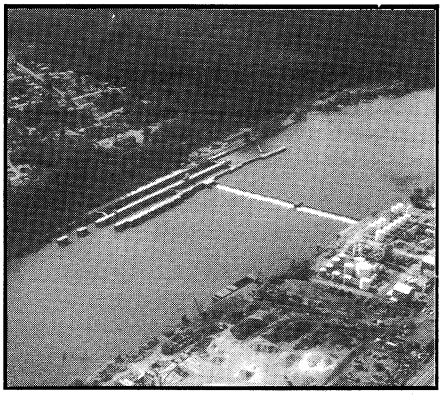
US Army Corps
of Engineers
Pittsburgh District

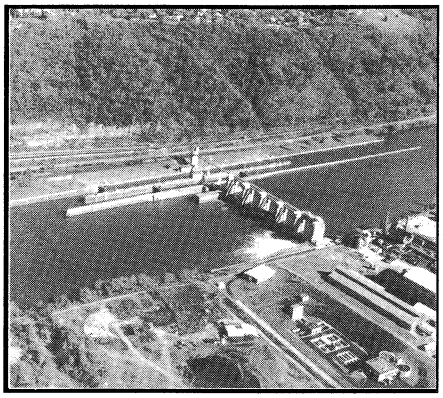
Lower Monongahela River Navigation System Feasibility Study

Interim Report



Locks and Dam 3

Locks and Dam 2



Locks and Dam 4

Volume 4 of 6

Hydraulics, Hydrology, and
Cost Analysis Appendices

FINAL
December 1991

LOWER MONONGAHELA RIVER NAVIGATION SYSTEM STUDY

FEASIBILITY REPORT

VOLUME 4

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HYDRAULICS

HYDROLOGY

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APPENDIX

HYDRAULICS

U.S. Army Engineering District, Pittsburgh
Corps of Engineers
Pittsburgh, Pennsylvania

MONONGAHELA RIVER NAVIGATION SYSTEM
PENNSYLVANIA
LOCKS AND DAMS 2, 3 AND 4

HYDRAULICS APPENDIX

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HYDRAULICS APPENDIX

1. STUDY SCOPE AND DESCRIPTION OF EXISTING STRUCTURES

a. Scope Of Study

Hydraulic features of existing Locks and Dams 2, 3, and 4 on the Monongahela River are summarized and deficiencies identified. Structural modifications that may be appropriate if a major rehabilitation were undertaken are discussed. Various replacement alternatives are examined with comparative hydraulic data presented for all options considered. Results of more detailed investigations of the seven most promising comprehensive replacement plans are given. Features of the recommended plan are discussed further in the ENGINEERING TECHNICAL APPENDIX.

b. Existing Structures Description

i. Locks and Dam 2

This structure is located at river mile 11.2 and consists of a landward chamber 110 feet (ft) by 720 ft, a riverward chamber 56 ft by 360 ft, and a 748 ft fixed crest dam. Normal lift is 8.7 ft from the Emsworth pool, elevation 710.0 to Pool 2, elevation 718.7. All elevations are in feet above the National Geodetic Vertical Datum. The dam dates to 1905 but was modified in 1919 to provide the present fixed concrete weir. The dam is supported on timber piles with an adjacent high apron on the downstream side which is on rock-filled cribbing. Severe erosion below the apron was repaired in 1987 by placement of stone protection across the entire dam which should prevent similar problems in the future. The concrete is eroded causing uneven flow over the dam with the possibility of settlement as a contributing factor.

The present locks were built during the years 1949-1953. Both locks are filled and emptied via side-port systems with the large lock utilizing both land and middle wall culverts and small lock only the river culvert. The 56 ft lock is provided with emergency bulkheading facilities which enable it to also be used as a floodway during high river flows. The typical reduction in upper pool stages attributable to the floodway is 1.7 ft for the one-year flood, diminishing to 0.3 ft for the 10-year flood. The 110 ft by 720 ft lock is equipped with an emergency closure; however, it never has been placed under emergency conditions and doubts exist concerning its capabilities. A minor navigation problem exists in the upper approach where an outdraft is caused by flow contraction at the end of the guard wall which is aggravated at times by discharge from Turtle Creek, a tributary which enters in this area.

ii. Locks and Dam 3

Located at river mile 23.7, this project originally was placed in operation in 1907, and included twin 56 ft by 360 ft locks and a 670 ft gated dam. The dam was converted to a fixed weir in 1919. The land lock was extended in the downstream direction in 1923-1924 to produce the present 56 ft by 720 ft chamber. Lift is 8.2 ft to Pool 3, elevation 726.9. Major rehabilitation of the locks was performed in 1978-1980. Emergency bulkhead facilities do not exist.

Similar to Dam 2, Dam 3 is a concrete gravity structure on wood bearing piles with apron resting on rock filled cribbing. Scour also has occurred below this structure exposing and, in some cases, washing out supporting timbers and rock. Conditions are being closely monitored but none presently exist that seriously compromise the stability of the dam. A protection scheme has been developed through model testing by the Waterways Experiment Station (WES). It consists of excavation/ fill to provide a uniform streambed configuration, filter layer, and armoring with 3 to 4 ft stone or grout-filled fabric bags. There are no present plans for implementing these measures.

The large lock is filled by 15 individually operated butterfly valves located in the upper half of the chamber which receives water from a flume in the landwall. The rate of valve opening must be manually regulated depending on type of craft in the chamber, if any. The system is considered to be unsatisfactory mainly on account of the unsymmetrical inflow. Emptying is performed via 16 valved ports through the middle wall. The small riverward lock is filled by two eight-feet diameter cylindrical valves in the river wall and emptied by two similar valves. This system is adequate for the auxiliary chamber. Lock approach conditions are inadequate though not hazardous and double lockages are not permitted. Upstream, a projecting bankline makes maneuvering difficult for both arriving and departing tows, especially those using the large land chamber. Downstream, a water intake at mile 23.4 must be avoided. Another deficiency is the low lock walls which causes navigation to be suspended two to three times per year due to high water.

iii. Locks and Dam 4

The locks are located at Monongahela river mile 41.5. The land chamber, 56 ft by 720 ft, and river chamber, 56 ft by 360 ft, were built in 1931-1932. The original fixed crest dam was reconstructed during the years 1964-1967 to provide the present gated structure, which maintains a pool at elevation 743.5. Lift from Pool 3 is 16.6 ft. There are no emergency bulkhead closures for the locks.

The large lock is filled and emptied by means of a side-port system utilizing culverts in the land and middle walls. The small lock is served by a culvert and ports in the river wall. Navigation conditions are difficult for tows approaching the locks from upstream during high flows. The problems are associated with a bank line that is offset landward of the guide wall plus an unported guard wall, which cause cross-currents at the lock entrance. A spur dike and mooring cells farther upstream are effective in reducing current magnitudes but aggravate the alignment problem by preventing approaching tows from staying close to the bank. The lower approach also is less than ideal as it involves negotiating a sharp bend and bridge just prior to entering the locks.

The derrick stone protection below the stilling basin of the dam has been scoured out to various depths over its entire length. The deficiency may be that the apron, which is part of the original structure that was incorporated into the reconstructed dam, is at a higher than optimum elevation. A permanent solution to this problem cannot be devised without physical model studies which, thus far, have not been initiated.

2. MAJOR REHABILITATION CONSIDERATIONS

a. Locks and Dam 2

i. Locks

Hydraulic considerations do not indicate a need for any significant alterations to the present configuration or operating equipment.

ii. Dam

The downstream scour protection placed in 1987 previously was modelled by WES and is considered to be a permanent remedy. However, the concrete surface itself is severely eroded and the foundation condition is unknown. It is likely that extensive rehabilitation of the existing antiquated structure, requiring dewatering by sections within cofferdams, would be necessary to assure its long-term reliability. Constructing an entirely new dam may be preferable to attempting this rehabilitation. A preliminary design was developed for a concrete fixed crest similar to the Grays Landing dam which is under construction at river mile 82.0. The length, 748 ft, and weir elevation, 718.7 would not change but the new dam would be ogee shaped, with a stilling basin at streambed level, approximate elevation 690. Since the vertical distance from crest to basin floor would be close to Grays Landing's 28 ft, useful design data was available from this project's model study report, WES Technical Report HL-81-13. Tailwater conditions at Dam 2 vary with backwater from the Allegheny River but analysis of past pool records indicate the minimum tailwater is higher than Gray's

Landing's for the entire range of unit discharge, q. The deeper tailwater depth and associated smaller plunging unit discharge at Dam 2 make for less severe conditions than at Grays Landing. On this basis, it appears the stilling basin for a reconstructed Dam 2 should be about 60 ft long, which is 32 ft shorter than Grays Landing's. Similarly, two rows of 5 ft high baffle piers would be provided (vs. 9 ft) and a 2.5 ft high end sill (vs. 4.5 ft). These preliminary design values are adequate for cost estimates but a new model study would be desirable to optimize final dimensions.

b. Locks and Dam 3

i. General

It has been determined that the existing lock walls and dam cannot be repaired and stabilized for the long term. Therefore "rehabilitation" amounts to rebuilding the entire structure in place or replacing it in kind. The "replacement in kind" option would involve constructing new locks one at a time and slightly riverward of their present positions. This option is very similar to the mile 23.8 replacement site alternative to be discussed in Section IV, although the replacement plan calls for 84 ft rather than 56 ft wide locks. The other option, "rebuild in place" is discussed herein. The major items include the filling and emptying system for the new land chamber, temporary lock needed during construction of the new locks, lock wall elevations, cofferdams, and new dam configuration.

ii. Filling and Emptying System

Preliminary design of a new side port filling and emptying system was needed since the present system is unsatisfactory and it appears that both the land and middle walls will have to be replaced. WES Miscellaneous Paper H-75-7 was consulted for appropriate system dimensions. Culverts would be 9 ft high by 11 ft wide. Invert elevation of culverts and ports would be at 703, one foot above the chamber floor. Thirty ports, at 14 ft spacing, would each have a cross-sectional area of 3.3 ft. Both culverts would empty into an excavated basin on the river side of the middle wall near the lower miter gates. Times for filling and emptying would decrease slightly from present values.

iii. Temporary Lock

A temporary lock, patterned after those at Ohio River Locks and Dams Nos. 52 and 53, would be constructed to pass river traffic while the permanent locks are being rehabilitated. It would be located paralled to, but about 90 ft riverward of, the existing river wall. The 56 ft by 720 ft structure would be comprised of two rows of steel sheet-pile cells with concrete monoliths at both ends containing the miter-gate control

valves. Filling and emptying would be accomplished by means of a parallel flume separated from the lock proper by a third row of cells. Twenty-four diaphragms between the cells would have alternate sheets, partially raised, forming ports at the bottom of each one. Ten-feet by ten-feet valved culverts at the ends of the flume would control filling and draining. Total port area would be about five times that of the culvert; therefore, water levels in the flume and chamber should not vary by more than about 0.5 ft during operations. Time for filling or emptying at normal lift is calculated to be about ten minutes, about double the times presently experienced.

iv. Lock Rehabilitation Cofferdam

Cofferdams would span between the temporary lock and banks enclosing both existing locks in their entirety for the rehabilitation work. Encroachment on the dam would leave 430 ft of the 670 ft long crest available. The assumed top of cofferdam and temporary lock upstream of the dam is elevation 742, which would provide 2-year protection against overtopping, as shown on PLATE 1. (Cofferdam elevations would be optimized in future studies.) The downstream cofferdam could be about six feet lower.

v. Lock Wall Elevation

The nominal top of existing lock walls is elevation 736 which is exceeded about twice per year on the average. Following the 1978 to 1980 rehabilitation, actual reported top of walls varies from 736.3 on the riverwall to 737.25 - 737.4 for the major portions of the middle and land wall. Low points near the miter gates prevent the benefits of the higher walls from being fully realized, however. If the walls are not raised when they are reconstructed, frequent overtoppings and navigation suspensions will be unavoidable for the period of dam reconstruction when the crest is restricted. PLATE 1 indicates that about six overtoppings per year would be expected if elevation 736 is utilized. Since it is proposed that the walls be totally replaced, it is recommended that they be built to elevation 742. Overtoppings would be reduced to about a 5.6-year frequency, after completion of all rehabilitation, which is approximately equivalent to Locks and Dam 2. During the dam reconstruction, one overtopping per year would be expected. If an emergency closure is provided enabling one of the new locks to be used as a floodway during construction, swellheads and overtopping frequencies could be further reduced.

vi. Dam Rehabilitation Cofferdams

The dam would be rebuilt in three stages within cofferdams. During each stage, approximately 370 ft of weir would be available for passing river flow. Backwater effects in the upper pool would be about one foot greater than during the lock rehabilitation, as shown on PLATE 1. With top of cofferdams at elevation 742, one-year overtopping protection would be provided. A two-stage construction plan also was investigated but rejected because of its severe backwater effects. Expected project-induced damages would amount to about $18,000,000 versus $7,000,000 for the the three-stage plan.

vii. Dam

As discussed for Dam 2, it is assumed that a replacement for Dam 3 would follow the Grays Landing geometry. The stilling basin would be at elevation 699, or 27.9 ft below the crest. A minimum tailwater versus flow relationship was developed from gage records in order to provide a preliminary estimate for the length of stilling basin. The maximum plunging unit discharge would be 125 cfs per foot which would require a 41 ft long basin.

c. Locks and Dam 4

i. Locks

Hydraulic considerations do not indicate a need for any significant alterations to the present configuration or operating equipment if the existing locks are rehabilitated.

ii. Dam

Major rehabilitation of the dam itself is not proposed. However, the need for repairing washed-out derrick stone downstream has been recognized. Although it may be accomplished as a part of normal maintenance, this is a significant item which warrants special attention. The stilling basin of the original fixed crest dam was incorporated into the present gated structure built in 1964-67. Tops of most baffle piers are broken off and the end sill, which is level with the gate sill at elevation 724.0, may be higher than optimum. As mentioned previously, the downstream derrick stone protection has been eroded. Gate operation records were reviewed to determine the relationship between gate opening and minimum tailwater to evaluate basin jump characteristics. The ratio of tailwater to sequent depth, TW/D2, increases with gate opening, and is below unity for openings up to six feet, with a minimum value of 0.70 for the two-foot opening. The maximum end sill velocity is 18 ft per second at full open. A model study should be performed to determine the most critical hydraulic conditions and cost-effective plan prior to designing any

remedy to the scour problem. However, since tailwater is adequate for the larger openings it appears that major structural modifications will not be necessary. The sizing and configuration of new stone protection or other armoring material would be determined by modelling. At present, D50 stone size required for replacement stone protection is estimated to be four feet, based on HDC 712-1, as well as guidance available in REMR Draft Technical Note HY-N-1.6 "Scour Protection Downstream from Gated Low-Head Navigation Dams." The riprap should slope downward at 1V on 3H beginning at the cutoff wall four feet below the end sill.

3. COMPARISON OF HYDRAULIC FEATURES FOR REPLACEMENT STRUCTURES - INITIAL SCREENING

a. General

Hydraulic considerations would determine or influence a variety of major project features including dam type and geometry, critical elevations such as lock walls, requirements for real estate acquisition, and site navigability. Data for initial screening of alternative sites and structures have been developed during studies conducted over the period from 1984 to 1989. All structures were evaluated individually, i.e., without considering possible effects on water surfaces at the site from alterations or replacements of other existing locks or dams. However, required dredging and removal of downstream dams for a proposed upstream relocation or "one structure for two" replacement were accounted for. Hydraulic data were calculated by backwater and weir flow computations or estimated based on existing water surface profiles. Roughness coefficients vary with flow having been calibrated to existing rating curves and actual high water marks.

b. Project Location and Preliminary Layout

Topographic maps, with a scale of one inch to 400 ft, were initially scanned for lock and dam replacement sites on relatively straight undeveloped reaches between river miles zero and 41.5. At the sites chosen for study, locks were positioned by a consensus of individuals from Engineering, Planning, and Operations Divisions to provide good approach conditions for navigation. Dual chambers were assumed with nominal 84 ft by 720 ft dimensions. Dams would be perpendicular to locks and located near the upper miter gates. At existing sites, the assumptions mentioned above may not apply because of special conditions.

c. **Dam Type and Length**

In most cases, both fixed crest and gated-type dams were considered for alternative replacement structures. Total length was determined by the natural river width between proposed locks and the opposite river bank. In some cases, more than one dam length was considered due to revisions in the original plan over the course of the study. For discharge capacity computations fixed crest dams were assumed to be ogee-shaped, similar to the Grays Landing project, which currently is under construction at river mile 82.0. For gated dams, bays were assumed to be 84 ft wide with 10 ft piers patterned after the Maxwell Dam which is located at river mile 61.2. Sills would be approximately five feet above streambed level. Either five or six gates would be provided, with the remaining width filled with a fixed weir or weirs near normal pool level.

d. **Lock Walls**

Top of lock wall elevations were established to provide a maximum navigable stage comparable to other modern locks on the Monongahela River. Frequencies of navigation suspensions due to high water at existing locks, plus those under construction, are listed in TABLE 1.

TABLE 1
MONONGAHELA RIVER LOCKS
FREQUENCY OF NAVIGATION SUSPENSION DUE TO HIGH WATER

Project	River Mile	Frequency (Years)
Emsworth (Ohio R.)	6.2	4.0
Locks 2	11.2	0.5
Locks 3	23.8	0.4
Locks 4	41.5	1.3
Maxwell	61.2	3.7
*Grays Landing	82.0	4.0
*Point Marion	90.8	5.0
Morgantown	102.0	70.0
Hildebrand	108.0	1,000
Opekiska	115.4	1,000

*under construction

It is apparent from TABLE 1 that the lower Monongahela locks, particularly Nos. 2 and 3, are deficient in terms of shutdown frequency. Therefore, the proposed standard for the replacement locks is a four-year navigable frequency which is roughly equivalent to Emsworth Locks on the Ohio River and what soon will be available on the middle Monongahela. Since navigation normally can continue until lock wall freeboard becomes less than two feet, tops of walls for new locks would

be two feet above the modified four-year upper pool elevation. Also, walls should be at least five feet above proposed normal pool to provide sufficient ordinary operating freeboard. TABLE 2 lists top of wall elevations determined using these criteria for the structures evaluated.

e. Ordinary High Water

i. Existing Conditions

Ordinary high water is the boundary between public and private rights on navigable rivers. In 1970, several ordinary high water mark elevations in Pools 2 and 3 were determined by means of field examinations of riverbank vegetation. A backwater profile giving the best fit of those "physical fact" marks was developed which represents existing ordinary high water. A flow of 70,000 cfs was utilized upstream of the Youghiogheny River at river mile 15.5. This has an average exceedence frequency of once in 0.6 years and duration of 1.4 days per year. The adopted flow downstream of the Youghiogheny River, 90,000 cfs, has a 0.6-year frequency and a 1.1 day per year duration. The existing ordinary high water profile is shown on PLATE 2.

ii. Modified Conditions

Replacement structures that would raise ordinary high water would require the purchase of a permanent flowage easement based on the profile change. Modified profiles were calculated for various alternative structures to determine the amount and limits of increase. Those evaluated included most of the same structures listed in TABLE 2. TABLE 3 summarizes the replacement alternatives effects on ordinary high water.

TABLE 2
TOP OF WALL ELEVATIONS FOR LOCK
REPLACEMENT ALTERNATIVES

Location (River Mile)	Replacement For	Lock Side	Normal Pool Elev.	Gross Crest Length (feet)	Top of Wall Elevation Type of Dam	
					Fixed Crest	Gated
4.5	L/D #2	R	718.7	620	-----	727.5
6.9	L/D #2	R	718.7	650	-----	729.5
11.2*	L/D #2	R	718.7	748	735.0	-----
11.2*	L/D #2 & 3	R	723.7	748	-----	733.5
11.3*	L/D #2 (Dam & River Lock)	R	718.7	650	735.5	733.5
12.3	L/D #2	R	718.7	495	736.5	735.0
	L/D #2 & 3	R	726.9	495	-----	735.0
17.5	L/D #2	R	718.7	700	738.0	738.0
	L/D #3	R	726.9	700	741.0	739.0
	L/D #2 & 3	R	726.9	700	740.5	738.0
22.2	L/D #3	R	726.9	550	742.5	741.0
	L/D #3	L	726.9	650	742.0	-----
	L/D #3	L	726.9	560	-----	741.0
	L/D #2 & 3	L	726.9	650	742.0	-----
	L/D #2 & 3	L	726.9	560	-----	740.5
23.8*	L/D #3	R	726.9	576	743.0	-----
23.9*	L/D #3	L	726.9	700	742.5	-----
24.6	L/D #3	R	726.9	950	742.0	742.0
	L/D #3	R	726.9	750	742.5	-----
26.1	L/D #3	R	726.9	700	742.5	-----
	L/D #3	L	726.9	850	742.5	-----
	L/D #4	L	743.5	850	757.0	748.5
	L/D #3 & 4	L	743.5	850	757.0	748.5
26.8	L/D #3	R	726.9	600	743.5	-----
	L/D #4	R	743.5	600	756.5	748.5
	L/D #3 & 4	R	743.5	600	756.5	748.5
30.7	L/D #3	L	726.9	620	746.0	745.5
	L/D #4	L	743.5	620	758.0	748.5
	L/D #3 & 4	L	743.5	620	758.0	748.5
34.0	L/D #3	R	726.9	610	747.0	747.0
	L/D #4	R	743.5	610	759.0	748.5
	L/D #3 & 4	R	743.5	610	759.0	748.5
41.5*	LOCK #4	R	743.5	535	-----	753.0

* = Existing Site

TABLE 3
REPLACEMENT STRUCTURES' EFFECTS
ON ORDINARY HIGH WATER

Location (River Mile)	Replacement For	Dam Fixed Crest (F) or Gated (G)	Ordinary High Water Increase Limits Mile to Mile	Range (ft) Max.	Min.
4.5	L/D #2	G	4.7 - 11.2	1.0	0.6
6.9	L/D #2	G	6.7 - 11.2	0.6	0.4
11.3*	L/D #2 (Dam & River Lock)	F	11.3 - 23.8	0.5	0.2
	L/D #2 or 2 & 3	G	NONE		
12.3	L/D #2	F	12.3 - 23.8	1.6	1.0
	L/D #2 or 2 & 3	G	NONE		
17.5	L/D #2	F or G	NONE		
	L/D #3 or 2 & 3	F	17.5 - 41.5	4.3	0.1
	L/D #3	G	17.5 - 23.8	1.0	0.8
	L/D #2 & 3	G	NONE		
22.2	L/D #3 or 2 & 3	F	22.2 - 23.8	3.2	3.1
(locks	L/D #3	G	22.2 - 23.8	0.7	0.7
on left)	L/D #2 & 3	G	NONE		
23.8*	L/D #3	F	23.8 - 41.6	0.6	0.2
(locks on rt)					
23.9*	L/D #3	F	NONE		
(locks on lt)					
24.6	L/D #3	F or G	NONE		
26.1	L/D #3	F or G	NONE		
	L/D #4 or 3 & 4	G	26.1 - 61.2	7.5	0.5
26.8	L/D #3	F or G	NONE		
	L/D #4 or 3 & 4	F	26.8 - 61.2	16.5	3.1
	L/D #4 or 3 & 4	G	26.8 - 61.2	7.4	0.5
30.7	L/D #3	F or G	NONE		
	L/D #4 or 3 & 4	F	30.7 - 61.2	13.5	2.6
	L/D #4 or 3 & 4	G	30.7 - 61.2	6.1	0.3
34.0	L/D #3	F or G	NONE		
	L/D #4 or 3 & 4	F	34.0 - 61.2	13.5	2.8
	L/D #4 or 3 & 4	G	34.0 - 61.2	4.8	0.2
41.5*	L #4	G	NONE		

* = Existing Site

f. 100-Year Flood

i. Existing Conditions

The computed profile is plotted on PLATE 2. Associated discharges are 231,000 cfs below the Youghiogheny River and 198,000 cfs above.

ii. Modified Conditions

Existing locks and dams would be deeply submerged by the 100-year flood. Similar conditions would exist with most replacement structures; consequently, the 100-year profile would be little changed. However, several fixed crest alternatives for downstream or "one structure for two" replacements would cause the 100-year profile to be raised significantly. They are identified in TABLE 4. A modified flowage easement would be required in these situations, defined by a stepped line encompassing the modified 100-year profile. Owners of property in this zone would be given the option of government acquisition or having structures flood-proofed.

TABLE 4
FIXED CREST REPLACEMENT ALTERNATIVES
CAUSING INCREASE IN 100-YEAR FLOOD

River Mile	Replacement For	Increase in 100-Year Flood Limits Mile to Mile		Range (ft.) Max.	Min.
17.5	L/D 3	17.5	23.8*	NOT DETERMINED	
22.2	L/D 3	22.2	23.8	1.0	1.0
26.1	L/D 4 or 3 & 4	26.1	61.2*	NOT DETERMINED	
26.8	L/D 4 or 3 & 4	26.8	61.2*	NOT DETERMINED	
30.7	L/D 4 or 3 & 4	30.7	61.2	6.1	0.5
34.0	L/D 4 or 3 & 4	34.0	61.2	5.0	0.5

* = estimated

g. Standard Project Flood

The Standard Project Flood profile (SPF) was computed from the mouth of the Monongahela River through Maxwell Locks and Dam. Applicable discharges are 526,200 cfs on the Ohio River, 291,700 cfs on the Monongahela River below the Youghiogheny River, and 249,300 cfs above. This flood is in the 500- to 1000-year frequency range. The profile for existing conditions is shown on PLATE 2. The desirable minimum elevation of fully raised tainter gates at navigation dams is often related to the standard project flood level. On the Ohio River, a five-feet freeboard criterion has been adopted to minimize chances of damage to gates from debris impact. No specific criteria have been established for the Monongahela River dams. Existing dams

in the study area satisfy the Ohio River standard. At Dam 4, the clearance elevation is 776.0, providing about 6.5 ft of freeboard above the standard project flood. At Maxwell, with gates at elevation 792.5, about seven feet are available. Any new gated dams should be designed to meet the Ohio River criterion.

h. **Probable Maximum Flood**

The Probable Maximum Flood (PMF) profile was also computed from the mouth of the Monongahela River through Maxwell Dam. Since the elevation of this flood exceeded the limits described by the backwater cross sections by a considerable amount, the National Weather Service Dambreak program, as modified by the Pittsburgh District, was used instead. Discharges for this flood are 1,038,000 cfs on the Ohio River, 795,600 cfs on the Monongahela below the Youghiogheny, and 609,100 cfs above. The PMF profile is 20-25 ft higher than the SPF profile, as shown on PLATE 2.

i. **Navigation Conditions**

i. Tow Simulator Studies

The Waterways Experiment Station conducted a study using the tow simulator to compare the relative navigability of all 13 proposed replacement sites. Existing locks as well as some less promising alternatives listed in previous tables were not tested. The WES report describing study procedures and results in detail is not complete although a draft is available. Conditions were evaluated for a one-year flow on the Monongahela River, with minimum backwater from the Allegheny River, which gives conservatively high current velocities. Water surface elevations and mean velocities were generated via backwater computations and furnished to WES. Where appropriate, effects of a 300 ft wide, nine feet deep excavated navigation channel, were represented.

ii. Rankings

Based on numerical data collected from the simulator tests and pilots' comments, WES classified each structure as "Recommended," "Feasible," or "Not Recommended" and assigned it a relative rank. Subsequent to the WES rankings the configuration of the Locks and Dam 3 replacement structure at river mile 24.6 had to be revised on account of construction problems. This would require that the locks be shifted riverward. WES reviewed the revised plan and expressed the opinion that this site's classification should be downgraded. Proposed work at mile 11.2, the existing Locks and Dam 2 site, also was revised after completion of the testing. A new river chamber and upstream relocation of the dam originally were proposed but eliminated following subsequent studies. One

TABLE 5
NAVIGABILITY CLASSIFICATION AND RANKING
OF REPLACEMENT ALTERNATIVES

River Mile	Type of Dam	Ranking	Classification
	Locks and Dam No. 2 Sites		
4.5	G	6	NOT RECOMMENDED
6.9	G	5	NOT RECOMMENDED
11.2* (w/existing lock)	F	3	RECOMMENDED
11.3* (w/new river lock)	F	2	RECOMMENDED
12.3	F	1	RECOMMENDED
17.5	F	4	NOT RECOMMENDED
	Locks and Dams Nos. 2 and 3 Combination Sites		
11.2* (w/existing locks)	G	3	FEASIBLE
17.5	F	4	NOT RECOMMENDED
	G	5	NOT RECOMMENDED
22.2	F	1	FEASIBLE
	G	2	FEASIBLE
	Locks and Dam No. 3 Sites		
17.5	F	8	NOT RECOMMENDED
	G	9	NOT RECOMMENDED
22.2	F	2	FEASIBLE
	G	3	FEASIBLE
23.9* (locks on lt)	F	1	RECOMMENDED
24.6	F	5	FEASIBLE
26.1	F	7	NOT RECOMMENDED
26.8	F	4	FEASIBLE
30.7	F	6	NOT RECOMMENDED
	Locks and Dams Nos. 3 and 4 Combination Sites		
26.8	G	2	RECOMMENDED
30.7	G	3	NOT RECOMMENDED
34.0	G	1	RECOMMENDED
	Lock and Dam No. 4 Sites		
30.7	G	2	NOT RECOMMENDED
34.0	G	1	RECOMMENDED
41.5* (w/new locks)	G (existing)	3	NOT RECOMMENDED

* = Existing Site

proposal for mile 11.2 utilizes an untested gated dam for a combination Locks and Dams 2 and 3 replacement rather than a fixed crest. Discussions with WES led to the downgrading of the gated option. The fixed crest option now is virtually identical to existing conditions so its ranking is made less important by actual experience which indicates conditions generally are good. Another late change involved consideration of the mile 34.0 site for a replacement for Locks and Dams 3 and 4. Since navigation conditions would be similar to the tested alternative for a Locks and Dam 4 replacement at the same site, a classification and rating could be inferred. The rankings in TABLE 5 represent the WES assessment adjusted for the changes mentioned. It should be assumed that alternatives designated as "Feasible" could be improved to provide acceptable navigation conditions only by modifying the approach channels with excavation, fill, or training dikes. "Not Recommended" alternatives should be avoided, if possible, as they would require similar but more extensive treatment.

4. COMPREHENSIVE REPLACEMENT PLANS - FINAL SCREENING

a. Sites and Plans Examined

i. General

A total of six replacement sites were studied in more detail for the final screening of alternatives. Seven comprehensive plans each comprised of two or three individual sites were then evaluated. For a Locks and Dam 2 replacement, only mile 11.2, the existing site, was studied. This site as well as mile 22.2 were evaluated for a combination Locks and Dams 2 and 3 replacement. Three sites were studied for Locks and Dam 3 replacements: mile 22.2, mile 23.8 (existing site) and mile 24.6. For a Locks and Dams 3 and 4 combination replacement, only one site, mile 34.0, was studied. Finally, the existing site at mile 41.5 was the only option evaluated for a Locks and Dam 4 replacement.

In this section, changes in water surface elevations are discussed by plan, as the combined effects of all proposed structures need to be considered. In order to avoid repetition, other items are discussed site by site. These include the major features of the proposed replacement locks and dams, dimensions, controlling elevations, navigation conditions, and model studies. Very limited investigations also were performed regarding construction cofferdams.

ii. Lock Sizes

For new locks, an 84 ft by 720 ft chamber size was assumed. For other size(s), dam crest length, size and number of tainter gates, backwater effects, required flowage easements, filling and emptying systems, and cofferdam staging could be significantly different. Navigability of the river channel and lock approaches would not be very sensitive to variations in tow widths related to alternative chamber widths of 56 ft or 110 ft. However, providing safe approach conditions would be much more difficult with longer chambers and tows. Also, investigations by the Huntington Navigation Center indicate there would be problems with longer tows passing at bridges and sharp bends along the lower Monongahela. Numerous locations were identified where 1200 ft tows could not pass in low flow conditions whereas 685 ft tows would be restricted at only a few points. Therefore, longer chambers are not recommended.

b. Plan Descriptions and Effects on Water Surfaces

i. Plan 1

(1) Description

This plan would retain and rehabilitate the existing Locks No. 2 and Dam No. 4, which are the more recent components in the system. The existing Dam No. 2, at mile 11.2, would be replaced with a gated dam on the present axis. The normal pool would be raised five feet to elevation 723.7. Locks and Dam 3, at mile 23.8, would be eliminated with the new pool extending to Locks and Dam 4 at mile 41.5. A 300 ft wide navigation channel would be excavated in present Pool 3 where required to provide nine feet of depth. The existing Locks No. 4 would be replaced by two 84 ft by 720 ft chambers.

(2) Ordinary High Water.

Although normal pool would be raised five feet between miles 11.2 and 23.8, the ordinary high water profile would be reduced due to the replacement of Dam 2, presently a fixed crest, with a gated dam. Ordinary high water would also be lowered from mile 23.8 to 41.5 as a result of the proposed work at Dam 2, removal of Locks and Dam 3, and excavation in present Pool 3. A profile is shown on PLATE 3. No flowage easements would be required on the Monongahela River main stem. However, Real Estate has determined that flowage easements based on ordinary high water would be needed on non-navigable tributaries where a pool raise is proposed.

(3) 100-Year Flood

For the same reasons given in the paragraph above, the 100-year as well as all other floods would be reduced above mile 11.2. While these reductions would carry through into Pool 4, they would typically amount to less than one foot. Stage frequencies showing existing and proposed conditions at miles 11.2, 23.8, and 41.5 are shown on PLATES 4 through 6, respectively.

(4) Turtle Creek

This tributary drains 147 square miles and enters from the right bank just above the upper guide wall of Locks and Dam 2. A Corps-constructed local flood protection project thereon begins at the mouth. The channel has experienced heavy siltation as the result of backwater from Pool 2. Under Plan 1, pool levels would be higher than at present during the majority of the time causing increased deposition. Additionally, extraction costs would be higher because of deeper submergence as well as loss of barge access due to limiting bridge clearances at the mouth. This plan would not be detrimental to the flood protection project's effectiveness if the channel is maintained.

Plans are presently being prepared for restoration of the Turtle Creek project to include removal of sediment from the channel and upstream debris basins. Assuming the basins are properly maintained following restoration, it is estimated that the annual channel deposition will increase from 12,000 cubic yards to 18,000 cubic yards under Plan 1. This estimate is based on an average sediment load of 0.2 acre-ft/square mile/year, debris basin trap efficiency varying from 50% to 80%, and channel trap efficiency rising from 50% to 75%. The channel trap efficiencies are based on an analysis of sedimentation records and average cross-sectional flow areas with the present and proposed pools. If this plan is selected a more detailed investigation will be undertaken.

ii. Plan 2

(1) Description.

This plan utilizes existing sites for Locks and Dams Nos. 2 and 4, with a Locks and Dam 3 replacement downstream of the present site. At mile 11.2, the existing locks would be rehabilitated. A new fixed crest dam would be built with the same crest elevation and length. Two new 84 ft by 720 ft locks and a fixed crest dam would replace existing Locks and Dam 3 which would be removed. The new locks would be located on the left bank at mile 22.2, which is 1.6 miles below the present site. The elevation of Pool 3 would remain at 726.9 but would extend 1.6 miles farther downstream. At mile 41.5, two new 84 ft by 720 ft locks would replace the existing smaller chambers.

(2) Ordinary High Water

Between miles 22.2 and 23.8, ordinary high water would be raised about 3.8 ft necessitating acquisition of a flowage easement. Upstream of existing Locks and Dam 3 at mile 23.8, the computed increase is 0.3 ft diminishing at 0.1 ft at Locks and Dam 4, mile 41.5. At the present time it is assumed that this slight change would not require a flowage easement in existing Pool 3. More detailed studies including a physical model of the new structure and possible approach channel alterations would be conducted to accurately define the backwater effects. In any case, options are available to avoid an unacceptable increase in water levels above mile 23.8. These would include making new Dam 3 longer or lowering the crest elevation a fraction of a foot. Ordinary high water in Pool 4 would not change. PLATE 7 presents profiles.

(3) 100-Year Flood

PLATE 7 shows that the 100-year flood would be raised 1.1 ft above new Dam 3 at mile 22.2. This effect would extend to mile 23.8. A modified flowage easement would be required in this area. Since existing Dam 3 would be removed, the increase in the 100-year profile would drop to an insignificant 0.1 ft above mile 23.8. Stage frequency comparisons with this plan are given at four locations, miles 11.2, 22.2, 23.8, and 41.5. The applicable PLATES are, in order, Nos. 4, 8, 9, and 10.

iii. Plan 3

(1) Description

Existing sites of Locks and Dams Nos. 2, 3, and 4 would be retained. A new fixed crest dam would be built and existing locks rehabilitated at mile 11.2. Two new 84 ft by 720 ft locks and new fixed crest dam would be constructed at mile 23.8. Two new 84 ft by 720 ft chambers also would be provided at mile 41.5.

(2) Ordinary High Water

As indicated on PLATE 11, the only change would be in Pool 3. The 0.8 ft rise at mile 23.8 would diminish to 0.3 ft at Locks and Dam 4 lower pool, mile 41.5. A flowage easement would be required.

(3) 100-Year Flood

The floodway at mile 23.8 would be open for all floods that would overtop lock walls at elevation 743.0, i.e., exceeding the seven-year frequency. The floodway capacity would offset the loss of about 90 ft of dam crest. Thus moderate and high flood levels including the 100-year would basically be unchanged. The stage frequency curves for Locks and Dam 3 are shown on PLATE 12. Mile 11.2 and 41.5 curves with Plan 3 are shown on PLATES 4, and 13, respectively.

iv. Plan 4

(1) Description

Existing sites for Locks and Dams 2 and 4 are retained, with a Locks and Dam 3 replacement upstream of the present site. A new fixed crest dam and rehabilitated locks would be provided at mile 11.2. Two new 84 ft by 720 ft locks and a fixed crest dam would be built at mile 24.6 to replace Locks and Dam 3. After removal of the existing structure, Pool 2 would extend an additional 0.8 mile upstream. At Mile 41.5, two new 84 ft by 720 ft locks would replace the existing smaller chambers.

(2) Ordinary High Water

The only significant change would be between miles 23.8 and 24.6 where the profile would be lowered by over three feet. There would be a slight reduction from mile 24.6 to 41.5. PLATE 14 presents a profile. No flowage easements would be required.

(3) 100-Year Flood

Between miles 23.8 and 24.6 the 100-year flood would be lowered by about one foot. It would be virtually unchanged at all other locations. Stage frequency curves for miles 11.2, 23.8, 24.6, and 41.5 are given on PLATES 4, 5, 15, and 16, respectively.

v. Plan 5

(1) Description

This is an alternative to Plan 1 for replacing Locks and Dams 2 and 3 with a single structure. The new combination replacement would consist of two 84 ft by 720 ft locks and a fixed crest dam. It would be located at Mile 22.2 with the locks on the left bank. The pool above the new dam would be at elevation 726.9, the same level as present Pool 3. From mile 22.2 to mile 23.8, the pool would be raised 8.2 ft. Upon

removal of Locks and Dam 2 at mile 11.2, the Emsworth Pool, which, at elevation 710.0 and 8.7 ft lower than Pool 2, would extend an additional 11 miles upstream. This reach would be dredged to provide the nine-feet minimum navigation channel depth.

(2) Ordinary High Water

The only increase would be from mile 22.2 to 23.8 averaging 3.7 ft. This is shown on PLATE 17. A flowage easement would be needed. The profile would be lowered an average of four feet between miles 11.2 and 22.2.

(3) 100-Year Flood

The 100-year flood level would be raised 0.3 ft at mile 22.2 with the backwater extending to mile 23.8. It is assumed that this can be considered as negligible. Removal of existing structures would cause the 100-year profile to be slightly lowered through existing Pool 3 and most of Pool 2. PLATES 4, 8, 9, and 18 show Plan 5 stage frequency comparisons at miles 11.2, 22.2, 23.8, and 41.5, respectively.

(4) Turtle Creek

This plan would benefit the Corps-constructed local flood protection project on this tributary which enters just upstream of Locks 2. Siltation would be greatly reduced because elimination of Locks and Dam 2 would lower the normal pool at the mouth by 8.7 ft. The new pool elevation would be 710.0, same as the flood control channel invert.

vi. Plan 6

(1) Description

This plan includes a combination Locks and Dams 3 and 4 replacement. The new structure would be located at mile 34.0. Two new 84 ft by 720 ft locks with 24.8 ft lift would be constructed on the right bank. The new dam would be gated, maintaining a normal pool at the level of existing Pool 4, elevation 743.5. Existing Locks and Dams 3 and 4 would be extracted. The pool would be lowered 8.2 ft between miles 23.8 and 34.0, requiring excavation of the navigation channel. Between miles 34.0 and 41.5, the pool would be raised 16.6 ft.

(2) Ordinary High Water

PLATE 19 presents a profile. Due to proposed dredging and removal of existing Locks and Dam 3, ordinary high water would be lowered between miles 23.8 and 34.0. From miles 34.0 to 61.2 the profile would be raised. The increase would be 4.8 ft at mile 34.0, diminishing to 3.6 ft at mile 41.5, the site of existing Locks and Dam 4 lower pool. With removal of the existing structure, the amount of increase would drop to 2.0 ft in the upper pool. The effect at mile 61.2, lower pool at Maxwell dam, would be 0.2 ft. Flowage easements would be required.

(3) 100-Year Flood

There would be no increases to the 100-year elevations. In two reaches, reductions would occur. Between miles 23.8 and 34.0, the profile would be lowered about one foot. At mile 41.5, the reduction would be about 1.2 ft, diminishing to zero at mile 61.2. The profile would be virtually unchanged below mile 23.8 and between miles 34.0 and 41.5. Stage frequency curves are given on PLATES 4, 5, 20, and 21. They apply to, in order, miles 11.2, 23.8, 34.0, and 41.5.

vii. Plan 7

(1) Description

This plan is a hybrid of Plans 1 and 6. A gated dam would be built at mile 11.2, maintaining a pool at elevation 723.7 extending to mile 34.0. New locks and a gated dam would be built at this location. The upper pool would be at elevation 743.5. Existing locks and dams 3 and 4 would be eliminated. Even though the normal pool would be lowered by 3.2 ft between miles 23.8 and 34.0, only minimal excavation would be required to provide a 9 ft deep navigation channel.

(2) Ordinary High Water

The profile would be lowered between two and five feet from mile 11.2 to 34.0. As shown on PLATE 22, from mile 34.0 to Maxwell Dam at mile 61.2, there would be an increase identical to that of Plan 6. Flowage easements would be required along this reach.

(3) 100-Year Flood

There would be a 0.3 ft increase between miles 34.0 and 41.5. It is assumed this can be considered negligible, i.e., not requiring a modified flowage easement. The only effective means of eliminating this increase would be by additional downstream dredging. PLATES 4, 5, 23, and 24 show Plan 7 stage frequencies at miles 11.2, 23.8, 34.0, and 41.5, respectively.

(4) Turtle Creek

Increased siltation would result as discussed in Paragraph b.i.(4)

c. Replacement Structure Features

i. Common Features

It was assumed that all new replacement structures would have certain common features. These items were not studied individually, as variations from site to site would have a minimal effect on costs.

(1) Filling and Emptying Systems

EM 1110-2-1611 recommends side port systems for lifts of 10 to 40 ft. Normal lifts for the 84 ft by 720 ft replacement locks would vary from 8.2 to 25.8 ft. Considering that actual lifts often would approach 10 ft even for the 8.2 ft normal lift structures, side port systems would be appropriate for all replacement locks. However, utilizing side port systems for adjacent chambers would require an unusually wide middle wall containing two culverts. This would reduce the length of the dam which is undesirable in most instances and probably would be more costly than other options. Therefore, this configuration was not adopted for the present study although it cannot entirely be ruled out at this time. Instead, it was assumed that a side port system would be utilized only for one "main" lock, with the auxiliary chamber to be served by a bottom lateral system. Layout of the side port system would follow the Grays Landing and Point Marion locks which are under construction. The bottom lateral system would be based on the Maxwell design.

(2) Guide and Guard Walls

The assumed arrangement is that shown in Figure 8-2 (b) of EM 1110-2-1611 which also is in agreement with the Maxwell Locks. Guard walls would extend approximately one chamber length upstream and downstream of the river wall. They would be built on cells with those upstream having gaps forming ports to reduce outdraft. Guide walls would extend a similar distance above and below the land wall.

(3) Lock Sills

Miter gate sills would be 18 ft or more below final minimum pool to conform to recommendations in Miscellaneous Paper HL-89-5. This is about three feet more than has been provided at other recent Monongahela locks. This criteria also would apply to other items within the extent of the confining middle wall including guard sills, chamber floor, and filling/emptying laterals.

(4) Floodways

Single lock floodway capability would be required at all new locks with the exception of mile 41.5 where there is an existing gated dam. The floodways are needed to minimize swellheads during dam construction in all cases, and, in some instances, permanently. Emergency bulkheading facilities capable of initiating and shutting off flow plus paved chamber floors, which are also prerequisite to floodway operation, would likely be provided regardless of floodway considerations. Some additional features would have to be included specifically for the purpose of using one chamber as a floodway. One item would be extending the chamber paving through the confined approaches to the ends of the middle wall, which amounts to less than 300 additional lineal feet. For the expanded areas from the middle wall to the ends of guide and guard walls, it was assumed that a layer of riprap would be adequate to protect the channel bottom from being scoured by floodway flows. In the case of fixed crest dams, required bulkheading height would be higher. Since these are not exceptionally high cost items, it appears that providing the floodway capability would be justified even if only used during construction.

(5) Bank Protection

Bank protection upstream and downstream of new locks would be required to resist erosion related to river currents, waves and towboat propeller wash. It was assumed that graded stone riprap would be used but that the required size and extent would not vary greatly between sites. Quantities for preliminary costs were based on the Maxwell project which has dual locks similar to the proposed replacement structures. The total extent of protected bank at Maxwell, including the concrete-walled reach, is about 6,000 ft. This is reasonable compared to the single lock projects now under construction, Grays Landing (8,700 ft), and Point Marion (5,800 ft). An average layer thickness of two feet was assumed. Estimates for new dams also include costs for 100 ft of stone protection on the abutment side following the Maxwell project.

ii. Mile 11.2

(1) Locks

Lock walls at existing elevation 730.5 would be overtopped about once every 3.2 years with the new gated dam proposed under Plans 1 and 7, versus 2.4 years under present conditions. Maximum navigable stage would be reached once in 2.0 years as compared to the present 0.5 years which is a significant improvement. Raising lock walls during the lock rehabilitation would not be justified even though the four-year maximum navigable standard on the middle Monongahela would not be met. After construction of a gated dam there would be no further need for usage of a lock as a floodway.

Since a gated dam is not included in Plans 2, 3, 4, and 6, frequencies of wall overtopping and exceeding maximum navigable stage would remain at 2.4 and 0.5 years, respectively, assuming lock walls are not raised. The benefits to navigation plus reduced cleanup costs after overtoppings would not appear to justify the cost of raising walls, providing higher gates and other associated adjustments. There would be a continuing need to operate the small lock chamber as a floodway under Plans 2, 3, 4, and 6. The overhead closure structure would be replaced with a more reliable system.

(2) Gated Dam

The new dam would be built on the existing axis. Length of the existing fixed crest and approximate gross length of the new proposed structure is 748 ft. Under Plans 1 or 7, this would be comprised of six 84 ft gates separated by 10 ft piers and flanked by two fixed weirs with a combined length of about 165 ft. The lock-side weir would enable the existing 56 ft by 360 ft lock to be replaced by a larger chamber in the future without impacting the gated portion of the new dam. The configuration of the gates and stilling basin would follow the Maxwell design. The gate sills would be at elevation 698, i.e., approximately 26 ft below normal pool. The stilling basin floor would be five feet lower, elevation 693, which is near streambed level. Minimum lower pool would be elevation 710, or 17 ft above the basin floor. Basin performance was evaluated for the minimum tailwater condition determined from Dam 2 lockmaster records, with five of the proposed six gates operable. Model test data obtained from WES Technical Report No. 2-579 were utilized for this analysis. Results show that a submerged hydraulic jump would occur for all possible combinations of gate opening and tailwater. Maximum bottom velocities exiting the basin would be less than six feet per second, which implies acceptable basin performance and minimal requirement for downstream riprap scour protection under normal operating conditions.

According to EM 1110-2-1605, a single gate should be able to be opened half full to pass ice and debris without causing damage downstream of the structure under minimum tailwater conditions. Full open would be equivalent to about 17 ft, and half open, eight feet. The model data indicate this condition can be accommodated with normal riprap as the basin exit velocity would be about nine feet per second. At full open with minimum tailwater, a condition that might result from operator error, some damage is acceptable so long as the integrity of the structure is not jeopardized. Model data are not available to evaluate this condition. Theoretical computations indicate tailwater would be deficient initially but the release eventually would cause the lower pool to rise providing nearly full conjugate depth. With the basin founded on bedrock over 30 ft lower, there would be no threat to the structure.

Low steel of a gate in the fully raised position would be at elevation 753.5. This would provide about six feet of clearance above the SPF, which is approximately one foot less than what is available at Maxwell Dam. The Ohio River criterion requiring five feet minimum clearance above the SPF would be met.

