nitrogen as N	0.10	0.3	0.30
Nitrite Nitrogen as N	0.02	< 0.01	< 0.01
Phosphate Total as P	0.19	0.02	0.02
Ortho-Phosphate as P	-	< 0.01	< 0.01
<u>Indicators of Industrial and Municipal Contaminants</u>			
BOD, 5 day	<5.0	<1.0	<1.0
COD	30.0	6.0	11.0
Chloride	6.0	9.0	12.0
Cyanide	<0.01	<0.001	<0.001
Oil and Grease	<5.0	7.0	1.0
Phenols (ppb)	2.8	-	-
Sulfide (as S)	<0.1	-	<0.02
Surfactant (as MBAS)	-	0.01	0.01
Thiocyanate	<1.0	-	<0.4
<u>Trace Elements (Total conc.)</u>			
Aluminum	2.2	-	0.4
Antimony	0.6	-	<0.1
Arsenic	<0.01	<0.01	<0.01
Barium	-	<0.1	<0.1
Beryllium	<0.01	-	<0.02
Boron	0.1	-	<0.5
Cadmium	<0.01	<0.01	<0.01
Chromium, Total	<0.05	<0.03	<0.03

EXHIBIT 7-19 (Continued)

SURFACE WATER QUALITY DATA
P&M/SRC-II SITE
TRIBUTARY OF CROOKED RUN (T-1)

<u>PARAMETERS (mg/l except as indicated)</u>	<u>SAMPLING DATE</u>		
	<u>Aug. 78</u>	<u>Nov. 78</u>	<u>Feb. 79</u>
Chromium, Hexavalent	-	0.004	<0.002
Copper	<0.05	-	<0.02
Iron	3.8	0.19	0.77
Lead	0.01	<0.05	<0.05
Manganese	0.25	0.08	0.24
Mercury	<0.0005	<0.0002	<0.0002
Molybdenum	<0.1	-	<0.05
Nickel	<0.05	-	<0.02
Selenium	<0.002	<0.01	<0.01
Silver	-	<0.02	<0.02
Uranium	-	-	<0.10
Vanadium	<0.1	-	<0.10
Zinc	0.15	-	0.11
<u>Trace Organics (ppt)</u>			
Benz(a)anthracene	0.0	-	-
Benzo(a)pyrene	<10.0	-	-
Benzo(e)pyrene	0.0	-	-
Benzo(g,h,i)perylene	0.0	-	-
Benzene Soluble Fraction (mg/kg)	0.070	-	-

NOTE: a = field measurements

EXHIBIT 7-20

SEDIMENT ANALYSES
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-1, FEBRUARY 1979

<u>PARAMETERS (ppm dried wt. basis, except as indicated)</u>	<u>Rep. 1</u>	<u>Rep. 2</u>	<u>Composite</u>	<u>PNA's</u>
<u>General</u>				
Silt (%)	40.94	52.00	47.42	-
Clay (%)	8.40	12.16	9.68	-
Dissolved and Organics (%)	0.45	1.83	0.57	-
Organic Carbon (% C)	2.71	3.16	3.18	-
Total Solids (%)	52.40	51.00	53.20	-
Fluoride	330.00	310.00	270.00	-
Sulfate (SO ₄)	1,350.00	2,180.00	1,500.00	-
<u>Indicators of Industrial and Municipal Contaminants</u>				
Cyanide, Total	2.92	2.61	2.67	-
Sulfide	1,030.00	480.00	960.00	-
Thiocyanate	46.00	<10.00	<10.00	-
<u>Trace Elements</u>				
Arsenic	15.00	19.00	19.00	-
Barium	150.00	130.00	140.00	-
Cadmium	3.00	1.00	2.00	-
Chromium, Total	21.00	22.00	21.00	-
Chromium, Hexavalent	0.10	< 0.08	0.11	-
Copper	53.00	47.00	57.00	-
Iron (%)	4.80	4.50	4.10	-
Lead	130.00	83.00	91.00	-
Manganese	630.00	740.00	770.00	-
Mercury	0.20	0.20	0.26	-
Nickel	55.00	52.00	43.00	-
Selenium	1.00	< 1.00	< 1.00	-
Silver	< 2.00	< 2.00	< 2.00	-
Uranium	< 60.00	< 60.00	< 60.00	-
Vanadium	< 20.00	< 20.00	< 20.00	-
Zinc	540.00	540.00	520.00	-
<u>Trace Organics (ppb)</u>				
Benz(a)anthracene	-	-	-	549.00
Benzo(a)pyrene	-	-	-	554.00
Benzo(e)pyrene	-	-	-	283.00
Benzo(g, h, i)perylene	-	-	-	475.00

EXHIBIT 7-21
SEDIMENT ANALYSES
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-3, FEBRUARY 1979

PARAMETERS (ppm dried wt. basis, except as indicated)	Rep. 1	Rep. 2	Composite	PNA's
<u>General</u>				
Silt (%)	36.67	46.44	39.77	-
Clay (%)	8.44	8.36	6.32	-
Dissolved and Organics (%)	1.35	< 0.10	0.45	-
Organic Carbon (% C)	2.76	2.25	2.85	-
Total Solids (%)	52.40	58.00	56.40	-
Fluoride	260.00	240.00	250.00	-
Sulfate (SO ₄)	1,820.00	<1,370.00	<1,370.00	-
<u>Indicators of Industrial and Municipal Contaminants</u>				
Cyanide, Total	2.39	1.58	1.79	-
Sulfide	350.00	276.00	380.00	-
Thiocyanate	<10.00	<10.00	35.00	-
<u>Trace Elements</u>				
Arsenic	15.00	18.00	17.00	-
Barium	150.00	140.00	160.00	-
Cadmium	2.00	<1.00	<1.00	-
Chromium, Total	22.00	15.00	19.00	-
Chromium, Hexavalent	< 0.06	< 0.07	0.12	-
Copper	42.00	40.00	45.00	-
Iron (%)	4.10	3.30	3.50	-
Lead	51.00	33.00	45.00	-
Manganese	840.00	360.00	610.00	-
Mercury	0.21	0.17	0.16	-
Nickel	41.00	38.00	31.00	-
Selenium	<1.00	<1.00	<1.00	-
Silver	<2.00	<2.00	3.00	-
Uranium	<60.00	<60.00	<60.00	-
Vanadium	<20.00	<20.00	<20.00	-
Zinc	400.00	280.00	320.00	-
<u>Trace Organics</u>				
Benz(a)anthracene	-	-	-	153.00
Benzo(a)pyrene	-	-	-	707.00
Benzo(e)pyrene	-	-	-	284.00
Benzo(g,h,i)perylene	-	-	-	256.00

EXHIBIT 7-22

SEDIMENT ANALYSES
P&M/SRC-II SITE
ROBINSON RUN
STATION R-1, FEBRUARY 1979

<u>PARAMETERS (ppm dried wt basis, except as indicated)</u>	<u>Rep. 1</u>	<u>Rep. 2</u>	<u>Composite</u>	<u>PNA's</u>
<u>General</u>				
Silt (%)	11.76	8.16	18.61	-
Clay (%)	1.36	1.04	1.28	-
Dissolved and Organics (%)	< 0.10	< 0.10	0.15	-
Organic Carbon (% C)	1.20	1.34	3.86	-
Total Solids (%)	69.10	70.00	70.60	-
Fluoride	320.00	210.00	250.00	-
Sulfate (% SO ₄)	3.09	3.13	2.93	-
<u>Indicators of Industrial and Municipal Contaminants</u>				
Cyanide, Total	0.25	0.31	0.68	-
Sulfide	77.00	3.30	4.40	-
Thiocyanate	< 10.00	< 10.00	< 10.00	-
<u>Trace Elements</u>				
Arsenic	27.00	26.00	29.00	-
Barium	80.00	70.00	80.00	-
Cadmium	< 1.00	< 1.00	< 1.00	-
Chromium, Total	25.00	24.00	24.00	-
Chromium, Hexavalent	< 0.06	< 0.07	0.10	-
Copper	-	36.00	62.00	-
Iron (%)	15.00	14.00	14.00	-
Lead	26.00	26.00	40.00	-
Manganese	330.00	330.00	300.00	-
Mercury	0.10	0.09	0.18	-
Nickel	21.00	21.00	19.00	-
Selenium	1.00	1.00	< 1.00	-
Silver	< 2.00	< 2.00	< 2.00	-
Uranium	< 60.00	< 60.00	< 60.00	-
Vanadium	20.00	40.00	40.00	-
Zinc	100.00	250.00	150.00	-
<u>Trace Organics (ppb)</u>				
Benz(a)anthracene	-	-	-	< 0.10
Benzo(a)pyrene	-	-	-	< 0.10
Benzo(e)pyrene	-	-	-	< 0.10
Benzo(g,h,i)perylene	-	-	-	< 0.10

EXHIBIT 7-23

SEDIMENT ANALYSES
P&M/SRC-II SITE
CROOKED RUN
STATION C-2, FEBRUARY 1979

<u>PARAMETERS (ppm dried wt. basis, except as indicated)</u>	<u>Rep. 1</u>	<u>Rep. 2</u>	<u>Composite</u>	<u>PNA's</u>
<u>General</u>				
Silt (%)	23.96	39.68	30.80	-
Clay (%)	3.40	1.80	4.00	-
Dissolved and Organics (%)	1.60	1.69	1.64	-
Organic Carbon (% C)	1.69	1.26	1.66	-
Total solids (%)	74.60	71.60	74.70	-
Fluoride	140.00	250.00	103.00	-
Sulfate (SO ₄)	1,870.00	1,420.00	<1,360.00	-
<u>Indicators of Industrial and Municipal Contaminants</u>				
Cyanide, Total	0.02	0.13	0.06	-
Sulfide	36.00	11.00	95.00	-
Thiocyanate	<10.00	<10.00	<10.00	-
<u>Trace Elements</u>				
Arsenic	24.00	39.00	23.00	-
Barium	97.00	80.00	80.00	-
Cadmium	<1.00	<1.00	<1.00	-
Chromium, Total	17.00	23.00	15.00	-
Chromium, Hexavalent	0.08	0.15	<0.04	-
Copper	30.00	41.00	53.00	-
Iron (%)	1.70	1.60	1.70	-
Lead	18.00	19.00	16.00	-
Manganese	480.00	1,200.00	690.00	-
Mercury	0.10	0.13	0.11	-
Nickel	23.00	28.00	24.00	-
Selenium	<1.00	<1.00	1.00	-
Silver	<2.00	<2.00	<2.00	-
Uranium	<60.00	<60.00	<60.00	-
Vanadium	30.00	40.00	<20.00	-
Zinc	52.00	74.00	69.00	-
<u>Trace Organics</u>				
Benz(a)anthracene	-	-	-	308.00
Benzo(a)pyrene	-	-	-	468.00
Benzo(e)pyrene	-	-	-	383.00
Benzo(g,h,i)perylene	-	-	-	790.00

SECTION 8

AQUATIC ECOLOGY

8.1 DESCRIPTION

Aquatic ecology studies for the proposed SRC-II plant site, involved sampling of the Monongahela River as well as the runs on the plant site, and three ponds near the site. Field studies beginning in the summer of 1978 through spring 1979 included sampling for adult fish, fish larvae, benthic macroinvertebrates, macrophyton, periphyton, phytoplankton, and zooplankton. Existing data and ongoing studies performed by the West Virginia Department of Natural Resources (DNR) were used to augment these studies as appropriate.

8.2 METHODS AND PROCEDURES

Sampling stations are shown in Figure 8-1. M-1, M-2, and M-3 are located on the Monongahela River, C-1 and C-2 are on Crooked Run, K-1 on Crafts Run, and R-1 on Robinson Run. Pond 1 is located by Keeners Knob and Ponds 2 and 3 are located in the vicinity of Ft. Martin School. Because of incomplete data, only Pond 1 will be discussed in this report.

8.2.1 Adult Fish

The Monongahela River was sampled twice at M-2, September 1978 and May 1979, for adult fish. The DNR also collected adult fish during September 1979 at the Morgantown and Hildebrand Locks. During the spring of 1979 frequent fish spawning surveys were made in Crooked Run and in shallow areas of the M-2 vicinity.

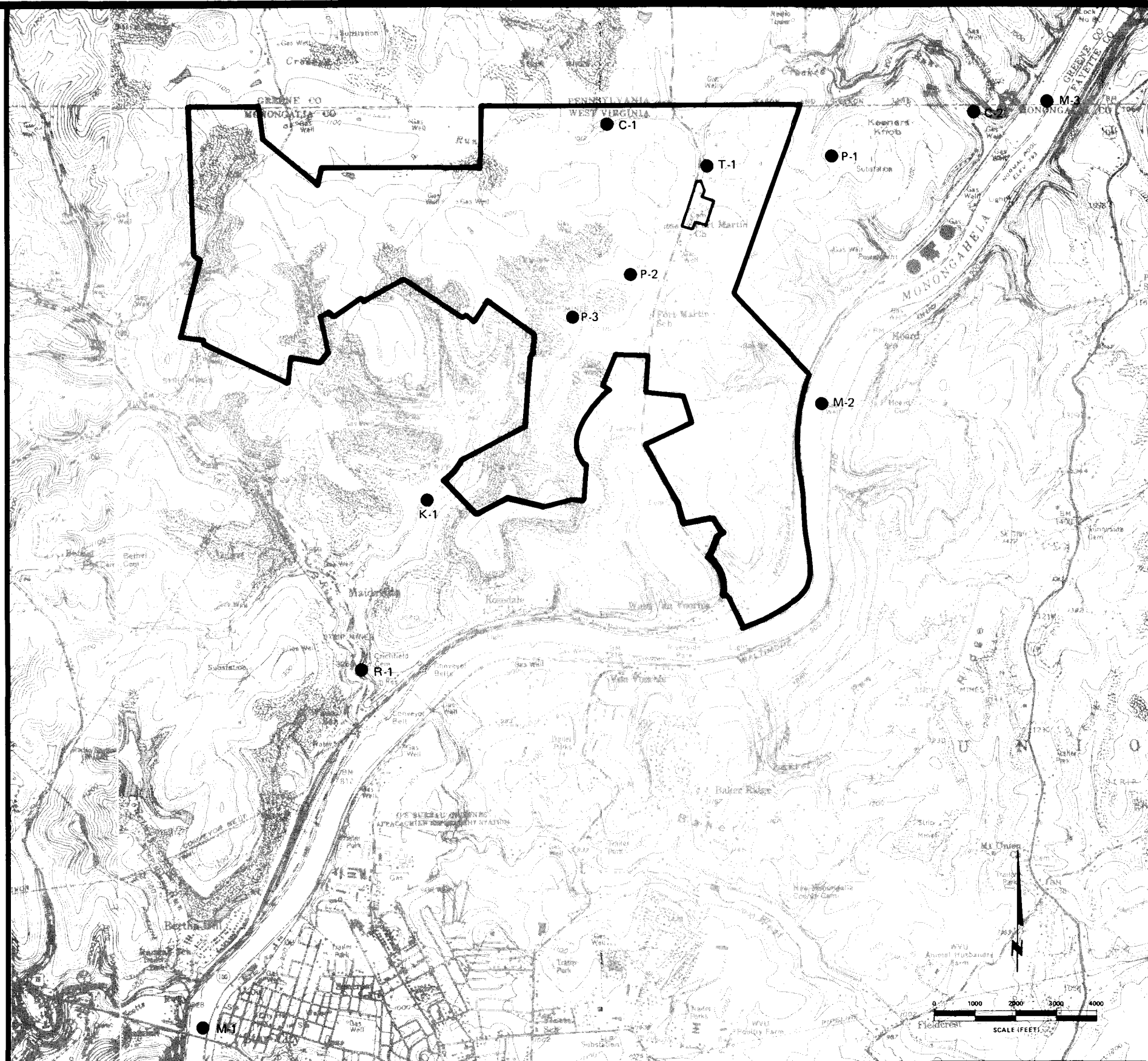
Techniques and equipment employed on the Monongahela included gill nets, dip nets, and electrofishing, as well as rotenone used by DNR. On Crooked Run, seines, dip nets, and electrofishing were used.

Fish which were readily identifiable by field personnel were returned to the water. Other fish were preserved in formalin for laboratory identification by Stearns-Roger and Frostburg State College personnel, using Eddy and Underhill (1978).

8.2.2 Fish Larvae (Ichthyoplankton)

The Monongahela River near M-2 was sampled 11 times for fish larvae during spring and summer 1979.

A towed net with a 0.5 meter stainless steel ring and a 710 micron mesh nitex cloth was used in the sampling process. Samples were collected near the surface and bottom during both day and night. The sampled volume of water (filtered) was generally in excess of 100 m³. Samples were immediately preserved in formalin if no larvae were observed among debris. If larvae were present, a count of live-dead was made and samples were preserved separately for



M-1	Monongahela River
M-2	Monongahela River
M-3	Monongahela River
R-1	Robinson Run
K-1	Crafts Run
C-1	Crooked Run
C-2	Crooked Run
T-1	Tributary of Crooked Run
P-1	Pond 1
P-2	Pond 2
P-3	Pond 3

PM The Pittsburgh & Mahanoy Coal Mining Co. **Gulf**
A WHOLLY OWNED SUBSIDIARY OF GULF OIL CORPORATION

FIGURE 8-1
SRC-II DEVELOPMENT AREA
AQUATIC ECOLOGY
SAMPLING STATIONS

identification. Frostburg State College AEL personnel identified the larval fish.

8.2.3 Benthic Macroinvertebrates

Benthic macroinvertebrates were sampled on the Monongahela River at Stations M-1, M-2, and M-3 and on Crooked Run at Stations C-1 and C-2 on a quarterly basis. Three ponds near or on the plant site were sampled once.

Duplicate petite Ponar samples were taken at all stations. Surber square foot bottom samples were also collected from riffles in Crooked Run. The Monongahela River was sampled on the east and west side at each station. Mid-channel sampling of the Monongahela River was discontinued after the initial summer collection trip because mid-stream dredging and barge traffic impeded sampling procedures.

Invertebrates, retained by a U.S. Standard No. 30 mesh (595M) seive from sediment samples, were considered macrobenthos. Samples were preserved in 70 percent ethanol and selected by Stearns-Roger personnel.

Identifications were completed by Stearns-Roger and subcontractors using Edmondson (1959), Edmunds et al (1976), Mason (1975), Pennak (1953), Saether (1977), Usinger (1956), and Wiggins (1977).

8.2.4 Macrophyton

Available data on macrophytes near the proposed SRC-II site were used with a single summer sampling survey of the Monongahela River. Samples collected were preserved in formalin and identified using Smith (1950) and Strausbaugh and Core (1970).

8.2.5 Periphyton

Periphytic algae were collected from all stations quarterly, except from the ponds, Robinson Run, and Crafts Run, where single samples were sufficient. Natural substrates collected included wood, rock, and

sediment samples. Artificial substrates (slides) were placed in the Monongahela River for four to eight weeks for comparison to natural substrates.

Periphyton samples were preserved in five percent formalin with a small amount of Lugol's solution added as a staining agent. Identifications were completed at the University of Colorado, Limnology Laboratory, Boulder, Colorado. The references used included Bourrelly (1968, 1970, and 1972), Hustedt (1930), Patrick and Reimer (1975), Smith (1920, 1950), and Thieneman (1938).

8.2.6 Phytoplankton

Phytoplankton samples were collected at Stations M-1, M-2, and M-3 on the Monongahela River. At each station a 2.2 liter Kemmerer water bottle was used to collect surface water samples from the east and west sides of the river. These samples were composited in a large pan and two 120 milliliter subsamples were poured into plastic containers for phytoplankton analysis. Samples were immediately preserved with Lugol's solution.

Identifications were performed by taxonomists at the University of Colorado in the same manner as the periphyton.

8.2.7 Zooplankton

Zooplankton samples were collected from the same locations as were phytoplankton samples using a 64 micron Wisconsin net. Two samples were collected at each station. The first was collected by towing the net from the river bottom near mid-channel to the east side of the river. The second was collected by repeating this procedure to the west side of the river. Samples were preserved by first adding carbonated water (Gannon and Gannon 1975) to relax the organisms, then adding formalin to make a four percent solution.

Rose Bengal stain was added before identification. Zooplankton were enumerated as organisms per cubic meter. Those which could not be positively identified were dissected and mounted for detailed examination.

Copepods were identified to species. The copepodid (immature) stages were grouped either as Diaptomidae or Cyclopidae. Nauplii of both calanoids and cyclopoids copepods were grouped together. The cladocera and rotifera were identified to genera except for species known without further taxonomic examination.

Identifications were made with the aid of taxonomic keys including Edmondson (1959), Forke (1976), Brooks (1957), and Pennak (1953).

8.3 RESULTS AND DISCUSSION

8.3.1 Adult Fish

Twenty-eight taxa of fish were collected at the Morgantown and Hildebrand Locks by the West Virginia Department of Natural Resources (Table 8-1). The dominant genera was Notropis (the shiners). Seven species were found, with N. atherinoides and N. stramineus comprising over 90 percent of the individuals and biomass within the genera. Other important taxa were the Bluntnose minnow, Pimephales notatus, the yellow bullhead, Ictalurus natalis, the channel catfish, I. punctatus, the Johnny darter, Etheostoma nigrum, and the logperch, Percina caprodes. Common gamefish collected were bluegill, Lepomis macrochirus, pumpkinseed, L. gibbosus, green sunfish, L. cyanellus, large-mouth bass, Micropterus salmoides, channel catfish, yellow bullhead, brown bullhead, I. nebulosus, walleye, Stizostedion vitreum, and muskellunge, Esox mosquinongy.

The fish collected represent a balanced Appalachian ichthyofauna, with the exception of the introduced gamefish, the walleye, and muskellunge.

8.3.2 Fish Larvae

No fish larvae have been collected to date. Fish larvae sampling will continue through the middle of July 1979.

8.3.3 Benthic Macroinvertebrates

Benthic macroinvertebrates are aquatic organisms large enough to be seen with the unaided eye and are retained by a U.S. Standard No. 30 sieve. These organisms live part of their life cycles within, or upon, available substrates in a water body. The major taxonomic groups in freshwater include insects, annelids, molluscs, flatworms, roundworms, and crustaceans.

TABLE 8-1
FISH DATA
P&M/SRC-II SITE
MONONGAHELA RIVER
SEPTEMBER 1978

<u>Scientific Name</u>	<u>Common Name</u>	<u>Location</u>	
		<u>Morgantown Locks</u>	<u>Hildebrand Locks</u>
Centrarchidae	Sunfishes		
<u>Lepomis cyanellus</u>	Green sunfish	2	-
<u>Lepomis gibbosus</u>	Pumpkinseed	-	7
<u>Lepomis macrochirus</u>	Bluegill	-	6
<u>Lepomis sp.</u>	Unidentified hybrid	-	68
<u>Micropterus salmoides</u>	Largemouth bass	-	8
<u>Pomoxis nigromaculatus</u>	Black crappie	8	36
Clupeidae	Herrings		
<u>Dorosoma cepedianum</u>	Gizzard shad	1	-
Cyprinidae	Minnows and Carps		
<u>Carassius auratus</u>	Goldfish	-	2
<u>Cyprinus carpio</u>	Carp	1	2
<u>Nocomis micropogon</u>	River chub	1	-
<u>Notemigonus crysoleucas</u>	Golden shiner	1	6
<u>Notropis atherinoides</u>	Emerald shiner	288	1,398
<u>Notropis atherinoides</u> x ^a	Emerald shiner x ^a	1	1
<u>N. stramineus</u>	Sand shiner		
<u>Notropis buechanani</u>	Ghost shiner	9	41
<u>Notropis sp.</u>	Unidentified shiner	2	91
<u>Notropis spilopterus</u>	Spotfin shiner	2	2
<u>Notropis stramineus</u>	Sand shiner	97	49
<u>Notropis volucellus</u>	Mimic shiner	4	6
<u>Pimephales notatus</u>	Bluntnose minnow	182	3,336
<u>Semotilus atromaculatus</u>	Creek chub	-	1
Esocidae	Pikes		
<u>Esox mosquinongy</u>	Muskellunge	1	1
Ictaluridae	Catfishes		
<u>Ictalurus catus</u>	White catfish	2	-
<u>Ictalurus natalis</u>	Yellow bullhead	76	7
<u>Ictalurus nebulosus</u>	Brown bullhead	4	12
<u>Ictalurus punctatus</u>	Channel catfish	39	8
Percidae	Perches		
<u>Etheostoma nigrum</u>	Johnny darter	37	58
<u>Percina caprodes</u>	Logperch	40	-
<u>Stizostedion vitreum</u>	Walleye	4	6
Total		802	5,152

Note: x^a= hybrid fish species

Benthic organisms are important members of aquatic food chain, particularly for fish. Many species are also important in the realm of commercialization and recreation. Mosquitos, black flies, and Asiatic clams, Corbicula manilensis, are of considerable public health significance. Many species are also important in cycling detritus and nutrients.

A community of benthic organisms is often sensitive to stress and can be used to detect changes in water quality. Because many of these organisms have life spans exceeding one year and obtain limited mobility, existing and recent-past conditions can be detected.

Eighty taxa of benthic macroinvertebrates were collected in the plant site vicinity (Table 8-2; Exhibits 8-1 to 8-7). Thirty of these taxa were found in Pond 1, 32 taxa were found in the Monongahela River, and 42 taxa were found in Crooked Run. The taxa found in the pond and flowing water habitats were typical of those water body types, and similar to those found in northern West Virginia by Wojcik and Butler (1977), and Tarter (1976).

8.3.4 Periphyton

Periphyton is an assemblage of organisms which grow on underwater substrates. This assemblage includes, but is not limited to, bacteria, yeasts, and molds, algae, protozoans, and sponges. In the present study, only the algal portion of the periphyton community is described.

Diatoms dominated the periphyton samples at all locations, as Tables 8-3 and 8-4 connote. Similar genera and species were found at all locations.

Genera of diatoms common on mud substrates found in this study were as follows: Amphora, Bacillaria, Cymbella (Motile spp.), Frustulia, Navicula, Neidium, Nitzschia, Oscillatoria, Scenedesmus, Spirulina, and Surirella. Genera usually found living on plants included Achnanthes (also found on stones), Cocconeis, Cymbella, Gomphonema, and Synedra.

TABLE 8-2
BENTHIC MACROINVERTEBRATE CHECKLIST
P&M/SRC-II SITE

<u>TAXA</u>	<u>Monongahela River</u>	<u>Crooked Run</u>	<u>Pond 1</u>
ANNELIDA			
Hirudinea			
Unidentified	- a	-	X
Oligochaeta			
Lumbriculidae	-	X	-
Naididae	x b		-
Tubificidae			
Immatures with capilliform setae	X	X	-
Immatures without capilliform setae	X	X	X
Limnodrilus cervix	X	X	-
Limnodrilus hoffmeisteri	X	X	-
Limnodrilus profundicola	-	X	-
Peloscolex superiorensis	X	-	-
Unidentified	-	X	-
ARTHROPODA			
Crustacea			
Amphipoda			
Gammaridae			
Gammarus minus	-	X	-
Ostracoda	-	-	X
Insecta			
Coleoptera			
Elmidae			
Dubiraphia sp.	-	X	-
Stenelmis sp.	-	X	-
Halipilidae			
Peltodytes sp.	-	-	X
Hydrophilidae			
Tropisternus sp.	-	-	X
Unidentified	-	X	-
Diptera			
Ceratopogonidae			
Bezzia sp.	X	X	X
Ceratopogon sp.	-	X	-
Palpomyia sp.	-	X	-
Probezzia sp.	X	X	-
Serromyia sp.	-	-	X
Chaoboridae			
Chaoborus sp.	X	-	-

TABLE 8-2 (Continued)

BENTHIC MACROINVERTEBRATE CHECKLIST
P&M/SRC-II SITE

<u>TAXA</u> (Continued)	<u>Monongahela</u> <u>River</u>	<u>Crooked</u> <u>Run</u>	<u>Pond 1</u>
Chironomidae			
<u>Alabesmyia mallochi</u>	X	-	-
<u>Chironomus decorus</u> type	X	-	-
<u>Chironomus</u> sp.	X	X	-
<u>Cladopelma</u> sp.	X	-	X
<u>Cladotanytarsus</u> sp.	-	-	X
<u>Clinotanypus piguis</u>	-	-	X
<u>Coelotanypus concinnus</u>	X	-	-
<u>Coelotanypus scapularis</u>	X	X	-
<u>Cricotopus trifascia</u>	-	X	-
<u>Cryptochironomus fulvus</u> type	X	-	X
<u>Cryptotendipes pseudotener</u>	X	-	X
<u>Dicrotendipes modestus</u>	X	-	-
<u>Dicrotendipes</u> sp.	X	-	X
<u>Endochironomus nigricans</u>	-	-	X
<u>Glyptotendipes lobiferous</u>	-	-	X
<u>Harnischia curtillamellata</u>	X	X	-
<u>Labrundinia</u> sp.	-	-	X
<u>Microtendipes</u> sp.	-	X	-
<u>Orthocladius</u> sp.	-	X	-
<u>Parakiefferiella</u> sp.	X	-	-
<u>Paratanytarsus</u> sp.	-	X	-
<u>Polypedilum near fallax</u>	-	X	-
<u>Polypedilum halterale</u>	X	-	X
<u>Polypedilum illinoense</u>	-	-	X
<u>Procladius</u> sp.	X	X	X
<u>Pseudochironomus prasinatus</u>	-	-	X
<u>Stictochironomus</u> sp.	-	X	-
<u>Tanypus carinatus</u>	-	-	X
<u>Tanypus neopunctipennis</u>	-	X	-
<u>Tanytarsus</u> sp.	-	X	X
Unidentified Chironomini	-	X	-

TABLE 8-2 (Continued)

BENTHIC MACROINVERTEBRATE CHECKLIST
P&M/SRC-II SITE

<u>TAXA</u> (Continued)	<u>Monongahela River</u>	<u>Crooked Run</u>	<u>Pond 1</u>
Empididae	-	X	-
Tabanidae			
<u>Chrysops</u> sp.	-	X	X
Tipulidae			
<u>Tipula</u> sp.	-	X	-
Unidentified	X	-	-
Ephemeroptera			
Baetidae	-	X	-
Caenidae			
<u>Caenis diminuta</u>	-	-	X
Hemiptera			
Corixidae			
<u>Hesperocorixa</u> sp.	-	-	X
Megaloptera			
Corydalidae			
<u>Chauloides</u> sp.	-	X	-
Odonata			
Coenagrionidae			
<u>Enallagma</u> sp.	-	-	X
Libellulidae			
<u>Leucorrhinia</u> sp.	-	-	X
Plecoptera			
Capniidae			
<u>Allocaenia</u> sp.	-	X	-
Chloroperlidae	-	X	-
Trichoptera			
Hydropsychidae			
<u>Cheumatopsyche</u> sp.	-	X	-
<u>Hydropsyche</u> sp.	-	X	-
Hydroptilidae			
<u>Hydroptila</u> sp.	-	X	-
<u>Ochrotrichia</u> sp.	X	X	-
Leptoceridae			
<u>Oecetis</u> sp.	X	-	X

TABLE 8-2 (Continued)
BENTHIC MACROINVERTEBRATE CHECKLIST
P&M/SRC-II SITE

<u>TAXA</u> (Continued)	<u>Monongahela River</u>	<u>Crooked Run</u>	<u>Pond 1</u>
BRYOZOA			
Unidentified	-	X	-
COELENTERATA			
Hydrozoa			
Hydridae			
<u>Hydra</u> sp.	X	-	-
ARACHNIDA			
Hydracarina			
Unidentified	X	-	-
MOLLUSCA			
Gastropoda			
Physidae			
<u>Physa</u> sp.	X	-	-
Planorbidae			
<u>Gyraulus</u> sp.	X	-	X
<u>Helisoma</u> sp.	-	X	-
Pelecypoda			
Corbiculidae			
<u>Corbicula manilensis</u>	X	-	-
Sphaeriidae			
<u>Pisidium</u> sp.	X	X	-
<u>Sphaerium</u> sp.	-	-	X

Note ^a-- = not present
 ^b X = present

TABLE 8-3

PERIPHYTON CHECKLIST
P&M/SRC- II SITE

Location	Monongahela River		Crooked Run	Robinson Run	Crafts Run	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>DIATOMS</u>						
<u>Achnanthes</u>						
<u>affinis</u>					X	
<u>tanceolata</u>	Xa	X		X		
<u>linearis</u>						X
<u>linearis</u>						
cf. <u>curta</u>	X	X	X			
<u>microcephala</u>		X				
<u>minutissima</u>	X	X	X	X		X
<u>sp.</u>	X					
<u>Amphipleura</u>						
<u>pellucida</u>	X	X	X			
<u>Amphora</u>						
<u>ovalis</u>	X					
<u>perpusilla</u>			X	X		
<u>Anomoeoneis</u>						
<u>vitrea</u>	X	X	X			
<u>Asterionella</u>						
<u>formosa</u>	X					
<u>Bacillaria</u>						
<u>paxillifer</u>	X	X	X			
<u>paxillifer</u>						
var. <u>tumidula</u>			X			
<u>Cocconeis</u>						
<u>fluviatilis</u>			X			
<u>pediculus</u>			X			
<u>placentula</u>			X			
<u>Compylodiscus</u>						
<u>clyperus</u>	X					
<u>Cyclotella</u>						
<u>meneghiniana</u>	X	X	X	X		
<u>sp.</u>	X					
<u>stelligera</u>	X	X	X			
<u>styriaca</u>	X					

TABLE 8-3 (Continued)

PERIPHYTON CHECKLIST
P&M/SRC-II SITE

Location	Monongahela River		Crooked Run	Robinson Run	Crafts Run	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>DIATOMS</u>						
<u>Cymatopleura</u>						
<u>solea</u>		X	X			
<u>Cymbella</u>						
<u>aequalis</u>			X			
<u>affinis</u>	X	X				
<u>cf. diluviana</u>						X
<u>minuta</u>	X	X	X			
<u>cf. rupicola</u>						X
<u>sinciata</u>			X			
<u>sp.</u>	X	X		X		
<u>triangulum</u>	X	X	X			
<u>tumida</u>	X	X	X			
<u>tumidula</u>	X	X				
<u>ventricosa</u>	X					
<u>vulgar</u>	X					
<u>Diatoma</u>						
<u>vulgare</u>			X			
<u>Diatomella</u>						
<u>cf. hustedfii</u>			X			
<u>Eunotia</u>						
<u>curvata</u>	X	X				
<u>cf. faba</u>					X	
<u>glacialis</u>		X				
<u>joba</u>		X				
<u>lunaris</u>		X				
<u>sp.</u>		X				
<u>tenella</u>	X					
<u>Fragilaria</u>						
<u>capucina</u>		X	X			
<u>construens</u>	X	X	X			
<u>crotonensis</u>				X		X
<u>sp.</u>		X			X	
<u>vaucheriae</u>	X		X			

TABLE 8-3 (Continued)

PERIPHYTON CHECKLIST
P&M/SRC-II SITE

Location	Monongahela River		Crooked Run	Robinson Run	Crafts Run	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>DIATOMS</u>						
<u>Frustulia</u>						
<u>vulgaris</u>	X	X	X			
<u>Gomphonema</u>						
<u>affine</u>	X					
<u>affinis</u>						
<u>var. insigne</u>	X					
<u>angustatum</u>		X	X			X
<u>apuncto</u>			X			
<u>consector</u>		X				
<u>gracile</u>		X				
<u>grunorvii</u>	X					
<u>obvocium</u>			X			
<u>parvulum</u>	X	X	X			
<u>simus</u>		X				
<u>sp.</u>			X	X		
<u>sphaerophorum</u>	X					
<u>subclavatum</u>	X	X				
<u>cf. subclavatum</u>		X				
<u>Gomphononitzschia</u>						
<u>sp.</u>	X					
<u>Gyrosigma</u>						
<u>nodiferum</u>	X		X			
<u>sp.</u>	X					
<u>Hantzschia</u>						
<u>amphioxys</u>		X		X		
<u>elougata</u>			X			
<u>Melosira</u>						
<u>islandica</u>	X					
<u>sp.</u>	X	X				
<u>varians</u>	X					

TABLE 8-3 (Continued)

PERIPHYTON CHECKLIST
P&M/SRC-II SITE

Location	Monongahela River		Crooked Run	Robinson Run	Crafts Run	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>DIATOMS</u>						
<u>Meridian</u>						
<u>circularis</u>		X				
<u>Navicula</u>						
<u>angusta</u>	X		X			
<u>arvensis</u>		X		X		
<u>bicephala</u>	X	X				
<u>cryptocephala</u>			X			
<u>gottlandica</u>	X					X
<u>graciloides</u>	X					
<u>heufleri</u>				X		
<u>lanceolata</u>	X			X		X
<u>cf. luzonensis</u>	X					
<u>minima</u>	X		X			
<u>minuscula</u>			X			
<u>mutica</u>	X	X	X			
<u>mutica</u>						
<u>var. undulata</u>	X					
<u>pupula</u>						X
<u>radiosa</u>	X	X				
<u>rhynchocephala</u>	X	X	X	X		X
<u>schroeteri</u>						
<u>var. escombia</u>	X		X			
<u>secrata</u>	X					
<u>sp.</u>	X			X		X
<u>subtilissima</u>		X				
<u>symmetrica</u>	X	X	X	X		
<u>vanheurckii</u>		X	X			X
<u>viridula</u>	X	X	X			
<u>viridula</u>						
<u>var. avenacea</u>	X					X
<u>var. rostellata</u>			X	X		
<u>valpina</u>	X		X			
<u>cf. valpina</u>	X					

TABLE 8-3 (Continued)

PERIPHYTON CHECKLIST
P&M/SRC-II SITE

Location	Monongahela River		Crooked Run	Robinson Run	Crafts Run	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>DIATOMS</u>						
<u>Neidium</u>						
<u>iridis</u>	X					
<u>Nitzschia</u>						
<u>acicularis</u>	X	X	X	X		X
<u>acicularis</u>						
var.						
<u>closterioides</u>		X				
<u>acuta</u>			X			
<u>amphibia</u>	X					
cf. <u>apiculata</u>			X			
<u>baccata</u>	X					
<u>clausii</u>	X		X	X		X
cf. <u>clausii</u>		X				
<u>dissipata</u>	X	X	X	X		
<u>dubia</u>		X				
<u>filiformis</u>	X	X	X			
<u>fonticola</u>	X	X	X	X		X
<u>frustulum</u>	X					
<u>frustulum</u>						
var. <u>purpusilla</u>				X		
<u>gracilis</u>	X	X	X			
<u>kutzingiana</u>	X	X	X	X		X
<u>linearis</u>	X		X			X
cf. <u>luzonensis</u>	X					
<u>obtusa</u>	X	X	X			X
<u>obtusa</u>						
var.						
<u>scalpelliformis</u>	X					
<u>ovicularis</u>	X					
<u>palea</u>	X	X	X	X	X	X
<u>pseudoamphioxus</u>	X					
<u>scalaris</u>	X					

TABLE 8-3 (Continued)

PERIPHYTON CHECKLIST
P&M/SRC-II SITE

Location	Monongahela River		Crooked Run	Robinson Run	Crafts Run	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>DIATOMS</u>						
<u>sigma</u>	X	X	X			
<u>sp.</u>	X	X		X		
<u>stagnorum</u>			X			
<u>sublinearis</u>	X		X			
<u>subrostata</u>		X				
<u>Opephora</u>						
<u>martyi</u>	X					
<u>Pinnularia</u>						
<u>brebissoni</u>				X		
<u>cf. intermedia</u>				X		
<u>microstauvan</u>						
<u>f. diminuta</u>					X	
<u>obscura</u>		X		X		
<u>sp.</u>	X	X	X			
<u>Rhoicosphenia</u>						
<u>curvata</u>	X	X	X	X		X
<u>Rhopalodia</u>						
<u>musculus</u>						X
<u>Scoliopleura</u>						
<u>tumida</u>	X					
<u>Stauroneia</u>						
<u>phoenicentevon</u>						X
<u>Steuroneis</u>						
<u>karsteuui</u>	X					
<u>Surirella</u>						
<u>angustata</u>						X
<u>caproni</u>			X			
<u>cellebesiana</u>						X
<u>delicatissima</u>	X					

TABLE 8-3 (Continued)

PERIPHYTON CHECKLIST
P&M/SRC-II SITE

Location	Monongahela		Crooked	Robinson	Crafts	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>DIATOMS</u>						
<u>linearis</u>	X		X			
<u>linearis</u>						
var.						
<u>constrictal</u>	X					
<u>ovata</u>	X	X	X			
<u>robusta</u>	X	X	X			
sp.	X					
<u>Synedra</u>						
<u>cyclopus</u>			X			
<u>delicatissima</u>	X					
<u>filiformis</u>	X	X				
<u>goulardi</u>	X		X			
<u>incisa</u>	X					
<u>minuscula</u>			X			
<u>pulchella</u>	X	X	X	X		
<u>pulchella</u>						
var. <u>lacerata</u>	X					
<u>pulchella</u>						
var. <u>lanceolata</u>	X					
<u>radians</u>	X					
<u>rumpens</u>	X	X	X			
<u>rumpens</u>						
var.						
<u>familiaris</u>	X					
<u>socia</u>	X					
sp.	X					
<u>ulna</u>	X	X	X			
<u>ulna</u>						
var. <u>contrastata</u>	X					
<u>Syrosigma</u>						
<u>nodiferum</u>			X			
<u>Thalassiosira</u>						
<u>fluviatilis</u>	X	X	X			

TABLE 8-3 (Continued)

PERIPHYTON CHECKLIST
P&M/SRC-II SITE

Location	Monongahela River		Crooked Run	Robinson Run	Crafts Run	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>FILAMENTS</u>						
<u>Anabaena</u>						
<u>anomala</u>	X					
sp.	X					
cf. <u>constricta</u>	X	X				
<u>Ankistrodesmus</u>						
cf. <u>falcatus</u>		X				
<u>Calothrix</u>						
sp.	X					
<u>Diatoma</u>						
<u>vulgare</u>			X			
<u>Fragilaria</u>						
<u>capucina</u>	X					
<u>construens</u>			X			
sp.	X	X				
<u>Lyngbya</u>						
cf. <u>bipunctata</u>	X					
<u>cryptovoginata</u>			X			
cf. <u>hieronymusii</u>	X					
<u>lacustris</u>	X	X	X			
<u>lagerheimii</u>	X	X				
<u>limnetica</u>	X	X	X	X	X	X
sp.	X					
<u>Melosira</u>						
sp.	X					
<u>varians</u>	X	X	X			
<u>Microspora</u>						
sp.	X					
<u>Mougeotia</u>						
sp.	X	X	X	X		X

TABLE 8-3 (Continued)

PERIPHYTON CHECKLIST
P&M/SRC- II SITE

Location	Monongahela		Crooked	Robinson	Crafts	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>FILAMENTS</u>						
<u>Oscillatoria</u>						
<u>amphibia</u>	X	X	X			X
<u>amphigranulata</u>	X					
<u>chlorina</u>	X					
<u>formosa</u>	X					
<u>limnetica</u>	X	X	X	X	X	X
<u>ogardhii</u>	X	X				
<u>proteus</u>	X					
<u>pseudogeminata</u>	X	X				
<u>quadripunctulata</u>	X		X			
<u>splendida</u>	X	X				
<u>subbrevis</u>	X	X	X	X		X
<u>subbrevis</u>						
<u>cf. major</u>	X					
<u>Oscillatoria</u>						
<u>tenuis</u>	X					
<u>tenuis</u>						
<u>var. tergestina</u>	X					
<u>sp.</u>	X					
<u>Phormidium</u>						
<u>fragile</u>	X					
<u>cf. mucicola</u>		X				
<u>sp.</u>	X		X			X
<u>Plectonema</u>						
<u>sp.</u>			X			
<u>notatum</u>			X			
<u>Rhizoclonium</u>						
<u>sp.</u>			X			
<u>Scenedesmus</u>						
<u>cf. armatus</u>	X					
<u>cf. obliquis</u>	X					
<u>sp.</u>	X					X

TABLE 8-3 (Continued)

PERIPHYTON CHECKLIST
P&M/SRC-II SITE

Location	Monongahela River		Crooked Run	Robinson Run	Crafts Run	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>FILAMENTS</u>						
<u>Spirulina</u>						
cf.						
<u>labyrinth-</u>						
<u>iformis</u>			X			
<u>major</u>		X				
<u>meneghiniana</u>			X			
sp.	X					
<u>subsalsa</u>			X			
sp.			X			
cf. <u>rotula</u>	X					
<u>Synedra</u>						
<u>ulna</u>	X	X	X			
<u>Tabellaria</u>						
sp.			X			
<u>fenestra</u>						
var.						
<u>asterionel-</u>						
<u>loides</u>			X			
<u>Ulothrix</u>						
sp.	X	X	X			X

Note: ^aX = present at that location

TABLE 8-4
PERIPHYTON - NUMBER OF SPECIES
P&M/SRC-II SITE

Location	Monongahela River		Crooked Run	Robinson Run	Crafts Run	Pond 1
Substrate	<u>Natural</u>	<u>Artificial</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>	<u>Natural</u>
<u>TAXA</u>						
Diatoms	107	69	73	28	4	24
Filaments	<u>40</u>	<u>18</u>	<u>23</u>	<u>4</u>	<u>2</u>	<u>8</u>
Total	147	87	96	32	6	32

At all stations in the Monongahela River, periphyton species composition on natural substrates changed between seasons (Exhibits 8-7 to 8-9). During each season, a few genera or species were dominant. Species composition varied between the east and west sides of the river and between natural and artificial substrates. During the fall (November 1978), artificial substrates appeared to show more similarity between species found at all stations (Exhibit 8-10), but variability was higher with respect to species composition on natural substrates.

In Crooked Run, the largest number of species and organisms were found in the summer and fall at Stations C-2 and C-1, respectively. See (Exhibits 8-11 and 8-12). A larger number of species were found at Station C-2, although 18 out of 39 species were found at both stations in November. Dominant genera at both stations included the diatoms Navicula and Nitzschia, and the filaments Lyngbya and Oscillatoria.

Robinson Run, Crafts Run, and Pond 1 were each sampled once for periphyton (Exhibits 8-13 to 8-15). In Robinson Run a fairly even distribution of species exists. But in Crafts Run and Pond 1 one to four species were dominant. These data may indicate the presence of a

constant, stressful environment in Robinson Run, since periphyton populations are controlled by several factors including substrate, light, nutrients, available CO₂, temperature, and other minerals.

8.3.5 Phytoplankton

Phytoplankton are the microscopic plant components of the plankton community. They often form the base of the food pyramid and are fed upon by zooplankton and other herbivores.

Seventy-five taxa of phytoplankton were found on the Monongahela River at Stations M-1, M-2, and M-3 (Table 8-5). Thirty-four were green algae (Chlorophyta), 12 were cyanophytes, 11 were diatoms (Bacillario phyta), and other groups were represented by fewer taxa.

The seasonal variability of the phytoplankton population was marked by a rapid reduction in species diversity, from a summer high of 40 taxa at station M-1, to a winter low of two taxa at M-2 (Exhibits 8-16 to 8-18). There was a bloom of algae in November, dominated by the green algae Closterium sp., Chlorella sp. and, to a lesser extent, by Ankistrodesmus falcatus. The cryptophyte Cryptomonas sp., the cyanophyte Synechocystis sp., and a large heterotrophic phytoflagellate population, were also apparent in the fall collections. Winter showed a dramatic reduction in the number of taxa and individuals present, as well as in the striking dominance of the cyanophytes. The seasonal succession observed on the Monongahela River is characteristic of an industrialized waterway.

