

FLOOD DAMAGE REPORT FOR FRANKFORT, KENTUCKY

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KENTUCKY RIVER

U.S. ARMY ENGINEERS DISTRICT, LOUISVILLE KENTUCKY

CORPS OF ENGINEERS

86 3

JULY 1981

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	AD-A164942	
4. TITLE (and Subtitle) Flood Damage Report for Frankfort, Kentucky		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER PD-E-12-86
7. AUTHOR(s) Shehab Eddin (all except Section E) Larry Montgomery (Section E)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Louisville District, U.S. Army Corps of Engineers P.O. Box 59 Louisville, Kentucky 40201-0059		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Same as no. 9		12. REPORT DATE July 1981
		13. NUMBER OF PAGES 112
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Floods Frankfort, Kentucky Flood Damage Emergency Cost		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This is a study to evaluate flood damage in unprotected sections of the City of Frankfort that were affected by the December 1978 flood, the maximum of record.		

FLOOD DAMAGE REPORT
FOR
FRANKFORT, KENTUCKY

PREPARED BY

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
July 1981

SUMMARY

This is a study to evaluate flood damage in unprotected sections of the City of Frankfort that were affected by the December 1978 flood, the maximum of record. Evaluation of emergency cost was subject to a research effort. All estimates shown in this summary are stated in October 1980 price levels.

A Presidential declaration of a major flood disaster in Kentucky was made in December 1978, and as a result the full spectrum of Federal disaster assistance was made available to affected communities, including Frankfort.

Total damage estimates for the December 1978 flood are as follows:

Physical Damage	\$33,070,000
Nonphysical Damage	9,976,000
Emergency Cost	<u>6,640,000</u>
Total	\$49,686,000

Total damage estimates for the December 1978 flood by study section are as follows:

South Frankfort Section	\$33,442,000
Old Capitol Section	5,052,000
Benson Creek Section	5,738,000
Distillery Section	<u>5,454,000</u>
Total	\$49,686,000

Average annual damage estimates are as follows:

Physical Damage	\$936,000
Nonphysical Damage	235,000
Emergency Cost	116,000
Flood Insurance	
Administrative Cost	<u>22,000</u>
Total	\$1,309,000

Average annual damage estimates by study section are as follows:

South Frankfort Section	\$878,000
Old Capitol Section	147,000
Benson Creek Section	166,000
Distillery Section	<u>118,000</u>
Total	\$1,309,000



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FRANKFORT, KENTUCKY
 FLOOD DAMAGE REPORT
 FOR
 WATER RESOURCE DEVELOPMENT

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SECTION A
THE STUDY AND REPORT

This is a detailed study of urban flood damages and losses including costs associated with disaster assistance and emergency activity relative to the December 1978 flood in Frankfort, Kentucky, which was subject to a Presidential Declaration of a major flood disaster.

Section A presents background information concerning authority, purpose, coordination, and prior reports. Section B presents socioeconomic effects in view of incurred damages and a Presidentially declared major disaster. Problems and needs of the community are presented in Section C. Derivation and identification of emergency cost items and other component costs incorporated in flood damage estimates are presented in Section D. Flood damage and emergency cost estimates and their relationships are analyzed and presented in Section E. The Appendix includes information on coordination of the study effort, sources of information, impact of flood insurance and other effects.

PURPOSE

This study represents an effort by the Louisville District, U.S. Army Corps of Engineers, to survey, evaluate and report on flood damages resulting from the flood of December 1978 in the subject area. No protection plans are considered in this study.

AUTHORITY

The study was conducted under authority of Section 22, Public Law 93-251, Planning Assistance to States. Report No. 96-242 of the U. S. Senate Committee on Appropriations includes a statement concerning the resumption of study of the Kentucky River and Tributaries toward assessing the advisability and economic feasibility of protecting the unprotected portions of the City of Frankfort:

In view of the recent flooding experienced in the area, the Committee has provided \$150,000 for resumption of the Kentucky River and Tributaries study. As part of the study and as one of the first efforts, it is expected that the Corps of Engineers will investigate and report on the feasibility of providing protection, by means of upstream reservoirs, or other means deemed appropriate, for portions of the City of Frankfort which presently are without protection work. ^{1/}

PRIOR REPORTS

In 1963, an economic study on local flood protection was made and reported in Design Memorandum (DM) No. 1. This study indicated that local protection for the Old Capitol Section and the part across Jones Run Valley were the only parts economically justified and desired by local interests at that time.

Following approval of the plan presented in DM No. 1, the advanced engineering and design of this plan was presented in DM No. 2, dated November 1965, with minor departures from the plan as originally proposed in the earlier study. Work on this project was completed in 1970.

In 1967, DM No. 3 proposed the addition of pumping stations to the existing local protection project on the right bank of the Kentucky River for the purpose of removing the interior drainage from the protected areas during periods when the flood stage is exceeded.

In 1977, a feasibility study on local flood protection in Frankfort was made and reported on in DM No. 4. This was a study of alternative plans to protect the Benson Creek and South Frankfort areas of the city. The study indicated that the annual costs of all considered plans exceeded the annual benefits by a wide margin and as a result the project was reclassified as inactive. However, it was recommended that the Louisville District assist in developing an evacuation plan for the city. A detailed flood forecasting emergency evacuation plan for the City of Frankfort is being prepared by the Louisville District under the auspices of the Flood Plain Management Services Program. The final draft of the plan is under review at this time.

^{1/} Report No. 96-242, 90th Congress, 1st Session, p. 75.

SECTION B

SOCIOECONOMIC EFFECTS

This section presents socioeconomic conditions and consequences pertaining to the December 1978 flood in Frankfort and highlights the disruptive effects of flooding on flood plain dwellers and economic activity. The susceptibility of local and State governmental services and activities during the flood, and the impact of the consequent Presidential declaration of a major flood disaster in Kentucky, are also highlighted.

INTRODUCTION

The December 1978 flood, which is the maximum of record in Frankfort, brought about critically adverse conditions and consequences from human and economic standpoints. The flood occurred at the threshold of winter, a factor which maximized the immediate needs of affected citizens and the burden of local public authorities and public and private disaster assistance entities to respond to these needs. Because flooding in several localities in Kentucky was destructive enough to warrant a Presidentially declared major flood disaster, the full spectrum of Federal disaster relief was made available, at significant costs, to affected communities including Frankfort. Since Frankfort is the State capital and seat of Franklin County, the flood disrupted some of the services and activities needed to respond to the disaster elsewhere.

At the time the flood crested, on 10 December, telephone service within Frankfort and between Frankfort and other parts of the State was disrupted. Also, water supply services were interrupted and gas lines were clogged, thus causing substantial disruption of dependent activities. Emergency services, including fire and ambulance equipment and personnel, had to be moved temporarily from their regular flood-prone headquarters to higher locations. The only accessibility between the northern and southern parts of the city during the flood was through

Interstate Highway 64 (see Plate B-1), representing about 10 miles of additional driving around the city because connecting bridges on the river and/or access streets were flooded. However, a new 4-lane east-west connector route (Highway 676) and bridge over the Kentucky River has recently been opened to traffic (see location on Plate B-1). This new route and bridge are above the crest of the December 1978 flood and would have significantly shortened the rerouting distance traveled on I-64 during the December 1978 flood.

The Governor of Kentucky put several thousand State employees on paid administrative leave and State offices were closed from Monday, 11 December, to Friday, 15 December. Likewise, city and county offices were closed for one work week. The only governmental services which remained open during the flood were offices mandated to engage in emergency and police work. Further, the flood compelled the postponement of the State General Assembly Legislative Session. The flood and its aftermath came about at the height of the pre-Christmas shopping season and prevented many businesses from realizing a substantial portion of their annual profits. Over 1,500 residential flood victims were displaced from their homes and many suffered traumatic experiences, especially the elderly and those with low income. The flood separated the city into two parts and disrupted transportation. As a result, limited accessibility impaired normal activity and made emergency and relief efforts more difficult.

Since this was both a record flood and a fast rising flood, which allowed for about two days between the first warning by the National Weather Service on the evening of Friday, 8 December, and the flood crest on the afternoon of Sunday, 10 December, the community was relatively unprepared for dealing with such an overwhelming situation. The evacuation plan, which is being prepared by the Louisville District for Frankfort, aims to improve community preparedness for future events.

Because the flood resulted in a sizable evacuation activity and since private and public properties were left unattended, a curfew was imposed in downtown Frankfort, including flood prone and flood-free

areas, for several days during which business owners, including those located in the flood-free areas, were deprived of access to their businesses and/or customers, thus incurring income losses. Affected utilities, including telephone, water, sewage, gas and electricity, incurred substantial damages which resulted in significant disruption in business activity even in areas beyond the flooded areas.

DISASTER RELIEF

Affected residents either fled from the fast-rising flood or were evacuated from their homes to live under unsettled conditions for a period of time ranging from a few days to several months before they could return. The average period of living away from home was approximately two months. The immediate critical needs of flood victims were largely met by disaster and emergency alleviation responses from the American Red Cross, Salvation Army, Mennonite Disaster Service, governments, churches, businesses, civic clubs and individuals. Further, Federal disaster assistance programs provided disaster housing rehabilitation for low and moderate income families, temporary housing to 200 families, limited home repair to 232 families, IFGP grants to 316 families, 199 Small Business Administration (SBA) low interest loans, disaster related tax deductions, emergency food, and disaster unemployment compensation. State and local governments provided evacuation service, fire and ambulance services, police protection, temporary mass shelters, property protection and other services. Although alleviation responses averted much of the financial losses and eased critical human needs, there were lingering feelings of helplessness and varying levels of tension and anxiety stemming from being displaced and/or facing an economic injury, especially among the poor and the infirm.

Within existing disaster relief legislation, businesses could qualify for public disaster assistance by means of SBA low interest loans for repair and disaster-related income tax deductions for physical damage. Businesses had more limited disaster relief options than the residential sector. Also, few businesses had flood insurance.

FLOOD INSURANCE

About 600, or 83 percent, of affected property owners could have avoided substantial financial losses relative to physical damage by taking advantage of flood insurance. Although flood insurance coverage has increased significantly since December 1978, flood insurance compensated for a small portion of physical damage caused by the 1978 flood. Only 117 residential and business properties, or 17 percent, of 719 affected private properties, filed flood insurance claims. Since 1974, the Flood Insurance Program (FIP) has been available to all flood plain occupants, including those in the floodable zone above the 100-year flood plain. Derivation of administrative cost of flood insurance is given in Section D and the cost is incorporated in damage estimates in Section E. Impact of Flood Insurance is discussed in the Appendix.

PROTRACTED SOCIOECONOMIC EFFECTS

Floods in Frankfort create adverse socioeconomic effects which vary in duration from several days to several years after a flood event. Protracted effects on employment, income, transportation, housing and land use are especially significant.

Employment. There was a substantial apparent flood-related increase in recorded unemployment between the months of December 1978 and January 1979. As the unemployment rate climbed from 2.9 percent immediately before the flood to 5.9 percent through January 1979, an investigation of whether this unemployment increase was flood related was made. Table B-1 shows how unemployment increased between the months of December and January from 1970 to 1980.

TABLE B-1
 UNEMPLOYMENT CHANGE
 DECEMBER-JANUARY (1970-1980)
 FRANKLIN COUNTY, KENTUCKY

Year	Rate December	Rate January	Change
1970-71	4.3	4.9	+0.6
1971-72	4.7	5.6	+0.9
1972-73	3.0	3.9	+0.9
1973-74	2.8	3.7	+0.9
1974-75	4.8	6.1	+1.3
1975-76	4.6	4.4	-0.2
1976-77	4.0	5.2	+1.2
1977-78	4.3	4.3	0.0
1978-79	2.9	5.9	+3.0
1979-80	4.0	5.4	+1.4
Total Change			+10.0
Average Change			+ 1.0

Source: Bureau of Manpower Services, Kentucky Department for Human Resources

Data in this table indicate that the increase in unemployment between December 1978 and January 1979 (3.0 percent) was three times as high as the average increase (1.0 percent) in the December-January period from 1970 to 1980. Apparently 2 percent increase in unemployment, representing 377 workers in Franklin County, persisted for at least one month as a result of the flood, with a declining effect through several months thereafter.

Further, two major retail stores, IGA and Heck's, closed down permanently and laid off their employees. Some 27 jobs were lost as a result of closure of the IGA store and 45 jobs were lost because the Heck's store closed down for over one year in order to relocate in a flood-free location. A year had elapsed before the effect of the flood on employment finally subsided.

Affected Income. The long-term effect on income is evident from ad valorem tax reductions to the county and city since these reductions represent annual losses, notwithstanding the inadmissibility of such losses as flood damage. The short-term effect on income is represented by public loss of payroll, overhead and other administrative costs, disaster relief grants and services, subsidies of SBA loans and flood insurance, loss of income to labor, and loss of profits to business and public utility services. Care is taken to avoid both duplication of net income losses in this study among the residential, business, public and disaster items and exclusion without identification of items doubted to reflect on flood related income losses.

Transportation. The protracted effect of flooding on transportation is indicated by the fact that navigation on the Kentucky River ceased for about one month and Taylor Avenue, which is a major local traffic artery, was closed to traffic for over three weeks, although the December 1978 flood was above flood stage for 6 days only. Because a curfew was imposed in downtown Frankfort during the flood, transportation was disrupted on a large scale. Traffic diversion cost pertaining to the difference in motorist time and mileage between normal conditions and the flood-curfew impedance is derived in Section D.

Housing. Floods also have a protracted effect on housing. Although the quality of housing in the City of Frankfort is good in general, there are several neighborhoods which have pockets of deteriorated housing including those of the study sections where pockets of poor housing "appears to be in the floodable area of the Kentucky River, indicating a potential correlation between the housing conditions and the flood conditions." ^{1/}

There are some 50 potential housing units (apartments) in the flood prone areas located in the upper floors of commercial buildings and are either underutilized (used for storage) or vacant, although the housing situation in the city is characterized by both a housing shortage and a

^{1/} City Housing Assistance Plan, HUD.

general lack of building space. Flood conditions apparently discourage developers and investors from pursuing demolition-rebuilding, for both the same use and different land use. Also, it appears that residential property owners in these neighborhoods are generally disinclined to pursue major remodeling or additions under existing conditions. Flood conditions pose typical constraints on land use.

Land Use and Population. Land use in the City of Frankfort is characterized by a relative scarcity of suitable land for development for industrial, commercial and residential purposes. Although there were 902 acres of vacant land in 1978, as indicated in Table B-2, some of this land has been developed and most of the remainder is unsuitable for business development. Land use needs are estimated by the Bluegrass Area Development District (BGADD) at 972 acres of suitable land by the year 2000, assuming a population strength of 62 percent of the county population, which is the existing trend (see Table B-3). Currently, the population of the city is 25,922 and the population of Franklin County is 41,731 according to preliminary U.S. Census count for 1980. ^{1/} This population would change, as indicated in Table B-4, which includes projections to the year 2000, according to BGADD, depending on the extent to which the city pursues annexation in the future. In the past, the city pursued annexation of other adjacent areas in order to meet land use needs. A little more than one half of all land use needs pertains to the residential category. Already the City Housing Assistance Plan (HAP), as approved by HUD, indicates that annexation would be pursued to accommodate assisted public housing. Consequently, it is possible, as a result of annexation, that up to 90 percent of population growth in Franklin County between the years 1980 and 2000 could occur in the City of Frankfort with the result that up to 1,423 acres of land suitable for all categories of use would be required. It appears that the comparative cost of infrastructure improvement would be a factor in annexation.

^{1/} Preliminary unpublished population count for 1980, received by local officials from the U.S. Census, which may be adjusted.

TABLE B-2
1978 LAND USE
FRANKFORT, KENTUCKY

Category	Acreage
Residential	2,272
Commercial	260
Industrial	53
Public	1,091
Transportation	728
Utilities	18
Vacant	902

Source: Bluegrass Area Development District

It was reported by the management of the Schenley Distillery that at least 25 acres of their adjacent vacant land would have been available for industrial and commercial development and that the distillery facilities would have expanded in several more acres, had their vacant land been flood-free.

Although flood conditions pose constraints on land use in some locations within the study sections, investigation of whether potential location and intensification benefits exist, without protection plans, would not be appropriate in this pilot type study. Given significant indication that flood plain land might stand a competitive chance of producing net income benefits versus comparable flood free land, future more advanced studies may consider undertaking such an investigation depending on locally contemplated development plans, if any, at the appropriate time.

Table B-2 shows the number of acres by category of land use in Frankfort in 1978. Table B-3 indicates land use needs of the city for all categories of land use needs with and without annexation up to the year 2000. Plate B-2 shows the locations of projected land use. Table B-4 shows population projections to the year 2000 for Frankfort and Franklin county.

TABLE B-3
 LAND USE NEEDS
 FRANKFORT, KENTUCKY

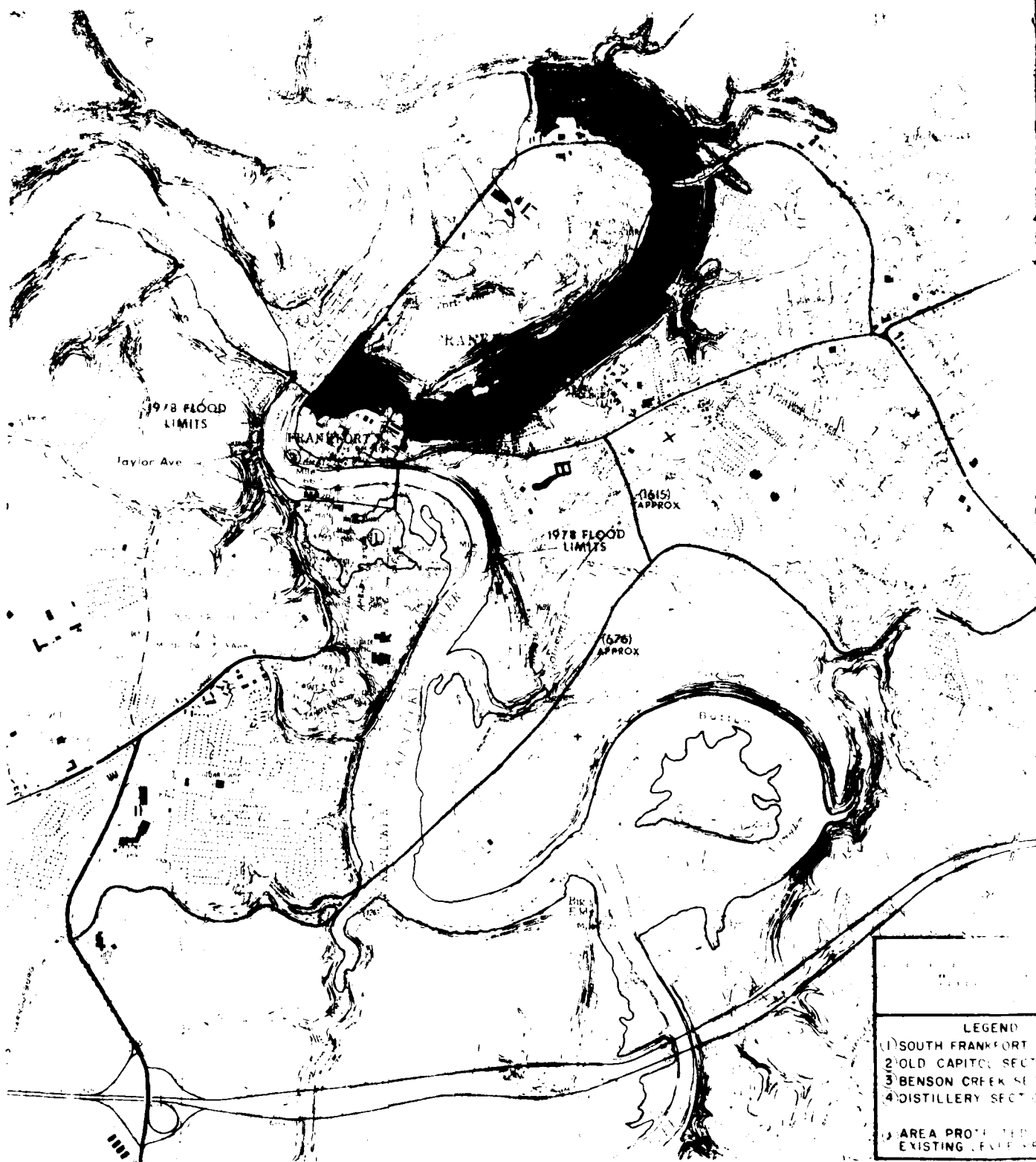
	1985 (Acres)	1990 (Acres)	1995 (Acres)	2000 (Acres)
Without Annexation	190	389	482	503
With Some Annexation	238	492	756	972
With Major Annexation	349	714	1,074	1,423

Source: BGADD, Comprehensive Plan for Frankfort - Franklin County, 1978

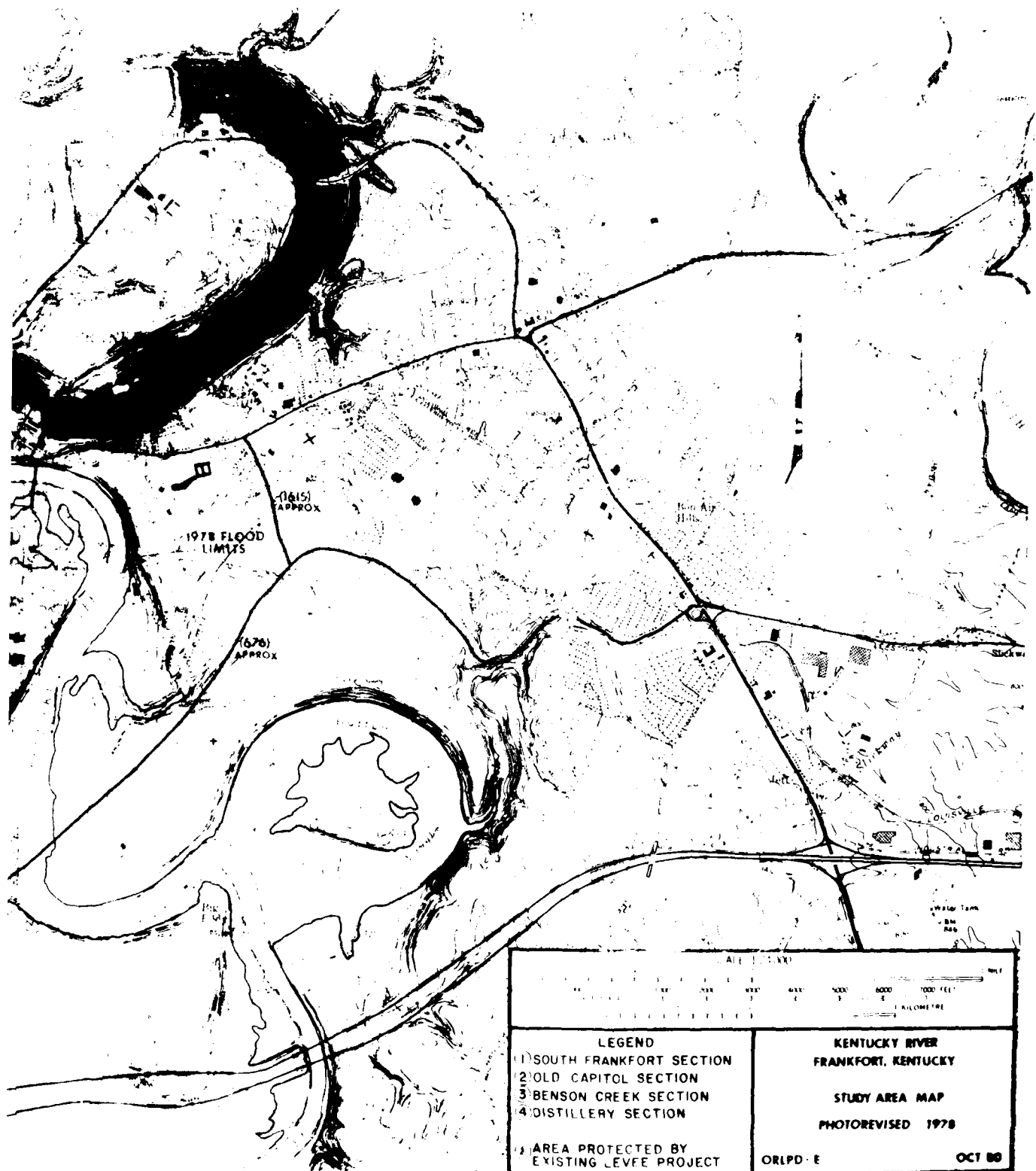
TABLE B-4
 POPULATION PROJECTIONS
 FRANKFORT - FRANKLIN COUNTY, KENTUCKY

	1985	1990	1995	2000
1. City				
a. Without Annexation	25,450	26,500	27,000	27,100
b. With Some Annexation	25,700	27,050	28,360	29,600
c. With Major Annexation	26,290	28,235	30,140	32,000
2. County	41,492	43,633	45,749	47,804

Source: BGADD, Comprehensive Plan for Frankfort - Franklin County, 1978



LEGEND
 1) SOUTH FRANKFORT SEC.
 2) OLD CAPITOL SEC.
 3) BENSON CREEK SEC.
 4) DISTILLERY SEC.
 5) AREA PROTECTED BY EXISTING LEVEE



ALL IN FEET 	
LEGEND 1 SOUTH FRANKFORT SECTION 2 OLD CAPITOL SECTION 3 BENSON CREEK SECTION 4 DISTILLERY SECTION 5 AREA PROTECTED BY EXISTING LEVEE PROJECT	KENTUCKY RIVER FRANKFORT, KENTUCKY STUDY AREA MAP PHOTOREVISED 1978 ORLPD-E OCT 80

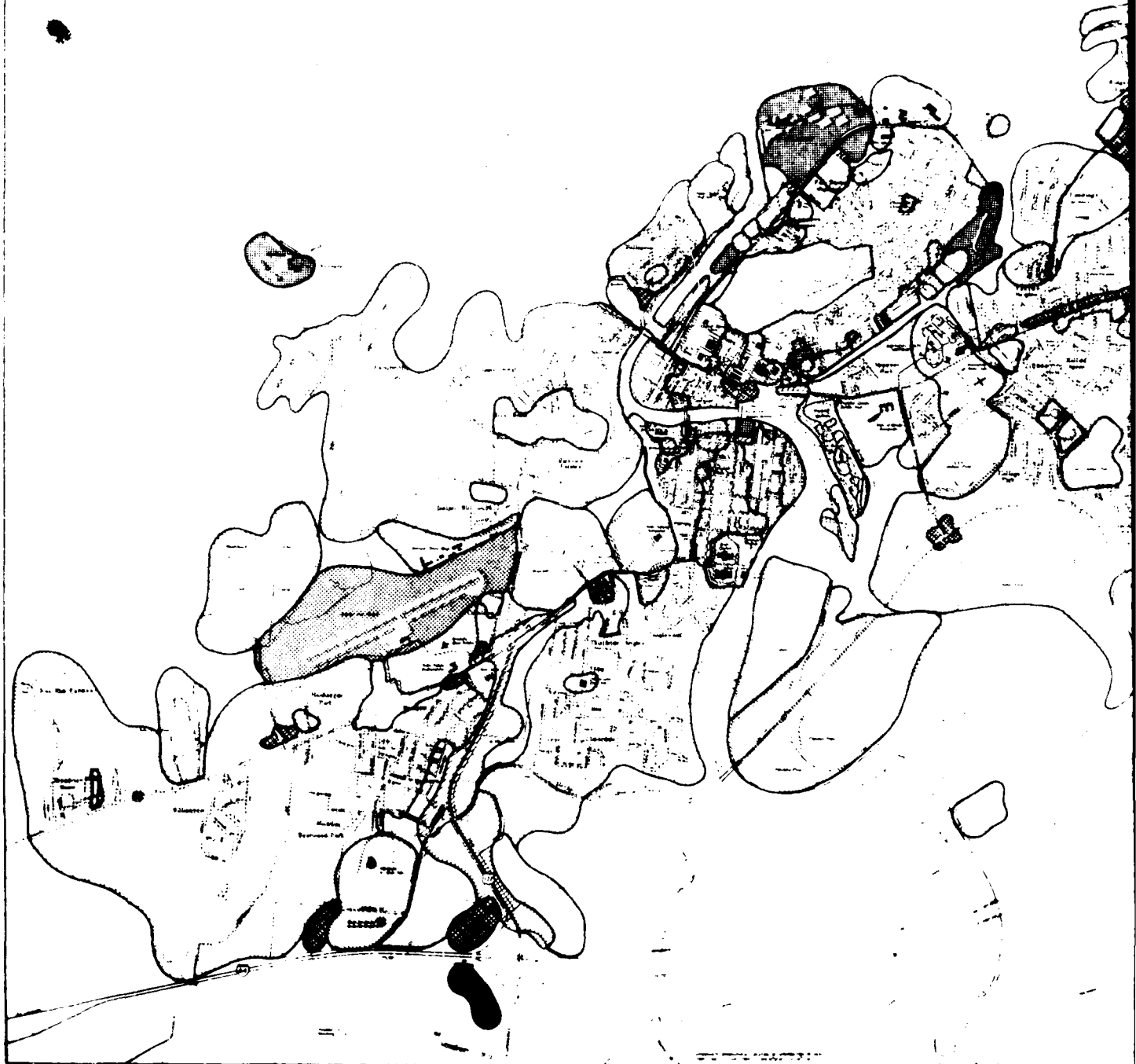
PLATE B-1

FRANKFORT

FRANKFORT URBAN AREA FUTURE LAND USE

FRANKFORT, KY
 PLANNING DEPARTMENT
 1970

- | | | | |
|--|--------------------------|--|------------------|
| | HIGH DENSITY RESIDENTIAL | | RPO |
| | MOBILE HOMES | | GENERAL BUSINESS |
| | MEDIUM DENSITY RES. | | LIMITED BUSINESS |
| | LOW DENSITY RESIDENTIAL | | INDUSTRIAL |
| | SPECIAL USE | | EXTRACTION |
| | PUBLIC | | TRANSPORTATION |
| | OPEN SPACE | | |



AREA

- GENERAL BUSINESS
- LIMITED BUSINESS
- INDUSTRIAL
- EXHAUSTION
- TRANSFORMATION



PLATE B-2

NOT TO SCALE
SEE PLATE B-1 FOR DIMENSIONS
AND PLATE B-3 FOR DETAILS
AND PLATE B-4 FOR NOTES

SECTION C

PROBLEMS AND NEEDS

As a result of the December 1978 flood, a 10-member task force on floods was appointed by the Governor of Kentucky in early 1979 to study flood problems, identify needs and make recommendations in a report to the Governor. The activity of the Task Force during the year 1979 included organizational/business sessions, public meetings, fact finding travel and communication with interested parties and State, local and Federal agencies. The public meetings offered the opportunity for flood plain dwellers, environmental groups, interested parties, the Task Force and interested agencies to air problems and to make constructive suggestions. Although the report of the Task Force was not available for release at the time of writing, an account of recommendations contemplated by the Task Force was printed in the Courier-Journal and The Louisville Times on 19 September 1979. The contemplated recommendations included the following:

1. The Kentucky River Basin be improved toward control of flooding and the Kentucky River be made a navigable route for transporting the eastern Kentucky coal to the market.
2. Federal income tax deductions be advocated and State income tax deductions be allowed by the State on the flood proofing of structures.
3. State government buildings in the flood plain be covered under the Federal Flood Insurance Program.
4. An information program be developed to assist local communities in the development of flood plain management plans.
5. The capability of the National Weather Service and the Ohio River Forecast Center to provide the public with timely and more frequent updates on river stage forecasts during periods of flooding, be increased.

