FERC/FEIS-0051

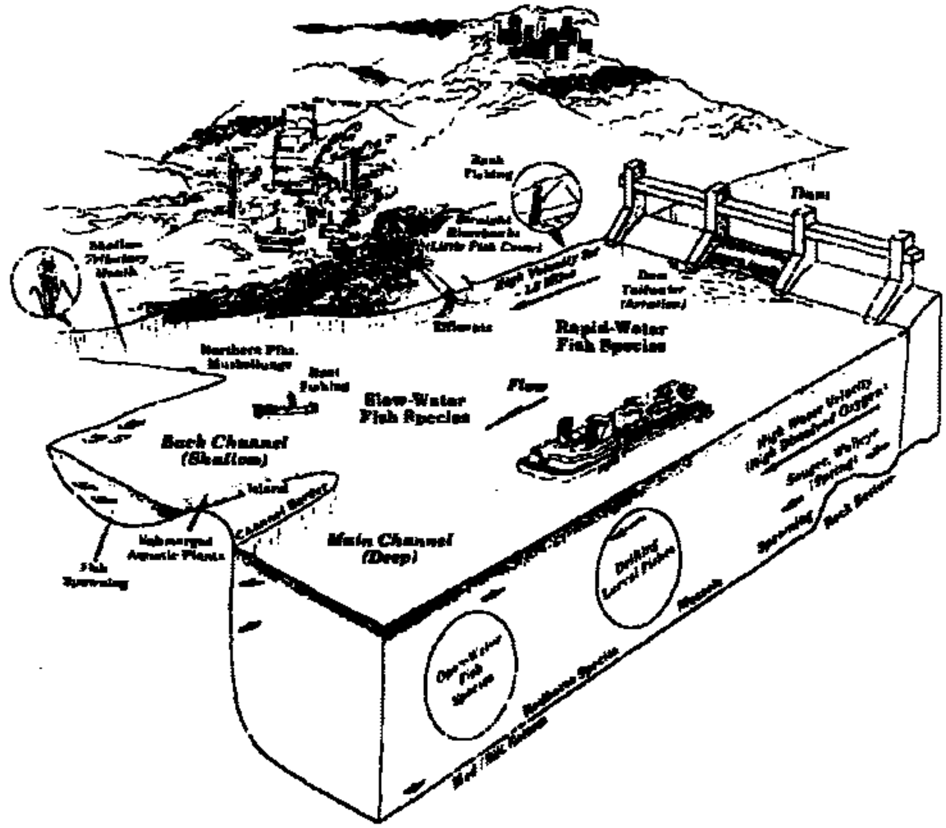
Part 2 of 2

Filed: 10/1/88

HYDROELECTRIC DEVELOPMENT
IN THE
UPPER OHIO RIVER BASIN
FERC Docket No. EL85-19-114

Ohio, Pennsylvania, West Virginia

FINAL
Environmental Impact Statement



Federal Energy Regulatory Commission
Office of Hydropower Licensing

September 1988

FERC – FEIS

Hydroelectric Development
In the Upper Ohio River Basin under:

EL85-19-114
P-7914-003
P-7909-002
P-4474-003
P-4017-002
P-7307-000
P-7399-000
P-8990-000
P-8654-001
P-7660-000
P-8908-000
P-4675-002
P-7041-001
P-7568-001
P-2971-002
P-3490-003
P-6901-001
P-10332-000
P-3218-001
P-6902-003
P-9999-000
P-6939-001
P-9042-000
P-10098-000
P-6998-0001

APPENDIX A

LIST OF APPLICANT NAMES AND ADDRESSES

APPENDIX A

Table A-1. Names and addresses of the applicants for 24 proposed hydropower projects in the Upper Ohio River Basin.

Project name 1/	FERC No.	Applicant's name and address
Allegheny River L&D No. 7	7914-003	Allegheny Hydropower, Inc. 109 Union Street P.O. Box 45 Manchester, VT 05254
Allegheny River L&D No. 4	7909-002	County of Allegheny 119 Courthouse Grant Street Pittsburgh, PA 15219
Allegheny River L&D No. 3	4474-003	Borough of Cheswick 1410 Spruce Street Cheswick, PA 15024 and Allegheny Valley North Council of Governments Springdale Borough Building 325 School Street Springdale, PA 14144
Allegheny River L&D No. 2	4017-002	The City of Pittsburgh 301 City-County Building Pittsburgh, PA 15219
Tygart Dam	7307-000	The City of Grafton City Building 1 West Main Street Grafton, WV 26354
Tygart Dam	7399-001	Noah Corporation 120 Calumet Court Aiken, SC 29801
Opekiska L&D	8990-000	Noah Corporation P.O. Drawer 640 Aiken, SC 29802
Hildebrand L&D	8654-001	Noah Corporation P.O. Drawer 640 Aiken, SC 29802
Point Marion L&D	7660-000	The Borough of Point Marion Point Marion Borough Building Point Marion, PA 15474 and Noah Corporation 120 Calumet Court Aiken, SC 29801

Table A-1. (continued).

Project name	FERC No.	Applicant's name and address
Maxwell L&D	8908-000	The Borough of Brownsville Municipal Hall Brownsville, PA Washington County Board of Commissioners Courthouse Square 100 West Beau Street Washington, PA 15301 and Pennsylvania Renewable Resources, Inc. Gulf and Western Building 15 Columbus Circle, Suite 906 New York, NY 10023
Monongahela L&D No. 4	4675-000	The Borough of Charleroi Municipal Hall Charleroi, Pennsylvania Washington County Board of Commissioners Courthouse Square 100 West Beau Street Washington, PA 15301 and Pennsylvania Renewable Resources, Inc. Gulf and Western Building 15 Columbus Circle, Suite 906 New York, NY 10023
Emsworth L&D	7041-001	Potter Township 206 Mowry Road Monaca, PA 15061
Dashields L&D	7568-001	County of Allegheny 119 Courthouse Grant Street Pittsburgh, PA 15219
Montgomery L&D	2971-002	Allegheny Electric Cooperative, Inc. 212 Locust Street P.O. Box 1266 Harrisburg, PA 17108-1266
Montgomery	3490-003	Potter Township 206 Mowry Road Monaca, PA 15061
New Cumberland L&D	6901-001	The City of New Martinsville, 203 Main Street New Martinsville, WV 26155

Table A-1. (concluded).

Project name	FERC No.	Applicant's name and address
New Cumberland Hydroelectric Development	10332-000	WV Hydro, Inc. 120 Calumet Court Aiken, SC 29801
Pike Island	3218-001	The City of Orrville, Ohio Department of Public Works P.O. Box 126 Orrville, OH 44667
Willow Island L&D	6902-003	The City of New Martinsville 203 Main Street New Martinsville, WV 26155
Willow Island	9999-000	The City of St. Marys, St. Marys, WV 26170
Belleville	6939-001	The City of Jackson Memorial Building Broadway Street Jackson, OH 45640
Gallipolis L&D	9042-000	Gallia Hydro Partners c/o Mitex, Inc. 91 Newbury Street Boston, MA 02116
Gallipolis Development	10098-000	The City of Point Pleasant, West Virigina 400 Viand Street Point Pleasant, WV 25550 and WV Hydro, Inc. 120 Calumet Court Aiken, SC 29801
Muskingum L&D No. 3	6998-001	The Upper Mississippi Water Company, Inc. c/o Mitex, Inc. 91 Newbury Street Boston, MA 02116

1/ L&D = Lock and Dam

APPENDIX B

WATER QUALITY IMPACTS

MODELING METHODS AND DOCUMENTATION

B.1 INTRODUCTION

The water quality modeling conducted for the Ohio River Basin environmental impact statement is designed to provide information for the licensing decisions that FERC must make on proposed hydropower projects in the upper Ohio River Basin. These decisions include the acceptance or rejection of pending license applications, and the design or operation constraints to be placed on licensees. Several steps are involved in model development: (1) data acquisition to describe the system of interest, (2) formulation of an appropriate model to represent the system, (3) calibration of the model, (4) experimentation with the model, and (5) interpretation of model results for decisionmaking. Models are tools for problem solving, and the tool must fit the problem. We have attempted to keep our model building within the limitations of available data and the needs of the FERC licensing decisions.

The following sections discuss the conceptual formulations of the models used for impact assessment. The sources of data used for modeling and calibration, and the results of calibration are presented. A detailed description of the dissolved oxygen model is presented in Section B.4.

B.2 WATER QUALITY

B.2.1 COMPONENTS OF THE DO BUDGET

The dynamics of DO in large rivers can be represented by several sources and sinks: (1) bacterial respiration and biodegradation of carbonaceous and nitrogenous compounds in the water column and in the sediments, (2) algal respiration, (3) reaeration at the water surface, (4) primary production by algae, and (5) aeration of water spilled over dams.

B.2.1.1 Biochemical Oxygen Demand

Oxygen is removed from solution by respiration of microorganisms as they decay organic and nitrogen-containing materials. Higher concentrations of such materials, such as wastewater treatment plant effluents and ammonia, increase the populations of microorganisms and the rate at which they remove oxygen from the water. The biological oxidation (decay) of organic waste (measured as biochemical oxygen demand, or BOD) can be the major sink of DO where high BOD concentrations occur. Biological oxidation is typically modeled as a first-order decay process, as originally described by Streeter and Phelps (1925). The first-order model assumes the rate at which oxygen is removed from the water (milligrams per Liter per day) is equal to a constant (k_1) times the concentration of BOD. The Streeter-Phelps first-order model was used in this study.

BOD comes from both point sources such as wastewater discharges and tributaries and from nonpoint sources such as runoff, decay of algae, and decay of benthic matter. Because of the high flow rates of the study rivers, only a few large dischargers contribute enough BOD to directly increase concentrations significantly. The DO model includes BOD contributed from major wastewater dischargers where sufficient information was available to quantify the loading (sources of waste loading data are discussed in Section 2.3.2). Nitrogenous BOD (NOD) has not been modeled separately from carbonaceous BOD. NOD typically decays slower than carbonaceous BOD, but in a system as large and complex as the upper Ohio River basin, where the BOD concentration at any given point is the sum of contributions from a number of sources, the errors caused by using a single rate coefficient for all BOD are probably minor.

Benthic oxygen demand can be an important nonpoint source of BOD where organic matter accumulates in sediments (USEPA, 1985). Studies by the Corps Waterways Experiment Station in the lower Ohio River have shown that benthic oxygen demand can be a large fraction of the total BOD (personal communication, Mark Dortch, Corps Waterways Experiment Station, January 21, 1988). However, benthic oxygen demand rates are very difficult to measure or estimate, and little or no information is available for the upper Ohio River basin. No separate decay rate constant for benthic BOD was included in the model because inadequate information on benthic BOD rates exist. The model essentially assumes that benthic BOD and dissolved and suspended BOD can be modeled together using one rate coefficient and one concentration value.

Little information on other nonpoint sources of BOD is available. Calibration of the water quality model and comparison of measured instream BOD concentrations to point-source loadings indicate that non point-source BOD is significant. Loadings of non point-source BOD were estimated by using them to calibrate the DO model; BOD loads were added at approximately evenly spaced intervals along the rivers until the simulated oxygen demand was sufficient to make the modeled DO concentrations match measured ones (Section B.2.4). The objective of the modeling study is to assess the impacts in changes in a DO source, dam aeration, and not to assess changes in any of of the BOD sources. Therefore, it is not crucial to the accuracy of the assessment to identify the individual sources of BOD.

B.2.1.2 <u>Aeration at the Water Surface</u>

Reaeration via gas transfer at the air-water interface (not at dams) is commonly modeled by assuming that the gas transfer rate is equal to a constant (k_2) times the DO deficit in the water. There are a number of equations to estimate k_2 (USEPA 1985, p. 102). For the Ohio River model, the model of O'Connor and Dobbins (1958) was selected to estimate k_2 because (1) it was originally verified using data from the Ohio River and, unlike most other models, is designed for use in deep channels; (2) it has been widely used and accepted; and (3) it was recommended by Ohio River Valley Water Sanitation Commission (ORSANCO) staff. The equation is:

$$k_2(20^oC) = 12.9\ (U^{1/2})\ /\ (H^{3/2}),$$

where k_2 is the reaeration rate coefficient at 20^{o}C in units of days^{-1}, U is the average velocity in feet per second, and H is the depth in feet. The value of k_2 is then adjusted for the actual river temperature using the equation (USEPA 1985, p.125):

$$k_2(T) = k_2(20^oC)\ (1.024^{T-20})$$

B.2.1.3 <u>Aeration at Dams</u>

To model changes in DO in the basin caused by hydropower development, the aeration provided by each dam has been modeled. Each dam in the study has unique hydraulic characteristics that can affect aeration. There are two main types of navigation dams in the system, fixed-crest and gated dams.

The aeration capacity of the fixed-crest dams is probably highly influenced by the design of the apron at the base of the dam. There is generally good entrainment of air bubbles into the water as it crests the dam, and at some fixed-crest dams the water plunges deeply, which encourages dissolution of air from the bubbles. Other fixed-crest dams have a nearly horizontal apron that prevents a deep plunge, but some of these aprons have energy-dissipating structures that cause additional turbulence and aeration. There are 14 fixed-crest dams in the study area on the Allegheny, Monongahela, Muskingum, and Ohio rivers.

Several design characteristics influence aeration at the gated structures. Some of the gated dams have submerged outflows; flow beneath the opened gate exits below the surface of the downstream pool, so there is little entrainment of air as the water passes the dam. Other gated dams release water well above the downstream pool, so air is entrained and there is ample mixing and plunge for good aeration. Some of the gated dams also include small fixed-crest weirs that can discharge much of the total river flow at low flows. There are 15 gated dams in the study area on the Monongahela and Ohio rivers.

B.2.1.3.1 Development of a Statistical Model of Dam Aeration

The method used to model aeration at the navigation dams was to perform a statistical analysis of field data collected at each dam. Aeration data for each dam were provided by applicants for hydropower licenses and/or were available from historic data collected by the Pittsburgh District of the Corps (Section 2.3.5). At each dam, data were available from a number of measurements of the DO concentration above the dam (C_a), the DO concentration below the dam (C_b), the flow rate, and the temperature. These field data were used to determine a best-fit relation between the DO deficit (difference between the measured concentration and the saturation concentration) above the dam (D_a) and the deficit below the dam (D_b), and to evaluate the influence of flow rate and temperature on aeration. The saturation concentration was estimated for each field measurement using tables in Colt (1984); two-way interpolation was used to correct table values for the elevation and water temperature of the field samples.

The field data for dam aeration are presented in Table B-1.

Theoretically, the rate at which oxygen is transferred from air into water is related to the DO deficit; the higher the DO deficit, the higher the rate of oxygen transfer into the

Table B-1. Dam aeration data.

Allegheny No. 7

Temp1/	C_s2/	C_a3/	C_b4/	D_a5/	D_b6/	Flow7/
20.00	8.82	9.26	9.23	0.44	0.41	18,900.
19.10	8.98	9.35	9.41	0.37	0.43	17,700.
19.10	8.98	9.30	9.30	0.32	0.32	17,700.
19.40	8.93	9.21	9.21	0.28	0.28	17,700.
19.60	8.89	9.25	9.22	0.36	0.33	17,700.
19.80	8.86	9.38	9.29	0.52	0.43	17,700.
17.30	9.32	10.25	9.93	0.93	0.61	16,500.
17.30	9.32	10.00	9.75	0.68	0.43	16,500.
17.00	9.38	9.99	9.81	0.61	0.43	16,500.
24.9	8.1	8.1	7.8	0.0	0.3	
25	8.1	7.5	7.5	0.6	0.6	
23.7	8.3	8	7.9	0.3	0.4	
21.8	8.7	8.3	8.2	0.4	0.5	
25.4	8.1	7.3	7.2	0.8	0.9	
27.3	7.8	7.8	7.8	-0.0	-0.0	
27.9	7.7	7.4	7.6	0.3	0.1	
26.6	7.9	7.6	7	0.3	0.9	
24.3	8.2	8.1	7.7	0.1	0.5	
24.1	8.3	8.9	8.4	-0.6	-0.1	

Allegheny No. 6

Temp	C_s	C_a	C_b	D_a	D_b
24.90	8.03	8.10	8.10	0.07	0.07
24.80	8.04	7.00	7.60	1.04	0.44
24.00	8.17	7.00	7.60	1.17	0.57
22.10	8.47	8.10	8.30	0.37	0.17
25.00	8.01	6.70	6.90	1.31	1.11
27.30	7.68	7.40	7.60	0.28	0.08
27.10	7.71	7.00	7.00	0.71	0.71
26.60	7.78	6.70	7.00	1.08	0.78
23.30	8.28	8.20	8.20	0.08	0.08

Allegheny No. 5

Temp	C_s	C_a	C_b	D_a	D_b
24.5	8.2	8.7	8.1	-0.49	0.11
24	8.3	8.4	9	-0.11	-0.71
24	8.3	8.5	8.6	-0.21	-0.31
24	8.3	8.5	8.3	-0.21	-0.01
24	8.3	7.4	7.8	0.89	0.49
23.5	8.4	8.8	7.2	-0.43	1.17
23.5	8.4	6.2	8.2	2.17	0.17
18	9.4	9.3	9.1	0.08	0.28
17.5	9.5	8.9	9.2	0.58	0.28
17	9.6	9	9.5	0.58	0.08
17	9.6	9.2	9.3	0.38	0.28
17	9.6	9	9.2	0.58	0.38
17	9.6	9.2	9.1	0.38	0.48
17.5	9.5	8.5	8.5	0.98	0.98
24.8	8.2	8	8.2	0.16	-0.04

Table B-1. Dam aeration data (continued)

Allegheny No. 5 (continued)					
Temp	C_s	C_a	C_b	D_a	D_b
24.6	8.2	7.3	7.4	0.89	0.79
24.3	8.2	7.3	7.5	0.94	0.74
22.2	8.6	8.3	8.4	0.29	0.19
25.6	8.0	6.5	6.9	1.53	1.13
27.1	7.8	7.2	7.5	0.60	0.30
27.5	7.7	6.7	7.1	1.04	0.64
27	7.8	6.7	6.5	1.11	1.31
23.1	8.4	8.1	8.1	0.34	0.34

Allegheny No. 4					
Temp	C_s	C_a	C_b	D_a	D_b
24.10	8.16	8.00	8.00	0.16	0.16
24.30	8.13	7.40	7.90	0.73	0.23
24.60	8.08	7.40	7.50	0.68	0.58
22.30	8.44	8.00	8.30	0.44	0.14
24.50	8.10	6.90	7.50	1.20	0.60
27.10	7.72	7.40	7.50	0.32	0.22
27.10	7.72	6.80	7.00	0.92	0.72
26.60	7.79	6.90	7.40	0.89	0.39
22.70	8.38	7.80	8.00	0.58	0.38

Allegheny No. 3						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
27.90	7.61	7.20	8.20	0.41	-0.59	7,000.
28.00	7.60	8.80	9.90	-1.20	-2.30	7,000.
27.90	7.61	8.80	9.20	-1.19	-1.59	7,000.
27.00	7.74	7.00	7.60	0.74	0.14	3,100.
27.00	7.74	7.30	8.10	0.44	-0.36	3,100.
28.50	7.53	7.00	8.00	0.53	-0.47	3,100.
28.90	7.48	7.60	8.50	-0.12	-1.02	3,100.
13.80	10.07	10.60	10.90	-0.53	-0.83	3,100.
13.80	10.07	10.20	10.90	-0.13	-0.83	3,100.
13.80	10.07	10.60	10.90	-0.53	-0.83	3,100.
25.5	8.0	7.7	8.3	0.3	-0.3	
25	8.1	7.8	8.5	0.3	-0.4	
24.5	8.2	7.1	7.9	1.1	0.3	
24.6	8.2	8.1	8.6	0.1	-0.4	
25.5	8.0	6.8	7.6	1.2	0.4	
27.9	7.7	6.6	7.5	1.1	0.2	
28	7.7	6.9	7.1	0.8	0.6	
28.2	7.6	7	7.7	0.6	-0.1	
23.6	8.4	7.7	8.5	0.7	-0.1	

Table B-1. Dam aeration data (continued)

Allegheny No. 2

Temp	C_s	C_a	C_b	D_a	D_b	Flow
16.10	9.58	7.80	8.90	1.78	0.68	6,500.
25.30	7.98	7.30	8.40	0.68	-0.42	9,900.
28.00	7.60	7.10	7.70	0.50	-0.10	6,600.
28.00	7.60	7.80	8.00	-0.20	-0.40	5,580.
27.41	7.82	7.66	7.98	0.16	-0.16	3,800.
27.61	7.78	7.89	7.96	-0.13	-0.18	3,844.
27.86	7.75	8.39	8.75	-0.66	-1.00	3,888.
28.21	7.69	9.22	8.28	-1.54	-0.59	3,932.
28.29	7.68	8.94	8.54	-1.29	-0.86	3,976.
28.18	7.69	8.76	8.24	-1.11	-0.55	4,019.
28.20	7.69	8.47	8.07	-0.80	-0.38	4,063.
28.10	7.71	8.13	7.78	-0.42	-0.07	3,107.
21.50	8.75	8.83	10.19	-0.06	-1.44	11,900.
21.46	8.76	8.90	10.41	-0.13	-1.65	11,663.
21.41	8.77	8.88	10.31	-0.10	-1.54	11,425.
21.54	8.75	8.61	10.10	0.16	-1.35	11,188.
21.55	8.74	9.16	10.35	-0.30	-1.61	10,950.
21.30	8.79	9.27	10.25	-0.48	-1.46	10,713.
21.14	8.82	8.89	10.12	-0.09	-1.30	10,475.
20.95	8.85	9.19	10.10	-0.35	-1.25	10,238.
20.85	8.87	9.21	10.29	-0.34	-1.42	10,000.
20.79	8.87	8.72	9.35	0.12	-0.48	22,200.
20.52	8.92	8.58	9.38	0.35	-0.46	22,613.
20.50	8.93	8.57	9.35	0.39	-0.42	23,025.
20.44	8.94	8.84	10.14	0.12	-1.20	23,438.
20.39	8.95	8.83	9.65	0.12	-0.70	23,850.
20.37	8.95	8.98	9.57	-0.02	-0.62	24,263.
20.23	8.98	9.04	9.64	-0.06	-0.66	24,675.
21.13	8.82	8.69	9.46	0.12	-0.64	25,200.
21.13	8.80	8.61	9.68	0.18	-0.88	24,725.
21.23	8.80	8.34	9.26	0.45	-0.46	24,250.
21.58	8.74	8.35	9.11	0.39	-0.37	23,775.
21.52	8.75	8.65	9.42	0.11	-0.67	23,300.
21.23	8.80	8.68	9.36	0.11	-0.56	22,825.
21.20	8.81	8.74	9.34	0.07	-0.53	22,350.
21.09	8.82	8.93	9.66	-0.13	-0.84	21,875.
21.30	8.79	8.63	9.41	0.16	-0.62	21,400.

Opekiska

Temp	C_s	C_a	C_b	D_a	D_b	Flow
25.8	8.00	8.5	8.2	-0.50	-0.20	448
25.8	8.00	9.2	9	-1.20	-1.00	675
26.2	7.94	9.4	9.2	-1.46	-1.26	855
25.4	8.06	8.1	7.9	-0.04	0.16	630
25.9	7.98	7.5	7.4	0.48	0.58	490
25.5	8.05	6.3	6.2	1.75	1.85	467
25.5	8.05	6.3	6.4	1.75	1.65	440
25.4	8.06	6.9	7	1.16	1.06	464
25.7	8.01	7.7	8.4	0.31	-0.39	1,050
25.3	8.08	7.7	7.6	0.38	0.48	849
23.5	8.37	6	6.3	2.37	2.07	822
23.3	8.40	7.6	8.1	0.80	0.30	730
22.7	8.51	8.5	8.6	0.01	-0.09	1,040

Table B-1. Dam aeration data (continued)

Opekiska (continued)

Temp	C_s	C_a	C_b	D_a	D_b	Flow
22.7	8.51	8.8	8.4	-0.29	0.11	1,040.
22.7	8.51	8.6	9	-0.09	-0.49	1,040.
22.1	8.61	8.2	8.9	0.41	-0.29	998.
22.2	8.59	9.2	9.3	-0.61	-0.71	950.
21	8.81	7.3	7.9	1.51	0.91	899.
20.5	8.90	7.5	8.5	1.40	0.40	2,918.
17.8	9.42	8.3	9.3	1.12	0.12	1,417.
14.3	10.18	8.4	8.8	1.78	1.38	1,620.
15.1	9.99	8.9	9.6	1.09	0.39	744.

Hildebrand

Temp	C_s	C_a	C_b	D_a	D_b	Flow
26.20	7.82	6.80	7.40	1.02	0.42	478
26.00	7.85	6.30	7.20	1.55	0.65	535
26.10	7.84	6.40	7.20	1.44	0.64	468
26.10	7.84	5.80	7.00	2.04	0.84	432
25.90	7.86	5.70	7.30	2.16	0.56	465
26.00	7.85	6.90	7.30	0.95	0.55	700
24.90	8.01	6.40	7.40	1.61	0.61	836
23.40	8.24	6.20	7.70	2.04	0.54	717
23.90	8.16	7.20	7.80	0.96	0.36	1,071
22.30	8.41	7.90	8.00	0.51	0.41	1,030
22.00	8.46	6.90	7.20	1.56	1.26	970
21.80	8.50	7.90	8.00	0.60	0.50	4,974
17.00	9.36	8.70	9.60	0.66	-0.24	2,242
14.40	9.90	8.70	9.60	1.20	0.30	1,230
14.20	9.94	8.70	9.90	1.24	0.04	909

Morgantown

Temp	C_s	C_a	C_b	D_a	D_b	Flow
24.20	8.12	6.40	7.10	1.72	1.02	700
24.10	8.14	6.30	7.00	1.84	1.14	
24.00	8.15	6.70	7.20	1.45	0.95	
24.00	8.15	6.50	7.00	1.65	1.15	
24.00	8.15	7.00	7.50	1.15	0.65	
24.00	8.15	7.10	7.40	1.05	0.75	
24.20	8.12	6.80	7.60	1.32	0.52	
24.50	8.08	7.30	7.90	0.78	0.18	670
24.00	8.15	7.10	7.70	1.05	0.45	955
24.00	8.15	6.80	7.40	1.35	0.75	
24.00	8.15	6.90	7.40	1.25	0.75	
24.00	8.15	7.00	7.70	1.15	0.45	
23.90	8.17	7.00	7.70	1.17	0.47	
23.90	8.17	6.80	7.90	1.37	0.27	
23.90	8.17	7.00	7.90	1.17	0.27	
24.10	8.14	7.10	8.10	1.04	0.04	1,190
16.50	9.47	8.50	9.00	0.97	0.47	1,330
16.80	9.41	9.00	9.50	0.41	-0.09	
16.90	9.39	8.60	9.30	0.79	0.09	

Table B-1. Dam aeration data (continued)

Morgantown (continued)						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
16.80	9.41	8.90	9.40	0.51	0.01	
16.80	9.41	9.00	9.30	0.41	0.11	
16.80	9.41	8.90	8.80	0.51	0.61	
16.70	9.43	8.50	8.90	0.93	0.53	
16.50	9.47	8.70	9.40	0.77	0.07	1,300
15.00	9.78	9.40	9.80	0.38	-0.02	1,240
15.00	9.78	9.50	9.60	0.28	0.18	
15.00	9.78	9.50	9.60	0.28	0.18	
15.00	9.78	9.40	9.60	0.38	0.18	
15.30	9.72	9.10	9.60	0.62	0.12	
15.30	9.72	9.40	9.80	0.32	-0.08	
15.50	9.67	9.40	9.70	0.27	-0.03	
15.30	9.72	9.40	9.70	0.32	0.02	1,200

Point Marion						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
24.30	8.11	6.80	8.30	1.31	-0.19	640
24.20	8.13	7.00	8.10	1.13	0.03	
24.20	8.13	7.20	8.40	0.93	-0.27	
24.20	8.13	6.90	8.10	1.23	0.03	
24.10	8.14	6.80	7.40	1.34	0.74	
24.20	8.13	6.70	7.20	1.43	0.93	
24.00	8.16	6.50	7.00	1.66	1.16	
24.10	8.14	6.80	7.40	1.34	0.74	690
24.10	8.14	6.90	8.00	1.24	0.14	1,190
24.20	8.13	6.70	7.90	1.43	0.23	
24.20	8.13	6.40	8.20	1.73	-0.07	
24.00	8.16	6.50	8.20	1.66	-0.04	
24.00	8.16	6.50	8.30	1.66	-0.14	
24.00	8.16	6.30	8.10	1.86	0.06	
24.00	8.16	6.30	8.20	1.86	-0.04	
24.00	8.16	6.00	8.10	2.16	0.06	1,530
21.30	8.59	8.00	8.90	0.59	-0.31	1,100
21.20	8.61	8.20	9.00	0.41	-0.39	
21.00	8.64	8.30	9.20	0.34	-0.56	
21.00	8.64	8.30	9.20	0.34	-0.56	
21.00	8.64	8.10	9.00	0.54	-0.36	
20.80	8.68	7.60	8.00	1.08	0.68	
20.70	8.70	7.50	8.00	1.20	0.70	
21.00	8.64	7.90	8.30	0.74	0.34	1,100
14.90	9.81	9.40	10.20	0.41	-0.39	1,070
15.00	9.79	9.60	10.20	0.19	-0.41	
15.00	9.79	9.50	10.20	0.29	-0.41	
15.00	9.79	9.90	10.50	-0.11	-0.71	
14.90	9.81	9.60	10.50	0.21	-0.69	
14.90	9.81	9.60	10.20	0.21	-0.39	
14.70	9.85	9.60	10.90	0.25	-1.05	
14.70	9.85	9.70	11.00	0.15	-1.15	700

Table B-1. Dam aeration data (continued)

Monongahela No. 7						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
23.93	8.24	7.34	7.91	0.91	0.33	715
23.89	8.17	7.30	8.09	0.90	0.08	1,382
23.94	8.18	7.02	8.02	1.24	0.16	2,125
23.44	8.32	6.77	7.65	1.49	0.67	1,468
23.05	8.36	6.84	7.52	1.50	0.84	685
23.78	7.78	7.03	7.86	0.78	-0.08	3,575
23.02	7.98	6.99	7.82	0.86	0.16	6,900
23.50	7.84	7.15	7.92	0.71	-0.08	7,800
23.29	7.93	6.76	7.85	1.19	0.08	9,380
23.00	7.96	6.56	7.72	1.34	0.24	7,050
22.83	7.98	6.48	7.82	1.42	0.16	3,370
22.90	7.93	6.14	7.77	1.83	0.16	4,375
22.71	7.98	6.86	7.90	1.12	0.08	6,050

Maxwell						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
23.52	7.31	7.20	6.80	0.15	0.51	780
22.53	7.49	6.97	6.97	0.52	0.52	594
22.50	7.46	6.64	6.64	0.82	0.82	727
22.20	7.53	6.40	6.40	1.13	1.13	856
22.04	7.60	6.17	7.22	1.35	0.38	971
22.00	7.56	6.81	7.26	0.67	0.30	978
23.00	7.83	6.85	7.36	1.02	0.47	2,994
23.00	7.88	6.57	7.17	1.16	0.71	2,991
23.00	7.85	6.85	7.69	0.93	0.16	3,979
23.50	7.74	7.05	7.74	0.70	0.00	6,278
23.00	7.85	7.10	7.77	0.70	0.08	7,394
23.00	7.82	7.07	7.74	0.79	0.08	8,853
23.00	7.88	6.99	7.72	0.86	0.16	6,588
23.00	7.84	6.98	7.37	0.95	0.47	3,501
21.00	7.83	7.79	8.22	0.00	-0.39	3,712
21.02	7.81	7.52	7.81	0.31	0.00	3,076
21.20	7.75	7.31	7.98	0.47	-0.23	2,519
21.10	7.75	7.54	7.52	0.23	0.23	2,252
20.89	7.81	7.70	8.12	0.08	-0.31	1,927
20.65	7.85	7.88	8.40	0.00	-0.55	2,708

Monongahela No. 4					
Temp	C_s	C_a	C_b	D_a	D_b
23.50	8.25	7.60	8.00	0.65	0.25
27.00	7.73	7.00	7.40	0.73	0.33
27.00	7.73	7.10	7.50	0.63	0.23
25.00	8.02	7.70	8.00	0.32	0.02
21.00	8.66	8.70	8.70	-0.04	-0.04
27.50	7.66	7.70	7.80	-0.04	-0.14
23.00	8.33	8.80	8.80	-0.47	-0.47
22.30	8.44	9.00	9.00	-0.56	-0.56
22.50	8.41	6.80	8.00	1.61	0.41
27.00	7.73	6.80	7.30	0.93	0.43

Table B-1. Dam aeration data (continued).

Monongahela No. 4 (continued)

Temp	C_s	C_a	C_b	D_a	D_b
23.00	8.33	7.80	8.30	0.53	0.03
24.30	8.13	7.30	7.80	0.83	0.33
26.40	7.82	7.50	8.00	0.32	-0.18

Monongahela No. 3

Temp	C_s	C_a	C_b	D_a	D_b	Flow
24.86	7.50	7.35	7.05	0.31	0.45	1,100
24.50	7.60	7.06	6.76	0.61	0.84	3,630
23.00	7.87	6.53	6.53	1.34	1.34	3,750
23.50	7.74	6.59	6.58	1.07	1.16	3,685
23.00	8.23	7.71	7.74	0.49	0.49	5,320
23.00	8.22	7.41	7.56	0.82	0.66	5,320
24.00	8.06	8.29	8.46	-0.24	-0.40	3,790
24.00	8.04	7.82	7.80	0.24	0.24	4,314
23.00	8.25	7.96	7.92	0.25	0.33	5,594
23.00	8.25	7.78	8.00	0.41	0.25	3,972
21	8.81	7.50	7.80	1.31	1.01	
32	7.08	6.30	6.50	0.78	0.58	
26	7.97	8.60	8.10	-0.63	-0.13	
26.6	7.87	8.50	7.90	-0.63	-0.03	
25.5	8.05	7.20	7.40	0.85	0.65	
31.8	7.10	7.20	7.10	-0.10	0.00	
26.6	7.87	7.00	7.10	0.87	0.77	
29	7.51	7.90	7.70	-0.39	-0.19	

Monongahela No. 2

Temp	C_s	C_a	C_b	D_a	D_b	Flow
24.14	7.66	6.76	7.51	1.01	0.15	3,720
24.15	7.60	6.77	6.61	0.92	0.99	4,310
23.61	7.76	6.25	6.44	1.56	1.32	6,290
23.00	8.26	7.18	7.60	1.07	0.66	1,135
22.80	8.24	7.88	8.08	0.50	0.16	8,690
22.20	8.34	7.65	8.01	0.67	0.33	11,200
30	7.4	6	6.2	1.4	1.2	
26.2	7.9	7.1	7.3	0.8	0.6	
26	7.9	7.4	7.4	0.5	0.5	
24.3	8.3	7.1	7.8	1.2	0.5	
28.6	7.5	6.3	6.5	1.2	1	
25	8.1	7	7.2	1.1	0.9	
26.4	7.9	7.2	7.4	0.7	0.5	

Table B-1. Dam aeration data (continued)

Emsworth						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
13.10	10.24	10.26	10.51	-0.02	-0.27	33,700
13.17	10.22	10.27	10.76	-0.05	-0.54	33,700
12.84	10.30	12.24	13.44	-1.94	-3.14	33,700
13.24	10.20	11.80	11.12	-1.60	-0.92	33,700
13.86	10.06	11.64	10.98	-1.58	-0.92	33,700
13.79	10.08	9.58	8.71	0.50	1.37	31,200
13.39	10.17	11.37	11.17	-1.20	-1.00	31,200
13.45	10.16	10.86	10.81	-0.70	-0.65	31,200
12.44	10.39	10.72	10.71	-0.33	-0.32	25,300
12.49	10.38	10.74	10.70	-0.36	-0.32	25,300
12.45	10.39	10.67	10.69	-0.28	-0.30	25,300
12.54	10.37	10.95	10.96	-0.58	-0.59	25,300
12.54	10.37	10.93	10.96	-0.56	-0.59	25,300
12.43	10.39	10.68	10.69	-0.29	-0.30	25,300
12.33	10.42	10.06	10.05	0.36	0.37	25,300
12.34	10.41	9.87	10.32	0.54	0.09	25,300
9.37	11.16	10.59	10.78	0.57	0.38	15,000
9.39	11.15	10.50	10.80	0.65	0.35	13,800
9.37	11.16	10.11	10.77	1.05	0.39	13,800
9.45	11.14	9.84	10.39	1.30	0.75	13,800
9.60	11.10	9.77	10.35	1.33	0.75	13,800
9.58	11.10	9.62	10.25	1.48	0.85	13,800
9.58	11.10	9.61	10.18	1.49	0.92	13,800
9.49	11.13	9.52	10.08	1.61	1.05	13,800
18.0	9.38	9.4	9.2	-0.0	0.2	
26.9	7.83	6.1	7.0	1.7	0.8	
18.2	9.34	8.4	8.7	0.9	0.6	
10.0	11.26	11.4	11.4	-0.1	-0.1	
18.0	9.38	9.1	9.2	0.3	0.2	
23.9	8.30	6.8	7.3	1.5	1.0	
26.8	7.84	6.8	7.6	1.0	0.2	
24.8	8.16	7.5	7.6	0.7	0.6	
25.4	8.06	7.0	6.8	1.1	1.3	
24.3	8.24	7.9	8.2	0.3	0.0	
27.7	7.71	6.8	7.8	0.9	-0.1	
25.4	8.06	7.7	8.7	0.4	-0.6	
25.7	8.01	7.7	8.1	0.3	-0.1	

Dashields					
Temp	C_s	C_a	C_b	D_a	D_b
18.00	9.22	9.10	9.60	0.12	-0.38
26.30	7.85	5.70	7.30	2.15	0.55
19.00	9.03	8.00	8.70	1.03	0.33
9.40	11.16	11.40	12.00	-0.24	-0.84
18.00	9.22	9.10	9.70	0.12	-0.48
23.30	8.30	6.90	8.20	1.40	0.10
26.80	7.78	7.10	8.40	0.68	-0.62
24.80	8.07	7.30	7.65	0.77	0.42
25.50	7.96	6.80	7.30	1.16	0.66
25.00	8.04	7.60	8.10	0.44	-0.06
27.50	7.68	7.30	8.60	0.38	-0.92
25.70	7.93	8.50	9.30	-0.57	-1.37
25.60	7.95	7.90	8.60	0.05	-0.65

Table B-1. Dam aeration data (continued)

Montgomery						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
27.50	7.68	7.90	8.10	-0.22	-0.42	5,270
28.00	7.61	9.80	9.70	-2.19	-2.09	5,990
27.70	7.65	9.50	8.40	-1.85	-0.75	5,250
27.80	7.64	8.50	8.50	-0.86	-0.86	5,230
27.60	7.67	8.30	8.30	-0.63	-0.63	6,000
27.30	7.71	8.30	8.50	-0.59	-0.79	5,990
27.30	7.71	8.10	8.40	-0.39	-0.69	5,190
27.60	7.67	8.50	8.60	-0.83	-0.93	5,990
24.00	8.19	7.70	9.10	0.49	-0.91	11,370
23.80	8.22	7.60	9.20	0.62	-0.98	11,470
23.80	8.22	7.70	8.90	0.52	-0.68	10,040
23.50	8.27	7.70	8.70	0.57	-0.43	10,400
23.50	8.27	8.00	9.20	0.27	-0.93	10,400
23.50	8.27	8.10	9.50	0.17	-1.23	10,460
23.50	8.27	7.70	9.20	0.57	-0.93	10,500
23.60	8.25	7.70	9.60	0.55	-1.35	10,540
19.05	9.03	9.84	8.71	-0.81	0.32	32,800
18.55	9.12	9.83	8.91	-0.71	0.21	32,800
18.65	9.10	9.86	9.58	-0.76	-0.48	32,800
18.64	9.10	9.78	9.64	-0.68	-0.54	32,800
18.75	9.08	9.85	9.71	-0.77	-0.63	32,800
18.57	9.11	9.61	9.42	-0.50	-0.31	32,800
18.55	9.12	8.86	8.56	0.26	0.56	29,000
18.46	9.13	8.62	8.70	0.51	0.43	26,500
9.30	11.19	10.50	10.86	0.69	0.33	10,100
9.33	11.18	10.55	10.89	0.63	0.29	10,100
9.35	11.17	10.60	10.89	0.57	0.28	8,840
9.38	11.17	10.09	10.67	1.08	0.50	8,840
9.41	11.16	9.89	10.36	1.27	0.80	8,840
9.39	11.16	9.81	10.20	1.35	0.96	10,100
9.35	11.17	10.02	10.32	1.15	0.85	10,100
9.33	11.18	9.89	10.09	1.29	1.09	10,100

New Cumberland						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
25.90	7.91	7.93	8.32	-0.02	-0.41	6,000
25.60	7.96	8.04	8.51	-0.08	-0.55	7,500
25.90	7.91	7.98	8.54	-0.07	-0.63	6,000
26.20	7.87	7.89	8.31	-0.02	-0.44	3,000
26.70	7.80	7.42	8.00	0.38	-0.20	4,500
27.70	7.66	7.01	7.96	0.65	-0.30	6,000
25.90	7.91	6.96	7.79	0.95	0.12	14,000
25.80	7.93	6.81	7.94	1.12	-0.01	9,000
25.40	7.99	6.70	8.02	1.29	-0.03	9,000
25.10	8.03	6.95	8.27	1.08	-0.24	7,500
27.40	7.70	7.41	8.63	0.29	-0.93	6,000
24.30	8.15	7.64	8.64	0.51	-0.49	7,500
24.60	8.11	7.97	8.65	0.14	-0.54	4,500
24.70	8.09	7.90	8.66	0.19	-0.57	4,500
24.20	8.17	8.71	8.76	-0.54	-0.59	4,500
24.70	8.09	8.76	8.82	-0.67	-0.73	4,500
25.40	7.99	8.71	8.74	-0.72	-0.75	4,500

Table B-1. Dam aeration data (continued).

New Cumberland (continued)

Temp	C_s	C_a	C_b	D_a	D_b	Flow
24.30	8.15	8.86	9.01	-0.71	-0.86	13,000
23.50	8.28	8.85	9.18	-0.57	-0.90	7,500
23.80	8.23	8.85	9.01	-0.62	-0.78	9,000
25.40	7.99	8.40	8.65	-0.41	-0.66	12,000
25.50	7.97	8.10	8.50	-0.13	-0.53	17,000
26.00	7.90	8.35	8.70	-0.45	-0.80	14,000
26.50	7.83	8.40	8.70	-0.57	-0.87	15,500
25.50	7.97	8.50	8.50	-0.53	-0.53	7,500
25.20	8.02	8.10	8.50	-0.08	-0.48	9,000
27.20	7.73	8.30	8.50	-0.57	-0.77	9,000
27.90	7.63	8.40	8.40	-0.77	-0.77	7,500

Pike Island

Temp	C_s	C_a	C_b	D_a	D_b
20.00	8.87	8.70	9.00	0.17	-0.13
28.00	7.62	6.10	6.20	1.52	1.42
20.40	8.80	8.10	8.40	0.70	0.40
13.10	10.26	9.80	9.90	0.46	0.36
17.80	9.27	9.00	9.60	0.27	-0.33
24.50	8.13	6.50	7.80	1.63	0.33
23.30	8.31	6.60	7.40	1.71	0.91
27.70	7.67	6.70	7.40	0.97	0.27
25.80	7.93	7.90	8.40	0.03	-0.47
27.80	7.65	6.80	6.80	0.85	0.85
26.10	7.89	7.60	7.80	0.29	0.09
29.10	7.48	7.50	7.70	-0.02	-0.22
26.80	7.79	7.80	8.00	-0.01	-0.21
27.40	7.71	8.60	8.60	-0.89	-0.89

Hannibal

Temp	C_s	C_a	C_b	D_a	D_b	Flow
27.4	7.75	8.19	8.11	-0.44	-0.36	14,900
27.2	7.78	7.89	8.82	-0.11	-1.04	9,400
27.2	7.78	8.14	8.14	-0.36	-0.36	5,700
26.9	7.83	7.89	7.96	-0.06	-0.13	5,700
26.7	7.86	7.51	8.26	0.35	-0.40	9,400
26.3	7.92	7.82	7.8	0.10	0.12	5,700
26.4	7.90	7.62	7.75	0.28	0.15	5,700
27	7.81	6.64	7.06	1.17	0.75	7,400
27.2	7.78	6.47	6.9	1.31	0.88	7,400
27.5	7.74	6.63	6.99	1.11	0.75	7,400
27.9	7.68	6.81	6.94	0.87	0.74	11,400
28	7.66	6.62	6.83	1.04	0.83	18,800
28	7.66	7.21	7.33	0.45	0.33	11,400
28	7.66	6.72	6.98	0.94	0.68	7,400
27.9	7.68	6.23	6.52	1.45	1.16	13,150
27.4	7.75	6.37	7.37	1.38	0.38	9,400
27.1	7.80	6.19	6.58	1.61	1.22	7,400
27	7.81	6.5	6.67	1.31	1.14	13,150

Table B-1. Dam aeration data (continued)

Hannibal (continued)						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
27	7.81	6.71	6.86	1.10	0.95	7,400
27.1	7.80	6.82	7.13	0.98	0.67	18,800
27	7.81	7.17	7.35	0.64	0.46	14,900
26.7	7.86	7.32	8.48	0.54	-0.62	9,400
26.6	7.87	7.25	8.02	0.62	-0.15	9,400
26.4	7.90	7.18	7.55	0.72	0.35	7,400

Willow Island						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
24.50	8.14	9.00	9.10	-0.86	-0.96	10,500
24.00	8.22	9.00	9.40	-0.78	-1.18	9,060
24.50	8.14	8.70	9.20	-0.56	-1.06	10,500
25.00	8.06	9.00	9.00	-0.94	-0.94	14,700
26.00	7.92	8.25	8.40	-0.33	-0.48	13,300
26.00	7.92	8.00	8.00	-0.08	-0.08	47,500
27.00	7.77	7.35	7.40	0.42	0.37	68,000
26.50	7.85	7.30	7.40	0.55	0.45	92,000
26.50	7.85	7.65	7.70	0.20	0.15	74,300
26.00	7.92	6.80	7.10	1.12	0.82	45,300
25.00	8.06	7.05	7.30	1.01	0.76	62,400
25.50	7.99	7.40	7.70	0.59	0.29	38,300
26.00	7.92	7.80	8.00	0.12	-0.08	51,800
26.00	7.92	8.00	8.20	-0.08	-0.28	24,400
26.00	7.92	8.00	8.05	-0.08	-0.13	17,800
26.00	7.92	8.20	8.30	-0.28	-0.38	22,900
26.00	7.92	8.30	8.50	-0.38	-0.58	14,700
26.00	7.92	8.20	8.40	-0.28	-0.48	17,700
26.00	7.92	8.15	8.30	-0.23	-0.38	13,300
27.00	7.77	7.90	7.90	-0.13	-0.13	13,300
26.50	7.85	7.70	8.10	0.15	-0.25	10,500
27.00	7.77	8.10	8.20	-0.33	-0.43	9,000

Belleville						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
29.00	7.51	6.57	6.78	0.94	0.73	13,500
29.00	7.51	6.55	7.04	0.96	0.47	13,500
29.45	7.45	7.12	7.31	0.33	0.14	13,500
29.50	7.44	7.61	6.91	-0.17	0.53	13,500
29.73	7.41	7.01	7.02	0.40	0.39	13,500
29.78	7.41	6.60	6.82	0.81	0.59	13,500
28.84	7.53	6.61	6.85	0.92	0.68	13,500
28.85	7.53	6.58	6.85	0.95	0.68	12,000
27.47	7.71	5.77	5.92	1.94	1.79	15,000
26.43	7.86	5.80	6.11	2.06	1.75	18,000
26.49	7.85	5.98	5.87	1.87	1.98	18,000
26.56	7.84	6.67	6.43	1.17	1.41	18,000
26.46	7.86	6.54	6.14	1.32	1.72	18,000
26.61	7.84	5.93	6.04	1.91	1.80	18,000
26.83	7.80	5.36	6.47	2.44	1.33	18,000

Table B-1. Dam aeration data (continued).

Belleville (continued)

Temp	C_s	C_a	C_b	D_a	D_b	Flow
26.74	7.82	5.83	6.36	1.99	1.46	18,000
16.20	9.61	9.22	9.58	0.39	0.03	31,500
16.60	9.53	9.11	9.23	0.42	0.30	29,750
17.00	9.45	8.80	8.32	0.65	1.13	29,750
16.40	9.57	8.32	9.17	1.25	0.40	29,750
16.40	9.57	9.41	9.93	0.16	-0.36	29,750
16.00	9.65	9.34	9.50	0.31	0.15	29,750
15.50	9.76	9.27	6.41	0.49	3.35	29,750

Gallipolis

Temp	C_s	C_a	C_b	D_a	D_b	Flow
20.00	8.90	7.20	7.40	1.70	1.50	91,900
18.50	9.18	6.80	7.20	2.38	1.98	141,100
23.00	8.39	5.60	7.20	2.79	1.19	130,900
23.50	8.31	6.70	6.40	1.61	1.91	56,700
25.00	8.08	7.30	7.50	0.78	0.58	35,400
25.00	8.08	7.70	7.90	0.38	0.18	47,400
26.00	7.94	7.50	7.80	0.44	0.14	73,500
22.00	8.56	8.90	8.60	-0.34	-0.04	74,100
25.00	8.08	7.50	7.80	0.58	0.28	72,500
26.00	7.94	7.40	7.60	0.54	0.34	65,400
25.00	8.08	7.90	7.70	0.18	0.38	62,200
24.00	8.24	7.30	7.60	0.94	0.64	52,800
24.00	8.24	7.10	7.30	1.14	0.94	51,900
27.00	7.79	5.80	7.20	1.99	0.59	66,800
27.00	7.79	6.50	7.20	1.29	0.59	69,500
27.00	7.79	7.10	7.30	0.69	0.49	67,200
27.00	7.79	7.00	7.10	0.79	0.69	64,800
28.00	7.65	7.60	7.90	0.05	-0.25	59,500
28.00	7.65	7.40	8.00	0.25	-0.35	50,100
27.50	7.72	7.70	7.10	0.02	0.62	41,900
28.00	7.65	7.20	7.00	0.45	0.65	39,100
28.00	7.65	7.70	8.00	-0.05	-0.35	37,800
28.00	7.65	7.70	8.00	-0.05	-0.35	27,200
29.00	7.52	7.90	8.20	-0.38	-0.68	24,400
29.00	7.52	8.80	9.20	-1.28	-1.68	20,400
28.00	7.65	9.10	8.10	-1.45	-0.45	20,000
28.00	7.65	8.20	10.00	-0.55	-2.35	22,200
28.00	7.65	8.00	8.00	-0.35	-0.35	24,200
28.00	7.65	7.30	7.50	0.35	0.15	31,700
27.00	7.79	7.40	7.70	0.39	0.09	25,600
27.50	7.72	7.30	7.50	0.42	0.22	28,300
28.00	7.65	7.90	7.90	-0.25	-0.25	23,200
28.00	7.65	7.60	7.70	0.05	-0.05	16,300
28.00	7.65	6.80	6.80	0.85	0.85	20,200
27.50	7.72	6.60	6.70	1.12	1.02	16,700
27.50	7.72	6.50	6.70	1.22	1.02	20,800
28.00	7.65	6.50	6.40	1.15	1.25	19,400
27.50	7.72	6.70	6.70	1.02	1.02	17,600
27.00	7.79	6.40	6.40	1.39	1.39	25,500
26.50	7.86	6.60	6.90	1.26	0.96	20,800
26.00	7.94	6.60	6.70	1.34	1.24	16,400
26.00	7.94	6.80	6.90	1.14	1.04	17,100

Table B-1. Dam aeration data (continued).

Gallipolis (continued)

Temp	C_s	C_a	C_b	D_a	D_b	Flow
26.00	7.94	6.50	7.00	1.44	0.94	14,200
26.00	7.94	6.40	6.80	1.54	1.14	13,400
26.00	7.94	6.50	6.30	1.44	1.64	16,000
26.00	7.94	6.40	6.50	1.54	1.44	22,500
26.00	7.94	6.50	6.50	1.44	1.44	30,200
24.50	8.16	7.10	7.10	1.06	1.06	21,600
24.00	8.24	6.90	6.90	1.34	1.34	12,200
24.00	8.24	7.20	7.40	1.04	0.84	17,200
24.00	8.24	6.90	7.10	1.34	1.14	20,100
24.50	8.16	7.20	7.40	0.96	0.76	18,000
24.00	8.24	7.30	7.50	0.94	0.74	15,600
24.00	8.24	6.80	7.30	1.44	0.94	14,200
24.00	8.24	7.10	7.40	1.14	0.84	13,800
24.00	8.24	7.10	7.40	1.14	0.84	11,900
24.00	8.24	7.10	7.30	1.14	0.94	15,700
24.00	8.24	7.20	7.30	1.04	0.94	14,500
24.00	8.24	7.10	7.20	1.14	1.04	15,600
23.50	8.31	6.60	7.30	1.71	1.01	18,000
25.00	8.08	6.60	7.20	1.48	0.88	35,000
25.00	8.08	6.70	6.80	1.38	1.28	29,200
23.00	8.39	6.60	6.80	1.79	1.59	119,400
19.00	9.08	8.00	8.10	1.08	0.98	56,100
17.00	9.46	8.70	8.70	0.76	0.76	32,500
17.00	9.46	9.30	9.40	0.16	0.06	29,700

Muskingum No. 3

Temp	C_s	C_a	C_b	D_a	D_b	Flow
29.30	7.47	10.30	7.40	-2.83	0.07	1,400
29.40	7.45	6.98	6.90	0.47	0.55	1,700
29.00	7.51	6.80	7.30	0.71	0.21	1,700
29.50	7.44	8.50	7.50	-1.06	-0.06	1,700
29.30	7.47	7.50	7.40	-0.03	0.07	1,700
29.50	7.44	5.70	5.90	1.74	1.54	1,700
29.30	7.47	5.30	6.50	2.17	0.97	1,900
26.50	7.85	6.90	7.70	0.95	0.15	2,800
27.00	7.78	6.60	7.60	1.18	0.18	2,800
26.80	7.81	6.60	7.10	1.21	0.71	2,600
27.10	7.76	6.70	7.60	1.06	0.16	2,600
26.60	7.83	6.80	6.50	1.03	1.33	2,600
26.00	7.92	6.30	7.30	1.62	0.62	2,300
26.40	7.86	5.70	7.30	2.16	0.56	2,300
25.70	7.96	9.80	8.40	-1.84	-0.44	1,800
24.80	8.10	7.30	7.50	0.80	0.60	2,100
26.30	7.88	11.00	8.80	-3.12	-0.92	2,100
26.40	7.86	12.10	8.60	-4.24	-0.74	2,100
26.50	7.85	7.60	8.20	0.25	-0.35	1,800
25.80	7.95	7.30	9.10	0.65	-1.15	1,800
26.20	7.89	10.70	6.10	-2.81	1.79	1,800
26.50	7.85	9.30	6.40	-1.45	1.45	1,900
26.00	7.92	5.80	7.90	2.12	0.02	1,560
26.80	7.81	7.90	6.00	-0.09	1.81	1,560
26.70	7.82	9.10	8.10	-1.28	-0.28	1,560
26.50	7.85	7.70	6.90	0.15	0.95	1,360

Table B-1. Dam aeration data (concluded)

Muskingum No. 3 (continued)						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
26.80	7.81	7.60	8.00	0.21	-0.19	1,360
27.00	7.78	7.20	6.80	0.58	0.98	1,360

Muskingum No. 2						
Temp	C_s	C_a	C_b	D_a	D_b	Flow
26.00	7.92	7.50	7.00	0.42	0.92	2,391
26.00	7.92	7.20	7.20	0.72	0.72	2,391
26.00	7.92	7.00	7.20	0.92	0.72	2,391
26.10	7.90	7.80	7.20	0.10	0.70	2,391
26.20	7.89	8.70	7.20	-0.81	0.69	2,391
26.00	7.92	6.90	6.30	1.02	1.62	2,272
26.20	7.89	6.70	6.60	1.19	1.29	2,272
26.50	7.85	6.60	6.60	1.25	1.25	1,350
24.30	8.17	8.60	8.50	-0.43	-0.33	1,350
23.90	8.23	7.80	7.60	0.43	0.63	1,425
23.80	8.25	7.30	7.20	0.95	1.05	1,425
23.80	8.25	6.80	6.70	1.45	1.55	1,425
24.00	8.22	6.60	6.70	1.62	1.52	1,425
23.90	8.23	7.20	7.30	1.03	0.93	1,425
23.90	8.23	7.20	7.30	1.03	0.93	1,944
24.00	8.22	6.80	6.90	1.42	1.32	1,944
24.00	8.22	6.50	7.00	1.72	1.22	1,944
24.00	8.22	6.70	7.00	1.52	1.22	1,878
23.40	8.31	7.40	7.70	0.91	0.61	1,878
23.00	8.37	6.90	7.50	1.47	0.87	1,878
23.20	8.34	6.80	7.40	1.54	0.94	1,878
22.50	8.45	7.70	8.10	0.75	0.35	1,878
22.50	8.45	8.10	8.20	0.35	0.25	1,610
22.30	8.49	8.90	8.70	-0.41	-0.21	1,610
22.30	8.49	7.70	8.00	0.79	0.49	1,610
22.50	8.45	6.30	6.70	2.15	1.75	1,500
22.00	8.54	6.60	7.30	1.94	1.24	1,500
22.00	8.54	6.40	7.10	2.14	1.44	1,500
22.00	8.54	6.80	7.80	1.74	0.74	1,500
22.10	8.52	6.80	7.70	1.72	0.82	1,500
22.30	8.49	7.40	7.80	1.09	0.69	1,500

1/ Water temperature, degrees Celsius.

2/ Oxygen saturation concentration, mg/L.

3/ Dissolved oxygen concentration above the dam, mg/L.

4/ Dissolved oxygen concentration below the dam, mg/L.

5/ Dissolved oxygen deficit above the dam, mg/L.

6/ Dissolved oxygen deficit below the dam, mg/L.

7/ River flow rate, cfs.

water is expected to be. Linear regression was used to determine the relation between D_a and D_b for each dam. The value of D_a was plotted against D_b for each pair of field-measured values; the data generally fell near straight lines, although scatter occurs, which is expected because of field measurement errors, errors in estimated DO saturation concentrations, and small variations in head (the distance the water falls at a dam) that normally occur.

Graphs of D_b vs D_a at some dams appeared to approximate straight lines that do not meet the common assumption that when D_a is zero, then D_b is zero (in other words, that no aeration occurs when the DO above the dam is at saturation). The dam aeration model is therefore:

$$D_b = M\,D_a + b\ ,$$

where M is referred to as the dam aeration coefficient and b is the dam aeration constant. Figure B-1 is an example aeration graph where b is zero, and Figures B-2 and B-3 are example plots of D_b vs. D_a at dams where the assumption that when D_a is zero then D_b is zero does not appear to be true.

There are three explanations that could account for the apparent aeration (D_b less than zero) when the above-dam deficit (D_a) is zero: field measurement errors, erroneous estimates of the saturation concentration, and the occurrence of supersaturation. Errors in field measurements of DO concentration are not believed to be the only cause of nonzero values of b, because the value of b was consistently negative at dams where the statistical fit of the aeration equation was good.

The actual saturation concentration (C_s) in the river may be significantly different from the literature values used in the analyses. This error would cause there to actually be a non-negative value of D_a when the data show that D_a is zero. Variability in actual C_s values could be documented by measuring C_s in the field as Butts and Adkins (1987) did. Some field measurements of the DO saturation concentration were made by applicants, and significant variation from book values sometimes occurred. However, because of the few data collected and the unknown accuracy of the data, the results are not conclusive.

The third explanation for apparent mass transfer when D_a is zero is that supersaturation occurs. According to Henry's law, the value of C_s in water in equilibrium with air is proportional to the air pressure. Because air bubbles plunged beneath the surface below a dam are under higher than atmospheric pressure (the pressure on bubbles is twice atmospheric at a depth of approximately 32 feet), the local value of C_s in water surrounding submerged bubbles would be higher than C_s at the surface of the water column. Theoretically, supersaturation could occur if bubbles are submerged for a long enough time for sufficient mass transfer to occur. Measurement of supersaturation below navigation dams was not investigated as part of this study. However, a comparison between those dams where visual observations indicated that deep plunging of bubbles occurred and those dams where the linear regression model indicated that significant aeration occurred when D_a was zero indicates that aeration when D_a is zero is more likely to occur at dams where deep plunging occurs.

The linear regression coefficients for dam aeration used in the water quality models are listed in Table B-2. This table can be used to rank dams by their aeration capacity; in general, dams with lower aeration coefficients (M) and more negative values of b aerate better.

The regression models of below-dam DO deficit as a function of the above-dam deficit generally are adequate predictors of D_b, as shown by the root mean square errors in Table B-2 that are generally within the range of accuracy that can be expected with DO models. At several dams, the linear model does not seem to describe aeration well. At Muskingum 3 and Allegheny 2, the aeration data are extremely scattered. The data indicate that the best model for aeration at these two dams may be that saturation is reached or exceeded for all upstream deficits; this situation is approximated by the low value of the aeration coefficient M determined by the regression analysis.

B.2.1.3.2 Incorporation of Turbine and Lockage Flows

DO below dams during hydropower generation is modeled by determining how much of the river flow passes through the turbines, with the remaining flow passing over or through the dam and becoming aerated, then: (1) calculating how much DO the water passing the dam picks up using the dam aeration model described above, (2) assuming that generating flows are not aerated, and

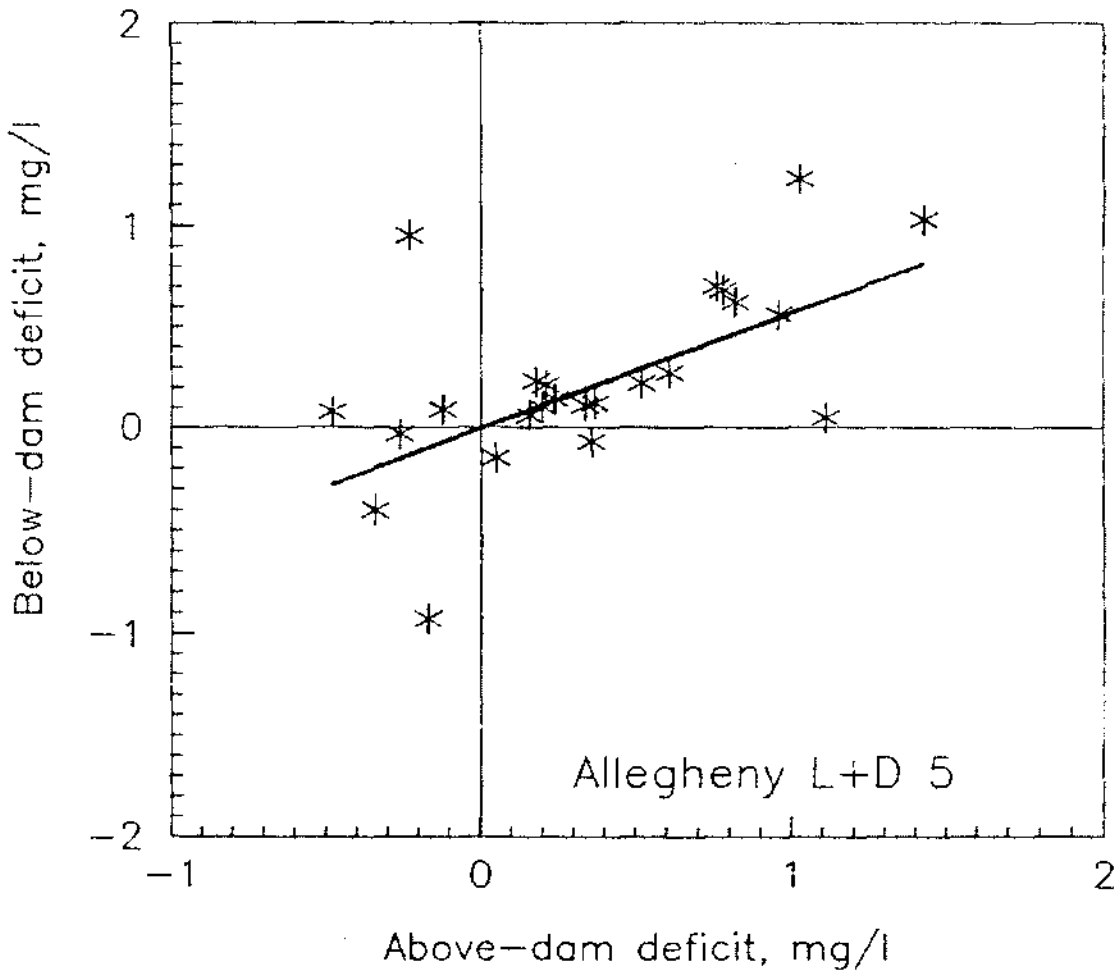


Figure B-1. Aeration graph for Allegheny L&D No. 5.

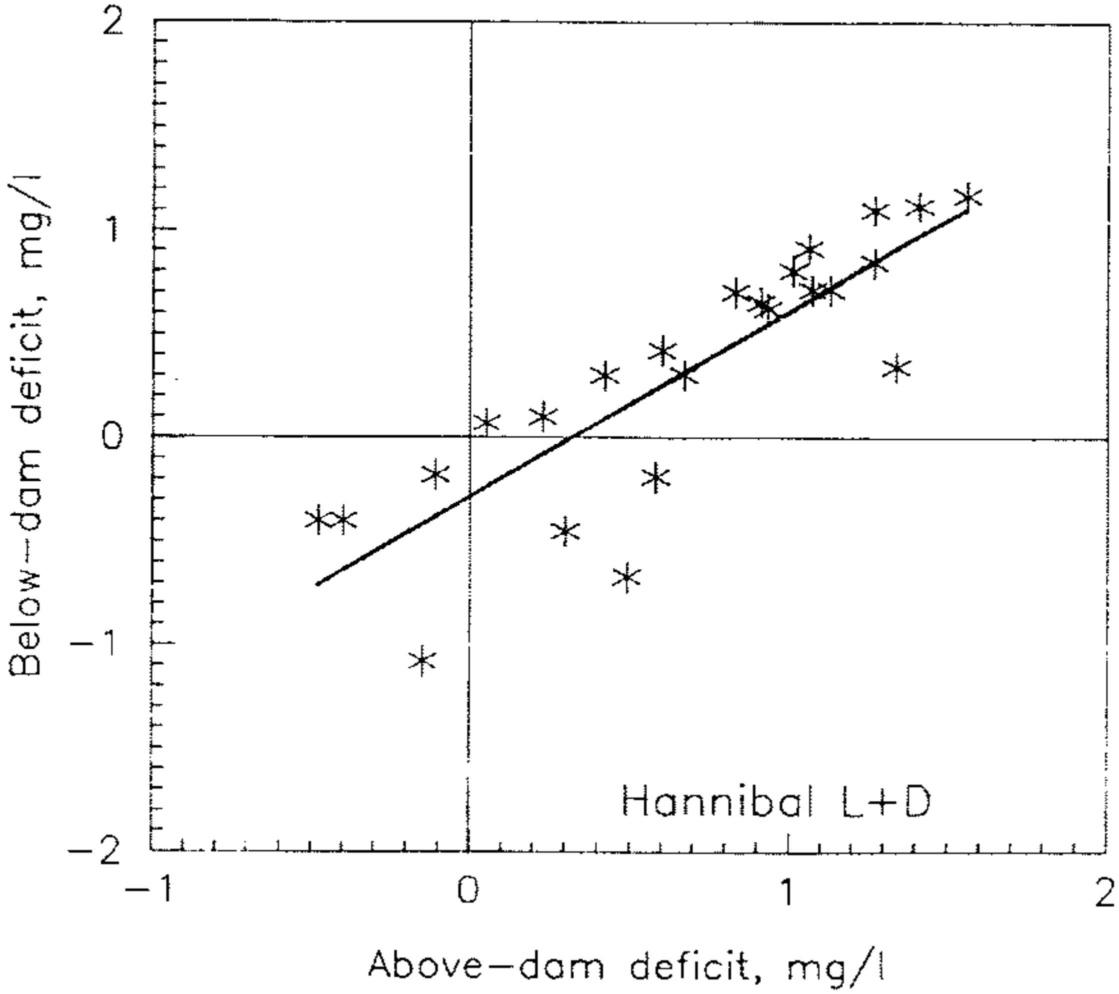


Figure B-2. Aeration graph for Hannibal Dam.

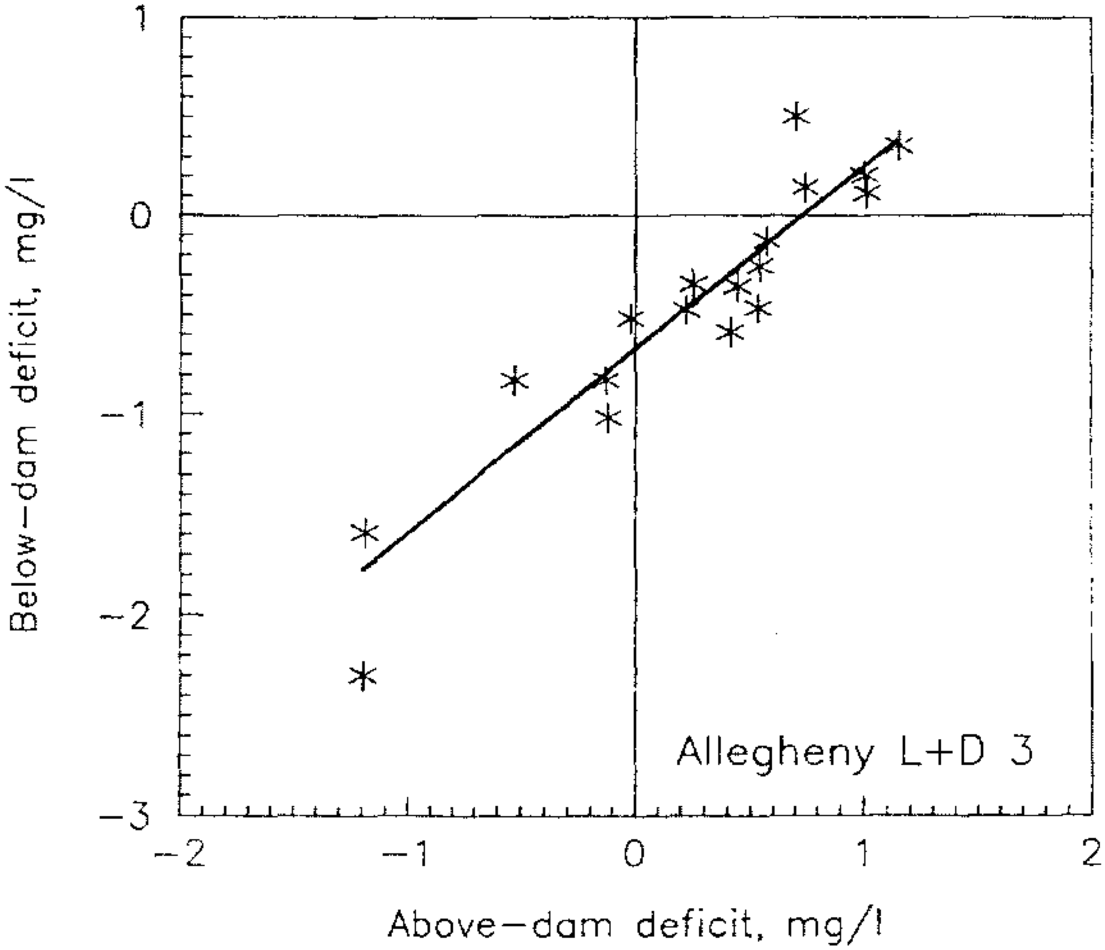


Figure B-3. Aeration graph for Allegheny L&D No. 3.

Table B-2. Linear regression model parameters.

Model: Below-dam deficit = (Above-dam deficit x M) + b, in mg/L

Dam	b1/	M2/	Corr. coef.3/ r^2	No. obs.4/	RMS error,5/ mg/L	Data source6/
Muskingum 3	0.38	0.13	0.08	28	0.77	appl
Muskingum 2	0	0.72	0.55	30	0.34	appl
Gallipolis	-0.1	0.84	0.74	66	0.39	appl
Belleville	0	0.89	0.74	23	0.72	appl
Willow Island	-0.17	0.97	0.97	21	0.14	appl
Hannibal	-0.28	0.89	0.72	24	0.34	appl
Pike Island	-0.23	0.72	0.76	14	0.32	COE
New Cumberland	-0.5	0.38	0.71	28	0.15	appl
Montgomery	-0.61	0.78	0.44	34	0.64	comb
Dashields	-0.67	0.72	0.71	13	0.36	COE
Emsworth	-0.19	0.77	0.76	37	0.42	comb
Allegheny 2	-0.92	0.12	0.01	34	0.48	appl
Allegheny 3	-0.67	0.92	0.86	19	0.26	comb
Allegheny 4	0	0.56	0.59	9	0.15	COE
Allegheny 5	0	0.57	0.37	24	0.34	comb
Allegheny 6	0	0.82	0.91	15	0.28	comb
Allegheny 7	0.13	0.90	0.79	19	0.2	comb
Allegheny 8	-0.62	0.61	0.88	10		COE
Allegheny 9	0	0.58	0.58	1		COE
Monongahela 2	-0.2	0.93	0.72	13	0.26	comb
Monongahela 3	0.14	0.81	0.88	18	0.22	comb
Monongahela 4	-0.18	0.61	0.92	12	0.13	comb
Maxwell	-0.22	0.69	0.45	20	0.32	appl
Monongahela 7	-0.1	0.36	0.50	14	0.15	appl
Point Marion	-0.64	0.40	0.55	24		appl
Morgantown	-0.21	0.65	0.69	32	0.21	appl
Hildebrand	0.1	0.32	0.26	15	0.3	appl
Opekiska	-0.15	0.8	0.83	22	0.38	appl

1/ Dam aeration constant.

2/ Dam aeration coefficient.

3/ Coefficient of correlation between above-dam deficit and below-dam deficit.

4/ Number of measured observations.

5/ Root mean squared error, an estimate of the average difference between predicted and measured values of the observed below-dam deficit.

6/ appl: data from aeration studies conducted by applicants.
COE: data from Pittsburgh District water quality surveys.
comb: data from Pittsburgh District and applicants combined.

(3) calculating the final DO concentration after all the flow is mixed together again below the dam. Step (3) is done by calculating the average, weighted by flow, of the DO concentrations in the aerated and unaerated portions. The hydropower plants would withdraw water from all depths, so it is assumed that any stratification occurring above the plant would be eliminated.

B.2.1.3.3 Influence of Temperature and Flow on Aeration

A univariate linear regression analysis was also performed on data from each dam to determine whether temperature and the river flow rate had significant effects on aeration. The below-dam deficit D_b was used as the dependent variable, and D_a, the temperature, and the flow rate were attempted as independent variables. Results from these analyses are in Table B-3 for dams where sufficient data were available. The value of the correlation coefficient for each independent variable indicates the apparent ability of the variable to explain variation in below-dam deficits.

From the values in Table B-3, the conclusion can be drawn that neither temperature nor flow rate has a consistently significant effect on aeration. Some fairly high correlation coefficients for temperature and flow occur, but because these coefficients are not consistently positive or negative, it appears that correlations between below-dam deficit and temperature or flow may be spurious. The correlation coefficient for D_a, however, is always positive and generally high.

Table B-3. Linear regression results for dam aeration.

Independent variable:	Coefficient of correlation (r) 1/		
	Above-dam deficit	Temperature	Flow
Muskingum 3			
Muskingum 2	0.74	0.16	0.02
Gallipolis			
Belleville	0.55	0.07	-0.07
Willow Island			
Hannibal			
Pike Island			
New Cumberland			
Montgomery	0.51	0.63	-0.65
Dashields			
Emsworth	0.89	-0.58	-0.67
Allegheny 2	0.11	0.47	0.03
Allegheny 3	0.91	-0.07	-0.64
Allegheny 4			
Allegheny 5			
Allegheny 6			
Allegheny 7	0.91	0.56	0.48
Monongahela 2	0.87	0.61	-0.31
Monongahela 3	0.97	0.02	-0.28
Monongahela 4			
Maxwell	0.67	0.21	-0.67
Monongahela 7	0.71	-0.77	0.10
Point Marion	0.67	0.64	0.00
Morgantown	0.83	0.66	-0.22
Hildebrand			
Opekiska			

1/ The magnitude of the correlation coefficient indicates how much of the variation in below-dam deficit is apparently explained by the independent variables above-dam deficit, temperature, and flow rate. The analyses were separate for each independent variable.

The independence of D_b from temperature should not be confused with the dependence of the value of C_s (which is used to calculate the DO deficits) on temperature. The temperature is required to determine C_s but appears to have no other consistent effect on D_b. The independence of D_b from the flow rate is not surprising because the only factor controlling mass transfer of oxygen that flow would affect is the degree of turbulence; apparently, either turbulence is not an important factor controlling aeration at these navigation dams or flow does not affect turbulence sufficiently to affect aeration. Both of these situations are possible at navigation dams; from visual observations, it appears that there is high turbulence at almost all flows. At gated dams there is high turbulence but sometimes low air entrainment, so the rate of air entrainment probably controls aeration rates; at some fixed-crest dams there is high turbulence and high air entrainment but little plunge below the dam, which may limit aeration. It must also be considered that the data used in this study were deliberately collected at relatively low flows and that measurements made over a wider range of flows may show a higher influence of flow on aeration.

B.2.1.4 Algal Production

Algal production is a potentially important component of the overall DO budgets of the Ohio River. Gross production rates estimated by Odum (1956) in rivers similar to the main stem of the Ohio River ranged up to 40 $g/m^2/d$ and more. However, very little information is available to quantify this oxygen source for this study. Diurnal variation in DO concentrations measured by hydropower applicants in the summer of 1987 was quite variable, ranging from 2.5 mg/L on the Muskingum River to essentially zero at several locations on the Ohio River. Insufficient data were collected in the 1987 studies to quantify DO production by algae. The high summer DO concentrations and algae blooms that sometimes occur in the Ohio River system indicate that under certain conditions primary productivity contributes a substantial amount of DO.

The 1987 data and historic data collected by ORSANCO indicate that diurnal variations in DO concentration are usually small, indicating that primary productivity is usually a minor part of the DO budget. Research conducted by the University of Cincinnati in the Meldahl pool indicated that the navigation dams have increased depths sufficiently that algal production is limited by light penetration of the water, so the DO contributed by algae is relatively minor (personnal communication, Dr. Michael C. Miller, Department of Biological Sciences, University of Cincinnati, June 1, 1987).

Algal production of DO may be important at times, but because modeling analysis is interested in periods of low DO concentrations when algal production is low and because insufficient information is available to estimate or model algal production, it was not modeled as a DO source term separate from water surface aeration.

B.2.2 FORMULATION OF THE BASIN-LEVEL MODEL

The equations describing the various components of the DO budget (water surface aeration, dam aeration, and BOD decay) for the Ohio River system were implemented in a LOTUS 1-2-3 spreadsheet on a microcomputer. The spreadsheet model is a simple implementation of the equations describing the important components of the DO budget, including the Streeter-Phelps equations for BOD decay and surface aeration, the dam aeration models, and a simple hydraulic routing scheme. The model assumes that flows and water quality are steady state over time and that plug flow (no longitudinal mixing) occurs. The spreadsheet solves the equations analytically and determines the DO concentration at the beginning, end, and sag point (if any) of each reach of a river and can graph output. A new reach begins at each point where a wastewater discharge or tributary enters the river or where a dam is located. River velocities are estimated by assuming that the navigation dams maintain a constant pool elevation and cross-sectional area over the range of flows being modeled, so the velocity is equal to the flow rate divided by the cross-sectional area.

The spreadsheet model has several important advantages over other potential implementations. The number of input parameters is low because of the model's simplicity, and input is generally restricted to parameters for which measured or reliably estimated values are available. Under the low-flow conditions that are of most interest, the assumptions of plug flow and constant cross-sectional area are probably valid. The spreadsheet model is documented in Section B.4.

B.2.3 DATA SOURCES

B.2.3.1 River Flows

Flow data were obtained from U.S. Geological Survey stream gages throughout the upper Ohio River basin. Recent and simulated historic flows on the Ohio River were obtained from the Ohio River Division and the Pittsburgh District of the Corps. Flow duration curves and estimates of lockage and leakage flows at dams were also obtained from the Corps.

B.2.3.2 Waste Loadings

Major point-source dischargers were identified using the retrieval program MSP on EPA's STORET water quality data base. Actual BOD discharge rates for the major dischargers were obtained from Discharge Monitoring Reports in EPA's Permit Compliance System data base, and in the files of the Ohio EPA, the Pennsylvania Department of Environmental Resources, and the West Virginia Department of Natural Resources. Point-source dischargers included in the model are those that (1) discharge enough BOD to cause a significant depression in DO and (2) also monitor the BOD of their discharge. There are a number of major industrial dischargers throughout the basin where BOD is not monitored, so the waste loads from such dischargers are unknown and were not modeled. Where available, waste loading data compiled by the states for waste allocation studies and basin management plans were also used to estimate loadings from major dischargers. BOD concentrations in tributaries were estimated as approximately equal to those of the main stem. Calibration of the model generally required the addition of higher waste loads at some point sources and BOD loads representing nonpoint sources (Section 2.4). The point-source discharges used in the model are shown in Figures B-4 and B-5.

B.2.3.3 Historic Water Quality

Data from the ORSANCO electronic monitors were analyzed to estimate the historic distribution of temperatures and DO concentrations. These distributions were used to estimate the frequency with which certain DO and temperature conditions occur. Data from the Pittsburgh District summer surveys (Section 2.3.6) were also used to determine typical summer DO profiles along the study rivers.

B.2.3.4 Channel Geometry

Channel cross sections were obtained in computer files from the Corps. These cross sections are generally a mile or less apart and cover the entire study system, including the Muskingum. A program was written to use these cross sections to determine average cross-sectional areas, depths, and widths for any river reach at a given pool elevation. This program was used to estimate channel geometry parameters for the models.

B.2.3.5 Dam Aeration Rates

To evaluate aeration, hydropower applicants were requested by FERC to collect two-dimensional transect measurements of DO and temperature above and below each of the dams in the study basin during the summer and early fall of 1987, except where applicants had previously made such measurements. Results were obtained at all but two dams. Data from the Pittsburgh District summer water quality surveys were also used to estimate dam aeration rates. The district annually measures DO and temperature in vertical profiles above and below each dam in the district. These Corps data were used to (1) fit the aeration models at the sites where applicants did not collect data, (2) extend the range of DO deficits measured, and (3) demonstrate that the dam aeration models developed are constant over the time period (13 years) the district has collected data.

B.2.3.6 Water Quality Data for Model Calibration

The DO models were calibrated to field data collected in July and August of 1983 by the Water Quality section of the Pittsburgh District of the Corps, supplemented with ORSANCO data. The Pittsburgh District's annual summer water quality surveys provide the most comprehensive data on DO concentrations collected throughout most of the study area during a limited time period, and the data are of high quality. The data from 1983 were selected for calibration because (1) DO deficits were high, (2) the Pittsburgh District's survey covered the entire study system down to the Hannibal dam pool, and (3) waste load data were not available from the state of Pennsylvania for years prior to 1983. DO and temperature measurements were made by

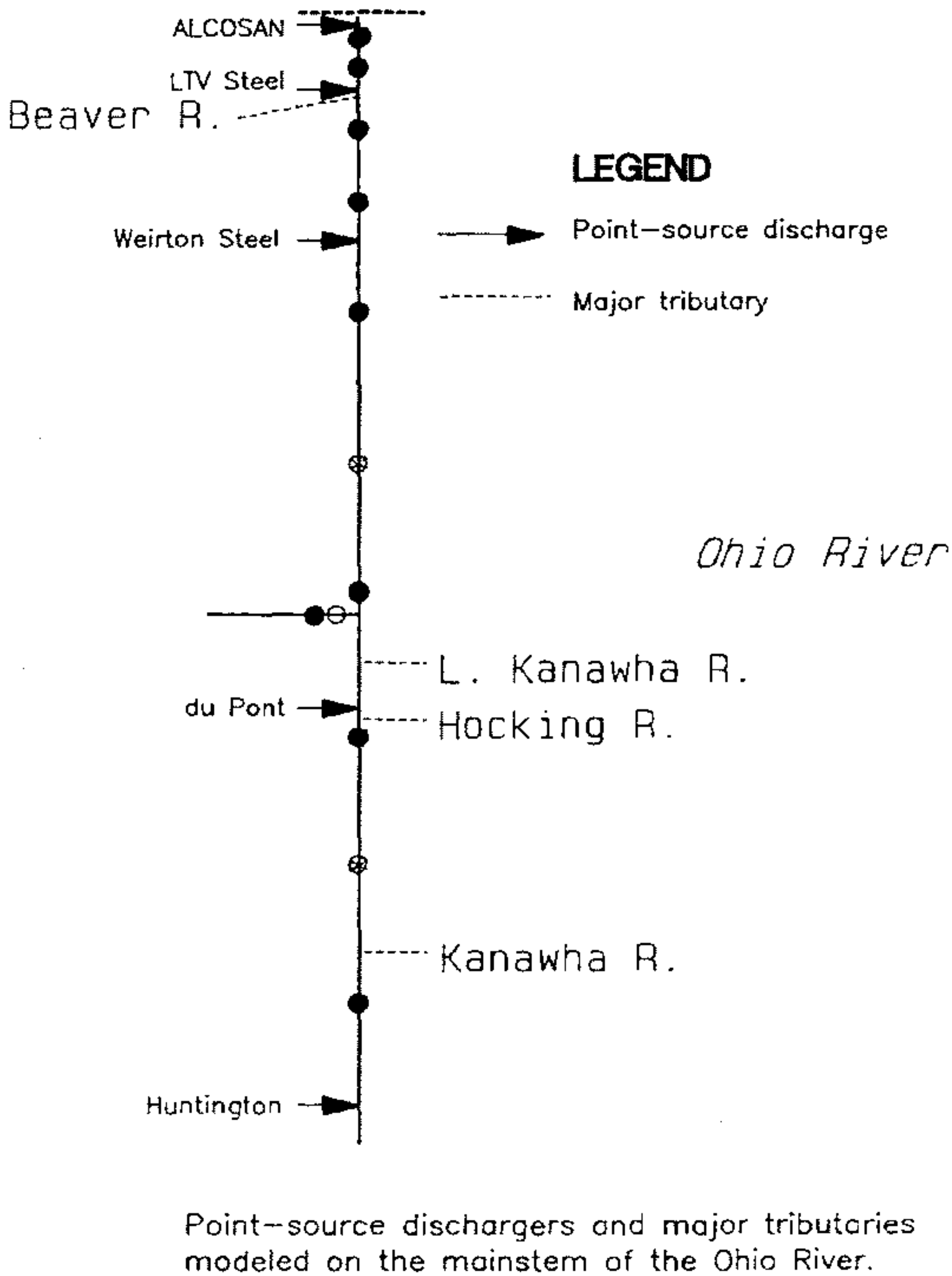


Figure B-4. Point-Source dischargers and major tributaries modeled on the main stem of the Ohio River.

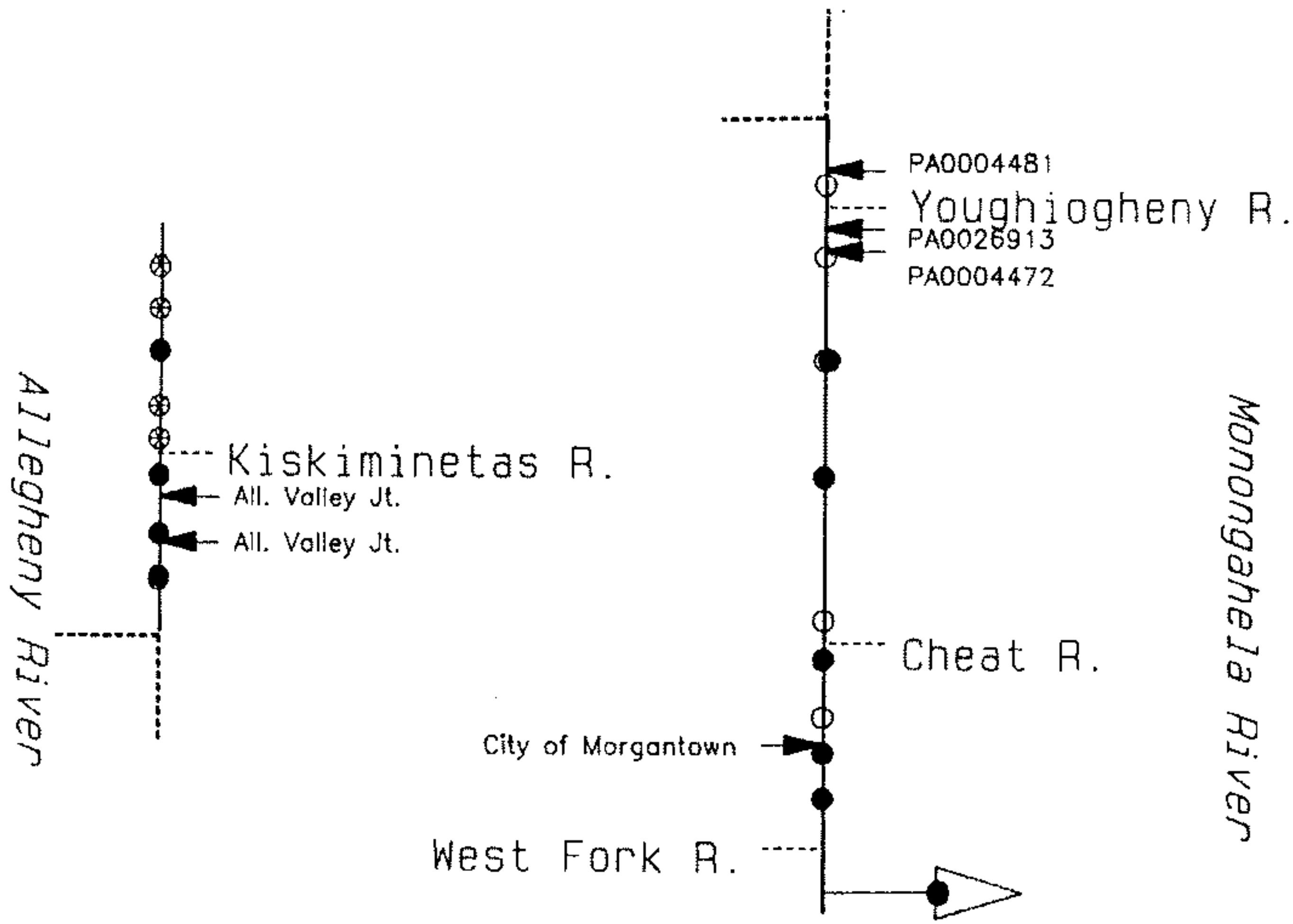


Figure B-5. Point-Source dischargers and major tributaries modeled on the Allegheny, Monongahela Rivers.

the Pittsburgh District at 108 sites on the Allegheny, Monongahela, Tygart, and Ohio rivers, between July 26 and August 26. ORSANCO electronic monitor data were used for calibration below the Hannibal pool; unfortunately ORSANCO data are not available on the Allegheny and Monongahela rivers except near their confluence.

When the 1983 calibration data were collected, flows in the Allegheny and Ohio were at approximately the 70 percent exceedance level on the annual flow duration curves (that is, the flows were at a rate equalled or exceeded 70 percent of the time during the year). On the Monongahela, flows were at about the 90 percent annual exceedance level. On the Allegheny, temperatures were at a level exceeded only about 5 percent of the time in July and August. On the Monongahela, temperatures were at a level exceeded about 25 percent of the time in July and August. On the Ohio, temperatures were at a level exceeded about 20 percent of the time in July and August (data from the ORSANCO monitors were used as a historic baseline for water temperatures).

B.2.4 MODEL CALIBRATION

The following measures were required for calibration of the DO models for each river. In each river, the addition of substantial amounts of BOD was required to simulate DO deficits as large as measured deficits. The additional BOD loadings are required to account for BOD sources for which data are not available, including (1) major wastewater dischargers that are not required to monitor BOD, so no loading information is available; (2) the many minor wastewater dischargers in the system; (3) benthic oxygen demand; and (4) other non point sources of BOD such as rural and urban runoff.

B.2.4.1 Allegheny River

Calibration to 1983 conditions was achieved by assuming a starting BOD of 4 mg/L at Allegheny dam 9 and adding additional BOD at lower pools. A BOD decay rate (k_1) of 0.1 was used, except in the dam 7, 6, and 5 pools where a value of 0.2 was used. Figure B-6 is a comparison of measured and modeled DOs.

B.2.4.2 Monongahela River

The assumption was made that flows coming from Tygart Dam will be saturated with DO; however, DO conditions in the Opekiska pool and below appear not to be controlled by Tygart River conditions. Calibration was obtained by adding BOD loads at the head of most pools, and by setting water surface aeration to nearly zero in the Opekiska and Hildebrand pools. The reduced aeration is justified to simulate the stratified conditions caused by temperature differences between the Tygart and West Fork rivers and a thermal discharge above Opekiska. Stratification is passed downstream to the Hildebrand pool by the bottom discharge at Opekiska dam. Aeration at Opekiska was set to zero. A BOD decay rate (k_1) of 0.1 was used. Figure B-7 is a comparison of measured and modeled DOs.

B.2.4.3 Ohio River

Calibration was obtained by tripling the BOD discharge at ALCOSAN to simulate other Pittsburgh discharges and non-point BOD sources, and by adding BOD loads at the heads of the lower pools. During the 1983 calibration period, there was higher aeration at Emsworth and Dashields than the dam aeration models predict. Because the dam models are based on data collected under many different conditions, they were not adjusted to match the single set of 1983 conditions. Therefore the model predicts lower DO peaks than the 1983 data show. A BOD decay rate (k_1) of 0.18 was used. Figure B-8 is a comparison of measured and modeled DOs.

B.2.5 APPLICATION OF MODELS TO IMPACT ASSESSMENT

There is a fundamental dilemma in modeling natural systems for decisionmaking. An accurate model of a natural system must account for the variability in time and space of all the model parameters and outputs, but the range of model results must be limited enough to allow decision making. To reduce the variability in the decision-making process, the following set of design river conditions, based upon 'typical' and 'worst-case' conditions, were used as a basis for decisions that will protect water quality during most natural conditions:

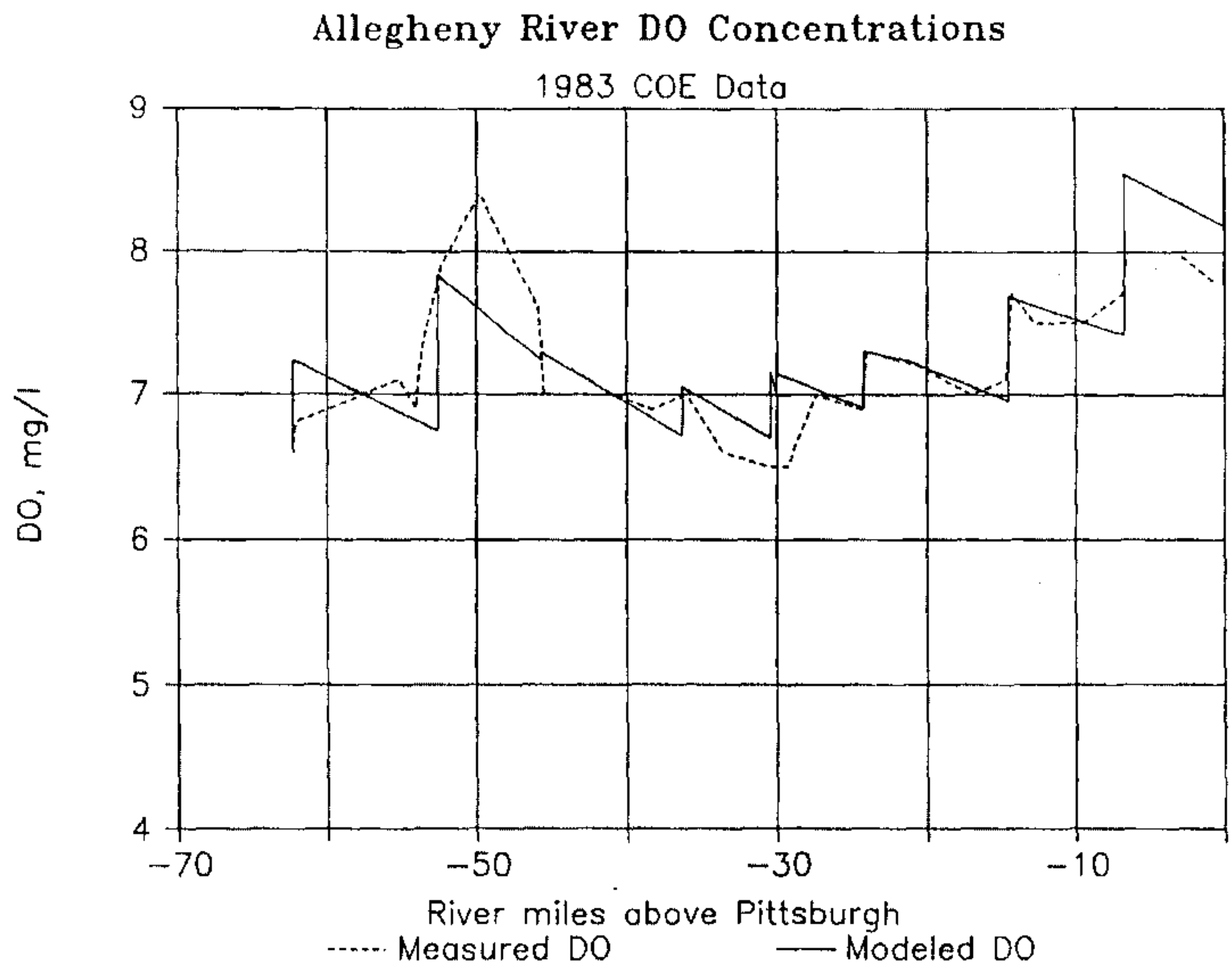


Figure B-6. Allegheny River DO model calibration results.

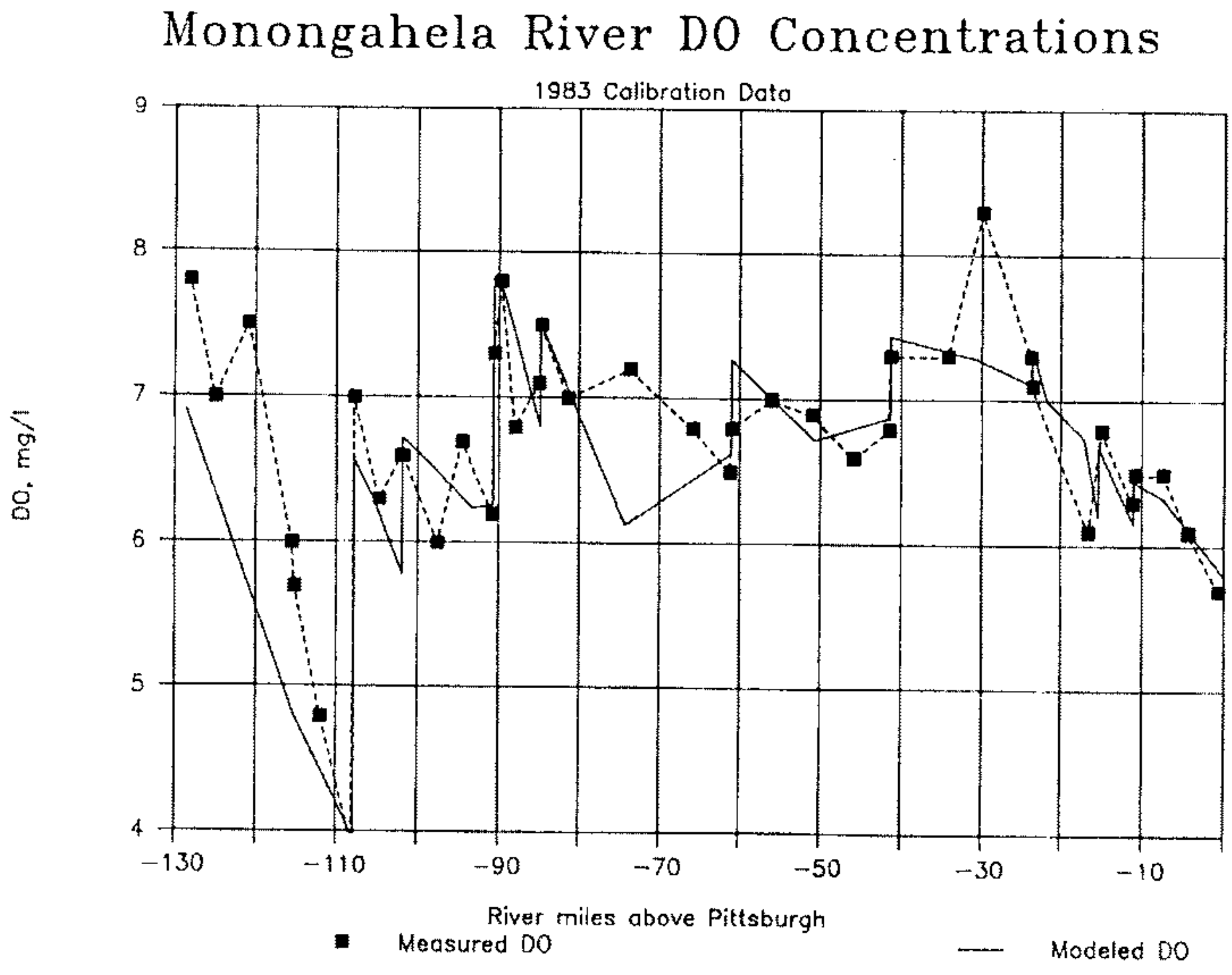


Figure B-7. Monongahela River DO model calibration results.

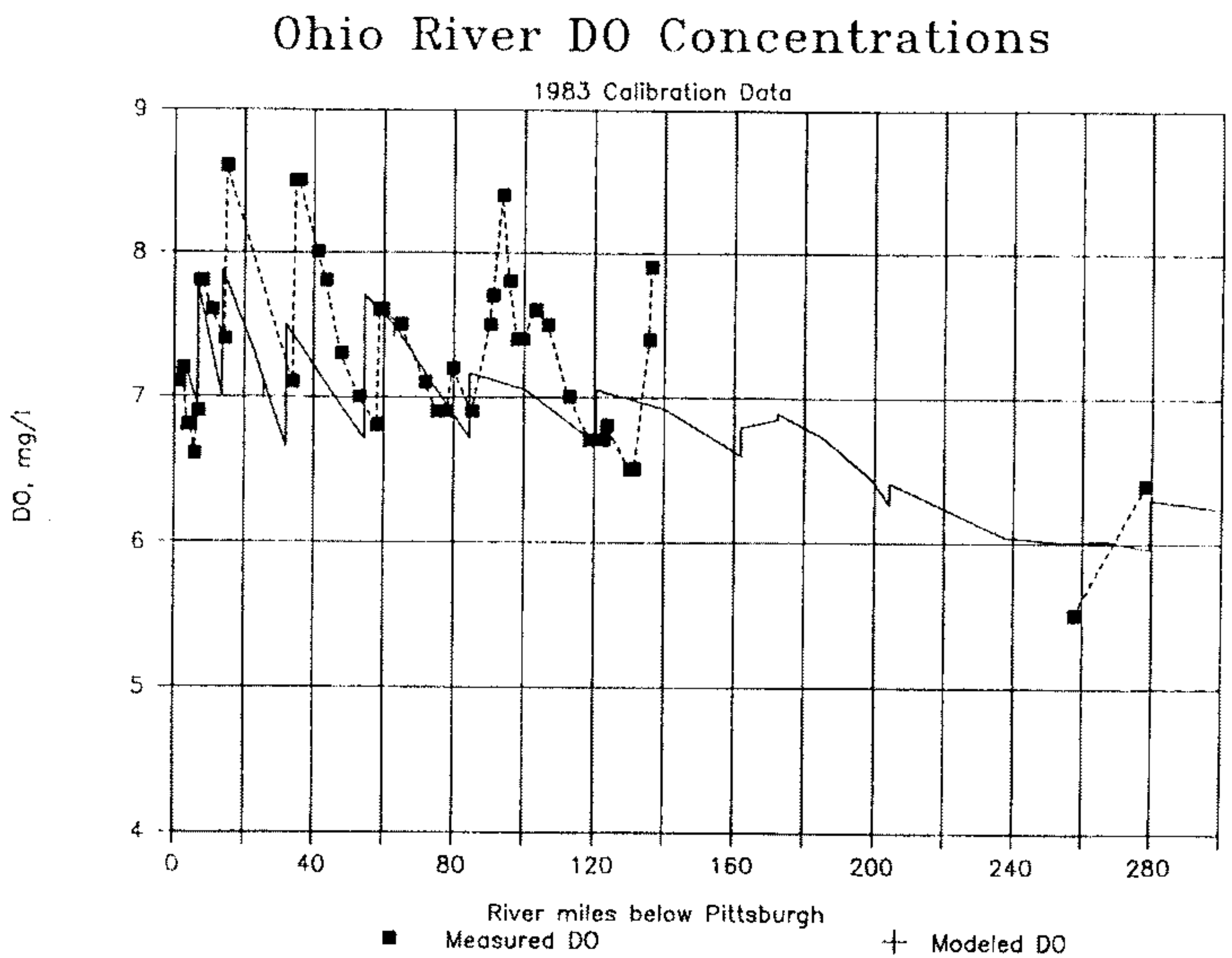


Figure B-8. Ohio River DO model calibration results.

(1) BOD loadings are those obtained from calibration.
(2) Water temperatures are those exceeded 10 percent of the time in August at the ORSANCO robot monitors.
(3) Flows are from two sets of conditions: low flows, where 7Q10 flows are used; and moderate flows, approximately the minimum flow at which all of the proposed projects would operate. The low flow conditions are those when DO concentrations are more likely to be low. The moderate flow conditions are those when the projects would have the greatest impacts on DO concentrations.
(4) Rate coefficients for reaeration and BOD decay are those obtained from calibration.
(5) Projects that have already been licensed (at Allegheny dams 5, 6, 8, and 9; and Racine and Hannibal dams on the Ohio River) are modeled as operating, with the spill flows required by their licenses (or spill flows expected to be required by operating agreements with the Corps at Allegheny 8 and 9).

Results of modeling under these conditions are presented in Section 4 of the EIS. Additional model runs were made using mean monthly flows and water temperatures for the months of April through November. Results of these runs (Figures B-9 through B-17) show how DOs and project impacts would change seasonally and were used to model impacts of the proposed projects on fish growth.

Although not documented as thoroughly as the above conditions were, experimentation with different temperatures, flow rates, and BOD loads has been conducted to ensure that recommendations based on the model are valid over a wide range of environmental conditions.

B.3 OPTIMIZATION MODELING

B.3.1 DECISIONS AND ALTERNATIVES TO BE CONSIDERED

The systems-level decision problem in licensing multiple hydroelectric projects on the upper Ohio River basin involves potential trade-offs between energy production and water quality. At each project, energy production is inversely related to the amount of water spilled over the dam because water that is spilled does not pass through the turbine and does not generate hydroelectricity, and reducing the spillage at dams adversely effects downstream DO concentrations (Section B.2.1.3.2). An objective of the FERC licensing process is to find the best combination of sites or operating schedules that can be licensed without causing unacceptable degradation of water quality. This objective can be formalized in words and a system of equations as follows:

MAXIMIZE ANNUAL HYDROELECTRIC PRODUCTION IN THE BASIN

SUBJECT TO PHYSICAL CONSTRAINTS AND MINIMUM WATER QUALITY CONDITIONS

or

$$\text{MAX: } P_N = \Sigma \; p_i$$

$$\text{Subject to: } c_{ik} \geq C_S \text{ for all } i,k$$
$$\text{and } g_i + l_i + s_i = q_i \text{ for all } i \quad ,$$

where:
P_N is the total annual energy production for all N sites;
p_i is the annual energy production for the ith site, a function of g_i;
c_{ik} is the DO concentration at the kth location downstream from the ith site (defined by the Streeter-Phelps equation or modifications thereof);
C_S is the water quality standard for DO;
g_i is the generating flow through the turbine at the ith site;
l_i is the combined lockage and leakage flows at the ith site;
s_i is the spillage at the ith site; and
q_i is the total flow of the river at the ith site.

In this system of equations, the decision variable is the spillage flow, s_i, which determines both the energy production and downstream DO concentrations. At any of the sites of interest, the minimum spillage has been proposed by the license applicant and may be subject to

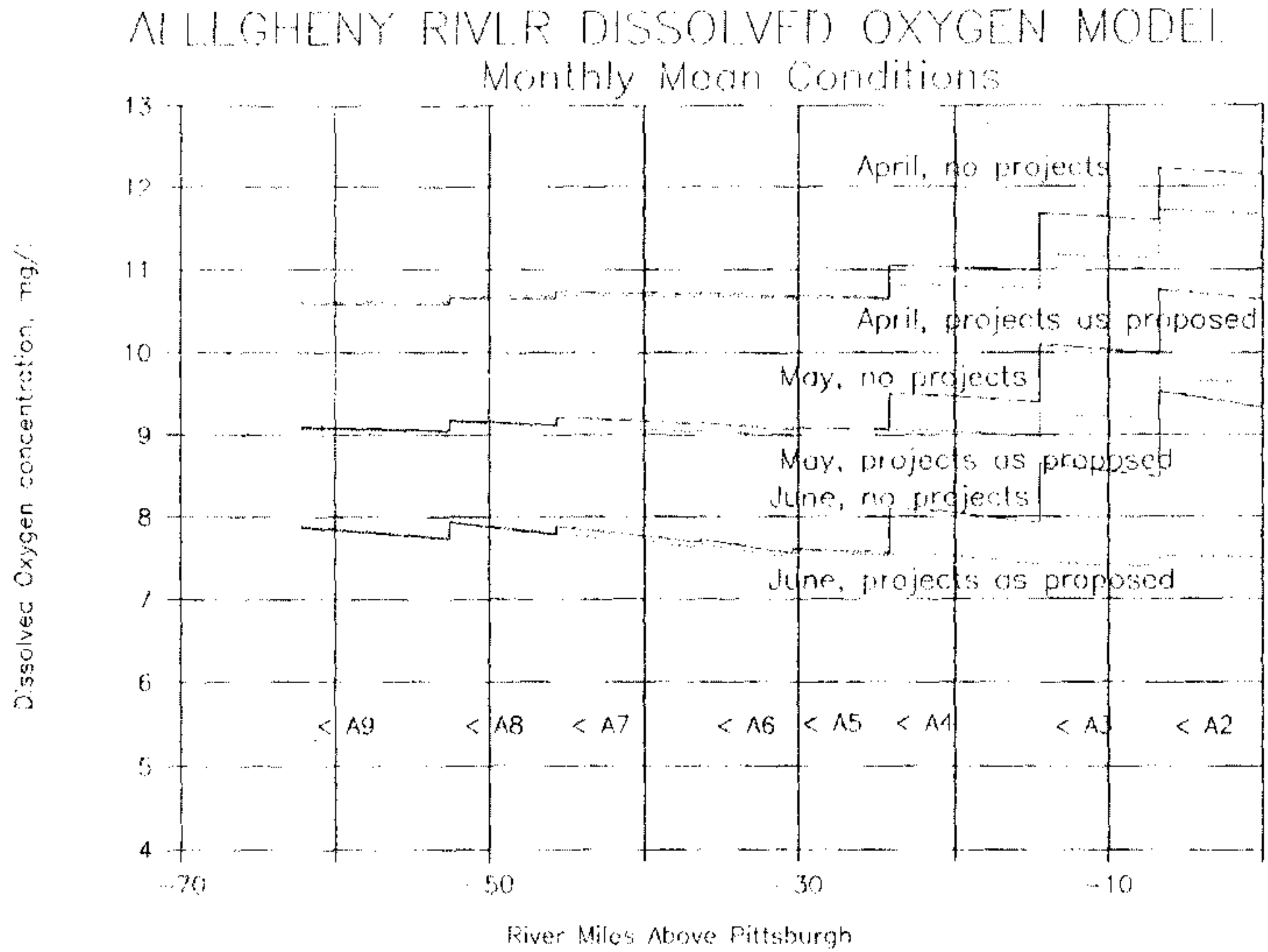


Figure B-9. **Allegheny River DO model results from April to June, mean monthly flows and temperatures.**

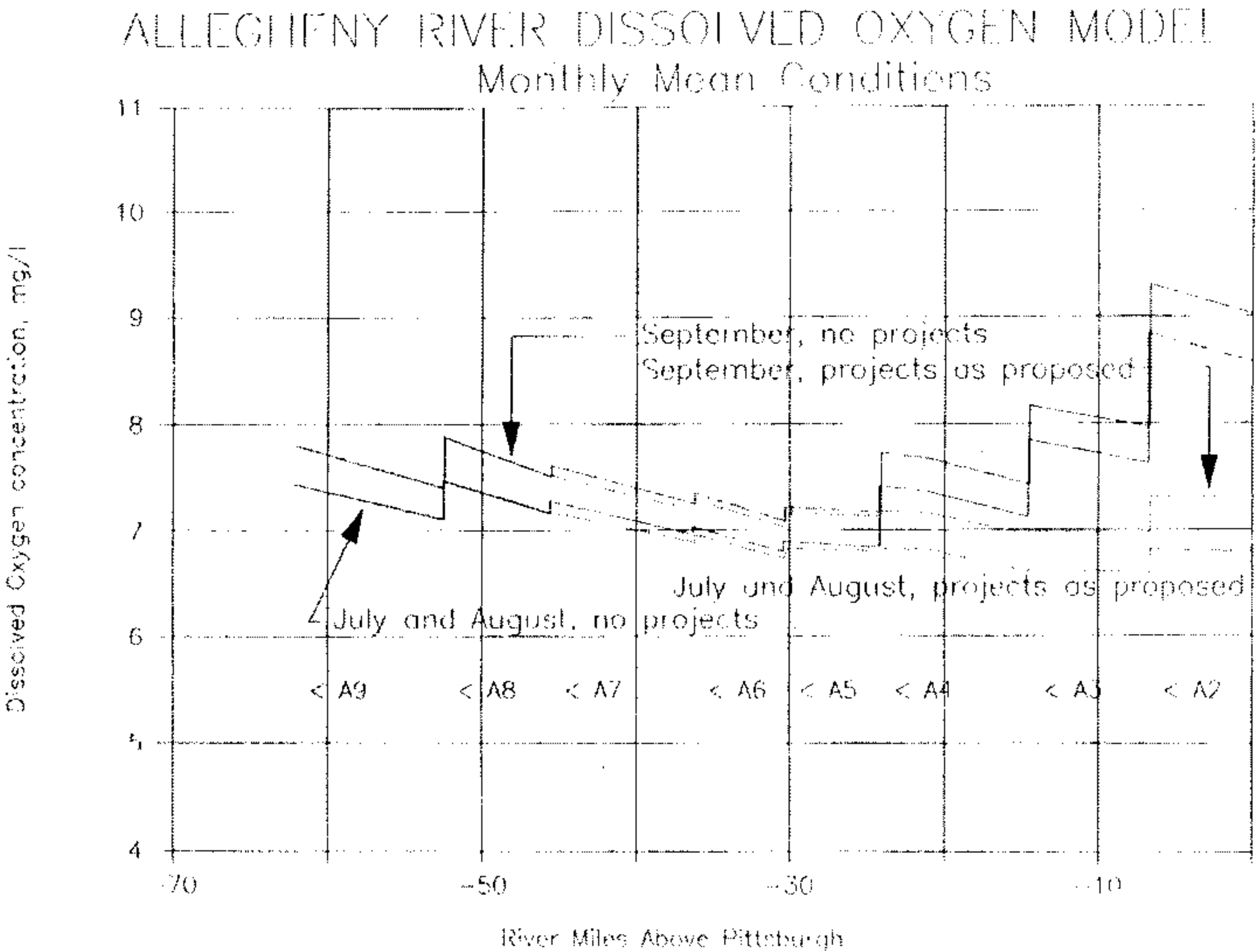


Figure B-10. Allegheny River DO model results from July to September, mean monthly flows and temperatures.

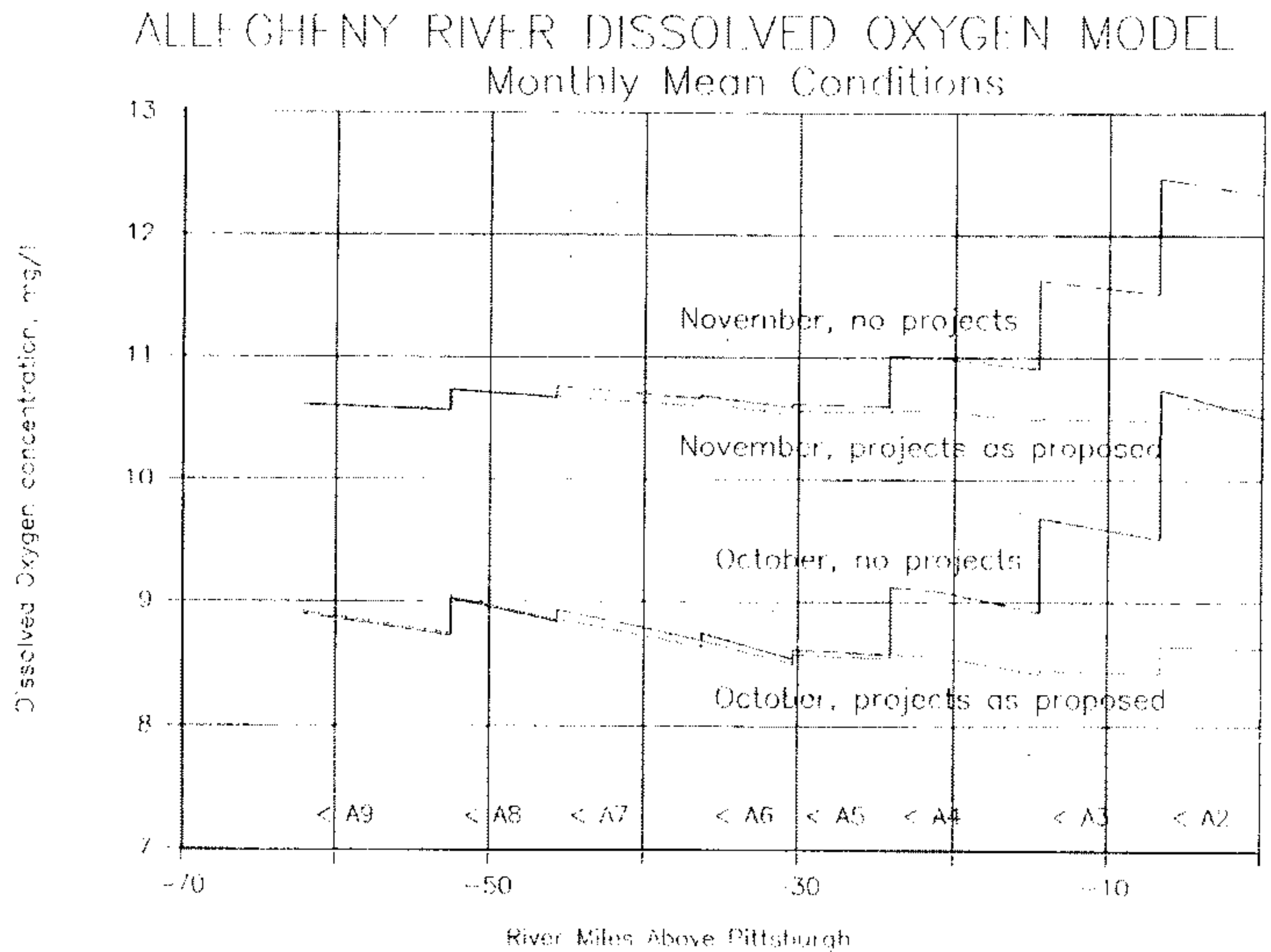


Figure B-11. Allegheny River DO model results from October to November, mean monthly flows and temperatures.