8.3.6 Zooplankton

Zooplankton are animals suspended in a body of water which are incapable of sustained mobility in directions counter to water currents due to their physical characteristics or size (Weber 1973). In aquatic food webs, zooplankton constitute a prominent pathway for energy flow between phytoplankton and fish. As an intermediate in planktonic trophic relationships, zooplankton are also important in

TABLE 8-5

PHYTOPLANKTON CHECKLIST
P&M/SRC-II SITE
MONONGAHELA RIVER

TAXA

BACILLARIOPHYTA

Cyclotella meneghiniana
Cyclotella stelligera
Cyclotella sp.
Melosira granulata

Navicula exigua
Navicula sp.
Nitzschia acicularis
Nitzschia palea

Nitzschia sp.
Rhizosolenia erliensis
Synedra radians

CHLOROPHYTA

Actinastrum hantzschii
Ankistrodesmus convolutus
Ankistrodesmus falcatus
Chlamydomonas sp.
Chlorella sp.
Closterium sp.
Coccomyxa sp.
Coelastrum reticulatum

Crucigenia apiculata
Crucigenia fenestrata
Crucigenia quadrata
Dyctyosphaerium sp

Kirchneriella lunaris
Kirchneriella obesa
Kirchneriella sp.
Oocystis sp.

CHLOROPHYTA (Continued)

Scenedesmus acuminatusi
Scenedesmus bicaudatus
Scenedesmus ecornis
Scenedesmus quadricauda

Scenedesmus spinosus
Scenedesmus wisconsinensis
Schroederia setigera
Sphaerocystis Schroeteri

Spondylosium sp.
Staurastrum sp.
Tetrachlorella alternans
Tetrastrum sp.

Tetraedron minimum
Treubaria triappendiculata

TABLE 8-5 (Continued)

PHYTOPLANKTON CHECKLIST
P&M/SRC-II SITE
MONONGAHELA RIVER

TAXA

CHRYSTOPHYTA

Chromulina sp.
Chrysococcus sp.
Cymbella sp.
Dinobryon sp.

PROTOZOANS & BACTERIO PLANKTON

Ciliate (large)
Heterotrophic flagellate (small)
Planctomyces bekefi

CRYPTOPHYTA

Cryptomonas caudata
Cryptomonas marssonii

PYROPHYTA

Peridinium sp

CYANOPHYTA

Anabaena sp.
Aphanocapsa elachista
Aphanothece nidulans
Chroococcus dispersus

Chroococcus sp.
Lyngbya limnetica
Merismopedia tenuissima
Oscillatoria limnetica

Oscillatoria sp.
Raphidiopsis sp.
Rhabdoderma sp.
Synechocystis sp.

EUGLENOPHYTA

Euglena sp.
Malomonas sp.
Phytoflagellate (large)
Phytoflagellate (small)

Trachelomonas volvocina
Trachelomonas sp.

the transfer of the chemical constituents of water and sediment incorporated in their food.

A freshwater zooplankton community usually consists of three groups, the rotifers, cladocerans, and copepoda. Zooplankton identified from the three Monongahela River stations included 21 taxa of rotifers, 11 taxa of cladocera, and five taxa of copepoda (Table 8-6). Numbers and identity of the zooplankters collected are presented in Exhibits 8-19 to 8-21. Dominant zooplankters were Keratella cochlearis, Bosmina longirostris, and Cyclops vernalis, representing the groups Rotifera, Cladocera, and Copepoda, respectively.

The Dipteran, Chaoborus sp., a planktonic larval form, and members of the group Ostracoda, were also found.

Rotifers dominated the summer samples, which also contained moderate numbers of zooplankters. Zooplankton increased in the fall due to the large number of copepod nauplii and copepodids. Winter samples showed a radical decline in adult zooplankton, while copepod nauplii still dominated.

The zooplankton identified are typical of a river-reservoir ecosystem in West Virginia. The dominance of Keratella, Polyarthra, Bosmina, Mesocyclops, and Diaptomus, is similar to other West Virginia studies (Bible 1972a and b; Janicki 1976, and Decosta 1975).

TABLE 8-6

ZOOPLANKTON CHECKLIST
P&M/SRC- II SITE
MONONGAHELA RIVER

TAXA

ROTIFERA

Ascomorpha sp.
Asplanchna sp.
Brachionus sp.
Cephalodella sp.
Conochilus sp.

Cupelopagis sp.
Euchlanis sp.
Filinia sp.
Gastropus sp.
Kellicottia sp.

Keratella cochlearis
Keratella quadrata
Lecane sp.
Lepadella sp.
Monostyla sp.

Notholca sp.
Polyarthra sp.
Synchaeta sp.
Tetrasiphon sp.
Trichotria sp.
Trichocerca sp.

CLADOCERA

Alona affinis
Bosmina coregoni
Bosmina longirostris
Camptocercus sp.

Ceriodaphnia sp.
Chydorus sphaericus
Daphnia catawba
Daphnia parvula

Ilyocryptus sordidus
Pleuroxus sp.
Sida sp.
Nauplii

COPEPODA

Nauplii
Cyclopoid copepodids
Diaptomid copepodids
Cyclops vernalis
Diaptomus pallidus

Eucyclops agilis
Macrocyclops albidus
Mesocyclops edax

Harpacticoids

Ergasilids

Other:

Diptera
Chaoborus sp.

Ostracods

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EXHIBIT 8-1

BENTHIC MACROINVERTEBRATES - ORGANISMS/M²
P&M/SRC-II SITE
POND 1
AUGUST 1978

TAXA

ANNELIDA

Hirudinea	
Unidentified	21.38
Oligochaeta	
Immatures without capilliform setae	42.76

ARTHROPODA

Crustacea	
Ostracoda	21.38
Insecta	
Coleoptera	
Halipilidae	
<u>Peltodytes</u> sp.	21.38
Hydrophilidae	
<u>Tropisternus</u> sp.	21.38
Diptera	
Ceratopogonidae	
<u>Bezzia</u> sp.	21.38
<u>Serromyia</u> sp.	192.42
Chironomidae	
<u>Cladopelma</u> sp.	85.52
<u>Cladotanytarsus</u> sp.	64.14
<u>Clinotanypus</u> piguis	299.32
<u>Cryptochironomus</u> fulvus type	42.76
<u>Cryptotendipes</u> pseudotener	21.38
<u>Dicrotendipes</u> sp.	42.76
<u>Endochironomus</u> nigricans	149.66
<u>Glyptotendipes</u> lobiferous	42.76
<u>Labrundinia</u> sp.	42.76
<u>Polypedilum</u> halterale	106.90
<u>Polypedilum</u> illinoense	21.38
<u>Procladius</u> sp.	128.28
<u>Pseudochironomus</u> prasinatus	21.38
<u>Tanypus</u> carinatus	128.28
<u>Tanytarsus</u> sp.	213.80

EXHIBIT 8-1 (Continued)

BENTHIC MACROINVERTEBRATES - ORGANISMS/M²

P&M/SRC-II SITE

POND 1

AUGUST 1978

TAXA

Diptera (continued)

Tabanidae	
<u>Chrysops</u> sp.	21.38
Ephemeroptera	
Caenidae	
<u>Caenis diminuta</u>	384.84
Hemiptera	
Corixidae	
<u>Hesperocorixa</u> sp.	21.38
Odonata	
Coenagrionidae	
<u>Enallagma</u> sp.	64.14
Libellulidae	
<u>Leucorrhinia</u> sp.	42.76
Trichoptera	
Leptoceridae	
<u>Oecetis</u> sp.	21.38

MOLLUSCA

Gastropoda	
Planorbidae	
<u>Gyraulus</u> sp.	149.66
Pelecypoda	
Sphaeridae	
<u>Sphaerium</u> sp.	2,031.10
Total	4,489.80

EXHIBIT 8-2

BENTHIC MACROINVERTEBRATES-ORGANISMS/M²
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-1

Date	August, 1978		November, 1978		January, 1979	
Location	Transects of		East	West	East	West
	River		Side	Side	Side	Side
Replicate	1	2	1	2	1	2
<u>TAXA</u>						
ANNELIDA						
Oligochaeta						
Naididae	-	-	106.90	-	-	-
Tubificidae						
Immatures with capilliform setae	-	14.25	128.28	-	-	-
Immatures without capilliform setae	14.25	57.00	1,004.86	983.48		
<u>Limnodrilus cervis</u>	-	-	320.70	42.76		
<u>Limnodrilus hoffmeisteri</u>	14.25	28.50	64.14	21.38		
<u>Peloscotlex superiorensis</u>	-	-	320.70	277.94		
ARTHROPODA						
Insecta						
Diptera						
Chaoboridae						
<u>Chaoborus</u> sp.	-	-	171.04	-	-	-
Chironomidae						
<u>Chironomus</u> sp.	-	-	897.96	555.88	-	-
<u>Coelotanypus concinnus</u>	-	-	42.76	-	-	-
<u>Cryptochironomus fulvus</u>						
type	-	14.25	-	-	-	-
<u>Dicrotendipes</u> sp.	-	-	-	21.38	-	-
<u>Procladius</u> sp.	-	-	684.16	42.76	-	-
MOLLUSCA						
Pelecypoda						
Corbiculidae						
<u>Corbicula manilensis</u>	-	-	42.76	-	-	-
Sphaeriidae						
<u>Pisidium</u> sp.	-	-	-	64.14	-	-
TOTAL	28.50	114.00	3,784.26	2,009.72	0	0

EXHIBIT 8-3

BENTHIC MACROINVERTEBRATES - ORGANISMS/M²
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-2

Date	August, 1978		November, 1978		January, 1979	
Location	Transects of		East	West	East	West
	River		Side	Side	Side	Side
Replicate	1	2	1	2	1	2
<u>TAXA</u>						
ANNELIDA						
Oligochaeta						
Tubificidae						
Immatures with						
capilliform setae	-	-	21.38	-	-	-
Immatures without						
capilliform setae	85.5	28.50	64.14	21.38	-	-
<u>Limnodrilus</u>						
<u>hoffmeisteri</u>	-	-	21.38	-	-	-
ARTHROPODA						
Insecta						
Diptera						
Ceratopogonidae						
<u>Probezzia</u> sp.	-	-	106.90	-	-	-
Chironomidae						
<u>Alabesmyia</u> <u>mallachi</u>	14.25	-	-	-	-	-
<u>Cladopelma</u> sp.	14.25	14.25	-	-	-	-
<u>Chironomus</u> sp.	-	-	4,660.84	277.94	-	320.70
<u>Coelotanypus</u>						
<u>concinus</u>	-	-	299.32	85.52	21.38	-
<u>Cryptochironomus</u>						
<u>fulvus</u> type	-	14.25	21.38	21.38	-	-
<u>Dicrotendipes</u>						
<u>modestus</u>	-	-	213.80	427.60	-	-
<u>Harnischia</u>						
<u>curtillamellata</u>	-	14.25	-	-	-	-
<u>Parakiefferiella</u> sp.	-	14.25	-	-	-	-
<u>Procladius</u> sp.	85.5	14.25	705.54	171.04	21.38	21.38
Tipulidae						
Unidentified	-	-	-	-	-	21.38
MOLLUSCA						
Pelecypoda						
Corbiculidae						
<u>Corbicula</u> <u>manilensis</u>	-	14.25	42.76	64.14	-	-
Total	199.50	114.00	6,157.44	1,069.00	42.76	363.46

EXHIBIT 8-4

BENTHIC MACROINVERTEBRATES - ORGANISMS/M²P&M/SRC-II SITE
MONONGAHELA RIVER

STATION M-3

Date	August, 1978		November, 1978		January, 1979	
Location	Transects of		East	West	East	West
	River		Side	Side	Side	Side
Replicate	1	2	1	2	1	2

TAXA

ANNELIDA

Oligochaeta

Tubificidae

Immatures with
capilliform setae

14.25

-

-

-

-

-

Immatures without
capilliform setae

327.75

-

21.38

-

-

64.14

ARTHROPODA

Insecta

Diptera

Ceratopogonidae

Bezzia sp.

14.25

-

-

-

-

-

Probezzia sp.

-

-

21.38

-

-

-

Chaoboridae

Chaoborus sp.

-

-

106.90

-

-

-

Chironomidae

Cladopelma sp.

313.50

-

-

-

-

-

Chironomusdecorus type

1,068.75

-

-

-

-

-

Chironomus sp.

-

-

-

-

-

21.38

Coelotanypusconcinnus

14.25

-

427.60

-

-

-

Cryptochironomusfulvus type

14.25

14.25

-

-

-

-

Cryptotendipespseudotener

-

-

21.38

-

-

-

Polypedilumhalterale

42.75

-

-

-

-

-

Procladius sp.

498.75

-

-

-

-

-

Tanytarsus sp.

14.25

-

-

-

-

-

Tabanidae

Chrysops sp.

14.25

-

-

-

-

-

EXHIBIT 8-4 (Continued)

BENTHIC MACROINVERTEBRATES - ORGANISMS/M²

P&M/SRC-II SITE

MONONGAHELA RIVER

STATION M-3

Date	<u>August, 1978</u>		<u>November, 1978</u>		<u>January, 1979</u>	
Location	<u>Transects of</u>		<u>East</u>	<u>West</u>	<u>East</u>	<u>West</u>
	<u>River</u>		<u>Side</u>	<u>Side</u>	<u>Side</u>	<u>Side</u>
Replicate	<u>1</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>1</u>	<u>2</u>

TAXA (Continued)

Insecta (continued)

Trichoptera

Hydroptilidae

Ochrotrichia sp.

14.25	-	-	-	-	-

ARACHNIDA

Hydracarina

-	-	42.76	-	-	-

MOLLUSCA

Gastropoda

Planorbidae

Gyraulus sp.

-	-	21.38	-	-	-

Pelecypoda

Corbiculidae

Corbiculamanilensis

42.75	28.25	171.04	85.52	-	-

Total

2,394.00	42.75	833.82	85.52	0	85.52

EXHIBIT 8-5

BENTHIC MACROINVERTEBRATES - ORGANISMS/M²
P&M/SRC-II SITE
CROOKED RUN
STATION C-1

Date	November, 1978		January, 1979	
Location	Pool	Riffle	Pool	Riffle
Sampler	Ponar	Surber	Ponar	Surber
Replicate	1	1	1	1 2

TAXA

ANNELIDA

Oligochaeta					
Tubificidae					
Immatures with capilliform setae	555.88	-	-	-	-
Immatures without capilliform setae	1,154.52	-	-	-	-
<u>Limnodrilus cervix</u>	42.76	-	-	-	-
<u>Limnodrilus hoffmeisteri</u>	448.98	-	-	-	-
<u>Limnodrilus profundicola</u>	42.76	-	-	-	-
Unidentified	-	-	-	10.87	-

ARTHROPODA

Insecta

Coleoptera

Elmidae

<u>Dubiraphia</u> sp.	299.32	10.87	-	10.87	-

Diptera

Ceratopogonidae

<u>Bezzia</u> sp.	42.76	-	-	-	-
<u>Ceratopogon</u> sp.	192.42	-	-	-	-
<u>Palpomyia</u> sp.	-	21.74	-	-	-
<u>Probezzia</u> sp.	42.76	-	-	-	-

Chironomidae

<u>Chironomus</u> sp.	320.70	-	-	-	-
<u>Coelotanypus scapularis</u>	149.66	-	-	-	-
<u>Paratanytarsus</u> sp.	-	10.87	-	-	-
<u>Procladius</u> sp.	1346.94	-	-	-	-
<u>Tanypus neopunctipennis</u>	213.80	-	-	-	-
<u>Tanytarsus</u> sp.	-	10.87	-	-	-

Empididae

	-	21.74	-	10.87	-

Tabanidae

<u>Chrysops</u> sp.	42.76	-	-	-	-

EXHIBIT 8-5 (Continued)

BENTHIC MACROINVERTEBRATES-ORGANISMS/M²

P&M/SRC-II SITE

CROOKED RUN

STATION C-1

Date	<u>November, 1978</u>		<u>January, 1979</u>	
Location	<u>Pool</u>	<u>Riffle</u>	<u>Pool</u>	<u>Riffle</u>
Sampler	<u>Ponar</u>	<u>Surber</u>	<u>Ponar</u>	<u>Surber</u>
Replicate	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>
<u>TAXA</u> (Continued)				
Plecoptera				
Capniidae				
<u>Allocapnia</u> sp.	-	-	- 10.87	-
Trichoptera				
Hydropsychidae				
<u>Cheumatopsyche</u> sp.	-	97.83	-	-
<u>Hydropsyche</u> sp.	-	-	- 21.74	184.78
MOLLUSCA				
Gastropoda				
Planorbidae				
<u>Helisoma</u> sp.	21.38	-	-	-
Pelecypoda				
Sphaeridae				
<u>Pisidium</u> sp.	149.66	-	-	-
TOTAL	5,067.06	152.18	0	65.22 184.78

EXHIBIT 8-6

BENTHIC MACROINVERTEBRATES - ORGANISMS/M²
P&M/SRC-II SITE
CROOKED RUN
STATION C-2

Date	August, 1978		November, 1978		January, 1979		
Location	Pool	Riffle	Pool	Riffle	Pool	Riffle	
Sampler	Ponar	Surber	Ponar	Surber	Ponar	Surber	
Replicate	1	1	1	1	1	1	2
<u>TAXA</u>							
ANNELIDA							
Oligochaeta							
Lumbriculidae	-	10.87	-	-	-	-	-
Tubificidae							
Immatures without capilliiform setae	-	10.87	21.38	-	-	-	-
ARTHROPODA							
Crustacea							
Amphipoda							
Gammaridae							
<u>Gammarus minus</u>	-	369.57	-	32.61	-	-	-
Insecta							
Coleoptera							
Elmidae							
Stenelmis sp.	21.38	21.74	-	-	-	-	-
Unidentified	21.38	-	-	-	-	-	-
Diptera							
Chironomidae							
<u>Cricotopus trifascia</u>	-	32.61	-	-	-	-	-
<u>Harnischia curtillamellata</u>	21.38	-	-	-	-	-	-
<u>Microtendipes</u> sp.	-	10.87	-	-	-	-	-
<u>Orthocladius</u> sp.	-	54.35	-	-	-	-	-
<u>Polypedilum</u> near <u>fallax</u>	-	10.87	-	-	-	-	-
<u>Procladius</u> sp.	-	-	21.38	-	-	-	-
<u>Stictochironomus</u> sp.-	-	-	-	-	42.76	-	-
<u>Tanytus neopunctipennis</u>	-	-	21.38	-	-	-	-
Unidentified							

EXHIBIT 8-6 (Continued)

BENTHIC MACROINVERTEBRATES - ORGANISMS/M²
P&M/SRC-II SITE
CROOKED RUN
STATION C-2

Date	<u>August, 1978</u>		<u>November, 1978</u>		<u>January, 1979</u>	
Location	<u>Pool</u>	<u>Riffle</u>	<u>Pool</u>	<u>Riffle</u>	<u>Pool</u>	<u>Riffle</u>
Sampler	<u>Ponar</u>	<u>Surber</u>	<u>Ponar</u>	<u>Surber</u>	<u>Ponar</u>	<u>Surber</u>
Replicate	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>
TAXA (Continued)						
Diptera (continued)						
Chironomini	21.38	-	-	-	-	-
Tabanidae						
<u>Chrysops</u> sp.	-	-	-	-	21.38	-
Tipulidae						
<u>Tipula</u> sp.	-	10.87	-	10.87	-	-
Ephemeroptera						
Baetidae	-	10.87	-	-	-	-
Megaloptera						
Corydalidae						
<u>Chauloides</u> sp.	-	-	-	10.87	-	-
Plecoptera						
Capniidae						
<u>Allocapnia</u> sp.	-	-	-	-	-	10.87
Chloroperlidae	-	-	-	10.87	-	-
Trichoptera						
Hydropsychidae						
<u>Cheumatopsyche</u> sp.	-	21.74	-	54.35	-	-
<u>Hydropsyche</u> sp.	-	32.61	-	97.83	-	21.74
Hydroptilidae						
<u>Hydroptila</u> sp.	-	10.87	-	-	-	-
<u>Ochrotrichia</u> sp.	-	10.87	-	-	-	-
BRYOZOA						
Unidentified	384.84	-	-	-	-	-
Total	470.36	619.58	32.61	217.40	32.61	0 32.61

EXHIBIT 8-7

PERIPHYTON
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-1

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
<u>DIATOMS</u>				
<u>Achnanthes minutissima</u>	530	70	-	4
<u>Achnanthes sp.</u>	-	-	12	-
<u>Amphipleura pellucida</u>	6	1	-	-
<u>Amphora ovalis</u>	1	-	-	-
<u>Anomoeoneis vitrea</u>	34	1	-	-
<u>Cyclotella stelligera</u>	-	4	-	1
<u>Cymbella minuta</u>	-	1	-	-
<u>Cymbella triangulum</u>	2	-	-	-
<u>Cymbella tumida</u>	1	1	-	1
<u>Cymbella ventricosa</u>	5	-	-	-
<u>Cymbella vulgar</u>	3	-	-	-
<u>Diatoma vulgare</u>	-	-	3	-
<u>Fragilaria sp.</u>	15	-	-	-
<u>Gomphonema affinis</u>				
<u>var. insigne</u>	1	-	-	-
<u>Gomphonema grunorvii</u>	-	1	-	-
<u>Gomphonema parvulum</u>	5	3	-	3
<u>Gomphonema sphaerophorum</u>	16	-	-	1
<u>Melosira islandica</u>	-	1	-	-
<u>Navicula angusta</u>	-	1	-	-
<u>Navicula graciloides</u>	-	-	3	4
<u>Navicula cf. luzonensis</u>	-	-	-	2
<u>Navicula minima</u>	-	-	15	27
<u>Navicula mutica</u>	-	-	25	24
<u>Navicula mutica</u>				
<u>var. undulata</u>	-	-	4	8
<u>Navicula rhynchocephala</u>	6	1	2	4
<u>Navicula schroeteri</u>				
<u>var. escombia</u>	3	-	-	-
<u>Navicula sp.</u>	-	-	1	-
<u>Navicula symmetrica</u>	-	4	1	8
<u>Nitzschia acicularis</u>	-	1	-	-

EXHIBIT 8-7 (Continued)

 PERIPHYTON
 P&M/SRC-II SITE
 MONONGAHELA RIVER
 STATION M-1

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
<u>Nitzschia amphibia</u>	-	-	-	3
<u>Nitzschia clausii</u>	8	-	-	-
<u>Nitzschia dissipata</u>	15	7	1	2
<u>Nitzschia filiformis</u>	-	-	-	3
<u>Nitzschia fonticola</u>	-	-	90	138
<u>Nitzschia frustulum</u>	-	-	230	235
<u>Nitzschia obtusa</u> var.				
<u>scalpelliformis</u>	5	-	-	-
<u>Nitzschia ovicularis</u>	1	-	-	-
<u>Nitzschia palea</u>	30	8	2	8
<u>Nitzschia sp.</u>	4	1	-	-
<u>Pinnularia sp.</u>	-	-	2	1
<u>Rhoicosphenia curvata</u>	1	2	-	-
<u>Surirella linearis</u>				
var. <u>constricta</u>	1	-	-	-
<u>Surirella robusta</u>	-	-	-	1
<u>Surirella sp.</u>	1	1	-	-
<u>Synedra delicatissima</u>	1	-	-	-
<u>Synedra filiformis</u>	-	1	-	-
<u>Synedra gouldi</u>	-	1	-	-
<u>Synedra pulchella</u>	-	-	-	3
<u>Synedra radians</u>	-	1	-	-
<u>Synedra rumpens</u>				
var. <u>familiaris</u>	6	1	-	-
<u>Synedra ulna</u>	8	-	1	-
<u>Anabaena anomala</u>	-	-	-	1
<u>Calothrix sp.</u>	-	1	-	-
<u>Lyngbya cf. bipunctata</u>	1	-	-	-
<u>Lyngbya lacustris</u>	-	-	1	6
<u>Lyngbya lagerheimii</u>	-	-	1	10
<u>Lyngbya limnetica</u>	18	41	67	36
<u>Melosira sp.</u>	-	-	1	1
<u>Melosira varians</u>	1	1	-	-

EXHIBIT 8-7 (Continued)

PERIPHYTON
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-1

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
<u>FILAMENTS</u>				
<u>Microspora</u> sp.	1	-	-	-
<u>Mougeotia</u> sp.	1	6	-	-
<u>Oscillatoria</u> <u>amphibia</u>	6	18	4	6
<u>Oscillatoria</u> <u>amphigranulata</u>	5	-	-	-
<u>Oscillatoria</u> <u>formosa</u>	-	1	-	-
<u>Oscillatoria</u> <u>limnetica</u>	18	23	43	53
<u>Oscillatoria</u> <u>quadripunctulata</u>	3	2	-	-
<u>Oscillatoria</u> <u>splendida</u>	1	5	-	-
<u>Oscillatoria</u> <u>subbrevis</u>	-	9	8	5
<u>Oscillatoria</u> <u>tenuis</u>	-	-	4	8
<u>Oscillatoria</u> <u>tenuis</u>				
var. <u>tergestina</u>	7	-	-	-
<u>Phormidium</u> sp.	1	-	-	-
<u>Scenedesmus</u> cf. <u>obliquis</u>	1	-	-	-
<u>Staurastrum</u> cf. <u>rotula</u>	-	-	1	-
<u>Ulothrix</u> sp.	1	-	-	-

Note: E = East side of river
W = West side of river

Note: January samples couldn't be collected
due to ice formation in shallow areas

EXHIBIT 8-8

 PERIPHYTON
 P&M/SRC-II SITE
 MONONGAHELA RIVER
 STATION M-2

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
<u>DIATOMS</u>				
<u>Achnanthes minutissima</u>	13	29	82	98
<u>Anomoeoneis vitrea</u>	5	-	-	2
<u>Bacillaria paxillifer</u>	1	-	-	1
<u>Cyclotella meneghiniana</u>	7	-	-	-
<u>Cyclotella sp.</u>	-	5	-	-
<u>Cyclotella stelligera</u>	1	3	4	11
<u>Cymbella affinis</u>	-	-	-	1
<u>Cymbella minuta</u>	-	-	-	1
<u>Cymbella sp.</u>	-	-	-	1
<u>Cymbella tumida</u>	-	4	1	-
<u>Cymbella tumidula</u>	3	-	-	-
<u>Eunotia curvata</u>	-	-	1	5
<u>Fragilaria vaucheriae</u>	2	-	-	-
<u>Frustulia vulgaris</u>	-	1	10	-
<u>Gomphonema affine</u>	5	-	-	-
<u>Gomphonema grunorvii</u>	-	6	-	-
<u>Gomphonema parvulum</u>	-	6	4	13
<u>Gomphonema sphaerophorum</u>	-	-	2	-
<u>Gomphonema subclavatum</u>	-	-	-	6
<u>Gomphonitzschia sp.</u>	-	-	1	-
<u>Gyrosigma sp.</u>	1	-	-	-
<u>Melosira sp.</u>	-	-	2	3
<u>Navicula bicephala</u>	-	1	-	-
<u>Navicula gottlandica</u>	6	-	2	11
<u>Navicula cf. luzonensis</u>	3	-	-	-
<u>Navicula mutica</u>	8	3	1	-
<u>Navicula radiosa</u>	-	-	-	3
<u>Navicula rhynchocephala</u>	9	4	1	21
<u>Navicula schroeteri</u>				
var. <u>escombia</u>	5	-	-	-
<u>Navicula symmetrica</u>	-	-	-	2

EXHIBIT 8-8 (Continued)

PERIPHYTON
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-2

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
<u>Navicula viridula</u>				
var. <u>avenacea</u>	-	2	-	-
<u>Neidium iridis</u>	1	1	-	-
<u>Nitzschia acicularis</u>	2	3	1	1
<u>Nitzschia amphibia</u>	-	3	-	-
<u>Nitzschia dissipata</u>	4	1	1	-
<u>Nitzschia filiformis</u>	-	-	5	10
<u>Nitzschia fonticola</u>	-	-	1	-
<u>Nitzschia gracilis</u>	-	-	2	1
<u>Nitzschia kutzingiana</u>	60	12	-	-
<u>Nitzschia linearis</u>	3	-	-	-
<u>Nitzschia cf. luzonensis</u>	-	4	-	-
<u>Nitzschia obtusa</u>	-	5	1	1
<u>Nitzschia obtusa</u>				
var. <u>scalpelliformis</u>	6	-	-	-
<u>Nitzschia palea</u>	-	-	4	6
<u>Nitzschia pseudoamphioxus</u>	1	-	-	-
<u>Nitzschia sigma</u>	-	2	-	-
<u>Nitzschia sp.</u>	-	1	-	1
<u>Opephora martyi</u>	-	1	-	-
<u>Pinnularia sp.</u>	-	-	2	-
<u>Rhoicosphenia curvata</u>	1	1	-	-
<u>Scoliopleura tumida</u>	-	1	-	-
<u>Steuroneis karsteuui</u>	-	1		
<u>Surirella ovata</u>	-	-	1	-
<u>Synedra filiformis</u>	-	-	1	-
<u>Synedra incisa</u>	1	-	-	-
<u>Synedra pulchella</u>	2	1	5	17
<u>Synedra rumpens</u>	-	-	-	4
<u>Synedra socia</u>	-	1	-	-
<u>Synedra sp.</u>	-	-	1	-
<u>Synedra ulna</u>	1	8	4	8
<u>Thalassiosira</u>				
<u>fluviatilis</u>	-	2	-	-

EXHIBIT 8-8 (Continued)

PERIPHYTON
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-2

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
<u>FILAMENTS</u>				
<u>Anabaena</u> sp.	1	1	-	-
<u>Anabaena</u> cf. <u>constricta</u>	-	-	-	26
<u>Fragilaria</u> sp.	1	-	-	-
<u>Lyngbya</u> <u>lagerheimii</u>	-	-	4	7
<u>Lyngbya</u> <u>limnetica</u>	10	50	24	2
<u>Lyngbya</u> sp.	4	3	-	-
<u>Melosira</u> sp.	2	-	1	3
<u>Melosira</u> <u>varians</u>	9	1	-	5
<u>Microspora</u> sp.	-	-	1	-
<u>Mougeotia</u> sp.	2	-	8	1
<u>Oscillatoria</u> <u>amphibia</u>	4	-	5	7
<u>Oscillatoria</u> <u>amphigranulata</u>	6	7	6	-
<u>Oscillatoria</u> <u>limnetica</u>	19	16	50	13
<u>Oscillatoria</u> <u>ogardhii</u>	2	-	-	-
<u>Oscillatoria</u> <u>proteus</u>	-	3	-	3
<u>Oscillatoria</u> <u>pseudogeminata</u>	-	-	-	50
<u>Oscillatoria</u> <u>splendida</u>	1	1	-	-
<u>Oscillatoria</u> <u>subbrevis</u>	25	6	3	3
<u>Oscillatoria</u> <u>subbrevis</u> cf. <u>major</u>	3	-	-	-
<u>Oscillatoria</u> <u>tenuis</u>	3	-	-	-
<u>Oscillatoria</u> sp.	3	-	-	-
<u>Scenedesmus</u> <u>obliquis</u>	-	-	-	2
<u>Synedra</u> <u>ulna</u>	-	-	-	1
<u>Ulothrix</u> sp.	1	2	-	-

Note: E = East side of river
W = West side of river

Note: January samples couldn't be collected
due to ice formation in shallow areas

EXHIBIT 8-9

PERIPHYTON
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-3

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
<u>DIATOMS</u>				
<u>Achnanthes lanceolata</u>	-	-	-	1
<u>Achnanthes linearis</u>				
cf. <u>curta</u>	2	-	10	-
<u>Achnanthes minutissima</u>	21	36	35	9
<u>Achnanthes sp.</u>	-	2	-	-
<u>Anomoeoneis vitrea</u>	-	1	9	1
<u>Asterionella formosa</u>	1	-	-	-
<u>Bacillaria paxillifer</u>	-	3	2	4
<u>Cocconeis placentula</u>	-	1	-	-
<u>Compylodiscus clyperus</u>	-	-	-	3
<u>Cyclotella meneghiniana</u>	3	1	-	-
<u>Cyclotella stelligera</u>	11	5	7	19
<u>Cyclotella styriaca</u>	1	-	-	-
<u>Cymbella minuta</u>	2	2	-	-
<u>Cymbella tumida</u>	4	4	-	-
<u>Eunotia tenella</u>	2	-	-	-
<u>Fragilaria construens</u>	1	4	-	-
<u>Fragilaria sp.</u>	-	2	-	-
<u>Frustulia vulgaris</u>	-	-	1	-
<u>Gomphonema parvulum</u>	1	5	4	-
<u>Gomphonema subclavatum</u>	-	-	-	4
<u>Gyrosigma nodiferum</u>	-	-	3	-
<u>Melosira islandica</u>	-	-	-	2
<u>Melosira sp.</u>	3	-	-	-
<u>Melosira varians</u>	-	-	1	-
<u>Navicula bicephala</u>	-	-	-	3
<u>Navicula gottlandica</u>	-	8	1	-
<u>Navicula lanceolata</u>	1	-	-	-
<u>Navicula cf. luzonensis</u>	1	-	-	-
<u>Navicula minima</u>	-	-	-	2
<u>Navicula mutica</u>	3	3	7	2
<u>Navicula radiosa</u>	-	5	-	-

EXHIBIT 8-9 (Continued)

 PERIPHYTON
 P&M/SRC- II SITE
 MONONGAHELA RIVER
 STATION M-3

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
<u>Navicula rhynchocephala</u>	22	21	2	7
<u>Navicula secrata</u>	-	1	-	1
<u>Navicula sp.</u>	-	-	1	1
<u>Navicula symmetrica</u>	-	-	1	1
<u>Navicula viridula</u>	1	-	-	-
<u>Navicula viridula</u>				
var. <u>avenacea</u>	-	4	-	-
<u>Navicula valpina</u>	-	-	3	-
<u>Navicula cf. vulpina</u>	-	-	-	1
<u>Nitzschia acicularis</u>	4	2	1	4
<u>Nitzschia baccata</u>	1	1	-	-
<u>Nitzschia dissipata</u>	1	7	1	3
<u>Nitzschia filiformis</u>	-	-	6	5
<u>Nitzschia fonticola</u>	-	-	-	1
<u>Nitzschia frustulum</u>	-	-	2	-
<u>Nitzschia gracilis</u>	-	2	-	1
<u>Nitzschia kutzingiana</u>	18	18	1	26
<u>Nitzschia obtusa</u>	6	7	-	-
<u>Nitzschia palea</u>	19	29	7	30
<u>Nitzschia scalaris</u>	1	-	-	-
<u>Nitzschia sublinearis</u>	-	-	-	2
<u>Pinnularia sp.</u>	-	-	-	2
<u>Surirella delicatissima</u>	2	-	-	5
<u>Surirella linearis</u>	-	-	-	1
<u>Surirella robusta</u>	-	4	-	10
<u>Synedra pulchella</u>	-	2	-	3
<u>Synedra pulchella</u>				
var. <u>lacerata</u>	-	3	-	-
<u>Synedra pulchella</u>				
var. <u>lanceolata</u>	-	1	-	-
<u>Synedra rumpens</u>	-	-	-	4

EXHIBIT 8-9 (Continued)

PERIPHYTON
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-3

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
<u>Synedra socia</u>	1	-	-	-
<u>Synedra sp.</u>	-	-	1	-
<u>Synedra ulna</u>	3	3	3	12
<u>Synedra ulna</u> var. <u>contrastata</u>	2	-	-	-
<u>Thalassiosira fluviatilis</u>	-	1	-	-
<u>FILAMENTS</u>				
<u>Anabaena cf. constricta</u>	-	-	3	1
<u>Fragilaria capucina</u>	-	1	-	-
<u>Fragilaria sp.</u>	1	-	-	-
<u>Lyngbya cf. hieronymusii</u>	-	-	1	-
<u>Lyngbya lacustris</u>	3	-	1	1
<u>Lyngbya lagerheimii</u>	-	-	2	-
<u>Lyngbya limnetica</u>	9	20	32	6
<u>Melosira sp.</u>	1	-	-	-
<u>Melosira varians</u>	27	7	3	-
<u>Mougeotia sp.</u>	-	-	6	-
<u>Oscillatoria amphibia</u>	4	9	14	12
<u>Oscillatoria</u> <u>amphigranulata</u>	-	-	1	-
<u>Oscillatoria chlorina</u>	-	-	3	10
<u>Oscillatoria formosa</u>	2	-	-	-
<u>Oscillatoria limnetica</u>	19	4	32	8
<u>Oscillatoria</u> <u>pseudogeminata</u>	-	-	1	53
<u>Oscillatoria subbrevis</u>	25	59	-	29
<u>Oscillatoria tenuis</u>	7	2	-	-
<u>Oscillatoria sp.</u>	-	-	1	-
<u>Phorimidium fragile</u>	8	4	-	-

EXHIBIT 8-9 (Continued)

PERIPHYTON
P&M/SRC-II SITE
MONONGAHELA RIVER
STATION M-3

	August 1978		November 1978	
	<u>E</u>	<u>W</u>	<u>AE</u>	<u>W</u>
<u>Scenedesmus</u> sp.	-	1 ^C	-	3 ^C
<u>Scenedesmus</u> cf. <u>armatus</u>	-	-	1	-
<u>Spirulina</u> sp.	-	-	1	-

Note: E = East side of river
W = West side of river
C = Colonies of 4 cells

Note: January samples couldn't be collected
due to ice formation in shallow areas

EXHIBIT 8-10

PERIPHYTON
P&M/SRC-II SITE
MONOGAHELA RIVER STATIONS
ARTIFICIAL SUBSTRATES
NOVEMBER 1978

<u>DIATOMS</u>	<u>M-1</u>	<u>M-2</u>	<u>M-3</u>
<u>Achnanthes lanceolata</u>	-	1	-
<u>Achnanthes linearis</u> cf. <u>curta</u>	-	5	6
<u>Achnanthes microcephala</u>	-	-	4
<u>Achnanthes minutissima</u>	130	109	232
<u>Amphipleura pellucida</u>	-	1	-
<u>Anomoeoneis vitrea</u>	-	1	6
<u>Bacillaria paxillifer</u>	1	-	2
<u>Cyclotella meneghiniana</u>	6	3	-
<u>Cyclotella stelligera</u>	11	3	2
<u>Cymatopleura solea</u>	-	1	-
<u>Cymbella affinis</u>	-	1	-
<u>Cymbella sp.</u>	1	1	2
<u>Cymbella triangulum</u>	-	1	-
<u>Cymbella tumida</u>	2	1	2
<u>Cymbella tumidula</u>	1	-	-
<u>Eunotia curvata</u>	-	-	1
<u>Eunotia glacialis</u>	-	1	-
<u>Eunotia joba</u>	-	1	-
<u>Eunotia lunaris</u>	-	1	-
<u>Eunotia sp.</u>	-	-	1
<u>Fragilaria capicina</u>	-	2	-
<u>Fragilaria construens</u>	1	-	-
<u>Fragilaria sp.</u>	-	1	11
<u>Frustulia vulgaris</u>	-	-	2
<u>Gomphonema angustatum</u>	3	-	-
<u>Gomphonema consector</u>	-	4	-
<u>Gomphonema gracile</u>	-	3	-
<u>Gomphonema parvulum</u>	6	5	7
<u>Gomphonema simus</u>	-	1	-
<u>Gomphonema subclavatum</u>	-	-	1
<u>Gomphonema cf. subclavatum</u>	-	4	-
<u>Hantzschia amphioxys</u>	-	1	-

EXHIBIT 8-10 (Continued)

PERIPHYTON
P&M/SRC- II SITE
MONOGAHELA RIVER STATIONS
ARTIFICIAL SUBSTRATES
NOVEMBER 1978

	<u>M-1</u>	<u>M-2</u>	<u>M-3</u>
<u>Melosira</u> sp.	-	1	3
<u>Meridian</u> <u>circularis</u>	-	-	1
<u>Navicula</u> <u>arvensis</u>	-	-	1
<u>Navicula</u> <u>bicephala</u>	-	4	-
<u>Navicula</u> <u>mutica</u>	1	2	-
<u>Navicula</u> <u>radiosa</u>	-	-	9
<u>Navicula</u> <u>rhynchocephala</u>	4	4	2
<u>Navicula</u> sp.	1	1	-
<u>Navicula</u> <u>subtilissima</u>	-	1	-
<u>Navicula</u> <u>symmetrica</u>	2	-	1
<u>Navicula</u> <u>vanheurckii</u>	1	1	-
<u>Navicula</u> <u>viridula</u>	1	1	-
<u>Nitzschia</u> <u>acicularis</u>	2	1	1
<u>Nitzschia</u> <u>acicularis</u> var. <u>closterioides</u>	1	-	-
<u>Nitzschia</u> cf. <u>clausii</u>	-	-	1
<u>Nitzschia</u> <u>dissipata</u>	1	1	-
<u>Nitzschia</u> <u>dubia</u>	2	-	-
<u>Nitzschia</u> <u>filiformis</u>	-	5	-
<u>Nitzschia</u> <u>fonticola</u>	2	-	-
<u>Nitzschia</u> <u>gracilis</u>	1	-	-
<u>Nitzschia</u> <u>kutzingiana</u>	1	2	5
<u>Nitzschia</u> <u>obtusa</u>	13	1	12
<u>Nitzschia</u> <u>palea</u>	17	6	4
<u>Nitzschia</u> <u>sigma</u>	-	-	1
<u>Nitzschia</u> sp.	-	1	-
<u>Nitzschia</u> <u>subrostrata</u>	5	-	-
<u>Pinnularia</u> <u>obscura</u>	1	-	-
<u>Pinnularia</u> sp.	-	1	-
<u>Rhoicosphenia</u> <u>curvata</u>	-	1	-
<u>Surirella</u> <u>ovata</u>	-	1	-
<u>Surirella</u> <u>robusta</u>	3	1	2
<u>Synedra</u> <u>filiformis</u>	1	-	-

EXHIBIT 8-10 (Continued)

PERIPHYTON
P&M/SRC-II SITE
MONOGAHELA RIVER STATIONS
ARTIFICIAL SUBSTRATES
NOVEMBER 1978

	<u>M-1</u>	<u>M-2</u>	<u>M-3</u>
<u>Synedra pulchella</u>	-	1	6
<u>Synedra rumpens</u>	2	1	2
<u>Synedra ulna</u>	1	3	6
<u>Thalassiosira fluviatilis</u>	-	1	-

FILAMENTS

<u>Anabaena cf. constricta</u>	-	1	-
<u>Ankistrodesmus cf. falcatus</u>	-	2	-
<u>Fragilaria sp.</u>	-	-	1
<u>Lyngbya lacustris</u>	6	2	1
<u>Lyngbya lagerheimii</u>	4	-	-
<u>Lyngbya limnetica</u>	29	21	74
<u>Melosira varians</u>	3	-	9
<u>Mougeotia sp.</u>	6	1	14
<u>Oscillatoria amphibia</u>	17	1	-
<u>Oscillatoria limnetica</u>	8	13	2
<u>Oscillatoria ogardii</u>	-	1	-
<u>Oscillatoria pseudogeminata</u>	-	1	-
<u>Oscillatoria splendida</u>	-	1	-
<u>Oscillatoria subbrevis</u>	2	-	1
<u>Phorimidium cf. mucicola</u>	-	1	1
<u>Spirulina major</u>	3	-	-
<u>Synedra ulna</u>	-	-	1
<u>Ulothrix sp.</u>	1	1	-

EXHIBIT 8-11

 PERIPHYTON
 P&M/SRC-II SITE
 CROOKED RUN
 C-1

<u>DIATOMS</u>	<u>November 1978</u> <u>Rep 1</u>	<u>January 1979</u> <u>Rep 1</u>
<u>Achnanthes linearis</u> cf. <u>curta</u>	1	-
<u>Achnanthes minutissima</u>	50	4
<u>Amphineura pellucida</u>	1	-
<u>Bacillaria paxillifer</u> var. <u>tumidula</u>	1	-
<u>Cyclotella stelligera</u>	-	1
<u>Cymbella minuta</u>	9	-
<u>Cymbella</u> sp.	-	1
<u>Cymbella triangulum</u>	2	-
<u>Frustulia vulgaris</u>	-	2
<u>Gomphonema angustatum</u>	5	4
<u>Gomphonema parvulum</u>	5	-
<u>Hantzschia elongata</u>	1	-
<u>Navicula cryptocephala</u>	3	-
<u>Navicula minima</u>	-	1
<u>Navicula rhynchocephala</u>	11	-
<u>Navicula symmetrica</u>	1	-
<u>Navicula valpina</u>	1	-
<u>Nitzschia acuta</u>	5	-
<u>Nitzschia</u> cf. <u>apiculata</u>	3	-
<u>Nitzschia dissipata</u>	3	-
<u>Nitzschia filiformis</u>	-	1
<u>Nitzschia fonticola</u>	1	-
<u>Nitzschia gracilis</u>	1	-
<u>Nitzschia kutzingiana</u>	3	1
<u>Nitzschia obtusa</u>	3	-
<u>Nitzschia palea</u>	7	-
<u>Nitzschia sigma</u>	6	-
<u>Nitzschia stagnorum</u>	-	1
<u>Nitzschia sublinearis</u>	1	-
<u>Surirella linearis</u>	5	-
<u>Surirella robusta</u>	-	3
<u>Synedra cyclopus</u>	1	-

EXHIBIT 8-11 (Continued)

 PERIPHYTON
 P&M/SRC-II SITE
 CROOKED RUN
 C-1

<u>DIATOMS</u>	<u>November 1978</u> <u>Rep 1</u>	<u>January 1979</u> <u>Rep 1</u>
<u>Synedra ulna</u>	4	-
<u>Syrosigma nodiferium</u>	1	-
<u>FILAMENTS</u>		
<u>Lyngbya cryptovoginata</u>	1	-
<u>Lyngbya limnetica</u>	25	2
<u>Mougeotia sp.</u>	3	-
<u>Oscillatoria amphibia</u>	4	1
<u>Oscillatoria limnetica</u>	27	3
<u>Spirulina cf. labyrinthiformis</u>	1	-
<u>Spirulina meneghiniana</u>	26	-
<u>Spirogyra sp.</u>	1	-

EXHIBIT 8-12

PERIPHYTON
P&M/SRC-II SITE
CROOKED RUN
STATION C-2

<u>DIATOMS</u>	Aug. 1978 Rep 1	Nov. 1978 Rep 1	Jan. 1979 Rep 1
<u>Achnanthes linearis</u> cf. <u>curta</u>	-	11	1
<u>Achnanthes minutissima</u>	27	61	1
<u>Amphora perpusilla</u>	1	-	-
<u>Anomoeoneis vitrea</u>	-	-	1
<u>Bacillaria paxillifer</u>	2	2	-
<u>Cocconeis fluviatilis</u>	-	4	-
<u>Cocconeis pediculus</u>	3	-	-
<u>Cocconeis placentula</u>	6	12	-
<u>Cyclotella meneghiniana</u>	-	3	-
<u>Cymatopleura solea</u>	-	2	-
<u>Cymbella aequalis</u>	-	3	-
<u>Cymbella minuta</u>	6	-	-
<u>Cymbella sinciata</u>	5	11	1
<u>Cymbella triangulum</u>	1	-	-
<u>Diatoma vulgare</u>	1	1	-
<u>Diatomella</u> cf. <u>hustedfii</u>	1	-	-
<u>Fragilaria capucina</u>	3	-	-
<u>Fragilaria construens</u>	2	-	-
<u>Fragilaria vaucheriae</u>	-	-	1
<u>Gomphonema angustatum</u>	2	-	4
<u>Gomphonema apuncto</u>	2	-	-
<u>Gomphonema obvocium</u>	-	5	-
<u>Gomphonema parvulum</u>	2	2	-
<u>Gomphonema</u> sp.	1	-	-
<u>Gyrosigma nodiferum</u>	1	-	-
<u>Navicula angusta</u>	1	-	-
<u>Navicula cryptocephala</u>	-	49	-
<u>Navicula minuscula</u>	-	1	-
<u>Navicula mutica</u>	1	-	-
<u>Navicula rhynchocephala</u>	19	6	-
<u>Navicula schroeteri</u> var. <u>escombia</u>	5	-	-
<u>Navicula</u> sp.	1	-	-

EXHIBIT 8-12 (Continued)

