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Simulation of Streamflow Regulation Effects on the Water Quality of the Allegheny River

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14. ABSTRACT
This report documents the water quality impact on the Allegheny River basin for the existing regulation of all nine Corps reservoirs compared to both smaller low flow season releases and natural flow conditions. The Corps computer model, "Water Quality for Rivers-Reservoir Systems" (WQRRS), was calibrated and verified to observed water quality data and used to simulate the two alternative conditions.

15. SUBJECT TERMS
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PREFACE

This report was prepared by G. T. Orlob and Associates of Benicia, California, under the supervision of Dr. Gerald T. Orlob. Mr. Paul W. Hadley performed the computer simulations for the study and prepared the draft report. Mr. Donald J. Smith of Resource Management Associates of Lafayette, California, served as consultant to the project.

Appendix C was written by Mr. R. G. Willey of the Hydrologic Engineering Center to provide the reader with water quality duration curves. The development of the water quality duration curves was beyond the scope of the contract with G. T. Orlob and Associates.

The entire project was administered under the direction of Mr. Willey for the Corps of Engineers Pittsburgh District and the Office Chief of Engineers.

SIMULATION OF STREAMFLOW REGULATION EFFECTS
ON THE WATER QUALITY OF THE
ALLEGHENY RIVER

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I. INTRODUCTION

The United States Army Corps of Engineers (COE) operates a system of nine reservoirs in the Allegheny River basin that controls approximately 45% of the total drainage area of the basin. In addition to the flood control and recreation benefits that these facilities provide, the COE has operated the reservoir system to enhance the water quality of the Allegheny River since the construction of Allegheny Reservoir (Kinzua Dam) in 1967. The principal water quality objective of the system operation is to control the adverse effects of the acid mine drainage that pollutes the Kiskiminetas River on the water quality of the lower Allegheny River.

The purpose of this study was to develop and test a model that could simulate water quality conditions in the Allegheny River basin under different hydrologic and reservoir operational conditions. The periods chosen for study were 1 June 1975 through 31 October 1975, and 1 July 1977 through 30 September 1977. Streams modeled in this study include a 190.5 mile reach of the Allegheny River from Kinzua Dam downstream to the vicinity of Pittsburgh, Pennsylvania, and three major, regulated tributaries: French Creek, the Clarion River, and the Kiskiminetas River. The selected hydrologic conditions are:

- Existing Conditions - all facilities in place and operated as they were during the study period.
- Pattern A - all facilities in place and operated as they were during the study period, except that the outflow from Kinzua Dam is reduced to 500 cfs during the period from 5 July through 30 September for both test years.
- No Corps Storage - unregulated streamflows as they would occur without Corps of Engineers reservoirs in the basin.

Hydraulic and water quality simulations were performed using a COE computer program entitled "Water Quality for River-Reservoir Systems" (Smith, 1978). Data required as input to the program included geometric cross section data for each river or river reach, flow rates, meteorological data and water quality data.

Results of water quality simulations were analyzed using the COE computer programs "Water Quality Statistics" (WQSTAT), "Water Quality Plot" (WQPLOT), and "Water Quality Profile" (WQPROFILE). Information is provided for comparison purposes in the form of statistical summaries of system responses and graphical displays of selected water quality constituents at key locations and times. Data files, including both input data and simulation results, are the principal products of the study. This report provides documentation of study methodology and preliminary interpretation of illustrative examples of simulation results.

II. SUMMARY

The Hydrologic Engineering Center (HEC) computer program "Water Quality for River-Reservoir Systems" (WQRRS) was applied to the Allegheny River System between Lock and Dam No. 2 (River Mile 6.7) and Kinzua Dam (River Mile 197.2). Hydrologic conditions for the system, including major tributaries, were simulated for the summers of 1975 and 1977. Three conditions of operation were considered:

- Existing Conditions--with all facilities in place and operating,
- Pattern A--with the outflow of Allegheny Reservoir reduced to 500 cfs over the period 5 July through 30 September, and
- No Corps Storage--with no Corps of Engineers regulation.

These results were then used in WQRRS to simulate changes in water quality, including temperature, alkalinity, total dissolved solids, pH, BOD, and dissolved oxygen for each of the selected operating conditons. Simulation results of Existing Conditions study case compared favorably with observed water quality conditions during the 1975 and 1977 study periods. Therefore, the model was considered suitable for use in analysis of the effects of storage and regulation on water quality, particularly of extreme events that may be of environmental or economic consequence. Illustrative examples of comparisons that can be made with the results of simulations are presented and briefly described.

Streamflows during both the 1975 and 1977 study periods were considered to be above normal. As such, these study periods provided little representation of the low-flow conditions under which streamflow regulation can provide maximum enhancement of water quality throughout the basin, and particularly in the lower Allegheny River. However, the following general conclusions are evident from analysis of the simulation results.

- The existence of storage and regulation in the Allegheny River system tends to reduce water quality extremes.
- In the absence of Corps of Engineers facilities in the basin or without planned system operation of existing facilities, there is an increased likelihood that adverse water quality changes could occur.

Additional detailed analysis, not within the scope of the present study, is required to evaluate specific consequences of storage, regulation or other means of water quality control in the Allegheny River System. Basic water quality data which were used in this study and which may be required in subsequent analysis are documented on files. They are identified as to source in Appendix A. Results of 30 simulation runs performed with WQRRS are available also on computer output files and are summarized in statistical form in Appendix B.

III. DESCRIPTION OF THE STUDY AREA

PHYSICAL SETTING

From its source in north central Pennsylvania, the Allegheny River flows in a northwest direction into New York State. The river then turns toward the southwest and flows back into Pennsylvania. After re-entering Pennsylvania, the Allegheny River flows southwest for 210 miles to Pittsburgh, Pennsylvania, where it joins the Monongahela River to form the Ohio River (Figure 1). The total length of the Allegheny River is 321 miles.

The Allegheny River drains an area of 11,778 square miles. Approximately 83% of the drainage basin is in Pennsylvania, and the remainder is in New York State. The Allegheny River basin, including major tributaries, is shown in Figure 1. The drainage areas and slopes of principal tributaries are listed in Table 1.

Elevations in the Allegheny River basin range from 2,993 feet NGVD* on Allegheny Mountain to less than 700 feet NGVD in the thalweg at the mouth of the Allegheny River. The northwestern portion of the basin is a mature glaciated plateau with gentle slopes and many lakes and swamps. The remainder of the Allegheny River drainage basin is characterized by rough topography, particularly in the eastern tributary areas. The northeastern part of the basin is a highly dissected peneplain. To the southeast in the Allegheny Mountain section, the drainage is dominated by several large structural folds. In this area, the amplitude of folding is approximately 2,000 feet between anticlinal crest and synclinal troughs. The Conemaugh River and Loyalhanna Creek are the major Allegheny River tributaries draining this mountainous region.

The climate of the Allegheny River basin is temperate and humid with fairly wide seasonal variations in temperature. Temperatures in excess of 90°F and below 0°F can be expected annually throughout the study area. The prevailing wind is from the west or has a westerly component. Precipitation in the basin varies with location and ranges from 36 to 43 inches per year.

The unregulated stream discharges in the Allegheny River basin have a wide seasonal variation. The highest flows generally occur during the months of December through April when soils are saturated or frozen and conducive to high runoff. However, it is possible for major floods to occur at anytime of the year. Most of the floods during the winter and early spring periods are the results of prolonged rainfall over large areas, sometimes accompanied by snow melt. The summer floods generally result from intense thunderstorm rainfall, which may be very local in extent. However, tropical storms may also occur during the summer and fall seasons and can cause extensive flooding over the basin. The river normally freezes in the winter months, and ice jams frequently cause local flooding.

The Allegheny River basin can be characterized as low to moderate yielding at base flow with the ground water contribution to stream flow being relatively uniform throughout the basin. The discharge of unregulated streams is often low in the late summer and early fall. The average 7-consecutive-day-once-in-ten-year low-flow is shown in Table 2 for selected locations on the Allegheny River mainstem.

*National Geodetic Vertical Datum

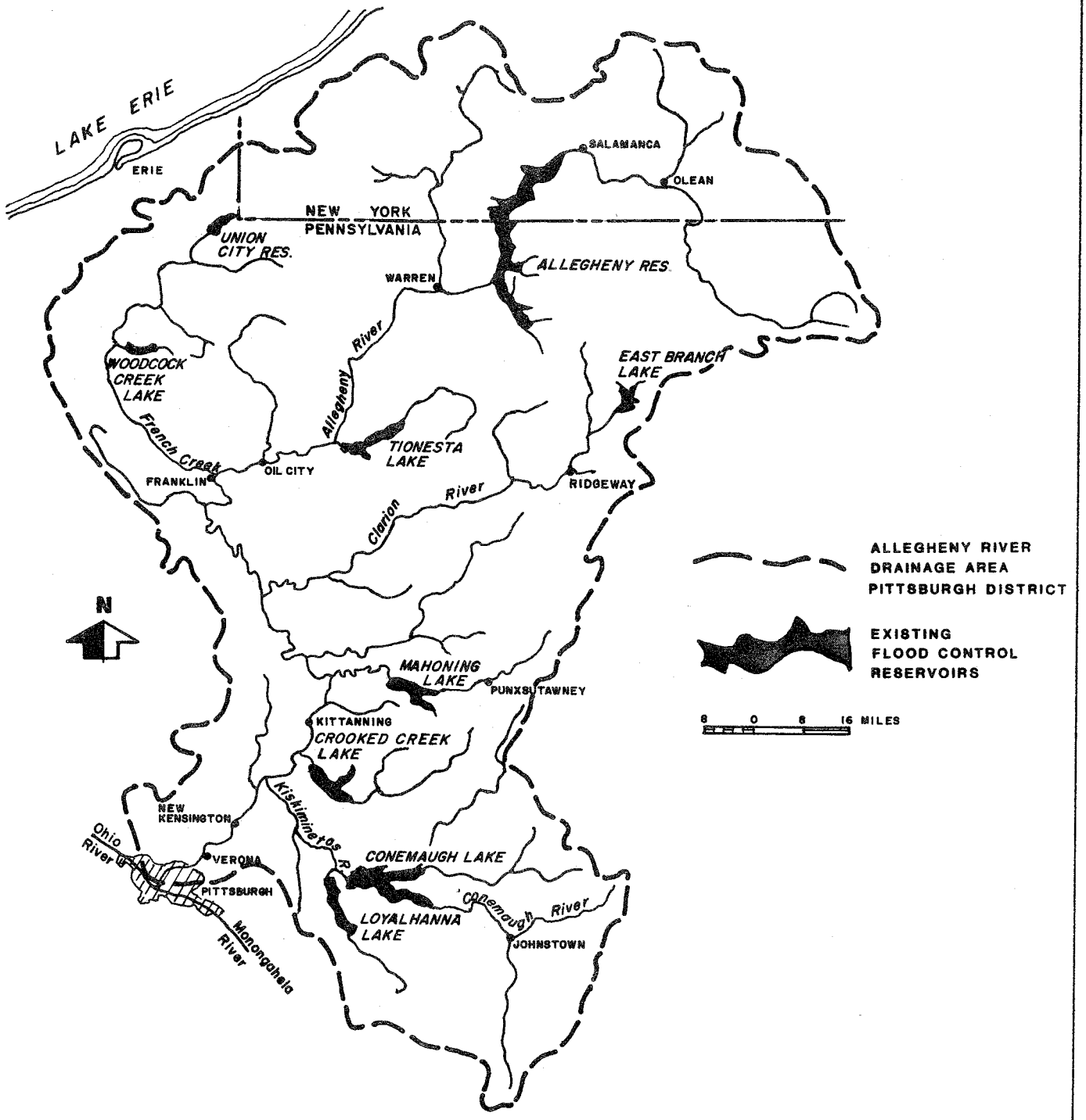


Figure 1. Allegheny River Watershed

Table 1. ALLEGHENY RIVER BASIN PRINCIPAL TRIBUTARIES

TRIBUTARY	DRAINAGE AREA SQ. MI.	LENGTH MILES	ENTERS ALLEGHENY RIVER LB OR RB	ENTERS ALLEGHENY RIVER MILES ABOVE MOUTH	AVERAGE SLOPE FT/MI
Kiskiminetas River	1,887	27	LB	30.2	3.4
Crooked Creek	292	57	LB	40.2	9.1
Mahoning Creek	425	64	LB	55.5	8.0
Red Bank Creek	573	56	LB	64.0	8.4
Clarion River	1,252	101	LB	84.5	6.0
French Creek	1,235	115	RB	124.1	6.5
Oil Creek	318	43	RB	131.4	9.5
Tionesta Creek	478	39	LB	151.4	13.1
Brokenstraw Creek	338	51	RB	181.3	5.8
Conewango Creek	898	51	RB	188.9	4.0
Olean Creek (a)	208	9	RB	251.9	3.6
Potato Creek (a)	224	27	LB	273.7	5.4
Allegheny River (TOTAL)	11,778	321	--	---	3.1

(a) Upstream of Kinzua Dam.

Table 2. ALLEGHENY RIVER LOW FLOW

Location	Drainage Area (sq. mile)	River Mile	7-consecutive-day 10-year average recurrence interval (cfs)
Franklin	5,982	123.9	1,250
L/D 7 (Kittanning)	8,973	45.7	2,250
L/D 4 (Natrona)	11,410	24.2	2,900

Approximately 1.5 million persons reside within the boundaries of the Allegheny River drainage basin. Population densities are highest in the lower Allegheny and Kiskiminetas River basin counties of Allegheny, Westmoreland, Armstrong, and Cambria. The total combined population of counties entirely or partially within the basin is 3.7 million persons (from 1970 census).

Along the 30 miles of the Allegheny River downstream of the confluence of the Kiskiminetas River, there are ten water supply treatment plants that withdraw water from the river. The combined design average withdrawal of these ten facilities is more than one hundred million gallons per day, and the population served is approximately 900,000 persons.

Manufacturing industries in the basin are diversified. The major industries are: primary metal products, electrical machinery equipment and supplies, fabricated metal products, petroleum, wood, stone, clay, and glass products. The principal manufacturing communities include: Jamestown and Olean, New York; and Oil City, Meadville, Bradford, Warren, Franklin, Johnstown, Indiana, Punxsutawney, Johnsonburg, Ridgeway, Dubois, New Kensington, Vandergrift, and Pittsburgh, Pennsylvania.

A series of locks and dams in the lower 72 miles of the Allegheny River facilitates commercial and recreational navigation.

There are nine existing fossil fuel, one hydroelectric, and one pumped storage electric power generating facilities in the basin. Total combined capacity is 6,744.5 megawatts, and thermal pollution problems exist at low flow in several reaches of the river.

Coal, oil, natural gas, stone, clay, sand and gravel are commercially extracted in the basin. Oil production, especially in the northeastern portion of the basin, has resulted in localized pollution by brines and other oil field wastes. Acid mine drainage from active and abandoned bituminous coal mining operations is the most serious water quality problem in the southern part of the Allegheny River drainage basin. Mine drainage is contributed by all major left bank tributaries from the Clarion River south to the mouth of the Allegheny River. The severely degraded Kiskiminetas

River, however, is the most significant single source of acid loading not only in the Allegheny River drainage, but the entire Ohio River basin.

Other important land uses include agriculture and silviculture. All of the Allegheny National Forest is drained by the Allegheny River. Considerable outdoor recreation facilities exist in the National Forest, Corps of Engineers projects, and State Forests, gamelands and parks of the basin.

THE CORPS OF ENGINEERS RESERVOIR SYSTEM AND ITS OPERATION

Eight tributary reservoirs and one mainstem impoundment have been constructed in the Allegheny River basin by the Corps of Engineers. The locations of these projects are shown in Figure 1, and the pertinent data are presented in Table 3.

All of the reservoirs are operated for flood control. The reservoirs reduce flood flows by storing water during peak runoff periods. Stream flows are then increased during low-flow periods by gradually releasing the water stored during the high runoff periods. Allegheny Reservoir, Woodcock Creek Lake, and East Branch Clarion River Lake also have storage allocated for low-flow augmentation and water quality: 549,000, 4,000, and 64,300 acre-feet, respectively. With its large volume of storage, Allegheny Reservoir is the most effective for maintaining downstream water quality. The rate of normal low-flow release is predicated on the natural flows at Franklin and Natrona, Pennsylvania. The outflow, however, can be adjusted to control critical water quality conditions on either the Allegheny River or the Ohio River. Woodcock Creek Lake and East Branch Clarion River Lake are operated primarily to meet tributary requirements rather than mainstem objectives.

In 1967, a system operation of Allegheny River basin reservoirs was initiated to control water quality in the Allegheny River. One of the principal objectives of the system operation is to mitigate the impact of the grossly polluted Kiskiminetas River on the lower Allegheny River.

The acidic Kiskiminetas River enters the Allegheny River 30 miles upstream of Pittsburgh. It drains an area of 1,887 square miles. Below its point of confluence with the Allegheny River, the Kiskiminetas River drainage accounts for 17% of the total Allegheny River drainage area. Experience has demonstrated that during summer low-flow periods when the contribution of the Kiskiminetas River is roughly 17% or less of the total Allegheny River flow, the Allegheny River can assimilate the Kiskiminetas acid loading through dilution and neutralization without any significant depression in downstream pH. Prior to the initiation of the current system operation, this 17% limit was frequently exceeded and produced acid slugs and fish kills in the lower Allegheny River.

Reservoir operations are now designed to limit the percentage of the total discharge that the Kiskiminetas River contributes to the total Allegheny River flow at their confluence. This limitation is more restrictive during summer low-flow periods. During higher flow periods that generally occur during the winter and early spring months, a greater percentage of the Kiskiminetas River flow can be tolerated without any adverse effect on Allegheny River water quality and aquatic life.

Table 3. CORPS OF ENGINEERS RESERVOIRS IN THE ALLEGHENY RIVER BASIN

Reservoir	Initial Date of Operation	Drainage Area sq.mi.	Storage (acre feet) Full Pool	Storage (acre feet) Summer Pool	Average Discharge* cfs	Authorized Project Uses
Allegheny Reservoir (Kinzua Dam)	Jan 1967	2,180	1,180,000	573,000	3,834	Flood control, low-flow augmentation for water quality control of Allegheny River and downstream points, power generation and recreation.
Tionesta Lake	Dec 1940	478	133,400	7,800**	867	Flood control
Union City Reservoir	Jul 1970	220	47,650	20	427	Flood control
Woodcock Creek Lake	Jan 1974	45.6	20,000	4,930	76.3	Flood control, low-flow augmentation for water quality control and recreation
East Branch Clarion River Lake	Jun 1952	72.4	84,300	65,300	136	Flood control, low-flow augmentation of Clarion and downstream rivers for water quality
Mahoning Creek Lake	Jun 1951	340	74,200	9,520***	598	Flood control and recreation
Crooked Creek Lake	May 1940	277	93,900	4,500**	423	Flood control
Conemaugh River Lake	Nov 1953	1,351	273,600	4,000**	2,388	Flood control
Loyalhanna Lake	Sep 1942	290	95,300	2,000**	483	Flood control

* Through 1979
** Minimum Pools
*** As of August 27, 1981 a summer recreational pool storage of 9,520 feet was initiated

Potentially, eight of the nine reservoirs in the Allegheny River basin can be utilized in this water quality system operation (Union City Reservoir is excluded since it does not have a permanent storage pool). However, Allegheny Reservoir and Conemaugh River Lake play the principal and crucial roles in the operation.

Allegheny Reservoir, located 168 miles upstream of the mouth of the Kiskiminetas River, supplies most of the high quality augmentation for dilution and neutralization. Conemaugh River Lake is located within and controls 72% of the Kiskiminetas River basin. As can be seen in Table 4, the Conemaugh Dam outflow is extremely acidic. When necessary, Conemaugh River Lake is used to retain acid flows until augmentation is available from Allegheny Reservoir and to prevent acid peaks from the Conemaugh River basin from coinciding with first flush acid shock loading from the downstream uncontrolled portion of the Kiskiminetas watershed. Conemaugh River Lake was not designed for this purpose, and the operation temporarily uses a portion of its flood control storage for one to two weeks following a storm event.

Table 4. SUMMARY OF pH* VALUES IN THE KISKIMINETAS RIVER

Location	Period	Number of Observations	Max	Min	Mean
Conemaugh Dam Outflow	Jan 72 to Dec 77	154	4.8	2.6	3.9
Kiskiminetas River at Vandergrift (River Mile 10.9)**	Jan 75 to Dec 77	17,719	6.0	2.4	4.2

* Unadjusted arithmetic mean of observed pH values.

** ORSANCO robot monitor data.

The day-to-day success of the water quality system operation is dependent upon the ability to predict downstream conditions in sufficient time to enable the augmentation releases to travel the reach from Kinzua Dam (which controls Allegheny Reservoir) to the mouth of the Kiskiminetas River. This system cannot immediately counteract heavy thundershowers that occur over the lower uncontrolled Kiskiminetas watershed. There still could be a fish-killing slug of highly acidic water flowing from the lower Allegheny River before any Corps operation could minimize the problem. However, since Kinzua Dam was placed into operation in 1967, there have been no fish kills.

The Corps of Engineers presently has a four-station Allegheny River water quality monitoring network to provide real time surveillance in the basin. The system is presently being operated by the Ohio River Valley Water Sanitation Commission (ORSANCO) and consists of three Corps of Engineers robot monitors and the existing ORSANCO monitor at Oakmont. The Corps

stations are located at the Allegheny Reservoir outflow (River Mile 197.2), the Allegheny River at Lock and Dam (L/D) 5 above the Kiskiminetas River (River Mile 30.4), the Kiskiminetas River at Vandergrift, and the Allegheny River at Oakmont below the Kiskiminetas River (River Mile 13.3). Water quality data collected hourly by ORSANCO are available to the Corps of Engineers. These data, in combination with other available data, are used during critical periods as part of the reservoir regulation considerations. The monitor at L/D 5 serves as the base station for operations and generally reflects the upstream water quality conditions. The Vandergrift monitor gives an indication of the severity of the acid slug, while the monitor at Oakmont located on the left bank of the Allegheny River, 20 miles downstream of the mouth of the Kiskiminetas River, reflects the conditions after mixing. Experience has shown that total mixing does not always occur in the river. Therefore, additional data are collected from water companies along both banks of the lower Allegheny River to supplement robot monitor data during these periods.

IV. METHOD OF STUDY

WQRRS MODEL

The Water Quality for River-Reservoir System (WQRRS) model consists of three separate but integrable programs: the reservoir water quality module (WQRRSR), the stream hydraulics module (SHP), and the stream water quality module (WQRRSQ). The Muskingum Hydrologic Routing option of SHP and WQRRSQ are discussed below.

STREAM HYDRAULICS - MUSKINGUM ROUTING

The stream system in SHP is represented as a linear network of volume elements as illustrated in Figure 2. Each element is characterized by length, width, cross sectional area, hydraulic radius, and a specific relationship between flow and depth.

The Muskingum method provides the capability to route streamflow dynamically through the system, rather than assuming steady state hydraulic conditions and either uniform or gradually varied flow profiles. This method is well suited to simulation of the rapidly changing flow conditions actually experienced in the Allegheny River basin.

The Muskingum method is based on the assumption that the incremental storage in a stream element is related to flow entering and leaving a channel reach (an element in the model), i.e.,

$$S = K(O) + X(K)\,(I-O) \qquad (1)$$

where

- S = total storage in the element, m^3
- I = inflow, m^3/sec
- O = outflow, m^3/sec
- K = empirical coefficient, seconds
- X = empirical coefficient (dimensionless)

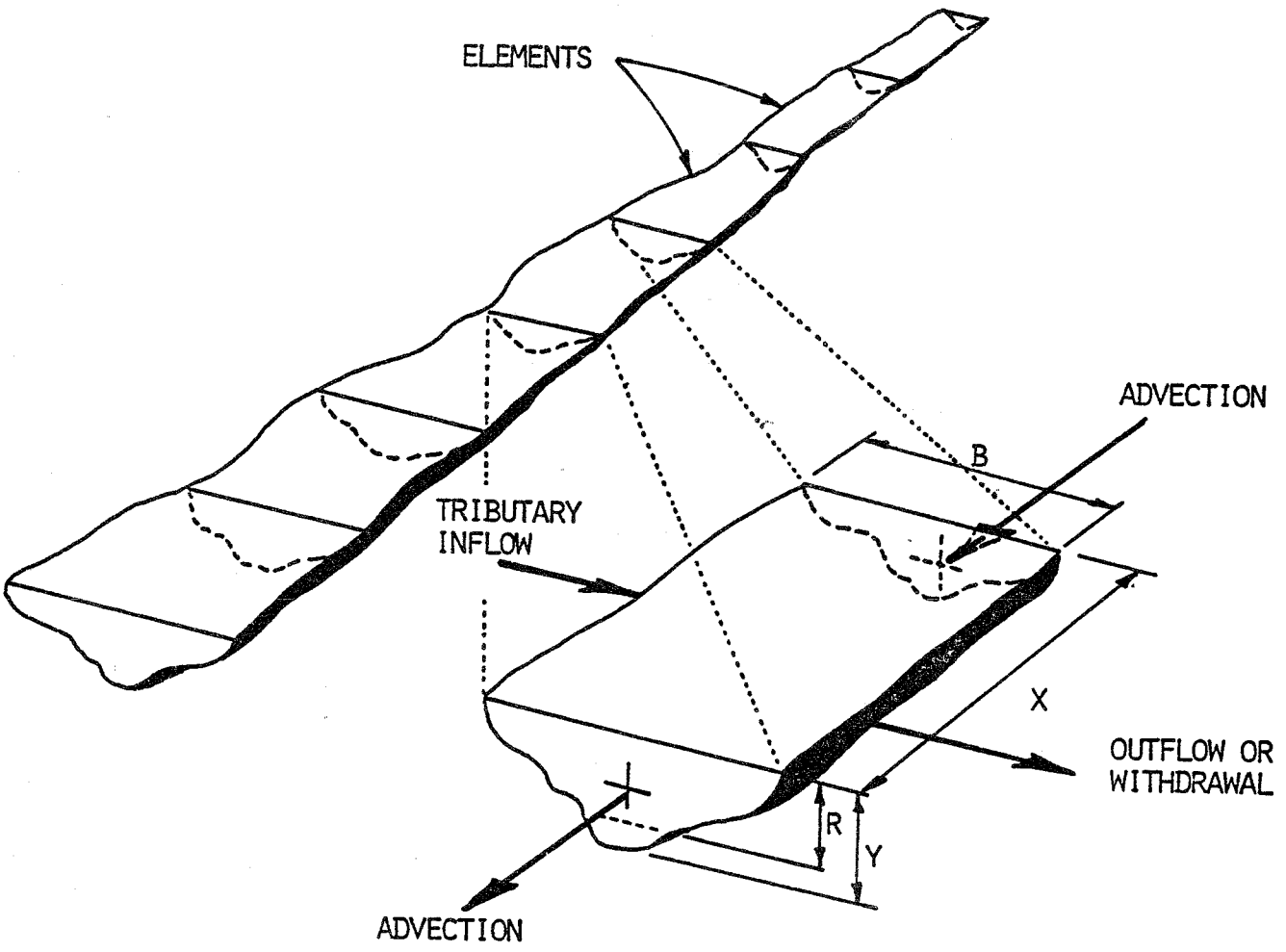


Figure 2. Geometric Representation of Stream System and Mass Transport Mechanisms

The routing coefficients K and X for the rivers simulated in this study were provided by the Pittburgh District of the Corps of Engineers. These coefficients have been integrated into the operational program for the Allegheny system.

WATER QUALITY MODULE

The stream water quality module WQRRSQ simulates water quality changes in a stream system by using the same series of elements in the hydraulics module, each element acting as a completely mixed reactor. The principles of conservation of heat and mass are used to derive equations that represent the dynamics of temperature and conservative and non-conservative substances. In general form the conservation equation is stated for WQRRSQ as

$$V \frac{\partial C}{\partial t} = \Delta z \, Q_z \frac{\partial C}{\partial z} + \Delta z \, A_z \, D_c \frac{\partial^2 C}{\partial z^2} + Q_i \, C_i - Q_o \, C \pm V \, S \qquad (2)$$

where

C = thermal energy or concentration of a specified constituent in a stream in appropriate units, e.g., kcal, mg/L

V = volume of the fluid element, m^3

t = time coordinate, seconds

z = space coordinate, meters (vertical for reservoirs and horizontal for streams)

Q_z = advection, m^3/sec

A_z = element cross sectional area, m^2

D_z = coefficient of effective diffusion, m^2/sec

Q_i = lateral inflow, m^3/sec

C_i = inflow thermal energy or constituent concentration in appropriate units, e.g., kcal, mg/l

Q_o = lateral outflow, m^3/sec

S = all sources and sinks in appropriate units, e.g., kcal/sec, mg/L/sec, etc.

Details concerning individual terms in equation 2 may be found in documentation for WQRRS (Smith, 1978).

The WQRRSQ model was modified for this study to simulate three power plants along the Allegheny River. To represent prototype behavior, a quantity of water equal to the amount of cooling water used by each plant was assumed to be withdrawn from an upstream element and returned to the Allegheny River at the location of the particular power plant discharge. The

quality of the water discharged by each power plant was set equal to the quality of water in the withdrawal element plus a user-specified increment of quality. The average temperature rise of effluent cooling water was simulated in this way for each computational time step. Evaporation losses were considered to be negligible in the overall water budget.

Because of the low pH values common in both the Kiskiminetas River and the lower Clarion River, special attention was given to the technique for estimation of pH changes, particularly over the pH range of 3 to 7 likely to be experienced in the system. Tetra Tech, Inc., of Lafayette, California, was retained by HEC to study and modify, as necessary, the WQRRSQ pH subroutine PHCO2 (Tetra Tech, 1980).

Normally, the model calculates pH based on the carbonate buffering system. Although this scheme does not take into account the sulfate system also present in waters polluted by acid mine drainage, Tetra Tech determined that low pH waters could be simulated using WQRRSQ with the same accuracy achieved by more complex models (Tetra Tech, 1980). The subroutine PHCO2 was modified to avoid stability problems with the carbonate equilibrium equations in the low pH region. Modifications are included in the WQRRSQ programs currently being distributed by HEC.

CHANNEL GEOMETRY

Cross section data for the Allegheny River were obtained from the Corps of Engineers, Pittsburgh District. French Creek, Clarion River, and Kiskiminetas River cross section data were obtained from the Flood Insurance Administration. Channel geometry data were processed for use in the WQRRSQ model at HEC; the computer program Geometric Elements from Cross Section Coordinates (GEDA) was used.

HYDROLOGIC - METEROLOGIC DATA

Meterologic data required by the WQRRSQ model include dry bulb and dewpoint temperatures, wind speed and cloud cover. The necessary data are recorded at National Weather Service Class One Stations. Data for this study were recorded at the Pittsburgh Airport on an hourly basis. The Pittsburgh data were applied basin-wide with no adjustments.

Streamflow in the study area was considered by the U.S. Geological Survey (USGS) as "excessive" for both the 1975 and 1977 study periods (USGS, 1975, 1976, 1977). Flow data were taken from USGS recording gages located throughout the basin. These data were compiled on a mean daily basis.

The locations of USGS gages on the mainstem Clarion, French, Kiskiminetas and Allegheny rivers and at COE reservoirs are shown in Figure 3. USGS gages on other tributaries are noted in Figures 4 through 7.

Two methods were used to estimate the magnitudes of flows from ungaged tributaries. In the first method, a representative hydrograph was chosen for each river reach between streamflow gaging stations for tributaries to the Allegheny River and to the Clarion River downstream of the Piney Dam Gage. The total volume of ungaged flow occurring during the study period between gages was then calculated. This volume was allocated to ungaged tributaries based on the fraction of flow occurring in the pattern hydrograph on a given

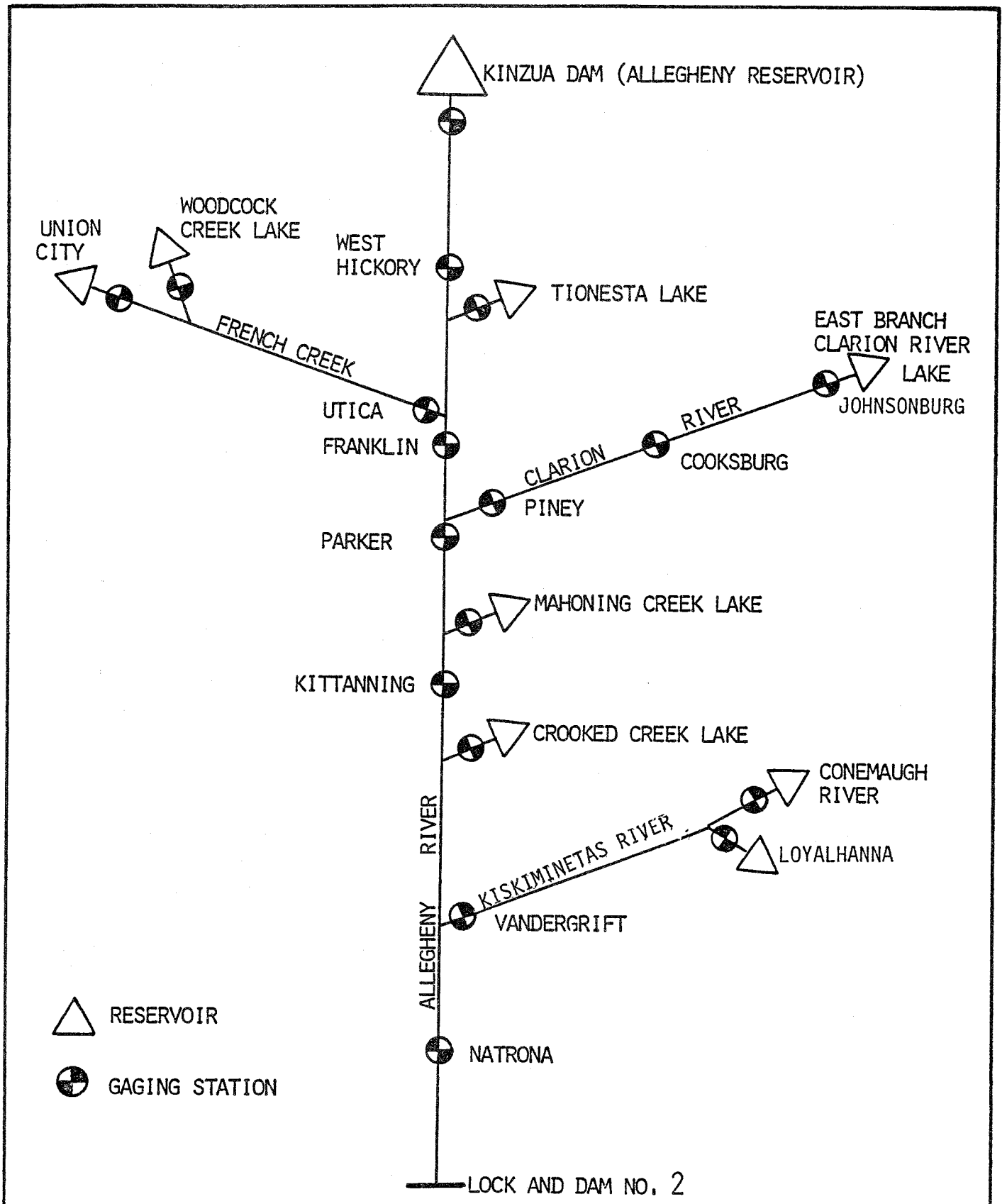


Figure 3. Schematic Diagram of Allegheny River System

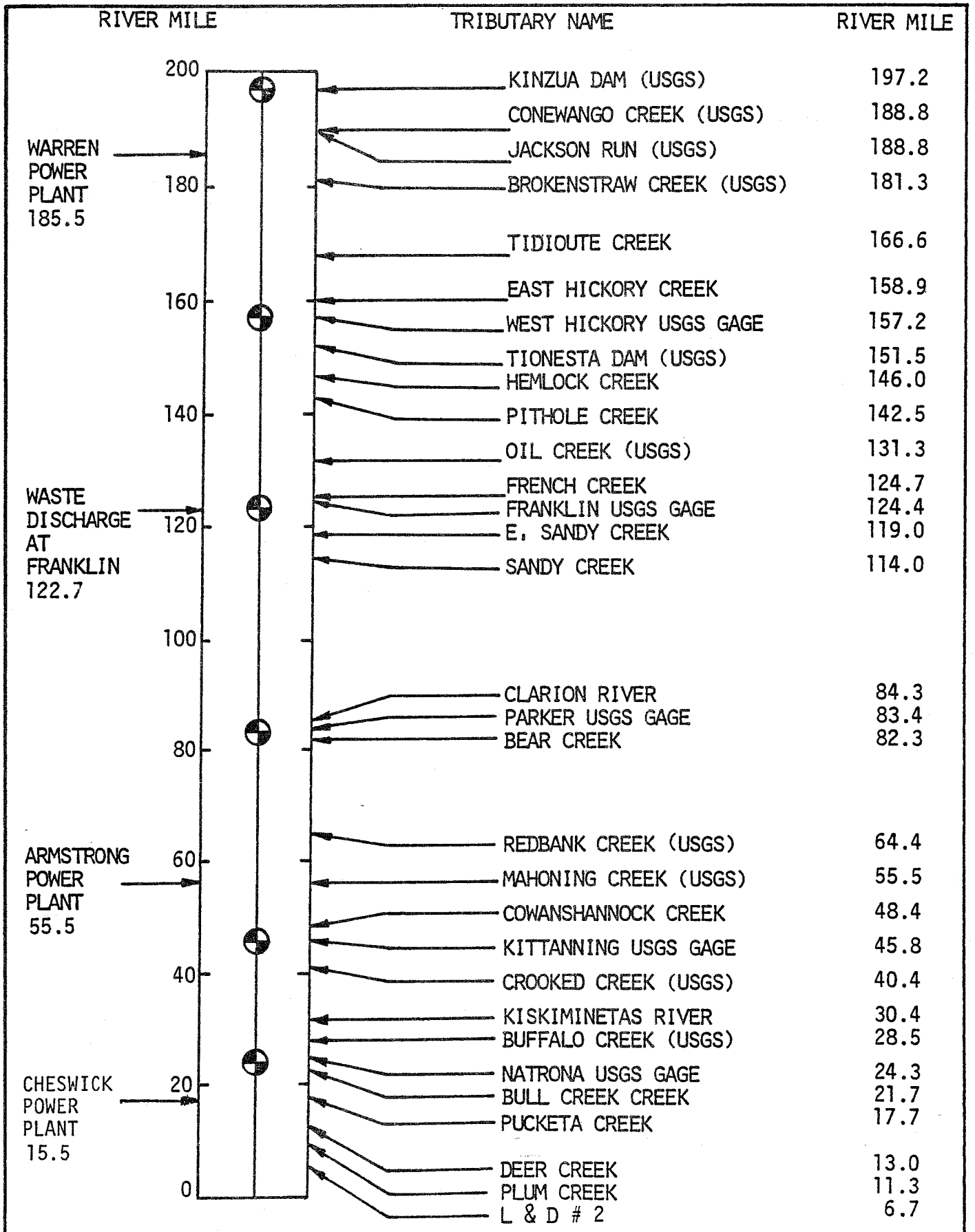
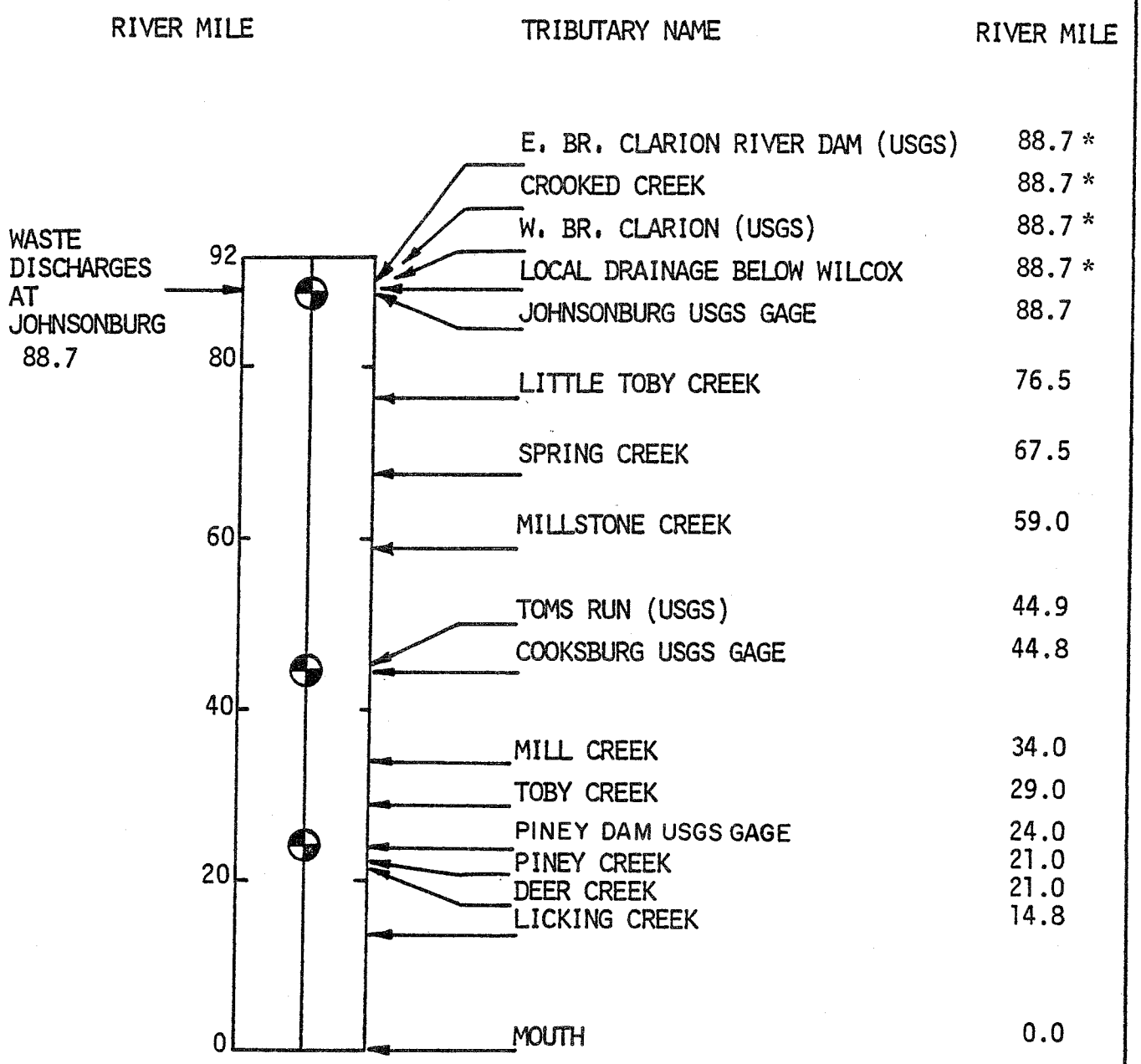


Figure 4. Schematic Diagram of the Allegheny River



*The contribution of flow to the Clarion River from this source was assumed to be located at river mile 88.7 as a boundary condition due to the lack of channel cross section data above river mile 88.7.