(3) Fixed Crest Dam

Under Plans 2, 3, 4, and 6 a new fixed crest dam would be built on the existing axis with the same length as the existing dam, 748 ft, and crest elevation 718.7. The new dam would be ogee-shaped, with a 60 ft long stilling basin at elevation 690. Basis for this preliminary design was described in Paragraph 2.a.ii.

(4) Navigation Conditions

Under Plans 2, 3, 4, and 6 conditions would be virtually unchanged. An occasional upper approach problem associated with high discharge from Turtle Creek, a tributary entering just above the guide wall, was mentioned in Paragraph 1.b.i. It is not considered serious enough to warrant special study or corrective measures.

Under Plans 1 and 7, a gated dam with higher controlled pool would replace the existing fixed crest. During low flows, upstream water surfaces would be higher due to the pool raise with resulting lower current magnitudes. During higher navigable flows the reverse would be true as the gated dam would reduce upper pool stages thereby increasing velocities. The computed increase for the one-year flow is about 25% above the four to five feet per second that would exist with the fixed crest. The WES tow simulator study assigned this site a "Recommended" rating and second preference ranking of five Locks and Dam 2 replacement sites. However, besides using a fixed crest dam, WES tested an earlier layout provided by the District that included a new 84 ft by 720 ft lock chamber. It would have been located about 100 ft farther riverward than the existing smaller river chamber which it would have replaced. The new longer upstream guard wall would have reduced the exposure of approaching tows to outdraft in the area above the locks. While the simulator study results are not directly applicable to Plans 1 or 7, the alignment of walls and upstream banks was proven to be good. Current magnitudes still would be reasonable and, with the favorable lock orientation, it appears that satisfactory approach conditions would be obtainable with these Plans. However, after discussions with WES, it was concluded that in the absence of further testing it should be assumed that its rating is reduced to "Feasible." Also, a series of submerged upstream dikes to reduce velocities in the immediate approach might be desirable. At present, inclusion

of costs for a group of five upstream dikes is appropriate with Plan 1 or 7. Of course, the need for and design of dikes or other approach alterations could only be determined by a physical model. Should the new gated dam be constructed upstream of the present axis, which is not presently assumed, upper approach conditions would be worsened and the guide wall probably would need to be extended.

(5) Model Studies

General navigation physical model studies would be conducted only if Plan 1 or 7 is selected. The need for dikes, excavation, or other measures to reduce upper approach velocities would be investigated as well as cofferdams.

Current practice for gated dams is to use a three-dimensional model including several gate bays which enables simulation of the interaction between flows below adjacent gates having different openings. This is the only accurate means of evaluating large openings on a single gate required by current criteria. Therefore, a detailed site-specific model of at least a group of gate bays would be appropriate to optimize the dam and stilling basin design. Downstream stone protection requirements could be defined by such tests as well.

A section model study would be required for design of a fixed crest dam and stilling basin at mile 11.2.

(6) Cofferdams

Preliminary comparison studies between two and three-staged schemes for construction of the new fixed crest dam indicate three stages probably will be needed. The two-stage scheme would cause higher unacceptable damages from backwater flooding. Approximately 420 ft of total crest length, including new and/or existing dam, would be available in all three stages. A rehabilitated small chamber floodway would provide additional discharge capacity. Upper pool swellhead would amount to about three feet for a 1.5-year flood (approximate initial damage stage), dropping to 0.9 ft for a 100-year flood. These surcharges would diminish by approximately 25% at McKeesport, mile 14.6, and 50% at Elizabeth, PA, mile 23.0.

For construction of a gated dam at mile 11.2, again, a three-stage plan with floodway is favored because a two-stage scheme does not appear feasible. Constructing the new dam on the existing axis means that there is no open river portion during the first stage, when swellhead is greatest. Computed effects during this stage match the values for fixed crest construction listed in the preceding paragraph. Availability of completed gate bays reduce the surcharge during the second and third stages.

iii. Mile 22.2

(1) Locks

Under Plan 2, elevation 742.5 is proposed for top of lock walls to provide a 3.7-year maximum navigable frequency. The wall overtopping frequency would be 6.8 years.

Under Plan 5, top of lock walls would be at elevation 742.0. The maximum navigable frequency would be 3.5 years, and overtopping frequency, 7 years.

(2) Fixed Crest Dam

The overflow shape would follow Grays Landing. The floor of the stilling basin would be near streambed level at elevation 699. Excavation extending 200 ft into the right bank would permit construction of a 650 ft long dam which approximates the 670 ft structure that it would replace. An analysis of minimum tailwater conditions at the site indicates the maximum pluging unit discharge would be 135 cfs per foot under Plan 2. Comparing this value to Grays Landing's 325 cfs per foot yields a preliminary estimate of the required basin length of 40 ft.

Removal of existing Locks and Dam 2 plus pool dredging would result in lower tailwater conditions with Plan 5. The computed maximum plunging unit discharge is 210 cfs per foot. A 61 ft long stilling basin is indicated.

(3) Navigation Conditions

WES ranked this structure third of nine alternatives for Locks and Dam 3 replacements (Plan 2) but only gave it a "Feasible" rating due to a less than ideal upper approach condition. Basically, the same condition would exist for a combination Locks and Dams 2 and 3 replacement. For this alternative (Plan 5) it achieved the same rating although ranking first of four options tested. The difficulty stems from an upstream highway bridge whose channel span is at mid-river which, according to simulation trials, affects the downbound entering condition. Tows must move from mid-channel to a position inside the guard wall over the 3,000 ft distance between the bridge and wall. It is likely that a group of upstream training dikes would be desirable to aid this lateral movement. The number, location, etc., of such structures would be highly speculative at this time. Considering this plus early indications that these plans do not appear competitive economically, no preliminary dike layout was developed.

(4) Model Studies

General navigation physical model studies would be required if this site is utilized, mainly for design of upper approach improvements.

A section model would be required for design of the fixed crest dam and stilling basin.

(5) Cofferdams

Site specific cofferdam studies were not performed for mile 22.2. Such studies were not warranted because early cost comparisons indicated that plans utilizing this site were not competitive. Based on investigations for other sites, plus the fact that the community of Elizabeth, PA is located immediately upstream, it is believed that a three-stage construction scheme would be required for the dam. Both locks would be built first within a single cofferdam.

iv. Mile 23.8

(1) Locks

Replacement Plan 3 utilizes this site. The new locks would be located on the right bank but would extend about 100 ft farther riverward than the existing locks. The lower miter gates would be situated just below the dam. This upstream position is required to avoid blocking the emptying ports of the existing land chamber during construction of the river lock. Top of walls would be at elevation 743, giving 3.2-year maximum navigable stage and 7-year overtopping protection. The river lock would be utilized as a floodway both during construction of the dam and afterward to reduce upstream backwater effects.

(2) Fixed Crest Dam

The new dam would be built on the existing axis but would be only 576 ft long versus 670 ft at present. The overflow section would be ogee-shaped with the crest at elevation 726.9. The stilling basin at elevation 699 would be 61 ft long to accommodate a maximum plunging unit discharge of 170 cfs per foot.

(3) Navigation Conditions

This site with locks on the right bank was not evaluated in the WES tow simulator study. Presently, maneuvering is difficult in the upper approach due to the projecting bank. The proposed new locks and guard wall would extend about 900 ft farther upstream. Therefore, extensive excavation of the projecting right bank would be required to provide access to the locks. It is believed that, through modelling, an excavation scheme to provide good approach conditions could be devised. The preliminary layout made for costing cuts a 3,000 ft section of the bank extending a maximum distance of 400 ft back from the present shoreline and averaging 25 ft deep. A high contingency allowance is recommended because there is a possibility that more excavation or even training dikes may be needed.

Locating the new large river lock about 120 ft riverward of the existing large land lock should alleviate the downstream situation where tows must maneuver around a water intake.

(4) Model Studies

General physical model studies would be needed. The upstream bank excavation plan and any other features required to assure good navigation conditions would be designed. Navigation during construction, cofferdam backwater effects, and floodway operation would be investigated as well.

A section model would be used for design of the fixed crest dam and stilling basin.

(5) Cofferdams

Upstream stage increases, caused by the lock cofferdam, would be small, i.e., less than one foot for floods of greater than 10-year magnitude. Backwater effects would be greater during construction of the dam, even with one of the new 84 ft locks opened as a floodway. Approximately 310 ft of crest would be available during each of the assumed three stages. The computed swellhead is 1.6 ft at the 10-year level and one foot at the 100-year level. The community of Monongahela, PA, at mile 32.0, would experience surcharges about 40% less than the damsite values. At Charleroi, PA, mile 41.5, they would be 60% less.

v. Mile 24.6

(1) Locks

Replacement Plan 4 utilizes this site. The locks would occupy an area of the right bank flood plain, cutting off a broad peninsula on the inside of a bend. Top of walls would be at elevation 742.5, thereby providing a 3.7-year maximum navigable stage and 6-year protection against overtopping. The lock would not be needed as a floodway except during construction.

(2) Fixed Crest Dam

The length would be 750 ft. Due to the relatively long dam and higher tailwater associated with this location, the maximum calculated plunging unit discharge is only 100 cfs per foot. On this basis a 41 ft stilling basin is proposed. The configuration would follow Grays Landing with the basin at elevation 699, approximately 28 ft lower than the crest.

(3) Navigation Conditions

As mentioned in Paragraph 3.i., the configuration of locks and dam was revised after the tow simulator testing. In order to avoid undercutting a railroad track, the upstream end of the locks was rotated about 200 ft riverward.

According to WES, dikes would be needed in the upper approach to provide safe entrance conditions. A plan of L-dikes extending 3,000 ft upstream of the guard wall along the right bank has been devised to provide a basis for cost estimates. The intent would be to create an artificial bank line leading to the guide wall. It also has been assumed that the channel along the left bank would be deepened to reduce velocities in the approach area. The ultimate configuration of dikes/ excavation undoubtedly would change after modelling.

(4) Model Studies

A general navigation model would be needed to design upstream approach alterations which are expected to be fairly extensive. The model would include the existing locks downstream so that navigation conditions during construction could be thoroughly evaluated.

A section model would be required for design of the fixed crest dam and stilling basin.

(5) Cofferdams

Since the river is relatively wide at mile 24.6 and the locks would be built in the bank, backwater effects associated with the lock cofferdam should be minimal. Regarding the dam, it appears a two-stage plan is feasible if the discharge capacity is augmented by employing one 84 ft lock as a floodway. Swellheads would be roughly equalized between the two stages, if 490 ft of crest were constructed during the first stage, leaving a 200 ft wide navigable opening between the cofferdam and riverwall. The remaining 260 ft of crest would be built in the second stage during which time 430 ft of completed crest would be available. Computed swellheads show an overall average effect of about 1.5 ft with a maximum of two feet in the two to five-year flood range. Surcharge would be 25% less at Monongahela, PA, mile 32.0, and 60% less at Charleroi, PA, mile 41.5.

vi. Mile 34.0

(1) Locks

This site is utilized by Plans 6 and 7. Top of walls would be at elevation 748.5, five feet above normal upper pool. Overtopping would occur once in eight to nine years. Theoretical maximum navigable stage, two feet below top of lock walls, would be exceeded once in 5.7 years with Plan 6 or 5.1 years with Plan 7. This is more than adequate in either case.

(2) Gated Dam

The dam would be comprised of six 84 ft tainter gates plus a fixed weir approximately 50 ft long. Initial layout of the dam and tainter gates was based on the Maxwell configuration. Gate sills would be at elevation 717.5 which is 26 ft below pool and a few feet above the present streambed. An analysis was made of stilling action using the Maxwell model data and minimum expected tailwater conditions under Plan 6 with five of six gates available. It shows that under these "normal operating" conditions, good basin performance and relatively low exit velocities would be expected. However, with the Maxwell-type basin floor only five feet below the gate sill, it would be difficult meeting the current criteria for a single gate half or fully open without heavy downstream armoring. Therefore, it appears that the basin should be lower and larger than Maxwell's. Preliminary design computations, using procedures in EM-1110-2-1605, indicate the basin should be no higher than elevation 699 which is 18.5 ft below the sill. Total breadth of the dam and stilling basin would be 165 ft compared to 92 ft at Maxwell. With a basin of these dimensions, no damage would be expected for a single gate half open and normal lower pool (elevation 718.7). A single gate

open full with the same tailwater would likely cause some scour, but with the foundation in firm rock approximately 20 ft below the basin, the structure itself should not be threatened. It is possible that an even lower basin would be appropriate. While it would be longer with more downstream excavation, a lowered floor would reduce damage for the full open condition, while tending to reduce the quantity of concrete. Model tests and cost comparisons would be needed to optimize the basin design.

Under Plan 7 the normal lower pool would be at elevation 723.7, five feet higher than with Plan 6. However, with significant flow in the river, tailwater curves for the two plans would nearly converge. The stilling basin with Plan 7 probably could be slightly higher than described above for Plan 6.

Low steel of a fully raised gate would be at elevation 773.0 allowing about six feet of clearance above the SPF. This is about a foot less than Maxwell Dam upstream and satisfies the five feet Ohio River criterion.

(3) Navigation Conditions

WES did not specifically evaluate a combination replacement at this site, however, a "Recommended" classification and top ranking can be inferred from other tests. The upper approach, which usually is more critical, would be identical to the tested Locks and Dam 4 replacement structure. The outside-of-bend position was found to provide a favorable alignment for vessels approaching from upstream. The downstream approach for the Locks and Dam 4 replacement also was determined to be good. For the combination replacement structure, tailwater would be slightly lower but compensating dredging for the new navigation channel would yield similar velocities. As with the single structure replacement, the inside-of-bend position would tend to shelter the lower approach area and provide ample room for maneuvering. Thus, it can be concluded that the downstream approach would be good for the combination structure. Other than some obvious bank excavation needed at the lower lock entrance, no special channel alterations for navigability are envisioned.

(4) Model Studies

General navigation physical model studies would be required at mile 34.0 to confirm navigability as well as to optimize guide and guard wall designs and downstream excavation. Construction conditions also would be investigated.

A separate larger scale model of the dam and stilling basin would be required to optimize their configuration, determine gate operating schedule limitations, and define downstream stone protection requirements. At least three gate bays would be modelled to assure accurate representation of the interaction of discharges below adjacent gates.

(5) Cofferdams

Conditions were only evaluated for Plan 6 as Plan 7 would be similar. Since this is not an existing site, the lock cofferdam should not cause a severe encroachment or significant backwater problem. A two-stage scheme was investigated for construction of the gated dam. An open pass approximately 240 ft wide would be available for passing discharge during the first stage. Additionally, it was assumed that one new 84 ft wide lock would be used as a floodway during both stages. It would be advantageous if the downstream navigation channel were excavated (Plan 6) prior to dam construction as lower pool stages would be reduced by one-half foot. This would alleviate the upstream swellhead to some degree. Compared to existing conditions, upper pool elevations during stage one construction would be increased an average of 1.5 ft. During the second stage, the average increase would be about two feet with three feet maximum for the five-year flood. Surcharges would be 30% less at Charleroi, PA, mile 41.5. Although the backwater effects mentioned above are more severe than with most other sites, early acquisition of the required flowage easement would negate damage to private property during lower floods. More detailed studies including investigation of three-staged construction would be necessary if this site is selected.

vii. Mile 41.5

(1) Locks

During the dam reconstruction in the mid-1960's a portion of a new river wall for a future 84 ft by 720 ft lock also was constructed. The proposed new river lock would utilize this existing "stub wall." Top of the wall segment and proposed new locks is at elevation 751, two feet higher than the walls of the old locks. Therefore, existing overtopping frequency (2.3 years) and maximum navigable (1.3 years) would be improved. The new frequencies depend on downstream conditions which would vary with each plan. Under Plan 1, overtopping would occur once in 4.6 years with maximum navigable stage exceeded once in 2.8 years. With Plans 2 through 5, the overtopping frequency would range from 3.7 to 4.1 years, and maximum navigable, 2.0 to 2.3 years. While not meeting the middle Monongahela standard of four years, the frequency of future navigation interruptions appears to be acceptable under all plans.

(2) Gated Dam

The broken baffle piers, tailwater deficiency for certain gate openings, and scoured derrick stone downstream were discussed in Paragraph 2.c.ii. Under Plan 1, tailwater elevations at the site would be reduced significantly due to the 3.2 ft lowering of the pool. The existing deficiency in the TW/D2 ratio would be worsened further, extending through the entire range of gate openings under conditions of minimum tailwater and one gate out of service. The minimum ratios would range from 0.42 at two feet open to 0.93 at full open. The average exit velocity for full open would exceed 20 ft per second. Present needs have not yet been defined but it should be assumed that scour protection requirements would be increased under Plan 1. According to the general guidance contained in REMR Technical Note HY-N-1.6, very large riprap (D50 minimum = 4 ft) would be required. It also is stated that 20 ft long by 6.75 ft wide by 2.75 ft high grout filled fabric bags can be used instead of four to five-foot riprap. This is the treatment presently proposed to protect the area downstream of Dam 4 with Plan 1. This would be superior to placement of loose riprap and has been employed successfully at other projects in the District. The bags would be placed on a 1V on 3H slope which has been shown in numerous model studies to provide the desired expansion and stability. The offset from the end sill would be four feet to be even with the top of the concrete capped cutoff wall installed in the mid-1960's. In a model study to be conducted later, consideration could be given to reducing the end sill height which is as high as the gate sill. This could reduce the exit velocity while still deflecting the jet upward at the end of the basin. A high contingency factor is appropriate for the scour protection cost estimate under this plan. There is a remote possibility that a model study will show the need for an auxiliary stilling basin adjacent to the existing basin.

Under Plans 2 through 5, tailwater conditions would not change significantly. A scour protection scheme designed for existing conditions also would be adequate should any of these plans be implemented in the future.

The existing 43 ft fixed weir would be eliminated under all plans due to construction of the new river lock. The overall effect on discharge capacity of the structure would be minimal.

(3) Navigation Conditions

WES rated this site "Not Recommended" and the least desirable of three replacement sites for Locks and Dam 4. The plan evaluated had the locks positioned farther upstream than presently proposed. Also, velocities would vary slightly because of downstream conditions which are different for each plan. However, the test results should be fairly

representative of expected conditions under any plan. The upbound entering reach was found to be difficult due to a sharp bend and bridge just downstream. The downbound entrance maneuver also was difficult because a spur dike and mooring cells prevent tows from moving close enough to the right bank to get lined up.

A physical model study which provides more insight into navigation conditions at mile 41.5 was conducted from 1958 to 1963. Results are presented in WES Technical Report No. 2-736. The model included a 110 ft by 720 ft land chamber instead of the proposed 84 ft by 720 ft chamber. Also, modelled river levels and velocities were slightly different. These differences are minor so the basic results and recommendations should be applicable.

It was found that although a large eddy would form in the lower approach, tows would not have serious difficulties maneuvering. Velocity vector plots indicate the lower guard wall in combination with bank curvature shelter the approach area and channel span of the aforementioned bridge from fast river currents. Based on these findings, no modifications to the downstream channel are proposed other than under Plan 1, deepening of the approach area to provide 12 ft of depth below the new lower pool from the locks to just downstream of the bridge. This is mainly intended to provide a transition to the new nine-foot navigation channel.

In the upper approach, the physical model findings were in general agreement with the tow simulator study. High velocities, the irregular right bank line, and unfavorable alignment of currents in the area resulting from the projecting spur dike were cited as contributing to difficulties encountered by approaching tows. It was found that elimination of the spur dike would cause some increase in velocities but would improve the alignment of currents appreciably. It is assumed that the dike would be removed. Fill to eliminate the bank irregularities also is proposed as the modelling indicated this would improve the current alignment and allow tows to maneuver close to the bank. To slow velocities near the bank, various schemes for excavation and spoil placement in the channel were found to be effective in the model. The proposed scheme is the same for all of the replacement plans (No. 1 through 5) and is taken from that designated as model "Plan 5." It consists of dredging a 200 ft wide channel along the left bank with a bottom elevation of 713.5 and extending from the dam to a point about 4,500 ft upstream. The dredged material would be deposited between the excavated channel and right bank to elevation 728.5. This spoil would extend approximately 1,900 ft upstream from the present location of the spur dike.

(4) Model Studies

A general navigation model would be desirable. Even though the site was modelled previously, there are sufficient changes to the old plan plus new data to create uncertainties that justify remodelling. Results from the earlier model would give a starting point for the new model, possibly eliminating some of the usual early trials.

Dam 4 spillway and stilling basin were not model-tested before the 1960's alterations. A model is needed to determine downstream scour protection needs after which appropriate measures can be designed. Tailwater would not change significantly under Plans 2 through 5. However, tailwater would be lowered by as much as 3.2 ft under Plan 1 so more substantial downstream armoring would probably be required. In the model, as a minimum, one full gate bay plus half bays on either side should be represented. In the event downstream armoring proves inadequate, stilling basin modifications or an auxiliary basin would be considered.

(5) Cofferdams

The cofferdam for construction of the new river lock would put one of five gate bays out of service but should not cause serious backwater problems.

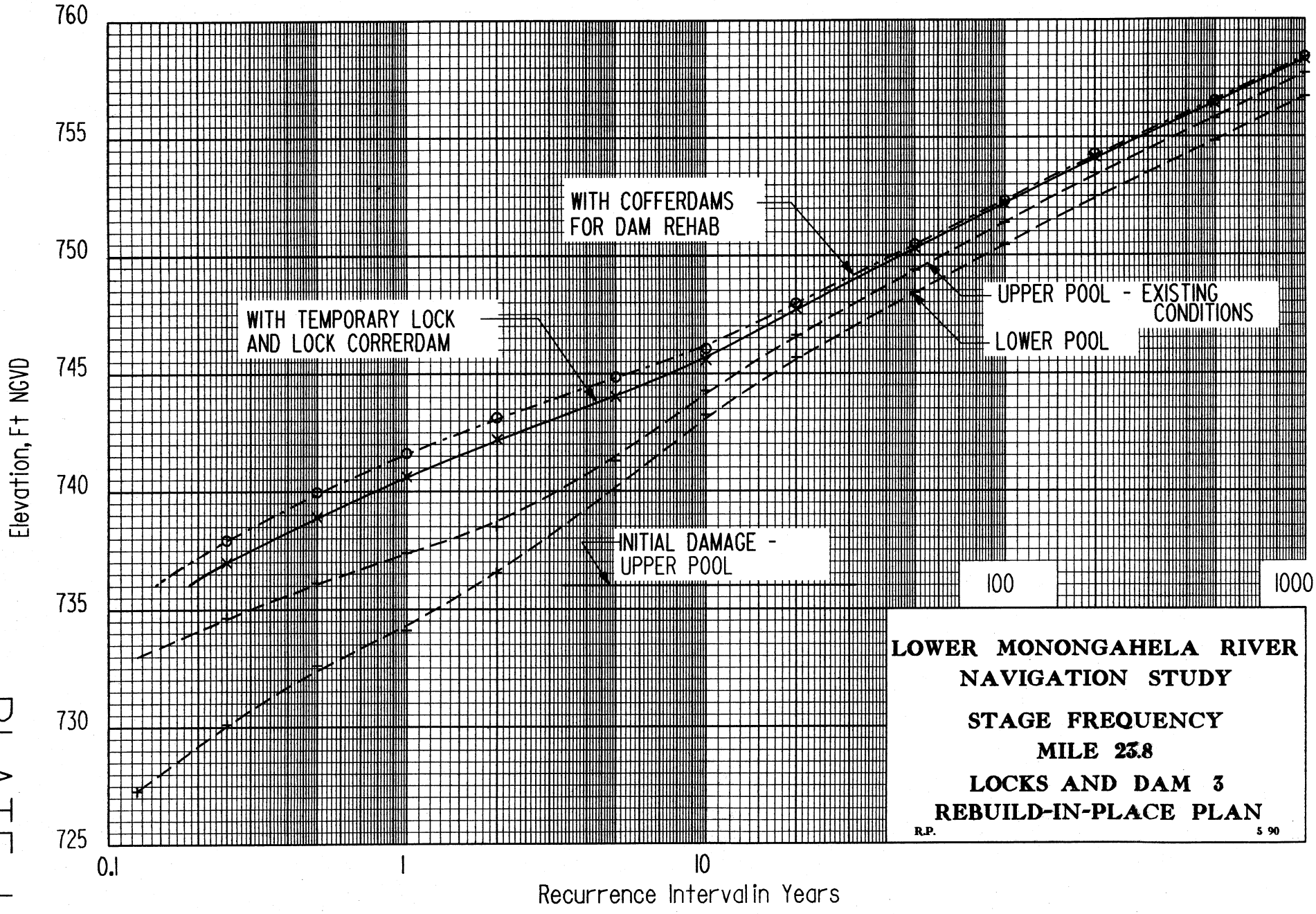

760
755
750
745
740
735
730
725
Elevation, Ft NGVD
0.1
1
10
100
1000
Recurrence Interval in Years
WITH COFFERDAMS FOR DAM REHAB
WITH TEMPORARY LOCK AND LOCK CORRERDAM
UPPER POOL - EXISTING CONDITIONS
LOWER POOL
INITIAL DAMAGE - UPPER POOL
LOWER MONONGAHELA RIVER NAVIGATION STUDY
STAGE FREQUENCY
MILE 23.8
LOCKS AND DAM 3
REBUILD-IN-PLACE PLAN
R.P.
5 90

PLATE 1

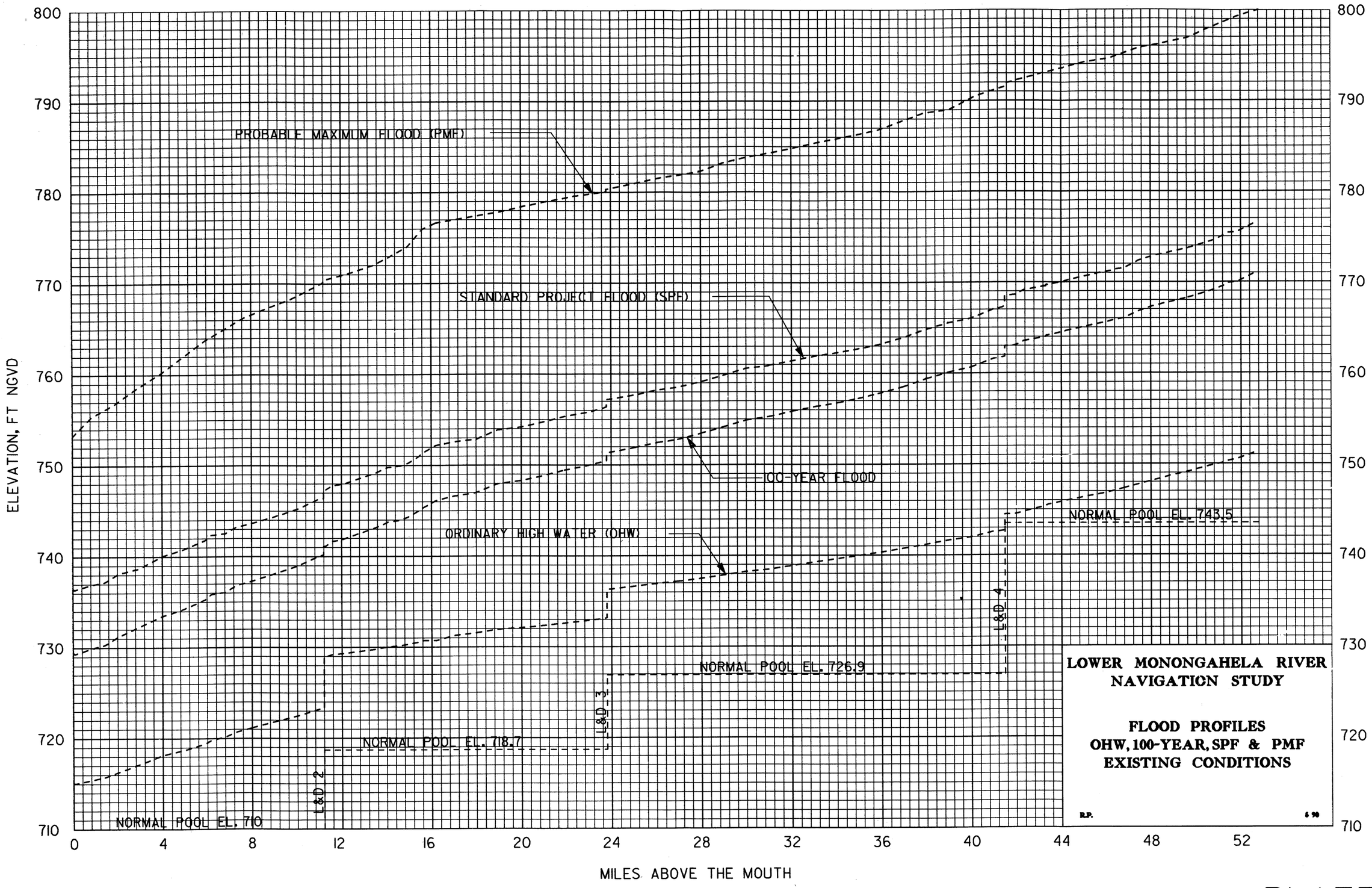

PROBABLE MAXIMUM FLOOD (PMF)
STANDARD PROJECT FLOOD (SPF)
100-YEAR FLOOD
ORDINARY HIGH WATER (OHW)
NORMAL POOL EL. 743.5
NORMAL POOL EL. 726.9
NORMAL POOL EL. 718.7
NORMAL POOL EL. 710
L&D 2
L&D 3
L&D 4
ELEVATION, FT NGVD
MILES ABOVE THE MOUTH
800
790
780
770
760
750
740
730
720
710
0
4
8
12
16
20
24
28
32
36
40
44
48
52
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
FLOOD PROFILES
OHW, 100-YEAR, SPF & PMF
EXISTING CONDITIONS

PLATE 2

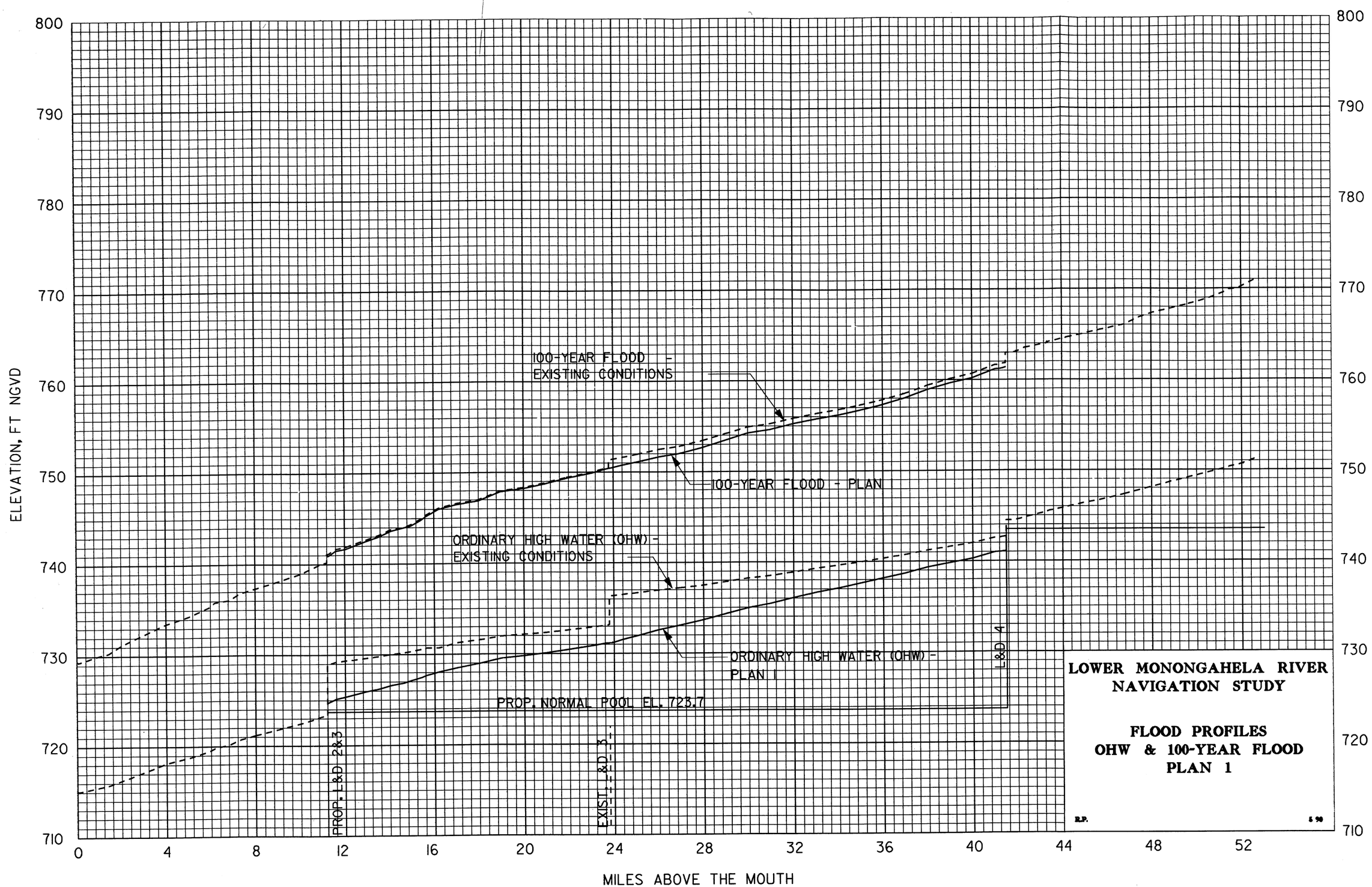

800
790
780
770
760
750
740
730
720
710
ELEVATION, FT NGVD
0
4
8
12
16
20
24
28
32
36
40
44
48
52
MILES ABOVE THE MOUTH
100-YEAR FLOOD - EXISTING CONDITIONS
100-YEAR FLOOD - PLAN 1
ORDINARY HIGH WATER (OHW) - EXISTING CONDITIONS
ORDINARY HIGH WATER (OHW) - PLAN 1
PROP. NORMAL POOL EL. 723.7
PROP. L&D 2&3
EXIST. L&D 3
L&D 4
LOWER MONONGAHELA RIVER NAVIGATION STUDY
FLOOD PROFILES
OHW & 100-YEAR FLOOD
PLAN 1
R.P.

PLATE 3

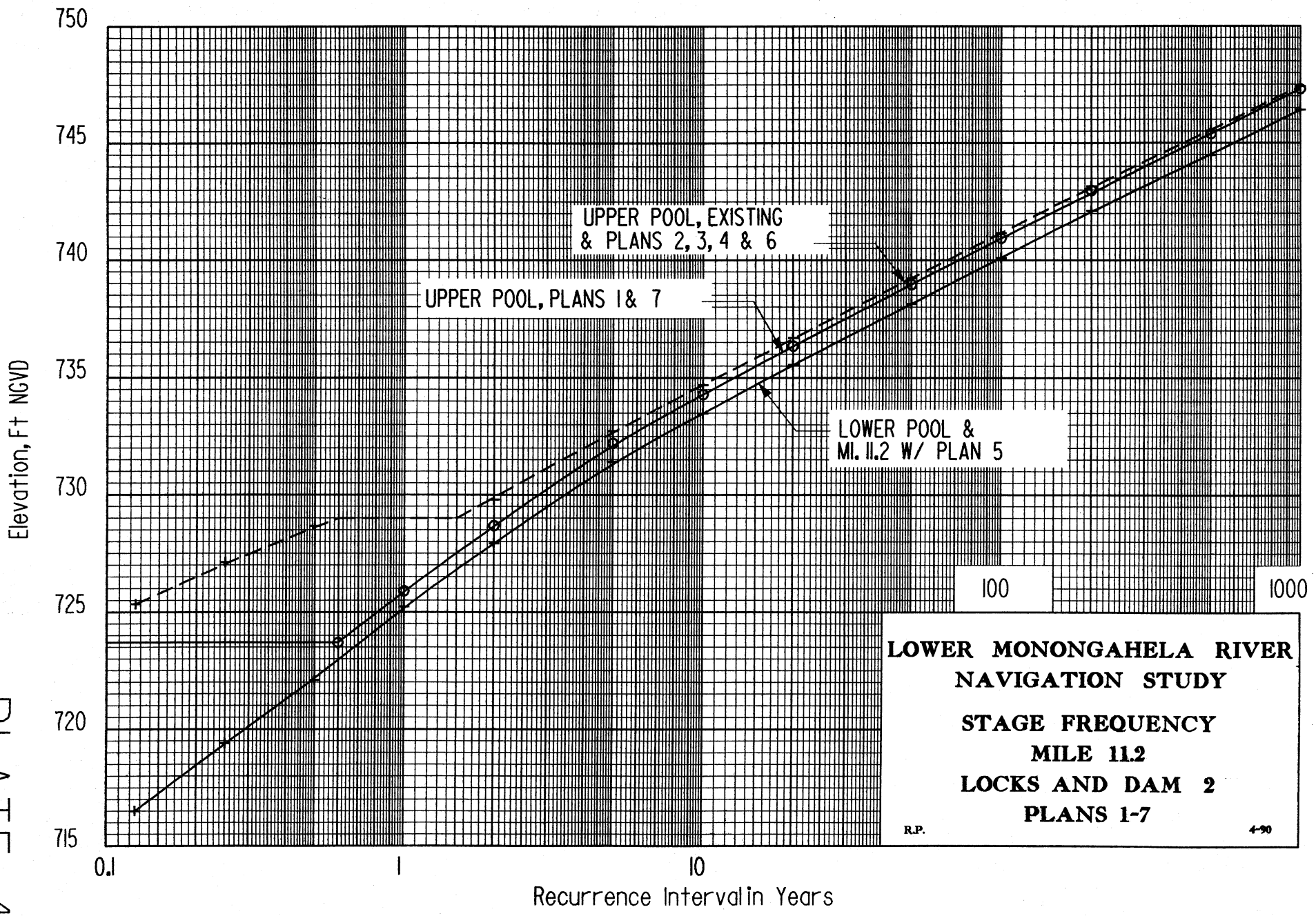

750
745
740
735
730
725
720
715
Elevation, Ft NGVD
UPPER POOL, EXISTING
& PLANS 2, 3, 4 & 6
UPPER POOL, PLANS 1 & 7
LOWER POOL &
MI. 11.2 W/ PLAN 5
100
1000
0.1
1
10
Recurrence Interval in Years
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
STAGE FREQUENCY
MILE 11.2
LOCKS AND DAM 2
PLANS 1-7
R.P.
4-90

PLATE 4

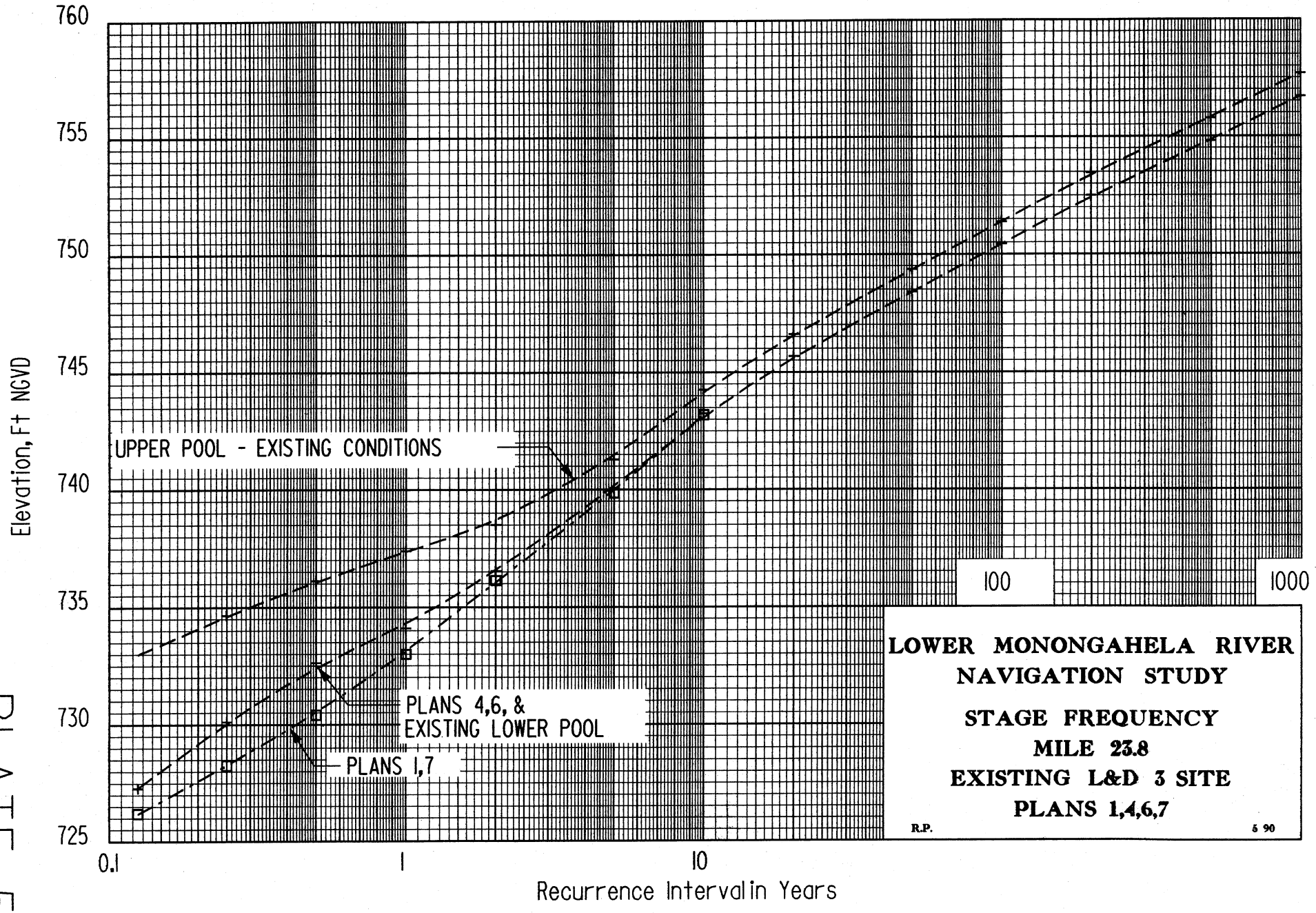

760
755
750
745
740
735
730
725
Elevation, Ft NGVD
0.1
1
10
100
1000
Recurrence Intervalin Years
UPPER POOL - EXISTING CONDITIONS
PLANS 4,6, &
EXISTING LOWER POOL
PLANS 1,7
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
STAGE FREQUENCY
MILE 23.8
EXISTING L&D 3 SITE
PLANS 1,4,6,7
R.P.
5 90

PLATE 5

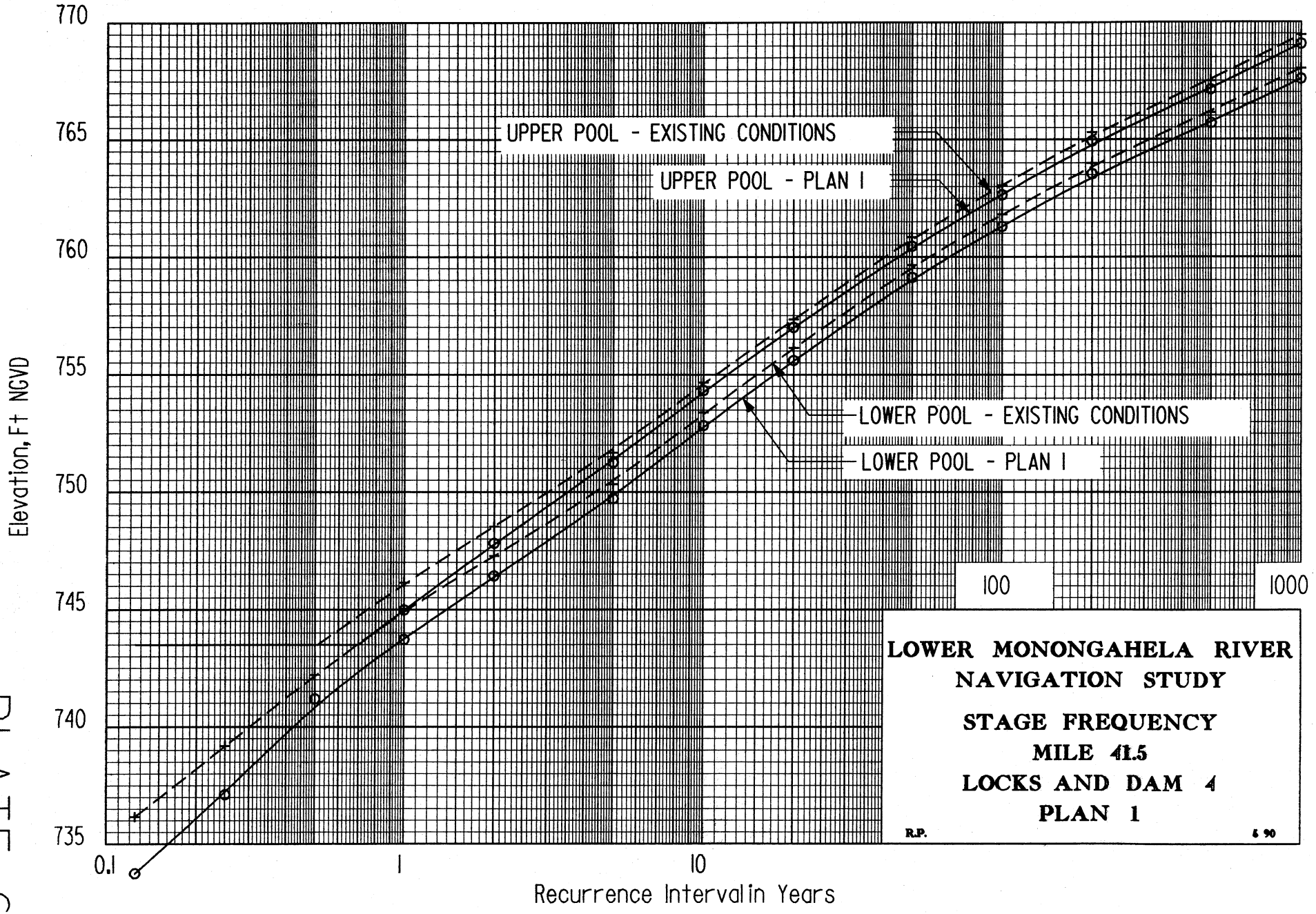
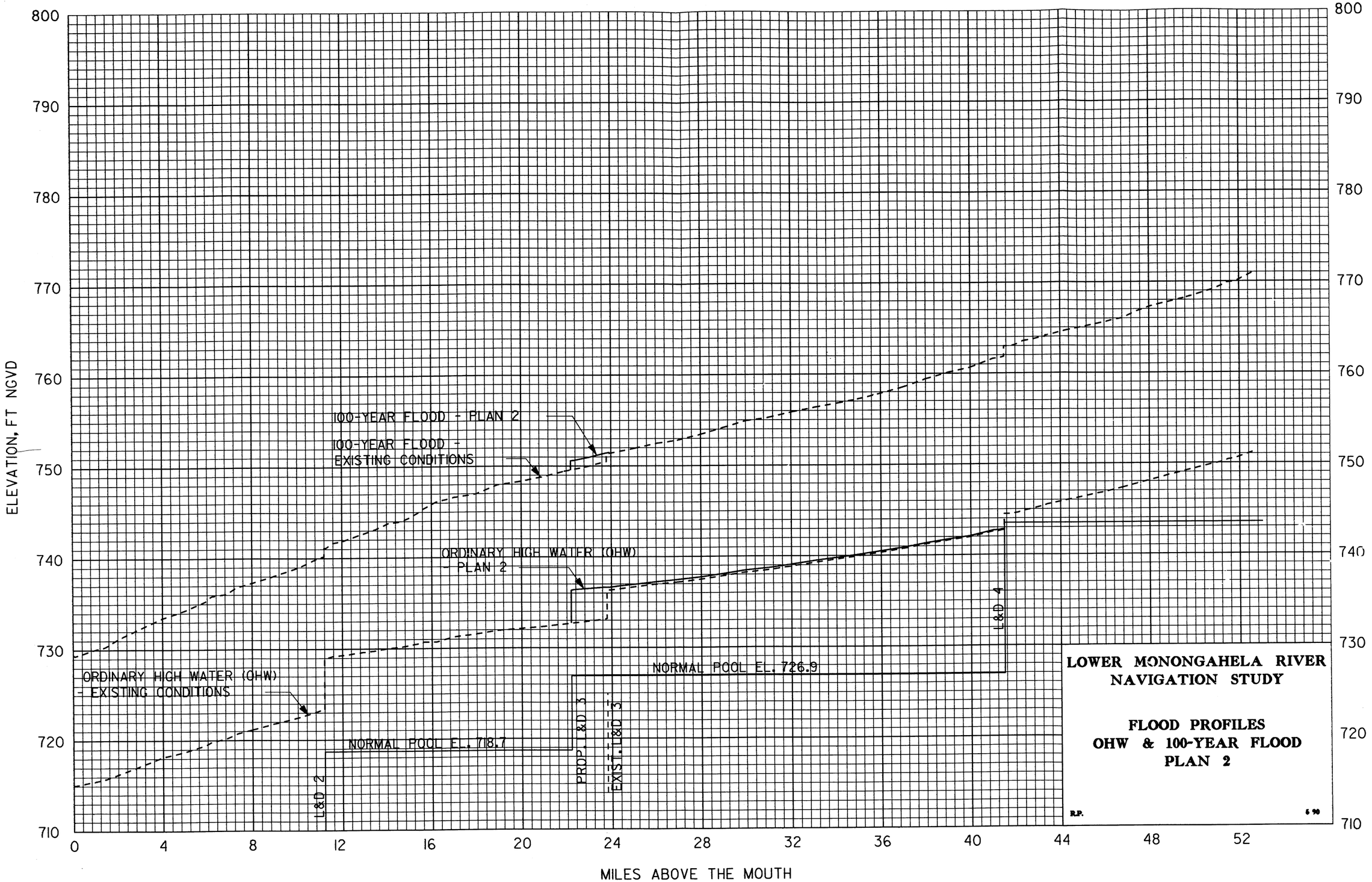