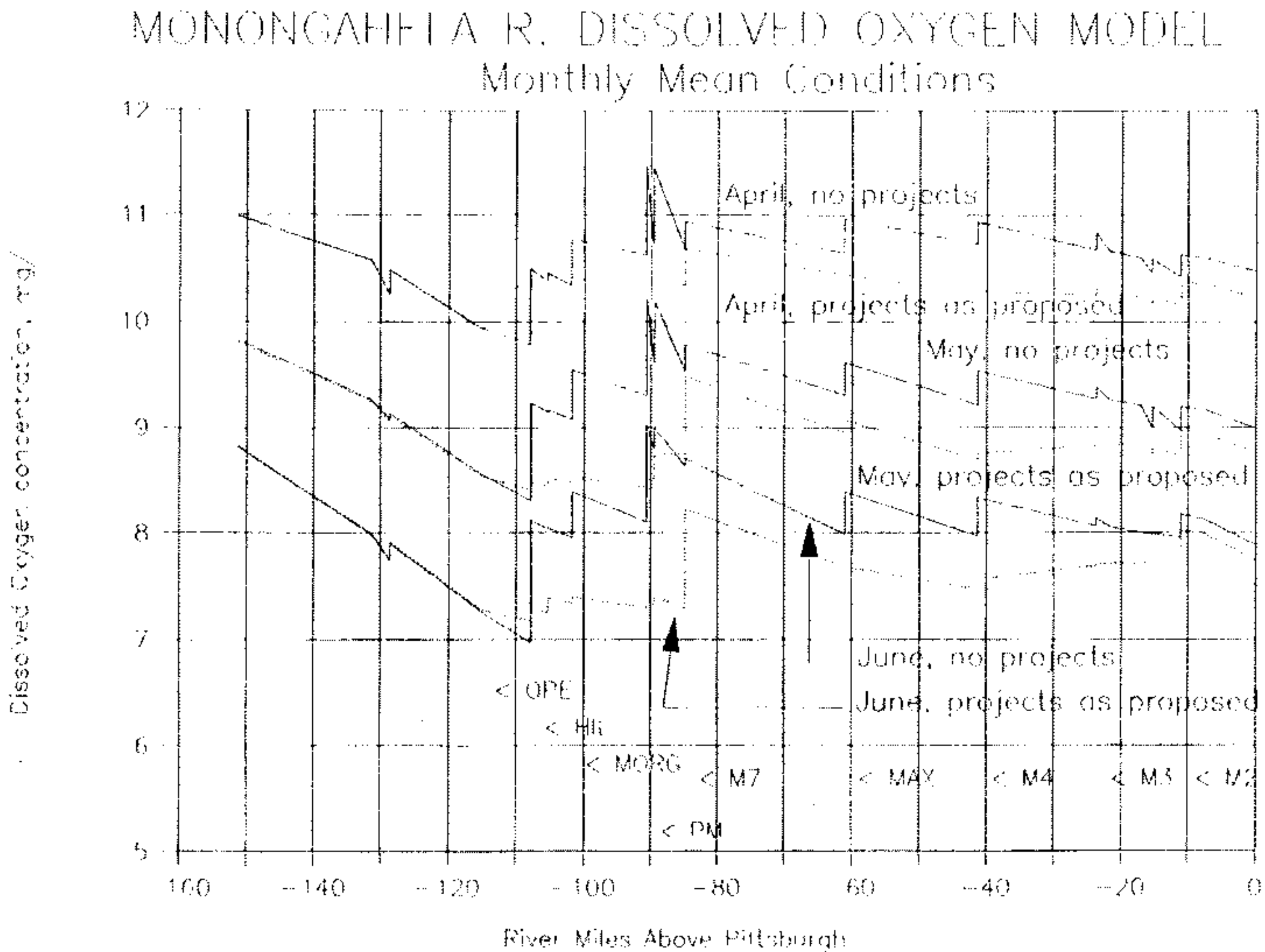


Figure B-12. Monongahela River DO model results from April to June, mean monthly flows and temperatures.

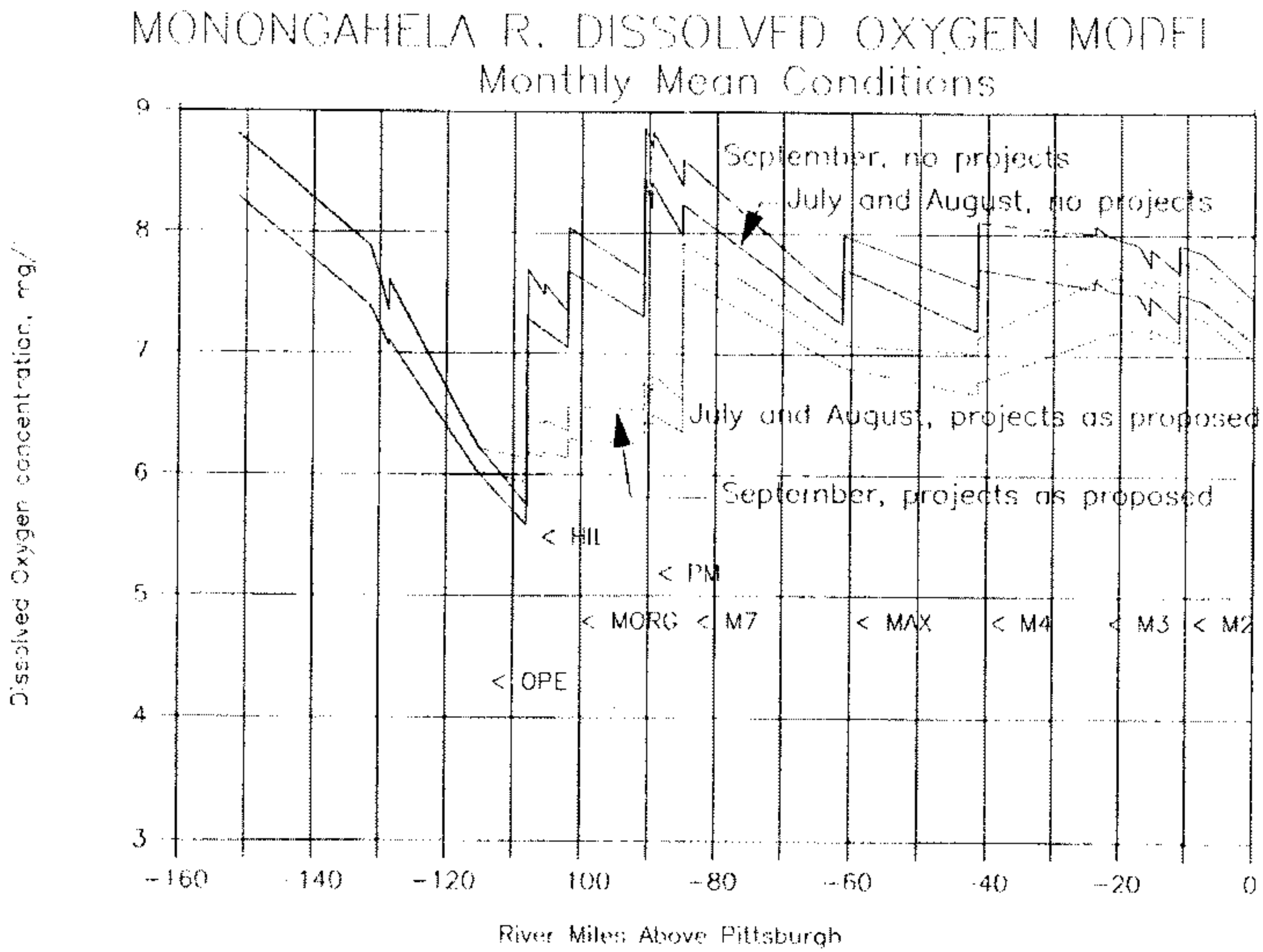


Figure B-13. Monongahela River DO model results from July to September, mean monthly flows and temperatures.

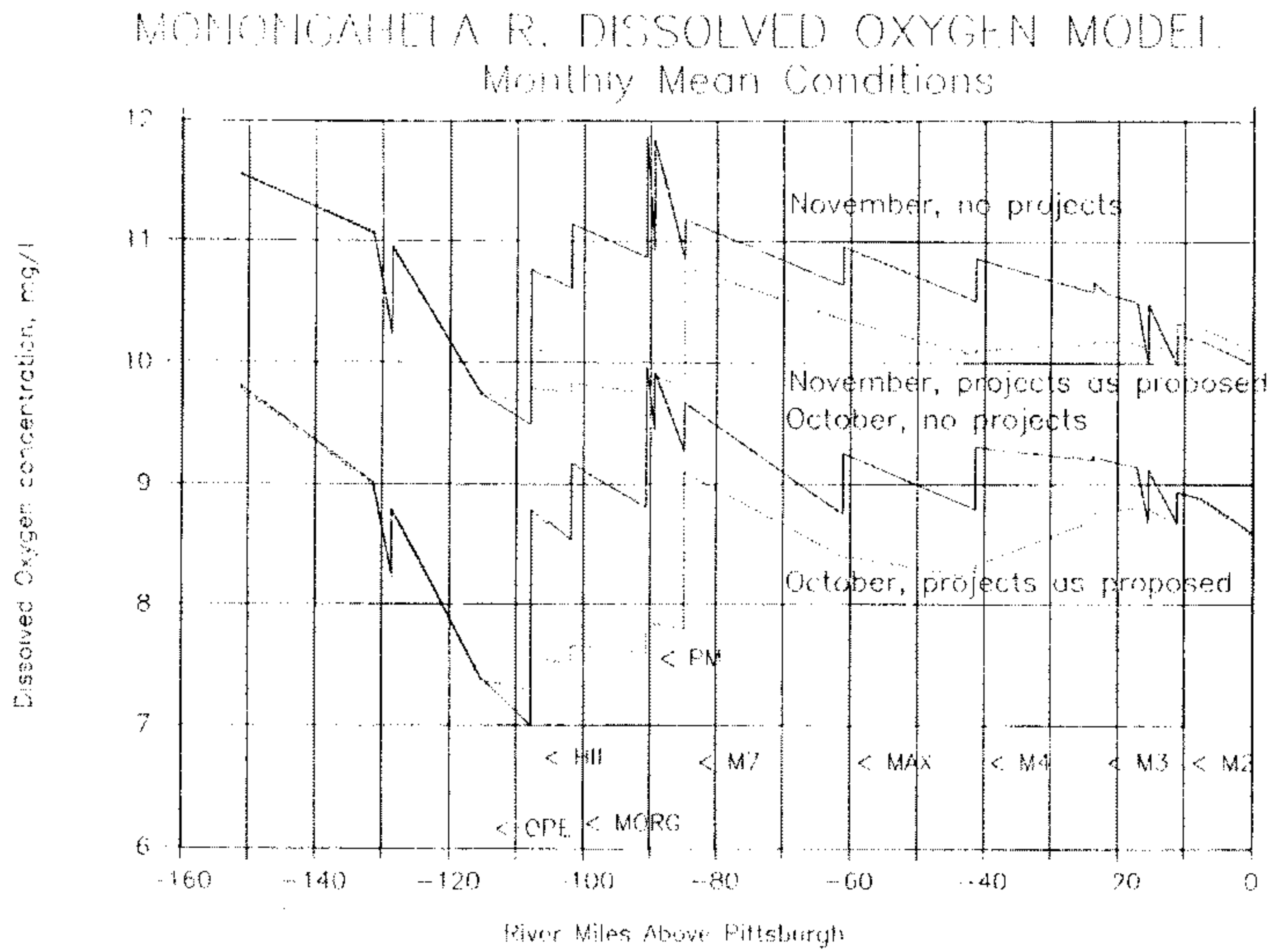


Figure B-14. Monongahela River DO model results from October to November, mean monthly flows and temperatures.

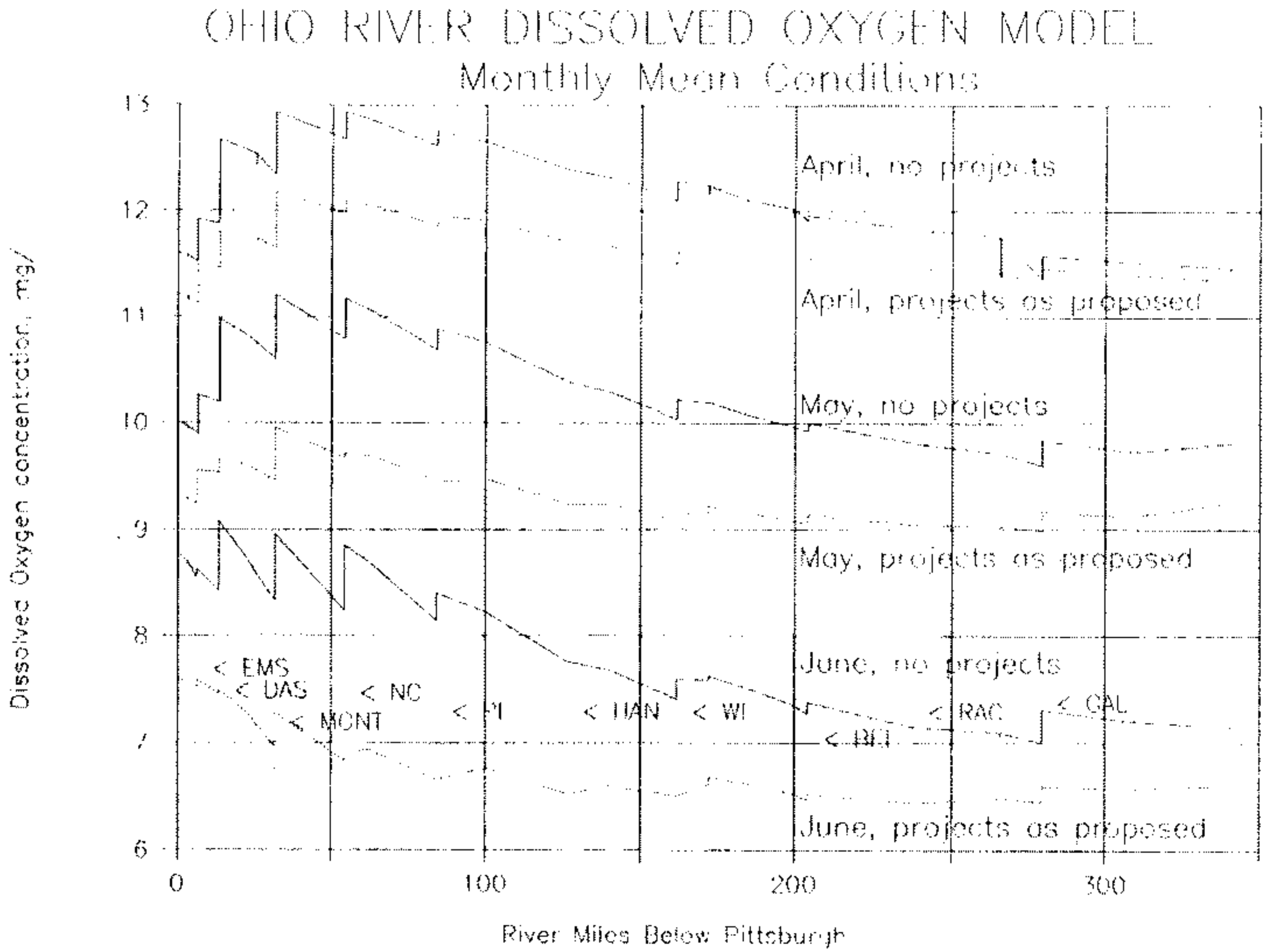


Figure B-15. Ohio River DO model results from April to June, mean monthly flows and temperatures.

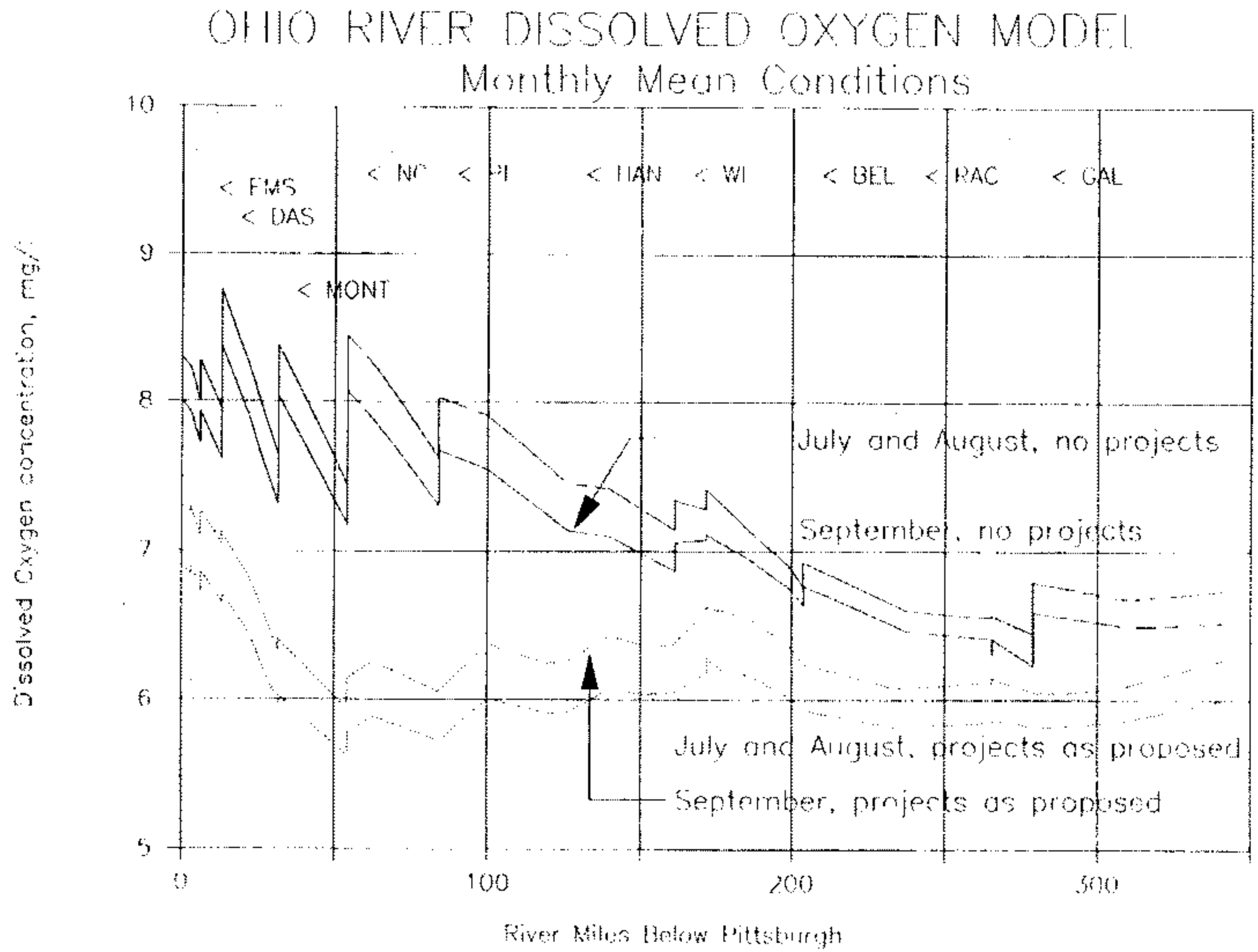


Figure B-16. Ohio River DO model results from July to September, mean monthly flows and temperatures.

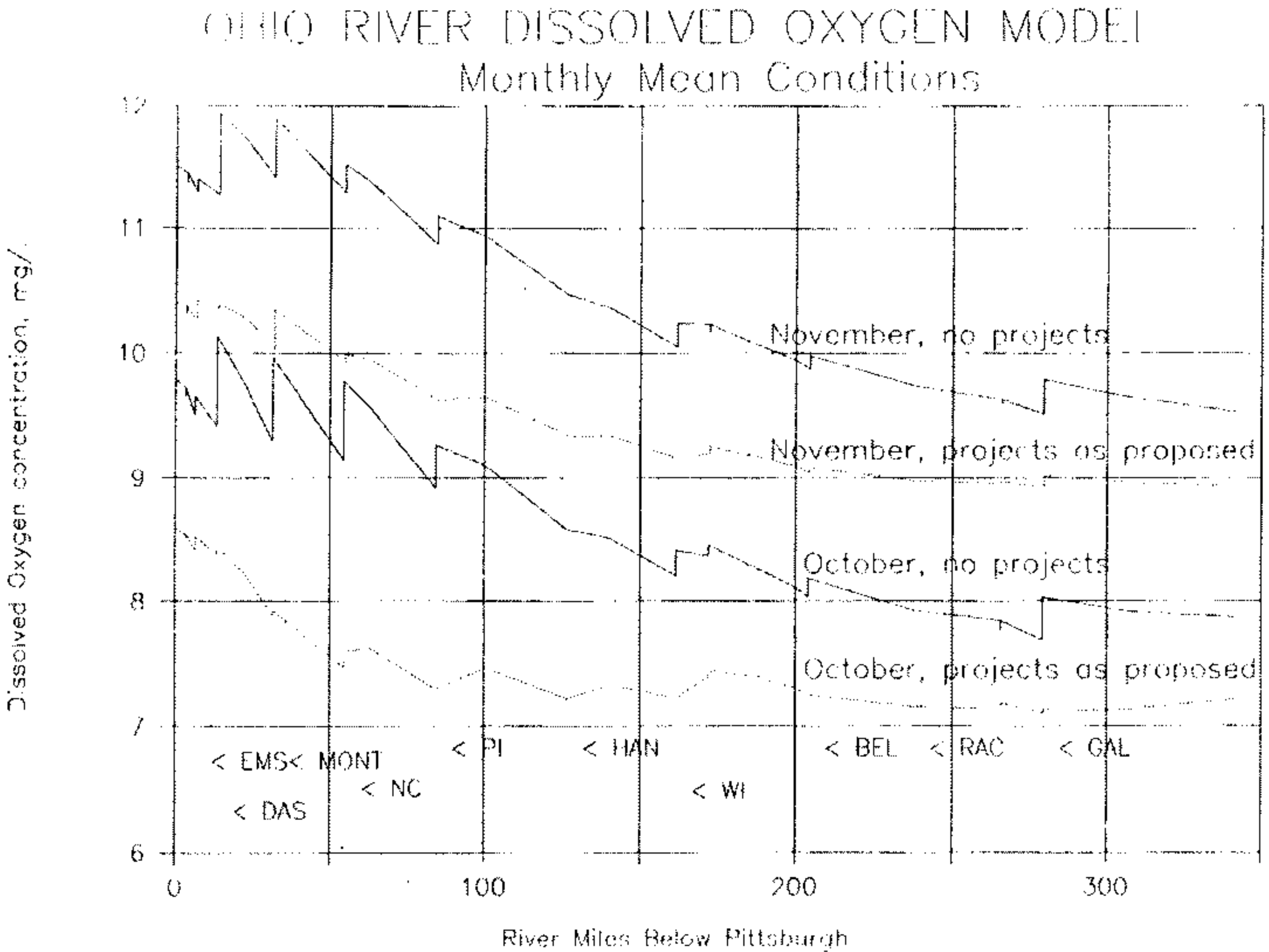


Figure B-17. Ohio River DO model results from October to November, mean monthly flows and temperatures.

modification by FERC. Spillage values may range between zero (all water through the turbines) and $q_i - l_i$ (no water through the turbines). These equations can be solved to find the optimum combination of energy production and spillage values that will satisfy water quality standards. If optimal spillage is found to be high at some sites, rejection of the license application is a strong possibility. The equations can also be analyzed in a trade-off analysis to evaluate any number of alternative licensing scenarios. There are also a number of alternative objective formulations that can be used, but at this time we will not go beyond a simple formulation of the problem.

Sets of equations such as those listed above are called mathematical programs. They can be solved in a number of different ways, including linear programming, nonlinear programming, dynamic programming, and implicit enumeration. There are many applications of all four of these approaches in the water resources literature where math programming has been used to solve water quality problems. In the situation of interested on the Ohio River, multiple hydroelectric projects arranged in a branched series, the value of the objective function at any particular site is a function of the values of the decision variables at all sites upstream. That is, the energy production and the spillage required at a site is dependent on the energy production and spillage at all upstream sites. If there are upstream branches in the river network, as there are on the Ohio, then specific downstream outcomes can be determined from more than one unique combination of upstream decisions. This structure of the system complicates the solution technique that can be used. We believe that implicit enumeration is the best choice for this application.

B.3.2 BOUNDED IMPLICIT ENUMERATION

Enumerative methods are one approach to solving math programs. Explicit enumeration is the exhaustive solution of all possible combinations of the decision variables. Implicit enumeration methods are nonexhaustive algorithms that use some structured bookkeeping scheme to eliminate a priori certain combinations of variables that can be shown to yield non-optimal solutions. Bounded implicit enumeration (BIE) is one of these more efficient enumerative methods that uses an upper and lower bound to exclude undesirable solutions (Chang and Liaw 1987).

In the Ohio River system, each dam is a stage or node where decisions must be made on the spillage requirements. The first step in BIE is to define a number of discrete values for spillage at each site, ranging between zero and all the flow. These spillage options are indexed by the subscript j. The subscript i indexing each site increases from 1 to N from upstream to downstream. Then the BIE algorithm can be defined as the following steps, starting at the most upstream site and moving downstream:

(1) Find the minimal production value at each site and calculate the lower bound (P_i^L) of the objective function at that site (this lower bound is the minimum production at sites below the current site):

$$P_i^L = \sum_{k=i+1}^{N} P_k;$$

(2) Iterate through all the spillage options at the current site, setting a new upper bound on the objective function for each successively higher production level. For each spillage option that yields a production level between the current upper and lower bound, a complete DO curve is calculated downstream and a check on the DO constraint is made.

(3) Move to the next downstream node, and iterate through the spillage options, trying to find a combination of feasible spillage and production levels that will exceed the current upper bound. For any combination of spillage options that do exceed the upper bound, the DO curve is calculated again and DO constraints are checked.

The calculation of DO curves within these iterations uses the same DO modeling equations for BOD decay, surface aeration, and dam aeration described in Section B-2 above. The BIE series of calculations proceeds through all hydropower sites in the basin until the last node (Gallipolis) is reached. During the calculations, combinations of the spillage options that have been enumerated and were feasible are saved, along with the DO profile that was calculated for them. To examine the trade-offs of generating power vs maintaining successively higher DO standards, the BIE algorithm is then restarted with a higher value for C_S. These secondary iterations can be repeated with DO values up to the current conditions. After all iterations are complete, the set of optimal and nonoptimal spillage combinations can be evaluated.

B.4 DISSOLVED OXYGEN MODEL DOCUMENTATION

The DO model is implemented at Lotus 1-2-3 spreadsheets and as a FORTRAN program. Complete documentation of both implementations is provided in Railsback and Jager (1988). The following is a list of the input and output parameters for the model. Each parameter is input or calculated for each of the rivers.

1. Reach name (input).

2. River mile (input).

3. Reach length (calculated).

4. Tributary flow (input).

5. Flow in reach (calculated).

6. Cross-sectional area (input). The average cross-sectional area of the river in the reach (in square feet).

7. Depth (input). Average depth of the reach (in feet).

8. Velocity (calculated). The average velocity of the reach (in feet per second).

9. Travel time (calculated). The average time it takes water to travel the length of the reach (in days).

10. Tributary DO (input).

11. Tributary BOD concentration (input).

12. BOD loading (input). The point source BOD loading that takes place at the head of the reach, if any.

13. Dam aeration coefficient (input).

14. Dam aeration constant (input).

15. Flow not aerated (input). The flow rate in cubic feet per second (between zero and the total river flow) that does not pass over the dam or through the gates. This flow is used for lockage and hydropower generation.

16. DO above dam (calculated). The DO at the head of the reach (in milligrams per Liter), not including dam aeration if the reach starts at a dam.

17. Starting BOD (calculated). The BOD at the head of the reach (in milligrams per Liter).

18. Reach temperature (input).

19. DO saturation concentration (calculated).

20. k1 at 20 degrees (input).

21. k2 at 20 degrees (calculated).

22. k1(T) (calculated). The BOD decay rate at stream temperature.

23. k2(T) (calculated). The stream reaeration rate at stream temperature.

24. Initial deficit (calculated). The DO deficit at the upstream end of the reach (in milligrams per Liter).

25. Final deficit (calculated). The DO deficit at the downstream end of the reach (in milligrams per Liter).

26. Starting DO (calculated). The DO concentration at the upstream end of the reach, following dam aeration.

27. Final DO (calculated). The DO concentration at the downstream end of the reach (in milligrams per Liter).

28. Final BOD (calculated). The BOD concentration remaining at the downstream end of the reach (in milligrams per Liter).

29. Critical time, final (calculated). The travel time from the top of the reach to the point of the critical DO concentration (in days), corrected to equal the travel time of the reach if the raw critical time is greater than the travel time of the reach and to equal zero if the raw critical time is negative.

30. Critical deficit, final (calculated). The critical DO deficit, corrected to equal the DO deficit at the downstream end of the reach if the raw critical time is greater than the reach travel time. This value is the highest deficit that occurs in the reach, whether it occurs at the beginning, end, or within the reach.

31. Critical DO concentration (calculated). The lowest DO concentration in the reach.

32. Critical point, in river miles (calculated). The river mile at which the lowest DO concentration (highest deficit) in the reach occurs.

33. DO index (calculated). The DO index is the integral of the curve of DO vs distance for the reach. This parameter can be used as an indicator of impacts of changes in aeration or discharge on DO, because it combines both changes in DO concentration and the distance affected.

B.5 SENSITIVITY AND UNCERTAINTY OF THE MODEL

B.5.1 INTRODUCTION

The sensitivity and uncertainty of the Ohio River basin DO model, with the parameters used for the EIS, were analyzed. The sensitivity analysis investigates which parameters the model results are most sensitive to (i.e., which parameters, when varied, cause the greatest change in the modeled DO concentrations). The sensitivity analysis identifies processes (such as dam aeration, water surface aeration, and BOD decay) that have the greatest effect on DO concentrations at different locations. The uncertainty analysis is an investigation of variability in the results predicted by the model. This procedure is performed by including the estimated uncertainty in the model parameters into the model results to determine the uncertainty in the results. The uncertainty analysis essentially creates a stochastic DO model by treating model parameters as means of probability distributions instead of as constants.

B.5.2 SENSITIVITY ANALYSIS

B.5.2.1 Methods

The sensitivity analysis was performed using the Gradient Enhanced Software System (GRESS), developed at Oak Ridge National Laboratory (Oblow, 1983a, 1983b). GRESS enhances FORTRAN code by giving it the ability to determine partial derivatives of any selected output variable with respect to any selected input variable. GRESS also calculates a normalized sensitivity index that can be used to compare the model sensitivity among parameters having different units. GRESS was used to determine the partial derivatives and sensitivity indexes of the critical (lowest) DO concentration in each reach with respect to the following variables:

1. the initial DO concentrations in the Allegheny and Monongahela rivers,
2. the initial BOD concentrations in the Allegheny and Monongahela rivers,
3. the initial flows in the Allegheny and Monongahela rivers,
4. k_1 in the Allegheny and Monongahela rivers,
5. k_2 in each reach,

6. the tributary flow in each reach,
7. the tributary DO concentration in each reach,
8. the tributary BOD concentration in each reach,
9. the point-source BOD loading in each reach,
10. the dam aeration constant in each reach with a dam,
11. the dam aeration coefficient in each reach with a dam,
12. the aeration rate (the increase in DO concentration in the spill flow at a dam) in each reach with a dam,
13. the flow rate used for generation (flow not aerated) in each reach with a dam, and
14. the water temperature in each reach.

The GRESS sensitivity analyses were conducted on the model with the parameters used for the design conditions (Section B.2.5) with the spill flows recommended for Alternative 3 in the EIS, the scenario upon which the staff recommendations in the EIS were based. The GRESS analyses were also conducted on the model with the parameters for the design conditions with none of the proposed new hydropower projects in operation (but with existing and licensed projects in operation). Each of these analyses produces over 27,700 partial derivatives as output; a small fraction of these values was analyzed graphically to develop an overall understanding of model sensitivities at important locations along the rivers.

B.5.2.2 Results

The GRESS sensitivity analysis shows that DO concentrations are generally most sensitive to water temperature (for example, see the values in Table B-4). This result is not surprising because of the direct dependency of DO saturation and the rate constants k_1 and k_2 on temperature. It should be noted that the values in Table B-4 for sensitivity to water temperature are related to the water temperature in the same reach that the output was calculated for; the sensitivity to changes in water temperature in the upstream reaches is not included. The sensitivity analysis also shows that model results are highly sensitive to the flow rate in most reaches (compare values in Table B-4 to sensitivity indexes in Figures B-18 through B-25). This result means that significant changes in predicted DO concentrations can be expected when different water temperatures and flows are modeled. The following analyses emphasize the sensitivity of the model to parameters other than temperature and flow.

The sensitivity to initial conditions (starting DO and BOD concentrations in the Allegheny and Monongahela rivers) were compared to sensitivities to the rate coefficients k_1 and k_2 to determine the extent (over distance downstream) over which the assumed initial conditions are important. The sensitivities to the rate coefficients k_1 and k_2 were used for comparison to the sensitivity to initial conditions because they represent BOD decay and water surface aeration, which control DO concentrations when initial conditions and dam aeration are not important, and because they are relatively constant throughout the rivers. Figures B-18 and B-19 show the results of these analyses. In the Allegheny, the model is not particularly sensitive to the initial BOD concentration. The predicted DO concentrations are more sensitive to the initial DO concentration than to k_1 and k_2 from Allegheny dam 9 to about Allegheny dam 5 This result is not surprising, because the licensed hydropower plants at Allegheny dams 9, 8, 6 and 5, combined with the low aeration efficiency of dam 7, provide little dam aeration in these reaches. If dam aeration were higher, the effects of initial DO concentrations would be overwhelmed by the effects of dam aeration. This result indicates that the DO concentration at Allegheny dam 9 will have a strong influence on DO concentrations as far downstream as dam 5 wh all the licensed hydropower projects are in operation.

The predicted DO concentrations in the Monongahela River are relatively sensitive to initia and BOD concentrations as far downstream as Hildebrand Dam. Hildebrand is the first efficient aerator on the river, and apparently DO concentrations below Hildebrand are controlled more by aeration, water surface aeration, and BOD loads than by assumed initial conditions. This resul means that predicted DO concentrations in the Monongahela downstream of Hildebrand are insensit to assumed conditions at Tygart Dam.

The sensitivities of predicted DO concentrations to a number of parameters were determined critical locations on each river. The critical locations are those where the proposed hydropow would reduce DO concentrations the most, according to model analyses presented in the EIS. The critical locations are river mile (RM) 0 on the Allegheny, RM 65 (the sag point below Monongahe dam 7) on the Monongahela, and RM 100 on the Ohio River.

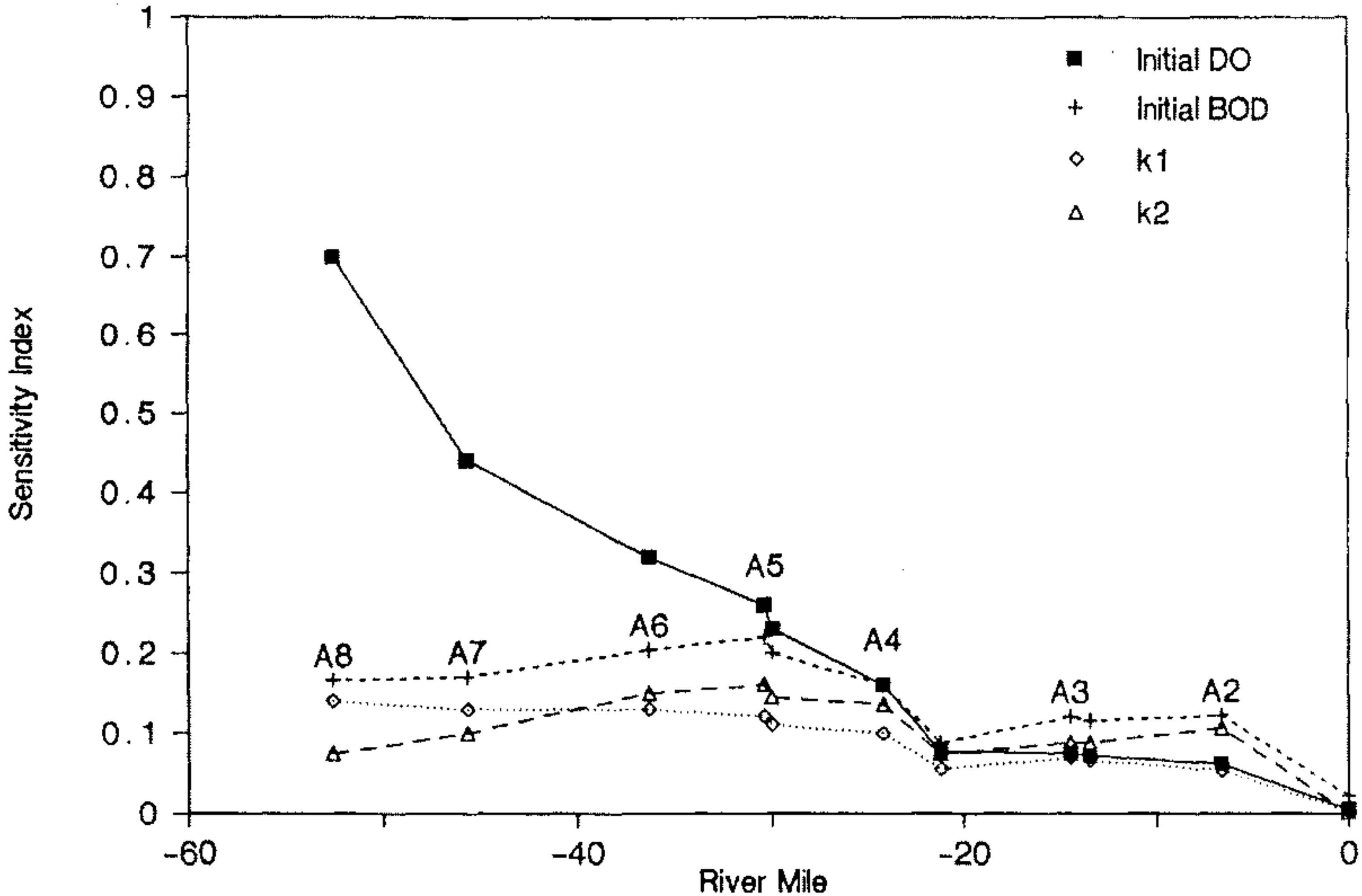


Figure B-18. Sensitivities of Allegheny River critical DO concentrations to initial conditions (Alternative 3, moderate flows).

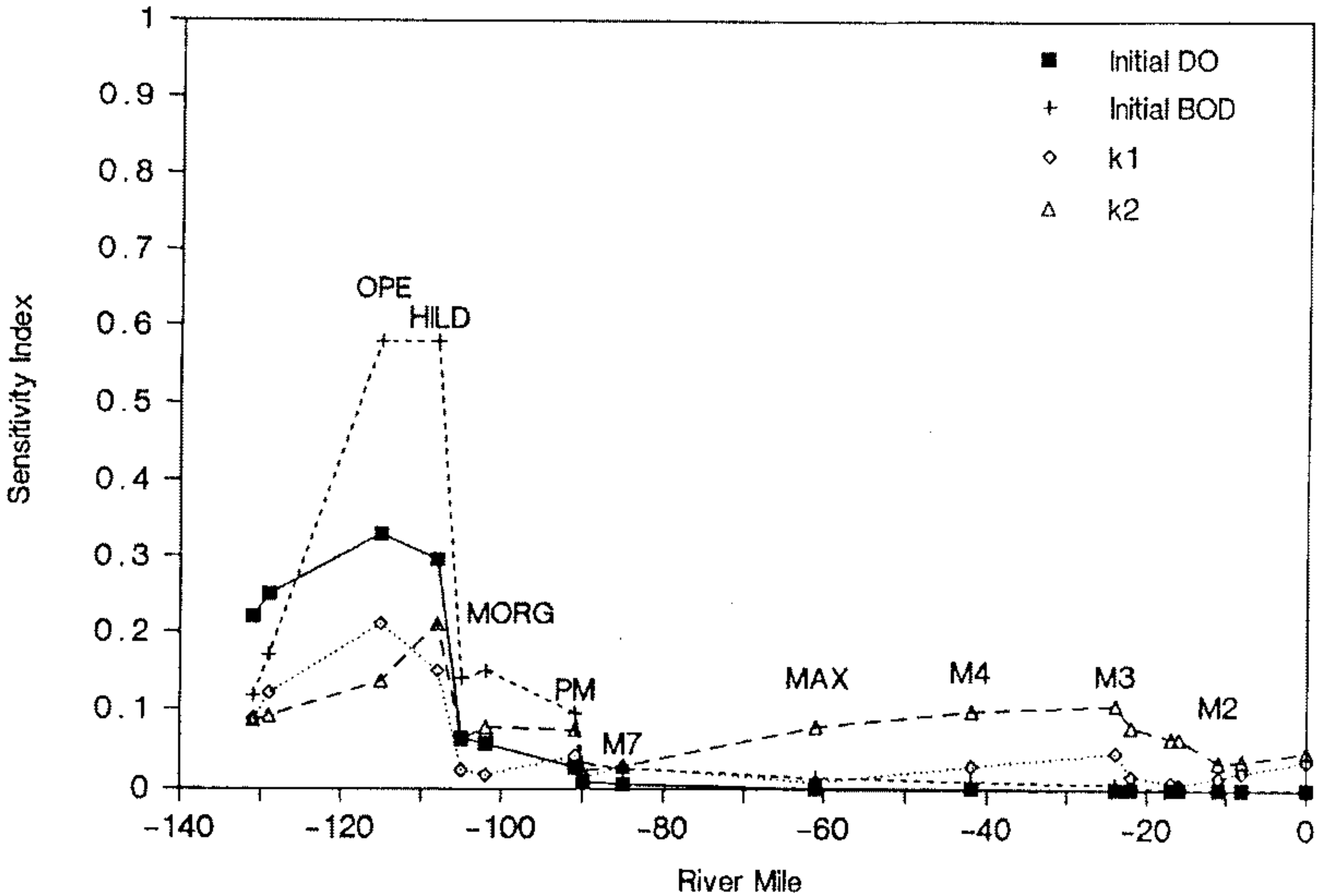


Figure B-19. Sensitivities of Monongahela River critical DO concentrations to initial conditions (Alternative 3, moderate flows).

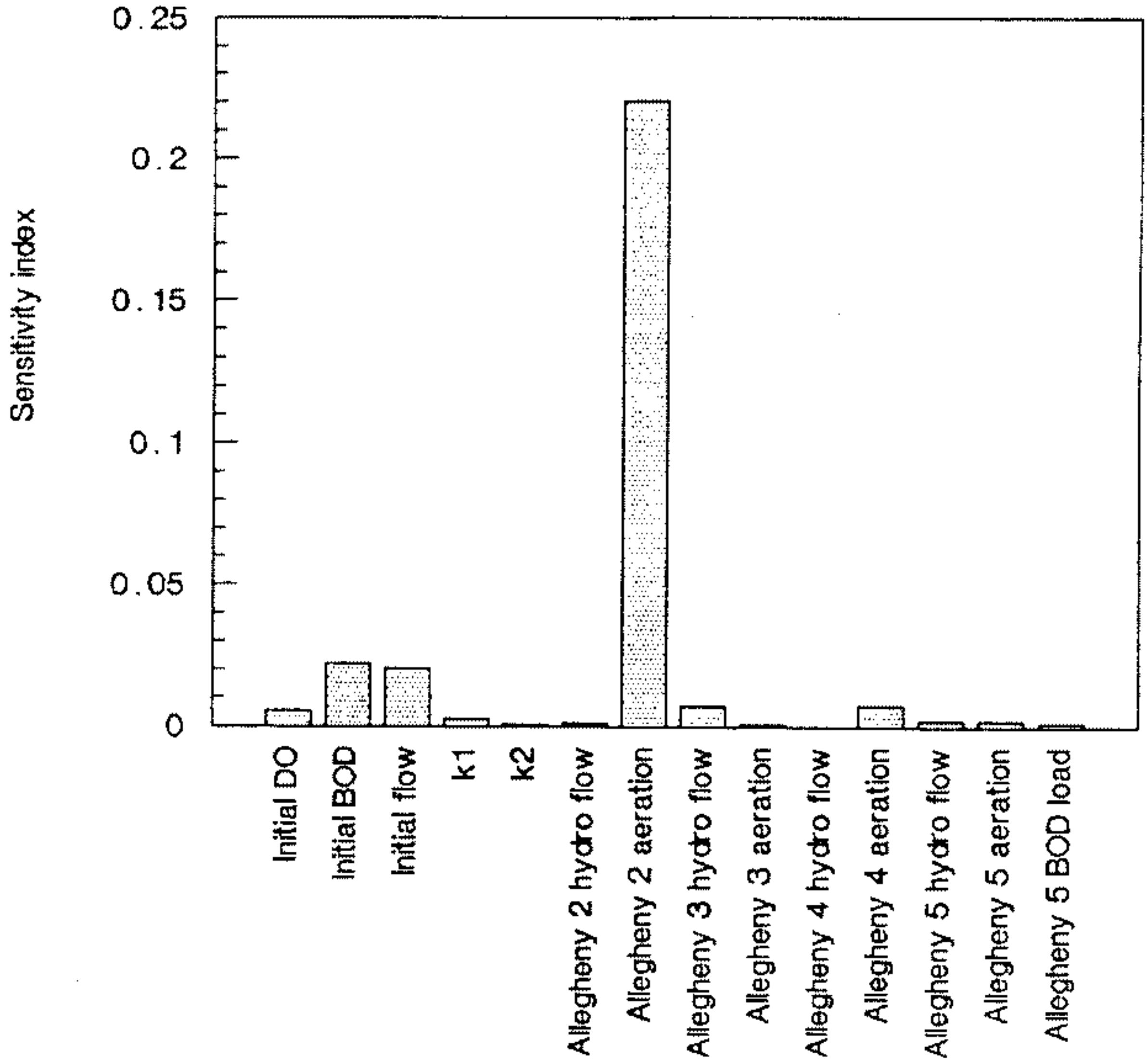


Figure B-20. Sensitivities of the critical DO concentration at Allegheny river mile 0.

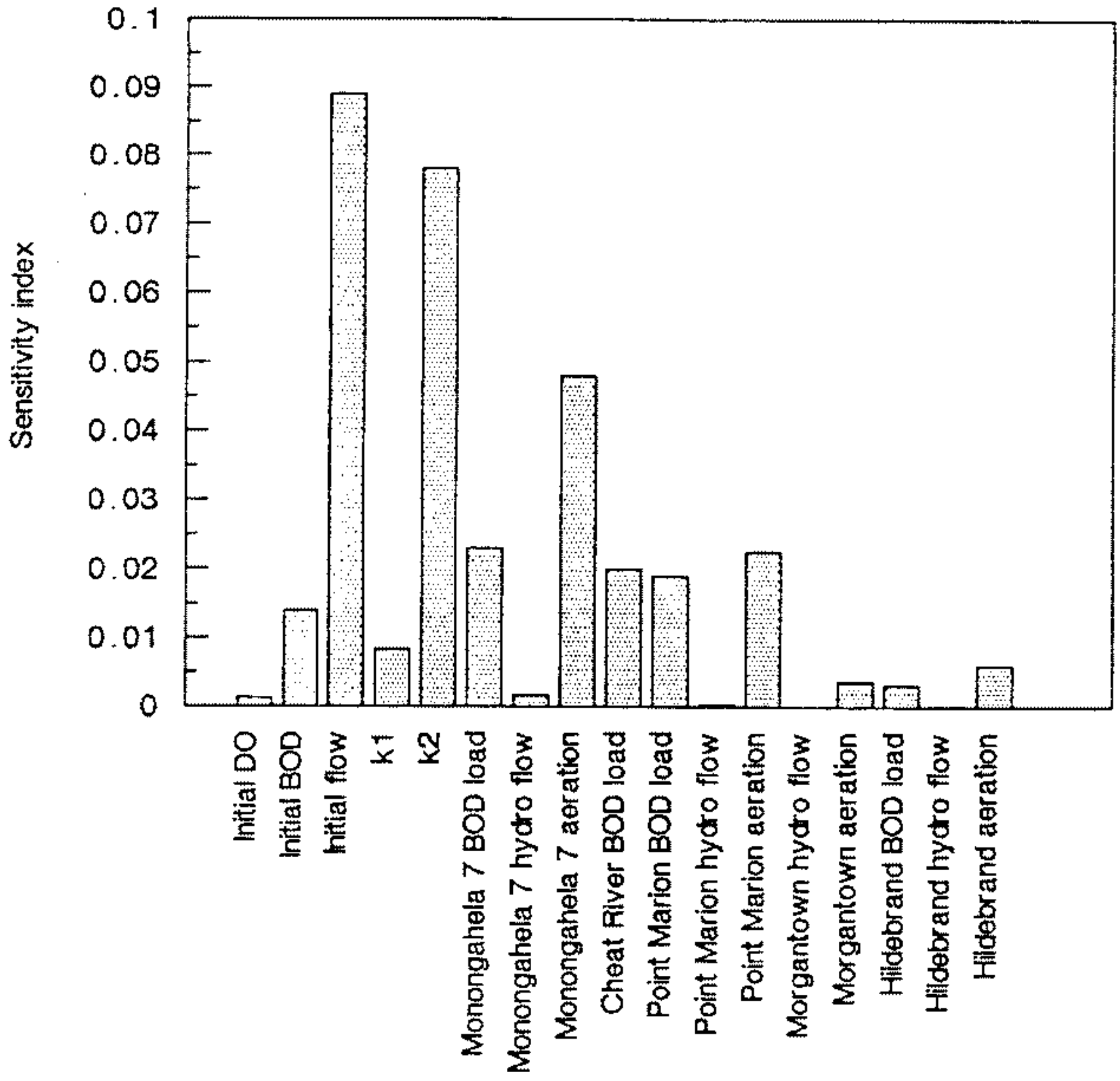


Figure B-21. Sensitivities of the critical DO concentration at Monongahela river mile 65.

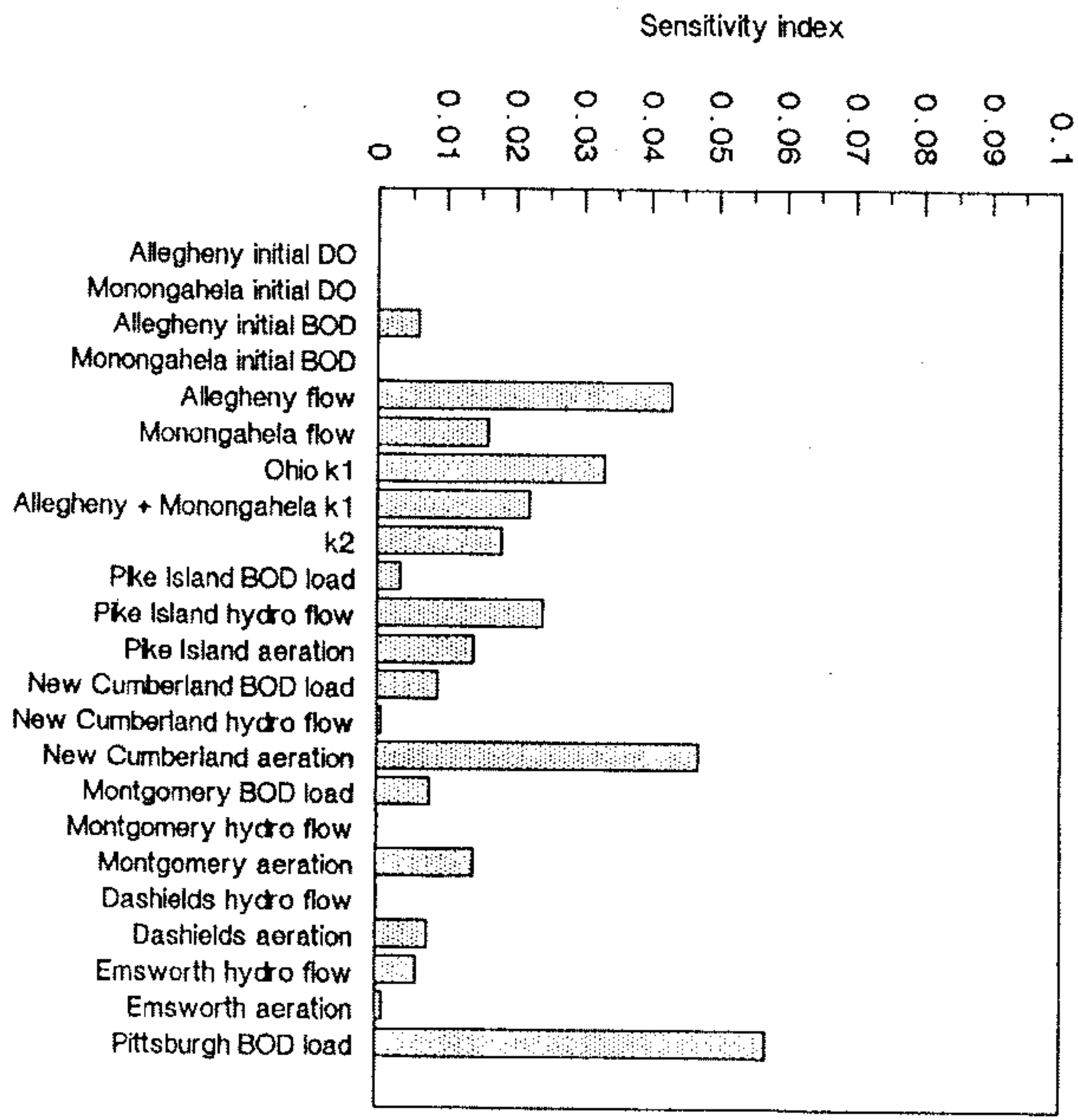


Figure B-22. Sensitivities of the critical DO concentration at Ohio river mile 100.

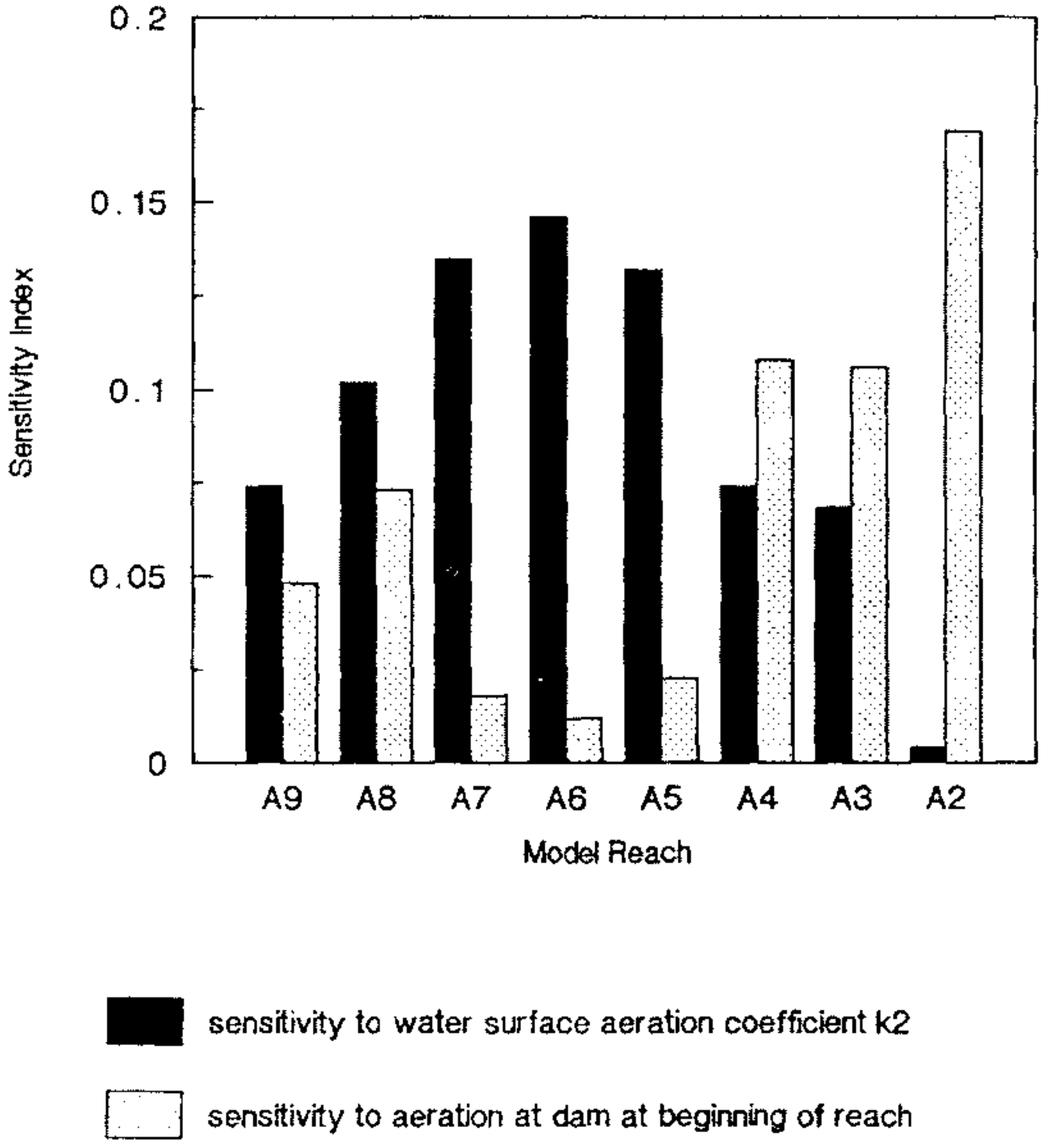


Figure B-23. Sensitivities of Allegheny River critical DO concentrations to k_2 and dam aeration without the proposed projects.

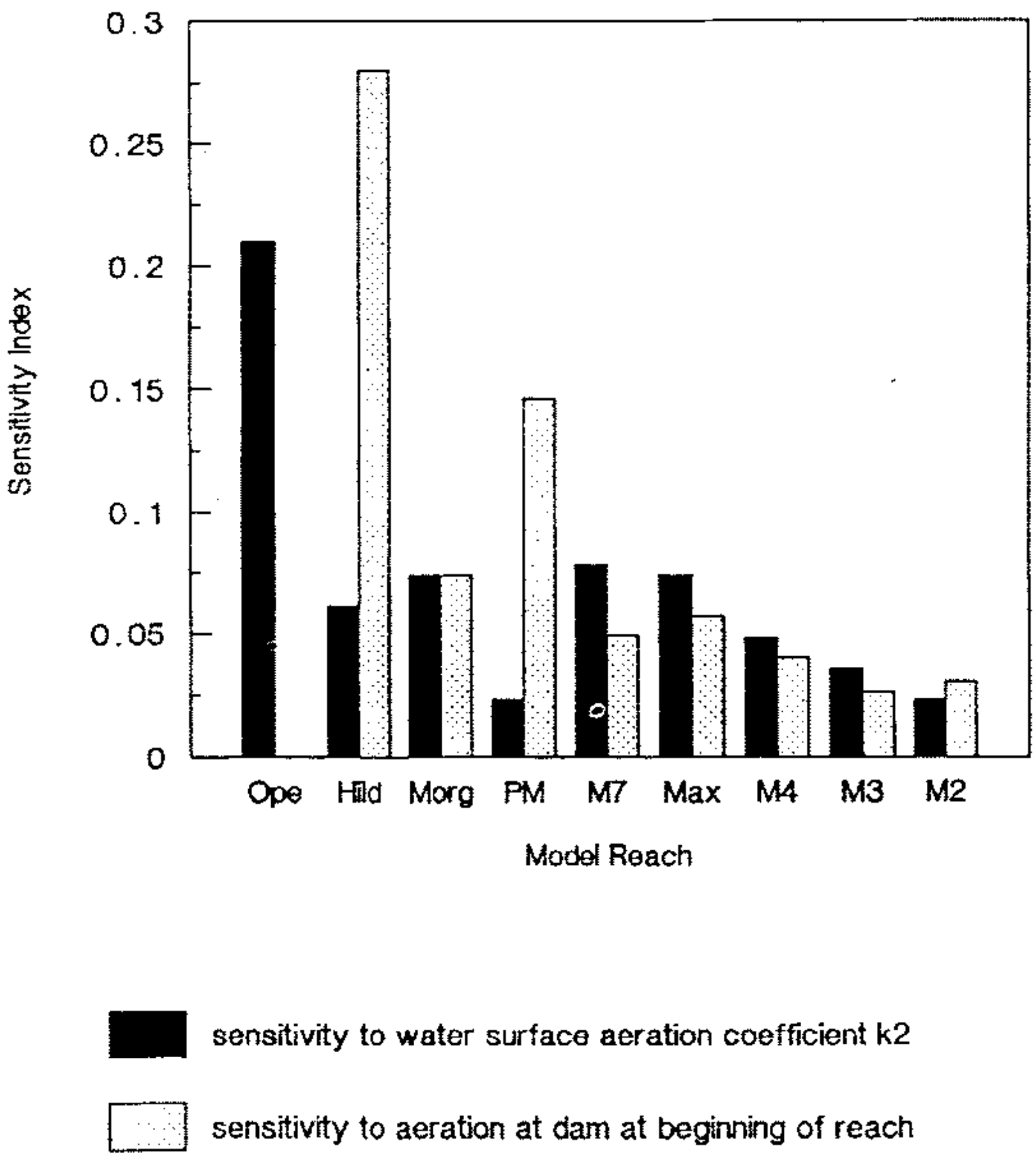


Figure B-24. Sensitivities of Monongahela River critical DO concentrations to k_2 and dam aeration without the proposed projects.

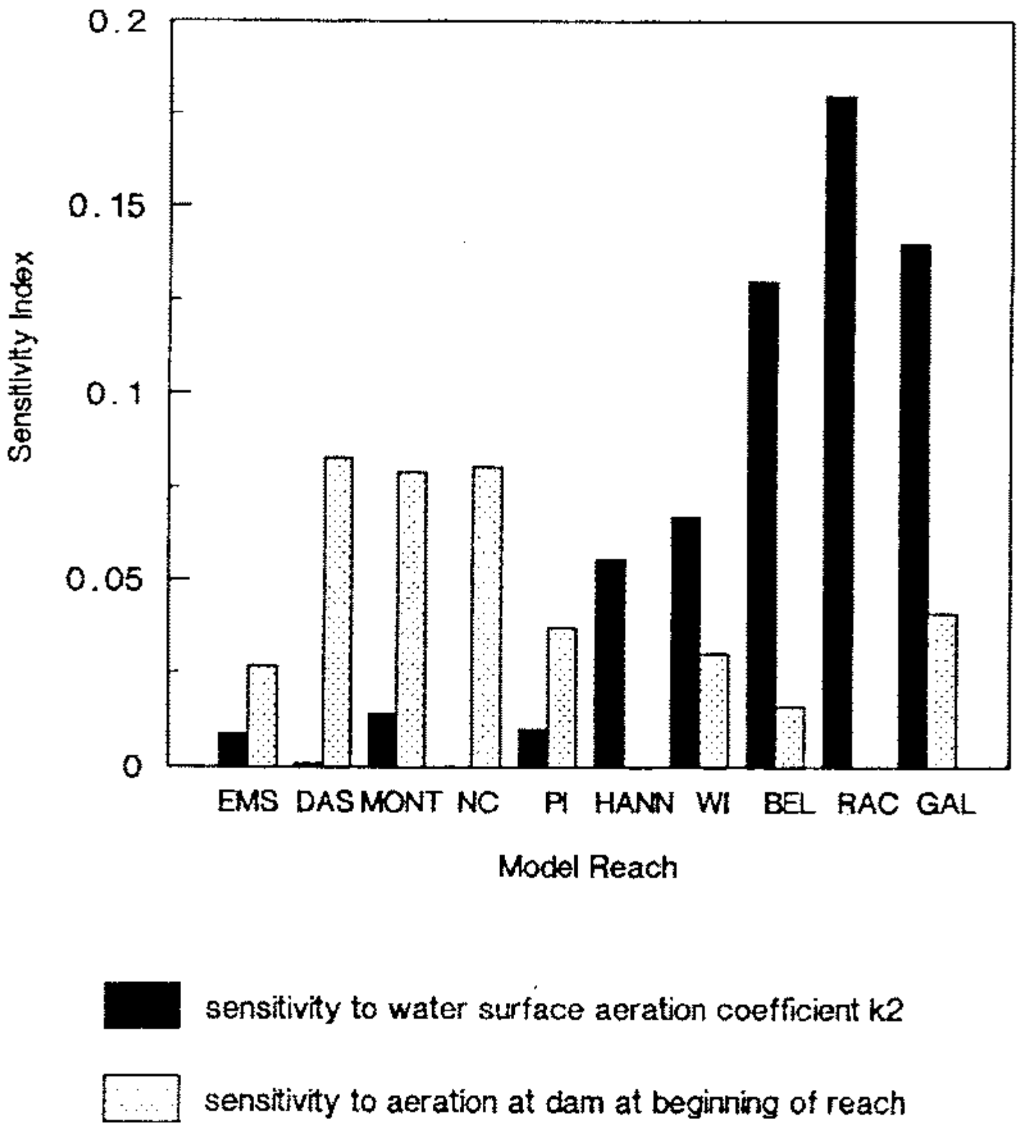


Figure B-25. Sensitivities of Ohio River critical DO concentrations to k_2 and dam aeration without the proposed projects.

Table B-4. Example sensitivities to flow and temperature at critical locations under design conditions and Alternative 3 spill flows

Location 1/	dC/dQ 2/ (mg/L)/cfs	dC/dT 3/ (mg/L)/°C	Sensitivity index for Q 4/	Sensitivity index for T 5/
Allegheny RM 30	0.00032	-0.015	0.30	0.066
Allegheny RM 0	0.000028	-0.145	0.02	0.50
Monongahela RM 0	0.00011	-0.04	0.029	0.17
Monongahela RM 65	0.00033	-0.132	0.089	0.54
Ohio RM 545/		-0.084		0.08
Ohio RM 100		-0.052		0.21
Ohio RM 250		-0.022		0.11

1/ RM=river mile.

2/ Partial derivative of the critical DO concentration with respect to river flow.

3/ Partial derivative of the critical DO concentration with respect to the water temperature in the same reach.

4/ GRESS sensitivity index for flow, which can be compared to values in Figures 12-19.

5/ GRESS sensitivity index for the water temperature in the same reach, which can be compared to values in Figures 12-19.

6/ The sensitivity of Ohio River DO concentrations to river flow was not estimated because it is complicated by the effects of many tributary inflows.

Figure B-20 shows the sensitivity of predicted DO concentrations at Allegheny RM 0 to initial conditions, the water surface aeration rate k_2, the BOD decay rate k_1, the flow rates used for generation (equal to the sensitivity to the spill flow rate), and the dam aeration rates (the increase in DO concentration, in milligrams per liter, that occurs in the spill flow) at the first four dams upstream. The figure shows that DO concentrations at Allegheny RM 0 are highly sensitive to aeration at Allegheny dam 2 under the conditions simulated for Alternative 3. Under this alternative, dam 2 has a high spill flow, which controls DO concentrations because this dam is a very efficient aerator. The DO concentrations at Allegheny RM 0 are relatively insensitive to flow, though DO concentrations upstream of dam 2 are sensitive to flow.

The sensitivity of predicted DO concentrations at Monongahela RM 65 is shown in Figure B-21. The DO concentrations at this location are most sensitive to the flow rate, the water surface aeration rate coefficient k_2, and the aeration rate at Monongahela dam 7 (where no hydropower is proposed). Other parameters of importance to DO concentrations are the BOD loadings at several upstream reaches.

The sensitivity of predicted DO concentrations at Ohio RM 100 is shown on Figure B-22. This figure shows that DO concentrations are relatively sensitive to flow, BOD decay rate k_1, and aeration at the dams upstream of RM 100. The sensitivity to the value of k_1 used in the Allegheny and Monongahela rivers indicates that DO concentrations in these rivers still affect DO concentrations at Ohio RM 100.

Figure B-23 compares the relative sensitivity of the modeled critical DO concentrations in each reach of the Allegheny River that starts with a dam to the surface aeration rate coefficient k_2 and to the amount of aeration (the milligram-per-liter increase in DO in the spill flow) taking place at the dam. The sensitivity indexes are for conditions without the proposed new hydropower projects but with the licensed projects at dam 9, 8, 6, and 5. These sensitivity indexes indicate the relative importance of surface aeration vs dam aeration in these reaches. The figure shows that below Allegheny dams 7, 6, and 5, water surface aeration is more important for maintaining DO concentrations, which is expected because dam 7 is a poor aerator and because of the licensed projects with low spill flows at dams 5 and 6. However, below dams 4, 3, and 2, the model becomes much more sensitive to dam aeration. This sensitivity indicates that below dam 4, dam aeration is important for maintaining DO concentrations in the Allegheny.

Figure B-24 shows the relative sensitivity of the model to k_2 and dam aeration in the Monongahela River without the proposed new hydropower. In the reach below Opekiska Dam, which provides little aeration, the model is not sensitive to dam aeration. Below Hildebrand and Point Marion dams, the model is more sensitive to dam aeration; and for the rest of the river, the model seems to be about equally sensitive to water surface aeration and dam aeration. These results indicate that dam aeration is especially important for maintaining DO concentrations below Hildebrand and Point Marion dams and remains of importance in the reaches further down the Monongahela River.

The relative sensitivity of the model to k_2 and dam aeration in the Ohio River, without the proposed new hydropower, is shown in Figure B-25. The figure shows that predicted DO concentrations below the first five dams on the Ohio River are more sensitive to dam aeration than to water surface aeration. Below about RM 100, the model becomes much more sensitive to water surface aeration. This sensitivity, indicates that aeration at the first five dams of the Ohio is more important for maintaining DO concentrations than is aeration at the rest of the dams in the study. This result is expected because of the more efficient aeration at the upper five dams.

B.5.2.3 Conclusions

In general, the DO model is most sensitive to water temperature and flow rate. The values of these parameters should be selected carefully in future modeling studies. The effects of variation in these parameters should be at least qualitatively investigated in any new studies because since they strongly influence predicted DO concentrations.

From Allegheny dam 9 downstream to dam 5, the modeled DO concentrations are sensitive to the starting DO concentration at Allegheny dam 9, which is an input parameter. This starting DO concentration should be selected carefully, and the effects of variation in it should be investigated in any additional modeling studies. The model is not especially sensitive to the initial BOD concentration in the Allegheny nor to the initial DO and BOD concentrations in the Monongahela.

The DO concentrations at RM 0 of the Allegheny River and in the upper reaches of the Ohio River are very sensitive to aeration at Allegheny dam 2 when this dam is spilling water. This dam is very important for maintenance of DO concentrations in these reaches.

In the upper 100 river miles of the Ohio River, dam aeration is important for maintaining DO concentrations. The model is sensitive to the decay rate, k_1, of BOD below Pittsburgh; consequently, obtaining measured values of this parameter would be useful to improve the model. Processes controlling DO in the Allegheny and Monongahela rivers have an important effect on DO in the Ohio River at least as far downstream as RM 100.

There are reaches in each river where dam aeration is and is not relatively important for maintaining DO concentrations (i.e., where DO concentrations are and are not sensitive to dam aeration). The reaches where the model is most sensitive to dam aeration are below Allegheny dam 4, below Hildebrand and Point Marion dams, and below the first five dams on the Ohio River. These reaches are generally where the most dam aeration occurs, so it appears that the model is more sensitive to dam aeration where the dam aeration rate is high. This fact implies that dam aeration has a greater than linear effect on critical DO concentrations; i.e., that as dam aeration increases, the DO concentrations rise at an increasing rate.

It should be noted that the sensitivities determined in this analysis change when the model parameters change. The sensitivities of the model to various parameters could change significantly when different scenarios or conditions are modeled. The results presented here describe the sensitivities of the model as it represents the design conditions and recommended spill flows in the EIS.

B.5.3 UNCERTAINTY ANALYSIS

B.5.3.1 Methods

The uncertainty analysis incorporates the estimated uncertainty in model parameters into an estimated uncertainty in the model results and provides confidence bounds for the model's predictions of DO concentrations. This method does not address uncertainties in how the model is formulated but assumes that the structure of the model (i.e., the equations used) is correct and addresses the uncertainty in the values of the model parameters.

The model parameters for the design conditions used in the EIS were determined by using the following steps (Section B.2):

1. River flows, water temperatures, and the initial Allegheny River DO concentration were selected to represent conditions where DO concentrations are expected to be low. The values were selected after examining the range of measured historic values for these parameters. The initial DO concentration on the Monongahela River, at the outlet from Tygart Dam, was assumed to be at saturation because of aeration at the dam.

2. Dam aeration parameters (b and M) were estimated from field data. The k_2 values were estimated using the O'Connor-Dobbins equation. Tributary DO and BOD concentrations were estimated.

3. The values for BOD loadings, k_1, and, in one case, tributary DO concentrations were determined by calibrating the model to measured data.

The uncertainty analysis was performed by estimating the uncertainty in all the input parameters that were either estimated or determined from calibration. No uncertainty was assigned to the parameters (flow, temperature, and initial DO concentrations) that were selected as design conditions.

The uncertainty analysis was performed for the design conditions used in the EIS (Sect. B.2.5) with the proposed hydropower plants operating with the spill flows recommended under Alternatives 3 and 4 of the EIS because this is the model run on which the recommendations in the EIS were based. The analysis was also performed for the model with the assumption that none of the proposed new hydropower projects were in operation. The software used for the uncertainty analysis is the PRISM system developed at Oak Ridge National Laboratory (Gardner Rojder, and Bergstrom 1983; Gardner 1984).

The expected uncertainty in model parameters is represented by a frequency distribution that actual values of the parameter are expected to follow. The analysis therefore requires a description of the frequency distribution each parameter follows and a description of any important correlations between parameters. Each distribution is described by (1) the type of distribution followed, such as normal (Gaussian), uniform, or lognormal; (2) a mean value and a variance for normal and lognormal distributions; and (3) minimum and maximum values for uniform distributions. PRISM allows the use of bivariate distributions that describe the joint frequency distribution of two parameters whose values are correlated. The frequency distributions for model parameters were determined as follows.

The uncertainty in the dam aeration coefficients (M's) and constants (b's) was estimated from the linear regression analyses that were used to estimate these parameters. For each dam, a bivariate normal distribution was assigned to describe the joint frequency distribution of b and M. Regression analysis for the linear dam aeration model (Section B.2.1.3) using field data for each dam provided a full description of the bivariate normal distribution of b and M. The least-squares regression estimates of b and M (the values used in the model; Table B-2) are the means, and the variance-covariance matrix of the parameters provided by the Statistical Analysis System program complete the description of the bivariate normal distribution.

The uncertainty in the k_2 estimates from the O'Connor-Dobbins equation was estimated from measured and calculated values of k_2 in the Ohio River presented by O'Connor and Dobbins (1958). The equation for k_2 is

$$k_2 = Z(V^{0.5})/\text{depth}^{1.5} \quad ,$$

where Z is a constant with a value of 12.9. The uncertainty in k_2 was assigned to the constant Z. Values of Z that reproduced the measured k_2 values for 22 field measurements were calculated. These values of Z were approximately lognormally distributed with a mean of 2.76 and a standard deviation of 0.633, and this lognormal distribution was assigned as the uncertainty in k_2.

Uncertainties in tributary DO and BOD concentrations were assumed to be uniformly distributed within a range of ± 2 mg/L of the mean (the mean being the value used in the model).

The uncertainty in the point-source BOD loadings were assumed to be normally distributed with a standard deviation of 25 percent of the value used in the model.

The uncertainty in k_1 was estimated from data published in USEPA (1985, p. 147). This document presents values of k_1 from a variety of rivers, including sediment oxygen demand, as does the k_1 used in the Ohio River model. The measured values of k_1 in rivers with approximately the same depths as those in this study were approximately uniformly distributed over a range of 0.08 to 0.5. A uniform distribution with this range was used for k_1.

After frequency distributions were assigned to the parameters that reflected uncertainty, the model was executed 2000 times. A Latin-hypercube method (Rose and Schwartzman, 1981) was used to systematically assign parameter values for each execution that, over the 2000 executions, fit the frequency distributions assigned to each parameter. Statistics on the critical (lowest) DO concentration in each reach of the model was stored for each of the 2000 executions. The mean, maximum, minimum, and standard deviation of the 2000 values of critical DO concentration for each reach were determined.

B.5.3.2 Results

The mean critical DO concentrations and the 95 percent confidence intervals (CIs) for each reach of the Allegheny, Monongahela, and Ohio rivers for the model with the proposed hydropower projects are plotted in Figures. B-25, B-26, and B-27. If the structure of the model is correct (i.e., the uncertainty lies in the parameter values) and the critical DO concentrations generated in the uncertainty analysis are normally distributed for each reach, there is a 95 percent probability that true value of the critical DO lies within these CIs. (The 95 percent CIs are equal to the mean ± 1.96 times the standard deviation of the 2000 critical DO values for each reach.) In most cases the 95 percent CIs calculated in this way are close to the observed minimum and maximum DO concentrations generated by the uncertainty analysis.

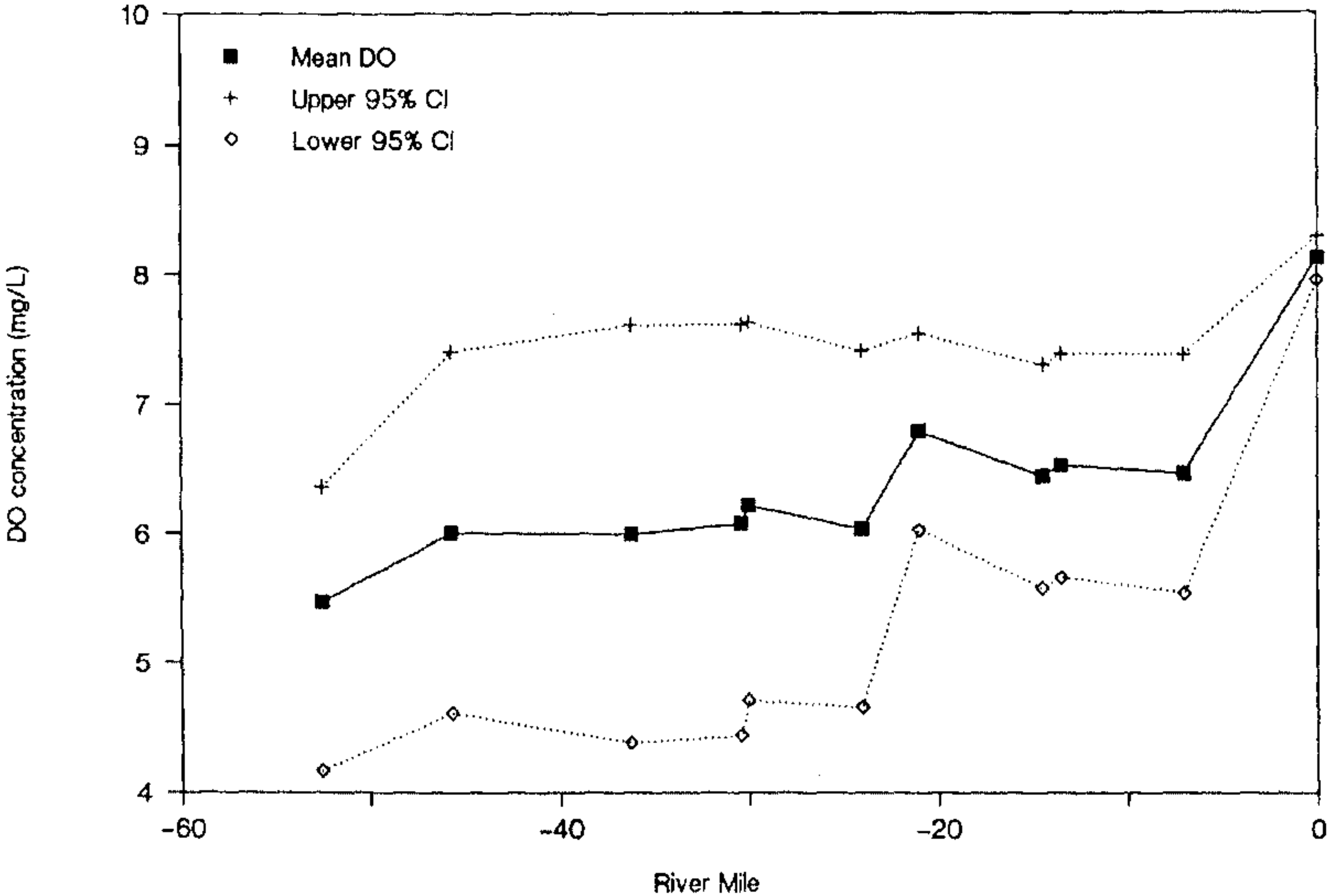


Figure B-26. Uncertainty analysis for the Allegheny River with the proposed projects (CI = confidence intervals, DO = dissolved oxygen).

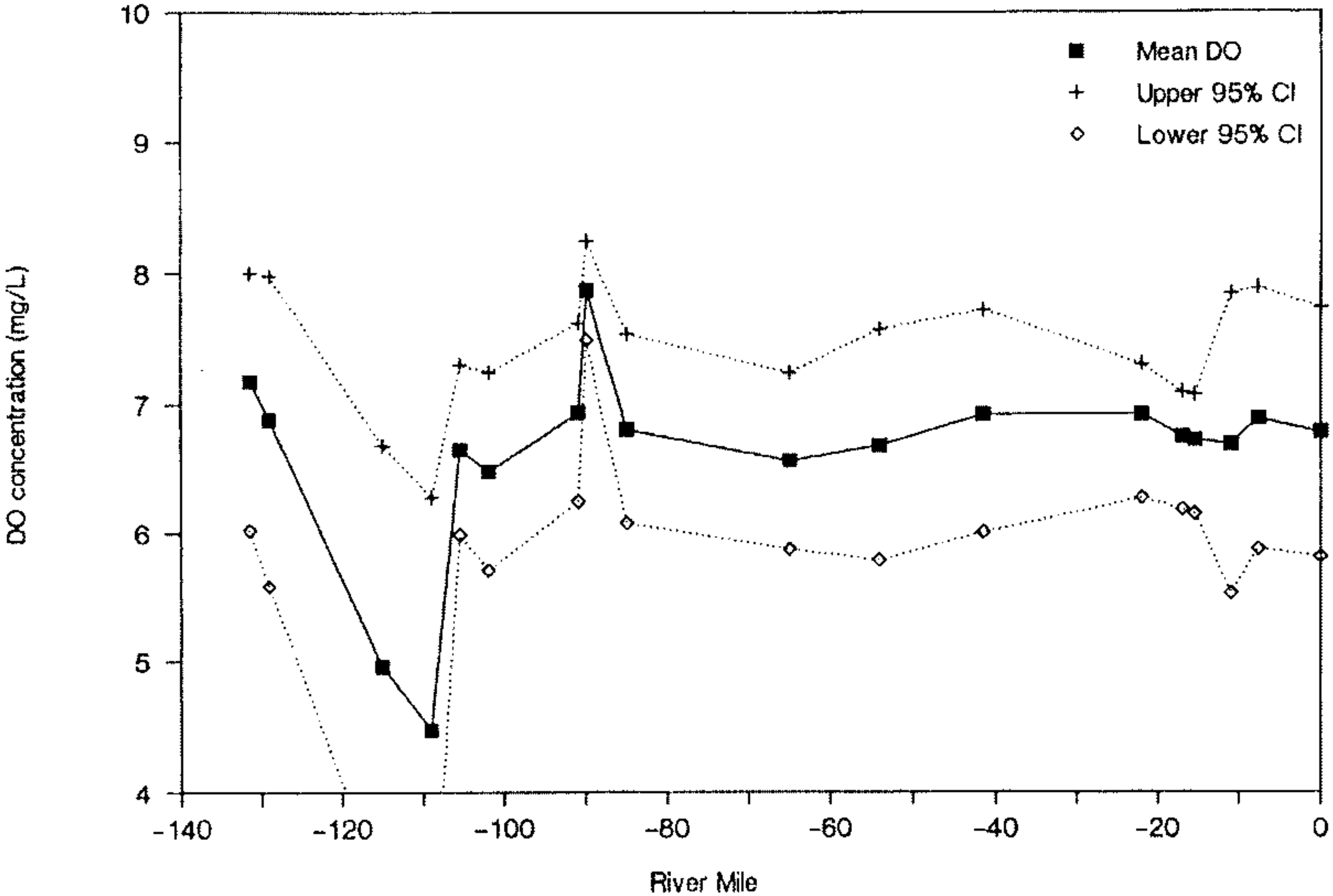


Figure B-27. Uncertainty analysis for the Monongahela River with the proposed projects (CI = confidence intervals, DO = dissolved oxygen)

There is relatively high uncertainty (95 percent CIs within about 1.5 mg/L of the means) in the Allegheny River model results from dam 9 as far downstream as the dam 4 reach (Figure B-26). The uncertainty decreases until RM 0, where the value is very small.

There is also relatively high uncertainty in the Monongahela River model results from Tygart Dam to the Hildebrand Dam reach, as Figure B-27 indicates. For the rest of the Monongahela, the uncertainty is relatively low, with the 95 percent CI within about 1 mg/L of the mean.

The model uncertainty on the Ohio River is low until it gradually increases below RM 100 (Figure B-28). In the reach between RM 0 and RM 100 where dam aeration is especially important, the 95 percent CI is within about 0.5 mg/L of the mean. At the reach below Gallipolis Dam, the 95 percent CI has expanded to about 1.5 mg/L from the mean.

Figures B-29, B-30, and B-31 show the uncertainty analysis results for the Allegheny, Monongahela, and Ohio rivers without the proposed new hydropower development. Also shown on these three figures are the ranges of measured DO concentrations (the mean and the mean $\pm$ 2 standard deviations) at the ORSANCO water quality monitoring stations. These ORSANCO data were collected in the months of July, August, and September between 1980 and 1988, at times when the water temperature was between 26 and 30^{o}C.

The DO model uncertainties without the proposed new hydropower projects are similar to those for the model with Alternative 3 spill flows. At the ORSANCO monitoring stations on the Allegheny and Monongahela rivers and at the first three stations on the Ohio River, the mean measured DO concentration is very close to the mean concentration modeled in the uncertainty analysis. The similarity between the modeled and measured mean concentrations indicates that the parameter frequency distributions used in the uncertainty analysis accurately model actual DO concentrations. There is much more variability in the measured data than there is uncertainty in the model. The variability in the measured data is probably caused by variability in flow rate and in other processes such as primary productivity that are not incorporated in the model.

In all three rivers, the uncertainty in the model is lowest in the reaches that are most influenced by dam aeration. The clearest example of this is the Allegheny dam 2 reach, where the DO concentration is highly controlled by the aeration at dam 2 (Section B.5.2.2). Even though the aeration parameters for dam 2 have more uncertainty than those for most other dams, the resulting uncertainty in model results is essentially negligible. In contrast, below Ohio RM 200 where dam aeration has very little effect on DO concentrations, the uncertainty is relatively high. Below Ohio RM 200, DO concentrations are controlled more by the rate coefficients k_1 and k_2 than in the upper end of the river, and uncertainties in the values of these coefficients increase the uncertainty in the model.

B.5.3.3 Conclusions

The 95 percent CIs in the Ohio River basin DO model range from less than $\pm$ 5 percent of the mean to about $\pm$25 percent of the mean. The uncertainty analysis shows that the dam aeration models give stability to the model results because the uncertainty is much lower in reaches where DO concentrations are dominated by dam aeration. There is apparently less uncertainty in the linear regression dam aeration parameters (Secion B.2.1.3) than in the other parameters controlling DO concentrations. This conclusion is important because the purpose of the model is to evaluate impacts of changes in dam aeration and to select spill flows that provide adequate DO concentrations. The uncertainty in the model is lowest in the reaches where the decisions based on the model are most important.

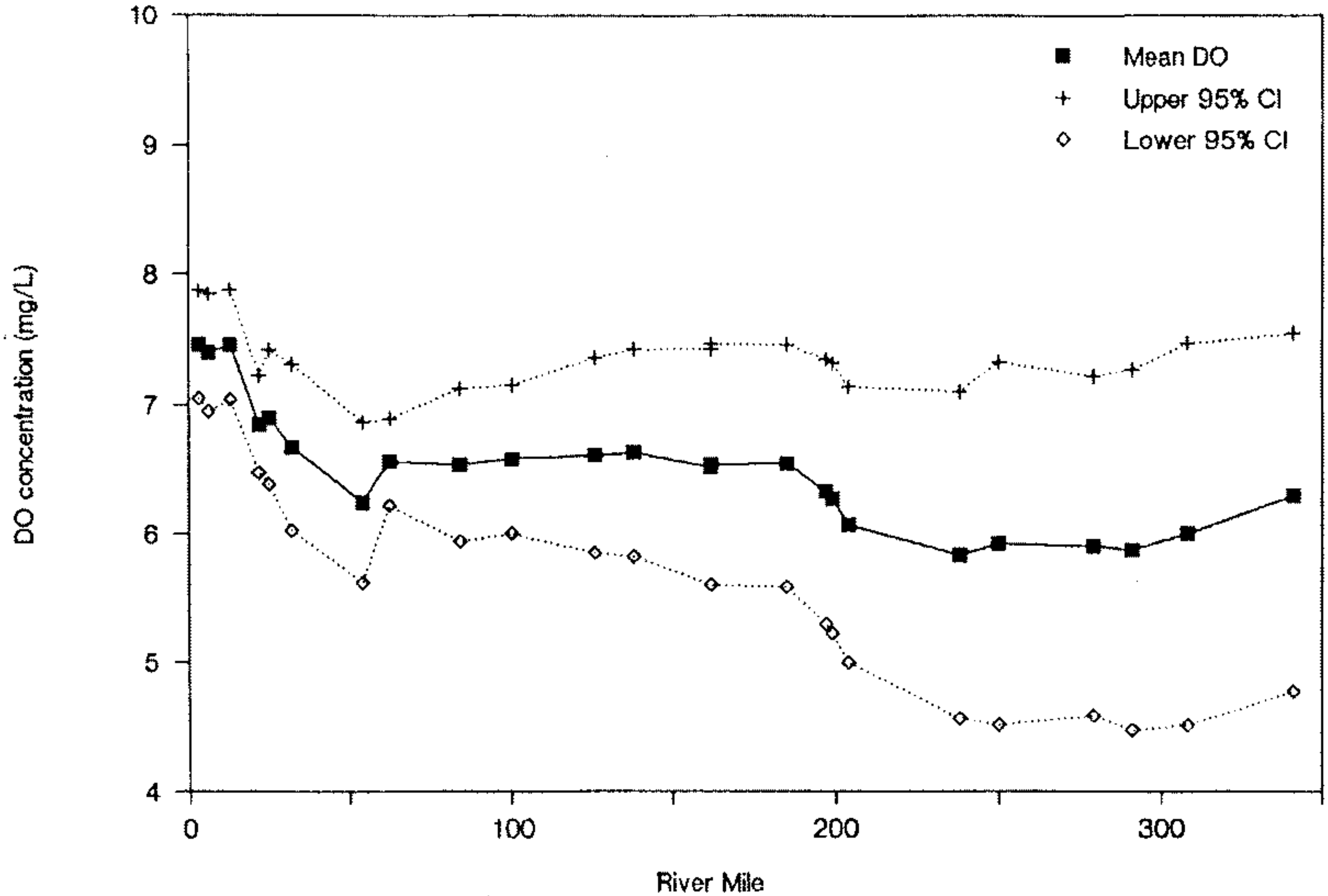


Figure B-28. Uncertainty analysis for the Ohio River with the proposed projects (CI = confidence intervals, DO = dissolved oxygen).

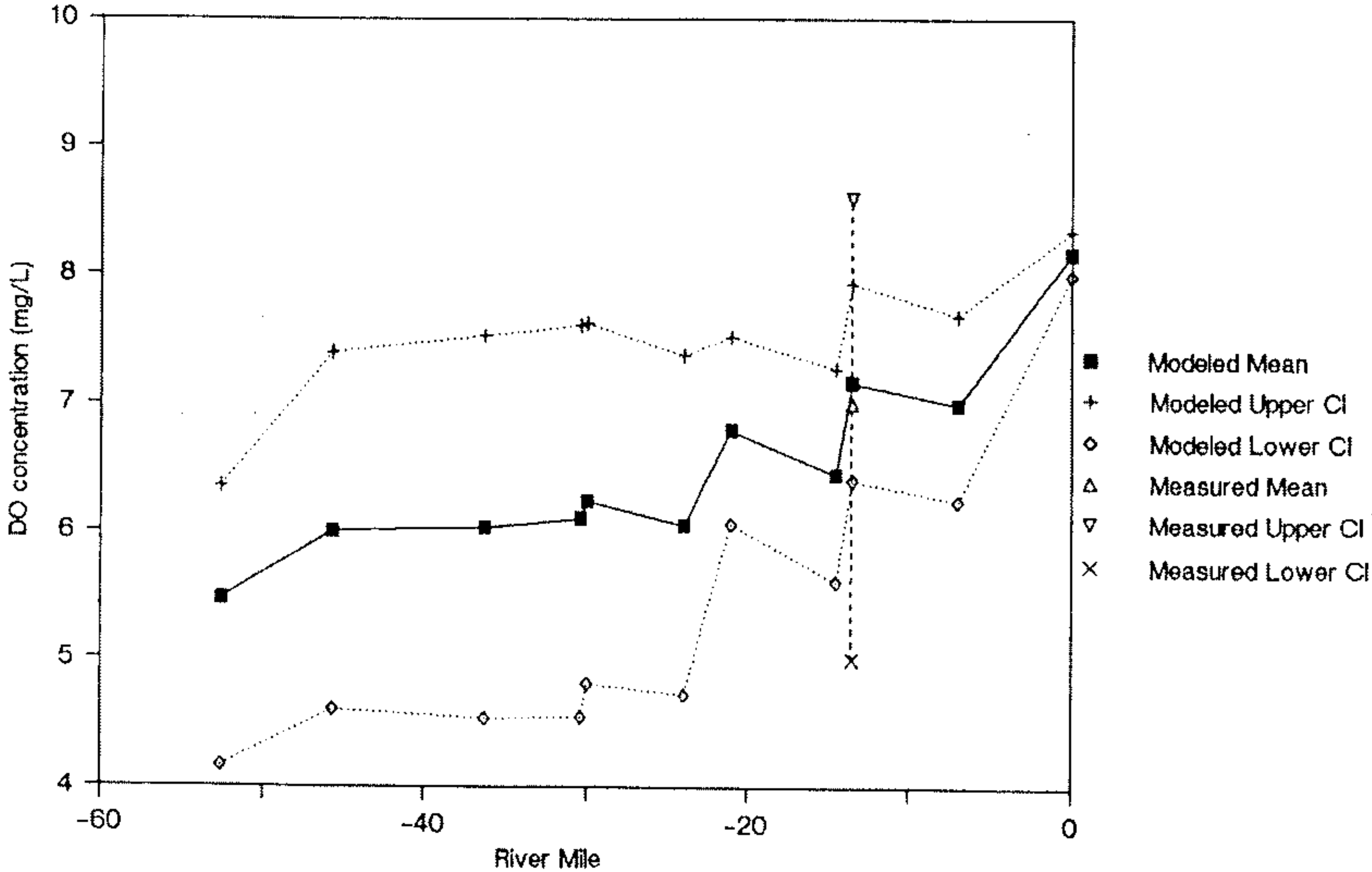


Figure B-29. Uncertainty analysis for the Allegheny River without the proposed projects (CI = confidence intervals, DO = dissolved oxygen).

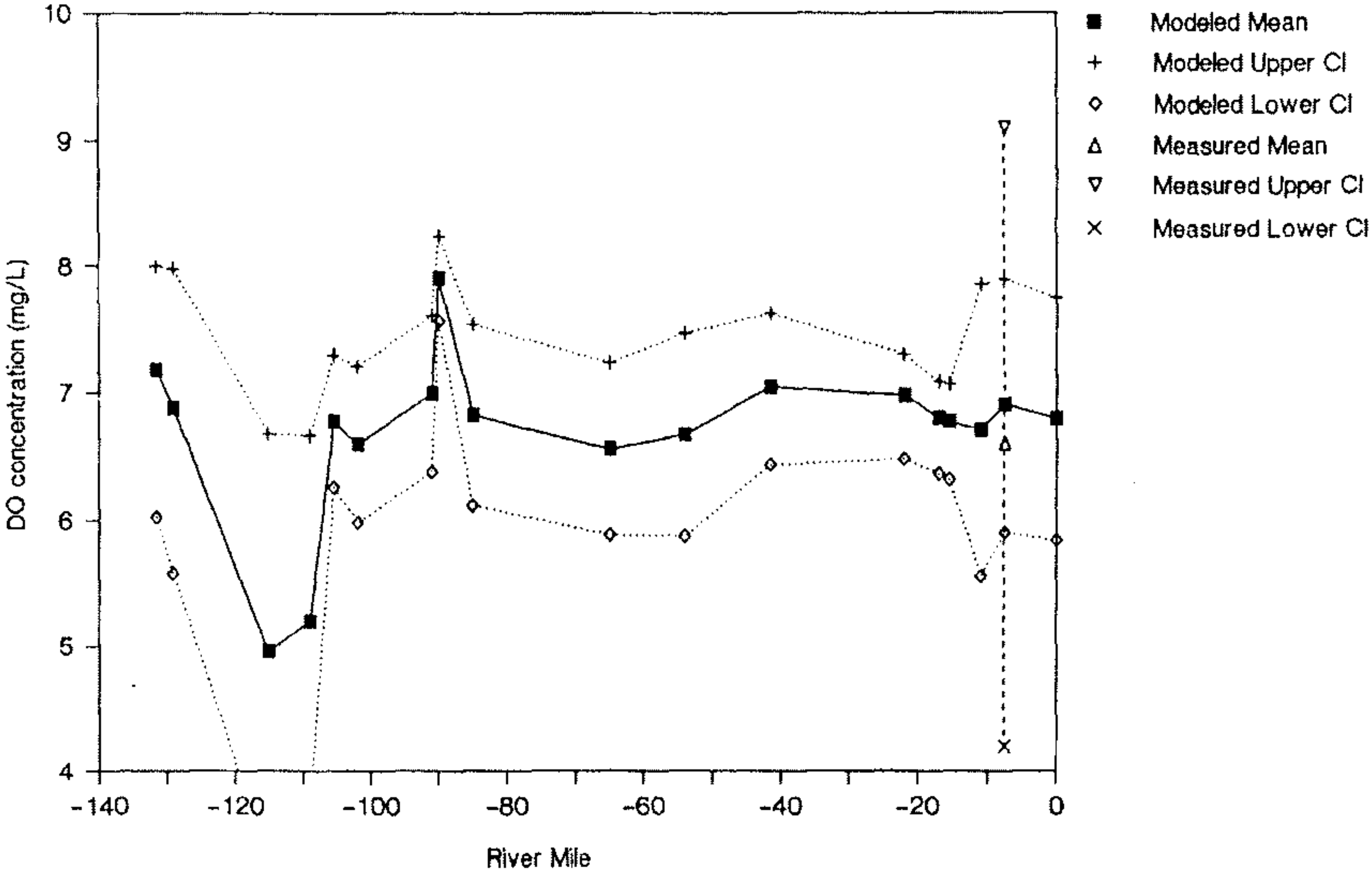


Figure B-30. Uncertainty analysis for the Monongahela River without the proposed projects (CI = confidence intervals, DO = dissolved oxygen).

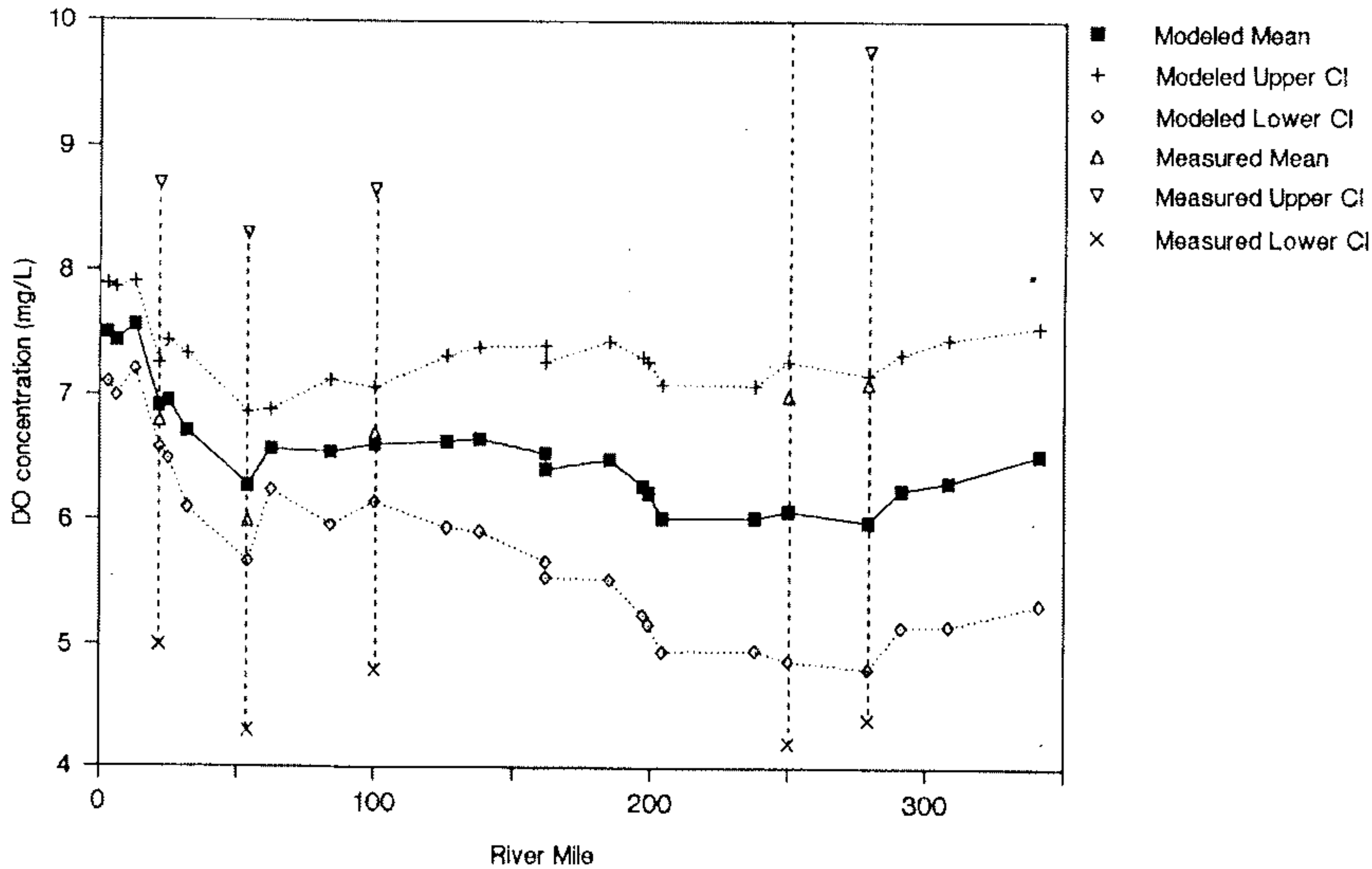


Figure B-31. Uncertainty analysis for the Ohio River without the proposed projects (CI = confidence intervals, DO = dissolved oxygen).

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APPENDIX C

AERIAL PHOTOGRAPHS OF EXISTING LOCKS AND DAMS[1/]

1/ Source of photographs is recreational boat dock surveys conducted by the Pittsburgh and Huntington Districts of the Corps.

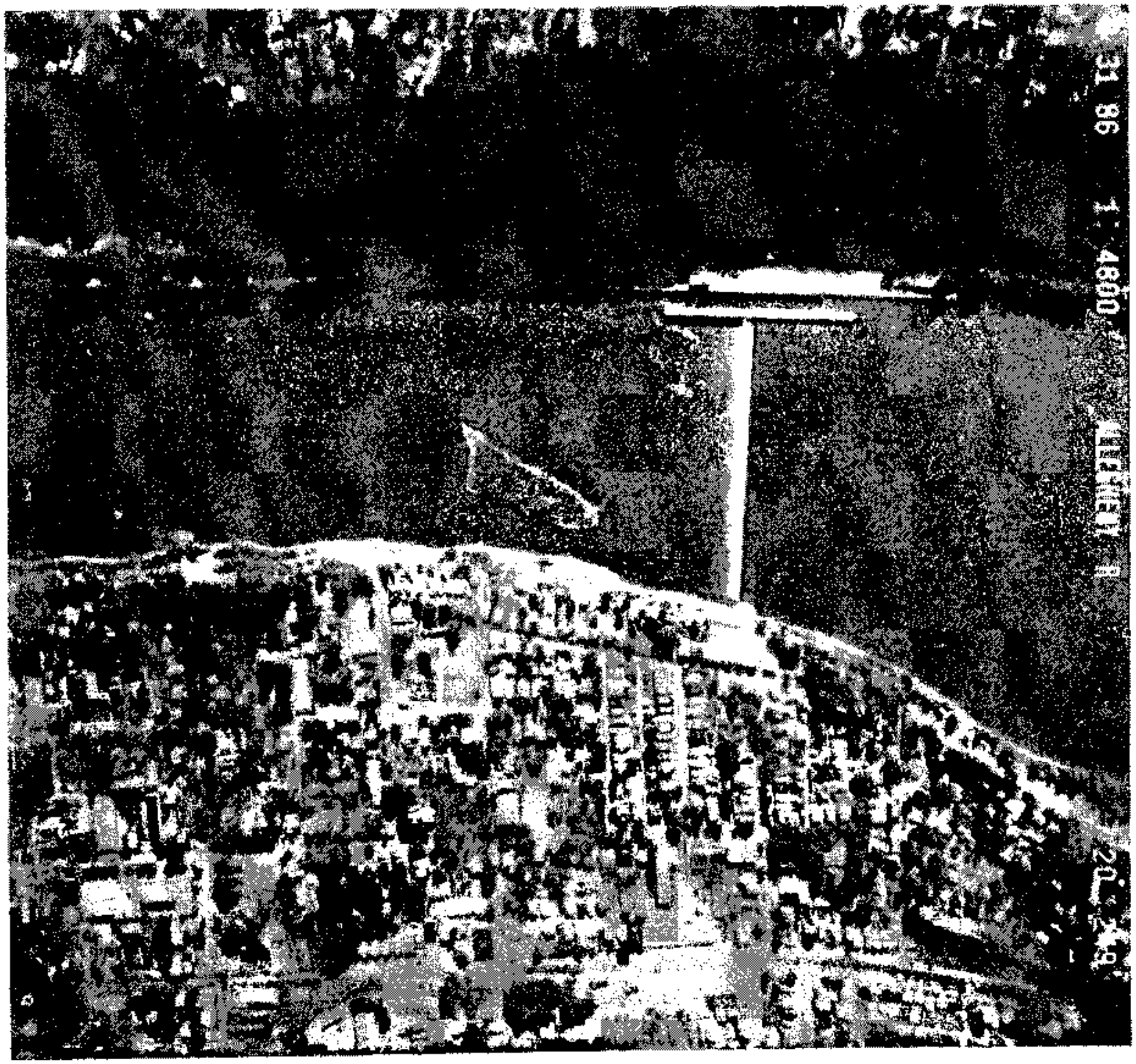

Figure C-1. Recent aerial photograph of Allegheny L&D No. 7 (FERC No. 7914).

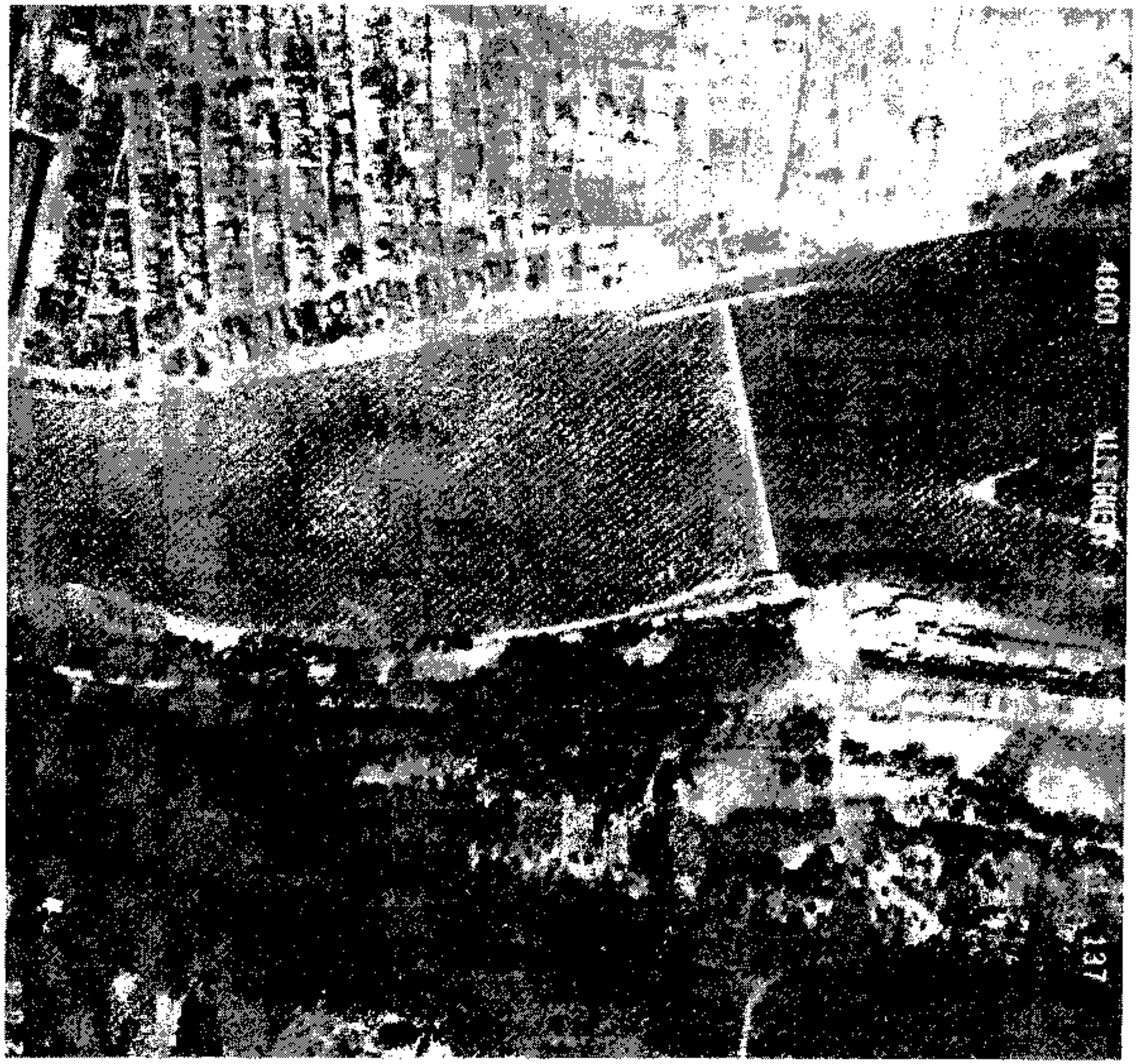

Figure C-2. Recent aerial photograph of Allegheny L&D No. 4 (FERC No. 7909).

Figure C-3 Recent aerial photograph of Alleghny L&D No. 3 (FERCNo. 4474).

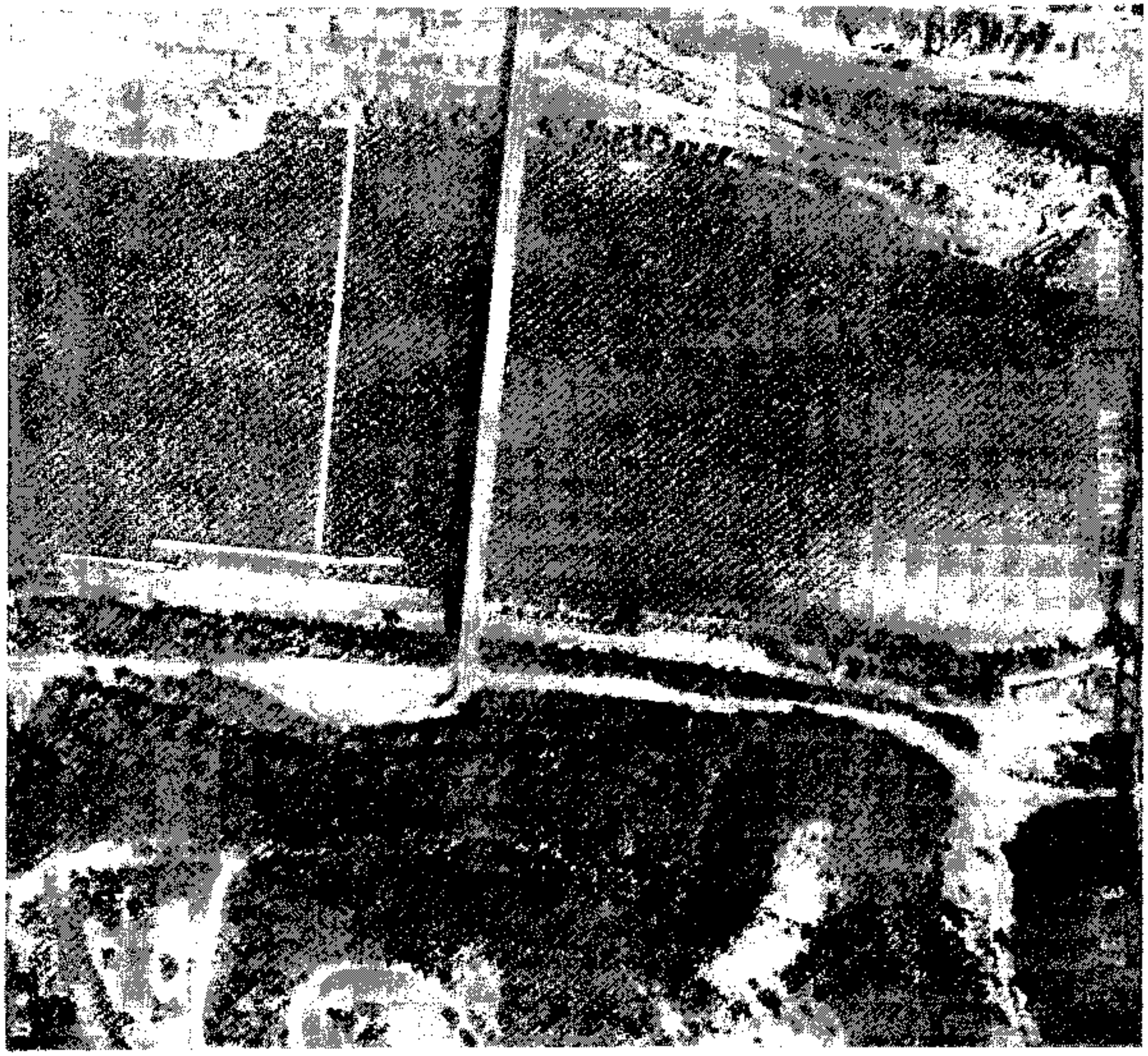

Figure C-4. Recent aerial photograph of Allegheny L&D No. 2 (FERC No. 4017).

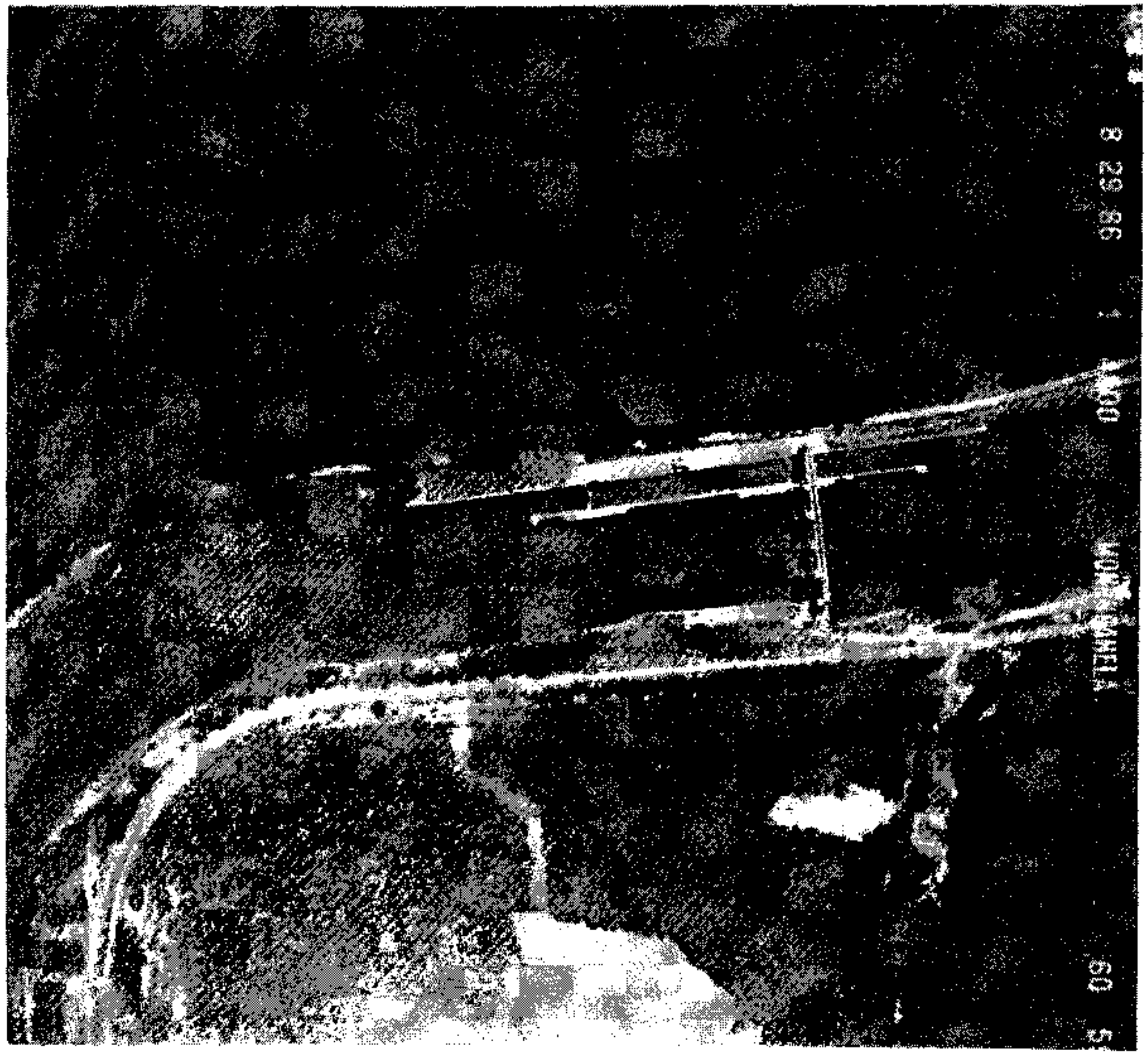

Figure C-5. Recent aerial photograph of Opekiska L&D (FERC No. 8990).

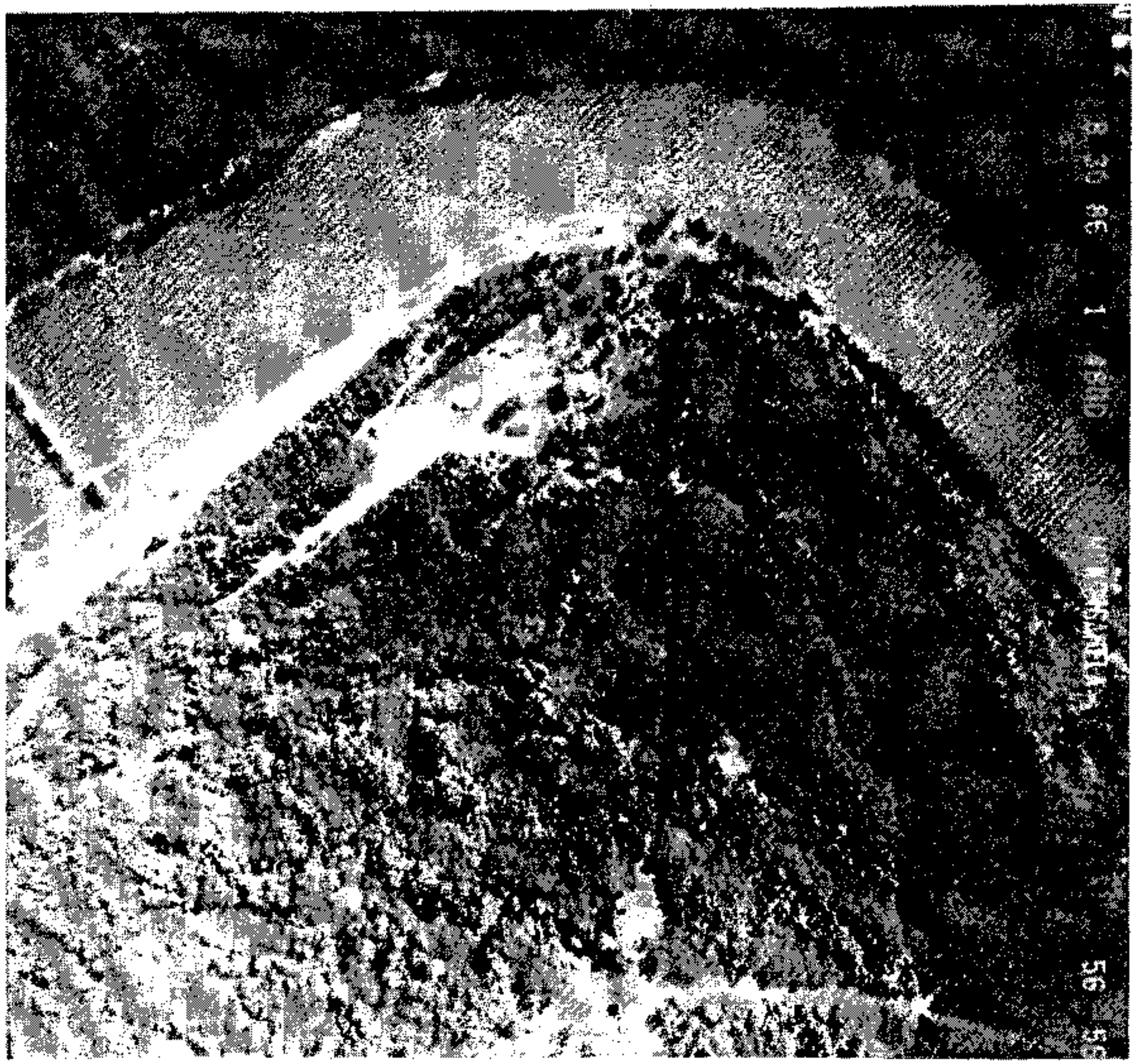

Figure C-6. Recent aerial photograph of Hildebrand L&D (FERC No. 8654)

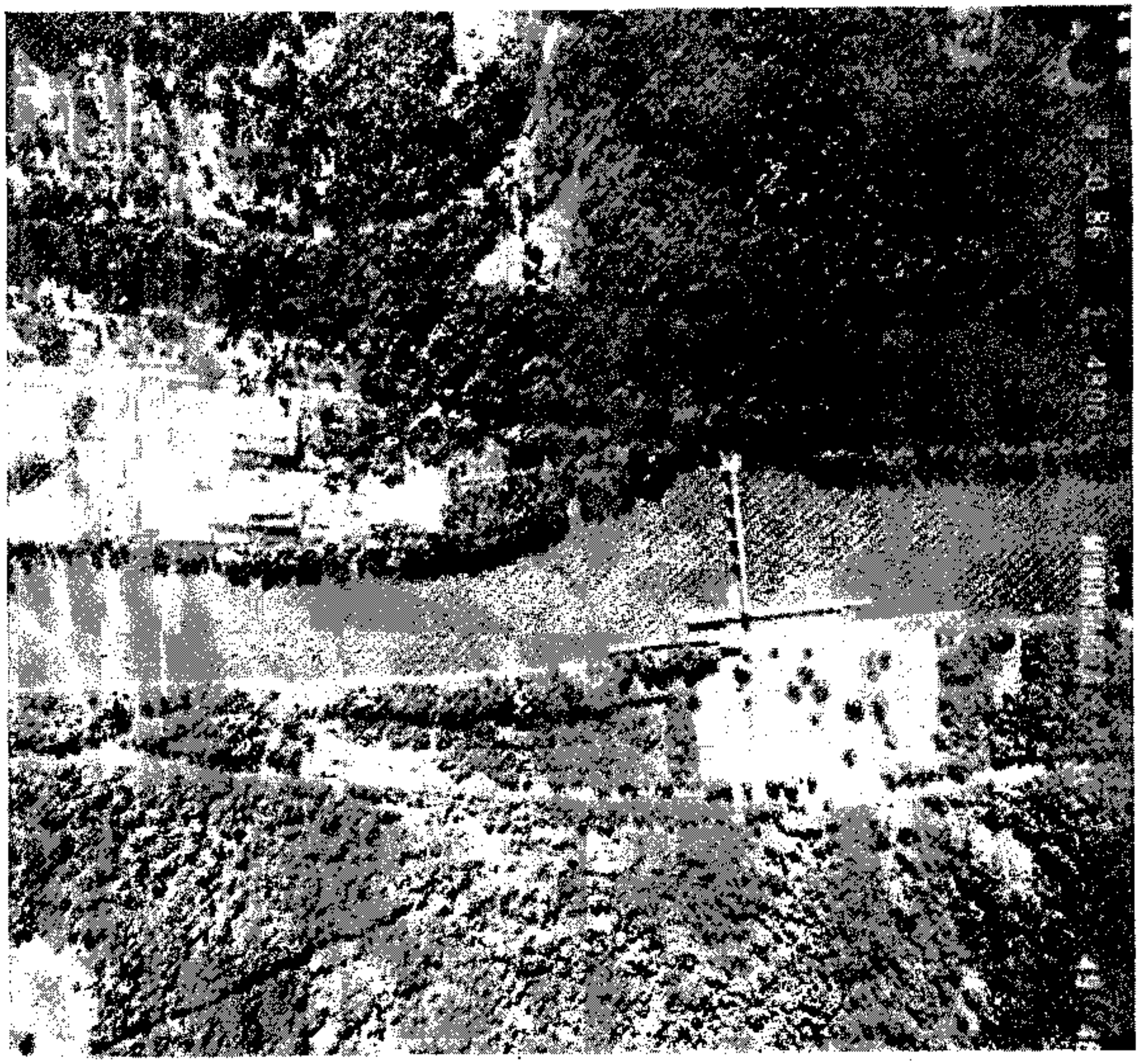

Figure C-7. Recent aerial photograph of Point Marion L&D (FERC No. 7660).