Figure 5. Schematic of Clarion River

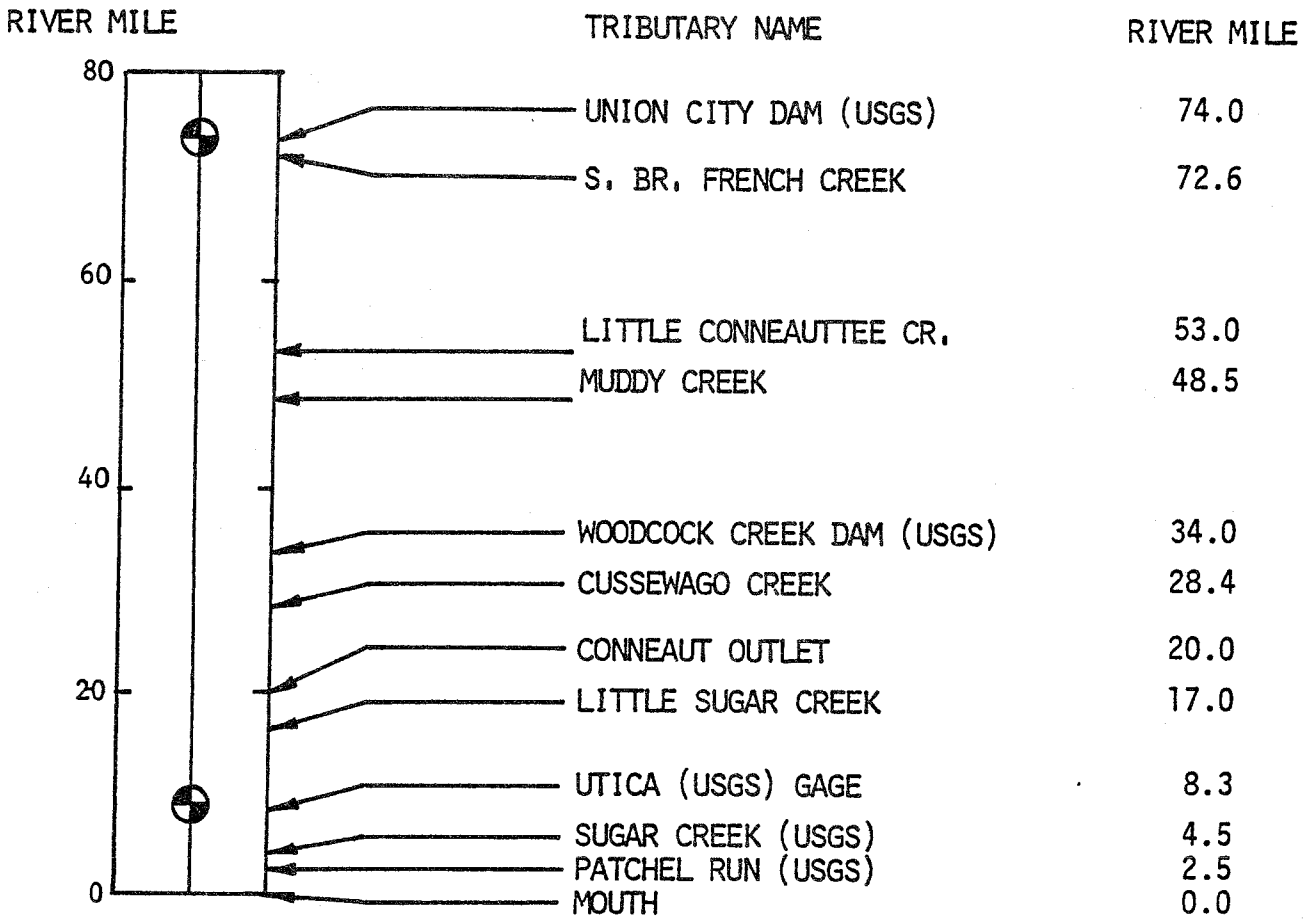


Figure 6. Schematic of French Creek

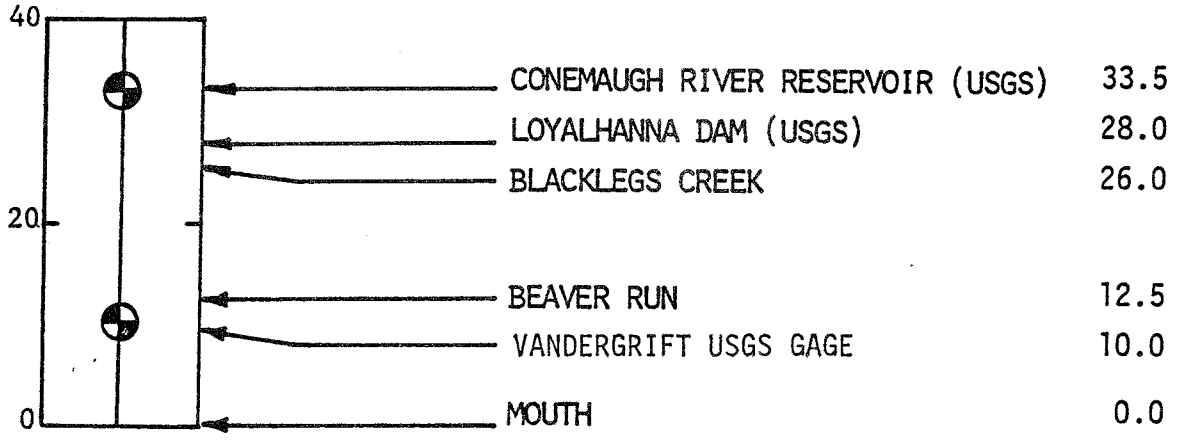


Figure 7. Schematic of Kiskiminetas River

day and on the relative size of each ungaged drainage area. Pattern hydrographs used for this method of allocating flow are listed in Table 5.

In the second method, a daily flow balance was made to estimate the magnitudes of flows from ungaged tributaries to French Creek, the Clarion River upstream of the gage at Piney Dam, and the Kiskiminetas River. After the recorded flows at all upstream gages were subtracted from that of the most downstream gage, the difference was distributed to ungaged tributaries based on their relative drainage areas. When this difference was negative, a small flow was assigned to each ungaged tributary. In these rivers the mean daily flow balance method proved superior to the model hydrograph approach in reproducing observed flows at the downstream gages.

Piney Dam is a significant feature of the Clarion River. It is a hydroelectric project near the community of Clarion, Pennsylvania. Peaking operations at Piney Dam can cause irregular flow in the 24 miles of the Clarion River below the project and further downstream along the Allegheny River. Because of a lack of data on the pattern of releases made by Piney Dam, actual reservoir operations could not be simulated.

An example of the results of the flow routing performed in this study, in preparation for the water quality simulation, is shown in Figure 8. Agreement between observed flows (indicated by x's) and simulated flows (solid line) is regarded as excellent, considering the assumptions inherent in the model and the accuracy of field measurements. Agreement between simulated and observed flows is generally confirmed, also, by the correlation graph of Figure 9, where the regression line of best fit is not distinguishable from a 45° line of perfect correlation. It is noted that greatest scatter occurs for higher flows, where differences are often accounted for by slight shifts in phase between simulated peaks and actual observations.

Typical simulated water surface profiles for the Allegheny River between Franklin and Parker (a distance of about 42 miles) are shown in Figure 10. Profiles are shown for four conditions at 10-day intervals during the 1977 study period in order to illustrate the consistent hydraulic behavior of the system over a fairly wide range of flow conditions. The channel bottom is indicated for reference purposes.

ADJUSTMENT OF FLOW MEASUREMENTS

Flow measurements are typically accurate to within plus or minus five percent of the actual flow. A particularly noteworthy error in flow measurement occurs in the lower Allegheny. A flow balance based on USGS recording gages consistently produces a net negative inflow of water between Kittanning and Natrona. For example, recorded mean daily flows for water year 1975 are shown in Table 6 (USGS, 1975).

Table 5. PATTERN HYDROGRAPHS FOR DISTRIBUTING UNGAGED FLOWS

River	Upstream Gage(s)	Downstream Gage	Pattern Hydrograph
Allegheny	Allegheny Reservoir	West Hickory	Brokenstraw Creek
Allegheny	West Hickory, French Creek at Utica	Franklin	Oil Creek
Allegheny	Franklin and Clarion River at Piney Dam	Parker	Oil Creek
Clarion	Piney Dam and Allegheny at Franklin	Allegheny at Parker	Toms Run
Allegheny	Parker	Kittanning	Redbank Creek
Allegheny	Kittanning, Kiskiminetas at Vandergrift	Lock & Dam #2	Buffalo Creek

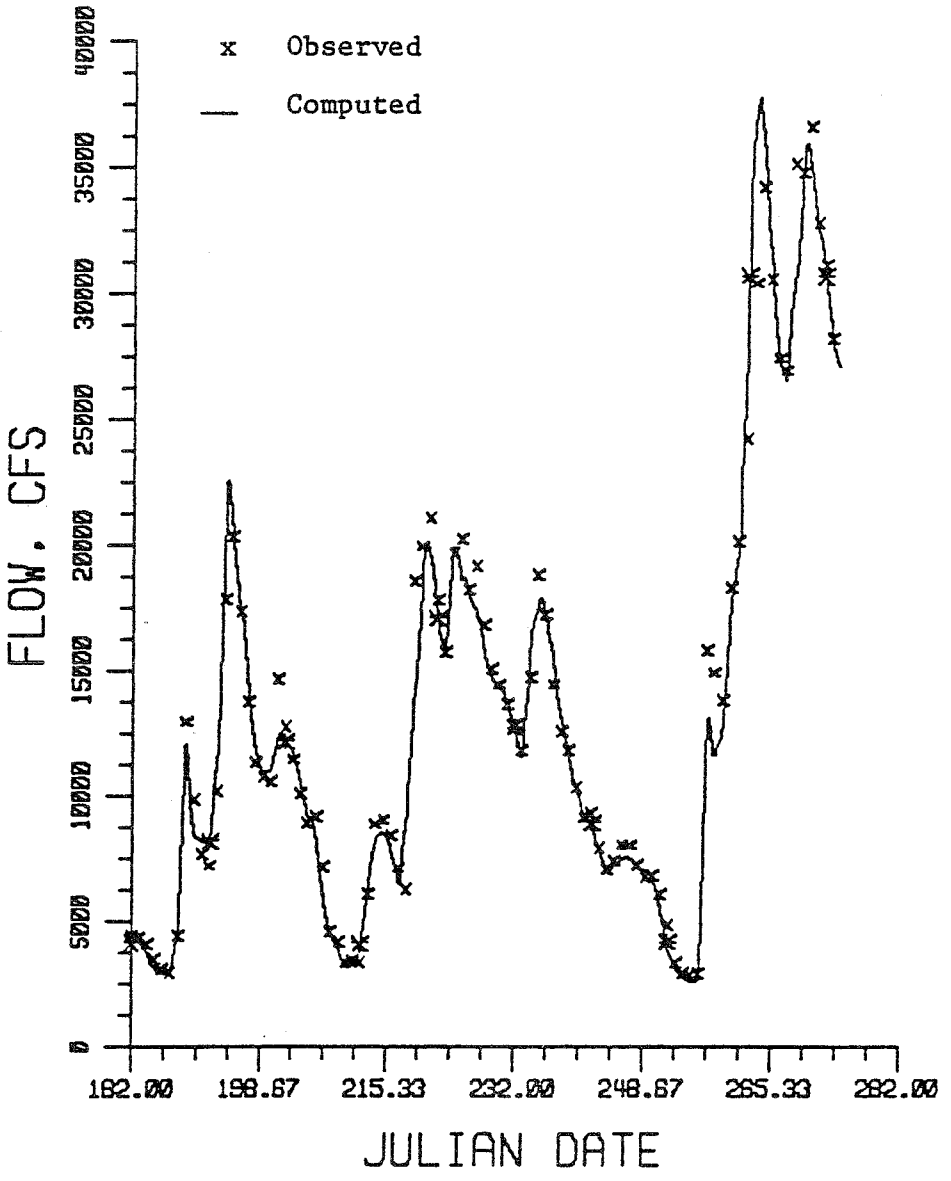


Figure 8. Observed and Computed Flows, Allegheny River at Franklin, PA. 1977 Study Period

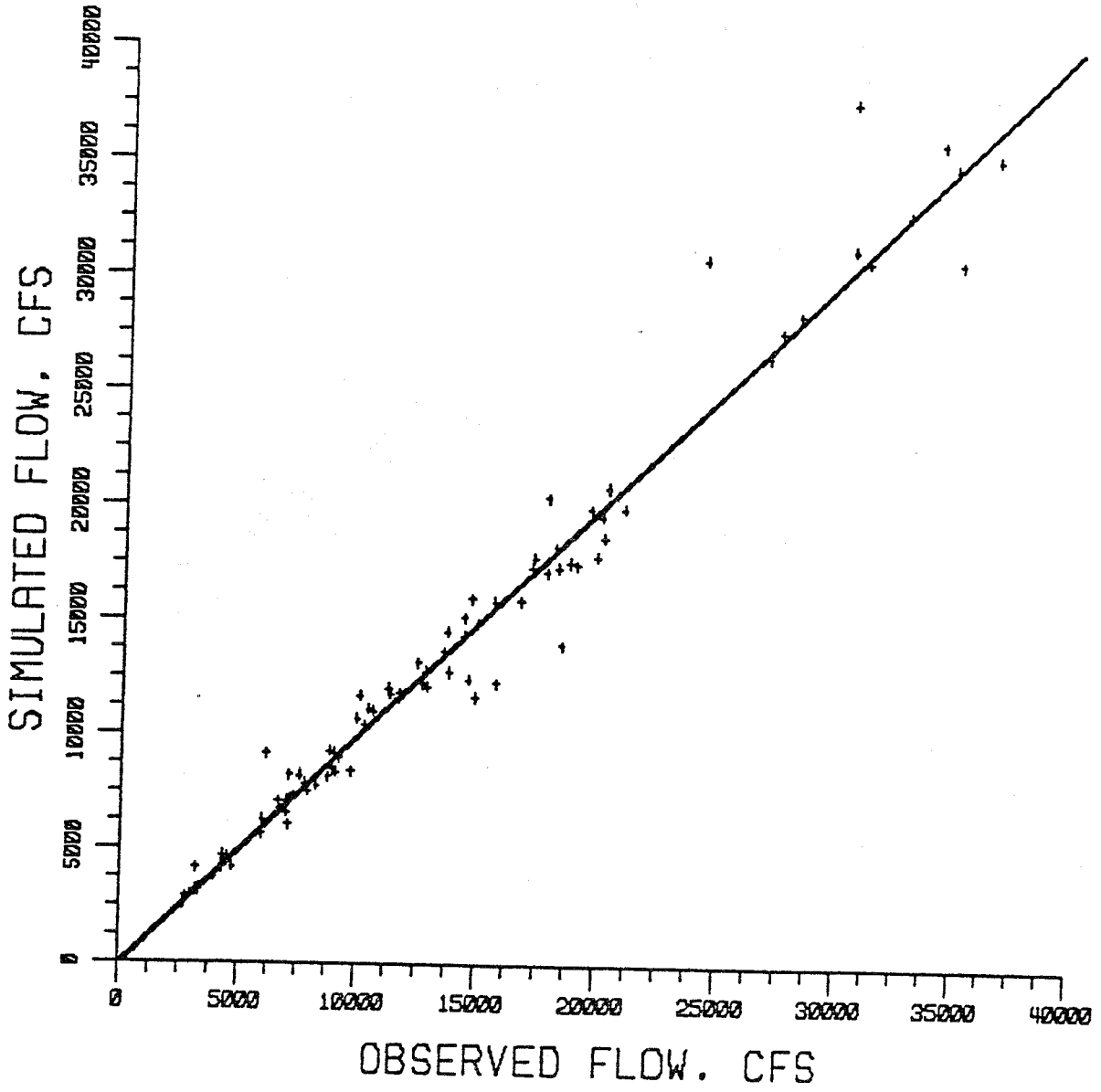


Figure 9. Regression Analysis of Observed and Computed Flows Allegheny River at Franklin, PA. 1977 Study Period

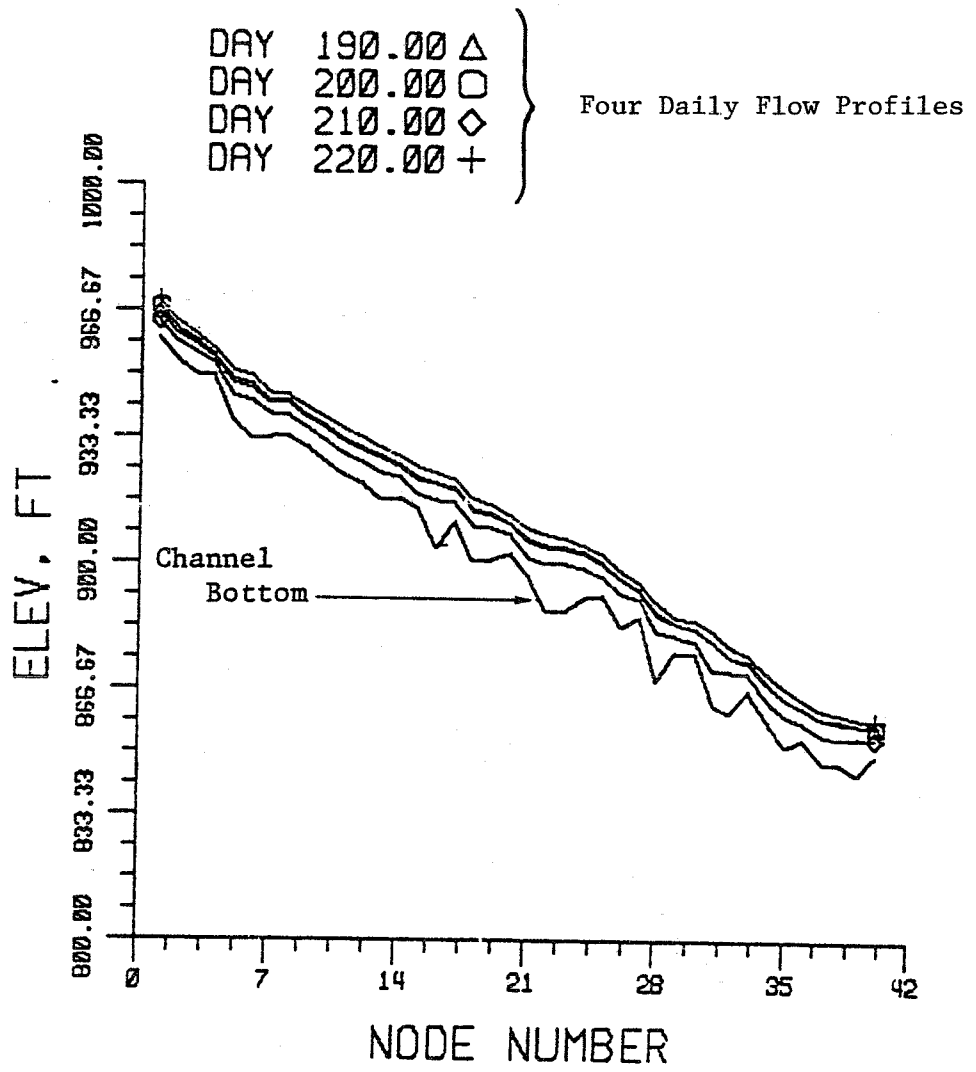


Figure 10. Computed Water Surface Profiles
Allegheny River Between Franklin and Parker
1977 Study Period

Table 6. ALLEGHENY RIVER FLOW BALANCE

USGS Gage Location	Flow Into System	Flow Out Of System
Allegheny River at Kittanning	18,730 cfs	
Crooked Creek Dam	527 cfs	
Kiskiminetas River at Vandergrift	4,154 cfs	
Buffalo Creek near Freeport	247 cfs	
Allegheny River at Natrona		23,070 cfs
Totals:	23,658 cfs	23,070 cfs

Because of the negative flow balance in the USGS gages between Kittanning and Natrona, flow measured by the COE at Lock and Dam No. 2 was used to determine the volume of water to be allocated to ungaged tributaries in the Allegheny River below Kittanning. Flow measurements at Natrona were not used. This resulted in a better water balance for the system as a whole; that is, it minimized error attributable to water balance.

WATER QUALITY DATA

To represent the effect of rapidly changing hydrologic and meteorologic conditions on water quality, an extensive water quality data base was necessary. Flow/quality relationships were developed for those streams where sufficient data were available. These relationships and temperature measurements were adjusted as appropriate to describe the quality in nearby streams where data were lacking. Mr. Michael Koryak of the Pittsburgh District Corps of Engineers contributed greatly in the development of water quality data for this project through his special experience in the study area.

Excellent data were derived from the four Ohio River Sanitation Commission (ORSANCO) robot monitors described in Section III.B. The ORSANCO monitors record water temperature, dissolved oxygen, conductivity, and pH on an hourly basis.

Dissolved oxygen concentrations in the tributaries and reservoir outflows were considered to be at 95 percent of saturation based on temperature observations. The exception was for the outflow of Allegheny Reservoir, where the ORSANCO dissolved oxygen measurements were used.

Observed BOD measurements in the study area are scarce. Those records available suggested that reservoir outflows contain significant organic matter, comparable to concentrations found in streams in the study area (Pennsylvania Department of Environmental Resources, 1975, 1976). Hence, in the absence of more definitive data, BOD's were estimated to be at the fixed level of 2.0 mg/l for both tributaries and reservoir outflows.

The only wastewater discharges considered in the study were at Johnsonburg on the Clarion River and at Franklin on the Allegheny River. The quality of these discharges was based on typical values in the literature (Gehm and Rudolfs, 1953; Isaac, 1953; Metcalf and Eddy, 1972), except when effluent concentrations were actually recorded. Significant improvement in the treatment of these wastewaters occurred between the 1975 and 1977 study periods. This improvement was noted in assigning the quality in the 1977 study period.

Three thermal discharges were considered in the study. Temperatures of cooling water discharged from each of three coal fired power plants on the mainstem of the Allegheny River were determined from the net temperature rise over the condensers. Average temperature rises and discharge rates were specified for each plant according to the Federal Energy Regulatory Commission (1980) and the USGS (1981) (Allegheny Power System, 1980).

A listing of water quality data sources is presented in Appendix A.

V. RESULTS

An enormous body of information concerning the water quality responses of the Allegheny River system to the three operation scenarios and the two hydrologic sequences is available for review. Details of some 30 simulation runs (15 each for two study periods, involving a system of 6 major stream reaches, 7 water quality parameters, etc.) are presented in output files supplied to HEC. Statistical summaries are included as Appendix B.

The top half of the statistical summaries define the characteristics (minimum, maximum, mean, and standard deviation) of the simulated water quality at a specified river mile location and an associated error analysis, if observed data is available for that location. The bottom half is used for constructing the quality duration graphs shown in Appendix C. These data describe the percent of simulated values that exceed one of the ten linearly-spaced lower bounds between a user specified maximum and minimum.

These data are of such magnitude that it is unrealistic to review them all here. Rather, it is more appropriate to highlight results with a few selected examples. Accordingly, the following illustrative comparisons have been chosen:

- Simulated vs. Observed Water Quality
- Effects of Operations on Allegheny River Water Temperature Extremes
- Effects of Operations on the Kiskiminetas River
- Effects of Operations on the Lower Allegheny River
- Effects of Operations on the Upper Clarion River

SIMULATED VS. OBSERVED WATER QUALITY

Figures 11 through 15 illustrate the capability of the model to represent water quality changes in the lower Allegheny River and the Kiskiminetas River under Existing Conditions for the 1977 study period. Simulated pH and TDS histories are compared to observations at three locations: at Freeport and Natrona on the Allegheny River (above and below the Kiskiminetas River confluence) and in the lower reach of the Kiskiminetas River.

The TDS simulations appear to give a good account of observed behavior at Freeport and Vandergrift. The TDS history at Natrona responds closely to the more variable Kiskiminetas flow, which superimposes its more mineralized water on the less variable and lower TDS water of the Allegheny River passing Freeport.

The well mixed condition assumed in deriving the model is not entirely appropriate to the Allegheny River below its confluence with the Kiskiminetas River, since an acid plume often occurs along the left bank in this reach. Observed data at Natrona are taken from the right bank and often do not reflect the low pH condition along the left bank resulting from incomplete to minimal mixing of the two streams.

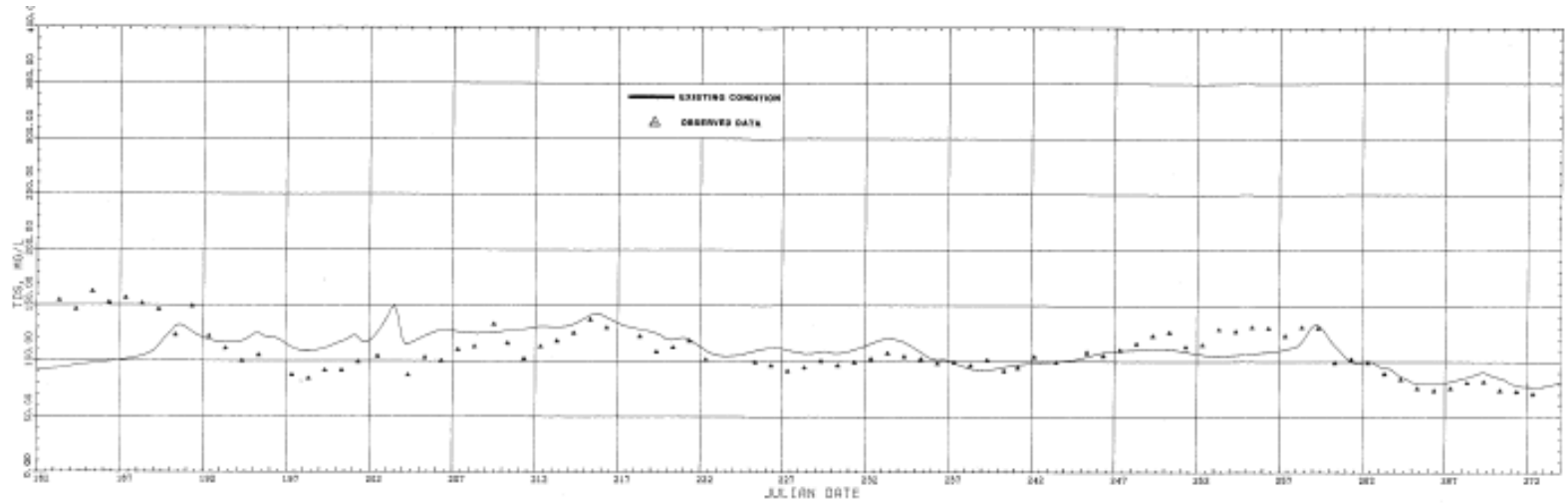


Figure 11
ALLEGHENY RIVER AT FREEPORT (RM 32)
1977 TDS

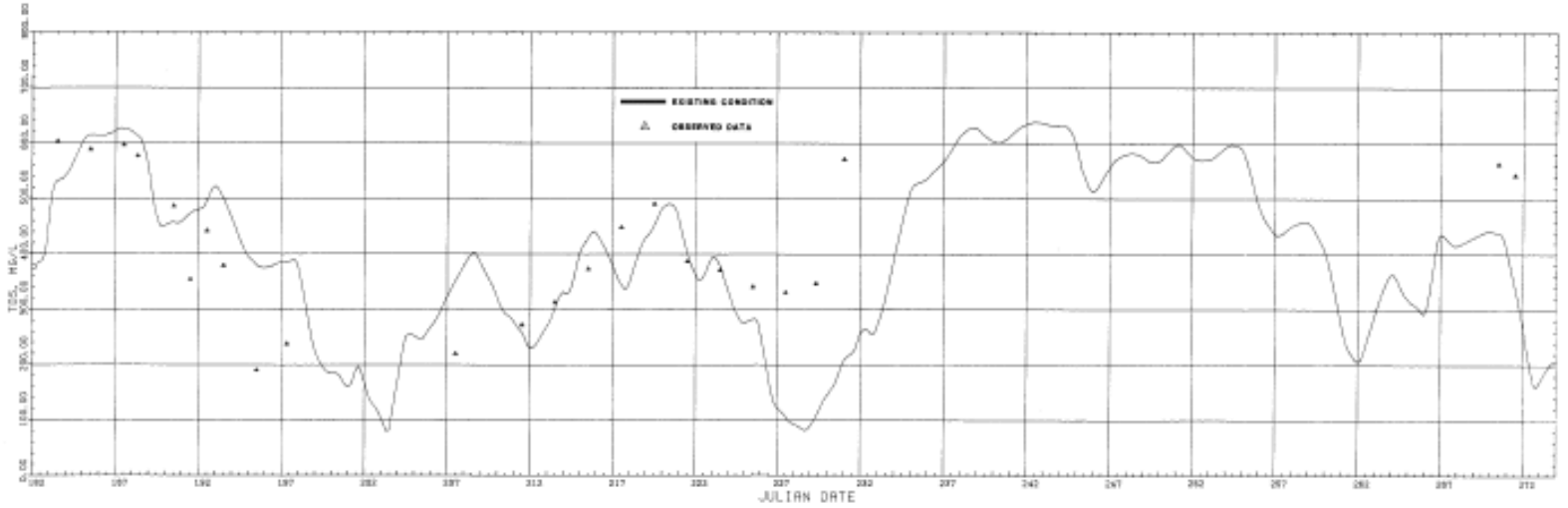


Figure 12
KISKIMINETAS RIVER AT VANDERGRIFT
1977 TDS

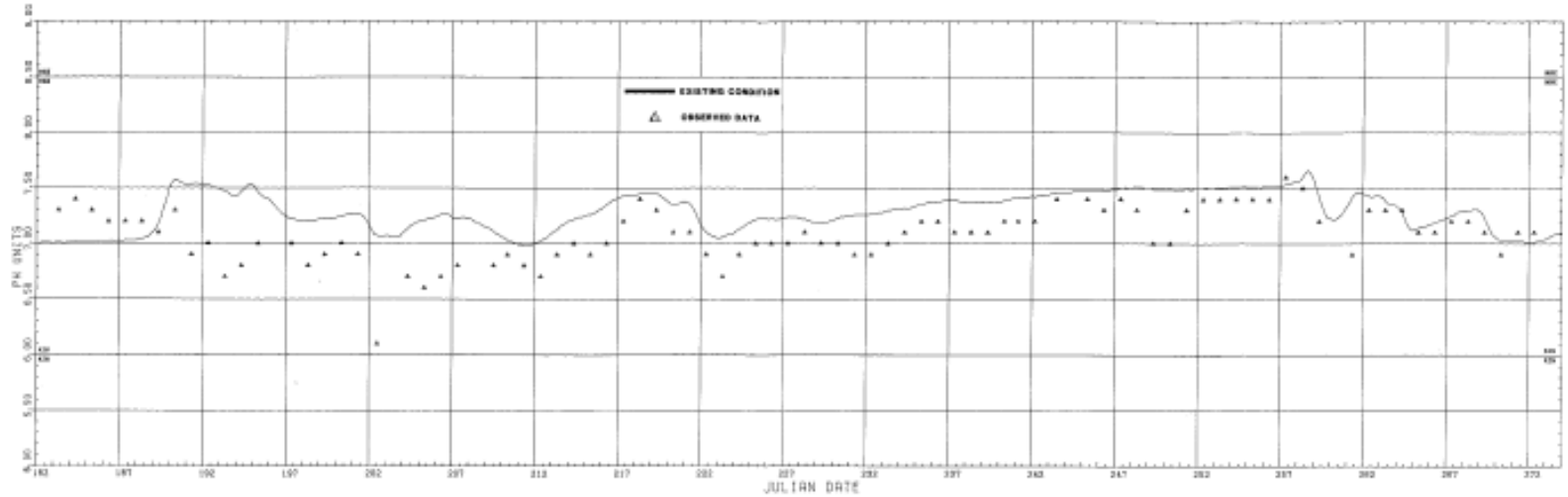


Figure 13
ALLEGHENY RIVER AT FREEPORT (RM 32)
1977 pH

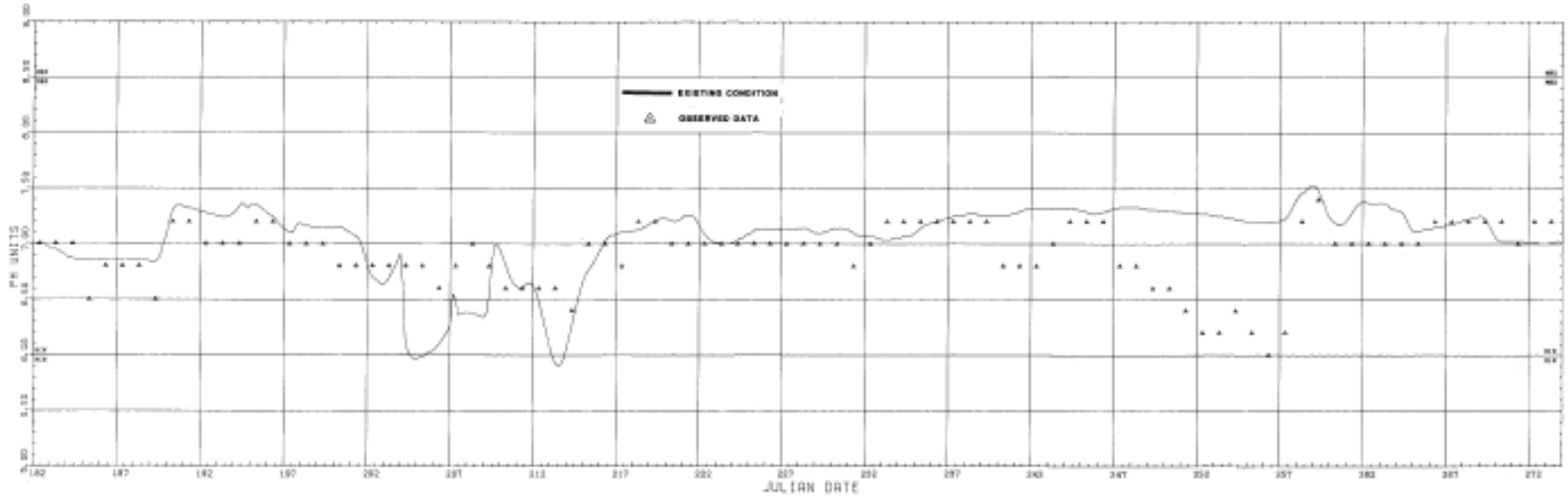


Figure 14
ALLEGHENY RIVER AT NATRONA
1977 pH

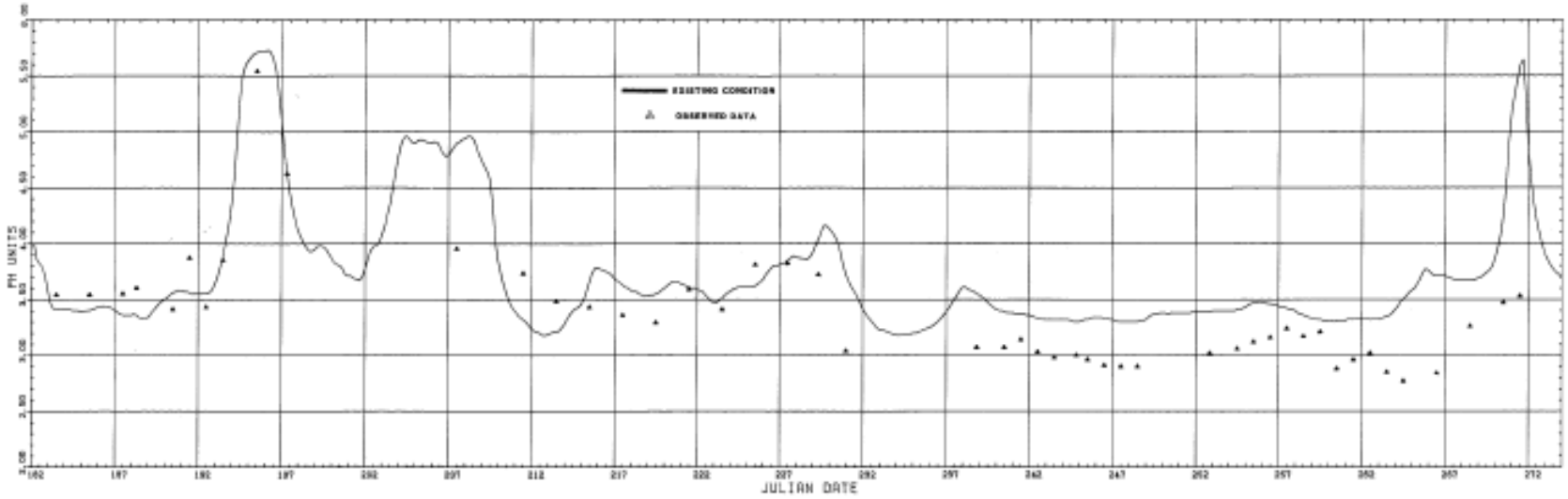


Figure 15

KISKIMINETAS RIVER AT VANDERGRIFT

1977 pH

During the period 28-29 July 1977, this unmixed condition gave rise to violations of the minimum pH standard of 6.0 along the left bank of the Allegheny River over the entire thirty mile reach from the Kiskiminetas River to Pittsburgh. Except for a minor depression in pH, no evidence of such a severe condition can be found in the observed data at Natrona. Results of simulation during this time also show only a minor depression in pH.