770
765
760
755
750
745
740
735
Elevation, Ft NGVD
UPPER POOL - EXISTING CONDITIONS
UPPER POOL - PLAN I
LOWER POOL - EXISTING CONDITIONS
LOWER POOL - PLAN I
0.1
1
10
100
1000
Recurrence Interval in Years
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
STAGE FREQUENCY
MILE 41.5
LOCKS AND DAM 4
PLAN 1
R.P.
6 90

PLATE 9


800
790
780
770
760
750
740
730
720
710
ELEVATION, FT NGVD
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12
16
20
24
28
32
36
40
44
48
52
MILES ABOVE THE MOUTH
100-YEAR FLOOD - PLAN 2
100-YEAR FLOOD - EXISTING CONDITIONS
ORDINARY HIGH WATER (OHW) - PLAN 2
ORDINARY HIGH WATER (OHW) - EXISTING CONDITIONS
NORMAL POOL EL. 726.9
NORMAL POOL EL. 718.7
L&D 2
PROP. L&D 3
EXIST. L&D 3
L&D 4
LOWER MONONGAHELA RIVER NAVIGATION STUDY
FLOOD PROFILES
OHW & 100-YEAR FLOOD
PLAN 2
R.P.
6 90

PLATE 7

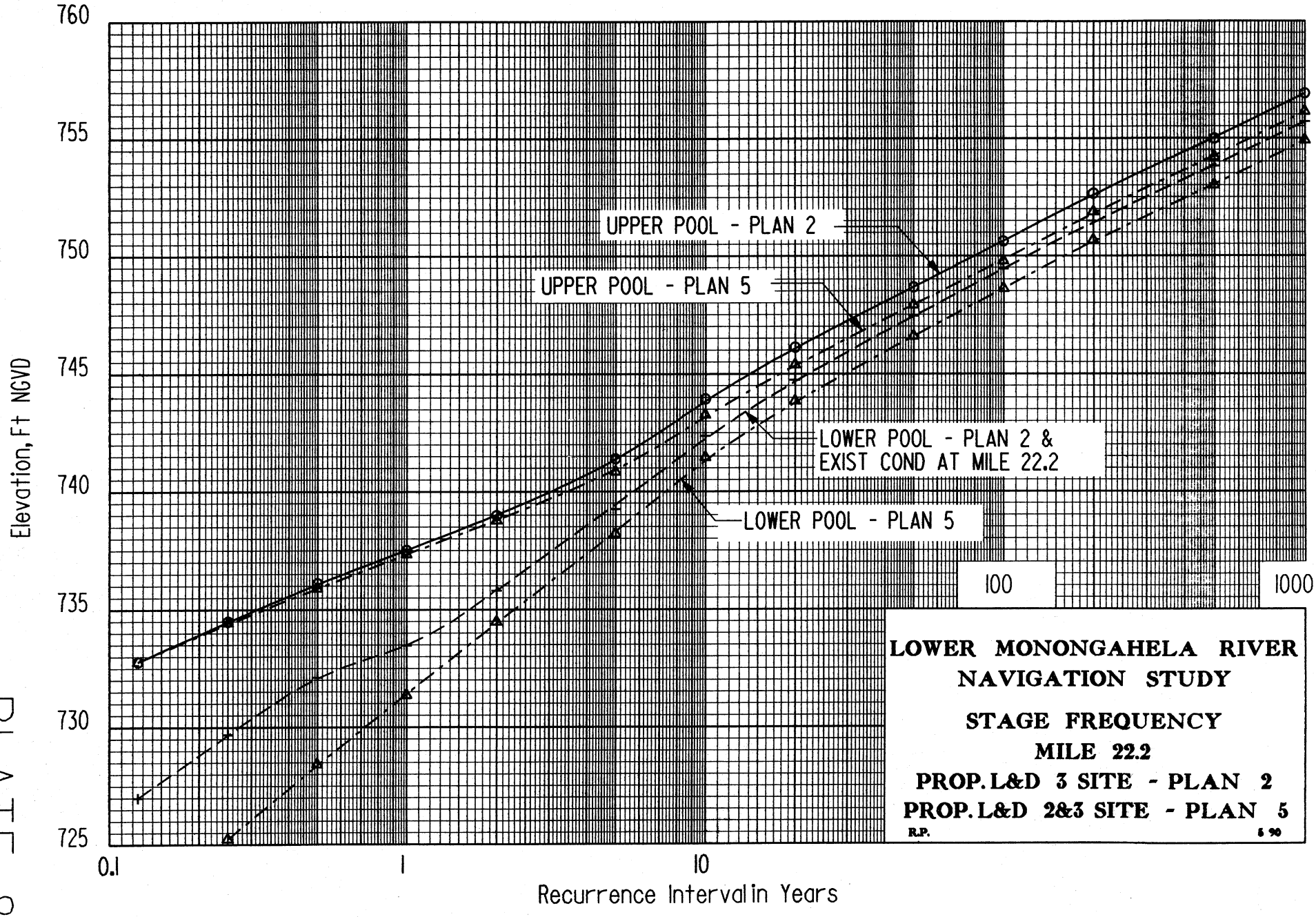
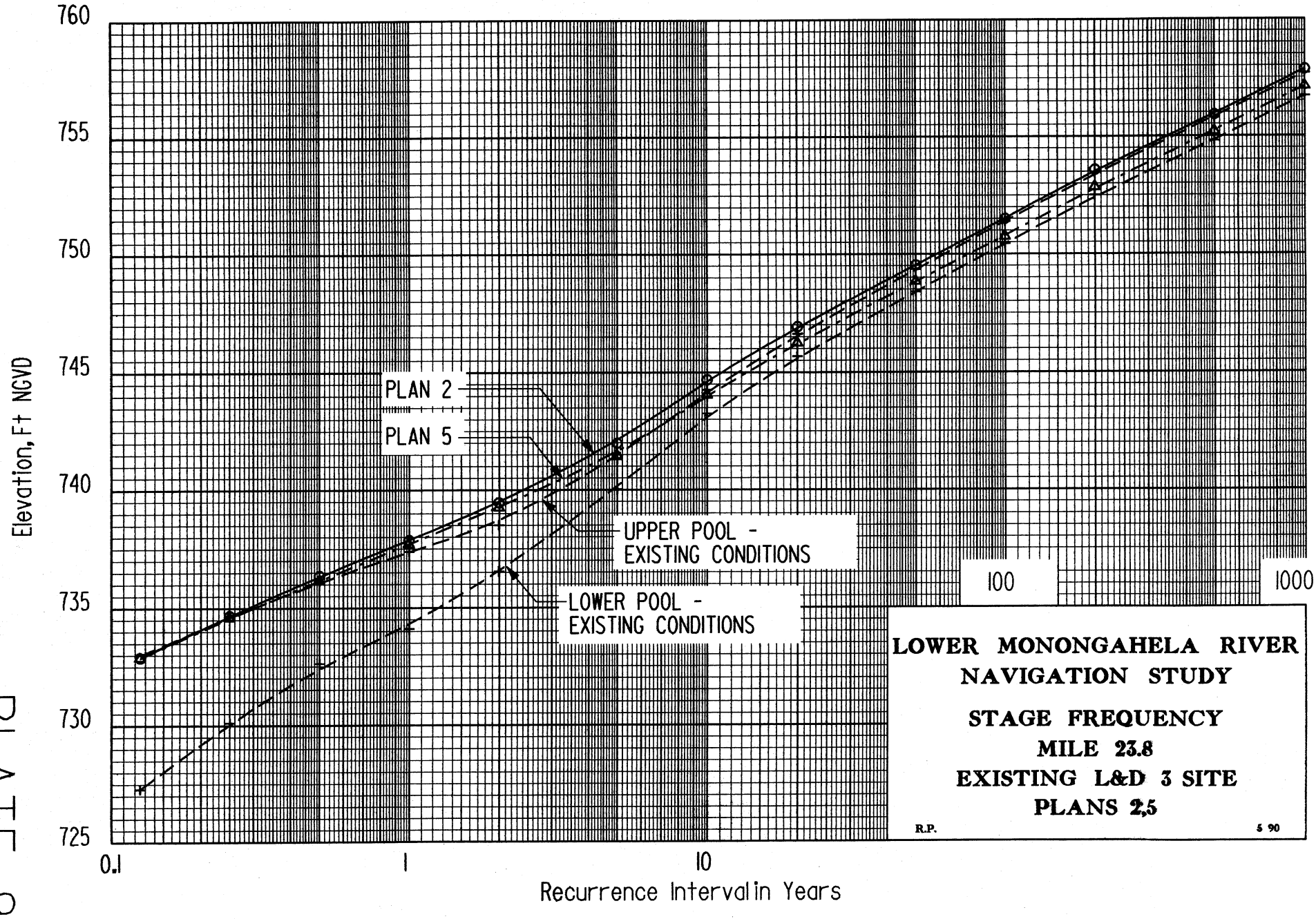

760
755
750
745
740
735
730
725
Elevation, Ft NGVD
0.1
1
10
100
1000
Recurrence Interval in Years
UPPER POOL - PLAN 2
UPPER POOL - PLAN 5
LOWER POOL - PLAN 2 &
EXIST COND AT MILE 22.2
LOWER POOL - PLAN 5
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
STAGE FREQUENCY
MILE 22.2
PROP. L&D 3 SITE - PLAN 2
PROP. L&D 2&3 SITE - PLAN 5
R.P.
5 90

PLATE 8


760
755
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Elevation, Ft NGVD
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1000
Recurrence Interval in Years
PLAN 2
PLAN 5
UPPER POOL -
EXISTING CONDITIONS
LOWER POOL -
EXISTING CONDITIONS
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
STAGE FREQUENCY
MILE 23.8
EXISTING L&D 3 SITE
PLANS 2,5
R.P.
5 90

PLATE 9

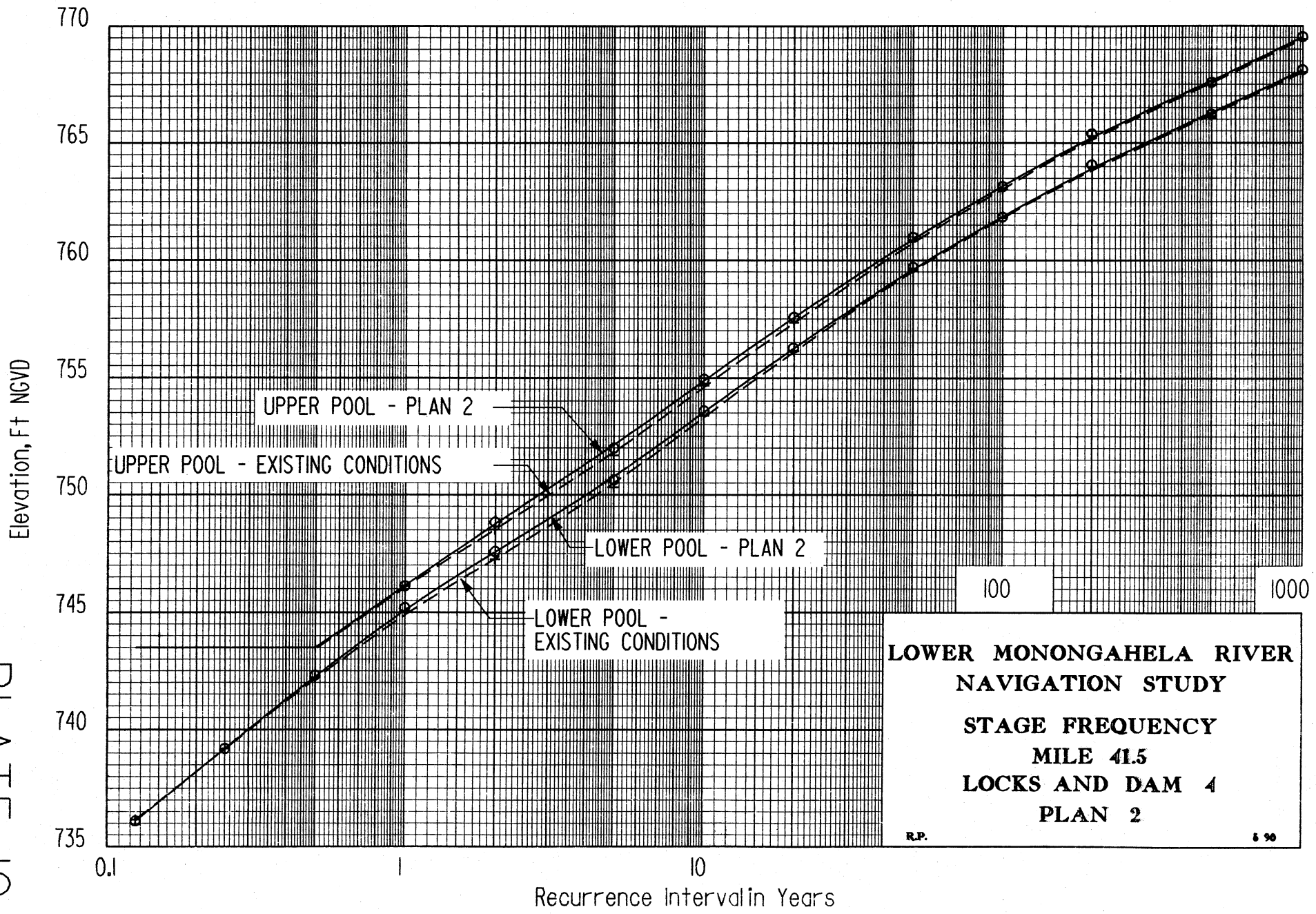

770
765
760
755
750
745
740
735
Elevation, Ft NGVD
UPPER POOL - PLAN 2
UPPER POOL - EXISTING CONDITIONS
LOWER POOL - PLAN 2
LOWER POOL -
EXISTING CONDITIONS
0.1
1
10
100
1000
Recurrence Interval in Years
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
STAGE FREQUENCY
MILE 41.5
LOCKS AND DAM 4
PLAN 2
R.P.
6 90

PLATE 10

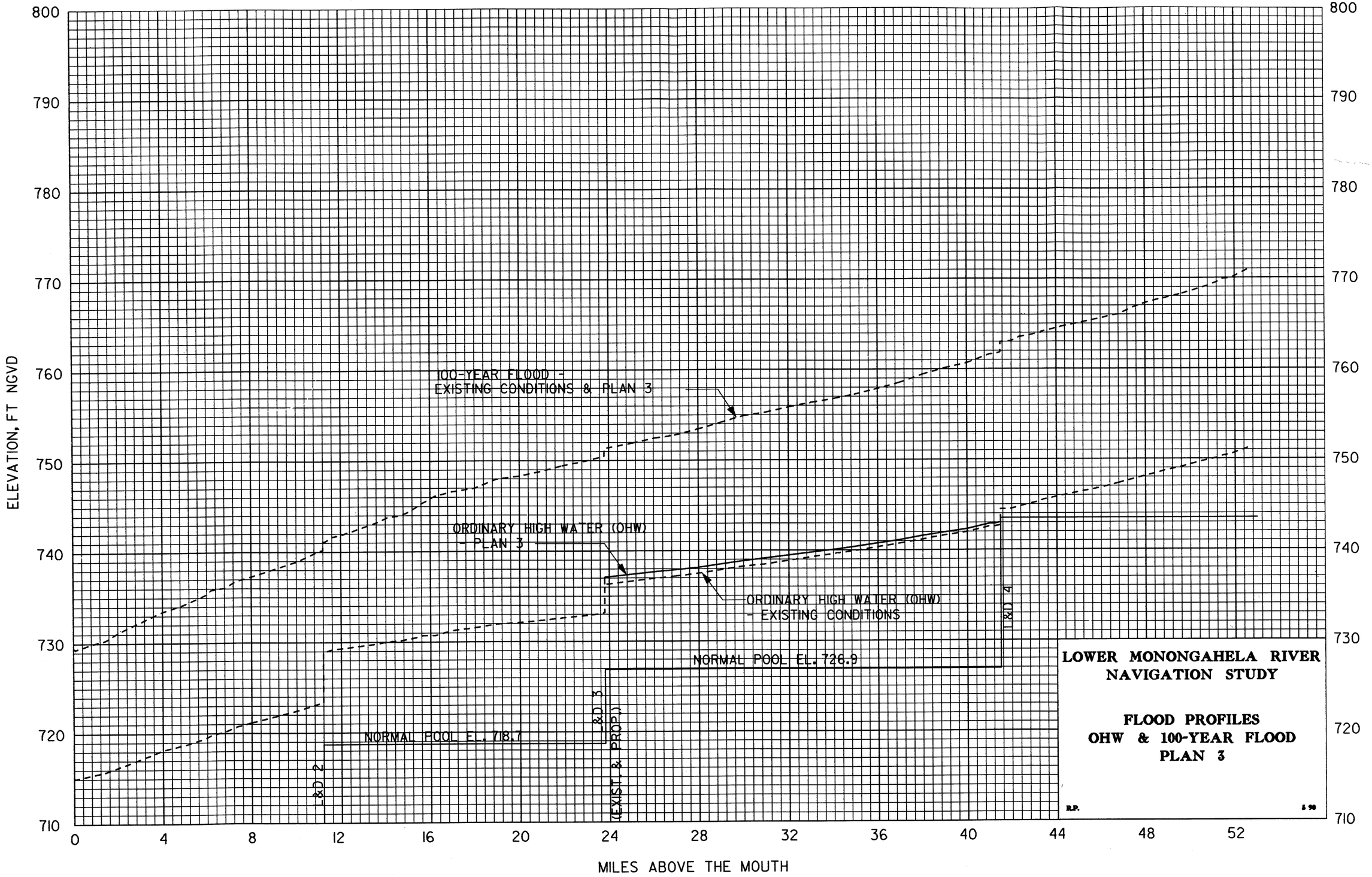

800
790
780
770
760
750
740
730
720
710
ELEVATION, FT NGVD
0
4
8
12
16
20
24
28
32
36
40
44
48
52
MILES ABOVE THE MOUTH
100-YEAR FLOOD - EXISTING CONDITIONS & PLAN 3
ORDINARY HIGH WATER (OHW) - PLAN 3
ORDINARY HIGH WATER (OHW) - EXISTING CONDITIONS
NORMAL POOL EL. 726.9
NORMAL POOL EL. 718.7
L&D 2
L&D 3 (EXIST. & PROP.)
L&D 4
LOWER MONONGAHELA RIVER NAVIGATION STUDY
FLOOD PROFILES
OHW & 100-YEAR FLOOD
PLAN 3

PLATE II

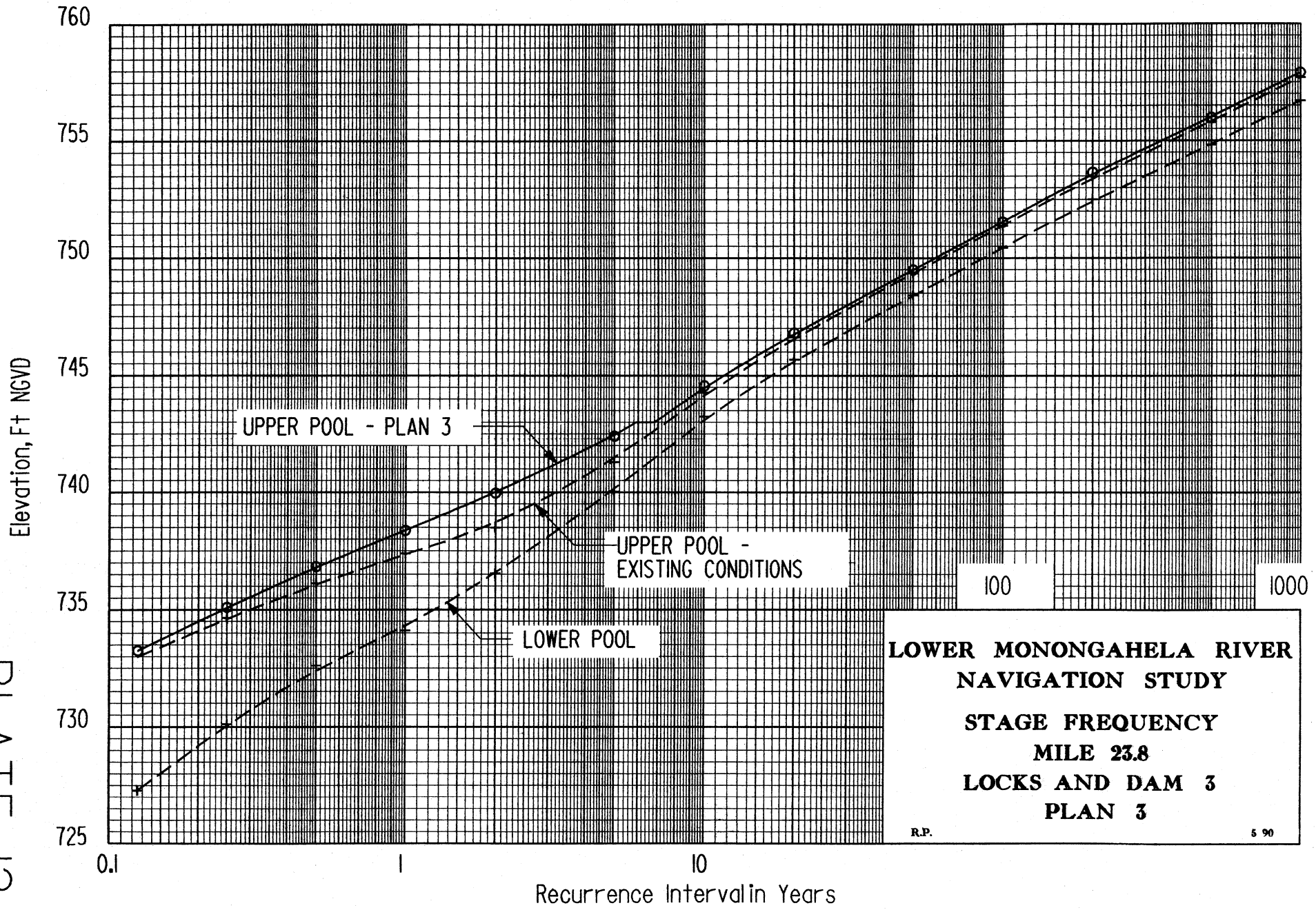

760
755
750
745
740
735
730
725
Elevation, Ft NGVD
UPPER POOL - PLAN 3
UPPER POOL - EXISTING CONDITIONS
LOWER POOL
0.1
1
10
100
1000
Recurrence Interval in Years
LOWER MONONGAHELA RIVER NAVIGATION STUDY
STAGE FREQUENCY
MILE 23.8
LOCKS AND DAM 3
PLAN 3
R.P.
5 90

PLATE 12

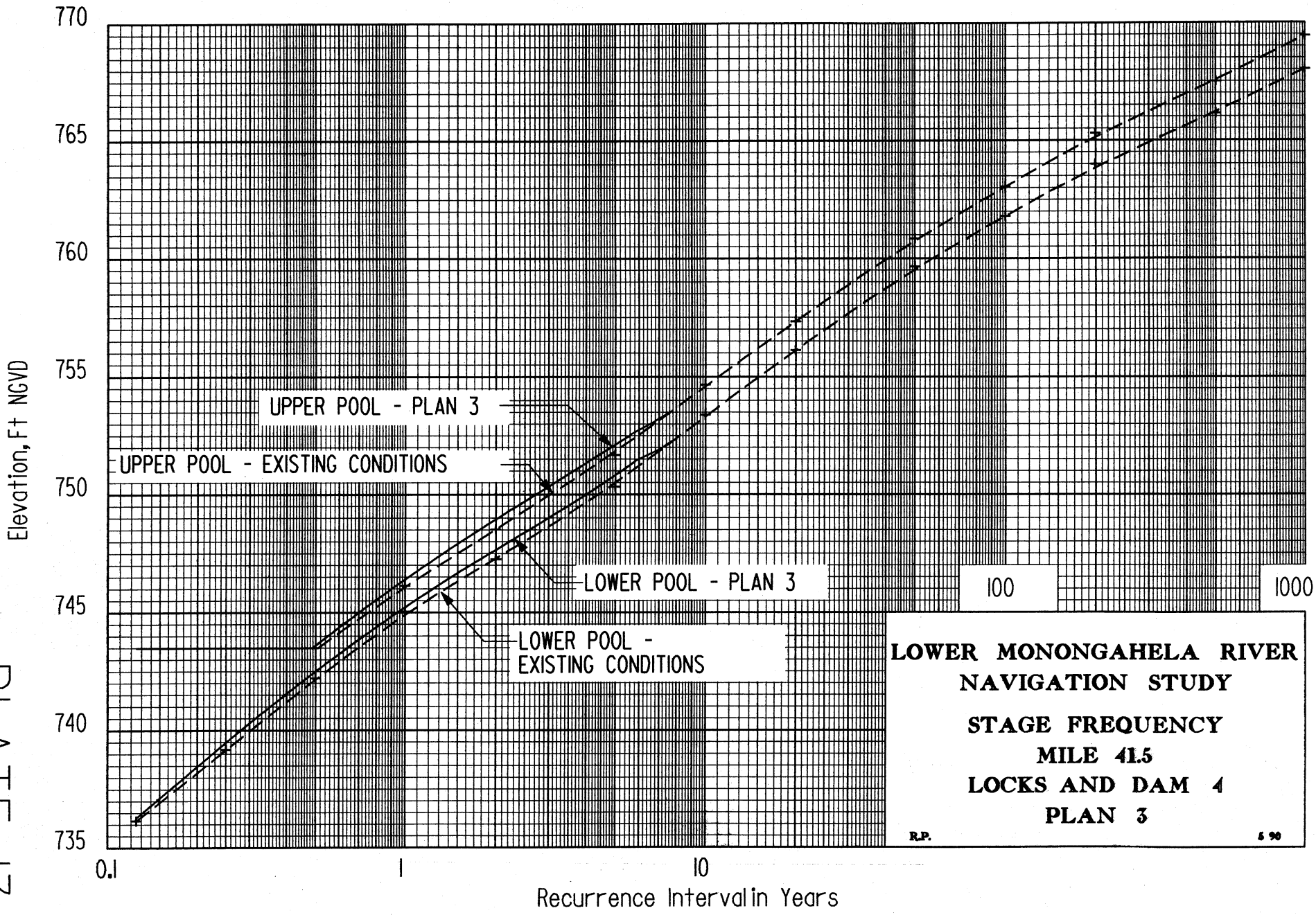

770
765
760
755
750
745
740
735
Elevation, Ft NGVD
UPPER POOL - PLAN 3
UPPER POOL - EXISTING CONDITIONS
LOWER POOL - PLAN 3
LOWER POOL - EXISTING CONDITIONS
0.1
1
10
100
1000
Recurrence Interval in Years
LOWER MONONGAHELA RIVER NAVIGATION STUDY
STAGE FREQUENCY
MILE 41.5
LOCKS AND DAM 4
PLAN 3
R.P.
5 90

PLATE 13

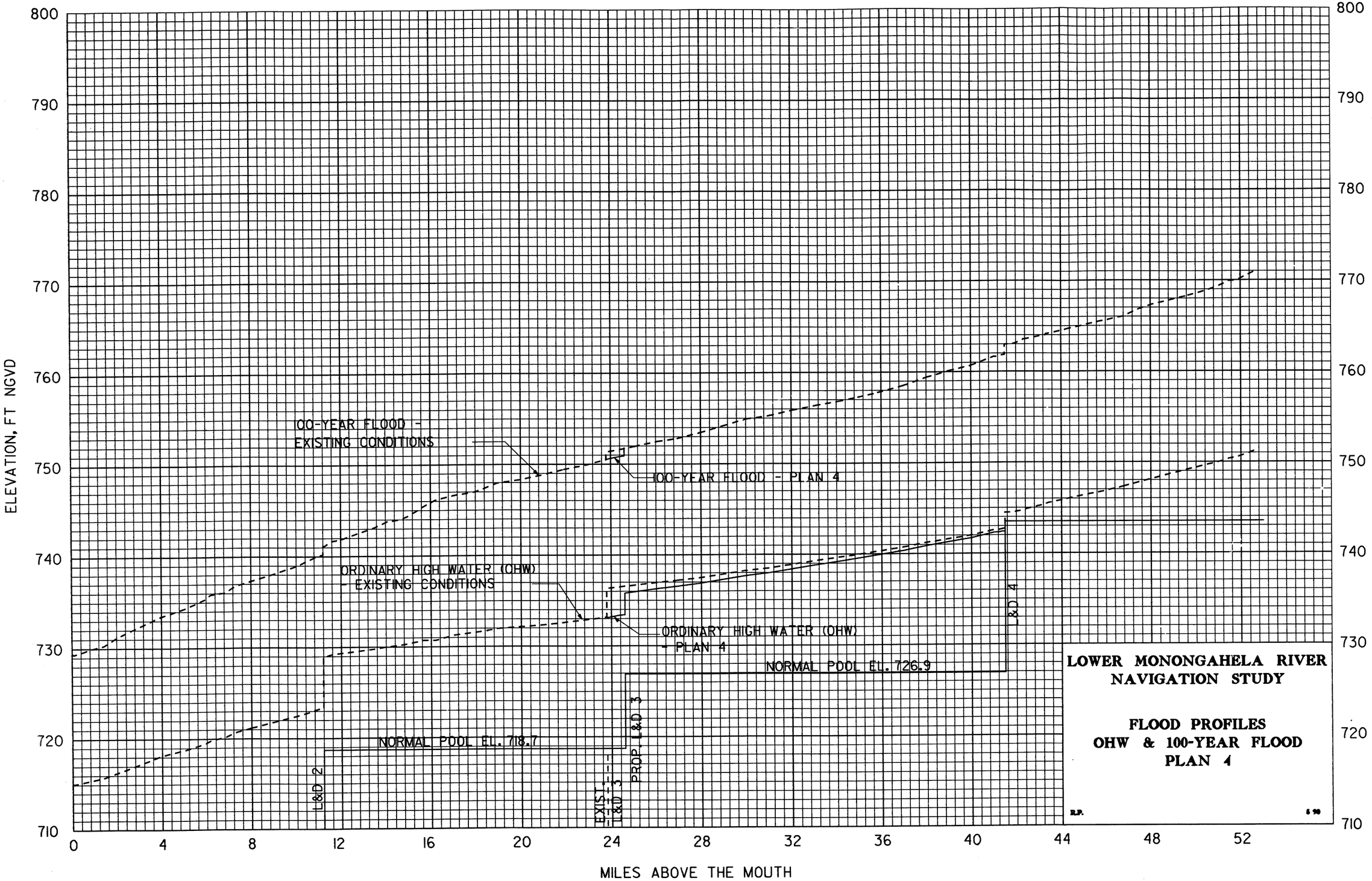

ELEVATION, FT NGVD
MILES ABOVE THE MOUTH
100-YEAR FLOOD - EXISTING CONDITIONS
100-YEAR FLOOD - PLAN 4
ORDINARY HIGH WATER (OHW) - EXISTING CONDITIONS
ORDINARY HIGH WATER (OHW) - PLAN 4
NORMAL POOL EL. 726.9
NORMAL POOL EL. 718.7
L&D 2
EXIST. L&D 3
PROP. L&D 3
L&D 4
LOWER MONONGAHELA RIVER NAVIGATION STUDY
FLOOD PROFILES
OHW & 100-YEAR FLOOD
PLAN 4
R.P.

PLATE 14

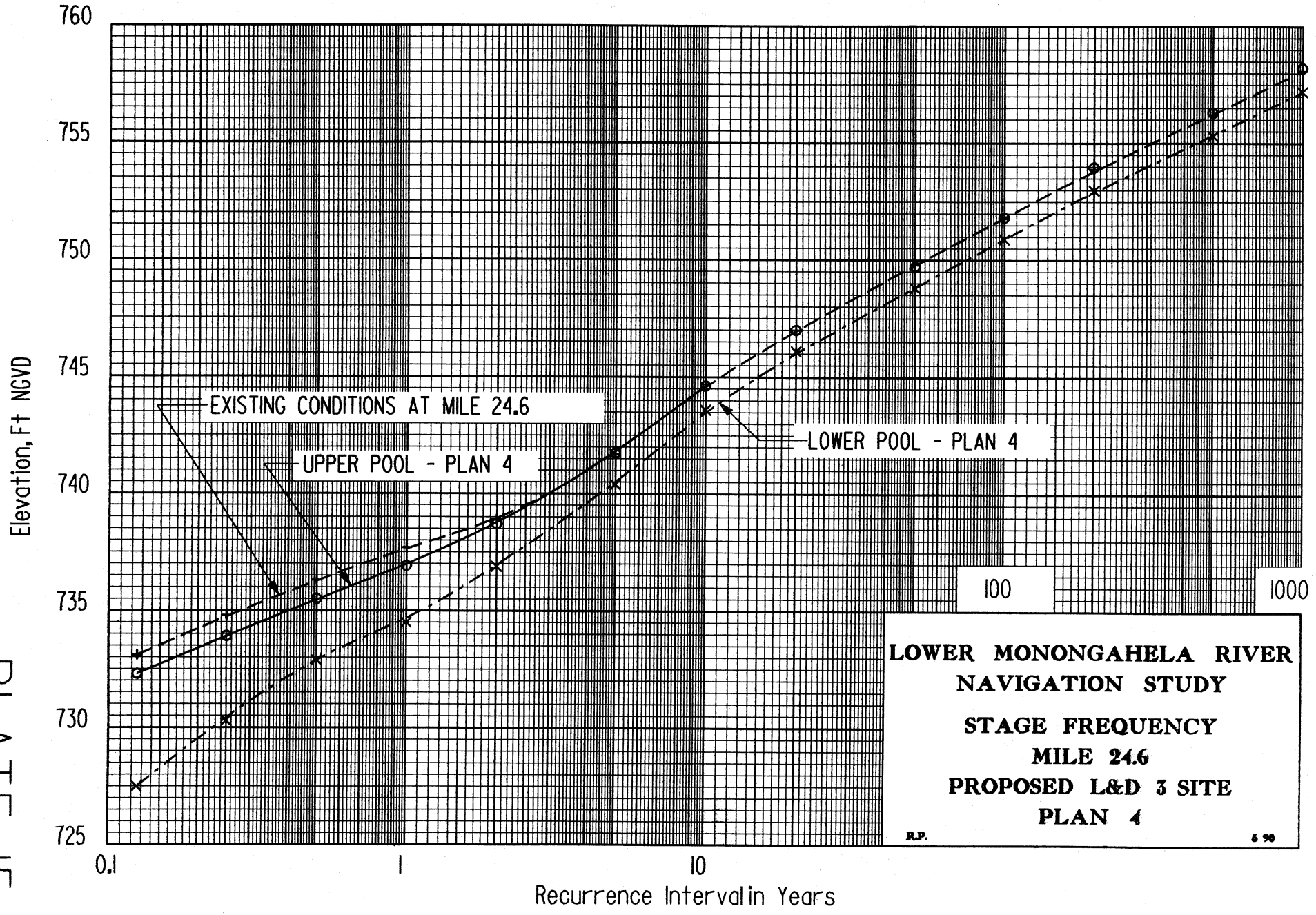
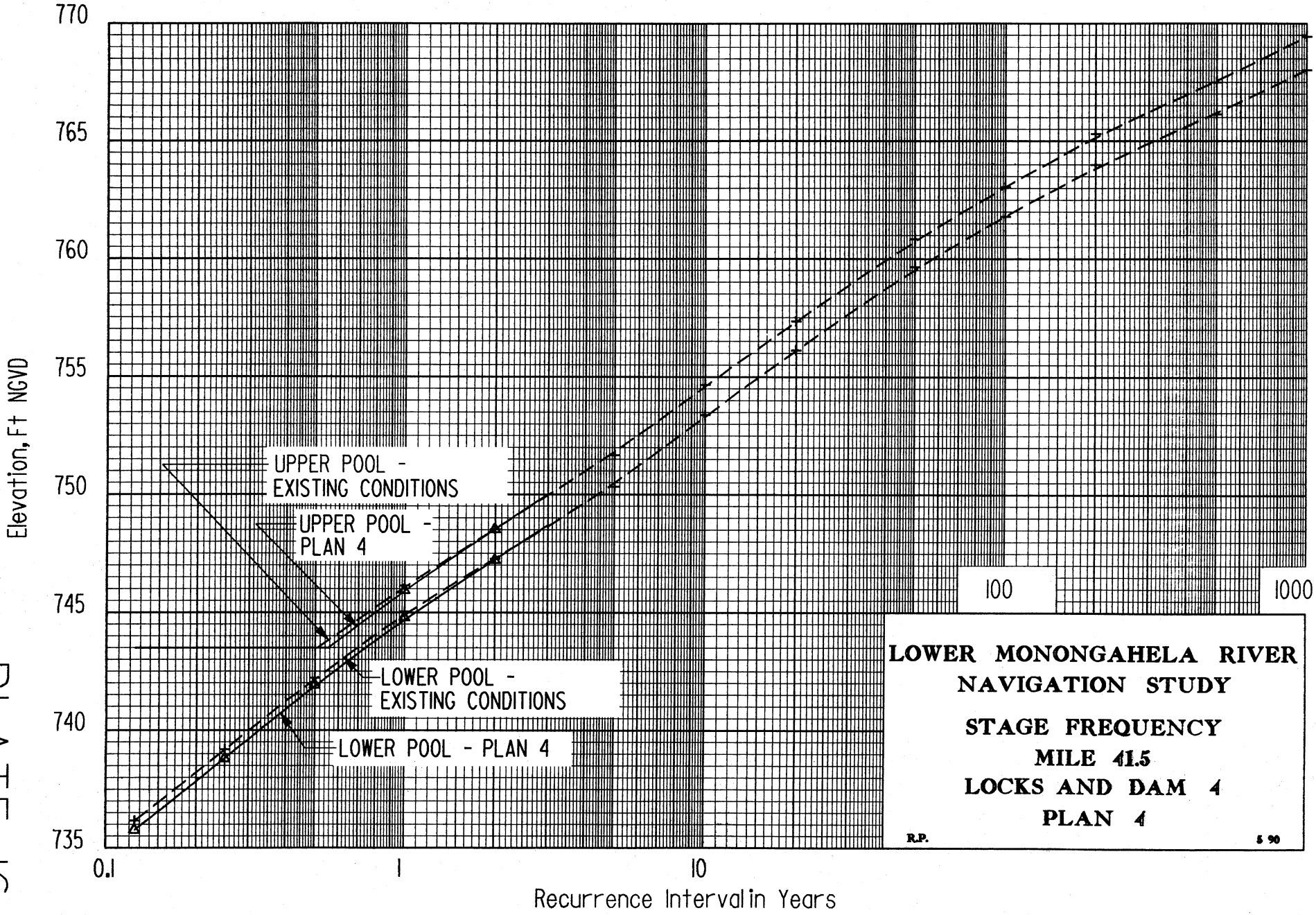

760
755
750
745
740
735
730
725
Elevation, Ft NGVD
EXISTING CONDITIONS AT MILE 24.6
UPPER POOL - PLAN 4
LOWER POOL - PLAN 4
0.1
1
10
100
1000
Recurrence Interval in Years
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
STAGE FREQUENCY
MILE 24.6
PROPOSED L&D 3 SITE
PLAN 4
R.P.
6 90

PLATE 15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740
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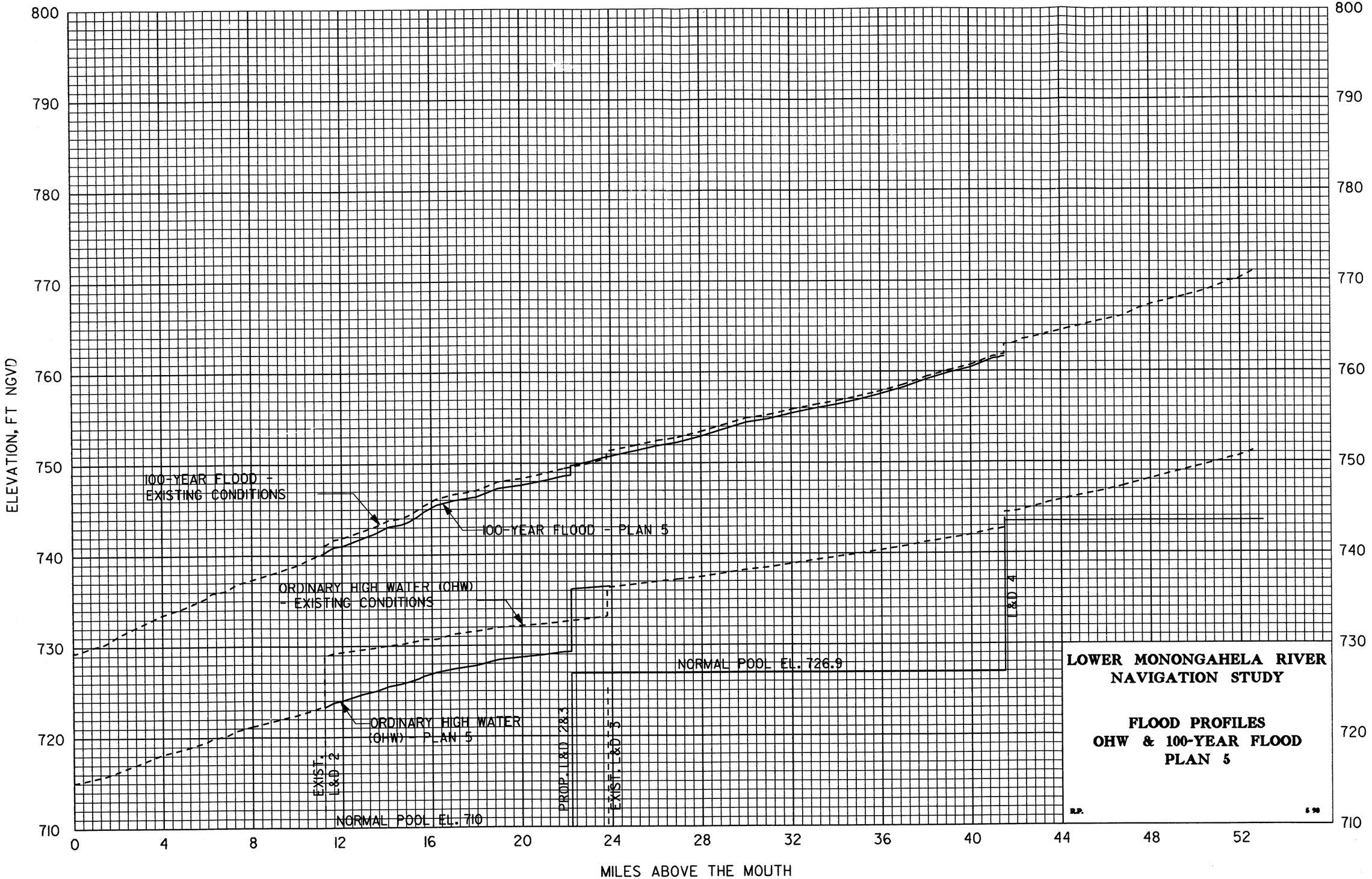
Recurrence Interval in Years
UPPER POOL - EXISTING CONDITIONS
UPPER POOL - PLAN 4
LOWER POOL - EXISTING CONDITIONS
LOWER POOL - PLAN 4
LOWER MONONGAHELA RIVER NAVIGATION STUDY
STAGE FREQUENCY
MILE 41.5
LOCKS AND DAM 4
PLAN 4
R.P.
5 90

PLATE 16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48
52
MILES ABOVE THE MOUTH
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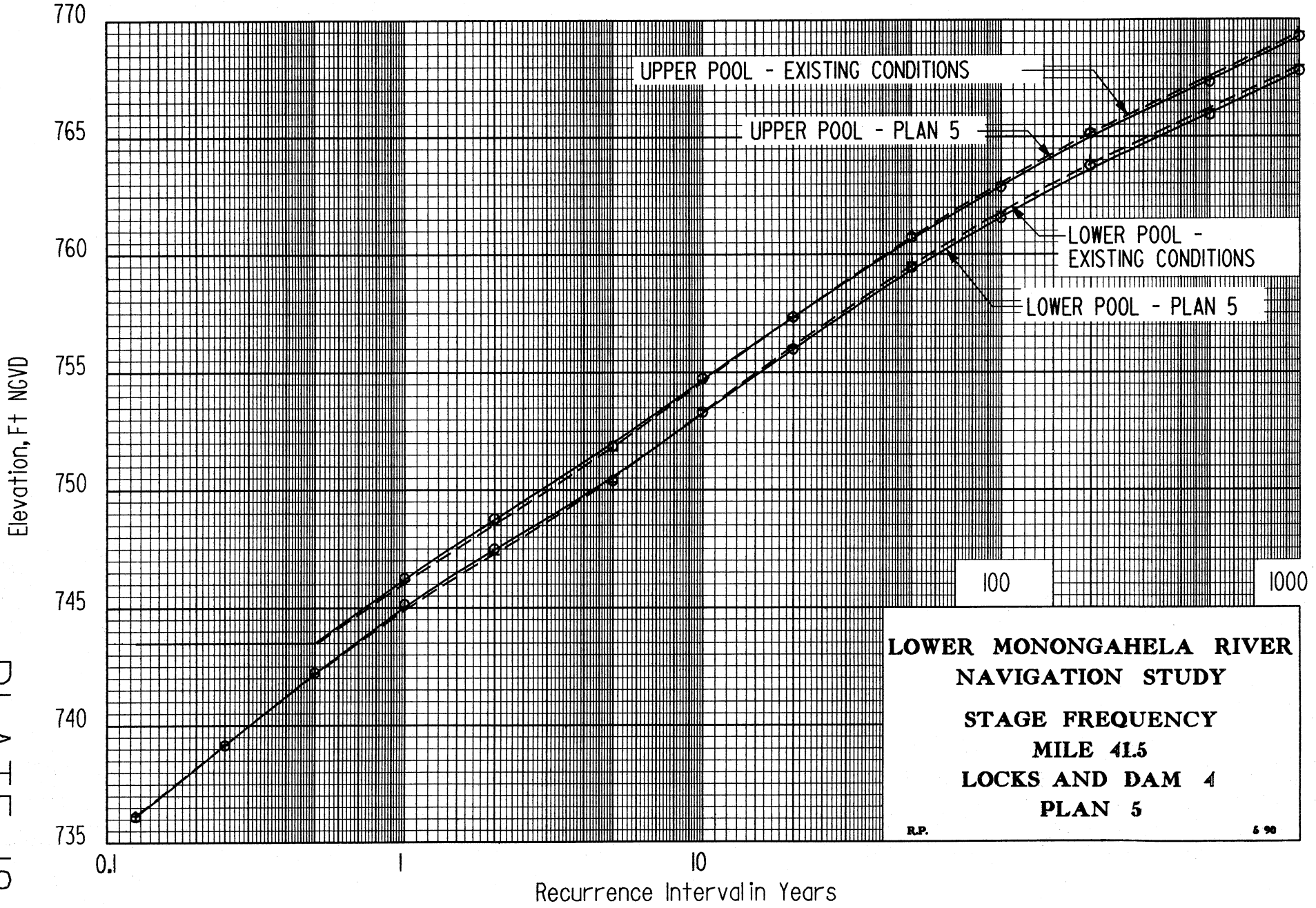
100-YEAR FLOOD - PLAN 5
ORDINARY HIGH WATER (OHW) - EXISTING CONDITIONS
ORDINARY HIGH WATER (OHW) - PLAN 5
NORMAL POOL EL. 726.9
NORMAL POOL EL. 710
EXIST. L&D 2
PROP. L&D 2&3
EXIST. L&D 3
L&D 4
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
FLOOD PROFILES
OHW & 100-YEAR FLOOD
PLAN 5
R.P.