PERIPHYTON
P&M/SRC-II SITE
CROOKED RUN
STATION C-2

	Aug. 1978 Rep 1	Nov. 1978 Rep 1	Jan. 1979 Rep 1
<u>Navicula</u> <u>symmetrica</u>	10	2	-
<u>Navicula</u> <u>vanheurckii</u>	1	-	-
<u>Navicula</u> <u>viridula</u>	-	1	-
<u>Navicula</u> <u>viridula</u> var. <u>rostellata</u>	4	-	-
<u>Nitzschia</u> <u>acicularis</u>	1	1	-
<u>Nitzschia</u> <u>acuta</u>	-	1	-
<u>Nitzschia</u> <u>clausii</u>	1	-	-
<u>Nitzschia</u> <u>dissipata</u>	6	11	-
<u>Nitzschia</u> <u>gracilis</u>	-	1	-
<u>Nitzschia</u> <u>kutzingiana</u>	10	2	-
<u>Nitzschia</u> <u>linearis</u>	-	4	-
<u>Nitzschia</u> <u>obtusa</u>	2	-	-
<u>Nitzschia</u> <u>palea</u>	6	15	-
<u>Nitzschia</u> <u>sigma</u>	-	2	-
<u>Pinnularia</u> <u>sp.</u>	-	1	-
<u>Rhoicosphenia</u> <u>curvata</u>	-	1	-
<u>Surirella</u> <u>caproni</u>	2	-	-
<u>Surirella</u> <u>linearis</u>	-	4	-
<u>Surirella</u> <u>ovata</u>	2	-	-
<u>Surirella</u> <u>robusta</u>	2	25	3
<u>Synedra</u> <u>goulardi</u>	6	-	-
<u>Synedra</u> <u>minuscule</u>	-	2	-
<u>Synedra</u> <u>pulchella</u>	2	1	-
<u>Synedra</u> <u>rumpens</u>	1	-	-
<u>Synedra</u> <u>ulna</u>	8	9	-
<u>Thalassiosira</u> <u>fluviatilis</u>	1	-	-

FILAMENTS

<u>Diatoma</u> <u>vulgare</u>	3	-	-
<u>Fragilaria</u> <u>construens</u>	1	-	-
<u>Lyngbya</u> <u>lacustris</u>	-	-	8
<u>Lyngbya</u> <u>limnetica</u>	79	77	12

EXHIBIT 8-12 (Continued)

 PERIPHYTON
 P&M/SRC- II SITE
 CROOKED RUN
 STATION C-2

	Aug. 1978 <u>Rep 1</u>	Nov. 1978 <u>Rep 1</u>	Jan. 1979 <u>Rep 1</u>
<u>Melosira varians</u>	1	1	-
<u>Mougeotia</u> sp.	3	-	-
<u>Oscillatoria amphibia</u>	13	6	1
<u>Oscillatoria limnetica</u>	10	34	8
<u>Oscillatoria quadripunctulata</u>	3	-	-
<u>Oscillatoria subbrevis</u>	1	-	-
<u>Phormidium</u> sp.	5 ^a	-	-
<u>Plectonema notatum</u>	9	-	-
<u>Plectonema</u> sp.	-	1	-
<u>Rhizoclonium</u> sp.	1	-	-
<u>Spirulina subsalsa</u>	1	-	-
<u>Synedra ulna</u>	2	-	-
<u>Tabellaria</u> sp.	-	1	-
<u>Tabellaria fenestra</u>			
var. <u>asterionelloides</u>	1	-	-
<u>Ulothrix</u> sp.	1	-	-

NOTE: a = massive filaments

EXHIBIT 8-13

PERIPHYTON
P&M/SRC-II SITE
ROBINSON RUN
R-1

DIATOMS

Aug. 1978
Rep 1

<u>Achnanthes lanceolata</u>	1
<u>Achnanthes minutissima</u>	2
<u>Amphora perpusilla</u>	1
<u>Cyclotella meneghiniana</u>	1
<u>Cymbella</u> sp.	2
<u>Fragilaria crotonensis</u>	2
<u>Gomphonema</u> sp.	1
<u>Hantzschia amphioxys</u>	1
<u>Navicula arvensis</u>	7
<u>Navicula heufleri</u>	1
<u>Navicula lanceolata</u>	1
<u>Navicula rhynchocephala</u>	2
<u>Navicula symmetrica</u>	1
<u>Navicula viridula</u> var. <u>rostellata</u>	1
<u>Nitzschia acicularis</u>	1
<u>Nitzschia clausii</u>	4
<u>Nitzschia dissipata</u>	1
<u>Nitzschia fonticola</u>	2
<u>Nitzschia frustulum</u> var. <u>purpusilla</u>	1
<u>Nitzschia kutzingiana</u>	8
<u>Nitzschia palea</u>	3
<u>Nitzschia</u> sp.	1
<u>Pinnularia brebissoni</u>	3
<u>Pinnularia</u> cf. <u>intermedia</u>	1
<u>Pinnularia obscura</u>	2
<u>Rhoicosphenia curvata</u>	1
<u>Synedra pulchella</u>	1
<u>Synedra</u> sp.	1

FILAMENTS

<u>Lyngbya limnetica</u>	1
<u>Mougeotia</u> sp.	1
<u>Oscillatoria limnetica</u>	2
<u>Oscillatoria subbrevis</u>	1

EXHIBIT 8-14

PERIPHYTON
P&M/SRC- II SITE
CRAFTS RUN
BELOW K-1

DIATOMS

November 1978

Achnanthes affinis
Eunotia cf. faba
Nitzschia palea
Pinnularia microstauron
cf. diminuta

2
6
3
61

FILAMENTS

Lyngbya limnetica
Oscillatoria limnetica

1
2

EXHIBIT 8-15

 PERIPHYTON
 P&M/SRC-II SITE
 POND 1
DIATOMSAugust 1978

<u>Achnanthes linearis</u>	8
<u>Achnanthes minutissima</u>	45
<u>Cymbella cf. diluviana</u>	2
<u>Cymbella cf. rupicola</u>	1
<u>Fragilaria cf. crotonensis</u>	3
<u>Gomphonema angustatum</u>	3
<u>Navicula gottlandica</u>	2
<u>Navicula lanceolata</u>	1
<u>Navicula pupula</u>	2
<u>Navicula rhynchocephala</u>	1
<u>Navicula vanheurckii</u>	3
<u>Navicula viridula</u> var. <u>avenacea</u>	1
<u>Nitzschia acicularis</u>	1
<u>Nitzschia clausii</u>	1
<u>Nitzschia fonticola</u>	11
<u>Nitzschia kutzingiana</u>	6
<u>Nitzschia linearis</u>	2
<u>Nitzschia obtusa</u>	1
<u>Nitzschia palea</u>	4
<u>Rhoicosphenia curvata</u>	1
<u>Rhopalodia musculus</u>	1
<u>Stauroneis phoenicenteron</u>	1
<u>Surirella angustata</u>	3
<u>Surirella celtebesiana</u>	1
<u>Lyngbya limnetica</u>	86
<u>Mougeotia sp.</u>	3
<u>Oscillatoria amphibia</u>	15
<u>Oscillatoria limnetica</u>	5
<u>Oscillatoria subbrevis</u>	5
<u>Phormidium sp.</u>	5
<u>Scenedesmus sp.</u>	1
<u>Ulothrix sp.</u>	2

EXHIBIT 8-16

 PHYTOPLANKTON
 P&M/SRC- II SITE
 MONONGAHELA RIVER
 STATION M-I

<u>TAXA</u>	<u>Aug. 1978</u>	<u>Nov. 1978</u>	<u>Jan. 1979</u>	<u>Apr. 1979</u>
<u>BACILLARIOPHYTA</u>				
<u>Cyclotella meneghiniana</u>	-	615	-	
<u>Cyclotella stelligera</u>	-	200	-	
<u>Cyclotella sp.</u>	77.39	-	-	
<u>Melosira granulata</u>	7.04	-	-	
<u>Nitzschia acicularis</u>	14.07	-	-	
<u>Nitzschia palea</u>	63.32	-	-	
<u>Nitzschia sp.</u>	126.64	-	-	
<u>Rhizosolenia erliensis</u>	647.25	-	-	
<u>Synedra radians</u>	-	260	-	
<u>CHLOROPHYTA</u>				
<u>Actinastrum hantzschii</u>	7.04	-	-	
<u>Ankistrodesmus convolutus</u>	239.20	-	-	
<u>Ankistrodesmus falcatus</u>	84.43	40	-	
<u>Chlamydomonas sp.</u>	-	75	-	
<u>Chlorella sp.</u>	232.17	975	-	
<u>Closterium sp.</u>	21.11	-	-	
<u>Coccomyxa sp.</u>	-	975	-	
<u>Coelastrum reticulatum</u>	14.07	-	-	
<u>Crucigenia apiculata</u>	35.18	-	-	
<u>Crucigenia quadrata</u>	14.07	80	-	
<u>Dyctyosphaerium sp.</u>	35.18	-	-	-
<u>Kirchneriella sp.</u>	133.68	-	-	-
<u>Oocystis sp.</u>	7.04	-	-	-
<u>Scenedesmus acuminatus</u>	14.07	-	-	-
<u>Scenedesmus bicaudatus</u>	14.07	-	-	-
<u>Scenedesmus ecornis</u>	232.17	-	-	-
<u>Scenedesmus quadricauda</u>	77.39	40	-	-
<u>Sphaerocystis Schroeteri</u>	7.04	-	-	-
<u>Spondylosium sp.</u>	7.04	-	-	-
<u>Staurastrum sp.</u>	7.04	-	-	-
<u>Tetrachlorella alternans</u>	21.11	-	-	-
<u>Tetrastrum sp.</u>	7.04	-	-	-
<u>Treubaria triappendiculata</u>	28.14	-	-	-

EXHIBIT 8-16 (Continued)

 PHYTOPLANKTON
 P&M/SRC-II SITE
 MONONGAHELA RIVER
 STATION M-I

TAXA	Aug. 1978	Nov. 1978	Jan. 1979	Apr. 1979
<u>CHRYSTOPHYTA</u>				
<u>Chromulina</u> sp.	-	215	-	-
<u>Chrysococcus</u> sp.	84.43	-	-	-
<u>Cymbella</u> sp.	7.04	-	-	-
<u>Dinobryon</u> sp.	14.07	-	-	-
<u>CRYPTOPHYTA</u>				
<u>Cryptomonas</u> caudata	281.41	500	-	-
<u>Cryptomonas</u> marssonii	147.74	625	-	-
<u>CYANOPHYTA</u>				
<u>Aphanothece</u> nidulans	-	-	174	-
<u>Chroococcus</u> sp.	21.11	-	-	-
<u>Merismopedia</u> tenuissima	7.04	-	-	-
<u>Oscillatoria</u> limnetica	7.04	-	87	-
<u>Oscillatoria</u> sp.	-	-	174	-
<u>Raphidiopsis</u> sp.	119.60	-	-	-
<u>Rhabdoderma</u> sp.	105.53	40	-	-
<u>Synechocystis</u> sp.	-	-	910	-
<u>EUGLENOPHYTA</u>				
<u>Euglena</u> sp.	7.04	-	-	-
<u>Phytoflagellate</u> (large)	-	500	-	-
<u>Phytoflagellate</u> (small)-	-	80	-	-
<u>Trachelomonas</u> volvocina	-	220	-	-
<u>Trachelomonas</u> sp.	267.35	-	-	-
<u>PROTOZOANS & BACTERIO PLANKTON</u>				
<u>Heterotrophic flagellate</u> (small)	-	170	-	-
<u>Planctomyces</u> bekefii	481.67	-	-	-
TOTAL	3,725.06	5,627.0	1,349	-

NOTE: Estimates of units counted are made from sub-samples as number/CC from two sample collections and recorded as mean values.

EXHIBIT 8-17

 PHYTOPLANKTON
 P&M/SRC- II SITE
 MONONGAHELA RIVER
 STATION M-2

<u>TAXA</u>	<u>Aug. 1978</u>	<u>Nov. 1978</u>	<u>Jan. 1979</u>	<u>Apr. 1979</u>
BACILLARIOPHYTA				
<u>Cyclotella meneghiniana</u>	-	510	-	-
<u>Cyclotella stelligera</u>	-	350	-	-
<u>Cyclotella sp.</u>	77.39	-	-	-
<u>Melosira granulata</u>	14.07	-	-	-
<u>Navicula exigua</u>	-	-	44	-
<u>Navicula sp.</u>	14.07	-	-	-
<u>Nitzschia palea</u>	42.21	-	-	-
<u>Nitzschia sp.</u>	91.46	-	-	-
<u>Rhizosolenia erliensis</u>	605.04	-	-	-
<u>Synedra radians</u>	-	80	-	-
CHLOROPHYTA				
<u>Ankistrodesmus convolutus</u>	147.75	-	-	-
<u>Ankistrodesmus falcatus</u>	84.42	488	-	-
<u>Chlamydomonas sp.</u>	-	257	-	-
<u>Chlorella sp.</u>	133.67	925	-	-
<u>Closterium sp.</u>	21.11	-	-	-
<u>Coccomyxa sp.</u>	-	2,150	-	-
<u>Crucigenia quadrata</u>	21.11	40	-	-
<u>Dyctyosphaerium sp.</u>	14.07	-	-	-
<u>Kirchneriella sp.</u>	140.71	-	-	-
<u>Oocystis sp.</u>	7.04	-	-	-
<u>Scenedesmus acuminatus</u>	14.07	-	-	-
<u>Scenedesmus bicaudatus</u>	35.18	-	-	-
<u>Scenedesmus ecornis</u>	281.42	40	-	-
<u>Scenedesmus quadricauda</u>	70.35	175	-	-
<u>Scenedesmus spinosus</u>	14.07	-	-	-
<u>Scenedesmus wisconsinensis</u>	-	40	-	-
<u>Schroederia setigera</u>	7.04	-	-	-
<u>Treubaria triappendiculata</u>	-	14.07	-	-

EXHIBIT 8-17 (Continued)

 PHYTOPLANKTON
 P&M/SRC-II SITE
 MONONGAHELA RIVER
 STATION M-2

<u>TAXA</u>	<u>Aug. 1978</u>	<u>Nov. 1978</u>	<u>Jan. 1979</u>	<u>Apr. 1979</u>
CHRYSTOPHYTA				
<u>Chromulina</u> sp.	-	215	-	-
<u>Chrysococcus</u> sp.	63.32	-	-	-
<u>Dinobryon</u> sp.	21.11	-	-	-
CRYPTOPHYTA				
<u>Cryptomonas caudata</u>	443.23	800	-	-
<u>Cryptomonas marssonii</u>	274.38	170	-	-
CYANOPHYTA				
<u>Chroococcus</u> sp.	91.46	-	-	-
<u>Lyngbya limnetica</u>	-	6	-	-
<u>Oscillatoria limnetica</u>	7.04	-	-	-
<u>Oscillatoria</u> sp.	7.04	-	207	-
<u>Rhabdoderma</u> sp.	-	210	-	-
EUGLENOPHYTA				
<u>Mallomonas</u> sp.	7.04	-	-	-
<u>Phytoflagellate</u> (small)	-	1,675	-	-
<u>Trachelomonas volvocina</u>	-	435	-	-
<u>Trachelomonas</u> sp.	246.24	-	-	-
PROTOZOANS & BACTERIO PLANKTON				
<u>Ciliate</u> (large)	-	20	-	-
<u>Heterotrophic flagellate</u> (small)	-	1,085	-	-
<u>Planctomyces bekefii</u>	506.55	-	-	-
PYROPHYTA				
<u>Peridinium</u> sp.	14.07	-	-	-
TOTAL	3,531.80	9,671	251	

NOTE: Estimates of units counted are made from sub-samples as number/CC from two sample collections and recorded as mean values.

EXHIBIT 8-18

 PHYTOPLANKTON
 P&M/SRC-II SITE
 MONONGAHELA RIVER
 STATION M-3

<u>TAXA</u>	<u>Aug. 1978</u>	<u>Nov.1978</u>	<u>Jan. 1979</u>	<u>Apr. 1979</u>

BACILLARIOPHYTA

<u>Cyclotella meneghiniana</u>	-	950	-
<u>Cyclotella stelligera</u>	-	675	-
<u>Cyclotella sp.</u>	35.18	-	-
<u>Melosira granulata</u>	7.04	-	-
<u>Navicula sp.</u>	7.04	-	-
<u>Nitzschia acicularis</u>	21.11	-	-
<u>Nitzschia palea</u>	21.11	-	-
<u>Nitzschia sp.</u>	84.42	-	-
<u>Rhizosolenia erliensis</u>	168.85	-	-
<u>Synedra radians</u>	-	175	-

CHLOROPHYTA

<u>Actinastrum hantzschii</u>	7.04	-	-
<u>Ankistrodesmus convolutus</u>	84.42	-	-
<u>Ankistrodesmus falcatus</u>	42.21	1,550	-
<u>Chlamydomonas sp.</u>	7.04	525	-
<u>Chlorella sp.</u>	112.57	4,100	-
<u>Coccomyxa sp.</u>	-	4,700	-
<u>Crucigenia fenestrata</u>	14.07	-	-
<u>Crucigenia quadrata</u>	35.18	170	-
<u>Dyctyosphaerium sp.</u>	21.11	-	-
<u>Kirchneriella lunaris</u>	-	85	-
<u>Kirchneriella obesa</u>	7.04	-	-
<u>Kirchneriella sp.</u>	126.64	-	-
<u>Oocystis sp.</u>	14.07	-	-
<u>Scenedesmus acuminatusi</u>	14.07	-	-
<u>Scenedesmus bicaudatus</u>	14.07	-	-
<u>Scenedesmus ecornis</u>	232.17	175	-
<u>Scenedesmus quadricauda</u>	28.14	335	-
<u>Tetraedron minimum</u>	7.04	-	-
<u>Treubaria triappendiculata</u>	21.11	85	-

EXHIBIT 8-18 (Continued)

 PHYTOPLANKTON
 P&M/SRC-II SITE
 MONONGAHELA RIVER
 STATION M-3

<u>TAXA</u>	<u>Aug. 1978</u>	<u>Nov. 1978</u>	<u>Jan. 1979</u>	<u>Apr. 1979</u>
CHRYSTOPHYTA				
<u>Chromulina</u> sp.	-	950	-	-
<u>Chrysococcus</u> sp.	42.21	-	-	-
CRYPTOPHYTA				
<u>Cryptomonas</u> <u>caudata</u>	260.31	1,950	-	-
<u>Cryptomonas</u> <u>marssonii</u>	105.53	40	-	-
CYANOPHYTA				
<u>Anabaena</u> sp.	-	-	44	-
<u>Aphanocapsa</u> <u>elachista</u>	-	-	44	-
<u>Aphanothece</u> <u>nidulans</u>	-	-	44	-
<u>Chroococcus</u> <u>dispersus</u>	-	-	44	-
<u>Chroococcus</u> sp.	63.32	-	-	-
<u>Lyngbya</u> <u>limnetica</u>	-	14	-	-
<u>Oscillatoria</u> sp.	14.07	-	477	-
<u>Rhabdoderma</u> sp.	-	250	-	-
<u>Synechocystis</u> sp.	-	-	87	-
EUGLENOPHYTA				
Phytoflagellate (large)	-	260	-	-
Phytoflagellate (small)	-	2,000	-	-
<u>Trachelomonas</u> <u>volvocina</u>	-	775	-	-
<u>Trachelomonas</u> sp.	337.70	-	-	-
PROTOZOANS & BACTERIO PLANKTON				
Heterotrophic flagellate (large)	-	85	-	-
Heterotrophic flagellate (small)	-	2,250	-	-
<u>Planctomyces</u> <u>bekefii</u>	443.23	-	-	-
TOTAL	2,399.11	22,099	740	-

NOTE: Estimates of units counted are made from sub-samples as number/CC from two sample collections and recorded as mean values.

EXHIBIT 8-19

ZOOPLANKTON ORGANISMS/M³
P&M/SRC II SITE
MONONGAHELA RIVER STATION M-1

TAXA	Aug. 1978		Nov. 1978		Jan. 1979	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
ROTIFERA						
<u>Ascomorpha</u> sp.	79	4	42	19	4	3
<u>Asplanchna</u> sp.	11	6	184	198	7	18
<u>Brachionus</u> sp.	25	8	-	19	3	7
<u>Cephalodella</u> sp.	48	14	-	94	-	1
<u>Cupelopagis</u> sp.	6	-	-	-	-	-
<u>Filinia</u> sp.	11	4	-	-	-	-
<u>Gastropus</u> sp.	3	-	-	-	-	-
<u>Kellicottia</u> sp.	20	6	-	-	1	6
<u>Keratella cochlearis</u>	458	143	410	1,884	30	35
<u>Keratella quadrata</u>	45	11	-	19	1	-
<u>Lecane</u> sp.	8	8	-	-	10	4
<u>Lepadella</u> sp.	3	-	-	-	-	-
<u>Notholca</u> sp.	-	-	-	-	-	1
<u>Polyarthra</u> sp.	53	40	42	85	4	7
<u>Synchaeta</u> sp.	8	17	-	9	7	8
<u>Tetrasiphon</u> sp.	-	-	-	-	3	8
<u>Trichotria</u> sp.	31	-	-	-	-	-
CLADOCERA						
<u>Alona affinis</u>	-	-	-	-	-	3
<u>Bosmina longirostris</u>	88	17	127	38	6	4
<u>Ceriodaphnia</u> sp.	-	4	-	-	-	-
<u>Chydorus sphaericus</u>	3	-	-	19	1	1
<u>Daphnia parvula</u>	6	3	14	9	1	1
<u>Pleuroxus</u> sp.	-	-	-	-	1	1
<u>Sida</u> sp.	-	-	-	-	-	1

EXHIBIT 8-19 (Continued)

ZOOPLANKTON ORGANISMS/M³
P&M/SRC II SITE
MONONGAHELA RIVER STATION M-1

TAXA	Aug. 1978		Nov. 1978		Jan. 1979	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
COPEPODA						
<u>Nauplii</u>	520	71	1,342	970	27	58
<u>Cyclopoid copepodids</u>	107	39	1,596	405	11	18
<u>Diaptomid copepodids</u>	31	1	-	-	-	-
<u>Cyclops vernalis</u>	8	3	127	75	10	7
 <u>Diaptomus pallidus</u>	 11	 10	 -	 -	 -	 1
<u>Macrocyclus albidus</u>	-	-	-	-	-	1
<u>Mesocyclops edax</u>	11	1	14	9	4	-
<u>Harpactacoids</u>	3	-	-	-	-	3
OTHER:						
<u>Diptera</u>						
<u>Chaoberus sp.</u>	-	6	-	-	-	-
TOTAL	<u>1,490</u>	<u>416</u>	<u>3,898</u>	<u>3,852</u>	<u>131</u>	<u>197</u>
Mean of Replicates	953		3,875		164	

NOTE: E = East side of river
W = West side of river

EXHIBIT 8-20

ZOOPLANKTON ORGANISMS/M³
P&M/SRC-II SITE
MONONGAHELA RIVER STATION M-2

TAXA	Aug. 1978		Nov. 1978		Jan. 1979	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
ROTIFERA						
<u>Ascomorpha</u> sp.	6	7	-	42	1	4
<u>Asplanchna</u> sp.	16	-	212	466	1	8
<u>Brachionus</u> sp.	6	4	-	14	3	1
<u>Cephalodella</u> sp.	11	4	42	127	-	10
<u>Conochilus</u> sp.	-	-	-	-	1	-
<u>Filinia</u> sp.	48	13	-	-	-	-
<u>Gastropus</u> sp.	6	1	28	-	1	1
<u>Kellicottia</u> sp.	13	4	-	-	-	3
<u>Keratella cochlearis</u>	307	97	1,427	1,483	-	25
<u>Keratella quadrata</u>	24	14	-	28	1	1
<u>Lecane</u> sp.	13	6	-	-	1	7
<u>Lepadella</u> sp.	-	-	-	-	-	1
<u>Polyarthra</u> sp.	86	38	127	85	-	7
<u>Synchaeta</u> sp.	7	10	-	85	3	6
<u>Tetrasiphon</u> sp.	-	-	-	-	1	6
<u>Trichotria</u> sp.	1	1	-	-	-	1
<u>Trichocerca</u> sp.	3	-	-	-	-	-
CLADOCERA						
<u>Alona affinis</u>	-	-	-	-	-	1
<u>Bosmina longirostris</u>	35	28	170	198	3	16
<u>Ceriodaphnia</u> sp.	4	6	-	-	-	-
<u>Chydorus sphaericus</u>	-	-	14	28	4	6
<u>Daphnia parvula</u>	4	3	-	-	-	1
<u>Pleuroxus</u> sp.	-	-	-	-	-	1
<u>Nauplii</u>	3	-	-	155	-	-

EXHIBIT 8-20 (Continued)

ZOOPLANKTON ORGANISMS/M³
P&M/SRC-II SITE
MONONGAHELA RIVER STATION M-2

<u>TAXA</u>	Aug. 1978		Nov. 1978		Jan. 1979	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
COPEPODA						
<u>Nauplii</u>	189	61	4,733	6,428	9	71
<u>Cyclopoid copepodids</u>	7	48	947	1,173	1	4
<u>Diaptomid copepodids</u>	58	1	28	-	-	-
<u>Cyclops vernalis</u>	8	6	509	141	-	1
 <u>Diaptomus pallidus</u>	 14	 8	 14	 -	 -	 3
<u>Eucyclops agilis</u>	-	-	-	-	-	4
<u>Mesocyclops edax</u>	3	4	-	-	-	-
<u>Harpacticoids</u>	3	-	99	-	-	-
OTHER:						
 <u>Diptera</u>						
<u>Chaoberus sp.</u>	-	1	-	-	-	3
 <u>Ostracods</u>	 -	 -	 14	 -	 -	 -
 TOTAL	 875	 365	 8,364	 10,453	 30	 192
Mean of Replicates		620	9,409		111	

NOTE: E = East side of river
W = West side of river

EXHIBIT 8-21

ZOOPLANKTON ORGANISMS/M³
P&M/SRC-II SITE
MONONGAHELA RIVER STATION M-3

TAXA	Aug. 1978		Nov. 1978		Jan. 1979	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
ROTIFERA						
<u>Ascomorpha</u> sp.	17	3	-	311	6	7
<u>Asplanchna</u> sp.	51	24	283	198	6	4
<u>Brachionus</u> sp.	40	10	-	141	-	3
<u>Cephalodella</u> sp.	48	6	-	88	1	-
<u>Conochilus</u> sp.	-	-	-	-	6	3
<u>Cupelopagis</u> sp.	23	-	-	-	-	-
<u>Euchlanis</u> sp.	6	-	-	-	-	-
<u>Filinia</u> sp.	73	42	9	-	-	-
<u>Gastropus</u> sp.	3	-	-	-	-	-
<u>Kellicottia</u> sp.	31	4	-	-	6	1
<u>Keratella cochlearis</u>	593	147	7,384	27,011	28	42
<u>Keratella quadrata</u>	42	4	38	-	-	3
<u>Lecane</u> sp.	17	-	-	-	-	1
<u>Monostyla</u> sp.	-	1	-	-	-	-
<u>Notholca</u> sp.	-	-	-	57	-	1
<u>Polyarthra</u> sp.	226	34	57	452	1	6
<u>Synchaeta</u> sp.	99	-	-	-	6	8
<u>Tetrasiphon</u> sp.	-	-	-	-	3	4
<u>Trichotria</u> sp.	3	10	-	-	-	-
CLADOCERA						
<u>Alona affinis</u>	-	-	-	28	-	1
<u>Bosmina longirostris</u>	73	21	311	198	11	6
<u>Ceriodaphnia</u> sp.	8	3	-	-	-	-
<u>Chydorus sphaericus</u>	-	-	-	85	1	-
<u>Daphnia catawba</u>	-	1	-	-	-	-
<u>Daphnia parvula</u>	8	-	-	-	-	-
<u>Nauplii</u>	6	1	-	-	-	-

EXHIBIT 8-21 (Continued)

ZOOPLANKTON ORGANISMS/M³
P&M/SRC-II SITE
MONONGAHELA RIVER STATION M-3

TAXA	Aug. 1978		Nov. 1978		Jan. 1979	
	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>	<u>E</u>	<u>W</u>
COPEPODA						
<u>Nauplii</u>	444	160	5,199	10,426	32	49
<u>Cyclopoid copepodids</u>	102	57	1,074	1,130	3	4
<u>Diaptomid copepodids</u>	28	7	19	-	-	-
<u>Cyclops vernalis</u>	40	10	245	396	8	1
<u>Diaptomus pallidus</u>	11	13	-	-	-	1
<u>Eucyclops agilis</u>	-	-	-	-	-	1
<u>Mesocyclops edax</u>	28	6	-	-	-	-
<u>Harpacticoids</u>	-	3	-	-	-	-
Other:						
<u>Diptera</u>						
<u>Chaoborus</u> sp.	6	-	9	-	-	-
Ostracods	<u>-</u>	<u>-</u>	<u>19</u>	<u>-</u>	<u>-</u>	<u>-</u>
TOTAL	2,026	567	14,647	40,521	118	146
Mean of Replicates	1,297		27,584		132	

NOTE: E = East side of river
W = West side of river

SECTION 9

PLANT ECOLOGY

9.1 PURPOSE

The objectives of plant ecology studies were to map and characterize the existing vegetation communities, to inventory the vascular plant species, and to determine potential impacts on plant communities from construction and operation of the proposed facility. The study area for vegetation encompasses the 950 ha (2350 a) within the property boundaries of the proposed site for the SRC-II demonstration plant near Morgantown, West Virginia.

Originally, the vegetation was deciduous broadleaf forest. Over a period of time, these forests were affected by agricultural, lumbering, and mining activities which resulted in the gradual transition to the existing mixture of plant communities. Presently about 25 percent of the study area is forested.

While West Virginia plant communities have been researched (Core 1966), no previous site-specific studies have been found. The ecological processes observed on the plant site are common to the eastern deciduous forest, thereby making literature from other states (Curtis 1959) useful. Strausbaugh and Core (1970, 1971, 1974, 1977) provide the most comprehensive treatment of the flora of the area. Information has also been obtained from a Monongalia County plant checklist (Davis et al 1950).

9.2 METHODS

9.2.1 Species Inventory

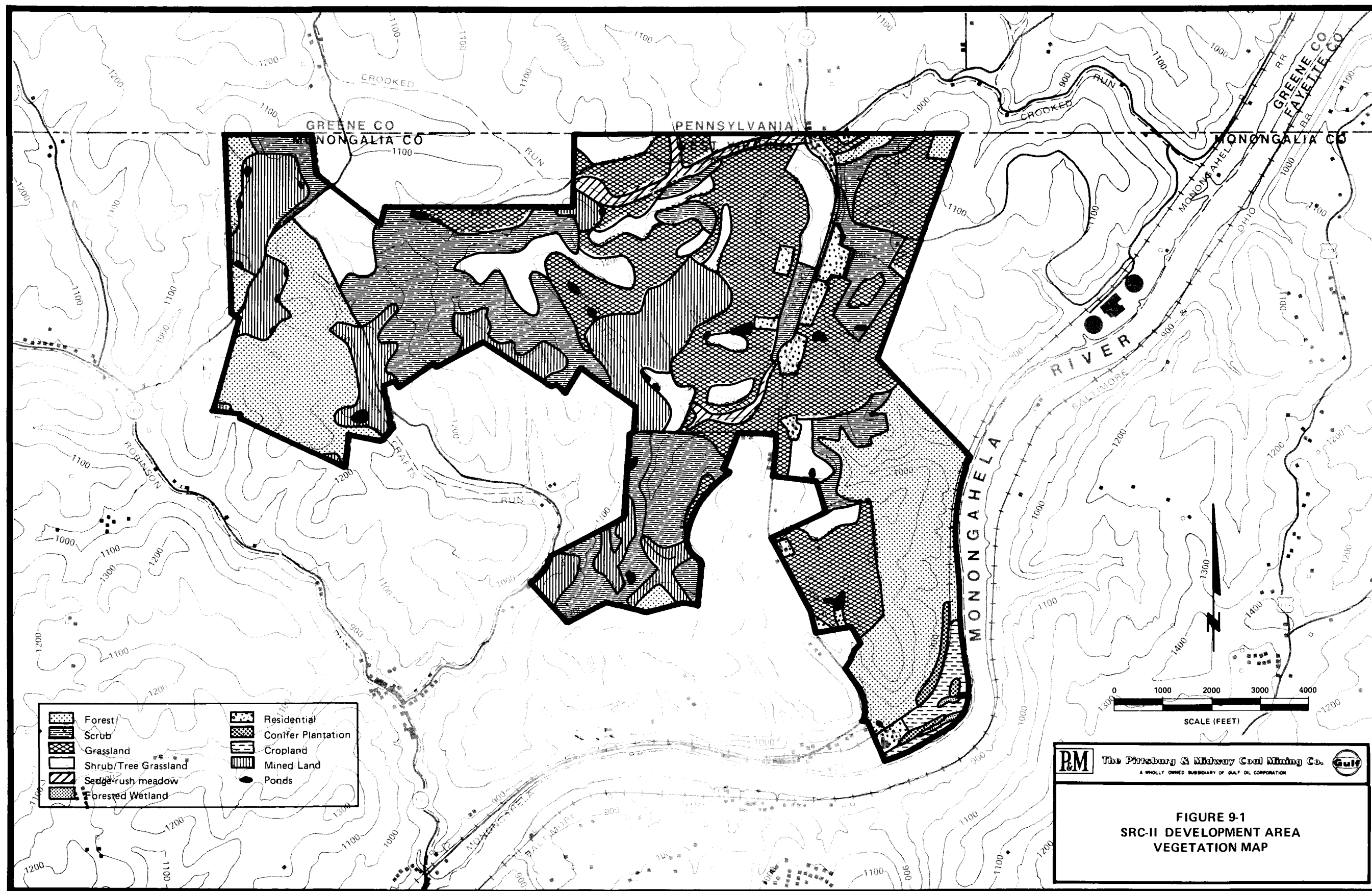
Plant specimens were collected in all phases of vegetation studies. In each season, flowering species were collected in all vegetation communities except residential. Specimens of each plant species collected were pressed, identified, and preserved. Plants were collected in August and October 1978, and in April, May, and June 1979 in a total of 30 field days.

The main taxonomic keys utilized were by Strausbaugh and Core (1970) with support information by Fernald (1970) and Hitchcock (1971). Special attention was paid to the potential occurrence of West Virginia special status plant species (Fortney et al 1978). Nomenclature primarily follows Strausbaugh and Core (1970, 1971, 1974, 1977).

9.2.2 Mapping Of Communities

The vegetation map (Figure 9-1) was developed using a combination of air photo interpretation and ground checking. Stereo pairs of black and white aerial photographs were used to delineate basic communities and land uses, and subsequent field work was used to confirm the identification of some units. Several units were based on land-use categories such as residential, mined land, cropland, and conifer plantation. Forest was defined as stands with a closed canopy of trees more than 5 meters (16.4 ft.) tall. Scrub consisted of stands with smaller trees or shrubs with at least a 30 percent woody cover.

Grasslands were mapped as two units, those with virtually no woody species and those with up to 30 percent shrub or tree cover. Herbaceous wetlands were identified by the presence of rushes and sedge tussocks. Wooded wetlands were determined by the presence of standing water in February and April 1979, and by species composition.

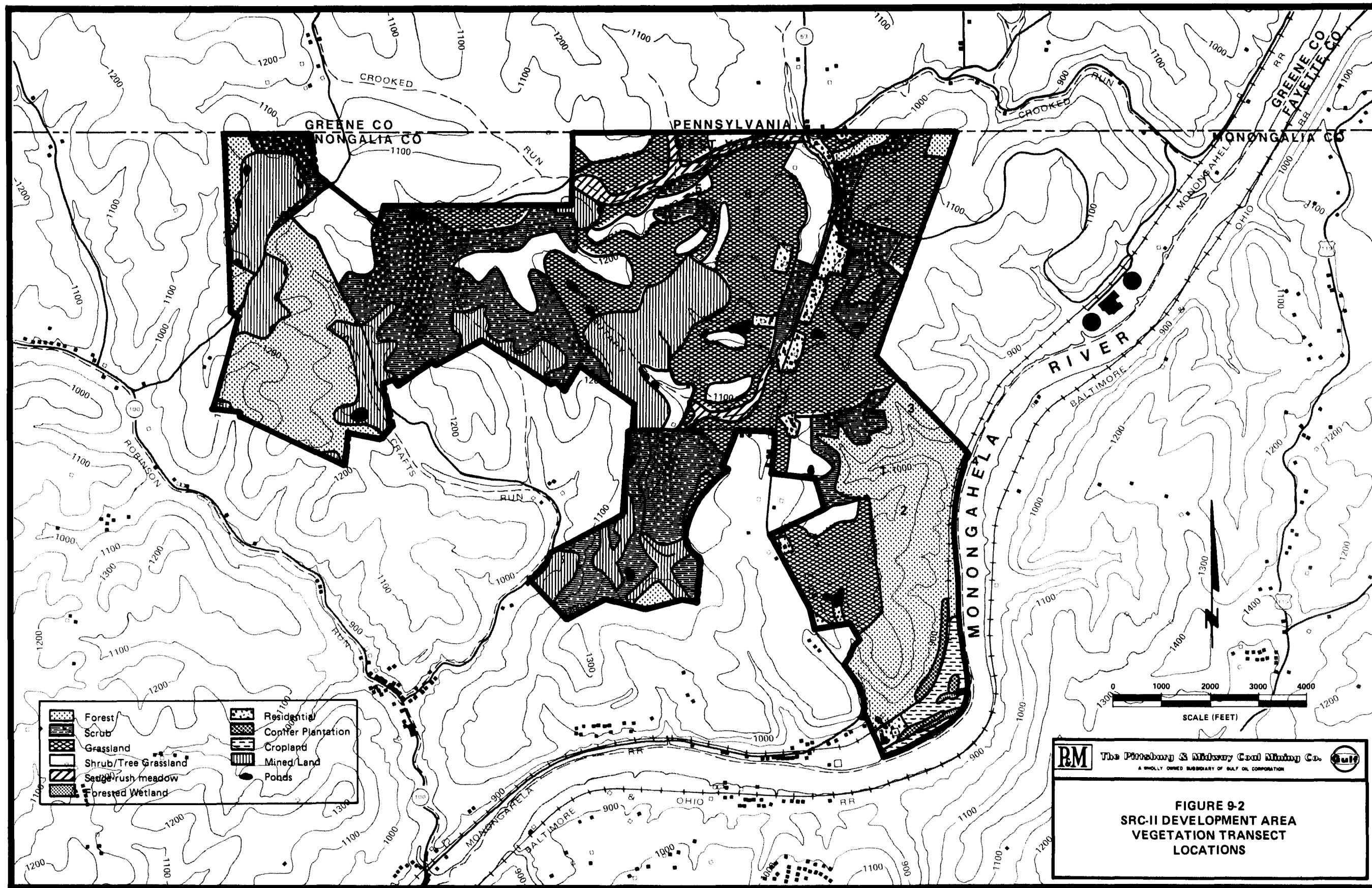


9.2.3 Characterization Of Plant Communities

The composition and structure of plant communities were investigated by observation and quantitative sampling. All mapped units of each community were visited. Observations encompassed dominant and significant species, evidence of disturbance or successional growth, and general topographical and environmental factors.

Quantitative vegetation sampling was conducted in seven stands, representing the three largest communities occurring on the site. Four transects were located in hardwood forest, two in grassland, and one in scrub. Transects, shown in Figure 9-2, were located at sites that appeared homogeneous in terms of vegetation composition and topography.

Each transect was 100 meters (328.1 ft.) in length and was sampled in various quadrats, stratified for trees, shrubs/saplings, and ground layer. Plants greater than 2.5 centimeters (1.0 in.) in diameter at breast height (dbh), or more than 3 meters (9.8 ft.) high, were sampled in ten 10 x 10 meter (32.8 x 32.8 ft.) quadrats. Woody plants between 1 meter (3.3 ft.) and 3 meters (9.8 ft.) in height, and less than 2.5 centimeters (1.0 in.) dbh, were sampled in ten 4 x 4 meters (13.1 x 13.1 ft) quadrats at each site. Herbaceous species and woody plants less than 1 meter (3.3 ft.) in height were sampled in ten 1 x 1 meter quadrats, with the smaller quadrats nested within the larger. Plants sampled in the 100 m² (1076.5 ft²) quadrats were sampled for dbh, density, and frequency. The basal area was calculated from dbh and importance values were determined as an average of relative density, frequency, and dominance. In the 16 m² (172.2 ft²) quadrats, plant density and frequency were determined, and importance values were calculated from relative density and relative frequency. Plants in the 1 m² (10.8 ft²) quadrats were measured for density, frequency, and cover. Seven cover classes were



used: 95-100 percent, 75-95 percent, 50-75 percent, 25-50 percent, 5-25 percent, 1-5 percent and less than 1 percent. The 100 m² (1076.5 ft²) and 16 m² (172.2 ft²) quadrats were sampled in August 1978, and the 1 m² (10.8 ft²) quadrats were sampled seasonally, in October 1978, and April and June 1979.

9.3 RESULTS AND DISCUSSION

9.3.1 Species Inventory

A total of 279 species, representing 79 plant families, have been identified from specimens collected on the site in fall 1978, and April 1979. These species are listed in Exhibit 9-1. This list includes 10 ferns, three gymnosperms, 58 monocots, and 208 dicots. The largest families identified were Compositae, with 43 species, and Gramineae, with 37 species. Forty-one families were represented by only a single species each. One-thousand-fifty vascular plant species are known to occur in Monongalia County (Davis et al 1950). The present list represents about 25 percent of that number, and about 13 percent of the 2126 species listed for West Virginia (Strausbaugh and Core 1970).

One species was found which was not previously known in West Virginia. The species was Panicum verrucosum, a panic grass, which was commonly known in other areas, and was not a special-status species. The identification of this species has been verified by the West Virginia University herbarium.

None of the West Virginia special status plant species listed (Fortney et al 1978) have been observed.

9.3.2 Vegetation Communities

A generalized vegetation map of the plantsite, divided into broadly defined mapping units, can be found on Figure 9-1. On that map, grassland includes hay meadow, grazed pasture, and old field. Forest includes dry oak-hickory forests, and mixed mesophytic and floodplain forests. Scrub is a general term representing all successional stages between a primarily herbaceous community and a closed-canopy forest. In addition to the mapped communities, several minor communities were also present and will be discussed briefly.

The results of quantitative sampling are provided in Exhibits 9-2, 9-3, and 9-4, and are discussed under each appropriate community description.

9.3.2.1 Forest

Mixed hardwood forests were identified over 24 percent of the study area. Forest vegetation occurred in two major blocks, the largest in the southeast corner of the plantsite near the Monongahela River, and the other in the west side of the study area. The eastern block consisted of short valleys and moderate to steep slopes, on hillsides above the Monongahela River. The western block was also hilly and was located near coal mine operations and old coal spoils.

Four forested sites in the eastern forest area were selected for quantitative study. Because the forest includes considerable compositional variability, sites were selected which would describe some of this variation. Transect 1 was on a north-facing slope, transect 2 was on an east-facing slope, transect 3 was high on a southeast-facing slope, and transect 4 was on a level bench near the Monongahela River.

Sampling of the tree strata produced an average of 14-15 species per transect, and 5-6 species per 100 m² (1076.5 ft²) quadrat. Shrub/sapling samples primarily included the same species, adding only 2-3 species to the total for each transect.

In transect 1, sugar maple (Acer saccharum) had the highest importance value, followed by white ash (Fraxinus americana), red oak (Quercus rubra), and slippery elm (Ulmus rubra). The most important understory species were witch-hazel (Hamamelis virginiana), black haw (Viburnum prunifolium), sapling-size sugar maple, and white ash. Several large, red oak trees formed a large percentage of the total basal area, but showed little evidence of reproduction.

The most important species recorded in transect 2 were slippery elm (Ulmus rubra), hackberry (Celtis occidentalis), and butternut (Juglans cinerea). Collectively, oaks and hickories were also significant. The most abundant understory species were spicebush (Lindera benzoin), blackhaw, sapling-size slippery elm, and white ash. Mockernut hickory (Carya tomentosa), butternut, white oak, and red oak were found solely as large individuals. Hackberry, white ash, slippery elm, pignut hickory (Carya glabra), and bitternut hickory (Carya cordiformis) appeared to be reproducing satisfactorily. The understory stratum was well-developed on this site. The presence of hackberry and redbud (Cercis canadensis) may indicate a limestone-derived soil.

In transect 3, white oak (Quercus alba), black oak (Quercus velutina), and black cherry (Prunus serotina) were the most important overstory species. The most common understory species were flowering dogwood (Cornus florida), hawthorn (Crataegus sp.), spicebush, young white ash, and black cherry. White oaks 40 centimeters (15.8 in.) dbh and larger were prevalent, covering 60 percent of the basal area. While oak reproduction was limited, black cherry seedlings and saplings were abundant.

Black cherry, box elder (Acer negundo), slippery elm, tree-of-heaven (Ailanthus altissima), and tulip tree (Liriodendron tulipifera) were the most important tree species in transect 4. The understory was dominated by these species, as well as by spicebush and black elderberry (Sambucus canadensis). Tree-of-heaven is a naturalized exotic. Box-elder is a bottomland species, but the other species are not necessarily characteristic of floodplains. This site showed evidence of more recent disturbance than did the other transects, likely as a result of its close proximity to the railroad tracks.

The herbaceous layer of the forest was sampled in 1 m² (10.8 ft²) quadrats in fall 1978 and early spring 1979. In addition to forbs, grasses, and ferns, woody seedlings and small shrubs were also counted. In the fall, woody species accounted for the majority of relative cover, while in the spring the total and relative herbaceous cover was higher and most woody plants were still leafless. Total plant cover ranged from 10-38 percent in the fall, and from 22-71 percent in the spring. Litter cover was high with less than 10 percent of the area consisting of bare ground.

In transect 1, total plant cover was 19 percent in the fall and 26 percent in the spring. The only species with more than one percent cover in the fall was maple leaf viburnum (Viburnum acerifolium). In the spring, great chickweed (Stellaria pubera), cutleaf toothwort (Dentaria laciniata), and sweet cicely (Osmorhiza spp.) were abundant.

Forbs and grasses were more apparent than woody plants in the ground layer of transect 2, which had the highest total cover of the four forest transects. The most abundant species in the fall were Short's aster (Aster shortii), white avens (Geum canadense), ground-ivy (Glechoma hederacea), Virginia knotweed (Tovara virginiana), Yellow ironweed (Verbesina alternifolia), bluegrass (Poa sp.), and slender wedgrass (Sphenopholis intermedia). In the spring, the most common species were jewelweed (Impatiens spp.), wild onion (Allium sp.), sweet cicely, cutleaf toothwort, violets, and ground ivy.

The ground was covered with a fairly thick layer of oak leaves in transect 3, while grasses and forbs were scarce. Most of the 20 percent cover measured in the fall was produced by young flowering dogwood, black cherry, and sassafras. The only important forbs observed in the spring were may-apple (Podophyllum peltatum) and cutleaf toothwort.

In the fall sample of transect 4, the ground layer was dominated by woody plants, especially poison ivy (Rhus radicans). Bluegrass and ground-ivy were also common. Herbaceous plants were abundant in the spring, especially cutleaf toothwort, wild onion, bedstraw (Galium spp.), yellow corydalis (Corydalis flavula), Carolina spring beauty, and bluegrass.

The transects exhibited considerable heterogeneity. Indices of similarity for the transects were calculated from the formula $I = \frac{2c}{a + b} \times 100$ wherein "a" equals the number of species in the first sample, "b" equals the number of species in the second sample, and "c" equals the number of species in common. The highest similarity determined for tree strata was 43 percent. When additional species recorded in the 16 m² (172.2 ft²) quadrats were included, the highest coefficient of similarity was only 55 percent. The most dissimilar stand was transect 4, which had only 30-40 percent of its species akin to those in other transects. This is likely due to its bottomland position and level of disturbance.

Compositional heterogeneity was found throughout the forested parts of the plantsite. While one or a group of species may have achieved local dominance, no well-defined communities were obvious. In addition to the species found in the transects, other important tree species included Chinquapin oak (Quercus muehlenbergii), Sycamore (Platanus occidentalis), Honeylocust (Gleditsia tricanthos), and Yellow Buckeye (Aesculus octandra).