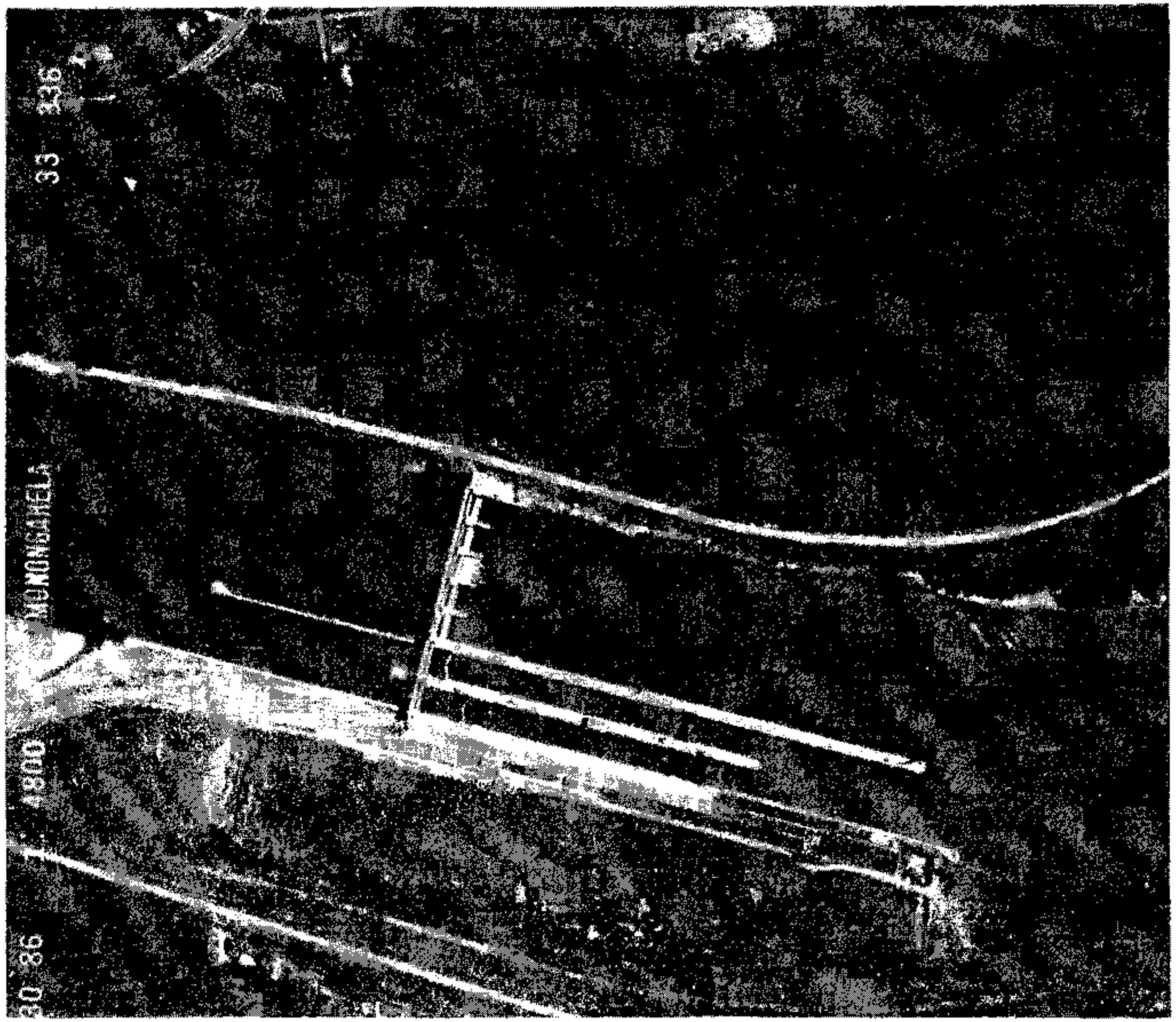

Figure C-8. Recent aerial photograph of Maxwell L&D (FERC No. 8908).

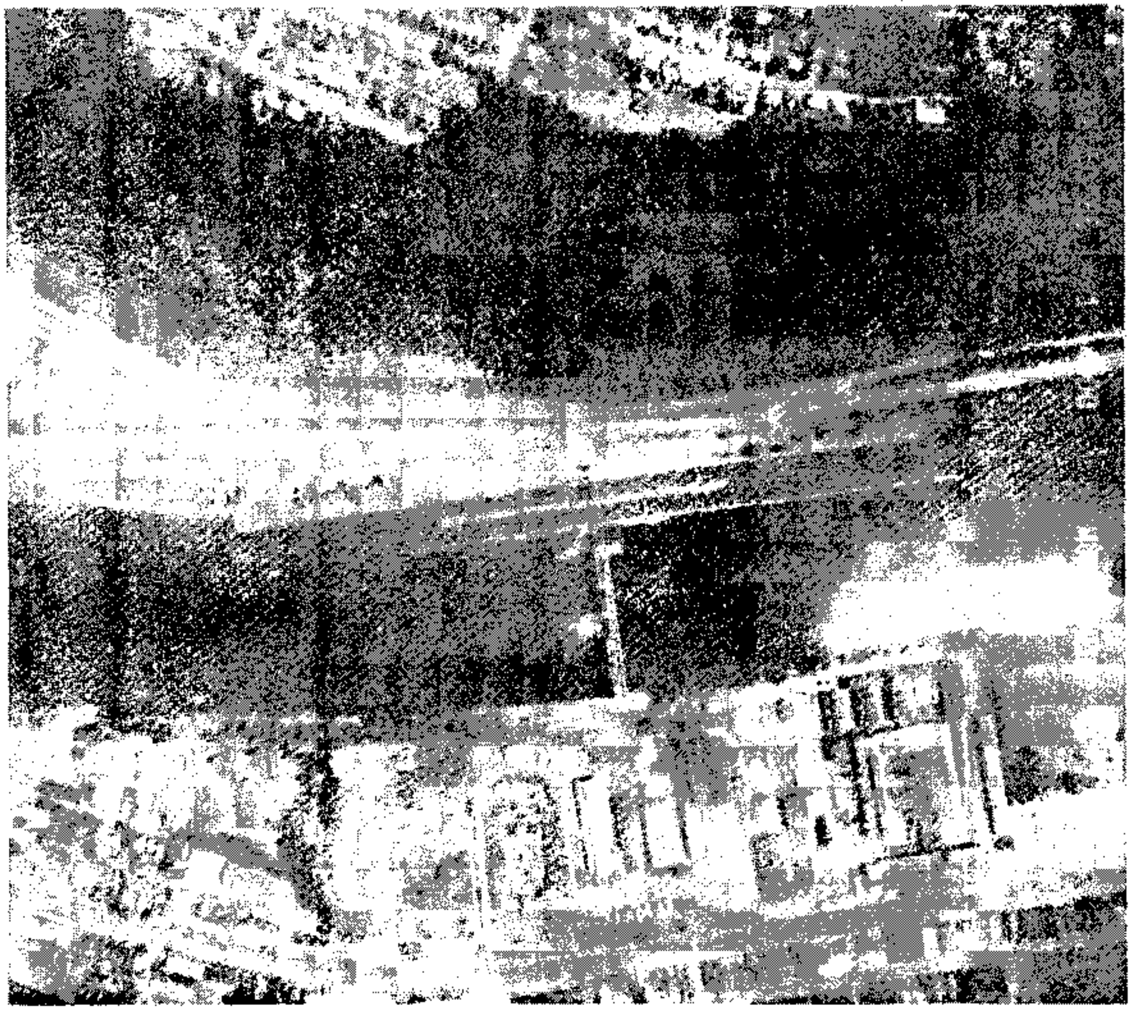

Figure C-9. Recent aerial photograph of Monongahela L&D No. 4 (FERC No. 4675)

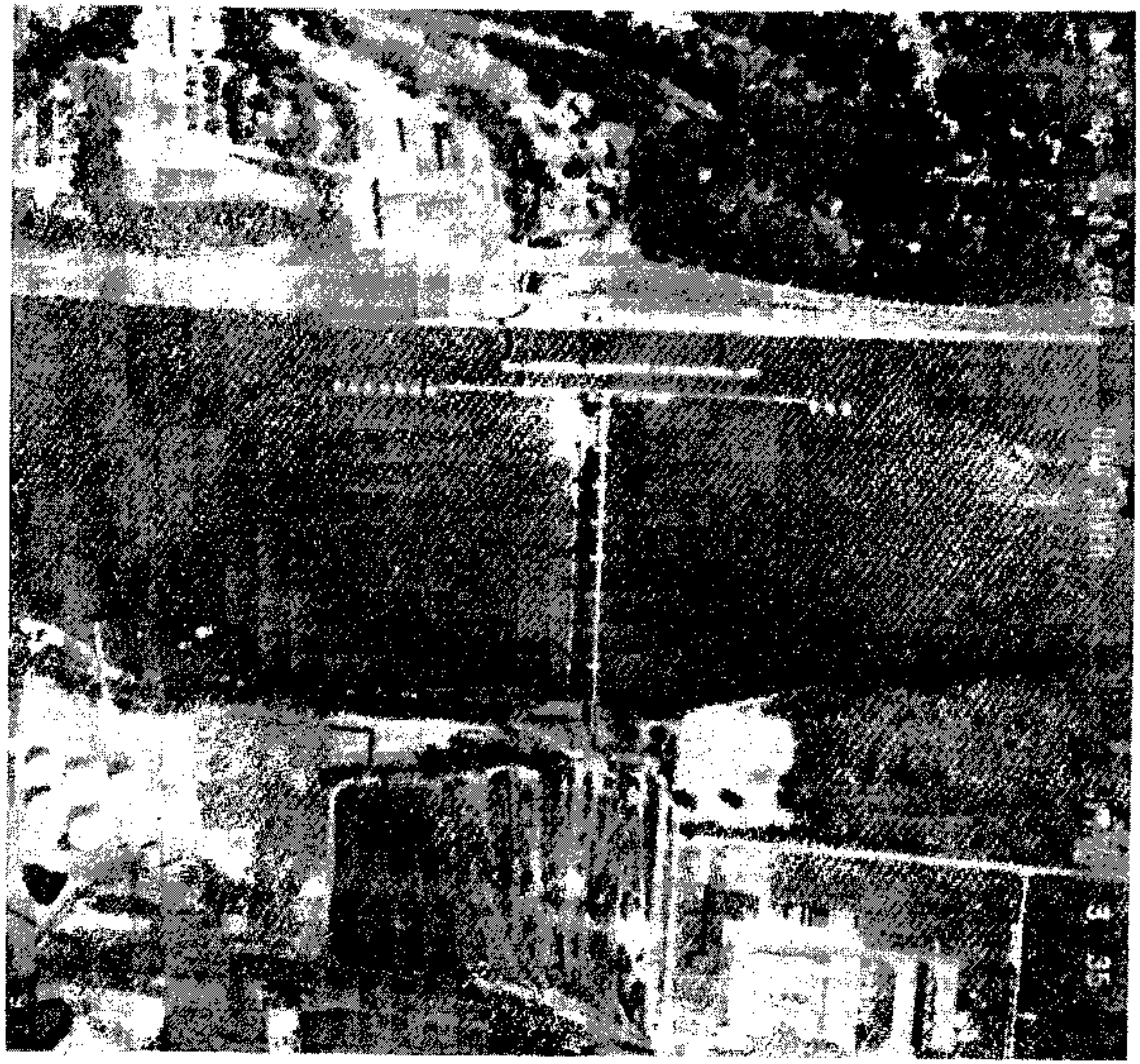

Figure C-10. Recent aerial photograph of Emsworth L&D (FERC No. 7041).

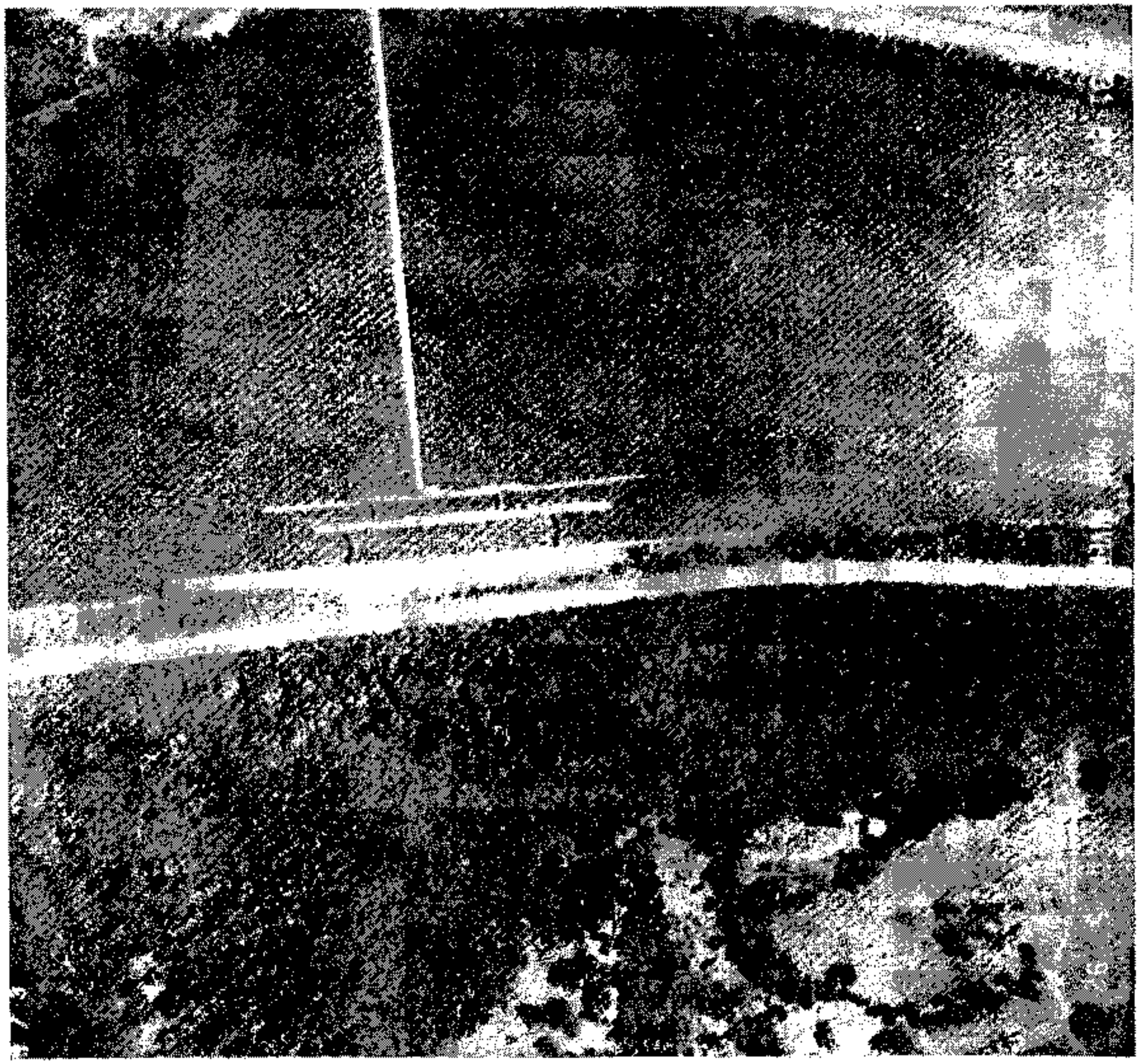

Figure C-11. Recent aerial photograph of Dashields L&D (FERC No. 7568).

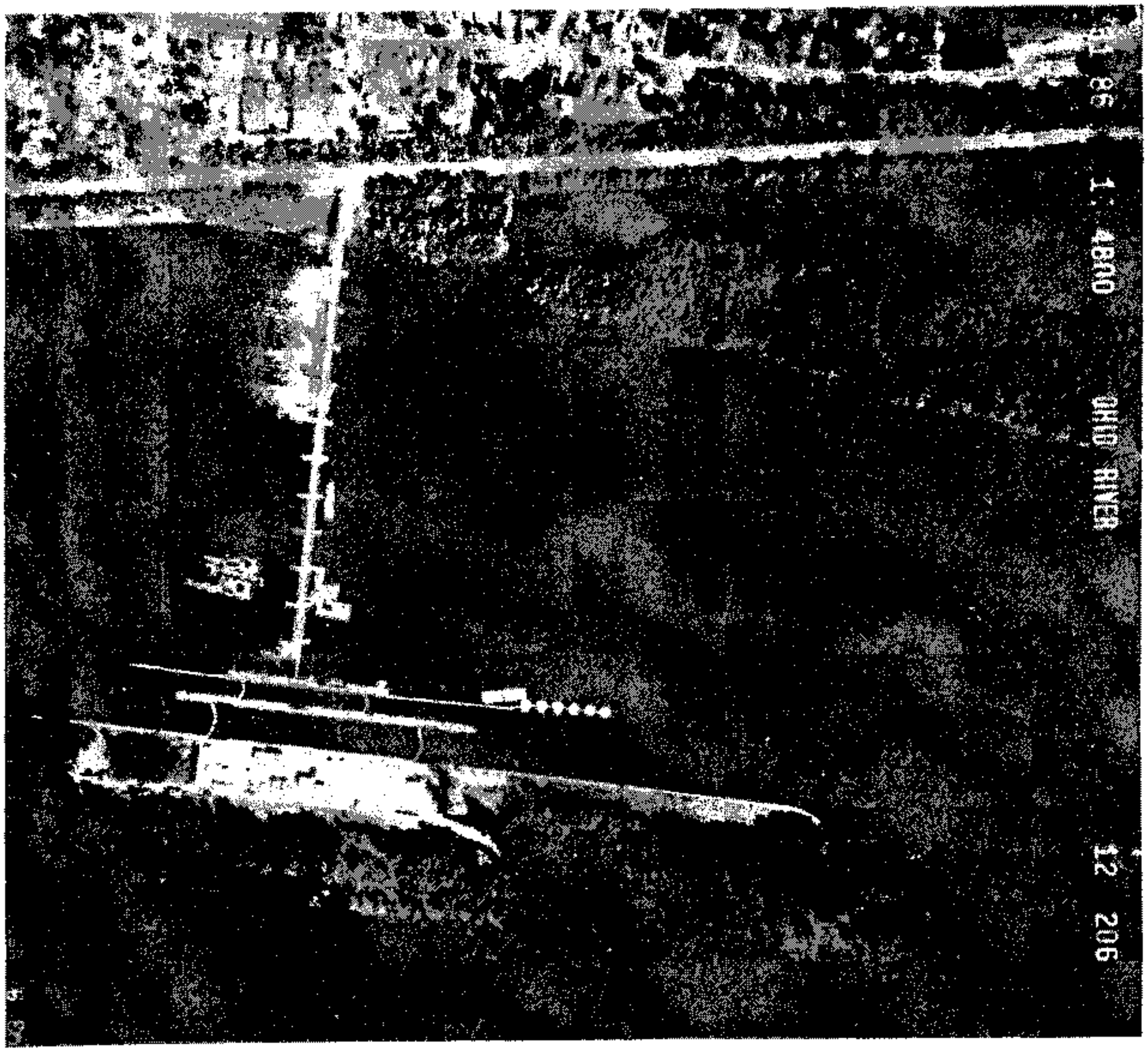

Figure C-12. Recent aerial photograph of Montgomery L&D (Competing applications - FERC Nos. 2971 and 3490).

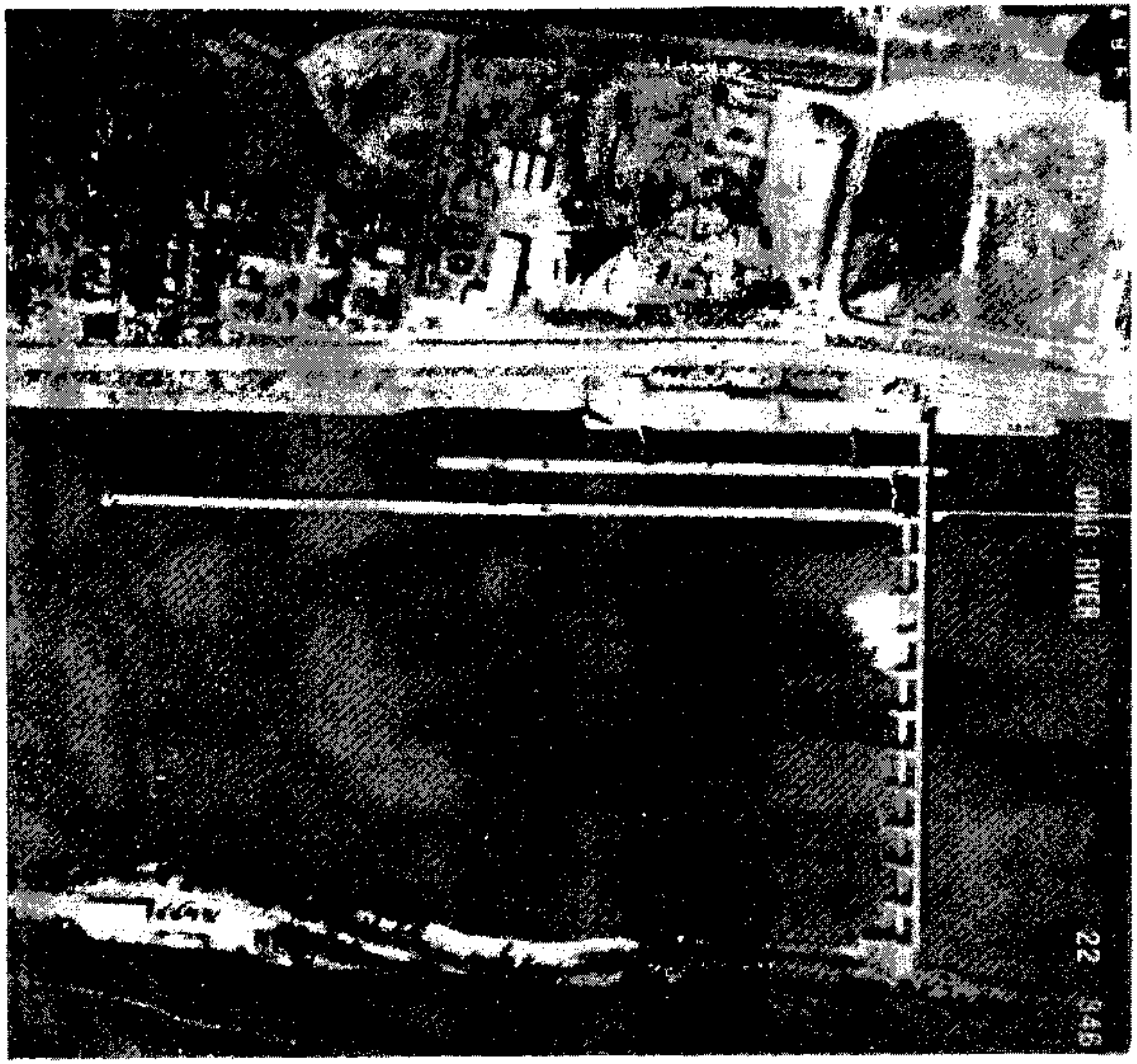

Figure C-13. Recent aerial photograph of New Cumberland L&D (Competing applications - FERC Nos. 6901 and 10332).

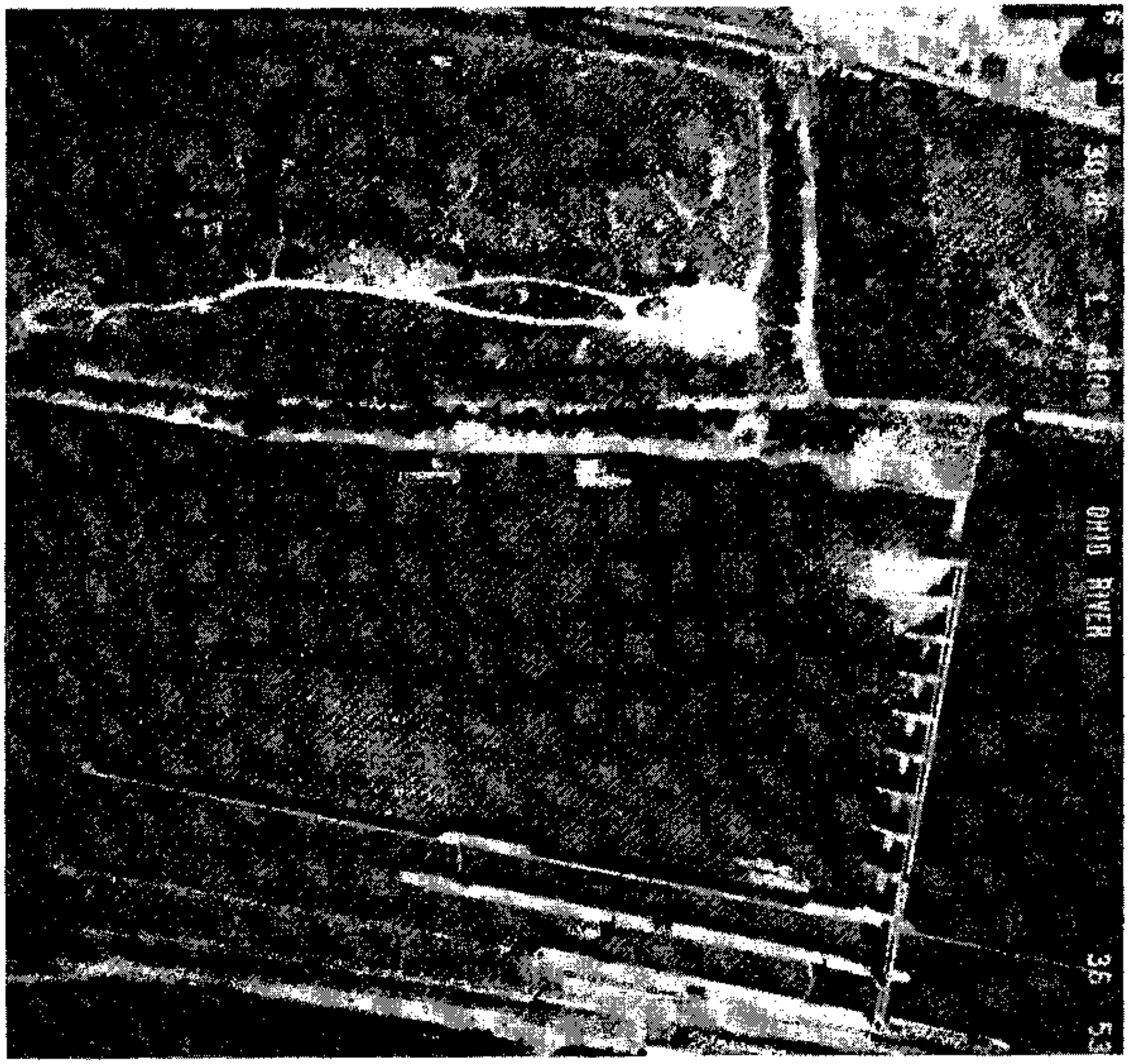

Figure C-14. Recent aerial photograph of Pike Island L&D (FERC No. 3218).

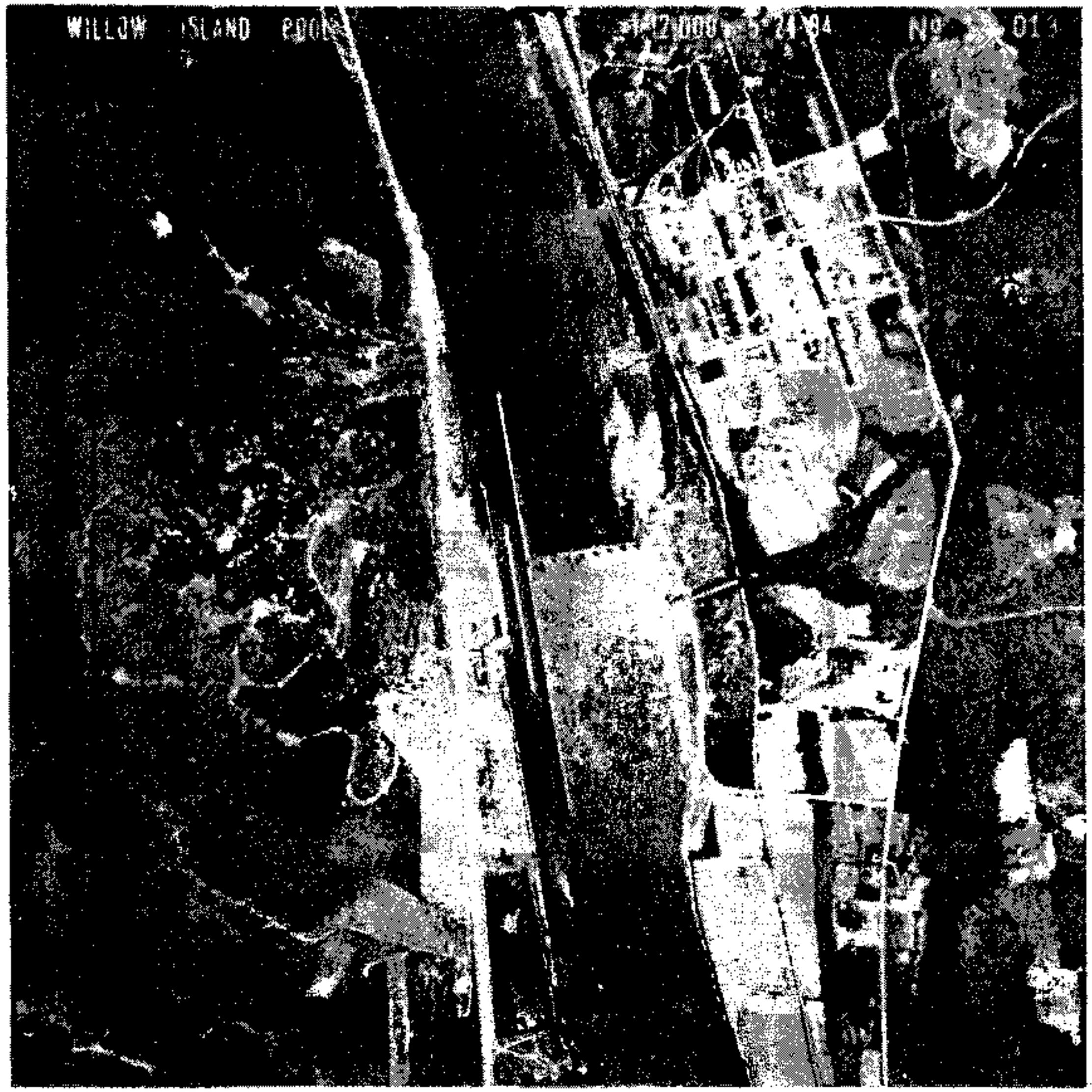

Figure C-15. Recent aerial photograph of Willow Island L&D (Competing applications - FERC Nos. 6902 and 9999).

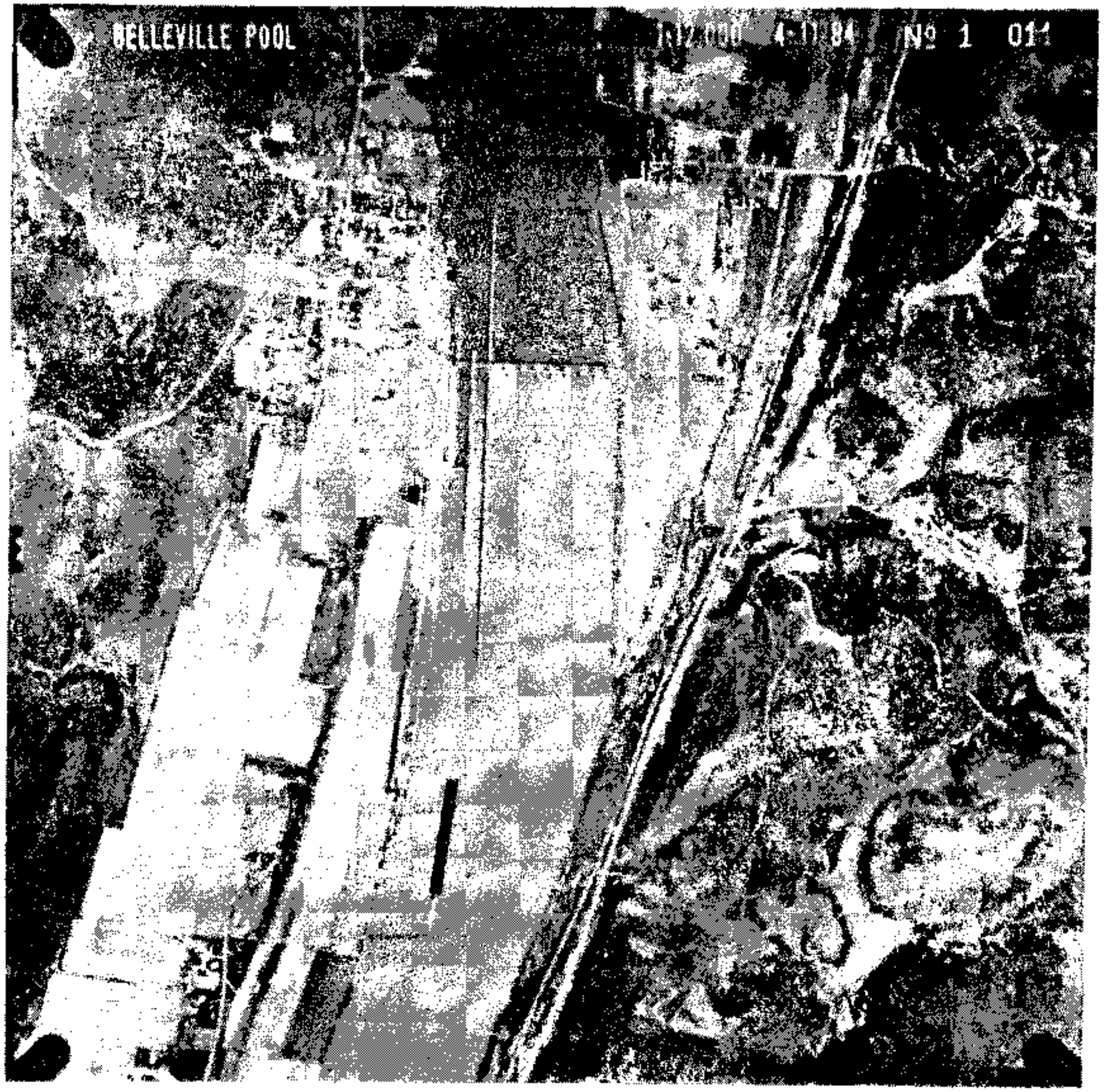

Figure C-16. Recent aerial photograph of Belleville L&D (FERC No. 6939).

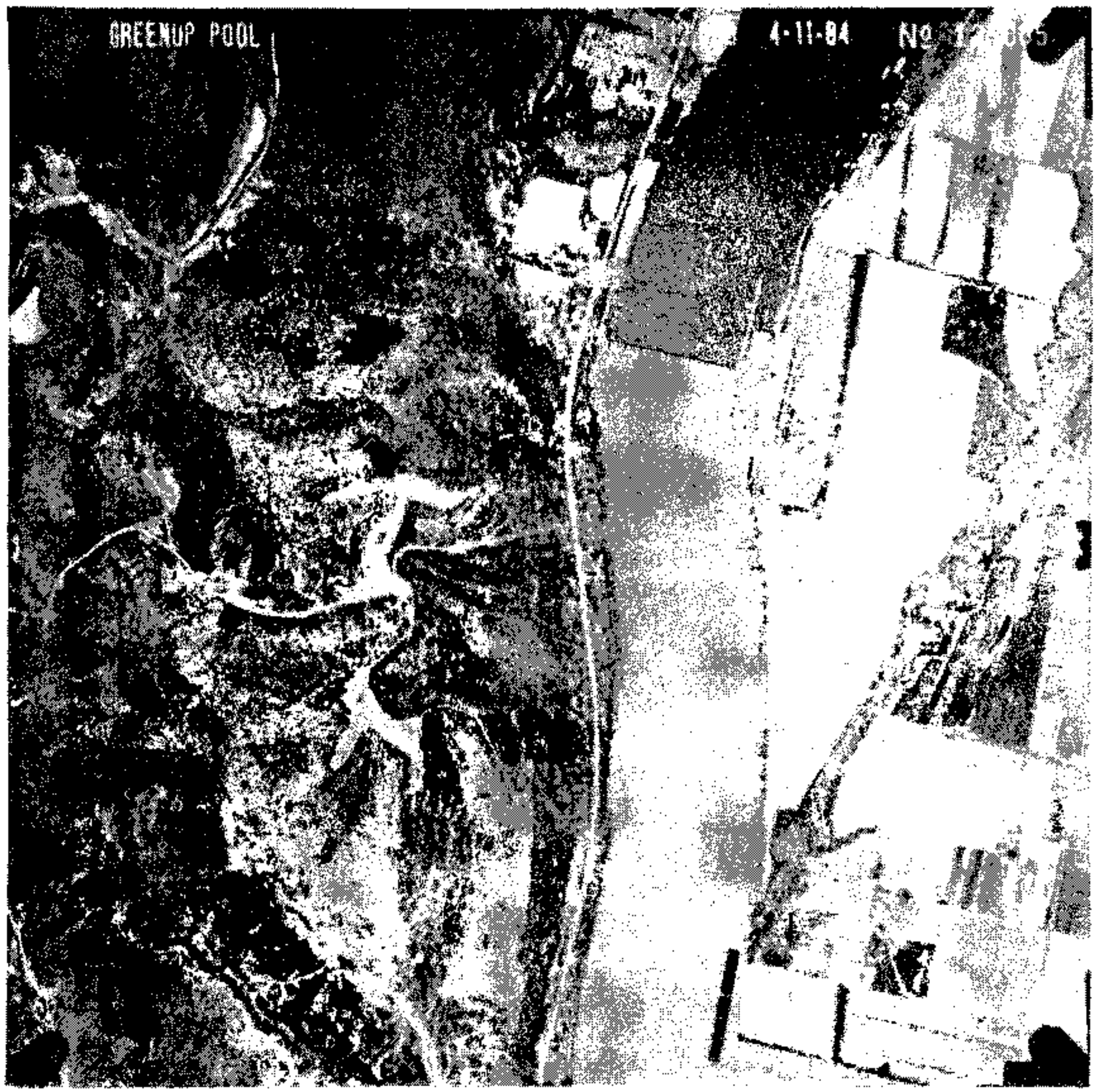

Figure C-17. Recent aerial photograph of Gallipolis L&D (Competing applications - FERC Nos. 9042 and 10098).

Figure C-18. Recent aerial photograph of Muskingum L&D No. 3 (FERC No. 6998).

Figure C-19. Recent aerial photograph of Tygart Dam (Competing applications FERC No.7307 and 7399).

APPENDIX D

ACCESS FACILITIES INVENTORIED IN THE OHIO RIVER ACCESS STUDY

Table D. Access facilities inventoried in the Ohio River access study.

Navigational pool	Launch ramp facilities	Launch lanes	Unuseable launch ramp facilities	Launch lanes	Total/useable launch lanes	Car/trailer parking spaces	Total/useable car trailer spaces	Car parking spaces	Boat dock (wet berths)
New Cumberland (Ohio)									
Public	5	5			5	45	45	132	143
Private	1	1	1	1		25		30	0
Total	6	6	1	1	5	70	45	162	143
New Cumberland (West Virginia)									
Public	3	4	1	1	3	40	40	60	60
Private	2	2			2	25	25	87	87
Total	5	6	1	1	5	65	65	147	147
Pike Island (Ohio)									
Public	2	3	1	1	2	135	60	110	76
Private	3	3			3	60	60	70	86
Total	5	6	1	1	5	195	120	180	162
Pike Island (West Virginia)									
Public	3	4			4	95	95		
Private	1	1			1	40	40	50	50
Total	4	5			5	135	135	50	50
Hannibal (Ohio)									
Public	3	4			4	135	135	61	
Private						30	30	45	71
Total	3	4			4	165	165	106	71
Hannibal (West Virginia)									
Public	1	2			2	15	15	46	
Private	6	6	1	1	5	25	10	50	93
Total	7	8	1	1	7	40	25	96	93
Willow Island (Ohio)									
Public	5	8	2	2	6	106	106	310	5
Private									
Total	5	8	2	2	6	106	106	310	5
Willow Island (West Virginia)									
Public	8	18			18	170	170	65	51
Private									
Total	8	18			18	170	170	65	51

Table D. (Continued)

Navigational pool	Launch ramp facilities	Launch lanes	Unuseable launch ramp facilities	Launch lanes	Total/useable launch lanes	Car/trailer parking spaces	Total/useable car trailer spaces	Car parking spaces	Boat dock (wet berths)
Belleville (Ohio)									
Public	5	10	2	2	8	287	237	320	50
Private	8	8	4	4	4	8	8	120	140
Total	13	18	6	6	12	295	245	440	190
Belleville (West Virginia)									
Public	3	10			10	136	136	30	40
Private						30	30	45	98
Total	3	10			10	166	166	75	138
Racine (Ohio)									
Public	1	1			1	10	10	115	
Private									
Total	1	1			1	10	10	115	
Racine (West Virginia)									
Public	1	4			4	100	100		
Private									
Total	1	4			4				
Gallipolis (Ohio)									
Public	9	14	1	2	12	149	149	219	120
Private									
Total	9	14	1	2	12	149	149	219	120
Gallipolis (West Virginia)									
Public	3	4			4	50	50	116	70
Private									
Total	3	4			4	50	50	116	70
Greenup (Ohio)									
Public	5	12			12	140	140	415	242
Private									4
Total	5	12			12	140	140	415	246
Greenup (West Virginia)									
Public	5	11				320		580	232
Private						20		10	90
Total	5	11				340		590	322

APPENDIX E

APPROACH USED TO MODEL THE IMPACTS
OF DISSOLVED OXYGEN CHANGE ON FISH GROWTH

APPENDIX E

E.1 INTRODUCTION

A 3-tiered approach was taken to analyze the impacts of reduced dissolved oxygen content of river water on fishes (Section 4.1.2.1). The first, most simple tier was comparison of predicted dissolved oxygen concentrations along the river length after hydroelectric installations are completed to applicable state water quality standards for dissolved oxygen. The second analytical tier compared the estimated dissolved oxygen concentrations along the river length to the suite of data presented in the latest EPA water quality criteria document for dissolved oxygen (EPA, 1986). This criteria document includes species-specific data on the life stages generally thought to be most sensitive to low oxygen content of water (juveniles), and it recommends levels of protection somewhat more stringent than current state standards.

This appendix describes the third tier of our analysis of the impacts of dissolved oxygen change on fish, which involves bioenergetics modeling. The oxygen-, temperature-, and size-dependent energetics of juvenile fish growth is modeled to estimate alterations in fish biomass production over a typical growing season due to projected effects of hydroelectric development on dissolved oxygen concentrations of the upper Ohio River system. Bioenergetics models have attained widespread use for estimating impacts of environmental conditions on fishes (Kitchell et al., 1977; Adams and Breck, in press).

Modeling is advisable for several reasons. First, because the impact of dissolved oxygen change on fish metabolism and growth is incremental and continuous rather than discrete over concentrations often found in the natural environment. That is, reduction in dissolved oxygen content of the water, even at generally accepted levels above water quality standards, can have some effect. The effect is small at high oxygen concentrations and it becomes more pronounced at lower concentrations. There is a more discrete "critical oxygen concentration" (usually, but not always, below water quality standards) below which oxygen metabolism decreases rapidly. Second, it is useful to use models to include the important influence of water temperature on fish metabolism throughout the range of oxygen concentrations. Temperature determines rates of metabolism and the levels of oxygen availability that are "critical." A third reason to use models is to incorporate the influence of fish size on metabolism and growth. Models can integrate size-specific effects as fish grow and yield an endpoint of accumulated biomass at the end of a growing season. It is also possible to include effects of various feeding rates, which can be slowed by depressed oxygen levels in the water, and other water quality features (e.g., ammonia) in bioenergetics models.

E.2. CHOICE OF THE BIOENERGETICS-BASED POND CULTURE MODEL

EPA's dissolved oxygen criteria document (EPA, 1986) notes that "A detailed discussion and model for evaluating interactions among temperature, dissolved oxygen, ammonia, fish size, and ration on the resulting growth of individual fish (Cuenco, Stickney, and Grant, 1985a-c) provides an excellent, in-depth evaluation of potential effects of dissolved oxygen on fish growth." Discussions with the author of the EPA document (personal communication, G. Chapman, EPA, Newport, Oregon) amplified the belief that this model is the best currently available for evaluating impacts of changing dissolved oxygen concentrations on long-term fish health in the context of other system dynamics. We, therefore, chose the Cuenco, Stickney, and Grant model for this analysis of the cumulative impacts of installing hydroelectric facilities on the upper Ohio River system.

The Cuenco, Stickney, and Grant model was developed for evaluating growth of channel catfish in a simple pond environment in Texas under varying conditions of aquaculture. Some conditions were controlled (e.g., stocking rate, artificial feeding rate, initial size distribution), whereas others changed according to season, pond productivity, and fish growth and competition (e.g., temperature, light, ammonia concentration, dissolved oxygen, natural food). The model includes an individual fish growth component and a population growth component; a pond environment submodel generates many of the pond's environmental features through a growing season. The size distribution of stocked fish at the end of the growing season and the percentage of fish above a marketable size were the main endpoints of the original application.

Although the Cuenco, Stickney, and Grant model contains elements specific to channel catfish aquaculture in ponds, it is capable of being generalized to other environments and other species. The environmental features with which the fish interact in the model are common to fish living in any water body. Input parameters such as artificial feeding can be replaced with estimates of natural food availability. Oxygen concentrations that are driven in the original model by biodegradation of uneaten food and phytoplankton can be replaced by inputs from another water quality model of interest, such as from the Ohio River. The attributes are similar wherever applied: the ability to estimate the capacity of a valued fish species to attain weight gain under an array of environmental conditions. For our application, changing dissolved oxygen is of central importance. Growth parameters in the model are specified according to the fish species; parameters in the Cuenco, Stickney, and Grant formulation for population growth were estimated for channel catfish. We substituted parameter estimates for other species as well.

E.3 MODEL DESCRIPTION

E.3.1 Individual Fish Bioenergetics Model

The growth of fish is a complex process that represents the net outcome of a series of physiological and behavioral processes beginning with food intake and culminating in deposition of animal tissue (Brett, 1979). For a given time period, the energy consumed must equal the sum of energy losses in the form of wastes, the energy used to perform work (e.g., swimming), and the change in energy of the body (Warren and Davis, 1967):

$$I = E + M + G \, , \tag{1}$$

where I is the food ingested, E is the total amount of waste excreted (feces, urine, wastes lost through the gills and skin), M is total metabolism, and G is the change in energy of the body or growth. These terms are measured in kilocalories (kcal) of energy (1 kcal = 4.1868 kJ) and refer to a particular time period, T, in days. Intake and excretion are often handled together, and the equation can be rearranged to solve for growth, as:

$$G = AR * I - M \, , \tag{2}$$

where AR is the assimilation ratio for the particular food ingested by the fish.

All of these processes are a function of body size:

$$EAT = I / W * T \tag{3}$$
$$RES = M / W * T \tag{4}$$
$$GR = G / W * T \, , \tag{5}$$

where EAT is relative food consumption rate in kcal of food per day per kcal of fish, RES is relative respiration rate in kcal respiration per kcal of fish, GR is relative growth rate in kcal growth per day per kcal of fish, W is mean energy of the body of the fish in kcal, and T is the period of time in days. Substituting Equations 3-5 into Equation 2, we get:

$$GR = AR * EAT - RES \, . \tag{6}$$

Thus, from a bioenergetic standpoint, the growth of a fish can be expressed as the difference between the amount of food energy the fish consumes and the distribution of this food into various losses and uses, each of which is proportional to the size of the fish at the moment.

Although Equation 6 is a useful relationship, it describes the fish only under one set of environmental conditions. Growth in freshwater fishes is governed by a variety of environmental factors (Brett, 1979) including water temperature, dissolved oxygen concentration, photoperiod, unionized ammonia concentration, and food availability. Genetic features of the species also determine characteristic growth responses. Water temperature sets the pace of metabolic activity in cold-blooded organisms. Dissolved oxygen is needed for respiration. Unionized ammonia is an index of waste accumulation that depresses growth.

In formulating a growth model for aquaculture, Cuenco, Stickney, and Grant (1985a-b) identified size or weight of the fish (W), water temperature (TP), dissolved oxygen concentration (DO), food (FD), and unionized ammonia concentration (AM) as most important. They likewise will be the most important for evaluating effects of dissolved oxygen changes in natural environments.

Because the effect of any factor on growth is through its influence on food consumption and metabolism, the basic approach used by Cuenco, Stickney, and Grant to structure the model was to define the biological relationships of each factor to food consumption and metabolism and then find an appropriate mathematical expression to approximate the known biological relation. The specific formulations are found in the papers.

Dissolved oxygen is a limiting factor characterized by dependent and independent states. Increasing DO up to a critical value (DOCRIT) at constant levels of all other factors increases the fish's appetite and feeding. There is also a lower level of DO (DOZERO) at which appetite, feeding, and metabolism cease. DOCRIT and DOZERO are both dependent on the respiration rate of the fish (Davis, 1975; Herreid, 1980). High metabolic rates (e.g., from high temperatures) increase DOCRIT and DOZERO, while low metabolic rates depress them.

E.3.2 Population Growth and Pond Culture Models

The pond culture model used for this impact assessment is a combination of the individual fish bioenergetic model just described (Cuenco, Stickney, and Grant 1985a,b), with a population growth model and a pond environment model (Cuenco, Stickney, and Grant, 1985c). The population growth model was developed from the individual fish bioenergetics model by including social interactions, mostly competition for food. It also includes the influences of seasonal and diel temperature fluctuations and of diel oxygen oscillations. The pond environment model calculates various environmental characteristics of a pond ecosystem during a growing season. Many features of the population growth and pond environment submodels are not relevant to the Ohio River system study and were removed or set to constants. The output values, however, were retained.

The following assumptions and limitations define the set of conditions to which the population growth model applies:

1. Only the growth stage from fingerling (past yolk sac and well beyond first feeding) to the end of the first growing season is considered.
2. No reproductive activity occurs during the growth phase.
3. Because diet quality is complex and difficult to quantify, a fixed diet of high quality is assumed.
4. Lethal factors are absent.
5. The species being evaluated exists in a monoculture.

For the pond culture model, growth of a known number of fish with a specified weight and coefficient of variation is started at a certain date in a known water volume. The water volume is assumed to be well mixed and all water quality features uniform in space but changing in time. The seasonal temperature cycle determines the end of the growing season. Fish growth is terminated at temperatures known to inhibit weight gain of the species.

The minimum diel DO should be used as DO input to the growth model. A few revealing studies have shown that diel fluctuations in DO result in lower growth rates and a higher critical level of DO for fishes than would be expected from the average DO (Fisher, 1963 for coho salmon; Stewart, Shumway, and Dondoroff, 1967 for largemouth bass; Whitworth, 1968 for brook trout). Periods of higher DO in a daily cycle do not compensate for periods of low DO. This require-ment is difficult to apply to the Ohio River assessment, however, because data on diel variations are scanty. Where they do occur, the diel change seems to amount to only a few tenths of a milligram per liter. The dissolved oxygen model used to calculate concentrations in the water quality analyses (Section 4.1.1 and Appendix B) also do not consider diel variations. Thus, the bioenergetics model is run using typical (average) values.

Outputs of the pond culture model that are used to evaluate effects of DO changes in the upper Ohio River system are (1) average weight of fish at the end of the growing season with coefficient of variation, (2) average absolute growth rate for the growing year, (3) the total weight of the initial group of fish at the end of the growing season kilograms per hectare (kg/ha), (4) the total harvestable weight of the initial group of fish at the end of the growing season (kg/ha) (harvestable being above a certain size limit appropriate for the fishery), (5) average yield (kg/ha/day), and (6) average harvestable yield (kg/ha/day). All of these results are to be considered relative among the scenarios tested, and not true predictions of yields. Average weight at the end of the growing season appears to summarize the results adequately for assessment of impacts from alternatives.

E.4. PARAMETER ESTIMATION

The bioenergetic growth model requires 17 species-specific parameters. The model as developed by Cuenco, Stickney, and Grant was tested for four species: brown trout, rainbow trout, tilapia, and channel catfish. To estimate those parameters, Cuenco, Stickney, and Grant used data for the particular species when available. In the absence of data for a particular species, available data for the most closely related species or "best judgement" were used. Parameter estimates and data sources for species used by Cuenco, Stickney, and Grant in developing and testing the individual fish bioenergetics model are given in those papers. The channel catfish parameters only were used by Cuenco, Stickney, and Grant for extending the bioenergetics model to a population growth model and the pond culture model.

We reparameterized the model for species other than channel catfish that are important for the upper Ohio River system. Although channel catfish is considered by EPA (1986) to be an oxygen-sensitive species, we assumed that cool-water species such as walleye and sauger will be the most sensitive of those in the upper Ohio River system to low dissolved oxygen and high temperature conditions. Parameter values intermediate between those for channel catfish and two trout species, brown and rainbow, were selected as reasonable for the cool-water sauger or walleye. These values were as follows: WEF = -0.30, A = -80, B = 30, WER = 0.20, C = 0.14, D = 0.14, AR = 0.75, RMC = 0.37, TEOPT = 22, TEHIGH = 32 (these parameters are defined in Cueno, Stickney, and Grant, 1985 a-c). All other parameters remained the same.

E.5 APPLICATION TO THE UPPER OHIO RIVER SYSTEM

Typical monthly dissolved oxygen values for the upper Ohio River system as estimated by water quality modeling (Section 4.1.1 and Appendix B) for various no-hydro and operating scenarios are used to drive the fish growth model. These estimates are made at representative monthly times over the fish growing season from April to November, allowing interpolation of daily DO values. Temperatures used in the water quality modeling are also used for estimating fish growth. Three cases were examined: Case One in which river flows reach summer extremes of the 7Q10 summer low flow, Case Two in which a more moderate summer low flow occurs from mid-June through mid-September, and Case Three in which monthly average values are used throughout (Section 4.1.2.1.3).

For purposes of this assessment, the upper Ohio River system is considered to be composed of 55 "ponds," each either the upper or lower half of a navigation pool. The upper half is the tailwater of the upstream dam (often having DO values elevated above those in the lower section because of aeration at many dams). Exceptions are the pools bounding the study area: the upper boundary on the Monongahela River is the Tygart tailwater; only the lower pool segment is considered for the uppermost projects evaluated on the Allegheny River (Allegheny L&D No. 7) and Muskingum River (Muskingum L&D No. 3); and only the tailwater segment is considered in the Greenup pool below Gallipolis. There are two upper sections of the Emsworth pool: one in the Allegheny and the other in the Monongahela. Water quality input values for the fish growth model are averaged within the half-pools.

A hatch of juvenile fish prior to the summer-fall period of depressed dissolved oxygen in the system is assumed in each half-pool according to the life history of the fish species. For each species, 3-gram fish (average) are assumed on June 1. The growth of these juvenile fish is followed through the growing season in each half-pool as the half-pool's temperatures and dissolved oxygen concentrations for the modeled scenario change.

Each half-pool ends the growing season with a set of values describing growth of the DO-sensitive juvenile fish there, as listed above. Differences in these values, as percent decline from preproject conditions, are plotted along the river system (Figures 4.1.1-3 and 4.1.1-6), in a manner that allows comparison among alternative scenarios (e.g., current no-hydro condition, hydro installations as proposed, selected installations only, with and without artificial aeration, etc.). The analysis is thus a comparative one in which it is the relative differences that are important rather than the actual biomass production. Thus, only the relative results are presented.

Although it is reasonable to ask about the effect on populations of a reduction in annual accumulation of growth, this question has not been addressed in this analysis. It is clear, however, that failure to grow sufficiently during the growing season can cause overwinter mortality in several species that have been studied, including smallmouth bass (Shuter et al., 1980) and largemouth bass (Adams, McLean, and Huffman, 1982).

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APPENDIX F

DIAGRAMS SHOWING APPLICANTS' PLANS FOR ENHANCING RECREATION FACILITIES

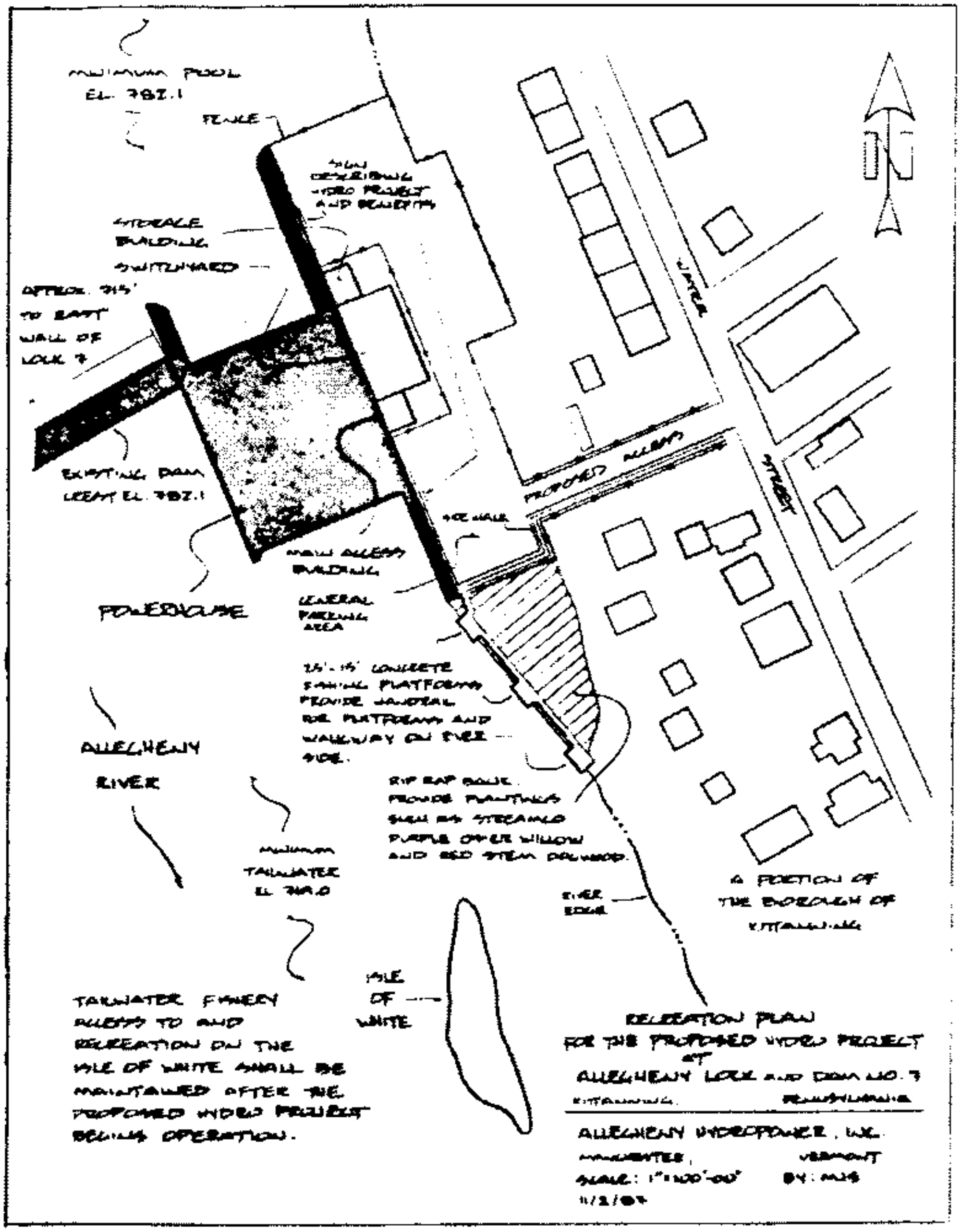


Figure F-1. Proposed recreational enhancements at Allegheny River Lock and Dam No. 7 Project. Source: Allegheny Hydropower, Inc., November 1987.

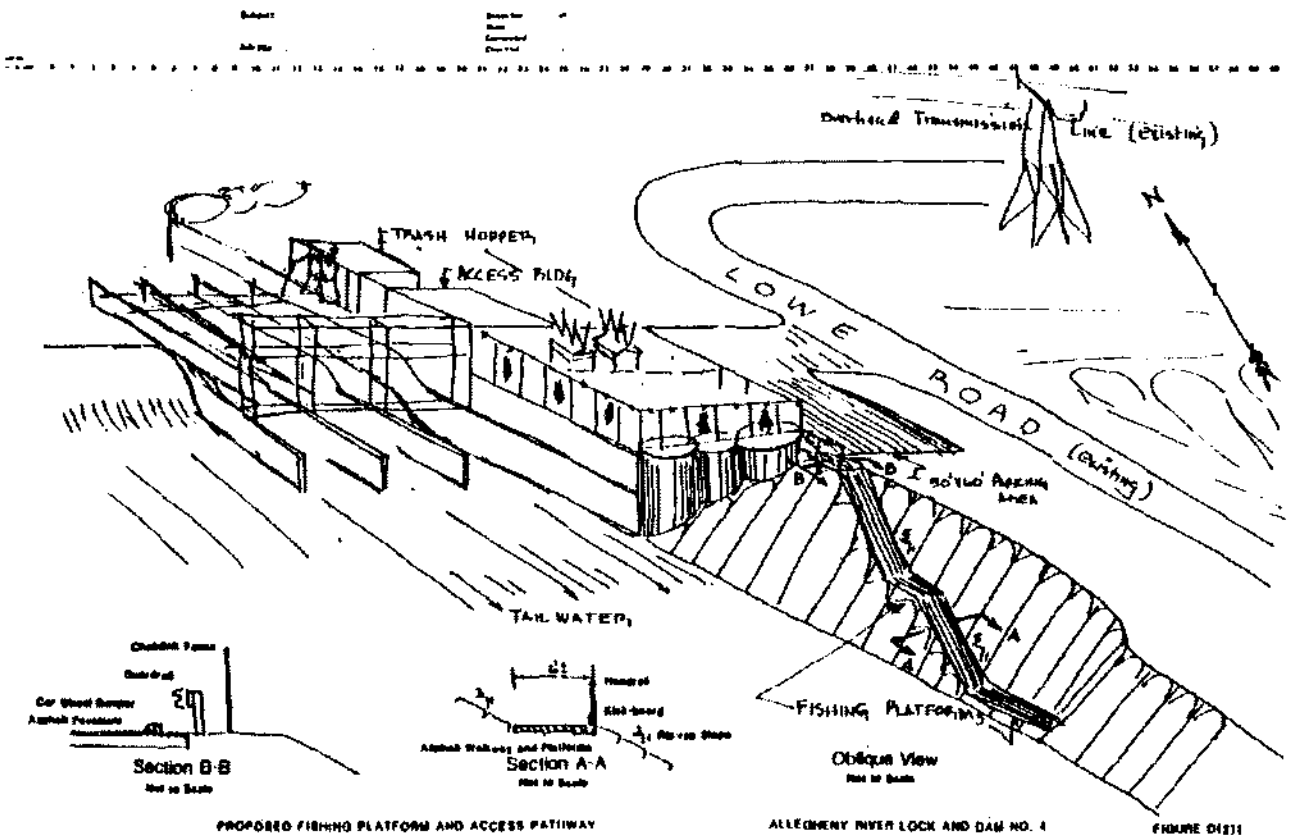


Figure F-2. Proposed recreational enhancements at Allegheny River Lock and Dam No. 4 Project. Source: Allegheny County, November 1984.

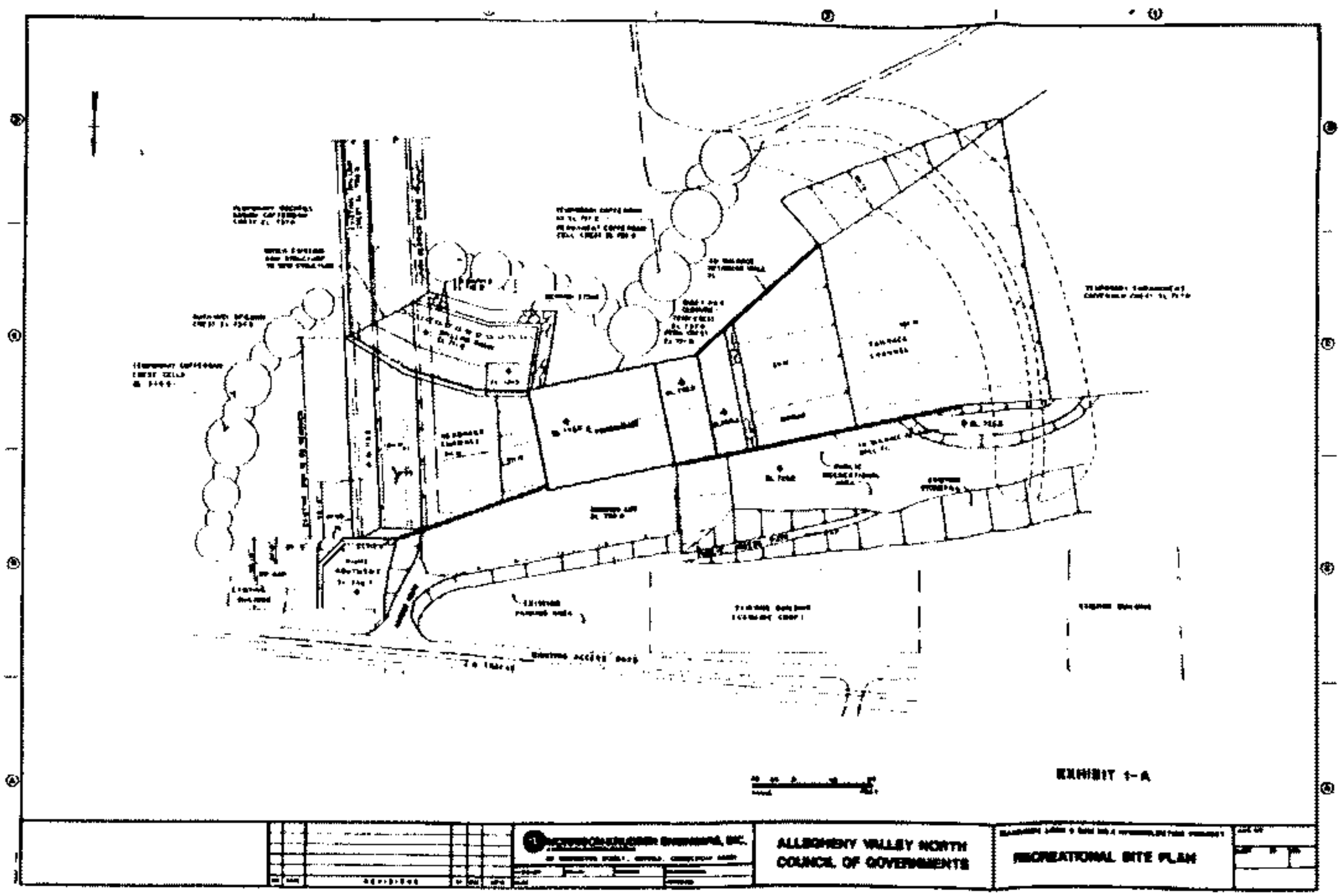


Figure F-3. Proposed recreational enhancements at Allegheny River Lock and Dam No. 3 Project. Source: Allegheny Valley orth Council of Governments, November, 1987.

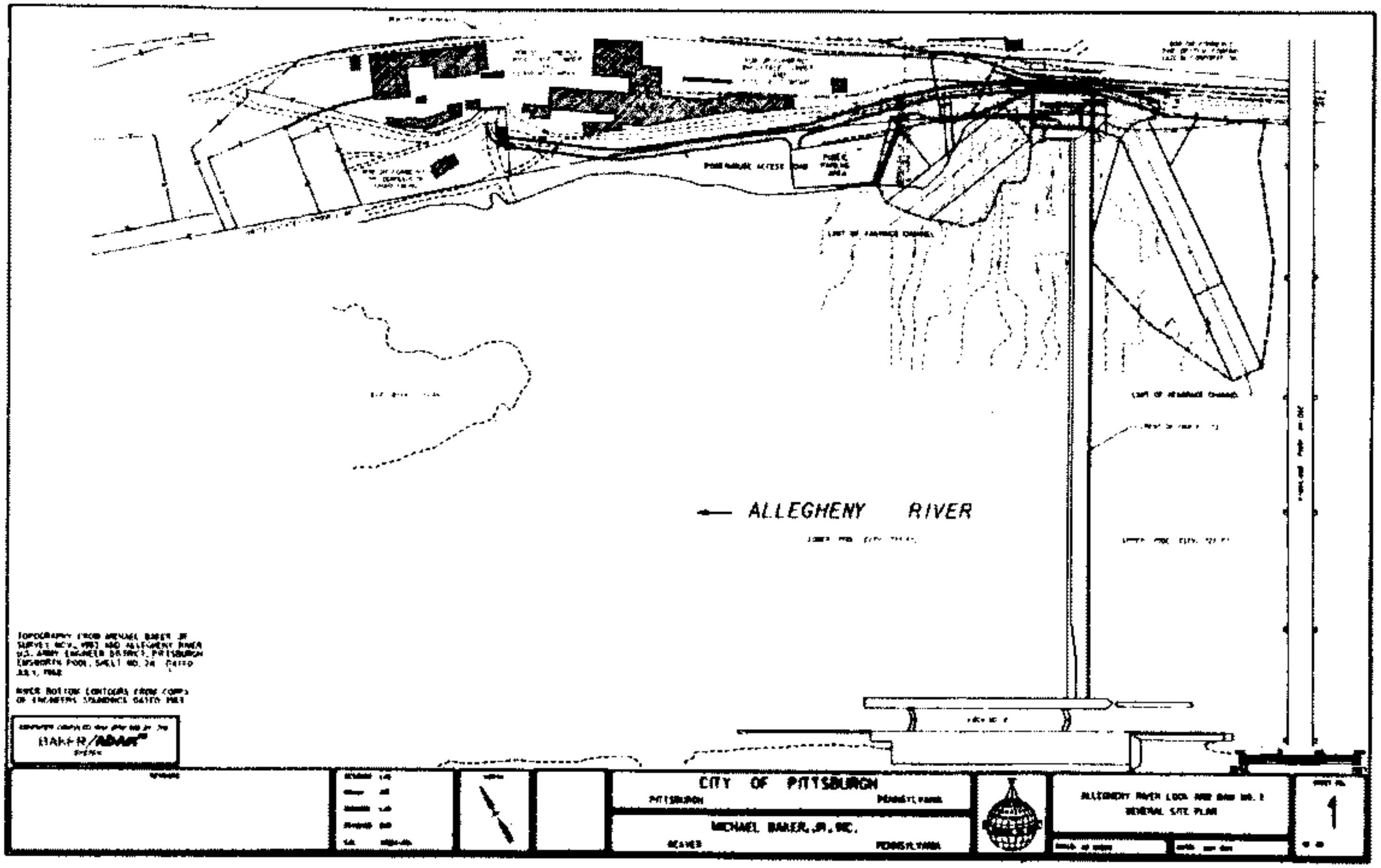


Figure F-4. Proposed recreational enhancements at Allegheny River Lock and Dam No. 2 Project. Source: City of Pittsburgh, October 1987.

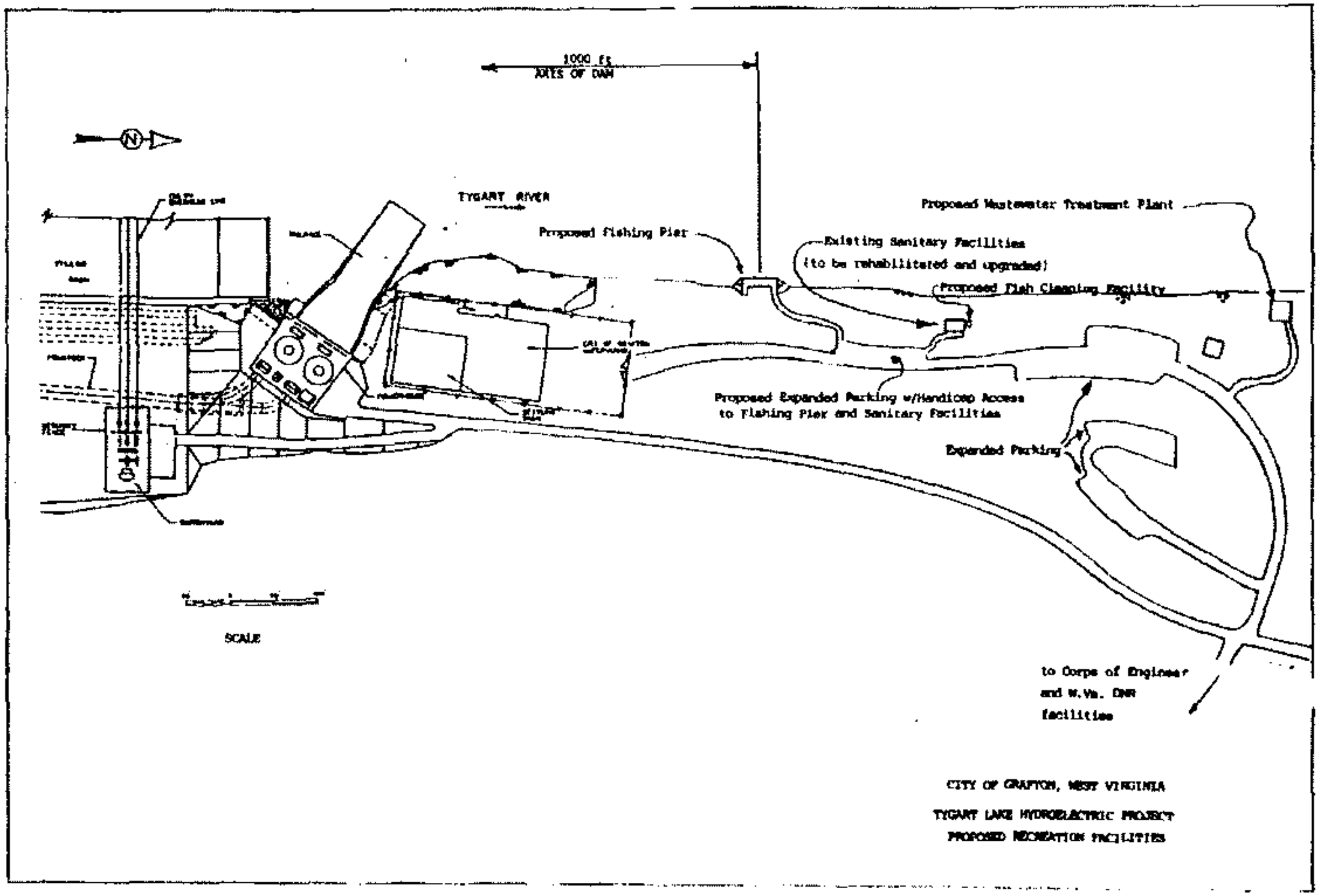


Figure F-5. Proposed recreational enhancements at Tygart Dam Project (FERC No. 7307). Source: City of Grafton, 1987.

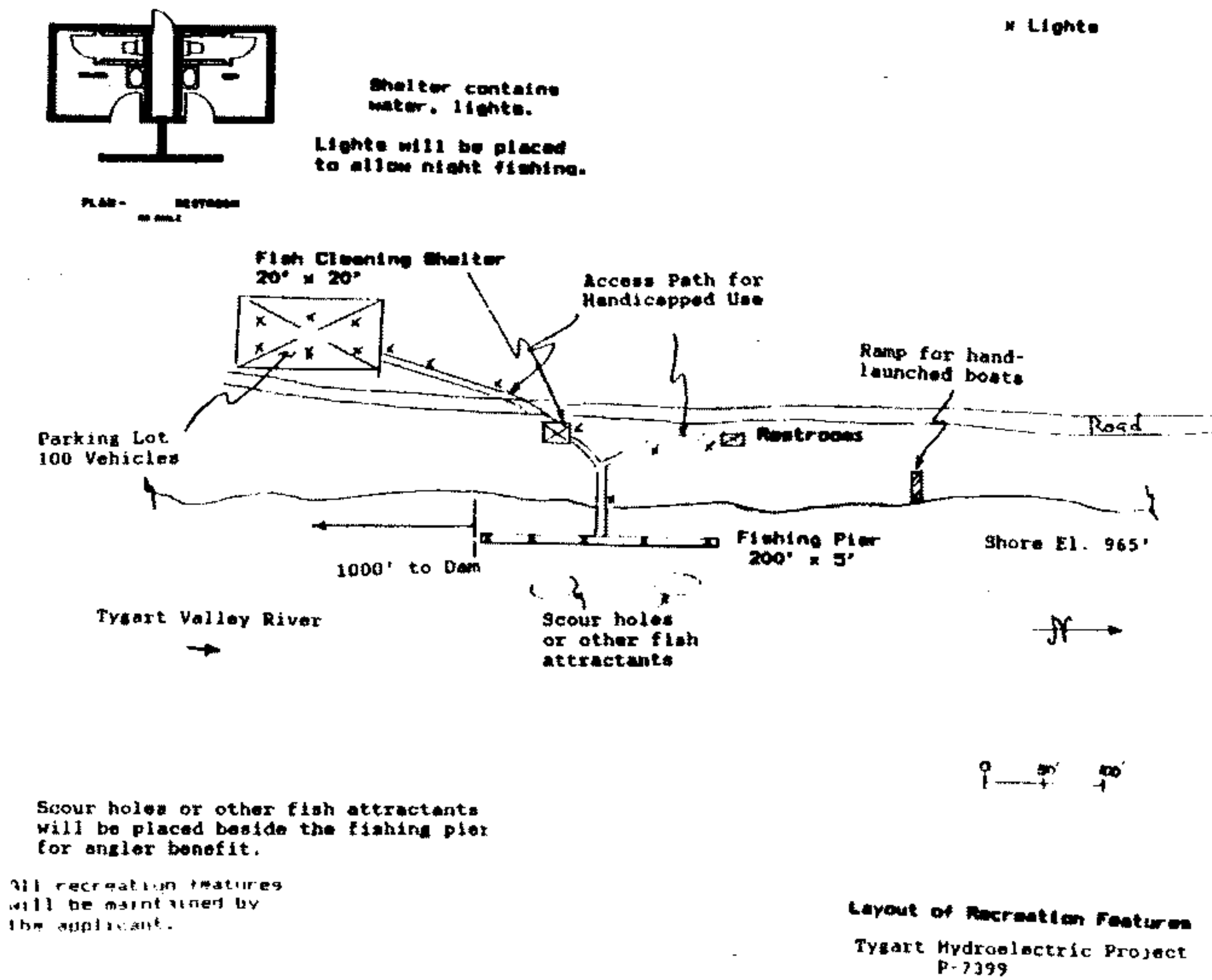


Figure F-6. Proposed recreational enhancements at Tygart Dam Project (FERC No. 7399). Source: Noah Corporation, 1987d.

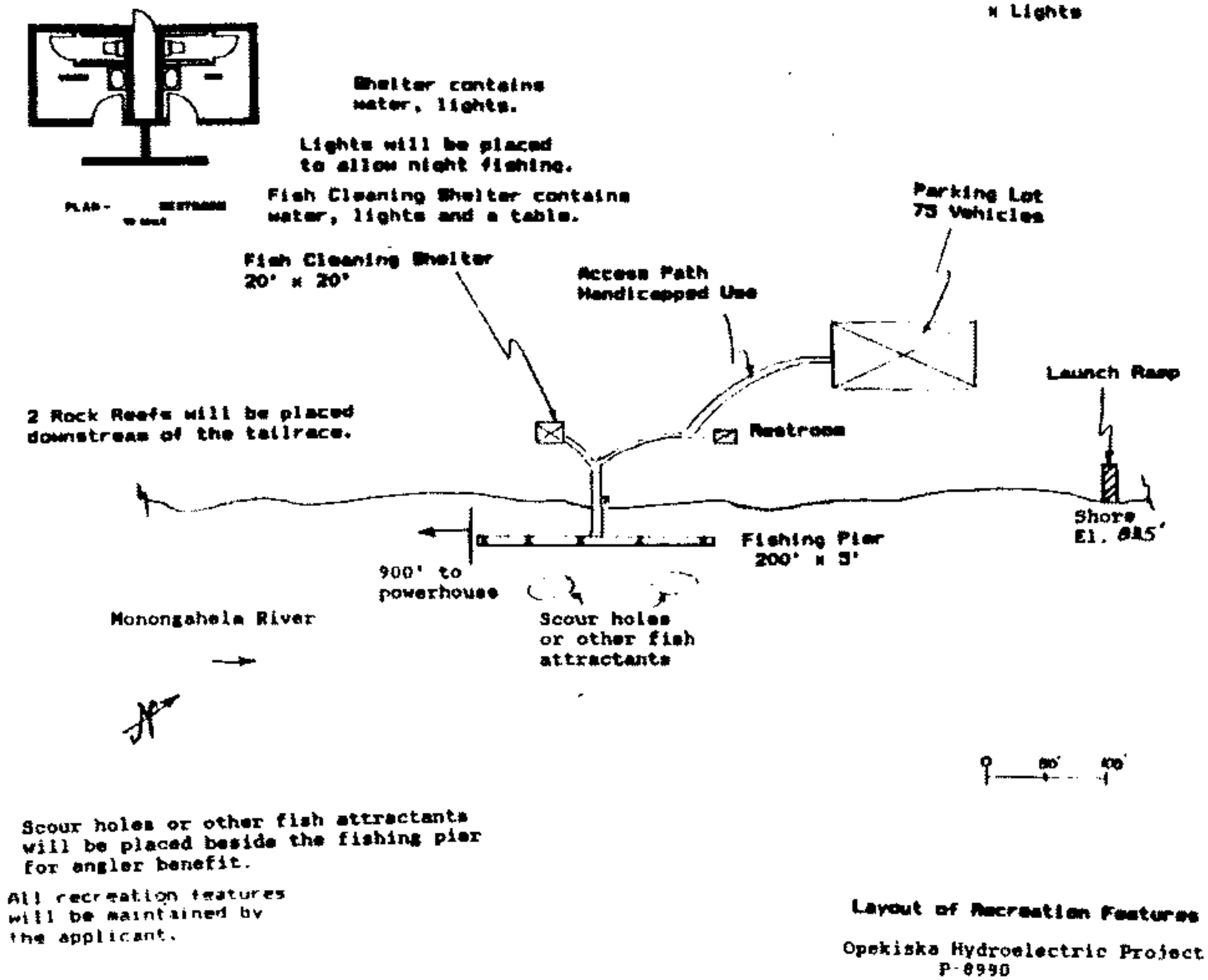


Figure F-7. Proposed recreational enhancements at Opekiska Lock and Dam Project. Source: Noah Corporation, 1987c.

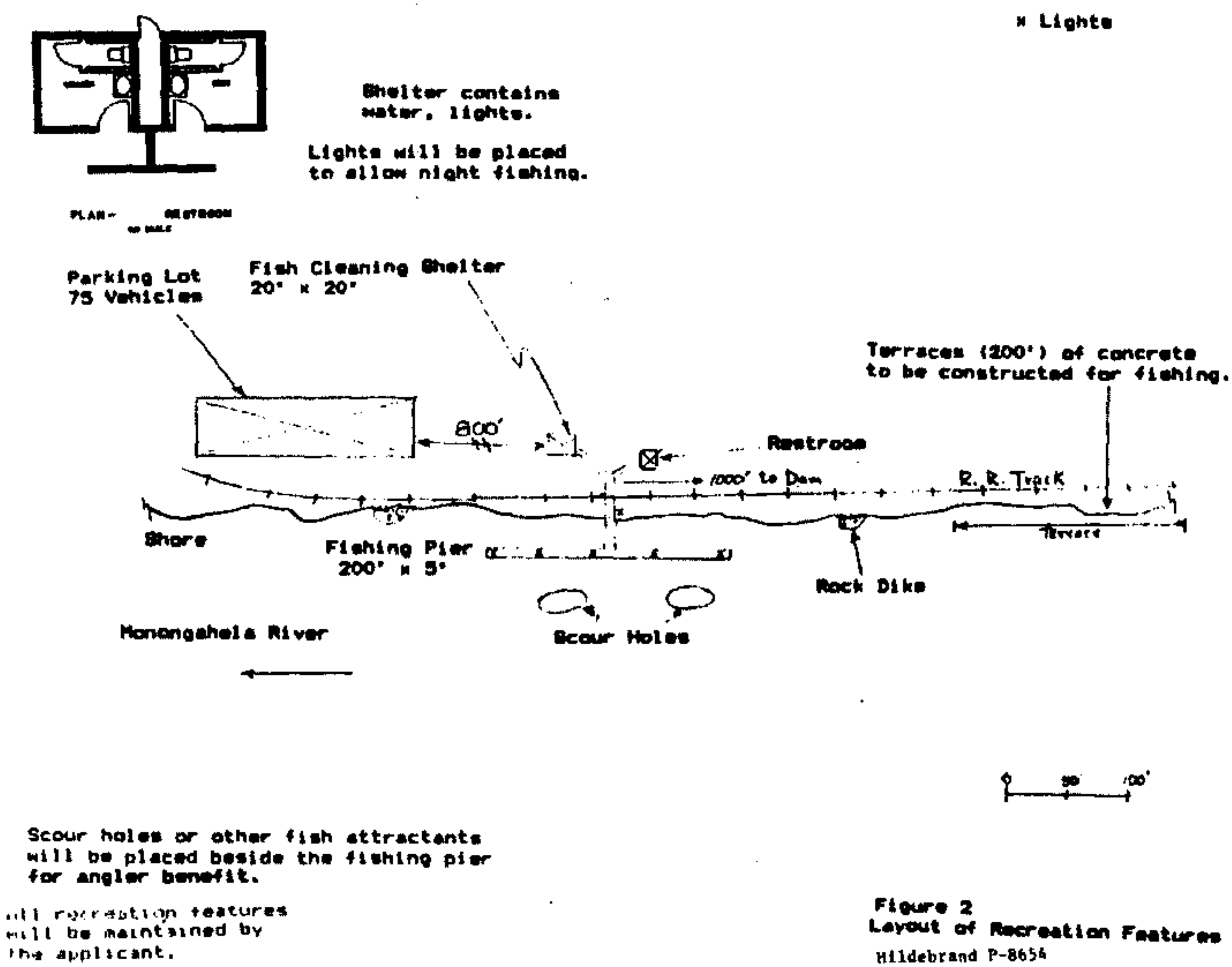


Figure F-8. Proposed recreational enhancements at Hildebrand Lock and Dam Project. Source: Noah Corporation, 1987b.

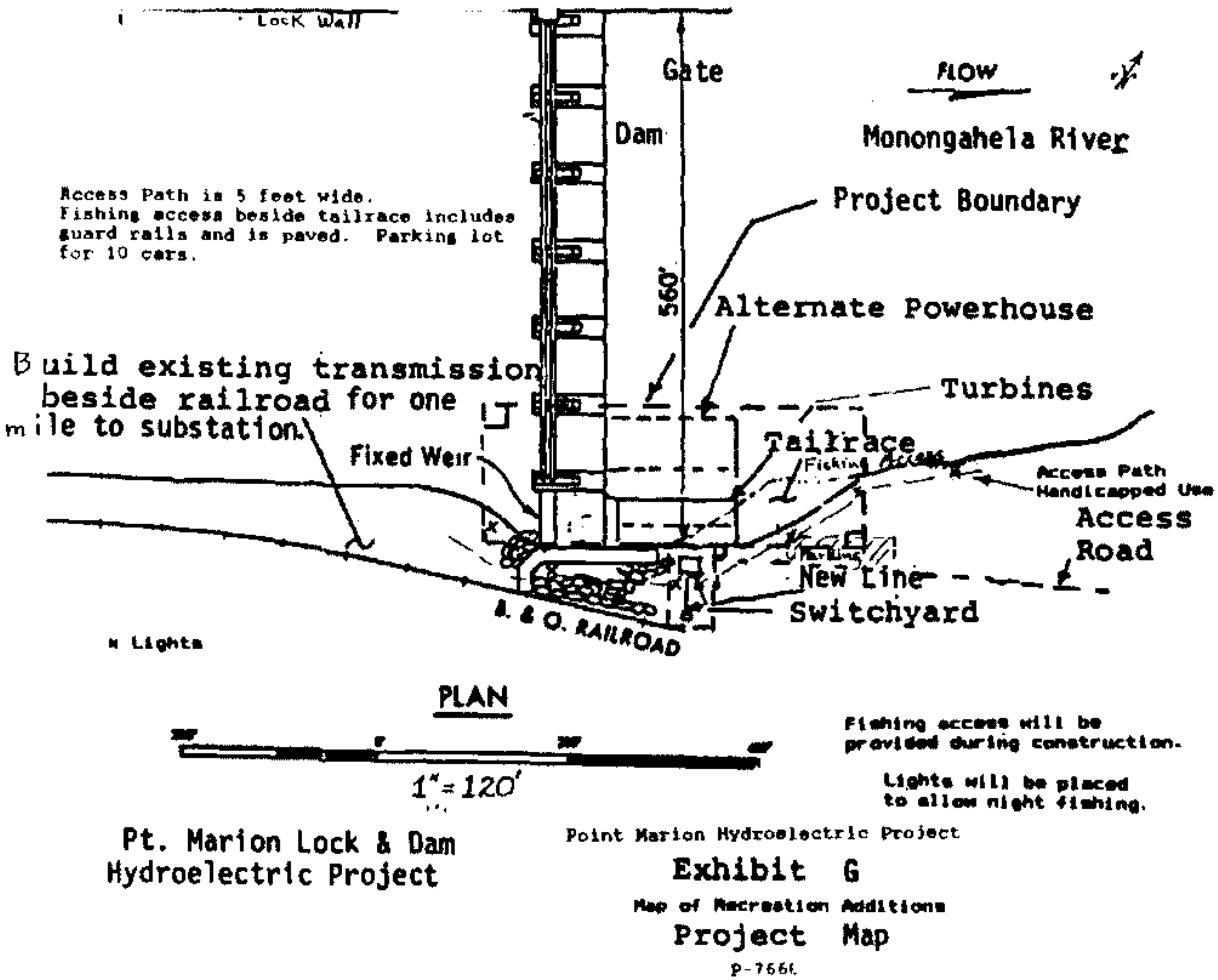


Figure F-9. Proposed recreational enhancements at Point Marion Lock and Dam Project. Source: Noah Corporation, 1987a.

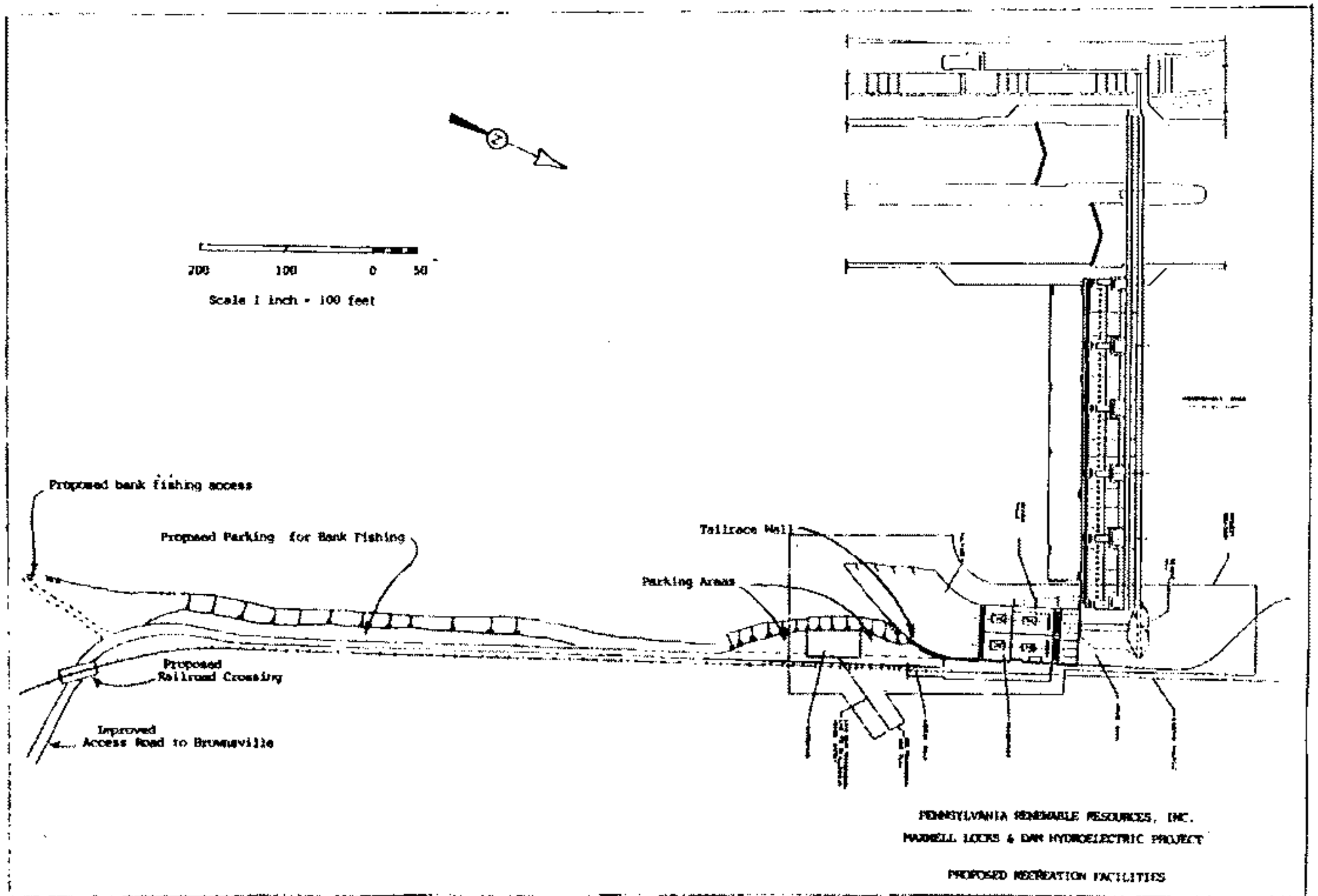


Figure F-10. Proposed recreational enhancements at Maxwell Lock and Dam Project. Source: Pennsylvania Renewable Resource, Inc., December 1987b.

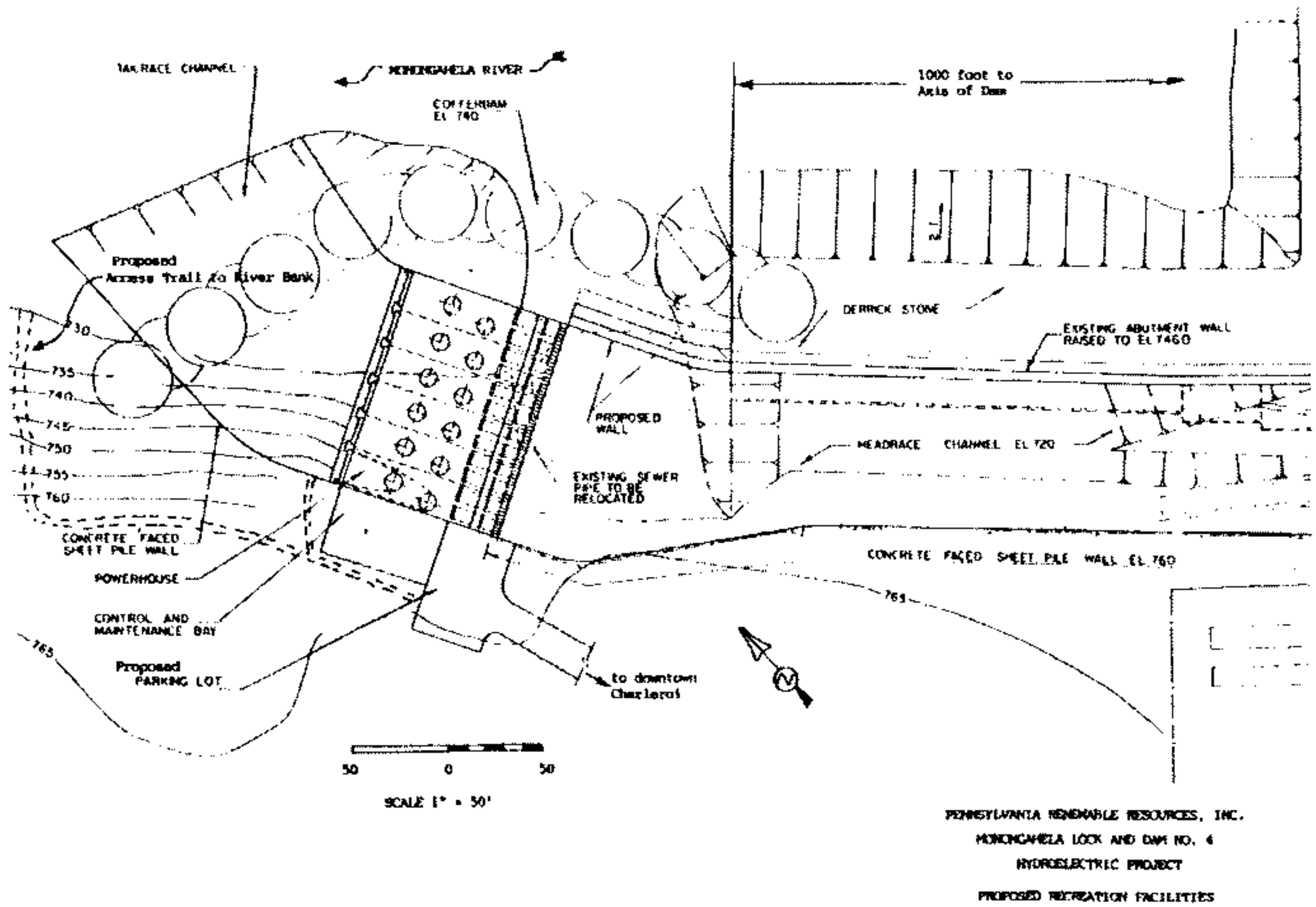


Figure F-11. Proposed recreational enhancements at Monongahela River Lock and Dam No. 4 Project. Source: Pennsylvania Renewable Resources, Inc., December 1987a.

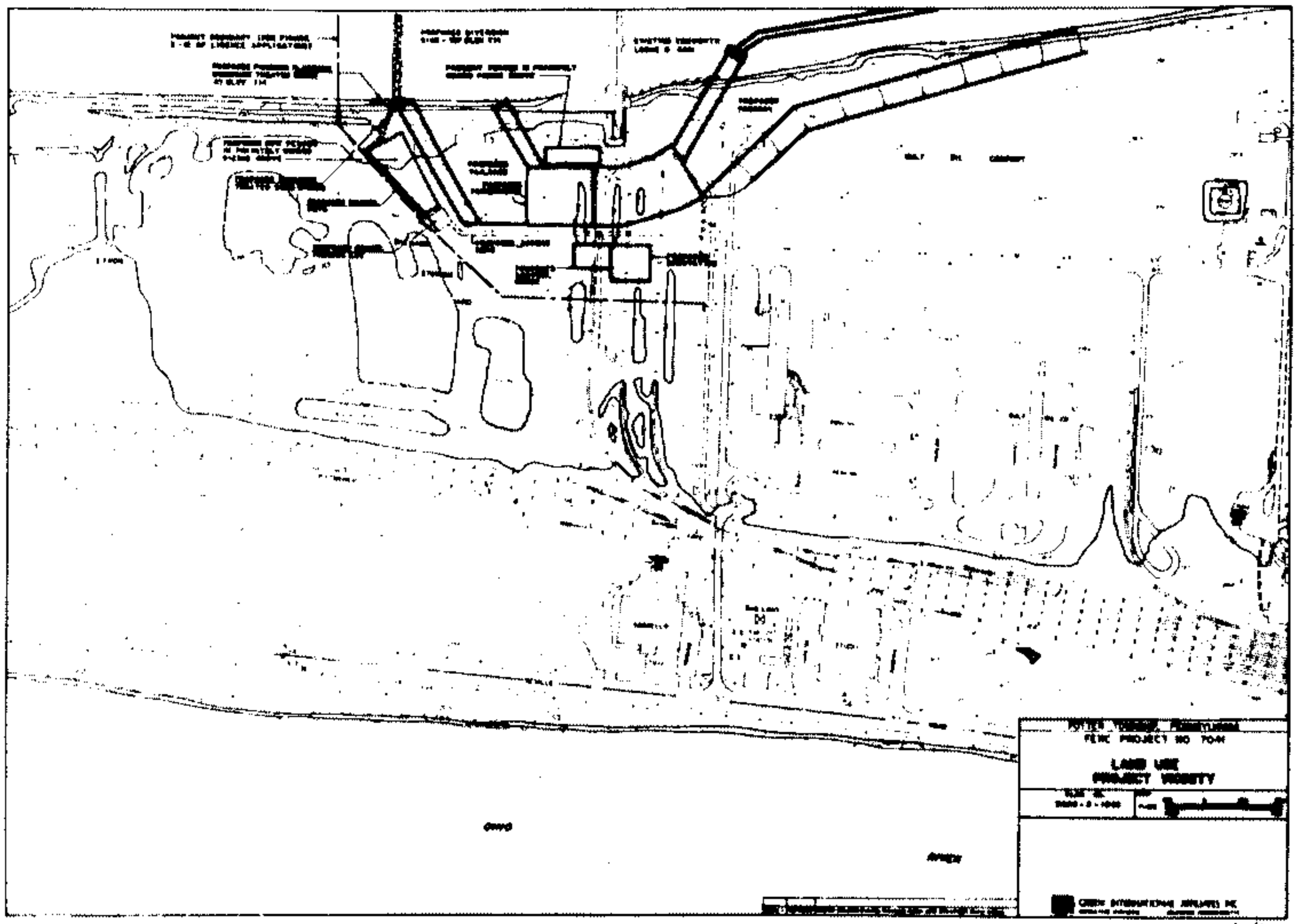


Figure F-12. Proposed recreational enhancements at Emsworth Lock and Dam Project. Source: Potter Township, November, 1987.

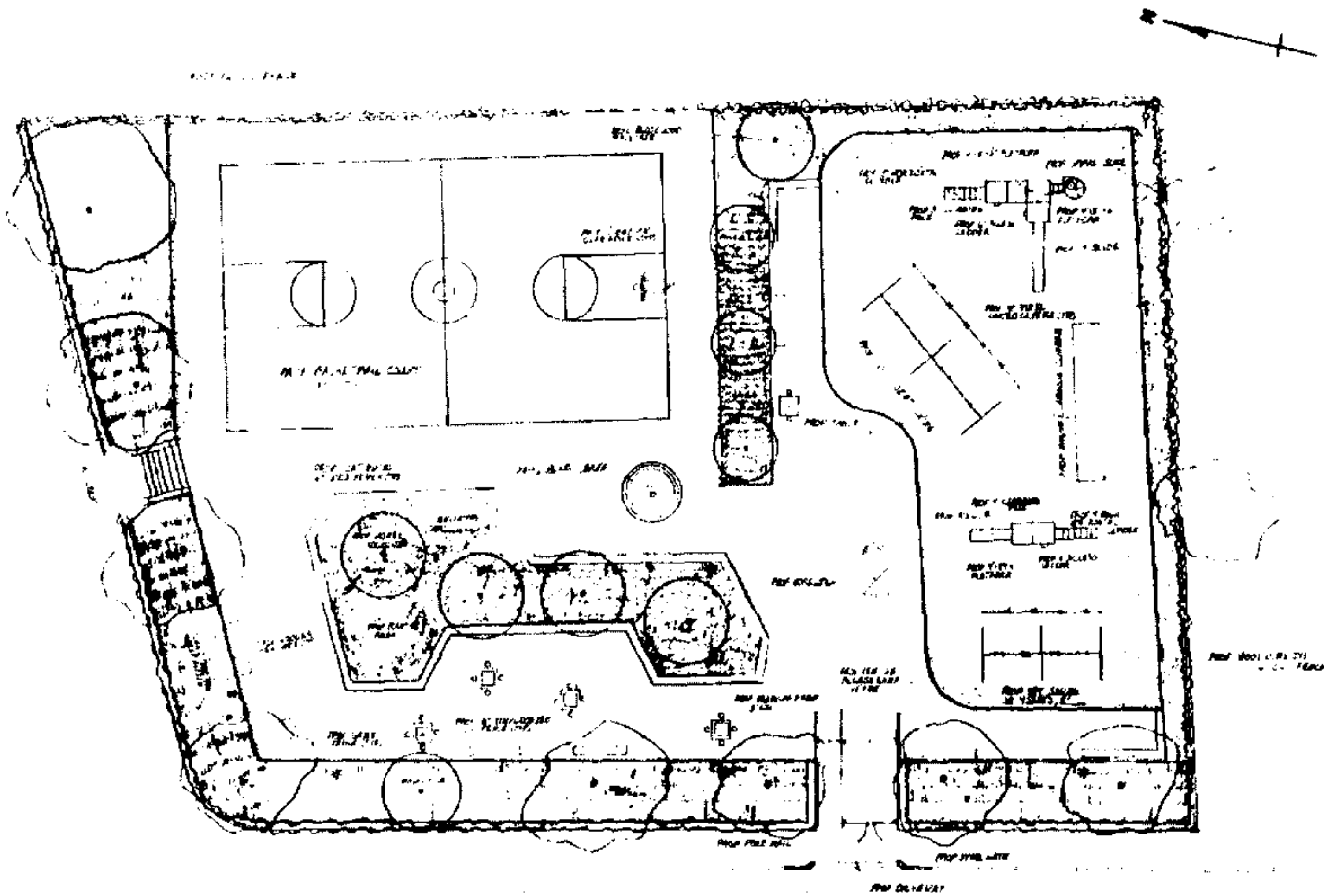


Figure F-13. Proposed "play area" at Emsworth Lock and Dam Project. Source: Potter Township, November, 1987.

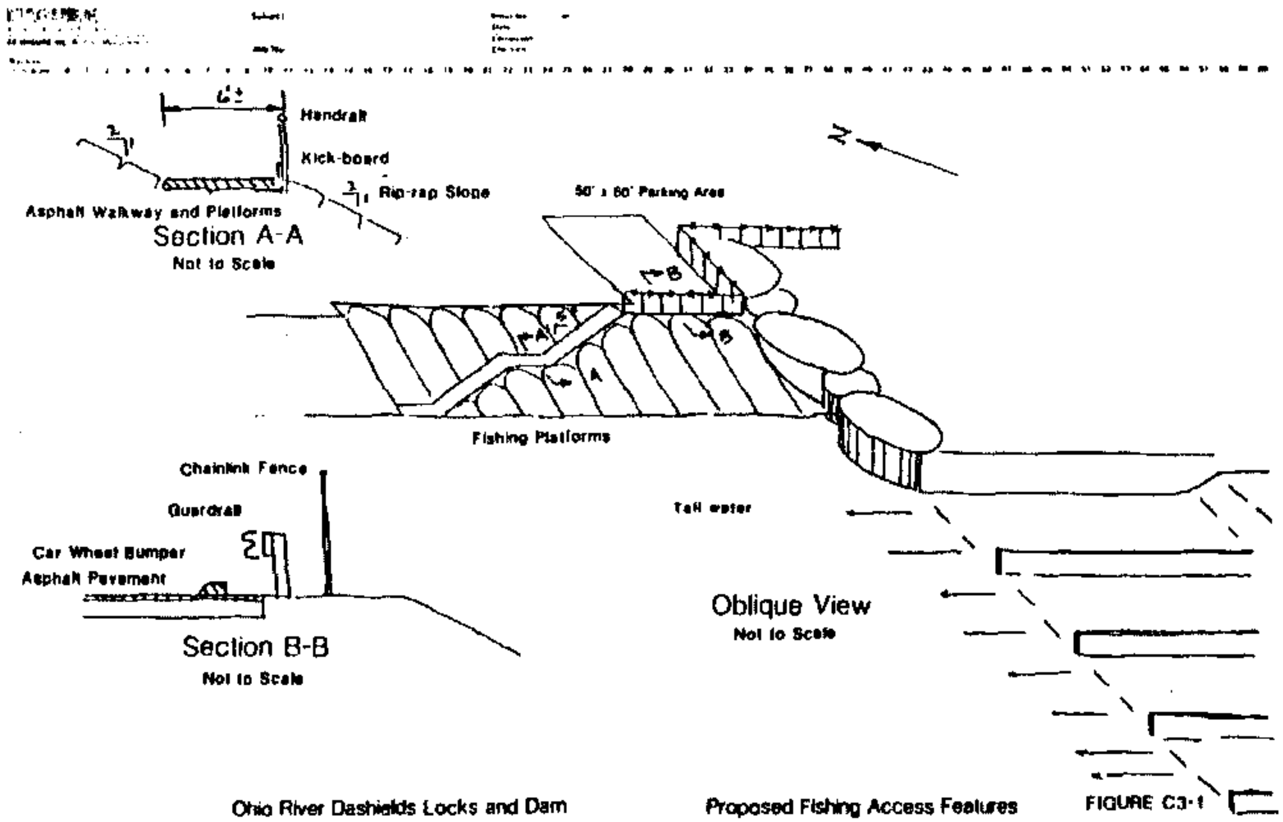


Figure F-14. Proposed recreational enhancements at Dashields Lock and Dam Project. Source: County of Allegheny, November 1987.

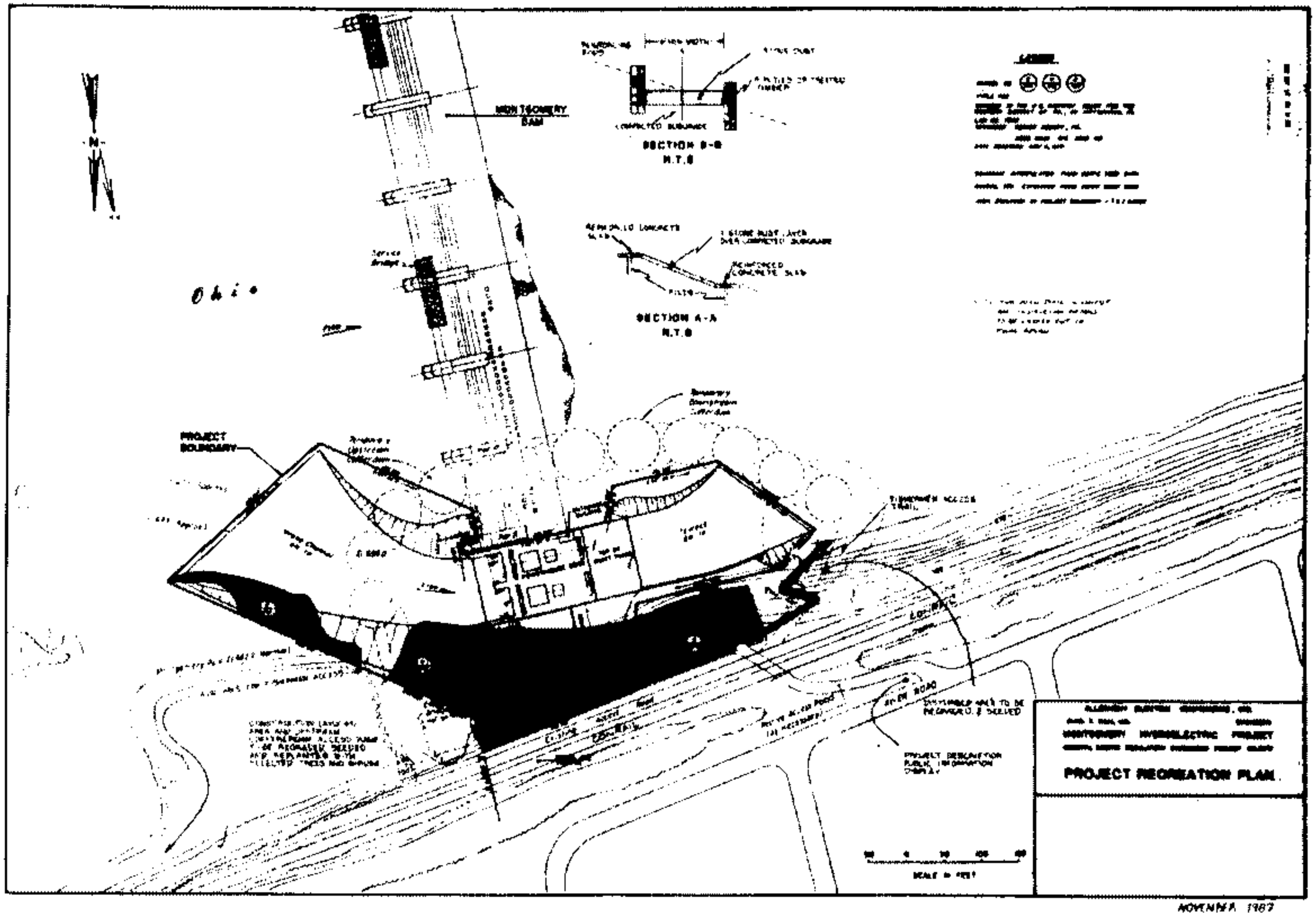
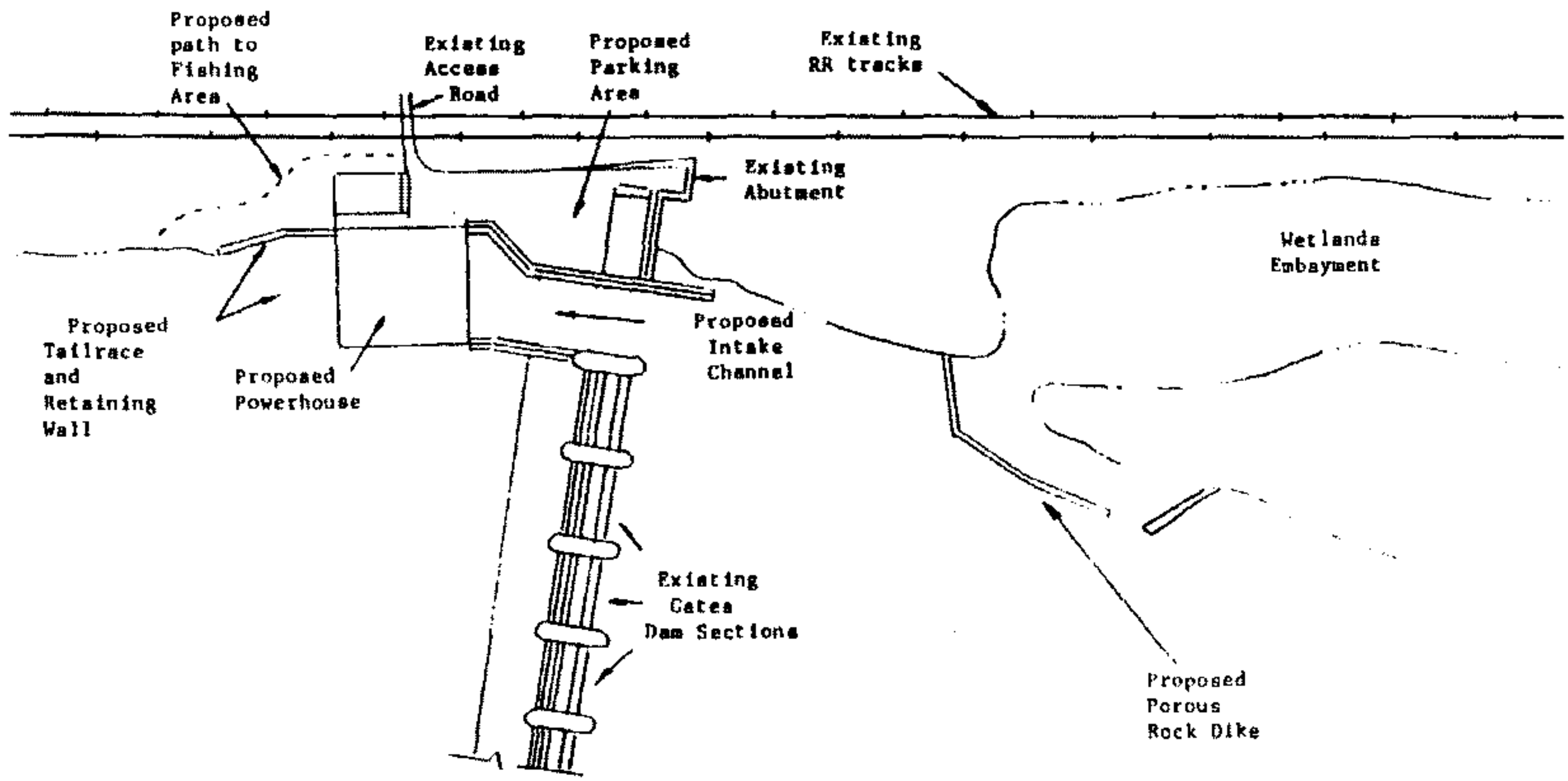


Figure F-15. Proposed recreational enhancements at Montgomery Lock and Dam Project (FERC No. 2971). Source: Allegheny Electric Cooperative, Inc., November, 1987.



Conceptual Layout
Proposed Montgomery Hydro Project

Figure F-16. Proposed recreational enhancements at Montgomery Lock and Dam Project (FERC No. 3490). Source: Potter Township, 1986.

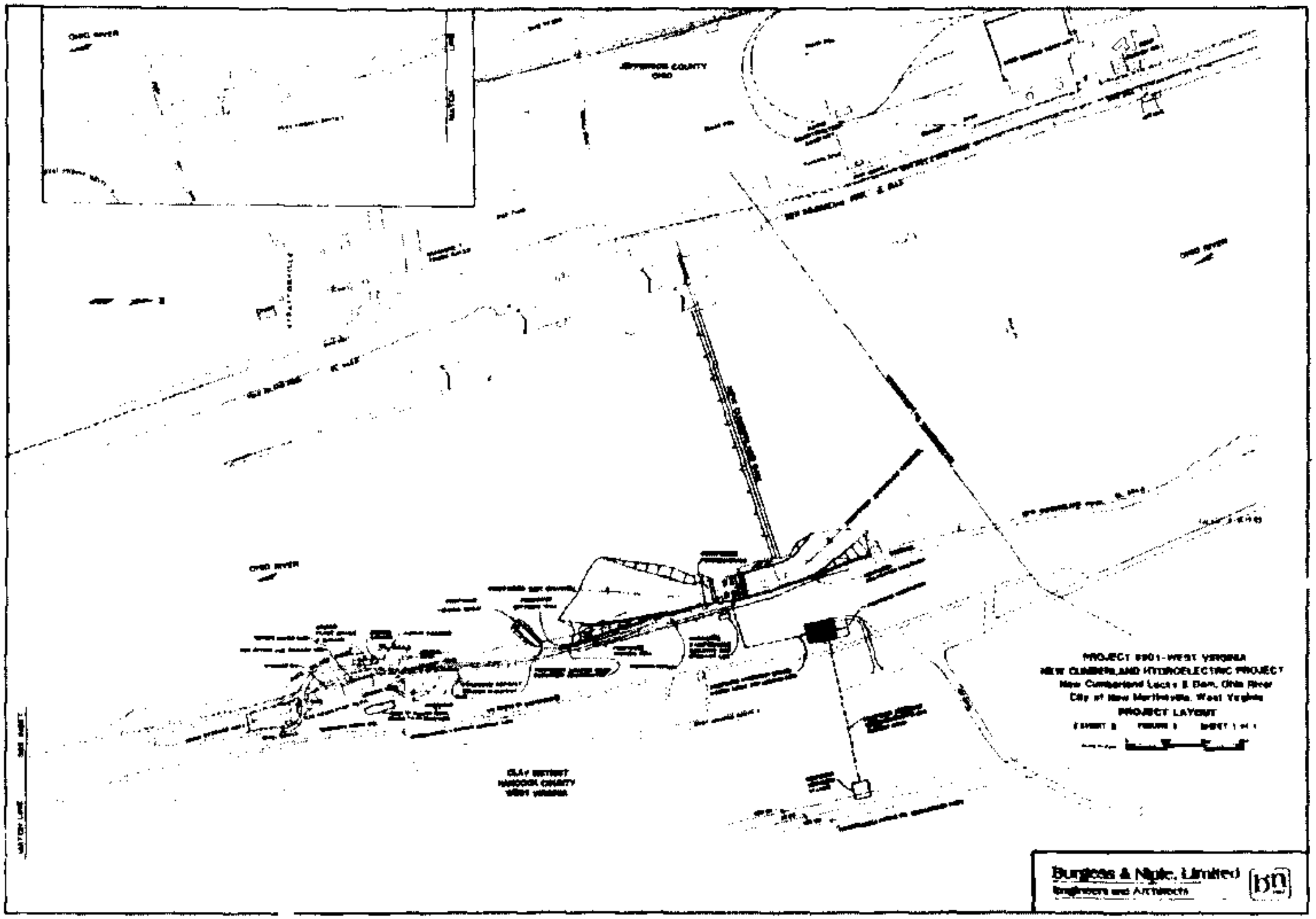


Figure F-17. Proposed recreational enhancements at New Cumberland Lock and Dam Project (FERC No. 6901). Source: Burgess and Niple, October, 1987.