6. Federal flood insurance requirements be included in the licensing examination of real estate and insurance agents, and procedures for processing flood insurance claims be simplified.

7. The State Division of Disaster and Emergency Services be transferred from the Department of Military Affairs to the Governor's office, or made a separate agency with responsibility for disaster and emergency in Franklin County in addition to its current responsibilities.

No further information was available at the time of writing as to decisions by the State Government on these or other recommendations which may have been included in the report of the Task Force.

FLOOD CHARACTERISTICS AND CONSEQUENCES

General. The Kentucky River flows in a northwesterly direction from eastern Kentucky to its confluence with the Ohio River at Carrollton, Kentucky. The stream drains a total of 6,966 square miles. The river slopes about 1.3 feet per mile in the vicinity of Frankfort and has an average channel width of 460 feet. The drainage area above Lock No. 4 at Frankfort is 5,412 square miles.

Characteristics. The threat of flooding in low lying areas of Frankfort is greatest during winter and early spring, as indicated in Table C-1. During this time, often streams are full and grounds are frozen or saturated, thus contributing to the flood threat. Cold temperatures during this time add to the suffering and cost of evacuation and repair of damages.

TABLE C-1
 FLOOD DATA
 KENTUCKY RIVER AT LOCK NO. 4, FRANKFORT, KENTUCKY

Flood Period	Number of Days above Flood Stage	Crest Stage Upper Gage	Estimated Maximum Discharge	
			cfs	Square Mile
28 December 1936 - 28 February 1937	12	47.46	115,000	21.2
29 January 1939 - 25 February 1939	5	35.6	88,800	16.4
5 February 1948 - 24 February 1948	4	35.61 1/2	88,700	16.4
26 January 1950 - 18 February 1950	6	37.84 1/2	87,000	16.1
2 March 1952 - 12 April 1952	4	33.21 1/2	76,400	14.1
21 January 1957 - 20 February 1957	4	35.46 1/2	84,200	15.6
28 February 1962 - 4 March 1962	5	40.73 1/2	94,700	17.5
10 March 1964 - 11 March 1964	2	38.71 1/2	81,300	15.0
13 April 1972 - 20 April 1972	7	42.25 1/2	101,000	18.0
12 January 1974 - 15 January 1974	4	34.46 1/2	79,100	14.6
16 March 1975 - 18 March 1975	3	35.16 1/2	78,300	14.5
8 December 1978 - 14 December 1978	6	48.47 1/2	118,000	22.0

Drainage Area - 5,412 Square Miles

Flood Stage - 31 Feet

1/ Recorder Gage, 0.9 mile upstream from Lock No. 4

The 1937 flood with a stage of 47.46 feet and a peak discharge of 115,000 cubic feet per second (cfs) was the maximum flood of record up to 1978 when the December 1978 flood registered a flood stage of 48.47 feet and a peak discharge of 118,000 cfs. The high stage of the 1937 flood was due to the largest recorded streamflow on the Kentucky River coinciding with a peak record on the Ohio River wherewith the backwater of the Ohio River had a significant effect on the Kentucky River stage in Frankfort. The 1978 flood was entirely due to headwater flooding as the Ohio River had no impact on the stage in Frankfort. The December 1978 flood occurred as a result of two rain storms falling earlier in December. The first storm (3-4 December) was fairly evenly distributed over the Kentucky River Basin with a total rainfall of 3.5 to 4 inches over most of the Commonwealth of Kentucky. The second storm (7-10 December) contributed some 9 to 10 inches of rainfall over the central part of the Kentucky River Basin. The earlier storm caused the soils to be saturated and increased streamflow above the normal base, thus creating conditions which intensified the flooding that resulted from the later storm.

The December 1978 flood was a fast rising flood which did not conform to the usual expectations as it reached its record peak in about two days after the first forecast and about 42 hours after reaching flood stage. Usually, it takes the Kentucky River several days after the first flood forecast to reach the crest stage during the rarer events. A hydrograph of the December 1978 flood is shown graphically on Figure C-1.

EXISTING PROTECTION

A local protection project was completed by the Louisville District in 1970. The project protects an area of 2,224 acres of urban and suburban lands in the Jones Run, Thornhill, and Old Capitol areas of Frankfort (see Plate B-1). The project consists of 3,300 feet of levee structure with an average height of 28 feet, 700 feet of concrete wall, two pumping plants, four closures and a grout curtain. Upon completion,

the project was assigned to local interests in March 1971. Although this project contributes to damage prevention substantially, flood problems still exist in the study sections of the city.

FLOOD WARNING AND EVACUATION

The 1978 flood rose too fast to allow sufficient time for moving or elevating all movable property. Further, it was found that some flood plain dwellers heard an early NWS forecast, but did not keep up with the updates. Some kept up with the NWS information but could not fully relate it to their location, and some were not aware of the NWS forecasts early enough to prepare adequately for evacuation. As a result, damage to personal property was extensive. However, on the whole, the affected population acted and cooperated with public authorities to avoid loss of life and injury. No casualties were reported and minor injuries were minimal, although emotional distress was frequent.

Towards improving the flood warning system, the evacuation plan of the City of Frankfort, which was being prepared by the Louisville District at the time of writing, includes the following improvements:

1. Identification of an emergency operations center staff and basic duties of each staff member.
2. Establishment of a schedule of activity denoting appropriate measures and responses relative to existing and predicted river stages and the affected locations in the flood plain.
3. Designation of evacuation centers for displaced flood plain residents and evacuation routes.
4. Preparation for the remote eventuality that the existing flood protection project is overtopped.
5. Enforcement procedure by designated city, county and State personnel.
6. Implementation under city initiative.

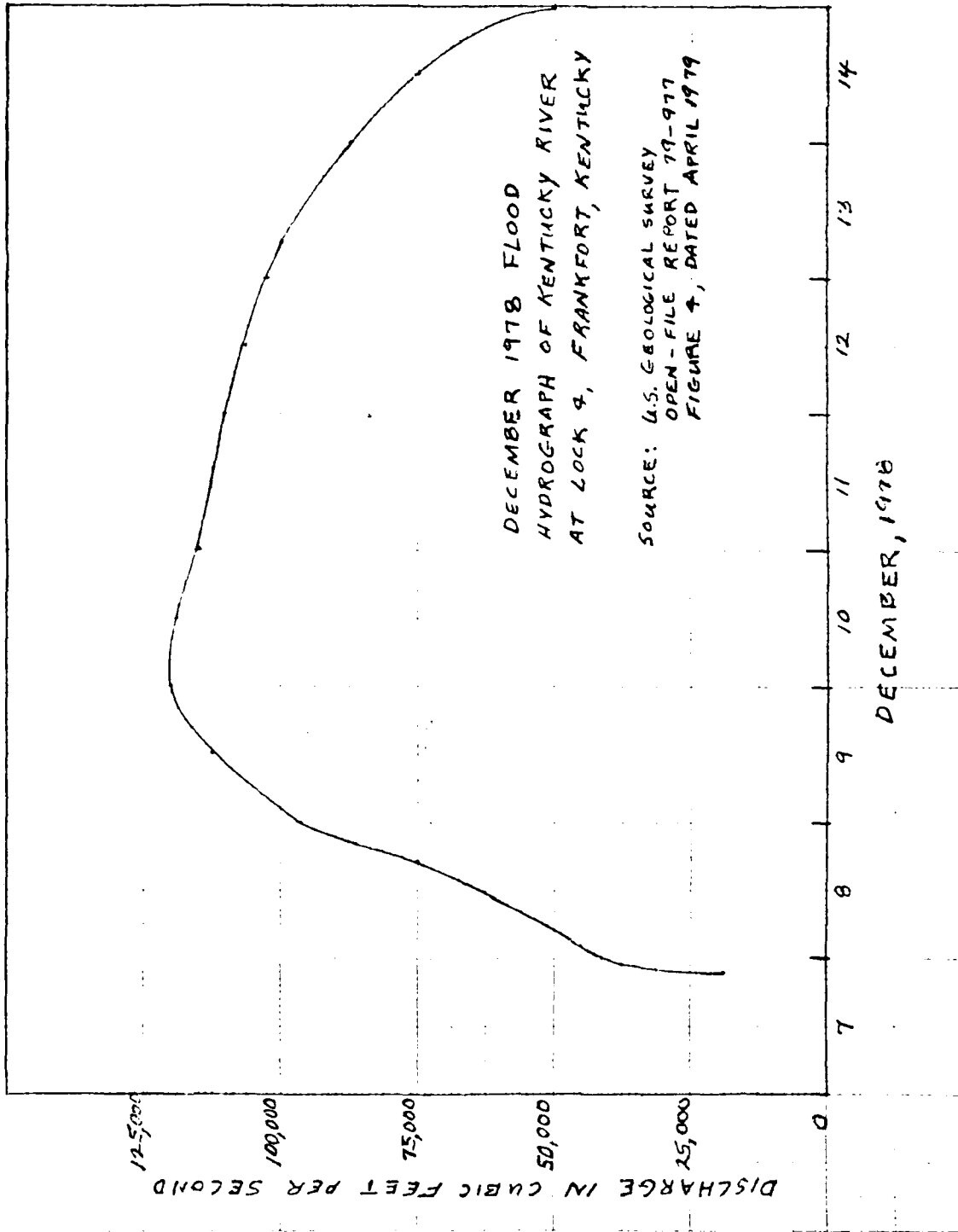


FIGURE C-1

SECTION D
METHODOLOGY

INTRODUCTION

The main purpose of this section is to introduce the methods and procedures employed in deriving emergency costs. Various other costs, some of a non-traditional nature, are also identified and/or derived in this section.

EMERGENCY COST

Estimates of emergency cost are given in Table D-1. This table presents estimates under five general headings representing component cost items, expressed in 1978 and 1980 price levels. Cost estimates in this table were obtained from public agencies and nonprofit organizations involved with emergency work in Frankfort or were derived from partial or statewide data. Items which were derived are those listed under Evacuation-Transition-Reoccupation and Administrative Cost of Emergency. Estimates of all other items in this table, gathered directly during the survey, are of a self-explanatory nature.

EVACUATION-TRANSITION-REOCCUPATION COST

This is an emergency cost item of \$1,148,000 as shown in Table D-1. Derivation of this amount is described in the following paragraphs and a breakdown of its components is shown in Table D-2.

About 640 households lived away from home for an average of two months beyond the month of December 1978. It was estimated that an average of 1.9 hours per household were spent daily by adult persons for additional work in contracting for, supervising, and inspecting damage repair as well as attending to necessary maintenance. Further, each household spent an estimated average of 14 hours weekly in additional time in order to replace damaged personal property, drive children to school because of bus line change, drive longer to and from work and in

TABLE D-1

DECEMBER 1978 FLOOD EMERGENCY COSTS
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Cost Item	Costs in \$1,000	
	1978 Values	1980 Values
<u>Protection of Life, Health and Property</u>		
Kentucky National Guard	99	123
Curfew Enforcement	20	25
Police Protection	16	19
Consumer Health Protection	17	20
Ambulance Service	10	13
Subtotal	162	200
<u>Evacuation, Transition and Reoccupation</u>		
Cost to Flood Victims	1,148	1,440
<u>Emergency and Mass Care</u>		
Blankets, Clothes, etc.	128	161
Red Cross	311	390
Salvation Army	209	263
Mennonite Disaster Service	80	101
Bluegrass Community Action	34	43
Food	105	132
Subtotal	867	1,090
<u>Emergency Preparedness</u>	200	250
<u>Administrative Cost of Emergency</u>	2,911	3,660
TOTAL EMERGENCY COSTS	5,228	6,640

TABLE D-2

EVACUATION-TRANSITION-REOCCUPATION COST TO FLOOD VICTIMS
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Emergency Related Activity	Number of Entities Engaging in Activity	Unit of Activity	Cost Per Unit	Number of		Average Duration of Activity (Days)	Number of Hours Per Week	Average Duration of Activity (Weeks)	Total Cost
				Activity Units Per Day	Activity Per Week				
Work Related ¹	640	Hour	\$4.00		4.9	8.5		8.5	\$106,624
School	640	Hour	1.42		1.4	8.5		8.5	10,814
Secondary Household	640	Hour	2.00		4.2	8.5		8.5	45,696
Leisure	640	Hour	4.00		3.5	8.5		8.5	76,160
Work	640	Hour	8.00	1.9		60			583,680
Vehicle Use	640	Mile	.20	35		60			268,800
Grant Application	537	Grant	25.00						13,425
Subsidized Loan Application	697	Loan	25.00						17,425
Commercial Loan Application	22	Loan	350.00						7,700
Tax Amendment	719	Claim	25.00						17,975
								Total	\$1,148,299

pursuing secondary household activity and leisure activity, due to change of location. In order to determine the value of these activities a methodology on value of time ^{1/}, the average hourly wage, and the minimum wage was used. The 14 hours weekly in additional time per household were apportioned into 35 percent for work related activity (4.9 hours), 10 percent for school activity (1.4 hours), 30 percent for secondary household activity (4.2 hours), and 25 percent for leisure activity (3.5 hours), according to the time value methodology ^{2/}. Value of various activities per hour were assessed as follows:

<u>Activity</u>	<u>Time Value Per Hour</u> ^{3/}
Work related	One half of the average hourly wage
School	One half of the minimum wage
Secondary household	Two dollars per hour
Leisure	The average hourly wage
Work	The average hourly wage

The minimum wage in 1979 was \$2.85. The average hourly wage was determined as follows. Since traditionally about one-third of the labor force in Frankfort worked part time, the average work week for all part time and full time workers was about 81.5 percent of full time as derived from the 1970 Census.^{4/} The average full time work week is about 34.5 work hours, based on 1,800 hours annually divided by 52 weeks, and the average work week is approximately 28 hours (34.5 x .815). The average weekly earning in 1979 was \$225 as reported by the State Bureau of Manpower Services. The average hourly wage is therefore about \$8 ($\$225 \div 28$).

^{1/} Source: Social Impact Assessment Manual, p.p. 147.01-147.09, ILDOT, 1980.
^{2/} *ibid.*
^{3/} *ibid.*
^{4/} U. S. Census, PC(1)-C19, Ky, 1970, page 357.

Flood victims used their vehicles in the above activities and in connection with applying for disaster relief, subsidized loans and/or commercial loans, and Federal income tax amendment claims^{1/} for damage-related funds. Additional driving for these purposes is estimated to average 35 miles daily per household. The cost of applying for disaster relief, loans, and tax refunds was estimated on the basis of known transactions.

ADMINISTRATIVE COST OF EMERGENCY

This cost of \$2,911,000 in Table D-1 was derived from data and cost estimates obtained from the Small Business Administration (SBA), the Disaster Field Office (DFO) of FEMA, Housing and Urban Development (HUD), the State Division of Emergency and Disaster Services (DESD), and several other Federal, State and local agencies. Table D-3 presents a breakdown of this cost.

SBA. The administrative cost to the SBA of \$384,755, line 1, Table D-3, was derived as follows. The portion of SBA activity in Frankfort was 35 percent of its activity within Kentucky based on 199 loans in Frankfort divided by 571 loans in Kentucky. The estimate of loan processing cost in employee salaries to SBA in Kentucky, relative to the 1978 flood only, was \$305,000 as obtained from the SBA District Office in Louisville. By estimating a general overhead to employee salary ratio of 1.36 as used in the Louisville District plus an estimated .5 ratio for regional and central overhead, the overhead cost of \$567,300 was derived. Travel expenses were \$227,000 as estimated by the SBA District Office in Louisville. The portion of loan processing cost applicable to Frankfort is 35 percent, or \$384,755 (\$1,099,300 total in Ky. x 35 percent in Frankfort = \$384,755).

Further, the cost of \$165,000, line 2, Table D-3, was derived on the basis of information obtained from the SBA regional office in

^{1/} In a declared disaster, flood victims are entitled to amend their tax returns for refund.

TABLE D-3

ADMINISTRATIVE COST OF EMERGENCY
KENTUCKY RIVER, FRANKFORT, KENTUCKY

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
	Employee Salary	General Overhead 1.36 ratio	Regional/Central Overhead .5 ratio	Travel	Other Expenses	Total In Kentucky	Percent In Frankfort	Total In Frankfort
1. SBA (Disaster Loans -1979)	\$ 305,000	\$ 414,800	\$152,500	\$227,000	\$	\$1,099,300	35	\$ 364,755
2. SBA (Loan Servicing Cost)	6,480	8,813	3,240				100	165,000 ^{1/}
3. FEMA (Temporary Housing)	1,097,000	1,492,000	548,500	211,433	162,000	3,510,933	37	1,299,045
4. Agencies Loaning Employees to FEMA for Temporary Housing	319,000	433,840	159,500	61,470		973,810	37	360,310
5. HUD (Disaster Housing Rehabilitation)	5,000	6,800	2,500		150,000	164,300	100	164,300
6. State DESD	141,978	193,000			14,198	349,266	50	174,632
7. Other Agency Activities - Kentucky ^{2/}	53,645	72,957	26,822	6,646	117,000	277,070	42	116,369
8. Other Agency Activities - Frankfort ^{3/}	23,424	31,856					100	55,280
9. Grant Review and Auditing					191,635 ^{4/}		100	191,635
Total								\$2,911,325

^{1/} Present worth of \$18,533 annually over 15 years at 7.375% interest rate

^{2/} IRS, SSA, VA, MMS, EPA, FHigway A, USCE, State TFF, HEW

^{3/} Comprehensive Care Center, USDL, USDA

^{4/} See breakdown in narrative

Atlanta as follows: A journeyman, GS-12, (\$27,000), would service about 1,000 loans annually. By dividing 199 loans in Frankfort by 1,000 and multiplying by \$27,000, the journeyman's one-year servicing cost of \$5,400 was obtained. For legal servicing, an attorney, GS-12 (\$27,000) services about 5,000 existing loans annually, or five times the loans serviced by a journeyman. Thus the legal cost of loan servicing would be one-fifth of the journeyman's cost, or \$1,080. The one-year employee salary payments for loan servicing is \$6,480 and the overhead cost relative to \$6,480 is \$12,053. Thus, the total one-year loan servicing cost is \$18,533 and the present worth of \$18,533 over the average loan period of 15 years at the Federal interest rate of 7.375 is \$165,000 which is the amount under column H, line 2, Table D-3.

The SBA is empowered to and makes local disaster declarations, under its own jurisdiction, and provides low interest home repair and business repair loans concerning floods which are not subject to a Presidential declaration.

FEMA. The administrative cost of temporary housing (TH) of \$1,299,045 to FEMA, line 3, Table D-3, was estimated on the basis of statewide data and partial data as follows. The expenditure in regular salary payments to FEMA employees and overtime payments to employees borrowed by FEMA from other agencies, for phases 1 and 2 of the FH program in Kentucky, was \$1,097,000 as obtained from the DFO budget outline and verified by the FEMA regional TH Office in Atlanta. Travel expenses were \$211,433 as obtained from the same source. The overhead cost to FEMA was estimated at \$2,040,500 based on the method used in deriving the SBA administrative cost above. In addition, FEMA spent \$162,000 in management and appraisal services. The total FEMA administrative cost in Kentucky is \$3,501,933, of which 37 percent, or \$1,299,045, is applicable to Frankfort, based on 200 households receiving TH in Frankfort out of 540 such recipients in Kentucky ($200 \div 540 = .37$).

Agencies Loaning Employees to FEMA. The cost of \$360,310 on line 4, Table D-3, was incurred by other agencies in connection with TH. Regular salary payments of \$319,000 were paid by several agencies

loaning their employees to FEMA to assist in TH, as obtained from the FEMA Disaster Field Office (DFO) in Frankfort. The overhead cost to these agencies was estimated at \$593,340 according to the method used above. Since these employees left their home agencies on travel vouchers, a travel expense of \$61,470 was estimated based on 19 percent of employee salaries which is the same ratio of travel expense to employee salary on line 3 as obtained from the DFO. The total administrative cost to these agencies in Kentucky is \$973,810, of which 37 percent, \$360,310, is applicable to Frankfort on the same basis as under FEMA above.

Administrative Cost to Other Agencies. The cost on line 5, Table D-3, consists of \$150,000 administrative cost within a Disaster Housing Rehabilitation (DHR) grant by HUD to the city of Frankfort, and \$14,300 payroll-overhead cost consisting of estimated \$5,000 employee salary cost to HUD and \$9,300 for overhead derived the same way as discussed above.

The cost on line 6, Table D-3, was derived from estimates of employee salaries of \$141,978 and other expenses obtained from the State Disaster and Emergency Services Division (DESD). The general overhead cost of \$193,090 was derived the same way as above, but there is no regional-central overhead in this item because DESD is a State agency located in the State capitol. The cost of \$14,198 under Column E represents estimates of other expenses including travel. The cost applicable to Frankfort, \$174,632 under Column H, is 50 percent of the total in Kentucky, Column F, because about one-half of all FEMA grants relative to IFGP, LHR, and public assistance in the State was spent in Frankfort (\$4,404,000) grants in Frankfort \div \$8,810,000 in Kentucky = 50 percent). DESD was the disbursing officer of these grants on behalf of FEMA.

The cost on line 7, Table D-3, was derived the same way from estimates of employee salaries, travel expenses, and other expenses obtained from several Federal agencies which engaged in disaster relief activities in Kentucky and from estimates of reconnaissance and fact-finding work of the State Task Force on Floods (TFF). The amount of

\$117,000, under Column E, consists of \$70,000 given by FEMA to the Environmental Protection Agency (\$10,000), the Federal Highway Administration (\$20,000), and the U.S. Army Corps of Engineers (\$40,000) for emergency reconnaissance work during the flood and \$47,000 estimated for the work of TFF in the State. The amount of \$116,369 under Column H, total in Frankfort, is about 42 percent of the total in Kentucky because 42 percent of known Federal grants except those for disaster food stamp and disaster unemployment compensation, were made in Frankfort ($\$5,725,000$ all disaster grants in Frankfort \div $\$13,501,000$ all disaster grants in Kentucky = 42 percent).

The cost on line 8, Table D-3, consists of estimates of employee salaries and general overhead derived the same way on the basis of information obtained from agencies which engaged in disaster relief activities exclusively in Frankfort.

Grant Application, Review and Auditing Cost. All requests for Federal disaster relief were submitted on application forms with supporting information such as damage inventories. All grant applications were processed by the State DESD and the administrative cost to this agency appears on line 6 of Table D-3. Yet grant applications were further reviewed by the State Bureau of Social Insurance and by interested Federal agencies, especially the granting agencies. Further, grants were subject to auditing by the State Audit Office and the granting Federal agencies. Information on grant application, review and auditing cost to the State, other than the DESD cost, was obtained from State sources, but no information could be obtained from Federal sources. It was assumed that the review and auditing cost to State agencies other than the DESD approximates that of the Federal counterpart, with adjustment of overhead. The amount of \$191,635 on line 9, Table D-3, represents grant application, review and auditing cost to the State and Federal agencies. Based on data obtained from the State Bureau of Social Insurance, a cost of \$8,264, to the State in employee salaries for reviewing grants to individuals was estimated and an overhead cost of \$11,239 was derived (1.36 times employee salaries). Since this review effort assumably approximates final review by granting agencies, an equal amount in employee salaries, \$8,264, was estimated

for review by Federal agencies and an overhead cost of \$15,371 was derived (1.86 times employee salaries). The review cost of grants to individuals is therefore \$43,138. For grants to public agencies, a cost of \$5,000 was estimated for application preparation and followup (\$100 per application) and grant review (\$100 per grant) relative to 25 grants (19 original requests plus six supplements). The application and review is therefore \$48,138.

According to the State Audit Office, a cost of \$27,506 to the State was incurred in employee salaries for grant auditing relative to 19 agencies receiving Federal grants, plus a 10 percent sample of grants (63 grant sample) to individuals. The average cost in employee salaries per public assistance grant was \$850 and the average cost per grant to individuals was \$180 ($19 \times 850 + 63 \times 180 = \$27,490$). The overhead cost was \$37,386 and the auditing cost to the State is therefore \$64,876 ($\$27,490 + \$37,386$). Since this auditing effort assumably approximates final auditing by granting agencies, an equal amount in employee salaries, \$27,490, was estimated for auditing by Federal agencies and an overhead cost of \$51,131 was derived. The auditing cost is therefore \$143,497. The total review and auditing cost is \$191,635 ($\$48,138 + \$143,497$).

DERIVATION OF OTHER COST COMPONENT ITEMS

Other costs considered include (1) traffic diversion cost derived from partial data obtained separately; (2) estimates of supervision, inspection and administration (SIA) cost of damage repair to public and certain corporate entities; (3) continued fixed cost of damaged residential property; (4) value of unusable space within reoccupied property under substantial repair; and (5) administrative cost of national flood insurance.

Traffic Diversion Cost. Derivation of this cost is based on the following criteria:

1. An average daily traffic count of vehicles crossing the three river bridges under normal conditions.

2. An estimate of the average number of passengers per vehicle.
3. Percent of traffic per trip purpose and value of motorist time relative to the purpose.
4. An estimate of the portion of traffic which would use an alternate route, with an estimated time impedance of 20 minutes during the flood and 10 minutes during the closure of Taylor Avenue for 21 days after the flood.
5. Estimates of the average hourly wage and the minimum hourly wage.
6. An assumption that work trips remained at the volume of normal conditions during the flood, since increase in emergency traffic assumably offset decrease in work trips and since business activity outside the flooded areas was considered to be normal.

Traffic count on two bridges was obtained from the Kentucky Department of Transportation (KYDOT) and the traffic on one bridge was estimated. Average daily traffic on the three bridges under normal conditions was 34,455 trips. The average number of passengers per vehicle was obtained from KYDOT. Percent of traffic per trip purpose and value of motorist time relative to the purpose was determined according to a methodology developed by the Illinois Department of Transportation (ILDOT). The detoured traffic on alternate routes was approximated from a methodology presented in Highway Research Record No. 114, Highway Research Board, Washington, D.C., 1966. The minimum wage was \$2.85 in December 1978 and the average hourly wage was estimated at \$8 as derived above in this section. It was determined that nonwork trips using alternate routes were reduced to 24 percent during the flood and 45 percent during the closure of Taylor Avenue, based on the respective time impedance. Work trips in the general market area and the immediately adjacent area were assumed to be normal during bridge and road closures because no damage was counted in these areas. Tables D-4 through D-7 give estimates of traffic diversion cost during the flood. Value of

TABLE D-4

TRAFFIC DIVERSION - TIME VALUE (9-15 DECEMBER 1978)
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Trip Purpose	Percent of All Trips 1/	Average Daily Trips - Normal Conditions 2/	Percent Under Flood Condition 3/	Average Daily Trips - Flood Conditions	Average Time		Passengers Per Vehicle 4/	Number of Days	Total Time Value
					Per Trip (Hours)	Per Hour 1/			
Work Related	35	12,059	100	12,059	.33	\$4.00	1.35	7	\$150,873
School	10	3,446	24	827	.33	1.43	1.35	5	2,634
Secondary Household	30	10,336	24	2,481	.33	2.00	1.35	7	15,474
Leisure	25	8,614	24	2,067	.33	4.00 5/	1.35	7	25,784
Total									\$194,765

- 1/ Based on a methodology developed by the Illinois Department of Transportation (ILDOT).
- 2/ Based on traffic count under normal conditions obtained from the Kentucky Department of Transportation (KYDOT).
- 3/ Estimated on the basis of a methodology for traffic under impedance in Highway Research Record No. 114, Highway Research Board, 1966.
- 4/ Estimated by KYDOT.
- 5/ Estimated 50 percent of the average hourly wage.