It was found (Peet and Loucks 1977) that most of the compositional variability in southern Wisconsin hardwood forests could be explained by variations in soil moisture and nutrients, and by succession. Variation along both of these gradients was evident in the forests of the plantsite.

West Virginia central hardwood forests were divided (Core 1966) into three types (xeric, mesic, and hydric), based primarily on soil moisture, and indirectly on topographic position. Dry ridges and south exposures could predictably be occupied by xeric oak-hickory forest, while north slopes and sheltered valleys were likely to contain mixed mesophytic forest. Floodplains were dominated by soft maples, sycamore, and similar species. A transect run through the Core Arboretum near Morgantown (Matheny 1952), also revealed these three basic forest communities. While typical stands of each were distinct, the forest types graded into each other imperceptibly, making boundary delineations impossible.

Xeric forest communities have not been observed on the site, although much of the upper slope areas tended toward oak-hickory dominance. Transect 3 was dominated by white oak and may be a typical xeric forest on the site, but white oak can be considered typical of mesic sites (Core 1966). Due to leaf litter chemistry, moisture, and light conditions, oak-hickory forests have comparatively less herbaceous cover, more summer-flowering, and fewer spring-flowering species than do mesic forests (Braun 1972). Shrubs may be considered relatively common.

The best example of a hydric forest on the plantsite is discussed in the wetlands section of this report. Most of the forests on the Monongahela floodplain were transitional from mesic to hydric. Transect 4 was within this transitional type. Bottomland species such as box elder (Acer negundo) were common, as were other woody species.

Most of the forest area can be considered mixed mesophytic. A large number of overstory tree species were noted, and the local composition showed considerable variation. Smaller trees and shrubs were often abundant, as in transect 2. Many herbaceous plants flower in early spring prior to trees leafing. These include many well known species such as large-flowered trillium (Trillium grandiflorum),

Dutchman's breeches (Dicentra cucullaria), Carolina spring beauty (Claytonia caroliniana), and wild blue phlox (Phlox divaricata). Considerably fewer species flower in summer and fall.

Another major cause of variation in forest composition is succession, both large-scale from old fields, and small-scale from light gaps caused by dying overstory trees and other local disturbances. Succession from old fields was evident along the forest perimeter. Black cherry was commonly dominant on the upland sites, and box elder dominated the Monongahela floodplain. Most of the western forest block was distinctly early successional in character, dominated by species such as black cherry, black locust, tulip tree, and red maple. According to the gap-phase theory of forest succession, supported by Olive and Stephens (1977), mature hardwood forests are a mosaic of small stands, each originating from a separate disturbance. Clearings dominated by blackberry, tall forbs, and saplings represent an early stage in this succession. Studies have been performed to assign successional status to various overstory trees (Zedler and Goff 1973) but no information is available for West Virginia. The successional sequence will be different in xeric, mesic, and hydric sites.

Lumbering represents another form of disturbance. Most of the forest on the site was logged in the past, but, lumbering has not occurred in the eastern block for many years, as evidenced by the lack of tree stumps. Old overgrown roads, however, are present in the woods. Portions of the western block have been logged recently, leaving a relatively open canopy.

A third source of forest variation is substrate. The slopes above the Monongahela intersected with numerous rock strata, producing soils of various chemistry and nutrient status. The localized occurrence of hackberry and redbud, as in transect 2, was one result.

A portion of the trees observed on the site were of marketable size and quality, but no assessment of the commercial values of the stands has been made. The U. S. Forest Service (USDA 1978) regards stands with more than 23 m²/ha (100 ft²/acre) basal area as overstocked and, therefore, not achieving maximum growth. By this criterion, all of the sampled stands were overstocked, but no conclusions can be made for the entire forest since sampled areas were very small. Commercial forest types which occur include white oak, red oak, hickory, and mixed hardwoods.

9.3.2.2 Scrub

Scrub communities, dominated by shrubs and small trees, occupied 16.5 percent of the plantsite. This category included all stages of old field succession, from the time woody plants became dominant until a closed-canopy forest developed. The appearance and species composition of stands can be highly variable, or virtually monotypic. The most characteristic woody species were blackberry, hawthorn, black cherry, crabapple (Pyrus spp.), and osage-orange (Maclura pomifera). Black locust was common in some areas, likely due to strip-mine reclamation. Occasionally, mature trees were interspersed with scrub in some locations. Woody scrub varied in cover, from virtually impenetrable thickets to open communities.

Research by Core (1966) discusses old field succession in West Virginia, and describes stages similar to those observed on the plantsite. Tree composition depended on availability of seed trees.

Transect 7 was located in scrub. The shrub and tree strata have not yet been sampled, but it primarily consisted of black cherry, with the occasional presence of hawthorn, crabapple, and blackberry. The stand was fairly open with little underbrush. Most black cherry trees were 4-5 meters (13.1-16.4 ft.) tall. The total cover of the ground layer was less than 50 percent in the fall. The most common species were Kentucky bluegrass, ground-ivy, strawberry, and blackberry, but

there was considerable heterogeneity between quadrats. The total plant cover for spring 1979 was 75 percent. Common species included Kentucky bluegrass, strawberry, wild onion, and yarrow (Achillea millefolium).

9.3.2.3 Grassland and Shrub/Tree Grassland

Plant communities dominated by grasses and forbs occupied 41 percent of the study area. There was little difference between these two mapping units except for the presence of scattered shrubs and trees in shrub/tree grassland. Most of the grassland type was located in the northeast portion of the plantsite within one kilometer of the Ft. Martin Road.

Quantitative sampling was conducted in two grassland stands, transects 5 and 6 (Exhibit 9-4). Transect 5 was on a north-facing slope, on soils classified as strip-mine udorthents. It appeared this area was stripped approximately 15-20 years ago. Osage-orange trees larger than 10 centimeters (3.9 in.) in diameter occur nearby. Transect 6 was on a west-facing slope, on Westmoreland silt loam soil. Although both sites were grazed, it appears transect 6 receives heavier use.

In fall 1978, several species occurred with 100 percent frequencies in both transects. They included common ragweed (Ambrosia artemisiifolia), Queen Anne's lace (Daucus carota), narrow leaf plantain (Plantago lanceolata), clover (Trifolium sp.), and Kentucky bluegrass (Poa pratensis). Other common species included dandelion (Taraxacum officinale), New York ironweed (Vernonia noveboracensis), and orchard grass (Dactylis glomerata) in both transects, asters (Aster spp.), goldenrod (Solidago spp.), yarrow (Achillea millefolium), and broomsedge (Andropogon virginicus) in transect 5, and crabgrass (Digitaria spp.), chicory (Cichorium intybus), horse nettle (Solanum carolinense), and ground-ivy (Glechoma hederacea) in transect 6. Common ragweed, narrow leaf plantain, clover, and

Kentucky bluegrass comprised 61 percent of the relative cover in transect 5. Common ragweed, crabgrass, and Kentucky bluegrass comprised 69 percent of the relative cover in transect 6. Total plant cover was more than 90 percent and bare ground was less than five percent on each transect.

Excluding the fall composite, most of the same species were common in spring 1979. The most abundant species recorded on each transect in the April sample were Kentucky bluegrass, orchard grass, and clover.

While transects 5 and 6 had many similarities, important differences were evident. For example, forbs comprised more than 62 percent of the relative cover in transect 5 in fall 1978, but only 35 percent of the relative cover of transect 6. Differences between samples may be related to soil differences, slope-aspect, and grazing use. Both areas were grazed and show a characteristic late summer mosaic of tall and low herbage. The islands of tall herbage consisted of ragweed, aster, goldenrod, ironweed, and tall grasses; the low matrix was comprised of bluegrass, clover, and plantain. Grassland stands which were mowed rather than grazed did not exhibit this mosaic, and had a much higher proportion of grass cover. Core (1966) lists Kentucky bluegrass, orchard grass, timothy (Phleum pratense), redtop (Agrostis alba), and red clover as among the more desirable pasture species in West Virginia.

The grassland communities present on the site were all anthropogenic in origin. Such communities were maintained by grazing and/or mowing and, to some extent, by distance from seed sources of forest species. The common plant species were primarily non-native, naturalized from Europe, but a few were native weedy species.

In about one-fourth of the grassland area, woody species were present, making up a small but significant portion of the composition. The most common species included black cherry, blackberry (Rubus spp.), osage-orange, crabapple, hawthorn (Crataegus spp.), and multiflora rose (Rosa multiflora). If left alone, grassland areas would revert to scrub and ultimately to forest. This process was underway, to some extent, in the old fields and in the hedgerows and fence lines that divided many fields.

The area mapped as grassland consisted of upland mesic sites. Herbaceous communities on bottomland hydric sites are discussed under wetlands, although there were no sharp boundaries between these two communities.

9.3.2.4 Wetlands

The term wetland, in this context, refers to areas other than ponds or streams where the ground is seasonally or permanently saturated with water. As shown on Figure 9-1, about one percent of the plantsite was wetland. A sedge-rush meadow wetland follows Crooked Run in the northwest portion, and two very small forested wetland areas are shown in the southeast area along the river.

The most common plant species found in the sedge-rush meadow was Tussocks of common rush (Juncus effusus). Sedges (Carex spp.), spikerush (Eleocharis sp.), and other species were less common. On the drier margins, Kentucky bluegrass and other pasture grasses and forbs occurred between the rush tussocks. A small seasonal creek flowed through each wet meadow area, with an occasional willow shrub occurring near the creeks. A similar community has been described for Wisconsin (Curtis 1959). Such a community results from grazing and periodic soil saturation. Bottomland forest would be the natural vegetation of this site.

Another herbaceous wetland community occurred in units too small to be mapped. This was emergent marsh, dominated by broad-leaved

cattail (Typha latifolia), although many other species of emergents occurred as well. This community occurred in a ditch along the railroad tracks, in a depression atop an old strip mine located in the west side of the plantsite, and in areas similar to these. Throughout the study period, shallow standing water was observed in these areas.

Forested wetland occupied small depressions in the floodplain. In the southern unit, standing water was observed in February and April. The predominant species was silver maple, but sycamore and boxelder were also present. Nearby, black willow and other species grew on the seasonally flooded margin of a small pond. Excluding these areas, the Monongahela floodplain was sufficiently elevated to prevent the development of true depressional floodplain communities.

While the dominant species was willows, shrubs also occurred along the stream in Crooked Run and were associated with forested wetland on the Monongahela floodplain. Shrub cover was insufficiently developed to warrant mapping and full description of shrub wetland.

9.3.2.5 Residential

The plantsite contained both active and abandoned homesites. Areas mapped as residential included houses, barns, lawns, gardens, exotic and native trees, and shrubs. Active residential areas were not thoroughly evaluated in this study. Abandoned homesites were generally surrounded by scrub or old field vegetation and were mapped as such.

Garlow cemetery represented a specialized type. This old, stonewalled cemetery was presently surrounded by strip mines. Three species were recorded solely in this area, including red cedar (Juniperus virginiana), Adam's needle (Yucca filamentosa), and periwinkle (Vinca minor). Core (1966) mentions periwinkle and graveyard weed (Euphorbia cyparissias) as being typical of poorly maintained farm cemeteries.

9.3.2.6 Conifer Plantation

Portions of the Monongahela floodplain have been planted with conifers. Blocks of mature conifers occurred on the northwest side of the railroad tracks and adjacent to fields near the river. The primary species were Scotch pine (Pinus sylvestris) and hemlock (Tsuga canadensis). Most of the area occupying about 0.5 percent of the plantsite, was mature, closed-canopy forest, with a sparse ground cover and understory. However, newer stands also occurred.

9.3.2.7 Cropland

Cropland fields occupied about one percent of the plantsite, and all fields occurred on the Monongahela floodplain near the Paradise Gardens greenhouses. Corn, tomatoes, and other vegetables were grown in this area in 1978.

9.3.2.8 Mined Land

About 13 percent of the plantsite was being strip-mined or showed evidence of recent mining activity. Areas currently undergoing mining or partial reclamation were characterized by bare soil and sparse vegetation. Most species which occurred were herbaceous, such as weeds and plants seeded in from neighboring communities or from relics of pre-mining activity. Reclaimed areas, showing evidence of disturbance and reclamation, were mapped in this unit. However, areas presently indistinguishable from other pastures were mapped according to current vegetation. Reclaimed areas may be dominated by trees such as black locust (Robinia pseudo-acacia), by shrubs such as sericea (Lespedeza cuneata), or by grasses and forbs. Black cherry and other successional tree species may naturally occur.

9.3.2.9 Other Communities

Additional communities occurred on the site but were not mapped. These included the low ruderal community of railroads, roadsides, and barnyards, as well as the tall herbaceous community of forest edges and clearings. A great variety of annual and perennial herbs were found in each community.

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EXHIBIT 9-1

PLANT SPECIES ENCOUNTERED ON THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Equisetaceae	
<u>Equisetum arvense</u> L.	Common Horsetail
Lycopodiaceae	
<u>Lycopodium lucidulum</u> Michx.	Shining Clubmoss
Ophioglossaceae	
<u>Botrychium dissectum</u> Spreng.	Cutleaf Grapefern
<u>Botrychium virginianum</u> (L.) Sw.	Rattlesnake Fern
Osmundaceae	
<u>Osmunda regalis</u> L.	Royal Fern
Polypodiaceae	
<u>Asplenium platyneuron</u> (L.) Oakes	Ebony Spleenwort
<u>Asplenium trichomanes</u> L.	Maidenhair Spleenwort
<u>Aythium asplenoides</u> A. Eaton	Southern Lady Fern
<u>Dennstaedtia punctilobula</u> (Michx.) Moore	Hay-scented Fern
<u>Dryopteris spinulosa</u> (O.F. Muell) Watt.	Spinulose Shield Fern
<u>Onoclea sensibilis</u> L.	Sensitive Fern
<u>Polystichum acrostichoides</u> (Michx.) Schott.	Christmas Fern
Pinaceae	
<u>Pinus sylvestris</u> L.	Scotch Pine
<u>Tsuga canadensis</u> (L.) Carr.	Hemlock
Cupressaceae	
<u>Juniperus virginiana</u> L.	Red Cedar
Typhaceae	
<u>Typha latifolia</u> L.	Broad-leaved Cattail
Gramineae	
<u>Agropyron trachycaulum</u> (Link.) Malte.	Slender Wheatgrass
<u>Agrostis alba</u> L.	Redtop
<u>Agrostis tenuis</u> Sibth.	Colonial Bent Grass
<u>Andropogon virginicus</u> L.	Broomsedge
<u>Anthoxanthum odoratum</u> L.	Sweet Vernal Grass
<u>Aristida dichotoma</u> Michx.	Three-awn Grass
<u>Cinna arundinacea</u> L.	Wood Reed-grass
<u>Dactylis glomerata</u> L.	Orchard Grass

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Gramineae (Continued)	
<u>Digitaria ischaemum</u> (Schreb.) Muhl.	Smooth Crabgrass
<u>Digitaria sanguinalis</u> (L.) Scop.	Crabgrass
<u>Echinochloa crusgalli</u> (L.) Beauv.	Barnyard Grass
<u>Eleusine indica</u> (L.) Gaertn.	Goose Grass
<u>Elymus canadensis</u> L.	Canada Wild Rye
<u>Eragrostis pectinacea</u> (Michx.) Nees	---
<u>Eragrostis pilosa</u> (L.) Beauv.	India Lovegrass
<u>Holcus lanatus</u> L.	Velvet Grass
<u>Hystrix patula</u> Moench.	Bottle-brush Grass
<u>Muhlenbergia schreberi</u> J. F. Gmel.	Nimble-will
<u>Muhlenbergia sobolifera</u> (Muhl.) Trin.	Branched Muhly
<u>Panicum anceps</u> Michx.	Flat-stemmed Panic Grass
<u>Panicum clandestinum</u> L.	Deertongue Grass
<u>Panicum dichotomiflorum</u> Michx.	Spreading Witch Grass
<u>Panicum lanuginosum</u> Ell.	Hairy Panic Grass
<u>Panicum microcarpon</u> Muhl.	Small-fruited Panic Grass
<u>Panicum stipitatum</u> Nash	Tall Flat Panic Grass
<u>Panicum verrucosum</u> Muhl.	---
<u>Paspalum pubescens</u> Muhl.	---
<u>Phleum pratense</u> L.	Timothy
<u>Poa annua</u> L.	Annual Bluegrass
<u>Poa compressa</u> L.	Canada Bluegrass
<u>Poa pratensis</u> L.	Kentucky Bluegrass
<u>Poa sylvestris</u> Gray	Sylvan Bluegrass
<u>Setaria glauca</u> (L.) Beauv.	Yellow Foxtail
<u>Setaria viridis</u> (L.) Beauv.	Green Foxtail
<u>Sphenopholis intermedia</u> Rydb.	Slender Wedgegrass
<u>Sporobolus vaginiflorus</u> (Torr.) Wood	Dropseed
<u>Triodia flava</u> (L.) Smyth	Purpletop
Cyperaceae	
<u>Carex frankii</u> Kunth	---
<u>Carex lurida</u> Wahl.	---
<u>Carex squarrosa</u> L.	---
<u>Carex pennsylvanica</u> Lam	---

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Cyperaceae (Continued)	
<u>Cyperus esculentus</u> L.	Edible Nutgrass
<u>Cyperus strigosus</u> L.	Galingale
<u>Eleocharis obtusa</u> (Willd.) Schultes.	Spikerush
<u>Scirpus atrovirens</u> Muhl.	---
<u>Scirpus rubricosus</u> Fernald	Woolgrass
Araceae	
<u>Arisaema triphyllum</u> (L.) Schott.	Jack-in-the-Pulpit
Commelinaceae	
<u>Commelina virginica</u> L.	Virginia Day-flower
Juncaceae	
<u>Juncus effusus</u> L.	Common Rush
<u>Juncus tenuis</u> Willd.	Wiregrass
Liliaceae	
<u>Polygonatum biflorum</u> (Walt.) Ell.	Common Solomon's Seal
<u>Smilacina racemosa</u> (L.) Desf.	False Solomon's Seal
<u>Smilax glauca</u> Walt.	Saw Brier
<u>Smilax rotundifolia</u> L.	Common Greenbrier
<u>Trillium erectum</u> L.	Ill-scented Trillium
<u>Trillium grandiflorum</u> (Michx.) Salisb.	Large Flowered Trillium
<u>Yucca filamentosa</u> L.	Adam's Needle
Salicaceae	
<u>Salix interior</u> Rowlee	Sandbar Willow
Juglandaceae	
<u>Carya cordiformis</u> (Wang.) K. Koch	Bitternut Hickory
<u>Carya glabra</u> (Mill.) Sweet	Pignut Hickory
<u>Carya ovata</u> (Mill.) K. Koch	Shagbark Hickory
<u>Carya tomentosa</u> Nutt.	Mockernut Hickory
<u>Juglans nigra</u> L.	Black Walnut
Corylaceae	
<u>Ostrya virginiana</u> (Mill.) K. Koch	Hop Hornbeam
Fagaceae	
<u>Castanea dentata</u> (Marsh.) Borkh.	Chestnut
<u>Fagus grandiflora</u> Ehrh.	American Beech
<u>Quercus alba</u> L.	White Oak
<u>Quercus coccinea</u> Muench.	Scarlet Oak

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Fagaceae (Continued)	
<u>Quercus muehlenbergii</u> Engelm	Chinquapin Oak
<u>Quercus rubra</u> L.	Red Oak
<u>Quercus velutina</u> Lam.	Black Oak
Ulmaceae	
<u>Celtis occidentalis</u> L.	Hackberry
<u>Ulmus rubra</u> Muhl.	Slippery Elm
Moraceae	
<u>Maclura pomifera</u> (Raf.) Schneider	Osage-orange
Urticaceae	
<u>Boehmeria cylindrica</u> (L.) Sw.	False Nettle
<u>Pilea pumila</u> (L.) Gray	Clearweed
Aristolochiaceae	
<u>Asarum canadense</u> L.	Wild Ginger
Polygonaceae	
<u>Polygonum caespitosum</u> Blume	Asiatic Water Pepper
<u>Polygonum punctatum</u> Ell.	Water Smartweed
<u>Polygonum sagittatum</u> L.	Arrowleaf Tearthumb
<u>Polygonum scandens</u> L.	Climbing False Buckwheat
<u>Rumex acetosella</u> L.	Field Sorrell
<u>Tovara virginiana</u> (L.) Raf.	Virginia Knotweed
Portulacaceae	
<u>Claytonia caroliniana</u> Michx.	Carolina Spring Beauty
Phytolaccaceae	
<u>Phytolacca americana</u> L.	Pokeweed
Caryophyllaceae	
<u>Arenaria serpyllifolia</u> L.	Thymeleaf Sandwort
<u>Dianthus armeria</u> L.	Deptford Pink
<u>Lychnis alba</u> Mill.	White Campion
<u>Paronychia canadensis</u> (L.) Wood	Smooth Forked-chickweed
<u>Saponaria officinalis</u> L.	Bouncing Bet
<u>Stellaria media</u> (L.) Cyrillo	Common Chickweed
<u>Stellaria pubera</u> Michx.	Great Chickweed

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Ranunculaceae	
<u>Anemone lancifolia</u> Pursh	Mountain Anemone
<u>Anemone quinquefolia</u> L.	Wood Anemone
<u>Anemonella thalictroides</u> (L.) Spach.	Rue Anemone
<u>Delphinium tricornes</u> Michx.	Dwarf Larkspur
<u>Ranunculus allegheniensis</u> Britton	Allegheny Crowfoot
<u>Hepatica acutiloba</u> DC.	Sharplobe Hepatica
<u>Thalictrum dioicum</u> L.	Early Meadowrue
<u>Thalictrum polygamum</u> Muhl.	Tall Meadowrue
Berberidaceae	
<u>Berberis thunbergii</u> DC	Japanese Barberry
<u>Jeffersonia diphylla</u> (L.) Pers.	Twinleaf
<u>Podophyllum peltatum</u> L.	May-apple
Menispermaceae	
<u>Menispermum canadense</u> L.	Canada Moonseed
Magnoliaceae	
<u>Liriodendron tulipifera</u> L.	Tuliptree
Annonaceae	
<u>Asimina triloba</u> (L.) Dunal	Pawpaw
Lauraceae	
<u>Lindera benzoin</u> (L.) Blume	Spicebush
<u>Sassafras albidum</u> (Nutt.) Nees	Sassafras
Papaveraceae	
<u>Sanguinaria canadensis</u> L.	Bloodroot
Fumariaceae	
<u>Corydalis flavula</u> (Raf.) D.C.	Yellow Corydalis
<u>Dicentra canadensis</u> (Goldie) Walp.	Squirrel Corn
<u>Dicentra cucullaria</u> (L.) Bernh.	Dutchman's Breeches
Cruciferae	
<u>Arabis laevigata</u> (Muhl.) Poir.	Smooth Rockcress
<u>Barbarea vulgaris</u> R. Br.	Yellow Rocket
<u>Capsella bursa-pastoris</u> (L.) Medic.	Shepherd's Purse
<u>Cardamine hirsuta</u> L.	Hairy Bittercress

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Cruciferae (Continued)	
<u>Cardamine</u> <u>pensylvanica</u> Muhl.	Pennsylvania Bittercress
<u>Dentaria</u> <u>laciniata</u> Muhl.	Cutleaf Toothwort
<u>Draba</u> <u>verna</u> L.	Whitlowgrass
<u>Rorippa</u> <u>islandica</u> (Oeder) Borbas	Marsh Yellow Cress
Crassulaceae	
<u>Sedum</u> <u>ternatum</u> Michx.	Wild Stonecrop
Hamamelidaceae	
<u>Hamamelis</u> <u>virginiana</u> L.	Witch-hazel
Platanaceae	
<u>Platanus</u> <u>occidentalis</u> L.	Sycamore
Rosaceae	
<u>Agrimonia</u> <u>parviflora</u> Ait.	Smallflowered Agrimony
<u>Agrimonia</u> <u>pubescens</u> Wallr.	Soft Agrimony
<u>Crataegus</u> spp.	Hawthorn
<u>Duchesnea</u> <u>indica</u> (Andr.) Focke	Indian Strawberry
<u>Fragaria</u> <u>virginiana</u> Duchesne	Virginia Strawberry
<u>Geum</u> <u>canadense</u> Jacq.	White Avens
<u>Potentilla</u> <u>canadensis</u> L.	Canada Cinquefoil
<u>Prunus</u> <u>americana</u> Marsh.	Wild Plum
<u>Prunus</u> <u>serotina</u> Ehrh.	Black Cherry
<u>Pyrus</u> <u>coronaria</u> L.	Wild Crabapple
<u>Pyrus</u> <u>malus</u> L.	Apple
<u>Rosa</u> <u>multiflora</u> Thunb.	Rambler Rose
<u>Rubus</u> spp.	Blackberry
Leguminosae	
<u>Apios</u> <u>americana</u> Medic.	Groundnut
<u>Cercis</u> <u>canadensis</u> L.	Redbud
<u>Gleditsia</u> <u>tricanthos</u> L.	Honeylocust
<u>Medicago</u> <u>lupulina</u> L.	Black Medic
<u>Robinia</u> <u>pseudo-acacia</u> L.	Black Locust
<u>Trifolium</u> <u>pratense</u> L.	Red Clover
Oxalidaceae	
<u>Oxalis</u> <u>corniculata</u> L.	Creeping Lady's Sorrell
<u>Oxalis</u> <u>europaea</u> Jord.	European Yellow Wood Sorrell

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Geraniaceae <u>Geranium maculatum</u> L.	Wild Geranium
Simaroubaceae <u>Ailanthus altissima</u> (Mill.) Swingle	Tree-of-Heaven
Polygalaceae <u>Polygala sanguinea</u> L.	Rose Polygala
Euphorbiaceae <u>Euphorbia dentata</u> Michx. <u>Euphorbia maculata</u> L. <u>Euphorbia supina</u> Raf.	Toothed Spurge Spotted Spurge Prostrate Spurge
Anacardiaceae <u>Rhus glabra</u> L. <u>Rhus radicans</u> L. <u>Rhus typhina</u> L.	Smooth Sumac Poison Ivy Staghorn Sumac
Aceraceae <u>Acer negundo</u> L. <u>Acer rubrum</u> L. <u>Acer saccharinum</u> L. <u>Acer saccharum</u> Marsh	Boxelder Red Maple Silver Maple Sugar Maple
Hippocastanaceae <u>Aesculus octandra</u> Marsh	Yellow Buckeye
Balsaminaceae <u>Impatiens capensis</u> Meerb. <u>Impatiens pallida</u> Nutt.	Spotted Touch-me-not, Jewel Weed Pale Touch-me-not, Jewel Weed
Vitaceae <u>Parthenocissus quinquefolia</u> (L.) Planch <u>Vitus</u> sp.	Virginia Creeper Grape
Tiliaceae <u>Tilia americana</u> L.	American Linden, Basswood
Guttiferae <u>Hypericum perforatum</u> L.	Common St. John's-wort

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Violaceae	
<u>Viola papilionacea</u> Pursh	Common Blue Violet
<u>Viola pensylvanica</u> Michx.	Smooth Yellow Violet
<u>Viola primulifolia</u> L.	Primrose-leaf Violet
<u>Viola rafinesquii</u> Greene	Wild Pansy
<u>Viola sagittata</u> Ait.	Arrow-leaf Violet
<u>Viola striata</u> Ait.	Striped Violet
Nyssaceae	
<u>Nyssa sylvatica</u> Marsh.	Black Gum
Onagraceae	
<u>Gaura biennis</u> L.	Gaura
<u>Ludwigia alternifolia</u> L.	Seedbox
<u>Oenothera biennis</u> L.	Common Evening-primrose
Araliaceae	
<u>Aralia spinosa</u> L.	Hercules' Club
Umbelliferae	
<u>Daucus carota</u> L.	Queen Anne's Lace
<u>Osmorhiza claytoni</u> (Michx.) Clarke	Hairy Sweet Cicely
<u>Osmorhiza longistylis</u> (Torr.) DC.	Smooth Sweet Cicely
<u>Pastinaca sativa</u> L.	Parsnip
<u>Sanicula</u> sp.	Snakeroot
Cornaceae	
<u>Cornus florida</u> L.	Flowering Dogwood
Pyrolaceae	
<u>Monotropa uniflora</u> L.	Indian Pipe
Ericaceae	
<u>Gaylussacia baccata</u> (Wang.) K. Koch	Black Huckleberry
Primulaceae	
<u>Lysimachia ciliata</u> L.	Fringed Loosestrife
Oleaceae	
<u>Fraxinus americana</u> L.	White Ash

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Apocynaceae	
<u>Apocynum</u> <u>cannabinum</u> L.	India Hemp
<u>Vinca</u> <u>minor</u> L.	Periwinkle
Asclepiadaceae	
<u>Asclepias</u> <u>tuberosa</u> L.	Butterfly Weed
Convolvulaceae	
<u>Convolvulus</u> <u>sepium</u> L.	Hedge Bindweed
Polemoniaceae	
<u>Phlox</u> <u>divaricata</u> L.	Wild Blue Phlox.
Boraginaceae	
<u>Hackelia</u> <u>virginiana</u> (L.) I. M. Johnston	Beggar's-lice
Verbenaceae	
<u>Verbena</u> <u>hastata</u> L.	Blue Vervain
<u>Verbena</u> <u>urticifolia</u> L.	White Vervain
Labiatae	
<u>Blephilia</u> <u>ciliata</u> (L.) Benth.	Downy Woodmint
<u>Blephilia</u> <u>hirsuta</u> (Pursh) Benth.	Hairy Woodmint
<u>Glechoma</u> <u>hederacea</u> L.	Ground-ivy
<u>Lycopus</u> <u>americanus</u> Muhl.	Water Horehound
<u>Lycopus</u> <u>virginicus</u> L.	Bugleweed
<u>Monarda</u> <u>clinopodia</u> L.	Basil Balm
<u>Prunella</u> <u>vulgaris</u> L.	Heal-all
<u>Satureja</u> <u>vulgaris</u> (L.) Fritsch	Field Basil
<u>Scutellaria</u> <u>integrifolia</u> L.	Large-flowered Skullcap
Solanaceae	
<u>Physalis</u> <u>subglabrata</u> MacKenzie and Bush	Smooth Ground-cherry
<u>Solanum</u> <u>carolinense</u> L.	Horse-nettle
Scrophulariaceae	
<u>Lindernia</u> <u>dubia</u> (L.) Pennell	False Pimpernel
<u>Veronica</u> <u>officinalis</u> L.	Common Speedwell
Phrymaceae	
<u>Phryma</u> <u>leptostachya</u> L.	Lopseed

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Plantaginaceae	
<u>Plantago lanceolata</u> L.	Narrow-leaf Plantain
<u>Plantago rugelii</u> Dene.	Common Plantain
Rubiaceae	
<u>Galium triflorum</u> Michx.	Sweet-scented Bedstraw
<u>Houstonia caerulea</u> L.	Bluets
Caprifoliaceae	
<u>Sambucus canadensis</u> L.	Black Elderberry
<u>Symphoricarpos orbiculatus</u> Moench.	Coralberry
<u>Viburnum acerifolium</u> L.	Maple-leaf Viburnum
<u>Viburnum cassinoides</u> L.	Wild Raisin
<u>Viburnum prunifolium</u> L.	Black Haw
<u>Viburnum recognitum</u> Fernald	Smooth Arrowwood
Dipsacaceae	
<u>Dipsacus sylvestris</u> Huds.	Common Teasel
Campanulaceae	
<u>Campanula americana</u> L.	Tall Bellflower
Lobeliaceae	
<u>Lobelia inflata</u> L.	Indian Tobacco
Compositae	
<u>Achillea millefolium</u> L.	Yarrow
<u>Ambrosia artemisiifolia</u> L.	Common Ragweed
<u>Ambrosia trifida</u> L.	Giant Ragweed
<u>Antennaria plantaginifolia</u> (L.) Richards	Pussytoes
<u>Arctium minus</u> (Hill.) Bernh.	Common Burdock
<u>Aster cordifolius</u> L.	Blue Wood Aster
<u>Aster divaricatus</u> L.	White Wood Aster
<u>Aster laterifolius</u> (L.) Britton	Calico Aster
<u>Aster novae-angliae</u> L.	New England Aster
<u>Aster pilosus</u> Willd.	White Heath Aster
<u>Aster shortii</u> Lindl.	Short's Aster
<u>Aster simplex</u> Willd.	Panicked Aster

EXHIBIT 9-1 (Continued)

PLANT SPECIES ENCOUNTERED ON
THE P&M/SRC-II PLANTSITE

<u>Scientific Name</u>	<u>Common Name</u>
Compositae (Continued)	
<u>Bidens bipinnata</u> L.	Spanish Needles
<u>Bidens frondosa</u> L.	Beggar-ticks
<u>Bidens tripartita</u> L.	Beggar-ticks
<u>Chrysanthemum leucanthemum</u> L.	Ox-eye Daisy
<u>Cichorium intybus</u> L.	Chicory
<u>Cirsium</u> sp.	Thistle
<u>Erechtites hieracifolia</u> (L.) Raf.	Pilewort
<u>Erigeron strigosus</u> Muhl.	Daisy Fleabane
<u>Eupatorium fistulosum</u> Barratt	Common Joe-pye Weed
<u>Eupatorium perfoliatum</u> L.	Boneset
<u>Eupatorium pubescens</u> Muhl.	Hairy Thoroughwort
<u>Eupatorium rugosum</u> Houtt.	White Snakeroot
<u>Galinsoga ciliata</u> (Raf.) Blake	Galinsoga
<u>Gnaphalium obtusifolium</u> L.	Cudweed
<u>Helenium autumnale</u> L.	Yellow Sneezeweed
<u>Hieracium pratense</u> Tausch.	Field Hawkweed
<u>Lactuca canadensis</u> L.	Wild Lettuce
<u>Rudbeckia hirta</u> L.	Black-eyed Susan
<u>Rudbeckia laciniata</u> L.	Tall Coneflower
<u>Solidago altissima</u> L.	Tall Goldenrod
<u>Solidago bicolor</u> L.	Silverrod
<u>Solidago caesia</u> L.	Wreath Goldenrod
<u>Solidago canadensis</u> L.	Canada Goldenrod
<u>Solidago graminifolia</u> (L.) Salisb.	Grass-leaved Goldenrod
<u>Solidago juncea</u> Ait.	Early Goldenrod
<u>Solidago nemoralis</u> Ait.	Oldfield Goldenrod
<u>Solidago rugosa</u> Ait.	Wrinkled-leaf Goldenrod
<u>Taraxacum officinale</u> Weber	Common Dandelion
<u>Tussilago farfara</u> L.	Coltsfoot
<u>Verbesina occidentalis</u> (L.) Walt.	Small Yellow Crownbeard
<u>Vernonia noveboracensis</u> (L.) Michx.	New York Ironweed

EXHIBIT 9-2

DATA SUMMARY - 10 x 10 M QUADRATS (TREE LAYER)
P&M/SRC-II SITE
TRANSECT 1

	Density (n/quadrat)	Relative Density (%)	Frequency (%)	Relative Frequency (%)	Dominance (basal area (cm) per quadrat)	Relative Dominance (%)	Importance Value
<u>Acer rubrum</u>	0.1	0.9	10	2.5	3	0.1	1.2
<u>Acer saccharum</u>	4.6	42.2	100	25.0	811	28.8	32.0
<u>Carya glabra</u>	0.3	2.8	30	7.5	100	3.6	4.6
<u>Cornus florida</u>	0.2	1.8	10	2.5	2	0.1	1.5
<u>Fagus grandifolia</u>	0.3	2.8	20	5.0	37	1.3	3.0
<u>Fraxinus americana</u>	0.6	5.5	60	15.0	678	24.1	14.9
<u>Hamamelis virginiana</u>	3.1	28.4	60	15.0	28	1.0	14.8
<u>Ostrya virginiana</u>	0.2	1.8	10	2.5	19	0.7	1.7
<u>Quercus alba</u>	0.1	0.9	10	2.5	90	3.2	2.2
<u>Quercus rubra</u>	0.6	5.5	30	7.5	952	33.8	15.6
<u>Sassafras albidum</u>	0.1	0.9	10	2.5	38	1.4	1.6
<u>Ulmus rubra</u>	0.7	6.4	50	12.5	57	2.0	7.0
Total	10.9	99.9	400	100.0	2,815	100.1	100.1

EXHIBIT 9-2 (Continued)

DATA SUMMARY - 10 x 10 M QUADRATS (TREE LAYER)
P&M/SRC-II SITE
TRANSECT 2

	Density (n/quadrat)	Relative Density (%)	Frequency (%)	Relative Frequency (%)	Dominance (basal area (cm) per quadrat)	Relative Dominance (%)	Importance Value
<u>Carya cordiformis</u>	0.4	3.0	30	4.8	219	8.8	5.5
<u>Carya glabra</u>	0.5	3.7	40	6.5	134	5.4	5.2
<u>Carya tomentosa</u>	0.4	3.0	20	3.2	175	7.0	4.4
<u>Celtis occidentalis</u>	2.2	16.4	60	9.7	125	5.0	10.4
<u>Cercis canadensis</u>	0.9	6.7	40	6.5	25	1.0	4.7
<u>Cornus florida</u>	0.1	0.7	10	1.6	2	0.1	0.8
<u>Crataegus sp.</u>	0.2	1.5	20	3.2	1	0.0	1.6
<u>Fraxinus americana</u>	1.2	9.0	60	9.7	95	3.8	7.5
<u>Juglans cinerea</u>	0.3	2.2	30	4.8	575	23.0	10.0
<u>Lindera benzoin</u>	2.2	16.4	80	12.9	13	0.5	9.9
<u>Prunus serotina</u>	0.1	0.7	10	1.6	32	1.3	1.2
<u>Quercus alba</u>	0.5	3.7	40	6.5	429	17.2	9.1
<u>Quercus rubra</u>	0.1	0.7	10	1.6	217	8.7	3.7
<u>Ulmus rubra</u>	3.2	23.9	100	16.1	444	17.8	19.3
<u>Viburnum acerifolium</u>	0.1	0.7	10	1.6	1	0.0	0.8
<u>Viburnum prunifolium</u>	1.0	7.5	60	9.7	9	0.4	5.9
Total	13.4	99.8	620	100.0	2,496	99.9	100.0

EXHIBIT 9-2 (Continued)

DATA SUMMARY - 10 x 10 M QUADRATS (TREE LAYER)
P&M/SRC II SITE
TRANSECT 3

	Density (n/quadrat)	Relative Density (%)	Frequency (%)	Relative Frequency (%)	Dominance (basal area (cm) per quadrat)	Relative Dominance (%)	Importance Value
<u>Carya ovata</u>	0.6	5.6	50	8.8	98	2.7	5.7
<u>Cornus florida</u>	1.1	10.3	50	8.8	59	1.6	6.9
<u>Crataegus sp. (1)</u>	0.8	7.5	60	10.5	10	0.3	6.1
<u>Crataegus sp. (2)</u>	0.6	5.6	30	5.3	9	0.2	3.7
<u>Fagus grandifolia</u>	0.9	8.4	20	3.5	25	0.7	4.2
<u>Fraxinus americana</u>	0.7	6.5	30	5.3	15	0.4	4.1
<u>Gleditsia tricanthos</u>	0.1	0.9	10	1.7	3	0.1	0.9
<u>Lindera benzoin</u>	0.4	3.7	20	3.5	2	0.1	2.4
<u>Nyssa sylvatica</u>	0.3	2.8	10	1.7	21	0.6	1.7
<u>Prunus serotina</u>	1.2	11.2	70	12.3	398	10.9	11.5
<u>Quercus alba</u>	1.5	14.0	60	10.5	2,218	60.6	28.4
<u>Quercus rubra</u>	0.2	1.9	20	3.5	2	0.1	1.8
<u>Quercus velutina</u>	0.4	3.7	50	8.8	528	14.4	9.0
<u>Robinia pseudoacacia</u>	0.7	6.5	30	5.3	242	6.6	6.1
<u>Sassafras albidum</u>	0.7	6.5	50	8.8	23	0.6	5.3
<u>Viburnum prunifolium</u>	0.5	4.7	10	1.7	4	0.1	2.2
Total	10.7	99.8	570	100.0	3,657	100.0	100.0

EXHIBIT 9-2 (Continued)

DATA SUMMARY - 10 x 10 M QUADRATS (TREE LAYER)
P&M/SRC-II SITE
TRANSECT 4

	<u>Density (n/quadrat)</u>	<u>Relative Density (%)</u>	<u>Frequency (%)</u>	<u>Relative Frequency (%)</u>	<u>Dominance (basal area (cm) per quadrat)</u>	<u>Relative Dominance (%)</u>	<u>Importance Value</u>
<u>Acer negundo</u>	3.3	18.1	80	13.1	556	17.3	16.2
<u>Acer saccharum</u>	0.4	2.2	20	3.3	129	4.0	3.2
<u>Ailanthus altissima</u>	3.9	21.4	50	8.2	420	13.0	14.2
<u>Carya cordiformis</u>	0.6	3.3	40	6.5	42	1.3	3.7
<u>Crataegus sp.</u>	0.2	1.1	20	3.3	2	0.1	1.5
<u>Fraxinus americana</u>	0.3	1.7	30	4.9	3	0.1	2.2
<u>Juglans nigra</u>	0.3	1.7	30	4.9	4	0.1	2.2
<u>Lindera benzoin</u>	1.1	6.0	50	8.2	8	0.2	4.8
<u>Liriodendron tulipifera</u>	1.5	8.2	40	6.5	675	20.9	11.9
<u>Prunus serotina</u>	2.3	12.6	80	13.1	809	25.1	16.9
<u>Robinia pseudoacacia</u>	0.3	1.7	20	3.3	368	11.4	5.5
<u>Rhus typhina</u>	0.2	1.1	10	1.6	11	0.3	1.0
<u>Sassafras albidum</u>	1.1	6.0	50	8.2	20	0.6	4.9
<u>Ulmus rubra</u>	2.7	14.8	90	14.8	176	5.5	11.7
Total	18.2	99.9	610	99.9	3,223	99.9	99.9

EXHIBIT 9-3

DATA SUMMARY - 4 x 4 M QUADRATS (SHRUBS/SAPLINGS)
P&M/SRC-II SITE
TRANSECT 1

	<u>Density (n/quadrat)</u>	<u>Relative Density</u>	<u>Frequency</u>	<u>Relative Frequency</u>	<u>Importance Value</u>
<u>Acer rubrum</u>	0.2	3.9	10	4.8	4.3
<u>Acer saccharum</u>	0.7	13.7	60	28.6	21.2
<u>Crataegus sp.</u>	0.1	2.0	10	4.8	3.4
<u>Fraxinus americana</u>	0.4	7.8	30	14.3	11.1
 <u>Hamamelis virginiana</u>	 1.4	 27.5	 50	 23.8	 25.6
<u>Quercus rubra</u>	0.3	5.9	20	9.5	7.7
<u>Ulmus rubra</u>	0.2	3.9	10	4.8	4.4
<u>Viburnum acerifolium</u>	1.8	35.3	20	9.5	22.4
 Total	 5.1	 99.9	 210	 100.1	 100.1

EXHIBIT 9-3 (Continued)

DATA SUMMARY - 4 x 4 M QUADRATS (SHRUBS/SAPLINGS)
P&M/SRC-II SITE
TRANSECT 2

	<u>Density</u> <u>(n/quadrat)</u>	<u>Relative</u> <u>Density</u>	<u>Frequency</u>	<u>Relative</u> <u>Frequency</u>	<u>Importance</u> <u>Value</u>
<u>Carya glabra</u>	0.1	1.7	10	4.5	3.1
<u>Crataegus</u> sp.	0.4	6.7	10	4.5	5.6
<u>Celtis occidentalis</u>	0.1	1.7	10	4.5	3.1
<u>Fraxinus americana</u>	0.6	10.0	30	13.6	11.8
<u>Lindera benzoin</u>	3.0	50.0	70	31.8	40.9
<u>Prunus serotina</u>	0.2	3.3	20	9.1	6.2
<u>Rubus</u> sp.	0.6	10.0	10	4.5	7.3
<u>Ulmus rubra</u>	0.4	6.7	20	9.1	7.9
<u>Viburnum acerifolium</u>	0.1	1.7	10	4.5	3.1
<u>Vitis</u> sp.	0.5	8.3	30	13.6	11.0
Total	6.0	100.1	220	99.7	100.0

EXHIBIT 9-3 (Continued)

DATA SUMMARY - 4 x 4 M QUADRATS (SHRUBS/SAPLINGS)
P&M/SRC-II SITE
TRANSECT 3

	<u>Density (n/quadrat)</u>	<u>Relative Density</u>	<u>Frequency</u>	<u>Relative Frequency</u>	<u>Importance Value</u>
<u>Acer rubrum</u>	0.1	0.5	10	2.5	1.5
<u>Carya ovata</u>	0.1	0.5	10	2.5	1.5
<u>Cornus florida</u>	0.8	3.8	30	7.5	5.7
<u>Fraxinus americana</u>	1.1	5.2	70	17.5	11.3
<u>Lindera benzoin</u>	1.4	6.7	30	7.5	7.1
<u>Nyssa sylvatica</u>	0.1	0.5	10	2.5	1.5
<u>Prunus serotina</u>	3.3	15.7	70	17.5	16.6
<u>Quercus alba</u>	0.1	0.5	10	2.5	1.5
<u>Quercus velutina</u>	0.3	1.4	10	2.5	1.9
<u>Rhus radicans</u>	1.9	9.0	20	5.0	7.0
<u>Sassafras albidum</u>	0.4	1.9	30	7.5	4.7
<u>Smilax rotundifolia</u>	11.0	52.4	70	17.5	35.0
<u>Viburnum prunifolium</u>	0.3	1.4	20	5.0	3.2
<u>Unknown species</u>	0.1	0.5	10	2.5	1.5
Total	21.0	100.0	400	100.0	100.0

EXHIBIT 9-3 (Continued)

DATA SUMMARY - 4 x 4 M QUADRATS (SHRUBS/SAPPLINGS)
P&M/SRC-II SITE
TRANSECT 4

	<u>Density (n/quadrat)</u>	<u>Relative Density</u>	<u>Frequency</u>	<u>Relative Frequency</u>	<u>Importance Value</u>
<u>Acer negundo</u>	1.1	5.1	40	9.3	7.2
<u>Ailanthus altissima</u>	2.9	13.6	40	9.3	11.5
<u>Asimina triloba</u>	0.1	0.5	10	2.3	1.4
<u>Fraxinus americana</u>	0.2	0.9	20	4.7	2.8
<u>Lindera benzoin</u>	3.7	17.3	40	9.3	13.3
<u>Prunus serotina</u>	0.8	3.7	40	9.3	6.5
<u>Rhus radicans</u>	1.6	7.5	50	11.6	9.6
<u>Rhus typhina</u>	0.3	1.4	20	4.7	3.1
<u>Rubus sp.</u>	2.4	11.2	30	7.0	9.1
<u>Sambucus canadensis</u>	5.0	23.4	10	2.3	12.9
<u>Sassafras albidum</u>	0.5	2.3	40	9.3	5.8
<u>Ulmus rubra</u>	2.8	13.1	90	20.9	17.0
Total	21.4	100.0	430	100.0	100.2

EXHIBIT 9-4

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 1 - FALL 1978

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody Plants			
<u>Acer rubrum</u>	0.1	10	0.30
<u>Acer saccharum</u>	0.4	20	0.60
<u>Carya cordiformis</u>	0.1	10	0.05
<u>Carya sp.</u>	0.1	10	0.05
<u>Fraxinus americana</u>	0.3	10	0.30
<u>Hamamelis virginiana</u>	0.4	30	0.65
<u>Lindera benzoin</u>	0.4	20	0.35
<u>Ostrya virginiana</u>	0.1	10	0.30
<u>Parthenocissus quinquefolia</u>	0.8	30	0.15
<u>Prunus serotina</u>	0.4	30	0.4
<u>Rhus radicans</u>	0.2	20	0.10
<u>Sassafras albidum</u>	0.1	10	0.30
<u>Ulmus rubra</u>	1.5	60	0.55
<u>Viburnum acerifolium</u>	1.1	10	1.50
Forbs			
<u>Aster divaricatus</u>	1.6	10	0.30
<u>Aster shortii</u>	0.6	20	0.35
<u>Galium triflorum</u>	0.1	10	0.05
<u>Geum canadense</u>	5.8	30	0.65
<u>Polygonum scandens</u>	0.1	10	0.05
<u>Sanicula sp.</u>	2.2	60	0.30
<u>Sedum ternatum</u>	2.1	40	0.20
<u>Stellaria pubera</u>	12.1	90	0.95
<u>Tovara virginiana</u>	0.1	10	0.05
<u>Viola papilionacea</u>	0.1	10	0.05
Unknown I	1.5	20	0.10
Seedlings	2.7	70	0.35
Grasses and grass-like plants			
<u>Sphenopholis intermedia</u>	0.2	10	0.05
Moss	-	-	0.30
Total plant cover			10.05
Total litter cover			62.25
Bare ground			32.75

