

# The Impact of Airport Deicing Runoff on Water Quality and Aquatic Life in a Pennsylvania Stream

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## ABSTRACT

The impacts of a large airport on the water quality and aquatic life of a small (94.8 km<sup>2</sup> drainage area) western Pennsylvania stream were examined. The principal adverse effects of airport runoff were related to runway deicing operations. Microbial metabolism of glycols and urea utilized as deicing reagents exerted a strong biochemical oxygen demand in receiving waters. Similarly, the breakdown of urea led to elevated concentrations of ammonia. The use of alkaline mill slag as a fill material in the construction of the runways was probably responsible for some elevated alkalinity and pH values from runway leachates. The organic waste load stimulated the growth of dense biological slimes on streambeds. Invertebrate communities in waters influenced by airport runoff were severely stressed and dominated by pollution tolerant Chironomidae and Oligochaeta. The fishery of the watershed was also impaired, although transient fishes from the nearby Ohio River apparently reinvaded the stream at certain times of the year.

## INTRODUCTION

Airlines commonly utilize large quantities of propylene glycol and ethylene glycol based fluids to deice aircraft, and a mixture of ethylene glycol and urea is often used to deice runways. The types and amounts of deicing reagents used vary with airport location and sizes, and with variations in the weather. During the winter of 1995-1996, immediately preceding initiation of this study, about three million L of ethylene glycol, more than a half million kg of urea, and about 23,000 kg of potassium acetate were spread on Pittsburgh International Airport (PIA) runways and presumably all drained into a nearby stream, Montour Run. This investigation was an examination of the impacts of PIA deicing operations on the water quality and aquatic life of Montour Run and its tributaries.

The Montour Run watershed is located in western Pennsylvania, U.S.A., and covers an area of 94.8 km<sup>2</sup>, between the approximate limits of 40.43° and 40.51° north latitude and 80.13° and 80.29° west longitude. Total relief in the drainage basin is 190 m, ranging from elevation 210 m National Geodetic Vertical Datum (NGVD) at the mouth of Montour Run, where it confluences with the Ohio River, to about 400 m NGVD on the western edge of the basin. The Montour Run drainage basin is located within the unglaciated Appalachian Plateaus physiographic province. On the hilltops, beginning at about elevation 335 m NGVD, the lower portion of rocks from the Monongahela