TABLE D-5
 TRAFFIC DIVERSION - VEHICLE COST (9-15 DECEMBER 1978)
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Trip Purpose	Average Daily Trips Flood Conditions	Days	Total Trips	Mileage at 10 Miles per Trip	Cost per Mile	Total Cost
Work Related	12,059	7	84,413	844,130	\$.20	\$168,826
School	827	5	4,135	41,350	.20	8,270
Secondary Household	2,481	7	17,367	173,670	.20	34,734
Leisure	2,067	7	14,469	144,690	.20	28,938
TOTAL						\$240,768

TABLE D-6

TRAFFIC DIVERSION - TIME VALUE ^{1/}
 TAYLOR AVENUE (16 DECEMBER 1978 - 5 JANUARY 1979)
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Trip Purpose	Percent of all Trips	Average Daily Trips - Normal Conditions	Percent Trips Under Flood Conditions	Average Time per Trip (hour)	Time Value per Hour	Passengers per Vehicle	Number of Days	Total Time Value
Work Related	35	3,306	100	.17	\$4.00	1.35	21	\$63,733
School	10	944	100	.17	1.43	1.35	15	4,647
Secondary Household	30	2,834	45	.17	2.00	1.35	21	12,290
Leisure	25	2,361	45	.17	4.00	1.35	21	<u>20,473</u>
TOTAL								\$101,143

^{1/} Derived the same way as in Table D-4

TABLE D-7

TRAFFIC DIVERSION - VEHICLE COST
 TAYLOR AVENUE (16 DECEMBER 1978 - 5 JANUARY 1979)
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Trip Purpose	Average Daily Trips - Flood Related Conditions	Days	Total Trips	Mileage		Cost Per Mile	Total Cost
				at 4 Miles Per Trip			
Work Related	3,306	21	69,426	277,704		\$.20	\$55,540
School	944	15	14,160	56,640		.20	11,328
Secondary Household	1,275	21	26,775	107,100		.20	21,420
Leisure	1,062	21	22,302	89,208		.20	17,842
TOTAL							\$106,130

motorist time of \$194,765 is given in Table D-4 and vehicle cost of \$240,768 is given in Table D-5. Cost of traffic diversion relative to Taylor Avenue is \$207,273, consisting of \$101,143 from Tables D-6 and \$106,130 from Table D-7. Total traffic diversion cost for the flood is \$642,802. See the Appendix for deriving traffic diversion cost per household per day in other urban studies in the absence of traffic count.

Supervision, Inspection and Administration (SIA) Cost. It was found that public agencies estimated their physical damage without including the SIA cost of damage repair. An inquiry concerning SIA costs within the Districts of ORD revealed that the SIA cost is about 10 percent. Therefore, 10 percent was added to the physical damage estimates of public agencies. Since a few large businesses also incur SIA costs, 10 percent was added to their physical damage estimates also. No SIA cost was considered for physical damages incurred by small businesses or residential property owners.

Continued Fixed Cost of Damaged Property. An estimate of the mortgage equivalent of structure value of damaged residential property was added to the damage estimates of displaced homeowners who temporarily lived away from home. Damage estimates of displaced homeowners who lived in a mobile home provided by the Government were increased by the difference between the fair market rent of the mobile home and the mortgage equivalent of structure value of the damaged residence. Also, the cost of utilities consumed in the damaged property was estimated and added to damage estimates. The continued fixed cost and cost of utilities thus incurred were estimated within the residential survey on the basis of information given by realtors and affected flood victims. Generally, the mortgage equivalent of structure value was estimated at the rate of 1 percent of value per month. Utility cost was that given by property owners.

Cost of Unusable Space. Estimates of unusable space were included in the survey on the basis of unusable square footage awaiting repair and the mortgage equivalent of structure value as used in the continued fixed cost above.

Administrative Cost of Flood Insurance. The administrative cost per policy in force per year was \$29, as obtained from the FIA. Therefore, \$29 per insurable property was counted according to the procedures of the WRC. Estimates of this cost are presented in Table E-11.

Nationwide, the net loss to the FIA in FY 1979 was \$166,992,000 and the policies in force were 1,605,000.^{1/} Some \$71 per policy in force of this net loss represents cost of studies and surveys.^{2/} This appears to be an investment cost which is not specified in the procedures of the WRC as administrative cost; therefore, it was not counted. See impact of flood insurance in the Appendix.

IDENTIFICATION OF OTHER COST ITEMS

Loss of Employee Wages. This item consists of losses by public and private employers from payment to their employees who did not work because of the flood and were not required to make up for lost time.

Increased Living Expenses. This item includes increased costs of eating out, laundering, caring for children and pets, and other miscellaneous expenses incurred by residents while displaced from their homes. Direct interviews and other contacts enabled the obtainment of estimates of this item during the course of conversations.

Income Loss. This is income (e.g., profit, salary or rent) which would have been earned by business, transportation carriers, utilities, and labor, had the flood not occurred. Income loss as used herein is based largely on the survey.

^{1/} See Appendix.
^{2/} *ibid.*

Temporary Closing and Reopening Cost. This cost includes extraordinary expenses incurred by businesses that temporarily closed (in some cases moved to other locations) and special advertising and other expenses prior to reopening. These cost estimates were based on the survey.

SECTION E
FLOOD DAMAGE ANALYSIS

INTRODUCTION

This section includes analysis of physical flood damages and non-physical damages such as income loss, additional living expenses, fixed costs, transportation disruption costs, emergency costs, and flood insurance administrative costs. Many of the nonphysical damage items are nontraditional and have not been evaluated previously. Section D and the following paragraphs describe and illustrate the evaluation methods and sources used.

DESCRIPTION OF STUDY AREA

For purposes of this study, the flood prone areas of Frankfort were divided into four study sections. These sections are shown on a map of the area (Plate B-1) and are described briefly as follows.

South Frankfort Section. This section includes properties north of the State capital, west and south of the Kentucky River, and along Taylor Avenue.

Old Capitol Section. This section includes properties north of and adjacent to the Kentucky River outside the protection of the existing floodwall.

Benson Creek Section. This section includes properties north of Benson Creek and west of the Kentucky River.

Distillery Section. This section includes distillery, commercial, and other properties east of the Kentucky River along U. S. Highway 421 downstream and in the vicinity of Lock and Dam No. 4.

PHYSICAL FLOOD DAMAGES

The following paragraphs proceed from discussions of December 1978 flood damage estimates to determination of average annual physical flood losses. The procedures used in discounting and developing average annual equivalent values are discussed where appropriate.

Physical Flood Damage Curves. Estimates of physical losses resulting from the December 1978 flood were obtained largely from comprehensive survey interviews conducted in 1979 and 1980. Damage data were gathered for virtually all of the affected residential, commercial, public, transportation, and utility properties. Estimates were also obtained for flood heights 2 feet lower and 3 feet higher than the December 1978 flood. Table E-1 shows unit, value, and physical damage estimates summarized from data obtained during the survey. Damage estimates were summed by flood heights and zero damage stages were determined and related to the upper gaging station at Lock and Dam No. 4 to derive stage-physical damage curves for the various study sections and property categories. These categories are described in the following paragraphs.

Residential. This category consists of single-family residential units and units that were formerly single family units but are now being partially or wholly rented. Multi-unit apartment buildings built solely for that use are included in the commercial category. Flood damages and losses to the residential category include physical damage to structural items such as foundations, walls, floors, heating plants, and auxiliary buildings, and damages to driveways, walks, and grounds. Damages to contents such as appliances, furniture and personal items and damages to vehicles and clean up costs were also included. It should be noted that due to the nature of the December 1978 flood, most residential contents were not moved and were damaged extensively.

TABLE E-1

UNIT, VALUE AND PHYSICAL DAMAGES FROM RECURRENCE
OF SPECIFIC FLOOD HEIGHTS
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section and Property Category	Number of Units ^{1/}	Property Value ^{1/} ^{2/} in \$1,000	Physical Damages in \$1,000 ^{2/} for Specific Flood Heights		
			1978 -2ft.	Dec 1978	1978 +3 ft.
<u>South Frankfort Section</u>					
Residential	470	41,804	8,727	11,041	16,113
Commercial	49	17,257	2,028	2,843	4,446
Public	22	36,258	2,945	6,596	10,688
Transportation	--	4,022	125	172	343
Utilities	--	7,052	815	1,554	2,698
Subtotal		106,393	14,640	22,206	34,288
<u>Old Capitol Section</u>					
Residential	36	4,994	264	444	704
Commercial	11	7,196	156	197	390
Public	10	27,367	1,260	2,138	5,355
Transportation	--	1,508	29	53	81
Utilities	--	1,194	178	277	348
Subtotal		42,259	1,887	3,109	6,878
<u>Benson Creek Section</u>					
Residential	134	9,583	1,562	2,588	4,034
Commercial	8	1,043	327	397	630
Public	3	10,360	108	199	316
Transportation	--	1,508	27	45	70
Utilities	--	2,011	268	427	570
Subtotal		24,505	2,292	3,656	5,620
<u>Distillery Section</u>					
Commercial	11	15,828	2,450	3,440	5,293
Public	1	7,039	163	363	829
Transportation	--	2,640	24	46	77
Utilities	--	1,659	124	250	295
Subtotal		27,166	2,761	4,099	6,494
TOTAL ALL SECTIONS		200,323	21,580	33,070	53,280

^{1/} Within December 1978 flood plain.

^{2/} October 1980 values and 1978 development, includes estimate for lots, structures, and contents, where applicable.

The survey-obtained estimates for residential properties physically damaged by the December 1978 flood were analyzed by flooding depth versus damages for major structure types and their contents to derive the depth-percent damage factors shown in Table E-2. These factors and damage estimates in Table E-1 were used to derive the physical damage curves shown as curve numbers 1 and 2 on Figures E-1, E-2 and E-3 for South Frankfort, Old Capitol, and Benson Creek Sections, respectively. Curve number 1 consists of physical damages to contents and is subsequently used in evaluation of affluence-related increases in damages.

Commercial. This category includes wholesale, retail, service, rental, and other properties aggregated to avoid disclosure of data on individual establishments. Flood losses evaluated consist of physical damages to structures, grounds, merchandise, equipment and products. Clean-up costs were also included as physical damages. Figures E-4 through E-7 include physical damage curves, shown as Curve Number 1, for commercial properties subject to flooding in South Frankfort, Old Capitol, Benson Creek, and Distillery Sections, respectively.

Public. This category includes school, religious, government, and civic properties. Losses considered include physical damages to structures and contents and costs of clean-up. Curve Number 1 of Figures E-8 through E-11 shows physical damages to public properties within the four study sections.

Transportation. This category includes physical damages to roads and facilities and clean-up costs. Curve number 1 of Figures E-12 through E-15 shows physical transportation damage curves for the four study sections.

Utilities. This category consists of an evaluation of physical damages to electrical, telephone, gas, water, and sewage lines and facilities. Curve Number 1 of Figures E-16 through E-19 shows utility physical damage curves for the four study sections.

TABLE E-2

DAMAGES BY FLOODING DEPTH TO RESIDENTIAL PROPERTY
AS PERCENT OF STRUCTURE AND CONTENT VALUES 1/
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Flood Depth in Feet	Percent Damage 1-1/2 & 2 Stories				Percent Damage 1 Story			
	Structure		Contents		Structure		Contents	
	With Basement	Without Basement	With Basement	Without Basement	With Basement	Without Basement	With Basement	Without Basement
20	60	56	77	80	55	50	81	83
16	55	52	72	75	55	50	81	83
15	52	50	70	73	55	50	81	83
14	50	48	69	72	55	50	81	83
13	48	46	68	70	55	50	81	83
12	45	43	64	66	54	49	81	83
11	42	40	58	60	53	48	81	83
10	40	38	52	53	51	47	81	83
9	38	37	49	50	49	46	80	82
8	35	34	47	48	47	44	79	81
7	32	30	45	47	45	42	78	80
6	29	27	44	46	42	39	76	78
5	27	25	42	43	38	36	71	73
4	24	22	37	40	35	33	65	67
3	20	18	32	35	30	28	57	58
2	16	15	28	30	26	25	47	48
1	14	13	19	15	23	22	38	25
0	11	4	14	3	10	4	20	4
7	8	1	12	0	7	2	13	0
6	7	0	11		6	0	12	
5	6		9		5		10	
4	5		7		4		8	
3	4		5		4		5	
2	3		3		3		3	
1	2		1		2		2	
0	0		0		0		0	

1/ Based on survey of December 1978 Flood

Present Average Annual Physical Damages. Present average annual damages (AAD) were evaluated based on present flow conditions. Present flows refer to runoff from the Kentucky River Drainage area with 1978 land use. Future changes in drainage area land use are not considered to significantly affect flows and were not hydrologically evaluated.

AAD were computed by relating incremental stage-physical damage data from appropriate curves on Figures E-1 through E-19 to incremental stage-frequency data from Figure E-20 (Curve "B"). Figure E-21 includes Kentucky River flood profiles in the vicinity of Frankfort. Column (1) of Table E-3 summarizes physical AAD estimates for the various study sections and property categories, expressed in October 1980 values.

Future Average Annual Physical Damages. No future increases in average annual damages were considered in this report except affluence-related increases in residential content damages. Content AAD were computed by relating data from curve number 1 of Figures E-1, E-2, and E-3 to frequency data from Figure E-20. Future AAD increases were estimated at the same rate as per capita income projections by OBERS for BEA Economic Area 053, the area in which the Frankfort study area is located. Affluence projections were carried out to the year in which the value of residential contents equate to 75 percent of the value of the residential structures, with no increase thereafter. Columns (2) and (3) of Table E-3 include undiscounted affluence damage increases to base year 1991 and year 2091. Column (4) of this table shows 1991 to 2091 affluence damages discounted to average annual equivalents at the current Federal 7-3/8 percent interest rate.

NONPHYSICAL FLOOD DAMAGES

The following paragraphs proceed from discussion of December 1978 flood damage estimates to determination of average annual nonphysical flood losses. These losses were discussed in Sections B and D and include all nonphysical damages except emergency costs and flood insurance administrative costs. These latter items were also discussed in these sections and are evaluated in subsequent paragraphs of this section.

TABLE E-3

AVERAGE ANNUAL PHYSICAL DAMAGES ^{1/}
 AT 7-3/8 PERCENT INTEREST RATE
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section and Property Category	Present 1980 Damages (1)	Future 1991 Damages ^{2/} (2)	Future 2091 Damages (3)	AAE Affluence Damages ^{3/} (4)	Total AAED ^{4/} (5)
<u>South Frankfort Section</u>					
Residential	261	319	427	66	385
Commercial	77	77	77	--	77
Public	125	125	125	--	125
Transportation	8	8	8	--	8
Utilities	38	38	38	--	38
Subtotal	<u>509</u>	<u>567</u>	<u>675</u>	<u>66</u>	<u>633</u>
<u>Old Capitol Section</u>					
Residential	10	13	16	2	15
Commercial	9	9	9	--	9
Public	61	61	61	--	61
Transportation	1	1	1	--	1
Utilities	6	6	6	--	6
Subtotal	<u>87</u>	<u>90</u>	<u>93</u>	<u>2</u>	<u>92</u>
<u>Benson Creek Section</u>					
Residential	54	69	98	18	87
Commercial	17	17	17	--	17
Public	4	4	4	--	4
Transportation	1	1	1	--	1
Utilities	12	12	12	--	12
Subtotal	<u>88</u>	<u>103</u>	<u>132</u>	<u>18</u>	<u>121</u>
<u>Distillery Section</u>					
Commercial	83	83	83	--	83
Public	3	3	3	--	3
Transportation	1	1	1	--	1
Utilities	3	3	3	--	3
Subtotal	<u>90</u>	<u>90</u>	<u>90</u>	<u>--</u>	<u>90</u>
TOTAL ALL SECTIONS	774	850	990	86	936

^{1/} October 1980 values in \$1,000.

^{2/} Base year. (Estimated earliest year considered local protection projects could be operational.)

^{3/} Average annual equivalent (AAE) affluence increase in damages to residential contents discounted at 7-3/8%

^{4/} Columns (2) + (4)

Nonphysical Flood Damage Curves. Estimates of nonphysical losses resulting from the December 1978 flood were obtained from survey interview and by methods described in Sections B and D. Estimates were also derived for flood heights 2 feet lower and 3 feet higher than the December 1978 flood. These estimates are shown in Table E-4 by study section and property category. Damage data in this table were used to derive the nonphysical damage curves shown on Figures E-1 through E-19. The components of nonphysical damages included for the various property categories are briefly discussed in the following paragraphs.

Residential. Estimated losses to this category include additional living expenses incurred while living in temporary quarters and arranging for repair of physical damages. Fixed costs such as mortgage equivalents and utility bills while residences were uninhabitable and losses of portions of living space in residences that were partly habitable while being repaired were also considered.

Commercial. Items evaluated in this category include losses of income, rental, and employee wages. Fixed costs such as mortgage equivalents and utility bills while businesses were closed and being repaired were also considered. Other considerations include costs incurred by businesses to temporarily close and reopen and costs borne by large firms during administration of flood damage repair contracts.

Public. Loss of employee wages and costs borne by State governmental agencies during administration of flood damage repair contracts were estimated.

Transportation. Costs were estimated for vehicular traffic disruption and rerouting and disruption of railroad activities.

Utilities. Loss of income and costs incurred during administration of flood repair contracts were estimated.

Nonphysical Unit Damages. Nonphysical damages shown in Table E-4 and described in the foregoing paragraphs are broken down into unit damages per day in Table E-5. This breakdown includes all categories

TABLE E-4

NONPHYSICAL DAMAGES FROM RECURRENCE
OF SPECIFIC FLOOD HEIGHTS
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section and Property Category	Nonphysical Damages in \$1,000 ^{1/} For Specific Flood Heights		
	1978 -2ft.	Dec 1978	1978 +3 ft.
<u>South Frankfort Section</u>			
Residential	322	644	805
Commercial	572	802	1,254
Public	1,655	3,711	6,012
Transportation	195	268	537
Utilities	435	836	1,452
Subtotal	3,179	6,261	10,060
<u>Old Capitol Section</u>			
Residential	15	29	35
Commercial	64	80	160
Public	740	1,256	3,145
Transportation	111	198	304
Utilities	47	73	92
Subtotal	977	1,636	3,736
<u>Benson Creek Section</u>			
Residential	80	157	196
Commercial	103	125	200
Public	42	78	124
Transportation	108	181	280
Utilities	132	211	280
Subtotal	465	752	1,080
<u>Distillery Section</u>			
Commercial	650	895	1,407
Public	57	127	291
Transportation	96	180	308
Utilities	61	125	145
Subtotal	864	1,327	2,151
TOTAL ALL SECTIONS	5,485	9,976	17,027

^{1/} October 1980 values.

except transportation and reflects the duration of the December 1978 flood and its after effects. Most of the nonphysical transportation damages reflected in Table E-4 are related to vehicular traffic diversion due to flooding of roads and bridges. Based on data contained in Tables D-4 and D-5, traffic diversion cost per day per mile is derived in Table E-6 for the December 1978 flood. Unit cost in this table is dependent on traffic counts. For study areas where traffic count data are unavailable, a method relating diversion cost to numbers of households may be appropriate. This method is discussed in the following paragraph.

The December 1978 flood disrupted vehicular traffic for an interdependent population in two primary traffic zones. Total cost of traffic diversion, which was derived in Section D, is further derived in Table E-7 by household in Frankfort, since the cost was incurred by detoured motorists from within and without the flood plain. See the Appendix for deriving traffic diversion cost per household per day in other urban studies.

TABLE E-5
NONPHYSICAL FLOOD DAMAGES PER UNIT
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Property Categories	Damage <u>1/</u> (Dollars) (1)	Average Duration <u>2/</u> (Days) (2)	Units Affected (Number) (3)	Unit Damage Per Day <u>5/</u> (Dollars) (4)
Residential	830,000	60	640 <u>3/</u>	20
Commercial	1,902,000	45	79 <u>3/</u>	530
Public	5,172,000	45	36 <u>3/</u>	3,190
Utilities	1,245,000	45	5 <u>4/</u>	5,530

- 1/ December 1978 flood in October 1980 values.
2/ Estimated duration of the December 1978 flood and its after effects.
3/ From Table E-1.
4/ Number of utility companies affected.
5/ Column (1) ÷ Column (2) ÷ Column (3), rounded to nearest \$10.

TABLE E-6

TRAFFIC DIVERSION COST ^{1/} PER MILE
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Average Daily Trips - Flood Condition ^{2/}	Total Extra Miles Driven Flood Condition ^{3/}	Flood Duration ^{3/} (Days)	Total Diversion Cost (Dollars) ^{4/}	Cost per Day per Mile ^{5/} (Dollars)
(1)	(2)	(3)	(4)	(5)
17,434	1,203,840	7	547,000	.30

^{1/} For December 1978 flood.

^{2/} From Table D-4.

^{3/} From Table D-5.

^{4/} Table D-4 plus D-5 with costs updated to October 1980 values.
Taylor Avenue costs in Tables D-6 and D-7 were considered
untypical and excluded.

^{5/} Column (2) ÷ Column (3) ÷ Column (4), rounded to nearest \$0.10.

TABLE E-7

TRAFFIC DIVERSION COST PER HOUSEHOLD
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Total Cost ^{1/} (Dollars)	Households in Frankfort ^{2/} (Number)	Flood Duration (Days) ^{3/}	Cost per Household Per Day (Dollars)
(1)	(2)	(3)	(4)
\$808,000	8,647	7	13.35

^{1/} Total of Tables D-4, D-5, D-6 and D-7 updated to Oct 80 values.

^{2/} Frankfort population of 25,922 divided by average occupants
of 3 per household.

^{3/} December 1978 flood.

^{4/} Column (1) ÷ Column (2) ÷ Column 3.

Average Annual Nonphysical Damages. Incremental damage data from nonphysical damage curves shown on Figures E-1 through E-19 were related to incremental frequency data from Figure E-20 (Curve "B") to compute average annual damage estimates shown in Table E-8.

TABLE E-8
 AVERAGE ANNUAL NONPHYSICAL DAMAGES ^{1/}
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section and Property Category	Damages
<u>South Frankfort Section</u>	
Residential	15
Commercial	22
Public	71
Transportation	12
Utilities	21
Subtotal	141
<u>Old Capitol Section</u>	
Residential	1
Commercial	3
Public	36
Transportation	5
Utilities	2
Subtotal	47
<u>Benson Creek Section</u>	
Residential	3
Commercial	5
Public	1
Transportation	5
Utilities	6
Subtotal	20
<u>Distillery Section</u>	
Commercial	22
Public	1
Transportation	2
Utilities	2
Subtotal	27
TOTAL ALL SECTIONS	235

^{1/} October 1980 values in \$1,000.

COMPARISON OF CURRENT AND PRIOR DAMAGE ESTIMATES

Flood damage surveys were previously conducted in 1963 and 1976. Flood damage curves derived from these surveys were updated to December 1978 values and are shown as curve number 1 on Figures E-22 through E-25. Flood damage curves derived from surveys conducted following the December 1978 flood are shown as curve number 2 on these figures. Comparisons of these curves show current flood damage estimates are substantially greater than prior estimates. Both curves include evaluation of physical damages; however, the currently estimated curves more fully evaluate nonphysical damage items listed in the foregoing paragraphs.

The current damage curves were derived from a very extensive survey conducted soon after the December 1978 maximum flood of record, at a time when estimates of damages could be readily obtained from flood plain occupants. At the time the prior surveys were conducted in 1963 and 1976, a flood approaching the magnitude of the December 1978 flood had not occurred since 1937. Lack of major flooding immediately prior to the 1963 and 1976 surveys resulted in collection of hypothetical flood damage estimates from flood plain occupants that had either never experienced a major flood or had not been flooded since 1937. Other reasons for the large increases in the current estimate are due to the great inflationary increases in property values and damage repair costs, and new developments and property improvements since the prior estimates were made. For these reasons, estimates derived from survey of the December 1978 flood are considered to more fully reflect flooding at Frankfort than price level updated estimates from the 1963 and 1976 surveys. Table E-9 shows a comparison of prior and current estimates of damages from the December 1978 flood in the four study sections of Frankfort.

As a result of the December 1978 flood, frequency curves previously provided in January 1977 (shown on Figure E-26) were revised in April 1979 (shown on Figure E-20). Table E-10 shows comparisons of prior and current AAD estimates based on these frequency curves and the damage

curves shown on Figures E-22 through E-25. Data in this table indicate changes in flood frequency resulted in about a 70 percent increase in AAD, whereas changes in damage curves resulted in about a 320 percent AAD increase.

TABLE E-9
 COMPARISON OF PRIOR AND CURRENT ESTIMATES
 OF DAMAGE FROM THE DECEMBER 1978 FLOOD ^{1/}
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section	Flood Damages	
	Prior Estimate ^{2/}	Current Estimate ^{3/}
South Frankfort Section -	4,800	22,600
Old Capitol Section	1,300	3,800
Benson Creek Section	600	3,500
Distillery Section	<u>2,400</u>	<u>4,300</u>
Total	9,100	34,200

- ^{1/} December 1978 values in \$1,000.
 (Represents physical and nonphysical damages).
^{2/} Based on 1963 and 1976 surveys of damages updated to
 December 1978 values.
^{3/} Based on extensive survey of damages after the December 1978 flood.

TABLE E-10

COMPARISON OF PRIOR AND CURRENT ESTIMATES
OF AVERAGE ANNUAL DAMAGES 1/ BASED ON
JANUARY 1977 AND APRIL 1979 FREQUENCY CURVES 2/
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section	Average Annual Damages Based On:			
	Jan 77 Frequency Curve		Apr 79 Frequency Curve	
	Prior Damage Curves 3/	Current Damage Curves 4/	Prior Damage Curves 3/	Current Damage Curves 4/
South Frankfort Section	59	319	102	533
Old Capitol Section	13	67	25	109
Benson Creek Section	8	55	12	87
Distillery Section	<u>30</u>	<u>52</u>	<u>57</u>	<u>93</u>
Total	110	493	196	822

- 1/ December 1978 values in \$1,000.
(Represents physical and nonphysical damages)
- 2/ With Buckhorn Lake operating.
- 3/ Based on update to December 1978 values damage curves
derived from 1963 and 1976 surveys.
- 4/ Based on damage curves derived from extensive surveys
following the December 1978 flood.

FLOOD EMERGENCY COSTS

Costs in this category were incurred during and after the December 1978 flood and as a result of a Presidential disaster declaration. Sources and methods used to estimate these costs were discussed in considerable detail in Section D. These costs relate to protection of life, health, and property; evacuation, transition and reoccupation; emergency and mass care; emergency preparedness; and administrative costs.

Flood Emergency Cost Curves. Cost estimates shown in Table D-1 are broken down into unit cost per day in Table E-11 on the basis of residential, commercial, and public unit costs per day resulting from the duration of the December 1978 flood and its after effects. Based on judgment and other urban-disaster declarations in recent years, unit costs per day derived in Column (4) of Table E-11 are considered applicable to all stages greater than the height of a 50-year flood. The average durations shown in Column (2) of this table are estimated to decline about half for a 50-year flood. Also, emergency costs are estimated to continue to decline below a 50-year flood and become insignificant at about the height of a 15-year flood. On this basis, Table E-12 shows a breakdown of emergency cost by study section for the December 1978 flood and for a hypothetical 50-year flood. Emergency cost curves, shown on Figures E-27 through E-30, are based on data in Table E-12 and assuming cost decline to zero at about the elevation of a 15-year flood.

Average Annual Emergency Costs. Average annual emergency cost (AAEC) were computed by relating incremental stage-emergency cost data from Figures E-27 through E-30 to incremental stage-frequency data from Figure E-20 (Curve "B"). Table E-13 shows a summary of estimated AAEC by study section.

TABLE E-11
 FLOOD EMERGENCY COSTS PER UNIT
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Cost Item	Total Costs <u>1/</u> (Dollars) (1)	Average Dura- tion <u>2/</u> (Days) (2)	Units Affected <u>3/</u> (Number) (3)	Unit Cost per Day <u>4/</u> (Dollars) (4)
Protection of life, health & property	200,000	7	755 <u>5/</u>	40
Evacuation, transi- tion & reoccupation	1,440,000	60	640 <u>6/</u>	40
Emergency & mass care	1,090,000	20	640	90
Emergency preparedness	250,000	7	755	50
Administrative cost of emergency	3,660,000	60	755	80
Weighted average cost				60

- 1/ From Table D-1 (October 1980 values).
2/ Estimated duration of December 1978 flood and its after effects.
3/ From Table E-1.
4/ Column (1) ÷ Column (2) ÷ Column (3), rounded to nearest \$10.
5/ Includes residential, commercial, and public units.
6/ Residential units only.

TABLE E-12
EMERGENCY COST BREAKDOWN
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section	Costs in \$1,000 1/	
	Dec 1978 Flood	50-Year Flood
South Frankfort Section	4,975	1,557
Old Capitol Section	307	115
Benson Creek Section	1,330	346
Distillery Section	<u>28</u>	<u>12</u>
Total	6,640	2,030

1/ October 1980 values.

TABLE E-13
AVERAGE ANNUAL EMERGENCY COSTS (AAEC) 1/
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section	AAEC in \$1,000
South Frankfort Section	88
Old Capitol Section	6
Benson Creek Section	21
Distillery Section	<u>1</u>
Total	116

1/ October 1980 values.