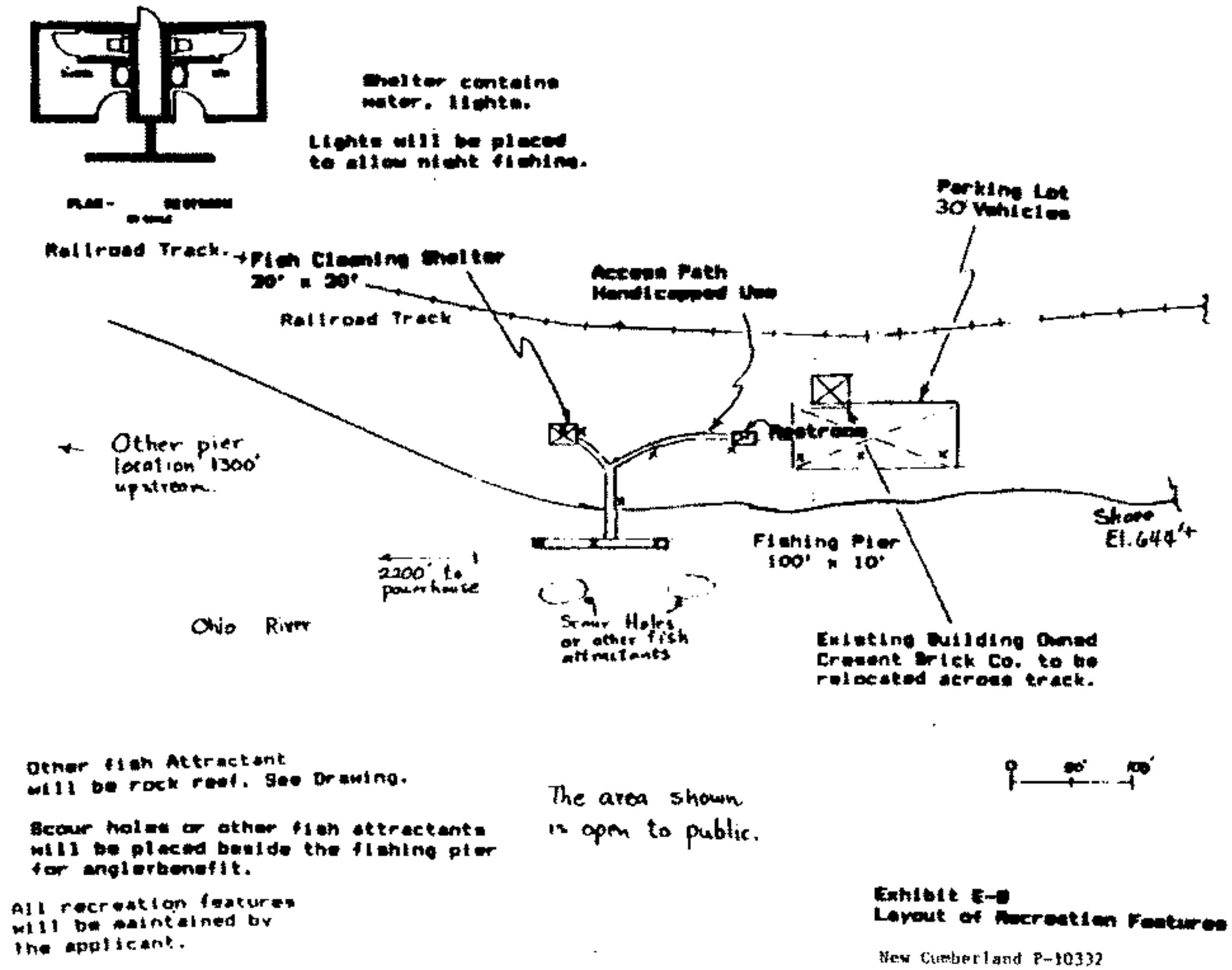


Figure F-18. Proposed recreational enhancements at New Cumberland Lock and Dam Project (FERC No. 10332). Source: WV Hydro, November, 1987a.

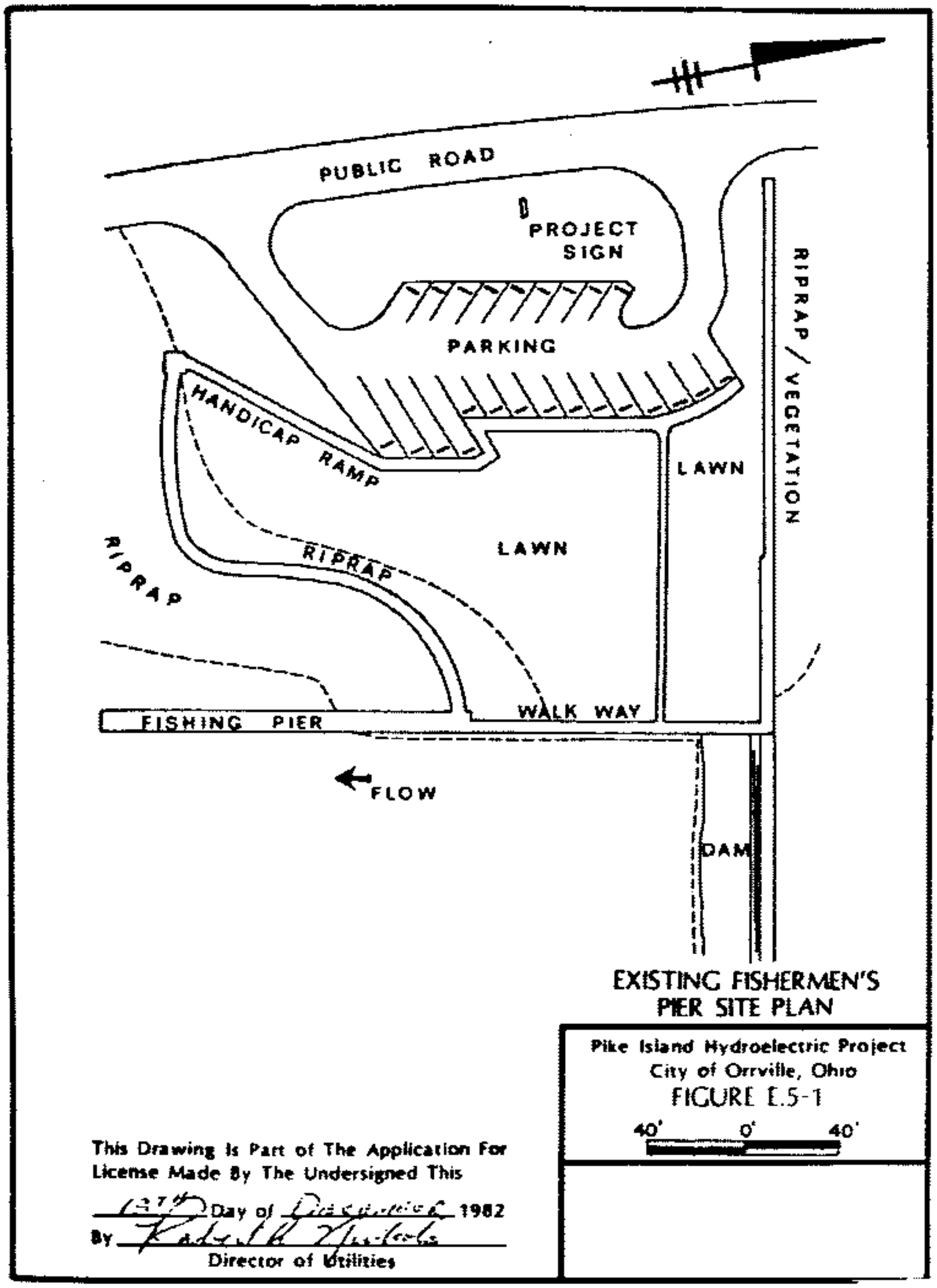


Figure F-19. Existing fishing access facilities at Pike Island Lock and Dam Project. Source: City of Orrville, 1982.

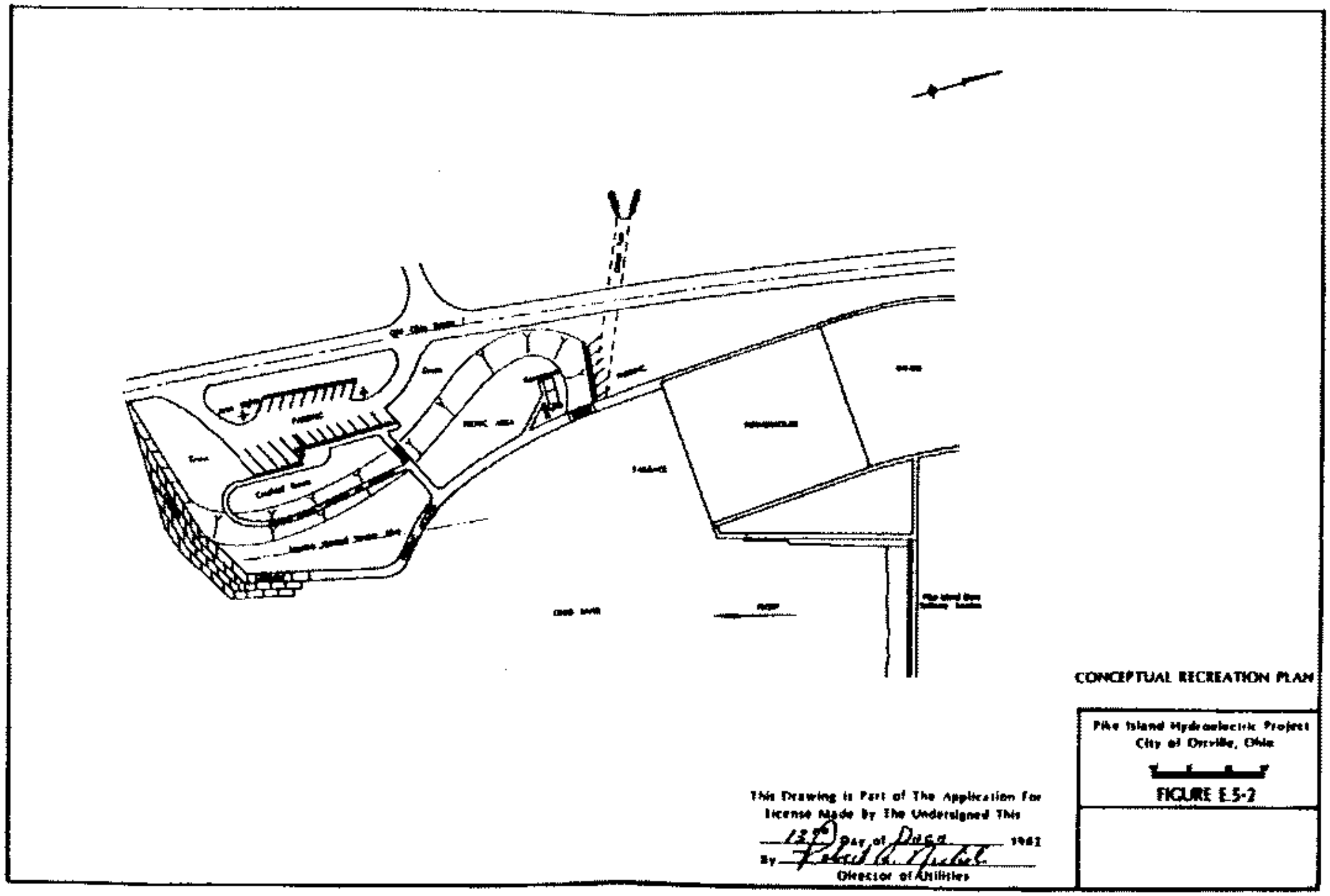


Figure F-20. Proposed recreational enhanceents at Pike Island Lock and Dam Project. Source: City of Orrville, 1982.

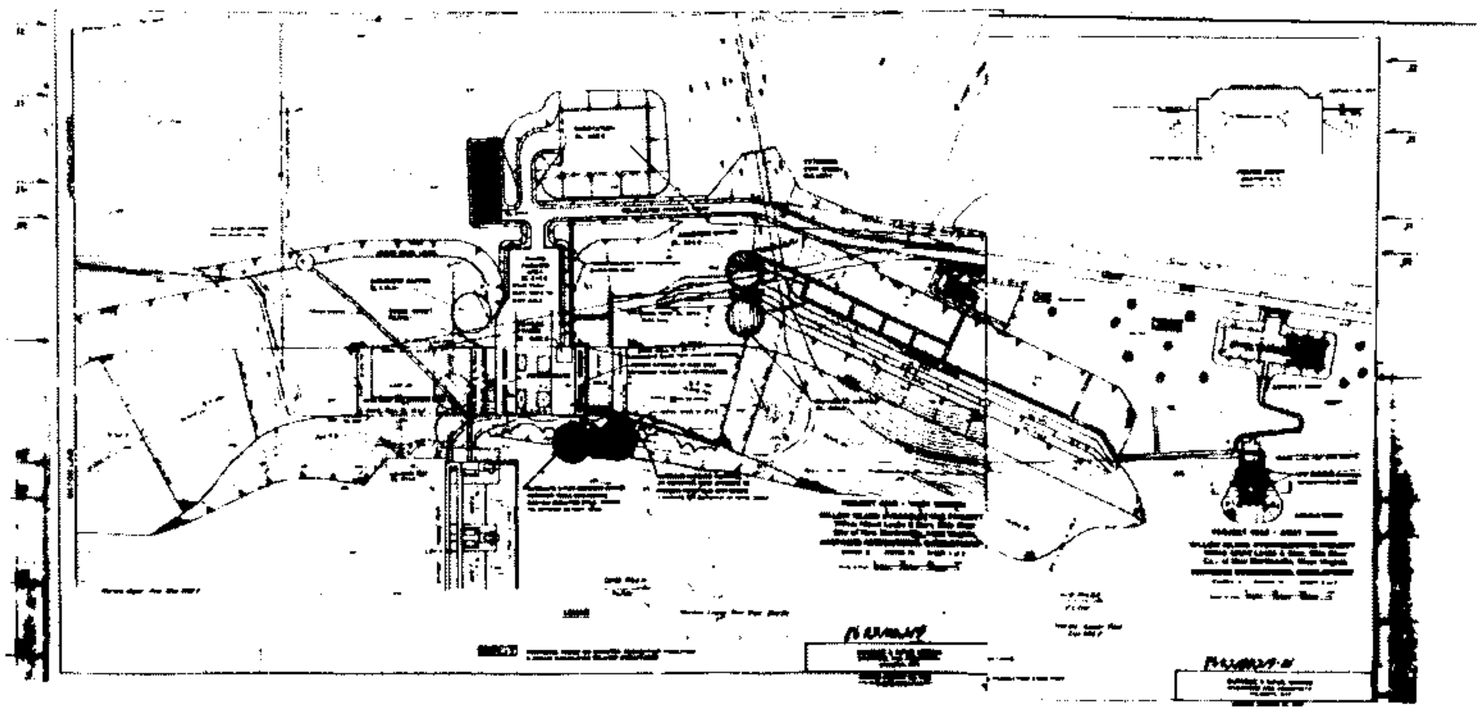


Figure F-21. Proposed recreational enhancements at Willow Island Lock and Dam Project (FERC No. 6902). Source: Burgess and Niple, September, 1986.

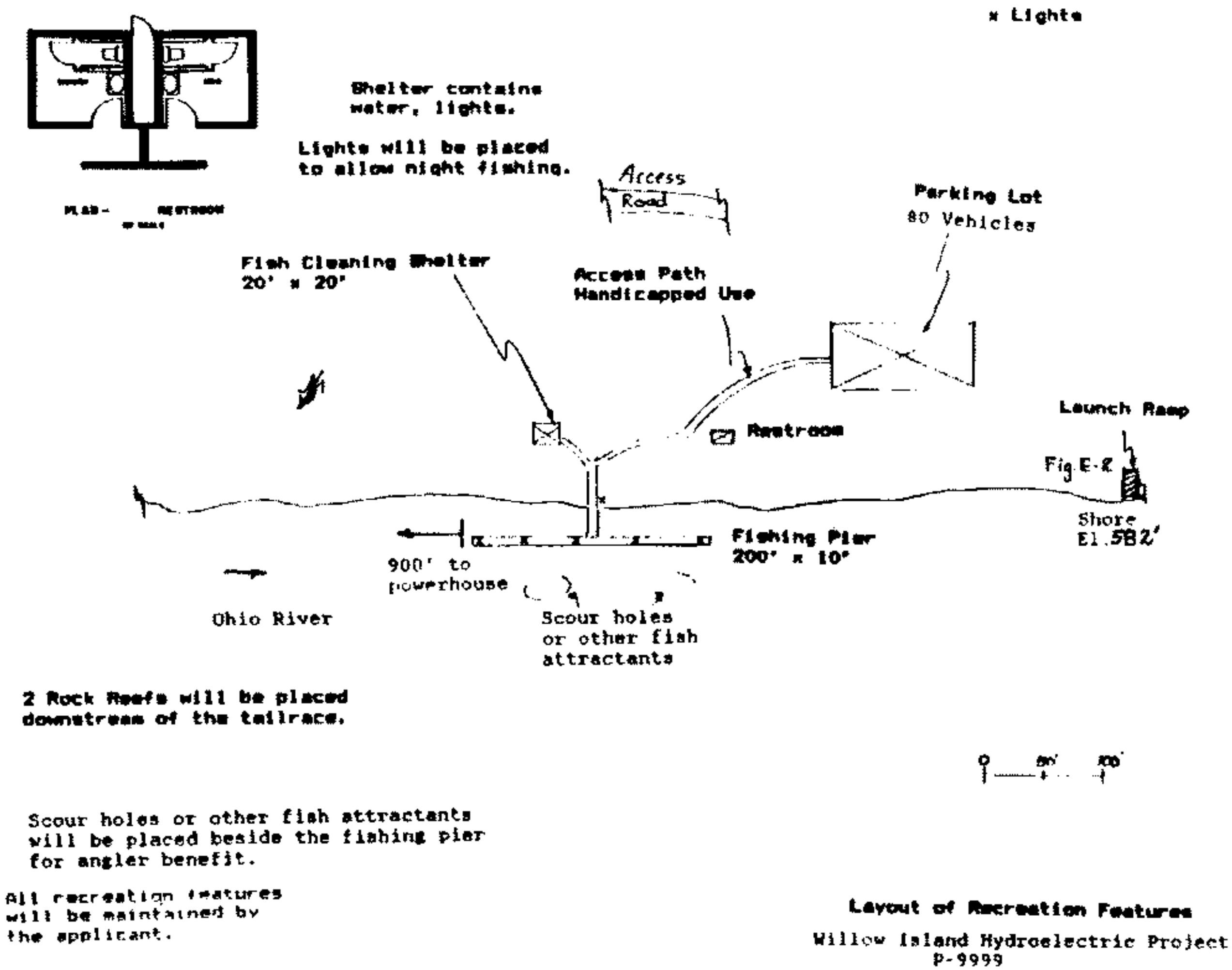


Figure F-22. Proposed recreational enhancements at Willow Island Lock and Dam Project (FERC No. 9999).

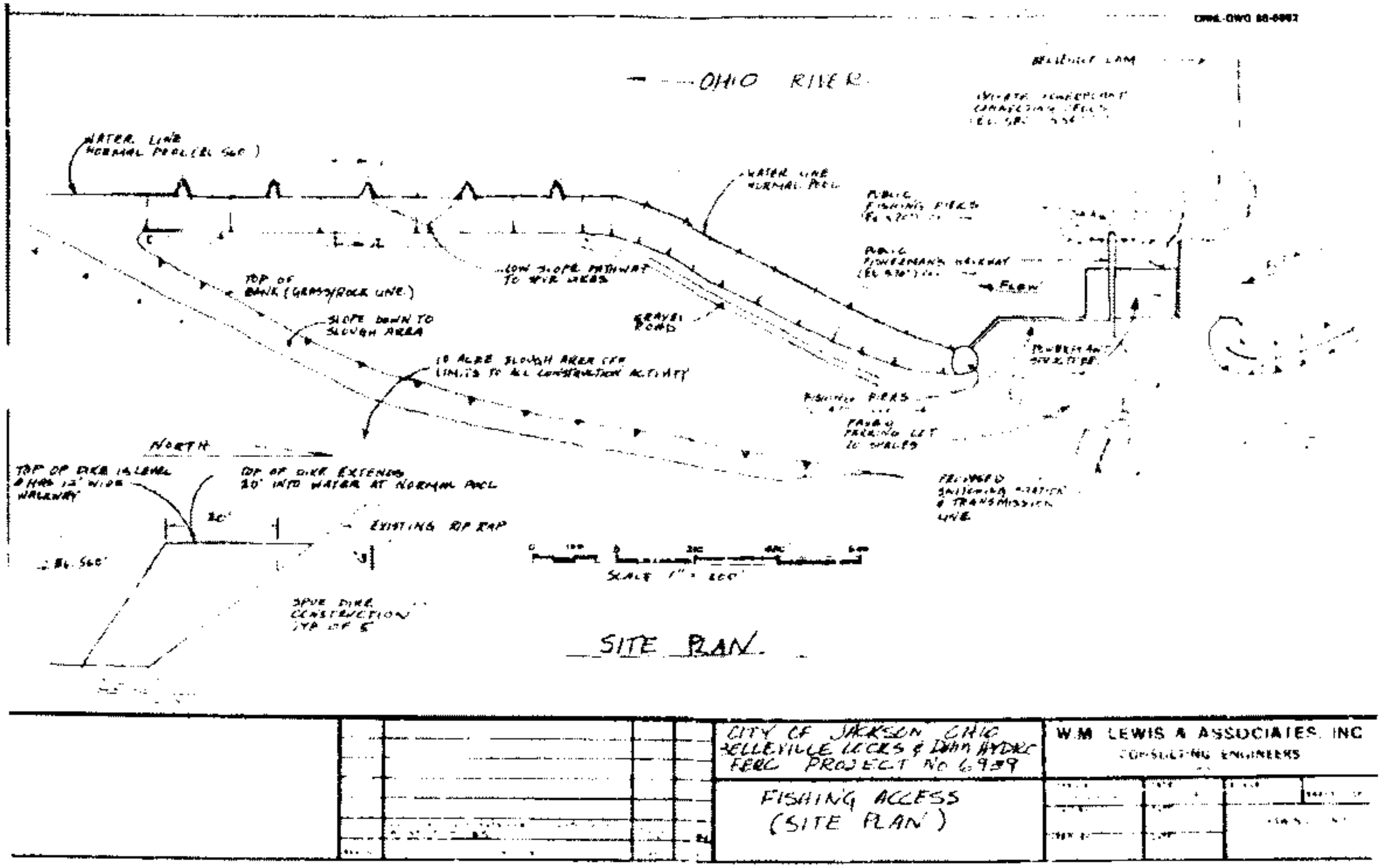


Figure F-23. Proposed recreational enhancements at Belleville Lock and Dam Project. Source: W. M. Lewis and Associates, November 1984.

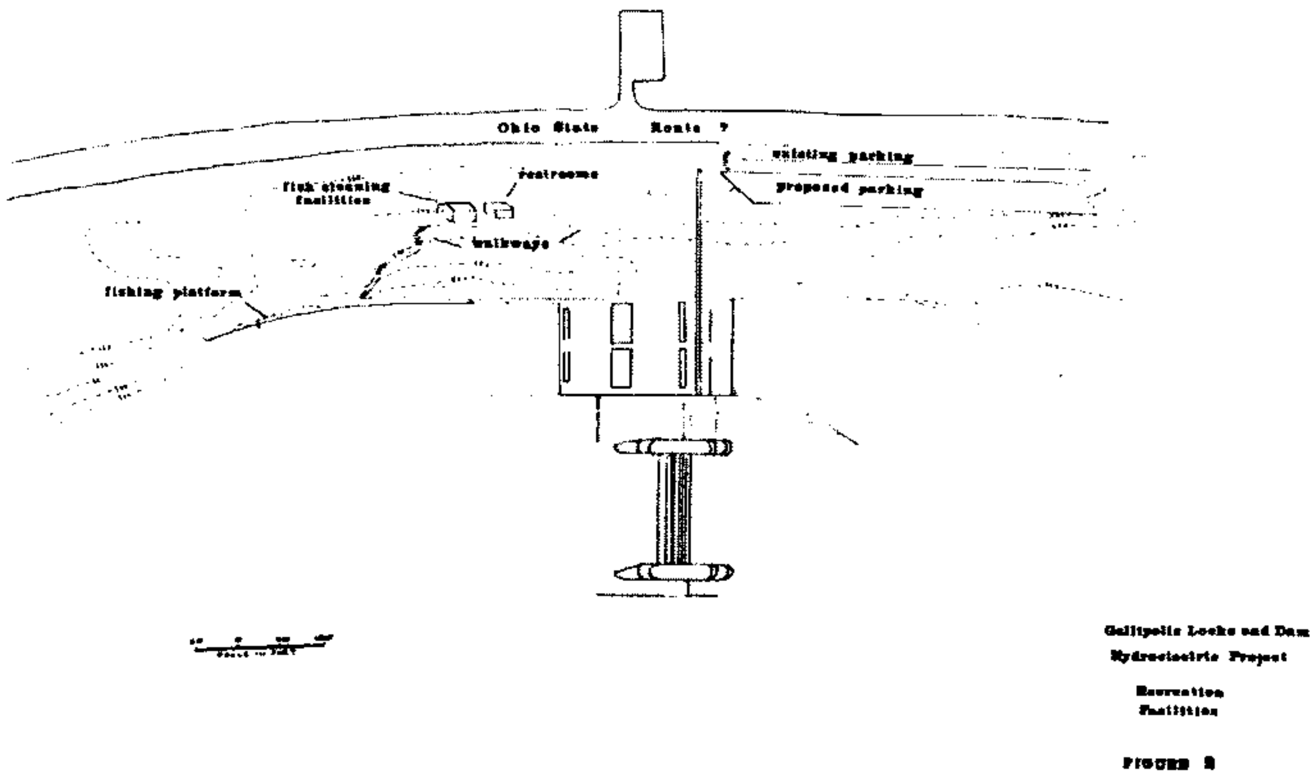


Figure F-24. Proposed recreational enhancements at Gallipolis Lock and Dam Project(FERC No. 9042). Source: Gallia Hydro Partners, November, 1987.

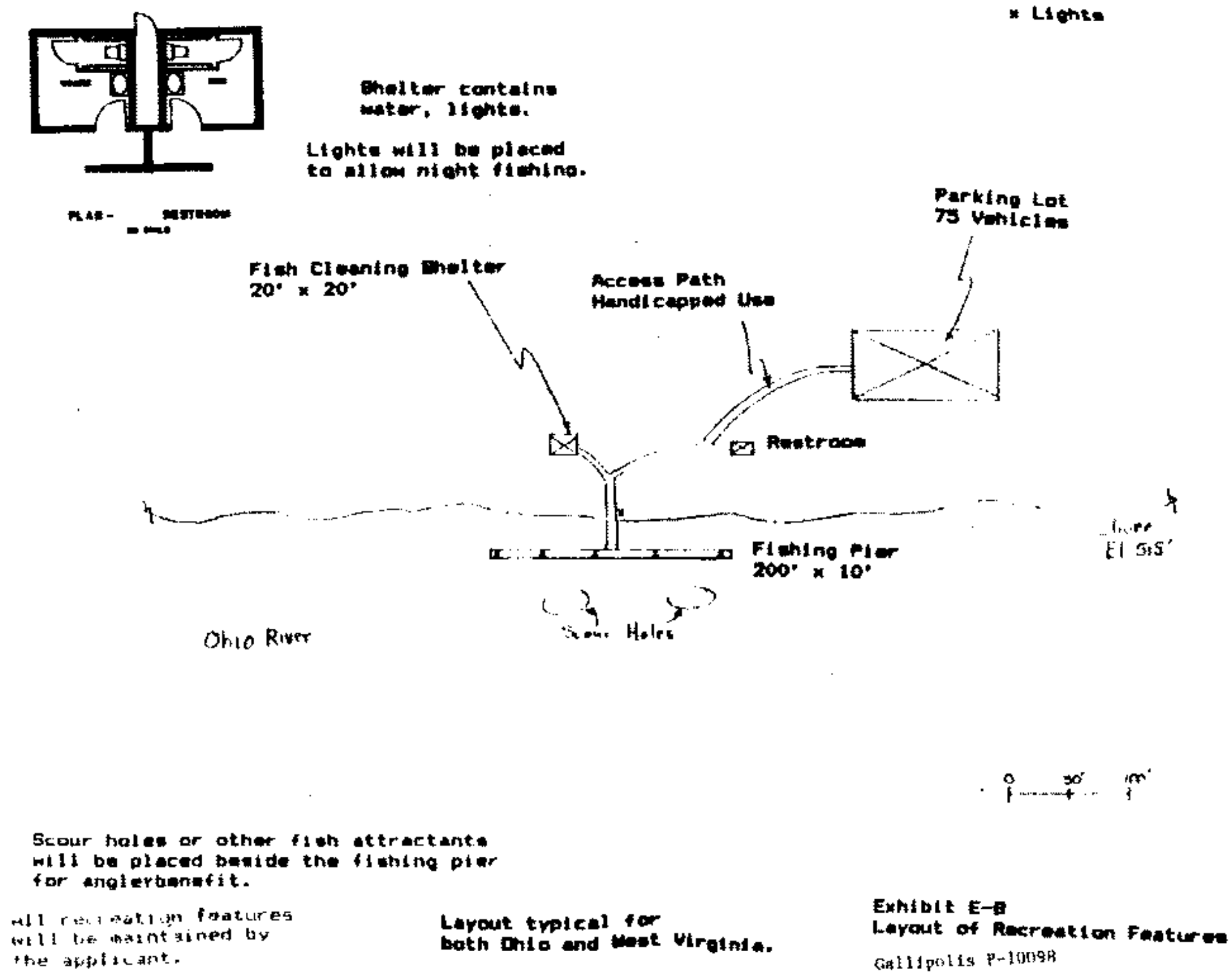


Figure F-25. Proposed recreational enhancements at Gallipolis Lock and Dam Project (FERC No. 10098). Source: WV Hydro, Inc., 1987.

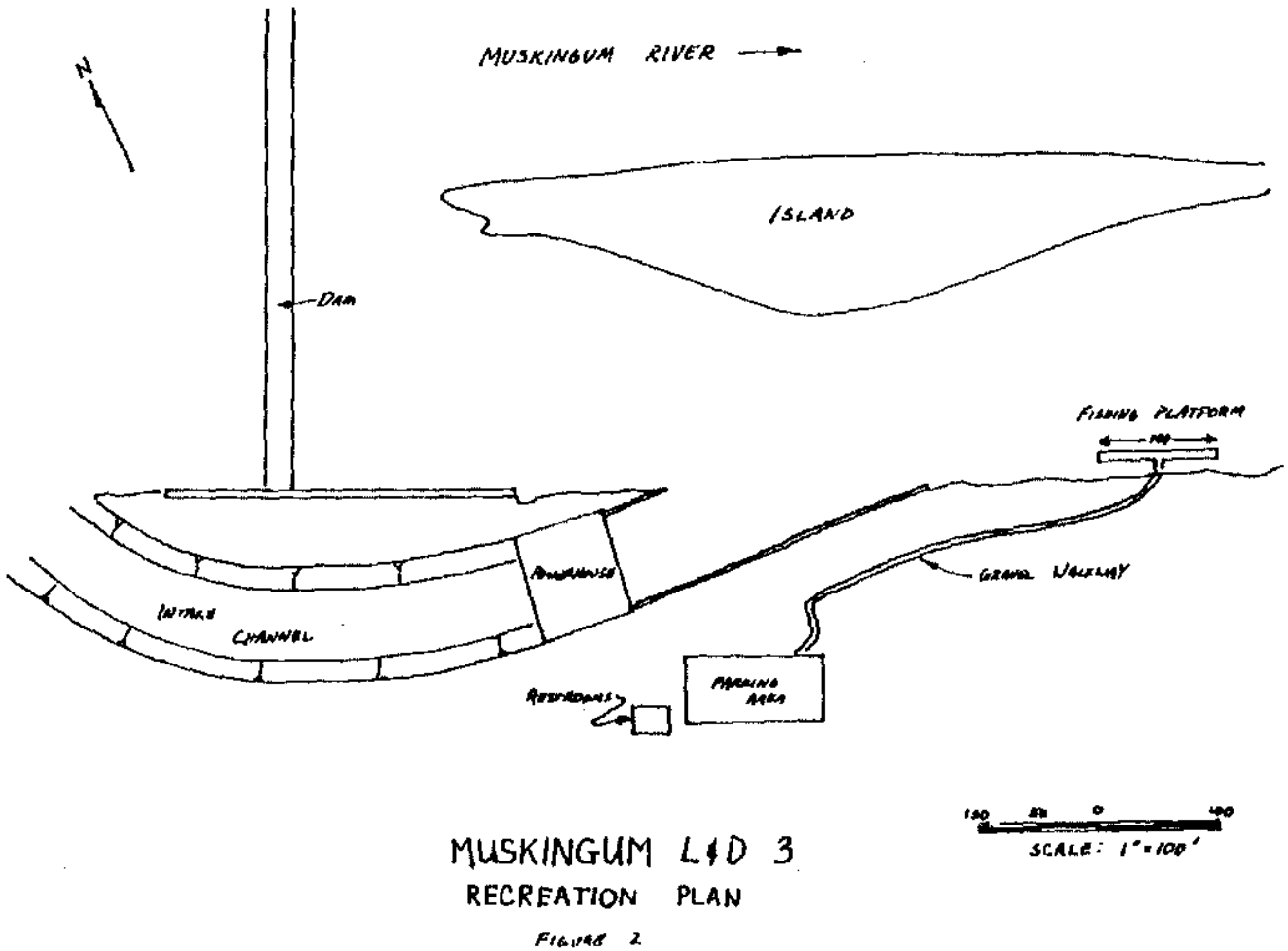


Figure F-26. Proposed recreational enhancements at Muskingum Lock and Dam No. 3 Project. Source: Mitex, November, 1987.

APPENDIX G

ASSESSMENT OF THE ABILITY OF LOCAL LABOR FORCES TO PROVIDE CONSTRUCTION WORKERS

APPENDIX G

ASSESSMENT OF LOCAL LABOR FORCES TO PROVIDE CONSTRUCTION WORKERS

A key aspect of the socioeconomic impacts of the proposed hydropower projects is the ability of local labor forces to provide construction workers for all projects. If the labor requirements of the projects are greater than the supply of workers in the area, a substantial number of workers would have to relocate to the area during the construction period. Such an influx of new, temporary residents would initiate a complex series of impacts, including an increased demand and competition for housing and a requirement for increased public services (e.g., fire and police protection, capacity for additional students in local schools).

The purpose of this analysis is to determine if the combination of projects addressed in the DEIS would be likely to result in the in-migration of a significant number of workers during the construction period. The potential problem of in-migration arises when the proposed projects are considered cumulatively. No single project among those proposed would require more construction workers than reside within commuting distance of the construction site. Simultaneous construction of several projects within a given area, however, could generate a combined demand for workers that exceeded the number of available workers in the local area. In this case, additional workers would have to be brought in from other areas.

Some uncertainty is involved in several of the procedures used in this analysis. Every effort has been made to ensure that the errors associated with all assumptions are conservative (i.e., that they tend to overestimate the demand for workers and underestimate the supply). It is felt that adherence to this principle will help ensure the validity of the results of the analysis.

G.1 ESTIMATING WORK FORCE REQUIREMENTS

Project work force requirements were estimated using a procedure developed by FERC based on an analysis of the agency's experience with hydropower projects (personal communication, Jim Haimes, FERC, Division of Environmental Analysis, March 3, 1988). This analysis found that (1) approximately 20 percent of a project's total direct construction cost was paid as wages and salaries of construction workers and (2) the average wage (including all benefits) of a construction worker was about $40,000 per year, or $3,333 per month. Because of the uncertainties inherent in these and other assumptions used in the estimating process, a range of work force requirements was obtained by calculating low and high figures based on 15 percent and 25 percent, respectively, of the construction costs being paid as wages and salaries.

The estimated construction work force required for each project is shown in Table G-1. The total direct construction costs were obtained from the project applications and subsequent materials submitted by the applicants and adjusted to 1988 dollars using an annual adjustment rate of 4 percent. Low and high estimates of construction wages and salaries were calculated by assuming that between 15 percent and 25 percent of the direct construction costs would be paid to workers. The estimates of wages and salaries were divided by the number of months in the construction period (from project applications and subsequent materials provided by the applicants). These estimates of total monthly wages were then divided by the average monthly wage ($3,333) to obtain low and high estimates of the number of workers required to construct each project.

Proposed project construction schedules submitted by the applicants were used to assess the potential for simultaneous construction of several projects in a given area. This information is summarized in Figure G-1. Although there is considerable variety in the proposed schedules, it is likely that construction activities would be under way on many of the projects during some months. In addition, unexpected developments in obtaining project financing and designing the facilities could alter the schedules. Consequently, a worst-case scenario was adopted, and it was assumed that all projects would be constructed simultaneously. Under this scenario, all workers listed in Table G-1 would be required at the same time.

G.2 ESTIMATING THE SUPPLY OF CONSTRUCTION WORKERS

It was assumed that construction workers would be willing to commute to jobs up to 40 miles from their residences. The number of construction workers expected to be available was estimated for all counties whose main population center was within 40 road miles of any of the proposed projects. The overall 1986 unemployment rate for the county was multiplied by the

Table G-1. Estimated construction work force requirements.

Project	Estimated project costs (in thousands of 1988 dollars)			Months of construction	Estimated number of construction workers	
	Total direct construction1/	Estimated wages & salaries				
		low	high		low	high
Gallipolis (9042)2/	71,699	10,755	17,925	33	98	163
Gallipolis (10098)2/	74,803	11,221	18,701	24	140	234
Belleville (6939)	82,554	12,383	20,639	28	133	221
Willow Island (6902)2/	NA 3/					
Willow Island (9999)2/	74,803	11,221	18,701	22	153	255
Muskingum L&D No. 3	19,241	2,886	4,810	22	39	66
Pike Island (3218)	46,433	6,965	11,608	25	84	139
New Cumberland (6901)2/	93,904	14,086	23,476	32	132	220
New Cumberland (10332)2/	76,180	11,427	19,045	39	88	147
Montgomery (2971)2/	54,737	8,211	13,684	18	137	228
Montgomery (3490)[1]	33,746	5,062	8,436	26	58	97
Dashields (7568)	44,965	6,745	11,241	25	81	135
Emsworth (7041)	28,169	4,225	7,042	24	53	88
Allegheny L&D No. 2 (4017)	25,476	3,821	6,369	30	38	64
Allegheny L&D No. 3 (4474)	30,359	4,554	7,590	33	41	69
Allegheny L&D No. 4 (7909)	28,706	4,306	7,176	23	56	94
Allegheny L&D No. 7 (7914)	28,077	4,211	7,019	22	57	96
Monongahela L&D No. 4 (4675)	12,348	1,852	3,087	24	23	39
Maxwell (8908)	14,641	2,196	3,660	23	29	48
Point Marion (7660)	NA 3/			24	160 4/	180 4/
Hildebrand (8654)	10,304	1,546	2,576	21	22	37
Opekiska (8990)	10,776	1,616	2,694	20	24	40
Tygart (7307)2/	23,842	3,576	5,961	29	37	62
Tygart (7399)2/	58,155	8,723	14,539	30	87	145

1/ Source: Project applications and materials subsequently provided by project applicants. Costs were adjusted to 1988 dollars using an escalation rate of 4 percent per year.

2/ Competing applications.

3/ NA = Not available.

4/ Source: FERC, Office of Hydropower Licensing, Division of Environmental Analysis, 1984. Environmental Assessment, Point Marion Lock and Dam Project, FERC No. 7660--Pennsylvania.