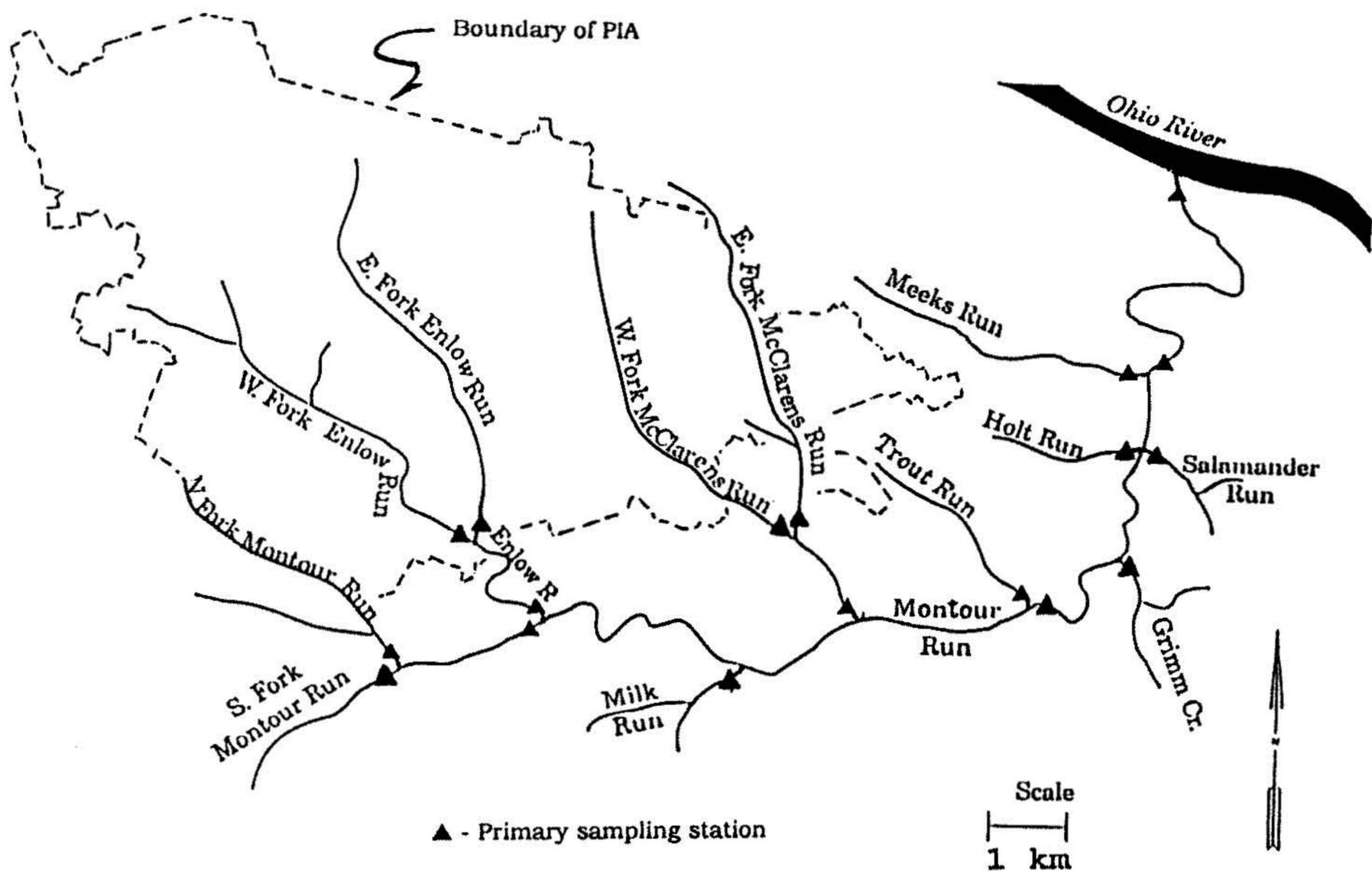


Figure 1. Montour Run Watershed and station locations.

Formation of the Pennsylvania System are present. The valuable Pittsburgh Coal Seam lies at the base of this formation (U.S. Geological Survey, 1981). Along with natural gas and oil extraction, the Pittsburgh Coal Seam has been extensively mined in the basin. Hilltop deep and strip mines, especially near the western edge of the watershed, contribute metal-polluted and mineralized mine drainage to the stream.

Various past and present land use activities influence the water quality of the streams in the Montour Run watershed. However, the PIA's overwhelming presence in the basin, and activities associated with its operation and maintenance, probably have the most significant impact on these waters. The high organic load of deicing materials and their breakdown products encourages profuse growths of a type of "sewage fungi" on the substrate surfaces of load receiving streams. While commonly referred to as sewage fungi, these biological slimes are more typically heterogeneous communities of microorganisms held in a matrix of *Sphaerotilus sp.*, a filamentous bacterium.

## METHODS AND MATERIALS

The ten principal Montour Run tributaries were selected as study units, and a primary sampling station was designated at the mouth of each stream. The east and west forks of the two largest tributaries (Enlow Run and McClarens Run) were also sampled at their mouths. In addition to these 14 tributary stations, four stations were selected on the mainstem of Montour Run (Fig. 1).

Four sampling rounds were conducted in the Montour Run basin during 1996. During the first round initiated in April, a modified

invertebrate rapid biological assessment (RBA) was performed for the 18 primary sampling stations. The technique involved 20 minutes of net sampling per station by two samplers, each collecting for ten minutes in a variety of habitats. With some modifications to account for local reference conditions, assessment protocols described by the Ohio Environmental Protection Agency (1988) and Plafkin *et al.* (1989) were utilized. Included in this assessment was calculation of the family biotic index (FBI) as adapted from Hilsenhoff (1982) by Plafkin *et al.* (1989).