PLATE 17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Elevation, Ft NGVD
UPPER POOL - EXISTING CONDITIONS
UPPER POOL - PLAN 5
LOWER POOL - EXISTING CONDITIONS
LOWER POOL - PLAN 5
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100
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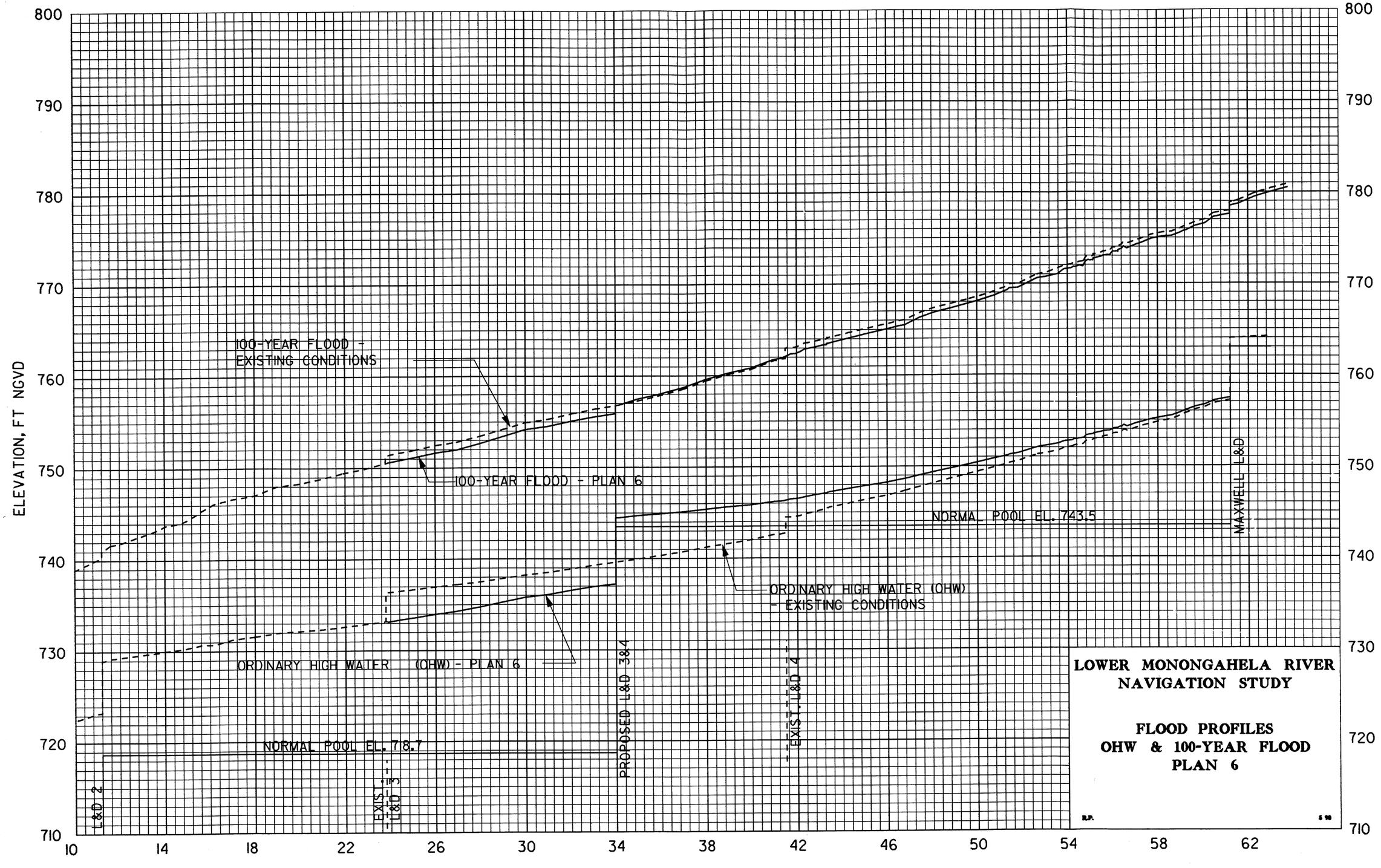
Recurrence Interval in Years
LOWER MONONGAHELA RIVER NAVIGATION STUDY
STAGE FREQUENCY
MILE 41.5
LOCKS AND DAM 4
PLAN 5
R.P.
5 90

PLATE 18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ELEVATION, FT NGVD
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42
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62
MILES ABOVE THE MOUTH
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100-YEAR FLOOD - PLAN 6
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ORDINARY HIGH WATER (OHW) - PLAN 6
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PROPOSED L&D 38.4
EXIST. L&D 4
EXIST. L&D 3
L&D 2
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
FLOOD PROFILES
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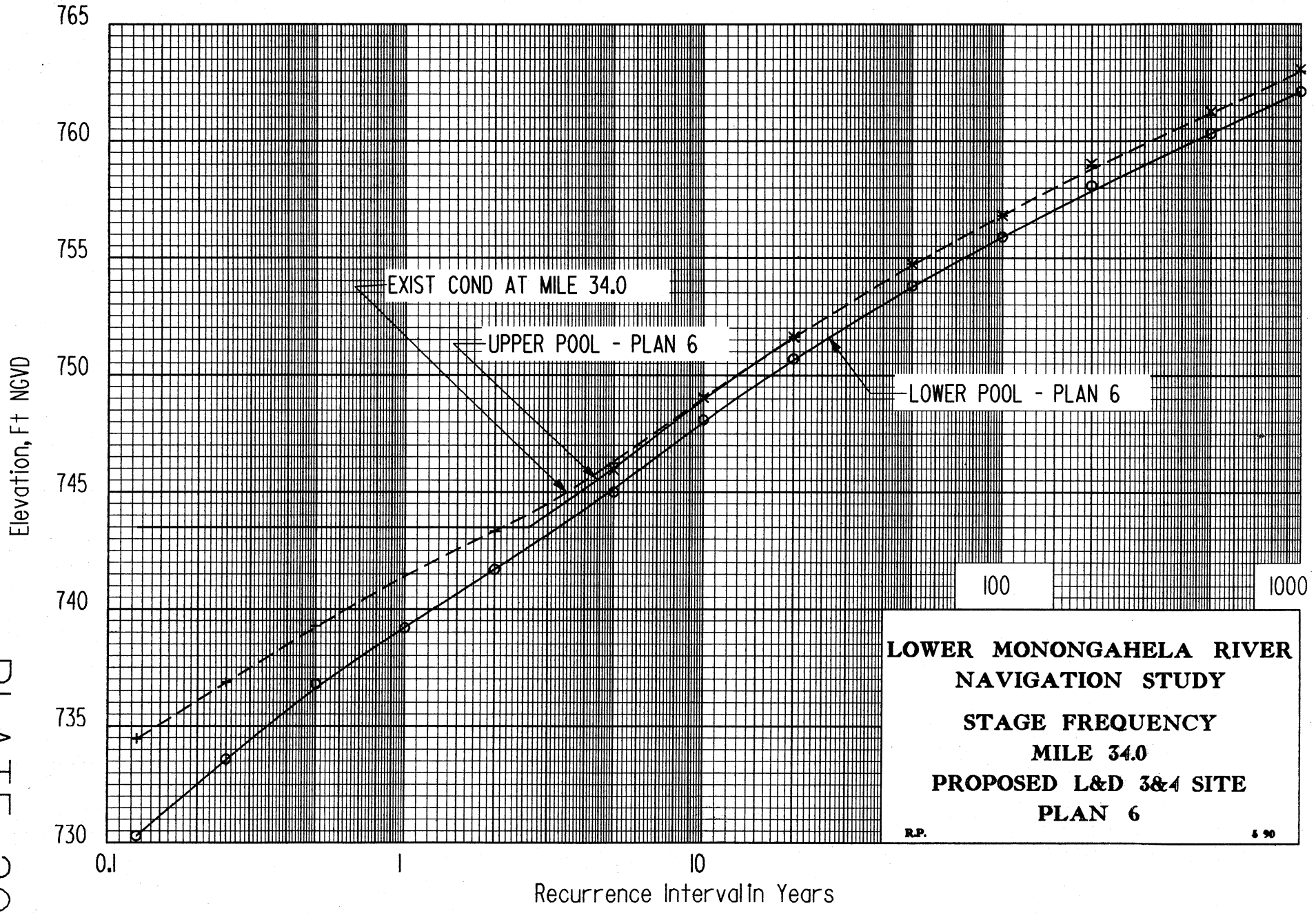
PLAN 6

PLATE 19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Elevation, Ft NGVD
EXIST COND AT MILE 34.0
UPPER POOL - PLAN 6
LOWER POOL - PLAN 6
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1000
Recurrence Interval in Years
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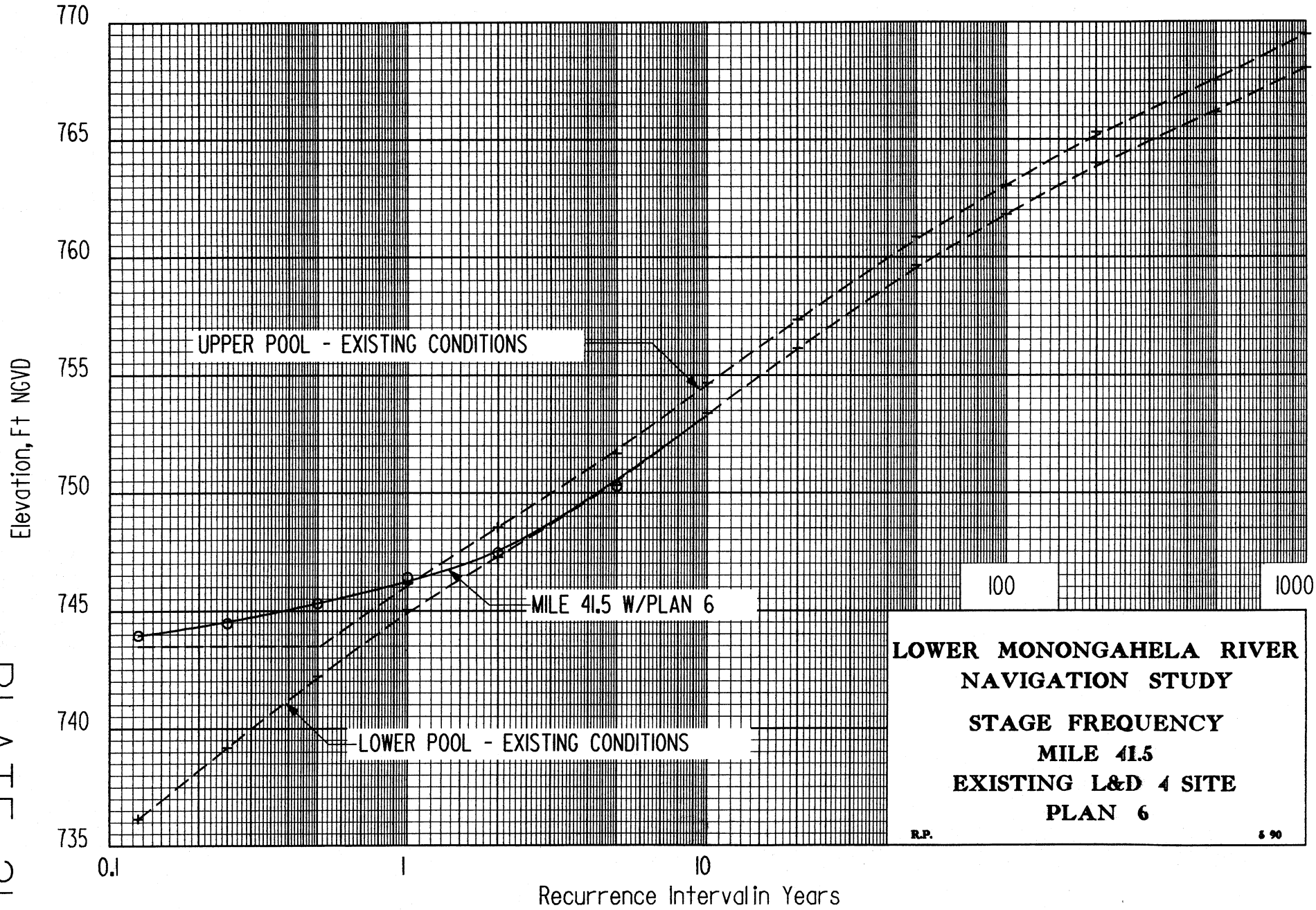
R.P.
5 90

PLATE 20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MILE 41.5 W/PLAN 6
LOWER POOL - EXISTING CONDITIONS
0.1
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Recurrence Interval in Years
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NAVIGATION STUDY
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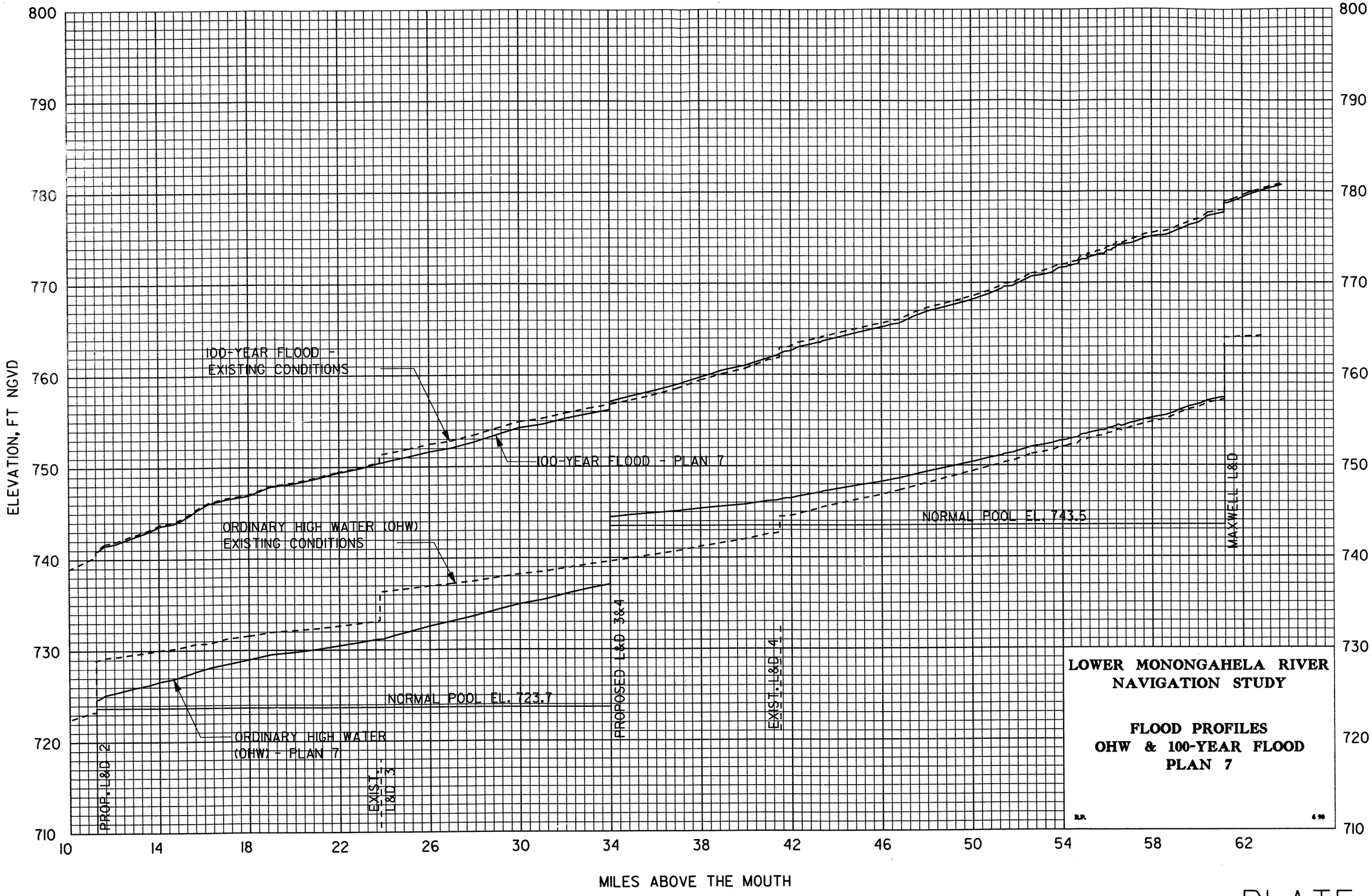
PLATE 21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58
62
MILES ABOVE THE MOUTH
100-YEAR FLOOD - EXISTING CONDITIONS
100-YEAR FLOOD - PLAN 7
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NORMAL POOL EL. 723.7
ORDINARY HIGH WATER (OHW) - PLAN 7
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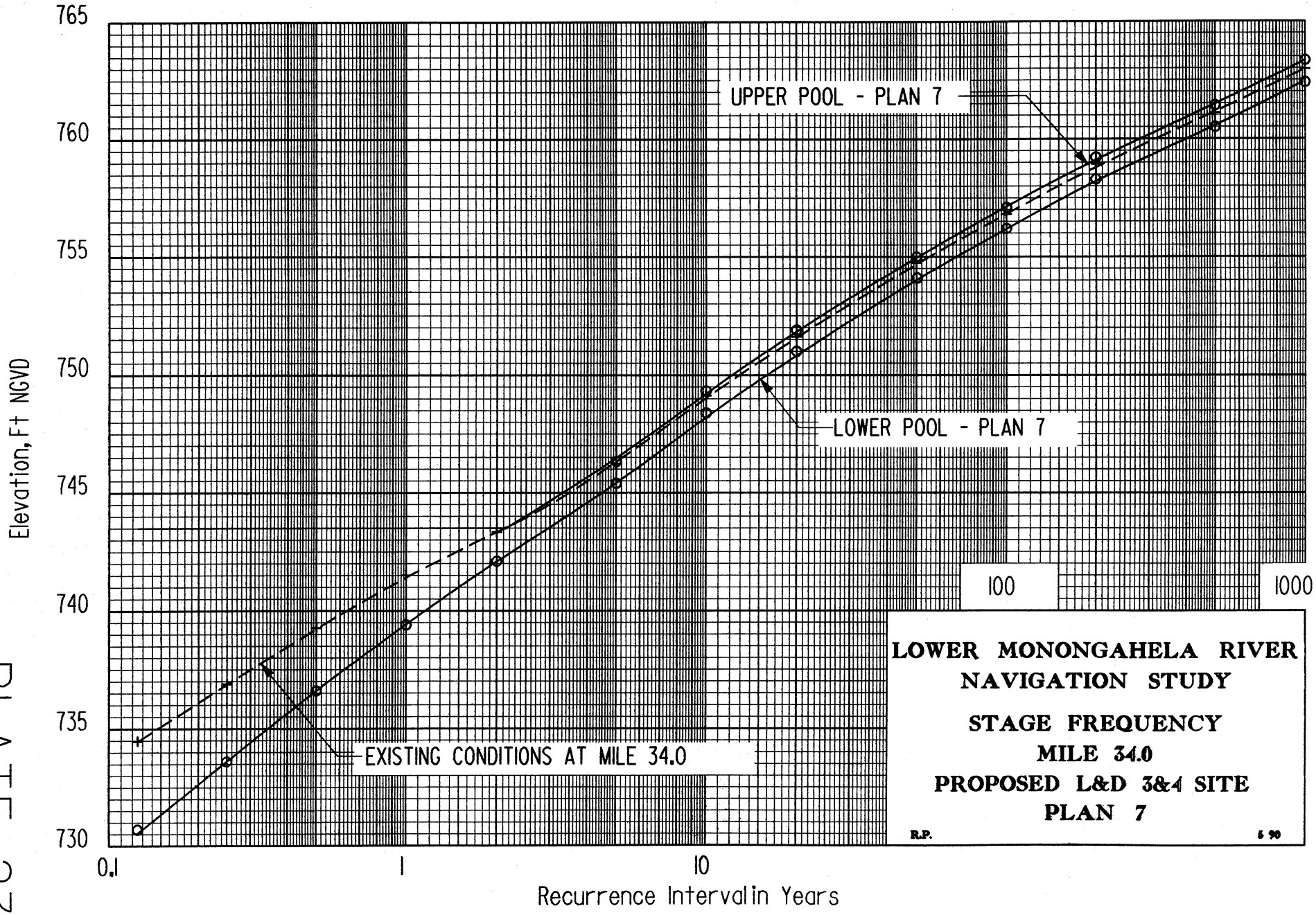
EXIST. L&D 3
PROPOSED L&D 3&4
EXIST. L&D 4
MAXWELL L&D
LOWER MONONGAHELA RIVER NAVIGATION STUDY
FLOOD PROFILES
OHW & 100-YEAR FLOOD
PLAN 7

PLATE 22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745
740
735
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Elevation, Ft NGVD
0.1
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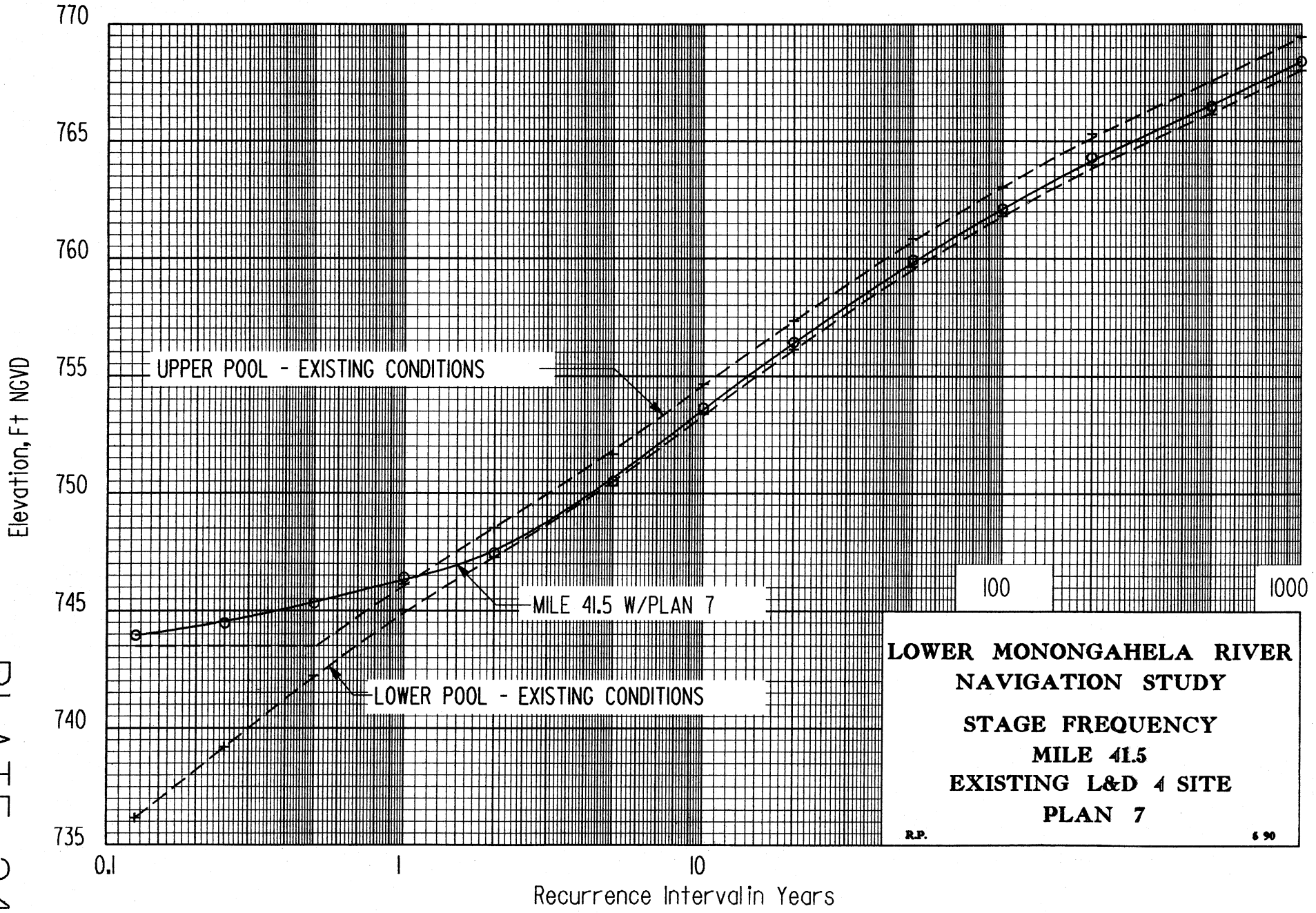
10
100
1000
Recurrence Interval in Years
UPPER POOL - PLAN 7
LOWER POOL - PLAN 7
EXISTING CONDITIONS AT MILE 34.0
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
STAGE FREQUENCY
MILE 34.0
PROPOSED L&D 3&4 SITE
PLAN 7
R.P.
5 90

PLATE 23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Elevation, Ft NGVD
UPPER POOL - EXISTING CONDITIONS
MILE 41.5 W/PLAN 7
LOWER POOL - EXISTING CONDITIONS
0.1
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10
100
1000
Recurrence Interval in Years
LOWER MONONGAHELA RIVER
NAVIGATION STUDY
STAGE FREQUENCY
MILE 41.5
EXISTING L&D 4 SITE
PLAN 7
R.P.
6 90

PLATE 24

LOWER MONONGAHELA RIVER
NAVIGATION SYSTEM STUDY

APPENDIX

HYDROLOGY

U.S. Army Engineering District, Pittsburgh
Corps of Engineers
Pittsburgh, Pennsylvania

MONONGAHELA RIVER NAVIGATION SYSTEM
PENNSYLVANIA
LOCKS AND DAMS 2, 3, AND 4
FEASIBILITY STUDY

APPENDIX H
HYDROLOGY

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SECTION I. THE STUDY AND REPORT

1. SCOPE OF STUDY

This Appendix presents the basis for and the results of the hydrologic studies pertaining to the rehabilitation or replacement of Locks and Dams No. 2, 3, and 4 on the Monongahela River in Pennsylvania. Plate 1 shows a basin map of the Monongahela River and the location of Locks and Dams No. 2, 3, and 4.

2. PLAN DESCRIPTION

a. Plan 1

The existing dam at Locks and Dam No. 2, river mile (r.m.) 11.2, would be replaced with a new gated dam near the site of the present Dam No. 2. The normal pool elevation would be raised from elevation 718.7 to elevation 723.7 feet. The existing lock chambers, one 110' x 720' and one 56' x 360, would undergo extensive rehabilitation. The existing Locks and Dam No. 3 would be removed and the existing locks at Dam No. 4 would be replaced with 2 - 84' x 720' lock chambers.

The recommended Plan is based on Plan 1 with several significant departures from the previous described Plan 1. The new dam would be located 485 feet upstream of the existing Dam 2. This change would enable the existing 110 ft land chamber to utilize the emergency bulkhead for the new lock. In the existing Pool 3 the new navigation channel would be excavated to 11 feet as opposed to the present nine feet. A hydraulically operated wicket dam similar to that proposed for the Olmsted project on the Ohio River will be evaluated as an alternative to the tainter gates in Plan 1.

b. Plan 2

The existing dam at Locks and Dam No. 2 would be replaced with a new fixed crest dam at r.m. 11.2. The crest elevation would remain the same as at present, elevation 718.7. The existing lock chambers would be rehabilitated as in Plan 1. A new fixed crest dam with a crest elevation of 726.9 would be constructed at r.m. 22.2 (1.6 miles downstream of existing Dam No. 3) and two new 84' x 720' lock chambers would be constructed at this site. At Dam 4, the existing 56' x 360' and 56' x 720' lock chambers would be replaced with two 84' x 720' chambers.

c. Plan 3

The existing dam at Locks and Dam No. 2 would be replaced with a new fixed crest dam at the present site and elevation while the existing locks would be totally rehabilitated. The existing dam at river mile 23.8 will be replaced with a new dam at the same site and with the same crest elevation. The existing lock chambers will be replaced with two 84' x 720' lock chambers. The existing Locks at Dam No. 4 would be replaced with two 84' x 720' lock chambers.

d. Plan 4

The existing Dam No. 2 would be replaced with a new fixed crest dam at the present site and elevation. The two existing lock chambers would be rehabilitated. A new fixed crest dam would be constructed at rm. 24.6 (0.8 mile upstream of the existing Dam No. 3) at the same crest elevation as the existing Dam N0. 3. Two new 84' x 720' lock chambers would be constructed at this site. Again at Dam No. 4 the existing locks would be replaced with two 84' x 720' lock chambers.

e. Plan 5

The existing Dam Nos. 2 and 3 would be removed and a new dam will be constructed at rm. 22.2 (1.9 miles downstream of Dam No. 3) at the same crest elevation as the present Dam N0. 3. The Pittsburgh pool would extend an additional 11.0 miles up the Monongahela River. Two new 84' x 720' locks will be constructed at this new dam site. The existing locks at Dam No. 4 would be replaced by two 84' x 720' locks.

f. Plan 6

The existing Dam No. 2 would be replaced with a new fixed crest dam at the present site and at the same crest elevation and the two existing lock chambers would be rehabilitated. A new gated dam would be constructed at rm. 34.0 with the upper pool at elevation 743.5 and the lower pool at elevation at 718.7. Two new 84' x 720' locks would be constructed at this site. The existing Locks and Dams No. 3 and 4 would be removed.

g. Plan 7

The existing Dam No. 2 would be replaced with a gated dam at r.m. 11.2 with the normal pool elevation raised 5 feet to elevation 723.7. The existing locks will also be rehabilitated as in the previous plans. A new gated dam would be constructed at r.m. 34.0 with a normal upper pool at elevation 743.5. Two new 84' x 720' lock chambers would be constructed at this site. The existing Locks and Dam Nos. 3 and 4 would be removed.

SECTION II. BASIN CHARACTERISTICS

1. GENERAL TOPOGRAPHY AND RIVER CURVATURE

The drainage areas at Locks and Dams Nos. 2, 3, and 4 are 7,431, 5,332, and 5,205 square miles, respectively. The tributary area between Locks and Dam No. 4 and Locks and Dam No. 2 is 2,226 square miles. Most of this tributary area between Dam 2 and Dam 4 is contained in the Youghiogheny River Basin with a drainage area of 1,764 square miles. The Monongahela River, from the headwaters at Fairmont, West Virginia, to the mouth at Pittsburgh, Pa., flows generally northward, following a sinuous course for its entire 128.7- mile length. Curves vary from 45 degrees to 135 degrees with radii of 0.5 to 1.5 miles. The maximum sight distance, therefore, may be limited to about one-half mile in certain reaches. The average gradient of the natural river from mile 11.2 to mile 41.5 is about 0.6 foot per mile.

2. RIVER MILE 11.2, 23.8 and 41.5

The area tributary to the proposed sites is located in the unglaciated Allegheny Plateau. Westward of the river and over the smaller tributaries the relief is about 600 to 800 feet. Over the Youghiogheny River Basin the relief increases rapidly within a few miles of the mouth to the Appalachian Mountians which rise to elevations of more than 2000 feet along the eastern boundary of the basin.

The present stream banks have an average height of about 15 feet upstream from the present Dam 2 and about 20 to 25 feet downstream of the dam. At Dam 3, the average heights of the banks upstream of the dam is about 10 feet and about 15 feet downstream. At Dam 4, the banks are 15-feet high upstream and 25 feet downstream of the dam. The replacement of Dam 2 with a fixed crest dam would not change the height of the banks but the replacement with a gated dam would reduce this height upstream by five feet. With Plan 1, the height of the banks would increase by 3.1 feet from r.m. 23.8 to r.m. 41.5. With Plan 2, the height of the banks will decrease by 8.2 feet between r.m. 22.2 and 23.8. Under Plan 3 there will be no change in the height of the banks since this is a replacement at the same pool levels. Plan 4 will increase the height of the banks from r.m. 23.8 to 24.6 by 8.2

feet. With Plan 5 the height of the banks will increase from r.m. 11.2 to r.m. 22.2 by 8.7 feet while they will decrease from rm. 22.2 to 23.8 by 8.2 feet. Plan 6 will increase the heights of the banks from r.m. 23.8 to r.m. 34.0 by 8.2 feet. Upstream of r.m. 34.0, the height of the banks will be reduced by 16.6 feet. With Plan 7, the height of the banks will be reduced by 5 feet from r.m. 11.2 to 23.8 while they will increase by 3.2 feet from r.m. 23.8 to 34.0. The height of bank will be reduced by 16.6 feet from r.m 34.0 to r.m. 41.5, the same as in Plan 6.

The greatest tributary contribution to the mainstem flow within this reach of the Monongahela River comes from the Youghiogheny River, with a drainage area of 1,764 square miles. Four other lesser, though sizable, tributary streams also enter the river in this area. They are Turtle Creek, Peters Creek, Pigeon Creek, and Mingo Creek. These smaller streams are generally steep from the headwaters to the mouth. They are especially conducive to rapid runoff and early concentration of flood flows into the pools above the dams. Basic data for the tributaries are presented in TABLE 1.

TABLE 1

LOWER MONONGAHELA RIVER REPLACEMENT STUDY
LOCKS AND DAM NO.S 2, 3, AND 4
FEASIBILITY STUDY
MAJOR TRIBUTARIES - RIVER MILES 11.2-41.5

Stream	Bank	Location on Monongahela River Mile	Drainage Area Square Miles	Total Length Miles	Relief above Pool Feet
Turtle Creek	Right	11.5	148.0	19.5	530
Youghiogheny Riv	Right	15.5	1,764.0	132.0	2,080
Peters Creek	Left	19.7	51.5	16.5	370
Mingo Creek	Left	29.8	22.2	10.6	470
Pigeon Creek	Left	32.3	59.2	19.5	360
Other Areas			91.1		
Total			2136.0		
Monongahela River					
Locks and Dam No. 2	Right	11.2	7,341.		
Locks and Dam No. 3	Right	23.8	5,332.		
Locks and Dam No. 4	Right	41.5	5,205.		

Section III. UPSTREAM RESERVOIR AND FLOOD PROTECTION PROJECTS

1. EXISTING PROJECTS

No local flood protection projects exist on the Monongahela River within the study reach, r.m. 11.2 to 41.5. There is a local flood protection project on Turtle Creek that enters the Monongahela River on the right bank at r.m. 11.5. However, flood reduction and low-water regulation on the Monongahela River upstream of the Youghiogheny River has been afforded by Tygart Dam since 1938 and more recently by the completion of Stonewall Jackson Dam. These control 1,286 square miles or about 24 percent of the drainage area upstream of the Youghiogheny River. Downstream of the Youghiogheny River the flood flows are further reduced by the Youghiogheny River Lake and Dam. The low-water regulated flows are augmented by the low water releases provided by this project. This system of flood-control projects controls about 23 percent of the drainage area at Locks and Dam No. 2. These projects have provided an average reduction of about 2.5 feet during high flows upstream of the Youghiogheny River and about 4.5 feet downstream at L/D No. 2. During low-flow periods, these projects assure no less than 420 cubic feet per second (cfs) in the Monongahela River upstream of the Youghiogheny River and 700 cfs from the Youghiogheny River to the mouth of the Monongahela River.

SECTION IV. CLIMATOLOGY

1. CLIMATE

The climate in the vicinity of r.m. 11.2 to r.m. 41.5 is typical of this geographical area, being humid with fairly large seasonal temperature variation. This region of variable air mass activity, is subjected to polar and tropical, continental and maritime air-mass invasion. The weather is usually moderate, but may have frequent and rapid changes resulting from the passage of fronts associated with air-mass movement. The normal percent of sunshine during the year varies from about 35 percent in the winter months to about 65 percent during the summer months. Measurable precipitation occurs about 104 days each year while the average frost-free period is 136 days. The mean daily temperature falls below freezing about 35 days per year. The prevailing winds come from the southwest with some slight monthly variation.

2. TEMPERATURE AND PRECIPITATION

Temperature and precipitation records applicable to this area are available for Locks and Dam No. 4, Charleroi, Pa., and Locks and Dam No. 2, Braddock, Pa. Records are also available at the National Weather Service station (NWS) at Pittsburgh, Pa., which is located near the mouth of the Monongahela River. Precipitation records have been maintained since 1948 at both Dam Nos. 2 and 4. Temperature records have been maintained by the NWS at the city station for the period 1926 to 1979 and at the airport since 1952. The normal monthly precipitation ranges from 2.37 inches in February to 3.88 inches in July at Charleroi. Severe local storms which sometimes result in rainfalls of 4 to 8 inches within a few hours, are not unusual during the summer months. Short-duration point-rainfall values as great as 12 inches have unofficially been recorded during several thunderstorms within 50 miles of the proposed projects. Snowfall averages about 28 inches per year along the lower Monongahela River and almost always occurs within the period of November to March. The maximum recorded snow for one storm in this area was 30 inches in November 1950. Snow cover along the Monongahela River is frequently lost during the course of the winter season. The average temperatures in this area vary from 32.1 degrees F in January to 74.9 degrees F in July at Pittsburgh. The extremes of 103 degrees F and -20 degrees F were recorded at the NWS station in Pittsburgh. Various types of

TABLE 2
CLIMATIC SUMMARY

Station	Years Of Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Normal Monthly and Annual Precipitation - Inches														
Braddock	41	2.58	2.37	3.31	3.47	3.60	3.98	3.99	3.81	2.90	2.41	2.90	2.59	37.91
Charleroi	41	2.78	2.41	3.48	3.56	3.69	3.61	3.88	3.55	2.95	2.42	2.95	2.69	37.91
Pittsburgh	54	2.68	2.37	3.40	3.26	3.51	3.64	3.67	3.25	2.83	2.48	2.42	2.56	36.07
Maximum Monthly and Annual Precipitation - Inches														
Braddock	41	5.77	5.72	5.81	5.98	7.30	10.62	9.09	7.88	6.32	8.18	11.11	5.10	53.01
Charleroi	41	5.69	5.39	6.85	6.02	7.00	10.90	7.50	8.01	6.30	6.70	11.02	5.10	50.60
Pittsburgh	54	7.75	5.97	6.38	6.26	6.55	7.73	7.90	8.17	8.84	7.79	7.40	5.09	47.45
Minimum and Annual Precipitation - Inches														
Braddock	41	0.53	0.32	1.00	0.59	1.48	0.91	1.38	0.33	0.22	0.21	0.49	0.28	26.93
Charleroi	41	0.78	0.40	1.02	1.17	1.70	0.42	0.58	0.07	0.28	0.61	0.56	0.27	28.93
Pittsburgh	54	0.73	0.37	0.94	0.44	0.66	0.78	1.33	0.29	0.57	0.16	0.26	0.17	22.60
Mean Monthly and Annual Snowfall - Inches														
Braddock	41	6.2	4.7	2.7	0.1							0.6	2.9	17.2
Charleroi	41	8.1	5.6	4.2	0.6	0.1					0.1	2.0	4.3	25.0
Pittsburgh	54	12.0	9.7	8.3	1.8						0.2	3.5	8.2	43.7
Normal Monthly and Annual Temperatures - Degrees F														
Pittsburgh	54	32.0	32.5	40.5	51.5	62.0	71.0	73.5	74.5	66.5	55.5	44.5	34.5	53.0
Maximum Monthly and Annual Temperatures - Degrees F														
Pittsburgh	54	51.0	49.0	63.0	70.0	81.0	86.0	89.0	88.0	82.0	75.0	59.0	50.0	65.0
Minimum Monthly and Annual Temperatures - Degrees F														
Pittsburgh	54	7.0	10.0	23.0	35.0	45.0	56.0	62.0	58.0	52.0	41.0	28.0	18.0	41.0

climatological data are available for the following stations in the vicinity of Dams 2 and 4: Allegheny County Airport, McKeesport, Bruceton, Sutersville, Donora, and Newell, Pa. TABLE 2 presents a summary of climatological data for Braddock, Charerloi, and the NWS station at Pittsburgh, Pa.

TABLE 3
STREAM GAGING STATIONS AND RECORDS

Stream	Station	Drainage Sq. Mi.	Period of Record	Minimum Discharge Period of Record cfs	Minimum Discharge Period of Record Date	Maximum Discharge Period of Record cfs	Maximum Discharge Period of Record Date
Monongahela River							
	L/D 2,* Braddock, Pa.	5,621	Oct 1938-Date	703	Sep 1946	201,800	Nov 1985
	L/D 3,** Elizabeth, Pa.	4,046	Oct 1933-Date			184,900	Nov 1985
	L/D 4,**	3,919	Oct 1933-Date			191,300	Nov 1985
Youghiogheny River							
	Sutters-ville, Pa.	1,218***	Oct 1920-Date	57	Sep 1922	108,000	Oct 1954
	Connells-ville, Pa.	892***	Jul 1908-Date	11	Sep 1908	103,000	Oct 1954
Turtle Creek	Wilmerding, Pa.	121	Apr 1940 Date			16,100	Jun 1972

* Reduced by Tygart, Stonewall Jackson, and Youghiogheny Dams since 1938, 1990, and 1948 respectively.
** Reduced by Tygart and Stonewall Jackson Dams since 1938, and 1948 respectively.
*** Reduced by Youghiogheny Dam since 1948.

SECTION V. HYDROLOGY

1. STREAM GAGING STATIONS AND RECORDS

a. Pittsburgh District

Stage records are available in the Pittsburgh District for Locks and Dams 2, 3, and 4. The Locks and Dam 2 were orginally constructed in 1904-1906. The Locks and Dam 3 were built from 1905 to 1907 and Dam 4 was reconstructed from 1930 to 1932. The dam, which was reconstructed to provide a gated crest and to raise Pool 4 by six feet, was completed in June 1967. Prior to 1935, the upper and lower gages at all locks and dams were read once a day and more often during rises. From 1935 -1940, hourly readings were taken during high stages. Starting in 1940, readings have been taken at three hour intervals starting at 1 AM each day during normal stages and hourly during high stages. Each dam has a critical stage at which these hourly readings are recorded and this record continues until the river recedes below this stage.

b. Geological Survey

In October 1933, the U. S. Geological Survey (USGS) installed a recording stream-gaging station at Dam 4 on the right bank upper guide wall. In 1967, the USGS relocated the recording gaging station to the end of the lower guide wall since the upper pool remains relatively constant with the gated dam.

In October 1976 the gaging station was relocated to a location just upstream from the upstream guide wall of Locks and Dam 3. A good stage-discharge relationship has been developed. This relationship, along with a lower pool rating, is shown on PLATE 2. The USGS established a gaging station in 1938, 1000 feet upstream of the dam at Locks and Dam No. 2 at Braddock. In 1951, the gage was moved to a site near the right bank on the river guide wall, 300 feet upstream from the dam. A fairly good stage-discharge relation has been developed for this gage during normal flows. However, during flood events, the streamward lock chamber is used as a floodway and the rating curve is not valid under

this condition. Also, this gaging station may be affected by the backwater caused by the Allegheny and Ohio Rivers. The stage discharge curves for normal conditions is shown as PLATE 3. TABLE 3 presents pertinent data for the stream-gaging stations from r.m. 11.2 to 41.5.

2. HISTORICAL AND RECORDED FLOODS

a. Highest Known Historical Flood

The highest known flood prior to the installation of the gaging stations in the reach from Dam 4 to Dam 2 occurred in July 1888. The estimated peak discharge reached a flow of 156,000 cfs at Dam 4 and only had a slight increase at Dam 2 since this was an upper basin flood. This flood was caused by a severe convectional summer storm over the upper Monongahela River and the Cheat River Basins. The discharge reached a maximum immediately downstream of the Cheat River, where the high discharges from the upper Monongahela River combined with high flows from the Cheat River to produce the record flood downstream. It decreased only slightly as the flood wave moved downstream to the mouth.

b. Highest Floods of Record

At Dam 2, the highest stage was recorded on the upper gage when the river rose to elevation 745.5 NGVD on 18 March 1936. This high stage occurred from the backwater from the Ohio and Allegheny Rivers and prior to the construction of any of the Pittsburgh Engineer District flood control dams. It would have been reduced to elevation 732.4 NGVD with the present reservoir system.

The highest flood of record, reduced by the present reservoir system, in the reach from r.m. 41.5 to r.m. 17.0, occurred on 5-6 November 1985. The remnants of Hurricane Juan passed over West Virginia during the first four days of November causing moderate to heavy rainfall. On November 4th, an intense slow-moving upper-level trough over the Ohio Valley set the stage for the heavy rainfall that fell in the upper Monongahela River Basin on the 4th and 5th of November. A high-pressure ridge located over the eastern seaboard and a low-level jet stream orginating in the Gulf of Mexico carried large amounts of moisture into the Upper

Ohio Valley during the 4th and 5th of November. The peak discharge of 191,300 cfs at Dam 4 resulted in a crest elevation of 761.7 feet NGVD. The peak flow only increased slightly to 201,800 cfs at Dam 2 with a crest elevation of 738.4 feet NGVD. Numerous highwater marks were obtained shortly after the flood and a high water profile was drawn through these points. The highest flood recorded at Dam 2, reduced by the present reservoir system, occured in June 1972. This flood, the result of Tropical Storm Agness, produce a crest elevation at Dam 2 of 739.2 feet NGVD.

PLATE 4 presents profiles from r.m. 11.2 to r.m. 41.5 for the June 1972 and the November 1985 floods for present conditions. The June 1972 flood stages in the lower reach reflects the backwater effects from the Allegheny and Ohio Rivers in addition to the flood on the Monongahela River. The November 1985 flood was only on the Monongahela River.

3. FLOOD FLOWS

a. Monongahela River Flood Flows

The timing and magnitude of flood crests at all sites depend, of course, on the intensity, duration, and distribution of the rainfall, and during the winter and spring periods on the magnitude of any coincidental snowmelt. The flood crests on the lower Monongahela River are also affected by the backwater conditions from the Allegheny and Ohio Rivers. High flows from the Youghiogheny River can also cause backwater effects at Dam 3. Usually, these crests occur about 24 hours after the end of significant runoff-producing rainfall over the basin. Examination of flood flows since Tygart, Stonewall Jackson, and Youghiogheny Dams commenced operation reveals that flow from the Monongahela River mainstem, that is, water passing Dam No. 4 has contributed about 82 percent of the Dam No. 2 peak discharge. This is an average proportion; the actual ratio of individual peak discharge at Dam No. 4 to that of Dam No. 2 has varied from about 64 percent to 94 percent during the period of record. The Youghiogheny River normally contributes about 15 percent of the total flow at Dam No. 2 with the remaining flow coming from the tributaries. An exception to this was the October 1954 flood when much of the flow at Dam 2 came from the Youghiogheny River.

b. Youghiogheny River Flood Flows

The Youghiogheny River, the largest of the tributaries, enters the Monongahela River on its right bank at McKeesport, Pennsylvania, 15.5 miles upstream of the mouth of the Monongahela River, 4.3 miles upstream of Dam No. 2, and 8.3 miles downstream of Dam No. 3. Although this is a tributary, it has mainstream runoff characteristics. The rate of runoff is influenced and partially controlled by Youghiogheny River Dam. The Youghiogheny River Dam controls 25 percent of the Youghiogheny River drainage area.

c. Tributary Flood Flows, River Mile 11.2 to 41.5

As previously noted, the local area immediately adjacent to the river reach from r.m. 11.2 to r.m. 41.5 is of fairly steep relief and thus conducive to rapid runoff. Records of stream-flow stations indicate that tributaries to Dam No. 2 pool, such as Turtle Creek with a drainage area of 148 square miles, should crest about 6 hours after the end of significant rainfall. The highest flow on Turtle Creek during the 50 years of record, was 16,100 cfs on June 23, 1972. Since the uncontrolled drainage area between Locks and Dam 3 and Locks and Dam 2 is 1,575 square miles, and the combined uncontrolled drainage area from the Youghiogheny River and Turtle Creek is 1,477 square miles, it is clear that a localized flood over the lower Monongahela River Basin could cause a sudden rise on the lower Monongahela River within a period of a few hours. Since the drainage area between Locks and Dam 3 and Locks and Dam 4 is only 127 square miles, a local storm over these tributaries would cause only a rise to be observed at Locks and Dam 3 within a few hours after the rain. The tributaries with small drainage areas should crest within two to three hours after the end of significant rainfall and would have little effect on the Monongahela River stages.

4. FLOOD FREQUENCY

a. River Mile 11.2 - 41.5

The natural discharge frequency was developed from 66 years of record at Dam No. 2 and 54 years years at Dam No. 4. Floods occuring after construction of Tygart, Youghiogheny, and Stonewall Jackson Dams were adjusted to reflect the natural peak discharges which would have ocurred without the flood control dams. The method outlined in Statistical Methods in Hydrology, ER 1110 - 2 - 1450, dated January 1962, was used in making the computation. The natural frequency thus obtained was subsequently adjusted for the reduction by Tygart River, Stonewall Jackson, and Youghiogheny River Dams as applicable to produce a reduced-discharge frequency. TABLE 4 shows the reduced flood flow frequency at r.m. 11.2, 22.2, 23.8, 34.0, and 41.5.

TABLE 4
MONONGAHELA RIVER NAVIGATION SYSTEM
REPLACEMENT OF LOCKS AND DAMS 2, 3, 4
FEASIBILITY STUDY
FLOW FREQUENCY REDUCED BY EXISTING RESERVOIRS

Recurrence Interval	River Mile 11.2	River Mile 22.2, 23.8, 24.6 34.0 and 41.5
0.50	85,000	67,000
1.00	102,500	84,000
2.0	124,000	101,000
5.0	150,500	123,000
10.0	168,500	140,000
20.0	186,000	154,800
50.0	211,500	177,000
100.0	231,500	198,000
200.0	250,000	219,000
500.0	275,500	249,000
1000.0	295,000	260,000

The 100-year profile from the mouth of the Monongahela River to upstream of Dam 4 is shown on PLATE 5. The discharge at the mouth wase 231,500 cfs while at Dam 4 the peak discharge was 194,000 cfs shown in the above TABLE 4.

5. MINIMUM LOW FLOW

The most sustained and severe drought period on the Monongahela River occurred during the summer and autumn of 1930. Upstream of the Youghiogheny River, it was estimated that the Monongahela River flow fell to below 250 cfs during this period. These drought flows were sustained for over two months. Throughout the drought period, flows in the Monongahela River downstream of the Cheat River were augmented to some degree by periodic emergency releases of reserve storage in Lake Lynn Dam. This is normally conserved to maintain the power head at the dam. The lowest five - day average flow at Locks and Dam 4 was about 30 cfs, from 26 - 30 November, when releases of water from Lake Lynn Dam were discontinued for five days in sucession. The minimum average daily inflow into Pool 4 was even lower, however, and dropped to approximately 10 cfs on several occasions in October when Lake Lynn outflow was curtailed for shorter periods and the natural flow was at its lowest. Low-flow augmentation by Tygart River Lake and Stonewall Jackson Lake would have improved conditions at dams 4 and 3, as can be seen in TABLE 5.