The depression in pH along the left bank of the lower Allegheny River during the period mentioned above resulted from intensive dewatering of mines in the Conemaugh River basin. The extreme acidity of that drainage was not detected by ORSANCO's Vandergrift monitor, which was transmitting erroneously high pH values during this time. While simulation of the pH conditions at Vandergrift can be seen to be falling during the period 28-29 July 1977 (Julian dates 209-210), the extreme acidity of the Kiskiminetas River during this time may have been underestimated in simulation.

Recognizing the conservative nature of the model in assuming a well mixed condition and the possible underestimate of the acid load of the Kiskiminetas River during extreme acid pollution events, the simulation results suggest a credible performance of the model in simulating short term water quality trends. The results also suggest that a subsequent analysis focusing on the unique hydraulic and water quality characteristics of the lower Allegheny River is required to accurately quantify changes in water quality across the width of the Allegheny River, as well as along the direction of flow.

EFFECTS OF ALTERNATIVE OPERATIONS

Effects of Operations on Allegheny River Water Temperature Extremes

Figure 16 illustrates the effect of reservoir storage and operation on temperature extremes (maxima and minima) in the reach of the Allegheny River between Parker and Lock and Dam No. 2 (River Mile 83 to 7). As might be expected, the existing scheme of regulation assures the narrowest range of variation, roughly between 15.5°C and 26°C for the 1977 study period (1 July through 30 September). Pattern A preserves similar minima. However, due to greater control of releases, maxima are 1-2°C higher than for Existing Conditions. The No Corps Storage case exhibits generally higher values, both in minima and maxima. Minimum temperatures are about 1.5°C higher, while maxima are 1.5°C to 3°C higher than for Existing Conditions and 0.2°C to 1.5°C higher than for "Pattern A."

Effects of Operations on the Kiskiminetas River

The influence of Corps of Engineers storage on the Kiskiminetas River is demonstrated in Figures 17 through 20. The histories of pH and TDS in the Kiskiminetas River at Vandergrift for 1977 are simulated under the hypothetical condition of No Corps Storage. Generally, the absence of reservoirs results in higher, less attenuated pollutional episodes. Fluctuations in TDS are indicative of the close association of quality and flow in the Kiskiminetas drainage. The flows in Figures 18 and 20 are mean daily flows.

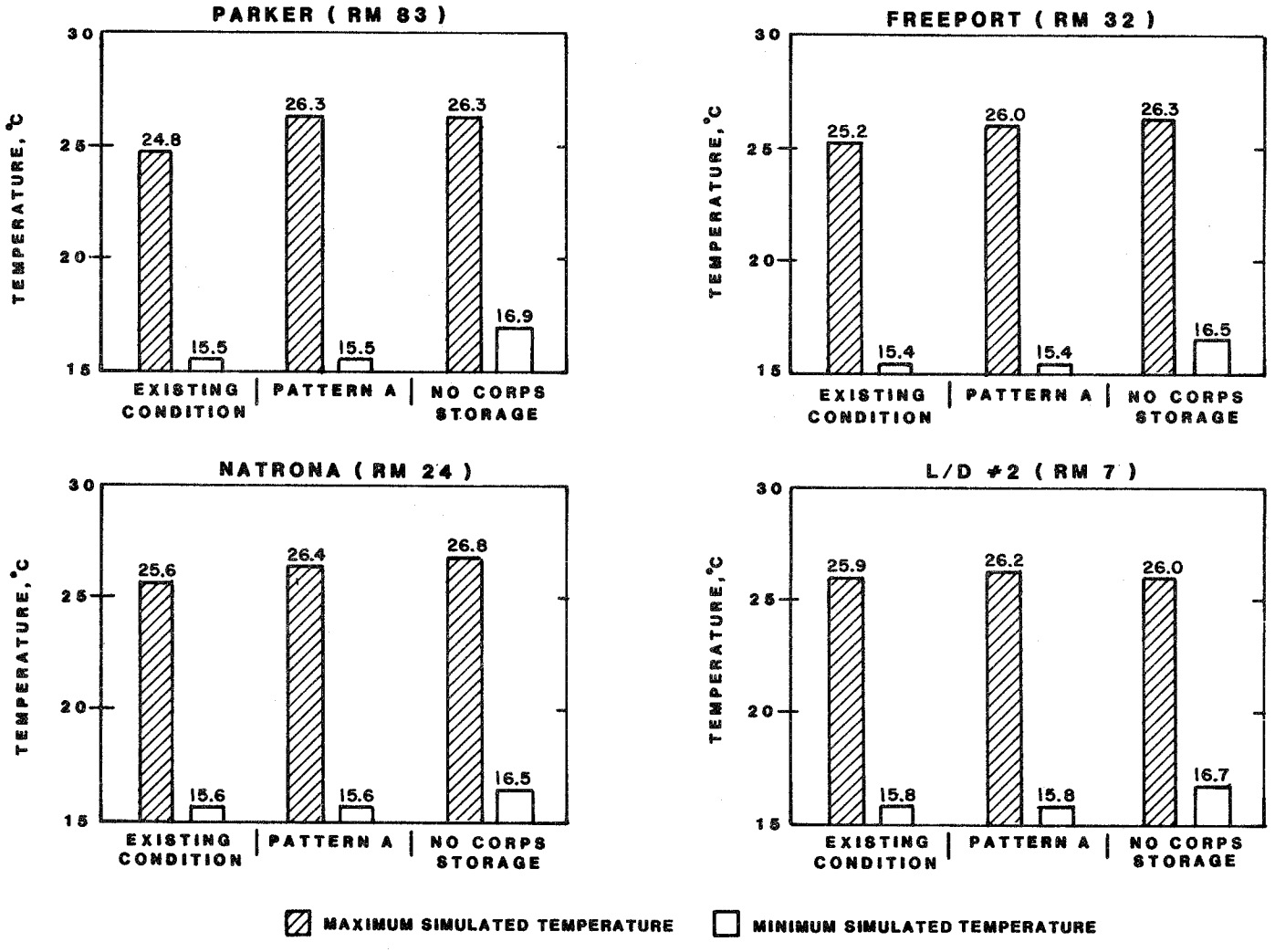


Figure 16 ALLEGHENY RIVER WATER TEMPERATURE

(Simulated Temperatures from 1977, Julian Days 182 - 274)

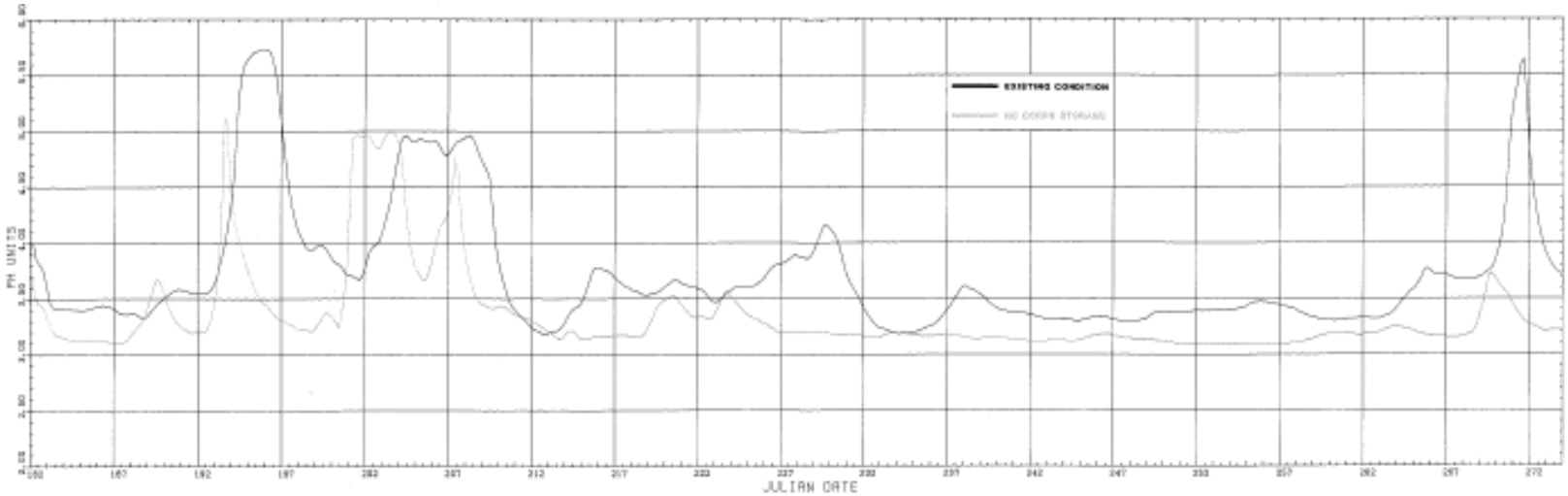


Figure 17

KISKIMINETAS RIVER AT VANDERGRIFT

1977 pH

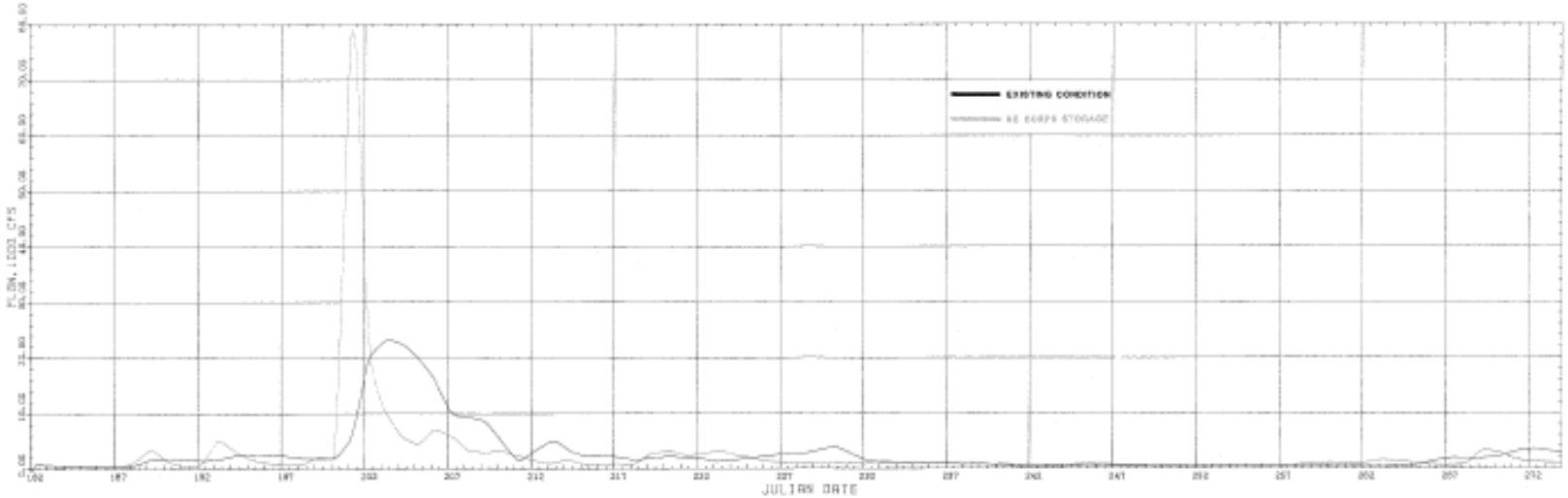


Figure 18

KISKIMINETAS RIVER AT VANDERGRIFT

1977 FLOW

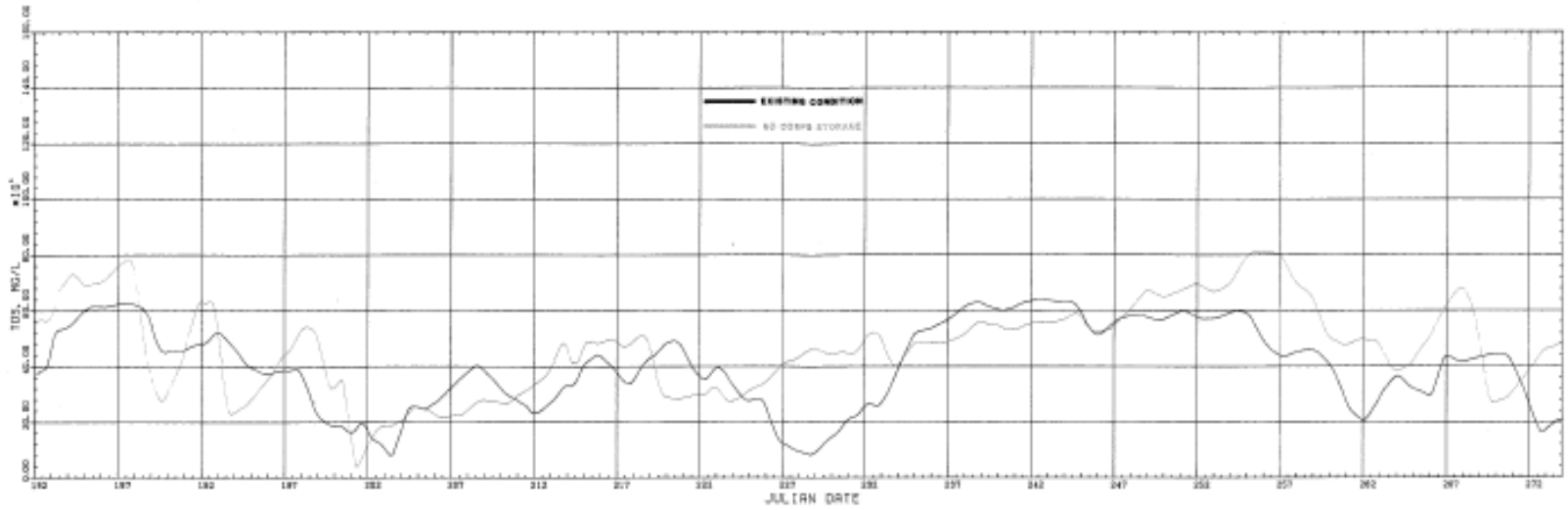


Figure 19

KISKIMINETAS RIVER AT VANDERGRIFT

1977 TDS

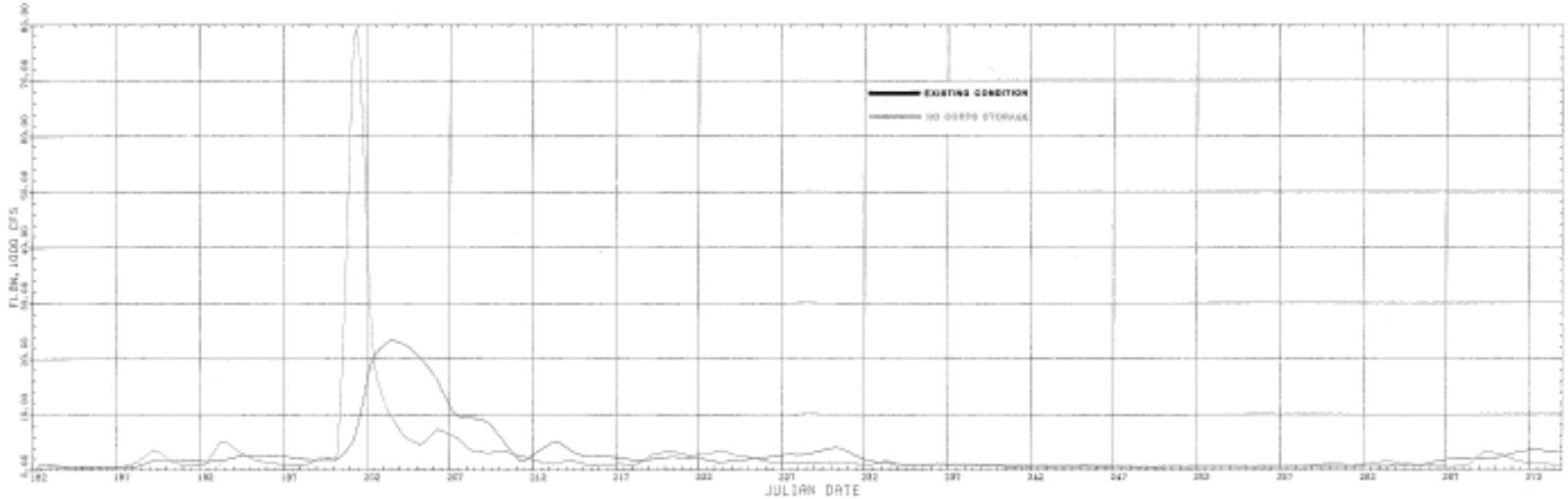


Figure 20

KISKIMINETAS RIVER AT VANDERGRIFT

1977 FLOW

Effects of Operations on the Lower Allegheny River

The simulated impact of the Kiskiminetas River on the Allegheny River under Existing Conditions in 1977 is demonstrated in Figures 21 through 24. A significant increase in flow at Natrona can be seen (Figure 22) starting on day 202 compared to the flow at Freeport. Associated with this increased flow is a significant decrease in pH between Freeport and Natrona (Figure 21). A similarly significant increase in TDS at Natrona (Figure 23) can be attributed to the Kiskiminetas River flows. The flows in Figures 22 and 24 are mean daily flows.

In contrast to the above discussion, Figures 25 and 26 illustrate the impacts of regulation during the 1977 study period on the pH at Natrona due to the Pattern A operation at Kinzua Dam and due to all nine projects in the basin. Most notable in this comparison is the attenuation by storage (Figure 25) of the occasional pH extremes that result with the first wash following a storm. This effect is seen in the event beginning at day 200, when the pH under unregulated conditions dropped to about 4.0. In contrast, with regulation according to Pattern A, the pH was maintained above 7.0. Again, the severe acid dewatering episode of days 209 and 210 that was previously discussed did not show up in these simulations. The flows in Figure 26 are mean daily flows.

Effects of Operations on the Upper Clarion River

The influence of existing storage in moderating the impact of organic wastewater in the system is illustrated by comparison of simulation results depicted in Figures 27 through 30 for the Clarion River near Ridgeway (River Mile 81) for 1975 conditions. The BOD load carried by the stream is greatly attenuated by regulation as compared to the No Corps Storage condition (Figure 29). The peak BOD in the No Corps Storage case was about 16 mg/l (see Day 255), while under Existing Conditions it was reduced to about 5.2 mg/l. As shown in Figure 27, this would result in an increased dissolved oxygen concentration at Ridgeway and points downstream. The flows in Figures 28 and 30 are mean daily flows.

VI. CONCLUDING COMMENT

The comparisons made here only illustrate the capabilities of the model and merely serve to show the general nature of changes in water quality that can occur due to the existence of a capacity for streamflow regulation in the Allegheny system. Many more comparisons can be made, and much more detailed analysis of results is possible. The data are on tape and have been summarized in graphical and statistical forms for HEC and the Pittsburgh District Corps of Engineers.

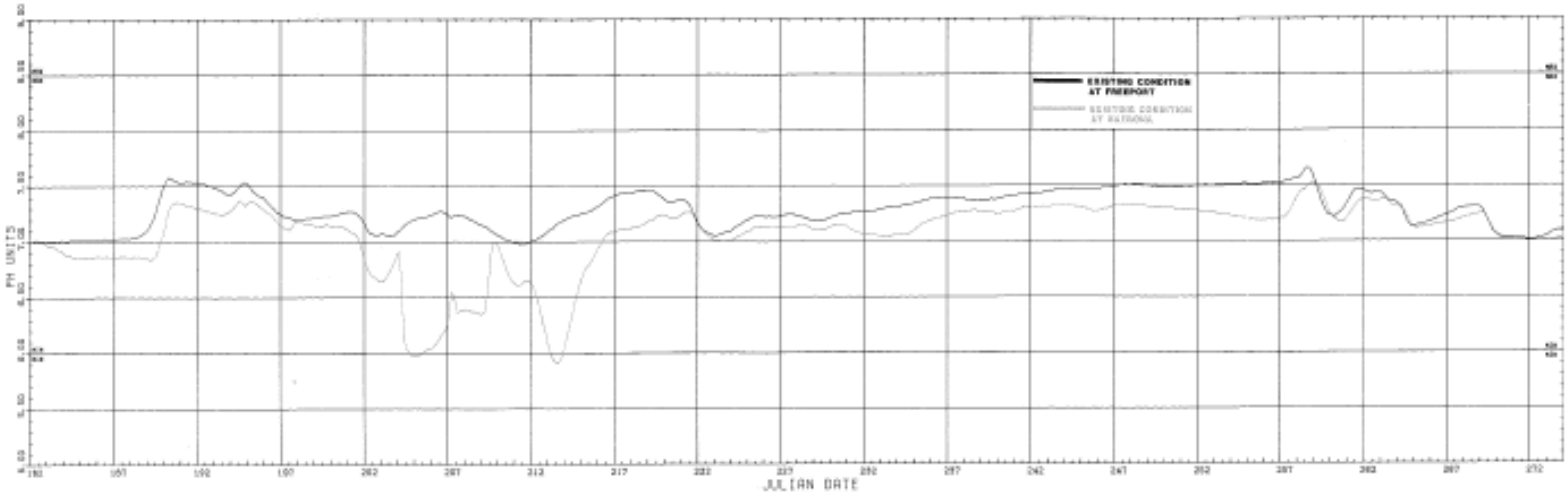


Figure 21

ALLEGHENY RIVER AT FREEPORT AND NATRONA

1977 pH

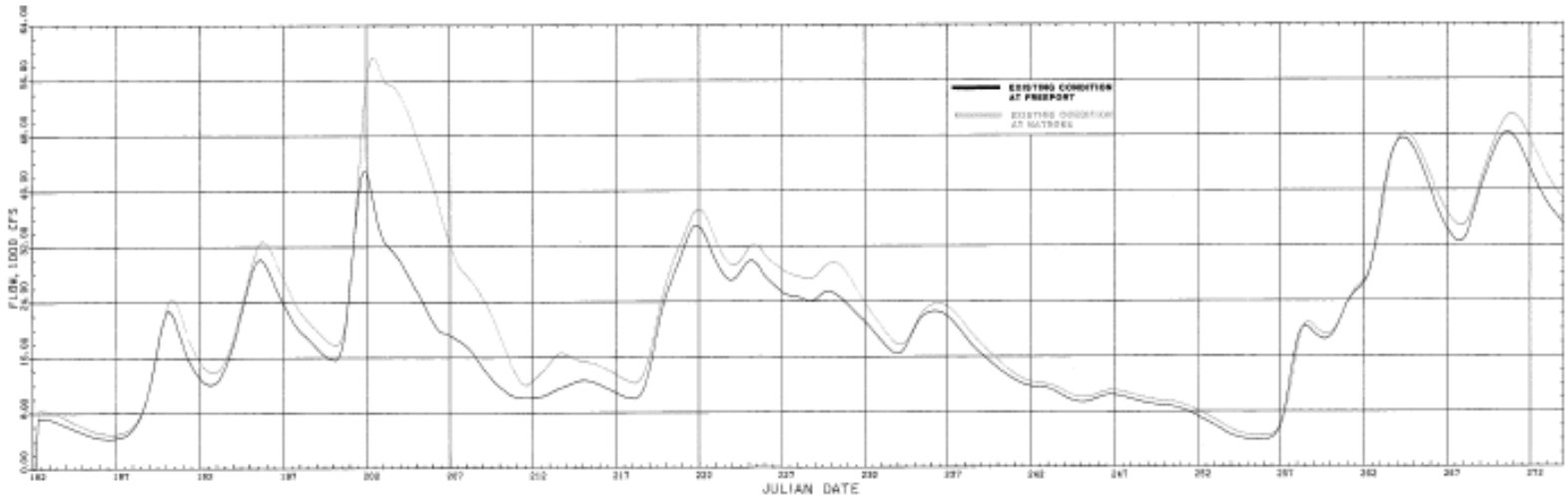


Figure 22

ALLEGHENY RIVER AT FREEPORT AND NATRONA

1977 FLOW

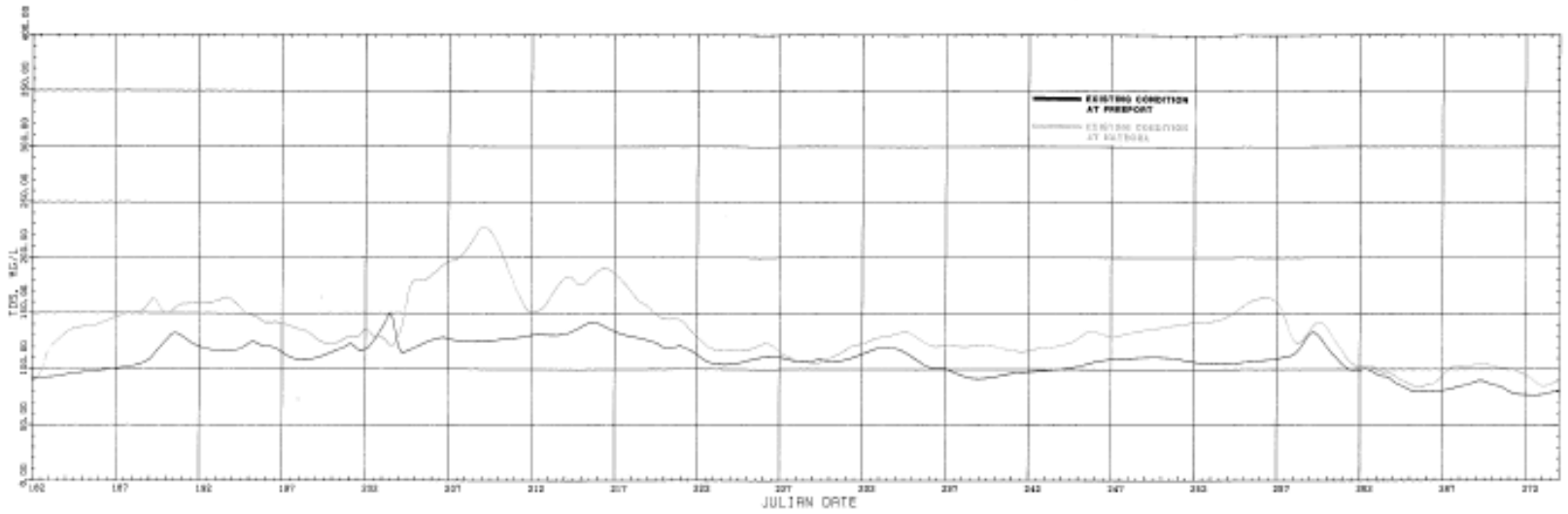


Figure 23

ALLEGHENY RIVER AT FREEPORT AND NATRONA

1977 TDS

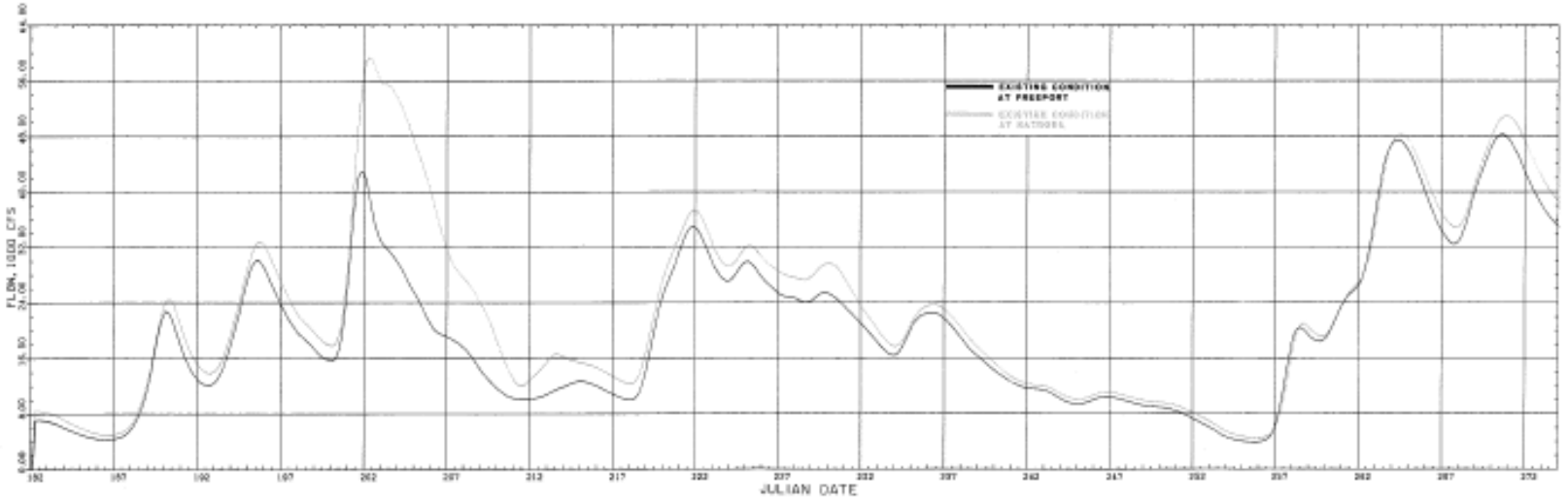


Figure 24

ALLEGHENY RIVER AT FREEPORT AND NATRONA

1977 FLOW

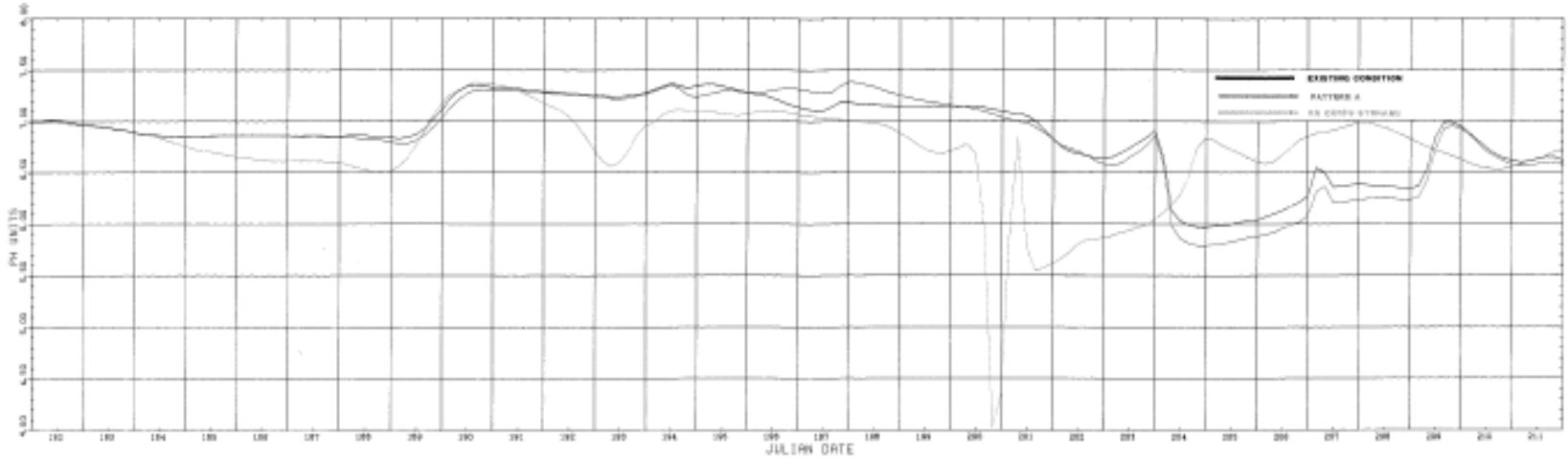


Figure 25
ALLEGHENY RIVER AT NATRONA
1977 pH

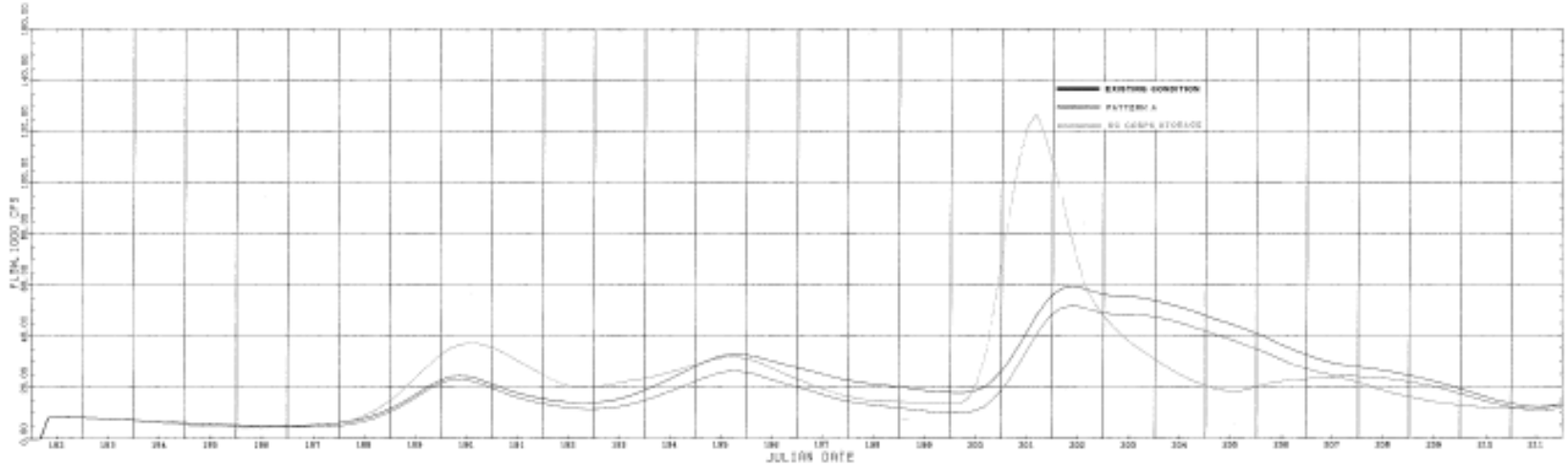


Figure 26
ALLEGHENY RIVER AT NATRONA
1977 FLOW

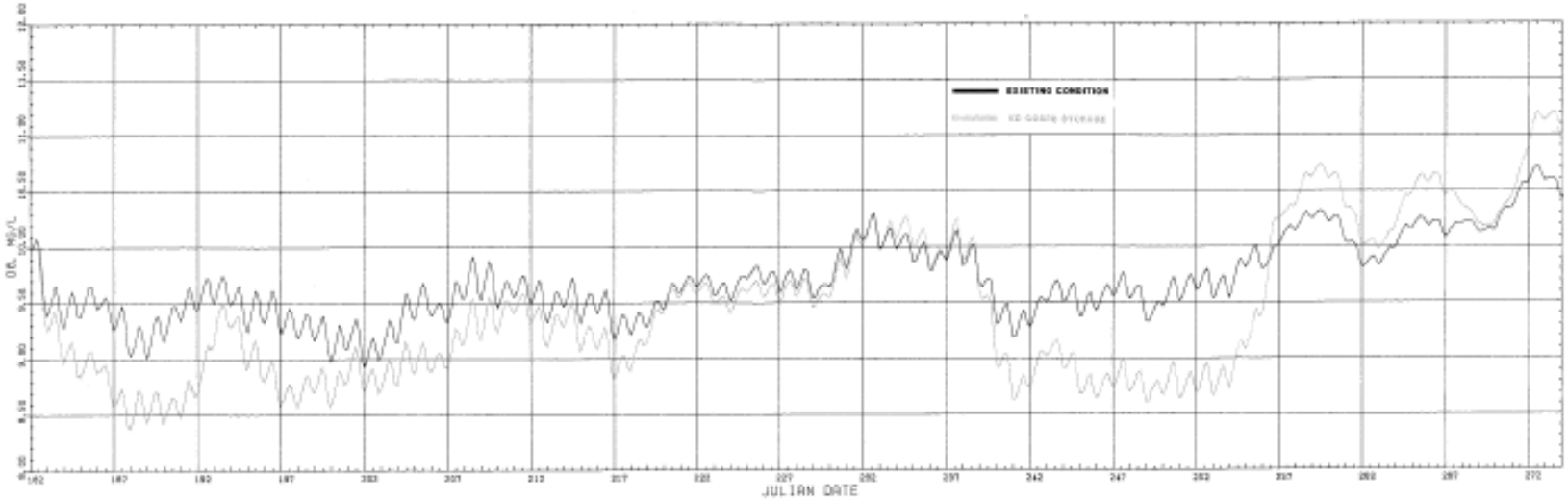


Figure 27
CLARION RIVER NEAR RIDGEWAY (RM 61)
1977 DO

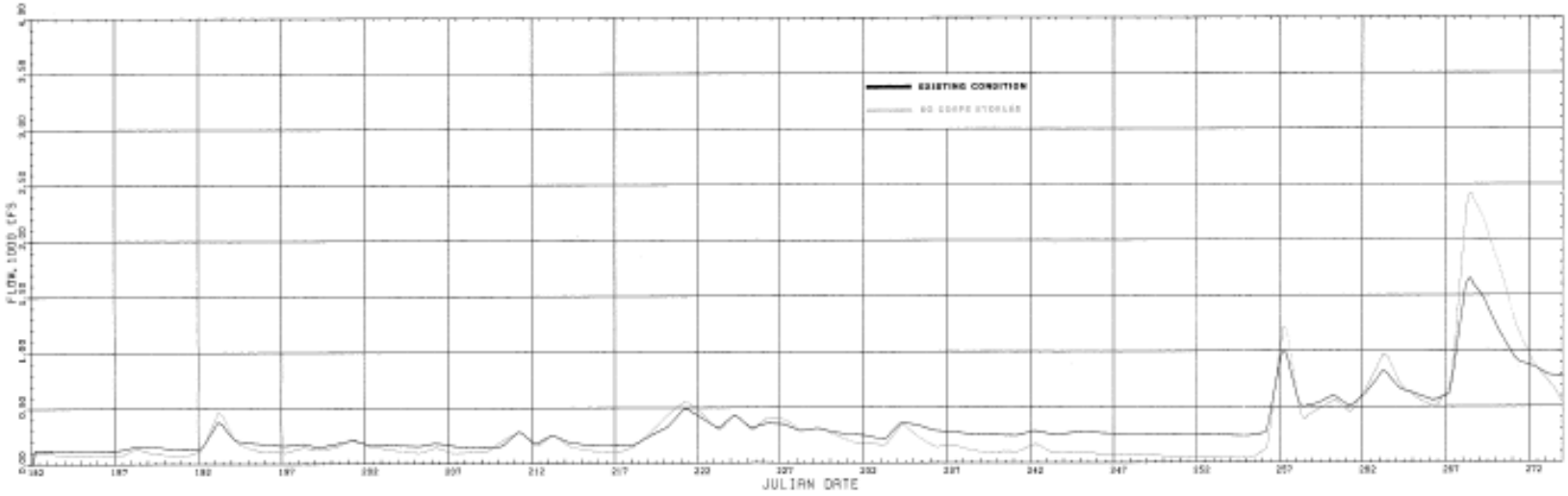


Figure 28
CLARION RIVER NEAR RIDGEWAY (RM 61)
1977 FLOW

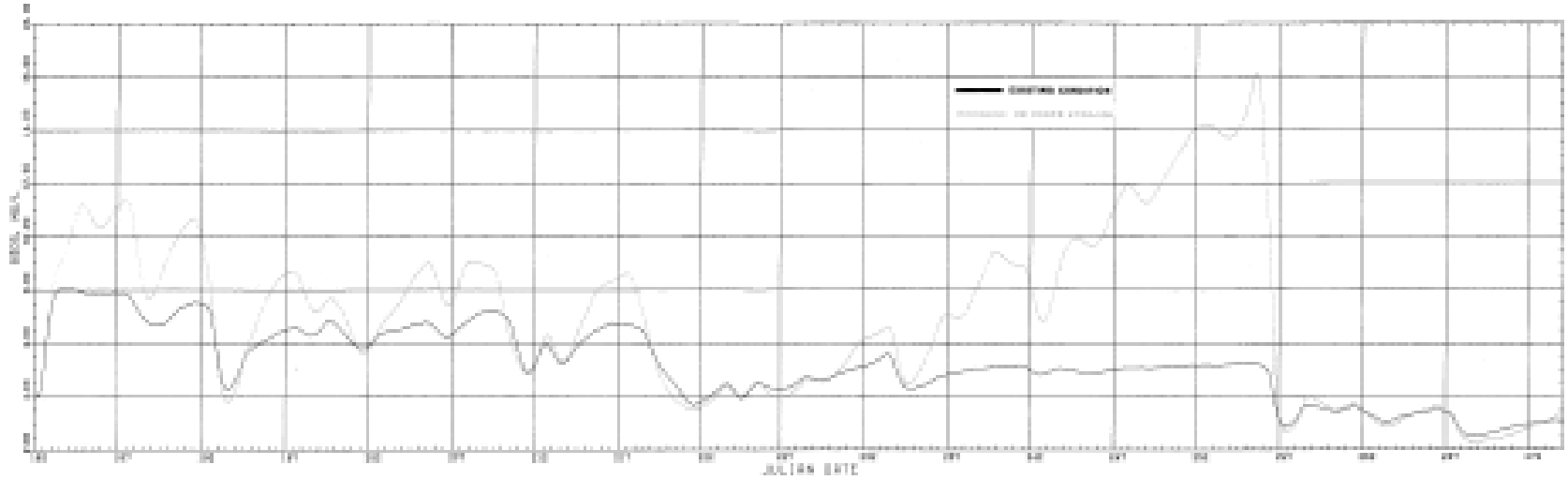


Figure 29

CLARION RIVER NEAR RIDGEWAY (RM 6.0)

