Environmental Report
Operating License Stage

Limerick Generating Station

Units 1 & 2

PHILADELPHIA ELECTRIC COMPANY

Vol. 1

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LGS EROL

SUMMARY TABLE OF CONTENTS

Section	Title	Volume
1	PURPOSE OF LIMERICK GENERATING STATION AND ASSOCIATED TRANSMISSION	I
1.1	System Demand and Reliability	I
1.2	Another Objective	I
1.3	Consequences of Delay	I
1.1A	Conservation of Energy Programs	I
1.1B	Energy Forecasting Methodology	I
1.1C	Annual Peak Demand Forecasting Method	I
2	THE SITE AND ENVIRONMENTAL INTERFACES	I
2.1	Geography and Demography	I
2.2	Ecology	I
2.3	Meteorology	II
2.4	Hydrology	II
2.4A	Appendix 2.4A - DRBC Approval	II
2.5	Geology	II
2.6	Regional Historic, Archaeological, and Natural Features	II
2.7	Noise	II
3	THE STATION	
3.1	External Appearance	II
3.2	Reactor and Steam-Electric System	II
3.3	Station Water Use	II
3.4	Heat Dissipation System	II
3.5	Radwaste Systems and Source Term	II
3.6	Chemical and Biocide Wastes	II
3.7	Sanitary and Other Waste Systems	II

Section	Title	Volume
3.8	Reporting of Radioactive Material Movement	II
3.9	Transmission Facilities	II
4	ENVIRONMENTAL EFFECTS OF SITE PREPARATION, STATION CONSTRUCTION, AND TRANSMISSION FACILITY CONSTRUCTION	III
4.1	Site Preparation and Station Construction	III
4.2	Transmission Facilities Construction	III
4.3	Resources Committed During Construction	III
4.4	Radioactivity	III
4.5	Construction Impact Control Programs	III
5	ENVIRONMENTAL EFFECTS OF STATION OPERATION	III
5.1	Effects of Operation on Heat Dissipation System	III
5.2	Radiological Impact from Routine Operation	III
5.2A	Radiological Dose Model - Liquid Effluent	III
5.2B	Radiological Dose Model - Gaseous Effluent	III
5.2C	50-Mile Population and Contiguous Population Dose Model	III
5.3	Effects of Chemical and Biocide Discharges	III
5.4	Effects of Sanitary Waste Discharges	III
5.5	Effects of Operation and Maintenance of the Transmission Systems	III
5.6	Other Effects	III
5.7	Resources Committed	III
5.8	Decommissioning and Dismantling	III
5.9	The Uranium Cycle	III

Section	Title	Volume
6	EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS	III
6.1	Applicant's Preoperational Environmental Programs	III
6.2	Applicant's Proposed Operational Monitoring Program	III
6.3	Related Environmental Measurement and Monitoring Programs	III
6.4	Preoperational Environmental Radiological Monitoring Data	III
7	ENVIRONMENTAL EFFECTS OF ACCIDENTS	IV
7.1	Station Accidents Involving Radioactivity	IV
7.2	Transportation Accidents Involving Radioactivity	IV
7.3	Other Accidents	IV
8	ECONOMIC AND SOCIAL EFFECTS OF STATION CONSTRUCTION AND OPERATION	IV
8.1	Benefits	IV
8.2	Costs	IV
9	ALTERNATIVE ENERGY SOURCES AND SITES	IV
10	STATION DESIGN ALTERNATIVES	IV
10.1	Alternative Circulating Systems	IV
10.2	Alternative Intake Systems	IV
10.3	Alternative Discharge Systems	IV
10.4	Alternative Chemical Waste Systems	IV
10.5	Alternative Biocide Treatment Systems	IV
10.6	Alternative Liquid Radwaste Systems	IV
10.7	Alternative Liquid Radwaste Systems	IV
10.8	Alternative Gaseous Radwaste Systems	IV

Section	Title	Volume
10.9	Alternative Transmission Facilities	IV
11	SUMMARY BENEFIT-COST ANALYSIS	IV
11.1	Benefits	IV
11.2	Costs Incurred	IV
11.3	Conclusions	IV
12	ENVIRONMENTAL APPROVALS AND CONSULTATIONS	IV
13	REFERENCES	IV
A	ENVIRONMENTAL TECHNICAL SPECIFICATIONS	IV

CHAPTER 1

PURPOSE OF LIMERICK GENERATING STATION AND ASSOCIATED TRANSMISSION

TABLE OF CONTENTS

Section	Title
1.1	SYSTEM DEMAND AND RELIABILITY
1.1.1	Load Characteristics
1.1.1.1	Load Analysis
1.1.1.2	Demand Projections
1.1.1.3	Power Exchanges
1.1.2	System Capacity
1.1.3	Reserve Margins
1.1.3.1	Definitions
1.1.3.2	Criterion
1.1.3.3	Method
1.1.3.4	Interconnection Benefits
1.1.3.5	Effects of the Addition of the Limerick Units
1.1.3.6	Reserve Margin Responsibility
1.1.4	External Supporting Studies
1.2	OTHER OBJECTIVES
1.3	CONSEQUENCES OF DELAY
1.3.1	Effect of Delay on Reliability
1.3.2	Environmental Consequences of Delay
1.3.3	Economic Consequences of Delay
1.4	REFERENCES
Appendix A	Deleted
Appendix B	Energy Forecasting Methodology
Appendix C	Annual Peak Demand Forecasting Method

CHAPTER 1

TABLES

Table No.	Title
1.1-1	Projected Sales by Customer Class
1.1-2	Annual Sales, System Peak Demand, Generation and Reserves
1.1-3	PJM Interconnection Annual Output, Peak Demand, Generation, and Reserves
1.1-4	Energy and Peak Demand Projections
1.1-5	Philadelphia Electric Company System - Total Monthly Sales
1.1-6	Philadelphia Electric Company - Existing Generation Capacity as of January 1, 1983
1.1-7	Philadelphia Electric Company Future Generating Capability Changes
1.1B-1	Gross National Product Projection
1.1C-1	Maximum DWF between 10 a.m. and Time of Peak of Demand
1.1C-2	Standard Demand Factor
1.1C-3	Actual Average of April and October Output
1.1C-4	Weather Sensitive Demand - MW

CHAPTER 1

FIGURES

Figure No.	Title
1.1-1	Load Duration Curves for 1982
1.1-2	Load Duration Curves for 1985
1.1-3	Load Duration Curves for 1986
1.1-4	Load Duration Curves for 1987
1.1-5	Load Duration Curves for 1988
1.1-6	Load Duration Curves for 1989
1.1-7	Load Duration Curves for 1990
1.1C-1	1982 Demand Load Versus Daily Weather Factor
1.1C-2	Demand Versus Daily Weather Factor
1.1C-3	Demand Weather Characteristic 1982
1.1C-4	Basic Demand Factor
1.1C-5	Coincident Weather Sensitive Demand Response

CHAPTER 1

PURPOSE OF LIMERICK GENERATING STATION AND ASSOCIATED TRANSMISSION

1.1 SYSTEM DEMAND AND RELIABILITY

1.1.1 LOAD CHARACTERISTICS

The Applicant, Philadelphia Electric Company, serves customers in the southeastern portion of the Commonwealth of Pennsylvania, and in a small northeastern portion of the state of Maryland. In 1982, the Applicant's system served 1,331,729 electric customers in an area of 2340 square miles, with a population of approximately 3.7 million people. The customers located in the Pennsylvania portion of the territory used 98.3% of the total kilowatt-hours sold.

The Applicant's customer load has similar characteristics to other metropolitan power systems in the northeastern U.S. Table 1.1-1 lists by customer class the 1982 actual energy sales and the estimated energy sales for 1983 through 1992. In 1982, the percentage split between major classes of customers was residential 30%; small commercial and industrial 12%; large commercial and industrial 54%; and other 4%. Large commercial and industrial customers include such heavy industries as steel production, single-point-metered apartment buildings, and department stores.

The Applicant is the largest electric power system, in terms of both peak demand and kilowatt-hour sales, in the Commonwealth of Pennsylvania. The Applicant serves Philadelphia, the largest city in the state, and the fourth largest city in the country. The maximum system demand of 6095 MW occurred on July 21, 1980. At the time of the peak, 5577 MW of the Applicant's 7698 MW of installed generating capacity were available to meet this demand.

The deficit was supplied by the Pennsylvania-New Jersey-Maryland Interconnection (PJM).

In 1927, the Applicant became one of the three original members of the Pennsylvania-New Jersey-Maryland (PJM) Interconnection. The present PJM pool members are: Public Service Electric and Gas Company, Philadelphia Electric Company, Atlantic Electric Company, Delmarva Power & Light Company, Pennsylvania Power & Light Company Group (Pennsylvania Power & Light Company, UGI Corporation), Baltimore Gas and Electric Company, General Public Utilities Corporation (Jersey Central Power & Light Company,

Metropolitan Edison Company, Pennsylvania Electric Company), and the Potomac Electric Power Company.

This power pool serves a population of about 21 million people in a 50,000-square-mile area including three-quarters of Pennsylvania, almost all of New Jersey, more than half of Maryland, all of Delaware and the District of Columbia, and a small part of Virginia. The maximum PJM system demand of 34,420 megawatts occurred July 21, 1980. At the time of the peak 35,419 megawatts of the power pools 45,030 megawatts of installed generating capacity were available to meet this demand. The pool operates under a written agreement that provides for operating the bulk power supply (generation and transmission) of each company as an integral part of the total PJM system. The pool operates as a single control area with minute-to-minute economic dispatch of generation, and free flow of power between the companies.

The Applicant is also a party to the Mid-Atlantic Area Council (MAAC) which provides for the coordinated planning of generation and transmission facilities by the companies included in the PJM Interconnection. Since the service territories of the signatories to the MAAC agreement are the same as those included in the PJM Interconnection, all references to the PJM Interconnection will also apply to the MAAC reliability council.

1.1.1.1 Load Analysis

The Applicant's past and projected system annual energy output, peak demand, installed generating capacity, and installed reserve capacity from 1970 to 1992 are shown in Table 1.1-2. The energy output and peak demand projections are based upon the Applicant's customers continuing to conserve energy. Information on the Applicant's activities to promote the conservation of energy is detailed in Ref. 1.1-4, which is submitted annually to the Pennsylvania Public Utility Commission in compliance with Legistative Act 216.

The projected PJM Interconnection system's annual energy output, peak demand, installed generating capacity, and installed reserve capacity from 1970 to 1992 are shown in Table 1.1-3.

The projected load duration curves for the Applicant's system for the year 1982 and the years 1985 through 1990 are shown in Figures 1.1-1 through 1.1-7.

1.1.1.2 Demand Projections

The Applicant's baseline annual peak demand projections are listed in Table 1.1-2. The high and low range annual peak demand projections are shown in Table 1.1-4. The Applicant has an ongoing program for reviewing the methodology for forecasting the annual peak demand. The current method was adopted in 1975 after

extensive testing showed that it was superior to the method then in use. The current method for forecasting peak demand is outlined in Appendix C.

The uncertainty of the effects of energy policies and laws being formulated at the national level, and the uncertainty of the effects of the amount of economic activity in the Applicant's service area, have prompted the Applicant to develop a range of peak demand forecasts. As with any forecast, the accuracy of the basic assumptions directly affects the accuracy of the forecast. If there is an upsurge of economic activity in the Applicant's service territory, then the annual peak demands will approach the high range demand projections. From past experience, unforeseen and unforeseeable events can substantially alter actual levels from those that are forecasted. Energy projections that correspond to these peak demand projections are found in Table 1.1-4. The methodology and the assumptions underlying these demand and energy forecasts are described in Appendix 1.1B.

Monthly data for actual peak demand and total kWh sales from October 1972 through December 1982 are shown in Table 1.1-5.

1.1.1.3 Power Exchanges

Large long-term capacity purchases have been investigated and are not feasible to meet the Applicant's requirements. Therefore, the Applicant must carry out its responsibility and provide generating capacity to meet future system demands.

The Applicant's only past capacity purchase occurred when the Applicant temporarily purchased 200 MW of generating capacity from Delmarva Power & Light Company from August 1973 to April 1975.

The Applicant owns a 42.59% undivided interest in the 1115-MW Unit 2 at Salem Nuclear Generating Station, which was placed in service in October 1981. An agreement between the Applicant and Jersey Central Power & Light Company provides for the sale by the Applicant of energy and capacity to Jersey Central Power & Light Company during an initial period beginning with the date of the first electric output from Salem Unit 2 to January 1, 1985, and, upon mutual agreement of the parties, during additional successive periods of 1 year each.

Under the agreement, Jersey Central Power & Light Company will purchase energy and operating capacity from the Applicant in an amount equal to the Applicant's share of the output of Salem Unit 2. Jersey Central Power & Light Company will also purchase installed capacity whenever it needs additional capacity to meet its requirements, provided the amount of such purchase does not exceed either the Applicant's share of Salem Unit 2 capacity, or the Applicant's capacity in excess of its own requirements. Such

capacity requirements will be determined in accordance with the PJM Agreement.

This agreement will have no effect on the Applicant's reserve calculations as presented in this report.

There are no other planned capacity exchanges.

1.1.2 SYSTEM CAPACITY

The object of the Applicant's planning process is to plan an electric system that will reliably supply electricity at a minimum cost to customers.

A list of all installed generating units, with their respective fuel types and capacity as of January 1, 1983, is shown in Table 1.1-6. Capacity additions and retirements for 1983 through 1992 are listed in Table 1.1-7.

Generation planning begins with the forecast of annual sales and peak demands. At least once a year, the annual sales and peak demands are estimated for a minimum of 10 years. In addition, the generation reserves necessary to reliably supply these forecast annual peak demands are calculated. The total generation required, peak demand plus reserve, is compared to the installed generation minus scheduled retirements plus committed new generating capacity. When this total forecast generation requirement exceeds the forecast supply, additional generating capacity is planned.

Historically, the Applicant has planned generating capacity additions using the baseline annual demand forecast to determine need. In the late 1960s, demand forecasts fell short of actual peaks, resulting in a decrease in reserve levels. In the early 1970s, when the available reserve generating capacity was lower than anticipated, the option to install short lead time oil-fired generating units was available. Because of current Federal government policies, short lead time oil-fired generating units can no longer be used to bridge the gap if installed generating capacity shortages occur.

If the annual peak demand grows at a more rapid rate than expected, the installation of large generating units cannot be expedited. If installed generating capacity should be inadequate to supply annual peak demand, nothing can be done but reduce, or eliminate, service to selected customers. (See Section 1.3.1, Effect of Delay on Reliability.)

The program of planned generation additions and retirements is reviewed annually. It is modified on a timely basis as changes in peak demand forecasts, and slippages in the service dates of committed generating units warrant. The type of generating unit

and its required service date governs the point when the commitment is made to build a particular generating unit. For example, a nuclear unit requires about 12 years from the time of the decision to build to the time of commercial operation (lead time) compared to a combustion turbine which requires 2 to 3 years. Lengthening the lead time for new generation requires earlier planning and earlier commitments to build generating stations. Plans may be altered to conform with changes in the financial, regulatory, and/or legal environment that the applicant experiences until the time when the financial penalty, resulting from the additional delay or cancellation, becomes too great.

Sufficient generation must be installed to reliably supply forecast annual peak demands. Some additional generating capacity, above the amount needed to just supply the anticipated annual peak demands, is needed. This additional capacity provides a margin of reserve to ensure that the probability of the demand exceeding available generating capacity is at an acceptable level. This safety margin is necessary to allow for day-to-day variations in the operating condition of the installed generation, and for deviations of the annual peak demand from its estimate.

Generation may become unavailable due to either being forced out, or scheduled out, for preventive maintenance. Unit failure, or forced outage, is usually the dominant factor in establishing the desired reserve margin. The first generating unit of a particular size or type to be built could have startup problems, or the failure of the generating unit could involve damage or destruction of major items of equipment. In either circumstance, the generating unit may be forced out for many months at a time. Preventive maintenance, usually 3 to 5 weeks for most units, will ordinarily be performed in the seasons of the year when there is low daily peak demand. However, forced outages are just as likely to occur on the day of the annual peak demand as on any other day. Thus, if large seasonal variations exist in the daily peak demand, the effect of scheduled preventive maintenance on the required reserve will be small. The converse would be true for a system with relatively small seasonal variations in daily peak demand.

Electric utilities are mandated to provide reliable service. If generating reserves are inadequate because the annual peak demand is higher than estimated, nothing can be done but reduce, or eliminate, service to selected customers. Conversely, if the annual peak demand is much lower than estimated because of unforeseen circumstances, generation reserves are higher than necessary at that time. The long lead times required to construct large generating units impose a severe restriction upon the flexible planning needed to supply sudden, drastic changes in customers' demands.

Because generating units come in discrete sizes, rarely will the installed and planned generation exactly match the required generation. However, the generation requirement is matched as closely as can be justified economically. For instance, two small peaking units would not be installed in a year prior to the installation of a large base unit just to have sufficient reserves during that year.

The sharing of excess reserves is an example of one major advantage of power pools. If one company has a generating capacity deficit, another company that has an excess can be the source of generating capacity for the deficit company. Of course, the transmission system must be adequate to permit transfer of this capacity from one company to another. The Applicant, as a member of MAAC, coordinates the planning of generation with the other member companies in order to take maximum advantage of shared reserves.

The amount of generation reserves required depends on the desired reliability of the system. The public has grown to expect, and depend on highly reliable electric service. However, electric utilities can only supply service as reliably as can be justified economically. As a result of considerable study, a criterion has been established that appears to satisfy the customers' needs for reliable service without imposing excessive costs upon the electric utility. This criterion, which is explained in Section 1.1.3.2, is a goal that utilities try to achieve during periods of growth in annual peak demand.

Generation reserves that are higher than those needed to meet the reliability criterion may be economically justified. A new unit should be installed regardless of reserve capacity when the net cost of the new unit (including capital carrying charges, fuel cost, operating, and maintenance costs) are less than existing system operating costs.

The capacity factor of an individual generating unit is one of many operating statistics that are used to measure plant performance. The capacity factor is defined as follows:

$$\text{Capacity Factor} = \frac{\text{Actual Output of Generating Unit (MWh)}}{\text{Maximum Possible Output of Genrating Unit (MWh)}}$$

Both the actual output and the maximum possible output must cover the same time period. Usually, the time period is 1 year.

Historically, the Applicant has installed a mixture of generating units -- base capacity, intermediate capacity, and peaking capacity. Base capacity must have low fuel and operating costs, but may have high capital costs. Intermediate capacity has intermediate operating, fuel, and capital costs. These units are

often the older generating units that were previously base capacity. Peaking units are characterized by high operating and fuel costs, and low capital costs. The expected range of capacity factors for each type of unit is shown in the table below.

Capacity Factors for Different Types of Generating Units

Type	Range of Capacity Factors (%)
Base	Greater than 50
Intermediate	20 to 50
Peaking	Less than 20

Sometimes, as a result of unforeseen circumstances, the different types of generating capacity operate outside the expected range of capacity factors. For instance, if a large amount of generating capacity is out for an extended period of time, the peaking units may be required to operate more hours than expected. Likewise, base units may be forced out by equipment failure for an extended period of time, thus operating fewer hours than expected.

1.1.3 RESERVE MARGINS

The Applicant, as a member of both MAAC and PJM, participates in coordinated planning of generation facilities. The installed reserve requirement of PJM as a whole is based upon calculations using the loss of load probability (LOLP) method, and a criterion of 0.1 day of loss of load probability per year.

Since the calculated installed reserve requirement can vary from year to year due to variations in system characteristics (e.g., discrete generating unit additions and retirements), PJM adopts a nominal installed reserve requirement standard based upon annual reviews of calculated installed reserve requirements. PJM's nominal standard is currently 22% of the annual peak demand.

For planning purposes, the Applicant bases its nominal installed reserve requirement standard upon an annual review of its forecast allocation of the PJM nominal standard. The Applicant's nominal standard is currently 25% of the annual peak demand.

1.1.3.1 Definitions

a. Installed Capacity (MW) = The sum of the summer rated capacities of all generating units.

b. Daily Peak Demand (MW) = Maximum hourly integrated demand occurring during the day.

c. Annual Peak Demand (MW) = Maximum daily peak demand occurring during the year.

d. Installed Reserve (%) =

$$\frac{\text{Installed capacity - Annual peak demand}}{\text{Annual peak demand}} \times 100\%$$

e. Available Capacity (MW) = The sum of the rated capacities of all available generating units, i.e., units which are not unavailable due to either scheduled or forced outages.

f. Loss Of Load Probability (days/year) = The expected number of days per year in which the available capacity is less than the daily peak demand.

g. Installed Reserve Requirement (%) = The installed reserve associated with a specified loss-of-load probability criterion.

1.1.3.2 Criterion

The "Reliability Principles and Standards for Planning Bulk Electric Supply System of MAAC Group" (Ref 1.1-1) requires that the MAAC system as a whole, and its members individually maintain reserves to meet the reliability criterion. The criterion is that the probability of occurrence of demand exceeding the available capacity resources shall not be greater, on the average, than 1 day in 10 years. This generally accepted reliability standard for the industry, an LOLP of 0.1 days per year, is the criterion for determining the installed reserve requirement of both PJM and the Applicant.

1.1.3.3 Method

To satisfy its reliability criterion, PJM periodically reviews its nominal installed reserve requirement standard by LOLP calculations. LOLP is the most widely accepted method of determining installed reserve requirement and is used more often than any other approach. In essence, the LOLP method is based upon a comparison of mathematical (probabilistic) models for capacity and demand. In comparing the capacity model with the

demand model, the probability that the available capacity will be less than the daily peak demand can be determined. A general discussion of the LOLP method can be found in "The 1970 National Power Survey" (Ref 1.1-2) and in "Power System Reliability Evaluation" (Ref 1.1-3).

In performing its LOLP calculations, PJM uses a digital computer program, GEBGE, which was originally written by the General Electric and Baltimore Gas and Electric companies. The GEBGE program has been used by PJM since 1964 and has been extensively revised and updated by various other PJM member companies and the Applicant.

GEBGE calculates LOLP on a weekly basis and combines the weekly LOLP's to obtain LOLP on an annual basis. For each week of the year, mathematical (probabilistic) models are constructed for both generating capacity and demand.

The capacity model schedules outages of individual generating units by incorporating them into an optimized system schedule. Two constraints are placed on scheduled outages of individual units: (1) there may be only one scheduled outage per planning year, and (2) its duration must be an integral number of calendar weeks.

In order to minimize the effect of generating unit scheduled outages on installed reserve requirement, full advantage of seasonal demand variation is taken in preparing the system schedule. Each generating unit in turn (largest units first) is scheduled out during the weeks with the lowest sum of weekly demand plus accumulated capacity. Thus, the scheduling algorithm develops a system schedule in which demand plus capacity scheduled out is leveled, thereby minimizing the impact on installed reserve requirement.

The weekly capacity model consists of three pieces of data: (1) the system installed capacity, (2) the system capacity unavailable due to scheduled outages, and (3) the system capacity unavailable due to forced outages. The system installed capacity, as previously defined, is the sum of the rated capacities of all generating units. Similarly, the system capacity unavailable due to scheduled outages is the sum of the rated capacities of all generating units that have been scheduled out during the week. The system capacity unavailable due to forced outages is the sum of all generating units on forced outage. Unlike scheduled outages, forced outages occur randomly; therefore, this summation is a cumulative discrete probability distribution. An exact computation of this probability distribution is made using the rated capacities and forced outage rates of all the individual generating units that are not scheduled out during the week. The result of this computation is a tabulation containing the probability that the system capacity

unavailable due to forced outage will be equal to, or greater than, a given amount of megawatts. Subtraction of the system capacity unavailable, due to both scheduled and forced outage, from the system installed capacity results in a tabulation of the probability that the available capacity will be less than a given demand.

The capacity model also incorporates weekly capacity changes, additions and retirements, seasonal variations in capacity ratings due to ambient temperature variations, and annual revisions to individual generating unit's scheduled and forced outage rates.

The weekly demand models are based upon a computerized statistical analysis of 5 years of historical daily peak demand data. Weekend days are excluded from the analysis because of their relatively low demand levels and negligible contribution to the total LOLP. Therefore, each weekly demand model is based upon a statistical analysis of 25 daily peak demands. Each weekly demand model is represented by a Gaussian, or bell-shaped, probability distribution, with the mean and standard deviation of the probability distribution having been determined in the statistical analysis. For calculation purposes, the Gaussian distribution is approximated by discrete demand levels with their associated probabilities of occurrence. For ease of calculation, the discrete demand levels are expressed in per unit of the annual peak. Seasonal or monthly adjustments can also be incorporated if changes in seasonal patterns are required (e.g., winter demand growing faster than summer demand). Demand forecast error, in addition to that due to weather variations, can also be included. Thus, a set of weekly perunitized demand models is derived from analysis of historical data and adjusted as required. A set of weekly megawatt demand models can be obtained directly for a given forecast annual peak demand by multiplying each perunitized discrete demand level unit by the forecast annual peak demand. Therefore, changes in the forecast annual peak demand are easily modeled.

For each week of a given planning year, LOLP is calculated by a convolution (mathematical comparison) of the capacity model and the megawatt demand model associated with a given forecast annual peak demand. For each discrete demand level, the megawatt demand is compared with the available capacity tabulation of the weekly generating capacity model to determine the probability that the available capacity will be less than the megawatt demand. Such an insufficiency is, by definition, a loss of load. Since the variations in demand and available capacity are independent of each other, the joint probability of the discrete demand level occurring and the available capacity being insufficient is equal to the product of (1) the discrete demand level's probability of occurrence and (2) the probability of insufficient available capacity. This joint probability is the probability of loss of

load associated with the discrete demand level for each day in the week. The daily probability of loss of load is calculated by summing the contributions of all of the discrete demand levels. The weekly LOLP equals the daily probability of loss of load times 5 days. Finally, the annual LOLP is calculated by summing all 52 weekly LOLPs, thus obtaining the expected number of daily occurrences of loss of load during the entire planning year. The GEBGE program is used in this manner to calculate the annual LOLP of a given system demand and capacity representation. In addition, the program is used to find, for a given system representation, the installed reserve requirement needed to obtain a specified annual LOLP (e.g., a 0.1 day per year criterion). The installed reserve is varied, and the annual LOLP is recalculated, until the specified annual LOLP is reached. Changes in installed reserve are modeled by changing the forecast annual peak demand.

The calculated installed reserve margin associated with the specified annual LOLP criterion is expressed as a percentage of the forecast annual peak demand. This is the calculated installed reserve requirement.

1.1.3.4 Interconnection Benefits

An additional feature of the GEBGE computer program is its ability to analyze either a single system or two interconnected systems. PJM periodically uses this feature to determine reserve requirement benefits of interconnections to adjacent regional reliability councils and/or power pools. The capacities of present and planned future interconnection between PJM and neighboring power pools are sufficient to obtain optimal benefits.

1.1.3.5 Effects of the Addition of the Limerick Units

The addition of the Limerick units will not materially affect either PJM's or the Applicant's installed reserve requirement. The reasons for this are twofold: the forecast forced outage rate of these units is less than the current average forced outage rates of both PJM and the Applicant, and these units are not abnormally large relative to the size of the PJM system. The April 1, 1982, "MAAC Regional Reliability Council Coordinated Bulk Power Supply Program" report to The Department of Energy indicated that by 1990 PJM plans to have 9 generating units with installed capacities of 1000 MW or greater. Each Limerick unit will be about 2% of the PJM installed capacity.

1.1.3.6 Reserve Margin Responsibility

The PJM nominal installed reserve requirement standard is reviewed annually and allocated to its member companies according to the contractual provisions of the Pennsylvania-New

Jersey-Maryland (PJM) Interconnection Agreement dated September 26, 1956, as amended and supplemented. This agreement recognizes that the installed reserve requirement should be allocated to the member companies according to how their diverse system characteristics affect the overall requirement. These system characteristics include generating unit forced and scheduled outage rates, seasonal load variations, and annual peak demand diversity.

System characteristics are not constants and are susceptible to large variations. Although 10-year estimates of installed reserve requirement allocations are made annually, contractual obligations are only determined for the first 3 planning years. For example, the Applicant's reserve obligation for the 1985-86 planning year will not be determined until June 1, 1983. Due to the uncertainty inherent in these forecast characteristics, and the error in the forecast allocations, the Applicant's nominal standard is reviewed annually.

For planning purposes, the Applicant bases its nominal installed reserve requirement standard on a review of annual 10-year forecast allocations of PJM installed reserve requirement. The current forecasts of the Applicant's allocation of PJM's installed reserve requirement for 1985 and 1989 are 21% and 22% for contract purposes. The Applicant's nominal installed reserve requirement design standard for planning purposes is currently 25%.

1.1.4 EXTERNAL SUPPORTING STUDIES

There are no external supporting studies.

TABLE 1.1-1

PROJECTED ELECTRIC SALES BY CUSTOMER CLASS
PHILADELPHIA ELECTRIC COMPANY

MILLION kWh

	Actual 1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Residential	6,639	6,683	6,653	6,599	6,538	6,477	6,414	6,327	6,238	6,146	6,057
House Heating	1,238	1,357	1,470	1,600	1,733	1,870	2,008	2,142	2,275	2,409	2,542
Small Comm. and Ind.	3,142	3,244	3,313	3,356	3,405	3,447	3,491	3,537	3,584	3,631	3,677
Large Comm. and Ind.	14,178	14,587	14,795	14,999	15,213	15,418	15,575	15,722	15,874	16,023	16,181
Street Lighting	194	186	187	189	191	193	194	195	196	197	198
Railroads & Railways	651	639	639	639	639	639	639	639	639	639	639
Sales for Resale	107	112	113	114	115	116	117	118	119	120	121
Interdepartment	61	58	58	59	60	60	61	62	62	63	63
Total	26,210	26,866	27,228	27,555	27,894	28,220	28,499	28,742	28,987	29,228	29,478

TABLE 1.1-2

ANNUAL SALES, SYSTEM PEAK DEMAND, GENERATION, AND RESERVES
PHILADELPHIA ELECTRIC COMPANY

YEAR	ANNUAL SALES (10^6 kWh)	APPLICANT PREDICTED ANNUAL SALES (10^6 kWh)	PEAK DEMAND(1) (MW)	APPLICANT PREDICTED DEMAND(2) (MW)	TOTAL SYSTEM CAPACITY AT TIME OF PEAK (MW)		RESERVE CAPACITY (MW)	
					AVAILABLE	INSTALLED	AVAILABLE	INSTALLED
1970	22,813	-	4,712	-	4,475	5,357	-237	645
1971	23,458	-	4,922	-	4,780	5,928	-142	1,006
1972	24,506	-	5,313	-	4,851	6,136	-462	823
1973	26,301	-	5,760	-	5,660	6,377	-100	617
1974	25,556	-	5,431	-	6,110	6,967	679	1,536
1975	25,335	-	5,530	-	5,826	7,214	296	1,684
1976	26,273	-	5,346	-	6,711	7,167	1,365	1,821
1977	27,197	-	5,888	-	6,121	8,202	233	2,314
1978	27,394	-	5,667	-	6,643	7,727	976	2,060
1979	27,601	-	5,641	-	6,388	7,727	746	2,086
1980	27,621	-	6,095	-	5,577	7,698	-518	1,603
1981	27,050	-	5,731	-	7,246	7,574	1,515	1,843
1982	26,272	-	5,691	-	7,122	8,006	1,431	2,315
1983	-	26,866	-	5,600	-	7,957	-	2,357
1984	-	27,229	-	5,650	-	7,957	-	2,307
1985	-	27,555	-	5,700	-	8,370	-	2,670
1986	-	27,894	-	5,750	-	8,370	-	2,620
1987	-	28,226	-	5,800	-	8,370	-	2,570
1988	-	28,499	-	5,850	-	8,012	-	2,162
1989	-	28,742	-	5,900	-	8,795	-	2,895
1990	-	28,987	-	5,950	-	8,795	-	2,845
1991	-	29,228	-	5,980	-	8,795	-	2,815
1992	-	29,475	-	6,010	-	8,795	-	2,785

(1) Peak demand is not adjusted for temperature variations, voltage reductions, or other curtailments.
(2) This is the baseline annual peak demand forecast.

TABLE 1.1-3

ANNUAL OUTPUT, PEAK DEMAND, GENERATION, AND RESERVES
PENNSYLVANIA, NEW JERSEY, MARYLAND INTERCONNECTION

YEAR	ANNUAL OUTPUT (10^6 kWh)	PJM PREDICTED OUTPUT (10^6 kWh)	PEAK DEMAND (MW)	PJM PREDICTED DEMAND (MW)	TOTAL SYSTEM CAPACITY (MW)		RESERVE CAPACITY (MW)	
					AVAILABLE	INSTALLED	AVAILABLE	INSTALLED
1970	130,504	-	23,838	-	24,316	28,235	478	4,397
1971	136,208	-	25,529	-	27,001	31,116	1,472	5,587
1972	145,158	-	27,852	-	28,793	33,864	941	6,012
1973	148,950	-	30,993	-	30,981	35,879	-12	4,886
1974	155,362	-	29,065	-	31,160	37,215	2,095	8,150
1975	151,274	-	28,969	-	34,770	40,425	5,801	11,276
1976	159,679	-	29,264	-	34,969	41,636	5,705	12,372
1977	163,363	-	32,180	-	34,410	44,362	5,146	12,182
1978	169,766	-	31,686	-	38,038	44,026	6,352	12,340
1979	172,540	-	31,654	-	36,524	44,891	4,870	13,237
1980	176,920	-	34,420	-	35,419	45,030	999	10,660
1981	175,760	-	33,528	-	34,651	44,855	1,123	11,327
1982	172,818	-	33,741	-	36,511	45,796	2,770	12,055
1983	-	173,819	-	34,080	-	48,137	-	14,057
1984	-	179,253	-	34,730	-	48,913	-	14,183
1985	-	183,655	-	35,340	-	50,313	-	14,973
1986	-	187,690	-	35,890	-	50,506	-	14,616
1987	-	191,421	-	36,440	-	51,514	-	15,074
1988	-	195,723	-	37,110	-	51,777	-	14,667
1989	-	197,951	-	37,800	-	52,560	-	14,760
1990	-	204,002	-	38,450	-	52,385	-	13,935
1991	-	207,785	-	39,050	-	51,340	-	12,290
1992	-	211,488	-	39,630	-	52,203	-	12,573

TABLE 1.1-4

PHILADELPHIA ELECTRIC COMPANY
ENERGY AND PEAK DEMAND PROJECTIONS

	LOW		BASE		HIGH	
	PEAK (MW)	ENERGY (10^6 kWh)	PEAK (MW)	ENERGY (10^6 kWh)	PEAK (MW)	ENERGY (10^6 kWh)
1983	5,450	26,158	5,600	26,866	5,630	27,006
1984	5,430	26,186	5,650	27,228	5,750	27,691
1985	5,420	26,218	5,700	27,555	5,870	28,364
1986	5,410	26,235	5,750	27,894	5,990	29.041
1987	5,400	26,261	5,800	28,220	6,120	29,753
1988	5,400	26,285	5,850	28,499	6,260	30,476
1989	5,400	26,288	5,900	28,742	6,400	31,192
1990	5,400	26,299	5,950	28,987	6,550	31,929
1991	5,380	26,311	5,980	29,228	6,690	32,684
1992	5,370	26,321	6,010	29,478	6,820	33,446

TABLE 1.1-5

PHILADELPHIA ELECTRIC COMPANY SYSTEM
TOTAL MONTHLY SALES

10^6 kWh

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Jan	-	2,151	2,078	2,133	2,200	2,338	2,424	2,529	2,436	2,598	2,477
Feb	-	2,079	2,050	2,081	2,154	2,254	2,301	2,450	2,406	2,364	2,350
Mar	-	2,122	2,025	2,078	2,147	2,224	2,321	2,304	2,384	2,212	2,186
Apr	-	1,988	2,015	1,967	2,033	2,071	2,108	2,156	2,141	2,084	2,101
May	-	2,037	2,004	1,907	2,013	2,053	2,045	2,110	1,920	1,913	1,821
Jun	-	2,187	2,050	2,063	2,145	2,176	2,255	2,203	2,106	2,229	2,106
Jul	-	2,277	2,230	2,178	2,376	2,456	2,323	2,320	2,438	2,492	2,365
Aug	-	2,554	2,383	2,398	2,430	2,614	2,602	2,554	2,669	2,435	2,372
Sep	-	2,528	2,365	2,260	2,380	2,519	2,514	2,415	2,561	2,245	2,182
Oct	2,101	2,260	2,191	2,205	2,154	2,141	2,128	2,222	2,150	2,372	2,040
Nov	2,005	2,122	2,078	1,964	2,053	2,063	2,091	2,085	2,042	2,282	2,032
Dec	2,020	1,989	2,080	2,095	2,182	2,282	2,282	2,251	2,369	2,282	2,179

Yearly total may not agree with Table 1.1-2 due to rounding.

TABLE 1.1-6 (Page 1 of 2)

PHILADELPHIA ELECTRIC COMPANY EXISTING GENERATION CAPABILITY
AS OF JANUARY 1, 1983

Station	Unit No.	Unit Type(1)	Unit Function(2)	Net Capacity-MW Summer	Net Capacity-MW Winter
Conemaugh	1(3)	C	B	176	176
	2(3)	C	B	176	176
Conowingo	1-11	H	P	512	512
Cromby	1	C	B	150	153
	2	O	I	201	211
Delaware	7	O	I	126	128
	8	O	I	124	128
Eddystone	1	C	B	301	321
	2	C	B	334	343
	3	O	I	380	380
	4	O	I	380	380
Keystone	1(3)	C	B	178	181
	2(3)	C	B	179	180
Muddy Run	1-8	PS	P	880	880
Peach Bottom	2(3)	N	B	447	449
	3(3)	N	B	439	439
Richmond	9	O	P	166	175
Salem	1(3)	N	B	459	468
	2(3)	N	B	471	477
Schuylkill	1	O	I	166	175
	3	O	I	47	54
Southwark	1	O	P	178	188
	2	O	P	178	188
Combustion Turbines (56)	-	CT	P	1344	1797
Diesels (9)	-	D	P	18	18
TOTAL				8010	8577

TABLE 1.1-6 (Cont'd) (Page 2 of 2)

(1) Unit Type:

O = oil-fired steam
C = coal-fired steam
N = nuclear steam
H = hydroelectric
PS= pumped storage hydro
CT= combustion turbine
D = diesel

(2) Unit Function:
(current operating status)

B = base load
I = intermediate
P = peaking

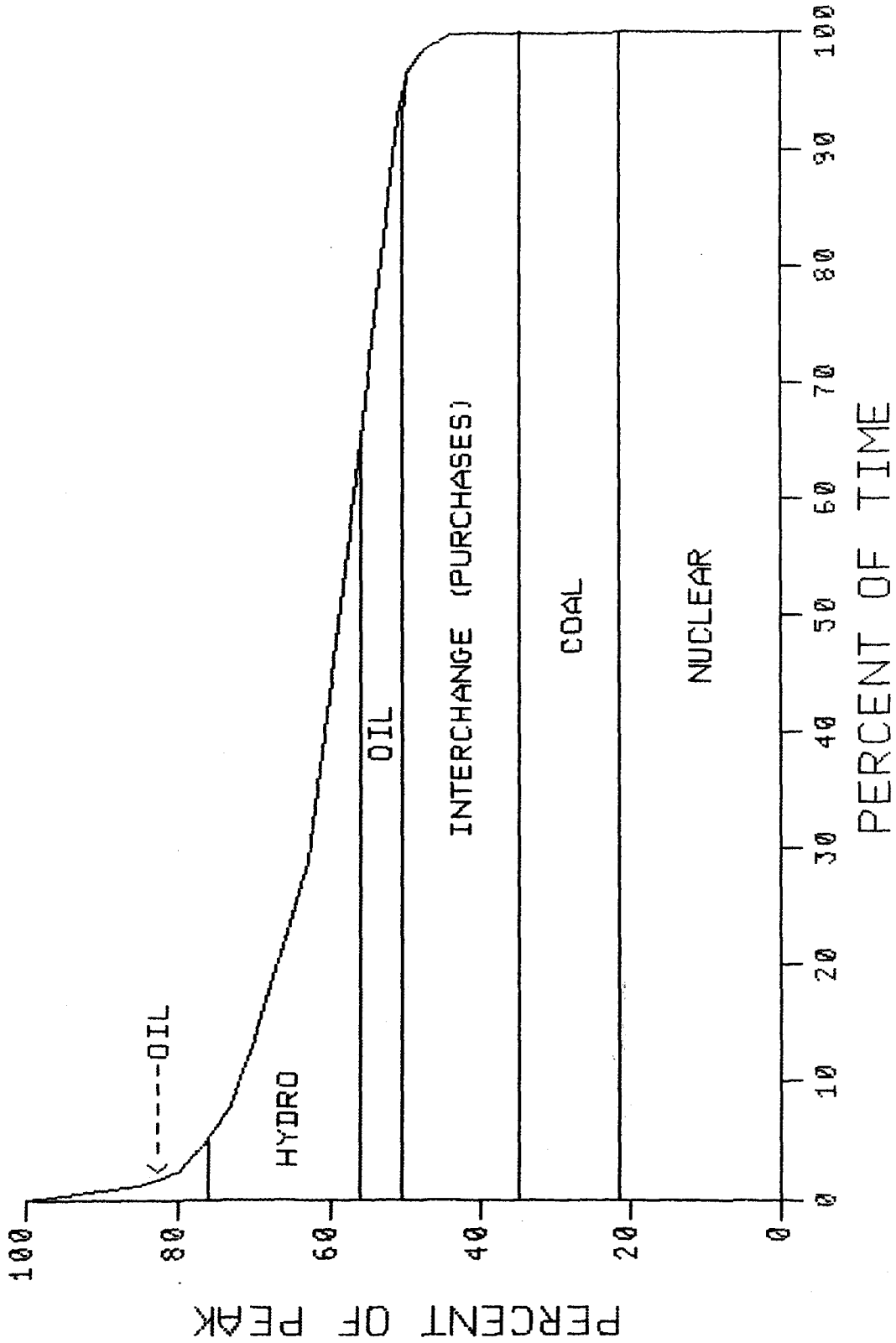
(3) Joint Ownership:
Conemaugh - Philadelphia Electric Company share = 20.7%.
Keystone - Philadelphia Electric Company share = 21.0%.
Peach Bottom - Philadelphia Electric Company share = 42.5%.
Salem - Philadelphia Electric Company share = 42.6%.

TABLE 1.1-7

FUTURE GENERATING CAPACITY CHANGES

Station	Unit No.	Unit Type[1]	Unit Function[1]	Net Capacity-MW Summer	Net Capacity-MW Winter	Service Date
Eddystone	1 & 2	C	B	-19	-19	1/83
Cromby	1	C	B	-6	-6	1/83
Schuylkill	3	O	I	-28	0	5/83
Limerick	1	N	B	+1055	+1055	4/85
Richmond	9&Diesel	O	I	-169	-178	5/85
Misc CT's(19)		CT	P	-473	-641	5/85
Southwark	1,2&Diesel	O	I	-358	-378	12/87
Schuylkill	3	O	I	-19	-54	12/88
Limerick	2	N	B	+1055	+1055	10/88
Delaware	7,8&Diesel	O	I	-253	-259	12/92
Southwark	3,4&5	CT	P	-39	-54	12/92

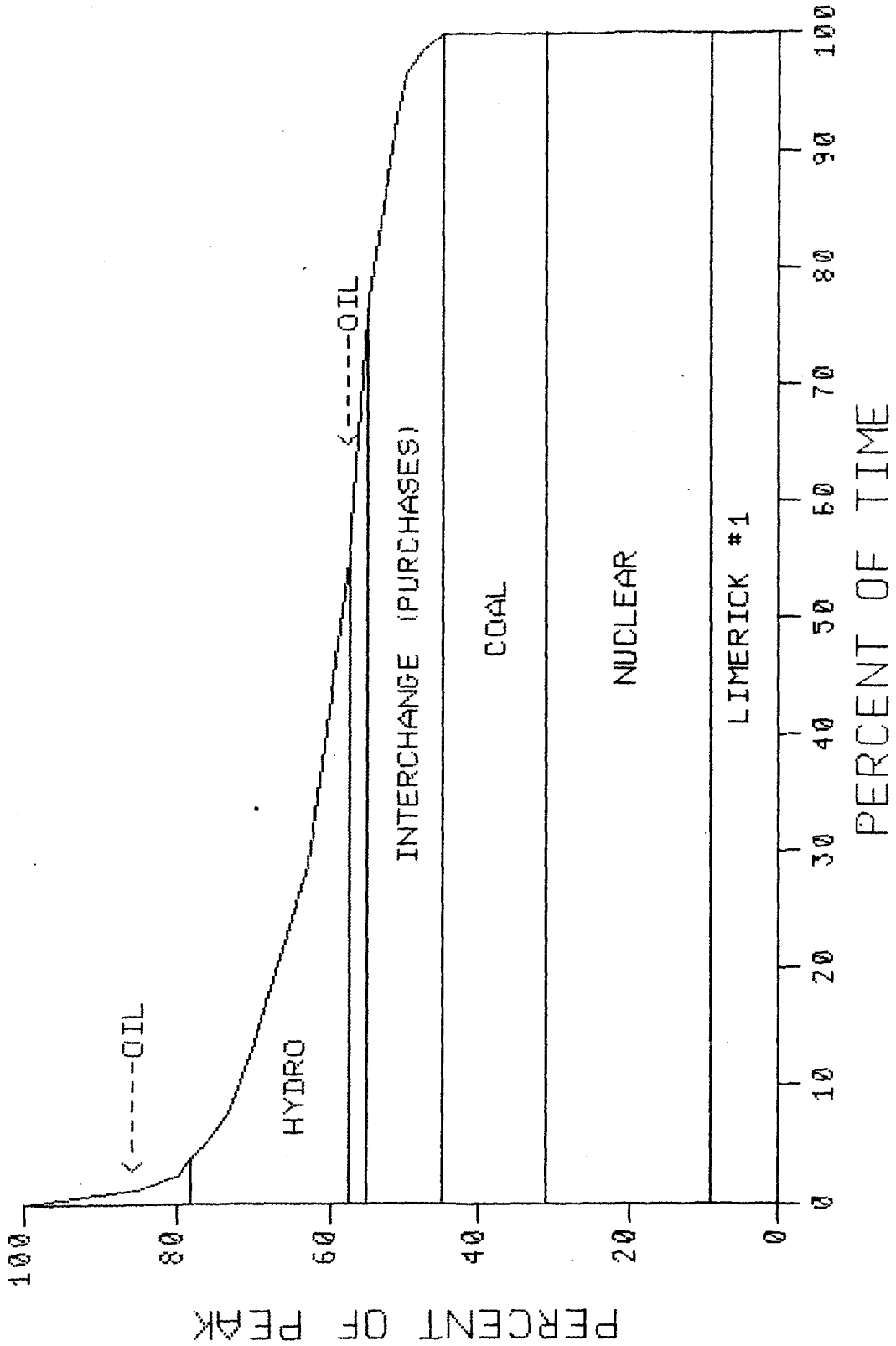
[1] Refer to Table 1.1-6 for definition of abbreviations.



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

LOAD DURATION CURVE
1982 ACTUAL

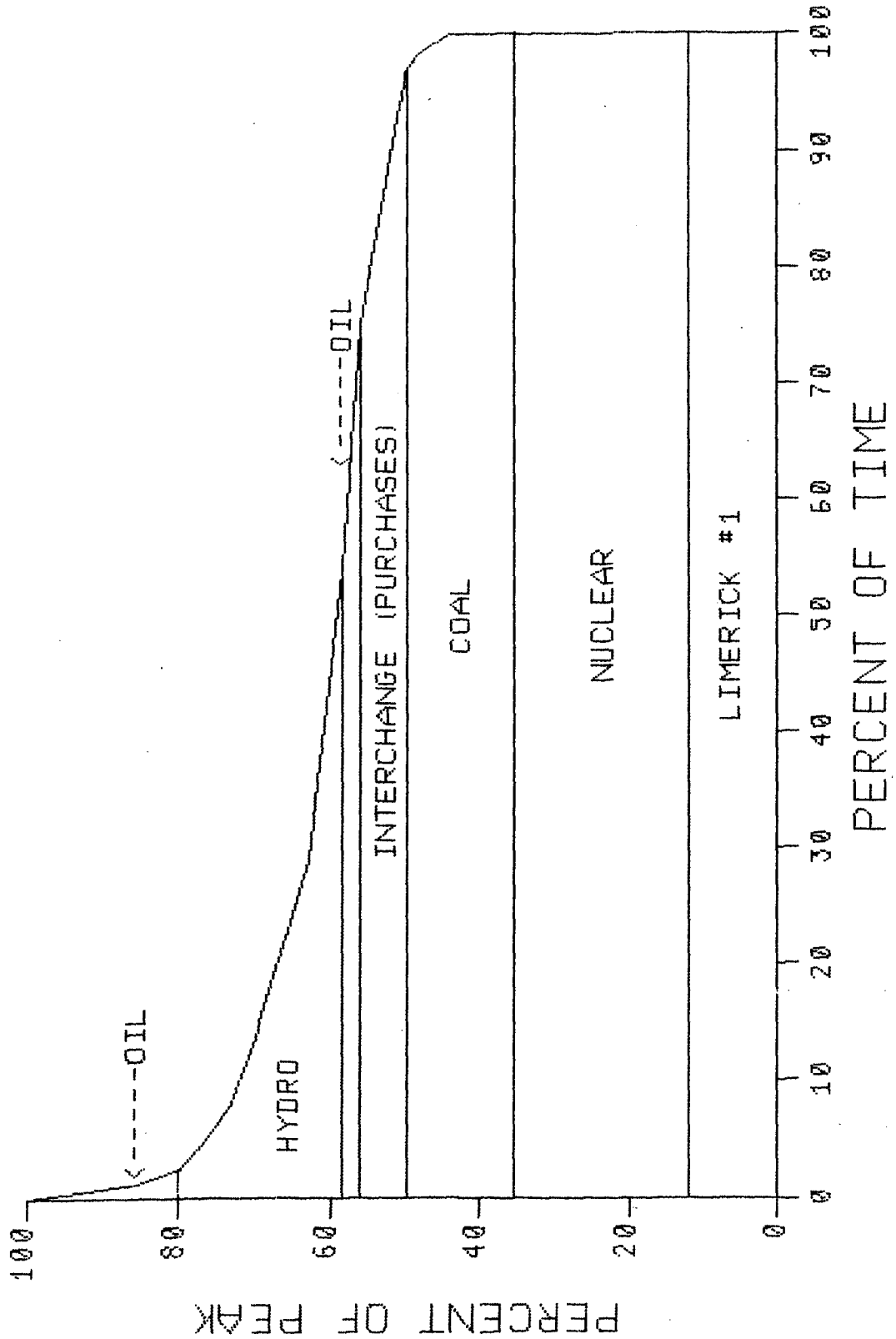
FIGURE 1.1-1 **REV. 13, 05/83**



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

LOAD DURATION CURVE 1985

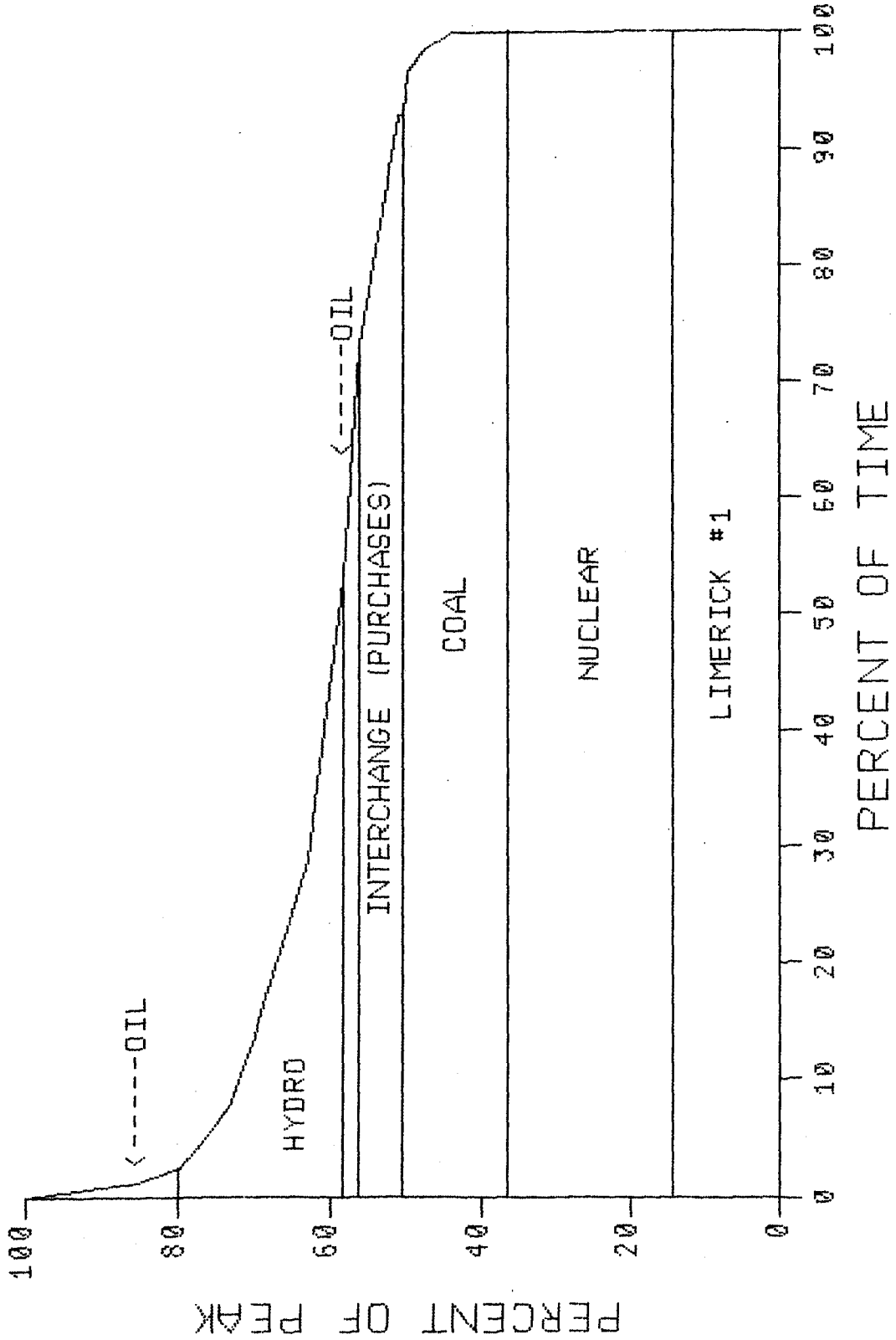
FIGURE 1.1-2 **REV. 13, 05/83**



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

LOAD DURATION CURVE 1986

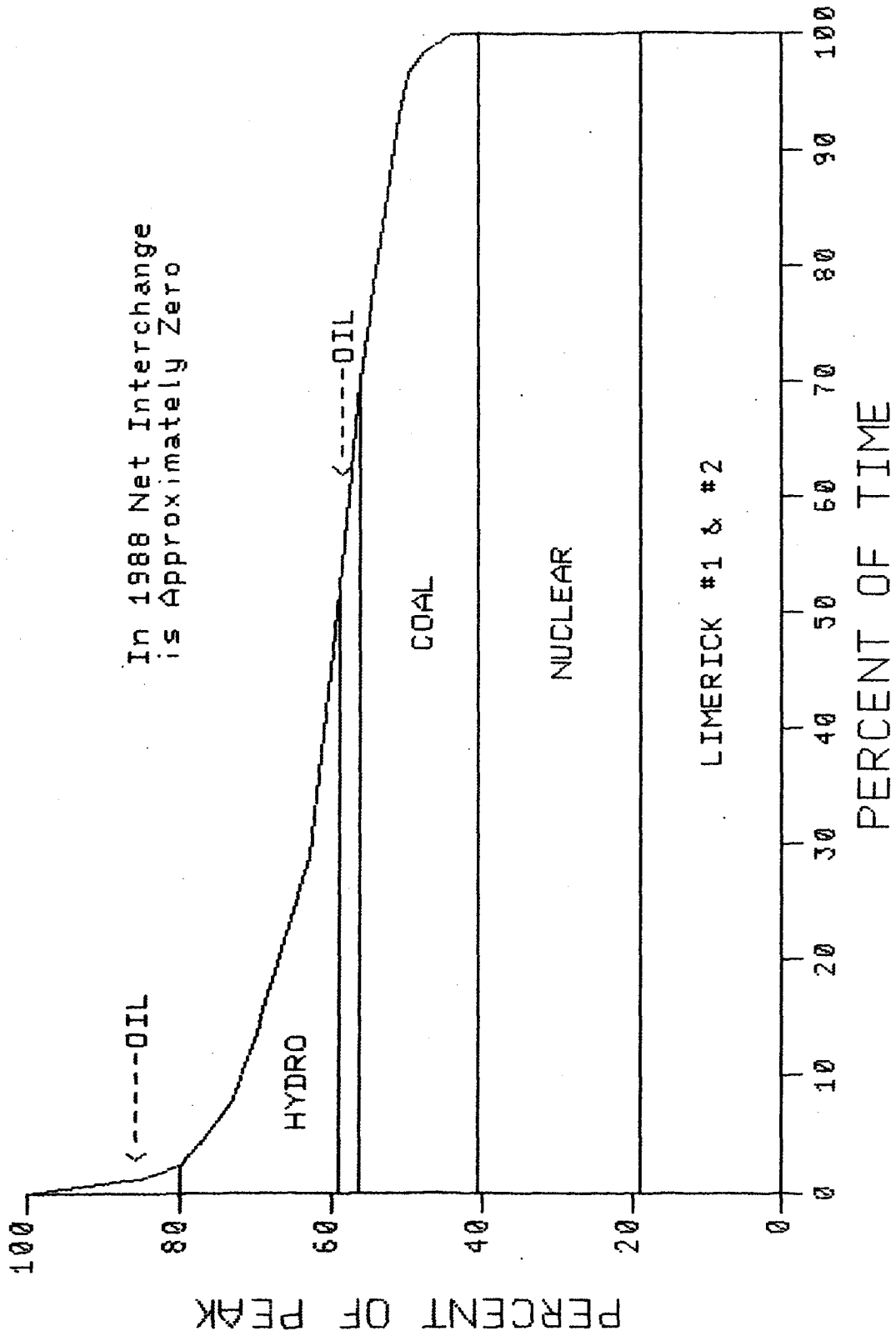
FIGURE 1.1-3 REV. 13, 05/83



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

LOAD DURATION CURVE 1987

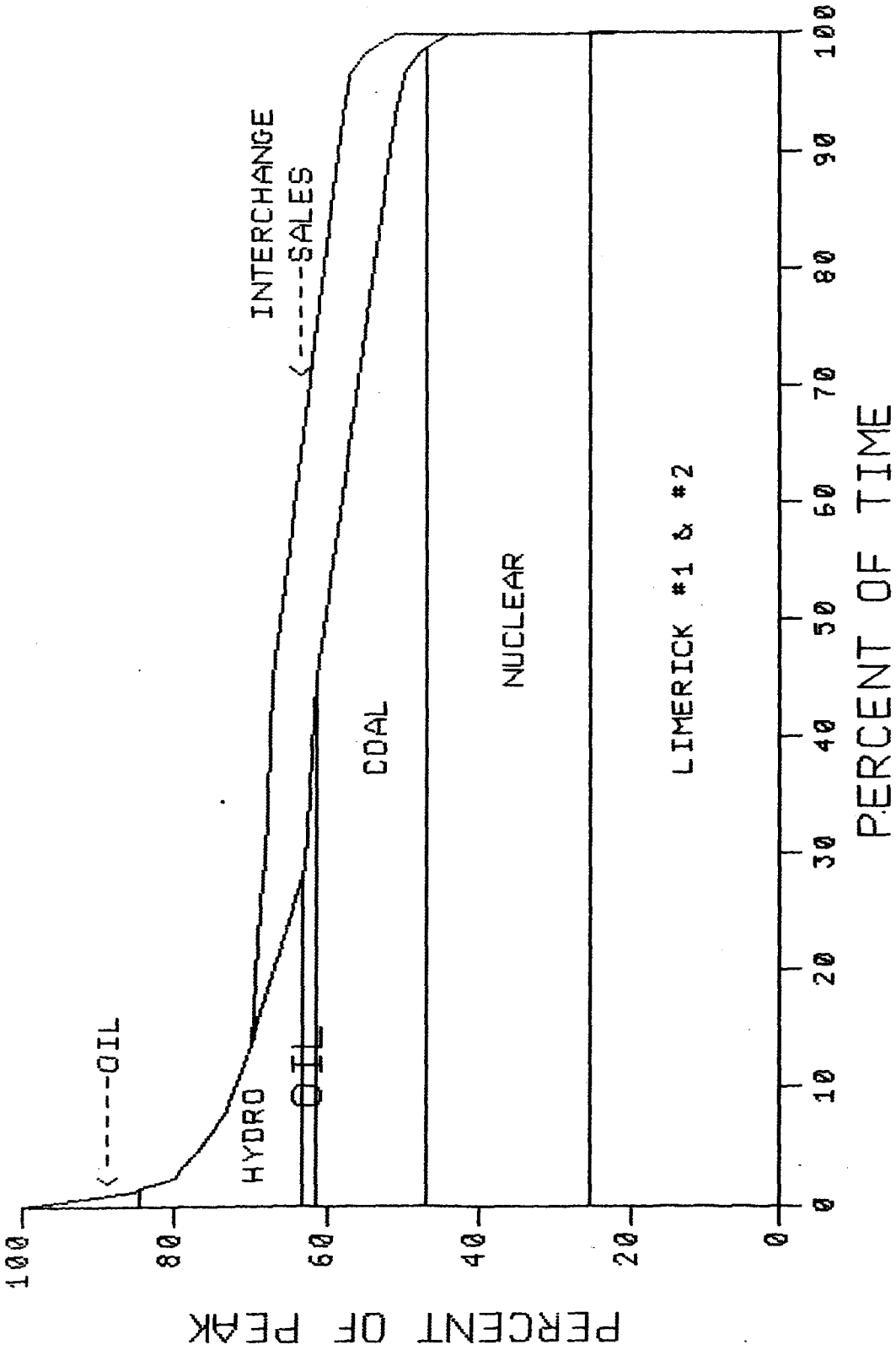
FIGURE 1.1-4 **REV. 13, 05/83**



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

LOAD DURATION CURVE 1988

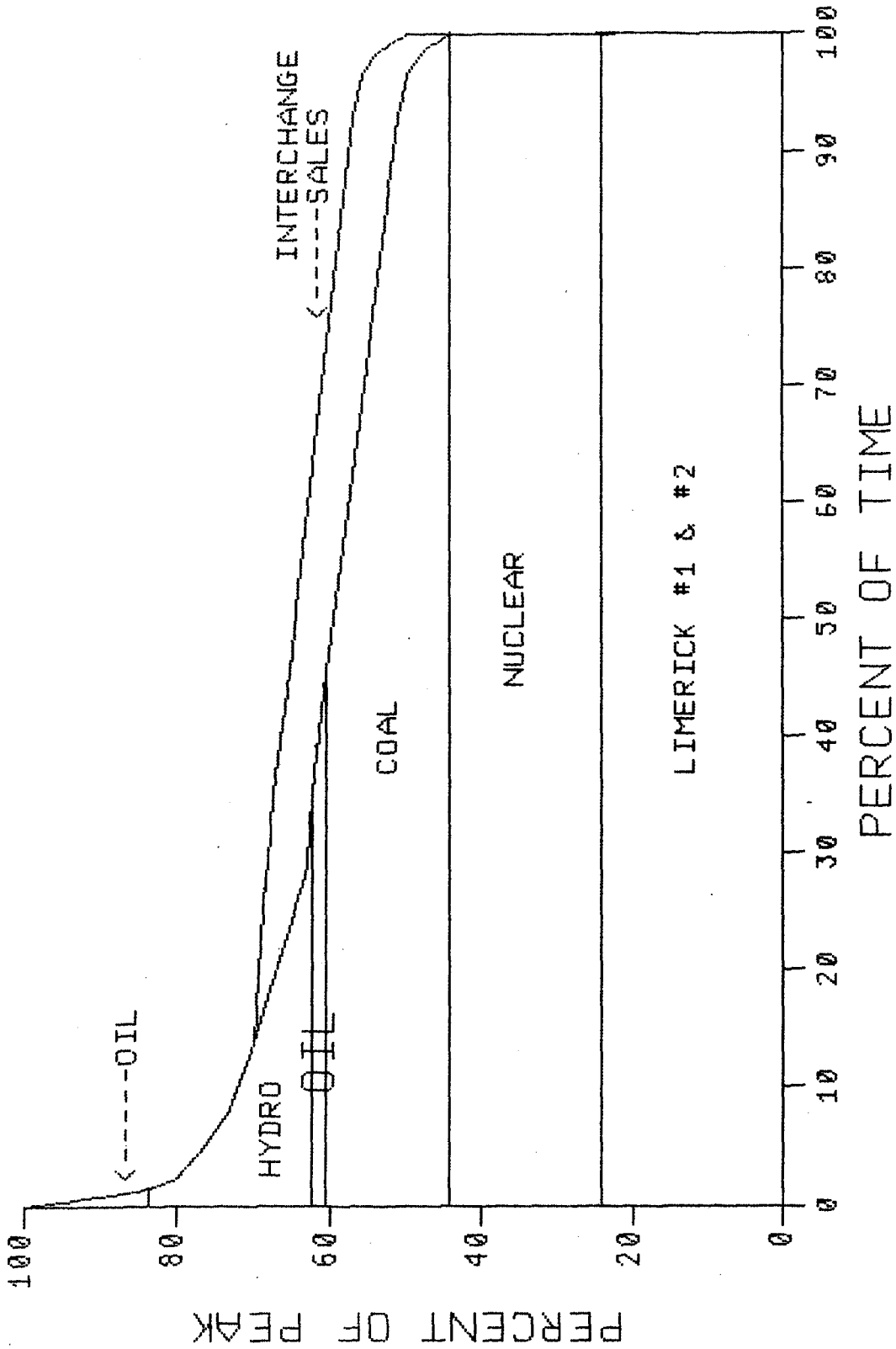
FIGURE 1.1-5 **REV. 13, 05/83**



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

LOAD DURATION CURVE 1989

FIGURE 1.1-6 **REV. 13, 05/83**



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

LOAD DURATION CURVE 1990

FIGURE 1.1-7 **REV. 13, 05/83**

1.2 OTHER OBJECTIVES

The primary objective of installing Limerick Generating Station is to supply economical and reliable electric power to the customers of the Applicant.

Another objective is to reduce the amount of oil used to produce electricity.

The following table demonstrates the Applicant's reliance on oil-fired generation in 1990 to supply the forecast baseline demand, and the high and low range demands.

1990 INSTALLED CAPACITY BY FUEL
AS A PERCENTAGE OF FORECAST PEAK DEMAND

	Percentage of Forecast Peak Demand		
Fuel	High Range (6550 MW)	Baseline (5950 MW)	Low Range (5400 MW)
Coal	22	25	27
Hydro	21	23	26
Nuclear (without Limerick)	28	31	34
Total A*	71	79	87
Limerick Units 1 and 2	32	35	39
Total B*	103	114	126
Oil	31	32	37
Total C*	134	146	163

* Total A excludes Limerick Units 1 and 2 oil-fired generation.
Total B excludes oil-fired generation.
Total C includes all units.

From the above table, the oil-fired installed generating capacity is approximately one-third of the estimated peak demand regardless of the forecast peak demand used. In all cases, total B is greater than 100%. This means that all oil-fired generation will be used for peaking and reserve capacity. Because of the continuing uncertainty in supply, and consistent with current Federal government policy the Applicant desires to decrease its dependence on oil. The installation of the Limerick nuclear units will accomplish this objective regardless of the peak demand.

1.3 CONSEQUENCES OF DELAY

The consequences of delay to the Applicant and the customers served by the Applicant are threefold: decreased reliability, economic loss, and increased adverse environmental impact. Since the Applicant is required by Section 401 of the Public Utility Law of the Commonwealth of Pennsylvania (66 PS 1171) to furnish and maintain adequate, safe, efficient, and reasonable service to its customers, the Applicant cannot consider not serving the anticipated demand as an alternative. The law further states that service shall be reasonably continuous and without unreasonable interruption or delay. The following discussion is based upon meeting the system demand and assessing the consequences of the absence of the Limerick generation.

1.3.1 EFFECT OF DELAY ON RELIABILITY

The effect of delaying the Limerick units on reliability is demonstrated by the following table. In calculating the reserves, the high peak demand from Table 1.1-4 was used; this represents the worst case.

The Applicant's and PJM's planning year is from June 1 to May 31 of the following year. Limerick Unit 1 is scheduled for service in April 1985, and will therefore be available for the 1985 summer peak. Limerick Unit 2 is scheduled for service in October 1988 and therfore will not be available for the summer peak until 1989.

EFFECT OF DELAY OF SERVICE DATES ON INSTALLED RESERVES

	SUMMER RESERVES (%)						
Service Dates	1985	1986	1987	1988	1989	1990	1991
1985-88	42.6	39.7	36.8	28.0	37.4	35.3	31.5
1986-89	24.6	39.7	36.8	28.0	20.9	35.3	31.5
1987-90	24.6	22.1	36.8	28.0	20.9	19.1	31.5
1988-91	24.6	22.1	19.5	28.0	20.9	19.1	15.7

However, if the Limerick units are delayed, the planned retirement of the obsolete oil-fired generation would also, in all probability, be delayed to maintain system reliability.

If the national oil supply is interrupted the effect of delaying the Limerick units on reliability would be profound. When the Limerick units are placed in service they will be capable of producing 50 million kilowatt-hours of electricity daily. To produce this much electricity with the oil fired units would require 100,000 barrels of oil daily. Therefore, without Limerick, if a severe oil shortage would occur the 50 million

kilowatt-hours would be unavailable. This 50 million kilowatt-hours is capable of supplying the daily needs of 3 million average residential customers under normal circumstances and even more customers under adverse conditions.

The increased used of obsolete oil fired generation with normal oil supply will also adversely effect reliability. Increased forced outage rates of the oil units will increase required reserve margins. For further discussion see Section 1.1.3.

1.3.2 ENVIRONMENTAL CONSEQUENCES OF DELAY

If Limerick generation is not installed, increased operation of fossil-fueled generation will be required. The increased oil consumption will increase competition for house-heating and industrial use for available oil. The increased operation of fossil generation will increase air pollutants. The estimated increases based upon the unavailability of Limerick generation, and with no replacement for this generation from 1985 through 1990 are indicated below:

INCREASED FOSSIL FUEL CONSUMPTION AND AIR POLLUTANTS WITHOUT LIMERICK GENERATION

	1985	1986	1987	1988	1989	1990
Oil, millions of barrels	2.9	3.7	3.9	7.2	6.1	7.4
Coal, millions of tons	1.2	1.6	2.0	2.3	3.8	3.4
SO_2, thousands of tons	67.3	89.2	109.1	134.3	202.9	188.0
NOx, thousands of tons	14.5	19.1	22.9	29.8	41.9	39.9
Particulates, thousands of tons	2.3	3.1	3.7	4.9	6.6	6.4

1.3.3 ECONOMIC CONSEQUENCES OF DELAY

The delay of Limerick generation for one or two years will require the operation of higher cost generation to serve energy requirements. In addition, a delay in the service dates will increase the ultimate plant cost due to escalation of total capital and AFUDC. The effects are summarized below:

ECONOMIC CONSEQUENCES OF DELAY OF LIMERICK GENERATION SERVICE DATES ($ MILLIONS)

	One-Year Delay (1986 - 1989)	Two-Year Delay (1987 - 1990)
Energy penalty	400	830
Capital penalty	650	1375

1.4 REFERENCES

Ref. No.

1.1-1 "Reliability Principles and Standards for Planning Bulk Electric Supply System of MAAC Group."

1.1-2 The 1970 National Power Survey, Federal Power Commission, Washington, D.C., Part II, Chapter 5.

1.1-3 Billington, R., Power System Reliability Evaluation, Gordon and Breach, Sciences Publishers, Inc., New York, NY (1970) Chapter III.

1.1-4 Philadelphia Electric Company, Energy Management and Conservation Report for 1982, submitted to the Pennsylvania Public Utility Commission, April 30, 1983.

APPENDIX 1.1A

DELETED

APPENDIX 1.1B

ENERGY FORECASTING METHODOLOGY

The Applicant utilizes most of the known forecasting methods to some degree in estimating future system annual energy requirements. These methods include trend analysis, correlation analysis with regressions, economic projections, technological forecasting of changes in energy-using equipment, and data derived from a regional econometric model. Models of sensitive parts of the forecast, such as air conditioning loads and population analysis, have been programmed for a computer. An econometric model has been developed by Wharton Econometric Forecasting Associates (WEFA).

The forecast is produced by estimating energy sales for individual years for each rate class -- Residential, House Heating, Small Commercial and Industrial, Large Commercial and Industrial, Other Public Authorities, Railroads, Street Lighting, Resale, and Interdepartmental. In order to satisfy the need for special data to compute revenue, peaks, etc, energy sales for key months are forecast for each year along with numbers of customers and selected data on special uses such as air conditioning.

The forecast is prepared as a baseline forecast based upon assumptions considered most likely to occur. High and low ranges based upon variations of these assumptions are also forecast. If the forecast is seen to be deviating toward the high or low range, alternative futures can also be modeled and planned as changing conditions warrant.

The forecast is estimated by classes and then aggregated. Each class, in turn, consists of several parts. Because of the substantial amount of data collected from field forces, trade associations, and government agencies, estimating each component with its own correlations and data -- based upon uniform assumptions concerning the region and economy -- produces a more precise forecast than a general forecast driven by a national econometric model. This is especially true of local large manufacturing customers whose use and plans often bear little resemblance to the national performance of their industries.

Residential

The residential energy sales forecast is based primarily upon the number of customers and the average use per customer. There is a long history of the correlation between the number of customers and the area population derived from census material. Correlations are made between dwelling units and various demographic factors, such as women over 19 years of age, total

population, and total women. Sociological material is reviewed to determine the effects of expected changes in life-style and marriage rates on population per household, and the mix of apartments and various types of houses.

A computer program is used to test the effects of different migration, fertility, and mortality rates on the population.

Before analyzing average use, new construction must be estimated as this is a significant factor in such uses as electric space and water heating.

Construction data have been collected for more than 12 years from our field representatives. Trends are established based upon various demographic factors and existing housing. Information on new construction covering the next few years is obtained from local builders, builders' associations, and national statistical services in the construction field.

New construction is forecast by single homes, townhouses, individually-metered and common-metered apartments. Single-point-metered apartments billed in the Large Commercial and Industrial class are estimated along with the general residential class.

Demolitions and abandonments are estimated based upon past experience and data compiled by Philadelphia County.

Space heating for new construction is estimated based upon past saturation results and builders' plans, with consideration given to fuel prices and the future availability of gas. Electric space heating is separated into resistance heating and heat pumps, taking into account the expected improvements in heat pump efficiency.

Records on air conditioning have been kept since 1945. These data are collected from distributors and manufacturers through the Electrical Association of Philadelphia. These data cover unit sales and the sizes of units sold.

Since 1972, annual residential surveys have been used to update and check the air conditioning data base. The forecast of air conditioning energy sales is based upon saturation of the market -- defined as full dwelling-unit air conditioning in the equivalent of 63% of the space.

The air conditioning forecast is adjusted for new units, considering the cooling capacity and wattage, a replacement rate, and expected strong acceptance of high-efficiency air conditioning program.

Other appliances are forecast separately. The annual survey provides saturation data and the acquisition rate. Monthly sales statistics are also received from the Electrical Association, but these must be adjusted for anticipated replacements.

Annual use of appliances is obtained from test data and industry average data (EEI and other utilities).

The consumption for each appliance and application is summed to obtain the class totals for Residential House Heating, and the single-point-metered apartment component of Large Commercial and Industrial sales.

Small Commercial and Industrial Sales

These sales are obtained in much the same manner as large commercial sales.

Large Commercial and Industrial Sales

This class is broken down into the largest 8 manufacturing customers, all other manufacturing, single-point-metered apartments, and other nonmanufacturing (commercial, education, government, utilities) users.

The largest 8 manufacturers' sales forecasts -- which make up over 40% of manufacturing sales -- are based upon frequent interviews with these customers concerning their plans. These manufacturers' estimates are often modified, based on analysis of conditions in the industry, since in the past the customer's projections have been generally optimistic.

Forecasts of other manufacturing sales are based upon a historical correlation with GNP, GRP, the Industrial Production Index (IPI), and kWh per manhour for two-digit SICs.

Unusually large increases or decreases in energy sales are usually known ahead of time. Whether or not to treat these changes individually, or to include them in the general growth rate, is a matter of judgment.

Space heating, air conditioning, and environmental energy sales are forecast individually. Field reports on each change in usage provide data on square footage (new or additional) and changes in usage of lighting, space conditioning, process heating, and power. This establishes a large data base. These reports are factored into the energy sales estimates.

The commercial energy sales growth is based upon GNP, GRP, real disposable income, commercial employment and commercial square footage.

Other Classes

The forecasts for other classes are based upon close discussions with the limited numbers of customers involved, time-series analysis, and technological changes expected (as in street lighting sources).

Price Elasticity

Projections of energy prices are prepared by the Applicant. These prices are applied to various types of heating systems as a basis for estimating saturation percentages for each fuel. Because the cost of electricity in the Applicant's territory is not expected to rise faster than the Consumer Price Index, no specific coefficient of elasticity is applied. Past studies here and elsewhere were inconclusive as to values for the price elasticity of electricity. However, the forecast does assume that energy conservation will continue for several reasons. Two of the reasons are increasing energy prices and consumer efforts to use energy more efficiently. When forecasting energy sales for each component, whatever is applicable in optimizing energy use, such as full insulation, ASHRAE-90 standards, Pennsylvania House Bill 222, high-efficiency (high EER) air conditioning, accelerating acceptance of heat pumps with continually improving COPs, solid-state appliances, microwave cooking, high-efficiency light resources, and others are assumed. A strong restrictive effect is thus derived because of the high value of electricity, without relying on a fixed coefficient of elasticity with its necessary estimate of future prices. Forecasts of technological changes and data on future improvements are obtained from following a large number of publications including Futurist, Technology Review, Spectrum, Electrical World, Electrical Week, Business Week, Energy Review, Energy User News and the U.S. Information Service energy materials, etc. These are used in judging future efficiencies, and new uses such as solar energy.

Weather and Business Cycles

The energy sales forecasts are based upon normal weather and normal economic conditions. Whether the economy is in a recession or at a peak will cause sales to swing considerably from the base forecast trend line.

Other Forecasts

Meetings with other forecasters from PJM utilities are held several times a year. Forecast data and techniques are exchanged. Members of the group also participate in the Electric Utility Market Research Council, Wharton Regional Model meetings, and special conferences, meetings, and seminars on energy forecasting as available. A file is maintained on the forecasts of national forecasters (such as McGraw-Hill, EPRI, FEA, FPC, A.

D. Little) and of utilities all over the country as a check on the positioning of our forecast, though these are not direct inputs in building our projections.

ASSUMPTIONS

The following assumptions apply to all classes of service in the 10-year forecast and cover the base, high, and low cases.

1. GROSS NATIONAL PRODUCT - Real GNP and real Gross Regional Product (GRP) for the Philadelphia Standard Metropolitan Statistical Area (SMSA), Pennsylvania portion, are projected to grow at the following indicated average annual rates:

	1982-83	1980-85	1985-90	1980-90
GNP - Base	2.2	2.5	2.5	2.5
GNP - Low	1.9	1.5	1.6	1.6
GNP - High	2.8	3.2	4.0	4.0

2. POPULATION - Service area population was derived from the 1980 Census. A population model was then developed using the Cohort-Component method. This model was used to make projections through the year 2000. Calculations were based upon the Census Bureau's Series III fertility rates and current survival rate tables. Estimates from 1970-80 include the 323,800 net out-migration estimate made by the Bureau of Census for the Pennsylvania portion of the Philadelphia SMSA. All estimates and projections for the Conowingo Power Company's service area assume a neutral net migration over the entire period from 1980-2000.

   Base case projections for the Applicant's service area show a growth rate of less than 0.1% between 1981 and 2001, similar to the rate estimated by the Bureau of Census. The low forecast's projections maintain a constant net migration rate at the 1970-78 level for the entire period. The high forecast assumes a reduction of the 1970-80 rate over the forecast period.

3. FERTILITY RATES - The Census Bureau Series III fertility rates were used for all forecast scenarios. This schedule ultimately leads to below replacement level fertility on a national level.

4. COSTS OF ENERGY - The following annual average rates of growth were assumed for fuel costs for the 10-year forecast period. The percentage figures apply to constant 1982 dollars so that the changes indicate a relationship to the Consumer Price Index (CPI).

	Real Annual Increase
Electricity	0.9%
No. 2 Oil	1.7%
Gas	2.5%

Fuel cost projections were based on: the Applicant's Corporate Assumptions, natural gas price projections as developed by Gas Operations, and two DOE studies. The many unresolved policy decisions and the instability of the Middle-East situation make forecasts of energy prices an inexact process.

The fuel price projections in the Corporate Assumptions are based on the best available studies, but because of the uncertainties should only be considered as relative indicators of competitive relationships.

For the low case, it was assumed that the cost of oil will maintain its present relationship to electric costs and will be in adequate supply. For the high case, it is assumed that oil will be in tight supply, contributing to increased penetration of electric space heating.

5. CONSERVATION - In all three scenarios, government agencies and private organizations, including the Applicant, will continue to encourage energy conservation through the use of high-efficiency appliances and applications, and energy-efficient construction.

6. PRICE ELASTICITY - This will continue to lead to the purchase of high-efficiency appliances and energy-efficient buildings and systems as mentioned in 5, above, and in the earlier discussion on price elasticity. Efficiencies are based upon technology and expected government policy rather than an estimated coefficient of elasticity, because of the inexactness to be expected in projecting relative energy prices and elasticity coefficient values for each class.

7. OFF-PEAK APPLICATIONS - The Applicant will continue to promote off-peak applications -- electric space heating (particularly heat pumps) and night lighting for safety -- that improve load factor for the base and high forecasts. A neutral stance is implied in the low forecast.

8. GAS - New and additional gas sales to all customer classes resumed with no restrictions in early 1979. It is assumed that new gas sales will continue throughout the ten year forecast.

9. BUSINESS CYCLES - The three forecasts assume the currently expected economy in 1983, and are based upon a normal peacetime economy through 1992.

   Based on historical analysis of sales, whether the economy is in a recession or at the peak of a boom can cause a -4% to +4% deviation from the probable trend which is based upon a smooth growth rate.

   In addition, recognized economists offer different projections of national economic growth, some of which are given in Table 1.1B-1. If the high and low projections shown are imposed on the business-cycle effect described in the above paragraph, deviations from these two causes could cause an increase in sales of 15% or a decrease of 8% in the later years of this forecast. Most of the listed assumptions would still be applicable.

10. WEATHER - Average weather conditions are projected, affecting heating and cooling loads. Normal weather for each calendar day of the year is determined by averaging actual weather data over a historic period. For the heating season, this average is computed over a 50-year period from 1930 to 1979. For the summer cooling season, the historic data covers a 34-year period from 1946 to 1980. Monthly and seasonal normal weather are the sum of normal weather for individual days. A new normal is calculated every 5 years.

    To correct actual sales for normal weather conditions in any given year, the difference between actual weather and normal weather for the heating and cooling season is computed. These differences are then multiplied by either a summer or winter weather electric usage factor. These factors are developed using linear and multiple regression techniques, and are a measure of the relationship between the changes in electrical usage and changes in weather. The resulting product, when subtracted from, or added to, actual sales, gives kWh usage on a normal weather basis.

ECONOMIC AND DEMOGRAPHIC ASSUMPTIONS

Base Case

1. The annual Gross National Product growth rate for 1980-90 will be 2.5%.

2. The annual Gross Regional Product growth rate for 1980-90 will be less than 1%.

3. The probable case is based upon the Census Bureau's Series III fertility rates and current survival rate tables. Estimates from 1970-80 include the 323,800 net

out migration estimate made by the Bureau of Census for the Pennsylvania portion of the Philadelphia SMSA. All estimates and projections for the Conowingo Power Company's service area assume a neutral net migration over the entire period from 1980-2000.

4. Fertility rate is based upon the U.S. Bureau of Census Series-III rate of below replacement level fertility on a national level.

5. The number of people per household is expected to decrease to 2.3 in 1995.

6. The number of households per female over 19 is expected to increase slightly from 0.97 in 1980 to 1.00 in 1991, due to the increasing number of single females per household.

7. "Other" manufacturing sales growth will lag behind the growth in the Industrial Production Index by approximately 2.6%. The Industrial Production Index is projected to grow at about 3.6%/year from 1982 to 1992.

   "Other" manufacturing sales equal total manufacturing sales minus the 8 largest industrial customers' sales.

8. The decreased birthrates of the sixties will cause a fall in growth of the potential labor force during the forecast period which will result in reduced demand and supply for some products.

9. FOSSIL FUEL CONVERSION - Some electrification of manufacturing processes -- existing or potential -- is expected to occur if the price of industrial electricity rises in line with the increase in the price of goods generally -- as is assumed here -- then the cost of fossil fuels will rise at a faster rate that should further stimulate conversion.

   Opportunities for increased power use include metal holding furnaces, electric boilers, induction heaters, high-temperature furnaces, high-temperature heat pumps, and microwave drying.

10. COGENERATION - There are 16 customers on the system using private generation. Of these, 15 are connected to the Applicant's system, while 1 major refiner operates independently.

    Estimated demand of private generation is 170 MW with approximate annual consumption of 1 billion kWh. The forecast, being based upon factors and growth rates that

apply equally to all kWh -- purchased or self-generated -- allows for an increase in private generation of about 300 million kWh by 1989, consistent with past forecast assumptions.

Future plans for generation by these customers, and nongenerating customers, are continuously monitored. There are no identified large customers committed to adding independent generation, although several have been studying the cost-benefits.

Because of the uncertainties existing in the areas of regulation, financing, costs, and government incentives no change in the existing ratio of self-generated to purchased power has been factored into this, or previous, forecasts. Future forecasts will be adjusted by specific changes, if any.

11. CONSERVATION (existing commercial buildings) - Reductions in the use of electricity that can be made without capital improvements have been largely accomplished. Customer billing records indicate that these customers have reduced electric usage by 17% since 1973. Because most space is rented and not owner-occupied, there is little incentive for building owners to make investments in energy-saving equipment.

12. CONSERVATION (new commercial buildings) - ASHRAE 90-80 has been adopted by the state for use in commercial buildings under Pennsylvania House Bill 222.

13. ELECTRIC SPACE HEATING (Commercial) - 75% of new large commercial space and 40% of new small commercial customers are currently installing electric heat. Among new small commercial electric heat customers, 40% are now installing heat pumps. This percentage is expected to rise to 60% by 1992.

14. AIR CONDITIONING - 95% of the current new commercial space is being air conditioned, and this percentage is expected to continue. The connected air conditioning watts per square foot is expected to remain level at 3.4 watts per square foot during the forecast period.

15. SOLAR ENEGRY - During the forecast period, solar energy will be used by a small but increasing number of small commercial and industrial customers for water and space heating. As of 1982, there were 25 small commercial and industrial customers with solar heating systems either installed or being installed. By 1989, this number is projected to increase to approximately 250 customers.

The impact of solar energy on the class is, therefore, expected to be negligible.

16. ELECTRIC VEHICLES - Commercial electric vehicles are expected to contribute little to electric consumption during the 1982-92 forecast period. Significant acceptance of commercial electric vehicles is not expected to occur until after 1992, if then.

17. COMPUTER LOADS - Studies by the NECA and FEA revealed that the single most influential factor on the amount of energy used in an office building is computer load. As the use of computers increases, the additional energy used will offset some of the reduction caused by conservation efforts.

Low Range Case

1. Gross National Product 1980/90 is expected to grow by 1.6%/year.

2. Gross Regional Product 1980/90 will show little growth.

3. Net out migration will continue at the 1970-1980 rate.

4. "Other" manufacturing sales will lag behind the GNP and the Industrial Production Index (IPI), which is approximately 3.6%, by 3.6%.

High Range Case

1. Gross National Product 1980/90 is expected to grow by 4.0% a year.

2. Gross Regional Product 1980/90 is expected to grow by 2.0% a year.

3. Net migration will slow down after the 1970-80 period.

4. "Other" manufacturing sales will lag the Industrial Product Index by about 2.6%. The IPI is approximately 4.6%.

TABLE 1.1B-1

GROSS NATIONAL PRODUCT PROJECTIONS
1972 $ (BILLION)

ACTUAL 1980 GNP $1474.0
ACTUAL 1981 GNP 1502.6
ACTUAL 1982 GNP 1475.6

	YEAR MADE	1985	1990	1995	2000
PREVIOUS FORECAST:					
McGraw-Hill	1981	1786	2136	2562	3087
Wharton EFA	1981	1691	1934	2222	2545
Low	1981	1645	1839	2047	2302
High	1981	1726	2017	2362	2766
PECo (D. F. King)	1981	1686	1928	X	X
PRESENT FORECAST:					
Council of Economic Advisors	1983	1617	X	X	X
McGraw-Hill	1982	1677	1972	2320	2741
Wharton EFA	1982	1663	1899	X	X
Low	1982	1589	1723	X	X
High	1982	1726	2095	X	X
PECo (D. F. King)	1982	1590	1799	2086	2418

APPENDIX 1.1C

ANNUAL PEAK DEMAND FORECASTING METHOD -- DESCRIPTION OF DAILY WEATHER FACTOR (DWF) FORMULA

Prior to estimating future peak demands, historical peak demands are adjusted to a standard weather condition. In this way actual peak demand growth rates are determined.

Analyses to date indicate that the weather variable most highly correlated with daily peak demands consists of 29 hours of weighted dry bulb temperature, and 1 hour of weighted wet-bulb temperature. The formula for this weather variable, called the daily weather factor (DWF), is as follows:

$$DWF = \left[\frac{1}{29} \sum_{n=1}^{29} T_{(n)_{DB}} \frac{n+27}{56} \right] + 0.5\, T_{(29)_{WB}}$$

where:

$T_{(29)_{DB}}$ = Dry bulb temperature at the hour of peak weather

$T_{(1)_{DB}}$ = Dry bulb temperature 28 hours prior

$T_{(29)_{WB}}$ = Wet bulb temperature at the hour of peak weather.

Generally, during hot weather, the higher the DWF, the higher the daily peak load.

USE OF DAILY WEATHER FACTOR (DWF) FORMULA IN ANALYZING HISTORICAL PEAKS

Figure 1.1C-1 is a plot of peak load versus daily weather factor for all weekdays (excluding holidays) from April through October 1982. Examination of similar plots for past years indicates that there is a constant demand value for daily weather factors between 64 and 77 and a uniformly rising trend for all daily weather factors above 86. The sloping line of Figure 1.1C-1 is the linear regression for all daily peak demands occurring above 86 DWF. A vertical dashed line is drawn at the most probable peak weather value (standard weather) as determined from analysis of past weather records. Data for calculating standard weather is given in Table 1.1C-1. The intersection of the sloping line and the vertical dashed line is defined as the regression demand. The most probable peak demand (standard demand) for a year has been determined to be a value slightly above the regression demand.

Table 1.1C-2 is a tabulation of the historical relationships between the regression demands and actual peak demands. The last column shows the difference in percent between the corrected actual demand that occurred in each year and the regression demand at standard weather. The average difference is plus 3.8% of the regression demand. The standard demand for a year, therefore, is determined by increasing the regression demand by 3.8%.

The interrelationships between the regression demand, standard demand, and standard DWF are shown in Figure 1.1C-2. The solid sloping line is the linear regression line of actual daily peak demands for 1982. Its intersection with the standard DWF line gives a regression demand of 5407 MW. The standard demand for 1982 is 3.8% above this, or 5610 MW. The actual peak demand for 1982 was 5691 MW.

USE OF DWF APPROACH IN ESTIMATING FUTURE PEAK DEMANDS

The demand weather characteristic line for 1982 (Figure 1.1C-3) illustrates the foundation for the development of the demand forecast procedure. The horizontal segment is defined as base demand. The sloping segment is a function of weather sensitive demand. Coincident weather sensitive demand is derived by subtracting base demand from the value of demand at standard weather.

The base demand has been found to have a high correlation with the average April and October output.

The first column of Table 1.1C-3 is a tabulation of the historical average total monthly outputs of April and October. The second column is a tabulation of the corresponding base demands. In the last column the ratio of base demand to base output has been calculated. These historical ratios, and an extrapolation into the future, are plotted in Figure 1.1C-4. (A horizontal segment of the plotted curve would indicate a constant base load factor.) The extrapolated base demand factors are applied to the forecast of base output to compute the base demand forecast. The base output forecasts do not include any off-peak sales that result from new, nontypical loads such as electric car charging.

The coincident weather-sensitive demand is derived by subtracting the base demand from the value of weather-sensitive demand at the standard DWF. Historically, the coincident weather-sensitive demand has been found to have a good correlation with the estimates of actual MW's of connected air conditioning.

Table 1.1C-4 shows the historical coincident weather-sensitive demand and estimates of connected air conditioning for the years 1968 through 1982. The estimates of connected air conditioning are year-end values and are obtained from the Commercial Operations Department.

Figure 1.1C-5 is a plot of the relationship between coincident weather-sensitive demand and connected air conditioning load for the years 1968-1982. The coincident demand increased linearly with increasing connected load in the 1968-1974 period. The 1975-1982 period shows the result of the impact of energy conservation programs. The impact of conservation is expected to continue in the future with little increase in effective connected air conditioning load anticipated. Future estimates have been determined based on a regression of the points for 1973 to 1982 and are expected to lie in the range indicated by the dashed line marked "Future Estimates". The mathematical expression for this line is applied to the forecast of connected air conditioning load to compute the coincident weather-sensitive demand forecast.

The sum of the base and weather-sensitive components of the demand forecast produces a forecast of the regression demands (value of demand on the regression line at the standard DWF). The regression demands must be increased by 3.8% (Standard Demand Factor) to obtain a forecast of the most probable peak demands (standard demands).

SAMPLE CALCULATION OF 1983 PEAK DEMAND FORECAST

Base Demand

Base Monthly Output	2188	GWHRS	(Based upon the energy estimate of December 1978)
Base Demand Factor	x 1.660		
Base Demand	3632	MW	

Coincident Weather-Sensitive Demand

Connected Air Conditioning Load = 4315 MW

Coincident Weather-Sensitive Demand Obtained From Figure 1.1C-5 = 1759 MW

Base Demand + Weather-Sensitive Demand = Regression Demand
3632 + 1759 = 5391 MW

Regression Demand x Standard Demand Factor = Standard Demand
5391 x 1.038 = 5595 MW

5600 MW (rounded)

TABLE 1.1C-1

MAXIMUM DWF BETWEEN 10 A.M. AND TIME OF PEAK DEMAND

	DWF	Date
1968	102.7	7-18
1969	104.0	7-17
1970	102.8	9-23
1971	100.7	7-1
1972	104.3	7-20
1973	104.7	8-30
1974	101.6	7-9
1975	104.5	8-4
1976	96.9	6-28
1977	106.3	7-21
1978	101.6	8-17
1979	101.7	8-1
1980	105.4	7-21
1981	104.3	7-9
1982	103.4	7-19
(Running average)	103.0(1)	

(1) Because the running average fluctuates due to a single year's weather and because weather patterns take several years to cycle, the most probable DWF is being held at 102.7 for consistency in forecasts from year to year.

TABLE 1.1C-2

STANDARD DEMAND FACTOR

	Demand at 102.7 DWF	Net Actual Peak Demand	Corrected Peak Demand	Corrected Demand Divided by Demand at 102.7 DWF
1968	4316	4375	(4445)	1.030
1969	4661	4592	(4746)	1.018
1970	4750	4712	(4954)	1.043
1971	4878	4922	(5034)	1.032
1972	5162	5313	5313	1.029
1973	5448	5760	5760	1.057
1974	5434	5431	(5492)	1.011
1975	5344	5530	(5545)	1.038
1976	5462	5346	5346	.979
1977	5397	5888	5888	1.091
1978	5445	5667	5667	1.041
1979	5562	5641	5641	1.014
1980	5598	6095	6145	1.098
1981	5522	5731	5731	1.038
1982	5407	5691	5691	1.053
		Average Standard Demand Factor		1.038(1)

(1) 15 year average

TABLE 1.1C-3

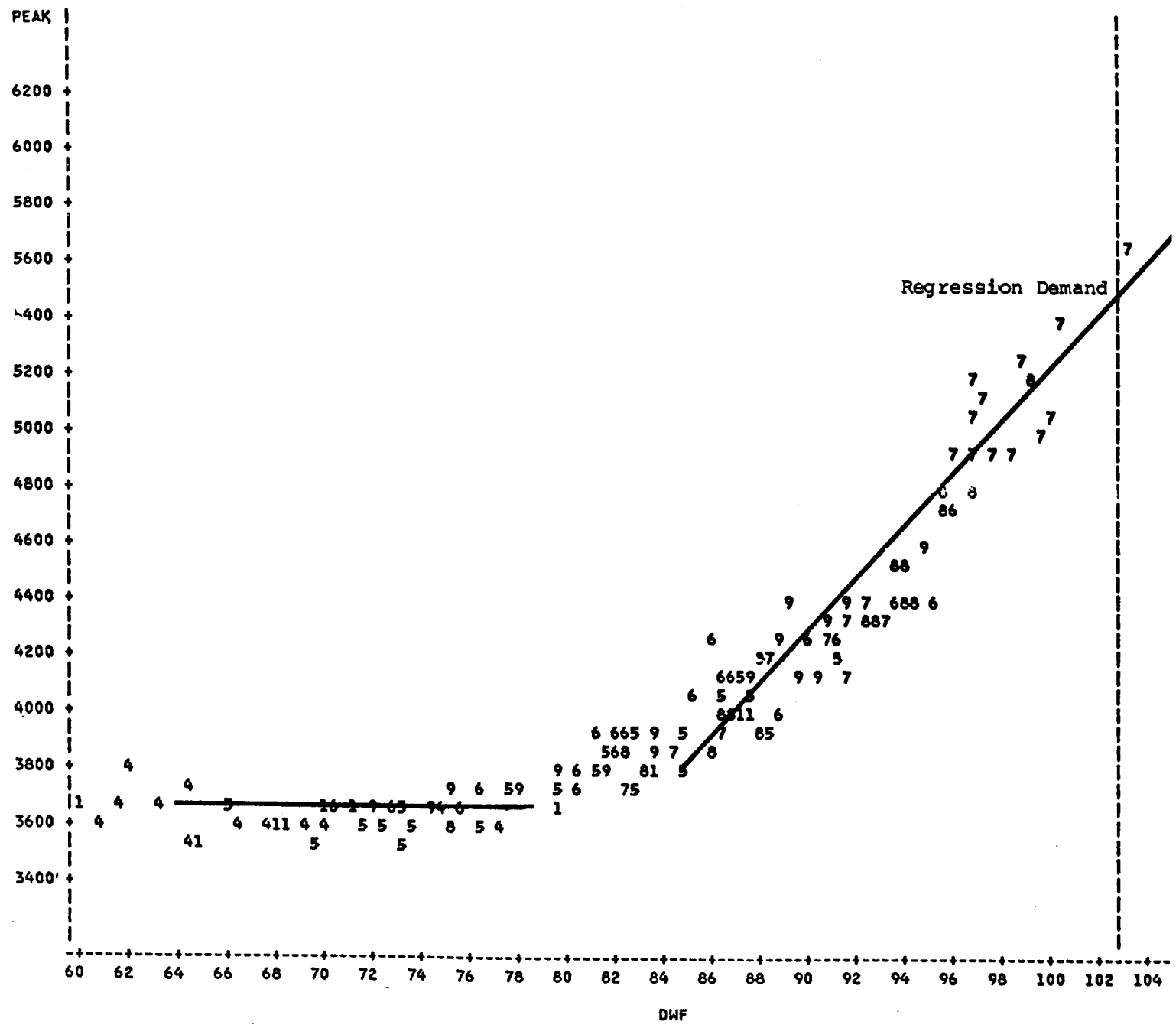
ACTUAL AVERAGE OF APRIL AND OCTOBER OUTPUTS
-- PHILADELPHIA ELECTRIC COMPANY SYSTEM

	Base Output GW Hrs	Base Demand MW	Demand Divided by Output
1968	1734	2998	1.729
1969	1840	3142	1.708
1970	1906	3255	1.707
1971	1939	3326	1.716
1972	2060	3493	1.696
1973	2169	3668	1.691
1974	2138	3612	1.689
1975	2127	3632	1.708
1976	2210	3723	1.685
1977	2196	3763	1.713
1978	2246	3813	1.698
1979	2312	3830	1.657
1980	2246	3732	1.662
1981	2210	3697	1.673
1982	2190	3644	1.664

TABLE 1.1C-4

WEATHER SENSITIVE DEMAND - MW

	Regression Demand at 102.7 DWF	- Base Demand	=	Coincident Weather Sensitive Demand	Connected Air Conditioning
1968	4316	2998		1318	2470
1969	4661	3142		1519	2755
1970	4750	3255		1495	3041
1971	4878	3326		1552	3298
1972	5162	3493		1669	3524
1973	5448	3668		1780	3758
1974	5434	3612		1822	3966
1975	5344	3632		1712	4050
1976	5462	3723		1738	4085
1977	5397	3763		1634	4124
1978	5445	3813		1632	4200
1979	5562	3830		1732	4294
1980	5598	3732		1866	4352
1981	5522	3697		1825	4387
1982	5407	3644		1763	4351

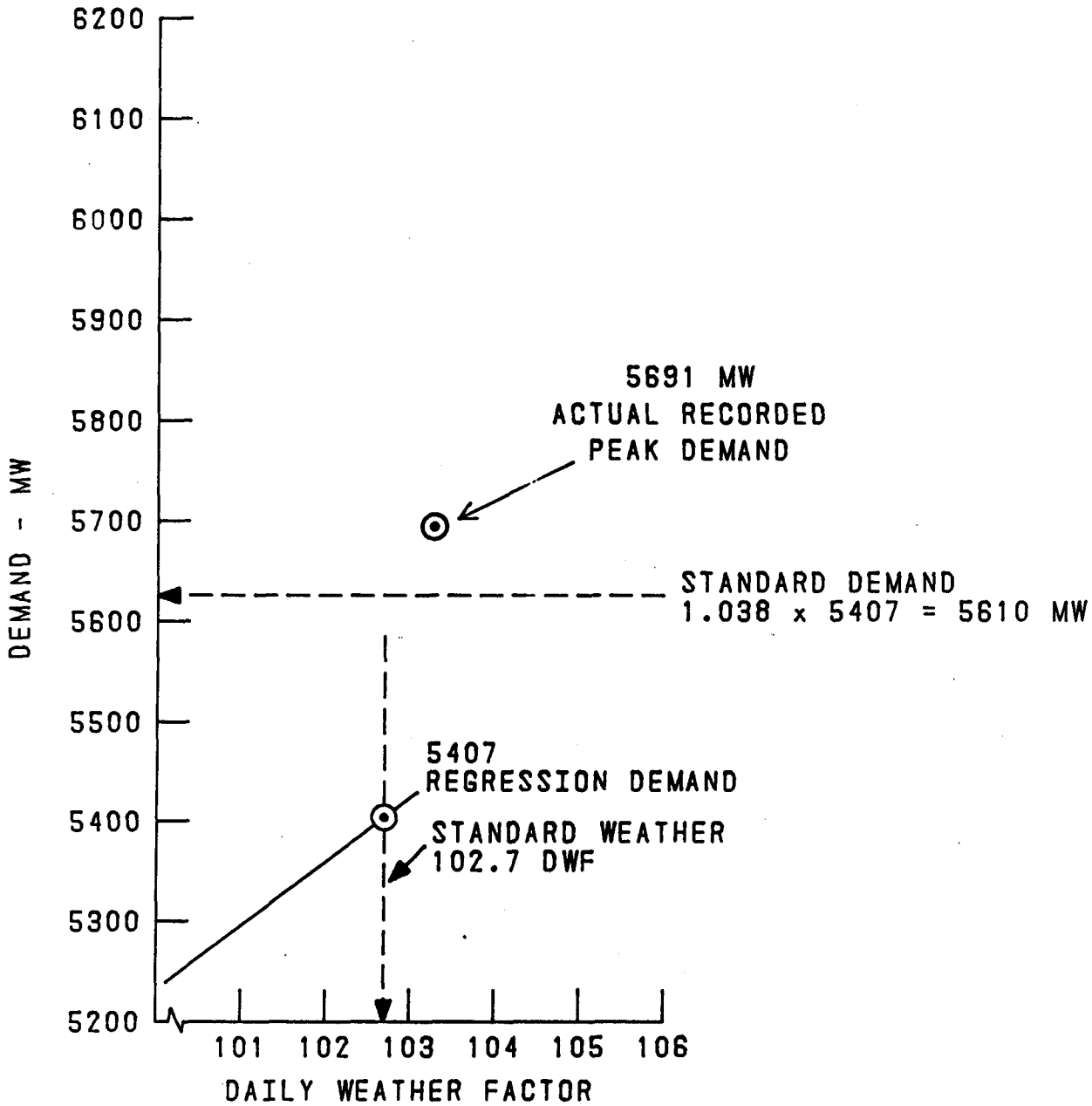


LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

1982 DEMAND VERSUS
DAILY WEATHER FACTOR

FIGURE 1.1C-1

REV. 13, 05/83



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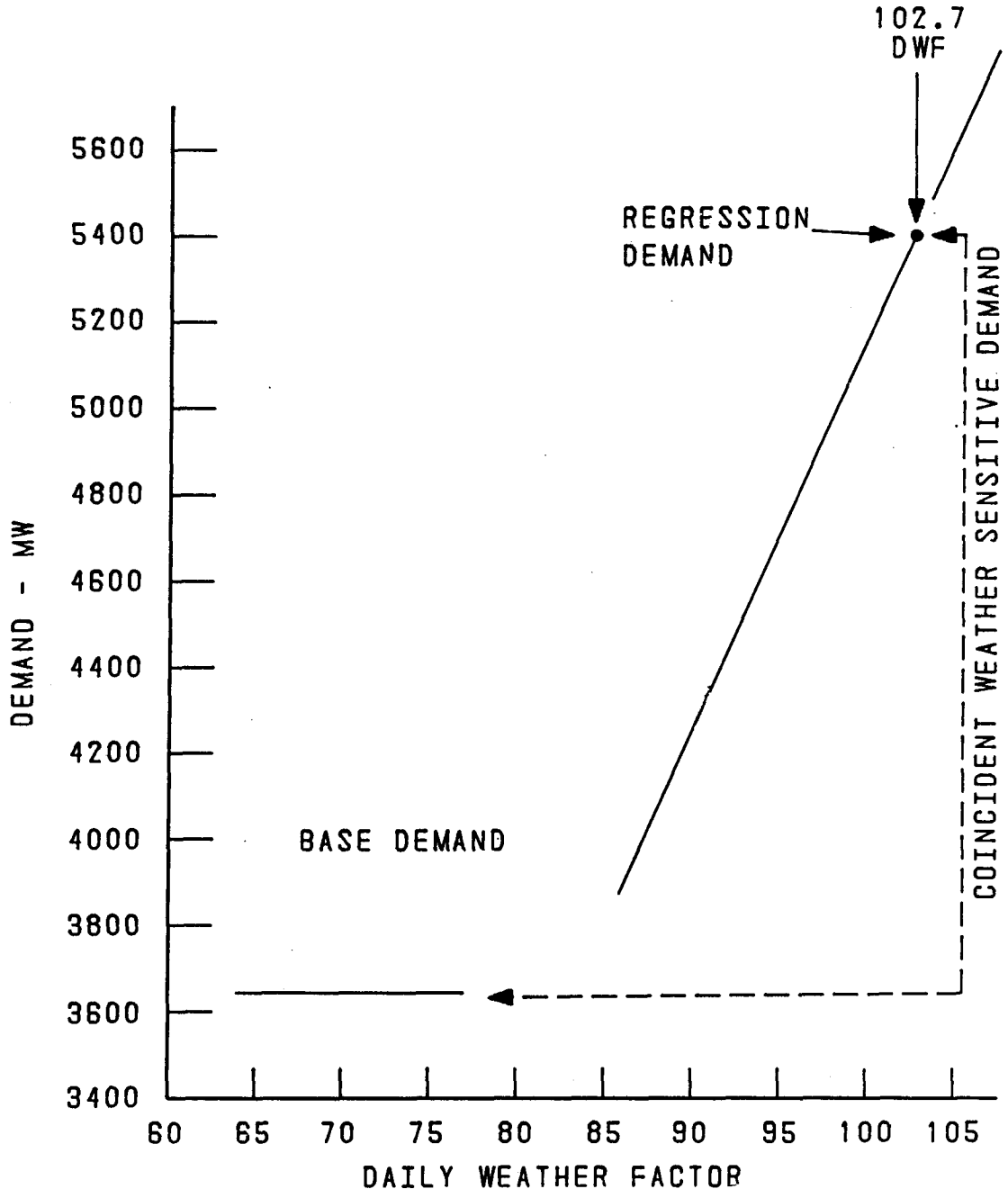
ENVIRONMENTAL REPORT

DEMAND VERSUS DAILY WEATHER FACTOR

FIGURE 1.1C-2

REV. 13, 05/83



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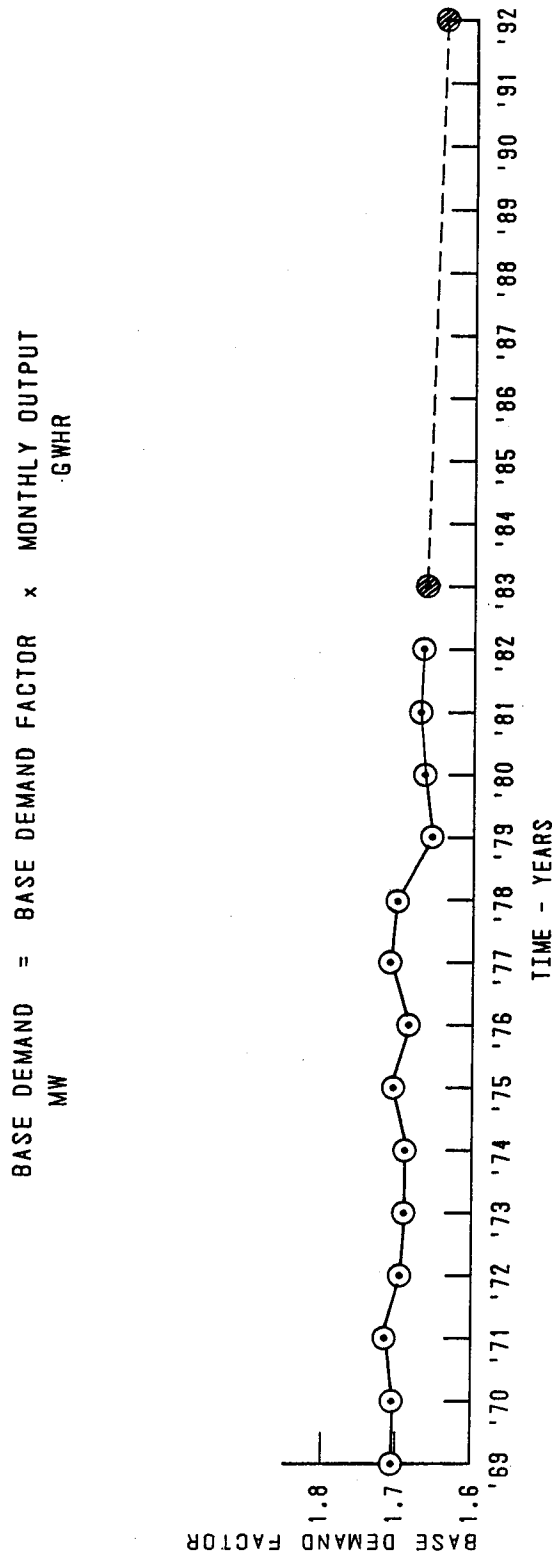
DEMAND-WEATHER
CHARACTERISTIC
1982

FIGURE 1.1C-3 **REV. 13, 05/83**



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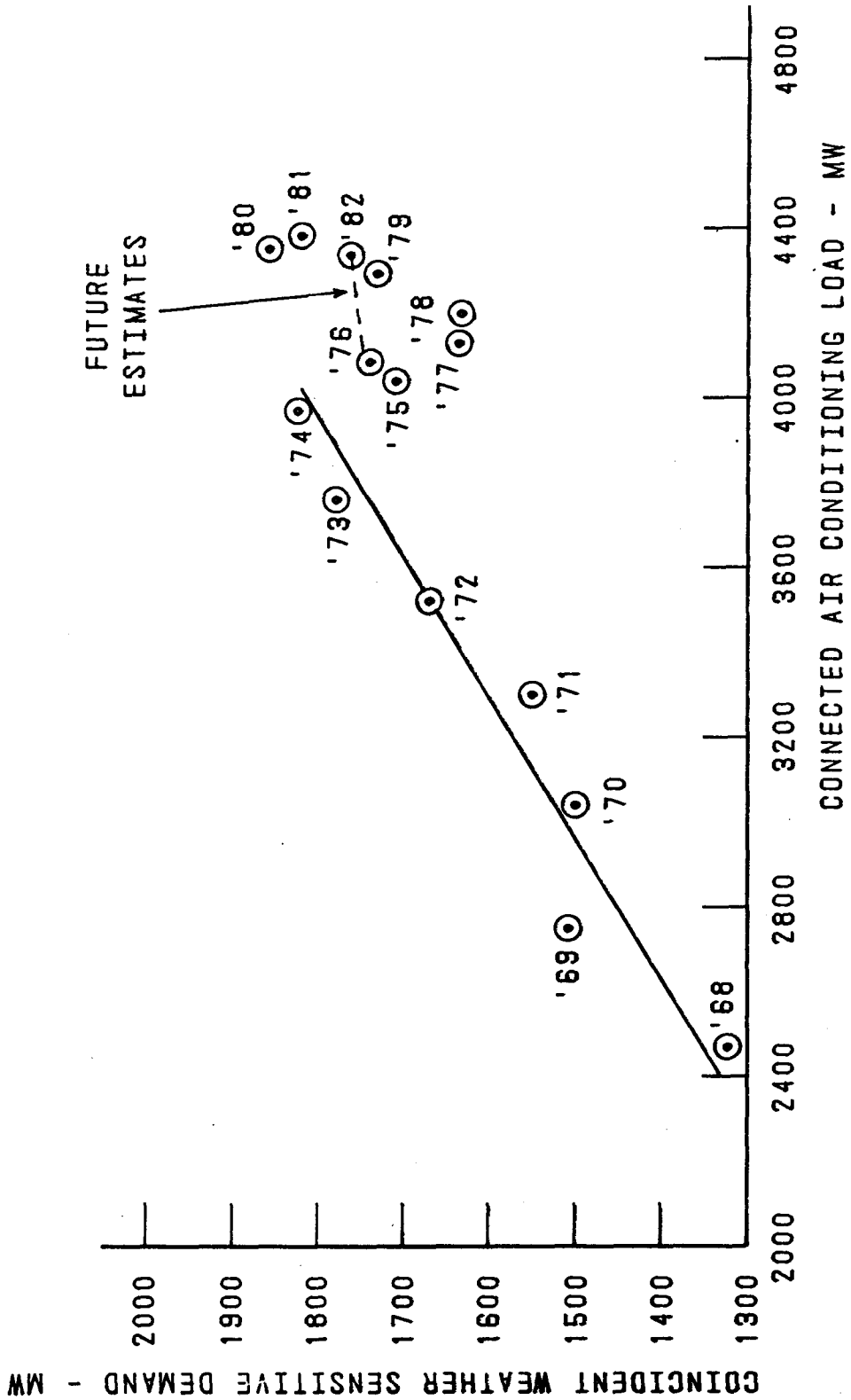
BASIC DEMAND FACTOR

FIGURE 1.1C-4 **REV. 13, 05/83**



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COINCIDENT WEATHER
SENSITIVE DEMAND RESPONSE

FIGURE 1.1C-5 **REV. 13, 05/83**

CHAPTER 2

THE SITE AND ENVIRONMENTAL INTERFACES

TABLE OF CONTENTS

Section	Title
2.1	GEOGRAPHY AND DEMOGRAPHY
2.1.1	Site Location and Description
2.1.1.1	Specification of Location
2.1.1.2	Site Area
2.1.1.3	Boundaries for Establishing Effluent Release Limits
2.1.2	Population Distribution
2.1.2.1	Population Within 10 Miles
2.1.2.2	Population Between 10 and 50 Miles
2.1.2.3	Transient Population
2.1.2.4	Age Distribution
2.1.3	Use of Adjacent Lands and Waters
2.1.3.1	Industries
2.1.3.2	Transportation Routes
2.1.3.3	Recreational Areas
2.1.3.4	Agricultural Land Use
2.1.3.5	Residences
2.1.3.6	Surface Water Use
2.1.3.7	Groundwater Use
2.2	ECOLOGY
2.2.1	Terrestrial Ecology
2.2.1.1	Flora
2.2.1.1.1	Species Inventory
2.2.1.1.2	Community Description
2.2.1.1.3	Important Species
2.2.1.2	Amphibians and Reptiles
2.2.1.3	Birds
2.2.1.3.1	Species Inventory
2.2.1.3.2	Community Description
2.2.1.3.3	Important Species
2.2.1.4	Mammals
2.2.1.5	Trophic Relationships
2.2.2	Aquatic Ecology
2.2.2.1	Schuylkill River
2.2.2.1.1	Water Quality and Environmental Stress
2.2.2.1.2	Phytoplankton
2.2.2.1.3	Periphyton
2.2.2.1.4	Macrophytes

TABLE OF CONTENTS (Cont'd)

Section	Title
2.2.2.1.5	Zooplankton
2.2.2.1.6	Macroinvertebrates
2.2.2.1.7	Fish
2.2.2.1.8	Trophic Relationships
2.2.2.2	Perkiomen Creek
2.2.2.2.1	Water Quality and Environmental Stress
2.2.2.2.2	Phytoplankton
2.2.2.2.3	Periphyton
2.2.2.2.4	Macrophytes
2.2.2.2.5	Zooplankton
2.2.2.2.6	Macroinvertebrates
2.2.2.2.7	Fish
2.2.2.2.8	Trophic Relationships
2.2.2.3	East Branch Perkiomen Creek
2.2.2.3.1	Water Quality and Environmental Stress
2.2.2.3.2	Phytoplankton
2.2.2.3.3	Periphyton
2.2.2.3.4	Macrophytes
2.2.2.3.5	Zooplankton
2.2.2.3.6	Macroinvertebrates
2.2.2.3.7	Fish
2.2.2.3.8	Trophic Relationships
2.2.3	Farm Crops, Cows, and Goats
2.2.4	References
2.3	METEOROLOGY
2.3.1	Regional Climatology
2.3.1.1	General Climate
2.3.1.1.1	Air Masses and Synoptic Features
2.3.1.1.2	General Airflow
2.3.1.1.3	Temperature
2.3.1.1.4	Relative Humidity
2.3.1.1.5	Precipitation
2.3.1.1.6	Relationship Between Synoptic and Local Scale Meteorology
2.3.1.2	Seasonal and Annual Frequencies of Severe Weather Phenomenon
2.3.1.2.1	Hurricanes
2.3.1.2.2	Tornadoes
2.3.1.2.3	Thunderstorms and Lightning
2.3.1.2.4	Hail
2.3.1.2.5	Ice Storms and Freezing Rains
2.3.1.2.6	Peak Winds
2.3.1.3	Regional Air Quality
2.3.1.3.1	Summary of Regional Air Quality Data

TABLE OF CONTENTS (Cont'd)

Section	Title
2.3.1.4	References
2.3.2	Local Meteorology
2.3.2.1	Normal and Extreme Values of the Meteorological Parameters
2.3.2.1.1	Wind Direction and Speed
2.3.2.1.2	Atmospheric Stability
2.3.2.1.3	Temperature
2.3.2.1.4	Precipitation
2.3.2.1.5	Humidity
2.3.2.1.6	Fog
2.3.2.2	Topography
2.3.2.3	References
2.4	HYDROLOGY
2.4.1	Surface Water Hydrology
2.4.2	Groundwater Hydrology
2.4.2.1	Historic Floods
2.4.2.2	Low Streamflows
2.4.2.3	Perkiomen Creek and Delaware River Flows
2.4.3	Water Levels
2.4.3.1	Schuylkill River
2.4.3.2	Perkiomen Creek
2.4.3.3	East Branch of Perkiomen Creek
2.4.3.4	Delaware River
2.4.4	Hydrologic Description of the Site Environment
2.4.5	Surface Water Users
2.4.6	Plant Water Requirement
2.4.7	Water Quality
2.4.7.1	Chemical Characteristics of Surface Water Bodies
2.4.7.2	Water Temperature
2.4.7.3	Sediment Characteristics
2.4.8	Water Impoundments
2.4.9	Conclusion
2.4.10	Ground Water Hydrology
2.4.10.1	Description of Aquifers
2.4.10.2	Site Ground Water Occurrence
2.4.10.2.1	Aquifer Parameters
2.4.10.2.2	Water Quality
2.4.10.2.3	Ground Water Levels and Fluctuations
2.4.10.2.4	Directions of Groundwater Flow
2.4.10.2.5	Seepage From the Spray Pond
2.4.11	References
2.4A	Appendix 2.4A

TABLE OF CONTENTS (Cont'd)