Along with the biotic sampling in April, water chemistry was surveyed at the 18 primary sampling locations. Later in April, a second water chemistry survey was conducted where data was collected at 19 locations in addition to the 18 primary sampling locations. From these sites, 36 stations were selected for a third survey in September. The Pennsylvania Department of Environmental Protection, in accordance with its sampling protocols, performed all laboratory analyses.

Electrofishing and triplicate Surber (0.09m<sup>2</sup>) benthic macroinvertebrate sampling were conducted in June at the four mainstem stations and at the mouth of Meeks Run. To characterize the lower Montour Run fishery, an index of biotic integrity (IBI) was computed for each station. The IBI metrics and scoring criteria were developed by the Ohio Environmental Protection Agency (1988).

## **RESULTS AND DISCUSSION**

### Water Chemistry

Sixty-two chemical parameters were initially analyzed at each station during the April sampling round. The number of chemical parameters analyzed was then reduced to 37 during the September round. However, only pH, total alkalinity, hardness, Ca, SO<sub>4</sub>, Fe, Mn, Al, NH<sub>3</sub>-N, BOD, and specific conductance were judged to be pertinent chemical quality variations in the watershed. Therefore, only the results for these eleven parameters are presented and discussed here.

Relative to other local streams draining the unglaciated Appalachian Plateau, the waters of Montour Run can be characterized as being mineralized (calcium sulfate dominated), hard, and alkaline. Waters draining from the western portion of the basin were degraded by metals (iron, manganese, and especially aluminum) originating from abandoned coal mines. Waters draining the central portion of the basin were impaired by high BOD and elevated ammonia concentrations that result from airport deicing operations. Water from tributaries draining the eastern portion of the Montour Run watershed was of relatively high quality. Water quality problems related to sewage discharges, construction runoff, mill slag fill leachates, oil well seepage, and other sources were apparent in the watershed. However, these all appeared to be relatively minor in comparison with the pollution generated from mine drainage and airport operations.

Table 1. Summary of pertinent chemical data collected from streams in the Montour Run Watershed.

Station	Month Collected	pH	Total Alk mg/l as CaCO <sub>3</sub>	Hardness mg/l as CaCO <sub>3</sub>	Total Ca mg/l	Total SO <sub>4</sub> mg/l	Total Fe ug/l	Total Mn ug/l	Total Al ug/l	Total NH <sub>3</sub> -N mg/l	BOD mg/l	Cond umhos/cm
Montour Run	Apr	7.4	90	434	110	295	380	1,230	525	1.31	15.2	1,090
@ mouth	Sep	7.7	102	414	134	279	236	365	37	0.02	1.1	1,080
Montour Run	Apr	7.4	90	430	114	297	454	1,160	941	1.27	34.4	1,090
km 4.5	Sep	8.0	110	465	138	302	204	70	74	0.02	0.3	1,150
Montour Run	Apr	7.2	92	400	116	113	400	962	765	1.83	20.0	1,062
km 10.6	Sep	7.7	112	525	154	371	307	192	122	0.04	0.3	1,227
Montour Run	Apr	6.9	74	580	159	477	1,440	1,740	2,470	0.20	2.4	1,176
km 18.9	Sep	7.2	76	880	249	692	69	440	70	0.02	0.6	1,496
Meeks Run	Apr	8.6	86	178	60	84	98	14	69	0.04	2.6	525
@ mouth	Sep	7.5	130	194	74	70	46	2	20	0.02	0.9	560
Holt Run	Apr	8.0	74	132	55	62	35	3	32	0.02	0.8	400
@ mouth	Sep	7.1	96	174	64	60	135	6	50	0.02	0.3	474
Salamander Run	Apr	7.2	60	330	110	157	889	380	398	0.02	1.0	1,372
@ mouth	Sep	6.9	92	480	138	194	1,090	2,357	76	0.09	0.3	1,500
Grimm Creek	Apr	8.2	90	326	111	204	45	84	150	0.02	0.4	1,010
@ mouth	Sep	8.1	138	424	133	203	19	9	22	0.02	0.3	1,172
Trout Run	Apr	7.3	80	204	70	113	44	49	602	0.02	2.8	525
@ mouth	Sep	7.8	122	247	83	106	891	51	244	0.02	1.0	590
McClarens Run	Apr	7.8	156	336	99	154	512	914	74	3.15	116.0	830
@ mouth	Sep	7.8	218	384	115	103	185	56	12	0.02	0.3	991
West Fork McClarens	Apr	8.1	142	269	74	118	353	509	54	4.51	62.0	800
Run @ mouth	Sep	8.1	268	351	118	96	270	80	16	0.05	0.4	907
West Fork McClarens	Apr	7.6	174	373	128	115	1,210	1,220	283	5.37	229.0	1,292
Run km 4.2	Sep	7.0	316	573	155	118	2,350	1,060	62	0.75	355.0	1,296
East Fork McClarens	Apr	8.8	78	256	70	116	63	23	35	0.16	1.2	987
Run @ mouth	Sep	8.0	108	269	105	115	82	23	37	0.02	0.3	1,106
Spring drainage from runway fill tributary @ km 1.4 East Fork	Sep	6.9	54	325	127	352	129	98	65	16.60	3.9	862