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 1 - SPRING 1979

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody Plants			
<u>Hamamelis virginiana</u>	1.2	10	1.50
<u>Prunus serotina</u>	0.2	10	0.05
<u>Ulmus rubra</u>	1.1	50	0.50
Unknown species	1.4	50	0.25
Forbs			
<u>Claytonia caroliniana</u>	14.6	100	2.95
<u>Denteria laciniata</u>	20.5	90	3.40
<u>Fragaria spp.</u>	3.0	30	0.40
<u>Galium spp.</u>	4.8	50	0.25
<u>Osmorhiza spp.</u>	4.7	80	2.10
<u>Podophyllum peltatum</u>	0.2	10	0.05
<u>Sedum ternatum</u>	3.3	30	0.15
<u>Stellaria pubera</u>	34.5	100	10.20
<u>Viola papilionacea</u>	0.2	10	0.05
<u>Viola spp.</u>	0.5	10	0.30
Unknown species 1	0.9	10	0.30
Seedlings	24.1	100	0.50
Grasses			
Unknown grass species 1	0.1	10	0.05
Moss	-	40	0.95
Total plant cover			26.25
Total litter cover			85.50
Bare ground			14.30

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 2 - FALL 1978

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
<u>Carya cordiformis</u>	0.1	10	0.30
<u>Carya sp.</u>	0.1	10	0.30
<u>Celtis occidentalis</u>	0.2	20	0.10
<u>Crataegus sp.</u>	0.1	10	0.30
<u>Fraxinus americana</u>	0.2	10	0.30
<u>Lindera benzoin</u>	0.3	20	0.35
<u>Parthenocissus quinquefolia</u>	1.1	50	0.50
<u>Prunus serotina</u>	0.5	30	0.15
<u>Rhus radicans</u>	0.1	10	0.05
<u>Rubus sp.</u>	0.2	20	0.35
<u>Ulmus rubra</u>	0.5	30	1.50
<u>Viburnum acerifolium</u>	0.1	10	0.05
<u>Vitis sp.</u>	0.1	10	0.05
Forbs			
<u>Allium sp.</u>	2.1	50	0.25
<u>Aster shortii</u>	4.7	80	2.85
<u>Blephilia hirsuta</u>	0.4	20	0.35
<u>Eupatorium rugosum</u>	0.2	10	0.05
<u>Geum canadense</u>	4.3	90	2.90
<u>Glechoma hederacea</u>	-	70	5.45
<u>Impatiens sp.</u>	0.5	10	0.05
<u>Pilea pumila</u>	1.6	60	0.80
<u>Polygonum scandens</u>	0.2	10	0.30
<u>Sanicula sp.</u>	2.5	90	0.45
<u>Satureja vulgaris</u>	0.7	20	0.35
<u>Tovara virginiana</u>	2.1	70	1.85

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 2 - FALL 1978 (Continued)

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Forbs (Continued)			
<u>Verbesina alternifolia</u>	0.3	10	0.3
<u>Viola sp.</u>	5.3	80	2.1
<u>Seedlings</u>	54.1	90	2.15
Grasses and grass-like plants			
<u>Poa sp.</u>	-	20	6.30
<u>Sphenopholis intermedia</u>	7.6	90	1.45
<u>Unknown Sedge 1</u>	0.8	20	1.30
<u>Unknown Sedge 2</u>	0.6	10	0.30
Total plant cover			37.75
Total litter cover			85.50
Bare ground			10.05

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC-II SITE
TRANSECT 2 - SPRING 1979

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
<u>Lindera benzoin</u>	0.1	10	0.05
<u>Prunus serotina</u>	0.1	10	0.05
<u>Unknown species</u>	0.2	20	0.10
<u>Seedlings</u>	0.2	20	0.10
Forbs			
<u>Allium spp.</u>	14.0	90	9.65
<u>Cardamine spp.</u>	0.1	10	0.05
<u>Claytonia virginiana</u>	16.9	100	2.70
<u>Corydalis flavula</u>	5.0	80	0.90
<u>Delphinium tricornes</u>	2.3	60	2.75
<u>Dentaria laciniata</u>	43.4	100	6.60
<u>Fragaria spp.</u>	0.3	20	0.10
<u>Galium spp.</u>	13.8	100	1.95
<u>Geum spp.</u>	2.9	80	3.10
<u>Glechoma hederacea</u>	27.0	70	5.45
<u>Impatiens spp.</u>	65.6	100	12.45
<u>Osmorhiza spp.</u>	20.1	90	4.35
<u>Podophyllum peltatum</u>	2.4	10	1.50
<u>Ranunculus allegheniensis</u>	1.1	40	0.70
<u>Stellaria media</u>	1.6	30	0.65
<u>Viola papilionacea</u>	6.4	70	5.30
<u>Viola spp.</u>	6.0	80	4.80
<u>Viola striata</u>	0.1	10	0.05
<u>Unknown species 1</u>	2.4	50	0.50
<u>Unknown species 2</u>	1.1	30	0.40
<u>Unknown species 3</u>	0.1	10	0.05
<u>Unknown species 4</u>	0.2	10	0.05

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC-II SITE
TRANSECT 2 - SPRING 1979 (Continued)

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Unknown species 5	0.1	10	0.30
Seedlings	56.2	100	1.00
Grasses			
Poa spp.	-	10	6.25
Unknown grass species 1	-	100	3.20
Unknown grass species 2	0.2	10	0.05
Moss	-	40	2.15
Total Plant Cover			71.25
Total Litter Cover			84.25
Bare Ground			2.95

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 3 - FALL 1978

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
<u>Acer rubrum</u>	0.1	10	0.05
<u>Carya sp.</u>	0.2	20	0.60
<u>Cornus florida</u>	2.1	30	5.30
<u>Crataegus sp.</u>	0.1	10	0.30
<u>Gaylussacia baccata</u>	0.1	10	0.05
<u>Lindera benzoin</u>	0.2	20	0.10
<u>Parthenocissus quinquefolia</u>	0.2	10	0.05
<u>Prunus serotina</u>	8.6	90	5.65
<u>Quercus alba</u>	0.4	20	0.35
<u>Rhus radicans</u>	0.5	20	0.35
<u>Rubus sp.</u>	0.5	20	0.60
<u>Sassafras albidum</u>	3.8	80	8.00
<u>Smilax sp.</u>	0.5	20	0.10
<u>Ulmus rubra</u>	1.3	50	0.50
<u>Vitis sp.</u>	0.5	30	0.40
<u>Unknown sp.</u>	0.1	10	0.50
Forbs			
<u>Eupatorium rugosum</u>	0.1	10	0.30
<u>Phytolacca americana</u>	0.3	20	0.60
<u>Seedlings</u>	3.9	80	0.40
Grasses and grass-like plants			
<u>Sphenopholis intermedia</u>	0.4	10	0.05
<u>Unknown Sedge</u>	0.4	10	0.3
Total plant cover			20.40
Total litter cover			92.75
Bare ground			6.40

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 3 - SPRING 1979 (Continued)

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
<u>Prunus serotina</u>	7.5	100	5.45
<u>Rubus spp.</u>	0.4	20	0.10
<u>Sassafras albidum</u>	0.1	10	0.05
<u>Smilax spp.</u>	6.4	20	0.35
Unknown species	1.6	40	0.45
Forbs			
<u>Dentaria laciniata</u>	11.7	30	2.10
<u>Podophyllum peltatum</u>	9.0	60	9.65
<u>Stellaria pubera</u>	1.0	10	0.30
Unknown species 1	2.2	20	0.35
Seedlings	5.0	90	0.70
Grass-like plants			
Unknown sedge species	0.3	10	0.05
Moss	-	10	0.3
Total Plant Cover			21.70
Total Litter Cover			95.00
Bare Ground			3.90

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 4 - FALL 1978

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
<u>Acer negundo</u>	0.4	30	0.15
<u>Ailanthus altissima</u>	1.6	30	1.85
<u>Carya cordiformis</u>	0.2	30	0.35
<u>Fraxinus americana</u>	0.2	10	0.30
 <u>Lindera benzoin</u>	 1.1	 50	 0.25
<u>Prunus serotina</u>	5.3	90	1.20
<u>Rhus radicans</u>	8.9	80	4.80
<u>Rubus</u> sp.	0.5	40	0.95
 <u>Sambucus canadensis</u>	 0.8	 10	 0.30
<u>Sassafras albidum</u>	0.1	10	0.05
<u>Ulmus rubra</u>	1.4	60	1.05
Forbs			
<u>Allium</u> sp.	8.0	70	0.60
<u>Aster</u> sp.	0.5	30	0.40
<u>Eupatorium rugosum</u>	1.0	60	0.55
<u>Fragaria virginiana</u>	0.2	10	0.05
 <u>Geum canadense</u>	 1.5	 60	 0.80
<u>Glechoma hederacea</u>	-	60	2.75
<u>Impatiens capensis</u>	0.1	10	0.30
<u>Polygonum scandens</u>	0.1	10	0.05
 <u>Potentilla canadensis</u>	 0.1	 10	 0.05
<u>Sanicula</u> sp.	2.0	70	0.35
<u>Solidago</u> sp.	0.1	10	0.30
<u>Tovara virginiana</u>	0.1	10	0.30

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 4 - FALL 1978 (Continued)

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Forbs (Continued)			
<u>Verbesina alternifolia</u>	0.1	10	0.05
<u>Viola sp.</u>	2.1	30	0.65
Seedlings	22.2	90	0.45
Grasses and grass-like plants			
<u>Cinna arundinacea</u>	0.2	10	0.05
<u>Hystrix patula</u>	0.6	20	0.10
<u>Poa sp.</u>	-	80	5.50
<u>Sphenopholis intermedia</u>	3.2	70	0.60
Unknown Sedge	0.5	10	0.05
Ferns			
<u>Botrychium sp.</u>	0.5	10	0.30
Total plant cover			21.75
Total litter cover			96.25
Bare ground			3.70

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC-II SITE
TRANSECT 4 - SPRING 1979

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
<u>Prunus serotina</u>	4.6	60	2.50
<u>Rubus spp.</u>	0.3	30	0.15
<u>Rhus radicans</u>	5.8	40	0.95
<u>Ulmus rubra</u>	0.9	40	0.95
Unknown species	4.4	50	1.00
Seedlings	2.6	20	0.35
Forbs			
<u>Allium spp.</u>	8.3	80	6.70
<u>Cardamine spp.</u>	0.3	10	0.05
<u>Claytonia caroliniana</u>	36.3	90	4.60
<u>Corydalis flavula</u>	22.8	80	4.55
<u>Dentaria laciniata</u>	41.6	40	14.05
<u>Fragaria spp.</u>	0.1	10	0.05
<u>Galium spp.</u>	22.6	100	5.45
<u>Geum spp.</u>	1.1	50	1.05
<u>Glechoma hederacea</u>	12.8	50	3.65
<u>Impatiens spp.</u>	4.5	30	0.65
<u>Osmorhiza spp.</u>	3.6	50	2.70
<u>Podophyllum peltatum</u>	1.5	20	1.80
<u>Polygonatum biflorum</u>	2.1	20	1.80
<u>Polygonum spp.</u>	0.1	10	0.05
<u>Stellaria pubera</u>	0.8	10	0.30
<u>Viola spp.</u>	2.8	40	2.40
Unknown species 1	3.8	30	0.65
Unknown species 2	0.5	20	0.60
Unknown species 3	0.1	10	0.30
Unknown species 4	0.6	10	0.30
Seedlings	25.2	100	0.75

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC-II SITE
TRANSECT 4 - SPRING 1979 (Continued)

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Grasses and grass-like plants			
<u>Dactylis glomerata</u>	-	20	0.35
<u>Poa</u> spp.	-	100	20.65
Unknown grass species 1	-	30	0.65
Unknown grass species 2	-	10	0.30
Unknown grass species 3	-	10	0.05
Unknown grass species 4	-	10	0.05
Unknown sedge species	0.6	10	0.30
Ferns			
<u>Botrychium</u> spp.	0.1	10	0.05
Moss	--	10	0.3
Total Plant Cover			64.25
Total Litter Cover			96.25
Bare Ground			0.75

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 5 - FALL 1978

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
<u>Maclura pomifora</u>	0.1	10	0.05
<u>Prunus serotina</u>	0.1	10	0.05
Forbs			
<u>Achillea millefolium</u>	6.1	60	1.05
<u>Agrimonia parviflora</u>	0.2	10	0.30
<u>Ambrosia artemisiifolia</u>	21.2	100	10.90
<u>Aster laterifolius</u>	1.8	40	.70
<u>Aster pilosus</u>	3.2	80	4.05
<u>Cichorium intybus</u>	0.8	20	0.60
<u>Cirsium sp.</u>	0.1	10	0.30
<u>Daucus carota</u>	11.6	100	1.75
<u>Fragaria sp.</u>	1.3	60	0.30
<u>Plantago lanceolata</u>	39.4	100	18.30
<u>Plantago rugelii</u>	0.7	20	0.35
<u>Prunella vulgaris</u>	0.3	10	0.05
<u>Satureja vulgaris</u>	1.2	30	0.15
<u>Solidago canadensis</u>	0.9	10	1.50
<u>Solidago nemoralis</u>	0.6	10	0.30
<u>Taraxacum officinale</u>	2.8	60	1.05
<u>Trifolium sp.</u>	-	100	15.00
<u>Vernonia noveboracensis</u>	0.9	30	2.10
<u>Viola sp.</u>	0.6	20	0.10
Unknown sp. 1	5.5	60	1.30
Unknown sp. 2	5.5	80	1.15
Unknown sp. 3	1.7	50	0.25
Unknown sp. 4	1.1	20	0.35
Unknown sp. 5	1.1	50	0.50
Unknown sp. 6	0.1	10	0.05
Seedlings	0.5	10	0.05

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 5 - FALL 1978 (Continued)

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Grasses and grass-like plants			
<u>Agropyron trachycaulum</u>	0.2	20	0.10
<u>Agrostis alba</u>	1.6	40	0.45
<u>Andropogon virginicus</u>	1.9	60	2.25
<u>Dactylis glomerata</u>	4.2	40	2.40
<u>Digitaria sp.</u>	0.4	30	0.15
<u>Panicum sp.</u>	1.4	50	0.25
<u>Paspalum pubescens</u>	1.4	10	0.30
<u>Phleum pratense</u>	1.3	50	0.50
<u>Poa pratensis</u>	-	100	17.10
<u>Sporobolus vaginiflorus</u>	1.5	40	0.45
<u>Triodia flava</u>	0.4	10	0.30
Unknown grass 1	9.5	80	3.60
Unknown grass 2	0.1	10	0.05
Unknown grass 3	1.5	10	1.50
Ferns			
<u>Botrychium sp.</u>	0.1	10	0.05
Moss			8.70
Total plant cover			90.00
Total litter cover			33.00
Bare Ground			4.20

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS

P&M/SRC-II SITE

TRANSECT 5 - SPRING 1979

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
Seedlings	0.2	20	0.10
Forbs			
<u>Achillea millefolium</u>	23.2	90	4.35
<u>Allium</u> spp.	1.4	20	0.10
<u>Cardamine hirsuta</u>	0.3	20	0.10
<u>Cerastium</u> spp.	4.5	80	0.40
<u>Chrysanthemum leucanthemum</u>	6.5	90	1.20
<u>Daucus carota</u>	3.3	80	0.65
<u>Fragaria</u> spp.	-	80	2.10
<u>Hieracium pratense</u>	21.5	60	4.90
<u>Plantago lanceolata</u>	23.8	100	2.50
<u>Stellaria minus</u>	5.4	60	0.30
<u>Taraxacum officinale</u>	16.4	70	2.80
<u>Trifolium</u> spp.	-	100	21.75
<u>Viola</u> spp.	3.7	90	0.45
Unknown species 1	1.7	40	0.45
Unknown species 2	0.4	10	0.05
Unknown species 3	0.3	20	0.10
Unknown species 4	4.8	60	0.80
Unknown species 5	0.1	10	0.05
Unknown species 6	6.0	30	0.15
Seedlings	101.5	100	1.75

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC-II SITE
TRANSECT 5 - SPRING 1979 (Continued)

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Grasses			
<u>Dactylis glomerata</u>	20.5	100	9.80
<u>Panicum spp.</u>	0.6	30	0.15
<u>Poa pratensis</u>	-	100	38.25
Unknown grass species 1	-	10	0.30
Unknown grass species 2	-	40	2.15
Moss	-	100	23.85
Total Plant Cover			90.00
Total Litter Cover			61.75
Bare Ground			5.40

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 6 - FALL 1978

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Forbs			
<u>Agrimonia parviflora</u>	0.2	10	0.05
<u>Ambrosia artemisiifolia</u>	13.8	100	13.15
<u>Aster pilosus</u>	0.1	10	0.05
<u>Cichorium intybus</u>	1.6	60	0.55
<u>Daucus carota</u>	10.9	100	1.25
<u>Fragaria</u> sp.	0.7	50	0.25
<u>Glechoma hederacea</u>	10.2	70	0.60
<u>Oxalis corniculata</u>	1.7	50	2.50
<u>Plantago lanceolata</u>	12.2	100	2.25
<u>Plantago rugelii</u>	2.2	60	0.80
<u>Solanum carolinense</u>	2.3	70	2.10
<u>Taraxacum officinale</u>	12.0	100	2.00
<u>Trifolium</u> sp.	-	100	1.75
<u>Vernonia noveboracensis</u>	1.6	70	2.80
<u>Viola</u> sp.	1.3	20	0.10
Unknown sp. 1	0.4	20	0.10
Unknown sp. 2	3.2	50	0.50
Unknown sp. 3	0.7	40	0.20
Unknown sp. 4	0.2	20	0.10
Seedlings	1.2	50	0.25
Grasses and grass-like plants			
<u>Agrostis alba</u>	19.5	10	1.50
<u>Digitaria</u> sp.	44.0	90	22.10
<u>Juncus tanuis</u>	0.3	20	0.10
<u>Panicum anceps</u>	0.3	10	0.05

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 6 - FALL 1978 (Continued)

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Grasses and grass-like plants (Continued)			
<u>Panicum</u> sp.	0.3	10	0.05
<u>Paspalum pubescens</u>	0.5	30	0.15
<u>Poa pratensis</u>	-	100	24.10
<u>Setaria glauca</u>	3.9	10	1.50
Unknown grass 1	10.9	90	5.30
Unknown grass 2	0.3	20	0.10
Unknown grass 3	0.1	10	0.05
Moss			0.0
Total plant cover			96.25
Total litter cover			47.50
Bare Ground			2.75

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC-II SITE
TRANSECT 6 - SPRING 1979

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Forbs			
<u>Achillea millefolium</u>	0.7	10	0.30
<u>Cerastium</u> spp.	12.2	70	1.35
<u>Chrysanthemum leucanthemum</u>	1.9	20	0.35
<u>Dancus carota</u>	5.2	90	1.45
<u>Fragaria</u> spp.	0.2	10	0.05
<u>Glechoma hederacea</u>	1.8	30	0.15
<u>Plantago lanceolata</u>	12.5	90	3.90
<u>Plantago</u> sp.	1.9	60	1.05
<u>Stellaria media</u>	0.4	20	0.10
<u>Taraxacum officinale</u>	10.3	100	6.35
<u>Trifolium</u> spp.	-	100	7.55
<u>Viola</u> spp.	0.2	20	0.10
Unknown species 1	17.0	10	0.30
Unknown species 2	0.1	10	0.05
Unknown species 3	0.3	10	0.05
Seedlings	105.5	100	2.00
Grasses			
<u>Anthoxanthum odoratum</u>	1.1	20	0.35
<u>Dactylis glomerata</u>	10.4	90	13.35
<u>Poa pratensis</u>	-	100	56.75
Unknown grass species 1	-	90	5.10
Unknown grass species 2	-	10	1.50
Unknown grass species 3	-	30	3.05
Unknown grass species 4	-	10	0.30
Total Plant Cover			90.25
Total Litter Cover			90.00
Bare Ground			3.95

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 7 - FALL 1978

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
<u>Prunus serotina</u>	0.2	20	0.10
<u>Rubus</u> sp.	2.8	70	4.25
<u>Sambucus canadensis</u>	0.1	10	0.30
<u>Seedlings</u>	0.1	10	0.05
Forbs			
<u>Achillea millefolium</u>	3.8	70	1.35
<u>Allium</u> sp.	1.4	40	0.20
<u>Ambrosia artemesiifolia</u>	0.2	20	0.10
<u>Aster laterifolius</u>	2.3	10	1.50
<u>Glechoma hederacea</u>	(8.7) ¹	30	5.55
<u>Lycopus virginicus</u>	0.2	10	0.30
<u>Oxalis</u> sp.	2.9	40	2.15
<u>Phytolacca americana</u>	0.6	40	0.95
<u>Potentilla canadensis</u>	8.1	70	4.30
<u>Prunella vulgaris</u>	1.4	10	1.50
<u>Rumex acetosella</u>	2.9	10	0.30
<u>Satureja vulgaris</u>	0.3	10	0.05
<u>Solidago altissima</u>	0.5	10	1.50
<u>Stellaria media</u>	2.0	10	1.50
<u>Taraxacum officinale</u>	0.1	10	0.05
<u>Trifolium</u> sp.	0.1	10	0.05
<u>Viola</u> sp.	0.5	20	0.10
<u>Unknown</u> sp. 1	0.1	10	0.05
<u>Unknown</u> sp. 2	0.9	40	0.20
<u>Unknown</u> sp. 3	0.1	10	0.05

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
P&M/SRC II SITE
TRANSECT 7 - FALL 1978 (Continued)

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
<u>Viola</u> sp. (Continued)			
Unknown sp. 4	0.1	10	0.05
Unknown sp. 5	0.9	10	0.30
Unknown sp. 6	0.1	10	0.05
Seedlings	0.1	10	0.05
Grasses and grass-like plants			
<u>Agropyron trachycaulum</u>	1.4	10	1.50
<u>Agrostis alba</u>	1.1	10	0.30
<u>Poa pratensis</u>	-	30	4.10
Unknown grass 1	-	100	11.25
Unknown grass 2	0.3	10	0.30
Unknown grass 3	1.8	10	0.30
Unknown grass 4	0.2	10	0.05
Unknown grass 5	0.7	10	0.50
Total plant cover			45.25
Total litter cover			92.50
Bare ground			0.65

EXHIBIT 9-4 (Continued)

DATA SUMMARY - 1 x 1 M QUADRATS
 P&M/SRC-II SITE
 TRANSECT 7 - SPRING 1979

<u>Species</u>	<u>Density (n/quadrat)</u>	<u>Frequency</u>	<u>Cover</u>
Woody plants			
<u>Prunus serotina</u>	1.4	40	0.20
<u>Rubus</u> spp.	0.8	20	0.10
Forbs			
<u>Achillea millefolium</u>	14.3	60	4.75
<u>Allium</u> spp.	9.3	80	5.75
<u>Cardamine hirsuta</u>	0.8	30	0.40
<u>Oxalis</u> spp.	3.8	40	0.20
<u>Polygonum</u> spp.	0.1	10	0.05
<u>Potentilla canadensis</u>	27.2	100	6.10
<u>Ranunculus allegheniensis</u>	0.1	10	0.05
<u>Stellaria media</u>	1.6	20	1.80
<u>Trifolium</u> spp.	0.1	10	0.05
<u>Unknown species 1</u>	18.8	60	3.70
<u>Unknown species 2</u>	4.0	20	1.80
<u>Seedlings</u>	19.1	100	0.50
Grasses			
<u>Dactylis glomerata</u>	0.3	10	0.30
<u>Poa</u> spp.	--	100	33.50
<u>Unknown grass species 1</u>	--	30	3.30
<u>Unknown grass species 2</u>	--	40	8.25
<u>Unknown grass species 3</u>	--	10	1.50
Moss	--	20	0.10
Total Plant Cover			75.00
Total Litter Cover			96.25
Bare Ground			3.45

SECTION 10

TERRESTRIAL ANIMAL ECOLOGY

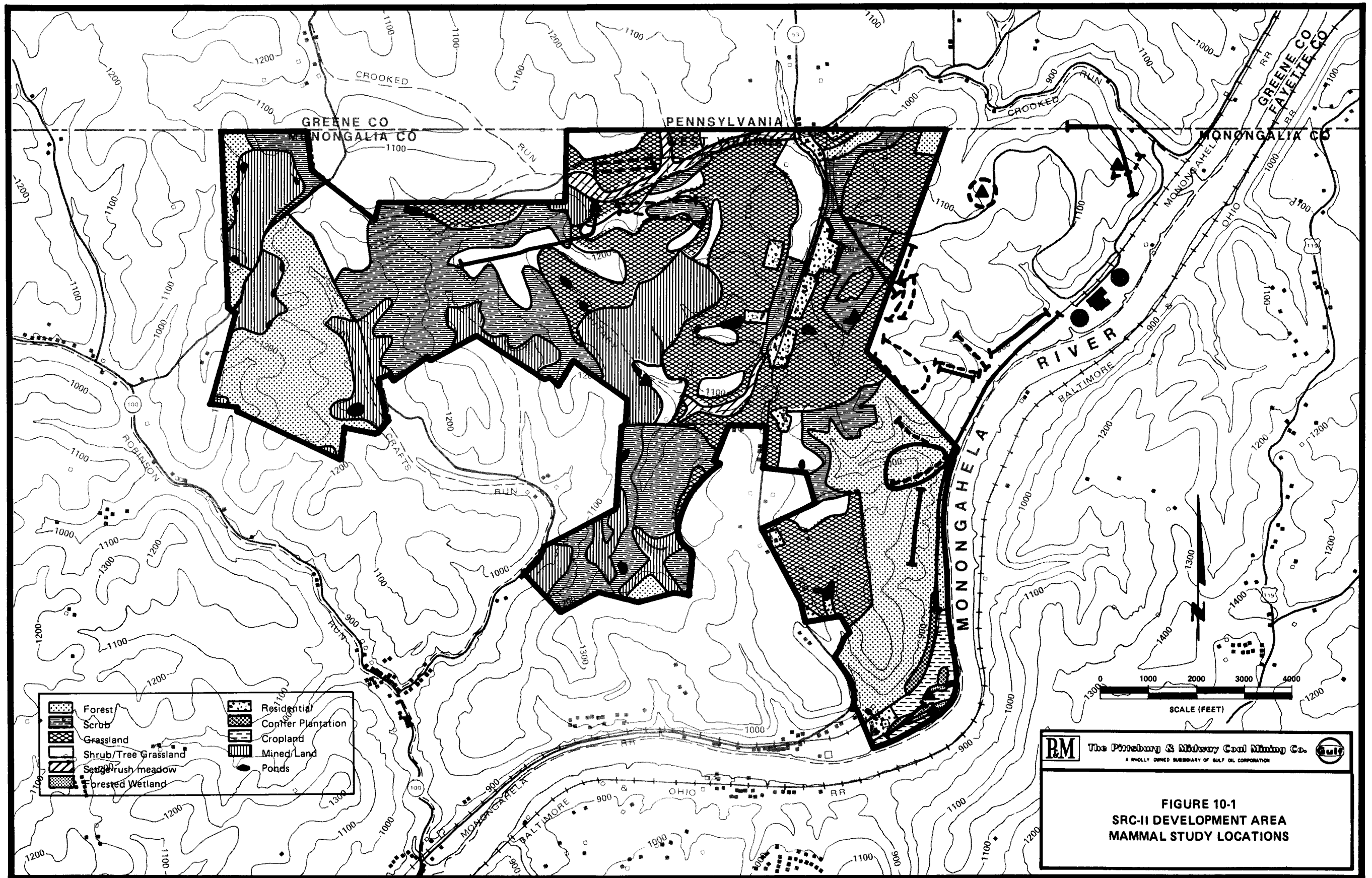
10.1 INTRODUCTION

Biologic surveys were conducted at the site during four consecutive seasons (Summer 1978, Fall 1978, Winter 1978-79, and Spring 1979) to describe the baseline condition of terrestrial animal ecology at the proposed SRC-II site.

This section presents the specific studies conducted and data collected during the first three seasonal surveys. For clarity, the terrestrial vertebrate fauna has been divided into three groups as follows: mammals, birds, and herpetofauna (reptiles and amphibians). These groups are presented by habitat type and treated separately under Results and Discussion.

The project vicinity is situated in the Ohio-West Virginia Hills subpart of the Appalachian Plateau physiographic province which is characterized by relatively low, rounded hills and narrow valleys, with elevations under 2000 feet. The average annual temperature is 11-12°C (52-54°F) and the average annual precipitation is 102-114 centimeters (40-45 in.).

The southeast area of the site borders the Monongahela River and encompasses a 9.6 square kilometer (3.7 mi²) portion of the forested east-facing slope of the river valley. Elevation ranges from 245 meters (805 ft.) at the river to 384 meters (1260 ft.) atop the highest hills on the west side. The climax vegetation of the area is eastern mixed-mesophytic forest. However, the area in general, and the site in particular, has been altered in the past century by timbering, agriculture, and strip-mining. For this reason, broad, functional categories have been used in this section to describe terrestrial animal habitats. A discussion of the vegetation of the habitat-types used in Figure 10-1 is given in the previous section, "Plant Ecology."



10.2 METHODS

Roughly 550 field hours will be devoted to studying the terrestrial vertebrate fauna of the site during Phase Zero of the SRC-II project. This report will concern the studies performed and the results obtained after about 300 field hours of sampling during the summer (August 1978), fall (October 1978) and winter (February, March 1979) seasons. The field effort to date has been evenly divided between mammals and birds. Since the primary field effort for herpetofauna will occur during spring 1979, the information currently available for the group is minimal.

10.2.1 Mammals

Three methods used to study mammals included live-trapping for small mammals (rodents, insectivores), an aerial survey for deer population census and squirrel leaf nest count, and qualitative observations (animal sightings, tracks, scats, dens) during transect or habitat-specific investigations.

Transect traplines were established for live trapping in the major habitat types of the site (Figure 10-1). The number of traps used, and the number of nights in which trapping was conducted varied by season and habitat type (Table 10-1). Traps were placed along each transect at 10 to 15 meters (30-50 ft.) intervals, and were set during the day baited with a mixture of rolled oats, bird seed, and peanut butter. A small ball of cotton for warmth was placed in each trap during the fall and spring seasons. Traps were checked the following morning. Captured animals were released after identification of species level, sex, and released. Representative voucher specimens were collected and prepared according to standard museum practice.

An aerial survey of the site vicinity was conducted in February 1979, to produce a population census (total count) for deer and a count of squirrel leaf nests on the site. A Bell Jet Ranger helicopter was employed (9:50 a.m. to 11:40 a.m.) to survey an area

TABLE 10-1
SMALL MAMMAL, LIVE TRAPPING EFFORT
P&M/SRC-II SITE

<u>Habitat Type</u>	<u># Trap Nights</u>		
	<u>Summer</u> (8/78)	<u>Fall</u> (10/78)	<u>Winter</u> (2/79)
Forest (upland)	100	120	-
Forest (streamside)	100	120	-
Forest-meadow border	160	240	-
Scrub (brushland)	-	240	-
Grassland (pasture)	160	80	-
Wetland	40	40	-
Meadow hedgerow	-	20	-

(Figure 10-2) of 13 square kilometers (5.0 sq. mi.). This aerial survey area was larger than the project site for two reasons. Boundaries easily navigable from the air were chosen because of the difficulty in flying the actual site boundaries. The wooded areas in census units 2 and 3 formed a habitat continuum with unit 1.

Substrate and weather conditions were excellent. An average speed of 80 kilometers per hour (50 m.p.h.) was maintained at an altitude of 60-120 meters (200-400 ft.). A fresh snowfall uniformly blanketed the site, providing a high contrast background for observation. Vertical visibility was acceptable since the forest has little persistent foliage and only a few, small conifer plantings. The sky was clear, the early morning fog had burned off, there were light winds, and the temperature was about 4⁰ C (39.2⁰F). The survey, therefore, produced accurate results.

Presence, distribution, and abundance of other mammalian species was evaluated by qualitative observation. Documenting evidence included animal sightings, tracks, scats, nests, dens, fur, skeletal parts, and audible sounds. Transects were established in various habitats to characterize species distribution patterns (Figure 10-1). Habitat features likely to receive concentrated use by mammals were

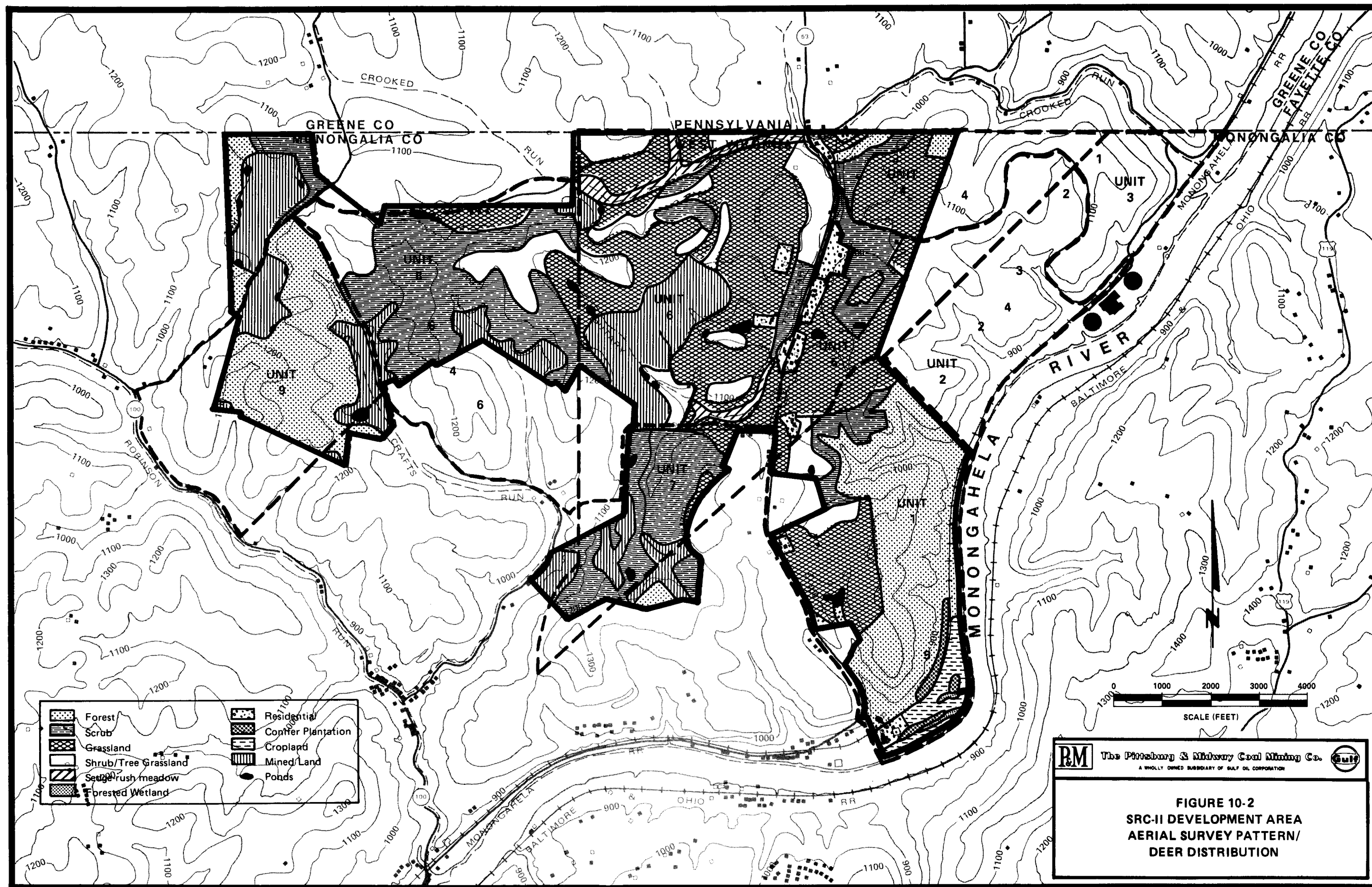


FIGURE 10-2
SRC-II DEVELOPMENT AREA
AERIAL SURVEY PATTERN/
DEER DISTRIBUTION

intensively searched for signs. Such features included trails, riparian and pond margins, marshes, rocky ledges and outcroppings, and locations with newly planted or early seral vegetation.

The reliability of signs to provide population estimates depends upon sign visibility, fidelity of animals to particular habitats or travel routes, animal density, and observer experience. Track presence of canids, felids, raccoon, opossum, skunk, and mink were used to roughly estimate abundance. Sign of weasel or flying squirrel was difficult to locate and could be used only to establish presence. Leaf nest and call counts from transects provided a good estimate of abundance for tree squirrels. The visibility of woodchucks and their burrows allowed an accurate assessment of their numbers. Clear muskrat population estimates were possible due to easily located lodge, slide, track, and scat sign. The relative abundance of cottontails was determined by sighting frequency. Deer tracks and pellet groups have been used through all seasons to establish use patterns.

10.2.2 Birds

In order to provide site specific data, a baseline study was initiated with the following objectives: 1) To provide a seasonal analysis of the occurrence, distribution, and relative abundance of bird species in major habitats on the project site; 2) To obtain additional, more specific data for special status species; and 3) To compare seasonal patterns of these parameters with those of the broader region in which the site is located.

Surveys were conducted to characterize bird populations of the site during the late summer breeding period (August 6-11, 1978), fall migration (October 2-6, 1978) and late winter (March 12-15, 1979). Additional winter data were collected during animal surveys in February 1979.

Representative study areas were surveyed seasonally in major habitats on and immediately adjacent to the site. Surveys were

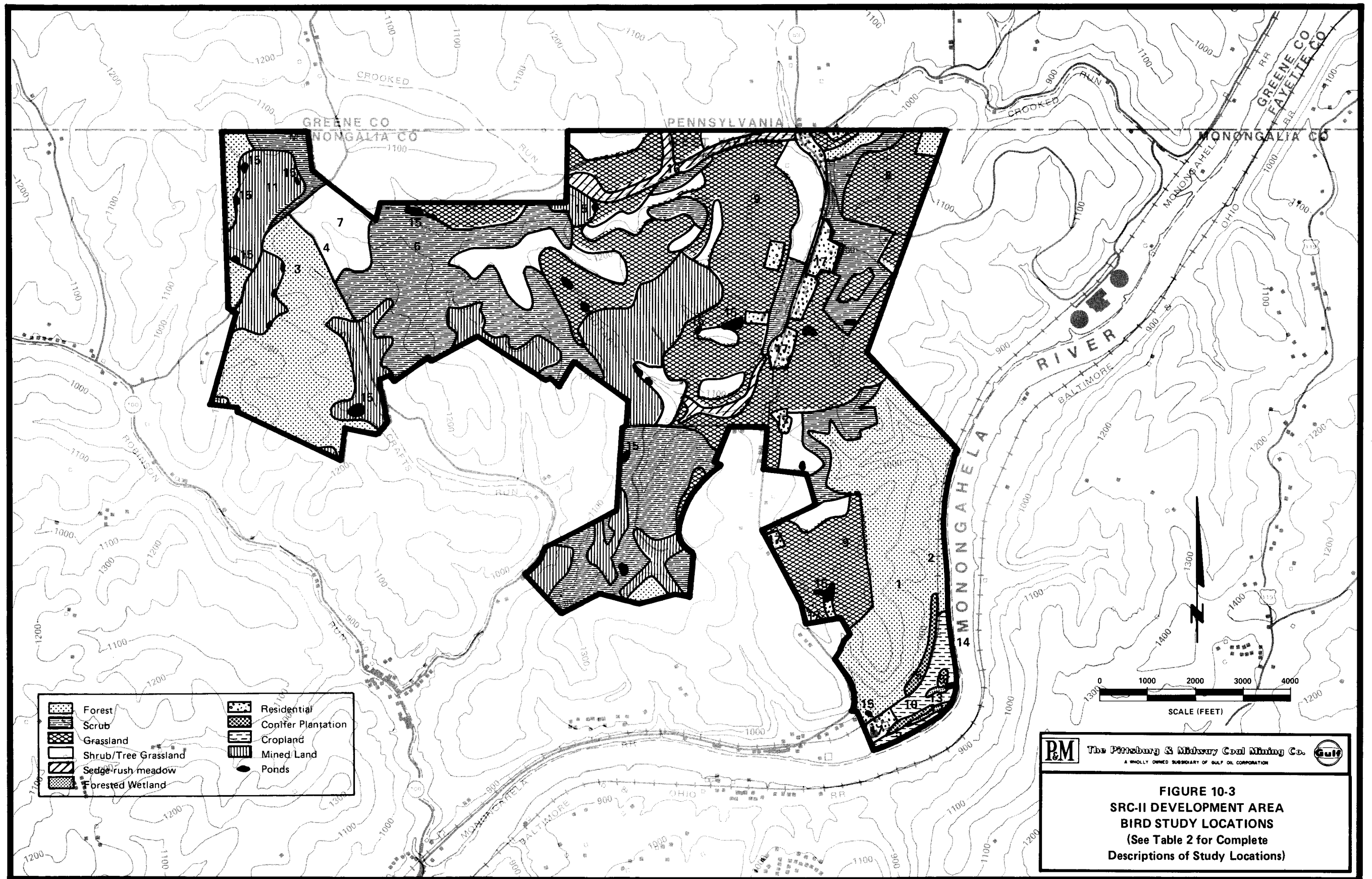


TABLE 10-2
BIRDS, STUDY EFFORT
P&M/SRC-II SITE

<u>Study^a Location No.</u>	<u>Habitat Type</u>	<u>Seasonal^b Coverage</u>	<u>Census Technique</u>	<u>Belt Transect Length</u>	<u>Dimensions Width</u>	<u>Total Coverage Area</u>
	<u>Forest</u>					
1	slope deciduous forest interior	Su,Fa,Wi	General observation (Su,Fa); belt transect sample (Wi)	1128m(3700ft)	91m(300ft)	10.2ha(25.5 ac)
2	slope deciduous forest edge	Su,Fa,Wi	Same	1082(3550)	61(200)	6.5(16.3)
3	upland deciduous forest interior	Wi	Belt transect sample	625(2050)	91(300)	5.6(14.1)
4	upland deciduous forest edge	Su,Fa,Wi	General observation (Su,Fa); belt transect sample (Wi)	762(2500)	61(200)	4.6(11.5)
5	conifer plantation interior and edge (three areas covered)	Wi	Direct observation and count; total coverage	--	--	3.0(7.6)
6	<u>Scrub</u>	Wi	Belt transect sample	457(1550)	61(200)	2.8(6.9)

TABLE 10-2 (Continued)

BIRDS, STUDY EFFORT
P&M/SRC-II SITE

Study ^a Location No.	Habitat Type	Seasonal ^b Coverage	Census Technique	Belt Transect Length	Dimensions Width	Total Coverage Area
7	<u>scrub</u>	Su,Fa,Wi	General observation (Su,Fa); belt transect sample (Wi)	777m(2550ft)	46m(150ft)	3.5ha(8.8a)
	<u>Grassland</u>					
8	meadow	Su,Fa,Wi	General observation (Su,Fa); belt transect sample (Wi)	381(1250)	61(200)	2.3(5.7)
9	pasture (grazed) (two areas covered)	Su,Fa,Wi	Same	1. 671(2200) 2. 488(1600)	91(300) 91(300) Total	6.1(15.2) 4.4(11.0) 10.5(26.2)
	<u>Cropland</u>					
10	floodplain crop- land-two types covered (tilled field and harvested cornfield)	Wi	Direct observation and count; total coverage	--	-- (two types combined)	5.6(14.0)

TABLE 10-2 (Continued)

BIRDS, STUDY EFFORT
P&M/SRC- II SITE

Study ^a Location No.	Habitat Type	Seasonal ^b Coverage	Census Technique	Belt Transect Length	Dimensions Width	Total Coverage Area
11	<u>Mined Land</u> revegetated spoil area-grassland	Wi	Belt transect sample	427m(1400ft)	91m(300ft)	3.8ha(9.6ac)
12	<u>Wetland</u> wooded floodplain pond	Wi	Direct observation and count; total coverage	--	--	.6(1.6)
13	shrubby and open floodplain pond	Wi	Same	--	--	.6(1.4)
14	Monongahela River (open water and shoreline; entire length of river bordering site boundary)	Wi	Same	--	--	28(70.3)
15	open ponds	Su,Fa,Wi	General observation (Su,Fa); direct observation and count- total coverage (six ponds)-Wi	--	--	1.7(4.1)

TABLE 10-2 (Continued)

BIRDS, STUDY EFFORT
P&M/SRC-II SITE

<u>Study^a Location No.</u>	<u>Habitat Type</u>	<u>Seasonal^b Coverage</u>	<u>Census Technique</u>	<u>Belt Transect Length</u>	<u>Dimensions Width</u>	<u>Total Coverage Area</u>
16	shrub wetland	Wi	Direct observation and count; total coverage	--	--	4.5(11.3)
17	residential Areas	Su,Fa,Wi	General observation (Su,Fa); direct observation and count-total coverage (Wi)	--	--	15(37.0)

^aSee Figure 10-3 for location of study areas.

^bSu = Summer (August 1978)
 Fa = Fall (October 1978)
 Wi = Winter (March 1979)

observer slowly walked a straight compass line through the habitat and recorded all species and individuals observed within a maximum perpendicular distance to both sides of the compass line. The distance of birds from the centerline was estimated visually. Individuals observed outside the transect but in the habitat were recorded separately. Belt widths differed by habitat depending on the density of vegetation and bird detectability. Belt widths ranged from 46 meters (150 ft.) in scrub habitat composed of very dense vegetation, to 91 meters (300 ft.) in more open habitats such as deciduous forest interior and pasture. The lengths of transects in each habitat were similar and ranged from 381 meters (1250 ft.) to 1128 meters (3700 ft.). All belt transect censuses were conducted in the morning, usually between 0700 and 1100 hours (EST). In sufficiently small or open habitats, (i.e. conifer plantation, floodplain cropland, all wetland habitats, and residential areas) all species and individuals present were directly observed and recorded. One census was completed in each study area.

The relative abundance of each species recorded in a belt transect or in a total habitat was defined as the percent composition of the species with respect to the total community. Species were grouped in the following relative abundance classes, which reflect the reliability of the data:

1	=	0	-	20%
2	=	21	-	40%
3	=	41	-	60%
4	=	61	-	80%
5	=	81	-	100%

Absolute community densities (totaled individual species densities) were calculated for winter populations in terrestrial or semi-terrestrial (shrub wetland) habitats where passerines (songbirds) and similar groups are usually most abundant. Community densities were not calculated for habitats in which populations fluctuated widely (ponds, Monongahela River, and residential areas). Densities were also grouped into five classes which reflect the reliability of the data:

- 1 = 0 - 100 birds per 40 ha (100 ac)
- 2 = 101 - 200
- 3 = 201 - 300
- 4 = 301 - 400
- 5 = 401 - 500

In the winter survey, diurnal raptors and other relatively large and wide-ranging species were censused by walking much of the site and directly searching for individuals. The location of each observation was recorded. During each seasonal survey, additional general observations of birds were used to supplement data collected by more specific techniques. A literature review provided supplementary and comparative information.

10.2.3 Herpetofauna

Information regarding site herpetofauna during the August and October field trips was obtained solely from observations incidental to the conduct of other studies. The April field trip was chosen as a period for active sampling of amphibian populations due to their pronounced breeding activity during that time period.