Section	Title
2.5	GEOLOGY
2.6	REGIONAL HISTORIC, ARCHAEOLOGICAL, AND NATURAL FEATURES
2.7	NOISE

CHAPTER 2

TABLES

Table No.	Title
2.1-1	Population Distribution, 0-10 Miles, 1970
2.1-2	Population Distribution, 0-10 Miles, 1980
2.1-3	Population Distribution, 0-10 Miles, 1983
2.1-4	Population Distribution, 0-10 Miles, 1990
2.1-5	Population Distribution, 0-10 Miles, 2000
2.1-6	Population Distribution, 0-10 Miles, 2010
2.1-7	Population Distribution, 0-10 Miles, 2020
2.1-8	Population Distribution, 10-50 Miles, 1970
2.1-9	Population Distribution, 10-50 Miles, 1980
2.1-10	Population Distribution, 10-50 Miles, 1983
2.1-11	Population Distribution, 10-50 Miles, 1990
2.1-12	Population Distribution, 10-50 Miles, 2000
2.1-13	Population Distribution, 10-50 Miles, 2010
2.1-14	Population Distribution, 10-50 Miles, 2020
2.1-15	Sources of Projected Populations
2.1-16	Bureau of Census Populations of Counties Within 50 Miles of the Site
2.1-17	Industries Within 5 Miles of Site
2.1-18	Present Land Usage Within 5 Miles of LGS
2.1-19	Projected Land Usage Within 5 Miles of LGS
2.1-20	Hooker Chemical Company
2.1-21	Pipelines Within 5 Miles of LGS
2.1-22	Airports Within 10 Miles of the Site

TABLES (Cont'd)

Table No.	Title
2.1-23	Airways Within 10 Miles of the Site
2.1-24	Location of Nearest Milk Cow, Milk Goat, Residence, Site Boundary, and Vegetable Garden
2.1-25A	Location of Dairy Pastures Within 5 Miles of LGS and Grazing Factors at Each Location
2.1-25B	Location of Beef Pastures Within 5 Miles of LGS
2.1-25C	Location of Sheep Pastures Within 5 Miles of LGS
2.1-25D	Location of Swine Pastures Within 5 Miles of LGS
2.1-25E	Location of Goat Pastures Within 5 Miles of LGS
2.1-26	Milk Destination/Production 0-5 Miles From LGS
2.1-27	Distribution of Milk for Pennsylvania
2.1-28	Annual Milk Production Within 50 Miles of LGS
2.1-29	Annual Meat Production Within 50 Miles of LGS
2.1-30	Annual Chicken Production Within 50 Miles of LGS
2.1-31	Annual Vegetable Production Within 50 Miles of LGS
2.1-32	Annual Fruit Production Within 50 Miles of LGS
2.1-33	Annual Grain Production Within 50 Miles of LGS
2.1-34	Annual Silage Corn Production Within 50 Miles of LGS
2.1-35	Annual Production of All Hay Within 50 Miles of LGS
2.1-36	Crop Production and Yield Summary
2.1-37	Location of Residences Within 1 Mile of LGS
2.1-38	Schuylkill River - Municipal Water Suppliers Downstream of Limerick Site
2.1-39	Schuylkill River - Industrial Water Users Downstream of Limerick Site

TABLES (Cont'd)

Table No.	Title
2.1-40	Accessible Recreational Areas on the Schuylkill River Downstream of the LGS Site
2.1-41	Accessible Recreational Areas of the Schuylkill River Downstream of the LGS Site (Projected)
2.1-42	Boating Hours on the Schuylkill River Downstream of the LGS Site
2.1-43	Present and Projected Fishing Hours and Edible Fish Catch in the Schuylkill River Downstream of the LGS Site
2.1-44	Percentage of Fish Species Most Frequently Caught in the Vicinity of the LGS Site
2.2-1	Terrestrial Vascular Plants Found on the LGS Site from 1972 through 1978
2.2-2	Amphibians and Reptiles Found on the LGS Site from 1972 through 1978
2.2-3	Sampling History for Ecological Studies of Birds on the LGS Site
2.2-4	Birds Found Within an 8-km Radius of LGS From 1972 to 1978
2.2-5	Important Bird Species Selected for the LGS Site and Criteria for Selection
2.2-6	Mammals Found on the LGS Site from 1972 to 1979
2.2-7	Summary of Collections Made From the Schuylkill River, Perkiomen Creek, and East Branch Perkiomen Creek, by Program and Year 1971-1978
2.2-8	Number of Samples by Year, Program, and Site Collected From the Schuylkill River, 1971 through 1977
2.2-9	Number of Samples by Month, Program, and Collected From the Schuylkill River Near LGS, 1971 through 1977
2.2-10	Listing of Phytoplankton Taxa with Quarterly (Seasonal) Densities per Taxa Collected from Station S77720, Schuylkill River, Limerick Generation Station, 1974

TABLES (Cont'd)

Table No.	Title
2.2-11	Periphyton Production Listed as Total Biomass (Standing Crop) (mg/dm^2) and Total Productivity Rates ($mg/dm^2/day^{-1}$)
2.2-12	Species List and Relative Abundance of Aquatic Macrophytes in the Vicinity of LGS, Observed in 1977
2.2-13	Species List and Relative Abundance of Aquatic Macroinvertebrates Collected by All Methods from the Schuylkill River, 1970 through 1976
2.2-14	Numerical Summary Data on Important Species (taxa) of Benthic Macroinvertebrates Collected in Quantitative Samples (1972-1976) from the Schuylkill River
2.2-15	Biomass of Important Benthic Macroinvertebrates Collected in Quantitative Samples (1972-1974) from the Schuylkill River
2.2-16	Monthly Densities (Mean Number per Square Meter) of Important Species (Taxa) of Benthic Macroinvertebrates, Collected from the Schuylkill River, 1972 through 1976
2.2-17	Monthly Densities of Important Species (Taxa) of Benthic Macroinvertebrates Collected from the Schuylkill River, 1972 through 1974
2.2-18	Total Number of Species (Taxa) of Benthic Macroinvertebrates Collected per Sample from the Schuylkill River Near LGS 1973 through 1976
2.2-19	Monthly Percent Composition of Dominant Drift Species (Taxa) of Macroinvertebrates Collected from the Schuylkill River at S77568, 1972 through 1975
2.2-20	Monthly Densities of Selected Species (Taxa) of Macroinvertebrates Collected in Drift Samples from S77560 in the Schuylkill River, 1972 through 1975
2.2-21	Monthly Estimates of the Percent of Benthos Drifting in the Schuylkill River near Limerick Generating Station, 1972 through 1975

TABLES (Cont'd)

Table No.	Title
2.2-22	Fish and Hybrids Collected in the Vicinity of Limerick Generating Station, Schuylkill River, 1970 through 1976
2.2-23	Mean Density and Relative Abundance of Selected Larval Fish Collected from the East Channel of the Schuylkill River at S77560, May-August 1974 and 1975
2.2-24	Horizontal Variation in Density of Larval Fish Collected from the Schuylkill River at S77560 in 1975
2.2-25	Total Catch and Relative Abundance of Larval Fish Collected by Trap Net from the Schuylkill River Shoreline at S77560, May through August 1975
2.2-26	Total Number and Percent Catch of Shoreline Larval Fish Sampled by Push Net from the Schuylkill River During the Spawning Period in 1976
2.2-27	Total Number and Catch per Effort of Larval Fish Collected by Push Net in the Schuylkill River Near Limerick Generating Station, in 1976
2.2-28	Total Catch, Relative Abundance, and Frequency of Occurrence (FO%) of Fish Collected by Seine from the Schuylkill River (all Sites Combined) in 1975 and 1976
2.2-29	Monthly Variation in Total Catch and Relative Abundance of Important Species of Fish and Total Number of Species Collected by Seine from the Schuylkill River (all Sites Combined), 1975 and 1976
2.2-30	Spatial Variation in Total Catch and Relative Abundance of Important Species of Fish and Total Number of Species Collected by Seine from the Schuylkill River, 1975 and 1976
2.2-31	Total Catch and Relative Abundance of Small Fish Collected from the Schuylkill River Near LGS, 1973 through 1976
2.2-32	Total Catch and Relative Abundance of Fish and Hybrids Collected During Large Fish Population Estimate Sampling, 1973 through 1975

TABLES (Cont'd)

Table No.	Title
2.2-33	Total Catch and Relative Abundance of Fish Collected During Catch-per-Unit-Effort Sampling, July through December 1976
2.2-34	Fish Taken by Trap Net From the Schuylkill River at Vincent Pool From May 1971 through December 1976
2.2-35	Criteria for Determining Important Fish of the Schuylkill River
2.2-36	Spatial and Temporal Variation in Catch-per-Unit-Effort (no./min of Electrofishing x100) of Important Species Collected from the Schuylkill River Near Limerick Generating Station July through December 1976
2.2-37	Estimated Number and Biomass of Selected Important Species Collected from the Schuylkill River During Large Fish Population Estimate Sampling, 1973 through 1977
2.2-38	Mean Calculated Fork Length at Annulus for Selected Important Species Collected from the Schuylkill River Near Limerick Generating Station, 1973 through 1975
2.2-39	Length-Weight Relationships for Selected Important Fish Species collected from the Schuylkill River near Limerick Generating Station, 1973 through 1978
2.2-40	Number of Samples Collected by Year, Program, and Site Collected from Perkiomen Creek, 1972 through 1977
2.2-41	Number of Samples by Month, Program, and Year Collected from Perkiomen Creek, 1972 through 1977
2.2-42	Monthly Qualitative Listing of Phytoplankton Genera Collected at P14390 in Perkiomen Creek in 1974
2.2-43	Periphyton Production Listed as Total Biomass (Standing Crop) mg/dm^2 and Total Productivity Rates $mg/dm^2/day$
2.2-44	Species List and Relative Qualitative Abundance of Macroinvertebrates Collected by all Methods from

TABLES (Cont'd)

Table No.	Title
	all Habitats in East Branch Perkiomen Creek and Perkiomen Creek, 1970 through 1976
2.2-45	Selected Measurements for Total Macrobenthos in the Riffle Biotope of Perkiomen Creek and East Branch Perkiomen Creek (1972-1976)
2.2-46	Mean Density (no./m²), Percent Composition (%), and Frequency Of Occurence (FO%) of Benthic Macroinvertebrates Collected in Quantitative Samples (1972-1976) from The Riffle Biotope of East Branch Perkiomen Creek, all Stations Combined
2.2-47	Mean Density (mg/m²), Percent Composition (%), and Frequency of Occurence (FO%) of Benthic Macroinvertebrates Collected in Quantitative Samples from the Riffle Biotope of East Branch Perkiomen Creek, all Stations Combined
2.2-48	Monthly Densities (Mean no./m²) of Important and Total Taxa of Benthic Macroinvertebrates, Collected from East Branch Perkiomen Creek and Perkiomen Creek, all Stations and Years Combined, 1972-1976
2.2-49	Spatial Distribution, by Station, by Year, of Important Benthic Macroinvertebrates Collected in Quantitative Samples (1972-1976) from the Riffle Biotope of East Branch Perkiomen Creek and Perkiomen Creek
2.2-50	Spatial Distribution, by Station by Year, of Important Benthic Macroinvertebrates Collected in Quantitative Samples (1973, 1974) from the Riffle Biotope of East Branch Perkiomen Creek and Perkiomen Creek
2.2-51	Summary Table of Aquatic Macronivertebrate Drift as Measured for Each Monthly 24-Hour Study in East Branch Perkiomen Creek and Perkiomen Creek
2.2-52	Diel Periodicity of Aquatic Drift on East Branch Perkiomen Creek and Perkiomen Creek Expressed as a Percent of the 24-hour Total, All Drift Studies Combined

TABLES (Cont'd)

Table No.	Title
2.2-53	Fish Collected in Perkiomen Creek by all Types of Gear During the Period June 1970 through December 1977
2.2-54	Mean Density and Relative Abundance of Drifting Larval Fish Collected from Perkiomen Creek at P14390, May through August, 1973, 1974 and 1975
2.2-55	Total Catch and Relative Abundance of Larval Fish Collected by Trap Net from Perkiomen Creek Shoreline at P14390, May through August 1975
2.2-56	Daily Mean Density (no./m^3) of Drifting Larval Fish Collected from Perkiomen Creek at P14390, May through August, 1974 and 1975
2.2-57	Horizontal Variation in Density of Larval Collected from Perkiomen Creek at P14390 in 1975
2.2-58	Mean Drift Density of Larval Fish in the East and West Channels of Perkiomen Creek at P14390 in 1975
2.2-59	Annual and Spatial Variation in Mean Catch-per-Unit-Effort (C/F and Relative Abundance of Fish Collected by Seine from the Perkiomen Creek in 1975 and 1976)
2.2-60	Annual Variation and Frequency of Occurrence (FO) in Age 0 Sunfish Species Collected by Electrofishing in Perkiomen Creek (all Sites Combined) in 1975 and 1976
2.2-61	Monthly Variation in Mean Catch-per-Unit-Effort of Fish Collected by Seine from Perkiomen Creek (all Sites Combined) in 1975 and 1976
2.2-62	Total Catch and Relative Abundance of Fish Collected by Electrofishing from Perkiomen Creek in 1974, 1975 and 1976
2.2-63	Criteria for Determination of Important Fish of Perkiomen Creek
2.2-64	Annual and Spatial Variation in Redbreast Sunfish Population Estimates at Four Sites on Perkiomen Creek in 1975 and 1976

TABLES (Cont'd)

Table No.	Title
2.2-65	Population Estimates (Number per Hectare) and Estimated Biomass (weight per Hectare) of Large Fish Collected by Electrofishing from Four Sites, on Perkiomen Creek in 1974, 1975, and 1976
2.2-66	Population Estimates by Age-Group for Redbreast Sunfish Collected from Four Sites on Perkiomen Creek in 1974, 1975, and 1976
2.2-67	Length-Weight Relationships of Important Species Collected by Seine from Perkiomen Creek in 1975 and 1976
2.2-68	Mean Calculated Lengths at Annulus for Redbreast Sunfish, White Sucker, and Smallmouth Bass Collected From Perkiomen Creek in 1973 and 1976
2.2-69	Length-Weight Relationships for White Sucker Collected by Electrofishing at Four Sites on Perkiomen Creek in 1976
2.2-70	Number of Samples by Year, Program, and Site Collected from East Branch Perkiomen Creek, 1972 through 1977
2.2-71	Number of Samples by Month, Program, and Year Collected from East Branch Perkiomen Creek, 1972 through 1977
2.2-72	Periphyton Standing Crop Biomass (mg/dm^2) in Ash-free dry Weight and Productivity Rates ($mg/dm^2/day$) in Ash-free Dry Weight by Station in East Branch Perkiomen Creek, 1973 and 1974
2.2-73	Fish Collected in the East Branch Perkiomen Creek by all Types of Gear during the Period of June 1970 through December 1976
2.2-74	Mean Density and Relative Abundance of Drifting Larval Fish Collected from East Branch Perkiomen Creek at E2650, May-August in 1973 and 1974
2.2-75	Mean Daily Drift Density ($no./m^3$) for Selected Larval Fish Collected from East Branch Perkiomen Creek at E2650, 1973 and 1974

TABLES (Cont'd)

Table No.	Title
2.2-76	Mean Catch-per-Unit-Effort (C/F) and Relative Abundance of Fish Species Collected by Seine from East Branch Perkiomen Creek in 1975 and 1976
2.2-77	Relative Abundance (%N) and Biomass (%W) of Fish Collected by Electrofishing from Lotic Sites, East Branch Perkiomen Creek, 1973 and 1975
2.2-78	Relative Abundance (% Total Catch) of all Species Collected by Electrofishing From Fretz (E15500) and WaWa (F5650) Reservoirs, East Branch Perkiomen Creek in 1974 and 1975
2.2-79	Criteria for Determination of Important Fish of East Branch Perkiomen Creek
2.2-80	Population Estimates and Estimated Biomass of Selected Species Collected by Electrofishing from Lotic Sites, East Branch Perkiomen Creek, 1973 and 1975
2.2-81	Population Estimates and Estimated Biomass of Selected Species Collected by Electrofishing from Lentic Sites, East Branch Perkiomen Creek, 1974 and 1975
2.2-82	Length-Weight Relationships of Selected Species Collected by Seine from East Branch Perkiomen Creek in 1975 and 1976
2.2-83	Length-Weight Relationships of Selected Species Collected by Electrofishing from Lotic Sites, East Branch Perkiomen Creek, 1973 and 1975
2.2-84	Mean Calculated Lengths at Annulus for Redfin Pickerel Collected at Five Sites on the East Branch Perkiomen Creek in 1973 and 1975
2.2-85	Mean Calculated Lengths at Annulus for White Sucker Collected by Electrofishing Upstream and Downstream of Sellersville, East Branch Perkiomen Creek, in 1973
2.2-86	Mean Calculated Lengths at Annulus for Redbreast Sunfish Collected by Electrofishing from Lotic Sites, East Branch Perkiomen Creek, in 1973 and 1975

TABLES (Cont'd)

Table No.	Title
2.2-87	Mean Calculated Lengths at Annulus for Green Sunfish Collected by Electrofishing from Lotic Sites, East Branch Perkiomen Creek, in 1973 and 1975
2.2-88	1976 Total Wheat Production Within 5 Miles of LGS--Summary in Acres by Sector and Distance
2.2-89	1976 Total Grain Core Production Within 5 Miles of LGS--Summary in Acres by Sector and Distance
2.2-90	1976 Total Corn (Silage) Production Within 5 Miles of LGS--Summary in Acres by Sector and Distance
2.2-91	1976 Total Alfalfa, Timothy, and Clover Within 5 Miles of LGS--Summary in Acres by Sector and Distance
2.2-92	1976 Total Production (all Crops) Within 5 Miles of LGS--Summary in Acres by Sector and Distance
2.2-93	1976 Total Cow Population Within 5 Miles of LGS by Sector and Distance
2.2-94	Total Goat Population Within 5 Miles of LGS by Sector and Distance
2.3.1-1	Comparison of Annual Wind Direction Frequency Distributions (%)
2.3.1-2	Mean Monthly Temperature Comparison (°F)
2.3.1-3	Comparison of Mean Morning and Afternoon Relative Humidity (%)
2.3.1-4	Distribution of Precipitation, Philadelphia International Airport
2.3.1-5	Distribution of Precipitation, Allentown Airport
2.3.1-6	Mean Number of Thunderstorms, Days per Year
2.3.1-7	Fastest Mile of Wind
2.3.1-8	Applicable State Federal Ambient Air Quality Standards

TABLES (Cont'd)

Table No.	Title
2.3.1-9	Summary of South East Pennsylvania Air Basin Air Quality Data
2.3.1-10	Summary of COPAMS, Air Quality Data
2.3.2-1	LGS Percent Data Recovery for Meteorological Sensors
2.3.2-2(1)	Weather Station No. 1, Annual Wind Distribution by Brookhaven Turbulence Class, January 1972 to December 1976
2.3.2-3(1)	Weather Station No. 1, Monthly Wind Distribution by Brookhaven Turbulence Class, January 1972 to December 1976
2.3.2-4(1)	Weather Station No. 1, Annual Wind Distribution by NRC Lapse Rate Stability Class, 266-26 ft. Height Interval, January 1972 to December 1976
2.3.2-5(1)	Weather Station No. 1, Monthly Wind Distribution by NRC Lapse Rate Stability Class, 226-26 ft. Height Interval, January 1972 to December 1976
2.3.2-6(1)	Weather Station No. 1, Annual Wind Distribution by NRC Lapse Rate Stability Class, 171-26 ft. Height Interval, January 1972 to December 1976
2.3.2-7(1)	Weather Station No. 1, Monthly Wind Distribution by NRC Lapse Rate Stability Class, 171-26 ft. Height Interval, January 1972 to December 1976
2.3.2-8(1)	Weather Station No. 1, Annual Wind Distribution by Brookhaven Turbulence Class, April 1972 to March 1973
2.3.2-9(1)	Weather Station No. 1, Monthly Wind Distribution by Brookhaven Turbulence Class, April 1972 to March 1973
2.3.2-10(1)	Weather Station No. 1, Annual Wind Distribution by NRC Lapse Rate Stability Class, 266-26 ft. Height Interval, April 1972 to March 1973
2.3.2-11	Weather Station No. 1, Monthly Wind Distribution by NRC Lapse Rate Stability Class, 266-26 ft. Height Interval, April 1972 to March 1973

TABLES (Cont'd)

Table No.	Title
2.3.2-12[1]	Weather Station No. 1, Annual Wind Distribution by NRC Lapse Rate Stability Class, 171-26 ft. Height Interval, April 1972 to March 1973
2.3.2-13[1]	Weather Station No. 1, Monthly Wind Distribution by NRC Lapse Rate Stability Class, 171-26 ft. Height Interval, April 1972 to March 1973
2.3.2-14[1]	Weather Station No. 2 Annual Wind Distribution by Brookhaven Turbulence Class, April 1972 to March 1973
2.3.2-15[1]	Weather Station No. 2, Monthly Wind Distribution by Brookhaven Turbulence Class, April 1972 to March 1973
2.3.2-16[1]	Weather Station No. 2, Annual Wind Distribution by NRC Lapse Rate Stability Class, 300-26 ft. Height Interval, April 1972 to March 1973
2.3.2-17[1]	Weather Station No. 2, Monthly Wind Distribution by NRC Lapse Rate Stability Class, 300-26 ft. Height Interval, April 1972 to March 1973
2.3.2-18[1]	Weather Station No. 2, Annual Wind Distribution by NRC Lapse Rate Stability Class, 155-26 ft. Height Interval, April 1972 to March 1973
2.3.2-19[1]	Weather Station No. 2, Monthly Wind Distribution by NRC Lapse Rate Stability Class, 155-26 ft. Height Interval, April 1972 to March 1973
2.3.2-20[1]	Satellite Tower, Annual Wind Distribution by Brookhaven Turbulence Class, January 1975 to December 1976
2.3.2-21	Satellite Tower, Monthly Wind Distribution by Brookhaven Turbulence Class, January, 1975 to December 1976
2.3.2-22[1]	Satellite Tower, Annual Wind Distribution by NRC Lapse Rate Stability Class, 266-26 ft. Height Interval, January 1975 to December 1976
2.3.2-23[1]	Satellite Tower, Monthly Wind Distribution by NRC Lapse Rate Stability Class, 266-26 ft. Height Interval, January 1975 to December 1976

TABLES (Cont'd)

Table No.	Title
2.3.2-24[1]	Satellite Tower, Annual Wind Distribution by NRC Lapse Rate Stability Class, 171-26 ft. Height Interval, January 1975 to December 1976
2.3.2-25[1]	Satellite Tower, Monthly Wind Distribution by NRC Lapse Rate Stability Class, 171-26 ft. Height Interval, January 1975 to December 1976
2.3.2-26	Limerick Generating Station Comparison of Annual Wind Direction Frequency Distributions (%) Weather Station No. 1
2.3.2-27	LGS Monthly Average Wind Speeds (mph) Weather Station No. 1
2.3.2-28	LGS Comparison of Annual Wind Direction Frequency Distributions (%) Weather Station No. 1
2.3.2-29	LGS Comparison of Annual Wind Direction Frequency Distributions (%) Weather Station No. 2
2.3.2-30	LGS Comparison of Annual Wind Direction Frequency Distributions (%) from Equivalent Heights
2.3.2-31	LGS Comparison of Annual Wind Direction Frequency Distributions (%) Low Level Sensors
2.3.2-32	LGS Comparison of Monthly Average Wind Speeds (mph)
2.3.2-33[1]	Annual Wind Direction Persistence, Weather Station No. 1, January 1972 to December 1976
2.3.2-34[1]	Monthly Wind Direction Persistence, Weather Station No. 1, January 1972 to December 1976
2.3.2-35[1]	Annual Wind Direction Persistence, Weather Station No. 1, April 1972 to March 1973
2.3.2-36[1]	Monthly Wind Direction Persistence, Weather Station No. 1, April 1972 to March 1973
2.3.2-37[1]	Annual Wind Direction Persistence, Weather Station No. 2, April 1972 to March 1973
2.3.2-38[1]	Monthly Wind Direction Persistence, Weather Station No. 2, April 1972 to March 1973

TABLES (Cont'd)

Table No.	Title
2.3.2-39	Comparison of Wind Speed Frequency Distributions (%)
2.3.2-40	Annual Frequency Distribution of Brookhaven Turbulence Classes, Weather Station No. 1, January 1972 to December 1976
2.3.2-41	Annual Frequency Distribution of Pasquill Stability Classes, Weather Station No. 1, January 1972 to December 1976
2.3.2-42	Annual Frequency Distribution of Brookhaven Turbulence Classes, Weather Stations No. 1 and 2, April 1972 to March 1973
2.3.2-43	Annual Frequency Distribution of Pasquill Stability Classes, Weather Station No. 1 and 2, April 1972 to December 1973
2.3.2-44	BNL Turbulence Classification
2.3.2-45(1)	Annual Temperature Inversion Persistence, Weather Station No. 1, January 1972 to December 1976
2.3.2-46(1)	Monthly Temperature Inversion Persistence, Weather Station No. 1, January 1972 to December 1976
2.3.2-47	Annual Temperature Inversion Persistence, Weather Station No. 1, April 1972 to March 1973
2.3.2-48(1)	Monthly Temperature Inversion Persistence, Weather Station No. 1, April 1972 to March 1973
2.3.2-49(1)	Annual Temperature Inversion Persistence, Weather Station No. 2, April 1972 to March 1973
2.3.2-50(1)	Monthly Temperature Inversion Persistence, Weather Station No. 2, April 1972 to March 1973
2.3.2-51	LGS Mean Morning and Afternoon Mixing Heights
2.3.2-52	Monthly and Annual Means and Extremes of Ambient Temperature, Weather Station No. 1, January 1972 to December 1976
2.3.2-53(1)	Annual Frequency Distribution of Ambient Temperature, Weather Station No. 1, January 1972 to December 1976

TABLES (Cont'd)

Table No.	Title
2.3.2-54(1)	Monthly Frequency Distribution of Ambient Temperature, Weather Station No. 1, January 1972 to December 1976
2.3.2-55(1)	Annual Summary of Diurnal Temperature Variation, Weather Station No. 1, January 1972 to December 1976
2.3.2-56(1)	Monthly Summary of Diurnal Temperature Variation Weather Station No. 1, January 1972 to December 1976
2.3.2-57	Comparison of Monthly Mean Temperatures, Limerick Versus Philadelphia
2.3.2-58	Comparison of Monthly Mean Temperatures, Limerick Versus Allentown
2.3.2-59	Monthly Precipitation Distribution, Weather Station No. 1, January 1972 to December 1976
2.3.2-60(1)	Annual Precipitation Wind Roses by Precipitation Rate Class, Weather Station No. 1, January 1972 to December 1976
2.3.2-61(1)	Monthly Precipitation Wind Roses by Precipitation Rate Class, Weather Station No. 1, January 1977 to December 1976
2.3.2-62(1)	Annual Precipitation Rate Distribution, Weather Station No. 1, January 1972 to December 1976
2.3.2-63(1)	Monthly Precipitation Rate Distribution, Weather Station No. 1, January 1972 to December 1976
2.3.2-64(1)	Annual Summary of Precipitation Intensity Versus Duration, Weather Station No. 1, January 1972 to December 1976
2.3.2-65(1)	Monthly Composite Summary of Precipitation Intensity Versus Duration, Weather Station No. 1, January 1972 to December 1976
2.3.2-66	Comparison of Monthly Mean Precipitation, Limerick Versus Philadelphia
2.3.2-67	Comparison of Monthly Mean Precipitation, Limerick Versus Allentown

TABLES (Cont'd)

Table No.	Title
2.3.2-68(1)	Annual Frequency Distribution of Relative Humidity
2.3.2-69(1)	Monthly Frequency Distribution of Relative Humidity
2.3.2-70(1)	Annual Summary of Diurnal Relative Humidity Variation
2.3.2-71(1)	Monthly Summary of Diurnal Relative Humidity Variation
2.3.2-72(1)	Annual Frequency Distribution of Absolute Humidity
2.3.2-73(1)	Monthly Frequency Distribution of Absolute Humidity
2.3.2-74(1)	Annual Summary of Diurnal Absolute Humidity Variation
2.3.2-75(1)	Monthly Summary of Diurnal Absolute Humidity Variation
2.3.2-76(1)	Annual Frequency Distribution of Dew Point Temperature
2.3.2-77(1)	Monthly Frequency Distribution of Dew Point Temperature
2.3.2-78(1)	Annual Summary of Diurnal Dew Point Temperature Variation
2.3.2-79(1)	Monthly Summary of Diurnal Dew Point Temperature Variation
2.3.2-80(1)	Annual Cumulative Frequency Distribution of Wet Bulb Temperature
2.3.2-81(1)	Monthly Cumulative Frequency Distribution of Wet Bulb Temperature
2.3.2-82	Comparison of Mean Morning and Afternoon Relative Humidity
2.3.2-83	Comparison of Frequency Distributions of Daily Average Relative Humidity Values
2.3.2-84	Comparison of Annual Frequency Distributions of Hourly Relative Humidity Values
2.3.2-85	Mean Number of Days with Heavy Fog
2.3.2-86	Offsite Elevations Versus Distance from Vent
2.3.2-87	Onsite Elevations Versus Distance from Vent
2.3.2-88(1)	Joint Frequency Distribution of Relative Humidity, Wind Direction, Wind Speed and Atmospheric Stability Class
2.4-1	Principal Tributaries of the Schuylkill River

TABLES (Cont'd)

Table No.	Title
2.4-2	Surface Water Gauging Stations Upstream From Limerick Site
2.4-3	Minor Dams Upstream of LGS
2.4-4	Dams on the Schuylkill Downstream of LGS
2.4-5	Major Floods at Selected Stations on the Schuylkill River
2.4-6	Instantaneous and Average Daily Minimum Flows Each Year for the Schuylkill at Pottstown, Pennsylvania, (cfs)
2.4-7	Duration Table of Daily Flow for the Schuylkill River, Perkiomen Creek, and Delaware River (cfs)
2.4-8	Long-Term Average Stream Flows for the Schuylkill River, Perkiomen Creek, and Delaware River
2.4-9	Observed and Estimated Water Surface Elevations of the Schuylkill River at LGS
2.4-10	Domestic Water Users on the Schuylkill River Downstream of Limerick Site
2.4-11	Industrial Water Users on the Schuylkill River Downstream of Limerick Site
2.4-12	Summary of Average (1974-78) Water Quality Data During November Through May for the Schuylkill River
2.4-13	Summary of Average (1974-78) Water Quality Data During June Through October for the Schuylkill River
2.4-14	Summary of East Branch Perkiomen Creek Water Quality, 1975 through 1978
2.4-15	Summary of East Branch Perkiomen Creek Water Quality 1975 through 1978
2.4-16	Water Quality Records of the Delaware River at Trenton, New Jersey
2.4-17	Summary of Schuylkill River Water Temperature at Pottstown, Pennsylvania

TABLES (Cont'd)

Table No.	Title
2.4-18	Daily Suspended Sediment Discharge of the Schuylkill River at Manayunk, Pennsylvania
2.4-19	Duration Table for Suspended Sediment Concentrations of the Schuylkill River
2.4-20	Permeability Data
2.4-21	Chemical Analyses of Ground Water in the Brunswick Lithofacies in Montgomery County, Pennsylvania
2.4-22	Chemical Analyses of Ground Water From the Wells in the Brunswick Lithofacies at the Limerick Project Site
2.7-1	Ambient Noise Levels From 1973 Survey

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(1) These tables have been omitted from this report because of the large number of pages.
They are presented in Reference 2.3.2-9.

CHAPTER 2

FIGURES

Figure No.	Title
2.1-1	The General Location of LGS
2.1-2	General Site Area Map
2.1-3	LGS Site Plan
2.1-4	LGS Principal Station Structures
2.1-5	Population Distribution Map Within 10 Miles of LGS
2.1-6	Population Distribution Map Between 10 and 50 Miles of LGS
2.1-7	Industries Within the LPZ
2.1-8	Transportation Routes and Pipelines
2.1-9	Location of Downstream Surface Water Users, Schuylkill River
2.2-1	Principal Plant Communities
2.2-2	Hypothetical Food Web
2.2-3	Study Area
2.2-4	Species Distribution of Dominant Aquatic Macrophytes
2.2-5	Temporal Variation in Larval Fish Drift at S77560, 1974 and 1975
2.2-6	Temporal Variation in Number of Fish Larvae Collected by Push Net, 1976
2.2-7	Number of Fish Species Collected by Seine by Month and Station
2.2-8	Swallowtail Shiner Seine Catch and Relative Abundance
2.2-9	Spotfin Shiner Seine Catch and Relative Abundance
2.2-10	Brown Bullhead Population Age Structure
2.2-11	Adult Redbreast Sunfish Seasonal Feeding Habits

FIGURES (Cont'd)

Figure No.	Title
2.2-12	Mean Population Estimate for Age O Redbreast, Green, and Pumpkinseed Sunfish
2.2-13	Pumpkinseed Population Age Structure
2.2-14	Structure and Function of Selected Biotic Components
2.2-15	Perkiomen Creek and East Branch Perkiomen Creek Study Area
2.2-16	Temporal Variation in Larval Fish Drift Density at P14390, for 1973 Through 1975
2.2-17	Monthly Drift Density of Larval Fish Species at P14390
2.2-18	Temporal Variation in Larval Fish Drift Density at E2650
2.2-19	Population Estimates of Redbreast Sunfish at 5 Lotic Sites in 1973
2.2-20	Population Estimates of Redbreast at 5 Lotic Sites in 1975
2.2-21	Population Estimates of Green Sunfish by Age Group at 5 Lotic Sites in 1973
2.2-22	Population Estimates of Green Sunfish by Age Group at 5 Lotic Sites in 1975
2.3.1-1	COPAMS Monitoring Stations
2.3.2-1	Limerick Versus Philadelphia Wind Direction Percentage
2.3.2-2	Limerick Versus Allentown Wind Direction Percentage
2.3.2-3	Limerick Versus Peach Bottom Wind Direction Percentage
2.3.2-4	Philadelphia Versus Philadelphia Wind Direction Percentage
2.3.2-5	Allentown Versus Allentown Wind Direction Percentage at 20 and 270 Feet
2.4-1	Schuylkill River Basin

FIGURES (Cont'd)

Figure No.	Title
2.4-2	Location of Downstream Surface Water Users
2.4-3	Flood Frequency Curve
2.4-4	Low Flow Frequency Curves - Schuylkill River at Pottstown, Pa.
2.4-4a	Low Flow Frequency Curves - Perkiomen Creek at Graterford, Pa.
2.4-4b	Low Flow Frequency Curves - Delaware River at Trenton, N. J.
2.4-5	Flow Duration Curve
2.4-6	Rating Curve
2.4-7	Computed Water Surface Profiles
2.4-7a	100-year Floodplain Near Schuylkill Pumping Station
2.4-7b	100-year Floodplain Near Perkiomen Pumping Station
2.4-7c	100-year Floodplain Near Discharge Location of Perkiomen Water Transmission Main - East Branch of Perkiomen Creek
2.4-7d	Energy Dissipator Channel, Perkiomen Water Transmission Main - East Branch of Perkiomen Creek
2.4-7e	100-year Floodplain Near Point Pleasant Pumping Station - Delaware River
2.4-8	Consumptive Makeup Water Supply
2.4-9	Cummulative Annual Water Discharges
2.4-10A	Hydrographs of Observation Wells - Spray Pond Area
2.4-10B	Hydrographs of Observation Wells - Power Block Area
2.4-10C	Groundwater Elevations - Daily Precipitation
2.4-11	Observation Wells and Potentiometric Contours of Water Table, May 25, 1979
2.4-12	Flownet for Spray Pond with Semi-impervious Lining

FIGURES (Cont'd)

Figure No.	Title
2.7-1	Measuring Points for 1973 Ambient Noise Survey

CHAPTER 2

THE SITE AND ENVIRONMENTAL INTERFACES

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 SITE LOCATION AND DESCRIPTION

2.1.1.1 Specification of Location

Limerick Generating Station is located in southeastern Pennsylvania on the Schuylkill River, about 1.7 miles southeast of the limits of the Borough of Pottstown, and about 20.7 miles northwest of the Philadelphia city limits. The Schuylkill River passes through the site, separating the western portion, located in East Coventry Township, Chester County, from the eastern portion, located in Limerick Township and Pottsgrove Township, Montgomery County, Pennsylvania. Figure 2.1-1 identifies the general location of the Limerick site, and Figure 2.1-2 shows the immediate environs, within 5 miles of the site.

The Universal Transverse Mercator coordinates of the Limerick Unit 1 reactor are 4,452,582.462 meters north and 449,984.170 meters east, Zone 18T. The corresponding Greenwich coordinates for Unit 1 are 40°13'26.67" north latitude and 75°35'16.27" west longitude. The Unit 2 reactor is located at 4,452,582.462 meters north and 450,033.548 meters east, Zone 18T of the Transverse Mercator Coordinate System, with corresponding 40°13'26.64" north latitude and 75°35'14.15" west longitude coordinates.

2.1.1.2 Site Area

The land portion of the site consists of 595 acres, as shown in Figure 2.1-3. The property within the site boundary is owned by Philadelphia Electric Company except as noted below. The site boundary is shown in Figure 2.1-3. As shown in Figure 2.1-3, the site is traversed by several public roads, a ConRail right-of-way, and the Schuylkill River. These areas, including the island in the river, are considered public passageways and not part of the site property.

The site is located in gently rolling countryside, traversed by numerous valleys containing small streams that empty into the Schuylkill River. On the eastern bank of the Schuylkill River, the terrain rises from just under el 110 MSL, at the river, to approximately el 300 MSL toward the east, which is the highest ground on the site boundary. Two parallel streams, Possum Hollow Run and Brooke Evans Creek, cut through the site in wooded valleys, running southwest into the Schuylkill River. Grade in the area of the reactor and turbine enclosures is about el 217

MSL. On the western bank of the river the terrain is relatively flat, rising only about 50 feet from the shore to the western edge of the site. One small stream flows southeastward through the site to the Schuylkill River.

The exclusion area for Limerick Generating Station, shown in Figure 2.1-3, is defined as the area encompassed by a radius of 2500 feet from the center of each reactor unit. The property within the exclusion area is owned by Philadelphia Electric Company, except as noted below. As shown in Figure 2.1-3, the exclusion area is traversed by several public roads, a ConRail right-of-way, and the Schuylkill River. These areas, including the island in the river, are considered public passageways and not part of the site property. Arrangements for control of public access to these areas in the event of an emergency have been made with the Pennsylvania State Police and with ConRail, as described in the Emergency Plan.

There are no outstanding mineral rights within the exclusion area.

The locations of principal station structures are shown in Figure 2.1-4. In addition, the Limerick Atomic Information Center is located on the site property. The information center, owned and operated by Philadelphia Electric Company, is open to the public during specified hours. Admission to the information center is controlled by Philadelphia Electric Company.

A power plant simulator, used for training operating personnel, is adjacent to the site. This facility is operated by General Physics Corporation. Use of the facility is controlled by Philadelphia Electric Company.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

The boundary line of the restricted area, as defined in 10 CFR Part 20, is identical to the site boundary line shown in Figure 2.1-3. The land area within the boundary lines is owned by Philadelphia Electric Company. Control of public passageways is discussed in Section 2.1.1.2.

There are no permanent residences within the restricted area.

Station effluent release points are shown in Figure 3.1-2.

2.1.2 POPULATION DISTRIBUTION

2.1.2.1 Population Within 10 Miles

The population distribution within 10 miles, as a function of distance and direction, for the decades 1970 through 2020 and for 1985, is listed in Tables 2.1-1 through 2.1-7. The 1970 and 1980

data are taken from actual census data and the other years are taken from projections (Table 2.1-15). The 1985 projections are considered to be representative of population near the year of initial station operation, and the 2020 projections represent population near the end of station operation. These projections are based on 1980 census data. The 1980 data shows that population has decreased. A map, keyed to Tables 2.1-1 through 2.1-7, is provided in Figure 2.1-5.

The population distribution within 10 miles is based upon the number of households, obtained from a 1980 meter count of Philadelphia Electric Company's residential customer billing file, and a 1980 meter count of Metropolitan Edison Company's billing file. A factor of 2.88 persons per residential meter in Philadelphia Electric Company territory, and a factor of 2.70 persons per residential meter for the Metropolitan Edison Company territory were used to convert the meter count into population.

Projected populations were determined by using county projection factors obtained from state agencies. Where information was not available to the year 2020, Philadelphia Electric Company extended the available information through that year. Table 2.1-15 lists the sources of population information.

Population for the year 1983 was estimated by Philadelphia Electric Company by extrapolation of data between 1980 and 1990. Projections for the years 2010 and 2020 were made by increasing projections for the year 2000 at a rate of 20% per 10-year period.

2.1.2.2 Population Between 10 and 50 Miles

Population distribution between 10 and 50 miles for the decades between 1970 through 2020 and for the year 1985 is listed in Tables 2.1-8 through 2.1-14. The 1970 and 1980 data are taken from actual census data and the other years are based on projections (Table 2.1-15). A map, keyed to Tables 2.1-8 through 2.1-14, is provided in Figure 2.1-6.

Projected populations were determined by using county projection factors obtained from state agencies. Where information was not available to the year 2020, Philadelphia Electric Company extended the available information through that year. Table 2.1-15 lists the sources of population information.

Population changes for 1950 through 1980 in the counties within 50 miles of the station are indicated in Table 2.1-16.

2.1.2.3 Transient Population

The transient population in the site area is classified as daily or seasonal. The daily transients result from an influx of employees to local business and industrial facilities. Local industries, and their location and employment, are listed in Table 2.1-17. The only industries with a significant daily transient population are Mrs. Smith's Pie Company, Sircom Knitting Company, and Crouse Company.

Seasonal transients result from use of recreational areas, of which there is only the Countryside Swim Club, Inc., within 1.3 miles of the station. The maximum daily attendance at the swim club is estimated to be 800, with a daily average of 400 during the summer season.

A 1976 creel survey of people fishing the Schuylkill River within 5 km of the station showed that 96 percent lived within 10 km of the river and thus do not comprise a transient population. These data also projected 1980 fishing pressure within 5 km of the station at 8800 angler hours for the principal fishing months of May through September. The average time spent fishing was 3.5 hours from shore and 4.7 hours by boat. Less than 20 percent of the fishing pressure came from boats. Table 2.1-42 describes boating hours per year as cited by the Pennsylvania Fish Commission. Based on these data and data collected in a 1980 creel survey conducted as part of the Limerick preoperational program, an average of 1100 boaters per year could be expected to use the Schuylkill River within 10 miles of the station, most of which would occur below Vincent Dam (3.3 miles below the station).

2.1.2.4 Age Distribution

The age distribution in Montgomery County compared with the U.S. population in 1980 is shown below:

Age	Percent in Age Group	
	Montgomery County	United States
0-11	14.9	17.7
12-17	10.5	10.3
18 and over	74.6	72.0
Total	100.0	100.0

There is no reason to believe that there will be a significant difference in age distribution in the year 2000 between the United States and Montgomery County. The United States age distribution in 2000 is shown below:

Age	Percent in Age Group
0-11	16.5
12-17	8.7
18 and over	74.8
Total	100.0

2.1.3 USE OF ADJACENT LANDS AND WATERS

The general land use character of the area within 5 miles of the Limerick site is rural and open, and contains one major forest, located in northern Limerick and Lower Pottsgrove Townships. A discussion of local land use was provided in Section 2.1.4 of the Limerick Generating Station Environmental Report - Construction Permit Stage (Revised). There have been no major changes in actual or projected land use patterns.

Present and projected land use within a 5-mile radial area of Limerick is presented in Tables 2.1-18 and 2.1-19. The urban development and population concentration near Limerick lies outside a 2-mile ring and, historically, has been oriented along the Schuylkill River, with recent suburban growth spilling out over municipal boundaries. About half of the 1980 population was located in the Boroughs of Pottstown, Royersford, Spring City, and unincorporated areas of South Pottstown and Kenilworth. Pottstown Borough, with a 1980 population of 22,729 people, is the largest local municipality. The borough's population declined from 1960 to 1970 and continued to decline from 1970 to 1980.

2.1.3.1 Industries

Industries with 10 or more employees within 5 miles of Limerick Generating Station are listed in Table 2.1-17. The number of employees, products, and locations is listed for each establishment.

The nearest industry to the site is the Pottstown Trap Rock Quarry, Inc. Operations of the quarry include the detonation of explosives in the process of quarrying stone. However, the use of explosives is infrequent and only enough explosives for one particular application are brought to the quarry. There are no explosives stored on the quarry site. Other industries located within 1.3 miles of the station include Hooker Chemical Company, Mahr Printing, Inc., Eastern Warehouses, Inc., Amerind-MacKissic, Inc., and Structural Foam, Inc. The location of these industries is shown in Figure 2.1-7. Hooker Chemical Company is the only establishment near the Limerick Generating Station that has significant quantities of hazardous materials stored onsite. These materials are listed in Table 2.1-20.

As shown in Figure 2.1-8, there is a natural gas pipeline adjacent to the site, consisting of two separate pipes, operated by the Columbia Gas Transmission Company, and an oil pipeline operated by

Atlantic Richfield Company within the site area. Other pipelines within 5 miles of the station are operated by Philadelphia Electric Co, Mobil Oil, Texas Eastern Transmission Corp, Transcontinental Gas Pipe Line Corp, and UGI Corp. Pipe sizes, age, operating pressure, etc., are listed in Table 2.1-21. At the present time, there are no plans to utilize these pipelines to transport products other than those currently transported.

2.1.3.2 Transportation Routes

The major transportation routes located within 5 miles of the site include the following:

a. U.S. Route 422, an east-west highway passing approximately 1-1/2 miles to the north of the site.

b. Pennsylvania (PA) Route 100, a north-south highway passing approximately 4 miles west of the site.

c. Pennsylvania (PA) Route 724, a southeast-northwest highway passing approximately 1 mile southwest of the site.

d. The Consolidated Rail Corporation line (formerly Reading Company), passing through the site along the north bank of the Schuylkill River. The line is comprised of three tracks and has a rail spur serving the station.

e. The Consolidated Rail Corporation line (formerly Pennsylvania Central Railroad), running in north-south direction, passing along the western boundary of the site.

These transportation routes are shown in Figure 2.1-8. Planned changes to local transportation routes include the extension of the Schuylkill Expressway, and Interstate Route No. 76 from Valley Forge to the terminus of the Pottstown bypass, U. S. Route 422. The proposed alignment follows the Schuylkill River, generally about a mile away, and passes near the northern boundary of Royersford Borough. About midway through Limerick Township, the expressway veers northward to join with U.S. Route 422. In the vicinity of the Limerick site, the expressway is located farther away from the Schuylkill River than in any other location.

Expressway interchanges now exist along the Pottstown Bypass at PA Route 100, Hanover Street, Keim Street, PA Route 724, Firestone Blvd., Township Line Road (presently labeled Evergreen Road on all street signs), and existing U.S. Route 422. The PA Route 100 interchanges are modified types, which necessitate turning movements across traffic flow to get onto and off the ramps. This turning movement tends to lower traffic capacity of the feeder streets, as well as the ramps.

The Township Line Road intersection, now a rural ramp interchange, would be rebuilt to provide for high speed continuity between the existing Pottstown Bypass and the Expressway extension. Township Line Road is a rather short road, about a mile in length, extending between existing U.S. Route 422 and Possum Hollow Road. Philadelphia Electric Company has extended and improved this road to a modern two-lane road with paved shoulders as the main access to the Limerick Site. Another important interchange of the Expressway extension is with Linfield Road, near Barlow Heights. Linfield Road is planned as an important regional traffic route, since it is now one of the only roads with an adequate bridge crossing the Schuylkill River between Pottstown and Royersford. The only remaining new interchange with the Expressway within a 5-mile radius is with the road leading to the Royersford Borough.

The lower Perkiomen Valley Plan proposes several highway improvements for Limerick Township. Linfield Road is another important regional route to be improved to a semicontrolled access highway that would selectively restrict access of adjacent property owners, although still having grade level intersections. According to Department of Transportation design criteria, a semicontrolled access highway is designed to handle 5,000 to 13,000 vehicles per day. Also included in this recommendation is the proposed relocation of existing U.S. Route 422 and Township Line Road that are recommended to be upgraded to collector roads. It was recommended that Township Line Road be extended and partially relocated to connect with Long View Road.

The widening and improvement of PA Route 724 to a four-lane arterial highway, the programmed Phoenixville spur, and the long-range proposal for the Piedmont Expressway, are the highway factors critical to the future development south of the Schuylkill River in Chester County. The PA Route 724 improvement will include a new interchange with PA Route 100. This southern area is planned for less intensive development than the northern area. New industrial areas, however, are planned in Spring City, near improved PA Route 724 in East Coventry Township, and west of Pottstown Landing. This area is served by a lower level highway network, and the 1968 long-range sewer plans for Chester County anticipate extensions in only the Pottstown Landing, South Pottstown, Kenilworth, and Spring City areas.

The Schuylkill River, in the vicinity of the Limerick site, is used only for recreational boating. Due to the presence of downstream dams, there is no commercial traffic on the river near the Limerick site.

Pottstown Municipal Airport lies about 5 miles northwest of the site and is the only municipal airport within 5 miles. The 1978 National Airport Plan classed it as a general utility airport, one that can handle general aviation craft, except transports and jets. Pottstown Municipal Airport has no scheduled airline

service, but serves a charter service, flying school, and privately owned aircraft. The airport runway is hard-surfaced, 2700 feet long, and has a heading of 250°. A line extending from the runway to the northeast, along the runway's axis, would pass about 3.3 miles from the site boundary at its point of closest approach. Approximately 53 aircraft are based at the airport, and estimated operations are 16,000 annually.

Two additional airports exist at New Hanover, 5 miles north of the site, and at Limerick Center (Pottstown-Limerick airport). The latter facility lies about 2 miles northeast of the site, and is owned by Philadelphia Electric Company and leased to the airport operators. A few small private aircraft use this field. The New Hanover Airport has a sod runway, 3450 feet long, at a heading of 270 degrees. The airport has no scheduled service, but serves skydiving operations and privately owned aircraft. Skydiving is the primary activity, with peak movements taking place on weekends, weather permitting. Approximately 70 percent of the aircraft using the airport are single-engine and 30 percent are twin-engine. The total number of movements is about 2500 annually.

All landing fields within 10 miles of the site are listed in Table 2.1-22. These include 11 landing strips that are for private/restricted use only, and the Perkiomen Valley Airport.

The Perkiomen Valley Airport has a hard-surfaced landing strip with no scheduled airline service, but it supports a charter service, flying school, and privately owned aircraft. The runway is 3000 feet long and has a heading of 270°. About 80 aircraft are based at this airport. Operations are estimated to be 7000 for all aircraft annually.

The Pottstown VOR (Very High Frequency Omni-Direction Range) is located 1.3 miles east of the Limerick Site. This radio range serves as a hub for several VOR airways used for commercial aircraft flights. These airways extend for 4 miles on each side of their centerlines. The Pottstown VOR is the main departure route from Philadelphia International Airport for flights going north and northwest but, due to traffic patterns, it is not used for arrivals. By the time departures reach Pottstown VOR, the flights have reached an altitude of 7000 feet. The federal airways passing within 10 miles of the site are listed in Table 2.1-23.

2.1.3.3 Recreational Areas

There are no major parks or recreational areas within 5 miles of the Limerick site. However, the Schuylkill River downstream of the site is utilized for recreational boating and fishing as discussed in Section 2.1.3.6.

The Countryside Swim Club, shown in Figure 2.1-7, is located approximately 1 mile from the site. Estimated average daily attendance during the swimming season is 400 people.

The 5-mile area also contains the Eastern State Game Farm and State Game Refuge. The Eastern State Game Farm raised and released 60,000 pheasants between July 1, 1975 and June 30, 1976. No other wildlife is raised or released from this facility. There is no other designated hunting area. However, small-game hunting is extensively pursued in almost all areas except where prohibited by Pennsylvania law.

2.1.3.4 Agricultural Land Use

The agricultural industry in the vicinity of the Limerick site is mainly made up of small independent farmers producing small amounts of agricultural goods for local distribution. An agricultural land use survey in the vicinity of Limerick was performed in early 1976. This survey utilized data from a door-to-door survey of farmers within 5 miles of the site, and published agricultural data for the area from 5 to 50 miles. The State of Pennsylvania had lost about 170,000 acres of farm land per year from 1960 through 1974.

Table 2.1-24 gives the location of the nearest milk cow, milk goat, residence, site boundary, and vegetable garden within 5 miles of the site, for each of 16 sectors.

Table 2.1-25A lists the location of dairy pastures by sector and distance. Tables 2.1-25B through 2.1-25E list the locations of beef, swine, sheep, and goat pastures within 5 miles of Limerick Generating Station by sector and distance. The actual locations of these pastures were established by field survey, and transferred to U.S. Geological Survey maps, scale 1:24,000. The distances and directions of the approximate center of each pasture from the point midway between the Limerick vents were determined from these maps.

The milk produced by the dairy farmers in the vicinity of Limerick is used for a variety of purposes. The destination of milk produced within 5 miles of the site is shown in Table 2.1-26. A majority (95%) is sold to nine dairy processors for distribution. The remaining 5% is sold directly to consumers and to the Hershey Chocolate Company for making candy. The distribution of milk for the state of Pennsylvania is presented in Table 2.1-27. Approximately 66% of all milk is used as whole milk by consumers. The remainder is used for processed foods.

The production of milk, meat, and crops within 50 miles of Limerick is given in Tables 2.1-28 through 2.1-35. A breakdown of individual crop types and yield is given in Table 2.1-36.

The feeding practices of dairy farmers were also investigated as part of the 0-5 mile survey. It is believed that the results of this investigation apply to distances to 50 miles. A wide variety of feeding regimes are employed. For the purposes of this survey an "imported" feed is one produced outside the area. The small dairy farms generally depend heavily upon pasture feeding during the pasture season, and on home-grown crops during the winter months. The relative contribution of pasture grass to the cows' diet may be determined by examining the change in the amount of nonpasture feeds consumed from grazing to nongrazing seasons. Since dairy farmers try to maintain the total milk production of their herds at a constant level, they must keep energy intake constant throughout the year. They will substitute non-pasture feeds for pasture grass during the winter months. Data indicate that during the pasture season grass contributes about 30% of the total feed intake. The pasture season in the vicinity of the site ranges from early April to late October. Larger farms tend to depend upon imported feeds, and not on pasture as a major feed constituent. This is due to the high cost of land in this area, and the low productivity of pastures.

2.1.3.5 Residences

The location of all real residences within 1 mile of a point midway between the Limerick vents was established by field survey. The distance to each of these real residences, as measured from a 1:24,000-scale U.S. Geological Survey Map, is listed by sector in Table 2.1-37. The nearest residence in the SSE sector is located outside the 1-mile radius, at about 5400 feet from the Limerick vents. Since the location of real residences in the interval from 1 mile to 5 miles from the Limerick vents were numerous and uniformly distributed, it was neither practical nor necessary to determine their location by field survey.

2.1.3.6 Surface Water Use

Table 2.1-38 and Figure 2.1-9 locate the downstream municipal water users on the Schuylkill River between the station and the Fairmount Dam in Philadelphia. No other municipal water supplier can be affected by station liquid effluents within 50 miles of the site. Table 2.1-38 lists present and projected withdrawal rates and the populations served by each supplier. Two of the suppliers, Keystone Water Company-Norristown District and the Borough of Phoenixville, use Schuylkill River water exclusively.

The city of Philadelphia also utilizes the Delaware River upstream of the confluence of the Schuylkill River as an additional surface water source, at a rate of 282 million gallons per day. The Delaware River, at the point of water withdrawal, is not affected by the station effluents.

The Philadelphia Suburban Water Company utilizes additional surface and ground water sources. The ground water sources are located in hydrologic provinces completely separated from the site and are not affected by station effluents. Additional surface water sources used are the 4400-million-gallon Green Lane Reservoir on Perkiomen Creek and the 350-million-gallon Pickering Reservoir on Pickering Creek. Neither of these reservoirs is affected by station liquid effluents. The Citizens Utilities Home Water Company draws an additional 1.4 million gallons per day from a 600-foot well near the Schuylkill River, approximately 2 miles downstream from the Limerick site.

A door to door agricultural survey within 5 miles of the station as well as information for distances to 50 miles have provided no positive indication of the existence of agricultural irrigation downstream of Limerick Generating Station. Information was provided by the following agencies: Philadelphia County Extension Service, Montgomery County Extension Service, Delaware County Extension Service, Chester County Extension Service, New Jersey Dept. of Environmental Protection-Division of Water Resources, and the Delaware River Basin Commission.

Industrial water users are listed in Table 2.1-39 and located in Figure 2.1-9.

There is no commercial fishing or shellfishing industry throughout the entire length of the Schuylkill River. Furthermore, as a result of the river's physical restraints, future commercial fishing development is not anticipated.

The river downstream of the Limerick site is utilized for recreational boating and fishing. Table 2.1-40 lists the areas that are presently accessible for these purposes, and Table 2.1-41 lists potential downstream recreational areas. Boating and fishing hours spent on the river are listed in Tables 2.1-42 and 2.1-43, respectively. Table 2.1-44 lists the species of fish most frequently caught in the vicinity of Limerick Generating Station.

2.1.3.7 Ground Water Use

Present and projected ground water usage is discussed in Section 2.4.

TABLE 2.1-1

POPULATION DISTRIBUTION 0-10 MILES
1970
DISTANCE (MILES)

Sector	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
N	48	579	423	533	782	6,969	9,334
NNE	110	206	262	360	152	3,121	4,211
NE	21	74	223	322	311	2,982	3,933
ENE	25	71	276	368	180	1,839	2,759
E	18	113	318	474	376	11,995	13,294
ESE	57	131	333	290	328	14,366	15,505
SE	0	417	1,175	4,419	1,235	3,191	10,437
SSE	11	308	1,326	3,612	1,498	25,337	32,092
S	3	390	244	67	337	4,043	5,084
SSW	0	460	290	314	223	2,023	3,310
SW	55	186	163	281	266	3,191	4,142
WSW	42	205	473	397	948	1,120	3,185
W	49	59	1,190	1,192	1,896	304	4,690
WNW	7	76	3,256	11,072	3,323	8,267	26,001
NW	23	466	3,338	8,481	1,987	1,091	15,386
NNW	10	675	1,112	1,093	815	6,234	9,939
Total	479	4,416	14,402	33,275	14,657	96,073	163,302

TABLE 2.1-2

POPULATION DISTRIBUTION 0-10 MILES
1980
DISTANCE (MILES)

Sector	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
N	58	682	894	397	753	3,158	5,942
NNE	46	1,088	244	478	204	2,428	4,488
NE	46	40	202	334	276	3,732	4,630
ENE	12	58	199	380	228	5,139	6,016
E	20	150	271	389	418	5,120	6,368
ESE	29	179	297	268	579	9,223	10,575
SE	6	369	141	4,844	4,055	6,830	16,245
SSE	0	190	285	2,664	1,587	20,992	25,718
S	3	343	331	164	340	3,864	5,045
SSW	12	611	308	513	268	1,848	3,560
SW	69	181	204	311	300	1,783	2,848
WSW	46	179	533	458	1,596	1,899	4,711
W	35	118	1,754	1,515	1,054	2,239	6,715
WNW	40	320	2,992	11,076	3,545	9,791	27,764
NW	20	288	1,872	6,667	1,309	4,004	14,160
NNW	35	711	1,727	1,237	1,304	6,555	11,569
Total	477	5,507	12,254	31,695	17,816	88,605	156,354

TABLE 2.1-3

POPULATION DISTRIBUTION 0-10 MILES
1985
DISTANCE (MILES)

Sector	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
N	60	712	933	414	786	3,296	6,201
NNE	48	1,135	254	499	212	2,533	4,681
NE	48	42	210	349	288	3,894	4,831
ENE	12	60	207	397	237	5,359	6,272
E	21	156	282	406	436	5,341	6,642
ESE	30	186	309	279	604	9,620	11,028
SE	6	385	147	5,054	4,230	7,126	16,948
SSE	0	204	306	2,861	1,704	22,544	27,619
S	3	368	356	176	365	4,150	5,418
SSW	12	656	331	551	288	1,986	3,824
SW	74	195	220	334	322	1,913	3,058
WSW	49	192	572	492	1,714	2,041	5,060
W	37	127	1,884	1,627	1,132	2,405	7,212
WNW	42	334	3,122	11,556	3,699	10,215	28,968
NW	21	300	1,953	6,955	1,366	4,176	14,771
NNW	36	742	1,802	1,290	1,361	6,839	12,070
Total	499	5,794	12,888	33,240	18,744	93,438	164,603

TABLE 2.1-4

POPULATION DISTRIBUTION 0-10 MILES
1990
DISTANCE (MILES)

Sector	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
N	63	741	972	431	818	3,433	6,458
NNE	50	1,182	265	519	221	2,637	4,874
NE	50	44	219	363	300	4,055	5,031
ENE	13	63	216	413	247	5,582	6,534
E	22	163	294	422	454	5,563	6,918
ESE	31	194	322	291	629	10,019	11,486
SE	6	401	153	5,263	4,406	7,423	17,652
SSE	0	218	327	3,058	1,822	24,097	29,522
S	3	393	380	188	390	4,436	5,790
SSW	13	701	354	588	307	2,123	4,086
SW	79	208	235	357	344	2,046	3,269
WSW	53	205	612	526	1,831	2,179	5,406
W	40	136	2,013	1,739	1,210	2,570	7,708
WNW	44	347	3,251	12,035	3,852	10,639	30,168
NW	22	313	2,034	7,244	1,423	4,351	15,387
NNW	38	773	1,876	1,344	1,417	7,123	12,571
Total	527	6,082	13,523	34,781	19,671	98,276	172,860

TABLE 2.1-5

POPULATION DISTRIBUTION 0-10 MILES
2000
DISTANCE (MILES)

Sector	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
N	64	756	990	440	834	3,499	6,583
NNE	51	1,205	270	529	225	2,690	4,970
NE	51	45	223	370	306	4,134	5,129
ENE	13	64	220	421	252	5,691	6,661
E	22	166	300	431	463	5,672	7,054
ESE	32	198	329	297	641	10,213	11,710
SE	6	408	156	5,365	4,491	7,566	17,992
SSE	0	224	336	3,141	1,871	24,749	30,321
S	3	404	390	194	401	4,557	5,949
SSW	14	720	363	604	316	2,179	4,196
SW	81	214	241	367	353	2,102	3,358
WSW	54	211	628	540	1,881	2,239	5,553
W	41	139	2,068	1,786	1,243	2,640	7,917
WNW	45	354	3,314	12,268	3,927	10,844	30,752
NW	22	319	2,073	7,384	1,450	4,435	15,683
NNW	38	788	1,913	1,370	1,444	7,261	12,814
Total	537	6,215	13,814	35,507	20,098	100,471	176,642

Rev. 20, 09/84

TABLE 2.1-6

POPULATION DISTRIBUTION 0-10 MILES
2010
DISTANCE (MILES)

Sector	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
N	77	907	1,189	528	1,001	4,199	7,901
NNE	61	1,446	324	635	271	3,227	5,964
NE	61	54	268	444	367	4,960	6,154
ENE	15	77	264	505	302	6,828	7,991
E	27	199	360	517	555	6,806	8,464
ESE	38	237	394	356	769	12,257	14,051
SE	8	490	188	6,438	5,390	9,081	21,595
SSE	0	269	403	3,769	2,245	29,703	36,389
S	4	485	469	232	481	5,468	7,139
SSW	16	864	436	725	379	2,616	5,036
SW	98	257	289	440	424	2,523	4,031
WSW	65	253	754	648	2,258	2,685	6,663
W	49	167	2,482	2,143	1,491	3,168	9,500
WNW	54	425	3,977	14,722	4,712	13,013	36,903
NW	27	383	2,488	8,861	1,740	5,323	18,822
NNW	46	945	2,295	1,644	1,733	8,714	15,377
Total	646	7,458	16,580	42,607	24,118	120,571	211,980

TABLE 2.1-7

POPULATION DISTRIBUTION 0-10 MILES
2020
DISTANCE (MILES)

Sector	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
N	92	1,088	1,426	633	1,202	5,039	9,480
NNE	73	1,736	389	762	325	3,873	7,158
NE	73	64	322	533	441	5,952	7,385
ENE	18	92	317	606	363	8,195	9,591
E	32	239	432	620	666	8,167	10,156
ESE	46	285	473	427	923	14,708	16,862
SE	9	588	225	7,726	6,468	10,895	25,911
SSE	0	323	484	4,523	2,694	35,640	43,664
S	5	582	562	279	577	6,562	8,567
SSW	20	1,037	523	870	455	3,140	6,045
SW	117	308	347	528	509	3,027	4,836
WSW	78	303	905	777	2,709	3,226	7,998
W	59	200	2,978	2,572	1,790	3,801	11,400
WNW	64	510	4,773	17,667	5,655	15,616	44,285
NW	32	459	2,986	10,634	2,089	6,385	22,585
NNW	55	1,135	2,754	1,972	2,080	10,455	18,451
Total	773	8,949	19,896	51,129	28,946	144,681	254,374

TABLE 2.1-8

POPULATION DISTRIBUTION 10-50 MILES
(1970)

DISTANCE (MILES)

SECTOR	0-10	10-20	20-30	30-40	40-50	50-MILE TOTAL
N	9,334	6,253	40,245	42,944	27,908	126,684
NNE	4,211	19,178	188,605	170,433	35,189	417,616
NE	3,933	21,396	14,868	22,233	38,547	100,977
ENE	2,759	38,121	38,625	17,188	28,712	125,405
E	13,294	52,056	94,689	164,754	338,592	663,385
ESE	15,505	131,917	724,262	610,275	73,658	1,555,617
SE	10,437	90,554	1,255,972	566,597	103,147	2,026,707
SSE	32,092	24,552	250,377	25,563	21,282	353,866
S	5,084	60,017	29,018	332,241	18,248	444,608
SSW	3,310	28,071	23,849	36,668	45,361	137,259
SW	4,142	4,060	34,181	9,976	14,319	66,678
WSW	3,185	7,472	19,717	62,299	126,433	219,106
W	4,690	3,644	15,006	41,717	70,654	135,711
WNW	26,001	123,107	71,310	18,760	26,015	265,193
NW	15,386	7,797	16,911	14,553	61,969	116,616
NNW	9,939	9,816	14,500	5,792	34,883	74,930
TOTAL	163,302	628,011	2,832,135	2,141,993	1,064,917	6,830,358

TABLE 2.1-9

POPULATION DISTRIBUTION 10-50 MILES
1980
DISTANCE (MILES)

Sector	0-10	10-20	20-30	30-40	40-50	50-Mile Total
N	5,942	7,884	53,061	55,728	24,830	147,445
NNE	4,488	24,323	185,370	175,555	38,751	428,487
NE	4,630	18,810	19,791	25,253	49,483	117,967
ENE	6,016	54,025	52,445	19,874	36,108	168,468
E	6,368	60,790	88,479	178,907	331,487	666,031
ESE	10,575	124,311	654,399	609,017	105,734	1,504,036
SE	16,245	84,571	1,042,915	509,968	182,225	1,835,924
SSE	25,718	24,010	260,063	31,240	22,748	363,779
S	5,045	71,662	37,832	329,479	23,712	467,730
SSW	3,560	41,678	25,473	47,226	48,771	166,708
SW	2,848	7,171	34,583	11,577	18,878	75,057
WSW	4,711	9,298	24,662	72,930	133,537	245,138
W	6,715	4,729	17,437	49,786	74,846	153,513
WNW	27,764	120,554	72,875	25,831	29,043	276,067
NW	14,160	9,026	17,164	17,026	63,480	120,856
NNW	11,569	12,706	16,031	7,502	34,491	82,299
Total	156,354	675,548	2,602,580	2,166,899	1,218,124	6,819,505

TABLE 2.1-10

POPULATION DISTRIBUTION 10-50 MILES
1985
DISTANCE (MILES)

Sector	0-10	10-20	20-30	30-40	40-50	50-Mile Total
N	6,201	15,786	55,411	58,654	26,896	162,948
NNE	4,681	25,699	193,709	184,827	40,999	449,915
NE	4,831	19,495	21,217	26,719	52,088	124,350
ENE	6,272	54,208	56,225	21,111	39,128	176,944
E	6,642	71,745	94,178	191,806	348,565	712,936
ESE	11,028	136,168	600,174	571,592	108,755	1,427,717
SE	16,948	84,872	948,054	500,820	186,962	1,737,656
SSE	27,619	31,051	257,792	32,345	23,407	372,214
S	5,418	78,282	39,399	343,371	24,571	491,041
SSW	3,824	43,076	27,358	49,699	50,543	174,500
SW	3,058	9,030	37,127	12,403	19,894	81,512
WSW	5,060	9,084	26,382	78,015	142,849	261,390
W	7,212	4,335	18,608	53,247	79,911	163,313
WNW	28,968	129,767	76,716	27,363	30,747	293,561
NW	14,771	4,579	18,068	17,852	66,226	121,496
NNW	12,070	13,491	16,858	7,843	36,416	86,678
Total	164,603	730,668	2,487,276	2,177,667	1,277,957	6,838,171

TABLE 2.1-11

POPULATION DISTRIBUTION 10-50 MILES
1990
DISTANCE (MILES)

Sector	0-10	10-20	20-30	30-40	40-50	50-Mile Total
N	6,458	16,501	57,759	61,579	28,963	171,260
NNE	4,874	26,941	202,042	193,452	43,149	470,458
NE	5,031	20,676	22,643	28,000	54,138	130,488
ENE	6,534	56,983	60,007	22,529	41,340	187,393
E	6,918	74,718	99,879	204,701	368,386	754,602
ESE	11,486	141,812	545,945	545,422	118,787	1,363,452
SE	17,652	87,619	853,199	509,471	201,709	1,669,650
SSE	29,522	33,077	255,520	35,376	24,065	377,560
S	5,790	83,674	40,942	356,138	25,115	511,659
SSW	4,086	46,044	29,239	52,309	53,205	184,883
SW	3,269	9,652	39,671	13,226	21,149	86,967
WSW	5,406	9,678	28,101	83,101	152,160	278,446
W	7,708	4,486	19,777	56,708	84,972	173,651
WNW	30,168	136,351	80,556	28,896	32,451	308,422
NW	15,387	4,929	18,974	18,681	68,972	126,943
NNW	12,571	14,243	17,682	8,183	38,340	91,019
Total	172,860	767,384	2,371,936	2,217,772	1,356,901	6,886,853

TABLE 2.1-12

POPULATION DISTRIBUTION 10-50 MILES
2000
DISTANCE (MILES)

Sector	0-10	10-20	20-30	30-40	40-50	50-Mile Total
N	6,583	16,837	58,743	62,871	29,786	174,820
NNE	4,970	27,473	205,566	198,282	44,225	480,516
NE	5,129	21,141	23,177	30,320	59,686	139,453
ENE	6,661	58,184	61,422	24,904	47,162	198,333
E	7,054	76,172	102,127	209,526	389,831	784,710
ESE	11,710	144,573	542,450	572,224	137,627	1,408,584
SE	17,992	89,099	844,309	550,741	224,521	1,726,662
SSE	30,321	33,947	256,615	39,309	25,600	385,792
S	5,949	85,943	42,015	368,752	26,026	528,687
SSW	4,196	47,295	30,036	54,130	55,746	191,403
SW	3,358	9,915	40,738	13,566	21,947	89,524
WSW	5,553	9,931	28,797	85,157	155,924	285,362
W	7,917	4,564	20,260	58,108	87,041	177,890
WNW	30,752	139,379	82,329	29,560	33,205	315,225
NW	15,683	5,078	19,391	19,088	70,460	129,700
NNW	12,814	14,581	18,059	8,347	39,276	93,077
Total	176,642	784,114	2,376,034	2,324,885	1,448,063	7,109,738

TABLE 2.1-13

POPULATION DISTRIBUTION 10-50 MILES
2010
DISTANCE (MILES)

Sector	0-10	10-20	20-30	30-40	40-50	50-Mile Total
N	7,901	20,203	70,491	75,444	35,745	209,784
NNE	5,964	32,968	246,677	237,938	53,069	576,616
NE	6,154	25,371	27,813	36,384	71,622	167,344
ENE	7,991	69,822	73,705	29,886	56,593	237,997
E	8,464	91,406	122,553	251,430	467,794	941,647
ESE	14,051	173,487	650,942	686,669	165,153	1,690,302
SE	21,595	106,916	1,013,175	660,888	269,426	2,072,000
SSE	36,389	40,734	307,940	47,173	30,722	462,958
S	7,139	103,134	50,417	442,504	31,232	634,426
SSW	5,036	56,752	36,041	64,955	66,896	229,680
SW	4,031	11,895	48,889	16,280	26,336	107,431
WSW	6,663	11,919	34,557	102,185	187,108	342,432
W	9,500	5,478	24,311	69,729	104,447	213,465
WNW	36,903	167,256	98,795	35,473	39,845	378,272
NW	18,822	6,094	23,269	22,906	84,552	155,643
NNW	15,377	17,499	21,671	10,016	47,131	111,694
Total	211,980	940,934	2,851,246	2,789,860	1,737,671	8,531,691

TABLE 2.1-14

POPULATION DISTRIBUTION 10-50 MILES
2020
DISTANCE (MILES)

Sector	0-10	10-20	20-30	30-40	40-50	50-Mile Total
N	9,480	24,242	84,586	90,526	42,888	251,722
NNE	7,158	39,555	296,007	285,513	63,674	691,907
NE	7,385	30,441	33,371	43,654	85,939	200,790
ENE	9,591	83,778	88,441	35,859	67,908	285,577
E	10,156	109,680	147,060	301,706	561,341	1,129,943
ESE	16,862	208,176	781,112	823,984	198,173	2,028,307
SE	25,911	128,297	1,215,788	793,046	323,302	2,486,340
SSE	43,664	48,875	369,510	56,603	36,862	555,514
S	8,567	123,754	60,496	530,994	37,474	761,285
SSW	6,045	68,045	43,245	77,941	80,271	275,597
SW	4,836	14,273	58,659	19,532	31,599	128,899
WSW	7,998	14,296	41,466	122,616	224,521	410,897
W	11,400	6,573	29,168	83,668	125,325	256,134
WNW	44,285	200,700	118,545	42,560	47,807	453,897
NW	22,585	7,310	27,917	27,482	101,452	186,746
NNW	18,451	20,994	26,002	12,018	56,551	134,016
Total	254,374	1,129,039	3,421,369	3,347,702	2,085,087	10,237,571

TABLE 2.1-15

SOURCES OF PROJECTED POPULATIONS

State	1970	1980	1985	1990	2000	2010	2020
Delaware	1	7	8	2	2	6	6
Maryland	1	7	8	3	3	6	6
New Jersey	1	7	8	4	4	6	6
Pennsylvania	1	7	8	5	5	6	6

		Year of Estimate
1	U.S. Census	1970
2	Delaware Development Office, Delaware Population Consortium	1982
3	Maryland Department of State Planning	1982
4	New Jersey Department of Labor, Division of Planning and Research, Office of Demographic and Business Economic Analysis	1983
5	Pennsylvania Department of Environmental Resources	1983
6	Philadelphia Electric Company	1984
7.	U.S. Census	1980
8.	Philadelphia Electric Company, based on projections made by sources 2, 3, 4, and 5	1984

TABLE 2.1-16

BUREAU OF CENSUS POPULATIONS OF COUNTIES WITHIN 50 MILES OF THE SITE

COUNTY	STATE	1950	1960	1970	1980
New Castle	DE	218,879	307,446	385,856	399,002
Cecil	MD	33,356	48,408	53,291	60,430
Burlington	NJ	135,910	224,499	323,132	362,542
Camden	NJ	300,743	392,035	456,291	471,650
Gloucester	NJ	91,727	134,840	172,681	199,917
Hunterdon	NJ	42,736	54,107	69,718	87,361
Mercer	NJ	229,781	266,392	303,968	307,863
Salem	NJ	49,508	59,711	60,346	64,676
Somerset	NJ	99,052	143,913	198,372	203,129
Warren	NJ	54,374	63,220	73,879	84,429
Berks	PA	255,740	275,414	296,382	312,509
Bucks	PA	144,620	308,567	415,056	479,211
Carbon	PA	57,558	52,889	50,573	52,285
Chester	PA	159,141	210,608	278,311	316,660
Delaware	PA	414,234	553,154	600,035	555,007
Lancaster	PA	234,717	278,359	319,693	362,346
Lebanon	PA	78,905	90,853	99,665	109,829
Lehigh	PA	198,207	227,536	255,304	273,582
Monroe	PA	33,803	39,567	45,422	69,409
Montgomery	PA	353,068	516,682	623,799	643,621
Northampton	PA	185,243	201,412	214,368	225,418
Philadelphia	PA	2,071,605	2,002,517	1,948,609	1,688,210
Schuylkill	PA	200,577	173,027	160,089	160,630
York	PA	202,737	238,336	272,603	312,963

TABLE 2.1-17

INDUSTRIES WITHIN 5 MILES OF SITE

COMPANY	PRODUCT	LOCATION	TOTAL NUMBER OF EMPLOYEES	DISTANCE FROM SITE (MILES)	DIRECTION FROM SITE
Montgomery County					
Mrs. Smith's Pie Co	Frozen Specialties	Charlotte & Water Sts Pottstown	1,700	3.6	WNW
Princess Bakery	Bread and Bakery Products	113 S. Washington St Pottstown	14	3.2	WNW
Lincoln Underwear Co	Knit Underwear Mills	175 S. Evans St Pottstown	240	3.5	WNW
Spring City Knitting Co	Circular Knit Fabric Mills	475 N. Lewis Rd Boyersford	129	2.6	ESE
Pottstown Textile Co., Inc	Dresses	420 Apple St Pottstown	36	3.2	WNW
Sunset Manufacturing Inc	Dresses	24 Moser Rd Pottstown	300	2.0	NW
INA-Lin Dress Co	Dresses	119 N. York St Pottstown	40	3.8	WNW
Frederick Bros, Inc	Millwork	Hanover and East Sts Pottstown	14	3.7	NW
Dela Foil, Inc.	Aluminum Products	Shoemaker & Robinson Rds Pottstown	10	4.3	WNW
Rixie Paper Products, Inc	Paperboard Products	Quinter and H Sts Pottstown	40	5.1	WNW
Peerless Publications, Inc	Newspapers	Hanover and King Sts Pottstown	99	3.6	WNW
Mahr Printing	Commercial Printing	R. D. 3 Pottstown	13	1.1	NNW
Smales Printery	Commercial Printing	785 N. Charlotte St Pottstown	20	3.5	NW

TABLE 2.1-17 (Cont'd)

COMPANY	PRODUCT	LOCATION	TOTAL NUMBER OF EMPLOYEES	DISTANCE FROM SITE (MILES)	DIRECTION FROM SITE
Risson Press, Inc	Commercial Printing	244 King St Pottstown	12	3.5	WNW
S.T.V., Inc.	Engineering	Robinson Rd Pottstown	225	4.3	WNW
Polymeric Systems, Inc	Adhesives and Sealants	860 Cross St Pottstown	34	2.6	WNW
Pottstown Roller Mills, Inc.	Ball and Roller Bearings	625 Ind Hwy Pottstown	10	2.9	WNW
Stanley Tools, Inc	Miscellaneous Plastics Products	Upper Lewis Rd Limerick Twp	136	2.9	E
Diamond Glass Co	Glass Containers	First Ave Royersford	780	4.0	SE
Keystone Gray Iron Foundry Co	Gray Iron Foundries	Keim and Cross Sts Pottstown	60	2.6	WNW
Albright Paper & Box Co.	Carboard Conversion	Robinson Rd Pottstown	8	4.3	WNW
Reading Crane & Engineering Co.	Conveying Equipment	1200 High St Pottstown	30	2.3	NW
Morris Wheeler & Co, Inc Fabricating Works	Fabricated Structural Steel	First Ave Royersford	80	4.1	SE
Pottstown Metal Welding Co, Inc	Fabricated Plate Work	350 W. High St Pottstown	45	4.4	WNW
Sanatoga Metal Co, Inc	Sheet Metal Work	Sanatoga Lower Pottsgrove Twp	15	1.0	WNW
Superior Metal Prod Co, Inc	Sheet Metal Work	Berks St Pottstown	45	5.3	WNW
Cann and Saul Steel Co	Iron and Steel Forgings	N. 4th Ave Royersford	190	3.6	SE

TABLE 2.1-17 (Cont'd)

COMPANY	PRODUCT	LOCATION	TOTAL NUMBER OF EMPLOYEES	DISTANCE FROM SITE (MILES)	DIRECTION FROM SITE
Mrs. Smith's Foil Co	Metal Stampings, N.E.C.	255 South St Pottstown	75	3.6	WNW
American Metal Finishers, Inc	Electroplating	1346 Farmington Ave Pottstown	30	4.5	NW
Platers, Inc	Electroplating	Keim and Cross Sts Pottstown	12	2.6	WNW
Pottstown Plating Works	Electroplating	Washington & Laural Sts Pottstown	52	3.2	WNW
Rivlin Bros.	Scrap Processing	Old Reading Pike Pottstown	10	5.5	WNW
Pottstown Pipe Products, Inc	Valve and Pipe Fittings	412-42 Laurel St Pottstown	44	3.2	WNW
Royersford Spring Co	Wire Springs	Main Street & 1st Ave Royersford	29	3.7	SE
B and S Specialties, Inc	Fabricated Metal Products, N.E.C.	RT 20 & Levengood Rd Pottstown	23	4.7	NW
Teleflex, Inc Mechanical Division	Internal Combustion Engines, N.E.C.	North Wales Limerick Twp	200	2.5	E
Neapco Products, Inc	Construction Machinery and Equipment	Queen and Bailer Sts Pottstown	400	3.0	WNW
United States Axle Co	Construction Machinery and Equipment	275 Shoemaker Pottstown	40	4.8	WNW
Pottstown Machine Co	Machine Tools	Roland and Reading RR Pottstown	80	2.3	WNW
Brusch Machine and Tool Co	Special Dyes and Tools	342 W. Ridge Pike Limerick Twp	15	3.6	E
Chop Rite Mfg Co	Food Products Machinery	859 Cross St Pottstown	22	2.7	WNW

TABLE 2.1-17 (Cont'd)

COMPANY	PRODUCT	LOCATION	TOTAL NUMBER OF EMPLOYEES	DISTANCE FROM SITE (MILES)	DIRECTION FROM SITE
American Machine and Tool Co, Inc	Woodwcrking Machinery	Spring and 4th Sts Royersford	100	3.9	SE
Clover Lamp Co, Inc	Lighting Equipment, N.E.C.	First Ave Royersford	100	3.9	SE
Dana Corp - Spicer Division	Motor Vehicle Parts and Accessories	125 S. Keim St Pottstown	625	2.5	WNW
Tri-Rx Laboratories	Optical Instruments and Lens	701 High St Pottstown	45	2.7	WNW
Power Wash, Inc	Manufacturing Industries, N.E.C.	High and Berks St Pottstown	20	4.7	WNW
Montgomery County					
A & L Handles, Inc.	Plastic Products	244 Shoemaker Rd. Pottstown	30	4.7	WNW
Amcord, Inc.	Redwood Furniture	Adam & Queen Sts. Pottstown	106	3.1	WNW
Gudebrod, Inc.	Thread, Sewing Kits & Cord	Shoemaker Road Pottstown	250	4.7	WNW
Hooker Chemical Co./PVC Div.	PVC Resins and Fabricated Products	Firestone Boulevard Pottstown	750	1.5	WNW
Pollock Research & Design, Inc.	Special Design Machinery & Material Handling Equipment	1200 High St.	90	2.3	NW
Pottstown Plating Works, Inc.	Electroplating & Finishing - Metals	Washington & Laurel Pottstown	52	3.1	WNW
Bemiss-Jason Corp.	Corrugated Paper Displays, Crepe Papers, School Supplies	Railroad Avenue Royersford	20	3.4	SE
Dow Chemical Co.	Plastic Lined Pipe	1st Avenue Royersford	7	4.2	SE

TABLE 2.1-17 (Cont'd)

COMPANY	PRODUCT	LOCATION	TOTAL NUMBER OF EMPLOYEES	DISTANCE FROM SITE (MILES)	DIRECTION FROM SITE
French Creek Products	Plastic Products	1st Avenue Royersford	18	3.4	SE
H. E. Quay Welding	Welding Specialties	Robinson Rd. Pottstown	3	4.7	WNW
Snow King Frozen Foods, Inc.	Processing of Frozen Foods	980 Glascow St. Pottstown	120	4.8	WNW
Pottstown Cement Block Co.	Concrete Block & Brick	W. High Street Pottstown	7	5.5	WNW
Crouse Co., Inc.	Fabricated Pipe and Industrial Controls	Upper Lewis Rd. Royersford	1,300	3.1	E
Gretz Machine Products	Machinery	40 Sacco Rd. Linfield, Limerick Twp.	13	1.4	SE
Videotek, Inc.	Radio - TV Transmitting, & Detectional Equipment	125 N. York St. Pottstown	85	3.8	WNW
D - B Construction Co.	Wood Kitchen Cabinets	1949 N. Charlotte St Pottstown	41	3.6	NNW
"The Guardian"	Newspaper	40 High St. Pottstown	9	3.9	WNW
Sermetal, Inc.	Inorganic Chemical Coatings	International Hq. 155 S. Limerick Rd. Limerick	83	2.8	E
Nelson's Ice Cream Inc.	Ice Cream	651 Walnut St. Royersford	35	3.8	SE
Bechtel Dairies	Dairy	617 S. Lewis Rd. Royersford	52	4.8	ESE
Columbia Boiler Co. of Pottstown	Heating Equipment	Old Reading Pike W. Pottsgrove Twp.	89	5.3	WNW
Roll Form, Inc.	Roll Forming & Metal Fab.	Rt. 422 Limerick	10	4.1	E

TABLE 2.1-17 (Cont'd)

COMPANY	PRODUCT	LOCATION	TOTAL NUMBER OF EMPLOYEES	DISTANCE FROM SITE (MILES)	DIRECTION FROM SITE
Imperial Specialty, Inc.	Screw Machine Products	1153 Sembling Ave. Pottstown	20	2.4	WNW
Baker Equipment Engr. Co. of Pa.	Comm. - Ind. Machinery	Airport Rd. Ben Franklin Hwy Limerick	41	2.4	E
Beechwood Co.	Plastic	1356 Farmington Ave. Pottstown	12	4.5	NW
A. W. Walker	Electrical Construction	826 North Lewis Royersford	30	2.5	E
Jacob Castings Pattern Work, Inc.	Industrial Patterns - Alum. & Zinc Molded Castings	Old Reading Pike Pottstown	70	5.4	WNW
Mayer - Pollack Steel Corp.	Fabricated Structural Steel	S. Keim St. Pottstown	200	2.6	WNW
"The Mercury"	Newspaper	Hanover & King Sts. Pottstown	99	3.6	WNW
Interstate Energy	Energy Research	Robinson Road Pottstown	12	4.5	WNW
Pottsgrove Metal Finishers	Electroplater	533 W. High St. Pottstown	45	5.5	WNW
Chester County					
Norco Finishing, Inc	Electroplating	238 Root Ave Pottstown	14	3.7	WNW
Bard Mfg. Div. Miller Seal	Precision Parts (Screw Machine Parts)	Elliswood Rd. Pottstown	25	1.9	WSW
Pickar Bros.	Die Cast & Plastic Molds	876 E. Schuylkill Rd. Pottstown	14	2.6	WNW
Meadowbrook Farms, Inc	Fluid Milk	895 S. Keim St Pottstown	53	2.7	W

TABLE 2.1-17 (Cont'd)

COMPANY	PRODUCT	LOCATION	TOTAL NUMBER OF EMPLOYEES	DISTANCE FROM SITE (MILES)	DIRECTION FROM SITE
Sunny Slope Dairies, Inc	Fluid Milk	Bridge St Ext Spring City	88	3.2	S
Sircom Knitting Co, Inc	Male Underwear	475 N. Lewis St Spring City	1,000	2.6	ESE
Valley Forge Flag Co, Inc	Fabricated Textile Prod, N.E.C.	Main St Spring City	175	3.6	SSE
Weekly Advisor, Inc c/o The Reporter	Newspapers, Publishing and Printing	225 Schuylkill Rd Spring City	11	3.4	SSE
Tursack Printing, Inc.	Commercial Printers, Lithographic	R.D. 1 Spring City	32	5.3	SW
Taylor Industires	Cut Stone and Stone Products	Anderson Rd Parkerford	26	1.4	SSW
Little Lake Industries (U.S. Leisure, Inc)	Wood Household Furniture	Sanatoga Rd East Coventry Twp	105	0.6	W
Mingo Nonferrous Metals, Inc	Nonferrous Foundries	N. Church St Spring City	34	3.4	SSE
Allied Steel Products Corp of PA	Fabricated Plate Work	Rt. 724 & Wells Rd Parkerford	28	1.4	S
Spring City Electric Mfg Co.	Cast Metal Housings	Hall and Main Sts Spring City	90	3.9	SSE
Brinser Mfg Co	Screw Machine Products	312 Church St Spring City	10	3.7	SSE
Norco Foundry and Specialty Co, Inc	Valves and Pipe Fittings	216 River Rd Pottstown	25	3.8	WNW
Amerind-Mackessic, Inc	Garden Tractors and Equipment	Old Schuylkill Rd Parkerford	59	1.3	SSW
Progressive Machine Co, Inc	Special Industrial Machinery, N.E.C.	Pughtown Rd, R.D. 1 Spring City	20	5.2	SSW

TABLE 2.1-17 (Cont'd)

COMPANY	PRODUCT	LOCATION	TOTAL NUMBER OF EMPLOYEES	DISTANCE FROM SITE (MILES)	DIRECTION FROM SITE
Spring City Foundry	Noncurrent - Carrying Wiring Devices	Hall and Main Sts Spring City	100	4.0	SSE
Recticon Corp	Semiconductors and Related Devices	Rt 724 & Wells Rd Parkerford	75	1.4	S
LaSalle Steel Co	Cold Finished Steel Bars	Main & Bridge Sts Spring City	81	3.5	SSE
Micro-Strain, Inc	Electronic Measuring Devices	Stoney Run Rd Spring City	9	3.6	S
Spring City Hoisery Mill, Inc	Women's Hosiery	Pikeland Ave Spring City	12	4.2	SSE

TABLE 2.1-18

PRESENT LAND USAGE WITHIN 5 MILES OF LGS[1]

Usage	Area (m^2)	% of Total
Agricultural	4.46×10^7	21.9
Cropland	3.68×10^7	82.5
Pasture	4.48×10^6	10.1
Timber and Brush	1.56×10^6	3.5
Other	1.75×10^6	3.9
Residential	2.69×10^7	13.3
Industrial [2]	1.59×10^7	7.8
Transportation	7.11×10^6	3.5
Recreation	5.14×10^6	2.5
Wildlife Preserve	5.18×10^5	0.3
Miscellaneous [3]	1.03×10^8	50.7
Total	2.03×10^8	100.0%

(1) Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1977. Comprehensive plans of boroughs and townships within the study area.

(2) Included within industrial land usage are commercial land use, institutional land use, and land use attributable to utilities.

(3) Miscellaneous land use primarily includes open space and vacant lands.

TABLE 2.1-19 (Page 1 of 2)

PROJECTED LAND USAGE WITHIN 5 MILES OF LGS
BY YEAR 2000

Usage	Area (m^2)	% of Total
Agricultural	3.23×10^7	15.9
Cropland	2.66×10^7	82.5
Pasture	3.26×10^6	10.1
Timber and Brush	1.13×10^6	3.5
Other	1.26×10^6	3.9
Residential	1.23×10^8	60.4
Industrial (1)	2.48×10^7	12.2
Transportation	1.18×10^7	5.8
Recreational	1.09×10^7	5.4
Wildlife Preserve	5.18×10^5	0.3
Total	2.03×10^8	100.0%

(1) Included within industrial land usage are commerical land use, institutional land use, and land use attributable to utilities.

Source: Comprehensive plans of boroughs and townships within the study area (Comprehensive plans used are listed below.

1) Borough of Pottstown Comprehensive Plan - 1968, Montgomery County Planning Commission, Norristown, Pa.

2) Royersford Borough Comprehensive Plan - 1964, Montgomery County Planning Commission, Norristown, Pa.

3) Spring City Borough Comprehensive Plan - 1965, Chester County Planning Commission, West Chester, Pa.

TABLE 2.1-19 (Cont'd) (Page 2 of 2)

4) Upper Pottsgrove Township Comprehensive Plan - 1972, Montgomery County Planning Commission, Norristown, Pa.

5) Lower Pottsgrove Township Comprehensive Plan - 1964, Montgomery County Planning Commission, Norristown, Pa.

6) New Hanover Township Comprehensive Plan - 1969, Montgomery County Planning Commission, Norristown, Pa.

7) Upper Providence Township Comprehensive Plan - 1972, Montgomery County Planning Commission, Norristown, Pa.

8) East Coventry Township Comprehensive Plan - 1966, Chester County Planning Commission, West Chester, Pa.

9) East Pikeland Township Comprehensive Plan - 1965, Chester County Planning Commission, West Chester, Pa.

10) North Coventry Township Comprehensive Plan - 1977, Chester County Planning Commission, West Chester, Pa.

TABLE 2.1-20

HOOKER CHEMICAL COMPANY

Bag Chemical	Maximum Quantity	Elevation of Tanks	Relief Valve Capacity	Storage Temp °F and Pressure Psig
Vinyl Chloride	3,000,000 lb	12 feet	100 psig	30 psig-ambient
Butadiene	500,000 lb	12 feet	100 psig	20 psig-ambient
Tri-fluro-chloroethylene	2,000 lb	Portable cylinder	375 psig	68 psig-ambient
Tri-fluro-chloroethylene	1,000 lb	In process	--	Ambient
Formaldehyde	50 Drums	Warehouse	--	Ambient
Methanol	10 Drums	Warehouse	--	Ambient
Nitrogen	139,000 SCF	3 feet	350 psig	-325°F
Toluene	13,000 gal.	12 feet	100 psig	Ambient-vent
Gasoline	52,000 gal.	Underground	--	Ambient-vent
Styrene	50,000 gal.	12 feet	100 psig	Ambient-vent
Vinyl Acetate	25,000 gal.	12 feet	100 psig	Ambient-vent
Trichloro-ethylene	25,000 gal.	12 feet	100 psig	Ambient-vent
Vinyl Pyridine	10,000 gal.	8 feet	--	40°F-vent

TABLE 2.1-21 (Page 1 of 3)

PIPELINES WITHIN 5 MILES OF LIMERICK GENERATING STATION

Pipeline	Columbia Gas Transmission Co No. 1278	Columbia Gas Transmission Co No. 1010	Atlantic Richfield Co
Size (inch)	14	20	8
Operating Pressure (psig)	1000 max	1200 max	1200 max
Age (years)	31	13	11
Depth of Burial (feet)	3 min	3 min	3 min
Fluid Carried	Natural gas	Natural gas	Refined hydrocarbons
Isolation Valves	1. South of Schuylkill River near Parkerford 2. Each side of Schuylkill River crossing (line divides into two 10-inch lines for river crossing with plug valves located on either side of river) 3. One mile southeast of Feqleysville at intersection of Houck Rd and Swamp Pike.	1. South of Schuylkill River near Parkerford 2. One mile southeast of Feqleysville at intersection of Houck Rd and Swamp Pike	1. Each side of Schuylkill River crossing 2. Approximately 8 miles north of Limerick site

TABLE 2.1-21 (Cont'd)

Pipeline	Mobil Oil	UGI Corp	Texas Eastern Transmission Corp
Size (inch)	8	12	2 lines, each 20 inch
Operating Pressure (psig)	1440	150 max.	650
Age (years)	33	26	38
Depth of Burial (ft)	2 min	2 min	3 min
Fluid Carried	Gasoline and fuel oil	Natural gas	Natural gas
Isolation Valves	1. Each side of Schuylkill River crossing, 2. Limerick Township at Grebe Road, approximately 4-1/2 miles northeast of Limerick site.	1. Gate Station located at tie-in to Columbia Gas line south of Royersford, PA, 2. North Coventry Twp. near Route 100, approxmately 4 miles west of Limerick site.	1. Each side of Schuylkill River crossing near Royersford; 2. Near Eagle, PA, approximately 11 miles southwest of Limerick site. 3. Near Landsdale, PA approximately 15 miles east of Limerick site.

TABLE 2.1-21 (Cont'd)

Pipeline	Transcontinental Gas Pipe Line Corp	PECo	PECo
Size (inch)	6	12	6/8
Operating Pressure (psig)	750	100 max	20 max
Age (year)	29	Original main installed in 1929, sections replaced as necessary	Original main installed in 1930, sections replaced as necessary
Depth of Burial (ft)	2 min	3 min	3 min
Fluid Carried	Natural gas	Natural gas	Natural gas
Isolation Valves	1. Pottstown gate station in western Pottstown near Keim St. and Conrail Railroad tracks. 2. West Vincent Twp near Hollow Rd. approximately 7 miles south of Limerick site.	1. Kenilworth 800 ft. west of Keim St. on Schuylkill Rd. 2. East Coventry Twp., 1600 ft. south of Vaughn Rd. on Schuylkill Rd. 3. Parkerford, 100 ft east of Anderson Rd. on Schuylkill Rd. 4. Parkerford, 1600 ft east of Bethel Rd. on Schuylkill Rd. 5. Spring City, south of Park Ave on Schuylkill Rd.	1. Pottstown, west of Beech St. on High St. 2. Lower Pottsgrove Twp. 100 ft. east of Brown St. on Route 422. 3. Lower Pottsgrove twp. west of Rupert Rd. on Route 422. 4. Limerick Twp., west of Penn Rd. on Route 422. 5. Limerick Twp, east of Neiffer Rd. on route 422. 6. Limerick Twp. south of Route 422 on Lewis Rd.

TABLE 2.1-22

AIRPORTS WITHIN 10 MILES OF THE SITE(1)

Airport	Approximate Distance From Site (mi)	Type	Runway Surface/Service	Longest Runway (ft)
Pottstown-Limerick	2	Public use	Hard surface/lights	3412
Pottstown Municipal	5	Public use	Hard surface/lights	2700
New Hanover	5	Public use	Soft surface	3450
Perkiomen Valley	8.5	Public use	Hard surface/lights	2900
Sunset Strip	5	Private use	Soft surface	1550
Godshall	8	Private use	Soft surface	2000
Kings	8	Private use	Soft surface	1700
Yarrow	9	Private use	Soft surface	1800
Kunda	8.5	Private use	Soft surface	1300
Malickson	7	Private use	Soft surface	1800
Kolb	5	Private use	Soft surface	1500
Ginrich	4.5	Private use	Soft surface	1600
Emery	2	Private use	Soft surface	1300
Dinascio	5.5	Private use	Soft surface	1300
Hansen	7.5	Private use	Soft Surface	1800

(1) VFR Terminal Area Chart for Philadelphia, PA, January 1, 1980

TABLE 2.1-23

AIRWAYS WITHIN 10 MILES OF THE SITE[1]

Designation	Centerline distance from site	Flight direction	Magnetic Radial From Pottstown VOR
V143	Approximately 1 mi to south	East-west	095° and 269°
V29,V147	Approximately 1.3 mi to east	North-south	205° and 354°
V210	Approximately 8 mi to south	East-west	
V276	Approximately 10 mi to northeast	Northwest-southeast	

[1] VFR Terminal Area Chart for Philadelphia, PA, September 7, 1978

TABLE 2.1-24

LOCATION OF NEAREST[1] MILK COW, MILK GOAT, RESIDENCE, SITE BOUNDARY, AND VEGETABLE GARDEN[3] (DISTANCE IN METERS)

Sector	Milk Cow	Milk Goat	Residence	Site Boundary	Vegetable[2] Garden
N	8534	-	914	884	914
NNE	-	6980	792	792	792
NE	4267	-	1052	792	1052
ENE	6706	-	823	792	823
E	6980	-	1021	762	1021
ESE	4511	1770[4]	945	762	945
SE	3597	-	1554	762	1554
SSE	7376	-	1770	1006	1770
S	3627	-	1341	762	1341
SSW	3048	-	1524	762	1524
SW	2835	-	1006	884	1006
WSW	2134	-	1173	853	1173
W	4755	-	975	853	975
WNW	-	-	1128	792	1128
NW	-	-	1128	762	1128
NNW	-	-	1204	884	1204

(1) Nearest within 5 miles.

(2) It is assumed that the nearest vegetable garden is located at the nearest residence in each sector.

(3) Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

(4) This goat farm has been established since the RMC "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979.

TABLE 2.1-25A

LOCATION OF DAIRY PASTURES WITHIN 5 MILES OF LIMERICK GENERATING STATION UNITS 1 AND 2 AND GRAZING FACTORS AT EACH LOCATION[1]

Sector	Distance From Vents (Feet)	Distance From Vents (Meters)	Fraction of Year Cows Are On Pasture	Fraction of Food Required During Grazing Season Obtained From Pasture
N	28,000	8,534	0.750	0.884
NE	14,000	4,267	0.583	0.749
ENE	22,000	6,706	0.583	0.246
E	22,900	6,980	0.667	0.576
ESE	14,800	4,511	0.583	0.244
ESE	19,200	5,852	0.583	0.235
ESE	25,600	7,803	0.583	0.204
SE	11,800	3,597	0.750	0.884
SE	23,900	7,285	0.833	0.546
SE	24,100	7,346	0.667	0.337
SE	24,750	7,544	0.667	0.337
SE	25,500	7,772	0.667	0.337
SSE	24,200	7,376	0.750	0.640
S	11,900	3,627	0.583	0.238
S	13,400	4,084	0.750	0.599
S	13,600	4,145	0.667	0.762
S	17,250	5,258	0.333	0.167
S	17,650	5,380	0.750	0.246
S	18,300	5,578	0.667	0.344
S	22,400	6,828	0.166	0.330
SSW	10,000	3,048	0.583	0.222
SSW	14,600	4,450	0.583	0.459
SSW	17,750	5,410	0.667	0.394
SSW	21,450	6,538	0.583	0.298
SSW	22,100	6,736	0.583	0.444
SSW	24,550	7,483	0.667	0.865
SSW	24,600	7,498	0.583	0.884
SW	9,300	2,835	0.583	0.293
SW	12,300	3,719	0.583	0.264
SW	15,200	4,633	0.583	0.272
SW	21,000	6,401	0.750	0.884
WSW	7,000	2,134	0.583	0.253
WSW	14,000	4,267	0.583	0.253
WSW	14,100	4,298	0.583	0.253
WSW	15,200	4,633	0.583	0.276
WSW	23,000	7,010	0.667	0.215
W	15,600	4,755	0.667	0.450

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-25B

LOCATION OF BEEF PASTURES WITHIN 5 MILES OF LIMERICK GENERATING STATION UNITS 1 AND 2[1]

Sector	Distance From Vents (Feet)	(Meters)
N	11,200	3,414
N	15,600	4,755
N	20,100	6,126
N	22,350	6,812
N	26,100	7,955
NNE	5,200	1,585
NNE	18,100	5,517
NNE	21,500	6,553
NNE	21,650	6,599
NNE	22,050	6,721
NNE	22,750	6,934
NNE	24,800	7,559
NE	14,000	4,267
NE	17,800	5,425
NE	20,750	6,325
NE	24,800	7,559
NE	26,150	7,971
NE	27,600	8,412
ENE	12,700	3,871
ENE	13,600	4,145
ENE	17,450	5,319
ENE	19,750	6,020
ENE	21,250	6,477
ENE	22,000	6,706
ENE	22,050	6,721
ENE	24,750	7,544
E	6,200	1,890
E	9,300	2,835
E	22,900	6,980
E	23,250	7,087
E	24,650	7,513
E	25,150	7,666
ESE	14,800	4,511
ESE	19,200	5,852
ESE	25,600	7,803
ESE	25,900	7,894
ESE	26,900	8,199
SE	23,900	7,285
SSE	23,700	7,224
SSE	24,200	7,376
S	11,900	3,627
S	13,400	4,084
S	16,050	4,892
S	16,300	4,968
S	17,250	5,258
S	17,650	5,380

TABLE 2.1-25B (Cont'd)

Sector	Distance From Vents (Feet)	(Meters)
S	17,900	5,456
S	18,550	5,654
S	20,400	6,218
S	22,400	6,828
S	23,000	7,010
S	23,850	7,269
S	24,000	7,315
S	25,900	7,894
SSW	4,700	1,433
SSW	10,000	3,048
SSW	14,600	4,450
SSW	17,750	5,410
SSW	19,400	5,913
SSW	20,700	6,309
SSW	21,450	6,538
SSW	22,100	6,736
SSW	22,900	6,980
SSW	24,550	7,483
SSW	24,600	7,498
SSW	25,600	7,803
SW	9,300	2,835
SW	12,200	3,719
SW	14,800	4,511
SW	15,200	4,633
SW	20,150	6,142
SW	21,000	6,401
SW	24,150	7,361
SW	24,450	7,452
WSW	7,000	2,134
WSW	14,000	4,207
WSW	14,100	4,298
WSW	15,200	4,633
WSW	23,000	7,010
WSW	24,600	7,498
W	15,600	4,755
W	16,850	5,136
NW	21,850	6,660
NNW	20,750	6,325
NNW	23,500	7,163
NNW	24,000	7,315

(1) Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-25C

LOCATION OF SHEEP PASTURES WITHIN 5 MILES OF LIMERICK GENERATING STATION UNITS 1 AND 2[1]

Sector	Distance From Vents (Feet)	(Meters)
N	15,600	4,755
NNE	18,100	5,517
NNE	18,400	5,608
NE	17,800	5,425
NE	20,000	6,096
NE	21,600	6,584
NE	26,000	7,925
E	3,000	914
SE	23,000	7,010
S	9,900	3,018
S	10,000	3,048
SW	14,000	4,267
W	13,400	4,084
W	16,000	4,877
W	16,850	5,136
NNW	24,000	7,315

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-25D

LOCATION OF SWINE PASTURES WITHIN 5 MILES OF LIMERICK GENERATING STATION UNITS 1 AND 2[1]

Sector	Distance From Vents (Feet)	(Meters)
NNE	5,200	1,585
NNE	25,000	7,620
NE	3,600	1,097
NE	24,800	7,559
ENE	13,600	4,145
ENE	19,750	6,020
ENE	24,750	7,544
E	6,200	1,890
E	9,300	2,835
E	24,650	7,513
S	17,900	5,456
SSW	20,700	6,309
SW	9,300	2,835
W	13,400	4,084
W	16,850	5,136

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-25E

LOCATION OF GOAT PASTURES WITHIN 5 MILES OF LIMERICK GENERATING STATION UNITS 1 AND 2[1]

Sector	Distance From Vents (Feet)	(Meters)
NNE	22,900	6,980
ESE[2]	5,800	1,770
ESE	15,600	4,755

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

[2] This goat farm has been established since the RMC "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979.

TABLE 2.1-26

MILK DESTINATION AND PRODUCTION 0-5 MILES FROM LGS[1]

Processor	No. of Farms Contributing	Liters/Yr	% of Total
Raw Jug Milk	2	1.19×10^5	1.1
Hershey Chocolate	2	2.97×10^5	2.6
Lehigh Valley Dairy	6	2.07×10^6	18.0
Interstate Co-Op	17	4.61×10^6	41.0
Bechtel Dairy	4	1.41×10^6	12.0
Sunny Slope Dairy	1	2.05×10^5	1.8
Tri-County Dairy	1	2.07×10^5	1.8
Brenningers Dairy	1	5.06×10^5	4.5
High Dairy Store	1	5.94×10^5	5.2
Meadow Brook Farms	3	1.31×10^6	12.0
Totals	38	1.12×10^7	100.0

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1977. Survey based on data collected in 1975-1976.

TABLE 2.1-27

DISTRIBUTION OF MILK FOR PENNSYLVANIA[1][2]

	1975 % of Total	1979 % of Total
Marketed Whole Milk (Through Distributors)	60.26	53.60
Frozen Products	14.47	13.38
Cheese	8.42	8.82
Butter	6.06	12.97
To Consumers (Raw Jug Milk)	4.05	4.63
Home Use	1.40	.37
As Animal Feed	0.57	.74
Other	4.77	5.37

(1) Pennsylvania Corp Reporting Service, "1975 Crop and Livestock Annual Summary," CRS-66, July 1976.
(2) Pennsylvania Crop Reporting Service, "1980 Crop and Livestock Annual Summary," CRS-78, 1981.