Figure 1. Estimated project construction time lines. 1/

```
Months of Construction (0 = License approval)
                                                    1                   2                   3                   4                   5
Project                         0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1

Gallipolis (9042) 2/            * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
Gallipolis (10098) 2/             * * * * * * * * * * * * * * * * * * * * * * * * *
Belleville (6939)                                                     * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
Willow Island (6902) 2/         N.A.
Willow Island (9999) 2/                   * * * * * * * * * * * * * * * * * * * * * * *
Muskingum L&D No. 3                                     * * * * * * * * * * * * * * * * * * * * * * *
Pike Island (3218)                                    * * * * * * * * * * * * * * * * * * * * * * * * * *
New Cumberland (6901) 2/              * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
New Cumberland (10332) 2/                   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
Montgomery (2971) 2/                                          * * * * * * * * * * * * * * * * * * *
Montgomery (3490) 2/                                  * * * * * * * * * * * * * * * * * * * * * * * * * * *
Dashields (7568)                            * * * * * * * * * * * * * * * * * * * * * * * * * *
Emsworth (7041)                                         * * * * * * * * * * * * * * * * * * * * * * * * *
Allegheny L&D No. 2 (4017)              * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
Allegheny L&D No. 3 (4474)                                            * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
Allegheny L&D No. 4 (7909)                  * * * * * * * * * * * * * * * * * * * * * * * *
Allegheny L&D No. 7 (7914)                  * * * * * * * * * * * * * * * * * * * * * * *
Monongahela L&D No. 4 (4675)              * * * * * * * * * * * * * * * * * * * * * * * * *
Maxwell (8908)                                        * * * * * * * * * * * * * * * * * * * * * * * *
Point Marion (7660)                                                           * * * * * * * * * * * * * * * * * * * * * * * * *
Hildebrand (8654)                               * * * * * * * * * * * * * * * * * * * * * *
Opekiska (8990)                                   * * * * * * * * * * * * * * * * * * * * *
Tygart (7307) 2/                * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
Tygart (7399) 2/                                        * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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1/ Source: Project applications and subsequent materials submitted by project applicants.

2/ Competing applications.

1980 percentage of the county's labor force which worked in the construction industry to produce an estimate of the number of unemployed construction workers. The resulting estimate is likely to be slightly low because unemployment in construction trades is generally higher than overall unemployment. The estimated number of unemployed construction workers in each county is shown in Table G-2.

G.3 MATCHING THE SUPPLY AND DEMAND

To determine whether the construction work force requirements of the proposed projects could be met without significant relocation or in-migration of workers, the estimated supply of construction workers in each county was apportioned to the projects within 40 road-miles until the supply was exhausted or the estimated demands were filled. In an attempt to compensate for uncertainties inherent in the analysis, "worst-case" conditions were assumed whenever appropriate. The high estimates of work force requirements were used, and, in cases of competing applications for projects at a single site, the project with the highest work force requirement was included.

Because it is reasonable to assume that workers would prefer to work as close as possible to their homes, the apportionment of unemployed workers to projects was performed in several iterations. First, an attempt was made to satisfy each project's demand for workers using the available workers in the county in which the project was located. Any remaining unemployed construction workers in the county were then considered available for employment at other projects. In subsequent iterations, projects with unmet work force requirements drew workers from the next closest counties that had remaining supplies of unemployed workers.

The results of the apportionment are shown in Tables G-3 and G-4 on the basis of this analysis, construction work force requirements of the proposed projects could be met by available workers living within commuting distance of each project, even if all projects were constructed concurrently. Thus, no significant relocation of workers within the region or in-migration of workers from outside the region is expected to occur. It should be noted that no information was available to estimate either the demand for or supply of construction specialists (e.g., welders, pipe fitters, electricians). It is possible that an insufficient number of such specialists will be available in some local areas and that appropriate workers will have to be brought in from outside the areas. However, the number of specialists imported is likely to be small and should not result in significant socioeconomic impacts in the area.

Table G-2. Estimated number of construction workers available by county.

County	Overall unemployment (1986) 1/	Construction as percent of labor force (1980) 2	Estimated construction unemployment
Gallia, Ohio	1,400	8.32	116
Meigs, Ohio	1,100	11.33	125
Washington, Ohio	3,600	7.54	271
Mason, W. Va.	1,160	10.07	117
Jackson, W. Va.	1,200	9.58	115
Pleasants, W. Va.	270	11.88	32
Ritchie, W. Va.	520	8.93	46
Tyler, W. Va.	490	8.60	42
Wood, W. Va.	3,160	7.42	234
Belmont, Ohio	4,100	5.78	237
Jefferson, Ohio	3,000	4.74	142
Brooke, Ohio	710	4.68	33
Hancock, Ohio	720	2.95	21
Ohio, Ohio	1,560	5.94	93
Pittsburgh PMSA 3/ (Allegheny, Fayette, Washington, & Westmoreland, Pa.)	76,200	5.31	4,046
Armstrong, Pa.	3,100	4.99	155
Beaver, Pa.	8,100	5.37	435
Greene, Pa.	1,700	7.30	124
Barbour, W. Va.	800	7.71	62
Harrison, W. Va.	2,430	7.00	170
Marion, W. Va.	2,320	5.79	134
Monongalia, W. Va.	1,370	5.25	72
Preston, W. Va.	1,230	7.61	94
Taylor, W. Va.	580	6.93	40

1/ Sources: Ohio Bureau of Employment Services, 1987, County Labor Force Estimates by Month; Pennsylvania Department of Labor and Industry, 1987, Civilian Labor Force Series by County of Residence, 1977-1986; West Virginia Department of Employment Security, 1987, Monthly Report on the Civilian Labor Force, Employment, and Unemployment.

2/ Source: U.S. Department of Commerce, Bureau of the Census, 1983, 1980 Census of Population, Characteristics of the Population, General Social and Economic Characteristics.

3/ PMSA = Primary Metropolitan Statistical Area.

Table G-3. Ability of local labor forces to meet construction work force requirements.

Project	Estimated maximum workers required	Counties supplying workers/ number of workers supplied 2/
Gallipolis (10098) 1/	234	Gallia, Ohio/116; Mason, W. Va./117; Meigs, Ohio/1
Belleville (6939)	221	Wood, W. Va./221
Willow Island (9999) 1/	255	Pleasants, W. Va./32; Wood, W. Va./13; Tyler, W. Va./42; Ritchie, W. Va./46; Washington, Ohio/122
Muskingum L&D No. 3	66	Washington, Ohio/66
Pike Island (3218)	139	Belmont, Ohio/139
New Cumberland (6901) 1/	220	Hancock, W. Va./21; Brooke, W. Va./33; Jefferson, Ohio/142; Pittsburgh PMSA/24
Montgomery (2971) 1/	228	Beaver, Pa./228
Dashields (7568)	135	Pittsburgh PMSA/135
Emsworth (7041)	88	Pittsburgh PMSA/88
Allegheny L&D No. 2 (4017)	64	Pittsburgh PMSA/64
Allegheny L&D No. 3 (4474)	69	Pittsburgh PMSA/69
Allegheny L&D No. 4 (7909)	94	Pittsburgh PMSA/94
Allegheny L&D No. 7 (7914)	96	Armstrong, Pa./96
Monongahela L&D No. 4 (4675)	39	Pittsburgh PMSA/39
Maxwell (8908)	48	Pittsburgh PMSA/48
Point Marion (7660)	180	Greene, Pa./90; Pittsburgh PMSA/90
Hildebrand (8654)	37	Monongalia, W. Va./36; Marion, W. Va./1
Opekiska (8990)	40	Monongalia, W. Va./36; Marion, W. Va./4
Tygart (7399) 1/	145	Taylor, W. Va./40; Barbour, W. Va./62; Harrison, W. Va./43

1/ Project with highest estimated work force requirement of two competing projects at this site.

2/ PMSA = Primary Metropolitan Statistical Area.

Table G-4. Amount of local unemployed construction workers employed by projects.

County	Estimated construction unemployment	Number of unemployed workers remaining after project assignments
Gallia, Ohio	116	0
Meigs, Ohio	125	124
Washington, Ohio	271	83
Mason, W. Va.	117	0
Jackson, W. Va.	115	115
Pleasants, W. Va.	32	0
Ritchie, W. Va.	46	0
Tyler, W. Va.	42	0
Wood, W. Va.	234	0
Belmont, Ohio	237	98
Jefferson, Ohio	142	0
Brooke, W. Va.	33	0
Hancock, W. Va.	21	0
Ohio, W. Va.	93	93
Pittsburgh PMSA 1/ (Allegheny, Fayette, Washington, & Westmoreland, Pa.)	4,046	3,509
Armstrong, Pa.	155	59
Beaver, Pa.	435	207
Greene, Pa.	124	62
Barbour, W. Va.	62	0
Harrison, W. Va.	170	127
Marion, W. Va.	134	129
Monongalia, W. Va.	72	0
Preston, W. Va.	94	94
Taylor, W. Va.	40	0

1/ Primary Metropolitan Statistical Area.

APPENDIX H

LICENSE ARTICLES APPLICABLE TO OHIO RIVER PROJECTS

APPENDIX H

LICENSE ARTICLES APPLICABLE TO OHIO RIVER PROJECTS

H.1 FEDERAL ENERGY REGULATORY COMMISSION TERMS AND CONDITIONS OF LICENSE FOR UNCONSTRUCTED MAJOR PROJECT AFFECTING NAVIGABLE WATERS AND LANDS OF THE UNITED STATES [Form L-6 (Revised October, 1975)]

Article 1. The entire project, as described in this order of the Commission, shall be subject to all of the provisions, terms, and conditions of the license.

Article 2. No substantial change shall be made in the maps, plans, specifications, and statements described and designated as exhibits and approved by the Commission in its order as a part of the license until such change shall have been approved by the Commission: Provided, however, That if the Licensee or the Commission deems it necessary or desirable that said approved exhibits, or any of them, be changed, there shall be submitted to the Commission for approval a revised, or additional exhibit or exhibits covering the proposed changes which, upon approval by the Commission, shall become a part of the license and shall supersede, in whole or in part, such exhibit or exhibits theretofore made a part of the license as may be specified by the Commission.

Article 3. The project works shall be constructed in substantial conformity with the approved exhibits referred to in Article 2 herein or as changed in accordance with the provisions of said article. Except when emergency shall require for the protection of navigation, life, health, or property, there shall not be made without prior approval of the Commission any substantial alteration or addition not in conformity with the approved plans to any dam or other project works under the license or any substantial use of project lands and waters not authorized herein; and any emergency alteration, addition, or use so made shall thereafter be subject to such modification and change as the Commission may direct. Minor changes in project works, or in uses of project lands and waters, or divergence from such approved exhibits may be made if such changes will not result in a decrease in efficiency, in a material increase in cost, in an adverse environmental impact, or in impairment of the general scheme of development; but any of such minor changes made without the prior approval of the Commission, which in its judgment have produced or will produce any of such results, shall be subject to such alteration as the Commission may direct.

Upon the completion of the project, or at such other time as the Commission may direct, the Licensee shall submit to the Commission for approval revised exhibits insofar as necessary to show any divergence from or variations in the project area and project boundary as finally located or in the project works as actually constructed when compared with the area and boundary shown and the works described in the license or in the exhibits approved by the Commission, together with a statement in writing setting forth the reasons which in the opinion of the Licensee necessitated or justified variation in or divergence from the approved exhibits. Such revised exhibits shall, if and when approved by the Commission, be made a part of the license under the provisions of Article 2 hereof.

Article 4. The construction, operation, and maintenance of the project and any work incidental to additions or alterations shall be subject to the inspection and supervision of the Regional Engineer, Federal Power Commission, in the region wherein the project is located, or of such other officer or agent as the Commission may designate, who shall be the authorized representative of the Commission for such purposes. The Licensee shall cooperate fully with said representative and shall furnish him a detailed program of inspection by the Licensee that will provide for an adequate and qualified inspection force for construction of the project and for any subsequent alterations to the project. Construction of the project works or any feature or alteration thereof shall not be initiated until the program of inspection for the project works or any such feature thereof has been approved by said representative. The Licensee shall also furnish to said representative such further information as he may require concerning the construction, operation, and maintenance of the project, and of any alteration thereof, and shall notify him of the date upon which work will begin, as far in advance thereof as said representative may reasonably specify, and shall notify him promptly in writing of any suspension of work for a period of more than one week, and of its resumption and completion. The Licensee shall allow said representative and other officers or employees of the United States, showing proper credentials, free and unrestricted access to, through, and across the project lands and project works in the performance of their official duties. The Licensee shall comply with such rules and regulations of general or special applicability as the Commission may prescribe from time to time for the protection of life, health, or property.

Article 5. The Licensee, within five years from the date of issuance of the license, shall acquire title in fee or the right to use in perpetuity all lands, other than lands of the United States, necessary or appropriate for the construction, maintenance, and operation of the project. The Licensee or its successors and assigns shall, during the period of the license, retain the possession of all project property covered by the license as issued or as later amended, including the project area, the project works, and all franchises, easements, water rights, and rights of occupancy and use; and none of such properties shall be voluntarily sold, leased, transferred, abandoned, or otherwise disposed of without the prior written approval of the Commission, except that the Licensee may lease or otherwise dispose of interests in project lands or property without specific written approval of the Commission pursuant to the then current regulations of the Commission. The provisions of this article are not intended to prevent the abandonment or the retirement from service of structures, equipment, or other project works in connection with replacements thereof when they become obsolete, inadequate, or inefficient for further service due to wear and tear; and mortgage or trust deeds or judicial sales made thereunder, or tax sales, shall not be deemed voluntary transfers within the meaning of this article.

Article 6. In the event the project is taken over by the United States upon the termination of the license as provided in Section 14 of the Federal Power Act, or is transferred to a new licensee or to a non-power licensee under the provisions of Section 15 of said Act, the Licensee, its successors and assigns shall be responsible for, and shall make good any defect of title to, or of right of occupancy and use in, any of such project property that is necessary or appropriate or valuable and serviceable in the maintenance and operation of the project, and shall pay and discharge, or shall assume responsibility for payment and discharge of, all liens or encumbrances upon the project or project property created by the Licensee or created or incurred after the issuance of the license: Provided, That the provisions of this article are not intended to require the Licensee, for the purpose of transferring the project to the United States or to a new licensee, to acquire any different title to, or right of occupancy and use in, any of such project property than was necessary to acquire for its own purposes as the Licensee.

Article 7. The actual legitimate original cost of the project, and of any addition thereto or betterment thereof, shall be determined by the Commission in accordance with the Federal Power Act and the Commission's Rules and Regulations thereunder.

Article 8. The Licensee shall install and thereafter maintain gages and stream-gaging stations for the purpose of determining the stage and flow of the stream or streams on which the project is located, the amount of water held in and withdrawn from storage, and the effective head on the turbines; shall provide for the required reading of such gages and for the adequate rating of such stations; and shall install and maintain standard meters adequate for the determination of the amount of electric energy generated by the project works. The number, character, and location of gages, meters, or other measuring devices, and the method of operation thereof, shall at all times be satisfactory to the Commission or its authorized representative. The Commission reserves the right, after notice and opportunity for hearing, to require such alterations in the number, character, and location of gages, meters, or other measuring devices, and the method of operation thereof, as are necessary to secure adequate determinations. The installation of gages, the rating of said stream or streams, and the determination of the flow thereof, shall be under the supervision of, or in cooperation with, the District Engineer of the United States Geological Survey having charge of stream-gaging operations in the region of the project, and the Licensee shall advance to the United States Geological Survey the amount of funds estimated to be necessary for such supervision, or cooperation for such periods as may be mutually agreed upon. The Licensee shall keep accurate and sufficient records of the foregoing determinations to the satisfaction of the Commission, and shall make return of such records annually at such time and in such form as the Commission may prescribe.

Article 9. The Licensee shall, after notice and opportunity for hearing, install additional capacity or make other changes in the project as directed by the Commission, to the extent that it is economically sound and in the public interest to do so.

Article 10. The Licensee shall, after notice and opportunity for hearing, coordinate the operation of the project, electrically and hydraulically, with such other projects or power systems and in such manner as the Commission may direct in the interest of power and other beneficial public uses of water resources, and on such conditions concerning the equitable sharing of benefits by the Licensee as the Commission may order.

Article 11. Whenever the Licensee is directly benefited by the construction work of another licensee, a permittee, or the United States on a storage reservoir or other headwater improvement, the Licensee shall reimburse the owner of the headwater improvement for such part of the annual charges for interest, maintenance, and depreciation thereof as the Commission shall determine to be equitable, and shall pay to the United States the cost of making such determination as fixed by the Commission. For benefits provided by a storage reservoir or other headwater improvement of the United States, the Licensee shall pay to the Commission the amounts for which it is billed from time to time for such headwater benefits and for the cost of making the determinations pursuant to the then current regulations of the Commission under the Federal Power Act.

Article 12. The United States specifically retains and safeguards the right to use water in such amount, to be determined by the Secretary of the Army, as may be necessary for the purposes of navigation on the navigable waterway affected; and the operations of the Licensee, so far as they affect the use, storage and discharge from storage of waters affected by the license, shall at all times be controlled by such reasonable rules and regulations as the Secretary of the Army may prescribe in the interest of navigation, and as the Commission may prescribe for the protection of life, health, and property, and in the interest of the fullest practicable conservation and utilization of such waters for power purposes and for other beneficial public uses, including recreational purposes, and the Licensee shall release water from the project reservoir at such rate in cubic feet per second, or such volume in acre-feet per specified period of time, as the Secretary of the Army may prescribe in the interest of navigation, or as the Commission may prescribe for the other purposes hereinbefore mentioned.

Article 13. On the application of any person, association, corporation, Federal agency, State or municipality, the Licensee shall permit such reasonable use of its reservoir or other project properties, including works, lands and water rights, or parts thereof, as may be ordered by the Commission, after notice and opportunity for hearing, in the interests of comprehensive development of the waterway or waterways involved and the conservation and utilization of the water resources of the region for water supply or for the purposes of steam-electric, irrigation, industrial, municipal or similar uses. The Licensee shall receive reasonable compensation for use of its reservoir or other project properties or parts thereof for such purposes, to include at least full reimbursement for any damages or expenses which the joint use causes the Licensee to incur. Any such compensation shall be fixed by the Commission either by approval of an agreement between the Licensee and the party or parties benefiting or after notice and opportunity for hearing. Applications shall contain information in sufficient detail to afford a full understanding of the proposed use, including satisfactory evidence that the applicant possesses necessary water rights pursuant to applicable State law, or a showing of cause why such evidence cannot concurrently be submitted, and a statement as to the relationship of the proposed use to any State or municipal plans or orders which may have been adopted with respect to the use of such waters.

Article 14. In the construction or maintenance of the project works, the Licensee shall place and maintain suitable structures and devices to reduce to a reasonable degree the liability of contact between its transmission lines and telegraph, telephone and other signal wires or power trans- mission lines constructed prior to its transmission lines and not owned by the Licensee, and shall also place and maintain suitable structures and devices to reduce to a reasonable degree the liability of any structures or wires falling or obstructing traffic or endangering life. None of the provisions of this article are intended to relieve the Licensee from any responsibility or requirement which may be imposed by any other lawful authority for avoiding or eliminating inductive interference.

Article 15. The Licensee shall, for the conservation and development of fish and wildlife resources, construct, maintain, and operate, or arrange for the construction, maintenance, and operation of such reasonable facilities, and comply with such reasonable modifications of the project structures and operation, as may be ordered by the Commission upon its own motion or upon the recommendation of the Secretary of the Interior or the fish and wildlife agency or agencies of any State in which the project or a part thereof is located, after notice and opportunity for hearing.

Article 16. Whenever the United States shall desire, in connection with the project, to construct fish and wildlife facilities or to improve the existing fish and wildlife facilities at its own expense, the Licensee shall permit the United States or its designated agency to use, free of cost, such of the Licensee's lands and interests in lands, reservoirs, waterways and project works as may be reasonably required to complete such facilities or such improvements thereof. In addition, after notice and opportunity for hearing, the Licensee shall modify the project operation as may be reasonably prescribed by the Commission in order to permit the maintenance and operation of the fish and wildlife facilities constructed or improved by the United States under the provisions of this article. This article shall not be interpreted to place any obligation on the United States to construct or improve fish and wildlife facilities or to relieve the Licensee of any obligation under this license.

Article 17. The Licensee shall construct, maintain, and operate, or shall arrange for the construction, maintenance, and operation of such reasonable recreational facilities, including modifications thereto, such as access roads, wharves, launching ramps, beaches, picnic and camping areas, sanitary facilities, and utilities, giving consideration to the needs of the physically handicapped, and shall comply with such reasonable modifications of the project, as may be prescribed here after by the Commission during the term of this license upon its own motion or upon the recommendation of the Secretary of the Interior or other interested Federal or State agencies, after notice and opportunity for hearing.

Article 18. So far as is consistent with proper operation of the project, the Licensee shall allow the public free access, to a reasonable extent, to project waters and adjacent project lands owned by the Licensee for the purpose of full public utilization of such lands and waters for navigation and for outdoor recreational purposes, including fishing and hunting: Provided, That the Licensee may reserve from public access such portions of the project waters, adjacent lands, and project facilities as may be necessary for the protection of life, health, and property.

Article 19. In the construction, maintenance, or operation of the project, the Licensee shall be responsible for, and shall take reasonable measures to prevent, soil erosion on lands adjacent to streams or other waters, stream sedimentation, and any form of water or air pollution. The Commission, upon request or upon its own motion, may order the Licensee to take such measures as the Commission finds to be necessary for these purposes, after notice and opportunity for hearing.

Article 20. The Licensee shall consult with the appropriate State and Federal agencies and, within one year of the date of issuance of this license, shall submit for Commission approval a plan for clearing the reservoir area. Further, the Licensee shall clear and keep clear to an adequate width lands along open conduits and shall dispose of all temporary structures, unused timber, brush, refuse, or other material unnecessary for the purposes of the project which results from the clearing of lands or from the maintenance or alteration of the project works. In addition, all trees along the periphery of project reservoirs which may die during operations of the project shall be removed. Upon approval of the clearing plan all clearing of the lands and disposal of the unnecessary material shall be done with due diligence and to the satisfaction of the authorized representative of the Commission and in accordance with appropriate Federal, State, and local statutes and regulations.

Article 21. Material may be dredged or excavated from, or placed as fill in, project lands and/or waters only in the prosecution of work specifically authorized under the license; in the maintenance of the project; or after obtaining Commission approval, as appropriate. Any such material shall be removed and/or deposited in such manner as to reasonably preserve the environmental values of the project and so as not to interfere with traffic on land or water. Dredging and filling in a navigable water of the United States shall also be done to the satisfaction of the District Engineer, Department of the Army, in charge of the locality.

Article 22. Whenever the United States shall desire to construct, complete, or improve navigation facilities in connection with the project, the Licensee shall convey to the United States, free of cost, such of its lands and rights-of-way and such rights of passage through its dams or other structures, and shall permit such control of its pools, as may be required to complete and maintain such navigation facilities.

Article 23. The operation of any navigation facilities which may be constructed as a part of, or in connection with, any dam or diversion structure constituting a part of the project works shall at all times be controlled by such reasonable rules and regulations in the interest of navigation, including control of the level of the pool caused by such dam or diversion structure, as may be made from time to time by the Secretary of the Army.

Article 24. The Licensee shall furnish power free of cost to the United States for the operation and maintenance of navigation facilities in the vicinity of the project at the voltage and frequency required by such facilities and at a point adjacent thereto, whether said facilities are constructed by the Licensee or by the United States.

Article 25. The Licensee shall construct, maintain, and operate at its own expense such lights and other signals for the protection of navigation as may be directed by the Secretary of the Department in which the Coast Guard is operating.

Article 26. Timber on lands of the United States cut, used, or destroyed in the construction and maintenance of the project works, or in the clearing of said lands, shall be paid for, and the resulting slash and debris disposed of, in accordance with the requirements of the agency of the United States having jurisdiction over said lands. Payment for merchantable timber shall be at current stumpage rates, and payment for young growth timber below merchantable size shall be at current damage appraisal values. However, the agency of the United States having jurisdiction may sell or dispose of the merchantable timber to others than the Licensee: Provided, That timber so sold or disposed of shall be cut and removed from the area prior to, or without undue interference with, clearing operations of the Licensee and in coordination with the Licensee's project construction schedules. Such sale or disposal to others shall not relieve the Licensee of responsibility for the clearing and disposal of all slash and debris from project lands.

Article 27. The Licensee shall do everything reasonably within its power, and shall require its employees, contractors, and employees of contractors to do every thing reasonably within their power, both independently and upon the request of officers of the agency concerned, to prevent, to make advance preparations for suppression of, and to suppress fires on the lands to be occupied or used under the license. The Licensee shall be liable for and shall pay the costs incurred by the United States in suppressing fires caused from the construction, operation, or maintenance of the project works or of the works appurtenant or accessory thereto under the license.

Article 28. The Licensee shall interpose no objection to, and shall in no way prevent, the use by the agency of the United States having jurisdiction over the lands of the United States affected, or by persons or corporations occupying lands of the United States under permit, of water for fire suppression from any stream, conduit, or body of water, natural or artificial, used by the Licensee in the operation of the project works covered by the license, or the use by said parties of water for sanitary and domestic purposes from any stream, conduit, or body of water, natural or artificial, used by the Licensee in the operation of the project works covered by the license.

Article 29. The Licensee shall be liable for injury to, or destruction of, any buildings, bridges, roads, trails, lands, or other property of the United States, occasioned by the construction, maintenance, or operation of the project works or of the works appurtenant or accessory thereto under the license. Arrangements to meet such liability, either by compensation for such injury or destruction, or by reconstruction or repair of damaged property, or otherwise, shall be made with the appropriate department or agency of the United States.

Article 30. The Licensee shall allow any agency of the United States, without charge, to construct or permit to be constructed on, through, and across those project lands which are lands of the United States such conduits, chutes, ditches, railroads, roads, trails, telephone and power lines, and other routes or means of transportation and communication as are not inconsistent with the enjoyment of said lands by the Licensee for the purposes of the license. This license shall not be construed as conferring upon the Licensee any right of use, occupancy, or enjoyment of the lands of the United States other than for the construction, operation, and maintenance of the project as stated in the license.

Article 31. In the construction and maintenance of the project, the location and standards of roads and trails on lands of the United States and other uses of lands of the United States, including the location and condition of quarries, borrow pits, and spoil disposal areas, shall be subject to the approval of the department or agency of the United States having supervision over the lands involved.

Article 32. The Licensee shall make provision, or shall bear the reasonable cost, as determined by the agency of the United States affected, of making provision for avoiding inductive interference between any project transmission line or other project facility constructed, operated, or maintained under the license, and any radio installation, telephone line, or other communication facility installed or constructed before or after construction of such project transmission line or other project facility and owned, operated, or used by such agency of the United States in administering the lands under its jurisdiction.

Article 33. The Licensee shall make use of the Commission's guidelines and other recognized guidelines for treatment of transmission line rights-of-way, and shall clear such portions of transmission line rights-of-way across lands of the United States as are designated by the officer of the United States in charge of the lands; shall keep the areas so designated clear of new growth, all refuse, and inflammable material to the satisfaction of such officer; shall trim all branches of trees in contact with or liable to contact the transmission lines; shall cut and remove all dead or leaning trees which might fall in contact with the transmission lines; and shall take such other precautions against fire as may be required by such officer. No fires for the burning of waste material shall be set except with the prior written consent of the officer of the United States in charge of the lands as to time and place.

Article 34. The Licensee shall cooperate with the United States in the disposal by the United States, under the Act of July 31, 1947, 61 Stat. 681, as amended (30 U.S.C. sec. 601, et seq.), of mineral and vegetative materials from lands of the United States occupied by the project or any part thereof: Provided, That such disposal has been authorized by the Commission and that it does not unreasonably interfere with the occupancy of such lands by the Licensee for the purposes of the license: Provided further, That in the event of disagreement, any question of unreasonable interference shall be determined by the Commission after notice and opportunity for hearing.

Article 35. If the Licensee shall cause or suffer essential project property to be removed or destroyed or to become unfit for use, without adequate replacement, or shall abandon or discontinue good faith operation of the project or refuse or neglect to comply with the terms of the license and the lawful orders of the Commission mailed to the record address of the Licensee or its agent, the Commission will deem it to be the intent of the Licensee to surrender the license. The Commission, after notice and opportunity for hearing, may require the Licensee to remove any or all structures, equipment and power lines within the project boundary and to take any such other action necessary to restore the project waters, lands, and facilities remaining within the project boundary to a condition satisfactory to the United States agency having jurisdiction over its lands or the Commission's authorized representative, as appropriate, or to provide for the continued operation and maintenance of non-power facilities and fulfill such other obligations under the license as the Commission may prescribe. In addition, the Commission in its discretion, after notice and opportunity for hearing, may also agree to the surrender of the license when the Commission, for the reasons recited herein, deems it to be the intent of the Licensee to surrender the license.

Article 36. The right of the Licensee and of its successors and assigns to use or occupy waters over which the United States has jurisdiction, or lands of the United States under the license, for the purpose of maintaining the project works or otherwise, shall absolutely cease at the end of the license period, unless the Licensee has obtained a new license pursuant to the then existing laws and regulations, or an annual license under the terms and conditions of this license.

Article 37. The terms and conditions expressly set forth in the license shall not be construed as impairing any terms and conditions of the Federal Power Act which are not expressly set forth herein.

H.2 SPECIAL LICENSE ARTICLES FOR HYDROPOWER PROJECTS CONSTRUCTED AT U.S. ARMY CORPS OF ENGINEERS DAMS

Article 301. The design and construction of those permanent and temporary facilities, including reservoir impounding cofferdams and deep excavations, that should be an integral part of, or that could affect the structural integrity or operation of the government project shall be done in consultation with and subject to the review and approval of the Corps' Division

Engineer. Within 90 days from the issuance date of the license, the licensee shall furnish the Corps and the Commission's Regional Director, for their information, a schedule for submission of design documents and the plans and specifications for the project. If the schedule does not afford sufficient review and approval time, the licensee, upon request of the Corps, shall meet with the Corps' and Commission's staff to revise the schedule accordingly.

Article 302. The licensee shall review and approve the design of contractor-designed cofferdams and deep excavations other than those approved according to Article prior to the start of construction and shall ensure that construction of the cofferdams and deep excavations are consistent with the approved design. At least 30 days prior to start of construction of the cofferdam, the licensee shall file 2 copies with the Commission, and submit 1 copy each to the Commission's Regional Director and the Corps of Engineers, of the approved cofferdam construction drawings and specifications and letter(s) of approval.

Article 303. Within 90 days from the issuance date of the license, the licensee shall enter into an agreement with the Corps of Engineers to coordinate plans for access to and site activities on lands and property administered by the Corps so that the authorized purposes, including operation of the Federal facilities, are protected. In general, the agreement shall not be redundant with the Commission's requirements contained in th.s license, shall identify the facility, and the study and construction activities, as applicable, and terms and conditions under which studies and construction will be conducted. The agreement shall set forth reasonable arrangements for access to the Corps site to conduct studies and construction activities, such access rights to be conditioned by the Corps as may be necessary to protect the federally authorized project purposes and operations. Should the licensee and the Corps fail to reach an access agreement, the licensee shall refer the matter to the Commission for resolution.

Article 304. The construction, operation and maintenance of the project works that, in the judgement of the Corps of Engineers may affect the structural integrity or operation of the Corps project shall be subject to periodic or continuous inspections by the Corps. Any construction, operation and maintenance deficiencies or difficulties detected by the Corps' inspection shall be immediately reported to the Commission's Regional Director. Upon review, the Regional Director shall refer the matter to the licensee for appropriate action. In cases where construction, operation or maintenance practices or deficiencies may create a situation posing imminent danger to the structural integrity and safety of Corps project, the Corps' inspector has the authority to stop construction, operation, or maintenance while waiting resolution of the problem.

Article 305. At least 60 days prior to start of construction, the licensee shall submit for approval a regulating plan to the Corps of Engineers, describing (a) the designed mode of hydropower operation, and (b) reservoir flow diversion and regulation requirements as established by the Corps for operation of the Corps project during construction. In addition, the licensee, prior to start of power plant operation, shall enter into an operating Memorandum of Agreement (MOA) with the Corps describing the detailed operation of the powerhouse acceptable to the Corps. The MOA shall specify any restrictions needed to protect the primary purposes of the Corps project for navigation, recreation, water quality, and flood control. The Regional Director shall be invited to attend meetings regarding the agreement. The MOA shall be subject to revision by mutual consent of the Corps and licensee as experience is gained by actual project operation. Should the licensee and the Corps fail to reach an agreement, the matter shall be referred to the Commission for resolution. Three copies of the regulating plan and signed MOA between the Corps and the licensee and any revision thereof shall be filed with the Commission and one copy submitted to the Regional Director.

Article 306. The licensee shall have no claim under this license against the United States arising from the effect of any changes made in the operation or reservoir levels of the Corps of Engineers' project.

Article 307. The licensee shall provide the Regional Director two copies of all correspondence between the licensee and the Corps of Engineers. The Regional Director shall not authorize construction of any project work until the Corps of Engineers' written approval of construction plans and specification has been received by the Regional Director.

APPENDIX I

ADDITIONAL INFORMATION AND EVALUATION OF POTENTIAL IMPACTS ON THE PINK MUCKET PEARLY MUSSELL (*LAMPSILIS ABRUPTA*) SUBMITTED TO THE U.S. FISH AND WILDLIFE SERVICE

APPENDIX I

The Notice of Availability of the draft environmental impact statement (DEIS) was published in the Federal Register on May 20, 1988. The DEIS was mailed to Federal, state, and local agencies and individuals for comments on May 12, 1988. Chapter 8 of the final environmental impact statement (FEIS) contains a listing of those agencies and individuals that were sent copies of both the DEIS and FEIS. A public meeting on the DEIS was conducted on July 15, 1988 in Pittsburgh, Pennsylvania, to allow participants to express their views on the DEIS.

All timely letters of comment that address specific analyses in the DEIS were reviewed by FERC staff. Suggestions for correcting text or data and requests for further discussion of a subject have been considered. Those editorial changes and suggestions which were practicable, reasonable, and which improved the quality of the EIS are incorporated herein.

Constructive criticism presenting a major environmental point of view or one in opposition to staff, when persuasively supported, is treated by making revisions in the appropriate part of the FEIS. When the major point of view is not persuasive, reasons are given why the staff did not change its point of view.

The sections or pages of the FEIS that have been modified as a result of comments received are identified in the staff responses to the right of the letters of comments. Other FERC staff responses are self-explanatory.

A "no response required" response is given to comments that are statements that raised no questions concerning treatment of subject matter in the DEIS. A "your opinion has been noted" or "comment noted" response is given to comments that are considered to be statements or opinions.

Letters were received form the U.S. Soil Conservation Service, U.S. Public Health Service, and the Ohio State Clearing House which acknowledged receipt of the DEIS but offered no comments.

The respondents and the page on which their letters occur are as follows:

Name Page

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON D C 20426

SEP 08 1988

Mr. Christopher Clower
Elkins Suboffice
U.S. Fish & Wildlife Service
P.O. Box 1278
Elkins, WV 26214

Dear Mr. Clower:

This is in partial response to the letter dated August 1, 1988, from the United States Department of the Interior (Interior) that provides comments on the draft environmental impact statement (DEIS) for proposed hydropower projects in the upper Ohio River Basin, Docket No. EL85-19-114 (Enclosure 1).

Comments on pages 3, 4, and 5, in the August 1, 1988, letter reference the need for completion of a biological assessment and consultation on the pink mucket pearly mussel, a federally-listed endangered species that occurs in the Ohio River Basin, pursuant to Section 7 of the Endangered Species Act, as amended.

Consistent with Section 7(c)(1) of the Endangered Species Act, as amended, and 50 C.F.R. § 402.06 (1987), staff's biological assessment was included in the DEIS transmitted to your office by letter dated June 27, 1988 (Enclosure 2). That letter specifically addressed the DEIS assessment of impacts on the endangered mussel and requested your comments. Pursuant to 50 C.F.R. § 402.12(j) (1987), which permits an agency to initiate formal consultation concurrently with its submission of the biological assessment, it was our intent that the request constitute our request for formal consultation. In response to Interior's request for additional data included in its DEIS comments, staff has compiled additional information in the attached document concerning the species (Enclosure 3). This information will be included in the final environmental impact statement.

As reflected in the DEIS and the enclosed supplemental information, staff has determined that the proposed development of hydroelectric projects in the upper Ohio River Basin could have some effect on the species but that the effect is not likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of its critical habitat. The effect varies with the alternative considered, and the impact of the preferred alternative is so small as to be considered to have no demonstrable effect. Therefore, we request that consultation be concluded expeditiously and that you proceed to prepare your biological opinion regarding the endangered pink mucket pearly mussel.

If you have any questions on this matter, please telephone George Taylor at 202/376-1900.

Sincerely,

Dean L. Shumway
Director, Division of
Project Review

Enclosures:

Draft Environmental Impact Statement for Hydroelectric Development in the Upper Ohio River Basin, Docket No. EL85-19-114.
Letter from Dean Shumway, FERC, to Christopher Clower, USFWS, dated June 27, 1988.
Additional Information on the Effects of Hydroelectric Development in the Upper Ohio River Basin on the Pink Mucket Pearly Mussel, Lampsilus abrupta (Say 1831)=L. orbiculata.

Enclosure 2

Mr. Christopher Clower
Elkins Suboffice
U.S. Fish and Wildlife Service
P.O. Box 1278
Elkins, WV 26214

JUN 27 1988

Dear Mr. Clower:

Enclosed is the Draft Environmental Impact Statement (EIS) for Hydroelectric Development in the Upper Ohio River Basin, Docket No. EL85-19-114.

The EIS assesses the impacts associated with 24 proposed hydroelectric projects located at 19 sites in the upper basin, including the potential impacts of the proposed projects on the endangered pink mucket pearly mussel.

Page 3-19 of the EIS provides information on the distribution of the endangered mussel in the upper basin. This section of the DEIS also identifies suitable habitat for this species in the downstream areas of the proposed hydropower projects located at Muskingum River Lock and Dam (L&D) No. 3 (FERC No. 6998), Belleville L&D (FERC No. 6939), and the competing proposals at Gallipolis L&D (FERC Nos. 9042 and 10098).

Page 4-62 discusses the effect of the hydropower proposals on the endangered mussel. Page 5-21 indicates staff's recommended alternative, alternative 4. Under this alternative, there would be no hydropower development at Muskingum River L&D No. 3 and, therefore, no effect on this endangered species. Page 5-29 provides staff's recommendations for the protection of this species associated with hydropower development at Belleville L&D and Gallipolis L&D.

We would appreciate receiving your review comments within 30 days, regarding the endangered pink mucket pearly mussel.

Sincerely,

for Dean L. Shumway,
Director, Division of
Project Review

Enclosure: Draft Environmental Impact Statement
for Hydroelectric Development in the
Upper Ohio River Basin, Docket No. EL85-19-114.

Enclosure 3

ADDITIONAL INFORMATION ON THE EFFECTS OF HYDROELECTRIC DEVELOPMENT IN THE UPPER OHIO RIVER BASIN ON THE PINK MUCKET PEARLY MUSSEL, *Lampsilus abrupta* (Say 1831) = *L. orbiculata*

September 7, 1988

Federal Energy Regulatory Commission
Washington, D. C.

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CONTENTS

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ABSTRACT

Proposed hydropower development of the upper Ohio River basin has been determined to have the potential for some impacts on the federally listed endangered freshwater mussel, Lampsilus abrupta (Say, 1931). The Federal Energy Regulatory Commission (FERC) is considering licensing 24 hydroelectric projects at 19 sites in the upper basin. Impacts at one confirmed locality, one recently occupied locality, and two localities anticipated by the U. S. Fish and Wildlife Service to contain the species have been analyzed. The evaluation is based on the best estimates of the environmental requirements of the species (using analogy with other freshwater mussel species where necessary), the locations of confirmed and suspected beds of the species, and the estimated changes in water quality (DO), habitat, and fish hosts that might be caused by hydropower development. There are important uncertainties in this information, especially the dissolved oxygen criterion for continued long-term mussel growth and production, that prevent precise definition of impacts. The impacts were determined to differ with alternative development scenarios. FERC staff believes that none of the four development alternatives examined in the DEIS would be likely to jeopardize the continued existence of L. abrupta or result in the destruction or adverse modification of L. abrupta critical habitat, while the preferred alternative (Projects Selected To Minimize Impacts To All Target Resources) will have no demonstrable effect on populations of this freshwater mussel. The proposed licensing action, therefore, would not jeopardize the continued existence of L. abrupta, in accord with requirements of the Endangered Species Act of 1973, as amended.

1. INTRODUCTION

The pink mucket pearly mussel, Lampsilus abrupta (Say 1831), which is synonymous with L. orbiculata (Stansbery 1985), is listed by the U. S. Fish and Wildlife Service (USFWS) as an endangered species (USFWS 1985, 41 FR 24062-24067). In compliance with Section 7(a) of the Endangered Species Act of 1973, as amended, the Upper Mississippi Water Company, which seeks a license from the Federal Energy Regulatory Commission (FERC) to construct a small hydropower project on the Muskingum River (FERC No. 6996-001), supplied the USFWS with biological and physical information on its project and its impacts on L. abrupta. (Mitex, Inc. 1987). The USFWS responded to Mitex, Inc. with a letter approving mitigation plans (Appendix I). This species has occupied habitats immediately downstream of Muskingum Lock and Dam 3, the site of the proposed hydropower project. Correspondence between FERC and the USFWS has revealed that L. abrupta was identified in 1987 from another site in the FERC study area, about 14 miles below the Gallipolis Locks and Dam on the Ohio River (Tolin et al. 1987, Appendix II). The USFWS believes habitats in other locations in the Ohio River, e.g., below Willow Island Locks and Dam and Belleville Locks and Dam, are also suitable and the species may be found there (Appendix II). FERC staff prepared a biological assessment in compliance with section 7(c) of the Endangered Species Act of 1973, as amended, on L. abrupta and incorporated it into the Draft Environmental Impact Statement (DEIS) on the cumulative impacts of hydroelectric development in the upper Ohio River basin of Ohio, Pennsylvania, and West Virginia in accordance with the National Environmental Policy Act of 1969 (FERC 1988; FERC Docket No. EL85-19-114). By letter of June 27, 1988, the FERC indicated to USFWS that it had conducted an evaluation of L. abrupta as part of the DEIS and requested comments (Appendix III). USFWS did not respond specifically to this letter. Comments by the USFWS on the DEIS indicated that additional assessment of upper basin hydroelectric development on L. abrupta should be undertaken. (Appendix IV).

This document presents additional information regarding the previously prepared biological assessment of potential impacts of hydropower development in the upper Ohio River basin on L. abrupta (= L. orbiculata). It describes the methods, results, and implications of studies conducted by license applicants, university researchers, the USFWS, state agencies, and others. This report was prepared by the Oak Ridge National Laboratory (ORNL) for the FERC staff.

2. DESCRIPTION OF THE PROPOSED PROJECTS

The proposed action is the licensing of 24 hydroelectric projects at 19 sites (5 sites have competing applications) located in the upper Ohio River basin in the states of Pennsylvania, West Virginia, and Ohio (Figure 1). The projects (Table 1) can be licensed if they can provide energy in an environmentally acceptable manner that is more economically feasible than the least-cost thermal alternative. A more complete description of the projects can be found in the DEIS (FERC 1988). The projects are located for the most part (17 sites) at locks and dams (L&D) constructed and operated by the U. S. Army Corps of Engineers (Corps). One site is on the Muskingum River where navigation dams are operated by the State of Ohio, and another site is on a high-head storage dam on the Tygart River. Power generation would be controlled by river flows and water use for navigation locks (Tygart Dam is a

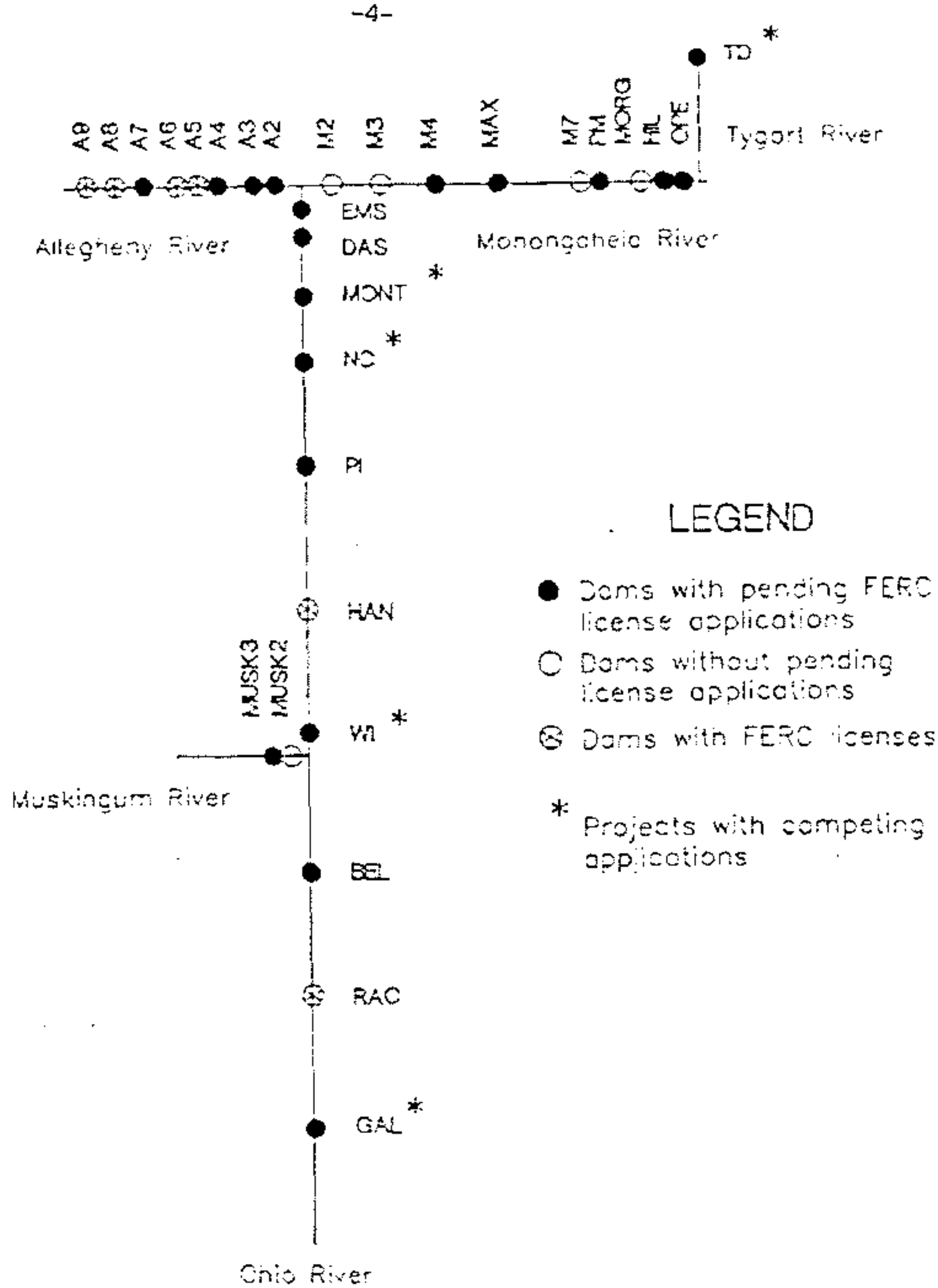


Figure 1. Schematic representation of projects within the FERC DEIS study area. (Table 1 gives project names and FERC project numbers for each of the abbreviations used in this figure). Source: FERC (1988).

Table I. Hydroelectric projects with pending FERC license applications evaluated in the DEIS.

Project name, abbreviation	FERC project no.
Allegheny River L&D No. 7, A7	7914-003
Allegheny River L&D No. 4, A4	7909-002
Allegheny River L&D No. 3, A3	4474-00
Allegheny River L&D No. 2, A2	4017-002
Tygart Dam, TD	7307-000 7399-000
Opekiska L&D, OPE	8990-000
Hildebrand L&D, HIL	8654-001
Point Marion L&D, PM	7660-000
Maxwell L&D, MAX	8908-000
Monongahela L&D No. 4, M4	4675-002
Emsworth L&D, EMS	7041-001
Dashields L&D, DAS	7558-001
Montgomery, MONT	2971-002 3490-003
New Cumberland L&D, NC	6901-001 10332-000
Pike Island, PI	3218-001
Willow Island L&D, WI	6902-003 9999-000
Belleville, BEL	6939-001
Gallipolis L&D, GAL	9042-000 10098-000
Muskingum River L&D No. 3, MUSK3	6998-001

special case not relevant to L. abrupta). All of the projects would be operated as run-of-the-river plants, producing base-load power. Operating agreements would be reached between the licensee and the Corps before operation begins.

Features common to most of the projects include: (1) the proposed powerhouses would be located at the end of the navigation dam opposite the locks, (2) projects propose to install bulb or propeller turbines, (3) projects would operate automatically and/or remotely with wicket gates and turbine blade angles determined by computer to maximize power, (4) and projects would shut down when river flows are either too low or too high. A typical project section and layout are shown in Figures 2 and 3. Summaries of the individual projects are included in the DEIS (pp. 2-5 to 2-24); details are found in individual project applications which have been reviewed by the USFWS.

FERC conducted an environmental assessment (EA) (FERC 1987) that concluded that the proposed projects would interact with one another in a manner that would contribute to significant adverse impacts to target resources, which were identified as dissolved oxygen, recreational fishing, and river navigation. From the analysis in the EA, the staff determined that the proposed construction and operation of multiple hydropower projects in the basin warranted the preparation of an EIS to address the specific and cumulative environmental impacts of licensing the proposed projects.

Although many of the potential impacts from hydroelectric development in the Upper Ohio River Basin are site specific, interactions and cumulative impacts were identified as a major concern in the EIS scoping process, including comments from the USFWS (FERC 1988). The primary mechanism for project interactions and cumulative effects is through flow regulation at navigation dams and subsequent impacts on water quality, river hydraulics, fish populations, and recreational fisheries. The pink mucket pearly mussel is a federally-listed endangered species in the basin (DEIS pp. 3-4, 3-16, 3-19, 3-20) that may be affected by one or more of these mechanisms and by other cumulative impacts. Cumulative impacts are discussed in general in the DEIS Section 1.4 and in detail in the resource impact analyses (DEIS Section 4).

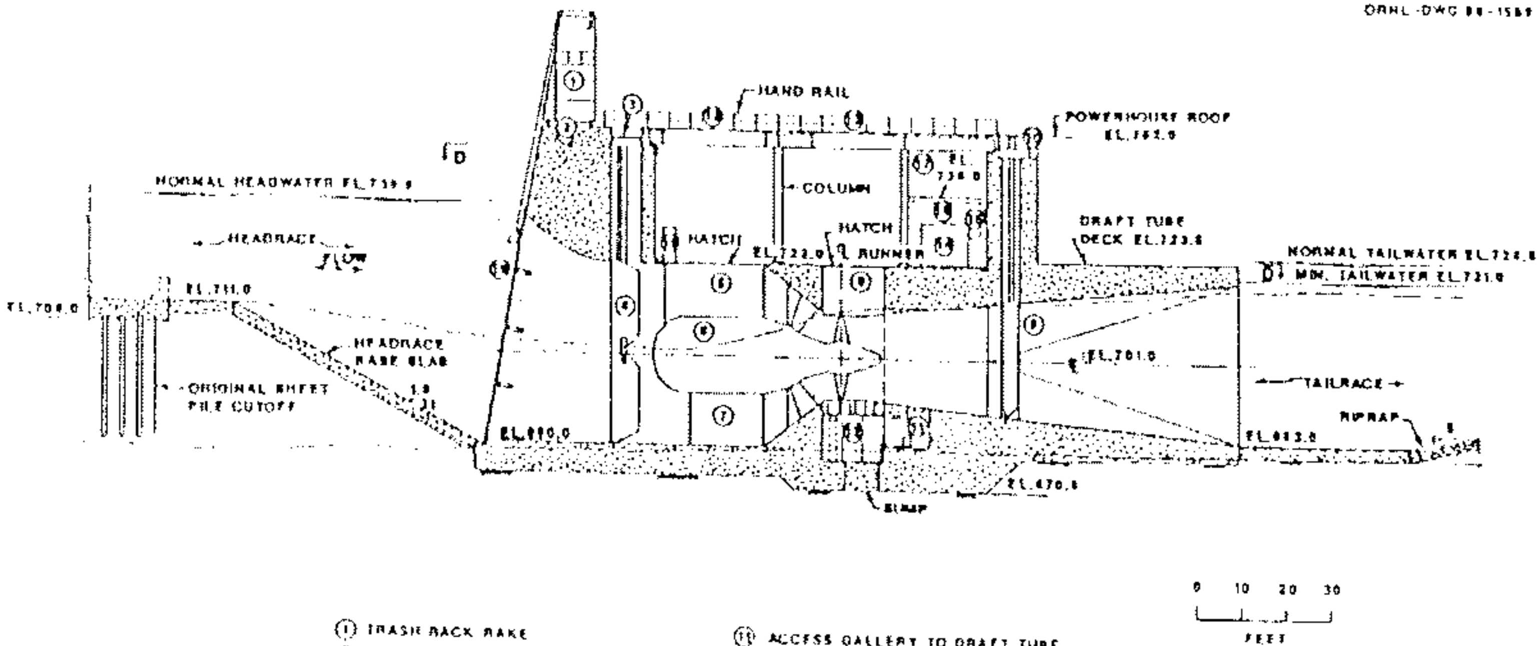
3. ECOLOGY OF THE PINK MUCKET PEARLY MUSSEL

3.1 TAXONOMIC STATUS

Stansbery (1985) conducted a review of the taxonomy of the species in order to resolve matters of synonomy that had been raised in the USFWS Recovery Plan (USFWS 1985). In order to locate and retrieve information from both the literature and from museum collections, it was necessary to become familiar with the various names under which the information and museum specimens were listed. He resolved that the valid name is Lampsilus abrupta (Say, 1831) having major synonomy with L. orbiculata. Some specimens were judged to have been misidentified as the subject species rather than the appropriate sibling species, L. higginsi (Lea, 1856).

3.2 DISTRIBUTION

Stansbery (1985) summarized the distribution of the species as entirely limited to the Mississippi River drainage basin. A few records outside the



1. TRASH RACK RAKE
2. TRASH CHANNEL
3. GATE DOGGING DEVICE
4. UPSTREAM GATE
5. GENERATOR ACCESS
6. BULB UNIT
7. BULB SUPPORT PIER
8. TURBINE PIT
9. DOWNSTREAM GATE
10. DOWNSTREAM GATE OPERATOR
11. ACCESS GALLERY TO DRAFT TUBE
12. EQUIPMENT GALLERY
13. HATCH COVER
14. POWER TRANSFORMER
15. CIRCUIT BREAKER
16. TRANSFORMER VAULT
17. AUXILIARY FLOOR
18. COOLING WATER TANK
19. TRASH RACK

Figure 2. Longitudinal section of a hydropower station proposed for the upper Ohio River, showing typical turbine features. Source: FERC (1988).

ORNL-DWG 89-1677

NEW CUMBERLAND LOCK AND DAM PROJECT FERC NO. 6901-001

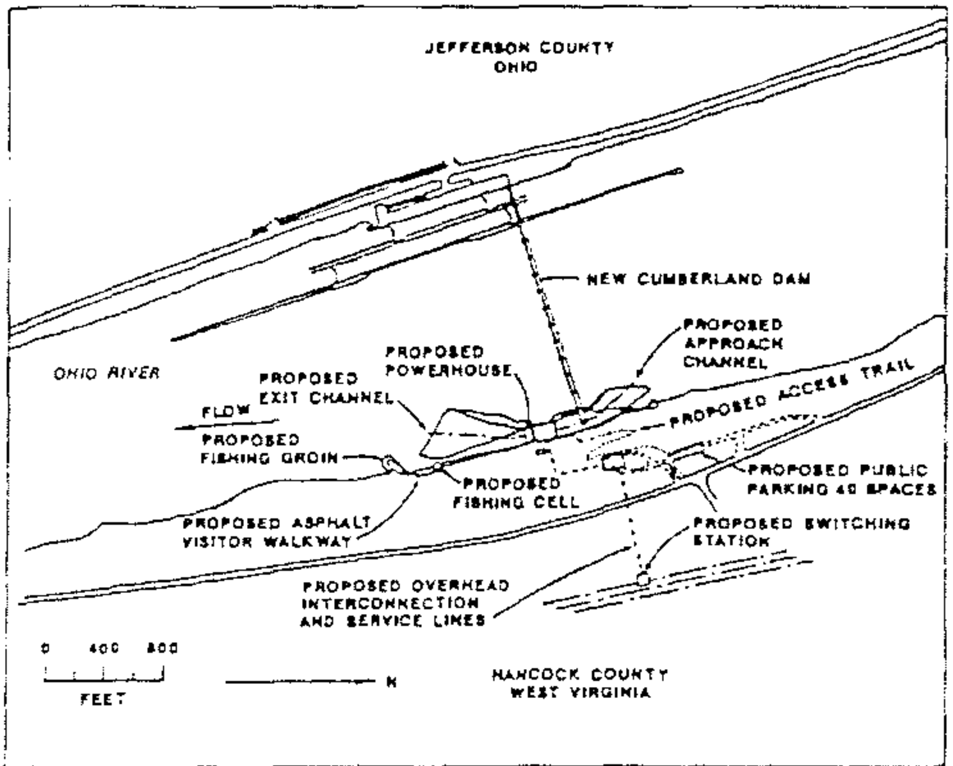


Figure 3. Layout diagram for the New Cumberland Lock and Dam hydropower project, showing typical features for upper Ohio hydropower proposals that consist of a powerhouse along the shoreline opposite the locks. Source: FERC (1988).

basin were attributed by Stansbery to L. higginsi or to improper changes in museum labels. The species was originally widespread, although generally uncommon or rare, historically occurring in 25 river systems (USFWS 1985). Collection records listed by Stansbery show that it has been distributed mainly in the Ohio River system, including the Tennessee and Cumberland rivers (Figure 4). A population has existed, however, in the western part of the Mississippi basin, where thriving populations have been found in the Black River drainage of Arkansas-Missouri, and three river basins in Missouri: the Meramec-Big, Gasconade, and Osage river basins (USFWS 1985).

L. abrupta has been known recently from 16 rivers representing three major geographic regions, with the greatest concentration reported from the Tennessee River system (USFWS 1985). Age structure suggests continued reproduction at most sites (USFWS 1985). J. Jenkinson (pers. comm.; Appendix V) notes that it is fairly widespread in the Tennessee River system, comprising 0.1 to 0.2 of the mussel community; it seems to occur in small numbers whenever the mussel species list amounts to 12 to 14 species. Nearly all sites are in the largest rivers (4th or 5th order) rather than in tributaries; the Spring River, Missouri, is uncharacteristically small for the species. The species seems to have adapted to dam tailwaters in the Tennessee River system (USFWS 1985).

Stansbery (1985) hypothesizes that the original range in the Ohio River drainage once extended from its mouth at Cairo, Illinois, through the river's entire length to Pittsburgh, Pennsylvania, and in its major tributaries above Pittsburgh. Ortmann (1921) notes that this species (which he calls L. orbiculata) was a major constituent of the shell beds of the Ohio River between Pittsburgh and Cincinnati. Museum lots exist from the mainstem Ohio River, and the Allegheny, Monongahela, and Muskingum rivers of the FERC study area (Table 2; Stansbery 1985). The Kanawha River, which enters the Ohio in the Gallipolis pool, has a good population in a small stretch below Kanawha Falls (Clarke 1982, Taylor 1983). There are live populations in the lower Ohio River 50-100 miles above the mouth (USFWS 1985, S. Ahlstedt and W. Tolin pers. comm., Appendix V).

The species had not been found alive in the upper Ohio River and its tributaries for many years until recent discoveries (see DEIS pp. 3-20) below Gallipolis L&D (Tolin et al. 1987; discussed below). A relatively recent study of the unionid freshwater mussels of the Ohio River in Pennsylvania did not find any evidence of the continued existence of L. abrupta (Dennis 1970). Neither did surveys of mussels of the Ohio from Pittsburgh to Greenup Locks and Dam in 1979, which turned up only subfossil L. abrupta shells (Taylor 1980), or a 1983-1985 survey of the same reach (Zeto et al. 1987).

Because of the number of sites confirmed to contain L. abrupta, some attention has been given to delisting the species or downgrading it from endangered to threatened (Clarke 1982, USFWS 1985, Ahlstedt, pers. comm., Appendix V). Delisting criteria are described in the USFWS recovery plan (USFWS 1985). There apprars to be no effort currently underway to delist.

The habitat of the species is judged by Stansbery (1985), USFWS (1985) and all experts contacted, to be restricted to the riffles and runs of the larger rivers within its range. This habitat consists of relatively shallow (0.5 to 8.0 m), fast-flowing water over a firm, stable, gravel-cobble substrate. The

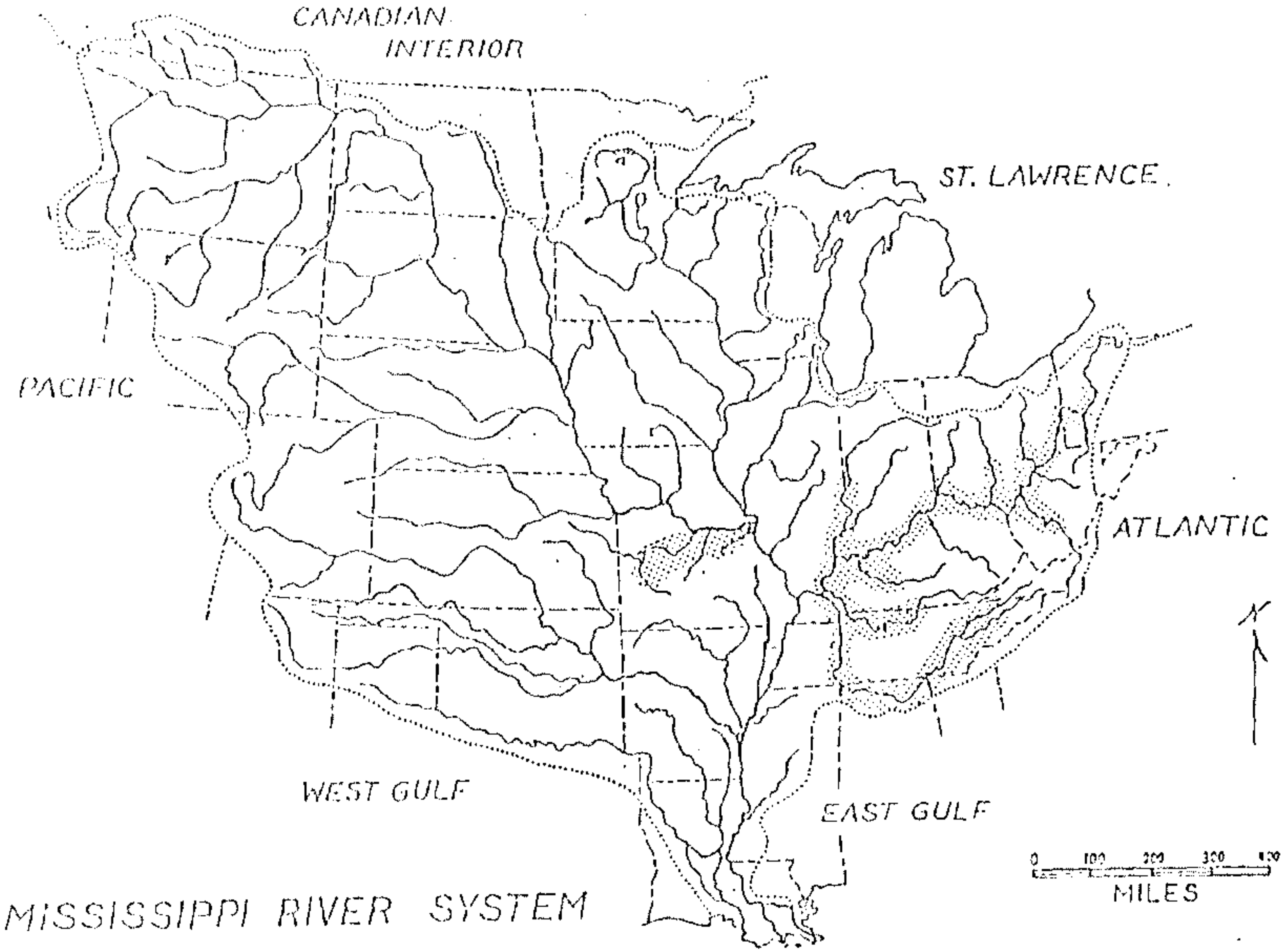


Figure 4. The distribution of *Lampsilis abrupta* (Say, 1831). Source: Stansbery (1985).

Table 2. Muskingum River specimens of Lampsilis abrupta (Say, 1831) in the collections of the Ohio State University Museum of Zoology, November 1985. Source: Stansbery 1985.

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o OSUM 47283
Locale: "B.Musk.", (MRM ?)
Date: ca. 1830
Collector: Samuel P. Hildreth
Specimens: 2 dry shells, males

o OSUM 47284
Locale: "Muskn.", (MRM?)
Date: ca. 1830
Collector: Samuel P. Hildreth
Specimens: 3 dry shells, females

o OSUM 19261
Locale: "Ohio River at Marietta," (MRM?)
Date: 1879
Collector: William Holden
Specimens: 5 dry shells: 2 males and 3 females

o OSUM 43980
Locale: Muskingum River below Luke Chute Dam [3.9 mi. S. of Stockport, 4.5 mi. WSW of Beverly, Windsor/Waterford Twp.], Morgan/Washington Co., Ohio, (MRM 34)
Date: 4 Aug. 1929
Collector: H. Ray Eggleston
Specimens: 1 dry shell, male

o OSUM 46951
Locale: Muskingum River at West Side Beach, just above its mouth, at Marietta, Washington Co., Ohio, (MRM 0 --> 1)
Date: 5 April 1930
Collector: H. Ray Eggleston
Specimens: 1 left valve only, weathered dry, male

o OSUM 44243
Locale: Muskingum River at Swift, [4.5 mi. W of Beverly, Windsor/Waterford Twp.], Morgan/Washington Co., Ohio (MRM 33.0)
Date: 27 July 1930
Collector: H. Ray Eggleston
Specimens: 1 dry juvenile shell, female?

o OSUM 46955
Locale: Muskingum River below Luke Chute, [3.9 mi. ESE of Stockport, 4.5 m. WSW of Beverly, Windsor/Waterford Twp.], Morgan/Washington Co., Ohio, (MRM 34.0)
Date: 3 Aug. 1930
Collector: H. Ray Eggleston
Specimens: 5 dry and 1 weathered dry shells: 2 males, 4 females

Table 2. (continued)

* OSUM 7195

Locale: Muskingum River at Lowell below dam, Adams Twp., Washington Co., Ohio (MRM 14)
Date: 19 Jan. 1963)
Collector: David H. Stansbery, Carol B. Stein, Mary Lightner and William Davies
Specimens: 1 dry left valve, male

o OSUM 8817

Locale: Muskingum River below Luke Chute Dam, Windsor Twp., Morgan Co., Ohio, (MRM 34)
Date: 25 Sept. 1963
Collector: David H. Stansbery, Carol B. Stein
Specimens: 1 badly weathered dry right valve, male

* OSUM 16424

Locale: Muskingum River at Luke's Chute, Windsor Twp., Morgan Co., Ohio, (MRM 34)
Date: 21-22 June 1966
Collector: Milton B. Trautman
Specimens: 1 weathered dry shell, female; 1 weathered dry left valve, male

* OSUM 17074

Locale: Muskingum River below Lowell Dam, Adams Twp., Washington Co., Ohio, (MRM 14)
Date: 22 Oct. 1966
Collector: David H. Stansbery
Specimens: 1 weathered dry shell, male; 1 weathered dry right valve, male

o OSUM 45612

Locale: Muskingum River 1.9 mi. SW of Coal Run, 5.6 mi. WNW of Lowell, Waterford Twp., Washington Co., Ohio, (MRM 22)
Date: 25 May 1977
Collector: Robert Rothwell
Specimens: 3 subfossil valves, sex uncertain

o OSUM 50021

Locale: Muskingum River 2.6 m. N. of Luke Chute Dame, 4.5 mi. WNW of Beverly, Windsor/Waterford Twp., Morgan/Washington Co., Ohio, (MRM 30.9 - 31.8)
Date: 3 Oct. 1980
Collector: William N. Kasson, A. E. Spreitzer
Specimens: 1 badly weathered dry right valve, female

Table 2. (continued)

o OSUM 50889

Locale: Muskingum River 1.6 mi. ENE of Beverly, 5.9 mi. WNW of Lowell, Waterford Twp., Washington C., Ohio, (MRM 22.0 - 22.6)
Date: 15 Oct. 1980
Collector: William N. Kasson, A. E. Spreitzer
Specimens: 1 subfossil shell, male; 2 unmatched weathered dry valves, male

o OSUM 51307

Locale: Muskingum River 0.3 m. S of Lowell, 8.6 mi. NWN of Marietta, Adams/Muskingum Twp., Washington Co., Ohio, (MRM 13.2 - 13.7)
Date: 6 Nov. 1980
Collector: William N. Kasson, A. E. Spreitzer
Specimens: 1 badly weathered dry left valve, male

* OSUM 50938

Locale: Muskingum River 2.1 mi. SE of Lowell, 7.2 mi. N of Marietta, Adams/Muskingum Twp., Washington Co., Ohio, (MRM 10.7 - 12.8)
Date: 16 Aug. 1981
Collectors: William N. Kasson, A. E. Spreitzer
Specimens: 1 weathered dry right valve, male

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o = Records based upon pre-1960 collections, subfossil specimens or badly weathered (old) specimens
* = Records based upon recent evidence (1960 --> 1985)
MRM = Muskingum River Mile

hypothesis that this characterization has been skewed because of a preponderance of collections in the swift tailwaters compared to other sites has been dismissed by Stansbery (1985) on the basis of his own collections that ranged across habitat types and which used a more comprehensive technique. A. Miller (pers. comm., Appendix V) notes that the species has usually been found in gravel bars intermixed with dense mixed-species mussel communities, although it has also been found occasionally in sandy stretches with few other mussels.

Within the FERC study area there are two locations where the species has been confirmed or is strongly suspected based on fresh shell material. These locations are the Muskingum River below L&D 3 at Lowell, Ohio and a zone 12-15 miles downstream of Gallipolis L&D on the mainstem Ohio River (DEIS pp. 3-20) The USFWS has indicated a strong likelihood of occurrences at two other sites. These lie below Willow Island L&D between the confluences of the Muskingum and Little Kanawha rivers and below Belleville L&D from the dam to the downstream end of Buffington Island (Appendix II) although these localities have not been confirmed (DEIS pp. 3-20).

3.2.1. Muskingum River

Stansbery (1985) summarizes the Muskingum River locality as follows:

> "This species would most likely be found in the Muskingum River mainstem only; and only from Luke Chute Dam (No. 5) downstream. ... Within the lower Muskingum River range described above, it is most probable that this species occurs in the first 1-3 miles downstream from dams 2, 3, 4, and 5. ... A greater number of fresh or relatively fresh shells of L. abrupta have been found at Lock and Dam Number 3 at Lowell than at any other site on the Muskingum River in recent years. We have not seen any living specimens from the Muskingum River in recent years even though the occasional collection of fresh shells indicates their continuing presence."

The strength of evidence for living specimens in the tailwaters of L&D 3 (DEIS pp. 3-79) is controversial. Historic occupation is not in question because of the numerous museum specimens available for study (listed in Stansbery 1985). The hydropower license applicant, the Upper Mississippi Water Company (Mitex, Inc. 1987), emphasizes the doubt that the species occurs at L&D 3 because the only specimens found lately have been "a few fossil and sub-fossil shells" rather than live specimens, and expresses the opinion that "It is quite possible that the species has already been extirpated from this reach of the Muskingum." The applicant acknowledges, however, that there is "no conclusive evidence that L. abrupta (sic) does not currently exist in the project impact area." The USFWS, however, quotes Stansbery's assertion "that the occasional collection of fresh dead shells in recent years indicates the continued presence of the species." (letter of August 7, 1986 from K. E. Kroonemeyer to B. Fowler of Mitex Inc.).

Lack of evidence for living specimens in the Muskingum River is apparently not due to lack of effort expended to find them. Stansbery himself acknowledges that, "The evidence of [L. abrupta's] continued existence there has become noticeably weaker over the years in spite of increasing collecting effort." (Stansbery 1985). The chronology of these mostly fruitless collecting efforts is listed by Stansbery (1985) and includes a survey of the Muskingum River by Bates (1970) who reported L. orbiculata (but Stansbury could not confirm the record in Bates' data), Davies (1963), Stillwell et al. (1974), Rothwell (1979), and Stansbery and King (1983).

3.2.2 Ohio River Below Gallipolis L&D

By letter of September 28, 1987, the USFWS notified FERC that L. abrupta had been collected in the mainstem Ohio River on August 13, 1987 (Appendix II). The find was reported promptly in the scientific literature (Tolin et al. 1987). Two live specimens, a male and a female, were collected; identifications were confirmed by D. Stansbery (the male specimen resides in the collection of the Ohio State University Museum of Zoology) and Dr. Andrew Miller of the U. S. Army Corps of Engineers Waterways Experiment Station. The location was the upper Greenup pool between river mile 292.0 and 292.4 near the Greenbottom light and daymark along the right bank just downstream of Shoal Run. The location is approximately 12 miles downstream of the Gallipolis Locks and Dam, the most downstream hydroelectric project included in the FERC impact analysis(DEIS pp. 3-16). L. abrupta had not been discovered in a previous sampling of that general area in 1985 (Zeto et al. 1987). The area but not the exact bed had been listed as a source of mussel material by Taylor (1980).

3.2.3 Elsewhere in the Upper Ohio River Basin

In its September 28, 1987, letter to FERC, the USFWS identified three reaches in the upper Ohio River basin where it believed the endangered L. abrupta might be found (Appendix II). These areas are: (1) river miles 280 to 305, Gallipolis Locks and Dam to the confluence of the Guyandotte River, which includes the confirmed locality; (2) river miles 204.0 to 218.0, Belleville Locks and Dam to the toe of Buffington Island; and (3) river miles 172.0 to 184.0, between the confluences of the Muskingum River and the Little Kanawha River in the Belleville pool ten river miles below the Willow Island L&D (DEIS pp. 3-20). Although L. abrupta has not been located in the latter two reaches, the USFWS believes that conditions there are suitable for their existence (Appendix II and W. Tolin, pers. comm., Appendix V). Additional fi .d sampling by the USFWS and the West Virginia Department of Natural Resources in these areas is planned for late August and September 1988.

3.3 DISSOLVED OXYGEN REQUIREMENTS

Based on its occurrence in riffle-run habitats of big rivers, Stansbery (1985) presumed that L. abrupta requires well-aerated water having high dissolved oxygen and low carbon dioxide concentrations. The habitat also suggested to him that the species might be intolerant of large amounts of organic debris and silt in suspension over long periods of time. No experimental studies have been conducted to verify such requirements for the species, however, as determined by a search of the scientific literature and discussions with mussel experts (personal communications listed in Appendix V). The best that can be done is to infer L. abrupta's dissolved oxygen requirements by analogy with species that have been studied. All experts contacted agreed that the species requires a well-washed, stable substrate, usually of small gravel, that will prevent suffocation.

There is a general belief that freshwater mussels as a group are tolerant of low dissolved oxygen concentrations. Cole (1926) established that Anadontoides ferrussacianus Lea, a species found in organic mud and silt, could survive at nearly zero dissolved oxygen concentrations for several days in an early experimental study. Anodonta implicata (Say 1829) could survive when the dissolved oxygen concentration was exhausted (Eddy and Cunningham 1934), and Hiestand (1938) demonstrated that A. imbecilis could respire normally at about 0.73 mg/L of oxygen. The largest mussels had the lowest metabolic rate and thus were the least sensitive to low oxygen concentrations (Hiestand (1938). Imlay (1971) found a pool species, Amblema plicata, survived for 10 weeks at 0 mg/L.

Two traits seem to assist in tolerance of hypoxia--(1) behavioral, structural, and metabolic adaptations that allow mussels to clamp their shells together very tightly to seal themselves off from adverse conditions and maintain a lowered metabolic rate of dormancy and (2) a physiological amplitude for surviving at low oxygen tensions, seen mostly in the Anodontae (Fuller 1974). Freshwater mussels exhibit "rest periods" during which their oxygen consumption is much lower than during periods of activity, although it does not drop to zero (Salanki and Lukacsovics 1967).

Badman and Chin (1973; Pleurobema coccineum) and Dietz and his colleagues (e.g., Silverman et al. 1983; Ligumia subrostrata) have studied the physiological adaptations that allow mussels to live with minimal amounts of oxygen for long periods. These experiments have shown that the animals are capable of storing energy reserves in the form of simple sugars which can be metabolized with or without oxygen. There is a well-developed oxygen debt capacity for animals exposed to periods of shell closure, which is correlated with the disappearance of glycogen under anaerobic conditions (Badman and Chin 1973). Silverman et al. (1983) studied a species that has calcium concretions in the gills and other tissues that serve as a reservoir of calcium that is lost from the shell when blood pH drops during extended periods of hypoxia. The test organisms remained alive in hypoxic water for 2-4 weeks. Steffens et al. (1985) showed that the concretions, and presumably the adaptations to hypoxia, were evident in other species as well, including Anodonta grandis, Margaritifera hembeli, and Elliptio crassedens. "Adequate" oxygen concentrations that did not stimulate compensatory metabolic shifts were as low as 3% of saturation for P. coccineum (Badman and Chin 1973).

Riffle species may not fit the pattern observed for the more common slack-water species, however. Imlay (1971) examined the low oxygen tolerances of several unspecified "riffle species" of mussels in the laboratory and found that they required 2.5 mg/L of dissolved oxygen for survival at temperatures corresponding to summer. Imlay (1971) expressed the opinion that all species (both riffle and pool) require 6 mg/L for normal growth, based on as-yet-unpublished experiments. Ellis (1931) reported that mussels became inactive when the saturation level of dissolved oxygen was less than one-fifth of atmospheric. Grantham (1969) found no live mussels in the Mississippi River where oxygen concentrations dropped as low as 3 mg/L even for short periods.

Low dissolved oxygen concentrations below some dams is providing an in situ experiment that indicates mussel sensitivities. J. Jenkinson (pers. comm., Appendix V) indicated that L. abrupta has been found in mixed mussel communities below TVA dams where there has been periodic low dissolved oxygen. He described a survey in 1986 that showed no mussel mortalities at several sites when there was a minimum of 1 mg/L recorded at monitoring stations for more than one week. However, in 1988 there has been 0 to 0.5 mg/L dissolved oxygen below Watts Bar Dam (Tennessee River) for two weeks and adult mussels are being killed (the stressful period is underway as this is written in mid-August). The kill is not species-specific, and rarer species such as L. abrupta did not appear to be killed first (J. Jenkinson, pers. comm.).

Coon et al. (1977) found the sibling species L. higginsii (Lea) to have disappeared from Mississippi River Pools 8, 9, and 10 where it had been found in low numbers in a survey 45 years earlier prior to damming. The combined impacts of navigation pools (e.g., sedimentation, lower velocities, and barge traffic) is detrimental to these closely related species, but the critical environmental factor in their demise is not known.

Reproduction causes strains on mussel respiration which might affect survival. Portions of the gills are used in producing the dispersal phase, the glochidia, which renders these gill portions unsuitable for gas exchange (Matteson 1955, Fuller 1974).

S. Ahlstedt (pers. comm.) expressed the opinion that the juvenile mussel, immediately after release from the gills of the host fish, is the life stage most sensitive to low dissolved oxygen. He bases this opinion on unpublished observations of laboratory cultures in which mortality of early juveniles was high. Isely (1911) included abundant dissolved oxygen as a requirement for successful colonization of riffle substrates by juvenile mussels released from host fish. He reported that mussels radiate to other, more sandy or silty habitats as they grow larger.

In summary, freshwater mussels like L. abrupta that inhabit riffle habitats probably need fairly high dissolved oxygen concentrations, perhaps near 6.0 mg/L, for normal growth and production. Like other mussels, however, the adults may be capable of tolerating quite low concentrations for periods of time that could extend to a few days. Low dissolved oxygen concentrations in the Ohio River have probably exceeded these tolerance durations in historical times.

3.4 FISH HOSTS

Unionid molluscs require a discrete fish species as an intermediate host for the glochidia stage. There seems to be confusion over the host for L. abrupta = orbiculata, and assignment of a host is currently considered speculative (S. Ahlstedt, pers. comm.). The host has not been identified for L. abrupta according to Stansbery (1985). Taylor (1980) lists "sauger?" as the host fish for L. orbiculata, which he presumed to be extinct in the Ohio River. However, Fuller (1974) tabulates the host fish for L. orbiculata as the sauger Stizostedion canadense, citing as authorities Coker et al. (1921), Surber (1913), and Wilson (1916). W. Tolin of the USFWS (pers. comm.), who collected the species alive below Gallipolis, feels that there could be multiple host fish species for L. abrupta.

Historical reproductive failure of L. abrupta may have been caused by decline in populations of the required fish host, because it is well documented that the fish fauna, including the sauger, became depauperate in the Ohio River during years of severe pollution (Pearson and Krumholz 1984). There are now abundant sauger in much of the upper Ohio River basin (DEIS pp. 3-35), including the confirmed and probable sites of L. abrupta.

4. ASSESSMENT OF IMPACTS

Installation of hydroelectric turbines on 18 navigation dams in the upper Ohio River basin has the potential for (1) reducing dissolved oxygen concentrations in the river below Gallipolis Locks and Dam (where L. abrupta is confirmed) and at the two possible sites identified by the USFWS (Appendix II), (2) altering the physical habitat in the tailwaters of Muskingum Lock and Dam No. 3 (where occurrence of the species is suspected), and (3) lowering population numbers of the fish host species through entrainment or low dissolved oxygen (FERC 1988). Whereas the possible habitat change at Muskingum No. 3 is a site-specific impact (DEIS pp. 4-23 and 4-24), the possible change in dissolved oxygen concentration of the mainstem Ohio River is a cumulative impact of all upstream (DEIS pp. 4-8), facilities, and loss of fish may be a cumulative impact of losses at all nearby facilities, both upstream and downstream (although the extent of fish movements is not documented).

The DEIS (FERC 1988) analyzed four alternatives for licensing action: (1) Projects as proposed, (2) Project operation to meet dissolved oxygen standards, (3) Project operation to meet antidegradation criteria, and (4) Projects selected to minimize impacts to all target resources. Impacts to L. abrupta are further analyzed here for these four alternatives. Each alternative is briefly summarized here; additional details are in the DEIS.

4.1 IMPACTS OF PROJECTS AS PROPOSED

4.1.1 Dissolved Oxygen

The DEIS (FERC 1988) estimates, on the basis of water quality modeling (DEIS pp. 4-4 to 4-9), that average daily dissolved oxygen (DO) concentrations in the Greenup pool below Gallipolis Locks and Dam could be depressed by a maximum of approximately 0.5 mg/L when all upstream projects operate as proposed under summer moderate flow conditions (Figure 5a). This decrease in DO is a conservative estimate of the greatest impacts of hydropower, made by assuming no aeration would occur at hydroturbines. In reality, slight amounts of aeration may occur at turbines, and the decrease in DO may be less than 0.5 mg/L. The impacts of hydropower on DO in this reach are minor because the 5 upstream dams provide little aeration. Little or no aeration would thus be lost (even though further reduction could be more significant for the ecosystem than if the water was well aerated). The estimated 0.5 mg/L maximum depression could cause current DO concentrations that are slightly above 6.0 mg/L to be depressed to slightly below 6.0 mg/L. At the summer low flow conditions (7Q10; Figure 5b) a similar DO decrease is estimated, but occurring between 5.5 and 6.0 mg/L (again, the estimated difference is the maximum expected impact of hydropower). At these lower flows, many projects cease operation.

Duration of low DO concentrations can be estimated from the ORSANCO monitor at Gallipolis L&D. DO concentrations at Gallipolis have fallen below 6 mg/L about 25% of the time in the critical high temperature-low DO summer months of

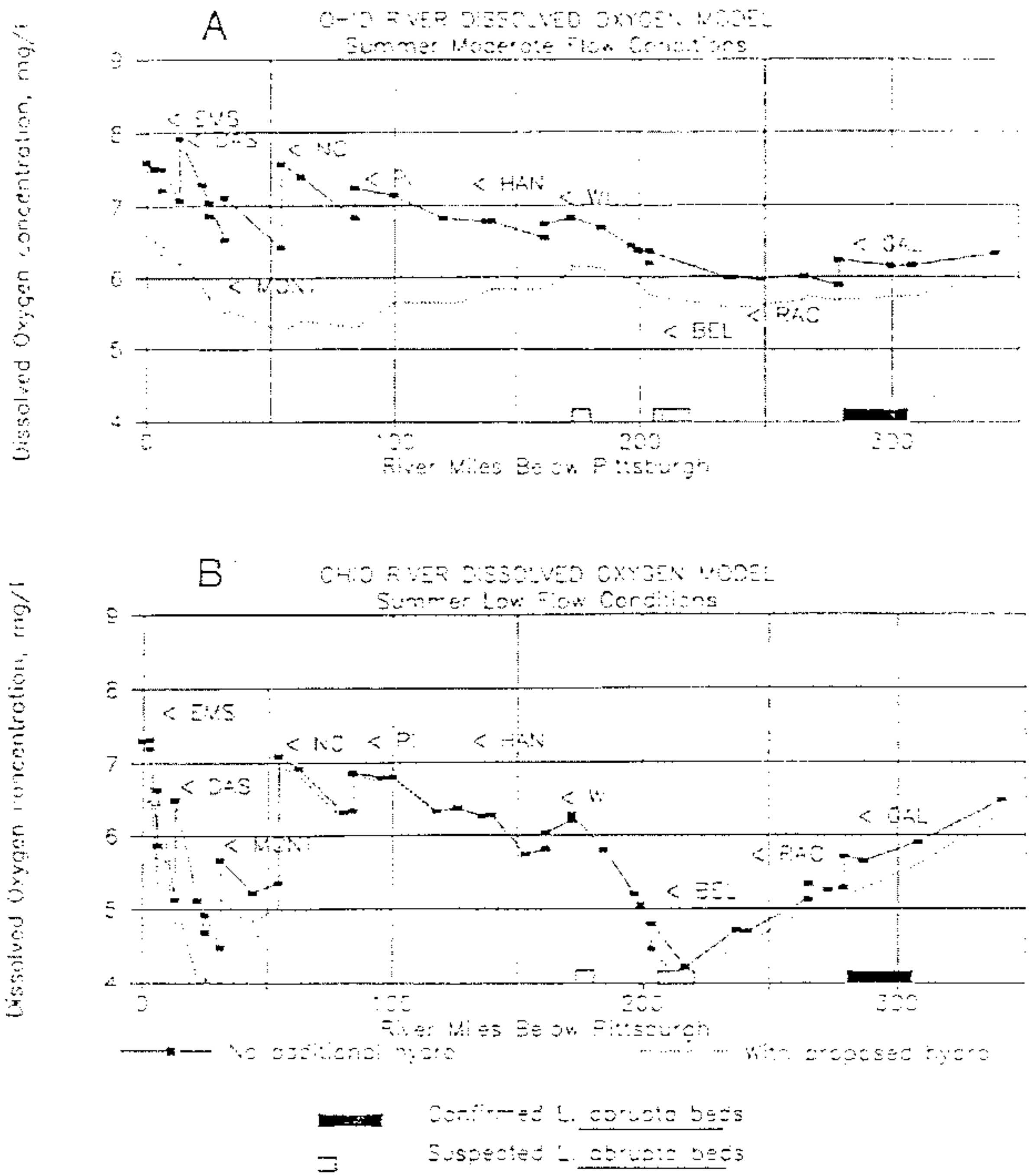

Figure 5. Ohio River dissolved oxygen model results for (a) summer moderate flow conditions and (b) summer low flow conditions (7Q10) for projects as proposed, in relation to confirmed and suspected beds of *Lampsilis abrupta*. Modified from FERC (1985).

July to September over the period 1980 to 1986 (Figure 6). A deficit of about 0.5 mg/L due to hydropower could extend the duration to 30 to 40 % of the time.

The estimates of current and project-impacted DO concentrations over the Greenup Pool mussel beds during typical summer conditions straddle the 6.0 mg/L DO concentration believed necessary for long-term growth of freshwater mussels, although this value is poorly substantiated as discussed in Sect. 3.3 (Imlay 1971). Thus, some small reduction in growth of L. abrupta may occur, based on analogy with other mussel species. Daily fluctuations, although reported to be small in this reach historically (FERC 1988), could further lower instantaneous mussel growth. The DO concentrations are not projected to be reduced to anywhere near what could be considered an acutely lethal level, based on analogy with other mussel species.

In the Ohio River reaches in which the USFWS suspects that L. abrupta may occur (Appendix II), the incremental change under summer moderate low flow conditions is also estimated to be about 0.5 mg/L (Figure 5a). The tailwaters of Belleville Locks and Dam present a near identical picture to that below Gallipolis—a shift in DO concentrations from just above 6.0 mg/L to just below that value. Impacts on L. abrupta should also be similar. Between the confluences of the Muskingum and Little Kanawha rivers with the Ohio, the incremental change occurs between about 6.8 and 6.3 mg/L (DEIS pp. 4-7, Figure 4.1.1-7), each above a level that might cause loss of growth of mussels.

Summer low flow conditions (7Q10) present a more severe pattern at the suspected L. abrupta site below Belleville L&D, however (Figure 5b). DO concentrations there are estimated to fall to near 4.5 mg/L both with and without hydro (DEIS pp. 4-7, Figure 4.1.1-7), with a differential due to hydro of only a few tenths of a mg/L (within model error). This level would be inimical to long-term productivity of mussels such as L. abrupta but could probably be tolerated for short periods. Such levels may be a limiting factor currently during periods of low flows and high temperatures. Between the Muskingum and Little Kanawha Rivers there is expected to be no change in DO concentrations near 6.0 mg/L at 7Q10 flows due to cessation of most hydropower operations at such low flows.

4.1.2 Physical Habitat

Although no flow or bottom habitat modifications at the Greenup pool mussel beds are anticipated by hydropower development at the Gallipolis L&D and above, the habitat will be altered by the project proposed at Muskingum No. 3. The DEIS indicates that the tailwater of this proposed facility will be significantly altered with reduction in habitat for all mussels, including L. abrupta if it occurs there (DEIS pp. 4-24). Habitat change could be in the form of a shift of current flow to one side of the river with significant reduction in flow of the existing tailwater for a distance of about 1 mile downstream. This change could occur in spite of the minimum spillage over the dam of 1520 cfs agreed to by the USFWS and the applicant (Mitex Inc. 1987; Appendix I). Channel erosion by the diverted flow is expected to cause substrate instability and sedimentation until the channel reequilibrates. These impacts may be severe enough to significantly reduce the available habitat for a period of time long enough to extirpate any extant L. abrupta.

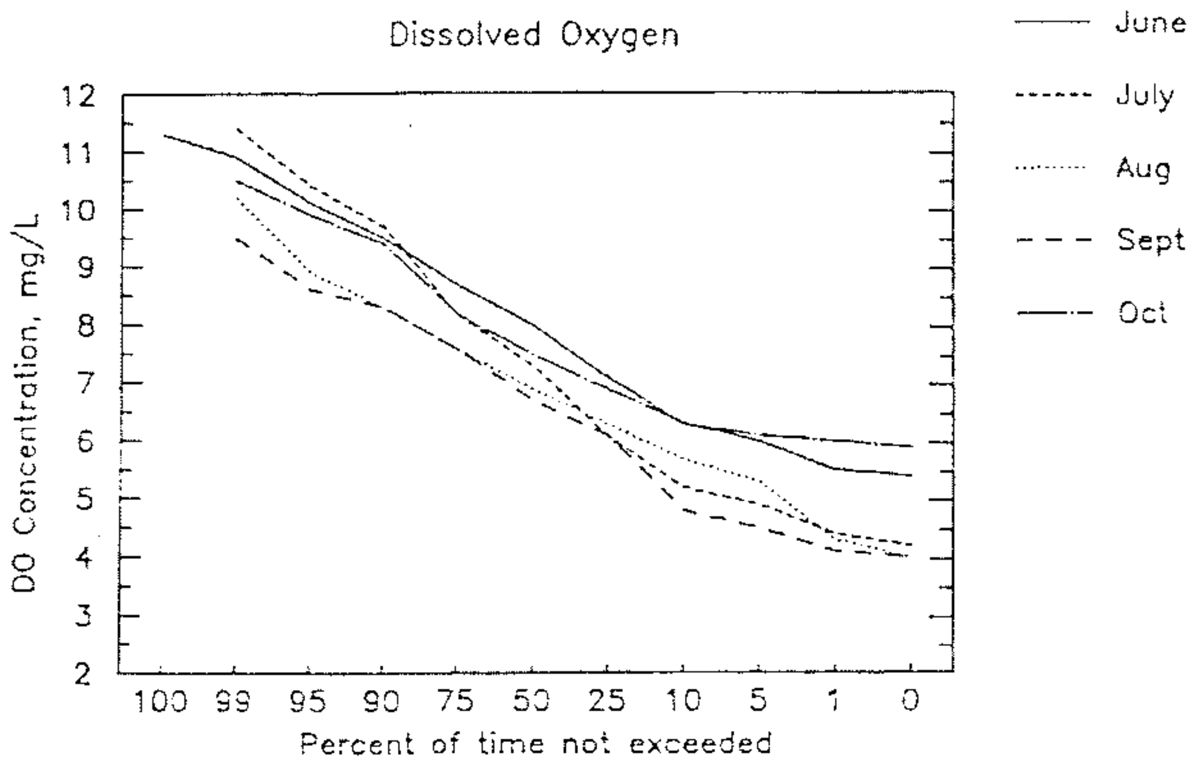

Figure 5. Frequencies of summer dissolved oxygen concentrations at the ORSANCO monitor at RM 279, Gallipolis L&D, 1980-1986. Source: FERC (1988).

4.1.3 Host Fish

Some losses of the presumed host fish, sauger, might occur if the projects are built and operated as proposed (FERC 1988). Reductions in DO of magnitudes discussed above could affect the growth and production of coolwater fish according to USEPA (1986; Table 3) and a bioenergetics
model applied by FERC staff(DEIS pp. 4-15 t 4-18 and Appendix E), although levels are not in the acutely lethal range. In the vicinity of the known or presumed L. abrupta beds, the zone with the greatest impact of DO on fish would be in the reach below Belleville L&D. There, DO levels for the maximum expected impact under summer moderate flow conditions are depressed to the zone of slight production impairment for all life stages (Figure 5a). Under summer low flow (7Q10; Figure 5b), conditions both with and without hydropower are well into the zones of moderate to severe growth and production impairment below Belleville, with hydropower causing little further DO decrease. Below Gallipolis and Willow Island, there would be slight production impairment. Slight to moderate reduction in growth and production might result in fewer numbers of host fish in the river, although the relationship is speculative.

Entrainment of larger fish through the hydropower turbines is likely to kill from 0 to 10% of those entrained, although experimental evidence for that range is poorly supported (FERC 1988). Small fish have a much lower mortality rate. Vulnerability of sauger to entrainment may be low, for Holland et al. (1984) found movements of sauger in the Mississippi River usually did not take them through the dams, and most interpool movements occurred at high water when turbines would not operate (DEIS pp. 4-26 and 4-28). Elsewhere, e.g., in the Tennessee River, combined navigation-hydropower dams are not detrimental to sauger populations, for the most productive fisheries for the species are below them. Fish protection devices with proven effectiveness for excluding sauger from turbines under conditions such as the Ohio River are not available (FERC 1988, Sect. 4.1.2.3). Therefore, there may be residual losses of fish hosts of L. abrupta that cannot be mitigated with present technology. Whether these losses will be compensated by fish populations is uncertain. Multiple host species, as suggested by Tolin (pers. comm.), would reduce the risk of loss of host fish.

4.2 IMPACTS OF PROJECT OPERATION TO MEET DISSOLVED OXYGEN STANDARDS

4.2.1 Dissolved Oxygen

This alternative was selected to allow hydroelectric generation so long as spill flows at dams can assure maintenance of the standard of 5.0 mg/L that has been adopted by each of the relevant states (DEIS pp. 4-71, 4-74, 4-75). Because violations of the standard now occurs without hydropower, the criterion held violations to be no more frequent nor over more river miles than at present (FERC 1988; Sect. 4.2).

The moderate summer flows of Figure 5a showed no violation of state standards, so no additional spill would be required and the estimated dissolved oxygen concentrations and impacts on L. abrupta would be the same. Additional spill flows would be needed to meet the standard at flows below about 9,000 cfs at Pittsburgh (DEIS pp. 4-75). When summer spill flows are regulated to maintain the state standard at these flows, there are only small improvements in dissolved oxygen between operating the projects as proposed and those estimated to maintain state standards at the lowest point in the sag curve. That point is near the suspected L. abrupta beds below Belleville L&D (Figure 7). The greatest estimated improvement would be in the suspected locality below Willow Island L&D, where the difference (which is minor compared to natural variation) would approximate 0.5 mg/L. This largest change would be in a range just above 6.0 mg/L whereas the changes in estimated concentrations at the other two sites are in the range of 5 to 6 mg/L. Spilling to maintain 5.0 mg/L at flows below 9,000 cfs will not prevent dissolved oxygen concentrations in the verified L. abrupta bed and one suspected bed from dropping below 6.0 mg/L where growth might be inhibited.

For summer low flows (7Q10), the DO profile essentially matches the profile with no hydropower (Figure 5b). This is because only the projects at dams that are poor aerators would be allowed to operate (FERC 1988).

4.2.2 Physical Habitat and Host Fish

There would be little change in the impacts on physical habitat at Muskingum L&D No. 3 with this alternative (DEIS pp. 4-78). Increased spillage requirements would slightly reduce the time when large fish would be entrained. The difference is small, however, and some entrainment damages would continue.

4.3 IMPACTS OF PROJECT OPERATION TO MEET ANTI-DEGRADATION CRITERION

4.3.1 Dissolved Oxygen

This alternative allows hydroelectric generation with sufficient spill flows to maintain a DO concentration of 6.5 mg/L or better in all locations where this level occurs without hydropower (DEIS pp. 4-78, and 4-79). The value of 6.5 mg/L was selected from biological data on fishes as a minimum concentration that avoids deleterious effects (Table 3), mostly to early life stages (EPA 1986). DO concentrations below 6.5 mg/L occur frequently in the Ohio river basin even without hydroelectric development. However, spill flows were selected by the FERC (1988) optimization model that would allow hydropower generation yet maintain this oxygen level wherever it occurs now.

Under summer moderate flow conditions (Figure 8), efforts to maintain 6.5 mg/L where it occurs presently would still cause a few tenths of a mg/L drop in dissolved oxygen concentration in the Gallipolis pool at the L. abrupta bed (DEIS pp. 4-80, Figure 4.3.1-3). This estimate is minor compared to natural variability, however. Concentrations could be depressed from slightly above 6.0 mg/L to just below that value. Below Belleville L&D at the presumed L. abrupta bed, DO could be reduced slightly to near 6.0 mg/L. There would be little change in concentrations at presumed beds below Willow Island L&D, where concentrations are likely to be in the 6.5 to 7.0 range under these conditions. The biological effect on L. abrupta from these changes could amount to a small decrease in longterm growth and production by lowering the dissolved oxygen concentrations at summer moderate flow conditions at the known site below Gallipolis L&D. It should be emphasized, however, that the predicted decreases in dissolved oxygen are the maximum expected impact of hydropower and are minor compared to natural variability in DO.

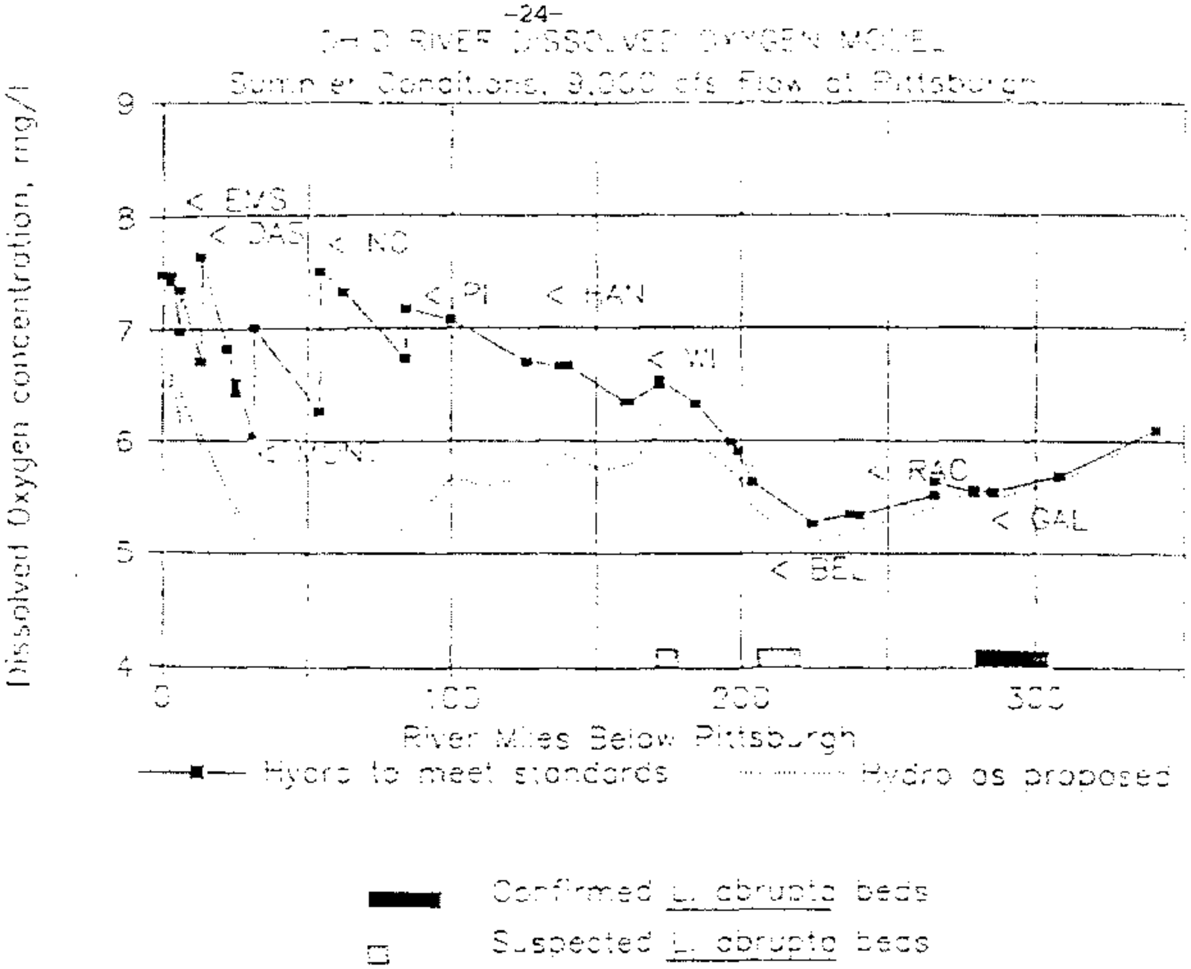

Figure 7. Ohio River DO model results for summer flow conditions, 9,000cfs at Pittsburgh, with spill flows to maintain state standards of 5 mg/L. Source: FERC (1988).

Table 3. Levels of impairment to be expected for fishes at two age classes in nonsalmonid waters at different DO concentrations (USEPA, 1986):

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a. Early Life Stages

- o No production impairment = 6.5 and above
- o Slight production impairment = 5.5
- o Moderate production impairment = 5.0
- o Severe production impairment = 4.5
- o Limit to avoid acute mortality = 4.0

b. Other Life Stages

- o No production impairment = 6.0 and above
- o Slight production impairment = 5.0
- o Moderate production impairment = 4.0
- o Severe production impairment = 3.5
- o Limit to avoid acute mortality = 3.0

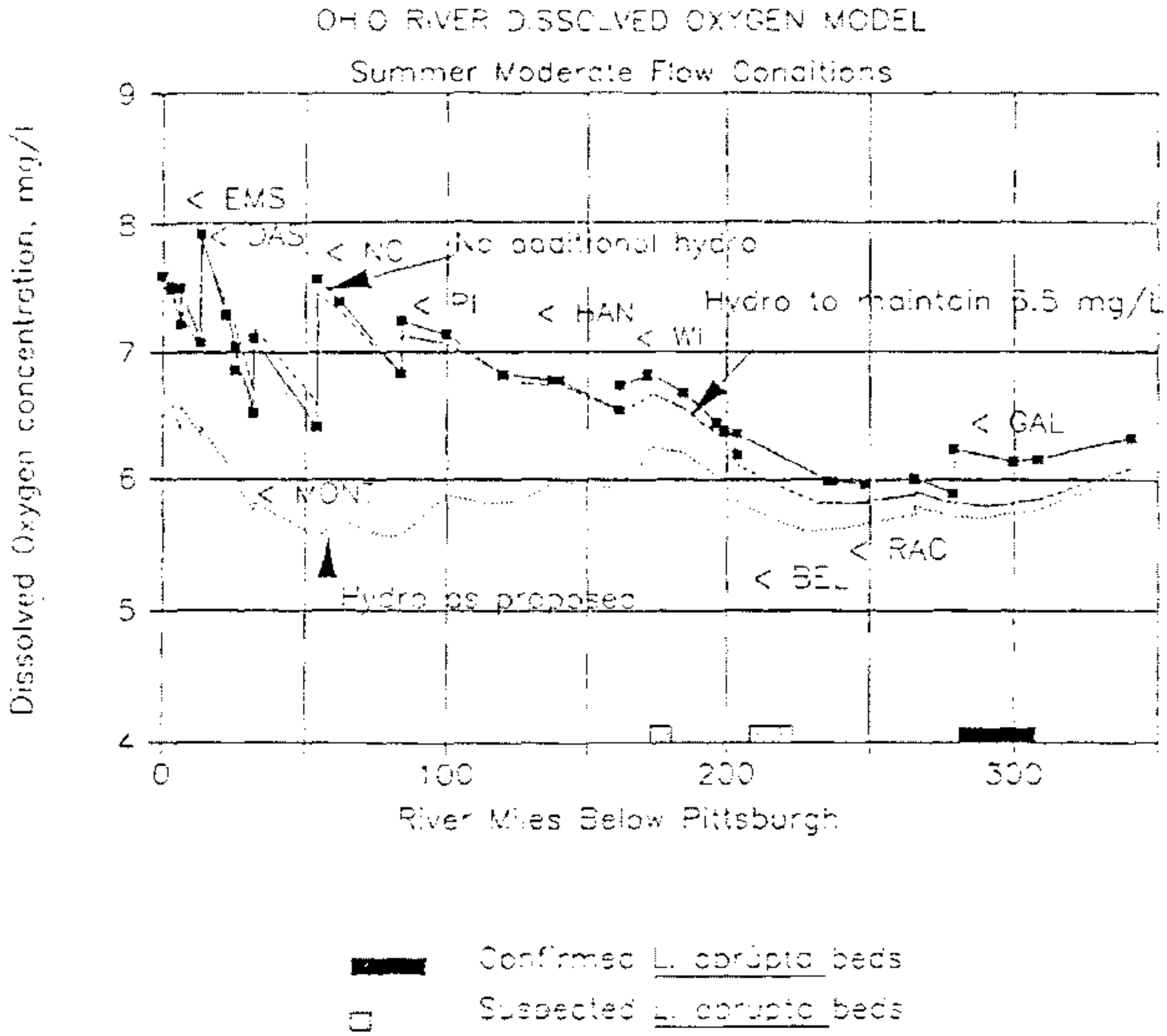

Figure 8. Ohio River DO model results for summer moderate flow conditions, with spill flows to maintain 6.5 mg/L wherever they occur prior to hydropower development. Source: FERC (1988).

At summer low flows (7Q10), few projects would operate. Thus, the DO concentrations for this case are essentially the same as with no hydropower. There would be little additional impact on L. abrupta at any site beyond the naturally stressing conditions (Figure 5b).

4.3.2 Physical Habitat and Host Fish

As with Alternative 2, there would be little change in the physical habitat difficulties at Muskingum L&D No. 3 with this alternative (DEIS pp. 4-81). Increased spillage requirements would further slightly reduce the time when large fish would be entrained. The difference is small, however, and some entrainment damages would continue.

4.4 PROJECTS SELECTED TO MINIMIZE IMPACTS TO ALL TARGET RESOURCES

4.4.1 Dissolved Oxygen

The dissolved oxygen criterion under this alternative was the same as for the antidegradation alternative; other constraints were applied, however, that altered the projects that would operate and the spill flow regime (DEIS pp. 4-81 to 4-83). Dissolved oxygen concentrations and their expected biological effects at the known or presumed L. abrupta sites would be essentially identical under this alternative to those seen under the nondegradation alternative (Figure 9).

4.4.2 Physical Habitat

The principal effect of this alternative would be elimination of potential damages to any surviving population of L. abrupta in the lower Muskingum River below the proposed Muskingum No. 3 project. This project would not be recommended for development under this alternative in order to protect the tailwater habitat from physical alteration (DEIS pp. 4-84).

4.4.3 Host Fish

Projects near the confirmed or suspected L. abrupta beds would be licensed to operate under this alternative, and spill flows would be the same as in Alternative 3. Therefore, fish mortalities due to entrainment should be the same as in Alternative 3.

4.5 SIGNIFICANCE OF IMPACTS

The Endangered Species Act of 1973, as amended, requires the federal agency to determine whether its action will "affect listed species or their habitat". FERC staff has determined in its biological assessment incorporated into its DEIS that the proposed development of hydroelectric projects in the upper Ohio River basin could have some effect on L. abrupta, the pink mucket pearly mussel. The additional information provided in this report confirms staff's previous conclusions concerning this species presented in the DEIS. Staff's conclusions on these effects, contained in the previously prepared biological assessment and those included herein, are based on the best estimates of the environmental requirements of the species (using analogy with other freshwater mussel species where necessary), the locations of confirmed and suspected beds of the species, and the estimated changes in water quality (DO), habitat, and

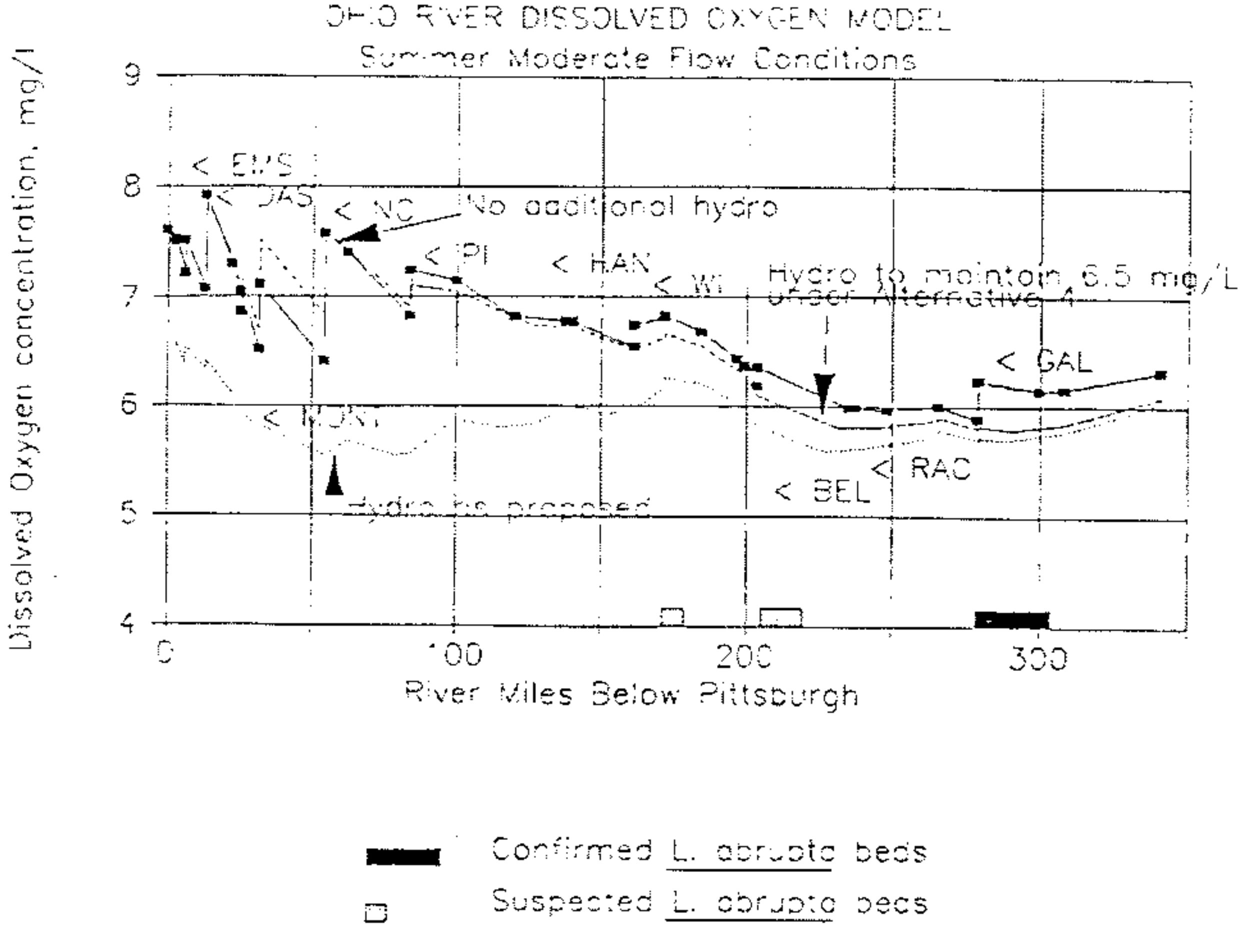

Figure 9. Ohio River DO model results for summer moderate flow conditions, with spill flows to maintain 6.5 mg/L wherever they occur prior to hydropower development under Alternative 4 that protects all target resources. Source: FERC (1988).

fish hosts that might be caused by hydropower development. There are important uncertainties in this information, however, that prevent precise definition of impacts. These uncertainties are discussed in Section 5.

The impacts were determined to differ with alternative development scenarios. FERC staff believes that the preferred alternative 4, "Projects Selected To Minimize Impacts To All Target Resources, will have no demonstrable effect on populations of L. abrupta, for the following reasons:

a. Dissolved oxygen concentrations will remain close to levels now occurring in the vicinity of a confirmed population of L. abrupta downstream of the Gallipolis L&D and two suspected population sites below Belleville L&D and Willow Island L&D. Small estimated reductions of 0.5 mg/L or less in average concentrations are insignificant compared to existing variability in DO, and they would be largely offset by aeration of riverflow by turbines, which may amount to a few tenths of a mg/L.

   The estimated maximum oxygen reductions below Belleville and Gallipolis due to hydropower development are to levels only slightly below the concentration of 6.0 mg/L suggested in the literature to be the level below which normal long-term growth of freshwater mussels is impaired. This limit is poorly documented in the scientific literature, however, and may have an error associated with it that is as great as the estimated decline in DO levels. Freshwater mussels as a group are known to tolerate much lower DO concentrations (to nearly zero) for periods of days, suggesting that they could survive short-term transient low DO concentrations so long as the estimated average is maintained. DO concentrations significantly lower than 6.0 mg/L would occur only as a result of conditions occurring without hydropower; the proposed hydropower projects are not capable of lowering DO to lethal levels.

b. The tailwater of Muskingum L&D No. 3, which has recently held a population of L. abrupta and may still do so (although no recent collectors have found live specimens), would not be recommended for development in order to protect riffle and run species. This is the only locality where significant habitat change detrimental to a known or likely population of L. abrupta was predicted.

c. Although entrainment in hydropower turbines will kill some fishes, it is uncertain but viewed as unlikely that this source of additional mortality would significantly reduce populations of the presumed fish host, the sauger Stizostedion canadense, or of any other host. There is no information available, however, relating fish numbers to the strength of mussel populations.

d. Maintenance of dissolved oxygen of 6.5 mg/L in areas of the river where these levels now occur might allow oxygen to be only slightly degraded (by 0-0.5 mg/L) to levels which cause only moderate to slight impairment of fish production in the vicinity of L. abrupta beds. It is speculative whether this decline in production will be enough to cause a loss of numbers of host fish that is significant for mussel populations.

If other alternatives considered by FERC staff (1988) are selected for licensing, the results of this assessment would be somewhat different.

Differences among alternatives are not great for dissolved oxygen in the vicinity of the confirmed or suspected L. abrupta beds between Willow Island L&D and mid-Greenup pool (Figures 5, 7-9). All of the differences are minor because the proposed projects have little effect on DO in these reaches. Reduced spillage requirements could cause a somewhat larger entrainment loss of potential fish host(s). A decision to license a project at Muskingum L&D No. 3 might eliminate or reduce the value of this tailwater as a site for the present population (if it exists), which is likely to be disturbed by realignment of the flows in the river channel. Surviving individuals or a restocked population may be able to survive there after reestablishment of a substrate equilibrium, however.

5. ADEQUACY OF THE DATA

FERC staff believes the information provided in the DEIS was adequate to determine the effects of the proposed hydropower development on L. abrupta. The additional information provided in this document references many of the conclusions reached in staff's biological assessment incorporated into its DEIS. Based on that assesssment, and the additional information provided herein, staff therefore concludes that sufficient information exists to determine that the proposed hydropower development of the upper Ohio River Basin, under each of the four alternatives, is not likely to jeopardize the continued existence of L. abrupta or result in the destruction or adverse modification of its critical habitat.

Although the FERC considers that overall the information is adequate for making a reasonable judgement, certain types of information were lacking in the scientific literature and were not adequate to predict impacts with a great deal of certainty. This information concerns the following subjects:

a. There are no thorough locality records for L. abrupta in the study area. If additional confirmed localities are determined, however, then the endangered status of the species, already questioned in the USFWS Recovery Plan, would be in doubt. Further surveys of the Ohio River basin are desirable, especially in the zones in which the USFWS has suggested that populations should exist (Appendix II).

b. The species' physiological and ecological requirements for physical habitat, dissolved oxygen, and other features relevant to hydropower development are not known with certainty. Much of the information used herein has been by analogy with other species of freshwater mussels or with the general mussel community with which L. abrupta associates. Although this information is useful, a more certain judgement could be made with more species-specific data.

c. Data on long-term and short-term requirements for dissolved oxygen by L. abrupta (and all mussels) are especially needed. The experimental data which forms the basis of an opinion that 6 mg/L DO is needed for normal growth of freshwater mussels (Imlay 1971) should be published in the refereed scientific literature and/or confirmed by independent research. It is difficult to obtain such experimental data on a species whose occurrence is so limited, however.

d. The definitive fish host(s) remain unclear in the recent literature, even though there seems to be some concensus in the older literature that it is sauger. This uncertainty makes it difficult to assess the possibility that loss of host(s) could cause loss of the species. Detailed life history information would assist preservation of the species.

e. Entrainment damages to fish populations are not well quantified, so damages to the mussel's fish host(s) remain uncertain. Furthermore, there is no information available relating fish numbers to the strength of mussel populations. As discussed in detail in the DEIS (FERC 1988), neither accurate estimates of the impact of entrainment on Ohio River fish nor effective fish protection devices for the Ohio are available. Resolution of the entrainment issue would aid in evaluating impacts on freshwater mussels.

6. SUMMARY

Installation of hydroelectric facilities at navigation dams in the upper Ohio River Basin is estimated to have some impact on the endangered freshwater mussel, Lampsilus abrupta, that varies with the development scenario selected. FERC staff judges the impact of the preferred alternative to be so small as to be considered no demonstrable effect. FERC staff believes that none of the four hydropower development alternatives examined in the DEIS would be likely to jeopardize the continued existence of L. abrupta or result in the destruction or adverse modification of L. abrupta critical habitat.

Under Alternative 1 (Projects as Proposed), reduced dissolved oxygen concentrations (that are the cumulative result of reductions in aeration capacity of existing structures) by an estimated maximum of 0.5 mg/L at a confirmed L. abrupta locality about 14 miles below Gallipolis L&D could lower mussel growth there by an unquantifiably small amount during 30-40% of the time during summer months. The DO reduction would occur from just above the 6.0 mg/L concentration that is the reported (but unsubstantiated) lower limit for normal growth to just below it. The DO reduction that could impact growth would, therefore, be <0.5 mg/L. Impacts to L. abrupta from lowered DO at two localities that the USFWS considers likely to contain the species are estimated to be similar or less than at the confirmed site, although existing DO conditions are less satisfactory at the site below Belleville L&D.

Detrimental changes in the physical habitat in riffles and runs downstream of Muskingum L&D No. 3, where L. abrupta has occurred recently, are predicted with the project as proposed, and the DEIS does not recommend the project for licensing at this time. Physical habitat changes are not anticipated at other L. abrupta locations.

Reductions in numbers of fish hosts (presumably sauger) for glochidia dispersal due to entrainment mortality at nearby hydroprojects might occur. There is little information available for quantitatively linking host fish abundance to the strength of mussel populations. The impact is judged to be small, however, because sauger are not especially prone to movement between pools (based on migration studies on the Mississippi River) and some of the most productive sauger fisheries in other river systems are below multiple-use dams (e.g., on the Tennessee River).

For Alternative 2 (Project Operation to Meet Dissolved Oxygen Standards), when summer spill flows are regulated to maintain the state standards, there are only minor improvements in DO concentrations (compared to Aternative 1) at the suspected L. abrupta beds below Belleville L&D and Willow Island L&D. Spilling to maintain DO standards, however, will not prvent DO concentrations in the verified L. abrupta bed and one suspected bed from dropping below 6.0 mg/L where growth might be inhibited. There would be little change in the impacts on physical habitat (compared to Alternative 1) at Muskingum L&D No. 3 with this alternative. Increased spillage requirements would slightly reduce the time when large fish would be entrained; however, the difference is small.

Alternative 3 (Project Operation to Meet Anti-Degradation Criterion) would cause a few tenths of a mg/L drop in DO concentrations, from slightly above 6.0 mg/L to just below that value, at the L. abrupta bed in the Gallipolis pool. At the presumed L. abrupta bed below Belleville L&D, DO could be reduced slightly to near 6.0 mg/L. There would be little change in DO concentrations at presumed beds below Willow Island L&D. The predicted DO decreases are the maximum expected and are minor compared to natural variability in DO. As with Alternative 2, there would be little change in the physical habitat difficulties at Muskingum L&D No. 3 with this alternative. Increased spillage requirements would further slightly reduce the time that large fish would be entrained.

Under Alternative 4 (Projects Selected to Minimize Impacts to All Target Resources), DO concentrations and their expected biological effects at the known or presumed L. abrupta sites would be essentially identical to those seen under Alternative 3. Spill flows would be the same as in Alternative 3, therefore fish mortalities due to entrainment should be the same as in Alternative 3. The principle effect of this alternative would be the elimination of potential damages to any surviving population of L. abrupta in the lower Muskingum River below the proposed Muskingum No. 3 project.

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APPENDIX I. Letter from K. E. Kroonemeyer, USFWS, to W. Fowler, Mitex, Inc., dated April 6, 1987.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Columbus Field Office
6950-H Americana Parkway
Reynoldsburg, Ohio 43068

IN REPLY REFER TO:

April 6, 1987

Mr. William Fowler
Mitex, Inc.
91 Newbury Street
Boston, Massachusetts 02116

Dear Mr. Fowler:

We have reviewed the February 26, 1987 revised Biological Assessment of the effects of the Muskingum Lock and Dam No. 3 hydroelectric project on the pink mucket pearly mussel, _Lampsilis orbiculata_ or _Lampsilis abrupta_.

This letter is prepared in accordance with provisions of the Endangered Species Act of 1973, as amended and provides informal consultation.

Muskingum Lock and Dam No. 3 consists of an 840-foot long uncontrolled, rock fill crib dam with a concrete cap. The lock is located in a 5,400-foot long, 75-foot wide canal along the left bank of the river. The proposed hydroelectric project would redirect flows from the dam spillway through two hydraulic turbines. As proposed, an intake channel would be constructed upstream of and around the right abutment of the dam. Flows would pass through the proposed powerhouse and be released to the river via a 200-foot long tailrace. The powerhouse would contain two 3,500 cfs turbines requiring a total capacity of 7,000 cfs.

Dr. David H. Stansbery, of the Ohio State University Museum of Zoology, provided Mitex with a report on the status of _Lampsilis abrupta_ with special attention given to the Muskingum River population. Stansbery's report reached the following conclusions:

1. The Ohio Mucket, _Lampsilis abrupta_, has a distribution limited to the Mississippi River drainage basin. A single record for western Lake Erie and another for the Niagara River are very doubtful and are suspected of being transpositions of labels or specimens.

2. The habitat of this species is the riffles and runs of the largest rivers within its range.

3. The above habitat (2) consists of relatively shallow, fast flowing water over a firm, stable, gravel-cobble substrate.

4. This species would most likely be found in the Muskingum river main stem only; and only from Luke Chute Dam (No. 5) downstream.

5. Within the lower Muskingum River range described above, it is most probable that this species occurs in the first 1-3 miles downstream from dams 2, 3, 4, and 5. (Dam No. 1 has been removed for navigation purposes.)

6. A greater number of fresh or relatively fresh shells of Lampsilis abrupta have been found at Lock and Dam Number 3 at Lowell than at any other site on the Muskingum River in recent years. We have not seen any living specimens from the Muskingum River in recent years even though the occasional collection of fresh shells indicates their continuing presence.

Although no live specimens have been seen or collected at Lock and Dam No. 3 in recent years, there is no conclusive evidence that Lampsilis abrupta does not exist in the proposed project area. With this in mind, Dr. Stansbery recommended the following mitigation measures to preserve, improve, or expand the habitat for Lampsilis abrupta at the site.

1. Maintenance of the natural regimen of water flow and water temperature.

2. Assurance of adequate suspended organics of the type used as food by the unionids in question.

3. Precautionary measures to avoid adding any toxic materials to the rivers or the removal of any materials necessary to the continued life of these species.

4. Avoidance of any changes which would significantly decrease the species diversity of the fishes at this site, reduce population sizes or alter their movements (feeding forays, breeding runs, etc.)

5. Taking measures to insure that the water effluent from the generating unit would re-enter the river at the present dam site with the same or improved quality of the water currently passing over the dam. As I understand it, the only resource sought in this retrofit hydroelectric project is the energy held by the water above the dam by virtue of its higher elevation. Theoretically, at least, this could be accomplished without the alteration of any factors critical to the biota of the river.

We have recommended a minimum flow of 2,280 cfs (30 percent of mean annual flow) for the April 1 - June 30 time period and 1,520 cfs (20 percent of mean annual flow) for the remainder of the year, July 1 - March 31. However, we have agreed, that if the proposed modeling studies indicate that a flow of 1,000± cfs during the July-March time period provides adequate velocity and depth over the substrate, we will accept 1,000 cfs as the minimum flow. The recommendation of 2,280 cfs for the April – June time period would still remain. With this understanding, Mitex, the consultant for Upper Mississippi Water Company, has developed the following mitigation proposals:

1. Project operation will be subject to a continuous minimum flow as confirmed in physical model tests. The range will be 1,000 to 1,520 cfs from July to March. These are 165 percent and 235 percent respectively, of the 7Q10 flow. A minimum flow of 2,230 cfs will be maintained from April 1 to June 30.

2. A detailed erosion and sediment control plan will be prepared prior to commencement of construction. Upper Mississippi will consult with the ODNR, OEPA, USFWS, and USEPA in preparation of this plan. A primary goal will be to minimize introduction and resuspension of river sediments.

3. Upper Mississippi will operate the facility in a strict "run-of-river" mode.

4. Upper Mississippi will operate D.O. monitors at the project. In the event levels drop below the state standard as a result of hydropower operations, aerators will be run, or minimum flows increased to whatever level is necessary.

5. Upper Mississippi will field survey all areas to be dredged prior to actual dredging. In the event any specimens of Lampsilis abrupta are found, they will be transplanted, using methods approved by the FWS, to locations approved by the FWS.

6. Upper Mississippi will schedule dredging and other disruptive in-river operations to avoid times of maximum mussel sensitivity to turbidity. The best time would be from late fall to early winter.

Should the above conditions be incorporated into the project, this precludes the need for further action on this project as required by the 1973 Endangered Species Act, as amended. Should the project be modified or the above conditions not be incorporated or new information become available that indicates listed or proposed species may be affected, consultation should be initiated.

In item Number 5 above, it states that if any Lampsilis Abrupta are found, they will be transplanted. This action would require that a Federal endangered species permit be obtained. The permit can be obtained from our Regional Office in Twin Cities, Minnesota. We will assist the applicant in obtaining this permit prior to any relocation efforts.

We appreciate this opportunity to comment on your proposed project. If you have any questions, please call Ken Multerer at 641/469-6923.

Sincerely yours,

Kent E. Kroonemeyer

Kent E. Kroonemeyer
Supervisor

cc: Chief, Ohio Division of Wildlife, Columbus, OH
Ohio DNR, Outdoor Recreation Serv, M. Colvin, Columbus, OH

APPENDIX II. Letter from Charles. J. Kulp, USFWS, to James Keany, FERC, dated September 28, 1987.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Suite 322
315 South Allen Street
State College, Pennsylvania 16801

FILED 1987 OCT -6 PM 4:33

September 28, 1987

Mr. James Keany
Ecologist (308RB)
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D. C. 20426

Dear Mr. Keany:

This alerts you to significant new biological data from the Ohio River pertaining to a federally-listed endangered mussel. On August 13, 1987, biologists from the Fish and Wildlife Service and the West Virginia Department of Natural Resources, Water Resources Division, collected the pink mucket pearly mussel, *Lampsilis abrupta* from the upper Greenup pool between rivermile 292.0 and 292.4 near the Greenbottom light and daymark along the right bank just downstream of Shoal Run. *Lampsilis abrupta* is listed as an endangered species by the Service under the Endangered Species Act of 1973. A mussel population at the site was discovered by Service and WVDNR personnel in 1985, but *L. abrupta* was not encountered at that time. These data are expected to be published in *The Nautilis* in October 1987. This reach of the Ohio River was also identified in the Service's report entitled *A Physical and Biological Survey of the Ohio River Islands* as having significant mussel resources.

Dr. Ralph Taylor identified ten sites in the reach between Gallipolis Locks and Dam and the confluence of the Guyandotte River (rivermiles 280 - 305) which contained shell material on the shore. Two sites were brailled by Dr. Taylor but no mussels were apparently discovered. Dr. Taylor did not find evidence of mussels in the vicinity of the Greenbottom site. Twenty-one species are known to exist in the reach surveyed by Dr. Taylor and may exist in the Greenbottom mussel bed as well. Sixteen species have been collected from rivermile 292-292.4 including *L. abrupta*. We suspect that *L. abrupta* exists at other sites which contain suitable habitat in the Ohio River, especially in this reach.

We collected mussels, including *L. abrupta*, at the Greenbottom site by brailling (dove tail). The mussel bed, of unknown size and shape, is located in 14 to 23 feet of water over sand, gravel, cobble, and boulder substrate. *L. abrupta* was located in water 16 to 18 feet deep approximately 200 feet off the shoreline. The dominant species in the bed are *Elliptio crassidens crassidens*, (elephant ear); *Actinonaias ligamentina carinata*, (mucket); *Quadrula pustulosa pustulosa*, (pimpleback), and *Pleurobema cordatum*, (Ohio River pigtoe).

The elephant ear and mucket were presumed extirpated from the Ohio River. Pleurobema. cordatum, Quadrula metanevra, (monkeyface), and Plethobasus cyphyus, (bullhead), were relatively abundant in the population but are considered rare by the State of Ohio. Two adult specimens of Fusconaia ebena, (ebony shell), represent a significant upriver range extension for this species. The collection of Truncilla truncata, (deertoe), is also unique since it was once very abundant in the mainstem Ohio River but has not been reported for approximately 75 years.

Two adult specimens of L. abrupta were collected, one male and one female. The male was sacrificed at the site for identification. The female was kept alive and later shipped to Dr. Andrew Miller at the Waterways Experiment Station for research purposes. The male L. abrupta and representatives of our collections from the site are accessioned at the OSU Museum of Zoology.

Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), requires that federal agencies, in consultation with the Service, insure that their actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. Therefore, Service recommends that special attention be given to potential impacts on endangered mussels from ongoing and future projects within the following three reaches of the Ohio River: rivermiles 280.0 - 305.0, Gallipolis Lock and Dam to the confluence of the Guyandotte River; rivermiles 204.0 to 218.0, Belleville Lock and Dam to the toe of Buffington Island; and rivermiles 172.0 to 184.0, between confluences of the Muskingum River and the Little Kanawha River. Although L. abrupta has not been located in the latter two reaches, habitat conditions are suitable for their existence.

In accordance with Section 7 of the Endangered Species Act, as amended, informal consultation with the Service will be required on any federally funded, licensed, or permitted project within these three Ohio River reaches. This informal consultation will be required on all projects which may affect freshwater mussels, such as commercial sand and gravel dredging, navigation maintenance dredging, fleeting, and/or mooring facilities which are located in the three previously mentioned reaches of the Ohio River. The extent of the informal consultation will be determined on a case-by-case basis but should include mussel surveys by qualified consultants approved by the Service.

If you require additional information on this matter, please contact us.

Sincerely,

Charles J. Kulp

Charles J. Kulp
Field Supervisor

Enclosure

Table 1. Check list of freshwater mussels collected in the upper Greenup Navigation Pool, with specific reference to the mussel bed containing *L. abrupta*, Mason and Cabell Counties, West Virginia. Data from 1985 and 1987 combined.

SCIENTIFIC NAME	COMMON NAME
Strophitus undulatus undulatus (Say, 1987)	Squaw foot
**Megalonaias nervosa* (Raf, 1820)	Washboard
Lasmigona complanata (Barnes, 1923)	White heelsplitter
**Quadrula quadrula* (Raf, 1820)	Mapleleaf
**Quadrula metanevra* (Raf, 1820)	Monkeyface
**Quadrula pustulosa pustulosa* (Lea, 1831)	Pimpleback
**Amblema plicata plicata* (Say, 1817	Three ridge
**Fusconaia ebena* (Lea, 1831)	Ebony shell
**Fusconaia flava* (Raf, 1820)	Pigtoe
**Plethobasus cyphyus* (Raf, 1820)	Bullhead
**Pleurobema cordatum* (Raf, 1820)	Ohio River pigtoe
**Elliptio crassidens crassidens* (Lamarck, 1819)	Elephant ear
**Obliquaria reflexa* (Raf, 1820)	Threehorn
**Actinonaias ligamentina carinata* (Barnes, 1823)	Mucket
Truncilla truncata (Raf, 1820)	Deertoe
Leptodea fragilis (Raf, 1820)	Fragile papershell
**Potamilus alatus* (Say, 1817)	Pink heelsplitter
**Lampsilis radiata luteola* (Lamarck, 1819)	Fat mucket
**Ligumia recta* (Lamarck, 1819)	Black sandshell
**Lampsilis abrupta* (Say, 1831)	Pink mucket
**Lampsilis ventricosa* (Barnes, 1823)	Pocketbook

*Represented in the mussel bed occupied by *L. abrupta* at the Greenbottom site.

APPENDIX III. Letter from Dean Shumway, FERC, to C. Clower, USFWS, dated June 27, 1988.

Mr. Christopher Clower
Elkins Suboffice
U.S. Fish and Wildlife Service
P.O. Box 1278
Elkins, WV 26214

JUN 27 1988

Dear Mr. Clower:

Enclosed is the Draft Environmental Impact Statement (EIS) for Hydroelectric Development in the Upper Ohio River Basin, Docket No. EL85-19-114.

The EIS assesses the impacts associated with 24 proposed hydroelectric projects located at 19 sites in the upper basin, including the potential impacts of the proposed projects on the endangered pink mucket pearly mussel.

Page 3-19 of the EIS provides information on the distribution of the endangered mussel in the upper basin. This section of the DEIS also identifies suitable habitat for this species in the downstream areas of the proposed hydropower projects located at Muskingum River Lock and Dam (L&D) No. 3 (FERC No. 6998), Belleville L&D (FERC No. 6939), and the competing proposals at Gallipolis L&D (FERC Nos. 9042 and 10098).

Page 4-62 discusses the effect of the hydropower proposals on the endangered mussel. Page 5-21 indicates staff's recommended alternative, alternative 4. Under this alternative, there would be no hydropower development at Muskingum River L&D No. 3 and, therefore, no effect on this endangered species. Page 5-29 provides staff's recommendations for the protection of this species associated with hydropower development at Belleville L&D and Gallipolis L&D.

We would appreciate receiving your review comments within 30 days, regarding the endangered pink mucket pearly mussel.

Sincerely,

Edward J. Fowlkes
for
Dean L. Shumway,
Director, Division of
Project Review

Enclosure: Draft Environmental Impact Statement
for Hydroelectric Development in the
Upper Ohio River Basin, Docket No. EL85-19-114.

APPENDIX IV. USFWS Comments on the FERC DEIS.

United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
WASHINGTON, D.C. 20240

TAKE PRIDE IN AMERICA

ER 88/419

AUG 1 1988

Ms. Lois D. Cashell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

Dear Ms. Cashell:

The Department of the Interior has completed its review of your draft environmental impact statement for Hydroelectric Development in the Upper Ohio River Basin, Ohio, Pennsylvania, and West Virginia. We have the following comments and recommendations on the document. Specific comments are enclosed as a separate document.

FISH AND WILDLIFE COORDINATION ACT AND SECTION 10(j) ISSUES

It is our understanding that FERC intends to have the final environmental statement serve as a licensing document. In this context, FERC has stated (on page 4-87) that Departmental comments filed pursuant to the National Environmental Policy Act (NEPA) will be considered by FERC to be the most current recommendations filed pursuant to the Fish and Wildlife Coordination Act (FWCA). Departmental comments on a particular impact statement are provided pursuant to NEPA and do not represent comments pursuant to FWCA or Section 7 of the Endangered Species Act (ESA). Comments under Section 2(b) of FWCA are provided when draft applications are made available for each project. Comments under Section 7 of ESA are provided when FERC initiates the consultation process.

FERC also states on page 4-87 that its response to our comments on this environmental statement will be used as a mechanism to comply with Section 10(j) of the Federal Power Act (FPA). In our opinion, a response to comments on a general environmental statement covering numerous projects does not constitute issue resolution under Section 10(j) since there is insufficient information to determine whether the staff's recommendations are consistent with those of the FWS. Furthermore, this does not reflect the spirit of the FPA since FERC's action may limit future opportunities to resolve issues on individual licensing actions.

We believe that all comments made during the licensing process of any project should be part of the administrative record for that project and there should be dialogue between parties at any time if conflicts arise. If FERC intends to use these environmental documents as part of the Section 10(j) process, then 10(j) discussions should be presented in a separate section that contains specific recommendations for each project, a detailed discussion of any disagreements with the FWS, and adequate documentation of the FERC staff's position.

CUMULATIVE IMPACT ANALYSIS

On June 29, 1987, the FWS commented on FERC's notice of intent to prepare an environmental impact statement on the potential cumulative impacts of hydroelectric projects in the Ohio River Basin. At that time, FWS concurred with FERC's decision to prepare such an impact statement; however, concern was expressed about which projects were to be included. Since that time FWS has maintained the position that FERC's proposal to examine the potential cumulative impacts of 24 projects (with pending prelicense action at 19 sites) does not and cannot adequately address the potential cumulative adverse impacts of hydropower development throughout the basin. All proposed, constructed, and reasonably potential (regardless of licensing status) hydroelectric projects should be included in the cumulative impact analysis. This is consistent with the definition of cumulative impacts contained in the FERC regulations implementing NEPA.

Under this definition "cumulative impact" is the effect on the environment that results from the incremental impact of the action when added to past, present, and future actions regardless of the agency or person undertaking such actions. In our opinion, the Ohio River cumulative impact study is not being conducted in accordance with this definition. FERC argues that "...increasing the size and scope of the study area (additional licensed or exempted projects) ...would introduce sufficient additional uncertainty to make the results of the impact statement of limited value..." (August 10, 1987, Scoping Document II, page 15). Contrary to that argument, we believe that the draft, as written, precludes meaningful analysis of potential or real adverse cumulative impacts on fish and wildlife resources in the Ohio River Basin from existing and proposed hydroelectric projects because it does not include such projects. Therefore, we believe that FERC should prepare and circulate for comment a revised draft statement including all licensed, exempted, and proposed projects in the Ohio River Basin. We have enclosed a list of additional projects which we believe must be included in any revised environmental document.

The draft statement does not indicate which competing application would be licensed at Tygart Dam, Montgomery Locks and Dam, New Cumberland Locks and Dam, Willow Island Locks and Dam, or Gallipolis Locks and Dam, although the proposed action is to license hydroelectric projects at these sites. The draft states that there are no major differences among these projects; therefore, no preference is indicated. In our opinion, major differences do exist. For example, one of the applicants for the Gallipolis project plans to install four turbines, two on each side of the river. The competing application only plans to install two turbines at one abutment of the dam. The effects of these projects on water currents and patterns would differ significantly, as would proposed fishing access and aquatic habitat requirements. Furthermore, recreational areas proposed at several sites on government-owned lands are of insufficient size to allow the development. FWS previously described major concerns with several of these projects during review of individual license applications. Unfortunately, FERC has not responded to those concerns. Therefore, the draft should be revised to show which competing application is likely to be licensed and what mitigation measures would be required.

ALTERNATIVES ANALYSIS

Conservation and load management is briefly discused as a principal non-generating alternative to the proposed projects. However, the concept was dismissed by the conclusion that implementation of such measures has been adopted in many cases. That assumption is contrary to the conclusions drawn and recommendations made in the Department of Energy's (DOE) study of alternatives to the Davis Power Project released in 1980. That study concluded that implementation of any of the three conservation and load management scenarios would result in significantly lower costs than building a proposed 1,000 MW pumped storage facility. The DOE report also showed that implementation of conservation and load management could, in and of itself, preclude the need for 1,000 MW of peaking power. As such, a detailed analysis of conservation and load management is appropriate for the present study and highly recommended by FWS. Further, the conservation and load management alternatives presently being used should be discussed in concert with all economically available alternatives.

The draft states that hydropower alternatives were developed to "...give equal consideration to power generation and environmental quality values." Contrary to this statement, the data projecting dissolved oxygen (DO) content (Section 4 and Appendix B) clearly show degradation of water quality values with each of the four proposed hydropower alternatives. Specifically, the DO model for Alternative 3 (Project Operation to Meet Antidegradation Criterion) and Alternative 4 (Project Selected to Minimize Impacts to All Target Resources) predicts DO reductions below Willow Island Locks and Dam for approximately 180 river miles (see Figures 4.4.1-1, 4.4.1-2, 4.3.1-3, etc.). FERC's recent decision (Commission Order 464) to waive Section 401 water quality certification for 11 projects does not reflect equal consideration of power generation and environmental quality.

ENDANGERED SPECIES

The data contained in the draft are insufficient to demonstrate that adverse impacts will not occur to the pink mucket pearly mussel (Lampsilis orbiculata), a listed endangered species. In fact, FWS believes adverse impacts to that species would occur. Our concerns are based on the potential depressed DO levels resulting from the proposed hydropower projects. Additionally, FWS believes a significant reduction in numbers of finfish, as indicated, may also adversely affect the pink mucket pearly mussel since fish are an integral part of their life cycle requirements.

The endangered pink mucket pearly mussel occurs in the area below Gallipolis Lock and Dam and may also occur below Willow Island and Belleville Locks and Dams. Section 7(c) of ESA requires the Federal agency proposing a major construction activity significantly affecting the quality of the human environment to conduct and submit an assessment to determine the effects of the proposal on listed and proposed species. The biological assessment must be completed before any construction contracts are let. We do not believe that we can adequately assess the effects of proposed actions on the pink mucket pearly mussel without a complete assessment. When conducting a biological assessment, the following may be considered for inclusion:

1. The results of an on-site inspection of the area to be affected by the action to determine if listed or proposed species are present or occur seasonally.

2. The views of recognized experts on the species at issue.

3. A review of the literature and other information.

4. An analysis of the effects of the action on the species habitat, including consideration of the cumulative effects and the results of any related studies.

5. An analysis of alternate actions considered by the Federal agency for the proposec action.

After FERC has completed and reviewed the assessment, it has the responsibility to determine if the proposed action "may affect" the pink mucket pearly mussel. If it determines that the project "may affect" a listed species, FERC must request formal consultation from the appropriate field office of the FWS. When FERC provides the biological assessment to the FWS, it should include any other relevant information used in reaching its conclusion.

Section 7(d) of ESA underscores the requirement that the Federal agency or the applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which, in effect, would deny the formulation or implementation of reasonable and prudent alternatives regarding their actions on any endangered or threatened species.

MINERAL RESOURCES

On page 3-27 we believe the document is deficient in its listing of mineral resources and resource-based industries. The list should include: coal, oil and gas, steel, ferroalloys, zinc, lime, cement, clay, and sand and gravel. The document also states that impacts on mineral resources from this project consist of land impairment and utilization of mine quarry and pit sites for waste (spoil) disposal. Mineral deposits are apparently viewed only as convenient dump sites that have no other interest or value. Also, the document does not mention the network of natural gas and petroleum product pipelines that may be affected by the various proposed construction and distribution lines.

We recommend that the draft include a section on mineral resources. The mineral deposits and/or mineral-related facilities, including pipelines, pertinent to each site or facility nd its ancillary components should be described, the impacts of the projects on them should be discussed, and mitigating measures should be described.

SUMMARY

The draft does not provide adequate coverage of the following issues which were identified in the scoping process as issues of primary concern: water quality, endangered species, hydraulics, altered flow patterns, flow modifications, turbine-induced fish mortality, recreational fishing, and dredged spoil disposal. The draft does not provide adequate recommendations or articles to protect fish and wildlife resources or the public use thereof. No indication is given as to which competing applications will be licensed. Conservation and load management was not adequately addressed as a project alternative.

FERC claims to have complied with the Section 7 consultation process of ESA by providing FWS with a review copy of the draft statement. This does not constitute consultation which has yet to be initiated by FERC. Further, the FWS does not concur with staff recommendations to postpone resolution of the previously identified issues regarding fish turbine mortality and fish passage until the post-licensing phase. Because of these concerns, and the exclusion of numerous basin projects from the analysis, we recommend that the draft be revised and recirculated. A final statement should not be released until these issues are resolved.

Unless these issues are adequately resolved, the FWS may recommend that this project be referred to the Council on Environmental Quality (CEQ) under Section 1504 of its regulations. The referral would be based on the precedent-setting nature of this type of cumulative impact study and the severity of potential water quality impacts. However, we wish to coordinate fully at the earliest possible time because a solution to our concerns can be implemented with a minimum of delay and could preclude the necessity for referral. Coordination can be initiated by contacting the Field Supervisor, U. S. Fish and Wildlife Service, Suite 322, 315 South Allen Street, State College, Pennsylvania 16801, (814) 234-4090.

Sincerely,

Bruce Blanchard, Director

cc: Mr. Dean Shumway
(Rm. 204RB)

APPENDIX V. Summary of Expert Contacts

The following contacts have been made with USFWS staff and individuals in other appropriate governmental agencies and private organizations to obtain information used in this biological assessment. A statement of relevant expertise is included. Specific information communicated is cited in the text by personal communication.

Mr. Stephen Ahlstedt
Biologist
Office of Natural Resources
Tennessee Valley Authority, Norris, TN
(615) 632-1790
Author of USFWS Recovery Plan for *L. orbiculata* (= *L. abrupta*); freshwater mussel surveys in the Tennessee Valley and Arkansas.

Mr. Ronald R. Cicerello
Aquatic Biologist
Kentucky Nature Preserve Commission
407 Broadway
Frankfort, KY 40601
(502) 564-2886
Surveys of endangered mussels in the lower Ohio River.

Mr. John Jenkinson
Office of Natural Resources
Evans Building
Tennessee Valley Authority
Knoxville, TN 37902
(615) 632-3516
Mussel surveys at TVA facilities and in the Tennessee Valley region.

Mr. John H. Marshall
Environmental Affairs Specialist
Division of Wildlife, Ohio Department of Natural Resources
Fountain Square
Columbus, OH 43224
(614) 265-6306
Ten years of experience working on the Ohio River, including mollusks; general environmental quality and impact assessment.

Dr. Andrew C. Miller
Research Limnologist WESER-A
Waterways Experiment Station
U. S. Army Corps of Engineers
Vicksburg, MS 39180-0631
Freshwater mussel specialist; conducted surveys of mussel populations in the lower Ohio River for 10 years.

Mr. Kenneth Multerer
Endangered Species Coordinator
Columbus Field Office
U. S. Fish and Wildlife Service
P. O. Box 3990
Columbus, OH 43216-5000
(614) 231-3416
USFWS coordinator of endangered species for Ohio.

Dr. David H. Stansbery
Director, Museum of Zoology
Department of Zoology
Ohio State University
1813 N. High Street
Columbus, OH 43210
(614) 292-8560
Leading freshwater mussel taxonomist; curator of mussel collections; author of 1985 review of status of *L. abrupta* with special reference to the Muskingum River.

Dr. Ralph W. Taylor
Professor, Department of Biological Sciences
Marshall University
Huntington, WV 25701
(304) 696-2338
10 years experience conducting mussel surveys of the Upper Ohio River, especially between Greenup Locks and Dam and Pittsburgh.

Mr. William A. Tolin
Biologist, U. S. Fish and Wildlife Service
P. O. Box 1278
Elkins, WV 26241-1278
(304) 636-6586
Twelve years experience conducting mussel and other aquatic habitat surveys of the Ohio River; discoverer of *L. abrupta* in the reach below Gallipolis Locks and Dam in 1987.

Dr. John C. Williams
Professor of Biological Sciences (retired)
Eastern Kentucky University
home phone (606) 299-4072
Mussel surveys of Ohio River

APPENDIX J

LETTERS OF COMMENT ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND STAFF RESPONSES

The Notice of Availability of the draft environmental impact statement (DEIS) was publishe in the Federal Register on May 20, 1988. The DEIS was mailed to Federal, state, and local agencies and individuals for comments on May 12, 1988. Chapter 8 of the final environmental impact statement (FEIS) contains a listing of those agencies and individuals that were sent copies of both the DEIS and FEIS. A public meeting on the DEIS was conducted on July 15, 1988 i Pittsburgh, Pennsylvania, to allow participants to express their views on the DEIS.

All timely letters of comment that address specific analyses in the DEIS were reviewed by FERC staff. Suggestions for correcting text or data and requests for further discussion of a subject have been considered. Those editorial changes and suggestions which were practicable, reasonable, and which improved the quality of the EIS are incorporated herein.

Constructive criticism presenting a major environmental point of view or one in opposition to staff, when persuasively supported, is treated by making revisions in the appropriate part of the FEIS. When the major point of view is not persuasive, reasons are given why the staff did not change its point of view.

The sections or pages of the FEIS that have been modified as a result of comments received are identified in the staff responses to the right of the letters of comments. Other FERC staff responses are self-explanatory.

A "no response required" response is given to comments that are statements that raised no questions concerning treatment of subject matter in the DEIS. A "your opinion has been noted" o "comment noted" response is given to comments that are considered to be statements or opinions.

Letters were received form the U.S. Soil Conservation Service, U.S. Public Health Service, and the Ohio State Clearing House which acknowledged receipt of the DEIS but offered no comments

The respondents and the page on which their letters occur are as follows:

DEPARTMENT OF THE ARMY

Ms. Lois D. Cashell, Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, DC 20426

Dear Ms. Cashell:

The [illegible] on Hydroelectric Development in the Upper Ohio River Basin [illegible] been reviewed for technical accuracy. This review follows an earlier policy review with comments provided by my letter of March 23, 1988. The enclosed technically related comments are organized into four enclosures. Enclosures 1, 2, 3, and 4 provide substantive comments, editorial notations, typographical errors and a listing of slack water embayments, respectively.

If we may be of further assistance, please contact Mr. [illegible] of my staff. He may be reached at 412-644-3277.

Sincerely,

Ernest J. Harrell
Brigadier General, U.S. Army
Commanding

Enclosures

88 JUL 13 AM 9:44

J-3

[illegible]

[illegible]

1. [illegible] forwarded separately by Mr. Borgia, [illegible] [illegible] 1

2. In paras. [illegible], 4.3.4, and others, it is [illegible] that the report [illegible] about the [illegible] immediately up and downstream from an installation which can be determined during the physical modeling stage [illegible] environmental conditions [illegible] (ORBES AP), [illegible] velocities, etc., while still protecting navigation interests. It is recommended that the [illegible] be conditioned so that if mitigative measures are demonstrated to be possible, then additional consideration will be given to their inclusion in the system. At AR L&D #3, [illegible] miles of river will be physically modeled [illegible] the specifications prepared by the Corps [illegible] request. The reach below the dam would be modeled for [illegible] miles [illegible] Bridge and include the two major islands in their entirety; the reach upstream would extend [illegible] mi. It is believed that many mitigative measures could be examined in a model this large. 2

3. Recognizing that EIS is primarily an environmental report, there may be merit, in some instances, to consider the economic and technical feasibility aspects as well [illegible] in decision making. 3

4. The Division is familiar with problems faced in the scoping of this study. It is felt that at least one table and/or map showing all main stem and tributary, existing and potential, hydro projects in the Upper Ohio Basin should be presented in the report to determine the total extent of hydro development proposed for the region. 4

5. In view of the lack of experience with structural and behavioral barriers to fish entrainment at low-head hydro facilities on inland rivers, we concur in the recommendation of FERC staff (DEIS, page 5-[illegible]) that developers establish a bioengineering test facility in association with one or more of the hydro projects in the Upper Ohio River System. This developer-funded facility should support the [illegible] promising fish protection technology to practical testing. In addition, this facility should also test the efficacy of various mechanical aeration methods that could be used to replace some or all of the dissolved oxygen that is lost due to reduced spill flows. We believe that the commitment of the hydro developers to install such impact alleviation systems (if required) must remain open-ended. 5

1. Text has been modified.

2. Staff is aware of the Corps' requirement for licensees to conduct physical modeling studies at Corps dam structures prior to construction of the hydropower project. The primary purpose of the modeling is to determine the effects of hydropower operation on river flows and to design the hydropower project to eliminate any effect on river navigation. The modeling study requires final detailed design plans for the hydropower facility that are not available until after a license is issued and does not provide the information to staff needed to assess the environmental impacts prior to licensing. Staff has recommended in the FEIS (Section 5.4.1) that the three projects for which inadequate mitigation has been proposed to date be reconsidered should adequate proposals for mitigation be proposed in the future.

3. Staff has analyzed the economic benefits of each of the proposed projects and has summarized this information in Section 5.2. The Commission has long recognized the need to study the economics of proposed projects. A project that is not economically beneficial is not in the public interest, unless the applicant or the record demonstrates overriding public interest or benefits of licensing the project. Technical feasibility of proposed projects and mitigation measures have been considered to the extent possible without conducting detailed engineering studies.

4. Two new maps have been provided in the FEIS (Figures 1.1-1 and 1.3-1).

5. Staff appreciates the support of the Corps in its recommendation of a bioengineering test facility for evaluating fish protection and guidance systems in the Ohio river. Staff concurs that the commitment must remain open-ended to be successful at meeting unforeseen opportunities for mitigation.

6. It would be [illegible] operating agreement [illegible] Article [illegible] page [illegible] states that the licensee, prior to the [illegible], shall enter into an operating Memorandum of Agreement (MOA) with the Corps. 6

7. It is [illegible] that the first sentence of third full para, page [illegible], FEIS be [illegible] as follows: "Appendix C includes recent aerial photos for all of the existing L&D's; no aerial photo was available for Tygart Dam." (An aerial photo of Tygart Dam is available from this [illegible] should you require it.) 7

8. It is suggested that the first sentence of the fourth para, page 4-16, sec 4.1.1.2, FEIS be restated as follows: "The reduction in pool [illegible] of a fixed-crest dam also increases the river's velocity and sediment transport capacity (Section 4.1.5)." 8

9. It is suggested that an aerial photograph of Tygart Dam be shown on the title page of Appendix C. 9

10. In regard to Recommendation 7 on page 5-[illegible] of the FEIS, it is unclear how Corps participation in the basin wide water quality management program would be funded. 10

11. In reference to the numerous statements in the DEIS concerning the potential for pool drawdown behind fixed-crest dams due to hydro operation, [illegible] staff should clarify that the Corps will require that a minimum six inch depth of water flow be maintained over these dams during all periods of hydro operation. 11

12. It is suggested that a Table be added to the FEIS to better illustrate the flows that are discussed in Section 5.4.3. 12

13. FERC staff should add a statement early in the text of the DEIS which informs the public (and others) that the authorized purpose of the lock and dam structures is navigation, and that hydro plant operation cannot impact upon this primary function. 13

14. The bypass flow systems described under Recommendation 4 on page 5-73 FEIS, would not be necessary for the flow would pass over the dam (at fixed crest structures) and under the gates (at gated dam structures) when the hydro plants are not operating. 14

6. As required by article 305 of Appendix H.2 of the FEIS, each licensee must enter into an operating agreement with the Corps for development of hydroelectric facilities at a federal dam. In accordance with the MOU (1981) between FERC and the Corps, the operating agreement must be made prior to start of power plant operation.

7. Text has been modified to indicate that aerial photographs of all L&Ds are provided in Appendix C.

8. Text has been modified.

9. The footnote indicating no aerial photograph is available for Tygart Dam has been deleted.

10. The purpose of recommendation 7 is to allow increased power generation and to improve water quality management, by implementing system-wide water quality and flow monitoring and coordinated operation of the hydropower projects. The project owners would benefit financially because spill flows could be reduced below those recommended by staff at some times. The Corps and other agencies involved in water quality management would benefit from the improved monitoring and control of the system. Funding for this system should be shared by each of the beneficiaries. However, since hydropower project owners could obtain substantial economic benefits from the relatively low additional cost of maintaining a system-wide monitoring program, project developers should be willing to contribute to such a program. For example, a program could be designed that would use system-wide monitoring and modeling to determine instantaneous spill flow requirements for any projects that have participated in financing the program; projects that have not participated in the program would still be subject to the spill flow requirements recommended by staff.

11. The spill flows recommended by the staff for projects at the fixed-crest dams will guarantee that a minimum depth will be continuously passed over these structures.

12. The spill flows recommended in Section 5.4.3 are summarized in Table 2.3.1-1; text has been modified to reference this table.

13. A sentence mentioning the authorized navigational purpose of the locks and dams has been added to Section 1.1. FERC has a responsibility to balance the addition of hydropower against other project purposes.

14. Flows passing over the dam or under the gates may not be sufficiently close to the shoreline access points where there are developed fishing access facilities and, therefore, may not be comparable to the tailrace currents which normally would attract fish to these areas. Recommendation 4 of Section 5.4.2.3 has been revised to address the site-specific issues which would need to be resolved during physical hydraulic modeling. Developers would need to file a plan with the Commission for providing flows in the tailrace fishing areas when the turbines are inoperative (e.g., via selective gate openings and/or bypass flow systems) based on the results of hydraulic modeling and consultation with appropriate state and federal agencies.

PAGE/PARA/LINE	REMARKS	
1-3/[illegible]	Tygart Lake is a multi-purpose project authorized for flood control and low flow augmentation. This information should be inserted.	Text has been modified.
1-6/1.3	Raising water levels in pools during the 100-year flood, especially, should be included in the issues.	15. Text has been modified, referencing flood elevations in No. 1 in the list of issues addressed in the FEIS.
2-5/2.1.1.1-2	Change "near" to "at"	
2-5/2.1.1.2.2	Change "near" to "to"	
2-3	Spill flows should be further footnoted that they are subject to change by Corps and possibly by other environmental agencies.	16. Text has been modified in Section 2.1.3 and 5.4.3 to reference the recommendation that spill flows be subject to temporary modification for water quality management.
2-5/2.1.1.3, all	Reference to flashboards and 130 feet spill section no longer applies.	17. A July 26, 1988, letter from the Corps' Pittsburgh District concerning Allegheny River L&D No. 3(FERC No. 4474-003) indicated that the Corps would consider the installation of facilities to control pool levels during periods of low flow, such as crest gates that are fully controllable. Staff has analyzed the proposed project at this site to include this consideration in the FEIS.
2-[illegible]/fig.[illegible] 1-5	Outline based on applicant's material for Corps to prepare model specifications.	
2-[illegible]/2.1.1.5/[illegible]	Change RM 151.4 to 15.4 RM. The former presumes an official mile point, which it isn't since Mon River ends at RM 128.72.	
2-18/2.1.1.E.4	Remove "not" and add after "submerged" the phrase, "except during very low flows."	
2-18/2.1.1.18/2	Remove "that"	
2-7.6	Some of the larger flows shown in the "critical" column are not now always achieved.	18. Comment noted. When the river flow minus the minimum turbine flow required for generation is less than the required spill flow, the projects will be unable to operate.
2-27/2.1.4	Spillage will have to be increased if minimum depth over fixed crest spillways falls below 0.5 ft. after powerhouse construction.	19. See response to comment #11.
3-18/3.1.4.4, [illegible]	It would be better to substitute "deeper" for "channelized". Scour areas occur before reaching the channelized areas, the latter of which only show up downstream at the ends of the locks.	Correction made.
3-31/fig.3.1.9-3	Captions of this and fig. 3.1.9-? should be interchanged.	Corrections made.

PAGE/PARA/LINE	REMARKS		
3-37 [illegible]	[illegible]	20	20. Text has been modified.
3-38 [illegible]	[illegible]		
3-39 [illegible]	[illegible]	21	21. See response to comment #11.
3-40 [illegible]	[illegible] not totally true. [illegible] study of scour protection for this dam [illegible] energy and turbulent flows plunging through most flow ranges except at very high stages when a [illegible] not developed. Turbulence was so severe that [illegible] rock sizes could not be found. As a result, sunken barges filled with stone and concrete [illegible] will be used.	22	22. Text has been modified to state that aeration at Allegheny L&D 7 is probably low because the apron, which is longer than at other Allegheny River dams, allows less plunge than at other dams.
3-50 [illegible]	Revise the second sentence as follows: "The Corps navigation projects, real estate easements were purchased and all other provisions made prior to construction to compensate for project-induced flood effects only (to exclude hydropower) where necessary.	23	23. Text has been modified.
3-51	On the figure, show [illegible] in the legend box, a line and dot configuration labeled, "100-year flood with Hydro		Correction made.
3-56, [illegible]	Tables 3.4.4-1 through 3.4.4-4. It is assumed they refer to Monongahela L/D 2, 3, 4 and 7 rather than like numbers on the Allegheny. Also, the projects in these tables are not arranged in any order. Use the format of Table 3.4.4-5 for an accurate description and listing of these projects.		Correction made.
3-62 [illegible]	Revise third sentence as indicated in page 3-50 above.		Correction made.
3-63	Fig. 3.4.6-1 title should be, "Flood Routing Elevations ..." instead of "Expected Flood Elevations"		
3-67 [illegible]	Pike Island should be deleted from the [illegible] in that it discharges a minimum of 6ft. below level of downstream pool.	24	24. Text has been modified to delete reference to the dam designs. However, Pike Island is retained in the list of dams that are effective aerators. A statistical analysis of dam aeration data measured by the Pittsburgh District indicates that flow has a relatively low influence on aeration at this dam. Some observations taken at low flows show little aeration, but significant aeration was measured during other low flow periods.
3-67 [illegible]	"Comparison" should be plural.		

PAGE/PARA/LINE	REMARKS		
3-78/3.5.5/6-8	[illegible] Ohio [illegible] Navigation [illegible] Program [illegible] between [illegible] Ohio River [illegible]	25	25. Comments noted; text has been modified; see Section 3.5.5.
[illegible]	[illegible]	26	26. Comments noted.
[illegible]	[illegible] page 3-50 [illegible]		Correction made.
[illegible]	Fig. 3.5.6.1 [illegible]		Correction made.
4-2	Table 4.3 [illegible] should be [illegible]		Correction made.
4-20	Add: [illegible] models be constructed and [illegible] described tailwater flow regimes.		Correction made.
4-22	At bottom of page, insert after "Specific [illegible]", the phrase "If not altered in conjunction with physical model studies."		Correction made.
4-50	While Mon. River L&D 4 was originally constructed as a fixed-crest dam, it was reconstructed in the 1960's to provide a gated crest.	27	27. Comment noted.
[illegible]	Fifth paragraph should be re-examined. [illegible] flash-boards are being presently [illegible] model [illegible]	28	28. See response to comment #17.
[illegible]	In third paragraph, change [illegible] In fifth paragraph, the Dam numbers should be reversed: [illegible] at Dam #8 and [illegible] at Dam [illegible]		Correction made.
[illegible]	Comment: The [illegible] is pleased to see recommendations to [illegible] management [illegible] hazards and [illegible]		Comment noted.

PAGE PARA LINE | REMARKS

[illegible] Subparagraph 4. [illegible] at Tygart should be [illegible] it is [illegible] that the Corps will [illegible] flow to avoid [illegible] pulsating, or [illegible] known as "Scheduled Releases" [illegible] Subparagraph 4. Reference is made at the bottom of [illegible] page [illegible] which [illegible] 29

[illegible] [illegible] the CEIS [illegible] it may be beneficial to [illegible] flows for [illegible] at [illegible] with regards to [illegible] significant wetland [illegible]

29. The third basin-wide water quality recommendation in Section 5.4.2.1 has been modified to refer to Section 5.4.3 for the issue of flows at Tygart Dam. Section 5.4.3 now includes recommendations for walleye flushing flows and for flow regulation in accordance with Corps prohibitions on peaking flows.

Comments noted.

OHIO RIVER SLACKWATER EMBAYMENTS CREATED
IN THE PITTSBURGH DISTRICT SINCE 1950

Embayments over 500 feet in length that are located in reaches that have been affected by the Ohio River modernization program since 1950 are listed in Appendix A. There is a total of 43 such embayments within the 94.7 mile long reach of the Ohio River in question, 25 of which are in Hannibal Pool. The total length of the slackwater embayments in Hannibal Pool is more than 15 miles. Most of the Ohio River embayments within the jurisdiction of the Pittsburgh District are relatively narrow. There are, however, several exceptions where the embayments widen, usually near the mouths of the tributary streams. The most notable embayments in this respect are listed below. 30

Embayment	Approximate Maximum Width in Feet	
Indian Short Creek	1,500	
Proctor Creek	1,400	(35 acres)
Virginia Cross Creek	700	
Opossum Creek	600	
Dry Creek	600	
Fish Creek	500	
Sunfish Creek	400	

30. Comments noted; text has been modified; see Section 3.5.5.

Two pages of typographical error corrections also provided by the Corps are not reproduced here.

APPENDIX A

Slackwater Embayments Over 500 Feet Long on the Ohio River From River Mile [illegible] to [illegible]

Location Ohio River Mile	Name of Tributary Stream Pooled	Length of Slackwater Embayment (Miles)
	New Cumberland Pool at Normal Pool Elevation 664.5 msl	
39.5	Little Beaver River	0.8
40.1	Mill Creek	0.2
43.5	Cunningham Run	0.1
47.1	Little Yellow Creek	0.4
47.6	Congo Run	0.2
50.5	Yellow Creek	2.1
52.8	Tomlinson Run	0.6
	Pike Island Pool at Normal Pool Elevation 644.0 msl	
60.1	Kings Creek	0.3
62.3	Island Creek	0.2
65.7	Harmon Creek	0.3
72.4	Indian Cross Creek	1.0
72.4	Virginia Cross Creek	0.7
75.3	Buffalo Creek	1.2
77.1	Salt Run	0.2
78.0	Beech Bottom Run	0.1
79.0	Rush Run	0.2
82.6	Virginia Short Creek	0.4
82.7	Indian Short Creek	1.9
	Hannibal Pool at Normal Pool Elevation 623.0 msl	
90.8	Wheeling Creek (WV)	1.1
94.7	McMahon Creek	0.9
98.7	Wegee Creek	0.2
101.4	Little Grave Creek	0.5
102.4	Grave Creek	1.0
104.1	Big Run	0.2
105.0	Pipe Creek	0.3
107.7	Fish Run	0.1
108.1	Little Captina Creek	0.2
109.6	Captina Creek	2.1
110.8	Fish Creek	3.3
	(Long Run Sub-embayment)	0.5

Location Ohio River Mile	Name of Tributary Stream Pools	Slackwater Embayment (Miles)
	Hannibal Pool at Normal Pool Elevation 623.0 msl (continued)	
111.2	Johnson Run	0.3
113.3	Blair Run	0.1
116.4	Stillhouse Run	0.3
117.9	Sunfish Creek	1.4
119.8	Opossum Creek	0.9
121.7	Unnamed Stream	0.4
121.9	Dry Run	0.2
122.2	Proctor Creek	0.8
122.9	Haynes Run	0.1
125.2	N cross Run	0.1
126.1	Etcher Run	0.1
128.3	Fisher Run	0.1

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Suite 322
315 South Allen Street
State College, Pennsylvania 16801

July 27, 1988

Ms. Lois D. Cashell, Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, NE
Washington, D.C. 20426

Dear Ms. Cashell:

The Fish and Wildlife Service (Service) has reviewed the Draft Environmental Impact Statement (DEIS) for Hydroelectric Development in the Upper Ohio River Basin, Ohio, Pennsylvania and West Virginia as requested. These comments are submitted in accordance with the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) to supplement comments already submitted to the Federal Energy Regulatory Commission (Commission) for each license application evaluated in the DEIS (Table 1.1-1.). These comments do not preclude separate evaluations and comments on applications for permits under Sections 10, 402, or 404 of the Clean Water Act.

Our review of the DEIS leads us to conclude that the Service is not able to support many of the analyses and conclusions contained in the document. The Service requests that the DEIS be revised and recirculated and suggests changes to protect and develop fish and wildlife resources in the basin.

General Comments

The Commission intends to have the final Environmental Impact Statement (FEIS) serve as a licensing document that will be part of the record from which the Commission will make future licensing decisions in the Ohio River Basin. In this context, the Commission has stated that comments received on the DEIS will be considered by the Commission to be the most current set of recommendations filed pursuant to the Fish and Wildlife Coordination Act during the ongoing proceedings of 24 license applications, and that the Commission's response in the FEIS to comments will constitute issue resolution pursuant to Section 10(j) of the Federal Power Act. In our opinion, this does not reflect the spirit of the Federal Power Act, as amended by the Electric Consumers Protection Act, since this action would limit future opportunities to resolve issues in individual licensing actions. The Service believes that all comments, including these, made during the licensing process of any project should be part of the administrative record for that project and that there should be dialogue between parties if conflicts arise. 31