TABLE 5
MONONGAHELA RIVER NAVIGATION STUDY
LOCKS AND DAMS 2, 3, 4
FEASIBILITY STUDY
ACTUAL AND AUGMENTED FLOWS AT LOCKS AND DAMS 4 AND 3
MONONGAHELA RIVER, DURING 1930 LOW WATER PERIOD

	Month of				
	July	Aug	Sep	Oct	Nov
Average discharge, cfs actual (augmented by Lake Lynn drawdown*)	420	190	370	320	250
Average natural discharge augmented by Tygart and Stonewall Jackson Lakes cfs	810	560	490	460	500

* Augmentation was made by special arrangement with West Penn Power Company

Flow values do not represent a recurrent condition. If the natural low flows were to occur today, augmentation by Tygart River Lake, Stonewall Jackson Lake, and Youghiogheny River Lake would improve conditions at Locks and Dam 2 as indicated by TABLE 6.

TABLE 6
MONONGAHELA RIVER NAVIGATION SYSTEM
LOCKS AND DAMS 2, 3, AND 4
FEASIBILITY STUDY
ACTUAL AND AUGMENTED FLOWS AT LOCKS AND DAM 2
MONONGAHELA RIVER, DURING 1930 LOW WATER PERIOD

	Month of				
	Jul	Aug	Sep	Oct	Nov
Average discharge, cfs actual (augmented by Lake Lynn drawdown*)	950	430	381	324	334
Average natural discharge augmented by Tygart Lake, Stonewall Jackson Lake, and Youghiogheny Lake,cfs	860	830	760	720	720

* Augmentation was made by special arrangement with West Penn Power Company

6. LOCKAGE WATER NEEDS AT RIVER MILE 11.2 LOCKS AND DAM 2

a. General

The water requirements for lockages at r.m. 11.2 have been determined from recent records of tonnages at Locks 2. The estimated future requirements are based on traffic projections prepared by the Navigation center located in Huntington District. At this lock most of the lockages were accomplished as single lockages through the 110' x 720' lock chamber. The actual traffic volume is about 11 percent above the average during the low-flow months of summer and autumn.

b. Estimated Water Needs-Plans 1,7

During the low-flow periods, the lockage head would average 13.7 feet with the gated dam. Water use for a 110' x 720' lock for one lockage per day, therefore, would be equal to an average flow of about 12.7 cfs. It is assumed that through random distribution, one out of four lockages would be an upstream lockage following a downstream lockage. Since filling for upstream lockages would require no release of water, the average quantity required per lockage would be 75 percent of 12.7 or 9.5 cfs. An assumed average load would be 1000 tons per barge and 9 barges per tow. One half of all tows would return empty.

c. Estimated Water Needs Plans 2, 3, 4, and 6

During the low - flow periods, the lockage head would average 8.7 feet with the fixed crest dam. Water use for a 110' x 720' lock chamber would be equal to an average flow of 8 cfs. Since the same assumptions are made as in Plan 1B, the actual water per filling would be 6 cfs. The actual water needs would also include leakage as well as the water to pass the potential river traffic. Leakage through the culvert valves, lock mitre gates and possibly under and around the dam sill could eventually reach 20 cfs. TABLE 7 shows a summary of the number of lockages and the total water requirements for the 110' x 720' chamber for the years 1990 - 2050.

TABLE 7
MONONGAHELA RIVER NAVIGATION SYSTEM
REPLACEMENT LOCKS AND DAMS 2, 3, AND 4
LOCKAGE AND WATER REQUIREMENTS
RIVER MILE 11.2

Year	No. of Lockages	Maximum Daily Lockages	Total Water Needs (cfs) Plan 1, 1B, 7	Plan 2,3,4,6<
1990	4,313	13	187	124
2000	5,827	18	236	156
2010	6,649	20	256	175
2020	7,041	22	276	182
2030	8,180	25	305	207
2040	8,946	27	325	226
2050	9,841	30	353	224

d. Estimated Water Needs-Plan 5

This plan eliminates Dam 2 so there is no water requirement.

7. LOCKAGE WATER NEEDS AT RIVER MILE 22.2, 23.8 (EXISTING Locks 3) AND 24.6

a. General

The present water requirements for lockages at r.m. 23.8 have been determined from recent records of tonnage at Locks and Dam 3. Estimated future requirements are based on traffic projections. Most of these present lockages were accomplished as multiple lockages, since the existing locks are only 56' x 720' and 56' x 360'. Revised lockage requirements have been developed for the twin 84' x 720' lock chambers. The traffic volume was about 11 percent above the average during the low water months of summer and autumn.

b. Estimated Water Needs-Plans 1, 6, and 7

Under plans 1, 6, and 7, Dam 3 is to be removed so their are no water needs at this site.

c. Estimated Water Needs, Plans 2, 3, 4, and 5

These plans have a new dam at either r.m. 22.2, 23.8, or 24.6. The lockage head, during the low flow periods, would be 8.2 feet. Water use for the 84' x 720' lock for one lockage per day, would be equal to an average flow of about 6.1 cfs. Again it was assumed that through random distribution, one out of four lockages would be an upstream lockage. Since it would require no release of water, the average quantity of water required per lockage would be 75 percent of 6 or 4.5 cfs. An average assumed load would be 1000 tons per barge and 9 barges per tow and one half of all tows would return empty.

Actual water needs at 22.2, 23.8, and 24.6 sites would also include leakage as well as the water necessary to pass the water required to pass the potential river traffic. Leakage through the culvert valves, lock miter gates, and possibly under and around the dam could eventially reach 20 cfs. TABLE 8 shows a summary of lockages and total water requirements for the twin 84' x 720' feet chambers.

TABLE 8
MONONGAHELA RIVER NAVIGATION STUDY
REPLACEMENT OF LOCKS AND DAMS 2, 3, AND 4
LOCKAGE AND WATER REQUIREMENTS
RIVER MILE 22.2, 23.8, AND 24.6

Year	Number Lockages	Maximum Daily Lockages	Total Water Needs (cfs) Plan 2, 3, 4	Plan 5
1990	5,614	17	117	193
2000	7,652	23	144	247
2010	8,770	27	162	283
2020	9,512	29	171	301
2030	11,044	33	189	337
2040	12,187	37	207	373
2050	13,517	41	225	409

8. LOCKAGE WATER NEEDS AT MILE 34.0 WITH 84 FEET X 720 FEET LOCKS

a. General

The present water requirements for lockages have been determined from records of tonnages at Locks 3 and Locks 4. Estimated future requirements are based on the traffic projections for Locks 3 and 4 since this site is located between the existing locks. Revised lockage requirements have been developed for the proposed 84' x 720' lock chambers. Traffic volume was again assumed to average about 11 percent above average during the low-water months of summer and autumn. A new gated dam is proposed to be constructed at this site.

b. Estimated Water Needs - Plan 6

During the low flow periods the lockage head would average 24.8 feet with the fixed crest dam at mile 11.2. Water use for a 84' x 720' lock for one lockage per day therefore would be equal to an average flow of about 17.4 cfs. Again it is assumed that through random distribution, one out of four would be an upstream lockage following a downstream lockage. As before, the average quantity of water required per lockage would be 75 percent of 17.4 or 13.0 cfs. The average assumed load would be 1000 tons per barge and 9 barges per tow and one half would return empty.

The actual water needs at the proposed damsite at r.m. 34.0 would also include leakage as well as the water necessary to pass the potential river traffic. Leakage through the crest gates and possibly around and under the dam could eventually reach 60 cfs. TABLE 9 shows a summary of the number of lockages and the total water requirements for the twin 84' x 720' chamber under Plans 6 and 7.

TABLE 9
MONONGAHELA RIVER NAVIGATION SYSTEM
REPLACEMENT OF LOCKS AND DAMS 2, 3, AND 4
LOCKAGE AND WATER REQUIREMENTS
RIVER MILE 34.0
LOCK CHAMBERS 84' X 720'

Year	Number of Lockages	Maximum Daily Lockages	Total Water Needs (cfs) Plan 6	Plan 7
1990	4,754	14	252	217
2000	6,767	21	343	291
2010	7,874	24	382	322
2020	8,590	26	408	343
2030	10,190	31	473	396
2040	11,396	35	525	438
2050	12,807	39	577	480

c. Estimated Water Needs-Plan 1-5

There are no water needs for these plans at this site.

d. Estimated Water Needs - Plan 7

During the low flow period, the lockage head would average 19.8 feet with a gated dam at river mile 11.2 and the gated dam at r.m. 34.0. Water use for one lockage per day therefore, would be equal to an average flow of about 13.9 cfs. It is again assumed that through random distribution, one out of four lockages would be an upstream lockage following a downstream lockage. AS before, the average quantity of water would be 75 percent of 13.9 or 10.4 cfs. As in the previous assumptions, the average load would be 1000 tons per barge and 9 barges per tow, and one half of all barges would be empty when locked through this site.

The actual water needs at this site r.m. 34.0 would also include leakage as well as the water necessary to pass the potential river traffic. Leakage through crest gates, culvert valves, mitre gates, and possibly around and under the dam could reach 60 cfs. TABLE 9 also shows a summary of the lockages and the total projected water requirements for the 84' x 720' chambers.

9. LOCKAGE WATER NEEDS AT RIVER MILE 41.5 WITH TWIN 84' 720' LOCKS

a. General

The present water requirements for lockages at r.m. 41.5 have been determined from recent records of tonnage at the present Locks and Dam 4. Estimates of future requirements are based on the traffic projections. Most of these present lockages were accomplished as multiple lockages. The existing locks are one 56' x 720' and one 56' x 360' chambers. Revised lockage requirements have been developed for the two new proposed 84' x 720' locks. Again traffic volume is about 11 percent above the average during the low-water months of summer and autumn.

b. Estimated Water Needs - Plan 1

Under plan 1, Dam 3 is to be removed and the pool at Dam 2 is to be raised by five feet. The lockage head during the low flow would be 19.8 feet. Water use for the 84' x' 720' lock for one lockage per day, would be equal to an average flow of about 13.9 cfs. Again it was assumed that through the random distribution, one out of four lockages would be an upstream lockage folowing a downstream lockage. As before, the average flow required would be 75 percent of 13.9 or 10.4 cfs. The average tow was again assumed to be made up of 9 barges each carrying 1000 tons and one half of the tows would return empty.
Actual water needs at r.m. 41.5, Dam 4, would also include leakage as well as the water necessary to pass the projected river traffic. Leakage through the culvert valves, lock mitre gates, crest gates and possibly around or under the dam could eventually reach 50 cfs. TABLE 10 shows a summary of the number of lockages and the total water requirements for the replacement chambers.

c. Estimated Water Needs-Plans 2, 3, 4, and 5

During low flow periods the lockage head would be 16.6 feet with the proposed dam at either r.m. 22.2, 23.8, or 24.6. Water usage for the 84' x 720' lock chamber for one lockage per day would be 11.6 cfs. Again with the same traffic distribution assumptions as were previously discussed for the other site, the quantity of water would be 8.7 cfs per lockage. The average tow would again consist of 9 barges each carrying 1000 ton and one half would be returning empty.

Actual water needs at r.m. 41.5 would also include the leakage as discussed above and the water required to lock through the projected river traffic. TABLE 10 also shows The water requirements for Plans 2, 3, 4, and 5.

d. Estimated Water Needs - Plans 6 and 7

Under Plans 6 and 7, the existing Locks and Dam at r.m. 41.5 would be removed. Therefore, there would be no water requirement at this site.

TABLE 10
MONONGAHELA RIVER NAVIGATION STUDY
REPLACEMENT OF LOCKS AND DAMS 2, 3 AND 4
LOCKAGE AND WATER REQUIREMENT
RIVER MILE 41.5

Year	Number of Lockages	Maximum Daily Lockages	Total Water Needs (cfs) Plan 1	Plans 2-5
1990	4,754	15	228	205
2000	6,767	21	293	259
2010	7,874	24	326	286
2020	8,590	26	349	304
2030	10,190	31	404	349
2040	11,396	35	448	385
2050	12,807	44	542	421

10. INTERMITTENT LOW FLOW

a. General

The continued variation in precipitation and runoff results in periods of low flows interspersed with periods of high flows. Even in years of normal average flow, these periods of low flow and shortness of intermittent higher-flow duration may impose severe limitations on water usage. Such conditions cannot always be detected by examining monthly averages or from ordinary duration studies. The regulation by Tygart and Stonewall Jackson Lakes will provide a fairly constant low flow in the Monongahela River upstream of the Youghiogheny; downstream the low flow is increased by the further augmentation by Youghiogheny River Lake. There will continue to be a strong element of variable runoff periodically orginating from the uncontrolled portions of the drainage basins.

Over the 50-year period from 1930 through 1979, there were some years with consistently above-normal precipitation and runoff while there are other years with consistently below-normal precipitation and runoff. During the drought year of 1988 the total precipitation was only 27.09 inches, while in 1990, over 52 inches were recorded.

b. Flow Duration

(1) General

Natural flow-duration curves were developed using a 50-year period, water years 1930 - 1979.

The 50 year-record of daily flows was adjusted to reflect the present regulated conditions (i.e. as modified by Tygart, Stonewall Jackson, and Youghiogheny River Lakes). The regulated flows were obtained by adding the uncontrolled flows to the routed actual or routed simulated outflows. For Tygart River Lake, the actual outflows were used from January 1967, the effective date of the present operating schedule which altered the outflows significantly, to September 1979. The remaining record prior to January 1967 was simulated using the present operating schedule to reflect existing conditions. For Stonewall Jackson Lake, simulated records were used for the entire period of record. For Youghiogheny River Lake, the actual outflows were used from 1 January 1967, the effective date of the present operating schedule, which altered the outflow, to September 1979. The period of record prior to January 1967 was simulated using the present operating schedule to reflect current conditions. This flow duration curve for Dams 3, and 4 is shown on PLATE 6. The flow duration for Dam 2 is shown on PLATE 7.

To show the potential conditions in droughts, four of the driest years of recent record were analyzed. For the Locks and Dam 4, located upstream of the Youghiogheny Rive, the years of 1930, 1953, 1965, and 1988 were selected. Average daily flows, reflecting modification by Tygart and Stonewall Jackson Lakes were used as a basis for this analysis.

(2) River Mile 41.5

Plate 8 presents flow duration curves for 1930, 1953, 1965, and 1988 at Locks and Dam 4. These curves show the longest duration within each year that the flows would have equalled or exceeded the curve values. Examination of the lowest points of these curves indicate that even in the driest years, flows could be sustained continuously above 420 cfs for 365 days, and above 1000 cfs for 275 days with the present reservoir system. During the 1930 drought the 1000 cfs could be maintained for only 200 days.

(3) River Mile 11.2

PLATE 9 presents duration for 1930, 1953, 1965, and 1988 at r.m. 11.2, Locks and Dam 2. These curves show the longest duration of time within each year that a given flow would have equalled or exceeded the curve value. Examination of the lowest point of these curves shows that even in the driest year, flow could be sustained continunously above 700 cfs for 365 days, and above 1000 cfs for 330 days. In addition to these curves for assured flow in the individual dry years, Plate 9 shows the duration curve on the average number of days per year that a given discharge will be equalled or exceeded without regard to the distribution of the discharge value throughout the 50-year period.

11. STAGE DURATION

a. General

The flow durations that were developed in Section 11 were converted to stage duration curves by means of rating curves developed for the existing dams. Upper and lower stage durations at Dam 4, Dam 3, and Dam 2 for the existing conditions are shown on PLATES 10 to 12.

PLATE 13 shows upper and lower stage duration for Locks and Dam 2 (r.m. 11.3), the recommended Plan. Plate 14 shows the upper and lower stage duration at Dam 4 (r.m. 41.5) for the recommended Plan. The upper pool duration at Dam 2 will be different due to the gated dam while at Dam 4 the lower pool duration will change due to the reduced normal pool elevation. The upper stage duration will remain the same as at present.

12. STREAM VELOCITIES AND RATE OF FLOW IN POOL

a. Existing System

(1) River Mile 11.2

The area capacity curve on PLATE 15 shows that between r.m. 11.2 and r.m. 23.8 there would be a total volume of 13,500 acre feet at normal pool, elevation 718.7. With the minimum augmented low flow to be supplied by Tygart, Stonewall Jackson, and Youghiogheny Lakes, and no precipitation, the displacement time for the total storage replacement, at normal pool, would be 16 days. Although this represents the time for inflow water to actually replace the storage in the pool, it does not indicate the time lag between an increase in inflow and the resultant increase in outflow. Under present conditions, translation times for flood waves between Locks and Dam 3 and Locks and Dam 2 averages about 2 hours.

(2) River Mile 23.8

The area capacity curve on PLATE 16 shows that between Locks and Dam 3 and Locks and Dam 4 r. m. 41.5 there is a volume of 16,600 acre feet at elevation 726.9. With the minimum augmented low-flow to be supplied by Tygart and Stonewall Jackson Lakes, the displacement time for total storage replacement at normal pool elevation, would be 20 days. Although this does represent the time for inflow water to actually become outflow over the dam, it does not indicate the time between an increase in inflow and the resultant increase in outflow. Under present conditions, translation time for flood waves between the two dams is about 4 hours

b. Proposed Damsites

(1) Plan 1

The area capacity curve on PLATE 17 shows the that between Dam 2, r.m. 11.2, and Dam 4, r.m. 41.5, the total volume at elevation 723.7 would be 31,500 acre feet. With the minimum augmented low flow supplied by Tygart, Stonewall Jackson, and Youghiogheny Lakes, displacement times for the total storage would be 38 days. Under this Plan the translation time for flood waves between Dam 4 and Dam 2 is 6 hours.

(2) Plan 2

The area capacity curves on PLATES 18 and 19 show that between Dam 2, r.m. 11.2, and the proposed site at r.m. 22.2 and between r.m. 22.2 and Dam 4, the volume at elevation 718.7 and 726.9 is 12,500 and 19,000 acre-feet, respectively. With the minimum augmented low flow to be supplied by the existing reservoir system, the displacement time would be 15 and 23 days respectively. With Plan 2 the translation times for waves from Dam 4 to Dam 2 would remain the same as under present conditions.

(3) Plan 3

This Plan is the same as the existing conditions, so storages, displacement, and translation times will remain the same as at present. These were previously shown on PLATES 15 and 16.

(4) Plan 4

The area capacity curves for this Plan are shown on PLATES 20 and 21. Between Dam 2, r.m. 11.2, and the proposed site, r.m. 24.6, and r.m. 24.6 and Dam 4, (r.m. 41.5), the capacity at elevation 718.7 and 726.9 is 14,200 and 16,200 acre feet respectively. The displacement and translation times will between Dam 4 and Dam 2 will remain the same as under present conditions.

(5) Plan 5

With this Plan the capacity of the reach from Dam 2, r.m. 11.2, to r.m. 22.2 will be included in the Ohio River Emsworth Locks and Dam storage. The area capacity curve for the reach from r.m. 22.2 to Dam 4 is the same as shown on PLATE 19.

(6) Plan 6

The area-capacity curve for this Plan is shown on PLATES 22 and 23. Between Dam 2 and r.m. 34.0, and r.m. 34.0 and Maxwell Locks and Dam, the storage at elevation 718.7 and 743.5 will be 26,000 and 45,500 acre-feet, respectively. With the minimum augmented low flows to be supplied by the existing reservoir system, the displacement time would be 31 and 55 days, respectively. The translation time from r.m. 34.0 to Dam 2 would be reduced to 4.5 hours.

(7) Plan 7

The area-capacity curve for the reach from Dam 2, r.m. 11.2, to the proposed site at r.m. 34.0 is shown on PLATE 24. The area-capacity for the reach from r.m. 34.0 to Maxwel Locks and Dam is the same as shown on PLATE 23. With the minimum regulated low flow to be supplied by the existing reservoir system, the displacement time from r.m. 34.0 to Dam 2 would be 31 days. Again the translation time from r.m. 34.0 to Dam 2 would be the same as in Plan 6.

(8) Recommended Plan

The area-capacity curve for this plan with the normal pool at Dam 2 at elevation 723.7 is shown on PLATE 25.

13. STANDARD PROJECT FLOOD

The Standard Project Flood (SPF) is defined as one which would be exceeded in magnitude only on rare occasions. It establishes a standard for design that would provide a high degree of flood protection without regard to economic or other practical limitations. The standard project flood, however, is substantially less than the probable maximum flood.

The standard project flood for the lower Monongahela River would be caused by a storm with rainfall as set forth in Corps of Engineers' Engineer Manual (EM) 1110-2-1411, subject: Standard Project Flood Determination, dated March 1952. On this basis, the basin average rainfall would have a maximum intensity of 3.61 inches in six hours and 4.23 inches in 24 hours with a total of 6.34 inches in four days. The intensities and magnitude of the standard project flood indicates that this would probably be a summer-type storm. Infiltration rates computed for other storms in or near the Pittsburgh District for the season in which the standard project storm would probably occur have been assumed. Total storm losses were assumed to be 2.40 inches and the total storm runoff of 3.94 inches of which 1.56 inches would occur within an 18-hour period. Since this was considered a summer-type storm, occuring during a period when antecedent rainfall would be normal or below normal, it was assumed that the river would be at or near normal pool levels. The peak discharge reduced by Tygart and Stonewall Jackson Dams would be 253,250 cfs at existing Dams 4 and 3 and reach elevations 768.5 and 757.1 feet on the upper, gages respectively. The peak discharge reduced by Tygart, Stonewall Jackson, and Youghiogheny Dams at Dam 2 would be 291,200 cfs and reach elevation 747.2 feet. The profile for the existing condition is shown on PLATE 26.

14. PROBABLE MAXIMUM FLOOD

The probable maximum flood (PMF) on the lower Monongahela River has been developed from the probable maximum precipitation centered over the Monongahela River basin. The estimates of maximum rainfall used for the determination of the probable maximum flood were obtained by use of charts in Hydrometeorological Report (HMR) No. 51 (June 1978),"Seasonal Variation of Probable Maximum Precipitation East of the 105th Meridian," prepared by the Hydrometeorological Section of the U.S. National Weather Service. The probable maximum precipitation is defined in No. 51 as representing "the critical depth-duration-area rainfall relations for a particular area during various seasons of the year that would result if conditions during an actual storm in the region were increased to represent the most critical meteorolocical conditions that are considered probable of occurrence." The computed total precipitation over a three-day period over the lower Monongahela River is approximately 15.0 inches which is about one-third of the normal

annual precipitation of this region. Rainfall of this magnitude has been recorded in this geographic region over much smaller areas, such as the July 1942 storm in northern Pennsylvania. However, the chances of such an occurrence over the entire Monongahela River basin are extremely remote. The computed modified peak, as reduced by Tygart Dam and Stonewall Jackson Dam at Dam 4, would be 609,100 cfs. At Dam 2, the peak flow as modified by Tygart Dam, Stonewall Jackson Dam, and Youghiogheny Dam would be 796,000 cfs. The PMF profile will be from 20 to 25 feet higher than the SPF profile shown on PLATE 26.

15. RATES OF RISE AND FALL

a. Rate of Rise

All major flood events from 1938 to date, were investigated to determine the shortest possible time interval during which the river might rise from various initial stages. The upper pool records at Dams 2, were searched to find the minimum times for changes in river levels of 2, 5, and 7 feet and relationships were developed These curves are shown on PLATE 27.

b. Rate of Flood Fall

Similar analyses were performed to determine the shortest possible time interval which the river might fall 2, 5, and 7 feet from various stages. Curves for the upper pool for Dam 2 is shown on PLATES 28.

c. Lake Lynn Effects

Intermittent releases from the non-federal Lake Lynn hydropower dam on the Cheat River have caused waves on the Cheat and Monongahela River since the plant commenced operation in 1926. At Dam 4, lower-pool stage increases up to 1.5 feet due to the power releases and about 1 foot at Dam 2. Normally the rise at Dam 4 occurs over a two to five-hour period and the rate rarely exceeds one foot per hour. The leading edge of the wave is observed at Dam 4 about 3 hours, and at Dam 2 about 6 hours, after the initial release of water from Lake Lynn.

16. WIND WAVES

Actual record of wind velocities are not available for the immediate vicinity of Dams 2 to Dam 4. However, records at Pittsburgh, the nearest first-order National Weather Service station with wind velocity data, indicate that high winds have a predominantly western component. Pittsburgh is about 20 miles to the west of the study reach but these data are believed to be applicable to the study reach. They have been reviewed and expended graphically to show the maximum wind velocities for duration of one to 60 minutes for each month of the year and for the eight compass directions. The maximum velocity determined for one minute, in any direction, was in excess of 90 miles per hour; the maximum for one hour was 56 miles per hour. High-wind velocities may occur simultaneously with maximum river stages. During the passage of a cold front at the time of the flood crest on 5 March 1963, gusts from the southwest of about 63 miles per hour with an hourly average of 40 miles per hour were recorded at Greater Pittsburgh International Airport.

The Monongahela River flows in a northwesterly direction for a distance of of about 1.5 miles upstream of Dam 2 following a gradual bend in its course. The method outlined in Corps of Engineers Engineer Technical Letter (ETL) 1110-2-305, dated 16 February 1984, "Determining Sheltered Water Wave Characteristics" was used to determine the effective wave fetch distances in the Dam 2 pool as well as to determine the resultant critical wind velocity and maximum wind height. The maximum one-minute southern component wind towards the dam, as determined from the study of records at Pitsburgh, is 65 miles per hour. The critical wind direction in this reach would be 6.7 minutes with a wind velocity of 58 miles per hour. The computed wave height under such conditions would be two feet.

17. FOG

Morning fog is very common along the Monongahela River often persisting from dawn until late morning. Records from 1961 to 1964 and 1983 to 1986 at Dam 2 , mile 11.2, indicate that fog occurs about 84 days per year. About 50 percent of the time the fog is dense enough to interfere with navigation. TABLE 11 gives the distributation of fog during the year.

TABLE 11
LOWER MONONGAHELA RIVER NAVIGATION STUDY
LOCKS AND DAMS 2, 3 AND 4
FEASIBILITY STUDY
MORNING FOG CONDITIONS

Month	Fog Days	Month	Fog Days
January	1	July	12
February	2	August	14
March	2	September	15
April	4	October	11
May	8	November	2
June	12	December	1

18. ICE

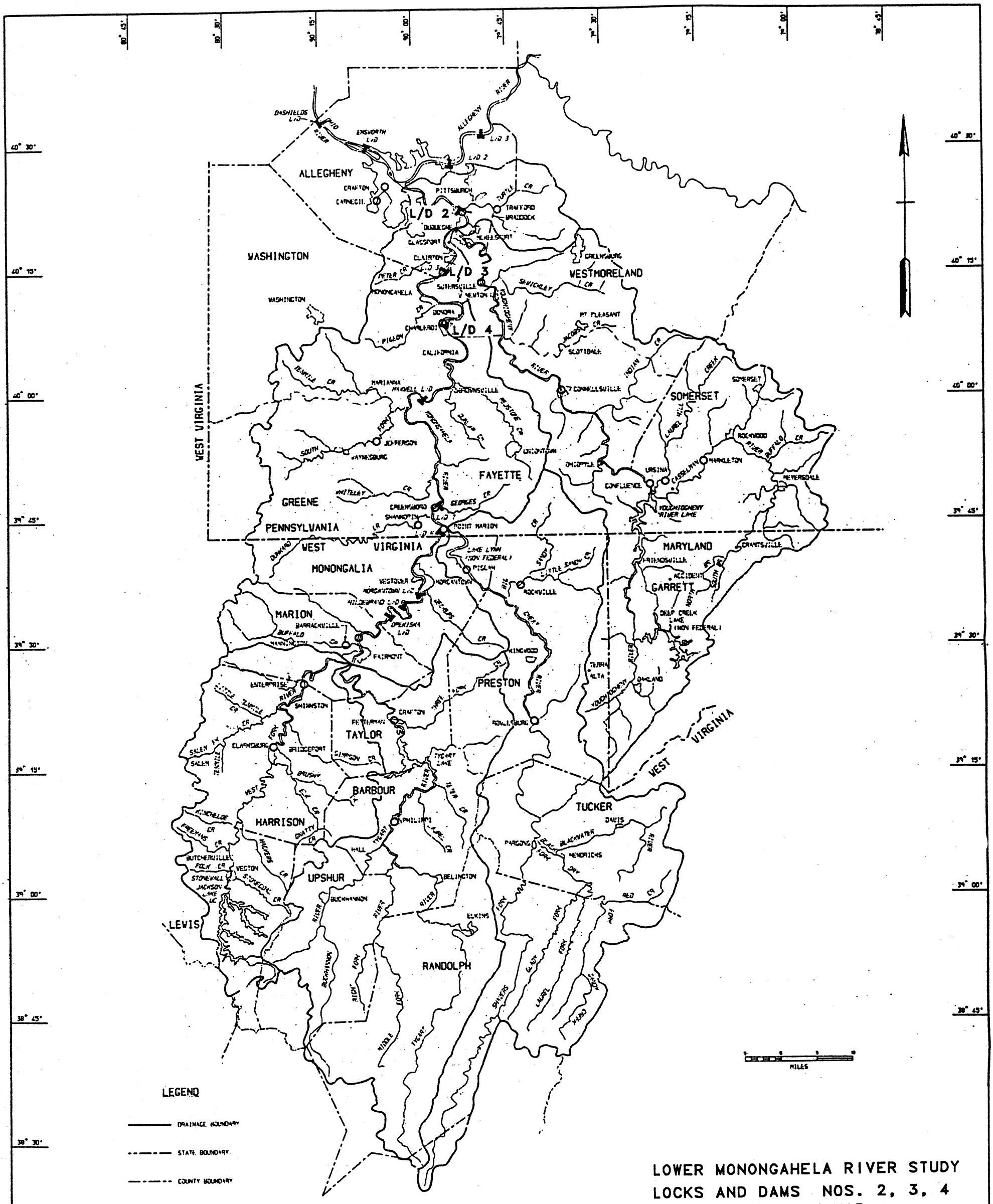
Investigation of records of ice at Dam 2 to Dam 4 reveals that ice usually begins to form after about 4 days with night temperatures below 15 degrees F or one or two days when temperatures are below 10 degrees F. These are average values since this will also depend on the actual water temperature at the start of the cold weather. During prolonged periods of cold weather, ice may reach thicknesses of six inches or more in this reach of the river. There have been instances of major ice buildup behind the existing dams.

In recent years, varying thicknesses of ice have formed at some times during many winters behind these dams. In January and February 1963 one of the most severe cold spells of record caused ice to reach thicknesses of several inches during this period.

The most prolonged period of ice occurred in January and February 1977 when ice was recorded for 16 days in sucession reaching a maximum thickness of 6 inches at Dam 4. In all these instances of heavy ice cover, three or four days of temperatures reaching around 50 degrees F and a rise of several feet at the head of the pool was sufficient to dislodge the ice and move it downstream.

The greatest interference by ice to navigation results when floating broken ice accumulates in the upper approaches. The ice collects near the locks when it is running and also when it follows in the wake of tows as they navigate an open track in an ice sheet. Artifical breaking of this ice in itself has negligible effects on local ice movement unless there has been a substantial deterioration. Ice buildup on the keel of a tow often causes inefficiency but generally does not cause great difficulty clearing the lock sills due to the depth of water over these sills.

Recent and ongoing research and experience in ice engineering have added to the present knowledge of more efficient ice handling to benefit navigation. The recent River Ice Management (RIM) Research and Development Program findings will be utilized to the fullest to meet the need at these dams. As new information is made available, present methods will be improved to mimimize the navigation ice problems. Other benefits of this research program, which have and will be utilized, when applicable, are long-term and mid-winter forecasting techniques, travel-frequency procedures (convoying), possible vessel-based techniques (prows), unconventional energy applications to melt ice, optimum use of waste heat (power plant discharge), air screens, wall coatings, and ice control structures or methods. The District is presently working with the U.S. Army Engineer Cold Regions Research and Engineering Laboratory (CRREL) to adress these ice problems.



LOWER MONONGAHELA RIVER STUDY
LOCKS AND DAMS NOS. 2, 3, 4
BASIN MAP

US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH
PLOTTED BY: CEH SEP 1990

PLATE 1

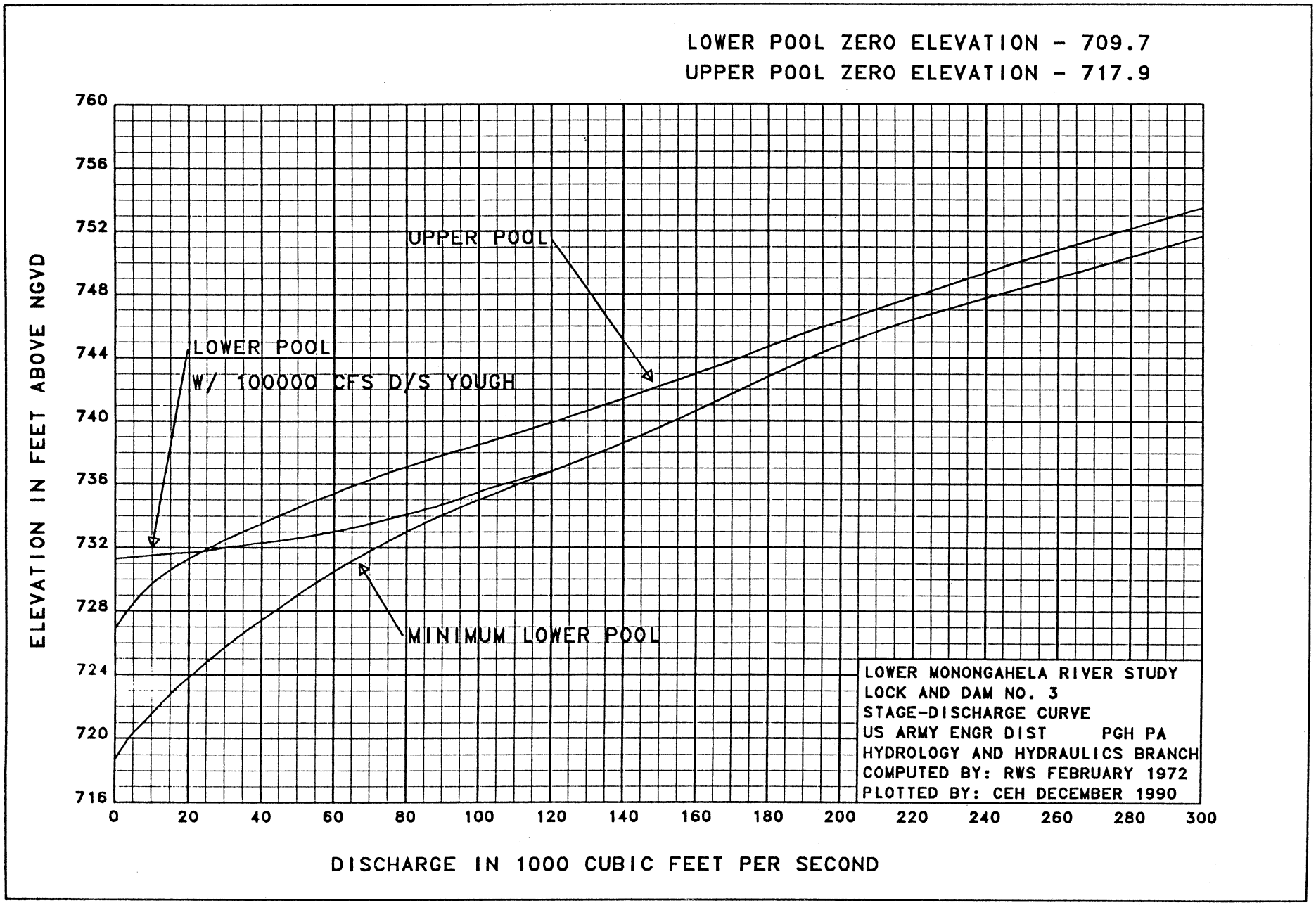

LOWER POOL ZERO ELEVATION - 709.7
UPPER POOL ZERO ELEVATION - 717.9
760
756
752
748
744
740
736
732
728
724
720
716
ELEVATION IN FEET ABOVE NGVD
UPPER POOL
LOWER POOL
W/ 100000 CFS D/S YOUGH
MINIMUM LOWER POOL
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
DISCHARGE IN 1000 CUBIC FEET PER SECOND
LOWER MONONGAHELA RIVER STUDY
LOCK AND DAM NO. 3
STAGE-DISCHARGE CURVE
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: RWS FEBRUARY 1972
PLOTTED BY: CEH DECEMBER 1990

PLATE 2

LOWER POOL ZERO ELEVATION - 694.2
UPPER POOL ZERO ELEVATION - 709.7

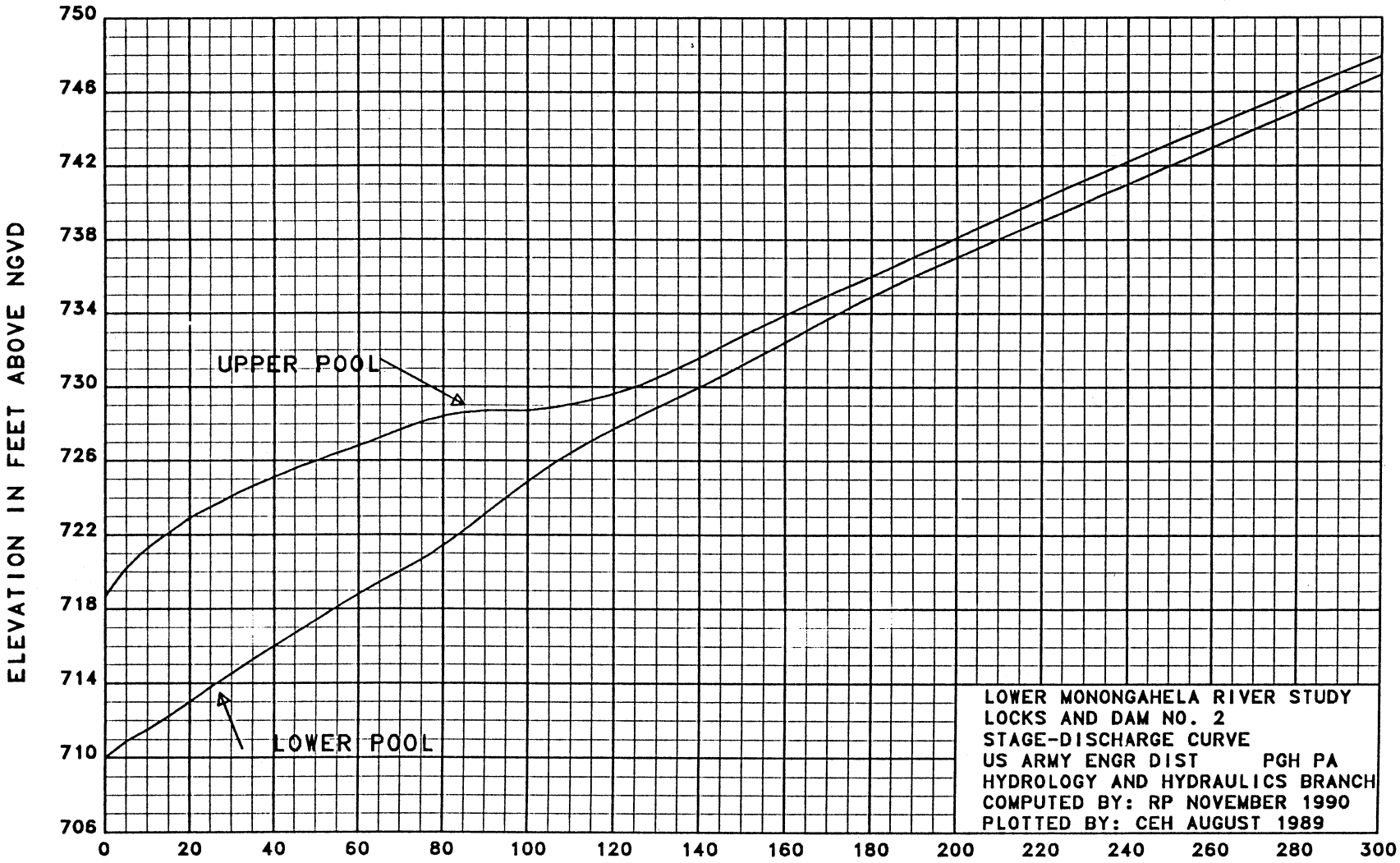


PLATE 3

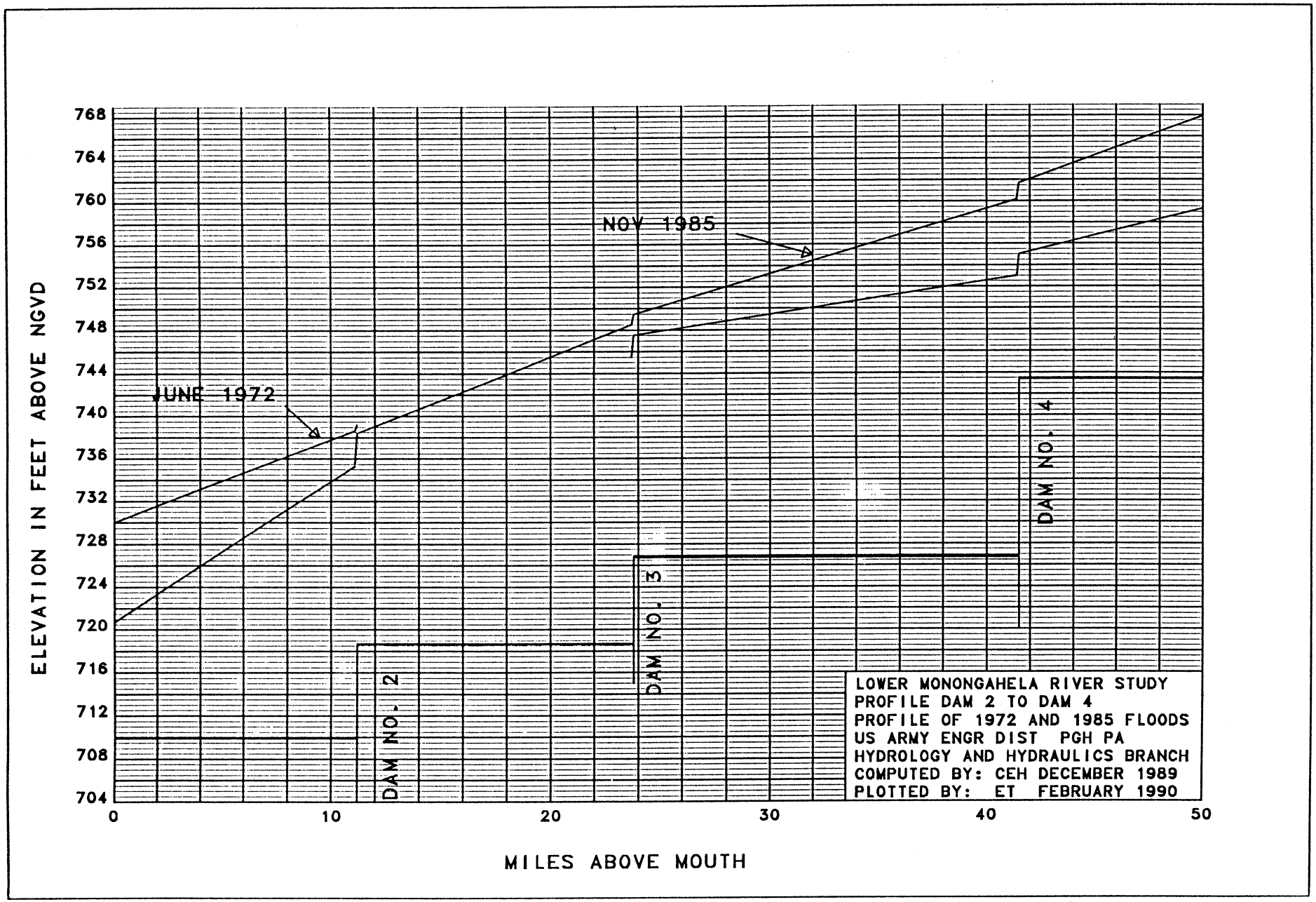

ELEVATION IN FEET ABOVE NGVD
768
764
760
756
752
748
744
740
736
732
728
724
720
716
712
708
704
0
10
20
30
40
50
MILES ABOVE MOUTH
JUNE 1972
NOV 1985
DAM NO. 2
DAM NO. 3
DAM NO. 4
LOWER MONONGAHELA RIVER STUDY
PROFILE DAM 2 TO DAM 4
PROFILE OF 1972 AND 1985 FLOODS
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: ET FEBRUARY 1990

PLATE 4

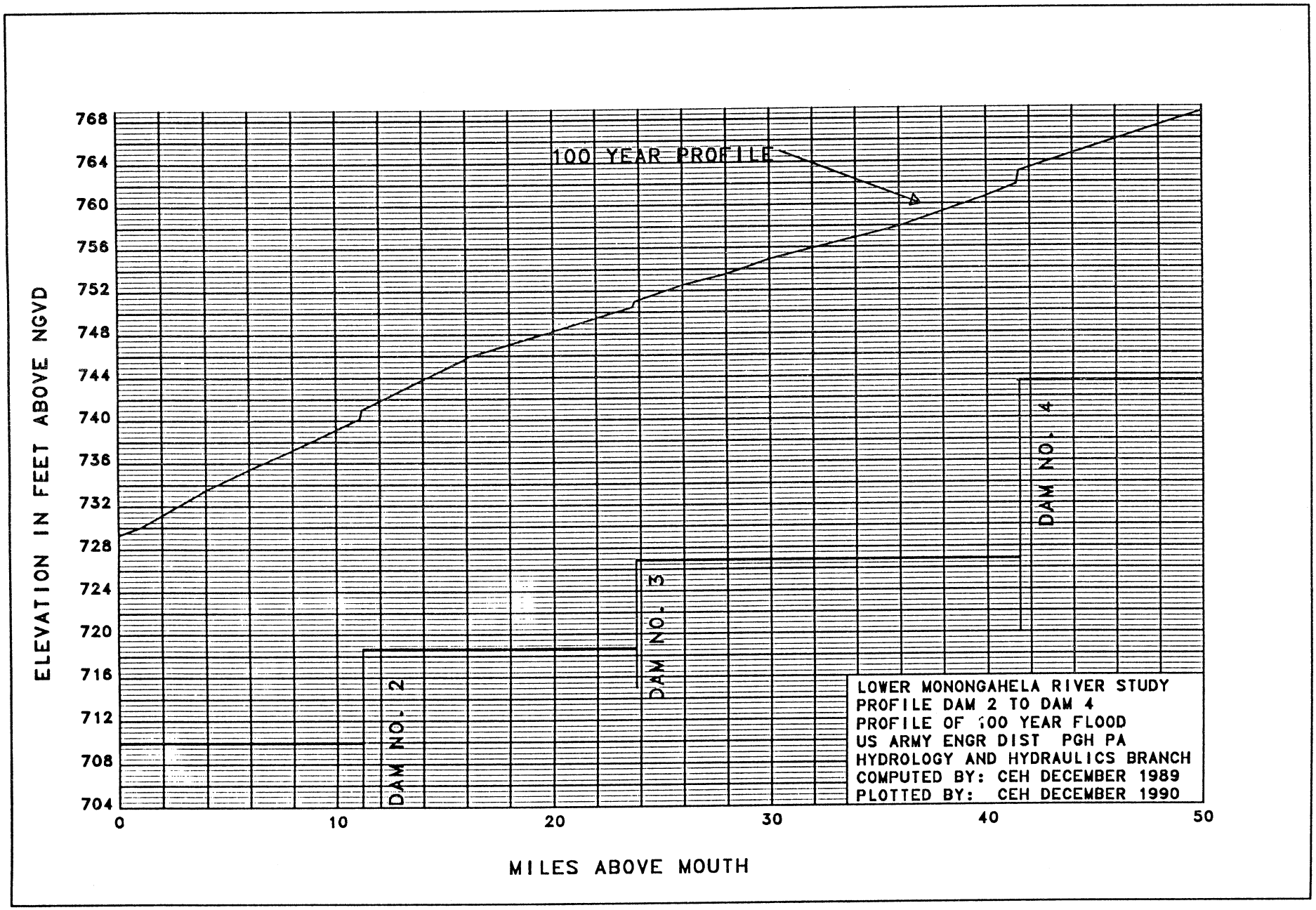

100 YEAR PROFILE
ELEVATION IN FEET ABOVE NGVD
768
764
760
756
752
748
744
740
736
732
728
724
720
716
712
708
704
0
10
20
30
40
50
MILES ABOVE MOUTH
DAM NO. 2
DAM NO. 3
DAM NO. 4
LOWER MONONGAHELA RIVER STUDY
PROFILE DAM 2 TO DAM 4
PROFILE OF 100 YEAR FLOOD
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH DECEMBER 1990