TABLE 2.1-28

ANNUAL MILK PRODUCTION (Liters/Year) WITHIN 50 MILES OF LGS

DISTANCE RANGE IN MILES(1)

Direction	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	-	-	-	-	-	$1.68 \times 10^{+6}$	$4.60 \times 10^{+6}$	$4.64 \times 10^{+6}$	$1.29 \times 10^{+7}$	$2.83 \times 10^{+6}$	$2.67 \times 10^{+7}$
NNE	-	-	-	-	-	$1.44 \times 10^{+6}$	$4.21 \times 10^{+6}$	$6.93 \times 10^{+6}$	$1.66 \times 10^{+7}$	$2.38 \times 10^{+7}$	$5.30 \times 10^{+7}$
NE	-	-	$5.63 \times 10^{+4}$	-	-	$1.37 \times 10^{+6}$	$3.35 \times 10^{+6}$	$6.55 \times 10^{+6}$	$1.60 \times 10^{+7}$	$2.13 \times 10^{+7}$	$4.86 \times 10^{+7}$
ENE	-	-	$6.29 \times 10^{+5}$	$8.05 \times 10^{+5}$	$3.46 \times 10^{+5}$	$1.34 \times 10^{+6}$	$5.13 \times 10^{+6}$	$8.16 \times 10^{+6}$	$1.09 \times 10^{+7}$	$1.32 \times 10^{+7}$	$3.99 \times 10^{+7}$
E	-	-	$2.57 \times 10^{+5}$	-	$2.69 \times 10^{+5}$	$1.44 \times 10^{+6}$	$5.09 \times 10^{+6}$	$7.02 \times 10^{+6}$	$7.95 \times 10^{+6}$	$5.66 \times 10^{+6}$	$2.77 \times 10^{+7}$
ESE	-	-	$9.42 \times 10^{+4}$	$6.86 \times 10^{+5}$	$1.91 \times 10^{+5}$	$1.44 \times 10^{+6}$	$4.08 \times 10^{+6}$	$2.23 \times 10^{+6}$	$4.72 \times 10^{+6}$	$1.61 \times 10^{+7}$	$2.95 \times 10^{+7}$
SE	-	-	-	-	$7.04 \times 10^{+5}$	$1.63 \times 10^{+6}$	$3.69 \times 10^{+6}$	$3.09 \times 10^{+5}$	$1.27 \times 10^{+6}$	$1.09 \times 10^{+6}$	$8.69 \times 10^{+6}$
SSE	-	-	$7.92 \times 10^{+4}$	$7.88 \times 10^{+5}$	$2.01 \times 10^{+5}$	$3.10 \times 10^{+6}$	$9.09 \times 10^{+6}$	$1.19 \times 10^{+6}$	$7.62 \times 10^{+6}$	$1.35 \times 10^{+7}$	$3.56 \times 10^{+7}$
S	-	-	$7.13 \times 10^{+4}$	$1.30 \times 10^{+6}$	$2.55 \times 10^{+5}$	$2.48 \times 10^{+6}$	$1.02 \times 10^{+7}$	$1.05 \times 10^{+7}$	$8.53 \times 10^{+6}$	$1.43 \times 10^{+7}$	$4.76 \times 10^{+7}$
SSW	-	$3.15 \times 10^{+5}$	$1.25 \times 10^{+5}$	$1.25 \times 10^{+5}$	$4.58 \times 10^{+5}$	$2.75 \times 10^{+5}$	$3.45 \times 10^{+6}$	$1.26 \times 10^{+7}$	$2.37 \times 10^{+7}$	$1.85 \times 10^{+7}$	$8.04 \times 10^{+7}$
SW	-	$5.06 \times 10^{+5}$	$1.56 \times 10^{+6}$	$1.71 \times 10^{+5}$	-	$3.45 \times 10^{+6}$	$1.06 \times 10^{+7}$	$2.02 \times 10^{+7}$	$4.71 \times 10^{+7}$	$5.23 \times 10^{+7}$	$1.36 \times 10^{+8}$
WSW	-	$3.33 \times 10^{+5}$	$5.50 \times 10^{+5}$	-	$6.07 \times 10^{+5}$	$9.66 \times 10^{+5}$	$8.77 \times 10^{+6}$	$3.66 \times 10^{+7}$	$5.64 \times 10^{+7}$	$5.25 \times 10^{+7}$	$1.57 \times 10^{+8}$
W	-	-	$2.25 \times 10^{+5}$	-	-	$1.71 \times 10^{+6}$	$2.19 \times 10^{+6}$	$3.23 \times 10^{+7}$	$5.16 \times 10^{+7}$	$6.00 \times 10^{+7}$	$1.48 \times 10^{+8}$
WNW	-	-	-	-	-	$3.13 \times 10^{+6}$	$1.07 \times 10^{+7}$	$1.88 \times 10^{+7}$	$3.41 \times 10^{+7}$	$3.92 \times 10^{+7}$	$1.06 \times 10^{+8}$
NW	-	-	-	-	-	$2.61 \times 10^{+6}$	$1.26 \times 10^{+7}$	$2.22 \times 10^{+7}$	$1.17 \times 10^{+7}$	$5.45 \times 10^{+6}$	$5.46 \times 10^{+7}$
NNW	-	-	-	-	-	$1.52 \times 10^{+6}$	$3.65 \times 10^{+6}$	$1.95 \times 10^{+7}$	$9.07 \times 10^{+6}$	$1.25 \times 10^{+6}$	$3.50 \times 10^{+7}$
Total	-	$1.15 \times 10^{+6}$	$3.64 \times 10^{+6}$	$4.21 \times 10^{+6}$	$2.85 \times 10^{+6}$	$3.27 \times 10^{+7}$	$1.10 \times 10^{+8}$	$2.18 \times 10^{+8}$	$3.20 \times 10^{+8}$	$3.41 \times 10^{+8}$	$1.03 \times 10^{+9}$

(1) Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-29

ANNUAL MEAT PRODUCTION (KILOGRAMS/YEAR) WITHIN 50 MILES OF LGS

DISTANCE RANGE IN MILES[1]

Direction	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	-	-	$2.24 \times 10^{+3}$	$3.18 \times 10^{+3}$	-	$3.59 \times 10^{+5}$	$7.90 \times 10^{+5}$	$1.53 \times 10^{+6}$	$1.80 \times 10^{+6}$	$9.16 \times 10^{+5}$	$5.40 \times 10^{+6}$
NNE	$7.02 \times 10^{+3}$	-	-	$1.00 \times 10^{+3}$	$6.61 \times 10^{+4}$	$3.38 \times 10^{+5}$	$1.00 \times 10^{+6}$	$1.15 \times 10^{+6}$	$1.34 \times 10^{+6}$	$1.90 \times 10^{+6}$	$5.80 \times 10^{+6}$
NE	$1.54 \times 10^{+4}$	-	$3.32 \times 10^{+3}$	$1.64 \times 10^{+3}$	$2.47 \times 10^{+4}$	3.23 c 10^{+5}	$6.00 \times 10^{+5}$	$9.69 \times 10^{+5}$	$1.36 \times 10^{+6}$	$1.59 \times 10^{+6}$	$4.89 \times 10^{+6}$
ENE	$6.15 \times 10^{+2}$	-	$3.70 \times 10^{+4}$	$3.69 \times 10^{+4}$	$2.69 \times 10^{+4}$	$3.16 \times 10^{+5}$	$9.98 \times 10^{+5}$	$1.23 \times 10^{+6}$	$1.23 \times 10^{+6}$	$1.53 \times 10^{+6}$	$5.41 \times 10^{+6}$
E	-	$2.64 \times 10^{+3}$	$1.15 \times 10^{+4}$	-	$1.23 \times 10^{+4}$	$3.38 \times 10^{+5}$	$1.19 \times 10^{+6}$	$1.24 \times 10^{+6}$	$1.23 \times 10^{+6}$	$1.43 \times 10^{+6}$	$5.45 \times 10^{+6}$
ESE	$4.27 \times 10^{+2}$	$1.78 \times 10^{+2}$	$3.03 \times 10^{+3}$	$3.91 \times 10^{+4}$	$5.63 \times 10^{+3}$	$3.38 \times 10^{+5}$	$9.63 \times 10^{+5}$	$5.26 \times 10^{+5}$	$1.13 \times 10^{+6}$	$4.16 \times 10^{+6}$	$7.17 \times 10^{+6}$
SE	-	-	-	-	$3.84 \times 10^{+4}$	$3.35 \times 10^{+5}$	$8.06 \times 10^{+5}$	$1.06 \times 10^{+5}$	$3.40 \times 10^{+6}$	$2.64 \times 10^{+6}$	$7.33 \times 10^{+6}$
SSE	-	$6.40 \times 10^{+2}$	$7.51 \times 10^{+3}$	$3.09 \times 10^{+4}$	$1.47 \times 10^{+4}$	$3.76 \times 10^{+5}$	$1.21 \times 10^{+6}$	$5.47 \times 10^{+5}$	$7.66 \times 10^{+6}$	$3.70 \times 10^{+6}$	$1.35 \times 10^{+7}$
S	-	$5.33 \times 10^{+2}$	$2.45 \times 10^{+3}$	$8.14 \times 10^{+4}$	$1.54 \times 10^{+4}$	$2.95 \times 10^{+5}$	$1.21 \times 10^{+6}$	$1.54 \times 10^{+6}$	$8.82 \times 10^{+5}$	$1.50 \times 10^{+6}$	$5.53 \times 10^{+6}$
SSW	$1.15 \times 10^{+3}$	$1.20 \times 10^{+4}$	$4.19 \times 10^{+3}$	$2.94 \times 10^{+4}$	$1.66 \times 10^{+4}$	$4.10 \times 10^{+5}$	$1.49 \times 10^{+6}$	$2.49 \times 10^{+6}$	$2.68 \times 10^{+6}$	$1.69 \times 10^{+6}$	$8.82 \times 10^{+6}$
SW	-	$1.71 \times 10^{+4}$	$7.09 \times 10^{+4}$	$8.95 \times 10^{+3}$	$1.44 \times 10^{+3}$	$4.10 \times 10^{+5}$	$1.26 \times 10^{+6}$	$3.23 \times 10^{+6}$	$9.58 \times 10^{+6}$	$1.09 \times 10^{+7}$	$2.55 \times 10^{+7}$
WSW	-	$1.83 \times 10^{+4}$	$2.38 \times 10^{+4}$	-	$3.10 \times 10^{+4}$	$1.15 \times 10^{+5}$	$1.23 \times 12^{+6}$	$8.17 \times 10^{+6}$	$1.27 \times 10^{+7}$	$1.18 \times 10^{+7}$	$3.41 \times 10^{+7}$
W	-	$6.06 \times 10^{+3}$	$5.69 \times 10^{+4}$	$4.27 \times 10^{+3}$	-	$2.35 \times 10^{+5}$	$3.27 \times 10^{+5}$	$6.99 \times 10^{+6}$	$1.10 \times 10^{+7}$	$1.22 \times 10^{+7}$	$3.08 \times 10^{+7}$
WNW	-	-	-	-	-	$4.73 \times 10^{+5}$	$1.59 \times 10^{+6}$	$2.81 \times 10^{+6}$	$5.07 \times 10^{+6}$	$6.81 \times 10^{+6}$	$1.68 \times 10^{+7}$
NW	-	-	-	-	$5.77 \times 10^{+2}$	$4.01 \times 10^{+5}$	$1.87 \times 10^{+6}$	$3.31 \times 10^{+6}$	$2.78 \times 10^{+6}$	$2.42 \times 10^{+6}$	$1.08 \times 10^{+7}$
NNW	-	-	-	-	$6.18 \times 10^{+3}$	$2.57 \times 10^{+5}$	$5.45 \times 10^{+5}$	$3.15 \times 10^{+6}$	$2.86 \times 10^{+6}$	$5.65 \times 10^{+5}$	$7.38 \times 10^{+6}$
Total	$2.45 \times 10^{+4}$	$5.75 \times 10^{+4}$	$2.22 \times 10^{+5}$	$2.36 \times 10^{+5}$	$2.60 \times 10^{+5}$	$5.32 \times 10^{+6}$	$1.71 \times 10^{+7}$	$3.90 \quad 10^{+7}$	$6.67 \times 10^{+7}$	$6.58 \times 10^{+7}$	$1.95 \times 10^{+8}$

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-30

ANNUAL CHICKEN PRODUCTION (KILOGRAMS/YEAR) WITHIN 50 MILES OF LGS

DISTANCE RANGE IN MILES(1)

Direction	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	-	-	-	-	-	$1.19 \times 10^{+5}$	$6.20 \times 10^{+5}$	$4.42 \times 10^{+4}$	$1.61 \times 10^{+5}$	$2.53 \times 10^{+4}$	$9.70 \times 10^{+5}$
NNE	-	-	-	-	$7.64 \times 10^{+1}$	$5.76 \times 10^{+4}$	$9.18 \times 10^{+4}$	$7.90 \times 10^{+4}$	$2.42 \times 10^{+5}$	$2.98 \times 10^{+5}$	$7.68 \times 10^{+5}$
NE	-	-	-	-	-	$5.50 \times 10^{+4}$	$7.44 \times 10^{+4}$	$8.72 \times 10^{+4}$	$5.56 \times 10^{+5}$	$7.86 \times 10^{+5}$	$1.56 \times 10^{+6}$
ENE	-	-	-	-	-	$5.38 \times 10^{+4}$	$1.39 \times 10^{+5}$	$1.08 \times 10^{+5}$	$8.86 \times 10^{+5}$	$1.35 \times 10^{+6}$	$2.54 \times 10^{+6}$
E	-	-	-	-	-	$5.76 \times +0^{+4}$	$2.02 \times 10^{+5}$	$1.51 \times 10^{+5}$	$1.27 \times 10^{+5}$	$2.83 \quad 10^{+5}$	$8.21 \times 10^{+5}$
ESE	-	-	-	-	-	$5.76 \times 10^{+4}$	$1.64 \times 10^{+5}$	$9.16 \times 10^{+4}$	$5.94 \times 10^{+4}$	$1.59 \times 10^{+5}$	$5.32 \times 10^{+5}$
SE	-	-	-	-	-	$7.89 \times 10^{+4}$	$1.74 \times 10^{+5}$	$1.28 \times 10^{+4}$	$1.81 \times 10^{+5}$	$1.59 \times 10^{+5}$	$6.06 \times 10^{+5}$
SSE	-	-	-	-	-	$2.25 \times 10^{+5}$	$6.38 \times 10^{+5}$	$6.03 \times 10^{+3}$	$6.71 \times 10^{+5}$	$9.47 \times 10^{+5}$	$2.49 \times 10^{+6}$
S	-	-	-	-	-	$1.82 \times 10^{+5}$	$7.47 \times 10^{+5}$	$8.34 \times 10^{+5}$	$6.50 \times 10^{+5}$	$1.58 \times 10^{+6}$	$3.99 \times 10^{+6}$
SSW	$3.79 \times 10^{+2}$	-	-	-	-	$2.52 \times 10^{+5}$	$9.19 \times 10^{+5}$	$1.54 \times 10^{+6}$	$1.72 \times 10^{+6}$	$8.52 \times 10^{+5}$	$5.28 \times 10^{+6}$
SW	-	-	-	-	-	$2.52 \times 10^{+5}$	$7.78 \times 10^{+5}$	$4.71 \times 10^{+6}$	$1.90 \times 10^{+7}$	$2.11 \times 10^{+7}$	$4.58 \times 10^{+7}$
WSW	-	-	-	-	-	$7.07 \times 10^{+4}$	$1.35 \times 10^{+6}$	$1.75 \times 10^{+7}$	$2.75 \times 10^{+7}$	$2.56 \times 10^{+7}$	$7.20 \times 10^{+7}$
W	-	-	-	-	-	$2.12 \times 10^{+5}$	$3.47 \times 10^{+5}$	$1.45 \times 10^{+7}$	$2.30 \times 10^{+7}$	$2.43 \times 10^{+7}$	$6.24 \times 10^{+7}$
WNW	-	-	-	-	-	$4.88 \times 10^{+5}$	$1.69 \times 10^{+6}$	$2.98 \times 10^{+6}$	$5.86 \times 10^{+6}$	$9.03 \times 10^{+6}$	$2.00 \times 10^{+7}$
NW	-	-	-	-	-	$3.98 \times 10^{+5}$	$1.99 \times 10^{+6}$	$3.51 \times 10^{+6}$	$3.38 \times 10^{+6}$	$3.23 \times 10^{+6}$	$1.25 \times 10^{+7}$
NNW	-	-	-	-	-	$1.99 \times 10^{+5}$	$5.77 \times 10^{+5}$	$2.89 \times 10^{+6}$	$2.77 \times 10^{+6}$	$5.96 \times 10^{+5}$	$7.03 \times 10^{+6}$
Total	$3.79 \times 10^{+2}$	-	-	-	$7.64 \times 10^{+1}$	$2.76 \times 10^{+6}$	$1.05 \times 10^{+7}$	$4.91 \times 10^{+7}$	$8.68 \times 10^{+7}$	$9.03 \times 10^{+7}$	$2.39 \times 10^{+8}$

(1) Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-31

ANNUAL VEGETABLE PRODUCTION (KILOGRAMS/YEAR) WITHIN 50 MILES OF LGS

DISTANCE RANGE IN MILES[1]

Direction	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	-	-	$1.08 \times 10^{+4}$	-	-	$1.95 \times 10^{+5}$	$1.50 \times 10^{+6}$	$1.55 \times 10^{+7}$	$1.38 \times 10^{+7}$	$6.82 \times 10^{+6}$	$3.78 \times 10^{+7}$
NNE	$2.71 \times 10^{+3}$	-	-	-	$1.36 \times 10^{+5}$	$1.96 \times 10^{+5}$	$4.99 \times 10^{+6}$	$9.19 \times 10^{+6}$	$6.39 \times 10^{+6}$	$9.00 \times 10^{+6}$	$2.99 \times 10^{+7}$
NE	-	-	-	-	$3.25 \times 10^{+3}$	$1.87 \times 10^{+5}$	$1.20 \times 10^{+6}$	$3.04 \times 10^{+6}$	$3.09 \times 10^{+6}$	$2.63 \times 10^{+6}$	$1.02 \times 10^{+7}$
ENE	$1.63 \times 10^{+3}$	-	$2.71 \times 10^{+4}$	-	$5.42 \times 10^{+2}$	$1.83 \times 10^{+5}$	$1.53 \times 1^{0+6}$	$3.82 \times 10^{+6}$	$2.69 \times 10^{+6}$	$3.47 \times 10^{+6}$	$1.17 \times 10^{+7}$
E	-	$1.08 \times 10^{+4}$	-	-	-	$1.96 \times 10^{+5}$	$7.22 \times 10^{+5}$	$2.58 \times 10^{+6}$	$4.05 \times 10^{+6}$	$8.76 \quad 10^{+6}$	$1.63 \times 10^{+7}$
ESE	-	-		$3.25 \times 10^{+3}$	-	$1.96 \times 10^{+5}$	$5.57 \times 10^{+5}$	$3.51 \times 10^{+5}$	$7.40 \times 10^{+6}$	$2.58 \times 10^{+7}$	$3.43 \times 10^{+7}$
SE	-	-	-	-	$8.13 \times 10^{+4}$	$2.24 \times 10^{+5}$	$6.50 \times 10^{+5}$	$2.47 \times 10^{+5}$	$2.98 \times 10^{+7}$	$2.70 \times 10^{+7}$	$5.80 \times 10^{+7}$
SSE	-	-	-	-	$2.17 \times 10^{+3}$	$4.38 \times 10^{+5}$	$1.47 \times 10^{+6}$	$7.41 \times 10^{+5}$	$7.98 \times 10^{+7}$	$7.65 \times 10^{+7}$	$1.59 \times 10^{+8}$
S	-	$5.42 \times 10^{+2}$	$3.25 \times 10^{+3}$	$5.42 \times 10^{+3}$	$5.96 \times 10^{+3}$	$3.51 \times 10^{+5}$	$1.44 \times 10^{+6}$	$3.43 \times 10^{+7}$	$5.54 \times 10^{+7}$	$1.85 \times 10^{+8}$	$2.77 \times 10^{+8}$
SSW	$21.7 \times 10^{+3}$	-	-	$1.08 \times 10^{+4}$	-	$4.87 \times 10^{+5}$	$1.77 \times 10^{+6}$	$2.96 \times 10^{+6}$	$7.33 \times 10^{+7}$	$1.75 \times 10^{+8}$	$2.54 \times 10^{+8}$
SW	-	-	$21.7 \times 10^{+3}$	$2.71 \times 10^{+3}$	-	$4.87 \times 10^{+5}$	$1.50 \times 10^{+6}$	$2.68 \times 10^{+6}$	$5.82 \times 10^{+6}$	$4.79 \times 10^{+7}$	$5.84 \times 10^{+7}$
WNW	-	-	-	-	-	$1.36 \times 10^{+5}$	$6.22 \times 10^{+6}$	$1.10 \times 10^{+6}$	$6.70 \times 10^{+6}$	$6.24 \times 10^{+6}$	$1.86 \times 10^{+7}$
W	-	-	$1.63 \times 10^{+4}$	$1.08 \times 10^{+4}$	-	$1.57 \times 10^{+5}$	$1.28 \times 10^{+5}$	$3.60 \times 10^{+6}$	$5.77 \times 10^{+6}$	$6.31 \times 10^{+6}$	$1.60 \times 10^{+7}$
WNW	-	-	-	-	-	$1.88 \times 10^{+5}$	$1.28 \times 10^{+5}$	$1.10 \times 10^{+6}$	$2.14 \times 10^{+6}$	$1.04 \times 10^{+7}$	$1.45 \times 10^{+7}$
NW	-	-	-	-	-	$1.62 \times 10^{+5}$	$7.33 \times 10^{+5}$	$1.30 \times 10^{+6}$	$8.45 \times 10^{+6}$	$1.23 \times 10^{+7}$	$2.29 \times 10^{+7}$
NNW	-	-	-	-	-	$1.16 \times 10^{+5}$	$2.13 \times 10^{+5}$	$5.48 \times 10^{+6}$	$1.52 \times 10^{+7}$	$2.82 \times 10^{+6}$	$2.38 \times 10^{+7}$
Total	$8.68 \times 10^{+3}$	$1.14 \times 10^{+4}$	$6.02 \times 10^{+4}$	$3.30 \times 10^{+4}$	$2.29 \times 10^{+5}$	$3.90 \times 10^{+6}$	$2.02 \times 10^{+7}$	$9.13 \times 10^{+7}$	$3.20 \times 10^{+8}$	$6.06 \times 10^{+8}$	$1.04 \times 10^{+9}$

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-32

ANNUAL FRUIT PRODUCTION (APPLE AND PEACH, KILIOGRAMS/YEAR) WITHIN 50 MILES OF LGS

DISTANCE RANGE IN MILES[1]

Direction	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	-	-		-	-	$3.07 \times 10^{+4}$	$6.16 \times 10^{+4}$	$6.40 \times 10^{+5}$	$6.72 \times 10^{+5}$	$4.82 \times 10^{+4}$	$1.45 \times 10^{+6}$
NNE	-	-	-	-	-	$3.53 \times 10^{+4}$	$2.84 \times 10^{+5}$	$4.52 \times 10^{+5}$	$4.51 \times 10^{+5}$	$5.85 \times 10^{+5}$	$1.81 \times 10^{+6}$
NE	$1.80 \times 10^{+2}$	-	-	-	$9.00 \times 10^{+1}$	$3.38 \times 10^{+4}$	$1.49 \times 10^{+5}$	$3.50 \times 10^{+5}$	$5.18 \times 10^{+5}$	$6.51 \times 10^{+5}$	$1.70 \times 10^{+6}$
ENE	-	-	-	-	$1.77 \times 10^{+2}$	$3.30 \times 10^{+4}$	$2.00 \times 10^{+5}$	$4.43 \times 10^{+5}$	$4.11 \times 10^{+5}$	$4.94 \times 10^{+5}$	$1.58 \times 10^{+6}$
E	$9.00 \times 10^{+2}$	-	-	-	-	$3.53 \times 10^{+4}$	$1.28 \times 10^{+5}$	$3.18 \times 10^{+5}$	$4.56 \times 10^{+5}$	$1.67 \times 10^{+6}$	$2.61 \times 10^{+6}$
ESE	-	-	-	-	-	$3.53 \times 10^{+4}$	$1.00 \times 10^{+5}$	$5.55 \times 10^{+4}$	$2.63 \times 10^{+6}$	$8.00 \times 10^{+6}$	$1.08 \times 10^{+7}$
SE	-	-	-	-	-	$3.67 \times 10^{+4}$	$1.78 \times 10^{+5}$	$5.85 \times 10^{+4}$	$1.17 \times 10^{+7}$	$1.28 \times 10^{+7}$	$2.48 \times 10^{+7}$
SSE	-	-	-	-	$1.36 \times 10^{+3}$	$5.17 \times 10^{+4}$	$2.83 \times 10^{+5}$	$4.21 \times 10^{+5}$	$1.99 \times 10^{+7}$	$6.75 \times 10^{+6}$	$2.74 \times 10^{+7}$
S	-	$1.80 \times 10^{+2}$	$2.34 \times 10^{+3}$	-	$6.50 \times 10^{+2}$	$4.10 \times 10^{+4}$	$1.69 \times 10^{+5}$	$4.65 \times 10^{+5}$	$5.24 \times 10^{+4}$	$7.91 \times 10^{+4}$	$8.10 \times 10^{+5}$
SSW	-	-	-	$1.77 \times 10^{+2}$	-	$5.70 \times 10^{+4}$	$2.07 \times 10^{+5}$	$3.47 \times 10^{+5}$	$5.20 \times 10^{+5}$	$8.87 \times 10^{+5}$	$2.02 \times 10^{+6}$
SW	-	-	$2.50 \times 10^{+1}$	-	-	$5.70 \times 10^{+4}$	$1.76 \times 10^{+5}$	$2.66 \times 10^{+5}$	$4.55 \times 10^{+5}$	$1.01 \times 10^{+6}$	$1.96 \times 10^{+6}$
WNW	-	-	-	-	-	$1.60 \times 10^{+4}$	$1.19 \times 10^{+5}$	$2.94 \times 10^{+5}$	$4.42 \times 10^{+5}$	$4.12 \times 10^{+5}$	$1.28 \times 10^{+6}$
W	-	-	-	-	-	$1.15 \times 10^{+4}$	$2.31 \times 10^{+2}$	$2.23 \times 10^{+5}$	$4.94 \times 10^{+5}$	$6.78 \times 10^{+5}$	$1.41 \times 10^{+6}$
WNW	-	-	-	-	-	$1.89 \times 10^{+3}$	$1.12 \times 10^{+3}$	$1.99 \times 10^{+3}$	$2.10 \times 10^{+5}$	$9.22 \times 10^{+5}$	$1.14 \times 10^{+6}$
NW	-	-	-	-	-	$3.40 \times 10^{+3}$	$1.32 \times 10^{+3}$	$2.34 \times 10^{+3}$	$3.41 \times 10^{+5}$	$5.26 \times 10^{+5}$	$8.74 \times 10^{+5}$
NNW	-	-	-	-	-	$8.76 \times 10^{+3}$	$3.85 \times 10^{+2}$	$1.84 \times 10^{+5}$	$6.17 \times 10^{+5}$	$1.05 \times 10^{+5}$	$9.15 \times 10^{+5}$
Total	$1.08 \times 10^{+3}$	$1.80 \times 10^{+2}$	$2.37 \times 10^{+3}$	$1.77 \times 10^{+2}$	$2.28 \times 10^{+3}$	$4.88 \times 10^{+5}$	$2.06 \times 10^{+6}$	$4.52 \times 10^{+6}$	$3.99 \times 10^{+7}$	$3.57 \times 10^{+7}$	$8.27 \times 10^{+7}$

(1) Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-33

ANNUAL GRAIN PRODUCTION (KILOGRAMS/YEAR) WITHIN 50 MILES OF LGS

DISTANCE RANGE IN MILES[1]

Direction	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	-	-	$4.41 \times 10^{+4}$	$9.64 \times 10^{+4}$	-	$2.46 \times 10^{+6}$	$9.52 \times 10^{+6}$	$4.43 \times 10^{+7}$	$5.75 \times 10^{+7}$	$8.43 \times 10^{+6}$	$1.22 \times 10^{+8}$
NNE	$8.36 \times 10^{+4}$	-	-	-	$2.35 \times 10^{+5}$	$2.12 \times 10^{+6}$	$1.71 \times 10^{+7}$	$3.43 \times 10^{+7}$	$4.93 \times 10^{+7}$	$5.93 \times 10^{+7}$	$1.62 \times 10^{+8}$
NE	$1.84 \times 10^{+5}$	-	$1.15 \times 10^{+4}$	-	$2.10 \times 10^{+5}$	$2.02 \times 10^{+6}$	$6.38 \times 10^{+6}$	$1.40 \times 10^{+7}$	$2.30 \times 10^{+7}$	$2.19 \times 10^{+7}$	$6.77 \times 10^{+7}$
ENE	-	-	$5.94 \times 10^{+5}$	$3.98 \times 10^{+5}$	$1.55 \times 10^{+5}$	$1.97 \times 10^{+6}$	$9.16 \times 10^{+6}$	$1.73 \times 10^{+7}$	$1.71 \times 10^{+7}$	$2.07 \times 10^{+7}$	$6.74 \times 10^{+7}$
E	-	-	$3.23 \times 10^{+5}$	-	$1.49 \times 10^{+5}$	$2.12 \times 10^{+6}$	$7.55 \times 10^{+6}$	$1.35 \times 10^{+7}$	$1.73 \times 10^{+7}$	$1.54 \quad 10^{+7}$	$5.63 \times 10^{+7}$
ESE	$1.25 \times 10^{+4}$	-	-	$7.14 \times 10^{+5}$	$1.79 \times 10^{+5}$	$2.12 \times 10^{+6}$	$6.02 \times 10^{+6}$	$3.40 \times 10^{+6}$	$8.18 \times 10^{+6}$	$2.45 \times 10^{+7}$	$4.51 \times 10^{+7}$
SE	-	-	-	-	$7.78 \times 10^{+5}$	$2.26 \times 10^{+6}$	$5.34 \times 10^{+6}$	$9.10 \times 10^{+5}$	$2.37 \times 10^{+6}$	$2.58 \times 10^{+6}$	$1.42 \times 10^{+7}$
SSE	-	-	$3.65 \times 10^{+4}$	$7.83 \times 10^{+5}$	$9.98 \times 10^{+5}$	$3.55 \times 10^{+6}$	$1.08 \times 10^{+7}$	$2.87 \times 10^{+6}$	$8.20 \times 10^{+6}$	$1.25 \times 10^{+7}$	$3.97 \times 10^{+7}$
S	-	-	$3.86 \times 10^{+4}$	$1.28 \times 10^{+6}$	$4.13 \times 10^{+5}$	$2.83 \times 10^{+6}$	$1.16 \times 10^{+7}$	$1.87 \times 10^{+7}$	$1.14 \times 10^{+7}$	$4.05 \times 10^{+7}$	$8.68 \times 10^{+7}$
SSW	$3.75 \times 10^{+4}$	$2.18 \times 10^{+5}$	$6.19 \times 10^{+4}$	$5.00 \times 10^{+5}$	$3.83 \times 10^{+5}$	$3.92 \times 10^{+6}$	$1.43 \times 10^{+7}$	$2.39 \times 10^{+7}$	$3.74 \times 10^{+7}$	$4.38 \times 10^{+7}$	$1.25 \times 10^{+8}$
SW	-	$1.91 \times 10^{+5}$	$6.99 \times 10^{+5}$	$1.29 \times 10^{+5}$	$6.80 \times 10^{+4}$	$3.92 \times 10^{+6}$	$1.21 \times 10^{+7}$	$1.52 \times 10^{+7}$	$1.63 \times 10^{+7}$	$2.69 \times 10^{+7}$	$7.55 \times 10^{+7}$
WNW	-	$2.19 \times 10^{+5}$	$4.03 \times 10^{+5}$	-	$4.45 \times 10^{+5}$	$1.10 \times 10^{+6}$	$8.63 \times 10^{+6}$	$5.87 \times 10^{+6}$	$7.77 \times 10^{+6}$	$7.24 \times 10^{+6}$	$3.17 \times 10^{+7}$
W	-	-	$1.68 \times 10^{+5}$	$5.55 \times 10^{+4}$	-	$2.24 \times 10^{+6}$	$3.12 \times 10^{+6}$	$9.53 \times 10^{+6}$	$1.20 \times 10^{+7}$	$1.95 \times 10^{+7}$	$4.66 \times 10^{+7}$
WNW	-	-	-	-	-	$4.46 \times 10^{+6}$	$1.52 \times 10^{+7}$	$2.68 \times 10^{+7}$	$4.17 \times 10^{+7}$	$4.08 \times 10^{+7}$	$1.29 \times 10^{+8}$
NW	-	-	-	-	$9.05 \times 10^{+3}$	$3.72 \times 10^{+6}$	$1.79 \times 10^{+7}$	$3.16 \times 10^{+7}$	$2.10 \times 10^{+7}$	$1.45 \times 10^{+7}$	$8.87 \times 10^{+7}$
NNW	-	-	-	-	$8.01 \times 10^{+4}$	$2.18 \times 10^{+6}$	$5.20 \times 10^{+6}$	$3.85 \times 10^{+7}$	$3.28 \times 10^{+7}$	$3.77 \times 10^{+6}$	$8.25 \times 10^{+7}$
Total	$3.18 \times 10^{+5}$	$6.28 \times 10^{+5}$	$2.38 \times 10^{+6}$	$3.95 \times 10^{+6}$	$4.10 \times 10^{+6}$	$4.30 \times 10^{+7}$	$1.60 \times 10^{+8}$	$3.01 \times 10^{+8}$	$3.63 \times 10^{+8}$	$3.62 \times 10^{+8}$	$1.24 \times 10^{+9}$

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-34

ANNUAL SILAGE CORN PRODUCTION (KILOGRAMS/YEAR) WITHIN 50 MILES OF LGS

DISTANCE RANGE IN MILES[1]

Direction	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	-	-	-	-	-	$2.85 \times 10^{+6}$	$9.21 \times 10^{+6}$	$1.44 \times 10^{+6}$	$1.03 \times 10^{+7}$	$8.08 \times 10^{+6}$	$3.18 \times 10^{+7}$
NNE	-	-	-	-	-	$2.16 \times 10^{+6}$	$5.29 \times 10^{+6}$	$5.67 \times 10^{+6}$	$1.52 \times 10^{+7}$	$2.55 \times 10^{+7}$	$5.38 \times 10^{+7}$
NE	-	-	-	-	-	$2.07 \times 10^{+6}$	$5.85 \times 10^{+6}$	$1.20 \times 10^{+7}$	$2.69 \times 10^{+7}$	$3.76 \times 10^{+7}$	$8.44 \times 10^{+7}$
ENE	-	-	$9.98 \times 10^{+4}$	$1.60 \times 10^{+6}$	$4.99 \times 10^{+5}$	$2.02 \times 10^{+6}$	$8.62 \times 10^{+6}$	$1.52 \times 10^{+7}$	$2.44 \times 10^{+7}$	$3.35 \times 10^{+7}$	$8.59 \times 10^{+7}$
E	-	-	$3.81 \times 10^{+5}$	-	$2.00 \times 10^{+5}$	$2.16 \times 10^{+6}$	$7.71 \times 10^{+6}$	$1.23 \times 10^{+7}$	$1.56 \times 10^{+7}$	$1.91 \times 10^{+7}$	$5.75 \times 10^{+7}$
ESE	-	-	-	$1.22 \times 10^{+6}$	$2.32 \times 10^{+5}$	$2.16 \times 10^{+6}$	$6.16 \times 10^{+6}$	$3.49 \times 10^{+6}$	$1.05 \times 10^{+7}$	$3.60 \times 10^{+7}$	$5.98 \times 10^{+7}$
SE	-	-	-	-	$1.57 \times 10^{+6}$	$2.53 \times 10^{+6}$	$6.95 \times 10^{+6}$	$1.42 \times 10^{+6}$	$1.02 \times 10^{+7}$	$7.68 \times 10^{+6}$	$3.04 \times 10^{+7}$
SSE	-	-	$6.53 \times 10^{+4}$	$7.26 \times 10^{+5}$	$1.27 \times 10^{+6}$	$5.24 \times 10^{+6}$	$1.69 \times 10^{+7}$	$6.60 \times 10^{+6}$	$3.50 \times 10^{+7}$	$4.18 \times 10^{+7}$	$1.08 \times 10^{+8}$
S	-	-	$7.26 \times 10^{+4}$	$1.03 \times 10^{+6}$	$3.17 \times 10^{+5}$	$4.21 \times 10^{+6}$	$1.73 \times 10^{+7}$	$2.22 \times 10^{+7}$	$2.30 \times 10^{+7}$	$3.64 \times 10^{+7}$	$1.05 \times 10^{+8}$
SSW	-	$4.76 \times 10^{+5}$	$4.35 \times 10^{+4}$	$6.53 \times 10^{+5}$	$1.81 \times 10^{+5}$	$5.85 \times 10^{+6}$	$2.13 \times 10^{+7}$	$3.56 \times 10^{+7}$	$3.44 \times 10^{+7}$	$4.54 \times 10^{+6}$	$1.03 \times 10^{+8}$
SW	-	$1.27 \times 10^{+6}$	$3.25 \times 10^{+6}$	$2.00 \times 10^{+5}$	-	$5.85 \times 10^{+6}$	$1.80 \times 10^{+7}$	$4.10 \times 10^{+7}$	$1.12 \times 10^{+8}$	$1.62 \times 10^{+8}$	$3.44 \times 10^{+8}$
WSW	-	$5.71 \times 10^{+5}$	$9.25 \times 10^{+5}$	-	$1.22 \times 10^{+6}$	$1.64 \times 10^{+6}$	$1.66 \times 10^{+7}$	$9.32 \times 10^{+7}$	$1.45 \times 10^{+8}$	$1.35 \times 10^{+8}$	$3.94 \times 10^{+8}$
W	-	-	$3.15 \times 10^{+5}$	-	-	$3.44 \times 10^{+6}$	$4.87 \times 10^{+6}$	$8.16 \times 10^{+7}$	$1.26 \times 10^{+8}$	$1.39 \times 10^{+8}$	$3.55 \times 10^{+8}$
WNW	-	-	-	-	-	$6.92 \times 10^{*6}$	$2.37 \times 10^{*7}$	4.19×10^{7}	$7.06 \times 10^{+7}$	$6.46 \times 10^{+7}$	$2.08 \times 10^{+8}$
NW	-	-	-	-	$1.12 \times 10^{*5}$	5.72×10^{6}	$2.80 \times 10^{*7}$	4.94×10^{7}	$1.84 \times 10^{+7}$	$2.88 \times 10^{+5}$	$1.02 \times 10^{+8}$
NNW	-	-	-	-	-	$3.16 \times 10^{+6}$	$8.12 \times 10^{+6}$	$4.09 \times 10^{+7}$	$9.00 \times 10^{+6}$	$1.03 \times 10^{+6}$	$6.22 \times 10^{+7}$
Total	-	$2.32 \times 10^{+6}$	$5.15 \times 10^{+6}$	$5.43 \times 10^{+6}$	$5.61 \times 10^{+6}$	$5.78 \times 10^{+7}$	$2.05 \times 10^{+8}$	$4.64 \times 10^{+8}$	$6.86 \times 10^{+9}$	$7.52 \times 10^{+8}$	$2.18 \times 10^{+9}$

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-35

ANNUAL PRODUCTION OF ALL HAY (KILOGRAMS/YEAR) WITHIN 50 MILES OF LGS

DISTANCE RANGE IN MILES[1]

Direction	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	-	-	$3.85 \times 10^{+4}$	$4.54 \times 10^{+4}$	-	$1.46 \times 10^{+6}$	$5.84 \times 10^{+6}$	$1.46 \times 10^{+7}$	$1.95 \times 10^{+7}$	$9.54 \times 10^{+6}$	$5.10 \times 10^{+7}$
NNE	-	-	-	-	$9.07 \times 10^{+4}$	$1.11 \times 10^{+6}$	$6.47 \times 10^{+6}$	$1.16 \times 10^{+7}$	$1.70 \times 10^{+7}$	$2.55 \times 10^{+7}$	$6.18 \times 10^{+7}$
NE	-	-	$6.44 \times 10^{+4}$	-	$1.89 \times 10^{+5}$	$1.06 \times 10^{+6}$	$3.10 \times 10^{+6}$	$6.56 \times 10^{+6}$	$1.75 \times 10^{+7}$	$2.35 \times 10^{+7}$	$5.20 \times 10^{+7}$
ENE	-	-	$3.04 \times 10^{+5}$	$1.50 \times 10^{+5}$	$2.14 \times 10^{+5}$	$1.03 \times 10^{+6}$	$4.53 \times 10^{+6}$	$8.18 \times 10^{+6}$	$1.55 \times 10^{+7}$	$2.11 \times 10^{+7}$	$5.10 \times 10^{+7}$
E	-	-	$4.07 \times 10^{+5}$	-	$1.66 \times 10^{+5}$	$1.11 \times 10^{+6}$	$3.95 \times 10^{+6}$	$6.55 \times 10^{+6}$	$8.06 \times 10^{+6}$	$6.53 \times 10^{+6}$	$2.68 \times 10^{+7}$
ESE	-	-	-	$5.71 \times 10^{+5}$	$1.18 \times 10^{+5}$	$1.11 \times 10^{+6}$	$3.15 \times 10^{+6}$	$1.78 \times 10^{+6}$	$4.96 \times 10^{+6}$	$1.61 \times 10^{+7}$	$2.78 \times 10^{+7}$
SE	-	-	-	-	$4.76 \times 10^{+5}$	$1.21 \times 10^{+6}$	$2.73 \times 10^{+6}$	$4.06 \times 10^{+5}$	$2.05 \times 10^{+6}$	$2.11 \times 10^{+6}$	$8.98 \times 10^{+6}$
SSE	-	-	$6.53 \times 10^{+4}$	$6.58 \times 10^{+5}$	$9.89 \times 10^{+5}$	$2.10 \times 10^{+6}$	$6.18 \times 10^{+6}$	$8.83 \times 10^{+5}$	$7.37 \times 10^{+6}$	$1.10 \times 10^{+7}$	$2.92 \times 10^{+7}$
S	-	-	$2.72 \times 10^{+4}$	$1.12 \times 10^{+6}$	$4.13 \times 10^{+5}$	$1.68 \times 10^{+6}$	$6.91 \times 10^{+6}$	$7.31 \times 10^{+6}$	$6.63 \times 10^{+6}$	$1.12 \times 10^{+7}$	$3.53 \times 10^{+7}$
SSW	$2.27 \times 10^{+4}$	$3.58 \times 10^{+5}$	$7.07 \times 10^{+4}$	$4.61 \times 10^{+5}$	$1.94 \times 10^{+5}$	$2.33 \times 10^{+6}$	$8.50 \times 10^{+6}$	$1.42 \times 10^{+7}$	$1.71 \times 10^{+7}$	$1.63 \times 10^{+7}$	$5.95 \times 10^{+7}$
SW	-	$2.04 \times 10^{+5}$	$1.41 \times 10^{+6}$	$4.63 \times 10^{+4}$	$6.80 \times 10^{+4}$	$2.33 \times 10^{+6}$	$7.19 \times 10^{+6}$	$1.26 \times 10^{+7}$	$2.68 \times 10^{+7}$	$3.19 \times 10^{+7}$	$8.25 \times 10^{+7}$
WSW	-	$2.27 \times 10^{+5}$	$4.48 \times 10^{+5}$	-	$6.12 \times 10^{+5}$	$6.54 \times 10^{+5}$	$6.07 \times 10^{+6}$	$1.99 \times 10^{+7}$	$3.04 \times 10^{+7}$	$2.83 \times 10^{+7}$	$8.66 \times 10^{+7}$
W	-	-	$2.72 \times 10^{+5}$	$7.53 \times 10^{+4}$	-	$1.64 \times 10^{+6}$	$2.52 \times 10^{+6}$	$1.99 \times 10^{+7}$	$2.92 \times 10^{+7}$	$3.57 \times 10^{+7}$	$8.93 \times 10^{+7}$
WNW	-	-	-	-	-	$3.58 \times 10^{+6}$	$1.23 \times 10^{+7}$	$2.17 \times 10^{+7}$	$3.47 \times 10^{+7}$	$3.49 \times 10^{+7}$	$1.07 \times 10^{+8}$
NW	-	-	-	-	$6.80 \times 10^{+4}$	$2.95 \times 10^{+6}$	$1.44 \times 10^{+7}$	$2.55 \times 10^{+7}$	$1.60 \times 10^{+7}$	$1.02 \times 10^{+7}$	$6.91 \times 10^{+7}$
NNW	-	-	-	-	$9.80 \times 10^{+4}$	$1.61 \times 10^{+6}$	$4.20 \times 10^{+6}$	$2.51 \times 10^{+7}$	$1.71 \times 10^{+7}$	$2.61 \times 10^{+6}$	$5.07 \times 10^{+7}$
Total	$2.27 \times 10^{+4}$	$7.89 \times 10^{+5}$	$3.11 \times 10^{+6}$	$3.13 \times 10^{+6}$	$3.69 \times 10^{+6}$	$2.70 \times 10^{+7}$	$9.81 \times 10^{+7}$	$1.97 \times 10^{+8}$	$2.70 \times 10^{+8}$	$2.86 \times 10^{+8}$	$8.89 \times 10^{+8}$

[1] Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-36

CROP PRODUCTION AND YIELD SUMMARY[1]

Crop	Production (kg/yr)	% Total	Yield (kg/m^2)
Vegetables	1.04×10^9	19.2	3.36
Apples and Peaches	8.27×10^7	1.5	-
Grain[2]	1.24×10^9	22.8	1.37
Silage Corn	2.18×10^9	40.2	3.12
Hay	8.89×10^8	16.4	1.14
Total	5.43×10^9	100.0	

(1) Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, August 1979.

(2) Grain comprised of wheat, 12%; oats, 4%; barley, 6% and grain corn, 78%.

TABLE 2.1-37 (Page 1 of 3)

LOCATION OF RESIDENCES WITHIN 1 MILE OF
LIMERICK GENERATING STATION UNITS 1 AND 2 VENTS[1]

Sector	Distance From Vents (Feet)	(Meters)
N	3000	914
N	3100	945
N	3100	945
N	3100	945
N	3150	960
N	3200	975
N	3200	975
N	3200	975
N	3300	1006
N	3300	1006
N	3400	1036
N	3400	1036
N	3450	1052
N	3500	1067
N	3500	1067
N	3550	1082
N	3600	1097
N	4550	1387
N	4550	1387
N	4900	1494
N	5000	1524
N	5150	1570
N	5280	1609
N	5280	1609
NNE	2600	792
NNE	2800	853
NNE	3600	1097
NNE	3700	1128
NNE	3850	1173
NNE	3950	1204
NNE	4000	1219
NNE	4050	1234
NNE	4200	1280
NNE	4200	1280
NNE	4300	1311
NNE	4450	1356
NNE	4450	1356
NNE	4850	1478
NNE	5050	1539
NNE	5150	1570
NE	3450	1052
NE	4100	1250
NE	4200	1280

TABLE 2.1-37 (Cont'd) (Page 2 of 3)

Sector	Distance From Vents (Feet)	(Meters)
NE	4400	1341
ENE	2700	823
ENE	2950	899
ENE	3650	1113
ENE	4100	1250
ENE	4500	1372
E	3350	1021
E	3900	1189
E	4750	1448
E	4900	1494
ESE	3100	945
ESE	4200	1280
ESE	4200	1280
ESE	4250	1295
ESE	4250	1295
ESE	4400	1341
ESE	4400	1341
ESE	4900	1494
ESE	5000	1524
SE	5100	1554
SE	5300	1615
S	4400	1341
SSW	5000	1524
SSW	5050	1539
SSW	5100	1554
SSW	5200	1585
SSW	5250	1600
SW	3300	1006
SW	3450	1052
SW	3900	1189
SW	4000	1219
SW	4100	1250
SW	4150	1265
SW	4400	1341
SW	4500	1372
SW	4600	1402
SW	4650	1417
SW	4700	1433
SW	4750	1448
SW	4800	1463
SW	4900	1494
SW	5050	1539
SW	5150	1570
SW	5150	1570
SW	5200	1585
WSW	3850	1173

TABLE 2.1-37 (Cont'd) (Page 3 of 3)

Sector	Distance From Vents (Feet)	(Meters)
WSW	3900	1189
WSW	4000	1219
WSW	4150	1265
WSW	4300	1311
WSW	4300	1311
WSW	4500	1372
WSW	4650	1417
WSW	4750	1448
W	3200	975
W	3600	1097
W	3650	1113
W	3700	1128
W	3800	1158
W	3800	1158
W	3850	1173
W	4600	1402
W	5250	1600
WNW	3700	1128
WNW	3800	1158
WNW	3800	1158
WNW	3900	1189
WNW	3900	1189
WMW	3950	1204
WNW	4000	1219
WNW	4150	1265
WNW	4150	1265
WNW	4150	1265
WNW	4300	1311
WNW	4400	1341
WNW	4600	1402
WNW	4700	1433
WNW	4900	1494
NW	3700	1128
NNW	3950	1204
NNW	4300	1311
NNW	4500	1372
NNW	4900	1494
NNW	4900	1494
NNW	5100	1554

(1) Radiation Management Corporation, "Agricultural Land Use Survey in the Vicinity of Limerick Generating Station," RMC-TR-12, June 1979. Survey based on data collected in 1975-1976.

TABLE 2.1-38

SCHUYLKILL RIVER - MUNICIPAL WATER USERS
DOWNSTREAM OF LIMERICK SITE

Location No. (1)	User	Radial Distance From Station (mi)	River Distance From Station (mi)	Withdrawal Rate (GPM) 1976	Withdrawal Rate (GPM) Entitlement (2)	Population Served 1976
1.	City of Philadelphia, Belmont Plant	27.8	27.8	130,764	179,160	959,700
2.	City of Philadelphia, Queen Lane Plant	26.1	35.2		(3)	
3.	Keystone Water Co (Norristown District)	14.1	24.0	5,972	11,666	72,200
4	Philadelphia Suburban Water Co	7.5	13.6	Not Available	13,889	831,000
5	Phoenixville Water Authority	5.4	9.0	3,125	4,861	19,800
6	Citizens Utility Home Water Co	2.2	2.5	929	1,389	14,000

(1) Refer to Figure 2.1-9 for locations of water users.
(2) Withdrawals authorized by Delaware River Basin Commission.
(3) Queen Lane Plant withdrawals and populations included with Belmont plant.

TABLE 2.1-39

SCHUYLKILL RIVER - INDUSTRIAL WATER USERS
DOWNSTREAM OF LIMERICK SITE

Location No. (1)	User	1971 Use (GPM)	Entitlement (gpm) (2) Total	Non-Consumptive	Consumptive	River Distance From Station (mi)
7	Connelly Container, Inc, Philadelphia Plant	26.5	40.0	36.0	4.0	34.4
8	Container Corp of America Philadelphia Plant, Mill Div.	5,650	7,500	7,350	150	33.0
9	Nicolet Industries, Inc, Norristown Plant	39	300	286	14	30.0
10	Philadelphia Electric Co W. Conshohocken Gas Plant	600	1,273.5	1,260.8	12.7	27.2
11	National Gypsum Co W. Conshohocken Plant	1,523	1,523	1,507.7	15.3	27.05
*12	Lukens Steel Co(3)		1,247.3	1,190.3	57.0	25.7
13	Philadelphia Electric Co Barbadoes Generating Station	67,368	100,600	99,425	1,175	23.7
14	Synthane-Taylor Corp	557.8	900	891	9	17.4
15	Phoenix Steel Corp (Phoenixville Plant)	571.1	11,639	9,311	2,238	12.4
16	Philadephia Electric Co Cromby Generating Station	230,470	255,000	252,980	2,020	8.9
*17	Keystone Coke Co(3)		1,493.1	1,130.9	362.2	26.1

(1) Refer to Figure 2.1-9 for locations of water users.
(2) Withdrawals authorized by Delaware River Basin Commission.
(3) No entitlement, rather a fee is paid for water withdrawn from the river.

TABLE 2.1-40 (Page 1 of 2)

ACCESSIBLE RECREATION AREAS ON THE SCHUYLKILL RIVER DOWNSTREAM OF THE LGS SITE (1)(2)

	Location Name	River Mile From Site
1.	Vincent Dam	3.3
2.	East Main Street Area, Spring City	6.6-6.9
3.	Vicinity of Phoenixville Water Company	8.7-8.9
4.	Montgomery County Geriatric and Rehabilitation Center Area	9.7-10.2
5.	Route 113 Bridge Boat Ramp	10.2
6.	Black Rock Dam Area	11.0-11.6
7.	Route 29 Bridge, Phoenixville	12.3
8.	Port Providence Area	13.3-13.6
9.	Oaks Area	14.3-14.7
10.	Pawling Road Bridge, Perkiomen Junction	16.0
11.	Valley Forge State Park	16.1-19.4
12.	Betzwood Bridge Boat Ramp	19.4
13.	Boat Ramp North of Barbadoes Island	23.1
14.	Spring Mill Road Area	29.1
15.	Miquon Area	30.0
16.	Shawmont Area	31.0-32.2
17.	Lower Gladwyn	32.3
18.	Flat Rock Tunnel	32.4-32.5
19.	Green Lane Bridge	33.5-33.6
20.	Main Street Area, Manayunk	33.8
21.	Fairmont Park	34.7-39.6

TABLE 2.1-40 (Cont'd) (Page 2 of 2)

(1) Pennsylvania Environmental Council, "Recreational Uses of the Schuylkill River," Draft Report, November 1977.
(2) Personal communication, 1982, Pennsylvania Fish Commission.

TABLE 2.1-41

ACCESSIBLE RECREATION AREAS ON THE SCHUYLKILL RIVER DOWNSTREAM OF THE LGS SITE (PROJECTED)(1)(2)

	Location Name	River Miles From Site
1.	Impounding Basin Near Abrams	21.9
2.	Pennsylvania Turnpike Bridge	24.9
3.	Blue Route Bridge Near Plymouth Dam	26.7
4.	Fayette Street Bridge, Conshohocken	27.4
5.	Area Near Barren Hill Road	28.9
6.	Strawberry Mansion Bridge Boat Ramp	36.9

(1) Pennsylvania Environmental Council, "Recreational Uses of the Schuylkill River," Draft Report, November 1977.
(2) Personal communication, 1982, Pennsylvania Fish Commission.

TABLE 2.1-42

BOATING HOURS ON THE SCHUYLKILL RIVER DOWNSTREAM OF THE LIMERICK GENERATING STATION[1][2]

River Miles Downstream of LGS Site	Boating Hours/Year
0-10	5,000
10-20	59,000
20-30	88,000
30-40	23,000
40-50	82,000

(1) Pennsylvania Fish Commission, "1975 Fishing and Boating Inventory."
(2) Personal communication, 1982, Pennsylvania Fish Communication.

TABLE 2.1-43

PRESENT AND PROJECTED FISHING HOURS AND EDIBLE FISH CATCH IN THE SCHUYLKILL RIVER DOWNSTREAM OF THE LIMERICK GENERATING STATION[1][2]

River Miles Downstream of the LGS Site	Fishing-Hours/Year		Edible Fish Catch (kg/yr)	
	Present	Projected	Present	Projected
0-10	175,000	255,000	3,200	4,700
10-20	228,000	320,000	4,200	6,000
20-30	256,000	356,000	4,700	6,700
30-40	472,000	822,000	8,700	15,700
40-50	364,000	634,000	6,700	12,000

(1) Pennsylvania Fish Commission, "1975 Fishing and Boating Inventory."
(2) Personal communication, 1982, Pennsylvania Fish Commission.

TABLE 2.1-44

PERCENTAGE OF FISH SPECIES MOST FREQUENTLY CAUGHT IN THE VICINITY OF THE LIMERICK GENERATING STATION[1]

FISH SPECIES	PERCENTAGE CAUGHT
Lepomis (undefined)	48.7
Redbreast sunfish	8.3
Brown bullhead	5.5
Carp	4.4
Goldfish	3.5
Green sunfish	2.9
Pumpkinseed	2.8
Smallmouth bass	2.3
American eel	2.1
Freshwater catfish	2.0
Golden shiner	1.6
Yellow bullhead	1.6
Channel catfish	1.3
Lepomis hybrid	1.3
White catfish	<1.0
Black bullhead	<1.0
Rock bass	<1.0
Pomoxis	<1.0
White crappie	<1.0
Yellow perch	<1.0
Creek chub	<1.0
White sucker	<1.0
Largemouth bass	<1.0

Total Catch: 932 Fish

(1) Ichthyological Associates, "Survey of Anglers on the Schuylkill River near Pottstown in 1976," Draft Report, August 1977.

TABLE 2.1-44 (Cont'd)

A LIST OF THE FISH SPECIES TAKEN IN THE SCHUYLKILL RIVER AND NEARBY TRIBUTARIES FROM POTTSTOWN, PENNSYLVANIA, TO VINCENT DAM[a]

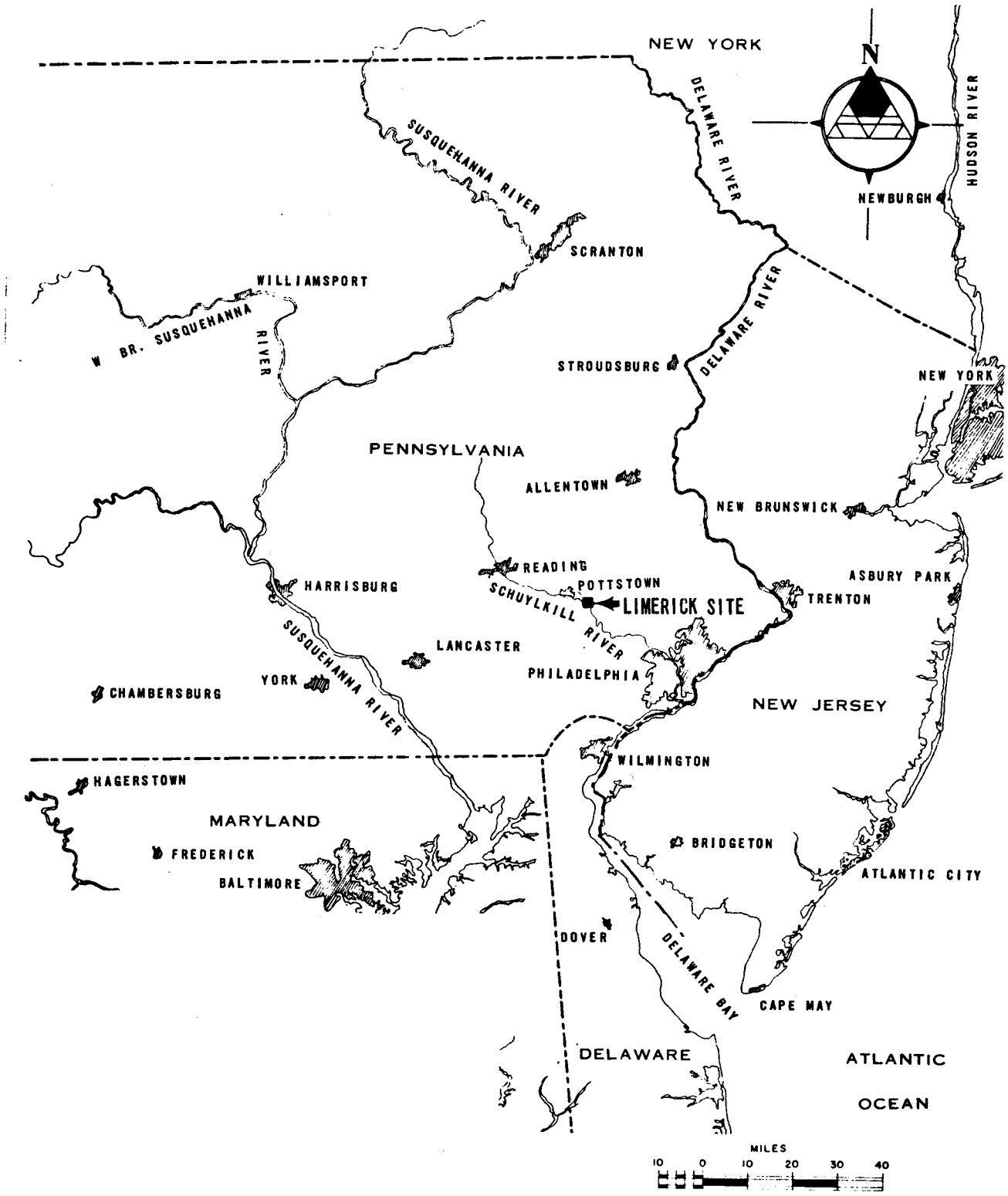
	FRESH WATER EELS	ANGUILLIDAE
American eel		Anguilla rostrata (LeSueur)
	TROUT	SALMONIDAE
Brook trout		Salvelinus fontinalis (Mitchill)
	PIKES	ESOCIDAE
Redfin pickerel		Esox americanus (Gmelin)
Muskellunge		Esox masquinongy (Mitchill)
	MINNOWS AND CARPS	CYPRINIDAE
Goldfish		Carassius auratus (Linnaeus)
Carp		Cyprinus carpio (Linnaeus)
Cutlips minnow		Exoglossum maxillingua (LeSueur)
Golden shiner		Notemigonus crysoleucas (Mitchill)
Comely shiner		Notropis amoenus (Abbott)
Satinfin shiner		Notropis analostanus (Girard)
Bridle shiner		Notropis bifrenatus (Cope)
Common shiner		Notropis cornutus (Mitchill)
Spottail shiner		Notropis hudsonius (Clinton)
Swallowtail shiner		Notropis procne (Cope)
Spotfin shiner		Notropis spilopterus (Cope)
Bluntnose minnow		Pimephales notatus (Rafinesque)
Fathead minnow		Pimephales promelas (Rafinesque)
Blacknose dace		Rhinichthys atratulus (Hermann)
Longnose dace		Rhinichthys cataractae (Valenciennes)
Creek chub		Semotilus atromaculatus (Mitchill)
Fallfish		Semotilus corporalis (Mitchill)
	SUCKERS	CATOSTOMIDAE
Quillback		Carpiodes cyprinus (LeSueur)
White sucker		Catostomus commersoni (Lacepede)
Creek chubsucker		Erimyzon oblongus (Mitchill)
	FRESH WATER CATFISH	ICTALURIDAE
White catfish		Ictalurus catus (Linnaeus)
Black bullhead		Ictalurus melas (Rafinesque)
Yellow bullhead		Ictalurus natalis (LeSueur)
Brown bullhead		Ictalurus nebulosus (LeSueur)
Channel catfish		Ictalurus punctatus (Rafinesque)
Margined madtom		Noturus insignis (Richardson)
	KILLIFISH	CYPRINODONTIDAE
Banded killifish		Fundulus diaphanus (LeSueur)

TABLE 2.1-44 (Cont'd)

A LIST OF THE FISH SPECIES TAKEN IN THE SCHUYLKILL RIVER AND NEARBY TRIBUTARIES FROM POTTSTOWN, PENNSYLVANIA, TO VINCENT DAM[2]

SUNFISH	CENTRARCHIDAE
Rock bass	Ambloplites rupestris (Rafinesque)
Redbreast sunfish	Lepomis auritus (Linnaeus)
Green sunfish	Lepomis cyanellus (Rafinesque)
Pumpkinseed	Lepomis gibbosus (Linnaeus)
Bluegill	Lepomis macrochirus (Rafinesque)
White crappie	Pomoxis annularis (Rafinesque)
Black crappie	Pomoxis nigromaculatus (LeSueur)
Smallmouth bass	Micropterus dolomieui (Lacepede)
Largemouth bass	Micropterus salmoides (Lacepede)
PERCH	PERCIDAE
Tessellated darter	Etheostoma olmstedi (Storer)
Yellow perch	Perca flavescens (Mitchill)
Shield darter	Percina peltata (Stauffer)

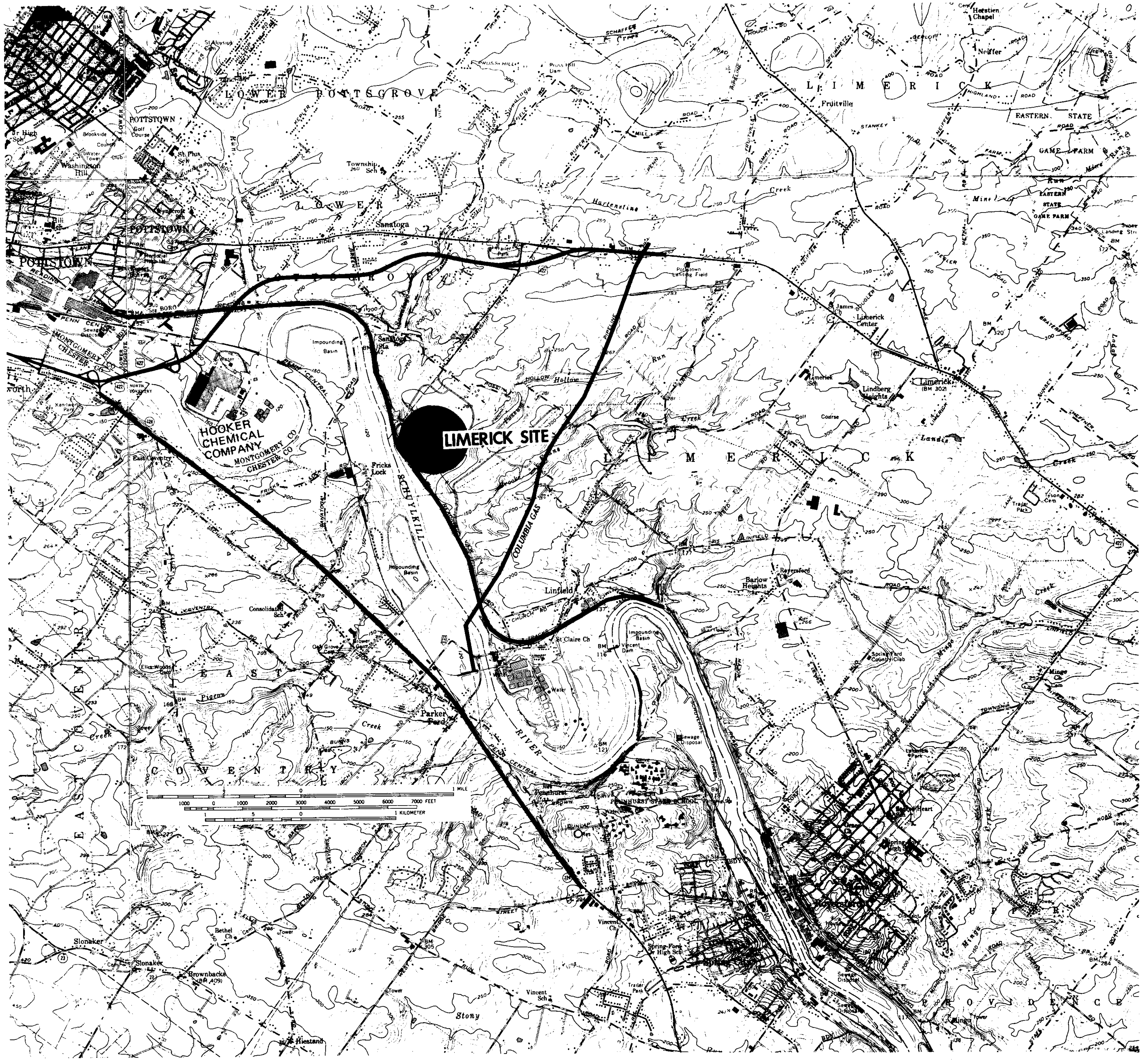
(2) Philadelphia Electric Company, "Limerick Generating Station Units 1 and 2 Environmental Report - Construction Permit Stage (Revised)," May 1972.



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

SITE LOCATION MAP

FIGURE 2.1-1



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

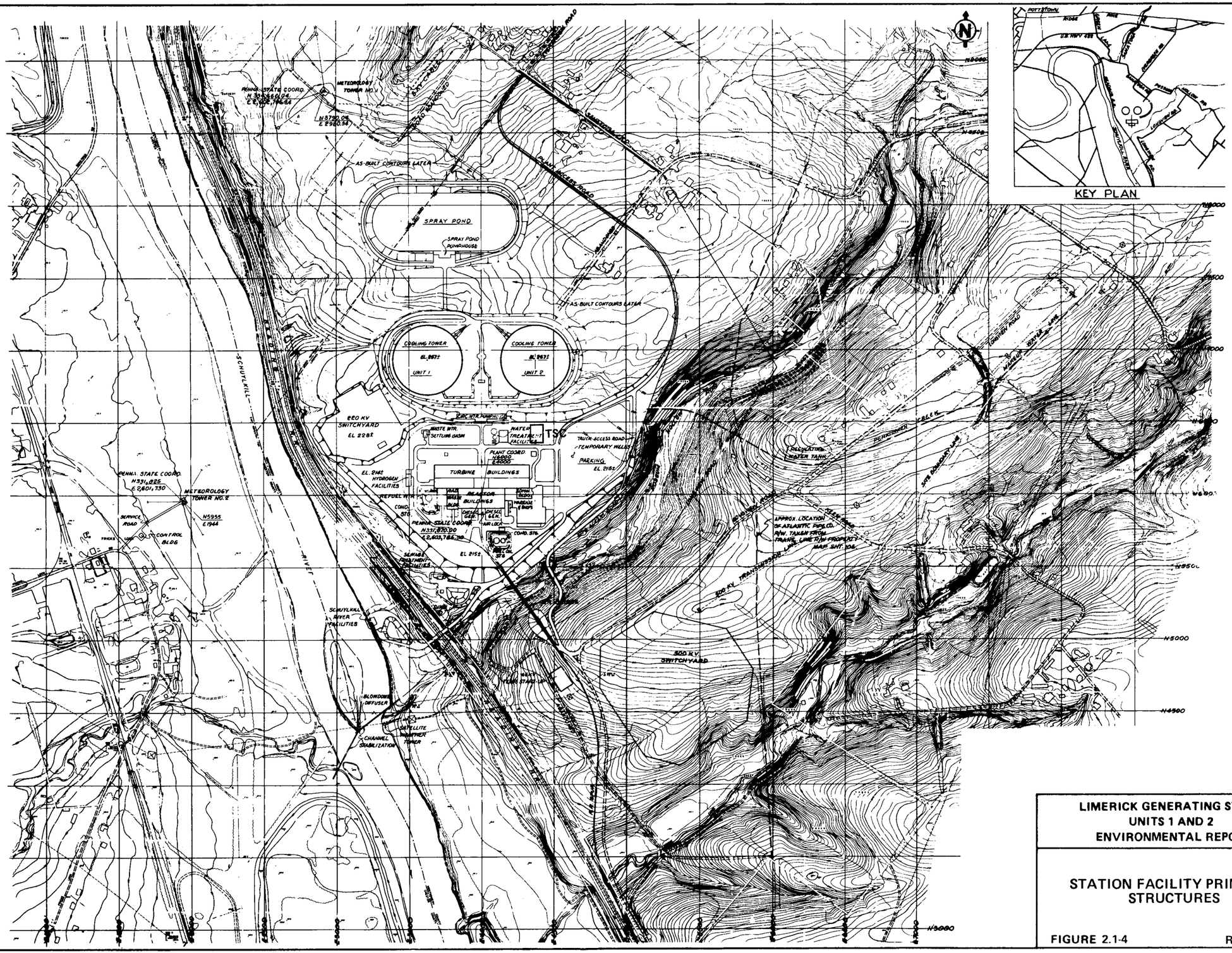
GENERAL SITE AREA MAP

FIGURE 2.1-2 **REV. 4, 07/82**

LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

SITE PLAN

FIGURE 2.1-3 REV. 10, 02/83

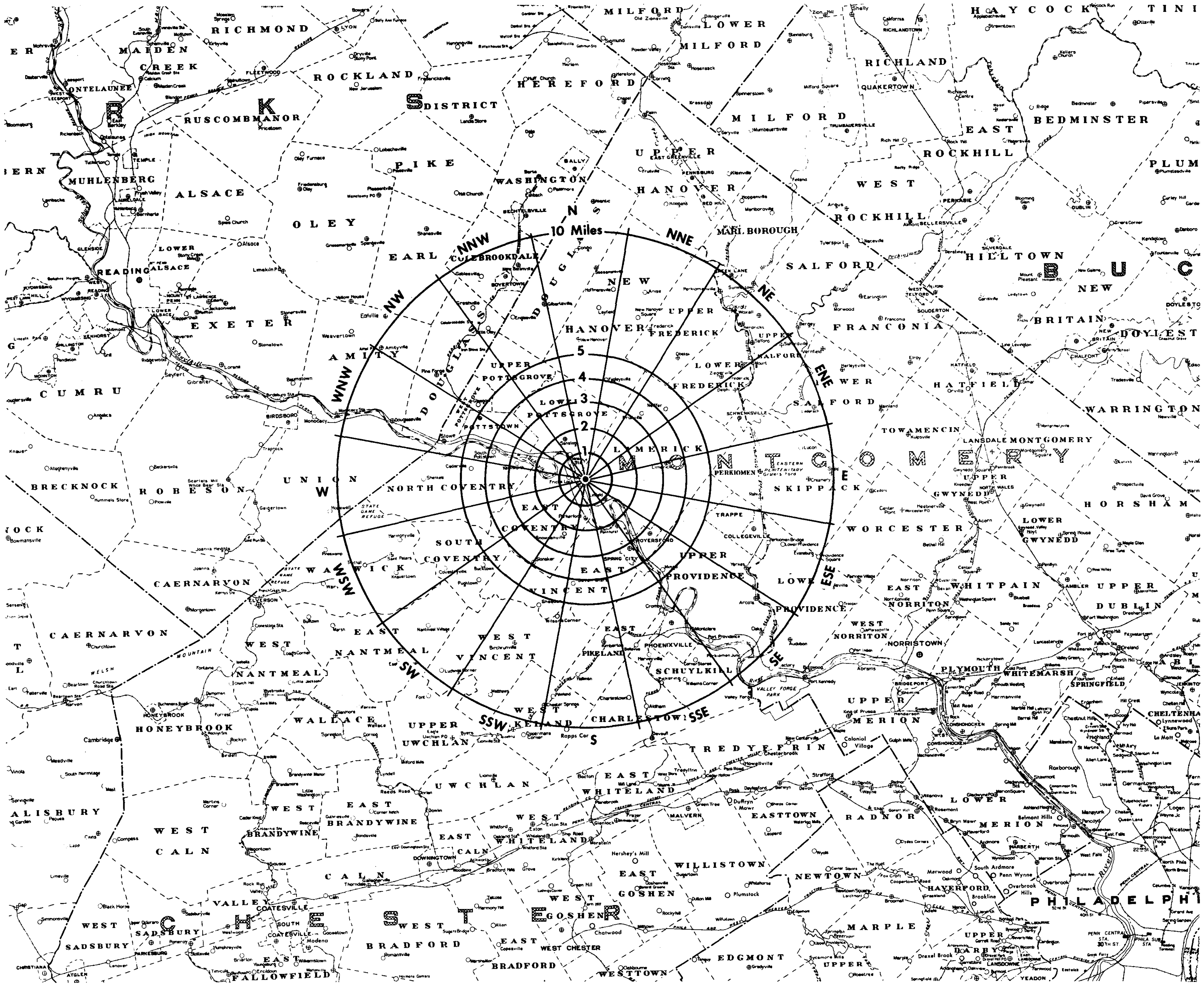


LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

STATION FACILITY PRINCIPAL STRUCTURES

FIGURE 2.1-4

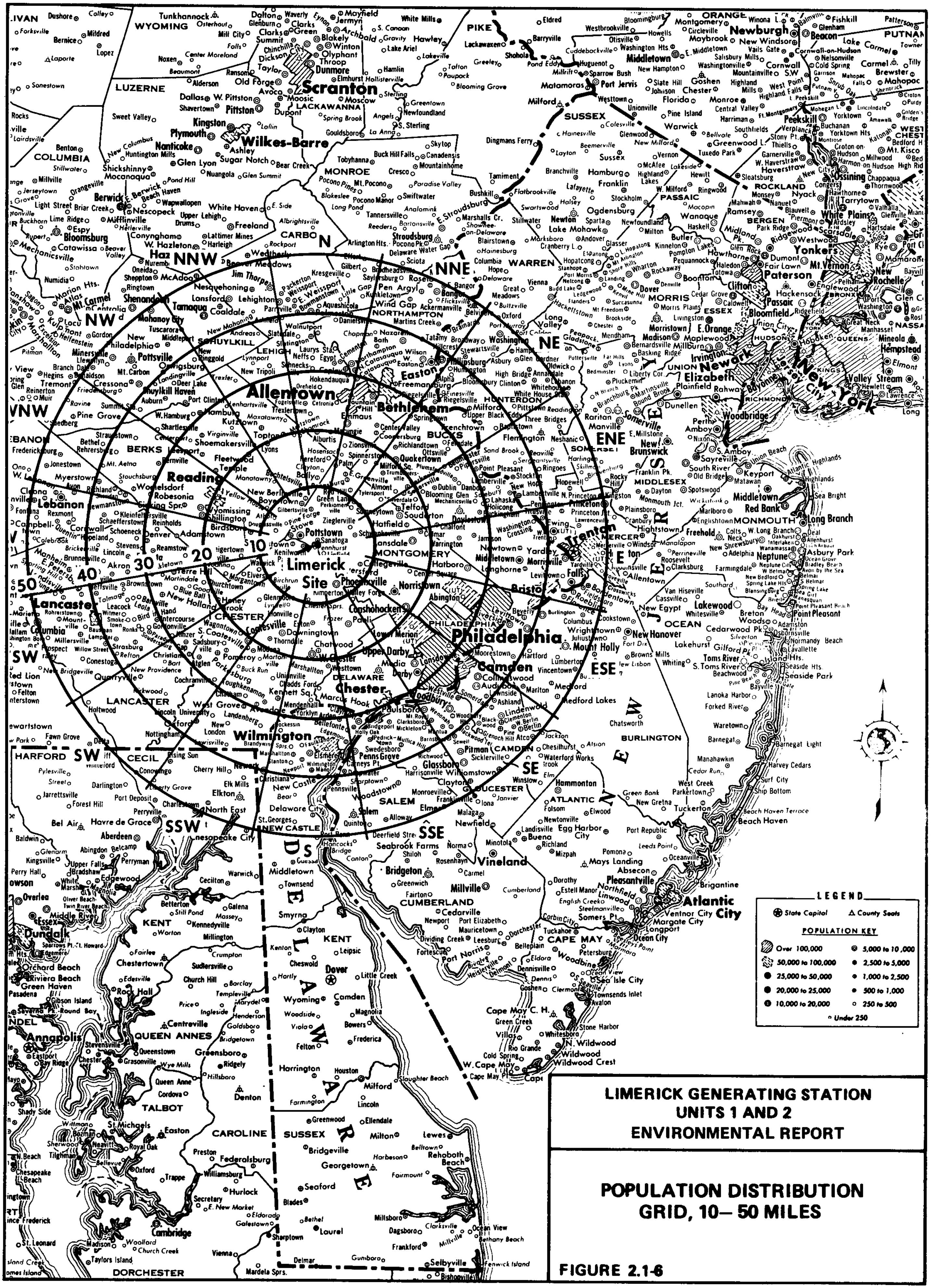
REV. 16, 12/83



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

POPULATION DISTRIBUTION GRID, 0 – 10 MILES

FIGURE 2.1-5



LIMERICK GENERATING STATION UNITS 1 AND 2 ENVIRONMENTAL REPORT

POPULATION DISTRIBUTION GRID, 10– 50 MILES

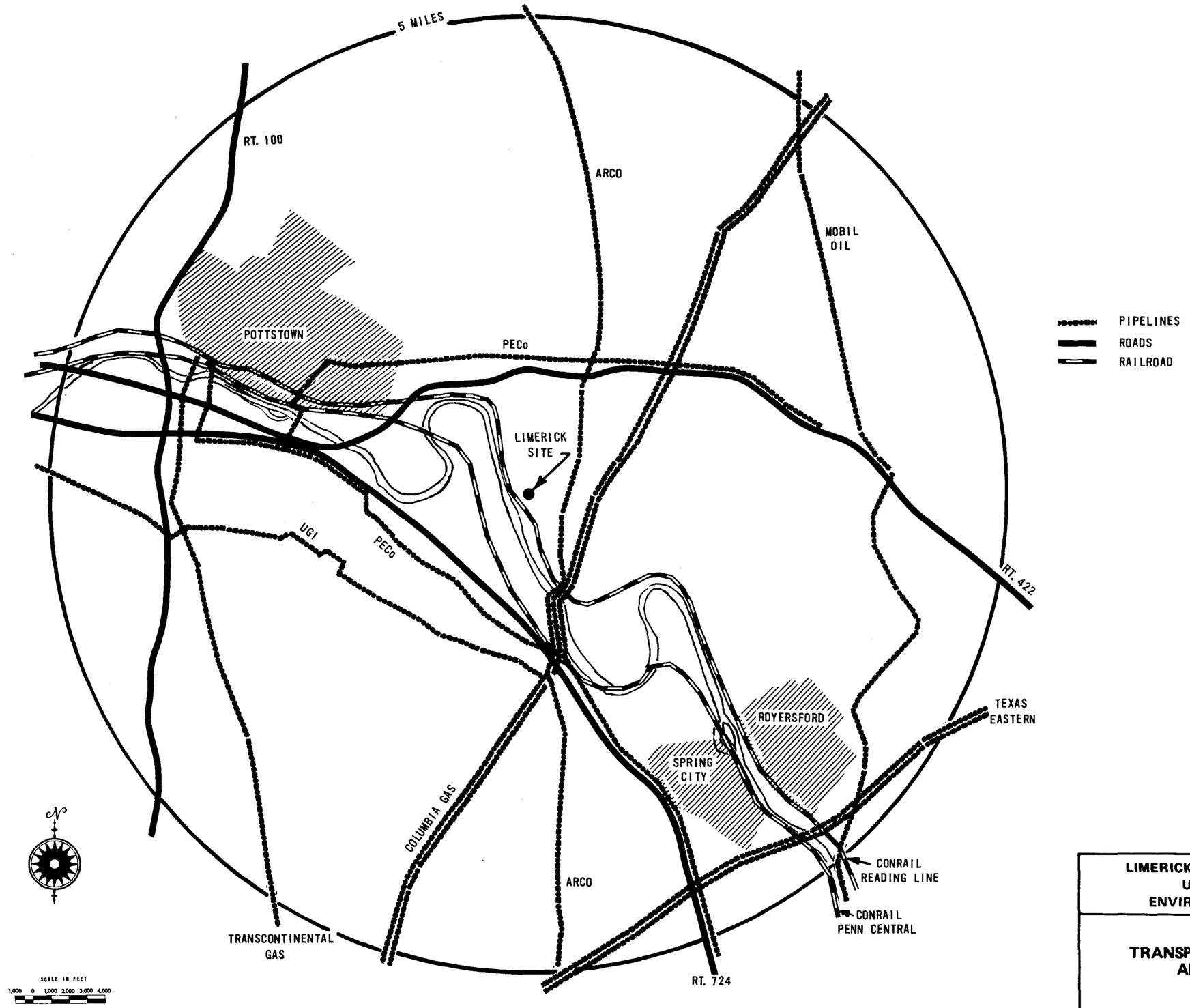
FIGURE 2.1-6

LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

INDUSTRIES WITHIN THE LPZ

FIGURE 2.1-7

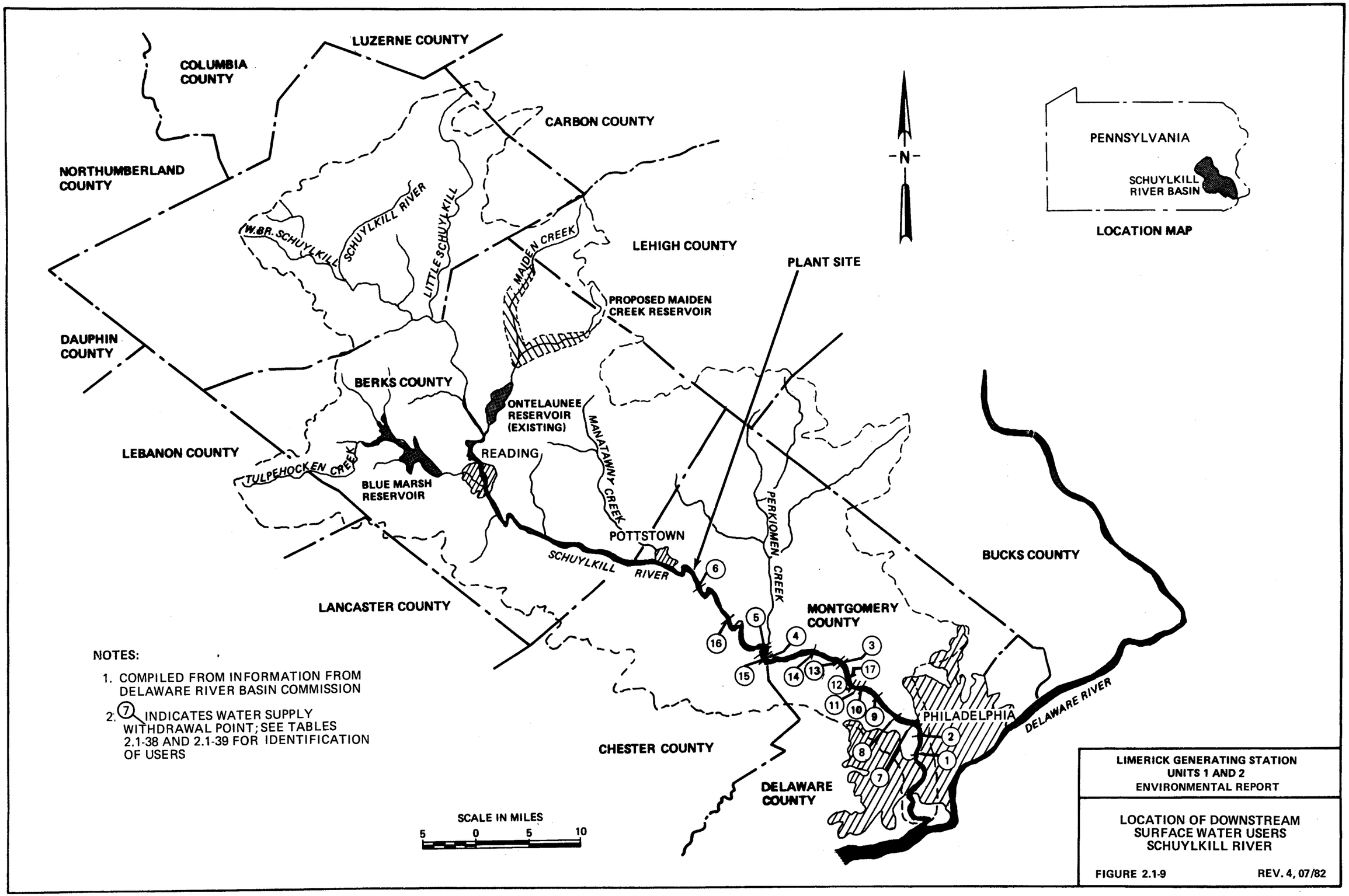
REV. 4, 07/82



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

TRANSPORTATION ROUTES AND PIPELINES

FIGURE 2.1-8


LUZERNE COUNTY
COLUMBIA COUNTY
CARBON COUNTY
NORTHUMBERLAND COUNTY
W.BR. SCHUYLKILL
SCHUYLKILL RIVER
LITTLE SCHUYLKILL
MAIDEN CREEK
LEHIGH COUNTY
PLANT SITE
PROPOSED MAIDEN CREEK RESERVOIR
DAUPHIN COUNTY
BERKS COUNTY
ONTELAUNEE RESERVOIR (EXISTING)
MANATAWNY CREEK
LEBANON COUNTY
TULPEHOCKEN CREEK
BLUE MARSH RESERVOIR
READING
POTTSTOWN
PERKIOMEN CREEK
SCHUYLKILL RIVER
BUCKS COUNTY
LANCASTER COUNTY
MONTGOMERY COUNTY
PHILADELPHIA
DELAWARE RIVER
CHESTER COUNTY
DELAWARE COUNTY
N
PENNSYLVANIA
SCHUYLKILL RIVER BASIN
LOCATION MAP
NOTES:
1. COMPILED FROM INFORMATION FROM DELAWARE RIVER BASIN COMMISSION
2. 7 INDICATES WATER SUPPLY WITHDRAWAL POINT; SEE TABLES 2.1-38 AND 2.1-39 FOR IDENTIFICATION OF USERS
SCALE IN MILES
5 0 5 10
LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT
LOCATION OF DOWNSTREAM SURFACE WATER USERS SCHUYLKILL RIVER
FIGURE 2.1-9
REV. 4, 07/82

2.2 ECOLOGY

This section provides a general description of the flora and fauna of the Limerick Generating Station (LGS) site, adjacent reaches of the Schuylkill River, the middle reach of Perkiomen Creek, and East Branch Perkiomen Creek. It identifies important species in these areas and discusses their life history and population dynamics. Information was obtained from extensive field investigations conducted by the Applicant's ecological consultant (1970-1978) and from literature sources. Details of methodology for ecological investigations are provided in Section 6.1.

Important species were selected by criteria outlined in NRC Regulatory Guide 4.2, Revision 2 (U.S. Nuclear Regulatory Commission, Ref 2.2-1). This states that "a species, is important if a specific causal link can be identified between the nuclear power station and the species, and if one or more of the following criteria applies: (a) the species is commercially or recreationally valuable, (b) the species is threatened or endangered, (c) the species affects the well-being of some important species within criteria (a) or (b), or (d) the species is critical to the structure and function of the ecological system." In this report, the abundance and role (niche) of a species in the community were used as measures of importance to community structure and function.

It should be emphasized that important species include representatives of available niches, and general categories of commercial or recreational interest. They should not be considered individually as indicator organisms, but rather collectively as a representative in-depth description of the ecosystem. Information on local biology of important species is presented in phylogenetic order within biotic categories and the ecosystem.

2.2.1 TERRESTRIAL ECOLOGY

The LGS site is located in Chester and Montgomery counties in southeastern Pennsylvania and is bordered by the Schuylkill River. It encompasses 182 ha in the Piedmont Region between the coastal plain to the southeast and the ridge and valley section to the northwest. The term 'site' refers to the 762-m radius exclusion zone of LGS. The surrounding area is residential, industrial, and farmlands.

Throughout the plant site, the land slopes upward from the river to an elevation of about 30 to 85 m above sea level. The surrounding countryside is gently rolling and cut by several

small creeks that drain into the Schuylkill. There are no 'wilderness' areas adjacent to LGS. The climate is temperate. The average temperature is 24°C in the summer and 0°C in the winter, and the annual rainfall averages 1.1 m. Snow cover is generally light. The site is in the Carolinian life zone.

2.2.1.1 Flora

Vegetation is important in the terrestrial ecosystem because plants are the major primary producers. Plants convert solar energy into chemical energy and biomass. Animals depend upon plants for both food and cover, and the vegetation of an area is a major determinant of what animal communities the area can support.

Pennsylvania forms part of what was the vast Eastern Deciduous Forest. After a long history of settlement and cultivation, vegetation in Pennsylvania is now patchy in distribution and floristically diverse. The regional climax is the Oak-Chestnut Forest and changes in vegetation proceed toward this end.

In the summer and fall of 1972 the LGS site was surveyed to determine principal plant communities, and to identify rare and endangered plants and critical or unique habitats. In the summer of 1973 a quantitative study of the structure and species composition of a 6.4-ha wooded area along Possum Hollow Run was conducted. Since the major impact of construction occurred prior to 1972, flora near LGS have not been studied since the initial inventories. However, new species that were encountered on the site between 1973 and 1978 were recorded.

2.2.1.1.1 Species Inventory

Some 402 terrestrial vascular plants were identified on the LGS site from 1972 through 1978 and should represent all but the least common species (Table 2.2-1). Lower plants such as mosses, lichens, and fungi were not surveyed, and only the more common grasses were identified. Thorough examination of the site in 1972 and 1973 yielded no rare or endangered species (Smithsonian Institute, Ref 2.2-2), and no habitats or plant communities that were critical or unique to Pennsylvania.

2.2.1.1.2 Community Description

Vegetation of the LGS site comprised eight plant communities: forest, old-field, grassland, pioneer herbaceous, wetland,

cultivated field, orchard, and residential (Figure 2.2-1). The distribution of the dominant plants of each community except residential is discussed below.

2.2.1.1.2.1 Forest

The larger wooded areas on the site were found along Possum Hollow Run and Brooke Evans Creek in Montgomery County, the floodplain of the Schuylkill, and the bed of the old Schuylkill Canal in Chester County. Smaller wooded areas occurred as hedgerows and woodlots. Some 25% of the 762-m radius exclusion zone was wooded. Trees that dominated each area depended upon slope, exposure, drainage, and time since clearing. Apparently all woods on the site have been cut at least once.

The narrow strip of trees along the banks of the river (riparian forest) and the woods on Limerick Island were composed of river birch, box elder, and black willow. A few large silver maple and sycamore were also present. As a consequence of rather regular exposure to flood waters, many trees in the riparian forest were bent or uprooted.

Silver maple, sycamore, American elm, and slippery elm were the dominant trees on the floodplains of the Schuylkill and its larger tributaries. These low, flat woods often had standing water in winter and spring, and plants that occurred there were characteristic of wet areas. Associated trees were box elder, river birch, bitternut hickory, red maple, black walnut, ailanthus, beech, basswood, catalpa, and white ash. Common shrubs and vines were spicebush, bladdernut, common elder, frost grape, and Japanese honeysuckle.

The structure and composition of upland woods on the LGS site were surveyed in a representative 6.4-ha forested area along Possum Hollow Run. Twenty-seven species of trees, greater than 9 cm in diameter at breast height (DBH), were recorded. The most common, in terms of a relative measure of density, frequency of occurrence, and basal area (DBF), were white ash, tulip-tree, red maple, chestnut oak, American elm, black walnut, slippery elm, flowering dogwood, bitternut hickory, beech, and red oak. Common spicebush, red maple, flowering dogwood, elms, oaks, frost grape, white ash, bitternut hickory, and black cherry were most important in the size class from 1.5 to 9 cm DBH. In the seedling-size class (<1.5 cm DBH), Japanese honeysuckle, poison ivy, bitternut hickory, oaks, black cherry, frost grape, Virginia creeper, white ash, and common spicebush were most common.

Four easily distinguished forest types comprised the Possum Hollow woods. Most of the area was occupied by a forest type dominated by white ash, probably the most abundant tree on the site. American elm, black walnut, red maple, and black cherry

were common in the tree-size class. A second type that was dominated by chestnut and oak, and also included beech, red maple, and tulip-tree. This area was characterized by an ericaceous shrub layer that included early low blueberry, black huckleberry, and tall deerberry. Spotted wintergreen occupied the sparse herbaceous stratum. A third forest type was dominated by tulip-tree, white ash, and red maple. Oaks, red maple, and flowering dogwood were common in the seedling and sapling strata. This area was considerably earlier in the successional continuum than the adjacent chestnut - oak woods (separated by a narrow dirt road), probably because it was grazed or cultivated more recently. The fourth type occupied a small fenced island in the middle of the white ash type. Beech, white oak, chestnut oak, and black oak were dominant. The sparse understory was composed of beech, smooth blackhaw, and black cherry.

Isolated patches of other forest species also occurred onsite. For example, Virginia pine was dominant on some of the surrounding ridge tops, and stands of other conifers occurred as plantations (e.g., scotch pine, white pine, and Norway spruce were planted at several locations). Pure stands of black locust occurred rarely along the old Schuylkill Canal and in the dry impounding basins that remained from the Schuylkill River desilting project (Section 2.2.2.1.1).

2.2.1.1.2.2 Old Field

Old field communities containing red cedar, hawthorns, viburnums, flowering dogwood, various cherries, roses, and brambles occurred onsite. Seedlings and saplings of tulip-tree, black cherry, white ash, and black locust were also present. As red cedar matures it will eventually overtop the shrubs and dominate the community. With time, deciduous saplings will compete with and eventually dominate red cedar until a more stable forest association forms.

2.2.1.1.2.3 Grassland

A section of abandoned farmland southeast of the construction area, bounded generally by Possum Hollow Run, the Schuylkill River, and Brooke Evans Creek, contained most of the grassland near LGS. Vegetation in these fields was dense and varied with respect to site characteristics and season. The following plants were well represented: grasses (Graminae), goldenrods, daisy, fleabane, aster, (especially heath aster), evening primrose, cinquefoils, wild carrot, teasel, clovers, smartweeds, and brambles (Rubus sp.). Red cedar seedlings were widely scattered throughout the fields, indicating that an old field community will probably replace the grassland.

2.2.1.1.2.4 Pioneer Herbaceous

Some 32% of the plant site was disturbed by construction, and much of this area continues to be stressed by man (e.g., mowing, paving, grading). As a result, present vegetation is low and sparse compared to adjacent undisturbed areas. Plant species identified in this pioneer herbaceous community included orchard grass, foxtails, lambs-quarters, lady's thumb, Pennsylvania and long-bristled smartweed, curled dock, wild carrot, amaranth pigweed, butter-and-eggs, red clover, yellow and white sweet clover, and deptford pink. This area is bounded on two sides by woodland and on one side by orchards.

2.2.1.1.2.5 Cultivated Fields and Orchards

Cultivated fields occupy about 13% of the LGS study area. Corn, wheat, and hay are grown here. Several small orchards northeast of the reactor site yielded apples, pears, and peaches. Woody hedgerows bordered most corn, wheat, and hay fields. Characteristic trees of the hedgerows were black cherry, black walnut, osage orange, white ash, mazzard cherry, red cedar, hackberry, sassafras, and tulip. Poison ivy, honeysuckle, and spicebush were found in the understory. Although hedgerows occupied only a fraction of the cultivated land area, they were important ecologically by creating edge habitat, thereby increasing the number of niches available for both plants and animals.

2.2.1.1.2.6 Wetlands

Wetlands were found along the Schuylkill and its tributaries and as a band of permanently wet shrubby vegetation adjacent to Akm Run. Wet-adapted shrubs included gray dogwood, black willow, common elder, and spicebush. Herbaceous plants such as bedstraws, tearthumb, Japanese hops, nut-grass, wild onion, hollow joe-pyeweed, and swamp milkweed formed a thick mat close to the ground.

2.2.1.1.3 Important Species

The major impacts of LGS construction on the terrestrial ecosystem have already occurred and include tree removal, land clearing, excavation, and grading of the site and access roads. Much of the site is now used for temporary construction buildings and material laydown. These areas will be regraded and landscaped when construction is completed. Because the impacts that have already occurred are irreversible in the short term, and because the potential for a specific causal link between

remaining flora and plant operation is low, no plants were chosen as important.

2.2.1.2 Amphibians and Reptiles

There was no formal program to study the amphibians and reptiles on the Limerick site. However, as amphibians and reptiles were encountered during other terrestrial and aquatic ecological studies, they were noted and often taken to the laboratory for identification. In this manner, 13 amphibians and 10 reptiles were found to occur on the LGS site (Table 2.2-2).

The red-backed salamander and two-lined salamander were the most common salamanders. Fowler's toad and spring peeper appeared to be the most common toad and frog. Snapping and stinkpot turtles were the most common aquatic turtles in the Schuylkill, and the painted turtle was common in ponds. The box turtle was the most frequently collected terrestrial turtle. The water snake and eastern garter snake were the most common aquatic and terrestrial snakes, respectively.

None of the amphibians or reptiles encountered is listed as rare or endangered. Although the bog turtle, listed as endangered by the U. S. Fish and Wildlife Service (Office of Endangered Species, Ref 2.2-5), is known to occur in southeastern Pennsylvania, a careful examination of likely sites did not produce any evidence of their presence. The bullfrog and snapping turtle have very limited commercial or sport value.

2.2.1.3 Birds

Birds are an important constituent of any terrestrial community. Many birds are commercially, recreationally, or aesthetically valuable. They are often the most diverse vertebrate component of an ecosystem, probably because of their ability to fly that enables them to more fully exploit available niches, both temporally and vertically.

Pennsylvania's avifauna has components of three major life zones, the Carolinian, Alleghenian, and Canadian. Because of its proximity to the Atlantic coast, and the situation of the Applachian mountains, Pennsylvania lies in an important migration corridor. Philadelphia was an early center for the study of bird natural history, and the birds of Pennsylvania have been extensively studied. The most recent statewide work is an annotated list by Poole (Ref 2.2-6). This work briefly treats the status of 361 bird species for which Pennsylvania records have been authenticated.

The abundance and distribution of birds at the LGS site were studied from September 1972 through March 1976 (Table 2.2-3). Studies were conducted around the perimeter of the construction area but within the 762-m radius exclusion zone. Estimates of breeding density were made for three seasons at a 5.8-ha oldfield plot and a 6.4-ha wooded plot on the LGS site. The abundance of birds in winter was studied during two seasons at the same two plots. The relative abundance of birds during spring and fall migration periods was studied in 1972, 1973, and 1974. A 13-km stretch of the river was censused from December 1973 to March 1976 to determine the distribution and abundance of waterfowl.

2.2.1.3.1 Species Inventory

Some 187 species of birds were observed within an 8-km radius of LGS from September 1972 through January 1978 (Table 2.2-4). With few exceptions, all regularly resided in or migrated through Pennsylvania, and most could be expected on site each year. This list represents the majority of birds that occur near LGS, as a 12-year survey of adjacent Chester County by 55 observers yielded 228 species (West Chester Bird Club, Ref. 2.2-9).

One peregrine falcon and one bald eagle (both endangered) were observed flying over the site in December 1975 and May 1978, respectively. However, neither was a regular migrant nor winter resident, and neither is known to breed near LGS or in eastern Pennsylvania. Therefore, the potential for LGS operation to have any effect on the survival of these birds is virtually nonexistent. No other rare or endangered species were observed.

2.2.1.3.2 Community Description

The bird community at LGS was typical of those found in similar suburban areas in southeastern Pennsylvania. Species present varied with habitat, season, and year.

The terrestrial bird community in winter was considerably less diverse than in other seasons. A total of 80 bird species spent all or part of winter at the site. Of the 32 species observed during winter studies at the wooded and oldfield plots, ring-necked pheasant, common crow, downy woodpecker, black-capped chickadee, tufted titmouse, mockingbird, American robin, cedar waxwing, cardinal, dark-eyed junco, tree sparrow, white-throated sparrow, and song sparrow were among the most abundant. The number and diversity of birds were greater in the wooded plot in both winters.

A total of 87 birds (including waterfowl) may breed on or near the site. Breeding bird communities of a wooded and old field plot were surveyed in 1973, 1974, and 1975. On the wooded plot, wood thrush, cardinal, grey catbird, rufous-sided towhee, house wren, tufted titmouse, common flicker, carolina wren, ovenbird, and common yellowthroat were most abundant. On the old field plot, common yellow throat, field sparrow, rufous-sided towhee, song sparrow, grey catbird, indigo bunting, and blue-winged warbler were most abundant. The wooded plot supported greater numbers and more species than the old field plot.

Virtually any of the 187 species recorded within 8 km of LGS may be present during spring and fall migration periods. In general, migrants were most abundant in April, May, September, October, and November. Most birds observed during migration periods were Passeriformes, and the flycatcher, thrush, warbler, blackbird, and sparrow families were well represented. Brady et al (Ref 2.2-8) and the West Chester Bird Club (Ref 2.2-9) listed migration dates and relative abundance information for the birds of the Delaware Valley region and Chester County, Pennsylvania, respectively.

Waterfowl on the Schuylkill were most abundant in winter, and Canada goose, mallard, and black duck accounted for the majority of waterfowl observed. Wood duck, common merganser, bufflehead, great blue heron, ring-billed gull, and belted kingfisher were also common in winter. Although waterfowl were well distributed along the Schuylkill, the largest numbers were observed downriver of LGS in Vincent Pool at the mouth of Pigeon Creek.

The largest number of waterfowl species was observed during the spring and fall migration periods. Many species were represented by only one or two individuals in the 28-month study. Herons, such as the snowy and great egret, were usually seen in July and August. Shorebirds, such as the least, semipalmated, and pectoral sandpipers, were observed in late summer only when mudflats were exposed by low flow.

The osprey was a common and regular migrant near LGS in both spring and fall. One or two ospreys apparently reside on the Schuylkill for short periods, but none has spent the summer. There was no evidence to suggest that osprey nested along the Schuylkill.

In summer, the number of birds and species decreased sharply. Most ducks and geese migrated in spring; however, Canada goose and mallard were common breeders, and nests and downy young of both species were seen regularly. Other waterfowl known or suspected to nest near LGS included green heron, yellow-crowned night heron, wood duck, black duck, killdeer, spotted sandpiper, belted kingfisher, and fish crow.

2.2.1.3.3 Important Species

A large number of birds met the criteria of importance outlined in Section 2.2. However, a causal link to plant operation is tenuous. The most serious impact, habitat destruction, was essentially complete after excavation and grading of the site. Other potential adverse impacts that might affect all birds at LGS are collisions with the cooling towers, and exposure to cooling tower drift. Changes in the aquatic ecosystem might also affect waterfowl.

Because so many species met importance criteria, a subset composed of 11 representatives of major groups was selected (Table 2.2-5). Canada goose, mallard, and black duck (valuable game birds) were the most abundant waterfowl on the river. Great blue heron and common merganser were chosen as typical of piscivorous waders and ducks, respectively. The osprey (listed as 'status undetermined' by the Office of Endangered Species and International Activities Ref 2.2-5) is a fish-eating raptor that was common along the Schuylkill during migration. The ring-necked pheasant was chosen for its recreational value as the major upland game bird near LGS. American kestrel, present on the site throughout the year, was chosen as a representative raptor. Because of their fairly typical food habits and wide distribution, the common crow (an omnivore), the common yellowthroat (an insectivore), and the song sparrow (a seed eater) were chosen to represent the large number of Passeriformes present at LGS. Information on the biology of these species is presented below.

2.2.1.3.3.1 Great Blue Heron

The great blue heron (Ardea herodias), adapted for wading and feeding in aquatic habitats, is a common permanent resident near LGS. Breeding occurs from April through early June, usually in colonies or rookeries in wooded swamps. No rookeries occurred near LGS. Fish are the principal food, although frogs, tadpoles, salamanders, snakes, lizards, and even some small rodents are also eaten by this bird. Little economic importance is attributed to the great blue heron, but it is ecologically and aesthetically valuable.

2.2.1.3.3.2 Canada Goose

The Canada goose (Branta canadensis) has a strong propensity to home to particular migration and winter grounds, resulting in highly localized populations. In Pennsylvania, this bird is a common migrant in spring and autumn; nonbreeding birds may

remain, and feral birds breed, in several areas in the state, including the vicinity of LGS (Limerick Island and river shores). Canada geese were among the most abundant waterfowl observed on the Schuylkill River near LGS. Their food is largely vegetable. Near LGS they grazed on fallen grain in the stubble of grainfields, and on green herbage in pastures. They fed regularly, usually in the morning and just before sunset, and often returned daily to the same feeding grounds. Spring flocks may cause considerable damage to young crops of wheat, barley, corn, and oats. Canada geese are recreationally valuable as a migratory game bird, and as an aesthetically important waterfowl species.

2.2.1.3.3.3 Mallard

In Pennsylvania, mallards (Anas platyrhynchos) are common spring and autumn migrants, as well as breeding and wintering residents. They are one of the most abundant waterfowl observed near LGS. The mallard begins to nest in April, usually within 100 m of water, and the peak of nest initiation occurs in May. Birds were observed breeding on river shores near LGS. This duck is mainly a herbivore, feeding on sedges, grasses, smartweeds, pondweeds, and other aquatic plants. Farm crops such as barley, wheat, corn, and buckwheat are also eaten by mallards. The small amount of animal matter in their diet consists mainly of insects and mollusks. The mallard is recreationally valuable as a migratory game bird and as an aesthetically important waterfowl species.

2.2.1.3.3.4 Black Duck

In fall, winter, and spring black ducks (Anas rubripes) are common on the Schuylkill. Their breeding status in Pennsylvania varies from rare to common. They nest and feed in a variety of aquatic habitats including floodplains, ponds, and streams. Breeding and nesting begin in March and April. No young black duck were observed in summer near LGS, although several adults were; therefore, its nesting status was undeterminable. However, these birds are presumed to breed occasionally along the river. Food includes the seeds of pondweeds, smart weeds, pond lily, and millets. Waste corn in harvested fields near water is an important food source for black ducks in late fall and winter. Black ducks are important for their recreational value as a migratory game bird as well as for their aesthetic appeal.

2.2.1.3.3.5 Common Merganser

The common merganser (Mergus merganser) is a common spring migrant and winter resident on the Schuylkill River near LGS. It inhabits lentic and lotic fresh waters that contain sufficient

fish. It was not observed nesting near LGS. Common mergansers are mostly piscivorous, but they also eat crayfish, amphibians, and fish eggs. This bird is not particularly important as a game species, because its predominantly fish diet imparts a strong flavor to its flesh. In warm water areas, their food most often consists of nongame fish.

2.2.1.3.3.6 Osprey

The osprey (Pandion haliaetus) is a common transient near LGS. However, no nests were observed along the river. This bird is not known to breed regularly anywhere in Pennsylvania. Preferred habitats include seacoasts, lakes, rivers, and other areas near large bodies of water. Breeding (not observed near LGS) usually takes place near a large body of water, probably from April through June. Food consists almost entirely of fish, especially species that habitually swim in schools near the surface. The number of fish taken by osprey is of little commercial importance. Some farmers feel that an osprey nesting in an area is beneficial because it keeps out other raptors, which may feed on domestic fowl.

2.2.1.3.3.7 Ring-necked Pheasant

This pheasant (Phasianus colchicus) is a popular game bird in Pennsylvania and is abundant in the immediate vicinity of LGS. It inhabits open woods and farmland with brush, hedgerows, and cornfields. Breeding usually takes place from late April through June in open country, such as brushy pastures and fields of grain or grass. Pheasant feed on a variety of herbaceous materials, including flowers, fruits, buds, leaves, stems, shoots, roots, seeds, and grains. Animal foods include insects, worms, and other small animal forms. Young pheasant feed almost exclusively on insects. Most feeding occurs in early morning or late afternoon. This bird is important recreationally as a game bird; it is the most popular game bird in southeastern Pennsylvania. Its effect on farm crops depends upon local conditions, season, and proportion of weeds and injurious insects eaten compared to cultivated crops.

2.2.1.3.3.8 American Kestrel

The American kestrel (sparrow hawk, Falco sparverius) is the smallest and most common falcon. It is a common permanent resident and breeder near LGS. It inhabits open and semi-open country including farmlands, orchards, woodlots, and suburban areas. Most nesting occurs from early April to mid-May in the middle states. The sparrow hawk is almost exclusively insectivorous, except when insects are difficult to obtain. When

insects are low in numbers, other foods such as mice, shrews, small snakes, lizards, and birds are preyed upon. Although a direct economic or commercial value cannot be attributed to the American kestrel, it is aesthetically valuable and an important predator on insects that can be agriculturally destructive.

2.2.1.3.3.9 Common Crow

This bird (Corvus brachyrhynchos) is a common breeding resident, migratory transient, and winter resident near LGS. The crow is not selective as to habitat; it occupies both field and woodland areas throughout its range. In winter it often congregates in large flocks called roosts, from which it disperses northward in spring to nesting sites. Nesting occurs in woodland areas from mid-April through June in northern states. The common crow is omnivorous. Approximately one-third of its diet consists of animal food including bird eggs, young birds, small mammals, reptiles, fish, insects, crustaceans, worms, and carrion. Plant foods include a variety of seeds, grains, acorns, nuts, and fruits. This crow may cause damage to agricultural crops on a local basis. In Pennsylvania, it was recently classified as a game bird, and is protected part of the year.

2.2.1.3.3.10 Common Yellowthroat

This insectivorous bird (Geothlypis trichas) is a common breeding summer resident, and spring and fall migrant. It prefers wet areas uninhabited by man, and overgrown with briers and low brush. Breeding usually takes place from May to late June in this part of its range. Yellowthroats are susceptible to high mortality during migration through exposure to severe storms, and collisions with buildings, towers, and other tall obstructions. Little economic importance is attributed to this bird despite its ecological and aesthetic value.

2.2.1.3.3.11 Song Sparrow

This sparrow (Melospiza melodia) is a common permanent resident near LGS. It is tolerant of a wide variety of habitats, such as brushy fence rows, small woodland clearings, second growth forests, and suburban gardens and yards. However, it prefers moist areas such as stream banks, brushy shores of ponds, shrubby wet meadows, and cattail swamps. Breeding takes place from April until August. Approximately one-third of the song sparrow's diet consists of insects, taken mostly from May to August. The remaining two-thirds consists of seeds, fruits, and berries. Little economic importance is attributed to the song sparrow, despite its ecological and aesthetic value.

2.2.1.4 Mammals

Mammals display a wide variety of adaptation to both terrestrial and semi-aquatic life. Many are important as a forage base for larger mammalian and avian predators, and many are economically and recreationally important. However, no formal mammal study was conducted. Habitat destruction, the major adverse impact to mammals, was essentially complete after excavation and grading of the site and, therefore, only a simple inventory of mammals (22 species) was undertaken, incidental to other terrestrial and aquatic ecological studies (Table 2.2-6).

Little was known about the distribution and abundance of mammals on the LGS site, beyond a general knowledge of mammals of southeastern Pennsylvania derived from literature and interviews with District Game Protectors of the Pennsylvania Game Commission, local naturalists, and sportsmen.

The white-tailed deer was the only large herbivore present. It was observed regularly, but the LGS site probably comprised only a small portion of its home range. Raccoon, striped skunk, opossum, red fox, woodchuck, gray squirrel, and eastern cottontail were typical of the site, and were probably the most abundant mammals exclusive of small rodents. White-footed mouse, meadow vole, and short-tailed shrew were the most abundant and widely distributed small mammals near LGS. The meadow vole was restricted to non-wooded habitats, while the others appeared ubiquitous.

Criteria used to choose important mammals were discussed in Section 2.2. Exposure to cooling tower drift provides a potential causal link between mammals and operation of LGS. Therefore, a representative subset of 11 species was chosen as important. Eastern cottontail, eastern gray squirrel, muskrat, raccoon, and red fox were selected because of their recreational and commercial value as small game animals and furbearers. All were sought after by hunters and trappers on the LGS site. The white-tailed deer was chosen because it was the only big game animal on the LGS site. The white-footed mouse, because of its wide distribution and abundance, was chosen to represent small mammals.

2.2.1.4.1 Raccoon

Raccoons (*Procyon lotor*) are common onsite. They prefer stream and lake borders where there are wooded areas or rocky cliffs nearby. During most of the year, an adult male occupies a home range about 1.6 km in diameter, while in breeding season he may travel farther. Adult males come into breeding condition in December or January and remain sexually active until late June or

July, although most breeding occurs in February. The raccoon is omnivorous and opportunistic, feeding on the most readily available plant and animal foods. It is a valuable fur and game species and is edible; however, some individuals may cause minor damage to crops and poultry.

2.2.1.4.2 Red Fox

The red fox (Vulpes fulva) is commonly found onsite. It prefers a mixture of forest and open country. Home range is 2.5-5 km^2 in size, but is often larger in winter. Mating may occur from late December to March, but January and February are generally the peak months. Its food consists of available animals ranging in size from insects to hares, and berries and other fruits. The red fox is an important fur-bearer and game animal, and fox hunting with hounds is a popular sport near LGS. Red foxes feed on rodents and help control their numbers; livestock and poultry losses are usually insignificant.

2.2.1.4.3 Eastern Gray Squirrel

The gray squirrel (Sciurus carolinensis) is common in wooded areas near LGS. This primarily arboreal, crepuscular animal prefers deciduous forests dominated by oak, beech, and hickory, and river bottom with shrub understories. Its home range varies in size from 0.8 to 2.8 ha. It mates once in January, or February and again in June or July. Acorns, hickory nuts, walnuts, and butternuts form an important part of the gray squirrel's diet, especially in autumn. Spring and summer diet is more varied and includes the buds of elms and maples, mushrooms, and some insect larvae. The gray squirrel is an important small game species both statewide and near LGS. Its practice of storing nuts in the ground often aids tree dispersal. Some minor damage may result from girdling of trees and feeding on crops such as corn.

2.2.1.4.4 White-footed Mouse

The white-footed mouse (Peromyscus leucopus) is ubiquitous near LGS and is commonly found in woods, fields, and hedgerows. This species prefers wooded or brushy areas, but can be found in most terrestrial habitats where overhead cover is present. Its home range extends from 0.2 to 0.6 ha. In northern areas, breeding takes place from March to June and from September to November. The white-footed mouse feeds on seeds, nuts, insects, domestic grains, fruits, and some leafy vegetation. It is very important as a prey species for predatory birds and mammals; when abundant, its predators also become abundant. The mice may damage crops

and stores of grain, and in fall they often enter buildings where they may become a nuisance.

2.2.1.4.5 Muskrat

The muskrat (Ondatra zibethicus) is abundant along the Schuylkill River and tributary creeks near LGS. It prefers still or slow-running water such as marshes, sloughs, streams, and the edges of ponds and lakes vegetated with aquatic plants such as cattails, rushes, and water lilies. The muskrat breeds from April through August in the northern states. Its food consists mainly of aquatic vegetation such as cattails, bulrushes, and wild celery. It also feeds on corn, clover, and animals such as freshwater clams, snails, crayfish, frogs, fish, and young birds. The muskrat is an abundant and important fur-bearing animal that is trapped for both its recreational and commercial value. However, its burrowings may damage dikes, canal systems, and farm ponds.

2.2.1.4.6 Eastern Cottontail

The cottontail (Sylvilagus floridanus) is abundant on the LGS site. This species is highly adaptable and inhabits a variety of cover types; however, it shows a preference for areas with open brushy fields, hedge fences, thickets, dense high grass, and the edges of swamps and forests. Home range varies from 1.2 to 8 ha in size, depending upon the availability of food and cover. Reproduction usually extends from early March through September. Cottontails feed on a wide variety of green vegetation in summer, and browse on bark and twigs in winter. The cottontail is one of the most important small game mammals in the United States, and an important link in the food web. In some areas it may cause considerable damage to gardens, shrubs, and small trees.

2.2.1.4.7 White-tailed Deer

The white-tailed deer (Odocoileus virginianus) is the major big game animal in Pennsylvania. It is common near LGS, although not as abundant in southeastern Pennsylvania as in the rest of the Commonwealth. It lives in a restricted area, usually an average home range of 130 to 388 ha. It shows a preference for timbered areas; however, distribution of timber is important because deer utilize borders more often than dense uniform stands. This habitat preference results from the high variety of foods available along forest edges. Males can mate successfully from September through February, but the peak of the rutting season is in November. The white-tailed deer is a browser and feeds chiefly on leaves, twigs, fruits of trees and shrubs, and foliage of herbaceous plants. Winter is the critical period for deer because they must subsist on woody growth, twigs, and buds formed

during the previous summer. Deer are the most important eastern big game mammal, and are recreationally as well as commercially valuable. They are aesthetically important where abundant, although they can do considerable damage to young orchards and vegetable crops.

2.2.1.5 Trophic Relationships

A terrestrial ecosystem comprises numerous food chains and trophic levels. At the first trophic level are the producers, green plants that convert solar energy to biomass and provide cover for numerous organisms. Animal diversity is associated with the stratification and growth forms of plants.

Primary consumers (herbivores) feed on a variety of plant material including leaves, twigs, bark, fruit, and nuts. Common small herbivores in the vicinity of LGS (Figure 2.2-2) are the eastern cottontail rabbit, meadow mouse, muskrat, song sparrow, and grasshopper. The only large herbivore present is the white-tailed deer. Herbivores in turn are an energy source for carnivores (predators), represented on the site by red-backed salamander, black racer, common yellowthroat, and some mammals. Third-level consumers are represented by the sparrow hawk, osprey, and great horned owl.

Consumers that feed on both plant and animal material are called omnivores. Scavengers occupy this group and their food habits vary with season, food availability, size of organisms, and stage of life cycle. Omnivores near LGS include frogs, turtles, common crows, raccoons, and red foxes.

Decomposers provide the final link in most food chains; they utilize dead plant and animal matter, reducing complex materials into simple substances. Two groups of decomposer organisms are recognized, macroscopic and microscopic. Macroorganisms include earthworms, millipedes, and slugs; microorganisms are primarily bacteria, fungi, and protozoans.

2.2.2 AQUATIC ECOLOGY

Aquatic biota in three streams, (Schuylkill River, East Branch Perkiomen Creek, Perkiomen Creek) in the vicinity of LGS was studied by the Applicant's consultant from 1970 through 1978. A summary of sampling history by river system and biotic component is given in Table 2.2-7.

2.2.2.1 Schuylkill River

The temperate warm water of the Schuylkill River meanders 209 km from its source at Tuscarora Springs, Schuylkill County, Pennsylvania, to its confluence with the Delaware River at Philadelphia. The river cuts through portions of the Appalachian Mountain, Great Valley, Reading Prong, Triassic Lowland, Piedmont Upland, and Coastal Plain physiographic regions, and drains 4972 km^2 of southeastern Pennsylvania. The river near the plant site (Figure 2.2-3) is productive, and dependent to a large degree on allochthonous sources of energy as it is measureably heterotrophic most of the year.

Extensive environmental degradation has occurred in the Schuylkill in the past. These conditions have adversely affected aquatic biota, and the present community is somewhat depauperate and unstable in comparison with historic records. It is anticipated that future amelioration of existing stresses will result in increased diversity and stability of the Schuylkill River community.

Plant operation will impact the river due to cooling-water withdrawal and discharge. The LGS study area as used in this section refers to the Schuylkill River from U.S. 422 bridge downstream to Vincent Dam. For a further description of this area, refer to Section 6.1. Sample stations are designated by common name, and by the letter 'S' followed by a number that indicates distance in meters from the mouth of the river. Where stations include several meters of stream, site numbers designate the downstream end of the station. Summaries of sampling history for each program are given in Tables 2.2-8 and 9.

2.2.2.1.1 Water Quality and Environmental Stress

When the first settlers arrived in the Schuylkill Valley in the 17th century, they found a pure and pristine stream that abounded with many species of fish, including American shad and striped bass. The Schuylkill Valley quickly became a center of development in Pennsylvania, and the river became a major means by which raw materials were transported to Philadelphia. In 1817, the Schuylkill Navigation Company began construction of the Schuylkill Canal which was completed in 1824. The canal operated until 1928, when high maintenance costs and excessive siltation caused its closure.

Commercial coal mining in the upper Schuylkill watershed began about 1824, and the river was used as a convenient and inexpensive place to dump excess mine water and culm. Mine water contained much free sulfuric acid and iron that degraded water

quality as far downstream as Reading, and reduced the waste assimilative capacity of the river. Culm compounded the problem by silting the channel; the decrease in depth rendered the river unsuitable for navigation, and caused downstream flooding.

These conditions persisted until 1945 when the Brunner, or Clean Streams, Act was passed that prohibited discharging wastes into the river. It set as its goal the elimination of pollutant discharges by 1985. The Desilting Act also was passed in 1945 and provided for removal of silt and culm from the Schuylkill from its source at Tuscarora Springs downriver to Norristown. Twenty-two desilting basins were constructed in this reach, and sediment was pumped from the river into the basins where silt was trapped and the water decanted. Desilting improved the quality of the Schuylkill dramatically. However, as the volume of municipal and industrial wastes increased, water quality once again deteriorated. Further regulation under the Clean Streams Act has resulted in a gradual improvement in water quality since the late 1960's.

The present status of river water quality ranges from poor to good and, according to a recent water quality inventory (Pennsylvania Department of Environmental Resources; p. 40, Ref 2.2-12), the river near LGS has the best water quality. The headwaters continue to be degraded by mine water and raw or poorly treated sewage. This state of degradation persists as far downstream as Reading, at which point the limestone in Maiden and Tulpehocken Creeks enters the Schuylkill and neutralizes the mine acid. Siltation from coal mining remains a problem downstream from Reading, although the rate has decreased with reduced mining activity.

Flooding frequently occurs on the Schuylkill. Records indicate that the Schuylkill at Pottstown floods every three years (based upon a 210-year period of record, Bourquard and Associates, p. II-8, Ref 2.2-13). Flooding disrupts aquatic habitat and causes temporary degradation of water quality due to increased runoff from point and nonpoint pollution sources. The record flood at Pottstown occurred in June 1972 with the passage of Tropical Storm Agnes. At Pottstown, this flood crested at a river discharge of 2714 m^3/s (95,900 ft^3/s). Flood waters that accompanied Agnes inundated nine large, used-oil storage lagoons at Douglassville, Pennsylvania, and flushed approximately 22,700 m^3 ($6x10^6$ gal) of sludge into the river. This created the largest inland oil spill ever recorded. A similar spill from the same source had occurred in 1970 when 11.4 m^3 (3012 gal) of oil sludge were flushed into the river. Acute effects of the spills were obvious, but chronic effects may be subtle, and still operating since oil has persisted in bottom sediments.

Heavy metals are an additional stress in the vicinity of LGS. Schuylkill River sediments are particularly contaminated with

heavy metals (Reisinger, Ref 2.2-14), and serve as a constant source of contamination in the aquatic food chain. The metals have come from many sources, most of them anthropogenic. Coal mine water, with its low pH, provides a means by which naturally occurring metals such as copper, arsenic, and zinc are brought into solution. Effluents from metal processing industries and sewage treatment plants upstream of LGS also contribute to heavy metal contamination. Spills in the Douglassville area were a major source of heavy metal contamination since the sludge was the unreclaimable fraction of used crankcase oil.

Nutrient loading from point sources, such as sewage treatment plants, occurs near LGS and nitrogen, phosphorus, and carbon are present in elevated concentrations (Delaware Valley Regional Planning Commission and Chester-Betz Engineers, Ref 2.2-15; also see Section 2.4). Nutrients stimulate aquatic plant growth that may create nocturnal sags in dissolved oxygen (DO) concentration. Aquatic plants also remove nutrients and toxicants from the sediments, and thus incorporate them into the food chain.

Nonpoint source runoff also is a stress. Much of the land upriver of LGS is developed, or used for agriculture. Runoff from such areas generally contains high silt and nutrient concentrations. Nutrients originate not only from farmland, but also from on-lot sewage treatment facilities. Pesticides are also present. These compounds may persist in the environment, and some are bioamplified as they pass through aquatic food chains. Polychlorinated biphenyls (PCB's) are present in runoff from landfill areas. The Pennsylvania Department of Environmental Resources' surveys (unpublished) indicate that fish upstream of LGS contain higher levels of PCB's than fish from any other part of the Commonwealth.

Dams installed for navigation purposes have been present on the Schuylkill since colonial times. The greatest number of dams present at one time was 38 in 1820 (Bourquard and Associates, Ref 2.2-13); today there are nine. The five dams between LGS and the Delaware River prevent migration of anadromous and catadromous fishes, and reduce habitat heterogeneity.

2.2.2.1.2 Phytoplankton

Phytoplankton near LGS was studied in 1973 and 1974 (Tables 2.2-8 and 9). In all, 68 genera were identified, and diatoms were the most abundant (Table 2.2-10). Seasonal succession of major groups was typical of a temperate river and accompanied seasonal changes in water temperature. Diatoms were most dominant in spring, when they comprised up to 99% of total phytoplankton, and gradually decreased to 30 to 40% of the community in summer. Navicula, Cyclotella, Nitzschia, Melosira, Syneda, and

Asterionella were dominant. Numbers of green algae were highest in summer (up to 50% of total), decreased with the onset of lower temperatures in late fall, and were lowest in winter and spring. Scenedesmus and Ankistrodesmus were the most numerous green algae, and attained maximum densities in late August. Blue-green algae occurred in greatest numbers in the fall, but never comprised more than 2% of the total. The two most common blue-greens were Stichosiphon and Cylindrospermun. In general, phytoplankton density was low, characteristic of shallow lotic systems in temperate regions. They were not considered to have a major role in the trophic structure in this reach of the river.

2.2.2.1.3 Periphyton

Periphyton is a seasonally important primary producer in the Schuylkill River, and may be impacted by plant discharge. The periphyton community near LGS was studied by the Applicant's consultant in 1973 and 1974. (Tables 2.2-8 and 9).

2.2.2.1.3.1 Species Inventory

In all, 26 genera of algae were observed on Plexiglas slides (Table 2.2-11). Algae in the periphyton community were largely diatoms (19 genera), although 5 genera of green algae, and 1 genus of blue-green algae also were present. Diatoms typically dominate periphyton in stony streams and rivers.

2.2.2.1.3.2 Community Description

Seasonal changes in periphyton flora were observed. Genera typical of winter included Navicula, Diatoma, and Gomphonema. In spring, these diatoms declined in abundance, although Navicula remained dominant, and were joined by the diatoms Cymbella, Melosira, Cocconeis, and Synedra. Desmids, Closterium and Cosmarium, were often abundant in late spring and early summer. In early autumn, there was a short recrudescence of growth as water temperature declined, and some spring diatom flora again became very common. With the onset of winter, the periphyton community declined as all but winter diatoms disappeared.

Periphyton populations built up during periods of low river velocity and turbidity were often scoured from the substrate during sudden increases in river discharge. For example, periphyton standing crop declined from a yearly maximum of 134 mg/dm^2 on May 7, 1974 to 17 mg/dm^2 on May 14, as a result of

substantially increased velocity over the 7-day period (Table 2.2-11). However, populations recolonized rapidly.

The annual pattern of periphyton growth in the Schuylkill River was typical of lotic systems in temperate regions. Periphyton productivity was highest in summer and fall, except for periods of high velocity. The highest estimated daily growth rate (10 mg organic matter/dm^2/day) occurred during low flow in September 1974. Lowest productivity occurred in winter and early spring when river discharge was high (due to rain and meltwater), and temperatures were low.

2.2.2.1.3.3 Important Species

Periphytic algae were considered important if, by qualitative microscopic observation, they appeared dominant at any time on plates selected randomly throughout the study. These taxa were considered critical to the existing structure and function of the ecosystem (Section 2.2). Eight diatom genera (Nitzschia, Navicula, Cocconeis, Synedra, Melosira, Diatoma, Cymbella, and Gomphonema) and two green algae genera (Cosmarium and Closterium) met this criterion (Table 2.2-11). Blue-green algae were not common at any time during the study.

2.2.2.1.4 Macrophytes

Aquatic macrophytes are seasonally abundant primary producers in the Schuylkill near LGS, and were studied in 1984 and 1977 (Tables 2.2-8 and 9). Macrophytes downstream of LGS may be affected by plant discharge.

2.2.2.1.4.1 Species Inventory

In all, 10 species of aquatic macrophytes, representing 3 divisions and 9 families, were found in the vicinity of LGS (Table 2.2-12). Eight species were aquatic angiosperms, one a filamentous green alga (Cladophora sp.), and one a moss (Fissidens sp.). All are submergent except Lemna minor (floating), Jussiaea repens (emergent with an extensive mat of floating leaves), and Sagittaria latifolia (emergent). Lemna minor, usually uncommon in lotic systems, was abundant in the river during low flow periods. Elodea canadensis was common in 1974, but was rare in 1977.

2.2.2.1.4.2 Community Description

Peak growth of macrophytes in 1977 occurred in mid-July, when they (exclusive of Cladophora) occupied 20 to 25% of the river's surface area (Figure 2.2-4). The plant community was loosely structured with no persistent species associations. Growth patterns were influenced by current; generally, each plant species formed hummocks that were separated by channels of swift water.

Species composition in various areas did not change appreciably during the 1977 growing season (May-September). Generally, plants present in an area simply became more abundant. Occasionally, a species (e.g., P. crispus) invaded new areas. Rarely was a species observed to disappear from an area where it had become established. This did occur near S75700, however, where M. exalbesecens was present in spring, but reduced or absent in midsummer; by late summer it had reappeared.

Throughout the growing season, a multifarious group of organisms used the macrophyte beds. Macrophytes provided habitat for numerous macroinvertebrates, particularly Ephemeroptera, Trichoptera, and Chironomidae. The snails Goniobasis virginica and Physa were observed grazing on macrophytes in high numbers in August. The plants also provided cover for many fish. Macrophytes were used as substrate by epiphytic algae, and the quiet water created by extensive beds supported large quantities of the filamentous green algae Spirogyra and Hydrodiction. Autochthonous detritus was added to the river during dieback in the fall.

2.2.2.1.4.3 Important Species

Important species were selected by criteria described in Section 2.2, and on the basis of relative qualitative abundance (Section 6.1.1.2.2.3). Abundant or common species (Table 2.2-12) were considered important and included Cladophora sp., Potamogeton crispus, P. berchtoldi, Heteranthera dubia, and Myriophyllum exalbescens. All are submergent. Important species occurred throughout the study area; some locations contained a heterogenous mixture of plants, whereas other areas were dominated by a single species. Pertinent local data on important species are provided below.

2.2.2.1.4.3.1 Thallophyta

Cladophora, an attached alga, was ubiquitous in the river near LGS and generally absent only from areas of low current (e.g.,

backwater areas and in the lee of large hummocks of other macrophytes). It generally exhibited a bimodal growth curve. Growth was relatively extensive in May, reduced in July, and extensive again in late August.

2.2.2.1.4.3.2 Spermatophyta

The remaining important species (Potamogeton crispus, P. berchtoldi, Heteranthera dubia, Myriophyllum exalbescens) are vascular plants. They are rooted in the substrate and possess adventitious roots that enable them to maintain their position in the current. Growth began in April or May and continued until September or October. In the fall, plants either died back to persistent roots or stolons (e.g., P. crispus), or stopped growing (e.g., M. exalbescens).

2.2.2.1.5 Zooplankton

Zooplankton near LGS was not studied, but results of a study conducted 13 km downriver in 1975 and 1976 provided information on composition, density, and seasonality (PECo: p.3-13, Ref 2.2-16). The mainstream zooplankton community was dominated by rotifers, copepods, and cladocerans. Mean seasonal density was highest in spring (22,784/m^3) and fall (22,334/m^3), and lowest in summer (4649/m^3) and winter (6524/m^3). These densities are relatively low, and typical of middle reaches of moderately sized rivers. Zooplankton in this section of the Schuylkill was not considered to have a dominant role in the trophic structure, and likely does not at the Limerick site.

2.2.2.1.6 Macroinvertebrates

The macroinvertebrate community in the Schuylkill River near LGS plays an important functional role by converting allochthonous and autochthonous materials into temporary storage within their own tissue, ultimately becoming an essential component in the food web. Macroinvertebrates also shred coarse organic material (e.g., leaves) into finer particles that can be utilized by smaller macroinvertebrates. Plant operation is expected to affect Schuylkill macroinvertebrates through entrainment of drift, and water quality changes caused by blowdown discharge. Macroinvertebrates were studied from 1970 through 1976 (Tables 2.2-8 and 9).