Milk Run	Apr	6.7	36	415	131	338	613	769	7,620	0.02	0.5	1,110
@ mouth	Sep	6.7	54	575	141	360	223	481	870	0.02	0.6	1,195
Enlow Run	Apr	7.2	84	370	106	284	304	1,020	367	2.98	17.9	1,039
@ mouth	Sep	7.8	172	659	168	342	216	79	25	0.02	0.3	1,445
West Fork Enlow Run												
@ mouth	Sep	6.2	28	799	215	603	354	4,920	109	0.02	0.6	1,430
West Fork Enlow Run												
@ km 6.0	Sep	5.7	11	753	171	568	2,560	6,770	6,000	0.38	0.3	1,618
Mine discharge												
tributary to West Fork	Sep	3.3	0	734	129	550	6,720	7,120	25,400	0.04	0.3	1,360
Enlow Run @ km 6.2												
East Fork Enlow Run	Apr	8.2	152	282	83	146	385	471	209	5.57	15.9	884
@ mouth	Sep	7.7	266	620	186	235	480	94	25	0.11	0.6	1,524
East Fork Enlow Run	Apr	8.3	188	360	113	174	768	685	653	5.62	16.4	818
@ km 2.1	Sep	7.8	268	787	217	314	550	321	75	0.25	1.7	1,807
Runway drainage to	Apr	8.0	442	354	132	111	2,030	1,080	48	53.30	942.0	----
stream tributary to	Sep	7.9	530	848	263	180	1,550	1,270	10	0.63	813.0	1,716
East Fork Enlow Run												
@ km 1.9												
Runway drainage to	Apr	12.0	576	123	244	30	35	11	49	4.25	9.9	----
right bank of stream	Sep	8.0	110	367	101	216	10	46	10	1.95	1.2	756
tributary to East Fork												
Enlow Run @ km 1.9												
North Fork Montour	Apr	6.5	56	656	161	577	1,280	2,235	3,550	0.17	1.9	1,297
Run @ mouth	Sep	6.5	52	923	245	731	210	3,030	455	0.10	0.6	1,580
North Fork Montour												
Run @ km 2.1	Sep	5.4	9.2	761	185	594	14,900	6,800	4,620	1.30	0.5	1,426
North Fork Montour												
Run @ km 3.5	Sep	2.9	0	707	139	575	9,170	9,620	10,500	1.25	0.3	1,780
South Fork Montour	Apr	6.7	78	635	176	573	1,660	1,700	1,610	0.36	2.1	1,221
Run @ mouth	Sep	6.7	80	959	282	765	124	196	71	0.02	0.6	1,645
South Fork Montour												
Run @ km 3.2	Sep	5.7	8	1,303	276	90	15,800	8,710	693	3.33	1.2	1,913