PLATE 5

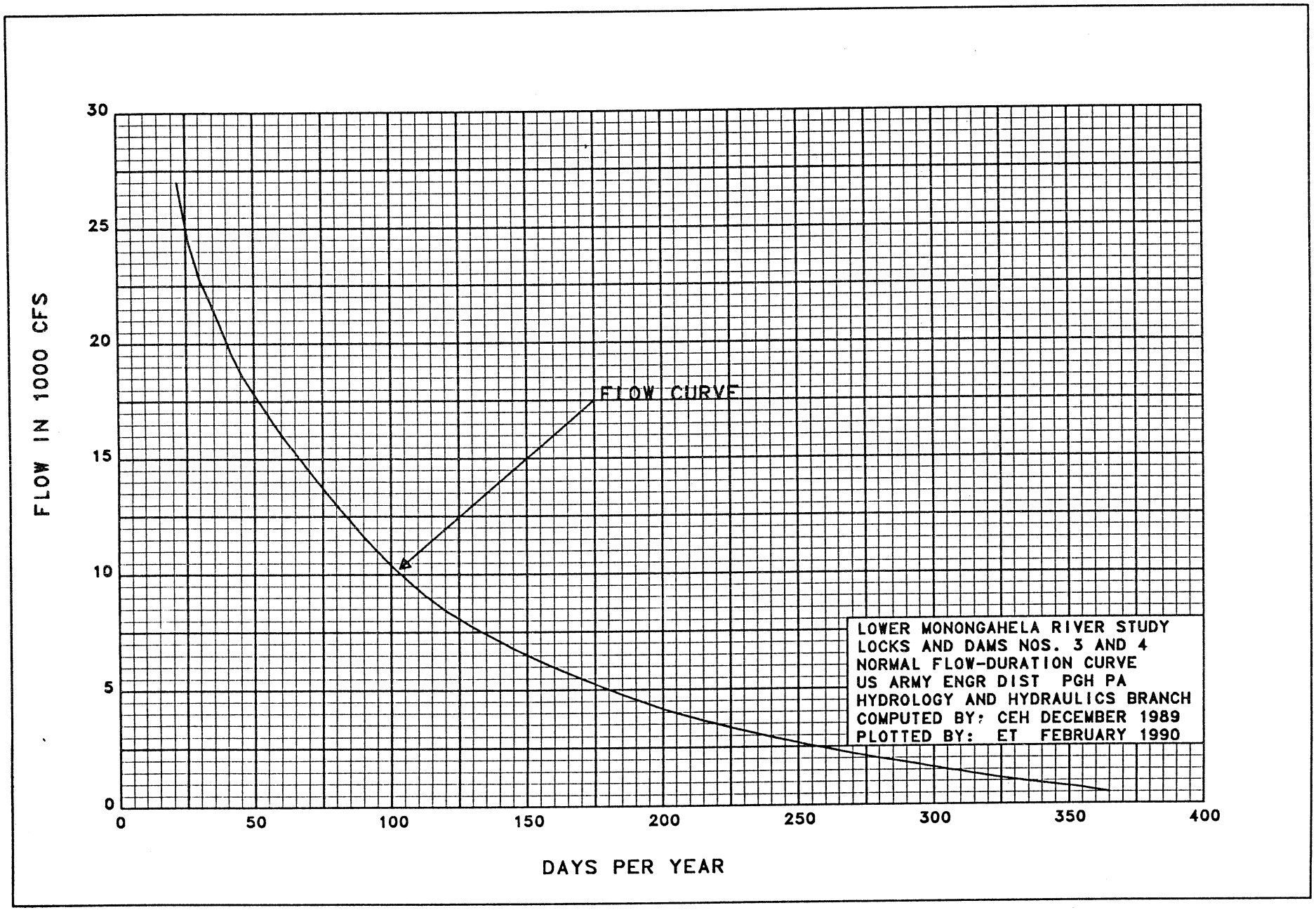

30
25
20
15
10
5
0
FLOW IN 1000 CFS
FLOW CURVE
0
50
100
150
200
250
300
350
400
DAYS PER YEAR
LOWER MONONGAHELA RIVER STUDY
LOCKS AND DAMS NOS. 3 AND 4
NORMAL FLOW-DURATION CURVE
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: ET FEBRUARY 1990

PLATE 6

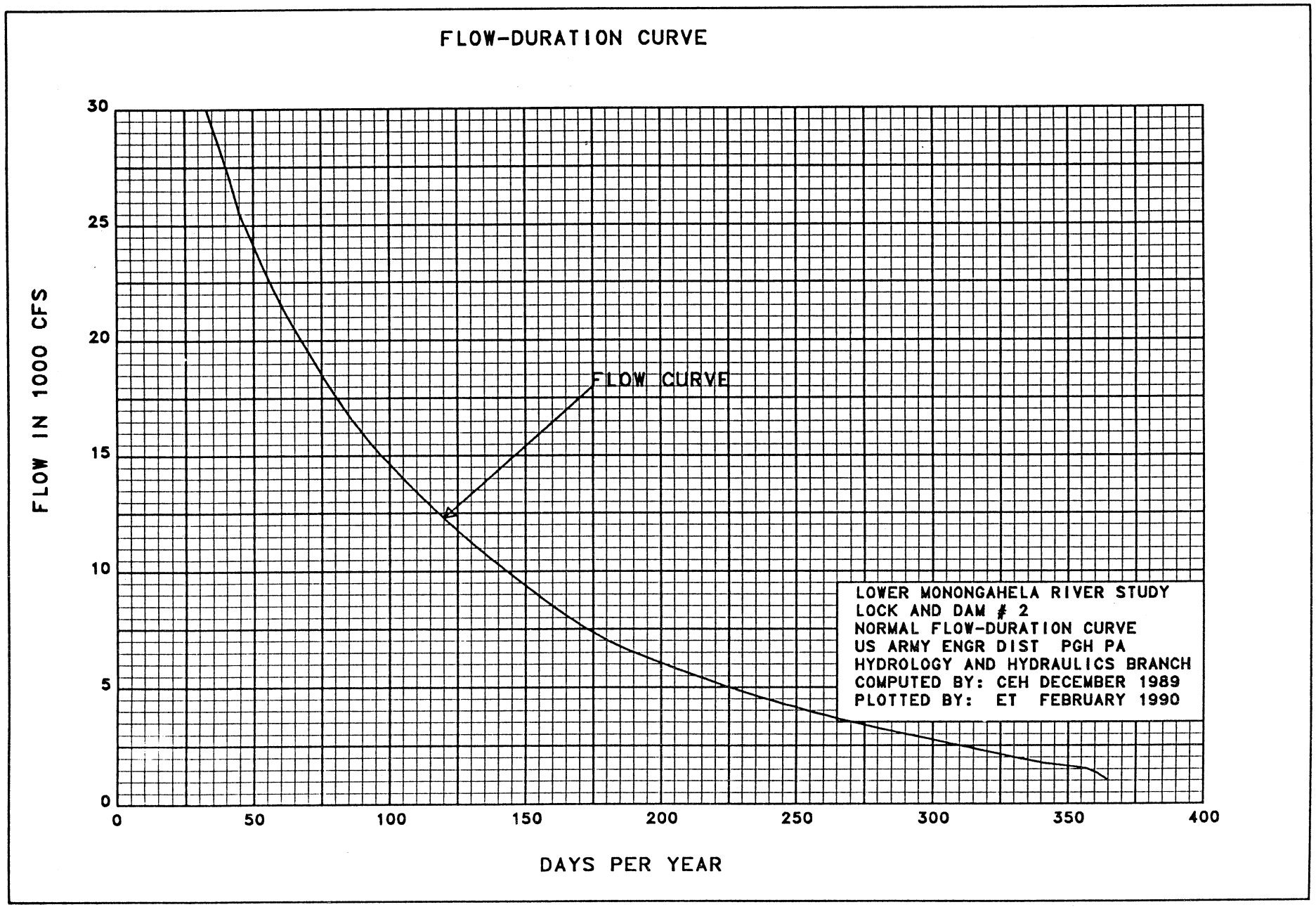

FLOW-DURATION CURVE
FLOW IN 1000 CFS
30
25
20
15
10
5
0
0
50
100
150
200
250
300
350
400
DAYS PER YEAR
FLOW CURVE
LOWER MONONGAHELA RIVER STUDY
LOCK AND DAM # 2
NORMAL FLOW-DURATION CURVE
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: ET FEBRUARY 1990

PLATE 7

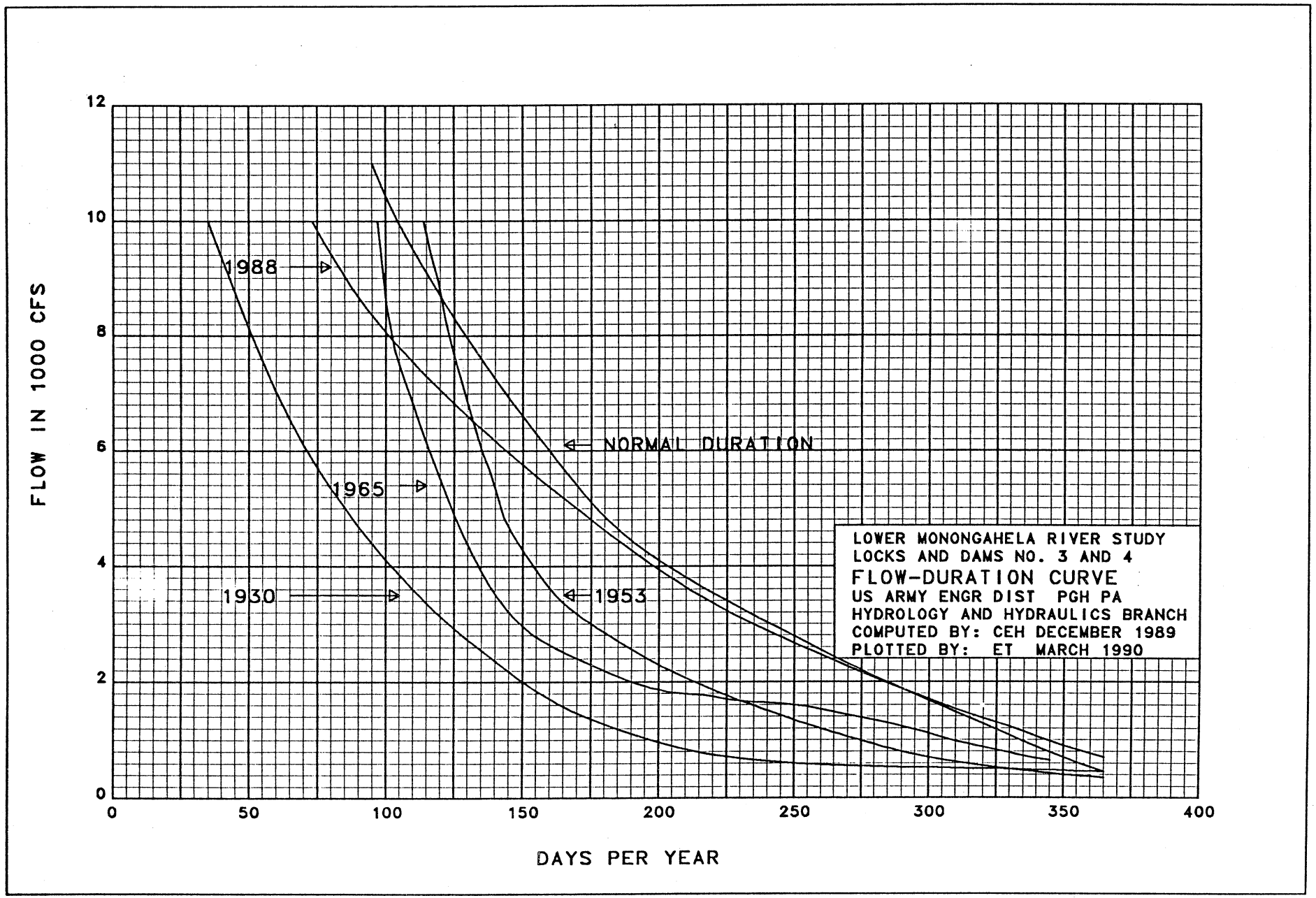

FLOW IN 1000 CFS
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350
400
DAYS PER YEAR
1988
1965
1930
1953
NORMAL DURATION
LOWER MONONGAHELA RIVER STUDY
LOCKS AND DAMS NO. 3 AND 4
FLOW-DURATION CURVE
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: ET MARCH 1990

PLATE 8

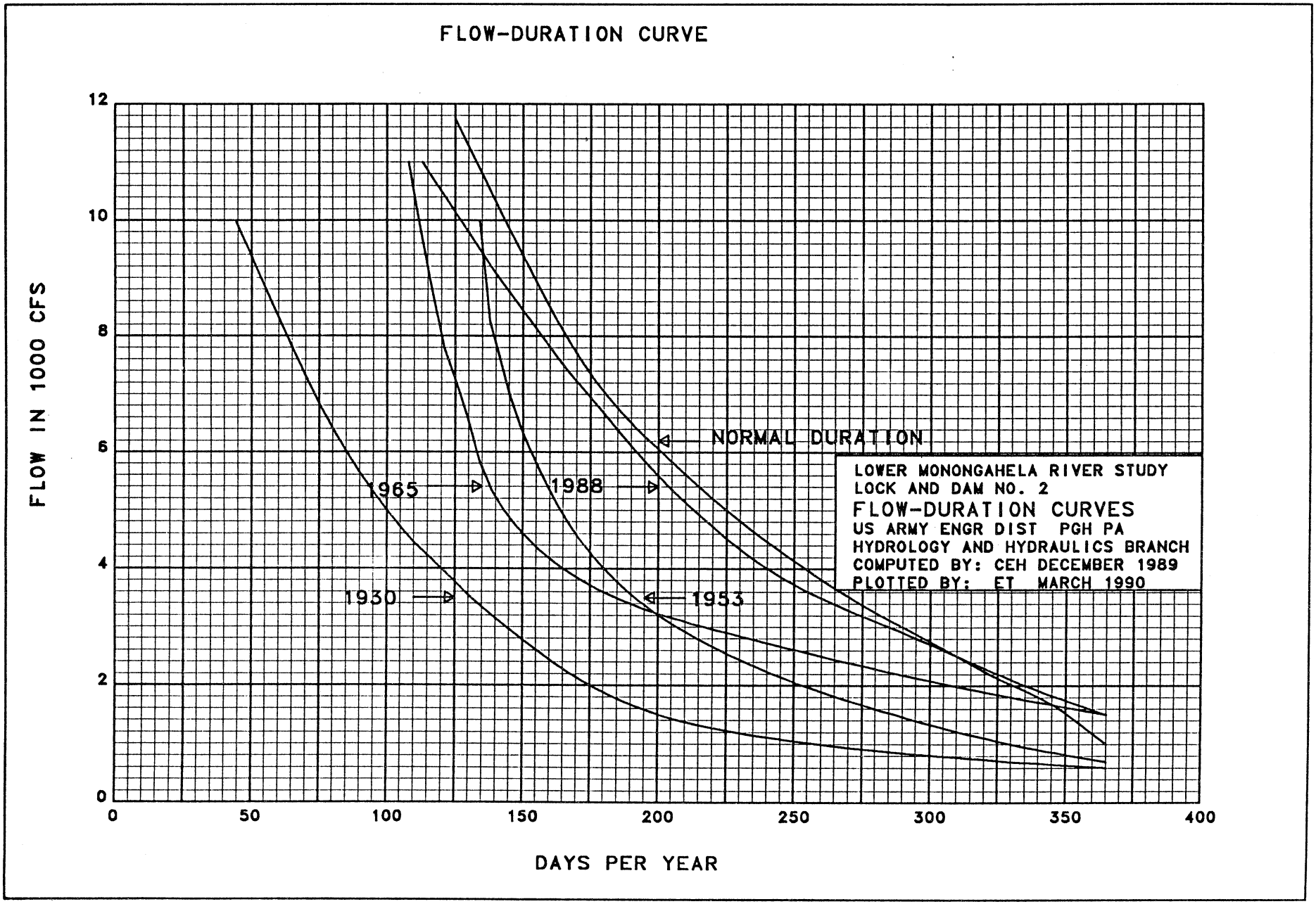

FLOW-DURATION CURVE
FLOW IN 1000 CFS
DAYS PER YEAR
0
2
4
6
8
10
12
0
50
100
150
200
250
300
350
400
NORMAL DURATION
1965
1988
1930
1953
LOWER MONONGAHELA RIVER STUDY
LOCK AND DAM NO. 2
FLOW-DURATION CURVES
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: ET MARCH 1990

PLATE 9

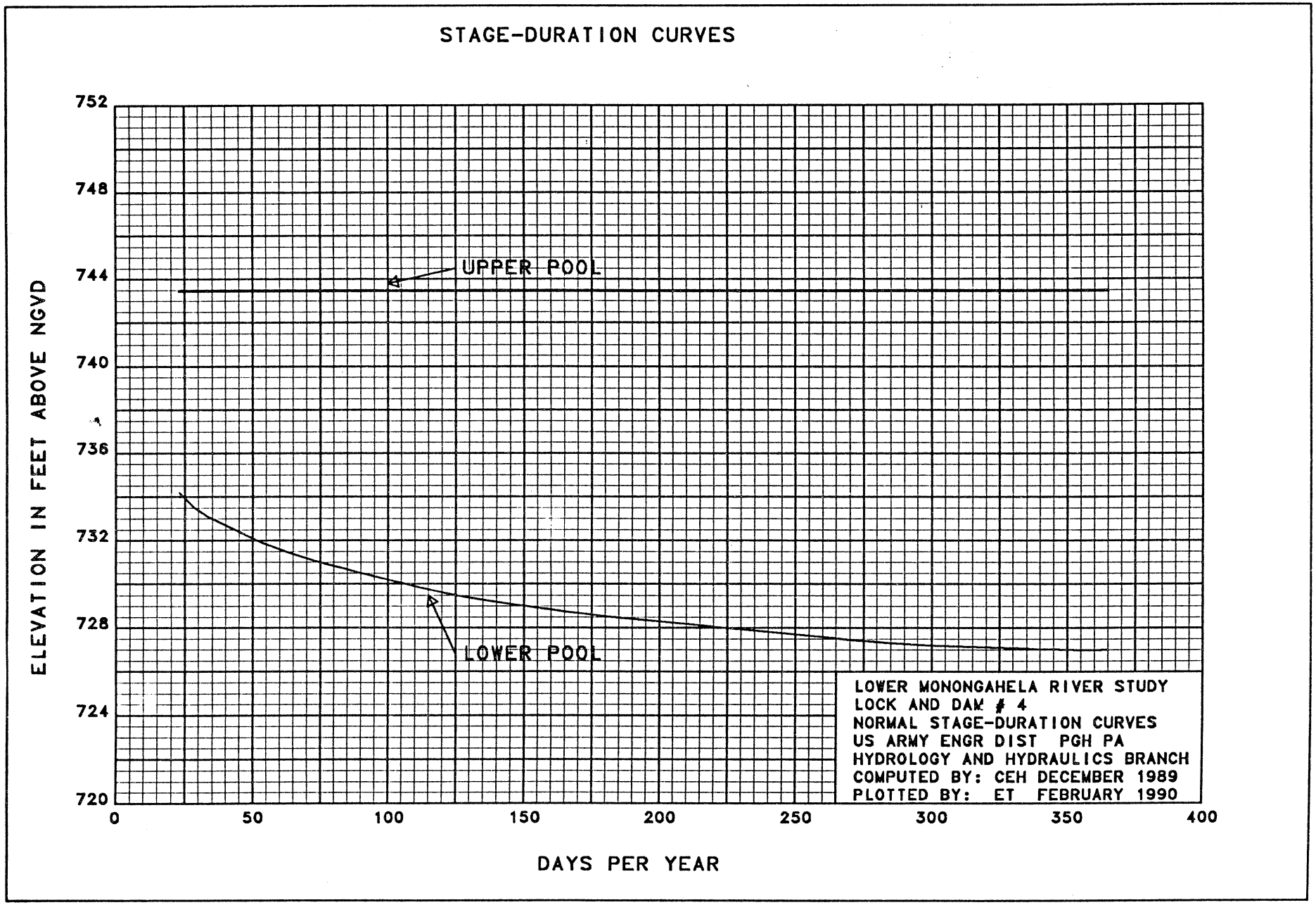

STAGE-DURATION CURVES
752
748
744
740
736
732
728
724
720
ELEVATION IN FEET ABOVE NGVD
UPPER POOL
LOWER POOL
0
50
100
150
200
250
300
350
400
DAYS PER YEAR
LOWER MONONGAHELA RIVER STUDY
LOCK AND DAM # 4
NORMAL STAGE-DURATION CURVES
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: ET FEBRUARY 1990

PLATE 10

STAGE-DURATION CURVES

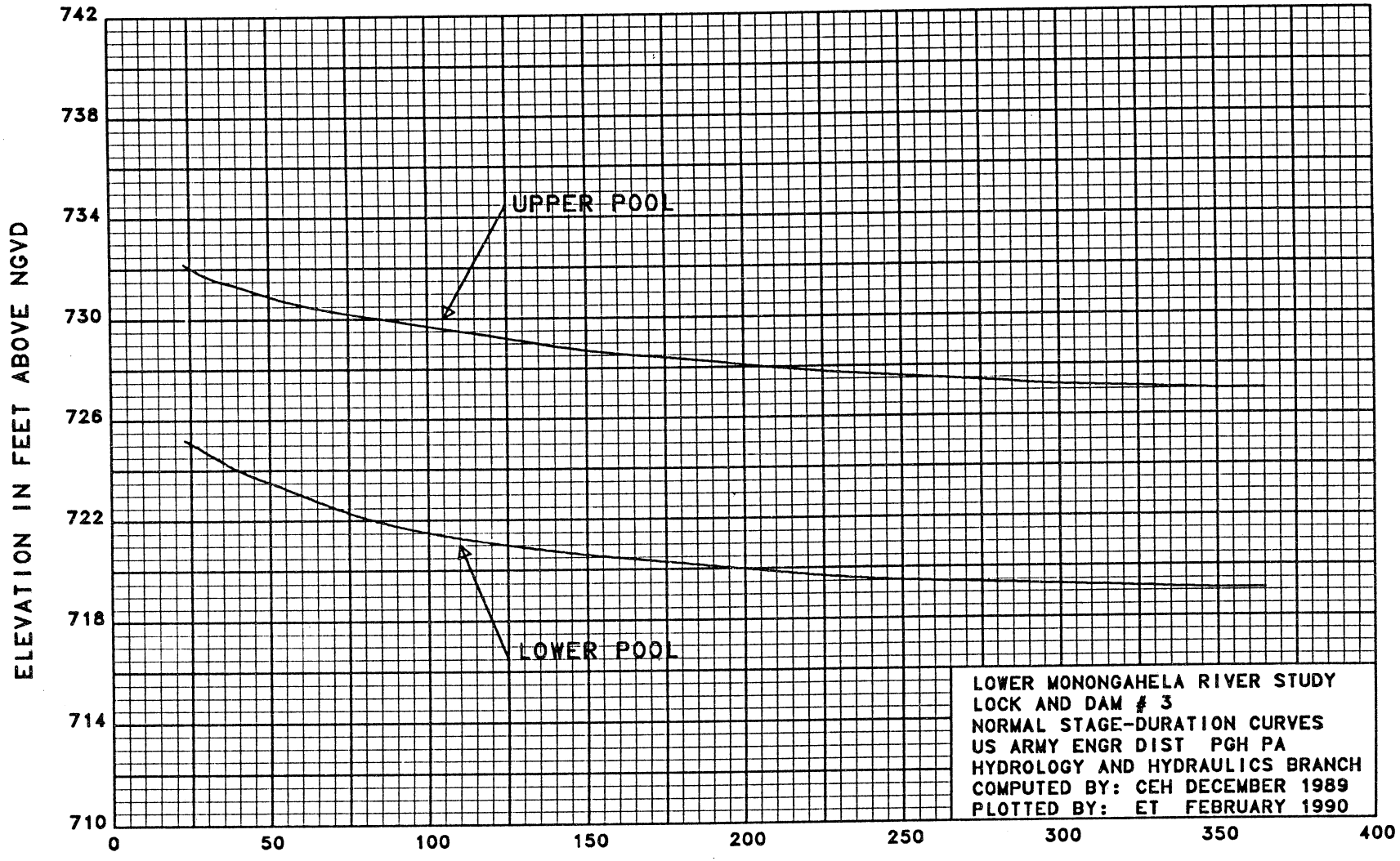


PLATE 11

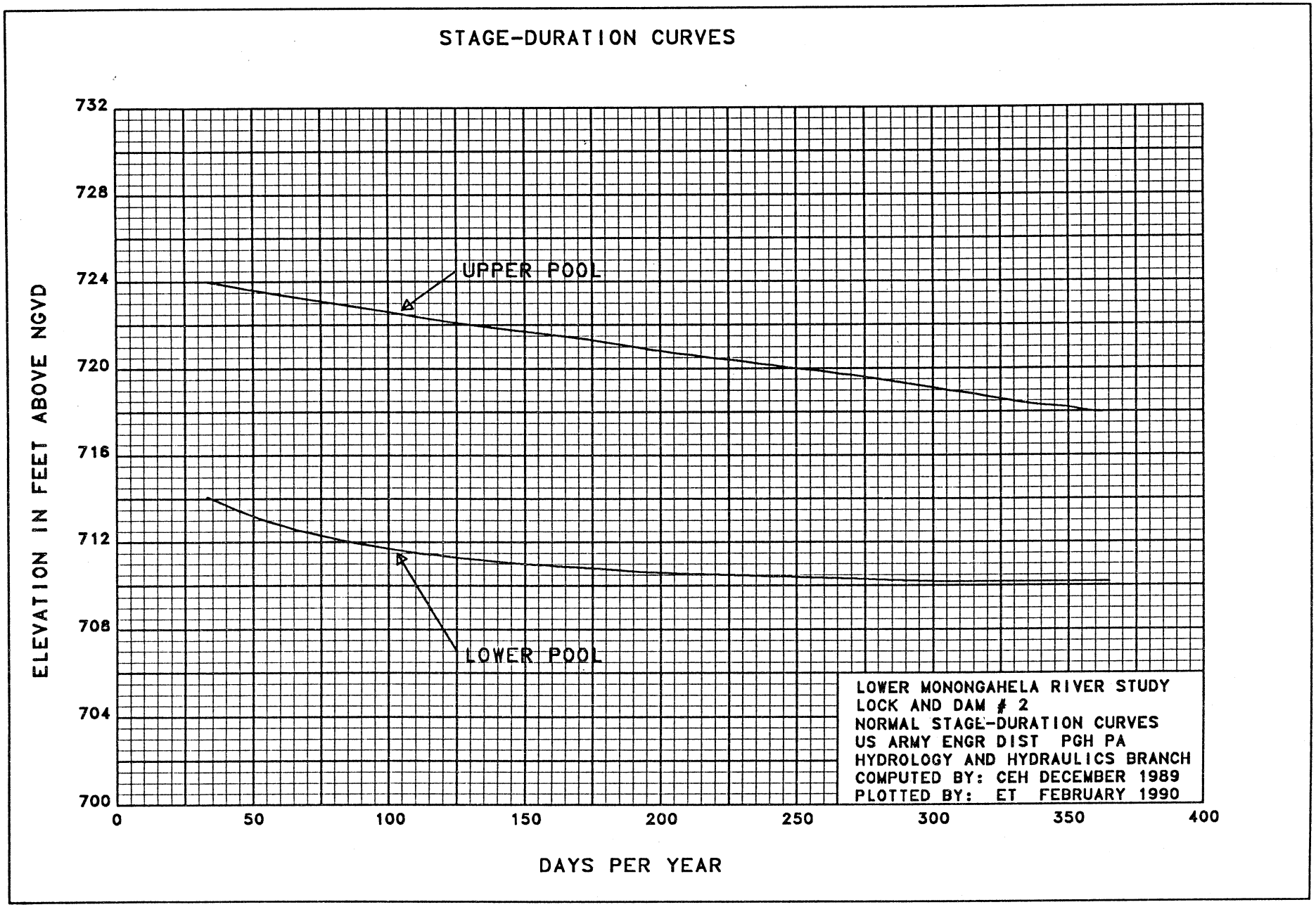

STAGE-DURATION CURVES
ELEVATION IN FEET ABOVE NGVD
732
728
724
720
716
712
708
704
700
0
50
100
150
200
250
300
350
400
DAYS PER YEAR
UPPER POOL
LOWER POOL
LOWER MONONGAHELA RIVER STUDY
LOCK AND DAM # 2
NORMAL STAGE-DURATION CURVES
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: ET FEBRUARY 1990

PLATE 12

STAGE-DURATION CURVES

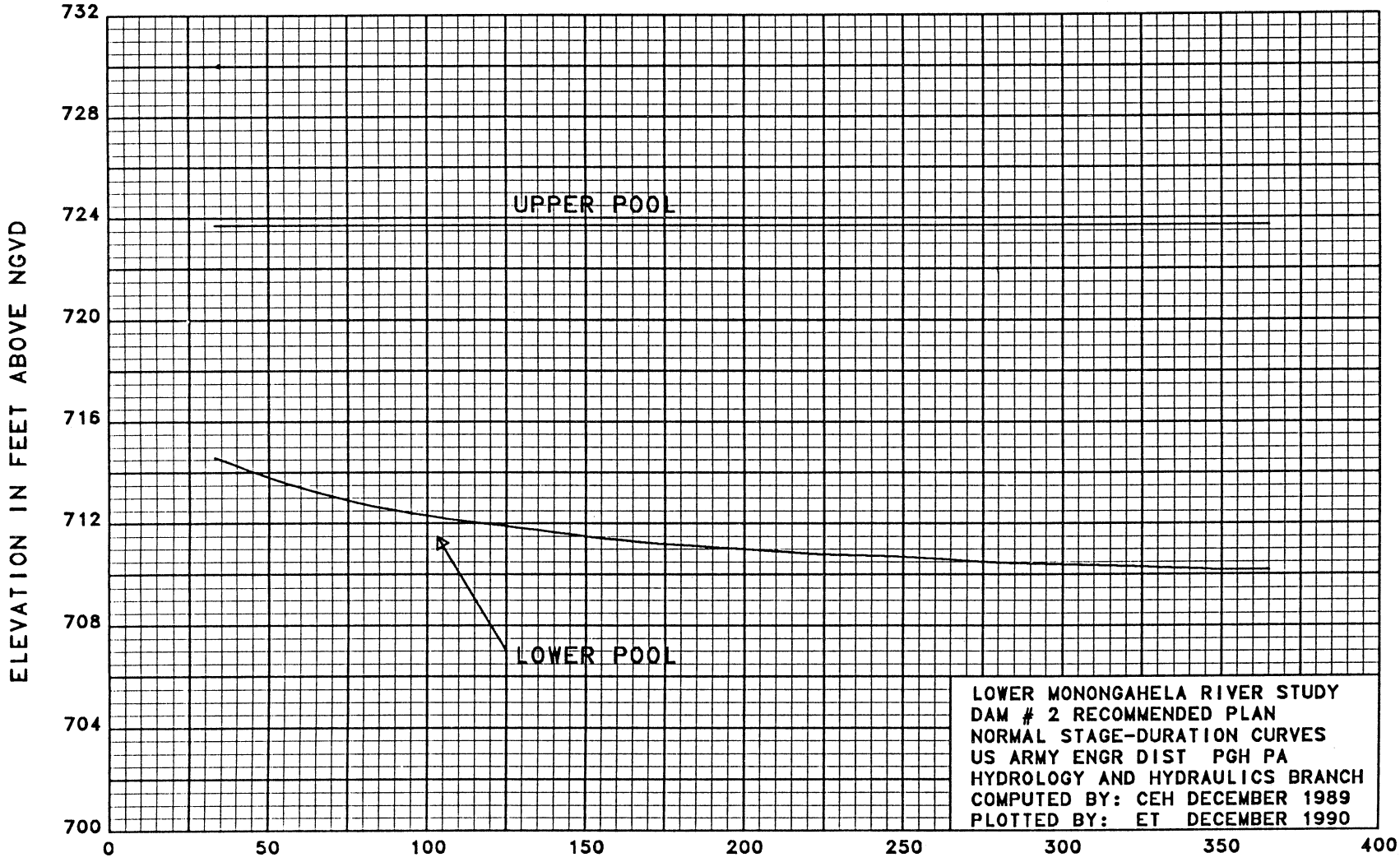


PLATE 13

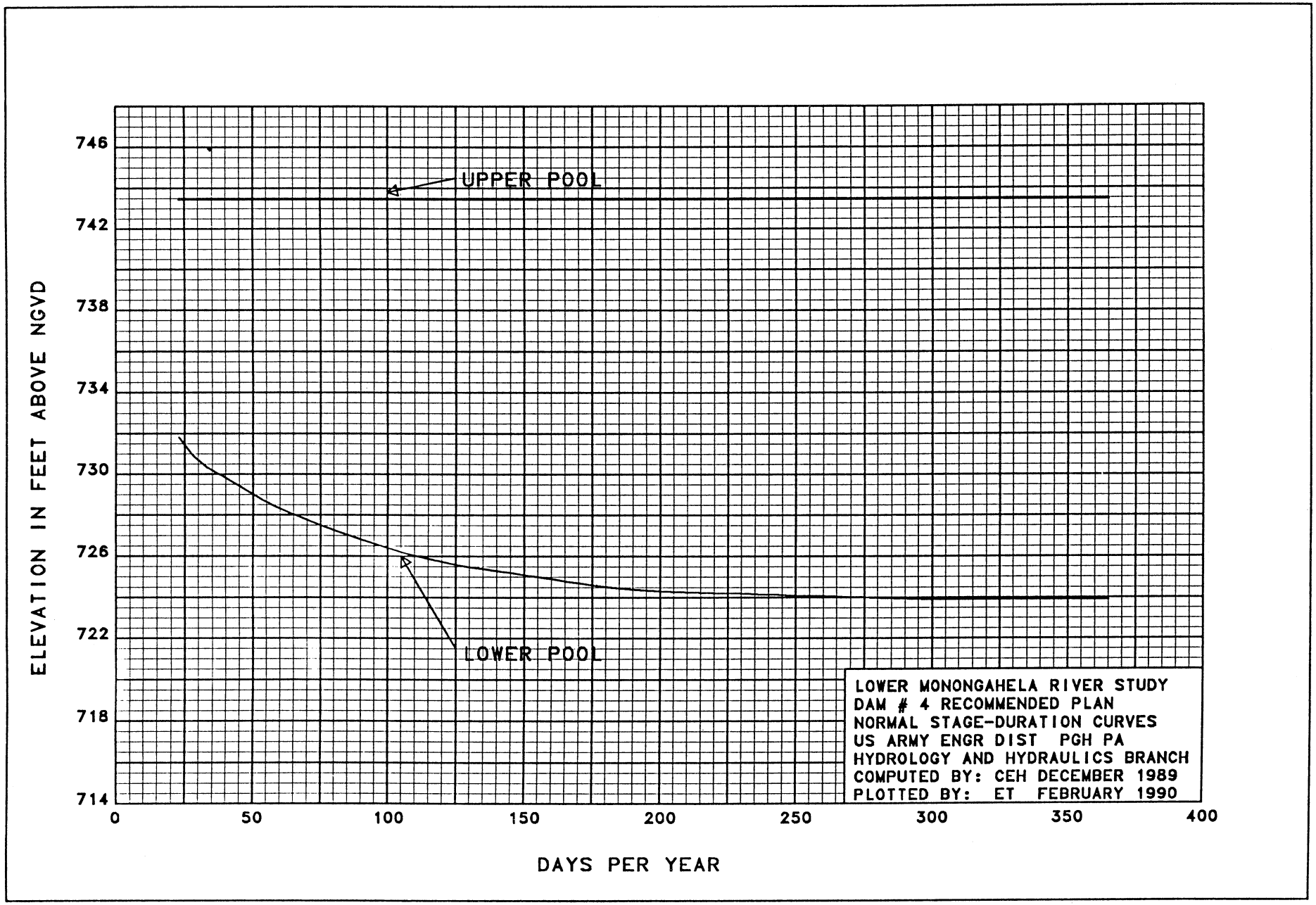

746
742
738
734
730
726
722
718
714
ELEVATION IN FEET ABOVE NGVD
UPPER POOL
LOWER POOL
0
50
100
150
200
250
300
350
400
DAYS PER YEAR
LOWER MONONGAHELA RIVER STUDY
DAM # 4 RECOMMENDED PLAN
NORMAL STAGE-DURATION CURVES
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: ET FEBRUARY 1990

PLATE 14

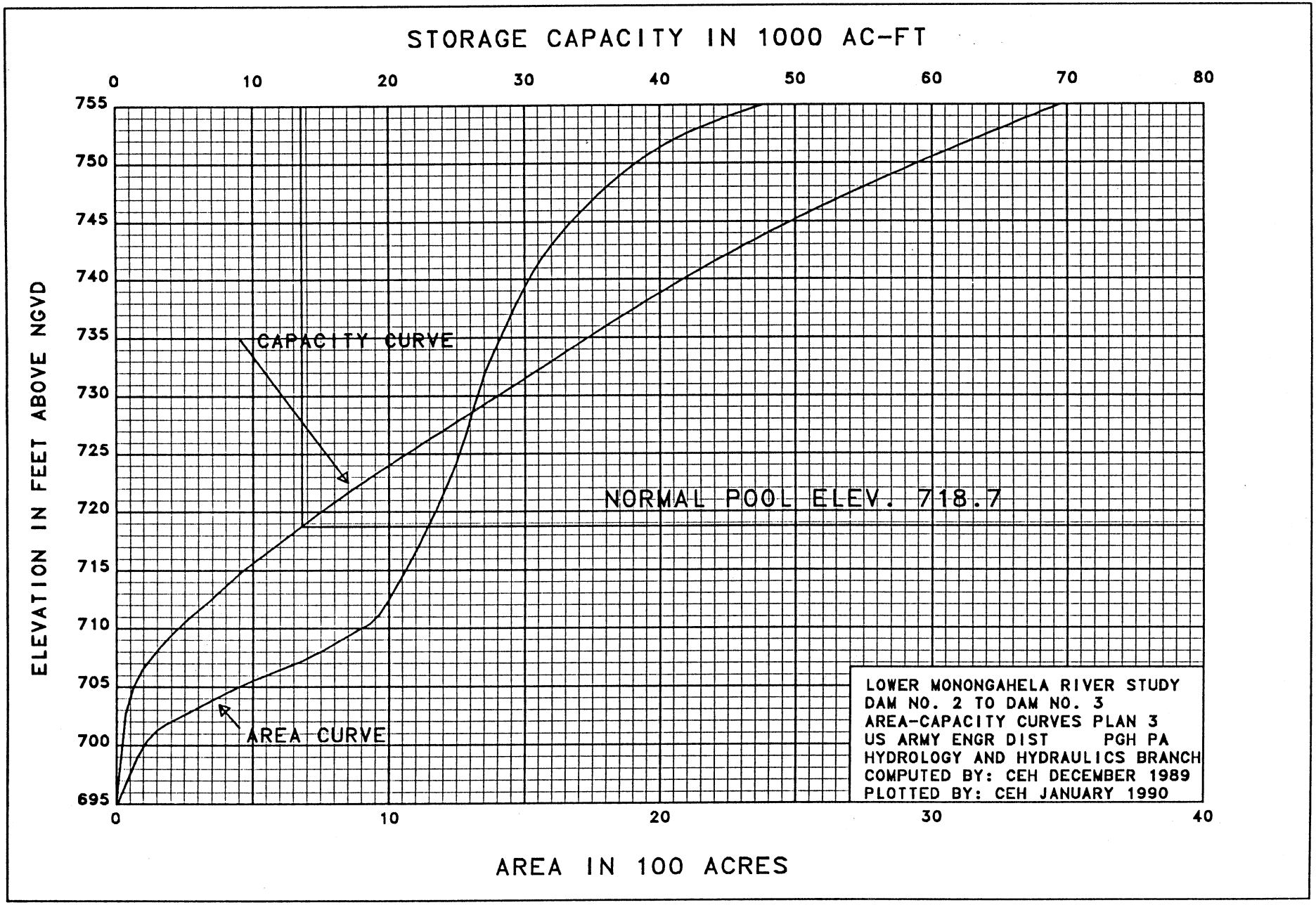

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
ELEVATION IN FEET ABOVE NGVD
755
750
745
740
735
730
725
720
715
710
705
700
695
CAPACITY CURVE
NORMAL POOL ELEV. 718.7
AREA CURVE
LOWER MONONGAHELA RIVER STUDY
DAM NO. 2 TO DAM NO. 3
AREA-CAPACITY CURVES PLAN 3
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH JANUARY 1990
0
10
20
30
40
AREA IN 100 ACRES

PLATE 15

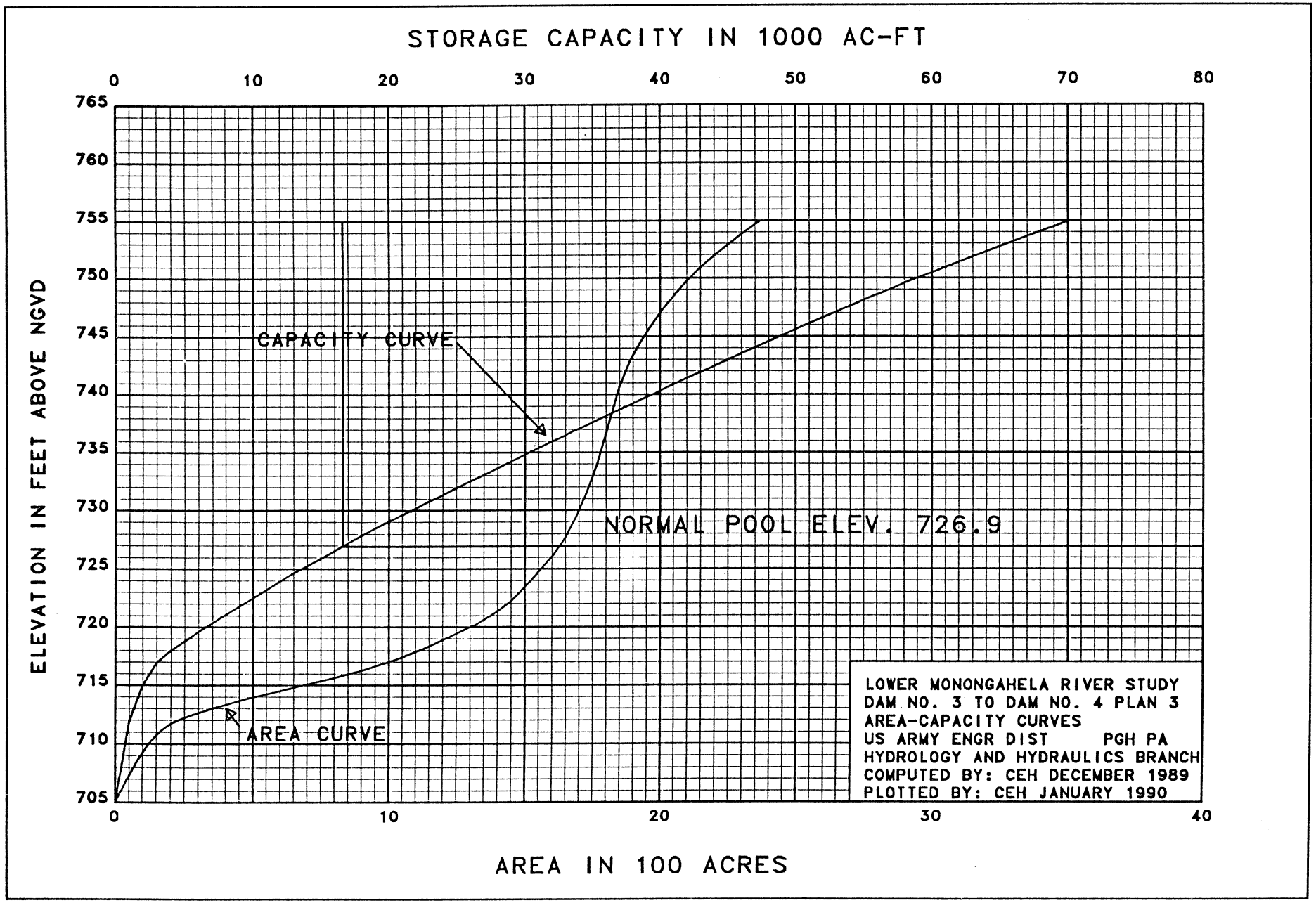

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
765
760
755
750
745
740
735
730
725
720
715
710
705
ELEVATION IN FEET ABOVE NGVD
CAPACITY CURVE
NORMAL POOL ELEV. 726.9
AREA CURVE
LOWER MONONGAHELA RIVER STUDY
DAM NO. 3 TO DAM NO. 4 PLAN 3
AREA-CAPACITY CURVES
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH JANUARY 1990
0
10
20
30
40
AREA IN 100 ACRES

PLATE 16

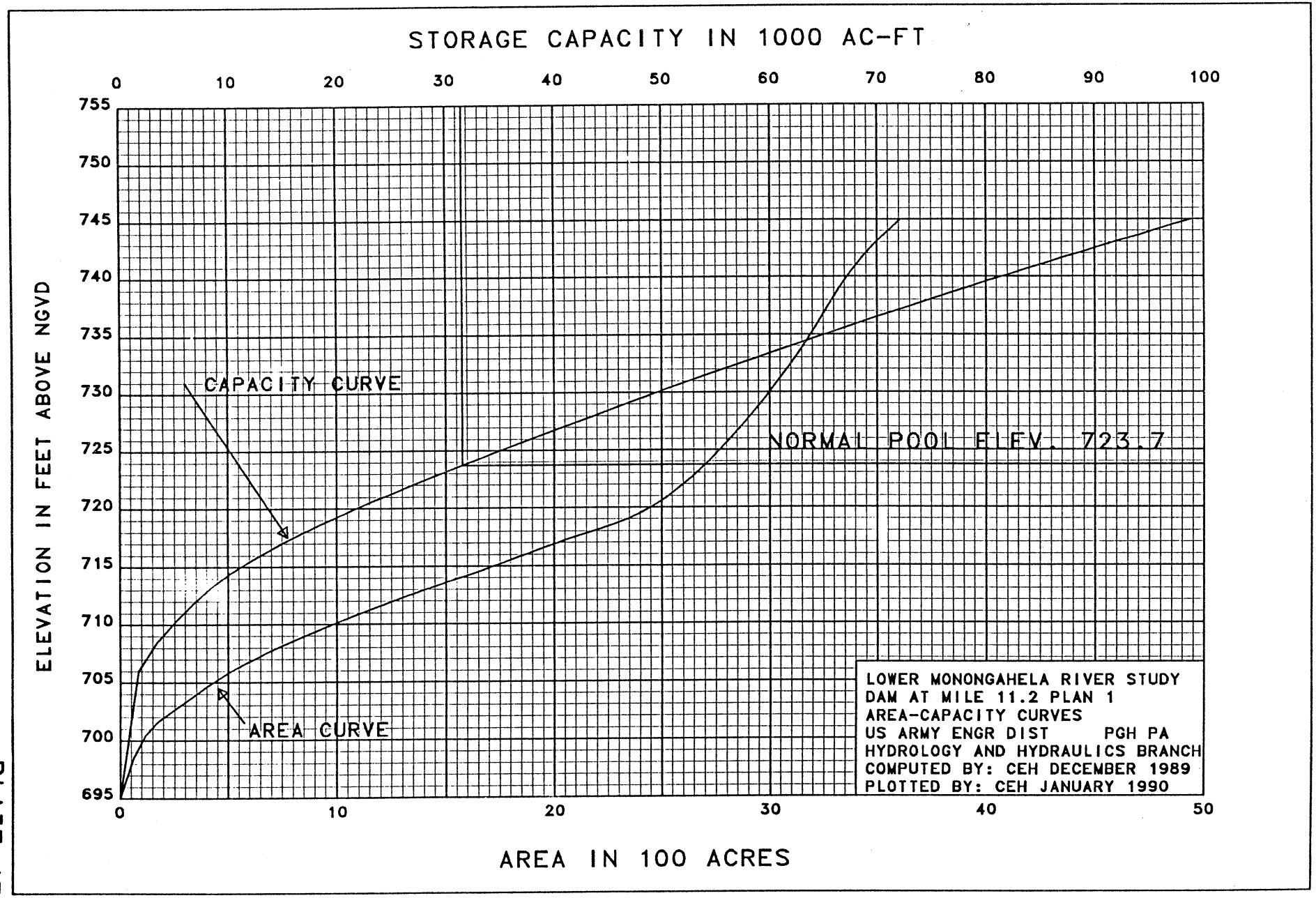

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
90
100
ELEVATION IN FEET ABOVE NGVD
755
750
745
740
735
730
725
720
715
710
705
700
695
CAPACITY CURVE
NORMAL POOL ELEV. 723.7
AREA CURVE
LOWER MONONGAHELA RIVER STUDY
DAM AT MILE 11.2 PLAN 1
AREA-CAPACITY CURVES
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH JANUARY 1990
0
10
20
30
40
50
AREA IN 100 ACRES