2.2.2.1.6.1 Species Inventory

Macroinvertebrates collected by all methods and from all habitats from 1970 through 1976 represented 8 phyla, 30 orders, 81 families, 218 genera, and at least 297 species (Table 2.2-13). The taxonomic distribution included all major orders of aquatic insects, 6 orders of annelids, 4 orders of molluscs, and 3 orders of crustaceans. The greatest taxonomic diversity (number of taxa) was found in the orders Diptera and Ephemeroptera that contained representatives of 16 families and at least 108 species, and 6 families and at least 55 species, respectively. Trichoptera, Odonata, Plecoptera, and Plesiopora also showed considerable diversity. Of the remaining 24 orders, 13 were represented by only one or two species. The most diverse family was Chironomidae, represented by 37 genera.

The kinds and number of macroinvertebrate species found in the river near LGS agreed well with previous surveys of the Schuylkill (Wurtz and Dolan, Ref 2.2-46), and other eastern temperate rivers (Patrick, Ref 2.2-47). The highest number of insect taxa reported by Patrick (Ref 2.2-47) for any of the 9 rivers she studied was 95 in the upper Potomac. The number of taxa reported by Wurtz and Dolan (Ref 2.2-46) was 160 for the Schuylkill River about 10 km downriver from LGS. The relatively high diversity recorded by the Applicant's consultant resulted from the long (6-year) study, which provided considerably more seasonal data.

A relative qualitative abundance was assigned to each taxon on the species list based upon the following: abundant - organisms found in almost all samples, and usually present in relatively high numbers; common - organisms found in over one-half of all samples, but usually present in relatively low numbers; uncommon - organisms found only occasionally in samples (i.e., several times a year), and present in low numbers; and rare - organisms found in one sample per year or once every few years and present in very low numbers. Bias was inherent in these subjective abundance terms since the majority of samples were collected with cylinder samplers in run/rubble habitat. For example, organisms listed as rare or uncommon in run habitat (dominant near LGS) may have been common or abundant in backwater or littoral areas.

2.2.2.1.6.2 Community Description

Annual mean densities (no./m^2) were consistently higher at the upstream station than at downstream stations (Table 2.2-14). This was due mainly to the higher number of midge larvae upstream. Annual mean densities (g dry wt/m^2) have increased by

station in an upstream progression since 1972 (Table 2.2-15). As noted below, this increase was due almost entirely to the upstream movement of the river snail Goniobasis virginica.

The monthly total of taxa per sample did not differ significantly from 1974 to 1976 at any station (Table 2.2-18). The total number of taxa was reduced in 1973 because the macroinvertebrate community was still recovering from the June 1972 flood and oil spill (Section 2.2.2.1.1).

Only five taxa (Tubificidae - predominantly Limnodrilus hoffmeisteri, Chironomidae - predominantly Cricotopus bicinctus, Goniobasis virginica, Physa heterostropha, Cheumatopsyche spp.) comprised over 10% of the total number in any year (Table 2.2-14). Tubificids were abundant at S76760 and S75770, and comprised up to 64% of the total number of organisms collected at S76760 in 1973. Chironomids were abundant at S78620, and reached their maximum relative abundance (54%) at this station in 1973. P. heterostropha was dominant in 1972 at S78620, where it comprised 68% of all organisms collected. This was the only time this snail was relatively dominant in any year, or at any station. The reason for this is unknown, but may have been due to a selective advantage gained from the 1972 flood. G. virginica was not relatively abundant until 1974 at the two downstream stations. It comprised up to 53% of the total number of organisms collected in 1974 at S76760. It has increased in relative abundance upstream since 1974. Cheumatopsyche spp. have recovered from the 1972 flood and oil spill to the point where, at S78620, it was second only to Chironomidae in relative abundance in 1976.

Before the fall of 1973, the snails Helisoma anceps and P. heterostropha, tubificids, and occasional crayfish and leeches dominated biomass in most samples. Although some organisms such as midges were relatively abundant by number, they made up only a relatively small percentage of total biomass due to their small size. Since the fall of 1973, G. virginica has comprised over 90% of the total biomass in many samples, especially at downstream stations.

2.2.2.1.6.3 Important Species

NRC criteria for selection of important species (Section 2.2) are quite broad in scope. Many macroinvertebrate species could be considered important in terms of either being a food source for recreationally valuable species (fish), or a critical link in the structure and function of the aquatic ecosystem. To limit the number selected, taxa considered critical to the community were restricted to those that comprised 2% or greater of the total number or biomass in any annual collection at any station, or

macropredators that occurred frequently in monthly quantitative samples.

On this basis, 17 taxa were selected: Dugesia tigrina, Prostoma graecense, Tubificidae, Crangonyx gracilis, Cheumatopsyche spp., Hydropsyche phalerata, Chironomidae, Physa heterostropha, Helisoma anceps, Ferrissia tarda, Goniobasis virginica, Pisidium spp., Sphaerium spp., Erpobdella punctata, Cambarus bartoni, Orconectes spp., and Argia spp. The last four taxa are macropredators. Most of these taxa were highly dominant in the river in all years and at all stations. Together, they comprised over 90% of the total number collected in every year and at all stations.

The following treatment of important species includes information on taxonomy, local distribution, life cycle, and food habits. Population dynamics are also discussed and include data on spatial and temporal variation in numbers (Table 2.2-16), and biomass (Table 2.2-17). These tables complement the text description.

2.2.2.1.6.3.1 Dugesia tigrina

This planarian was collected at all stations in similar numbers. The highest annual mean density (387/m²) occurred in 1972 at S75770. In 1973, densities declined at all stations and remained below 1972 levels through 1976. Peak seasonal density usually occurred in late summer and fall, and maximum density in a single sample (1836/m²) was recorded in October 1972 at S75770. Variability in biomass density (1972-1974) was similar to that for numbers.

2.2.2.1.6.3.2 Prostoma graecense

This nemertean was collected at all stations. Highest annual mean density (521/m²) occurred in 1972 at S75770. In 1973, densities declined at all stations, and by 1976 had not regained 1972 levels, except at S78620 in 1975. Peak seasonal density occurred in late summer or fall, and worms were rarely collected the rest of the year. Maximum density in a single sample (2123/m²) was recorded in November 1972 at S75770. Variability in biomass density followed the same trend as variability in numerical density.

2.2.2.1.6.3.3 Tubificidae

Aquatic oligochaetes were identified only to family. Large numbers of tubificids were collected from the river, and the considerable time required to clear, mount, and identify all

specimens was prohibitive. However, in qualitative samples (1972 and 1973), and subsamples of quantitative samples (1976), tubificids were identified to species to determine the species present and their relative abundance. These samples revealed that Limnodrilus hoffmeisteri was by far the most abundant tubificid in the Schuylkill River study area, and that the only other tubificid present in relatively high numbers was Peloscolex multisetosus.

Tubificids are preyed upon by many aquatic invertebrates, and by fishes. In the river, two cases of predation on tubificids were recorded: (1) the leech Erpobdella punctata preyed heavily on tubificids and (2) chironomids (mainly Pentaneourini) cleared for identification showed considerable quantities of tubificid setae and whole parts in their guts.

Highest annual mean density (3972/m²) of tubificids in the river occurred in 1972 at S75770. Densities at S76760 and S75770 were consistently higher than at S78620 in all years. Substrate at S78620 was not ideal for tubificids, and a greater number of predatory chironomid larvae and leeches were present. Peak seasonal density at all stations usually occurred in spring or summer, but fairly large numbers were present throughout the year. Maximum density in a single sample (14,898/m²) was recorded in June 1973 at S76760. Maximum biomass density in a single sample (4.5 g dry wt/m²) occurred in July 1972 at S75770. Variability in biomass closely followed variability in numbers.

2.2.2.1.6.3.4 Erpobdella punctata

This leech was collected at all stations, but the highest densities were found at S78620. Highest annual mean density (20/m²) occurred in 1975 at S76760. Peak seasonal density usually occurred in spring and summer. Maximum density (135/m²) was recorded in June 1974 at S78620. Maximum biomass density (0.9 g dry wt/m²) occurred in September 1973 at S78620.

In 1973, a study of food habits was conducted to determine the kinds of food consumed by E. punctata. It was found that, on an annual basis, food consisted of about 50% tubificids and 50% chironomids. Cricotopus and Polypedilum were the most frequently ingested midge larvae. The unusual abundance of predatory leeches (particularly Erpobdella) in the river was probably responsible for the relatively small number of tubificids present at any one time at S78620. E. punctata was occasionally consumed by fish in the study area.

2.2.2.1.6.3.5 Crangonyx gracilis

This amphipod was found at all stations in the river. Highest annual mean density (432/m²) occurred in 1976 at S75770. Annual mean density of C. gracilis has increased steadily at all stations since 1972. Peak seasonal density averaged highest in the spring, but densities were also relatively high in summer and fall. Maximum density in a single sample (2275/m²) was recorded in June 1976 at S75770. Variability in biomass density followed the same trend as that for numbers.

2.2.2.1.6.3.6 Crayfish

The three crayfish species found in the Schuylkill study area, Orconectes obscurus, O. limosus, and Cambarus bartoni, are well described and easily differentiated on the basis of mature males (Hobbs, Ref 2.2-48). However, unidentifiable females and immature males of Orconectes were frequently collected so the two species were treated at the genus level. All species were found at all sample stations, but were more common at downstream stations (S76760 and S75770).

Highest annual mean density (1/m²) of C. bartoni occurred in 1976 at S78620. Peak seasonal density usually occurred in the fall. Maximum density in a sample (8/m²) was recorded in December 1974 at S75770, and in April 1976 at S78620. Maximum biomass density in a single sample (3.3 g dry wt/m²) was recorded in October 1972 at S76760.

Highest annual mean density (2/m²) of Orconectes spp occurred in 1976 at S78620. Peak seasonal density usually occurred in late spring and early summer. Maximum density in a sample (20/m²) was recorded in June 1975 at S76760, and in September 1975 at S76820. Maximum biomass density in a single sample (13.9 g dry wt/m²) was recorded in December 1974 at S75770. Although numerical densities for both taxa were quite low, crayfish comprised a relatively high percentage of biomass.

It is known from food habits studies that various fish and probably turtles, and birds, racoons, muskrats, and snakes in the river consume crayfish. Mature crayfish stay in burrows or under rocks during the day, and come out to feed at night. Immatures are active at any time.

2.2.2.1.6.3.7 Argia spp.

Damselfly naiads were collected at all stations in the study area. Highest annual mean density (85/m²) was recorded in 1976 at S75770. Annual mean densities have increased since 1974. Peak seasonal densities usually occurred in late summer and fall.

Maximum density in a single sample (459/m²) was recorded in September 1975 at S76760. Maximum biomass density in a single sample (0.2 g dry wt/m²) occurred in November 1973 at S76760.

Argia spp. adults were observed emerging in June, and flight activity was observed throughout summer. The immatures are found on and under the surface of large and small rocks, and are voracious predators.

2.2.3.1.6.3.8 Cheumatopsyche spp.

Whereas most adult species of Cheumatopsyche have been described, the larval stages have not been associated and thus larvae were treated at genus level. Cheumatopsyche spp. were commonly collected at all stations. Highest annual mean density (2413/m²) was recorded in 1976 at S78620. Highest densities were always recorded at station S78620, where faster current velocity was probably conducive to more efficient net feeding.

Peak seasonal densities occurred in summer. Maximum density of Cheumatopsyche spp. in a single sample (7299/m²) occurred in September 1976 at S78620. A marked increase in density has occurred since 1972. This increase probably reflects recovery from the flood and oil spill of 1972 (Section 2.2.2.1.1). Variability in biomass paralleled changes in numerical density.

2.2.2.1.6.3.9 Hydropsyche phalerata

This net-building caddisfly was collected at all stations in the river. Highest annual average density (838/m²) occurred in 1975 at S78620. Peak seasonal density occurred in the summer, and maximum density in a single sample (3533/m²) was recorded in September 1975 at S78620., Like Cheumatopsyche spp., H. phalerata has increased markedly in density since 1972. Variability in biomass paralleled changes in numerical density.

2.2.2.1.6.3.10 Chironomidae

Due to the relatively large number of midge larvae collected in quantitative samples and the time required to clear, mount, and identify them, midges were identified to genus or species only in 1974 and 1976. Dominant chironomid taxa were Cricotopus bicinctus (most abundant), other unidentifiable species of Cricotopus, Polypedilum spp., and Pentaneurini. For quantitative data analysis, midges were treated at the family level.

Highest annual mean density of chironomidae larvae (5288/m²) occurred in 1974 at S78620. No pattern in density was apparent between years or stations. Peak seasonal densities usually

occurred in the spring. Maximum density in a single sample (20,889/m²) was recorded in March 1974 at S78620.

2.2.2.1.6.3.11 Physa heterostropha

This pulmonate snail was found at all stations. Highest annual mean density (10,038/m²) occurred in 1972 at S78620. Peak seasonal density always occurred in the fall. Maximum density in a single sample (30,635/m²) was recorded in November 1972 at S78620, and the biomass of this sample (24.4 g dry wt/m²) was also the highest recorded. Densities declined after 1972 and this may have been due to replacement by Goniobasis virginica, another dominant snail in the river.

2.2.2.1.6.3.12 Helisoma anceps

This snail was collected at all stations. Highest annual mean density (654/m²) occurred in 1974 at S78620. Peak seasonal densities usually occurred in the summer. Maximum density in a single sample (4365/m²) was recorded in August 1974 at S78620. Wherever G. virginica moved in, H. anceps seemed to be replaced. This may be related to competition for food or space.

2.2.2.1.6.3.13 Ferrissia tarda

This limpet was collected at all stations. Highest annual mean density (515/m²) occurred in 1972 at S78620. Peak seasonal density usually occurred in the fall. Maximum density in a single sample (1860/m²) was recorded in October 1972 at S76760.

2.2.2.1.6.3.14 Goniobasis virginica

Highest annual mean density (4325/m²) of G. virginica occurred in 1975 at S76760. Peak seasonal density occurred in summer and fall. Maximum density in a single sample (18,984/m²) was recorded in November 1974 at S76760. From 1970 to 1972 this snail was collected only from the downriver station, but from 1973 through 1976 the population moved steadily upriver. For example, the annual mean number of G. virginica collected from or near the farthest upstream station (S78620) in successive years was zero in 1970 and 1971, 3/m² in 1972, 16/m² in 1973, 1159/m² in 1974, 2096/m² in 1975, and 2221/m² in 1976. Since mid-1973, the biomass of almost every sample has been highly dominated by this snail. Maximum biomass (185 g dry wt/m²) occurred in November 1974 at S76760.

This snail appeared to be most abundant in run habitat where current was moderate (near 0.3 m/s). Snails oriented themselves with their spires pointed downstream. Snails observed in slackwater areas and near banks were not positioned in any particular manner. Crutchfield (Ref 2.2-49) reported a positive rheotaxis for closely related G. proxima in Bolin Creek, North Carolina, where 53 marked individuals all moved upstream over a 15-week period. It is therefore possible that the upriver movement of this local population may represent a normal phenomenon.

2.2.2.1.6.3.15 Pisidium spp.

Highest annual mean density (621/m²) of these fingernail clams occurred in 1976 at S78620. Since 1972, densities have generally increased in most years and at all stations. Peak seasonal densities occurred in the fall, and the maximum density in a single sample (2218/m²) was recorded in November 1976 at S78620. Maximum biomass density in a single sample (0.1 g dry wt/m²) was recorded in January 1973 at S78620.

2.2.2.1.6.3.16 Sphaerium spp.

Highest annual mean density (1130/m²) of these fingernail clams occurred in 1972 at S78620. Peak seasonal densities occurred in the fall. Maximum density in a single sample (4357/m²) was recorded in November 1972 at S78620, and maximum biomass density (5.2 g dry wt/m²) was recorded in December 1972 at S78620.

2.2.2.1.6.4 Drift

For many benthic macroinvertebrates, drift is apparently a passive phenomenon that occurs when organisms are dislodged by the water current and enter the water column. Drifting macroinvertebrates are utilized as a food source by many fish predators. Macroinvertebrate drift was studied from 1972 through 1975. (Tables 2.2-8 and 9).

The only important benthic taxa abundant in drift were Chironomidae, Cheumatopsyche spp., and Hydropsyche phalerata. The remaining important taxa (mostly worms, leeches, crayfish, and snails) were found only rarely in drift samples, due either to their weight (e.g., crayfish, snails), ability to swim against the current (e.g., the leech Erpobdella punctata), or burrowing ability (e.g., Tubificidae). Taxa that were common in drift but rare or uncommon in benthos samples were the mayfly Tricorythodes sp., and the moth-flies Psychoda spp. and Telmatoscopus albipunctatus. These organisms were rarely collected in benthic

samples because their preferred habitat was not run/rubble (where benthic samples were collected).

In all, 8 drift taxa were highly dominant and together comprised over 95% of all organisms collected each year (Table 2.2-19). Chironomidae (larvae and pupae) averaged almost 50% of all drift organisms collected in all years. Since chironomids were identified only to family level in most years, intrafamily changes were not determined. However, chironomids dominant in benthos (Cricotopus spp. and Polypedilum spp.) were also dominant in drift. The next most abundant taxa were psychodid pupae (Psychoda sp., Telmatoscopus albipunctatus) and Tricorythodes sp.

Variability of monthly drift densities (no./1000 m^3) within any year was quite high (Table 2.2-20) and most likely caused by the variability and short duration of chironomid pupation and emergence. No significant difference in monthly drift densities among years (1972-1974) was observed.

Because most benthic macroinvertebrates in the river were nocturnal feeders, increased levels of drift densities and taxa usually occurred during hours of darkness. This relationship between drift and changes in light intensity has been well-documented (Waters, Ref 2.2-50). However, only in summer did chironomids drift in greater densities at night, the rest of the year they showed no definite periodicity.

Drift densities (no./m^3) were compared with benthos densities (no./m^2) using Elliott's (Ref 2.2-51) method (see Section 5.1.3.2.2a). The percentage of benthic organisms present in the drift at any given time was found to be quite low, and ranged from 0.0002 to 1.3140% (Table 2.2-21).

2.2.2.1.7 Fish

Fish in the Schuylkill River are gradually recovering from an extended period of environmental degradation (Section 2.2.2.1.1). The river presently supports fish fauna typical of large warmwater rivers of the mid-Atlantic area of North America. The community contains many species and is dominated by cyprinid, centrarchid, and ictalurid fishes. Several species are actively sought by recreational fishermen (Harmon, Ref 2.2-52). It is anticipated that completion of fish passage facilities at the remaining river dams will restore anadromous fish runs.

Operation of LGS may affect the existing fish community through water withdrawal (i.e. entrainment-impingement) and blowdown discharge. To evaluate these potential impacts, the fish

community has been intensively studied for several years by using several types of gear (Tables 2.2-8 and 9).

2.2.2.1.7.1 Species Inventory

Fishes representing 42 species of 10 families, as well as hybrids within Cyprinidae, Esocidae, and Centrarchidae have been collected from the Schuylkill River and its tributaries near LGS since 1970 (Table 2.2-22). Of these, 27 were native to the drainage and 15 were introduced. None is considered threatened or endangered by either Federal or State regulatory agencies. Determination of qualitative abundance was made by subjective comparison of catch statistics as follows: abundant - fish that occurred regularly in large numbers (in samples taken with appropriate gear); common - those regularly collected in small numbers; uncommon - those irregularly collected in small numbers; and rare - those for which only a few individuals were collected throughout the study.

2.2.2.1.7.2 Community Description

2.2.2.1.7.2.1 Larval Fishes

Most fishes in the Schuylkill River are lithophilous (i.e., eggs are deposited on rock or gravel bottom and prolarvae develop on this substrate) or phytophilous (egg and prolarval development take place on or among aquatic vegetation, above muddy or silted bottoms). Suitable spawning sites in the river are restricted primarily to shallow riffle sections and quiet areas near shore where current, cover, and vegetation are appropriate for egg deposition.

Larvae of fishes near LGS were sampled in the water column by drift nets and in shoreline nursery areas by trap and push net (Section 6.1). Most spawning occurred from May through August. Larval fish drift density was low in April, peaked in June and late July or early August, and gradually declined through August (Figure 2.2-5). In nursery areas, larval fish were most abundant in early June, late July, and early August (Figure 2.2-6).

Unidentified minnows comprised the most abundant taxon in 1974 and 1975 drift collections, and accounted for 48 and 78% of the total catch, respectively (Table 2.2-23). In 1974, goldfish and carp were second and third in abundance. In 1975, white sucker and tessellated darter were the second and third most abundant taxa. Goldfish were the most abundant taxon (63%) in 1976, followed by minnows (25%) and Carp (7%). Larvae of Micropterus

sp. and brown bullhead rarely occurred in drift, probably because of the parental care adults afford their young. Most bullhead collected were recently transformed juveniles. Mean daily drift density in the east channel for the 1974, 1975 and 1976 major spawning periods (May-August) was 0.45, 0.09, and 0.59 fish/m^3, respectively. Densities were greatest between 2200 and 0500 hours, and usually peaked at 2200, 2400, or 0400 hours. Drift densities in these hours ranged from 3 to 95 times greater than daytime densities. Total biomass of drifting larvae usually varied with fluctuations in numeric density.

Vertical distribution of ichthyoplankton in the water column frequently varies (Taber, Ref 2.2-54 and Marcy, Ref 2.2-55). In the Schuylkill River, drift density was significantly greater near the bottom in the day. Density at night was greater near the surface but differences in catch with depth usually were not significant.

A definite horizontal gradient in larval fish drift was observed in the river (Table 2.2-24). Numeric density, as measured at different locations across the east channel around Limerick Island, was significantly different at night in 1974 with greatest larval abundance occurring near the Montgomery County shore. Biomass showed a similar pattern. In 1975 and 1976, density across the entire river was significantly different at night and during 24-hour periods. Densities generally decreased with increasing distance from shore.

The relative abundance of shoreline larvae sampled by trap was dissimilar to that of drifting larvae during the 1975 spawning period. Unidentified minnows, goldfish, and carp were the major components of trap-net catch (Table 2.2-25).

In push-net collections Lepomis spp. and unidentified minnows were the most widely distributed taxa; in 1976 each was collected from 11 of the 13 stations (Table 2.2-26). Goldfish, unidentified minnows, and Lepomis spp. were the most abundant taxa (all stations combined). White sucker and tessellated darter were infrequently collected, probably because their early developmental period was nearly completed at the time of sampling. Use of nursery areas depended upon habitat and time of spawning of each species. Some sites had habitat suitable to a variety of species and were occupied throughout the spawning season (S77320 and S77161), while other sites with limited desirability were used only occasionally (S77485, intake location). Most (70%) larvae were collected from S77161, S76794, S76970, and S77320 while greatest diversity (6 taxa) occurred at S77970 (Table 2.2-26). Catch-per-unit-effort of larvae was generally greater downstream of LGS and along the west shore (Table 2.2-27).

2.2.2.1.7.2.2 Minnows and Young

Adult minnows and young of other species were sampled by seine and DC electrofishing in conjunction with small fish population estimates (Section 6.1). Seine collections made in 1975 and 1976 revealed 8 families and 35 species (Table 2.2-28). In both years, swallowtail shiner and spotfin shiner dominated the catch, accounting for 95 and 88% of the total catch in 1975 and 1976, respectively. Relative abundance of the 15 most abundant species common to both years showed no significant relationship between years. A decrease in dominance of swallowtail shiner and spotfin shiner in 1976, and a concomitant increase in numbers of other species was responsible for the lack of association between years. Because these 2 species so completely dominated minnow populations, any change in their abundance affected total population structure.

The majority (92%) of fish collected in 1975 were captured from January through May at stations S81750, S77960, S76820, and S75730 (Tables 2.2-29 and 30). These sites were probably typical of important overwintering areas. A small increase in abundance occurred in September as a result of recruitment of young. In 1976, major peaks in abundance occurred from June through December and indicated that a more successful spawn occurred in this year. Large catches (>1000) were made at S77240, S77220, and S76820, which emphasized the importance of these areas as spawning and nursery habitat.

The diversity, or total number of species collected (Tables 2.2-29 and 30) peaked in 1975 during periods of winter aggregation, and after late spawns in September. In 1976, peaks occurred after spawns and in a mid-winter aggregation period. The number of species collected varied between stations (Figure 2.2-7). Peaks in both years occurred in areas of dense aquatic plants, or areas of spawning or nursery activity.

Relative abundance determined from electrofishing catches generally agreed with seine information, except for sunfish that were more abundant in electrofishing catches (Table 2.2-31). This was probably due to the cover-seeking behavior of small sunfish, which made them less susceptible to capture by seine, and the fact that sunfish were actively pursued in electrofishing.

2.2.2.1.7.2.3 Adults

Three programs were employed to sample adult fishes; the large fish population estimate, catch-per-unit-effort programs, and the Vincent Pool trap-net program (Section 6.1). Population estimate

and catch-per-unit-effort sampling was conducted throughout the study area; trap-net sampling was conducted only in Vincent Pool.

In three years of population estimate sampling, pike and sunfish hybrids and 21 species representing 6 families were collected (Table 2.2-32). In all sites and all years the catch was dominated by brown bullhead, redbreast sunfish, pumpkinseed, white sucker, and goldfish. The catch of these five species combined represented a minimum of 85% (S76440, Limerick B, 1975) and a maximum of 94% (S77240, Limerick A, 1974) of total catch. Brown bullhead was the most abundant species on four occasions (Limerick A, 1974 and 1975; Limerick B, 1974 and 1975), redbreast sunfish on two occasions (Limerick B, 1973; S79440, Firestone, 1974), and pumpkinseed on two occasions (Limerick B, 1973; S74365, Vincent Pool, 1974).

Although there were changes in species ordering, species composition in the study area was consistent over the study period. Species composition upstream (Firestone) was similar to that of the intake site (Limerick A), the discharge site (Limerick B), and the recovery site (Vincent Pool).

The limited data presently available from the catch-per-unit-effort program describe a similar fish community (Table 2.2-33). In all sites except Vincent B the catch was dominated by brown bullhead, redbreast sunfish, pumpkinseed, white sucker, and goldfish. These five species ranged from 33% of the catch at Vincent B to 88% at Firestone. Lower abundance at Vincent B was due to large winter catches of golden shiner, which made up 52% of total catch at that site. Species relative abundance was significantly correlated among all sites.

In trap-net collections at Vincent Pool, 27 species representing 7 families, as well as Lepomis and minnow hybrids, were taken from May 1971 through December 1976 (Table 2.2-34). The most abundant species were pumpkinseed (44% of total), brown bullhead (30%), redbreast sunfish (5%), green sunfish (3%), and white crappie (3%). Species composition at Vincent Pool, determined from trap-net collections, was similar to that determined from the population estimate and catch-per-unit-effort sampling in the same area. The brown bullhead was more abundant in trap-net catches, probably due to trap-net selectivity for demersal species.

2.2.2.1.7.3 Important Species

General criteria for selection of important species were given in Section 2.2. Schuylkill fishes selected as important represented all major ecological niches available, as well as taxa of sociological importance. All will be potentially affected by

plant operation. A list of important fishes with more specific justification is given in Table 2.2-35. A relatively large number of species were selected because the plant will have diverse impacts (entrainment, impingement, discharge) and the adjacent Schuylkill supports a recreational fishery. The local biology of important species is described below.

2.2.2.1.7.3.1 American Eel

The American eel (Anguilla rostrata) was common in the river and comprised 2% of the large fish taken in 1976 catch-per-unit-effort sampling (Table 2.2-33). Monthly catches exhibited significant variation, with the July catch significantly greater than December's (Table 2.2-36). The catch did not vary significantly among sites. The American eel was commonly caught by recreational anglers and was the preferred species of a small number of fishermen (Harmon, Ref 2.2-52).

2.2.2.1.7.3.2 American Shad

This specie (Alosa sapidissima) has not used the upper Schuylkill for spawning since the construction of the Fairmount Dam in Philadelphia in 1800-01 (Gay, Ref 2.2-56). Prior to this date, the Schuylkill River was an important shad fishing center. In 1784, 4000 shad were caught in a single net near Pottstown. Lampreys, striped bass, and shad migrated as far upstream as Port Carbon (Nolan, Ref 2.2-57).

Sampling below the Fairmount Dam in 1975-1976 revealed that adults were present but uncommon (Philadelphia Electric Company, pp. 3-33, Ref 2.2-58). A shad restoration feasibility study conducted by the Pennsylvania Fish Commission (Marshall, Ref 2.2-59) indicated that there were sufficient numbers of shad present below the Fairmount Dam so that, given access to the upper river, a spawning population might be reestablished without extensive help from man. As a result of this study, fish passage facilities have been completed at Fairmount Dam and are proposed for the Flat Rock, Plymouth, Electric, Black Rock, and Vincent dams. Completion of the construction projects will provide shad with access to the river as far upstream as the Felix Dam at Reading (river km 127).

2.2.2.1.7.3.3 Muskellunge

This species (Esox masquinongy) and its sterile hybrid with the Northern pike (Esox lucius) were rare in the Schuylkill River although both were stocked regularly by the Pennsylvania Fish Commission. No larval muskellunge were collected in drift or push-net sampling. Because no evidence of natural reproduction

in the river was found, it is likely the population has been maintained entirely by stocking. Most recent stockings have been the Northern pike/muskellunge hybrid. Juveniles were rarely collected from the river; only one was collected in population estimate sampling (1973-1976) and seine sampling (1976). However, several were collected by electrofishing in 1977. No adults equal to or exceeding the angling legal size limit were collected; the largest specimen was 463 mm FL.

2.2.2.1.7.3.4 Goldfish

The reproductive period of goldfish (Carassius auratus) in the Schuylkill generally lasted from June through September at water temperatures of 21 to 27° C. Drifting larvae occurred throughout the summer in 1974, 1975 and 1976. Eggs from the river hatched in 54 hours at 22.2° C.

Goldfish larvae were the second most abundant species in drift samples 1974, eighth in abundance in 1975 and first in abundance in 1976. Mean density in 1974, 1975 and 1976 was 0.1361/m³ (30% of total), and 0.0002/m³ (<1%), and 0.3753/m³ (63%) (Table 2.2-23). Peak densities in both years occurred between 2200 and 0500 hours and densities were greater near shore than in midriver in 1975 and 1976 (Table 2.2-24). They were also greater in the west, rather than the east, channel around Limerick Island in 1975 and greater in the east channel in 1976.

Relative abundance of shoreline goldfish larvae adjacent to drift sites was dissimilar to that of drifting larvae in 1975. Goldfish ranked second in abundance in trap collections and comprised nearly 37% of total catch (Table 2.2-25). Push-net sampling indicated that goldfish were the most abundant shoreline larvae in 1976 (Table 2.2-26). Larvae were generally more abundant along the west shoreline and downstream of the proposed LGS discharge (Table 2.2-27).

Young goldfish were rarely collected by seine, and only 15 specimens were captured in 1975 and 1976 combined (Table 2.2-28). Only 14 were collected in connection with small fish population estimates conducted in 1973, 1975, and 1976 (Table 2.2-31).

Adult goldfish population size at Limerick sites A and B fluctuated from 1973 to 1977. A mean standing crop of 326 fish/ha was estimated in 1973, 140 fish/ha in 1975, and 378 fish/ha in 1977 (Table 2.2-37). No difference in population size was detected between Limerick A and B in 1975, the only year valid among-site comparisons could be made. The standing crop at Firestone was more consistent; estimates were 195 fish/ha in 1974 and 259 fish/ha in 1977. The standing crop at Vincent Pool was estimated (1977)as 167 fish/ha.

In the second half of 1976, the goldfish catch-per-unit-effort did not show significant monthly variation. The catch-per-unit-effort did vary among sites, with catches at Limerick A significantly greater than those at Firestone and Vincent B (Table 2.2-36).

Estimates of the goldfish biomass standing crop at Limerick A and B generally varied in the same manner as numbers (Table 2.2-37), and ranged from 31.6 kg/ha in 1975 to 74 kg/ha in 1977. The biomass standing crop was greater at Firestone than at Vincent Pool.

No fish older than age II were collected from the river and maximum length was only 250 mm. Most growth occurred in the first year of life (Table 2.2-38). The longest goldfish collected (all studies) was 320 mm FL. Goldfish length-weight relationships determined for Limerick A and B in 1975 are shown in Table 2.2-39.

Goldfish collected from the Schuylkill River were found to be subject to a number of maladies. Approximately 43% of individuals collected exhibited some symptom of disease or parasitism. The most common abnormalities were open wounds and parasitism by copepods. Tumors, lordosis, various fin disorders, popeye, fluid eye, cataract, blindness, parasitic leeches, and external and internal nematodes were also noted.

Goldfish were frequently caught from the river by anglers and accounted for 4% of the angler catch sampled in a 1977 creel survey (Harmon, Ref 2.2-52).

2.2.2.1.7.3.5 Swallowtail Shiner

Peak spawning of swallowtail shiner (Notropis procne) occurred in mid-July in 1974 and in mid-June in 1976. Larvae were 4.8-5 mm at hatching and were identified in drift samples. However, because of difficulty in identification, this species was usually combined with other minnows in an "unidentifed minnow" category. Young-of-year swallowtail were collected by seine as early as June (1971) and as late as September (1975).

Minnows accounted for 48, 78 and 25% of the total drift sample catch in 1974, 1975 and 1976, respectively. The mean density of drifting minnow larvae in 1974 was 0.21380/m^3, 0.0691/m^3 in 1975, and 0.1463/m^3 in 1976 (Table 2.2-23). Peak drift density occurred between 2200 and 0500 hours. Drifting minnow larvae were more abundant in the west channel than the east channel (Table 2.2-24) in 1975, and more abundant in the east channel in 1976. The distribution of larvae across the breadth of the river was also significantly different, with density being greater near shore. Push-net sampling conducted in 1976 (Table 2.2-26)

indicated minnow larvae abundance was greatest along the west shore, with high densities at stations S77161 (west shore), S78973 (east shore), and S77970 (west shore).

The swallowtail shiner was one of the two most abundant minnows collected by seine, and comprised 56 and 32% of total seine catch in 1975 and 1976, respectively (Table 2.2-28). There was no significant difference in catch between years. In the 1975 seine collections it was most abundant prior to the spawning season (Figure 2.2-8). Few specimens were collected after May, indicating poor reproductive success, probably due to high water and increased turbidity, which occurred during frequent spates in June and July 1975. In 1976, the pattern was reversed and greatest catches were made late in the year; few specimens were collected prior to the spawning season (Table 2.2-29).

Variation in catch between locations was significant in both 1975 and 1976. The greatest catches in 1975 occurred at S75730 (3566 specimens), and the fewest individuals were taken at S78900 (150). In 1976, the largest number was found at S76840 (1333), the fewest were taken from S78460 (130), as shown in Table 2.2-30. Although catches were different between stations, analysis indicates that catches between all possible pairs of control and affected stations were significantly correlated.

Chironomid larvae were the most abundant food item in the identified portion of stomach contents of river swallowtail shiner and comprised 77% of the material found in the stomachs that contained food. Chironomid pupae and adults were also important. The largest specimen collected was 70 mm FL.

2.2.2.1.7.3.6 Spotfin Shiner

In the Schuylkill River, peak spawning of spotfin shiner (Notropis spilopterus) in 1974 and 1976 occurred in late-July, wereas in 1975 it occurred during the first half of August when water temperatures were 23 to 29°C. Larvae were identified in river drift collections, but because of the difficulty in identification this species was usually combined with others in an "unidentified minnow" category (see swallowtail shiner). Young-of-year were collected by seine as early as June (1973) and as late as September (1975).

The spotfin shiner was one of the two most abundant species collected by seine and represented 39 and 46% of the 1975 and 1976 catch, respectively (Table 2.2-28). There was no significant difference between 1975 and 1976 catches, but in both years significant variation in catch occurred between months. In 1975, the largest catches were made prior to the spawning season and few individuals were taken after May (Figure 2.2-9). In contrast, the greatest 1976 catches were made after spawning

occurred and few specimens were taken early in the year (Table 2.2-29). As discussed for the swallowtail shiner, frequent spates in June and July 1975 probably adversely affected spotfin shiner reproduction.

Variation in catch between locations was found to be significant in both years. In 1975, the catch ranged from 2728 individuals at S75730 to 173 at S78460. The greatest 1976 catch occurred at S76820 (1576 individuals), and the lowest at S76310 (291) as shown in Table 2.2-30.

Unidentified insect parts were found in 62% of all spotfin shiner stomachs containing food. Chironomids (larvae, pupae, and adults), terrestrial Coleoptera and Thysansoptera, composed the bulk of the summer diet. The maximum recorded length of a spotfin shiner was 86 mm FL.

2.2.2.1.7.3.7 White Sucker

Breeding of white suckers (Catostomus commersoni) took place in the first half of May 1974, May through mid-June at temperatures of 12 to 24°C in 1975, and late-April in 1976. Larvae had absorbed yolk sacs by the time they were 13-14 mm long. Larvae were often found in river drift, and in 1974 and 1976 were the sixth most abundant species; in 1975 they ranked second. Mean density of the white sucker drift was 0.0011/m³ in 1974, contrasted to 0.0133/m³ in 1975 and 0.0042/m³ in 1976 (Table 2.2-23). Peak drift density generally occurred between 2200 and 0500 hours. In 1975, densities were greater along the west shore in 1975 and greater along the east shore in 1976 (Table 2.2-24). Relative abundance of shoreline white sucker larvae, sampled by trap in 1975 (Table 2.2-25), differed from drift samples.

Young collected by seine were more abundant in 1976 than 1975 (Table 2.2-28). In both years most young were collected in June and were abundant at the mouths of Brooke Evans and Akm Run (S76820 and S77220), as shown in Table 2.2-30. Abundance of young at creek mouths indicated the importance of tributaries as white sucker spawning areas.

The white sucker was one of the most abundant large fish in the river, and comprised from 7 to 32% of large fish collected from 1973 to 1977. The mean standing crop of adult white sucker at Limerick sites A and B decreased between 1973 and 1975, but remained consistent from 1975 to 1977 -- 324 fish/ha was estimated in 1973, 203 in 1975, and 243 in 1977 (Table 2.2-37). The standing crop at Firestone and Vincent Pool increased from 1974 to 1977. In the second half of 1976, the catch-per-unit-effort was significantly greater in October than in July, probably reflecting recruitment of young-of-year (Table 2.2-36).

Population size was generally greatest at Firestone, smallest at Vincent Pool, and intermediate at Limerick sites A and B (Table 2.2-37). Catch-per-unit-effort sampling in 1976 indicated that the white sucker was significantly more abundant at Firestone than at Vincent B (Table 2.2-36). Studies of Schuylkill fish have indicated that the white sucker prefers a fast water habitat, such as that at Firestone, and is less likely to be found in quiet water like that at Vincent Pool.

The mean biomass of white sucker at Limerick A and B varied in a manner similar to numbers (Table 2.2-37). The standing crop biomass in 1977 was greater at Firestone than at Vincent Pool.

In young white suckers examined, Cladocera and chironomid larvae were the most abundant food items, and were found in 64 and 62%, respectively, of all stomachs containing food. Other important items included, in decreasing order of abundance, algae, copepods, chironomid pupae, tubificids, and chironomid adults.

Most specimens collected in 1973 were age II, the oldest age IV. Greatest growth occurred during the second year (Table 2.2-38). Length-weight relationships for these fish are presented in Table 2.2-39. The longest white sucker collected was 409 mm FL.

A number of disorders were noted including open wounds, fungus; scoliosis, opercle deformity, numerous fin disorders, blindness, parasitic leeches, copepods, nematodes, and black spot. About 8.3% of white suckers collected were afflicted. Open wounds, parasitic copepods, and leeches were the most common maladies.

White suckers support a small spring fishery during their spawning run and are of some recreational importance.

2.2.2.1.7.3.8 Brown Bullhead

In 1975, brown bullhead (Ictalurus nebulosus) spawned from early June to mid-July at temperatures of 21 to 25° C; peak spawning occurred in mid-June to early July. Larvae were rarely collected in the drift because of adult nesting behavior and parental care. Most drift specimens were recently transformed juveniles, and density was generally low (Table 2.2-23). In contrast to other species, drifting brown bullheads were more abundant in midriver than along the shore (Table 2.2-24). No brown bullhead was collected along the shore in push-net samples.

Young were rarely collected by seine before 1977 (Table 2.2-28). Preliminary inspection of 1977 seine collections indicated a large catch in excess of 500 individuals. This may have represented the first successful spawn since 1971. Age and growth data indicated that the brown bullhead suffered virtual failure of the 1972 year class, probably due to the catastrophic

June 1972 flood and concomitant oil spill. Since that time, seine and small fish population estimate collections have indicated little or no production of young.

Brown bullheads comprised from 4 to 43% of the large fish population estimate catch from sites near LGS in 1973, 1975, and 1977. They were most numerous in 1974 at Limerick A, and least numerous in 1977 at Firestone (Table 2.2-32). The mean number of adults at Limerick sites A and B remained quite constant from 1973 to 1975, but dropped dramatically from 1975 to 1977 (Table 2.2-37). The standing crop at Firestone and Vincent Pool showed a similar decline. The substantial decrease was a result of the unsuccessful spawning discussed above.

In the second half of 1976, brown bullhead catch-per-unit-effort did not exhibit significant variation between months (Table 2.2-36). Mean population size was greatest at Vincent Pool (1468 fish/ha), least at Firestone (139/ha), and intermediate at Limerick sites A and B (419/ha). Brown bullheads prefer slow water habitats and were thus likely to be found in greater abundance at Vincent Pool than at Firestone. The mean biomass at Limerick A and B varied in the same manner as numbers (Table 2.2-37). Biomass at Firestone was much less than that at Vincent Pool.

Plant material (in 87% of stomachs containing food) and chironomid larvae (71%) and pupae (51%) were the most common items in the identifiable portion of bullhead stomachs from the Schuylkill River. Other food items, in decreasing order of occurrence, were plant material, insect parts, various aquatic organisms, terrestrial organisms and tubificids.

Age and growth of this species were studied in collections made from 1973 to 1975. The oldest individuals were age VIII. The greatest growth in length occurred in the first year of life (Table 2.2-38). Mean calculated lengths at annuli were slightly, but consistently, greater in 1975 than in 1973 to 1974. No differences were detected between sexes in all year-classes from 1973 to 1974. No population-wide difference in growth in length between Limerick A and B was detected from 1973 to 1974. The longest specimen collected from the river was 389 mm FL. Length-weight relationships for the collections are shown in Table 2.2-39. The rate of weight gain decreased with each successive year of life. No consistent difference in instantaneous growth was detected between sexes.

The age structure in late summer 1973 was characterized by a very small age-group I, dominant age-group II, and a strong age-group V. The population appeared quite stable, except for the weak age-group I. In 1975, a very strong age-group III dominated, and the lack of recent successful spawning was evidenced by very weak age-groups I and II (Figure 2.2-10).

Specimens were commonly afflicted with disease or parasites; 8.6% of specimens collected from 1974 through 1976 exhibited at least one disorder. Symptoms noted included open wounds, fungus, tumor, scoliosis, various fin disorders, cataract, blindness, leeches, parasitic copepods and nematodes, and yellow and white cyst. Maladies that occurred most frequently were open wounds and parasitic leeches.

A creel survey conducted in 1976 indicated that the brown bullhead was the preferred specie of anglers on the Schuylkill River (Harmon, Ref 2.2-52).

2.2.2.1.7.3.9 Banded Killifish

In the river, peak spawning of banded killifish (Fundulus diaphanus) in 1974 occurred in mid-June, in 1975 from early July through early August, (at temperatures of 22 to 29° C) and in 1976, from late-June through mid-July. Larvae were identified in drift samples where they accounted for <1% of catch in 1974, 1% in 1975 and <1% in 1976. Mean density was 0.0011 larvae/m^3 in 1974, 0.0012/m^3 in 1975 and 0.00005/m^3 in 1976 (Table 2.2-23). The greatest daily drift density occurred between 2200 and 0500 hours. Drift tended to be slightly more dense near shore in the east channel (Table 2.2-24). Few larvae were collected by shoreline trap sampling (Table 2.2-25) or push-net sampling (Table 2.2-26). Young-of-year killifish appeared in seine catches from early July (1971) to late September (1976).

The banded killifish ranked sixth in abundance in 1975 seine collections and accounted for <1% of the catch. In 1976, it ranked eighth and comprised 1% of the catch (Table 2.2-28). The small fish population estimate data also indicated an increase in abundance from 1975 to 1976 (Table 2.2-31).

Greatest seine catches of banded killifish in 1975 occurred early in the year. Low summer and fall catches indicated poor reproductive success. In 1976, large catches were made in August and July, probably reflecting recruitment of young; few were taken in other months (Table 2.2-29). The greatest number of banded killifish was taken from S75730 and S77960 in 1975; catches at other stations were generally low. In 1976, the greatest catches were made at S77960 and S76820 (Table 2.2-30).

In the Schuylkill, chironomid larvae and pupae were the most common food items in the stomachs of killifish. Chironomid adults and tubificids were also among gut contents.

The maximum length of banded killifish collected from the LGS study area was 81 mm FL from East Branch Perkiomen Creek.

2.2.2.1.7.3.10 Redbreast Sunfish

Redbreast sunfish (Lepomis auritus) breeding took place in mid-July in 1974, and mid-June to early August in 1975 when water temperatures were 19 to 29° C. Eggs were demersal and loosely adhered to stones and gravel of the nest. Hatching occurred in 48 hours at 22°C and larvae were 5.5-5.7 mm long. The yolk was absorbed in 3 to 4 days, when larvae had attained a length of 8 mm. Yolk-sac larvae remained in the general nesting area. Post-larvae were found in vegetative shallows. Drifting redbreast sunfish larvae were not identified by species, but were included in a Lepomis spp. category. Also in this group were larvae of the pumpkinseed, green sunfish, and bluegill. This group ranked fourth in abundance in 1974, 1975 and 1976. Mean drift density in 1974 was 0.0350 fish/m^3, 0.0012/m^3 in 1975 and 0.0196/m^3 in 1976 (Table 2.2-23). Larvae were collected in the drift from May through August in all three years. Peak drift density generally occurred between 2200 and 0500 hours. The density of drifting Lepomis spp. larvae was greater along the west shore in 1975 and greater along the east shore in 1976 (Table 2.2-24).

The relative abundance of shoreline Lepomis spp. larvae sampled by trap in 1975 agreed well with the relative abundance determined from drift samples (Tables 2.2-23 and 25). Most larvae were collected in August (1975). In 1976 push-net sampling, larvae of Lepomis spp. ranked third in abundance, and were collected from 11 of 13 stations (Table 2.2-26). Larvae were more abundant along the west shoreline and downstream of the proposed LGS discharge location (Table 2.2-27).

Population estimates of age 0 redbreast sunfish varied significantly from 1973 through 1976. Young redbreast sunfish were most numerous in 1974 and 1976, present in low numbers in 1973, and absent in 1975 (Figure 2.2-12). These data agreed well with seine collections. No significant variation in abundance of redbreast sunfish was detected between sites. Biomass estimates of young redbreast sunfish corresponded with changes in numerical abundance, exhibiting only an insignificant temporal variation.

The redbreast sunfish was the most abundant sunfish species collected in the large fish population estimate and catch-per-unit-effort sampling It accounted for 10 to 50% of the population estimate catch from 1973 through 1977 (Table 2.2-32), and 5 to 44% of 1976 catch-per-unit-effort catch (Table 2.2-33).

At the Limerick A population estimate site, the redbreast sunfish showed an increase in abundance from 1973 through 1977. At Limerick B however, population size was more constant (Table 2.2-37). Estimated number/ha at Firestone and Vincent Pool increased from 1974 through 1977.

The redbreast sunfish was significantly more abundant at Limerick A than at Limerick B in 1975; no difference was detected in 1973. Preliminary review of 1977 data indicated the redbreast sunfish was again more abundant at Limerick A. Since Firestone and Vincent Pool were not sampled in the same years as Limerick A and B, and since they were different in size, rigorous statistical analysis among all four sites was inappropriate. However, inspection of mean estimated number/ha at Firestone (550), Limerick A (369), Limerick B (253), and Vincent Pool (240) indicated an obvious difference between sites, probably a result of different physical habitats (Table 2.2-37). Results of 1976 catch-per-unit-effort sampling also indicated differences between sites; the catch was significantly greater at Firestone and Limerick C than at Vincent B. Catch per unit effort values were generally greater in September and October, probably reflecting recruitment of young-of-year (Table 2.2-36).

Estimates of mean redbreast sunfish biomass at Limerick A and B varied in a manner similar to numbers (Table 2.2-37). The biomass at Firestone was greater than that at Vincent Pool.

Adult redbreasts from the Schuylkill were found to contain Hymenoptera adults, snails, other adult insects, and chironomid larvae among their stomach contents. Aquatic insects and terrestrial organisms were the most commonly occuring food items (Figure 2.2-11).

Greatest growth occurred in the second year of life (Table 2.2-38); after the first year, males grew faster than females. Based upon age and growth and population estimate data, most redbreast sunfish in the river appeared to be age II in 1973. In 1975, the age II group was consistently smaller than in 1973.

The length-weight relationships for 1973 and 1975 are shown in Table 2.2-39. Examination of instantaneous growth rates showed slower rates with each successive year of life, and higher rates in males.

Redbreast sunfish collected from the Schuylkill occasionally exhibited symptoms of disease, or were parasitized. Of the individuals collected from 1974 through 1976 2% exhibited at least one disorder. Symptoms of disease and parasites that were noted included open wounds, fungus, scoliosis, deformed opercle, various fin disorders, cataracts, eye flukes, blindness, parasitic leeches and copepods, yellow cysts, and internal nematodes. The maladies that occurred most frequently were parasitic copepods and open wounds.

This species ranked first in abundance in angler catch from the Schuylkill River (Harmon, Ref 2.2-52).

2.2.2.1.7.3.11 Pumpkinseed

Pumpkinseed (Lepomis gibbosus) spawned during the same time period as redbreast sunfish. Nests were constructed among or near vegetation. Eggs loosely adhered to small stones or gravel in the nest. Larvae were approximately 3 mm long when hatched and absorbed their yolk in 5 to 7 days. Yolk-sac larvae remained in the general nesting area and juveniles inhabited vegetative shallows. See the redbreast sunfish for a description of Lepomis larvae population dynamics.

Population estimates of age 0 pumpkinseeds varied significantly from 1973 through 1976. Young pumpkinseeds were most numerous in 1974, and present in low numbers in 1973, 1975, and 1976 (Figure 2.2-12). Seine data confirmed the comparative absence of young pumpkinseeds in 1975 and 1976 (Table 2.2-28). Population size of pumpkinseed young-of-year did not vary significantly among sites. Biomass estimates varied in a manner similar to numbers.

The pumpkinseed was the second most abundant sunfish collected in the large fish population estimate and catch-per-unit-effort sampling in the Schuylkill River. It accounted for 1 to 39% of the population estimate catch from 1973 through 1977 (Table 2.2-32), and 3 to 21% of the 1976 catch-per-unit-effort catch (Table 2.2-33).

The river population of pumpkinseeds decreased steadily after 1973 (Table 2.2-37). Abundance dropped significantly between 1973 and 1975 at both Limerick A and B. A preliminary analysis has revealed that the number per hectare continued to fall through 1977. The estimated number per hectare also decreased at Vincent Pool.

In both 1973 and 1975, the pumpkinseed was significantly more abundant at Limerick B than Limerick A. Preliminary analysis of 1977 data indicated that the same was true in that year. Since Vincent Pool was not sampled in the same years as Limerick A and B, and was also of different size, rigorous statistical analysis between all three areas was inappropriate. However, inspection of the mean estimated number per hectare at Limerick A (55), Limerick B (147), and Vincent Pool (263) revealed obvious spatial variation, probably habitat-related. Interestingly, the pumpkinseed and redbreast sunfish numbers have varied in an opposite manner, both spatially and temporally.

Within the latter half of 1976, the pumpkinseed catch-per-unit-effort was generally greatest in September and October, probably reflecting recruitment of young-of-year (Table 2.2-36). No significant spatial variation in pumpkinseed catch-per-unit-effort was detected in 1976.

The biomass at Limerick A and B varied correspondingly with number estimates. Estimated biomass at Vincent Pool (1977) was 3.7 kg/ha (Table 2.2-37).

Pumpkinseeds feed on chironomid larvae and pupae, plant material, snails, terrestrial insects, and numerous other items.

No pumpkinseed older than age IV were collected at Limerick A and B in 1973 and 1975. In 1973, the greatest growth occurred in the first year, while in 1975 most growth took place in the second year (Table 2.2-38) Growth at Limerick B was greater in 1973 than in 1975. Length-weight relationships (Table 2.2-39) were not significantly different between sites in 1973, but were in 1975. Data from both years indicated that instantaneous growth decreased with each succeeding year of life.

The age structure of the pumpkinseed in 1973 was characterized by a dominant age-group II and a very weak age-group I, while the 1975 age structure appeared stable, with no obvious dominant or weak age groups (Figure 2.2-13).

Pumpkinseeds collected from the river were frequently diseased or parasitized; 11% of specimens collected from 1974 through 1976 were afflicted with at least one disorder. Symptoms of disease and parasites noted included open wounds, fungus, various fin disorders, eye flukes, blindness, parasitic leeches and copepods, external nematodes, black spots, yellow and white cysts, and internal nematodes. Maladies that occurred most frequently were parasitic copepods and internal nematodes.

The pumpkinseed was frequently caught by recreational anglers on the Schuylkill (Harmon, Ref 2.2-52).

2.2.2.1.7.3.12 Largemouth Bass

The largemouth bass (*Micropterus salmoides*) was common in the river, but larvae were rarely collected in drift samples. It was assumed that, because of parental care, larvae of this species seldom drift. No larvae were collected in 1976 push-net sampling. Young bass were infrequently collected from the Schuylkill by seine or the small fish population estimate sampling (Tables 2.2-28 and 31).

The relative abundance of largemouth bass in large fish collections decreased from 1973 through 1977. In 1973, they made up nearly 3% of the catch from two sites near LGS, but dropped to 1% in 1975. Only one individual was captured from each of these sites in 1977 (Table 2.2-32). Estimates of the standing crop of largemouth bass were made only for Limerick A and B in 1975. The estimated number per hectare was six at Limerick A and eight at Limerick B. Biomass estimates were 1.1 kg/ha for both sites.

A study of food habits of 7 river largemouth bass, 48 to 98 mm FL, revealed that fish were the primary food item. Larval fish were found in 43% of the stomachs containing food, cyprinid (39%), fish remains (29%), and centrarchids (14%). Other items identified were chironomid pupae, terrestrial Hymenoptera, and tubificids.

The longest largemouth captured from the Schuylkill was 351 mm FL. Of 103 specimens collected in 1973, only 17 were older than age 0 and none was older than age III. Mean calculated lengths at annuli I, II, and III were 90, 126, and 242 mm FL, respectively (Table 2.2-38). The small sample size made comparison of growth by year difficult. Age structure of largemouth bass in 1973 showed young-of-year fish were dominant, comprising 92% of fish collected.

Largemouth bass occasionally exhibited symptoms of disease or parasitism. From 1974 through 1976, 2% of largemouth bass collected were afflicted with at least one malady. Symptoms included open wounds, various fin disorders, parasitic copepods, yellow cyst, and "bass boils." Parasitic copepods were the most frequently observed disorder.

The largemouth bass was infrequently caught by anglers on the river, but was actively sought by some fishermen (Harmon, Ref 2.2-52).

2.2.2.1.7.3.13 Tessellated Darter

Spawning of tessellated darter (Etheostoma olmstedi) occurred from May through June at temperatures of 12 to 24°C. Larvae were 4 to 5 mm long upon hatching and were usually found among shallow vegetation. Larvae accounted for 1.6% of the total catch in 1975 and <1% in 1976 (Table 2.2-23). Most larvae were collected in May, and peak drift density occurred between 2200 and 0500 hours. Drift density was greater along the east shore (Table 2.2-24). Few larvae were collected in trap or push-net samples along the shoreline, and only in May 1976 (Tables 2.2-25 and 26).

The tessellated darter ranked eleventh in abundance in 1975 seine collections , and made up <1% of the total catch. Abundance increased in 1976 when the species ranked seventh and accounted for 2% of the catch (Table 2.2-28). Data collected in small fish population estimate sampling also indicated an increase in abundance from 3% of the catch in 1975 to 10% in 1976 (Table 2.2-31).

Greatest seine catches in 1975 occurred in February; very few individuals were collected in any other month. In 1976, the greatest numbers were collected in June and July, with few specimens taken from February through March (Table 2.2-29). The

most individuals collected were from S76840 in 1975 and S75730 in 1976 (Table 2.2-30).

Tessellated darters in the river fed primarily on Cyclopidae and chironomid larvae. Other food items were cladocerans and isopods.

The maximum length of tessellated darters collected from the study area was 78 mm FL, from East Branch Perkiomen Creek.

2.2.2.1.8 Trophic Relationships

The stability of perpetuating assemblages of organisms is due largely to nutritional relationships among component populations. Assessment of the trophic organization is necessary for an adequate understanding of the roles of individual species and biotic components in the ecosystem.

A generalized diagram (Figure 2.2-14) was constructed to summarize the structure and function of selected biotic components within the LGS study area. The representative organisms pictured are important in one or more of the three river systems. Construction of trophic pathways was based largely upon literature, although some studies of food habits were conducted by the Applicant's consultant. Phytoplankton (primarily of periphytic origin) and zooplankton were present in low densities in all systems and therefore were not included.

Benthic diatoms and detritus presumably provide the main food base in all systems. Detritus, whether derived from within the stream (autochthonous) or surrounding watershed (allochthonous), is any nonliving organic matter that has begun to be utilized by microconsumers (bacteria, fungi, and, protozoa). Diatoms and the filamentous green alga Cladophora were important primary microroproducers and macroproducers, respectively, in the river and both creeks. Macrophytes (e.g., Myriophyllum) were seasonally abundant primary producers in the river.

Macroconsumers include invertebrates and fish. Invertebrates exhibit a wide variety of feeding mechanisms. Cummins (Ref 2.2-61) partitioned them into four functional groups, all of which are represented by species important within the study area: (1) grazers and scrapers (e.g., mayflies, beetles, and snails) - large herbivores feeding on attached algae and associated mineral and detritus deposits; (2) shredders (e.g., stoneflies, craneflies, and crayfish) - large particle feeding detritivores; (3) collectors (e.g., caddisflies, blackflies, and midges) - both suspension (filter) and deposit (surface) fine particle feeding detritivores; and (4) predators (e.g., hellgrammite, and midges) - carnivores.

Lagler et al. (Ref 2.2-62) partioned fish into four general feeding types, three of which were represented by important species within the study area: (1) predators (e.g., muskellunge and brown bullhead), (2) grazers (e.g. Redbeast sunfish and pumpkin seed), and (3) suckers (e.g., white sucker.)

Cummins (Ref 2.2-60) stated that ecological communities follow a transition from headwater to higher order streams that involves both producers and consumers and, further, that transition in organic inputs and plant growth undoubtedly represents the basis of changing overall community structure and function. In general, headwater streams like East Branch Perkiomen Creek are characteristically more dependent upon terrestrial contributions of particulate organic matter, especially coarse particles such as leaf litter. There is evidence that allochthonous input is also important to the Schuylkill River near LGS because the river is measureably heterotrophic most of the year.

2.2.2.2 Perkiomen Creek

Perkiomen Creek is located in the Triassic Lowland section of the Piedmont physiographic province, a rich farming area of rolling hills. It is a major Schuylkill tributary in this province and drains 938 km^2 of Lehigh, Berks, Bucks, and Montgomery counties.

The aquatic community of the Perkiomen Creek system has been influenced by man's long history of activities in the watershed. Water quality and flows have been altered, habitats changed or eliminated, and the species complex directly manipulated. Although these activities have probably reduced diversity somewhat, the community remains relatively stable and healthy.

The creek downstream of the East Branch confluence will be impacted by water diversion; water withdrawal will occur at Graterford. The Perkiomen Creek study area includes that stretch from Spring Mount Road bridge downstream to below the U.S. 113 bridge (Figure 2.2-15). For a further description of this area, refer to Section 6.1. Sample stations are designated by common name and by the letter 'P' followed by a number that indicates distance in meters from the mouth of the creek. Where stations include several meters of stream, site numbers designate the downstream end of the station.

Aquatic biota of the Perkiomen Creek study area was extensively studied by the Applicant's consultant from 1970 through 1978. A summary of sampling history by program is given in Tables 2.2-40 and 2.2-41.

2.2.2.2.1 Water Quality and Environmental Stress

Perkiomen Creek is a major tributary to the middle reach of the Schuylkill River. Its relatively rural watershed contains a number of small boroughs, but no major population centers. Most surrounding land is residential or used for agriculture. Low base flows and frequent spates characterize an extremely variable flow regime. Spring flows are generally high due to snow melt and precipitation; late summer and early autumn flows are very low, but subject to rapid fluctuation due to local thunderstorms.

Water quality near Graterford is relatively good, with nutrient loading being the most serious stress (Section 2.4). Nutrients enter the stream from both point and nonpoint sources, and from Green Lane Reservoir. Primary point sources are municipal sewage treatment plants. Nonpoint source nutrients originate from onsite sewage treatment facilities and from agricultural runoff. Green Lane Reservoir also receives point and nonpoint source nutrients. Of 17 Pennsylvania lakes inventoried by the EPA's National Eutrophication Survey in 1973 and 1974, Green Lane was found to be most eutrophic (DVRPC and Chester-Betz Engineers, Ref 2.2-15). Water released from the hypolimnion during summer stratification is anoxic, and highly enriched with nutrients.

2.2.2.2.2 Phytoplankton

A qualitative study of phytoplankton in 1974 (Tables 2.2-40 and 41) yielded 54 taxa (Table 2.2-42). Diatoms were represented by 22 genera and were found throughout the year. Green and blue-green algae were represented by 25 and 6 genera, respectively, and were found predominantly in summer and early fall. Seasonal succession of these three groups in Perkiomen Creek followed seasonal changes in water temperature, and was similar to that previously described for the Schuylkill River (Section 2.2.2.1.2).

The benthic diatom Navicula was the most common phytoplankter, and occurred throughout the year; it was particularly abundant in the winter. The planktonic diatom Melosira was abundant in late summer. Three genera (Ankistrodesmus, Scenedesmus, and Pediastrum) of green algae were abundant phytoplankters; all were present in low numbers in winter and spring, and increased in the summer. Anabaena was the only abundant genus of blue-green algae and was most common in the summer.

In general, phytoplankton densities in Perkiomen Creek appeared to be low, and the most abundant phytoplankters were of periphytic origin. For these reasons, Perkiomen Creek was considered to be an area of low potential impact for phytoplankton.

2.2.2.2.3 Periphyton

Periphyton, an important primary producer in Perkiomen Creek, was studied from July through December 1973 (Tables 2.2-40 and 41). Taxonomic composition was very similar to that in the East Branch (Section 2.2.2.3.3), and was almost exclusively diatoms. Maximum standing crop biomass (106 mg dry wt/dm^2) and production rate (8 mg dry wt/dm^2/day) were recorded in October; lowest values for both parameters occurred in December (Table 2.2-43).

2.2.2.2.4 Macrophytes

Macrophytes were not studied in Perkiomen Creek. Qualitative observations indicated that macrophytes were not common, and they were therefore considered to be of low potential impact.

2.2.2.2.5 Zooplankton

Zooplankton was not studied in Perkiomen Creek because it was considered to be of low potential impact. Studies conducted in other temperate small streams have shown that zooplankton is typically low in density.

2.2.2.2.6 Macroinvertebrates

Benthic macroinvertebrates play an important functional role in most lotic ecosystems by converting allochthonous and autochthonous materials into temporary storage within their own tissue, thus ultimately becoming an essential component in the food web. Macroinvertebrates also shred coarse organic material (e.g., leaves) into finer particles that can be utilized by smaller macroinvertebrates.

A pilot study was conducted in Perkiomen Creek and East Branch Perkiomen Creek from June 1970 through December 1971. Data collected during this period were used to develop an experimental design for a preoperational quantitative program that began in January 1972, and was continued in 1973, 1974, and 1976. Only the riffle biotope was sampled quantitatively; it was common in the creeks, and invertebrate diversity and production are typically highest in this type of habitat. Pilot study data, because of their qualitative nature, were used only in the compilation of a species list. Qualitative collections were also made periodically in 1972 and 1973 to aid in compiling a comprehensive species list for each location.

Two locations were sampled on Perkiomen Creek (Spring Mount station - P22000, above the East Branch confluence; Rahns station - P13600, below the confluence), and 6 on East Branch Perkiomen Creek (Elephant station - E36725, Branch station - E32200, Sellersville station - E26700, Cathill station - E23000, Moyer station - E12500, WaWa station - E5600). For a summary of Perkiomen Creek and East Branch Perkiomen Creek macroinvertebrate sample history, see Tables 2.2-40 and 41, and Tables 2.2-70 and 71 respectively.

2.2.2.2.6.1 Species Inventory

A species list (Table 2.2-44) of macroinvertebrates collected by all methods (i.e., benthos quantitative and qualitative, and drift) indicated that both creeks were characterized by a diverse macroinvertebrate assemblage. Representatives of all major orders of aquatic insects were collected between June 1970 and December 1976, as were planarians, annelids, isopods, amphipods, decapods, mollusks, and others. The more diverse groups were Arthropoda (82% of total taxa, of which 96% were insects), Annelida (8%; 48% leeches, 32% worms, and Mollusca (6%; 58% snails, 42% clams). The more diverse insect orders were Diptera, Coleoptera, Trichoptera, and Ephemeroptera. Diptera was represented by the greatest number of families and one family, Chironomidae, contained the greatest number of genera. Of the 301 taxa collected, 15 were considered abundant, 65 common, 97 uncommon, and 124 rare.

Designation of abundance (abundant, common, uncommon, rare) for taxa on this list was highly subjective, particularly for non-riffle organisms. Abundance was based on field observation and range within each Creek. Seasonal fluctuations were not considered. For example, a taxon was considered "rare" if only a few specimens were collected. A taxon present in high densities at only one or two stations were considered "uncommon" as was a taxon present throughout the study area but in low numbers. A cosmopolitan taxon present in high numbers was termed "abundant". Other taxa were considered "common".

2.2.2.2.6.2 Community Description

Based upon quantitative sampling of the riffle biotope, it was apparent that longitudinal changes in macrobenthos in East Branch Perkiomen Creek were strongly influenced by intermittent flow in the headwaters and degraded water quality in the middle section. Benthic invertebrates exhibited a high degree of resiliency in response to short-term phenomena such as spates and localized channelization. There were no major anthropogenic stresses

operating in that section of Perkiomen Creek included in the study area, and diversity (richness) was greater here than in the East Branch.

Faunal patterns, with few exceptions, were relatively constant as relative abundance data showed little variation between years. All forms of feeding mechanisms were represented among the dominant invertebrates as were primary, secondary, and tertiary consumers. Macrobenthos communities in both creeks were diverse and productive.

2.2.2.2.6.2.1 Standing Crop Numbers and Biomass

For both creeks, numerical and biomass standing crop data were highly variable between sites in the same month, and between months within a year for the same site. When data from all months were combined and averaged by year, spatial trends in abundance were apparent (Table 2.2-45). Intermittent flow and degraded water quality reduced standing crop numbers in the upper (Elephant 4-year mean, 5736 organisms/m^2; Branch, 8339/m^2) and middle East Branch (Sellersville 8277/m^2, Cathill 6578/m^2), respectively. Recovery, in terms of increased density, was evident in the lower section (Moyer 14,925/m^2, WaWa 23,781/m^2). Standing crops in Perkiomen Creek averaged 14,996/m^2 at Spring Mount, upstream of the confluence, and 12,906/m^2 at Rahns, downstream of the confluence. Spatial trends in biomass density in both creeks were like those for numbers; biomass at Cathill was particularly low in 1973 and 1974 due to the preponderance of small-size chironomid larvae.

In general, both Perkiomen Creek stations (Table 2.2-45) and the East Branch, all stations combined (numbers Table 2.2-46); and biomass (Table 2.2-47), showed an increase in benthic density in all consecutive sample years. The marked increase in mean density in the East Branch between 1974 and 1976 was due largely to the increase in the fingernail clam Sphaerium rhomboideum at WaWa. Although 1972 was the year of Tropical Storm Agnes (greatest flood of record), invertebrate density was reduced below normal only in June and there was little effect on the annual mean.

Within-year trends in total standing crop largely reflected the population dynamics of dominant organisms (described below under "Important Species"). In general, total numbers and biomass were greatest in the fall (Table 2.2-48).

2.2.2.2.6.2.2 Richness

The taxonomic diversity (richness component) of riffle benthos was high in both creeks throughout the year. In the East Branch of Perkiomen Creek, annual diversity (Table 2.2-45) was highest at upstream stations (Elephant 4-year mean, 59 taxa; Branch, 55 taxa), decreased at Sellersville (52 taxa), and reached a low midpoint in the creek at Cathill (32 taxa). Diversity then increased with increasing distance downstream (Moyer, 46 taxa; WaWa, 47 taxa) but did not recover to levels found in the headwaters.

High richness at Elephant was due in large part to intermittent flow, which typically occurred in late summer and fall. Surface flow often ceased during this period, and the riffle habitat was replaced temporarily by isolated pools maintained by subsurface percolation. This change to a pool habitat, still effectively sampled, was accompanied by an invasion of quite water species, primarily of the groups Hemiptera and Coleoptera. The relatively large fluctuations in total taxa collected between years at Elephant, and perhaps Branch, may have been related to the intensity and duration of discontinuous flow.

Diversity at Sellersville was below that at Branch, but was still relatively high. This station was sporadically subjected to storm sewer discharge from two pipes under the Main Street Bridge. Quantitative sampling transected the entire channel directly downstream of the bridge at this site, and both affected and unaffected areas were sampled. The relatively high diversity here may not indicate an entirely healthy environment, but rather a diverse set of water quality conditions.

The reduction in benthic richness at Cathill was due to the station's continual exposure to the Sellersville Borough sewage treatment plant effluent (Section 2.2.2.3.1). A zone of recovery extended the remaining length of the creek.

The annual total number of taxa collected in the East Branch, all stations combined, decreased slightly from 1972 to 1974, but increased to a maximum in 1976 (Table 2.2-46). This variability reflected: (1) annual variation in the intensity of perturbations already discussed (i.e., intermittency and effluent degraded water quality), as well as short-term stresses such as spates at all stations, stormwater input at Sellersville, channelization at Branch in June 1974, etc; (2) decrease in sample size from 5 to 4 replicates in July 1973, in general more uncommon taxa are collected as 'n' increases; and (3) absence of sampling in winter 1974. The June 1972 flood had little effect on annual diversity.

Benthic diversity was greater in Perkiomen Creek than in the East Branch, and slightly greater above the confluence (Spring Mount, 68) than below it (Rahns, 63) as shown in Table 2.2-45. Flow at

Spring Mount was near torrential, substrate was mixed rubble and supported an epilithic algal community for much of the year. Flow at Rahns was more laminar, and the compacted sand-gravel substrate (overlain by a few large rocks) was susceptible to scouring during high-water periods.

2.2.2.2.6.23 Similarity Between Stations

Monthly computation of Morisita's index of overlap (Brower and Zar, p. 144, Ref 2.2-75) provided a single value denoting benthic community similarity between selected pairs of stations in terms of taxonomic composition and abundance; the higher the value (range 0-1) the more similar. Yearly means were determined by averaging all monthly values within the year. Similarity between adjacent sites in East Branch Perkiomen Creek, excluding Chironomidae, ranged from lows of 0.426 and 0.431 (4-year means) between Cathill and Moyer and Elephant and Branch, and respectively, to 0.675 between Moyer and WaWa (Table 2.2-45). Mean index values for the East Branch, all stations combined, were very similar in all years but 1976 (1972, 0.594; 1973, 0.583; 1974, 0.558; 1976, 0.367). Monthly variability was high. Similarity between the two Perkiomen Creek stations was higher (0.727) than that for any East Branch pair.

In addition to computing Morisita's index of overlap between adjacent stations, all East Branch sites were compared individually with Moyer station. The East Branch shows pronounced longitudinal differences in macrobenthos due primarily to intermittent flow in the headwaters and degraded water quality midpoint in the creek. Moyer is considered (on the basis of flow regime, substrate composition, faunal assemblage, and magnitude of stress as described in Section 2.2.2.3.1) to be the site that presently is most indicative of what more (in terms of length of stream) benthos may be like after diversion. East Branch pairings with Moyer gave the following 4-year mean values, in decreasing order; WaWa (0.675, most similar), Branch (0.598), Sellersville (0.493), Cathill (0.425), and Elephant (0.367, least similar). It is expected that similarity between stations will increase following diversion, as flow and water quality conditions become more similar throughout the creek.

Overlap values that included Chironomidae (not shown) were higher in all instances due to the abundance of this group at all sites. These values overestimated similarity in one sense, because the taxonomic composition of Chironomidae was known to differ, in some cases markedly, between stations.

2.2.2.2.6.3 Important Species

Within-year and between-year trends in standing crop largely reflected the population dynamics of dominant organisms. Dominant species (taxa in this case, since not all macroinvertebrates were identified by species) were defined as those organisms, collected in quantitative benthic samples, that comprised 2% or greater of the total number or biomass for the station and year under consideration. Because of their high relative and absolute abundance, they were largely responsible for biotic interactions within the community, and hence were considered important (see Section 2.2) to existing community structure, function, and stability. Dominant (important) taxa were selected for each station, as well as for all East Branch stations combined, because benthic communities differed along the creeks, and a gradational spatial response to diversion is anticipated.

Taxa meeting this criterion were: (1) numbers only - Caenis sp., Tricorythodes sp., Perlesta placida; and Leucotrichia pictipes, (2) biomass only - Erpobdella punctata, Cambarus bartoni, Orconectes limosus, Argia spp., Corydalus cornutus, and Tipula spp.; and (3) numbers and biomass - Dugesia spp.; Oligochaeta, Ephemerella spp., Baetis spp., Stenonema spp., Allocapnia spp., Corixidae, Psephenus herricki, Stenelmis spp., Chimarra spp., Cheumatopsyche spp., Hydropsyche spp., Simuliidae, Chironomidae, Physa acuta, and Sphaerium spp. These 26 taxa represented 19% of the total number (139) of taxa collected in quantitative benthic samples during the 4-year study period.

The temporal (Table 2.2-48) and spatial (for numbers, see Table 2.2-49 and for biomass table 2.2-50) distribution of these taxa during the 4-year study period are discussed in phylogenetic order below. General trophic status is also indicated.

2.2.2.2.6.3.1 Dugesia spp.

Two species of this flatworm were found in the creeks, D. dorotocephala and D. tigrina, with the former by far the more abundant. D. dorotocephala is eurythermic, tolerant of moderate organic pollution, and has an ecological preference for headwaters. D. tigrina is a eurythermic species occurring in the lower stretches of rivers. Both species are carnivorous and feed on living, dead, or crushed animal matter.

Dugesia (primarily D. dorotocephala) was present in the creeks in all months, but attained maximum densities in August through November. It was dominant at Branch, Sellersville, Moyer, and WaWa (the station of maximum numbers and biomass) and essentially absent at Cathill. D. tigrina was found in Perkiomen Creek and was dominant at Spring Mount.

2.2.2.2.6.3.2 Oligochaeta

Four families comprised the majority of numbers or biomass of benthic oligochaetes; Lumbriculidae, Naididae, Tubificidae, and Lumbricidae. The first three are strictly aquatic, whereas Lumbricidae is almost entirely terrestrial. Lumbricids were only found occasionally in samples from all stations, but their relatively large size made them important contributors to total worm biomass.

Lumbriculids were common at all stations except Elephant and Cathill, and their density appeared to be inversely correlated with tubificid density. Two types were encountered, one with simple setae (common) and one with bifid setae (rare). This family was more abundant in Perkiomen Creek than in the East Branch. They are intermediate in size between Lumbricidae and Tubificidae.

Naididae was found principally at Sellersville and to a lesser extent at Cathill. Species identified were Ophidonais serpentina, Nais communis, Pristina breviseta, and P. foreli. These worms were periodically abundant in benthic samples, but because of their small size (about 3 mm) contributed little to standing crop biomass.

Tubificids (sludge-worms) were found at all stations, but occurred in greatest abundance at Sellersville and Cathill. Species identified were Limnodrilus hoffmeisteri, L. claparedianus, Branchiura sowerbyi, Peloscolex ferox (Elephant station only), and Aulodrilus limnobius. Increased numbers of tubificids in the vicinity of organic effluents is well documented and can be attributed mainly to the adaptation of the respiratory physiology of the worms to very low oxygen concentrations, or even anaerobic conditions. Some tubificids (including L. hoffmeisteri) have high tolerance limits for lead and zinc in solution. Riffle is not the optimum habitat for either Tubificidae or Naididae, since both prefer fine sediments in which to burrow and feed.

In the creeks, oligochaetes were dominant at all sites but WaWa, and reached maximum densities at Sellersville. They were collected year-round and there were no obvious seasonal trends in abundance. Except for day-active Naididae, oligochaetes were not often collected in drift. As a group, oligochaetes are sediment ingestors deriving most if not all of their nutrition from bacteria.

2.2.2.2.6.3.3 Erpobdella punctata

This is one of the most commonly encountered and widely distributed species of freshwater leeches in North America. It

is both predator (primarily oligochaetes and insect larvae) and scavenger. This leech is associated with polluted conditions. It was found in low numbers at all stations and was dominant in terms of biomass only at Sellersville. Individuals were present year-round, with the highest numbers present in summer and fall.

2.2.2.2.6.3.4 Cambarus bartoni and Orconectes limosus

Crayfish are principally omnivorous scavengers, seldom predaceous. They were most numerous and most often taken at Elephant station, and were taken sporadically and in low numbers at other stations. Only one, two and three individuals were collected at Cathill, WaWa, and Rahns stations, respectively, in the study period. C. bartoni was the abundant species in the upper 10 km of East Branch Perkiomen Creek, whereas O. limosus was essentially the only species inhabiting riffle habitat in the lower 26 km and in Perkiomen Creek. Crayfish were not abundant numerically but were often important contributors to biomass, particularly at upper East Branch stations.

Discontinuous flow was less severe in 1973 and 1974, and this may account for the higher crayfish densities in those years at Elephant station. The sampling method provided reliable estimates of crayfish density in riffle habitat; crayfish prefer to secrete themselves during the day under stones, and stones of appliciable size were routinely included within the sampling unit.

2.2.2.2.6.7.5 Caenis spp.

No key to the immatures of this mayfly genus exists, but only one species appeared to be present. Caenis appears to be more tolerant of low dissolved-oxygen concentration than any other mayfly. Like Tricorythodes, its preferred habitat is in those areas of streams that have greatly reduced current or no current, so their abundance in the creeks is probably greatest in non-riffle habitats. Feeding habits of nymphs are like those of Tricorythodes. Caenis was found at all stations, but was dominant only at Branch. Maximum densities occurred in September through November.

2.2.2.2.6.3.6 Tricorythodes sp.

No key to the immatures of this mayfly genus exists, but only one species appeared to be present. Nymphs are fairly common among gravel in permanent streams. Nymphs are detritivore-herbivore (active scrapers). Tricorythodes is a night-active drifter. It was rarely collected on the East Branch, but was numerous on

Perkiomen Creek, particularly at Rahns. It was generally found only in June through October, and was most abundant in September.

2.2.2.2.6.3.7 Ephemerella spp.

Three species of this mayfly were found in the creeks but only E. deficiens was common. It is associated with vegetation in rocky, swift, unpolluted streams. Nymphs are herbivorous. Rarely taken on the East Branch, Ephemerella was dominant at both Perkiomen Creek stations. It was present in all months, but attained the highest densities in May, and July through December.

2.2.2.2.6.3.8 Baetis spp.

At least five species of Baetis mayflies were found in the creeks. The only numerous species keyed to B. intercalaris in Burkes (Ref 2.2-22). Baetis is common in shallow running water under stones, or among debris or emergent vegetation along the banks of brooks or creeks. With few exceptions nymphs are herbivores or scavengers, living on vegetable detritus and minute aquatic organisms, principally diatoms. Baetis spp. were dominant at all stations except Elephant and Cathill (essentially absent), and Moyer. Maximum densities occurred in May through September. Baetis spp. were commonly collected in drift samples, and were night-active.

2.2.2.2.6.3.9 Stenonema spp.

Eight species of Stenonema mayflies were found, three of which were commony collected; Stenonema (=Stenacron) interpunctatum at Elephant, and S. nepotellum and S. rubrum on Perkiomen Creek. The S. (=Stenacron) interpunctatum complex is at present only superficially known and contains several subspecies; ours appeared to be S. (=Stenacron) interpunctatum heterotarsale. All three species are considered facultative and herbivorous. Maximum densities occurred in the fall. Stenonema was common in drift, and night-active.

2.2.2.2.6.3.10 Argia spp.

No regional key to species based upon the immature stage is available, but apparently at least two species of this damselfly were present, one of which was rare. The common species keyed to A. apicalis in Walker (Ref 2.2-76). The carnivorous nymphs occur commonly in streams where they cling to rocks and debris in the current. Argia was collected at all stations, and was dominant at Branch (in both numbers and biomass). Maximum densities occurred in the fall.

2.2.2.2.6.3.11 Allocapnia spp.

Several species of Allocapnia were founded in the creeks, but the common one was A. vivipara, found in greatest numbers at Elephant. It is a small, dark, brachypterous stonefly that emerges in mid-winter (hence the common name of winter stoneflies). It can be abundant in temporary streams, and feeds (chewing) on detritus and algae and is most abundant in allochthonous debris. Allocapnia was found in the upper East Branch and in Perkiomen Creek. Greatest densities occurred at Elephant in November through February. Nymphs were uncommon from April through October.

2.2.2.2.6.3.12 Perlesta placida

This stonefly has a wide tolerance for different types of streams, including intermittent ones. It is also one of the few stoneflies that emerges in mid and late summer. It is strictly carnivorous (chewing) and feeds principally on Chironomidae, Ephemeroptera, and other insects. P. placida was found in the upper East Branch and in Perkiomen Creek. Greatest densities were at Elephant in April through June. Nymphs were essentially absent the rest of the year.

2.2.2.2.6.3.13 Corixidae

The preferred lotic habitat of corixids, or water boatmen, is in pools and quiet regions of streams. They were collected in high numbers in quantitative samples only at Elephant during extremely low flow periods, when the riffle habitat was temporarily replaced by standing water. All instars of Sigara modesta were often abundant in these pools, coexisting with small numbers of Trichocorixa calva, a species with which it is commonly found (Bobb, Ref 2.2-74). As herbivores, corixids are unique among aquatic Hemiptera.

2.2.2.2.6.3.14 Corydalus cornutus

C. cornutus (the adult is commonly called the dobsonfly, the larva the hellgrammite) is associated with larger components of substrate in riffle-run areas of well-aerated streams. The larva is a large (to 80 mm) and active macropredator that feeds mainly on Simuliidae, Hydropsychidae, and Chironomidae. It was rare in East Branch Perkiomen Creek, but dominant (in biomass) in Perkiomen Creek. Numerical densities were similar, and low throughout the year.

2.2.2.2.6.3.15 Psephenus herricki

Larvae of this beetle, known as 'water pennies' because of their flat and highly streamlined form, are aquatic and actively feed on algae and microcrustaceans. They exhibit a very strong positive thigmotaxis and prefer a riffle habitat. They were collected at all stations in the study period, but were most numerous in the lower East Branch and at Rahns (station of maximum density) in Perkiomen Creek. Maximum larval densities occurred in October, and December and adults were collected incidentally in June through September.

2.2.2.2.6.3.16 Stenelmis spp.

Three species of this beetle were found in the creeks, but only one was abundant, probably S. crenata. Stenelmis is common in the gravel substrate of streams, and both larvae and adults are aquatic herbivores. Adults, unlike larvae, showed a propensity to drift and exhibited a nocturnal behavioral periodicity. S. crenata has been recorded as tolerant of chlorides but sensitive to sewage and phosphate wastes.

Stenelmis was abundant in the creeks and was dominant at all but the Cathill and Spring Mount stations. Larvae were present in high densities April through November. Adults, like larvae, were collected in year-round but were most numerous in June through November.

2.2.2.2.6.3.17 Chimarra spp.

Two species of this caddisfly occurred in the creeks; C. aterrima, which was rare, and C. obscura, which was abundant. C. obscura is the most widely distributed of the genus. It inhabits flowing water and constructs fixed retreats on the undersides of rocks in riffles that consist of elongate, saclike capture nets in which the larvae dwell and trap drifting food particles, generally smaller-sized particles than co-existing Hydropsychidae (e.g., Cheumatopsyche and Hydropsyche).

Chimarra was abundant in the creeks and was dominant at most stations. It was uncommon at Elephant and Cathill. Larvae were most numerous in late summer and fall; pupae were collected from April through December, and peak numbers occurred in July through September. At least some instars drifted and exhibited a nocturnal periodicity.

2.2.2.2.6.3.18 Cheumatopsyche spp. and Hydropsyche spp.

These two genera of closely related net-building caddisflies (family Hydropsychidae) are perhaps the most abundant and widespread caddisfly genera. The two genera are easily separable

except for very early instars. Each genus in the creeks contained multiple species. No key to larval Cheumatopsyche is available, but adults of at least three species (C. analis, C. sordida, C. campyla) were taken in a light trap collection at Spring Mount station.

Seven species of Hydropsyche occurred in the creeks, based largely upon the key to larvae by Ross (Ref 2.2-39) and determinations by the Applicant's consultant which were based mainly upon larval head capsule color patterns. Common species were A, C, and E. Species A larvae were the largest, and were found principally in the lower East Branch and Perkiomen Creek. Species C was numerous in both creeks. Species E was restricted primarily to Sellersville and Cathill.

The larvae are omnivorous and can be found in almost every stream that is not severely polluted. They build loose stone retreats and capture nets where current speed is suitable for efficient food (seston) gathering. Both genera were commonly collected in drift samples, and exhibited an increase in density during darkness.

Although closely-related, the two genera exhibit differences in tolerance to organic enrichment and intermittent flow as evidenced by their contrasting spatial patterns in East Branch Perkiomen Creek. Cheumatopsyche was dominant at all stations in relatively high numbers, whereas Hydropsyche was abundant at most stations, but essentially absent from Elephant (discontinuous flow) and Sellersville and Cathill (degraded water quality). In East Branch Perkiomen Creek, Hydropsyche outnumbered Cheumatopsyche only at WaWa. In Perkiomen Creek, the annual mean standing crop of Cheumatopsyche was roughly twice that of Hydropsyche. Cheumatopsyche in this system clearly had the competitive advantage. Larvae of both genera were most abundant in summer and fall. Pupae were present from April through October.

2.2.2.6.3.19 Leucotrichia pictipes

L. pictipes is an easily recognizable, fast-water micro-caddisfly intolerant of organic pollution. Its case adheres tightly to the upper surface of stones, and for this reason its numbers are certainly underestimated. It actively feeds on surrounding algae and associated detritus. It was essentially absent from the upper and middle East Branch Perkiomen Creek, dominant in the lower East Branch (Moyer and WaWa), and common but not dominant in Perkiomen Creek. Highest larval numbers occurred in late summer and fall.

2.2.2.2.6.3.20 Tipula spp.

This is the largest cranefly genus and several species were collected in the creeks. No key to the immatures is available. The only commonly encountered species was quite large (up to 70 mm extended), and on this basis was provisionally called T. abdominalis. It was collected most frequently in the upper East Branch. The preferred habitat is submerged vegetative matter in riffles, runs, or pools. They are detritivorous. Numerical densities were low and greatest in late fall and winter.

2.2.2.2.6.3.21 Simuliidae

Two genera of blackfly larva were identified in the creeks, Prosimulium (rare) and Simulium (abundant). It is difficult to key larval Simulium to species, but on the basis of pupae S. vittatum is the most common species in the creeks, and is also one of the most common species in the U.S. Blackfly larvae are found in the shallows of streams where current is swift, their cephalic fans screening passing water for food particles. Some species of Simulium are very tolerant of organic pollution and can become abundant in partially polluted streams.

Simuliidae was abundant in the creeks and was dominant at all stations. Larval standing crops were high throughout the year with peaks in May, September, and November. Pupae, also present in all months, were most numerous in May and June. Larvae were often abundant in drift, and exhibited a nocturnal periodicity.

2.2.2.2.6.3.22 Chironomidae

The true midges were the most abundant and diverse group of invertebrates in the creeks, comprising at least 37 genera (Table 2.2-44). Midge larvae and pupae were abundant at all stations throughout the 4-year study period. Larvae often represented the highest percentage of total aquatic drift, but did not exhibit any periodicity at the family level.

Based upon intrafamily data collected in 1974, four midge taxa were dominant in the creeks; Cricotopus spp. (subfamily Orthocladiinae), Polypedilum spp. and Tanytarsini (subfamily Chironominae), and Pentaneurini (subfamily Tanypodinae). Larvae of the tribe Pentaneurini do not build cases and are predaceous; other insect larvae form a large portion of their diet. They were numerous in the upper East Branch, peaked in abundance at Cathill, and were much reduced in number farther downstream and in Perkiomen Creek.

Larvae of Tanytarsini (Micropsectra and Tanytarsus) were found at all stations in varying numbers, but were present in maximum densities at Spring Mount where near torrential flow and rubble substrate were evidently conducive to the support of large

populations. Larvae of stream species characteristically construct a fixed case, and net that strains food particles from the current.

Only two species of Polypedilum were found in the creeks, P. fallax and P. illinoense. P. fallax was rare. The genus was found at all stations, but maximum numbers occurred in the lower East Branch in summer. Larvae construct flimsy tubes, and food is derived from seston caught on temporary nets extending across the lumen of the tube or from actively grazing sediment. Other important taxa in the tribe Chironomini were Chironomus spp., Dicrotendipes sp, Microtendipes tarsalis, and Stictochironomus sp Chironomini was not abundant in Perkiomen Creek.

Cricotopus spp. dominated the chironomid community at all stations but Elephant, and were most abundant at Spring Mount. Several species of this genus were recognized, but only 2 could be identified with any degree of certainty, C. bicinctus and C. sp. 1 (Roback, Ref 2.2-38). Roback (Ref 2.2-38) found C. bicinctus to be the most common Cricotopus species in southeastern Pennsylvania. It has been collected from intermittent streams and is particularly resistent to organic enrichment, low dissolved oxygen concentration, and at least some heavy metals.

Most Orthocladiinae are either algal or algal-detrital feeders, and larvae probably seek out and ingest their food directly from the substrate on which they live. In general, the subfamily is more abundant in colder months. Cardiocladius obscurus was present in relatively high numbers at WaWa, Spring Mount, and Rahns. From field observation, Orthocladius rivulorum was at times present in large numbers at Spring Mount inhabiting flexible tubes attached at one end to substrate surfaces.

In 1974, chironomid diversity was highest at Elephant probably because this station displayed the most varied flow conditions that ranged from intermittent (static) to flood. The fewest taxa were collected at WaWa.

2.2.2.2.6.3.23 Physa acuta

Physa snails collected from all stations on one date in 1977 were identified as P. acuta by William J. Clench (personal comment). The Applicant's consultant has often observed this snail out of water on rocks near the air-water interface, although it probably cannot tolerate drying. Like most Physa species it is tolerant of organic enrichment, and by using atmospheric oxygen for respiration can exist in anaerobic waters for extended periods.

Physa is a scavenger and essentially omnivorous. The coating of living algae, which covers most submerged surfaces, forms its

chief food, but dead plant and animal material is frequently ingested.

P. acuta was collected from all stations in the study period, but was most numerous in the middle East Branch where, on some occasions, it was extremely abundant on all types of substrate. It was present in all months, but reached maximum densities in late summer and fall.

2.2.2.2.6.3.24 Sphaerium spp.

At least two species of Sphaerium (fingernail clams) were found in the creeks, S. striatinum and S. rhomboideum. The former was common at Sellersville; the latter was abundant at WaWa. The family is considered to be tolerant of polluted conditions. Sphaerium was collected year-round and was present in greatest density (due to high numbers of young) in late summer and fall. Sphaerium spp. are sessile and utilize organic seston, filtered from the water brought in through the incurrent siphon, as a food source.

2.2.2.2.6.4 Drift

Macroinvertebrate drift refers to the downstream transport of benthic macroinvertebrates in freshwater streams. Stream drift is utilized as a food source by many fishes, and may play an important role in the recolonization of depopulated areas and redistribution of benthos.

A pilot 24-hour drift study was conducted on Perkiomen Creek at Graterford in August 1972. Subsequent studies were conducted concurrently in the East Branch and Perkiomen creeks once a month during April through October 1973 and April through September 1974 (Tables 2.2-40 and 41 and 2.2-70 and 71). Study periods corresponded to the period when flow augmentation may be required during plant operation. Concurrent sampling allowed a comparative assessment of drift between creeks.

Aquatic drift densities in both creeks were variable over the study period, and ranged from 471 to 11,012 animals/1000 m^3 in East Branch Perkiomen Creek and 321 to 11,492/1200 m^3 in Perkiomen Creek (Table 2.2-51). Although mean monthly numerical drift densities averaged 48% greater in Perkiomen Creek in the 13-month study period, they were often similar to those recorded in the East Branch. Biomass (mg dry wt/1000m^3) ranged from 22 to 453 and from 43 to 629 in East Branch and Perkiomen Creek, respectively. Monthly biomass densities were often similar between creeks, but averaged 14% greater in Perkiomen Creek. Mean monthly drift densities, numbers and biomass, were significantly (P is less than, or equal to 0.10) correlated

(Spearman's rank correlation coefficient) between streams. Total drift per unit of time was consistently greater in Perkiomen Creek due to greater velocity (2.0-3.7 times greater in Perkiomen Creek) and discharge.

Drift densities varied, sometimes markedly, from month to month in the same creek, and appeared to fluctuate in response to short-term phenomena which essentially precluded extrapolation of results to the entire month or even several days.

In all, 61 taxa were collected in drift samples from East Branch Perkiomen Creek and 92 from Perkiomen Creek in the study period. When drift studies were combined by year within creek it was evident that chironomid larvae and pupae dominated drift numerically in both creeks (Table 2.2-51), followed by Baetis, Hydropsyche, and Cheumatopsyche. These organisms were also relatively abundant in most months. The Naididae was dominant in Perkiomen Creek, but was taken in high numbers only in May 1974.

More taxa were collected in Perkiomen Creek samples in all months. This reflected the greater benthic richness of Perkiomen Creek, and the higher velocities that resulted in the chance capture of more organisms uncommon in the drift over an equal sampling period.

The aquatic component generally accounted for the greatest percentage of total drift; emergent drifters were next in numbers. Input from strictly terrestrial sources was the smallest, although certain insects were occasionally abundant.

Based upon monthly estimates in 1973 the proportion of benthos in the drift ranged from 0.0009 to 0.0099% in the East Branch and from 0.0020 to 0.1316% in Perkiomen Creek. Higher percentages would be expected at certain times in the life histories of individual populations. For example, a high proportion of pupal Cricotopus (midge) may be in the water column prior to eclosion.

Mean monthly densities of aquatic drifters per 1000 m^3 in Perkiomen Creek were compared with benthic densities per m^2 at Rahns (790 m downstream) in corresponding months. Although benthos, like drift, was dominated by Diptera and Trichoptera, there was no clear consistent proportional relationship between benthic standing crop and drift density. Note that benthic values were based upon riffle habitats, whereas drift organisms originated primarily from run habitats.

Sampling every 2 hours provided data on diel periodicity of aquatic drift. Total densities varied markedly, but somewhat predictably over the 24-hour period. Maximum densities (numbers and biomass) in both creeks occurred after sunset since most drifters exhibited a nocturnal behavioral periodicity (Table 2.2-52), a phenomenon apparently unaffected by dissolved

oxygen concentration, water temperature, or velocity as measured in this study. This relationship between invertebrate drift and changes in light intensity has been well-documented (Waters, Ref 2.2-50).

Dominant drift organisms (Table 2.2-51) that did not display behavioral nocturnal drift were Chironomidae (no apparent periodicity) and Naididae (day-active). Chironomids as a group rarely exhibit a diel periodicity. This is not surprising since these insects are commonly diverse in lotic systems, and their treatment at the family level may obscure any discrete but overlapping periodicities that may otherwise be evident at the genus or species level. Chironomidae was the most diverse family in the study area, comprising at least 37 genera. The number of taxa that drifted was greatest during darkness (Table 2.2-52).

2.2.2.2.7 Fish

The fish community of Perkiomen Creek was typical of those found in other lotic systems of similar size in southeastern Pennsylvania (Mihursky, Ref 2.2-77). In general, the fish fauna ranged from minnows, important as both primary consumers and forage for top-level carnivores, to the pike and sunfish families that are sociologically important for recreation, and ecologically significant as key predators. With few exceptions the species were indigenous and reproduced locally.

Historically, man has influenced the fish community of Perkiomen Creek by altering water quality, changing morphology and flow patterns with dams and reservoirs, and introducing or maintaining species by stocking. Operation of LGS may affect the existing fish community due to diversion and water withdrawal (entrainment and impingement). In order to evaluate these impacts, the fish community has been intensively sampled, primarily by seine and electrofishing, for 7 years (Tables 2.2-40 and 41).

2.2.2.2.7.1 Species Inventory

A list of species collected from the creek from 1970 through 1977 is presented in Table 2.2-53. Qualitative abundance (defined in Section 2.2.2.1.7) was established by subjective comparison of recent catch statistics. In all, 8 families, including 40 species, were inventoried as well as hybrids of Esocidae, Cyprinidae, and within-genus Lepomis. This was a relatively large number of species considering the limited area sampled and the historic and geologic factors that have reduced the number of species in mid-Atlantic streams. None of the species in Perkiomen Creek is considered commercially valuable,

or rare, or endangered by either Federal or state regulatory agencies. The American eel is the only true migratory species. The brook trout cannot maintain itself in Perkiomen Creek due to high water temperature, but has often been stocked in downstream tributaries by the Pennsylvania Fish Commission. Muskellunge was also stocked, although the capture of one young individual in 1977 indicated that limited natural reproduction had occurred.

2.2.2.2.7.2 Community Description

2.2.2.2.7.2.1 Larval Fish

Larval fish drift in the area of the proposed Graterford intake (P14390) on Perkiomen Creek was investigated from 1973 through 1975. Larvae inhabiting the shoreline were studied using traps in 1975. Relative abundance of drifting larvae was similar between years (Table 2.2-54). Carp and minnows were first and second in abundance, respectively, while Lepomis spp. was usually third, and white sucker fourth. With the exception of carp, relative abundance of shoreline larvae was similar to that of drifting larvae; minnows were the most abundant, followed by white sucker and Lepomis spp. (Table 2.2-55).

The spawning seasons extend primarily from April through August. Larval drift densities were low through April, peaked in late May or early June, peaked slightly again in early July or August, and decreased through September (Figure 2.2-16). These variations were caused by species-specific spawning periods (Table 2.2-56). The perch family and white sucker spawned primarily in May. Two peak spawnings (early and mid-summer) occurred for both Notropis spp. and Lepomis spp. Spawning times varied somewhat between years due to environmental conditions.

Diel fluctuation in drift occurred regularly in Perkiomen Creek. Most larvae were collected between sunset and sunrise, and peak densities usually occurred between 2200 and 0400 hours.

A horizontal gradient in the abundance of drifting larvae was present in 1974 and 1975, with the highest densities usually occurring near shore. The horizontal distribution of individual taxa is discussed in following sections (Table 2.2-57). Total drift density did not vary between channels in 1975, although differences did occur for some taxa (Table 2.2-58).

2.2.2.2.7.2.2 Minnows and Young

In 1975 and 1976, 29 species and Lepomis hybrids were collected by seine (Table 2.2-59). Most were minnows and young of larger species. The most abundant species (1975 and 1976 combined) were spotfin shiner (68% of total catch), spottail shiner (10%),

satinfin shiner (4%), comely shiner (3%), and white sucker (3%). Each of the remaining species comprised less than 2% of the total catch. The relative abundance of dominant species varied between 1975 and 1976. Minnows and young were generally more abundant in 1976 than in 1975. Within-year catches were highest in summer and fall months, reflecting the appearance of young-of-year fish (Table 2.2-61).

Redbreast sunfish and green sunfish dominated the electrofishing catch in 1975 and 1976; the relative abundance of young sunfish was similar between the years (Table 2.2-60).

The spotfin shiner was the most numerous species in each site in both years (Table 2.2-59). Relative abundances of other dominant species (spottail shiner, satinfin shiner, comely shiner, white sucker) varied little between sites. Total mean catch per net sweep was similar between sites. Relative abundance of young sunfish was significantly correlated between sites in both years.

The number of species captured per seine collection was used as an index of species diversity. Diversity was significantly greater in 1976 than in 1975, and significantly greater in summer and fall than in winter and spring due to the appearance of young-of-year fish during the former period (Table 2.2-61). Spatial variability in diversity was due primarily to a signficantly greater number of species at P13580.

2.2.2.2.7.2.3 Adults

In all, 21 species of large fish were collected by electrofishing in 1974, 1975, and 1976 (Table 2.2-62). Esocid, Cyprinid, and Lepomis hybrids were also captured. Large fish populations were relatively stable in Perkiomen Creek, as the total catch was similar at the same site between years, and catch of the 16 most abundant species was significantly correlated between years and between sites. The redbreast sunfish was the dominant species at all sites in all years, comprising 49% of the total catch. White sucker (12%) and smallmouth bass (11%) were the next most abundant species, followed by pumpkinseed, carp, green sunfish, and rock bass (each about 5% of total).

2.2.2.2.7.3 Important Species

General criteria governing the designation of important species were given in Section 2.2. Important fishes selected for Perkiomen Creek, together with applicable criteria, are presented in Table 2.2-63. Generally, this diverse group includes the more sensitive fish of direct use to man, and species important to the structure and function of the ecosystem. Those chosen are also

likely to be affected by the operation of the Graterford intake. The local biology of important species is described below.

2.2.2.2.7.2.3.1 American Shad

The American shad (Alosa sapidissima) was not found in Perkiomen Creek, and its introduction is dependent on the results of the Pennsylvania Fish Commission's program to provide fish passageways at dams downstream of LGS, on the Schuylkill River.

2.2.2.2.7.2.3.2 Muskellunge

Young muskellunge (Esox masquinongy) and its sterile hybrid with the northern pike (Esox lucius) were uncommon in Perkiomen Creek. Only three individuals were taken in three annual electrofishing surveys at four sites (Table 2.2-62). Monthly electrofishing yielded four in 1977. No muskellunge young were taken by seine in monthly sampling in 1975 and 1976; however, 1 small (30 mm FL) individual captured in May 1977 indicated that limited natural reproduction had occurred in the creek. Adults were also uncommon. One immature adult was captured in 1976, and 1 large (330 mm FL) individual was captured on 3 separate occasions in 1977. Muskellunge populations have apparently been primarily maintained by Pennsylvania Fish Commission stocking.

2.2.2.2.7.2.3.3 Carp

Spawning of carp (Cyprinus carpio) in Perkiomen Creek took place in May of 1974 and 1975 at temperatures of 18 to 24°C. The abundance of drifting carp larvae varied somewhat between 1973, 1974, and 1975, although it was always the most abundant species (Table 2.2-54). Mean drift densities were 0.1126 individuals/m^3 (50% of total drift) in 1973, 0.4328 individuals/m^3 (80%) in 1974, and 0.1269 individuals/m^3 (46%) in 1975. The carp ranked fifth in abundance of trap catches of shoreline larvae (Table 2.2-55). Maximum drift densities shifted from July in 1973 to May in 1974 and 1975 (Table 2.2-56 and Figure 2.2-17). Carp frequently drifted during the day in May, but were always more numerous at night. Carp were generally more abundant in drift near midstream than near shore (Table 2.2-57). Post-larvae and juveniles inhabited sheltered areas of quiet water.

Numerically, carp comprised a relatively small percentage of the electrofishing catch in all years (1974-1976) at all sites (Table 2.2-62). Adult carp ranged from 1% of total catch at P14160 in 1975 to 9% at P20000 in 1976. Differences in relative abundance were slight at the same site between years. Carp were more abundant upstream of the intake site at P20000 (131 fish/ha)

and P14390 (67 fish/ha), due primarily to the abundance of their preferred habitats, (Table 2.2-65).

Carp were an important contributor to biomass at all sites, and dominated at P14390 in 1974 and 1976. They ranked second at other sites where their abundance was estimated. Biomass estimates varied both temporally and spatially in the same manner as numerical estimates. The longest carp collected in Perkiomen Creek measured 680 mm FL. A recreational fishery for carp exists on Perkiomen Creek because of the fish's size and fighting ability.

2.2.2.2.7.2.3.4 Comely Shiner

In late July 1975 and 1976, young comely shiner (Notropis amoenus) appeared in seine catches from quiet, sheltered backwater areas downstream of runs and riffles. They ranked fourth in overall abundance in Perkiomen Creek seine catches (Table 2.2-59), and their temporal and spatial variations were not significant. Total mean catch per net sweep increased slightly from 6.2 in 1975 to 6.7 in 1976.

The longest comely shiner collected was 85 mm FL. The length-weight relationship was significantly different between 1975 and 1976, and between sites. Fish were heavier in 1975 than in 1976 (Table 2.2-67). Fish gained proportionately more weight per unit increase in length the farther upstream they were found.

2.2.2.2.7.2.3.5 Spottail Shiner

Spawning of this species (Notropis hudsonius) in Perkiomen Creek occurred from May through June in 1974 and 1975. Larvae were identified in drift. The spottail shiner ranked second in overall abundance in seine catches (Table 2.2-59). Adults were most often collected in slow-moving water over gravel shoals. Total mean catch per net sweep was significantly greater in 1976 (37.6) than in 1975 (2.9), and catches were highest in early summer when young appeared (Table 2.2-61). Distribution of individuals was more clumped in winter, but spatial variation of catch between sites was not significant.

The maximum length of fish caught was 97 mm FL. The spottail shiner length-weight relationship was significantly different between years and among sites. Increase in weight with length was greater in 1975 than in 1976 (Table 2.2-65). Faster growth in 1975 may have been due to reduced competition within the smaller population.

2.2.2.2.7.2.3.6 Spotfin Shiner

Refer to Section 2.2.2.1.7 for information on feeding habits of spotfin shiner (Notropis spilopterus). Based upon larval collections, spotfin shiner spawned in mid-August of 1974, and in July through August of 1975, at temperatures between 26 and 29° C. It was the dominant species taken by seine and comprised 67% of the combined total catch for 1975 and 1976 (Table 2.2-59). It appeared to have stable populations in Perkiomen Creek with no significant variation between years or sites. The total mean catch of spotfin shiner per net sweep was, however, significantly higher in late summer and fall than at other times (Table 2.2-61). Length-weight relationships were similar between years but significantly different between sites (Table 2.2-67).

2.2.2.2.7.2.3.7 White Sucker

Refer to Section 2.2.2.1.7 for information on feeding habits, diseases and the human importance of the white sucker. (Catostomus commersoni). White suckers spawned early, since drifting larvae were collected only in May (Table 2.2-56). Larvae frequently drifted during the day, but were always more numerous at night. Densities of drifting larvae were similar between 1973 and 1975, but were somewhat lower in 1974 (Table 2.2-54). The white sucker usually ranked fourth in abundance, and ranged from 1% of catch in 1974 to 7% in 1975. It ranked second in abundance (8%) in shoreline trap catches in 1975 (Table 2.2-55). In 1975, drifting larvae at P14390 were more abundant in the east, rather than the west, channel (Table 2.2-58).

Seine catch of young white suckers increased from 0.1 per unit effort in 1975 to 12.5 in 1976 (Table 2.2-59). Largest catches occurred at the extreme upstream and downstream seine sites in 1976.

The white sucker was the second most abundant large fish in Perkiomen Creek (Table 2.2-62). Differences in abundance between years was variable depending on the site. Estimates at P14390 were not statistically different between 1974 and 1976, but estimates were higher in 1976 than in 1974 at P14020 and P14160 (Table 2.2-65). Spatial variation was also inconsistent. All three sites in 1974 had similar estimates of abundance. In 1976, abundance was less at P14390 and P14020 (139 and 258 fish/ha, respectively) than at P20000 and P14160 (314 and 334 fish/ha).

The white sucker was the most important contributor to biomass at all sites except P14390, where it was exceeded by carp. Spatial and temporal trends were similar for biomass and number estimates. Most growth occurred in the first year of life (Table 2.2-68). White suckers at P14020 were significantly

smaller at age II than individuals at other sites. No general trend in growth patterns was evident for the length of white suckers studied in the area of Perkiomen Creek. A significant difference in length-weight regression coefficients existed between four sites in 1976. Fish gained proportionately more weight per unit increase in length the further downstream they were found (Table 2.2-69).

2.2.2.2.7.2.3.8 Redbreast Sunfish

Refer to Section 2.2.2.1.7 for information on food habits and diseases of the redbreast sunfish (Lepomis auritus). Larvae grouped as Lepomis spp. were usually third in overall drift abundance (Table 2.2-54). The majority were probably redbreast sunfish because this species is the dominant adult in Perkiomen Creek, and most larval sunfish collected in 1975 were identified as belonging to this species. Lepomis spp. comprised a consistent percentage of drift catch from 1973 to 1975 (4-8%). Composition of trap samples of shoreline larvae was similar (Table 2.2-55). Peak drift densities of Lepomis occurred in July 1973, mid-June 1974, and early July 1975 (Table 2.2-56 Figure 2.2-17). Larval sunfish were generally most abundant in samples taken closer to shore in 1975 (Table 2.2-57).

Redbreast sunfish young ranked eighth in overall abundance in the seine catch. Annual variation in abundance was not great; mean catch per net sweep increased in numbers from 1.6 (1% of total catch) in 1975 to 3.1 (1% of total catch) in 1976 (Table 2.2-59). Electrofishing estimates of redbreast sunfish abundance exhibited a similar trend (Table 2.2-64). Spatial variation in abundance between the six seine sites was slight and usually ranged between 1 and 2%. Electrofishing estimates varied from 24 fish per 20 m of shoreline at P14225 to 75 fish per 20 m of shoreline at P14690 in 1976.

The redbreast sunfish was consistently the most abundant large fish in Perkiomen Creek (Table 2.2-62). It ranged from 36% of total catch at P20000 to 61% at P14160 in 1976. Annual variation for the total population was slight. Although estimates of age I were significantly lower in 1976 compared to 1974 at most sites, estimates of older age groups were always similar (Table 2.2-66). Estimates by age group revealed that 1975 was a relatively weak year-class compared to 1973. Spatial variation in the number of fish per hectare was great (Table 2.2-65). Site P14160 had the greatest density of redbreast sunfish in both years (1622/ha in 1974, 1397/ha in 1976) followed by P14020 (897/ha in 1974, 511/ha in 1976), P20000 (415/ha in 1976), and P14390 (437/ha in 1974, 338/ha in 1976).

Maximum age in 1973 was V (Table 2.2-68). Greatest growth in length occurred in the second year. In 1976, temporal and

spatial variations in length at annulus were evident. Fish were generally smaller at each annulus at P20000, larger at P14390, and approximately equal at P14020 and P14160.

2.2.2.2.7.2.3.9 Smallmouth Bass

Smallmouth bass (Micropterus dolomieui) larvae (unlike juveniles) rarely occurred in Perkiomen Creek drift. Young bass were relatively low in abundance (1% of total seine catch), although they comprised the second most abundant member of the sunfish family (Table 2.2-59). Abundance varied annually, increasing in numbers from 0.4 fish per net sweep in 1975 (<1% of total catch) to 3.8 (1%) in 1976. This species was more abundant at P14320, P16500, and P19775 where it accounted for roughly 2% of the total catch. At other sites it averaged 1% of the total catch.

The smallmouth bass was the third most abundant large fish (11% of total) based upon 3 years of electrofishing in Perkiomen Creek (Table 2.2-62). Relative abundance remained constant within site between years. Population estimates were similar between 1975 and 1976 at P14160, but different between 1974 and 1976 at P14390 (Table 2.2-65). Estimates of abundance were larger at downstream sites. In 1976, site P14160 contained 163 fish per ha compared to 84 fish per ha at P14390.

Smallmouth bass ranked fourth in biomass at sites where abundance of all important species could be estimated. Their biomass was greatest at sites where numerical abundance was greatest. Bass appeared to weigh less in 1975 than 1976, due to the smaller size structure of the population. Individuals ranged up to 469 mm FL. An age and growth study in 1973 revealed that the oldest specimen was age III (Table 2.2-68). Most growth (39% of total) occurred in the first year of life. The 1970 year-class exhibited the highest growth rate. Significant spatial variation occurred for fish length at each annulus. Age structure indicated dominant age-groups I and II and a weak age-group III. Smallmouth bass was actively sought by fishermen in Perkiomen Creek.

2.2.2.2.7.2.3.10 Shield Darter

Peak spawning of shield darters (Percina peltata) occurred in May (Table 2.2-55). Larval catches were consistently low in drift and trap samples (Tables 2.2-54 and 55). Number per m^3 ranged from 0.2% of total in 1974 to 1.0% in 1973 and 1975. Shield darters drifted during the day, but were more numerous at night. Spatial distribution across the stream was fairly consistent in 1975 (Table 2.2-57). Shield darters comprised <1% of the total catch in 1975 and 1976 (Table 2.2-59). Total mean catch per net sweep showed little temporal or spatial variation.

2.2.2.2.8 Trophic Relationships

Refer to Section 2.2.2.1.8.

2.2.2.3 East Branch Perkiomen Creek

East Branch Perkiomen Creek is a warm water stream that drains 158 km^2 of the Piedmont physiographic province in southeastern Pennsylvania. It flows southwest approximately 39 km from its source in Bedminster Township to its confluence with Perkiomen Creek just below Schwenksville, Pennsylvania (Figure 2.2-15). The creek has a low gradient (1.9 m/km) and consists of riffle and run habitats with few natural pools. Several small man-made impoundments are located in the lower half. The stream supports diverse and productive flora and fauna.

Because the entire creek will be used for diversion, the East Branch Perkiomen Creek study area includes the creek from just above Elephant Road bridge downstream to the confluence with Perkiomen Creek. For a further description of this area, refer to Section 6.1. Sample stations are designated by common names, and by the letter 'E' followed by a number that indicates the distance in meters from the mouth of the creek. Where stations include several meters of stream, site numbers designate the downstream end of the station.

The biota of East Branch Perkiomen Creek was extensively stufied by the Applicant's consultant from 1970 through 1978. A sampling history by program is given in Tables 2.2-70 and 71.

2.2.2.3.1 Water Quality and Environmental Stress

East Branch Perkiomen Creek is a major tributary to Perkiomen Creek. Much of the watershed is used for agriculture, but land is increasingly being developed for residential use. The major population concentration occurs midway on the creek at Sellersville-Perkasie.

Low natural base flows and frequent localized storms produce an extremely variable flow regime. Spring flows are generally high due to snow melt and precipitation, and spates occur throughout the year. As summer approaches, flows become lower, and in late summer and fall surface flow in upper reaches often ceases. Riffle habitat is much reduced or eliminated in about one-third of the stream length, and the creek becomes a series of pools or quiescent reaches connected by subsurface percolation. Several low dams are present.

Anthropogenic stresses from nonpoint source runoff is a problem, particularly in the headwaters where most of the surrounding land is used for agriculture. Runoff from farmland carries a heavy load of nutrients. Stormwater and sewage enter the East Branch via storm drains under the Route 309 bridge in Sellersville. This enriched discharge is most persistent during periods of heavy rainfall when the Sellersville-Perkasie Sewage Treatment Plant capacity is exceeded.

The greatest point source stress is the Sellersville-Perkasie Sewage Treatment Plant (secondary treatment) effluent that enters the creek about 3 km upstream of Cathill Road (E23000, about midpoint on the creek). The effluent contains very high levels of chlorine, nutrients, and heavy metals (Table 2.4-9). Residual chlorine has its greatest effect in the immediate vicinity of the outfall. Chlorine rapidly diffuses into the atmosphere and decays as a result of photochemical reactions. However, since the effluent is highly enriched with nitrogenous compounds, chloramines are formed as a result of chlorination and these may persist in the stream. The stimulating effect of nutrients on aquatic plant growth can produce marked diel fluctuations in dissolved oxygen (DO). Several 24-hour DO studies conducted by the Applicant's consultant showed that a critical DO depression (<2mg/l; the Commonwealth's minimum criterion is 4.0) and extreme diel fluctuation occurred downstream of the effluent. Heavy metals such as cadmium, chromium, copper, and zinc are concentrated in the effluent. All the factors described above produce a stressed community downstream of the outfall.

Indian Creek (which enters the East Branch near meter 6900) may also stress the East Branch. It receives effluents from the Telford Borough and Lower Salford Township Sewage Treatment Plants, and a number of food-processing industries. The primary stress created by Indian Creek is nutrient loading, and it appears that this creek may periodically degrade lower East Branch water quality.

2.2.2.3.2 Phytoplankton

Phytoplankton was not studied by the Applicant's consultant in East Branch Perkiomen Creek because it was considered to be of low potential impact. Studies conducted in other shallow, temperate headwater streams have indicated that phytoplankton is typically low in density and essentially of periphytic origin.

2.2.2.3.3 Periphyton

Periphyton is a seasonally important primary producer in East Branch Perkiomen Creek and was studied by the Applicant's consultant in 1973 and 1974 as shown in Tables 2.2-70 and 71. Periphytic algae were almost exclusively diatoms and only the common genera were recorded. These were Navicula, Melosira, Synedra, Nitzschia, and Cocconeis. Local biology and habitat requirements for these algae have already been described, and seasonal changes in the taxonomic composition of periphyton were similar to those observed in the Schuylkill River (Section 2.2.2.1.3).

Periphyton standing crop biomass in the East Branch was highly variable, and apparently responsive to a number of environmental factors. Biomass was maximum in April through October under conditions of relatively stable low flow and high temperature (Table 2.2-72). Highest biomass occurred in August of both years (1973, 48 mg/dm^2; 1974, 106 mg/dm^2). Biomass was low from January through March and from November through December, due to increased velocities and lower temperatures. This seasonal pattern of periphyton productivity is typical of lotic systems in temperate regions.

Periphyton in the upper East Branch (E32115, E22867) was more susceptible to scouring during increased flow than periphyton in the lower section (E2800). During periods of low flow E32115 and E22867 exhibited higher periphyton biomass than E2800, probably because the shallower water allowed more light to reach the periphyton community.

2.2.2.3.4 Macrophytes

Refer to Section 2.2.2.2.4.

2.2.2.3.5 Zooplankton

Refer to Section 2.2.2.2.5.

2.2.2.3.6 Macroinvertebrates

Refer to Section 2.2.2.2.6.

2.2.2.3.7 Fish

The fish community of East Branch Perkiomen Creek consists of warmwater species typical of small lotic systems in southeastern Pennsylvania (Mihursky, Ref 2.2-77). In general, the fish include minnows and suckers, important as food convertors and forage; and freshwater catfish, pike, and sunfish, important ecologically at higher trophic levels and sociologically as pan and sport fish. Most species are indigenous and reproduce locally.

To some extent fish distribution in the East Branch reflected longitudinal zonation typical of lotic systems. However, characteristic distributions were modified somewhat by major point source domestic and industrial discharge (Section 2.2.2.3.1) and the presence of several small impoundments.

Operation of LGS will require the diversion of Delaware River water through the East Branch. Fish in the creek will be affected directly by the increased discharge, and indirectly by habitat alteration.

The entire East Branch was intensively sampled at least monthly, from June 1970 through December 1976 (Tables 2.2-70 and 71). Fishes were captured primarily by seine and electrofishing.

2.2.2.3.7.1 Species Inventory

In all, 9 families, including 23 genera and 40 species, were collected (Table 2.2-73), as well as hybrids of both the minnow and carp family and the genus Lepomis. No species were commercially valuable, or considered threatened or endangered by Federal or state regulatory agencies. The American eel was the only true migratory (catadromous) species.

Qualitative abundance was established within a family, or among related families, by subjective comparison of recent catch statistics (Section 2.2.2.1.7). Species designated rare or uncommon were low in abundance, and significant alteration of their environment could result in a change in distribution or possible extirpation. Brook trout, a coldwater fish, was occasionally stocked in the creek by the Pennsylvania Fish Commission, but did not sustain itself. A single muskellunge captured near the mouth of the creek was assumed to have originated from Perkiomen Creek, where muskellunge have been stocked.

2.2.2.3.7.2 Community Description

2.2.2.3.7.2.1 Larval Fish

Larval fish drift at E2650 was investigated in 1973 and 1974 using drift nets. Data collected from this site were representative only of the lower East Branch. Relative abundance of dominant taxa (comprising >90% of the total identified catch) varied between years (Table 2.2-74). In 1973, the white sucker and yellow bullhead were first and third in abundance, respectively, whereas Lepomis spp. were first, and white sucker third, in 1974. Unidentified minnows (mostly Notropis spp.) ranked second in both years.

Spawning extended primarily from May through August. Density of drifting larvae varied during this period (Figure 2.2-18) as a result of species-specific peak spawns (Table 2.2-75). White suckers and tessellated darters spawned primarily from late April to early May, while yellow bullheads spawned in early June. Two peak spawning periods for both Notropis spp. and Lepomis spp. were observed; one in early June, and one from July to early August. Few (22) drifting eggs were taken because most East Branch fishes spawn demersal eggs.

Diel fluctuation in drift occurred regularly. Most larvae were collected between sunset and sunrise; peak densities usually occurred between 2200 and 0200 hours.

2.2.2.3.7.2.2 Minnows and Young

In 1975 and 1976, 30 species and Lepomis and Notropis hybrids were collected by seine from lotic sites in East Branch Perkiomen Creek (Table 2.2-76). Most were minnows and young-of-year pan and sport fishes. The few adult pan and sport fishes that were included did not affect results.