During the April first round survey, conductivity values along the mainstem of Montour Run averaged about 1,105 umhos/cm (Table 1). The mean mainstem alkalinity was 87 mg/l as CaCO<sub>3</sub>, the mean calcium concentration was 125 mg/l, and the mean sulfate concentration was 296 mg/l. Aluminum concentrations were extremely high at the mouths of the North and South Forks of Montour Run and Milk Run (3,550, 1,610, and 7,620 ug/l, respectively). For comparison, in the eastern portion of the basin, the aluminum concentrations of Trout Run, Grimms Creek, Holt Run, Salamander Run, and Meeks Run were 602, 150, 32, 398, and 69 ug/l, respectively. Along the mainstem of Montour Run, from source to mouth, aluminum concentrations declined from 2,470 to 525 ug/l during the spring sampling round.

The BOD of Montour Run above the confluence of airport runoff via Enlow and McClarens Runs was 2.4 mg/l, but ranged from 15.2 to 34.4 mg/l along the mainstem below the confluence of airport drainage (Table 1). The BOD of Enlow and McClarens Runs at their mouths was 17.9 and 116.0 mg/l, respectively. BOD values as high as 942 mg/l were measured on airport property in the headwaters of Enlow Run, and 229 mg/l in the headwaters of McClarens Run. For comparison, except for a slightly elevated BOD of 2.6 mg/l in Meeks Run, the BOD values of tributaries in the eastern portion of the watershed were all 1.0 mg/l or less.

The concentration of ammonia in Montour Run above the confluence of Enlow and McClarens Runs was 0.2 mg/l, but ranged from 1.27 to 1.83 mg/l below their confluences (Table 1). Enlow and McClarens Runs at their mouths had ammonia concentrations of 2.98 and 3.15 mg/l, respectively. Ammonia concentrations as high as 53.3 mg/l were measured on airport property in the headwaters of Enlow Run. The ammonia concentrations of the tributaries draining the eastern portion of the watershed were all 0.04 mg/l or less.

The large quantities of ammonia observed in Enlow Run and McClarens Run airport drainage are almost certainly the result of microbial breakdown of nitrogenous urea utilized for runway deicing. Urea in aqueous solution is in equilibrium with ammonium cyanate, and the cyanate ion is itself hydrolyzed to ammonium and bicarbonate ions. Ammonia is most toxic in its nonionized form (NH<sub>3</sub> rather than the ammonium ion NH<sub>4</sub><sup>+</sup>), and the ratio of NH<sub>3</sub> to NH<sub>4</sub><sup>+</sup> increases rapidly between pH 7 and pH 12. Therefore, the alkaline character of the waters of the Montour Run basin tends to increase the potential of its ammonia load to cause toxicity to susceptible aquatic life.

The alkalinity of waters leaching from airport runway fill was unusually high. For instance, the alkalinity at one runway seep was 576 mg/l as CaCO<sub>3</sub>, and its pH was 12.0. This suggests that extremely alkaline mill slag was probably utilized as a fill material in portions of the airport when it was originally constructed.

The chemical sampling conducted in September was during a warm low flow period. The stream was even more mineralized and alkaline than during previous surveys. Conductivity values along the mainstem of Montour Run had increased from a mean of 1,105 to a mean of 1,238 umhos/cm and the mean alkalinity from 87 to 100 mg/l as CaCO<sub>3</sub> (Table 1). The mean concentration of aluminum along the mainstem declined to 76 ug/l. The highest BOD found along the mainstem of Montour Run and at the mouth of all of its major tributaries was only 1.1 mg/l. Similarly, along the mainstem of Montour Run, ammonia concentrations had declined to a mean of 0.025 mg/l, and the highest major tributary ammonia concentration was 0.11 mg/l at the mouth of the North Fork of Montour Run.

Nearly six months after the seasonal termination of airport deicing operations, however, some high BOD and ammonia concentrations were still apparent in the headwaters of the East Fork of Enlow Run and the West Fork of McClarens Run, with maximum BOD concentrations of 355 mg/l and 813 mg/l, respectively (Table 1). An ammonia concentration of 16.6 mg/l was still apparent in September in seepage from one runway. The continued discharge of waters with high BOD concentrations this late in the season suggests either leakage from glycol storage facilities, and/or significant groundwater contamination from deicing reagents.