31. Staff considered all previous comments in the preparation of the DEIS on these project proposals, including comments contained in the individual project applications, filed during the comment period noticed for each application, and submitted during the EIS scoping process. State and federal fish and wildlife agencies' comments provided for the DEIS may be considered the most current set of comments and recommendations since these most recent comments may reflect new recommendations different from earlier recommendations. Staff's recommendations for the projects included in the FEIS have been developed after considering all comments (agency, applicant, and individual) filed to date.

Comments and recommendations provided in the DEIS have been used by staff in developing and revising its recommendations as needed for the FEIS. The FEIS, including the responses to comments, indicates documentation of staff's position and evidence of disagreements between staff's position and appropriate fish and wildlife agencies' positions on resource protection.

On June 29, 1987, the Service commented on the Commission's notice of intent to prepare an environmental impact statement (EIS) on the potential cumulative impacts of hydroelectric projects in the Ohio River Basin. At that time, the Service concurred with the Commissions's decision to prepare such an EIS, but expressed concern about which projects were to be included. The Service's position remains that the Commission's proposal to examine the potential cumulative impacts of 24 projects (with pending pre-licensing action at 19 sites) cannot adequately address the potential cumulative adverse impacts of hydropower development throughout the basin. Moreover, the Service maintains that all licensed and operating, licensed and unconstructed, exempted, proposed, and reasonably potential hydroelectric projects should be included in the cumulative impact analysis. 32

The Commission argues that "increasing the size and scope of the study area" (additional licensed and/or exempted projects) "would introduce sufficient additional uncertainty to make the results of the EIS of limited value," (August 10, 1987, Scoping Document II, page 15). Contrary to that argument, the Service believes that the DEIS, as written, precludes meaningful analysis of potential or real adverse cumulative impacts on fish and wildlife resources in the Ohio River Basin from existing and proposed hydroelectric projects (40 CFR 1502.9). Therefore, the Service requests that the Commission prepare and circulate a revised DEIS that includes all licensed, exempted and proposed hydroelectric projects in the Ohio River Basin. A list of other projects that should be included in the revised DEIS analysis is enclosed. 33

The DEIS does not indicate which competing application would be licensed at Tygart Dam, Montgomery Locks and Dam, New Cumberland Locks and Dam, Willow Island Locks and Dam, or Gallipolis Locks and Dam, although the proposed action is to license hydroelectric projects at these sites. The DEIS states there are no major differences between these projects and no preference is indicated. In our opinion, major differences exist. For example, one of the applicants for the Gallipolis project plans to install four turbines, two on each side of the river, while the competing application proposes only two turbines at the abutment end of the dam. The effects of these projects on water currents and patterns would differ significantly, as would proposed fishermen access and aquatic habitat requirements. Also, recreational areas proposed at several other sites on government-owned lands are of insufficient size to allow development. The Department of the Interior (Department) previously described major concerns with several of these projects during review of individual license applications. The Commission has not responded to those concerns. Therefore, the DEIS should be revised to show which competing application will be licensed and what mitigating measures would be required. 34

Conservation and load management is briefly discussed as a principal non-generating alternative to the proposed projects. However, the concept was summarily dismissed by the conclusion that implementation of such measures has been adopted in many cases. That assumption is contrary to the conclusions drawn and recommendations made in the Department of Energy's study of alternatives to the Davis Power Project released in 1980. That study concluded that implementation of any of the three conservation and load management scenarios would result in significantly lower costs than building a proposed 1,000 MW pumped storage facility. The DOE report also showed that implementation of conservation and load management could, in and of itself, preclude the need for 1,000 MW's of peaking power. A detailed analysis of 35

32. Numerous comments on the geographical scope of the staff's study have been received during preparation of the EIS recommending the inclusion and exclusion of hydropower projects different from the 24 hydropower projects analyzed by staff. Staff maintains that the study area contained in the FEIS encompasses the most concentrated stretch of pending and licensed hydropower projects in the Ohio River Basin. In addition to the 19 dams where hydropower projects are pending in the upper basin, 5 dams with no pending license applications and 6 dams where hydropower licenses have been issued by the Commission have also been evaluated in the water quality modeling portion of the FEIS. Staff believes that the licensed projects within the study area represent the existing conditions in the basin, which then can be compared to the impacts contributed by the proposed projects. Preliminary hydropower permits are not viewed collectively as reasonably foreseeable actions. Preliminary permit applications do not contain sufficient information to allow study of the environmental impacts of the development, do not contain sufficient agency consultations, and do not address the feasibility of the proposed development. Because of their incomplete status, preliminary permits cannot collectively be compared to pending license applications. The staff contends that the scope of the FEIS is therefore to address the cumulative and site-specific environmental impacts of licensing up to 19 proposed hydropower projects and to provide recommendations on those 19 proposed hydropower sites.

33. See response to comment #32. Although there are other existing and proposed hydropower projects in the basin, staff does not believe that any other projects with accepted applications would have cumulative impacts in the study area. The DO model indicates that, because the dams between Ohio River miles 100 and 280 do not provide much aeration without hydropower projects, significant changes in DO due to the proposed projects do not extend down the Ohio beyond the study reach. Impacts of licensed projects were included in the analysis and, in fact, the need to reconsider spill requirements at some licensed projects is identified. If new license applications are accepted for projects in the basin, the impacts of such projects will be assessed in relation to any other projects, proposed or existing, with which there would be cumulative or interactive impacts.

34. Staff has compared the competing hydropower applications at Tygart Dam, and at New Cumberland, Willow Island, and Gallipolis Locks and Dams. Staff has concluded no significant differences occur between the competing applications, either in environmental acceptability or in power generating capabilities. Staff believes the implementation of its recommended mitigative measures at the competing sites renders projects at these sites to have similar environmental effects. However, at the competing Montgomery L&D site neither of the competing proposals provide adequate mitigation to offset significant adverse environmental impacts due to hydropower development at this site.

In the event that sufficient lands are not available for construction of the recreational developments, a recreational compensation plan would need to be filed with the Commission. The plan would be developed in consultation with appropriate state and federal agencies.

If it is determined that the plans of competing applicants are equally well adapted to develop, conserve, and utilize the water resources of the region in the public interest, the Commission may issue a license for the applicant with the earliest applicant acceptance filing date [Commission Regulation 4.37(b)(2)]. However, the Commission may issue a license for the applicant with the more recent filing date if it is a municipality or state [Commission Regulation 4.37(b)(3)]. The Commission will make the final licensing decisions on the projects, including the competing projects, in the public's interest.

conservation and load management is appropriate for the present study and highly recommended by the Service. Further, the conservation and load management alternatives presently being used should be discussed in concert with all economically available alternatives.

The DEIS states that hydropower alternatives were developed to "give equal consideration to power generation and environmental quality values". Contrary to this statement, the data projecting dissolved oxygen (DO) content (Section 4 and Appendix B) clearly show degradation of water quality values with each of the four proposed hydropower alternatives. Specifically, the DO model for Alternative 3 (Project Operation to Meet Antidegradation Criterion) and Alternative 4 (Project Selected to Minimize Impacts to All Target Resources) predicts DO reductions below Willow Island Locks and Dam for some 160 river miles (see Figures 4.4.1-1, 4.4.1-2, 4.3.1-3, etc.). The Commission's recent decision (Commission Order 464) to waive Section 401 Water Quality Certification for eleven projects appears to indicate less consideration for environmental quality than hydropower development. 36

The DEIS does not support the Commission staff's decision to exclude certain projects from the cumulative impact assessment. Yet the Commission staff states in Section 3 of the DEIS that including certain projects would increase the complexity of the analysis, without contributing to an understanding of the cumulative impacts. However, the document also states that hydropower projects in the basin warrant an analysis of specific and cumulative environmental impacts and that " ... the value of the objective function at any particular site is a function of the values of the decision variables at <u>all sites upstream</u> (emphasis added)." And, "A cumulative <u>system-wide</u> (emphasis added) modeling analysis ... is required.". The DEIS also indicates that energy production and spillage required at a site are dependent on energy produced at all upstream sites (Appendix B, page 27) and that the studies indicate it may be beneficial to re-evaluate spillage at projects previously licensed on the Allegheny River (page 5-26). In view of the above, the Service cannot agree with the decision to exclude numerous basin-wide projects, and recommends the analysis be revised to include all projects which will have potential adverse cumulative effects. 37

The Service believes that the data contained in the DEIS are insufficient to demonstrate that adverse impacts will not occur to the pink mucket (<u>Lampsilis abrupta</u>), a listed endangered species. In fact, the Service believes adverse impacts to that species could occur from potential depressed DO levels resulting from the proposed hydropower projects. Additionally, the Service believes a significant reduction in numbers of finfish, as indicated, may also adversely affect the pink mucket since fish are an integral part of their life cycle requirements. 38

The endangered pink mucket occurs in the area below Gallipolis Lock and Dam and may also occur below Willow Island and Belleville Locks and Dams. Section 7(c) of the Endangered Species Act of 1973, as amended, requires the Federal agency proposing a major construction activity significantly affecting the quality of the human environment to conduct and submit an assessment to determine the effects of the proposal on listed and proposed species. The biological assessment should be completed within 180 days after the date of

35. The potential benefits of conservation and load management are well understood by the electric utilities distributing power to end-use customers and the utilities have been making a serious effort to educate their end-use customers concerning available cost-effective conservation practices. The historic and projected effects of conservation and load management on peak capacity demands and annual net energy requirements are quantified and submitted to the concerned Reliability Council by each utility in a Reliability Council area. Each Reliability Council totals these projections for its Council area and reports these totals annually in the Department of Energy Code IE-411 Report (Report). The Report covers a 10-year planning period and presents historic data for the first year and projected for the nine future years. The Report does not give these data for the individual reporting utilities but gives the totals for the entire Council area.

Load management affects peak capacity demand, but has little effect on annual net energy requirements. Conservation affects both peak demand and annual net energy requirements. As a result, the IE-411 Report gives the effect of load management on peak demand as a separate item. Since conservation affects the peak demand, this effect is accounted for in the IE-411 Report in the reported values for "internal demand" -which are reduced by conservation. Conservation also reduces annual net energy requirements and this reduction is subtracted from gross requirements to obtain the net requirements shown in the Report.

36. The dissolved oxygen model projections show some decreases in DO under each of the four hydropower alternatives; it is impossible to have any generation without some decrease in DO at dams that aerate because of the lost dam aeration. As stated in Sections 2.1.3 and 2.1.4, the DO objectives of Alternative 3 and Alternative 4 (the recommended alternative) are to allow hydropower generation without allowing decreases in DO to levels (less than 6.5 mg/L) that would affect aquatic life. Staff believes this objective gives full consideration to environmental quality, as it is designed to prevent significant decreases in water quality. In Figs. 4.3.1-3 and 4.4.1-2, showing predicted DO concentrations in the Ohio River for Alternatives 3 and 4, DO concentrations for these alternatives are shown to be slightly less than without hydropower development below about RM 200. Under the conditions used for the model analyses, DO concentrations were less than 6.5 mg/L without hydropower in these reaches, and additional spill at any of the dams would not be effective in increasing DO. The difference between the predicted DO without hydropower and under alternatives 3 and 4 below RM 200 is caused by the conservative assumption that the hydropower turbines would provide no aeration. In reality, some small increases in DO concentration will probably occur at the hydropower plants, similar to those occurring without hydropower at the submerged-outflow gated dams in these reaches, further reducing the differences in DO concentration caused by the proposed hydropower projects and those occurring without hydropower below Ohio RM 200. None of the decreases in DO concentration predicted for Alternatives 3 or 4 would significantly reduce the quality of the aquatic environment.

this letter or a time mutually agreed upon between the agency and the Service. The assessment must be completed before any construction contracts are let or begun. We do not believe that we can adequately assess the effects of proposed actions on the pink mucket without a complete assessment. When conducting a biological assessment, you should, at a minimum: 38

1. Conduct a scientifically sound on-site inspection of the area to be affected by the action. This inspection must, unless otherwise directed by the Service, include a detailed survey of the area to determine if listed or proposed species are present and whether suitable habitat exists within the area for either expanding the existing population or potential reintroduction of populations.

2. Interview recognized experts of the species at issue, including those within the Service, state conservation agencies, universities, and others who may have data not yet found in scientific literature.

3. Review literature and other scientific data to determine the species' distribution, habitat needs, and other biological requirements.

4. Review and analyze the effects of the action on the species, in terms of individuals and populations, including consideration of the cumulative effects of the action on the species and habitat.

5. Analyze alternative actions that may provide conservation measures.

6. Conduct any studies necessary to fulfill the requirements of (1) through (5) above.

7. Review any other relevant information.

After your agency has completed and reviewed the assessment, it is your responsibility to determine if the proposed action "may affect" the pink mucket. If you determine that the project "may affect" a listed species, you must request formal consultation from the appropriate field office of the Service. When you provide the biological assessment, you should include any other relevant information that assisted you in reaching your conclusion.

Your attention is also directed to Section 7(d) of the Endangered Species Act, as amended, which underscores the requirement that the Federal agency or the applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which, in effect, would deny the formulation or implementation of reasonable and prudent alternatives regarding their actions on any endangered or threatened species.

37. The quotes cited in this paragraph reflect staff's opinion that water quality and power production for the proposed new projects should be analyzed and managed as an interacting system. However, staff disagrees that the system considered should include additional projects on tributaries of the Allegheny, Monongahela, and Ohio rivers. A system-wide analysis is not the same as a watershed-wide analysis; the system considered in the EIS includes all projects (existing and those with license applications accepted) whose operation can reasonably be exected to have cumulative and interactive effects on water quality.

38. Text has been modified to include a discussion of the impacts of depressed DO levels on freshwater mussels, particularly the endangered species *Lampsilis abrupta* (= *L. orbiculata*). Additional information and evaluation of *L. abrupta* have been submitted to the USFWS to supplement the biological assessment contained in the DEIS in order to comply with Section 7(c) of the Endangered Species Act. Physical habitat issues for mussels were addressed in Section 4.1.2.2.3, and one project (Muskingum L&D No. 3) was determined by staff to cause significant adverse impacts to aquatic habitat, including habitat for mussels. Appendix I of the FEIS includes the supplemental information and analysis impacts for the four alternatives on *L. abrupta*. Staff concludes that whereas any alteration of river flow or water quality will have some affect on the mussel fauna of the Ohio River and its tributaries, selection of the preferred alternative (Alternative 4) will cause no demonstrable effect on *L. abrupta*.

Specific Comments

Section 2.3 pages 2-1 thru 2-27 Hydropower Generation Alternatives. Staff has evaluated three DO criteria: (1) those proposed by the applicants, (2) State Standards (5 mg/l), and (3) an antidegradation criterion ([illegible] mg/l). Had the Service been afforded the opportunity to participate in the scoping of the alternatives, we would have requested that evaluation of pre-project DO concentrations be made a major alternative. We do not believe that staff's recommended alternative of maintaining [illegible] mg/l of DO immediately downstream of any existing or proposed hydroelectric project will ensure protection and maintenance of downstream fish and wildlife resources. Therefore, the Service requests that the evaluation of pre-project DO concentrations be included in the revised DEIS. 39

Page 2-25. Given that there is insufficient information to allow definition of existing DO conditions, the approach several resource agencies recommended during the scoping process should have been utilized. That approach; i.e., filling the DO data gaps prior to licensing, would eliminate many unknowns regarding basin wide hydro development. If it is not prudent to rely on unproven technology to maintain water quality, then it certainly is not prudent to rely on inadequate data to develop models to determine "existing conditions" and to project future conditions. 40

Page 2-30. The Service does not agree that potential fish passage mortality can be considered a moderate or minor impact. Previously, staff stated (see Section 4.1.2.3) that (1) the results of existing turbine mortality studies are highly varied; (2) all entrainment studies completed in the basin are incomplete and inconclusive; (3) a firm basis for making mortality estimates awaits better results; and (4) much more work must be done before a fish protective device can be selected. An analysis of existing data does not lead one to the conclusion of minor or moderate impact. 41

Page 3-20, paragraph 2. In addition to federally listed species, one fish species is being studied for possible future listing. The blue sucker (*Cycleptus elongatus*), known from the mainstem of the Ohio River in the immediate study area is classified by the Service as Category 2. Category 2 comprises taxa for which information now in possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules. (Reference Federal Register, Vol. 51, No. 106, Rules and Regulations, page 19941, third column, 4th paragraph.) 42

Page 3-20, 3.1.6.2. State Listing. Species list, paragraph 3. The smallmouth buffalo (*Ictiobus bubalus*) and the black redhorse (*Moxostoma duquesnei*) have been removed from the special concern category.

Page 3-20, 3.1.6.2. State Listing, Mollusks. Ohio Species List, paragraph 6. Add the butterfly (*Ellipsaria lineolata*).

39. The Department of Interior (DOI) and several other agencies have requested that the FEIS include an alternative that would require maintenance of "preproject DO conditions", in accordance with anti-degradation policies for water quality. This request was made by DOI in scoping meetings and was considered in preparing the EIS (see Section 2.1.3). Staff believes that (1) DOI and other agencies have not recognized significant technical problems that arise in determining what "preproject conditions" are; and (2) requirements for strict maintenance of preproject DO concentrations would prohibit power generation, without resulting in significant water quality benefits during times when DO concentrations are not low enough to affect aquatic organisms.

At dams that aerate well, any amount of hydropower generation (with its necessary decrease in spill flows) would reduce DO concentrations downstream when DO deficits occur. Strict maintenance of "preproject conditions" would prohibit hydropower generation at such dams. DOI and the states apparently are requesting that some level of spill flows or mechanical aeration be implemented that would allow power generation without decreasing DO concentrations. Staff's water quality and economic analyses indicate that requiring rates of either spill flow or mechanical aeration (if mechanical aeration is shown effective) high enough to reproduce existing aeration rates year-round would make projects at dams that aerate well infeasible.

DO concentrations at any point vary continuously over a wide range with concentrations being controlled by temperature, waste loadings, river flows, and biological processes. There is no single set of preproject DO concentrations for the system. Staff did evaluate preproject DO conditions for the DEIS in the following ways: (1) historic DO and temperature frequency distributions are presented for the ORSANCO electronic monitors, the only locations where DO measurements are extensive enough to do so; (2) DO concentrations measured by the Corps during typically poor water quality conditions are presented; (3) parameters that mathematically describe the dam aeration available under existing conditions are presented; and (4) in all the modeling analyses, DO concentrations without the proposed hydropower projects are presented for comparison to concentrations with the projects (including model analyses based on monthly mean conditions presented in Appendix B).

DOI and other agencies request that DO concentrations be monitored for one or two years at each proposed hydropower site to define "existing conditions." One or two years of DO measurements are not adequate to define baseline conditions. For example, DO measurements made in the summers of 1987 and 1988, as recommended by several agencies, represent unusually low DO conditions and if used as a baseline could result in significant degradation. In addition, the experience of project applicants that attempted to monitor DO at their sites indicated that frequent gaps in monitoring data must be expected and that the monitors tend to underestimate DO concentrations. Staff believes that having applicants monitor DO for one or two years would not provide information adequate to base spill flow requirements on, and would be an unjustified burden on license applicants.

DOI and other agencies have not defined what is meant by "preproje... or "existing conditions", or how these conditions would be determined from measured DO data for application to anti-degradation criteria. Staff does not believe it is justifiable to require collection of data that (1) will contain gaps and errors due to monitoring problems, (2) will not define the historic range of conditions adequately, and (3) will be used to determine DO criteria when the methods used for such a determination have not been specified and may not take into account effects on either aquatic organisms or generating capacity.

Staff believes that it is more prudent as well as more practical to maintain a specific DO criteria, based on the best available scientific research and selected to avoid impacts to fish, than to try to maintain undefined and poorly measured "existing conditions". This approach is especially appropriate in rivers whose water quality is as highly affected by development as are the Allegheny, Monongahela, Muskingum, and Ohio rivers. Staff believes that much more success will be had in implementing a relatively simple DO management objective (maintaining concentrations of at least 6.5 mg/L) than in attempting to implement DOI's proposed anti-degradation policy on rivers whose water quality is already heavily affected by man. The cumulative nature of hydropower impacts on DO would make implementation of anti-degradation DO criteria that vary between sites and seasons extremely complex and difficult to enforce.

Requiring no degradation of DO could essentially preclude development at dams that currently are important aerators. At such dams, the only ways to strictly maintain existing aeration rates are to either spill all the water or to aerate mechanically. Mechanical aeration is expensive and could make projects economically infeasible if required continuously. During much of the year hydropower can be generated without causing DO concentrations low enough to affect aquatic life, even though some decreases in aeration would occur. (The model analyses based on monthly mean conditions presented in Appendix B, Figs. B-9 through B-17, show how the projects as proposed would decrease DO concentrations in spring and fall without causing concentrations low enough to be of concern for aquatic life.) This hydropower would be used to displace power currently generated by other sources, mainly coal-fired and nuclear plants, that cause significant environmental impacts.

West Virginia, the only state whose comment letter implied they had antidegradation regulations that apply to the waters considered in the EIS, has designated the Monongahela and Ohio rivers as "high quality waters". West Virginia's water quality regulations (46 CSR Section 46-1-4.1.e) states that such designated high quality waters "must be maintained at their existing high quality unless it is determined after opportunity for public comment and hearing that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. If limited degradation is allowed, it shall not result in injury or interference with existing stream water uses or in violation of State or Federal water quality criteria that describe the base levels necessary to sustain the national water quality goal uses of protection and propagation of fish, shellfish and wildlife and recreating in and on the water." Staff believes that the environmental and economic benefits of hydropower development (as recommended by staff) that would not cause violations of the State criteria would justify the limited degradation allowed in this regulation.

To assure that hydropower projects do not cause significant impacts due to low DO concentrations, staff has recommended that DO concentrations upstream and downstream of each project (recommendation 4, Section 5.4.2.1) be monitored and the data provided electronically to ORSANCO, and that water quality management agencies and FERC be authorized to require increased spill flows during low DO events (recommendation 2, Section 5.4.2.1). In addition, formation of a basin-wide group to monitor and manage DO at the projects is also recommended (recommendation 7, Section 5.4.2.1). Staff feels these recommendations (1) will fully protect the aquatic environment, (2) are practical to implement, and (3) will allow generation of significant amounts of power.

The staff's recommended alternative is not to maintain 6.5 mg/L of DO immediately downstream of hydropower projects, as stated in this comment. The recommendation (Sections 2.1.4 and 5.4.2.1) is to operate the projects in such a way that they would not cause DO concentrations to fall below 6.5 mg/L, anywhere in the rivers where DO concentrations are affected by the projects.

40. The staff does not believe that collection of one or two years of DO measurements at each dam would describe the so-called existing DO conditions, due to the high variability in DO concentrations and the problems and errors that can be expected in monitoring DO (see response to comment #39). Instead, the staff chose to measure the existing aeration rates at each dam, which were used in models to quantify the effects of hydropower.

41. Staff has determined that hydropower development at the Montgomery site would result in a predicted high level of susceptibility to entrainment of fishes traversing the embayment mouth. At other hydropower sites the relative degree of impact is predicted to be minor or moderate, and mitigation plans for fish protection can be established accordingly.

42. Text has been modified to correct these lists.

Page 3-21/22, Table [illegible]. The list only indicates that certain states are concerned about certain species, whereas federally protected species are a concern of all the states and should be so noted. The federally listed species are:

Indiana myotis	Myotis sodalis
Ohio (pink) mucket	Lampsilis abrupta
Peregrine falcon	Falco peregrinus

In addition, the following species have been designated as candidate species and classified Category 2. Reference our comments on page 3-20, paragraph [illegible]. Those species from the list include:

Bewick's wren	Thryomanes bewickii
Eastern woodrat	Neotoma magister
New England cottontail	Sylvilagus transitionalis
Salamander shell	Simpsonaias ambigua

Page 3-67, Fisheries. This section should include a discussion of potential water quality (i.e., DO) degradation on shellfish. In Imlay's (1971) experiments, all species examined required 6 ppm of DO for normal growth. 43

43. See response to comment #38.

Section 4. Environmental Consequences. Paragraphs 4.1.2, 4.2.2, and 4.3.2 should all contain an assessment of the potential impact of DO change on shellfish.

Page 4-4, paragraph 4. DO depletion is probably the most significant issue dealt with in the DEIS. The DO model was designed to predict both existing and post-project DO concentrations. Considerable effort was obviously expended in its development and the subsequent analysis. The baseline data are, therefore, of paramount importance. As such, the unpublished data upon which the model was based should be provided in the revised draft. The value of the model and predictions must be questioned if they were based on limited field data, such as the number of observations reported on page B-7, Table B-1. 44

44. The dam aeration measurements used in the model are presented in Appendix B of the FEIS. Staff believes the field measurements used to develop the aeration models are sufficient. The uncertainty analysis which is presented in Appendix B shows that the model uncertainty resulting from variability in the dam aeration measurements is less than the uncertainty in other parameters controlling DO concentrations, and that uncertainty is least in reaches where DO is controlled by dam aeration. These results indicate that the dam aeration models developed from the field data are of acceptable precision.

Page 4-1, Assessment Methods. DO measurements were determined at a number of different flow rates and temperatures. Subsequently, dam-aeration constants (b) and dam-aeration coefficients (M) were developed via statistical analysis. The DEIS does not, however, indicate how many measurements were made at each flow level and/or whether the data used are representative of existing conditions. The DO data analyzed should be provided in table form so reviewers can make a reasoned decision as to its applicability. The scientific validity of model predictions of future conditions with or without the proposed developments should be verified by water quality experts in state and federal environmental agencies. 45

45. The dam aeration measurements used in the model are presented in Appendix B of the FEIS. The modeling methods were presented to water quality experts from the Corps and ORSANCO at a meeting in Cincinnati, Ohio, on January 21, 1988 and have also been reviewed by state agencies as part of their review of the DEIS.

Figure B-8 shows there were no data to calibrate the DO model between Ohio River miles 140 and 250 and that only two data points exist below Ohio River mile 250. Without reliable and adequate calibration data we further question 46

46. The model was calibrated to the most appropriate data available. Staff does not believe that the lack of calibration data below RM 140 is a serious problem. Below RM 140, the proposed hydropower projects occur at submerged-discharge gated dams that provide little aeration and where hydropower projects would have little effect on DO concentrations; this fact is adequately demonstrated by the field data.

the model's validity, particularly for all points below Ohio River mile 140. Further, the projection that locks and dams below Ohio River mile 140 do not provide significant aeration must be suspect; again limited field data exist.

It is unclear which of the competing applications were used to develop the DO model. As significant variations in size and operating mode occur, we must presume the project's impacts on DO would vary. If generic hydropower proposals were used in the model, then it would seem a simple matter to include all hydropower sites in the basin in the cumulative assessment. 47

Page 4-20, paragraph 4. No information is presently available regarding the direction or timing of fish movements in the Ohio River and its major tributaries. However, available literature indicates that resident migratory species move downstream frequently. In fact, downstream migrations of walleye from Tygart Dam are most likely responsible for the establishment of walleye populations in the upper portions of the Monongahela River. 48

Page 4-25, paragraphs 3 and 4. The staff states that existing entrainment field studies are incomplete and inconclusive and much more development work must be completed before fish protective or guidance devices can be selected. As such, licensing of any projects within the Ohio basin, in advance of the completion of studies necessary to determine impacts to fish and wildlife resources, would violate provisions of the Federal Power Act (Yakima et al. v. FERC). 49

Page 4-25, Vulnerability to Entrainment. No information is available which indicates fish would select a non-hazardous downstream route instead of a hazardous one. Fish normally follow current patterns unless habitat and cover exhibit significant influences. In the case of lock and dam hydropower development, habitat and cover and current patterns will all increase the likelihood of entrainment. While passage alternatives may be available, the majority of downstream migrants are expected to pass through the units unless the greatest percentage of river flow is through the dam gates. 50

Page 4-28, paragraph 1. While the statement is very qualitative, the Service has not seen any data regarding gamefish movements through locks and dams. The analysis done by Simmons (1987) indicates significant downstream movements for centrarchids and catfishes. Given the staff conclusion that the studies at Racine are highly debatable and inconclusive, the postulation that only small numbers of gamefish are entrained and that those numbers are most likely insignificant is questionable. 51

Page 4-30, paragraph 6. The Service agrees with the staff conclusion that damage to gamefish from turbine passage will be greater than ten percent and that the loss could be significant. 52

Page 4-32, Fish Diversion and Protection Devices. Staff has determined there is " ... little experience with species most affected by entrainment ... "; that "No applicant has carried design plans to sufficient detail to evaluate their proposal fully ... "; and that " ... more work at developing and 53

47. In the model calibration and analyses, the competing applicants that would have the most impact on DO concentrations (i.e. the lowest proposed spill flow) were included.

48. Although no information on direction and timing of fish movements has been collected on the Ohio River or major tributaries, the DEIS made extensive use of similar information gathered for relevant species in the Mississippi River (Holland et al. 1984; Normandeau Associates, Inc. 1986; Sections 3.2.3 and 4.1.2.3.1). Interpool movements of walleye and channel catfish in those reports have been highlighted in the EIS. The amount of movements of other species was summarized. Downstream movements of walleye at Tygart Dam that are important for populating the downstream river reaches are discussed in Section 3.4.3.2.

49. Staff does not agree that its extensive treatment of the entrainment issue violates provisions of the Federal Power Act as interpreted specifically by the Yakima et al. v. FERC decision and the National Environmental Policy Act as interpreted by the LaFlamme v. FERC decision.

Staff has considered the issue of entrainment at length in Section 4.1.2.3. It has followed Council on Environmental Quality (CEQ) guidelines (40 CFR Parts 1500-1508, par. 1502.22) concerning incomplete or unavailable information. A workshop of agency staffs and noted experts was held to bring to light all pertinent information that is currently available. Relevant studies nationwide and in the Ohio River basin were summarized in the DEIS. Discrete aspects of the entrainment issue were treated, including summaries of vulnerability of fishes to entrainment (Section 4.1.2.3.1), damages to entrained fish (Section 4.1.2.3.2), and fish diversion and protection devices available for mitigating damages (Section 4.1.2.3.3). Staff analyzed what is known and identified in the DEIS the deficiencies in available information. Staff judged that all information that would be desirable for making a reasoned choice among alternatives cannot be obtained at reasonable cost.

Staff used the extensive, but still incomplete, body of "existing credible scientific evidence which is relevant to evaluating the reasonable forseeable significant adverse impacts on the human environment," to reach its conclusions. Conclusions were presented in the DEIS regarding the severity of risk to fish and what might be done to reduce and/or compensate for that risk. Because experience has shown entrainment to be highly site-specific, staff has recommended a sequential mitigation process that included some activities after licensing: (1) monitoring of entrainment (i.e., measuring the actual entrainment after operation has begun), (2) compensation to the resource agency for measured losses until appropriate site-specific mitigation can be designed and installed, (3) a basin-wide cooperative effort to develop and test at selected operating sites a series of prototype bioengineering facilities for fish protection and/or guidance that have not yet been shown to be effective in the Ohio River basin, and (4) reevaluation of alternative mitigation approaches that could include installation of fish protection or guidance devices demonstrated to be effective, continued compensation, or other appropriate mitigation schemes.

Participation of licensees in this sequential mitigation process, to be overseen by FERC and coordinated with resource agencies, would be assured by license article. Aspects of this analysis and mitigation framework in the DEIS that may have been misinterpreted or are in need of clarification have been addressed in the FEIS.

50. Comment noted. Section 4.1.2.3 of the DEIS indicated that the route of passage may approximate the division of flows between turbine and gates. Additional clarification regarding cover and flow effects has been added to Section 4.1.2.3.1 on vulnerability to entrainment.

51. Section 3.2.3 of the DEIS discussed movements of specific gamefish species at navigation dams on the Mississippi River as summarized by Holland et al. (1984) and Normandeau Associates, Inc. (1986). Walleye and channel catfish were frequently oberved moving between pools. There was no movement of smallmouth bass or largemouth bass. About 20 percent of tagged sauger showed interpool movements. These are the same species found in the Ohio River basin. Text has been modified to remove the conclusion regarding significance of Racine gamefish entrainment from this section.

52. Comment noted.

53. See response to comment #49.

evaluating experimental prototypes will be necessary.". We must, therefore, conclude that licensing of basin projects would be at odds with provisions of the Federal Power Act (Yakima et al. v. FERC, and, LeFlamme v. FERC).

Page 4-33, paragraph 3. Compensation is the least preferred approach to 54
mitigate adverse impacts such as fish passage mortality. Compensation means full replacement of project-induced losses with resources of equivalent biological value. If used, compensation must remain the responsibility of the licensee to implement and maintain during the project life. The Service will only endorse a compensation plan that (1) demonstrates compliance with the sequential mitigation process; (2) provides for full replacement; (3) will be incorporated as an enforceable license condition; and (4) assures that mitigative measures are the responsibility of the licensee.

As turbine induced mortality has not yet been defined, a properly designed and conducted study is essential prior to developing a mitigation plan. Without an adequate impact evaluation, the adequacy and effectiveness of mitigation will remain undetermined.

Page 4-47, Section 4.1.3.3. Loss of recreational fishing opportunities during 55
concurrent construction of basin projects is identified as an impact for which mitigation has not yet been resolved. Resolution of this issue should be achieved prior to licensing and after consultation with the Service and state wildlife agencies.

Page 4-49, Section 4.1.3.6. This section identified numerous significant 56
adverse impacts to water quality and finfish should projects be licensed as originally proposed. Based on the data previously submitted, the Service concurs that these impacts must be avoided; clearly, licensing as originally proposed would be environmentally unacceptable.

Page 4-62, Section 4.1.6.2. Endangered/Threatened Species, paragraph 1. It 57
should be added that any habitat disturbance below Willow Island Lock and Dam, Belleville Lock and Dam, and Gallipolis Lock and Dam will also require additional consultation with the Service in accordance with Section 7 of the Endangered Species Act. Reference our letter dated September 28, 1987 and the DEIS, pages 3-19 and 3-20.

Page 4-71, Section 4.1.6.6. A response to the previous Departmental and state 58
wildlife agency recommendations to utilize clean rock spoil to construct fishery habitat structures should be provided. Implementation of that recommendation would offset project impacts to fishery habitat and recreational use while likely reducing developers spoil-disposal costs.

Page 4-87, Section 4.7. Departmental comments provided pursuant to the 59
National Environmental Policy Act do not represent comments pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661, et seq.) or Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). Comments under Section 2(b) of the Fish and Wildlife Coordination Act will be provided when draft licenses, including site-specific articles, are provided for each project.

54. The development of compensation plans is recommended by staff for inclusion in any licenses issued for the projects. Staff recognizes that there is no universal agreement among resource agencies that compensation is "the least preferred approach" to mitigate adverse impacts of fish passage mortality. The WVDNR has "contended for some time that adequate monetary compensation of state resource agencies may be the only equitable solution to entrainment mortality problems" (see response to comment #154). Staff outlines a sequential mitigation process (see response to comment #49) in which compensation plays a role in two ways: (1) as interim mitigation while prototypes of engineering schemes for protecting fish from entrainment damages are tested, and (2) as an option for consideration should fish protection devices be shown to be infeasible and other alternative mitigation measures must be chosen. It will be necessary for the licensee and the resource agencies to develop appropriate compensation that amounts to "full replacement for measured losses." This agreement is recommended as part of the FERC license and would be a responsibility of the licensee. A further elaboration of the compensation alternative has been added to Section 4.1.2.3.4.

55. The provision of temporary fishing access facilities during construction is identified as a means of mitigating the loss of recreational fishing during concurrent construction. Recommendation 5 of Section 5.4.2.3 specifies that developers file a plan for providing temporary fishing access facilities with the Commission after consulting with the appropriate state and Federal agencies.

56. Comment noted.

57. Text has been modified to include all of the sites referenced.

58. Staff agrees that the utilization of clean rock spoil to construct fishery habitat structures could offset project impacts to recreational use. The provision of reefs and/or other fishery habitat structures is specified as part of the standard level of recreational development in recommendation 1 of Section 5.4.2.3.

59. Comment noted. The statement concerning agency comments to be provided when draft licenses are provided for each project is unclear. The Commission does not issue draft licenses.

Page 4-67, Section 4.7, Relationships to Laws and Policies, paragraph 4. A copy of the DEIS does not constitute consultation under Section 7 of the Endangered Species Act. The consultation process is separate and has not yet been requested by the Commission. Reference our General Comments. 60

Further, the DEIS lacks adequate information (site-specific location, design measures to minimize harm) for a full understanding of how the Section 10 and 404 permits from Corps of Engineers or possible Section 402 NPDES permits, affect fish and wildlife resources. Accordingly, our comments do not preclude separate evaluation and comments by the Department when reviewing the permit applications. The Department may concur, with or without stipulations, or recommend denial depending on effects to fish and wildlife resources.

When appropriate site-specific information is available, the Service would be pleased to coordinate with the Commission and/or licensees to preclude delay and to insure that any permit stipulations or conditions are understood and included in the revised draft and final statement.

60. Comment noted. See response to comment #38 regarding endangered species consultation. The text has been amended to include a description of Section 10 and 404 permits required by the Corps pertaining to the placement of dredge or fill materials in waters of the United States. Licensees, for any license issued, would be required to obtain these permits prior to the start of hydropower construction. Staff does not know what the specific stipulations or conditions attached to these permits are and, therefore, cannot include them in the FEIS.

Page 5-8, paragraph 2. While mitigation could reduce impacts of concurrent construction to recreational fishing, site specific mitigative measures are not identified. The National Environmental Policy Act requires documentation to explain exactly how measures will mitigate project impacts (Jones v. Gordon). 61

61. Recommendation 5 of Section 5.4.2.3 discusses specific measures for mitigating the impacts of concurrent construction to recreational fishing.

Page 5-16, Section 5.1.4. Given that "fish mortality concerns" are not resolved by licensing under any of the alternatives considered, license issuance prior to resolution of those issues would appear to violate provisions of the Federal Power Act (Yakima et al v. FERC) and National Environmental Policy Act (LaFlamme v. FERC). 62

62. See response to comment #49.

Page 5-23, paragraph 2. The Service feels that there are significant differences between competing license applications and refers staff to project specific Departmental letters regarding the proposed "Hannibal, New Cumberland, Willow Island, and Gallipolis projects. 63

63. See response to comment #34.

Page 5-25, Basin-wide Recommendations. Prior Departmental and Service recommendations requested that the Service be identified as a coordinating agency in license articles dealing with fish, wildlife, and public uses thereof; as well as with spoil disposal, water quality, and mitigation of project related effects. In accordance with provisions of the National Environmental Policy Act, Fish and Wildlife Coordination Act, Federal Power Act, and the Electric Consumers Protection Act, the Service and appropriate state wildlife agencies must be specifically identified in each such article. The Council on Environmental Quality Regulations for Implementing the National Environmental Policy Act list the Service as having jurisdiction by law and/or special expertise on these issues. 64

64. Comment noted. The U.S. Fish and Wildlife Service has been identified as a coordinating agency, as appropriate, in many of the recommendations identified in Section 5. The text has been changed to also include the U.S. Fish and Wildlife Service as a coordinating agency in the following recommendations: Section 5.4.2.1, items 4, 5, and 8; Section 5.4.2.5, item 6.

Page 5-27, Item 3. Although monitoring fish populations may provide some insight into long-term impacts, an indirect approach is expected to be much less successful than a direct one. Numerous variables affect the results of even direct sampling and analysis methodologies. Indirect approaches would add or confound many variables, such as catch, harvest, recruitment rates, 65

65. Direct measurement of fish entrained and damaged during entrainment at representative sites is identified under recommendation 4 of Section 5.4.2.2. Staff believes that such measurement could be accomplished sufficiently accurately at a representative set of sites rather than at each site. Staff notes that confusion could arise between two forms of "monitoring" discussed in the DEIS: (1) measurement of entrainment rates and damages (recommendation 4), and (2) measurement of combined impacts from all sources on populations (recommendation 3). Staff concurs that the variables mentioned in the comment are sufficient to make direct comparisons of population success with entrainment nearly impossible. The broader form of monitoring, however, is useful for assessment of the overall state of fish populations and can be the trigger for implementing more specific monitoring studies if problems are shown.

weather, river condition, water quality, habitat, emigration, immigration, etc. A direct approach must be developed if successful turbine mortality studies are to be completed.

Page 5-27, Item 4, and Page 5-28, Item 5. The proposals for the agencies and some 15 applicants to develop joint plans to study fish entrainment, turbine-induced mortality, and to develop a bioengineering test facility, are commendable. However, the Service is concerned that coordination, administration, and implementation of such large scale undertakings, with as yet undefined financing and leadership, would result in an unworkable proposal. If the Commission elects to pursue this endeavor, then one party, to represent all applicants, should be appointed and the Commission should assess equitable fees to each developer to fund the effort. The Service also recommends the work be contracted through an independent organization. Further, reliance on post-licensing studies to determine the impacts and to develop adequate mitigation measures appears to violate the National Environmental Policy Act, which requires consideration of environmental impacts before licensing decisions are made (LaFlamme v. FERC). 66

Page 5-29, Section 5.4.2.5, 1. Endangered and Threatened Species. Developers at Willow Island Lock and Dam must also consult with the Service and the state resource agencies. Reference our letter dated September 28, 1987 and the DEIS, pages 3-19 and 3-20. 67

Page B-2, Section B.7.1.1.1. Data and figures showing the number of DO samples taken at each river flow, by location, date, time, temperature and climatic conditions are needed to enable reviewers to place the model into perspective with existing conditions. 68

Page B-3, paragraph 6 and Table B-1. The statement that dams with lower aeration coefficients "M" and more negative values of "b" aerate better, is inconsistent with text in Section 4 and Table 4.1.1.1. 69

Page B-16, Figure B-8, and associated text. The DEIS should explain why the model predicts DO reductions of 0.7 mg/l between Ohio River mile 160 and 240 but no reduction for the 40 miles below Racine Dam; and a DO increase below Gallipolis Dam, despite the fact that Gallipolis is reported to be a poor aerator. Further, since both actual data and model predictions (see Figure B-8, 4.1.1-4, and 4.1.2-3) show a DO surge at Gallipolis, why is Gallipolis said to be a poor aerator? 70

It should also be noted that Racine apparently adds no significant DO surge. (As a licensed project, Racine was not included in the cumulative analysis.) Inclusion of Racine may have meant recommendations for spill flows which would significantly improve DO in the lower river. 71

Page B-27, paragraph 2. See our General Comments regarding inclusion of all Basin projects in the cumulative assessment.

66. Staff recognizes the need for detailed arrangements for cooperative efforts by developers. The proper time for establishing such details is in the postlicensing consultation process. The suggestions of the USFWS are appreciated. See response to comment #49 in reference to LaFlamme v. FERC.

67. Comment noted. Text modified.

68. Text has been modified in Appendix B to include tables showing the dam aeration data used in the model, including flow and temperature (as available).

69. The dam aeration equation in Appendix B is slightly different than the one in Section 4.1.1.1; the sign of the constant b has been changed in Section 4.1.1.1 so that the value of b reflects the amount of supersaturation at a dam. The equations and parameter values are consistent and correct within each section.

70. Below Pike Island dam, dam aeration has little effect on DO because the remaining dams are poor aerators. Without dam aeration, DO is provided to the river through aeration at the water surface, which increases as the DO concentration decreases. What the model is predicting below RM 240 is that DO concentrations have decreased to the point where the amount of oxygen added by water surface aeration equals the amount removed by BOD decay.

The field data show that Gallipolis dam is a slightly better aerator than Racine, Belleville, Willow Island, or Hannibal dams. However, the amount of DO predicted to be provided by Gallipolis is minor. There may be some confusion caused by Figure B-8 (showing calibration of the Ohio River model), which indicates an increase in measured DO concentrations between the two stations (ORSANCO electronic monitors) at river miles 260 and 279. These two measured data points are above and below the mouth of the Kanawha River, not above and below Gallipolis dam, so they do not measure aeration at Gallipolis.

71. In all the model analyses, Racine and the other licensed hydropower projects were assumed to be in operation. Racine, having no required spill flow, was assumed to provide no aeration. Racine dam is structurally very similar to Belleville dam, with a deeply submerged discharge. Spill flows at Racine would not significantly increase DO concentrations.

Summary Comments

The Service does not believe the DEIS provides adequate coverage of the following issues which were identified in the scoping process as issues of primary concern: water quality, endangered species, hydraulics, altered-flow patterns, flow modifications, turbine-induced fish mortality, recreational fishing and dredge spoil disposal. 72

The DEIS does not provide adequate recommendations or articles to protect fish and wildlife resources or the public use thereof. Yet, staff proposes that our comments on the DEIS will be the most current set of comments under the Fish and Wildlife Coordination Act and that their response in the FEIS will constitute issue resolution under 10(j) of the Electric Consumers Protection Act. 73

No indication is given as to which competing applications will be licensed. Conservation and load management was not adequately addressed as a project alternative. Also, the Commission claims to have complied with the Section 7 consultation process of the Endangered Species Act, by providing the Service with a review copy of the DEIS. This does not constitute consultation. Further, the Service does not concur with staff recommendations to postpone resolution of the issues regarding fish turbine mortality and fish passage until the post-licensing phase. 74

Because of these concerns and the exclusion of numerous basin projects from the analysis, the Service requests that the DEIS be revised to address the fish and wildlife related problems previously discussed and then recirculated for review and comment. 75

Unless these issues are adequately resolved, we may request that the Department refer this project to the Council on Environmental Quality under Section 1504 of the Council's Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. However, we wish to coordinate fully at the earliest possible time because a solution to our concerns can be implemented with a minimum of delay and could preclude the necessity for referral. Coordination can be initiated by contacting me at this address. 76

Thank you for the opportunity to comment.

Sincerely,

Charles J. Kulp
Supervisor

Enclosures

72. Your opinion is noted. Staff believes the EIS does assess the environmental impacts of the proposed projects for these issues, determines the significance of the impacts, and where possible, makes recommendations that would reduce significant adverse impacts to an acceptable level in the study area. Staff assessed all available information and used their best professional judgement to resolve any areas where there was conflict in existing information.

73. See responses to comments #31 and #72.

74. See responses to comments #34, #35, #38, and #49.

75. Your opinion is noted.

76. Your opinion is noted.

Literature Cited

Imlay, M. J. 1971. Bioassay tests with naiads. In Jorgensen and Sharp (1971, pp 31-41).

Simmons, L. L. 1987. Fish entrainment studies for the Millville Hydro Station, FERC Project # 2343, report from Energy and Environmental Management, Inc., to the Potomac Edison Company.

U.S. Department of Energy. 1980. Draft. A study of alternatives to the Davis (West Virginia) pumped storage project. Volumes I, II, and III. Printed under contract by ICF, Inc., and ESEI, Inc. U.S. Government Printing Office, Washington, D. C.

ADDITIONAL PROJECTS TO BE INCLUDED IN THE CUMULATIVE IMPACT ASSESSMENT OF THE OHIO RIVER BASIN

Allegheny River Subbasin (Pennsylvania)

Allegheny River Lock and Dam No. 5 Project (FERC No. 3671)*
Allegheny River Lock and Dam No. 6 Project (FERC No. 3494)
Allegheny River Lock and Dam No. 8 Project (FERC No. 3021)
Allegheny River Lock and Dam No. 9 Project (FERC No. 3021)
Piney Project/Clarion River (FERC No. 309)
East Branch Project/Clarion River (FERC No. 3292)
Loyalhanna Project/Kiskiminetas River (FERC No. 7580 et al.)
Conemaugh Project/Kiskiminetas River (FERC No. 3207)
Kinzua Project/Allegheny River (FERC No. 2206)

Monongahela River Subbasin (Maryland, West Virginia and Pennsylvania)

Monongahela River Lock and Dam No. 2 Project (FERC No. 3973 et al.)
Monongahela River Lock and Dam No. 3 Project (FERC No. 3752 et al.)
Morgantown Lock and Dam Project (FERC No. 9949)
Lake Lynn Project/Cheat River (FERC No. 2459)
Deep Creek Lake Project/Youghiogheny River (FERC No. 2370)
Youghiogheny Dam Project/Youghiogheny (FERC No. 3623)

Beaver River Subbasin (Ohio and Pennsylvania)

Townsend Project/Beaver River (FERC No. 3451)
Patterson Project/Beaver River (FERC No. 3519)
Eastvale Project/Beaver River (FERC No. 3450)
Shenango Project/Shenango River (FERC No. 4142 et al.)
Pymatuning Project/Shenango River (FERC No. 9390 et al.)
Lake Arthur/Muddy Creek
Ellwood City Project/Connoquenessing Creek (FERC No. 7293)
Mosquito Lake Project/Mosquito Creek/Ohio
Berlin Lake Project/Mahoning River/Ohio
M.J. Kirwan Project/Mahoning River/Ohio
Milton Lake Project/Mahoning River/Ohio (FERC No. 9972)
Meander Reservoir Project/Meander Creek/Ohio

Muskingum River Subbasin (Ohio)

Devola Lock and Dam No. 2 (FERC No. 7751)
Muskingum Lock and Dam No. 3 (FERC No. 6998)
Beverly Lock and Dam No. 4 (FERC No. 7234)
Luke Chute Lock and Dam No. 5 (FERC No 7261)
Stockport Lock and Dam No. 6 (FERC No. 7759)
McConnelsville Lock and Dam No. 7 (FERC No. 7262)
Rockeby Lock and Dam No. 8 (FERC No. 7222)
Philo Lock and Dam No. 9. (FERC No. 7221)
Muskingum Lock and Dam No. 10 (FERC No. 6563)

Ellis Lock and Dam No. 11 (FERC No. 7220)
Dillon Lake (FERC No. 8268)
Milton Dam (FERC No. 9972)
Pleasant Hill (FERC No. 8270)
Wills Creek (FERC No. 8269)

Kanawha River Subbasin (Virginia and West Virginia)

Winfield Lock and Dam Project (FERC No. 1290)
Marmet Lock and Dam Project (FERC No. 1175)
London Lock and Dam Project (FERC No. 1175)
Sutton Project Elk River/ (FERC No. 7344)
Summersville Project/Gauley River (FERC No. 10226)
Claytor Lake Project, (FERC 739)

Tippecanoe River Subbasin (Indiana)

Lake Shaefer Project
Lake Freeman Project

Ohio River Mainstem (Pennsylvania, Ohio, West Virginia, Indiana, and Illinois

Hannibal Locks and Dam Project (FERC No. 3206)
Racine Locks and Dam Project (FERC No. 2570)
Greenup Lock and Dam Project (FERC No. 2614)
Capt. Anthony Meldahl Locks and Dam Project (FERC No. 2739)
Markland Locks and Dam Project (FERC No. 2211)
McAlpine Locks and Dam Project (FERC No. 289)
Cannelton Locks and Dam Project
Newburgh Locks and Dam Project
Uniontown Locks and Dam Project
Smithland Locks and Dam Project (FERC No. 6641)
Locks and Dam No. 52 Project
Locks and Dam No. 53 Project

*Where known the FERC No. has been included.

United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
WASHINGTON, D.C. 20240

ER 88/419

AUG 1 1989

Ms. Lois D. Cashell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

Dear Ms. Cashell:

The Department of the Interior has completed its review of your draft environmental impact statement for Hydroelectric Development in the Upper Ohio River Basin, Ohio, Pennsylvania, and West Virginia. We have the following comments and recommendations on the document. Specific comments are enclosed as a separate document.

FISH AND WILDLIFE COORDINATION ACT AND SECTION 10(j) ISSUES

77 It is our understanding that FERC intends to have the final environmental statement serve as a licensing document. In this context, FERC has stated (on page 4-87) that Departmental comments filed pursuant to the National Environmental Policy Act (NEPA) will be considered by FERC to be the most current recommendations filed pursuant to the Fish and Wildlife Coordination Act (FWCA). Departmental comments on a particular impact statement are provided pursuant to NEPA and do not represent comments pursuant to FWCA or Section 7 of the Endangered Species Act (ESA). Comments under Section 2(b) of FWCA are provided when draft applications are made available for each project. Comments under Section 7 of ESA are provided when FERC initiates the consultation process.

FERC also states on page 4-87 that its response to our comments on this environmental statement will be used as a mechanism to comply with Section 10(j) of the Federal Power Act (FPA). In our opinion, a response to comments on a general environmental statement covering numerous projects does not constitute issue resolution under Section 10(j) since there is insufficient information to determine whether the staff's recommendations are consistent with those of the FWS. Furthermore, this does not reflect the spirit of the FPA since FERC's action may limit future opportunities to resolve issues on individual licensing actions.

We believe that all comments made during the licensing process of any project should be part of the administrative record for that project and there should be dialogue between parties at any time if conflicts arise. If FERC intends to use these environmental documents as part of the Section 10(j) process, then 10(j) discussions should be presented in a separate section that contains specific recommendations for each project, a detailed discussion of any disagreements with the FWS, and adequate documentation of the FERC staff's position.

77. See response to comment #31.

CUMULATIVE IMPACT ANALYSIS

78 On June 29, 1987, the FWS commented on FERC's notice of intent to prepare an environmental impact statement on the potential cumulative impacts of hydroelectric projects in the Ohio River Basin. At that time, FWS concurred with FERC's decision to prepare such an impact statement; however, concern was expressed about which projects were to be included. Since that time FWS has maintained the position that FERC's proposal to examine the potential cumulative impacts of 34 projects (with pending pre-license action at 19 sites) does not and cannot adequately address the potential cumulative adverse impacts of hydropower development throughout the basin. All proposed, constructed, and reasonably potential (regardless of licensing status) hydroelectric projects should be included in the cumulative impact analysis. This is consistent with the definition of cumulative impacts contained in the FERC regulations implementing NEPA.

78. See response to comment #32.

79 Under this definition "cumulative impact" is the effect on the environment that results from the incremental impact of the action when added to past, present, and future actions regardless of the agency or person undertaking such actions. In our opinion, the Ohio River cumulative impact study is not being conducted in accordance with this definition. FERC argues that "...increasing the size and scope of the study area (additional licensed or exempted projects) ...would introduce sufficient additional uncertainty to make the results of the impact statement of limited value..." (August 10, 1987, Scoping Document II, page 15). Contrary to that argument, we believe that the draft, as written, precludes meaningful analysis of potential or real adverse cumulative impacts on fish and wildlife resources in the Ohio River Basin from existing and proposed hydroelectric projects because it does not include such projects. Therefore, we believe that FERC should prepare and circulate for comment a revised draft statement including all licensed, exempted, and proposed projects in the Ohio River Basin. We have enclosed a list of additional projects which we believe must be included in any revised environmental document.

79. See response to comment #33.

80 The draft statement does not indicate which competing application would be licensed at Tygert Dam, Montgomery Locks and Dam, New Cumberland Locks and Dam, Willow Island Locks and Dam, or Gallipolis Locks and Dam, although the proposed action is to license hydroelectric projects at these sites. The draft states that there are no major differences among these projects; therefore, no preference is indicated. In our opinion, major differences do exist. For example, one of the applicants for the Gallipolis project plans to install four turbines, two on each side of the river. The competing application only plans to install two turbines at one abutment of the dam. The effects of these projects on water currents and patterns would differ significantly, as would proposed fishing access and aquatic habitat requirements. Furthermore, recreational areas proposed at several sites on government-owned lands are of insufficient size to allow the development. FWS previously described major concerns with several of these projects during review of individual license applications. Unfortunately, FERC has not responded to those concerns. Therefore, the draft should be revised to show which competing application is likely to be licensed and what mitigation measures would be required.

80. See response to comment #34.

ALTERNATIVES ANALYSIS

81 Conservation and load management is briefly discussed as a principal non generating alternative to the proposed projects. However, the concept was dismissed by the conclusion that implementation of such measures has been adopted in many cases. That assumption is contrary to the conclusions drawn and recommendations made in the Department of Energy's (DOE) study of alternatives to the Davis Power Project released in 1980. That study concluded that implementation of any of the three conservation and load management scenarios would result in significantly lower costs than building a proposed 1,000 MW pumped storage facility. The DOE report also showed that implementation of conservation and load management could, in and of itself, preclude the need for 1,000 MW of peaking power. As such, a detailed analysis of conservation and load management is appropriate for the present study and highly recommended by FWS. Further, the conservation and load management alternatives presently being used should be discussed in concert with all economically available alternatives.

81. See response to comment #35.

82 The draft states that hydropower alternatives were developed to "...give equal consideration to power generation and environmental quality values." Contrary to this statement, the data projecting dissolved oxygen (DO) content (Section 4 and Appendix B) clearly show degradation of water quality values with each of the four proposed hydropower alternatives. Specifically, the DO model for Alternative 3 (Project Operation to Meet Antidegradation Criterion) and Alternative 4 (Project Selected to Minimize Impacts to All Target Resources) predicts DO reductions below Willow Island Locks and Dam for approximately 180 river miles (see Figures 4.4.1-1, 4.4.1-2, 4.3.1-3, etc.). FERC's recent decision (Commission Order 464) to waive Section 401 water quality certification for 11 projects does not reflect equal consideration of power generation and environmental quality.

82. See response to comment #36.

ENDANGERED SPECIES

83 The data contained in the draft are insufficient to demonstrate that adverse impacts will not occur to the pink mucket pearly mussel (Lampsilis orbiculata), a listed endangered species. In fact, FWS believes adverse impacts to that species would occur. Our concerns are based on the potential depressed DO levels resulting from the proposed hydropower projects. Additionally, FWS believes a significant reduction in numbers of finfish, as indicated, may also adversely affect the pink mucket pearly mussel since fish are an integral part of their life cycle requirements.

The endangered pink mucket pearly mussel occurs in the area below Gallipolis Lock and Dam and may also occur below Willow Island and Belleville Locks and Dams. Section 7(c) of ESA requires the Federal agency proposing a major construction activity significantly affecting the quality of the human environment to conduct and submit an assessment to determine the effects of the proposal on listed and proposed species. The biological assessment must be completed before any construction contracts are let. We do not believe that we can adequately assess the effects of proposed actions on the pink mucket pearly mussel without a complete assessment. When conducting a biological assessment, the following may be considered for inclusion:

1. The results of an on-site inspection of the area to be affected by the action to determine if listed or proposed species are present or occur seasonally.

83. See response to comment #38.

2. The views of recognized experts on the species at issue.

3. A review of the literature and other information.

4. An analysis of the effects of the action on the species habitat, including consideration of the cumulative effects and the results of any related studies.

5. An analysis of alternate actions considered by the Federal agency for the proposed action.

After FERC has completed and reviewed the assessment, it has the responsibility to determine if the proposed action "may affect" the pink mucket pearly mussel. If it determines that the project "may affect" a listed species, FERC must request formal consultation from the appropriate field office of the FWS. When FERC provides the biological assessment to the FWS, it should include any other relevant information used in reaching its conclusion.

Section 7(d) of ESA underscores the requirement that the Federal agency or the applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which, in effect, would deny the formulation or implementation of reasonable and prudent alternatives regarding their actions on any endangered or threatened species.

MINERAL RESOURCES

84 On page 3-27 we believe the document is deficient in its listing of mineral resources and resource-based industries. The list should include: coal, oil and gas, steel, ferroalloys, zinc, lime, cement, clay, and sand and gravel. The document also states that impacts on mineral resources from this project consist of land impairment and utilization of mine quarry and pit sites for waste (spoil) disposal. Mineral deposits are apparently viewed only as convenient dump sites that have no other interest or value. Also, the document does not mention the network of natural gas and petroleum product pipelines that may be affected by the various proposed construction and distribution lines.

We recommend that the draft include a section on mineral resources. The mineral deposits and/or mineral-related facilities, including pipelines, pertinent to each site or facility and its ancillary components should be described, the impacts of the projects on them should be discussed, and mitigating measures should be described.

84. The intent of the discussion of resource-based Industries in Section 3.1.9.1 was to provide a general overview of the regional landscape. The issue of potential project impacts to mineral deposits and/or mineral-related facilities was not identified during the scoping process and staff, therefore, believes a detailed discussion of mineral resources is not within the scope of the document.

SUMMARY

85 The draft does not provide adequate coverage of the following issues which were identified in the scoping process as issues of primary concern: water quality, endangered species, hydraulics, altered flow patterns, flow modifications, turbine induced fish mortality, recreational fishing, and dredged spoil disposal. The draft does not provide adequate recommendations or articles to protect fish and wildlife resources or the public use thereof. No indication is given as to which competing applications will be licensed. Conservation and load management was not adequately addressed as a project alternative.

85. See response to comment #72.

FERC claims to have complied with the Section 7 consultation process of ESA by providing FWS with a review copy of the draft statement. This does not constitute consultation which has yet to be initiated by FERC. Further, the FWS does not concur with staff recommendations to postpone resolution of the previously identified issues regarding fish turbine mortality and fish passage until the post-licensing phase. Because of these concerns, and the exclusion of numerous basin projects from the analysis, we recommend that the draft be revised and recirculated. A final statement should not be released until these issues are resolved. 86

86. See responses to comments #32, 33, 38, and #49.

Unless these issues are adequately resolved, the FWS may recommend that this project be referred to the Council on Environmental Quality (CEQ) under Section 1504 of its regulations. The referral would be based on the precedent-setting nature of this type of cumulative impact study and the severity of potential water quality impacts. However, we wish to coordinate fully at the earliest possible time because a solution to our concerns can be implemented with a minimum of delay and could preclude the necessity for referral. Coordination can be initiated by contacting the Field Supervisor, U. S. Fish and Wildlife Service, Suite 322, 315 South Allen Street, State College, Pennsylvania 16801, (814) 234-4090. 87

87. See response to comment #76.

Sincerely,

Bruce Blanchard, Director

cc: Mr. Dean Shumway
(Rm. 204RB)

Attachment

Fish and Wildlife Service's Specific
Comments on the Upper Ohio River Draft
Environmental Impact Statement

Section 2.1, pages 2-1 thru 2-27. Hydropower Generating Alternatives. Commission staff has evaluated three dissolved oxygen criteria: (1) those proposed by the applicants, (2) State standards (5 milligrams per liter), and (3) an antidegradation criterion (6.5 milligrams per liter). Had the Service had the opportunity to participate in the scoping of dissolved oxygen alternatives, we would have requested that evaluation of pre-project dissolved oxygen concentrations as an alternative. We do not believe that staff's recommended alternative of maintaining 6.5 milligrams per liter of dissolved oxygen immediately downstream of any existing or proposed hydroelectric project will ensure protection and maintenance of downstream fish and wildlife resources. Therefore, the Service requests that the evaluation of pre-project dissolved oxygen concentrations be included in a revised Draft Statement. 88

Page 2-25. Given that there is insufficient information to allow definition of existing dissolved oxygen conditions, the approach several resource agencies recommended during the scoping process should have been utilized. That approach, filling the dissolved oxygen data gaps prior to licensing, would eliminate many unknowns regarding basin-wide hydropower development.

Page 2-30. The Service does not agree that potential fish passage mortality can be considered a moderate or minor impact. In section 4.1.2.3 the Commission staff states that: (1) the results of existing turbine mortality studies are highly varied; (2) all entrainment studies completed in the basin are incomplete and inconclusive; (3) a firm basis for making mortality estimates awaits better results; and (4) much more work must be done before a fish protective device can be selected. An analysis of existing data does not lead to the conclusion of minor or moderate impact.

Page 3-20, paragraph 2. In addition to federally listed species, one fish species is being studied for possible future listing. The blue sucker (*Cycleptus elongatus*), known to occur in the mainstem of the Ohio River in the immediate study area, is classified by the Service as Category 2. Category 2 comprises taxa for which information now in possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules. (Reference *Federal Register*, Vol. 51, No. 106, Rules and Regulations, page 19941, third column, 4th paragraph.) The Commission is not required to confer with the Service on this species. However, the Commission is encouraged to confer informally when deemed appropriate to avoid jeopardy and to avoid potential economic loss through project modification if the species is later listed.

Page 3-20, 3.1.6.2, Paragraph 3. The smallmouth buffalo (*Ictiobus bubalus*) and the black redhorse (*Moxostoma duquesnei*) have been removed from the special concern category.

88. See responses to comments #39-71.

Page 3-20, 3.1.6.2, Paragraph 6. The butterfly (Plagiola lineolata) should be added.

Page 3-21/22, Tables 3.1.6.1. Federally protected species should be so noted. The federally listed species are:

Indiana bat	Myotis sodalis
Ohio (pink) mucket pearly mussel	Lampsilis orbiculata
Peregrine falcon	Falco peregrinus
Eastern small-footed bat	Myotis subulatus leibi

In addition, the following species have been designated as candidate species and classified as Category 2.

These species from the list include:

Appalachian Bewick's wren	Thryomanes bewickii altas
Eastern woodrat	Neotoma floridana magister
New England cottontail	Sylvilagus transitionalis
Salamander mussel	Simpsonaias ambigua

Page 3-67, Fisheries. This section should include a discussion of potential water quality (i.e., dissolved oxygen) degradation on shellfish. In Imlay's (1971) experiments, all species examined required 6 parts per million of dissolved oxygen for normal growth.

Section 4. Paragraphs 4.1.2, 4.2.2, and 4.3.2 should all contain an assessment of the potential impact of dissolved oxygen changes on shellfish.

Page 4-4, paragraph 4. Dissolved oxygen depletion is probably the most significant issue dealt with in the Draft Statement. The dissolved oxygen model was designed to predict both existing and post-project dissolved oxygen concentrations. Considerable effort was obviously expended in its development and the subsequent analysis. The baseline data are, therefore, of paramount importance. As such, the unpublished data upon which the model was based should be provided in a revised draft statement. The value of the model and predictions must be questioned if they were based on limited field data, such as the number of observations reported on page B-7, Table B-1.

Page 4-1, Assessment Methods. Dissolved oxygen measurements were determined at a number of different flow rates and temperatures. Subsequently, dam-aeration constants "b" and dam-aeration coefficients "M" were developed by statistical analysis. The Draft Statement does not, however, indicate how many measurements were made at each flow level and/or whether the data used are representative of existing conditions. The dissolved oxygen data analyzed should be provided in table form so reviewers can make a reasoned decision as to its applicability. The scientific validity of model predictions of future conditions with or without the proposed developments should be reviewed by water quality experts in State and Federal agencies.

Figure 8-8 shows there were no data to calibrate the dissolved oxygen model between Ohio River miles 140 and 250 and that only two data points exist below Ohio River mile 250. Without reliable and adequate calibration data we further question the model's validity, particularly for all points below Ohio River mile 140.

It is unclear which of the competing applications were used to develop the dissolved oxygen model. As significant variations in size and operating mode occur, we presume the project's impacts on dissolved oxygen would vary. If generic hydropower proposals were used in the model, then it would seem a simple matter to include all hydropower sites in the basin in the cumulative assessment.

Page 4-20, paragraph 4. No information is presently available regarding the direction or timing of fish movements in the Ohio River and its major tributaries. However, available literature indicates that some species move downstream frequently. In fact, downstream migrations of walleye from Tygart Dam are most likely responsible for the establishment of walleye populations in the upper portions of the Monongahela River.

Page 4-25, paragraphs 3 and 4. The Commission staff states that existing entrainment field studies are incomplete and inconclusive and much more development work must be completed before fish protective or guidance devices can be selected. As such, licensing of any projects within the Ohio basin, in advance of the completion of studies necessary to determine impacts to fish and wildlife resources, would violate provisions of the Federal Power Act and would be contrary to several court decisions.

Page 4-25, Vulnerability to Entrainment. There is no information available to support the contention that fish would select a nonhazardous downstream route instead of a hazardous one. Fish normally follow current patterns unless habitat and cover exert significant influences. In the case of lock-and-dam hydropower development, habitat, cover, and current patterns will all increase the likelihood of entrainment. While passage alternatives may be available, the majority of downstream migrants are expected to pass through the units unless the greatest percentage of river flow is through the dam gates.

Page 4-28, paragraph 1. While the Draft Statement is very qualitative, the Service has not seen any data regarding gamefish movements through locks and dams. The analysis done by Simmons (1987) indicates significant downstream movements for centrarchids and catfishes. Given the staff conclusion that the studies at Racine Dam are highly debatable and inconclusive, the postulation that only small numbers of gamefish are entrained and that those numbers are most likely insignificant, is questionable and should be addressed in a revised document.

Page 4-30, paragraph 6. The Service agrees with the staff conclusion that damage to gamefish from turbine passage will be greater than 10 percent and that the loss could be significant.

Page 4-32, Fish Diversion and Protection Devices. Commission staff has determined that there is " ... little experience with species most affected by entrainment ... "; that "No applicant has carried design plans to sufficient detail to evaluate their proposal fully ... "; and that " ... more work at developing and evaluating experimental prototypes will be necessary.". Licensing of basin projects without adequate studies and mitigation in our opinion would violate provisions of the Federal Power Act.

Page 4-33, paragraph 3. Compensation is used to mitigate adverse impacts such as fish passage mortality only after adverse impacts are avoided and/or minimized. Compensation means full replacement of project induced losses with resources of equivalent biological value. If used, compensation must remain the responsibility of the licensee to implement and maintain during the project life. The Service will only endorse a compensation plan after adverse impacts are avoided and/or minimized and one that: (1) provides for full replacement; (2) will be incorporated as an enforceable license condition; and, (3) assures that mitigative measures are the responsibility of the licensee.

As turbine induced mortality has not yet been defined, a properly designed and conducted study is essential prior to developing a mitigation plan. Without an adequate impact evaluation, the adequacy and effectiveness of mitigation will remain undetermined.

Page 4-47, Section 4.1.3.3. Loss of recreational fishing opportunities during concurrent construction of basin projects is identified as an impact for which mitigation has not yet been resolved. Resolution of this issue should be achieved prior to licensing and after consultation with the Service and State wildlife agencies.

Page 4-49, Section 4.1.3.6. This section identified numerous significant adverse impacts to water quality and finfish should projects be licensed as originally proposed. Based on the data previously submitted, the Service concurs that these impacts must be avoided if possible; clearly, licensing as originally proposed would be environmentally unacceptable.

Page 4-62, Section 4.1.6.2. Endangered/Threatened Species, paragraph 1. It should be added that any habitat disturbance below Willow Island Lock and Dam, Belleville Lock and Dam, and Gallipolis Lock and Dam will also require consultation with the Service in accordance with section 7 of the Endangered Species Act. Reference our letter to the Commission dated September 28, 1987, and the Draft Statement, pages 3-19 and 3-20.

Page 4-71, Section 4.1.6.8. A response to the previous Service and State wildlife agency recommendations to utilize clean rock spoil to construct fishery habitat structures should be provided. Implementation of that recommendation would offset project impacts to fishery habitat and recreational use while likely reducing developers' spoil-disposal costs.

Page 4-87, Section 4.7. Departmental comments are provided pursuant to the National Environmental Policy Act and do not represent comments pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661, et seq.) or section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). Comments under section 2(b) of the Fish and Wildlife Coordination Act are provided when draft licenses are provided for each project. Comments under section 7 of the Endangered Species Act will be provided when the Commission initiates the consultation process.

Page 4-87, Section 4.7, paragraph 4. A copy of the Draft Statement does not constitute consultation under section 7 of the Endangered Species Act. The consultation process is separate and has not yet been initiated by the Commission.

The Draft Statement lacks adequate information (site specific location, design measures to minimize harm) to evaluate section 10 and 404 permits from the Corps of Engineers or possible section 402 National Pollution Discharge Elimination System permits. Accordingly, our comments do not preclude separate evaluation and comments by the Service when reviewing the permit applications. The Service may concur, with or without stipulations, or recommend denial depending on effects to fish and wildlife resources.

When appropriate site-specific information is available, the Service would be pleased to coordinate with the Commission and/or licensees to preclude delay and to insure that any permit stipulations or conditions are understood and included in revised draft and final statement.

Page 5-8, paragraph 2. While mitigation could reduce impacts of concurrent construction to recreational fishing, site-specific mitigative measures are not identified. The National Environmental Policy Act requires documentation to explain exactly how measures will mitigate project impacts.

Page 5-16, Section 5.1.4. Given that fish mortality concerns are not resolved by licensing under any of the alternatives considered, license issuance prior to resolution of those issues would violate provisions of the Federal Power Act and the National Environmental Policy Act.

Page 5-23, paragraph 2. The Service feels that there are significant differences between competing license applications and refers staff to project-specific Departmental letters regarding the proposed Tygart, New Cumberland, Willow Island, and Gallipolis projects.

Page 5-25, Basin-wide Recommendations. Prior Departmental and Service recommendations requested that the Service be identified as a coordinating agency in license articles dealing with fish, wildlife, and public uses thereof, and spoil disposal, water quality, and mitigation of project-related effects. In accordance with provisions of the National Environmental Policy Act, the Fish and Wildlife Coordination Act, the

Federal Power Act and the Electric Consumers Protection Act, the Service and appropriate State fish and wildlife agencies must be specifically identified in each such article. The Council on Environmental Quality Regulations for Implementing the National Environmental Policy Act list the Service as having jurisdiction by law and/or special expertise on these issues.

Page 5-27, Item 3. Although monitoring fish populations may provide some insight into long-term impacts, an indirect approach is expected to be much less successful than a direct one. Numerous variables affect the results of even direct sampling and analysis methodologies. Indirect approaches involve many variables, such as catch, harvest, recruitment rates, weather, river condition, water quality, habitat, emigration, immigration, etc. A direct approach of sampling and analysis must be developed if successful turbine mortality studies are to be completed.

Page 5-27, Item 4, and Page 5-28, Item 5. The proposals for the agencies and some 15 applicants to develop joint plans to study fish entrainment and turbine-induced mortality, and to develop a bioengineering test facility, are commendable. However, the Service is concerned that coordination, administration, and implementation of such large scale undertakings, with as yet undefined financing and lead responsibility, would be difficult. If the Commission elects to pursue this endeavor, then one party to represent all applicants should be appointed and the Commission should assess equitable fees to each developer to fund the effort. The Service also recommends the work be contracted through an independent organization.

Further, reliance on post-licensing studies to determine the impacts and to develop adequate mitigation measures appears to violate the National Environmental Policy Act, which requires consideration of environmental impacts before licensing decisions are made.

Page 5-29, Section 5.4.2.5.1. Endangered and Threatened Species. Developers at Willow Island Lock and Dam must also consult with the Service through the Commission and the State resource agencies. Reference our letter dated September 28, 1987, and the Draft Statement, pages 3-19 and 3-20.

Page B-2, Section B.2.1.3.1. Data and figures showing the number of dissolved oxygen samples taken at each river flow, by location, date, time, temperature and climatic conditions are needed to enable reviewers to place the model into perspective with existing conditions.

Page B-3, paragraph 6 and Table B.1. The statement that dams with lower aeration coefficients "R" and more negative values of "b" aerate better is inconsistent with text in Section 4 and Table 4.1.1.1.

Page B-16, Figure B-8, and associated text. The Draft Statement should explain why the model predicts dissolved oxygen reductions of 0.7 milligrams between Ohio River miles 160 and 240 but no reduction for the 40 miles below Racine Dam; and a dissolved oxygen increase below Gallipolis Dam, despite the fact that Gallipolis is reported to be a poor aerator. Further, since both actual data and model predictions (see Figure B-8, 4.1.1-4, and 4.1.2-3) show a dissolved oxygen surge at Gallipolis, it is not consistent that Gallipolis is considered a poor aerator.

It should also be noted that Racine apparently adds no significant dissolved oxygen surge. (As a licensed project, Racine was not included in the cumulative analysis). Inclusion of Racine may have resulted in recommendations for spill flows which would significantly improve dissolved oxygen in the lower river.

Page B-27, paragraph 2. See our General Comments regarding inclusion of all basin projects in the cumulative assessment.

Literature Cited

Imlay, M.J. 1971. Bioassay tests with naiads. In Jorgensen and Sharp (1971, pp 38-41).

Simmons, L.L. 1987. Fish entrainment studies for the Millville Hydro Station, FERC Project # 2343, report from Energy and Environmental Management, Inc., to the Potomac Edison Company.

U.S. Department of Energy. 1980. Draft. A study of alternatives to the Davis (West Virginia) pumped storage project. Volumes I, II, and III. Printed under contract by ICF, Inc., and ESEI, Inc. U.S. Government Printing Office, Washington, D.C.

ADDITIONAL PROJECTS TO BE INCLUDED IN THE CUMULATIVE IMPACT ASSESSMENT OF THE OHIO RIVER BASIN

Allegheny River Subbasin (Pennsylvania)

Allegheny River Lock and Dam No. 5 Project (FERC No. 3671)*
Allegheny River Lock and Dam No. 6 Project (FERC No. 3494)
Allegheny River Lock and Dam No. 8 Project (FERC No. 3021)
Allegheny River Lock and Dam No. 9 Project (FERC No. 3021)
Piney Project/Clarion River (FERC No. 309)
East Branch Project/Clarion River (FERC No. 3292)
Loyalhanna Project/Kiskiminetas River (FERC No. 7586 et al.)
Conemaugh Project/Kiskiminetas River (FERC No. 3207)
Kinzua Project/Allegheny River (FERC No. 7208)

Monongahela River Subbasin (Maryland, West Virginia and Pennsylvania)

Monongahela River Lock and Dam No. 2 Project (FERC No. 3973 et al.)
Monongahela River Lock and Dam No. 3 Project (FERC No. 3752 et al.)
Morgantown Lock and Dam Project (FERC No. 9949)
Lake Lynn Project/Cheat River (FERC No. 2459)
Deep Creek Lake Project/Youghiogheny River (FERC No. 2370)
Youghiogheny Dam Project/Youghiogheny (FERC No. 3623)

Beaver River Subbasin (Ohio and Pennsylvania)

Townsend Project/Beaver River (FERC No. 3451)
Patterson Project/Beaver River (FERC No. 3519)
Eastvale Project/Beaver River (FERC No. 3450)
Shenango Project/Shenango River (FERC No. 4142 et al.)
Pymatuning Project/Shenango River (FERC No. 9390 et al.)
Lake Arthur/Muddy Creek
Ellwood City Project/Connoquenesing Creek (FERC No. 7293)
Mosquito Lake Project/Mosquito Creek/Ohio
Berlin Lake Project/Mahoning River/Ohio
M.J. Kirwan Project/Mahoning River/Ohio
Milton Lake Project/Mahoning River/Ohio (FERC No. 9972)
Meander Reservoir Project/Meander Creek/Ohio

Muskingum River Subbasin (Ohio)

Devola Lock and Dam No. 2 (FERC No. 7751)
Muskingum Lock and Dam No. 3 (FERC No. 6998)
Beverly Lock and Dam No. 4 (FERC No. 7234)
Luke Chute Lock and Dam No. 5 (FERC No 7261)
Stockport Lock and Dam No. 6 (FERC No. 7750)
McConnelsville Lock and Dam No. 7 (FERC No. 7262)
Rockeby Lock and Dam No. 8 (FERC No. 7222)
Philo Lock and Dam No. 9. (FERC No. 7221)
Muskingum Lock and Dam No. 10 (FERC No. 6563)

Ellis Lock and Dam No. 11 (FERC No. 7229)
Dillon Lake (FERC No. 8268)
Milton Dam (FERC No. 9972)
Pleasant Hill (FERC No. 8270)
Wills Creek (FERC No. 8269)

Kanawha River Subbasin (Virginia and West Virginia)

Winfield Lock and Dam Project (FERC No. 1290)
Marmet Lock and Dam Project (FERC No. 1175)
London Lock and Dam Project (FERC No. 1175)
Sutton Project/Elk River,' (FERC No. 3344)
Summersville Project/Gauley River (FERC No. 10226)
Claytor Lake Project, (FERC 739)

Tippecanoe River Subbasin (Indiana)

Lake Shaeffer Project
Lake Freeman Project

Ohio River Mainstem (Pennsylvania, Ohio, West Virginia,
Indiana, and Illinois

Hannibal Locks and Dam Project (FERC No. 3206)
Racine Locks and Dam Project (FERC No. 2570)
Greenup Lock and Dam Project (FERC No. 2614)
Capt. Anthony Meldahl Locks and Dam Project (FERC No. 2739)
Markland Locks and Dam Project (FERC No. 2211)
McAlpine Locks and Dam Project (FERC No. 289)
Cannelton Locks and Dam Project
Newburgh Locks and Dam Project
Uniontown Locks and Dam Project
Smithland Locks and Dam Project (FERC No. 6641)
Locks and Dam No. 52 Project
Locks and Dam No. 53 Project

*Where known the FERC No. has been included.

MR. TAYLOR: If not, at this time I would like to ask if anybody has an oral statement that they would like to provide to us. Does anybody have an oral statement?

MR. CLOWER: I do.

MR. TAYLOR: Yes?

MR. CLOWER: I'm Chris Clower, C-l-o-w-e-r, with the U. S. Fish and Wildlife Service.

The Service appreciates the opportunity to comment on the draft EIS and express our interest. These comments are generic in nature and do not represent the Service or Interior's official response. The Service departmental comments are forthcoming.

89 The Federal Energy Regulatory Commission has indicated that the final EIS will serve as the licensing document, and the first response of the Service and state wildlife agencies will constitute issue resolution under Section 10-J of ECWA. I do not believe this approach reflects the spirit or intent of the Federal Power Act as amended by ECWA, National Environmental Policy Act, official Wildlife Coordination Act, and other federal statutes and policies. I feel that all previous and future comments must be considered and that additional dialogue between the agencies is necessary if conflicts arise.

89. See response to comment #31.

90 I remain concerned with the Commission's omission of numerous basin projects. As stated in the document, the value of the objective function of any particular site is a function of the values of the decision variables at all sites upstream. I believe a cumulative system-wide mulling analysis is required. Further, since insufficient information exists to find existing DO conditions,

90. See responses to comments #32, 33, and 39.

I believe DO data gaps should be filled prior to licensing.

91 I believe the Commission's analysis of the principal and non-generating alternative should be greatly expanded. Conservation and load management was briefly discussed but summarily dismissed, reportedly because implementation of such measures had been adopted in many cases. Those cases, however, were not identified.

91. See response to comment #35.

The Department of Energy's own study of alternatives to the Davis Power Project in 1980 includes the opposite and, in fact, recommended conservation of load management scenarios be implemented. The staff acknowledged that the results of previous terminal mortality studies are inconclusive and that a firm basis for making mortality estimates awaits better results.

92 I cannot agree that postponing studies until after construction is the best solution to develop mitigating measures. Project impact should be identified prior to licensing and unavoidable impacts mitigated during construction.

92. See response to comments #49 and 72

I do not believe the fish population

93 monitoring as described in the document will provide such insight into long-term impacts on the fish populations. Too many variables affect the results of indirect analysis approaches. A direct sample methodology must be developed if terminal mortality studies are to be successful.

94 In addition to these issues, I do not believe the documents provided adequate coverage to water quality of endangered species, altered flow patterns and recreational fishing opportunities.

95 I also believe if the EIS is to serve as a licensing document of the project, specific articles and recommendations should be included to protect fish and wildlife resources.

Thank you.

MR. TAYLOR: Thank you, Mr. Clower.

Does anybody else have an oral statement that they would like to make at this time?

(No response.)

MR. TAYLOR: Are there any questions you would like to ask at this time?

(No response.)

MR. TAYLOR: Well, before we finish

93. See responses of comments #207, 212, and 234.

94. Your comment is noted.

95. Staff has provided specific recommendation in the FEIS to protect fish and wildlife resources. See the rcommendations in Sections 5.4.2 and 5.4.3 on these protection measures.

up here this morning, I would like to remind you that we will break here and come back after lunch in the event that anybody has anything they would like to say at that time.

So with that, I would like to conclude this public meeting for the draft environmental impact statement on hydroelectric development in the Upper Ohio River Basin. Thank you very much for your attendance.

Like I said, the idea was to have the meeting from ten until noon and break for lunch and come back at one o'clock and we will run from one o'clock to three o'clock.

MR. RICH: I would like you to explain why you are having a public meeting with a court reporter. You're definitely not -- that is, you have a choice, you didn't have to do this.

MR. TAYLOR: Well, we felt like we needed to have a public meeting to allow the public, agencies and individuals, an opportunity to provide comments. We certainly think that these comments at this time on the draft environmental impact statement should become part of the public record and, therefore, we have a stenographer here to provide us with a transcript, which we will also use those comments and information in preparing the final environmental impact statement.

MR. ABRAMS: So we don't have to take a lot of notes.

MR. TAYLOR: So with that, are there any further questions?

(No response.)

MR. TAYLOR: No further questions, we will break here and be back at one o'clock. Thank you again.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

JUL 2 · 1988

Ms. Lois D. Cashell, Acting Secretary
Federal Energy Regulatory Commission
825 No. Capitol St., N.E.
Washington, D.C. 20426

Dear Ms. Cashell: Re: FERC Docket No. EL85-19-114

In accord with NEPA and Section 309 of the Clean Air Act, EPA has completed its review of the Draft EIS, entitled, Hydroelectric Development in the Upper Ohio River Basin. The number of proposed projects is very large and the Federal Energy Regulatory Commission (FERC) has grouped several proposals under one umbrella Draft EIS. 96

Our review has concentrated upon analyses of alternatives and the description of the affected environment. We have identified some areas where we believe the EIS could be substantially improved and others where we feel FERC should have included additional information and analyses. These areas are examples of where we believe FERC could substantially improve the product:

- Alternatives and alternatives analyses
- Wetlands and riparian description
- Modeling for dissolved oxygen
- Impacts to fish from impingement & entrainment
- Toxics in water and sediments

For reasons spelled out in the attached technical comments, we believe FERC should consider either a Supplemental Draft EIS to cover additional information or tiering as each of the proposed projects is considered for design. Based upon these findings, EPA is rating the Draft EIS EO-2 (Environmental Objections; Insufficient Information). We believe FERC should investigate additional alternative which, based upon our analysis, may may prove to be less environmentally harmful and, perhaps, less costly.

If you have any questions, please contact Bob Davis on FTS/Comm. 215-597-8327.

Sincerely,

Jeffrey M. Alper, Chief
NEPA Compliance Section

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96. Your comment has been noted. Responses to your specific concerns are addressed in response to comments #97-105.

Technical Comments

Introduction:

EPA's review of the Draft EIS has identified several areas where the information presented is either too abbreviated to draw conclusions of minimal impacts or which can be developed into at least one additional alternative. In our opinion, the information used for determining riparian values was of a reconnaissance nature and while it is of use as good observation, it should be supplemented by detailed and site specific information.

In the matter of additional alternatives, the information presented in the document was too sketchy for the alternative to be developed to its fullest. It would be appropriate for FERC to evaluate the suggestions below below and to meet with EPA staff as necessary to carry out analysis.

Our review also showed that the dissolved oxygen information should be further developed. The modeling has been based upon insufficient baseline information and upon too many assumptions to assure accuracy. In this case, too, FERC should gather additional information and present it either in a Supplemental Draft EIS or as tiered Supplemental Draft documents, presented for review as the proposed projects are brought into specific design phase.

The comments are organized in the following order:

- Alternatives and alternatives analysis,
- Wetlands and riparian description,
- Dissolved oxygen and modeling,
- Impacts to fish from impingement & entrainment;
- Toxics in water and sediments.

Alternatives and alternatives analysis:

Based on our review, we question some of the information in the EIS intended for use in developing additional alternatives. This information is found in Section 3, Affected Environment, and is used in conjunction with the Alternatives of Section 2 and the Staff Conclusions of Section 5 to develop the new lines of reasoning.

The four alternatives investigated in the Draft EIS are: 1) operation proposed by the applicant, 2) operation to maintain dissolved oxygen (D.O.) at the 5.0 mg/l concentration; 3) operation of the hydroelectric plants to maintain a D.O. at 5.5 mg/l; and 4) operation to maintain a D.O. of 6.5 mg/l as well as to provide protection of other target resources. We recommend that at least two other alternatives can be considered: 1) operation of the plants to maintain existing dissolved oxygen concentrations so that the reaches of the river where D.O. concentrations greater than 6.5 mg/l would be maintained. 2) retrieval of power needs from other sources that are already in existence.

The first suggestion would involve some additional modeling work to predict operational modes that would meet both the power as well as the environmental targets. However, it appears to us that the needs could be met through specifying where the needs are geographically located, allocation of power from conventionally available sources, and operating the proposed power stations selectively so that objectives of power production and environmental quality are met. These would have to be matrixed with those reaches where D.O. is higher than the 6.5 mg/l D.O. Then the whole power supply system matrix and model balanced to achieve both power needs and environmental quality objectives. 97

The second suggestion would require some additional research on the part of the applicant. One possible approach is described below for consideration in completing the NEPA process. On page 3-1, current land uses are described as follows: 61% forested, 20% agricultural, 7% urban, and 2% mining. On page 3-22 ff, socio/economic resources, it is explained that subregion III, the Allegheny County, Pennsylvania area, represents the greatest population concentration (Table 3.1.7-1). All economic activities in the subregion are also greater than in other regions (Table 3.1.7-3). It is assumed that the greatest power demand would coincide with these activities. Section 2, however, does not factor these into the alternatives analysis, leading to our opinion that another alternative is possible. However, additional information is required to complete the scenario. 98

On pp 2-27ff the Draft EIS states, without sufficient backup, that it is preferrable to use hydropower to replace "... generation from ... less efficient steam units." The document does not list these units or their power-production life expectancy, although it appears that roughly 30 are in operation. These should be listed. In addition, it should specify where the greatest demand occurs to assure that the proposed stations scattered throughout the study area would be sufficient to fulfill the demand.

On page 2-29ff and 2-30ff, it is clear that FERC does not believe that 400mw of energy can be supplied from the 30 plants currently in operation. However, the Draft EIS should have included incremental additional loads from the several plants in operation. For example, if only 20 mw were to supplied by 20 of the most efficient plants in operation the demand would be satisfied. While the additional loads would require more coal and other resources than are currently required, it seems reasonable that economies of scale would at least partially offset the loss.

This same approach could be used to develop a subalternative, namely, the re-distribution of power from within the service area grid, including power units outside the service area (i.e., the Northeast grid). This, too, is dismissed with very little supporting data, yet deserves in-depth study which could be based upon information available from FERC and other sources. If that supply is peaked or over peak, then FERC should include the information in its documentation.

97. See response to comment #39. Staff believes that maintenance of "preproject" DO concentrations would preclude development of projects at dams that aerate well.

98. The FEIS states that it would be in the public interest and useful to conserve non-renewable fossil fuels and to reduce atmospheric pollution; displacing steam generation with hydropower will accomplish both. The displacement of inefficient steam generation by hydroelectric generation improves the cost-effectiveness of the displacement.

A review of the April 1988 DOE Code IE-411 Reports submitted by ECAR, MAAC and by SERC for its VACAR sub region (see Sect. 1.2 for definitions of abbreviations) shows that, as of January 1, 1988, the existing generating resources of utilities in the MAAC Council Area included 36,211 megawatts of fossil-fueled capacity; existing resources in the ECAR Council Area included 86,328 megawatts of fossil-fueled capacity; and the VACAR Sub-region had 12,700 megawatts of existing fossil-fueled capacity.

With more than 135,000 megawatts of existing fossil-fueled generating capacity in these three Reliability Council Areas, the identification of specific steam plants which can be cost-effectively off-loaded by 400 megawatts of hydroelectric capacity is unwarranted.

In the third of the four paragraphs being addressed, it is apparently assumed that FERC staff wishes to establish a need for the 400 megawatts of hydropower, over and above the existing and planned additions of generating capacity. This is not the case. The 1988 IE-411 Reports prepared by ECAR, MAAC and by SERC for its VACAR Sub-Region indicate that existing generating resources and projected capacity additions are sufficient to meet projected load growths and maintain acceptable capacity reserve margins. The objective of staff is to establish the substantial usefulness of 400 megawatts of hydropower by reducing the consumption of non-renewable fossil fuels; by reducing atmospheric pollution, in a nation deeply concerned about acid rain and the greenhouse effect; and by possible long-term reductions in energy production costs.

The above-cited IE-411 reports show that utilities in the ECAR Council Area plan to add 4,813 megawatts of additional fossil-fueled generating capacity during the next ten years to meet projected load growths. Utilities in the MAAC Council Area plan to add 3,950 megawatts of fossil-fueled capacity during the same period and for the same purpose. The VACAR Sub-region of SERC plans to add 993 megawatts of fossil-fueled capacity. The 400 megawatts of proposed hydroelectric capacity can obviate the addition of a small fraction of these planned fossil-fueled additions and effect accompanying reductions in fossil fuel consumption. Possible long-term reductions in electric energy production costs should also not be ignored.

The development of possible "subalternatives", such as those proposed in the fourth paragraph being addressed, are being continuously considered by utility planning engineers. Economy purchases and transfers of capacity and energy are implemented daily and by long-term contracts to avoid the necessity of adding new generating facilities. The impacts of such "subalternatives" are accounted for in the IE-411 reports. Such procedures are also of great value during system emergencies, as well.

Wetlands and Riparian Descriptions:

On page 3-46, a description is presented of how information on wetlands and riparian areas was gathered. Apparently, observations from a boat were used as the sole source of riparian vegetation information. While such information is usually adequate for reconnaissance investigations, it should not replace detailed studies for specific planning and decision-making purposes. It is further stated on the same page that detailed surveys were made at 14 sites, but the citation in Table 3.3.5 1 ("Vegetation survey sites ...") is unpublished information. A call to the Pittsburgh COE indicates that these casual observations were made mainly for informational purposes on navigational charts. Detailed studies were made at only 14 sites while at least a dozen more power sites are under study. In addition, it does not appear that the observations led to detailed analyses at other sites where power plants are not under consideration but where impacts may occur. 99

Evaluations appear to be based upon this reconnaissance information: on page 4 90 it is stated that "(t)here would be unavoidable loss of riparian and wetland vegetation ..." at three locations that FERC, justifiably, believes should be excluded from construction plans (pp 5-23 & 24). While we agree with this, it is important to acknowledge that extending such reconnaissance information to other sites may be inappropriate and should be supplemented by detailed studies prior to design. The extrapolation of this information may not cover some areas that may be prone to damage from construction and operation.

We are gratified that wetland and riparian areas are to be monitored for the first 5 years of the operation of all proposed facilities. However, we believe decisions to build should be held in abeyance until full and detailed information regarding these valuable resources is collected.

99. Text has been modified. Comments noted.

Staff used the best available information to assess the impacts of the proposed projects on wetlands. Very limited wetlands research and detailed surveys have been conducted in this region. A recommendation for detailed monitoring is made (Section 5.4.2.4). Staff is concerned with the impacts caused by the loss of wetlands on recreational use, fish and wildlife habitat, and the potential changes or destruction of the wetland habitat itself. Wetlands are scarce in this region and as a valuable resource should be preserved and maintained.

Modeling and Dissolved Oxygen.

Appendix B describes the modeling effort that is to be used as a predictive tool in the decisions regarding the proposed projects and their impacts upon D.O. The dam aeration effort appears to be good and therefore useful in predicting D.O. increases due to the dams. However, the modeling effort for areas upstream of the dams is based upon assumptions that we believe limit the usefulness of the model as a predictive tool. 100

The parameters of importance in D.O. depression and maintenance are biochemical oxygen demand (CBOD), sediment oxygen demand (SOD), and nitrogenous oxygen demand (NOD). From our review, it appears that one rate of decay has been applied to all three parameters. In our opinion, SOD and NOD demand rates vary greatly from that for CBOD. Furthermore, SOD is suspected to be of much greater significance in D.O. depression upstream from the dams than is represented by the models and therefore should be considered separately. The decay rates (K_1) are usually based upon actual stream measurements, but we were unable to see where the decay and reaeration rates were determined. As a combined rate, especially with SOD, the normal procedure for estimating a decay rate would be most difficult to use.

100. The BOD loads included in the model at reaches without wastewater dischargers simulate the following: (1) loads from major wastewater dischargers that are not required by the states to monitor effluent BOD concentrations, so no data are available; (2) loads from small, unpermitted, or illegal dischargers, which often have high BOD concentrations; (3) non-point sources of BOD; and (4) sediment BOD. ORSANCO monitoring data show that summer BOD concentrations typically range between 1 and 3 mg/L of ultimate BOD (including five-day BOD and nitrogenous BOD).

Staff conducted a search of National Pollutant Discharge Elimination System files, and EPA's Permit Compliance System was used to quantify BOD loads from dischargers required to monitor BOD and nitrogen. A simple mass balance shows, however, that the major dischargers where effluent BOD concentrations are monitored do not contribute enough BOD to account for the measured in-stream concentrations. For example, a typical discharge from ALCOSAN, the largest municipal discharger in the system, raises BOD concentrations only about 0.6 mg/L when there is 20,000 cfs in the Ohio River. The states in the study area have not conducted sufficient numbers of waste load allocation studies to quantify BOD sources, loadings, and the related rate constants. As far as staff was able to determine, the BOD decay rate for ALCOSAN has never been measured. In the absence of data on these other sources of BOD, calibration of model input BOD loads and decay rates to approximate measured DO and BOD concentrations is necessary. The reaeration rate was determined using the O'Connor-Dobbins equation (Appendix B, Section B.2.1.2).

The Draft EIS (p B-9) notes that it is not crucial to the accuracy of the assessment to identify or quantify individual sources of BOD. This may be true, however, it is important to the accuracy of the model calibration and final rate determination. Artificially adjusting loading rates to achieve calibration with the DO data results in questionable rates. Loadings were apparently adjusted to account for unknown sources of BOD and SOD. It appears that rates were not adjusted to conditions. This process yields questionable rates at the calibration flow and we believe unacceptable rates for production runs. It is our opinion that the model has not been properly calibrated and should not be used for predictive purposes without further data analysis and proper calibration exercises.

In our review, we also noted (p B-9) that algal uptake of DO was not included in the DO calculations. The justification is based on the assumption that algal growth is minimal during the low flow months when DO levels are lowest. In our opinion, algal impacts will be greatest during the period of interest, i.e., low flow conditions coinciding with high temperatures. If the preparers have information to the contrary, it should be included in the EIS. Algal growths, to our knowledge, are greatest during the warm months of the year. They are suspected to have a great impact on DO maintenance and should be factored into the model as such. If insufficient data are available to model algal impacts, then a program should be developed to collect such information. 101

In further regard to flows and their relationship to DO, we note that an exceedence flow of 70% is used for calibration. We believe that this is too high for accurate comparison with the 7Q10 and would prefer to see an exceedence flow for calibration in the range of 10 to 15% greater than the 7Q10 flow. This would lead to greater confidence in the model as a predictive tool during low flow design periods than we currently can share with the preparer. 102

Impacts to Fish From Impingement & Entrainment:

On page 4-F9 of the Draft EIS, FERC states that some of the fish passing through the turbines would experience injury or mortality. The Draft states: 103

> "There are insufficient data to quantify extent of losses, and technology is insufficiently developed for Ohio River basin applications to require installation of effective devices for excluding entrainment. (post license) monitoring is recommended to quantify the extent of these losses and to develop mitigation."

We support the recommendation that fish losses be monitored and appropriate mitigation be developed. We do not support a monitoring and mitigation plan that would not be developed and implemented until after the installation of hydropower, as suggested on page 5-27. Fish mortality/injury studies, as well as mitigation plans, should be designed and approved prior to the issuance of a hydropower license. The fish studies should be undertaken before the installation of hydropower to determine pre-project conditions. The studies should

101. Historic DO data in the Ohio River basin typically show little diurnal variation in concentrations, indicating little effect of algal production on DO. There has been noticeable algal growth in some parts of the basin during the summers of 1987 and 1988. Data collected by the hydropower applicants in the summer of 1987 were analyzed using the single transect method of Odum (Odum H.T. 1956. Primary production in flowing waters. Limnol. Ocanog. 1:103-117) to determine if DO production and consumption by algae was significant. The analysis showed that bacterial respiration (BOD decay) far outweighed algae as a factor controlling DO concentrations. Because this analysis was unable to quantify significant algal production, algal effects were not included in the model. Data collected by the Corps at their electronic monitors during the summer of 1988 did show diurnal variation in DO concentrations, but the extremely low flows and high temperatures occurring when these data were collected are very atypical and cannot be used to represent the system.

102. The calibration data set from 1983 was selected because it was the most complete set of field measurements made during a recent low flow, low DO event. The flows that occurred during that period are higher than the 7Q10 flows, but 7Q10 flows are not used as a design flow in the EIS because many of the proposed hydropower projects would not operate at 7Q10 flows (as a result of minimum flows required for generation and the recommended spill flows). The calibration flows are reasonably close to the design flows used for most of the modeling analyses (referred to as summer moderate flows in Section 4). At the mouth of the Allegheny River the calibration flow was 5,600 cfs and the design flow was 7,500; at the mouth of the Monongahela River the calibration flow was 2,200 cfs and the design flow was 5,800; at Gallipolis dam the calibration flow was 23,000 cfs and the design flow was 24,000.

103. See response to comment #49. Staff agrees that the sequential mitigation plan for fish protection should include those aspects that can reasonably be known prior to the measurement of entrainment and testing of prototype fish protection devices at specific, representative sites. Staff agrees that local fish population monitoring would need to commence before project construction and continue after operation. Staff considered trash racks as a potential fish protection device (Section 4.1.2.3.3), and Nettles and Gloss (1987) is cited in the literature review. Staff is familiar with that study and is aware of its limitations as well as its strengths.

be continued after hydropower generation has begun, if any adverse fisheries impacts are detected, the already approved mitigation plans should be put into practice.

In developing the mitigation plans, we recommend that FERC consider the relative merits of a number of mitigation techniques. One technique that we suggest is the use of trash racks to reduce fish passage through turbines. Please find enclosed a copy of an article by Nettles and Gloss (1987) on the subject.

Toxics In Water and Sediments:

104 As stated on page 4-10 of the Draft EIS, "(a)lthough concentrations of volatile compounds are relatively low in the Ohio River system, any increase in concentration would be of significant concern because of the high toxicity of some of these compounds." Discussion of this statement is inadequate. We ask that the following information be provided: a listing of the toxic compounds found in the Ohio River system, the pre-project concentrations of these compounds after installation of hydropower; the anticipated effect of these concentration changes on human health and the environment, and the source of these compounds.

105 On page 5-31 of the Draft EIS, FERC recommends that hydropower developers "... sample river sediments and bank soils that will be disturbed during construction, or by erosion during operation, to determine the presence of chemical contamination." We reiterate the need for sediment sampling and testing. If the sediment is found to be moderately or heavily polluted, toxic or hazardous, or if the material is to be disposed of in a wetland area, the developer must obtain the proper permits prior to dredging and disposal. Sufficient time should be allowed for the developer to plan and conduct the sampling and testing properly and to arrange for safe and proper disposal. This timetable should be incorporated into the FERC license.

104. Concentrations of toxic compounds in the Ohio River basin are monitored by ORSANCO. The discussion of ORSANCO monitoring results has been expanded in Section 3.1.3.

The only field data on volatilization of organic compounds at Ohio River Basin dams are from the Ashland oil spill in early 1988. The few data collected above and below Monongahela L&Ds 2 and 3 and New Cumberland dam were inconclusive. Chloroform may be a special concern because (1) it is the compound for which the most criteria exceedances occur in the Ohio River and (2) it is highly volatile and therefore likely to be removed by volatilization at the dams. Text has been modified to include a reference to chloroform in Section 4.1.1.2.

105. Text has been modified. As stated in recommendation 6 of Section 5.4.2.4, the developer must file a sediment and spoil testing and disposal plan 90 days prior to the scheduled start of any land disturbance activities. The plan must contain a timetable for testing and safe disposal of all contaminated material. This plan is to be developed in consultation with appropriate federal, state, and local agencies.

RATING SYSTEM CRITERIA.

a. Rating the Environmental Impact of the Action.

(1) LO (Lack of Objections). The review has not identified any potential environmental impacts requiring substantive changes to the preferred alternative. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposed action.

(2) EC (Environmental Concerns). The review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact.

(3) EO (Environmental Objections). The review has identified significant environmental impacts that should be avoided in order to adequately protect the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). The basis for environmental objections can include situations:

(a) Where an action has the potential to violate a national environmental standard;

(b) Where the Federal agency violates its own substantive environmental requirements that relate to EPA's areas of jurisdiction or expertise;

(c) Where there is a violation of an EPA policy declaration;

(d) Where there are no applicable standards or where applicable standards will not be violated but there is potential for significant environmental degradation that could be corrected by project modification or other feasible alternatives; or

(e) Where proceeding with the proposed action would set a precedent for future actions that collectively could result in significant environmental impacts.

(4) EU (Environmentally Unsatisfactory). The review has identified adverse environmental impacts that are of sufficient magnitude that the proposed action must not proceed as proposed. The basis for an environmentally unsatisfactory determination consists of identification of environmentally objectionable impacts as defined above and one or more of the following conditions:

(a) It is highly probable that a violation of national environmental standards will occur;

(b) There are no applicable standards but the severity, duration, or geographical scope of the impacts associated with the proposed action warrant special attention; or

(c) The potential environmental impacts resulting from the proposed action are of national importance because of the threat to national environmental resources or policies or for some other reason.

b. Adequacy of the Impact Statement.

(1) "1" (Adequate). The draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

(2) "2" (Insufficient Information). The draft EIS does not contain sufficient information to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS which could reduce the environmental impacts of the action. The inadequate information, data, analyses, or discussion should be included in the final EIS.

(3) "3" (Inadequate). The draft EIS does not adequately assess the potentially significant environmental impacts of the action, or the reviewer has identified new, reasonably available, alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS which should be analyzed in order to reduce the potentially significant environmental impacts. The inadequate information, data, analyses, or discussions are of such a magnitude that they require full public review at a draft stage. This rating constitutes a finding that the draft EIS does not meet the purposes of NEPA and/or the Section 309 review, and thus must be formally revised and made available for public comment in a supplemental or revised draft EIS.

ODNR

July 6, 1988

Ms. Lois D. Cashell, Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol St., N.E.
Washington, D.C. 20426

88 JUL 20 PM 3:57

RE: FERC Docket No. EL 85-19-114

Dear Ms. Cashell:

The Ohio Department of Natural Resources (ODNR) has reviewed the Hydroelectric Development in the Upper Ohio River Basin Draft Environmental Impact Statement and have the following comments: 106

These comments were generated by an inter-disciplinary review in consultation with the Division of Wildlife and other Divisions of the Department. These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), the National Environmental Policy Act and other applicable laws and regulations.

The ODNR concurs with the Federal Energy Regulatory Commission's selection of Alternative 4 as the preferred alternative. Under this alternative, four projects, Allegheny L & D No. [illegible], Allegheny L & D No. 3, Montgomery, and Muskingum L & D No. 3 would be removed from the list of 19 proposed hydropower sites. The remaining 15 projects should not cause significant unavoidable impacts. Alternative 4 would avoid all major impacts to the target resources of fish habitat, recreation and wetlands, etc. The Federal Energy Regulatory Commission's approval to issue licenses for the remaining 15 projects should insure the enhancement of recreational facilities that would provide access to rivers, fishing piers, walkways, etc.

106. Comment noted. Based on information filed by the applicant at Allegheny L&D No. 3, staff's analysis in the FEIS concludes that development of hydropower at this site can occur in an acceptable environmental manner. Revisions to the text for this project has been made and the conclusions for staff's preferred alternative has been changed.

Ms. Lois D. Cornell
July 6, [illegible]
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Thank you for the opportunity to provide these comments. Should you have any questions, please contact Mr. Dave Bergman, Environmental Review Section of this office at (614) 265-6410.

Sincerely,

Michael Cradr [illegible]

Dr. Michael D. Cradr, Chief
Office of Outdoor Recreation Services

[illegible]

cc: State Clearinghouse
Clayton Lakes, Chief
Division of Wildlife
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Toward A Cleaner Environment

Richard F. Celeste
Governor

July 1, 1988

Ms. Lois D. Cashell
Acting Director
Federal Energy Regulatory Commission
825 North Capitol Street, NE
Washington, D.C. 20426

RE: FERC Docket Number EL85-19-114

Dear Ms. Cashell:

The Ohio EPA has received and reviewed the Draft Environmental Impact Statement (DEIS) entitled Hydroelectric Development in the Upper Ohio River Basin. These comments are limited to the water quality issues discussed in the DEIS.

The alternatives investigated in the DEIS include (1) operating the hydroelectric plants as proposed by the license applicants, (2) operating the hydroelectric plants to maintain a minimum instream dissolved oxygen (DO) concentration of 5.0 mg/l, (3) operating the hydroelectric plants to maintain a minimum DO concentration of 6.5 mg/l and (4) operating the hydroelectric plants to maintain a minimum DO concentration of 6.5 mg/l and provide protection for the other target resources identified in the DEIS. The FERC staff recommends selection of alternative 4.

107 The Ohio EPA believes that a fifth alternative should be investigated; the operation of the hydroelectric projects to maintain existing DO concentrations which currently exceed the 6.5 mg/l minimum value identified in alternatives 3 and 4. We understand that insufficient data are currently available to adequately assess the DO systemwide, but believe an investigation of this type is essential to the alternatives analysis and should be included in the EIS. To collect sufficient data to conduct the analysis, we recommend that licensees be required to conduct pre-construction DO and temperature monitoring both upstream and downstream of proposed hydroelectric sites. Data collection should continue for a time period sufficiently long to define pre-development conditions. The duration of the data collection will vary depending on the climatic and hydrologic conditions which occur during the data collection period. An accurate assessment of DO and temperature conditions under moderate to low-flow conditions is appropriate.

107. See reponse to comment #39.

108 The water quality model designed for the DEIS can not accurately predict post-construction instream DO concentrations because the model was not adequately calibrated to existing conditions. More detailed comments on this topic are provided on the attached page.

108. See responses to comments #112-121.

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Ms. Lois Cashell
July 1, 1988
Page 2

The Ohio EPA indicated in a letter sent to FERC on July 8, 1987 that the possibility of increased concentrations of volatile compounds due to hydroelectric dev lopment was of concern to this agency. While the DEIS does acknowledge the significance of any increase in the concentrations of the compounds in the Ohio River, no significant discussion is included. Additional information, analysis and discussion should be added including estimates of volatilization rates, and predicted impacts on instream concentrations. 109

109. See response to comment #104.

The Ohio EPA agrees with the assessment that mechanical and/or artificial aeration not be considered as an alternative to maintain instream DO concentrations. The technology has not been proven and it would be unwise to rely on such unproven methods to maintain water quality in the Ohio River at this time. 110

110. Comment noted.

In summary, the Ohio EPA agrees with the target resources identified for assessment in the EIS. However, insufficient data prevent the detailed analysis which is needed to accurately assess and predict impacts to water quality in the Ohio River caused by the construction of hydroelectric power plants. Additional data is needed for use in the water quality model calibration and the assessment of impacts on the volatilization of organic compounds prior to the selection of the operating guidelines for the hydroelectric power plants. 111

111. Staff believes that the model used for the EIS is appropriate for analysis of impacts of changes in dam aeration resulting from hydropower development. See responses to comments #112 through #121.

We appreciate the opportunity to provide these comments. If you have any questions regarding our comments please contact Ms. Colleen Crook at (614) 644-2856.

Sincerely,

Andrew Turner

Andrew Turner, Ph.D., P.E.
Chief
DIVISION WATER QUALITY MONITORING AND ASSESSMENT

AT/CSC

cc: Randy Bournique, Ohio EPA-DWQMA
William Franz, USEPA-Region V
Dave Bergman, Ohio DNR-Outdoor Recreation Services
John Marshall, Ohio DNR-Division of Wildlife
Peter Tennant, ORSANCO
Paul Hill, West Virginia DNR
Carl Wilhelm, OEPA-Planning

DETAILED COMMENTS ON THE WATER QUALITY MODELING PRESENTED IN DRAFT ENVIRONMENTAL IMPACT STATEMENT

1) The model used assumes complete mixing occurs in the river. This is an unrealistic assumption for the Ohio River. Even under the low flow conditions simulated, the amount of background flow relative to discharger flow is extremely large and would preclude, under most conditions, complete mixing. 112

2) It is unclear how much data were incorporated into the above-dam deficit versus below-dam deficit relationships. Page 4-1 states that this information was collected primarily under the summer low flow conditions. Does the observed linear correlation hold under the moderate flow levels simulated? 113

3) Page B-1 states "Benthic oxygen demand was not modeled separately from other BOD sources, but the effects were included as part of the overall BOD." It is not clear what this statement means or how the benthic demand was incorporated into the analysis. This discussion should be expanded. 114

4) It is indicated on page B-3 that there were significant differences observed between the predicted and the observed D.O. saturation values. This can have a significant effect on the calibration of the model and any impacts projected by the model. 115

5) There is no support for the statement on page B-9 which says that algal production is low when instream D.O. concentrations are low. The reverse may be true which would indicate that algal productivity is an important factor which must be considered. 116

6) Page B-13 indicates that the model calibration was accomplished by including "...the addition of substantial amounts of BOD...". Unless the BOD inputs can be better quantified, the inclusion of the additional loads for curve fitting purposes is inappropriate. 117

7) The discussion of model calibration on page B-13 reports the use of BOD decay rates as low as 0.1 day^{-1}. The lowest BOD decay rate recommended in the USEPA Simplified Method Guidance is 0.2 day^{-1}. This rate is recommended for rivers downstream of facilities with advanced wastewater treatment which is generally not the case for the Ohio River. A higher rate would seem more appropriate. 118

8) The explanation of the differences between the predicted and observed aeration at several of the simulated dams (page B-13) is not adequate. If the measurements were made at the low flows as stated, then the equations should be able to simulate instream conditions without further adjustment. It is assumed that part of the data which were used in the dam aeration analysis was collected in 1983. If not, the data set used for calibration may not be appropriate. 119

112. The water quality model calculates a cross-sectionally averaged (one-dimensional) value of DO and assumes that waste loads are uniformly mixed across the river instantly. While this assumption is known not to be completely true, it is reasonable for the analyses done for the EIS. Modeling of mixing zones below major wastewater discharges may show some differences in DO and BOD concentration across the channel, but the fact that most of the BOD in the model is from non-point sources (see response to comment #100) indicates that such differences are not expected to be large enough to be of biological concern.

113. Appendix B has been modified to include tables showing the dam aeration data used in the model (including DO concentrations and deficits, flow, and temperature, as available). The range of flows under which the data were collected generally overlaps the range of flows modeled.

114. Appendix B (Section B.2.1.1) has been modified to clarify how benthic BOD is treated.

115. Differences between actual and modeled DO saturation concentrations were discussed as a possible explanation of apparent supersaturation at some dams. There is no conclusive evidence that actual DO saturation concentrations in the Ohio River basin do or do not vary from standard values used in modeling. The methods used for estimating DO saturation concentrations are widely used in water quality models.

116. See response to comment #101.

117. See response to comment #100.

118. The BOD decay rates (k1) used in the model range between 0.1 and 0.2 $days^{-1}$. Measured values of BOD decay rates that include benthic BOD for deep rivers are presented by USEPA (1985; reference in Appendix B). These values range from less than 0.1 to about 0.5. A low value of k1 is appropriate for this model because the major sources of BOD are not wastewater discharges.

119. The differences between measured and modeled dam aeration rates shown in Figure B-8 are a result of the natural variability in aeration. Because the models for dam aeration were statistically based on all the available data, they cannot be expected to exactly reproduce aeration rates for any individual measurement. An analysis of the uncertainty in the statistical dam aeration models has been added to Appendix B. This uncertainty analysis indicates that the uncertainty resulting from the dam aeration models is low compared to other uncertainties inherent in water quality modeling.

9) Information provided in Section 3.5.2 indicates that approximately 58 municipalities and over 100 industrial entities discharge wastewater to the Ohio River between Pittsburgh and Gallipolis. Only 11 dischargers were include in the water quality modeling. This seems inadequate. Inclusion of some of these dischargers in the model may preclude the need to 'invent' substantial additions of BOD. 120

10) Figure B-8 illustrates that no DO data were included in the calibration of the water quality model from approximately RM 140 to RM 255. The model can not be declared calibrated with such a paucity of data. 121

Based on the comments above, there does not appear to be sufficient data available to realistically model the Ohio River. Conclusions based solely on the modeling analysis presented should not be used. The inclusion of a sensitivity analysis would improve the report, but likely not to the point where the modeling results would present a representative picture of what is actually going on in the Ohio River. 122

120. All major dischargers (dischargers included in EPA's Permit Compliance System) that are required by state permits to monitor effluent BOD concentrations were considered for inclusion in the model. Some major dischargers may have been dropped because their BOD loadings were negligible. There are many major dischargers, however, that the states do not require to monitor BOD discharges. Minor dischargers were not included in the model because their individual contributions to BOD are generally negligible.

121. See response to comment #70.

122. The modeling analysis used does not purport to simulate all the detailed processes and rates that affect DO concentrations in the study area. The purpose of the model was to simulate effects of changes in one component of the DO budget, which is dam aeration. Although it would be preferable to have a model that accurately simulates all components of the DO budget, there is not sufficient data available to justify such an approach. Because the model accurately simulates changes in dam aeration resulting from hydropower, and demonstrates how these changes affect downstream DO concentrations, its results are appropriate for determining hydropower impacts on DO.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
Post Office Box 2063
Harrisburg, Pennsylvania 17120

June 21, 1988

Bureau of Water Quality Management

717-787-2666

Lois D. Cashell, Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, NE
Washington, D.C. 20426

Re: DER File No. 32[illegible]

Dear Ms. Cashell:

We have reviewed the May 19, 1988 Draft Environmental Impact Statement (DEIS) entitled "Hydroelectric Development in the Upper Ohio River Basin," FERC Docket No. EL85-19-114, covering Ohio, Pennsylvania, and West Virginia.

Pennsylvania State Water Quality Standards require that operation of these proposed projects do not result in violation of criteria which would adversely impact on designated water uses. The major parameter of concern in this regard is dissolved oxygen. Pennsylvania dissolved oxygen criteria for the streams affected by these projects are minimum daily average 5.0 mg/l and no value less than 4.0 mg/l (25 PA Code, Chapter 93, Water Quality Standards). 123

We appreciate the opportunity to comment on this document and anticipate review of the Final Environmental Impact Statement.

Sincerely,

Daniel B. Drawbaugh
Acting Director

88 JUL -6 PM 4:01

123. Comment noted. The recommended alternative is designed to maintain DO concentrations of 6.5 mg/L anywhere in the rivers where DO concentrations would be affected by the proposed projects.

COMMONWEALTH OF PENNSYLVANIA
July 15, 1988

SUBJECT: Comments o. DEIS for Hydroelectric Development in the Upper Ohio River Basin. FERC Docket No. EL 85-19-114.

TO: George Taylor
Federal Energy Regulatory Commission

FROM: Steve Kepler, Fisheries Biologist
Division of Environmental Services
Pennsylvania Fish Commission

The subject document has been reviewed by the PFC staff and the following comments should be included in the final EIS.

88 JUL 20 PM 2:34

General Comments:

As was discussed in the numerous scoping meetings the exclusion of numerous projects from the EIS makes the document of little use in evaluating cumulative impacts for the basin. 124

The use of existing water quality data in developing models gives question as to the reliability of the model. The lack of additional water quality parameters and the effect the dams have on volatilization of chemicals by the dams have not been adequately addressed. 125

Fishing impacts were considered throughout the DEIS as being moderate or minimal. If every hydropower facility on the river system were to have "moderate or minimal" fishery impacts, then the overall "cumulative" effects would be substantial. 126

Recreational use for the Ohio River system is a part of the study which needs to be studied more extensively. Use of existing data for the Pennsylvania section, does not give a true picture of the existing recreational trends. 127

Specific Comments Water Quality - Page 3-33

Each of the navigation dams in the study area aerates differently. The effects of changing aeration (hydropower development) at different dams in the system are clearly cumulative and interactive. 128

Differences in DO caused by changes in aeration at one dam affect not only the pool immediately downstream of that dam but also the aeration rate of the next downstream dam, etc. These statements, contained in

124. See responses to comments #32 and 33.

125. Compared to most rivers, there is a large base of existing water quality data for the Ohio River Basin. These data were used to parameterize and calibrate the water quality model (see Appendix B). Additional data were collected by the hydropower applicants in the summer and fall of 1987 and used to model dam aeration. The responses to comments #104 and #140 discuss effects of projects on concentrations of toxic compounds. Because mechanisms by which the proposed projects could affect other water quality parameters are unknown, no impacts to other parameters are expected.

126. See response to comment #236. Staff assumes that the regulation and management of impacts of the recreational fishery catches on gamefish populations will be handled effectively by the responsible resource agencies, with appropriate measures taken to reduce angler harvest, if deemed necessary.

127. Staff utilized the best available information for summarizing the existing recreational use in the Pennsylvania portion of the Ohio River system under study. Data sources included recreation use statistics from the Corps, a summary of recent fishing license sales and boat registrations, and a 1980 PFC Fishing and Boating Inventory.

128. See response to comment #37.

the DEIS show the need to include all the potential hydropower sites for the basin. This cumulative effect could also cause reductions in volitalization of other chemical components of the watershed. Without more intensive water quality monitoring at all the sites, the PFC is concerned about potential problems.

All dissolved oxygen data is presented as average concentrations. These values do not give the needed information to draw proper conclusions. Data which was used for the modeling needs to be included to help determine the models validity. More minimum DO concentration data is needed to show what the overall effect will be on the fish and aquatic life of the system. The PFC has recommended that for hydropower projects to be licensed there should be no water quality degradation. 129

129. The results of the DO model are cross-sectionally averaged concentrations. To determine the recommended spill flows, the model was used to simulate conditions (high temperatures, low flows, no primary productivity) that would result in near-worst case DO concentrations. The spill flows are designed to prevent impacts to fish populations under these conditions. See response to comment #39 regarding anti-degradation of DO concentrations and evaluation of preproject DO concentrations.

Turbine aeration was mentioned as a possible method to maintain existing DO conditions, yet this procedure has not been proven on the low-head dams on the Ohio River system. 130

130. Comment noted. If turbine aeration can be shown feasible, it is recommended as a way to increase power production without degrading water quality (see recommendation 8, Section 5.4.2.1).

Page 5-10
The proposed operations at fixed crest dams would decrease the upstream pool elevations when operating. These reductions in pool elevations would cause increases in river velocities of up to 40 percent. Was this taken into consideration for cumulative DO effects when modeling? Additionally, without consideration of Allegheny L&D's 5,6,8, and 9 how can overall effects be evaluated? 131

131. The model indicates that the predicted increases in water velocities cause little change in DO concentrations. The model analyses for the proposed projects assumed that the licensed projects (Allegheny L&Ds 9, 8, 6, and 5, Racine, and Hannibal) were operating with either spill flows required in their licenses or required by the Corps.

Fish Entrainment/Mortality

Sufficient data for fish mortality caused by hydropower development is not available. Page 5-6, using Racine Hydropower Plant data on fish mortality, states that "occasional individuals are entrained", which is approximately 39 gamefish/hour or 529,500 gamefish per year. This number of fish if comparable at other sites would cause serious reductions in the populations in the river system. 132

132. Staff believes that although such mortality extrapolations are speculative at this time, they do indicate that fish protection devices may be needed. Staff recommends a plan for measuring the entrainment rates and for testing fish protection devices (see response to comment #49).

Entrainment of fish is another situation for which no data is available. Each of the dam sites are different; therefore studies will be different. Angled trash racks/fish screens have questionable value, especially with expected intake velocities at some of the proposed sites. With the "migratory" gamefish populations in the river (ie. walleye, sauger), seasonal fish entrainment/impingement could be a real problem. Pre - and post operation fishery studies will have to be mandatory to evaluate the above situations. 133

133. See response to comment #49 concerning the entrainment data and its analysis. Pre- and post-operation fishery studies are included in recommendation 3, Section 5.4.2.2.

Recreational Use/Loss

Again insufficient information is available for assessing the recreational use/loss which would be caused by development. Creel surveys should be conducted before as well as after construction of any project. In addition, facilities should be constructed to enhance the recreational use of the area. 134

Other Environmental/Physical Consequences

Wetland and fish habitat loss due to pool elevation changes will probably be greater than that predicted by the DEIS. At fixed crest dams, pool elevations could change up to three feet causing damage to wetland areas and the shallower fish habitat. All of these factors need to be addressed in more detail. 135

srh

cc: FFC - Arway
FFC - Young
FWS - Kulp
COE - Miller

134. Recommendation 6 of Section 5.4.2.3 specifies that developers should monitor recreation use at their project sites in order to assess the adequacy of their recreational facilities. Creel studies are specifically recommended before and after project construction as part of this monitoring effort.

135. Staff agrees that pool elevation levels at fixed-crest dams could possibly change as much as 3 to 4 feet. The best available data were used to calculate elevation changes for each site where wetlands occurred and could be affected. The calculated elevation changes are for specific sites. Monitoring of wetlands for 5 years is recommended in Section 5.4.2.4, with mitigative measures subject to approval of appropriate federal and state agencies.

DEPARTMENT OF CULTURE AND HISTORY

STATE OF WEST VIRGINIA
ARCH A. MOORE, JR., GOVERNOR

NORMAN L. FAGAN COMMISSIONER

June [illegible], 1988

Ms. Lois D. Cashell
Acting Secretary
FERC
825 N. Capitol Street, N.E.
Washington, D.C. 20426

RE: [illegible] Hydroelectric Development
FERC [illegible]

Dear Ms. Cashell:

Our office has reviewed the draft EIS for Hydroelectric Development on the Upper Ohio River Basin (FERC docket no. [illegible]). 136

In West Virginia we have been dealing with each project applicant at specific sites needing attention on cultural resources. In all cases our concerns about cultural resources have been met or will be prior to project implementation.

Thank you for the opportunity to review this document.

Sincerely,

William C. Farrar

William C. Farrar
Deputy State Historic Preservation
Officer

WCF/MED:[illegible]

88 JUL -6 PM 3:21

THE CULTURAL CENTER / CAPITOL COMPLEX / CHARLESTON, WEST VIRGINIA / 25305 / 304-348-0240

136. No response required.

STATE OF WEST VIRGINIA
DEPARTMENT OF NATURAL RESOURCES
CHARLESTON 25305

ARCH A. MOORE, JR.
Governor

RONALD R. POTESTA
Director

ROBERT K. PARSONS
Deputy Director

July 21, 1988

Ms. Lois D. Cashell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

RE: Hydroelectric Development in the Upper Ohio River Basin; FERC Docket No. EL85-19-114; Draft Environmental Impact Statement (DEIS)

Dear Ms. Cashell:

The West Virginia Department of Natural Resources has completed a review of the above referenced document issued May 10, 1988 by the Federal Energy Regulatory Commission (FERC). By formal request dated June 22, 1988, the Department received an extension of the comment period to July 25, 1988. Today's comments are a result of our final analysis of the draft.

The FERC staff evaluated and made recommendations on licensing 24 proposed hydroelectric projects at 19 sites in the Upper Ohio River basin. All of the projects are at existing dams on the Allegheny, Monongahela, Tygart, Muskingum and Ohio rivers. The DEIS presents the following five alternative actions by FERC concerning licensing of hydroelectric projects:

1. licensing projects at all 19 sites as proposed by developers;

2. licensing projects at all 19 sites with restrictions requiring operational modifications to maintain downstream dissolved oxygen (DO) levels at 5 mg/l.;

3. licensing projects at all 19 sites with restrictions requiring operational modifications to maintain downstream DO levels at 6.5 mg/l.;

4. licensing projects at 15 sites with restrictions requiring operational modifications to maintain downstream DO levels at or above 6.5 mg/l; and

5. no action (i.e., not issuing licenses at any of the 19 sites under consideration),

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J-70

Ms. Lois D. Cashell
Page 2
July 21, 1988

The Department is not in complete agreement with any of alternatives presented. Alternative four is the most acceptable, but requires considerable modification. The following are general and specific comments regarding the subject document.

General

1. The Ohio and Monongahela rivers are listed by the Department of Natural Resources as high quality streams and as such are regulated by the State's anti-degradation standard. With respect to hydropower facilities, the anti-degradation standard requires that pre-existing, pre-project dissolved oxygen (DO) conditions be maintained after the project becomes operational. The Department currently recommends that hydropower applicants conduct DO and temperature monitoring above and below the project prior to operation and for a minimum one year period. The data gathered is used to establish existing conditions which are not to be degraded by hydrogeneration. After operation, monitoring above and below the project is continued in order to sustain pre-existing conditions. The maintenance of DO at or above concentrations of 6.5 mg/l, as per the recommended action, will violate the State's anti-degradation standard and in addition, bring a reduction in the current standards for resource protection. 137

2. The operation of hydropower facilities should in no case result in the degradation of pre-project DO conditions as established by DO studies. The Department will require that the developer use the means necessary (air injection, alteration of spill flow or porject shutdown) to maintain DO concentrations. If a project continuously degrades DO, the Department has the option to withdraw State 401 Certification. 138

3. The DEIS failed to evaluate the potential impacts of reduced volatilization of contaminants and the increased re-suspension of contaminated sediments. The impacts of both should be further assessed prior to the final EIS. 139

4. Reductions in pool levels at fixed crest dams, which is likely to occur when the hydropower facility is in operation, may influence groundwater flow from adjacent aquifers. The reduction in hydrostatic pressure resulting from lower pool elevation may increase the groundwater movement into surface 140

137. See response to comment #39.

138. See response to comment #39.

139. The response to comment #104 discusses volatilization of contaminants. The potential for impacts of resuspension of contaminated sediments is highly site-specific; as stated in Section 4.1.1.3, it is expected that most sites will not contain contaminated sediments. Site-specific analyses for sediment contamination have not been included in the FEIS because project developers will be required to comply with Corps dredging permit requirements and to file a sediment testing and disposal plan (recommendation 6, Section 5.4.2.5) with FERC and the states. Compliance with these requirements should prevent significant impacts from sediment contamination.

140. A discussion of water quality effects of increased groundwater inflows at pools above fixed-crest dams has been added to Section 4.1.1.2. Since this issue was not raised during scoping, detailed analyses have not been conducted.

waters. If the adjacent aquifer is contaminated, the contaminated groundwater could be introduced into surface waters. Further consideration should be given to those pools which will be affected by lower elevations with emphasis placed on those where there is or has been heavy industrialization. 140

5. Dissolved oxygen conditions should be assessed throughout the basin rather than just at proposed project locations. 141

6. The impacts associated with the changes in river hydraulics during hydropower generation (i.e. alteration of flow patterns and the effect on aquatic habitat and drinking water intakes) were not thoroughly evaluated in the DEIS. Further consideration and evaluation should be given to these potential impacts. 142

7. The end result of the final EIS should not be a simultaneous licensing of all projects and the subsequent concurrent construction of all the hydroelectric facilities. If all projects are licensed, construction of the facilities should be staggered. 143

The next general comments deal with basin-wide recommendations (5.4.2) made by FERC staff. These recommendations are addressed in the general comments due to the far-reaching nature of their impacts.

1. Basin-wide Recommendations

5.4.2.1 Recommendations on Water Resources

1. Current West Virginia regulations concerning State 401 Certification require maintenance of pre-project DO conditions on those streams considered High Quality. The Ohio and Monongahela rivers are classified as High Quality streams and FERC action permitting hydropower operations to degrade DO levels to 6.5 mg/l. will violate this regulation. 144

The Department does not concur that all staff's recommendations concerning spillage were based on accurate or adequate data. The Department objects to the "no spillage" provisions included for projects at Opekiska Lock and Dam (L and D), Willow Island L and D, Belleville L and D, and Gallipolis L and D. The Department recommends that the 145

141. Dissolved oxygen concentrations were simulated throughout the pools between dams in the study area. Although the graphs showing model output plot only concentrations at the beginning and end of each reach, the model calculates the minimum DO concentration in each reach. This minimum concentration in each reach was used to evaluate impacts and assure compliance with DO criteria.

142. Section 4.1.5.1 has been modified to include a discussion of effects of changes in hydraulics on water intakes. Development of hydraulic models during design of other hydroelectric projects has successfully maintained acceptable flow conditions during hydropower generation.

The effects of changes in tailwater hydraulics on fish habitat was extensively discussed in the Section 4.1.2.2 of the DEIS. Entrainment of fish from hydraulic changes at the intake was discussed in Section 4.1.2.3.

143. The suggestion that construction of licensed projects should be staggered would extend project construction over a longer period than necessary and increase costs due to inflation. Staggered construction of hydroelectric projects in the basin is, therefore, not a feasible option for mitigating the recreational impacts of concurrent construction. The large number of projects as well as the extended construction period make this suggestion prohibitive. Furthermore, it is highly unlikely that all of the licensed projects would be built during the exact same time frame, as project financing and final approvals of project plans will likely transpire during different time periods. The provision of temporary fishing access facilities is the best means of mitigating recreational impacts during construction.

144. See response to comment #39 concerning maintenance of preproject DO concentrations.