Total abundance of minnows and young (mean catch-per-unit-effort) did not differ between years. Dominant species, based upon in 1975 and 1976 combined seine data, were the spotfin shiner (54% of total), bluntnose minnow, banded killifish, tessellated darter (each 6%), and common shiner (5%). All other species individually comprised less than 5% of the mean catch-per-unit-effort. Relative abundance of the more numerous species varied between 1975 and 1976. In 1975, spotfin shiner, comely shiner, swallowtail shiner, common shiner, and satinfin shiner dominated the catch, while in 1976, spotfin shiner, tessellated darter, banded killifish, bluntnose minnow, and white sucker (young) were most numerous.

The spotfin shiner was the most numerous species in each site, and abundance of dominant species varied between sites. Variation in spatial relative abundance was indicative of species, zonation. Bridle shiner, common shiner, spottail shiner, swallowtail shiner, spotfin shiner, bluntnose minnow, creek chubsucker, and Lepomis hybrid were common in the upstream section of the East Branch; goldfish, golden shiner, and creek chub were established primarily in the middle reaches; and carp, cutlips minnow, satinfin shiner, longnose dace, fallfish, and margined madtom were more prevalent downstream. Other species were generally distributed throughout the creek. Other investigators have demonstrated similar patterns of longitudinal zonation in small streams (Burton and Odum, Ref 2.2-78; Larimore and Smith, Ref 2.2-79; and Hocutt and Stauffer, Ref 2.2-80). Species segregation occurred as a result of longitudinal changes in habitat and water quality.

The number of species per collection was used as a general index of diversity. This parameter also indicated a pattern of longitudinal zonation in the creek. Number of species increased from headwaters to about midpoint in the stream, then decreased downstream toward the confluence. Usually, the number of species increases downstream as a result of increased habitat heterogeneity (Larimore and Smith, Ref 2.2-79). Lower diversity in the downstream reaches of the East Branch may have reflected degraded water quality downstream of Sellersville, and sampling method bias toward smaller (i.e., upstream) stream size.

2.2.2.3.7.2.3 Adults

2.2.2.3.7.2.3.1 Lotic Sites

In all, 18 species of large fish (defined as all members larger than 50 mm FL of the pike, sucker, freshwater catfish, and sunfish families, and goldfish and carp) were collected from lotic sites by dc electrofishing in 1973 and 1975. Goldfish x carp and Lepomis hybirds also were collected. White sucker, green sunfish, yellow bullhead, and redbreast sunfish dominated in both years (Table 2.2-77), and comprised 25, 23 19, and 15%, respectively, of the total estimated streamwide number.

Relative abundance of the 14 most abundant species remained essentially the same between 1973 and 1975 at each site, but often varied between sites in each year. The four dominant species were generally important throughout the stream and comprised from 50 to 91% of the large fish community at each site. Pumpkinseed and Lepomis hybrid were only 4 and 3% of total, respectively, but were important at E36020. Other locally important species were redfin pickerel (E36020), bluegill (E30540), and smallmouth bass and margined madtom (E1550).

Species zonation was likely due to habitat variety and water quality differences, as mentioned previously.

Results of biomass analyses were very similar to those based upon population estimates. White sucker (46% of total estimated biomass), yellow bullhead (13%), carp (11%), redbreast sunfish (9%), and green sunfish (8%) comprised most of the of biomass. No other species accounted for more than 5% of the total, but the following fishes made significant contributions at specific locations and times: pumpkinseed (E36020, 1975), Lepomis hybrid (E36020, both years), creek chubsucker (E36020, 1973), redfin pickerel (E36020, 1975), chain pickerel (E36020, 1975), brown bullhead (E22240,1975), and smallmouth bass (E1550, 1975).

2.2.2.3.7.2.3.2 Lentic Sites

In all, 16 species and carp x goldfish and Lepomis hybrids were collected in spring 1974 and fall 1975 at Fretz (E15500) and WaWa (E5650) reservoirs (Table 2.2-78). Percent composition of total catch was used to evaluate community structure, because unbiased population estimates could not be calculated for each species. The green sunfish was the most abundant species in both reservoirs in 1974 and 1975. White sucker, pumpkinseed, and yellow bullhead followed green sunfish in order of overall abundance at the two sites. The bluegill and pumpkinseed were more numerous in Fretz than WAWa, probably because of habitat differences. The yellow bullhead was relatively more abundant in WaWa where, during low flows, the site was more characteristic of lotic habitat. The brown bullhead was more common in Fretz, which was typically lentic.

Studies of fishes in the East Branch identified the presence of large numbers of hybrid sunfish (offspring of interspecific matings within the genus Lepomis), particularly in the headwaters (Tables 2.2-76 and 77). Hybrid sunfish ranked sixth among large fish in streamwide abundance, and ninth in streamwide biomass for 1973 and 1975 combined (Table 2.2-77). Hybrids often comprised more than 25% of the total sunfish population in headwater sites (more than 40% at E36020). Abundance declined somewhat steadily downstream where they were 5 to 10% of total.

The high incidence of hybrid sunfish in the East Branch was unusual. Hybrids commonly occur in habitat suitable for compatible sunfishes; however they commonly comprise only a very small percentage of the total sunfish population (Bailey and Lagler, Ref 2.2-81; and Birdsong and Yerger, Ref 2.2-82). Hybrids were rare or nonexistant in several sites on nearby Tohickon and Neshaminy Creeks, which have habitats similar to those in the upper East Branch. Hybrids were also uncommon in the Schuylkill River and Perkiomen Creek study areas. Hybridization in the East Branch was most likely due to crowding

in isolated pools during the spawning season when flow in the upstream reaches was often intermittent (Section 2.2.2.3.1).

2.2.2.3.7.3 Important Species

General criteria for designation of important species were given in Section 2.2. A relatively large number of species were selected because effects of diversion on fishes of East Branch Perkiomen Creek are expected to be diverse and spatially variable due to the variety of habitats and the presence of existing stresses (Section 2.2.2.3.1). Important species were chosen to represent three general ecological niches present in the creek, and taxa of sociological importance (Table 2.2-79). These fishes will also most likely be affected by changes in the physical and chemical nature of the creek caused by diversion. The local biology of important species is described below.

2.2.2.3.7.3.1 Redfin Pickerel

The redfin pickerel (Esox americanus) was common only in the headwaters, often being found in isolated shallow pools with no flow and heavy aquatic vegetation. The species was most numerous at E36020 (62 individuals/500 m of stream), and showed a decreasing trend in abundance downstream (Table 2.2-80). Only one specimen was taken from the two impoundments sampled (Table 2.2-81). Populations increased dramatically from 1973 to 1975, especially at E36020, where numbers almost doubled. Variations in biomass were similar to those in abundance.

The maximum age was 4-5 years, but most specimens were age I (Table 2.2-84). Maximum length was 309 mm FL. Greatest (48%) growth in length occurred in the first year of life. The length-weight relationship of 32 specimens was $\ln W = -10.17 + 2.67 \ln FL$. Although this species is a common game fish, angling for redfin pickerel in the East Branch was virtually nonexistent because of small adult size.

2.2.2.3.7.3.2 Satinfin Shiner

The satinfin shiner (Notropis analostanus) was common in East Branch Perkiomen Creek, preferring habitat with fast current and bedrock substrate. Streamwide abundance based upon seine collections decreased from a mean catch-per-unit-effort of 13.4 in 1975 to 8.1 in 1976, and it ranked seventh in overall abundance (Table 2.2-76). This species was most important in downstream reaches at E1890, E5475, and E12440.

2.2.2.3.7.3.3 Common Shiner

Common shiners (Notropis cornutus) spawned from June through July. The occurrence of two peak larval drift periods, one each in June and July, may have indicated intermittent or multiple spawning (Table 2.2-75). Mean daily larval drift density in 1974 ranged from 0.007 larvae/m^3 in mid-June to 0.012 larvae/m^3 in late July. Common shiners ranked third in overall seine catch (Table 2.2-76). Mean catch-per-unit-effort increased from 14.8 in 1975 to 18.2 in 1976. Variation in abundance between sites was significant. This fish was more prevalent in upstream reaches at E32170 and E29810. Abundance was lowest at E22980, probably due to degraded water quality downstream of Sellersville (Section 2.2.2.3.1). Length-weight relationships of the common shiner differed significantly between 1975 and 1976, as well as between sites (Table 2.2-82). Individuals at E29810 grew slower in weight per unit length relative to other sites.

2.2.2.3.7.3.4 Spotfin Shiner

Larval drift densities of spotfin shiner (Notropis spilopterus) in the East Branch were highest in July and August in 1974. This species ranked first in overall seine catch (Table 2.2-76). Mean catch-per-unit-effort decreased from 234.2 in 1975 to 110.8 in 1976. Variation between sites was significant, the species being more prevalent in upstream reaches at E29810 and E32170. Abundance did not decrease sharply downstream of Sellersville, indicating that this species was tolerant of degraded water quality (Section 2.2.2.3.1). Length-weight relationships varied significantly between 1975 and 1976 as well as between sites (Table 2.2-82). The high regression coefficients at E12440 and E22980 (downstream of, and in Sellersville, respectively) was again indicative of this species' tolerance of poor water quality.

2.2.2.3.7.3.5 White Sucker

Refer to Section 2.2.2.1.7 for information on food habits and parasites and diseases of white sucker (Catostomus commersoni). The white sucker generally spawned in May in 1973 and 1974 (earlier than most important species in the East Branch) and had a relatively short spawning period. Abundance of larvae in drift varied between 1973 and 1974 (Table 2.2-74). In 1973, white sucker mean drift density was 0.1234 individuals/m^3 (60% of total drift), but in 1974 declined to 0.1032 (26%). Maximum drift densities occurred in early May in both 1973 and 1974, and declined to negligible levels by early June (Table 2.2-75). White suckers always drifted at a greater rate during the night, reaching peak densities between 2200 and 0400 hours.

White sucker young in the seine catch ranked fifth in overall abundance (Table 2.2-76). Variation in abundance between 1975 and 1976 was high, with mean catch-per-unit-effort increasing from 3.7 in 1975 to 20.0 in 1976. Variation was high between upstream seine sites, but comparatively low between downstream sites. The white sucker dominated at E29810 and E1890. Abundance of young was low at sites near Sellersville, but increased from E12440 downstream to E1890.

The white sucker was the most abundant adult fish collected by electrofishing (Table 2.2-80). Streamwide abundance decreased from a mean of 605 individuals/500 m in 1973 to 525 in 1975. Abundance was lowest in upstream and downstream reaches, and peaked just downstream of Sellersville. While the area downstream of Sellersville was not prime spawning or nursery habitat, adults apparently moved into the region to benefit indirectly from the organic enrichment there (Section 2.2.2.3.1).

The white sucker was the most important contributor to streamwide biomass (mean, 47 kg/500 m), and it dominated every site. Streamwide biomass increased from 1973 to 1975, even though numerical abundance declined. This is not an unusual short-term trend for a relatively long-lived species.

Estimated abundance of adult white suckers in Fretz reservoir (E15500) decreased from 1149 to 576 specimens from May 1974 to October 1975, while population levels in WaWa (E5650) during the same period remained essentially stable (Table 2.2-81). This species was slightly more numerous in Fretz than WaWa. Biomass, however, was somewhat higher in WaWa in 1975.

White suckers collected upstream and downstream of Sellersville exhibited fairly stable growth in length from 1968 to 1973 (Table 2.2-85). No significant difference in growth for combined stations upstream and downstream of Sellersville was observed, but fish collected downstream were consistently larger at each annulus for all year-classes than upstream. Specimens were not aged past their fourth year because of scale inconsistencies. Maximum length at capture was 344 mm FL.

Analysis of covariance indicated significantly different length-weight regressions among populations of white sucker collected at five sites in 1973 (Table 2.2-83). Generally, individuals upstream of Sellersville gained proportionately more weight per unit increase in length than those downstream.

2.2.2.3.7.3.6 Yellow Bullhead

Yellow bullheads (Ictalurus natalis) spawned in June and July in 1973 and June in 1974. Because of nesting behavior and parental care, yellow bullhead larvae rarely occurred in drift. In 1973,

mean drift density was 0.0184 individuals/m³ (9% of total drift), but declined to 0.0090 individuals/m³ (2%) in 1974 (Table 2.2-74). Peak densities occurred in late June of 1973 and 1974 (Table 2.2-75). This species always drifted at a greater rate during the night, reaching peak densities between 2200 and 0200 hours.

Yellow bullhead young were not abundant in the seine catch and comprised less than 1% of the mean catch-per-unit-effort in 1975 and 1976 (Table 2.2-76) Young were more prevalent upstream of Sellersville, but generally comprised less than 1% of total mean catch in this area.

The yellow bullhead was the third most abundant adult fish collected by electrofishing (Table 2.2-80). Streamwide abundance increased from a mean of 317 individuals/500 m in 1973 to 563 in 1975. The adults were generally more numerous downstream of Sellersville. The apparent contradiction between these and seine results was likely due to the fact that the seine is not an effective gear for sampling young in larger downstream areas.

Yellow bullhead adults were also the third most important contributors to streamwide biomass, with a mean of 12 kg/500 m (Table 2.2-80). Generally, annual and site variation in this parameter was similar to that of estimated abundance. However, biomass was much higher at E1550, where abundance was lower, indicating that many of these fish were larger and older. This may have been a reason for the decline in abundance noted at E1550 from 1973 to 1975.

Abundance of adults increased in both Fretz and WaWa reservoirs from May 1974 to October 1975 (Table 2.2-81). This was likely the result of successful spawns in 1973 and 1974, because abundance varied similarly in lotic regions during the same general period. Both abundance and biomass were higher in WaWa due to this species' apparent preference for the habitat in this reservoir. The longest yellow bullhead collected from East Branch Perkiomen Creek was 295 mm FL. This species was an important pan fish in the East Branch.

2.2.2.3.7.3.7 Redbreast Sunfish

Refer to Section 2.2.2.1.7 for information on food habits, parasites and diseases, and human importance for redbreast sunfish (Lepomis auritus). Sunfish larvae were only identified to genus (Lepomis spp.). Spawning of redbreast sunfish, green sunfish, pumpkinseed, and bluegill occurred from June through August in 1973 and 1974. Lepomis spp. larvae comprised only 6% (0.0128 individuals/m³) of East Branch drift in 1973, but increased to 37% (0.1469 individuals/m³) in 1974 (Table 2.2-74).

Peak densities occurred in late July in 1973 and mid-June and late July in 1974 (Table 2.2-75).

Redbreast sunfish young ranked ninth in overall abundance in the seine catch (Table 2.2-76). Annual variation in streamwide abundance was moderate, with mean catch-per-unit-effort increasing from 2.0 (<1% of total mean catch) in 1975 to 5.5 (2%) in 1976. Young were most abundant at E29810 and E32170. Abundance was lowest near Sellersville (E26630 and E22980), and highest downstream of the treatment plant.

The redbreast sunfish was the fourth most abundant adult fish collected by electrofishing (Table 2.2-80). Streamwide abundance increased from 257 fish/500 m in 1973 to 436 in 1975, probably as a result of populations recovering from severe flooding in June 1972 (Section 2.2.2.3.1). Abundance generally increased in an upstream to downstream direction, except for a depression downstream of Sellersville. Recovery from effects of Sellersville was evident at E12040.

The adult redbreast sunfish was also the fourth most important contributor to streamwide biomass with a mean of 10 kg/500 m (Table 2.2-80). Annual and site trends in biomass were similar to those of estimated abundance.

Redbreast sunfish abundance increased in both Fretz and WaWa from May 1974 to October 1975, probably as a result of a successful spawn in 1974 (Table 2.2-81). The redbreast sunfish was much more numerous in WaWa reservoir than in Fretz.

Growth in length often varied significantly by year-class and location (Table 2.2-86). Growth rates were generally lower at E36020 and increased downstream. Reduced habitat due to intermittent conditions (Section 2.2.2.3.1) and competition may have been responsible for poor growth at E36020. High growth rates downstream were probably due to greater habitat variety and space associated with increasing stream size.

Comparisons of length-weight regressions (Table 2.2-83) between sites indicated that average fish weight was similar at E12040, E30540, and E36020 in both 1973 and 1975. At E36020, fish collected in 1975 were heavier than those captured in 1973.

Stable age structures were observed at E12040 and E36020 in 1973 and E12040 and E1550 in 1975. With minor exceptions, the number of fish in each consecutive age-group decreased (Figures 2.2-19 and 2.2-20). Low abundance of age I fish caused slightly upset age structures at E30540, E22240, and E1550 in 1973 and at E36020, E30540, and E22240 in 1975.

2.2.2.3.7.3.8 Green Sunfish

Refer to the redbreast sunfish (above) for information on spawning periods and larval drift for sunfish in East Branch Perkiomen Creek. Green sunfish (Lepomis cyanellus) young ranked tenth in overall abundance in the seine catch (Table 2.2-76). The mean catch-per-unit-effort increased from 0.7 (<1% of total) in 1975 to 5.0 (2%) in 1976. The species was somewhat more prevalent in the middle and upstream sections of the creek.

The green sunfish was the second most abundant adult fish collected by electrofishing (Table 2.2-80). Downstream of Sellersville there was an increase in abundance from 1973 to 1975. This was primarily due to increases in the abundance of fish 51 to 90 mm FL, which indicated a good 1974 spawn. Upstream of Sellersville there also was an increase in abundance of this size group, but it was offset by a decline in the number of fish longer than 90 mm FL.

The distribution of adult green sunfish was different from that of redbreast sunfish. Green sunfish reached peak abundance downstream of Sellersville, and gradually decreased in abundance to the confluence. This suggested that green sunfish had a greater tolerance for the degraded water quality downstream of Sellersville (Section 2.2.2.3.1). However, where conditions were suitable for redbreast sunfish, green sunfish may have been at a competitive disadvantage.

The green sunfish was the fifth greatest contributor to streamwide biomass (mean, 7.7 kg/500 m) as shown in Table 2.2-80. Temporal and spatial variation in biomass was similar to that of abundance. The decline of larger, older fish upstream of Sellersville was also demonstrated by rather large decreases in biomass.

Green sunfish decreased in abundance at both Fretz and WaWa reservoirs from May 1974 to October 1975 (Table 2.2-81). In 1975, spatial differences in abundance and biomass were slight.

Food studies of 14 green sunfish from the Schuylkill River indicated chironomid larvae and pupae, cladocera, cyclopoids, algae, and other plant material were common food items.

Growth in length of green sunfish in 1973 and 1975 consistent among year-classes and sites (Table 2.2-87). Rates of growth in weight were similar between years at E36020, E22240, and E1550 (Table 2.2-83). Average weights of fish upstream of Sellersville were greater than those downstream.

Stable age structures were observed at E36020 and E1550 in 1973 and at all five sites sampled in 1975 (Figures 2.2-21 and 2.2-22). Absence of age I fish caused slightly upset structures at

E30540, E22240, and E12040 in 1973. Improvement of age structures in 1975 probably reflected recovery from the June 1972 flood (Section 2.2.2.3.1).

2.2.2.3.7.3.9 Pumpkinseed

Refer to Section 2.2.2.1.7 for information on food habits, parasites and diseases, and human importance for pumpkinseed (Lepomis gibbosus). Refer to redbreast sunfish (above) for information on spawning periods and larval drift. Pumpkinseed young were low in streamwide abundance and comprised less than 1% of total mean catch-per-unit-effort (Table 2.2-76). Annual variation in abundance was high, with mean catch-per-unit-effort increasing from 0.4 (<1% of total) in 1975 to 3.0 (1%) in 1976. Abundance of young was highest in the middle and upstream regions of the creek, and was lowest at E22980 downstream of Sellersville.

The pumpkinseed was the fifth most abundant adult fish collected by electrofishing (Table 2.2-80). Streamwide abundance differed slightly between 1973 and 1975, increasing from 83 to 86 fish/500 m, due primarily to a rise in abundance at E12040 and E1550. This species exhibited a streamwide pattern of abundance similar to that of the redfin pickerel. Both species prefer lentic habitat or the quiet water of small streams, which was generally available only in the upstream area of the creek.

Pumpkinseeds ranked ninth in streamwide biomass (mean, 1.4 kg/500 m). Annual and site trends in this parameter were the same as those for abundance (Table 2.2-80).

Pumpkinseeds decreased in abundance in Fretz reservoir but increased in WaWa from May 1974 to October 1975 (Table 2.2-81). Abundance and biomass were highest in Fretz due to this species' apparent preference for the habitat there.

2.2.2.3.7.2.10 Smallmouth Bass

Refer to Section 2.2.2.2.7 for information on growth and human importance for smallmouth bass (Micropterus dolomieui). Smallmouth bass young were low in streamwide abundance, comprising less than 1% of the total mean seine catch-per-unit-effort (Table 2.2-76). Annual variation in stream abundance was negligible. Young were prevalent only at E1890 and E32170. None were caught immediately downstream of Sellersville (E22980) in 1975 or 1976.

The smallmouth bass was the eighth most abundant adult fish encountered by electrofishing (Table 2.2-80). Streamwide abundance increased from 28 to 55 specimens/500 m from 1973 to

1975, primarily as a result of a twofold increase in number at E1550. Habitat preferred by smallmouth bass was prevalent from Sellersville downstream to the stream mouth. However, this species was abundant only at the extreme downstream reach (E1550). Degraded water quality downstream of Sellersville apparently inhibited smallmouth bass production at E22240 and E12040. The smallmouth bass was the sixth greatest contributor to community biomass (mean, 2.5 kg/500 m). Biomass was also highest at E1550. Although most collected specimens were young, legal-size bass were collected from three of the five sample sites in 1975.

Smallmouth bass comprised only a small portion of the adult fish population in Fretz and WaWa reservoirs (Table 2.2-81). Estimated abundance decreased slightly in both impoundments from May 1974 to October 1975.

2.2.2.3.7.3.11 Tessellated Darter

Refer to Section 2.2.2.1.7 for information on food habits of the tessellated darter (Etheostoma olmstedi). Larvae were collected infrequently in drift; at mean densities of 0.0021 individuals/m^3 in 1973 and 0.0001 in 1974, it comprised 1.0 and less than 0.1% of total drift, respectively (Table 2.2-74). Peak drift occurred in early May 1973 (0.010 individuals/m^3) and mid-May 1974 (0.002) (Table 2.2-75).

The tessellated darter was relatively numerous, comprising 5.8% of the mean catch-per-unit-effort in East Branch seine collections (Table 2.2-76). Annual variation was high, and mean catch-per-unit-effort increased from 6.0 (2% of total) in 1975 to 30.8 (10%) in 1976. Streamwide variation in abundance was also high, with the species being most prevalent in the upstream reaches of the creek. Abundance was low downstream of Sellersville, an indication of this species' intolerance of poor water quality (Section 2.2.2.3.1).

2.2.2.3.8 Trophic Relationships

Refer to Section 2.2.2.1.8.

2.2.3 FARM CROPS, COWS, AND GOATS

The 1976 distribution of the principal crop plant communities for the 5 miles surrounding the LGS station are included in sector-by-distance tables of crop production in acres. Tables for wheat, grain corn, corn (silage) and alfalfa, timothy and clover production, and, lastly, a table of total crop production are provided for in Tables 2.2-90 through 92.

The distribution of cows and goats in a 5 mile radius of the station are included in Tables 2.2-93 and 94.

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TABLE 2.2-1

TERRESTRIAL VASCULAR PLANTS FOUND ON THE LIMERICK GENERATING STATION SITE FROM 1972 TO 1978

Family	Scientific Name[1]	Common Name
Equisetaceae	Equisetum arvense	Common horsetail
Lycopodiaceae	Lycopodium sp.	Ground pine
Ophioglossaceae	Botrychium virginianum	Rattlesnake fern
Polypodiaceae	Onoclea sensibilis	Sensitive fern
	Polystichum acrostichoides	Christmas fern
	Dennstaedtia punctilobula	Hay-scented fern
	Asplenium platyneuron	Ebony spleenwort
Taxaceae	Taxus baccata	European yew
Pinaceae	Picea abies	Norway spruce
	Pinus strobus	White pine
	P. resinosa	Red pine
	P. sylvestris	Scotch pine
	P. virginiana	Virginia pine
	Thuja occidentalis	Northern white cedar
	Juniperus virginiana	Red cedar
Typhaceae	Typha latifolia	Common cattail
Alismataceae	Sagittaria latifolia	Broad-leaved arrowhead
Gramineae	Poa pratensis	Kentucky bluegrass
	Dactylis glomerata	Orchard-grass
	Lolium perenne	Perennial rye-grass
	Digitaria sanguinalis	Crab grass
	Echinochloa crusgalli	Barnyard grass
	Setaria spp.	Foxtails
Cyperaceae	Cyperus esculentus	Yellow nutgrass
	Carex stipata	Awl-fruited sedge
Araceae	Arisaema triphyllum	Jack-in-the-pulpit
	A. dracontium	Green dragon
	Symplocarpus foetidus	Skunk cabbage
Commelinaceae	Commelina communis	Asiatic dayflower
	Tradescantia virginiana	Spiderwort
Pontederiaceae	Heteranthera reniformis	Mud-plantain
Juncaceae	Juncus effusus	Common rush
Liliaceae	Veratrum viride	False hellebore
	Allium canadense	Wild garlic
	A. vineale	Field garlic
	A. stellatum	Wild onion
	Hemerocallis fulva	Day-lily
	Erythronium americanum	Trout-lily
	Ornithogalum umbellatum	Star-of-Bethlehem
	Muscari botryoides	Grape-hyacinth
	Polygonatum biflorum	True Solomon's-seal
	Asparagus officinalis	Asparagus
	Smilacina racemosa	False Solomon's-seal
Salicaceae	Salix nigra	Black willow
	Populus grandidentata	Bigtooth aspen

TABLE 2.2-1 (Cont'd)

Family	Scientific Name[1]	Common Name
Juglandaceae	Juglans cinerea	Butternut
	J. nigra	Black walnut
	Carya cordiformis	Bitternut hickory
	C. ovata	Shagbark hickory
	C. tomentosa	Mockernut hickory
	C. glabra	Pignut hickory
	C. ovalis	Sweet pignut hickory
Corylaceae	Corylus americana	American hazelnut
	Ostrya virginiana	Hop-hornbeam
	Betula lenta	Black birch
	B. nigra	River birch
	B. populifolia	Gray birch
	Alnus glutinosa	European black alder
Fagaceae	Fagus grandifolia	Beech
	Castanea dentata	Chestnut
	C. mollissima	Chinese chestnut
	Quercus alba	White oak
	Q. prinus	Chestnut oak
	Q. rubra	Red oak
	Q. palustris	Pin oak
	Q. coccinea	Scarlet oak
	Q. velutina	Black oak
	Q. ilicifolia	Scrub oak
Ulmaceae	Ulmus rubra	Slippery elm
	U. americana	American elm
	Celtis occidentalis	Hackberry
Moraceae	Morus rubra	Red mulberry
	Maclura pomifera	Osage orange
Urticaceae	Urtica gracilis	Slender nettle
	U. dioica	Stinging nettle
	Pilea pumila	Clearweed
	Boehmeria cylindrica	False nettle
Aristolochiaceae	Asarum canadense	Wild ginger
Polygonaceae	Rumex altissimus	Smooth dock
	R. crispus	Curled dock
	R. obstusifolius	Broad dock
	R. acetosella	Sheep sorrel
	Tovara virginiana	Virginia knotweed
	Polygonum pensylvanicum	Pennsylvania smartweed
	P. hydropiper	Common smartweed
	P. cespitosum	Long-bristled smartweed
	P. persicaria	Lady's thumb
	P. sagittatum	Tearthumb
Chenopodiaceae	Chenopodium album	Lambs-quarters
Amaranthaceae	Amaranthus retroflexus	Amaranth pigweed
Nyctaginaceae	Mirabilis nyctaginea	Four-o'clock
Phytolaccaceae	Phytolacca americana	Pokeweed
Portulacaceae		Purslane
	Claytonia virginica	Spring-beauty

TABLE 2.2-1 (Cont'd)

Family	Scientific Name[1]	Common Name
Caryophyllaceae	*Stellaria media*	Common chickweed
	S. graminea	Lesser stitchwort
	Cerastium vulgatum	Mouse-ear chickweed
	Lychnis alba	Evening lychnis
	Silene cucubalus	Bladder campion
	S. stellata	Starry campion
	S. antirrhina	Sleepy catchfly
	Saponaria officinalis	Bouncing bet
	Dianthus armeria	Deptford pink
Nymphaeaceae	*Nuphar variegatum*	Bullhead-lily
Ranunculaceae	*Ranunculus abortivus*	Kidneyleaf buttercup
	R. acris	Common buttercup
	R. bulbosus	Bulbous buttercup
	Thalictrum polygamum	Tall meadow rue
	Hepatica americana	Blunt-leaved hepatica
	Anemone virginiana	Thimbleweed
	Aquilegia canadensis	Columbine
	A. vulgaris	Garden columbine
	Delphinium ajacis	Garden larkspur
	Cimicifuga racemosa	Black cohosh
Berberidaceae	*Podophyllum peltatum*	Mayapple
	Berberis thunbergii	Japanese barberry
Menispermaceae	*Menispermum canadense*	Canada moonseed
Magnoliaceae	*Liriodendron tulipifera*	Tulip-tree
Annonaceae	*Asimina triloba*	Pawpaw
Lauraceae	*Sassafras albidum*	Sassafras
	Lindera benzoin	Common spicebush
Papaveraceae	*Sanguinaria canadensis*	Bloodroot
	Chelidonium majus	Celandine
	Dicentra cucullaria	Dutchman's-breeches
Capparidaceae	*Cleome spinosa*	Spider-flower
Cruciferae	*Thlaspi arvense*	Field pennycress
	Lepidium campestre	Cow cress
	L. ruderale	Roadside peppergrass
	Capsella bursa-pastoris	Shepherd's purse
	Brassica nigra	Black mustard
	B. rapa	Field mustard
	Alliaria officinalis	Garlic mustard
	Sisymbrium altissimum	Tumble mustard
	Hesperis matronalis	Dame's rocket
	Nasturtium officinale	Water cress
	Barbarea vulgaris	Wintercress
	B. verna	Early winter cress
	Dentaria laciniata	Cut-leaved toothwort
	Cardamine bulbosa	Spring cress
	Arabis laevigata	Smooth rock cress
Crassulaceae	*Sedum sarmentosum*	Stonecrop
	S. telephium	Orpine
Saxifragaceae	*Saxifraga virginiensis*	Early saxifrage
	Tiarella cordifolia	Foamflower
Hamamelidaceae	*Hamamelis virginiana*	Witch-hazel
Platanaceae	*Platanus occidentalis*	Sycamore

TABLE 2.2-1 (Cont'd)

Family	Scientific Name[1]	Common Name
Rosaceae	*Physocarpus opulifolius*	Ninebark
	Spiraea latifolia	Spirea
	Pyrus communis	Domestic pear
	P. malus	Domestic apple
	Amelanchier sp.	Shadbush
	Crataegus sp.	Hawthorn
	Fragaria virginiana	Common strawberry
	F. vesca	Woodland strawberry
	Duchesnea indica	Indian strawberry
	Potentilla argentea	Silvery cinquefoil
	P. recta	Rough-fruited cinquefoil
	P. norvegica	Rough cinquefoil
	P. canadensis	Dwarf cinquefoil
	P. simplex	Common cinquefoil
	Geum canadense	White avens
	Rubus phoenicolasius	Wine raspberry
	R. idaeus	Red raspberry
	R. occidentalis	Black raspberry
	R. allegheniensis	Blackberry
	Agrimonia sp.	Agrimony
	Rosa multiflora	Multiflora rose
	R. carolina	Pasture rose
	Prunus americana	Wild plum
	P. persica	Peach
	P. avium	Sweet cherry
	P. serotina	Black cherry
	P. virginiana	Chokecherry
Lequminosae	*Albizzia julibrissin*	Silk-tree
	Gleditsia triacanthos	Honey-locust
	Cassia fasciculata	Partridge-pea
	Cercis canadensis	Redbud
	Baptisia tinctoria	Wild indigo
	Trifolium arvense	Rabbit's-foot clover
	T. pratense	Red clover
	T. hybridum	Alsike clover
	T. procumbens	Smaller hop clover
	Melilotus officinalis	Yellow sweet clover
	M. alba	White sweet clover
	Lotus corniculatus	Birdfoot trefoil
	Amorpha fruticosa	Dull-leaf indigobush
	Robinia pseudoacacia	Black locust
	Coronilla varia	Crown vetch
	Desmodium nudiflorum	Naked-flowered tick-trefoil
	D. paniculatum	Panicled tick-trefoil
	Vicia cracca	Cow vetch
Oxalidaceae	*Oxalis stricta*	Yellow wood-sorrel
	O. europaea	Yellow wood-sorrel
Geraniaceae	*Geranium maculatum*	Wild geranium
	G. pusillum	Small-flowered cransebill
Simarubaceae	*Ailanthus altissima*	Tree of heaven
Euphorbiaceae	*Euphorbia* sp.	Spurge

TABLE 2.2-1 (Cont'd)

Family	Scientific Name[1]	Common Name
Anacardiaceae	Cotinus coggygria	Smoke-tree
	Rhus typhina	Staghorn sumac
	R. glabra	Smooth sumac
	R. copallina	Dwarf sumac
	R. radicans	Poison ivy
Aquifoliaceae	Ilex opaca	American holly
Celastraceae	Celastrus scandens	Bittersweet
Staphyleaceae	Staphylea trifolia	Bladdernut
Aceraceae	Acer pensylvanicum	Striped maple
	A. platanoides	Norway maple
	A. saccharum	Sugar maple
	A. rubrum	Red maple
	A. saccharinum	Silver maple
	A. negundo	Box elder
Hippocastanaceae	Aesculus hippocastanum	Horse chestnut
Balsaminaceae	Impatiens pallida	Pale jewelweed
	I. capensis	Spotted jewelweed
Vitaceae	Ampelopsis brevipedunculata	Amur ampelopsis
	Parthenocissus quinquefolia	Virginia creeper
	Vitis vulpina	Frost grape
Tiliaceae	Tilia americana	Basswood
Malvaceae	Malva neglecta	Common mallow
	M. moschata	Musk mallow
	Abutilon theophrasti	Velvet-leaf
	Hibiscus palustris	Swamp rose mallow
	H. palustris peckii	Crimson-eyed rose mallow
	H. trionum	Flower-of-an-hour
Guttiferae	Hypericum perforatum	Common St. Johnswort
Violaceae	Viola papilionacea	Common blue violet
	V. triloba	Three-lobed violet
	V. striata	Cream violet
Elaeagnaceae	Elaeagnus angustifolia	Russian olive
Lythraceae	Lythrum salicaria	Purple loosestrife
Nyssaceae	Nyssa sylvatica	Sour gum
Onagraceae	Epilobium coloratum	Purple-leaved willow-herb
	Oenothera biennis	Common evening primose
	Gaura biennis	Biennial gaura
	Circaea quadrisulcata	Enchanter's nightshade
Araliaceae	Hedera helix	English ivy
Umbelliferae	Osmorhiza claytoni	Sweet cicely
	Zizia aurea	Golden alexanders
	Cicuta maculata	Water-hemlock
	Cryptotaenia canadensis	Honewort
	Heracleum maximum	Cow parsnip
	Daucus carota	Queen Anne's lace
Cornaceae	Cornus florida	Flowering dogwood
	C. stolonifera	Red Osier
	C. amomum	Silky dogwood
	C. racemosa	Red-panicle dogwood
Pyrolaceae	Chimaphila maculata	Spotted wintergreen
	Monotropa uniflora	Indian pipe

TABLE 2.2-1 (Cont'd)

Family	Scientific Name[1]	Common Name
Ericaceae	Rhododendron nudiflorum	Pink azalea
	Kalmia latifolia	Mountain laurel
	Gaylussacia baccata	Black huckleberry
	Vaccinium stamineum	Deerberry
	V. vacillans	Early low blueberry
Primulaceae	Lysimachis quadrifolia	Whorled loosestrife
	L. nummularia	Moneywort
	L. ciliata	Fringed loosestrife
	Anagallis arvensis	Scarlet pimpernel
Oleaceae	Fraxinus americana	White ash
	Syringa vulgaris	Common lilac
Apocynaceae	Vinca minor	Myrtle
	Apocynum cannabinum	Indian hemp
Asclepiadaceae	Asclepias tuberosa	Butterfly weed
	A. incarnata	Swamp milkweed
	A. variegata	White milkweed
	A. syriaca	Common milkweed
Convolvulaceae	Ipomoea coccinea	Small red morning-glory
	I. hederacea	Ivy-leaved morning-glory
	I. purpurea	Common morning-glory
	Convolvulus sepium	Hedge bindweed
	C. arvensis	Field bindweed
Polemoniaceae	Phlox subulata	Moss phlox
Boraginaceae	Lithospermum arvense	Corn gromwell
	Myosotis scorpioides	True forget-me-not
	Mertensia virginica	Virginia cowslip
Verbenaceae	Verbena urticifolia	White vervain
	V. hastata	Blue vervain
Labiatae	Trichostema dichotomum	Bluecurls
	Teucrium canadense	Germander
	Scutellaria lateriflora	Mad-dog skullcap
	Nepeta cataria	Catnip
	Prunella vulgaris	Heal-all
	Glechoma hederacea	Gill-over-the-ground
	Leonurus cardiaca	Motherwort
	Lamium amplexicaule	Henbit
	L. purpureum	Purple dead nettle
	Stachys tenuifolia	Rough hedge-nettle
	Monarda didyma	Bee-balm
	M. fistulosa	Wild bergamot
	Blephilia hirsuta	Hairy wood-mint
	Hedeoma pulegioides	American pennyroyal
	Pycnanthemum virginianum	Virginia mt.-mint
	Lycopus virginicus	Bugleweed
	Mentha spicata	Spearmint
	M. piperita	Peppermint
Solanaceae	Solanum dulcamara	European bittersweet
	S. nigrum	Common nightshade
	S. carolinense	Horse nettle
	Physalis subglabrata	Smooth ground cherry
	P. heterophylla	Clammy ground cherry
	Datura stramonium	Jimsonweed

TABLE 2.2-1 (Cont'd)

Family	Scientific Name[1]	Common Name
Scrophulariaceae	*Verbascum thapsus*	Common mullein
	V. blattaria	Moth mullein
	Cymbalaria muralis	Kenilworth ivy
	Linaria vulgaris	Butter-and-eggs
	Scrophularia marilandica	Figwort
	Chelone glabra	Turtlehead
	Penstemon digitalis	Foxglove beardtongue
	P. hirsutus	Hairy beardtongue
	Paulownia tomentosa	Princess-tree
	Mimulus ringens	Square-stemmed monkey-flower
	Veronica officinalis	Common speedwell
	V. filiformis	Slender speedwell
	V. hederaefolia	Ivy-leaved speedwell
Bignoniaceae	*Campsis radicans*	Trumpet Creeper
	Catalpa bignonioides	Catalpa
Orobanchaceae	*Epifagus virginiana*	Beechdrops
	Orobanche uniflora	One-flowered cancerroot
Phrymaceae	*Phryma leptostachya*	Lopseed
Plantaginaceae	*Plantago major*	Broad-leaved plantain
	P. lanceolata	Narrow-leaved plantain
Rubiaceae	*Galium aparine*	Cleavers
	G. triflorum	Fragrant bedstraw
	G. mollugo	Wild madder
	G. asprellum	Rough bedstraw
	Houstonia caerulea	Bluets
Caprifoliaceae	*Lonicera xylosteum*	European honeysuckle
	L. canadensis	Fly-honeysuckle
	L. japonica	Japanese honeysuckle
	Symphoricarpos orbiculatus	Coralberry
	Viburnum alnifolium	Hobblebush
	V. cassinoides	Wild raisin
	V. prunifolium	Smooth blackhaw
	V. dentatum	Arrow wood
	V. acerifolium	Maple-leaved viburnum
	Sambucus canadensis	Common elder
Dipsacaceae	*Dipsacus sylvestris*	Teasel
Cucurbitaceae	*Sicyos angulatus*	Bur-cucumber
	Echinocystis lobata	Wild cucumber
Campanulaceae	*Specularia perfoliata*	Venus's looking-glass
	Lobelia siphilitica	Great lobelia
	L. inflata	Indian tobacco
Compositae	*Vernonia noveboracensis*	New York ironweed
	Eupatorium maculatum	Spotted joe-pye weed
	E. fistulosum	Hollow joe-pye weed
	E. perfoliatum	Boneset
	E. serotinum	Late-flowering thoroughwort
	E. rugosum	White snakeroot
	Solidago caesia	Blue-stemmed goldenrod
	S. macrophylla	Large-leaved goldenrod
	S. bicolor	Silver rod
	S. juncea	Early goldenrod
	S. nemoralis	Gray goldenrod

TABLE 2.2-1 (Cont'd)

Family	Scientific Name[1]	Common Name
Compositae (cont'd)	S. rugosa	Rough-stemmed goldenrod
	S. canadensis	Canadian goldenrod
	S. graminifolia	Lance-leaved goldenrod
	S. tenuifolia	Grass-leaved goldenrod
	Aster schreberi	Schreber's aster
	A. cordifolius	Heart-leaved aster
	A. novae-angliae	New England aster
	A. prenanthoides	Crooked-stemmed aster
	A. laevis	Smooth aster
	A. ericoides	Heath aster
	A. lowrieanus	Lowrie's aster
	Erigeron annuus	Daisy fleabane
	E. philadelphicus	Common fleabane
	Antennaria sp.	Pussytoes
	Anaphalis margaritaceae	Pearly everlasting
	Ambrosia trifida	Great ragweed
	A. artemisiifolia	Common ragweed
	Xanthium chinense	Cocklebur
	Rudbeckia laciniata	Green-headed coneflower
	R. triloba	Thin-leaved coneflower
	R. hirta	Black-eyed Susan
	Helianthus annuus	Common sunflower
	H. divaricatus	Woodland sunflower
	H. decapetalus	Thin-leaved sunflower
	H. tuberosus	Jerusalem artichoke
	Bidens frondosa	Beggar-ticks
	B. coronata	Tickseed-sunflower
	Galinsoga ciliata	Galinsoga
	Achillea millefolium	Yarrow
	Anthemis cotula	Mayweed
	Chrysanthemum leucanthemum	Oxeye daisy
	Artemisia vulgaris	Mugwort
	Arctium lappa	Great burdock
	Cirsium vulgare	Bull thistle
	C. arvense	Canada thistle
	Centaurea nigra	Black knapweed
	C. americana	American knapweed
	Cichorium intybus	Chicory
	Tragopogon pratensis	Yellow goat's-beard
	Taraxacum officinale	Common dandelion
	Sonchus asper	Spiny-leaved sow thistle
	S. arvensis	Field sow thistle
	Lactuca scariola	Prickly lettuce
	L. canadensis	Wild lettuce
	Hieracium pilosella	Mouse-ear hawkweed
	H. floribundum	Smoothish hawkweed
	H. pratense	King devil
	H. venosum	Rattlesnake weed

(1) Reference 2.2-2

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TABLE 2.2-2

AMPHIBIANS AND REPTILES FOUND ON THE LIMERICK GENERATING STATION SITE FROM 1972 TO 1978

Family	Scientific Name[1]	Common Name[1]
Amphibians		
Salamandridae	*Notophthalmus viridescens*	Red-spotted newt
Plethodontidae	*Desmognathus fuscus*	Dusky salamander
	Plethodon cinereus	Red-backed salamander
	Pseudotriton ruber	Red salamander
	Eurycea longicauda	Long-tailed salamander
	Eurycea bislineata	Two-lined salamander
Bufonidae	*Bufo americanus*	American toad
	Bufo woodhousei fowleri	Fowler's toad
Hylidae	*Hyla crucifer*	Spring peeper
Ranidae	*Rana pipiens*	Leopard frog
	Rana palustris	Pickerel frog
	Rana catesbeiana	Bullfrog
	Rana clamitans	Green frog
Reptiles		
Chelydridae	*Chelydra serpentina*	Snapping turtle
	Sternothaerus odoratus	Stinkpot
Testudinidae	*Clemmys guttata*	Spotted turtle
	Clemmys insculpta	Wood turtle
	Terrapene carolina	Box turtle
	Chrysemys picta	Painted turtle
Colubridae	*Natrix sipedon*	Water snake
	Thamnophis sirtalis	Garter snake
	Diadophis punctatus	Ringneck snake
	Coluber constrictor	Black racer

[1] Reference 2.2-4

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TABLE 2.2-3

SAMPLING HISTORY FOR ECOLOGICAL STUDIES OF BIRDS
ON THE LIMERICK GENERATING STATION SITE

Program/Sites	Sep 1972-Mar 1973	Apr 1973-Mar 1974	Apr 1974-Mar 1975	Apr 1975-Mar 1976
Waterfowl				
Schuylkill River S85000-S72000		X	X	X
Breeding Birds				
BB1		X	X	X
BB2		X	X	X
Winter Birds				
WB1	X			
WB2	X			
BB1		X	X	
BB2		X	X	
Migrating Birds				
Chester County Route	X	X	X	X
Montgomery County Route	X	X	X	X
Bird Mortality at Meteorological Towers				
Tower 1	X	X		
Tower 2	X	X		

TABLE 2.2-4

BIRDS FOUND WITHIN AN 8-KM RADIUS OF LIMERICK GENERATING STATION FROM 1972 to 1978

Family	Scientific Name (1)	Common Name (1)	Occurrence in the Delaware Valley Region (2)			
			Win	Spr	Sum	Fall
Gaviidae	Gavia immer	Common loon	FC	C	UC	C
Podicipedidae	Podiceps auritus	Horned grebe	C	FC	UC	FC
	Podilymbus podiceps	Pied-billed grebe	FC	FC	FC	C
Phalacrocoracidae	Phalacrocorax auritus	Double-crested cormorant	UC	FC	UC	FC
Ardeidae	Ardea herodias	Great blue heron	FC	C	C	C
	Butorides virescens	Green heron	-	C	C	UC
	Casmerodius albus	Great egret	UC	FC	FC	UC
	Egretta thula	Snowy egret	UC	FC	FC	UC
	Hydranassa tricolor	Louisiana heron	UC	FC	FC	UC
	Nycticorax nycticorax	Black-crowned night heron	FC	C	C	C
	Nyctanassa violacea	Yellow-crowned night heron	-	UC	UC	UC
	Ixobrychus exilis	Least bittern	-	UC	UC	UC
	Botaurus lentiginosus	American bittern	UC	FC	FC	FC
Anatidae	Cygnus olor	Mute swan	FC	FC	FC	FC
	Olor columbianus	Whistling swan	UC	UC	-	UC
	Branta canadensis	Canada goose	FC	C	FC	C
	Chen caerulescens	Snow goose	UC	UC	-	UC
	Anas platyrhynchos	Mallard	C	C	C	C
	A. rubripes	Black duck	C	C	C	C
	A. acuta	Pintail	UC	FC	UC	FC
	A. crecca	Green-winged teal	UC	FC	UC	FC
	A. discors	Blue-winged teal	UC	UC	UC	UC
	A. americana	American wigeon	FC	FC	-	FC
	A. clypeata	Northern shoveler	FC	FC	FC	C
	Aix sponsa	Wood duck	UC	FC	FC	UC
	Aythya valisineria	Canvasback	FC	UC	-	UC
	A. marila	Greater scaup	C	FC	-	UC
	A. affinis	Lesser scaup	FC	FC	-	FC
	Bucephala clangula	Common goldeneye	FC	FC	-	UC
	B. albeola	Bufflehead	C	FC	-	FC
	Clangula hyemalis	Oldsquaw	C	FC	-	FC
	Oxyura jamaicensis	Ruddy duck	C	C	UC	FC
	Lophodytes cucullatus	Hooded merganser	UC	UC	-	UC
	Mergus merganser	Common merganser	C	C	-	UC
Cathartidae	Cathartes aura	Turkey vulture	C	C	C	C
Accipitridae	Accipiter striatus	Sharp-shinned hawk	UC	UC	UC	FC
	A. cooperii	Cooper's hawk	UC	UC	UC	UC
	Buteo jamaicensis	Red-tailed hawk	FC	FC	UC	FC
	B. lineatus	Red-shouldered hawk	UC	UC	UC	FC
	B. platypterus	Broad-winged hawk	-	UC	UC	FC
	Circus cyaneus	Marsh hawk	UC	FC	UC	FC
Pandionidae	Pandion haliaetus	Osprey	UC	FC	FC	UC
Falconidae	Falco peregrinus	Peregrine falcon	UC	UC	-	UC
	F. sparverius	American kestrel	FC	FC	FC	C
Tetraonidae	Bonasa umbellus	Ruffed grouse	FC	FC	FC	FC
Phasianidae	Colinus virginianus	Bobwhite	FC	FC	FC	FC
	Phasianus colchicus	Ring-necked pheasant	C	C	C	C
Rallidae	Porzana carolina	Sora	-	UC	UC	UC

TABLE 2.2-4 (Cont'd)

Family	Scientific Name (1)	Common Name (1)	Occurrence in the Delaware Valley Region (2) Win	Spr	Sum	Fall
	Fulica americana	American coot	C	C	UC	C
Charadriidae	Charadrius vociferus	Killdeer	UC	FC	UC	UC
Scolopacidae	Philohela minor	American woodcock	UC	FC	UC	FC
	Capella gallinago	Common snipe	UC	FC	UC	FC
	Actitis macularia	Spotted sandpiper	-	UC	FC	UC
	Tringa solitaria	Solitary sandpiper	-	UC	UC	UC
	T. flavipes	Lesser yellowlegs	UC	UC	UC	FC
	Calidris melanotos	Pectoral sandpiper	-	UC	UC	UC
	C. minutilla	Least sandpiper	UC	FC	FC	UC
	C. pusillus	Semipalmated sandpiper	UC	FC	FC	FC
Phalaropodidae	Lobipes lobatus	Northern phalarope	-	UC	UC	UC
Laridae	Larus argentatus	Herring gull	C	C	C	C
	L. delawarensis	Ring-billed gull	FC	FC	FC	FC
Columbidae	Columba livia	Rock dove	C	C	C	C
	Zenaidura macroura	Mourning dove	C	C	C	C
Cuculidae	Coccyzus americanus	Yellow-billed cuckoo	-	UC	FC	UC
	C. erythropthalmus	Black-billed cuckoo	-	UC	FC	UC
Tytonidae	Tyto alba	Barn owl	FC	FC	FC	FC
Strigidae	Otus asio	Screech owl	C	C	C	C
	Bubo virginianus	Great horned owl	FC	FC	FC	FC
Caprimulgidae	Chordeiles minor	Common nighthawk	-	FC	C	FC
Apodidae	Chaetura pelagica	Chimney swift	-	FC	C	UC
Trochilidae	Archilochus colubris	Ruby-throated hummingbird	-	FC	C	FC
Alcedinidae	Megaceryle alcyon	Belted kingfisher	UC	FC	FC	FC
Picidae	Colaptes auratus	Common flicker	UC	C	C	C
	Centurus carolinus	Red-bellied woodpecker	FC	FC	FC	FC
	Melanerpes erythrocephalus	Red-headed woodpecker	UC	UC	UC	UC
	Sphyrapicus varius	Yellow-bellied sapsucker	UC	UC	-	FC
	Dendrocopos villosus	Hairy woodpecker	FC	FC	FC	FC
	D. pubescens	Downy woodpecker	C	C	C	C
Tyrannidae	Tyrannus tyrannus	Eastern kingbird	-	FC	C	FC
	Myiarchus crinitus	Great crested flycatcher	-	FC	C	UC
	Sayornis phoebe	Eastern phoebe	UC	FC	FC	UC
	Empidonax minimus	Least flycatcher	-	UC	FC	UC
	Contopus virens	Eastern wood pewee	-	UC	FC	UC
Alaudidae	Eremophila alpestris	Horned lark	FC	FC	UC	FC
Hirundinidae	Iridoprocne bicolor	Tree swallow	UC	FC	C	C
	Riparia riparia	Bank swallow	-	FC	C	UC
	Stelgidopteryx ruficollis	Rough-winged swallow	-	FC	FC	UC
	Hirundo rustica	Barn swallow	UC	FC	C	UC
	Progne subis	Purple martin	-	FC	C	UC
Corvidae	Cyanocitta cristata	Blue jay	FC	C	FC	C
	Corvus brachyrhynchos	Common crow	C	C	C	C
	C. ossifragus	Fish crow	FC	FC	FC	FC
Paridae	Parus atricapillus	Black-capped chickadee	C	FC	FC	C
	P. carolinensis	Carolina chickadee	C	C	C	C
	P. bicolor	Tufted titmouse	C	C	C	C
Sittidae	Sitta carolinensis	White-breasted nuthatch	FC	FC	FC	FC
	S. canadensis	Red-breasted nutchatch	FC	FC	UC	FC

TABLE 2.2-4 (Cont'd)

Family	Scientific Name (1)	Common Name (1)	Occurrence in the Delaware Valley Region (2) Win	Spr	Sum	Fall
Certhiidae	Certhia familiaris	Brown creeper	FC	FC	UC	FC
Troglodytidae	Troglodytes aedon	House wren	-	FC	C	FC
	T. troglodytes	Winter wren	UC	UC	-	UC
	Thyrothorus ludovicianus	Carolina wren	FC	FC	FC	FC
Mimidae	Mimus polyglottos	Mockingbird	C	C	C	C
	Dumetella carolinensis	Gray catbird	-	FC	C	FC
	Toxostoma rufum	Brown thrasher	-	UC	FC	UC
Turdidae	Turdus migratorius	American robin	-	C	C	C
	Hylocichla mustelina	Wood thrush	-	FC	C	FC
	Catharus guttata	Hermit thrush	UC	FC	UC	FC
	C. ustulata	Swainson's thrush	-	FC	UC	FC
	C. minima	Gray-cheeked thrush	-	UC	UC	UC
	C. fuscescens	Veery	-	FC	UC	FC
Sylviidae	Polioptila caerulea	Blue-gray gnatcatcher	-	FC	FC	UC
	Regulus satrapa	Golden-crowned kinglet	UC	FC	UC	C
	R. calendula	Ruby-crowned kinglet	UC	UC	-	FC
Motacillidae	Anthus spinoletta	Water pipit	UC	UC	-	UC
Bombycillidae	Bombycilla cedrorum	Cedar waxwing	UC	UC	UC	UC
Sturnidae	Sturnus vulgaris	Starling	C	C	C	C
Vireonidae	Vireo griseus	White-eyed vireo	-	FC	FC	FC
	V. flavifrons	Yellow-throated vireo	-	UC	UC	UC
	V. solitarius	Solitary vireo	-	UC	UC	UC
	V. olivaceous	Red-eyed vireo	-	UC	FC	UC
Parulidae	Mniotilta varia	Black-and-white warbler	-	FC	FC	FC
	Vermivora chrysoptera	Golden-winged warbler	-	UC	UC	-
	V. pinus	Blue-winged warbler	-	UC	FC	UC
	V. peregrina	Tennessee warbler	-	UC	UC	UC
	V. ruficapilla	Nashville warbler	-	UC	UC	UC
	Parula americana	Northern parula	-	UC	UC	UC
	Dendroica petechia	Yellow warbler	-	UC	FC	UC
	D. magnolia	Magnolia warbler	-	UC	UC	UC
	D. tigrina	Cape May warbler	UC	UC	UC	UC
	D. caerulescens	Black-throated blue warbler	-	UC	UC	UC
	D. coronata	Yellow-rumped warbler	UC	FC	-	FC
	D. virens	Black-throated green warbler	-	FC	UC	FC
	D. fusca	Blackburnian warbler	-	UC	UC	UC
	D. pensylvanica	Chestnut-sided warbler	-	UC	UC	FC
	D. striata	Blackpoll warbler	-	FC	UC	FC
	D. pinus	Pine warbler	UC	FC	FC	FC
	D. discolor	Prairie warbler	-	FC	C	FC
	D. palmarum	Palm warbler	UC	FC	-	FC
	Seiurus aurocapillus	Ovenbird	-	FC	C	FC
	S. motacilla	Louisiana waterthrush	-	UC	FC	UC
	Oporornis formosus	Kentucky warbler	-	UC	FC	UC
	O. agilis	Connecticut warbler	-	UC	-	UC
	Geothlypis trichas	Common yellowthroat	UC	FC	C	FC
	Icteria virens	Yellow-breasted chat	UC	UC	FC	UC
	Wilsonia canadensis	Canada warbler	-	UC	FC	UC
	Setophaga ruticilla	American redstart	-	FC	UC	FC

TABLE 2.2-4 (Cont'd)

Family	Scientific Name (1)	Common Name (1)	Occurrence in the Delaware Valley Region (1) Win	Spr	Sum	Fall
Ploceidae	Passer domesticus	House sparrow	C	C	C	C
Icteridae	Sturnella magna	Eastern meadowlark	FC	C	C	C
	Agelaius phoeniceus	Red-winged blackbird	C	C	C	C
	Icterus spurius	Orchard oriole	-	JC	UC	UC
	I. galbula	Northern oriole	-	FC	C	UC
	Euphagus carolinus	Rusty blackbird	UC	UC	-	UC
	Quiscalus quiscula	Common grackle	C	C	C	C
	Molothrus ater	Brown-headed cowbird	FC	FC	FC	FC
Thraupidae	Piranga olivacea	Scarlet tanager	-	FC	FC	FC
Fringillidae	Cardinalis cardinalis	Cardinal	C	C	C	C
	Pheucticus ludovicianus	Rose-breasted grosbeak	-	FC	FC	FC
	Passerina cyanea	Indigo bunting	-	UC	C	UC
	Hesperiphona vespertina	Evening grosbeak	FC	FC	-	FC
	Carpodacus purpureus	Purple finch	FC	FC	UC	FC
	C. mexicanus	House finch	C	FC	UC	FC
	Acanthis flammea	Common redpoll	UC	UC	-	-
	Spinus pinus	Pine siskin	UC	UC	UC	UC
	S. tristis	American goldfinch	C	C	C	C
	Loxia leucoptera	White-winged crossbill	UC	UC	-	UC
	Pipilo erythrophthalmus	Rufous-sided towhee	UC	FC	C	FC
	Ammodramus savannarum	Grasshopper sparrow	-	UC	UC	UC
	Junco hyemalis	Dark-eyed junco	C	FC	UC	FC
	Spizella arborea	Tree sparrow	C	FC	-	FC
	S. passerina	Chipping sparrow	-	FC	C	FC
	S. pusilla	Field sparrow	-	FC	FC	UC
	Zonotrichia leucophrys	White-crowned sparrow	UC	UC	-	UC
	Z. albicollis	White-throated sparrow	C	C	UC	C
	Passerella iliaca	Fox sparrow	UC	UC	-	UC
	Melospiza lincolnii	Lincoln's sparrow	-	UC	-	UC
	M. georgiana	Swamp sparrow	UC	FC	FC	FC
	M. melodia	Song sparrow	C	C	C	C

Winter = December, January, February
Spring = March, April, May
Summer = June, July, August
Fall = September, October, November

C = Common
FC = Fairly common
UC = Uncommon
- = Not present

(1) Reference 2.2-7
(2) Based upon Brady et al. (Ref 2.2-8) who defined Delaware Valley Region as the area bound by the Pocono Mountains of Pennsylvania in the north and by Cape Henlopen, Delaware to the south east by the New Jersey coast between the Shark River and Cape May; and to the west by the limits of the Delaware drainage.

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TABLE 2.2-5

IMPORTANT BIRD SPECIES SELECTED FOR THE LIMERICK GENERATING STATION SITE AND CRITERIA FOR SELECTION

	IMPORTANT CRITERIA			Link to Plant		
Species	Special Interest	Commercial or Recreational Value	Ecological Importance	Cooling Tower Collision	Cooling Tower Drift	Blowdown Discharge
Canada goose		X	X	X	X	X
Mallard		X	X	X	X	X
Black duck		X	X	X	X	X
Great blue heron			X	X	X	X
Common merganser		X	X	X	X	X
Osprey	X(1)		X		X	X
Ring-necked pheasant		X	X		X	
American kestrel			X		X	
Common crow		X	X		X	
Common yellowthroat			X	X	X	
Song sparrow			X	X	X	

(1)Listed as "status undetermined" Office of Endangered Species and International Activities, Ref. 2.2-5.

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TABLE 2.2-6

MAMMALS FOUND ON THE LIMERICK GENERATING STATION SITE FROM 1972 TO 1978

Family	Scientific Name [1]	Common Name [1]
Didelphiidae	Didelphis marsupialis	Opossum
Talpidae	Scalopus aquaticus	Eastern mole
Soricidae	Blarina brevicauda	Short-tailed shrew
Vespertilionidae	Pipistrellus subflavus	Eastern pipistrel
	Lasiurus borealis	Red bat
Procyonidae	Procyon lotor	Raccoon
Mustelidae	Mustela frevata	Long-tailed weasel
	Mephitis mephitis	Striped skunk
Canidae	Vulpes fulva	Red fox
	Urocyon cinereo argenteus	Gray fox
Sciuridae	Marmota monax	Woodchuck
	Tamias striatus	Eastern chipmunk
	Tamiasciurus hudsonicus	Red squirrel
	Sciurus carolinensis	Gray squirrel
Cricetidae	Peromyscus leucopus	White-footed mouse
	Microtus pennsylvanicus	Meadow vole
	Ondatra zibethicus	Muskrat
Muridae	Mus musculus	House mouse
	Rattus norwegicus	Norway rat
Zapodidae	Zapus hudsonicus	Meadow jumping mouse
Leporidae	Sylvilagus floridanus	Eastern cottontail
Cervidae	Odocoileus virginianus	White-tailed deer

[1] Reference 2.2-10

TABLE 2.2-7

SUMMARY OF COLLECTIONS MADE FROM THE SCHUYLKILL RIVER, PERKIOMEN CREEK, AND EAST BRANCH PERKIOMEN CREEK BY PROGRAM AND YEAR, 1971-1978

	Schuylkill River							
Program	1971	1972	1973	1974	1975	1976	1977	1978
Water Quality	-	-	-	42	86	144	168	-
Phytoplankton	-	-	29	43	-	-	-	-
Periphyton[1]	-	-	49	36	-	-	-	-
Macrophytes[2]	-	-	-	-	-	-	3	-
Benthic Macroinvertebrates[3]	-	26	36	34	22	35	-	-
Macroinvertebrate Drift[4]	-	264	132	144	72	-	-	-
Larval Fish Drift[5]	-	-	-	218	504	880	-	-
Larval Fish Trap[6]	-	-	-	-	82	-	-	-
Larval Fish Push Net[7]	-	-	-	-	-	104	-	-
Seine[8]	-	-	-	-	132	132	-	-
Small Fish Population Estimates[9]	-	-	30	12	21	11	-	-
Large Fish Population Estimates[10]	-	-	37	17	14	-	23	-
Large Fish Catch per Unit Effort[11]	-	-	-	-	-	30	55	44
Vincent Trap Net[12]	154	116	120	122	70	130	-	-
Age and Growth[13]								
Redfin pickerel	-	-	-	-	-	-	-	-
White sucker	-	-	303	-	-	-	-	-
Brown bullhead	-	-	241	-	68	132	-	-
Redbreast sunfish	-	-	544	-	88	-	-	-
Green sunfish	-	-	-	-	-	-	-	-
Pumpkinseed	-	-	337	-	66	-	-	-
Smallmouth bass	-	-	-	-	-	-	-	-

Table 2.2-7 (Cont'd)

Program	Schuylkill River						
	1972	1973	1974	1975	1976	1977	1978
Water Quality	-	-	14	24	24	48	-
Phytoplankton	-	-	11	-	-	-	-
Periphyton	-	14	-	-	-	-	-
Macrophytes	-	-	-	-	-	-	-
Benthic Macroinvertebrates	22	24	18	-	22	-	-
Macroinvertebrate Drift	12	84	72	-	-	-	-
Larval Fish Drift	-	479	514	504	696	-	-
Larval Fish Trap	-	-	-	84	240	-	-
Larval Fish Push Net	-	-	-	-	-	-	-
Seine	-	-	-	64	65	-	-
Small Fish Population Estimates	-	-	-	12	12	-	-
Large Fish Population Estimates	-	-	9	2	15	-	-
Large Fish Catch per Unit Effort	-	-	-	-	-	-	-
Vincent Trap Net	-	-	-	-	-	-	-
Age and Growth							
Redfin pickerel	-	-	-	-	-	-	-
White sucker	-	-	-	-	164	-	-
Brown bullhead	-	-	-	-	-	-	-
Redbreast sunfish	-	231	-	-	249	-	-
Green sunfish	-	103	-	-	-	-	-
Pumpkinseed	-	-	-	-	-	-	-
Smallmouth bass	-	82	-	-	-	-	-

Program	Schuylkill River 1972	1973	1974	1975	1976	1977	1978
Water Quality	-	-	70	120	120	120	-
Phytoplankton	-	-	-	-	-	-	-
Periphyton	-	28	81	-	-	-	-
Macrophytes	-	-	-	-	-	-	-
Benthic Macroinvertebrates	66	72	54	-	64	-	-
Macroinvertebrate Drift	-	84	69	-	-	-	-
Larval Fish Drift	-	136	56	-	-	-	-
Larval Fish Trap	-	-	-	-	-	-	-
Larval Fish Push Net	-	-	-	-	-	-	-
Seine	-	-	-	87	80	-	-
Small Fish Population Estimates	-	-	-	-	-	-	-
Large Fish Population Estimates	-	10	4	14	-	-	-
Large Fish Catch per Unit Effort	-	-	-	-	-	-	-
Vincent Trap Net	-	-	-	-	-	-	-
Age and Growth							
Redfin pickerel	-	37	2[14]	-	-	-	-
White sucker	-	172	-	-	-	-	-
Brown bullhead	-	-	-	-	-	-	-
Redbreast sunfish	-	449	-	210	-	-	-
Green sunfish	-	558	-	204	-	-	-
Pumpkinseed	-	-	-	-	-	-	-
Smallmouth bass	-	-	-	-	-	-	-

[1] One sample consisted of four sample units.
[2] One sample consisted of one aerial survey.
[3] One sample consisted of four sample units for the Schuylkill River (1972-1976) and for Perkiomen Creek and East Branch Perkiomen Creek (July 1973-1976). Five sample units comprised one sample for Perkiomen Creek and East Branch Perkiomen Creek (Jan 1972-June 1973).
[4] One sample consisted of two sample units.
[5] One sample consisted of one net contents per unit time per site per date (time unit is usually 1 hour on the Schuylkill River and Perkiomen Creek and 4 hours on the East Branch Perkiomen Creek).
[6] One sample consisted of one net contents per unit time per site per date (time unit is usually 4 hours).
[7] One sample consisted of one site per date.
[8] One sample consisted of one date per site.
[9] One sample consisted of one electrofishing pass per site date (one population estimate is determined from 3 passes at a site per date).
[10] One sample consisted of one date per site (depending on type of estimate, 2-8 dates per site per year constitutes one population estimate).
[11] One sample consisted of one date per site.
[12] One sample consisted of one net day per site.
[13] One sample consisted of the number of specimens per species.
[14] These fish were collected from Culvert Creek, a tributary of the East Branch Perkiomen Creek, approximately 235 m from the East Branch confluence.

TABLE 2.2-8

NUMBER OF SAMPLES BY YEAR, PROGRAM, AND SITE COLLECTED FROM THE SCHUYLKILL RIVER, 1971-1978 (1)

Program/Sites	1971	1972	1973	1974	1975	1976	1977	1978
Water Quality								
S77440	-	-	-	14	24	-	-	-
S77660(2)	-	-	-	-	-	-	-	-
Sublocation 1	-	-	-	-	-	24	24	-
Sublocation 2	-	-	-	-	-	24	24	-
Sublocation 3	-	-	-	-	-	24	24	-
S77140	-	-	-	14	24	24	24	-
S77040	-	-	-	14	24	24	24	-
S73880	-	-	-	-	14	24	24	-
S72500	-	-	-	-	-	-	24	-
Phytoplankton								
S77720	-	-	29	43	-	-	-	-
Periphyton								
S77580	-	-	25	9	-	-	-	-
S77260	-	-	24	27	-	-	-	-
Macrophytes	-	-	-	1	-	-	3	-
Benthic Macroinvertebrates								
S78620	-	8	12	12	11	12	-	-
S76760	-	11	12	10	11	12	-	-
S75770	-	7	12	12	-	11	-	-
Macroinvertebrate Drift								
S77560	-	132	132	144	72	-	-	-
S75770	-	132	-	-	-	-	-	-
Larval Fish Drift								
S77560	-	-	-	218	504	880	-	-
Larval Fish Trap								
S77560	-	-	-	-	82	-	-	-
Larval Fish Push Net								
S78973	-	-	-	-	-	8	-	-
S78432	-	-	-	-	-	8	-	-
S77970	-	-	-	-	-	8	-	-
S77550	-	-	-	-	-	8	-	-
S77485	-	-	-	-	-	8	-	-
S77320	-	-	-	-	-	8	-	-
S77230	-	-	-	-	-	8	-	-
S77161	-	-	-	-	-	8	-	-
S76970	-	-	-	-	-	8	-	-
S76840	-	-	-	-	-	8	-	-

TABLE 2.2-8 (Cont'd)

Program/Sites	1971	1972	1973	1974	1975	1976	1977	1978
Larval Fish Push Net								
S76794	-	-	-	-	-	8	-	-
S76632	-	-	-	-	-	8	-	-
S75781	-	-	-	-	-	8	-	-
Seine								
S81750	-	-	-	-	12	12	-	-
S78900	-	-	-	-	12	12	-	-
S78460	-	-	-	-	12	12	-	-
S77960	-	-	-	-	12	12	-	-
S77240	-	-	-	-	12	12	-	-
S77220	-	-	-	-	12	12	-	-
S77010	-	-	-	-	12	12	-	-
S76840	-	-	-	-	12	12	-	-
S76820	-	-	-	-	12	12	-	-
S76310	-	-	-	-	12	12	-	-
S75730	-	-	-	-	12	12	-	-
Small Fish Population Estimates								
S78140	-	-	3	-	-	-	-	-
S78040	-	-	-	-	3	-	-	-
S77940	-	-	3	-	-	-	-	-
S77740	-	-	-	-	-	-	-	-
Sublocation 1	-	-	3	-	-	-	-	-
Sublocation 5	-	-	3	3	3	3	-	-
S77640	-	-	-	3	3	3	-	-
S77440	-	-	3	-	3	-	-	-
S77140	-	-	3	3	3	-	-	-
S77040	-	-	3	3	3	3	-	-
S76940	-	-	3	-	-	-	-	-
S76640	-	-	3	-	3	2	-	-
S76540	-	-	3	-	-	-	-	-
Large Fish Population Estimates								
S79400	-	-	-	5	-	-	5	-
S78040	-	-	8	-	-	-	-	-
S77240	-	-	9	3	7	-	6	-
S76440	-	-	10	3	7	-	6	-
S76040	-	-	10	-	-	-	-	-
S74365	-	-	-	6	-	-	6	-
Large Fish Catch-per-Unit-Effort								
S79310	-	-	-	-	-	6	10	8
S77640	-	-	-	-	-	6	9	9
S76940	-	-	-	-	-	-	9	9
S76440	-	-	-	-	-	6	10	9
S74365	-	-	-	-	-	6	9	9
S72885	-	-	-	-	-	6	8	-

TABLE 2.2-8 (Cont'd)

Program/Sites	1971	1972	1973	1974	1975	1976	1977	1978
Vincent Trap Net								
S73810	32	23	24	25	14	26	-	-
S73800	32	23	24	25	14	26	-	-
S72960	32	24	24	25	14	26	-	-
S72950	30	22	24	24	14	26	-	-
S72120	28	24	34	23	14	26	-	-
Age and Growth								
S79310								
White sucker	-	-	-	-	-	-	-	-
Brown bullhead	-	-	33	-	-	14	-	-
Redbreast sunfish	-	-	-	-	-	-	-	-
Pumpkinseed	-	-	47	-	-	-	-	-
S77240								
White sucker	-	-	127	-	-	-	-	-
Brown bullhead	-	-	111	-	44	48	-	-
Redbreast sunfish	-	-	265	-	43	-	-	-
Pumpkinseed	-	-	62	-	23	-	-	-
S76440								
White sucker	-	-	176	-	-	-	-	-
Brown bullhead	-	-	66	-	24	33	-	-
Redbreast sunfish	-	-	279	-	45	-	-	-
Pumpkinseed	-	-	228	-	43	-	-	-
S72885								
White sucker	-	-	-	-	-	-	-	-
Brown bullhead	-	-	31	-	-	37	-	-
Redbreast sunfish	-	-	-	-	-	-	-	-
Pumpkinseed	-	-	-	-	-	-	-	-

(1) See footnotes in Table 2.2-7 for definition of what constitutes one sample.
(2) See Subsection 6.1.1.1.1 for a description of these sublocations.

TABLE 2.2-9

NUMBER OF SAMPLES BY MONTH, PROGRAM, AND YEAR COLLECTED FROM THE SCHUYLKILL RIVER NEAR LIMERICK GENERATING STATION, 1971-1978 (1)

Program/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Quality												
1974	-	-	-	-	-	6	6	6	6	6	6	6
1975	6	6	6	6	6	8	8	8	8	8	8	8
1976	12	12	12	12	12	12	12	12	12	12	12	12
1977	14	14	14	14	14	14	14	14	14	14	14	14
Phytoplankton												
1973	-	-	-	-	-	4	5	4	4	5	4	3
1974	4	4	4	4	5	1	2	4	4	4	4	3
Periphyton												
1973	-	-	-	-	4	8	8	8	5	10	2	4
1974	1	2	3	1	4	1	2	6	6	7	3	-
Macrophytes												
1974	-	-	-	-	-	-	-	-	-	1	-	-
1977	-	-	-	-	1	-	1	1	-	-	-	-
Benthic Macroinvertebrates												
1972	2	2	1	-	3	3	2	2	3	3	2	3
1973	3	3	3	3	3	3	3	3	3	3	3	3
1974	3	3	3	3	3	3	3	3	3	2	3	2
1975	-	2	2	2	2	2	2	2	2	2	2	2
1976	2	3	3	3	3	3	3	3	3	3	3	3
Macroinvertebrate Drift												
1972	-	12	12	12	12	12	12	12	12	12	12	12
1973	12	12	12	12	-	12	12	12	12	12	12	12
1974	12	12	12	12	12	12	12	12	12	12	12	12
1975	-	-	-	-	12	12	12	12	12	12	-	-
Larval Fish Drift												
1974	-	-	-	40	48	40	32	34	24	-	-	-
1975	-	-	-	-	72	144	72	144	72	-	-	-
1976	-	-	-	-	180	308	200	192	-	-	-	-
Larval Fish Trap												
1975	-	-	-	-	12	24	12	24	10	-	-	-
Larval Fish Push Net												
1976	-	-	-	-	-	26	39	39	-	-	-	-

TABLE 2.2-9 (Cont'd)

Program/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seine												
1975	11	11	11	11	11	11	11	11	11	11	11	11
1976	11	11	11	11	11	11	11	11	11	11	11	11
Small Fish Population Estimates(2)	-	-	-	-	-	-	-	-	-	-	-	-
Large Fish Population Estimates(2)	-	-	-	-	-	-	-	-	-	-	-	-
Large Fish Catch per Unit Effort												
1976	-	-	-	-	-	-	5	5	5	5	5	5
1977	-	6	6	6	6	6	6	6	6	1	4	2
1978	-	-	-	5	5	5	5	5	5	5	4	5
Vincent Trap Net												
1971	-	-	-	-	10	28	40	26	20	20	10	-
1972	-	-	-	-	19	10	20	20	20	19	8	-
1973	-	-	-	-	10	20	20	20	20	20	10	-
1974	-	-	-	-	20	20	20	20	14	20	8	-
1975	-	-	-	-	10	10	10	10	10	10	10	-
1976	-	-	-	-	20	20	20	20	20	10	20	-
Age and Growth(2)	-	-	-	-	-	-	-	-	-	-	-	-

(1)See footnotes in Table 2.2-7 for definition of what constitutes one sample.
(2)Samples for these programs were not included because only annual data was utilized.

TABLE 2.2-10

LISTING OF PHYTOPLANKTON TAXA WITH QUARTERLY (SEASONAL) DENSITIES[1] PER TAXA COLLECTED FROM STATION S77720, SCHUYLKILL RIVER, LIMERICK GENERATING STATION, 1974

Taxa	Winter Min	Winter Max	Winter Mean	Spring Min	Spring Max	Spring Mean
Chlorophyta						
Eudorina	-	500	45	-	2,000	182
Gonium	-	-	-	-	-	-
Pandorina	-	-	-	-	-	-
Pleodorina	-	-	-	-	-	-
Volvox	-	-	-	-	-	-
Chlorococcum	-	-	-	-	4,000	364
Ankistrodesmus	1,000	5,000	1,612	2,000	93,000	26,727
Kirchneriella	-	-	-	-	2,000	272
Selenastrum	-	-	-	-	32,000	3,455
Errerella	-	-	-	-	2,000	182
Micractinium	-	-	-	-	3,000	636
Dictyosphaerium	-	-	-	-	-	-
Astinastrum	-	-	-	-	-	-
Coelastrum	-	-	-	-	-	-
Scenedesmus	-	1,000	227	4,000	34,000	8,910
Hydrodictyon	-	-	-	-	-	-
Pediastrum	-	1,000	90	-	3,000	545
Oocystis	-	-	-	-	1,000	91
Oedogonium	-	-	-	-	-	-
Ulothrix	-	-	-	-	-	-
Microspora	-	-	-	-	-	-
Cladophora	-	-	-	-	4,000	545
Mougeotia	-	-	-	-	-	-
Spirogyra	-	-	-	-	-	-
Netrium	-	1,334	121	-	-	-
Closterium	-	-	-	-	21,000	2,273
Cosmarium	-	667	60	-	4,000	909
Zygnema	-	-	-	-	-	-
Staurastrum	-	-	-	-	2,000	455
Euglenophyta						
Euglena	-	-	-	-	2,000	454
Phacus	-	-	-	-	-	-
Pyrrhophyta						
Ceratium	-	-	-	-	-	-
Bacillariophyta						
Dinobryon	-	2,500	1,197	-	10,000	4,000
Mallomonas	-	2,000	182	-	2,000	364
Synura	-	500	45	-	-	-
Coscinodiscus	-	-	-	-	2,000	182
Cyclotella	2,668	404,000	105,561	63,000	518,000	218,636
Melosira	2,000	16,008	6,137	2,000	53,000	15,545
Rhizosolenia	-	-	-	-	1,000	273
Stephanodiscus	-	1,000	91	-	-	-

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TABLE 2.2-10 (Cont'd)

Taxa	Winter Min	Winter Max	Winter Mean	Spring Min	Spring Max	Spring Mean
Bacillariophyta (cont.)						
Asterionella	3,500	22,000	11,743	6,000	32,000	15,455
Diatoma	1,500	17,000	5,910	2,000	96,000	24,455
Fragilaria	-	2,000	712	-	14,000	4,364
Synedra	5,000	43,000	16,092	23,000	240,000	70,090
Meridion	-	11,000	3,500	-	7,000	2,091
Opephora	-	-	-	-	9,000	2,636
Tabellaria	-	500	45	-	-	-
Achnanthes	-	4,669	1,364	-	2,000	4,727
Cocconeis	-	5,000	1,409	-	16,000	7,636
Gyrosigma	-	1,000	152	-	3,000	818
Navicula	24,500	199,000	83,035	205,000	1,162,000	492,545
Pinnularia	-	1,334	485	-	5,000	818
Gomphonema	-	11,000	2,773	-	10,000	4,545
Cymbella	1,334	10,000	3,940	3,000	64,000	18,545
Nitzschia	8,500	69,000	24,153	18,000	170,000	52,091
Cymatopleura	-	1,000	91	-	-	-
Surinella	-	500	91	-	3,000	818
Eunotia	-	2,000	182	-	4,000	455
Stauroneis	-	-	-	-	-	-
Rhoicosphenia	-	-	-	-	-	-
Cyanophyta						
Coelosphaerium	-	-	-	-	-	-
Chroococcus	-	-	-	-	-	-
Merismopedia	-	-	-	-	-	-
Microdystis	-	-	-	-	-	-
Gloeocapsa	-	-	-	-	-	-
Stichosephon	-	-	-	-	-	-
Lyngbya	-	-	-	-	-	-
Oscillatoria	-	1,000	273	-	1,000	364
Anabaena	-	1,000	242	-	10,000	2,091
Aphanizomenon	-	-	-	-	-	-
Cylindrospermum	-	-	-	-	-	-
Rivularia	-	-	-	-	-	-
Total	50,002	837,512	271,559	328,000	2,661,000	989,544

TABLE 2.2-10 (Cont'd)

Taxa	Summer Min	Summer Max	Summer Mean	Fall Min	Fall Max	Fall Mean
Chlorophyta						
Eudorina	-	-	-	-	-	-
Gonium	-	1,000	222	-	-	-
Pandorina	-	-	-	-	-	-
Pleodorina	-	-	-	-	-	-
Volvox	-	-	-	-	-	-
Chlorococcum	-	46,000	23,555	-	69,000	9,500
Ankistrodesmus	3,000	102,000	59,444	4,000	242,000	62,583
Kirchneriella	-	17,000	5,111	-	27,000	4,083
Selenastrum	1,000	134,000	44,000	-	27,000	7,167
Errerella	-	-	-	-	-	-
Micractinium	-	2,000	555	-	-	-
Dictyosphaerium	-	2,000	333	-	50,000	9,833
Astinastrum	1,000	87,000	28,222	-	8,000	1,500
Coelastrum	-	82,000	28,889	-	51,000	9,583
Scenedesmus	6,000	668,000	235,444	2,000	548,000	114,917
Hydrodictyon	-	-	-	-	-	-
Pediastrum	6,000	280,000	86,778	-	156,000	24,000
Oocystis	-	12,000	2,667	-	6,000	500
Oedogonium	-	-	-	-	-	-
Ulothrix	-	4,000	556	-	-	-
Microspora	-	-	-	-	8,000	1,750
Cladophora	-	-	-	-	2,000	250
Mougeotia	-	4,000	778	-	6,000	1,167
Spirogyra	-	-	-	-	-	-
Netrium	-	-	-	-	-	-
Closterium	-	26,000	7,222	-	18,000	6,167
Cosmarium	-	284,000	48,333	-	9,000	3,250
Zygnema	-	8,000	1,111	-	-	-
Staurastrum	1,000	42,000	10,444	-	22,000	4,000
Euglenophyta						
Euglena	-	4,000	444	-	40,000	3,417
Phacus	-	-	-	-	-	-
Pyrrhophyta						
Ceratium	-	7,000	1,000	-	-	-
Bacillariophyta						
Dinobryon	-	1,000	111	-	33,000	6,583
Mallomonas	-	-	-	-	-	-
Synura	-	1,000	111	-	-	-
Coscinodiscus	-	12,000	2,333	-	3,000	500
Cyclotella	16,000	306,000	161,000	16,000	140,000	62,583
Melosira	-	254,000	87,667	1,000	96,000	34,333
Rhizosolenia	-	1,000	444	-	-	-
Stephanodiscus	-	17,000	3,222	6,000	194,000	40,000

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TABLE 2.2-10 (Cont'd)

Taxa	Summer Min	Summer Max	Summer Mean	Fall Min	Fall Max	Fall Mean
Bacillariophyta (cont.)						
Asterionella	-	3,000	556	-	318,000	60,333
Diatoma	-	8,000	3,500	-	36,000	7,917
Fragilaria	1,000	32,000	16,556	-	48,000	9,333
Synedra	3,000	42,000	16,000	-	87,000	17,167
Meridion	-	-	-	-	6,000	500
Operhora	-	5,000	2,111	-	3,000	333
Tabellaria	-	6,000	667	-	51,000	4,250
Achnanthes	-	1,000	111	-	-	-
Cocconeis	5,000	45,000	22,000	1,000	24,000	11,667
Gyrosigma	-	26,000	4,778	-	12,000	2,667
Navicula	96,000	558,000	391,444	35,000	528,000	231,500
Pinnularia	-	11,000	1,500	-	6,000	583
Gomphonema	-	1,000	111	-	3,000	250
Cymbella	-	39,000	11,833	-	24,000	6,833
Nitzschia	8,000	119,000	43,444	3,000	122,000	52,167
Cymatopleura	-	-	-	-	-	-
Surinella	-	5,000	2,000	-	24,000	7,833
Eunotia	-	-	-	-	3,000	250
Stauroneis	-	14,000	1,555	-	-	-
Rhoicosphenia	-	10,000	2,444	-	20,000	4,833
Cyanophyta						
Coelosphaerium	-	1,000	111	-	-	-
Chroococcus	-	-	-	-	4,000	583
Merismopedia	-	-	-	-	-	-
Microdystis	-	-	-	-	-	-
Gloeocapsa	-	-	-	-	4,000	667
Stichosephon	-	-	-	-	4,000	333
Lyngbya	-	-	-	-	-	-
Oscillatoria	-	3,000	444	-	14,000	2,250
Anabaena	-	18,000	5,222	-	6,000	1,750
Aphanizomenon	-	-	-	-	-	-
Cylindrospermum	-	-	-	-	4,000	333
Rivularia	-	-	-	-	9,000	917
Total	147,000	3,351,000	1,366,383	68,000	3,115,000	832,915

(1) Densities of phytoplankton are listed as numbers of organisms per liter of water.

TABLE 2.2-11 (Page 1 of 2)

PERIPHYTON PRODUCTION LISTED AS TOTAL BIOMASS--STANDING CROP (MG/DM^2) AND TOTAL PRODUCTIVITY RATES ($MG/DM^2/DAY^{-1}$) (1)

Dates	Stations Exposure Time (Days)	S77260		S77580	
		mg/dm^2	$mg/dm^2/day^{-1}$	mg/dm^2	$mg/dm^2/day^{-1}$
17 May 1973	7(2)	29.9	-(3)	8.8	-
24 May	14	78.9	7.00	34.7	3.70
6 Jun	27	5.0	-5.68(4)	7.6	-2.08
14 Jun	8	2.6	-	3.7	-
21 Jun	15	21.8	2.74	22.2	2.64
28 Jun	22	19.2	-0.37	34.4	1.74
28 Jun	7	5.4	-	6.8	-
9 Jul	18	5.8	0.04	5.1	-0.16
16 Jul	25	40.4	4.94	39.2	4.87
16 Jul	7	26.8	-	20.8	-
24 Jul	15	57.7	3.86	20.0	-0.10
31 Jul	22	42.4	-2.19	24.0	0.57
31 Jul	7	19.2	-	11.5	-
6 Aug	14	23.5	0.61	9.6	-0.27
13 Aug	21	26.1	0.37	11.5	0.27
13 Aug	7	11.6	-	6.4	-
21 Aug	15	30.4	2.35	16.9	1.31
28 Aug	22	59.7	4.19	20.9	0.57
28 Aug	7	25.6	-	7.4	-
4 Sep	14	29.0	0.49	9.1	0.24
11 Sep	21	54.4	3.63	22.8	1.96
11 Sep	7	29.3	-	13.2	-
24 Sep	20	-(5)	-	10.2	-0.23
1 Oct	27	-	-	11.8	0.23
1 Oct	7	8.5	-	8.7	-
8 Oct	14	16.9	1.20	9.6	0.13
15 Oct	21	33.0	16.1	19.0	1.34
22 Oct	7	7.2	-	4.2	-
29 Oct	14	17.4	1.46	10.1	0.84
5 Nov	21	13.7	-0.03	8.9	-0.17
13 Dec	15	4.0	-	5.0	-
20 Dec	22	3.8	-0.03	3.2	-0.26

TABLE 2.2-11 (Cont'd)

Dates	Stations Exposure Time (Days)	S77260 mg/dm²	S77260 mg/dm²/day⁻¹	S77580 mg/dm²	S77580 mg/dm²/day⁻¹
30 Jan 1974	14	1.5	-	-(6)	-
6 Feb	21	4.7	0.23	-	-
13 Feb	28	13.2	0.40	-	-
12 Mar	7	6.9	-	-	-
19 Mar	14	20.7	1.97	-	-
26 Mar	21	14.8	-0.42	-	-
30 Apr	8	81.6	-	-	-
7 May	15	133.9	7.47	-	-
14 May	22	16.6	-8.38	-	-
21 May	7	8.5	-	-	-
28 May	14	22.2	1.96	-	-
4 Jun	21	23.9	0.12	-	-
30-31(7) Jul	7	2.8	-	2.8	-
6-7 Aug	14	20.0	2.46	6.2	0.49
13-14 Aug	21	17.9	-0.15	18.7	0.89
27-28 Aug	7	1.0	-	3.9	-
3-4 Sep	14	13.3	1.75	73.8	9.98
10-11 Sep	21	72.4	4.22	78.9	0.36
24-25 Sep	7	1.7	-	0.2	-
1-2 Oct	14	2.5	0.10	3.4	0.45
8-9 Oct	21	4.0	0.11	9.3	0.84
16 Oct	7	1.0	-	-	-
23 Oct	14	2.9	0.30	-	-
30 Oct	21	3.4	0.004	-	-
13 Nov	7	0.6	-	-	-
20 Nov	14	5.2	0.65	-	-
27 Nov	21	8.8	0.26	-	-

[1] Values are listed as ash-free dry weights by station for 1973 and 1974, Schuylkill River, Limerick Generating Station.
[2] This represents the actual number of days that the artificial plates are exposed to periphytic growth from the date the samplers were set.
[3] Dash indicates no values recorded because of low growth rate during the first seven (7) days of colonization during each sampling period.
[4] A negative number for production rates indicates a sloughing of periphyton biomass resulting from scouring by high river flows.
[5] No values recorded due to loss of Plexiglas plates at station S77260.
[6] No samples were collected from this station except for peak growing season during July, August, September, and early October.
[7] These stations were sampled on two (2) consecutive days. On the first date station S77580 was sampled while station S77260 was sampled on the following day.

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TABLE 2.2-12

SPECIES LIST AND RELATIVE QUALITATIVE ABUNDANCE OF AQUATIC MACROPHYTES IN THE VICINITY OF LIMERICK GENERATING STATION

Scientific Name	Common Name	Abundance (1)
Thallophyta		
Chlorophyceae	Green algae	
Cladophora spp.		A
Bryophyta		
Musci	Moss	
Fissidens sp.		U
Spermatophyta		
Najadaceae		
Potamogeton crispus	Curly-leafed pondweed	C
P. berchtoldi	Thin-leafed pondweed	C
Alismataceae		
Saggittaria latifolia	Arrowhead	R
Hydrocharitaceae		
Elodea canadensis	Waterweed	R
Lemnaceae		
Lemna minor	Lesser duckweed	U
Pontederiaceae		
Heteranthera dubia	Water stargrass	A
Onagraceae		
Jussiaea repens	Creeping primrose willow	U
Haloragaceae		
Myriophyllum exalbescens	Water milfoil	A

(1) A = abundant, C = common, U = uncommon, R = rare

SPECIES LIST AND RELATIVE ABUNDANCE OF MACROINVERTEBRATES COLLECTED BY ALL METHODS FROM THE SCHUYLKILL RIVER, 1970-1976

PORIFERA
- Spongillidae[1] (R[2],25[3])

COELENTERATA
- *Hydra*[1] spp. (R,9)

PLATHYHELMINTHES
- Plagiostomidae
  - *Hydrolimax grisea* (U,19)
- Planariidae
  - *Dugesia dorotocephala*[1] (R,19)
  - *D. tigrina* (C,19)

NEMERTEA
- *Prostoma graecense* (C,12)

NEMATODA (U,9)

BRYOZOA
- *Urnatella gracilis*[1] (R,9)

ANNELIDA
- Oligochaeta
  - Lumbricidae (U,2)
  - Tubificidae
    - *Limnodrilus angustipenis* (U,2)
    - *L. cervix* (C,2)
    - *L. hoffmeisteri* (A,2)
    - *L. claparedianus* (U,2)
    - *Branchiura sowerbyi* (U,2)
    - *Peloscolex ferox* (R,2)
    - *P. multisetosus* (A,2)
    - *Psammoryctides curvisetosus*
    - *Rhyacodrilus* spp. (R,2)
    - *Audlodrilus limnobius* (R,2)
  - Aeolosomatidae[1] (R,2)
  - Naididae (U,2)
  - Lumbriculidae (A,2)
    - *Lumbriculus* sp. A
    - *L. variegata*
- Polychaeta
  - *Manayunkia speciosa*[1] (U,26)
- Hirudinea
  - Glossiphoniidae
    - *Glossiphonia complanata* (R,29)
    - *G. heteroclita* (R,29)
    - *Helobdella stagnalis* (R,29)
    - *H. lineata* (U,29)
    - *H. fusca* (R,29)
    - *H. elongata* (C,29)
    - *Placobdella ornata* (R,29)
    - *P. papillifera* (R,29)
    - *P. parasitica* (R,29)
    - *Actinobdella triannulata* (R,29)
    - *Batracobdella phalera* (U,29)
  - Piscicolidae
    - *Piscicolaria reducta* (R,22)
    - *Myzobdella lugubris*[1] (R,22)

ANNELIDA (cont'd)
- Hirudinea (cont'd)
  - Erpobdellidae
    - *Erpobdella punctata* (C,29)
    - *Mooreobdella fervida* (R,29)

ARTHROPODA
- Isopoda
  - Asellidae
    - *Asellus communis* (C,34)
    - *Lirceus* sp.[1] (R,25)
- Amphipoda
  - Gammaridae
    - *Gammarus fasciatus* (C,16)
    - *Crangonyx gracilis* (A,16)
    - *Stygonectes pizzini* (C,17)
- Decapoda
  - Cambaridae
    - *Cambarus bartoni* (U,15)
    - *Orconectes limosus* (C,15)
    - *O. obscurus* (U,15)
- Hydracarina (U,25)
- Collembola
  - Isotomidae
    - *Isotoma* sp.[1] (U,33)
    - *Isotomurus palustris*[1] (U,33)
  - Poduridae
    - *Podura aquatica*[1] (R,33)
  - Sminthuridae[1] (R,33)
- Ephemeroptera
  - Ephemeridae
    - *Ephemera simulans*
    - *E. guttulata* (R,6)
    - *Hexagenia limbata* (R,6)
    - *Potamanthus* (R,6)
  - Caenidae
    - *Caenis* spp. (U,6)
    - *Brachycerus* (R,6)
    - *Tricorythodes* sp. (C,6)
  - Ephemerellidae
    - *Ephemerella deficiens* (U,6)
    - *E. attenuata* (R,6)
    - *E. dorothea* (R,6)
    - *E. aestiva* (U,6)
    - *E. frisoni* (R,6)
    - *E. invaria* (U,6)
    - *E. needhami* (R,6)
    - *E. rotunda* (U,6)
    - *E. serratoides* (R,6)
    - *E. simplex* (R,6)
    - *E. temporalis* (C,6)
    - *E. tuberculata* (R,6)
    - *E. verismilis* (U,6)

ARTHROPODA (cont'd)
- Isopoda (cont'd)
  - Leptophlebiidae
    - *Leptophlebia* spp. (R,6)
    - *Paraleptophlebia moerens* (R,6)
    - *P. mollis* (R,6)
  - Baetidae
    - *Baetis intercalaris* (C,6)
    - *B. simplex* (R,6)
    - *B. levitans* (R,6)
    - *B. flavistriga* (R,6)
    - *B. vagans* (R,6)
    - *B. phoebus* (R,6)
    - *B. pluto* (R,6)
    - *Ameletus lineatus* (R,6)
    - *A. Ludens* (R,6)
    - *Pseudocloeon myrsum*[1] (C,6)
    - *P. dubrium* (R,6)
    - *Heterocloeon* sp. (R,6)
    - *Centroptilum* sp.[1] (R,6)
  - Siphlonoridae
    - *Siphlonurus marshalli*[1] (R,6)
    - *Isonychia* sp. (U,6)
  - Heptageniidae
    - *Stenacron interpunctatum* (U,20)
    - *S. gildersleevei*[1] (R,20)
    - *Stenonema ares* (R,20)
    - *S. bipunctatum* (R,20)
    - *Stenonema fuscum* (R,20)
    - *S. integrum* (U,20)
    - *S. ithaca* (R,20)
    - *S. pulchellum* (R,20)
    - *S. quinquespinum* (R,20)
    - *S. terminatum* (C,20)
    - *S. nepotellum* (R,20)
    - *S. rubromaculatum* (R,20)
    - *S. rubrum*[1] (R,20)
    - *S. vicarium* (R,20)
    - *S. tripunctatum* (R,20)
    - *Epeorus* sp.[1] (R,6)
- Odonata
  - Gomphidae
    - *Dromogomphus Spinosus* (R,23)
    - *Gomphus fraternus* (R,23)
    - *Lanthus albistylus* R,23)
    - *L. parulus* (R,23)
    - *Ophiogomphus aspersus* (R,23)
    - *Stylurus spiniceps* (R,23)
  - Libellulidae
    - *Leucorrhinia* sp.[1] (R,23)
    - *Perithemis* (R,23)

ARTHROPODA (cont'd)
- Ephemeroptera (cont'd)
  - Macromiidae
    - Macromia alleghaniensis (U,23)
  - Calopteryqidae
    - Calopteryx sp. (U,9)
    - Hetaerina (R,9)
  - Coenagrionidae
    - Anomalagrion hastatum[1] (R,9)
    - Argia sp. (C,9)
    - Enallagma spp. (R,9)
    - Ischnura spp. (U,9)
  - Aeschnidae
    - Boyeria vinosa (U,23)
  - Lestidae
    - Lestes[1] (R,9)
- Plecoptera
  - Taeniopteryqidae
    - Taeniopteryx nivalis (R,31)
    - T. maura (R,31)
    - T. parvula (R,31)
  - Capniidae
    - Allocapnia (U,31)
  - Nemouridae
    - Amphinemura delosa (R,31)
  - Perlidae
    - Brachyptera[1] (R,31)
    - Neoperla clymene (R,31)
    - Phasganophora capitata (U,31)
    - Perlesta placida (U,31)
    - Acroneuria abnormis (U,31)
    - A. internata (R,31)
    - A. lycorias (R,31)
    - A. melas (R,31)
    - A. perplexa (R,31)
    - A. ruralis (R,31)
  - Perlodidae
    - Isoperla bilineata (R,31)
  - Chloroperlidae
    - Alloperla mediana[1] (R,14)
- Hemiptera
  - Gerridae
    - Metrobates[1] (U,33)
  - Corixidae
    - Trichocorixa[1] (R,33)
    - Sigara[1] (R,33)
- Megaloptera
  - Sialidae
    - Sialis sp. (C,32)
  - Corydalidae
    - Chauliodes sp.[1] (R,32)
    - Corydalus cornutus (U,32)
    - Nigronia serricornis (U,32)
- Neuroptera
  - Sisyridae
    - Sisyra vicarium[1] (R,33)
    - Climacia areolaris (U,33)

ARTHROPODA (cont'd)
- Coleoptera
  - Haliplidae
    - Peltodytes duodecimpunctatus (R,33)
  - Dytiscidae
    - Agabus (R,33)
    - Hydroporus consimilis[1] (R,33)
    - Laccophilus proximus[1] (R,33)
    - Gyrinus analis (R,8)
  - Hydrophilidae
    - Berosus peregrinus (C,33)
    - Enochrus (R,33)
    - Laccobius[1] (R,33)
    - Hydrochus (R,33)
    - Hydrophilus (R,33)
    - Cercyon (R,33)
  - Hydrophilidae
    - Sphaeridium spp. (R,33)
  - Psephenidae
    - Psephenus herricki (C,3)
    - Ectopria[1] (R,3)
  - Dryopidae
    - Helichus sp. (R,3)
  - Elmidae
    - Ancyronyx variegata (R,3)
    - Dubiraphia vittata (C,3)
    - D. vivittata (C,3)
    - D. quadrinotata (R,3)
    - Microcylloepus pusillus[1] (R,3)
    - Ortiogeryus trivittatus (C,3)
    - Stenelmis crenata (R,3)
    - Stenelmis spp. (C,3)
    - Macronychus glabratus[1] (R,3)
  - Chrysomelidae
    - Galerucella (R,33)
- Trichoptera
  - Glossosomatidae
    - Glossosoma sp. (R,28)
  - Ryacophilidae
    - Rhyacophila amicus (R,28)
  - Philopotamidae
    - Chimarra obscura (U,28)
    - C. aterrima (U,28)
    - Wormaldia moestus[1] (R,28)
    - W. shawnee[1] (R,28)
  - Psychomyiidae
    - Psychomia (R,11)
    - Polycentropus remotus (R,28)
    - Neureclipsis sp. (U,28)
  - Limnephilidae
    - Neophylax sp.[1] (R,32)
  - Leptoceridae
    - Ceraclea sp. A (R,28)
    - Oecetis spp. (U,38)
    - Mystacides sepulchralis (R,28)
    - Triaenodes sp. (R,28)

ARTHROPODA (cont'd)
  - Hydropsychidae
    - Cheumatopsyche spp. (A,28)
    - Hydropsyche betteni (C,18)
    - H. phalerata (A,28)
    - H. simulans[1] (R,28)
    - H. sp. A (R,35)
    - H. sp. B[1] (R,35)
    - H. sp. C (C,35)
    - H. sp. D (R,35)
    - H. sp. E (U,35)
    - H. sp. F[1] (R,35)
    - H. sp. G[1] (R,35)
  - Hydroptilidae
    - Hydroptila ajax (R,28)
    - H. spatulata C, 28)
    - H. armata (R,28)
    - H. waubesiana (R,28)
    - Leucotrichia pictipes[1] (R,28)
    - Agraylea sp. (R,28)
    - Oxyethira sp. (R,28)
- Lepidoptera
  - Pyralididae
    - Paraqyractis sp. (U,33)
- Diptera
  - Tipulidae
    - Limnophila sp. (R,33)
    - Hexatoma (R,33)
    - Dicranota sp.[1] (R,33)
    - Antocha sp. (U,33)
    - Pseudolimnophila sp. (R,33)
    - Limonia sp. (R,33)
    - Tipula spp. (C,33)
  - Simuliidae
    - Simulium vittatum (U,30)
  - Chironomidae
    - Psectrotanypus dyari (R,27)
    - Procladius riparius (A,21)
    - Ablabesmyia auriensis (C,31)
    - Clinotanypus pinquis (U,1)
    - Pentaneurini spp. (A,21)
    - Tanytarsini spp. (A,21)
    - Chironomus supp. (C,21)
    - Cryptochironomus spp. (C,27)
    - Tribelos sp. (U,21)
    - Dicrotendipes sp. (U,27)
    - Glyptotendipes sp. (U,21)
    - Polypedilum supp. (A,21)
    - Paracladopelma sp. (U,21)
    - Microtendipes spp. (U,21)
    - Paralauterborniella sp. (R,21)9
    - Paratendipes sp. (R,21)
    - Stictochironomus sp. (U,21)
    - Stenochironomus sp. (R,21)
    - Parachironomus sp. (U,21)
    - Phaenopsectra sp. (C,21)

TABLE 2.2-13 (Cont'd)

ARTHROPODA (cont'd)
- Diptera (cont'd)
  - Zaverelia sp. (U,21)
  - Lasiodiamesa sp. (R,27)
  - Diamesa sp. (U,21)
  - Prodiamesa olivacea (R,27)
  - Cardiocladius obscurus (U,27)
  - Cricotopus bicinctus (A,21)
  - Other Cricotopus supp. (C,21)
  - Orthocladius sp. (C,21)
  - Eukiefferiella spp. (U,27)
  - Trichocladius sp. (U,21)
  - Trissocladius sp. (R,21)
  - Diplocladius cultriger (U,27)
  - Psectrocladius sp. (O,21)
  - Brillia sp. (U,21)
  - Smittia spp. (R,21)
  - Metriocnemus sp. (R,21)
  - Corynoneura sp. (R,27)
  - Thienemanniella sp. (R,21)
- Psychodidae
  - Psychoda sp. (C,18)
  - P. alternata[1] (U,18)
  - Pericoma sp. (R,18)
  - Telmatoscopus albipunctatus (C,18)

ARTHROPODA (cont'd)
- Diptera (cont'd)
  - Heleidae
    - Palpomyia spp. (U,33)
    - Stilobezzia sp.[1] (R,33)
    - Culicoides sp.[1] (R,33)
  - Empididae
    - Type A (U,35)
    - Type B (C,35)
  - Ephydridae
    - Brachydeutera agentata[1] (R,33)
    - Scatella-Neoscatella sp.[1] (R,33)
  - Culicidae
    - Chaoborus sp.[1] (U,33)
    - Aedes[1] (R,33)
    - Culex sp.[1] (R,33)
    - Lispe sp.[1] (R,33)
  - Mycetophilidae (R,33)
  - Dolichopodidae
    - Hydrophorus (R,33)
  - Tabanidae
    - Chrysops sp. (U,33)
    - Tabanus sp. (R,33)
  - Stratiomyiidae (R,37)
    - Eulalia (R,33)
  - Rhagionidae
    - Atherix variegata[1] (R,33)
  - Phoridae
    - Diploneura cornuta (R,33)
  - Anthyomiidae
    - Limnophora aequifrons[1] (R,33)

MOLLUSCA
- Gastropoda
  - Physidae
    - Physa heterostropha (A,24)
    - P. sayii (R,13)
  - Lymnaeidae
    - Lymnaea humilis (U,13)
  - Planorbidae
    - Gyraulus parvus (R,13)
    - Menetus sp. (R,13)
    - Promenetus exaucus (R,13)
    - Helisoma trivolvis (R,13)
    - H. anceps (A,13)
  - Ancylidae
    - Ferrissia tarda (A,13)
  - Pleuroceridae
    - Goniobasis virginica (A,13)
  - Hydrobiidae
    - Amnicola limosa (R,13)
- Pelecypoda
  - Sphaeriidae
    - Musculium (R,5)
    - S. striatinum (A,5)
    - Pisidium sp. (A,5)
  - Unionidae
    - Elliptio complanatus (R,7)
    - Alasmidonta sp.[1] (R,4)
    - Lasmigonia subviridis (R,4)

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(1) Taxa or species not collected by cylinder samplers (the primary quantitative gear).
(2) A = abundant, C = common, U = uncommon, R = rare.
(3) Numbers refer to the taxonomic references listed below. For complete citations, see the Literature Cited section.

1. Boesel (Ref 2.2-17)
2. Brinkhurst (Ref 2.2-18)
3. Brown (Ref 2.2-19)
4. Burch (Ref 2.2-20)
5. Burch (Ref 2.2-21)
6. Bruks (Ref 2.2-22)
7. Clarke and Berg (Ref 2.2-23)
8. Dillon and Dillon (Ref 2.2-24)
9. Edmondson (Ref 2.2-25)
10. Flint (Ref 2.2-26)
11. Flint (Ref 2.2-27)
12. Gibson (pers. comm.)
13. Harman and Berg (Ref 2.2-28)
14. Hitchcock (Ref 2.2-29)
15. Hobbs (Ref 2.2-30)
16. Holsinger (Ref 2.2-31)
17. Holsinger (pers. comm.)
18. Johannesen (Ref 2.2-32)
19. Kenk (pers. comm.)
20. Lewis Ref 2.2-33)
21. Mason (Ref 2.2-34)
22. Meyer (Ref 2.2-35)
23. Needham and Westfall (Ref 2.2-36)
24. Parodiz (pers. comm.)
25. Pennak (Ref 2.2-37)
26. Pettibone (pers. comm.)
27. Roback (Ref 2.2-38)
28. Ross (Ref 2.2-39)
29. Sawyer (Ref 2.2-40)
30. Stone (Ref 2.2-41)
31. Surdick and Kim (Ref 2.2-42)
32. Tarter (Ref 2.2-43)
33. Usinger (Ref 2.2-44)
34. Williams (Ref 2.2-45)
35. Consultant's Designator

NUMERICAL SUMMARY DATA ON IMPORTANT SPECIES (TAXA)(1) OF BENTHIC MACROINVERTEBRATES COLLECTED IN QUANTITATIVE SAMPLES (1972-1976) FROM THE SCHUYLKILL RIVER

Taxon	1972 No./m²	%	FO %	1973 No./m²	%	FO %	1974 No./m²	%	FO %	1975 No./m²	%	FO %	1976 No./m²	%	FO %
Station															
Dugesia tigrina															
S78620	126.3	(2)	46.9	1.7	(2)	6.3	22.2	(2)	27.1	13.4	(2)	27.3	20.5	(2)	35.4
S76760	104.1	(2)	29.5	0.3	(2)	2.1	1.6	(2)	10	3	(2)	13.6	5.5	(2)	22.9
S75770	332	3.9	32.1	5.1	(2)	10.4	4.8	(2)	8.3	-	-	-	21.2	(2)	31.8
Prostoma graecense															
S78620	152.7	(2)	34.4	2.4	(2)	6.3	14.3	(2)	16.7	91.7	(2)	36.4	31.8	(2)	29.2
S76760	98.4	(2)	27.3	18.4	(2)	18.8	-	-	-	13	(2)	20.5	11.3	(2)	10.4
S75770	446.7	5.3	39.3	4.1	(2)	8.3	15	(2)	16.7	-	-	-	33.2	(2)	18.2
Tubificidae															
S78620	345.8	2.4	43.8	1323.8	16.3	87.5	381.1	3.7	89.6	924	7.8	100	279.4	2.4	100
S76760	3123.8	50.5	90.9	3805	63.9	100	1850.8	24.2	100	3180.7	31.2	100	1960	32.4	100
S75770	3404.6	40	100	2191.6	39.1	93.8	647.2	12.9	91.7	-	-	-	1898.3	30.3	100
Erpobdella punctata															
S78620	1.5	(2)	9.4	15	(2)	33.3	15.4	(2)	20.8	10.4	(2)	36.4	3.8	(2)	20.8
S76760	3.7	(2)	11.4	7.2	(2)	22.9	7.8	(2)	25	19.7	(2)	47.7	5.8	(2)	25
S75770	2.3	(2)	10.7	4.4	(2)	20.8	1.7	(2)	10.4	-	-	-	10.4	(2)	31.8
Crangonyx gracilis															
S78620	-	-	-	40	(2)	35.4	157.4	(2)	52.1	248.1	2.1	84.1	185.8	(2)	77.1
S76760	8.9	(2)	11.4	32.4	(2)	31.3	63.5	(2)	55	288.7	2.8	88.6	316.6	5.2	75
S75770	4.1	(2)	10.7	15.7	(2)	29.2	30.1	(2)	52.1	-	-	-	431.4	6.9	72.7
Cambarus bartoni															
S78620	-	-	-	0.3	(2)	2.1	-	-	-	-	-	-	1.4	(2)	6.3
S76760	0.7	(2)	4.5	0.3	(2)	2.1	-	-	-	0.4	(2)	2.3	0.3	(2)	2.1
S75770	-	-	-	-	-	-	0.7	(2)	2.1	-	-	-	0.4	(2)	2.3
Orconectes															
S78620	0.5	(2)	3.1	-	-	-	1	(2)	6.3	0.4	(2)	2.3	1.7	(2)	10.4
S76760	0.4	(2)	2.3	1	(2)	6.3	2	(2)	12.5	4.1	(2)	15.9	1.4	(2)	8.3
S75770	-	-	-	0.7	(2)	4.2	1.1	(2)	10.4	-	-	-	1.5	(2)	9.1
Argia (nymph)															
S78620	0.3	(2)	3.1	20.5	(2)	33.3	47.5	(2)	60.4	17.9	(2)	45.5	62.5	(2)	41.7
S76760	0.4	(2)	2.3	18.8	(2)	18.8	43	(2)	42.5	65.6	(2)	47.7	24.2	(2)	39.6
S75770	-	-	-	13.3	(2)	12.5	71.4	(2)	56.3	-	-	-	84.9	(2)	52.3
Cheumatopsyche (larvae)															
S78620	24.1	(2)	37.5	215.8	2.7	64.6	1353.5	13.0	95.8	1574.5	13.3	100	2513	21.8	100
S76760	2.5	(2)	15.9	5.1	(2)	20.8	46.7	(2)	45	161.3	(2)	72.7	53.3	(2)	60.4
S75770	1.2	(2)	7.1	2	(2)	12.5	61.5	(2)	43.8	-	-	-	49.2	(2)	63.6
Cheumatopsyche (pupae)															
S78620	-	-	-	-	-	-	-	-	-	2.2	(2)	6.8	0.7	(2)	4.2
S76760	-	-	-	-	-	-	-	-	-	-	-	-	0.3	(2)	2.1
S75770	-	-	-	-	-	-	-	-	-	-	-	-	0.7	(2)	4.5

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TABLE 2.2-14
(Cont'd)

Taxon	1972 No./m²	%	FO %	1973 No./m²	%	FO %	1974 No./m²	%	FO %	1975 No./m²	%	FO %	1976 No./m²	%	FO %
Station															
Hydropsyche phalerata (larvae)															
S78620	3.2	(2)	9.4	-	-	-	14.3	(2)	39.6	837.6	7.1	88.6	196	(2)	85.4
S76760	0.2	(2)	2.3	-	-	-	2.5	(2)	7.5	93.1	(2)	63.6	31.1	(2)	52.1
S75770	-	-	-	-	-	-	2.4	(2)	12.5	-	-	-	27.6	(2)	40.9
Chironomidae (larvae)															
S78620	1503.8	10.3	96.9	4378.1	54	97.9	5289.3	50.8	97.9	4690	39.5	97.7	3730.2	32.3	97.9
S76760	1764.4	28.6	95.5	1402.7	23.5	95.8	1063.5	13.9	97.5	1504.5	14.8	90.9	1154.7	19.1	97.9
S75770	1271.2	27.9	82.1	1873.6	33.4	87.5	976.8	19.4	95.8	-	-	-	1125.6	17.9	100
Chironomidae (pupae)															
S78620	88.8	(2)	65.6	121.9	(2)	43.8	59.8	(2)	52.1	44.3	(2)	38.6	88.5	(2)	27.1
S76760	110	(2)	63.6	28	(2)	35.4	16.4	(2)	27.5	67.4	(2)	36.4	24.2	(2)	41.7
S75770	53.5	(2)	42.9	71	(2)	31.3	6.8	(2)	14.6	-	-	-	19.7	(2)	22.7
Physa integra															
S78620	10037.2	68.5	56.3	1148.6	14.2	89.6	611.7	5.9	89.6	60.7	(2)	65.9	300.5	2.6	64.6
S76760	403	6.5	45.5	102.5	(2)	50	207	2.7	75	26.5	(2)	36.4	13.7	(2)	37.5
S75770	1044.5	12.3	67.9	174.9	3.1	70.8	367.5	7.3	77.1	-	-	-	29.8	(2)	54.5
Helisoma anceps															
S78620	495.9	3.4	37.5	263	3.2	77.1	654.7	6.3	85.4	247.4	2.1	40.9	1	(2)	2.1
S76760	11.3	(2)	29.5	4.1	(2)	14.6	20.5	(2)	45	6	(2)	18.2	0.7	(2)	4.2
S75770	140.5	(2)	75	10.2	(2)	39.6	20.8	(2)	39.6	-	-	-	0.4	(2)	2.3
Ferrissia tarda															
S78620	514.7	3.5	59.4	71	(2)	50	77.5	(2)	37.5	13	(2)	31.8	270.8	2.3	52.1
S76760	293.6	4.8	38.6	36.9	(2)	39.6	59	(2)	27.5	2.2	(2)	11.4	4.1	(2)	12.5
S75770	258.8	3	71.4	51.9	(2)	47.9	45.4	(2)	20.8	-	-	-	2.6	(2)	13.6
Goniobasis virginica															
S78620	3.1	(2)	15.6	17.1	(2)	35.4	1158.8	11.1	93.8	2095.8	17.6	100	2221	19.3	100
S76760	4.5	(2)	13.6	378.4	6.4	39.6	4056.6	53	100	4323.8	42.4	100	2011.3	33.2	100
S75770	63.2	(2)	57.1	1051.9	18.7	95.8	2279.7	45.3	100	-	-	-	1565.9	25	100
Pisidium															
S78620	84	(2)	25	75.1	(2)	52.1	23.6	(2)	43.8	394.9	3.3	100	713.8	6.2	64.6
S76760	3.8	(2)	15.9	4.1	(2)	16.7	9.8	(2)	25	193	(2)	61.4	166.7	2.8	35.4
S75770	21.1	(2)	39.3	5.5	(2)	18.8	32.8	(2)	50	-	-	-	396.4	6.3	63.6
Sphaerium															
S78620	1130.1	7.7	43.8	214.1	2.6	79.2	324.1	3.1	62.5	236.2	(2)	90.9	533.8	4.6	89.6
S76760	41.5	(2)	45.5	10.2	(2)	18.8	85.7	(2)	50	17.9	(2)	31.8	87.4	(2)	70.8
S75770	282.8	3.3	92.9	32.1	(2)	54.2	302.3	6	70.8	-	-	-	196	3.1	93.2

LGS EROL
TABLE 2.2-14
(Cont'd)

Taxon	1972 No./m^2	%	FO %	1973 No./m^2	%	FO %	1974 No./m^2	%	FO %	1975 No./m^2	%	FO %	1976 No./m^2	%	FO %
All Others															
S78620	145	(2)	-	191.9	2.4	-	213.5	2	-	373	3.1	-	379.1	3.3	-
S76760	204.6	3.3	-	102.5	(2)	-	113.9	(2)	-	215	2.1	-	186.1	3.1	-
S75770	82.6	(2)	-	102.1	(2)	-	167	3.3	-	-	-	-	375.6	6	-
Annual Mean															
S78620	14656.9			8100.4			10419.7			11875.6			11535.2		
S76760	6179.7			5958.0			7650.4			10185.9			6058.7		
S75770	8508.8			5610.3			5035.5			-			6270.9		

(1) For each species, or taxon, the following parameters are given by station for each year: mean number per square meter, percent of composition (%), and frequency of occurrence (FO %).
(2) Less than 2%.

TABLE 2.2-15

BIOMASS(1) OF IMPORTANT BENTHIC MACRCINVERTEBRATES COLLECTED IN QUANTITATIVE SAMPLES (1972-1974) FROM THE SCHUYLKILL RIVER

Taxon	Station	1972 Biomass	%	1972 Biomass	%	1974 Biomass	%
Dugesia tigrina	S78620	27.4	(2)	0.3	(2)	6.5	(2)
	S76760	24.8	1.4	-	(2)	0.4	(2)
	S75770	94.7	2.5	1.1	(2)	0.9	(2)
Prostoma graecense	S78620	13.4	(2)	-	(2)	1.5	(2)
	S76760	11.6	(2)	2.0	(2)	-	-
	S75770	44.0	1.2	0.4	(2)	1.0	(2)
Tubificidae	S78620	61.8	(2)	218.8	4.1	284.3	1.8
	S76760	484.9	28.0	572.7	8.0	988.9	2.8
	S75770	1020.7	27.1	463.0	4.1	361.9	1.2
Erpobdella punctata	S78620	43.3	(2)	313.8	5.9	223.9	1.4
	S76760	151.4	8.7	174.8	2.5	146.9	(2)
	S75770	92.9	2.5	175.0	1.6	46.1	(2)
Crangonyx gracilis	S78620	-	-	16.9	(2)	51.1	(2)
	S76760	5.3	(2)	14.7	(2)	26.9	(2)
	S75770	2.2	(2)	6.9	(2)	9.9	(2)
Cambarus bartoni	S78620	-	-	1.2	(2)	-	-
	S76760	296.6	17.1	5.7	(2)	-	-
	S75770	-	-	-	-	327.2	1.1
Orconectes	S78620	800.1	8.6	-	-	402.7	2.6
	S76760	140.7	8.1	350.7	4.9	844.0	2.4
	S75770	-	-	242.5	2.2	2319.5	7.8
Argia (Nymph)	S78620	1.1	(2)	26.5	(2)	50.2	(2)
	S76760	0.3	(2)	23.5	(2)	19.3	(2)
	S75770	-	-	16.5	(2)	74.2	(2)
Cheumatopsyche (Larvae)	S78620	35.9	(2)	155.8	2.9	638.5	4.1
	S76760	3.9	(2)	3.5	(2)	25.0	(2)
	S75770	0.3	(2)	1.8	(2)	16.2	(2)
Hydropsyche phalerata (Larvae)	S78620	3.5	(2)	-	-	10.0	(2)
	S76760	0.4	(2)	-	-	1.3	(2)
	S75770	-	-	-	-	2.0	(2)
Chironomidae (Larvae)	S78620	58.8	(2)	266.6	5.0	272.5	1.7
	S76760	127.0	7.3	94.4	1.2	60.9	(2)
	S75770	103.2	2.7	138.2	1.2	62.6	(2)

TABLE 2.2-15 (Cont'd)

Taxon	Station	1972 Biomass	%	1972 Biomass	%	1974 Biomass	%
Chironomidae (Pupae)	S78620	6.8	(2)	11.0	(2)	6.9	(2)
	S76760	9.7	(2)	2.2	(2)	1.6	(2)
	S75770	4.3	(2)	4.8	(2)	0.7	(2)
Physa integra	S78620	5494.1	58.7	2022.2	38.1	859.8	5.5
	S76760	227.3	13.1	220.9	3.1	313.1	(2)
	S75770	825.1	21.9	299.4	2.7	421.5	1.4
Helisoma anceps	S78620	1891.1	20.2	1527.8	28.8	2646.6	16.9
	S76760	41.1	2.4	44.7	(2)	99.7	(2)
	S75770	764.6	20.3	63.7	(2)	131.8	(2)
Ferrissia tarda	S78620	98.9	1.1	16.6	(2)	16.7	(2)
	S76760	58.6	3.4	6.6	(2)	11.8	(2)
	S75770	45.8	1.2	11.1	(2)	7.4	(2)
Goniobasis virginica	S78620	4.4	(2)	75.4	1.4	9595.1	61.2
	S76760	17.5	1.0	5419.8	76.0	32198.2	90.9
	S75770	299.4	8.0	9491.4	84.6	25336.8	84.7
Pisidium	S78620	11.2	(2)	19.8	(2)	4.9	(2)
	S76760	2.7	(2)	3.3	(2)	1.6	(2)
	S75770	6.3	(2)	1.8	(2)	6.6	(2)
Sphaerium	S78620	565.2	6.0	193.1	3.6	182.4	1.2
	S76760	21.0	1.2	12.4	(2)	49.2	(2)
	S75770	76.2	2.0	25.6	(2)	129.4	(2)
All Others	S78620	236.1	2.5	440.7	8.3	431.2	2.7
	S76760	106.5	6.2	178.1	2.5	648.5	1.8
	S75770	380.1	10.1	282.3	2.5	660.3	2.2
Annual Mean (g/Sm^2)	S78620(1)(4)	9.4		5.3		15.7	
	S76760(3)(4)	1.7		7.1		35.4	
	S75770(4)	3.8		11.2		29.9	

(1) Mean biomass (milligrams per square meter) and percent composition (%).
(2) Less than 1%.
(3) Annual mean biomass in 1975 at S78620 and S76760 was 18.8 and 37.1, respectively. No samples were collected at S75770.
(4) Annual mean biomass in 1976 at S78620, S76760, and S75770 was 22.7, 25.1, and 24.7, respectively.