DECEMBER 1978 FLOOD TOTAL DAMAGES

Table E-14 summarizes current estimates of physical and nonphysical damages and emergency costs from recurrence in 1980 of the December 1978 flood in Frankfort.

NATIONAL FLOOD INSURANCE ANNUAL COSTS

The cost of administering flood insurance policies were evaluated based on information obtained from the Flood Insurance Administration (FIA). These costs, averaging about \$29 annually per policy, were apportioned to the four study sections on the basis of numbers of units eligible for flood insurance. This is discussed in greater detail in Sections B and D. Table E-15 shows a study section breakdown of estimated average annual flood insurance administrative costs.

TOTAL AVERAGE ANNUAL DAMAGES

Average annual damages are summarized in Table E-16 by study section.

TABLE E-14
SUMMARY OF DAMAGES 1/
FROM DECEMBER 1978 FLOOD
KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section	Physical Damages 2/	Nonphysical Damages 3/	Emergency Costs 4/	Total Damages
South Frankfort Section	22,206	6,261	4,975	33,442
Old Capitol Section	3,109	1,636	307	5,052
Benson Creek Section	3,656	752	1,330	5,738
Distillery Section	4,099	1,327	28	5,454
Total	33,070	9,976	6,640	49,686

- 1/ October 1980 values in \$1,000.
- 2/ From Table E-1.
- 3/ From Table E-4.
- 4/ From Table E-12.

TABLE E-15
 NATIONAL FLOOD INSURANCE PROGRAM
 AVERAGE ANNUAL ADMINISTRATIVE COSTS ^{1/}
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section	Average Annual Costs
South Frankfort Section	16
Old Capitol Section	2
Benson Creek Section	4
Distillery Section	<u>Nil</u>
Total	22

^{1/} October 1980 values in \$1,000.

TABLE E-16
 SUMMARY OF AVERAGE ANNUAL DAMAGES ^{1/}
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Study Section	Physical Flood Damages ^{2/}	Non-physical Flood Damages ^{3/}	Flood Emergency Costs ^{4/}	Flood Insurance Costs ^{5/}	Total
South Frankfort Section	633	141	88	16	878
Old Capitol Section	92	47	6	2	147
Benson Creek Section	121	20	21	4	166
Distillery Section	<u>90</u>	<u>27</u>	<u>1</u>	<u>Nil</u>	<u>118</u>
Total	936	235	116	22	1,309

^{1/} October 1980 values in \$1,000
^{2/} From Column (5) of Table E-3.
^{3/} From Table E-8.

^{4/} From Table E-13.
^{5/} From Table E-15.

APPLICATION TO OTHER STUDIES

It is hoped that this report will serve as a model study of flood emergency costs and other nonphysical damages, many of which are non-traditional. Substantial time and effort were expended gathering, compiling, analyzing, and describing the various items and methods. It is unlikely that such an exhaustive effort will be undertaken in the near future by the Louisville District.

Unit emergency cost data derived in Table E-11 and unit nonphysical damage data derived in Tables E-5, E-6 and E-7 may be applicable to other urban studies if flood duration and various unit data are known. However, considerable caution and judgment should be exercised, especially when relating commercial, public, and utility unit damages in Tables E-5 and traffic diversion unit costs in Tables E-6 and E-7 to other study areas. These items tend to be unique in each area.