1977 BOD

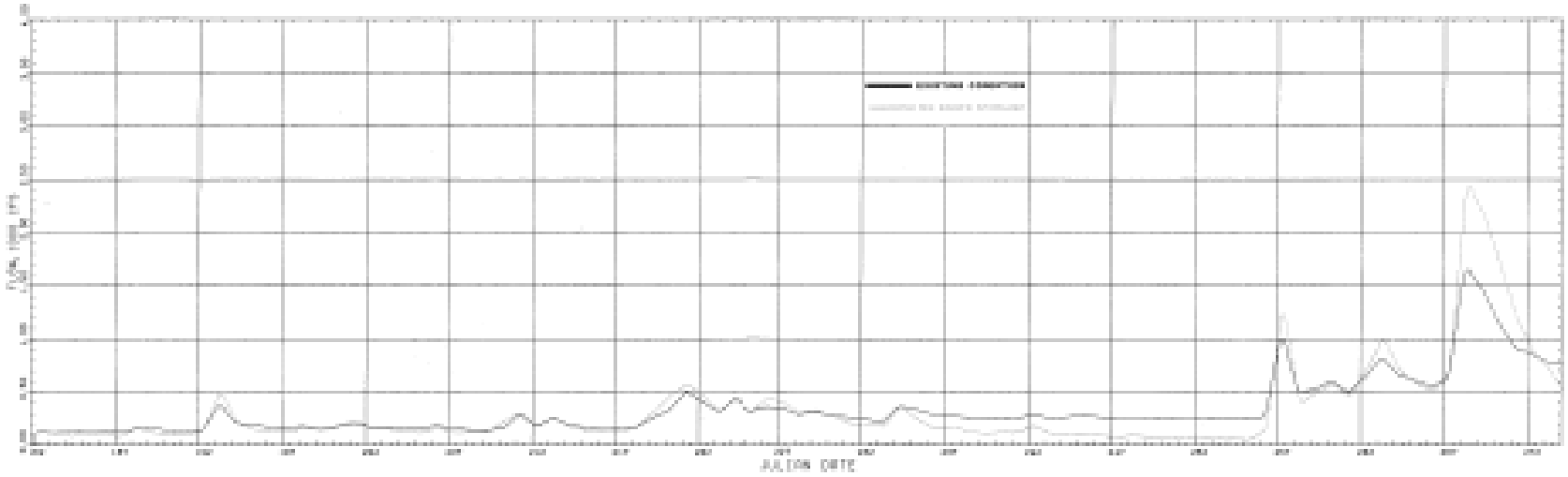


Figure 30

CLARION RIVER NEAR RIDGEWAY (RM 6.0)

1977 FLOW

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APPENDIX A

WATER QUALITY DATA SOURCES

A-1. ALLEGHENY RIVER WATER QUALITY DATA

TRIBUTARY	DATA SOURCE INDEX NUMBER TEMPERATURE	QUALITY
Conewango Creek	2	1
Jackson Run	2	1
Brokenstraw Creek	3	1
Tidioute Creek	4	1
East Hickory Creek	4	1
Hemlock Creek	4	1
Pithole Creek	5	1
Oil Creek	5	1
East Sandy Creek	6	6
Sandy Creek	6	6

STREAM	TEMPERATURE	QUALITY
Bear Creek	7	1, 10
Redbank Creek	9	1, 10
Cowanshannock Creek	7	1, 10
Buffalo Creek	8	1, 10
Bull Creek	8	1, 10
Pucketa Creek	8	1
Deer Creek	8	1
Plum Creek	8	1

DATA SOURCES

1. Flow/quality relationship
2. Allegheny Reservoir inflow temperature
3. Union City Reservoir inflow temperature
4. Union City Reservoir inflow temperature adjusted downward to account for local conditions
5. Woodcock Creek Lake inflow temperature
6. Same as Muddy Creek in French Creek basin
7. Loyalhanna Reservoir inflow temperature
8. Loyalhanna inflow temperature adjusted to account for local conditions
9. East Branch Clarion Reservoir inflow adjusted to account for local conditions
10. Observed data for Bull Creek from Tarentum water works, Tarentum, PA.

A-2. FRENCH CREEK WATER QUALITY DATA

TRIBUTARY	DATA SOURCE INDEX NUMBER	
	TEMPERATURE	QUALITY
South Branch, French Creek	3	1, 6
Little Conneautte Creek	2	1, 6
Muddy Creek	Twice per month measurements from COE	1, twice per month measurements from COE
Cussewago Creek	4	1, 6
Conneaut Outlet	5	1, 6
Little Sugar Creek	4	1, 6
Sugar Creek	4	1, 6
Patchel Run	4	1, 6

DATA SOURCES

1. Flow/quality relationship
2. Union City Reservoir inflow temperature
3. Union City Reservoir inflow temperature adjusted to account for local conditions
4. Woodcock Creek Reservoir inflow temperature
5. Woodcock Creek Reservoir inflow temperature adjusted to account for local conditions
6. pH measurements for Muddy Creek, Corps of Engineers

A-3. CLARION RIVER WATER QUALITY DATA

TRIBUTARY	DATA SOURCE INDEX NUMBER	
	TEMPERATURE	QUALITY
Crooked Creek	2	1
West Branch, Clarion River	2	1
Local drainage below Wilcox	2	1
Little Toby Creek	3	1
Spring Creek	3	1
Millstone Creek	3	1
Toms Run	3	1
Mill Creek	3	1
Toby Creek	3	1
Piney Creek	3	1
Deer Creek	3	1
Licking Creek	3	1

DATA SOURCES

1. Flow/quality relationship
2. East Branch Clarion River Reservoir inflow temperature
3. East Branch Clarion River Reservoir temperature adjusted to account for local conditions

A-4. KISKIMINETAS RIVER WATER QUALITY DATA

TRIBUTARY	DATA SOURCE INDEX NUMBER	
	TEMPERATURE	QUALITY
Blacklegs Creek	1	2
Beaver Run	1	2

DATA SOURCES

1. Daily data from COE Pittsburgh extrapolated from local thermographs
2. Flow/quality relationship

A-5. INFLOW/OUTFLOW WATER QUALITY DATA FOR COE RESERVOIRS IN THE ALLEGHENY RIVER BASIN

	DATA SOURCE INDEX NUMBER			
	INFLOW		OUTFLOW	
RESERVOIR	TEMPERATURE	QUALITY	TEMPERATURE	QUALITY
Allegheny	3	5	1	1, 2
Tionesta Lake	3	5	2	2
Union City	3	5	2	2
Woodcock Creek	3	5	2	2
East Branch Clarion River	3	5	2	2, 3
Mahoning Creek	6	5, 7	2	2
Crooked Creek	6	5, 7	2	2
Conemaugh	3	5	3	4
Loyalhanna	3	5	3	4

DATA SOURCES

1. ORSANCO monitor, hourly measurements
2. COE data, twice per month
3. Daily temperature data from COE Pittsburgh
4. Daily quality data from COE Pittsburgh
5. Flow/quality relationships
6. Loyalhanna Creek Reservoir inflow temperature
7. Alkalinity measurements of Loyalhanna Creek Reservoir inflow

A-6. INSTREAM WATER QUALITY DATA

RIVER	LOCATION	SOURCE
Allegheny	Freeport	ORSANCO monitor Freeport Water Co.
Allegheny	Natrona	Clearview Water Co.; USGS
Kiskiminetas	Vandergrift	ORSANCO monitor

APPENDIX B

WATER QUALITY STATISTICS FOR SELECTED SITES IN THE ALLEGHENY RIVER BASIN

B-1 French Creek Below Meadville

"Existing Conditions," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD-FRENCH CREEK
STATISTICS FOR EXISTING CONDITIONS NEAR MEADVILLE

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	73.13	
END OF REACH RIVER MILE	0.93	
SUBREACH LENGTH (MILES)	1.85	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	24.99	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 24.99
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	3.7	104.4	24.5	23.4
TEMP(DEGREE C)	4.1	32.8	18.6	5.4
OXY (MG/L)	7.5	12.6	9.4	1.0
ALKA(MG/L AS CACO3)	42.9	100.7	77.6	14.3
HARD(MG/L AS CACO3)	64.	125.	101.	15.
TDS (MG/L)	77.	148.	121.	18.
PH	6.6	8.3	7.5	7.3
BOD (MG/L)	1.4	1.9	1.8	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD-FRENCH CREEK
STATISTICS FOR EXISTING CONDITIONS NEAR MEADVILLE
WATER QUALITY PARAMETERS AT RIVER MILE 24.99
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.79	96.49	82.02	67.54	54.50	35.53	15.57	3.84	0.88
LOWER BOUND	4.15	7.01	9.88	12.74	15.61	18.47	21.34	24.21	27.07	29.94
OXY (MG/L)	100.00	96.82	79.17	51.21	37.50	28.29	15.13	3.40	1.10	0.77
LOWER BOUND	7.50	8.02	8.53	9.05	9.56	10.08	10.59	11.11	11.62	12.14
ALKA(MG/L AS CACO3)	100.00	95.29	92.87	87.50	79.28	66.12	53.18	41.12	22.70	12.83
LOWER BOUND	42.90	48.69	54.47	60.26	66.05	71.84	77.63	83.42	89.20	94.99
HARD(MG/L AS CACO3)	100.00	100.00	100.00	96.71	93.64	89.47	79.71	58.99	38.05	17.43
LOWER BOUND	39.96	48.45	56.93	65.42	73.91	82.39	90.88	99.37	107.85	116.34
TDS (MG/L)	100.00	94.63	93.53	90.46	78.51	70.61	59.87	39.47	31.69	12.94
LOWER BOUND	77.02	84.10	91.17	98.24	105.31	112.39	119.46	126.53	133.60	140.68
PH	100.00	95.94	94.08	90.24	87.39	79.93	55.37	30.81	22.48	6.91
LOWER BOUND	6.60	6.78	6.95	7.13	7.31	7.48	7.66	7.83	8.01	8.18
BOD (MG/L)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.78	81.80	52.52
LOWER BOUND	0.50	0.64	0.79	0.93	1.07	1.22	1.36	1.50	1.65	1.79

B-2 French Creek Below Meadville

"No Corps Storage," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD-FRENCH CREEK
STATISTICS FOR NO CORPS STORAGE NEAR MEADVILLE

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	73.13	
END OF REACH RIVER MILE	0.93	
SUBREACH LENGTH (MILES)	1.85	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	24.99	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 24.99
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	4.3	138.0	23.8	25.3
TEMP(DEGREE C)	3.7	32.9	18.3	5.6
OXY (MG/L)	7.5	12.8	9.5	1.1
ALKA(MG/L AS CACO3)	30.5	103.0	76.0	18.7
HARD(MG/L AS CACO3)	51.	136.	102.	18.
TDS (MG/L)	84.	168.	123.	20.
PH	6.7	8.3	7.6	7.5
BOD (MG/L)	1.4	1.9	1.8	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD-FRENCH CREEK
STATISTICS FOR NO CORPS STORAGE NEAR MEADVILLE
WATER QUALITY PARAMETERS AT RIVER MILE 24.99
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.90	95.29	79.39	66.23	53.29	36.51	15.90	4.06	0.88
LOWER BOUND	3.71	6.63	9.55	12.47	15.40	18.32	21.24	24.16	27.09	30.01
OXY (MG/L)	100.00	96.93	78.84	51.10	39.58	29.71	18.42	4.06	1.32	0.66
LOWER BOUND	7.47	8.01	8.54	9.08	9.62	10.15	10.69	11.22	11.76	12.30
ALKA(MG/L AS CACO3)	100.00	96.38	92.21	84.87	78.29	71.16	60.42	43.09	31.91	15.68
LOWER BOUND	30.46	37.72	44.99	52.25	59.52	66.78	74.05	81.31	88.57	95.84
HARD(MG/L AS CACO3)	100.00	100.00	99.01	95.18	88.60	76.21	64.58	42.76	24.23	7.79
LOWER BOUND	39.96	49.57	59.18	68.78	78.39	88.00	97.61	107.21	116.82	126.43
TDS (MG/L)	100.00	94.41	86.84	76.64	60.20	41.45	31.80	19.08	10.42	2.96
LOWER BOUND	83.72	92.13	100.55	108.96	117.38	125.79	134.21	142.62	151.04	159.45
PH	100.00	96.60	94.41	94.30	90.79	79.33	54.71	32.79	23.00	15.57
LOWER BOUND	6.69	6.86	7.02	7.19	7.36	7.52	7.69	7.85	8.02	8.18
BOD (MG/L)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.45	73.36	52.63
LOWER BOUND	0.50	0.64	0.79	0.93	1.08	1.22	1.36	1.51	1.65	1.80

B-3 Clarion River Near Ridgeway

"Existing Conditions," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	81.31	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 81.31
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	4.8	58.5	11.1	8.6
TEMP(DEGREE C)	5.8	25.0	15.3	4.0
OXY (MG/L)	8.2	12.0	10.0	0.8
ALKA(MG/L AS CACO3)	7.3	22.3	15.7	3.0
HARD(MG/L AS CACO3)	12.	56.	38.	7.
TDS (MG/L)	35.	111.	85.	14.
PH	6.1	7.4	7.0	7.0
BOD (MG/L)	2.6	8.2	6.0	1.6

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 81.31
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.03	92.00	79.82	61.95	50.77	32.35	20.61	6.58	1.54
LOWER BOUND	5.79	7.71	9.63	11.55	13.47	15.39	17.31	19.23	21.15	23.07
OXY (MG/L)	100.00	97.37	87.72	71.82	63.60	45.29	27.85	13.38	6.36	1.97
LOWER BOUND	8.23	8.61	8.99	9.36	9.74	10.12	10.49	10.87	11.25	11.62
ALKA(MG/L AS CACO3)	100.00	97.48	94.52	85.31	82.57	72.26	48.57	17.43	10.42	5.15
LOWER BOUND	7.29	8.80	10.30	11.80	13.31	14.81	16.32	17.82	19.32	20.83
HARD(MG/L AS CACO3)	100.00	98.68	97.37	93.64	89.25	83.55	52.74	20.18	9.76	2.85
LOWER BOUND	12.29	16.66	21.04	25.42	29.80	34.17	38.55	42.93	47.30	51.68
TDS (MG/L)	100.00	98.25	95.94	91.12	89.14	85.64	77.41	59.98	7.35	2.74
LOWER BOUND	35.06	42.70	50.33	57.97	65.60	73.24	80.87	88.51	96.14	103.78
PH	100.00	98.57	98.14	96.93	91.45	89.91	84.76	75.22	80.22	77.71
LOWER BOUND	6.11	6.25	6.38	6.52	6.65	6.79	6.92	7.05	7.19	7.32
BOD (MG/L)	100.00	96.82	86.73	79.17	72.48	63.93	54.06	43.53	34.10	18.86
LOWER BOUND	2.59	3.15	3.72	4.28	4.84	5.41	5.97	6.54	7.10	7.66

B-4 Clarion River Near Ridgeway

"No Corps Storage," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	81.31	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 81.31
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	0.4	82.7	7.7	10.7
TEMP(DEGREE C)	5.1	30.2	16.9	5.4
OXY (MG/L)	6.1	12.4	9.5	1.3
ALKA(MG/L AS CACO3)	6.8	68.4	33.7	14.8
HARD(MG/L AS CACO3)	11.	111.	60.	25.
TDS (MG/L)	30.	379.	153.	82.
PH	6.6	7.8	7.4	7.4
BOD (MG/L)	2.4	31.1	11.4	7.2

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 81.31
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.79	88.27	68.20	59.54	48.14	37.83	11.95	4.06	1.75
LOWER BOUND	5.07	7.59	10.11	12.63	15.15	17.67	20.19	22.70	25.22	27.74
OXY (MG/L)	100.00	98.36	96.49	91.45	70.07	56.58	41.89	31.69	7.57	1.21
LOWER BOUND	6.06	6.70	7.33	7.97	8.60	9.24	9.87	10.51	11.14	11.78
ALKA(MG/L AS CACO3)	100.00	94.08	81.91	68.20	49.12	34.98	30.15	19.52	6.36	2.63
LOWER BOUND	6.79	12.96	19.13	25.30	31.46	37.63	43.80	49.97	56.13	62.30
HARD(MG/L AS CACO3)	100.00	95.50	85.86	74.56	61.62	45.29	33.88	26.43	13.16	4.28
LOWER BOUND	11.29	21.30	31.31	41.33	51.34	61.35	71.36	81.37	91.39	101.40
TDS (MG/L)	100.00	88.60	69.08	45.07	34.43	29.39	20.50	9.21	4.71	2.19
LOWER BOUND	30.07	64.96	99.85	134.74	169.63	204.52	239.42	274.31	309.20	344.09
PH	100.00	99.67	98.25	96.27	92.32	87.83	82.46	74.78	65.57	41.34
LOWER BOUND	6.49	6.62	6.75	6.88	7.02	7.15	7.28	7.41	7.54	7.67
BOD (MG/L)	100.00	78.40	53.95	36.84	33.22	25.00	18.53	7.89	4.82	2.19
LOWER BOUND	2.42	5.29	8.17	11.04	13.92	16.79	19.67	22.55	25.42	28.30

B-5 Clarion River Near Piney

"Existing Conditions," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	24.29	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 24.29
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	9.3	240.2	48.9	39.3
TEMP(DEGREE C)	5.6	27.6	16.3	4.5
OXY (MG/L)	7.9	12.3	9.9	0.9
ALKA(MG/L AS CACO3)	-6.1	16.0	5.9	3.0
HARD(MG/L AS CACO3)	27.	130.	71.	20.
TDS (MG/L)	46.	205.	112.	31.
PH	3.9	7.3	5.8	5.1
BOD (MG/L)	2.1	5.0	2.8	0.6

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 24.29
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.68	92.54	71.49	62.28	53.18	38.93	12.83	2.96	1.21
LOWER BOUND	5.64	7.84	10.03	12.23	14.43	16.62	18.82	21.01	23.21	25.40
OXY (MG/L)	100.00	98.68	95.72	76.21	51.10	41.01	32.24	18.97	3.40	0.88
LOWER BOUND	7.86	8.30	8.74	9.18	9.62	10.06	10.50	10.94	11.38	11.82
ALKA(MG/L AS CACO3)	99.89	99.56	98.36	96.71	90.46	61.62	20.72	10.75	6.69	2.85
LOWER BOUND	-6.04	-3.84	-1.63	0.57	2.78	4.98	7.19	9.39	11.60	13.80
HARD(MG/L AS CACO3)	100.00	95.72	84.43	73.57	53.40	33.99	25.22	7.13	2.41	0.66
LOWER BOUND	26.67	36.99	47.30	57.62	67.94	78.25	88.57	98.88	109.20	119.51
TDS (MG/L)	100.00	95.94	83.22	74.01	49.67	31.14	20.61	5.81	2.30	0.44
LOWER BOUND	46.25	62.18	78.10	94.03	109.95	125.88	141.80	157.73	173.65	189.58
PH	100.00	99.23	98.25	98.14	97.37	95.94	92.21	80.15	32.46	6.47
LOWER BOUND	3.92	4.25	4.59	4.93	5.27	5.61	5.94	6.28	6.62	6.96
BOD (MG/L)	100.00	79.17	50.22	34.43	22.04	14.25	6.03	2.52	0.99	0.33
LOWER BOUND	2.09	2.38	2.67	2.96	3.25	3.55	3.84	4.13	4.42	4.71

B-6 Clarion River Near Piney

"No Corps Storage," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	24.29	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 24.29
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	4.9	263.4	45.5	40.8
TEMP(DEGREE C)	5.9	27.0	16.2	4.4
OXY (MG/L)	8.0	12.2	9.9	0.9
ALKA(MG/L AS CACO3)	-6.9	30.4	6.5	4.5
HARD(MG/L AS CACO3)	26.	171.	80.	29.
TDS (MG/L)	44.	265.	126.	44.
PH	3.9	7.5	5.7	4.9
BOD (MG/L)	2.1	8.7	2.9	0.8

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 24.29
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.79	90.68	71.49	63.05	55.48	39.36	14.47	3.29	1.21
LOWER BOUND	5.86	7.98	10.10	12.21	14.33	16.45	18.56	20.68	22.79	24.91
OXY (MG/L)	100.00	98.90	95.72	78.62	49.12	40.35	32.13	21.38	4.06	0.99
LOWER BOUND	7.95	8.38	8.80	9.22	9.64	10.07	10.49	10.91	11.34	11.76
ALKA(MG/L AS CACO3)	99.89	98.79	95.50	75.22	20.94	10.31	6.14	1.54	0.66	0.55
LOWER BOUND	-6.87	-3.14	0.59	4.31	8.04	11.77	15.50	19.23	22.96	26.69
HARD(MG/L AS CACO3)	100.00	93.97	79.06	60.64	39.69	28.84	16.89	6.36	1.64	0.22
LOWER BOUND	25.47	40.02	54.57	69.12	83.67	98.22	112.77	127.32	141.87	156.42
TDS (MG/L)	100.00	93.31	78.95	59.54	36.51	28.84	16.45	5.81	2.30	0.22
LOWER BOUND	43.56	65.75	87.94	110.13	132.32	154.51	176.70	198.89	221.08	243.27
PH	100.00	98.46	97.81	97.04	96.05	93.86	87.94	57.79	19.30	4.71
LOWER BOUND	3.87	4.23	4.59	4.96	5.32	5.69	6.05	6.42	6.78	7.14
BOD (MG/L)	100.00	42.87	17.98	5.81	2.30	1.54	1.21	0.88	0.55	0.33
LOWER BOUND	2.08	2.74	3.41	4.07	4.73	5.40	6.06	6.73	7.39	8.05

B-7 Clarion River Near St. Petersburg
"Existing Conditions," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	3.17	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 3.17
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	11.2	324.2	62.0	54.5
TEMP(DEGREE C)	5.5	27.8	16.8	4.8
OXY (MG/L)	8.0	12.3	9.8	0.9
ALKA(MG/L AS CACO3)	-5.0	11.8	3.8	2.2
HARD(MG/L AS CACO3)	42.	166.	103.	26.
TDS (MG/L)	62.	232.	147.	37.
PH	4.0	7.3	5.8	5.1
BOD (MG/L)	2.0	4.2	2.6	0.4

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 3.17
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.79	93.75	73.03	63.05	55.92	43.97	22.70	5.59	1.64
LOWER BOUND	5.47	7.71	9.94	12.17	14.41	16.64	18.87	21.11	23.34	25.57
OXY (MG/L)	100.00	97.26	84.76	58.66	45.72	38.49	30.92	10.96	1.97	0.88
LOWER BOUND	8.03	8.46	8.89	9.33	9.76	10.19	10.62	11.05	11.48	11.91
ALKA(MG/L AS CACO3)	99.89	99.45	97.81	92.76	66.67	22.04	8.22	2.08	0.44	0.00
LOWER BOUND	-5.00	-3.00	-1.00	1.00	3.00	5.01	7.01	9.01	11.01	13.01
HARD(MG/L AS CACO3)	100.00	98.57	93.64	84.21	73.57	55.39	36.73	21.60	5.81	1.21
LOWER BOUND	34.96	48.05	61.13	74.21	87.29	100.37	113.45	126.53	139.61	152.69
TDS (MG/L)	100.00	97.26	89.47	80.37	68.42	50.33	34.76	22.04	8.44	2.30
LOWER BOUND	62.24	79.20	96.16	113.12	130.08	147.03	163.99	180.95	197.91	214.87
PH	100.00	99.01	97.81	96.71	96.16	94.85	92.43	80.92	36.51	6.25
LOWER BOUND	4.00	4.32	4.65	4.97	5.30	5.63	5.95	6.28	6.60	6.93
BOD (MG/L)	100.00	64.58	38.92	21.05	10.31	2.96	0.66	0.33	0.00	0.00
LOWER BOUND	2.05	2.34	2.64	2.94	3.23	3.53	3.82	4.12	4.41	4.71

B-8 Clarion River Near St. Petersburg

"No Corps Storage," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	3.17	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 3.17
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	6.9	347.2	58.6	56.2
TEMP(DEGREE C)	5.6	27.7	16.8	4.8
OXY (MG/L)	8.1	12.3	9.9	0.9
ALKA(MG/L AS CACO3)	-6.0	21.1	3.9	3.3
HARD(MG/L AS CACO3)	39.	209.	116.	38.
TDS (MG/L)	60.	296.	165.	54.
PH	3.9	7.5	5.5	4.9
BOD (MG/L)	2.0	6.7	2.6	0.6

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 3.17
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.79	92.11	72.59	63.05	56.14	43.53	22.26	5.92	1.64
LOWER BOUND	5.60	7.82	10.03	12.24	14.45	16.66	18.87	21.08	23.30	25.51
OXY (MG/L)	100.00	97.48	83.99	57.13	43.53	37.72	30.26	11.95	1.54	0.88
LOWER BOUND	8.11	8.53	8.95	9.37	9.78	10.20	10.62	11.04	11.46	11.87
ALKA(MG/L AS CACO3)	99.89	98.57	93.86	72.70	29.61	10.42	3.84	1.75	0.66	0.44
LOWER BOUND	-5.94	-3.24	-0.53	2.18	4.89	7.60	10.31	13.02	15.72	18.43
HARD(MG/L AS CACO3)	100.00	97.70	88.27	75.66	56.14	37.50	29.93	17.54	8.77	1.75
LOWER BOUND	34.96	52.40	69.83	87.27	104.70	122.14	139.57	157.01	174.44	191.87
TDS (MG/L)	100.00	96.27	84.10	72.26	50.55	36.73	29.50	17.32	7.79	1.86
LOWER BOUND	59.64	83.31	106.97	130.64	154.30	177.97	201.63	225.30	248.96	272.63
PH	100.00	98.14	95.61	93.53	91.78	88.27	81.58	58.55	20.83	2.96
LOWER BOUND	3.93	4.28	4.64	5.00	5.35	5.71	6.07	6.43	6.78	7.14
BOD (MG/L)	100.00	44.85	17.11	5.92	2.52	1.54	1.21	0.88	0.55	0.33
LOWER BOUND	2.03	2.50	2.97	3.44	3.91	4.38	4.85	5.32	5.79	6.27

B-9 Kiskiminetas River Near Vandergrift

"Existing Conditions," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS KISKIMINETAS RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	33.01	
END OF REACH RIVER MILE	0.49	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	10.35	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 10.35
NUMBER OF SIMULATION POINTS 912

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.	ERROR (SIMULATED-OBS.) MEAN	STD. DEV.	NO. OF OBSERVED VALUES	MINIMUM OBSERVED VALUE	MAXIMUM OBSERVED VALUE
FLOW(M**3/S)	17.1	243.8	73.1	51.8					
TEMP(DEGREE C)	8.2	29.0	19.5	4.8	-2.1	1.4	129	13.9	30.1
OXY (MG/L)	7.7	11.1	8.9	0.9	1.8	0.9	108	5.6	8.9
ALKA(MG/L AS CACO3)	-29.3	1.2	-13.1	7.0					
HARD(MG/L AS CACO3)	93.	373.	201.	76.					
TDS (MG/L)	149.	722.	364.	154.	-27.	73.	108	145.7	618.8
PH	3.2	5.6	3.6	3.9	0.0	0.5	129	2.5	5.3
BOD (MG/L)	1.8	2.0	1.9	0.1					

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS KISKIMINETAS RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 10.35
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.57	95.18	77.08	64.80	58.55	50.11	35.86	10.53	2.08
LOWER BOUND	8.22	10.31	12.39	14.48	16.56	18.65	20.74	22.82	24.91	26.99
OXY (MG/L)	100.00	89.80	57.24	47.48	41.12	35.09	25.99	11.95	2.41	1.43
LOWER BOUND	7.67	8.02	8.36	8.70	9.05	9.39	9.74	10.08	10.42	10.77
ALKA(MG/L AS CACO3)	99.78	95.83	90.13	85.42	73.68	54.82	37.72	24.34	14.36	6.25
LOWER BOUND	-29.24	-26.19	-23.15	-20.10	-17.05	-14.00	-10.96	-7.91	-4.86	-1.82
HARD(MG/L AS CACO3)	100.00	87.61	71.82	50.55	37.83	30.15	20.61	17.43	14.58	4.82
LOWER BOUND	93.01	121.04	149.08	177.12	205.15	233.19	261.23	289.26	317.30	345.34
TDS (MG/L)	100.00	86.73	69.52	48.79	36.95	28.84	18.97	17.21	13.27	4.39
LOWER BOUND	149.05	206.46	263.86	321.27	378.68	436.09	493.49	550.90	608.31	665.71
PH	100.00	74.12	35.20	18.09	9.87	6.36	2.96	1.86	1.10	0.44
LOWER BOUND	3.23	3.46	3.70	3.93	4.17	4.41	4.64	4.88	5.11	5.35
BOD (MG/L)	100.00	93.20	86.51	68.31	61.29	51.75	44.96	33.99	3.73	0.00
LOWER BOUND	1.76	1.78	1.81	1.83	1.86	1.88	1.90	1.93	1.95	1.98

B-10 Kiskiminetas River Near Vandergrift

"No Corps Storage," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE KISKIMINETAS RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	33.01	
END OF REACH RIVER MILE	0.49	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	10.35	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 10.35
NUMBER OF SIMULATION POINTS 912

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	9.2	417.4	73.6	64.2
TEMP(DEGREE C)	8.9	30.3	19.1	5.1
OXY (MG/L)	7.6	10.8	9.0	0.9
ALKA(MG/L AS CACO3)	-49.5	2.8	-22.0	12.1
HARD(MG/L AS CACO3)	89.	425.	221.	88.
TDS (MG/L)	167.	724.	386.	145.
PH	3.0	5.8	3.4	3.6
BOD (MG/L)	1.7	2.0	1.9	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE KISKIMINETAS RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 10.35
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	96.38	81.25	67.32	60.42	50.66	42.00	20.29	4.71	1.21
LOWER BOUND	8.93	11.07	13.22	15.36	17.51	19.65	21.79	23.94	26.08	28.23
OXY (MG/L)	100.00	94.74	73.68	54.93	47.81	38.82	35.42	25.33	16.01	5.37
LOWER BOUND	7.55	7.88	8.21	8.54	8.88	9.21	9.54	9.87	10.20	10.53
ALKA(MG/L AS CACO3)	99.89	96.38	89.80	78.95	71.05	58.11	40.57	23.14	12.94	4.93
LOWER BOUND	-49.47	-44.25	-39.03	-33.80	-28.58	-23.36	-18.14	-12.91	-7.69	-2.47
HARD(MG/L AS CACO3)	100.00	90.13	70.61	52.63	39.80	32.13	25.00	15.13	9.65	4.61
LOWER BOUND	88.41	122.06	155.71	189.37	223.02	256.67	290.32	323.97	357.62	391.27
TDS (MG/L)	100.00	90.02	70.61	52.63	39.80	32.13	25.00	15.13	9.65	4.61
LOWER BOUND	167.03	222.75	278.47	334.19	389.91	445.63	501.35	557.07	612.79	668.50
PH	100.00	64.80	24.12	11.84	6.14	4.71	3.95	2.30	0.77	0.66
LOWER BOUND	3.01	3.29	3.58	3.86	4.15	4.43	4.72	5.00	5.29	5.57
BOD (MG/L)	100.00	98.25	95.50	91.56	77.74	61.40	51.97	42.32	25.00	0.00
LOWER BOUND	1.70	1.73	1.76	1.79	1.82	1.85	1.88	1.91	1.94	1.97

B-11 Allegheny River Near Warren
"Existing Conditions," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS NEAR WARREN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	196.28	
END OF REACH RIVER MILE	125.61	
SUBREACH LENGTH (MILES)	1.81	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	153	(2 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	185.41	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	24.1	391.2	127.4	97.9
TEMP(DEGREE C)	10.6	29.2	18.0	4.2
OXY (MG/L)	8.3	11.7	9.4	0.6
ALKA(MG/L AS CACO3)	24.5	49.0	36.9	6.0
HARD(MG/L AS CACO3)	33.	63.	47.	8.
TDS (MG/L)	63.	97.	82.	8.
PH	6.9	7.4	7.2	7.8
BOD (MG/L)	1.9	2.0	2.0	0.0

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS NEAR WARREN
WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	93.09	74.56	57.35	45.94	36.62	21.82	11.07	3.51	0.66
LOWER BOUND	10.56	12.43	14.30	16.17	18.04	19.90	21.77	23.64	25.51	27.38
OXY (MG/L)	100.00	94.41	73.46	46.38	24.23	15.02	10.53	6.91	3.40	0.77
LOWER BOUND	8.32	8.66	9.00	9.34	9.67	10.01	10.35	10.69	11.03	11.36
ALKA(MG/L AS CACO3)	100.00	91.12	86.62	81.14	67.00	54.61	38.38	21.49	13.27	3.62
LOWER BOUND	24.51	26.96	29.41	31.87	34.32	36.78	39.23	41.69	44.14	46.59
HARD(MG/L AS CACO3)	100.00	90.90	76.32	72.59	57.68	45.50	27.63	19.19	14.25	5.04
LOWER BOUND	33.37	36.37	39.37	42.37	45.37	48.36	51.36	54.36	57.36	60.36
TDS (MG/L)	100.00	94.30	89.14	84.76	72.04	65.35	51.32	30.92	17.32	3.73
LOWER BOUND	62.84	66.28	69.73	73.18	76.62	80.07	83.51	86.96	90.41	93.85
PH	100.00	99.01	95.61	88.93	69.08	49.23	32.24	16.89	5.37	0.88
LOWER BOUND	6.90	6.96	7.01	7.07	7.12	7.18	7.23	7.28	7.34	7.39
BOD (MG/L)	100.00	99.89	98.25	91.01	73.90	63.93	63.93	61.07	48.79	21.16
LOWER BOUND	1.90	1.91	1.91	1.92	1.93	1.94	1.95	1.96	1.97	1.97

B-12 Allegheny River Near Warren

"Pattern A," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR PATTERN A NEAR WARREN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	196.28	
END OF REACH RIVER MILE	125.61	
SUBREACH LENGTH (MILES)	1.81	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	185.41	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 912

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD.DEV.
FLOW(M**3/S)	19.6	391.2	119.7	104.0
TEMP(DEGREE C)	10.6	31.9	18.3	4.7
OXY (MG/L)	8.0	11.7	9.4	0.7
ALKA(MG/L AS CACO3)	24.5	59.6	41.3	9.6
HARD(MG/L AS CACO3)	33.	79.	53.	13.
TDS (MG/L)	63.	113.	88.	13.
PH	6.9	7.4	7.2	7.8
BOD (MG/L)	1.9	2.0	2.0	0.0

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR PATTERN A NEAR WARREN
WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	91.12	68.31	51.54	41.56	29.82	17.11	7.89	2.74	0.88
LOWER BOUND	10.56	12.69	14.83	16.96	19.09	21.23	23.36	25.49	27.63	29.76
OXY (MG/L)	100.00	96.82	85.53	62.06	38.05	17.21	12.94	7.79	4.17	0.88
LOWER BOUND	8.02	8.39	8.76	9.13	9.49	9.86	10.23	10.60	10.97	11.33
ALKA(MG/L AS CACO3)	100.00	89.14	83.55	69.19	57.13	47.26	41.67	25.22	14.14	4.50
LOWER BOUND	24.51	28.02	31.54	35.05	38.57	42.09	45.60	49.12	52.64	56.15
HARD(MG/L AS CACO3)	100.00	85.09	72.26	58.00	49.23	45.50	39.36	25.11	11.29	5.15
LOWER BOUND	33.37	37.90	42.43	46.96	51.49	56.02	60.55	65.08	69.62	74.15
TDS (MG/L)	100.00	92.54	85.86	71.49	63.05	49.01	41.45	31.36	17.21	5.81
LOWER BOUND	61.94	67.06	72.17	77.29	82.41	87.53	92.64	97.76	102.88	108.00
PH	100.00	99.01	95.61	89.04	71.05	53.84	39.91	28.73	12.06	1.43
LOWER BOUND	6.90	6.96	7.01	7.07	7.12	7.18	7.23	7.28	7.34	7.39
BOD (MG/L)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	68.86
LOWER BOUND	1.50	1.55	1.60	1.64	1.69	1.74	1.79	1.84	1.89	1.93

B-13 Allegheny River Near Warren

"No Corps Storage," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE NEAR WARREN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	196.28	
END OF REACH RIVER MILE	125.61	
SUBREACH LENGTH (MILES)	1.81	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	185.41	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD DEV.
FLOW(M**3/S)	18.6	789.6	116.9	118.3
TEMP(DEGREE C)	6.1	32.4	16.7	5.8
OXY (MG/L)	7.8	12.0	9.8	1.1
ALKA(MG/L AS CACO3)	17.4	80.5	40.2	12.5
HARD(MG/L AS CACO3)	42.	113.	78.	15.
TDS (MG/L)	52.	177.	113.	28.
PH	6.5	7.8	7.0	7.2
BOD (MG/L)	1.9	2.0	2.0	0.0

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE NEAR WARREN
WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	91.67	76.86	62.94	52.08	38.49	20.07	7.89	1.86	0.55
LOWER BOUND	6.08	8.72	11.36	14.00	16.64	19.28	21.92	24.56	27.20	29.84
OXY (MG/L)	100.00	98.03	88.82	67.98	52.52	39.91	34.65	26.21	15.02	6.03
LOWER BOUND	7.77	8.19	8.62	9.04	9.46	9.88	10.30	10.73	11.15	11.57
ALKA(MG/L AS CACO3)	100.00	94.52	80.26	61.18	33.33	16.89	9.87	8.99	3.73	2.63
LOWER BOUND	17.38	23.70	30.03	36.35	42.67	48.99	55.31	61.64	67.96	74.28
HARD(MG/L AS CACO3)	100.00	97.37	92.00	81.36	69.52	49.23	37.61	23.46	8.55	1.64
LOWER BOUND	42.06	49.13	56.21	63.28	70.36	77.44	84.51	91.59	98.66	105.74
TDS (MG/L)	100.00	96.71	90.02	78.95	58.88	43.86	35.96	20.61	8.11	2.19
LOWER BOUND	51.65	64.23	76.81	89.40	101.98	114.56	127.15	139.73	152.31	164.89
PH	100.00	93.42	81.58	63.49	55.59	46.49	33.22	4.82	2.63	0.99
LOWER BOUND	6.52	6.65	6.78	6.90	7.03	7.16	7.28	7.41	7.53	7.66
BOD (MG/L)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.01	67.87
LOWER BOUND	1.50	1.55	1.60	1.65	1.70	1.75	1.79	1.84	1.89	1.94