PLATE 17

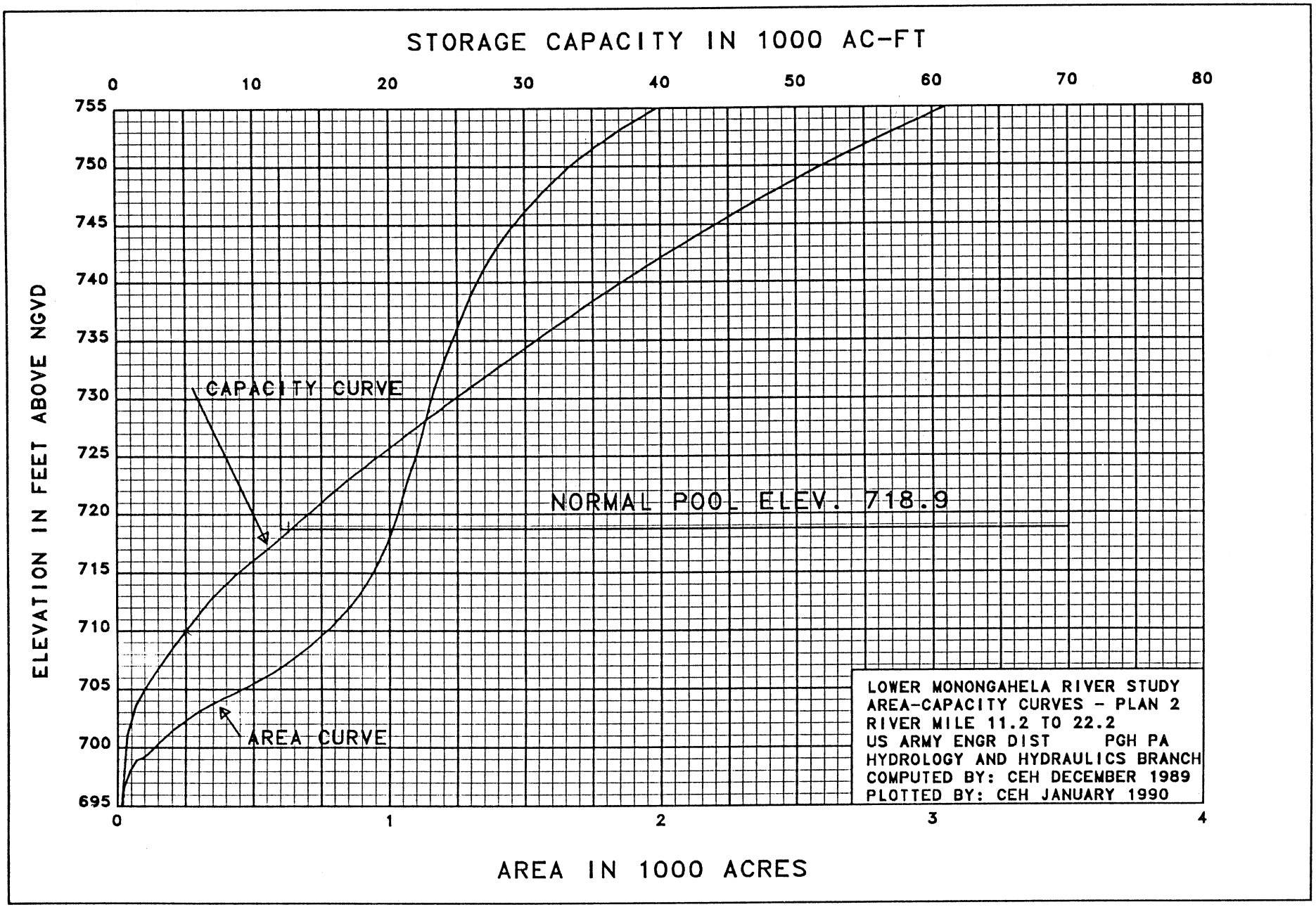

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
ELEVATION IN FEET ABOVE NGVD
755
750
745
740
735
730
725
720
715
710
705
700
695
CAPACITY CURVE
NORMAL POOL ELEV. 718.9
AREA CURVE
LOWER MONONGAHELA RIVER STUDY
AREA-CAPACITY CURVES - PLAN 2
RIVER MILE 11.2 TO 22.2
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH JANUARY 1990
0
1
2
3
4
AREA IN 1000 ACRES

PLATE 18

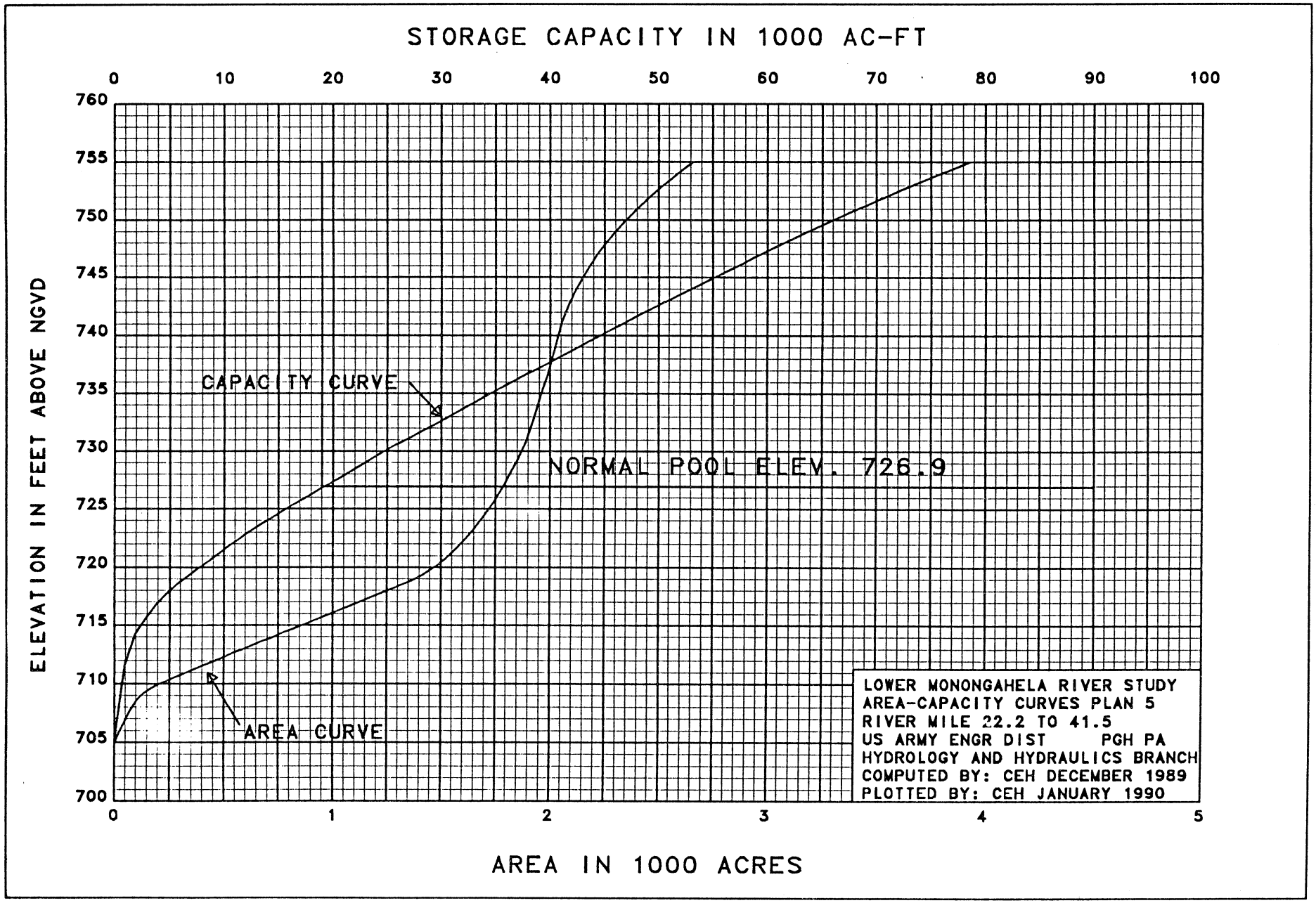

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
90
100
760
755
750
745
740
735
730
725
720
715
710
705
700
ELEVATION IN FEET ABOVE NGVD
CAPACITY CURVE
NORMAL POOL ELEV. 726.9
AREA CURVE
LOWER MONONGAHELA RIVER STUDY
AREA-CAPACITY CURVES PLAN 5
RIVER MILE 22.2 TO 41.5
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH JANUARY 1990
0
1
2
3
4
5
AREA IN 1000 ACRES

PLATE 19

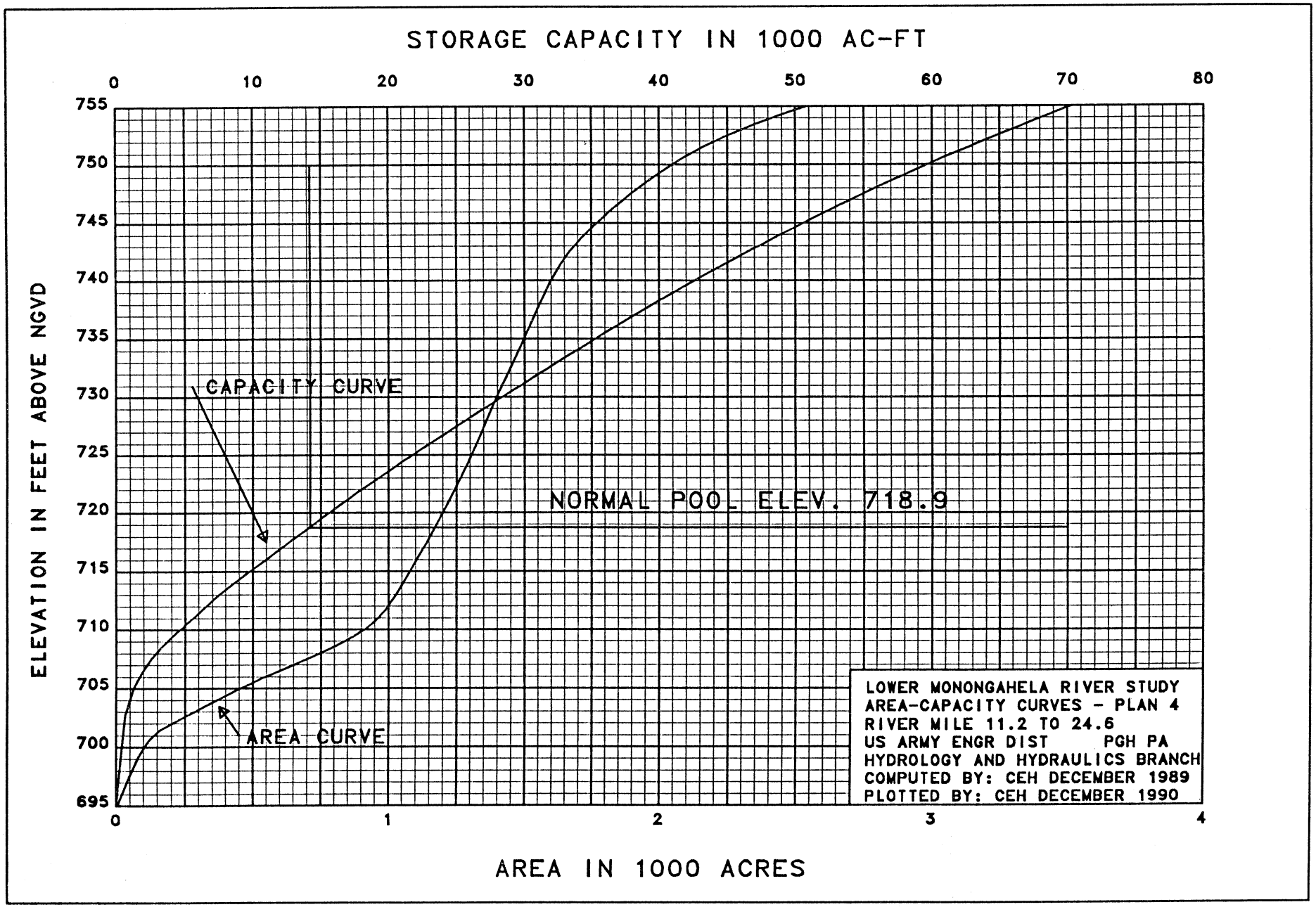

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
755
750
745
740
735
730
725
720
715
710
705
700
695
ELEVATION IN FEET ABOVE NGVD
CAPACITY CURVE
NORMAL POOL ELEV. 718.9
AREA CURVE
0
1
2
3
4
AREA IN 1000 ACRES
LOWER MONONGAHELA RIVER STUDY
AREA-CAPACITY CURVES - PLAN 4
RIVER MILE 11.2 TO 24.6
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH DECEMBER 1990

PLATE 20

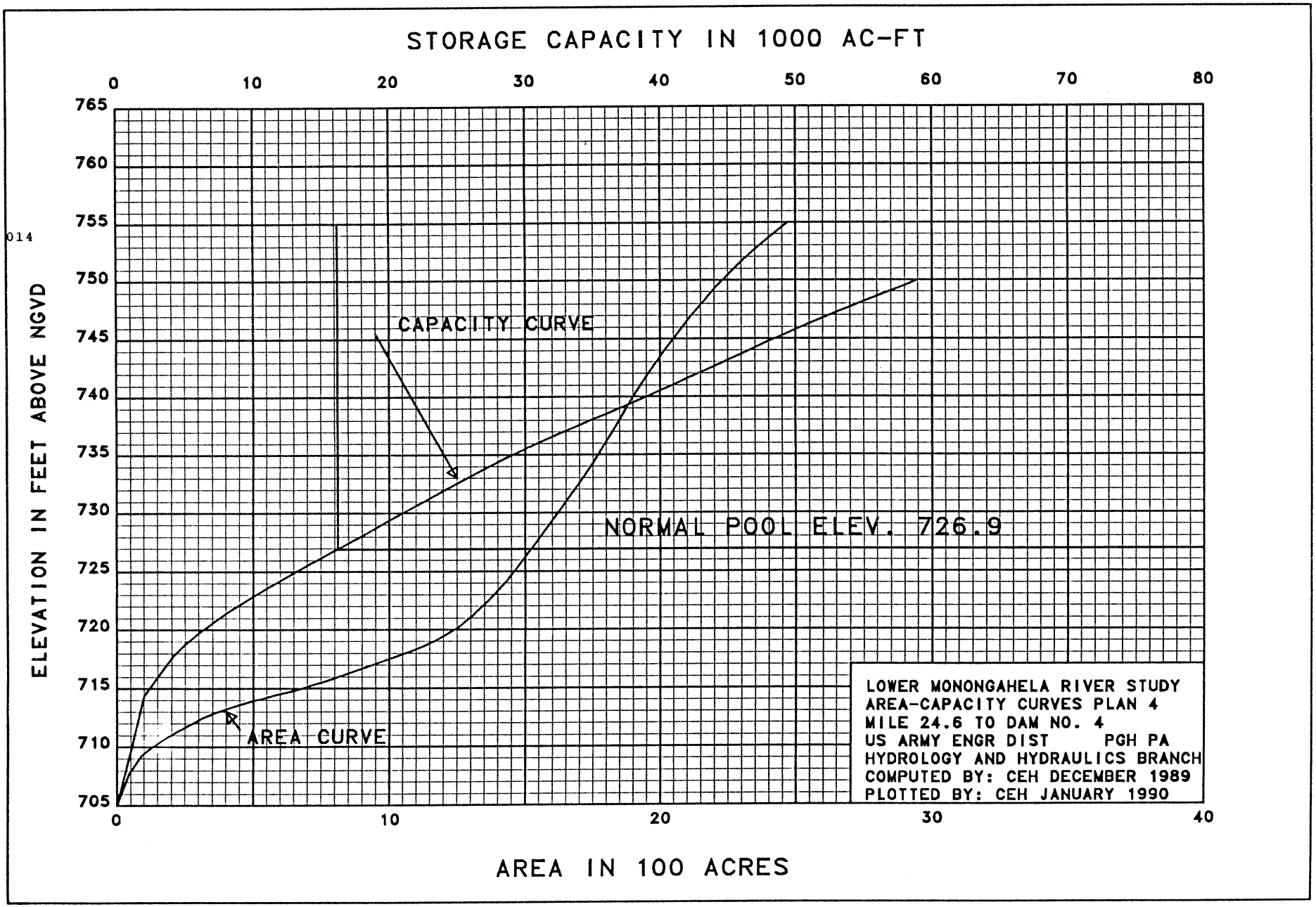

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
765
760
755
750
745
740
735
730
725
720
715
710
705
014
ELEVATION IN FEET ABOVE NGVD
CAPACITY CURVE
NORMAL POOL ELEV. 726.9
AREA CURVE
LOWER MONONGAHELA RIVER STUDY
AREA-CAPACITY CURVES PLAN 4
MILE 24.6 TO DAM NO. 4
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH JANUARY 1990
0
10
20
30
40
AREA IN 100 ACRES

PLATE 21

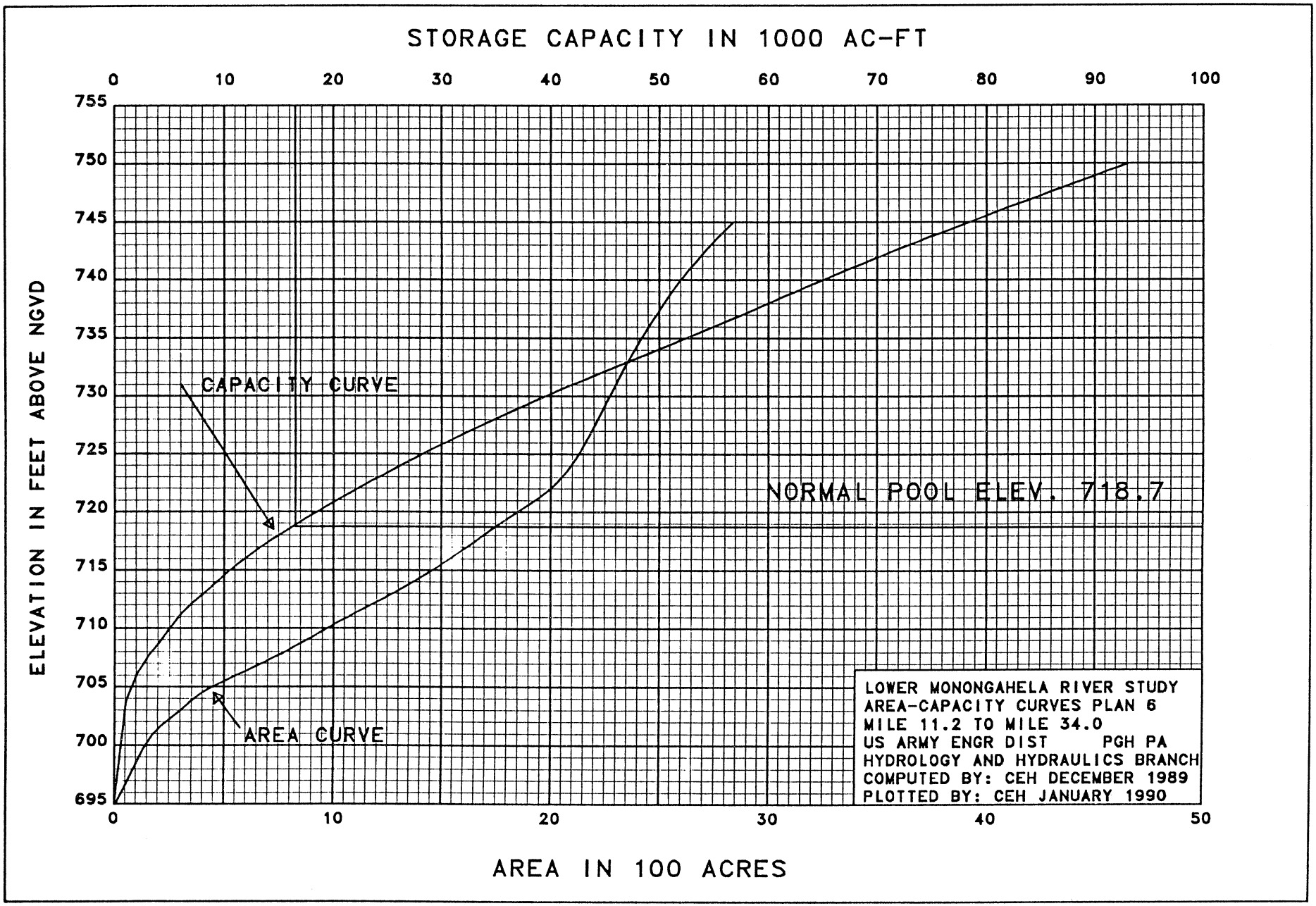

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
90
100
ELEVATION IN FEET ABOVE NGVD
755
750
745
740
735
730
725
720
715
710
705
700
695
CAPACITY CURVE
AREA CURVE
NORMAL POOL ELEV. 718.7
LOWER MONONGAHELA RIVER STUDY
AREA-CAPACITY CURVES PLAN 6
MILE 11.2 TO MILE 34.0
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH JANUARY 1990
0
10
20
30
40
50
AREA IN 100 ACRES

PLATE 22

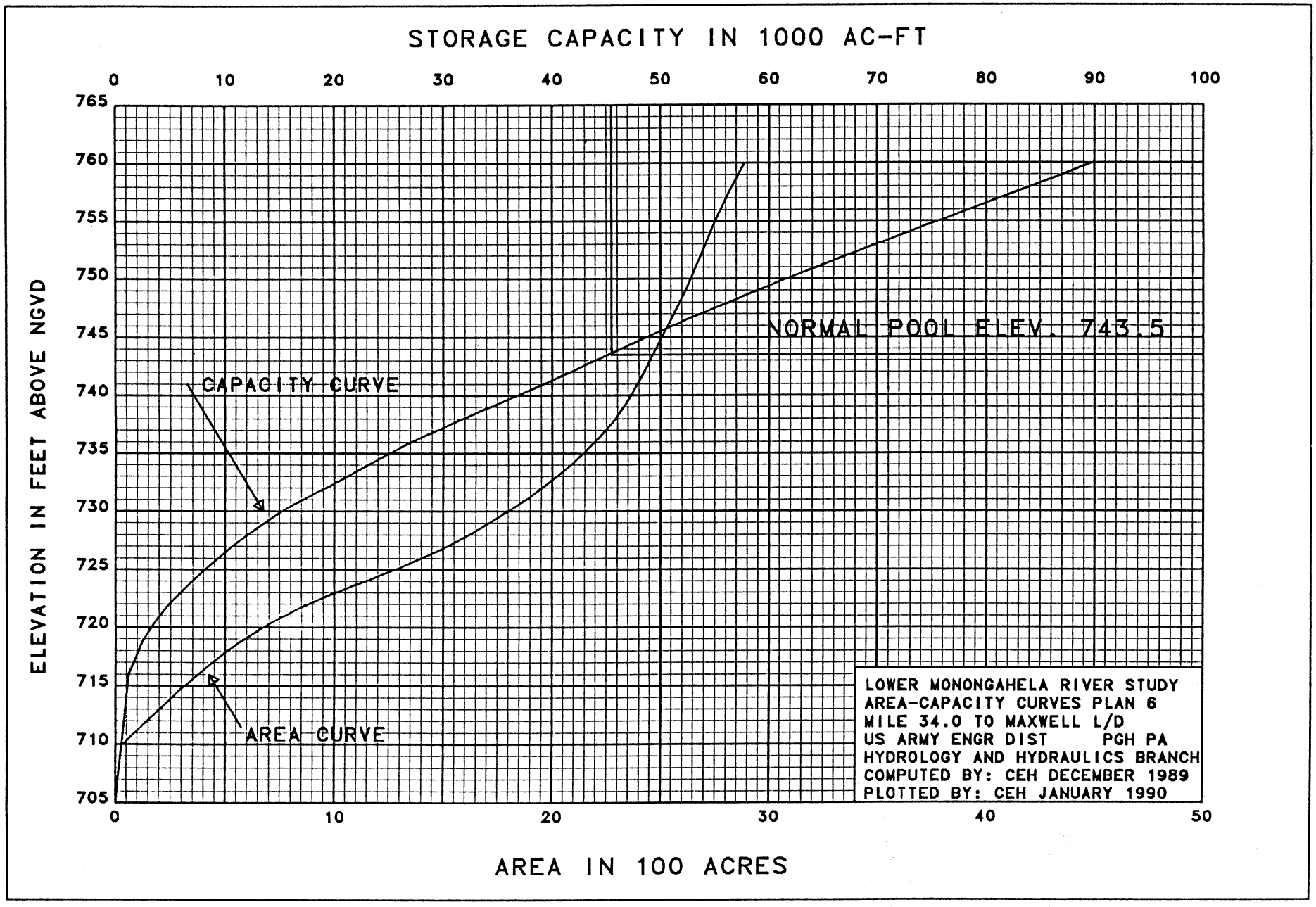

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
90
100
765
760
755
750
745
740
735
730
725
720
715
710
705
ELEVATION IN FEET ABOVE NGVD
NORMAL POOL ELEV. 743.5
CAPACITY CURVE
AREA CURVE
LOWER MONONGAHELA RIVER STUDY
AREA-CAPACITY CURVES PLAN 6
MILE 34.0 TO MAXWELL L/D
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH JANUARY 1990
0
10
20
30
40
50
AREA IN 100 ACRES

PLATE 23

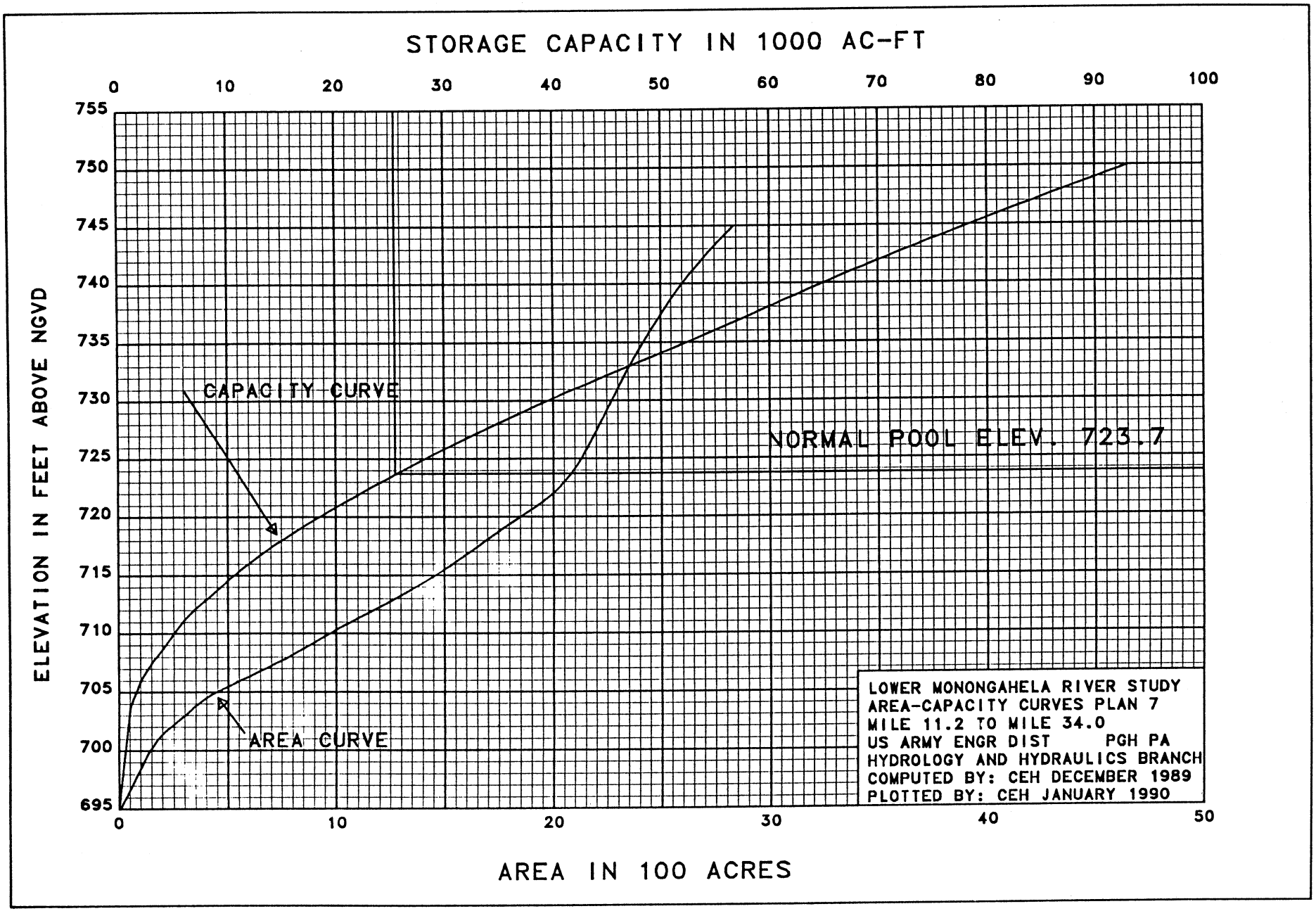
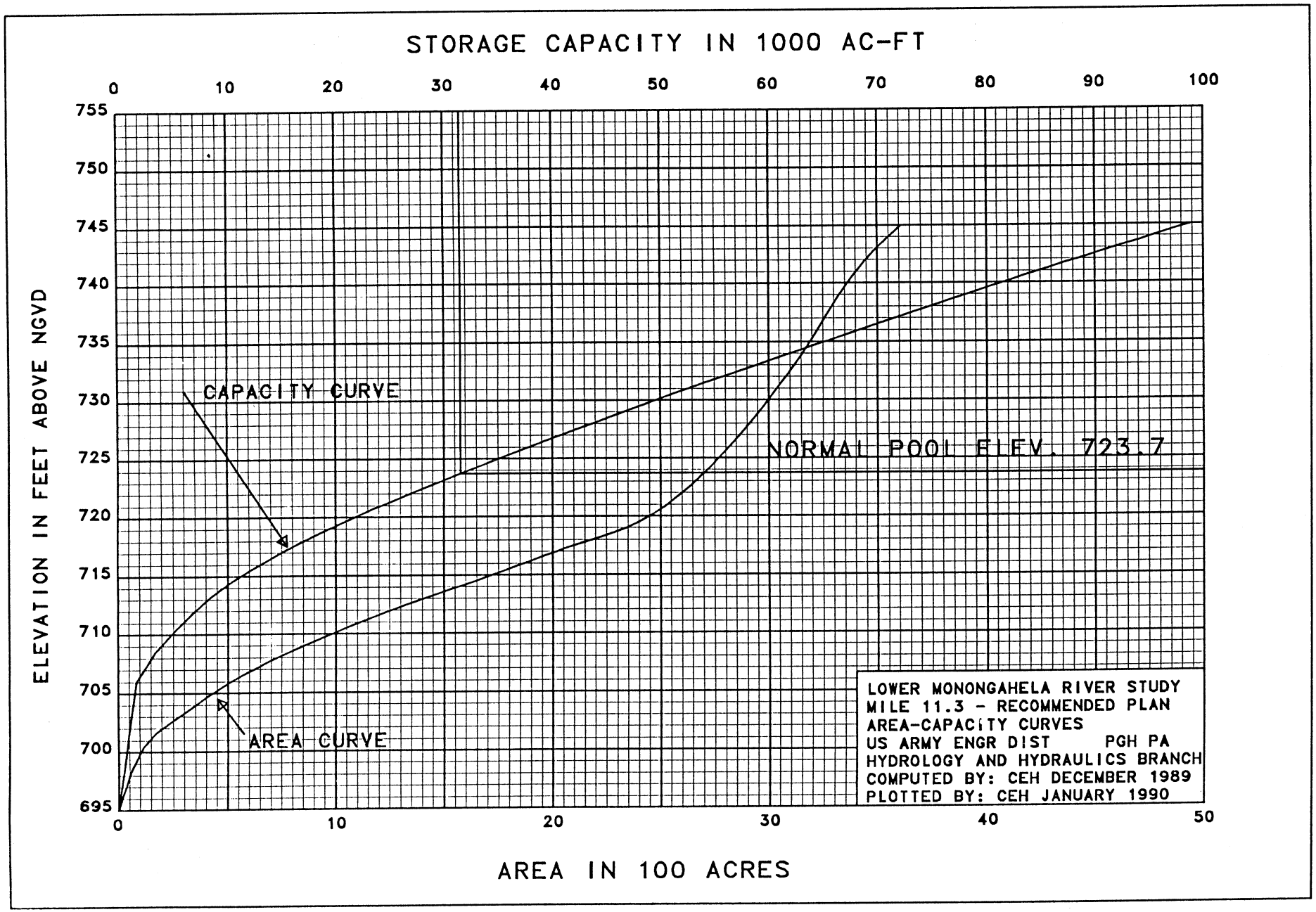

STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
90
100
ELEVATION IN FEET ABOVE NGVD
755
750
745
740
735
730
725
720
715
710
705
700
695
CAPACITY CURVE
AREA CURVE
NORMAL POOL ELEV. 723.7
LOWER MONONGAHELA RIVER STUDY
AREA-CAPACITY CURVES PLAN 7
MILE 11.2 TO MILE 34.0
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH JANUARY 1990
0
10
20
30
40
50
AREA IN 100 ACRES

PLATE 24


STORAGE CAPACITY IN 1000 AC-FT
0
10
20
30
40
50
60
70
80
90
100
ELEVATION IN FEET ABOVE NGVD
755
750
745
740
735
730
725
720
715
710
705
700
695
CAPACITY CURVE
NORMAL POOL ELEV. 723.7
AREA CURVE
LOWER MONONGAHELA RIVER STUDY
MILE 11.3 - RECOMMENDED PLAN
AREA-CAPACITY CURVES
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
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PLOTTED BY: CEH JANUARY 1990
0
10
20
30
40
50
AREA IN 100 ACRES

PLATE 25

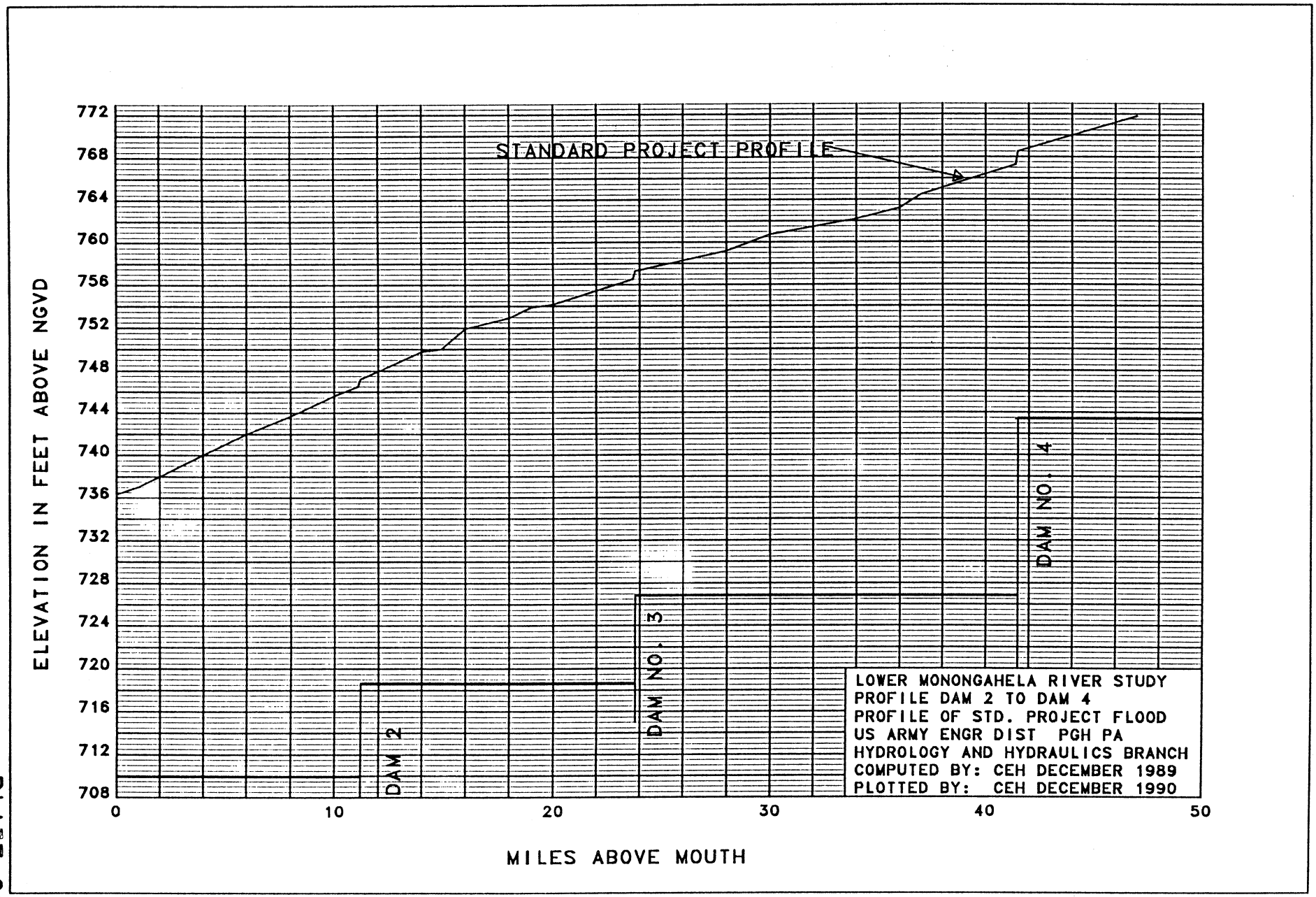
STANDARD PROJECT PROFILE
ELEVATION IN FEET ABOVE NGVD
772
768
764
760
756
752
748
744
740
736
732
728
724
720
716
712
708
0
10
20
30
40
50
MILES ABOVE MOUTH
DAM 2
DAM NO. 3
DAM NO. 4
LOWER MONONGAHELA RIVER STUDY
PROFILE DAM 2 TO DAM 4
PROFILE OF STD. PROJECT FLOOD
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1989
PLOTTED BY: CEH DECEMBER 1990

PLATE 26

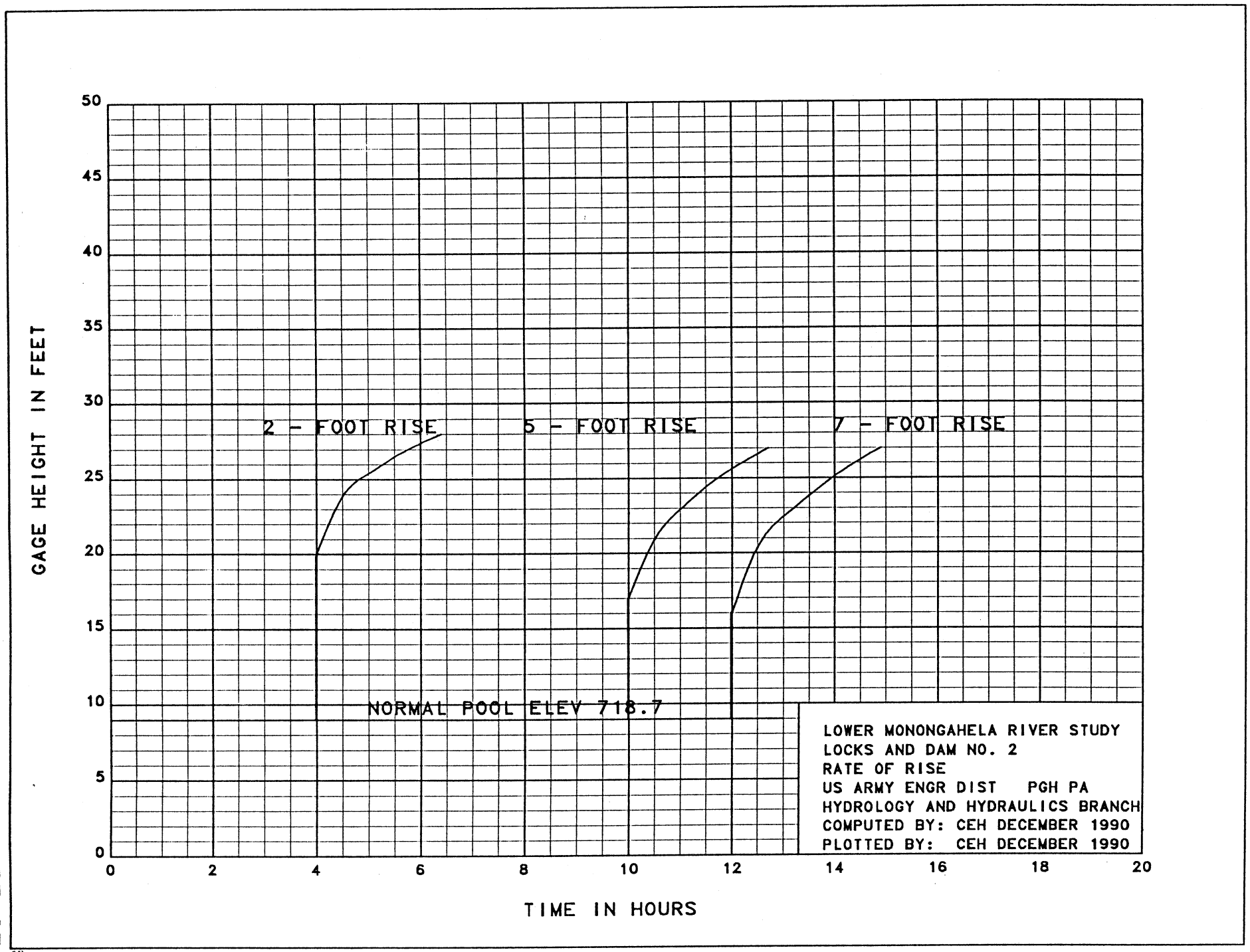
GAGE HEIGHT IN FEET
50
45
40
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
16
18
20
TIME IN HOURS
2 - FOOT RISE
5 - FOOT RISE
7 - FOOT RISE
NORMAL POOL ELEV 718.7
LOWER MONONGAHELA RIVER STUDY
LOCKS AND DAM NO. 2
RATE OF RISE
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1990
PLOTTED BY: CEH DECEMBER 1990

PLATE 27

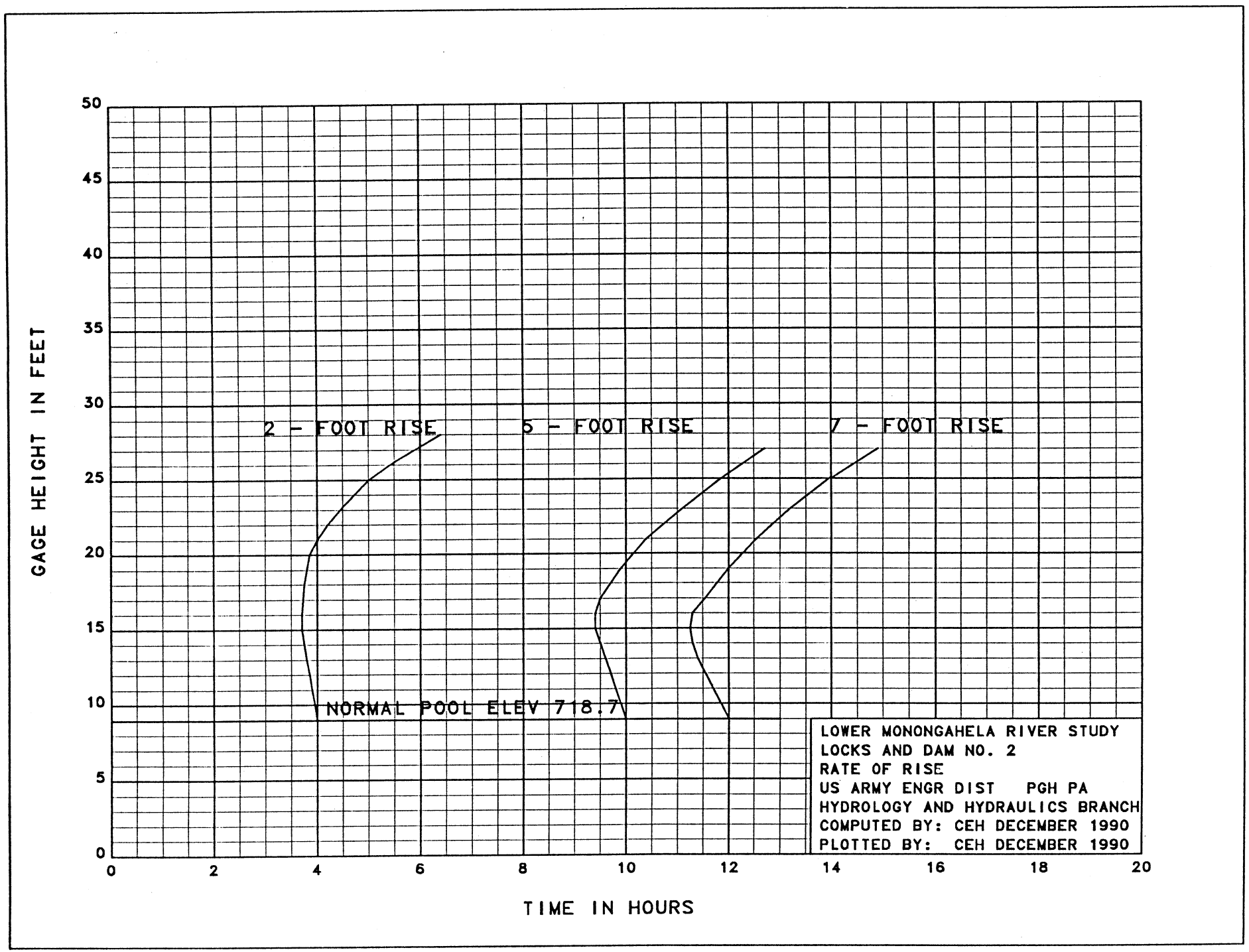
GAGE HEIGHT IN FEET
50
45
40
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
16
18
20
TIME IN HOURS
2 - FOOT RISE
5 - FOOT RISE
7 - FOOT RISE
NORMAL POOL ELEV 718.7
LOWER MONONGAHELA RIVER STUDY
LOCKS AND DAM NO. 2
RATE OF RISE
US ARMY ENGR DIST PGH PA
HYDROLOGY AND HYDRAULICS BRANCH
COMPUTED BY: CEH DECEMBER 1990
PLOTTED BY: CEH DECEMBER 1990

PLATE 28

LOWER MONONGAHELA RIVER
NAVIGATION SYSTEM STUDY

APPENDIX

COST ANALYSIS

U.S. Army Engineering District, Pittsburgh
Corps of Engineers
Pittsburgh, Pennsylvania

MONONGAHELA RIVER NAVIGATION SYSTEM
PENNSYLVANIA
LOCKS AND DAMS 2, 3 AND 4

COST ANALYSIS APPENDIX

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

PLAN DESCRIPTION

Without Project Condition

Rehabilitate the 110'x720' and 56'x360' locks at L/D 2, R.M. 11.2, and construct a new fixed crest dam. Replace the locks in kind (56'x720' and 56'x360') at L/D 3, R.M. 23.8, and construct a new fixed crest dam. Rehabilitate the 56'x720' and 56'x360' locks at L/D 4, R.M. 41.5, in the year 2002 and replace in kind in the year 2027.

Plan No. 1

Rehabilitate the 110'x720' and 56'x360' locks at L/D 2, R.M. 11.2, and construct a new gated dam. Raise Pool 2, five (5) feet. Remove L/D 3 at R.M. 23.8 and lower Pool 3, 3.2 feet. Construct twin 84'x720' locks at L/D 4, R.M. 41.5.

Plan No. 2

Rehabilitate the 110'x720' and 56'x360 locks at L/D 2, R.M. 11.2, and construct a new fixed crest dam. Construct twin 84'x720' locks and a fixed crest dam at R.M. 22.0 to replace L/D 3 at R.M. 23.8. Raise Pool 2, 8.2 feet from R.M. 22.0 to R.M. 23.8. Construct twin 84'x720' locks at L/D 4, R.M. 41.5.

Plan No. 3

Rehabilitate the 110'x720' and 56'x360' locks at L/D 2, R.M. 11.2, and construct a new fixed crest dam. Construct twin 84'x720' locks and a fixed crest dam at the existing site at L/D 3, R.M. 23.8. Construct twin 84'x720' locks at L/D 4, R.M. 41.5.

Plan No. 4

Rehabilitate the 110'x720' and 56'x360' locks at L/D 2, R.M. 11.2, and construct a new fixed crest dam. Construct twin 84'x720' locks and a fixed crest dam at R.M. 24.6 to replace L/D 3 at R.M. 23.8. Lower Pool 3, 8.2 feet from R.M. 23.8 to R.M. 24.6. Construct twin 84'x720' locks at L/D 4, R.M. 41.5.

Plan No. 5

Remove L/D 2 at R.M 11.2. Construct twin 84'x720' locks and a fixed crest dam at R.M. 22.2. Lower Pool 2, 8.7 feet from R.M. 11.2 to R.M. 22.2. Raise Pool 2, 8.2 feet from R.M. 22.2 to R.M. 23.8. Remove L/D 3 at R.M. 23.8. Construct twin 84'x720' locks at L/D 4, R.M. 41.5.

Plan No. 6

Rehabilitate the 110'x720' and 56'x360' locks at L/D 2, R.M. 11.2, and construct a new fixed crest dam. Remove L/D 3 at R.M. 23.8. Lower pool 3, 8.2 feet from R.M. 23.8 to R.M. 34.0. Construct twin 84'x720' locks and a gated dam at R.M. 34.0. Raise Pool 3, 16.6 feet from R.M. 34.0 to R.M. 41.5. Remove L/D 4 at R.M. 41.5.