#### Invertebrates – Qualitative Assessment

In addition to their importance as food for fish and other forms of aquatic life, benthic macroinvertebrate communities are also highly responsive indices of water quality. During the April RBA, a total of 42 different taxa of aquatic macroinvertebrates was collected and field identified (mostly to family and genus taxonomic levels) at the 18 primary stations.

The analysis of the waters of the Montour Run watershed is complicated by the fact that Montour Run receives both mine drainage and organic pollution. Mine drainage tends to depress both diversity and productivity, while organic pollution typically results in high productivity, but only by a few taxa of tolerant forms (Koryak *et al.* [1972]). The upper reaches of the West Fork of Enlow Run and the North and South Forks of Montour Run were all grossly degraded by extreme acidity and metal-polluted coal mine discharges in their headwaters; macroscopic aquatic life was essentially nonexistent. However, all three of these streams flow through large cattail marshes, and at their mouths they were only moderately-to-slightly impaired as judged by invertebrate life (Table 2). Even so, the water quality condition of the reach of the mainstem of Montour Run below the confluences of Enlow Run and McClarens Run was severely impaired, with mean RBA condition scores averaging only 17.0%.

In the central portion of the Montour Run watershed, McClarens Run and the West Fork of McClarens Run were severely impaired (Table 2.) Similarly, Enlow Run and the East Fork of Enlow Run were both severely

Table 2. Rapid biological assessment of streams in the Montour Run Watershed based on aquatic invertebrates.

Station	Taxa richness as % reference station <sup>a</sup>	Productivity as % reference station <sup>a</sup>	% EPT <sup>b</sup> organism	% Not AC <sup>c</sup> organism	FBI <sup>d</sup> as % reference station	Mean condition score % <sup>e</sup>
Montour Run km 0.16	25	15.4	0.0	9.2	20.6	14.0
Montour Run km 4.5	45	30.9	4.8	35.7	46.8	24.6
Montour Run km 10.6	10	30.9	0.0	0.0	20.8	12.3
Montour Run km 18.9	55	33.8	0.0	60.9	51.7	40.3
Meeks Run @ Mouth	85	100+	36.9	97.9	92.2	82.4
Holt Run @ Mouth	100	100+	75.1	92.4	91.7	91.8
Salamander Run @ Mouth	80	100+	20.3	54.2	66.5	64.2
Grimm Creek @ Mouth	70	100+	14.3	29.8	56.3	54.1
Trout Run @ Mouth <sup>a</sup>	100	100+	74.3	92.0	100.0	93.3
McClarens Run @ Mouth	25	72.0	0.0	1.1	43.4	28.3
West Fork McClarens Run	15	100+	0.0	0.0	16.2	26.4
East Fork McClarens Run	60	100+	17.2	72.1	44.7	58.8
Milk Run @ Mouth	45	21.3	6.9	86.2	71.8	46.2
Enlow Run @ Mouth	30	69.1	2.1	12.8	46.4	32.1
West Fork Enlow Run	55	19.8	63.0	88.9	90.7	63.5
East Fork Enlow Run	25	13.2	0.0	44.5	55.4	27.6
North Fork Montour Run	45	16.2	18.2	81.8	77.8	47.8
South Fork Montour Run	65	27.9	39.5	73.7	75.1	56.2

<sup>a</sup> Trout Run was utilized as the reference station

<sup>b</sup> EPT = Ephemeroptera, Plecoptera, and Trichoptera

<sup>c</sup> AC = Annelida and Chironomidae

<sup>d</sup> FBI = Family biotic index

<sup>e</sup> Mean Condition Score  $\geq 80$ , nonimpaired; 60-79, slightly impaired; 40-59, moderately impaired;  $\leq 39$ , severely impaired

impaired. The eastern portion of the watershed, which enters Montour Run downstream of km 12.7, was moderately-to-nonimpaired. The condition scores for the five tributary stations in this portion of the basin ranged from 54.1 to 93.3% and averaged 77.2%. This invertebrate bioassessment clearly points to airport runoff from the East Fork of Enlow Run and the West Fork of McClarens Run as being primarily responsible for the severe degradation of Montour Run.