B-14 Allegheny River Near Franklin

"Existing Conditions," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS NEAR FRANKLIN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	124.19	
END OF REACH RIVER MILE	84.80	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	120.16	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	49.9	875.7	245.9	185.9
TEMP(DEGREE C)	7.5	31.0	18.6	5.0
OXY (MG/L)	7.4	11.3	9.3	0.9
ALKA(MG/L AS CACO3)	27.6	57.0	43.5	7.8
HARD(MG/L AS CACO3)	39.	76.	57.	10.
TDS (MG/L)	63.	105.	87.	11.
PH	6.9	7.9	7.5	7.6
BOD (MG/L)	1.5	1.9	1.8	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS NEAR FRANKLIN
WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.36	89.80	71.82	58.55	46.71	37.50	13.49	4.50	1.86
LOWER BOUND	7.48	9.84	12.20	14.55	16.91	19.27	21.62	23.98	26.34	28.69
OXY (MG/L)	100.00	97.59	91.67	70.50	55.92	49.01	39.25	25.33	6.25	1.21
LOWER BOUND	7.43	7.82	8.20	8.58	8.97	9.35	9.74	10.12	10.50	10.89
ALKA(MG/L AS CACO3)	100.00	91.56	88.60	84.65	67.00	52.41	41.45	32.46	21.71	10.42
LOWER BOUND	27.57	30.52	33.46	36.41	39.35	42.30	45.25	48.19	51.14	54.08
HARD(MG/L AS CACO3)	100.00	91.78	88.71	75.33	58.88	49.67	34.76	24.67	12.28	4.82
LOWER BOUND	39.06	42.80	46.54	50.29	54.03	57.77	61.51	65.25	68.99	72.73
TDS (MG/L)	100.00	94.52	89.80	85.53	77.19	60.53	44.19	32.35	26.10	12.72
LOWER BOUND	61.94	66.21	70.49	74.77	79.04	83.32	87.60	91.87	96.15	100.43
PH	100.00	95.72	94.08	88.38	85.53	72.70	59.43	35.75	25.44	17.98
LOWER BOUND	6.91	7.02	7.12	7.22	7.32	7.43	7.53	7.63	7.73	7.84
BOD (MG/L)	100.00	98.79	97.81	95.72	89.80	71.27	58.33	49.56	41.12	8.77
LOWER BOUND	1.43	1.48	1.53	1.58	1.63	1.68	1.73	1.78	1.83	1.88

B-15 Allegheny River Near Franklin

"Pattern A," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR PATTERN A NEAR FRANKLIN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	124.19	
END OF REACH RIVER MILE	84.80	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	120.16	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 912

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	44.0	875.7	238.3	191.4
TEMP(DEGREE C)	7.5	31.9	18.6	5.0
OXY (MG/L)	7.4	11.3	9.3	0.9
ALKA(MG/L AS CACO3)	27.6	65.8	46.5	11.1
HARD(MG/L AS CACO3)	39.	87	61.	14.
TDS (MG/L)	63.	119.	90.	15.
PH	6.9	8.0	7.5	7.6
BOD (MG/L)	1.5	1.9	1.8	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR PATTERN A NEAR FRANKLIN
WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.04	89.36	70.07	56.58	45.50	31.36	9.76	3.40	1.32
LOWER BOUND	7.48	9.93	12.38	14.82	17.27	19.72	22.16	24.61	27.06	29.50
OXY (MG/L)	100.00	97.59	92.21	73.79	56.25	49.67	39.47	25.33	6.25	1.21
LOWER BOUND	7.40	7.79	8.18	8.56	8.95	9.34	9.72	10.11	10.50	10.88
ALKA(MG/L AS CACO3)	100.00	90.46	86.07	68.86	50.11	42.76	40.13	30.48	20.29	12.17
LOWER BOUND	27.57	31.40	35.24	39.07	42.90	46.73	50.57	54.40	58.23	62.06
HARD(MG/L AS CACO3)	100.00	91.12	80.70	60.42	49.45	42.54	39.36	28.62	17.76	3.73
LOWER BOUND	39.06	43.90	48.75	53.59	58.43	63.27	68.12	72.96	77.80	82.64
TDS (MG/L)	100.00	92.98	86.95	76.97	54.82	41.89	37.17	26.54	18.53	3.95
LOWER BOUND	61.94	67.70	73.45	79.21	84.97	90.73	96.49	102.24	108.00	113.76
PH	100.00	95.61	93.86	88.05	79.17	68.42	45.07	29.50	26.10	16.67
LOWER BOUND	6.91	7.03	7.14	7.26	7.37	7.49	7.60	7.71	7.33	7.94
BOD (MG/L)	100.00	100.00	99.34	97.81	94.19	81.91	66.67	49.56	41.23	8.77
LOWER BOUND	1.43	1.48	1.53	1.58	1.63	1.68	1.73	1.78	1.83	1.88

B-16 Allegheny River Near Franklin

"No Corps Storage," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE NEAR FRANKLIN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	124.19	
END OF REACH RIVER MILE	84.80	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	120.16	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	43.1	1473.6	235.3	229.9
TEMP(DEGREE C)	4.8	31.5	18.1	5.7
OXY (MG/L)	7.4	12.4	9.5	1.1
ALKA(MG/L AS CACO3)	19.5	69.7	45.7	10.4
HARD(MG/L AS CACO3)	40.	103.	74.	15.
TDS (MG/L)	50.	146.	102.	22.
PH	6.8	8.0	7.5	7.6
BOD (MG/L)	1.5	2.0	1.8	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE NEAR FRANKLIN
WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.79	92.32	72.48	63.38	50.66	43.97	17.43	4.71	1.86
LOWER BOUND	4.78	7.45	10.13	12.80	15.48	18.15	20.83	23.50	26.18	28.86
OXY (MG/L)	100.00	96.93	82.13	54.06	47.15	35.86	27.63	12.50	4.39	0.66
LOWER BOUND	7.41	7.92	8.42	8.93	9.43	9.94	10.44	10.95	11.45	11.96
ALKA(MG/L AS CACO3)	100.00	97.92	95.18	84.76	70.94	51.10	37.17	26.43	7.68	1.75
LOWER BOUND	19.44	24.48	29.51	34.55	39.58	44.62	49.66	54.69	59.73	64.76
HARD(MG/L AS CACO3)	100.00	97.59	93.09	81.80	69.41	54.39	40.02	27.96	18.75	4.28
LOWER BOUND	40.06	46.35	52.65	58.94	65.24	71.53	77.83	84.12	90.41	96.71
TDS (MG/L)	100.00	97.92	94.52	83.55	68.97	54.82	39.25	30.92	19.41	4.28
LOWER BOUND	49.55	59.19	68.83	78.47	88.11	97.75	107.39	117.03	126.67	136.31
PH	100.00	96.93	92.43	86.51	77.85	65.79	53.95	35.96	26.97	12.06
LOWER BOUND	6.83	6.96	7.08	7.20	7.32	7.45	7.57	7.69	7.81	7.94
BOD (MG/L)	100.00	99.78	99.23	96.27	87.17	69.96	55.59	50.11	37.72	21.27
LOWER BOUND	1.42	1.47	1.53	1.58	1.64	1.69	1.74	1.80	1.85	1.91

B-17 Allegheny River Near Freeport

"Existing Conditions," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	31.90	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 912

PARAMETER	SIMULATION VALUES MINIMUM	SIMULATION VALUES MAXIMUM	SIMULATION VALUES MEAN	SIMULATION VALUES STD. DEV.	ERROR (SIMULATED-OBS.) MEAN	ERROR (SIMULATED-OBS.) STD. DEV.	NO. OF OBSERVED VALUES	MINIMUM OBSERVED VALUE	MAXIMUM OBSERVED VALUE
FLOW(M**3/S)	87.1	1484.3	387.8	291.6					
TEMP(DEGREE C)	8.8	26.6	18.4	4.8	-2.6	0.8	138	10.9	28.6
OXY (MG/L)	6.9	11.1	8.9	1.2					
ALKA(MG/L AS CACO3)	20.7	46.5	32.8	7.0					
HARD(MG/L AS CACO3)	50.	100.	75.	13.					
TDS (MG/L)	64.	144.	110.	20.	35.	11.	137	41.5	109.7
PH	6.9	7.7	7.4	7.7	0.5	0.3	137	6.4	7.8
BOD (MG/L)	0.5	1.9	1.2	0.5					

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	95.94	85.96	71.60	63.93	57.35	48.36	44.08	19.52	3.95
LOWER BOUND	8.78	10.56	12.34	14.13	15.91	17.69	19.47	21.25	23.03	24.82
OXY (MG/L)	100.00	92.43	65.90	60.75	54.50	44.08	38.27	31.03	20.72	4.61
LOWER BOUND	6.91	7.33	7.75	8.16	8.58	9.00	9.41	9.83	10.25	10.66
ALKA(MG/L AS CACO3)	100.00	92.11	78.07	67.21	55.04	43.31	37.61	27.52	13.71	4.06
LOWER BOUND	20.64	23.23	25.81	28.40	30.99	33.58	36.17	38.75	41.34	43.93
HARD(MG/L AS CACO3)	100.00	91.12	86.18	75.11	57.89	46.82	39.69	26.75	12.06	2.41
LOWER BOUND	49.85	54.92	59.98	65.05	70.11	75.18	80.24	85.31	90.37	95.44
TDS (MG/L)	100.00	98.79	94.19	85.42	80.04	58.00	42.11	36.07	26.75	12.28
LOWER BOUND	61.94	70.13	78.32	86.51	94.70	102.89	111.08	119.27	127.46	135.65
PH	100.00	98.14	95.39	90.13	83.22	68.20	60.09	47.26	33.88	7.02
LOWER BOUND	6.88	6.97	7.05	7.14	7.22	7.31	7.40	7.48	7.57	7.65
BOD (MG/L)	100.00	82.02	69.74	64.69	61.40	59.76	48.79	40.90	14.69	1.10
LOWER BOUND	0.50	0.65	0.80	0.95	1.10	1.25	1.40	1.55	1.70	1.85

B-18 Allegheny River Near Freeport

"Pattern A," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR PATTERN A LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	31.90	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	68.2	1484.3	380.1	297.5
TEMP(DEGREE C)	8.8	26.5	18.4	4.8
OXY (MG/L)	6.9	11.1	8.8	1.3
ALKA(MG/L AS CACO3)	20.7	51.6	33.5	8.1
HARD(MG/L AS CACO3)	50.	105.	78.	16.
TDS (MG/L)	64.	159.	113.	24.
PH	6.9	7.8	7.4	7.7
BOD (MG/L)	0.4	1.9	1.2	0.5

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR PATTERN A LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	96.05	85.96	71.71	64.04	57.35	48.57	44.30	21.93	4.06
LOWER BOUND	8.78	10.56	12.33	14.10	15.88	17.65	19.43	21.20	22.98	24.75
OXY (MG/L)	100.00	90.46	65.13	60.86	54.50	44.19	38.60	31.36	20.72	4.61
LOWER BOUND	6.89	7.31	7.73	8.15	8.57	8.99	9.41	9.82	10.24	10.66
ALKA(MG/L AS CACO3)	100.00	88.93	73.57	60.42	44.52	38.93	25.88	19.74	8.00	2.63
LOWER BOUND	20.64	23.75	26.85	29.96	33.06	36.17	39.28	42.38	45.49	48.60
HARD(MG/L AS CACO3)	100.00	90.35	85.31	70.07	53.07	44.52	39.14	32.13	23.90	15.46
LOWER BOUND	49.85	55.39	60.92	66.46	71.99	77.53	83.06	88.60	94.13	99.67
TDS (MG/L)	100.00	98.46	88.93	83.55	66.12	43.75	35.20	31.47	22.81	5.59
LOWER BOUND	61.94	71.64	81.34	91.04	100.75	110.45	120.15	129.85	139.55	149.26
PH	100.00	97.70	95.18	88.71	76.75	65.90	58.00	39.47	21.93	5.92
LOWER BOUND	6.88	6.97	7.06	7.15	7.24	7.34	7.43	7.52	7.61	7.70
BOD (MG/L)	100.00	81.80	70.07	65.13	62.06	60.09	51.64	41.89	17.98	1.64
LOWER BOUND	0.43	0.59	0.74	0.90	1.06	1.22	1.37	1.53	1.69	1.84

B-19 Allegheny River Near Freeport

"No Corps Storage," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	63.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	31.90	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD.DEV.
FLOW(M**3/S)	63.1	2091.9	374.8	337.1
TEMP(DEGREE C)	7.9	26.8	18.2	5.2
OXY (MG/L)	7.0	11.5	8.9	1.4
ALKA(MG/L AS CACO3)	17.7	59.7	32.8	8.1
HARD(MG/L AS CACO3)	48.	117.	86.	19.
TDS (MG/L)	60.	183.	126.	33.
PH	6.8	7.8	7.2	7.5
BOD (MG/L)	0.4	1.9	1.2	0.5

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	95.39	83.33	71.16	64.04	57.24	49.89	45.94	20.50	4.06
LOWER BOUND	7.91	9.80	11.69	13.58	15.47	17.36	19.25	21.14	23.03	24.92
OXY (MG/L)	100.00	86.40	64.04	55.92	51.10	41.23	36.51	26.75	16.89	3.95
LOWER BOUND	6.98	7.44	7.89	8.34	8.80	9.25	9.71	10.16	10.61	11.07
ALKA(MG/L AS CACO3)	100.00	94.85	78.73	54.61	40.90	23.36	14.91	2.08	1.64	0.99
LOWER BOUND	17.64	21.86	26.07	30.28	34.49	38.71	42.92	47.13	51.34	55.56
HARD(MG/L AS CACO3)	100.00	96.60	93.86	81.36	66.56	52.19	41.45	35.09	25.00	17.54
LOWER BOUND	47.55	54.49	61.43	68.36	75.30	82.23	89.17	96.11	103.04	109.98
TDS (MG/L)	100.00	96.05	91.89	79.50	63.38	47.70	36.51	33.66	24.89	13.49
LOWER BOUND	59.64	72.00	84.37	96.73	109.10	121.46	133.83	146.19	158.55	170.92
PH	100.00	95.83	85.75	73.90	54.50	48.68	36.51	18.86	4.71	1.21
LOWER BOUND	6.77	6.88	6.98	7.09	7.19	7.30	7.40	7.50	7.61	7.71
BOD (MG/L)	100.00	86.84	70.07	65.90	62.39	59.76	50.77	43.53	18.42	2.96
LOWER BOUND	0.42	0.58	0.74	0.89	1.05	1.21	1.37	1.53	1.69	1.84

B-20 Allegheny River Near Natrona

"Existing Conditions," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	24.63	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 912

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.	ERROR (SIMULATED-OBS.) MEAN	STD. DEV	NO. OF OBSERVED VALUES	MINIMUM OBSERVED VALUE	MAXIMUM OBSERVED VALUE
FLOW(M**3/S)	108.7	1624.0	465.9	330.1					
TEMP(DEGREE C)	8.6	26.8	18.6	4.8	-1.9	0.9	47	12.0	27.0
OXY (MG/L)	7.1	10.9	8.8	1.2	-0.1	0.3	6	8.0	9.8
ALKA(MG/L AS CACO3)	15.1	40.1	25.0	5.9	0.8	6.5	47	11.0	33.0
HARD(MG/L AS CACO3)	58.	139.	94.	22.	-2.	19.	47	55.0	140.0
TDS (MG/L)	87.	234.	150.	40.	-11.	11.	6	108.5	217.0
PH	6.8	7.5	7.1	7.6	0.1	0.4	47	5.6	7.6
BOD (MG/L)	0.6	1.9	1.3	0.4					

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	96.71	87.94	73.46	64.14	58.11	48.79	45.18	19.52	3.95
LOWER BOUND	8.61	10.43	12.25	14.07	15.89	17.70	19.52	21.34	23.16	24.98
OXY (MG/L)	100.00	88.71	64.14	59.32	52.96	43.09	37.50	31.25	19.41	5.26
LOWER BOUND	7.10	7.49	7.87	8.25	8.64	9.02	9.41	9.79	10.17	10.56
ALKA(MG/L AS CACO3)	100.00	94.19	71.05	56.91	47.70	35.75	20.39	11.73	4.06	3.18
LOWER BOUND	15.13	17.63	20.13	22.62	25.12	27.62	30.11	32.61	35.11	37.60
HARD(MG/L AS CACO3)	100.00	89.25	83.11	63.71	48.68	43.20	32.57	27.85	13.05	3.51
LOWER BOUND	57.44	65.57	73.70	81.83	89.96	98.09	106.22	114.35	122.48	130.61
TDS (MG/L)	100.00	100.00	91.34	81.80	57.35	43.31	37.28	29.71	17.65	3.18
LOWER BOUND	61.94	79.12	96.30	113.48	130.66	147.84	165.02	182.19	199.37	216.55
PH	100.00	95.61	85.42	70.29	51.86	34.76	24.12	14.80	8.22	2.41
LOWER BOUND	6.80	6.87	6.94	7.01	7.08	7.16	7.23	7.30	7.37	7.44
BOD (MG/L)	100.00	85.09	73.79	65.57	62.94	60.31	48.90	40.90	15.02	1.10
LOWER BOUND	0.56	0.70	0.85	0.99	1.14	1.28	1.42	1.57	1.71	1.86

B-21 Allegheny River Near Natrona

"Pattern A," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR PATTERN A LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	24.63	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 912

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	89.3	1624.0	458.2	336.4
TEMP(DEGREE C)	8.6	26.8	18.6	4.8
OXY (MG/L)	7.2	10.9	8.8	1.2
ALKA(MG/L AS CACO3)	15.1	44.2	25.0	6.4
HARD(MG/L AS CACO3)	58.	157.	99.	27.
TDS (MG/L)	87.	267.	157.	48
PH	6.8	7.5	7.1	7.5
BOD (MG/L)	0.5	1.9	1.3	0.4

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR PATTERN A LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	96.71	87.72	73.25	64.04	58.00	48.79	45.18	17.98	4.06
LOWER BOUND	8.61	10.43	12.26	14.08	15.91	17.73	19.55	21.38	23.20	25.02
OXY (MG/L)	100.00	85.53	63.38	58.66	52.30	42.76	37.17	30.26	17.76	5.04
LOWER BOUND	7.18	7.56	7.94	8.31	8.69	9.07	9.44	9.82	10.20	10.57
ALKA(MG/L AS CACO3)	100.00	88.05	64.04	51.54	35.75	24.89	13.60	4.17	3.29	2.30
LOWER BOUND	15.13	18.04	20.95	23.86	26.77	29.68	32.59	35.50	38.41	41.32
HARD(MG/L AS CACO3)	100.00	87.06	78.07	51.54	44.85	34.98	29.61	26.54	6.14	2.63
LOWER BOUND	57.44	67.45	77.47	87.48	97.49	107.50	117.51	127.52	137.53	147.55
TDS (MG/L)	100.00	100.00	87.83	68.31	45.72	38.82	30.15	27.85	7.89	2.63
LOWER BOUND	61.94	82.44	102.94	123.45	143.95	164.45	184.96	205.46	225.96	246.46
PH	100.00	92.98	81.03	66.12	49.67	32.57	22.48	13.38	8.11	4.61
LOWER BOUND	6.80	6.87	6.94	7.01	7.08	7.16	7.23	7.30	7.37	7.44
BOD (MG/L)	100.00	87.61	75.00	66.12	63.49	60.75	52.30	41.45	17.00	1.10
LOWER BOUND	0.51	0.66	0.81	0.96	1.11	1.26	1.40	1.55	1.70	1.85

B-22 Allegheny River Near Natrona

"No Corps Storage," 1975

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	152	(1 JUN 75)
LAST DAY OF SIMULATION PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN SIMULATION PERIOD	152	
OBSERVATIONS AT RIVER MILE	24.63	
FIRST DAY OF STUDY PERIOD	153	(2 JUN 75)
LAST DAY OF STUDY PERIOD	304	(31 OCT 75)
NUMBER OF DAYS IN STUDY PERIOD	152	

WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 912

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	76.1	2283.3	453.6	382.4
TEMP(DEGREE C)	8.1	27.0	18.3	5.2
OXY (MG/L)	7.1	11.4	8.9	1.3
ALKA(MG/L AS CACO3)	13.0	49.1	23.3	6.4
HARD(MG/L AS CACO3)	53.	169.	107.	28.
TDS (MG/L)	72.	275.	167.	49.
PH	6.4	7.5	6.8	7.2
BOD (MG/L)	0.5	1.9	1.3	0.5

ALLEGHENY RIVER WATER QUALITY STUDY
1975 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 912

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	95.61	82.89	70.29	63.93	57.24	49.23	46.05	18.42	4.06
LOWER BOUND	8.12	10.01	11.90	13.79	15.68	17.57	19.46	21.35	23.24	25.13
OXY (MG/L)	100.00	87.50	63.60	53.62	50.11	40.90	35.96	26.54	14.80	4.06
LOWER BOUND	7.08	7.52	7.95	8.38	8.81	9.25	9.68	10.11	10.55	10.98
ALKA(MG/L AS CACO3)	100.00	90.46	59.87	39.36	23.68	11.62	5.92	2.63	1.64	0.99
LOWER BOUND	12.95	16.57	20.19	23.80	27.42	31.04	34.66	38.28	41.90	45.52
HARD(MG/L AS CACO3)	100.00	95.94	87.28	70.50	51.75	38.38	32.68	25.99	10.96	1.32
LOWER BOUND	53.15	64.72	76.29	87.86	99.44	111.01	122.58	134.15	145.72	157.30
TDS (MG/L)	100.00	97.48	91.56	77.74	57.35	42.21	33.00	28.95	13.27	1.32
LOWER BOUND	61.94	83.29	104.65	126.00	147.35	168.71	190.06	211.41	232.77	254.12
PH	100.00	98.57	92.00	77.08	58.77	40.46	19.85	13.27	8.77	4.61
LOWER BOUND	6.38	6.49	6.60	6.71	6.83	6.94	7.05	7.16	7.27	7.38
BOD (MG/L)	100.00	89.69	77.85	68.42	62.94	60.09	52.19	42.87	24.01	3.40
LOWER BOUND	0.47	0.62	0.78	0.93	1.08	1.24	1.39	1.54	1.70	1.85

B-23 French Creek Below Meadville

"Existing Conditions," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD-FRENCH CREEK
STATISTICS FOR EXISTING CONDITIONS NEAR MEADVILLE

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	73.13	
END OF REACH RIVER MILE	0.93	
SUBREACH LENGTH (MILES)	1.85	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	24.99	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 24.99
NUMBER OF SIMULATION POINTS 546

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD.DEV.
FLOW(M**3/S)	5.0	126.9	40.6	32.1
TEMP(DEGREE C)	14.8	28.7	20.8	3.0
OXY (MG/L)	7.9	9.9	8.9	0.5
ALKA(MG/L AS CACO3)	42.5	80.7	67.3	11.2
HARD(MG/L AS CACO3)	68.	163.	104.	19.
TDS (MG/L)	81.	185.	122.	20.
PH	6.9	8.2	7.5	7.5
BOD (MG/L)	1.6	1.9	1.8	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD-FRENCH CREEK
STATISTICS FOR EXISTING CONDITIONS NEAR MEADVILLE
WATER QUALITY PARAMETERS AT RIVER MILE 24.99
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	90.11	79.30	69.41	61.54	41.58	20.51	10.26	3.11	0.73
LOWER BOUND	14.84	16.23	17.62	19.02	20.41	21.80	23.20	24.59	25.98	27.38
OXY (MG/L)	100.00	97.25	88.28	69.05	51.47	39.01	28.75	20.33	8.79	0.73
LOWER BOUND	7.93	8.14	8.35	8.56	8.76	8.97	9.18	9.39	9.59	9.80
ALKA(MG/L AS CACO3)	100.00	93.96	85.16	81.50	77.29	75.09	70.33	59.34	40.66	17.58
LOWER BOUND	42.42	46.25	50.08	53.91	57.75	61.58	65.41	69.24	73.08	76.91
HARD(MG/L AS CACO3)	100.00	95.24	91.58	60.26	32.23	20.70	13.55	11.36	5.49	1.47
LOWER BOUND	67.63	77.14	86.64	96.14	105.64	115.15	124.65	134.15	143.66	153.16
TDS (MG/L)	100.00	95.24	93.22	63.55	36.63	20.88	16.30	8.79	5.31	1.65
LOWER BOUND	80.92	91.32	101.71	112.11	122.51	132.90	143.30	153.69	164.09	174.49
PH	100.00	95.24	92.31	84.07	80.77	72.16	59.89	21.43	10.44	6.04
LOWER BOUND	6.85	6.99	7.12	7.26	7.40	7.53	7.67	7.80	7.94	8.07
BOD (MG/L)	100.00	99.45	99.08	95.79	86.81	79.12	65.75	39.56	23.81	18.32
LOWER BOUND	1.56	1.59	1.63	1.66	1.70	1.73	1.76	1.80	1.83	1.87

B-24 French Creek Below Meadville

"No Corps Storage," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD-FRENCH CREEK
STATISTICS FOR NO CORPS STORAGE NEAR MEADVILLE

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	73.13	
END OF REACH RIVER MILE	0.93	
SUBREACH LENGTH (MILES)	1.85	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	24.99	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 24.99
NUMBER OF SIMULATION POINTS 546

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	6.3	190.9	43.3	39.7
TEMP(DEGREE C)	14.0	28.3	20.8	3.0
OXY (MG/L)	8.0	10.0	8.9	0.5
ALKA(MG/L AS CACO3)	34.4	83.5	60.7	14.7
HARD(MG/L AS CACO3)	55.	140.	90.	20.
TDS (MG/L)	82.	152.	110.	19.
PH	7.3	8.3	7.6	7.9
BOD (MG/L)	1.6	1.9	1.8	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD-FRENCH CREEK
STATISTICS FOR NO CORPS STORAGE NEAR MEADVILLE
WATER QUALITY PARAMETERS AT RIVER MILE 24.99
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.80	90.29	75.09	64.29	50.73	29.30	14.29	4.21	0.92
LOWER BOUND	13.97	15.40	16.83	18.26	19.69	21.12	22.55	23.98	25.42	26.85
OXY (MG/L)	100.00	95.24	85.16	67.95	48.35	35.90	26.56	14.65	4.76	2.01
LOWER BOUND	8.00	8.20	8.41	8.61	8.81	9.02	9.22	9.42	9.62	9.83
ALKA(MG/L AS CACO3)	100.00	90.11	81.14	71.25	63.92	56.59	49.27	40.66	25.46	8.61
LOWER BOUND	34.37	39.28	44.20	49.12	54.04	58.95	63.87	68.79	73.71	78.63
HARD(MG/L AS CACO3)	100.00	89.56	80.40	67.22	52.56	41.21	20.70	12.64	3.66	2.01
LOWER BOUND	54.45	62.99	71.54	80.09	88.64	97.19	105.74	114.29	122.84	131.39
TDS (MG/L)	100.00	81.50	71.98	60.07	45.79	39.38	25.27	12.64	8.79	3.11
LOWER BOUND	82.02	89.05	96.08	103.12	110.15	117.18	124.22	131.25	138.29	145.32
PH	100.00	100.00	98.90	84.07	77.47	67.03	39.38	16.30	10.07	4.76
LOWER BOUND	6.99	7.12	7.25	7.38	7.52	7.65	7.78	7.91	8.04	8.17
BOD (MG/L)	100.00	96.52	86.45	83.15	71.06	52.38	41.39	26.92	23.26	12.09
LOWER BOUND	1.64	1.66	1.69	1.72	1.74	1.77	1.80	1.82	1.85	1.88

B-25 Clarion River Near Ridgeway

"Existing Conditions," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	81.31	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 81.31
NUMBER OF SIMULATION POINTS 546

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	3.3	46.6	9.8	7.8
TEMP(DEGREE C)	10.9	22.9	17.1	2.4
OXY (MG/L)	8.9	10.7	9.7	0.4
ALKA(MG/L AS CACO3)	7.7	28.7	18.1	5.6
HARD(MG/L AS CACO3)	15.	61.	40.	13.
TDS (MG/L)	32.	152.	93.	30.
PH	6.7	7.7	7.3	7.5
BOD (MG/L)	2.5	8.1	5.2	1.4

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 81.31
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.44	92.67	83.70	73.44	56.96	35.35	17.22	6.41	1.53
LOWER BOUND	10.88	12.08	13.29	14.49	15.70	16.90	18.11	19.31	20.51	21.72
OXY (MG/L)	100.00	97.44	90.29	74.18	48.90	30.59	20.88	11.17	3.48	2.38
LOWER BOUND	8.92	9.10	9.28	9.46	9.64	9.82	10.00	10.18	10.36	10.54
ALKA(MG/L AS CACO3)	100.00	96.34	89.56	67.58	51.65	40.29	38.83	32.97	18.50	6.59
LOWER BOUND	7.66	9.77	11.88	13.98	16.09	18.20	20.30	22.41	24.52	26.62
HARD(MG/L AS CACO3)	100.00	95.42	84.25	66.30	37.73	31.14	24.36	18.13	0.00	0.00
LOWER BOUND	15.28	21.26	27.24	33.22	39.20	45.18	51.16	57.14	63.12	69.10
TDS (MG/L)	100.00	97.44	92.49	80.77	56.04	39.56	34.07	26.74	21.61	9.89
LOWER BOUND	32.07	44.03	55.98	67.94	79.90	91.86	103.82	115.78	127.73	139.69
PH	100.00	96.89	94.32	90.84	88.10	80.04	76.37	58.42	35.71	16.48
LOWER BOUND	6.72	6.82	6.91	7.01	7.10	7.20	7.29	7.38	7.48	7.57
BOD (MG/L)	100.00	92.31	81.32	77.11	65.57	37.91	32.60	24.18	10.44	5.13
LOWER BOUND	2.52	3.08	3.64	4.19	4.75	5.31	5.87	6.43	6.99	7.55

B-26 Clarion River Near Ridgeway

"No Corps Storage," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	81.31	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 81.31
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	0.9	68.3	9.0	11.4
TEMP(DEGREE C)	9.3	24.9	18.2	3.6
OXY (MG/L)	8.4	11.2	9.4	0.7
ALKA(MG/L AS CACO3)	6.9	51.3	28.4	10.9
HARD(MG/L AS CACO3)	13.	87.	51.	19
TDS (MG/L)	27.	264.	125.	55.
PH	6.6	7.8	7.3	7.4
BOD (MG/L)	2.3	16.1	7.0	3.2

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 81.31
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.99	90.84	83.70	75.82	66.48	52.38	36.08	14.84	2.75
LOWER BOUND	9.30	10.87	12.43	13.99	15.56	17.12	18.69	20.25	21.82	23.38
OXY (MG/L)	100.00	94.14	69.78	53.85	41.76	28.75	21.98	11.72	4.95	2.38
LOWER BOUND	8.36	8.65	8.93	9.22	9.50	9.79	10.07	10.36	10.64	10.93
ALKA(MG/L AS CACO3)	100.00	94.51	85.53	71.98	61.36	51.47	37.73	18.32	9.71	4.95
LOWER BOUND	6.92	11.36	15.80	20.24	24.68	29.12	33.56	38.00	42.44	46.88
HARD(MG/L AS CACO3)	100.00	94.69	86.81	74.73	64.65	55.86	44.14	27.47	15.02	5.49
LOWER BOUND	12.89	20.26	27.63	35.00	42.37	49.74	57.11	64.48	71.85	79.22
TDS (MG/L)	100.00	93.22	77.29	63.55	51.83	36.81	20.51	12.27	6.23	1.28
LOWER BOUND	27.27	50.99	74.71	98.43	122.15	145.87	169.59	193.31	217.03	240.74
PH	100.00	96.89	94.14	90.66	85.90	76.92	71.06	63.19	54.95	26.74
LOWER BOUND	6.63	6.75	6.87	6.99	7.10	7.22	7.34	7.46	7.57	7.69
BOD (MG/L)	100.00	81.14	64.29	52.93	38.64	22.34	13.92	7.14	5.49	1.10
LOWER BOUND	2.35	3.73	5.11	6.48	7.86	9.24	10.62	12.00	13.38	14.76

B-27 Clarion River Near Piney

"Existing Conditions," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	24.29	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 24.29
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	10.7	160.6	47.2	31.4
TEMP(DEGREE C)	10.7	25.6	19.0	3.0
OXY (MG/L)	8.5	11.1	9.4	0.6
ALKA(MG/L AS CACO3)	-13.2	16.4	7.0	3.8
HARD(MG/L AS CACO3)	40	145.	82.	19.
TDS (MG/L)	60	219.	121.	28
PH	3.6	7.7	5.4	4.6
BOD (MG/L)	2.1	3.3	2.5	0.3

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 24.29
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.62	92.49	85.16	79.49	67.95	48.17	26.74	6.04	1.47
LOWER BOUND	10.72	12.21	13.70	15.19	16.68	18.17	19.66	21.15	22.64	24.13
OXY (MG/L)	100.00	97.44	80.59	55.13	36.26	23.08	15.75	10.81	4.21	2.20
LOWER BOUND	8.45	8.72	8.98	9.24	9.51	9.77	10.04	10.30	10.56	10.83
ALKA(MG/L AS CACO3)	99.82	99.45	99.08	97.99	96.15	91.58	52.20	19.41	4.40	0.00
LOWER BOUND	-13.21	-9.88	-6.56	-3.24	0.08	3.41	6.73	10.05	13.37	16.70
HARD(MG/L AS CACO3)	100.00	96.52	84.62	68.32	49.08	26.01	13.19	5.68	1.10	0.37
LOWER BOUND	39.76	50.31	60.86	71.41	81.95	92.50	103.05	113.60	124.15	134.70
TDS (MG/L)	100.00	96.15	84.07	67.03	46.15	23.63	12.27	5.31	0.92	0.37
LOWER BOUND	60.14	76.07	92.00	107.92	123.85	139.78	155.71	171.64	187.56	203.49
PH	100.00	98.72	97.80	96.70	95.97	94.69	83.70	37.73	15.75	10.26
LOWER BOUND	3.58	3.99	4.41	4.82	5.24	5.66	6.07	6.49	6.91	7.32
BOD (MG/L)	100.00	66.30	42.31	28.39	15.57	6.23	2.20	0.00	0.00	0.00
LOWER BOUND	2.07	2.26	2.46	2.65	2.84	3.04	3.23	3.42	3.62	3.81

B-28 Clarion River Near Piney

"No Corps Storage," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	24.29	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 24.29
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD DEV.
FLOW(M**3/S)	6.8	180.8	46.4	34.8
TEMP(DEGREE C)	10.6	25.7	19.0	3.1
OXY (MG/L)	8.4	11.1	9.4	0.6
ALKA(MG/L AS CACO3)	-12.8	18.6	7.9	4.6
HARD(MG/L AS CACO3)	36.	163.	88.	25.
TDS (MG/L)	56.	244.	131.	38.
PH	3.6	7.8	5.4	4.7
BOD (MG/L)	2.0	4.8	2.5	0.4

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 24.29
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.62	92.49	85.16	79.49	68.32	49.27	27.29	6.59	1.65
LOWER BOUND	10.59	12.10	13.61	15.12	16.64	18.15	19.66	21.17	22.68	24.19
OXY (MG/L)	100.00	95.79	79.67	54.76	36.08	22.53	15.75	11.54	4.03	2.01
LOWER BOUND	8.42	8.69	8.97	9.24	9.51	9.78	10.05	10.33	10.60	10.87
ALKA(MG/L AS CACO3)	99.82	99.45	99.08	98.17	95.79	90.29	55.13	25.82	13.37	4.03
LOWER BOUND	-12.77	-9.49	-6.21	-2.93	0.35	3.63	6.91	10.18	13.46	16.74
HARD(MG/L AS CACO3)	100.00	96.52	83.88	69.41	53.66	28.21	15.38	9.34	4.95	1.47
LOWER BOUND	35.86	48.57	61.28	73.99	86.70	99.41	112.12	124.83	137.54	150.25
TDS (MG/L)	100.00	95.97	82.78	66.48	47.80	26.19	14.84	8.42	4.03	1.10
LOWER BOUND	55.54	74.43	93.32	112.21	131.10	149.99	168.88	187.77	206.66	225.55
PH	100.00	98.72	97.80	96.34	95.60	93.59	82.97	38.28	16.12	10.62
LOWER BOUND	3.60	4.01	4.43	4.84	5.26	5.68	6.09	6.51	6.93	7.34
BOD (MG/L)	100.00	55.13	32.97	18.68	6.23	2.93	0.73	0.73	0.37	0.37
LOWER BOUND	2.04	2.32	2.59	2.87	3.15	3.43	3.70	3.98	4.26	4.54

B-29 Clarion River Near St. Petersburg

"Existing Conditions," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	3.17	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 3.17
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV
FLOW(M**3/S)	14.1	209.4	63.5	42.6
TEMP(DEGREE C)	11.2	25.4	19.3	3.1
OXY (MG/L)	8.6	11.0	9.4	0.5
ALKA(MG/L AS CACO3)	-9.8	9.8	4.3	2.6
HARD(MG/L AS CACO3)	58.	184.	117.	25.
TDS (MG/L)	83.	246.	158.	34.
PH	3.7	7.2	5.4	4.7
BOD (MG/L)	2.0	2.9	2.3	0.2

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 3.17
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.25	90.29	84.43	80.22	70.33	51.47	31.68	9.89	1.28
LOWER BOUND	11.19	12.61	14.04	15.46	16.89	18.31	19.74	21.16	22.59	24.01
OXY (MG/L)	100.00	92.31	65.57	46.52	28.75	21.06	15.02	10.44	3.85	2.20
LOWER BOUND	8.57	8.82	9.06	9.30	9.55	9.79	10.04	10.28	10.52	10.77
ALKA(MG/L AS CACO3)	99.82	99.27	98.72	96.34	86.08	37.36	4.95	0.00	0.00	0.00
LOWER BOUND	-9.78	-6.80	-3.82	-0.84	2.14	5.12	8.10	11.08	14.06	17.04
HARD(MG/L AS CACO3)	100.00	97.25	88.10	78.02	62.64	48.35	29.67	13.37	2.93	0.55
LOWER BOUND	57.64	70.30	82.95	95.60	108.26	120.91	133.57	146.22	158.88	171.53
TDS (MG/L)	100.00	96.52	85.16	76.74	60.81	48.35	27.11	13.55	4.03	0.55
LOWER BOUND	83.22	99.51	115.80	132.10	148.39	164.68	180.97	197.27	213.56	229.85
PH	100.00	98.72	97.80	96.34	95.42	93.77	84.80	61.90	28.94	13.55
LOWER BOUND	3.71	4.06	4.41	4.76	5.11	5.46	5.81	6.16	6.52	6.87
BOD (MG/L)	100.00	51.47	26.01	10.07	3.11	0.00	0.00	0.00	0.00	0.00
LOWER BOUND	1.97	2.17	2.38	2.58	2.78	2.99	3.19	3.39	3.60	3.80