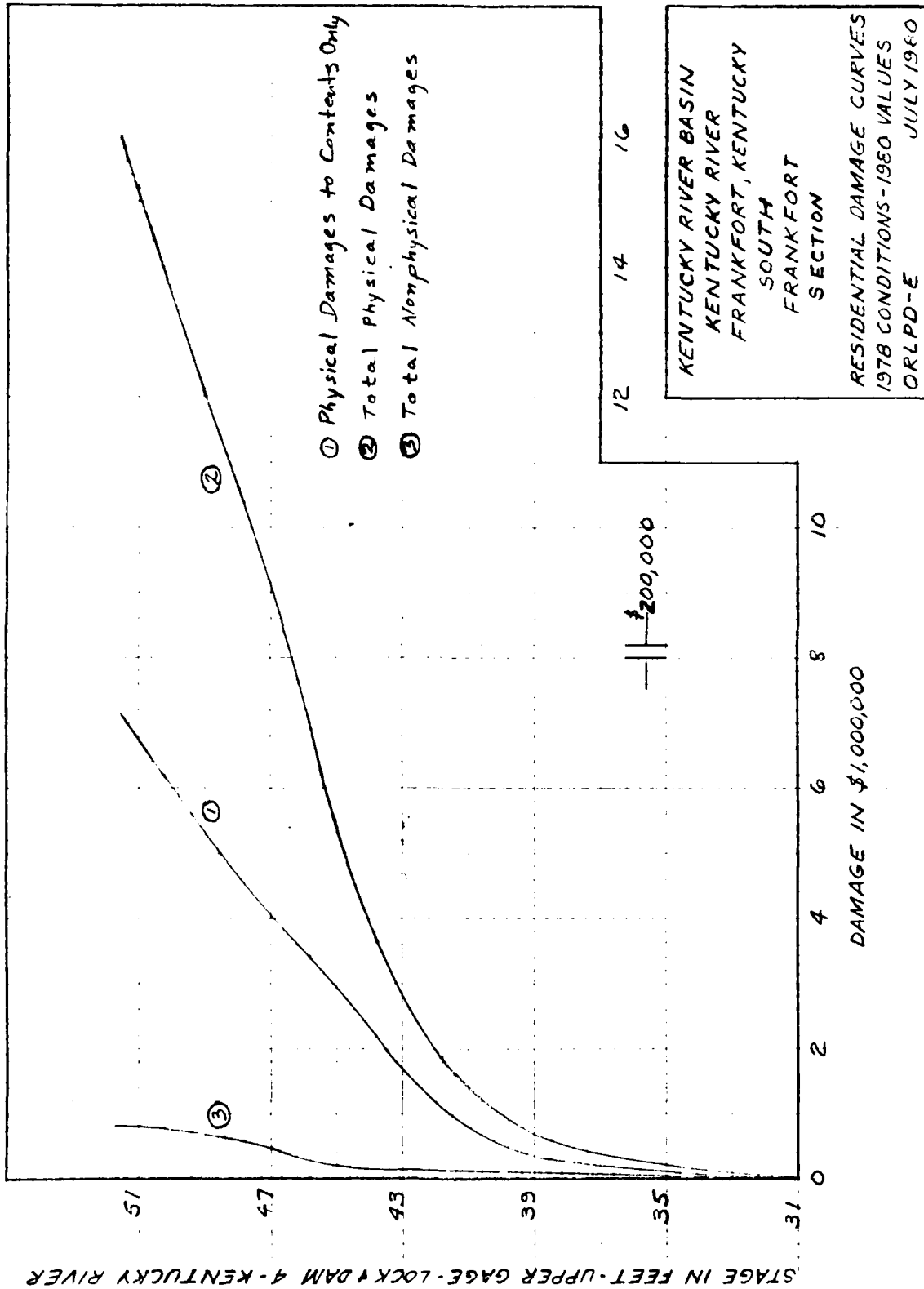


FIGURE E-1

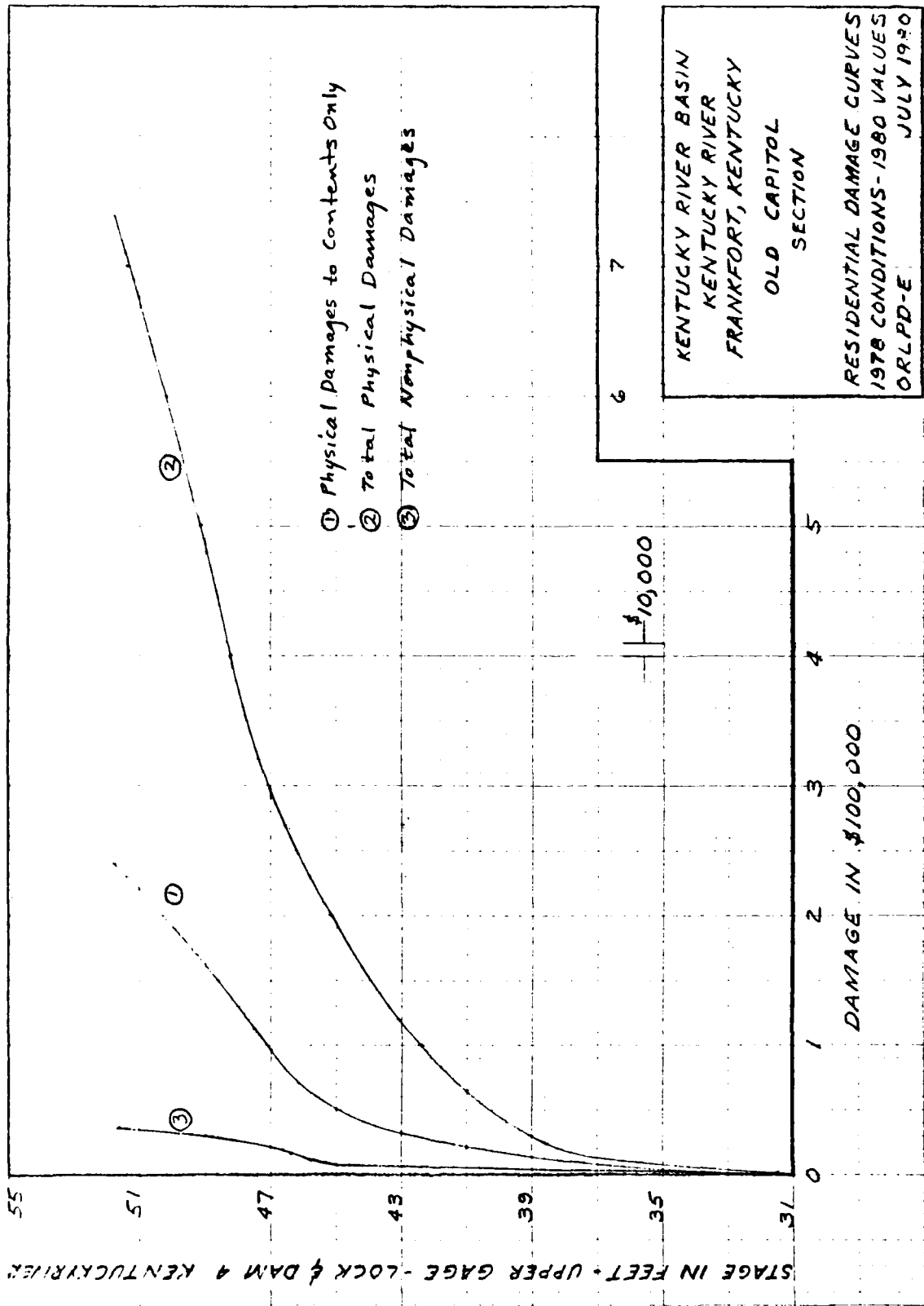


FIGURE E-2

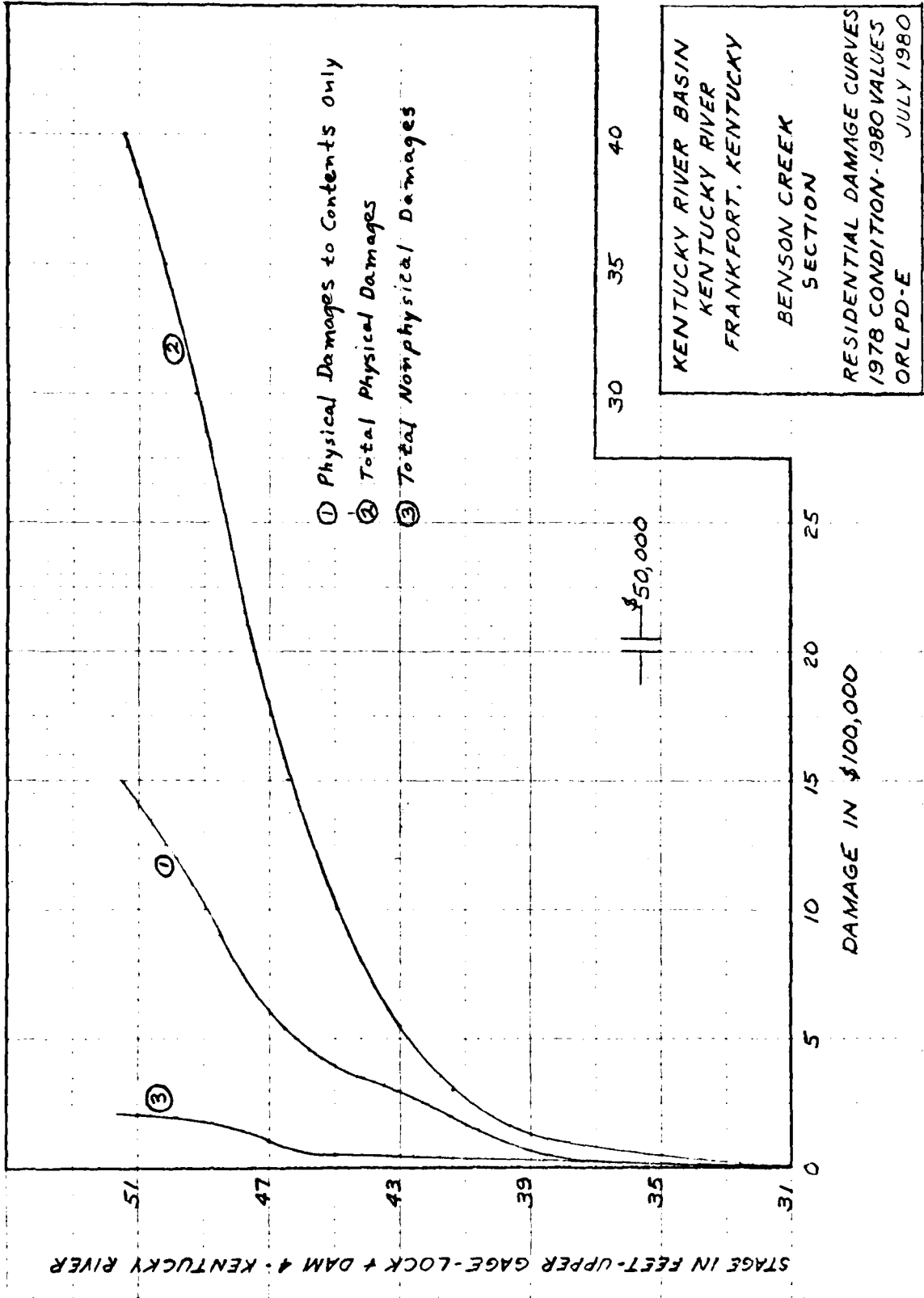


FIGURE E-3

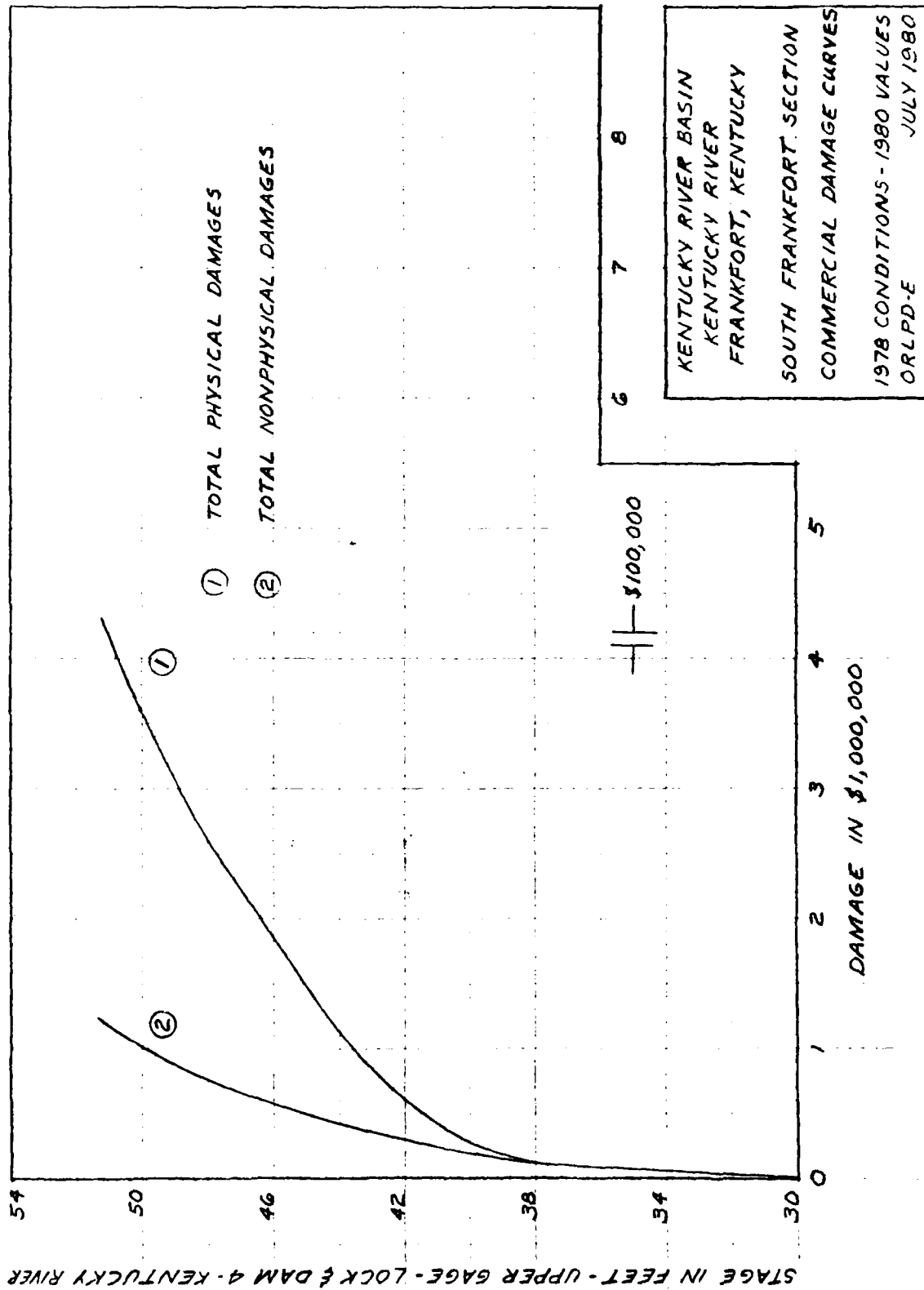


FIGURE E-4

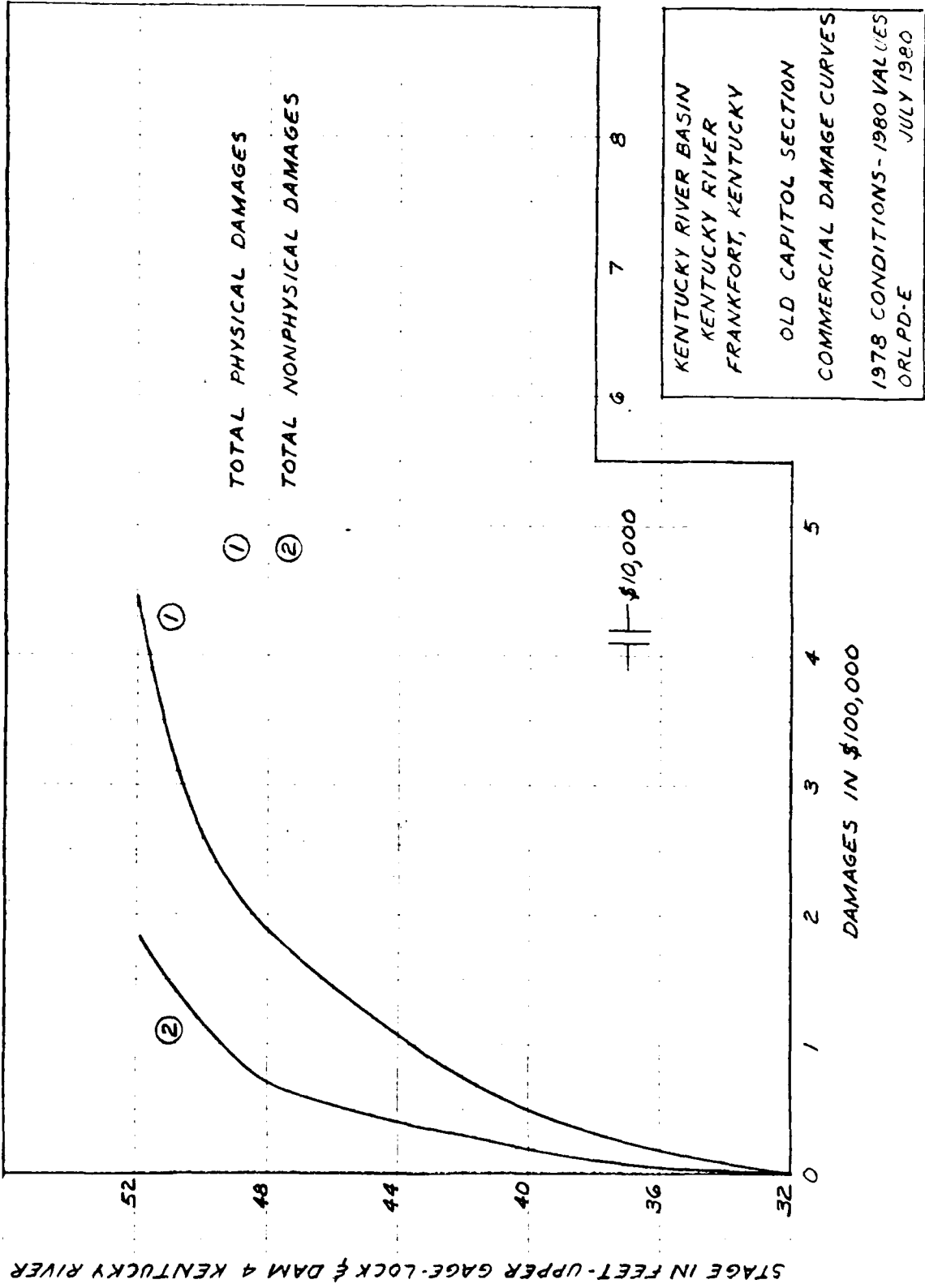


FIGURE E-5

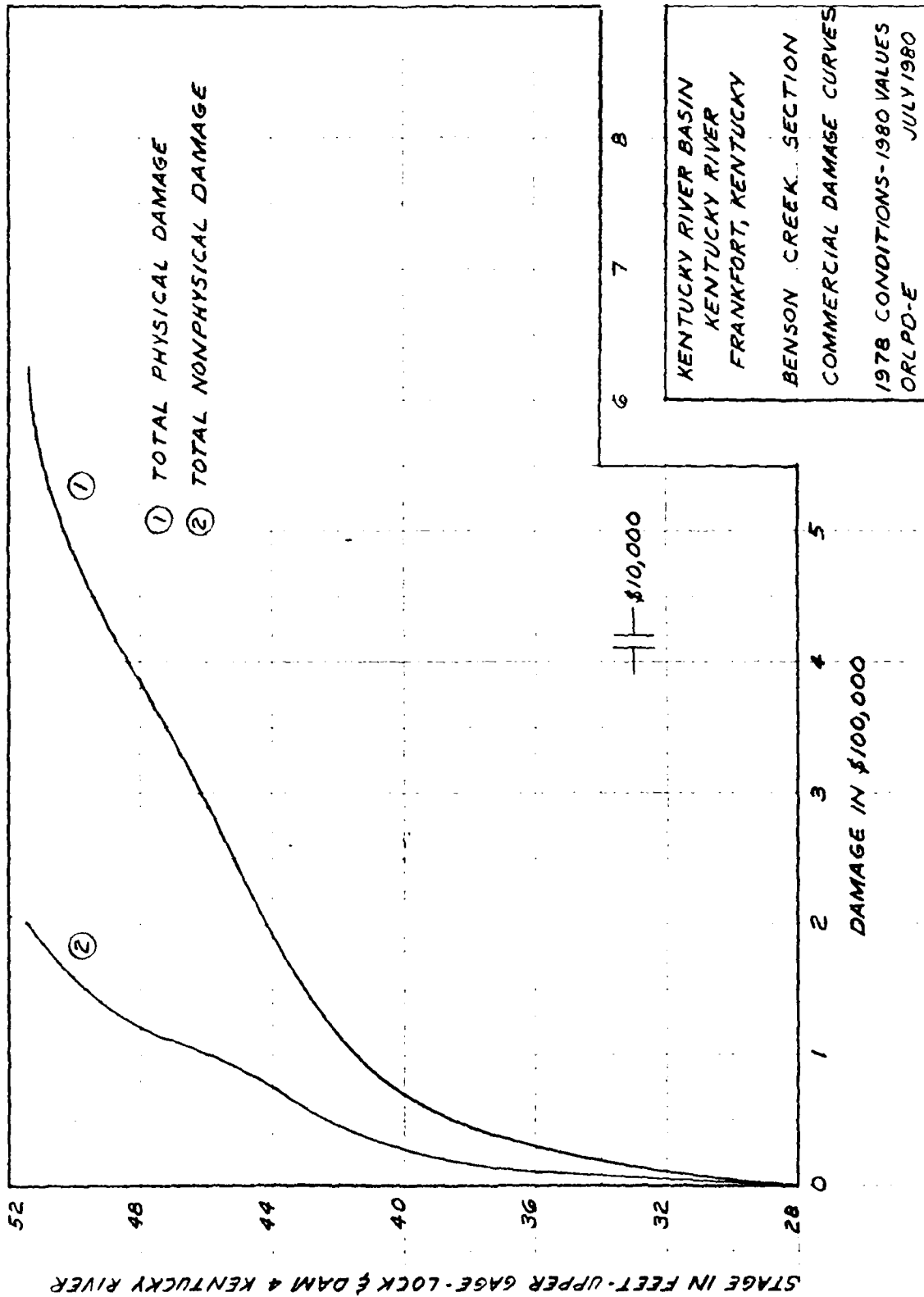


FIGURE E-6

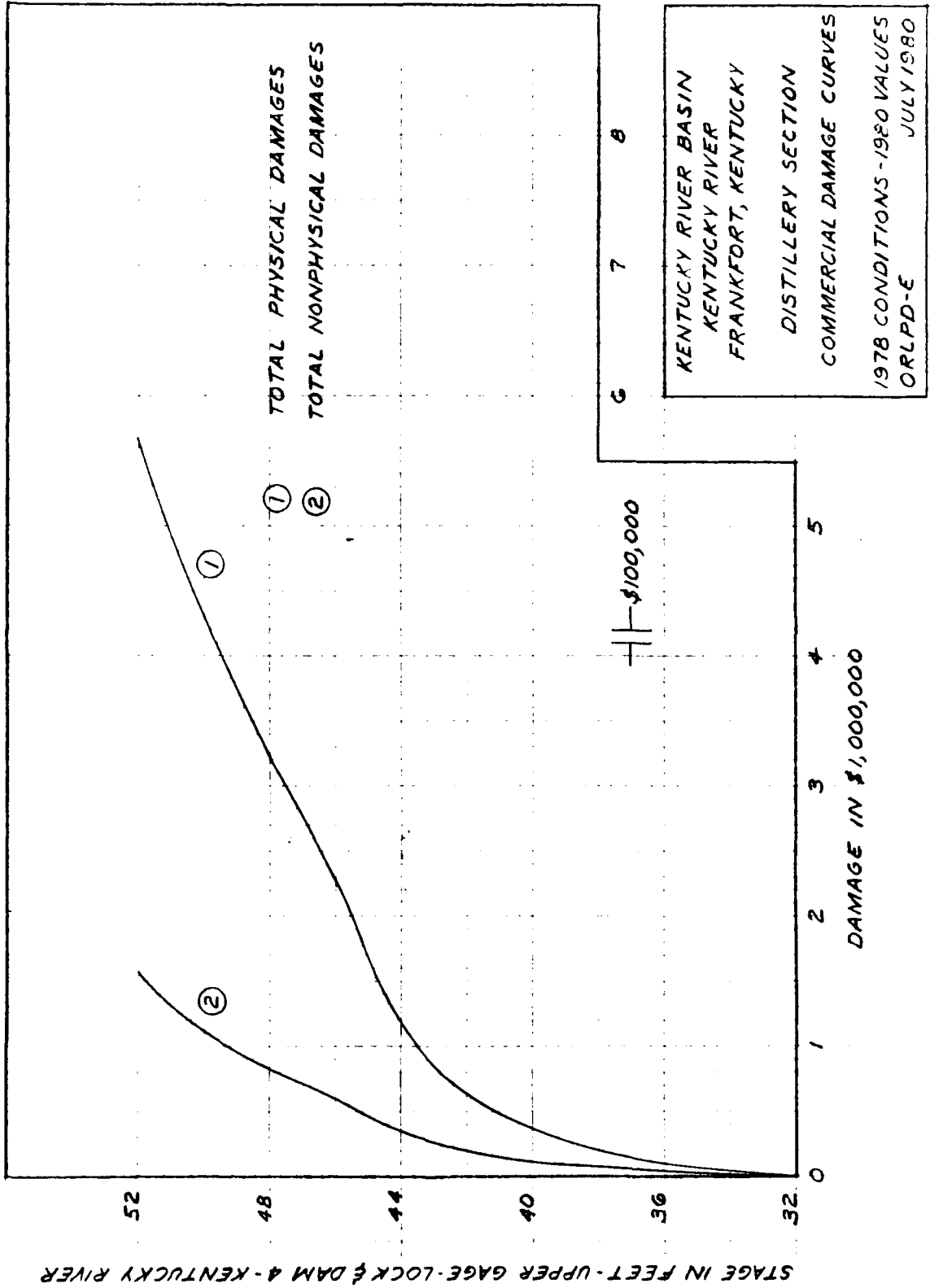


FIGURE E-7

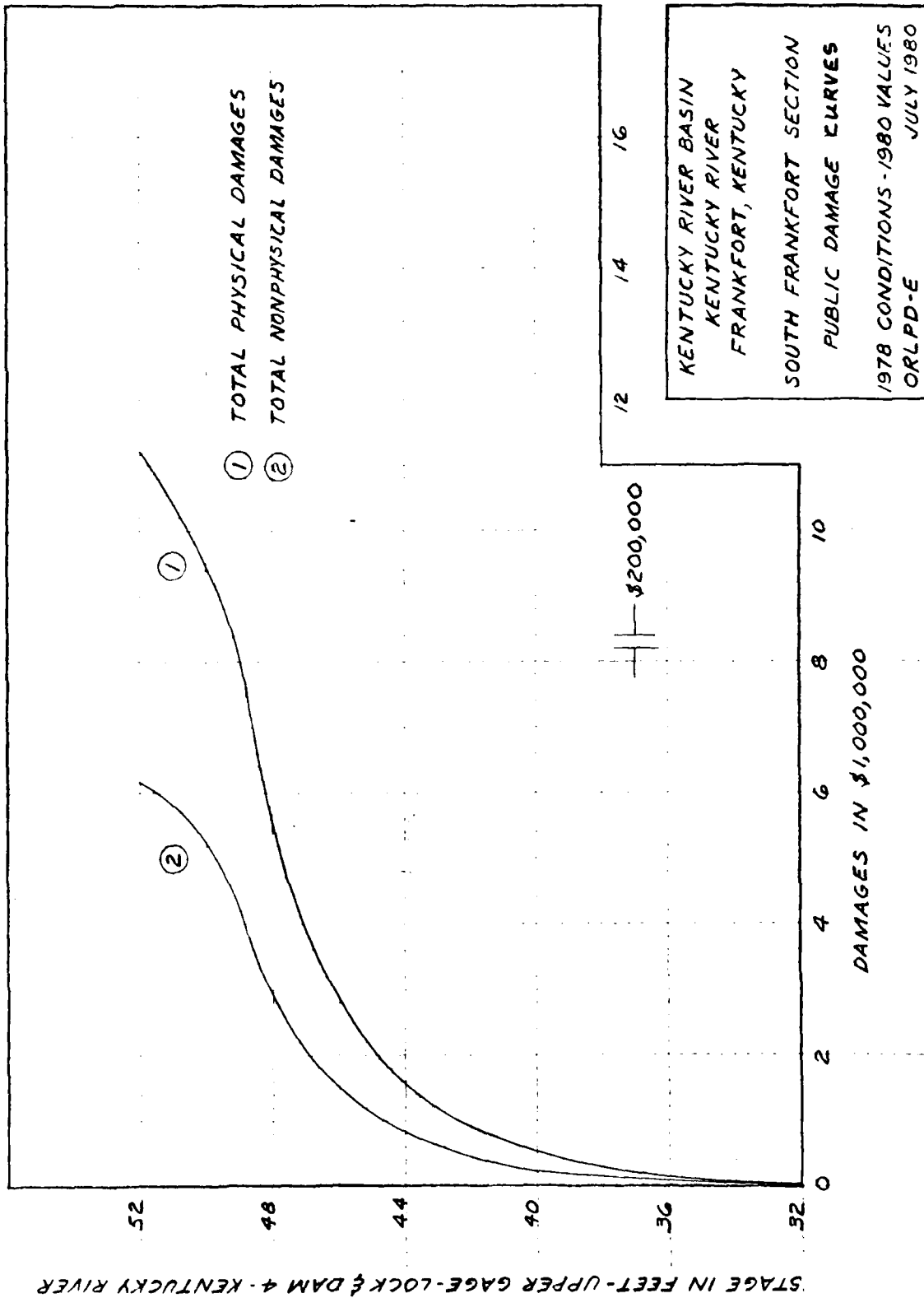


FIGURE E-8

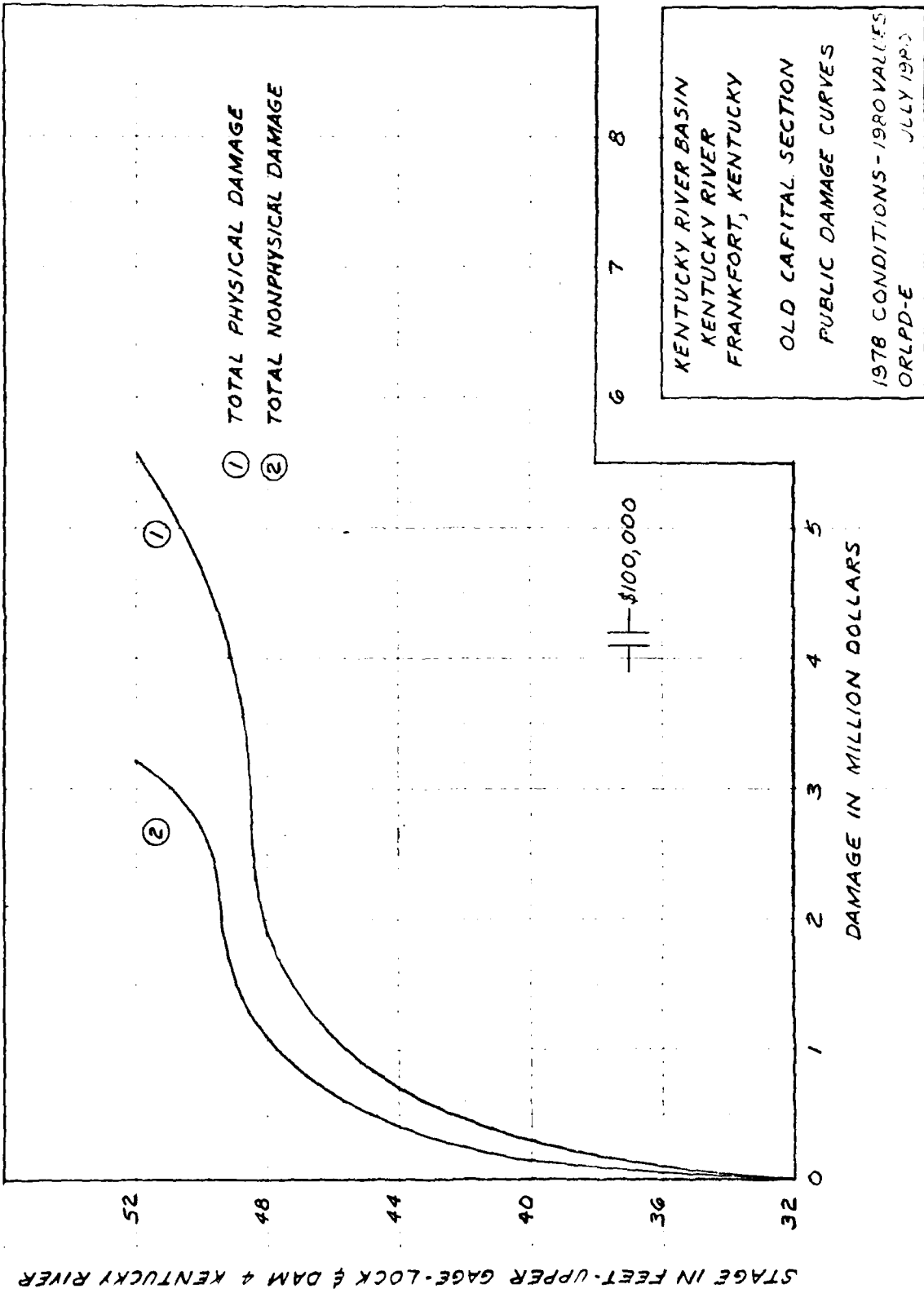


FIGURE E-9

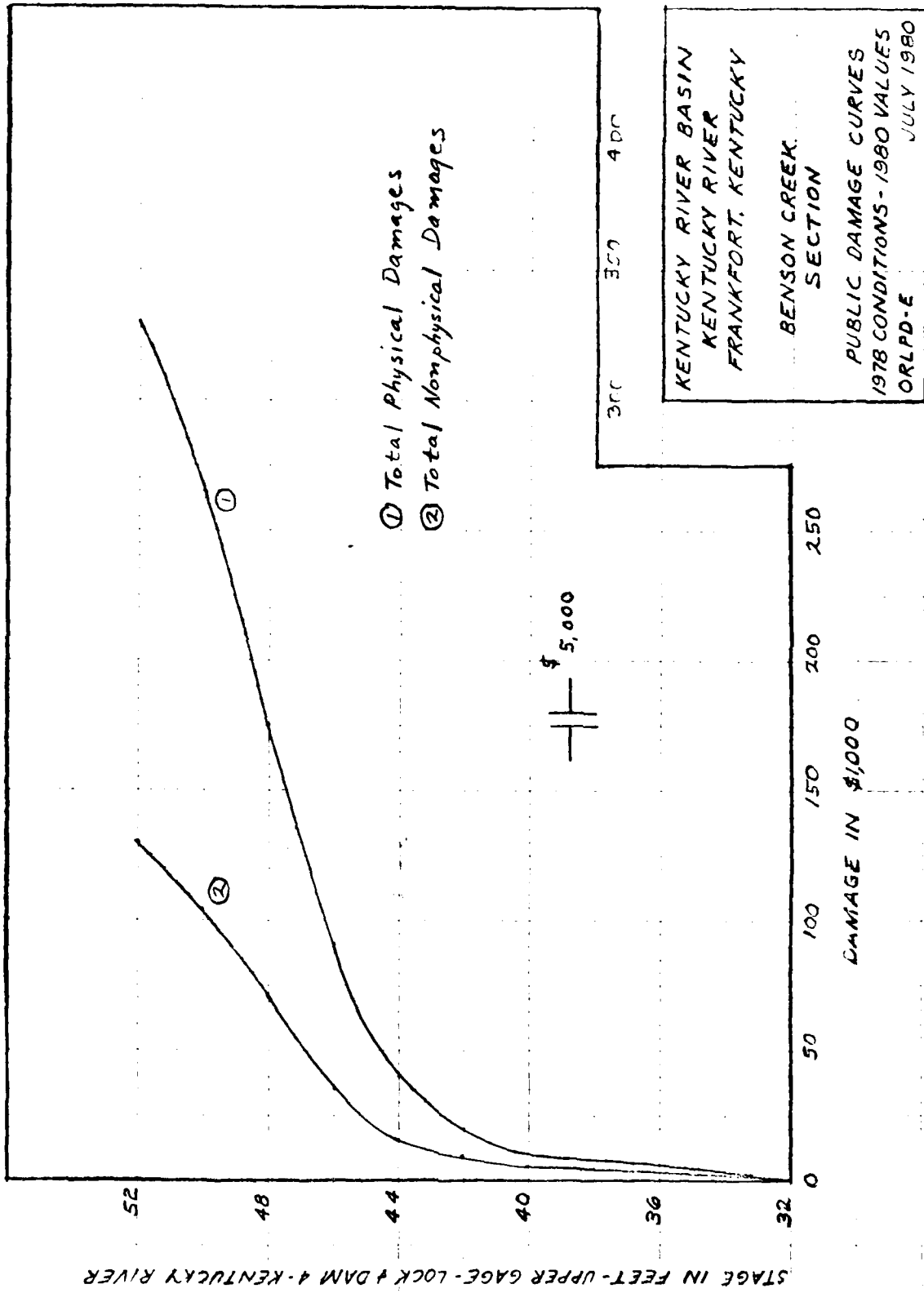


FIGURE E-10

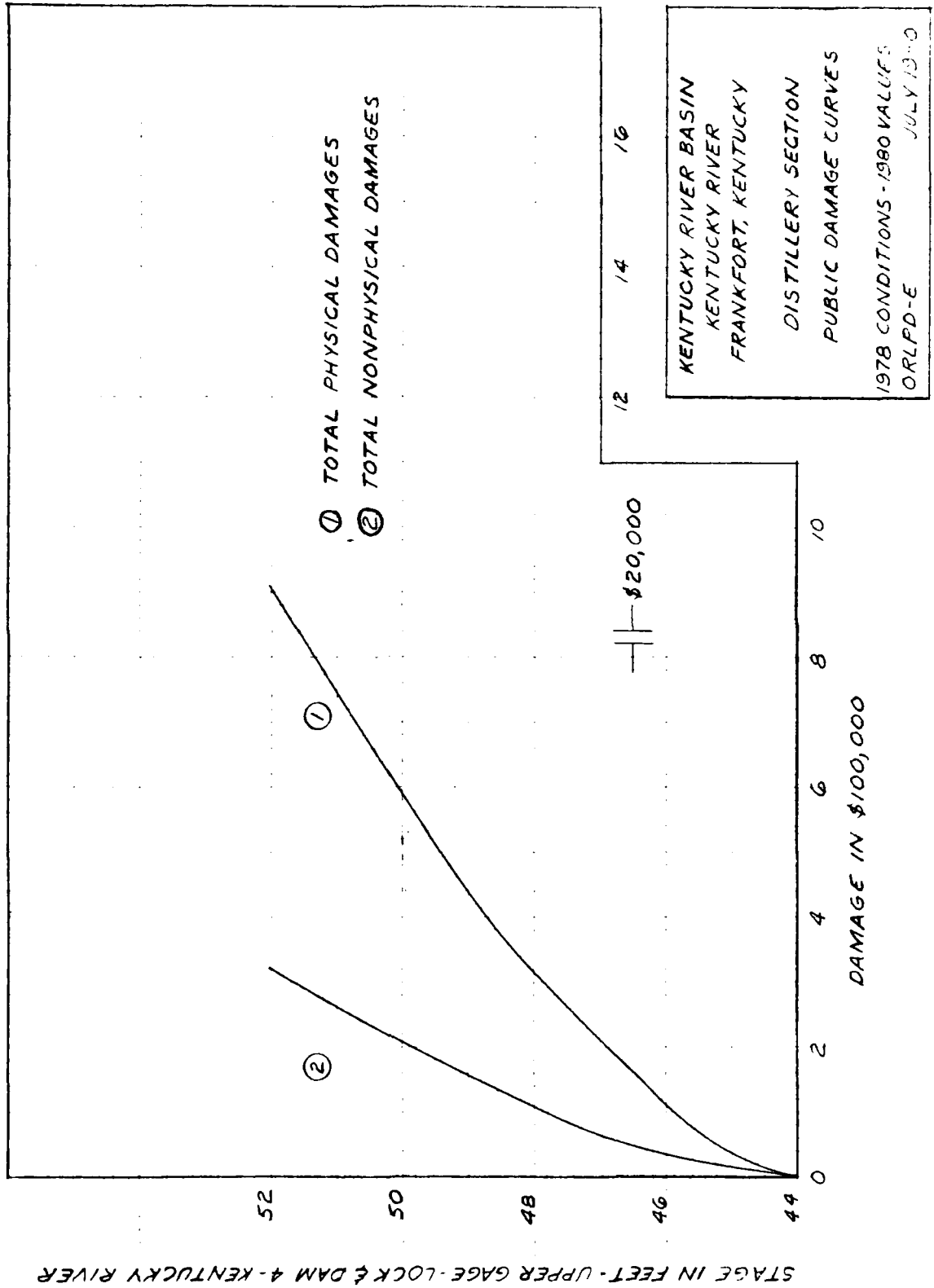


FIGURE E-11

FIGURE E-12

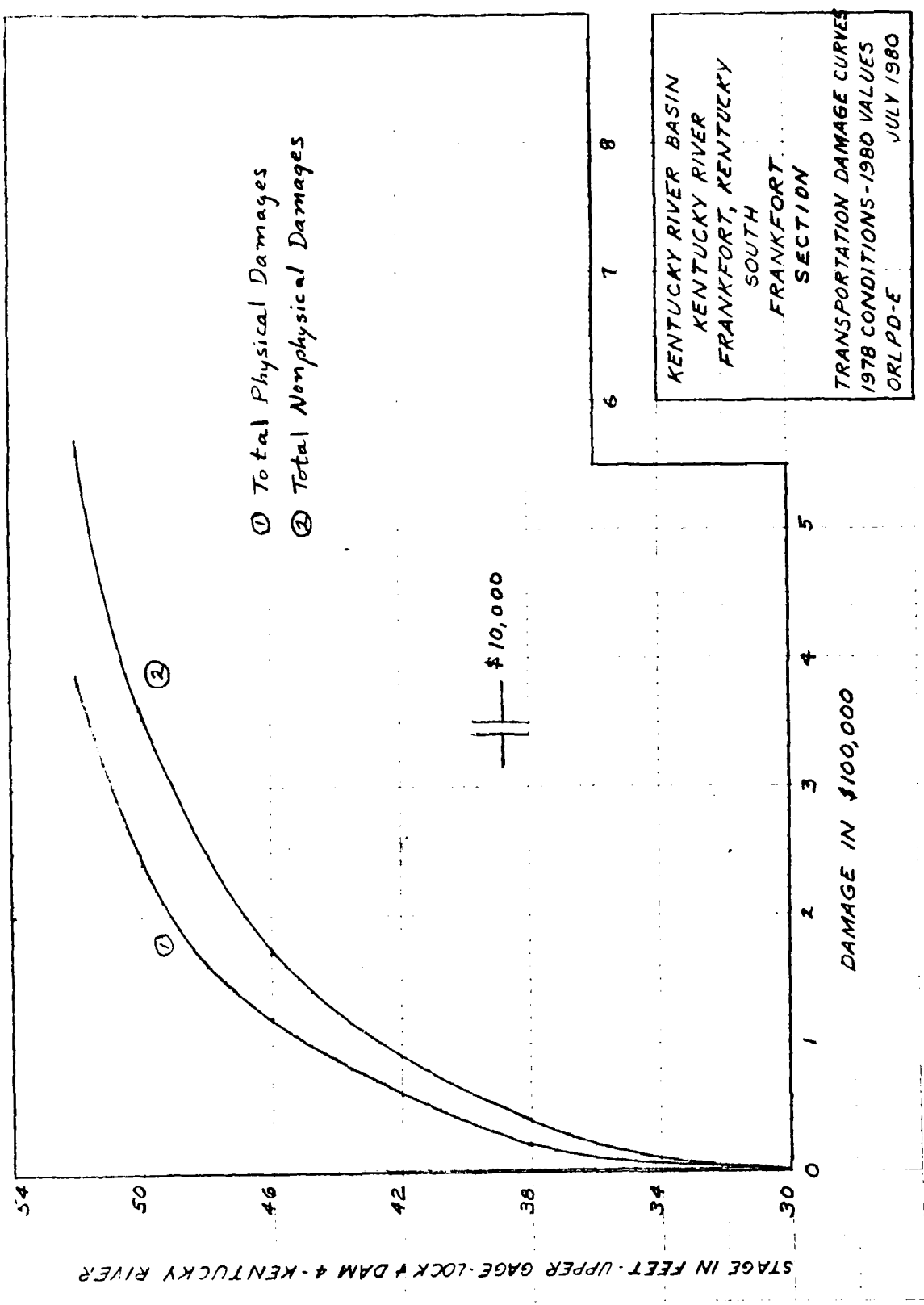


FIGURE E-12

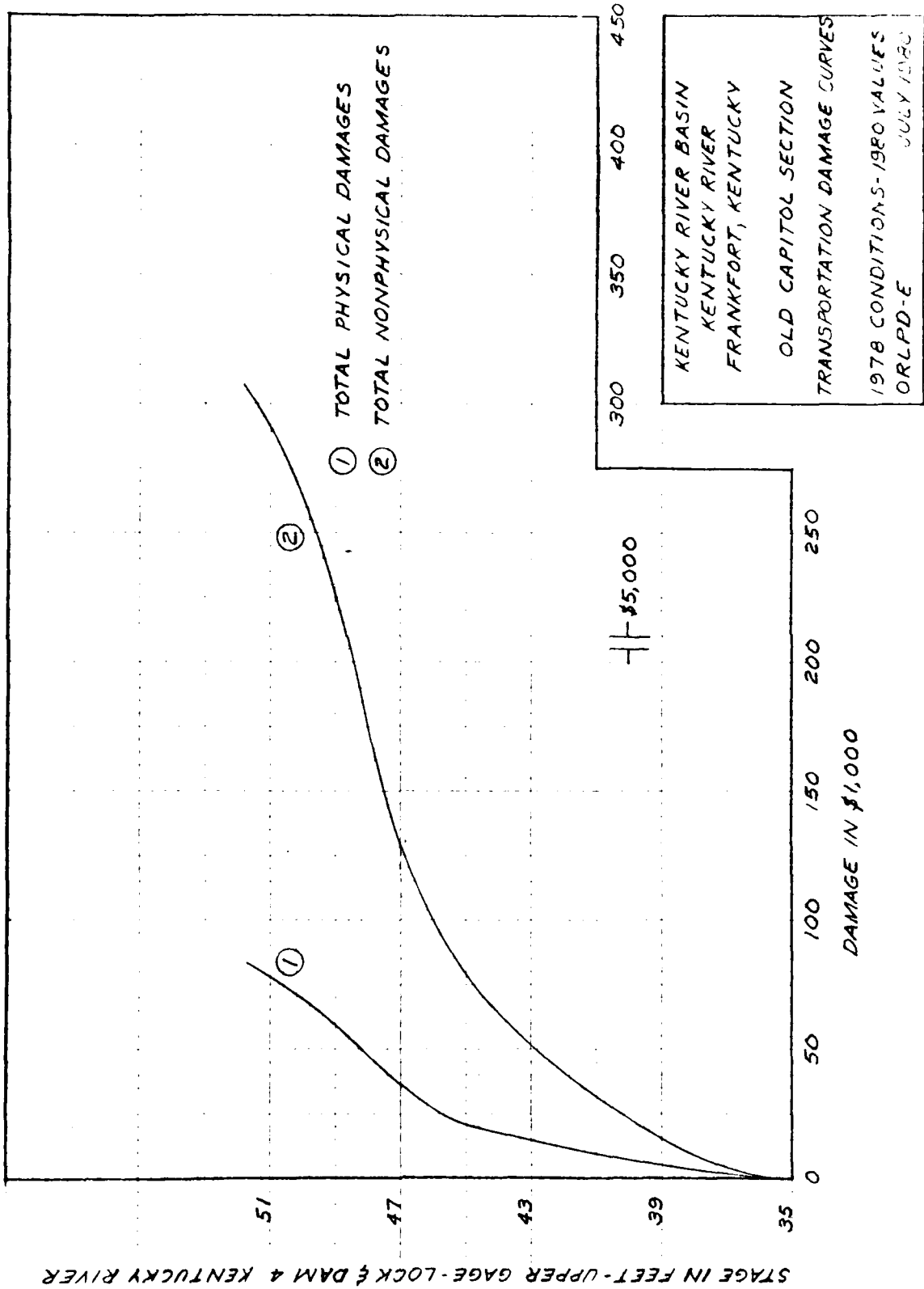


FIGURE E-13

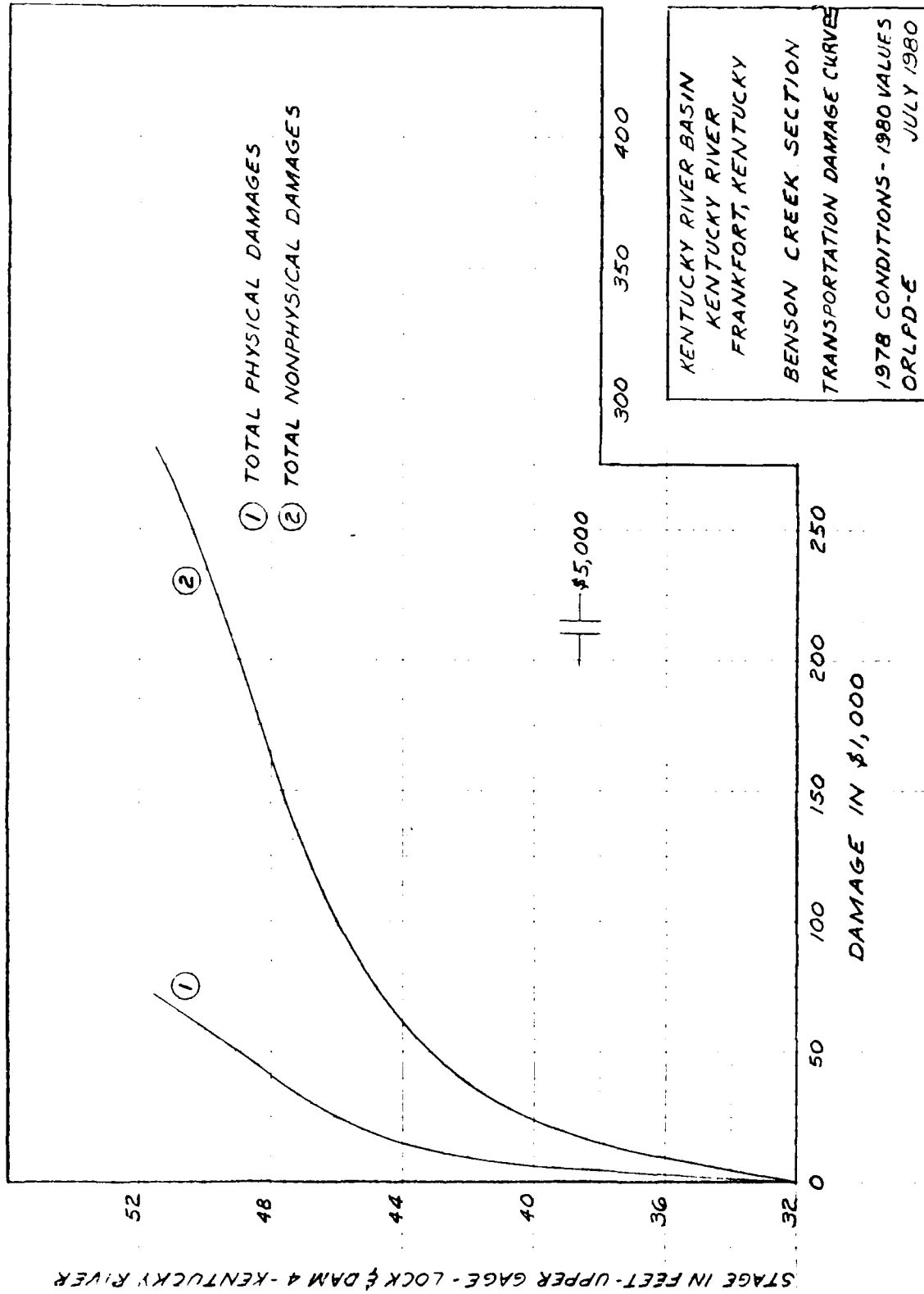


FIGURE E-14

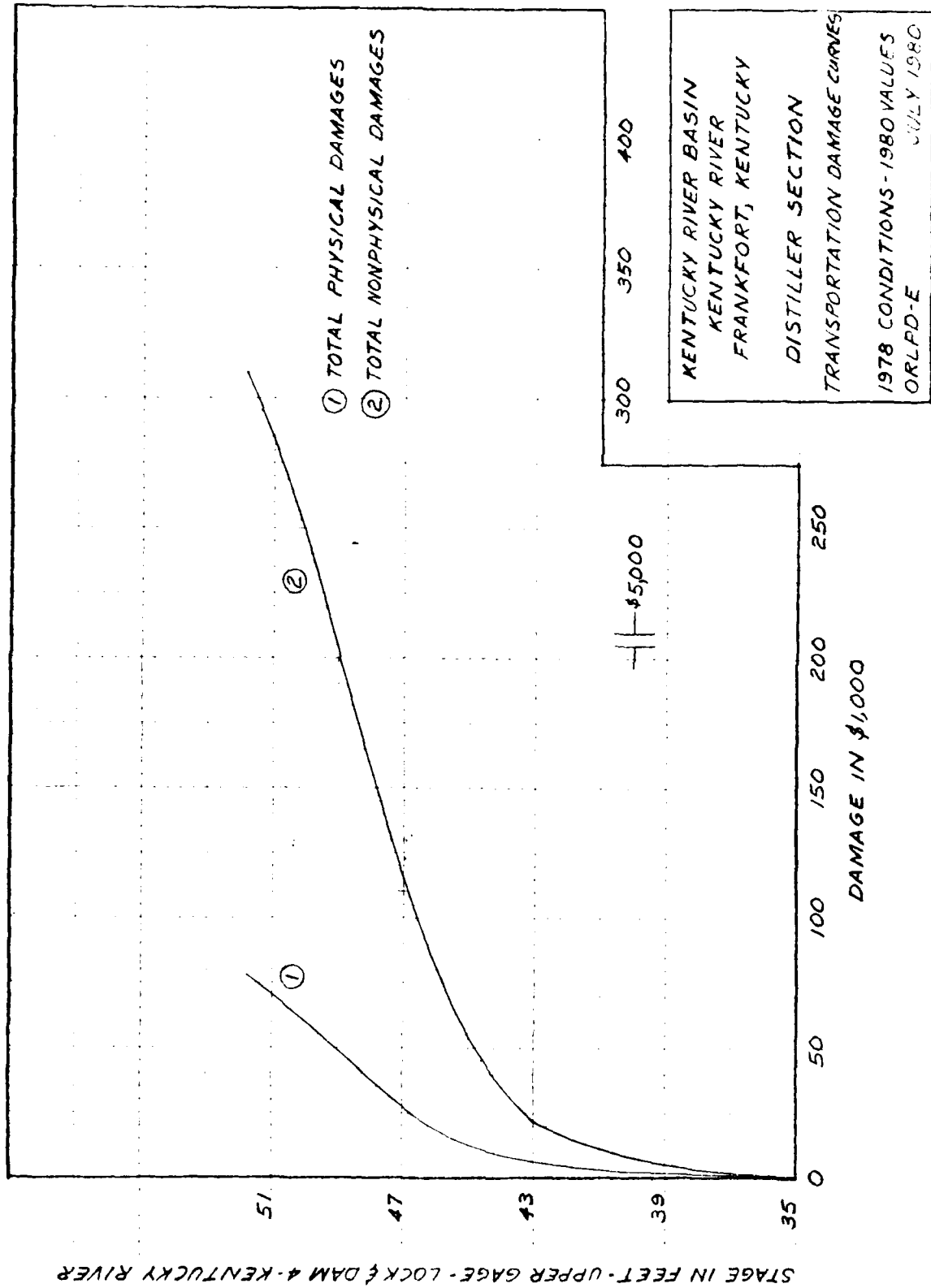


FIGURE E-15

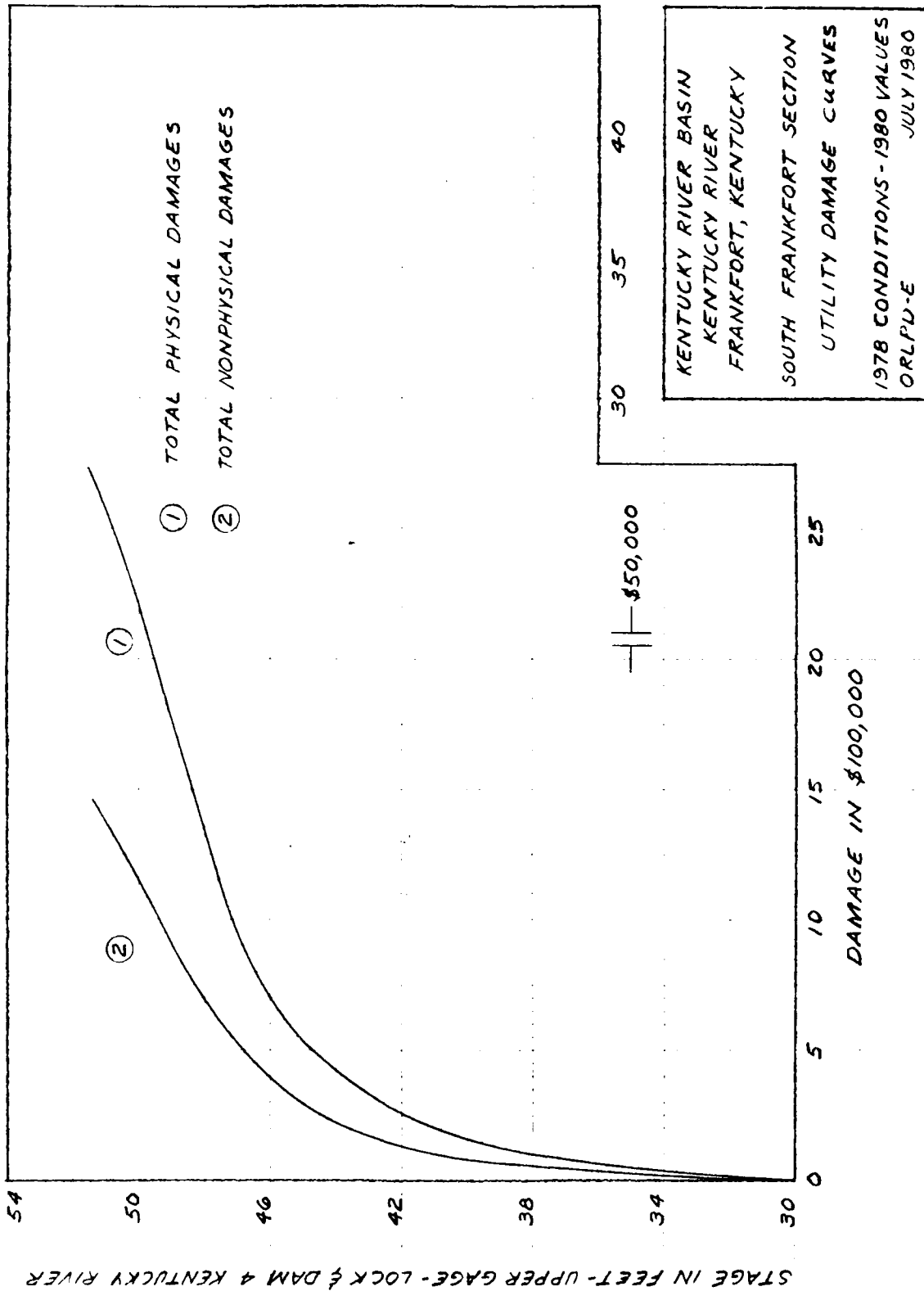


FIGURE E-16

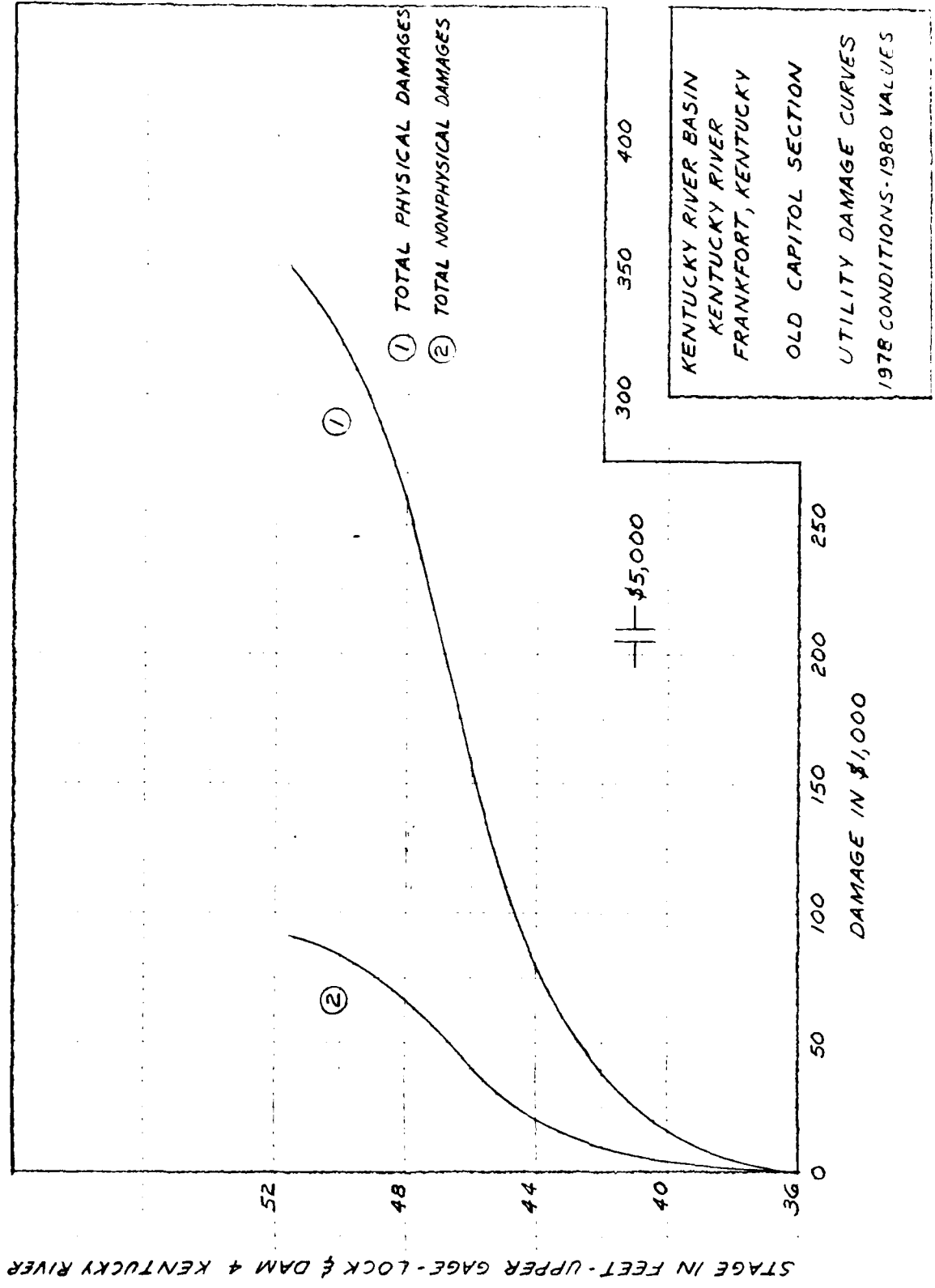


FIGURE E-17

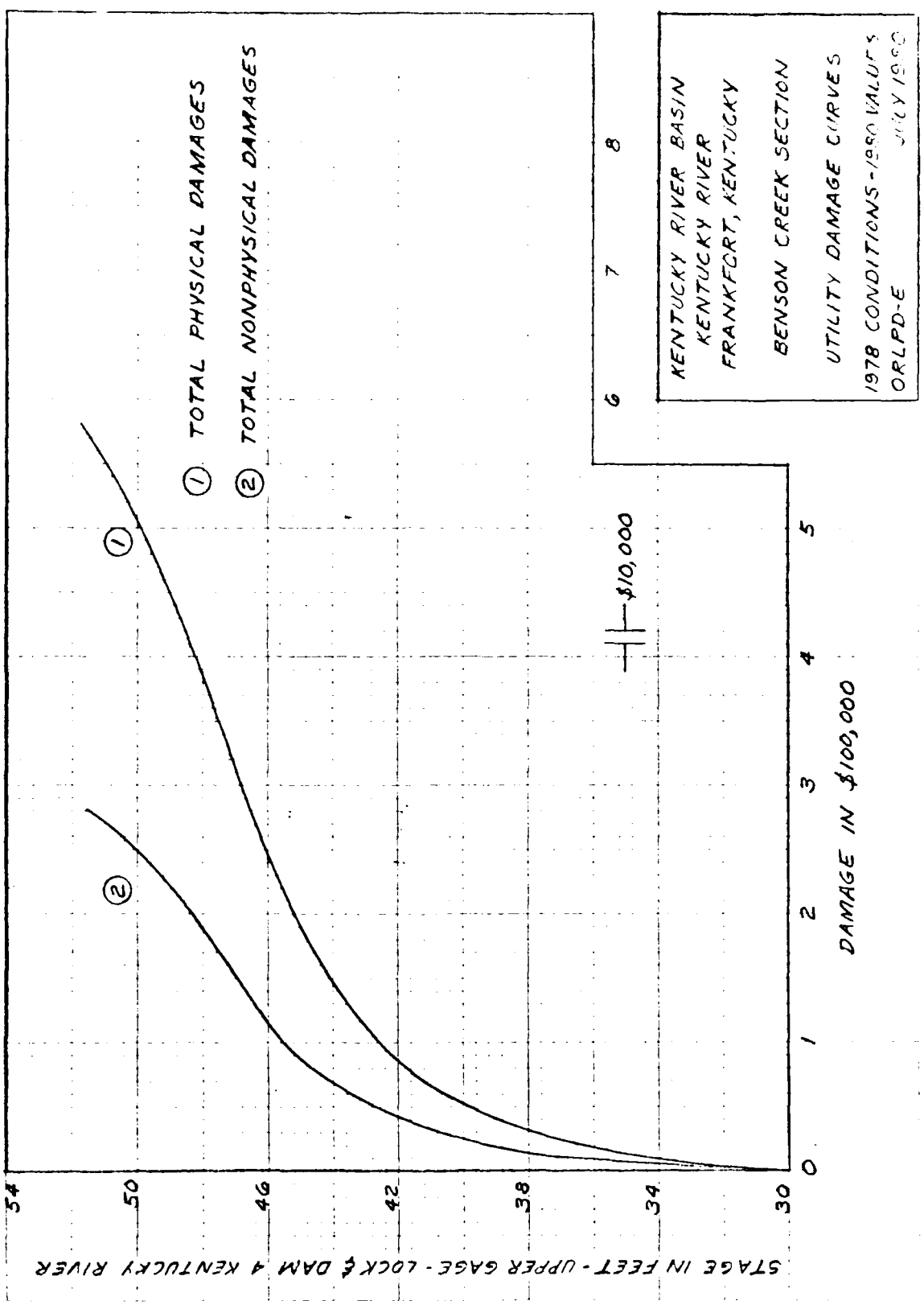


FIGURE E-18

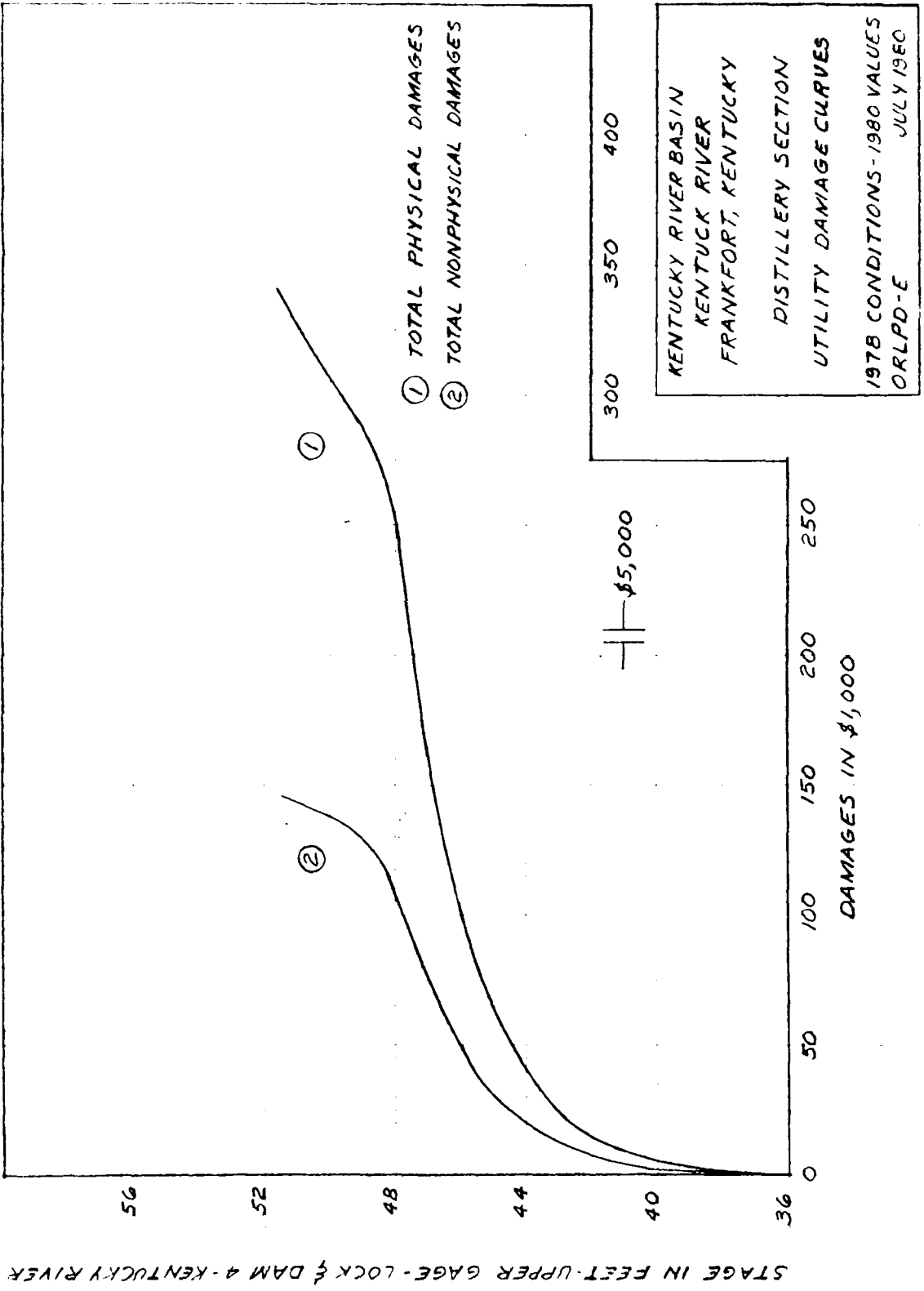
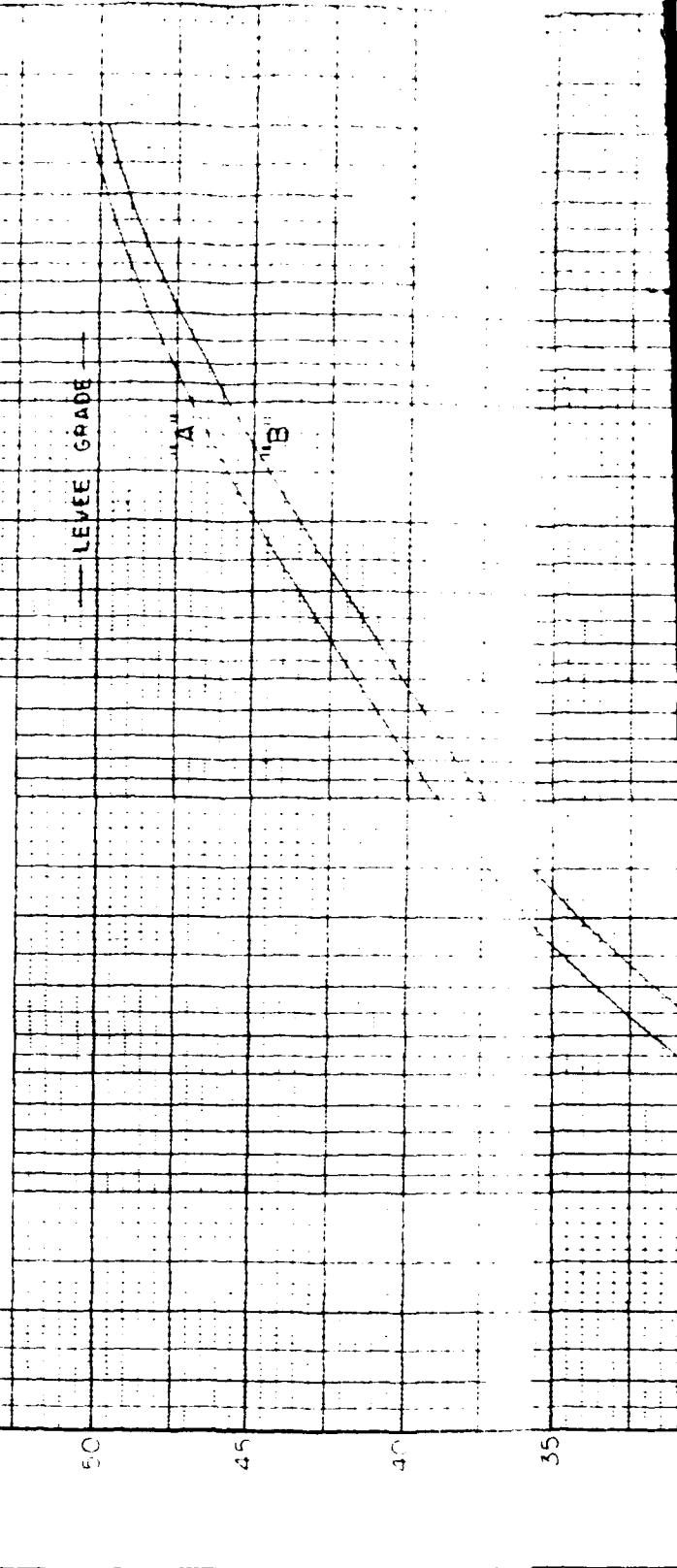


FIGURE E-19

FREQUENCY ANALYSIS BASED ON BULLETIN 17 (1976)
 Drainage Area - 5,412 Sq M. River Mile - 65.8
 Datum of Gage - 462.10 Feet above M.S.L. (1929 Adj.)