MONTHLY DENSITIES (MEAN NUMBER PER SQUARE METER) OF IMPORTANT SPECIES (TAXA) OF BENTHIC MACROINVERTEBRATES COLLECTED FROM THE SCHUYLKILL RIVER, 1972 THROUGH 1976

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dugesia tigrina												
S75770												
1972	-	-	-	-	-	-	-	-	32.8	1836.1	454.9	-
1973	8.2	-	-	-	16.4	4.1	32.8	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	8.2	36.9	-	12.3
1976	-	4.1	-	-	12.3	61.5	-	4.1	8.2	106.2	36.9	-
S76760												
1972	8.1	2.7	2.7	-	-	-	-	-	16.4	1028.7	65.6	20.5
1973	-	-	-	-	-	-	-	-	4.1	-	-	-
1974	-	-	-	-	-	-	-	4.1	8.2	-	4.1	-
1975	-	-	-	-	4.1	-	-	4.1	12.3	-	-	12.3
1976	4.1	-	-	-	-	-	-	-	16.4	12.3	32.8	-
S78620												
1972	5.4	29.6	-	-	-	-	-	-	446.7	467.2	61.5	-
1973	-	-	-	-	8.2	12.3	-	-	-	-	-	-
1974	-	-	-	-	-	4.1	12.3	90.2	102.5	24.6	24.6	8.2
1975	-	57.4	-	-	-	12.3	32.8	12.3	16.4	8.2	-	-
1976	-	-	-	-	-	8.2	32.8	82	49.2	61.5	12.3	-
Prostoma graecense												
S75770												
1972	-	-	-	-	-	-	-	-	-	963.1	2123	41
1973	36.9	-	-	-	-	-	-	-	-	-	-	12.3
1974	-	-	-	-	-	-	-	-	-	49.2	90.2	41
1976	-	-	-	-	-	-	-	-	-	184.4	180.3	-
S76760												
1972	-	-	-	-	-	-	-	-	-	627	413.9	41
1973	-	-	-	-	-	-	-	4.1	-	131.1	86.1	-
1975	-	-	-	77.9	-	-	-	-	-	57.4	-	8.2
1976	-	-	-	-	-	-	-	-	4.1	131.1	-	-
S78620												
1972	-	-	-	-	-	-	-	-	172.1	360.7	651.6	36.9
1973	-	-	-	-	-	-	4.1	-	24.6	-	-	-
1974	-	20.5	-	4.1	-	-	4.1	-	-	20.5	41	82
1975	-	24.6	-	4.1	-	-	-	-	36.1	541	57.4	45.1
1976	20.5	-	-	-	184.4	4.1	-	-	4.1	94.3	73.8	-
Tubificidae												
S75770												
1972	-	-	-	-	1086.1	-	11873.9	4397.5	4598.4	291	623	963.1
1973	1045.1	36.9	520.5	803.5	5319.7	14897.5	2028.7	344.3	1151.6	32.8	110.7	8.2
1974	459	106.6	495.9	274.6	811.5	3803.3	700.8	127	102.5	430.3	299.2	155.7
1976	-	571.5	493.2	409.8	965.8	129.5	784.2	579.9	864.8	907.8	717.2	239.1
S76760												
1972	37.6	357.5	10.8	185.5	-	5934.4	1122.8	3430.3	4635.2	1196.7	1245.9	6127
1973	2614.8	721.3	623	2573.8	10090.2	20532.8	4700.8	590.2	1147.5	1750	274.6	41
1974	979.5	3172.1	516.4	1053.3	3434.4	4495.9	3364.8	516.4	102.5	-	873	-
1975	-	4848.4	5532.8	1901.6	1877	2897.5	6938.5	1250	1065.6	3278.7	4106.6	1291
1976	229.5	214.5	219.3	2450.8	1104.5	1846.3	637.3	545.1	429	526.6	2350.4	848.4

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tubificidae (Cont'd)												
S78620												
1972	-	-	-	-	-	-	-	-	1291	340.2	754.1	831.1
1973	623	127	364.8	274.6	1754.1	8163.9	3942.6	163.9	233.6	69.7	155.7	12.3
1974	221.3	979.5	323.8	94.3	791	1524.6	118.9	12.3	24.6	82	36.9	364.8
1975	-	553.3	196.7	286.9	750	3717.2	1348.4	1836.1	635.2	295.1	311.5	233.6
1976	32.8	53.3	35.5	49.2	526.6	327.9	217.2	217.2	26.6	110.7	98.4	114.8
Crangonyx gracilis												
S75770												
1972	-	-	-	-	-	-	-	-	-	20.5	-	8.2
1973	4.1	-	-	4.1	-	32.8	12.3	28.7	61.5	-	-	45.1
1974	8.2	16.4	28.7	12.3	8.2	53.3	20.5	53.3	53.3	20.5	82	4.1
1976	-	463.1	28.76	32.8	82	2274.6	881.1	536.9	98.4	163.9	106.6	77.9
S76760												
1972	-	-	-	-	-	-	-	-	16.4	73.8	8.2	-
1973	-	20.5	4.1	-	-	20.5	-	69.7	16.4	143.4	16.4	98.4
1974	12.3	24.6	-	16.4	36.9	356.6	86.1	49.2	4.1	-	49.2	-
1975	-	323.8	377	135.2	926.2	344.3	229.5	102.5	45.1	229.5	163.9	299.2
1976	41	4.1	20.5	364.8	41	565.6	323.8	803.3	229.5	381.1	274.6	750
S78620												
1973	4.1	-	-	-	-	28.7	16.4	45.1	57.4	286.9	24.6	16.4
1974	4.1	28.7	-	61.5	61.5	606.6	8.2	20.5	20.5	8.2	836.1	233.6
1975	-	176.2	8.2	45.1	262.3	913.9	344.3	315.6	434.4	86.1	65.6	77.9
1976	16.4	16.4	16.4	65.6	8.2	979.5	209	123	315.6	131.1	262.3	86.1
Cambarus bartoni												
S75770												
1974	-	-	-	8.2	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	4.1	-	-	-
S76760												
1972	-	-	-	-	-	-	-	-	-	8.2	-	-
1973	-	-	-	-	-	-	-	-	-	-	4.1	-
1975	-	-	-	-	-	-	-	-	-	-	4.1	-
1976	-	-	-	4.1	-	-	-	-	-	-	-	-
S78620												
1973	-	-	-	4.1	-	-	-	-	-	-	-	-
1976	-	-	-	8.2	-	-	-	-	4.1	-	4.1	-
Orconectes spp.												
S75770												
1973	-	-	-	-	-	4.1	-	-	4.1	-	-	-
1974	-	-	-	-	-	-	-	4.1	-	4.1	4.1	8.2
1976	-	-	4.1	4.1	-	4.1	4.1	-	-	-	-	-
S76760												
1972	-	-	-	-	-	-	-	-	4.1	-	-	4.1
1973	-	-	-	-	-	8.2	-	-	-	-	-	-
1974	-	-	-	-	-	4.1	-	12.3	-	-	4.1	-
1975	-	-	-	-	6.1	20.5	-	8.2	4.1	-	-	-
1976	8.2	-	-	-	-	4.1	4.1	-	-	-	-	-

LGS EROL
TABLE 2.2-16
(Cont'd)

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Orconectes (Cont'd)												
S78620												
1972	-	-	-	-	-	-	-	-	-	-	4.1	4.1
1974	-	-	-	-	-	4.1	-	4.1	-	-	-	-
1975	-	-	-	-	-	-	-	-	-	-	4.1	4.1
1976	4.1	-	-	-	4.1	-	4.1	4.1	-	-	-	-
Argia spp.												
S75770												
1973	-	-	-	-	-	-	-	-	123.9	-	24.6	12.3
1974	12.3	4.1	12.3	4.1	8.2	4.1	-	53.3	250	209.9	229.5	69.7
1976	-	8.2	-	4.1	4.1	-	-	73.8	454.9	225.4	45.1	118.9
S76760												
1972	-	-	-	-	-	-	-	-	-	4.1	-	-
1973	-	-	-	4.1	-	-	-	-	53.3	-	131.1	36.9
1974	8.2	-	4.1	4.1	12.3	8.2	-	209	118.9	-	65.6	-
1975	-	24.6	61.5	8.2	4.1	32.8	-	-	459	86.1	16.4	28.7
1976	-	4.1	-	8.2	8.2	-	-	57.4	114.8	45.1	41.9	12.3
S78620												
1972	-	2.7	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	24.6	-	-	-	118.9	45.1	45.1	12.3
1974	4.1	12.3	4.1	12.3	8.2	28.7	4.1	65.6	213.1	135.2	36.9	45.1
1975	-	32.8	-	4.1	36.9	-	-	-	53.3	36.9	24.6	8.2
1976	4.1	-	4.1	-	4.1	-	-	69.7	385.2	163.9	106.6	12.3
Cheumatopsyche spp.												
S75770												
1972	-	-	-	-	-	-	-	-	-	-	8.2	-
1973	4.1	-	4.1	4.1	-	-	-	-	-	4.1	-	8.2
1974	8.2	32.8	4.1	-	-	-	4.1	12.3	16.4	151.6	352.5	155.7
1976	-	245.9	114.8	32.8	6.1	-	32.8	16.4	4.1	12.3	16.4	61.5
S76760												
1972	8.1	2.7	8.1	-	-	4.1	-	-	-	4.1	-	-
1973	4.1	4.1	8.2	-	-	-	-	-	16.4	4.1	16.4	8.2
1974	49.2	16.4	16.4	4.1	-	8.2	-	-	24.6	-	348.4	-
1975	-	53.3	151.6	41	41	131.1	49.2	139.3	491.8	479.5	131.1	65.6
1976	69.7	41	24.6	4.1	49.2	20.5	32.8	106.6	53.3	82	53.3	73.8
S78620												
1972	75.3	102.2	-	-	2.7	-	-	-	4.1	-	-	8.2
1973	8.2	20.5	12.3	8.2	-	45.1	-	8.2	610.7	602.5	643.4	631.1
1974	139.3	200.8	8.2	143.4	28.7	692.6	2266.4	6332	1848.4	3053.3	864.8	663.9
1975	-	467.2	127	401.6	200.8	1045.1	698.8	2405.7	6741.8	1618.9	1405.7	487.7
1976	115.7	188.5	258.2	106.6	43	1229.5	6151.6	3172.1	3651.6	6471.3	3979.5	1061.5

LGS EROL
TABLE 2.2-16
(Cont'd)

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hydropsyche phalerata												
S75770												
1974	-	8.2	-	-	-	-	-	-	-	4.1	8.2	8.2
1976	-	123	102.5	24.6	-	-	-	4.1	4.1	12.3	20.5	12.3
S76760												
1972	-	-	2.7	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	24.6	-
1975	-	-	41	4.1	8.2	53.3	24.6	151.6	245.9	327.9	135.2	32.8
1976	41	8.2	-	8.2	-	12.3	24.6	45.1	69.7	57.4	49.2	57.4
S78620												
1972	-	21.5	-	-	-	-	-	-	-	-	-	4.1
1974	4.1	-	-	-	-	4.1	20.5	-	28.7	41	45.1	28.7
1975	-	20.5	-	53.3	45.1	807.4	532.8	1799.2	3532.8	1032.8	1147.5	241.8
1976	180.3	86.1	90.2	41	-	397.5	57.4	274.6	348.4	319.7	368.9	188.5
Chironomidae (larvae)												
S75770												
1972	-	-	-	-	3500	-	36.9	2803.3	3364.8	733.8	159.8	-
1973	127	16.4	725.4	459	1864.8	7209	1028.7	1623	9192.6	4.1	135.2	98.4
1974	979.5	450.8	2733.6	1397.5	918	1836.1	163.9	155.7	12.3	57.4	827.9	2188.5
1976	-	377	614.8	1069.7	3504.1	1557.4	2557.4	1131.1	934.4	188.5	159.8	286.9
S76760												
1972	322.6	190.9	2021.5	2241.9	-	2967.2	36.9	3356.6	5233.6	2454.9	418	163.9
1973	422.1	422.1	643.4	1409.8	467.2	4893.4	3196.7	1344.3	3569.7	98.4	139.3	225.4
1974	1024.6	254.1	2754.1	1110.7	2586.1	2135.2	332	176.2	16.4	-	245.9	-
1975	-	2397.5	2528.7	2582	3032.8	1741.8	1922.1	2036.9	86.1	143.4	20.5	57.4
1976	278.7	90.2	139.3	1360.7	1172.1	2573.8	3135.2	1258.2	2598.4	532.8	299.2	418
S78620												
1972	86	414	-	-	169.4	3176.2	-	-	2840.2	2811.5	1627	905.7
1973	647.5	881.1	3172.1	12016.4	11024.6	4725.4	3959	1282.8	12180.3	1012.3	733.6	901.6
1974	713.1	4057.4	20889.3	6553.3	6946.7	8143.4	3065.6	24.6	61.5	1450.8	1327.9	10237.7
1975	-	9782.8	4274.6	14491.8	4684.4	4786.9	6766.4	4274.6	1991.8	373	90.2	73.8
1976	442.6	803.3	1961.7	16475.4	11004.1	4344.3	5086.1	1213.1	1500	696.7	983.6	741.8
Chironomidae (pupae)												
S75770												
1972	-	-	-	-	114.8	-	-	204.9	41	8.2	4.1	-
1973	-	-	8.2	57.4	590.2	8.2	8.2	180.3	-	-	-	-
1974	-	4.1	4.1	-	28.7	20.5	-	-	-	-	-	24.6
1976	-	-	-	45.1	118.9	20.5	28.7	-	-	-	4.1	-
S76760												
1972	21.5	10.8	104.8	610.2	-	24.6	-	176.2	147.5	114.8	-	-
1973	-	-	-	36.9	20.5	118.9	49.2	8.2	102.5	-	-	-
1974	-	-	-	45.1	57.4	57.4	4.1	-	-	-	-	-
1975	-	16.4	16.4	-	82	16.4	4.1	73.8	532.8	-	-	-
1976	-	-	4.1	49.2	49.2	110.7	28.7	4.1	32.8	4.1	4.1	4.1

LGS EROL
TABLE 2.2-16
(Cont'd)

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chironomidae (pupae) (Cont'd)												
S78620												
1972	13.4	10.8	-	-	153.2	106.6	-	-	90.2	336.1	-	-
1974	-	-	8.2	332	323.8	131.1	-	8.2	495.9	151.6	12.3	-
1975	-	28.7	77.9	168	123	135.2	12.3	-	-	143.4	20.5	8.2
1976	4.1	-	28.7	684.4	278.7	-	28.7	12.3	12.3	-	8.2	4.1
Physa integra												
S75770												
1972	-	-	-	-	4.1	-	8.2	20.5	307.4	3721.3	1852.5	1397.5
1973	467.2	155.7	217.2	45.1	12.3	172.1	16.4	-	69.7	57.4	32.8	852.5
1974	545.1	73.8	401.6	16.4	4.1	143.4	65.6	286.9	131.1	94.3	2577.9	69.7
1976	-	20.5	-	-	16.4	36.9	24.6	4.1	8.2	135.2	45.1	36.9
S76760												
1972	-	2.7	-	-	-	20.5	-	4.1	311.5	2528.7	1049.2	516.4
1973	217.2	102.5	16.4	20.5	-	8.2	4.1	-	102.5	-	299.2	459
1974	225.4	65.6	12.3	16.4	32.8	229.5	196.7	1106.6	-	-	184.4	-
1975	-	32.8	28.7	-	-	-	-	16.4	53.3	77.9	45.1	36.9
1976	8.2	-	-	-	4.1	4.1	12.3	4.1	45.1	61.5	20.5	4.1
S78620												
1972	-	2.7	-	-	-	32.8	-	-	11176.2	24172.1	30635.2	14278.7
1973	2106.6	1311.6	655.7	192.6	1024.6	401.6	4.1	8.2	3471.3	704.9	1602.5	2299.2
1974	307.4	672.1	82	131.1	12.3	848.4	2868.9	1930.3	82	168	114.8	123
1975	-	176.2	73.8	24.6	16.4	-	-	4.1	151.6	123	82	16.4
1976	20.5	4.1	4.1	-	-	28.7	508.2	82	844.3	1471.3	327.9	315.6
Helisoma ancepts												
S78620												
1972	-	-	-	-	184.4	-	-	4.1	61.5	274.6	299.2	159.8
1973	32.8	12.3	12.3	16.4	-	8.2	4.1	4.1	16.4	-	12.3	4.1
1974	4.1	4.1	4.1	4.1	-	-	98.4	69.7	16.4	4.1	20.5	24.6
1976	-	-	-	-	-	-	-	-	-	-	-	4.1
S76760												
1972	2.7	2.7	-	-	-	12.3	8.2	-	-	45.1	28.7	24.6
1973	-	-	24.6	4.1	-	4.1	-	-	-	-	8.2	8.2
1974	4.1	12.3	4.1	-	-	45.1	32.8	28.7	-	-	77.9	-
1975	-	36.9	20.5	4.1	4.1	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	4.1	4.1	-	-	-
S78620												
1972	-	-	-	-	-	-	-	-	-	463.1	2057.4	1446.7
1973	721.3	590.2	799.2	598.4	57.4	4.1	-	-	110.7	77.9	41	155.7
1974	65.6	49.2	16.4	12.3	4.1	106.6	868.9	4364.8	811.5	245.9	356.6	954.9
1975	-	528.7	1024.6	1053.3	86.1	28.7	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	-	-	-	12.3

LGS EROL
TABLE 2.2-16
(Cont'd)

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ferrissia tarda												
S75770												
1972	-	-	-	-	16.4	-	4.1	311.5	24.6	422.1	713.1	319.7
1973	147.5	73.8	36.9	24.6	16.4	151.6	-	4.1	20.5	147.5	-	-
1974	73.8	-	-	4.1	-	434.4	20.5	-	-	-	-	12.3
1976	-	-	-	-	-	16.4	-	-	-	4.1	-	8.2
S76760												
1972	-	-	-	-	-	-	-	8.2	163.9	1860.7	803.3	303.4
1973	57.4	65.6	69.7	12.3	-	94.3	12.3	-	-	131.1	-	-
1974	188.5	-	4.1	12.3	12.3	237.7	135.2	-	-	-	-	-
1976	-	4.1	-	-	4.1	-	-	-	4.1	4.1	-	8.2
S78620												
1972	2.7	8.1	-	-	-	-	-	-	885.2	877	1659.8	684.4
1973	217.2	498.2	73.8	94.3	36.9	143.4	4.1	-	196.7	36.9	-	-
1974	-	90.2	-	12.3	-	24.6	307.4	348.4	-	61.5	24.6	61.5
1975	-	65.6	-	-	8.2	-	4.1	4.1	-	24.6	28.7	8.2
1976	8.2	-	-	-	-	8.2	45.1	90.2	709	840.2	909.8	639.3
Goniobasis virginica												
S75770												
1972	-	-	-	-	-	-	-	-	57.4	110.7	213.1	61.5
1973	102.5	86.1	110.7	20.5	57.4	61.5	45.1	36.9	5254.1	2954.9	1524.6	2368.9
1974	1000	282.8	1209	561.5	639.3	1422.1	1717.2	5020.5	3434.4	5381.1	3073.8	3614.8
1976	-	557.4	3868.9	561.5	1643.4	1422.1	2123	1196.7	2647.5	1332	885.2	987.7
Goniobasis virginica												
S78620												
1972	-	-	-	-	-	-	-	-	12.3	8.2	4.1	-
1973	-	4.1	-	-	-	8.2	4.1	-	77.9	24.6	16.4	69.7
1974	94.3	28.7	49.2	36.9	45.1	77.9	430.3	655.7	2561.5	4131.1	3766.4	2028.7
1975	-	1561.5	2077.9	2692.6	2426.2	2729.5	3446.7	1692.6	1286.9	1401.6	713.1	3024.6
1976	2327.9	3282.8	5770.5	1024.6	987.7	885.2	166.2	2397.5	1963.1	3471.3	897.5	1967.2
Pisidum spp.												
S75770												
1972	-	-	-	-	61.5	-	4.1	12.3	-	32.8	36.9	-
1973	-	12.3	16.4	4.1	28.7	-	-	-	4.1	-	-	-
1974	-	-	-	8.2	8.2	32.8	-	49.2	49.2	98.4	61.5	86.1
1976	-	-	-	-	8.2	172.1	368.9	393.4	1069.4	1778.7	442.6	127
S76760												
1972	8.1	5.4	-	-	-	24.6	-	-	-	4.1	-	-
1973	16.4	8.2	-	4.1	-	-	4.1	-	-	12.3	4.1	-
1974	-	-	-	-	-	-	8.2	45.1	4.1	-	41	-
1975	-	950.8	143.4	270.5	139.3	-	-	-	172.1	282.8	86.1	77.9
1976	-	-	-	-	-	4.1	4.1	151.6	905.7	454.9	295.1	184.4

LGS EROL
TABLE 2.2-16
(Cont'd)

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spherium spp.												
S75770												
1972	-	-	-	-	77.9	-	8.2	373	73.8	627	491.8	327.9
1973	77.9	28.7	86.1	20.5	32.8	45.1	-	-	4.1	32.8	36.9	20.5
1974	12.3	-	8.2	4.1	4.1	237.7	176.2	590.2	422.1	897.5	868.9	405.7
1976	-	241.8	49.2	86.1	131.1	221.3	196.7	319.7	213.1	463.1	168	65.6
S76760												
1972	-	2.7	2.7	-	-	41	-	12.3	8.2	69.7	151.6	168
1973	41	45.1	4.1	-	-	32.8	-	-	-	-	-	-
1974	24.6	-	-	-	-	32.8	114.8	311.5	245.9	-	127	-
1976	36.9	32.8	69.7	-	12.3	28.7	86.1	200.8	180.3	188.5	139.3	73.8
S78620												
1972	-	-	-	-	-	-	-	-	57.4	610.7	4356.6	4016.4
1973	573.8	168	123	143.4	118.9	582	-	8.2	614.8	69.7	139.3	28.7
1974	24.6	24.6	-	16.4	-	73.8	-	463.1	709	1004.1	573.8	1000
1975	-	45.1	-	53.3	49.2	-	-	-	36.9	-	12.3	-
1976	36.9	32.8	69.7	-	12.3	28.7	86.1	200.8	180.3	188.5	139.3	73.8

LGS EROL
TABLE 2.2-17

MONTHLY DENSITIES(1) OF IMPORTANT SPECIES (TAXA) OF BENTHIC MACROINVERTEBRATES COLLECTED FROM THE SCHUYKILL RIVER, 1972 THROUGH 1974

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dugesia tigrina												
S75770												
1972	-	-	-	-	-	-	-	-	0.0074	0.5434	0.1123	-
1973	0.0004	-	-	0.0033	0.0012	0.0082	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	0.0033	0.0045	-	0.0025
S76760												
1972	0.0003	0.0011	0.0003	-	-	-	-	-	0.0053	0.2311	0.0295	0.0057
1973	-	-	-	-	-	-	-	-	0.0004	-	-	-
1974	-	-	-	-	-	-	-	0.0025	0.0012	-	0.0004	-
S78620												
1972	0.0005	0.0091	-	-	-	-	-	-	0.0971	0.0881	0.0242	-
1973	-	-	-	-	0.004	0.0037	-	-	-	-	-	-
1974	-	-	-	-	-	0.0004	0.0074	0.0250	0.0332	0.0037	0.0061	0.0025
Prostoma graecense												
S75770												
1972	-	-	-	-	-	-	-	-	-	0.1000	0.2045	0.0037
1973	0.0053	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	0.0020	0.0086	0.0016
S76760												
1972	-	-	-	-	-	-	-	-	-	0.0602	0.0508	0.0098
1973	-	-	-	-	-	-	-	-	-	0.0143	0.0094	-
S78620												
1972	-	-	-	-	-	-	-	-	0.0123	0.0234	0.0689	0.0029
1973	-	-	-	-	-	-	-	-	0.0004	-	-	-
1974	-	0.0025	-	0.0025	-	-	-	-	-	0.0012	0.0025	0.0090
Tubificidae												
S75770												
1972	-	-	-	-	0.4648	-	4.2992	0.8041	1.0152	0.1451	0.1037	0.3127
1973	0.5242	0.0234	0.2857	0.2352	0.6152	2.4869	0.4828	0.1295	0.5967	0.0189	0.1529	0.0049
1974	0.4242	0.1201	0.8443	0.1742	0.4414	1.5459	0.2053	0.0512	0.0422	0.1602	0.2721	0.0615
S76760												
1972	0.0288	0.1462	0.0051	0.0433	-	0.4475	1.5955	0.5316	0.4840	0.2549	0.4439	1.3529
1973	1.0152	0.2139	0.2541	0.6906	0.9602	1.3340	0.7016	0.1967	0.4971	0.7303	0.2324	0.0467
1974	0.2619	2.8045	0.3684	0.7270	2.4213	1.7984	0.8422	0.2902	0.0607	-	0.3049	-
S78620												
1972	-	-	-	-	-	-	-	-	0.1865	0.0840	0.1283	0.0955
1973	0.1533	0.0332	0.1037	0.1459	0.4373	0.8861	0.4316	0.0209	0.0492	0.0516	0.3078	0.0049
1974	0.2086	0.9217	0.3676	0.1139	0.3742	0.9975	0.0488	0.0057	0.0172	0.0324	0.0803	0.2430

LGS EROL
TABLE 2.2-17
(Cont'd)

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Crangonyx gracilis												
S75770												
1972	-	-	-	-	-	-	-	-	-	0.0123	-	0.0033
1973	0.0008	-	-	0.0029	-	0.0160	0.0016	0.0012	0.0328	-	-	0.0275
1974	0.0008	0.0143	0.0115	0.0029	0.0143	0.0074	0.0070	0.0082	0.0176	0.0061	0.0270	0.0012
S76760												
1972	-	-	-	-	-	-	-	-	0.0061	0.0488	0.0029	-
1973	-	0.0053	0.0037	-	-	0.0053	-	0.0066	0.0012	0.0574	0.0135	0.0828
1974	0.0012	0.0152	-	0.0148	0.0143	0.1758	0.0098	0.0148	0.0004	-	0.0225	-
S78620												
1973	0.0029	-	-	-	-	0.0008	0.0016	0.0033	0.0139	0.1561	0.0221	0.0020
1974	0.0020	0.0176	-	0.0316	0.0287	0.1545	0.0025	0.0029	0.0041	0.0041	0.3107	0.0545
Cambarus bartoni												
S75770												
1974	-	-	-	3.9622	-	-	-	-	-	-	-	-
S76760												
1972	-	-	-	-	-	-	-	-	-	3.2631	-	-
1973	-	-	-	-	-	-	-	-	-	-	0.0689	-
S78620												
1973	-	-	-	0.0143	-	-	-	-	-	-	-	-
Orconectes spp.												
S75770												
1973	-	-	-	-	-	0.0361	-	-	2.8734	-	-	-
1974	-	-	-	-	-	-	-	2.6914	-	8.3566	2.9266	13.8590
S76760												
1972	-	-	-	-	-	-	-	-	1.5475	-	-	-
1973	-	-	-	-	-	0.0348	-	-	-	-	-	4.1734
1974	-	-	-	-	-	0.0520	-	4.3705	-	-	4.0172	-
S78620												
1972	-	-	-	-	-	-	-	-	-	-	6.4008	-
1974	-	-	-	-	-	0.0430	-	0.3902	-	-	-	4.3988
Argia spp.												
S75770												
1973	-	-	-	-	-	-	-	-	0.1586	-	0.0283	0.0111
1974	0.0197	0.0082	0.0131	0.0061	0.0004	0.0246	-	0.0164	0.1770	0.1594	0.3898	0.0758
S76760												
1972	-	-	-	-	-	-	-	-	-	0.0033	-	-
1973	-	-	-	0.0176	-	-	-	-	0.0299	-	0.1766	0.0574
1974	0.0238	-	0.0070	0.0090	0.0189	0.0168	-	0.0262	0.0635	-	0.0279	-
S78620												
1972	-	0.0086	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	0.0447	-	-	-	0.1520	0.0414	0.0709	0.0086
1974	0.0037	0.0135	0.0250	0.0197	0.0221	0.1037	0.0193	0.0164	0.1832	0.1291	0.0414	0.0258

LGS EROL
TABLE 2.2-17
(Cont'd)

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cheumatopsyche												
S75770												
1972	-	-	-	-	-	-	-	-	-	-	0.0020	-
1973	0.0004	-	0.0012	0.0061	-	-	-	-	-	0.0012	-	0.0127
1974	0.0049	0.0086	0.0004	-	-	-	0.0057	0.0029	0.0020	0.0193	0.0975	0.0525
S76760												
1972	0.0148	0.0027	0.0102	-	-	0.0098	-	-	-	0.0053	-	-
1973	0.0004	0.0004	0.0041	-	-	-	-	-	0.0025	0.0041	0.0242	0.0066
1974	0.0434	0.0148	0.0225	0.0020	-	0.0029	-	-	0.0107	-	0.1541	-
S76720												
1972	0.1083	0.1621	-	-	0.0078	-	-	-	0.0037	-	-	0.0053
1973	0.0004	0.0127	0.0131	0.0033	-	0.0086	-	0.0070	0.1996	0.7061	0.5377	0.3811
1974	0.0930	0.1176	0.0078	0.1467	0.1045	0.0885	0.5180	3.5971	0.6197	1.6074	0.3676	0.3939
Hydropsyche phalerata												
S75770												
1974	-	0.0193	-	-	-	-	-	-	-	0.0008	0.0029	0.0016
S76760												
1972	-	-	0.0048	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	0.0131	-
S78620												
1972	-	0.0228	-	-	-	-	-	-	-	-	-	0.0053
1974	0.0004	-	-	-	-	-	0.0516	-	0.0225	0.0111	0.0143	0.0205
Chironomidae (larvae)												
S75770												
1972	-	-	-	-	0.3443	-	0.0037	0.1184	0.2066	0.0377	0.0119	-
1973	0.0086	-	0.0275	0.0291	0.0730	0.2270	0.0398	0.1184	1.1086	-	0.0180	0.0082
1974	0.0807	0.0943	0.1348	0.0746	0.0602	0.1705	0.0078	0.0102	0.0008	0.0037	0.0332	0.0803
S76760												
1972	0.0210	0.0175	0.0890	0.1806	-	0.5889	0.0033	0.1459	0.2016	0.1070	0.0311	0.0111
1973	0.0143	0.0205	0.0336	0.0930	0.0426	0.1611	0.0959	0.0955	0.5205	0.0070	0.0107	0.0377
1974	0.0811	0.0193	0.1484	0.0832	0.0943	0.1225	0.0221	0.0217	0.0016	-	0.0143	-
S78620												
1972	0.0059	0.0331	-	-	0.0073	0.0639	-	-	0.1074	0.1189	0.0824	0.0516
1973	0.0488	0.0414	0.0947	0.7680	0.6725	0.1434	0.1885	0.0734	0.9381	0.0857	0.0639	0.0807
1974	0.0639	0.2135	0.9049	0.4180	0.3512	0.5250	0.1799	0.0025	0.0057	0.1475	0.0766	0.3926
Chironomidae (pupae)												
S75770												
1972	-	-	-	-	0.0102	-	-	0.0139	0.0041	0.0008	0.0012	-
1973	-	-	-	-	0.0057	0.0201	0.0004	0.0008	0.0303	-	-	-
1974	-	0.0016	0.0004	-	0.0020	0.0025	-	-	-	-	-	0.0016
S76760												
1972	0.0011	0.0027	0.0097	0.0559	-	0.0045	-	0.0119	0.0197	0.0037	-	-
1973	-	-	-	0.0082	0.0033	0.0078	0.0004	0.0008	0.0061	-	-	-
1974	-	-	-	0.0049	0.0061	0.0045	0.0004	-	-	-	-	-
S78620												
1972	0.0022	0.0027	-	-	0.0148	0.0066	-	-	0.0074	0.0205	-	-
1973	-	-	0.0008	0.0246	0.0283	0.0074	-	0.0004	0.0639	0.0066	-	-
1974	-	0.0045	0.0115	0.0156	0.0172	0.0172	0.0025	-	-	0.0107	0.0033	0.0008

Taxon Station Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Physa integra												
S75770												
1972	-	-	-	-	0.0008	-	0.0086	0.0611	0.1537	1.9168	1.3844	2.2500
1973	0.4586	0.2184	0.1992	0.1746	0.0033	0.1500	0.0307	-	0.1828	0.0594	0.0721	2.0434
1974	1.3770	0.2492	1.5791	0.0770	0.0057	0.2357	0.0361	0.4176	0.1041	0.0750	0.7553	0.1459
S76760												
1972	-	0.0142	-	-	-	0.0225	-	0.0275	0.1266	0.6484	1.1738	0.4869
1973	0.3426	0.0975	0.0037	0.0865	-	0.0053	0.0008	-	0.1930	-	0.4217	1.4996
1974	0.5471	0.2779	0.0447	0.0520	0.0197	0.5332	0.1537	0.9553	-	-	0.5475	-
S78620												
1972	-	0.0030	-	-	-	0.0471	-	-	2.1189	6.3684	24.3574	11.0578
1973	2.0766	1.3430	0.5107	0.2971	0.2148	0.2832	0.0168	0.0098	3.2594	2.1102	5.6340	8.5111
1974	0.8885	1.0803	0.3791	0.4984	0.0443	1.7197	3.0475	1.5742	0.1361	0.1906	0.2857	0.4734
Helisoma anceps												
S75770												
1972	-	-	-	-	0.3291	-	-	0.0045	0.3176	1.8049	1.6557	1.2402
1973	0.1418	0.0045	0.1586	0.1619	-	0.0566	-	0.0209	0.1574	-	0.0307	0.0324
1974	0.0369	0.0172	0.0709	0.0742	-	-	0.4193	0.5689	0.0963	0.0119	0.2041	0.0820
S75760												
1972	0.0177	0.0422	-	-	-	0.0881	0.0078	-	-	0.0348	0.0709	0.1920
1973	-	-	0.1787	0.0102	-	0.0008	-	-	-	-	0.0984	0.2488
1974	0.0459	0.2389	0.0094	-	-	0.1033	0.1496	0.3037	-	-	0.1463	-
S78620												
1972	-	-	-	-	-	-	-	-	-	1.5639	5.4352	8.1299
1973	3.6049	2.6869	3.1061	2.3832	0.4049	0.0324	-	-	1.0467	0.6246	0.6742	3.7697
1974	1.0508	0.7123	0.3291	0.1344	0.0172	0.3111	14.9455	6.3004	1.9910	0.9836	0.5316	4.4525
Ferrissia tarda												
S75770												
1972	-	-	-	-	0.0102	-	0.0016	0.0434	0.0098	0.0582	0.1258	0.0713
1973	0.0225	0.0102	0.0061	0.0287	0.0053	0.0148	-	0.0012	0.0078	0.0361	-	-
1974	0.0127	-	-	0.0029	-	0.0615	0.0086	-	-	-	-	0.0029
S75760												
1972	-	-	-	-	-	-	-	0.0025	0.0373	0.2832	0.2033	0.1180
1973	0.0156	0.0041	0.0201	0.0139	-	0.0070	0.0025	-	-	0.0160	-	-
1974	0.0221	-	0.0016	0.0094	0.0049	0.0520	0.0275	-	-	-	-	-
S78620												
1972	0.0005	0.0035	-	-	-	-	-	-	0.0844	0.0955	0.4947	0.1123
1973	0.0561	0.0098	0.0156	0.0283	0.0373	0.0119	0.0008	-	0.0336	0.0053	-	-
1974	-	0.0393	-	0.0066	-	0.0061	0.0783	0.0344	-	0.0201	0.0012	0.0143
Goniobasis virginica												
S75770												
1972	-	-	-	-	-	-	-	-	0.0881	0.5738	1.1766	0.2574
1973	0.5570	0.4955	1.3615	0.2234	0.5340	0.5254	0.4836	1.5074	47.6455	24.0398	17.3852	19.1386
1974	9.0738	3.3512	10.8115	5.7316	9.5020	21.1988	26.0893	36.4881	36.6448	58.0352	44.5340	42.5615
1976	-	5.0680	41.1033	6.1971	16.2102	21.1742	32.0352	17.3602	44.9004	15.5820	18.0131	17.8975

Taxon Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Goniobasis virginica (Cont'd)												
S75760												
1972	-	-	-	-	-	-	-	-	0.0115	0.0648	0.0750	0.0418
1973	-	-	0.0172	-	0.0332	-	-	0.1566	0.9820	12.2066	34.5393	17.1025
1974	3.6234	5.5857	5.8020	5.6201	4.0266	10.2061	15.6742	35.4242	50.9283	-	185.0918	-
1975	-	39.0115	65.7135	21.5807	18.3602	17.8172	15.3480	85.2529	67.5340	14.7730	10.8668	10.3922
1976	19.3492	18.7230	21.5213	2.4172	6.4840	57.4967	33.4713	19.6307	62.1303	15.3217	9.5873	3.3094
S78620												
1972	-	-	-	-	-	-	-	-	0.0102	0.0193	0.0057	-
1973	-	0.0045	-	-	-	0.0111	0.0205	-	0.2738	0.1295	0.0725	0.3926
1974	1.2299	0.1988	0.3377	0.3598	0.3730	0.8836	12.0623	7.0311	22.5266	37.7291	17.5402	14.8689
1975	-	13.5430	15.9520	25.8467	14.0238	13.9697	20.0869	9.2959	8.2000	8.7307	6.7922	22.6270
1976	12.9582	24.4447	44.5098	8.0561	10.9562	10.8734	4.6262	7.3779	13.8287	31.4520	7.9697	34.7541
Pisidum spp.												
S75770												
1972	-	-	-	-	0.0086	-	0.0004	0.0045	-	0.0070	0.0234	-
1973	-	0.0033	0.0098	0.0020	0.0057	-	-	-	0.0004	-	-	-
1974	-	-	-	0.0016	0.0020	0.0209	-	0.0057	0.0094	0.0127	0.0061	0.0205
S75760												
1972	0.0022	0.0008	-	-	-	0.0258	-	-	-	0.0012	-	-
1973	0.0086	0.0004	-	0.0008	-	-	0.0012	-	-	0.0012	0.0279	-
1974	-	-	-	-	-	-	0.0004	0.0045	0.0025	-	0.0082	-
S78620												
1972	-	-	-	-	-	-	-	-	-	-	0.0434	0.0463
1973	0.1131	0.0193	0.0193	0.0291	0.0180	0.0385	-	-	-	-	0.0008	-
1974	-	-	-	-	0.0066	0.0012	-	0.0029	0.0061	0.0123	0.0090	0.0209
Sphaerium spp.												
S75770												
1972	-	-	-	-	0.0193	-	0.0082	0.0553	0.0344	0.1988	0.1344	0.0828
1973	0.0070	0.0025	0.0131	0.0053	0.0205	0.0340	-	-	0.0012	0.0393	0.0881	0.0959
1974	0.0406	-	0.0189	0.0074	0.0230	0.1004	0.0861	0.3197	0.3693	0.2156	0.2594	0.1131
S75760												
1972	-	0.0005	0.0003	-	-	0.0287	-	0.0148	0.0025	0.0098	0.1164	0.0586
1973	0.1176	0.0266	-	-	-	0.0041	-	-	-	-	-	-
1974	0.0332	-	-	-	-	0.0143	0.0094	0.2270	0.1787	-	0.0291	-
S78620												
1972	-	-	-	-	-	-	-	-	0.0115	0.0406	2.0410	2.4287
1973	0.6492	0.0828	0.1012	0.0258	0.0316	0.2123	-	0.0020	0.7598	0.0697	0.3111	0.0717
1974	0.0770	0.0434	-	0.0037	-	0.1184	-	0.3123	0.5902	0.3541	0.2828	0.4074

(1) Biomass, grams per meter

LGS EROL

TABLE 2.2-18

TOTAL NUMBER OF SPECIES (TAXA) OF BENTHIC MACROINVERTEBRATES COLLECTED PER SAMPLE FROM THE SCHUYLKILL RIVER NEAR LIMERICK GENERATING STATION, 1973 through 1976

Station/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean No. Taxa/Year
S78620													
1973	26	19	16	23	15	30	15	14	20	20	20	17	19.6
1974	17	34	14	28	31	28	27	25	14	24	18	26	23.8
1975	-	27	14	18	27	24	22	28	28	22	21	15	22.4
1976	24	17	17	23	23	30	33	27	31	31	27	29	26.0
S76760													
1973	24	16	14	16	7	15	12	10	14	22	22	19	15.9
1974	28	17	20	21	16	18	20	19	15	-	23	-	19.7
1975	-	33	27	22	28	18	14	22	27	27	20	23	23.7
1976	26	17	13	15	16	19	22	20	28	27	24	27	21.2
S75770													
1973	17	13	18	16	18	18	9	12	17	8	16	12	14.5
1974	27	22	18	24	11	19	15	19	15	25	20	25	20.0
1976	-	25	20	20	18	23	20	22	24	22	20	19	21.2

LGS EROL
TABLE 2.2-19

MONTHLY PERCENT COMPOSITION OF DOMINANT DRIFT SPECIES (TAXA)
OF MICROINVERTEBRATES COLLECTED FROM THE SCHUYKILL RIVER
AT S77560, 1972 THROUGH 1975

Taxon Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Naididate												
1972	-	-	-	-	-	-	-	(1)	-	1.8	-	-
1974	-	-	-	-	1.4	-	-	-	-	-	-	-
1975	-	-	-	-	2.9	-	-	-	-	-	-	-
Tricorythodes (nymphs)												
1972	-	-	-	-	-	(1)	-	(1)	(1)	-	(1)	-
1973	-	-	-	-	-	2.2	1.9	(1)	(1)	1.4	-	-
1974	-	-	-	-	(1)	-	-	(1)	6.6	17.8	-	(1)
1975	-	-	-	-	-	8.7	2.4	(1)	41.5	5.2	-	-
Cheumatopsyche (larvae)												
1972	-	1.8	-	(1)	(1)	-	-	(1)	-	-	(1)	(1)
1973	(1)	1.1	(1)	(1)	-	(1)	(1)	(1)	(1)	2.7	2.3	(1)
1974	1.9	7.6	(1)	(1)	(1)	-	(1)	4.5	6.3	5.2	10.0	(1)
1975	-	-	-	-	(1)	5.3	1.5	2.7	2.9	30.4	-	-
Hydropsyche phalerata (larvae)												
1972	-	1.8	-	-	-	-	-	-	-	-	(1)	(1)
1973	(1)	-	(1)	(1)	-	(1)	(1)	(1)	(1)	-	-	(1)
1974	-	-	-	-	-	-	(1)	-	-	15.1	-	-
1975	-	-	-	-	-	1.4	7.8	1.4	15.2	30.4	-	-
Hydroptila spatula (larvae)												
1972	-	-	-	-	-	(1)	-	-	-	-	-	(1)
1973	-	-	-	-	-	-	-	(1)	(1)	-	-	-
1974	-	-	-	-	-	-	-	(1)	-	-	-	-
1975	-	-	-	-	(1)	2.7	1.2	(1)	15.2	-	-	-
Psychode (larvae)												
1972	-	2.7	-	(1)	-	-	-	-	-	-	2.3	19.6
1973	2.6	1.7	49.6	4.8	-	(1)	(1)	-	(1)	-	-	(1)
1974	10	3.5	5.7	(1)	(1)	-	-	-	-	-	-	(1)
1975	-	-	-	-	(1)	-	-	-	-	-	-	-
Psychode (pupae)												
1972	-	23.4	-	22.8	2.8	-	-	-	(1)	2.4	26.8	22.9
1973	55.2	59.1	29.5	9.9	-	(1)	(1)	(1)	-	-	-	1.9
1974	33.1	30.6	70.2	24.9	(1)	(1)	-	-	(1)	-	-	1.9
1975	-	-	-	-	(1)	(1)	-	(1)	-	-	-	-

LGS EROL
TABLE 2.2-19
(Cont'd)

Taxon Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Telematoscopus albipunctatus (larvae)												
1972	-	-	-	-	-	-	-	-	-	-	3.1	4
1973	1.4	(1)	(1)	(1)	-	(1)	(1)	(1)	(1)	-	-	3.6
1974	27	5.3	(1)	2.3	(1)	-	-	-	-	-	-	3.4
Telmatoscopus albipunctatus (pupae)												
1972	-	-	-	(1)	-	-	-	-	-	1.2	58.5	48.2
1973	30.4	7.1	1.2	-	-	-	-	(1)	-	-	-	39.3
1974	6.5	20.6	1.2	2.3	(1)	-	-	-	(1)	-	-	(1)
Chironomidae (larvae)												
1972	-	16.2	-	23.5	19.7	40	52.2	58.8	26.4	7.6	3.7	1.4
1973	(1)	18.2	10.9	55.4	-	42.3	55	60.9	67.8	43.7	45.9	43.9
1974	14	21.8	8.3	34	59.7	68.9	77.4	51.1	41.1	24.7	50	13.2
1975	-	-	-	-	81.5	48.7	72.5	65.6	2078	23.7	-	-
Chironomidae (pupae)												
1972	-	34.2	-	47.9	75.6	46.2	36	39.9	68.6	75.3	(1)	(1)
1973	8.3	8	7.5	26.7	-	33	37.4	37.2	30.3	38.7	41.1	6.3
1974	1.7	3.5	13.1	32.4	35.8	30.3	19.8	23.7	24.8	19.2	10	79.8
1975	-	-	-	-	14.5	16.9	9.9	27.2	12.3	6.7	-	-

(1) Less than 1%.

LGS EROL
TABLE 2.2-20

MONTHLY DENSITIES(1) OF SELECTED SPECIES (TAXA) OF MICROINVERTEBRATES COLLECTED IN DRIFT SAMPLES FROM S77560 IN THE SCHUYLKILL RIVER, 1972 THROUGH 1975

Taxon/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Now	Dec	Annual Mean Density
Naididae													
1972	-	0	-	0	0	0	3.3	11.6	0	11.6	6.6	0	3.3
1973	-	0	0	0	-	14356.1	0	8.8	0	0	0	0	1436.5
1974	-	0	0	0	1060 8	0	0	0	0	0	0	0	88.4
1975	-	-	-	-	284.7	0	0	0	0	0	-	-	47.5
Tricorythoses													
1972	-	0	-	0	0	3.3	0	5.8	3.3	0	1.1	0	1.4
1973	-	0	0	0	-	1978.1	8.1	66.3	8.9	7.7	0	0	195.4
1974	-	0	0	0	0.8	0	0	10.5	46.3	54.7	0	2.7	9.6
1975	-	-	-	-	0	106.3	38.6	24.6	1423.3	3.1	-	-	266
Cheumatopsyche spp.													
1972	-	2.7	-	5.1	3.6	0	6.6	11.6	0	0	8.8	4.5	4.3
1973	1.8	3.4	3.9	2.2	-	349.3	32.9	8	17.8	0	20.7	6.6	40.6
1974	37	18.2	13.4	10.5	5.7	0	31.8	122.1	79.6	8.4	2.9	21.8	29.3
1975	-	-	-	-	6.9	65.2	23.9	86.8	98.7	8.2	-	-	47.5
Hydropsyche phalerata													
1972	-	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-	-	-
1974	0	0	0	0	0	0	5.8	0	0	0	0	0	0.5
1975	-	-	-	-	-	17.1	123.	3.6	177.6	19.1	-	-	56.8
Hydroptila spatula													
1972	-	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	0	0	0	0	0	0	0	0	0	0	0	0.4
1975	-	-	-	-	3.5	33.4	19.3	0	521.3	0	-	-	96.3
Psychoda (larvae)													
1972	-	4.1	-	2.6	0	0	0	0	0	0	59.5	473.6	54
1973	18.9	5.1	2283.4	61.2	-	42.1	3	0	12.5	0	0	5.8	221.1
1974	192.1	8.4	127.6	16.1	2.4	0	0	0	0	0	0	21.8	30.7
1975	-	-	-	-	1.7	0	0	0	0	0.4	-	-	0.4
Psychoda (pupae)													
1972	-	35.4	-	625	391.7	0	0	0	3.3	15.4	564.4	506.6	214.2
1973	469.7	178.3	1204.3	126.9	-	84.2	3.7	6.4	0	0	0	24	190.7
1974	635.8	73	1576.1	378.8	354.9	2.7	0	0	9.3	0	0	43	256.2
1975	-	-	-	-	27.8	0	0	0.7	0	0	-	-	4.8
Telmatoscopus albipunctatus (larvae)													
1972	-	0	-	0	0	0	0	0	0	0	65	94.4	15.9
1973	10.4	0.9	5.5	0.7	-	4.2	3.7	9.6	3.6	0	0	40.5	7.2
1974	0	0	0	0	0	0	0	0	0	0	0	133.4	11.1
1975	-	-	-	-	0	0	0	0	0	0	-	-	0

LGS EROL
TABLE 2.2-20
(Cont'd)

Taxon/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Now	Dec	Annual Mean Density
Telmatoscopus albipunctatus (pupae)													
1972	-	0	-	28.3	0	0	0	0	0	7.7	1264.3	1069.3	237
1973	1.8	21.4	39.7	0	-	0	0	5.6	0	0	0	490.7	50.8
1974	0	0	0	0	0	0	0	0	0	0	0	-	0
1975	-	-	-	-	0	0	0	0	0	0	-	-	0
Chironomidae (larvae)													
1972	-	24.5	-	794.8	2777.8	2570.8	585.3	7465.3	750.7	46.3	86	30.3	1413.2
1973	4.9	53.2	345.6	703.4	-	34528.6	2518.7	18054.8	11100.4	240.7	419.1	548.1	6228.9
1974	268.5	51.9	185.2	956.8	44400.6	13883.4	15593.2	1378.4	518.5	75.8	24.5	520.2	6487.3
1975	-	-	-	-	8125	593.3	1143.5	2073.2	711.4	15	-	-	2110.2
Chironomidae (pupae)													
1972	-	51.7	-	2062.8	10644.6	2109.8	403.4	5063.7	1951.1	563.3	16.3	4.5	2284.4
1973	0	24.0	237.5	339	-	26906.6	17777.9	11964.4	4568.9	213	375.2	79	4226
1974	33.2	8.4	293.2	857.2	27383	6108.4	5269.1	639.7	313	58.9	2.9	3137.3	3675.4
1975	-	-	-	-	1442.7	205.8	155.9	860.8	421.5	4.1	-	-	515.1

(1) Number of organisms/100M^3.

TABLE 2.2-21

MONTHLY ESTIMATES(1) OF THE PERCENT OF BENTHOS DRIFTING IN THE SCHUYLKILL RIVER NEAR LIMERICK GENERATING STATION, 1972-1975

	1972	1973	1974	1975
Jan	(2)	0.0088	0.0741	(2)
Feb	0.0094	0.0058	0.0024	(2)
Mar	(3)	0.0504	0.0068	(2)
Apr	(3)	0.0059	0.0227	(2)
May	1.3140	(2)	0.5727	0.0675
Jun	0.0651	0.3611	0.1035	0.0050
Jul	(3)	0.0377	0.1669	0.0067
Aug	(3)	1.2039	0.0121	0.0155
Sep	0.0016	0.0559	0.0119	0.0185
Oct	0.0014	0.0103	0.0019	0.0010
Nov	0.0036	0.0149	0.0002	(2)
Dec	0.0065	0.0182	0.0159	(2)

(1) Estimates are based upon benthos densities at S78620 and drift densities at S77560.
(2) No drift samples taken.
(3) No benthos samples taken.

TABLE 2.2-22

FISHES AND HYBRIDS[1] COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, SCHUYLKILL RIVER, 1970-1976

Common Name	Scientific Name	Relative Abundance	Status
Bowfin family	Amiidae		
Bowfin	*Amia calva* (Linnaeus)	Rare	I[2]
Freshwater eel family	Anguillidae		
American eel	*Anguilla rostrata* (Lesueur)	Common	N
Trout family	Salmonidae		
Rainbow trout	*Salmo gairdneri* (Richardson)	Rare	I
Brook trout	*Salvelinus fontinalis* (Mitchill)	Rare[3]	N
Pike family	Esocidae		
Redfin pickerel	*Esox americanus americanus* (Gmelin)	Rare	N
Muskellunge	*Esox masquinongy* (Mitchill)	Rare	I
Minnow family	Cyprinidae		
Goldfish	*Carassius auratus* (Linnaeus)	Common	I
Carp	*Cyprinus carpio* (Linnaeus)	Common	I
Goldfish x carp hybrid	*C. auratus* x *C. carpio* hybrid	Uncommon	I
Cutlips minnow	*Exoglossum maxillingua* (Lesueur)	Uncommon	N
Golden shiner	*Notemigonus crysoleucas* (Mitchill)	Common	N
Comely shiner	*Notropis amoenus* (Abbott)	Common	N
Common shiner	*Notropis cornutus* (Mitchill)	Common	N
Spottail shiner	*Notropis hudsonius* (Clinton)	Common	N
Swallowtail shiner	*Notropis procne* (Cope)	Abundant	N
Spotfin shiner	*Notropis spilopterus* (Cope)	Abundant	N
Bluntnose minnow	*Pimephales notatus* (Rafinesque)	Uncommon	N
Fathead minnow	*Pimephales promelas* Rafinesque	Rare	I
Blacknose dace	*Rhinichthys atratulus* (Hermann)	Common	N
Longnose dace	*Rhinichthys cataractae* (Valenciennes)	Uncommon	N
Creek chub	*Semotilus atromaculatus* (Mitchill)	Uncommon	N
Fallfish	*Semotilus corporalis* (Mitchill)	Uncommon	N

TABLE 2.2-22 (Cont'd)

Common Name	Scientific Name	Relative Abundance	Status
Sucker family	Catostomidae		
Quillback	Carpiodes cyprinus (Lesueur)	Rare	N
White sucker	Catostomus commersoni (Lacepede)	Abundant	N
Creek chubsucker	Erimyzon oblongus (Mitchill)	Common	N
Freshwater catfish family	Ictaluridae		
White catfish	Ictalurus catus (Linnaeus)	Common	N
Yellow bullhead	Ictalurus natalis (Lesueur)	Common	N
Brown bullhead	Ictalurus nebulosus (Lesueur)	Abundant	N
Channel catfish	Ictalurus punctatus (Rafinesque)	Uncommon	I
Margined madtom	Noturus insignis (Richardson)	Rare	N
Killifish family	Cyprinodontidae		
Banded killifish	Fundulus diaphanus (Lesueur)	Common	N
Sunfish family	Centrarchidae		
Rock bass	Ambloplites rupestris (Rafinesque)	Common	I
Redbreast sunfish	Lepomis auritus (Linnaeus)	Abundant	N
Green sunfish	Lepomis cyanellus (Rafinesque)	Common	I
Pumpkinseed	Lepomis gibbosus (Linnaeus)	Abundant	N
Bluegill	Lepomis macrochirus (Rafinessque)	Common	I
Sunfish hybrid	Lepomis hybrid	Common	
Smallmouth bass	Micropterus dolomieui (Lacepede)	Uncommon	I
Largemouth bass	Micropterus salmoides (Lacepede)	Common	I
White crappie	Pomoxis annularis (Rafinesque)	Common	I
Black crappie	Pomoxis nigromaculatus (Lesueur)	Common	I
Perch family	Percidae		
Tessellated darter	Etheostoma olmstedi (Storer)	Common	N
Yellow perch	Perca flavescens (Mitchill)	Uncommon	N
Walleye	Stizostedion vitreum vitreum (Mitchill)	Rare	I

[1] Reference 2.2-53
[2] I = introduced, N = native
[3] Only collected in a tributary of the river.

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TABLE 2.2-23

MEAN DENSITY AND RELATIVE ABUNDANCE OF SELECTED
LARVAL FISH COLLECTED FROM THE EAST CHANNEL OF THE
SCHUYLKILL RIVER AT S77560, MAY-AUGUST IN 1974, 1975 and 1976

Taxa	1974 No./m³	%	1975 No./m³	%	1976 No./m³	%
Minnows	0.21337	47.1	0.06908	78.1	0.14634	24.6
Goldfish	0.13611	30.0	0.00020	0.2	0.37527	63.0
Carp	0.04465	9.8	0.00102	1.2	0.04117	6.9
Golden Shiner	0.02186	4.8	0.00020	0.2	0.00670	1.1
White Sucker	0.00109	0.2	0.01328	15.0	0.00422	0.7
Brown Bullhead	0.00016	-	0.00082	0.9	0.00025	0.0
Banded Killifish	0.00109	0.2	0.00123	1.4	0.00050	0.1
Lepomis Sunfish	0.03503	7.7	0.00123	1.4	0.01959	3.3
Tessellated Darter	-	-	0.00143	1.6	0.00174	0.3
	0.45374		0.08850		0.59578	

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TABLE 2.2-24

HORIZONTAL VARIATION IN DENSITY OF LARVAL FISH
COLLECTED FROM THE SCHUYLKILL RIVER AT S77560 in 1975

	NET					
1975	1	2	3	4	5	6
Taxa	No./m³	No./m³	No./m³	No./m³	No./m³	No./m³
Minnows	0.2493	0.0254	0.0237	0.0238	0.0341	0.0834
Goldfish	0.0071	-	0.0003	0.0004	-	0.0007
Carp	0.0013	-	0.0003	0.0014	0.0022	0.0033
Golden Shiner	0.0033	0.0010	0.0007	0.0009	0.0004	0.0009
White Sucker	0.1790	0.0157	0.0096	0.0181	0.0160	0.0420
Brown Bullhead	0.0004	0.0003	0.0010	0.0014	0.0004	0.0005
Banded Killfish	0.0009	0.0005	0.0007	0.0003	0.0006	0.0013
Lepomis Sunfish	0.0083	0.0010	0.0011	0.0009	0.0009	0.0021
White Crappie	0.0536	0.0046	0.0082	0.0151	0.0060	0.0126
Tessellated Darter	0.0020	-	0.0006	0.0016	0.0017	0.0029
1976						
Minnows	0.1796	0.0586	0.0925	0.0628	0.1719	0.1910
Goldfish	0.0489	0.0552	0.0442	0.0350	0.1631	0.0858
Carp	0.0322	0.0272	0.0203	0.0202	0.1053	0.1017
Golden Shiner	0.0100	0.0037	0.0018	0.0013	0.0199	0.0247
White Sucker	0.0059	0.0017	0.0019	0.0034	0.0062	0.0118
Brown Bullhead	0.0000	0.0000	0.0000	0.0000	0.0026	0.0000
Banded Killfish	0.0011	0.0002	0.0002	0.0007	0.0000	0.0005
Lepomis Sunfish	0.0323	0.0085	0.0076	0.0069	0.0334	0.0490
White Crappie	0.0000	0.0000	0.0007	0.0013	0.0048	0.0041
Tessellated Darter	0.0014	0.0011	0.0007	0.0036	0.0067	0.0015

TABLE 2.2-25

TOTAL CATCH AND RELATIVE ABUNDANCE OF LARVAL FISH COLLECTED BY TRAP NET FROM THE SCHUYLKILL RIVER SHORELINE AT S77560, MAY-AUGUST IN 1975

Taxa	Total Catch	% Catch
Minnows	621	46.4
Goldfish	495	37.3
Carp	98	7.3
Golden shiner	26	1.9
White sucker	61	4.6
Brown bullhead	4	0.3
Banded killifish	3	0.2
Lepomis sunfish	15	1.1
White crappie	5	0.4
Tessellated darter	11	0.8
TOTAL	1339	100.0

TABLE 2.2-26

TOTAL NUMBER AND PERCENT CATCH OF SHORELINE LARVAL FISH SAMPLED BY PUSH NET FROM THE SCHUYLKILL RIVER DURING THE SPAWNING PERICD IN 1976

Stations[1]	S78973		S78432		S77970		S77550		S77485		S77320		S77230	
Taxa	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch
Unidentified minnows	68	54.0	20	83.3	53	46.9	1	25.0	0	0.0	6	3.6	0	0.0
Carp	0	0.0	0	0.0	12	10.6	0	0.0	0	0.0	15	8.9	0	0.0
Goldfish	0	0.0	0	0.0	27	23.9	2	50.0	0	0.0	135	80.4	0	0.0
Golden shiner	1	0.8	0	0.0	4	3.5	0	0.0	0	0.0	0	0.0	0	0.0
White sucker	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Lepomis spp.	57	45.2	4	16.7	10	8.8	0	0.0	1	100.0	4	2.4	5	100.0
Banded killifish	0	0.0	0	0.0	7	6.2	1	25.0	0	0.0	8	4.7	0	0.0
Tessellated darter	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	126		24		113		4		1		168		5	

Stations[1]	S77161		S76970		S76840		S76794		S76632		S75781		Combined	
Taxa	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch	Total No.	% Catch
Unidentified minnows	131	50.2	27	15.1	1	10.0	1	0.4	34	50.0	3	13.6	345	28.0
Carp	8	3.1	5	2.8	0	0.0	0	0.0	0	0.0	2	9.1	42	3.4
Goldfish	9	3.4	144	80.4	3	30.0	243	96.8	2	2.9	15	68.2	580	47.1
Golden shiner	21	8.1	1	0.6	1	10.0	1	0.4	0	0.0	0	0.0	29	2.4
White sucker	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.5	1	0.1
Lepomis spp.	92	35.2	2	1.1	5	50.0	6	2.4	31	45.6	0	0.0	217	17.6
Banded killifish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.5	17	1.4
Tessellated darter	0	0.0	0	0.0	0	0.0	0	0.0	1	1.5	0	0.0	1	0.1
Total	261		179		10		251		68		22		1232	

[1]Stations S77970, S77161, and S76794 were located off the Chester County shore; all other stations were off the Montgomery County shore.

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TABLE 2.2-27

TOTAL NUMBER AND CATCH-PER-UNIT- EFFCRT OF LARVAL FISH COLLECTED BY PUSH NET FROM SELECTED AREAS[1] IN THE SCHUYLKILL RIVER NEAR LIMERICK GENERATING STATICN IN 1976

	Upstream discharge		Downstream discharge		East Shore		West Shore	
Taxa	Total No.	C/f	Total No.	C/f	Total No.	C/f	Total No.	C/f
Unidentified minnows	148	24.67	197	28.14	160	16.00	185	61.67
Carp	27	4.50	15	2.14	22	2.20	20	6.67
Goldfish	164	27.33	416	59.43	301	30.10	279	93.00
Golden shiner	5	0.83	24	3.43	3	0.30	26	8.67
White sucker	0	0.00	1	0.14	1	0.10	0	0.00
Lepomis spp.	76	12.67	141	20.14	109	10.90	108	36.00
Banded killifish	16	2.67	1	0.14	10	1.00	7	2.33
Tessellated darter	0	0.00	1	0.14	1	0.10	0	0.00
Total	436	72.67	796	113.70	607	60.70	625	208.34

[1] Each area represents a combinaticn of data from several sites within the area.

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TABLE 2.2-28

TOTAL CATCH, RELATIVE ABUNDANCE, AND FREQUENCY OF OCCURRENCE (FO %) OF FISHES COLLECTED BY SEINE FROM THE SCHUYLKILL RIVER (ALL SITES COMBINED) IN 1975 AND 1976

Species	1975 Catch	%	FO (%)	1976 Catch	%	FO (%)	Total	%
American eel	1	(1)	0.76	-	-	-	1	(1)
Banded killifish	108	0.5	31.82	231	1.3	44.44	339	0.8
Black crappie	24	0.1	12.88	31	0.2	11.11	55	0.1
Blacknose dace	7	(1)	5.30	109	0.6	24.31	116	0.3
Bluegill	43	0.2	17.42	63	0.4	24.31	106	0.3
Bluntnose minnow	3	(1)	1.52	13	0.1	8.33	16	(1)
Brown bullhead	17	0.1	7.58	20	0.1	8.33	37	0.1
Comely shiner	128	0.5	28.03	129	0.7	31.25	257	0.6
Common shiner	29	0.1	15.91	135	0.8	16.67	164	0.4
Creek chub	-	-	-	9	0.1	5.56	9	(1)
Creek chubsucker	1	(1)	0.76	6	(1)	3.47	7	(1)
Cutlips minnow	-	-	-	5	(1)	3.47	5	(1)
Fallfish	2	(1)	1.52	-	-	-	2	(1)
Golden shiner	368	1.5	29.55	376	2.2	27.08	744	1.8
Goldfish	1	(1)	0.76	14	0.1	2.78	15	(1)
Green sunfish	61	0.3	26.52	71	0.4	25	132	0.3
Largemouth bass	10	(1)	5.30	12	0.1	4.86	22	0.1
Lepomis hybrid	7	(1)	5.30	8	(1)	2.78	15	(1)
Longnose dace	-	-	-	8	(1)	4.17	8	(1)
Margined madtom	-	-	-	1	(1)	0.69	1	(1)
Muskellunge	-	-	-	1	(1)	0.69	1	(1)
Pumpkinseed	97	0.4	29.55	131	0.8	31.94	228	0.6
Quillback	-	-	-	5	(1)	1.39	5	(1)
Redbreast sunfish	203	0.8	39.39	706	4.1	51.39	909	2.2
Rock bass	8	(1)	5.30	26	0.2	9.72	34	0.1
Smallmouth bass	1	(1)	0.76	6	(1)	2.78	7	(1)
Spotfin shiner	9259	38.7	87.88	8000	46.4	82.64	17259	41.9
Spottail shiner	44	0.2	14.39	775	4.5	31.94	819	2
Swallowtail shiner	13426	56.1	78.03	5611	32.5	77.08	19037	46.2
Tessellated darter	32	0.1	14.39	257	1.5	43.75	289	0.7
White catfish	-	-	-	2	(1)	0.69	2	(1)
White crappie	11	(1)	5.30	29	0.2	11.81	40	0.1
White sucker	19	0.1	6.82	449	2.6	23.61	468	1.1
Yellow bullhead	4	(1)	3.03	8	(1)	3.47	12	(1)
Yellow perch	-	-	-	1	(1)	0.69	1	(1)
Total	23914			17248			41162	

(1) Less than 0.1%

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TABLE 2.2-29

MONTHLY VARIATION IN TOTAL CATCH AND RELATIVE ABUNDANCE OF IMPORTANT SPECIES OF FISH AND TOTAL NUMBER OF SPECIES COLLECTED BY SEINE FROM THE SCHUYLKILL RIVER (ALL SITES COMBINED, 1975 AND 1976)

Species(1)	Year	Jan No.	Jan % Total Catch	Feb No.	Feb % Total Catch	Mar No.	Mar % Total Catch	Apr No.	Apr % Total Catch	May No.	May % Total Catch	Jun No.	Jun % Total Catch	Jul No.	Jul % Total Catch	Aug No.	Aug % Total Catch	Sep No.	Sep % Total Catch	Oct No.	Oct % Total Catch	Nov No.	Nov % Total Catch	Dec No.	Dec % Total Catch	No.	% Total Catch
American eel	1975	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.3	-	-	-	-	-	-	1	(2)
Muskellunge	1976	1	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	(2)
Goldfish	1975	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.5	-	-	1	(2)
	1976	-	-	-	-	-	-	-	-	-	-	5	0.5	9	0.6	-	-	-	-	-	-	-	-	-	-	-	-
Swallowtail shiner	1975	3006	65.2	5902	77.7	1504	58.8	2431	45.5	185	10.5	77	14.0	11	2.1	40	38.1	82	20.7	32	19.0	108	56.5	48	53.3	13426	56.1
	1976	301	66.4	77	59.2	71	48.0	53	16.3	2	0.6	24	2.2	316	22.2	271	9.7	219	10.6	-	-	2008	50.2	2269	50.8	5611	32.5
Spotfin shiner	1975	1339	29.1	1413	18.6	978	38.2	2857	53.4	1545	87.4	423	76.9	448	83.9	20	19	120	30.2	71	42.3	33	17.3	12	13.3	9259	38.7
	1976	67	14.8	29	22.3	56	37.8	210	64.4	184	57	35	3.2	169	11.9	1982	70.6	1616	77.9	-	-	1653	41.4	1999	44.7	8000	46.4
White sucker	1975	1	(2)	1	(2)	-	-	-	-	-2	0.1	12	12	-	-	-	-	3	0.8	-	-	-	-	-	-	19	0.1
	1976	-	-	-	-	-	-	1	0.3	43	13.3	326	29.8	71	5.0	4	0.1	-	-	-	-	4	0.1	-	-	449	2.6
Brown bullhead	1975	-	-	-	-	-	-	-	-	-	-	4	0.7	-	-	-	-	9	2.3	3	1.8	1	0.5	-	-	17	0.1
	1976	1	0.2	-	-	-	-	1	0.3	2	0.6	2	0.2	12	0.8	2	0.1	-	-	-	-	-	-	-	-	20	0.1
Banded killfish	1975	35	0.8	23	0.3	11	0.4	3	0.1	3	0.2	1	0.2	1	0.2	4	3.8	15	3.8	5	3	1	0.5	6	6.7	108	0.5
	1976	5	1.1	4	3.1	5	3.4	10	3.1	26	8.1	1	0.1	55	3.9	69	2.5	23	1.1	-	-	16	0.4	17	0.4	231	1.3
Redbreast sunfish	1975	14	0.3	10	0.1	8	0.3	13	0.2	5	0.3	2	0.4	4	0.7	4	3.8	117	29.5	15	8.9	10	5.2	1	1.1	203	0.8
	1976	5	1.1	-	-	1	0.7	5	1.5	5	1.5	4	0.4	237	16.6	189	6.7	133	6.4	-	-	104	2.6	23	0.5	706	4.1
Pumpkinseed	1975	30	0.7	14	0.2	8	0.3	3	0.1	5	0.3	5	0.9	2	0.4	3	2.9	14	3.5	7	4.2	5	2.6	1	1.1	97	0.4
	1976	6	1.3	1	0.8	-	-	7	2.1	15	4.6	17	1.6	16	1.1	29	1	21	1	-	-	11	0.3	8	0.2	131	0.8
Largemouth bass	1975	1	(2)	-	-	-	-	-	-	-	-	6	1.1	-	-	2	1.9	1	0.3	-	-	-	-	-	-	10	(2)
	1976	-	-	-	-	-	-	-	-	-	-	-	-	10	0.7	1	(2)	-	-	-	-	-	-	1	(2)	12	0.1
Tessellated darter	1975	6	0.1	16	0.2	2	0.1	1	(2)	1	0.1	-	-	-	-	-	-	-	-	-	-	2	1.0	4	4.4	32	0.1
	1976	10	2.2	3	2.3	3	2	3	0.9	3	0.9	42	3.8	56	3.9	14	0.5	19	0.9	-	-	48	1.2	56	1.3	257	1.5
Number of Species	1975	17		15		15		12		13		16		16		13		18		14		17		13			
Number of Species	1976	16		11		10		17		17		18		28		24		18		-		19		19			

(1)Not all species caught are listed, but all are included in the totals for the number of species caught.

(2)Less than 0.1%.

SPATIAL VARIATION IN TOTAL CATCH AND RELATIVE ABUNDANCE OF IMPORTANT SPECIES OF FISH AND TOTAL NUMBER OF SPECIES COLLECTED BY SEINE FROM THE SCHYLKILL RIVER, 1975 AND 1976

		81750		78900		78460		77960		77240		77220		77010		76840	
Species(1)	Year	No.	% Total Catch	No.	% Total Catch	No.	% Total Catch	No.	% Total Catch	No.	% Total Catch	No.	% Total Catch	No.	% Total Catch	No.	% Total Catch
American eel	1975	-	-	1	0.2	-	-	-	-	-	-	-	-	-	-	-	-
Muskellunge	1976	-	-	-	-	-	-	1	0.1	-	-	-	-	-	-	-	-
Goldfish	1975	-	-	-	-	-	-	-	-	-	-	-		1	0.1	-	-
	1976	-	-	-	-	-	-	-	-	-	-	1	(2)	2	0.2	-	-
Swallowtail shiner	1975	2822	71.5	150	22.8	302	60.2	1511	51.8	885	57.5	624	50.4	620	68.8	1083	55.1
	1976	179	16.3	1144	57.9	130	23.3	218	26.5	538	33.2	632	26.1	226	28	1333	49.1
Spotfin shiner	1975	1039	26.3	456	69.3	173	34.5	1032	35.4	567	36.9	546	44.1	203	22.5	808	41.1
	1976	701	64	497	35.3	353	63.4	315	38.3	796	49.1	1044	43.1	315	39	1147	42.2
White sucker	1975	-	-	-	-	1	0.2	2	0.1	2	0.1	-	-	-	-	1	0.1
	1976	73	6.7	7	0.4	10	1.8	33	4	15	0.9	136	5.6	27	3.3	6	0.2
Brown bullhead	1975	-	-	3	0.5	1	0.2	-	-	-	-	2	0.2	5	0.6	-	-
	1976	-	-	2	0.1	-	-	1	0.1	3	0.2	2	0.1	1	0.1	-	-
Banded killfish	1975	18	0.5	8	1.2	-	-	21	0.7	5	0.3	10	0.8	3	0.3	6	0.3
	1976	11	1	22	1.1	4	0.7	46	5.6	21	1.3	27	1.1	31	3.8	5	0.2
Redbreast sunfish	1975	18	0.5	25	3.8	12	2.4	4	0.1	23	1.5	5	0.4	21	2.3	17	0.9
	1976	35	3.2	41	2.1	7	1.3	83	10.1	136	8.4	61	2.5	53	6.6	67	2.5
Pumpkinseed	1975	2	0.1	-	-	1	0.2	18	0.6	7	0.5	6	0.5	11	1.2	11	0.6
	1976	2	0.2	3	0.2	1	0.2	4	0.5	7	0.4	16	0.7	8	1	8	0.3
Largemouth bass	1975	-	-	-	-	1	0.2	2	0.1	1	0.1	1	0.1	-	-	-	-
	1976	-	-	-	-	-	-	6	0.7	1	0.1	1	(2)	2	0.2	-	-
Tessellated darter	1975	-	-	2	0.3	-	-	-	-	-	-	2	0.2	6	0.7	11	0.6
	1976	2	0.2	14	0.7	11	2	14	1.7	6	0.4	30	1.2	23	2.8	44	1.6
Number of Species	1975	11		15		10		18		18		19		15		17	
Number of Species	1976	15		20		15		24		21		23		25		20	

LGS EROL
TABLE 2.2-30
(Cont'd)

Species(1)	Year	76820 No.	76820 % Total Catch	76310 No.	76310 % Total Catch	75730 No.	75730 % Total Catch	No.	% TOTAL
American eel	1975	-	-	1	-	-	-	-	(2)
Muskellunge	1975	-	-	-	-	-	-	-	(2)
Goldfish	1975	-	-	-	-	-	-	-	(2)
	1976	4	0.1	-	-	7	0.5	-	(2)
Swallowtail shiner	1975	1372	47.4	491	58	3566	54.8	13426	56.1
	1976	1576	21.2	200	29.5	365	24.3	5611	32.5
Spotfin shiner	1975	1378	47.6	329	38.9	2728	41.9	9259	38.7
	1976	1576	51.7	291	42.9	765	50.9	8000	46.4
White sucker	1975	12	0.4	1	0.1	-	-	19	0.1
	1976	121	4	2	0.3	19	1.3	449	2.6
Brown bullhead	1975	2	0.1	-	-	4	0.1	17	0.1
	1976	8	0.3	2	0.3	1	0.1	20	0.1
Banded killfish	1975	7	0.2	1	0.1	29	0.4	108	0.5
	1976	41	1.3	9	1.3	14	0.9	231	1.3
Redbreast sunfish	1975	5	0.2	10	1.2	63	1	203	0.8
	1976	27	0.9	51	7.5	145	9.6	706	4.1
Pumpkinseed	1975	3	0.1	1	0.1	37	0.6	97	0.4
	1976	62	2	5	0.7	15	1	131	0.8
Largemouth bass	1975	4	0.1	-	-	1	(2)	10	(2)
	1976	2	0.1	-	-	-	-	12	0.1
Tessellated darter	1975	2	0.1	6	0.7	3	(2)	32	0.1
	1976	13	0.4	47	6.9	53	3.5	257	1.5
Number of Species	1975	19		12		17			
Number of Species	1976	17		19		22			

(1) Not all species caught are listed, but all are included in the totals for the number of species caught.
(2) Less than 0.1%.

LGS EROL

TABLE 2.2-31

TOTAL CATCH AND RELATIVE ABUNDANCE OF SMALL FISHES COLLECTED(1)
FROM THE SCHUYLKILL RIVER NEAR LGS, 1973 THROUGH 1976

	1973		1974		1975		1976	
Species	No.	%	No.	%	No.	%	No.	%
American eel	4	0.3	3	0.5	5	0.5	1	0.1
Goldfish	1	0.1	(2)	-	13	1.2	-	-
Carp	7	0.4	(2)	-	-	-	-	-
Cutlips minnow	1	0.1	(2)	-	-	-	-	-
Golden shiner	10	0.6	(2)	-	-	-	2	0.1
Comely shiner	14	0.9	(2)	-	-	-	-	-
Satinfin shiner	3	0.2	(2)	-	-	-	-	-
Common shiner	19	1.2	(2)	-	-	-	7	0.5
Spottail shiner	56	3.6	(2)	-	14	1.3	45	3.2
Swallowtail shiner	155	10.1	(2)	-	339	31	253	17.9
Spotfin shiner	706	45.9	(2)	-	43	3.9	438	30.9
Bluntnose minnow	3	0.2	(2)	-	-	-	-	-
Blacknose dace	9	0.6	(2)	-	1	0.1	-	-
Creek chubsucker	-	-	-	-	1	0.1	3	0.2
White sucker	4	0.3	9	1.5	14	1.3	16	1.1
White catfish	11	0.7	1	0.2	1	0.1	3	0.2
Yellow bullhead	9	0.6	6	1	22	2	11	0.8
Brown bullhead	4	0.3	1	0.2	20	1.8	1	0.1
Banded killifish	56	3.6	(2)	-	11	1	214	15.1
Rock bass	5	0.3	-	-	5	0.5	2	0.1
Redbreast sunfish	68	4.4	276	46.2	83	7.6	196	13.8
Green sunfish	255	16.6	147	24.6	454	41.5	73	5.2
Pumpkinseed	54	3.5	152	25.4	19	1.7	7	0.5
Bluegill	36	2.3	-	-	5	0.5	1	0.1
Lepomis hybrid	3	0.2	3	0.5	8	0.7	4	0.3
Smallmouth bass	1	0.1	-	-	1	0.1	-	-
Largemouth bass	9	0.6	-	-	1	0.1	1	0.1
Black crappie	6	0.4	-	-	2	0.2	1	0.1
Tessellated darter	27	1.8	(2)	-	31	2.8	138	9.7
Yellow perch	1	0.1	-	-	-	-	-	-
Total	1537		598		1093		1417	

(1) From age 0 sunfish population estimate sampling.
(2) These species not sampled in 1974.

LGS EROL
TABLE 2.2-32

TOTAL CATCH AND RELATIVE ABUNDANCE OF FISHES AND HYBRIDS COLLECTED (1)
DURING LARGE FISH POPULATION ESTIMATE SAMPLING, 1973 THROUGH 1975

Species	Firestone 1974		Limerick A 1973		Limerick A 1974		Limerick A 1975		Limerick B 1973		Limerick B 1974		Limerick B 1975		Vincent Pool 1974		All Sites All Years	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Muskellunge	-	-	-	-	-	-	1	(2)	1	-	-	-	-	-	-	-	1	(2)
Goldfish	185	8.1	113	7.3	34	6.5	247	6.7	110	7.2	44	5.8	236	5.5	196	6.1	1165	6.5
Carp	16	0.7	4	0.3	-	-	20	0.5	5	0.3	2	0.3	21	0.5	17	0.5	85	0.5
Golden shiner	34	1.5	38	2.5	7	1.3	145	4.0	44	2.9	10	1.3	195	4.5	38	1.2	511	2.9
Fallfish	-	-	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	1	(2)
Minnow hybrid	1	(2)	-	-	-	-	1	(2)	-	-	-	-	-	-	2	0.1	5	(2)
White sucker	369	6.1	123	7.9	78	14.9	451	12.3	125	8.2	57	7.5	434	10.1	259	8.1	1896	10.6
Creek chubsucker		-	-	-	-	-	12	0.3	-	-	-	-	41	1.0	-	-	53	0.3
White catfish	29	1.3	15	-	8	1.5	57	1.6	1	0.1	3	0.4	37	0.9	12	0.4	162	0.9
Yellow bullhead	9	0.4	10	1.0	-	-	18	0.5	-	-	3	0.4	26	0.6	2	0.1	162	0.9
Brown bullhead	366	16.0	159	0.6	223	42.6	1295	35.3	222	14.5	258	33.8	1654	38.4	1103	34.5	5280	29.6
Channel catfish	-	-	-	10.3	-	-	-	-	1	0.1	-	-	-	-	2	0.1	3	(2)
Rock bass	4	0.2	11	0.7	4	0.8	45	1.2	5	0.3	4	0.5	41	1.0	11	0.3	125	0.7
Redbreast sunfish	1131	49.5	670	43.2	117	22.3	971	26.5	341	22.3	129	16.9	930	21.6	307	9.6	4596	25.8
Green sunfish	37	1.6	48	3.1	7	1.3	46	1.3	12	0.8	5	0.7	60	1.4	95	3.0	310	1.7
Pumpkinseed	71	3.1	262	16.9	43	8.2	210	5.7	596	39.0	223	29.2	384	8.9	1109	34.7	2898	16.3
Bluegill	6	0.3	27	1.7	-	-	36	1.0	15	1.0	-	-	87	2.0	7	0.2	178	1.0
Lepomis hybrid	5	0.2	6	0.4	-	-	10	0.3	3	0.2	1	0.1	14	0.3	20	0.6	59	0.3
Smallmouth bass	15	0.7	5	0.3	1	0.2	10	0.3	1	0.1	3	0.4	2	(2)	2	0.1	39	0.2
Largemouth bass	4	0.2	44	2.8	1	0.2	29	0.8	35	2.3	16	2.1	44	1.0	2	0.1	175	1.0
White crappie	4	0.2	5	0.3	-	-	12	0.3	3	0.2	1	0.1	44	1.0	5	0.2	74	0.4
Black crappie	-	-	8	0.5	-	-	47	1.3	6	0.4	4	0.5	57	1.3	9	0.3	131	0.7
Yellow Perch	-	-	1	0.1	1	0.2	3	0.1	3	0.2	-	-	4	0.1	1	(2)	13	0.1
Total	2286		1550		524		3666		1528		763		4312		3199		17828	

(1) From the Schuylkill River near Limerick Generating Station.
(2) Less than 0.1%.

TABLE 2.2-33

TOTAL CATCH AND RELATIVE ABUNDANCE OF FISHES COLLECTED[1]
DURING CATCH-PER-UNIT-EFFORT SAMPLING, JULY THROUGH DECEMBER 1976

	Firestone		Limerick A		Limerick C		Vincent A		Vincent B		Total	
Species	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
American eel	13	2	15	1.1	26	2.9	12	2	7	1.8	73	1.9
Goldfish	4	0.6	181	12.9	22	2.5	49	8.3	2	0.5	258	6.6
Carp	-	-	19	1.4	1	0.1	16	2.7	5	1.3	41	1
Golden shiner	1	0.2	44	3.1	6	0.7	11	1.9	204	52.4	266	6.8
Minnow hybrid	-	-	1	0.1	1	0.1	9	1.5	-	-	11	0.3
Quillback	-	-	-	-	1	0.1	-	-	-	-	1	(2)
White sucker	205	32.1	239	17.1	285	31.8	141	23.9	27	6.9	897	22.9
Creek chubsucker	-	-	19	1.4	-	-	2	0.3	-	-	21	0.5
White catfish	12	1.9	9	0.6	3	0.3	2	0.3	-	-	26	0.7
Yellow bullhead	10	1.6	12	0.9	20	2.2	4	0.7	6	1.5	52	1.3
Brown bullhead	57	8.9	302	21.6	60	6.7	40	6.8	24	6.2	483	12.3
Channel catfish	-	-	1	0.1	-	-	-	-	-	-	1	(2)
Rock bass	4	0.6	11	0.8	17	1.9	3	0.5	2	0.5	37	0.9
Redbreast sunfish	279	43.7	204	14.6	240	26.8	112	19	19	4.9	854	21.8
Green sunfish	10	1.6	85	6.1	58	6.5	23	3.9	18	4.6	194	5
Pumpkinseed	17	2.7	166	11.8	115	12.8	122	20.6	57	14.7	477	12.2
Bluegill	1	0.2	7	0.5	7	0.8	8	1.4	1	0.3	24	0.6
Lepomis hybrid	11	1.7	9	0.6	-	-	9	1.5	6	1.5	35	0.9
Smallmouth bass	11	1.7	-	-	2	0.2	5	0.8	1	0.3	19	0.5
Largemouth bass	1	0.2	22	1.6	18	2	2	0.3	3	0.8	46	1.2
White crappie	-	-	5	0.4	2	0.2	2	0.3	4	1	13	0.3
Black crappie	-	-	28	2	6	0.7	16	2.7	3	0.8	53	1.4
Yellow perch	2	0.3	21	1.5	6	0.7	3	0.5	-	-	32	0.8
Walleye	-	-	1	0.1	-	-	-	-	-	-	1	(2)
Total	638		1401		896		591		389		3915	

(1) From the Schuylkill River near Limerick Generating Station
(2) Less than 0.1%

TABLE 2.2-34

FISHES TAKEN BY TRAP NET FROM THE SCHUYLKILL RIVER AT VINCENT POOL FROM MAY 1971 THROUGH DECEMBER 1976

Species	1971 No.	%	1972 No.	%	1973 No.	%	1974 No.	%	1975 No.	%	1976 No.	%	TOTAL No.	%
Bowfin	-	-	1	(1)	1	(1)	1	(1)	-	-	-	-	3	(1)
American eel	8	0.2	5	0.2	14	0.3	15	0.4	-	-	55	1.6	97	0.5
Goldfish	9	0.2	10	0.3	34	0.7	185	4.7	35	3.8	25	0.7	298	1.5
Carp	12	0.3	6	0.2	7	0.1	6	9.2	-	-	5	0.1	36	0.2
Golden shiner	10	0.3	8	0.3	48	1	409	10.3	6	0.6	57	1.6	538	2.7
Spottail shiner	-	-	9	0.3	19	0.4	6	0.2	20	2.2	23	0.7	77	0.4
Swallowtail shiner	2	0.1	10	0.3	16	0.3	1	(1)	1	0.1	-	-	30	0.1
Spotfin shiner	-	-	-	-	-	-	1	(1)	-	-	5	0.1	6	(1)
Minnow hybrid	-	-	-	-	-	-	-	-	-	-	2	0.1	2	(1)
Quillback	-	-	1	(1)	-	-	4	0.1	-	-	4	0.1	9	(1)
White sucker	21	0.5	21	0.7	97	2	87	2.2	19	2.1	60	1.7	305	1.5
Check chubsucker	2	0.1	-	-	1	(1)	1	(1)	-	-	-	-	4	(1)
White catfish	22	0.6	44	1.5	94	2	65	1.6	48	5.2	73	2.1	346	1.7
Yellow bullhead	5	0.1	1	(1)	2	(1)	3	0.1	1	0.1	8	0.2	20	0.1
Brown bullhead	1496	38.3	1127	37.5	1309	27.4	991	25.1	287	31	615	17.5	5825	29
Channel catfish	4	0.1	10	0.3	15	0.3	34	0.9	6	0.6	10	0.3	79	0.4
Margined madtom	-	-	1	(1)	-	-	-	-	-	-	-	-	1	(1)
Rock bass	21	0.5	14	0.5	15	0.3	25	0.6	13	1.4	51	1.4	139	0.7
Redbreast sunfish	57	1.5	71	2.4	138	2.9	162	4.1	75	8.1	538	15.3	1041	5.2
Green sunfish	113	2.9	20	0.7	75	1.6	153	3.9	19	2.1	243	6.9	623	3.1
Pumpkinseed	1932	49.4	1449	48.2	2527	52.8	1471	37.2	298	32.2	1265	35.9	8942	44.5
Bluegill	15	0.4	73	2.4	119	2.5	81	2	31	3.3	105	3	424	2.1
Lepomis hybrid	3	0.1	15	0.5	23	0.5	29	0.7	8	0.9	118	3.4	196	1
Smallmouth bass	-	-	-	-	-	-	1	(1)	-	-	2	0.1	3	(1)
Largemouth bass	-	-	2	0.1	-	-	1	(1)	-	-	8	0.2	11	0.1
White crappie	146	3.7	68	2.3	171	3.6	136	3.4	32	3.5	66	1.9	619	3.1
Black crappie	31	0.8	39	1.3	59	1.2	85	2.1	27	2.9	163	4.6	494	2
Tessellated darter	-	-	-	-	-	-	-	-	-	-	1	(1)	1	(1)
Yellow perch	-	-	-	-	-	-	3	0.1	-	-	18	0.5	21	0.1
Total	3909		3005		4784		3956		926		3520		20100	

(1) Less than 0.1%

TABLE 2.2-35

CRITERIA FOR DETERMINING OF IMPORTANT FISHES OF THE SCHUYLKILL RIVER

	IMPORTANCE				LINK TO PLANT		
					DIRECT		
Common Name	Commercial	Recreational	Ecological	Abundant	Susceptible to Impingement	Susceptible to Entrainment	Susceptible to Discharge
American shad[1]	X	X			X	X	
American eel[2]		X	X	X[1]	X		
Muskellunge		X					
Goldfish[2,3,4]			X	X	X	X	X
Swallowtail shiner[4,5]			X	X	X	X	X
Spotfin shiner[4,5]			X	X	X	X	X
White sucker[2,3,6]		X	X	x	x	x	
Brown bullhead[2,3,6]		X	X	X	X		X
Banded killifish			X		X	X	
Redbreast sunfish[2,3,6]		X	X	X	X	X	X
Pumpskinseed[2,3,6]		X	X	X	X	X	X
Largemouth bass		X			X		X
Tessellated darter			X		X	X	

[1] Importance of species largely dependent on results of Pennsylvania Fish Commission program to provide fishways at dams downriver of LGS.
[2] Species samples by large fish catch-per-per-unit-effort program.
[3] Species sampled by large fish population estimate program.
[4] Species sampled by push-net program.
[5] Species sampled by seine program.
[6] Species sampled by age and growth program.

TABLE 2.2-36

SPATIAL AND TEMPORAL VARIATION IN CATCH-PER-UNIT-EFFORT (NO./MIN OF ELECTROFISHING X 100) OF IMPORTANT SPECIES COLLECTED FROM THE SCHUYLKILL RIVER NEAR LIMERICK GENERATING STATION, JULY THROUGH DECEMBER 1976

Common Name/ Month	Firestone	Limerick A	Limerick C	Vincent A	Vincent B
American eel					
Jul	18.81	2.08	14.89	5.58	1.75
Aug	0	2.23	5.41	3.37	1.52
Sep	2.22	8.29	6.09	0	1.52
Oct	0	2.08	0	3.57	0
Nov	4.04	2.96	6.44	1.25	4.00
Dec	0	0	0	0	1.45
Goldfish					
Jul	0	22.39	7.26	13.70	1.75
Aug	3.51	29.83	2.38	1.09	1.04
Sep	3.03	21.98	4.38	3.77	0
Oct	0	29.72	8.03	18.70	0
Nov	0	53.11	4.17	8.85	0
Dec	0	45.51	4.10	12.76	0
White sucker					
Jul	10.71	4.35	7.32	8.06	0
Aug	82.22	14.26	22.87	31.21	1.96
Sep	93.57	58.96	78.31	29.50	3.51
Oct	115.75	83.20	106.80	62.73	5.09
Nov	96.57	68.36	122.42	28.27	5.56
Dec	69.94	64.21	56.99	13.26	22.11
Brown bullhead					
Jul	57.94	14.00	25.04	7.38	0
Aug	37.87	25.80	25.16	20.97	0
Sep	4.79	23.05	16.93	3.59	1.75
Oct	0	12.86	4.61	11.09	8.34
Nov	16.18	163.78	3.91	4.42	14.44
Dec	2.22	74.30	2.78	0	8.84
Redbreast sunfish					
Jul	167.50	7.43	17.59	1.19	4.70
Aug	133.53	24.08	53.96	9.05	5.88
Sep	144.00	39.91	100.96	48.94	10.29
Oct	62.18	139.56	107.54	62.45	11.68
Nov	62.23	47.08	35.75	17.02	0
Dec	20.82	18.55	13.70	9.11	0
Pumpkinseed					
Jul	6.83	3.13	9.89	5.74	18.30
Aug	9.59	16.82	50.21	12.67	8.09
Sep	15.76	17.83	65.92	40.64	12.04
Oct	0	47.95	9.60	38.71	33.54
Nov	0	74.87	6.80	33.85	9.78
Dec	0	29.72	9.75	14.66	6.96

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TABLE 2.2-37

ESTIMATED NUMBER AND BIOMASS OF SELECTED IMPORTANT SPECIES COLLECTED FROM THE SCHUYLKILL RIVER DURING LARGE FISH POPULATION ESTIMATE SAMPLING, 1973 THROUGH 1977

		Firestone		Limerick A		Limerick B		Mean Limerick		Vincent Pool	
Common Name	Year	No/ha	kg/ha	No/ha	kg/ha	No/ha	kg/ha	No/ha	kg/ha	No/ha	kg/ha
Goldfish	1973	-	-	-	-	-	-	326	73.24	-	-
	1974	195	nc[1]	-	-	-	-	-	-	-	-
	1975	-	-	161	34.86	120	28.42	140	31.64	-	-
	1977	259	54.81	212	56.53	544	91.44	378	73.99	167	32.98
	Mean	227	-	187	45.70	332	59.93	281	59.62	-	-
White sucker	1973	-	-	-	-	-	-	324	80.70	-	-
	1974	300	nc	-	-	-	-	-	-	144	nc
	1975			239	45.00	168	30.42	203	37.71		
	1977	384	56.96	145	23.23	341	49.12	243	36.18	220	32.14
	Mean	342	-	192	34.12	255	39.77	257	51.53	182	-
Brown bullhead	1973	-	-	-	-	-	-	566	95.12	-	-
	1974	231	nc							1868	nc
	1975	-	-	517	50.53	558	88.13	537	69.23	-	-
	1977	46	6.10	152	34.93	158	36.22	155	35.58	1068	207.47
	Mean	139	-	335	42.73	358	62.18	419	66.64	1468	-
Redbreast sunfish	1973	-	-	271	10.22	239	9.14	255	9.68	-	-
	1974	377	nc	-	-	-	-	-	-	134	nc
	1975	-	-	341	10.55	237	8.59	289	9.57	-	-
	1977	723	22.37	494	18.83	283	10.99	389	14.91	345	8.20
	Mean	550	-	369	13.20	253	9.57	311	11.39	240	-
Pumpkinseed	1973	-	-	79	3.22	223	9.73	151	6.48	-	-
	1974	-	-	-	-	-	-	-	-	445	nc
	1975	-	-	59	2.12	127	4.80	93	3.46	-	-
	1977	-	-	28	1.34	91	4.68	60	3.01	81	3.65
	Mean	-	-	55	2.23	147	6.40	101	4.32	263	-

[1] not calculated

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TABLE 2.2-38

MEAN CALCULATED FORK LENGTH AT ANNULUS FOR SELECTED IMPORTANT SPECIES COLLECTED FROM THE SCHUYLKILL RIVER NEAR LIMERICK GENERATING STATION, 1973 THROUGH 1975

Common Name	Year	Location	No. of Specimens	Weighted Mean Length (mm FL) at Annulus						
				I	II	III	IV	V	VI	VII
Goldfish	1974	Combined	45	113	190	-	-	-	-	-
White sucker	1973	Limerick A	126	87	190	214	-	-	-	-
		Limerick B	172	98	204	279	303	-	-	-
		Combined	298	93	198	258	303	-	-	-
Brown bullhead	1973-74	Combined	351	91	141	179	209	239	258	264
	1975	Combined	81	103	155	194	222	251	276	-
Redbreast sunfish	1973	Combined	516	42	94	131	145	159	-	-
	1975	Combined	88	37	89	115	110	-	-	-
Pumpkinseed	1973	Limerick A	109	51	90	103	-	-	-	-
		Limerick B	228	50	98	124	-	-	-	-
		Combined	337	51	95	121	-	-	-	-
	1975	Limerick A	23	44	94	116	-	-	-	-
		Limerick B	43	39	90	106	-	-	-	-
		Combined	66	41	91	111	-	-	-	-
Largemouth bass	1973	Combined	17	90	126	242	-	-	-	-

TABLE 2.2-39

LENGTH-WEIGHT RELATIONSHIPS[1] FOR SELECTED IMPORTANT SPECIES COLLECTED FROM THE SCHUYLKILL RIVER NEAR LIMERICK GENERATING STATION, 1973 THROUGH 1978

Common Name	Year	Location	No. of Specimens	a	b
Goldfish	1975	Limerick A	12	- 9.93	2.88
		Limerick B	29	- 9.04	2.71
White sucker	1973	Limerick A	62	-10.24	2.82
		Limerick B	66	- 9.47	2.69
	1976-78	Combined[2]	2,034	-11.16	2.99
Brown bullhead	1973-74	Combined[3]	564	-10.62	2.90
	1975	Combined[3]	97	- 9.84	2.74
		Combined[2]	1,349	-11.54	3.08
Redbreast sunfish	1973	Combined[3]	345	-10.33	2.93
	1975	Combined[3]	88	-11.12	3.09
		Combined[2]	1,621	-11.70	3.21
Pumpkinseed	1973	Limerick A	124	-10.28	2.95
		Limerick B	31	- 9.18	2.72
	1975	Limerick A	23	-11.73	3.23
		Limerick B	43	- 7.26	2.30

(1) ln W = a+b ln FL.
(2) Sites Limerick A, B, C and Firestone.
(3) Sites Limerick A and B.

TABLE 2.2-40

NUMBER OF SAMPLES BY YEAR, PROGRAM, AND SITE
COLLECTED FROM PERKIOMEN CREEK, 1972 THROUGH 1977 (1)

Program/Sites	1972	1973	1974	1975	1976	1977
Water Quality						
P18700	-	-	-	-	-	24
P14390	-	-	14	24	24	24
Phytoplankton						
P14390	-	-	11	-	-	-
Periphyton						
P14390	-	14	-	-	-	-
Benthic Macroinvertebrates						
P22000	12	12	9	-	11	-
P13600	10	12	9	-	11	-
Macroinvertebrate Drift						
P14390	12	84	72	-	-	-
Larval Fish Drift						
P14390	-	479	514	504	696	-
Larval Fish Trap						
P14390	-	-	-	84	240	-
Seine						
P19775	-	-	-	11	11	-
P16500	-	-	-	11	11	-
P14455	-	-	-	10	10	-
P14320	-	-	-	10	11	-
P14130	-	-	-	11	11	-
P13580	-	-	-	11	11	-
Small Fish Population Estimates						
P14830	-	-	-	-	3	-
P14690	-	-	-	3	3	-
P14585	-	-	-	3	-	-
P14225	-	-	-	3	3	-
P14210	-	-	-	3	3	-

TABLE 2.2-40 (Cont'd)

Program/Sites	1972	1973	1974	1975	1976	1977
Large Fish Population Estimates						
P20000	-	-	-	-	4	-
P19765	-	-	-	-	2	-
P14390	-	-	5	-	5	-
P14160	-	-	3	2	3	-
P14020	-	-	2	-	2	-
Age and Growth						
P20000						
White sucker	-	-	-	49	-	-
Redbreast sunfish	-	-	-	64	-	-
P19860						
Redbreast sunfish	-	51	-	-	-	-
Green sunfish	-	30	-	-	-	-
Smallmouth bass	-	9	-	-	-	-
P17400						
Redbreast sunfish	-	50	-	-	-	-
Smallmouth bass	-	28	-	-	-	-
P14390						
White sucker	-	-	-	33	-	-
Redbreast sunfish	-	53	-	65	-	-
Green sunfish	-	32	-	-	-	-
Smallmouth bass	-	40	-	-	-	-
P14160						
White sucker	-	-	-	46	-	-
Redbreast sunfish	-	-	-	64	-	-
P14020						
White sucker	-	-	-	36	-	-
Redbreast sunfish	-	-	-	56	-	-
P13580						
Redbreast sunfish	-	77	-	-	-	-
Green sunfish	-	41	-	-	-	-
Smallmouth bass	-	5	-	-	-	-

(1) See footnotes in Table 2.2-72 for the definition of what constitutes one sample.

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TABLE 2.2-41

NUMBER OF SAMPLES BY MONTH, PROGRAM, AND YEAR COLLECTED FROM PERKIOMEN CREEK, 1972 THROUGH 1977 [1,2]

Program/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Quality												
1974	-	-	-	-	-	2	2	2	2	2	2	2
1975	2	2	2	2	2	2	2	2	2	2	2	2
1976	2	2	2	2	2	2	2	2	2	2	2	2
1977	4	4	4	4	4	4	4	4	4	4	4	4
Phytoplankton												
1974	1	1	1	1	1	-	1	1	1	1	1	1
Periphyton												
1973	-	-	-	-	-	-	-	4	3	4	2	2
Benthic Macroinvertebrates												
1972	1	2	2	2	2	2	2	2	2	2	2	1
1973	2	2	2	2	2	2	2	2	2	2	2	2
1974	-	-	-	2	2	2	2	2	2	2	2	2
1976	-	2	2	2	2	2	2	2	2	2	2	2
Macroinvertebrate Drift												
1972	-	-	-	-	-	-	-	12	-	-	-	-
1973	-	-	-	12	12	12	12	12	12	-	-	-
1974	-	-	-	12	12	12	12	12	12	-	-	-
Larval Fish Drift												
1973	-	-	-	48	96	120	95	96	24	-	-	-
1974	-	-	-	47	144	114	104	105	-	-	-	-
1975	-	-	-	-	144	72	144	144	-	-	-	-
1976	-	-	-	72	132	132	144	216	-	-	-	-
Larval Fish Trap												
1975	-	-	-	-	24	12	24	24	-	-	-	-
1976	-	-	-	24	48	48	48	72	-	-	-	-
Seine												
1975	-	4	6	6	6	6	6	6	6	6	6	6
1976	-	6	6	6	6	6	6	6	6	6	6	5

[1]See footnotes in Table 2.2-7 for definition of what constitutes one sample
[2]Number of samples for Small Fish Population Estimate, Large Fish Population Estimate, and Age and Growth programs was not included because only annual data was utilized.

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TABLE 2.2-42 (Page 1 of 2)

MONTHLY QUALITATIVE LISTING OF PHYTOPLANKTON GENERA COLLECTED AT P14390 IN PERKIOMEN CREEK IN 1974

	25 Jan	14 Feb	14 Mar	18 Apr	23 May	31 Jul	29 Aug	20 Sep	18 Oct	21 Nov	12 Dec
Chlorophyta											
Eudorina			X(1)	X		X					
Pleodorina							C				
Volvox		X									
Chlorococcum							X	X	X	X	
Ankistrodesmus					X	X	C	C	C	X	X
Kirchneriella						X	X	X	X		
Selenastrum						X	X	X		X	X
Oocystis											X
Coelastrum						X	X	X		X	
Scenedesmus					X	X	A	C	X	X	X
Hydrodictyon	X										
Pediastrum	X	X	X	X	X	X	C	X	X		
Ulothrix	X	X	X								
Microspora									X		
Stigeoclonium	X		X	X	X						
Oedogonium				X	X						
Cladophora	X										
Mougeotia									X	X	X
Spirogyra	X		X	X	X						
Closterium				X	X		X	X	X	X	X
Cosmarium					X	X	X	X	X		
Desmidium									X		X
Staurastrum	X				X	X	X	X	X	X	X
Unknown - Flagellated		X	X	X	X		X		X	X	
Euglenophyta											
Euglena		X	X								
Pyrrhophyta											
Ceratium				X							
Bacillariophyta											
Dinobryon				X							
Mallomonas									X	X	X
Synura	X	X		X							
Coscinodiscus		X		X		X					
Cyclotella			X		X	X	X	X	C	X	X
Melosira	X	X	X	X	X	X	A	C	C	X	X
Stephanodiscus										A	X
Asterionella	X	X	X	X	X					X	X
Diatoma	X		X		X	X			X	X	X
Fragilaria	X	X	X	X	X	X	X	X	X	X	C

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TABLE 2.2-42 (Cont'd)

	25 Jan	14 Feb	14 Mar	18 Apr	23 May	31 Jul	29 Aug	20 Sep	18 Oct	21 Nov	12 Dec
Bacillariophyta (cont.)											
Meridion	X	X	X	X	X				X		
Operhora										X	
Synedra	X	X	X	X	X	X	X	X	X		X
Tabellaria		X	X		X						
Cocconeis						X	X	X	X		X
Gyrosigma				X		X	X		X		
Navicula	X	X	X	X	X	X	C	X	A	A	A
Gomphonema	X	X	X	X	X						
Cymbella		X	X	X	X	X	X	X	X	X	
Nitzschia	X	X	X	X	X	X	X	X	C	X	X
Rhoicosphenia									X		
Surirella	X	X						X			X
Cyanophyta											
Coelosphaerium							X				
Merismopedia		X					X				
Microcystis		X									
Oscillatoria	X	X	X	X	X	X	X	X	X		
Anabaena							A				X
Stichosirhon									X		

(1) X = present, C = common, A = abundant

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TABLE 2.2-43

PERIPHYTON PRODUCTION LISTED AS TOTAL BIOMASS (STANDING CROP) MG/DM² AND TOTAL PRODUCTIVITY RATES MG/DM²/DAY. (1)

Date	Exposure Time (days)	Mean Ash-free Wt. (mg/dm²)	Accumulation (mg)	Production (mg/dm²/day⁻¹)
17 Aug	10	58.7	-	
24 Aug	17	80.9	22.2	3.17
31 Aug	24	73.0	- 7.9	-1.13
7 Sep	7	74.2	-	
14 Sep	14	98.3	24.1	3.44
21 Sep	21	23.8	-74.5	-10.64
5 Oct	7	34.5	-	
12 Oct	14	90.7	56.2	8.03
19 Oct	21	105.7	15.0	2.14
26 Oct	7	18.1	-	
2 Nov	14	12.6	- 5.5	-0.79
9 Nov	21	29.8	17.2	2.46
12 Dec	12	4.2	-	
19 Dec	19	3.2	- 1.0	-0.14

(1) Values (ash-free dry weights) are listed for station P14390, Perkiomen Creek, During 1973.

TABLE 2.2-44

SPECIES LIST AND RELATIVE QUALITATIVE ABUNDANCE OF MACROINVERTEBRATES COLLECTED BY ALL METHODS FROM ALL HABITATS IN EAST BRANCH PERKIOMEN CREEK AND PERKIOMEN CREEK, 1970 THROUGH 1976 (1),(2)

PORIFERA
- Spongillidae (U,28)

COELENTERATA
- *Hydra* sp. (C,12)

PLATYHELMINTHES
- Planariidae
  - *Dugesia dorotocephala* (A,21)
  - *D. tigrina* (U,21)

NEMERTEA
- *Prostoma graecense* (C,15)

NEMATODA (U,12)

BRYOZOA
- *Plumatella repens* (C,12)

ANNELIDA
- Oligochaeta
  - Lumbricidae (U,2)
  - Tubificidae
    - *Limnodrilus hoffmeisteri* (C,2)
    - *L. claparedianus* (U,2)
    - *Branchiura sowerbyi* (U,2)
    - *Peloscolex ferox* (U,2)
    - *Aulodrilus limnobius* (U,2)
  - Aeolosomatidae (U,2)
  - Naididae
    - *Ophidonais serpentina* (U,18)
    - *Nais communis* (U,18)
    - *Pristina breviseta* (U,18)
    - *P. foreli* (U,18)
  - Lumbriculidae (A,2)
  - Branchiobdellidae (U,2)
- Hirudinea
  - Glossiphoniidae
    - *Helobdella stagnalis* (U,32)
    - *H. lineata* (R,32)
    - *H. elongata* (R,32)
    - *Placobdella ornata* (R,32)
    - *P. parasitica* (U,32)
    - *Actinobdella triannulata* (R,32)
    - *Batracobdella phalera* (R,32)
  - Piscicolidae
    - *Piscicolaria reducta* (R,24)
    - *Piscicola milneri* (R,24)
  - Erpobdellidae
    - *Erpobdella punctata* (C,32)
  - Hirudinidae
    - *Haemopis marmorata* (R,32)
    - *Macrobdella decora* (R,32)

ARTHROPODA
- Isopoda
  - Asellidae
    - *Asellus communis* (C,38)
    - *A. stygius* (R,28)

ARTHROPODA (cont'd)
- Amphipoda
  - Talitridae
    - *Hyalella azteca* (U,28)
  - Gammaridae
    - *Gammarus fasciatus* (U,28)
    - *Crangonyx gracilis* (R,28)
    - *Stygonectes* sp. (R,19)
- Decapoda
  - Cambaridae
    - *Cambarus bartoni* (C,28)
    - *Orconectes limosus* (C,28)
- Hydracarina (C,28)
- Collembola
  - Isotomidae
    - *Isotoma* sp. (C,28)
    - *Isotomurus palustris* (C,28)
  - Poduridae
    - *Hypogastrura* sp. (U,28)
  - Sminthuridae (U,28)
- Ephemeroptera
  - Ephemeridae
    - *Ephemera simulans* (R,6)
  - Caenidae
    - *Caenis* sp. (C,12)
  - Tricorythidae
    - *Tricorythodes* sp. (C,12)
  - Ephemerellidae
    - *Ephemerella deficiens* (C,6)
    - *E. attenuata* (U,6)
    - *E. dorothea* (U,6)
  - Leptophlebiidae
    - *Paraleptophlebia praepedita* (U,6)
    - *Choroterpes basalis* (U,6)
  - Baetidae
    - *Baetis intercalaris* (A,6)
    - *B. frondalis* (R,6)
    - *B. flavistriga* (R,6)
    - *B. cingulatus* (U,6)
    - *B. pluto* (R,6)
    - *Callibaetis fluctuans* (R,6)
    - *Ameletus lineatus* (R,6)
    - *Pseudocloeon myrsum* (C,6)
    - *P. punctiventris* (U,6)
    - *Heterocloeon curiosum* (C,6)
    - *Cloeon alamance* (U,6)
    - *Centroptilum* sp. (R,6)
  - Siphlonuridae
    - *Siphlonurus* sp. (R,6)
    - *Isonychia* sp. (C,6)
  - Heptageniidae
    - *Heptagenia* sp. (R,6)
    - *Stenonema* (=*Stenacron*) (U,22)
      interpunctatum heterotarsale

ARTHROPODA (cont'd)
- Ephemeroptera (cont'd)
  - Heptageniidae (cont'd)
    - *Stenonema fuscum* (R,22)
    - *S. nepotellum* (C,22)
    - *S. rubromaculatum* (R,22)
    - *S. rubrum* (C,22)
    - *S. vicarium* (R,22)
    - *S. tripunctatum* (U,22)
    - *S. smithae* (R,22)
- Odonata
  - Gomphidae
    - *Gomphus quadricolor* (R,26)
    - *Lanthus albistylus* (U,26)
  - Libellulidae
    - *Plathemis lydia* (C,26)
    - *Leucorrhinia* sp. (R,12)
    - *Perithemis* sp. (R,26)
    - *Libellula* sp. (R,26)
  - Macromiidae
    - *Macromia alleghaniensis* (C,26)
  - Corduliidae
    - *Epicordulia princeps* (R,26)
    - *Neurocordulia obsoleta* (R,12)
  - Calopterygidae
    - *Calopteryx* sp. (R,12)
  - Coenagrionidae
    - *Argia* spp. (C,12)
    - *Enallagma* spp. (R,12)
    - *Ischnura* spp. (U,12)
  - Aeschnidae
    - *Basiaeschna janata* (R,28)
    - *Aeschna* sp. (U,12)
    - *Anax junius* (U,26)
- Plecoptera
  - Taeniopterygidae
    - *Strophopteryx fasciata* (R,35)
    - *Taeniopteryx nivalis* (C,35)
  - Capniidae
    - *Allocapnia vivipara* (C,35)
    - *A. pygmaea* (U,35)
    - *A. rickeri* (U,35)
  - Nemouridae
    - *Amphinemura delosa* (C,35)
  - Perlidae
    - *Neoperla clymene* (U,35)
    - *Phasganophora capitata* (R,35)
    - *Perlesta placida* (C,35)
    - *Acroneuria abnormis* (R,35)
  - Leuctridae
    - *Leuctra* sp. (R,35)
  - Perlodidae
    - *Isoperla bilineata* (U,35)
  - Chloroperlidae (R,35)

TABLE 2.2-44 (Cont'd)

ARTHROPODA
- Hemiptera
  - Gerridae
    - Gerris remigis (C,7)
    - Metrobates anomalus (C,7)
    - Rheumatobates rileyi (C,7)
    - Trepobates subnitidus (C,7)
  - Veliidae
    - Rhagovelia sp. (C,28)
    - Microvelia sp. (A,28)
  - Corixidae
    - Trichocorixa calva (U,40)
    - Sigara modesta (C,17)
    - Palmacorixa sp. (R,28)
  - Saldidae
    - Pentacora sp. (U,37)
    - Saldula sp. (U,37)
  - Notonectidae
    - Notonecta sp. (R,28)
  - Belostomatidae
    - Belostoma sp. (R,37)
- Megaloptera
  - Sialidae
    - Sialis sp. (C,28)
  - Corydalidae
    - Corydalus cornutus (C,28)
    - Nigronia serricornis (R,27)
- Coleoptera
  - Haliplidae
    - Peltodytes duodecimpunctatus (U,1)
    - P. muticus (R,1)
    - Haliplus fasciatus (R,1)
  - Dytiscidae
    - Ilybius sp. (R,11)
    - Bidessus affinus (R,11)
    - Agabus gagates (C,11)
    - Hydroporus consimilis (C,11)
    - H. sp. A (R,39)
    - Hydrovatus sp. (R,28)
    - Laccophilus proximus (C,11)
    - Copelatus glyphicus (R,11)
  - Gyrinidae
    - Gyrinus analis (R,11)
    - Dineutus hornii (R,11)
  - Hydrophilidae
    - Berosus peregrinus (C,11)
    - B. striatus (U,11)
    - Enochrus pygmaeus (C,11)
    - E. perplexus (U,11)
    - E. cinctus (C,25)
    - Helophorus lacustris (U,11)
    - Laccobius agilis (C,11)
    - Paracymus subcupreus (C,11)
    - Tropisternus glaber (U,11)

ARTHROPODA (cont'd)
- Coleoptera (cont'd)
  - Hydrophilidae (cont'd)
    - T. lateralis (C,11)
    - Anacaena limbata (C,11)
    - Sphaeridium spp. (U,37)
    - Hydrobius melaenum (R,11)
  - Hydraenidae
    - Hydraena sp. (U,37)
    - Ochthebius sp. (U,37)
  - Hydroscaphidae
    - Hydroscapha natans (R,37)
  - Psephenidae
    - Psephenus herricki (C,3)
  - Eubriidae
    - Ectopria nervosa (U,3)
  - Dryopidae
    - Helichus sp. (U,3)
  - Elmidae
    - Ancyronyx variegata (R,33)
    - Dubiraphia vittata (C,3)
    - D. bivittata (U,3)
    - D. quadrinotata (R,3)
    - Microcylloepus pusillus (C,33)
    - Optioservus trivittatus (C,3)
    - C. ovalis (R,3)
    - Stenelmis crenata (A,3)
    - S. sp. B (R,39)
    - Macronychus glabratus (R,33)
    - Culimnius latiusculus (R,33)
  - Chrysomelidae
    - Galerucella nymphaeae (U,11)
    - Donacia piscatrix (R,11)
- Neuroptera
  - Sisyridae
    - Climacia areolaris (U,28)
- Trichoptera
  - Glossosomatidae
    - Glossosoma sp. (R,31)
  - Rhyacophilidae
    - Protoptila sp. (R,31)
  - Philopotamidae
    - Chimarra obscura (A,31)
    - C. aterrima (U,31)
    - Wormaldia moestus (U,31)
  - Psychomyiidae
    - Nyctiophylax vestitus (R,14)
    - N. sp. A (R,14)
    - Polycentropus sp. (U,14)
    - Neureclipsis sp. (U,14)
  - Phryganeidae
    - Ptilostomis sp. (R,31)
  - Limnephilidae
    - Neophylax sp. (R,13)

ARTHROPODA (cont'd)
- Trichoptera (cont'd)
  - Leptoceridae
    - Ceraclea transversa (R,29)
    - C. sp. A (U,39)
    - Cecetis spp. (U,31)
    - Mystacides sepulchralis (R,31)
    - Triaenodes sp. (R,31)
  - Hydropsychidae
    - Cheumatopsyche spp. (A,31)
    - Hydropsyche betteni (U,31)
    - H. phalerata (R,31)
    - H. sp. A (C,39)
    - H. sp. B (R,39)
    - H. sp. C (A,39)
    - H. sp. D (U,39)
    - H. sp. E (C,39)
    - Macronema zebratum (C,31)
    - Diplectrona modesta (R,31)
  - Hydroptilidae
    - Hydroptila ajax (U,31)
    - H. consimilis (C,31)
    - H. spatulata (C,31)
    - H. armata (U,31)
    - H. waubesiana (R,31)
    - Leucotrichia pictipes (A,31)
    - Agraylea sp. (R,31)
    - Oxyethira sp. (R,12)
- Lepidoptera
  - Pyralididae
    - Parargyractis sp. (C,37)
- Diptera
  - Tipulidae
    - Limnophila sp. (R,37)
    - Helius sp. (R,37)
    - Dicranota sp. (R,37)
    - Eriopterа sp. (U,37)
    - Antocha sp. (U,37)
    - Pseudolimnophila sp. (U,20)
    - Limonia sp. (R,37)
    - Paradelphomyia sp. (R,37)
    - Dolichopeza sp. (R,37)
    - Tipula spp. (U,37)
  - Simuliidae
    - Simulium vittatum (A,34)
    - Prosimulium sp. (U,37)
  - Chironomidae
    - Psectrotanypus dyari (R,30)
    - Tanypus sp. (R,23)
    - Procladius riparius (U,30)
    - Ablabesmyia auriensis (U,30)
    - Pentaneurini spp. (A,23)
    - Tanytarsini (A) including
    - Micropsectra gmundensis (20)

TABLE 2.2-44 (Cont'd)

ARTHROPODA (cont'd)
- Diptera (cont'd)
  - Chironomidae (cont'd)
    - Tanytarsus exigua (30)
    - T. guerla (30), and
    - T. glabrescens (30)
    - Pseudochironomus fulviventris (R,30)
    - Chironomus spp. (C,23)
    - Cryptochironomus fulvus (U,30)
    - C. sorex (U,10)
    - C. blarina (U,10)
    - Endochironomus sp. (U,23)
    - Tribelos sp. (U,23)
    - Dicrotendipes modestus (U,30)
    - Glyptotendipes sp. (U,23)
    - Polypedilum illinoense (A,30)
    - P. fallax (R,20)
    - Paracladopelma sp. (R,23)
    - Microtendipes tarsalis (C,30)
    - Paralauterborniella sp. (R,23)
    - Paratendipes sp. (U,23)
    - Stictochironomus sp. (U,23)
    - Stenochironomus sp. (U,23)
    - Parachironomus sp. (U,23)
    - Phaenopsectra sp. (U,23)
    - Xenochironomus xenolabis (R,30)
    - Diamesa nivoriunda (U,30)
    - Cardiocladius obscurus (C,30)
    - Cricotopus bicinctus (A,30)
    - C. sp. 1 (R,30)
    - Other Cricotopus spp. (C,23)
    - Orthocladius rivulorum (U,30)
    - Eukiefferiella spp. (U,23)
    - Trichocladius sp. (U,23)
    - Diplocladius cultriger (U,30)
    - Psectrocladius sp. (U,23)
    - Brillia sp. (R,23)
    - Metriconemus sp. (R,23)
    - Corynoneura xena (R,30)

ARTHROPODA (cont'd)
- Diptera (cont'd)
  - Chironomidae (cont'd)
    - Heterotrissocladius sp. (U,23)
    - Thienemanniella sp. (R,23)
  - Psychodidae
    - Psychoda sp. (U,20)
    - Pericoma sp. (R,20)
    - Telmatoscopus sp. (R,20)
  - Heleidae
    - Palpomyia spp. (C,37)
    - Dasyhelea sp. (R,37)
    - Atrichopogon peregrinus (R,36)
    - A. sp. A (R,39)
    - A. sp. B (R,39)
    - Stilobezzia sp. (R,36)
    - Culicoides sp. (R,36)
  - Empididae
    - Clinocera sp. (U,37)
    - Hemerodromia sp. (C,37)
  - Ephydridae
    - Brachydeutera argentata (R,37)
    - Scatella-Neoscatella sp. (R,37)
  - Culicidae
    - Chaoborus sp. (R,37)
    - Anopheles sp. (R,20)
  - Muscidae
    - Lispe sp. (R,20)
  - Mycetophilidae (R,20)
  - Dolichopodidae
    - Aphrosylus sp. (R,20)
  - Tabanidae
    - Chrysops sp. (U,20)
    - Tabanus sp. (R,20)
  - Sciomyzidae
    - Dictya sp. (R,37)
  - Stratiomyiidae (R,37)
  - Rhagionidae
    - Atherix variegata (R,37)

ARTHROPODA (cont'd)
- Hymenoptera
  - Diapriidae
    - Trichopria sp. (R,37)
  - Mymaridae
    - Caraphractus sp. (U,37)

MOLLUSCA
- Gastropoda
  - Physidae
    - Physa acuta (A,9)
  - Lymnaeidae
    - Lymnaea humilis (C,16)
  - Planorbidae
    - Gyraulus parvus (C,16)
    - Helisoma trivolvis (R,16)
    - H. anceps (R,16)
  - Ancylidae
    - Ferrissia tarda (A,16)
  - Viviparidae
    - Campeloma decisa (R,16)
  - Pleuroceridae
    - Goniobasis virginica (R,16)
  - Hydrobiidae
    - Amnicola limosa (U,16)
  - Valvatidae
    - Valvata piscinalis (R,16)
- Pelecypoda
  - Sphaeriidae
    - Musculium securis (R,5)
    - Sphaerium rhomboideum (C,5)
    - S. striatinum (R,5)
    - Pisidium spp. (C,5)
  - Unionidae
    - Anodonta cataracta (U,8)
    - A. imbecilis (R,4)
    - Elliptio complanatus (F,8)
    - Ligumia nasuta (R,8)

(1) A = abundant, C = common, U = uncommon, R = rare.
(2) Numbers refer to the taxonomic references listed below. For complete citation see the Literature Cited section.