B-30 Clarion River Near St. Petersburg

"No Corps Storage," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	87.65	
END OF REACH RIVER MILE	1.06	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	3.17	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 3.17
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	9.0	229.5	62.7	46.0
TEMP(DEGREE C)	11.1	25.4	19.3	3.1
OXY (MG/L)	8.6	11.0	9.4	0.6
ALKA(MG/L AS CACO3)	-9.4	10.9	4.6	2.9
HARD(MG/L AS CACO3)	53.	211.	126.	34.
TDS (MG/L)	77.	295.	169.	46.
PH	3.7	7.3	5.4	4.8
BOD (MG/L)	1.9	3.4	2.3	0.2

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE CLARION RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 3.17
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.25	90.29	84.80	80.04	71.61	51.47	32.23	10.07	1.28
LOWER BOUND	11.10	12.53	13.97	15.40	16.83	18.27	19.70	21.13	22.57	24.00
OXY (MG/L)	100.00	91.76	63.55	45.79	28.02	20.51	14.84	10.62	3.66	2.20
LOWER BOUND	8.58	8.83	9.07	9.32	9.57	9.81	10.06	10.30	10.55	10.80
ALKA(MG/L AS CACO3)	99.82	99.27	98.72	95.24	81.68	41.94	8.79	0.00	0.00	0.00
LOWER BOUND	-9.43	-6.49	-3.54	-0.60	2.35	5.29	8.24	11.18	14.13	17.07
HARD(MG/L AS CACO3)	100.00	96.15	87.55	74.36	56.96	41.94	32.05	16.30	6.04	1.65
LOWER BOUND	53.25	68.99	84.74	100.49	116.23	131.98	147.72	163.47	179.22	194.96
TDS (MG/L)	100.00	95.79	83.52	68.50	51.65	36.08	21.79	10.07	4.21	1.47
LOWER BOUND	77.22	99.05	120.88	142.70	164.53	186.36	208.19	230.01	251.84	273.67
PH	100.00	98.72	97.25	95.24	94.32	92.67	82.97	57.33	26.01	12.45
LOWER BOUND	3.73	4.08	4.44	4.79	5.15	5.51	5.86	6.22	6.58	6.93
BOD (MG/L)	100.00	55.31	30.95	13.74	3.85	2.01	0.55	0.18	0.00	0.00
LOWER BOUND	1.94	2.14	2.35	2.56	2.76	2.97	3.18	3.38	3.59	3.80

B-31 Kiskiminetas River Near Vandergrift

"Existing Conditions," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS KISKIMINETAS RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	33.01	
END OF REACH RIVER MILE	0.49	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	10.35	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 10.35
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.	ERROR (SIMULATED-OBS.) MEAN	STD. DEV.	NO. OF OBSERVED VALUES	MINIMUM OBSERVED VALUE	MAXIMUM OBSERVED VALUE
FLOW(M**3/S)	12.5	659.8	82.0	128.8					
TEMP(DEGREE C)	15.3	28.9	22.2	2.8	-2.1	1.6	52	18.6	28.4
OXY (MG/L)	7.5	9.7	8.5	0.5	0.5	1.1	43	6.2	10.6
ALKA(MG/L AS CACO3)	-33.4	3.9	-14.7	9.2					
HARD(MG/L AS CACO3)	37.	341.	228.	83.					
TDS (MG/L)	81.	638.	404.	153.	23.	195.	32	99.8	602.6
PH	3.2	5.7	3.5	3.8	0.3	0.4	52	2.8	5.5
BOD (MG/L)	1.8	1.9	1.9	0.0					

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS KISKIMINETAS RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 10.35
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	98.17	90.11	80.77	73.08	58.24	32.42	17.40	8.42	1.28
LOWER BOUND	15.28	16.65	18.01	19.38	20.74	22.11	23.47	24.84	26.20	27.56
OXY (MG/L)	100.00	94.87	83.52	75.64	51.83	31.68	20.70	16.67	8.42	1.83
LOWER BOUND	7.51	7.73	7.95	8.17	8.39	8.61	8.83	9.05	9.27	9.49
ALKA(MG/L AS CACO3)	99.82	95.05	93.22	76.92	58.06	51.10	36.63	23.44	14.65	8.61
LOWER BOUND	-33.41	-29.68	-25.95	-22.22	-18.49	-14.76	-11.03	-7.30	-3.57	0.16
HARD(MG/L AS CACO3)	100.00	98.53	93.04	82.60	74.91	65.75	59.16	43.96	32.23	25.64
LOWER BOUND	37.36	67.73	98.10	128.47	158.83	189.20	219.57	249.94	280.30	310.67
TDS (MG/L)	100.00	95.24	89.38	82.23	71.06	62.27	49.45	34.62	27.66	15.93
LOWER BOUND	80.42	136.26	192.10	247.95	303.79	359.63	415.47	471.31	527.15	583.00
PH	100.00	58.24	33.52	19.41	13.92	12.27	10.44	4.21	3.66	2.75
LOWER BOUND	3.18	3.43	3.69	3.94	4.20	4.46	4.71	4.97	5.22	5.48
BOD (MG/L)	100.00	98.90	97.25	90.48	75.09	59.34	41.21	23.81	13.19	4.21
LOWER BOUND	1.75	1.77	1.79	1.81	1.83	1.85	1.86	1.88	1.90	1.92

B-32 Kiskiminetas River Near Vandergrift

"No Corps Storage," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE KISKIMINETAS RIVER

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	33.01	
END OF REACH RIVER MILE	0.49	
SUBREACH LENGTH (MILES)	2.11	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	10.35	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 10.35
NUMBER OF SIMULATION POINTS 546

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	11.5	2247.0	81.1	227.4
TEMP(DEGREE C)	14.3	28.8	21.7	2.9
OXY (MG/L)	7.6	9.9	8.6	0.5
ALKA(MG/L AS CACO3)	-39.9	4.6	-27.0	11.0
HARD(MG/L AS CACO3)	26.	478.	271.	97.
TDS (MG/L)	41.	812.	470.	162.
PH	3.1	5.1	3.3	3.7
BOD (MG/L)	1.8	2.0	1.9	0.0

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE KISKIMINETAS RIVER
WATER QUALITY PARAMETERS AT RIVER MILE 10.35
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.80	91.76	80.40	71.43	61.17	36.63	14.10	5.49	1.47
LOWER BOUND	14.27	15.72	17.17	18.63	20.08	21.53	22.99	24.44	25.89	27.35
OXY (MG/L)	100.00	95.97	87.55	73.44	43.96	31.68	25.82	17.77	7.88	2.01
LOWER BOUND	7.58	7.81	8.05	8.28	8.51	8.74	8.97	9.20	9.44	9.67
ALKA(MG/L AS CACO3)	99.63	79.85	48.90	33.70	26.37	18.86	13.00	9.34	6.96	3.30
LOWER BOUND	-39.86	-35.41	-30.96	-26.51	-22.05	-17.60	-13.15	-8.70	-4.25	0.20
HARD(MG/L AS CACO3)	100.00	98.90	96.52	84.25	71.25	60.44	37.18	22.53	15.93	5.13
LOWER BOUND	25.47	70.80	116.14	161.47	206.80	252.13	297.46	342.79	388.12	433.45
TDS (MG/L)	100.00	98.90	97.07	89.01	72.53	61.90	38.64	23.26	16.30	5.31
LOWER BOUND	40.76	118.00	195.25	272.49	349.74	426.99	504.23	581.48	658.72	735.97
PH	100.00	31.68	16.67	10.62	7.69	6.59	4.95	4.58	3.85	2.56
LOWER BOUND	3.10	3.30	3.50	3.71	3.91	4.12	4.32	4.52	4.73	4.93
BOD (MG/L)	100.00	97.80	93.04	78.75	59.34	41.76	21.25	5.13	2.93	1.47
LOWER BOUND	1.78	1.80	1.82	1.84	1.86	1.88	1.89	1.91	1.93	1.95

B-33 Allegheny River Near Warren

"Existing Conditions," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS NEAR WARREN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	196.28	
END OF REACH RIVER MILE	125.61	
SUBREACH LENGTH (MILES)	1.81	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	185.41	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 546

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	37.2	517.3	214.4	127.4
TEMP(DEGREE C)	17.4	25.1	20.2	1.4
OXY (MG/L)	7.8	10.0	9.0	0.4
ALKA(MG/L AS CACO3)	23.2	54.6	33.7	5.4
HARD(MG/L AS CACO3)	45.	98.	69.	13.
TDS (MG/L)	63.	111.	87.	11.
PH	6.6	7.3	6.9	7.5
BOD (MG/L)	1.9	2.0	2.0	0.0

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS NEAR WARREN
WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	95.79	83.70	61.72	37.73	19.41	8.42	5.49	1.47	0.92
LOWER BOUND	17.35	18.13	18.91	19.68	20.46	21.24	22.02	22.79	23.57	24.35
OXY (MG/L)	100.00	99.27	95.60	88.46	74.91	58.79	37.73	16.12	8.61	2.38
LOWER BOUND	7.74	7.97	8.20	8.43	8.66	8.89	9.11	9.34	9.57	9.80
ALKA(MG/L AS CACO3)	100.00	88.83	46.70	12.09	6.04	1.28	0.37	0.00	0.00	0.00
LOWER BOUND	23.14	28.33	33.52	38.72	43.91	49.11	54.30	59.49	64.69	69.89
HARD(MG/L AS CACO3)	100.00	90.29	86.08	71.98	54.95	39.01	27.47	12.82	4.03	0.92
LOWER BOUND	44.56	50.18	55.80	61.43	67.05	72.68	78.30	83.93	89.55	95.18
TDS (MG/L)	100.00	91.39	87.55	71.43	43.59	29.67	11.90	2.75	0.00	0.00
LOWER BOUND	63.04	69.26	75.47	81.69	87.91	94.13	100.35	106.57	112.79	119.01
PH	100.00	97.80	91.21	79.49	58.79	32.78	21.43	11.72	4.03	0.55
LOWER BOUND	6.63	6.70	6.77	6.84	6.90	6.97	7.04	7.11	7.17	7.24
BOD (MG/L)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	87.91	44.87
LOWER BOUND	1.80	1.82	1.83	1.85	1.87	1.89	1.91	1.93	1.95	1.96

B-34 Allegheny River Near Warren

"Pattern A," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR PATTERN A NEAR WARREN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	196.28	
END OF REACH RIVER MILE	125.61	
SUBREACH LENGTH (MILES)	1.81	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	185.41	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD DEV
FLOW(M**3/S)	20.2	517.3	128.4	139.6
TEMP(DEGREE C)	16.6	28.3	21.3	2.1
OXY (MG/L)	7.8	10.0	8.8	0.4
ALKA(MG/L AS CACO3)	23.2	59.7	46.6	10.3
HARD(MG/L AS CACO3)	45.	100.	75.	14.
TDS (MG/L)	63.	122.	98.	16.
PH	6.7	7.4	7.1	7.5
BOD (MG/L)	1.9	2.0	2.0	0.0

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR PATTERN A NEAR WARREN
WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	95.05	88.46	70.51	44.51	25.64	12.45	7.14	2.93	0.73
LOWER BOUND	16.61	17.78	18.95	20.12	21.29	22.46	23.62	24.79	25.96	27.13
OXY (MG/L)	100.00	99.27	96.15	89.38	65.75	37.55	19.78	7.14	2.93	1.65
LOWER BOUND	7.74	7.97	8.20	8.43	8.66	8.89	9.11	9.34	9.57	9.80
ALKA(MG/L AS CACO3)	100.00	92.12	85.71	72.16	67.22	56.96	29.49	0.37	0.00	0.00
LOWER BOUND	23.14	28.33	33.52	38.72	43.91	49.11	54.30	59.49	64.69	69.88
HARD(MG/L AS CACO3)	100.00	90.29	87.00	85.16	74.54	62.09	43.22	30.40	18.68	5.31
LOWER BOUND	44.56	50.18	55.80	61.43	67.05	72.68	78.30	83.93	89.55	95.18
TDS (MG/L)	100.00	91.39	87.55	86.08	75.82	68.50	52.20	36.63	21.79	3.66
LOWER BOUND	63.04	69.26	75.47	81.69	87.91	94.13	100.35	106.57	112.79	119.01
PH	100.00	96.52	88.10	82.42	76.37	64.84	54.95	26.37	9.16	3.85
LOWER BOUND	6.71	6.78	6.85	6.92	6.99	7.06	7.12	7.19	7.26	7.33
BOD (MG/L)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	97.62	77.84	43.59
LOWER BOUND	1.80	1.82	1.83	1.85	1.87	1.89	1.91	1.93	1.95	1.96

B-35 Allegheny River Near Warren

"No Corps Storage," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE NEAR WARREN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	196.28	
END OF REACH RIVER MILE	125.61	
SUBREACH LENGTH (MILES)	1.81	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	185.41	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 546

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	42.2	961.4	260.1	221.9
TEMP(DEGREE C)	16.3	27.4	21.6	2.1
OXY (MG/L)	8.0	9.5	8.6	0.3
ALKA(MG/L AS CACO3)	14.9	42.2	29.0	6.3
HARD(MG/L AS CACO3)	34.	100.	70.	15.
TDS (MG/L)	56.	225.	104.	29.
PH	6.9	7.4	7.2	7.8
BOD (MG/L)	1.9	2.0	2.0	0.0

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE NEAR WARREN
WATER QUALITY PARAMETERS AT RIVER MILE 185.41
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	94.32	90.84	85.35	73.99	38.10	21.79	10.26	4.21	1.47
LOWER BOUND	16.24	17.37	18.49	19.61	20.73	21.85	22.97	24.09	25.21	26.34
OXY (MG/L)	100.00	93.77	82.97	42.31	22.34	12.45	9.52	4.95	0.00	0.00
LOWER BOUND	7.96	8.17	8.37	8.58	8.78	8.99	9.19	9.40	9.60	9.81
ALKA(MG/L AS CACO3)	100.00	97.80	88.10	78.21	67.77	56.96	37.73	23.63	13.37	2.75
LOWER BOUND	14.85	17.58	20.32	23.06	25.79	28.53	31.27	34.00	36.74	39.48
HARD(MG/L AS CACO3)	100.00	99.45	93.59	79.85	70.33	60.81	42.67	27.47	15.20	7.14
LOWER BOUND	34.37	40.94	47.51	54.09	60.66	67.23	73.81	80.38	86.95	93.53
TDS (MG/L)	100.00	81.87	66.85	41.94	25.27	13.00	2.38	1.28	0.92	0.55
LOWER BOUND	55.64	72.61	89.58	106.55	123.52	140.48	157.45	174.42	191.39	208.36
PH	100.00	94.87	93.04	92.31	86.45	74.54	57.51	15.02	6.96	2.38
LOWER BOUND	6.92	6.97	7.01	7.06	7.10	7.15	7.20	7.24	7.29	7.33
BOD (MG/L)	100.00	100.00	100.00	99.63	96.89	87.73	87.73	71.98	54.40	28.75
LOWER BOUND	1.89	1.90	1.90	1.91	1.92	1.93	1.94	1.95	1.96	1.96

B-36 Allegheny River Near Franklin

"Existing Conditions," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS NEAR FRANKLIN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	124.19	
END OF REACH RIVER MILE	84.80	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	120.16	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	73.0	1068.1	381.2	250.1
TEMP(DEGREE C)	16.0	25.8	21.0	2.2
OXY (MG/L)	8.1	9.4	8.7	0.3
ALKA(MG/L AS CACO3)	25.9	55.3	38.1	6.4
HARD(MG/L AS CACO3)	46.	88.	70.	11.
TDS (MG/L)	69.	111.	92.	10.
PH	7.0	8.0	7.3	7.6
BOD (MG/L)	1.6	1.8	1.7	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS NEAR FRANKLIN
WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.07	93.41	82.05	68.86	63.19	47.80	24.91	5.86	1.28
LOWER BOUND	15.54	16.57	17.60	18.63	19.65	20.68	21.71	22.73	23.76	24.79
OXY (MG/L)	100.00	96.52	90.29	66.48	41.94	30.59	17.03	6.78	0.00	0.00
LOWER BOUND	8.12	8.28	8.43	8.59	8.74	8.90	9.05	9.21	9.36	9.51
ALKA(MG/L AS CACO3)	100.00	93.77	86.63	65.38	45.97	34.98	22.89	8.79	6.04	2.38
LOWER BOUND	25.83	28.78	31.73	34.68	37.63	40.57	43.52	46.47	49.42	52.37
HARD(MG/L AS CACO3)	100.00	95.05	89.74	83.15	75.27	59.16	48.90	39.01	19.23	11.36
LOWER BOUND	46.25	50.47	54.68	58.89	63.11	67.32	71.53	75.75	79.96	84.17
TDS (MG/L)	100.00	94.14	90.29	83.33	71.79	56.23	43.77	30.59	15.38	4.76
LOWER BOUND	68.83	73.05	77.27	81.49	85.70	89.92	94.14	98.36	102.57	106.79
PH	100.00	95.42	77.47	63.55	51.65	35.53	25.09	18.50	8.97	3.11
LOWER BOUND	6.97	7.07	7.17	7.27	7.37	7.48	7.58	7.68	7.78	7.88
BOD (MG/L)	100.00	91.76	71.79	51.83	40.11	23.81	17.22	0.37	0.00	0.00
LOWER BOUND	1.60	1.63	1.67	1.70	1.73	1.77	1.80	1.83	1.87	1.90

B-37 Allegheny River Near Franklin

"Pattern A," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR PATTERN A NEAR FRANKLIN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	124.19	
END OF REACH RIVER MILE	84.80	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	120.16	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 546

	SIMULATION VALUES			
PARAMETER	MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	49.3	1068.0	295.1	264.0
TEMP(DEGREE C)	16.0	27.6	21.5	2.6
OXY (MG/L)	7.9	9.4	8.7	0.4
ALKA(MG/L AS CACO3)	25.9	72.8	44.8	8.8
HARD(MG/L AS CACO3)	46.	111.	74.	14.
TDS (MG/L)	69.	143.	99.	17.
PH	7.0	8.0	7.5	7.7
BOD (MG/L)	1.6	1.8	1.7	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR PATTERN A NEAR FRANKLIN
WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

	INTERVALS									
PARAMETER	1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	96.70	89.19	76.37	66.48	55.13	33.33	15.38	7.69	2.75
LOWER BOUND	15.54	16.75	17.96	19.17	20.38	21.59	22.79	24.00	25.21	26.42
OXY (MG/L)	100.00	93.59	83.70	73.08	48.90	35.53	25.64	12.45	2.56	0.00
LOWER BOUND	7.90	8.08	8.26	8.43	8.61	8.79	8.96	9.14	9.32	9.49
ALKA(MG/L AS CACO3)	100.00	93.04	86.81	67.77	51.47	35.53	15.75	2.01	1.47	0.92
LOWER BOUND	25.83	30.54	35.24	39.95	44.65	49.36	54.06	58.77	63.47	68.18
HARD(MG/L AS CACO3)	100.00	92.86	84.07	74.18	55.86	37.36	24.73	11.17	5.13	3.11
LOWER BOUND	46.25	52.69	59.13	65.56	72.00	78.43	84.87	91.30	97.74	104.17
TDS (MG/L)	100.00	91.39	83.52	66.85	49.45	29.67	24.73	10.62	4.58	2.56
LOWER BOUND	68.83	76.22	83.61	91.00	98.40	105.79	113.18	120.57	127.96	135.35
PH	100.00	95.42	92.31	86.81	75.64	69.23	54.95	41.21	25.09	6.96
LOWER BOUND	6.97	7.07	7.17	7.27	7.37	7.48	7.58	7.68	7.78	7.88
BOD (MG/L)	100.00	95.97	81.68	58.79	47.07	27.11	18.68	10.81	0.00	0.00
LOWER BOUND	1.56	1.60	1.63	1.67	1.71	1.75	1.78	1.82	1.86	1.89

B-38 Allegheny River Near Franklin

"No Corps Storage," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE NEAR FRANKLIN

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	124.19	
END OF REACH RIVER MILE	84.80	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	120.16	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	73.3	1557.6	431.6	364.2
TEMP(DEGREE C)	17.4	26.9	21.6	2.2
OXY (MG/L)	7.9	9.4	8.6	0.4
ALKA(MG/L AS CACO3)	19.5	49.3	34.0	8.1
HARD(MG/L AS CACO3)	42.	93.	69.	15.
TDS (MG/L)	60.	160.	97.	22.
PH	7.1	7.9	7.4	7.8
BOD (MG/L)	1.5	1.8	1.7	0.1

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE NEAR FRANKLIN
WATER QUALITY PARAMETERS AT RIVER MILE 120.16
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	100.00	98.72	85.71	68.13	57.33	37.18	20.88	10.07	4.58
LOWER BOUND	15.54	16.68	17.81	18.95	20.09	21.22	22.36	23.49	24.63	25.76
OXY (MG/L)	100.00	89.19	83.15	71.25	50.73	24.91	12.64	7.51	1.10	0.00
LOWER BOUND	7.87	8.05	8.24	8.42	8.60	8.79	8.97	9.15	9.33	9.52
ALKA(MG/L AS CACO3)	100.00	90.48	80.04	69.78	61.90	49.45	37.73	26.37	12.64	3.66
LOWER BOUND	19.51	22.51	25.52	28.52	31.52	34.52	37.53	40.53	43.53	46.54
HARD(MG/L AS CACO3)	100.00	91.58	82.97	73.08	64.65	54.58	42.86	31.32	21.25	8.24
LOWER BOUND	41.66	46.84	52.03	57.21	62.39	67.58	72.76	77.94	83.13	88.31
TDS (MG/L)	100.00	87.73	74.91	60.07	44.69	26.92	18.86	8.24	1.47	0.92
LOWER BOUND	59.44	69.48	79.52	89.57	99.61	109.65	119.69	129.73	139.78	149.82
PH	100.00	100.00	97.44	81.32	60.62	48.35	33.52	21.25	8.97	3.66
LOWER BOUND	6.99	7.09	7.18	7.28	7.37	7.47	7.57	7.66	7.76	7.85
BOD (MG/L)	100.00	95.42	80.40	60.44	48.35	32.97	25.09	8.42	0.00	0.00
LOWER BOUND	1.55	1.59	1.62	1.66	1.70	1.74	1.77	1.81	1.85	1.88

B-39 Allegheny River Near Freeport

"Existing Conditions," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	31.90	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.	ERROR (SIMULATED-OBS.) MEAN	STD. DEV.	NO. OF OBSERVED VALUES	MINIMUM OBSERVED VALUE	MAXIMUM OBSERVED VALUE
FLOW(M**3/S)	110.2	1368.2	568.9	322.9					
TEMP(DEGREE C)	15.4	25.3	21.1	2.3	-1.5	1.5	57	19.7	26.4
OXY (MG/L)	7.5	9.3	8.3	0.5	-1.0	1.3	56	7.0	12.2
ALKA(MG/L AS CACO3)	16.3	40.2	29.4	5.9	-9.7	4.6	25	15.0	50.0
HARD(MG/L AS CACO3)	56.	114.	84.	13.					
TDS (MG/L)	77.	150.	110.	15.	3.	23.	55	84.3	161.8
PH	7.0	7.7	7.3	7.7	0.2	0.4	58	6.1	9.5
BOD (MG/L)	0.8	1.8	1.3	0.2					

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.62	91.76	84.43	79.49	67.58	54.21	36.08	16.85	4.03
LOWER BOUND	15.35	16.35	17.34	18.34	19.33	20.32	21.32	22.31	23.31	24.30
OXY (MG/L)	100.00	96.15	77.11	56.41	42.12	34.62	25.46	18.68	12.27	4.95
LOWER BOUND	7.45	7.64	7.83	8.02	8.22	8.41	8.60	8.79	8.98	9.17
ALKA(MG/L AS CACO3)	100.00	97.44	91.39	86.08	70.51	51.83	40.11	31.14	22.34	8.79
LOWER BOUND	16.30	18.69	21.08	23.48	25.87	28.26	30.65	33.04	35.43	37.82
HARD(MG/L AS CACO3)	100.00	92.49	87.91	81.14	70.15	50.73	34.43	25.82	5.13	0.55
LOWER BOUND	55.74	61.55	67.36	73.17	78.97	84.78	90.59	96.39	102.20	108.01
TDS (MG/L)	100.00	92.49	88.64	78.21	63.55	38.83	24.91	12.27	3.48	0.55
LOWER BOUND	77.12	84.41	91.69	98.97	106.25	113.54	120.82	128.10	135.38	142.67
PH	100.00	88.46	80.04	73.44	54.76	44.32	35.16	23.08	5.31	0.73
LOWER BOUND	6.97	7.04	7.11	7.18	7.25	7.32	7.39	7.46	7.53	7.60
BOD (MG/L)	100.00	94.69	85.71	79.12	65.38	45.97	23.99	7.51	0.55	0.00
LOWER BOUND	0.78	0.90	1.02	1.15	1.27	1.39	1.51	1.64	1.76	1.88

B-40 Allegheny River Near Freeport

"Pattern A," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR PATTERN A LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	31.90	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	110.2	1368.2	482.8	320.5
TEMP(DEGREE C)	15.4	25.9	21.2	2.3
OXY (MG/L)	7.4	9.3	8.2	0.5
ALKA(MG/L AS CACO3)	15.0	44.7	30.7	7.4
HARD(MG/L AS CACO3)	56.	125.	89.	14.
TDS (MG/L)	77.	167.	118.	19.
PH	7.0	7.7	7.3	7.6
BOD (MG/L)	0.8	1.8	1.3	0.2

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR PATTERN A LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	97.62	90.29	84.25	78.57	65.75	44.51	30.40	9.71	2.93
LOWER BOUND	15.35	16.41	17.46	18.52	19.58	20.63	21.69	22.74	23.80	24.85
OXY (MG/L)	100.00	93.96	77.11	49.82	42.86	26.74	22.71	17.22	12.82	4.95
LOWER BOUND	7.38	7.58	7.78	7.98	8.17	8.37	8.57	8.77	8.96	9.16
ALKA(MG/L AS CACO3)	100.00	97.07	91.03	84.98	63.37	49.08	40.11	31.32	15.02	8.06
LOWER BOUND	14.95	17.93	20.91	23.89	26.87	29.85	32.83	35.81	38.79	41.77
HARD(MG/L AS CACO3)	100.00	91.76	88.46	85.71	67.40	46.15	30.40	12.45	1.28	0.73
LOWER BOUND	55.74	62.71	69.68	76.65	83.62	90.58	97.55	104.52	111.49	118.46
TDS (MG/L)	100.00	91.03	87.00	79.67	58.79	41.21	26.37	13.00	4.21	0.73
LOWER BOUND	77.12	86.12	95.11	104.11	113.10	122.09	131.09	140.08	149.08	158.07
PH	100.00	88.46	81.32	73.81	66.85	50.92	42.12	35.53	25.64	5.13
LOWER BOUND	6.97	7.04	7.11	7.18	7.25	7.32	7.39	7.46	7.53	7.60
BOD (MG/L)	100.00	94.51	83.70	74.36	58.42	32.97	23.08	7.51	0.55	0.00
LOWER BOUND	0.78	0.90	1.02	1.15	1.27	1.39	1.51	1.64	1.76	1.88

B-41 Allegheny River Near Freeport

"No Corps Storage," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	31.90	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	106.7	1866.5	619.5	438.9
TEMP(DEGREE C)	16.5	26.2	21.4	2.2
OXY (MG/L)	7.4	9.0	8.2	0.5
ALKA(MG/L AS CACO3)	14.3	41.0	26.3	5.7
HARD(MG/L AS CACO3)	49.	108.	78.	15.
TDS (MG/L)	68.	189.	108.	24.
PH	6.9	7.7	7.2	7.6
BOD (MG/L)	0.7	1.8	1.3	0.2

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 31.90
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	95.60	88.10	78.75	68.13	55.86	36.26	20.70	7.14	2.75
LOWER BOUND	16.48	17.46	18.44	19.41	20.39	21.36	22.34	23.32	24.29	25.27
OXY (MG/L)	100.00	94.69	82.42	63.00	51.10	43.96	32.60	25.82	20.15	6.78
LOWER BOUND	7.36	7.53	7.70	7.87	8.04	8.21	8.38	8.55	8.72	8.89
ALKA(MG/L AS CACO3)	100.00	96.70	91.58	75.27	48.17	32.97	25.46	20.33	6.59	1.47
LOWER BOUND	14.25	16.93	19.61	22.29	24.97	27.65	30.33	33.01	35.69	38.37
HARD(MG/L AS CACO3)	100.00	91.58	87.00	75.27	63.19	46.34	36.45	26.01	11.90	2.93
LOWER BOUND	48.85	54.81	60.76	66.72	72.67	78.63	84.59	90.54	96.50	102.45
TDS (MG/L)	100.00	89.19	76.56	49.27	31.14	18.86	7.51	4.40	2.93	1.65
LOWER BOUND	67.53	79.70	91.86	104.03	116.20	128.36	140.53	152.69	164.86	177.02
PH	100.00	88.83	80.59	74.18	49.27	35.90	28.57	20.51	2.56	0.55
LOWER BOUND	6.93	7.01	7.09	7.17	7.25	7.33	7.40	7.48	7.56	7.64
BOD (MG/L)	100.00	93.96	90.11	83.88	72.34	50.37	27.47	12.82	0.73	0.00
LOWER BOUND	0.69	0.82	0.95	1.08	1.21	1.35	1.48	1.61	1.74	1.87

B-42 Allegheny River Near Natrona

"Existing Conditions," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	24.63	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.	ERROR (SIMULATED-OBS.) MEAN	STD. DEV.	NO. OF OBSERVED VALUES	MINIMUM OBSERVED VALUE	MAXIMUM OBSERVED VALUE
FLOW(M**3/S)	126.6	1677.1	654.3	377.5					
TEMP(DEGREE C)	15.6	25.6	21.2	2.3					
OXY (MG/L)	7.5	9.3	8.2	0.5					
ALKA(MG/L AS CACO3)	4.2	38.2	25.3	7.5	0.2	7.4	91	18.0	39.0
HARD(MG/L AS CACO3)	59.	149.	97.	19.					
TDS (MG/L)	85.	228.	136.	28.					
PH	5.9	7.5	6.9	6.7	0.1	0.4	91	6.0	7.4
BOD (MG/L)	0.8	1.8	1.3	0.2					

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR EXISTING CONDITIONS LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	96.70	88.83	84.07	77.29	65.75	49.45	29.12	12.82	3.85
LOWER BOUND	15.61	16.62	17.62	18.63	19.63	20.64	21.65	22.65	23.66	24.66
OXY (MG/L)	100.00	95.60	73.81	59.16	43.59	32.60	24.18	18.13	12.45	4.95
LOWER BOUND	7.45	7.64	7.83	8.02	8.20	8.39	8.58	8.77	8.95	9.14
ALKA(MG/L AS CACO3)	100.00	98.35	94.87	88.10	84.25	74.54	59.16	39.38	21.43	10.44
LOWER BOUND	4.23	7.62	11.02	14.42	17.81	21.21	24.61	28.01	31.40	34.80
HARD(MG/L AS CACO3)	100.00	92.67	86.26	68.32	51.47	35.35	21.25	8.61	4.95	2.75
LOWER BOUND	59.34	68.32	77.30	86.28	95.26	104.24	113.23	122.21	131.19	140.17
TDS (MG/L)	100.00	92.49	81.87	58.24	36.26	22.34	12.09	6.59	3.11	1.65
LOWER BOUND	84.62	98.95	113.28	127.61	141.94	156.27	170.60	184.93	199.27	213.60
PH	100.00	97.07	93.42	92.49	91.58	87.91	79.49	69.05	37.55	2.20
LOWER BOUND	5.90	6.07	6.23	6.39	6.56	6.72	6.88	7.05	7.21	7.37
BOD (MG/L)	100.00	93.77	85.16	79.49	63.00	46.34	25.27	9.34	0.37	0.00
LOWER BOUND	0.80	0.92	1.04	1.16	1.28	1.40	1.52	1.64	1.76	1.88

B-43 Allegheny River Near Natrona

"Pattern A," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR PATTERN A LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	24.63	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	126.5	1465.8	568.1	365.4
TEMP(DEGREE C)	15.6	26.3	21.3	2.3
OXY (MG/L)	7.4	9.3	8.2	0.5
ALKA(MG/L AS CACO3)	3.0	41.2	25.8	9.1
HARD(MG/L AS CACO3)	59.	161.	103.	21.
TDS (MG/L)	85.	245.	147.	33.
PH	5.7	7.5	6.8	6.6
BOD (MG/L)	0.8	1.8	1.3	0.2

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR PATTERN A LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	96.52	87.73	82.97	76.74	63.74	41.39	21.25	7.88	3.48
LOWER BOUND	15.61	16.69	17.76	18.83	19.91	20.98	22.05	23.13	24.20	25.27
OXY (MG/L)	100.00	94.32	77.29	59.52	45.42	27.47	20.88	16.48	12.82	4.95
LOWER BOUND	7.37	7.57	7.76	7.96	8.16	8.35	8.55	8.74	8.94	9.13
ALKA(MG/L AS CACO3)	100.00	97.62	92.67	85.16	81.32	65.93	51.65	41.03	21.25	8.97
LOWER BOUND	3.03	6.85	10.67	14.49	18.32	22.14	25.96	29.78	33.61	37.43
HARD(MG/L AS CACO3)	100.00	91.94	85.90	79.67	57.69	36.45	15.75	9.71	4.95	2.56
LOWER BOUND	59.34	69.53	79.72	89.92	100.11	110.30	120.49	130.68	140.88	151.07
TDS (MG/L)	100.00	91.76	82.42	69.41	42.86	22.34	13.37	9.71	5.86	2.01
LOWER BOUND	84.62	100.66	116.70	132.74	148.79	164.83	180.87	196.92	212.96	229.00
PH	100.00	97.07	93.42	92.86	91.38	88.46	84.98	70.15	48.72	15.02
LOWER BOUND	5.73	5.91	6.09	6.28	6.46	6.64	6.82	7.00	7.18	7.36
BOD (MG/L)	100.00	92.31	84.62	75.27	57.14	37.36	24.18	9.89	0.37	0.00
LOWER BOUND	0.80	0.92	1.04	1.16	1.28	1.40	1.52	1.64	1.76	1.88

B-44 Allegheny River at Natrona

"No Corps Storage," 1977

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE LOWER ALLEGHENY

********** INPUT DATA **********

BEGINNING OF REACH RIVER MILE	83.80	
END OF REACH RIVER MILE	6.72	
SUBREACH LENGTH (MILES)	1.01	
COMPUTATION INTERVAL (HOURS)	4	
FIRST DAY OF SIMULATION PERIOD	182	(1 JUL 77)
LAST DAY OF SIMULATION PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN SIMULATION PERIOD	91	
OBSERVATIONS AT RIVER MILE	24.63	
FIRST DAY OF STUDY PERIOD	183	(2 JUL 77)
LAST DAY OF STUDY PERIOD	273	(30 SEP 77)
NUMBER OF DAYS IN STUDY PERIOD	91	

WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 546

PARAMETER	SIMULATION VALUES MINIMUM	MAXIMUM	MEAN	STD. DEV.
FLOW(M**3/S)	121.0	3590.3	704.2	533.1
TEMP(DEGREE C)	16.5	26.7	21.4	2.1
OXY (MG/L)	7.4	9.0	8.2	0.4
ALKA(MG/L AS CACO3)	-4.6	39.2	21.9	6.1
HARD(MG/L AS CACO3)	44.	157.	93.	23.
TDS (MG/L)	67.	243.	136.	35.
PH	4.0	7.5	6.4	5.4
BOD (MG/L)	0.7	1.8	1.3	0.2

ALLEGHENY RIVER WATER QUALITY STUDY
1977 STUDY PERIOD
STATISTICS FOR NO CORPS STORAGE LOWER ALLEGHENY
WATER QUALITY PARAMETERS AT RIVER MILE 24.63
NUMBER OF SIMULATION POINTS 546

PERCENT OF SIMULATION POINTS EXCEEDING LOWER BOUND OF EACH INTERVAL

PARAMETER	INTERVALS 1	2	3	4	5	6	7	8	9	10
TEMP(DEGREE C)	100.00	95.05	86.26	77.84	67.95	52.38	34.07	10.62	3.48	0.73
LOWER BOUND	16.51	17.53	18.55	19.57	20.58	21.60	22.62	23.63	24.65	25.67
OXY (MG/L)	100.00	95.97	83.88	67.95	51.83	40.48	30.22	24.54	17.58	6.04
LOWER BOUND	7.40	7.57	7.73	7.90	8.07	8.23	8.40	8.56	8.73	8.89
ALKA(MG/L AS CACO3)	99.82	99.63	99.45	99.08	90.84	80.95	50.92	25.27	6.96	1.65
LOWER BOUND	-4.61	-0.22	4.16	8.54	12.93	17.31	21.70	26.08	30.46	34.85
HARD(MG/L AS CACO3)	100.00	94.14	87.36	71.61	54.40	35.90	17.03	10.81	4.21	0.92
LOWER BOUND	44.36	55.67	66.98	78.29	89.60	100.91	112.22	123.53	134.84	146.15
TDS (MG/L)	100.00	91.58	83.15	62.27	48.17	30.22	12.27	7.14	3.48	1.65
LOWER BOUND	67.23	84.82	102.41	120.01	137.60	155.19	172.78	190.37	207.96	225.55
PH	100.00	99.63	99.63	99.63	99.63	98.53	96.15	95.60	78.39	8.06
LOWER BOUND	4.03	4.38	4.73	5.09	5.44	5.79	6.14	6.50	6.85	7.20
BOD (MG/L)	100.00	93.41	87.73	84.43	71.06	48.72	28.39	10.26	1.28	0.00
LOWER BOUND	0.73	0.86	0.98	1.11	1.24	1.37	1.49	1.62	1.75	1.87

APPENDIX C

ALLEGHENY RIVER

WATER QUALITY DURATION CURVES

APPENDIX C

ALLEGHENY RIVER WATER QUALITY DURATION CURVES

by

R. G. WILLEY[1]

GENERAL INTRODUCTION

This report is an expansion of "Simulation of Streamflow Regulation Effects on the Water Quality of the Allegheny River" by Paul W. Hadley and Gerald T. Orlob. Preparation of the duration curves was beyond the scope of the contract leading to this report. This Appendix was written after the rest of the report was completed and is included for the readers convenience. The duration curves are to be used in conjunction with water quality benefit curves for computation of the water quality benefits due to modified flow regulations. Numerous graphical displays define the water quality impacts of Kinzua Reservoir reregulation (Pattern A) and the impacts of the entire nine Corps of Engineers (COE) Reservoirs under present regulation (No COE Storage). The data used to develop these graphs is provided in Appendix B.

In all of the graphs in this Appendix, the same legend applies. If no impact exists the Existing Condition symbol——— will suppress the Pattern A symbol — — —and/or the No COE Storage symbol— — —. The graphs show water quality constituent vs. percent of the time exceeded. The water quality duration curves are analogous to flow duration curves in their development and in their use to determine average annual benefits.

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ALLEGHENY RIVER WATER QUALITY AT NATRONA

The integrated impact of all nine COE reservoirs on river temperature, alkalinity, pH and TDS with present regulation or with Pattern A regulation is shown in Figures C-1 through C-4.

Allegheny River Temperature at Natrona

The graph for the temperature at Natrona during the 1975 study period (see Figure C-1) shows that about 35% of the time the No COE Storage case would cause slightly cooler water. No impact occurs during the remaining time. The Pattern A case shows no impact compared to Existing Conditions.

During the 1977 study period there is no significant impact for either alternative.

Allegheny River Alkalinity at Natrona

During the 1975 study period, Figure C-2 shows that the alkalinity would not change 95% of the time for the Pattern A case and would experience only minor impacts due to No COE Storage. The No COE Storage case would be slightly lower than the Existing Condition about 95% of the time. Both alternatives would exceed Existing Conditions about 5% of the time.

The graph for the 1977 study period shows that the alkalinity for the Pattern A case exceeds the Existing Condition about 50% of the time. The No COE Storage case is lower than the Existing Condition case about 90% of the time.

In general, the impact of the alternatives is only slightly significant. Although the impact is difficult to predict, existing regulation probably provides a slightly higher alkalinity than the alternative cases studied.