 Period of Record - 85 Years (1895-1979)
 Outliers Omitted - 1941 and 1954
 Historical Data Added - None
 Historicity Extended to - N/A
 Generalized Skew Applied - -0.50
 Base for Partial - 44,000 CFS or 18.9 Feet
 Discharges Applied to Rating Curve from USGS CoE Ext Proj
 Modified curves were based on 19 years of record
 (1961-1979) then adjusted to the 85 years.
 The seasonal curves were weighted to equal the
 All-Season curves
 Curve "A" - Natural, No modification
 Curve "B" - Modified by Buckhorn Lake, (Minimal
 reduction by Carr Fork Lake not included)



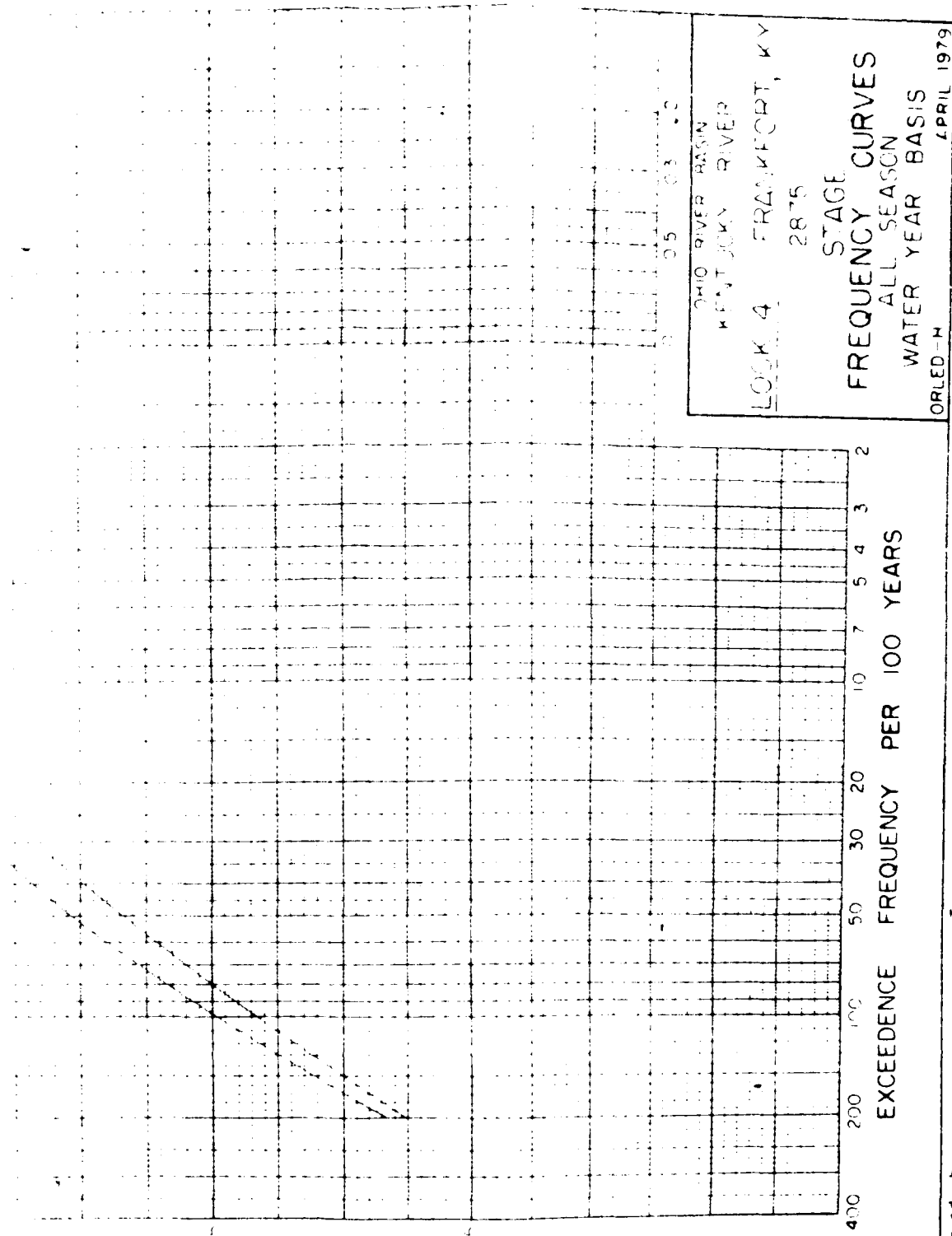
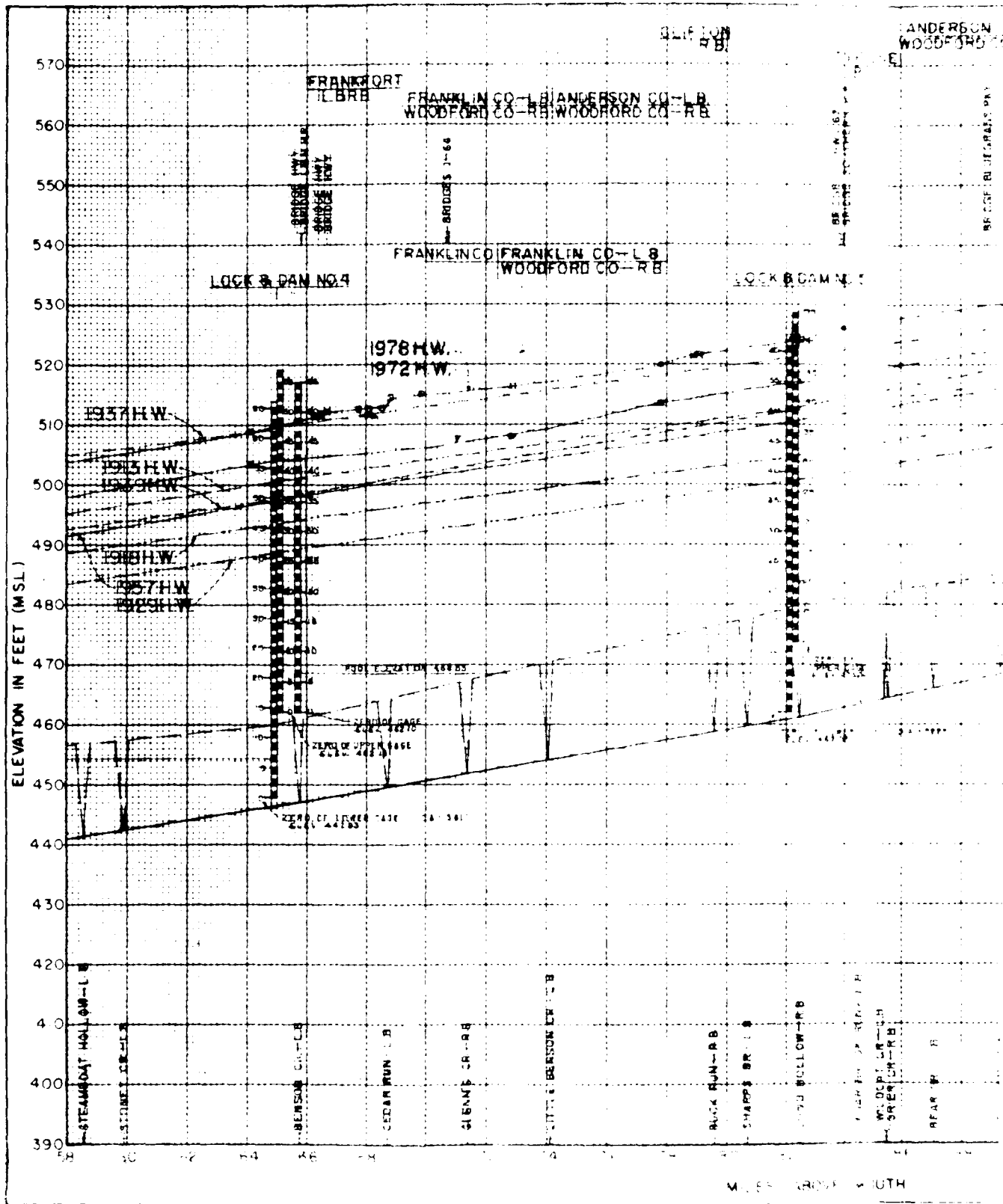


FIGURE E-20

Approved by _____ Transmitted to _____ on _____ 197

CORPS OF ENGINEERS



U.S. ARMY

ANDERSON CO - L.B.
MERCER CO - L.B.
WOODFORD CO - L.B.

MERCER CO - L.B.
WOODFORD CO - L.B.

OREGON

LOCK & DAM NO. 6

DAM NO. 5

ELEVATION IN FEET (M.S.L.)

LOW BANK

THALWEG

NOTE ELEVATIONS REFER
TO NATIONAL GEODETIC
VERTICAL DATUM OF 1929

KENTUCKY RIVER BASIN
MAIN STREAM KENTUCKY RIVER

PROFILE
FIGURE E-21

SCALE AS SHOWN
REVISED 1975
979

WALLOW - R.B.

EDWARDS - R.B.

W. COOPER - R.B.

454 - R.B.

W. COOPER - R.B.

LEAR - R.B.

BRISBY - R.B.

SHRYVER - R.B.