### Invertebrates – Quantitative Assessment

Thirty-one different taxa of aquatic invertebrates were collected in the June Surber samples - 18 taxa from the four primarily mainstem stations on Montour Run and 23 taxa from the single reference station on Meeks Run (Table 3). Relative to the reference stream as judged by basic assessment parameters, the quality of all four stations along Montour Run was severely stressed. The number of taxa, the number of organisms, the total wet and dry weights, and the diversity indices of the mainstem were all reduced compared with Meeks Run. The Montour Run invertebrate community was overwhelmingly dominated by Annelida and Chironomidae, and the average dry weight of organisms per unit area was only 4.8% of that of the reference station (range 0.2 - 12.1%).

Table 3. Summary of benthic macroinvertebrate data collected by Surber samples from the Montour Run Watershed.

PARAMETER	MONTOUR RUN				MEEKS RUN
	km 0.16	km 4.5	km 10.6	km 18.9	
Total Number of Taxa	6	9	7	12	23
Average Number of Taxa/Surber	3.3	6.0	5.0	6.3	12.3
Average Number of Organisms/m <sup>2</sup>	72	2,569	2,387	591	2,598
Average Diversity Indices <sup>a</sup>	1.54	1.16	0.72	1.38	2.04
Average Wet Weight mg/m <sup>2</sup>	20	762	6,592	952	34,306 <sup>b</sup>
Average Dry Weight mg/m <sup>2</sup>	9	153	504	128	4,170 <sup>b</sup>
Percent by Number AC organisms <sup>c</sup>	75.0	96.9	96.8	80.0	42.8
Percent by Number EPT Organisms <sup>d</sup>	10.0	1.4	0.2	11.5	6.9
Percent by Number Total Crustacea	10.0	1.0	0.2	3.6	44.0
Percent by Number EPT Organisms Plus Gammarus	10.0	2.4	0.3	12.1	40.3

<sup>a</sup> Cairns and Dickson, 1971

<sup>b</sup> The average wet and dry weights at this station, excluding Decapoda, were 23,551 and 2,165 mg/m<sup>2</sup>, respectively

<sup>c</sup> AC = Annelida and Chironomidae

<sup>d</sup> EPT = Ephemeroptera, Plecoptera, and Trichoptera

It is notable that the percentage composition of EPT (Ephemeroptera, Plecoptera, and Trichoptera) organisms found in Meeks Run Surber samples was numerically only 6.9% of the total sample, compared to 37.9% EPT organisms previously observed in the Meeks Run RBA sample. This shift in community structure was probably a consequence of seasonal emergence of EPT organisms. The reference station, however, was still nonetheless dominated by clean water invertebrates, and especially by Gammarus sp.

## Fishes

Sixteen species of fish were captured during electrofishing surveys of the Montour Run basin (Table 4). The most numerous fishes were creek chub, blacknose dace, and white sucker. These three species combined represented 90.6% of the total number and 16.2% of the total weight of all fishes collected, and they numerically dominated the headwaters fisheries. Rough fish originating from the nearby Ohio River (carp, drum, quillback, golden redhorse, shorthead redhorse, and black redhorse) dominated the fishery of the lower portion of Montour Run. Five sport fish species were collected in the basin: brook trout, rainbow trout, bluegill, spotted bass, and smallmouth bass, but these fishes represented only 3.0% of the total number and 6.5% of the total weight of all fish collected.