145. Staff believes that sufficient field data have been obtained to quantify aeration rates at the dams. The field observations used for each dam aeration model have been added to Appendix B (Table B-1). The recommendation for no spillage at Opekiska L&D was made because the submerged discharge at Opekiska, during summer, discharges cold water from the bottom of the stratified Opekiska pool into the bottom of the Hildebrand pool, causing stratification in the Hildebrand pool (Section 4.1.1.1; see discussion of assessment results for Case 2). The hydropower plant at Opekiska would withdraw from all elevations of the Opekiska pool and prevent stratification in the Hildebrand pool; the site-specific recommendations for Opekiska in Section 5.4.3 have been amended to include withdrawal from the entire water column of the Opekiska pool. Because staff believes that this benefit of hydropower at Opekiska, where thermal stratification is a more common and severe problem than in other pools, is especially important at low summer flows, no spill flow is recommended.

following spillage requirements be included when licensing the above projects in order that aeration of the dam be further studied: Opekiska L and D, 500 cfs; Willow Island L and D, 5,000 cfs; Belleville L and D, 5,000 cfs; and Gallipolis L and D, 6,000 cfs. After such a study on spillage flow (2 years seems appropriate), final spillage recommendations may be determined.

2. The Department should be included as a regulatory agency which would notify developers to increase or decrease spillage. 146

3. In addition to the Corps and ORSANCO, the appropriate State Fish and Wildlife and Water Resource agencies should be notified of any emergency operational modifications by hydropower facilities. Any other operational modifications are subject to review and mutual agreement between the developer, the Corps and the State agencies. 147

4. The Department contends that developers should monitor pre-project DO conditions for at least one year prior to operation to document pre-project conditions. Absence of pre-project monitoring requirements is in conflict with the State anti-degradation policy (see general comment above). 148

5. The Department recommends that the developers be required to consult with it when developing water quality monitoring plans. 149

6. The Department should be consulted by the developer when designing streamflow gages to measure flow through turbines and bypass channels. In addition, all flow data should be made available to the Department upon request. 150

7. A basin-wide water quality management group should include the Water Resources agencies form each state in the basin. The water quality group should represent the interests of both state and federal agencies and participation should not be limited to a single group or agency. 151

8. Developers should be required to consult with the appropriate State Fish and Wildlife and Water Resource agencies in addition to ORSANCO and the Corps when developing 152

The water quality analyses clearly indicate that spillage at the deeply-submerged discharge gated dams on the Ohio River (Willow Island, Belleville, and Gallipolis) provides no more aeration than can be expected from hydropower turbines. For example a DO deficit of 2 mg/L is predicted to be reduced by only 0.2 mg/L at Willow Island and Belleville, and by 0.4 mg/L at Gallipolis, with no hydropower generation. The spill flows recommended in this comment would have even smaller effects on DO concentrations, and the effects would not be distinguishable from natural variability if studied.

146. Staff agrees. The text for this recommendation has been modified to include appropriate state water quality management agencies.

147. Staff agrees. The text of this recommendation has been modified to include appropriate state fish and wildlife agencies.

148. See response to comment #39.

149. Staff agrees. The text for this recommendation has been modified to include USFWS and appropriate state water quality management agencies.

150. Staff disagrees. The text for this recommendation has been modified, however, to allow state water quality management agencies to request flow data.

151. Staff agrees. The text for this recommendation has been modified to include state water quality management agencies.

152. Staff agrees. The text for this recommendation has been modified to include USFWS and appropriate state fish and wildlife and water quality management agencies.

recommendations for changes in spill flow to include artificial aeration.

9. No comment.

5.4.2.2 Recommendations on Aquatic Ecology and Fisheries

1. The Department contends that intake designs should include provisions for installation of devices to measure fish passage (see below). 153

2. The Department remains concerned regarding entrainment mortality (EM). Entrainment studies conducted in the Ohio River basin to date are not conclusive and many statements in the DEIS concerning EM are not substantiated. Spatial and temporal fish passage studies have not been conducted in the fall, winter and early spring. Conclusions and assumptions concerning qualitative and quantitative fish passage at projects at navigation dams are unsubstantiated. 154

The Department contends that studies which adequately estimate turbine passage (spatial and temporal) are needed to determine the magnitude of the mortality problem. Some techniques to estimate passage (e.g., that used at the Greenup facility; No. 2614) show promise of providing adequate fish passage estimates. Obviously, new projects should be designed to accommodate sampling equipment. The Department believes that effective fish guidance and/or protection devices in the basin will be extremely costly to design, install and test. The Department believes that adequate passage estimates are needed to determine if installation of fish protection or deterrent devices are cost effective. The Department has contended for some time that adequate monetary compensation of state resource agencies may be the only equitable solution to EM problems. The Department has submitted a plan for the use of such funds for resource enhancement on the Ohio River. Similar plans for other affected rivers could be developed by the appropriate state wildlife agencies. The Department believes that the "reinvestment" of such funds in the form of fish stocking, habitat protection, habitat development, access improvement, and other activities in the affected waters can result in effective EM mitigation for the resource and its users. The rivers in question are public resources. Development of the

153. Staff included a recommendation in the DEIS that entrainment rates be monitored (Section 5.4.2.2, recommendation 4). The text of recommendation 1 stating that intakes be designed for future fish protection devices has been modified to include the additional provision for installation of devices for measuring fish passage.

154. See response to comment #49 concerning substantiation of staff's conclusions regarding entrainment. Deficiencies in the entrainment studies conducted in the Ohio River Basin were highlighted, including the lack of data from seasons other than summer. Recommendation 4 of Section 5.4.2.2 specifically addresses measurement of entrainment rates. Staff recognizes that there was confusion between the two forms of "monitoring" recommended (see response to comment #65). See response to comment #54 for discussion of the conflicting views of compensation and the staff's approach. Staff believes that its recommendations for measuring entrainment are in accord with this comment.

Ms. Lois D. Cashell
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rivers for corporate profit is acceptable provided that any adverse impacts to the resource are prevented or adequately mitigated.

It is therefore recommended by the Department that primary initial emphasis be placed on obtaining adequate estimates of annual fish passage at the proposed facilities. A mortality rate may then be assumed and the impact of EM assessed. Should it be deemed cost effective at that time, a bioengineering facility(s) could then be established. In the interim, state fish and wildlife agencies should receive annual monetary compensation for resource enhancement to compensate for EM (as recommended in the DEIS).

3. FERC staff concludes that the high reproductive potential of gizzard shad and freshwater drum dictates that losses from EM will not impair populations of these species. Ohio River basin streams considered in the DEIS are large, complex aquatic ecosystems. Many natural and man-induced factors affect them. These include (but are not limited to) commercial navigation, industrial water uses and discharges, climatic extremes, long term water quality trends, and domestic and industrial pollution. In any given year, these factors individually, cumulatively, and/or synergistically influence populations of aquatic life. The degree of impact resulting from the addition of another mortality factor (in this case, EM) is impossible to separate from other factors. In view of what is currently unknown regarding the above factors, EM could very well adversely impact gizzard shad or freshwater drum populations in any given year. 155

Staff concludes that a plan for monitoring fish populations be implemented to establish the effectiveness of compensatory and mitigative measures. It is the opinion of the Department that while studies to monitor fish can be designed and effected, attributing population variations to a single impact will be cost prohibitive if not impossible. Attempting to determine the effect of a specific mitigative measure by monitoring fish populations (which are subject to a myriad of influencing factors in addition to the "target" factor in question) is unrealistic. To be effective, such studies must consider the impact of all factors influencing the fish populations in question in order that the impact of the mitigative measures in question may be identified. The

155. Staff recognizes the complex nature of the aquatic ecosystems of the upper Ohio River basin and the multiple influences on fish population success that the comment relates. Entrainment mortality will be one more source of potential biological damage. Nonetheless, there is an abundance of scientific evidence that attests to the ability of fish species with high reproductive potential to compensate for relatively high mortality rates in many diverse aquatic systems. The DEIS cited one prominent symposium volume as an example reference. This is not to say that there cannot be year-to-year fluctuations in numbers. Most "forage" species exhibit such fluctuations in the absence of entrainment mortality. When mortality rates become excessive (e.g., during extremely cold winters), it may take several years for the population to rebound. In the meantime, predator populations may have reduced food consumption or switch to alternative prey. Staff concludes, however, that entrainment mortality of shad and drum is unlikely over the long term to be a deciding factor in their population numbers.

Staff did not intend to imply that studies monitoring field populations of fish could be devised and implemented to attribute population variations to a single impact. However, the cumulative impacts of hydropower which this EIS addresses should be reflected in population declines if the collective impacts are significant. Monitoring field populations provides an indicator of problems, the cause(s) of which must be established through effect-specific studies. Staff reiterates that the cumulative effects of several sources of potential biological damage to fish populations from hydropower requires an integrative monitoring program as well as effects-specific studies and mitigations. Such integrative information need not be in the form of massive ecosystem-wide studies, but can include common indicators shown useful in fishery management such as creel census (see recommendation 3, Section 5.4.2.2).

Department contends that monitoring fish populations to evaluate mitigative measures will provide inaccurate, misleading results while being extremely expensive. Fish population monitoring studies to determine the impact of entrainment should be eliminated as a basin-wide recommendation.

Staff also states that moderate numbers of fish killed or injured by entrainment would contribute to predation by gamefish in tailwaters and thus sustain highly productive predator populations. Navigation dams without hydropower projects currently sustain highly productive predator populations. It has not been demonstrated that the addition of EM to the existing tailwater habitats will significantly increase or "sustain" predator populations in navigation dam tailwaters. 156

156. Staff believes that injured fish will most certainly be consumed by predators and scavengers in the tailwaters. If there is evidence to the contrary (other than a few recorded cases in which the numbers of injured fish temporarily overwhelmed downstream consumers), then staff would be happy to review it. This food supply will contribute to sustenence of those predator/scavenger populations (food eaten could hardly do otherwise). Staff did not assert that this extra food supply would significantly increase predator populations in navigation dam tailwaters as the comment implied. There is evidence, however, that certain predator populations are increased below hydroelectric facilities, a fact attributed to entrainment mortality (e.g., squawfish below dams on the Columbia River; Northwest Power Planning Council, Portland, Oregon, annual reports).

4. Monitoring EM should not be initiated until adequate estimates of annual fish passage are obtained. Due to the nature of the sites, monitoring of entrainment mortality has proven to be expensive with reliable results difficult to obtain. 157

157. Staff agrees with this comment and modified the text in Sections 4.1.2.3.4 and 5.4.2.2) accordingly.

5. As mentioned earlier, the Department considers adequate estimates of annual fish passage a prerequisite for testing/developing fish bypass or protection systems. The Department recommends that at least two years of operation at all facilities be dedicated to obtaining such estimates. Effective development of a bioengineering test facility could then proceed based on spatial and temporal fish passage information. It is recommended that the plan referred to here not be submitted to the Commission until the above-mentioned studies are completed. 158

158. Staff agrees with this comment and modified the text in Sections 4.1.2.3.4 and 5.4.2.2) accordingly.

Staff is extremely vague regarding the bioengineering test facility. It is not stated if the facility will be located at one of the sites considered in the DEIS. No reference is made regarding funding of its development, operation and maintenance. 159

159. See response to comment #49.

<u>5.4.2.3 Recommendations for Recreational Resources</u>

1. The Department basically concurs with this section. The Department recommends that the reference to lighting be 160

160. The text has been modified to incorporate these recommendations.

clarified in order that developers understand that it is to be sufficient to permit night fishing. This will increase the use opportunity at these areas. Access paths from the top of the bank to the multi-level grouted/paved walkways parallel to the shoreline should be included in the required developments. The Department contends such paths should be ca. 100 feet apart (at most projects). This allows anglers to move freely to the area they wish to fish and eliminates conflict with those already fishing. Such paths are currently in place at Willow Island L and D tailwaters and have proven effective.

A major concern on several projects is that insufficient lands for recreational development and mitigation (during construction) are designated as project area. Until physical modeling is completed, the location of recreational developments cannot be determined. Often, lands owned by the U.S. Army Corps of Engineers (COE) on the abutment side of navigation dams are not of sufficient extent to support the recreational developments mentioned in 5.4.2.3.1. The Department recommends that project areas of all proposed projects be reviewed by staff with this issue in mind. The Department contends that this problem is particularly evident at the Hildebrand, Morgantown, New Cumberland, Gallipolis and Tygart projects and that their project boundaries should be increased sufficiently to ensure adequate recreational development and mitigation. 161

Appropriate state and federal fish and wildlife agencies should be granted consultation rights (in addition to "local" resource agencies). 162

2. The Department concurs with this requirement. 163

3. The Department contends that all permanent and temporary in-river fishermen access developments and bypass systems should be included in hydraulic modeling required by the COE. The Department has routinely recommended this action for three basic reasons: 164

   a) To ensure that the location of the developed fishermen facilities would be proximal to currents and eddys (both from the powerplant and the bypass system) that will concentrate fish at locations

161. In the event that sufficient lands are not available for construction of the recreational developments, a recreational compensation plan would need to be filed with the Commission. Off-site lands for recreation compensation are unlikely to have any significant impact on land use provided they conform to local zoning regulations. Compensation for impacts to recreation from project development could include the provision of off-site recreational facilities and/or the upgrading of existing access facilities. The compensation plan would be developed in consultation with the appropriate state and federal agencies and filed with the Commission for approval.

162. Text has been modified to incorporate the recommended changes.

163. Comment noted.

164. Recommendation 3 of Section 5.4.2.3 addresses physical hydraulic modeling of all permanent and temporary in-river fishing access facilities. Developers will be required to file a report with the Commission which discusses the design and results of the hydraulic modeling and documents consultations with the appropriate state and federal agencies.

Staff agrees that all facilities affecting hydrodynamics of the site, including the fisheries facilities, should be included in the modeling done for the Corps.

accessable to anglers using the developed facilities (e.g., a fishing pier should be located where fish can be caught). It is for this reason that the Department recommended that WRD biologists participate in the physical modeling (at developer expense), and that surveys correlating fishing success with flows be conducted at the undeveloped site prior to modeling;

b) To ensure that the developed facilities do not interfere with navigation and are acceptable to the COE; and

c) To ensure that temporary fisherman developments (during construction) do not interfere with navigation and are acceptable to the COE.

4. The Department contends that bypassing 500 cfs at flows 5,000 cfs and below will be insufficient at most facilities, and recommends that 1,000 cfs be released below 10,000 cfs. 165

5. The Department basically concurs with this requirement, but does not feel it provides sufficient detail for analysis. 166

6. The Department concurs with this requirement in principle, but feels that the filing of reports to the Commission should occur at specific intervals during the license life, i.e., every 3 to 5 years. Due to the length of the license period, predicting size, number, type, etc. of facilities necessary to meet angler demand is difficult, and reassessment of facility adequacy will periodically be required. The requirement should also dictate that appropriate state and federal fish and wildlife agencies' comments shall be included in reports filed with the Commission. 167

<u>5.4.2.4</u>

1. The Department concurs with this requirement. 168

<u>5.4.2.5</u>

1. The Department concurs with this requirement.

165. Recommendation 4 of Section 5.4.2.3 has been revised due to the site-specific issues that would need to be resolved during physical hydraulic modeling. The final specification of flow velocities as well as the plan for maintaining these velocities in the tailrace fishing areas would be determined during the physical modeling and consultations with the appropriate state and federal agencies.

166. Text has been modified to incorporate additional details to recommendation 5 of Section 5.4.2.3, such as the need to file a plan with the Commission regarding the provision of temporary fishing access facilities during construction.

167. Text has been modified to revise recommendation 6 of Section 5.4.2.3. The recommendation specifies that developers should file a report every five years with the Commission regarding the monitoring of recreational use at project locations. The monitoring effort and report preparation should be done in consultation with the appropriate state and federal agencies.

168. Comments noted.

2. The Department concurs with this requirement.

3. The Department concurs with this requirement.

4. The Department concurs with this requirement.

5. The Department concurs with this requirement.

6. The recommendation for contaminated sediment testing and disposals plans is satisfactory. However, the developer should also be required to consult with the Department concerning testing procedures and results and the disposal plan. 169

7. The Department concurs with this requirement. 170

8. The Department recommends that the developer consult with resource agencies regarding the suitability of disposal sites. If deemed necessary (due to endangered species, excellent existing habitat), alternate site designation or a habitat evaluation may be required. This will insure that spoil disposal will not result in destruction of valuable or irreplaceable wildlife or fisheries habitat. 171

The Department has consistently recommended that clean rock spoil be utilized to construct in-river developments (e.g., piers, underwater reefs and bars for fish cover). The Department recommends the staff permit such flexibility in spoil disposal provided it is recommended and approved by appropriate state and federal resource agencies. 172

A plan for revegetation should be developed in combination with Item 9; Control of erosion, dust and slope stability. 173

9. Sediment control plans currently submitted to the Department require vegetation and maintenance plans. If item 8. and 9. are not combined then the revegetation and maintenance plan required by Item 8 should be submitted to Water Resource agencies in addition to those agencies listed. 174

II. Cumulative Effects on Fish - The staff assumes positive impacts on recreational fishing opportunities from hydroelectric development. This may or may not be the case at every site. Excellent fishing now exists at many lock(s) 175

169. Comment noted. Text has been modified.

170. Comment noted.

171. See response to comment #105.

172. Staff agrees with the comment. See response to comment #58.

173. Comment noted. Staff recommended that the revegetation plan be developed in close coordination with the erosion and dust control and slope stability plan.

174. Comment noted.

175. Staff discusses potential impacts to sport fishing from changes in fish habitat quality in Sections 4.1.3.6 and 5.1.3.3. Although the new public fishing access facilities could greatly increase the potential fishing use in the basin, staff acknowledges that project-induced impacts to fish habitat quality, which would occur with the projects as proposed, would need to be mitigated to maintain the quality of recreational fishing in the basin.

and dam tailwaters. This is reflected by rapidly increasing use and harvest. Temporary fishing facilities will not compensate for all fishing opportunity lost during project construction and it is not currently known if fishing will be as good, better, or worse after the projects are constructed.

Should fishing recreation and/or success improve as hoped, recreational fish harvest will increase. The Department is charged with management of the fish populations in West Virginia waters, and will take action to reduce recreational harvest if necessary. A more desirable solution, as stated by FERC staff (page 5-7; Par. 1) would be enhancement of water and habitat quality and the reduction of other sources of mortality. As stated earlier, the Department considers fish habitat and population enhancement as integral components of resource mitigation programs to be funded by monetary compensation for EM. 176

III. The Department does not concur with staff that plans to provide fishing access during construction will reduce this impact to acceptable levels. When concurrent construction of basin projects is considered, the problem is magnified. The Department recommends that construction be "staggered" at adjacent projects to reduce this impact. 177

IV. The Department contends that spillage recommendations were sometimes based on insufficient data. For this reason, spillage (500 cfs at Opekiska, 5,000 cfs at Willow Island and Belleville, and 6,000 cfs at Gallipolis) is recommended until a definitive study demonstrates the spillage amounts, if any, that are needed at these sites. 178

As a matter of record, the Department objects to the action taken by FERC under Commission Order 464 which waived State 401 Certification for the listed projects in West Virginia. 179

V. The Department is extremely concerned regarding statements in the DEIS which contend that comments supplied by fish and wildlife agencies on the DEIS will be considered the most current recommendations applicable under the Fish and Wildlife Coordination Act (FWCA). The Department has submitted detailed comments on each project application within its jurisdiction. Initial FWCA comments have been filed on each project as well as additional comments when 180

176. Staff agrees with the comment. Recreational fish harvest at hydropower projects could certainly increase as a result of improved angler access at fish habitat-enhancing features. Staff anticipates that the fishery would require management attention by the WVDNR and other appropriate state and federal agencies. Staff believes its recommended actions would enhance water and habitat quality compard to project developments as proposed and would lead to minimization of entrainment mortality; actions depend on recommended testing of fish protection and guidance devices. Monetary compensation is recommended by staff as an interim mitigative measure and as a possible long-term mitigative alternative for consideration following testing and evaluation of fish protction and guidance devices (Section 5.4.2.2). See response to comment #54.

177. See response to comment #143.

178. See response to comment #145.

179. Your objection is noted. For discussion of the status of water quality certification of the projects in the study area see Section 4.7 of the FEIS.

180. See response to comment #31.

warranted. The Department contends that all comments (including those yet to be submitted on issued licenses) should be considered as comments under the FWCA. All of the above referenced comments should be considered in the Section 10(j) (Federal Power Act) resolution process.

VI. Staff concludes that there are no significant difference between competing applications at Tygart Lake, New Cumberland, Willow Island, and Gallipolis L and D. The Department does not concur. For example, one applicant at Gallipolis proposes to construct two powerhouses (one at the abutment and one in an unused lock chamber), while the other proposes one. Considerable differences in plans for recreational developments are also evident. This poses a major problem to reviewers because it is not known which projects will be licensed at sites where competing applications exist. 181

VII. One developer proposes that "scour holes" be excavated in the tailraces of several projects. These developments were not recommended by the Department and are not viewed as mitigative measures. 182

VIII. Site Specific Recommendations (Section 5.4.3) -- The Department has provided site specific recommendations for each project within its jurisdiction. The following comments concerning individual sites should not be construed as replacing those comments.

1. Opekiska L and D (5.4.3.4) -- The Department does not concur with the "zero spill flow" recommended here, since this contradicts current minimum requirements established by the Department. A minimum of 500 cfs should be spilled until thorough studies are completed. 183

2. Hildebrand L and D (5.4.3.5) -- Project lands are insufficient for recreational development at this site. The Department recommends that the project area be increased to accommodate all forseeable potential recreational developments. 184

3. Morgantown L and D (5.4.3.6) -- Project lands are insufficient for recreational development at this site. The Department recommends that the project area be increased to 185

181. See response to comment #34.

182. Staff has recommended bank undulations and reefs to enhance fish habitat and will depend on the resource agencies to advise on the design of specific mitigation measures: such consultation is included in recommendation 1 in Section 5.4.2.3.

183. See response to comment #145.

184. See response to comment #161.

185. See response to comment #161.

accommodate all forseeable potential recreational developments.

4. Willow Island L and D (5.4.3.14) -- The Department does not concur with the "zero spill flow" recommended here, and contends a minimum of 5,000 cfs should be spilled until thorough studies are completed. Zero or inadequate spillage may result in reduced DO concentration and violation of anti-degradation standards. 186

5. Belleville L and D (5.4.3.15) -- The Department does not concur with the "zero spill flow" recommended here, and contends a minimum of 5,000 cfs should be spilled until thorough studies are completed. Zero or inadequate spillage may result in reduced DO concentration and violation of anti-degradation standards. 187

6. Gallipolis L and D (5.4.3.16) -- The Department does not concur with the "zero spill flow" recommended here, and contends a minimum of 6,000 cfs should be spilled until thorough studies are completed. Zero or inadequate spillage may result in reduced DO concentration and violation of anti-degradation standards. In addition, the lack of spill flow at the three facilities above may reduce the volatilization of organics and contaminant materials that potentially occurs at these facilities. 188

IX. The issue of hydropower impacts on lockage of recreational vessels was not addressed by the DEIS. Should adverse impacts occur, they would adversely affect recreation on the rivers included in the analysis. 189

Specific Comments

Page 2-25; Par. 3 -- The Department maintains that the applicants should be required to install a blank piping system during initial construction for later installation of air/oxygen injection systems should they be required, deemed necessary or desirable. 190

Page 3-19; 3.1.6.1 -- Several species which may occur in the project area have been classified by the U.S. Fish and Wildlife Service as Category 2. Category 2 is comprised of taxa for which proposing to list as endangered or threatened may be appropriate, but for which conclusive data as to biological vulnerability and threat 191

186. See response to comment #145.

187. See response to comment #145.

188. See response to comment #145. The response to comment #104 addresses project effects on volatilization of contaminants. However, dams that aerate very little are also expected to have negligible effects on the concentrations of volatile chemicals. Aeration at Opekiska, Willow Island, Belleville, and Gallipolis dams is low because little air gets entrained in the water as it passes the dam, even though high turbulence occurs. The lack of air entrainment also restricts the transfer of volatile chemicals from the water to the air, so hydropower at these four dams is expected to have negligible effects on volatiles. This point has been clarified in Section 4.1.1.2.

189. Section 4.1.3.5 addresses potential recreational boating impacts from the proposed projects. The issue of adverse hydropower impacts on the lockage of recreational boats was not specifically raised during the scoping process. Physical hydraulic modeling required by the Corps should ensure that the projects will not significantly interfere with recreational navigation and/or lockage.

190. The recommendations on water quality (Section 5.4.2.1, recommendation 8) have been amended to recommend projects be built in such a way that installation of mechanical aeration systems is not precluded.

191. Text has been modified.

are not currently available. These species are: blue sucker (Cycleptus elongatus), Bewick's wren (Thryomanes bewickii), eastern woodrat (Neotoma floridana magister), northern long-eared bat (Myotis septentrionalis), small-footed myotis (Myotis leibii), New England cottontail (Sylvilagus transitionalis), and salamander shell (Simpsonaias ambigua).

Page 3-21; Table 3.1.6.1 -- This table should be amended to include Rafinesque's Big-eared bat Plecotus rafinesquerii found in West Virginia and with status (,SC); the Golden mouse Orchrotomus nutalli also found in West Virginia and with (,SC) status. 192

Page 3-31; Figure 3.1.9-3 -- This photograph does not depict New Cumberland L and D. 193

Page 3-34; Par. 2 -- The Department does not completely concur with these statements because spatial and temporal fish turbine passage and mortality have not been adequately investigated. 194

Page 3-35; 3.2.3.13 -- It is stated here that extensive inter-navigation pool movement has been documented for walleye. The Department contends that such movement indicates high entrainment potential for this species. 195

Page 3-35; 3.2.3.9 -- Not all sauger spawning habitats have been identified. The Department contends that sauger, particularly as eggs and larvae, may be highly vulnerable to EM. 196

Page 3-36; 3.2.4 Recreation; Par. 6 -- The Department contends that fishing recreation will be adversely impacted at each site during construction in spite of temporary fishing facilities. Temporary facilities must be constructed downstream of the powerhouse location. The area most impacted by construction is also where most fishing takes place at an undeveloped tailwater. Concurrent construction compounds this impact. 197

Page 3-67; 3.5.3.1 -- The impact of potential DO degradation on freshwater mussel populations should be addressed. 198

Page 4-9; Par. 6 -- The Department contends that a blank piping system that will permit later installation of air/oxygen injection systems should be a component of each powerplant. 199

192. Text has been modified.

193. The captions for Figures 3.1.9-2 and 3.1.9-3 were inadvertently reversed in the DEIS; these have been corrected.

194. Text has been modified in Section 3.2.3.1 to include minimization of mortality (e.g., entrainment mortality) as a protection in addition to habitat and water quality.

195. Staff agrees with the comment.

196. Staff does not agree that sauger eggs and larvae are highly vulnerable to entrainment mortality. Extensive studies of egg and larval drift at steam electric stations (ESE 1987) in the study area have not identified sauger eggs and larvae as abundant components. Sauger spawning is generally in the tailwaters rather than in more quiet pools above dams where drift would be into turbines. Spawning is early in the year during relatively high flows, much of which would not pass through turbines.

197. See response to comment #143.

198. See response to comment #38. The potential impact of DO degradation on freshwater mussels has been addressed and has been included in the text as Section 4.1.2.5, Assessing the Impact of Dissolved Oxygen Change on Freshwater Mussels. A more complete discussion of the topic is included in Appendix I of the FEIS.

199. See response to comment #190.

Page 4-11; 4.1.2.1.1 State Standards (Tier 1) -- West Virginia's regulations specify that existing water quality on Ohio River basin streams considered in this DEIS not be degraded. 200

Page 4-24; Par. 4 -- The Department contends that elimination of spillage flows at Opekiska, Willow Island, Belleville and Gallipolis will result in elimination of important summer and fall habitats at these tailwaters. The following spillage flows are recommended: 201

a) Opekiska -- 500 cfs;
b) Willow Island -- 5,000 cfs;
c) Belleville -- 5,000 cfs; and
d) Gallipolis -- 6,000 cfs.

Page 4-25; Par. 3 -- The Department recommends that initial studies be primarily concerned with obtaining adequate estimates of annual fish passage at all units to determine the magnitude of the problem. 202

Page 4-25; Par. 6; Sent. 3 -- The Department feels Staff is presumptuous in stating entrainment damages are local. This has not been documented. 203

Page 4-26; Par. 5; Sent. 1 -- The Department concurs with this sentence and feels it substantiates the need for determining fish passage rates throughout the year. Furthermore, the location of powerhouses near the shoreline may influence a disproportionate number of fish to pass through the powerhouse rather than the gates. 204

Page 4-28; Par. 1; Sent. 4 -- The Racine Study referred to here dealt with fish movement during a few months of the year. It is stated elsewhere (page 4-30; par. 1) in the DEIS that this study is inconclusive and, therefore, quantitative conclusions cannot be drawn. 205

Page 4-28; Par. 6 -- The Department does not concur with the summary presented here. Neither larval fish passage nor entrainment mortality have been estimated for Ohio River basin facilities. Due to the inherent fragility of many species of larval fish, turbine mortality could be high. 206

Page 4-28; Par. 7 -- Staff concludes here that since well-defined fish passage information is absent for existing facilities, monitoring at new projects is necessary. A more logical 207

200. See response to comment #39.

201. See response to comment #145 concerning effects of spill flows on DO at these projects. Complete elimination of spill flows will, indeed, affect downstream fish habitat. The flows recommended in the comment might improve habitat, although no justification is given for why these flows are recommended. The text has been modified to include comment on spill flows for fish habitat. However staff believes that for these dams, the turbine discharge would provide adequate habitat in the same general area (Section 4.1.2.2.3).

202. See response to comment #157.

203. Entrainment damages are clearly local in the turbines of each plant and not distributed through the river as are impacts of lowered DO concentrations. Staff has stated in the paragraph referenced by the commentor that these local damages can be cumulative in the entire river system.

204. The shoreline effect is discussed in Section 4.1.2.3.2.

205. The sentence in the text regarding species entrained has been amplified to include the points made in the comment.

206. The summary referred to in the comment dealt with vulnerability to entrainment and not mortality. Staff has summarized the pertinent literature and has based its summary on it. The review in Section 4.1.2.3.2 indicates that an abundant scientific literature attests to the resistance, not vulnerability, of egg and larval stages of fish to physical stresses of entrainment.

207. The commentor has repeated the staff's recommendation -- monitoring will be necessary to determine the rates of fish entrainment, i.e., "fish passage rates".

conclusion is that since no well defined fish passage rates are available, fish passage studies should be conducted.

Page 4-30; Par. 4 -- The Department does not concur that damages to early planktonic life stages of fishes are of no concern (based upon studies at stream electric stations). The Department contends hydropower developers should conduct studies to estimate egg and larval passage through turbines and estimate turbine caused mortality using in situ or laboratory tests. 208

Page 4-30; Par. 5 -- Conclusions in this paragraph are based upon studies Staff contend are inconclusive. The conclusion that prolific spawners can compensate for turbine caused mortality when other mortality factors affecting the population are not known is presumptuous. 209

Page 4-32; Par. 1; Last Sent. -- Studies to date are not conclusive and the fish species most frequently entrained on an annual basis have not been determined. 210

Page 4-33; Par. 3 -- This paragraph states that regional resources will be marshalled "... to select, construct, test, and evaluate engineering prototypes of fish guidance systems ..." The Department contends that clarification of this sentence is required for evaluation. 211

It is then stated that prototypes "that work" will be installed in full scale on newly constructed (operating) projects. This assumes the above referenced projects can be designed and constructed to accommodate a system of currently unknown design. Although paragraph 5 of this page states that plants will be designed to accommodate various possible bypass/deterrent devices, the Department questions if projects can be effectively designed to permit retrofitting for unknown eventualities.

Sentence four of the paragraph states that entrainment losses may be determined to be low (or presumably high) by monitoring. As stated earlier, the Department does not feel that fish population monitoring can successfully identify or quantify EM. The Department emphasizes that fish passage studies, rather than fish population monitoring, should be conducted. Staff does not identify a possible mitigation alternative should EM be determined to be high and if no systems to eliminate EM are proven effective. 212

208. The text has been modified to include the desirability of on-site studies of damages to early life stages of fishes in turbines even though staff has summarized the scientific literature that provides evidence different from the commentor's view.

209. See response to comment #155.

210. Comment noted; text has been modified to include mention of limited sampling.

211. See response to comments #5 and 66. The feasiblity of fish protection technology and retrofitting to a completed facility is uncertain and will remain so until attempted.

212. The commentor has incorrectly interpreted "monitoring" to mean monitoring of fish populations in the field. Staff referred to monitoring of fish passage and survival in this instance. Staff also clearly identified compensation as the alternative in the same sentence.

Page 4-31; Par. 4 -- Staff does not state if the bioengineering test facility mentioned here is to be located at one of the proposed projects mentioned in this DEIS, at a yet to be planned facility, or at an existing facility. Funding of facility construction, operation and maintenance are not discussed. 213

Page 4-33; Par. 5 -- See earlier comments (Page 4-3; Par. 3) regarding the proposed bioengineering test facility.

Page 4-33; Par. 7 -- The Department recommends that fish screens be installed on the Tygart project to reduce walleye EM as well as that of other fishes. Staff's conclusion that only minor mortality of fish through turbines is expected during spring, summer and fall is unsubstantiated and not based on any information known to the Department. 214

Page 4-34; Par. 2 -- Recreational fishing will be adversely impacted at the lock side of Gallipolis L and D due to hydropower development. 215

Page 4-34; Par. 3 -- See above comment.

Page 4-34; Par. 4 -- See comment concerning additional minimum recreational developments (5.4.2.3.1.).

Page 4-40; Tygart 7307 and Tygart 7399 -- The Department is not satisfied with recreational developments proposed by either applicant at this site. Both projects will require revision of their plans. The staff recognizes Department concerns regarding insufficient lands for recreational developments, but does not recommend a course of action. 216

Page 4-47; Par. 3; 4.1.3.2 -- See earlier comments (5.4.2.3.3) regarding bypassed flows.

Page 4-47; 4.1.3.3; Sents. 5-8 -- The Department does not concur with these statements in view of other statements in the document concluding that mitigative measures for recreation lost during construction and due to concurrent construction are adequately mitigated. The Department is not aware of alternative measures that would " ... in some manner be beneficial to recreational fishing in the region ..." This recommended mitigative measure is not sufficiently described by staff to permit evaluation by the Department. Staff does not define the term "local resource agency." 217

213. Staff stated in the beginning of the referenced paragraph that the bioengineering test facility would be "located at one project (or at most, a few)." It is premature at this stage to determine the site(s) most technically suited to the needs of such a facility. All new and existing sites could, in principle, be considered candidates although special design features could be accomodated most easily at a new site rather than an existing one. It is also premature to assign funding responsibilities.

214. Staff relied on local agency biologists for the opinion that walleye at Tygart are not likely to be entrained at times other than when they are now flushed downstream intentionally. The text has been modified to reflect the commentor's view. Staff recommends measurement of fish passage and testing of screening devices or other measures to minimize entrainment of fish at Tygart (Section 5.4.3) as a special case of the general recommendations on aquatic ecology and fisheries (Section 5.4.2.2).

215. Recreational fishing is more prevalent on the abutment side of the dam than it is on the lock side of the dam. Potential benefits to recreational fishing could occur from the proposed project by introducing tailrace flows on the lock side of the dam. Short-term construction impacts to recreational use could occur, but such impacts would probably not be serious due to the large amount of recreational land acreage on the lock side of the Gallipolis Lock and Dam.

216. See response to comment #161.

217. At project sites having small areas available for construction, it may not be possible to provide access during construction because of the limited land area. Compensation for impacts to recreation during construction at these sites could include the provision of off-site recreational developments and/or the upgrading of existing access facilities. Recreation plans would need to be amended accordingly after consultation with the appropriate state and federal agencies.

This should include the Department and other appropriate federal and state fish and wildlife agencies.

Page 4-50; Par. 2 -- The Department does not concur with staff conclusions regarding EN presented here. See comments concerning 5.4.2.2.2. 218

Page 4-53; Par. 5 -- It is stated here that hydropower flows may impact commercial navigation by slowing lockage times creating unsafe conditions. The contends that a greater potential exists to adversely impact lockage of noncommercial (recreational) craft. 219

Page 4-71; 4.1.6.8 -- The Department contends that in-river disposal of clean rock fill to construct piers, dikes, fish cover, reefs, etc. could be a beneficial mitigative measure. 220

Habitat evaluation procedures may be necessary at certain upland disposal sites. See comment concerning 5.4.2.5.8. 221

Page 4-71; 4.1.6.9 -- The Department recommends that developers be required to plant transmission line rights-of-way to low-growing shrubs beneficial to wildlife. Staff merely concludes that this would reduce impacts. Transmission lines should be cleared and maintained by mechanical rather than chemical means. 222

Page 4-71; 4.1.6.10 -- The Belleville L and D project (No. 6939) will also require new road and railroad crossing construction. The required this to eliminate existing conflicts between residents of Belleville and current users of the tailwater area. The existing road through Belleville is privately owned. 223

Page 4-71; 4.2.1 -- The Ohio River is designated by the State of West Virginia as a high quality stream. In this instance, water quality standards including dissolved oxygen, are superseded by the State's anti-degradation standard applied to high quality streams. 224

Page 4-82; Case 1 -- Generating on the recommended flows would violate West Virginia water quality regulations. The Department recommends a thorough water quality study at Opekiska, Willow Island, Belleville, and Gallipolis after the plants are operating. Appropriate flow should be spilled at these sites until the study is completed and final recommendations are filed with the Commission. 225

218. Comment noted.

219. Text has been modified to mention potential impacts to recreational boaters. No direct impacts to recreational boaters from changes in flow patterns is expected because recreational boats are generally much more maneuverable than barge tows. See response to comment #189.

220. See response to comment #58.

221. Revegetation and erosion control plans at upland spoil disposal sites developed in consultation with appropriate state and Federal agencies are recommended (Section 5.4.2.5). The necessity for habitat evaluations will be determined on a site-specific basis. Thirteen of the projects include proposals to use existing commercial landfills or abandoned strip mines as disposal sites (Section 4.1.6.1). With appropriate planning, wildlife habitat could be enhanced.

222. Recommendation 8 in Section 5.4.2.5 specifically requires revegetation in transmission line rights-of-way using low-growing shrubs and trees native to the area. Mechanical, rather than chemical, means of clearing for transmission line rights-of-way construction and maintenance is also required if at all feasible.

223. Text has been modified in Sections 4.1.6.3 and 5.4.3 to incorporate the recommended revision in the project access route.

The recommended new 450 foot-long road crosses the slough at Belleville. This slough is a feeding and resting area for migratory birds and is a feeding and spawning area for fish. The developer should consult with ODNR, FWS, and Corps before final development of plans for the road to determine the final placement of the road through the slough (recommendation 15, Section 5.4.3). Any necessary alterations in the alignment of the road and other site-specific mitigation to minimize impacts should be discussed with these agencies during consultation. The developer should obtain all required permits before initiating construction.

224. See response to comment #39. West Virginia regulations do not necessarily preclude minor degradation of water quality.

225. See response to comment #145. Staff believes that effects of West Virginia's recommended spill flows will be undetectable at these four projects.

Page 4-87; par. 6 -- The Department strongly objects to the last sentence in this paragraph. Fish and Wildlife Coordination Act comments from the State of West Virginia shall include all comments made in reference to each project and the resolution process dictated by Section 10 (j) of the Federal Power Act shall include all comments submitted by the Department concerning each project. See general comment 9. 226

226. See response to comment #31.

Page 4-89; Par. 8 -- The Department does not concur with staff's conclusions regarding entrainment. See general comment I (5.4.2.2). 227

227. Comment noted.

Page 4-89; Par. 9 -- Staff has not recommended specific habitat management procedures to mitigate this impact. 228

228. Contrary to the comment, staff has recommended mitigation for this impact -- turbine bypass flows to assure a constant movement of water in the turbine tailrace area during periods of shutdown. Such bypasses could be accomplished by special bypass structures in the powerhouse or by opening nearby gates, depending on site-specific characteristics.

Page 4-90; Par. 6 -- The Department contends that recreation impacts due to concurrent construction will be considerable. Much of this impact could be mitigated by staggering license issuance to prevent concurrent construction. 229

229. See response to comment # 143.

Page 5-3; Table 5.1.1-1 -- The Department does not concur with several values in this table for the various categories (as described in these comments). 230

230. Comment noted.

Page 5-3; Par. 1 -- The elimination of spillage at Opekiska, Willow Island, Belleville, and Gallipolis will aggravate this situation, particularly in the three adjacent lower river projects. 231

231. See response to comment #145.

Page 5-6; Par. 3 -- The quantitative and qualitative extent of turbine fish passage in the basin is unknown. Staff's conclusion that they do not anticipate demonstrable damages to ichthyoplankton is unsubstantiated. See general comment I (5.4.2.2). 232

232. See responses to comments #206 and 208 on the subject of susceptibility of ichthyoplankton to entrainment damage.

Page 5-6, Par. 4; Sent. 3 -- No conclusive evidence is presented to substantiate the contention that high reproductive potential of gizzard shad and freshwater drum make significant EM unlikely. See general comment I (5.4.2.2.3). 233

233. See response to comment #155.

Page 5-6; Par. 5; Sent. 2 -- Applicants have proposed entrainment studies after initiation of operation at resource agency insistence. The Department's intent in requiring such studies was to determine the nature and extent of EM. The Department contends that fish passage studies should be conducted at each project. See general comment I (5.4.2.2.3). 234

234. Staff appreciates the commentor's concurrence with staff's recommendation. However, it may not be necessary to quantify entrainment mortality (as opposed to rates of entrainment) at each site with similar hydropower facilities. Representative sites may suffice to establish the degree of survival for purposes of developing appropriate compensation or establishing the need for fish protection.

Page 5-6; Par. 5; Last Sent. -- Staff is not specific regarding this facility, and it would be premature to proceed with it until fish passage studies are completed at all projects. See general comment I (5.4.2.2.5). 235

Page 5-7; Par. 1; Sent. 3; (4) -- The Department is responsible for fish management in West Virginia waters and will take appropriate measures to reduce angler harvest if deemed necessary. See general comment II. 236

Page 5-7; Last. Par. -- Staff's conclusion that impacts to recreational fishing due to TM are not expected to be serious is speculation. Fish passage studies at all facilities are needed. See general comment I (5.4.2.2). 237

Page 5-8; Par. 2 -- Mitigative measures (fisherman access) during construction will provide some fishing recreation. It is not comparable to that now available because the areas to be affected by construction are currently the best fishing locations. Projects with limited federal lands intensify this problem. Project areas must be expanded to accommodate both fishing during construction and recreational developments after construction. See general comment III. 238

Page 5-8; Par. 3 -- Several features should be added to basin-wide requirements for recreational development. See general comment I (5.4.2.3.1). 239

Page 5-23; Par. 1; Sent. 4 -- The Department will initiate management measures to reduce any stress on fish populations caused by angler harvest at developed sites should it be deemed necessary. See general comment II. 240

Page 5-23; Par. 2 and 3 -- The Department contends there are major differences between competing projects at the sites mentioned. See general comment VI. 241

235. Staff also believes it is premature to determine specifics of the bioengineering test facility at this time. The need for better information on entrainment rates at operating facilities is one set of information needed for definition of the goals of the test facility. However, it seems undesirable to wait until all projects are completed before proceeding to test mitigating devices, as the commentor suggested, for some projects may never be built and some may be delayed significantly for reasons outside the licensing process. Putting a test facility into operation soon could usefully test prototype fish protection devices for the Ohio River Basin projects on the basis of entrainment information now available.

236. Comment noted. Staff assumed that fish management would be the responsibility of the WVDNR.

237. Comment noted. Staff agrees that fish passage studies are needed; mitigation for fish entrainment and turbine-induced mortality is recommended in Section 5.4.2.2. Text has been modified in Section 5.1.1.3 to read "impacts to recreational fishing from turbine-induced mortality are not expected to be unmitigable, except where an embayment is located immediately upstream of the proposed project."

238. See responses to comments #161 and 217.

239. See response to comment #160.

240. See response to comment #236.

241. See response to comment #34.

Ms. Lois D. Cashell
Page 21
July 21, 1988

Thank you for granting our request for an extension of the comment period so that we could adequately review this extensive document and have our comments made part of the record. If you should have any questions concerning our recommendations, please contact Dr. Paul L. Hill of my staff at (304) 348-2761.

Sincerely yours,

Ronald R. Potesta
Director

RRP/mrw/b

cc: U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Ohio Environmental Protection Agency
ORSANCO
WVDNR-Division of Water Resources
WVDNR-Division of Wildlife Resources
WVDNR-Office of Environmental
and Regulatory Affairs

Service Corporation

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OFFICE OF THE SECRETARY

88 JUN 30 AM 10: 29

FEDERAL ENERGY REGULATORY COMMISSION
PUBLIC REFERENCE ROOM

AMERICAN ELECTRIC POWER

88 JUL -1 PM 1:32

Ms. Lois D. Cashell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

June 29, 1988

Re: Docket No. EL85-19-114
Hydroelectric Development in the Upper Ohio River Basin Draft Environmental Impact Statement -- May 1988

Dear Ms. Cashell:

These comments on the "Hydroelectric Development in the Upper Ohio River Basin Draft Environmental Impact Statement" dated May 1988 are provided by American Electric Power Service Corporation on behalf of the electric utilities of the AEP System.[1] The AEP electric utilities serve customers in seven states including many in Ohio and West Virginia in the area affected by this report. Many of the residents and businesses of the upper Ohio River Valley are our customers and AEP has always had a strong interest in the prosperity and quality of life in the upper Ohio River Valley. Many of the powerplants which serve the region are built along the river and its tributaries. Power produced efficiently on the Ohio River ultimately benefits customers in most of the states in the Ohio River Basin. The river serves both as a source of water for the generation process and as a highway for shipment of coal and other materials used by the power industry and other industries. One of the AEP divisions operates a river transportation barge to supply system powerplants with coal.

That the Ohio River is one of the key resources in the region has long been recognized. It served as an early transportation artery. Navigation improvements over the

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[1]Appalachian Power Company, Columbus Southern Power Company, Indiana Michigan Power Company, Kentucky Power Company, Kingsport Power Company, Michigan Power Company, Ohio Power Company and Wheeling Power Company.

years have culminated in the present system of high-level dams which are the subject of applications for power additions and the subject of this draft Environmental Impact Statement (DEIS). Since the dams were built primarily for navigation, navigation takes primary importance, although other uses are accommodated and must be considered in the type of balancing that FERC does in licensing decisions. Flows in the river are largely controlled by releases at the various navigation dams by Corps lock masters in coordination with headwater releases from Corps flood control storage projects. The water available for hydropower generation is water which would otherwise be spilled. It is the question of evaluating the benefits from addition of power generation under certain regulatory conditions and the management of spill flows through or over dams which are the key considerations in the upper river basin which this DEIS addresses.

242 The recommendations of the draft EIS would effectively cause significant alterations of the water quality criteria levels by attempting to maintain dissolved oxygen levels of 6.5 mg/l or more by requiring spills at most dams during the low flow warm weather period of July through October.

We have serious reservations about whether the recommended alternative goals are justified by the information and analysis developed in the DEIS. The rationale for the staff recommendation requiring spill flows at specified dams to maintain dissolved oxygen levels at 6.5 mg/l or above is apparently based on two lines of reasoning.

The first justification apparently is based on an attempt to take figures for dissolved oxygen levels derived by the U.S. Environmental Protection Agency (EPA) in their document "Ambient Water Quality for Dissolved Oxygen - April 1986" USEPA (1986) and apply the 6.5 level to achieve "no production impairment." The table presented on page 4-12 of the DEIS is taken from page 31 of USEPA (1986). However, table 8 on page 34 of USEPA (1986) contains the EPA recommended National Criteria for Dissolved Oxygen. The recommended warmwater criteria are 6.0 as a 7-day mean and 5.0 as a one day minimum to protect early life stages. Early life stages are defined as "all embryonic and larval stages and all juvenile forms to thirty days following hatching." The criteria for other life stages are set at 5.5 as a 30-day mean and 3.0 as a one day minimum. The figures in Table 1 reflect judgment levels set for national guidance for use by individual states in setting water quality standards to protect fish populations. The EPA criteria are also set out in Table 1 of the Dissolved Oxygen chapter in Quality Criteria for

242. Staff is familiar with the documents on DO criteria cited in the comment and had consulted with the author of each of the documents prior to preparation of the DEIS. The commentor raises valid questions about (1) the reliability of data that are used to establish criteria and (2) the varied recommendations that can be found in different documents and in different places in a single document (especially when a variety of durations is considered, such as instantaneous low concentration, 7-day mean, etc.). It is difficult and imprecise to define a "no effect" level on the basis of the existing literature. Because staff felt that it was beyond the scope of the EIS to undertake a reanalysis of the entire literature on DO effects, it relied on the most recent scientific analyses. Staff also took several different approaches to protecting against impacts of low DO: existing state standards, bioenergetics modeling to show cumulative and integrated effects over a year of growth, and a generalized "no effect" level. The "no effect" level that was selected is justified by the best available information and is believed by staff to be protective of all species.

Water - 1986 published by EPA and referred to as the Gold Book. The criteria selected include allowance for worst case conditions and were judged to be adequate. However, where specific conditions would likely lead to production impairment, higher levels were presented in Table 2 of the Gold Book chapter on dissolved oxygen which recommends dissolved oxygen levels for early life stages and other life at levels 0.5 higher.

Staff should perform a critical review of studies cited in USEPA (1986) for acceptability for criteria derivation. This criterion document does not contain such an evaluation, as other U.S. EPA criteria documents do (see for example the document for the metal copper). Without such a review, our experience has shown that criteria can be based on faulty data. Apparently the DEIS selects 6.5 the higher of the numbers listed on page 31 of USEPA (1986), as being justified for no production impairment and then applies it as a goal in recommended alternative 3. We view the application of the 6.5 criteria directly as a goal in these circumstances to be a misapplication of water quality criteria, particularly when, according to USEPA (1986), the production impairment levels are subjective. We note, for instance, that data cited (Raible 1975 and Andrews et al. 1973) in USEPA (1986) for channel catfish show that the existing criterion of 5 mg/l could very well protect this species.

The scheme for meeting alternative 3 goals would apparently require spills from many proposed hydro power facilities to avoid modeled predictions of dissolved oxygen declines during what are perceived to be the critical months June through October. The "critical months" appear to be based on flow and temperature conditions during the time that the combination of lower flows, critical lower dissolved oxygen concentrations and higher temperatures usually occur but there is no statistical evaluation of the actual frequency of occurrence coincident of these three factors. Are large power losses through spillage necessary if such a frequency analysis shows that the conditions will occur, say, for a few days of a year? Spillage when critical conditions actually occur might be appropriate. Spillage apparently is recommended for the entire June through October period regardless of what actual dissolved oxygen levels are measured in the river. 243

The second line of reasoning is based on the predicted results of three-tiered modeling. First, predicted dissolved oxygen concentrations of the river were compared with state water quality standards. A second tier compared predicted dissolved oxygen levels with data from USEPA (1986). The question of the appropriateness of the 244

243. The critical season of July through October, when higher spill flows are recommended to protect water quality, was selected by reviewing historic dissolved oxygen data collected by ORSANCO.

The recommended mitigation requirements are designed to prevent the proposed projects from causing DO concentrations to go below 6.5 mg/L. Successful DO mitigation for the upper Ohio River basin projects must (1) protect DO concentrations over a wide variety of conditions (flow rates, temperatures, water quality, etc.), (2) be reliable enough that problems such as failure of DO monitors or water quality events do not allow projects to degrade DO, and (3) account for the cumulative effects of the multiple projects on DO. Staff proposes two alternative mitigation methods that meet the above three criteria. The mitigation method given most consideration is the requirement for spill flows during the season when DO concentrations are typically lowest. The spill flows recommended in Alternatives 3 and 4 of the EIS (Table 2.1.3-1) are designed to prevent DO concentrations from falling below 6.5 mg/L under a wide range of temperatures and flows. The spills were developed using a model simulating conditions when (1) river flows were approximately those at which the hydropower projects would have the greatest impact; (2) water temperatures are those exceeded only 10% of the time, as measured at the ORSANCO monitors; and (3) BOD concentrations are approximately those that occurred during a period in 1983 when DO concentrations were low. The spills were purposely determined using these conditions so that they should protect DO adequately over 90 percent of the range of water temperatures measured at the ORSANCO monitors, over all flows, and whenever BOD loads are not extremely high. The spill flows are a reliable mitigation system because spill flows can be measured fairly accurately and easily. The reliability of mitigation is increased by the recommendations that project operators provide real-time DO monitoring data to water quality agencies (recommendation 4, Section 5.4.2.1) and that the Corps, ORSANCO, and the appropriate state water quality agencies be given authority to increase spill flows when necessary (recommendation 2, Section 5.4.2.1). The recommended spill flows account for the cumulative nature of DO impacts because they were determined using a system-wide optimization model that considers the impacts of all upstream projects on the DO at any point, and determines the combinations of spill flows that produces the most power in the basin (Section 2.1.3). The recommended spill flows are a simple, reliable, and easily enforced mitigation system that would protect DO concentrations over a wide range of conditions.

The EIS allows an alternative to the recommended spill flows that also meets the three criteria for adequate mitigation. Recommendation 7 in Section 5.4.2.1 encourages development of a modeling system to determine instantaneous spill flow requirements based on real-time conditions, considering cumulative impacts of all the projects. The reliability of this system would result from the accumulation and analysis of information from throughout the upper Ohio River basin. Staff would be required to continually operate and interpret such a model. The model would intrinsically include the cumulative effects of hydropower on DO concentrations at each point and could determine the most effective combination of spill flows. This mitigation system, if implemented, would result in lower spill flows than those recommended for Alternatives 3 and 4 under many conditions, but would require an investment to develop and implement.

Several project applicants have simply proposed monitoring DO concentrations upstream of their projects and increasing spill flows whenever concentrations are low. Basing spill requirements only on DO concentrations monitored at a site does not meet the mitigation criteria. This mitigation method would not be reliable because spill flows at any site would be determined from readings from one or two DO monitors, which could be out of calibration or inoperative. Under some conditions, the lowest DO concentrations could occur at some point between hydropower projects, and therefore may not be detected by monitors. Basing spill requirements at a site on the DO concentration at that site also does not account for the cumulative impacts of upstream projects on DO. For example, low spill flows at several consecutive dams could cause high spills at a project downstream, when the most cost-effective solution may be to require moderate spill flows at all the projects.

244. Staff believes that actual growth rates predicted by the bioenergetics model are unlikely to be precise representations of what will actually occur in the river nor especially relevant to the analysis of hydropower impacts. It is the estimated changes in growth between the existing conditions and the conditions with hydropower that are meaningful. These changes can be estimated by using the same assumptions in model runs for both cases, even though the assumptions may not exactly match reality in the river. It is not possible to predict what a reduction in growth rate means for fish populations in the river, and this analysis was not attempted. The text and appendix have been expanded to help clarify the analysis and the significance of the results.

use of that data was discussed above. A third tier involving a bioenergetics model compared relative fish growth rate predictions with different dissolved oxygen levels. The model was apparently based on a model developed from catfish pond studies with some adjustments made to attempt to simulate what is believed might occur in the Ohio River. The model predicts a relative decline in fish growth rates in certain Ohio River pools on a comparative basis without reporting the actual numbers predicted. The analysis stops short of addressing the question of what predicted growth rate decline would mean for populations. Insufficient information is presented in the DEIS to enable any meaningful evaluation of the modeling results to be made. However, based on the results from the modeling the DEIS predicts certain percentage declines in fish growth for certain fish species, including channel catfish and sauger and walleye based on data substituted in a modified model. The discussion of the modeling and the results on pages 4-15 through 4-18 is incomplete and confusing.

The DEIS proposes three alternative schemes in addition to those proposed by the developers. Alternative 3 would require spills to be made at many proposed hydro power installations during the periods June through October, in order to avoid fish growth rate declines predicted to occur due to hydropower operations. The power loss for this alternative was calculated by the staff to be $13 million per year. Neither the total amount of the predicted fish production decline nor its value was estimated in the DEIS. 245

In summary, we question the appropriateness of the criteria levels of dissolved oxygen selected, the appropriateness of the time frames to which they were applied, and the validity of the conclusions derived from the fish production modeling study.

As noted above, AEP has a vital interest in the upper Ohio River Valley and through the years has developed information from studies which it has conducted or supported. Several of these studies were provided to the Commission staff for use in this report, some of them in early publication form. The Racine Project was licensed to Ohio Power Company and is operated by Appalachian Power Company, both AEP System companies. Data from the fishery study at the Racine Project, conducted jointly with the City of New Martinsville, was relied on to a great extent in evaluating fishery effects of installing bulb turbine hydroelectric units on the dams under consideration in this draft EIS. Although AEP has no applications pending before the Commission in this proceeding and does not plan

245. Without quantitative information on the fish biomass, age structure, and current productivity in the river, it is not possible to calculate more than a relative productivity change, as staff has done. Even that calculation is an advancement over anything attempted to date. To attempt to ascribe a monetary value to fish changes comparable to the monetary value of the hydropower forfeited is beyond the state of understanding. There is no requirement to assign monetary values to environmental resources.

new hydroelectric development in the region, it has provided data to the Commission and has reviewed the draft EIS for information relating to reports it furnished. Our detailed comments highlight some of the items of specific concern. Our failure to comment further on additional parts of the report should not be taken as concurrence.

From the general concerns expressed above, we now turn to some specific comments. The following comments are offered in order to clarify or amplify certain parts of the report in the hopes that future use of the document may be enhanced.

Page 1-3, next-to-last full paragraph:

Delete words "combustion turbine" from "coal-fired combustion turbine capacity"; change "oil-fired combustion turbine capacity" to "oil/gas-fired combustion turbine capacity." 246

246. Text has been modified.

Page 1-4, Table 1.2-1:

Add Toledo Edison Co., change Columbus and Southern Ohio Electric Co. to Columbus Southern Power Co. (AEP), and add (AEP) to Ohio Power Co., in the list of Utilities Serving Ohio Markets; 247

247. The list of power producers has been revised.

Add Indiana Michigan Power Co. (AEP) and, if appropriate, Hoosier Energy Rural Electric Cooperative to list of Utilities Serving Indiana Markets;

Change Michigan Gas and Electric Co. (AEP) to Michigan Power Co. (AEP), and change Indiana and Michigan Electric Co. (AEP) to Indiana Michigan Power Co. (AEP), in list of Utilities Serving Michigan Markets;

If appropriate, add Big Rivers Electric Corporation to list of Utilities Serving Kentucky Markets;

Change affiliation of Pennsylvania Power Co. (Ohio Edison Co.) from MAAC to ECAR in list of Utilities Serving Western Pennsylvania Markets;

Change Wheeling Electric Co. to Wheeling Power Co. (AEP) in list of Utilities Serving West Virginia Markets;

Page 1-5, second full paragraph:

The phrase "base load capacity from the proposed Basin projects" might cause some confusion. The hydroelectric generation in question will almost certainly be among the first energy resources dispatched on recipient utility systems, and is "base-load capacity" in that sense. However, the term "base-load capacity" also generally denotes resources which are dispatched at or near their maximum capacity, with little variation, for long periods of time. This would not be characteristic of the proposed run-of-river hydro projects. We suggest replacing the paragraph with the following: 248

> "Between 400 and 480 MW of capacity from the proposed Basin projects would be useful to regional utilities because the low-cost energy produced by these projects would displace energy produced by their most costly, least efficient load-following units (i.e., those highest in the loading order)."

248. The text has been modified to incorporate the suggested revision.

Page 3-3 through 3-16

This section discusses long-term water quality and aquatic ecology trends in the Ohio River Basin. New technical publications provide important documentation on more recent conditions. Enclosed are copies of these recent publications which may be useful. Two papers authored by American Electric Power biologists (with others) (Van Hassel et al. 1988, Attachment 1; Reash and Van Hassel 1988, Attachment 2) provide statistical trends of historic water quality data and fisheries data. Analysis of water quality data, for instance, indicated that pH increased in the upper and middle Ohio River whereas fecal coliform counts and concentrations of ammonia, lead, and zinc decreased from mid-1970's to mid-1980's. Other publications enclosed provide information on navigation impacts to Ohio River fishery resources (Nielsen et al. 1986, Attachment 3) and mussel populations of the upper Ohio River (Zeto, et al. 1987, Attachment 4). 249

249. Text has been modified to reference the papers by Van Hassel et al. and Reash and Van Hassel in Section 3.1.3.

Page 3-3

The third paragraph of section 3.1.3, particularly the first three sentences dealing with water temperatures, is misleading. Though powerplants discharge heated water, the entire river cross section is not affected, but only a limited area. Thus, increased river temperatures are limited spatially, and cooling is typically rapid longitudinally. The sentence "High water temperatures reduce DO concentrations and inhibit growth of some fish species" is correct in itself, but not accurate if pertaining to power 250

250. Staff believes there is sufficient evidence that power plants significantly increase water temperatures. Even though individual plants on the Ohio River may not cause measurable decreases in DO concentration, the cumulative effects of the many power plants does increase temperature and reduce the saturation concentration of oxygen. There are individual power plants on tributaries whose impacts on DO concentrations are significant.

plant effects. No powerplant on the Ohio River adds sufficient heat to the river to cause any deaeration. Results of site-specific fisheries monitoring studies sponsored by AEP and other electric utility companies (The Ohio River Ecological Research Program) have indicated that catch rates of fishes at thermal-influenced stations are typically greater or not significantly different than catch rates upstream of power plants. The most recent results of the study (1987 Ohio River Ecological Research Program) will be sent to FERC shortly.)

<u>Page 3-20</u>

Under the state lists of threatened and endangered species (page 3-20), the channel darter (*Percina copelandi*) should be added as this species is protected in Ohio. The silver chub should be deleted from the list. The species is the most common chub in the upper Ohio River and the Ohio DNR has removed this species from endangered status. One reference on page 3-20 (WAPORA, Inc., 1986) is not listed in the references section. 251

251. The list has been corrected.

<u>Page 3-29 states:</u>

"When hydropower facilities are added to a dam much of the river flow is routed through a turbine and is no longer spilled over the crest or through the gates of the dam. The result can be a net loss of oxygen input to the river because hydropower turbines provide little aeration (AEP, 1969; 1987)." 252

<u>Page 4-1 states:</u>

"Studies on the Ohio River have shown that little if any aeration takes place at existing hydropower plants when river flows are diverted through the powerhouse (AEP; 1969; 1987)."

AEPSC believes that these statements are misleading with respect to the results obtained during AEPSC's DO study conducted at the Racine Hydroelectric Project in 1987. The study at Racine found that the turbine discharges did increase downstream DO levels in the river by as much as 0.2 to 0.6 mg/l. It was also found that the turbine discharges provided increases in downstream DO levels equal to and greater than the dam discharges alone. Although the DO increases found at Racine may not be considered large increases, we believe that it should not be assumed that hydroelectric plant discharges provide no

252. The DO model simulates hydropower operation at a dam by assuming that the flow through the turbine receives no aeration. This assumption is based on (1) information in the references cited in Section 4.1.1.1, and (2) the observation that in the kinds of hydropower turbines proposed, although high turbulence occurs there is no source of bubbles sufficient to aerate well. Minor increases in DO concentration may actually occur at hydropower turbines, and these increases may be comparable to the amount of aeration occurring at some of the submerged-discharge gated dams that also provide little aeration. However, the amount of aeration that may occur at hydropower turbines is minor compared to other sources of DO, so the assumption that no aeration occurs in the turbines is reasonable, and conservative because any deviation from the assumption would lead to higher, not lower, water quality. Staff avoids conclusions based on the assumption that the dams with deeply submerged outflows (such as Opekiska, Willow Island, Belleville, and Gallipolis) provide more aeration than hydropower plants would.

increases in downstream DO levels. Potential DO increases from hydroelectric discharges should be given consideration in the DO modeling effort and any flow restrictions recommended for a specific project.

Section 4.1.2.2.1--Estimating Flow Regimes of Tailwaters

253 Staff should use caution applying mathematical models to tailwater areas to predict velocity changes in the tailwater. Figure 4.1.2-4 without powerhouse flows are not representative of flow patterns at Racine and may not be for other Ohio River sites. Based on hydraulic modeling by Alden Research Laboratory (Massachusetts) for the Racine Project, flow patterns will be similar from gated dam releases and the powerhouse at the same river flow (CFS).

Exhibits 1 and 2 show modeled tailwater flow patterns from the Racine dam and powerhouse at 30,600 CFS. This river flow is close to the 30,000 CFS flow used in Figure 4.1.2-4. The flow patterns in Exhibits 1 and 2 are similar because at the 30,600 CFS flow, only two of the dam gates are open. These modeling results have been field-verified by the Corps and AEP staff.

Section 4.1.2.2.3--Habitat Losses

254 Staff is correct that river flow is discharged through only one or a few dam gates now at low river flow. The statement needs clarification that gated flows are shifted operationally in contrast to the turbine discharge at a single location. The Corps now maintains a standard schedule of gate openings to maintain pool elevations at various river flows. Gates are sequentially opened for specific amounts of openings. For instance, at a low river flow, the center gate is open one foot. At higher river flow, the gate may be opened two feet. At greater river flows, a second gate may be opened one foot.

Habitat downstream of the dam gates will always receive the same gated release for a given river flow. At Racine dam, where there are eight Tainter gates, for river flows which would pass through the hydro project the Corps would open gate 5 up to 5 feet followed by gates 3 and 7. Full river width swift water habitat is therefore not changed with hydro project operation at gated dams.

Section 4.1.2.3--Entrainment and Turbine-Induced Fish Mortality

253. Staff is aware that physical model studies will be necessary to accurately predict downstream conditions, and a recommendation for such model studies has been included in the EIS for purposes of habitat and recreation management (see Sect. 5.4). Staff used existing models and experience at other sites to estimate tailwater velocity distributions. The commentor raises an important point -- that the "without hydro" flow regime depends greatly on the number and location of gates that are opened under current operating conditions. The Corps has a gate opening schedule for each dam that accommodates all flows. When there is but one or a few gate(s) open, the downstream velocity regime may resemble the single-point discharge of a hydropower turbine. This was noted in the Section 4.1.2.2.3, but not in the section referenced in the comment. A paragraph has been added to Section 4.1.2.2.1 to reflect this fact.

254. See response to comment #253. This section has been clarified to reflect the Corps' preset schedule of gate openings.

We are pleased Staff agreed with many of the concepts contained in the fish survival report for Racine. The following comments should be used to clarify Staff's statement.

Staff may want to replace Figure 4.1.2-6 with Exhibit 3 to improve the presentation of fish passage through wicket gates and runners. The Exhibit 3 was more useful at the Staff's fish passage workshop in Charleston as well as at other presentations we have made. 255

Staff should not use fish survival results from Dadswell et al. 1986 at the Annapolis Tidal Project to predict fish survival at Ohio River projects. Ohio River and Annapolis projects will use horizontal Kaplan turbines, but the similarities end there. Both wicket gates and runner blades will probably be adjustable in Ohio River projects; at the Annapolis only the wicket gates are adjustable because the blades on the rim generator are fixed for structural reasons. Because of these design differences, turbine efficiency is less for less operating time for the Annapolis Project compared to the turbine efficiency of Ohio River projects. Exhibit 4 illustrates these differences due to design. Higher turbine efficiency for longer operating times will yield higher fish survival. Turbine efficiency at Annapolis is further reduced because the head, changing on tides, is only at the one point for maximum efficiency for a relative short time. Because the head changes relatively slowly on the Corps-regulated Ohio River, efficiency is maintained longer. 256

We are not certain of Staff's basis for the 10% mortality estimate for shad and drum. The Racine report shows only 6% mortality. Staff's statement regarding more than 10% of game fish damaged should be clarified so that the percentage is not a mortality estimate. Fish which are struck by the blades at Racine can and do survive. 257

We believe that quantitative data from the 19-year Ohio River Ecological Research Program (cited by Staff as ESE 1987) support Staff's qualitative predictions that losses of gizzard shad and freshwater drum at Racine will not affect their populations near Racine. Based on the 9-year pre- and 5-year post start-up fisheries data downstream of Racine, the project has not detectably affected populations of the fish community. 258

We are pleased that Staff recognizes that any fish protective device needs to be biologically effective (i.e., yields survival rates greater than survival rates of entrained fish) before it should be considered for installation. Staff is also correct that the engineering 259 260

255. Staff agrees that the figure provided by AEP is superior to the one used in the DEIS, and it is being used as Figure 4.1.2-6 in the FEIS.

256. Staff recognizes the differences between the Annapolis (Nova Scotia) tidal power and Racine turbine efficiencies. Text has been modified in Section 4.1.2.3.2 to explain the differences.

257. Staff attempted to generalize from the Racine results to indicate that a range of mortalities from about 10 percent to none could be expected from such projects. The sentence about gamefish has been clarified.

258. Comment noted.

259. Comment noted.

260. Comment noted.

practicality and costs of such devices needs to be evaluated and considered.

Page 4-55

As suggested in the top paragraph on pages 4-55, each licensee should be required to have physical model studies to examine flow patterns and determine the structure design that would avoid undesirable flow patterns and so assure that the project does not cause significant impact to barge lockage. This should take the form of an additional Basin-wide Recommendation under Section 5.4.2.5, perhaps condition 10 dealing with a requirement to furnish a flow model study. 261

We thank you for the opportunity to provide comments and hope that you will find these additional materials useful.

Sincerely,

Robert W. Reeves

RWR/mac
Attachments

261. The Corps is the agency principally responsible for maintaining navigation. Because the Corps has indicated to FERC staff that they will specify and require the modeling studies to avoid navigation impacts of the proposed projects, no additional recommendation for such studies has been included in the EIS.

Four scientific papers provided as attachments by American Electric Power Company are not reproduced here.

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

In re Hydroelectric Development) in the Upper Ohio River Basin)	Docket No. EL 85-19-114. Project Nos. 7914-003, 7909-002, 4474-003, 4017-002, 7307-000, 7399-001, 9990-000, 8654-001, 7660-000, 8909-000, 4675-000, 7041-001, 7568-001, 2971-002, 3490-003, 6901-001, 10332-000, 3218-001, 6902-003, 9999-000, 6939-001, 9042-000, 10098-000, 6998-001

**MOTION TO INTERVENE OF AMERICAN RIVERS, INC.
AND FRIENDS OF THE EARTH
AND COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT**

American Rivers, Inc. and Friends of the Earth (Intervenors) hereby move pursuant to 18 CFR 385.214 and 18 CFR 380.10 for leave to intervene in Docket No. EL85-19-114 and in each of the project proceedings listed above, and also submit the following comments on the Commission's Draft Environmental Impact Statement (DEIS), "Hydroelectric Development in the Upper Ohio River Basin," issued May 1988. In support of this motion, Intervenors state as follows:

STATEMENTS OF INTEREST

American Rivers, Inc. is a not-for-profit corporation organized under the laws of the District of Columbia with offices located at 801 Pennsylvania Avenue, SE, in Washington DC. The mission of American Rivers is to preserve the nation's outstanding rivers and their landscapes. With approximately 10,000 members across the country, American Rivers is the nation's principal river conservation organization. Approximately 700 of American Rivers' members reside in the States of Pennsylvania, Ohio and West Virginia.

Friends of the Earth is a not-for-profit corporation incorporated under the laws of the State of New York, and has its principal offices at 530 Seventh Street, SE, in Washington DC. Friends of the Earth has approximately 15,000 members in the United States and is affiliated with conservation organizations in thirty-one different countries. Friends of the Earth has taken an active interest in hydroelectric licensing issues for many years, and has a particular interest in ensuring the proper implementation of the Electric Consumers Protection Act of 1986.

Intervenors are entitled to intervene in these proceedings because their members use and enjoy the upper Ohio River and immediately adjacent lands for fishing and other forms of recreation. The decision whether or not to permit construction of the projects that are the subject of the DEIS, and the terms and conditions under which such projects might be licensed, will directly affect the interests of Intervenors and their members. In particular, the proposed projects could have a significant adverse effect on fish and other aquatic and riparian wildlife, and Intervenors' members therefore wish to ensure that none of these projects is approved until the mandate of the National Environmental Policy Act has been satisfied and other applicable environmental requirements are met.

Intervenors also are entitled to intervene in these proceedings because their participation in these proceedings is in the public interest. As national organizations, Intervenors' participation will ensure that the value of the upper Ohio River and the importance of the issues raised by this DEIS are properly reflected in these proceedings. In addition, because Intervenors have recognized expertise in the laws and policies relating to hydroelectric development, Intervenors will bring valuable experience to the issues raised by

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these proceedings. The Commission already has recognized on numerous occasions that the participation of Intervenors in Commission proceedings serves the public interest.

Finally, Intervenors are entitled to intervene in these proceedings because they are expressly authorized to do so in 18 CFR 380.10.

COMMENTS

1. The DEIS proposes to license projects in violation of the Federal Power Act. In *Confederated Tribes and Bands of the Yakima Indian Nation v. FERC*, 746 F.2d 466, 470 (9th Cir. 1984), the Court of Appeals for the Ninth Circuit addressed the question whether or not the Commission could satisfy its obligations under the Federal Power Act "by deferring consideration and implementation of fishery protection measures until after licensing." The Court answered the question by stating: "FERC must consider fishery issues before, not after, issuance of a license." Id. at 471 (Emphasis in original.) 262

The DEIS indicates that the Commission intends to violate the holding in *Yakima* by proceeding with the licensing and construction of projects before fundamental fisheries issues have been resolved. For example, the DEIS recognizes that entrainment and turbine-induced fish mortality is a potentially significant adverse effect of constructing projects in the upper Ohio River, and that no adequate data are currently available to assess these impacts. (DEIS at 4-24 to 4-34.) Rather than proposing to develop a plan for resolving these questions prior to licensing, however, staff proposes that the Commission license the projects, and that possible changes in project structures and operations be considered after extensive study of the actual impacts of the projects and the establishment of a bioengineering test facility for fish

262. See the response to comment #49.

bypass systems for the Ohio River. (DEIS at 5-27 to 5-28.) This "power first/fish last" approach is flatly inconsistent with Yakima. See also House Report No. 99-507, 99th Cong. 2d Sess. 17-23 (1986).

263 Furthermore, the plan of action proposed in the DEIS violates the Commission's mandate under section 4(e) of the Federal Power Act, as amended by the Electric Consumers Protection Act, to give "equal consideration" to power generation and to fisheries, 16 U.S.C. 797(e), and violates section 10(j)(1) of the Act, which requires each license to "include conditions for the protection, mitigation, and enhancement" in order to "adequately and equitably protect, mitigate damages to, and enhance fish and wildlife (including related spawning grounds and habitat)." 16 U.S.C. 803(j)(1).

264 On the one hand, the DEIS gives practically no consideration to whether or not the proposed projects are needed to fill an actual physical demand for power, or to the environmental consequences of displacing other generating capacity or possibly avoiding the construction of alternative generating sources. So far as one can determine from the Commission's cursory analysis, the projects apparently would displace other, functioning generating equipment, and not fill an actual need for power. (See, e.g., DEIS at 1-4 to 1-5, 2-27 to 2-28.)

265 On the other hand, the Commission chooses to ignore the substantial, largely unanswered questions about the effects the projects would have on fish and other aquatic species. In short, the Commission is unmistakably placing a higher value on power than fish and other natural values, and thereby violating the Federal Power Act's "equal consideration" mandate.

2. The DEIS violates the National Environmental Policy Act. For several

263. The analysis in the FEIS provides information concerning significant trade-offs between hydropower development and environmental quality among the alternatives considered by staff. Non-hydroelectric and non-generating alternatives and the no-action alternative were also analyzed. Staff has provided recommendations in the FEIS on environmental protection of resources, including fish and wildlife, related to hydropower development in the study area. The information presented in the FEIS will be part of the record from which the Commission will make its decision. The Commission, before making a decision on issuing licenses for the projects, will take into account all concerns relevant to the public interest, to include giving equal consideration to power generation and fish and wildlife resources.

Though the technical feasibility of proposed devices for fish protection is undemonstrated and questionable for the Ohio River Basin conditions, staff believes it is reasonable to require that these mitigation devices be tested in prototype at operating facilities before they are mandated for installation at all sites. Such a phased implementation approach is standard practice for introducing any new technology into service. Staff believes that investment by developers in such a test facility, with commitment to consider effective devices for later installation if needed, is consistent with "equal consideration" for power generation and fisheries.

264. The DEIS states that it is in the public interest and useful to conserve non-renewable fossil fuels and to reduce atmospheric pollution; displacing steam generation with hydropower will accomplish both. The displacement of inefficient steam generation by hydroelectric generation improves the cost-effectiveness of the displacement. The addition of 400 megawatts of hydropower would reduce the consumption of non-renewable fossil fuels, reduce atmospheric pollution in a nation deeply concerned about acid rain and the greenhouse effect, and possibly reduce long-term energy production costs.

265. Comment noted. See response to comment #49 and 263.

reasons, the DEIS is inadequate to satisfy the requirements of the National Environmental Policy Act.

266 First, the DEIS does not analyze potential cumulative impacts in accordance with the guidelines of the Council on Environmental Quality. The Council's guidelines, which are binding on the Commission, <u>see</u> 18 CFR 380.1, define "cumulative impact" as an impact which results from the impact of a proposed action "when added to other past, present, and reasonably foreseeable future actions." 40 CFR 1508.7. Under this definition, the Commission, in considering the effects of projects for which license applications are pending, has a legal duty also to take into account the effects of already constructed obstructions in the river and of projects for which preliminary permit applications have been filed. <u>Compare National Wildlife Federation v. FERC</u>, 801 F.2d 1505 (9th Cir. 1986) (Commission has duty at preliminary permit stage either to prepare comprehensive plan or initiate environmental studies). The Commission has rejected out of hand performing a cumulative impact analysis of the type required. (DEIS at 1-5 to 1-6.)

267 Second, the DEIS is in violation of NEPA because the Commission proposes to license the projects and then turn to an evaluation of the environmental consequences of that decision after the projects are constructed. As discussed above, the Commission's approach of "power first/fish last" violates the Federal Power Act. It also violates the National Environmental Policy Act. As the Court of Appeals for the Ninth Circuit has stated, reliance on post-licensing studies violates the requirement of NEPA "that consideration of the environmental impacts of proposed projects take place before any licensing decision is made." <u>LaFlamme v. FERC</u>, No. 85-7571 (9th Cir. Issued March 18, 1988)

266. See responses to comments #32 and 33.

267. See response to comment #49.

268 Finally, the DEIS violates NEPA because the Commission has not gathered sufficient information to intelligently assess the environmental consequences of the proposed projects. In particular, the DEIS is based on inadequate information about current dissolved oxygen levels in the river and the likely consequences for dissolved oxygen levels of building the proposed projects. If the Commission issues licenses for a number of the proposed projects, significant fish kills and losses of other aquatic life could result through the increased stress from decreases in dissolved oxygen at low flow periods. (See DEIS, at 4-5 to -6, 4-8 to -10, 5-2 to -5). The Commission must seek additional information regarding current and projected dissolved oxygen levels and the effectiveness of mitigation measures prior to project licensing. (See DEIS, at 4-9 to -10, 5-2.) In the absence of this information, the Commission is simply not in a position to make a reasoned judgment.

268. Staff does not believe that collection of additional information on DO is required to design mitigation to avoid impacts to aquatic life (see response to comment #39). The spill flows recommended by staff would assure that aeration would be maintained during extremely low flows; few of the projects at dams that aerate well would operate at all during very low flows (compare the spill flow recommendations in Table 2.1.3-1 and the minimum turbine flows in Table 2.1.1-1 to the monthly mean flows in Table 3.3.1-1; the spill flow plus the minimum turbine flow must exceed the flow in the river before generation can occur). The response to comment #243 discusses the effectiveness of the proposed mitigation measures.

269 3. <u>The DEIS Cannot Substitute for Formal Consultations Under the Endangered Species Act</u>. The portion of the Ohio river being studied provides habitat for the pink mucket, <u>Lampsilis abrupta</u>, which is included on the Federal endangered species list. The DEIS states (at 4-87) that the DEIS is being provided to the U.S. Fish and Wildlife Service to comply with the consultation requirements of Section 7 of the Endangered Species Act. While it is appropriate in principle to integrate the NEPA process with the endangered species consultation process, simply distributing the DEIS for comment is insufficient to comply with the detailed procedural and substantive requirements of the Endangered Species Act, 16 U.S.C. 1531 <u>et seq</u>., and the Act's implementing regulations, <u>see</u> 50 CFR 402.01 <u>et seq</u>.

269. See response to comment #38. Additional information on <u>Lampsilis abrupta</u>, the federally listed endangered freshwater mussel, is included in Appendix I of the FEIS and has been submitted to the USFWS in compliance with Section 7(c) of the Endangered Species Act.

4. <u>The DEIS and Comments on the DEIS Cannot Satisfy the Federal Power Act Section 10(j) Process</u>. The DEIS states (at 4-87) that the Commission staff

will use its opportunity to respond to comments submitted on the DEIS by state and federal fisheries agencies "as the mechanism by which to comply with Section 10(j) of the FPA." Intervenors object to this proposed procedure because the DEIS does not contain sufficiently detailed information, including proposed license terms and conditions, for the fish and wildlife agencies to recommend appropriate terms and conditions in accordance with the purposes of section 10(j). Furthermore, should the Commission identify any inconsistency pursuant to section 10(j)(2), the EIS process would be inadequate to comply with the ECPA resolution requirements and would fail to give the necessary opportunity for fish and wildlife agencies and intervenors to participate. The Commission should therefore keep the section 10(j) process open until such time as the gaps in the DEIS are filled in and more detailed, project specific information has been developed. 270

270. See response to comment #31. Staff's recommendations have been developed after considering all comments and recommendations filed to date on the 24 license applications, including comments and recommendations received on the DEIS. Staff has provided both basin-wide and site-specific recommendations, based on information available in the geographical study area and from project-specific information.

CONCLUSION

For the foregoing reasons, the Commission should grant Intervenors' motion to intervene in these proceedings and consider the foregoing comments. In addition, the Commission should proceed to prepare a revised or supplemental DEIS that responds to the foregoing concerns.

Respectfully submitted,

John D. Echeverria, Esquire
American Rivers, Inc.
801 Pennsylvania, S.E.
Washington, D.C. 20003
(202) 547-6900

David R. Conrad
Friends of the Earth
530 Seventh Street, S.E.
Washington, D.C. 20003
(202) 543-4312

July 5, 1988.

CERTIFICATE OF SERVICE

I hereby certify that I have this 5th day of July 1988, served a copy of the foregoing document by first-class mail, postage prepaid on each of the persons listed on the official service lists maintained by the Secretary in each of the proceedings listed in the caption of this document.

John D. Echeverria

Darwin F. Johnson
Attorney At Law
P.O. Box [illegible], Morgantown, West Virginia [illegible]

July 22, 1988

Telephone
304 296-3393

Lois D. Cashell
Acting Secretary
United States of America
Federal Energy Regulatory Comm.
Washington, D.C. 20426

Re: Hydroelectric Development
Docket No. EL85-19-114
Round Bottom

Dear Ms. Cashell:

We are the owners of the ROUND BOTTOM track, which comprises 410 acres and three miles of river frontage and encompasses the Hilderbrand Lock and Dam on the east bank of the Monongahela River at the 106, 107, and 108 mile markers. You sent us a notice of a public hearing in Pittsburgh on July 15, 1988 at 10:00 a.m. The problem, however, is that we did not receive the notice until July 18. 271

We do, at this time, make a formal objection of any hydroelectric development on the Hilderbrand Lock and Dam in that our property abuts against said dam. The highest and best use of our property is for a high tech residential area. We have designed and commenced construction of roads for the development of said high tech residental area, and the hydroelectric development would be severely adverse to our development. Additionally, electric power is overabundant in West Virginia, and in fact, most of the electricity produced by West Penn Power and other utilities is sold out of our state.

Enclosed is a recent article from our local newspaper which reflects that the Governor has granted us an industrial roadway for the construction of our high tech residential area.

Please advise us timely as to any future public meetings so that we can go on record with the court reporter.

Please advise us accordingly.

Thank you kindly.

Respectfully yours,

Darwin F. Johnson

FERC - DOCKETED

JUL 27 1988

Enclosure

8808030550

271. This comment notes an individual's objection to the proposed Hildebrand project because of impacts on a "high tech residential area" under construction in the vicinity. The comment does not specify the nature of the adverse impacts anticipated, nor does it include any details that would permit staff to assess the impacts. Staff attempted to obtain additional information through a telephone call on August 30, 1988. The commenter declined to provide sufficient information on the basis of a telephone contact and indicated that he might supply it if officially requested by a letter. Unfortunately, the schedule for preparing the FEIS did not permit Staff to pursue this possible method of obtaining the needed information.

Sections 4.1.6.1 and 4.1.6.3 have been revised to include the potential impacts of the Hildebrand project on proposed residential development in the vicinity. The potential impacts include possible encroachment of some project facilities on land proposed for residential development and possible exposure of the residential area to noise, dust, and traffic during project construction. Recommendation 6 in Section 5.4.3 has been revised to call for compensation for deterioration of privately owned roads used by construction traffic at this project.

A newspaper article provided by Mr. Johnson is not reproduced here.

OHIO RIVER VALLEY
WATER SANITATION COMMISSION

49 EAST FOURTH STREET, CINCINNATI, OHIO 45202 [illegible]

PATRICK L. STANDING

ALAN H. VICORY, JR., P.E.

July 6, 1988

Ms. Lois D. Cashell, Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, NE
Washington, DC 20426

RE: FERC Docket No. EL85-19-114

Dear Ms. Cashell:

The Draft Environmental Impact Statement (DEIS) on Hydroelectric Development in the Upper Ohio River Basin has been reviewed by staff of the Ohio River Valley Water Sanitation Commission (ORSANCO). The DEIS considers the cumulative impacts of 24 proposed hydroelectric projects at 19 sites on the Allegheny, Monongahela, Muskingum, and Ohio Rivers and evaluates several alternatives for mitigation of identified impacts. The recommended alternative would permit hydropower development at 15 of the 19 sites.

Personnel from Oak Ridge National Laboratory who prepared the DEIS consulted frequently with ORSANCO staff, and made several presentations before this Commission's Technical Committee, which consists of representatives of eight states, including the six states along the Ohio River, U.S. Army Corps of Engineers, U.S. Geological Survey and U.S. EPA. This has provided ORSANCO with opportunities to review the work in progress and the methodologies used. We are pleased to see the degree to which environmental protection is supported in the final recommendations. 272

272. Comment noted.

At its May 26, 1988 meeting, the Commission adopted the following policy concerning dissolved oxygen monitoring at Ohio River hydroelectric facilities: 273

273. Comment noted.

Operating licenses for Ohio River hydropower facilities should contain provisions to assure that:

1. Adequate studies are conducted prior to facility operation to define aeration characteristics of the dam;

2. Continuous monitoring of dissolved oxygen is provided at representative locations above and below the facility as appropriate, with data available to ORSANCO through remote interrogations;

3. Provisions are made in the facility design and operation to allow maintenance of full aeration potential of the dam during critical conditions.

Specific application of this policy to individual hydropower projects shall be on a case-by-case basis.

It is our opinion that the recommendations of the DEIS are fully in concert with this policy.

On June 30, 1987, under the scoping process of the DEIS preparation, this Commission submitted comments which included the request that the study area be expanded to include the entire main stem of the Ohio River. That request was based on our dissolved oxygen monitoring results which show that the major problems, and hence the area most sensitive to effects of hydropower on aeration at navigation dams, have been on the middle and lower Ohio River, downstream of the study area. While the study area was not expanded, several of the recommendations can and should be applied to all Ohio River projects. 274

274. See responses to comments #32 and 33.

Another recommendation in our June 30, 1987 statement was that coordinated control of hydropower operations be investigated. We believe that the seventh recommendation under 3.4.2.1 - Recommendations on Water Quality - begins to address that concern. 275

275. Comment noted.

One of the problems encountered in preparing the DEIS was that critical dissolved oxygen conditions did not occur during the period when applicants were requested to perform field measurements. In applying the above stated policy of the Commission, it is envisioned that additional data collection would be required to fulfill the first requirement. Given the current drought situation in the Ohio Valley, this summer should provide an excellent opportunity for such data collection. 276

276. Staff did not believe it was necessary to request project applicants collect additional dam aeration data in the summer of 1988. Staff has reviewed the extensive data collected in 1988 by the Pittsburgh District of the Corps; however, the conditions occurring in the summer of 1988 are so unusual (compared to historic flow rates, water temperatures, etc.) that staff does not believe the data should be used to represent the system. For example, stratification of pools that have rarely before stratified radically changes the apparent aeration rate at some dams.

Given the time frame available for submitting comments on the DEIS, it was determined by this Commission's Technical Committee that it would not be practical to attempt to develop a single set of comments on behalf of this Commission and its member states. The states will therefore submit their own individual comments.

We appreciate the opportunity to comment on the DEIS, and the degree to which George Taylor of your staff as well as the Oak Ridge personnel have maintained communication with ORSANCO during the preparation period.

Sincerely,

Alan H. Vicory Jr.

Alan H. Vicory, Jr.

Copy to: George Taylor

COMMENTS OF

ALLEGHENY ELECTRIC COOPERATIVE, INC.
LICENSE APPLICANT FOR FERC PROJECT NO. 2971-002
MONTGOMERY HYDROELECTRIC PROJECT

ON

HYDROELECTRIC DEVELOPMENT ON THE UPPER RIVER BASIN
FERC DOCKET NO. EL85-19-114

DRAFT ENVIRONMENTAL IMPACT STATEMENT

JULY 1988

I. OVERVIEW

Allegheny Electric Cooperative has read, with interest, the FERC Draft Environmental Impact Statement (DEIS) on hydroelectric development in the Upper Ohio River Basin. The cumulative impact assessement prepared by Oak Ridge National Laboratories (ORNL) on behalf of the FERC is, as expected, a comprehensive document. The DEIS identifies a battery of potential environmental issues and assesses each issue at seemingly the level of current knowledge.

Whereas the DEIS would lead one to believe that the scope of the DEIS was born of the official scoping meetings, held in Pittsburgh, this does not appear to be the case. It seems evident to Allegheny that some of the real decisions were made after the two "informal" West Virginia meetings, the attendance and importance of which is somewhat of a mystery. It appears that many substantive decisions were made at these meetings, apart from limited scoping, thatthe Applicants had little input about what direction the study should take and what are the priorities. Obviously, from the beginning, dissolved oxygen (DO) was the real 277

277. Staff benefited from various sources of information in the preparation of the FEIS. Information provided in project applications, including documentation of applicant and agency consultations, was an important source. Staff used scoping meetings and public meetings to obtain comments on the scope of the EIS and to determine the issues to be discussed and analyzed. Staff also used the information filed by the applicants in response to staff's additional information requests. The responses provided staff with a standard base of information to conduct its analyses for the proposed projects in the study area. Staff meetings with applicants, agencies, and organizations provided the opportunity to obtain information and for staff to present the analytical procedures used in the EIS. Staff assessed all available information and used its best professional judgement in completing its own independent analysis for the proposed projects.

agency issue, with fisheries and wetlands taking a close second. However, no attempt was made in the DEIS to consider future changes to the river system or the effects of such system by other actions apart from hydroelectric generation.

278 Principally, and perhaps the greatest deficiency of the DEIS is, in Allegheny's opinion, the principal assumption in the development of Alternatives that <u>all</u> hydroelectric developments will be developed in accordance with the license application plans. In short, the assessment was strictly limited to the recent past hydro development environment and the further assumption that all hydro would be developed with no provisions for change. Certainly, this is a narrow and very loose interpretation of the real world and perhaps the fatal study assumption. It is ludicrous for the FERC or any other developmental agency to assume that all licensees, upstream or downstream of a particular site, have the capability, financing, and power purchase market available, to develop a hydroelectric project and that all of these sites will be developed within the exact same time frame predicated by the DEIS. This report acts as merely a snapshot of development in a very unlikely scenario that all license applicants will develop hydro plants as outlined in speculative license applications borne of the tax and PURPA incentive legislation of the late seventies.

Allegheny Electric Cooperative, as an operating, generating utility and licensee of a FERC Project in central Pennsylvania, is well aware of the responsibilities, capabilities and mitigation activities associated with the coordinated devel-

278. See response to comment #32 and 292. Staff concludes that at least one proposed project at each site would have positive net benefits under the recommended alternative and therefore assumes that all sites would be developed, if licensed.

opment of hydro facilities. The rather narrow stance taken by the FERC staff in assessing economics and abilities of the economic capability of all licensees to develop and sell hydroelectric power to the intended market, is a very shallow interpretation. Refinement of the DEIS into a final report should, at a minimum, include a case whereby the likelihood of development is assessed and alternative scenarios based on the capabilities and probabilities of development, which would include the generation and development of Montgomery as a viable project with Allegheny, an operating utility, as one developer. More discussion on this is contained later in Section III.

Section II discusses the specific technical issues related to Montgomery. At Montgomery, significant adverse impacts were identified for fisheries, wetland, and recreation. Fisheries (related to perceived dissolved oxygen (DO) and turbine mortality impacts) and wetlands (Montgomery embayment) were expected to be an issue since as early as our original agency contacts in 1980, these were the identified agency concerns.

Recreation, as a major impact, was something of a surprise in that the proximity of an active railroad and the steepness of the shoreline limits recreational fishing potential at the site currently, and provides safety hazards for access continually. We believe that the recreational fishing issue, as it relates to Montgomery, may have been overemphasized. The Pennsylvania Fish Commission has made previous statements about Montgomery being the best tailrace fishing on the Pennsylvania portion of the Ohio River, however, data in Allegheny's license 279

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279. Recreational fishing is not only valued in terms of the number of users that can be accommodated at a given site, but also in terms of the quality of the recreational fishing possible at that site. For example, both fishing success rates and species composition influence the quality of recreational fishing at a site. The high quality of recreational fishing at Montgomery is attributed to the embayment located immediately upstream of the Lock and Dam. In addition, the physical constraints at Montgomery do not warrant special consideration as they are not as limiting as those found at other project sites in the study area.

application indicates that many more people fish the Dashield Pool due to relative proximity to the Pennsylvania Fish Commission boat ramp. The physical constraints at Montgomery are mentioned in the DEIS, but never appropriately discounted and related to actual fishing ability. This is just one example of the narrowness of the DEIS on site-specific issues.

COMMENTS OF

ALLEGHENY ELECTRIC COOPERATIVE, INC.
LICENSE APPLICANT FOR FERC PROJECT NO. 2971-002
MONTGOMERY HYDROELECTRIC PROJECT

ON

HYDROELECTRIC DEVELOPMENT ON THE UPPER RIVER BASIN
FERC DOCKET NO. EL85-19-114

DRAFT ENVIRONMENTAL IMPACT STATEMENT

JULY 1988

II. SPECIFIC COMMENTS ON THE MONTGOMERY HYDROELECTRIC PROJECT

A. Dissolved Oxygen (DO)

According to the DEIS under Alternative Nos. 1 and 2, Montgomery has a moderate impact on DO. Alternative No. 3, a 4,000 to 16,000 cfs spillage, allows for development, but at reduced energy output. 280

The no-hydropower-development scenario (DEIS Figures 4.1.1-7 and 8-16) indicates about 0.5 to 1 mg/l of DO is added by Montgomery Dam reaeration during summer months. Allegheny's extensive field surveys in 1987 generally agree with this data. However, based upon Allegheny's 1987 data, which included a flow less than 7Q10, Ohio River DO was always high throughout the water column even upstream of the dam.

Allegheny questions how the model data showing low Ohio River DO (e.g. less than 5.0 or 6.5 mg/l; DEIS Figures 4.1.22, 4.1.2-3) can justifiably be taken as the benchmark to preclude hydro development when recent, rigorously controlled, DO data collected in 1987, during an adverse DO period, indicate

280. Several state and federal agencies also commented that DO analyses should be based on measured data instead of modeling. As stated in the response to comment #39, field measurements are inadequate for a complete analysis of project impacts because data from only a few years are inadequate to describe the range of potential conditions and DO concentrations. Data collected in 1987 do not necessarily represent conditions under which hydropower would have the greatest impact; simulation of such conditions is required to determine adequate spill flows for mitigation. In addition, field measurements of DO do not provide a means of predicting project impacts. Even though data measured in 1987 show adequate DO concentrations at Montgomery, staff is confident that had the projects proposed upstream of Montgomery been in operation with inadequate spill flows, the DO at Montgomery would have been much lower. The model is required to assess the cumulative impacts of all the projects.

The data collected by the Corps in 1983 was the best available set of data for calibration of the model. Temperatures, flow rates, and DO concentrations were measured at 108 sites (see Appendix B), during a short time period. The data collected by applicants in 1987 were used to model dam aeration rates, as part of the basin-wide DO model (the data are presented in reduced form in Appendix B of the FEIS). Data collected by project applicants in 1987 were not used for calibration of the basin-wide model because (1) measurements were not made at all the dams, since some applicants had previously provided the requested dam aeration data; (2) measurements were not made in the pools between dams, as they were in the 1983 Corps data; and (3) the measurements made by the applicants were not all taken during the same time period.

high ambient DO. At a minimum, some discussion of actual 1987 field conditions at all the projects should have been graphically displayed in the main text and Appendix B.

Models are notorious for providing numbers, good or bad. Controlled field studies provide actual, albeit limited, glimpses of the real world. Somehow the real world seems to have been lost amidst all the assumptions inherent in the model and the basis upon which it was calibrated (Corps 1983 data). The field data demonstrate that DO was not a problem in 1987 above or below Montgomery Dam either day or night or at high or low flow. In 1987, hydro development would not have adversely affected DO due to existing high saturation above the Dam.

Allegheny questions use of the Corps 1983 data to calibrate its model. Allegheny has not seen the 1983 data on which much of the DEIS's is based, but included in the Montgomery Application the 1984 to 1982 Corps data. If 1983 data was collected as in previous years, it represents a one upstream and one downstream profile taken irrespective of river flow, temperature, and time of day. Some earlier Corps upstream/downstream data were taken as much as one full day apart in earlier years. Allegheny questions the use of limited Corps data when a more recent and comprehensive data base was directed to be taken and available to FERC. If the model was calibrated based upon a high DO deficit (DEIS page B-10), then model results will reflect that condition. High DO deficits were not observed in 1987 field studies at Montgomery Dam.

In summary, DO modeling results and 1987 field data collected at Montgomery Dam present radically different pictures of what hydro development would mean in terms of DO at this site. Allegheny questions the absence of any text or graphics depicting 1987 field DO concentration data which was provided to FERC in a timely and efficient manner.

B. Fisheries

The preceding discussion of DO modeling and 1987 field results obviously has direct bearing upon the assessment of DO effects upon Ohio River fishes. Based upon the tiered analysis presented (DEIS page 4-11 to 4-18), had hydro been in operation at Montgomery in 1987, there would have been no adverse effect upon growth of channel catfish, sauger or walleye. 281

Entrainment and turbine mortality at Montgomery Dam is more of a potential due to the proximity of the Montgomery embayment. Turbine mortality questions remain unanswered after the Racine and Greenup/Vanceburg studies (and probably will forever and ever if the agencies have to have indisputable evidence). Note: On DEIS page 4-25, it is interesting that the Corps and WVDNR believe there is little mortality in passing through existing gates given they have no data to support that opinion.

In Allegheny's opinion, the entrainment/turbine mortality issue is a no-win situation at all hydro sites, given the fisheries recommendations at DEIS page 5-27, since it implies mortality studies, screening, monitoring, etc. without purpose other than to preclude development.

281. Staff is also concerned that highly certain and site-specific answers to the questions of entrainment impacts (e.g., numbers of fish entrained, degree of damage and mortality, effects on populations, and effectiveness of fish protection devices) will not be forthcoming even after expending large amounts of effort and funds. Management decisions must be made on the basis of incomplete evidence, and cooperatively among developers, resource agencies, and regulators. Until there are better data than at present, however, some data collection and prototype testing of mitigation devices is necessary at representative sites before reasoned management decisions can be made. Stocking is clearly one option for mitigation, but it is not accepted by all resource agencies as appropriate.

In Allegheny's opinion, field studies, no matter how comprehensive, may never answer these questions to the agencies' full satisfaction since there have been numerous studies with no conclusive results to show significant mortality. Stocking, as compensation for fish mortality, is a reasonable recommendation, one which, within limits, benefits all.

C. Recreation

282 There are conflicting statements and conclusions in this portion of the DEIS. The recreation section stresses both need for angler access and a "desirable concentration of sport fishes in the public fishing areas." Ergo, fish mortality due to angling is OK, but mortality due to turbine passage is unacceptable. Also increase access at Montgomery will increase angling pressure in the form of anglers' boats, motor oil, waves, pollution in the embayment (a FWS Resource Category 1). Allegheny questions whether the FWS and PFC consider this impact acceptable.

283 The minimum recreational development includes; a fishing pier, paved walkways, access to riverward coffers, fish attractant structures, parking access paths, restrooms, fish cleaning shelter, provisions for handicapped use, solid waste disposal, lighting and drinking water. Allegheny specifically challenges the siting of these facilities at Montgomery, given the active railroad and steepness of grade. In the event such facilities cannot be located at the development, the DEIS stipulates that offsite compensatory facilities be proposed. As a license Applicant, Allegheny is amenable to some mitigation for

282. If necessary, state agencies will initiate management measures to reduce any stress on fish populations caused by angler harvest at developed recreational fishing sites. The provision of shoreline fishing access at the project tailrace should have no affect on boat angling pressure in the embayment upstream.

283. FERC regulations require that the developer construct, maintain, and operate a standard level of recreational development (refer to recommendation 1, Section 5.4.2.3). Site-specific constraints prohibiting this level of recreational development would need to be discussed with the appropriate federal and state agencies in order that recreational compensation could be determined and a revised plan filed with the Commission.

the benefit of sport fishing, however, to be required to improve upon a condition at Montgomery which does not, in its current form, support natural access, is extortion.

Additionally, the DEIS calls for compensation during project construction (e.g. temporary facilities). Safety issues such as construction equipment and fishermen using the same access road makes this provision impractical. 284

Lastly, compensatory flow releases are recommended to be made for the newly-created shoreline fishing during the operational phase when the powerhouse is shutdown for maintenance. A flow of between 500 and 2,000 cfs is required as well as aeration capability and safe fish passage features. Once again, the agencies are overreaching the existing condition. 285

It may be worth noting that the only way fish routinely bypass the dam at present is over the fixed weir, through the gates or through lockage, all of which have some degree of attendant mortality.

D. Wetlands

Potential impacts to the Montgomery embayment are given on DEIS page 4-52. A course of action which has been considered by Allegheny includes a proposal to conduct a pre-license, physical model study by which protection of the embayment from sediment aggradation or degradation can be demonstrated. 286

The DEIS seems to state that the Montgomery Project will destroy this area, although DEIS does not provide one thread of evidence to support this view. About all DEIS says is that project impacts would be "unacceptable." This position

284. See response to comment #217.

285. See response to comment #14.

286. The proximity of the Montgomery Embayment and the associated shoreline wetlands is such that staff believes that at least one acre of wetlands would be affected during construction. Diversion of flows from the embayment area will lead to changes in species composition and areal extent of the wetlands. During construction, a potential also exists for damage and possible destruction from increased erosion, turbidity, and sedimentation. Aerial photographs and navigation charts for the area were used to assess the potential changes in wetlands. Staff calculated that at least 0.5 acres of emergent wetland would be affected directly and loss of about 0.5 acres due to increased velocities, erosion, sedimentation and turbidity is not unreasonable. Because of the high value of this embayment and associated wetlands as a nursery and feeding area for fish, development of a project at this site is not recommended until further studies result in adequate mitigation for these potential impacts.

once again discounts the fact that Allegheny has committed to a program that would avoid or mitigate any impacts to the embayment. DEIS concedes there will be no change in water elevation. This only leaves construction impacts and velocity. Allegheny's plan for the construction area does not approach into the embayment and only affects one-half acre of submerged wetland habitat (not 1 acre as stated on DEIS, page 5-9). A model study may show that velocities are nondetectable.

287 Allegheny just recently completed construction of a hydro project adjacent to a wetland and is pleased to report the ducks, beaver, snapping turtles and cattails are doing just fine.

287. Comment noted.

288 Allegheny is troubled that DEIS automatically assumes that the embayment will be impacted. It is interesting to note that while the DEIS refers to such impacts as "unacceptable" or "unavoidable" DEIS does not consider them as resulting in irreversible and irretrievable commitment of resources (see Section 4.9).

288. The loss of 0.5 acre of emergent wetlands due to construction would be irretrievable and irreplaceable. Changes in species composition and areal extent would result in one ecosystem being replaced over time by another ecosystem, thereby changing the character of the site.

289 In terms of the wetlands issue, another mitigation plan which potentially would complement, not replace, the above proposal might be as follows. At one of our earlier agency meetings, someone made the offhand remark that the embayment was created in the 1930's (?) from spoil excavated during the construction of the dam. Allegheny cannot vouch for the accuracy of that statement. However, assuming that it might be true, it is possible to propose to do the same thing with dredge spoil (assuming the sediment chemistry tests do not indicate polluted

289. It is perhaps possible to restore or reconstruct new wetland areas using clean spoil material as a mitigative measure. Studies of such potential mitigation are recommended before licensing (Section 5.4.1).

sediment). Rather than study and say No, the FERC and agencies should prioritize mitigation activities and work with Applicants on these obvious problems.

E. Endangered/Threatened Species

290 There are remarks regarding Montgomery on DEIS page 4-62, last paragraph, but due to a typographical error, the statement makes no sense. If, as expected, the statement refers to the attraction of bald eagles to the tailrace to feed on dead fish and subsequent mortality due to electrocution from the transmission lines, Allegheny challenges the likelihood of such mortality. Certainly hydro and bald eagles coexist in Maine, the Pacific Northwest and Alaska. Have bald eagles been adversely impacted elsewhere? Certainly Allegheny could highlight the minor spans of the transmission line (no river crossings are contemplated) with markers so that it would be avoided by any eagle, osprey or heron that might choose to feed in the tailwater.

F. Mitigation

291 The DEIS appeared to rely heavily on the Corps' 1983 data in which all other data was calibrated as well. As previously stated, Allegheny sees little adjustment for the more comprehensive 1987 data base provided which shows higher DO readings. Because of this, DEIS takes the position that the only way the Montgomery Project would be allowed to operate would be if a spill flow of 16,000 cfs was maintained during the four-month period, July through October. It is interesting to note that this 16,000 cfs figure is 12,800 more spillage than requested by the Pennsylvania Fish Commission. It is also 10,300 cfs

290. Staff concerns about the bald eagle being attracted by entrained fish are related to the proximity of the proposed project site to an urban area, which create additional hazards to the endangered raptors. Bald eagles and hydropower plants can co-exist in rural locations away from urban populations. The typographical error has been fixed in Section 4.1.6.2.

291. See the response to comment #280 concerning calibration data. The spill flow recommendations were based on a cumulative analysis of many projects' impacts on DO; the recommendations by fish and wildlife agencies may not have considered all the proposed projects at once. The reasons why staff does not recommend spill flows at a site be based on instantaneous conditions at that site are discussed in the response to comment #243. Staff has included a recommendation (recommendation 7, Section 5.4.2.1) that allows for real-time determination of spill flows based on basin-wide water quality conditions.

more than requested by the U.S. Fish and Wildlife Service in their review of Allegheny's license application. Staff justifies this high flow as that amount required to maintain DO levels above 6.5 mg/l. It would make more sense to restrict project operations when DO levels dropped below 6.5 mg/l, regardless of flow. Further, the DEIS disallows any benefits that may be derived from mechanical or artificial aeration.

On DEIS page 5-24, a spill flow of 16,000 cfs (July-October) and 4,000 cfs (November-June) was recommended if the project was to be licensed. Allegheny suggests that spillage up to 16,000 cfs should be required <u>after</u> upstream DO dropped to 7.0 mg/l. That is, if as in 1987, the river upstream was near DO saturation, there is no biological or BOD rationale for which spillage is required. The high ambient DO concentrations would merely be transported downstream without the need for spillage.

COMMENTS OF

ALLEGHENY ELECTRIC COOPERATIVE, INC.
LICENSE APPLICANT FOR FERC PROJECT NO. 2971-002
MONTGOMERY HYDROELECTRIC PROJECT

ON

HYDROELECTRIC DEVELOPMENT ON THE UPPER RIVER BASIN
FERC DOCKET NO. EL85-19-114

DRAFT ENVIRONMENTAL IMPACT STATEMENT

JULY 1988

III. ECONOMIC ANALYSIS

The cursory analysis of economic impact presented in the DEIS accepts the license application data as presented in the license applications for cost purposes, however, inaccurately compares the value of the project against a power output from a "generic coal-fired steam electric plant in the Ohio River Valley." This approach is far from reality. In the instant case, the Montgomery Hydroelectric Project would be developed by Allegheny Electric Cooperative, an operating utility (as distinguished from most of the other applicants in the DEIS) in a nonprofit manner for the benefit of over 170,000 consumers in Pennsylvania and New Jersey. The power generated would be used to offset purchases from private power companies at real not generic or proposed wholesale power cost rates. 292

In developing the estimated levelized annual cost of the project, Allegheny includes interest, depreciation, FERC Annual Charges, O&M, Administrative & General, insurance, wheeling and taxes, all escalating at utility trend rates. The levelized annual value of the project is based on offsetting wholesale

292. The economic benefits that would be realized from development of hydropower plants on the Ohio River are shown in Table 5.2-1. For each developer, the financial feasibility would be based on actual contracts for the purchase of power, which will not be available until after the projects are licensed.

purchases from our major power supplier (Penelec) and escalates according to our projections of Penelec's wholesale rate to Allegheny. Based on this analysis, and using the FERC criteria of a 9% discount rate, Allegheny computes the levelized net benefit of the project under Alternative 1 at 30.7 mills/kWh not 7.7 mills/kWh (DEIS Table 2.1.1-3). Under Alternative 3, Allegheny computes the levelized net benefit at 12.8 mills/kWh not (-6.2 mills/kWh (DEIS Table 5.3.1). Clearly the project remains viable in Allegheny's economic analysis, if licensed.

Finally, although FERC staff recognizes that the financial attractiveness of projects is under question, no attempt is made in the DEIS to ascertain the financial viability and capability of a license applicant to accurately develop and construct, operate, and maintain a project. Instead, a most unlikely scenario, utilizing the blanket assumption that <u>all</u> projects will be developed in exactly the same time frame and that the cumulative impacts <u>will occur</u>, is projected without regard to real life financing or the current downward trend in hydro development because of PURPA and loss of tax benefits. No sensitivity runs of a development strategy, where one or more of the projects are not developed, is presented. Allegheny believes that the study compounds the economic impact of no hydro development in the Upper Ohio River Basin with the currently depressed economic condition, and reports those findings as another equally unlikely scenario.

COMMENTS OF

ALLEGHENY ELECTRIC COOPERATIVE, INC.
LICENSE APPLICANT FOR FERC PROJECT NO. 2971-002
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IV. SUMMARY

In summary, Allegheny does not concur with the conclusions and recommendations reached in the DEIS and the conclusions as to the specific Montgomery Hydroelectric project for the following reasons:

A. The DEIS is a comprehensive but extremely narrow snapshot of hydroelectric development in the Upper Ohio River Basin. Some of the major assumptions do not take into account past, current, or future trends in the hydro industry, the environment, or the economic area, although the study purports to be expansive. 293

293. Comment noted.

B. While the environmental data and modeling attempts to predict DO water quality data, it is calibrated on 1983 data and in no way verifies field data taken by Applicants in the critical low flow periods in 1987 which show that the water quality is not as bad as originally perceived by all. 294

294. See response to comment #280.

C. The DEIS is flawed in that it assumes throughout that <u>all</u> projects will be developed in the <u>same</u> time frame, despite industry trends and the realities of hydro development success, to the contrary. 295

295. The four hydopower alternatives evaluated in the DEIS contain different combinations of project development. To assess the impacts of this construction, staff has assumed that the projects will come on line in a reasonable time frame and that unforeseen delays will be held to a minimum.

D. The DEIS presents a very simplistic view of the economics of hydro development and in the instant case of Montgomery, a prejudiced and inaccurate one, not taking into account the true benefits to the developer of long-term reliable power for Pennsylvanians. 296

E. That the recommendations for mitigation, while some are possible, are so comprehensive and in no way attempt to prioritize resources and are so egregious that the future for any hydro development in the region is doubtful and no attempt is made to negotiate reasonable economic solutions to develop clean, long-term, reliable and indigenous power resources. 297

296. Comments noted.

297. Staff believes that its recommendations allow for the development of hydropower projects in the upper Ohio River Basin in an environmentally acceptable manner. Staff's recommendations are based on the importance of certain environmental resources in the study area that would be cumulatively impacted by hydropower development and the importance of other environmental resources at specific hydropower sites.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Hydroelectric Development In The Upper Ohio River Basin	))	Docket No. EL85-19-114

COMMENTS OF ALLEGHENY HYDROPOWER, INC.
ON DRAFT ENVIRONMENTAL IMPACT STATEMENT

Pursuant to the Notice of Availability published in the Federal Register in the above captioned proceeding on May 20, 1988 (53 Fed. Reg. 18131), Allegheny Hydropower, Inc. ("Allegheny"), project sponsor of the Allegheny River Lock and Dam No. 7 project, Project No. 7914 (L&D No. 7), hereby respectfully submits its comments on the Draft Environmental Impact Statement on Hydroelectric Development in the Upper Ohio River Basin (DEIS).

I.

SUMMARY OF POSITION

As the project sponsor of the Allegheny Lock and Dam No. 7 project (Project No. 7917), Allegheny Hydropower, Inc. has a direct interest in the outcome of this proceeding and in the recommendations made in the final Environmental Impact Statement on Hydroelectric Development in the Upper Ohio River Basin.

Allegheny believes that the DEIS fails to adequately take into consideration various potential mitigative measures which, when undertaken, would serve to adequately address the concerns for short and long-term effects to the riverine environment expressed in the DEIS. Allegheny further believes that the DEIS overstates L&D No. 7's impact, especially in light of the fact that four adjacent projects (L&D Nos. 5, 6, 8 and 9) which are nearly identical to L&D No. 7 have already been licensed. Finally, Allegheny believes that its project is in fact compatible with the development of other projects in the Upper Ohio River Basin, and may in fact enhance and provide additional recreational resources to the public benefit.

II.

COMMENTS

Following are Allegheny's specific comments pertaining to various statements and recommendations contained in the draft EIS to which Allegheny seeks to respond.

Comment 1

On pages 1-6 and 3-38 the DEIS correctly points out that licenses have been issued for L&D Nos. 5, 6, 8 and 9 and construction has begun on L&D Nos. 5 and 6. However, the DEIS fails to point out that other projects already licensed are nearly identical in design and configuration to L&D No. 7, whose license application is now pending. Furthermore, the license applications for other similar adjacent projects were originally submitted only a few months before Allegheny submitted its application for L&D No. 7. The final EIS needs to address this matter in greater detail, as it goes towards the issue of estab- 298

298. Staff is aware that there are other licensed projects and pending projects in the study area with similar design and configuration to L&D No. 7. Staff is also aware that some of these pending projects filed license applications at an approximate time of the L&D No. 7 filing. Staff must assess the environmental impacts of the pending proposals and the environmental impacts of alternatives to the proposals prior to the Commissions's decision on licensing actions. Staff has documented in the FEIS the cumulative interaction occurring with multiple hydropower projects in the study area and has assessed the environmental impacts attributed to each of the pending projects. The application for Allegheny River L&D No. 7, as a pending project in the study area, warranted inclusion in the EIS analysis.

lishing cumulative impact. Failure to address why similar projects applied for within months of each other have been treated disparately brings the EIS' analysis process into question.

__Comments 2__

The DEIS currently places substantial emphasis on the subject projects' individual and cumulative impact on wetlands and biota habitat. However, the DEIS incorrectly concludes that L&D No. 7 will cause irreparable harm to wetlands and shallow-water habitat because no alternative mitigative measures are capable of alleviating the impact of turbine tailwater discharge and discharge channel dredging as currently proposed (__see e.g.__ DEIS §4.1.2.2.3 at 4-23; §5.1.1.2 at 5-5). These statements need to be clarified in the final EIS and staff must recognize the existance of alternative mitigative measures which will adequately address these issues. 299

The DEIS expresses concern that the L&D No 7 project as currently proposed will cause direct "significant, unavoidable adverse impacts to the target resources identified as fisheries, recreation and wetlands" on and around the Isle of White, a 14 acre shoal located downstream from L&D No. 7 (DEIS §5.4.1 at 5-23). The concern is that as currently proposed, tailrace dredging during construction, and subsequent turbine tailrace discharge just below the upper tip of the Isle of White, will result in the potential removal of and significant erosion of the

299. Staff used all known information in conducting its analysis for L&D No. 7. See responses to comments #300 through 316.

island with time (DEIS §5.1.1.4 at 5-8, 5-9). Furthermore, the DEIS is concerned that currently proposed project flow rates and patterns would alter existing flow regimes and possibly alter the survival and establishment of certain wetland species. (Id.)

The DEIS' analysis of this potential problem, however, is seriously flawed. Staff, in preparing the DEIS, either was unaware of or chose to ignore the existence of potential alternatives which could result in a plan with minimal cumulative impact best adapted to the comprehensive development of L&D No. 7 for beneficial purposes, and in compliance with the recommendations of the Commission and other resource agencies.

An example of a possible alternative which would result in an "alternative orientation of the turbine discharge...capable of avoiding significant, adverse habitat loss" (DEIS at §4.12.2.3 at 4-23 and §5.1.1.2 at 5-5) would be the installation of a Vertical Kaplan Siphon Turbine. 300

The Vertical Kaplan Siphon Turbine would avoid or effectively mitigate the direct adverse impacts with which the DEIS is concerned because it would permit the reorienting of turbine tailrace discharge away from the Isle of White and into the main center channel of the Allegheny River. This reorientation is possible because the Vertical Kaplan Siphon Turbine employs a compound draft tube which can accommodate any horizontal discharge angle. Vertical discharge angle would depend on submergence requirements, and on the design of the hydraulic smoothness of the draft tube.

300. Alternative designs that deflect flow toward the center of the river would increase velocities in the vicinity of the navigation lock. Navigation traffic could be adversely affected by increased velocities and cross currents. Disruption of navigation is not an acceptable proposal for this site.

Because the sweeping angle of the draft tube could be directed towards the center of the main channel, it would permit dredging further upstream and more riverward compared to that required of a conventionally oriented horizontal bulb turbine configuration. The result would be that tailrace dredging during construction would remove little if any of the upstream section of the Isle of White shoal and associated shallow-water habitat.

Furthermore, a vertical Kaplan Siphon Turbine requires a shorter overall powerhouse length than conventional horizontal turbine installations. This is because water is siphoned into a turbine scroll case via a vacuum pump, and then directed downward onto the turbine runner blades. Discharge is conveyed through the draft tube and into the turbine tailrace. Consequently, the vertical turbine shaft and runner blade location would be much farther upstream and closer to the axis of the dam than would be the case with a conventional horizontal turbine installation. The effect of this is that excavation and associated dredging in order to maintain submergence requirements in the tailrace are significantly less, and therefore, the impact of sedimentation, turbidity and erosion on and around the Isle of White could be effectively mitigated.

In addition, other possible and practical methods exist for avoiding significant, adverse wetland and habitat loss in and around the Isle of White. For example, the placement of a deflector in the lower end of the tailrace would direct turbine tailrace discharge into the main center channel of the river and 301

301. See response to comment #300.

away from the Isle of White. The Pennsylvania Fish Commission recognized this alternative mitigative measure in its comments on L&D No. 7 submitted to the Commission in 1985, and stated that it "would help to protect the island and also mix the turbine discharge across the river more quickly." (See Letter from Jack G. Miller, Chief Fisheries Environmental Services, Pennsylvania Fish Commission to Kenneth F. Plumb, January 11, 1985).

Accordingly, the DEIS incorrectly concluded that there is 302
"no alternative orientation of the turbine discharge...capable of avoiding significant, adverse habitat loss." The final EIS needs to investigate this issue further in light of the alternatives which Allegheny has presented.

<u>Comment 3</u>

The DEIS states that staff is unaware of any off-site 303
compensation that could mitigate potential adverse environmental impacts. (DEIS §5.4.1 at 5-23). The staff however, appears to ignore the suggestion of the United States Environmental Protection Agency that adversely impacted wetlands be replaced on an acre by acre basis. (See Letter from John R. Pomporio, Chief Environmental Impact and Marine Policy Branch, U.S. E.P.A. to Kenneth F. Plumb, January 11, 1985.) The final EIS should address and consider the acre by acre replacement of adversely impacted wetlands as a possible and practical mitigation alternative.

302. See response to comment #300.

303. Staff has recommended that monitoring plans for wetlands be developed (Section 5.4.2.4). Staff recommends that such plans be developed in consultation with appropriate state and federal agencies before licensing at Allegheny L&D No. 7 (Section 5.4.1).

Comment 4

The DEIS finds that flow rates and flow patterns caused by the operation of L&D No. 7 as proposed would alter existing flow regimes and may alter the survival and establishment of some wetland species. This finding however, does not take into consideration the availability of alternative turbine tailrace discharge orientations presented by Allegheny in Comment 2. 304

The ability to direct turbine tailrace discharge flows away from the Isle of White and its associated wetlands and shallow-water habitats, and into the main center channel of the Allegheny River, could effectively mitigate or avoid the short and long-term effects of aquatic habitat loss and erosion on and around the island. Adverse impacts could be further mitigated or avoided by the installation of deflectors such as rip-rap or sheet piles at the downstream, lower end of the tailrace. The final EIS should address and take into consideration these additional mitigative measures.

304. The developer will need to provide a detailed plan for the orientation of the turbines in order to properly assess the possible impacts on wetland areas in the tailrace channel. Staff agrees that, if the turbines can be oriented in such a manner that the island and shoal areas are not impacted, short and long-term impacts due to the discharge velocities and patterns could be mitigated. However, see response to comment #300.

Comment 5

The ability to direct turbine tailrace discharge into the main center channel of the Allegheny River as presented in Comment 2, would represent a better adopted use for hydroelectric production in an environmentally acceptable manner as it would result in a larger percentage of river water being diverted into the main river channel below L&D No. 7. Because a large 305

305. See response to comment #300.

percentage of river flow occurs in this channel, and key aquatic species thrive in this particular flow regime, the reorientation of turbine tailrace discharge into the main channel would enhance and benefit the survival of these key aquatic species and therefore, enhance and benefit recreational fishing.

Comment 6

Allegheny believes that section 4 of the DEIS fails to place sufficient emphasis on the value and use of physical hydraulic models in evaluating the cumulative and site specific impacts of the projects reviewed. Allegheny proposes to develop a physical hydraulic model of its L&D No. 7 project. Use of such a model would not only address the affects of powerhouse operations, but it will also model different flow rates at the dam, lock and powerhouse relative to the overall effect on flow patterns, velocities and elevations, sedimentation, turbidity and erosion, aquatic habitat, wetlands and navigation. The model would assist in maximizing the best location of the power house, subnerged dikes, riverward and landward coffer cells, bypass facilities, and fishing piers. In the event the model studies result in negative impact predictions, Allegheny would propose to develop appropriate mitigative measures for approval by the Corps of Engineers and appropriate resource agencies. 306

Furthermore, the Commission itself has made the use of a physical hydraulic model a requirement for the development of a post licensing study plan to determine mitigative measures in 307

306. Staff does not believe that sufficient mitigation to prevent the significant adverse impacts identified at Allegheny L&D 7 can be designed with physical hydraulic modeling to recommend licensing of the project at this time. The project's impacts on nearby wetlands and shoals could be modeled only with a movable-bed physical model (simulating sediment transport); such models are expensive and complicated to use. However, the recommended action on this project (Section 5.4.1) allows the applicant to pursue studies that could lead to adequate mitigation designs. See response to comment #2.

307. Staff does not recommend development of a proposed project it believes would have significant impacts that may not be mitigable even if physical modeling is used, unless such mitigation is demonstrated before licensing.

prior license proceedings. (see e.g. Article 40 of L&D No. 5's license, 29 FERC ¶ 62,028 at 63,056 (1984)).

Allegheny believes that proper formulation and calibration of the physical model will be key to the success of its L&D No. 7 project, especially in light of the availability of an alternative turbine configuration as set forth in Comment 2.

Comment 7

308 The DEIS correctly acknowledges that L&D No. 7 is a poor dissolved oxygen (DO) aerator (DEIS §3.3.2 at 3-40), but overemphasizes L&D No. 7's cumulative impact on DO.

The DEIS finds that reductions in the rate at which desirable water quality constituents such as DO will be added to the river and undesirable toxic constituents removed will be impacted by hydropower generation at L&D No. 7. The DEIS however, fails to adequately address the fact that since L&D No. 7 is, by the DEIS' own admission, the worst DO aerator of all the projects under review, hydropower operations at L&D No. 7 will have little if any impact on the maintenance of DO levels and the removal of volatile compounds such as chloroform and ammonia.

308. Staff has discussed the low aeration rate at Allegheny L&D 7 in Sections 3.3.2 and 4.1.1.1. It cannot be assumed that this project would have little impact on the removal of volatile chemicals because the mechanisms controlling the transfer of volatile chemicals from water to air are not identical to those controlling the transfer of oxygen from air to water. Deep plunging of bubbles, which improves aeration, may reduce removal of volatile chemicals.

Comment 8

309 The DEIS has determined that the project/pool area of L&D No. 7 has the third lowest level of recreational land area of all the projects under review (DEIS §4.1.3.1 at 4-38), and classifies

309. Although the recreational fishing enhancements proposed at the site would be beneficial to recreational users, the enhancements do not compensate for the potential loss of the Isle of White recreational refuge.

the downstream shoreline area as highly disturbed with little vegetation. (DEIS §3.3.5.1 at 3-47). The DEIS however, does not adequately address the beneficial enhancement to recreational resources that Allegheny has proposed to develop at L&D No. 7.

Furthermore, as Allegheny has established in Comment 5, the use of physical model studies would determine the best recreational enhancement configuration, including, but not limited to, such items as the need for shoreline undulations, underwater deflectors, terraces, rockpiles, or dikes in order to further enhance recreational opportunities while maintaining a high sensitivity to the protection of the existing aquatic resources on and around the Isle of White and the Allegheny River within the vicinity of L&D No. 7. The foregoing would be conducted with consultation and comment from appropriate resource agencies. The final EIS needs to further develop and consider these beneficial impacts.

Comment 9

Section 4.1.4.2 incorrectly finds that Allegheny will remove excavated construction material by barge and that "constant" barge traffic will contribute to serious damage to vegetation on the Isle of White. This section is incorrect and should be removed from the final EIS. 310

Allegheny does not propose to use barges to remove excavated material, but in fact proposes an onshore removal system for excavated and dredged material during construction. As Allegheny

310. Text has been modified. However, removal of spoil material on shore would cause additional adverse impacts to the neighborhood in which the project would be placed.

has stated in its application, the excavated material has commercial value. Accordingly, Allegheny proposes to process excavated material onshore and remove it by the use of trucks (See E.41 of Allegheny's L&D No. 7 application). Processing onshore and hauling the material offsite alleviates the need for barges and their associated adverse impacts on the Isle of White and the river within reach of the construction site. Accordingly, the final EIS needs to reconsider the impacts of construction at L&D No. 7.

Comment 10

Sections 4.1.6.1 and 4.1.6.3 overemphasize the direct impact construction at the site will have on the surrounding neighborhood. Allegheny would propose to mitigate the concerns contained in the DEIS by restricting working hours to weekdays from 8:00 a.m. to 6:00 p.m. Allegheny would further propose to mitigate construction related impacts associated with traffic, residential interference and roadway deterioration through the use of calcium chloride or spraying of water to control dust on roads and storage piles, cover haul trucks, limit construction traffic and access to particular roads, and the encouragement of employee car pools. The final EIS needs to further evaluate the impacts of construction in light of these mitigative proposals. 311

311. The impacts described in sections 4.1.6.1 and 4.1.6.3 are those of the project as proposed in the license application and subsequently filed materials. These sections also recommend mitigation measures (similar to those proposed in the comment) that would reduce, but not eliminate, the identified impacts.

Comment 11

Because the DEIS failed to adequately recognize and consider alternative turbine discharge orientations, and other mitigative and enhancement proposals, §4.8 and §5 are incorrect in finding that substantial unavoidable adverse impacts to wetland habitats will occur. In fact, if the alternatives proposed by Allegheny in its comments above were adopted, the unavoidable and irretrievable loss of wetlands habitat predicted at L&D No. 7 will not occur, and in fact, the loss of wetland habitat associated with the Isle of White will be avoided. Furthermore, if the alternatives proposed by Allegheny were adopted, the wetland habitat associated with the Isle of White may in fact be enhanced. The physical model study proposed in Comment 5 will ensure this, and should be adopted for this reason. Accordingly, the final EIS should contain a reevaluation of adverse impacts in light of Allegheny's suggestions herein. 312

312. Staff used available information to assess the impacts. Staff concurs that physical hydraulic modeling could assist in developing possible alternatives. See response to comments #304, 306, and 307.

Comment 12

The DEIS' recommendations in §5 should be further reevaluated because its review process would appear to be seriously flawed. The DEIS failed to consider alternative orientations of turbine tailrace discharge, incorrectly claims that construction barge traffic will adversely impact wetlands, and fails to adequately consider the benefits of L&D No. 7 to recreational resources and water chemistry. Accordingly, staff 313

313. Staff's evaluation of the hydropower project proposed at L&D No. 7, based on the information submitted, has not changed staff's conclusion that such development would cause significant adverse impact to the target resources identified as fisheries, recreation, and wetlands. Staff would not recommend studies be conducted after licensing, with unknown results, to determine mitigative measures for significant impacts that may not be mitigable.

must reconsider L&D No. 7's cumulative and individual impacts in light of Allegheny's comments herein.

<u>Comment 13</u>

Because the DEIS' evaluation of L&D No. 7 failed to adequately evaluate the project, the recommendation should be changed to recommend licensing of the project in conjunction with the post licensing development of a mitigation plan which would address the DEIS' concerns for wetlands, fisheries and recreational resources. As Allegheny has demonstrated through its comments, such a mitigation plan is not only possible, but practical. Development of such a mitigation plan in conjunction with consultation with other resource agencies will result in the development of a project in compliance with Commission recommendations and best adapted to the comprehensive development of the river for beneficial purposes.

<u>Comment 14</u>

314 Furthermore, because Allegheny has demonstrated that the DEIS wrongly concludes that there are no alternative orientations possible which will protect the Isle of White, the final EIS must address the issue of why Allegheny's L&D No. 7 project continues to be treated inequitably from other similar projects already licensed downstream from L&D No. 7 (<u>see</u> Comment 1). The Commission needs to address in the final EIS why it chose to allow

314. See response to comment #298, 307, and 313.

these similar projects to be licensed subject to the development of mitigative measures, but treats L&D No. 7 differently.

Comment 15

Failure to grant Allegheny a license for L&D No. 7 subject to the development of mitigative measures in compliance with Commission and other resource agency recommendations, denies Allegheny the finality of Commission action to which it is entitled. Failure to issue a license for L&D No. 7 prevents the limitation of issues involving this project and leaves Allegheny in a regulatory limbo subject to the concomitant burdens and expense entailed by such uncertainty. As a matter of equity, the Commission must close off the availability of objections, review and comment for L&D No. 7. Because the DEIS has unfairly neglected to perform a thorough and adequate evaluation of L&D No. 7, and fails to address why L&D No. 7 is being treated differently from other similar projects, the DEIS' recommendation should be changed to recommend licensing of L&D No. 7 subject to the implementation of post-licensing mitigative measures prior to construction. 315