1. Brigham (Ref 2.2-63)
2. Brinkhurst (Ref 2.2-18)
3. Brown (Ref 2.2-19)
4. Burch (Ref 2.2-20)
5. Burch (Ref 2.2-21)
6. Burks (Ref 2.2-22)
7. Calabrese (Pers. Comm.)
8. Clarke and Berg (Ref 2.2-23)
9. Clench (Pers. Comm.)
10. Curry (Ref 2.2-64)
11. Dillon and Dillon (Ref 2.2-24)
12. Edmundson (Ref 2.2-25)
13. Flint (Ref 2.2-26)
14. Flint (Ref 2.2-27)
15. Gibson and Moore (Ref 2.2-65)
16. Harman and Berg (Ref 2.2-28)
17. Hilsenhoff (Ref 2.2-66)
18. Hiltunen (Ref 2.2-67)
19. Holsinger (Ref 2.2-31)
20. Johannsen (Ref 2.2-68,69)
21. Kenk (Pers. Comm.)
22. Lewis (Ref 2.2-33)
23. Mason (Ref 2.2-34)
24. Meyer (Ref 2.2-35)
25. Miller (Pers. Comm.)
26. Needham and Westfall (Ref 2.2-36)
27. Neunzig (Ref 2.2-70)
28. Pennak (Ref 2.2-37)
29. Resh (Ref 2.2-71)
30. Roback (Ref 2.2-38)
31. Ross (Ref 2.2-39)
32. Sawyer (Ref 2.2-40)
33. Sinclair (Ref 2.2-72)
34. Stone (Ref 2.2-41)
35. Surdick and Kim (Ref 2.2-42)
36. Thomsen (Ref 2.2-73)
37. Usinger (Ref 2.2-44)
38. Williams (Ref 2.2-45)
39. Consultant's designator
40. Bobb (Ref 2.2-74)

TABLE 2.2-45

SELECTED MEASUREMENTS FOR TOTAL MACROBENTHOS IN THE RIFFLE BIOTOPE OF PERKIOMEN CREEK AND EAST BRANCH PERKIOMEN CREEK (1972-1976)

Station	1972 No./m²	Wt./m²(1)	Total Taxa	Morisitas Index of Overlap(2) Adjacent Stations	Morisitas Index of Overlap(2) With Moyer Station	1973 No./²	Wt./m²	Total Taxa	Morisitas Index of Overlap Adjacent Stations	Morisitas Index of Overlap With Moyer Station
East Branch										
Elephant	4716.7	-	51		0.438	5771.9	2.4953	58		0.349
				0.535					0.475	
Branch	6599.8	-	61		0.556	11371.0	1.5017	55		0.597
				0.594					0.555	
Sellersville	5958.6	-	43		0.539	5986.1	1.6511	54		0.442
				0.592					0.672	
Cathill	6499.2	-	28		0.462	2751.7	0.3097	25		0.513
				0.462					0.513	
Moyer	7545.2	-	42		n/a	7836.1	1.9451	42		n/a
				0.785					0.701	
Wawa	12497.7	-	46		0.785	11706.7	3.6821	50		0.701
				0.640					0.602	
Perkiomen										
Rahns	11980.4	-	61		0.566	10599.6	4.0538	65		0.498
				0.691					0.742	
Spring Mount	8261.3	-	67		0.714	14301.1	4.2128	73		0.651

TABLE 2.2-45 (Cont'd)

Station	1972 No./m²	Wt./m²(1)	Total Taxa	Morisitas Index of Overlap(2) Adjacent Stations	Morisitas Index of Overlap(2) With Moyer Station	1973 No./²	Wt./m²	Total Taxa	Morisitas Index of Overlap Adjacent Stations	Morisitas Index of Overlap With Moyer Station
East Branch										
Elephant	6066.7	2.3133	64		0.400	6390.5	1.7840	63		0.282
				0.413					0.300	
Branch	7444.4	2.2460	49		0.576	7941.8	2.6347	54		0.663
				0.669					0.348	
Sellersville	8669.2	2.2199	53		0.489	12493.2	4.7003	58		0.502
				0.685					0.270	
Cathill	5308.6	0.9791	28		0.478	11753.4	3.3642	45		0.249
				0.478					0.249	
Moyer	13871.9	5.7547	44		n/a	30446.6	7.6905	54		n/a
				0.543					0.670	
Wawa	20354.7	6.1566	44		0.543	50565.2	14.4593	49		0.670
				0.440					0.490	
Perkiomen										
Rahns	11433.9	3.0759	61		0.495	17612.5	4.4454	65		0.518
				0.744					0.731	
Spring Mount	16018.9	3.5074	71		0.718	21404.5	5.3368	61		0.689

(1) Biomass is expressed as g dry weight.
(2) Morisitas index of overlap, a measure of benthic community similarity between stations, computed excluding chironomide.

TABLE 2.2-46

MEAN DENSITY (NO./m²), PERCENT COMPOSITION (%), AND FREQUENCY OF OCCURRENCE (FO %) OF BENTHIC MACROINVERTEBRATES (1) COLLECTED IN QUANTITATIVE SAMPLES (1972-1976) FROM THE RIFFLE BIOTOPE OF EAST BRANCH PERKIOMEN CREEK, ALL STATIONS COMBINED

Taxon	1972 No./m²	%	FO %	1973 No./m²	%	FO %	1974 No./m²	%	FO %	1976 No./m²	%	FO %
Dugesia spp.	99.3	(2)	37.4	39.9	(2)	31.5	379.2	3.7	51.9	1133.6	5.6	63.2
Baetis spp.	181.1	2.5	36.5	197.3	2.6	37.1	205.6	(2)	54.6	289.4	(2)	44.4
Stenelmis spp.	282.2	3.8	68.7	318.7	4.2	72.9	676.9	6.6	88.9	2373.4	11.8	93.1
Chimarra spp.	697.9	9.5	48.1	571.1	7.5	50.2	1005.4	9.8	71.3	1836.1	9.1	68.2
Cheumatopsyche spp.	1360	18.5	84.1	1047.4	13.8	78.2	1912.1	18.6	96.3	2053.7	10.2	90.4
Hydropsyche spp.	420.8	5.7	47	362	4.8	42.7	967.7	9.4	62	888.7	4.4	55.9
Simuliidae	525.8	7.2	77.7	415.6	5.5	73.8	390	3.8	69.4	640.7	3.2	75.5
Chironomidae	3195.2	43.5	93.9	4148.7	54.7	99.7	3289.7	32	100	5505	27.4	96.9
Sphaerium spp.	13	(2)	22	4.5	(2)	15.6	647.9	6.3	35.2	3973.6	19.8	51.3
All Others	562.6	7.7	88.1	482.2	6.4	96.0	811.5	7.9	94	1393.2	6.9	95.8
Total Number	7337.8			7587.4			10285.9			20087.4		
Total Taxa	89			85			83			98		

(1) Comprising 2% or greater of the total number collected.
(2) Less than 2%.

TABLE 2.2-47

MEAN DENSITY (MG/M²), PERCENT COMPOSITION (%), AND FREQUENCY OF OCCURRENCE (FO %) OF BENTHIC MACROINVERTEBRATES[1] COLLECTED IN QUANTITATIVE SAMPLES FROM THE RIFFLE BIOTOPE OF EAST BRANCH PERKIOMEN CREEK, ALL STATIONS COMBINED

Taxon	1973 Mg/m²	%	FO %	1974 Mg/m²	%	FO %
Dugesia spp.	20.9	[2]	31.5	169.1	5.2	51.9
Oligochaeta	59.8	3.1	62.3	67.3	2.1	63.9
Cambarus bartonia	236.5	12.3	6.2	207.6	6.3	6.5
Orconectes limosus	178.1	9.2	0.9	240.3	7.3	3.2
Stenelmis spp.	69.2	3.6	72.9	170.4	5.2	88.9
Chimarra spp.	158.6	8.2	50.2	320.6	9.8	71.3
Cheumatopsyche spp.	384.4	20	78.2	678.7	20.7	96.3
Hydropsyche spp.	373.1	19.4	42.7	721.1	22	62
Simuliidae	36.8	2.9	73.8	36.6	[2]	69.4
Chironomidae	216.3	11.2	99.7	262.5	8	100
Sphaerium spp.	3	[2]	15.6	146.1	4.5	35.2
All Others	168.9	8.8	89.4	258	7.9	95.4
Total	1925.6			3278.3		

[1] Comprising 2% or greater of the total dry weight biomass in 1973 or 1974.
[2] Less than 2%.
(Note: mean total biomass in 1976 was 5790)

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TABLE 2.2-48

MONTHLY DENSITIES (MEAN NO./M^2) OF IMPORTANT AND TOTAL TAXA OF BENTHIC MACROINVERTEBRATES COLLECTED FROM EAST BRANCH PERKIOMEN CREEK, AND PERKIOMEN CREEK, ALL STATIONS AND YEARS COMBINED 1972-1976

Taxon	Jan No./M^2	Feb No./M^2	Mar No./M^2	Apr No./M^2	May No./M^2	June No./M^2	Jul No./M^2	Aug No./M^2	Sep No./M^2	Oct No./M^2	Nov No./M^2	Dec No./M^2
Dugesia spp.	30.1	47.3	33.4	42.1	46.2	140.3	196.9	578.5	926.9	771.9	679.1	296.0
Oligochaeta	37.2	114.3	81.7	156.5	234.3	168.7	61.8	67.0	112.5	84.8	185.9	66.1
Erpodbdella punctata	1.2	1.9	1.1	1.6	1.9	13.8	4.9	3.6	4.5	3.9	3.4	2.6
Cambarus bartoni	0.2	0.2	0.2	0.8	0.9	1.1	1.0	0.4	0.8	0.4	0.2	0.1
Orconectes limosus	0.3	0.1	-	0.4	-	0.4	0.4	0.7	0.5	0.2	0.2	0.2
Caenis sp. (nymphs)	17.2	16.0	17.3	46.6	53.2	9.0	51.3	16.4	263.3	118.1	102.7	48.5
Tricorythodes sp. (nymphs)	-	1.3	-	-	0.3	10.4	7.7	24.4	123.9	28.1	-	-
Ephemerella spp. (nymphs)	7.8	37.1	21.7	71.4	414.3	26.2	205.8	177.6	311.3	502.0	411.7	246.2
Baetis spp. (nymphs)	1.4	5.4	6.8	14.5	476.5	488.5	711.4	1059.3	1184.5	146.7	6.2	0.5
Stenonema spp. (nymphs)	19.7	41.0	28.5	59.6	72.5	44.4	98.3	89.9	285.2	313.5	245.1	84.9
Argia spp. (nymphs)	7.1	5.5	5.0	4.9	4.8	4.1	1.8	12.6	43.1	42.8	25.9	19.8
Allocapnia spp. (nymphs)	119.7	78.4	20.2	0.5	0.1	0.7	-	0.1	0.2	4.1	164.8	205.3
Perlespta placida (nymphs)	-	-	-	63.3	130.5	13.1	-	-	-	-	-	-
Corixidae (adults)	-	0.1	-	-	3.2	2.5	10.0	11.1	0.6	25.9	1.3	0.2
Corixidae (nymphs)	-	-	-	-	-	4.7	28.8	6.0	7.9	1.9	0.2	-
Corydalus cornutus (larvae)	0.8	1.6	1.1	0.8	0.7	0.4	0.5	1.3	1.5	0.9	1.0	0.7
Psephenus herricki (adults)	-	-	-	-	-	0.5	0.2	0.9	0.1	-	-	-
Psephenus herricki (larvae)	6.3	18.9	35.6	26.2	20.9	21.0	12.6	31.0	31.5	149.5	62.0	118.3
Stenelmis spp. (adults)	6.9	24.6	27.4	52.0	82.8	127.3	117.4	147.1	182.5	171.1	158.0	78.0
Stenelmis spp. (larvae)	15.7	41.8	132.1	429.8	485.6	840.1	670.4	1068.7	1612.8	921.2	458.5	254.0
Chimarra spp. (larvae)	25.5	271.0	145.2	174.0	48.8	395.0	754.5	2024.8	2784.3	1804.9	1103.9	471.3
Chimarra spp. (pupae)	-	-	-	0.3	9.3	0.5	53.3	59.4	33.5	1.5	0.1	0.1
Cheumatopsyche spp. (larvae)	243.3	502.1	304.1	262.6	390.2	1659.7	2687.2	2597.0	3740.7	2795.8	2424.0	1054.6
Cheumatopsyche spp. (pupae)	-	-	-	25.6	8.2	21.2	11.5	19.1	15.3	0.4	-	-
Hydropsyche spp. (larvae)	75.0	142.1	95.5	120.1	559.7	724.2	1145.0	1118.4	1389.7	1324.4	1072.4	257.7
Hydropsyche spp. (pupae)	-	-	-	17.8	8.0	52.4	9.7	21.2	9.9	0.3	-	-
Leucotrichia pictipes (larvae)	17.8	21.0	22.0	21.5	0.6	30.6	96.9	161.8	348.0	187.6	138.1	55.3
Leucotrichia pictipes (pupae)	-	-	-	-	0.6	0.1	0.2	3.5	3.5	0.2	-	-
Tipula spp.(larvae)	1.5	1.7	1.0	0.5	0.1	0.7	0.2	1.1	0.6	2.1	2.2	2.7
Simuliidae (larvae)	240.6	358.2	195.9	104.7	1242.7	877.4	783.7	752.1	988.8	314.3	1388.2	515.6
Simuliidae (pupae)	0.2	2.1	11.2	15.6	153.0	177.6	50.5	50.3	36.6	11.8	4.0	2.4
Chironomidae (larvae)	1854.5	3654.5	4184.0	4850.0	6783.0	3331.2	3734.4	3090.5	6314.7	3052.2	2902.2	1783.1
Chironomidae (pupae)	15.4	88.2	315.4	313.3	708.1	285.6	262.3	185.4	196.7	141.0	86.5	73.0
Physa acuta	10.9	12.7	9.2	3.1	7.1	44.1	69.2	140.9	367.1	226.3	109.9	64.4
Sphaerium spp.	8.0	16.8	11.7	6.9	8.6	64.0	120.9	1127.9	2807.6	2979.9	1175.4	624.2
All Others	85.7	149.6	175.2	283.3	207.3	228.9	266.9	397.2	912.0	519.5	459.5	230.8
Total Number	2849.8	5655.4	5882.2	7170.1	12163.9	19810.6	12227.1	15047.4	25042.5	16649.2	13372.5	6556.6
Total Biomass (G Day Weight)	1.0	1.8	1.5	1.4	1.9	2.4	2.4	2.9	4.2	4.5	3.5	2.7

SPATIAL DISTRIBUTION, BY STATION BY YEAR, OF IMPORTANT BENTHIC MACROINVERTEBRATES COLLECTED IN QUANTITATIVE SAMPLES (1972-1976) FROM THE RIFFLE BIOTOPE OF EAST BRANCH PERKIOMEN CREEK AND PERKIOMEN CREEK

	Elephant No./m^2(1)	%(2)	FO %(3)	Branch No./m^2	%	FO %	Sellersville No./m^2	%	FO %	Cathill No./m^2	%	FO %
Dugesia spp.												
1972	(4)	(4)	3.3	186.6	2.8	60	13.4	(4)	33.3	(4)	(4)	2.2
1973	3.3	(4)	13.7	43	(4)	37	1.4	(4)	11.1	-	-	-
1974	13.9	(4)	50	15	(4)	33.3	56.7	(4)	41.7	-	-	-
1976	7.1	(4)	26.8	130.7	(4)	68.2	417	3.3	84.1	2.3	(4)	13.6
Mean	5.2			102.1			109.6			(4)		
Oligochaeta												
1972	15.6	(4)	31.7	58.4	(4)	73.3	403.4	6.8	85	43	(4)	62.2
1973	58.8	(4)	68.6	76.9	(4)	57.4	515.9	8.6	83.3	59.7	2.2	66.7
1974	128.9	2.1	72.2	112.8	(4)	52.8	597.2	6.9	83.3	33.6	(4)	47.2
1976	95.4	(2)	63.4	50.9	(4)	54.5	671.4	5.4	90.9	142.7	(4)	72.7
Mean	66.4			71.9			531.5			70.7		
Erpobdella punctata												
1972	(4)	(4)	5.0	2.3	(4)	15	5.6	(4)	26.7	-	-	-
1973	(4)	(4)	5.9	(4)	(4)	3.7	10.8	(4)	33.3	-	-	-
1974	3.9	(4)	30.6	2.2	(4)	11.1	11.4	(4)	52.8	-	-	-
1976	-	-	-	1.4	(4)	9.1	46.1	(4)	70.5	2.7	-	13.6
Mean	1.1			1.6	(4)		17.3	(4)		(4)	(4)	
Cambarus bartoni												
1972	1.1	(4)	10	(4)	(4)	3.3	(4)	(4)	1.7	-	-	-
1973	5.1	(4)	31.4	(4)	(4)	3.7	(4)	(4)	3.7	-	-	-
1974	6.9	(4)	36.1	-	-	-	(4)	(4)	2.8	-	-	-
1976	2	(4)	14.6	1.4	(4)	13.6	-	-	-	(4)	(4)	2.3
Mean	3.5			(4)			(4)			(4)		
Orconectes limosus												
1972	(4)	(4)	3.3	(4)	(4)	6.7	(4)	(4)	1.7	-	-	-
1973	(4)	(4)	2	-	-	-	(4)	(4)	1.9	-	-	-
1974	(4)	(4)	5.6	-	-	-	(4)	(4)	2.8	-	-	-
1976	-	-	-	(4)	(4)	2.3	(4)	(4)	6.8	-	-	-
Mean	(4)			(4)			(4)					
Caenis spp.												
1972	56.3	(4)	26.7	300.2	4.5	81.7	62.5	(4)	66.7	(4)	(4)	6.7
1973	44.6	(4)	58.8	388.1	3.4	79.6	33.5	(4)	61.1	-	-	-
1974	49.4	(4)	83.8	465.3	6.3	75	81.9	(4)	77.8	(4)	(4)	2.8
1976	33.4	(4)	51.2	214.3	2.7	75	140.7	(4)	84.1	(4)	(4)	4.5
Mean	46.8			335.8			75.8			(4)		
Tricorythodes spp												
1972	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	(4)	(4)	1.9)	(4)	(4)	1.9	-	-	-
1974	-	-	-	(4)	(4)	2.8	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	-	-	-	-
Mean	-	-	-	(4)			(4)			-	-	-

LGS EROL
TABLE 2.2-49
(Cont'd)

	Elephant No./m^2(1)	%(2)	FO %(3)	Branch No./m^2	%	FO %	Sellersville No./m^2	%	FO %	Cathill No./m^2	%	FO %
Ephemerella spp.												
1972	-	-	-	-	-	-	(4)	(4)	1.7	-	-	-
1973	(4)	(4)	3.9	-	-	-	(4)	(4)	1.9	-	-	-
1974	1.4	(4)	2.8	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	(4)	(4)	2.3	-	-	-
Mean	(4)			-	-	-	(4)			-	-	-
Baetis spp.												
1972	75.8	(4)	30	628.3	9.5	50	36	(4)	45	1.4	(4)	11.1
1973	58.2	(4)	33.3	510.2	4.5	59.3	46.8	(4)	50	(4)	(4)	3.7
1974	10.8	(4)	30.6	483.6	6.5	75	243.3	2.8	86.1	2.2	(4)	16.7
1976	40.7	(4)	41.5	447.3	5.6	54.5	49.1	(4)	45.5	8.2	(4)	18.2
Mean	50.9			527.5			80.5			2.9		
Stenonema spp.												
1972	7	(4)	8.3	12.5	(4)	31.7	6.1	(4)	30	-	-	-
1973	14.4	(4)	35.3	26.9	(4)	44.4	5.8	(4)	24.1	-	-	-
1974	72.8	(4)	91.7	3.3	(4)	22.2	18.9	(4)	47.2	-	-	-
1976	82	(4)	53.7	10.5	(4)	29.5	5.1	(4)	(4)	(4)	(4)	2.3
Mean	37.9			14.4		8.1	8.1			(4)		
Argia spp.												
1972	(4)	(4)	1.7	37.6	(4)	33.3	7	(4)	28.3	(4)	(4)	2.2
1973	(4)	(4)	7.8	42.2	(4)	51.9	7.6	(4)	35.2	(4)	(4)	7.4
1974	(4)	(4)	5.6	9.2	(4)	30.6	20.6	(4)	55.6	2.2	(4)	8.3
1976	(4)	(4)	2.4	10	(4)	56.8	15.7	(4)	56.8	6.8	(4)	38.6
Mean	(4)			27.4			11.6			2.4		
Allocapnia spp.												
1972	335.7	7.1	41.7	3	(4)	15	-	-	-	(4)	(4)	2.2
1973	173.7	3	45.1	12.7	(4)	31.5	2.8	(4)	18.5	-	-	-
1974	510.3	8.4	38.9	6.7	(4)	22.2	5.6	(4)	22.2	-	-	-
1976	144.4	2.3	31.7	12.5	(4)	22.7	5.7	(4)	18.2	(4)	(4)	2.3
Mean	283.5			8.6	(4)		3.1			(4)		
Perlesta placida												
1972	115.4	2.4	16.7	9.3	(4)	8.3	1.1	(4)	6.7	-	-	-
1973	147.4	2.6	29.4	22.1	(4)	24.1	6	(4)	16.7	(4)	(4)	1.9
1974	125.8	2.1	30.6	26.4	(4)	22.2	3.3	(4)	13.9	-	-	-
1976	12.4	(4)	7.3	27.5	(4)	11.4	4.5	(4)	9.1	-	-	-
Mean	103.6			20.2			3.6			(4)		
Coriyidae												
1972	(4)	(4)	5	-	-	-	-	-	-	-	-	-
1973	43.4	(4)	33.3	1.8	(4)	3.7	(4)	(4)	1.9	-	-	-
1974	161.4	2.7	52.8	(4)	(4)	2.8	-	-	-	-	-	-
1976	142.4	2.2	41.5	(4)	(4)	4.5	1.4	(4)	2.3	-	-	
Mean	74			(4)			(4)			-	-	-

LGS EROL
TABLE 2.2-49
(Cont'd)

	Elephant No./m^2(1)	%(2)	FO %(3)	Branch No./m^2	%	FO %	Sellersville No./m^2	%	FO %	Cathill No./m^2	%	FO %
Corydalus cornutus												
1972	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	(4)	(4)	5.6	-	-	-
1976	-	-	-	-	-	-	-	-	-	-	-	-
Mean	-	-	-	-	-	-	(4)	-	-	-	-	-
Psephenus hericki												
1972	-	-	-	3.9	(4)	20	-	-	-	(4)	(4)	2.2
1973	(4)	(4)	7.8	9.4	(4)	33.3	(4)	(4)	3.7	(4)	(4)	1.9
1974	1.4	(4)	11.1	18.9	(4)	41.7	1.7	(4)	16.7	(4)	(4)	2.8
1976	2.4	(4)	22	65.9	(4)	68.2	23	(4)	36.4	1.1	(4)	9.1
Mean	(4)			22.3			5.6			(4)		
Stenelmis spp.												
1972	107	2.3	70	174.9	2.7	71.7	82.1	(4)	61.7	29.9	(4)	55.6
1973	81.2	(4)	86.3	186.2	(4)	74.1	69.1	(4)	70.4	13.9	(4)	46.3
1974	149.2	2.5	86.1	112.8	(4)	86.1	349.7	4	94.4	21.9	(4)	69.4
1976	140.2	2.2	82.9	363.2	4.6	79.5	1360.5	10.9	97.7	58.6	(4)	97.7
Mean	115.3			209.2			418.1			30.5		
Chimarra spp.												
1972	(4)	(4)	3.3	283	4.3	60	40.1	(4)	48.3	6.2	(4)	24.4
1973	12.2	(4)	19.6	397.1	3.5	55.6	58.5	(4)	40.7	(4)	(4)	7.4
1974	9.4	(4)	36.1	747.5	10	83.3	276.1	3.2	83..3	5.6	(4)	27.8
1976	35.1	(4)	31.7	671.1	8.5	86.4	54.5	(4)	72.7	3.6	(4)	15.9
Mean	13.1			489			92.3			3.8		
Cheumatopsyche spp.												
1972	1123.1	23.8	66.7	592.3	9	93.3	731.7	12.3	85	1408.6	21.7	80
1973	162	2.8	62.7	1052	9.3	68.5	476.7	8	79.6	183.6	6.7	72.2
1974	662.8	10.9	88.9	1732.8	23.3	91.7	1763.9	20.3	100	1312.2	24.7	97.2
1976	187.8	2.9	58.5	1753	22.1	90.9	969.3	7.8	97.7	553.4	4.7	93.2
Mean	570.3			1195.1			906.2			809.4		
Hydropsyche spp.												
1972	25.8	(4)	31.7	136.2	2.1	55	(4)	(4)	8.3	(4)	(4)	2.2
1973	(4)	(4)	5.9	156.1	(4)	55.6	5.2	(4)	18.5	(4)	(4)	1.9
1974	4.4	(4)	13.9	624.2	8.4	83.3	10.8	(4)	61.1	4.4	(4)	13.9
1976	(4)	(4)	4.9	581.8	7.3	77.3	3.9	(4)	22.7	7.5	(4)	27.3
Mean	9.4	(4)		333.4			4.6			2.9		
Leucotrichia pictipes												
1972	-	-	-	(4)	(4	1.7	-	-	-	-	-	-
1973	-	-	-	(4)	(4)	1.9	-	-	-	-	-	-
1974	-	-	-	-	-	-	1.1	(4)	8.3	(4)	(4)	8.3
1976	-	-	-	(4)	(4)	4.5	-	-	-	2	(4)	9.1
Mean	-	-	-	(4)			(4)			(4)		

LGS EROL
TABLE 2.2-49
(Cont'd)

	Elephant No./m^2(1)	%(2)	FO %(3)	Branch No./m^2	%	FO %	Sellersville No./m^2	%	FO %	Cathill No./m^2	%	FO %
Tipula spp.												
1972	1.8	(4)	8.3	3.2	(4)	15	(4)	(4)	3.3	-	-	-
1973	5.1	(4)	29.4	1.4	(4)	9.3	-	-	-	(4)	(4)	1.9
1974	3.3	(4)	27.8	-	-	-	(4)	(4)	2.8	(4)	(4)	5.6
1976	11.2	(2)	36.6	3.2	(4)	22.7	(4)	(4)	4.5	(4)	(4)	4.5
Mean	5			2.1			(4)			(4)		
Simulidae												
1972	574.4	12.2	55	564	8.5	80	252.7	4.2	85	1365.6	21	88.9
1973	170.6	3	58.8	713.1	6.3	79.6	584.8	9.8	85.2	192.8	7	55.6
1974	173.9	2.9	44.4	476.4	6.4	86.1	941.7	10.9	75	269.2	5.1	83.3
1976	136.6	2.1	36.6	770.9	9.7	77.3	246.6	(4)	81.8	1988	16.9	93.2
Mean	292.7			636.2			471.6			944.2		
Chironomidae												
1972	2192.8	46.5	75	3302	50	100	3831	64.3	100	3572	55	100
1973	4488	77.8	100	7516.1	66.1	100	4006	66.9	100	2289.9	83.2	100
1974	3706.9	61.1	100	2486.4	33.4	100	3790.3	43.7	100	3640	68.6	100
1976	5007.3	78.4	90.2	2565.9	32.3	90.9	4126.8	33	100	7678.2	65.3	100
Mean	3719.2			4156.7			3939.2			4208.3		
Physa acuta												
1972	8.8	(4)	28.3	5.2	(4)	25	261.1	4.4	46.7	20.8	(4)	20
1973	29.5	(4)	35.3	5.4	(4)	13	31.3	(4)	53.7	2.2	(4)	9.3
1974	8.9	(4)	38.9	9.2	(4)	47.2	80.3	(4)	72.2	4.2	(4)	16.7
1976	42.7	(4)	39	9.1	(4)	29.5	10	7.3	77.3	1156.4	9.8	65.9
Mean	21.8			6.9			10.7			291		
Sphaerium spp.												
1972	5.6	(4)	23.3	5.6	(4)	25	11.1	(4)	21.7	-	-	-
1973	2.1	(4)	17.6	3	(4)	20.4	2.8	(4)	20.4	-	-	-
1974	10.3	(4)	27.8	1.1	(4)	8.3	96.4	(4)	69.4	-	-	-
1976	5.9	(4)	22	8.9	(4)	34.1	2659.8	21.3	90.9	(4)	(4)	4.5
Mean	5.6			4.8			625.3			(4)		
All Others												
1972	67.4	(4)	61.7	289.8	4.4	95	211.8	3.6	90	49.7	(4)	62.2
1973	268.7	4.7	98	206.3	(4)	96.3	118.9	(4)	90.7	6.8	(4)	33.3
1974	249.2	4.1	100	110.3	(4)	88.9	16.9	3.7	97.2	11.1	(4)	44.4
1976	260.7	4.1	87.8	240.9	3	90.9	780.2	6.1	100	139.3	(4)	77.3
Mean	199			222.1			334.4			51		

LGS EROL
TABLE 2.2-49
(Cont'd)

	Moyer No./m^2	%	FO %	Wawa No./m^2	%	FO %	Spring Mount No./m^2	%	FO %	Rahms No./m^2	%	FO %
Dugesia spp.												
1972	191.6	2.5	60	178.9	(4)	61.7	89.2	(4)	71.7	163.9	(4)	54
1973	107.3	(4)	51.9	82.2	(4)	74.1	225.8	(4)	53.7	75.8	(4)	46.3
1974	781.7	5.6	86.1	1407.8	6.9	100	186.4	(4)	69.4	166.9	(4)	80.6
1976	3229.1	10.6	93.2	2938.4	5.8	90.9	731.1	3.4	77.3	190.5	(4)	79.5
Mean	966.5			1005.9			290.9			144.8		
Oligochaeta												
1972	29.9	(4)	53.3	61.1	(4)	50	36.9	(4)	63.3	101.7	(4)	64
1973	21.7	(4)	46.3	38.8	(4)	51.9	39.4	(4)	63	55.2	(4)	61.1
1974	46.1	(4)	77.8	41.1	(4)	50	88.9	(4)	80.6	136.9	(4)	77.8
1976	18.6	(4)	63.6	39.3	(4)	38.6	26.6	(4)	54.5	81.8	(4)	79.5
Mean	28.1			46.3			44.9			90.2		
Erpobdella punctata												
1972	1.4	(4)	11.7	4.1	(4)	21.7	1.8	(4)	10	(4)	(4)	2
1973	(4)	(4)	3.7	2.8	(4)	16.7	(4)	(4)	5.6	3.2	(4)	24.1
1974	2.5	(4)	19.4	8.1	(4)	41.7	(4)	(4)	2.8	1.8	(4)	13.9
1976	4.5	(4)	22.7	9.3	(4)	31.8	(4)	(4)	2.3	1.8	(4)	15.9
Mean	2			5.7			(4)			1.9		
Cambarus bartoni												
1972	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	-	-
1976	(4)	(4)	6.8	-	-	-	-	-	-	-	-	-
Mean	(4)	-	-	-	-	-	-	-	-	-	-	-
Orconectes limosus												
1972	(4)	(4)	6.7	(4)	(4)	3.3	(4)	(4)	3.3	(4)	(4)	2
1973	(4)	(4)	1.9	-	-	-	(4)	(4)	3.7	-	-	-
1974	1.1	(4)	11.1	-	-	-	(4)	(4)	2.8	(4)	(4)	2.8
1976	(4)	(4)	4.5	-	-	-	-	-	-	(4)	(4)	2.3
Mean	(4)			(4)			(4)			(4)		
Caenis spp.												
1972	1.3	(4)	10	24.7	(4)	51.7	4.1	(4)	13.3	11.4	(3)	30
1973	(4)	(4)	7.4	3.2	(4)	20.4	8.4	(1)	25.9	64.7	(4)	55.6
1974	2.2	(4)	13.9	12.2	(4)	22.2	1.1	(4)	2.8	27.5	(4)	38.9
1976	54.5	(4)	52.3	12.7	(4)	38.6	-	-	-	26.4	(2)	43.2
Mean	13.4			13.7			3.8			33.8		
Tricorythodes spp.												
1972	(4)	(4)	1.7	15.2	(4)	18.3	43.7	(4)	20	324.3	2.7	44
1973	-	-	-	(4)	(4)	5.6	4.2	(4)	11.1	11.4	(4)	16.7
1974	-	-	-	(4)	(4)	5.6	15	(4)	30.6	10.8	(4)	36.1
1976	(4)	(4)	2.3	22.5	(4)	15.9	18.4	(4)	25	65.7	(4)	34.1
Mean				10.1			21.6			109.3		
Ephemerella spp.												
1972	-	-	-	-	-	-	140.1	(4)	60	649.7	5.4	54
1973	(4)	(4)	1.9	1.4	(4)	7.4	929.9	6.5	90.7	520.3	4.9	85.2
1974	(4)	(4)	2.8	(4)	(4)	2.8	1541.4	9.6	100	449.2	3.9	91.7
1976	(4)	(4)	4.5	12.3	(4)	22.7	2631.6	12.3	86.4	511.8	2.9	79.5
Mean	(4)			3.2			1185.1			539.5		

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TABLE 2.2-49
(Cont'd)

	Moyer No./m^2	%	FO %	Wawa No./m^2	%	FO %	Spring Mount No./m^2	%	FO %	Rahms No./m^2	%	FO %
Baetis spp.												
1972	51.5	(4)	30	249.3	(4)	46.7	361.5	4.4	45	759.4	6.3	58
1973	97.4	(4)	27.8	463.2	4.0	48.1	665.7	4.7	57.4	784.9	7.4	61.1
1974	106.4	(4)	58.3	387.2	(4)	61.1	823.9	5.1	83.3	716.9	6.3	72.2
1976	531.6	(4)	52.3	642.7	(4)	54.5	1345.5	6.3	63.6	1388	7.9	59.1
Mean	183.2			423.6			755.1			908.9		
Stenonema spp.												
1972	-	-	-	(4)	(4)	3.3	366.5	4.4	83.3	371.8	3.1	66
1973	(4)	(4)	5.6	6.8	(4)	18.5	656.1	4.6	100	460.4	4.3	85.2
1974	-	-	-	(4)	(4)	2.8	675.8	4.2	100	229.2	2	94.4
1976	26.6	(4)	40.9	3	(4)	18.2	505	2.4	97.7	355.2	2	97.7
Mean	6.2			2.7			535.9			365.9		
Argia spp.												
1972	-	-	-	18.5	(4)	31.7	(4)	(4)	5	32	(4)	28
1973	8	(4)	24.1	9.2	(4)	33.3	11	(4)	31.5	20.9	(4)	37
1974	66.1	(4)	66.7	23.1	(4)	61.1	28.9	(4)	58.3	10.8	(4)	36.1
1976	47.7	(4)	95.5	18.2	(4)	61.4	21.1	(4)	40.9	29.1	(4)	36.4
Mean	25.3			16.7			13.5			23.9		
Allocapnia spp.												
1972	(4)	(4)	1.7	(4)	(4)	1.7	41	(4)	26.7	14	(4)	22
1973	-	-	-	(4)	(4)	1.9	17.3	(4)	16.7	43.6	(4)	40.7
1974	(4)	(4)	2.8	(4)	(4)	2.8	20.6	(4)	19.4	58.6	(4)	33.3
1976	-	-	-	(4)	(4)	2.3	8.9	(4)	18.2	83.6	(4)	25
Mean	(4)			(4)			23.3			48.1		
Perlesta placida												
1972	-	-	-	-	-	-	8.1	8.3	1.3	(4)	6	
1973	-	-	-	-	-	-	6.2	(4)	14.8	10.2	(4)	11.1
1974	-	-	-	(4)	(4)	2.8	33.1	(4)	30.6	11.1	(4)	22.2
1976	(4)	(4)	4.5	(4)	(4)	2.8	33.1	(4)	30.6	1.8	(4)	9.1
Mean	(4)			(4)			23.4			5.9		
Corixidae												
1972	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	(4)	(4)	1.9	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	-	-
1976	(4)	(4)	2.3	-	-	-	-	-	-	-	-	-
Mean	(4)			(4)			-	-	-	-	-	-
Corydalus cornutus												
1972	(4)	(4)	1.7	-	-	-	(4)	(4)	6.7	(4)	(4)	4
1973	(4)	(4)	7.4	(4)	(4)	3.7	2.6	(4)	16.7	2.4	(4)	14.8
1974	(4)	(4)	8.3	-	-	-	4.2	(4)	25	1.4	(4)	5.6
1976	3.9	(4)	27.3	2.3	(4)	15.9	5.7	(4)	38.6	5.	(4)	40.9
Mean	1.3			(4)			3			2.3		

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TABLE 2.2-49
(Cont'd)

	Moyer No./m^2	%	FO %	Wawa No./m^2	%	FO %	Spring Mount No./m^2	%	FO %	Rahms No./m^2	%	FO %
Psephaenus herricki												
1972	19.2	(4)	33.3	18.5	(4)	63.3	3.6	(4)	20	24.5	(4)	60
1973	10.2	(4)	37	47.6	(4)	81.5	8.8	(4)	40.7	101.6	(4)	83.3
1974	69.4	(4)	50	117.2	(4)	83.3	11.7	(4)	55.6	112.5	(4)	86.1
1976	96.8	(4)	86.4	263	(4)	100	22.7	(4)	52.3	549.1	3.1	93.2
Mean	43.6			100.3			10.9			189.8		
Steneimis spp.												
1972	504.7	6.7	73.3	731.5	5.9	85	24.2	(4)	65	404.9	3.4	98
1973	370	4.7	77.8	1178.4	10.1	83.3	38.8	(4)	77.8	632.8	6	90.7
1974	715.8	5.2	97.2	2711.7	13.3	100	100.6	(4)	97.2	636.4	5.6	94.4
1976	4869.1	16	100	7296.6	14.4	100	382.5	(4)	95.5	783	4.4	100
Mean	1496.2			2712.4			123.7			607.5		
Chimarra spp.												
1972	975.4	12.9	60	2708.6	21.7	95	138	(4)	76.7	287.3	2.4	58
1973	485.1	6.2	79.6	2442.1	20.9	96.3	79.3	(4)	81.5	609.1	5.7	83.3
1974	1634.7	11.8	97.2	3359.2	16.5	100	73.6	(4)	80.6	440	3.8	88.9
1976	4720.5	15.5	100	5409.1	10.7	100	1427	6.7	93.2	2235.5	12.7	97.7
Mean	1810.7			3367.6			402.1			877.5		
Cheumatopsyche spp.												
1972	2360	31.3	90	1956.6	15.7	96.7	1255.2	15.2	96.7	2191.4	18.3	96
1973	2724.6	34.8	88.9	1636.2	14	96.3	1322.6	9.2	100	2007	18.9	100
1974	4478.9	32.3	100	1522.2	7.5	100	1837.8	11.5	100	2535.8	22.2	100
1976	5739.1	18.8	100	2992.5	5.9	100	2669.8	12.5	100	2557.7	14.5	100
Mean	3621.1			2021.8			1702.9			2292.3		
Hydropsyche spp.												
1972	1278.9	16.9	83.3	977.4	7.8	98.3	888.5	10.8	91.7	1067.1	8.9	90
1973	664.9	8.5	79.6	1325	11.3	92.6	922.5	6.5	100	1264	11.9	98.1
1974	2109.7	15.2	100	3052.8	15	100	659.2	4.1	100	952.8	8.3	100
1976	1771.4	5.8	100	2906.4	5.7	100	1102.5	5.2	97.7	1476.4	8.4	100
Mean	1373.8			1896.8			904			1200.4		
Leucotrichia pictipes												
1972	80.1	(4)	33.3	233	(4)	38.3	78.7	(4)	36.7	134.2	(4)	38
1973	27.9	(4)	35.2	35.8	(4)	31.5	26.9	(4)	48.1	27.1	(4)	33.3
1974	354.7	2.6	61.1	434.2	2.1	61.1	126.1	(4)	66.7	117.8	(4)	61.1
1976	476.1	(4)	88.6	942.3	(4)	84.1	130.7	(4)	63.6	116.6	(4)	45.5
Mean	206.3			376.3			84.9			95.3		
Tipula spp.												
1972	(4)	(4)	3.3	(4)	(4)	1.7	(4)	(4)	1.7	(4)	(4)	2
1973	(4)	(4)	3.7	-	-	-	(4)	(4)	5.6	(4)	(4)	7.4
1974	-	-	-	-	-	-	(4)	(4)	5.6	-	-	-
1976	(4)	(4)	6.8	-	-	-	(4)	(4)	9.1	(4)	(4)	6.8
Mean	(4)			(4)			(4)			(4)		

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TABLE 2.2-49
(Cont'd)

	Moyer No./m^2	%	FO %	Wawa No./m^2	%	FO %	Spring Mount No./m^2	%	FO %	Rahms No./m^2	%	FO %
Simuliidae												
1972	358.4	4.8	83.3	249.5	(4)	85	1241	15	98.3	1287.7	10.7	78
1973	330.9	4.2	85.2	487.9	4.2	77.8	1135.4	7.9	94.4	782	7.4	96.3
1974	219.2	(4)	63.9	259.4	(4)	63.9	2131.9	13.3	100	1885.6	16.5	97.2
1976	319.5.	(4)	81.8	348.4	(4)	79.5	1416.8	6.6	97.7	2048.9	11.6	97.7
Mean	316.6			340.1			1416.8			1438.3		
Chironomidae												
1972	1516.2	20.1	100	4851.1	38.8	98.3	2900.9	35.1	96.7	3405.1	28.4	100
1973	2769.4	35.3	98.1	3841.7	32.8	100	7208.7	50.4	100	2552	24.1	100
1974	3004.7	21.7	100	3109.7	15.3	100	6548.1	40.9	100	2332.2	20.4	100
1976	7563.4	24.8	100	6054.3	12	100	7114.3	33.2	10	4483.4	25.5	100
Mean	3512.8			4519.9			5732.4			3202.7		
Physa Acuta												
1972	10	(4)	20	(4)	(4)	6.7	78.9	(4)	58.3	8.6	(4)	24
1973	47.2	(4)	42.6	(4)	(4)	3.7	44.2	(4)	50	7.4	(4)	35.2
1974	13.6	(4)	38.9	(4)	(4)	2.8	83.9	(4)	72.2	3.9	(4)	27.8
1976	29.5	(4)	38.6	2.3	(4)	11.4	178	(4)	77.3	9.1	(4)	29.5
Mean	25.5			(4)			92.6			7.4		
Sphaerium spp.												
1972	10.6	(4)	28.3	41.8	(4)	28.3	17	(4)	46.7	70.5	(4)	38
1973	4.8	(4)	5.6	13.9	(4)	29.6	12.1	(4)	40.7	12.7	(4)	25.9
1974	2.5	(4)	19.4	3776.9	18.6	86.1	8.1	(4)	33.3	108.3	(4)	66.7
1976	510.2	(4)	63.6	20385.9	40.3	90.9	175	(4)	72.7	93.2	(4)	65.9
Mean	120.8			5341.3			49.8			66.4		
All Others												
1972	154.7	2	75	176	(4)	75	540.1	6.5	100	668.4	5.6	98
1973	163.3	2.1	90.7	88.8	(4)	83.3	933.7	6.5	100	550.8	5.2	98.1
1974	261.3	(4)	88.9	130	(4)	94.4	1017.8	6.4	100	486.4	4.3	100
1976	430.7	(4)	100	263.4	(4)	97.7	1432.7	6.7	100	518.2	2.9	97.7
Mean	239.4			163			940.8			562.3		

(1) Mean density.
(2) Percent composition.
(3) Frequency of occurrence.
(4) Less than 1/square meter or less than 2%. Erpobdella punctata, Cambarus bartoni, Orconectes limosus, Argia spp, Corydalus cornutus, and Tipula spp. were dominant only as biomass (see Table 2.2-50).

TABLE 2-2-50

SPATIAL DISTRIBUTION, BY STATION BY YEAR, OF IMPORTANT BENTHIC MACROINVERTEBRATES COLLECTED IN QUANTITATIVE SAMPLES (1973, 1974) FROM THE RIFFLE BIOTOPE OF EAST BRANCH PERKIOMEN CREEK AND PERKIOMEN CREEK

		Elephant Mg/m²	%(2)	Branch Mg/m²	%	Sellersville Mg/m²	%	Cathill Mg/m²	%
Dugesia spp.									
	1973	(3)	(3)	15.3	(3)	(3)	(3)	-	-
	1974	5.6	(3)	4.4	(3)	23.5	(3)	-	-
	Mean	2.9		10.9		9.5		-	-
Oligochaeta									
	1973	56.7	2.3	54.7	3.6	115.3	7.0	9.8	3.2
	1974	33.3	(3)	54.7	2.4	84.6	3.8	15.2	(3)
	Mean	47.0		54.7		103.0		12.0	
Erpobdella punctata									
	1973	12.7	(3)	1.7	(3)	43.6	2.6	-	-
	1974	14.9	(3)	2.4	(3)	117.6	5.3	-	-
	Mean	13.6		2.0		73.2		-	-
Cambarus bartoni									
	1973	891.4	35.7	202.6	13.5	361.5	21.9	-	-
	1974	797.0	34.5	-	-	448.5	20.2	-	-
	Mean	852.3		121.6		396.3		-	-
Orconectes limosus									
	1973	554.2	22.2	-	-	484.9	29.4	-	-
	1974	72.7	3.1	-	-	314.4	14.2	-	-
	Mean	354.6		-	-	416.7		-	-
Caenis spp.									
	1973	4.1	(3)	11.4	(3)	2.9	(3)	-	-
	1974	7.9	(3)	21.4	(3)	8.3	(3)	(3)	(3)
	Mean	5.7		15.4		5.1		(3)	
Tricorythodes spp.									
	1973	-	-	(3)	(3)	(3)	(3)	-	-
	1974	-	-	(3)	(3)	-	-	-	-
	Mean	-	-	(3)		(3)		-	-
Ephemerella spp.									
	1973	(3)	(3)	-	-	(3)	(3)	-	-
	1974	(3)	(3)	-	-	-	-	-	-
	Mean	(3)				(3)		-	-
Baetis spp.									
	1973	5.4	(3)	34.1	2.3	2.7	(3)	(3)	(3)
	1974	1.6	(3)	34.0	(3)	12.1	(3)	(3)	(3)
	Mean	3.8		34.1		6.5		(3)	
Stenonema spp.									
	1973	4.8	(3)	12.5	(3)	1.5	(3)	-	-
	1974	48.9	2.1	(3)	(3)	4.4	(3)	-	-
	Mean	23.0		7.7		2.7		-	-
Argia spp.									
	1973	(3)	(3)	70.0	4.7	10.4	(3)	(3)	(3)
	1974	1.9	(3)	9.6	(3)	25.0	(3)	(3)	(3)
	Mean	(3)		45.8		16.2		(3)	

TABLE 2-2-50 (Cont'd)

		Elephant Mg/m²	%(2)	Branch Mg/m²	%	Sellersville Mg/m²	%	Cathill Mg/m²	%
Allocapnia spp.									
	1973	22.8	(3)	1.5	(3)	(3)	(3)	-	-
	1974	77.6	3.4	(3)	(3)	(3)	(3)	-	-
	Mean	45.5		1.1		(3)		-	-
Perlesta placida									
	1973	43.5	(3)	7.6	(3)	3.8	(3)	(3)	(3)
	1974	31.6	(3)	33.7	(3)	1.1	(3)	-	-
	Mean	38.5		18.0		2.7		(3)	
Corixidae									
	1973	39.0	(3)	(3)	(3)	(3)	(3)	-	-
	1974	99.6	4.3	(3)	(3)	-	-	-	-
	Mean	64.1		(3)		(3)		-	-
Corydalus cornutus									
	1973	-	-	-	-	-	-	-	-
	1974	-	-	-	-	1.2	(3)	-	-
	Mean	-	-	-	-	(3)		-	-
Psephenus herricki									
	1973	(3)	(3)	8.4	(3)	(3)	(3)	(3)	(3)
	1974	1.8	(3)	7.7	(3)	1.5	(3)	(3)	(3)
	Mean	(3)		8.1		(3)		(3)	
Stenelmis spp.									
	1973	24.5	(3)	55.1	3.7	18.3	(3)	5.7	(3)
	1974	42.2	(3)	32.1	(3)	65.1	2.9	7.5	(3)
	Mean	31.8		45.9		37.0		6.4	
Chimarra spp.									
	1973	(3)	(3)	83.0	5.5	13.2	(3)	(3)	(3)
	1974	1.9	(3)	320.1	14.3	88.7	4.0	(3)	(3)
	Mean	1.1		177.8		43.4		(3)	
Cheumatopsyche spp.									
	1973	97.9	3.9	419.7	27.9	197.1	11.9	107.9	34.8
	1974	359.2	15.5	813.8	36.2	561.0	25.3	689.1	70.4
	Mean	206.0		577.4		342.7		340.4	
Hydropsyche spp.									
	1973	(3)	(3)	188.1	12.5	7.3	(3)	(3)	(3)
	1974	(3)	(3)	477.8	21.3	18.3	(3)	5.6	(3)
	Mean	(3)		304.0		11.7		2.2	

TABLE 2-2-50 (Cont'd)

		Elephant Mg/m²	%(2)	Branch Mg/m²	%	Sellersville Mg/m²	%	Cathill Mg/m²	%
Leucotrichia pictipes									
	1973	-	-	(3)	(3)	-	-	-	-
	1974	-	-	-	-	(3)	(3)	(3)	(3)
	Mean	-	-	(3)		(3)		(3)	
Tipula spp.									
	1973	99.3	4.0	43.4	2.9	-	-	8.1	2.6
	1974	117.7	5.1	-	-	1.6	(3)	11.1	(3)
	Mean	106.9		26.0		(3)		9.3	
Simuiidae									
	1973	15.5	(3)	70.8	4.7	76.4	4.6	40.6	13.1
	1974	19.2	(3)	71.4	3.2	52.3	2.4	35.1	3.6
	Mean	17.0		71.1		66.8		38.4	
Chironomidae									
	1973	457.4	18.3	178.8	11.9	216.3	13.1	133.0	42.9
	1974	484.8	21.0	305.8	13.6	205.4	9.3	205.9	21.0
	Mean	468.7		229.6		212.0		162.2	
Physa acuta									
	1973	110.8	4.4	5.1	(3)	45.6	2.8	3.5	(3)
	1974	13.3	(3)	9.5	(3)	48.9	2.2	6.6	(3)
	Mean	70.4		6.9		46.9		4.7	
Sphaerium spp.									
	1973	(3)	(3)	4.3	(3)	(3)	(3)	-	-
	1974	(3)	(3)	(3)	(3)	28.7	(3)	-	-
	Mean	(3)		2.7		11.9		-	-
All Others									
	1973	52.2	2.1	33.0	2.2	48.0	2.9	(3)	(3)
	1974	80.1	3.5	45.9	2.0	107.4	4.8	(3)	(3)
	Mean	63.8		38.1		71.8		(3)	

TABLE 2-2-50 (Cont'd)

		Moyer Mg/m²	%	Wawa Mg/m²	%	Spring Mount Mg/m²	%	Rahns Mg/m²	%
Dugesia spp.									
	1973	60.5	3.1	47.4	(3)	28.7	(3)	24.9	(3)
	1974	362.6	6.3	618.8	10.1	31.0	(3)	38.0	(3)
	Mean	181.3		275.9		29.6		30.1	
Oligochaeta									
	1973	106.0	5.4	16.0	(3)	100.0	2.4	87.6	2.2
	1974	126.6	2.2	89.3	(3)	42.8	(3)	75.2	2.4
	Mean	114.2		45.3		77.1		82.6	
Erpobdella punctata									
	1973	3.8	(3)	41.0	(3)	13.5	(3)	38.3	(3)
	1974	16.6	(3)	68.3	(3)	(3)	(3)	47.8	(3)
	Mean	8.9		51.9		8.1		42.1	
Orconectes limosus									
	1973	50.1	2.6	-	-	173.8	4.1	-	-
	1974	1055.7	18.3	-	-	1.6	(3)	(3)	(3)
	Mean	452.4		-	-	104.9		(3)	
Caenis spp.									
	1973	(3)	(3)	(3)	(3)	(3)	(3)	2.5	(3)
	1974	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
	Mean	(3)				(3)		1.9	
Tricorythodes spp.									
	1973	-	-	(3)	(3)	(3)	(3)	1.5	(3)
	1974	-	-	(3)	(3)	1.5	(3)	(3)	(3)
	Mean	-	-	(3)		(3)		1.1	
Ephemerella spp.									
	1973	(3)	(3)	(3)	(3)	82.6	(3)	33.0	(3)
	1974	(3)	(3)	(3)	(3)	264.1	7.5	33.7	(3)
	Mean	(3)		(3)		155.2		33.3	
Baetis spp.									
	1973	5.0	(3)	15.9	(3)	36.7	(3)	52.7	(3)
	1974	8.0	(3)	28.9	(3)	65.7	(3)	57.2	(3)
	Mean	6.2		21.1		48.3		54.5	
Stenonema spp.									
	1973	(3)	(3)	(3)	(3)	247.7	5.9	54.4	(3)
	1974	-	-	(3)	(3)	213.1	6.1	55.9	(3)
	Mean	(3)		(3)		233.9		55.0	
Argia spp.									
	1973	4.1	(3)	14.2	(3)	5.6	(3)	12.3	(3)
	1974	65.7	(3)	46.7	(3)	34.7	(3)	11.3	(3)
	Mean	28.7		27.2		17.3		11.9	

TABLE 2-2-50 (Cont'd)

		Moyer Mg/m²	%	Wawa Mg/m²	%	Spring Mount Mg/m²	%	Rahns Mg/m²	%
Allocapnia spp.									
	1973	-	-	(3)	(3)	(3)	(3)	4.1	(3)
	1974	(3)	(3)	(3)	(3)	2.2	(3)	3.9	(3)
	Mean	(3)		(3)		1.1		4.0	
Perlesta placida									
	1973	-	-	-	-	3.4	(3)	(3) (3)	
	1974	-	-	(3)	(3)	21.9	(3)	4.1	(3)
	Mean	-	-	(3)		10.0		2.0	
Corixidae									
	1973	-	-	(3)	(3)	-	-	-	-
	1974	-	-	-	-	-	-	-	-
	Mean	-	-	(3)		-		-	
Corydalus cornutus									
	1973	2.2	(3)	17.4	(3)	615.3	14.6	142.0	3.5
	1974	7.1	(3)	-	-	400.4	11.4	129.6	4.2
	Mean	4.1		10.4		529.3		137.0	
Psephenus herricki									
	1973	5.5	(3)	35.1	(3)	8.6	(3)	30.5	(3)
	1974	36.6	(3)	112.6	(3)	11.0	(3)	85.3	2.8
	Mean	18.0		66.1		9.5		52.4	
Stenelmis spp.									
	1973	75.3	3.9	233.7	6.3	12.4	(3)	113.2	2.8
	1974	210.7	3.7	664.7	10.8	41.2	(3)	184.3	6.0
	Mean	129.5		406.1		23.9		141.7	
Chimarra spp.									
	1973	184.0	9.5	662.1	18.0	24.6	(3)	187.7	4.6
	1974	659.7	11.5	852.5	13.8	23.5	(3)	147.2	4.8
	Mean	374.2		738.3		24.2		171.5	
Cheumatopsyche spp.									
	1973	779.6	40.1	688.3	18.7	683.7	16.2	1146.9	28.3
	1974	1328.5	23.1	320.6	5.2	539.2	15.4	800.3	26.0
	Mean	999.2		541.2		626.0		1008.2	
Hydropsyche spp.									
	1973	406.8	20.9	1615.0	43.9	1058.0	25.1	1646.0	40.6
	1974	1609.3	28.0	2215.1	36.0	872.4	24.9	831.2	27.0
	Mean	887.8		1855.0		983.8		1320.1	
Leucotrichia pitcipes									
	1973	1.7	(3)	1.4	(3)	1.8	(3)	(3)	(3)
	1974	18.9	(3)	25.4	(3)	4.5	(3)	7.4	(3)
	Mean	8.6		11.0		2.9		3.3	

TABLE 2-2-50 (Cont'd)

		Moyer Mg/m²	%	Wawa Mg/m²	%	Spring Mount Mg/m²	%	Rahns Mg/m²	%
Tipula spp.									
	1973	12.4	(3)	-	-	31.8	(3)	52.0	(3)
	1974	-	-	-	-	30.3	(3)	-	-
	Mean	7.5				31.2		31.2	
Simulidae									
	1973	58.3	3.0	76.6	2.1	308.8	7.3	69.7	(3)
	1974	19.4	(3)	22.0	(3)	175.3	5.0	237.1	7.7
	Mean	42.8		54.8		255.4		136.7	
Chironomidae									
	1973	131.1	6.7	194.7	5.3	491.4	11.7	185.3	4.6
	1974	160.3	2.8	212.6	3.5	436.5	12.4	162.7	5.3
	Mean	142.8		201.9		469.4		176.2	
Physa acuta									
	1973	42.5	2.2	(3)	(3)	24.6	(3)	8.9	(3)
	1974	13.4	(3)	2.5	(3)	41.9	(3)	2.3	(3)
	Mean	30.9		1.0		31.5		6.3	
Sphaerium spp.									
	1973	(3)	(3)	11.8	(3)	11.9	(3)	3.0	(3)
	1974	(3)	(3)	846.0	13.7	1.9	(3)	49.0	(3)
	Mean	(3)		345.5		7.9		21.4	
All Others									
	1973	14.9	(3)	10.3	(3)	246.5	5.9	156.0	3.8
	1974	54.9	(3)	29.2	(3)	250.6	7.1	110.2	3.6
	Mean	30.9		17.9		248.1		137.7	

(1) Mean density in milligrams of dry weight per square meter.
(2) Percent of composition.
(3) Less than 1 Mg square meter or less than 2%. Caenis spp., Tricorythodes spp., Perlesta placida, and Leucotrichia pictipes were dominant only numerically (see Table 2.2.-49).

TABLE 2.2-51

SUMMARY TABLE OF AQUATIC MACROINVERTEBRATE DRIFT AS MEASURED FOR EACH MONTHLY(1) 24 HOUR STUDY IN EAST BRANCH PERKIOMEN CREEK AND PERKIOMEN CREEK. MONTHLY VALUES FOR INDIVIDUAL TAXA REPRESENT PERCENT OF TOTAL DRIFT

	1972	1973							
	Aug	Apr	May	Jun	Jul	Aug	Sep	Oct	Mean
East Branch Perkiomen Creek									
Dominant[2] taxa									
Baetis spp.	-	Absent	9.4	9.8	4.6	43.8	7.1	2.2	9.0
Coenagrionidae	-	Absent	Absent	(3)	Absent	Absent	2.7	Absent	(3)
Stenelmis spp.	-	4.0	4.6	7.6	8.1	1.1	1.0	Absent	5.7
Chimarra spp.	-	28.9	Absent	(3)	(3)	Absent	3.0	Absent	4.3
Cheumatopsyche spp.	-	4.0	(3)	18.7	29.9	2.2	10.1	2.2	13.4
Hydropsyche spp.	-	3.2	(3)	49.8	8.1	Absent	9.6	Absent	25.0
Chironomidae	-	35.6	72.9	7.3	43.1	51.7	64.7	84.4	33.6
Total percent	-	75.7	87.9	94.2	94.3	98.8	98.2	88.8	91.1
Total number/1000 m³	-	386	530	1921	902	689	1897	418	927
All taxa									
Total number ± SE/1000 m³	-	510±107	603±92	2039±799	957±282	697±268	1932±485	471±164	1019±157
Total biomass (mg dry wt) ± SE/1000 m³	-	71±19	74±15	352±148	192±50	57±38	223±107	80±30	148±28
Total taxa	-	19	13	16	12	5	10	7	12
Velocity (m/s)	-	0.125	0.116	0.110	0.052	0.037	0.034	0.030	0.072
Perkiomen Creek									
Dominant[1] taxa									
Naididae	-	0	0	0	0	0	0	0	Absent
Gammarus fasciatus	-	(3)	Absent	(3)	(3)	1.4	(3)	(3)	(3)
Tricorythodes sp.	-	Absent	Absent	6.7	3.4	1.0	(3)	1.0	3.4
Baetis spp.	-	Absent	17.5	7.0	(3)	33.2	18.1	3.1	6.1
Cheumatopsyche spp.	-	5.3	(3)	13.9	4.5	12.2	3.6	(3)	6.4
Simuliidae	-	(3)	3.4	4.8	(3)	(3)	(3)	2.4	1.6
Chironomidae	-	50.9	67.9	52.9	85.9	40.9	70.1	79.5	73.2
Heleidae	-	Absent	Absent	Absent	(3)	(3)	(3)	Absent	(3)
Total percent	-	56.4	88.8	85.3	95.8	93.8	89.7	87.0	91.7
Total number/1000 m³	-	181	625	2358	10,126	1285	2807	592	2550
All taxa									
Total number ± SE/1000 m³	1991±539	321±60	704±204	2765±701	10570±2294	1433±485	2993±1107	680±140	2781±520
Total biomass (mg dry wt) ± SE/1000 m³	82±20	69±23	69±17	275±145	482±114	134±45	201±63	98±39	190±32
Total taxa	20	34	19	31	37	25	26	20	27
Velocity (m/s)	0.146	0.360	0.238	0.244	0.171	0.101	0.116	0.110	0.191

TABLE 2.2-51 Cont'd)

	1974						
	Apr	May	Jun	Jul	Aug	Sep	Mean
East Branch Perkiomen Creek							
Dominant[2] taxa							
Baetis spp.	(3)	36.6	28.9	4.7	2.2	16.0	14.7
Coenagrionidae	Absent	Absent	1.3	(3)	7.1	3.0	(3)
Stenelmis spp.	5.7	2.5	1.3	30.0	(3)	3.0	7.1
Chimarra spp.	2.1	(3)	(3)	Absent	Absent	1.0	(3)
Cheumatopsyche spp.	(3)	Absent	4.4	3.2	3.5	6.0	2.9
Hydropsyche spp.	2.0	26.9	9.1	1.1	2.2	7.0	8.1
Chironomidae	77.7	32.6	48.1	45.8	57.7	44.0	50.5
Total percent	88.5	99.1	93.6	85.3	73.2	80.0	86.6
Total number/1000 m³	1077	5272	499	1267	806	450	1550.2
All taxa							
Total number ± SE/1000 m³	1217±189	5320±2001	533±132	1485±551	11012±3697	562±91	3355±1110
Total biomass (mg dry wt) ± SE/1000 m³	130±55	348±187	22±5	384±345	453±156	42±10	229±126
Total taxa	19	20	16	17	28	19	20
Velocity (m/s)	0.116	0.090	0.150	0.037	0.034	0.049	0.079
Perkiomen Creek							
Dominant[1] taxa							
Naididae	2.9	48.3	(3)	(3)	(3)	Absent	8.5
Gammarus fasciatus	Absent	Absent	1.4	(3)	9.4	2.2	2.2
Tricorythodes spp.	Absent	Absent	(3)	(3)	2.1	(3±	(3)
Baetis spp.	1.9	4.5	31.5	2.2	18.2	11.5	11.6
Cheumatopsyche spp.	1.4	(3)	7.8	1.5	41.1	8.4	10.0
Simuliidae	20.0	(3)	10.9	1.0	1.1	2.1	5.9
Chironomidae	56.7	43.6	31.9	78.4	13.3	50.5	45.7
Heledae	Absent	(3)	(3)	10.4	(3)	Absent	1.7
Total percent	82.9	97.9	85.0	94.5	85.9	75.0	86.9
Total number/1000 m³	610	9511	1047	10860	6312	2784	5187
All taxa							
Total number ± SE/1000 m³	736±97	9715±807	1232±368	11492±4155	7348±2932	3712±1036	5706±1565
Total biomass (mg dry wt) ± SE/1000 m³	43±15	251±46	86±29	629±244	488±171	152±50	274±925
Total taxa	30	23	28	47	41	35	34
Velocity (m/s)	0.322	0.138	0.247	0.131	0.137	0.170	0.191

(1) Monthly values for individual taxa represent percent of total drift.
(2) Taxa which comprised ≥2% of the total number in either 1973 or 1974. Numerous other taxa were dominant in individual months.
(3) Drifting, but at levels below 2% of total.

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TABLE 2.2-52

DIEL PERIODICITY OF AQUATIC DRIFT ON EAST BRANCH PERKIOMEN CREEK AND PERKIOMEN CREEK EXPRESSED AS A PERCENT OF THE 24-HOUR TOTAL, ALL DRIFT STUDIES COMBINED (1)

	1000	1200	1400	1600	1800	2000	2200	2400	0200	0400	0600	0800
Numbers												
East Branch	2.8	2.7	5.3	4.8	3.7	5.0	23.7	14.1	23.7	9.3	2.5	2.5
Perkiomen	3.6	3.0	3.9	4.7	4.4	6.5	19.1	15.4	17.3	14.3	5.0	2.6
Biomass												
East Branch	2.3	2.0	3.0	4.3	3.0	4.3	32.2	15.0	20.3	8.0	2.3	1.7
Perkiomen	1.2	1.1	2.8	3.1	4.1	7.2	21.2	23.1	17.1	14.7	3.3	1.3
Taxa												
East Branch	8.0	7.2	7.4	7.7	8.0	8.0	12.3	12.3	12.0	8.3	5.4	3.2
Perkiomen	5.0	5.4	6.8	8.4	8.0	9.9	10.9	12.2	10.8	10.6	7.0	5.0

(1) As an example, the highest numeric drift density (19.1%) on Perkiomen Creek generally occurs near 2200 hours.

TABLE 2.2-53

FISHES[1] COLLECTED IN PERKIOMEN CREEK BY ALL TYPES OF GEARS
DURING THE PERIOD JUNE 1970 THROUGH DECEMBER 1977

Common Name	Scientific Name	Relative Abundance
Freshwater eel family	Anguillidae	
American eel	Anguilla rostrata (Lesueur)	Rare
Trout family	Salmonidae	
Brook trout	Salvelinus fontinalis (Mitchell)	Rare
Pike family	Esocidae	
Redfin pickerel	Esox americanus americanus (Gmelin)	Uncommon
Muskellunge	Esox masquinongy (Mitchill)	Uncommon
Minnow family	Cyprinidae	
Goldfish	Carassius auratus (Linnaeus)	Common
Carp	Cyprinus carpio (Linnaeus)	Common
Carp x Goldfish hybrid		Uncommon
Cutlips minnow	Exoglossum maxillingua (Iesueur)	Common
Golden shiner	Notemigonus crysoleucas (Mitchill)	Uncommon
Comely shiner	Notropis amoenus (Abbott)	Abundant
Satinfin shiner	Notropis analostanus (Girard)	Abundant
Bridle shiner	Notropis bifrenatus (Cope)	Rare
Common shiner	Notropis cornutus (Mitchill)	Common
Spottail shiner	Notropis hudsonius (Clinton)	Abundant
Swallowtail shiner	Notropis procne (Cope)	Common
Spotfin shiner	Notropis spilopterus (Cope)	Abundant
Bluntnose minnow	Pimephales notatus (Rafinesque)	Common
Fathead minnow	Pimephales promelas (Rafinesque)	Rare
Blacknose dace	Rhinichthys atratulus (Hermann)	Common
Longnose dace	Rhinichthys cataractae (Valenciennes)	Common
Creek chub	Semotilus atromaculatus (Mitchill)	Uncommon
Fallfish	Semotilus corporalis (Mitchill)	Common
Sucker family	Catostomidae	
White sucker	Catostomus commersoni (Lacepede)	Abundant
Creek chubsucker	Erimyzon oblongus (Mitchill)	Uncommon

TABLE 2.2-53 (Cont'd)

Common Name	Scientific Name	Relative Abundance
Freshwater catfish family	Ictaluridae	
White catfish	Ictalurus catus (Linnaeus)	Rare
Yellow bullhead	Ictalurus natalis (Lesueur)	Common
Brown bullhead	Ictalurus nebulosus (Lesueur)	Uncommon
Channel catfish	Ictalurus punctatus (Rafinesque)	Rare
Margined madtom	Noturus insignis (Richardson)	Uncommon
Killifish family	Cyrinodontidae	
Banded killifish	Fundulus diaphanus (Lesueur)	Common
Mummichog	Fundulus heteroclitus (Linnaeus)	Rare[2]
Sunfish family	Centrarchidae	
Rock bass	Ambloplites rupestris ((Rafinesque))	Common
Redbreast sunfish	Lepomis auritus (Linnaeus)	Abundant
Green sunfish	Lepomis cyanellus (Rafinesque)	Common
Pumpkinseed	Lepomis gibbosus (Linnaeus)	Common
Bluegill	Lepomis macrochirus (Rafinesque)	Common
Sunfish hybrid	Lepomis hybrid	Uncommon
Smallmouth bass	Micropterus dolomieui (Lacepede)	Common
Largemouth bass	Micropterus salmoides (Lacepede)	Uncommon
White crappie	Pomoxis annularis (Rafinesque)	Rare
Black crappie	Pomoxis nigromaculatus (Lesueur)	Rare
Perch family	Percidae	
Tessellated darter	Etheostoma olmstedi Storer	Common
Shield darter	Percina peltata (Stauffer)	Uncommon

[1] Nomenclature from Ref 2.2-53
[2] Possible bait release.

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TABLE 2.2-54

MEAN DENSITY AND RELATIVE ABUNDANCE OF DRIFTING LARVAL FISH COLLECTED FROM PERKIOMEN CREEK AT P14390, MAY THROUGH AUGUST 1973, 1974, AND 1975.

Taxa	1973 No./m³	%	1974 No./m³	%	1975 No./m³	%
Minnows	0.08028	36	0.06707	12.4	0.09465	34.5
Carp	0.11258	50.5	0.43283	79.9	0.12685	46.3
White Sucker	0.01996	5.4	0.00775	1.4	0.01815	6.6
Yellow Bullhead	0.00185	0.8	0.00223	0.4	0.00108	0.4
Banded Killifish	-	-	0.00012	-	-	-
Lepomis Sunfish	0.00923	4.1	0.03007	5.6	0.02096	7.6
Tessellated Darter	0.00461	2.1	0.00047	0.1	0.00972	3.5
Shield Darter	0.00231	1	0.00117	0.2	0.00281	1
Total	0.22285		0.54171		0.27424	

TABLE 2.2-55

TOTAL CATCH AND RELATIVE ABUNDANCE OF LARVAL FISH
COLLECTED BY TRAP NET FROM PERKIOMEN CREEK SHORELINE
P14390, MAY THROUGH AUGUST 1975

Taxa	Total Catch	% Catch
Minnows	1270	83.0
Carp	18	1.2
White sucker	116	7.6
Lepomis sunfish	94	6.1
Tessellated darter	29	1.9
Shield darter	3	0.2
TOTAL	1530	

TABLE 2.2-56

DAILY MEAN DENSITY (No./m^3) OF DRIFTING LARVAL FISH
COLLECTED FROM PERKIOMEN CREEK AT P14390, MAY THROUGH AUGUST, 1974 AND 1975

	1974						
Taxa	08May	15May	20May	30May	05Jun	11Jun	27Jun
Minnows	0.003	0.001	0.557	0.032	0.039	0.060	0.029
Carp	0.003	-	7.304	0.659	0.011	0.127	-
White sucker	0.024	0.042	-	0.003	-	-	-
Yellow bullhead	-	-	-	-	-	-	0.003
Rock bass	-	-	-	0.006	0.006	0.007	-
Lepomis sunfish	-	-	0.002	0.002	0.022	0.300	0.025
Tessillated darter	0.002	0.002	0.002	-	-	-	-
Shield Darter	0.009	0.002	0.002	0.002	-	-	-

TABLE 2.2-56
(Cont'd)

	1974 (Cont'd)								
Taxa	02Jul	08Jul	16Jul	24Jul	29Jul	05Aug	13Aug	22Aug	27Aug
Minnows	0.027	0.142	0.059	0.089	0.037	0.094	0.042	0.037	0.020
Carp	-	0.003	0.006	0.006	0.003	0.057	-	-	-
White sucker	-	-	-	-	-	-	-	-	-
Yellow bullhead	-	0.038	0.006	-	-	-	-	-	-
Rock bass	-	0.005	-	-	-	-	-	-	-
Lepomis sunfish	-	0.025	0.019	0.039	0.118	0.035	-	-	-
Tessellated darter	-	-	-	-	-	-	-	-	-
Shield Darter	-	-	-	-	-	-	-	-	-

	1975						
Taxa	12May	27May	17Jun	01Jul	29Jul	12Aug	26Aug
Minnows	0.087	0.055	0.006	.0369	0.069	0.016	0.003
Carp	-	0.316	-	-	0.001	-	-
White sucker	0.155	0.011	-	-	-	-	-
Yellow bullhead	-	-	-	0.003	-	-	-
Rock bass	-	-	-	0.011	-	-	-
Lepomis sunfish	-	0.004	-	0.078	0.016	0.001	-
Tessellated darter	0.023	0.010	0.002	-	-	-	-
Shield Darter	0.019	0.001	-	-	-	-	-

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TABLE 2.2-57

HORIZONTAL VARIATION IN DENSITY OF LARVAL FISH
COLLECTED FROM PERKIOMEN CREEK AT P14390 IN 1975

	Net					
	1	2	3	4	5	6
Taxa	No./m³	No./m³	No./m³	No./m³	No./³	No./m³
Minnows	0.0584	0.0498	0.0481	0.0512	0.0098	0.0448
Carp	0.1494	0.1908	0.2549	0.2636	0.0366	0.0616
White Sucker	0.0363	0.0420	0.0408	0.0435	0.0850	0.1473
Yellow Bullhead	0.0017	0.0009	0.0019	0.0010	-	0.0026
Rock Bass	0.0042	0.0067	0.0068	0.0024	0.0066	0.0216
Lepomis Sunfish	0.0234	0.0138	0.0094	0.0097	0.0038	0.0396
Tessellated Dartfish	0.0113	0.0160	0.0134	0.0204	0.0082	0.0075
Shield Darter	0.0128	0.0092	0.0091	0.0109	0.0092	0.0068

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TABLE 2.2-58

MEAN DIRECT DENSITY OF LARVAL FISH IN THE EAST AND WEST CHANNELS OF PERKIOMEN CREEK AT P14390 IN 1975

Taxa	East Channel No./m³	West Channel No./m³
Minnows	0.0286	0.0521
Carp	0.0508	0.2103
White Sucker	0.1117	0.0404
Yellow Bullhead	0.0011	0.0014
Rock Bass	0.0161	0.0050
Lepomis Sunfish	0.0217	0.0146
Tessellated Darter	0.0080	0.0150
Shield Darter	0.0082	0.0106

TABLE 2.2-59

ANNUAL AND SPATIAL VARIATION IN MEAN CATCH-PER-UNIT-EFFORT (C/F, AND RELATIVE ABUNDANCE OF FISH COLLECTED BY SEINE FROM THE PERKIOMEN CREEK IN 1975 AND 1976)

Species	1975 P19775 C/F	%	1976 P19775 C/F	%	1975 P16500 C/F	%	1976 P16500 C/F	%	1975 P14455 C/F	%	1976 P14455 C/F	%	1975 P14320 C/F	%	1976 P14320 C/F
American eel	-	-	0.10	0.1	-	-	-	-	-	-	-	-	-	-	-
Cutlips minnow	-	-	1.23	0.8	.0.09	0.1	0.88	0.5	-	-	-	-	-	-	-
Golden shiner	-	-	0.18	0.1	0.08	0.1	-	-	-	-	1.60	0.3	-	-	0.13
Comely shiner	25.70	25.2	3.59	2.2	2.90	4.1	2.67	1.7	1.92	1.4	20.49	4.0	3.64	2.5	5.39
Satinfin shiner	1.06	1.0	2.96	1.8	7.44	10.5	18.68	11.6	0.64	0.5	1.89	0.4	3.76	2.6	7.95
Common shiner	1.97	1.9	4.00	2.4	0.61	0.9	3.13	1.9	1.62	1.2	0.60	0.1	0.86	0.6	0.61
Spottail shiner	2.27	2.2	26.68	16.3	0.48	0.7	44.94	27.8	3.39	2.5	80.60	15.7	2.09	1.5	27.81
Swallowtail shiner	9.48	9.3	4.06	2.5	1.68	2.4	4.53	2.8	1.82	1.4	6.74	1.3	54.24	37.7	1.30
Spotfin shiner	56.60	55.4	71.18	43.4	53.12	74.8	66.35	41.1	115.33	85.7	360.72	70.4	71.09	49.4	222.34
Bluntnose minnow	0.30	0.3	0.10	0.1	0.47	0.7	0.56	0.3	1.03	0.8	8.60	1.7	0.36	0.2	0.13
Blacknose dace	-	-	0.43	0.3	0.30	0.4	1.06	0.7	-	-	-	-	-	-	0.26
Longnose dace	0.89	0.9	5.23	3.2	0.10	0.1	0.65	0.4	-	-	-	-	-	-	-
Creek chub	-	-	0.39	0.2	-	-	0.30	0.2	-	-	-	-	-	-	-
Fallfish	1.79	1.8	0.26	0.2	0.20	0.3	0.48	0.3	-	-	-	-	0.14	0.1	-
White sucker	-	-	26.88	16.4	0.30	0.4	7.92	4.9	-	-	1.60	0.3	0.14	0.1	4.96
Yellow bullheaad	-	-	0.10	0.1	-	-	0.09	0.1	-	-	-	-	-	-	-
Brown bullhead	-	-	0.08	0.1	-	-	-	-	-	-	-	-	-	-	-
Margined madtom	-	-	-	-	-	-	0.08	-	-	-	-	-	-	-	-
Banded killfish	0.27	0.3	0.51	0.3	0.39	0.6	1.59	1.0	-	-	0.34	0.1	0.80	0.6	0.50
Rock bass	0.12	0.1	0.26	0.2	0.20	0.3	0.09	0.1	-	-	0.40	0.1	0.50	0.4	-
Redbreast sunfish	-	-	0.81	0.5	2.05	2.9	1.72	1.1	3.22	2.4	9.77	1.9	2.73	1.9	2.33
Green sunfish	0.09	0.1	-	-	-	-	0.20	0.1	0.81	0.6	4.80	0.9	-	-	0.26
Pumpkinseed	-	-	-	-	-	-	-	-	2.5	1.5	6.17	1.2	0.45	0.3	0.49
Bluegill	0.12	0.1	0.09	0.1	0.29	0.4	-	-	2.30	1.7	2.97	0.6	1.72	1.2	-
Lepomis hybrid	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Smallmouth bass	0.12	0.1	4.52	2.8	0.29	0.4	4.92	3.0	0.14	0.1	3.60	0.7	1.24	0.9	7.27
Largemouth bass	0.09	0.1	0.61	0.4	-	-	-	-	-	-	-	-	-	-	0.30
White crappie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tessellated darter	1.07	1.0	9.52	5.8	-	-	0.33	0.2	0.22	0.2	1.20	0.2	0.14	0.1	0.59
Shield darter	0.12	0.1	0.17	0.1	-	-	0.25	0.2	-	-	0.20	-	-	-	-

TABLE 2.2-59 (Cont'd)

Species	%	1975 P14130 C/F	%	1976 P14130 C/F	%	1975 P13580 C/F	%	1976 P13580 C/F	%	1975 Mean C/F	%	1976 Mean C/F	%	Years Mean C/F	%
American eel	-	-	-	-	-	-	-	-	-	-	-	0.02	-	0.01	-
Cutlips minnow	-	0.21	0.33	-	-	0.22	0.2	0.63	0.2	0.09	0.1	0.46	0.2	0.28	0.1
Golden shiner	-	-	-	0.34	0.1	0.40	0.3	0.39	0.1	0.08	0.1	0.42	0.2	0.25	0.1
Comely shiner	1.9	0.57	0.7	6.23	2.3	2.16	1.77	3.23	1.0	6.25	5.7	6.73	2.4	6.49	3.3
Satinfin shiner	2.8	11.22	13.4	13.98	5.2	9.58	7.6	7.56	2.4	5.73	5.2	8.94	3.2	7.33	3.8
Common shiner	0.2	5.03	6.0	2.63	1.0	8.05	6.4	2.71	0.9	3.08	2.8	2.31	0.8	2.69	1.4
Spottail shiner	9.8	4.11	4.9	24.98	9.3	5.17	4.1	24.50	7.8	2.92	2.7	37.60	13.4	20.26	10.4
Swallowtail shiner	0-.5	0.54	0.6	1.92	0.7	2.11	1.7	1.99	0.6	11.13	10.2	3.37	1.2	7.25	3.7
Spotfin shiner	78.7	59.30	70.6	197.47	73.7	91.62	73.0	212.41	67.6	73.93	67.7	185.76	66.3	129.84	66.7
Bluntnose minnow	-	-	-	0.47	0.2	1.29	1.0	9.31	3.0	0.57	0.5	3.11	1.1	1.84	0.9
Blacknose dace	0.1	-	-	4.66	1.7	0.53	0.4	1.99	0.6	0.14	0.1	1.42	0.5	0.78	0.4
Longnose dace	-	-	-	1.36	0.5	-	-	0.23	0.1	0.17	0.2	1.26	0.5	0.72	0.4
Creek chub	-	-	-	-	-	-	-	0.37	0.1	-	-	0.18	0.1	0.09	-
Fallfish	-	0.48	0.6	0.34	0.1	0.22	0.2	0.34	0.1	0.49	0.4	0.24	0.1	0.36	0.2
White sucker	1.8	0.11	0.1	10.68	4.0	-	-	21.80	6.9	0.09	0.1	12.47	4.4	6.28	3.2
Yellow bullheaad	-	-	-	-	-	-	-	2.23	0.7	-	-	0.41	0.1	0.21	0.1
Brown bullhead	-	-	-	-	-	-	-	-	-	-	-	0.01	-	0.01	-
Margined madtom	-	-	-	0.11	-	-	-	-	-	-	-	0.03	-	0.02	-
Banded killfish	0.2	0.97	1.2	1.08	0.4	1.21	1.0	2.89	0.9	0.61	0.6	1.17	0.4	0.89	0.5
Rock bass	-	-	-	-	-	0.09	0.1	0.08	-	0.15	0.1	0.13	-	0.14	0.1
Redbreast sunfish	-	-	0.81	0.5	2.05	2.9	1.72	1.1	3.22	1.58	1.4	3.14	1.1	2.36	1.2
Green sunfish	0.09	0.1	-	-	-	-	0.20	0.1	0.81	0.22	0.2	1.40	0.5	0.81	0.4
Pumpkinseed	-	-	-	-	-	-	-	-	2.5	0.43	0.4	1.77	0.6	1.10	0.6
Bluegill	-	-	-	-	-	-	-	0.92	0.3	0.70	0.6	0.63	0.2	0.66	0.3
Lepomis hybrid	-	0.10	0.1	-	-	0.11	0.1	-	-	0.04	-	-	-	0.02	-
Smallmouth bass	2.6	0.42	0.5	0.57	0.2	0.43	0.3	1.58	0.5	0.43	0.4	3.75	1.3	2.09	1.1
Largemouth bass	0.1	-	-	-	-	-	-	0.16	0.1	0.02	-	0.18	0.1	0.10	0.1
White crappie	-	-	-	-	-	-	-	0.08	-	-	-	0.01	-	0.01	-
Tessellated darter	0.2	0.33	0.4	0.73	0.3	0.39	0.3	6.25	2	0.36	0.3	3.13	1.1	1.75	0.9
Shield darter	-	0.09	0.1	-	-	-	-	0.42	0.1	0.04	-	0.17	0.1	0.10	0.1

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TABLE 2.2-60

ANNUAL VARIATION AND FREQUENCY OF OCCURRENCE (FO) IN AGE 0 SUNFISH SPECIES COLLECTED BY ELECTROFISHING IN PERKIOMEN CREEK (ALL SITES COMBINED) IN 1975 AND 1976

Species	1975 Total Catch	% Total	FO (%)	1976 Total Catch	% Total	FO (%)	Grand Total Catch	% Total
Rock bass	4	3.5	25.0	14	4.9	50.0	18	4.5
Redbreast sunfish	64	56.6	100.0	197	69.6	100.0	261	65.9
Green sunfish	41	36.3	83.3	36	12.7	58.3	77	19.4
Pumpkinseed	-	-	-	34	12.0	50.0	34	8.6
Smallmouth bass	4	3.5	25.0	2	0.7	8.3	6	1.5
Total	113			283			396	

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TABLE 2.2-61

MONTHLY VARIATION IN MEAN CATCH-PER-UNIT EFFORT OF FISH COLLECTED BY SEINE FROM PERKIOMEN CREEK (ALL SITES COMBINED) IN 1975 AND 1976)

Species	Feb 1975	1976	Mar 1975	1976	Apr 1975	1976	May 1975	1976	Jun 1975	1976	Jul 1975
American eel	-	-	-	-	-	-	-	-	-	-	-
Cutlips minnow	-	-	-	-	-	-	0.20	-	0.41	1.04	0.16
Golden shiner	0.21	-	0.15	-	0.20	0.14	-	2.57	0.20	-	0.17
Comely shiner	38.44	1.07	0.35	1.67	17.03	2.21	7.05	4.39	1.51	0.14	2.81
Satinfin shiner	1.29	0.81	3.64	0.47	2.39	11.34	2.82	11.42	2.05	2.77	4.38
Common shiner	1.41	-	0.17	-	8.26	-	2.92	-	5.75	7.31	9.50
Spottail shiner	0.75	0.24	3.08	-	4.45	-	5.58	0.21	7.61	225.33	5.78
Swallowtail shiner	2.19	0.36	0.28	0.13	2.02	0.42	87.54	3.46	0.57	3.64	-
Spotfin shiner	52.22	2.65	18.24	2.20	99.76	14.20	131.20	71.04	52.80	64.86	17.08
Bluntnose minnow	0.63	-	0.99	-	1.55	0.14	0.87	0.28	-	0.56	-
Blacknose dace	-	-	-	-	0.56	3.10	-	1.98	0.81	3.09	0.17
Longnose dace	-	-	-	-	0.33	0.15	1.07	0.30	0.22	8.45	-
Creek chub	-	-	-	-	-	-	-	-	-	0.15	-
Fallfish	0.26	0.26	0.33	-	1.54	-	1.09	-	1.04	1.02	0.65
White sucker	-	-	-	-	-	-	0.56	3.81	0.45	40.69	-
Yellow bullhead	-	-	-	-	-	-	-	-	-	-	-
Margined madtom	-	-	-	-	-	-	-	-	-	-	-
Banded killfish	0.31	0.45	1.64	0.41	2.92	0.21	0.61	0.60	-	1.20	-
Rock bass	-	-	-	-	-	-	0.41	0.14	0.24	0.15	0.19
Redbreast sunfish	-	-	-	-	0.48	1.31	1.63	0.56	3.37	1.25	0.34
Green sunfish	0.25	-	-	-	-	-	0.56	-	0.20	0.28	0.24
Pumpkinseed	-	-	-	0.28	0.28	-	0.20	0.14	2.29	0.47	0.37
Bluegill	-	-	-	-	-	0.28	-	-	2.02	-	1.38
Lepomis hybrid	-	-	-	-	-	-	0.20	-	-	-	-
Smallmouth bass	-	-	0.24	-	-	-	0.82	-	-	30.47	0.37
Largemouth bass	0.25	-	-	-	-	-	-	0.14	-	-	-
White crappie	-	-	-	-	-	-	-	-	-	-	-
Tessellated darter	0.23	-	0.92	0.33	0.57	0.59	0.20	-	0.79	14.91	-
Shield darter	-	-	-	-	-	0.13	-	0.33	0.22	0.86	-

Species	1976	Aug 1975	1976	Sep 1975	1976	Oct 1975	1976	Nov 1975	1976	Dec 1975	1976
American eel	0.19	-	-	-	-	-	-	-	-	-	-
Cutlips minnow	2.11	0.19	1.04	-	0.67	-	0.17	-	-	-	-
Golden shiner	0.67	-	0.42	-	0.15	-	0.21	-	0.42	-	-
Comely shiner	4.24	2.00	9.10	4.49	16.54	2.28	18.69	0.89	12.70	2.68	2.12
Satinfin shiner	4.96	6.26	11.59	9.85	10.46	5.93	15.05	8.60	16.37	14.31	11.83
Common shiner	8.40	3.88	3.42	0.83	2.59	0.61	0.50	-	0.85	-	1.91
Spottail shiner	47.31	1.33	24.69	1.00	49.40	1.52	30.17	0.19	14.24	0.17	15.76
Swallowtail shiner	0.46	2.79	3.32	3.44	9.93	0.97	10.34	1.92	3.59	17.78	0.88
Spotfin shiner	59.24	66.73	187.98	181.62	426.96	60.60	631.47	59.56	502.87	66.17	48.92
Bluntnose minnow	2.00	0.28	0.50	0.64	7.71	-	7.92	0.30	14.45	1.06	0.17
Blacknose dace	1.43	-	2.76	-	0.87	-	0.42	-	0.76	-	-
Longnose dace	1.46	-	0.19	-	0.15	-	-	-	-	-	0.14
Creek chub	1.32	0.37	-	-	0.19	-	0.51	-	-	-	-
Fallfish	0.63	-	2.53	-	0.30	-	0.67	-	0.14	-	-
White sucker	6.88	-	0.72	-	0.19	-	-	-	-	-	-
Yellow bullhead	3.54	-	-	-	0.21	-	0.14	-	-	-	-
Margined madtom	-	0.32	1.76	0.49	1.62	0.21	1.49	-	2.24	0.17	1.19
Banded killfish	1.51	-	0.50	0.58	-	0.19	0.33	-	0.33	-	-
Rock bass	-	2.11	13.46	6.72	6.57	0.42	2.64	1.76	-	-	-
Redbreast sunfish	8.30	0.16	9.54	0.50	1.16	0.56	1.51	-	0.81	-	-
Green sunfish	1.88	0.14	1.41	0.33	4.76	-	8.30	0.67	2.83	0.28	-
Pumpkinseed	1.04	0.52	1.33	1.42	-	0.83	2.89	1.00	-	0.28	-
Bluegill	2.29	0.19	-	-	-	-	-	-	-	-	-
Lepomis hybrid	-	1.58	2.96	0.38	0.97	0.21	0.15	0.39	-	-	-
Smallmouth bass	6.02	-	-	-	-	-	0.15	-	-	-	-
Largemouth bass	-	-	-	-	-	-	0.15	-	-	-	-
White crappie	-	0.35	1.85	-	2.80	-	2.03	0.71	1.57	0.19	1.12
Tessellated darter	8.76	-	-	-	0.19	-	-	-	-	0.17	-
Shield darter	0.35										

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TABLE 2.2-62

TOTAL CATCH AND RELATIVE ABUNDANCE OF FISHES COLLECTED BY ELECTROFISHING
FROM PERKIOMEN CREEK IN 1974, 1975, AND 1976

Species	1974 P14390 No.	%	P14160 No.	%	P14020 No.	%	1975 P14160 No.	%	1976 P20000 No.	%	P14390 No.	%	P14160 No.	%	P14020 No.	%	Total No.	Total %
American eel	7	0.3	2	0.3	1	0.1	4	0.4	7	0.6	9	0.4	5	0.7	2	0.3	37	0.4
Muskellunge	-	(1)	-	(1)	1	0.1	-	(1)	2	0.2	-	(1)	-	(1)	-	(1)	3	(1)
Goldfish	13	0.6	-	(1)	-	(1)	-	(1)	4	0.4	17	0.7	-	(1)	-	(1)	34	0.4
Carp	137	6.2	18	2.4	42	6.1	11	1.1	105	9.2	104	4.4	13	1.7	34	5.4	464	4.9
Golden shiner	-	(1)	-	(1)	-	(1)	3	0.3	-	(1)	-	(1)	-	(1)	-	(1)	3	(1)
Fallfish	1	(1)	-	(1)	-	(1)	7	0.7	-	(1)	-	(1)	-	(1)	-	(1)	8	0.1
Minnow hybrid	6	0.3	-	(1)	4	0.6	2	0.2	3	0.3	-	(1)	-	(1)	-	(1)	15	0.2
White sucker	241	10.8	50	6.6	59	8.5	101	10	272	23.9	215	9.1	123	16.4	99	15.8	1160	12.1
White catfish	-	(1)	-	(1)	-	(1)	-	(1)	1	0.1	-	(1)	-	(1)	-	(1)	1	(1)
Yellow bullhead	68	3.1	17	2.2	9	1.3	30	3	33	2.9	43	1.8	11	1.5	4	0.6	215	2.2
Brown bullhead	34	1.5	2	0.3	5	0.7	1	0.1	6	0.5	19	0.8	1	0.1	1	0.2	69	0.7
Channel catfish	-	(1)	-	(1)	-	(1)	-	(1)	1	0.1	1	(1)	-	(1)	-	(1)	2	(1)
Margined madtom	5	0.2	2	0.3	-	(1)	1	0.1	1	0.1	6	0.3	-	(1)	-	(1)	15	0.2
Rock bass	88	4.0	36	4.8	26	3.8	65	6.5	67	5.9	99	4.2	33	4.4	29	4.6	443	4.6
Redbreast sunfish	993	44.7	507	67.1	333	48.1	510	50.7	408	35.9	1172	49.6	458	60.9	275	43.9	4656	48.7
Green sunfish	127	5.7	19	2.5	48	6.9	30	3	36	3.2	116	4.9	22	2.9	27	4.3	425	4.4
Pumpkinseed	130	5.9	13	1.7	37	5.3	59	5.9	43	3.8	164	6.9	12	1.6	47	7.5	505	5.3
Bluegill	89	4.0	8	1.1	12	1.7	91	9	35	3.1	49	2.1	3	0.4	26	4.2	313	3.3
Lepomis hybrid	24	1.1	2	0.3	3	0.4	3	0.3	7	0.6	23	1	9	1.2	3	0.5	74	0.8
Smallmouth bass	254	11.4	79	10.4	108	15.6	87	8.6	90	7.9	324	13.7	62	8.2	78	12.5	1082	11.3
Largemouth bass	5	0.2	1	0.1	5	0.7	1	0.1	8	0.7	2	0.1	-	(1)	1	0.2	23	0.2
White crappie	-	(1)	-	(1)	-	(1)	-	(1)	5	0.4	-	(1)	-	(1)	-	(1)	4	(1)
Black crappie	-	(1)	-	(1)	-	(1)	-	(1)	5	0.4	-	(1)	-	(1)	-	(1)	5	0.1
Total	2222		756		693		1006		1138		2363		752		626		9556	

(1) Less than 0.1%

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TABLE 2.2-63

CRITERIA FOR DETERMINATION OF IMPORTANT FISHES OF PERKIOMEN CREEK

	IMPORTANCE				LINK TO PLANT	
					DIRECT	
Common Name	Commercial	Recreational	Ecological	Abundant	Susceptible to Impingement	Susceptible to Entrainment
American shad[1]	X	X			X	X
Muskellunge[2]		X				
Carp[2,3,4]		X	X	X	X	X
Comely shiner[5]			X	X	X	X
Spottail shiner[3,4,5]			X	X	X	X
Spotfin shiner[3,4,5]			X	X	X	X
White sucker[2,3,4,5,6]		X	X	X	X	X
Redbreast sunfish[2,3,4,5,6,7]	X	X	X	X	X	X
Smallmouth bass[2,5,6,7]	X	X	X	X		
Shield darter[3,4,5]			X		X	X

[1] Importance dependent on results of Pennsylvania Fish Commission program to provide fishways at dams downriver of IGS.
[2] Species sampled by large fish population estimate program.
[3] Species sampled by larval fish drift program.
[4] Species sampled by larval fish trap net program.
[5] Species sampled by seine program.
[6] Species sampled by age and growth program.
[7] Species sampled by small fish population estimate program.

TABLE 2.2-64

ANNUAL AND SPATIAL VARIATION IN REDBREAST SUNFISH POPULATION ESTIMATES AT FOUR SITES ON PERKIOMEN CREEK IN 1975 AND 1976

Site	1975[1] No/20 m	1976 No/20 m
P14830	-	53
P14690	-	75
P14225	-	24
P14210	-	49
Streamwide estimate	81	185

[1]Too few specimens were captured in 1975 to provide reliable estimates for the sites.

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TABLE 2.2-65

POPULATION ESTIMATES (No PER HECTARE) AND ESTIMATED BIOMASS (Wt PER HECTARE) OF LARGE FISHES COLLECTED BY ELECTROFISHING FROM FOUR SITES ON PERKIOMEN CREEK IN 1974, 1975, AND 1976

Species	Year	P20000		P14390		P14160		P14020	
		No/ha	Wt/ha (kg)	No/ha	Wt/ha (kg)	No/ha	Wt/ha (kg)	No/ha	Wt/ha (kg)
Redbreast sunfish	1974	-	-	437	20.9	1622	55.3	897	-
	1975	-	-	-	-	1479	46.5	-	-
	1976	415	14.5	338	18.7	1397	54.3	511	25.8
Carp	1974	-	-	110	208.0	41	90.1	-	-
	1975	-	-	-	-	-	-	-	-
	1976	131	160.0	67	95.0	-	-	-	-
White sucker	1974	-	-	154	80.4	174	149.0	137	-
	1975	-	-	-	-	451	110.0	-	-
	1976	314	175.0	139	58.1	334	90.8	258	67.6
Green sunfish	1974	-	-	87	2.12	-	-	-	-
	1975	-	-	-	-	-	-	-	-
	1976	18(1)	0.743	36	1.21	-	-	-	-
Smallmouth bass	1974	-	-	53	5.69	-	-	-	-
	1975	-	-	-	-	210	7.72	-	-
	1976	29(2)	2.717	84	7.29	163	12.4	-	-

(1) Represents fish considered to be >age 1.
(2) Represents fish considered to be age 2.

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TABLE 2.2-66

POPULATION ESTIMATES BY AGE-GROUP FOR REDBREAST SUNFISH COLLECTED FROM FOUR SITES ON PERKIOMEN CREEK IN 1974, 1975, AND 1976

Site	Age-Group	YEAR 1974	1975	1976
P20000	I	-	-	350
	II	-	-	156
	>II	-	-	169
	Total	-	-	675
P14390	I	734	-	247
	II	519	-	580
	>II	578	-	591
	Total	1831	-	1418
P14160	I	438	360	313
	II	406	403	397
	>II	177	137	167
	Total	1021	900	877
P14020	I	214	-	85
	II	332	-	174
	>II	165	-	143
	Total	711	-	402

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TABLE 2.2-67

LENGTH-WEIGHT RELATIONSHIPS[1] OF IMPORTANT SPECIES COLLECTED BY SEINE FROM PERKIOMEN CREEK IN 1975 AND 1976

Species	Site/Year	a	b
Comely shiner	P19775	-12.57	3.23
	P16500	-11.83	3.05
	P14455	-11.52	2.96
	P14320	-11.19	2.92
	P14130	-10.84	2.78
	P13580	-10.95	2.82
	1975	-12.00	3.09
	1976	-11.05	2.85
Spottail shiner	P19775	-11.63	3.04
	P16500	-11.75	3.09
	P14455	-11.82	3.08
	P14320	-12.43	3.25
	P14130	- 9.94	2.63
	P13580	-11.58	3.03
	1975	-12.82	3.33
	1976	-11.09	2.91
Spotfin shiner	P19775	-12.03	3.12
	P16500	-11.93	3.11
	P14455	-12.18	3.17
	P14320	-12.43	3.24
	P14130	-12.49	3.26
	P13580	-12.10	3.16
	1975	-12.39	3.22
	1976	-12.08	3.16

[1] $\ln W = a + b \ln L$.

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TABLE 2.2-68

MEAN CALCULATED LENGTHS AT ANNULUS FOR REDBREAST SUNFISH, WHITE SUCKER, AND SMALLMOUTH BASS COLLECTED FROM PERKIOMEN CREEK IN 1973 AND 1976

Species	Year	Site	No. of Fish	Weighted Mean Length (mm FL) at Annulus				
				I	II	III	IV	V
Redbreast sunfish	1973	Streamwide	208	41	90	127	150	166
Redbreast sunfish	1976	P20000	64	35	76	117	147	-
		P14390	63	43	88	130	156	-
		P14160	62	37	85	122	-	-
		P14020	55	38	86	125	145	-
	Population Mean			38	84	124	149	-
White sucker	1976	P20000	43	113	213	291	-	-
		P14390	31	111	213	293	-	-
		P14160	43	107	206	259	-	-
		P14020	34	98	178	263	-	-
	Population Mean			107	203	277	-	-
Smallmouth bass	1973	Streamwide	76	83	159	213	-	-

TABLE 2.2-69

LENGTH-WEIGHT RELATIONSHIPS[1]
FOR WHITE SUCKER COLLECTED BY ELECTROFISHING AT FOUR
SITES ON PERKIOMEN CREEK IN 1976

Site	a	b
P20000	-10.11	2.81
P14390	-10.72	2.91
P14160	-11.25	3.01
P14020	-11.71	3.09

[1] $\ln W = a + b \ln L$.

TABLE 2.2-70

NUMBER OF SAMPLES BY YEAR, PROGRAM, AND SITE COLLECTED FROM EAST BRANCH PERKIOMEN CREEK, 1972 THROUGH 1977 (1)

Program/Sites	1972	1973	1974	1975	1976	1977
Water Quality						
A11263	-	-	14	24	24	24
E32300	-	-	14	24	24	24
E26700	-	-	14	24	24	24
E22880	-	-	14	24	24	24
E2800	-	-	14	24	24	24
Periphyton						
E32115	-	-	29	-	-	-
E22867	-	-	26	-	-	-
E8350	-	14	-	-	-	-
E2800	-	14	26	-	-	-
Benthic Macroinvertebrates						
E36725	9	12	9	-	10	-
E32200	12	12	9	-	10	-
E26700	12	12	9	-	11	-
E23000	9	12	9	-	11	-
E12500	12	12	9	-	11	-
E5600	12	12	9	-	11	-
Macroinvertebrate Drift						
E2230	-	84	69	-	-	-
Larval Fish Drift						
E2650	-	136	56	-	-	-
Seine						
E36690	-	-	-	10	10	-
E32170	-	-	-	11	10	-
E29810	-	-	-	11	10	-
E26630	-	-	-	11	10	-
E22980	-	-	-	11	10	-
E12440	-	-	-	11	10	-
E5475	-	-	-	11	10	-
E1890	-	-	-	11	10	-
Large Fish Population Estimates						
E36020	-	2	-	2	-	-
E30540	-	2	-	2	-	-
E22240	-	2	-	2	-	-
E15500	-	-	2	2	-	-
E12040	-	2	-	2	-	-
E5650	-	-	2	2	-	-
E1550	-	2	-	2	-	-

TABLE 2.2-70 (Cont'd)

Program/Sites	1972	1973	1974	1975	1976	1977
Age and Growth						
F10235(2)						
Redfin pickerel	-	-	2	-	-	-
E36700						
Redbreast sunfish	-	1	-	-	-	-
E36020						
Redfin pickerel	-	24	-	-	-	-
White sucker	-	33	-	-	-	-
Redbreast sunfish	-	46	-	29	-	-
Green sunfish	-	50	-	36	-	-
E34350						
Redbreast sunfish	-	36	-	-	-	-
Green sunfish	-	46	-	-	-	-
E34250						
Redbreast sunfish	-	8	-	-	-	-
E32300						
Redbreast sunfish	-	33	-	-	-	-
Green sunfish	-	31	-	-	-	-
E32200						
Redbreast sunfish	-	11	-	-	-	-
Green sunfish	-	2	-	-	-	-
E31290						
Redfin pickerel	-	1	-	-	-	-
E30940						
Redbreast sunfish	-	39	-	-	-	-
Green sunfish	-	22	-	-	-	-
E30540						
Redfin pickerel	-	11	-	-	-	-
White sucker	-	40	-	-	-	-
Redbreast sunfish	-	56	-	56	-	-
Green sunfish	-	35	-	39	-	-
E26700						
Green sunfish	-	2	-	-	-	-
E22240						
Redfin pickerel	-	1	-	-	-	-
White sucker	-	28	-	-	-	-
Redbreast sunfish	-	14	-	24	-	-
Green sunfish	-	67	-	50	-	-
E18400						
Redbreast sunfish	-	5	-	-	-	-
Green sunfish	-	16	-	-	-	-
E18340						
Redbreast sunfish	-	2	-	-	-	-
Green sunfish	-	33	-	-	-	-
E12040						
White sucker	-	20	-	-	-	-
Redbreast sunfish	-	35	-	46	-	-
Green sunfish	-	60	-	36	-	-

TABLE 2.2-70 (Cont'd)

Program/Sites	1972	1973	1974	1975	1976	1977
Age and Growth (cont.)						
E10700						
Redbreast sunfish	-	19	-	-	-	-
Green sunfish	-	55	-	-	-	-
E8500						
Redbreast sunfish	-	34	-	-	-	-
Green sunfish	-	48	-	-	-	-
E7100						
White sucker	-	25	-	-	-	-
Redbreast sunfish	-	17	-	-	-	-
Green sunfish	-	34	-	-	-	-
E2100						
Redbreast sunfish	-	37	-	-	-	-
Green sunfish	-	25	-	-	-	-
E1550						
White sucker	-	26	-	-	-	-
Redbreast sunfish	-	56	-	55	-	-
Green sunfish	-	32	-	43	-	-

(1) See footnotes in Table 2.2-7 for definition of what constitutes one sample.
(2) Culvert Creek, a tributary of East Branch Perkiomen Creek.
Collection site approximately 235 m from East Branch confluence.

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TABLE 2.2-71

NUMBER OF SAMPLES BY MONTH, PROGRAM, AND YEAR COLLECTED FROM EAST BRANCH PERKIOMEN CREEK, 1972 THROUGH 1977 (1)(2)

Program/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Quality												
1974	-	-	-	-	-	10	10	10	10	10	10	10
1975	10	10	10	10	10	10	10	10	10	10	10	10
1976	10	10	10	10	10	10	10	10	10	10	10	10
1977	10	10	10	10	10	10	10	10	10	10	10	10
Periphyton												
1973	-	-	-	-	-	-	-	6	6	8	4	4
1974	-	12	6	5	15	3	-	8	9	9	9	5
Benthic Macroinvertebrates												
1972	5	5	5	6	6	6	6	5	5	5	6	6
1973	6	6	6	6	6	6	6	6	6	6	6	6
1974	-	-	-	6	6	6	6	6	6	6	6	6
1976	-	6	6	6	6	6	6	6	4	6	6	6
Macroinvertebrate Drift												
1973	-	-	-	12	12	12	12	12	12	-	-	-
1974	-	-	-	12	12	12	9	12	-	-	-	-
Larval Fish Drift												
1973	-	-	-	24	24	28	24	24	12	-	-	-
1974	-	-	-	6	14	12	14	10	-	-	-	-
Seine												
1975	-	7	8	8	8	8	8	8	8	8	8	8
1976	-	8	8	8	8	8	8	8	8	8	8	-

(1) See footnotes in Table 2.2-7 for definition of what constitutes one sample.
(2) The samples for Small Fish Population Estimate, Large Fish Population Estimate, and Age and Growth programs are not included because they are only collected on an annual basis.

TABLE 2.2-72

PERIPHYTON STANDING CROP BIOMASS (MG/DM²) ASH-FREE DRY WEIGHT AND PRODUCTIVITY RATES (MG/DM²/DAY) ASH-FREE DRY WEIGHT BY STATION IN EAST BRANCH PERKIOMEN CREEK, 1973 AND 1974

		E32115		E22867(4)		E8350(5)		E2800(6)	
Date	Days(1)	SC(2)	PR(3)	SC	PR	SC	PR	SC	PR
17 Aug 1973	10	17.9	-(7)			14.0	-		
24 Aug	17	39.7	3.11			19.3	0.76		
31 Aug	24	48.4	1.24			42.0	3.24		
7 Sep	7	14.3	-			10.8	-		
14 Sep	14	18.4	0.59			21.4	1.51		
21 Sep	21	11.8	-0.94			23.9	0.36		
5 Oct	7	11.8	-			4.9	-		
12 Oct	14	42.0	4.31			10.5	0.80		
19 Oct	21	48.1	0.87			17.9	1.06		
26 Oct	7	14.4	-			3.4	-		
2 Nov	14	14.5	0.01			6.3	0.41		
9 Nov	21	17.8	0.47			8.4	0.30		
12 Dec	12	3.3	-			3.0	-		
19 Dec	19	3.3	0.00			2.6	-0.06		
1 Feb 1974	7	4.0	0.57	2.0	0.29			4.3	0.61
7 Feb	14	6.8	0.20	3.4	0.10			5.2	0.06
14 Feb	21	13.8	0.33	3.9	0.02			7.4	0.10
21 Feb	28	15.0	0.04	3.3	-0.20			8.6	0.04
14 Mar	7	3.3	0.47	4.0	0.57			5.4	0.77
21 Mar	14	4.0	0.05	4.1	0.01			7.5	0.15
18 Apr	7	4.1	0.58	3.7	0.53			5.3	0.76
24 Apr	14	20.8	1.19	ns(8)	ns			81.5	5.44
2 May	7	25.9	3.70	42.6	6/09			14.5	2.07
9 May	14	32.7	0.48	40.2	-0.17			49.8	2.52
16 May	21	19.2	-0.64	27.5	-0.60			36.6	-0.63
23 May	7	7.4	1.05	15.7	2.24			18.0	2.57
31 May	14	19.7	0.60	28.4	0.95			30.5	0.89
6 Jun	21	35.2	0.74	62.0	1.60			45.3	0.70
8 Aug	7	59.1	8.44	43.4	6.20			ns	ns
15 Aug	14	19.7	-2.81	77.3	2.42			49.5	3.54
23 Aug	22	106.3	4.22	55.5	-0.99			22.8	-1.27
12 Sep	7	13.4	1.91	13.0	1.86			12.5	1.78
20 Sep	15	18.5	0.34	18.6	0.37			44.4	2.13
26 Sep	21	27.9	0.45	27.2	0.41			37.9	-0.31
10 Oct	7	5.1	0.73	ns	ns			4.5	0.64
18 Oct	(8)(9)15	9.7	0.31	3.3	0.41			7.7	0.23
24 Oct	(14) 21	14.2	0.21	17.7	1.03			4.4	-0.16
31 Oct	(21)	ns	ns	23.3	0.27			ns	ns
14 Nov	7	3.3	0.47	4.8	0.69			1.9	0.27
21 Nov	14	8.0	0.34	9.1	0.31			3.8	0.14
28 Nov	21	15.1	0.36	19.3	0.51			5.4	0.08
12 Dec	7	0.60	0.09	0.20	0.03			0.20	0.03
19 Dec	14	0.80	0.01	ns	ns			ns	ns
27 Dec	21	2.50	0.08	ns	ns			ns	ns

TABLE 2.2-72 (Cont'd)

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(1) This represents the actual number of days that the artificial plates are exposed to periphyton colonization.
(2) Standing crop.
(3) Productivity rate.
(4) Station E22867 was not sampled in 1973.
(5) Station E8350 was sampled only in 1973.
(6) Station E2800 was not sampled in 1973.
(7) No values were calculated for periphyton productivity rates for any station in 1973 due to low growth rates during the first 7 days of colonization.
(8) ns indicates that no samples were collected on that date.
(9) The numbers in parenthesis indicate the number of days of exposure for the artificial plates at station E22867 only.

TABLE 2.2-73

FISHES COLLECTED IN THE EAST BRANCH PERKIOMEN CREEK BY TYPES OF ALL GEARS DURING THE PERIOD JUNE 1970 THROUGH DECEMBER 1976 (1)

Common Name	Scientific Name	Relative Abundance
Freshwater eel family	Anguillidae	
American eel	Anguilla rostrata (Lesueur)	Uncommon
Trout family	Salmonidae	
Brook trout	Salvelinus fontinalis (Mitchell)	Occur only when stocked
Pike family	Esocidae	
Redfin pickerel	Esox americanus americanus (Gmelin)	Common
Muskellunge	Esox masquinongy (Mitchill)	Rare
Chain pickerel	Esox niger (Lesueur)	Rare
Minnow family	Cyprinidae	
Goldfish	Carassius auratus (Linnaeus)	Common
Carp	Cyprinus carpio (Linnaeus)	Common
Carp x Goldfish hybrid		Rare
Cutlips minnow	Exoglossum maxillingua (Lesueur)	Abundant
Golden shiner	Notemigonus crysoleucas (Mitchill)	Abundant
Comely shiner	Notropis amoenus (Abbott)	Abundant
Satinfin shiner	Notropis analostanus (Girard)	Abundant
Bridle shiner	Notropis bifrenatus (Cope)	Uncommon
Common shiner	Notropis cornutus (Mitchill)	Abundant
Spottail shiner	Notropis hudsonius (Clinton)	Common
Swallowtail shiner	Notropis procne (Cope)	Abundant
Spotfin shiner	Notropis spilopterus (Cope)	Abundant
Bluntnose minnow	Pimephales notatus (Rafinesque)	Abundant
Fathead minnow	Pimephales promelas Rafinesque	Rare
Blacknose dace	Rhinichthys atratulus (Hermann)	Abundant
Longnose dace	Rhinichthys cataractae (Valenciennes)	Abundant
Creek chub	Semotilus atromaculatus (Mitchill)	Uncommon
Fallfish	Semotilus corporalis (Mitchill)	Uncommon
Minnow hybrid		Rare

TABLE 2.2-73 (Cont'd)

Common Name	Scientific Name	Relative Abundance
Sucker family	Catostomidae	
White sucker	Catostomus commersoni (Lacepede)	Abundant
Creek chubsucker	Erimyzon oblongus (Mitchill)	Common
Freshwater catfish family	Ictaluridae	
White catfish	Ictalurus catus (Linnaeus)	Rare
Yellow bullhead	Ictalurus natalis (Lesueur)	Abundant
Brown bullhead	Ictalurus nebulosus (Lesueur)	Common
Marqined madtom	Noturus insignis (Richardson)	Common
Killifish family	Cyrinodontidae	
Banded killifish	Fundulus diaphanus (Lesueur)	Abundant
Sunfish family	Centrarchidae	
Rock bass	Ambloplites rupestris (Rafinesque)	Common
Redbreast sunfish	Lepomis auritus (Linnaeus)	Abundant
Green sunfish	Lepomis cyanellus Rafinesque	Abundant
Pumpkinseed	Lepomis gibbosus (Linnaeus)	Abundant
Blueqill	Lepomis macrochirus Rafinesque	Common
Sunfish hybrid	Lepomis hybrid	Abundant
Smallmouth bass	Micropterus dolomieui Lacepede	Common
Larqemouth bass	Micropterus salmoides (Lacepede)	Common
White crappie	Pomoxis annularis Rafinesque	Rare
Perch family	Percidae	
Tessellated darter	Etheostoma olmstedi Storer	Abundant
Yellow perch	Perca flavescens (Mitchill)	Rare
Shield darter	Percina peltata (Stauffer)	Uncommon

(1) Nomenclaturee from Ref 2.2-53.

TABLE 2.2-74

MEAN DENSITY AND RELATIVE ABUNDANCE OF DRIFTING LARVAL FISH COLLECTED FROM EAST BRANCH PERKIOMEN CREEK AT E2650, MAY-AUGUST IN 1973 and 1974

Taxa	1973 No./m³	%	1974 No./m²	%
Minnows	0.04735	23.0	0.12565	31.6
Carp-Goldfish(1)	0.00140	0.7	0.00952	2.4
Fallfish	0.00023	0.1	0.00024	0.1
White sucker	0.12339	60.0	0.10324	25.9
Yellow bullhead	0.01843	9.0	0.00904	2.3
Banded killifish	-	-	0.00048	0.1
Rock bass	-	-	0.00253	0.6
Lepomis sunfish	0.01283	6.2	0.14686	36.9
Smallmouth bass	-	-	0.00024	0.1
Tessellated darter	0.00210	1.0	0.00012	-
Total	0.20573		0.39792	

(1) All fish in the carp-goldfish category were identified as carp in 1974; most were probably carp in 1973.