ABOVE MONTH

U.S. GOVERNMENT PRINTING OFFICE

PROTECTIVE RELEASE

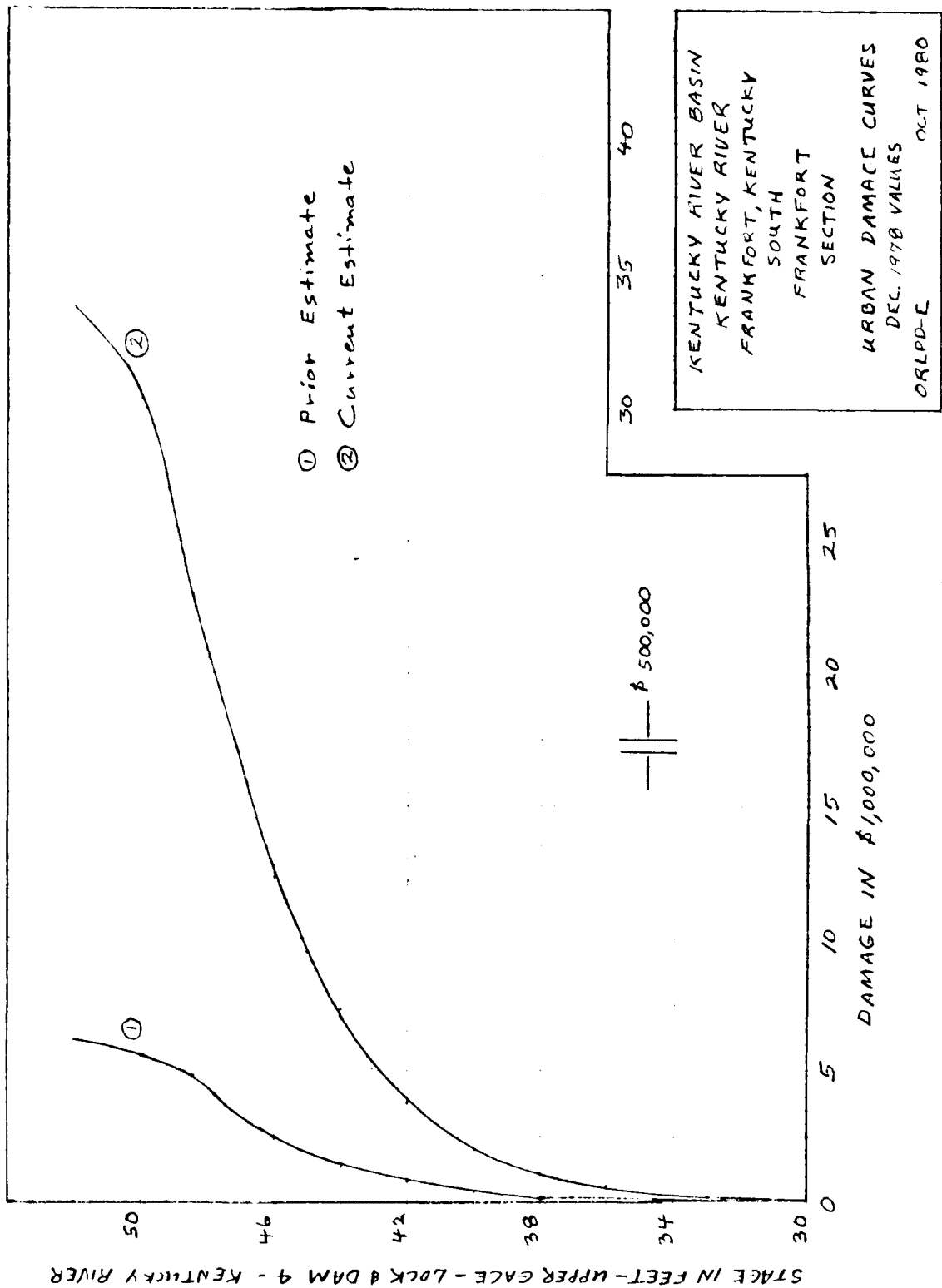


FIGURE E-22

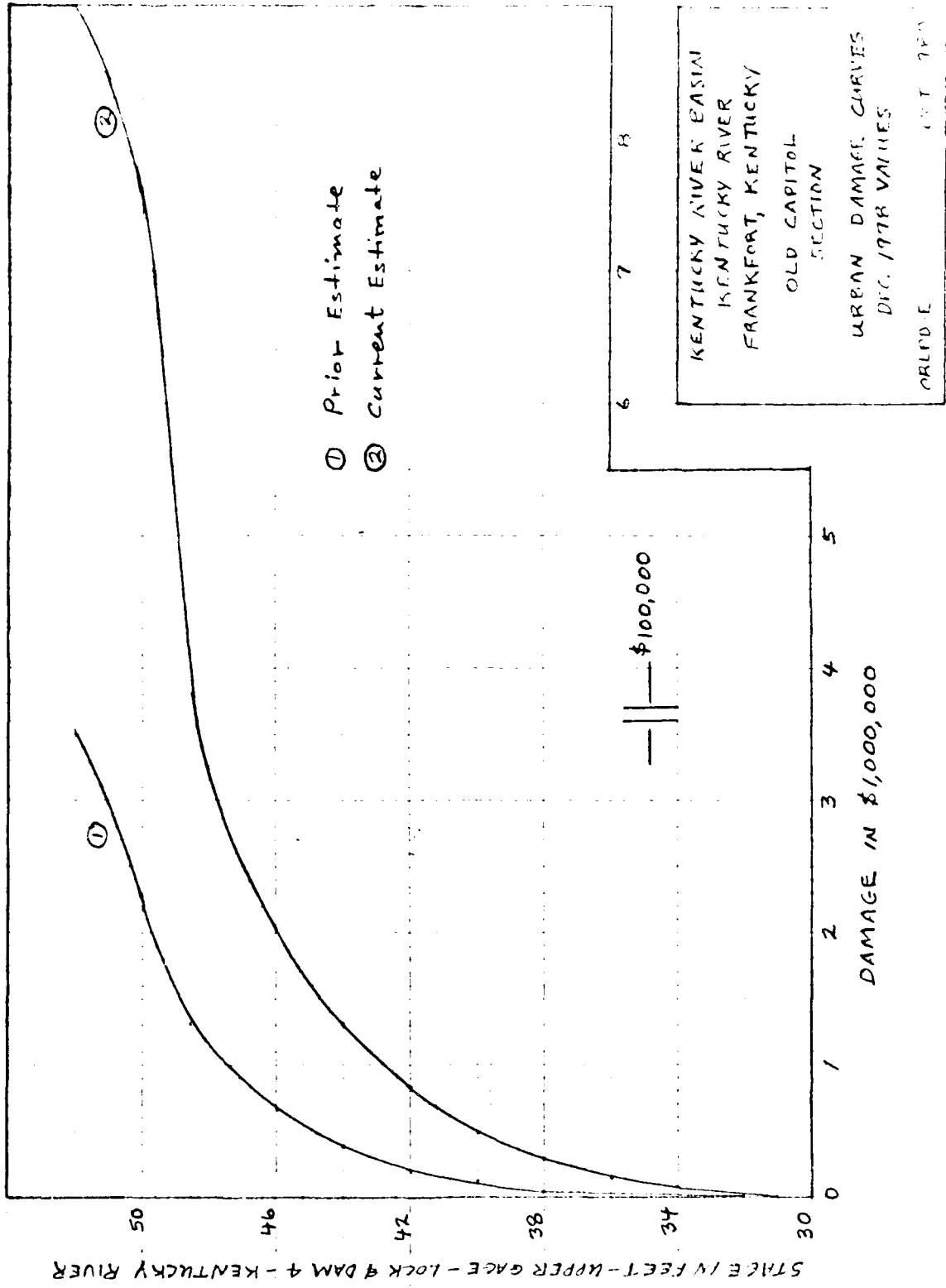


FIGURE E-23

AD-A164 942

FLOOD DAMAGE REPORT FOR FRANKFORT KENTUCKY(U) ARMY
ENGINEER DISTRICT LOUISVILLE KY S EDDIN ET AL. JUL 81
PD-E-12-86

2/2

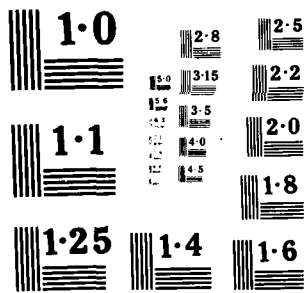
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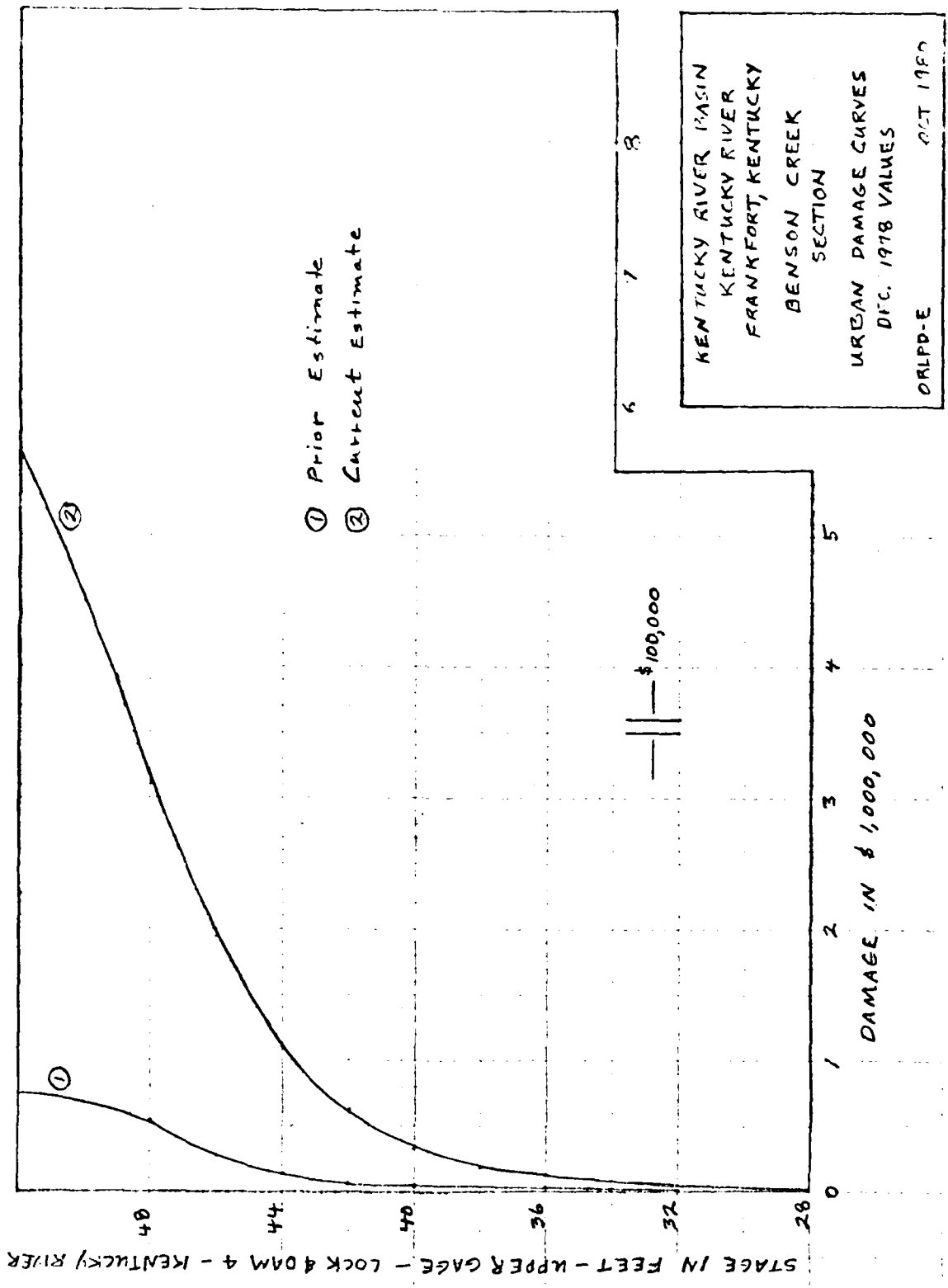


FIGURE E-24

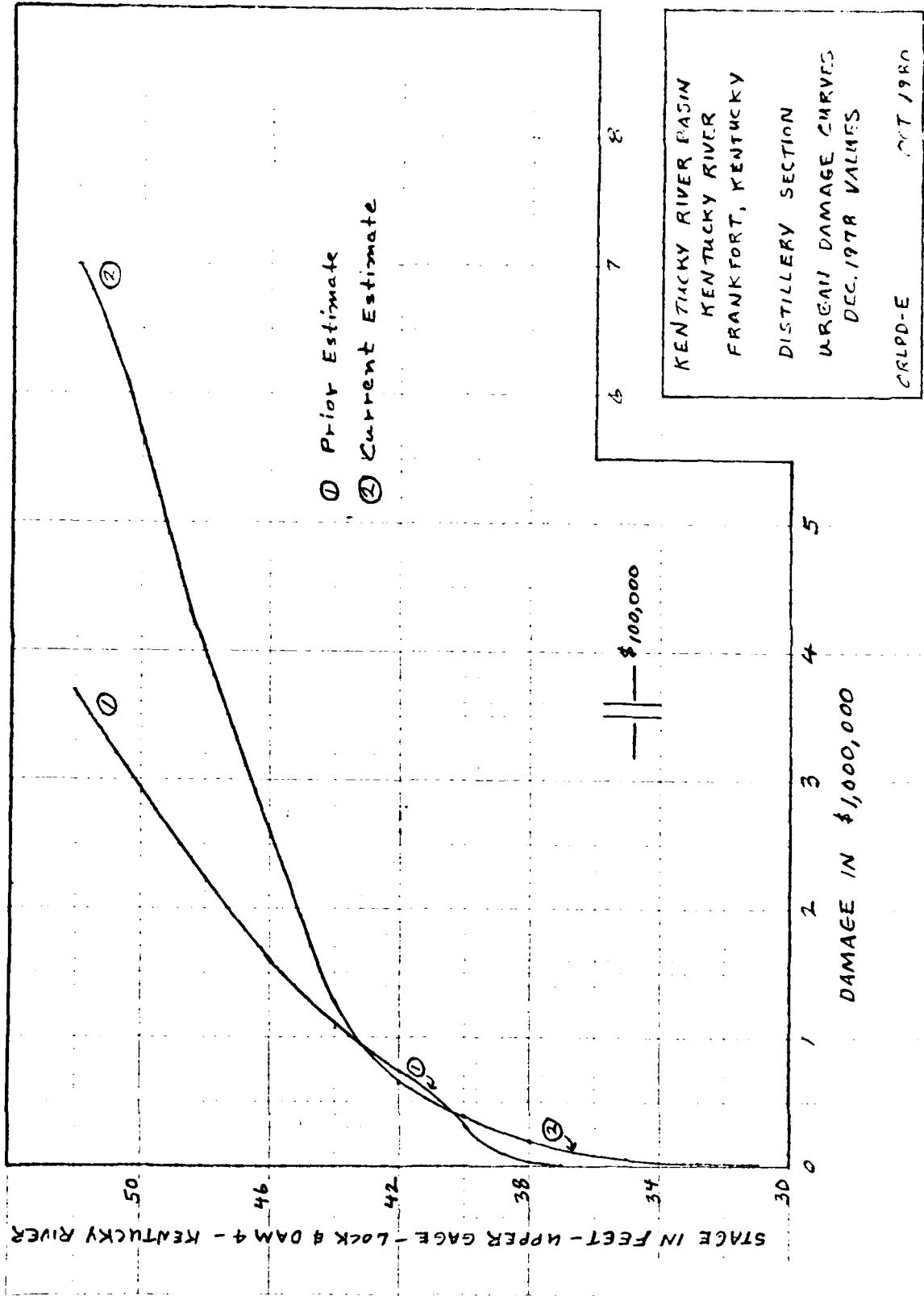


FIGURE E-25

NOTES

DRY WAGE AREA = 5.812 SQUARE MILES.

DATE OF GAGE = 1922. C. E. JENSEN, 1879 DATUM.

PERIOD OF RECORD = 41 YEARS (1895-1975).

COMPUTED FOR 1924, 1924, 1934, 1954 AND 1964 IN

COMPUTING ANNUAL EVENTS PORTION OF NATURAL

DISCHARGE - FREQUENCY CURVE (HISTORICALLY ADJUSTED TO 1977).

DATE OF REPORT OF SKETCHES = 1950, BASED ON

WATER RESOURCES CONTROL DISTRICTS, DATED MARCH 1974.

MODIFICATION NO. 11 - MADE BY BUCKHORN LAKE CANYON FORK LAKE HAF

VEGETATION SURVEY (FINAL REPORT AT SER 4 AND CONSIDERED TO

BE INCLUDED).

ESTIMATED TO BE PRESENT IN DESIGN TO THE JANUARY 1937

THE WATERSHED AREA IS NOT FEELING.

(LEVEE GRATED)

REFER

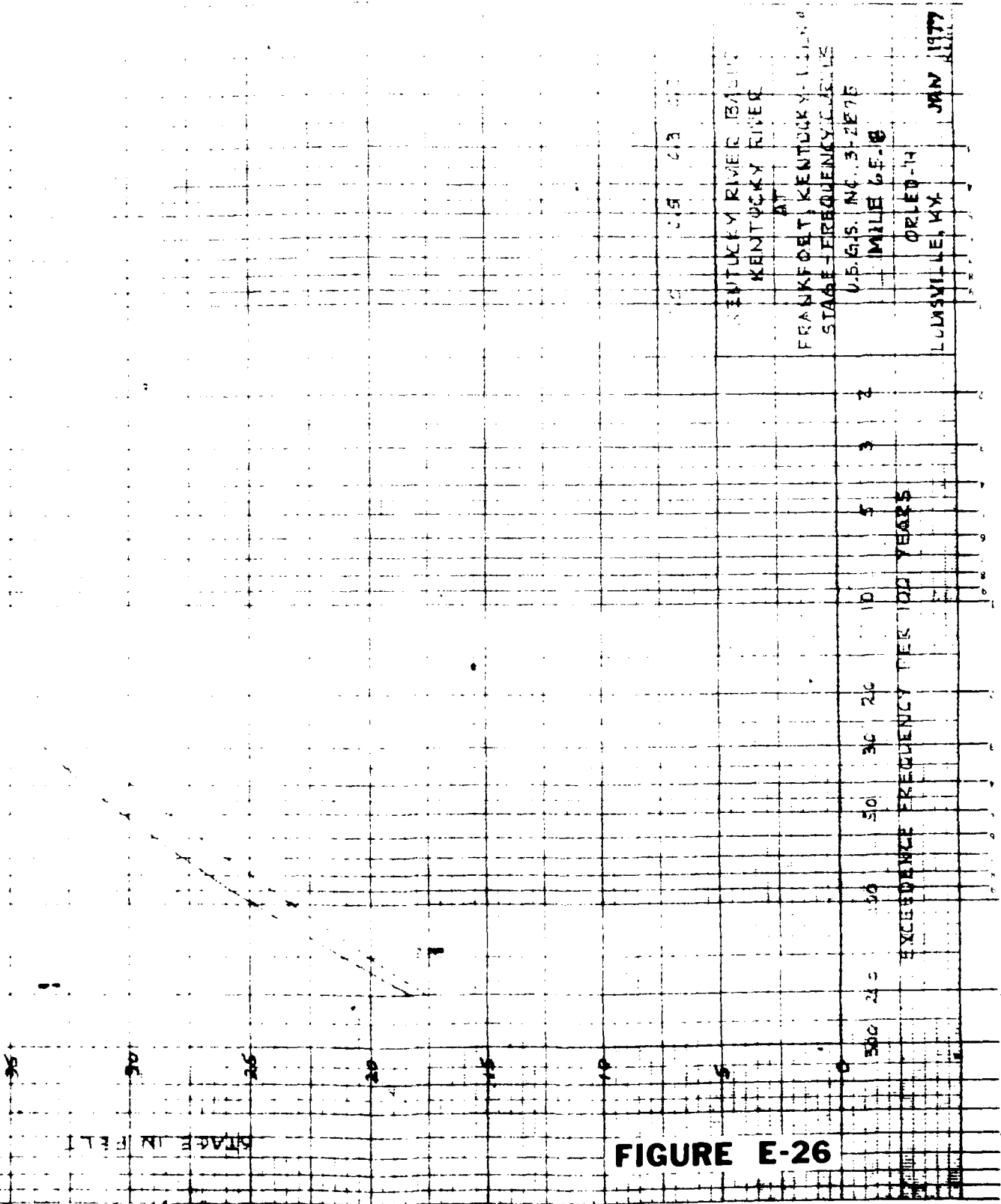


FIGURE E-26

12 119 613 573
 KENTUCKY RIVER BASIN
 KENTUCKY RIVER
 AT
 FRANKFORT, KENTUCKY - 111.0
 STAGE - FREQUENCY CURVE
 U.S.G.S. NO. 3-2275
 MILE 65-8
 ORLED-14
 LUISVILLE, KY. JAN 1977

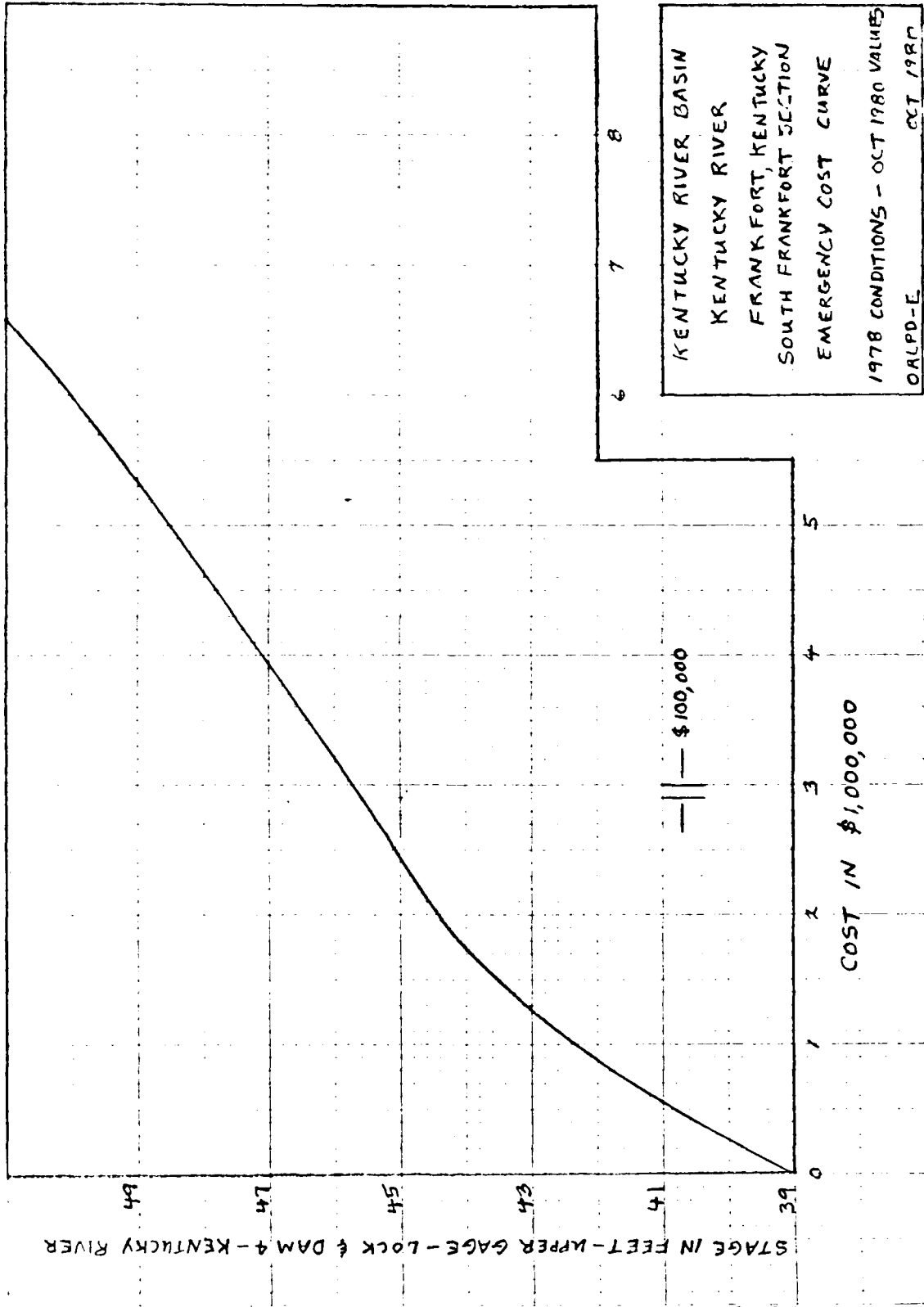


FIGURE E-27

NO. 30119 110 DIETZEN GRAPH PAPER
10 X 10 PER INCH

DIETZEN CORPORATION
MADE IN U.S.A.