Many reptiles wander widely and are often located by chance encounter. Various aquatic and semi-aquatic habitats were searched (Figure 10-4), in part for reptilian species which are attracted to or are dependent upon such habitats.

Amphibians are easier to sample than are reptiles, due to their reliance on moisture. Many species require standing or running water for a portion of their life cycle. Terrestrial amphibians were sampled by searching under objects (i.e. stones, boards, logs, bark, etc.) in various habitat types. Aquatic and semi-aquatic amphibians were sampled by searching ponds, streams, and springs in the site vicinity (Figure 10-4). Because many amphibians are nocturnal, lights were used to sample certain locations at night. Stream waters and banks were searched, stones were overturned, and ponds were waded with lights and dip nets.

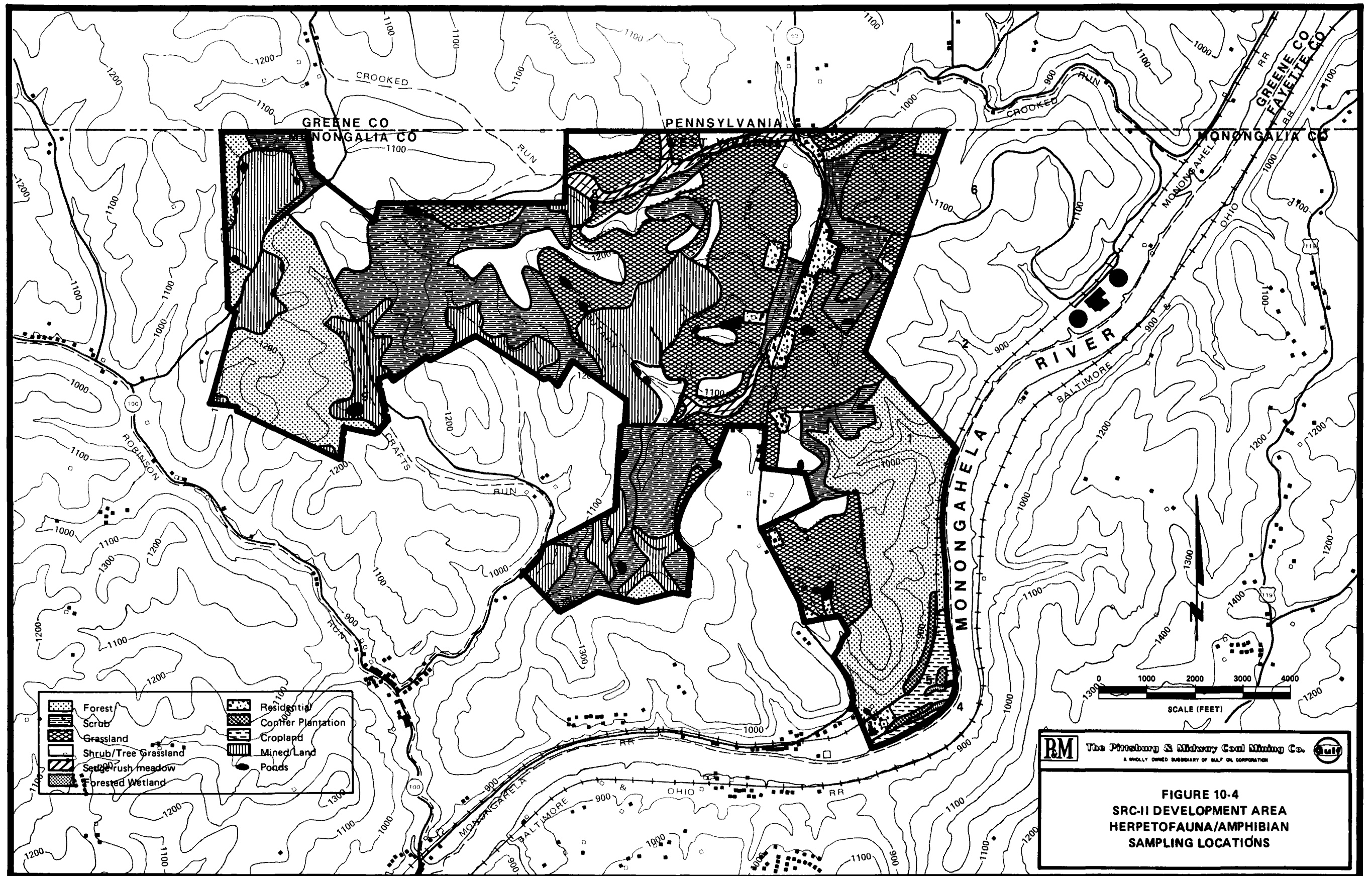


FIGURE 10-4 KEY

SAMPLING LOCATIONS
HERPETOFAUNA
P&M SRC-II SITE

1. Forest Ravine Stream #1: Small, clear spring-fed stream
2. Forest Ravine Stream #2: As above
3. Fort Martin Upland Stream: Small, clear pond and spring-fed stream through pasture scrub and woodlot.
4. Silver Maple Swamp: Small floodplain swamp (approximately 0.5 ha); silver maple, sycamore, slippery elm.
5. Floodplain Pond: Small pond (roughly 0.5 ha) surrounded by black willow, black locust, maples and slippery elm.
6. Keener's Knob Pond: Upland pond (roughly 0.25 ha) surrounded by second growth vegetation. Well developed organic sediment layer with anaerobic decomposition.
7. Upland Pasture Stream: Small pond and spring-fed pasture stream from strip-mine area.
8. Crooked Run Pond: Small pond (roughly 0.1 ha) along Crooked Run below an abandoned strip-mine pit. Bare margins.
9. Craft Run Pond: Small pond (roughly 0.25 ha) at base of revegetated strip-mine. Grassy margins.
10. Other locations include: forest-woodland habitats; wet-meadows, wetland margins; temporary pools at woodland edges.

10.3 RESULTS AND DISCUSSION

10.3.1 Mammals

The mammalian fauna of the project vicinity is evaluated by taxonomic category in Exhibit 10-1. A total of 58 mammals were considered. Following each table entry, three information columns evaluate each species' presence in Monongalia County, presence in the project area, and possible special status. The presence of each species in Monongalia County is evaluated with an affirmative "present" or an indeterminate entry of "unknown." The following references were used in this determination: Bradshaw and Gibbons 1967; Bradshaw 1965; McKeever 1952; Hall and Kelson 1959; and Burt and Grossenheider 1964. The status of each species in the project area is evaluated in the next column; entries include self-explanatory ones, such as, "present," "unknown," or "unlikely." Other possible entries form a graded series of qualitative abundance estimates (rare, occasional, common, abundant) for species encountered during project field work. These estimates are often subjective and must be interpreted with respect to the species' natural history and typical population level. Common names, as given by Jones, Carter and Genoways 1973, are used for mammal species throughout this report; corresponding scientific names are given in Exhibit 10-1.

Exhibit 10-1 includes 44 mammals which have been shown to occur in Monongalia County. The representation of mammalian orders among these 44 is as follows: one marsupial, six insectivores (shrews, moles), 10 chiropterans (bats), one lagomorph, 18 rodents, eight carnivores, and one ungulate. The orders marsupiala, lagomorpha, and ungulata, are represented by a single species on the site. All six insectivores are reasonably suited to occur in the project area, although the presence of only two was confirmed. Eleven chiropterans (bats) could potentially occur in the project area, although none were seen or mist netted there. The presence of 10 rodent species was confirmed in the project area; one more, or 11 species total, could potentially occur in the area. Of the eight carnivores known to occur in the county, each could occur in the project area and the presence of four species was confirmed.

10.3.1.1 Forest Habitat Type

The forest habitat type occupies about 24 percent (230 ha, 568 a) of the project site. Roughly three-fifths of this forested area is located on the east-facing slope of the Monongahela River valley and two-fifths is situated on the western project site (Figure 10-1). The forested river valley slope is deeply dissected at several locations by small streams, which provides the basis for a broad division of the forest habitat into upland and streamside subtypes. The forested slope has been timbered at least once. It is, however, less disturbed than the western forested area; most of the western area would fit in the upland subtype. Many mammals have found suitable habitat in the forest.

Traplines were established to sample small mammals (rodents and insectivores) according to the upland and streamside subtypes (Figure 10-1). Different locations were used to sample the forest habitat during the summer and fall seasons. The results of these samples are given in Tables 10-3 (upland) and 10-4 (streamside).

TABLE 10-3
FOREST (UPLAND) HABITAT TYPE, LIVE TRAPPING RESULTS
P&M/SRC-II SITE

	Summer (8/78)	Fall (10/78)	Both seasons
<u>Species (3)</u>	<u>100 trap nights</u>	<u>120 trap nights</u>	<u>220 trap nights</u>
Short-tailed shrew	1 (14%)	2 (25%)	3 (20%)
Eastern chipmunk	2 (29%)	-	2 (13%)
White-footed mouse	4 (57%)	6 (75%)	10 (67%)
Total	7 (100%)	8 (100%)	15 (100%)

TABLE 10-4
FOREST (STREAMSIDE) HABITAT TYPE, LIVE TRAPPING RESULTS
P&M/SRC-II SITE

	Summer (8/78)	Fall (10/78)	Both seasons
<u>Species (4)</u>	<u>100 trap nights</u>	<u>120 trap nights</u>	<u>220 trap nights</u>
Short-tailed shrew	3 (30%)	3 (17%)	6 (21%)
White-footed mouse	4 (40%)	15 (83%)	19 (68%)
Norway rat	1 (10%)	-	1 (4%)
Meadow jumping mouse	2 (20%)	-	2 (7%)
Total	10 (100%)	18 (100%)	28 (100%)

Five species of small mammals were trapped in the forest habitat-type: white-footed mouse, short-tailed shrew, eastern chipmunk, meadow jumping mouse, and norway rat. The white-footed mouse formed the bulk of all captures and was evenly distributed across the upland (67 percent) and the streamside (68 percent) subtypes. This semi-arboreal rodent is not, however, restricted to the forest; it is found in all habitats which provide sufficient cover. The short-tailed shrew was the second most abundant small mammal trapped in this habitat-type. Like the white-footed mouse, this insectivore is not restricted to the forest and was evenly distributed across the upland (20 percent) and streamside (21 percent) forest habitat subtypes. The short-tailed shrew feeds on worms, snails, and other small invertebrate animal life. This emphasis on a variety of animal food matter frees the shrew from habitation of specific vegetation types.

The eastern chipmunk represented 13 percent of the animals trapped in the upland forest subtype. Although it was not captured in the streamside subtype, this chipmunk was observed to include streamside forest in its range of activities. The chipmunk maintains

a fidelity to deciduous forest and brushy areas; it was not captured or observed in other habitat types on the site. The meadow jumping mouse was captured only in the streamside subtype, where it contributed seven percent to the total catch. Relatively little information is available on the habitat requirements of this species, although it is seldom found far from water. One specimen of the norway rat was captured in the streamside subtype near the confluence of a small stream with the Monongahela river.

No observation or sign of the muskrat was noted in the streamside forest subtype or along the Monongahela River. Bats were not observed or mist-netted in any habitat type. Both the woodchuck and the eastern cottontail preferred the forest edge, where they sought cover while feeding in adjacent grasslands. Woodchuck burrows were numerous in this habitat situation but cottontails were not commonly seen.

The winter aerial survey and numerous ground transects produced little evidence of tree squirrel activity in the forest habitat type. Three tree squirrel leaf nests, probably those of the gray squirrel, were found in the river slope and western site forests; these were in disrepair and judged inactive. Five gray squirrel leaf nests were found in one of the small conifer plantings in the floodplain but only one was maintained and occupied. The grouping of nests likely represents the efforts of one or a pair of gray squirrels. The gray squirrel is primarily arboreal and prefers extensive hardwood forest with an unbroken canopy. Much of the forested acreage of the site is broken into small copses which are unsuitable for the species. The eastern river slope supports the only significant continuous block of forest on the site. The gray squirrel also requires a sufficient supply of mast provided by oaks, beech, hickory, or walnut. Of these mast-producing species, oak and beech occur in the eastern slope forest, either singly or in very small pockets. This situation probably leads to limited, irregular mast crops at 2 to 10-year intervals. Competition for the limited mast by raccoon, fox, chipmunk, and deer aggravates the situation. While these species

consume mast facultatively, the gray squirrel requires it. Uhlig (1957) found an average density of 1.5 gray squirrels/ha (0.6/a) during a five-year study of four locations in West Virginia; he found half this value at Cooper's Rock State Forest.

There was no sign of the fox squirrel in the forest habitat type, nor was the typically loud red squirrel heard. Limited evidence of the fox squirrel was found, however, in another more appropriate habitat type (scrub). Although suitable habitat appears to exist on the project site for the southern flying squirrel, its presence was not established. Specialized study methods, are necessary to properly assess the status of this nocturnal, tree-hole dweller.

10.3.1.2 Scrub Habitat Type

The scrub habitat type is widely distributed on the project site where it represents 16.3 percent (156 ha, 386 a) of the total area. It comprises the seral recovery stages of oldfield and encompasses subtypes such as grassland scrub, brushland, woodland scrub, and ecotonal scrub. Sampling locations in the scrub habitat type are given in Figure 10-1.

A trapline was established in a brushy, wooded subtype; results for this small mammal sample are given in Table 10-5. Three species of small mammals were captured: the white-footed mouse, the short-tailed shrew, and the meadow vole. The meadow vole formed the bulk of the captures (47 percent) during the fall season. This vole is not restricted to scrub but is found in all habitat types and subtypes which have sufficient grassy cover. The white-footed mouse represented 41 percent of captures in the scrub sample. Cover in the form of brush or forest is an important determining factor in the presence of the species. The short-tailed shrew contributed 12 percent of the captures, which is a smaller showing than in the forest habitat.

TABLE 10-5
 SCRUB (BRUSHLAND) HABITAT TYPE, LIVE TRAPPING RESULTS
 P&M/SRC-II SITE

<u>Species (3)</u>	Fall (10/78) <u>240 trap nights</u>
Short-tailed shrew	2 (12%)
White-footed mouse	7 (41%)
Meadow vole	8 (47%)
Total	17 (100%)

Certain mammals are characteristic of the scrub habitat or forest edge. Woodchucks, cottontails, and fox squirrels are chief among these. Several carnivores use this habitat type as a portion of their larger range and will, therefore, be discussed under composite habitat types. No bats were observed in this habitat type.

Woodchuck burrows were numerous in the scrub habitat. Although cover is not a requisite for its burrow, it contributes to the woodchuck's success. An edge situation near a meadow or pasture where vegetation is consumed is ideal. Although there appears to be ample, suitable cottontail habitat in the scrub areas, very few sightings were made during field studies. This may reflect a more general condition in the northwestern West Virginia southwestern Pennsylvania region.

The eastern fox squirrel was detected at very low population levels in the scrubland although the reasons for this are unclear. A set of tracks was noted in a small scrub woodlot near the Ft. Martin road at the Keener's Knob turnoff; the presence of at least one pair may be inferred from this. Another fox squirrel nest, apparently inactive, was found in a similar setting on the western project site. The fox squirrel frequently forages on the ground and may be found there in open grassland scrub.

Eastern carnivores may not be considered true scrub species, although, two are commonly associated with such habitat. The spotted skunk inhabits brushy or open scrub vegetation over much of its range. Appropriate habitat, therefore, is present on the site. Although its presence was not confirmed, a possible spotted skunk scat was found at a suitable den entrance near Crooked Run. The spotted skunk will tentatively be considered present, although at low density.

A second eastern carnivore in this habitat is the least weasel which feeds almost exclusively on mice and lives in habitats such as scrub, where they are abundant. The weasel's home range is small, usually less than a hectare (2.5 acres), and tends to be uniform. The species has been documented in the county (Bradshaw and Gibbons 1967), but its presence has not been established on the site. Weasel sign is difficult to locate and no specific trapping effort was made. This species is considered rare in Monongalia County, hence, its presence on the site is low density.

10.3.1.3 Grassland Habitat Type

Grassland, in the form of pastures (grazed) and meadows (hayed) represents 40.9 percent (392 ha, 969 a) of the project site. It is, therefore, the most extensive of the major habitat types on the site. Only a few mammal species are restricted entirely to the grassland habitat, but many depend on it directly or indirectly for food. Special features of the grassland habitat, such as hedgerows or forest edge, have special value as animal habitat.

Trapline results obtained in the grassland of the site are given in Tables 10-6, 10-7, and 10-8. The results of trapping a large, heavily grazed pasture on the north-central project site are given in Table 10-6. The meadow vole was captured in this pasture. These results should not be interpreted critically since the traplines were seriously disturbed by cattle. Further, this microtine is well known to undergo extreme population fluctuations. The meadow vole is

TABLE 10-6

GRASSLAND (PASTURE) HABITAT TYPE, LIVE TRAPPING RESULTS
P&M/SRC-II SITE

	Summer (8/78)	Fall (10/78)
<u>Species (1)</u>	<u>160 trap nights</u>	<u>80 trap nights</u>
Meadow vole	7 (100%)	1 (100%)
Total	7 (100%)	1 (100%)

TABLE 10-7

GRASSLAND (MEADOW-FOREST BORDER) HABITAT TYPE
LIVE TRAPPING RESULTS
P&M/SRC-II SITE

	Summer (8/78)	Fall (10/78)	Both seasons
<u>Species (5)</u>	<u>160 trap nights</u>	<u>240 trap nights</u>	<u>400 trap nights</u>
Short-tailed shrew	-	19 (37%)	19 (32%)
Eastern cottontail	-	1 (2%)	1 (2%)
Meadow vole	6 (67%)	28 (54%)	34 (57%)
House mouse	-	1 (2%)	1 (2%)
Meadow jumping mouse	3 (33%)	3 (6%)	6 (10%)
Total	9 (100%)	52 (100%)	61 (100%)

TABLE 10-8
GRASSLAND (HEDGEROW) HABITAT TYPE, LIVE TRAPPING RESULTS
P&M/SRC-II SITE

<u>Species (2)</u>	Fall (10/78) <u>20 trap nights</u>
Short-tailed shrew	1 (50%)
White-footed mouse	1 (50%)
Total	2 (100%)

restricted to situations with sufficient grassy cover, therefore, it is found in the grassland-scrub habitat type as well as in the open grassland.

A meadow-forest edge situation bordering the eastern site river slope forest was sampled fairly intensively (Table 10-7). An interesting admixture of small mammals was found here at fairly high abundance. An active surface spring is located near one end of the trapline (Figure 10-1); it feeds a small wooded stream which gradually diverges from the course of the trapline. The meadow vole was the most abundant small mammal. The short-tailed shrew constituted 19 percent of the captures, which is very close to its relative abundance in the forest (20 percent). The shrew was also captured in scrub and hedgerows, but not in open pasture. The wooded stream near parts of the trapline housed the meadow jumping mouse, which comprised six percent of the captures. This mammal was previously found only in mesic habitats, which include the wetlands and forest (streamside subtype). A dispersing sub-adult house mouse was captured in the fall, as well as a single sub-adult cottontail. Although this edge habitat is an abrupt transition between forest and meadow, and it does not allow a variety of sightings, it has some value for cottontails.

Trapping in the grassland (meadow) hedgerow (Table 10-8) produced an equal response from the white-footed mouse and the short-tailed shrew. These species require the cover found here and are not typically found in open grassland without hedgerows.

Woodchucks were common, although burrows are most often located in scrub adjacent to grassland or forest edge. No other mammals, except domestic stock, were restricted to the grassland. Deer, carnivores, and lagomorphs, however, all forage in grasslands. The least weasel is restricted either to scrub or grassland habitat types. Its small home range may confine it to meadow areas where it feeds primarily on voles. The presence of the species has not been documented on the site.

10.3.1.4 Wetland Habitat Type

The wetland habitat type occupies roughly one percent (10 ha, 24a) of the project site and is comprised of widely distributed small ponds and wet meadows. All the ponds are manmade impoundments. Some of the ponds, streams, and their margins are suitable habitat for small mammals, obligatory habitat for the muskrat, and foraged by several carnivores for their small mammals, herpetofauna, and invertebrate forms. Wet meadows provide similar habitat, although lower diversity and higher productivity of small mammals is apparent. The wetlands contribute a significant insect crop available to chiropterans and omnivorous or carnivorous small mammals.

A trapline was placed on the margin of a small pond on Keener's Knob (Figure 10-1), which is situated off the prospective project site. A brushy scrubland encroaches on the pond and borders roughly half its circumference; cattails or dense grasses border the remainder.

Typically, the meadow vole was abundant (45 percent) in the wetland (Table 10-9). The species favors the dense grassy vegetation for cover and food. The short-tailed shrew was also abundant in the wetland, probably in response to the availability of invertebrates.

TABLE 10-9
WETLAND (POND MARGIN) HABITAT TYPE, LIVE TRAPPING RESULTS
P&M/SRC-II SITE

	Summer (8/78)	Fall (10/78)	Both seasons
<u>Species (4)</u>	<u>40 trap nights</u>	<u>40 trap nights</u>	<u>80 trap nights</u>
Short-tailed shrew	-	4 (44%)	4 (36%)
White-footed mouse	-	1 (11%)	1 (9%)
Meadow vole	2 (100%)	3 (33%)	5 (45%)
Meadow jumping mouse	-	1 (11%)	1 (9%)
Total	2 (100%)	9 (100%)	11 (100%)

The meadow jumping mouse was detected at low levels; this species typically prefers mesic conditions and associated cover. One white-footed mouse, probably associated with the nearby brush, was captured while foraging there.

Only those ponds in an advanced entrophic state support the emergent and submergent vegetation necessary to sustain a muskrat population. Cattails are one of the most important winter foods throughout their range (Martin et al 1951; Errington 1963). Arata (1959) found 75 percent of muskrat winter diets to consist of cattails. Other important winter foods included bulrush and burreed. Most of the small ponds of the project site are relatively new and do not support sufficient quantities of muskrat foods although wet meadows may provide habitat for small numbers of muskrats. Past evidence of the muskrat was found in the form of inactive lodges and slides. Fresh muskrat tracks and slides were observed at a small, wooded pond on the floodplain.

Wide-ranging carnivores which use the wetlands heavily, such as the raccoon, will be discussed in the following composite habitat

types. Only one carnivore, the mink, is restricted to the wetland habitat. Mink are found along streams, lakes, and in marshes where they feed on small mammals, birds (and their eggs), frogs, fish, and crayfish. Such aquatic fare is locally abundant in the many small ponds and streams on the site. Although a limited amount of suitable mink habitat does exist, a search for tracks, scats, or dens was not productive. The mink is solitary and are usually present at low density, as many wander widely. The species has been documented within three or four kilometers of the site (Bradshaw and Gibbons 1967) and could inhabit its wetland communities.

10.3.1.5 Other Habitat Types

Residential yards (1.6 percent), cropped fields (1.9 percent), and recently mined lands (13.3 percent) comprise the remaining project site. These types contribute little in the way of novel mammal species and they provide only slight modifications on the basic habitat themes presented thus far. Exceptions are the house mouse and norway rat which are restricted to residential or farm buildings. Some habitat may also be provided in buildings for bats and squirrels.

10.3.1.6 Composite Habitat Type-Carnivores

Most carnivores range widely in order to find sufficient prey. Many are opportunists, using a wide variety of food found in various habitats. These characteristics lead to the use of multiple (or a composite of) habitat types.

Although not a true carnivore, the opossum will be discussed here as a functional equivalent. It is a relatively sedentary creature, ordinarily living within a 20 hectare (50 ac.) territory. The opossum is opportunistic and fully exploits the habitat within its territory. Mixed bottomland forest, cropland and brushland is preferred but, cropland and bottomland are extremely limited on the project site. Sign of only one opossum was found in the site vicinity and that was along the Monongahela River.

The raccoon is invariably found near water but its home range (up to 5 km², 2 mi²) usually encompasses a variety of habitat types. The raccoon forages along streams or lakes for frogs, salamanders, and crayfish. In late summer, it may raid a cornfield or, in autumn, consume mast in an upland forest.

Abundant aquatic foods, local areas of mast production, and diversified habitat on the project site have produced a moderate raccoon population. The forest habitat along the Monongahela River seems to harbor the largest number. Available nest trees, mast, and both stream and pond margin hunting grounds are found along the river. Scrub near Crooked Run also appears to be well-populated. In fact, raccoon tracks have been seen near every pond and stream in the site vicinity.

The mustelids are an extremely diverse group, that is, some have narrow habitat tolerances while others require habitat diversity. The presence of only one, the striped skunk, has been documented on the project site. A single set of tracks was found in the brushland along Crooked Run. The reason for this apparent low density is unclear.

The long-tailed weasel is found in virtually all habitat types. While its presence on the site has not been confirmed, weasel sign is difficult to locate. Its presence in the Morgantown area was confirmed by Bradshaw and Gibbons (1967).

Two species of canids occur on the project site, the red fox and the gray fox. The two differ in habitat preference, but are essentially animals of edge habitat and are markedly omnivorous. An interspersed of crop and pastureland among woodlands, brushy hillsides, and weedy draws furnishes prime red fox habitat. The gray fox is less inclined to hunt open meadows, preferring to remain in cover. While the red fox often dens in open fields or on hillsides with a view, the gray fox usually dens in hollow logs, rock crevices, or under boulders hidden by vegetation.

Track occurrence reveals the red fox to be relatively common, ranging virtually all areas of the site vicinity. Most gray fox sign has been found near rock outcroppings, heavy brush, and woodland-edge thickets. A gray fox den was found at the base of an exposed rock face in an overgrown strip-mine near the project site.

In West Virginia, the bobcat is most abundant in the mountainous eastern part of the state, although it has been documented in Monongalia County (Bradshaw and Gibbons 1967). The bobcat prefers scrubby and rocky locations. In the eastern U.S., however, forested areas and cedar swamps are also commonly used as habitat for the bobcat (Young 1958). Den site criteria are similar to those of the gray fox. An indistinct track was found on hard, rocky ground at the gray fox rock den site. It may have been that of a bobcat; however, positive identification was not possible. Rabbit, which is the favorite prey of the bobcat, is scarce on the project site.

10.3.1.7 Composite Habitat Type-Deer

White-tailed deer are an important wildlife species on the project site from the perspective of economics and recreation. With the exception of the raccoon, the other game and fur species on the site are all present at low density.

Estimates show that 75 percent of West Virginia is forested (47,000 km²); 44 percent (21,000 km²) is mature forest (Bones 1978), and roughly 24 percent (11,000 km²) is in the seedling or sapling stages (Allen and Cromer 1977). Oak-hickory is the principal forest type (59 percent) and maple-beech-birch is secondary (20 percent) (Bones 1978). Further categories include four percent cropland, nine percent pasture, and a remainder of 12 percent devoted to other land uses (Bones 1978). West Virginia's December deer population (base herd) was estimated at 225,000 in 1978, which results in a density of 3.6/km², (9.4/mi²). By comparison, Pennsylvania may support two or three times this density.

Monongalia County is 64 percent forested. The age composition of the county's forests is similar to that for the state, i.e., 47 percent mature forests and 24 percent seedling or sapling stages (Bones 1978). Oak-hickory is also the dominant forest type (68 percent) and maple-beech-birch is secondary (14 percent). The density of deer in Monongalia County is estimated at 4.6 deer/km² (12.0/mi²).

Roughly 52 percent of the survey area is forest/scrub and 33 percent is grassland. This disproportionately large amount of grassland supports a lower deer density. While pasture does provide succulent grasses and herbs eagerly sought during the early growing season, it is generally devoid of critical winter foods and cover. It is these features which are significant in determining carrying capacity for deer. A total of 37 deer were counted during the intensive aerial survey, yielding a minimum density of 2.8 deer/km² (7.4/mi²) (Figure 10-2).

Studies of the efficiency of aerial census have shown that under natural conditions, accuracy is invariably less than 75 percent and often, less than 50 percent (Caughley 1977). Due to the intensive helicopter search procedure and excellent conditions, it is likely that a high efficiency was achieved. The upper efficiency level of 75 percent will be assumed in order to project the true population level of the survey area. Therefore, 49 deer are estimated to occupy the survey area at a density of 3.9/km² (9.8/mi²). This figure is somewhat lower than that estimated for the county (4.6 deer/km²), but a lower density was anticipated due to the relatively restricted forest cover and extensive grassland areas.

A white-tail base herd at or near carrying capacity will usually increase 50 percent during the fawning season (Taylor 1956). Thus, a fall population of 74 deer (5.7/km², 14.8/mi²) can be expected in the survey area. Using the average harvest rate for West Virginia (60-70 percent of bucks), 9-10 bucks would be harvested from the

survey area each year. At an average expenditure of about \$140 per hunter (corrected from 1975 values given for West Virginia by Allen and Cromer 1977), roughly \$1300-\$1400 can be expected to enter the state's economy as a result of site vicinity deer herds. In 1975, 15 percent of deer hunters were successful, spending an average of 4.9 hunting days. Thus, an estimated 65 hunters would predictably pursue this herd, spending a total of 319 recreational days.

Figure 10-2 depicts the distribution of deer found during the aerial survey. This pattern parallels the data gathered during ground field work and reflects the distribution of forest habitat in the project area. Two concentrated areas were found. Twenty-one deer were found on the forested slope along the Monongahela River in census units 1-4. Due to early seral (scrub) stages and adjacent mature forest cover, 16 of these were found in units 2, 3, and 4. Scrub areas provide winter browse, while the nearby mature stands provide mast and cover. The deep ravine in the northern part of unit 1 is heavily used by deer; cover, food and water are found on an eastern exposure. The scrub of the upper ravine provides protected travel lanes far into an upland meadow. This combination of factors encourages heavy use, particularly during inclement winter weather. Important foods here include mast (red and white oak, and various hickory species), hardwood browse, witch hazel, maple leaf viburnum, spicebush, flowering dogwood, black cherry, hawthorn, sassafras, greenbriar, blackberry, and various grasses. The floodplain at the southern end of unit 1 receives heavy deer use. Ponds and wet meadows have succulent hydric vegetation which attracts deer during the growing season and provides willow browse throughout the winter. Pine and hemlock groves provide protection and survival forage during severe winter weather. Conifers have great value in this respect but are generally lacking on the site, hence, greenbriar and blackberry thickets must replace this function.

Census units 8 and 9 provide good habitat for deer since forest and scrub are present in significant quantities. Dense thickets of

blackberry in unit 8 enhance deer survival during severe winter weather. In this area a second concentration of 16 deer exists.

The upland pastures in units 5 and 6 provide little cover for deer, however, scrub areas near the Fort Martin Church and along Crooked Run are sources of water and browse. Such locations are utilized during nocturnal feeding periods, although strip-mining in the Crooked Run vicinity does limit use of that area. As mining activities cease and reclamation efforts advance, deer use and overall densities should increase.

The project site overall, is below average range for the white-tailed deer in West Virginia (Table 10-10). Large areas of the site have been cleared, depriving deer of essential cover and food while strip-mining has further reduced its value. Much of the forested acreage is in early seral stages, improving food value through browse production. This feature also reduces available mast and developed forest cover.

10.3.2 Birds

Presented in this section of the report is data on the occurrence, relative abundance, and distribution of bird species on the P&M SRC-II site and surrounding region. The avifauna of West Virginia has been described by a number of ornithologists, although not to the extent that the avifaunas of many other states in the eastern deciduous forest biome have been. The most complete and modern discussion of the entire West Virginia avifauna is presented by Hall (1971), who summarized the seasonal occurrence and geographic distribution of all bird species known to have occurred in the state. An earlier and less complete account of the birds of West Virginia was published by Brooks (1944).

General descriptions of the birds occurring in limited geographical areas nearer the site have been provided by other

TABLE 10-10
DEER RANGE COMPARISONS
P&M/SRC-II SITE

	<u>West Virginia</u>	<u>Monongalia County</u>	<u>Census Area</u>
Forest/Woodland	75%	64%	52%
Mature	(33%)	(30%)	
Pole	(24%)	(19%)	
Scrub	(18%)	(15%)	
Cropland	4%	-	1%
Pasture	9%	-	33%
Other	12%	36%	14%
Deer Density	3.6/km ²	4.6/km ²	3.8/km ²

researchers. Buckelew (1976) supplemented an earlier publication (Sutton 1933) by summarizing the seasonal occurrence and relative abundance of bird species that have been recorded in the West Virginia panhandle, a northern extension of the state located to the northwest of the site. The seasonal occurrence and habitat preferences of species observed in the West Virginia University Arboretum, located near the site in Morgantown, were studied by Hall and Breiding (1966).

Despite the lack of major publications concerning the West Virginia avifauna, much information on the occurrence, abundance, and distributional patterns of species in the state has been collected by amateur ornithologists, especially members of the Brooks Bird Club based in Wheeling, West Virginia. General observations of amateur ornithologists in the state, and results of formal bird censuses conducted by amateurs, have been published in the journals American Birds, The Redstart, and The Cardinal.

A total of 83 species were recorded on the site over the three seasonal surveys (Exhibit 10-2). The marsh hawk was also observed in

the immediate site area. The recorded species are typical of the region, and 92 percent of them consist primarily of groups of landbirds (e.g., passerines and similar forms, raptors, pigeons, and swifts) associated with one or more terrestrial plant communities typical of the disturbed eastern deciduous forest. Lesser numbers of aquatic species were recorded on the site (eight percent of the species recorded). The low proportion of aquatic species on the site is typical of the region in which aquatic habitats are limited in number and extent.

Exhibit 10-2 presents a list of 237 species that regularly occur in West Virginia (based on Hall 1971). All of the 237 species are considered to have some chance of occurring on the site over a one-year period (including the adjacent section of the Monongahela River), based on their abundance in the region and the availability of appropriate habitat on the site. Twenty-three species (loons, grebes, double-crested cormorant, whistling swan, diving ducks, gulls, and terns) would be almost exclusively limited to the Monongahela River, as appropriate habitat for these species is not present on the actual site. Of the 154 species that were not recorded on the site but could occur, 67 species (44 percent) are considered to have a low probability of occurrence, 34 species (22 percent) have a medium probability, and 53 species (34 percent) have a high probability of occurrence.

There are large scale temporal variations in the ways different species and individuals occur on the site and in the region, i.e., not all species and individuals use habitats in these areas in the same way. Over a one-year period there are large seasonal variations in the number of species present on the site and in the primary activities and behaviors of large groups of species. Breeding (nesting) of most species (especially highly insectivorous species including most passerines) occurs primarily in May, June, and July although a few species breed earlier or later. A limited number of species (mostly waders) move into the region in the late summer from

areas in the southern United States. Fall migration for all species as a group occurs over a long period beginning in late July and continuing into mid-December. Largest numbers of species (especially passerines and similar species groups) migrate through the site area in September and to a lesser extent in August and October. Most shorebirds migrate through the area in July and August. The migrations of diurnal raptors occur over a long period from August to December. Waterfowl migration primarily occurs in October, November, and December, although a few species migrate in August and September. During fall migration the number of species and individuals in the region fluctuates widely, resulting from daily variations in migration magnitude. The winter period extends from December to early March and, like the breeding period, bird populations at this time are fairly stable, i.e., no large variations in the number of species and individuals present in the area occur. Spring migration starts in late February and continues through the end of May. Largest numbers of passerine and similar species migrate through the area in April and May. Most species of waterfowl move through the region in February and March and most shorebirds migrate in April and May. The migrations of diurnal raptors primarily occur in March, April, and May. As in fall migration, there are large daily variations in the number of species and individuals present in the area.

The species and individuals that occur in the state and in the site area can be divided into six groups based on their temporal occurrence in, and use of, the two areas: 1) Permanent residents are those species and individuals that breed in an area and are present all year; 2) Summer residents migrate into an area in the spring, breed in the summer and migrate out of the area in the fall; 3) Breeders are species that nest in an area; 4) Local summer visitors are primarily species that breed in more southern regions of the United States and move northward to the area in the late summer, after the completion of breeding; 5) Migrants pass through the area on the way to wintering and breeding areas in the fall and spring, respectively; and 6) Winter visitors move into the area in fall migration, remain in the winter and migrate north in the spring.

The number of species in the six occurrence categories for the total West Virginia avifauna and the species observed on the site are presented in Table 10-11. Individuals of most species occur in more than one category. An example of a species with this type of complex occurrence is the savannah sparrow. Different individuals of this species occur as summer residents, breeders, migrants, and winter visitors.

Breeding species are the most abundant group on the site and in West Virginia (Table 10-11). The breeding group as a whole is composed of summer residents and permanent residents. In both the state and on the site the number of summer residents outnumbers the permanent residents, which is a relatively small group of species adapted to environmental conditions present at all times of year, including the winter when environmental conditions are most severe. The second most abundant main group of species (i.e., breeders, migrants, and winter visitors) in the state and on the site is composed of migrants, and in both areas winter visitors are the least abundant main group.

The number of species recorded on the site in the summer, fall, and winter surveys was 45, 45, and 46, respectively. It is very likely that these numbers do not accurately reflect seasonal bird species richness on the site, however, because of variations in the degree of site coverage over the three seasonal surveys, (i.e., the number of species recorded in each season reflects the degree of site coverage in the survey). Over a one-year period largest numbers of species are probably present on the site during the spring (May) and fall (September) migration periods when large numbers of breeders and migrants are present on the site simultaneously. The number of breeding species on the site in the summer is generally lower than the number present during the main migration periods. Lowest numbers of species are present in the mid-winter period when environmental conditions are most severe.

TABLE 10-11
TABULATION OF BIRD SPECIES BY OCCURRENCE CATEGORIES
P&M/SRC-II SITE

<u>Occurrence Category</u>	<u>West Virginia^a</u> <u># of Species</u>		<u>P&M SRC-II Site^b</u> <u># of Species</u>	
<u>Permanent Residents</u>	34	(14%)	19	(30%)
Widespread	22	(9%)		
Local	11	(5%)		
Very local	1	(+)		
<u>Summer Residents</u>	129	(54%)	53	(64%)
Widespread	64	(27%)		
Local	64	(27%)		
Very local	1	(+)		
<u>Breeders</u>	166	(70%)	68	(82%)
Confirmed	157	(66%)		
Probable	9	(4%)		
<u>Local Summer Visitors</u>	7	(3%)	2	(3%)
<u>Migrants</u>	114	(48%)	63	(76%)
Widespread	85	(36%)		
Local	28	(12%)		
Local Fall	1	(+)		
<u>Winter Visitors</u>	51	(22%)	31	(37%)
Widespread	18	(8%)		
Local	30	(13%)		
Occasional	3	(1%)		

^aBased on Hall (1971). Total number of regularly occurring bird species in West Virginia = 237. Different individuals of 194 species (82% of total) occur in more than one category.

^bTotal number of species observed on site = 83. Different individuals of 81 species (98% of total) occur in more than one category.

The following is a discussion of bird communities in major habitats on the site in each of the three seasons covered to date (Figure 10-2). Emphasis throughout the discussion is directed toward: 1) Seasonal dominant species composition and inter-specific relationships between dominants, especially with regard to spatial and feeding niches, 2) Inter-habitat comparisons of species richness by season, and 3) Intra-habitat variations in species richness by season.

10.3.2.1 Forest Habitat Type (deciduous forest interior and edge and conifer plantation interior and edge).

Dominant species composition in the deciduous forest interior and edge habitats was very similar in the summer and fall (Exhibits 10-3 and 10-4), and most of the species were recorded in the two habitats in both seasons. The downy woodpecker, American robin, and cardinal were the most abundant species recorded in deciduous forest interior habitat in the summer and fall. The downy woodpecker is a common tree trunk and main branch driller in a variety of deciduous forest habitats. American robins are probably ground foragers in more open interior areas of the deciduous forest. Cardinals also occur largely in interior areas with an open tree canopy, and primarily feed in the ground and shrub strata.

Characteristic dominant deciduous forest edge species on the site in the summer and fall were common flicker, cardinal, indigo bunting, and field sparrow. The latter three species were common in shrub and small tree areas along forest edges, especially where true ecotones are present between deciduous forest and more open areas (e.g., grasslands and scrub areas). Common flickers feed on the ground in open areas along forest edges, and are also tree trunk and main branch foragers, as is the downy woodpecker.

A limited number of fall migrant species were observed in small quantities in forest habitats in October. Species recorded on the site which only occurred as migrants in the area were Nashville

warbler (uncommon), magnolia warbler (rare), and fox sparrow (rare). All three species were observed in deciduous forest edge habitat.

The dominant species were permanent residents of the three forest habitats but in winter, were primarily visitors. Seven species were most abundant in the three combined forest habitats in winter and two of the species (cardinal and Carolina chickadee) were recorded in at least two of the three forest habitats (Exhibit 10-4). Close associations between many bird species and habitats tend to diminish in the winter and permanent residents tend to become more eurytopic, occurring in a wider variety of habitats where competitors are lacking. Winter bird communities of forest habitats on the site and throughout the eastern deciduous forest are dominated by species that are tree trunk and branch foragers. Such species typically glean insects and insect larvae from bark (Carolina chickadee, brown creeper, tufted titmouse, white-breasted nuthatch) or drill for insects and insect larvae (downy woodpecker).

Species richness in the combined three forest habitats in each of the three seasons was much greater than in any other habitat (24, 32, and 24 species recorded in the summer, fall, and winter, respectively) (Table 10-12). A total of 57 species were observed in the three combined forest habitats over the three seasons, which is a larger total than in any other habitat. Of the three forest habitats censused, species richness was highest along deciduous forest edges in every season. The number of species recorded along deciduous forest edge areas in the summer (28) and fall (33) was much higher than in the winter (18 species), although the opposite was found in deciduous forest interior areas. The conifer plantation interior and edge study area was only censused in the winter and at that time the habitat supported fewer species than did the deciduous forest interior and edge areas.

The number of breeding bird species present in vegetated terrestrial habitats is primarily determined by the structural diversity of the plant community comprising the habitat (MacArthur and

TABLE 10-12
SEASONAL BIRD SPECIES RICHNESS BY HABITAT TYPE
P&M/SRC II SITE

<u>Habitat Type</u>	<u>Number of Species Recorded in Each Season</u> <u>(Species Richness)^a</u>			<u>Total</u>
	<u>Summer</u>	<u>Fall</u>	<u>Winter</u>	
<u>Forest</u>	29	32	24	57
deciduous forest interior	6	5	10	14
deciduous forest edge	28	33	18	53
conifer plantation interior and edge	-	-	7	7
<u>Scrub (Scrub/Tree Grassland)</u>	12	14	5	21
<u>Grassland</u>	11	11	8	18
meadow	10	9	3	13
pasture	1	1	7	8
<u>Wetland</u>	5	8	10	19
wooded floodplain pond	1	0	1	2
shrubby and open floodplain pond	-	-	5	5
Monongahela River	-	-	2	2
open ponds	1	5	1	5
shrub wetland	3	3	4	7
<u>Cropland</u>	-	-	0	0
<u>Mined land</u>	-	-	1	1
<u>Residential areas</u>	8	9	8	14
Total	45	45	46	83

^aSpecies recorded flying over habitat are not included.

MacArthur 1961). The two most important components of structural diversity of vegetation are vertical and horizontal distribution. Extensive bird species diversity and richness are positively correlated with equitable distribution of foliage in large numbers of strata, and with horizontal distribution of vegetation in differing patches within the community. A direct result of the structural diversity of vegetation comprising a habitat is the number of spatial niches available to different species. In general, deciduous forest habitats, especially forest edges (with high structural diversity of vegetation), support significantly greater numbers of breeding bird species than do less structurally complex habitats (e.g., grasslands and shrublands). Similar relationships exist between the species richness of non-breeding communities and the structural diversity of the plant communities in which they occur. This association is, however, subject to the effects of many seasonally related variables. The total absolute density of winter bird populations in two of the three forest habitats (deciduous forest edge and conifer plantation interior and edge) was fairly high relative to most other habitats (100 to 200 birds per 40 ha), while density in the deciduous forest interior was lower (Table 10-13).

10.3.2.2 Scrub Habitat Type

Censuses were not conducted in scrub habitat during the summer and fall surveys and in the winter census no individuals were recorded. Typical breeding species of the scrub habitat censused were mourning dove, American robin, eastern meadowlark, American goldfinch, chipping sparrow, and field sparrow. Typical wintering species include eastern meadowlark, savannah sparrow, and tree sparrow. In general, breeding bird species richness in most scrub habitats was much lower than in more structurally diverse plant communities (e.g., deciduous forest).

The most abundant species in a more open scrub habitat (scrub/tree grassland) during the summer survey were the common crow,

TABLE 10-13

BIRD COMMUNITY DENSITY CLASSES BY HABITAT TYPE
P&M/SRC II SITE

<u>Habitat Type</u>	<u>Absolute Density Class^a</u>
<u>Forest</u>	
deciduous forest interior	1
deciduous forest edge	2
conifer plantation interior and edge	2
<u>Scrub (Scrub/Tree Grassland)</u>	1
<u>Grassland</u>	
meadow	1
pasture	1
<u>Cropland</u>	1
<u>Mined Land</u>	1
<u>Wetland</u>	
shrub wetland	5

- ^a 1 = 0 - 100 birds/40ha(100ac)
 2 = 101 - 200
 3 = 201 - 300
 4 = 301 - 400
 5 = 401 - 500

mockingbird, and cedar waxwing, while in the fall the field sparrow was dominant (Table 10-14). The field sparrow was the characteristic species of this habitat type. The most abundant species in the winter were white-throated sparrow and cardinal. In general, the species composition of this scrub habitat type was most similar to deciduous forest edge, thus reflecting the mixed structural nature of both habitats (taller trees mixed with various sized shrubs and herbaceous vegetation). A large number of species were recorded in both habitats over the three seasons (e.g., downy woodpecker, mourning dove, common flicker, house wren, American robin, indigo bunting, American goldfinch, rufous-sided towhee, and field sparrow).

TABLE 10-14

SCRUB (SCRUB/TREE GRASSLAND) HABITAT TYPE,
SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC-II SITE

<u>Species</u>	<u>Occurrence and Relative Abundance^b</u>		
	<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Turkey vulture		C(as)	
Cooper's hawk		R	
Red-tailed hawk	U(as)	U(as)	
Ring-necked pheasant			P
Mourning dove	U	U	
Common nighthawk	C(as)		
Common flicker	U	U	
Downy woodpecker	U	U	
Common crow	A	A	
House wren	U	U	
Mockingbird	C	C	
Brown thrasher	R		
American robin	U	U	
Cedar waxwing	C	C	
Cardinal			2
Indigo bunting	U		
American goldfinch	U		
Rufous-sided towhee	U	U	
Vesper sparrow		U	
Tree sparrow			1
Field sparrow		A	
White-throated sparrow			3
Fox sparrow		R	
Song sparrow		U	1

NOTE: See Key on following page.

TABLE 10-14 (Continued)

SCRUB (SCRUB/TREE GRASSLAND) HABITAT TYPE,
SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC-II SITE

Key: ^bSummer and fall relative abundance categories:

A = abundance (more than 50 observations of individuals in
habitat during seasonal site survey).

C = common (11-50 observations).

U = uncommon (3-10 observations).

R = rare (1 or 2 observations).

as = airspace over habitat (flying individuals).

Winter relative abundance figures = total number of individuals
of each species recorded/number of individuals of all species.

Categories:

1 = 0 - 20%

2 = 21 - 40%

3 = 41 - 60%

4 = 61 - 80%

5 = 81 - 100%

P = present in habitat but not recorded in formal census.

Species richness in the scrub/tree grassland during the three seasons (21 species) was second only to forest habitat in the summer and fall (12 and 14 species recorded, respectively), and fifth in the winter (five species recorded) (Table 10-12). In terms of structural diversity this habitat is intermediate between scrub and deciduous forest and is composed of a mixture of herbaceous and multiple woody strata. The number and types of species recorded reflect the patchy structural nature of the habitat and its intermediate position between scrub and deciduous forest.

The absolute density of the winter bird community in the scrub/tree grassland was higher (200-300 birds per 40 ha) than that recorded in the three forest habitats or scrub habitat (Table 10-13). High winter densities are common in habitats which are intermediate (between grassland and forest) seral stages, resulting primarily from the availability of large quantities of seeds and fruits, produced by native plant species, to granivorous winter visitors (e.g., sparrows).