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TABLE 2.2-75

MEAN DAILY DRIFT DENSITY (No./m^3) FOR SELECTED LARVAL FISH COLLECTED FROM EAST BRANCH PERKIOMEN CREEK AT E2650, 1973 AND 1974

1973 Taxa	17 Apr	01 May	15 May	04 Jun	26 Jun	09 Jul	23 Jul	06 Aug	23 Aug	04 Sep
Minnows	-	0.008	0.017	0.082	0.025	0.031	0.120	0.287	0.024	-
White Sucker	-	0.353	0.289	0.030	-	-	-	-	-	-
Yellow Bullhead	-	-	-	-	0.075	0.034	0.029	-	-	-
Lepomis sunfish	-	-	-	-	0.001	-	0.220	0.004	-	-
Tessellated darter	-	0.010	-	-	-	-	-	-	-	-

1974 Taxa	02 May	08 May	15 May	20 May	30 May	05 Jun	11 Jun	19 Jun	27 Jun	08 Jul	16 Jul	24 Jul	29 Jul	06 Aug	13 Aug	22 Aug	27 Aug
Minnows	-	0.002	0.042	0.449	0.184	0.052	0.135	0.159	5.372	0.039	0.015	0.111	0.120	0.094	0.220	0.052	0.081
Carp	0.006	0.009	-	0.420	0.001	-	-	-	-	-	-	-	0.002	0.011	-	-	0.007
Common shiner	-	-	-	-	-	-	-	0.007	-	-	0.010	-	0.012	-	-	-	-
Spottail shiner	-	-	-	-	0.001	-	0.028	-	-	-	-	-	-	-	-	-	-
White sucker	0.230	1.200	0.106	0.107	0.022	0.021	-	-	-	-	-	-	-	-	-	-	-
Yellow bullhead	-	-	-	-	-	-	-	0.114	0.206	0.018	0.015	-	-	-	-	-	-
Rock bass	-	-	-	-	0.003	-	-	-	-	-	-	0.072	0.009	-	-	-	-
Lepomis sunfish	-	-	-	-	-	0.388	2.169	0.002	0.037	0.092	-	0.420	0.095	0.067	0.001	0.003	-
Tessellated darter	-	-	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-

LGS EROL
TABLE 2.2-76

MEAN CATCH-PER-UNIT-EFFORT (C/F) AND RELATIVE ABUNDANCE OF FISH SPECIES
COLLECTED BY SEINE FROM EAST BRANCH PERKIOMEN CREEK IN 1975 AND 1976

Species	1975 E36690 C/F	%	1976 E36690 C/F	%	1975 E32170 C/F	%	1976 E32170 C/F	%	1975 E29810 C/F	%	1976 E29810 C/F	%	1975 E26630 C/F	%	1976 E26630 C/F	%	1975 E22980 C/F	%	1976 E22980 C/F	%
Redfin pickerel	0.74	1.6	0.47	1.4	-	-	-	-	-	-	0.19	-	0.17	0.1	-	-	-	-	-	-
Goldfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.31	0.2
Carp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cutlips minnow	-	-	-	-	-	-	-	-	-	-	-	-	0.32	0.1	0.66	0.2	0.71	0.3	0.53	0.3
Golden shiner	0.23	0.5	4.19	13.0	1.36	0.1	5.24	0.7	0.98	0.2	1.50	0.3	3.32	1.3	1.96	0.5	1.73	0.7	11.85	6.2
Comely shiner	4.24	9.0	1.74	5.4	79.84	7.2	8.84	1.2	12.26	2.5	4.59	0.8	12.76	4.8	2.65	0.6	1.04	0.4	0.46	0.2
Satinfin shiner	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-
Bridle shiner	-	-	-	-	1.16	0.1	-	-	0.40	0.1	-	-	-	-	-	-	-	-	-	-
Common shiner	3.77	8.0	3.37	10.4	15.47	1.4	65.56	9.1	49.97	10.3	30.64	5.6	14.01	5.3	9.61	2.3	2.06	0.90	1.94	1.0
Spottail shiner	0.08	0.2	-	-	2.16	0.2	7.36	1.0	2.05	0.4	9.64	1.8	0.89	0.3	0.85	0.2	0.11	-	-	-
Swallowtail shiner	0.49	1.0	0.46	1.4	72.74	6.6	69.17	9.6	39.58	8.2	14.52	2.6	10.83	4.1	14.03	3.3	4.41	1.9	2.92	1.5
Spotfin shiner	28.14	59.7	1.43	4.4	775.43	70.4	238.42	33.2	329.97	68.3	224.41	40.8	194.98	73.9	154.80	36.5	203.25	86.1	64.49	33.9
Bluntnose minnow	0.46	1.0	3.13	9.7	71.01	6.4	141.18	19.7	8.92	1.8	39.30	7.1	5.10	1.9	6.17	1.5	4.88	2.1	1.60	0.8
Blacknose dace	-	-	-	-	1.09	0.1	13.50	1.9	1.86	0.4	42.35	7.7	5.05	1.9	41.79	9.9	2.07	0.9	2.36	1.2
Longnose dace	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.45	0.2	0.09	-
Creek chub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.58	0.8	-	-	-	-
Fallfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Minnow hybrid	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	-	-	-	-	-
White sucker	1.17	2.5	0.79	2.4	11.93	1.1	13.55	1.9	4.39	0.9	78.14	14.2	0.40	0.2	6.38	1.5	0.57	0.2	5.10	2.7
Creek chubsucker	0.49	1.0	1.13	3.5	0.39	0.0	0.44	0.1	0.20	-	-	-	-	-	-	-	-	-	-	
Yellow bullhead	-	-	-	-	0.13	0.0	0.67	0.1	-	-	1.69	0.3	-	-	0.24	0.1	-	-	0.36	0.2
Brown bullhead	-	-	0.19	0.6	-	-	0.44	0.1	-	-	-	-	-	-	-	-	-	-	0.15	0.1
Margined madtom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Banded killfish	-	-	-	-	37.28	3.4	38.95	5.4	10.13	2.1	27.52	5.0	4.07	1.5	47.05	11.1	9.68	4.1	91.05	47.8
Redbreast sunfish	1.00	2.1	0.80	2.5	7.82	0.7	24.61	3.4	3.79	0.8	9.27	1.7	1.11	0.4	0.41	0.1	0.22	0.1	0.33	0.2
Green sunfish	0.53	1.1	5.89	18.2	0.11	0.0	11.21	1.6	-	-	0.93	0.2	0.88	0.3	10.83	2.6	2.47	1.0	5.01	2.6
Pumpkinseed	0.67	1.4	1.21	3.7	0.91	0.1	4.03	0.6	0.22	-	-	-	1.18	0.4	13.38	3.2	0.19	0.1	1.12	0.6
Bluegill	1.06	2.3	0.18	0.5	1.00	0.1	5.50	0.8	1.46	0.3	0.19	-	0.13	0.1	4.05	1.0	0.33	0.1	0.50	0.3
Lepomis hybrid	1.60	3.4	5.13	15.9	0.23	0.0	2.15	0.3	-	-	-	-	0.20	0.1	1.22	0.3	0.79	0.3	0.30	0.2
Small bass	-	-	-	-	1.00	0.1	.22	-	0.51	-	-	-	-	0.2	0.12	-	-	-	-	-
Largemouth bass	0.43	0.9	0.09	0.3	0.93	0.1	-	-	0.51	0.1	-	-	0.44	0.2	1.41	0.3	0.11	-	-	-
Tessellated darter	2.04	4.3	2.15	6.6	19.63	1.8	66.27	9.2	16.15	3.3	65.21	11.9	8.04	3.0	102.49	24.26	1.07	0.5	-	-

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TABLE 2.2-76
(Cont'd)

Species	1975 E12440 C/F	%	1976 E12440 C/F	%	1975 E5475 C/F	%	1976 E5475 C/F	%	1975 E1890 C/F	%	1976 E1890 C/F	%	1975 Mean C/F	%	1976 Mean C/F	%	Years Mean C/F	%
Redfin pickerel	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-	0.08	-	0.9	-
Goldfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	-	0.2	-
Carp	-	-	0.08	-	-	-	-	-	0.09	0.1	-	-	0.1	-	0.01	-	0.1	-
Cutlips minnow	2.31	1.4	6.11	2.7	1.56	0.6	1.45	0.1	1 11	0.8	1.73	2.0	0.76	0.2	1.33	0.4	1.04	0.3
Golden shiner	0.05	-	0.45	0.2	-	-	0.12	0.1	-	-	-	-	0.97	0.3	3.15	1.0	2.06	0.6
Comely shiner	25.95	15.7	12.28	5.3	4.96	1.9	2.06	1.4	4.07	3.1	1.31	1.6	18.30	5.4	4.27	1.4	11.29	3.5
Satinfin shiner	14.85	9.0	26.76	11.6	67.33	26.1	22.83	15.5	23.90	18.1	13.91	16.5	13.41	4.0	8.09	2.7	10.75	3.4
Bridle shiner	-	-	-	-	-	-	-	-	-	-	-	-	0.20	0.1	-	-	0.10	-
Common shiner	8.28	5.0	15.02	6.5	18.50	7.2	13.67	9.3	5.35	4.1	4.46	5.3	14.80	4.4	18.22	6.1	16.51	5.2
Spottail shiner	0.18	0.1	0.85	0.4	0.41	0.2	0.85	0.6	0.11	0.1	1.04	1.2	0.76	0.2	2.61	0.9	1.68	0.5
Swallowtail shiner	2.11	1.3	1.33	0.6	2.63	1.0	2 05	1.4	0.35	0.3	0.09	0.1	16.83	5.0	13.23	4.4	15.03	4.7
Spotfin shiner	96.00	58.1	105.32	45.7	148.45	57.6	62.60	42.5	78.94	59.8	23.70	28.1	234.24	69.1	110.76	36.9	172.50	53.9
Bluntnose minnow	1.76	1.1	2.89	1.3	5.47	2.1	0.80	0.5	0.28	0.2	0.46	0.5	12.37	3.6	24.71	8.2	18.54	5.8
Blacknose dace	1.33	0.8	10.11	4.4	2.15	0.8	4.90	3.3	0.90	0.7	2.36	2.8	1.83	0.5	14.86	4.9	8.34	2.6
Longnose dace	3.25	2.0	9.21	4.0	0.74	0.3	7.34	5.0	0.90	0.7	4.00	4.7	0.68	0.2	2.61	0.9	1.64	0.5
Creek chub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.45	0.2	0.23	0.1
Fallfish	-	-	-	-	-	-	-	-	0.08	0.1	-	-	0.1	-	-	-	0.01	-
Minnow hybrid	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	0.01	-
White sucker	-	-	13.90	6.0	-	-	15.58	10.6	10.57	8.0	24.45	28.9	3.66	1.1	19.98	6.6	11.82	3.7
Creek chubsucker	-	-	-	-	-	-	-	-	-	-	-	-	0.13	-	0.19	0.1	0.16	0.1
Yellow bullhead	0.06	-	0.29	0.1	-	-	0.49	0.3	-	-	22	0.3	0.02	-	0.50	0.2	0.26	0.1
Brown bullhead	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	-	0.05	-
Margined madtom	-	-	-	-	-	-	0.08	0.1	0.08	0.1	-	-	0.1	-	0.1	-	0.01	-
Banded killfish	6.68	4.0	9.25	4.0	3.70	1.4	2.87	2.0	4.41	3.3	0.73	0.9	9.61	2.8	27.52	9.2	18.56	5.8
Redbreast sunfish	0.57	0.3	1.49	0.6	0.69	0.3	2.50	1.7	0.55	0.4	3.79	4.5	1.98	0.6	5.46	1.8	3.72	1.2
Green sunfish	0.77	0.5	4.06	1.8	0.50	0.2	1.49	1.0	0.20	0.2	0.77	0.9	0.68	0.2	5.01	1.7	2.85	0.9
Pumpkinseed	0.06	-	3.65	1.6	-	-	0.63	0.4	-	-	-	-	0.40	0.1	3.02	1.0	1.71	0.5
Bluegill	0.12	0.1	4.50	2.0	0.08	-	0.17	0.1	-	-	-	-	0.52	0.2	1.91	0.6	1.21	0.4
Lepomis hybrid	0.12	0.1	0.34	0.1	-	-	0.17	0.1	-	-	-	-	0.35	0.1	1.11	0.4	0.73	0.2
Small bass	0.13	0.1	-	-	-	-	0.24	0.2	0.19	0.1	1.27	1.5	0.18	0.1	0.23	0.1	0.21	0.1
Largemouth bass	-	-	0.31	0.1	-	-	-	-	-	-	-	-	0.30	0.1	0.23	0.1	0.26	0.1
Tessellated darter	0.52	0.3	2.45	1.1	0.48	0.2	4.32	2.9	-	-	0.22	0.3	6.04	1.8	30.75	10.2	18.39	5.8

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TABLE 2.2-77

RELATIVE ABUNDANCE (%N) AND BIOMASS (%W) OF FISHES COLLECTED BY ELECTROFISHING FROM LOTIC SITES, EAST BRANCH PERKIOMEN CREEK, 1973 AND 1975

	E36020				E30540				E22240			
	1973		1975		1973		1975		1973		1975	
Species	% N	% W	% N	% W	% N	% W	% N	% W	% N	% W	% N	% W
Redfin pickerel	3.0	3.1	7.0	6.1	0.1	1.2	0.6	0.9	<0.1	<0.1	0.0	0.0
Chain pickerel	0.0	0.0	0.6	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Goldfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	4.1	0.2	0.8
Carp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.8	<0.1	0.5
Carp x goldfish hybrid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Golden shiner	2.0	0.9	0.0	0.0	1.9	0.8	1.6	0.7	0.3	0.1	0.1	<0.1
White sucker	17.4	36.7	14.6	39.5	24.6	45.1	20.7	41.8	51.6	72.6	33.3	66.6
Creek chubsucker	5.0	6.6	3.9	3.4	0.1	0.7	2.2	2.8	0.2	0.2	0.1	0.2
White catfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow bullhead	10.3	3.5	5.8	6.5	5.8	10.6	25.5	11.7	6.5	5.7	11.4	11.7
Brown bullhead	1.6	2.2	2.1	1.3	2.4	4.6	0.8	3.7	1.6	1.7	2.0	5.3
Margined madtom	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1	0.0	0.0	0.0	0.0
Rock bass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redbreast sunfish	13.3	8.0	12.4	7.4	33.1	21.4	22.2	20.9	0.7	11.3	3.3	2.0
Green sunfish	12.8	18.6	12.1	5.6	13.9	7.3	6.2	5.1	31.6	11.0	43.7	11.5
Pumpkinseed	13.8	7.0	11.1	5.3	8.0	3.9	3.1	1.9	2.5	1.5	3.6	0.8
Bluegill	1.9	0.8	5.3	2.1	3.2	0.7	10.4	3.7	1.2	0.1	0.4	0.1
Lepomis hybrid	14.8	10.5	19.4	10.5	2.9	1.6	2.6	2.3	1.2	0.8	1.2	0.3
Smallmouth bass	1.2	0.4	0.0	0.0	1.3	1.2	0.7	1.7	<0.1	<0.1	0.2	0.1
Largemouth bass	2.7	1.4	5.8	2.7	1.5	0.9	3.5	2.8	0.2	<0.1	0.2	<0.1

	E12040				E1550				Sites Combined				Years Combined	
	1973		1975		1973		1975		1973		1975			
Species	% N	% W	% N	% W	% N	% W	% N	% W	% N	% W	% N	% W	% N	% W
Redfin pickerel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.7	0.5	0.6	0.5
Chain pickerel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.5	<0.1	0.3
Goldfish	0.6	1.8	0.3	3.5	5.0	4.6	0.7	2.1	1.2	3.0	0.2	1.3	0.6	2.1
Carp	0.0	0.0	0.1	1.4	0.1	31.8	4.4	35.8	0.5	11.4	0.7	11.4	0.6	11.4
Carp x goldfish hybrid	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.0	0.0	<0.1	0.6	<0.1	0.1
Golden shiner	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.7	0.2	0.5	0.1	0.6	0.1
White sucker	27.0	54.6	14.3	27.1	13.4	29.3	6.8	23.9	32.1	48.7	20.1	44.3	25.1	46.3
Creek chubsucker	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.5	0.7	0.9	0.7	0.9	0.7
White catfish	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1	0.0	0.0	<0.1	<0.1
Yellow bullhead	38.5	24.4	37.6	34.2	22.6	15.1	13.2	10.1	16.0	11.9	21.2	13.2	19.0	12.6
Brown bullhead	0.1	0.6	0.0	0.8	0.6	0.4	0.7	1.3	1.3	1.6	1.0	3.1	1.2	2.4
Margined madtom	0.0	0.0	0.4	0.2	7.7	0.7	7.5	0.3	1.0	0.2	1.2	0.1	1.1	0.2
Rock bass	0.0	0.0	0.0	0.0	2.9	1.5	1.1	0.7	0.4	0.5	0.2	0.2	0.3	0.3
Redbreast sunfish	7.5	4.4	10.1	15.4	28.7	10.6	37.9	15.0	13.4	7.9	15.8	10.6	14.8	9.4
Green sunfish	24.5	12.4	33.5	15.2	8.3	0.9	12.8	1.6	21.4	7.8	24.3	7.5	23.1	7.6
Pumpkinseed	0.7	0.7	1.8	0.8	0.7	0.2	1.9	0.8	4.6	1.7	3.3	1.2	3.8	1.4
Bluegill	0.5	<0.1	0.0	0.0	0.4	<0.1	2.5	0.6	1.4	0.2	3.7	0.9	2.7	0.6
Lepomis hybrid	0.2	0.2	0.9	0.3	0.0	0.0	0.7	0.4	2.7	1.3	2.7	1.2	2.7	1.2
Smallmouth bass	0.3	0.1	0.9	1.2	6.5	4.5	8.9	6.6	1.3	1.8	1.8	2.5	1.6	2.2
Largemouth bass	0.1	1.0	0.1	0.1	0.1	0.1	0.8	0.1	0.7	0.4	1.5	0.6	1.2	0.5

TABLE 2.2-78

RELATIVE ABUNDANCE (% TOTAL CATCH) OF ALL SPECIES COLLECTED BY ELECTROFISHING FROM FRETZ (15500) AND WAWA (E5650) RESERVOIRS, EAST BRANCH PERKIOMEN CREEK IN 1974 AND 1975

Species	15500 1974 %	1975 %	5650 1974 %	1975 %	Total %
American eel	0.1	-	-	-	0.01
Redfin pickerel	-	-	-	-	0.01
Goldfish	5.5	1.0	1.1	0.3	1.87
Carp	0.6	1.0	2.4	3.0	1.69
Golden shiner	1.9	0.5	0.1	0.1	0.60
Minnow hybrid	0.1	-	0.4	0.1	0.14
White sucker	23.1	13.8	16.2	6.9	14.97
Creek chubsucker	0.6	0.1	0.1	-	0.22
White catfish	-	-	0.1	-	0.01
Yellow bullhead	1.4	6.6	18.5	18.9	11.09
Brown bullhead	3.8	5.1	1.8	2.1	3.33
Redbreast sunfish	0.7	3.5	8.9	20.7	7.94
Green sunfish	31.3	28.6	38.3	36.6	33.34
Pumpkinseed	21.8	15.4	6.7	7.7	12.97
Bluegill	1.4	19.0	0.1	0.6	6.41
Lepomis hybrid	4.5	3.3	4.2	2.5	3.61
Smallmouth bass	0.9	0.6	0.3	0.2	0.53
Largemouth bass	2.3	1.4	0.7	0.5	1.24
Yellow perch	0.1	-	-	-	0.01

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TABLE 2.2-79

CRITERIA FOR DETERMINATION OF IMPORTANT FISHES OF EAST BRANCH PERKIOMEN CREEK

	IMPORTANCE			LINK TO PLANT (DIVERSION)
Common Name	Recreational	Ecological	Abundant	Altered Habitat
Redfin pickerel(1)		X		X
Satinfin shiner(2)		X	X	X
Common shiner(2)		X	X	X
Spotfin shiner(2)		X	X	X
White sucker(1)(3)	X	X	X	X
Yellow bullhead(1)	X	X	X	X
Redbreast sunfish(1)(3)	X	X	X	X
Green sunfish(1)(3)		X	X	X
Pumpkinseed(1)		X	X	X
Smallmouth bass(1)	X	X		X
Tessellated darter(2)		X	X	X

(1) Species sampled by large fish population estimate program.
(2) Species sampled by seine program.
(3) Species sampled by age and growth program.

LGS EROI

TABLE 2.2-80

POPULATION ESTIMATES[1] AND ESTIMATED BIOMASS[2] OF SELECTED SPECIES COLLECTED BY ELECTROFISHING FROM LOTIC SITES, EAST BRANCH PERKIOMEN CREEK, 1973 AND 1975

Species	Year	E36020		E30540		E22240		E12040		E1550		Sites Combined	
		No/500m	Wt/500m	No/500m	Wt/500	No/500m	Wt/500m	No/500m	Wt/500m	No/500m	Wt/500m	No/500m	Wt/500m
Redfin pickerel	1973	36	1.05	13	0.71	1	0.03	0	0.00	0	0.00	9	0.36
	1975	62	1.84	21	0.71	0	0.00	0	0.00	0	0.00	17	0.51
White sucker	1973	185	12.65	390	25.91	1661	100.86	586	35.40	203	47.54	605	44.47
	1975	130	11.81	676	31.84	1202	37.54	457	15.19	162	48.31	525	48.94
Yellow bullhead	1973	110	1.20	91	6.07	208	7.85	833	15.82	343	28.48	317	11.88
	1975	52	1.95	835	8.89	413	10.94	1199	19.16	315	20.51	563	12.29
Redbreast sunfish	1973	142	2.76	524	12.20	23	0.41	161	2.83	435	20.09	257	7.67
	1975	111	2.22	725	15.80	118	4.21	321	8.63	907	30.27	436	12.24
Green sunfish	1973	136	6.48	220	4.20	1018	15.34	530	7.82	125	1.76	406	7.12
	1975	108	1.68	202	3.84	1586	23.84	1069	8.53	307	3.17	654	8.21
Pumpkinseed	1973	147	2.43	126	2.22	112	2.14	16	0.02	12	0.46	83	1.45
	1975	99	1.57	100	1.47	129	1.57	57	0.42	47	1.57	86	1.32
Smallmouth bass	1973	13	0.13	20	0.68	1	0.02	6	0.08	98	8.56	28	1.89
	1975	0	0.00	24	1.31	7	0.25	30	0.69	213	13.43	55	3.14

(1) Number per 500 meters of stream length.
(2) Weight in kilograms per 500 meters of stream length.

LGS EROL

TABLE 2.2-81

POPULATION ESTIMATES (No.) AND ESTIMATED BIOMASS (Wt.) OF SELECTED SPECIES COLLECTED BY ELECTROFISHING FROM LENTIC SITES, EAST BRANCH PERKIOMEN CREEK, IN 1974 and 1975

Species	Year	E15500 No.	E15500 Wt.(kg)	E5650 No.	E5650 Wt.(kg)	Sites Combined No.	Sites Combined Wt.(kg)
Redfin pickerel	1974	0	-	0	-	0	-
	1975	1	-	0	-	1	-
White sucker	1974	1149	-	687	-	1836	-
	1975	576	98.53	654	122.29	1230	220.82
Yellow bullhead	1974	64	-	789	-	853	-
	1975	539	47.72	1433	104.68	1972	152.40
Redbreast sunfish	1974	11	-	230	-	241	-
	1975	113	2.95	827	23.52	940	26.47
Green sunfish	1974	1107	-	1180	-	2287	-
	1975	847	20.96	869	25.50	1716	46.46
Pumpkinseed	1974	931	-	160	-	1091	-
	1975	540	20.42	247	7.15	787	27.57
Smallmouth bass	1974	22	-	7	-	29	-
	1975	14	-	6	-	20	-

LGS ERCL

TABLE 2.2-82

LENGTH-WEIGHT RELATIONSHIPS[1] OF SELECTED SPECIES COLLECTED BY SEINE FROM EAST BRANCH PERKIOMEN CREEK IN 1975 and 1976

Species	Site/Year	a	b
Common shiner	E36690	-12.93	3.40
	E32170	-12.63	3.33
	E29810	-11.94	3.17
	E26630	-12.76	3.38
	E22980	-11.94	3.18
	E12440	-12.37	3.27
	E5475	-12.61	3.33
	E1890	-12.31	3.25
	1975	-12.67	3.34
	1976	-12.16	3.23
Spotfin shiner	E36690	-11.98	3.13
	E32170	-12.14	3.17
	E29810	-12.29	3.21
	E26630	-12.31	3.22
	E22980	-12.51	3.28
	E12440	-11.82	3.09
	E5475	-12.27	3.21
	E1890	-11.97	3.12
	1975	-12.28	3.20
	1976	-12.00	3.14

(1) $\ln W = a + b \ln L$

LGS EROL

TABLE 2.2-83

LENGTH-WEIGHT RELATIONSHIPS[1] OF SELECTED SPECIES COLLECTED BY ELECTROFISHING FROM LOTIC SITES, EAST BRANCH PERKIOMEN CREEK, IN 1973 AND 1975.

		1973		1975	
Species	Site	a	b	a	b
White sucker	E36020	-12.76	3.27	-	-
	E30540	-11.59	3.05	-	-
	E22240	-11.47	3.03	-	-
	E12040	-10.86	2.92	-	-
	E1550	-11.37	3.02	-	-
Redbreast sunfish	E36020	-11.92	3.24	-10.81	3.01
	E30540	-11.05	3.06	-10.77	3.01
	F22240	-10.29	2.92	-12.20	3.33
	E12040	-11.70	3.20	-11.14	3.08
	E1550	-10.98	3.05	-11.00	3.06
Green sunfish	E36020	-11.01	3.05	-11.68	3.21
	E30540	-12.81	3.42	-11.40	3.14
	E22240	-11.40	3.12	-11.28	3.12
	E12040	-13.29	3.53	-11.95	3.25
	E1550	-12.20	3.30	-11.11	3.08

(1) $\ln W = a + b \ln L$

IGS ERCL

TABLE 2.2-84

MEAN CALCULATED LENGTHS AT ANNULUS FOR REDFIN PICKEREL COLLECTED AT FIVE SITES ON THE EAST BRANCH PERKIOMEN CREEK IN 1973 AND 1975

Age-Group	No. of Fish	Mean Calculated Length (mm FL) at Annulus				
		I	II	III	IV	V
I	12	126	-	-	-	-
II	6	117	170	-	-	-
III	3	132	184	210	-	-
IV	2	132	178	201	234	
V	1	94	149	178	205	258
Total	24	24	12	6	3	1
Grand Average Length		124	173	202	224	258
Increment		124	49	29	22	34
% Total Growth		48.1	19.0	11.2	8.5	13.2

LGS ERCI

TABLE 2.2-85

MEAN CALCULATED LENGTHS AT ANNULUS FOR WHITE SUCKER COLLECTED BY ELECTROFISHING UPSTREAM AND DOWNSTREAM OF SELLERSVILLE, EAST BRANCH PERKIOMEN CREEK, IN 1973

				Mean Calculated Length (mm FL) at Annulus			
Age-Group	Year-Class	Location	No. of Fish	I	II	III	IV
I	1973	Upstream	7	63	-	-	-
		Downstream	24	95	-	-	-
II	1971	Upstream	19	79	143	-	-
		Downstream	26	91	158	-	-
III	1970	Upstream	22	78	133	194	-
		Downstream	28	81	139	197	-
IV	1969	Upstream	6	74	118	177	213
		Downstream	6	76	136	195	244
Total No. Fish		Upstream	54	54	47	28	6
		Downstream	84	84	60	34	6
Weighted Mean FL		Upstream		76	135	190	213
		Downstream		88	147	197	244
Increment		Upstream		76	59	55	23
		Downstream		88	59	50	47
% Total Growth		Upstream		35.7	27.7	25.8	10.8
		Downstream		36.1	24.2	20.5	19.2

LGS ERCL

TABLE 2.2-86

MEAN CALCULATED LENGTHS AT ANNULUS FOR REDBREAST SUNFISH COLLECTED BY ELECTROFISHING FROM LOTIC SITES, EAST BRANCH PERKIOMEN CREEK, IN 1973 AND 1975

			Weighted Mean Length (mm FL) at Annulu_				
Site	Year	No. of Fish	I	II	III	IV	_
E36020	1973	84	32	66	94	118	143
	1975	27	23	58	90	-	-
E30540	1973	118	34	65	74	116	138
	1975	54	32	64	93	114	-
E22240	1973	10	30	70	-	-	-
	1975	24	33	89	104	-	-
E12040	1973	79	37	86	122	148	166
	1975	46	31	80	119	-	-
E1550	1973	90	41	94	129	-	-
	1975	55	33	85	133	-	-

LGS ERCL

TABLE 2.2-87

MEAN CALCULATED LENGTHS AT ANNULUS FOR GREEN SUNFISH COLLECTED BY ELECTROFISHING FROM LOTIC SITES, EAST BRANCH PERKIOMEN CREEK, IN 1973 AND 1975

			Weighted Mean Length (mm FL) at Annulus			
Site	Year	No. of Fish	I	II	III	IV
E36020	1973	87	38	76	108	138
	1975	35	28	69	-	-
E30540	1973	79	38	75	106	-
	1975	37	40	80	-	-
E22240	1973	103	36	77	111	-
	1975	47	33	75	103	-
E12040	1973	149	37	77	112	133
	1975	30	35	71	108	-
E1550	1973	62	37	77	118	-
	1975	36	32	78	107	-

TABLE 2.2-88

1976 TOTAL WHEAT PRODUCTION WITHIN 5 MILES OF LGS--SUMMARY IN ACRES BY SECTOR AND DISTANCE

	Distance in Miles					
Direction	0-1	1-2	2-3	3-4	4-5	0-5
N	0	0	4	7	0	11
NNE	10	0	0	0	26	36
NE	0	0	0	0	19	19
ENE	0	0	105	50	0	155
E	0	0	35	0	22	57
ESE	0	0	0	58	10	68
SE	0	0	0	0	105	105
SSE	0	0	6	30	0	36
S	0	0	0	57	17	74
SSW	0	20	0	26	14	60
SW	0	0	25	0	10	35
WSW	0	10	22	0	0	32
W	0	0	30	4	0	34
WNW	0	0	0	0	0	0
NW	0	0	0	0	0	0
NNW	0	0	0	0	5	5
Total	10	30	227	232	228	727

TABLE 2.2-89

1976 TOTAL GRAIN CORN PRODUCTION WITHIN 5 MILES OF LGS--SUMMARY IN ACRES BY SECTOR AND DISTANCE

	Distance in Miles					
Direction	0-1	1-2	2-3	3-4	4-5	0-5
N	0	0	14	36	0	40
NNE	40	0	0	0	65	105
NE	50	0	11	0	60	121
ENE	0	0	148	146	50	344
E	0	0	90	0	51	141
ESE	5	0	0	200	60	265
SE	0	0	0	0	220	220
SSE	0	0	7	250	297	554
S	0	0	10	357	130	497
SSW	15	50	19	125	115	324
SW	0	50	170	31	20	271
WSW	0	35	96	0	140	271
W	0	0	35	5	0	40
WNW	0	0	0	0	0	0
NE	0	0	0	0	0	0
NNW	0	0	0	0	15	15
Total	110	135	600	1150	1223	3218

TABLE 2.2-90

1976 TOTAL CORN (SILAGE) PRODUCTION WITHIN 5 MILES OF LGS--SUMMARY IN ACRES BY SECTOR AND DISTANCE.

	Distance in Miles					
Direction	0-1	1-2	2-3	3-4	4-5	0-5
N	0	0	0	0	0	0
NNE	0	0	0	0	0	0
NE	0	0	0	0	0	0
ENE	0	0	10	130	50	190
E	0	0	35	0	22	57
ESE	0	0	0	90	16	106
SE	0	0	0	0	90	90
SSE	0	0	8	40	80	128
S	0	0	4	67	25	96
SSW	0	35	6	48	16	105
SW	0	70	205	11	0	286
WSW	0	35	60	0	75	170
W	0	0	50	0	0	50
WNW	0	0	0	0	0	0
NW	0	0	0	0	0	0
NNW	0	0	0	0	35	35
Total	0	140	378	386	409	1313

TABLE 2.2-91

1976 TOTAL ALFALFA, TIMOTHY AND CLOVER) WITHIN 5 MILES OF LGS--SUMMARY IN ACRES BY SECTOR AND DISTANCE

	Distance in Miles					
Direction	0-1	1-2	2-3	3-4	4-5	0-5
N	0	0	17	35	0	52
NNE	0	0	0	0	40	40
NE	0	0	34	0	83	117
ENE	0	0	75	70	32	177
E	0	0	0	0	12	12
ESE	0	0	0	0	30	30
SE	0	0	0	0	25	25
SSE	0	0	18	75	100	193
S	0	0	10	54	101	165
SSW	10	15	0	77	61	163
SW	0	45	140	6	30	221
WSW	0	0	63	0	125	188
W	0	0	60	30	0	90
WNW	0	0	0	0	0	0
NW	0	0	0	0	30	30
NNW	0	0	0	0	51	51
Total	10	60	417	347	720	1554

TABLE 2.2-92

1976 TOTAL (ALL CROPS) PRODUCTION WITHIN 5 MILES OF LGS--SUMMARY IN ACRES BY SECTOR AND DISTANCE

	Distance in Miles					
Direction	0-1	1-2	2-3	3-4	4-5	0-5
N	0	0	51	78	0	129
NNE	58	0	0	0	217	275
NE	80	0	50	0	284	414
ENE	0	0	528	433	152	1113
E	0	0	250	0	157	407
ESE	5	0	0	538	132	675
SE	0	0	0	0	552	552
SSE	0	0	42	515	610	1167
S	0	0	29	821.5	331	1181.5
SSW	25	178	62	380	274	919
SW	0	165	720	66	70	1021
WSW	0	155	319	0	390	864
W	0	0	191	47	0	238
WNW	0	0	0	0	0	0
NW	0	0	0	0	40	40
NNW	0	0	0	0	142	142
Total	168	498	2242	2878.5	3351	9137.5

LGS EROL

TABLE 2.2-93

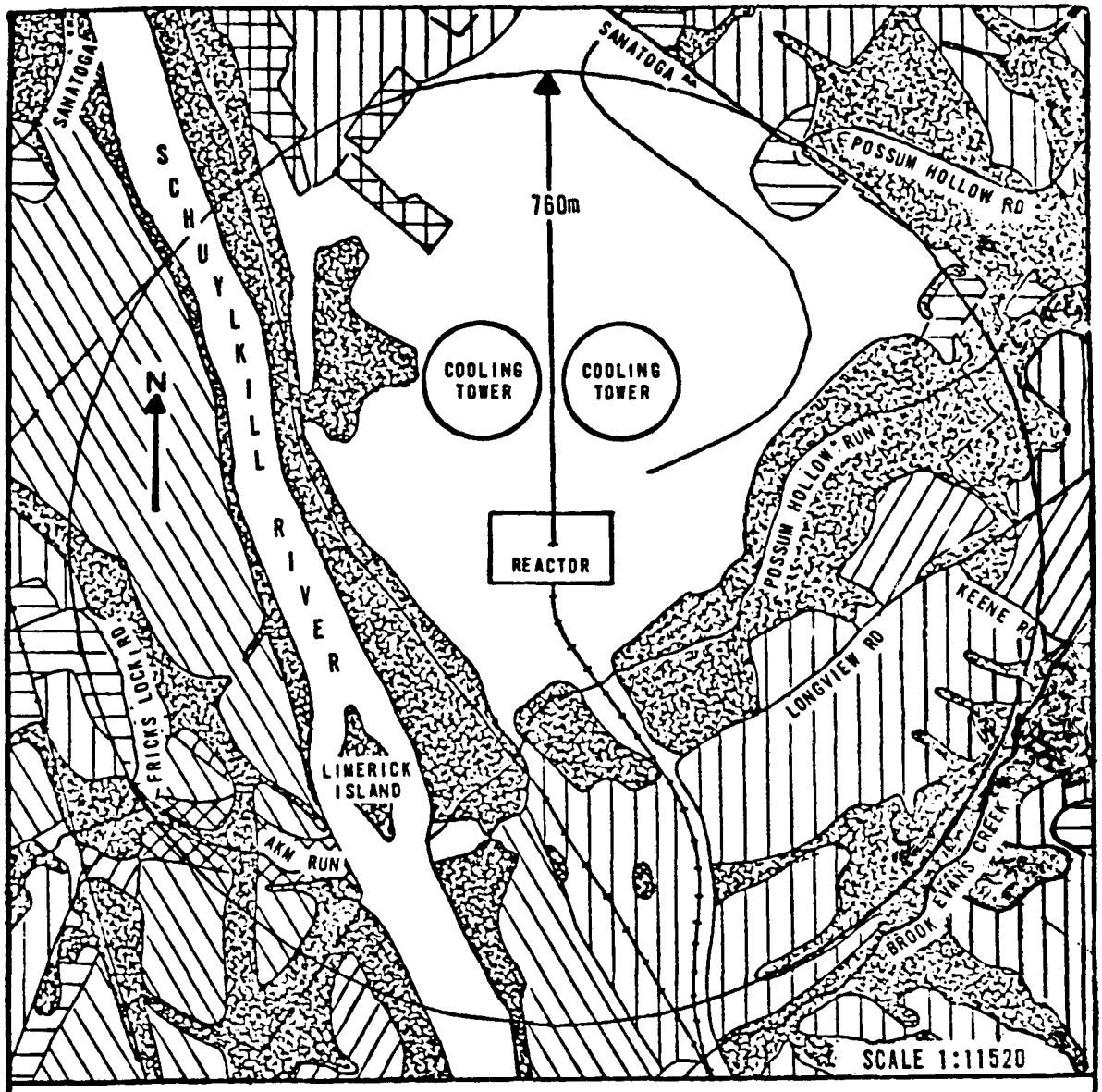
1976 TOTAL COW POPULATION WITHIN 5 MILES
OF LGS BY SECTOR AND DISTANCE

	Distance in Miles					
Direction	0-1	1-2	2-3	3-4	4-5	0-5
N	0	0	0	0	0	0
NNE	0	0	0	0	0	0
NE	0	0	16	0	0	16
ENE	0	0	30	125	60	215
E	0	0	40	0	43	83
ESE	0	0	21	119	34	174
SE	0	0	0	0	137	137
SSE	0	0	26	114	50	190
S	0	0	12	213	45	270
SSW	0	53	23	96	58	230
SW	0	70	245	38	0	353
WSW	0	87	90	0	105	262
W	0	0	35	0	0	35
WNW	0	0	0	0	0	0
NW	0	0	0	0	0	0
NNW	0	0	0	0	0	0
Total	0	190	538	705	532	1965

TABLE 2.2-94

1976 TOTAL GOAT POPULATION WITHIN 5 MILES
OF LGS BY SECTOR AND DISTANCE

	Distance in Miles					
Direction	0-1	1-2	2-3	3-4	4-5	0-5
N	0	0	0	0	0	0
NNE	0	0	0	0	2	2
NE	0	0	0	0	0	0
ENE	0	0	0	0	0	0
E	0	0	0	0	0	0
ESE	0	0	2	0	0	2
SE	0	0	0	0	0	0
SSE	0	0	0	0	0	0
S	0	0	0	85	1	86
SSW	0	0	0	0	1	1
SW	0	0	0	0	0	0
WSW	0	0	0	0	0	0
W	0	0	0	0	0	0
WNW	0	0	0	0	0	0
NE	0	0	0	0	0	0
NNW	0	0	0	0	0	0
Total	0	0	2	85	4	91



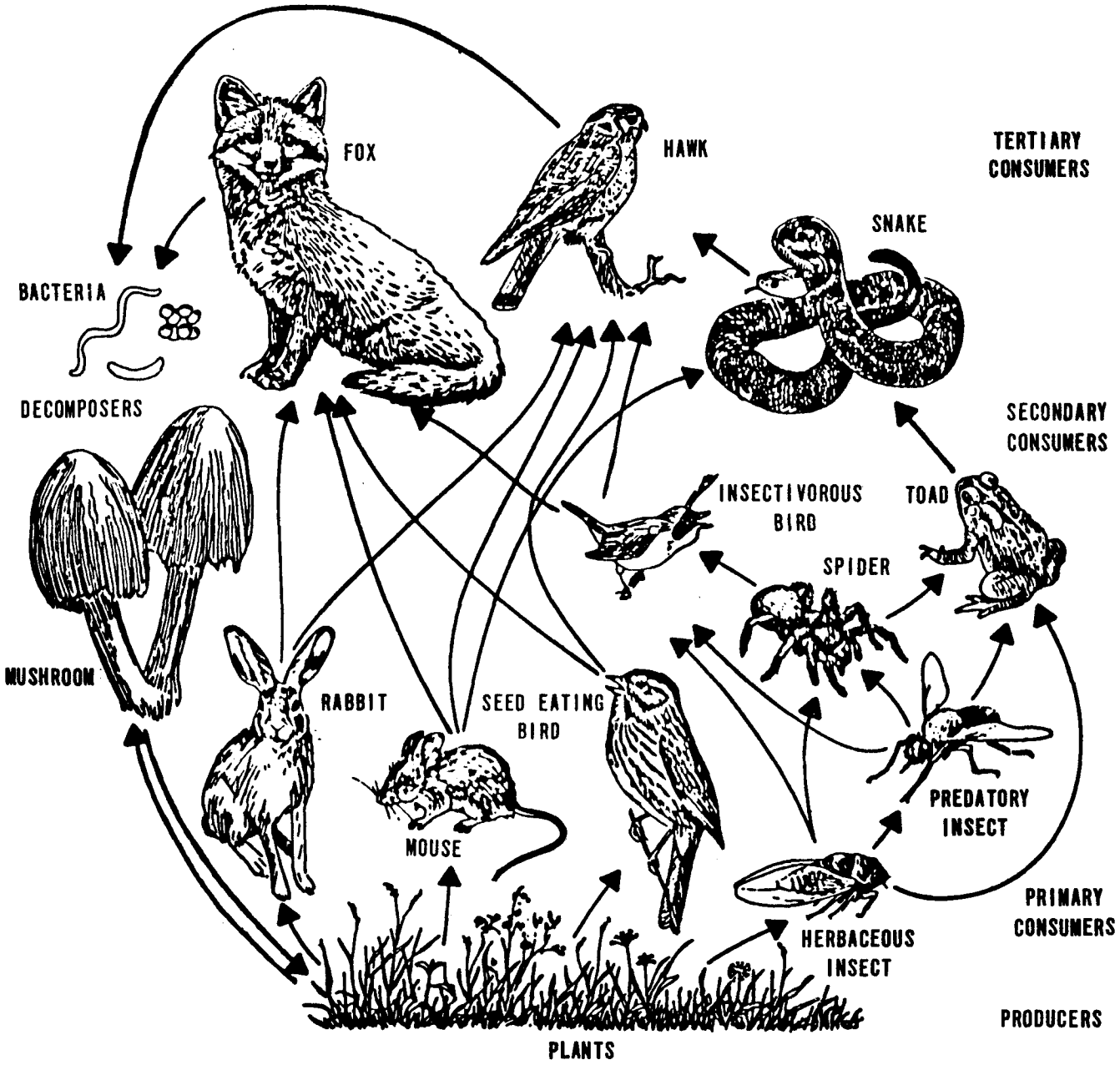
PENN CENTRAL & READING RAILROADS

SYMBOL	COMMUNITY TYPE	% OF 2500' RADIUS	SYMBOL	COMMUNITY TYPE	% OF 2500' RADIUS
	Pioneer	32		Old-field	3
	Wooded	25		Wetland	1
	Cultivated fields	13		Orchard	1
	Grass land	14		Residential	4

LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

PRINCIPAL PLANT COMMUNITIES

FIGURE 2.2-1

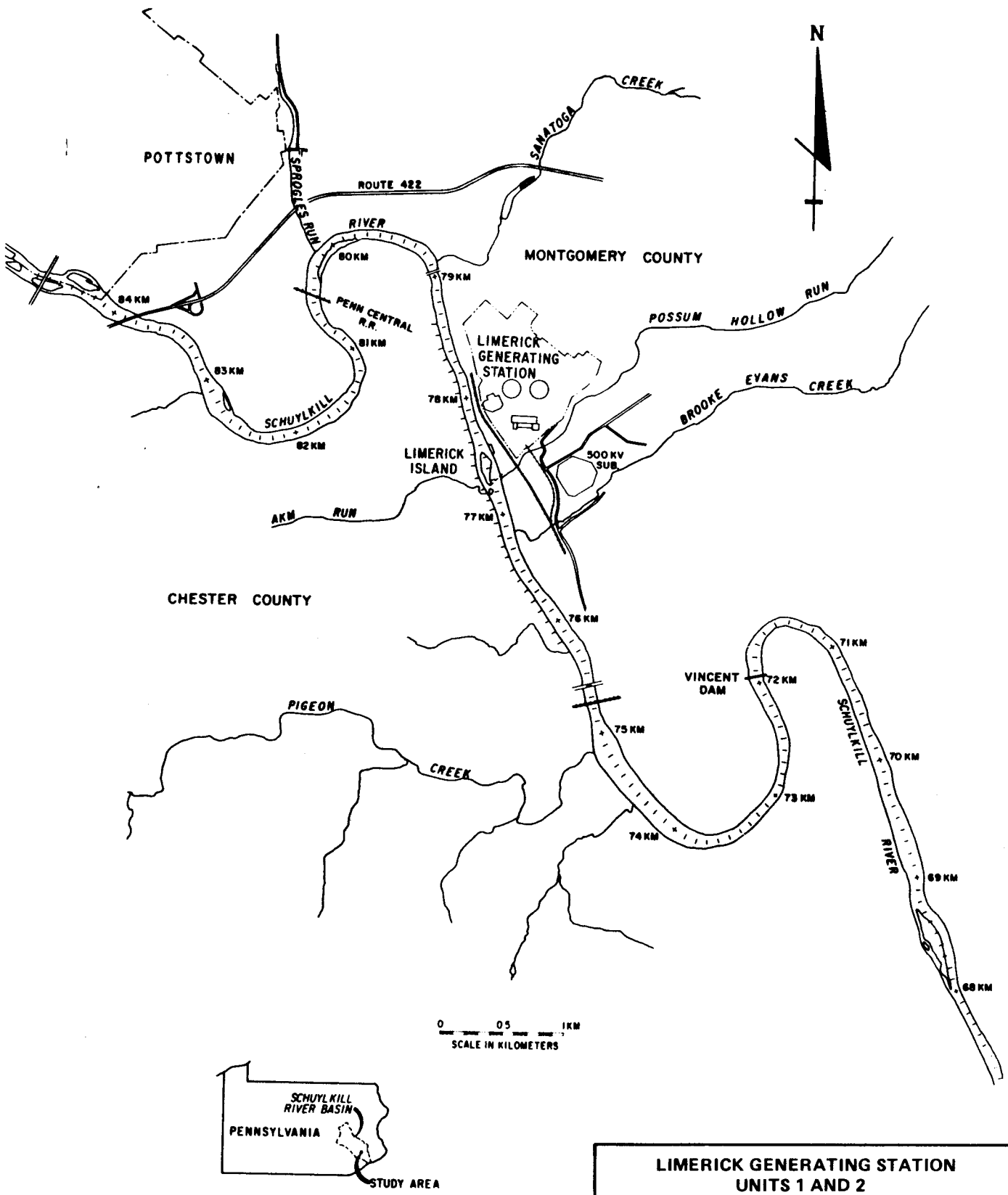


(MODIFIED FROM JENSEN & SALISBURY; p 742 Ref 2.2-11)

LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

HYPOTHETICAL FOOD WEB

FIGURE 2.2-2



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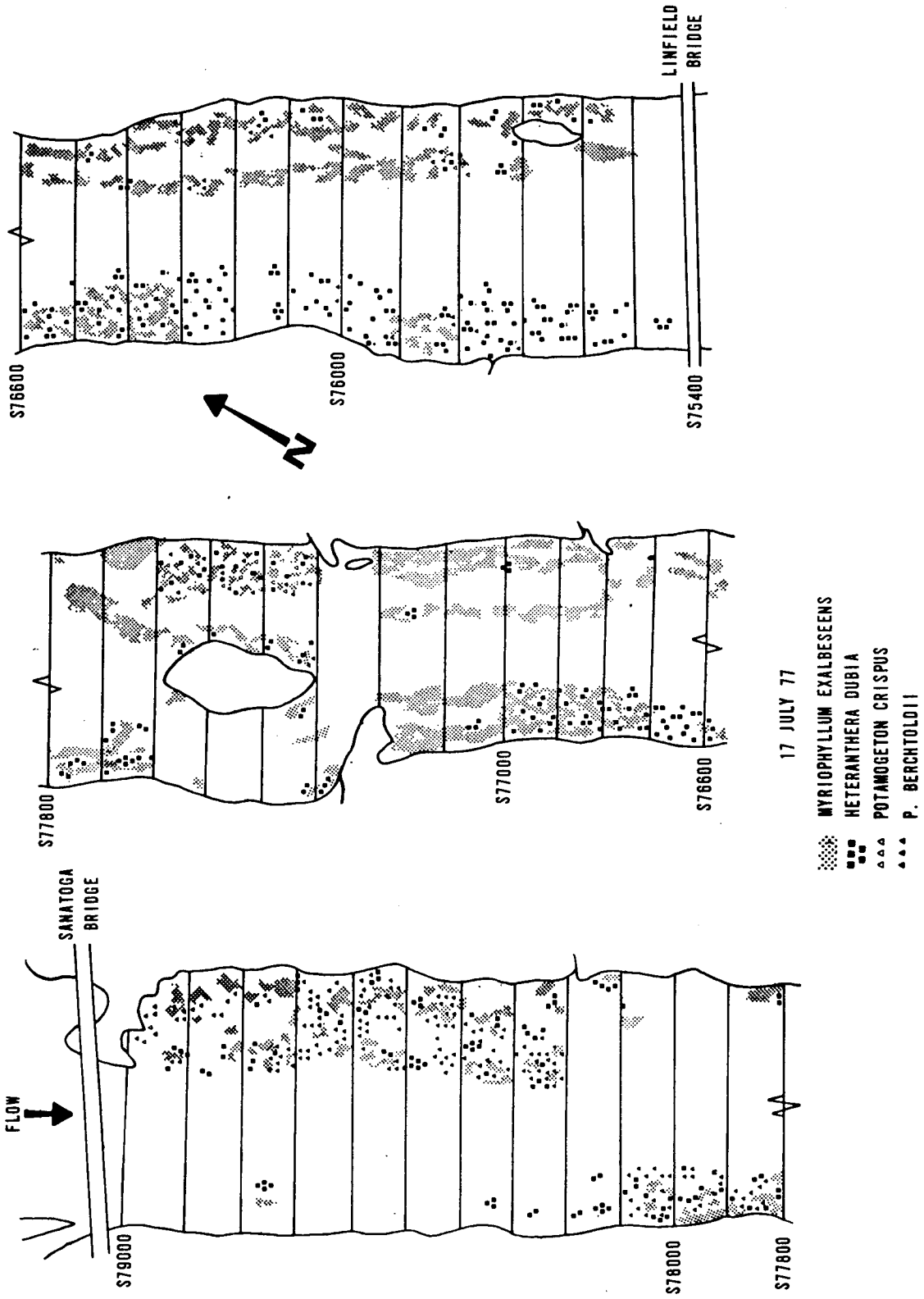
SCHUYLKILL RIVER, LGS STUDY AREA

FIGURE 2.2-3



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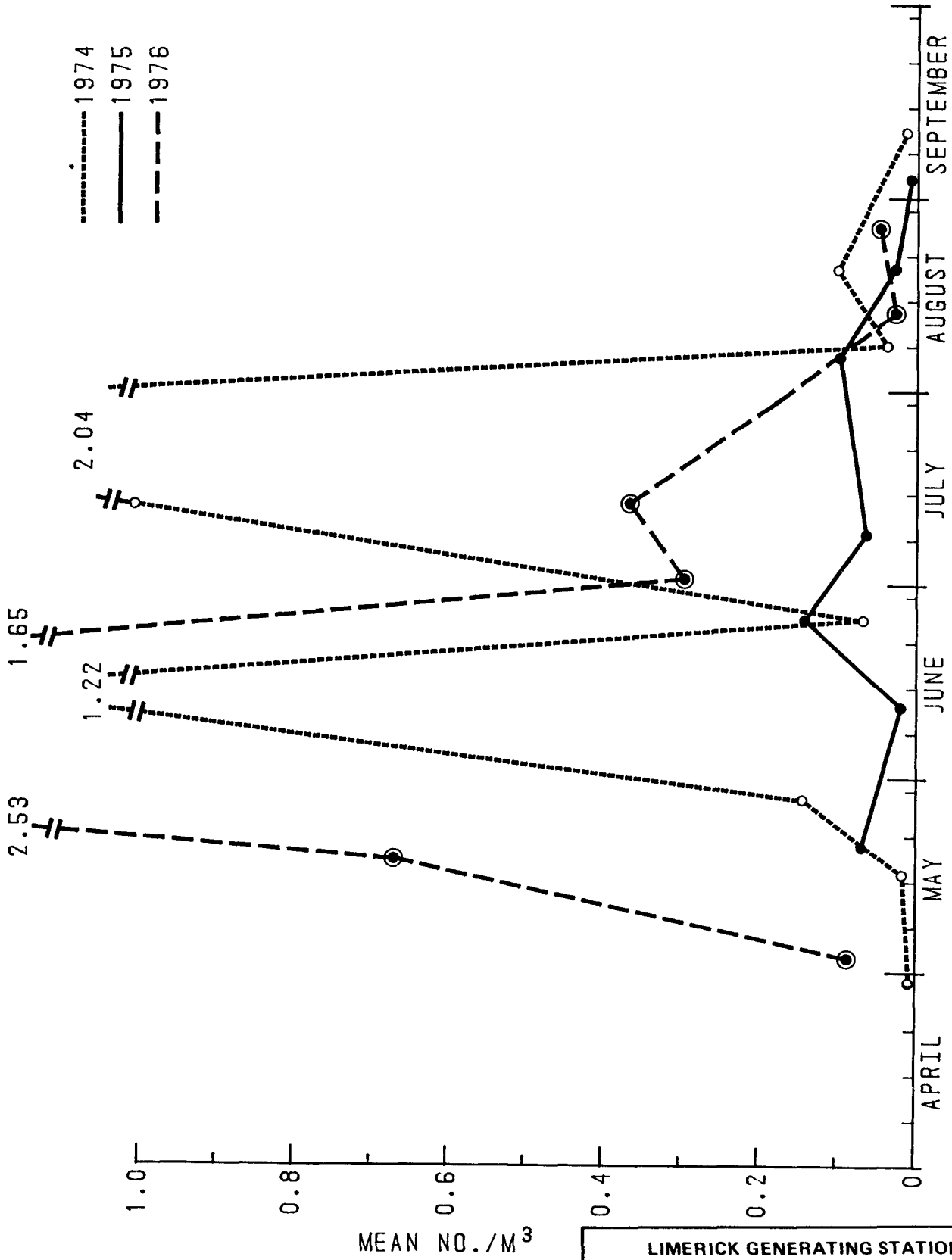
UNITS 1 AND 2
ENVIRONMENTAL REPORT

DISTRIBUTION OF DOMINANT AQUATIC MACROPHYTES

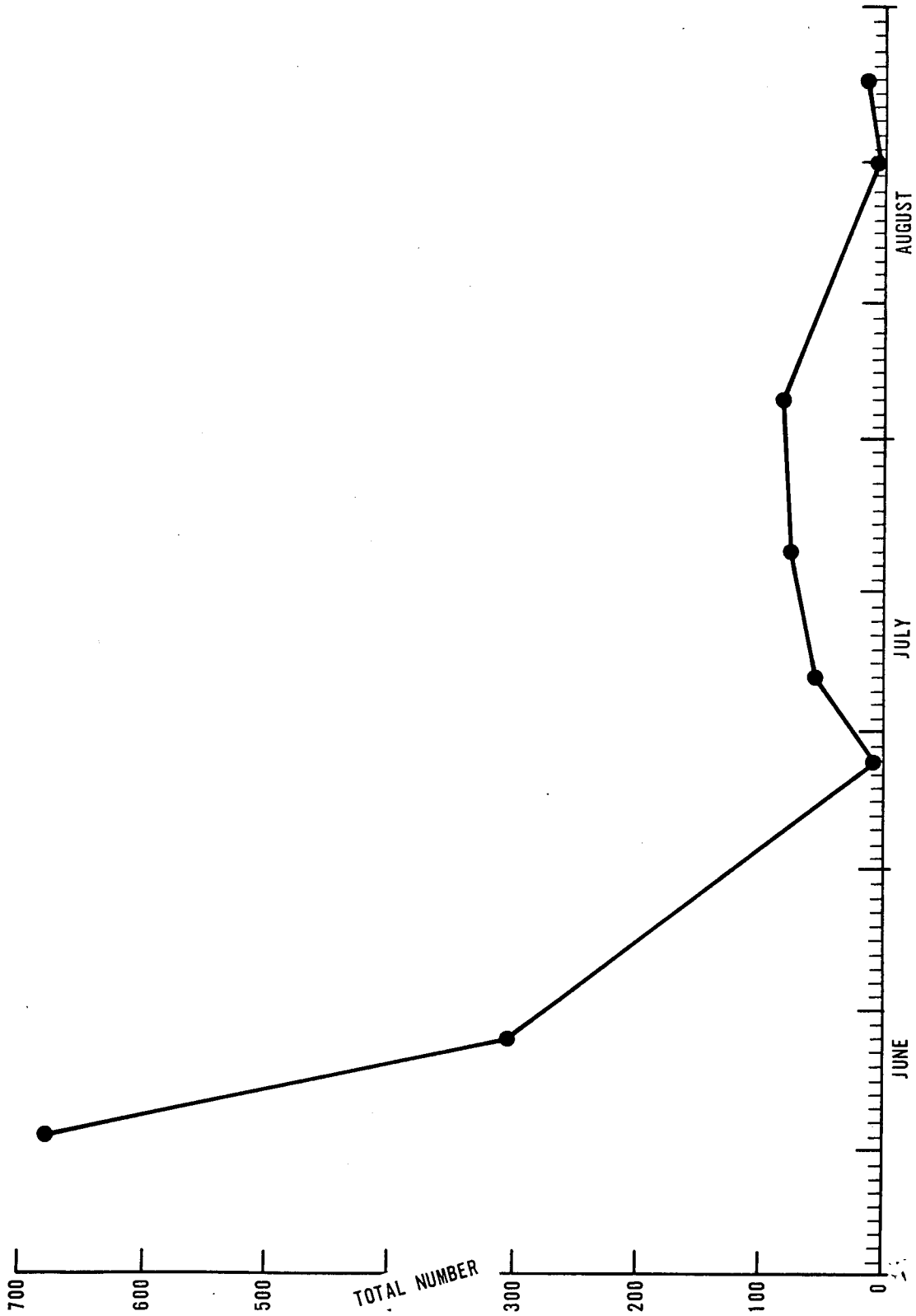
FIGURE 2.2-4



LIMERICK GENERATING STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

TEMPORAL VARIATION IN LARVAL FISH DRIFT DESITY (MEAN NO./M) AT S77560 IN THE SCHUYLKILL RIVER NEAR LGS. 1974-1976. DENSITY VALUES WERE BASED ON BOTTOM NETS IN THE EAST CHANNEL.

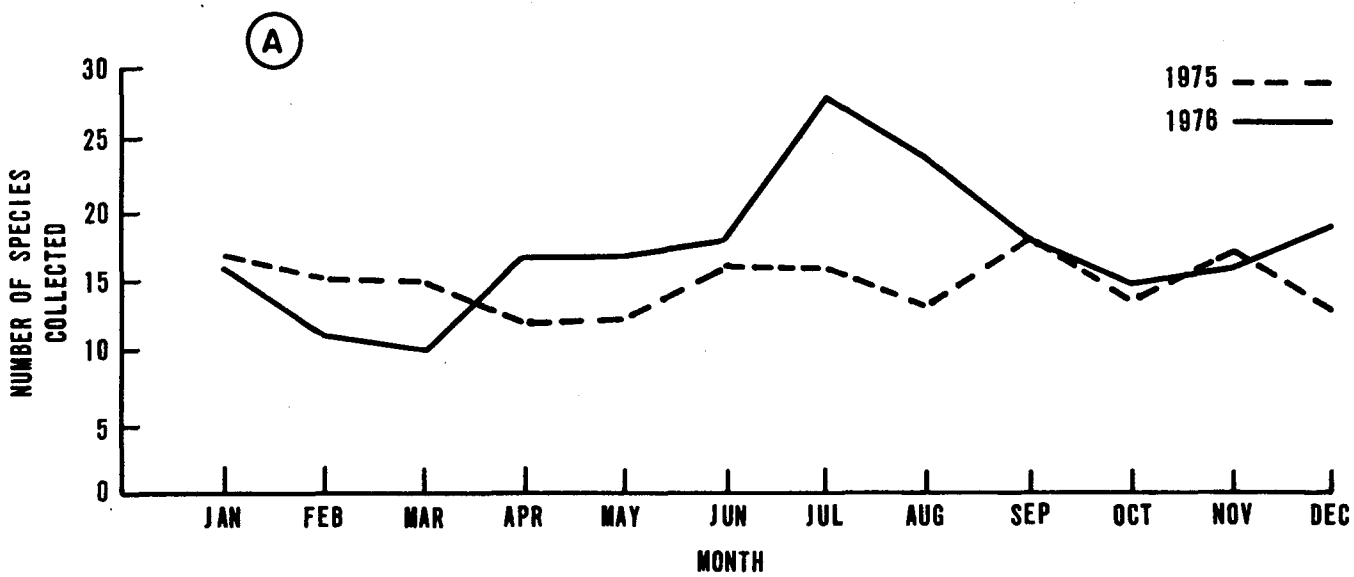
FIGURE 2.2-5

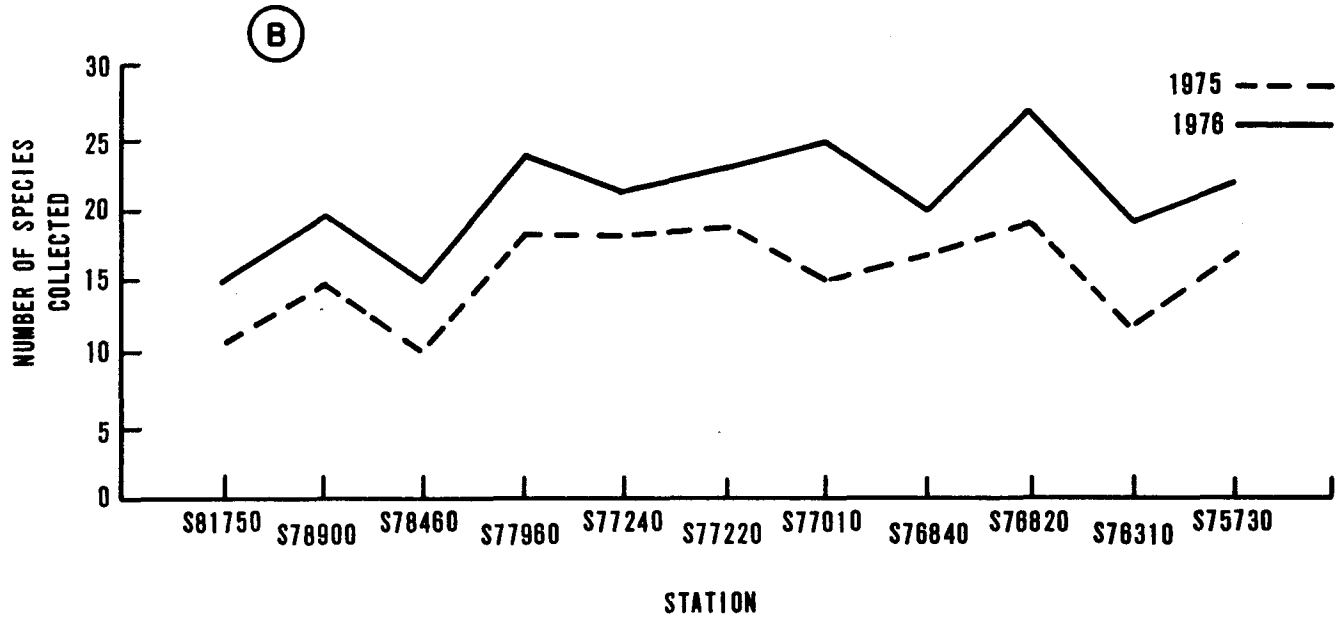


LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

TEMPORAL VARIATION IN TOTAL NUMBER OF LARVAL FISH COLLECTED BY PUSH NET FROM ALL SITES ON THE SCHUYLKILL RIVER NEAR LGS IN 1976.

FIGURE 2.2-6





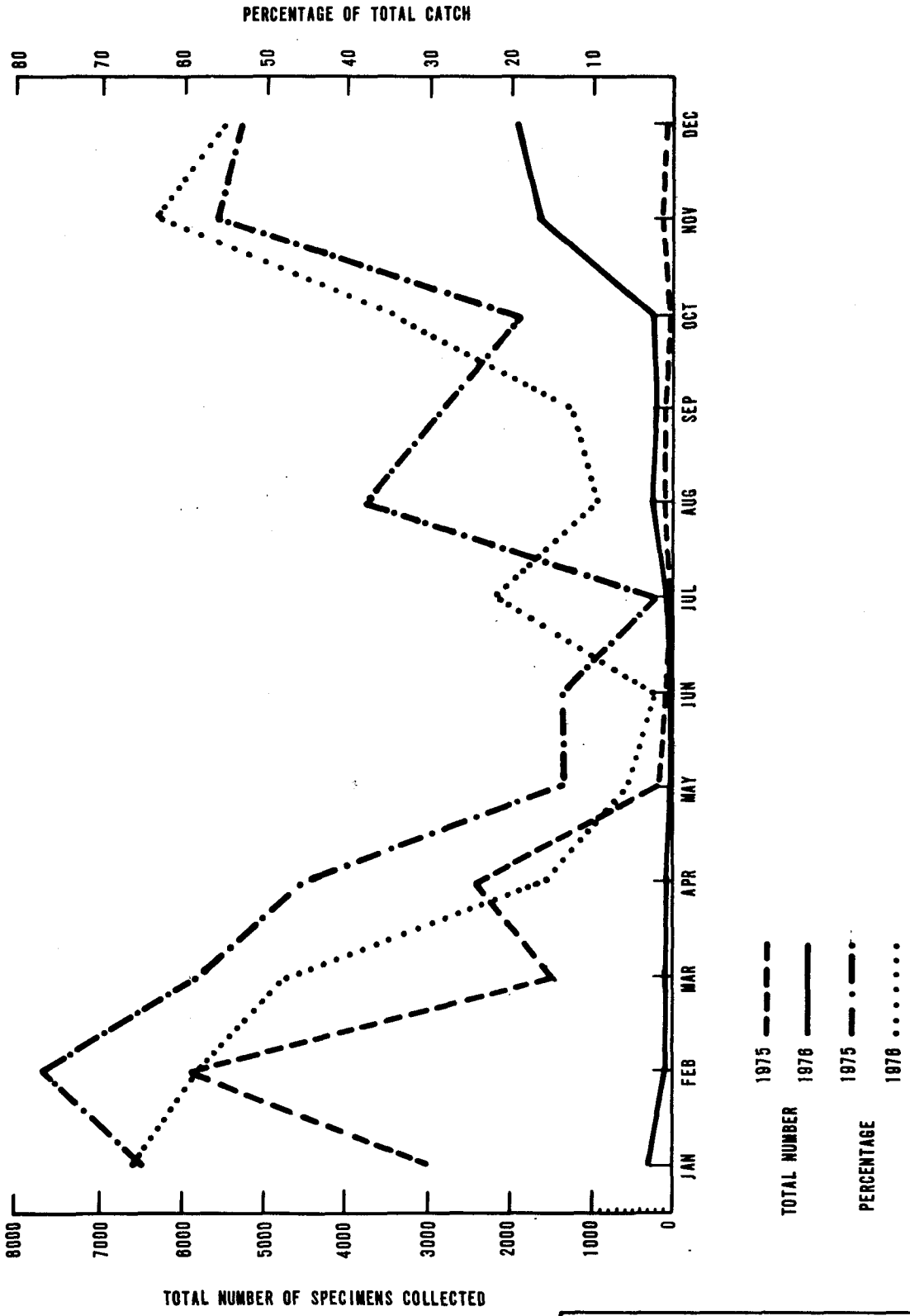
(A) BY MONTH ALL STATIONS COMBINED.

(B) BY STATION ALL MONTHS COMBINED.

LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

NUMBER OF FISH SPECIES COLLECTED BY SEINE FROM THE SCHUYLKILL RIVER

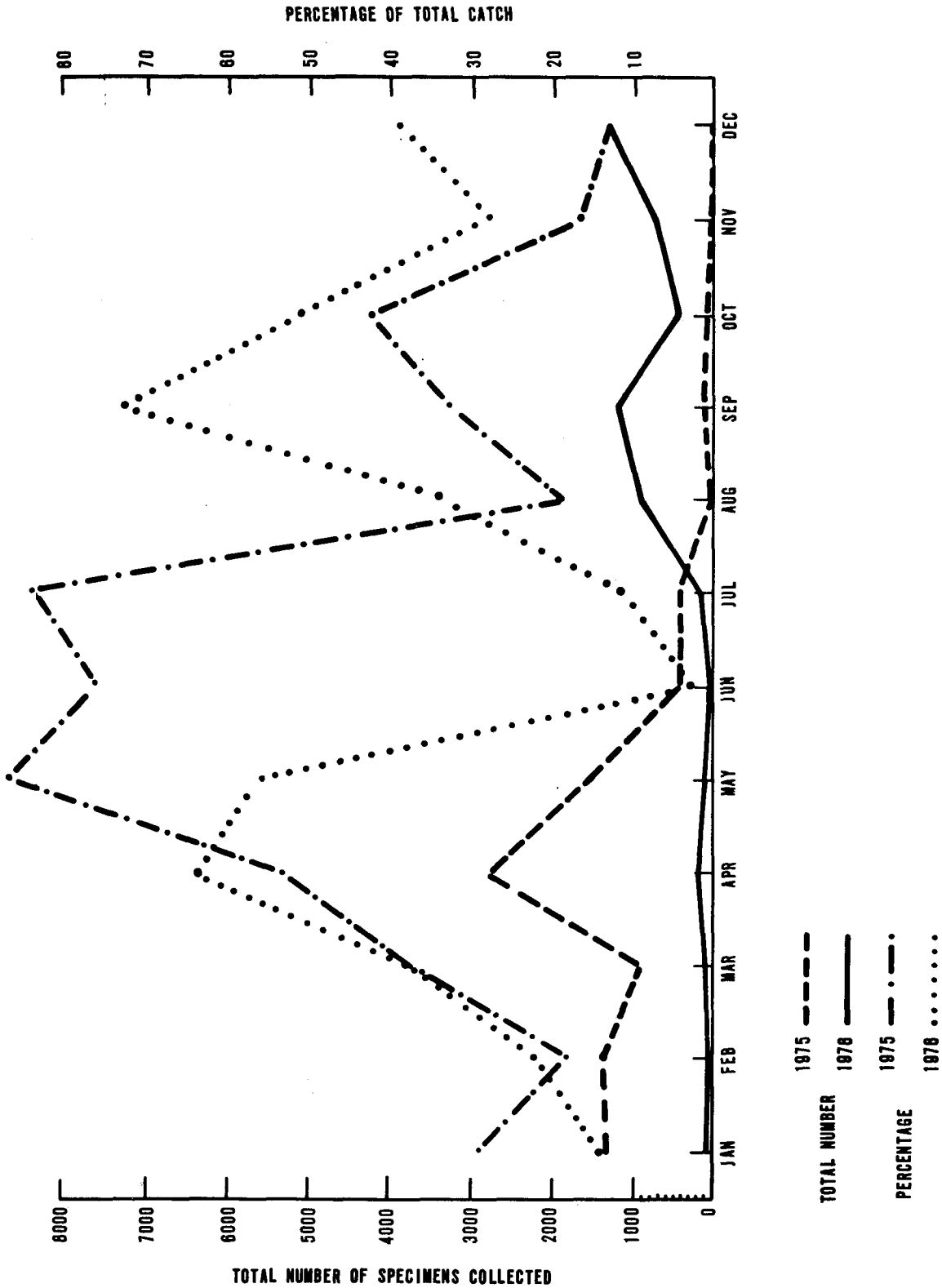
FIGURE 2.2-7



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

TEMPORAL VARIATION IN TOTAL CATCH AND PERCENT RELATIVE ABUNDANCE OF SWALLOWTAIL SHINER COLLECTED BY SEINE.

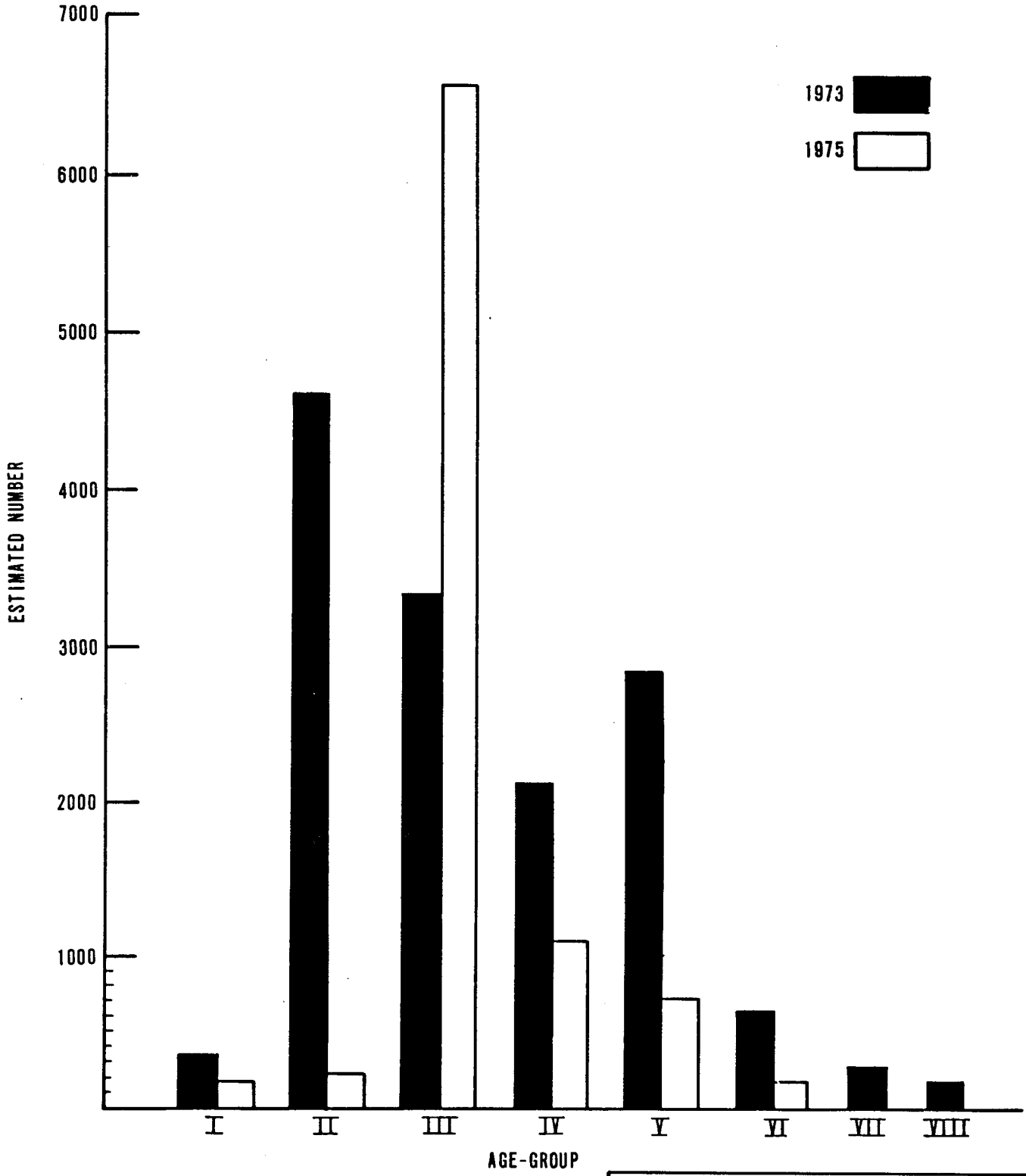
FIGURE 2.2-8



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

TEMPORAL VARIATION IN TOTAL CATCH AND PERCENT RELATIVE ABUNDANCE OF SPOTFIN SHINER COLLECTED BY SEINE.

FIGURE 2.2-9



LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

LATE SUMMER AGE STRUCTURE
OF BROWN BULLHEAD

FIGURE 2.2-10

LEGEND

A – AQUATIC INSECTS

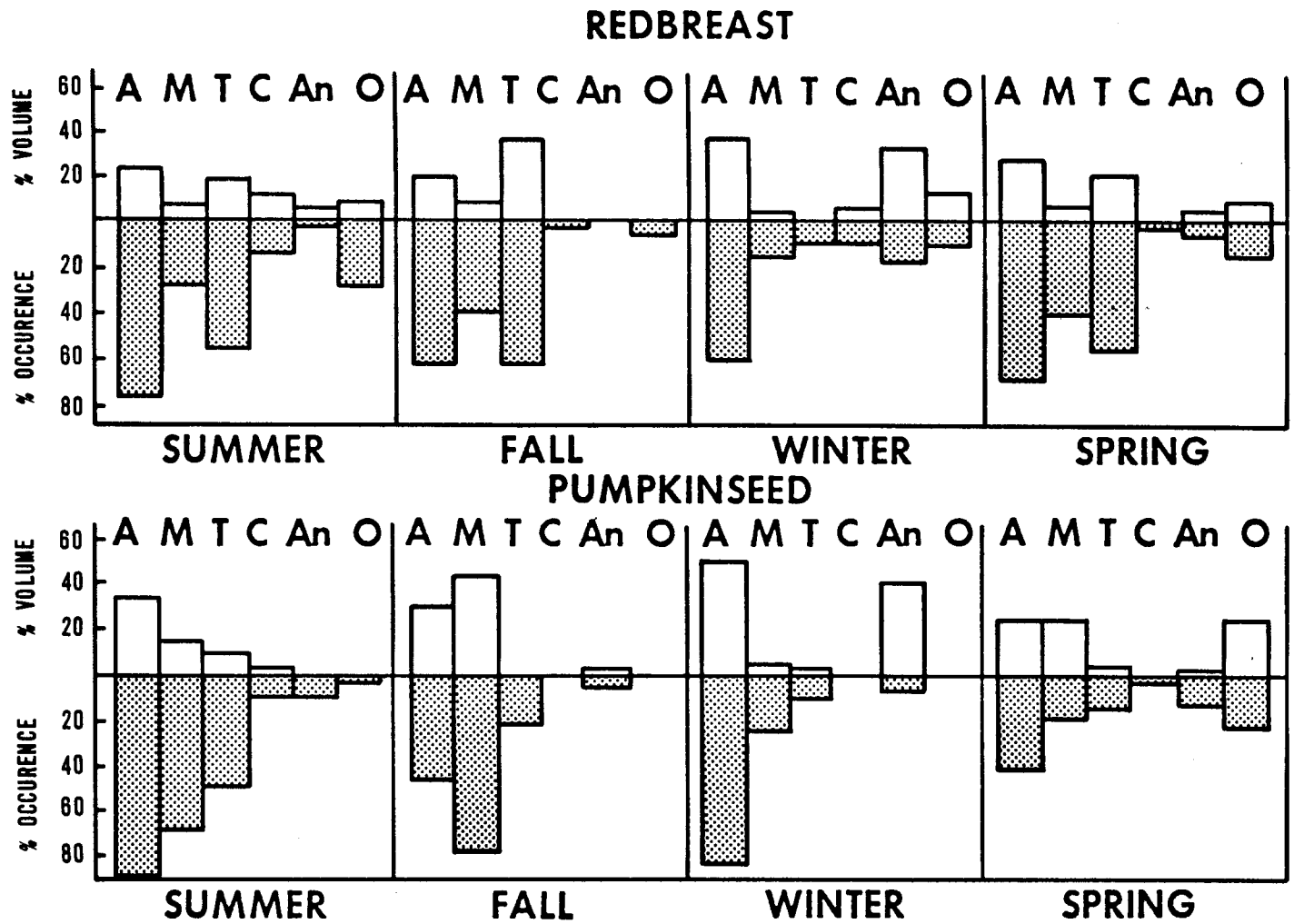
M – MOLLUSCA

T – TERRESTRIAL ORGANISMS

C – CRUSTACEA

An – ANNELIDA

O – OTHER AQUATIC ORGANISMS



FISH COLLECTED FROM THE SCHUYLKILL RIVER (S77240–S75350), 19 JUNE, 1973 THROUGH 11 JUNE, 1974.

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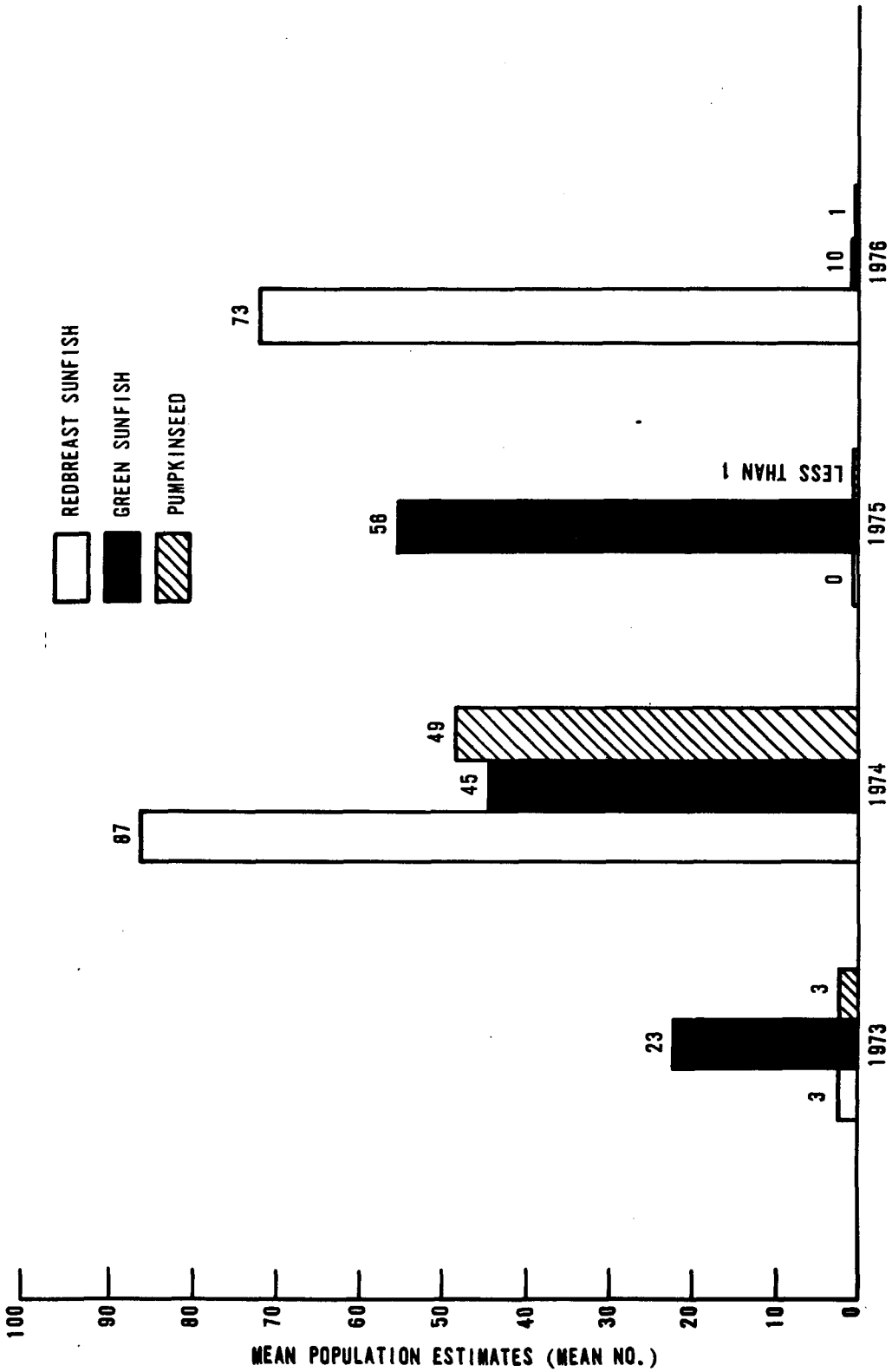
UNITS 1 AND 2
ENVIRONMENTAL REPORT

SEASONAL FEEDING TRENDS OF REDBREAST SUNFISH AND PUMPKINSEED

FIGURE 2.2-11



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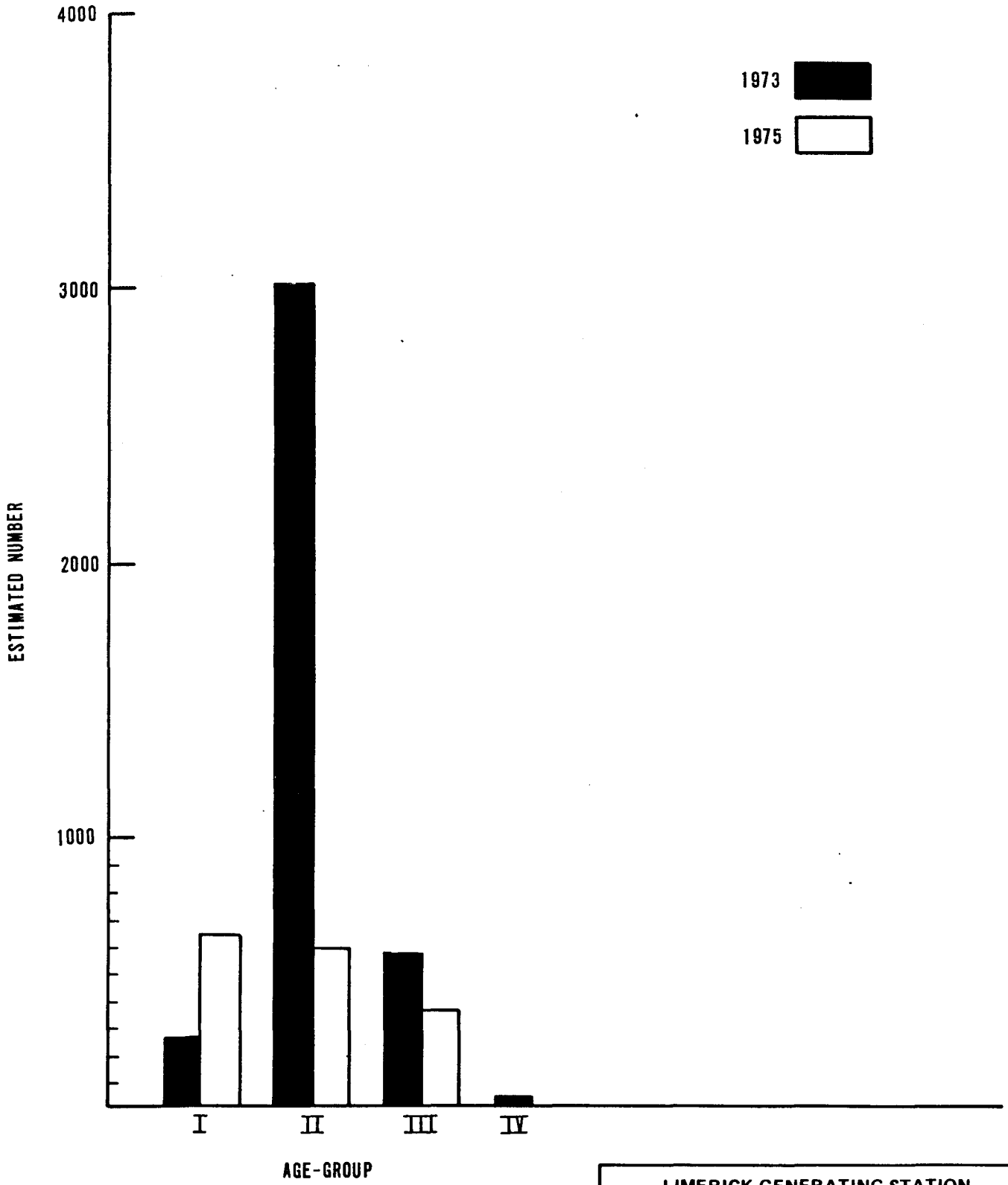
MEAN POPULATION ESTIMATES (MEAN NO. FOR ALL SITES COMBINED) BY YEAR OF AGE GROUP 0 REDBREAST SUNFISH, GREEN SUNFISH, AND PUMPKINSEED IN THE SCHUYLKILL RIVER NEAR LGS, 1973-1976.

FIGURE 2.2-12



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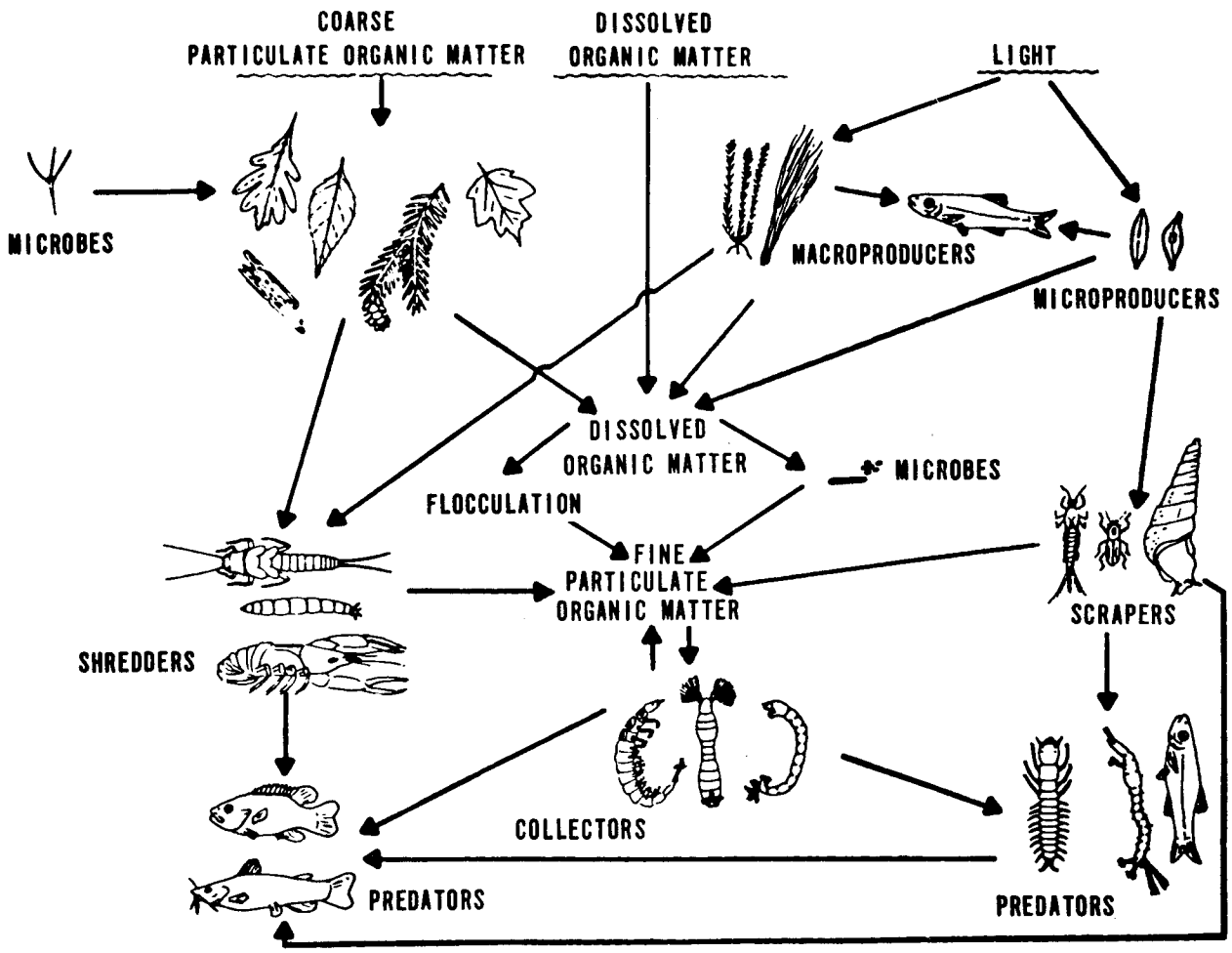
LATE-SUMMER AGE STRUCTURE
OF PUMPKINSEED

FIGURE 2.2-13



(MODIFIED FROM CUMMINS, REF 2.2-60)

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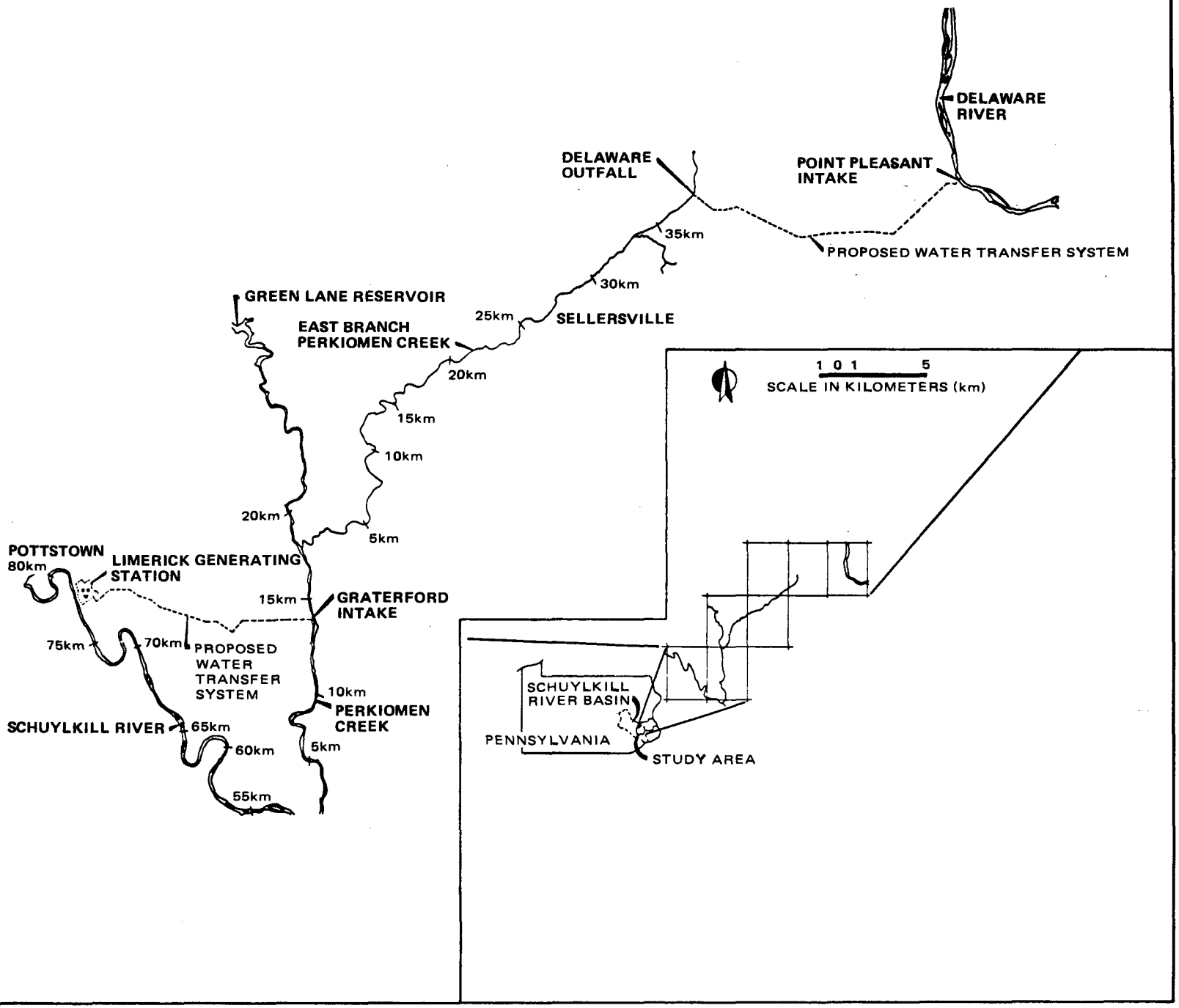
REPRESENTATION OF THE STRUCTURE AND FUNCTION OF SELECTED BIOTIC COMPONENTS

FIGURE 2.2-14



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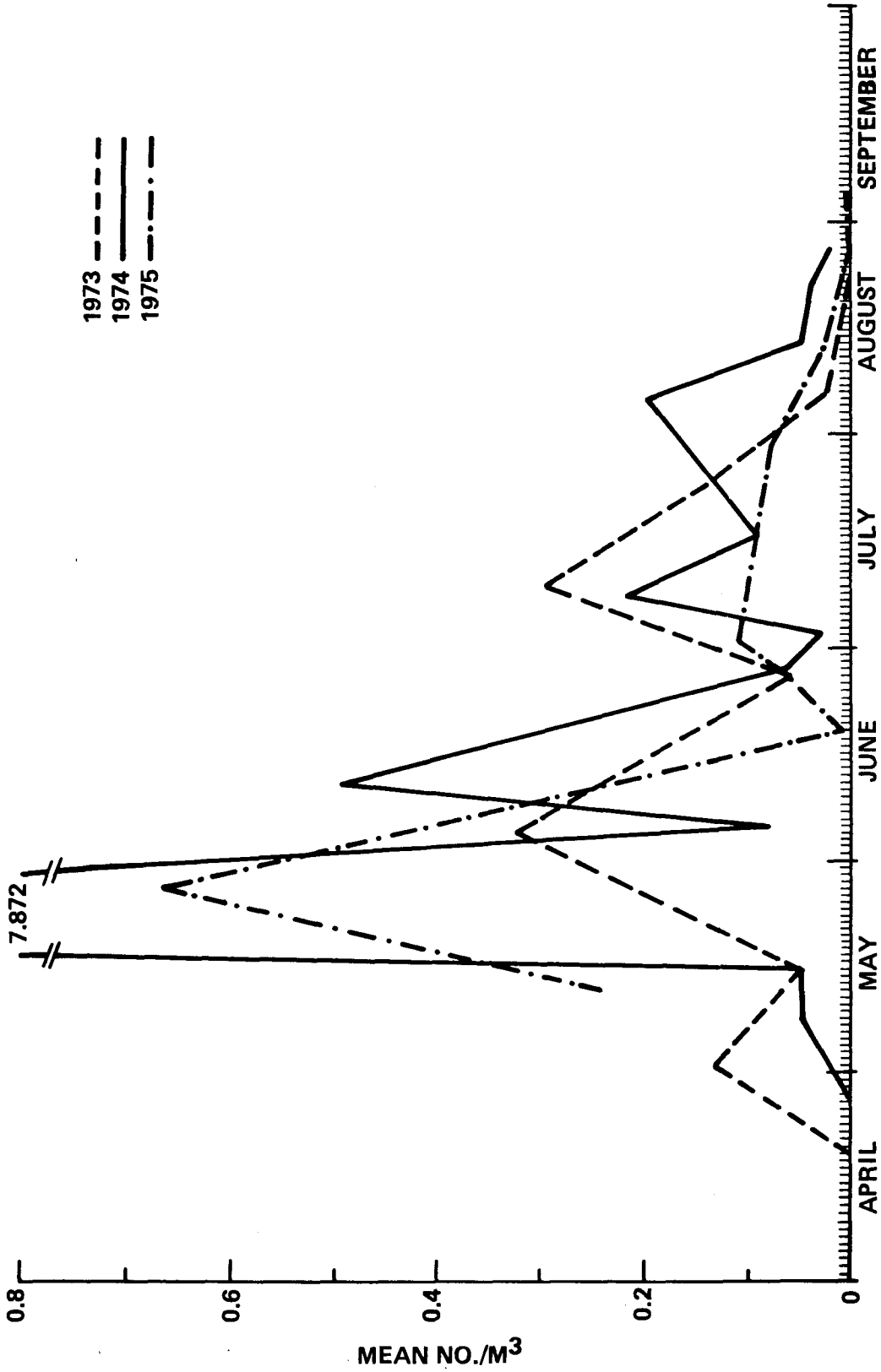
PERKIOMEN CREEK AND EAST BRANCH PERKIOMEN CREEK STUDY AREA.

FIGURE 2.2-15



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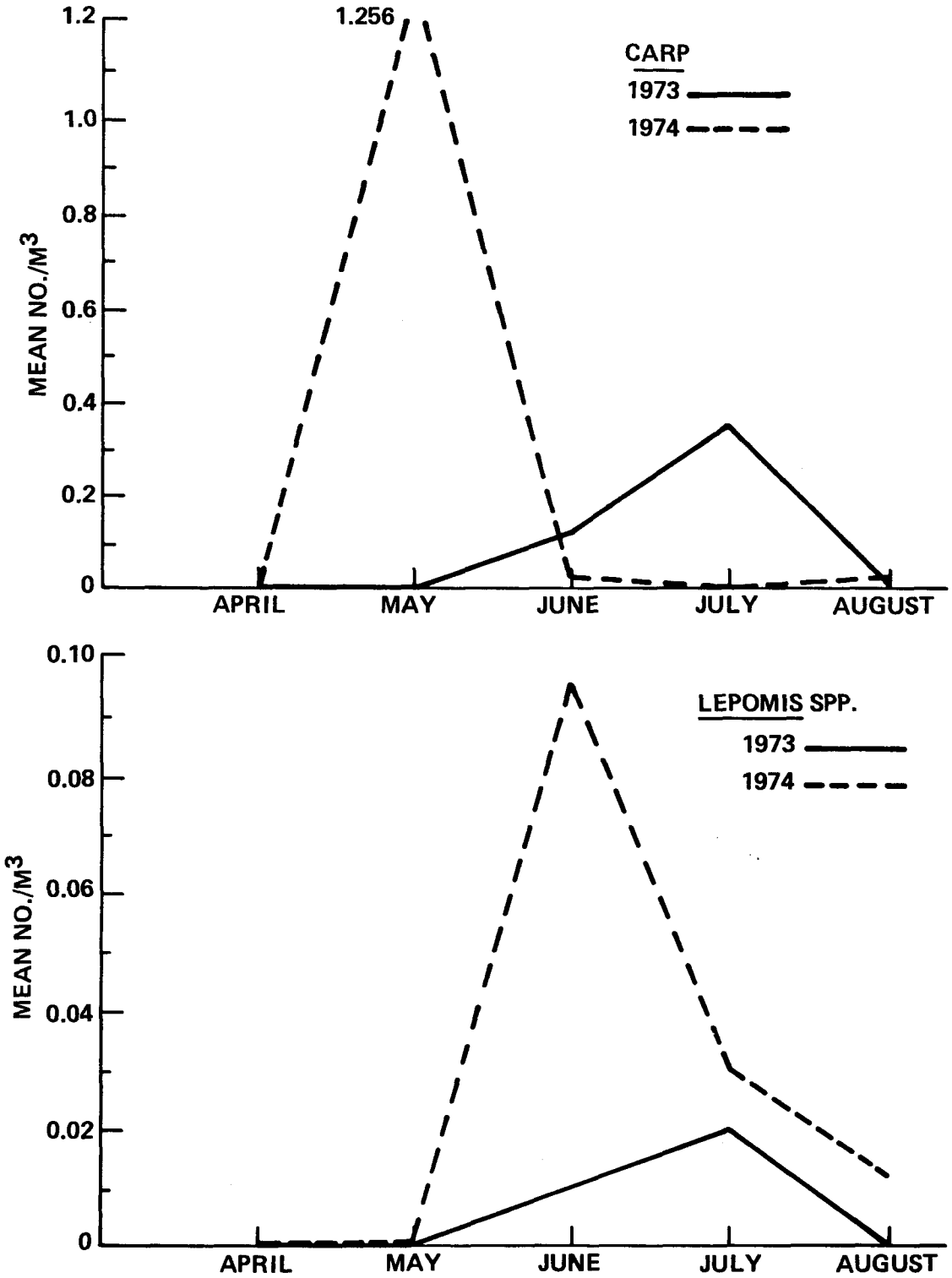
TEMPORAL VARIATION IN LARVAL FISH DRIFT DENSITY (MEAN NO./M^3) AT P14390 IN PERKIOMEN CREEK, 1973–1975. DENSITY VALUES WERE BASED ON BOTTOM NETS IN THE WEST CHANNEL

FIGURE 2.2-16



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UNITS 1 AND 2
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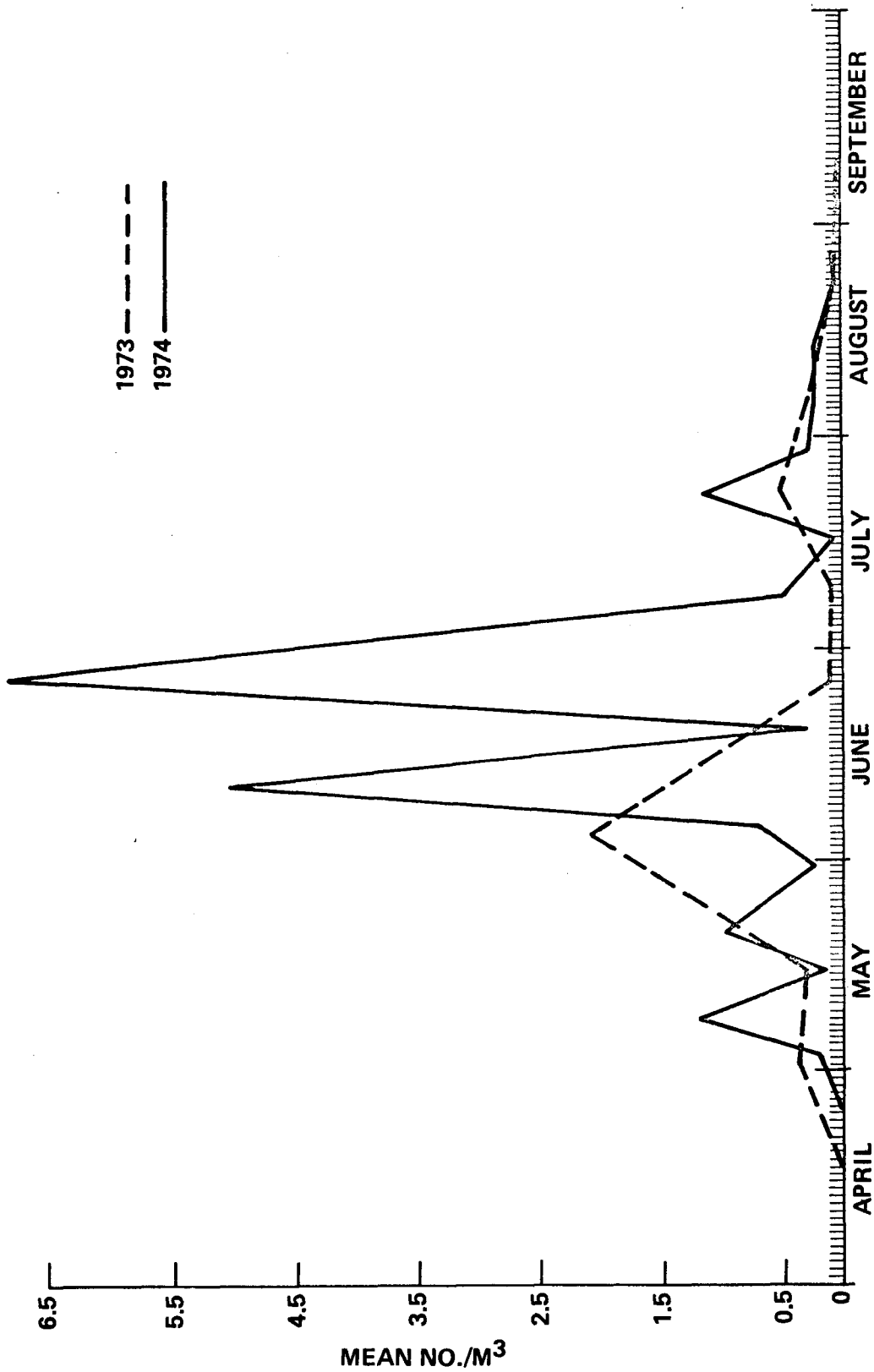
MONTHLY DRIFT DENSITY (MEAN NO./M^3) OF CARP AND LEPOMIS SPP LARVAE COLLECTED FROM PERKIOMENCREEK AT P14390 IN 1973 AND 1974.

FIGURE 2.2-17



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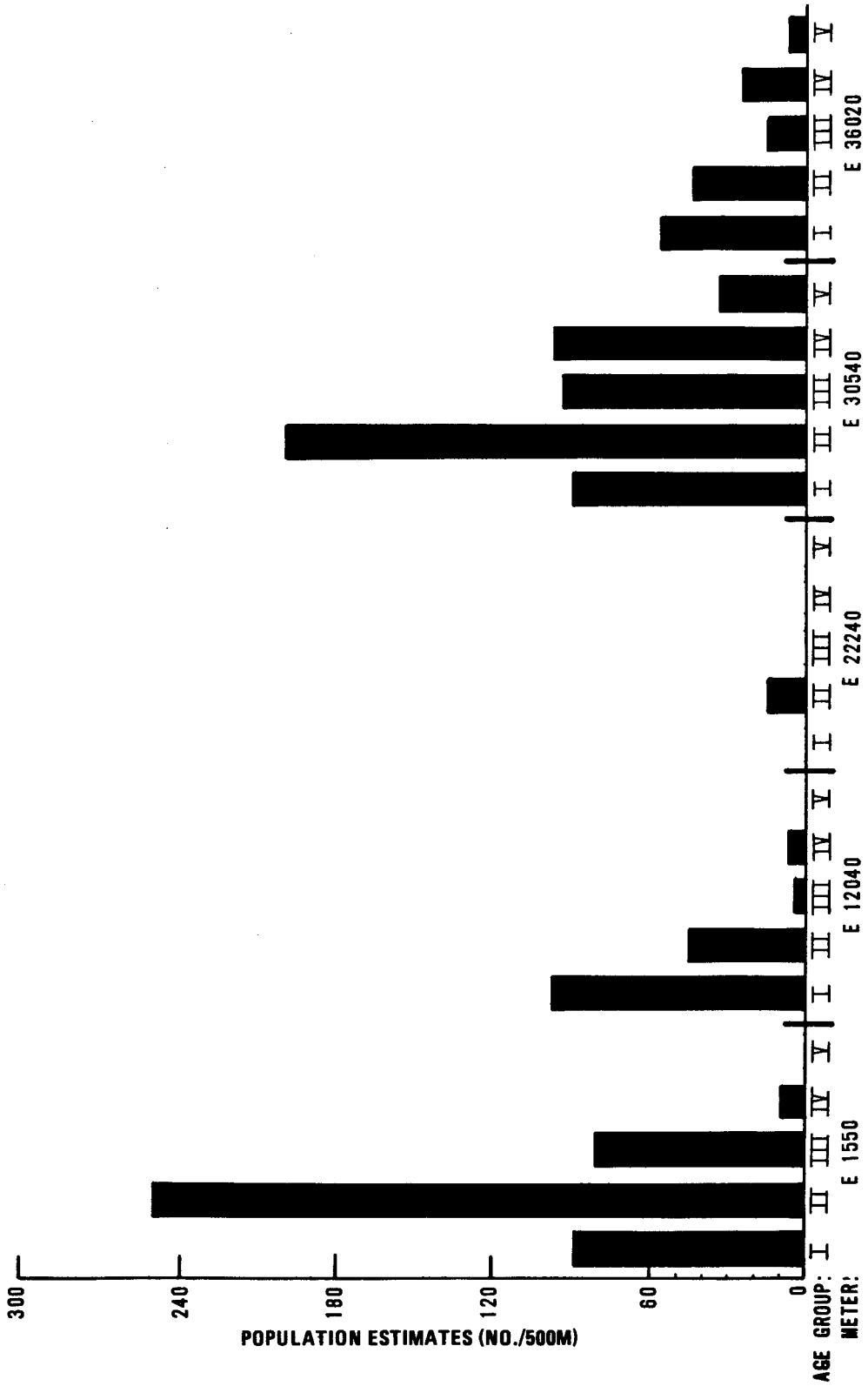
UNITS 1 AND 2
ENVIRONMENTAL REPORT

TEMPORAL VARIATION IN LARVAL FISH DRIFT DENSITY (MEAN NO./M^3) AT E2650 IN EAST BRANCH PERKIOMEN CREEK, 1973 AND 1974.

FIGURE 2.2-18



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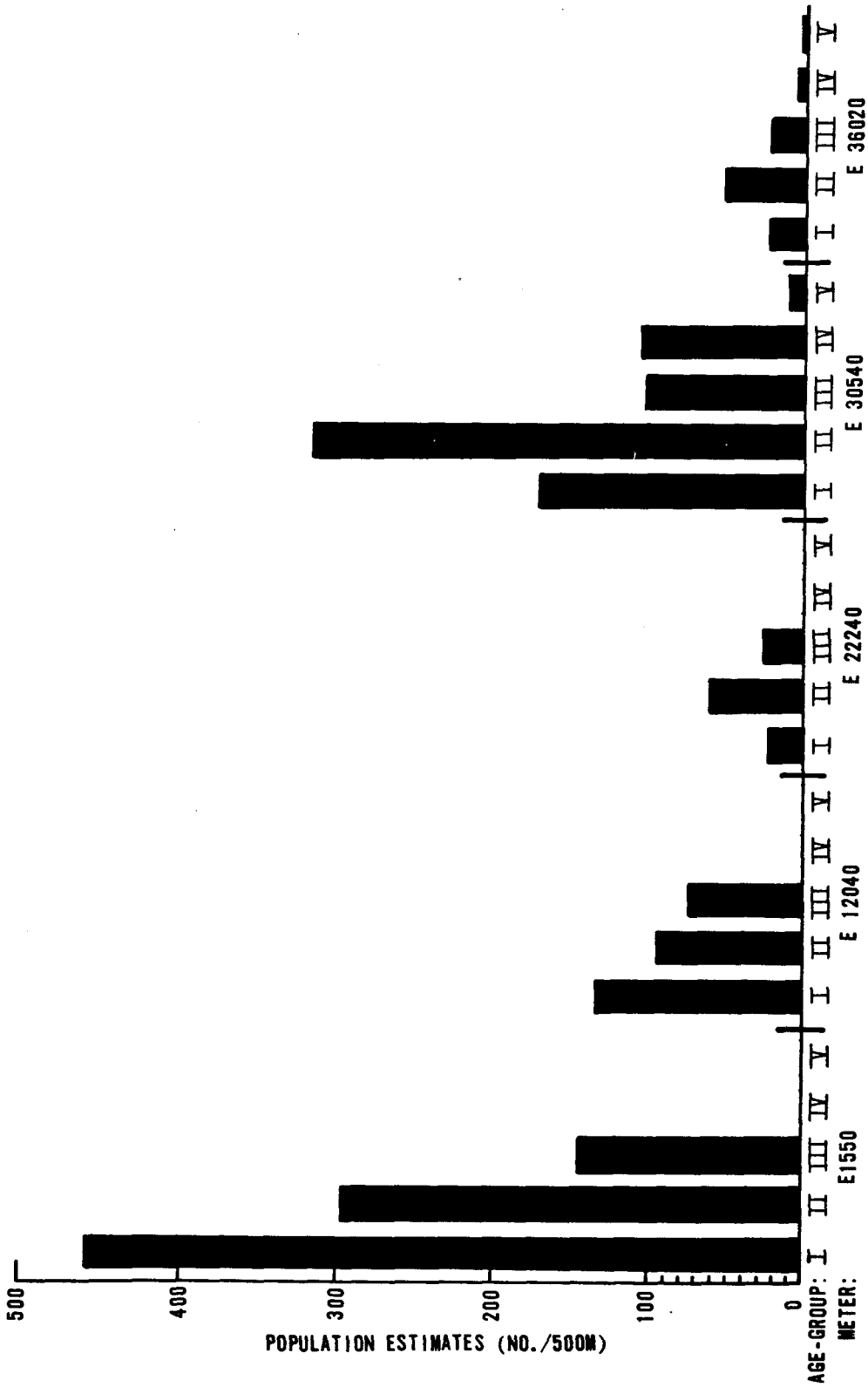
UNITS 1 AND 2
ENVIRONMENTAL REPORT

POPULATION ESTIMATES (NO./500M) OF REDBREAST SUNFISH BY AGE-GROUP FOR FIVE LOTIC SITES ON EAST BRANCH PERKIOMEN CREEK IN SEPTEMBER AND OCTOBER, 1973.

FIGURE 2.2-19



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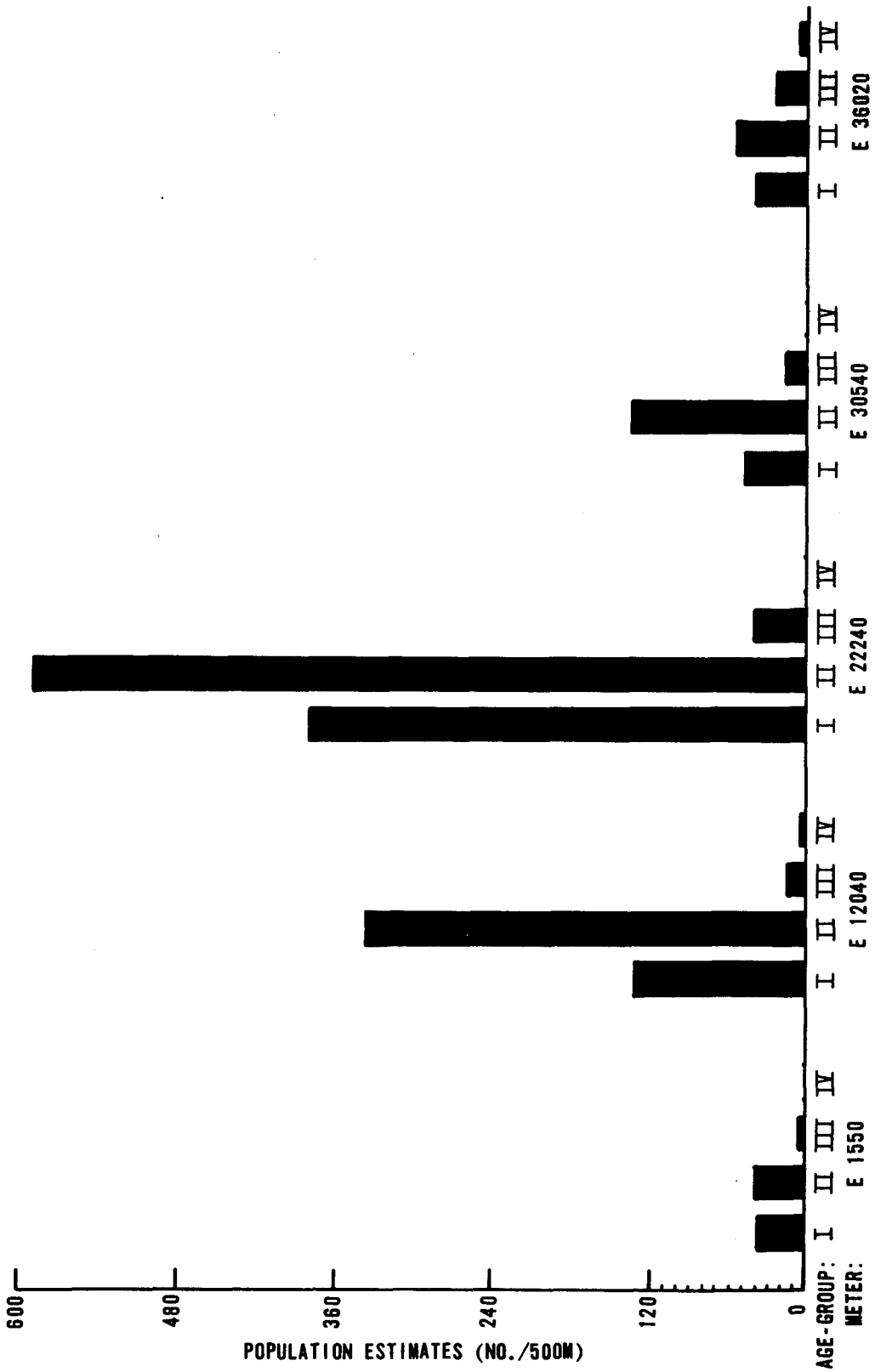
UNITS 1 AND 2
ENVIRONMENTAL REPORT

POPULATION ESTIMATES (NO./500M) OF REDBREAST SUNFISH BY AGE-GROUP FOR FIVE LOTIC SITES ON EAST BRANCH PERKIOMEN CREEK IN SEPTEMBER, 1975.

FIGURE 2.2-20



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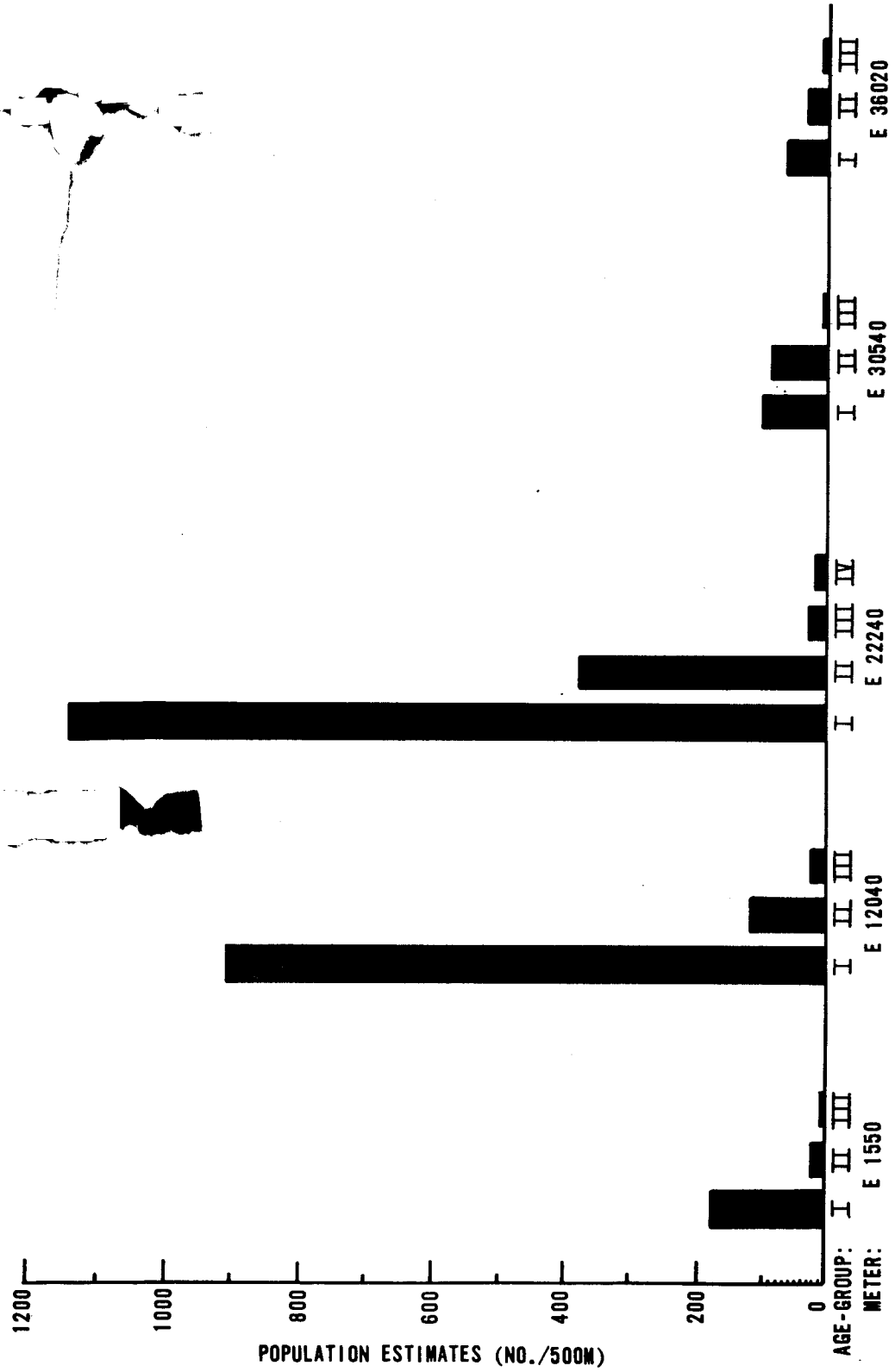
UNITS 1 AND 2
ENVIRONMENTAL REPORT

POPULATION ESTIMATES (NO./500M) OF GREEN SUNFISH BY AGE-GROUP AT FIVE LOTIC SITES ON EAST BRANCH PERKIOMEN CREEK IN SEPTEMBER AND OCTOBER, 1973.

FIGURE 2.2-21



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POPULATION ESTIMATES (NO./500M) OF GREEN SUNFISH BY AGE-GROUP AT FIVE LOTIC SITES ON EAST BRANCH PERKIOMEN CREEK IN SEPTEMBER, 1975.

FIGURE 2.2-22