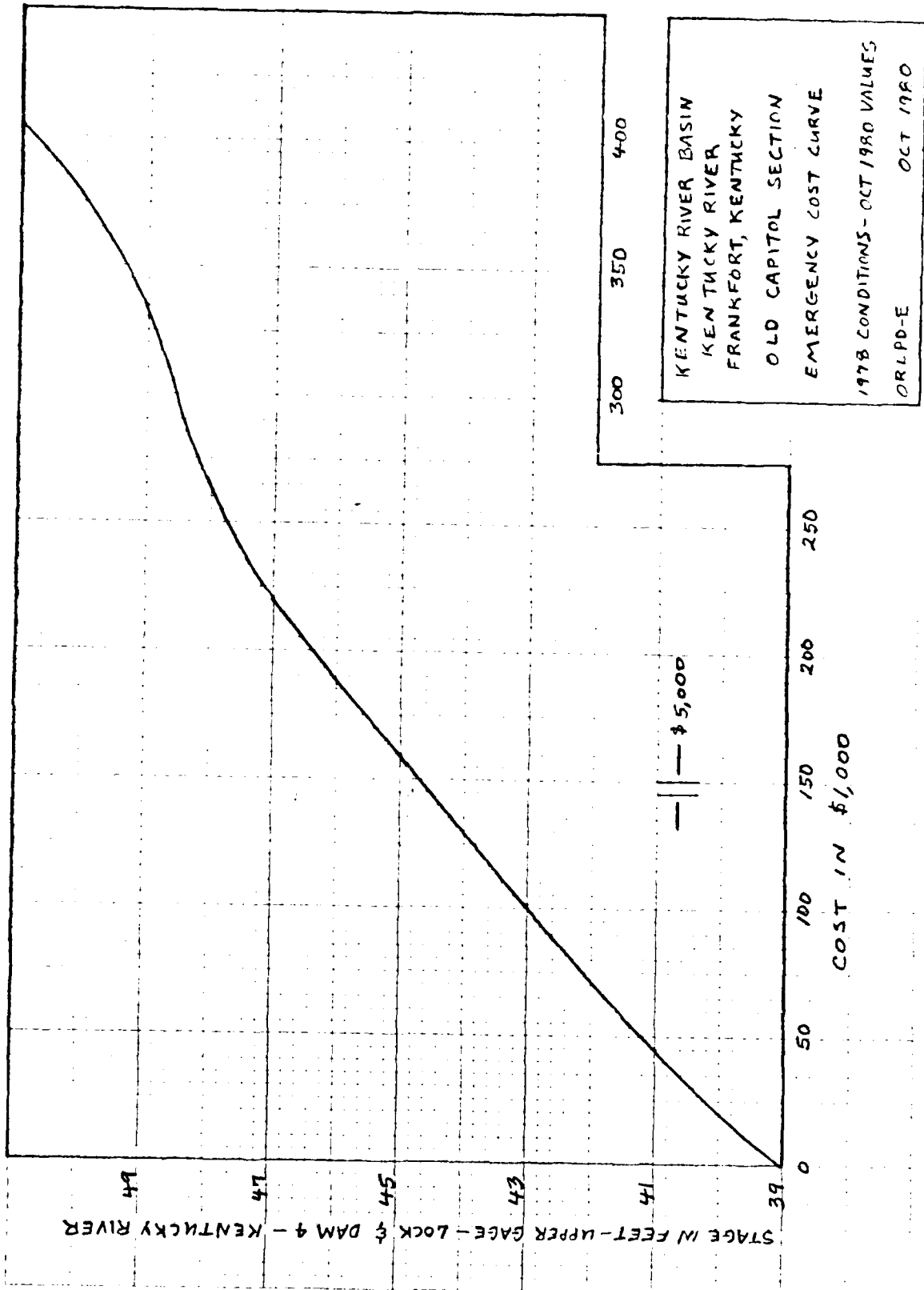


FIGURE E-28

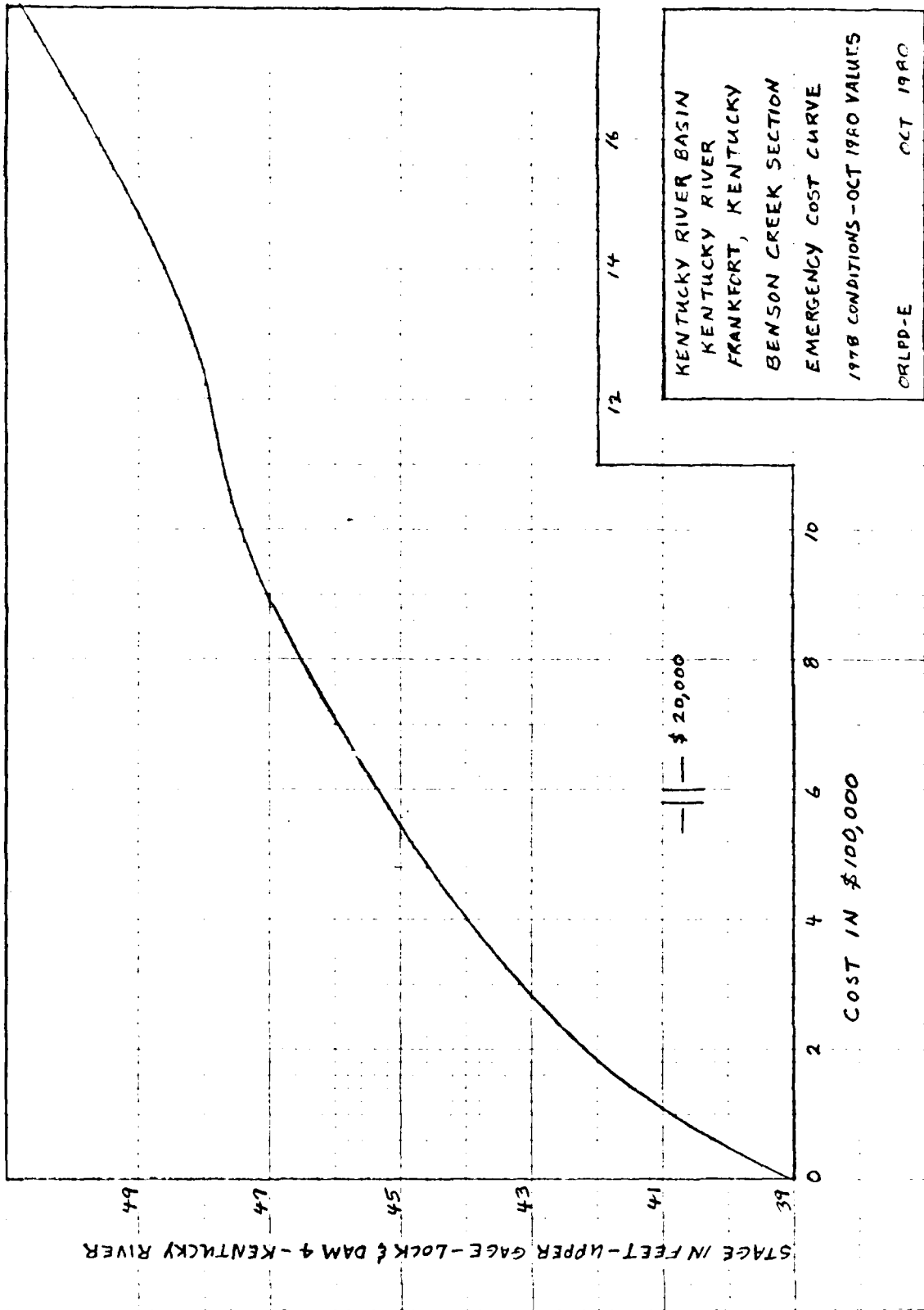


FIGURE E-29

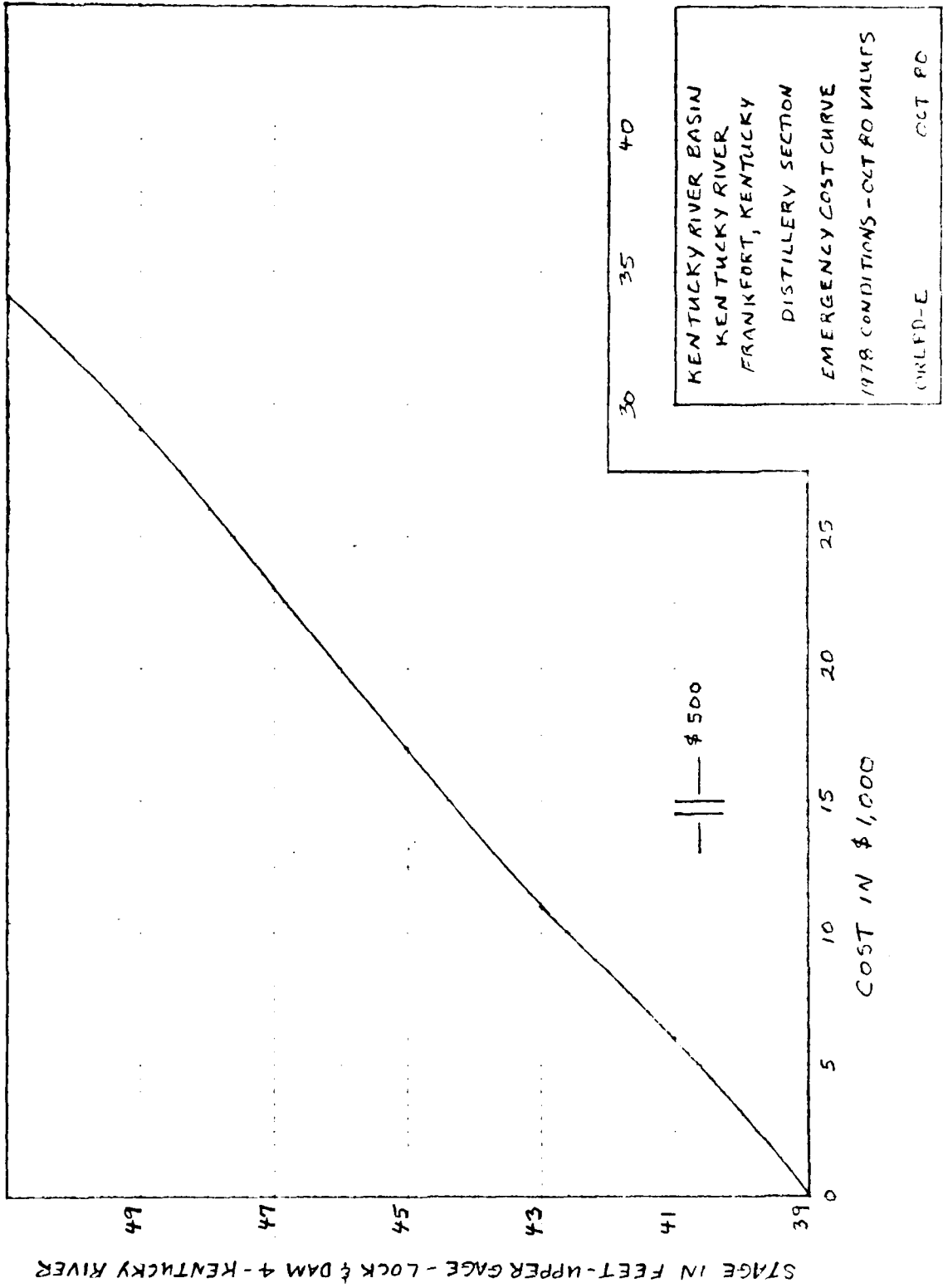


FIGURE E-30

SECTION F

APPENDIX

COORDINATION OF STUDY EFFORT

City Officials cooperated in the study effort and assisted the study staff both in obtaining flood damage information from sources within the city and in generating hard to obtain information through the city's initiative.

The study staff proceeded to identify all relevant sources of disaster relief and other information and to assemble a comprehensive body of legislations, Executive Orders, regulations, manuals, brochures and articles on the subjects of disaster relief and flood insurance.

A close perusal of acquired materials gave a general direction as to entities which would likely provide specific information on disaster relief and flood insurance concerning the December 1978 flood. It was necessary to identify at least one contact person within each entity who had and could authorize the giving of the desired information. This was accomplished through initial telephone inquiry, correspondence, and often travel. As the appropriate overtures of acquiring the information from each entity were followed, the study staff was able to collect data from public and private sources in Frankfort, Louisville, and Lexington, Kentucky; Atlanta, Georgia; and Washington, D. C. Numerous Federal, State, county and city agencies and private organizations and individuals participated in providing data. Since the convertibility of disaster information into flood damage and emergency cost estimates was largely unexplored and the data were irresilient to ready embodiment and availability, these agencies, organizations, and individuals assisted the study team in the effort of identifying and disaggregating relevant information, thus rendering an extraordinary service in support of the study effort. Especially the staffs of the State Disaster and Emergency Service Division (DESD) and the temporary Disaster Field Office (DFO) of the Federal Emergency Management Agency (FEMA) in Frankfort exhibited selfless cooperation, not only in providing voluminous disaster relief

data, but also in extracting data from aggregate and scattered sources. Meanwhile, the majority of residential property owners and renters, and owners or spokesmen of business, public, transportation and utility activities participated in direct survey interviews in which regular and disaster-related questionnaires were used. Obtaining flood damage information from railroads, businesses that left the flood site, and home offices of some businesses and organizations involved extensive correspondence and telephone communication.

Since appropriate techniques had to be developed for analyzing disaster relief data an effort to submit both data and analysis thereof to scrutiny by other opinions was pursued. Especially review of the materials and analytical techniques by Dr. George Antle of the Institute of Water Resources was helpful.

Sources of information on flood-related disaster cost and methodology of assessing disaster cost applicability and quantification were subject to a preliminary research effort which resulted in a paper on disaster cost and two approved disaster questionnaires for the residential and business surveys. Also, a new methodology was developed for quantifying other emergency cost, administrative cost of flood insurance, cost of traffic diversion, and non-traditional cost items.

IMPACT OF FLOOD INSURANCE

Underutilization of flood insurance prior to December 1978 was attributable in part to the initial indiscernibility of the FIP to most prospective users and the relative complexity surrounding the obtainment of flood insurance. Further, the tendency to view major future floods, as 100-year or 500-year events, looming too remote in terms of statistical probability to be of eminent threat, hindered the hedging against flood damages through flood insurance. Also, the relative unawareness on the part of some residents of the actual hazard in the flood plain was a contributing factor.

As the destructiveness of the December 1978 flood re-emphasized the advisability of flood insurance coverage, the number of subscribers has

increased considerably. The cost of flood insurance still discourages many lower income homeowners from subscription, even though the FIP is subsidized. Premium rates are based on location of property wherewith higher risk locations require higher rates, and conversely. The average premium per policy was \$84 in the year 1979 as reported by the Federal Insurance Administration (FIA). Federal loss per policy in force was \$104 based on \$166,992,000 FIP net loss for the year 1979 and 1,605,000 policies in force, as estimated in the Budget of the United States Government, FY 1979.^{1/} The estimated FIA net loss was the difference between total revenue from premiums of \$133,695,000 and total expense of \$300,687,000, including \$33,136,000 underwriting expense, \$139,935,000 insured flood losses and associated loss adjustment expense, \$114,000,000 estimated for detailed elevation studies and surveys to determine actuarial rates, and \$13,616,000 interest on borrowing needed to defray underwriting and loss expense. Of the \$104 average loss per policy, \$29 was estimated as the administrative cost per policy per year by FIA, including \$15 for commissions, \$5 for claim adjustment expense, and \$9 for other administrative expense. The estimated administrative cost of \$29 per policy per year was counted as flood damage for all eligible properties pursuant to the WRC procedures. Being a nonadministrative cost, the remaining loss of \$75 per policy was not counted. This loss represents \$71 per policy for studies and surveys and \$4 per policy in trade-off with flood damage as follows. The \$71 loss per policy is based on \$114,000 expense divided by 1,605,000 policies. The \$4 loss per policy is based on the difference of \$6,240,000 between losses in compensation of flood damage of \$139,935,000 and total revenue from premiums of \$133,695,000 divided by 1,605,000 policies. It appears that losses other than the \$29 annual administrative cost per policy represent a recurrent cost, the purpose and nature of which pose a problem for further research.^{2/}

^{1/} House Document No. 95-281, 95th Congress, Second Session, pp. 506.7.

^{2/} Another recurrent cost needing clarification is a fee of \$15 payable initially and upon renewal by subscribers, as reported by local insurance underwriters.

The WRC damage categories of income loss and emergency cost are not reimbursable from flood insurance and reimbursements for physical damage and are subject to specific limits. Under the emergency phase of the FIP, the insurable limits are \$200,000 for business (\$100,000 for structure and \$100,000 for contents), \$200,000 for multi-family residential (\$100,000 for structure and \$100,000 for contents), and \$45,000 for single family residential (\$35,000 for structure and \$10,000 for contents). Large business does not qualify for flood insurance. The city of Frankfort was in the emergency phase of the FIP at the time of writing.

EFFECTS ON ADJACENT FLOOD-FREE AREAS

Many flood-free businesses in downtown Frankfort indicated that they incurred income losses either as a result of the imposed curfew or due to the unavailability of utility services. Some contributed time and/or money to the disaster alleviation effort. In addition to a survey of physical damages and income loss made by the District of all businesses in flood-prone areas, a special city-wide mail survey was made through the initiative of the city of Frankfort for the purpose of assessing business income losses in the flood-free areas. With about 20 percent return on the special survey, it appears that significant but unreliably determinable income losses of about \$1,445,000 may have been incurred by businesses in the adjacent areas, largely by retail trade. The special survey aimed to assess whether increase or decrease in projected sales, or sales difference from the previous year, had occurred in the flood-free areas. No significant sales increase was reported; some businesses in the flood-free areas reported no significant difference; some reported significant quantified decrease; and some reported unquantified decrease. In this respect, a flood-free car wash business reported that cars could not be washed because the city water supply was turned off. Retailers reported that customers were turned back during the curfew. Businesses with answering service in some parts of the city could not operate without telephone service. A lawyer reported that he could not go to his flood-free office because of governmental imposition and a doctor's office was too affected by

utility disruption to conduct the usual schedule of activities. However, business income losses outside a flood plain are usually considered a trade-off with income gains in unaffected areas. Hence, these losses were not considered in this study. Arguments for and against counting such losses are given below, since there is a degree of uncertainty relative to rule 713.33 (F) in Procedures (Part IX) of the Water Resources Council.

Income losses from lost sales of household consumption goods may have resulted in indirect income losses to retailers, wholesalers, truckers, manufacturers, and service providers in the residential (nonexport) general market area. At least five arguments have floated in the practice and theory of flood damage concerning counting such indirect income losses. One, such losses are intangible because they cannot be reliably quantified. It is true that such losses are resilient to quantification by means of a survey, but they can be practically quantified through inter-industry earning share ratios in relation to the known income losses of at least one industry. The surveyed retail trade income losses could be used for this purpose. Two, retailers, wholesalers, truckers, manufacturers, and service providers outside a flood site usually shift their sales activity to areas other than those affected by the flood. Yet, this does not apply always to residential (nonexport) industries, especially during a major flood disaster in the general market area. A retailer whose undamaged inventory is not sold as expected, due to the flood, incurs income losses and reduces new orders to restock that inventory. Consequently, his residential supply sources including wholesalers, truckers, and manufacturers incur income losses conterminously. Three, household consumption goods which are not sold during the flood are marketed later. This argument does not apply invariably, especially in relation to the Christmas season pattern. Christmas shopping goods are predominantly nonrecurrent presents and items typical of the season. Four, business income losses resulting from sales decrease of household consumption goods in the directly affected areas coincides with sales increase in adjacent areas. Although this argument has validity in some situations, it tends to eradicate the basis of counting any business

income losses and contradicts the survey made by the city of Frankfort which indicated the occurrence of business income losses in other parts of the market. Yet, given the assumption that transfer sales occurred in Lexington, Kentucky, which is located about 25 miles away, those who went to shop in Lexington must have spent additional time and driving expense which were not considered in this study. Five, household income during the flood would be less than business sales decrease, if such indirect losses are considered. Nevertheless, Christmas shopping typically reflects expenditures composed largely of saved and/or borrowed income far in excess of the income earned at that time.

Assuming that the relationship between the reduced sales of household consumption goods and the earning share of retail trade has a cyclical impact on the earning share of other residentiary industries and services, the impact cannot be evaluated solely from data collected in the traditional survey without additional research. Transfer sales opportunity for wholesalers, truckers, manufacturers and service providers in the residentiary market area was limited by both nonexport scope and the widespread disaster situation during a business season known to be uncommonly productive of business profits. Given that retail trade is a part of a cycle, then its income losses, which were surveyed, may have caused income losses in the residentiary market beyond the areas which were directly affected. Otherwise, intangible business income losses would be those incurred by some other wholesalers, transporters, manufacturers, and service providers whose inputs are imported or exported extraneously and, as such, may or may not have had alternative sales opportunities.

EFFECTS ON THE PUBLIC SECTOR

Damages to the local public sector were subject to a special survey investigation involving extensive correspondence, interviewing, and telephone calling, which resulted in obtaining comprehensive well-documented estimates of physical damage, income loss, and emergency

cost, especially those incurred by the city, county and State governments. As a result of the Presidential disaster declaration, eligible physical damages reported on FEMA disaster (DSR) forms by agencies of State and local governments were subject to reimbursement for Repair, Replacement or Restoration (RRR) of affected property by the Federal Emergency Management Agency (FEMA) pursuant to the Disaster Relief Act of 1974. Some physical damages such as those incurred by city schools were subject to full reimbursement by the Federal government. Yet, not all physical damages to public facilities were fully reimbursed. The State of Kentucky sustained \$2,570,000 largely in physical damages other than those reported on DSR forms, apparently as a Federal matching requirement. Further, compensation of publicly incurred flood-related income loss or emergency cost from Federal disaster relief was unavailable except in case of expenditure made in connection with physical damage. Therefore, besides public damages for which there was compensation, additional flood damage incurred by local and State governments consisted of lost employee time, overhead, damages which did not meet FEMA criteria, matching from State sources, and some emergency cost items. Also, loss of local and State tax revenues are not reimbursable from Federal disaster relief sources.

Since erosion of public local and State revenues as a result of flood damages echoes strong concerns by public officials, income tax and sales tax losses to the State and ad valorem property tax loss to the county and the city represent real fiscal losses occurring within a "balanced budget" general concern. Such losses, having been unsupported by a firm precedent in terms of eligibility for counting, were not considered in this report.

Five percent of all business sales lost represent a State sales tax loss which was not estimated. Property tax loss may or may not occur as a result of flood damage. Property tax is scarcely affected by flood damage in that historically little or no adjustment is made by local taxing authorities in response to flood-related decreases in flood plain property market value. However, considering that the local taxing authorities recognize such decreases by devaluation and lowering of

ad valorem taxes accordingly, which is the case in Franklin County and the city of Frankfort, the resulting losses of about \$46,000 annually to the State, and county and the city are viewed as real damage by the community.

During the December 1978 flood, State spokesmen expressed concern over erosion of State income tax revenues due to business and labor income losses resulting from floods. In this connection, there is some typical uncertainty concerning availability of accurate data on income tax revenue losses for two main reasons. One, information on such losses is not kept and released by affected public entities. Two, although affected workers and commercial establishments could theoretically estimate the portion which would have been paid in income tax within estimates of their net income loss, existing survey questionnaires do not permit questions to this effect.

EXISTING NONSTRUCTURAL MEASURES

Although this study does not evaluate any nonstructural or structural plans, several existing nonstructural measures are discussed in terms of current and potential applicability. These measures include temporary evacuation, flood plain management, flood insurance, flood-proofing, and disaster assistance.

Temporary evacuation is subject to an evacuation plan which is being prepared by the Louisville District. The plan will provide safeguards against loss of life, injury, and unnecessary loss of movable property during that critical period when a flood danger becomes imminent. The plan is limited by its temporary nature and by being a precautionary measure which does not reduce inundation.

Flood plain management measures such as subdivision regulations, building code and sanitary regulations are enforced by the city. However, these measures are largely preventive of additional flood damage which could otherwise result from further development in the flood-prone

areas. The appropriate enforcement of these measures assures qualification of the city for the Federal flood insurance program and serves as a prerequisite for any Federally funded structural solutions.

Flood insurance provides means of compensation for physical flood damage incurred by property owners up to certain limits. The city of Frankfort has participated in the flood insurance program since 1974 and is currently in the process of preparing a flood insurance study aiming to refine regulatory measures required for continued participation. The city is currently in the emergency phase of the program. The flood insurance study would be reviewed upon completion and if approved would transfer the city to the regular phase of the program. As a nonstructural solution, flood insurance is limited by both certain limits regardless of the amount of damage above the limits and the eligibility of residential and small-business physical damages in exclusion of income loss and emergency cost. Also, flood insurance is not applicable to large business.

Floodproofing was not pursued significantly and the likelihood that flood plain dwellers would pursue this measure instead of relying on flood insurance, disaster assistance, subsidized loans for damage repair and tax reductions is unknown.

Federal disaster assistance under several programs may be available depending on whether a major disaster or an emergency is declared by the President. The full range of assistance which was available under the December 1978 major disaster declaration would not be available under a declaration of an emergency which would provide specialized assistance to supplement State and local efforts to save lives and protect property, public health and safety or to avert or lessen the threat of a disaster. Nonfederal disaster assistance is provided by nonprofit organizations such as the Red Cross, Salvation Army, and Mennonite Disaster Service. The emphasis of this assistance is on preserving life and health and meeting emergency needs and is usually available wherever it is needed with or without a Presidential declaration. Other assistance is available without or with a Presidential declaration. The SBA,

under its own jurisdiction, also provides home repair and business repair low interest loans in connection with lesser floods. Further, income tax deductions are allowed by the IRS and the Kentucky Department of Revenue on physical damage, without or with a disaster declaration. As nonstructural solutions, these types of assistance are limited by their inability to reduce flooding, by transferring some of the losses to society, and in case of FEMA programs, by being contingent upon a prior declaration for their availability.

SOURCES OF INFORMATION

A large volume of information can be acquired from non-traditional sources, especially in case of a Presidential declaration of a major disaster. Pursuing the appropriate overtures and identifying the appropriate contacts are essential to obtaining the desired information. Since some information cannot be obtained on the telephone or by correspondence, personal judgment is necessary. An exhaustive listing of sources is beyond the scope of this report which deals with a particular urban area. Insofar as the subject flood is concerned, the main sources of information, beyond the residential and business surveys, are listed in Table F-1 below. The sources in this table do not include those connected with a disaster in a rural area. Information on quantification can found in Section D. Many sources in Table F-1 and some quantification methods in Section D can be used in data collection and analysis in any flood damage evaluation.

TABLE F-1
 MAIN NON-TRADITIONAL SOURCES OF INFORMATION
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

SOURCE	LOCATION	INFORMATION
1. FEDERAL		
U.S. Office of Education	Wash., D.C.	Grants to affected schools
HEW Regional Office	Atlanta, GA	Travel and salary payments*
Social Security Admin.	Louisville, KY	Travel and salary payments*
Bureau of Unemployment Insurance, U.S. Dept of Labor	Atlanta, GA	Disaster Unemployment Compensation Salary payments*
U.S. Nutrition Service	Atlanta, GA	Emergency food Salary payments*
SBA, District Office	Louisville, KY	Residential and business repair loans. Average loan period and interest rate. Salary and travel payments*
SBA, Regional Office	Atlanta, GA	Loan servicing cost of journeymen and attorneys
IRS, District Office	Louisville, KY	Salary and travel payments*
IRS, Office of the Commissioner	Wash., D.C.	Aggregate disaster tax deductions
Veterans Administration	Louisville, KY	Salary and travel payments*
National Weather Service	Louisville, KY	Salary payments*
USCE, Louisville District	Louisville, KY	Estimate of SIA cost Estimate of overhead cost Estimate of damage to Corps facilities Evac. plan for Frankfort
FEMA, Central Office	Wash., D.C.	Pubs. on disaster relief
FEMA, Regional Office	Atlanta, GA	Payments to USCE, EPA and Federal Hwy Admin. for recon. work. DFO disaster budget outline

TABLE F-1 (Continued)

SOURCE	LOCATION	INFORMATION
FEMA, DFO (Temp. office)	Frankfort, KY	Cost of temp. housing and furniture programs Cost to FEMA of employees borrowed from other agencies. Cost to home agencies of employees loaned to FEMA
HUD, Louisville Area Office	Louisville, KY	Cost of Disaster Housing Rehabilitation Administrative cost
FIHM	Wash., D.C.	Aggregate flood insurance claims in Frankfort
FIA	Wash., D.C.	Flood insurance administrative cost per policy
2. STATE		
State Disaster and Emergency Division	Frankfort, KY	Cost of IFGP, LHR and public assistance State matching cost State uncompensated damage Salary and travel payments*
KYDOT	Frankfort, KY	Traffic count on affected roads under normal conditions. Average number of passengers per vehicle
KY National Guard	Frankfort, KY	Cost of rescue & evacuation
KY Dept. of Finance	Frankfort, KY	Salary payments to State employees on administrative leave
KY Audit Office	Frankfort, KY	Cost of grant auditing
Ky Dept of Human Resource	Frankfort, KY	Cost of grant review Salary payment*
Ky Dept of Agriculture	Frankfort, KY	Cost of emergency food
KY State Policy	Frankfort, KY	Emergency work and curfew enforcement

TABLE F-1 (Continued)

SOURCE	LOCATION	INFORMATION
KY Consumer Health Svc	Frankfort, KY	Cost of health inspection and destroyed goods
ILDOT	Springfield, IL	Methodology on value of motorist time per trip purpose
3. LOCAL		
Health Department	Frankfort, KY	Information on mass food and clothing distribution
Franklin County	Frankfort, KY	Information on property devaluation and ad valorem tax losses Salary payments to employees on administrative leave
City Emergency Office	Frankfort, KY	Flood-related fires, donated ambulance services and emergency preparedness
City Planning Office	Frankfort, KY	Survey of damages in adjacent areas
City Police	Frankfort, KY	Cost of emergency work and curfew enforcement
City	Frankfort, KY	Salary payments to employees on administrative leave
4. PRIVATE		
Red cross, Regional Office	Atlanta, GA	Cost of emergency services and volunteer time
Salvation Army, State Office	Frankfort, KY	Cost of emergency services and volunteer time
Mennonite Disaster Service (temp. office)	Frankfort, KY	Cost of emergency services and volunteer time
Blue Grass Community Action	Lawrenceburg, KY	Disaster assistance. Salary and travel payments*

* Payments incurred by agency in connection with disaster relief activity.

APPLICATION OF TRAFFIC DIVERSION UNIT COST TO OTHER STUDIES

Similarities in trip generation between urban areas have been reported in transportation research, and some research studies have reported the transferability of trip rates between small urban areas on the basis of number of households and rough estimates of the economic base.^{1/} Assumably, households in small urban areas, of up to 100,000 population, are expected to generate sufficiently proportionate vehicular trip rates, especially when locational differences in terms of socioeconomic and physical characteristics are considered to be insignificant. Frequently, locational differences among small urban areas within a river basin are inconsequential. Given sufficiently similar characteristics, it can be assumed that traffic disruption as a result of flooding may affect some small urban areas similarly in terms of traffic diversion cost per household per day, depending on whether flooding occurs in a high impact area, a medium impact area, or a low impact area within a community.

In situations where a traffic count on flooded routes is not available, the methodology of deriving traffic diversion cost in Section D cannot be employed, although the cost per household per day in Section E, Table E-7, can be used in case of traffic disruption in urban communities with characteristics and conditions similar to those of Frankfort during the 1978 flood. An alternative approach is suggested for estimating traffic diversion cost per household per day in similar urban areas of continuous physical boundaries^{2/} where traffic disruption affects a medium impact area and/or a low impact area, or affects a high impact area less extensively. Based on conditions and findings of this study, traffic diversion cost can be estimated for other small urban areas as suggested in Table F-2.

^{1/} For an analytical view of these phenomena, see Transportation Research Board, Transportation Planning for Small Urban Areas: National Cooperative Highway Research Program Report 167, (Appendix Section), Washington, D.C. 1976.

^{2/} For instance, Fairfield and Hamilton, Ohio, can be considered as one urban area.

TABLE F-2

TRAFFIC DIVERSION COST PER HOUSEHOLD PER DAY
 SUGGESTED FOR OTHER URBAN AREAS
 KENTUCKY RIVER, FRANKFORT, KENTUCKY

Affected Area Within a Community	Traffic Routes	Range of Cost per Household per Day for all Community Households
High Impact Area	Primary	\$ 8.91 - \$ 13.35
Medium Impact Area	Secondary	4.46 - 8.90
Low Impact Area	Tertiary	.01 - 4.45

It should be noted that the cost per household per day of \$13.35 in Section E, Table E-7, was disaggregated into three ranges for three different impact areas. If more than one impact area is affected, the upper range of cost should be considered. A high impact area is generally one in which flooding occurs where main roads dominate and/or main business activities exist. A medium impact area is generally one in which flooding occurs where secondary road traffic and/or residential and business activities are generally known to be exceeded by those of a high impact area within the same community. A low impact area is generally one in which flooding occurs where tertiary road traffic and/or residential and business activities are generally known to be exceeded by those of high impact and medium impact areas within the same community. Where flooding largely occurs in a marginal area such as vacant land, with alternate traffic routes, the cost is not applicable. Very small communities cannot be divided into different impact areas regardless of where flooding occurs, so personal judgment should be used.

The number of households can be obtained from the Census of Housing. The level of impact (high, medium or low), relative to affected traffic routes and/or community activities, can be determined from transportation and zoning maps in consultation with traffic and urban

planning officials, preferably after site inspection. Selection of cost per household per day, within the cost ranges in Table F-2, can be estimated by the study planning team through a consensual judgment, with due consideration of conditions which tend to worsen or improve flow of diverted traffic such as proximity and capacity of alternate routes, weather, and seasonal activity.

This alternative approach should not be used when traffic count is available and usable, and its use should be preceded by a thorough consideration of relevant factors as empirically observed, in view of the appropriate flood frequency.

In case some urban areas are expected to have socioeconomic and/or physical characteristics significantly different from those of Frankfort, the planner may resort to the factoring of auto ownership, median family income, accessibility and other factors, as applicable. For this purpose the Appendix section of the National Cooperative Highway Research Program Report 167 ^{1/} can be consulted as a source.

^{1/} Loc. Cit.

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