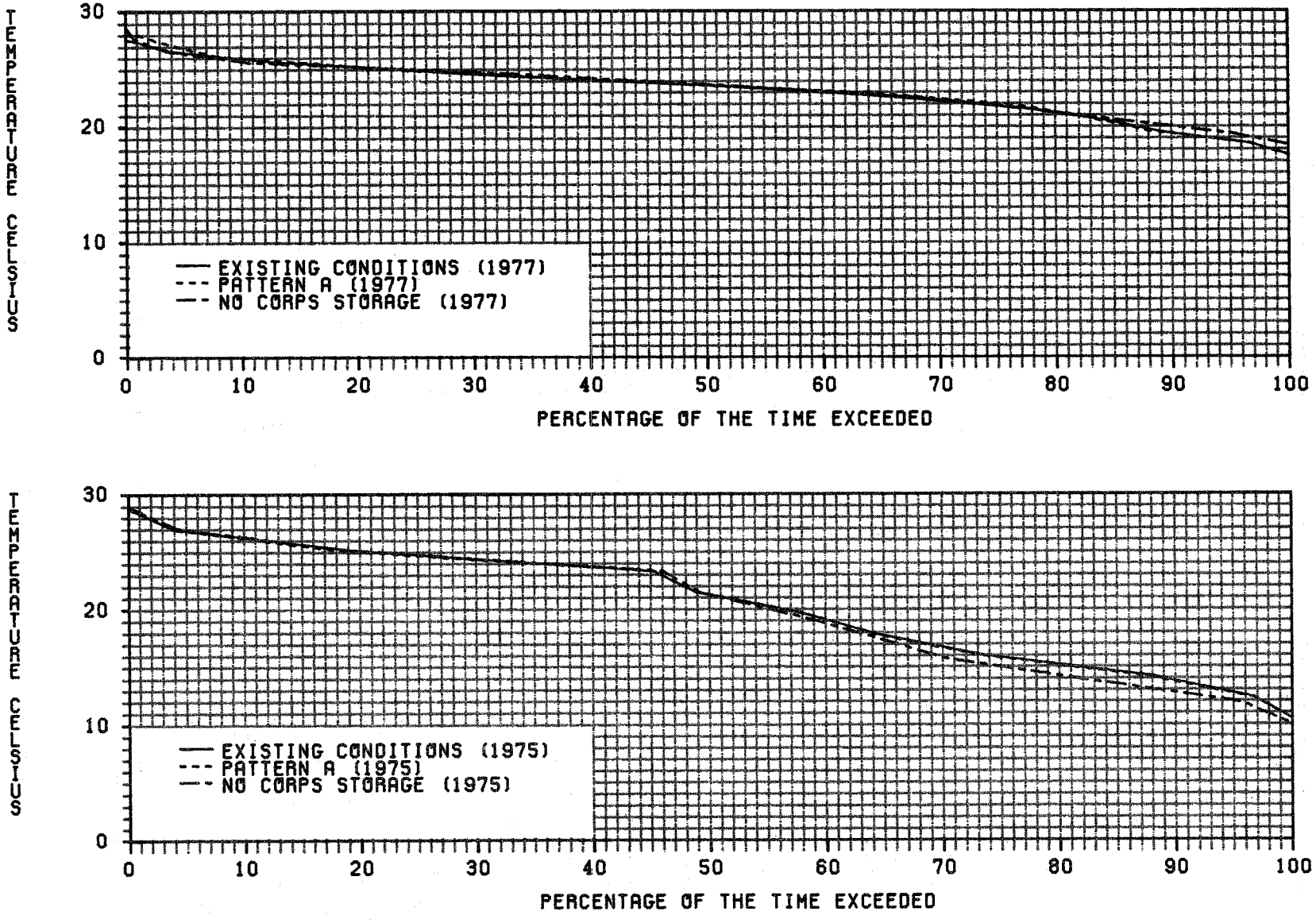


FIGURE C-1. ALLEGHENY RIVER WATER TEMPERATURE AT NATRONA

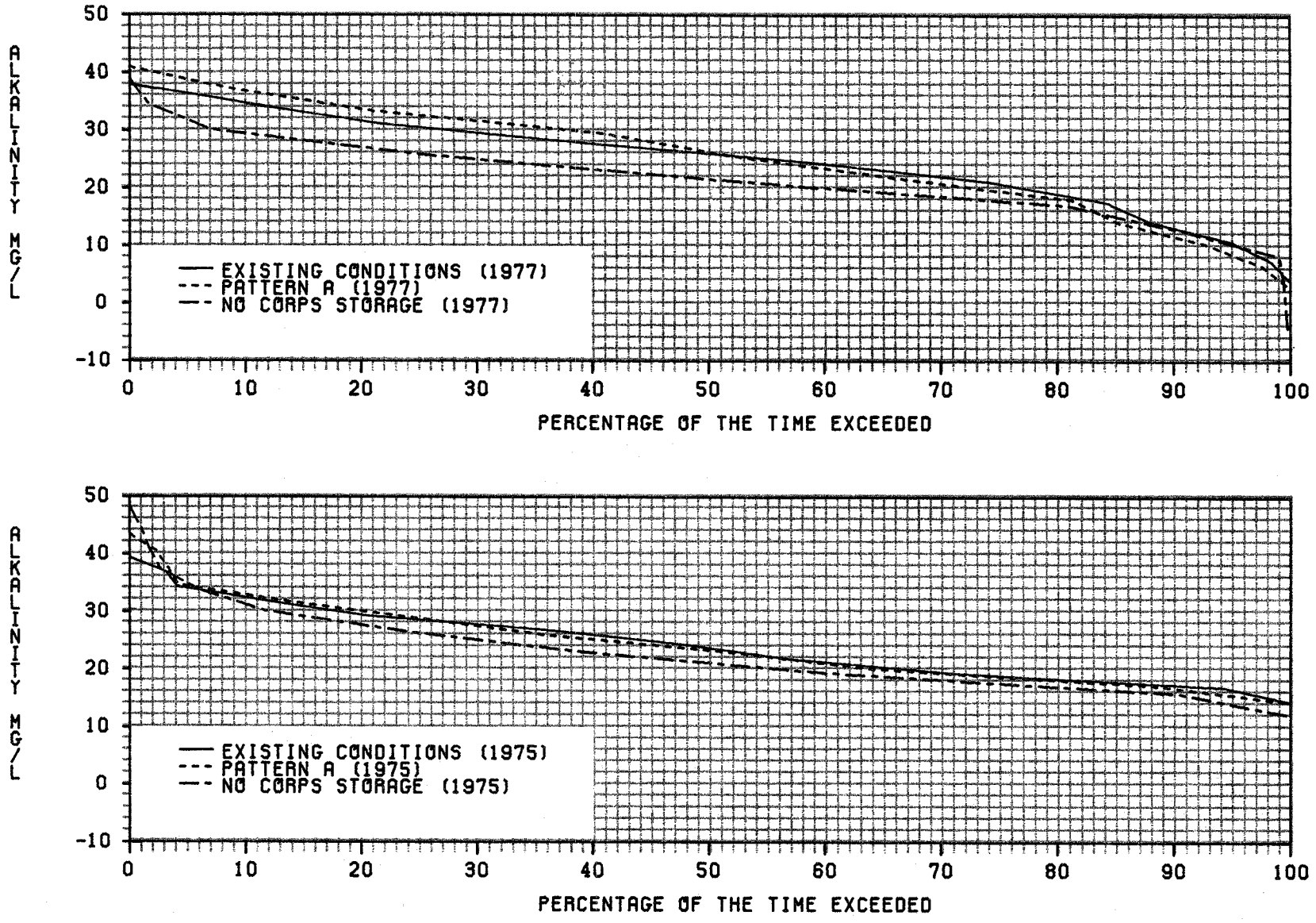


FIGURE C-2. ALLEGHENY RIVER ALKALINITY AT NATRONA

Allegheny River pH at Natrona

During the 1975 study period, Figure C-3 shows that the pH would be slightly lower 95% of the time for the No COE Storage case and no impact during the remaining time. The Pattern A case has no impact.

During the 1977 study period, the pH was slightly lower than the Existing Condition 90% of the time for the No COE Storage case. During an additional 2% of the time, a very significant drop in pH occurs for the No COE Storage case. The Pattern A case is slightly lower than the Existing Condition 10% of the time and no impact the remaining time.

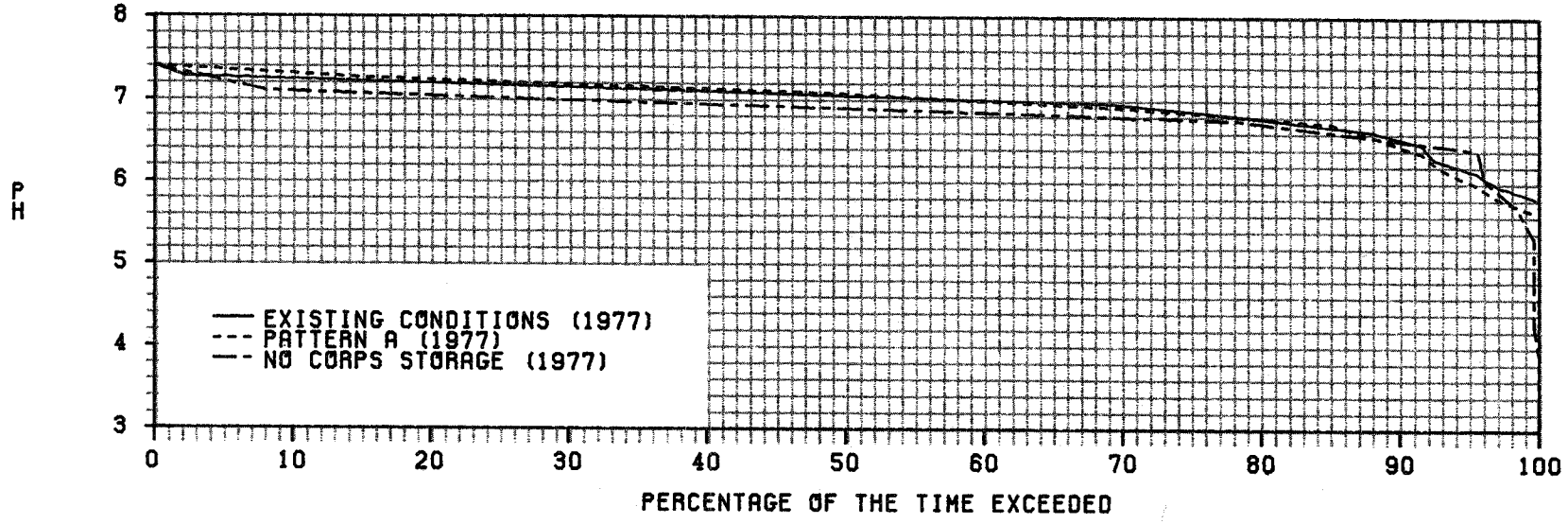
In general, slightly decreased pH would occur most of time for the No COE Storage case. No significant impact would occur for the Pattern A regulation.

Allegheny River TDS at Natrona

During the 1975 study period, Figure C-4 shows that the Pattern A case would cause higher TDS than the Existing Condition about 30% of the time and no significant impact during the remaining time. The No COE Storage case would cause significantly higher TDS than the Existing Condition 95% of the time and lower TDS for 2% of the time.

The graph for the 1977 study period shows that the Pattern A case would cause higher TDS than the Existing Condition about 90% of the time and no impact the remaining time. The No COE Storage case is only slightly higher than the Existing Condition about 50% of the time and only slightly lower the other 50% of the time.

In general, during a significant portion of the time, the Pattern A regulation would cause higher TDS, with no impact the remaining time. The No COE Storage case would cause higher TDS part of the time and equally lower TDS the remaining time. The proportion of the positive or negative impact time can not be predicted.



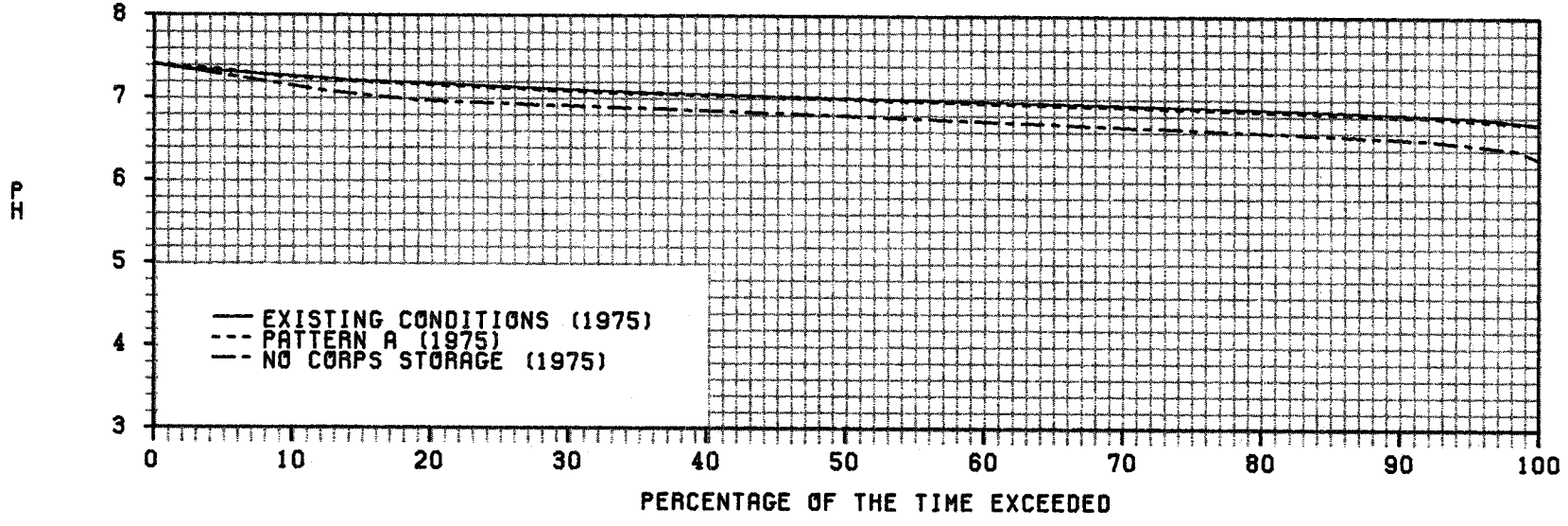


FIGURE C-3. ALLEGHENY RIVER PH AT NATRONA

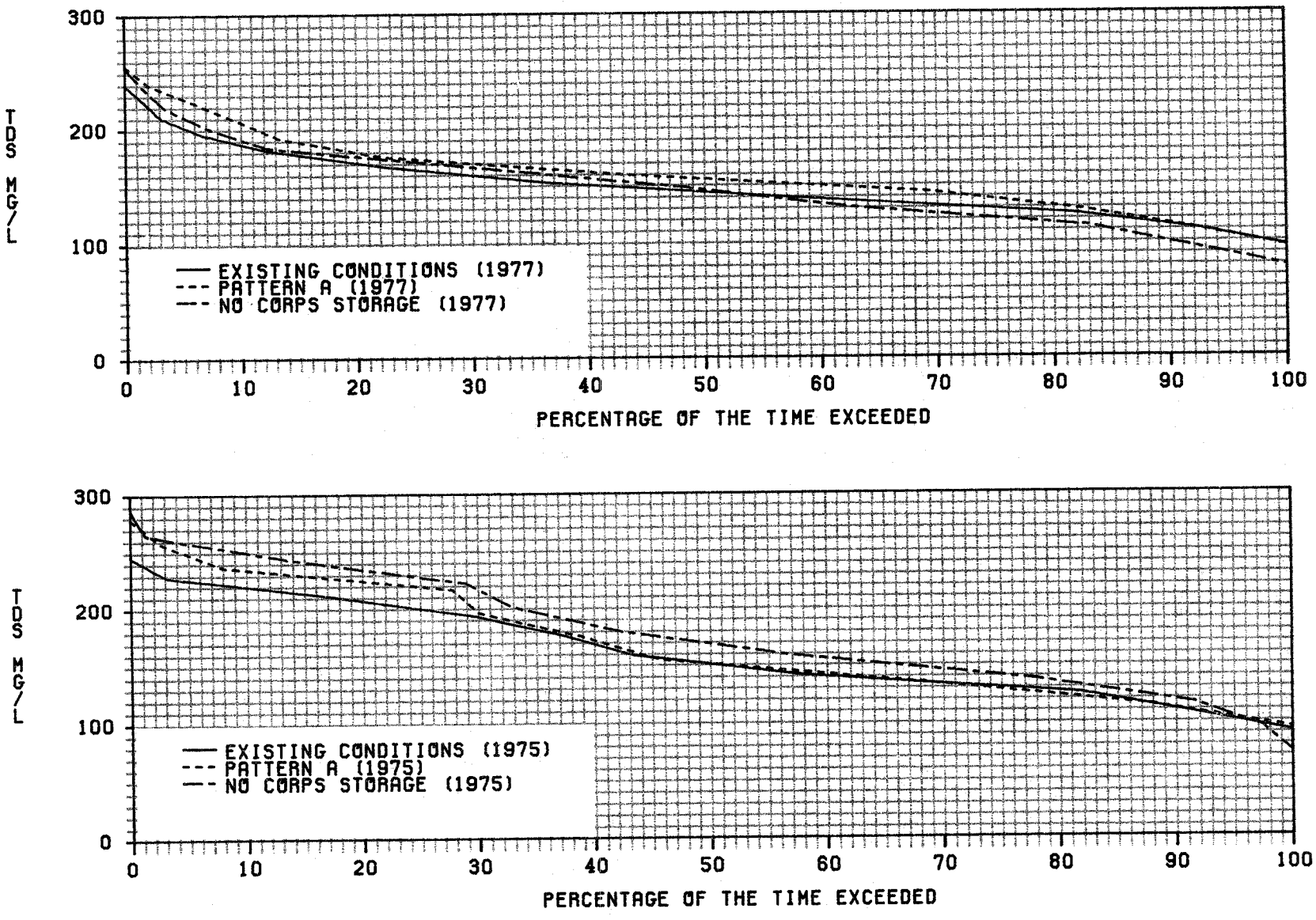


FIGURE C-4. ALLEGHENY RIVER TDS AT NATRONA

FRENCH CREEK WATER QUALITY AT MEADVILLE

The impact of Union City and Woodcock Reservoirs under present regulation is contrasted to the case without reservoir storage. The results are shown at Meadville in Figures C-5 through C-8.

French Creek Temperature at Meadville

During both the 1975 and 1977 study periods, Figure C-5 shows that the projects have no significant impact on the stream temperature.

French Creek Alkalinity at Meadville

During the 1975 study period, Figure C-6 shows that the alkalinity would be slightly higher for the No COE Storage case about 40% of the time and significantly lower about 40% of the time.

During the 1977 study period, the No COE Storage case causes significantly lower alkalinity 80% of the time and only slightly higher 5% of the time.

In general, the alkalinity for the unregulated case is significantly lower during at least 50% of the time with only minor differences the remaining time.

French Creek pH at Meadville

During both the 1975 and 1977 study periods, Figure C-7 shows that there is little impact due to regulation most of the time, with a slightly lower pH due to the regulated conditions 15% of the time.

French Creek TDS at Meadville

During the 1975 study period (see Figure C-8), the regulated case causes slightly lower TDS 20% of the time with no impact the remaining time.

During the 1977 study period, slightly higher TDS would exist during the entire time for the regulated case.

Although the 1975 impact is in the opposite direction of the 1977 impact, the magnitudes of the impacts are too small to be of any consequence.

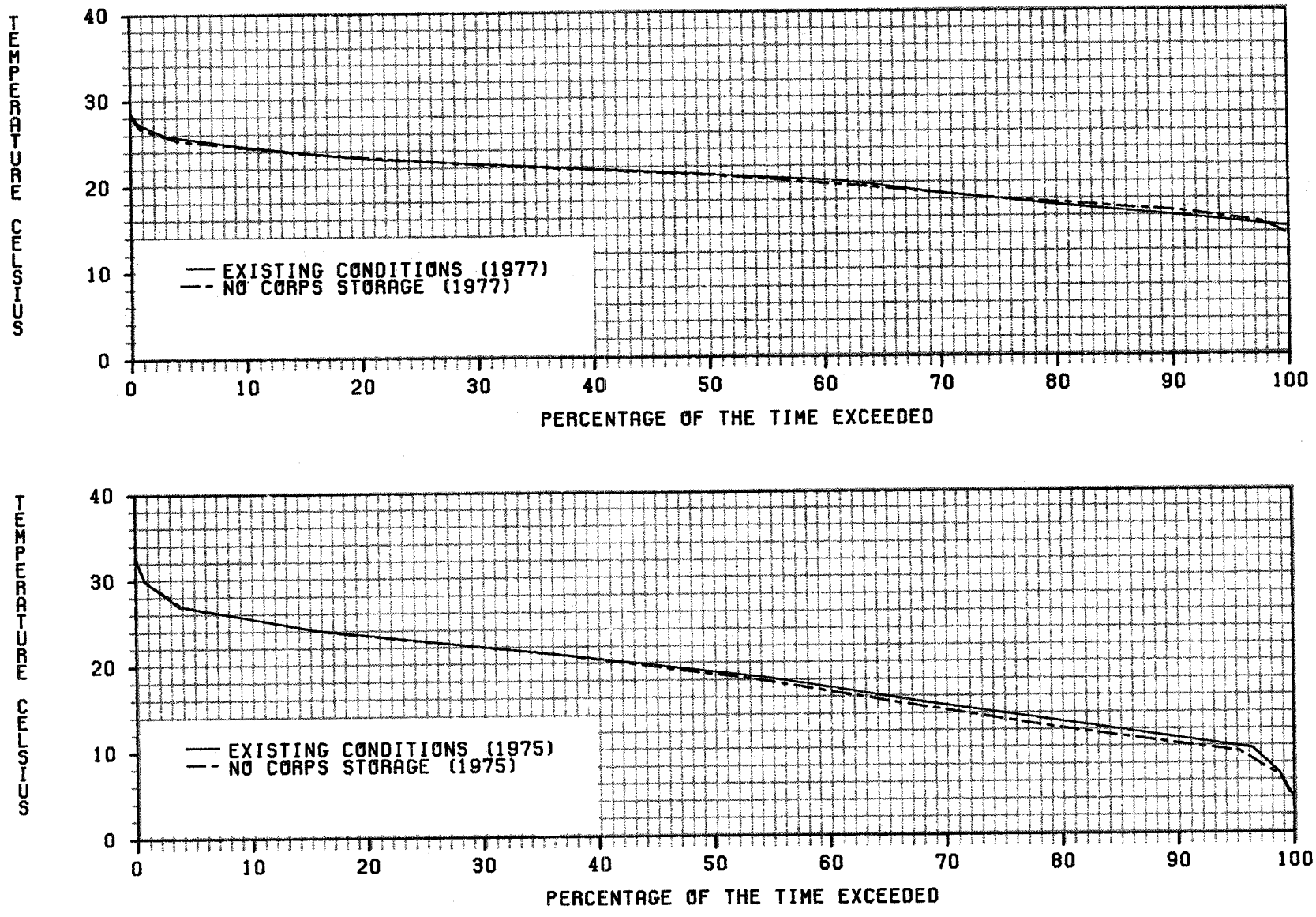
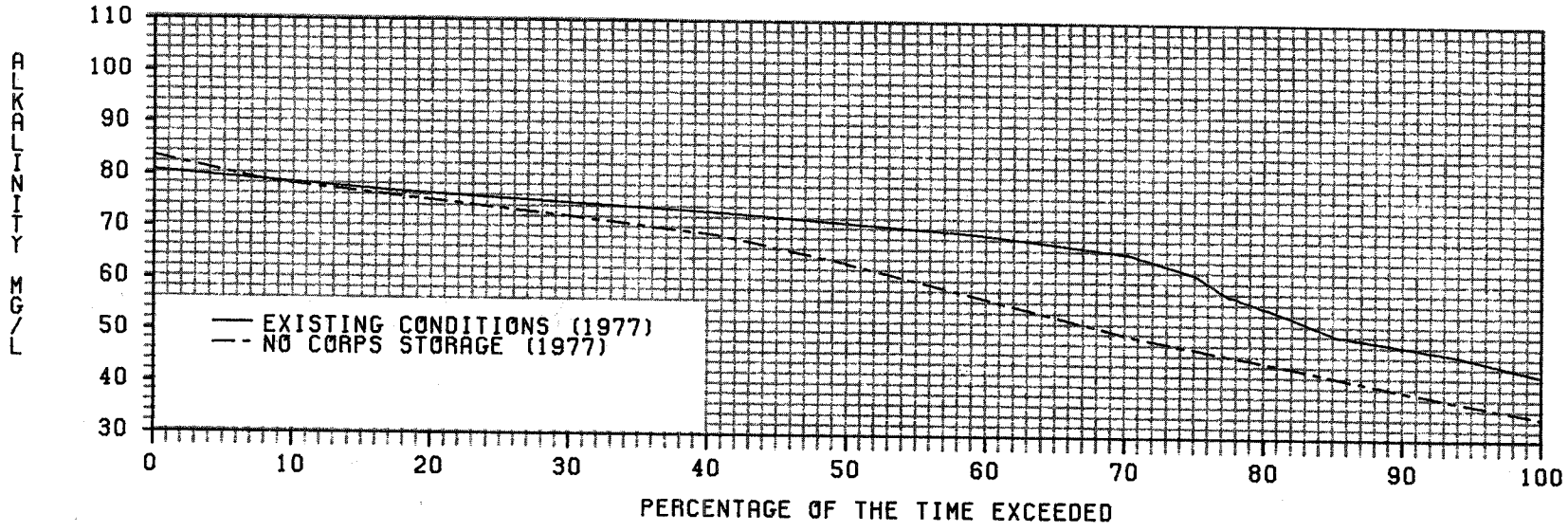


FIGURE C-5. FRENCH CREEK WATER TEMPERATURE AT MEADVILLE



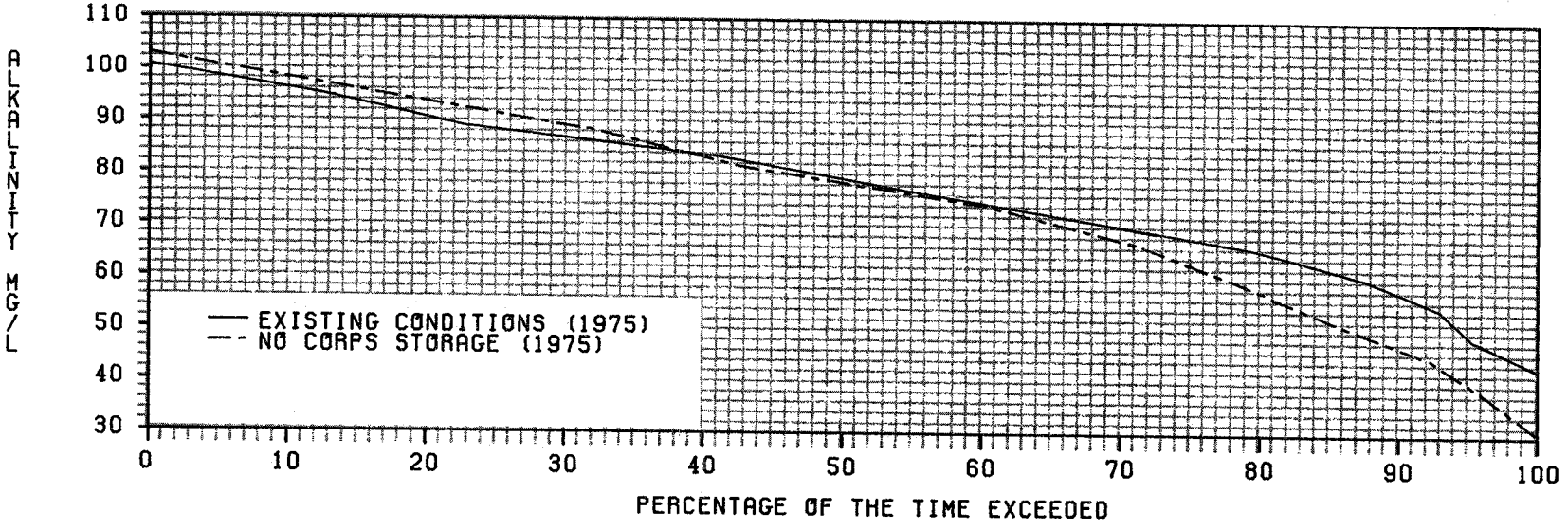


FIGURE C-6. FRENCH CREEK ALKALINITY AT MEADVILLE

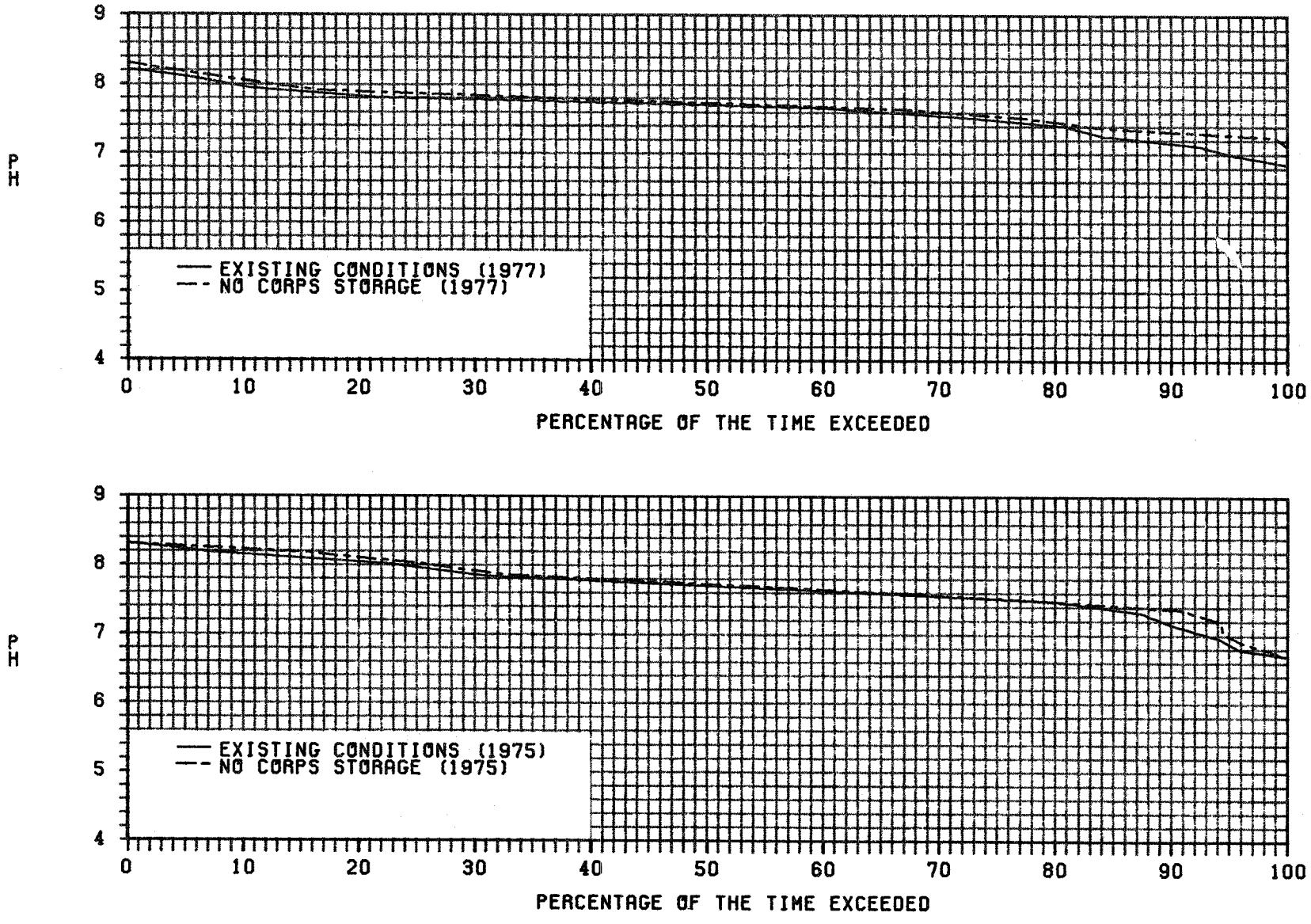
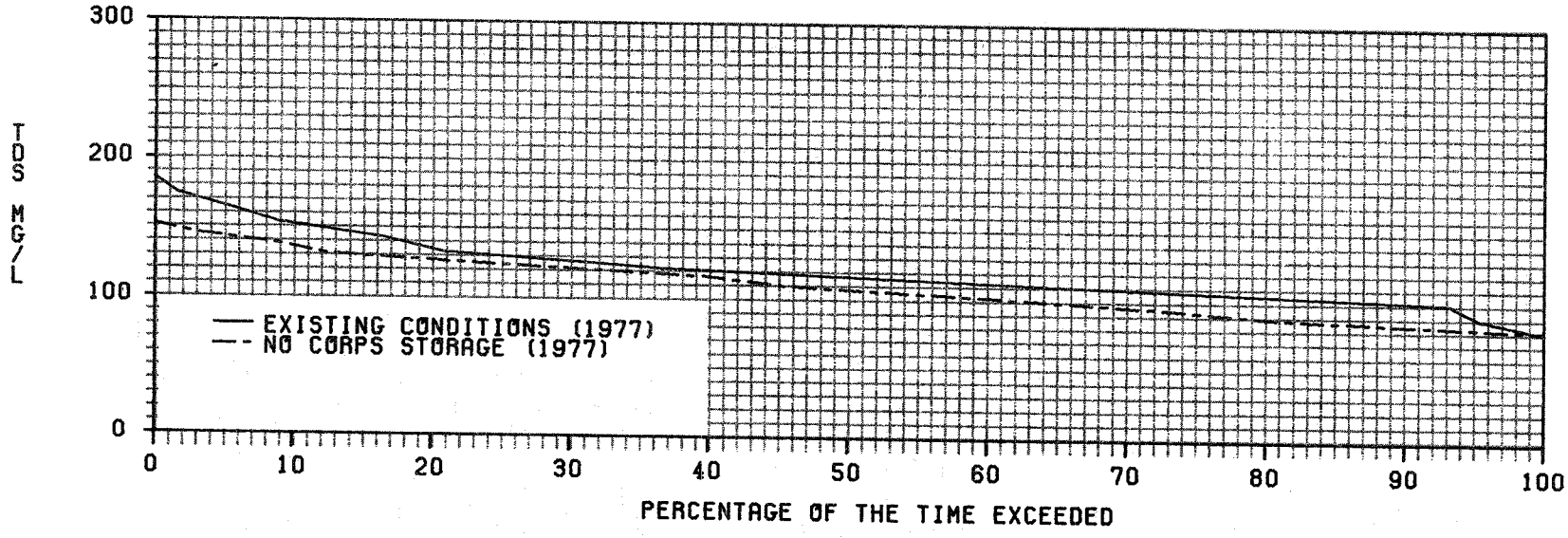


FIGURE C-7. FRENCH CREEK PH AT MEADVILLE



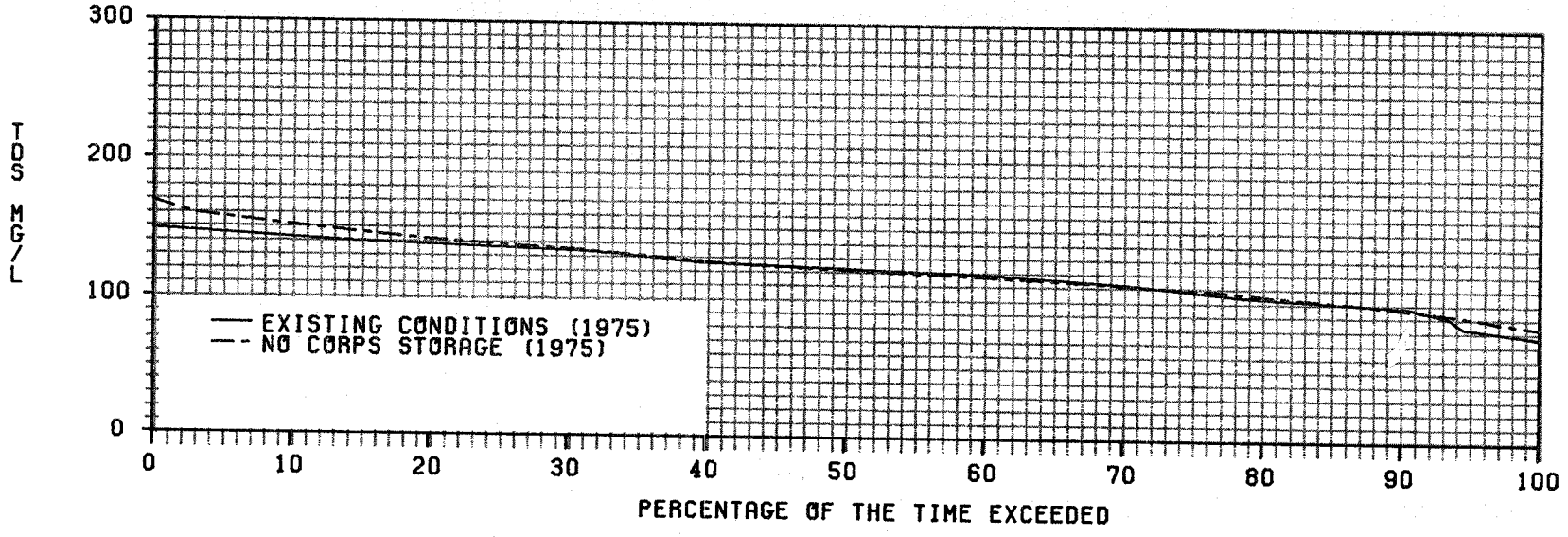


FIGURE C-8. FRENCH CREEK TDS AT MEADVILLE

KISKIMINETAS RIVER WATER QUALITY NEAR VANDERGRIFT

The impact of Loyalhana and Conemaugh Reservoirs under present regulation is contrasted to the case without reservoir storage. The results are shown near Vandergrift in Figures C-9 through C-12.

Kiskiminetas River Temperature near Vandergrift

During both the 1975 and 1977 study periods, Figure C-9 shows that the projects cause slightly warmer water under the regulated condition.

Kiskiminetas River Alkalinity near Vandergrift

During both the 1975 and 1977 study period, Figure C-10 shows that the projects cause significantly higher alkalinity under regulated conditions.

Kiskiminetas River pH near Vandergrift

During the 1975 study period, Figure C-11 shows that the projects cause higher pH water over 95% of the time under regulated conditions and only slightly lower pH during less than 5% of the time.

During the 1977 study period, the projects cause significantly higher pH all the time.

In general, higher pH should be expected most of the time under regulated conditions.

Kiskiminetas River TDS near Vandergrift

During the 1975 study period, Figure C-12 shows that the regulated conditions caused slightly lower TDS over 80% of the time and slightly higher TDS during 10% of the time.

During the 1977 study period, regulated conditions caused significantly lower TDS 99% of the time.

In general, regulated conditions would cause lower TDS.