The Montour Run watershed appears to have two distinct fisheries. The first is the headwaters and tributaries fishery, dominated almost exclusively by large numbers of creek chubs, blacknose dace, and white suckers. These three species are very tolerant of pollution and do well in shallow, narrow streams with relatively small pools. Their headwater

distribution and the wide size ranges observed for each species is a good indication that several year classes were present and that the three species were reproducing residents of the Montour Run basin. Similar to the Montour Run study, when Pillard (1996) examined the impacts of Stapleton International Airport on Sand Creek in Denver, Colorado, he also found dominance by a trio of pollution tolerant fishes. The Sand Creek fishery was dominated by creek chubs, white suckers, and fathead minnows, and its invertebrate community was dominated by Chironomidae. Sand Creek was also degraded by sewage, urban runoff, wastes from oil refineries, and had disturbed and limited habitat. Therefore, additional adverse deicer impacts from occasional airport

Table 4. Species of fish collected in the Montour Run Watershed in 1996

FISH SPECIES	LOCATION						
	Montour Run				East Fork McClarens Run	Trout Run	Meeks Run
km 18.9	km 10.6	km 4.5	km 0.2				
Rainbow Trout <u>Oncorhynchus mykiss</u>		X	X				
Brook Trout <u>Salvelinus fontinalis</u>		X	X				X
Carp <u>Cyprinus carpio</u>		X	X	X			
Golden Shiner <u>Notemigonus crysoleucas</u>				X			
Blacknose Dace <u>Rhinichthys atratulus</u>	X				X	X	X
Creek Chub <u>Semotilus atromaculatus</u>	X	X			X	X	X
Sand Shiner <u>Notropis stramineus</u>							X
Golden Redhorse <u>Moxostoma erythrurum</u>				X			
Shorthead Redhorse <u>Moxostoma macrolepidotum</u>		X		X			
Black Redhorse <u>Moxostoma duquesnei</u>				X			
White Sucker <u>Catostomus commersoni</u>	X	X	X		X	X	X
Quillback Carpsucker <u>Carpoides cyprinus</u>			X				
Smallmouth Bass <u>Micropterus dolomieu</u>				X			
Spotted Bass <u>Micropterus punctulatus</u>							X
Bluegill <u>Lepomis macrochirus</u>			X	X			
Freshwater Drum <u>Aplodinotus grunniens</u>		X	X				
Total number of species	3	7	7	7	3	3	6

storm runoff on its already impaired water quality and aquatic life were not as obvious as those observed in the Montour Run study.

The second distinct fishery occurs in the lower reach of Montour Run where even the pollution tolerant trio is uncommon or absent. This reach of the Montour Run mainstem is dominated by transient Ohio River fishes and trout stocked by a local sportsmen's club. The biotic integrity as described by the calculated IBI values was poor to fair (Table 5).

Table 5. Montour Run fishery, index of biotic integrity (IBI) at selected stations.

IBI Metric	IBI Metric Value ( ) and Score for Stations Identified by Stream Mile							
	km 10.6		km 4.5		km 0.16			
	May	June	May	June	May	June	May	June
Total Number of Species	(5)	1	(7)	1	(7)	1	(7)	1
Number of Darter Species	(0)	1	(0)	1	(0)	1	(0)	1
Number of Sunfish Species	(0)	1	(0)	1	(1)	1	(1)	1
Number of Sucker Species	(2)	3	(2)	3	(2)	3	(3)	3
Number of Intolerant Species	(0)	1	(0)	1	(0)	1	(1)	1
Percent Tolerant Species	(93.1)	0	(61.5)	1	(12.5)	5	(68.2)	1
Percent Omnivores	(41.4)	1	(30.8)	3	(50.0)	0	(68.2)	0
Percent Insectivores Species <sup>a</sup>	(6.9)	1	(23.1)	1	(56.2)	5	(27.3)	1
Percent Top Carnivores	(0)	1	(0)	1	(0)	1	(4.5)	3
Number of Individuals/300m	(29)	1	(24)	1	(24)	1	(21)	1
Percent Hybrids	(0)	5	(0)	5	(0)	5	(0)	5
Percent DELT Anomalies	(0)	5	(0)	5	(0)	5	(0)	5
SCORE		21		24		29		23
RATING <sup>b</sup>		POOR		POOR		FAIR		POOR

<sup>a</sup>Stocked trout were excluded from the Percent Insectivorous Species metric.

<sup>b</sup>Ratings for total scores are as follows:  $\geq 50$  exceptional, 35-49 good, 25-34 fair, 15-24 poor, and  $\leq 14$  very poor (Ohio Environmental Protection Agency 1988).

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