10.3.2.3 Grassland Habitat Type (meadow and pasture)

The dominant species recorded in the meadow and pasture habitats were typical of those in open habitats completely composed of short herbaceous vegetation (Table 10-15). Species composition in the two habitats was dissimilar, however. Nine species (mourning dove, common crow, mockingbird, brown-headed cowbird, common grackle, redwinged blackbird, American goldfinch, vesper sparrow, and song sparrow) were recorded in meadow habitat only, while four species (rock dove, American robin, eastern bluebird, and savannah sparrow) were observed only in pasture habitat. Four species were also present in both grassland habitats (killdeer, starling, eastern meadowlark, and American kestrel).

The eastern meadowlark was one of the most abundant species in meadow habitat over the three seasons, but three other species (common crow, starling, and brown-headed cowbird) were common in the

TABLE 10-15
GRASSLAND HABITAT TYPE, SEASONAL OCCURRENCE AND
RELATIVE ABUNDANCE OF BIRDS
P&M/SRC-II SITE

<u>Species</u>	<u>Habitat^a Type</u>	<u>Occurrence and Relative Abundance</u>		
		<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Turkey vulture	meadow		C(as)	
American kestrel	meadow			P
	pasture			P
Killdeer	meadow	C	C	
	pasture			2
Rock dove	pasture	A	A	
Mourning dove	meadow	C	C	
Common nighthawk	meadow	C(as)		
Chimney swift	meadow		C(as)	
Common crow	meadow	A	A	P
Barn swallow	meadow	A(as)		
Mockingbird	meadow	C	C	
American robin	pasture			2
Eastern bluebird	pasture			P
Starling	meadow	A	A	
Eastern meadowlark	meadow	A	A	5
Redwinged blackbird	meadow	C		
Common grackle	meadow	U		
Brown-headed cowbird	meadow	A	A	
American goldfinch	meadow	U		
Savannah sparrow	pasture			1
Vesper sparrow	meadow		U	
Song sparrow	meadow		U	

^aHabitat types: meadow = bird study location 8
pasture = bird study location 9

summer and fall (Exhibit 10-3). The rock dove was the dominant species observed in pastures in the summer and fall, while the American robin and killdeer were most abundant in the winter. All three dominant species in pasture habitat were common ground feeders in such areas, especially the American robin and killdeer.

Species richness over the three seasons in the combined grassland habitat (18 species recorded) was slightly lower than in scrub habitat, ranking third in each of the three seasons, which was expected due to the relatively low structural diversity of the habitat (Table 10-12). In summer and fall the number of species observed in hayfield habitat was much higher than in pastures (10 to one, and nine to one, respectively). The reverse was true in the winter, when seven species were observed in pastures and three in hayfield habitat. The total absolute densities of winter populations in both grassland habitats was low (0-100 birds per 40 ha) (Table 10-13).

10.3.2.4 Other Habitat Types

Two small harvested crop fields on the floodplain were censused in the winter survey with no individuals recorded in either field. Typical species that could occur on the site in this type of habitat are killdeer, mourning dove, common crow, redwinged blackbird, common grackle, brown-headed cowbird, and savannah sparrow. The bird species richness and density in the croplands will probably be very low in all seasons.

The horned lark was the only species observed in the mined land habitat which was censused in the winter survey alone (Table 10-16). The area of mined land censused was a revegetated spoilbank, composed of large areas of bare soil mixed with areas supporting grass and herbaceous vegetation. The horned lark is characteristic of such areas in which both bare soil and grassy areas are present. Other species thought to occur in this habitat are killdeer, mourning dove, common crow, and savannah sparrow. As only a few individuals in one

TABLE 10-16
WETLAND HABITAT TYPE, SEASONAL OCCURRENCE
AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC II SITE

<u>Species</u>	<u>Habitat^a Type</u>	<u>Occurrence and Relative Abundance</u>		
		<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Great blue heron	sofp			1
Green heron	op		R	
Black duck	wfp			5
	sofp			2
Blue-winged teal	mr		0	
	op		R	
Wood duck	sofp			3
	op		R	
Hooded merganser	sofp		1	
	mr		4	
Killdeer	op	C	C	5
American woodcock	sofp			P
Common snipe	sw			4
Ring-billed gull	mr			2
Common nighthawk	op	C(as)		
Belted kingfisher	op		R	
Mockingbird	sw	C	C	
Brown thrasher	sw	U		
Yellow warbler	wfp	R		
Palm warbler	sw		R	
Redwinged blackbird	sw	A		
Dark-eyed junco	sw			1
Song sparrow	sw		C	1

^aHabitat types: wfp = wooded floodplain pond (study location 12).
sofp = shrubby and open floodplain pond (study location 13).
mr = Monongahela River (study location 14).
op = open ponds (study location 15).
sw = shrub wetland (study location 16).

species were recorded, total absolute density was low (0-100 birds per 40 ha). Species richness and density in this habitat on the site will probably be low in all seasons, as it will in other very open and simple habitats (e.g., cropland).

10.3.2.5 Wetland Habitat Type (floodplain and upland ponds, shrub wetland and Monongahela River).

Although wetland habitats are limited in number and on the site, 18 species were recorded in wetland habitats over the three seasons (Table 10-16).

More species were recorded in the winter (ten) than in the summer (five) and fall (eight). Two groups of species were associated with wetlands on the site: 1) True aquatic and semi-aquatic species, consisting of herons, ducks, shorebirds, and gulls, and 2) Terrestrial species associated with wetland vegetation, including passerines and similar species.

Three types of small freshwater ponds were censused on the site: 1) A wooded pond on the floodplain, 2) A shrubby, open pond on the floodplain, and 3) A number of open ponds in upland areas of the site. Most species and individuals were observed on the shrubby, open pond. Five species were recorded on this pond in the winter survey: great blue heron (one), black duck (five in one flock), wood duck (seven), hooded merganser (one pair), and American woodcock (one). All of the ducks were present on the water surface of the pond and the great blue heron and American woodcock were observed along the shoreline. Three black ducks (one flock) were observed on the wooded floodplain pond and were probably members of the flock also observed on the shrubby and open pond. The ducks and great blue heron were probably spring migrants. The American woodcock was probably a migrant or was preparing to breed on the site.

The only species observed on any of the open upland ponds censused in the winter survey was the killdeer. Killdeer were also

commonly recorded along shorelines of open ponds in the summer and fall. Three additional species (green heron, blue-winged teal, and wood duck), likely migrants, were recorded on open ponds in the fall survey. Open ponds on the site generally lacked emergent and submerged aquatic vegetation used as food and protection by many species of surface ducks, thus, in general, probably support fewer individuals and species than do the floodplain ponds. Other aquatic species (e.g., waders and shorebirds), however, may find suitable habitat along shorelines of open upland ponds. One fish-eating species (belted kingfisher) not associated with aquatic vegetation was recorded on an open pond in the fall.

One semi-aquatic species was recorded in shrub wetland habitat in the winter (common snipe) and six terrestrial species associated with wetland vegetation were observed in this habitat over the three seasons (mockingbird, dark-eyed junco, and song sparrow). Aquatic (e.g., surface ducks) and semi-aquatic species (e.g., shorebirds) are primarily limited to stream and marsh areas of the shrub wetland while passerines and similar species occur in various types of vegetation comprising the habitat (e.g., shrubs and emergent aquatic vegetation). The total absolute density of winter populations present in the shrub wetland was higher than in any other habitat on the site (401 to 500 birds per 40 ha), primarily due to the presence of large numbers of migrating common snipe in one small area of marsh (up to a maximum of 40 individuals).

Suitable habitat for most aquatic species is lacking on the Monongahela River; only one ring-billed gull and two hooded mergansers were recorded on or flying over the river. The hooded mergansers had been previously flushed from one of the floodplain ponds and probably would not have been present on the river otherwise. River characteristics that preclude use by a large number of aquatic species (especially waders, ducks, and shorebirds) include steep and vegetated banks, high flow rate, high pollutant concentration, and lack of shallow areas. Table 10-16 presents a list of species which may occur

on the river over a one-year period, but with a few exceptions (horned grebe, common merganser, herring gull, and Bonaparte's gull), all have a low probability of occurrence.

Some species recorded on the site were associated with vegetation around residential areas along Ft. Martin Road (e.g., lawns, trees, and shrubs), structures in such areas (e.g., houses and barns), and features associated with structures (e.g., telephone and electric lines and poles). A total of 14 species were observed in residential areas (eight in the summer and winter, and nine in the fall) (Table 10-17). Species directly associated with structures were the rock dove, starling, and house sparrow (all common around barns and houses). These species were also present in areas around structures (lawns, trees, and shrubs). Other species were primarily observed in vegetation around houses and barns (e.g., common flicker, downy woodpecker, common crow, mockingbird, American robin, cedar waxwing, redwinged blackbird, common grackle, cardinal, and song sparrow). Large numbers of the two blackbird species (redwinged blackbird and common grackle) and starlings were present during the winter survey in small pasture areas located near barns.

10.3.2.6 Composite Habitat Type

A small group of species observed on the site show direct or indirect relationships with a large number of habitats. Species in this group are the wide-ranging and strong-flying aerial foragers. Two basic types of aerial foragers occur on the site: diurnal raptors and species that forage for flying insects. Two diurnal raptors ranged over large areas of the site while foraging, the turkey vulture and red-tailed hawk. Both species primarily forage over open habitats (e.g., hayfields, pastures, and scrub). At least one pair of red-tailed hawks nest on the site. One pair was found nesting in March 1979, northeast of the site in a deciduous forest edge area along the road to the Ft. Martin power station. It is likely that one additional pair nests off the site to the west. Some of the

TABLE 10-17
OTHER HABITAT TYPE, SEASONAL OCCURRENCE
AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC II SITE

<u>Species</u>	<u>Habitat Type</u>	<u>Occurrence and Relative Abundance</u>		
		<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Rock dove	residential	A	A	
Mourning dove	residential			1
Common nighthawk	residential	C(as)		
Chimney swift	residential	A(as)		
Common flicker	residential	C	C	
Downy woodpecker	residential	C	C	
Horned lark	mined-land			5
Common crow	residential	A	A	
Mockingbird	residential	C	C	1
American robin	residential	C	C	1
Cedar waxwing	residential			1
Starling	residential	A	A	3
House sparrow	residential			1
Redwinged blackbird	residential			2
Common grackle	residential			1
Cardinal	residential	C	C	
Song sparrow	residential		R	

red-tailed hawks on and adjacent to the site were probably residents. The occurrence status of turkey vultures observed on the site is unknown.

Species that foraged for flying insects over the site were the common nighthawk, chimney swift, and barn swallow. Of the three species, the common nighthawk and chimney swift ranged over the largest number of habitats and showed the least degree of relationship with ground areas. In contrast, barn swallows primarily foraged over open habitats (e.g., hayfields and pastures). It is unlikely that common nighthawks and chimney swifts observed over the site actually nest there, as common nighthawks prefer to nest on rooftops of city buildings and chimney swifts prefer chimneys of abandoned structures as nesting sites. Barn swallows do nest on the site.

10.3.3 Herpetofauna

The herpetofauna of the project vicinity is evaluated by taxonomic category in Exhibits 10-5 and 10-6. A total of 28 reptiles and 29 amphibians are considered. Following each entry on the tables, three information columns evaluate each species' presence in Monongalia County, presence in the project area, and possible special status. The presence of each species in Monongalia County is evaluated with an affirmative "present" or an indeterminate entry of "unknown." The following references were used in this determination: Green 1969; Green 1977 (pers. comm.); and Conant 1975. The status of each species in the project area is evaluated in the next column; possible entries include self-explanatory ones, such as, "present," "unknown," or "unlikely." Other possible entries form a graded series of qualitative abundance estimates (rare, occasional, common, abundant) for species encountered during field work. These estimates are often subjective and must be interpreted in perspective of the species' natural history and typical population level. Common names, as given by Conant 1975, were used throughout this report; corresponding scientific names are given in Exhibits 10-5 and 10-6.

The reptiles which potentially occur in Monongalia County are comprised of two orders, testudines (turtles), represented by nine species and squamata. The order squamata is divided into suborder lacertilia (lizards), represented by only two species, and suborder serpentes (snakes), comprised of 17 species. Of these 28 species, only 17 have been reported to occur in the county (Green 1969).

Two orders of amphibians are known to occur in the county: caudata (salamanders), potentially comprised of 19 species; and anura (frogs, toads), potentially represented by 10 species. Of the 29 species considered here, 25 have been reported to occur in the county (Green 1969).

In a partial characterization of the site herpetofauna, one reptile species was found. Terrestrial amphibians were largely inactive due to dry weather during the spring sample (April 1979). Therefore, sampling efforts were concentrated on aquatic amphibians (Figure 10-3). Five species of salamanders and five species of anurans (toads, frogs) were encountered during field studies. Hellbenders and mudpuppies probably do not occur in the site vicinity. Other salamanders which may be present, however, include terrestrial species of the families ambystomidae (three species) and plethodontidae (four species). Four-toed and green salamanders were not observed.

10.3.3.1 Forest Habitat Type

During August and October, American toads were occasionally found about on the forest floor or hiding under objects. Although none were found during April (Tables 10-18 to 10-20), egg masses were seen in temporary pools. A single eastern wood frog was located in October. A specimen of the eastern box turtle was found during the summer and fall samples in edge situations along the eastern forested river slope.

TABLE 10-18

HERPETOFAUNA SAMPLING RESULTS, SUMMER (8/78)
P&M/SRC-II SITE

Species	Sampling Location ^a			
	6	7	8	Other ^b
American toad	-	-	-	C
Green frog	C	C	C	O
Pickere1 frog	R	O	O	C

A = Abundant
C = Common
O = Occasional
R = Rare

^a Locations shown in Figure 4

TABLE 10-19

HERPETOFAUNA SAMPLING RESULTS, FALL (10/78)
P&M/SRC-II SITE

Species	Sampling Location ^a			
	6	7	8	Other
American toad	-	-	-	C
Green frog	A	C	C	O
Pickere1 frog	R	O	O	C
Wood frog	-	-	-	R

A = Abundant
C = Common
O = Occasional
R = Rare
U = Unknown

^a Locations shown in Figure 4

TABLE 10-20
HERPETOFAUNA SAMPLING RESULTS, SPRING (4/79)
P&M/SRC-II SITE

Species	Sampling Location ^a								
	1	2	3	4	5	6	8	9	Other
Red-spotted newt	-	-	-	-	R	A	-	C	-
Northern dusky salamander	A	C	C	-	-	-	-	-	-
Appalachian seal salamander	O	-	-	-	-	-	-	-	-
Slimy salamander	-	-	-	-	-	-	-	-	P
Northern two-lined salamander	O	-	-	-	-	-	-	-	-
American toad	-	-	-	-	-	-	-	-	P
Spring peeper	-	-	-	O	C	-	-	-	C
Green frog	-	-	-	-	-	A	O	O	O
Pickereel frog	-	-	-	-	C	R	C	O	R

A = Abundant
C = Common
O = Occasional
R = Rare
P = Present

^a Locations shown in Figure 4

Several species of salamanders are likely to occur in the forests and woodlands of the project site. These are primarily of the genera Ambystoma and Plethodon. However, dry weather during the sampling period precluded successful sampling of these groups. Only one species, the slimy salamander, was located.

10.3.3.2 Wetland Habitat Types

Numerous small ponds and open brooks in the site vicinity are variously populated with pickerel frogs, green frogs, and red-spotted newts. A pair of spring peepers was found breeding in the floodplain pond (Tables 10-18 to 10-20). Peepers were abundant in the wet meadow and forest edge of the floodplain during April, where they were actively breeding during the early evening hours.

Several woodland streams were sampled during the day and night. The species composition of salamanders was found to be similar wherever the water was clear and cool. Northern dusky salamanders

were the most common abundant species. The Appalachian seal salamander and the northern two-lined salamander were occasionally located. All species were streamside salamanders, hiding by day under rocks at water's edge.

Myers and Klimstra (1963) found that many species of local herpetofauna reinvaded the reclaimed strip-mines of southern Illinois. Semi-aquatic species were especially successful. Ponds on reclaimed strip mines in the project area have also been successfully colonized. Sampling locations eight and nine both have well established pickerel frog and, to a lesser extent, green frog populations. Newts are well established at location nine, but bass at location eight may have prevented successful newt colonization in this area.

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SPECIAL STATUS SPECIES (Now being edited)

U.S. Department of Interior (USFWS, Office of Endangered Species)

West Virginia Heritage Trust Program

Audubon Society Blue List

EXHIBIT 10-1

MAMMAL SPECIES LIST
P&M/SRC-II SITE

<u>Taxonomic Grouping</u>	<u>Common Name</u>	<u>Scientific Name</u>	<u>Presence Monongalia County</u>	<u>Status Site Vicinity</u>	<u>Special^a Status</u>
Marsupialia (1)	Opossum	<u>Didelphis virginiana</u>	present	occasional	-
Insectivora (10)	Smoky shrew	<u>Sorex fumeus</u>	"	unknown	-
	Long-tailed shrew	<u>Sorex dispar</u>	"	"	-
	Least shrew	<u>Cryptotis parva</u>	"	"	-
	Short-tailed shrew	<u>Blarina brevicauda</u>	"	abundant	-
	Masked shrew	<u>Sorex cinereus</u>	unknown	unknown	-
	Northern water shrew	<u>Sorex paulustris</u>	"	unlikely	-
	Pigmy shrew	<u>Microsorex hoyi</u>	"	"	-
	Star-nosed mole	<u>Condylura cristata</u>	present	unknown	-
	Hairy-tailed mole	<u>Parascalops breweri</u>	"	present	-
	Eastern mole	<u>Scalopus aquaticus</u>	unknown	unknown	-
Chiroptera (11)	Keen's myotis	<u>Myotis keeni</u>	present	unknown	WVHT
	Little brown myotis	<u>Myotis lucifugans</u>	"	"	WVHT
	Indiana myotis	<u>Myotis sodalis</u>	"	"	USFWS
	Small-footed myotis	<u>Myotis leibii</u>	"	"	-
	Silver-haired bat	<u>Lasionycteris noctivagans</u>	"	"	-
	Eastern pipistrelle	<u>Pipistrellus subflavus</u>	"	"	WVHT
	Red bat	<u>Lasiurus borealis</u>	"	"	-
	Big brown bat	<u>Eptesicus fuscus</u>	"	"	-
	Hoary bat	<u>Lasiurus cinereus</u>	unknown	"	-
	Evening bat	<u>Nycticeius humeralis</u>	"	"	-
	Townsend's big-eared bat	<u>Plecotus townsendii</u>	"	"	-

EXHIBIT 10-1 (Continued)

MAMMAL SPECIES LIST
P&M/SRC-II SITE

<u>Taxonomic Grouping</u>	<u>Common Name</u>	<u>Scientific Name</u>	<u>Presence Monongalia County</u>	<u>Presence Site Vicinity</u>	<u>Special^a Status</u>
Lagomorpha (3)	Snowshoe hare	<u>Lepus americana</u>	unknown	unlikely	-
	Eastern cottontail	<u>Sylvilagus floridanus</u>	present	occasional	-
	New England cottontail	<u>Sylvilagus transitionalis</u>	unknown	unlikely	-
Rodentia (22)	Eastern chipmunk	<u>Tamias striatus</u>	present	common	-
	Woodchuck	<u>Marmota monax</u>	present	abundant	-
	Gray squirrel	<u>Sciurus carolinensis</u>	"	rare	-
	Fox squirrel	<u>Sciurus niger</u>	"	"	WVHT
	Red squirrel	<u>Tamiasciurus hudsonicus</u>	"	unlikely	-
	Southern flying squirrel	<u>Glaucomys volans</u>	"	unknown	-
	Northern flying squirrel	<u>Glaucomys sabrinus</u>	unknown	"	-
	Beaver	<u>Castor canadensis</u>	present	unlikely	-
	Eastern harvest mouse	<u>Reithrodontomys humulis</u>	unknown	unknown	-
	Deer mouse	<u>Peromyscus maniculatus</u>	"	unknown	-
	White-footed mouse	<u>Peromyscus leucopus</u>	present	abundant	-
	Eastern woodrat	<u>Neotoma floridana</u>	unknown	unknown	-
	Boreal redback vole	<u>Clethrionomys gapperi</u>	"	unknown	-
	Meadow vole	<u>Microtus pennsylvanicus</u>	"	abundant	-
	Rock vole	<u>Microtus chrotorhinus</u>	unknown	unlikely	-
	Woodland vole	<u>Microtus pinetorum</u>	"	"	-
	Muskrat	<u>Ondatra zibethicus</u>	present	rare	-
	Southern bog lemming	<u>Synaptomys cooperi</u>	unknown	unlikely	WVHT

EXHIBIT 10-1 (Continued)

MAMMAL SPECIES LIST
P&M/SRC- II SITE

<u>Taxonomic Grouping</u>	<u>Common Name</u>	<u>Scientific Name</u>	<u>Presence Monongalia County</u>	<u>Presence Site Vicinity</u>	<u>Special^a Status</u>
Carnivora (10)	Norway rat	<u>Rattus norvegicus</u>	present	common	-
	House mouse	<u>Mus musculus</u>	"	"	-
	Meadow jumping mouse	<u>Zapus hudsonius</u>	"	"	WVHT
	Woodland jumping mouse	<u>Napaeozapus insignis</u>	"	unknown	-
	Red fox	<u>Vulpes vulpes</u>	"	common	-
	Gray fox	<u>Urocyon cinereoargenteus</u>	"	occasional	-
	Black bear	<u>Ursus americanus</u>	unlikely	unlikely	-
	Raccoon	<u>Procyon lotor</u>	present	common	-
	Least weasel	<u>Mustela nivalis</u>	"	unknown	-
	Longtail weasel	<u>Mustela frenata</u>	"	"	-
	Mink	<u>Mustela vison</u>	"	"	-
	Striped skunk	<u>Mephitis mephitis</u>	"	occasional	-
	Eastern spotted skunk	<u>Spilogale putorius</u>	unknown	unknown	-
Ungulata	Bobcat	<u>Lynx rufus</u>	present	unknown	-
	White-tailed deer	<u>Odocoileus virginianus</u>	"	common	-

^a USFWS - U.S. Fish and Wildlife Service (Endangered Species Status)
WVHT - West Virginia Heritage Trust program (Special Interest Species)

EXHIBIT 10-2

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Common loon	<u>Gavia immer</u>	WM, OWV	L(MR)	
Red-throated loon	<u>Gavia stellata</u>	LM	L(MR)	
Horned grebe	<u>Podiceps auritus</u>	WM	M(MR)	
Pied-billed grebe	<u>Podilymbus podiceps</u>	WM, LSR, B	M	
Double-crested cormorant	<u>Phalacrocorax</u> <u>auritus</u>	LM	L(MR)	BL
Great blue heron	<u>Ardea herodias</u>	WM, LSV	H	
Green heron	<u>Butorides striatus</u>	WSR, B	H	
Little blue heron	<u>Florida caerulea</u>	LSV	L	
Great egret	<u>Casmerodius albus</u>	LSV	L	
Black-crowned night heron	<u>Nycticorax</u> <u>nycticorax</u>	WM, LWV, LSV	L	BL
Yellow-crowned night heron	<u>Nyctanassa</u> <u>violacea</u>	LSV	L	
Least bittern	<u>Ixobrychus exilis</u>	LSR, B	L	
American bittern	<u>Botaurus lentiginosus</u>	WM, LSR, PB	L	BL
Whistling swan	<u>Olor columbianus</u>	LM	L(MR)	
Canada goose	<u>Branta canadensis</u>	WM	L	
Snow goose	<u>Chen caerulescens</u>	LM, LWV	L	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC- II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Mallard	<u>Anas platrynchos</u>	WM, LWV, LSR, B	H	
Black duck	<u>Anas rubripes</u>	WM, WWV, LSR, B	H	
Gadwall	<u>Anas strepera</u>	WM	L	
Pintail	<u>Anas acuta</u>	WM	L	
Green-winged teal	<u>Anas crecca</u>	WM	L	
Blue-winged teal	<u>Anas discors</u>	WM, LSV, B	H	
American wigeon	<u>Anas americana</u>	WM	M	
Northern shoveler	<u>Anas clypeata</u>	LM	L	
Wood duck	<u>Aix sponsa</u>	WSR, B, LWV	H	
Redhead	<u>Aythya americana</u>	WM	L (MR)	
Canvasback	<u>Aythya valisineria</u>	WM	L (MR)	BL
Ring-necked duck	<u>Aythya collaris</u>	WM	L (MR)	
Greater scaup	<u>Aythya marila</u>	LM	L (MR)	
Lesser scaup	<u>Aythya affinis</u>	WM	L (MR)	
Common goldeneye	<u>Bucephala clangula</u>	WM, WWV	L (MR)	
Bufflehead	<u>Bucephala albeola</u>	WM	L (MR)	
Oldsquaw	<u>Clangula hyemalis</u>	LM, LWV	L (MR)	
White-winged scoter	<u>Melanitta deglandi</u>	LM	L (MR)	
Black scoter	<u>Melanitta nigra</u>	LM	L (MR)	
Ruddy duck	<u>Oxyura jamaicensis</u>	WM	L (MR)	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
<u>Hooded merganser</u>	<u>Lophodytes</u> <u>cucullatus</u>	WM, LSR, B	H	
Common merganser	<u>Mergus merganser</u>	WM, WV	M (MR)	
Red-breasted merganser	<u>Mergus serrator</u>	WM	L (MR)	
<u>Turkey vulture</u>	<u>Cathartes aura</u>	WSR, B, LWV	H	
Black vulture	<u>Coragyps atratus</u>	LSV, PB, LWV	L	
Goshawk	<u>Accipiter gentilis</u>	LM, LWV	M	
<u>Sharp-shinned hawk</u>	<u>Accipiter striatus</u>	WM, LSR, B	H	BL
<u>Cooper's hawk</u>	<u>Accipiter cooperi</u>	WPR, B	H	BL
<u>Red-tailed hawk</u>	<u>Buteo jamaicensis</u>	WSR, B, LWV	H	
Red-shouldered hawk	<u>Buteo lineatus</u>	WSR, B	M	BL
Broad-winged hawk	<u>Buteo platypterus</u>	WSR, B	H	
Rough-legged hawk	<u>Buteo lagopus</u>	LFM, LWV	M	
Golden eagle	<u>Aquila chrysaetos</u>	LM, VLSR, PB	L	WVHT
Bald eagle	<u>Haliaeetus</u> <u>leucocephalus</u>	WV	L	E
Marsh hawk	<u>Circus cyaneus</u>	WM, LSR, B	M	BL
Osprey	<u>Pandion haliaetus</u>	WM, LSR, B	M	BL

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Peregrine falcon	<u>Falco peregrinus</u>	LM, LWV	L	E
Merlin	<u>Falco columbarius</u>	LM	L	BL, WVHT
American kestrel	<u>Falco sparverius</u>	WSR, B, WWV	H	BL
Ruffed grouse	<u>Bonasa umbellus</u>	WPR, B	H	
Bobwhite	<u>Colinus virginianus</u>	WPR, B	H	
Ring-necked pheasant	<u>Phasianus colchicus</u>	LPR, B	H	
Turkey	<u>Meleagris gallopavo</u>	LPR, B	L	
King rail	<u>Rallus elegans</u>	LSR, B	L	BL
Virginia rail	<u>Rallus limicola</u>	WM, LSR, B	L	
Sora	<u>Porzana carolina</u>	WM, LSR, PB	L	
Common gallinule	<u>Gallinula chloropus</u>	LSR, B	L	
American coot	<u>Fulica americana</u>	WM, LSR, PB	M	
Semipalmated plover	<u>Charadrius semipalmatus</u>	WM	L	
Killdeer	<u>Charadrius vociferus</u>	WSR, B	H	
Black-bellied plover	<u>Pluvialis squatarola</u>	LM	L	
American woodcock	<u>Philohela minor</u>	LSR, B	H	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Common snipe	<u>Capella gallinago</u>	WM, LSR, B, LWV	H	
Upland sandpiper	<u>Bartramia</u>			
	<u>longicauda</u>	LSR, B	L	BL
Spotted sandpiper	<u>Actitis macularia</u>	WSR, B	H	
Solitary sandpiper	<u>Tringa solitaria</u>	WM	M	
Greater yellowlegs	<u>Tringa melanoleucus</u>	WM	L	
Lesser yellowlegs	<u>Tringa flavipes</u>	WM	M	
Pectoral sandpiper	<u>Colidris melanotos</u>	WM	L	
Least sandpiper	<u>Colidris minutilla</u>	WM	L	
Semipalmated sandpiper	<u>Calidris pusillus</u>	WM	L	
Short-billed dowitcher	<u>Limnodromus</u> <u>griseus</u>	LM	L	
Herring gull	<u>Larus argentatus</u>	WM, OWV	H (MR)	
Ring-billed gull	<u>Larus delawarensis</u>	WM	H (MR)	
Bonaparte's gull	<u>Larus philadelphia</u>	LM	M (MR)	
Common tern	<u>Sterna hirundo</u>	WM	L (MR)	BL
Black tern	<u>Chilidonias nigra</u>	WM	L (MR)	BL
Rock dove	<u>Columba livia</u>	WPR, B	H	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Mourning dove	<u>Zenaida macroura</u>	WSR, B, LWV	H	
Yellow-billed cuckoo	<u>Coccyzus americanus</u>	WSR, B	H	BL
Black-billed cuckoo	<u>Coccyzus</u>			
	<u>erythrophthalmus</u>	WSR, B	M	
Barn owl	<u>Tyto alba</u>	WPR, B	L	BL
Screech owl	<u>Otus asio</u>	WPR, B	H	
Great horned owl	<u>Bubo virginianus</u>	WPR, B	H	
Barred owl	<u>Strix varia</u>	WPR, B	M	
Long-eared owl	<u>Asio otus</u>	LPR, B	L	
Short-eared owl	<u>Asio flammeus</u>	LM, LWV	L	
Saw-whet owl	<u>Aegolius acadicus</u>	VLPR, B, LM, LWV	M	
Whip-poor-will	<u>Caprimulgus</u>			
	<u>vociferus</u>	WSR, B	L	
Common nighthawk	<u>Chordeiles minor</u>	WSR, B	H	
Chimney swift	<u>Chaetura pelagica</u>	WSR, B	H	
Ruby-throated				
hummingbird	<u>Archilochus colubris</u>	WSR, B	H	BL
Belted kingfisher	<u>Megaceryle alcyon</u>	WSR, B, LWV	H	
Common flicker	<u>Colaptes auratus</u>	WSR, B, LWV	H	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
<u>Pileated woodpecker</u>	<u>Dryocopus pileatus</u>	WPR, B	H	
<u>Red-bellied</u> <u>woodpecker</u>	<u>Melanerpes carolinus</u>	WPR, B	H	
<u>Red-headed</u> <u>woodpecker</u>	<u>Melanerpes</u> <u>erythrocephalus</u>	LPR, B, LM	L	BL
<u>Yellow-bellied</u> <u>sapsucker</u>	<u>Sphyrapicus</u> <u>varius</u>	WM, LWV, LSR, B	H	
<u>Hairy woodpecker</u>	<u>Picoides villosus</u>	WPR, B	H	BL
<u>Downy woodpecker</u>	<u>Picoides pubescens</u>	WPR, B	H	
<u>Eastern kingbird</u>	<u>Tyrannus tyrannus</u>	WSR, B	H	
<u>Great crested</u> <u>flycatcher</u>	<u>Myiarchus crinitus</u>	WSR, B	H	
<u>Eastern phoebe</u>	<u>Sayornis phoebe</u>	WSR, B	H	
<u>Yellow-bellied</u> <u>flycatcher</u>	<u>Empidonax flaviventris</u>	LM	H	
<u>Acadian flycatcher</u>	<u>Empidonax virescens</u>	WSR, B	H	
<u>Alder flycatcher</u>	<u>Empidonax alnorum</u>	LSR, B	H	
<u>Willow flycatcher</u>	<u>Empidonax traillii</u>	LSR, B	H	
<u>Least flycatcher</u>	<u>Empidonax minimus</u>	WM, LSR, B	H	
<u>Eastern wood pewee</u>	<u>Contopus virens</u>	WSR, B	H	
<u>Olive-sided</u> <u>flycatcher</u>	<u>Nuttallornis borealis</u>	LSR, B, LM	L	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Horned lark	<u>Ereomophila alpestris</u>	WPR, B	H	
Tree swallow	<u>Iridoprocne bicolor</u>	WM, LSR, B	H	
Bank swallow	<u>Riparia riparia</u>	WM, LSR, B	H	
Rough-winged swallow	<u>Stelgidopteryx</u> <u>ruficollis</u>	WSR, B	H	
Barn swallow	<u>Hirundo rustica</u>	WSR, B	H	
Cliff swallow	<u>Petrochelidon</u> <u>pyrrhonata</u>	LSR, B	L	
Purple martin	<u>Progne subis</u>	WSR, B	M	BL
Blue jay	<u>Cyanocitta cristata</u>	LPR, B, WM	H	
Common raven	<u>Corvus corax</u>	LPR, B	L	
Common crow	<u>Corvus brachyrhynchos</u>	WPR, B	H	
Fish crow	<u>Corvus ossifragus</u>	LPR, PB	L	
Black-capped chickadee	<u>Parus</u> <u>atricapillus</u>	LPR, B, WWV	M	
Carolina chickadee	<u>Parus carolinensis</u>	WPR, B	H	
Tufted titmouse	<u>Parus bicolor</u>	WPR, B	H	
White-breasted nuthatch	<u>Sitta carolinensis</u>	WPR, B	H	
Red-breasted nuthatch	<u>Sitta canadensis</u>	WM, WWV, LSR, B	H	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC- II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Brown creeper	<u>Certhia familiaris</u>	WM, WWV, LPR, B	H	
House wren	<u>Troglodytes aedon</u>	WSR, B	H	
Winter wren	<u>Troglodytes</u>			
	<u>troglodytes</u>	WM, WWV, LSR, B	H	
Bewick's wren	<u>Thryomanes bewickii</u>	WSR, B	L	BL
Carolina wren	<u>Thryothorus</u>			
	<u>ludovicianus</u>	WPR, B	H	
Long-billed marsh wren	<u>Cistothorus</u>			
	<u>palustris</u>	LSR, PB	L	
Short-billed marsh Wren	<u>Cistothorus</u>			
	<u>platensis</u>	LSR, PRB, LM	L	WVHT
Mockingbird	<u>Mimus polyglottos</u>	LPR, B, WWV	H	
Gray catbird	<u>Dumetella carolinensis</u>	WSR, B	H	
Brown thrasher	<u>Toxostoma rufum</u>	WSR, B	H	
American robin	<u>Turdus migratorius</u>	WSR, B, WWV	H	
Wood thrush	<u>Catharus mustelina</u>	WSR, B	H	
Hermit thrush	<u>Catharus guttata</u>	WM, LSR, B, LWV	H	
Swainson's thrush	<u>Catharus ustulata</u>	WM, LSR, B	H	
Gray-cheeked thrush	<u>Catharus minama</u>	WM	M	
Veery	<u>Catharus fuscescens</u>	WM, LSR, B	M	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC- II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Eastern bluebird	<u>Sialia sialis</u>	WSR, B, LWV	H	BL
Blue-gray gnatcatcher	<u>Polioptila caerulea</u>	WSR, B	H	
Golden-crowned kinglet	<u>Regulus satrapa</u>	WM, WWV, LSR, B	H	
Ruby-crowned kinglet	<u>Regulus calendula</u>	WM	H	
Water pipit	<u>Anthus spinoletta</u>	LM	L	
Cedar waxwing	<u>Bombycilla cedrorum</u>	W, B	H	
Loggerhead shrike	<u>Lanius ludovicianus</u>	LPR, B	L	BL
Starling	<u>Sturnus vulgaris</u>	WPR, B	H	
White-eyed vireo	<u>Vireo griseus</u>	WSR, B	M	
Yellow-throated vireo	<u>Vireo flavifrons</u>	WSR, B	H	
Solitary vireo	<u>Vireo solitarius</u>	WM, LSR, B	M	
Red-eyed vireo	<u>Vireo olivaceus</u>	WSR, B	H	
Philadelphia vireo	<u>Vireo philadelphicus</u>	LM	M	
Warbling vireo	<u>Vireo gilvus</u>	WSR, B	H	BL
Black and white warbler	<u>Mniotilta varia</u>	WSR, B	H	
Prothonotary warbler	<u>Protonotaria citrea</u>	LSR, B	H	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Swainson's warbler	<u>Limnothlypis</u> <u>swainsonii</u>	LSR, B	L	WVHT
Worm-eating warbler	<u>Helminthos</u> <u>vermivorus</u>	LSR, B	M	
Golden-winged warbler	<u>Vermivora</u> <u>chrysoptera</u>	LSR, B	M	
Blue-winged warbler	<u>Vermivora</u> <u>pinus</u>	LSR, B	H	
Tennessee warbler	<u>Vermivora</u> <u>peregrina</u>	WM	H	BL
Orange-crowned warbler	<u>Vermivora</u> <u>celata</u>	LM	L	
Nashville warbler	<u>Vermivora</u> <u>ruficapilla</u>	WM, LSR, B	H	
Northern parula	<u>Parula</u> <u>americana</u>	WSR, B	M	
Yellow warbler	<u>Dendroica</u> <u>petechia</u>	WSR, B	H	
Magnolia warbler	<u>Dendroica</u> <u>magnolia</u>	WM, LSR, B	H	
Cape May warbler	<u>Dendroica</u> <u>tigrina</u>	WM	H	
Black-throated blue warbler	<u>Dendroica</u> <u>caerulescens</u>	WM, LSR, B	H	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Yellow-rumped warbler	<u>Dendroica coronata</u>	WM, LWV	H	
Black-throated green warbler	<u>Dendroica virens</u>	WM, LSR, B	H	
Cerulean warbler	<u>Dendroica cerulea</u>	WSR, B	H	
Blackburnian warbler	<u>Dendroica fusca</u>	WM, LSR, B	H	
Yellow-throated warbler	<u>Dendroica dominica</u>	LSR, B	M	
Chestnut-side warbler	<u>Dendroica pensylvanica</u>	WM, LSR, B	H	
Bay-breasted warbler	<u>Dendroica castanea</u>	WM	H	
Blackpoll warbler	<u>Dendroica striata</u>	WM	H	
Pine warbler	<u>Dendroica pinus</u>	LSR, B	M	
Prairie warbler	<u>Dendroica discolor</u>	WSR, B	H	
Palm warbler	<u>Dendroica palmarum</u>	WM	H	
Ovenbird	<u>Seiurus aurocapillus</u>	WSR, B	H	
Northern waterthrush	<u>Seiurus novaboracensis</u>	WM, LSR, B	H	
Louisiana waterthrush	<u>Seiurus motacilla</u>	WSR, B	H	
Kentucky warbler	<u>Oporornis formosus</u>	WSR, B	H	
Connecticut warbler	<u>Oporornis agilis</u>	LM	M	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Mourning warbler	<u>Oporornis philadelphia</u>	LSR, B	M	
Common yellowthroat	<u>Geothlypis trichas</u>	WSR, B	H	
Yellow-breasted chat	<u>Icteria virens</u>	WSR, B	H	BL
Hooded warbler	<u>Wilsonia citrina</u>	WSR, B	H	
Wilson's warbler	<u>Wilsonia pusilla</u>	WM	H	
Canada warbler	<u>Wilsonia canadensis</u>	WM, LSR, B	H	
American redstart	<u>Setophaga ruticilla</u>	WSR, B	H	
House sparrow	<u>Passer domesticus</u>	WPR, B	H	
Bobolink	<u>Dolichonyx orizivorus</u>	WM, LSR, B	H	
Eastern meadowlark	<u>Sturnella magna</u>	WSR, B, LWR	H	
Redwinged blackbird	<u>Agelaius phoeniceus</u>	WSR, B, LWV	H	
Orchard oriole	<u>Icterus spurius</u>	WSR, B	H	
Northern oriole	<u>Icterus galbula</u>	WSR, B	H	
Rusty blackbird	<u>Euphagus carolinus</u>	WM	M	
Common grackle	<u>Quiscalus quiscula</u>	WSR, B, LWV	H	
Brown-headed cowbird	<u>Molothrus ater</u>	WSR, B, LWV	H	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

Species ^a		Seasonal Occurrence ^b & Gen. Distribution in West Virginia	Probability of ^c Reg. Occurrence on Site	Special ^d Status
Common Name	Scientific Name			
Scarlet tanager	<u>Piranga olivacea</u>	WSR, B	H	
Summer tanager	<u>Piranga rubra</u>	LSR, B	H	
Cardinal	<u>Cardinalis cardinalis</u>	WPR, B	H	
Rose-breasted grosbeak	<u>Pheucticus</u> <u>ludovicianus</u>	WM, LSR, B	H	
Blue grosbeak	<u>Guiraca caerulea</u>	LSR, B	H	
Indigo bunting	<u>Passerina cyanea</u>	WSR, B	H	
Dickcissel	<u>Spiza americana</u>	LM, LSR, B	L	BL, WVHT
Evening grosbeak	<u>Hesperiphona</u> <u>vespertina</u>	WWV	H	
Purple Finch	<u>Carpodacus purpureus</u>	WM, LSR, B, LWV	H	
Pine siskin	<u>Carduelis pinus</u>	WM, WWV	H	
American goldfinch	<u>Carduelis tristis</u>	WSR, B, LWV	H	
Red crossbill	<u>Loxia curvirostra</u>	WWV, LSR, PB	M	
Rufous-sided towhee	<u>Pipilo</u> <u>erythrophthalmos</u>	WSR, B, WWV	H	
Savannah sparrow	<u>Passerculus</u> <u>sandwichensis</u>	WM, LSR, B, LWV	H	
Grasshopper sparrow	<u>Ammodramus savannarum</u>	WSR, B	H	BL
Henslow's sparrow	<u>Ammodramus henslowii</u>	LSR, B	M	BL, WVHT

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

<u>Common Name</u>	<u>Species^a</u> <u>Scientific Name</u>	<u>Seasonal Occurrence^b</u> <u>& Gen. Distribution</u> <u>in West Virginia</u>	<u>Probability of^c</u> <u>Reg. Occurrence</u> <u>on Site</u>	<u>Special^d</u> <u>Status</u>
<u>Vesper sparrow</u>	<u>Poocetes gramineus</u>	WSR, B	H	BL
<u>Lark sparrow</u>	<u>Chondestes grammacus</u>	LSR, B	L	WVHT
<u>Bachman's sparrow</u>	<u>Aimophila aestivalis</u>	LSR, B	L	BL
<u>Dark-eyed junco</u>	<u>Junco hyemalis</u>	WWV, WM, LSR, B	H	
<u>Tree sparrow</u>	<u>Spizella arborea</u>	WWV, WM	H	
<u>Chipping sparrow</u>	<u>Spizella passerina</u>	WSR, B	H	
<u>Field sparrow</u>	<u>Spizella pusilla</u>	WSR, B, LWV	H	
<u>White-crowned</u> <u>sparrow</u>	<u>Zonotrichia</u> <u>leucophrys</u>	WM, LWV	H	
<u>White-throated</u> <u>sparrow</u>	<u>Zonotrichia</u> <u>albicollis</u>	WM, WWV, LSR, B	H	
<u>Fox sparrow</u>	<u>Passerella iliaca</u>	WM, LWV	H	
<u>Lincoln's sparrow</u>	<u>Melospiza lincolni</u>	LM	M	
<u>Swamp sparrow</u>	<u>Melospiza georgiana</u>	WM, LSR, B	H	
<u>Song sparrow</u>	<u>Melospiza melodia</u>	WPR, B, WM	H	

EXHIBIT 10-2 (Continued)

BIRD SPECIES LIST
P&M/SRC-II SITE

^aNomenclature based on the American Ornithologists' Union Check-list of North American Birds (American Ornithologists' Union 1957) including the 32nd (A.O.U. 1973) and 33rd (A.O.U. 1976) supplements to the check-list. Underlined species are those that have been observed on the P&M/SRC-II Site.

^bBased on Hall (1971). W = widespread, L = local, VL = very local, P = possible, O = occasional, PR = permanent resident, B = breeder, SR = summer resident, M = migrant, F = fall, WV = winter visitor.

^cProbability of regular occurrence on site over a one-year period based on abundance in site area and availability of appropriate habitat on site. L = low, M = medium, H = high; (MR) = Monongahela River.

^dSpecial status categories: BL = species on the 1978 National Audubon Blue List; WVHT = species on the West Virginia Heritage Trust Program: list of species of scientific interest in the Monongahela River sub-basin from Fairmont to the Pennsylvania state line; E = Endangered species. Species on the U. S. Department of the Interior, Fish and Wildlife Service list of Endangered Species (U.S.D.I., 1978).

EXHIBIT 10-3

SEASONALLY DOMINANT BIRD SPECIES BY HABITAT TYPE
P&M/SRC-II SITE

<u>Habitat Type</u>	<u>Dominant Species In Each Season^a</u>		
	<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
<u>Forest</u>			
deciduous forest interior	Downy woodpecker American robin Cardinal	Downy woodpecker American robin Cardinal	Cardinal Carolina chickadee Brown creeper
deciduous forest edge	Common flicker Downy woodpecker Common crow American robin Cardinal Indigo bunting	Field sparrow Common flicker Downy woodpecker Common crow American robin Cardinal Indigo bunting	Carolina chickadee Song sparrow Tufted titmouse White-breasted nuthatch Cardinal Dark-eyed junco
conifer plantation interior and edge	-	-	Cardinal
<u>Scrub</u>			
	Common crow Mockingbird Cedar waxwing	Field sparrow Common crow Mockingbird Cedar waxwing	White-throated sparrow Cardinal
<u>Grassland</u>			
meadow	Common crow Starling Eastern meadowlark Brown-headed cowbird	Common crow Starling Eastern meadowlark Brown-headed cowbird	Eastern meadowlark

EXHIBIT 10-3 (Continued)

SEASONALLY DOMINANT BIRD SPECIES BY HABITAT TYPE
P&M/SRC-II SITE

Habitat Type	Dominant Species In Each Season ^a		
	Summer	Fall	Winter
<u>Grassland (cont.)</u>			
pasture	Rock dove	Rock dove	American robin Killdeer
<u>Wetland</u>			
wooded floodplain pond	Yellow warbler	no species recorded	Black duck
shrubby and open floodplain pond	NC	NC	Wood duck Black duck
Monongahela River	NC	NC	Hooded merganser
open ponds	Killdeer	Killdeer	Killdeer
shrub wetland	Redwinged blackbird Mockingbird	Mockingbird Song sparrow	Common snipe
<u>Cropland</u>	NC	NC	no species recorded
<u>Mined land</u>	NC	NC	Horned lark
<u>Residential Areas</u>	Rock dove Common crow Starling	Rock dove Common crow Starling	Starling Redwinged blackbird

^aSpecies presented in ranked order for the winter and unranked for the summer and fall.