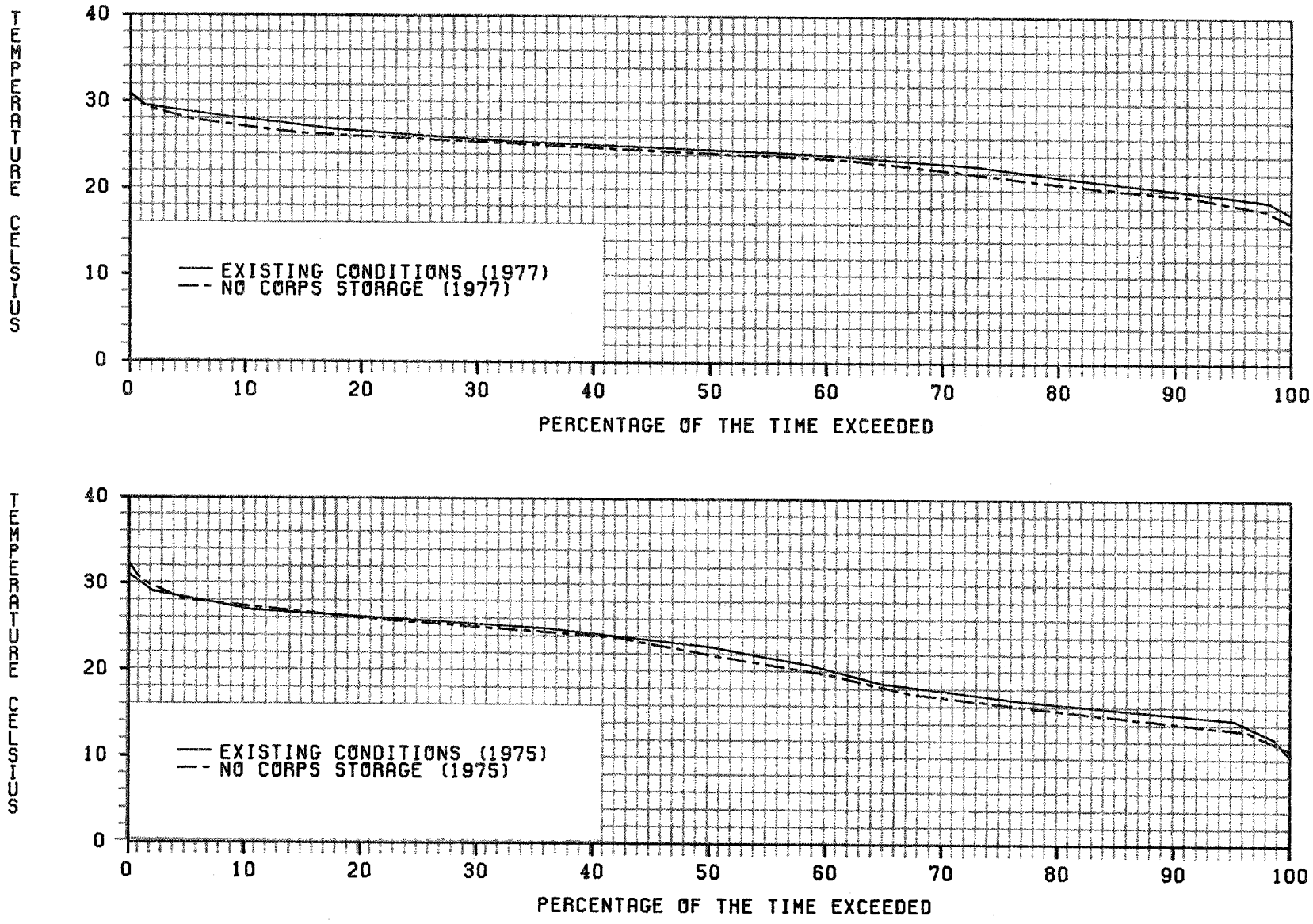


FIGURE C-9. KISKIMINETAS RIVER WATER TEMPERATURE NEAR VANDERGRIFT

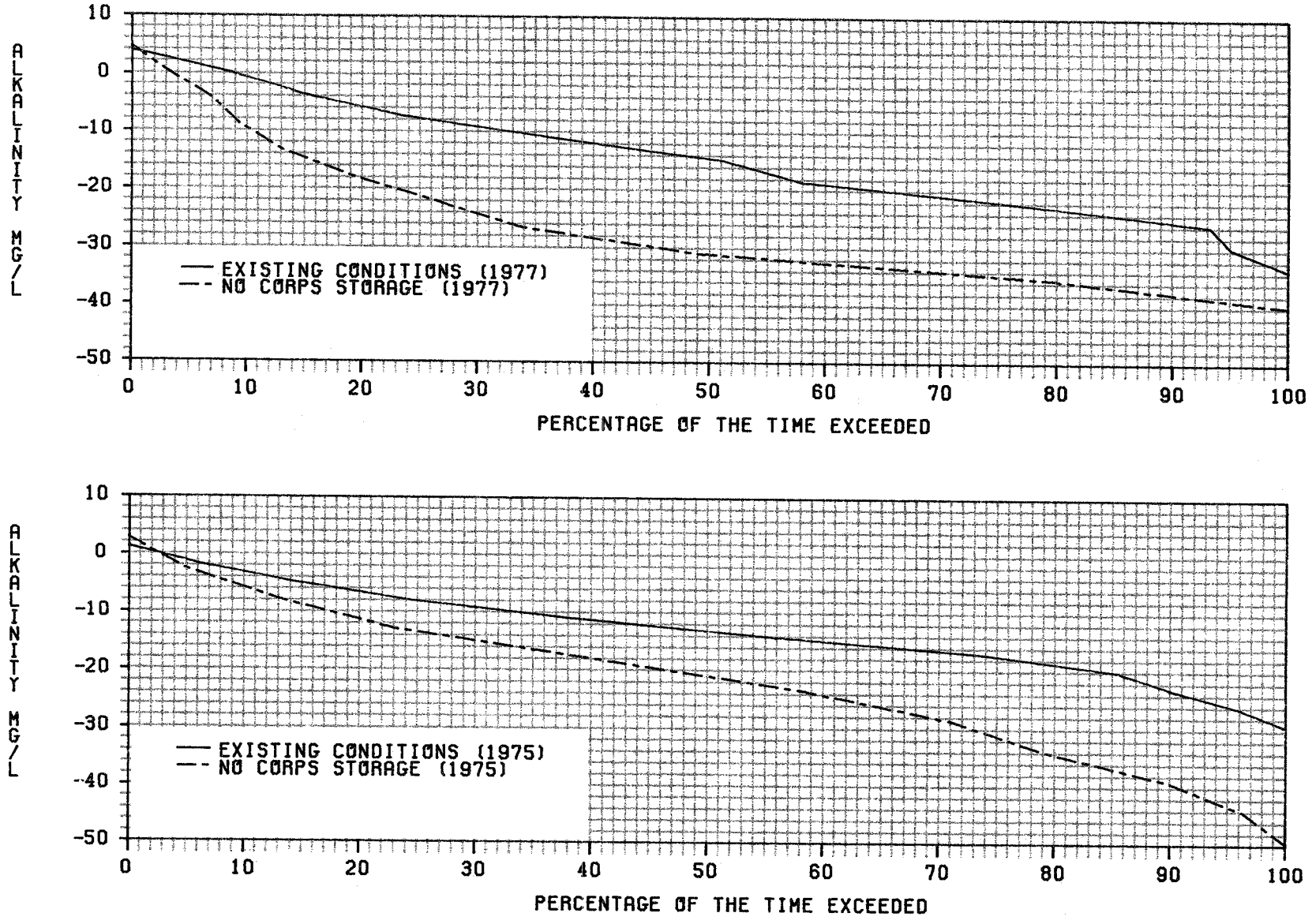
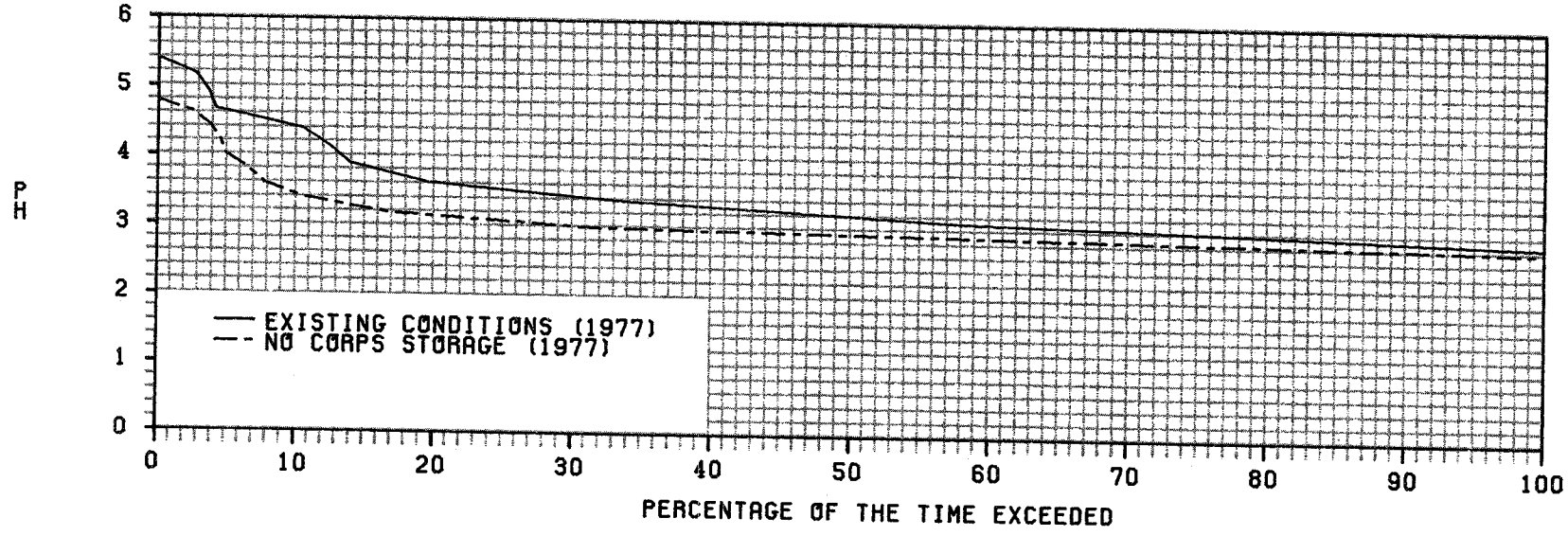


FIGURE C-10. KISKIMINETAS RIVER ALKALINITY NEAR VANDERGRIFT



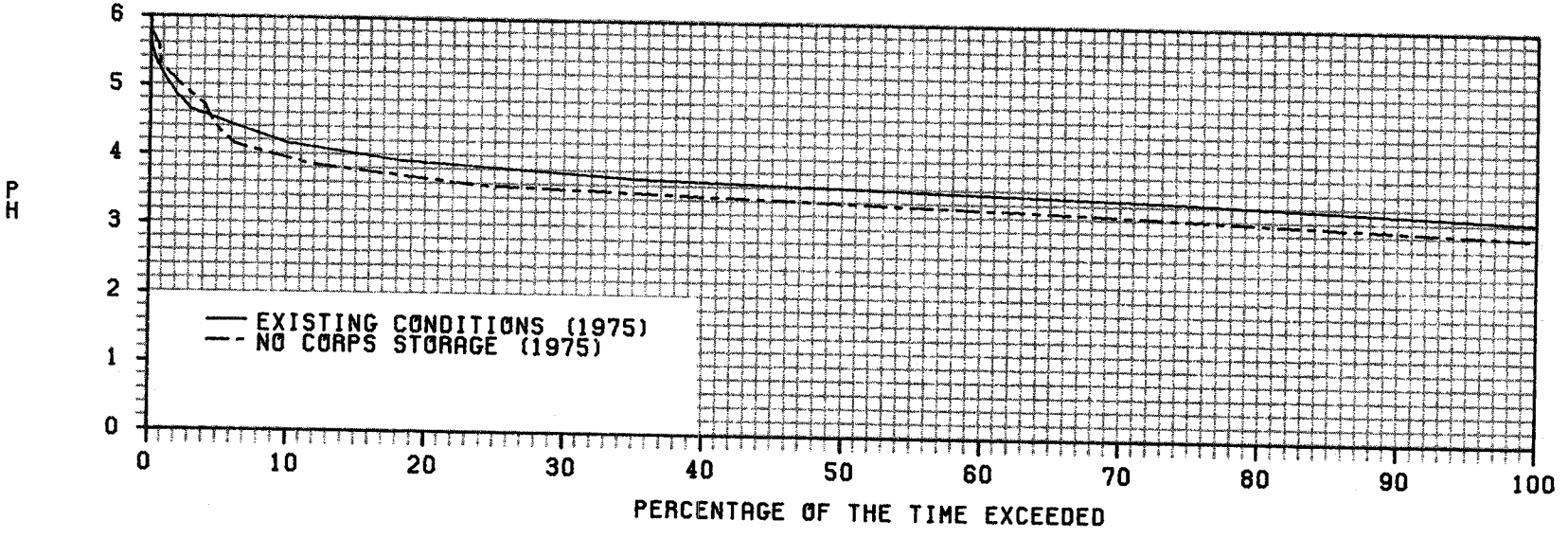
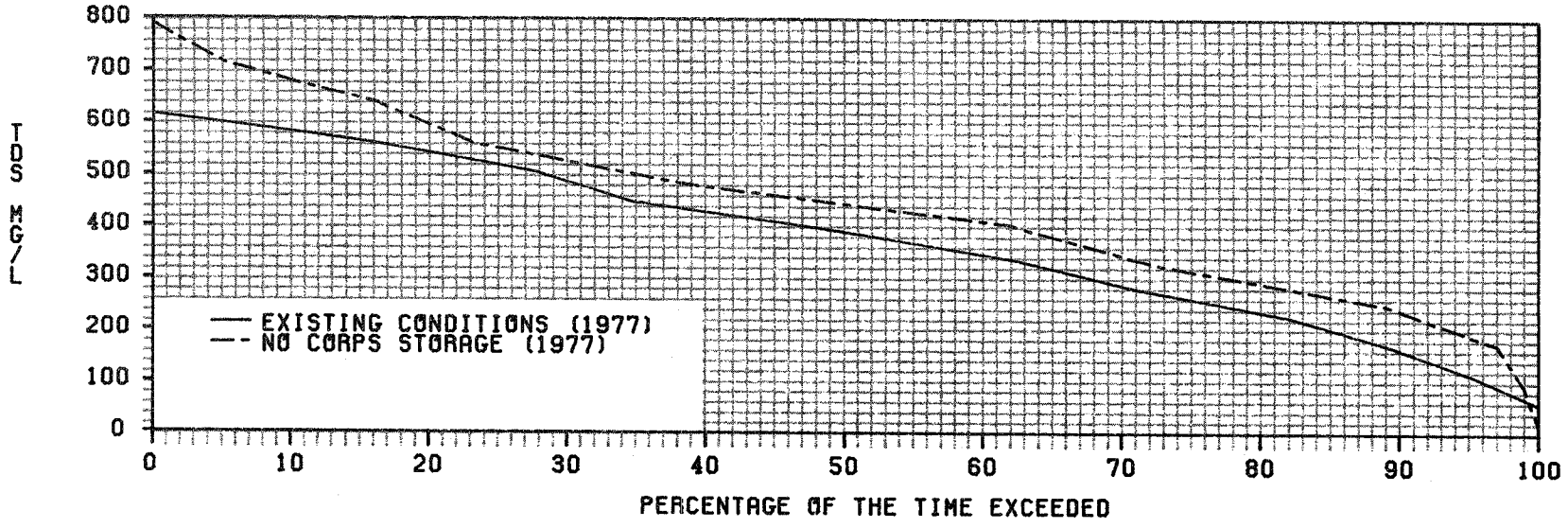


FIGURE C-11. KISKIMINETAS RIVER PH NEAR VANDERGRIFT



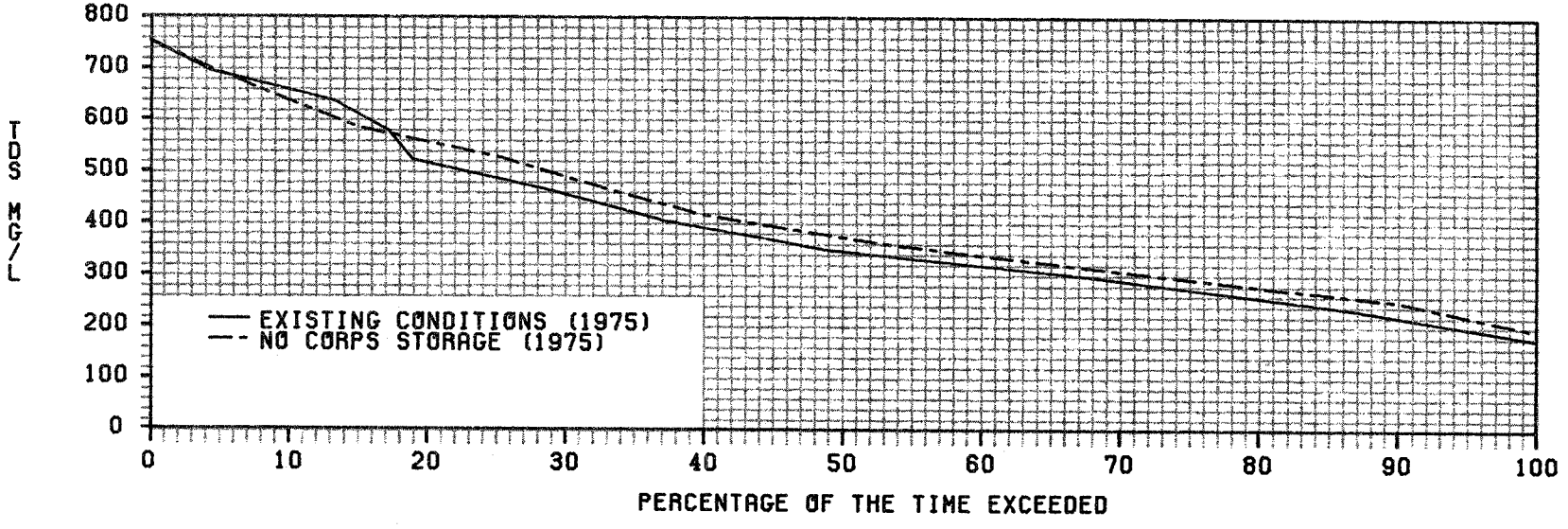


FIGURE C-12. KISKIMINETAS RIVER TDS NEAR VANDERGRIFT

CLARION RIVER WATER QUALITY NEAR ST. PETERSBURG

The impact of the East Branch Clarion Reservoir under present regulation is contrasted to the case without reservoir storage. The results near St. Petersburg are shown in Figures C-13 through C-16. Note that these results do not include any effects of Piney Dam regulation.

Clarion River Temperature near St. Petersburg

During both the 1975 and 1977 study periods (see Figure C-13), no impact is predicted near St. Petersburg for temperature due to regulation.

Clarion River Alkalinity near St. Petersburg

The graph of the 1975 study period (see Figure C-14) shows that the alkalinity from the unregulated case is slightly higher for 20% of the time and slightly lower for 20% of the time.

The graph for the 1977 study period shows that there is no significant impact on alkalinity.

In general, only slight impact on alkalinity may be caused by regulation for a very short period of time.

Clarion River pH near St. Petersburg

The graph of the 1975 study period (see Figure C-15) shows that the pH from the regulated case is significantly higher during more than 30% of the time. No significant impact exists the remaining time.

The graph of the 1977 study period shows that there is no significant impact on pH.

In general, the regulated case may cause significantly higher pH during high acid runoff events.

Clarion River TDS near St. Petersburg

During both the 1975 and 1977 study periods (see Figure C-16), the regulated case caused significantly lower TDS about 50% of the time, with no significant impact during the remaining time.

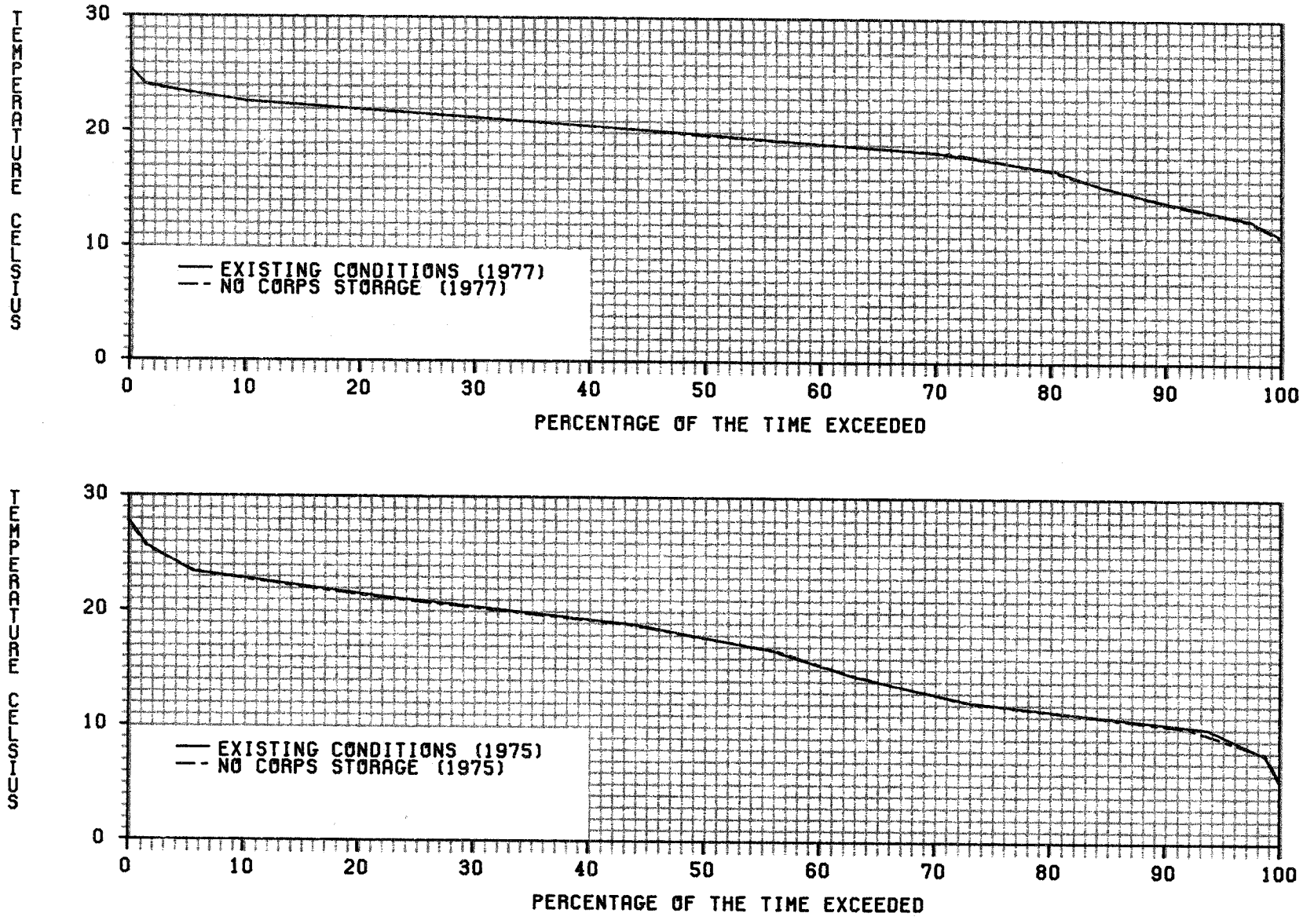
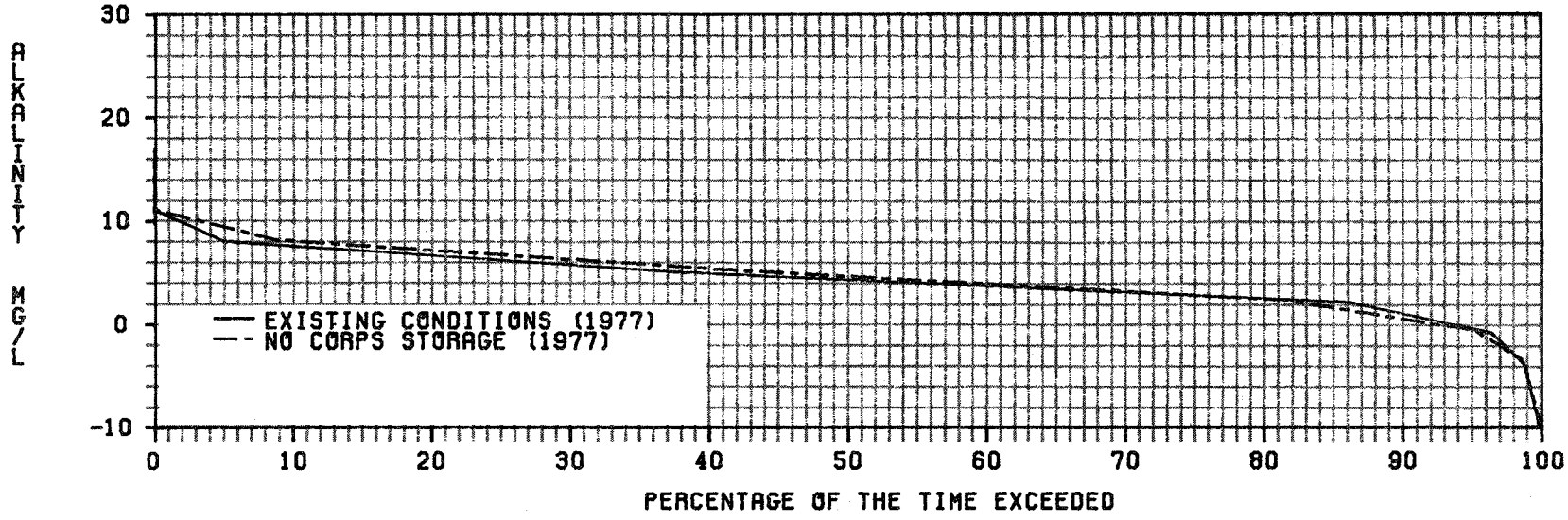


FIGURE C-13. CLARION RIVER WATER TEMPERATURE NEAR ST. PETERSBURG



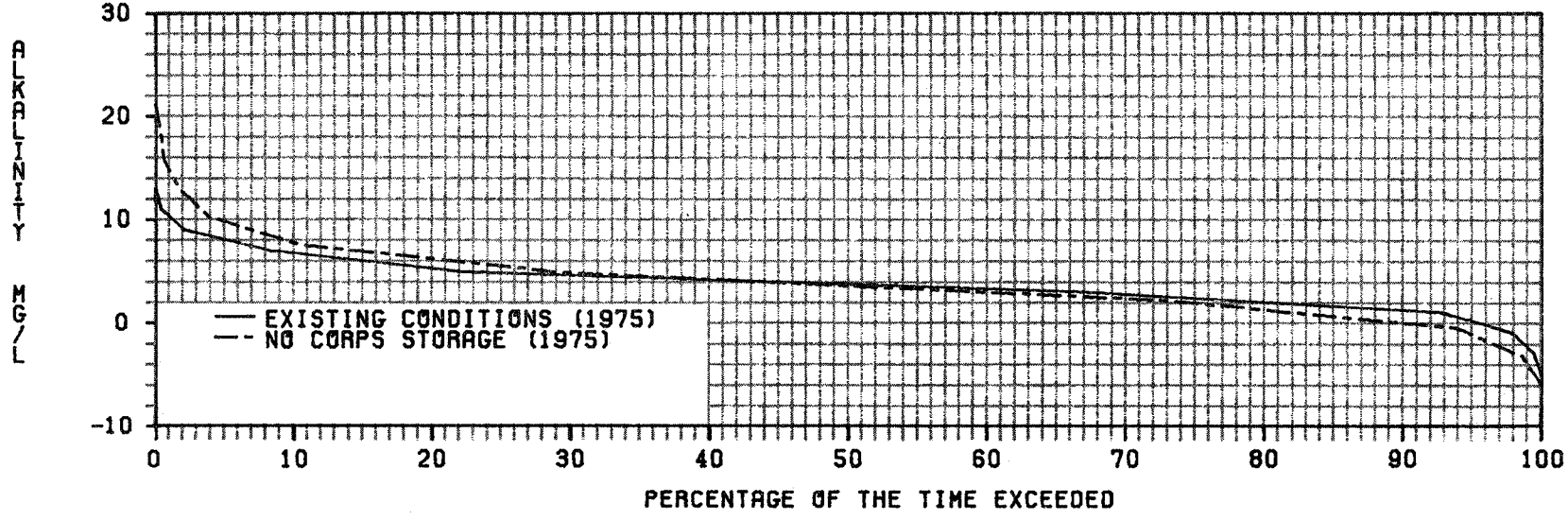


FIGURE C-14. CLARION RIVER ALKALINITY NEAR ST. PETERSBURG

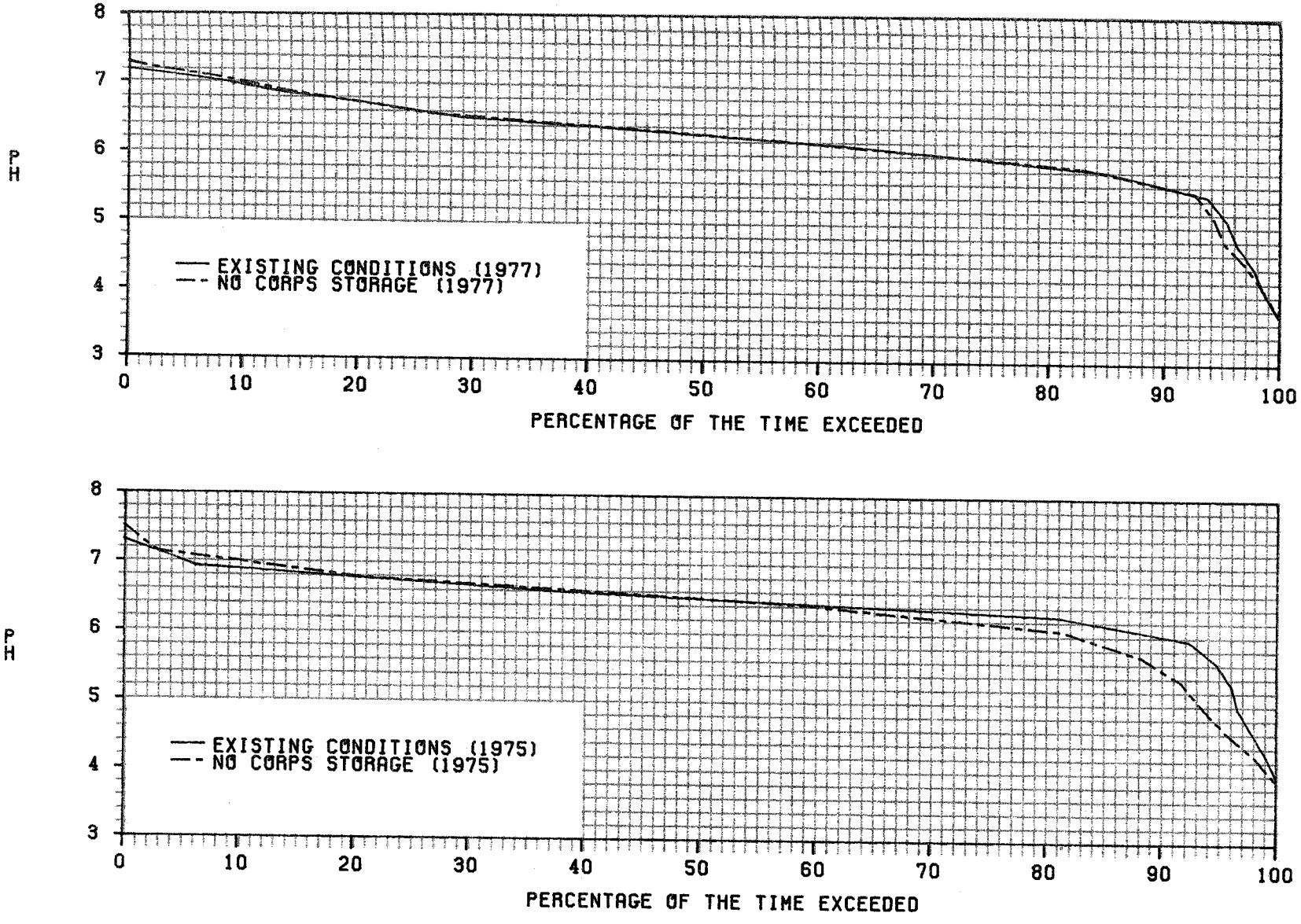
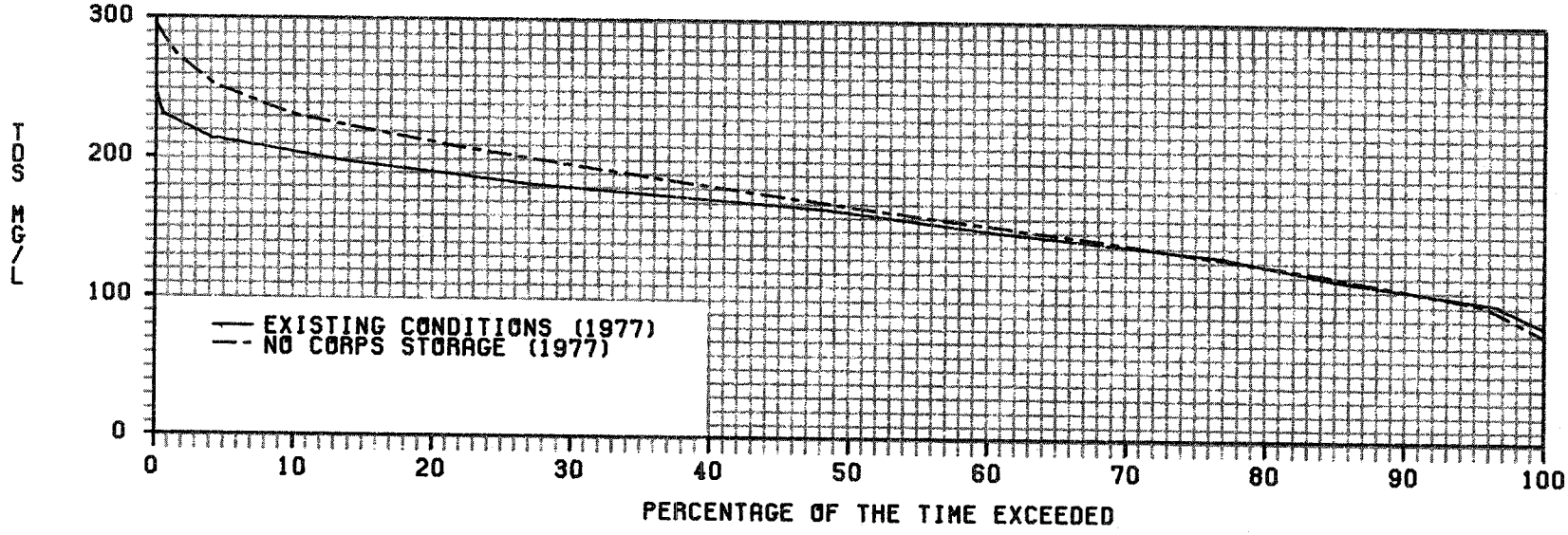


FIGURE C-15. CLARION RIVER PH NEAR ST. PETERSBURG



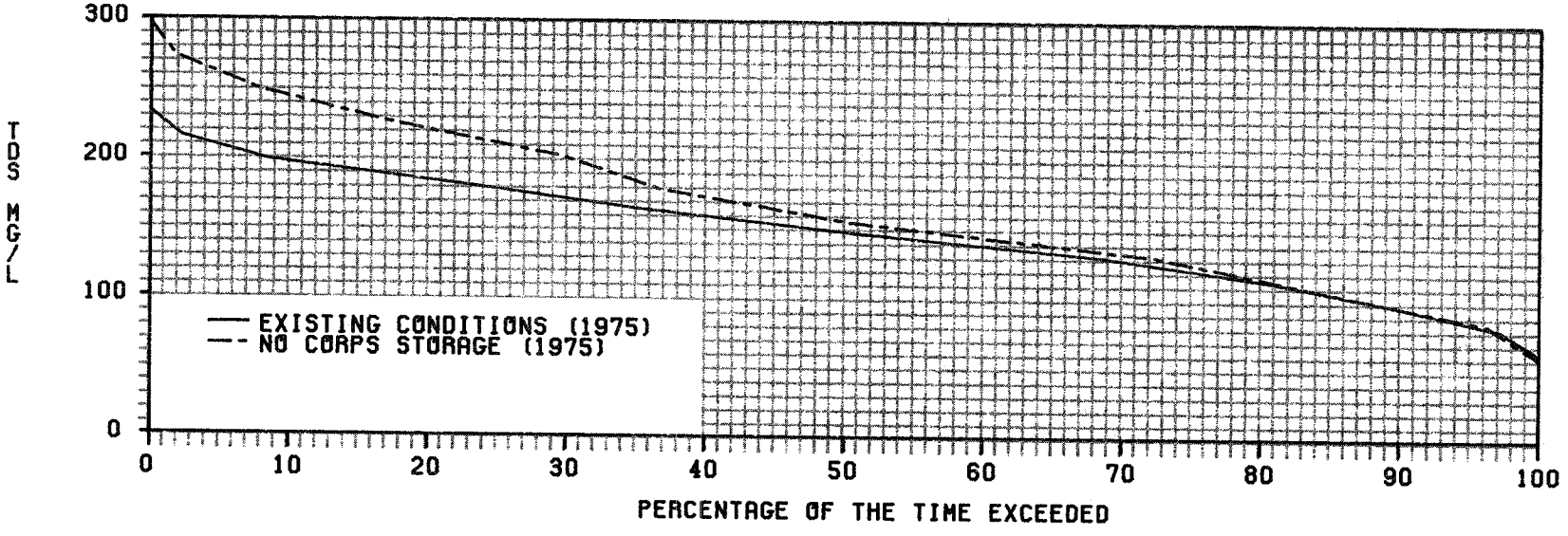


FIGURE C-16. CLARION RIVER TDS NEAR ST. PETERSBURG

CONCLUSIONS

The water quality impacts due to the Pattern A regulation and the No COE Storage (unregulated) case are summarized below. These conclusions include generalizations of the results from both study periods and discuss only the significant impacts.

Temperature

Temperature impacts on the Allegheny River are significant at Warren due to Kinzua Dam regulation but are rather difficult to predict. Simulation results show that present regulation will cause higher temperatures sometimes and lower temperatures other times. These impacts are insignificant at Natrona due to the moderating effects of meteorological conditions during the travel time involved. Also, the upstream impact receives no reinforcement from the three major tributaries.

The Clarion River impacts are similar to the Allegheny River with simulation results showing significant impact occurring at Ridgeway but no influence at Piney or St. Petersburg. The Ridgeway impact can cause higher or lower temperature releases at different times.

Alkalinity

Simulation results show that alkalinity impacts on the Allegheny River are significant at Warren due to Kinzua Dam regulation but are difficult to predict. The present regulation will cause higher values sometimes and lower values other times. Pattern A regulation always causes either the same alkalinity as existing regulation or significantly higher values at Warren.

The impacts at Warren are greatly reduced by the time they get to Natrona. The present regulation generally causes higher alkalinity at Natrona due to the influences of the French Creek and the Kiskiminetas River. The Pattern A regulation at Kinzua Dam does not cause any significant impact at Natrona.

pH

Simulation results show that the pH impact on the Allegheny River at Warren is significant but difficult to predict. The present regulation can cause either a higher or lower pH discharge. The Pattern A regulation causes either the same or slightly higher pH than the present regulation.

The pH at Natrona under present regulation is higher due to the influence of the Kiskiminetas and Clarion Rivers. The Pattern A regulation does not cause any significant impact at Natrona.

The Clarion River has significantly lower pH at Ridgeway under regulated conditions, with decreasing impact in the downstream direction. At St. Petersburg, a higher pH occurs under present regulation during 30% of the time.

TDS

At Warren, simulation results show that present regulation causes 75-100 mg/l less TDS, with decreasing impact downstream. Pattern A regulation causes considerably less impact, about 15-30 mg/l, at Warren and downstream.

The TDS impact at Natrona is significantly reduced from that at Warren and usually has lower TDS under present regulation. Pattern A regulation impacts at Natrona are similar. The change between Warren and Natrona is influenced mostly by the Clarion River.

The Clarion River regulation has significant impact and causes decreased TDS. While the impact is greatest (about 200 mg/l) at Ridgeway, it continues to remain significant (about 50 mg/l) downstream.