315. See response to comments #298-314. The Commission will make the final licensing decision on L&D No. 7 in the public's interest.

III.

CONCLUSION

The DEIS fails to recommend L&D No. 7 for licensing and development because it failed to fairly and adequately evaluate the project. Because Allegheny has thoroughly and succinctly 316

316. Your opinion is noted. See response to comments #298-315.

demonstrated the DEIS' flaws and inconsistencies in this matter on a point by point basis, the DEIS' recommendation should be changed. Allegheny has clearly demonstrated that L&D No. 7 can be developed in an environmentally and economically feasible manner which will adequately protect target resources and avoid adverse impacts on such target resources, in particular those target resources identified as fisheries wetlands and recreation, on and around the Isle of White.

Respectfully submitted,

ALLEGHENY HYDROPOWER, INC.

Lee M. Goodwin, Esq.
Jonathan W. Gottlieb, Esq.
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Suite 500
Washington, D.C. 20036

Counsel for
Allegheny Hydropower, Inc.

Dated: July 5, 1988.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

EASTERN DISTRICT OFFICE
80 WASHINGTON STREET, 8TH FLOOR
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8703-5673
WP8703
L005

July 14, 1988

Office of Hydropower Licensing
Federal Energy Regulatory Commission
825 North Capitol Street NE
Washington, D.C. 20426

Att: George H. Taylor RB-209B

Subject: FERC Docket No. EL85-19-114
Draft Environmental Impact Statement
Hydroelectric Development in the Upper
Ohio River Basin (Ohio, Pennsylvania, West Virginia)

Re: Allegheny River L/D No. 3 Hydroelectric Project
FERC Project No. 4474-003 - Pennsylvania

Gentlemen:

This filing contains the comments of Allegheny Valley North Council of Governments (AVNCOG) on the subject Draft Environmental Impact Statement (DEIS), which was issued for comment by FERC in May, 1988. AVNCOG is the applicant for a license at Allegheny River Lock and Dam No. 3 (the Project). The Applicant and its consultants have carefully reviewed the DEIS and have had informal meetings or discussions with the FERC staff, the U.S. Army Corps of Engineers (COE), and the U.S. Fish and Wildlife Service (USFWS) about the DEIS prior to preparing these comments. We have purposely confined our remarks to the more substantial issues associated with the Project. In other words, we have chosen not to comment on numerous items that would normally be considered significant, including inconsistencies between the analysis of similar issues at different projects, to focus on these selected issues.

BACKGROUND

The pending license application was filed nearly four year years ago with FERC in September 1984. The agency consultation process began in 1981 during the preparation of the prefeasibility study, when key agencies were contacted and requested to comment on the Project. These agencies were contacted again in August 1982 during the preparation of the feasibility study. In May 1984, the agencies were provided with a preliminary Project description and asked to update their comments during the preparation of Exhibit E of the license application. In July 1984, a draft of the FERC license application was circulated to the agencies for their comments.

After the Application was accepted for filing by FERC in December 1984 the Applicant responded to agency comments received by FERC during the public notice period. During the next year or so there was little direct activity associated with the Project, either by the applicant or FERC. AVNCOG was investigating various sources of funds to continue activities associated with the Project; FERC was deciding how to address the cumulative impacts of hydro development in the Ohio River Basin.

In September 1986 AVNCOG was successful in its efforts to raise funds to proceed with development of the Project and authorized its consultants to proceed with engineering and environmental studies associated with the Project.

Throughout the consultation process, the key issues have been instream releases, dissolved oxygen, protection of wetlands and fish habitat, and the use of flashboards. The Applicant proposed the use of flashboards to mitigate the possible impacts of the Project on upstream wetlands and increase power generation. The COE objected to the use of flashboards because of concerns about the potential impacts on the existing lock and dam structures and navigation. The Applicant has continued to pursue the use of flashboards, because it believes that the Project would be more economically and environmentally acceptable with flashboards. In the DEIS it appears that FERC concurs with our assessment that the use of flashboards would likely have a beneficial impact on upstream wetlands.

From the very beginning of the consultation process the Applicant has strived to identify mitigation plans that are reasonable and acceptable to all parties; that is, we were looking for solutions that both the Applicant and the concerned agency would find satisfactory over the long run. Over the past 18 months, the Applicant has expended substantial resources to collect additional information in an effort to resolve outstanding environmental, technical, and institutional issues associated with the Project. These efforts have included extensive consultation with the USFWS, Pennsylvania Fish Commission (PFC), and the COE. Data collection has included a continuous D.O. monitoring program developed in close consultation with the agencies, wetlands surveys, extensive topographic surveying, and the preliminary design of and selection of turbine/generating equipment for the Project. Ongoing studies include physical model testing and subsurface exploration programs developed in consultation with the COE.

The Applicant believes that the results of these activities have been well worth the effort. At a meeting in January of this year, the Applicant reached agreement with USFWS and PFC on mitigation associated with D.O. and recreation. In addition, our efforts have resulted in very productive discussions and imaginative approaches to impact avoidance and mitigation with other agencies. It is possible, however, that our efforts to keep FERC abreast of these developments were not as successful, as it appears that some information used by FERC in the preparation of the DEIS is out of date, incorrect, or superceded by later filings.

In any event, the DEIS process has been useful in that it has served to again highlight the critical issues. Further, it has resulted in significant progress towards resolving the flashboard issue with the COE, which will be discussed in a later section.

GENERAL COMMENTS ON DEIS

The recommendation proposed in the DEIS is that hydro development not be allowed at four of 19 sites to minimize the cumulative environmental impacts resulting from hydro development in the Upper Ohio River Basin. Allegheny River Lock and Dam No. 3 is one of these four sites. The Project received this designation because of what were assessed by FERC to be major, unavoidable impacts in the categories of fish habitat, wetlands habitat, and recreation that cannot be adequately lessened through modified operation, design, or mitigation. The Applicant strongly believes that these impacts can be avoided or adequately lessened through mitigation and design, and in several instances has already reached agreement with the applicable agencies. 317

317. Comment noted.

We are mystified as to why the analysis of the Project in the DEIS assumed that no flashboards are used, which is contrary to what is proposed in the application, but given this assumption, we are not at all surprised by the conclusions. We believe that the analysis should have been performed on the basis that

318

flashboards are used, since that is a Project feature specifically proposed by the Applicant to avoid an adverse impact upon wetlands. If FERC has concerns about the Applicants' ability to implement such a Project feature, we believe that it is more appropriately handled by a special license article, similar to the way instream releases or recreational facilities are dealt with in the licensing process. Then, if the Applicant can not obtain COE approval of flashboards or identify an alternative method to maintain the upper pool level, both FERC and the COE would have the ability to prevent construction of the Project.

319

The Applicant intends to use the results of the physical model testing to demonstrate avoidance and/or identify specific mitigation measures related to fish habitat and recreation. Developing the information necessary to implement the model testing has been a long and involved process that has included detailed site surveys, preparation of preliminary layouts of the powerplant based on the size and type of generating equipment, and extensive consultation with the COE, including the preparation of model testing specifications by COE personnel. Bids have recently been received and we anticipate that an award will be made shortly. Our schedule calls for preliminary results from the model testing to be available by approximately October 1988.

In the past, detailed model studies for projects located at COE navigation structures have been performed after the license was issued. While we are not suggesting that FERC issue a license before major environmental issues are resolved, we do request that the Applicant not be denied the opportunity to complete such activities as model testing to resolve these issues before making a recommendation that the Project not be developed.

INSTREAM RELEASES

320

In its 1984 license application, the Applicant proposed a continuous minimum spill flow of 300 cfs with incremental increases based on DO level measurements taken during plant operations. Since that time, the Applicant has consulted extensively with USFWS, PFC, COE, and Pennsylvania Department of Environmental Resources and has collected extensive DO data. At a meeting held on January 25, 1988, the Applicant reached agreement with USFWS and PFC on a proposed mitigation plan to protect water quality (see Enclosure 1). The plan provides for a minimum instream release of 300 cfs when DO levels exceed a specified value (approximately 7.6 ppm, saturation at 85°F). If DO levels measured upstream of the dam drop below this value,

318. Flashboards were not included in staff's analysis in the DEIS because the Corps objected to previous flashboard proposals for Allegheny L&D No. 3. Staff estimated that the applicant would not be able to meet all of the requirements imposed by the Corps. Recent discussions between the Corps and the applicant have shown that significant progress has been made towards resolving the flashboard issue with the Corps. Text has been modified in Sections 2.1.1.3 and 4.1.5.2 to reflect the possible addition of crest gates.

319. Staff's analysis in the FEIS concludes that, based on information filed by the applicant for Allegheny L&D No. 3 (see response to comment #17), development of hydropower at this site can occur in an acceptable environmental manner. Revisions to the text for this project has been made and the conclusions for staff's preferred alternative has been changed.

Development of a hydraulic model is a useful tool during detailed design of a hydroelectric plant. Results are used to refine details of a preliminary design. Because it is not reasonable to expect or require a model to be built at an early stage of project planning, development of the model should wait until after a license is issued.

320. Comment noted.

releases will be increased and/or natural and mechanical turbine venting systems will be used to bring the downstream DO up to an acceptable level. If these measures are unsuccessful, the Project will shut down.

FERC recommends a continuous minimum release of 1,000 cfs at the Project to protect instream water quality. The applicant is prepared to accept this recommendation, as the COE is currently requesting releases of a similar amount to prevent deterioration to the existing concrete spillway-dam.

RECREATION

321 A revised recreation plan was proposed by the Applicant in its November 1987 filing in response to FERC's request for additional information dated September 11, 1987. This plan provides for greatly improved access along the right bank with areas of the river bank developed for improved fishing access and picnicking. The plan provides for better fishing access for more individuals than currently exists.

Under current conditions at the site, water tends to stagnate in the back channel during times of low flow. As a result of the proposed Project, flows will increase through the back channel and along the right bank of the river. The proposed recreational facilities are designed to provide access to the moving water where fish tend to congregate, particularly in the spring.

The Applicant intends to look for additional opportunities to improve fishing during the physical model testing program. Such improvements might include habitat manipulation and/or additional modifications to the proposed recreation plan.

The proposed recreation plan has been accepted by the Pennsylvania Fish Commission and the USFWS, who have agreed to review the model with us to determine if additional measures would be beneficial (see Enclosure 1).

321. See response to comment #283.

322 The DEIS states that "Disruption of the existing fishing opportunities at Fourteen Mile Island would seriously impact the existing users of the site." The Applicant believes that the ability of fishermen to wade to Fourteen Mile Island is greatly overestimated. Only during very low flows (<5,000 cfs) it is advisable to attempt to wade out to the island. Based on observations during the various on-site environmental and engineering studies, the vast majority of fisherman and other individuals gain access to Fourteen Mile Island via boat.

322. Concern regarding the potential loss of recreational wading to Fourteen Mile Island was expressed by the Corps at a recreation workshop held on November 2, 1987. The provision of new public fishing access facilities, as specified in recommendation #1 of Section 5.4.2.3, could potentially compensate for the loss of recreational wading to Fourteen Mile Island. The developer should file a revised recreation plan with the Commission after consulting with state and federal agencies regarding any additional recreational compensation measures that may be needed.

323 Project construction activities represent an adverse impact on recreation, but the impact would be temporary. Facilities proposed by the Applicant would provide long-term (permanent) improved recreation. As previously mentioned, the Applicant intends to investigate other possible improvements to fisherman access as part of the physical model studies. The applicant is also willing to make 30 parking spaces available to the general public, provided their use can be temporarily restricted to Project-related vehicles and activities during times of major maintenance.

323. Recommendation 5 in Section 5.4.2.3 specifies measures required to mitigate potential construction impacts to recreational use.

324 The current recreation plan was developed in consultation with USFWS and PFC and it is the Applicant's understanding that the conceptual plans have been accepted by these agencies. Nonetheless, the Applicant recognizes that it may be necessary to make minor alterations to the plan during the initial years of operation and will cooperate with the agencies in identifying and making these improvements.

324. See response to comment #283.

325 The Applicant is confident that the proposed facilities represent a major improvement over existing conditions and will provide excellent recreational opportunities at Allegheny Lock and Dam No. 3.

325. See response to comment #283.

FISH HABITAT

326 FERC concludes that "there will be significant, adverse, and non-mitigatable effects to the downstream habitat" at the Project. The Applicant believes that it is highly speculative to draw such a conclusion based on the available information. In addition, this conclusion was largely based on the assumption that a 500-foot wide tailrace channel would be dredged, while more recent Project layouts show a considerably smaller (it varies between 100 and 300 feet wide) tailrace channel, thus only a portion of the existing gravel-cobble habitat will be disturbed.

326. Text has been revised taking into consideration changes in project layout made since preparation of the DEIS (Section 4.1.2.2.3).

327 Irrespective of the tailrace width, we noted with interest the following statement contained in the DEIS, as we believe it to be a far more accurate assessment of the situation:

> "Fish habitat may suffer initially as the channel stabilizes to new conditions. There may actually be more shallow riffle area available around the island complex after flows change to the back channel, although this is not clear."

327. The DEIS section quoted in the comment indicated that replacement for any lost habitat might be forthcoming as the new flow and substrate regime stabilizes.

The Applicant has discussed the proposed tailrace excavation with USFWS and PFC in an effort to formulate a plan to replace any lost habitat. Both agencies have indicated that they did not require such a mitigation plan. 328

328. Staff has an independent responsibility to assure mitigation for what staff considers to be probable losses to fishery and ecological resources.

The Applicant plans to use the physical model of the site to assess what, if any, habitat mitigation is appropriate. Based on field observations, the Applicant believes that fish habitat in the back channel will be improved simply by the increased flow through the channel, but is receptive to considering other mitigation opportunities if such proves not to be the case. The physical model testing affords the Applicant an excellent opportunity to work in cooperation with the interested agencies to evaluate various mitigation plans or alternative designs aimed at avoiding impacts. USFWS, PFC, and the COE all have expressed interest and a willingness to cooperate in such a program. We intend to take advantage of this opportunity. 329

329. See response to comment #319.

WETLANDS

FERC estimated that 2.5 acres of wetlands would be disturbed or removed as a result of the proposed Project. This estimate was comprised of the following components:

A. 0.2 Acres of riparian habitat along the intake and tailrace channels;

B. 1.0 acres which would be destroyed by the removal of an island in the downstream pool; and

C. 1.3 acres which would be disturbed by operational activities, primarily decreasing the pool elevation by 2 feet.

We believe that component B is based on a incorrect agency comment that was subsequently clarified. In addition, Component C would not apply if the Applicant's proposed design is implemented. 330

With respect to Component B, the U.S. Department of the Interior incorrectly concluded that the cofferdam extended all the way to Fourteen Mile Island and that the sandbar would be removed during the excavation of the tailrace. The misunderstanding was pointed out by the Applicant in a letter dated June 19, 1985 responding to DOI's letter dated March 27, 1985. Enclosure 2 shows the location of this small island, referred to as the

330. Staff used aerial photographs and navigation charts to determine the potential impacts on wetlands. Staff believes that the increased disturbance to the island, which the Corps has described as an emergent and shrub wetland dominated by water willow (Section 3.3.5.5) and not as a sandbar, is such that damage would be permanent to the aquatic plant species on and around the island.

sandbar in the application, relative to the proposed Project features.

The Applicant acknowledges that there will undoubtedly be some temporary disturbance to the edge of the island, however, the island (sandbar) will not be removed. Under existing conditions this sandbar changes size and shape in response to river flows, a process that will continue even after the Project is in operation.

With respect to component C, the staff's analysis was based on the assumption that flashboards would not be used at the site. The Applicant has specifically proposed the use of flashboards to provide a more stable pool to protect the wetlands. Additionally, the use of flashboards is highly beneficial to the Applicant because it increases energy generation and more effectively develops the water resources in the public interest. 331

Interestingly enough, while staff acknowledges in the DEIS that impacts on wetlands can be mitigated with the installation of flashboards, they choose not to analyze the Project with flashboards because the COE has reservations about their use.

The Applicant has had extensive discussions with USFWS and PFC about the potential impacts to upstream wetlands that may result from the Project. All parties agree that the use of flashboards will protect the existing upstream wetlands and, as a result of a more stable pool level, may enhance wetlands. The Applicant prepared and submitted a detailed report that identified the wetlands in the pool above Lock and Dam No. 3 and assessed the Project's impacts upon these wetlands.

The Corps of Engineers has been concerned about the use of flashboards at the Project because of potential technical problems. During a recent informal meeting between the Applicant and the COE to discuss the flashboard issue, however, the COE indicated that a more sophisticated means of controlling pool elevation, such as a crest gate system, may be acceptable, provided that it can be demonstrated that such a system did not have a negative impact on the stability of the lock and dam or cause downstream scour. The Applicant has requested that the COE provide a letter clarifying its current policy regarding the use of crest gates on navigation dams. Enclosure 3 is the Applicant's request. The response by the Corps of Engineers will be forwarded as soon as it is available.

The Applicant intends to continue to work with the Corps of Engineers to identify an acceptable crest gate system that can be

331. The use of crest gates at Allegheny L&D No. 3 would provide a more constant pool elevation. The Corps had previously indicated that they would not consider flashboards as a viable alternative and therefore they were not considered as an alternative in staff's analysis. If the Corps approves the use of crest gates at this project site, the disturbance of a potential 1.3 acres would be mitigated and usage of such structures could possibly enhance the wetlands in the pool.

used to protect and enhance the upstream wetlands. The Applicant has already discussed on a preliminary basis how the physical model might be used to demonstrate what impacts various crest gate systems might have on the existing structures. The Applicant intends to pursue these discussions as additional information becomes available.

CLOSING COMMENTS

332 FERC has obviously made an extraordinary effort to collect, review, and analyze a vast amount of information in a short period of time. While Applicant does not agree with staff's recommendation that the hydroelectric project proposed at Allegheny River Lock and Dam No. 3 not be developed, the methodology and data used to arrive at the conclusions are clearly stated.

332. Comment noted.

333 In our response to the DEIS we have tried demonstrate that in in some instances superceded information or a misunderstanding about the Project has resulted in an incorrect conclusion, while in other instances reasonable opportunities exist to modify the Project design to avoid major environmental impacts, and, in some cases, enhance existing resources. Specifically, we have shown the following:

- Recreation - The plan proposed by the Applicant represents a major improvement over existing conditions and will provide excellent recreation opportunities at the Project.
- Fish Habitat - Reasonable opportunities exist to assess and either avoid or mitigate any potential adverse impacts.
- Wetlands - Approximately 0.2 acres of wetlands will be destroyed by construction of the Project. Use of crest gates to stabilize the upstream pool elevation will protect and may improve the upstream wetlands. Crest gates can be stipulated as a license condition.

333. Comments noted.

334 On this basis we respectfully request that staff's recommendation with respect to the Project be changed in the final EIS.

334. See response to comment #319.

MORRISON-KNUDSEN ENGINEERS, INC.

Federal Energy Regulatory Commission
July 14, 1988
Page 10

The Applicant's actions throughout the licensing process demonstrate its commitment to the Project and its concerns about the resolution of the environmental issues. The Applicant intends to continue its efforts to resolve the outstanding environmental and technical issues. 335

Very truly yours,

Marsha A. Fickert, P.E.
Project Manager

Enclosures

cc: Celeste Calfe, AVNCOG
Carol Cunningham, MKE
Roy Slack, TES

335. Comment noted.

Three enclosures provided by Morrison-Knudson are not reproduced here.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

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88 AUG -5 AM 11:20

8703-5673
WP8703
L008

August 3, 1988

Office of Hydropower Licensing
Federal Energy Regulatory Commission
825 North Capitol Street NE
Washington, D.C. 20426

Att: George H. Taylor RB-2098

Subject: FERC Docket No. EL85-19-114
Draft Environmental Impact Statement
Hydroelectric Development in the Upper
Ohio River Basin (Ohio, Pennsylvania, West Virginia)

Re: Allegheny River L/D No. 3 Hydroelectric Project
FERC Project No. 4474-003 - Pennsylvania

88 AUG -8 PM 4:45

Gentlemen:

By letter dated July 14, 1988 the Allegheny Valley North Council of Governments (AVNCOG) provided comments on the subject Draft Environmental Impact Statement. In the discussion regarding the use of crest gates to avoid negative impacts on the upstream wetland, the Applicant indicated that it had requested the U.S. Army Corps of Engineers (COE) to clarify its position with respect to the use of crest gates at Allegheny River Lock and Dam No. 3. Attached hereto is the COE's response to that request. 336

336. The letter from the Corps is noted. See response to comment #318.

Very truly yours,

Marlene A. Pickert, P.E.
Project Manager

Enclosure

cc: Celeste Calfe, AVNCOG
Carol Cunningham, MKE
Roy Slack, TES

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE, PITTSBURGH, PA 15222-4186

July 26, 1988

Ms. Marsha A. Fickert, P.E.
Project Manager
Morrison-Knudsen Engineers, Inc.
50 Washington Street, 9th Floor
Norwalk, Connecticut 06854

Dear Ms. Fickert:

This is in response to your letter of June 27, 1988 requesting clarification of the Corps of Engineers' position on the use of dam crest gates in connection with development of a hydroelectric project at Lock and Dam 3, Allegheny River.

It is generally believed that the wetlands upstream of the dam would be damaged by lower than normal pool levels from the proposed hydropower operations at the existing fixed crest dam. The Corps of Engineers recognizes the possibility of avoiding these environmental losses by maintaining historic pool levels during hydropower operations. Therefore, we will consider the installation of facilities to control pool levels during periods of low flow provided the following concerns are addressed:

a. Any device installed on the dam, such as crest gates, must be fully controllable.

b. A detailed study of the wetlands should be conducted to determine the minimum required pool elevation. All possible means of protecting this resource, including dam crest gates, dikes around the wetlands, etc., should be evaluated. This must be carefully coordinated with the Corps of Engineers and other appropriate state and Federal agencies.

c. The optimum arrangement for a crest gate system would allow the device and its jet to conform to the dam crest profile when lowered. The hydraulic effects of any modification must be evaluated in a physical model study to ensure equal discharge efficiency and preclude any scour. Any increase in upstream flooding caused by the crest gates will be the responsibility of the Licensee.

d. If the upper pool/lower pool relationship is changed, a stability analysis must be performed for the lock walls and the dam to evaluate the new loading conditions.

Sincerely,

Joseph E Eyre LTC, En
For
George H. Miller, Jr.
Colonel, Corps of Engineers
District Engineer

Copies Furnished:

Commander, Ohio River Division
ATTN: CEORD-ED-T/Mr. Hart

Mr. Martin Inwald
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Jacksonville, FL

July 5, 1988

'88 JUL -5 PM 3:27

The Hon. Lois D. Cashell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capital Street, N.E.
Washington, DC 20426

Re: Docket No. EL85-19-114

Dear Ms. Cashell:

Enclosed for filing with the Commission on behalf of the City of New Martinsville, West Virginia are an original and 14 copies of a response to the draft Environmental Impact Statement (EIS) for the Upper Ohio River Basin for (1) the Willow Island Hydroelectric Project (Project No. 6902) and (2) the New Cumberland Project (Project No. 6901).

88 JUL -7 PM 12:04

Respectfully submitted,

Louis Roseman

Attorney for City of
New Martinsville,
West Virginia

Enclosure

cc: Michael Francis, Esq.
Mr. James Price

J-157

4.1.2.3 **Entrainment and Turbine Induced Mortality.** This section of the EIS considers factors that were similarly considered in the report of studies at the Racine project conducted jointly by the project applicant and the Ohio Power Company. The study at the Racine project gave a reasonable indication of the level of mortality to adult game fish and allowed the applicant to establish reasonable estimates of compensation. The approved plan for the study at Racine did not include the question of the effect of turbine induced mortality on overall fish populations (game and forage); the question of the effects on icthyoplankton and juvenile mortality; or the effect of mortality of forage species on game fish populations, as all parties (the Licensee, WVDNR, ODNR, USF & WS) agreed that such studies involved great expense with a substantial risk that the results would not be useful. We have, to date, seen no study approach that would yield reliable answers to these questions within reasonable time and cost frames. Such studies would need to address three areas: (1) extent of icthyoplankton and juvenile mortality and the resulting effect on population; (2) effect of forage fish mortality on game fish populations; and (3) geographic extent of local population effects of mortality, including adequate data on migratory habits of some of the species of fish present. 337

We do not feel that studies of fish mortality and mortality effects on population are likely to be economical or conclusive and suggest rather that the overall fishery resources be monitored, if necessary, by population sampling techniques as the Commission has recommended for the New Martinsville Project at Hannibal Dam. If no adverse pattern is revealed by these more general, effect-based studies, then the far more extensive and costly cause-based studies can be deferred. Use of funds paid by licensees as compensation for fish mortality to an "Ohio River Basin Environmental Fund" could be used for such studies, if considered appropriate by the administering agencies.

337. Staff believes that both entrainment and population monitoring are needed as post-licensing requirements. Entrainment monitoring for fish passage rates and percentage mortality probably would not be needed at every site. See comment #234.

4.1.2.3.4 **Staff Conclusions on Entrainment.** We concur with the staff conclusions that no fish diversion devices have been shown effective in the conditions considered. Proposed further investigations of the effectiveness of potential fish diversion structures may be warranted, but only if a need can be demonstrated. Contributions by licensees to an "Ohio River Basin Environmental Fund" are a reasonable alternative to diversion measures and have been accepted as such by Ohio and West Virginia. Such funds could be used to carry out such studies by the concerned agencies. We do not concur with the staff conclusion that installation of fish protection measures (structural devices) 338

338. Staff generally agrees with the comment. The "Ohio River Basin Environmental Fund" could be a practical way for developers to jointly fund studies such as the bioengineering studies of prototype fish diversion devices. Staff has altered the recommendation that includes the assumption that fish protection devices are likely to a suggestion that they may be shown to be practical and effective.

is likely and do not believe that installation of bypasses and related features in anticipation of such installation is desirable or economical at present.

We feel that the design concept adopted by the applicant for this project, incorporating a large, low velocity cross section for both the power plant intake and the inlet channel, provides the best protection against high mortalities and is consistent with sound power plant design. We do not believe that any structural system can be designed to economically or effectively divert fish in the environment. Because of the low head at each dam on the Ohio River, the flow of water required to generate a kilowatt hour of power is relatively large. Any device attempting to somehow process this flow is necessarily large and costly, and causes a loss of energy. This problem is compounded by the large trash loading of the river, which places great burdens on any structure installed in the flow. The associated costs will result in power production costs in excess of those warranted by current or expected future power values and consequently cancellation of projects.

5.1.1.2 **Aquatic Ecology and Fisheries (Turbine Induced Fish Mortality)**

The comment that "mortality of larger fish would be greater than 10 percent of those entrained" has no basis in the Racine study, data presented in this report, or other data which we have reviewed. This statement is inappropriate unless some basis can be provided. Data provided in the Racine report (Volume 1, page 13) shows survival rates of 88 to 100 percent with instantaneous survival of 97.9 percent and latent survival of 94.5 percent for game fish. 339

5.4.2.2 **Recommendations on Aquatic Ecology and Fisheries**

Item 1 - We disagree with the suggestion that licensees provide for undefined and unproven intake protection structures where there is no evidence that such are required and no evidence that any particular technology would be effective. Such installations would involve extensive costs for no indicated gain. 340

Item 2 - We disagree with this early timing (12 months after the license issue date) for agreement on compensation payments. 341

Item 3 - We disagree with the requirement that licensees conduct fisheries related studies. Compensation paid to the resource agencies should provide for this effort. The agencies could then properly decide on expenditures for various categories of effort; fish restocking, angler access, fisheries studies, or other uses. 342

Item 4 - We question the effectiveness of the requested mortality study but feel that any such studies to be conducted should be from compensation funds. 343

339. Staff has generalized from the Racine Studies. Larger fish are known to have a higher degree of damage than smaller fish. Until more studies are carried out, an estimate of 0-10 percent mortality, with closer to 10 percent for larger fish, seems to be a reasonable conclusion. The statement has been clarified in the text.

340. Staff believes that there are certain design features that can be built into plans at this time, such as passageways to allow transfer of fish to the tailrace or provisions for anchoring equipment to the powerhouse. Staff did not intend that any fish protection structures themselves be built until after prototype testing (that is considered in a subsequent recommendation).

341. Staff contends that the one-year period is in conformance with the timing on similar recommendations for fisheries protection and is therefore appropriate.

342. Staff believes that it is premature to determine at this stage whether funds for fish population monitoring, entrainment studies, or bioengineering test facilities are paid directly by developers or through a compensation fund to the resource agencies. Such a compensation fund seems to have merit. Selection of the funding scheme must be determined after licensing, in consultation with all parties.

343. See response to comment #342.

Item 5 - Bioengineering studies, if considered appropriate, should be paid for from compensation funds. Any open-ended requirement to install diversion structures should be subject to formal hearings at the commission and subject to economic constraints for each project. 344

344. See response to comment #342.

WATER QUALITY CONSIDERATIONS

3.5.2 **Water Quality**

This section discusses existing water quality in the river. The duration curves based on Orsanco data (1980-1986) for two locations, RM 40.2 (New Cumberland Pool) and RM 102 (Hannibal Pool), indicating recurrence of the two criteria level dissolved oxygen (DO) values at these locations for the summer months are as follows: 345

	5 mg/l	6.5 mg/l
RM 40.2 (New Cumberland Pool)	8%	25% (Fig. 3.5.2-2)
RM 102 (Hannibal Pool)	5%	25% (Fig. 3.5.2-3)

This data does not appear consistent with data presented in Figure 3.5.2-6 showing a DO profile of the river, where no DO values below 7 mg/l have been recorded since 1974 in the 5 years of data shown for that period. Data collected by the applicant in 1985 and submitted to the Commission shows a minimum upstream DO level of 6.7 mg/l, with values below 7 mg/l for only 4 days of the 52 days sampled in the period from July through September, 1985. We therefore consider any plan based on the duration curve discussed above to be an effort to correct problems that do not, in fact, occur with the frequency projected in the EIS.

4.1.1.1 **Water Quality - DO**

Assessment methods. The DO model used in the analysis is based on calibration using 1983 Corps of Engineers (COE) data. The explanation of the model and its calibration provided in Appendix B is not adequate to determine its reliability in this application. Data used in the calibration are not presented in full nor is a description of the method and extent of data collection. It is impossible to judge the adequacy of the analysis without this information. 346

The model also relies greatly upon correlation between a DO level, stated as a deficit, above and below (downstream from) the dams. Statistical measures of this correlation are given (see Table 4-1.1-1 and Table B-1); however, the statistical data are not adequate to allow a thorough evaluation of the analysis and of the subsequent water quality modeling. Based on the limited information provided in the report, it appears that the water quality model relies entirely on this correlation analysis for the reaeration coefficients assigned for each dam. The discussion in B 2.1.3.1 of problems encountered when b does not equal zero, that is, when the line of best fit 347

345. The temperature and DO duration curves based on ORSANCO data are presented to provide background information on the frequency with which specific values have occurred. The values presented in Figure 3.5.2-6 are from occasional samples taken by the Corps and do not necessarily represent any specific conditions. The DO duration curves were not used directly as a basis for any of the impact analyses. The temperature duration curves were used to determine what water temperatures represent reasonably-forseeable adverse conditions (the temperature exceeded 10% of the time in August was selected as a basis for spill flow recommendations). Electronic temperature measurements are generally highly accurate.

346. Appendix B has been expanded to include the data used in modeling dam aeration, and descriptions of sensitivity and uncertainty analyses performed on the model.

347. The discussion in Appendix B (Section B.2.1.3.1) of negative values of b includes several possible explanations of this result. The explanation that slight degrees of supersaturation occur is expected from aeration theory (since the saturation concentration of DO is higher at the depths to which bubbles are submerged at some dams). Gas supersaturation at dams is a common phenomenon.

crosses the x-axis at a negative value, gives an indication of the difficulties in developing these coefficients. However, the text provides no adequate rationalization for the methods of use of this inconsistent data. This section also references "RMS errors generally within the range of accuracy that can be expected with DO models" without noting that range and without noting the importance of any inaccuracies. There is no significant discussion of these reaeration coefficients as to the reasonableness of the coefficients or the sensitivity of the water quality model predictions to the range of error in the coefficients. Such a discussion is critical to the evaluation of the water quality modeling process and the modeling results because of the very large value of the resource here at stake.

Also, in Section B 2.1.4, Algae Production, the importance of this factor is noted as being relatively minor based on referenced personal communication with COE staff. We find this assumption to be an overriding critical error in the analysis. Field data filed by the applicant showed a substantial occurrence of supersaturation in the upstream pool at dams studied in 1985, with the only reasonable explanation being algal oxygen production. While such algal-source DO may not always be present, failure to account for its frequent (likely preponderant) presence ignores a major factor governing utilization of this resource. 348

348. See response to comment #101.

The modeling effort also appears to ignore the increase in dissolved oxygen (DO) concentrations caused by an operating hydroelectric facility when there is no flow through the dam gates. A report submitted to the Commission by American Electric Power (1988) on the Racine hydroelectric project showed that at the Racine site the hydro units increased DO levels downstream as much as the dam releases and sometimes more. In September 1987 testing at Racine showed a downstream DO increase in the range of 0.4 mg/l caused by the hydro while no significant increase due to passage through the dam gates was noted. This was thought to be due, in part, to the shallower depth water with higher dissolved oxygen concentrations drawn off and discharged by the hydro. The failure of the DEIS to consider this information results in unneccessarily high spillage requirements. 349

349. See response to comment #252. The withdrawal of water from the upper level of the upstream pool as a way of mitigating for aeration loss has been proposed in other river basins. This technique does not actually add any oxygen to the water but only moves the more highly oxygenated water from the pool above the dam to the pool below it. Throughout most of the upper Ohio River basin stratification strong enough to make this technique effective is rare. If a hydropower plant was successful in withdrawing only from the more highly oxygenated surface layer of the above-dam pool, it would promote stratification and lower water quality above the dam.

It is unclear whether the optimization procedure described for impact analysis properly evaluates the tradeoff in DO effects at various spills for each project (Section B.3.2 - Bounded Implicit Enumeration). In particular, the report should show the relative effects of reduced spillage requirements at the projects at the downstream range of those requiring spillage - Pike Island, New Cumberland, and Montgomery. We question whether the incremental improvements claimed to be produced by spillage at these projects are justified. 350

350. The optimization model works by finding the combination of spill flows (at dams that are effective aerators) that maximizes the power generation in the basin while maintaining DO concentrations above 6.5 mg/L in all pools where DO was above 6.5 mg/L without hydropower. In pools where DO was less than 6.5 mg/L without hydropower, only slight decreases (less than 0.5 mg/L) in DO are allowed. Under the design conditions used for the model analyses, the spill flows at Pike Island, New Cumberland, and Montgomery are required to maintain DO concentrations in approximately the first 200 miles of the Ohio River. Because dams downstream of Pike Island provide little aeration, aeration at these three dams affects DO far downstream and is required to prevent DO degradation. The sensitivity analysis of the DO model presented in Appendix B indicates that aeration at New Cumberland is important for maintaining DO concentrations at RM 100.

4.1.2.1 **Assessing the Impact of DO Change on Fish (For Hydrodevelopment as Proposed)**

This section discusses the three potential levels of DO maintenance with respect to fisheries. It establishes 6.5 mg/l DO as a standard for "zero effect" on fisheries. The need for the highest level considered (6.5 mg/l DO) appears not to be based on the survival data provided (Figure 4.2.1-1), as the data indicate that a level of 5.5 to 6 mg/l DO causes no decrease in survival. 351

The national criteria for ambient DO concentrations for the protection of freshwater aquatic life are presented below for warmwater fisheries:

	Early Life Stages	Other Life Stages
30-day Mean	N/A	5.5
7-day Mean	6.0	N/A
7-day Mean (minimum)	N/A	4.0
1-day Minimum	5.0	3.0

Source: U.S. Environmental Protection Agency (U.S. EPA) 1986 "Quality Criteria For Water."

These criteria recommend a 7-day mean DO concentration of 6.0 mg/l and a 1-day minimum of 5.0 mg/l to protect early life stages at warmwater fisheries.

The criteria were derived from production impairment estimates which were based primarily upon growth data and information on temperature, disease, and pollutant stresses. The average DO concentrations selected are 0.5 mg/l above the slight production impairment values and represent values between no production impairment and slight production impairment, therefore, each criterion is an estimate of the threshold concentration below which some detrimental effects may be expected. The criteria represent DO concentrations which the U.S. EPA believes to "provide a reasonable and adequate degree of protection for freshwater aquatic life."

The requirement in the Draft Environmental Impact Statement (EIS) (pages 5 through 25) that developers maintain DO concentrations of 6.5 mg/l throughout the basin during July through October is not reasonable and not supported by the U.S. EPA "Water Quality Criteria" or other research on DO. Reasons for our disagreement with this requirement are listed below:

A. The requirement is based on allowing no production impairment of fish in the Ohio River. U.S. EPA, (1986) states that DO levels 0.5 mg/l above slight production impairment provide a "reasonable and adequate" degree of protection. These levels (6.0 mg/l for early life stages) apply as a 7-day moving mean

351. See response to comment #242. The fish growth model is further explained in the text and Appendix E. Staff has sought to place the somewhat ambivalent documents on water quality criteria and the varying time frames for applying criteria into a quantitative framework that integrates effects over time. This seems preferable to matching arbitrarily selected conditions. In the fish growth model, there is an explicit summation of effects of DO on growth rate over the durations of exposure to varying levels of DO as determined by temperature, flow, and other factors included in the model of DO concentrations. The fact that the original formulation was developed for ponds should not invalidate its application to a series of navigation pools, especially when the model and its results are used in a comparative fashion (i.e., to compare relative performances between contrasting Ohio River conditions). The comparisons are not among ponds and the Ohio River, but among several conditions of the Ohio River using the same assumptions in each case.

only where and when early life stages are present. We disagree with this approach to the "no production impairment" philosophy and question whether protection of early life stages is needed during the entire July through October period. It is our opinion that fish fry are most abundant during May and June and do not require protection in the fall months of September and October.

B. The draft EIS does not state whether the 6.5 mg/l standard being required will be a 30-day mean, 7-day mean, or 1-day minimum and whether these means will be moving, calendar week, or calendar month. Insufficient data is presented for us to determine which condition was modeled.

U.S. EPA criteria recommend a 7-day moving average to protect early life stages of fish and a 30-day moving average to protect other life stages of fish. The draft EIS appears to be recommending a 7-day moving average criteria that is 0.5 mg/l above the EPA standard for early life stages (6.5 mg/l recommended as compared to 6 mg/l EPA standard) and then attempting to apply it to a 4-month period (July to October). This is clearly a misapplication of the criteria which were not intended to be applied to monthly averages. This misapplication results in an effective increase of at least 1 mg/l in the standard from the 5.5 mg/l EPA standard for the 30 day mean to the 6.5 mg/l level required in the draft EIS for the 123 day period of July through October.

The discussion of the growth model (Section 4.1.2.1.3) involves extrapolation of data for catfish being raised in a densely populated farm situation to a very different environment, that of the Ohio River pools, and involves extrapolation of the results for catfish to many other species. This is done based on minimal data and with no significant explanation of the process. This is a critical omission in consideration of the final recommendation of the report. The assumption that the growth of fish which must forage for food in the natural environment of the Ohio River will be affected by DO levels as greatly as fish raised in ponds with an abundant food supply is questionable based on published research on the subject.

4.2- In these sections, the report discusses the relative merits of
4.4 meeting the three tiers of uses and DO levels.

4.2 - Alternative 2 - Meet DO Standards
4.3 - Alternative 3 - Meet Antidegradation Standards
4.4 - Alternative 4 - Minimize impacts to all target resources.

This section builds entirely on the water quality modeling and, in Section 4.4, the fish growth modeling, discussed in Section 4.1 for the "projects as proposed." The applicant's questions regarding the validity of both of these modeling efforts have been noted above. In particular, we invite comparison of Figure 4.3.1-3, the graphic representation of modeled Ohio River DO profiles (meeting the 6.5 352

352. The DO model was used to simulate a set of design conditions under which hydropower impacts would be relatively severe; maintenance of DO concentrations under these design conditions is assumed to protect DO adequately under most reasonably-expectable conditions. There is no reason to expect the model to match the Corps data presented in Figure 3.5.2-6, which was collected under a variety of conditions.

mg/l criteria) with the measured DO data of Figure 3.5.2-6. It appears that spillage is being required at the New Cumberland Dam to allow for a DO decline in the Pike Island pool, modeled to be a decline of more than 1 mg/l DO.

A comparison to Figure 3.5.2-6 shows this pool as having a rising DO level rather than a declining DO level for the calibration year (1983), as well as for subsequent data sets of 1985 to 1986.

For only 2 of the 7 years sampled (1977 and 1978) did the DO levels in the pool decline by an amount in the range of 1 mg/l. Given the substantial reduction in waste loading of the upper Ohio River since 1978 (as noted by the COE in past public discussions on this topic), it appears that the modeling results for this pool are especially open to question.

5. STAFF CONCLUSIONS

5.1.1 Alternative 1 - Projects as Proposed

5.1.1.1 and 5.1.1.2 Water Quality Aquatic Ecology and Fisheries

Based on our preceding comments questioning the reliability and the basis for projecting impacts (the DO and fish growth models and supporting data), we consider the extrapolation of the results to the indicated conclusion to be poorly founded. We also note that the discussion of the potential reduction in toxic compound volatilization suggests possible problems but no supporting data is shown or referenced. This speculation is inappropriate unless some basis is provided. 353

353. See responses to comments #345-350 and response to comment #104 concerning volatile compounds.

The comment that "mortality of larger fish would be greater than 10 percent of those entrained" has no basis in the Racine study, data presented in this report, or other data which we have reviewed. This statement is inappropriate unless some basis can be provided. Data provided in the Racine report (Volume I, page 13) shows survival rates of 88 to 100 percent with instantaneous survival of 97.9 percent and latent survival of 94.5 percent average for game fish. 354

354. See response to comment #339.

We feel that the evaluation of all of the alternatives not selected (1 through 3) similarly relies on data and procedures for which the level of reliability is not adequately documented and attributes adverse impacts without a proper basis. 355

355. The methods and assumptions used in evaluating Alternatives 1-3 are the same as those used for the recommended Alternative 4.

5.2 Economic Evaluation of Alternatives

The energy production values provided in Table 5.2-1 are higher than those predicted by the applicant; however, we concur in the estimate of losses in energy production for Alternatives 3 and 4. 356

356. The applicant's prediction of generation and concurrence of losses between alternatives are noted.

The loss in energy production with alternative 3 or 4 at the New Cumberland project would have no economic justification in fisheries effects. The loss of 40 million kWh/year shown in Table 5.2-1 (178.9 million kWh minus 138.3 million kWh) at a value of 75 mills/kWh totaling $3,000,000 per year may be compared to the fisheries data presented in Table E-4 of the New Cumberland License Application. For a total of 13,800 fish kept from the pool and tailwater in 1981, the cost would be $217 per fish. If the growth model extrapolation of Section 4.1.2.1 is accepted (although we contest its validity), this $217 would result in a 20 percent increase in the size of a fish caught or, for a 2 pound fish, an increase of 0.465 pound at a cost of $542 per pound, or $33.90 per ounce. This seems a very high cost for a projected benefit which is itself speculative. 357

357. Environmental protection is not to be determined as a cost-benefit calculation according to numerous legislative and legal precedents.

The license application and supplementary information on DO submitted to the Commission by the Applicant (September 30, 1985) addresses the question of potential DO effects of the hydro project. The license application included consideration of incidental spillage (leakage) of 2,535 cubic feet per second (cfs) and low water shutdown of about 1 percent of the year or 4 days per year. The shutdown periods resulting from low flow would be entirely during the low flow and low DO months of July through October. 358

The supplemental filing of September 1985 included an analysis of DO data collected in the period of July through September 1985 and evaluated the effect on project operation of measures to assure adequate DO conditions. That analysis on page 17 noted that 16.7 days of shutdown could be provided with 100 percent bypass of the hydro facility as a mitigative measure when DO drops below 6 mg/l. Such DO related shutdowns would be based on DO measurements for each day of operation. These days of shutdown for DO would be expected to coincide with the 4 days of shutdown for low flow noted above. The economic loss due to this extent of shutdown was included in the estimates of energy production and economic evaluation of the project.

If the DO standard were to be raised to 6.5 mg/l as proposed in the EIS, we would estimate, from Figure 3.5.2-3, a 15 percentage point increase in shutdown periods during the months of July through October (123 days), an additional 18 days of shutdown, or 34.7 days total.

The facility will be operating at approximately 8 megawatts during the period. The resulting loss in energy production is:

$$8{,}000 \times 24 \times 18 = 3{,}456{,}000 \text{ kWh.}$$

358. See response to comment #243 concerning why continuous spill flows are recommended as mitigation.

This is equivalent to approximately 2.1 percent of energy production and is the additional energy loss not accounted for in the original application, resulting from modification of operation to achieve 6.5 mg/l on the basis of response when needed rather than the 6 mg/l as proposed in the license application.

Based on the report on DO studies conducted in 1987 at the Racine Hydroelectric Project, we consider the above analysis of shutdown for DO to be conservative. That report, on page 13, concludes that the hydroelectric power plant increased downstream DO levels by a combination of turbulence and withdrawal levels. The New Cumberland Project license application assumed that the hydroelectric plant would not make any addition to DO. Adopting the indicated typical DO improvement through the Racine power plant of 0.4 mg/l, the analysis filed by the Applicant in September of 1985 is essentially correct. The addition of 0.4 mg/l DO by the hydroelectric plant would nearly offset the 0.5 mg/l increase in the standard from 6 mg/l to 6.5 mg/l DO. The resultant energy loss would be very minimal. A 3 percent increase in spillage would result from the 0.1 mg/l DO margin required (0.5 - 0.4 = 0.1) or 4 days of spillage from the 123 day summer period. The resultant energy loss is:

$$8,000 \times 24 \times 4 = 768,000 \text{ kWh.}$$

This is equivalent to 0.5 percent of annual output and represents a minor effect on project economics.

In summary, the relative effects on energy production for the three levels of action are as follows:

a.	Applicant proposed bypass when needed at 6 mg/l DO.	Per license application
b.	Applicant modified for 6.5 mg/l DO ignoring reaeration by hydro.	2.1 percent energy loss
c.	Applicant modified for 6.5 mg/l DO allowing for reaeration by hydro.	0.5 percent energy loss
d.	EIS proposed constant 15,000 cfs bypass for 4 months and 4,000 cfs for 8 months.	22 percent energy loss

Based on the above analysis, the imposition of a 6.5 mg/l DO standard, with resulting bypass flows to be required only when justified by actual measurements of downstream DO on a daily basis, would have a minor adverse economic effect on the project. The year-round leakage through the dam of about 2,500 cfs, in conjunction with the relatively rare shutdowns for DO improvement, would provide the benefits considered necessary in the EIS while causing a modest loss in energy production. By comparison, the continuous year-round release of 4,000 cfs minimum and 15,000 cfs during 4 low flow months would have an extremely adverse affect on project economics.

5.4 Recommended Alternative

We strongly disagree with the staff's recommendation that the New 359
Cumberland project be subject to the spillage requirements of Alternative 4, given the inadequate basis for the assessment of adverse impacts and the disproportionate loss in power production in comparison to the claimed benefits. The staff is, in effect, raising the DO standard for the stream to 6.5 mg/l for hydropower projects, while all other river users are subject to no restriction (navigation and nonpoint pollution sources) or to the properly arrived at standard of 5 mg/l (for municipal and industrial wastewater discharge). Such a change in the standard should not be based on the limited data and inadequate, unproven analysis provided in this study and should not be applied to only one type of development, hydroelectric power plants. If, however the higher DO standard is to be imposed on hydroelectric projects, spillage should be based on real time measurements, and should not be set as a continuous spillage requirement.

Applicant - Proposed DO Maintenance Procedure. The applicant 360
suggests the procedure outlined below for assuring the quality of the Ohio River while maximizing energy production for the dams under consideration. This procedure is based on real-time coordination of hydroelectric plant operations with water quality measurements as suggested in the preceding discussion. The approach is based on the Memorandum of Agreement (MOA) between the Corps of Engineers (COE) and the City of New Martinsville (Licensee) for the New Martinsville Hydroelectric Project at Hannibal Locks and Dam. This MOA, developed in 1985, addresses project operation in relation to DO levels during the initial period of operation, before DO data for the operating plant is available. The wording of the MOA is as follows:

> "...The Licensee agrees to maintain interim standards that will minimize short-term water quality impacts, provide warning notification to the Corps, and an approved action plan for continued hydropower generation if the dissolved oxygen concentration falls below 6 mg/l, and cease power generation if dissolved oxygen levels drop below 5 mg/l."

We feel that a temporary and possibly permanent operating program based on the above concept would be effective and economic for the New Cumberland hydro site, as well as for other sites for which the study recommends spillage. Spillage would be an option during periods of concern when the DO level falls below 6 mg/l. In order to be effective, this program would need to be applied to, and coordinated with, all of the affected sites (per the report, dams

359. Staff recommends maintenance of 6.5 mg/L of DO for several reasons. Recent evidence indicates that concentrations as low as 5 mg/L may cause significant effects to some aquatic species. Allowing hydropower projects to reduce DO concentrations to 5 mg/L would leave no additional DO available for other uses, such as additional waste loads from industries and municipalities. The benefits of many millions of dollars worth of wastewater treatment should not be degraded by hydropower. Staff agrees that real-time monitoring and management of water quality should be considered as an alternative to continuous spill flows (see response to comment #243 and Recommendation 7, Section 5.4.2.1.

360. Recommendation 7 in Section 5.4.2.1 encourages implementation of a basin-wide model to determine instantaneous spill flows. Such a system would increase power production while monitoring and managing water quality.

upstream from and including Pike Island). We feel that such a program, coordinating all hydro projects through the COE as in the case of Hannibal Locks and Dam, would be effective.

Based on data we have gathered and analyzed, action would be required for only a few days in a typical year using the 6 mg/l "warning notification" criteria of the COE unless and until the upstream power plants were built, brought into operation, and were to cause degradation of upstream dissolved oxygen. It would be necessary to develop a scheme for allocation to each project of the responsibility for maintaining DO levels as each project passed through the development process. It should be feasible to develop flexible and fair guidelines for responses by project developers while meeting environmental criteria.

5.4.3 **Site Specific Recommendations.** New Cumberland Locks and Dam - The recommended spill of at least 4,000 cubic feet per second (cfs) year-round and 15,000 cfs during the summer months (July to October) is unreasonable, and may prevent development of the project and result in an uneconomic decision. The recommended spillage is not justified by the study for the following reasons: 361

1. The basis of analysis for DO and fish growth is unproven. 362

2. No adequate analysis of the benefits of the upstream spills without the New Cumberland spill or at a reduced New Cumberland spill is provided. 363

3. No adequate evaluation is given of the relationship of fisheries benefits provided to the value of fisheries protection measures. 364

4. No adequate consideration is given to the option of payments to resource agency programs in compensation for estimated adverse impacts. Such payments have been proposed as an appropriate mitigation measure by Ohio and West Virginia for fish mortality. 365

5. The loss of generation resulting from the high spillage recommended in the EIS may make the project infeasible and result in its not being built. The spillage requirements are unreasonably rigid. No reasonable justification is provided for the 4,000 cfs year-round spill; at the Racine and Greenup projects, zero spillage operation is practiced and the fishing is excellent. The 15,000 cfs summer spillage should not be required based on the study; if actual DO conditions experienced after start-up result in damaging DO conditions, operating programs for spillage based on real-time measurements of DO would allow a much more efficient operating program while protecting fish. This approach has been agreed to as a satisfactory program at an existing site. 366

361. Comment noted.

362. See responses to comments #337-350 concerning adequacy of the model analyses. Staff used a model published in the scientific literature and cited in the references as the basis for linking DO concentrations in the Ohio River and fish growth responses. The model was "proven" in the pond environments for which it was developed. The mechanisms incorporated into the model are not unique to ponds and apply as well to the Ohio River. The model was used in a comparative way (see response to comment #351) which yields an indication of the responses of fish to the conditions that change with hydropower.

363. Spill flows were determined in such a way that power production in the basin, not at any individual project, is optimized while meeting water quality constraints. This objective is in accordance with Commission responsibilities. Analyses of the benefits of additional upstream spills or reduced New Cumberland spills are not addressed in the discussions of the recommended alternative because such changes would result in either lower overall power production or failure to maintain the desired water quality.

364. See response to comment #357.

365. Staff recommends compensation as an interim alternative and potential long-term alternative in Section 5.4.2.2, recommendation 2.

366. The non-critical season spill flows are recommended to assure water quality and to protect aquatic habitat. See response to comment #243 concerning selection of mitigation measures. The comparison to the Racine and Greenup projects are not meaningful because those dams do not provide the relatively high aeration rates that New Cumberland dam does.

6. Loss of the project would result in losses much greater than the net benefits of power production because of the loss in potential employment during project construction, and to a lesser degree, during operation in an area with already high unemployment. 367

367. In addition to the lost benefits from power production, as shown in Table 5.2-1, the beneficial and adverse socioeconomic effects of project construction and operation (identified in Section 4.1.6.3.) would be eliminated.

FISH MORTALITY CONSIDERATIONS

4.1.2.3 **Entrainment and Turbine Induced Mortality.** This section of the EIS considers factors that were similarly considered in the report of studies at the Racine project conducted jointly by the project applicant and the Ohio Power Company. The study at the Racine project gave a reasonable indication of the level of mortality to adult game fish and allowed the applicant to establish reasonable estimates of compensation. The approved plan for the study at Racine did not include the question of the effect of turbine induced mortality on overall fish populations (game and forage); the question of the effects on icthyoplankton and juvenile mortality; or the effect of mortality of forage species on game fish populations, as all parties (the Licensee, WVDNR, ODNR, USF & WS) agreed that such studies involved great expense with a substantial risk that the results would not be useful. We have, to date, seen no study approach that would yield reliable answers to these questions within reasonable time and cost frames. Such studies would need to address three areas: (1) extent of icthyoplankton and juvenile mortality and the resulting effect on population; (2) effect of forage fish mortality on game fish populations; and (3) geographic extent of local population effects of mortality, including adequate data on migratory habits of some of the species of fish present. 368

We do not feel that studies of fish mortality and mortality effects on population are likely to be economical or conclusive and suggest rather that the overall fishery resources be monitored, if necessary, by population sampling techniques as the Commission has recommended for the New Martinsville Project at Hannibal Dam. If no adverse pattern is revealed by these more general, effect-based studies, then the far more extensive and costly cause-based studies can be deferred. Use of funds paid by licensees as compensation for fish mortality to an "Ohio River Bas'n Environmental Fund" could be used for such studies, if conside. :d appropriate by the administering agencies.

368. Nowhere in the DEIS did staff recommend the extensive studies outlined in this comment. Staff recommended monitoring of entrainment rates and fish mortality at selected, representative sites and general population monitoring in the vicinity of each facility.

4.1.2.3.4 **Staff Conclusions on Entrainment.** We concur with the staff conclusions that no fish diversion devices have been shown effective in the conditions considered. Proposed further investigations of the effectiveness of potential fish diversion structures may be warranted, but only if a need can be demonstrated. Contributions by licensees to an "Ohio River Basin Environmental Fund" are a reasonable alternative to diversion measures and have been accepted as such by Ohio and West Virginia. Such funds could be used to carry out such 369

369. See response to comment #338.

studies by the concerned agencies. We do not concur with the staff conclusion that installation of fish protection measures (structural devices) is likely and do not believe that installation of bypasses and related features in anticipation of such installation is desirable or economical at present.

We feel that the design concept adopted by the applicant for this project, incorporating a large, low velocity cross section for both the power plant intake and the inlet channel, provides the best protection against high mortalities and is consistent with sound power plant design. We do not believe that any structural system can be designed to economically or effectively divert fish in the Ohio River environment. Because of the low head at each dam on the Ohio River, the flow of water required to generate a kilowatt hour of power is relatively large. Any device attempting to somehow process this flow is necessarily large and costly, and causes a loss of energy. This problem is compounded by the large trash loading of the river, which places great burdens on any structure installed in the flow. The associated costs will result in power production costs in excess of those warranted by current or expected future power values and consequently cancellation of projects.

5.1.1.2 **Aquatic Ecology and Fisheries (Turbine Induced Fish Mortality)**

370 The comment that "mortality of larger fish would be greater than 10 percent of those entrained" has no basis in the Racine study, data presented in this report, or other data which we have reviewed. This statement is inappropriate unless some basis can be provided. Data provided in the Racine report (Volume I, page 13) shows survival rates of 88 to 100 percent with instantaneous survival of 97.9 percent and latent survival of 94.5 percent for game fish.

370. See response to comment #339.

5.4.2.2 **Recommendations on Aquatic Ecology and Fisheries**

371 Item 1 - We disagree with the suggestion that licensees provide for undefined and unproven intake protection structures where there is no evidence that such are required and no evidence that any particular technology would be effective. Such installations would involve extensive costs for no indicated gain.

371. See response to comment #340.

372 Item 2 - We disagree with this early timing (12 months after the license issue date) for agreement on compensation payments.

372. See response to comment #341.

373 Item 3 - We disagree with the requirement that licensees conduct fisheries related studies. Compensation paid to the resource agencies should provide for this effort. The agencies could then properly decide on expenditures for various categories of effort; fish restocking, angler access, fisheries studies, or other uses.

373. See response to comment #342.

Item 4 - We question the effectiveness of the requested mortality study but feel that any such studies to be conducted should be from compensation funds. 374

Item 5 - Bioengineering studies, if considered appropriate, should be paid for from compensation funds. Any open-ended requirement to install diversion structures should be subject to formal hearings at the commission and subject to economic constraints for each project. 375

374. See response to comment #342.

375. See response to comment #342.

Testimony Submitted at Public Meeting
Federal Energy Regulatory Commission
Docket No. EL85-19-114
Ohio River Environmental Impact Statement
Pittsburgh, Pennsylvania - July 15, 1988

Testimony submitted on behalf of the City of New Martinsville, West Virginia, Applicant for project Nos. 6901 and 6902.

The City of New Martinsville wishes to record the following comments with respect to the above referenced proceedings.

We have submitted comments on the EIS to the Commission on July 5, within the comment period. Those comments were in summary: (1) that the EIS proceeded from poorly founded analysis of dissolved oxygen (DO) conditions, (2) that recommended studies and provisions for fish diversion structures are not justified or shown to be effective; and (3) that the means proposed in the EIS for meeting the 6.5 milligrams per liter (mg/l) DO standard were wasteful. We proposed an equally effective and much more economical means of meeting the 6.5 mg/l DO standard, if it is to be applied.

Subsequent to submitting that material, we have considered several additional items which we wish to bring to the attention of the Commission:

1. The Commission should not judge the financial feasibility of a project prior to licensing, but should leave the decision to the Applicant/Licensee to make after the license is issued. Receipt of the license may allow the Licensee to negotiate a power sales contract that could not be negotiated without the license, and may allow the Licensee to negotiate a more supportive contract than would have been possible prior to issuance of the license. 376

2. The draft EIS does not give the equal consideration of environmental issues and power production required by the amendments to the Federal Power Act of 1986 (ECPA). The EIS recommends development to achieve the minimum environmental impact by "maximizing protection of all target (environmental) resources" (page xviii) without regard to the resulting power loss. The EIS proposes a major impact on power production (a reduction of 28 percent from the already restricted output of the facilities as proposed) while minimizing environmental impacts. For instance, the original New Cumberland Project application proposed spillage at a cost of 2 percent of output to minimize environmental impacts on water quality. The spillage program proposed in the EIS would result in a cost of more than 20 percent of output. We feel that the magnitude of cost proposed in the license application, 2 percent, represents a mitigative action conforming properly to the equal consideration requirements. 377

3. The Applicant has not been allowed to participate fully or equitably in the EIS process. When the initial notice of intent to conduct the EIS was circulated, the Applicant submitted information showing the extent and means of mitigating environmental impacts and requested to be held out of the EIS insofar as license issue is concerned. This request was denied by staff as was a further request to appeal the decision of staff to the Commission. 378

376. Your comment is noted that the Commission should not judge the financial feasibility of a project prior to licensing. Although staff realizes that an applicant usually cannot negotiate a power-sales contract until after a project is licensed, staff must make a judgement that a project is feasible to determine if it would be constructed (see response to comment #3).

377. Your comment that the EIS does not give equal consideration of environmental issues and power production is noted. Staff has evaluated a wide range of alternatives that generate varying amounts of power. Staff has made an effort to balance the effects on the environment with the loss of generation. At the New Cumberland project, staff agrees that the estimated 20 percent generation loss is substantial, but required to meet the goals established for Alternatives 3 and 4. Staff's analyses (Section 4.1.1.1) indicate that the applicant's proposed spill flows are not adequate to provide the desired degree of mitigation.

378. See responses to comments #32 and 277.

In the process of developing the draft EIS, the Commission and consultant staff conducted meetings with groups of environmental agency representatives which expressly excluded representation of Applicants. We feel that the resulting EIS represents agency opinions to the exclusion of the opinions of the Applicants or the general public. We feel that the study results make recommendations corresponding closely to subjective agency opinions even though the report presents the results as an objective scientific study. We feel that, as agencies were allowed to participate in the study during the analysis stage, their recommendations have been given unduly strong consideration in the draft report, to the exclusion of the potential recommendations of the applicants.

We feel that the Applicant should have been allowed to participate in the consideration of project Nos. 6901 and 6902 during the analysis stage, rather than only at the draft review stage. We feel that the Applicants' comments on the draft report are likely to have much less influence on the results when given at the draft report stage, rather than at the analysis stage as should have been permitted.

In its submittal of July 5, the Applicant provided proposals for mitigation which were not considered in the EIS analysis and which could have been presented and considered in EIS preparation had the proper participation been allowed. Therefore, the recommendation of the Applicant, included in the July 5 submittal, should be fully considered and adopted in the final report.

PETE FLAHERTY

TOM FOERSTER

BARBARA HAFER
COMMISSIONER

HYDROPOWER PROGRAMS

1307 ALLEGHENY BUILDING • 429 FORBES AVENUE
PITTSBURGH PA 15219 • (412) 355-5499

JAMES W. KNOX
DIRECTOR

July 1, 1988

Ms. Lois Cashell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

Dear Ms. Cashell

FERC Docket No. EL 19-114 DEIS

The Allegheny County Hydropower Programs is responding to the subject document through general comments regarding operation aspects of the proposed Ohio River Dashields Dam and Allegheny River L&D 4.

88 JUL -7 PM 3:09

There are two major categories of comment:

1. Water Quality Modeling

379 The statement by FERC in the document on page 2-25, "The most fundamental problem with the concept of licensing projects to maintain existing conditions is that insufficient data are available to define existing DO conditions throughout the system."

We concur, and therefore urge that the results of the water quality modeling not be adopted inflexibly as conditions of licensing.

380 FERC has concluded the relationships between DO deficits above and below the dams are linear. We are of the opinion the statement on page B-8, "neither temperature nor flow rate has a consistently significant effect upon aeration." We conclude that the measured data shows that a linear regression model is not acceptable as a model for dam aeration.

Even if linear relationships were accepted, those established for Dashields and L&D 4 obviously are highly questionable. The b and M parameters have been developed from only nine field observations at L&D 4, and 13 at Dashields. The correlation

379. The statement quoted in this comment is from a discussion of why staff chose to use a water quality model to determine spill flows that maintain 6.5 mg/L of DO, instead of requiring developers to maintain "existing DO conditions". See response to comment #243 concerning selection of mitigation measures.

380. A comprehensive review of the literature and analysis of the available data led staff to conclude that the linear aeration model is the best available technique for modeling dam aeration. There are fewer data available at Dashields and Allegheny L&D 4 for estimating the linear model parameters because the applicant at these sites, Allegheny County, chose not to respond to FERC's request for additional information (dam aeration studies) made in July, 1987. See response to comment #243 concerning how mitigation measures were selected. See responses to comments #100-102 and #112-121 concerning calibration and accuracy of the model. The spill flows recommended at Allegheny L&D 4 and Dashields are relatively high because these dams aerate well and are located where aeration requirements are high.

FERC Docket No. EL 19-114 DEIS

coefficients shown for these projects in Table B-1 do not demonstrate statistical reliability; quite the opposite. In short, the fundamental aeration capability determined by FERC for the existing dams at these sites can only be characterized as a broad approximation.

The field observations of DO on which the above relationships were established were taken generally during the summer low-flow season, and represent probably the most significant contribution to aeration rendered by the dams in question. Also, the entire river model was calibrated against data collected in the summer of 1983, which had July-October flows of only two-thirds normal for the past twenty years. Nonetheless, the model was then used to establish spill requirements which FERC proposes be applied to all years, wet or dry.

The statement on page B-13, "the addition of substantial amounts of BOD was required to simulate DO deficits as large as measured deficits." The possibility that inaccurate inputs (point and non-point sources) could skewer the calibration to most any assumption desired, occurs. The conditions of flow and temperature will not be constant for all times and conditions which in itself invalidates the assumed model calibration.

It appears the recommended spills during low-flow periods for Dashields and Allegheny River L&D 4 are higher than needed to maintain 6.5 mg/l DO. The recommended levels seem to place a penalty upon Dashields and L&D 4 (and others in the lower Allegheny region) in order to enhance downstream projects DO criteria.

2. Impact on Project Feasibility

To evaluate the impact of the operating constraints proposed by FERC on energy production at Dashields and L&D 4, computerized operation studies were performed for both projects based on mean daily recorded flows for the twenty-year period 1967-1986. Earlier flow data were not used since the flow regime was altered in 1967 by upstream storage projects which came on line in that year. 381

381. **The existing dams at Allegheny L&D 4 and Dashields are important aerators. The estimated generation loss of more than 20 percent is a tradeoff that must be considered when Alternatives 1, 2, 3, and 4 are evaluated by the Commission.**

Ms. Lois Cashell
Page Three
July 1, 1988

FERC Docket No. EL 19-114 DEIS

The results of the studies are summarized as follows:

	Average Annual Energy Generation, GWH	
	L&D 4	Dashields
With spills as proposed in County's license applications	77.6	115.0
With spills as proposed in FERC's DEIS	61.2	83.9
Percentage reduction in energy generation	21.1	27.0

It can be seen the impact on Dashields and L&D 4 are rather severe when several other Pittsburgh area dams are viewed in relationship to the entire river system.

We therefore suggest the water quality model is tenuous; FERC should develop alternative monthly spill requirements based on wet, average and dry years, as opposed to using dry year only under all conditions. 382

Cordially

James A. Knox

JAMES W. KNOX, Director
Hydropower Programs

cc: Mr. A. B. Carl

382. See response to comment #243 concerning selection of mitigation measures.

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FEDERAL ENERGY REGULATORY COMMISSION
PUBLIC REFERENCE ROOM

June 28, 1988

Ms. Lois D. Cashell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, NE
Washington, DC 20426

88 JUL -1 PM 1:53

RE: Gallipolis Hydro Project;
FERC Docket No. EL85-19-114;
Draft Environmental Impact Statement for Hydroelectric Development in the Upper Ohio River Basin

Dear Ms. Cashell:

Gallia Hydro Partners ("GHP") is the applicant for license for the proposed hydroelectric development at the Gallipolis Locks and Dam on the Ohio River (FERC Project No. 9042). GHP competes with WV Hydro, Inc. and the City of Pt. Pleasant, West Virginia (FERC Project No. 10098) for the license at this site. Gallipolis Locks and Dam is contained in the Commission's cumulative impact assessment for the upper Ohio River and evaluated in the Draft Environmental Impact Assessment for Hydroelectric Development in the Upper Ohio River Basin ("DEIS"). This letter contains GHP's comments on the DEIS as they pertain to Project Nos. 9042 and 10098.

The following represents the specific comments of GHP regarding Project No. 9042.

1) Land Use

On pg. 4-60, Table 4.1.6-1, the DEIS summarizes the land use requirements for transmission facilities. For Project No. 9042, the DEIS summarizes that 29.5 acres would be required, assuming a right-of-way width of 100 feet. Again, on pg. 4-74, Table 4.1.6-10, the DEIS summarizes the estimated area of habitat changed or lost from construction and maintenance of the proposed transmission line corridors. Here, the DEIS estimates that the habitat area changed or lost for new ROW would amount to 36.4 acres of land. 383

383. Text has been modified. Calculations are based on numbers provided in the application of a 10,000 foot new ROW, 3000 feet on existing ROW, and 2630 feet of new ROW. These numbers differ from the information provided in the June 28, 1988 response to the DEIS.

As GHP calculates the land use for transmission purposes, for Project No. 9042, approximately 10,500 feet of right-of-way ("ROW") will be new and approximately 5,730 feet will parallel an existing 100 foot ROW. Assuming a 100 foot ROW width for the new transmission line and only 50 feet additional for the paralleling segment, the "New ROW" is:

$[(10,500 \times 100) + (5730 \times 50)] / 43,560 = 30.6$ acres

Approximately 1000 feet of the 50 foot ROW is over the river so the 30.6 acres should be reduced by 1.1 acres leaving a "New ROW" of 29.5 acres (as shown in Table 4.1.6-1).

With regard to section 4.1.6.4, GHP would like to note that the Ohio Historic Preservation Officer did grant clearance for all construction at the Lock and Dam area (1986). He did, however, request a survey of the transmission line route. 384

384. Although the Ohio Historic Preservation Office granted a clearance of activity at the lock and dam areas, a conditional finding of no adverse effect was given for the transmission line route. A Phase II cultural resource survey of the transmission line corridor would need to be performed prior to project construction.

2) Recreation

Page 4-47, Section 4.1.3.4: It is recommended that a bypass flow system through the powerhouse of all projects be installed to maintain fishing opportunities when powerplants are not generating. GHP believes that this provision is unnecessary at the Gallipolis site because the incremental increase in fishing opportunity would be very small compared to the increase in capital costs and adverse impacts on generation. 385

385. See response to comment #165.

Such a bypass system would be useful only when the sum of the turbine minimum operating flow, spill flow, lockage, and leakage is less than the total river flow, when river flows are too high for sufficient operating head, or when the powerplant is shut down for any other reason. For GHP's proposed project, the minimum river flow for operations is approximately 5100 cfs which is exceeded more than 99.99% of the time (see Table B-1, Application for License, FERC Project No. 9042, January 1986; 99.99% exceedence flow is 7924 cfs); shutdowns for low flows will not be a problem at this site. The hydroproject will be shutdown for insufficient head when flows are greater than approximately 120,000 cfs at which point the downstream tailwater elevation is approximately 12 feet above normal and flows will be turbulent across the river; a 2000 cfs bypass would be insignificant. Finally all planned maintenance or shutdowns would be performed on only one unit at a time when flows allow operation of only one unit. Therefore, planned maintenance will require that only one unit be off-line, thus tailrace flows will be maintained. Unplanned shutdowns for hydroprojects average approximately 3%, or eleven days per year. These shutdowns would thus result in approximately four days of lost fishing opportunity during the four months of highest recreational usage (assuming that fishing conditions are favorable during the period of unplanned outage).

The cost of such a bypass system at this site would likely manifest itself in terms of decreased installed capacity as well as increased capital costs (a ten foot diameter pipe would likely be required to maintain velocities at 25 feet per second or less). Because of the site constraints at Gallipolis (pier 8 on the riverward side and the steep bank to Ohio Route 7 on the landward side), the ten foot pipe and associated structural elements would decrease the area available for turbine generator units so the 8.2 meter units proposed may not be usable. Smaller units would allow less efficient use of the available water resource and less energy.

In summary, the bypass system at Gallipolis would only mitigate for approximately four days of lost fishing opportunity during the four months of greatest recreational usage and would increase capital costs while decreasing generation. The benefits of the bypass system at the Gallipolis site are not of the same magnitude as those at dams which provide significant aeration and must cease operation during low river flows.

The following represents the specific comments of GHP with respect to Project No. 10098. In Section 5.4.1, "Recommended Alternatives", the staff states that their comparison of the competing hydropower applications at the Gallipolis L&D reveals that the proposed projects do not significantly differ, "..either in environmental acceptability or in power generating capabilities" (pg. 5-23). With respect to relative impact values, GHP believes that significant differences do exist with the second phase of construction proposed by Project No. 10098. GPH believes that consideration should be given to the environmental impacts associated with the Phase II development proposed by Project No. 10098. Specifically: 386

1) section 2.1.1.23 describes the proposed two phase development of Project No. 10098; the second phase consisting of installing two 12.5 MW units in the riverside

386. Development of a hydroelectric project at an existing Corps of Engineers' lock and dam will only be acceptable if it does not interfere with the existing navigation project. See response to comment #392.

lock. The Corps, in a letter dated February 16, 1988 (copy attached) and attached to GHP's Better Adapted Statement filed with the Commission on March 18, 1988, states that:

> no consideration will be given to a hydro plant located in an existing lock chamber or on the island created between the old and new locks. [emphasis added]

Therefore, all analyses of Project No. 10098, if "phase 2" is considered, must assume that the second powerhouse will replace a second gate outside the existing lock chamber (requiring a change to Figure 2.1-25 in the DEIS).

2) Section 2.1.1.23 also states that the transmission line would be 1.7 miles long. However, WV Hydro, Inc. and the City of Pt. Pleasant, WV propose two 1.7 mile long transmission lines, one on each side of the river (see Exhibit G, Project No. 10098).

Following is an itemization of the evaluated resources, and a description of the additional impacts associated with the phase II development of Project No. 10098.

A. **Water Quality** - The short term adverse impacts of increased turbidity and resuspension of sediments due to construction will be doubled with the two distinct phases of construction contemplated by Project No. 10098. 387

B. Fish Mortality - Project No. 10098 will utilize more water than Project No. 9042. The passage of additional water through the turbine units of Project No. 10098 will result in the increased potential for fish mortality. The location of the phase II station on the opposite side of the river for Project No. 10098 doubles the risk that shoreline species may be impinged or entrained. 388

C. Fish Habitat - The second phase of Project No. 10098 will cause greater decreases in fish habitat (in the same manner as described for initial project development in Section 4.1.2.2.3). 389

D. Wetlands Habitat - Phase 2 transmission line construction for Project No. 10098 may impact wetlands habitat associated with Flatfoot Creek which is located downstream on the West Virginia side. 390

E. Recreation - Project No. 10098 consists of two distinct construction periods which will cause twice the adverse short term impacts to recreation. Furthermore, the second 391

Mitex, Inc.

387. Although this additional impact may occur, it is considered minor.

388. Staff agrees that operating powerhouses on both sides of the river will increase the likelihood of entrainment damages to species that move along shorelines. This essentially doubles the risk of a single-shoreline plant, assuming equal numbers of fish move along each shoreline.

389. Staff believes that this assumption would need testing with a physical hydraulic model. A second powerhouse could actually spread flow across more of the river and create better tailwater habitat.

390. Correspondence dated May 22, 1987 to FERC from the applicant for Project No. 10098 indicates that the Phase 1 transmission line along the Ohio side has been deleted and Phase 2 is the preferred route. The path of the Phase 2, as shown on the maps, will pass through the Flatfoot Creek wetlands. A site-specific recommendation (recommendation 17, Section 5.4.3) is made that the applicant schedule a field trip to the site with WVDNR, FWS, and Corps staff prior to final pole location determinations. Minor deviations in alignment or other site-specific mitigation measures can also be determined. Prior to construction, the developer should provide a plan for approval by FERC and the appropriate state and federal agencies. Any necessary permits must also be obtained prior to construction.

391. See response to comment #215.

phase of construction will not provide any additional benefit to recreation.

F. Land Use

<u>Transmission Line</u>

392 GHP believes that the transmission line routes proposed by Project No. 10098 (see Exhibit G, Project No. 10098) will cause significant impacts to Land Use and aesthetic appeal in the 1.7 miles downstream of the dam on the Ohio and the West Virginia sides of the river. 138 kV lines will extend parallel to the river very close to the shore on both sides. Furthermore, the transmission line for the first phase of Project No. 10098 traverses a very large amount of residential land as may be seen in the attached Property Map for the Gallipolis Dam area. In this regard, pg. 4-59, last paragraph and Table 4.1.6-2 misrepresents the area through which Project No. 10098 will pass its' transmission line. In its first 5000 feet, the transmission line will traverse approximately 18 parcels of property; ten of which are almost definitely residential with associated structures (see USGS quadrangle, Apple Grove, WV, section attached). GHP's transmission line, on the other hand, crosses Ohio State Route 7 and two structures before entering wooded areas and bypassing all other structures.

In addition, the the 1.7 mile distance for Project No. 10098 in each phase is only the length to existing 138 kV line. It is highly unlikely that the two lines would terminate at the existing 138 kV line as the interconnection facility for each would cost in excess of $500,000 and probably closer to $1,000,000 based on interconnection experience with APS at projects under construction. A more likely solution would be to continue both lines, using ROWs parallel to the existing 138 kV line, to the Apple Grove substation as proposed by Project No. 9042. This would extend the required transmission line by approximately 1.4 miles for a total length of 4.8 miles.

Assuming a 100 foot ROW for single lines and 50 foot ROW for parallel lines, the total acreage required for Project No. 10098 is 58.2 acres. Using the same assumptions as for Project No. 9042 above, the "New ROW" for Project No. 10098 would be:

$$[(2 \times 1.7 \times 5280 \times 100)+(1.4 \times 5280 \times 50)-(1000 \times 50)]/ 43,560$$

= 48.5 acres.

392. The applicant for project 10098 filed a change in the proposed transmission line route with FERC in a letter dated May 26, 1987. This change eliminated the previously proposed route along the Ohio shore of the river. The impacts of the revised route are as described in the DEIS.

Access Road

As described under section 4.1.6.10, on pg. 4-71, an access road similar to that proposed by GHP for Project No. 9042 will be required by Project No. 10098 even if not specifically stated in the application for license for Project No. 10098. 393

G. Socioeconomics - Project No. 10098 has a much greater potential for increasing flood elevations due to the additional obstruction provided by its second powerhouse. As described under "Indirect Impacts" on pg. 4-61 there is a high probability of some increase in upstream flood elevations at the Gallipolis L&D. However, the replacement of two of eight gates (Project No. 10098) could provide as much as a 100% increase in flood impacts compared to replacing only one of eight gates (Project No. 9042). 394

With respect to project economics as presented in Table 2.1.1-3, on pg. 2-4, the cost for Project No. 10098 may be significantly higher than included in the table with the proposed second phase of construction requiring replacement of a gate bay instead of installation in the existing lock chamber (see item 1 (pg. 3) above). 395

Major sources of increased cost would include the demolition of the existing gate structure, installation of a complete cofferdam, and construction of a powerhouse similar to that proposed for the first phase of construction. In addition, Table 5.2-1, on pg. 5-20 would require revision to reflect any modifications made to Table 2.1.1-3.

Thank you very much for the opportunity to provide these comments on the DEIS.

Sincerely,

Michael G. LaRow
Agent, Gallia Hydro Partners

MGL/cay

Enclosures: Corps letter dated February 16, 1988
Copy of USGS Apple Grove Quadrangle
Property Map for Gallipolis Dam Area

cc: Jim Richards, Sithe
George Taylor, FERC
File

393. Text has been modified to reflect the need for a short access road in the Gallipolis (No. 10098) project.

394. Sections 4.1.6.1 and 4.1.6.3 have been revised to indicate that project 10098, because of the Phase 2 development, has a greater potential for causing long-term increases in upstream flood elevations than does the competing project (9042) at Gallipolis.

395. Comments are noted.

Three enclosures provided by Mitex, Inc., are not reproduced here.

Lois D. Cashell, Secretary
Federal Energy Regulatory Commission
825 N. Capitol St., NE
Washington, DC 20426

July 25, 1988

Comments on Draft
Ohio River Environmental Impact Statement, EL-85-19-114

Dear Ms. Cashell:

This letter responds to the Draft Environmental Impact Statement on the Ohio River Basin issued by the Federal Energy Regulatory Commission recently. Noah Corp. and a related company, WV Hydro, Inc., are pursuing six hydroelectric projects that are included in the study and two others that may be included. We view the Draft as an excellent effort performed in a short time period on a difficult topic. We wish to provide some comments on points that are important and should be considered in the final EIS.

396 1. The environmental impact of the four alternatives is not accurately assessed, because it does not consider the environmental effects of the alternatives to generation by hydropower. Decreasing hydropower generation as proposed in alternatives 2 through 4 of the DEIS will not result in less electrical demand, but will change the generation from hydropower to fossil-fired capacity. THe environmental impact of producing power by a fossil-fueled source rather than by hydropower has not been addressed.

The generation of several hundred GWh of electricity per year by hydropower would avoid the mining of hundreds of tons of coal, which would probably be strip mined, and would avoid air pollution of millions tons of sulfur and nitrous oxides.

During the 50 plus year life of the hydro projects in the heavily populated Ohio River Valley, the environmental impact of substituting fossil fired generation for the some of the hydropower generation proposed in alternative 1 will have a significant impact on the terrestrial and air quality of the region. There will be some effect on water quality from erosion of mined lands and runoff from ash piles. The benefit of hydroelectricity to the environment far exceeds the detriment and avoids the impact from acid rain and other fossil-fuel pollution.

397 2. The DEIS ignores the best method for adding DO to the river: air injection. This is a preferable method to the large spills suggested for projects in the upper Ohio and Mon Rivers. The DEIS repeatedly states an error: that injection is not a demonstrated technology.

Noah Corp. & WV Hydro, Inc.
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396. The concern for increased environmental impacts is noted. Table 5.1.4-1 and Figure 2.5-2 include the summation of the estimated effects of all of the proposed upper Ohio River Basin projects.

397. The EIS does not ignore mechanical aeration, but states that it must be proven as a viable mitigation measure before it can be recommended or approved (see Recommendation 8, Section 5.4.2.1). Turbine aeration has been used at a number of large high-head hydroelectric plant, but with mixed success. Even with the low flow rates of such plants (compared to the projects proposed in the Ohio River Basin) large blower capacities are required to attain much aeration. There are significant differences between such high-head plants and bulb turbines, so mixed success at high-head plants does not assure success at bulb turbines. Staff recommends developers be allowed to replace spill flows with mechanical aeration only after they have shown it to be effective, and that other benefits of spill flows (e.g., reliability and improvements to aquatic habitat) be taken into consideration in reducing spill flows.

This expected increase is consistent with those observed on the Kanawha River and at other hydro plants (ref. 2, 3, 4, 5, 7). The fact that injection has never been used in a bulb turbine on the Ohio River does not mean it will not work there. From successful installations referenced the design of an injection system can be tailored to the particular application. Page 4-9 of the DEIS correctly mentions the success of injection systems in other slightly different applications, then contradicts the success at several locations.

Injection seems like a more economical alternative to large spills and the resulting lost generation. This is particularly true of the New Cumberland project on the upper Ohio (ours - 103332) and is true to a lesser extent on the upper Mon (Point Marion through Hildebrand). Injection should be an option available to developers to add DO to the river to overcome any deficit caused by hydropower.

Minimum blower capacity on the upper Mon will equal 3,000 cfm (cubic ft./min.). The number and size of blowers can be increased if required by the measurement of dissolved oxygen during operation. The 3,000 cfm of air injected into the tailrace by the system will increase the DO level by 1.02 mg/l at the minimum discharge of 1200 cfs. This amount of air injection is equal to or greater than any aeration measured in the operating range for the upper Mon projects (ref. 1). Blower capacity at New Cumberland is sized according to the flow increase.

3. We do not agree that Alternative 4 is the best choice for implementing hydropower in the upper Ohio River. The reason for choosing alternative 4 seems to be that it requires a target value of 6.5 mg/l of DO and allows more capacity than alternative 3 by spilling a significant amount of water in the summer and fall. There are several reasons why we do not agree that alternative 4 is preferable. 398

398. Comment noted. See response to comment #399.

a. A target of 6.5 mg/l is an enhancement over present water quality, not maintenance of present conditions; hydropower generation should not be reduced to overcome losses in DO caused by other sources. A DO level of 6.5 mg/l is an unnecessarily restrictive burden for hydropower and is not merited by the potential impact on DO from hydropower. Apparently, aquatic life is doing well under the present conditions; we see no reason to improve them at the expense of hydropower. The quoted benefit on fish species at higher DO is a laboratory study and has not been verified in the Ohio River system; hundreds of GWh should not be wasted through spilled water based on a single lab experiment. 399

399. Staff does not recommend that hydropower projects enhance DO concentrations, since spill flows cannot increase DO above what it would be without hydropower. Staff does not believe hydropower generation should be allowed to negate water quality benefits of the many millions of dollars of public and private money spent on wastewater treatment in the basin.

b. As discussed in point 5, the DO model seems flawed. If 6.5 mg/l is desired there is no need to worry at the upper Mon projects (Point Marion through Opekiska), the DO is almost never below those values based on measurements we collected. The same is true of our other proposed project at New Cumberland. 400

400. The model was designed to simulate DO under relatively severe conditions, so that recommendations based on it will maintain DO concentrations over the wide range of conditions that occur. Comparison to measured DO concentrations (Figure 3.4.2-2) shows that model results are not unreasonable.

Noah Corp. & WV Hydro, Inc.
120 Calumet Ct. Aiken, SC 29801

The data presented in the license applications for all 5 of these projects (including Morgantown) as well as reference 1 and data measured by us at Morgantown and Point Marion in 1987 shows that DO is seldom below 6.5 mg/l. This is especially true by the operating plan we propose which does not generate at low flow.

Dissolved oxygen at Point Marion is seldom below 7 mg/l and has never been measured below 6.3 mg/l according to existing data. The average increase in DO at the dam is 0.6 mg/l for Corps measurements; our measurements in 1987 showed an average of 1.2 mg/l increase at generating flows.

Dissolved oxygen below Morgantown Dam is seldom below 6 mg/l and has never been measured below 5.7 mg/l according to existing data (see reference 1 and 1987 measurements). At planned generating flows (> 1050 cfs) the observed DO increase is 0.4 mg/l, which is within the measurement error for field DO measurements.

Dissolved oxygen below Hildebrand Dam is never below 6 mg/l according to the Corps of Engineers and recent data (ref. 1). About 70% of the time an increase in DO was observed (ref. 1) in 1986.

Measurements in 1986 at Opekiska showed a significant increase in DO occurs about 25% of the time, but usually at low flow. The average observed DO increase in reference 1 is slight, 0.2 mg/l. Air injection should not be necessary, because the DO increase does not occur during generating flows. Although a potential problem exists, dissolved oxygen below Opekiska Dam is rarely below 5 mg/l according to the Corps of Engineers, and not during generating flows. None of the observations in 1986 (ref. 1) showed DO below 6 mg/l.

Measurements at New Cumberland showed DO was not below 6.5 mg/l there. The aeration effect of the dam could be replaced by air injection of the capacity suggested in the license application.

c. We cannot determine the basis for the 1500 cfs spillage proposed in the DEIS for the upper MON (15,000 at New Cumberland). Based on the existing DO this spillage seems unnecessary; it is not supported by measurements at the sites. We cannot determine how the FERC arrived at a spillage flow because the DO model does not depend on flow. A high spillage means operation will only occur about 10 to 15% of the time in the critical months. We do not find spillage to be an economic alternative to injection; the cost is prohibitive at New Cumberland and probably at other upper Ohio dams. 401

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401. The recommended spill flows were determined by finding the combination of spill flows at all dams that provides the most power generation while maintaining DO concentrations of 6.5 mg/L (or maintaining preproject DO concentratiosn where preproject concentrations are less than 6.5 mg/L). This optimization was performed under the simulated "summer moderate flow conditions" described in Section 4.1.1.1. The DO model determines the amount of aeration as a function of (1) the aeration capacity of the dam (i.e. how much DO the spill flow picks up) and (2) the amount of flow that is used for hydropower vs. spillage. See response to comment #397 concerning mechanical aeration.

d. A spillage like that proposed will mean generation does not occur for a high percentage of the summer and fall months. We wonder if FERC considered the minimum generation necessary for the turbine configuration. At the upper Mon sites with a single large unit the minimum generating flow is about 800 - 1000 cfs. If we spill 1500 cfs there is no generation until the river flow is 2300 to 2500 cfs. Based on our proposed generation plan in the upper Mon and at New Cumberland, there is no generation about 70% of the summer and fall. 402

As a result of installing one large unit at the four dams on the upper Mon, the minimum flow used for generation is approximately 1050 cfs. A generating flow of 1050 cfs corresponds to a river flow of 1390 cfs because of the 340 cfs bypass. For 40% of the year the river flow is below 1390 cfs; all river flow will bypass the powerplant 40% of the time. Not operating for 40% of the time (at low flow) dramatically reduces the potential of an effect on dissolved oxygen, because DO is usually increased at lower flows and low DO occurs during low flow periods.

The spillage in Table 2.1.1-2 will change because gaskets will be installed with hydropower to reduce leakage under the dam gates.

4. The model used for calculating spillage does not seem to support the data from which it was derived. The estimated DO shown in Figures 4.1.1-3 and 4.1.1-6 does not agree with measured data from the sites in the upper Monongahela River, particularly no DO increase of 2 mg/l at moderate flow (or 2.5 at low flow) has been observed at Hildebrand. The low DO values at low flow are lower than observed. 403

The DO model as stated does not include any dependence on flow. How is there a difference at low and moderate flows? We agree that low flow usually, but not always, means low DO. We have found DO increase to be weakly correlated to flow in regression analysis of field data for the few cases we have examined. Because the correlation model is based on deficit the sensitivity to errors becomes greater. The error percentage of the deficit is much larger than the error percentage of the measurement. 404

We are concerned that the model used in the DEIS is indicating an excessive flow should be spilled to provide a certain level of DO. The Opekiska increase in DO from hydro generation does not appear to be shown in Figure 4.1.1-6. If DO is low upstream of Opekiska and just below Pittsburgh, injection at the turbine might increase DO easily so that high DO would propagate downstream. 405

No credit is taken for added DO by hydropower generation, although tests have shown that from 0.3 to 0.4 mg/l is added by hydropower (ref. 3). 406

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402. The minimum flows required for generation, as proposed by project applicants, were considered in determining the power produced under each alternative. The installation of gaskets to reduce leakage will increase power production, not change the spill flow requirements. The spill flow requirements are in addition to any leakage.

Under Alternative 1, staff estimates that there would be no generation 74 percent of the time at Hildebrand, 71 percent of the time at Opekiska, and 61 percent of the time at New Cumberland (#10332) during the July to October period. The applicant's estimate of no generation approximately 70 percent of the time is accurate.

403. The model was used to simulate conditions under which no field measurements have been made, so model results are not directly comparable to field data. However, data in Figure 3.4.2-2 show that DO increases of 2 to 2.5 mg/l do occur when DO above Hildebrand Dam is low.

404. The DO model does take flow into account in determining velocities, reaeration rates, and concentrations resulting from tributary and wastewater inflows (Appendix B). See Appendix B for discussions of sensitivity of the model to flow and other parameters, and of uncertainties in the results.

405. Staff believes that the aeration models used simulate effects of spill flows on aeration adequately. No aeration was assumed at Opekiska because under many conditions the dam discharges low-DO water from the stratified Opekiska pool into the Hildebrand pool. See response to comment #397 concerning mechanical aeration.

406. See response to comment #252 concerning aeration at turbines.

5. In several places the Draft indicates that competitive projects are roughly equivalent in environmental impact; this is stated for our projects 9999, 7399, 10332, and 10098. In each case our proposed project generates substantially more energy from hydroelectric power and proportionately avoids generation by fossil fuels. We feel that a major shortcoming of the Draft is that it does not take credit for the most obvious environmental benefit of hydropower: avoidance of mining and use of fossil fuels, primarily coal, to generate the energy that the Ohio River Basin needs. This was stated above in 1. 407

407. See response to comment #34.

The energy calculation in 5.2-1 is incorrect for New Cumberland (10332), Point Marion (7680) and Tygart (7399). We used flow data in monthly flow duration curves simulating upstream reservoir operation and vendor data on equipment performance. We do not believe there could be such a large discrepancy between our calculation and that of FERC. We plan to submit an additional calculation for Tygart. 408

408. Staff energy calculations for New Cumberland, Point Marion, Tygart, and all of the other projects were based on flow data from the Corps of Engineers. The same data was consistently applied to both projects at competing sites.

6. The fish mortality issue is an unanswered question and will likely always be an unanswered question. The best solution is as stated on page 4-28 that passage monitoring will be necessary at the new projects. The significant conclusion is that gizzard shad and drum will reproduce to offset any mortality losses. The only significant impact from mortality should be that associated with larger game fish; steps should be taken to minimize this impact if observations show it is occurring at a particular site. 409

The series of mortality mitigators (regional screen study, etc.) suggested on page 4-33 do not answer the mortality question, but spend money unnecessarily. We think the correct choice is to ignore mortality for the reason stated above unless observations show there is significant loss of game fish. There is no indication that any economic screening will ever be available for the Ohio River projects.

409. Comment noted.

Please call if there are any questions.

Yours truly,

James B. Price

James B. Price
President

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LIST OF LITERATURE

1. Noah Corp.: "Assessment of Cumulative Impacts on Water Quality and Fish Mortality", filed May 22, 1987 with the FERC for the Opekiska, Hildebrand and Point Marion Hydroelectric Projects.

2. D. C. Raney, "Turbine Aspiration for Oxygen Supplementation", Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol. 103, pp. 341 - 352, April 1977.

3. A. R. Sheppard, D. E. Miller, C. L. Buck, " Prediction of Oxygen Uptake in Hydroelectric Draft Tube Aeration Systems", Proceedings of American Society of Civil Engineers National Conference on Environmental Engineering, pp. 644 - 651, July 1981.

4. A. R. Sheppard, D. E. Miller, " Dissolved Oxygen in Hydro Plant Discharge Increased by Aeration", Power Engineering, Vol. 86(10), pp. 62 - 65, October 1982.

5. TVA/ONRED/A&WR-84/27, "Improving Reservoir Releases", Tennessee Valley Authority, Office of Natural Resources and Economic Development, Division of Air and Water Resources, Knoxville, Tennessee, September 1984 and successive issues.

6. Ohio Power Co., "Report on the Water Quality Studies at the Markland Dam", filed September, 1969 with the FERC on Racine Hydroelectric Project - Project 2570, Exhibit S, Appendix 3

7. Ohio Power Co., "Report on the Dissolved Oxygen Study at the Winfield Dam", filed September, 1969 with the FERC on Racine Hydroelectric Project - Project 2570, Exhibit S, Appendix 2

8. G. C. Holdren, R. A. Storm, N. R. Bhaskar, "Results of the Dissolved Oxygen Monitoring Program at the Ohio Falls Generating Station," Louisville Gas and Electric Company, February, 1986.

Sithe Energies U.S.A., Inc A Member of the Sithe/Energies Group

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June 28, 1988

Ms. Lois D. Cashell
Acting Secretary
Federal Energy Regulatory Commission
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Washington D.C. 20426

Re: Upper Ohio River Basin Draft Environmental Impact Statement
FERC Docket No. EL-85-19-114
Comments of Allegheny 8 and 9 Hydro Partners

Dear Ms. Cashell:

Sithe Energies is the managing general partner of Allegheny No. 8 Hydro Partners and Allegheny No. 9 Hydro Partners (collectively "the Partnerships"), which are the Licensees for the Allegheny River Locks and Dams 8 and 9 Hydroelectric Projects (FERC No. 3021). Although these facilities are not included within the decision scope of the referenced DEIS, they are nonetheless mentioned, impacts are assumed, and a conclusion is reached that includes proposed modifications to the operations of the L&D 8 and 9 projects. Thus the Partnerships have a direct interest in this proceeding.

Our concern is primarily with water quality related sections of the DEIS. The Commission has developed a dissolved oxygen model that means to characterize the Allegheny River from L&D 9 down to the confluence with the Monongahela, and then on down the mainstem Ohio. According to the DEIS (pg. 3-40) the model is based upon spot DO measurements taken by the Corps of Engineers, ORSANCO, and the State of Pennsylvania. 410

Although we cannot comment on the internal workings of the model, we can comment on the results. The DEIS implies (p. 4-5, and 5-26) that dams 8 and 9 efficiently aerate the Allegheny River, and that hydropower installation will result in elimination of most of this aeration effect. The DEIS concludes on page 5-26 that the interim minimum flows at L&D 8 and 9 should be re-evaluated in light of the model's results.

We find these conclusions to be incorrect, and apparently based on a selective portion and small fraction of the amount of data available. Mitex Inc., our sister corporation working on L&D 5 & 6 has conducted extensive dissolved oxygen sampling programs at Lock and Dams 4, 5, and 6 for nearly 3 years. Mitex is

410. The data collected at Allegheny L&Ds 8 and 9 by the Corps are sufficient to show that signficant aeration can be provided by these dams (see the linear model parameters for these dams in Appendix B, Section B.2.1.3). The licensed projects at these sites, if operated with low spill flows, would significantly reduce DO concentrations. If the spill flows for these projects are re-evaluated by FERC, a review of all the DO data measured there should be made.

Ms. Lois Cashell
June 28, 1988
Page 2

filing a separate response to the DEIS, and we would like to join in and incorporate by reference their comments into this letter.

With specific respect to Allegheny L&D 8 and 9, we note in the DEIS no reference to the DO monitoring work we conducted last summer. This included extensive transect based measurements during the summer low flow. It is our understanding that this data (which has been filed with the Commission), is significantly more detailed than the site specific Corps Data used to calibrate the DEIS Water Quality Model.

These data show that DO uptake at both Allegheny 8 and 9 is highly variable and difficult to predict. We do not how the Staff can make arguments like that on page 4-8 ("The other licensed projects at L&D Nos. 5 and 6 ... prevent DO concentrations from recovering from the decreases below L&D No. 8 and 9 ..."), or on page 5-26 ("... initial model results indicate that higher spill flows at Allegheny L&D 8 would reduce downstream DO degradation and allow more generation at downstream projects.") after having observed these field conditions. Certainly, if the Commission insists on referencing L&D's 8 and 9 in the DEIS, at a minimum the model should be recalibrated using the full amount of actual data gathered at the sites.

411 We finally take serious issue with the recommendation at page 5-26 of the DEIS that interim minimum flows at Allegheny 8 and 9 be reconsidered in light of "the studies conducted for this DEIS". First, we consider the DEIS model seriously flawed due to its limitation on input data, and its seeming incompatibility with observed field conditions. Second, and perhaps more importantly, the minimum flows at L&D 8 and 9 are being determined based upon extensive site specific study. Under no circumstances should this study be supplanted by regionalized, very general inferences that do not seem to account for true site specific conditions.

Thank you for the opportunity to submit these comments.

Sincerely,

William S. Fowler
Project Manager

WSF/dc

cc: Jim Richards, Sithe
George Taylor, FERC
File

411. The DO model clearly shows that the licensed hydropower projects at Allegheny L&Ds 5, 6, 8, and 9 have the cumulative potential to significantly reduce DO concentrations. The final paragraph of Section 5.4.2.1 recommends evaluating the tradeoffs between water quality and power generation that would be possible if spill flows were changed at these licensed projects. These projects were licensed without an analysis of cumulative impacts on water quality and power generation in the basin, and more effective management of the basin's resources may be possible. Because the effects of changes in aeration at these hydropower projects are cumulative and reach far downstream, the site-specific studies conducted by the licensees should be incorporated into a basin-wide analyses for impacts to be thoroughly assessed and for the best management decisions for the basin's hydropower resources to be made.

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June 28, 1988

Ms. Lois D. Cashell
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88 JUL -1 PM 1:55

Re: Docket No. EL85-19-114;
Comments of Upper Mississippi Water Company regarding Draft EIS for Upper Ohio Basin

Dear Ms. Cashell:

The Upper Mississippi Water Company ("UMWC" or the "Applicant") is the Applicant for License for the proposed Muskingum Lock and Dam No. 3 Hydroelectric Project. The site is being considered within the Commission's cumulative impact assessment, draft EIS for the Upper Ohio Basin. These comments represent the response of UMWC to the draft EIS.

On page 5-24 the draft EIS reaches the conclusion that the Muskingum L&D 3 site should not be licensed, because it would "have significant, unavoidable adverse impacts to the target resources identified as fisheries, recreation, and wetlands." The staff considers these impacts as "unavoidable", because their analysis reveals that "... adequate site-specific mitigative measures are not known at this time "(p. 5-23).

UMWC strongly believes these conclusions are erroneous. A detailed review of the DEIS shows many misleading or questionable assumptions and observations about the site. UMWC urges that the Commission reconsider its position based upon corrections and additional information supplied in this letter, and recommend license approval.

Following are specific comments, including statements of general conditions which are pertinent in the evaluation of the project and the impacted target resources.

1) The Islands and Downstream Channel

There are four islands located below the dam at Muskingum. The DEIS states that the navigation charts used to identify the tailwater area "depict the islands as being mostly shallow bars, with the center of the islands having floodplain forest vegetation". In addition, the DEIS implies that wetlands and riparian vegetation occur on the edges of all four small 412

412. Staff used navigation charts and aerial photographs of the lower Muskingum River to determine the number of islands; the license application did not provide a better set of charts. The commentor notes reports on river depths submitted by the applicant, but even the Commission's request for additional information did not yield the needed details of the river between the dam and the downstream navigation channel. Staff has reviewed all available information and revises its estimate of the extent of shallow rapids to about one mile, extending from the dam to the downstream navigation channel. The text has been changed to reflect this reassessment. The original characterization of the riffle in Section 4.1.2.2.3. as "approximately 1000 ft below the dam" is correct.

islands. These conditions do not characterize the site correctly.

The largest island located downstream (approximately 4 acres) is the only island which maintains any sort of permanent vegetation, that may be characterized as having "floodplain forest vegetation". Only one of the other islands have wetland and riparian type vegetation; the other islands have essentially no vegetation, and are only exposed cobbles at low flow.

Furthermore, the DEIS characterizes the channel for two miles downstream of the dam as "shallow rapids interspersed with small islands" (pgs. 4-23, 5-5). This characterization is not correct. Beyond the initial 1000 feet downstream of the dam, the Muskingum is a pool with relatively constant depth; indeed the opposite of "shallow rapids". This has been documented to the Commission in reports submitted by the Applicant in docket 6998.

Finally, the DEIS states that "[H]igh velocities and the large volume of water in the backchannel are likely to cause erosion of [the large] island, and staff believes this will extend to others downstream". As noted above, there are no islands downstream of the initial 1000 feet. This being the case, any erosion which may occur to the large island will not impact additional islands downstream.

2) Wetlands

413 The DEIS concludes that "significant, unavoidable adverse impacts" would occur to the wetlands associated with the construction of the facilities at Muskingum Lock and Dam No. 3. The description of those areas lost (pg. 4-52) indicates that for construction purposes 1 acre of riparian vegetation would potentially be lost "..along the main shore between the island and the shore...". The DEIS also states that the project operation may potentially damage about 1 additional acre of wetlands and riparian communities. Although riparian vegetation is often associated with wetlands in the transition zone, it generally comprises the terrestrial vegetation, not submerged by water.

Information filed by the UMWC clearly shows that the substrate in the affected channel is almost entirely silt and mud; not wetland type vegetation. In addition, most riparian vegetation is on the shoreline, above the zone that is usually flooded. Consequently, elimination of one to two acres of riparian vegetation may have a minor effect on terrestrial habitat. It will however, have little to no effect on actual "wetlands". The DEIS states at several points (e.g. p. 5-25) that the loss

The USFWS definition of wetlands was used in our analysis. The project area is classified as riverine, lower perennial, open water, intermittently exposed/permanent wetlands. The perimeters of the islands are classified as unconsolidated shore with sub-classes of cobble-gravel, sand, mud, or vegetated. These classifications do characterize the islands in this complex. The increased velocities and volume of water in the backchannel will cause increased erosion of the large island and the two smaller islands located downstream of the large island (Figure C-18) will be further affected by increased turbidity and sedimentation.

413. The substrate in the channel downstream of the dam is "predominantly medium to coarse gravel" (WAPORA 1986). The backchannel area also has exposed roots, snags, and submerged trunks of dead trees along the bank and within the channel. See response to comment #412. This area provides spawning and feeding areas for riffle-inhabiting species. The undercut bank and overhanging canopy are also used for cover, feeding, and spawning by game species. The shallow water around the islands may serve as an important nursery for fish and aquatic organisms. Vegetation on the islands, especially the large island, may provide protective cover for small mammals, amphibians, reptiles, and songbirds.

About 1 acre of riparian vegetation would be destroyed by construction of the tailrace channel and about 0.3 acre (wooded mud bank upstream) may be destroyed by construction of the intake channel. Another 0.5 to 1 acre of wetlands along the island perimeter and shoreline in the backchannel would be affected by the increased velocities, turbidity, and sedimentation. The islands complex and shallow substrate below the dam are unique and of ecological importance. Because of the scarcity of these wetland complexes in this area, the 1-2 acre loss and/or change in species composition and areal extent is considered to be significant and would impact recreational and aesthetic uses of the area.

Text has been modified in reference to "maintenance dredging."

of 1 to 2 acres of "wetlands" would cause a "major" or "significant" impact. This statement is questionable on two counts. First, although riparian vegetation is often associated with wetlands, the majority of the riparian vegetation along the main shore and the island shoreline is not associated with emergent "wetlands". It is emergent wetlands that are of importance to the fishery. Secondly, UMWC is not certain how the status of "significance" was determined, since there was no reference to how much similar habitat is available locally. The shoreline habitat in the channel is not unique to the area, nor is it a major fraction of the available shoreline in the tailwater area.

Finally, the DEIS states that "maintenance dredging" would be responsible for continued "additional" loss of wetland and riparian vegetation. This statement contradicts information which the UMWC has provided in docket 6998, as well as the estimates provided in the DEIS on spoil disposal requirements (Table 4.1.6-8.). Intake and tailrace channels of this type of project are expected to be self sustaining, without the need for maintenance dredging. Table 4.1.6-8 includes the estimate of cubic yards of spoil material for maintenance dredging as zero. Consequently, any anticipated increases in sedimentation and turbidity due to maintenance dredging should no longer be considered as having additional impacts on wetlands/riparian vegetation.

3. Fish Habitat

On p. 4-24 the DEIS asserts that "aquatic habitat changes would be inevitable .. in the scour pool and riffle extending approximately 1000 feet below the dam which would have little flow (1500 cfs minimum spill proposed by applicant) and be partially dewatered." 414

This statement indicates a poor understanding of river hydraulics. UMWC has proposed a minimum spillage flow of 1500 cfs, which is more than double the 7Q10 flow at the site, and close to 5 times the historic low flow. 1500 cfs is indeed in excess of average river flows for weeks in average water years, and months in dry years. Therefore, UMWC takes issue the statement that "[M]inimum flows .. to be maintained ... over fixed crests during low-flow periods .. are unlikely to be sufficient to generate currents in the tailwaters comparable to present conditions" (pg. 4-20).

In addition, 1500 cfs is well in excess of the minimum flows proposed by the DEIS for water quality at the site (600 cfs non-critical; 1000 cfs critical, pg. 2-26). The critical and 415

414. Staff considers a 1500 cfs flow at times when the river has significantly greater flow than this upstream of the dam to represent an important loss of habitat in the riffle below the dam. The commentor suggests that staff does not understand river hydraulics, but the comment suggests that the applicant will be providing a minimum flow when that water does not exist in the river. Such a situation cannot be the case unless the applicant is providing upstream storage.

Staff believes the following flow scenario will apply:

a) At very low river stages, e.g., in the range of historic low flows and 7Q10 flows, the turbines will not operate and all flow that is present above the dam will pass over the dam (<1500cfs). The applicant cannot alter river flows to maintain a 1500 cfs minimum flow.

b) At flows >1500 cfs but less than the minimum needed to operate the turbine, there will still be 100 percent passage of river flow over the dam (>1500 cfs).

c) At river flows that are greater than the sum of 1500 cfs and the minimum turbine flow, the turbine will operate and only 1500 cfs will be spilled over the dam. In this flow range, the downstream habitat would normally have the full flow spread across the riffle habitat but now it has only 1500 cfs. The difference is lost habitat space, some as dewatered shallows, some as shallower areas that still contain water, some as reduced flow velocity in the lower zones where more pool-like conditions begin. With a suitable physical hydraulic model the areas and durations affected could be calculated.

d) At river flows that are greater than the sum of 1500 cfs and the maximum turbine flow, a spill greater than 1500 cfs will again occur. The differences in habitat in the riffle below the dam between full river flow and the flow allowed over the dam after subtracting the turbine flow could be calculated if there was sufficient information such as a physical hydraulic model.

e) The annual loss of habitat in the zone extending primarily about 1000 ft downstream from the dam would be th sum of losses in c) and d) above. Staff did not have sufficient information to conduct such a quantitative analysis and was obliged to make more general statements.

f) Flow differences in reaches downstream of the riffle and islands will be ameliorated as the turbine discharge fans out and fills the channel. The extent to which this fanning will occur upstream of the navigation channel is uncertain.

This scenario is consistent with the staff's statement quoted from the DEIS p. 4-20.

415. The recommendations for Muskingum L&D No. 3 have been modified (Section 5.4.1) to include the spill flows recommended by USFWS for protection of mussels, plus any additional spill required for maintenance of DO concentrations. These spill flows would apply only if adequate mitigation was developed to allow the project to be recommended; staff believes that such mitigation has not yet been determined.

non-critical minimum flows identified for the project in the Upper Ohio River Basin were determined to meet (1) a "no effects" DO concentration that, if maintained, would not limit the survival, growth, or distribution of aquatic organisms; and (2) a spillage at dams sufficient to prevent DO concentrations from being below this "no effects" concentration as a result of hydropower generation.

For estimating flow regimes of tailwaters the DEIS uses "...available site-specific hydrographic data obtained from the applicants and the Corps, aerial photographs of the tailwater area, and general knowledge from developed sites" (pg. 4-22). UMWC is not certain how the staff arrives at the conclusion that with the proposed minimum flow "1000 feet below the dam would be partially dewatered." UMWC did not submit any references that may have indicated such a conclusion, nor are we aware of any in the DEIS references. As identified above, the 1500 cfs minimum flow proposed by the applicant exceeds natural flow quite often, and therefore, UMWC argues against the belief that this stretch of the streambed would be "dewatered". Most biologists agree that habitat is usually limited by the minimum flow events, which would not change under the project. 416

Finally, it appears that the conclusions reached for impacts to the tailwater fishery are based upon the same incorrect or and misrepresented conditions of downstream habitat, as were the conclusions of impacts to wetlands. The DEIS concludes (pg. 4-24) that "significant, adverse modifications of the tailwater habitat between the Muskingum L&D No. 3 and the navigation channel 2 miles downstream is inevitable ... This modification is expected to be detrimental to fish resources ...". Furthermore, the DEIS concludes on pg. 5-5 that the construction and operation of the proposed project at Muskingum L&D No. 3 "...would result in significant adverse impacts to the regional resource of shallow, tailwater, aquatic habitats and that there are no adequate means for mitigating these impacts." UMWC argues that the DEIS does not adequately evaluate the region of impact, nor does it properly evaluate the reasonable means of mitigation already proposed by the Applicant, specifically a minimum spill flow which usually exceeds natural summer low flow conditions. In addition, as a run-of-river facility, the flow of water as it is discharged below the large island would obliquely fan out and fill the river channel (on pg. 4-18 the DEIS states that this can occur at one length of the dam). There is no chain of downstream islands which may prevent this, and cause dewatering impacts for 2 miles downstream. 417

Throughout the evaluation, the DEIS ignores the comments of the ODNR, OEPA, and USFWS, all of whom have formally commented (in docket 6998) that the project as proposed will <u>not</u> lead to a 418

416. See response to comment #414. Within the operating range of the turbine, the recommended minimum flow of 1520 cfs during July through March would be similar to 235 percent of existing 7Q10 conditions. This lower flow would occur more frequently with hydropower operation than it has in the past.

Staff used bottom depth and velocity profile data supplied by the applicant to conclude that a drop in river elevation in the zone for which data were supplied would result in dewatering at edges of islands and shoals and shallowing of other depths. The analysis could not be quantitative because the applicant's depth data did not extend over the full downstream reach and there was no relationship established between flow over the dam and river elevation in the riffle.

The comment is correct in stating that some habitat features are determined by the minimum flow events, and that the river's minimum flows (<1500 cfs) will not be affected by hydropower (as described in response to comment #414). However, in addition to the instantaneous minimum, one must consider the duration of lower flows. As described in response to comment #414, there will be extended time periods when flows are approximately 1500 cfs with hydropower compared to the condition without hydropower.

In addition, staff considered the impacts of a major transition on the flow regime in this section of river due to hydropower development. A shift of a large percentage of the flow to the right bank would be likely to result in major riverbed reequilibration, including erosion and resedimentation of the riverbed, not just the islands. Mussel populations, some of which are on federal and state lists, may not tolerate such riverbed instability.

417. See response to comments #412, 414, and 416.

418. FERC is obliged by NEPA to conduct an independent analysis which embodies the concerns raised by agencies in the scoping process. Responses to comments #412, 414, 415, and 416 more fully explain staff's reasoning.

significant adverse effect on the fisheries. In arguing that the local, independent experts whose explicit mission is to protect the resource, are wrong, we would expect the DEIS to be very well documented, at minimum explaining why these experts are incorrect. No such effort is made.

4) Recreation.

On page 4-46 the DEIS states that the Applicant's Recreation Plan, with minor modifications, is adequate for the site. The DEIS proceeds, however, to conclude (pg 5-25) that the proposed project would have a significant adverse impact on recreation. Absent specific justification for this conclusion, we must assume it is a result of the perceived "major changes in fish habitat quality" (pg. 5-7), extended to mean a reduction in fish available for catching, thus less fishery. If the habitat concerns are alleviated, recreational ones should follow. 419

UMHC has demonstrated in the license application, supplementary filings, agency comments, and the above discussions that a signficant adverse effect should not be anticipated at Muskingum L&D No. 3. As such, there will be no significant impact to recreation.

5) Endangered Species.

The DEIS at numerous points implies or actually states that the proposed project will have a negative impact on the Federally Endangered Pink Mucket Pearly Mussel. Although not directly referenced as a reason to deny the license it is likely such a condition will influence the Commission's ultimate decision. We find this impact conclusion to be incorrect and unsupported by the evidence before the Commission. 420

On pg. 3-20 the DEIS states that "[I]n recent years, the greatest number of fresh or relatively fresh shells of the pink mucket pearly mussel has been found in the Muskingum L&D No. 3 site at Lowell, Ohio." A close scrutiny of Stanbery's report reveals that in fact only dry or weathered shells have been collected in the vicinity of L&D No. 3. Although shell material was found in this reach of river in a study completed in 1983, the exact locations of where they were found are not described. Also, in other recent studies (Davies, 1963; Stilwell, et. al. 1975; and Rothwell, 1979) no living specimens or fresh shells were encountered. Stansbery's report documents the most recent evidence of pink mucket populations at L&D No.3 to be a "badly weathered shell" found in 1980 (likely very old), and a "dry shell" found 25 years ago.

419. The proposed recreational enhancements cannot compensate for the loss of important ecological habitat that could occur from the development of the proposed project. The project site is unique in comparison to the other project sites in the study area due to its natural setting and location on a river managed solely for recreation purposes. The existing state park facilities, the undisturbed setting, and the unique fish and wetland habitats all contribute to the site's high recreational quality. Adequate mitigation for project impacts to the existing recreational quality of the area is not known to staff at this time.

420. See Appendix I for a additional information and analysis on impacts to _Lampsilis abrupta_, the pink mucket pearly mussel. Staff is obliged to make an independent assessment under NEPA, and it believes its conclusions are valid with available information.

Ms. Lois D. Cashell
June 28, 1988
Page 6

Contrary to the statement on pg. 4-23, the Pink Mucket Pearly Mussel is not found in the tailwaters of L&D 3. Given the information presented in Stansbery's report, one can only conclude that Pink Mucket Pearly Mussels <u>may</u> inhabit the tailwaters of L&D 3. To state that such a population is even <u>likely</u> is carrying this belief much further than either Stansbery or the US Fish and Wildlife Service is willing. If the Commission is to make this assertion, it should be documented with evidence.

Nonetheless, the Project (and its proposed mitigation) has been designed to operate in a way that minimizes impacts <u>should the mussel exist</u>.

The Commission is apparently unaware that the US Fish and Wildlife Service has issued an opinion letter specifically for Pink Muckets at L&D 3 (copy attached). This opinion, which is the FWS' formal decision document under the Endangered Species Act, specifically states that "[S]hould the above conditions be incorporated into the project, this precludes the need for further action on this project as required by the 1973 Endangered Species Act". The FWS has concluded that hydropower at L&D No.3 will not cause an adverse impact to the Pink Mucket Pearly Mussel. The contrary conclusion in the DEIS is thus highly suspect.

6. Alternatives and Implications of the "Proposed Action".

In the "Recommended Action" section, the DEIS proposes that the license for the Muskingum L&D 3 project be denied. The section goes on to generally discuss the implications of denial on the "target resources". The section fails, however, to recognize the implications of license denial on non "target" resources. 421

If the project is not completed, then an equivalent amount of power must be generated by an alternate means. According to the Alternatives Section (pg. 4-86) the offsetting generation would come from a coal fired plant. While obviously denial of L&D 3 will not force the construction of a 400 MW thermal power plant, it will force an equivalent amount (7 MW) of capacity and energy to be produced at a plant where it otherwise would not. This must be recognized.

If one ratios energy generation of the Muskingum L&D 3 facility against the Alternative Coal Plant used by the Commission (pg. 4-86), the Muskingum Facility would offset the following emissions:

421. The impact to non-target resources are recognized in the EIS (see Section 4.5). It is reasonable to assume that the Muskingum L&D 3 project would eliminate a percentage of the coal fired-emissions presented in Section 4.5 equal to its percentage (2.6 percent) of the annual generation of the proposed projects.

- 2.3 tons/year of ash;
- 59 tons/year of Sulphur Oxides;
- 114 tons/year of Nitrogen Oxides;
- 8.9 million gallons of water consumptively used in a cooling tower; plus
- Unquantified effects of cooling water intakes, coal transportation, sludge disposal, ash disposal, and CO-2 emission.

These benefits should be specifically weighed against any residual impacts associated with project approval.

422 In conclusion, we find various statements and positions in the DEIS regarding the Muskingum L&D 3 Project to be factually incorrect. Conclusions based upon such incorrect information should be critically reviewed, particularly when they are at odds with the prior comments from the state and federal jurisdictional agencies. Any decision should be carefully weighed against the full implications of license denial, including specific emissions offsets.

423 It is UMWC's position that, considering the full wealth of evidence, the FERC should reach a conclusion that the Muskingum L&D No. 3 project will not contribute to a significant adverse impact to the environment.

The Commission's decision with respect to this project will affect hundreds of thousands of dollars spent to date by UMWC in good faith reliance on the opinions and official comments of independent biological experts, as well as state and federal agencies. If the final EIS is to conclude, even with the factual corrections made in this letter, that license rejection is still warranted, the decision should be very well supported. To do otherwise would be grossly unfair to the Applicant.

Thank you for the opportunity to submit these comments.

Sincerely,

William S. Fowler

Project Manager
Agent for the
UPPER MISSISSIPPI WATER COMPANY

WSF/dc

Enclosure: FWS letter dated April 6, 1987

cc: Jim Richards, Sithe
George Taylor, FERC
File

Mitex, Inc.

422. Staff's evaluation of the hydropower project proposed at Muskingum L&D No. 3, based on the information submitted, has not changed staff's conclusion that such development would cause significant adverse impact to the target resources identified as fisheries, recreation, and wetlands. See responses to comments #412-421 for staff's discussion of this information. The Commission will make the final licensing decision on Muskingum L&D No. 3 in the public's interest.

423. Comment noted. See response to comment #422.

The enclosure provided by Mitex, Inc., is not reproduced here.

NATIONAL RENEWABLE RESOURCES, INC.
GULF & WESTERN BUILDING
15 COLUMBUS CIRCLE, SUITE 906
NEW YORK, N.Y. 10023
(212) 245-2721

June 27, 1988

Ms. Lois Cushell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.W.
Washington, D.C. 20426

Re: Maxwell Lock and Dam Hydroelectric Project #8908

Dear Ms. Cushell:

I am writing on behalf of the applicants, Pennsylvania Renewable Resources, Inc., Washington County and the Borough of Brownsville to enclose an original and thirteen copies of our Comments on the Draft Environmental Impact Statement issued on May 20, 1988.

If you have any further questions regarding this matter, please give me a call.

Sincerely,

Jeffrey Kossak

Jeffrey Kossak

JK/mj

cc: Mr. Bill Somber, Washington County
Mr. Estel Knisley, Borough of Brownsville

8807100055

J-200

Page 5-3
Item 8

The recommended spill of 500 cfs is excessive. 400 cfs would be sufficient.

424

424. Staff's water quality analyses show that a spill flow of 500 cfs is necessary to assure adequate DO concentrations (see Section 4.3.1).

NATIONAL RENEWABLE RESOURCES, INC.
GULF & WESTERN BUILDING
15 COLUMBUS CIRCLE, SUITE 906
NEW YORK, N.Y. 10023

(212) 246-2721

June 27, 1988

Ms. Lois Cushell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.W.
Washington, D.C. 20426

Re: Monongahela L&D Hydroelectric Project #4675

Dear Ms. Cushell:

I am writing on behalf of the applicants, Pennsylvania Renewable Resources, Inc., Washington County and the Borough of Charleroi, to enclose an original and thirteen copies of our Comments on the Draft Environmental Impact Statement issued on May 20, 1988.

If you have any further questions regarding this matter, please give me a call.

Sincerely,

Jeffrey Kossak

JK/mj

cc: Mr. Bill Sember, Washington County
Mayor McCluskey, Borough of Charleroi

8807100054

FERC - DOCKETED

J-202

Applicants' Draft EIS Comments
Monongahela L & D No. 4
4675-002

Table 2.1.1-3
Page 2-4
Table 5.2-1
Page 5-20

The draft EIS significantly underestimates energy production. Based on discussions with FERC staff, the number used in the draft EIS assumes that the turbines would be shut down for net heads of less than 10.3 feet. We have confirmed with our engineers and a major turbine supplier that the units would operate at reasonable efficiencies and without undue cavitation or vibration for heads not lower than 8.9 feet. As a result energy production would be increased approximately 3.5 Gwh. In addition, FERC staff and applicants appear to have used different tailwater curves. This accounts for an additional 3Gwh. Thus energy should be increased 6.5 Gwh. The additional energy production would also increase the levelized benefits in the last column of Table 2.1.1-3. 425

425. Comment noted.

Page 5-33
Item 9

The recommended spillage of 500 cfs is excessive. 400 cfs would be sufficient. This would increase energy production. 426

426. Staff's water quality analyses show that a spill flow of 500 cfs is necessary to assure adequate DO concentrations (see Section 4.3.1).

NATIONAL RENEWABLE RESOURCES, INC.
GULF & WESTERN BUILDING
15 COLUMBUS CIRCLE, SUITE 806
NEW YORK, N.Y. 10023
(212) 246-2781

June 27, 1988

Ms. Lois Cashell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.W.
Washington, D.C. 20426

Re: Tygart Dam Hydroelectric Project #7307

Dear Ms. Cashell:

I am writing on behalf of the applicant, the City of Grafton, to enclose an original and thirteen copies of our Comments on the Draft Environmental Impact Statement issued on May 20, 1988.

If you have any further questions regarding this matter, please give me a call.

Sincerely,

Jeffrey Kossak

Jeffrey Kossak

JK/mj

cc: Mayor John Murray, City of Grafton

8807100056

FERC - DOCKETED
JUN 29 1988

J-204

Section 4.1.6.1 Page 4-59	Applicant 7399-000, because of the size of its proposed project, would infringe upon the site of the city of Grafton/Taylor County water treatment plant, located immediately downstream of Tygart dam, and would likely require relocation of this plant. The effect of the project on the water treatment plant and availability of water to Grafton and Taylor County is a major adverse impact. Neither Grafton nor Taylor County have consented to the relocation of their water treatment plant nor has a proposal been made by applicant for the relocation and cost thereof.	427	427. As currently proposed, project No. 7399 at Tygart Dam would not encroach on the site of the City of Grafton/Taylor County water treatment plant. While the project tailrace would be located quite close to the treatment plant, it would not encroach on the city's property, and there has been no indication that it would intefere with operation of the treatment plant.
Section 4.1.6.3 Page 4-65	Same comment as above.		
Table 5.1.1-1 Page 5-3, Table 5.1.2-1 footnote 3 and Table 5.1.3.-1 Page 5-15, footnote 3 and Table 5.1.4-1 Page 5-17, footnote 3	Project 7399-000 should be stated to have significantly greater adverse land use impacts than competing project 7307.		
Section 5.1.1 Page 5-11	The impact on the Grafton/Taylor County water treatment plant should be noted as a major adverse impact.		

Mitex, Inc. A Member of the Sithe/Energies Group

91 Newbury Street Boston, Massachusetts 02116 Telephone (617) 424-1888
Telecopier (617) 267-7587

FILED
OFFICE OF THE SECRETARY
88 JUL -5 AM 10:50
REGULATORY COMMISSION

June 28, 1988

Ms. Lois D. Cashell
Acting Secretary
Federal Energy Regulatory Commission
825 North Capitol St. N.E.
Washington D.C. 20426

Re: Upper Ohio River Basin Draft Environmental Impact Statement
FERC Docket No. EL-85-19-114

Dear Ms. Cashell:

428

Mitex is the general partner of Allegheny Hydro Partners and Allegheny No. 6 Hydro Partners (collectively "the Partnerships"), which are the respective Licensees for the Allegheny River Locks and Dams 5 and 6 Hydroelectric Projects (FERC No. 3671 and 3494). Although these facilities are not included within the decision scope of the referenced DEIS, they are nonetheless mentioned, impacts are assumed, and a conclusion is reached that includes proposed modifications to the operations of the L&D 5 and 6 projects. Thus the Partnerships have a direct interest in this proceeding.

Our concern is primarily with water quality related sections of the DEIS. The Commission has developed a dissolved oxygen model that means to characterize the Allegheny River from L&D 9 down to the confluence with the Monongahela, and then on down the mainstem Ohio. According to the DEIS (pg. 3-40) the model is based upon spot DO measurements taken by the Corps of Engineers, ORSANCO, and the State of Pennsylvania.

Although we cannot comment on the internal workings of the model, we can comment on the results. The DEIS implies (p. 4-5) that dams 5 and 6 efficiently aerate the Allegheny River, and that hydropower installation will result in elimination of most of this aeration effect. The DEIS concludes on page 5-26 that the interim minimum flows at L&D 5 and 6 should be re-evaluated in light of the model's results.

We find these conclusions to be incorrect, and apparently based on a selective portion and small fraction of the amount of data available. Mitex has conducted extensive dissolved oxygen sampling programs at Lock and Dams 4, 5, and 6 for nearly 3

88 JUL 8 AM 11:16

428. Data from FERC licensees or applicants is not always directly cited in the FEIS; however, Sect. B.2.1.3.1 mentions that data used were from either hydropower applicants or the Corps and Table B-1 mentions that the aeration model developed for Allegheny L&D 5 was developed from data from both the Corps and the applicant (or in this case the licensee). The model for Allegheny L&D 6 was developed from Corps data in the DEIS and has been re-evaluated using transect data from the licensee and additional data collected by the Corps in 1988. The revised equation for aeration at Allegheny L&D 6 is: the DO deficit downstream of the dam = 0.82 times the deficit upstream of the dam. This revision of the dam aeration model will not affect results of the impact analyses in Sect. 4 because the low spill flow at Allegheny L&D 6 makes the effects of aeration there minor.

The hourly monitoring data collected by the licensees were not used to evaluate dam aeration at Allegheny L&Ds 5 and 6 because data from continuous monitors are not sufficiently accurate for aeration modeling.

The "analysis" of the Corps DO measurements presented in the table accompanying this comment letter is meaningless. Simply averaging the change in DO concentration for all the individual measurements does not take into account the mixing at the dam (measurements must be cross-sectionally averaged before above-dam can be compared with below-dam) and does not take into account the dependence of aeration on the above-dam DO deficit. The linear model of below-dam vs. above-dam DO deficit used in the EIS accounts for mixing and the dependence of aeration on the above-dam deficit. The linear model predicts that there are situations when deaeration, no aeration, and positive aeration will occur, depending on DO deficits above the dam. Staff recognizes that variability in aeration rates occurs, but believes the DO model is sufficiently accurate to predict impacts of project operations.

The enclosure provided by Mitex, Inc., is not reproduced here.

years. These studies included two years of transect-based measurements, and one year of continuous recording monitors up and downstream of Dams 5 and 6, and upstream of Dam 4. The results of this data collection effort have been continually filed with the Commission (in the Project 3494 and 3671 dockets) and made available to agencies. Much of the information was sent directly to the DEIS preparers. Yet not a single reference to any of this data, or the program, is found in the DEIS.

The COE data that apparently provides the DEIS' aeration assumptions for each dam were taken (we understand) over a one hour period, generally once a year. This is less than 1% of the site specific data gathered by the Partnerships. ORSANCO data is generally not taken both above and below the dams, and State data is very limited.

We would not be as concerned if relying on the Corps data to calibrate results ended up with an accurate model. We cannot, however, come to this conclusion. First, an analysis of the Corps data in our posession (copy enclosed, covering 1976 to 1983) yields an average amount of oxygen uptake at L&D 5 of 0.02 mg/l. At L&D 6 it is 0.03 mg/l. This is absolutely insignificant. We are very skeptical of any model that uses these figures to yield a conclusion of "efficient aeration" at these L&D's.

The data gathered by the Partnerships directly over the past years shows quite mixed results. At some times the dams aerate; at others they deaerate; and at still others, apparently no change to DO occurs. During the summer low flow, DO uptake varies considerably. Under no circumstances, however, can the dams be characterized as consistently "efficient aerators". Any conclusion based upon such a characterization must be flawed.

We finally take serious issue with the recommendation at page 5-26 of the DEIS that interim minimum flows at Allegheny 5 and 6 be reconsidered in light of "the studies conducted for this DEIS". First, we consider the DEIS model seriously flawed due to its limitation on input data, and its seeming incompatibility with observed field data. Second, and perhaps more importantly, the minimum flows at L&D 5 and 6 are being determined based upon a very extensive, very expensive, site specific study. Under no circumstances should this study be supplanted by regionalized, very general inferences that do not seem to account for true site specific conditions.

Thank you for the opportunity to submit these comments.

Sincerely,

William S. Fowler
Project Manager

WSF/dc

Enclosure: COE DO data

cc: Jim Richards, Sithe
George Taylor, FERC
File

GREEN INTERNATIONAL AFFILIATES

June 24, 1988

Dean L Shumway
Acting Director,
Division of Project Review
Federal Energy Regulating Commission
Room 9310
825 North Capitol Street N.E.
Washington DC. 20426

SUBJECT: Comments to DEIS
Montgomery Hydroelectric Plant
Project No.3490

88 JUL 21 AM 9:41

Dear Mr. Shumway:

Attached for filing with the Commission please find one original of the Comments to Draft Environmental Impact Statement for Potter Township Montgomery Hydroelectric Plant.

In the event you or your staff require more copies or have any questions regarding this submittal, please feel free to contact us.

Very truly yours,

GREEN INTERNATIONAL AFFILIATES, I C.

88 JUN 27 AM 10:55

Richard A. Volkin, P.E.
Executive Vice President

RAV/nk

J-209

FERC DOCKETED
JUN 2 8 1988

8807100001

CONSULTING ENGINEERS AND PLANNERS

POTTER TOWNSHIP
PENNSYLVANIA

MONTGOMERY HYDROELECTRIC PLANT
FERC PROJECT NO. 3490-001

COMMENTS TO DEIS

JUNE 1988

GREEN INTERNATIONAL AFFILIATES INC.
CONSULTING ENGINEERS BOSTON MASSACHUSETTS

J-210

Draft Environmental Impact Statement
Hydroelectric Development
in the Ohio River Basin
FERC Docket No. EL85-19-0114

Subject: Montgomery Hydroelectric Project

After careful review of the DEIS, the comments and evaluations as they relate to the Montgomery Hydroelectric Project, FERC Project No. 3490 as proposed by Potter Township, are not properly addressed as presented in the "Competing Application in Response to Project 2971-002 Application for License, Montgomery Hydroelectric Project" dated February 5, 1986 and all additional information submitted thereto. 429

Key issues that are contrary to the comments and evaluations in the DEIS are:

1. The competing application preserves the wetland areas.

2. Aeration is utilized in replacement of D.O.

3. Recreation area is improved and expanded.

4. Fish protection devices incorporated in the program.

It appears that considerations were given to the FERC Project 2971-002 by Allegheny Electric Cooperative, with little to no regard to FERC Project

429. Staff has reviewed the material provided in Attachment C without finding evidence to change any conclusions or recommendations. Staff still concludes that the effectiveness of mechanical aeration at bulb turbines (specifically, the oxygen transfer efficiency, which was not addressed in the material provided) is unknown.

Fish entrainment at Montgomery L&D, including both proposed projects, is discussed in Sections 4.1.2.3.5 and 4.1.2.3.6 of the FEIS. Staff concludes that the potential for significant, adverse impact to fish populations remains with this competing application and that the proposed mitigation is unproven in the Ohio River.

The FEIS includes a drawing of the recreational facilities proposed by the applicant (Figure F-16, Appendix F). Although the proposed facilities would improve recreational fishing access at the site, staff still concludes that specific adverse impacts to game fish from turbine-induced mortality would create unmitigable impacts to recreational fishing.

Staff has addressed the impacts of porous dikes on wetlands (Section 4.1.4.3) and has concluded that the level of protection these devices could provide would not be sufficient to adequately protect the embayment area. Staff recommended that the project not be licensed until mitigation measures proposed and designed by the developer to prevent impacts to the wetlands are approved by appropriate state and federal agencies.

The three attachments provided by Green International Associates are not reproduced here.

No. 3490 by Potter Township.

The wetlands abayment area is preserved and fisheries, juvenile and adult are preserved and enhanced by the porous dike profile incorporated in the design.

No construction vis a vis construction laydown area would be incorporated in this area as depicted in the DEIS and in Allgeheny Electric Cooperative Plan. Refer to Attachment A for backup data as it relates to addressing the Wetlands Abayment area.

With Incorporation of the porous dike and the further incorporation of a fishing platform on the downstream area of Hydropower plant, the recreation areas on both sides of the facilities will be enhanced. See Attachment B for support data that was not taken into consideration during the DEIS.

Flow and D.O. considerations, not considerations in the DEIS are detailed in Attachment C.

Therefore, with the enhanced and environmentally safe system that is proposed by Potter Township for the Montgomery Locks and Dam FERC No. 3490 should be considered and approved for licensing.