EXHIBIT 10-4

FOREST HABITAT TYPE, SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC-II SITE

<u>Species</u>	<u>Habitat^a Type</u>	<u>Occurrence and Relative Abundance^c</u>		
		<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Turkey vulture	udfe		C(as)	
Sharp-shinned hawk	sdfe			P
	udfe			P
Cooper's hawk	udfe		R	
Red-tailed hawk	sdfe	U(as)	U(as)	P
	sdfe	U(as)	U(as)	1
	udfe	U(as)	U(as)	
American kestrel	udfe	U		P
Ruffed grouse	udfe		R	
	cpie			1
American woodcock	sdfe			P
Mourning dove	udfe	U	U	
Great horned owl	cpie			1
Ruby-throated hummingbird	sdfe	U		
	udfi	U		
Belted kingfisher	sdfe	U		

EXHIBIT 10-4 (Continued)

FOREST HABITAT TYPE, SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC- II SITE

Species	Habitat ^a Type	Occurrence and Relative Abundance ^c		
		Summer	Fall	Winter
Common flicker	sdfe	C	C	
	udfe	C	C	
Common nighthawk	udfe	C(as)		
Pileated woodpecker	sdfi			P(ev)
	udfi			P
Downy woodpecker	sdfi	C	C	1
	sdfe	C	C	2
	udfi			1
	udfe	C	C	P
Eastern kingbird	udfe	R		
Eastern phoebe	sdfe		R	
		udfe		R
Acadian flycatcher	udfe	R		
Eastern wood pewee	sdfe		R	
Blue jay	sdfi			1
	sdfe			1
	udfe	U	U	
Common crow	udfe	A	A	P

EXHIBIT 10-4 (Continued)

FOREST HABITAT TYPE, SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC-II SITE

Species	Habitat ^a Type	Occurrence and Relative Abundance ^c		
		Summer	Fall	Winter
Carolina chickadee	sdfi	U	U	1
	sdfe	U	U	1
	udfi			2
	udfe	U	U	2
	cpie			P
Tufted titmouse	sdfi			1
	sdfe			2
	udfi			1
	udfe		U	1
	cpie			1
White-breasted nuthatch	sdfi			1
	sdfe			1
	udfi			1
Brown creeper	sdfi			1
House wren	udfe	U	U	
Mockingbird	udfe	C	C	
Gray catbird	sdfe		R	
American robin	sdfi	C	C	
	sdfe	C	C	1
	udfe	C	C	

EXHIBIT 10-4 (Continued)

FOREST HABITAT TYPE, SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC-II SITE

<u>Species</u>	<u>Habitat^a Type</u>	<u>Occurrence and Relative Abundance^c</u>		
		<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Eastern bluebird	udfe			P
Blue-gray gnatcatcher	udfe	U		
Cedar waxwing	udfe	C	C	
Yellow-throated vireo	sdfe		R	
Red-eyed vireo	sdfe	R		
Warbling vireo	sdfe	R		
Black and white warbler	sdfi	R		
Prothonotary warbler	sdfi		R	
	sdfe		R	
Nashville warbler	sdfe		U	
Yellow warbler	sdfe	R		
Magnolia warbler	sdfe		R	
Kentucky warbler	udfe		R	

EXHIBIT 10-4 (Continued)

FOREST HABITAT TYPE, SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC-II SITE

Species	Habitat ^a Type	Occurrence and Relative Abundance ^c		
		Summer	Fall	Winter
Common yellowthroat	sdfe		R	
Redwinged blackbird	sdfe	U		
	udfe	U		
Brown-headed cowbird	udfe	U		
Scarlet tanager	sdfe	R		
Summer tanager	sdfe	R		
Cardinal	sdfi	C	C	2
	sdfe	C	C	1
	udfi			2
	udfe	C	C	1
	cpie			3
Blue grosbeak	sdfe	R		
Indigo bunting	sdfe	C	C	
	udfe	C	C	
Pine siskin	sdfe			1
American goldfinch	sdfe	C	C	
	cpie			P

EXHIBIT 10-4 (Continued)

FOREST HABITAT TYPE, SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC-II SITE

<u>Species</u>	<u>Habitat^a Type</u>	<u>Occurrence and Relative Abundance^c</u>		
		<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Rufous-sided towhee	sdfe udfe	R	R	P
Vesper sparrow	udfe		U	
Dark-eyed junco	sdfi sdfe udfe cpie		U	1 1 1 1
Chipping sparrow	sdfe		U	
Field sparrow	sdfe udfe		A A	
White-throated sparrow	sdfe udfe			1 1

EXHIBIT 10-4 (Continued)

FOREST HABITAT TYPE, SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF BIRDS
P&M/SRC-II SITE

Species	Habitat ^a Type	Occurrence and Relative Abundance ^b		
		Summer	Fall	Winter
Fox sparrow	udfe		R	P
Song sparrow	sdfe			1
	udfe		U	2

^aHabitat types: sdfe = slope deciduous forest interior (study area 1).
sdfe = slope deciduous forest edge (study area 2).
udfi = upland deciduous forest interior (study area 3).
udfe = upland deciduous forest edge (study area 4).
cpie = conifer plantation interior and edge (study area 5).

^bSummer and fall relative abundance categories:

A = abundant (more than 50 observations of individuals in habitat during seasonal site survey).
C = common (11-50 observations).
U = uncommon (3-10 observations).
R = rare (1 or 2 observations).
as = airspace over habitat (flying individuals).

Winter relative abundance figures = total number of individuals of each species recorded/number of individuals of all species. Categories:

1 = 0 - 20%
2 = 21 - 40%
3 = 41 - 60%
4 = 61 - 80%
5 = 81 - 100%

P = present in habitat but not recorded in formal census.

EXHIBIT 10-5

REPTILE SPECIES LIST
P&M/SRC-II SITE

<u>Taxonomic Grouping</u>	<u>Common Name</u>	<u>Scientific Name</u>	<u>Presence Monongalia County</u>	<u>Presence Site Vicinity</u>	<u>Special Status a</u>
Testudines	Common snapping turtle	<u>Chelydra s. serpentina</u>	present	unknown	-
	Stinkpot turtle	<u>Sternotherus odoratus</u>	"	"	-
	Wood turtle	<u>Clemmys insculpta</u>	unknown	"	-
	Spotted turtle	<u>Clemmys guttata</u>	"	"	-
	Eastern box turtle	<u>Terrapene c. carolina</u>	present	occasional	-
	Map turtle	<u>Graptemys geographica</u>	"	unknown	-
	Midland painted turtle	<u>Chrysemys picta marginata</u>	unknown	"	-
	Smooth softshell turtle	<u>Trionyx muticus</u>	"	"	-
	Spiny softshell turtle	<u>Trionyx spiniferus</u>	present	"	-
Squamata					
Lacertilia	Northern fence lizard	<u>Sceloporus undulatus hyacinthinus</u>	"	"	-
	Five-lined skink	<u>Eumeces fasciatus</u>	"	"	-
Serpentes					
	Queen snake	<u>Natrix septemvittata</u>	"	"	-
	Northern water snake	<u>Natrix s. sipedon</u>	"	"	-
	Northern brown snake	<u>Storeria d. dekayi</u>	unknown	"	-
	Northern red-bellied snake	<u>Storeria o. occipitomaculata</u>	present	"	-

EXHIBIT 10-5 (Continued)

REPTILE SPECIES LIST
P&M/SRC-II SITE

<u>Taxonomic Grouping</u>	<u>Common Name</u>	<u>Scientific Name</u>	<u>Presence Monongalia County</u>	<u>Presence Site Vicinity</u>	<u>Special Status a</u>
Serpentes (cont.)	Eastern garter snake	<u>Thamnophis s. sirtalis</u>	present	unknown	-
	Eastern ribbon snake	<u>Thamnophis s. sauritus</u>	unknown	"	-
	Smooth earth snake	<u>Virginia valeriae</u>	"	"	-
	Eastern hognose snake	<u>Heterodon platyrhinos</u>	present	"	-
	Northern ringneck snake	<u>Diadophis punctatus edwardsi</u>	present	unknown	-
	Eastern worm snake	<u>Carphophis a. amoenus</u>	"	"	-
	Northern black racer	<u>Coluber c. constrictor</u>	"	"	-
	Eastern smooth green snake	<u>Opheodrys v. vernalis</u>	"	"	-
	Rough green snake	<u>Opheodrys aestivus</u>	unknown	"	-
	Black rat snake	<u>Elaphe o. obsoleta</u>	present	"	-
	Eastern milk snake	<u>Lampropeltis t. triangulum</u>	"	"	-
	Northern copperhead	<u>Agkistrodon contortrix mokasen</u>	"	"	-
	Timber rattlesnake	<u>Crotalus h. horridus</u>	"	"	-

- ^a USFWS - U.S. Fish and Wildlife Service (Endangered Species)
 WVHT - West Virginia Heritage Trust (Special Interest Species)

EXHIBIT 10-6

AMPHIBIAN SPECIES LIST
P&M/SRC-II SITE

Taxonomic Grouping	Common Name	Scientific Name	Presence Monongalia County	Presence Site Vicinity	Special Status ^a
Caudata	Hellbender	<u>Cryptobranchus a. alleganiensis</u>	present	unlikely	-
	Mudpuppy	<u>Necturus masculosus</u>	"	"	
	Red-spotted newt	<u>Notophthalmus v. viridescens</u>	"	abundant	-
	Jefferson salamander	<u>Ambystoma jeffersonianum</u>	unknown -	unknown	-
	Spotted salamander	<u>Ambystoma maculatum</u>	present	"	-
	Marbled salamander	<u>Ambystoma opacum</u>	unknown	"	-
	Mountain dusky salamander	<u>Desmognathus ochrophaeus</u>	present	"	-
	Northern dusky salamander	<u>Desmognathus f. fuscus</u>	"	abundant	-
	Appalachian seal salamander	<u>Desmognathus m. monticola</u>	"	occasional	-
	Red-backed salamander	<u>Plethodon c. cinereus</u>	"	unknown	-
	Ravine salamander	<u>Plethodon richmondi</u>	"	"	-
	Slimy salamander	<u>Plethodon g. glutinosus</u>	"	present	-
	Wehrle's salamander	<u>Plethodon wehrlei</u>	"	unknown	-
	Four-toed salamander	<u>Hemidactylium scutatum</u>	unknown	"	-
	Green salamander	<u>Aneides aeneus</u>	present	unlikely	-
	Northern spring salamander	<u>Gyrinophilus p. porphyriticus</u>	"	"	-
	Northern red salamander	<u>Pseudotriton r. ruber</u>	"	"	-
	Northern two-lined salamander	<u>Eurycea b. bislineata</u>	"	occasional	-
	Long-tailed salamander	<u>Eurycea l. longicauda</u>	"	unknown	-

EXHIBIT 10-6 (Continued)

AMPHIBIAN SPECIES LIST
P&M/SRC- II SITE

<u>Taxonomic Grouping</u>	<u>Common Name</u>	<u>Scientific Name</u>	<u>Presence Monongalia County</u>	<u>Presence Site Vicinity</u>	<u>Special Status^a</u>
Anura	American toad	<u>Bufo americanus</u>	present	common	-
	Fowler's toad	<u>Bufo woodhousei fowleri</u>	"	unknown	-
	Spring peeper	<u>Hyla crucifer</u>	"	common	-
	Gray tree frog	<u>Hyla versicolor</u> and <u>chrysoscelis</u>	"	unknown	-
	Mountain chorus frog	<u>Pseudacris branchyphona</u>	unknown	"	-
	Green frog	<u>Rana clamitans melanota</u>	present	abundant	-
	Bullfrog	<u>Rana catesbeiana</u>	"	unknown	-
	Northern leopard frog	<u>Rana pipiens</u>	"	unlikely	-
	Pickere1 frog	<u>Rana palustris</u>	"	abundant	-
	Wood frog	<u>Rana sylvatica</u>	"	rare	-

^a USFWS - U.S. Life and Wildlife Service (Endangered Species)
WVHT - West Virginia Heritage Trust (Special Interest Species)

SECTION 11

SOILS

11.1 INTRODUCTION

Soil investigations were performed at the SRC-II plant site for two primary purposes. The first was to provide a baseline description of the soils; the second, to provide information for soil salvage and reclamation operations. Initially, a literature review and agency contact was conducted to determine availability and extent of regional and site-specific soil information. Various publications of regional significance exist (Bear and Salter 1916; Bryan and Deatrick 1924; Browning 1941; Smith et al 1945), but are outdated and provide little insight to specific soil types found at the SRC-II project development area. A more site-oriented publication was produced by the USDA in 1912, but is also outdated and does not provide adequate information sought in this study. Unpublished information from the Monongalia County Interim Soil Survey Report, Volumes I and II (USDA 1977), provided the most comprehensive and reliable information of any available source.

Personal communication with soil scientists (Berg 1979; Hatfield 1979; Sencindiver 1979; van Eck 1978, 1979) familiar with West Virginia soils provided insights unavailable in published literature. Recent publications (Berg 1978, Smith and Sobek 1978) provided a basis for determining methods of soil sampling and types of soil analyses most suited to disturbed and mined soils.

Generalized soil maps and accompanying soil descriptions from the Interim Report (USDA 1977) were essential for an accurate evaluation of soil properties and suitability for salvage and reclamation purposes. These did not, however, supply sufficient information on site-specific physical and chemical characteristics to make reclamation recommendations. Therefore, an agronomic sampling and soil analysis program was undertaken and directed toward the physical and chemical characterization of soil units within the disturbance area.

Baseline data on trace elements and organic compounds (polynuclear aromatics and benzene-soluble organic compounds) were considered desirable for future use in monitoring programs. This portion of the sampling and analysis program focused on determining pertinent parameters in areas to be left undisturbed by plant operations. Implementation of monitoring programs will be facilitated by this approach.

11.2 METHODS

Agronomic, trace element, and organic compound (PNA, benzene-soluble) soil sampling programs were carried out in May 1979. Agronomic samples were taken at 15 locations. All locations, with the exception of one in the western portion of the development area, were in areas to be disturbed by construction of the SRC-II demonstration plant.

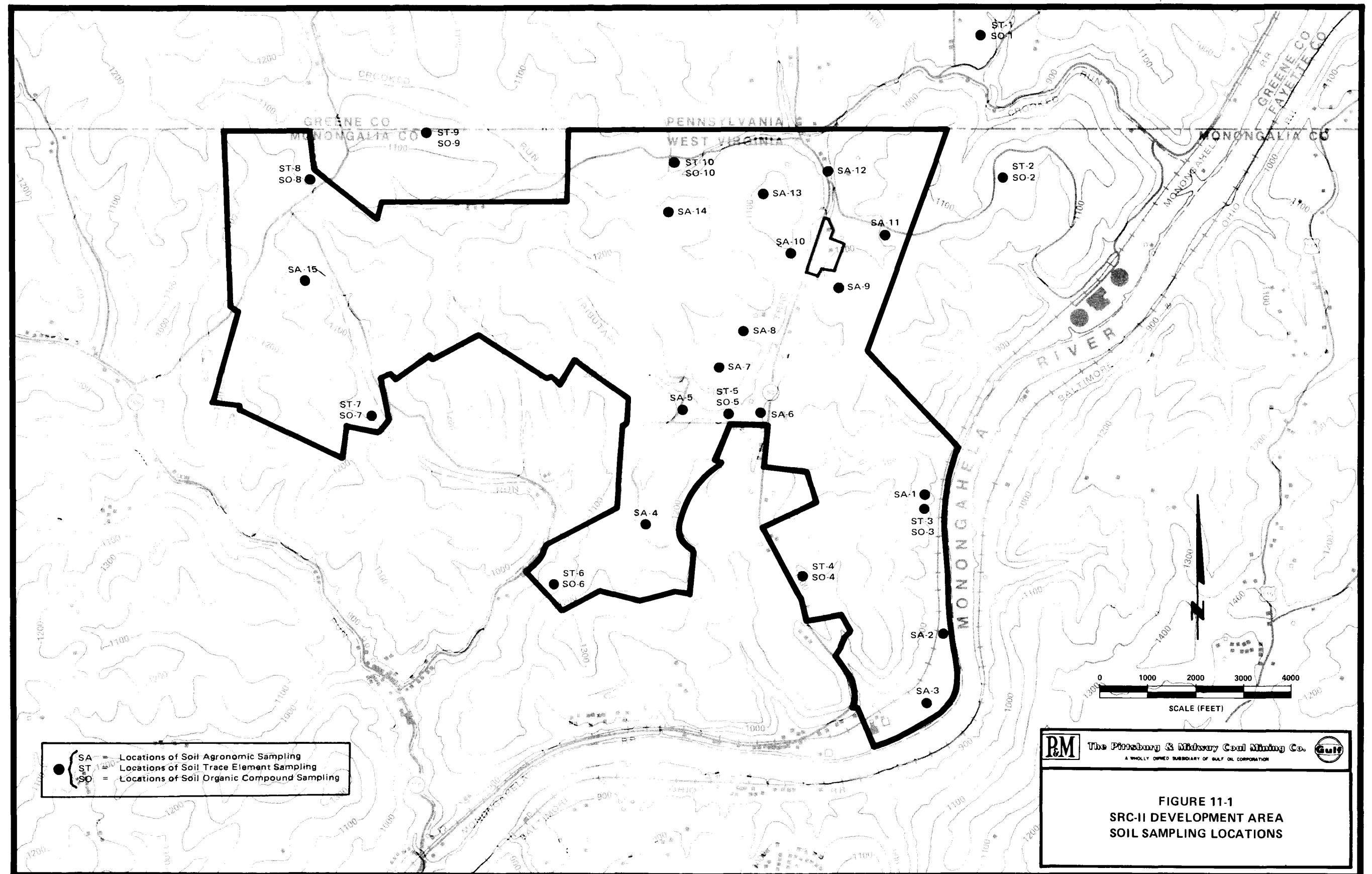
Sample locations are shown on Figure 11-1 and are distributed among soil types as follows:

Westmoreland silt loam	- 3 locations
Strip Mined Udorthents	- 3 locations
Clarksburg silt loam	- 2 locations
Culleoka-Westmoreland silt loam	- 2 locations
Dormont-Guernsey silt loam	- 2 locations
Holly silt loam	- 1 location
Lobdell silt loam	- 1 location
Kanawha loam	- 1 location

At each location agronomic samples were taken from 5 depths: 0 to 15 cm (0 to 6 in.), 15 to 31 cm (6 to 12 in.), 31 to 61 cm (12 to 24 in.), 61 to 91 cm (24 to 36 in.) and 91 to 122 cm (36 to 48 in.). Three samples were collected for quality assurance.

Manually operated core sampling tubes with 122-cm (48 in.) extension rods were used in the sampling process. Soil analyses were performed by the West Virginia University Soil Testing Laboratory and CDM/Accu-Labs of Denver, Colorado.

Analyses performed at the WVU laboratory include available phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), pH, percent organic matter, and lime requirement. Procedures followed are



those described in "Soil Testing Methods" (Ghazi, van Eck, and Bennett 1978). These procedures have been modified from those described by Black in 1965 to provide more accurate results on a regional basis.

Analyses beyond the scope of the WVU laboratory were performed by CDM/Accu-Labs. These analyses include available nitrogen, electrical conductivity, texture, moisture holding capacity, cation exchange capacity (CEC), and base saturation (BS). Procedures follow "Methods of Soil Analyses" (Black 1965). In addition, one-third, or approximately 25 samples, were tested for parameters also determined at WVU (P, K, pH, Ca, Mg, lime requirement and percent organic matter) as a quality assurance control measure.

Agronomic soil samples collected for the WVU laboratory were delivered to the lab directly after collection. Samples were air-dried by laboratory personnel and stored until analyses could be performed. Samples collected and transported back to Denver were removed from collection containers and spread out to dry at the end of each field day.

Samples for trace element analysis were collected from 10 locations around the perimeter of the demonstration plant site. Sample locations are shown on Figure 11-1 and are in areas to be left relatively undisturbed by plant construction and operation. Duplicate samples were taken at locations ST-2, ST-10, and ST-6 and were identified as samples ST-11, ST-12, and ST-13, respectively, for laboratory use. Sample locations are both upwind and downwind from proposed emission points, thus providing adequate monitoring stations once the plant is operational.

A total of 13 samples, including the aforementioned three samples for quality assurance, were collected for trace element analysis. Samples were collected by removing vegetation and/or the organic litter layer of humus-soil material and scraping the top 8 to 15 cm (3 to 6 in.) of soil into widemouthed polyethylene pint bottles.

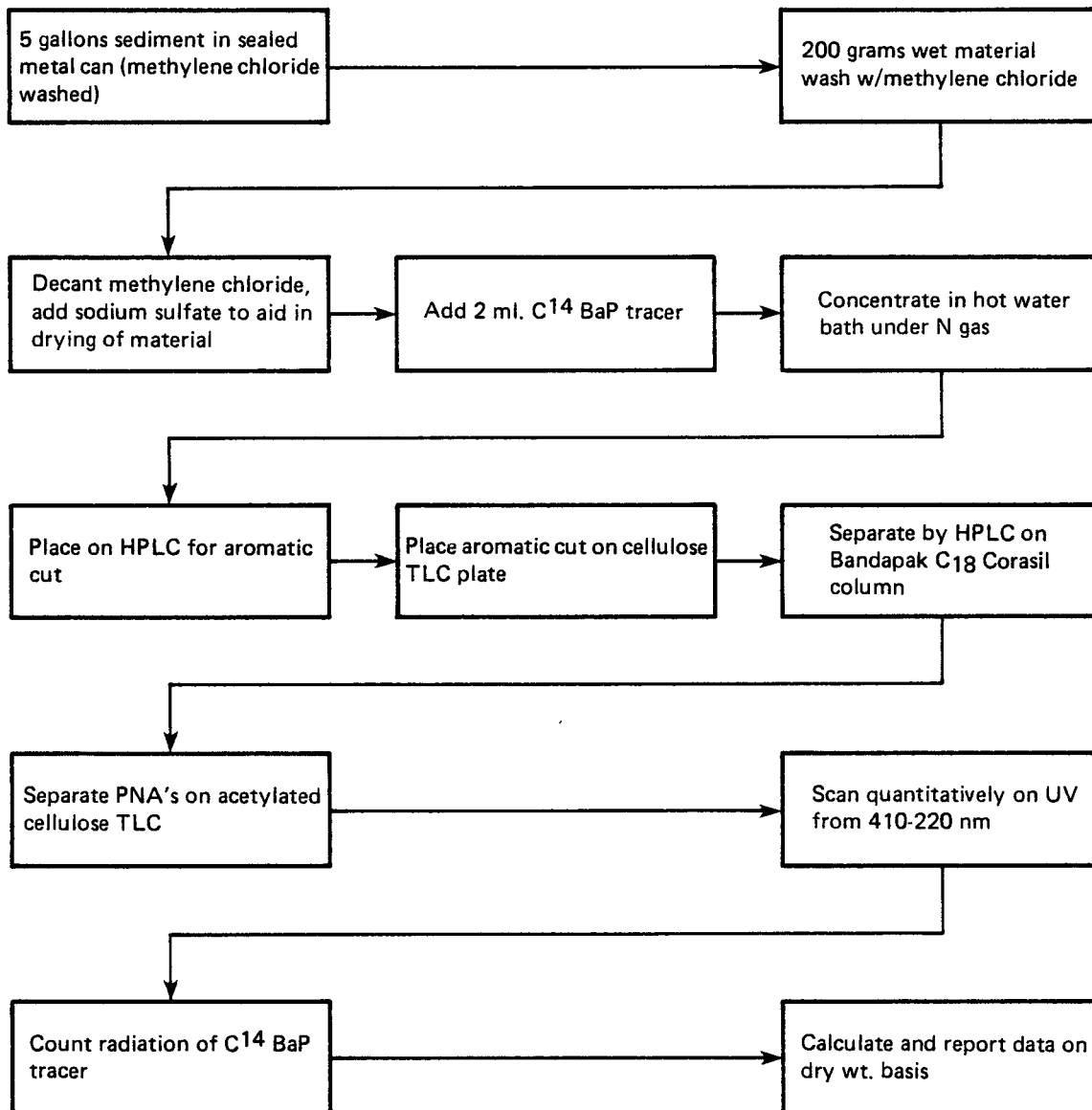
Although cumbersome, this method prevented contamination of samples by eliminating soil contact with objects other than sample containers. Samples were stored in cool areas (22°C) for 24 to 48 hours before being delivered to NUS Analytical Services Laboratory in Pittsburgh, Pennsylvania. Standard Methods specified in "Methods of Soil Analysis" (Black 1965) and approved by the EPA were used for trace element analyses. All samples were analyzed for:

Aluminum	Iron
Antimony	Lead
Arsenic	Manganese
Beryllium	Mercury
Boron	Molybdenum
Cadmium	Nickel
Chromium	Selenium
Chlorine	Vanadium
Copper	Zinc
Cyanide	pH
Fluoride	Specific Conductance

The 13 samples for PNA and benzene-soluble analysis were collected from the same locations as trace element samples (Figure 11-1). Quality assurance duplicate samples taken at sites S0-2, S0-10, and S0-6 were identified as S0-11, S0-12, and S0-13, respectively. As in trace element sampling, the organic litter layer was removed prior to sample collection. Stainless-steel garden trowels were used to collect samples from the upper 15 cm (6 in.) of soil, which were placed directly into one-gallon metal cans washed with methyl chloride. Cans were immediately sealed to prevent photodegradation of PNA's, then returned to the Gulf Science and Technology Company Laboratory in Pittsburgh within 48 hours. A summary of methods used for PNA analysis is provided in Figure 11-2. All samples were analyzed for the following compounds:

benz (a) anthracene
benz (a) pyrene
benz (e) pyrene
benzo (g,h,i) perylene
benzene solubles

FIGURE 11-2.
FLOW CHART - PNA ANALYSES FOR SOIL



11.3 RESULTS AND DISCUSSION

11.3.1 Soil Map And Descriptions

11.3.1.1 General

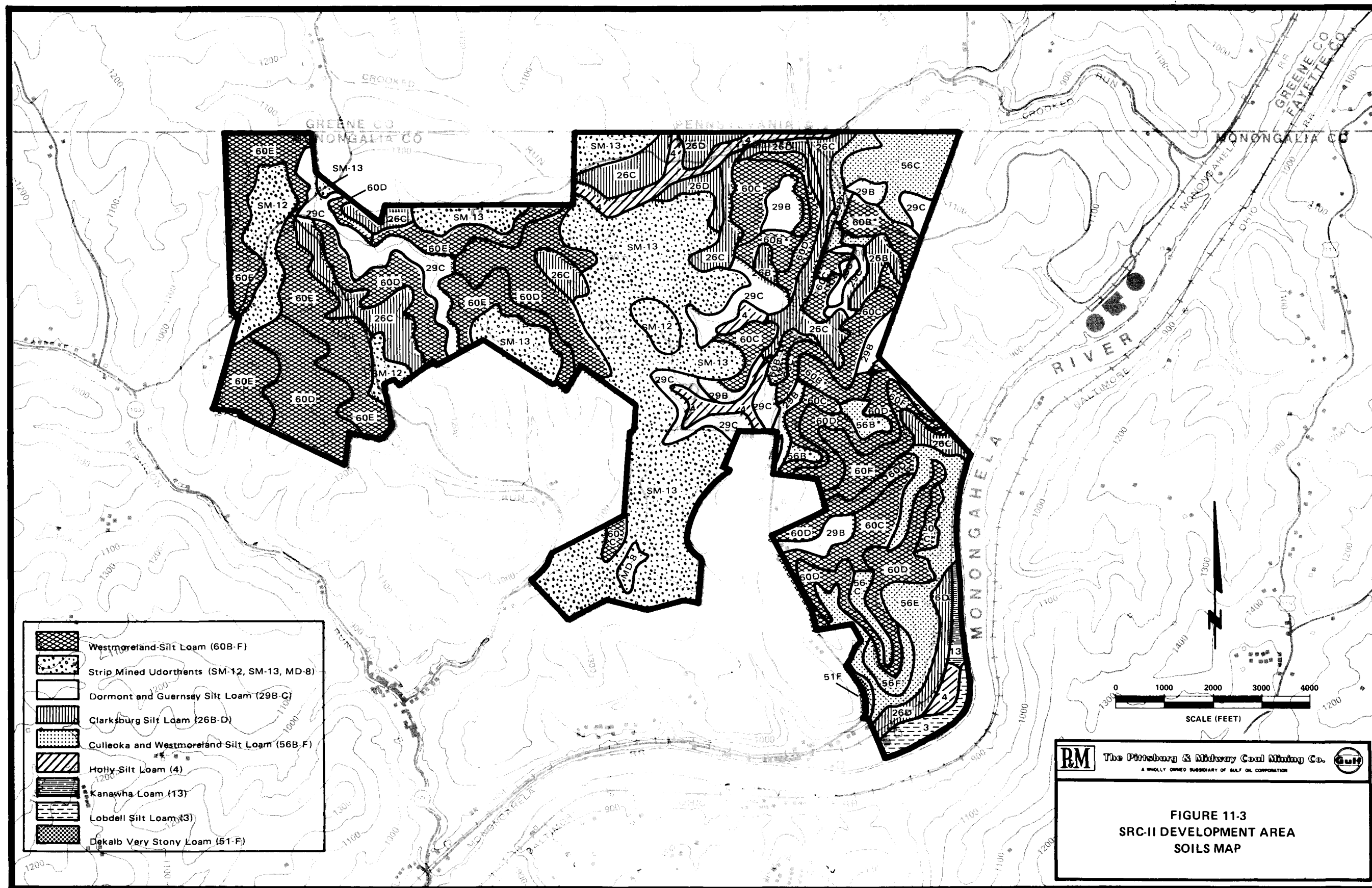
Twenty-two soil mapping units are present on Gulf property in Monongalia County, according to the Monongalia County Interim Soil Survey Report (USDA 1977). The 22 units represent 10 different soil series, or associations (complexes), which are subdivided on the basis of slope. A soil map (Figure 11-3) was prepared utilizing Volume II of the Interim Report (USDA 1977) in conjunction with site topographic maps. For purposes of brevity, the following mapping unit descriptions will not differentiate slope. Soils within each association have similar physical and chemical characteristics. Erosion hazards increase and land use capabilities decrease with increasing slope. Slopes are generally designated in the following manner:

- B - 3 to 8 percent slopes, gently sloping
- C - 8 to 15 percent slopes, strongly sloping
- D - 15 to 25 percent slopes, moderately steep
- E - 25 to 35 percent slopes, steep
- F - 35 to 65 percent slopes, very steep

11.3.1.2 Westmoreland Silt Loam

The Westmoreland silt loam complex, which includes mapping units 60B, C, D, D₃ (severely eroded), E and F, covers the greatest area within the site. This complex occupies approximately 39 percent, or 374 ha (923 ac), of the 950 ha (2350 ac) development area. Westmoreland silt loams are well drained soils formed in lime-influenced material weathered from shale, siltstone, sandstone, and some limestones. Included soils, which make up 20 to 25 percent of these mapping units, are Culleoka, Dekalb, Upshur, Dormont, and Guernsey soils.

The surface layer of the Westmoreland soils is generally a dark-brown silt loam varying from 8 to 15 cm (3 to 6 in.), and is



underlain by brown silt loam 8 to 13 cm (3 to 5 in.) thick. The surface layer of mapping unit 60D3 is severely eroded and is only 5 cm (2 in.) thick. It is not underlain by the brown silt loam layer.

The subsoil extends to a depth of approximately 102 cm (40 in.) and consists of a narrow 10 to 15 cm (4 to 6 in.) layer of friable yellowish-brown silt loam. Underneath are layers of friable strong-brown silty clay loam and friable strong-brown shaly silty clay loam. The substratum is firm strong-brown very shaly light silty clay loam extending to bedrock, a depth which varies from 102 to 183 cm (40 to 72 in.) or more.

Available water capacity is high and permeability is moderate throughout. Runoff rates vary from medium on mapping unit 60B to very rapid on units 60D3, 60E, and 60F. Natural fertility is high, although where unlimed, this soil is medium to very strongly acid in the surface and subsoil, and medium to strongly acid in the substratum.

Erosion hazard varies from moderate in units 60B to severe in units 60C,D, and very severe in units 60D3,E,F. Farming potential ratings correspond with erosion ratings (60B and 60C have good potential, 60D fair, and 60D3, 60E, and 60F poor potential for farming). All units have very limited use for urban development, but good potential for tree growth.

11.3.1.3 Udorthents

The Udorthents (mapping units MD-8, SM-12, and SM-13) constitute the second largest soil grouping within the development area, covering approximately 25 percent, or 239 ha (590 ac).

Mapping unit MD-8 consists of areas used for mine waste dumps. The properties of this soil are somewhat different from those of the SM soils and will be discussed separately. The surface layer of MD-8 (Udorthents, dumps, very low base) soil is typically a black loam 18 cm (7 in.) thick. This is underlain by a 13-cm (5 in.) layer of

friable, black sandy loam with mottles (red to yellow). A subsurface layer, approximately 97 cm (38 in.) thick, consists of friable, black reddish-yellow, reddish-brown, and dark grayish-brown sandy loam.

The upper 25 cm (10 in.) of soil consists of 35 to 70 percent coarse fragments. Below this depth coarse fragment content ranges from 70 to 90 percent. Included soils compose about 20 percent of this unit and include portions of nearly all nearby soil types.

Available water capacity, permeability and natural fertility are variable, the soil is generally droughty, and runoff is medium to rapid. The soil is extremely to very strongly acid where unlimed. Unprotected areas exhibit moderate to very severe erosion hazards. The soil has poor farming potential, due in part, to heat absorbed by the black surface layer.

Both high base (SM-13) and low base (SM-12) Udorthents, mudstone, and sandstone, appear in areas surface-mined for coal. High walls, benches and outcrops are generally evident. Parent material is variable with 30 percent of the unit being made up of Udorthents, dumps, low base, and Udorthents, dumps, very low base, and Culleoka, Dormont, Guernsey and Westmoreland soils.

Bench areas typically have a surface layer about 5 cm (2 in.) thick, consisting of dark-brown silty clay loam with yellowish-brown and light-gray mottles. Subsoil layers consist of a 30-cm (12 in.) band of friable, yellowish-brown channery silty clay loam with gray mottles, a 25-cm (10 in.) layer of friable, light yellowish-brown channery silty clay loam with variable mottles, and a 51-cm (20 in.) layer of very friable, dark grayish-brown very channery loam with pockets of strong-brown mottles. Depth to bedrock is variable. Coarse fragment content ranges from 30 to 50 percent in the upper 25 cm (10 in.) and from 45 to 80 percent below.

Available water capacity, permeability, and natural fertility are variable. Runoff is medium to rapid on benches and very rapid on high walls and out slopes. Where unlimed, SM-13 soils are medium acid to moderately alkaline and have fair farming potential. SM-12 soils are strongly to very strongly acid and lack potential for farming. The erosion hazard is moderate to very severe in unprotected areas but both soils show good potential for woodland and/or wildlife uses.

11.3.1.4 Clarksburg Silt Loam

Clarksburg silt loam (mapping units 26B, 26C, and 26D) covers about 12.6 percent, or 119 ha (294 ac), of the development area. These well-drained soils formed in material which has moved downslope by means of water, gravity, freezing, and thawing. Other soils included in the Clarksburg mapping units are small areas of Dormont, Guernsey, Culleoka, Gilpin, and Westmoreland soils. These comprise 15 to 20 percent of the Clarksburg association.

Surface layers are from 5 to 8 cm (2 to 3 in.) thick and are underlain by dark-brown silt loam 18 to 20 cm (7 to 8 in.) thick. Subsoil consists of several layers. The upper two are friable silt loams which vary only in color and are collectively about 46 cm (18 in.) thick. Below this occurs an 18 to 20-cm (7 to 8 in.) layer of firm yellowish-brown channery heavy loam mottled with brownish-gray and strong-brown. The lower 61 to 69 cm (24 to 27 in.) of subsoil is a fragipan layer of firm yellowish-brown, brittle channery heavy loam with light brownish-gray and strong-brown mottles. The substratum is a very firm dark yellowish-brown, channery heavy loam mottled with grayish-brown and strong-brown. Depth to bedrock is greater than 152 cm (60 in.).

Available water capacity is moderate and permeability is moderately slow, or slow. Runoff is medium and natural fertility is moderate or high. This soil has a seasonal high water table about 61 cm (24 in.) below the surface, which restricts the root zone of some plants. Unless limed, this soil is slightly to strongly acid.

The erosion hazard of unit 26B is moderate in unprotected areas, but units 26C and 26D exhibit severe erosion hazards under similar circumstances. Mapping units 26B and 26C have good potential for farming while unit 26D has fair farming potential. These soils are limited for most urban uses but have good potential for tree growth.

11.3.1.5 Dormont - Guernsey Silt Loam

The Dormont and Guernsey silt loam association (mapping units 29B and 29C) occupies approximately 8.7 percent, or 82 ha (203 ac), of the development area. These soils are moderately drained and were formed in lime-influenced material weathered from shale and thin beds of limestone. Soils included in these mapping units, composing 15 percent of the total area, are Culleoka, Westmoreland, Upshur, and Clarksburg series.

Dormont soil generally has a dark-brown silt loam surface layer 13 to 15 cm (5 to 6 in.) thick. This is underlain by 8 to 10 cm (3 to 4 in.) of dark yellowish-brown silt loam. The upper 10 to 13 cm (4 to 5 in.) of subsoil material is friable strong-brown heavy silt loam. The next 23 to 25 cm (9 to 10 in.) is friable to firm yellowish-brown heavy silty clay loam and is followed by 28 cm (11 in.) of firm yellowish-brown heavy silty clay loam mottled with gray. A 25-cm (10 in.) layer of firm-gray heavy silty clay loam mottled with strong-brown lies just above the substratum of firm-gray light silty clay mottled with strong-brown, and firm dark-brown shaly silt loam mottled with gray and strong-brown.

The surface layer of Guernsey soil is dark grayish-brown silt loam 8 to 10 cm (3 to 4 in.) thick, which is underlain by dark-brown silt loam 10 to 13 cm (4 to 5 in.) thick. The upper 13 cm (5 in.) of subsoil is friable strong-brown silt loam and is followed by 20 cm (8 in.) of friable yellowish-brown silty clay loam mottled with gray. The next 28 cm (11 in.) is firm-gray silty clay mottled with yellowish-red. The lower 25 cm (10 in.) of the subsoil is firm-gray heavy silty clay mottled with yellowish-brown and yellowish-red. A

substratum of firm-gray, brownish-yellow and yellowish-brown heavy silty clay with some brown and gray siltstone, extends to a bedrock which varies from 122 to 165 cm (48 to 65 in.) in both soils.

Available water capacity is high, and permeability is moderately slow to slow throughout these soils. Runoff is medium and natural fertility is moderate or high. The Dormont soil has a seasonal high water table about 61 cm (24 in.) below the surface and the Guernsey soil has a seasonal high water table about 46 cm (18 in.) below the surface. This seasonal fluctuation may restrict the root zone of some plants. Unless limed, Dormont and Guernsey soils are medium to very strongly acid.

In unprotected areas the erosion hazard is moderate in mapping unit 29B and severe in unit 29C. The soils have good potential for farming and growing trees but are limited for urban use by the high water tables.

11.3.1.6 Culleoka-Westmoreland Silt Loam

Culleoka-Westmoreland silt loam soils (mapping units 56B, C, D, E, F) also cover approximately 8.7 percent, or 82 ha (203 ac), of the development area. The soils of this complex are well drained and were formed in lime-influenced material weathered from shale, siltstone, sandstone and some limestone. This association consists of 40 to 55 percent Culleoka silt loam, 25 to 35 percent Westmoreland silt loam, and 20 to 25 percent other soils. The included soils contain small areas of Dekalb, Gilpin, Upshur, Clarksburg, Dormont, and Guernsey series.

Culleoka soils typically have a dark-brown silt loam surface layer 8 to 18 cm (3 to 7 in.) thick. Subsoil material occurs in four layers with the upper layer varying from 10 to 13 cm (4 to 5 in.) in thickness and consisting of friable brown heavy silt loam. The next 13 to 20 cm (5 to 8 in.) layer is a friable brown light silty clay loam. A 10 to 13 cm (4 to 5 in.) layer of friable strong-brown shaly,

silty clay loam occurs above the lower 4-inch layer of subsoil which is friable brown shaly silty clay loam. A substratum of friable to firm-brown very shaly light silty clay loam extends to bedrock which occurs at depths ranging from 51 to 102 cm (20 to 40 in.).

The surface of the Westmoreland soil is an 8-cm (3 in.) layer of dark-brown silt loam underlain by brown silt loam 8 to 13 cm (3 to 5 in.) thick. The upper layer of subsoil material is a friable yellowish-brown silt loam 10 cm (4 in.) thick. A 20 to 30-cm (8 to 12 in.) layer of friable strong-brown heavy silt loam occurs below this, and sits atop 25 to 36 cm (10 to 14 in.) of friable strong-brown heavy silt loam. The next 10 to 15 cm (4 to 6 in.) is friable strong-brown shaly silty clay loam. The substratum, consisting of firm strong-brown very shaly light silty clay loam, extends to bedrock, which varies from 102 to 183 cm (40 to 72 in.) or more.

The Culleoka soil has moderate available water capacity and permeability is moderate throughout. Runoff is medium in mapping unit 56B, rapid in units 56C and 56D, and very rapid in units 56E and 56F. Natural fertility in Culleoka soils is moderate and the soils are medium to strongly acid throughout when left unlimed. The Westmoreland soil has high available water capacity and moderate permeability. Runoff is medium in mapping unit 56B, rapid in units 56C and 56D, and very rapid in units 56E and 56F. Natural fertility in Westmoreland soils is high and acidity ranges from medium to very strongly acid when unlimed.

The erosion hazard is moderate in mapping unit 56B, severe in units 56C and 56D, and very severe in Units 56E and 56F. Soils with 3 to 8 percent slopes (56B) and 8 to 15 percent slopes (56C) have good potential for farming. Those with 15 to 25 percent slopes (56D) have fair potential while those with greater than 25 percent slopes (56E, F) have poor farming potential. All units have good potential for tree growth.

11.3.1.7 Holly Silt Loam

Holly silt loam (mapping unit 4) covers approximately 32 ha (79 ac), or 3.4 percent, of the development area. This poorly drained soil occurs on nearby level floodplains and along streams. Parent material is lime-influenced alluvial material washed from soils on uplands. Included soils comprise about 20 percent of the mapping unit and consist of small areas containing well drained Chagrin and Kanawha soils and moderately well drained Lobdell soil.

The surface layer is typically about 18 cm (7 in.) thick and consists of dark grayish-brown and dark-brown silt loam mottled with yellowish-red and strong-brown. The upper layer of subsoil is 10 cm (4 in.) thick and is friable gray loam mottled with strong-brown. A 64-cm (25 in.) layer below this is friable gray heavy loam mottled with strong-brown. Substratum material is friable gray heavy loam mottled with strong-brown and occurs in a band 91 to 132 cm (36 to 52 in.) below the surface. Below this lies a mixture of friable gray stratified loam, sandy loam, and gravel mottled with strong-brown and olive. Depth to bedrock is greater than 152 cm (60 in.).

Available water capacity is high and permeability is moderately slow in the subsoil. Runoff is slow and natural fertility is moderate to high. A high water table is present in this soil at or near the surface, possibly restricting root growth of some plants. Where unlimed, the soil is slightly to strongly acid.

The soil has a fair potential for farming and good potential for tree growth. It is used primarily for pasture and growing hay, as a flooding hazard does exist on Holly silt loam soils.

11.3.1.8 Lobdell Silt Loam

Lobdell silt loam (mapping unit 3) occurs on 1.2 percent of the development area, approximately 12 ha (30 ac). It occurs only on the level flood plain adjacent to the Monongahela River and is moderately well drained. Lime-influenced alluvial material washed from soils on

uplands serves as parent material. A few small areas of the well drained Chagrin and Kanawha soils and poorly drained Holly soils are included in this mapping unit, constituting about 15 percent of the mapping unit.

An 18-cm (7 in.) surface layer consists of dark-brown silt loam. The upper layer of subsoil is 13 cm (5 in.) of friable brown silt loam. Friable dark yellowish-brown, heavy silt loam comprises a 23-cm (9 in.) layer, below which lies 33 cm (13 in.) of friable dark yellowish-brown loam mottled with strong-brown and grayish-brown. The substratum, consisting of friable dark yellowish-brown loam mottled with strong-brown and grayish-brown, extends from 86 to 135 cm (34 to 53 in.). Below this layer is from 135 to 152 cm (53 to 60 in.) of friable dark yellowish-brown sandy loam mottled with strong-brown and grayish-brown. Depth to bedrock is greater than 152 cm (60 in.).

Available water capacity is high and permeability is moderate in the subsoil. Runoff is slow and natural fertility is moderate to high. This soil has a seasonal high water table about 21 inches below the surface, restricting effective rooting zones of some plants. The surface and upper subsoil are slightly to strongly acid when unlimed, whereas the lower portion of the subsoil and the substratum are neutral to medium acid.

The Lobdell soil has good potential for farming and tree growth. A flooding hazard exists, however, restricting urban use potential. Hence, the soil is primarily used for hay and pasture for which it is well suited.

11.3.1.9 Kanawha Loam

Kanawha loam (mapping unit 13) occupies 6.8 ha (16.8 ac), or 0.7 percent, of the development area, and occurs only on the nearby level flood plain adjacent to the Monongahela River. The well-drained soil formed in lime-influenced alluvial material washed from soils on

uplands. Fifteen percent of the mapping unit is composed of small areas of well drained Chagrin soil, moderately well drained Lobdell soil, and poorly drained Holly soil.

An 18 cm (7 in.) surface layer of dark-brown loam is typical of Kanawha soil. Subsoil consists of a 38 cm (15 in.) layer of friable dark-brown loam, below which lies 99 cm (39 in.) of friable dark-brown heavy loam. The substratum, from 160 to 188 cm (63 to 74 in.), is friable dark-brown loam.

High available water capacity and moderate permeability is characteristic of Kanawha loam. Runoff is slow and natural fertility is moderate to high. The surface and upper subsoil layers are medium to strongly acid when unlimed, while lower subsoil layers and substratum exhibit medium acid to neutral reactions.

Kanawha soils have good potential for both farming and tree growth, however, they are limited in potential for urban uses as a result of rare flood hazard.

11.3.1.10 Dekalb Very Stony Loam

Dekalb very stony loam (mapping unit 51F) occurs on a very small portion of the development area. It covers 1.3 ha (3.3 ac), or 0.1 percent, of the area and is found on very steep slopes. The soil is well drained and was formed in material weathered from sandstone. Twenty percent of the mapping unit consists of well drained Gilpin and Lily soils and moderately drained Buchanan and Ernest soils.

The surface layer is typically a black channery loam about 5 cm (2 in.) thick and is underlain by 5 cm (2 in.) of grayish-brown channery loam. The subsoil consists of two layers distinguishable only on the basis of texture. The upper 30 cm (12 in.) is a very friable yellowish-brown channery loam while the lower 15 cm (6 in.) is a very friable yellowish-brown, very channery loam. A friable yellowish-brown, very channery sandy loam substrate extends to sandstone bedrock at a depth of about 64 cm (25 in.).

Dekalb soils occurring on the plant site have a very low to low available water capacity with moderately rapid permeability. Runoff is very rapid and natural fertility is low. Where unlimed, the soil is strongly to extremely acid.

Due to slope and stoniness, this soil has poor potential for farming but is acceptable for tree growth. It has very limited potential for most urban uses due to slope and shallow depth to bedrock.

11.3.2 Prime Farmland

The following soil mapping units on the SRC-II plant site are considered by the State of West Virginia Soil Scientist to be prime farmland when other conditions are met (Hatfield personal communication 1979):

- 60B Westmoreland silt loam, 3 to 8 percent slope
- 56B Culleoka-Westmoreland silt loam, 3 to 8 percent slope
- 13 Kanawha silt loam
- 3 Lobdell silt loam

In order to be classified as prime farmland, an area must be "historically cultivated cropland." The Office of Surface Mining Reclamation and Enforcement defines this in 30 CFR VII 701.5 as land with a cropped history five of the preceding 10 years. Portions of the Monongahela floodplain mapping units 13 (Kanawha silt loam) and 3 (Lobdell silt loam) meet this requirement. It is estimated that 14 to 16 ha (35 to 40 ac) of this floodplain may ultimately be designated as prime farmland by the Soil Conservation Service.

The other mapping units eligible for consideration as prime farmland (60B or Westmoreland silt loam, 3 to 8 percent slope, and 56B or Culleoka-Westmoreland silt loam, 3 to 8 percent slope) do not meet the "historically cultivated cropland" requirements. These areas have consistently been used for pastureland.

11.3.3 On-site Soil Sampling Program

Results of analytical soil tests have not been received to date, thereby preventing immediate discussion of site-specific soil characteristics.

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SECTION 12 SOCIOECONOMICS

For a preliminary discussion of the socioeconomics baseline analysis and probable impacts of the SRC-II Demonstration Project, see the Site Suitability Report (contract deliverable number 16), Appendix D.

SECTION 13
HISTORICAL AND ARCHAEOLOGICAL RESOURCES

The West Virginia Geologic and Economic Survey is conducting a study to determine the presence of historical, archaeological, and paleontological resources on the project property. The field work has been slowed by weather, but is nevertheless approximately 50 percent complete. Evidence of previous habitation on the site has been found but the significance of these materials has not been determined. A final report will be available in mid-July.