Plan No. 7

Rehabilitate the 110'x720' and 56'x360' locks at L/D 2, R.M. 11.2, and construct a new gated dam. Raise Pool 2, five (5) feet. Remove L/D 3 at R.M. 23.8. Lower Pool 3, 3.2 feet from R.M. 23.8 to R.M. 34.0. Construct twin 84'x720' locks and a gated dam at R.M. 34.0. Raise Pool 3, 16.6 feet from R.M. 34.0 to R.M. 41.5. Remove L/D 4 at R.M. 41.5.

LOWER MONONGAHELA RIVER NAVIGATION STUDY
(October 1991 Cost Level)
FINAL SCREENING LEVEL ESTIMATES

CODE OF ACCOUNT	DESCRIPTION	W/O PLAN	PLAN 1*	PLAN 2	PLAN 3	PLAN 4	PLAN 5	PLAN 6	PLAN 7
		<----------	----------	(All costs shown are in $1,000's of dollars.)	----------	----------	----------	----------	---------->
01	LANDS AND DAMAGES **	$7,900	$3,100	$83,900	$7,900	$4,300	$83,900	$5,300	$5,700
02	RELOCATIONS								
	Utilities	$0	$10,915	$0	$0	$0	$0	$0	$0
	Structures	$0	$460	$2,250	$0	$0	$5,235	$39,905	$43,527
	Railroad	$0	$19,260	$0	$0	$0	$562	$670	$19,930
	Highway	$0	$0	$400	$0	$0	$707	$28,874	$29,874
	Major Storm Sewers	$0	$1,230	$850	$0	$0	$850	$140,770	$165,245
03	RESERVOIRS								
	Remove L/D #2	$0	$0	$0	$0	$0	$9,660	$0	$0
	Remove L/D #3	$0	$7,000	$7,000	$0	$7,000	$7,000	$7,000	$7,000
	Remove L/D #4	$0	$0	$0	$0	$0	$0	$10,432	$10,432
04	DAMS								
	Gated Dam at L/D #2	$0	$98,000	$0	$0	$0	$0	$0	$98,000
	Fixed Crest Dam at L/D #2	$28,583	$0	$28,583	$28,583	$28,583	$0	$28,583	$0
	Fixed Crest Dam at L/D #3	$36,876	$0	$0	$33,910	$0	$0	$0	$0
	Modify Dam(W/ Lock 4 Contract)	$0	$2,200	$2,200	$2,200	$2,200	$2,200	$0	$0
	Gated Dam at alternate site	$0	$0	$0	$0	$0	$0	$52,541	$52,541
	Fixed Crest Dam at alt. site	$0	$0	$26,024	$0	$49,138	$26,146	$0	$0
05	LOCKS								
	Rehab Locks at L/D #2	$40,000	$40,000	$40,000	$40,000	$40,000	$0	$40,000	$40,000
	Floodway Bulkhead at L/D #2	$3,600	$3,600	$3,600	$3,600	$3,600	$0	$3,600	$3,600
	Modify Locks(With Dam Contract)	$0	$11,300	$0	$0	$0	$0	$0	$11,300
	Twin 84x720 at L/D #3	$0	$0	$0	$168,028	$0	$0	$0	$0
	Replace L/D #3 in kind	$119,980	$0	$0	$0	$0	$0	$0	$0
	Twin 84x720 at L/D #4	$0	$184,000	$184,000	$184,000	$184,000	$184,000	$0	$0
	Rehab Locks at L/D #4	$30,736	$0	$0	$0	$0	$0	$0	$0
	Replace L/D #4 in kind	$134,488	$0	$0	$0	$0	$0	$0	$0
	Twin 84x720 at alternate site	$0	$0	$96,024	$0	$126,267	$94,629	$102,930	$102,930
06	FISH AND WILDLIFE FACILITIES	$800	$1,200	$650	$800	$1,400	$1,200	$1,200	$1,200
09	CHANNELS AND CANALS	$0	$27,000	$0	$0	$0	$39,200	$45,600	$2,850
16	BANK STABILIZATION	$0	$4,315	$453	$0	$0	$453	$647	$4,436
18	CULTURAL RESOURCES	$1,280	$780	$930	$1,280	$1,280	$930	$1,380	$1,380
20	PERMANENT OPERATING EQUIPMENT	$486	$325	$486	$486	$486	$325	$325	$325
30	PLANNING, ENGINEERING AND DESIGN	$40,150	$32,220	$36,640	$42,450	$40,995	$37,937	$86,868	$93,725
31	CONSTRUCTION MANAGEMENT	$30,060	$42,085	$27,467	$31,800	$30,710	$28,431	$65,125	$71,267
	CONTINGENCIES	$264,342	$134,468	$214,213	$245,951	$211,995	$246,110	$600,884	$623,920
SUBTOTAL, FEDERAL COSTS		$739,281	$623,458	$755,670	$790,988	$731,954	$769,103	$1,262,631	$1,388,222
SUBTOTAL, NON-FEDERAL COSTS		$0	$111,217	$1,570	$0	$10,274	$83,944	$100,275	$114,452
TOTAL, FEDERAL AND NON-FEDERAL COSTS		$739,281	$734,675	$757,240	$790,988	$742,228	$853,047	$1,362,906	$1,502,674

* Refer to Engineering Technical Appendix for detailed estimates.

** Refer to Real Estate Appendix for detailed estimates.

LOWER MONONGAHELA RIVER NAVIGATION STUDY
(October 1991 Cost Level)
FINAL SCREENING LEVEL ESTIMATES

CODE OF ACCOUNT	DESCRIPTION	W/O PLAN COST	W/O PLAN CONT.	PLAN 1 COST	PLAN 1 CONT.	PLAN 4 COST	PLAN 4 CONT.
		<----------(All costs shown are in $1,000's of dollars.)---------->					
01	LANDS AND DAMAGES	$7,900	$2,100	$3,100	$800	$4,300	$1,100
02	RELOCATIONS						
	Utilities	$0	$0	$10,915	$10,350	$0	$0
	Structures	$0	$0	$460	$225	$0	$0
	Railroad	$0	$0	$19,260	$5,740	$0	$0
	Major Storm Sewers	$0	$0	$1,230	$620	$0	$0
03	RESERVOIRS						
	Remove L/D #3	$0	$0	$7,000	$2,000	$7,000	$2,000
04	DAMS						
	Gated Dam at L/D #2	$0	$0	$98,000	$28,000	$0	$0
	Fixed Crest Dam at L/D #2	$28,583	$20,350	$0	$0	$28,583	$20,350
	Fixed Crest Dam at L/D #3	$36,876	$26,559	$0	$0	$0	$0
	Modify Dam(W/ Lock 4 Contract)	$0	$0	$2,200	$500	$2,200	$500
	Fixed Crest Dam at alt. site	$0	$0	$0	$0	$49,138	$36,576
05	LOCKS						
	Rehab Locks at L/D #2	$40,000	$15,000	$40,000	$15,000	$40,000	$15,000
	Floodway Bulkhead at L/D #2	$3,600	$1,500	$3,600	$1,500	$3,600	$1,500
	Modify Locks(With Dam Contract)	$0	$0	$11,300	$2,900	$0	$0
	Replace L/D #3 in kind	$119,980	$84,344	$0	$0	$0	$0
	Twin 84x720 at L/D #4	$0	$0	$184,000	$46,000	$184,000	$46,000
	Rehab Locks at L/D #4	$30,736	$15,009	$0	$0	$0	$0
	Replace L/D #4 in kind	$134,488	$81,047	$0	$0	$0	$0
	Twin 84x720 at alternate site	$0	$0	$0	$0	$126,267	$69,996
06	FISH AND WILDLIFE FACILITIES	$800	$120	$1,200	$200	$1,400	$360
09	CHANNELS AND CANALS	$0	$0	$27,000	$6,000	$0	$0
16	BANK STABILIZATION	$0	$0	$4,315	$1,185	$0	$0
18	CULTURAL RESOURCES	$1,280	$640	$780	$390	$1,280	$640
20	PERMANENT OPERATING EQUIPMENT	$486	$121	$325	$80	$486	$121
30	PLANNING, ENGINEERING AND DESIGN	$40,150	$10,040	$32,220	$10,680	$40,995	$10,209
31	CONSTRUCTION MANAGEMENT	$30,060	$7,512	$42,085	$2,298	$30,710	$7,643
SUBTOTAL, FEDERAL COSTS		$474,939	$264,342	$488,990	$134,468	$519,959	$211,995
SUBTOTAL, NON-FEDERAL COSTS		$0		$111,217		$10,274	
TOTAL, FEDERAL AND NON-FEDERAL COSTS		$739,281		$734,675		$742,228	

EXPLANATION OF CONTINGENCIES

Individual Contingencies for each line item were determined by Cost Engineering Branch with the concurrence of the District element responsible for the design quantities. In scenarios where the prepared M-CACES cost estimate was utilized to reflect the actual developed cost, contingences are reflected as such and explained in the Engineering Technical Appendix, Cost Estimates. A 40% contingency was applied to the other developed costs where confidence in the design, quantities, and unit cost for this level of project scope was determined to be average. Mobilization and Preparatory Work, Cofferdams and Cofferdam Instrumentation were given a 100% contingency due to the uncertain nature of this work. Justification for any deviations from these basic percentages are included on a line-by-line basis below.

LOCKS AND DAMS

R.M. 11.3, Replace L/D 2 Fixed Crest Dam; Plans 2,3,4,6 & Without Project

04.2.D.B. Excavation, Common. The district has reason to believe that a portion of the material excavated from the river banks (not all common excavation) may be contaminated to some degree requiring special treatment in a separate disposal area located away from any potable water sources. Further investigation is required to determine the exact extent of contamination, and the specific location and treatment of a suitable disposal area. This estimate includes costs for unloading the material from barge into truck and hauling as much as 25 miles away from the river. The 100% contingency covers any special treatment of the D.A. such as construction of a clay layer or any yet unknown more stringent requirements. This contingency was used for all dam common excavation.

04.2.D.B. Excavation, Rock. A 100% contingency was used to cover uncertainties in quantities at all new sites since limited subsurface investigations could be performed at the screening level.

04.2.D.B. Presplitting. A 100% contingency was used for the same reasons as explained above for Rock Excavation.

R.M. 22.2, Replace L/D 3 @ New Location; Plan 2

05.0.D.B. Excavation, Rock. A 100% contingency was used to cover uncertainties in quantities at all new sites since limited subsurface investigations could be performed at the screening level.

05.0.D.B. Presplitting. A 100% contingency was used for the same reasons as explained above for Rock Excavation.

5.0.E.B. Foundation Drilling. A 70% contingency was used to cover uncertainties in quantities. Actual quantities are dependent on field conditions.

12.0.4.B. Modify Approach Channel, Dredging. A 300% contingency was applied because of uncertainty in the quantities.

R.M. 22.2, Construct Fixed Crest Dam; Plan 2

The contingency percentages are similar to those for the previous dam estimates.

R.M. 22.2, Replace L/D 2 & 3, Construct 2 New Lock Chambers; Plan 5

The contingency percentages are similar to those for R.M. 22.2, Replace L/D 3 @ new location; Plan 2.

R.M. 22.2, Construct Fixed Crest Dam; Plan 5

The contingency percentages are similar to those for the previous dam estimates.

R.M. 23.8, Replace Lock Chambers "In Kind"; Plan Without Project

05.0.E.B. Strut Existing River Chamber. This is necessary since traffic will be maintained through the existing Land chamber while the new River chamber is being replaced. Although the estimate is based upon similar work done by CEORPOR-M recently at Pt Marion Lock, further investigation may produce unknown complications and hidden costs here since the new middle wall will be constructed while the struts are in place. Therefore, a contingency of 100% was used.

05.0.1.B. Modify Approach Channel, Rock/Gravel Fill. A 50% contingency was applied because of uncertainty in the quantities.

05.0.7.Q. and 05.0.8.R. Piping and Power and Lighting Systems. A contingency of 50% was used for all of these items to account for additional costs for temporary connections and possibly temporary equipment to maintain traffic through the Land chamber or River chamber during construction.

12.0.4.B. Modify Approach Channel Dredging. A 300% contingency was used to account for the possibility of potentially contaminated material. Since all of the approach dredging is located near the river bank all of this material is assumed to be potentially contaminated therefore a 300% contingency (instead of 100%) was used.

R.M. 23.8, Replace Fixed Crest Dam; Plan Without Project

The contingency percentages are similar to those for the previous dam estimates.

R.M. 23.8, Replace L/D 3 @ Existing Location; Plan 3

05.0.D.B. Excavation, Rock. A 100% contingency was used to cover uncertainties in quantities at all new sites since limited subsurface investigations could be performed at the screening level.

05.0.D.B. Presplitting. A 100% contingency was used for the same reasons as explained above for Rock Excavation.

05.0.E.B. Stabilize Existing Lock Structure. This is necessary since traffic will be maintained through the existing Land chamber while the new River chamber is being replaced. This estimate is based upon the installation of rock anchors similar to what has been done in Pittsburgh District Rehabilitation jobs however, since no detailed analysis could be done at the screening level a contingency of 100% was used to cover any quantity increases in the final design and construction.

5.0.E.B. Foundation Drilling. A 70% contingency was used to cover uncertainties in quantities. Actual quantities are dependent on field conditions.

12.0.4.B. Modify Approach Channel Dredging. Similar to explanation above for Approach Channel Dredging @ R.M. 23.8 for Lock 3.

R.M. 23.8, Replace Fixed Crest Dam; Plan 3

The contingency percentages are similar to those for the previous dam estimates.

R.M. 24.6, Replace L/D 3 @ New Location; Plan 4

The contingency percentages are similar to those for R.M. 22.2, Replace L/D 3 @ new location; Plan 2.

R.M. 24.6, Construct Fixed Crest Dam; Plan 4

The contingency percentages are similar to those for the previous dam estimates.

R.M. 34.0, Replace L/D 3 & 4 @ New Location; Plans 6 & 7

05.0.D.B. Excavation, Rock. A 100% contingency was used to cover uncertainties in quantities at all new sites since limited subsurface investigations could be performed at the screening level.

05.0.D.B. Presplitting. A 100% contingency was used for the same reasons as explained above for Rock Excavation.

12.0.4.B. Modify Approach Channel, Dredging. A 300% contingency was applied because of uncertainty in the quantities.

R.M. 34.0, Construct New Gated Dam; Plans 6 & 7

The contingency percentages are similar to those for the previous dam estimates.

R.M. 41.5, Major Rehab of Locks Only @ L/D 4; Plan Without Project

05.0.4.B. Remove Concrete, Pipe Galleries. A contingency of 50% was used because of uncertainties in the final quantities due to the actual extent of the deterioration. Also this type of extensive concrete removal and repair has not been done in the Pittsburgh District at a navigation lock before.

05.0.4.C. Concrete, Pipe Galleries. A contingency of 50% was used because of the same type of uncertainties in quantities as described above however, the unit price for placement of the concrete is more reliable than the concrete removal unit price.

05.0.4.C. Remove & Replace 12" Top Concrete, all Sills LC & RC. A contingency of 50% was used because of the possibility of more extensive deterioration requiring more extensive repairs.

05.0.7.Q. Temporary Diversion of Piping LW, MW, RW, & Esplanade. A contingency of 100% was used because the exact design of this temporary diversion was not known at the screening level.

R.M. 41.5, Replace Lock Chambers "In Kind"; Plan Without Project

05.0.E.B. Strut Existing River Chamber. This is necessary since traffic will be maintained through the existing Land chamber while the new River chamber is being replaced. Although the estimate is based upon similar work done by CEORPOR-M recently at Pt Marion Lock, further investigation may produce unknown complications and hidden costs here since the new middle wall will be constructed while the struts are in place. Therefore, a contingency of 100% was used.

05.0.E.B. Predrilled Concrete Caissons 4 FT. Diameter. No structural analysis has been performed and we have not used caissons recently in the district so a 70% contingency percentage was applied.

05.0.E.B. Foundation Drilling. A 70% contingency was used to cover uncertainties in quantities. Actual quantities are dependent on field conditions.

05.0.1.B. Modify Approach Channel, Rock/Gravel Fill. A 50% contingency was applied because of uncertainty in the quantities.

05.0.7.Q. and 05.0.8.R. Piping and Power and Lighting Systems. A contingency of 50% was used for all of these items to account for additional costs for temporary connections and possibly temporary equipment to maintain traffic through the Land chamber or River chamber during construction.

04.1.3.B. Dam Scour Protection. A 100% contingency was applied because of uncertainty in the quantities.

12.0.4.B. Modify Approach Channel, Dredging. A 300% contingency was applied because of uncertainty in the quantities.

DREDGING

Screening Level Dredging; Plans 5,6 & 7

A contingency of 150% was used for all the dredging estimates because the quantities were based upon sounding data that was not recent.

RELOCATIONS; RAILROAD AND HIGHWAY BRIDGES

Plan 5; Railroad Bridge

A contingency of 100% was applied for this railroad bridge since no specific quantity breakdowns were obtained and the exact design was not known at the screening level.

Plans 6 & 7; Highway Bridge

A contingency of 75% was used for this bridge estimate since the screening level estimates were based upon similar work done nearby within the state of Pennsylvania by the Department of Transportation, however no detailed quantities were obtained.

PERMANENT OPERATING EQUIPMENT

A contingency of 25% was applied due to the detailed information received from the functional chief responsible for this item of work, and that these are standard items with little variability.

FISH AND WILDLIFE FACTILITIES

A 15 - 25% contingency was determined to be sufficient for this part of the project.

CULTURAL RESOURCES MANAGEMENT

The 50% contingency was determined by the functional chief responsible for this part of the project and included hired labor and contracts, based on the assumed scope of work anticipated.

RELOCATIONS; MAJOR STORM SEWERS

A contingency of 200% was applied to the detailed costs estimated for all major storm sewers at the screening level because quantities were based on limited field visits and 1940's topography maps which do not necessarily reflect what is in existence today. More recent aerial photos (1980's) were not used because they and the topo maps did not coincide in the majority of sites.

RELOCATIONS; MUNICIPAL FACILITIES AND SUBMARINE CROSSINGS

A contingency of 200% was applied to all of these screening level estimates because they were obtained primarily from the owners and the basis and quality of each estimate is subject to variability.

LOWER MON NAVIGATION STUDY
RM 11.2, CONSTRUCTION OF GATED DAM
(OCTOBER 1991 PRICE LEVEL)
Plans 1 & 7

	DESCRIPTION	QUANTITY	UNIT	WITHOUT OVERHEAD & PROFIT PLANT	LABOR	MATERIALS	UNIT PRICE INCLUDING ALL OH&P (ROUNDED)	TOTAL AMOUNT	CONTI GENCY	TOTAL AMOUNT INCL CONT.
04.2.-.-	SPILLWAY DAM									
04.2.A.-	MOBILIZATION AND PREPARATORY WORK	1	JOB	$914,801	$1,359,956	$3,829,758	$7,300,000.00	$7,300,000.00	25%	$9,125,000.00
04.2.B.-	CARE AND DIVERSION OF WATER									
04.2.B.B	Cofferdams	1	JOB	$5,744,856	$4,527,140	$8,041,102	$21,250,000.00	$21,250,000.00	25%	$26,562,500.00
04.2.B.B	Cofferdam Overtopping	1	JOB	$0	$0	$320,000	$320,000.00	$320,000.00	25%	$400,000.00
04.2.B.Q	Cofferdam Instrumentation	1	JOB	$13,995	$165,891	$301,620	$600,000.00	$600,000.00	25%	$750,000.00
04.2.D.-	EARTHWORK FOR STRUCTURES									
04.2.D.B	Expl Drilling, Mobilization & Demobilization	1	JOB	$1,824	$1,422	$0	$4,600.00	$4,600.00	25%	$5,750.00
04.2.D.B	Expl Drilling, Drilling Without Coring	900	LF	$10,258	$7,996	$0	$25.00	$22,500.00	25%	$28,125.00
04.2.D.B	Expl Drilling, Core Drilling, 4" Dia Cores	1,200	LF	$27,354	$21,323	$0	$55.00	$66,000.00	25%	$82,500.00
04.2.D.B	Expl Drilling, Seal Exploration Holes w/Cement	1,500	CWT	$1,691	$14,941	$6,000	$20.00	$30,000.00	25%	$37,500.00
04.2.D.B	Erosion Control at the Disposal Area	1	JOB	$115,672	$348,934	$677,186	$1,400,000.00	$1,400,000.00	25%	$1,750,000.00
04.2.D.B	Clearing and Grubbing	3	ACRE	$1,019	$4,557	$0	$2,200.00	$6,600.00	25%	$8,250.00
04.2.D.B	Stripping	3,900	CY	$2,786	$7,230	$0	$3.00	$11,700.00	25%	$14,625.00
04.2.D.B	Excavation, Common	200,900	CY	$1,302,098	$954,726	$0	$13.00	$2,611,700.00	25%	$3,264,625.00
04.2.D.B	Excavation, Rock	30,400	CY	$229,044	$291,900	$27,200	$22.00	$668,800.00	25%	$836,000.00
04.2.D.B	Presplitting, Line Drilling	54,400	SF	$30,864	$90,496	$33,968	$3.00	$163,200.00	25%	$204,000.00
04.2.D.B	Pervious Backfill, Gated Dam & Abutment	3,100	CY	$2,953	$6,080	$46,500	$21.00	$65,100.00	25%	$81,375.00
04.2.D.B	Random Backfill, Gated Dam & Abutment	22,300	CY	$38,626	$66,988	$0	$6.00	$133,800.00	25%	$167,250.00
04.2.D.B	Impervious Backfill, Gated Dam & Abutment	770	CY	$1,321	$1,938	$4,620	$12.00	$9,240.00	25%	$11,550.00
04.2.D.B	Select Rock Fill at Abutment	5,900	CY	$5,719	$11,026	$118,000	$27.00	$159,300.00	25%	$199,125.00
04.2.D.B	Stone Protection at Abutment	3,100	CY	$11,983	$10,434	$52,836	$30.00	$93,000.00	25%	$116,250.00
04.2.D.B	Choke Material at Abutment	1,600	CY	$2,357	$4,940	$24,000	$23.00	$36,800.00	25%	$46,000.00
04.2.D.B	Dredging Above and Below the Dam	489,400	CY	$2,264,750	$1,824,171	$0	$11.00	$5,383,400.00	75%	$9,420,950.00
04.2.D.B	Derrickstone, 2.7 foot diameter	21,800	CY	$105,684	$79,230	$463,100	$40.00	$872,000.00	25%	$1,090,000.00
04.2.D.B	Derrickstone, 1.5 foot diameter	61,400	CY	$297,794	$223,135	$1,167,270	$38.00	$2,333,200.00	25%	$2,916,500.00
04.2.D.B	Filter Material	29,700	CY	$75,039	$47,696	$466,988	$26.00	$772,200.00	25%	$965,250.00

04.2.E.-	FOUNDATION WORK									
04.2.E.B	Foundation Prep, Primary Clean-up	5,100	SY	$7,456	$65,080	$0	$18.00	$91,800.00	25%	$114,750.00
04.2.E.B	Foundation Prep, Final Clean-up	4,110	SY	$9,811	$92,265	$0	$30.00	$123,300.00	25%	$154,125.00
04.2.E.B	Foundation Prep, Protective Coating for Rock	54,400	SF	$3,368	$17,865	$9,792	$1.00	$54,400.00	25%	$68,000.00
04.2.E.B	Foundation Prep, Temporary Earth Cover	4,110	SY	$3,881	$13,411	$0	$5.00	$20,550.00	25%	$25,687.50
04.2.E.C	Foundation Prep, Dental Treatment, Mortar	5	CY	$836	$4,640	$215	$1,400.00	$7,000.00	25%	$8,750.00
04.2.E.C	Foundation Prep, Dental Treatment, Mortar	15	CY	$2,509	$13,919	$645	$1,400.00	$21,000.00	25%	$26,250.00
04.2.E.C	Foundation Prep, Dental Treatment, Concrete	50	CY	$2,987	$16,570	$2,150	$500.00	$25,000.00	25%	$31,250.00
04.2.E.C	Foundation Prep, Dental Treatment, Concrete	150	CY	$8,961	$49,709	$6,450	$500.00	$75,000.00	25%	$93,750.00
04.2.E.C	Foundation Grouting	3,800	CY	$110,789	$607,845	$415,220	$350.00	$1,330,000.00	25%	$1,662,500.00
04.2.E.C	H-piles	26,800	LF	$165,935	$696,542	$303,871	$50.00	$1,340,000.00	25%	$1,675,000.00
04.2.E.C	Steel Sheet Piling w/Anchors	23,400	SF	$1,207,799	$1,468,065	$987,620	$190.00	$4,446,000.00	25%	$5,557,500.00
04.2.E.C	Steel Sheet Piling, Dam Cutoff Wall	9,200	LF	$15,800	$19,681	$137,115	$22.00	$202,400.00	25%	$253,000.00
04.2.2.-	CONCRETE OVERFLOW SECTION									
04.2.2.C	Conc Gravity Sect- < El. 678.7, Pier Monolith	21,000	CY	$374,089	$1,120,415	$873,002	$135.00	$2,835,000.00	25%	$3,543,750.00
04.2.2.C	Conc Gravity Sect- > El. 678.7, Pier Ovrflow Sect	5,910	CY	$112,093	$359,532	$247,879	$145.00	$856,950.00	25%	$1,071,187.50
04.2.2.C	Conc Gravity Sect- < El. 678.7, Abutment	8,630	CY	$153,748	$460,570	$357,655	$135.00	$1,165,050.00	25%	$1,456,312.50
04.2.2.C	Conc Gravity Sect- > El. 678.7, Abutment	6,630	CY	$126,794	$425,796	$278,982	$150.00	$994,500.00	25%	$1,243,125.00
04.2.2.C	Conc Gravity Sect- > El. 678.7, Abut Ovrflow Sect	830	CY	$16,198	$54,176	$35,181	$155.00	$128,650.00	25%	$160,812.50
04.2.2.C	Conc Gravity Sect- < El. 678.7, Abut. Ext.	2,640	CY	$47,207	$141,715	$109,613	$135.00	$356,400.00	25%	$445,500.00
04.2.2.C	Conc Gravity Sect- > El. 678.7, Abut. Ext.	2,730	CY	$48,357	$143,013	$113,213	$135.00	$368,550.00	25%	$460,687.50
04.2.2.C	Concrete-Abutment Cut-off Wall	880	CY	$16,785	$54,839	$37,021	$145.00	$127,600.00	25%	$159,500.00
04.2.2.C	Concrete-Slurry Wall beyond Cut-off	1,290	CY	$16,698	$29,749	$77,100	$120.00	$154,800.00	100%	$309,600.00
04.2.2.C	Concrete-Fixed Weir, Overflow Section	5,640	CY	$107,918	$343,842	$236,852	$145.00	$817,800.00	25%	$1,022,250.00
04.2.2.C	Concrete-Gate Bays, Overflow Section	19,100	CY	$363,295	$1,194,283	$796,521	$150.00	$2,865,000.00	25%	$3,581,250.00
04.2.2.C	Concrete-Gated Dam Piers, Pier Concrete	15,400	CY	$349,361	$1,026,847	$643,063	$160.00	$2,464,000.00	25%	$3,080,000.00
04.2.2.C	Concrete-Gated Dam Piers, High Strength	2,780	CY	$63,202	$186,021	$130,947	$165.00	$458,700.00	25%	$573,375.00
04.2.2.C	Conc in Recesses to Install Embedded Metal	320	CY	$13,754	$45,255	$14,116	$275.00	$88,000.00	25%	$110,000.00
04.2.2.C	Concrete, Miscellaneous	100	CY	$4,227	$12,054	$4,264	$250.00	$25,000.00	25%	$31,250.00
04.2.2.C	Portland Cement	770,500	CWT	$0	$0	$3,082,000	$5.00	$3,852,500.00	25%	$4,815,625.00
04.2.2.C	Pozzolan, Gated Dam & Appurtenances	127,430	CF	$0	$0	$89,198	$1.00	$127,430.00	25%	$159,287.50
04.2.2.C	Drill Holes and Grout Dowels	15,730	LF	$195,733	$156,348	$7,865	$28.00	$440,440.00	25%	$550,550.00
04.2.2.C	Steel Reinforcement, Dowels	200,240	LBS	$0	$0	$50,060	$0.40	$80,096.00	25%	$100,120.00
04.2.2.C	Steel Reinforcement, Rebar	2,873,000	LBS	$34,663	$277,274	$731,433	$0.50	$1,436,500.00	25%	$1,795,625.00
04.2.2.C	Waterstops, Gated Dam	670	LF	$129	$6,371	$8,033	$26.00	$17,420.00	25%	$21,775.00
04.2.3.-	APRON, STILLING BASIN AND DEFLECTORS									
04.2.3.B	Remove Existing Dam - Wood, Stone, & Fill	2,400	CY	$27,066	$56,603	$0	$50.00	$120,000.00	50%	$180,000.00
04.2.3.C	Remove Existing Dam - Concrete	9,620	CY	$189,194	$373,138	$32,444	$90.00	$865,800.00	25%	$1,082,250.00

04.2.3.C	Conc Gravity Sect- > El. 678.7, Abut Stlg Bsn Sect	630	CY	$12,422	$41,309	$26,838	$155.00	$97,650.00	25%	$122,062.50
04.2.3.C	Conc Gravity Sect- > El. 678.7, Pier Stlg Bsn Sect	3,570	CY	$68,392	$230,195	$150,264	$150.00	$535,500.00	25%	$669,375.00
04.2.3.C	Concrete-Gate Bays, Stilling Basin Section	11,680	CY	$250,882	$672,240	$483,695	$145.00	$1,693,600.00	25%	$2,117,000.00
04.2.3.C	Concrete-Fixed Weir, Stilling Basin Section	3,110	CY	$66,669	$219,005	$131,695	$160.00	$497,600.00	25%	$622,000.00
04.2.2.C	Concrete-Baffles	490	CY	$15,824	$47,591	$20,916	$210.00	$102,900.00	25%	$128,625.00
04.2.4.-	EMBEDDED METAL WORK									
04.2.4.E	Test Recesses & Embedded Metal Emerg Blkhd	1	JOB	$967	$5,330	$0	$7,500.00	$7,500.00	25%	$9,375.00
04.2.4.E	Dam Emerg Blkhd Embedded Metal Recess & Sills	1	JOB	$31,356	$77,874	$324,040	$520,000.00	$520,000.00	25%	$650,000.00
04.2.4.E	Doors and Frames, Piers 1 and 6	1	JOB	$322	$1,777	$850	$3,500.00	$3,500.00	25%	$4,375.00
04.2.4.E	Downstream Bulkhead Embedded Metal	1	JOB	$23,517	$58,406	$13,950	$115,000.00	$115,000.00	25%	$143,750.00
04.2.4.E	Bridge and Pier Handrailing	1	JOB	$322	$1,777	$2,649	$5,700.00	$5,700.00	25%	$7,125.00
04.2.4.E	Swinging Walkways	1	JOB	$484	$6,382	$7,360	$17,000.00	$17,000.00	50%	$25,500.00
04.2.4.E	Misc Metal for Doors and Frames	50,700	LBS	$22,630	$90,455	$101,400	$5.00	$253,500.00	25%	$316,875.00
04.2.4.Q	Common Water and Air Pipeline	1	JOB	$1,714	$13,146	$5,812	$30,000.00	$30,000.00	25%	$37,500.00
04.2.5.-	GATES, STOPLOGS AND EQUIPMENT									
04.2.5.E	Tainter Gate, Furnish and Install	5	EACH	$305,646	$753,885	$5,725,726	$1,650,000.00	$8,250,000.00	25%	$10,312,500.00
04.2.5.E	Tainter Gate Anchorage & Trunnion Girders	1	JOB	$246,938	$373,912	$497,280	$1,350,000.00	$1,350,000.00	25%	$1,687,500.00
04.2.5.E	Tainter Gate Embedded Metals Sills & Side Sills	1	JOB	$57,332	$133,679	$200,326	$470,000.00	$470,000.00	25%	$587,500.00
04.2.5.E	Tainter Gate Operating Machinery	1	JOB	$204,231	$599,782	$2,500,020	$4,000,000.00	$4,000,000.00	25%	$5,000,000.00
04.2.5.P	Bulkhead Dogging Assembly	1	JOB	$15,678	$38,937	$65,613	$145,000.00	$145,000.00	25%	$181,250.00
04.2.R.-	ASSOCIATED GENERAL ITEMS									
04.2.R.B	Government Field Office	1	JOB	$10,788	$84,880	$188,383	$350,000.00	$350,000.00	25%	$437,500.00
04.2.R.B	Project Information Sign	1	JOB	$13	$536	$1,000	$2,000.00	$2,000.00	25%	$2,500.00
04.2.R.C	Machinery Houses	1	JOB	$7,554	$86,145	$53,380	$180,000.00	$180,000.00	25%	$225,000.00
04.2.R.E	Service Bridge	1	JOB	$122,312	$427,352	$3,831,445	$5,300,000.00	$5,300,000.00	25%	$6,625,000.00
04.2.R.P	Maintenance Bulkhead Crane	1	JOB	$0	$0	$310,000	$370,000.00	$370,000.00	25%	$462,500.00
04.2.R.R	Power and Lighting System	1	JOB	$39,717	$481,743	$382,326	$1,300,000.00	$1,300,000.00	25%	$1,625,000.00
05.-.-.-	LOCKS									
05.0.1.-	APPROACH CHANNELS									
05.0.1.B	Construct Dikes- Random Rock Fill	4,200	CY	$10,081	$22,382	$0	$10.00	$42,000.00	25%	$52,500.00
05.0.1.B	Construct Dikes- Graded Riprap	18,000	CY	$27,039	$60,343	$306,646	$35.00	$630,000.00	25%	$787,500.00
05.0.1.B	Construct Dikes- Underwater Excavation	5,700	CY	$29,140	$27,001	$0	$12.00	$68,400.00	25%	$85,500.00
05.0.1.C	Upper Guard Wall Extension	1	JOB	$432,023	$438,218	$926,758	$2,200,000.00	$2,200,000.00	25%	$2,750,000.00

05.0.3.-	APPROACH WALLS, UPPER AND LOWER									
05.0.3.C	Concrete-Future Riv Wall Mono.	4,640	CY	$88,163	$290,237	$194,373	$150.00	$696,000.00	25%	$870,000.00
05.0.3.C	Concrete-Existg Riv Wall Mono,Sta 3+41A-Sta 5+03A	12,960	CY	$294,740	$883,815	$546,489	$160.00	$2,073,600.00	25%	$2,592,000.00
05.0.4.-	LOCK STRUCTURE									
05.0.4.B	Remove Existing Blkhd Structure	1	JOB	$13,390	$53,524	$0	$80,000.00	$80,000.00	25%	$100,000.00
05.0.4.B	Remove Existing Riverwall - Arc	1	JOB	$122,914	$118,885	$0	$290,000.00	$290,000.00	25%	$362,500.00
05.0.4.B	Remove Existing Riverwall - Concrete	1,100	CY	$31,277	$66,530	$11,256	$120.00	$132,000.00	25%	$165,000.00
05.0.4.B	Stabilize Existing Lock Structure	1	JOB	$411,982	$492,993	$283,348	$1,700,000.00	$1,700,000.00	25%	$2,125,000.00
05.0.4.C	Concrete-Lock Wall Piers	2,140	CY	$48,922	$144,569	$90,409	$160.00	$342,400.00	25%	$428,000.00
05.0.4.C	Waterstops, Future Riv Wall Mono.	300	LF	$58	$2,874	$3,624	$26.00	$7,800.00	25%	$9,750.00
05.0.4.C	Alter Emerg Blkhd Recesses & Sills 110' Chamber	1	JOB	$200,387	$429,763	$378,731	$1,200,000.00	$1,200,000.00	25%	$1,500,000.00
05.0.4.E	Embedded Metal,Future Riv Wall Mono, Emerg Blkhd	22,590	LBS	$10,083	$40,303	$45,180	$5.00	$112,950.00	25%	$141,187.50
05.0.4.E	Corner Protection, Future Riv Wall Mono	8,220	LBS	$4,272	$8,440	$9,002	$3.00	$24,660.00	25%	$30,825.00
05.0.4.E	Wall Armor, Future Riv Wall Mono	45,890	LBS	$23,820	$46,888	$37,281	$3.00	$137,670.00	25%	$172,087.50
05.0.4.E	Misc Metal, Future Riv Wall Mono	16,660	LBS	$7,454	$29,795	$41,750	$6.00	$99,960.00	25%	$124,950.00
05.0.4.N	New Emergency Bulkhead	1	JOB	$102,924	$147,075	$982,431	$1,500,000.00	$1,500,000.00	25%	$1,875,000.00
								$109,629,666.00	27.6%	$139,879,132.50

Prime Contractor's Overhead	$8,514,619.00	OR	10.7%	
Prime Contractor's Profit on His Own Work			8.7%	
Prime Contractor's Profit on Subcontracted Work			7.0%	
Subcontractor's Overhead and Profit on His Own Work			25.0%	
Prime Contractor's Overhead on Subcontracted Work	$620,800.00	OR	6.0%	

CODE OF ACCOUNTS SUMMARY, ROUNDED

04	DAM	$98,000,000.00	28.6%	$126,000,000.00
05	LOCKS	$11,300,000.00	25.7%	$14,200,000.00

R.M. 11.3 - REPLACE L/D 2 @ EXISTING LOCATION.
CONSTRUCT A NEW FIXED CREST DAM.
PLANS 2,3,4 & 6, Without Project
(October 1991 Cost Level)

FILE:PLAN6DM2

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REPLACEMENT OF FIXED CREST DAM						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
04.2.A.A	Mobilization and Prep. Work	JOB	1	$1,500,000.00	$1,500,000	100%	$3,000,000
	CARE AND DIVERSION OF WATER						
04.2.B.B	Cofferdams	JOB	1	$11,700,000.00	$11,700,000	100%	$23,400,000
04.2.B.N	Cofferdam Instrumentation	JOB	1	$120,000.00	$120,000	100%	$240,000
	EARTHWORK FOR STRUCTURES						
04.2.D.B	Clearing & Grubbing	JOB	1	$3,500.00	$3,500	40%	$4,900
04.2.D.B	Excavation, Common	C.Y.	137,200	$10.00	$1,372,000	100%	$2,744,000
04.2.D.B	Excavation, Rock	C.Y.	7,000	$20.00	$140,000	100%	$280,000
04.2.D.B	Pre-splitting	S.Y.	1,000	$30.00	$30,000	100%	$60,000
04.2.D.B	Compacted Earth Fill	C.Y.	18,200	$5.00	$91,000	40%	$127,400
04.2.D.B	Rock Fill	C.Y.	4,800	$30.00	$144,000	40%	$201,600
	FOUNDATION WORK						
04.2.E.B	Steel Sheet Piling with Anchors, PS27.5	S.F.	6,100	$50.00	$305,000	40%	$427,000
	CONCRETE OVERFLOW SECTION						
04.2.2.B	Backfill, Pervious	C.Y.	2,600	$20.00	$52,000	40%	$72,800
04.2.2.C	Concrete, Dam & Abutment	C.Y.	63,800	$150.00	$9,570,000	40%	$13,398,000
04.2.2.C	Cement	CWT	240,100	$4.00	$960,400	40%	$1,344,560
04.2.2.C	Steel Reinforcement	LBS	766,800	$0.50	$383,400	40%	$536,760
04.2.2.C	Waterstops, Non-metallic	L.F.	800	$20.00	$16,000	40%	$22,400
	OUTLET WORKS						
	APPROACH AND OUTLET CHANNELS						
04.3.1.B	Filter Material	C.Y.	100	$45.00	$4,500	40%	$6,300
04.3.1.B	Stone Protection	C.Y.	200	$45.00	$9,000	40%	$12,600
	Derrick Stone	C.Y.	5,800	$40.00	$232,000	40%	$324,800
	CHANNELS AND CANALS						
	CHANNELS, SITE WORK						
09.0.2.B	Removal of Existing Structure, Concrete Removal	C.Y.	13,000	$150.00	$1,950,000	40%	$2,730,000
	TOTAL CONSTRUCTION COSTS, DAM				$28,582,800		$48,933,120
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, DAM					71%	
30.-.-.-	Planning, Engineering and Design				$2,950,000	25%	$3,687,500
31.-.-.-	Construction Management				$2,200,000	25%	$2,750,000
	TOTAL FIRST COSTS, DAM				$33,732,800		$55,370,620
	AVERAGE OVERALL CONTINGENCY, DAM					64%	

LOWER MON NAVIGATION STUDY
RM 11.2, L/D 2 REHABILITATION
(OCTOBER 1991 PRICE LEVEL)
Plans 1,2,3,4,6,7 & Without Project

ACCOUNT NO.	DESCRIPTION	QUANTITY	UNIT	WITHOUT OVERHEAD & PROFIT PLANT	LABOR	MATERIAL	UNIT PRICE INCLUDING OVERHEAD & PROFIT	TOTAL AMOUNT	CONT	TOTAL AMOUNT INCLUDING CONTINGENCY
05.-.-.-	LOCKS									
05.0.A.-	MOBILIZATION, DEMOBILIZATION & PREPARATORY WORK									
05.0.A.A	MOBILIZATION & PREPARATORY WORK	1	JOB	$87,468	$165,258	$133,350	$490,000.00	$490,000.00	50%	$735,000
05.0.A.A	SWITCH BOAT NO. 1	105	DAYS	$209,344	$498,094	$14,438	$8,000.00	$840,000.00	25%	$1,050,000
05.0.A.A	SWITCH BOAT NO. 2	105	DAYS	$209,344	$498,094	$14,438	$8,000.00	$840,000.00	25%	$1,050,000
05.0.C.-	PERMANENT ACCESS ROADS & PARKING									
05.0.C.B	UNCLASSFIED EXCAVATION FOR PARKING AREA	4,000	CY	$18,843	$20,328	$1,288	$13.00	$52,000.00	25%	$65,000
05.0.C.B	CRUSHED AGGREGRATE BASE COURSE FOR PARKING AREA, 4"	240	CY	$273	$853	$5,981	$35.00	$8,400.00	25%	$10,500
05.0.C.B	NO. 57 AGGREGATE COURSE FOR PARKING AREA, 6"	360	CY	$411	$1,281	$7,567	$30.00	$10,800.00	25%	$13,500
05.0.C.B	BITUMINOUS PRIME COAT	2,160	SY	$276	$276	$1,290	$1.00	$2,160.00	25%	$2,700
05.0.C.B	BITMINOUS BINDER COURSE	2,160	SY	$1,932	$2,484	$8,556	$7.00	$15,120.00	25%	$18,900
05.0.C.B	BITUMINOUS WEARING COURSE	2,160	SY	$1,490	$2,049	$6,707	$6.00	$12,960.00	25%	$16,200
05.0.C.B	PAVED SHOULDER, TYPE 3	160	SY	$2,732	$309	$1,892	$18.00	$2,880.00	25%	$3,600
05.0.C.B	PRECAST CONCRETE PARKING BUMPERS	45	EA	$60	$813	$1,268	$55.00	$2,475.00	25%	$3,094
05.0.C.B	GUIDE RAIL, TYPE 2-W	345	LF	$161	$286	$4,438	$16.00	$5,520.00	25%	$6,900
05.0.C.B	PAVEMENT BASE DRAINS	810	LF	$559	$7,411	$3,494	$16.00	$12,960.00	25%	$16,200
05.0.C.J	PARKING LINES	1,000	LF	$44	$388	$38	$0.50	$500.00	25%	$625
05.0.C.K	TRAFFIC SIGNS	1	JOB	$101	$855	$945	$2,200.00	$2,200.00	25%	$2,750
05.0.B.-	CARE & DIVERSION of WATER									
05.0.B.B	56 FT CHAMBER SHUTDOWN	1	JOB	$111,025	$118,976	$257,510	$600,000.00	$600,000.00	50%	$900,000
05.0.B.B	FIRST 110 FT CHAMBER SHUTDOWN	1	JOB	$197,913	$228,875	$607,297	$1,300,000.00	$1,300,000.00	50%	$1,950,000
05.0.B.B	SECOND 110 FT CHAMBER SHUTDOWN	1	JOB	$15,113	$21,149	$255,010	$365,000.00	$365,000.00	50%	$547,500
05.0.B.B	OVERTOPPING	1	JOB	$0	$0	$135,000	$135,000.00	$135,000.00	50%	$202,500
05.0.G.-	DRAINAGE									
05.0.G.B	ESPLANADE TRENCH & PIPE DRAINAGE SYSTEM	1	JOB	$6,466	$26,935	$76,694	$125,000.00	$125,000.00	25%	$156,250
05.0.G.B	COMBINATION STROM SEWER AND UNDERDRAIN	950	LF	$1,839	$13,346	$25,225	$50.00	$47,500.00	25%	$59,375
05.0.G.B	TYPE E-S ENDWALL	2	EA	$720	$2,189	$1,163	$2,400.00	$4,800.00	25%	$6,000
05.0.G.B	TYPE "S" INLETS	5	EA	$1,201	$3,649	$2,238	$1,500.00	$7,500.00	25%	$9,375
05.0.G.B	SUBSURFACEDRAIN OUTLET AND ENDWALL	1	JOB	$104	$1,373	$259	$2,000.00	$2,000.00	25%	$2,500
05.0.G.B	END SECTION - 16 GAGE FOR 18" PIPE	1	EA	$29	$378	$40	$500.00	$500.00	25%	$625
05.0.2.-	GUARD & GUIDE WALLS, UPPER & LOWER									
05.0.2.B	CONCRETE REMOVAL, FACE OF GUIDE & GUARD WALLS, 12"	3,930	SY	$90,519	$386,001	$19,671	$160.00	$628,800.00	50%	$943,200
05.0.2.B	CONCRETE REMOVAL, TOP OF GUIDE & GUARD WALLS, 12"	580	CY	$27,099	$211,698	$275	$525.00	$304,500.00	50%	$456,750
05.0.2.B	DRILL HOLES AND GROUT DOWELS	3,200	LF	$85,596	$45,505	$4,352	$23.00	$73,600.00	50%	$110,400
05.0.2.C	CONCRETE REPAIR, FACE OF GUIDE & GUARD WALLS, 12"	3,930	SY	$108,896	$641,180	$131,672	$285.00	$1,120,050.00	50%	$1,680,075

05.0.2.C	CONCRETE RESURFACE, TOP OF GUIDE & GUARD WALLS, 12"	580	CY	$68,363	$177,889	$52,331	$655.00	$379,900.00	50%	$569,850
05.0.2.C	DEFORMED STEEL BARS FOR REINFORCEMENT	152,000	LBS	$17,864	$80,734	$53,200	$1.00	$152,000.00	50%	$228,000
05.0.2.C	DOWELS	1,750	LBS	$253	$916	$490	$1.00	$1,750.00	50%	$2,625
05.0.2.E	WALL ARMOR, STRAIGHT RUN	675,000	LBS	$347,233	$780,840	$541,541	$3.00	$2,025,000.00	50%	$3,037,500
05.0.2.E	CORNER PROTECTION	165,000	LBS	$72,579	$174,834	$178,091	$3.00	$495,000.00	50%	$742,500
05.0.2.E	CHECK POSTS, GUIDE & GUARD WALLS, UPPER & LOWER	38	EA	$2,137	$11,093	$30,425	$1,500.00	$57,000.00	50%	$85,500
05.0.2.E	LINE HOOKS & GUARDS	60	EA	$1,536	$18,782	$93,120	$2,400.00	$144,000.00	50%	$216,000
05.0.2.E	MISCELLANEOUS METAL	27,650	LBS	$10,951	$23,474	$24,885	$3.00	$82,950.00	50%	$124,425
05.0.2.E	THREADED BAR CRACK REPAIRS	1	JOB	$7,776	$28,406	$3,958	$50,000.00	$50,000.00	50%	$75,000
05.0.3.-	APPROACH WALLS, UPPER & LOWER									
05.0.3.B	SPUD BARGES	105	DAYS	$2,035	$11,114	$347,780	$4,400.00	$462,000.00	25%	$577,500
05.0.4.-	LOCK STRUCTURE									
05.0.4.B	DEMOLITION OF LANDWALL BUILDING	1	JOB	$2,313	$8,838	$0	$14,000.00	$14,000.00	25%	$17,500
05.0.4.B	DEMOLITION OF MIDDLE WALL OPERATIONS BUILDING	1	JOB	$13,191	$11,440	$100	$32,000.00	$32,000.00	25%	$40,000
05.0.4.B	DEMOLITION OF CONTROL SHELTER (4)	1	JOB	$3,753	$3,203	$0	$9,000.00	$9,000.00	25%	$11,250
05.0.4.B	CONCRETE REMOVAL, FACE OF LOCK WALLS, 12"	7,350	SY	$168,929	$722,642	$36,741	$160.00	$1,176,000.00	50%	$1,764,000
05.0.4.B	CONCRETE REMOVAL, TOP OF LOCK WALLS, 12"	1,920	CY	$90,488	$701,079	$940	$525.00	$1,008,000.00	50%	$1,512,000
05.0.4.B	CONCRETE REMOVAL, RECESS & OTHER MISC. CONCRETE	1,100	CY	$95,597	$511,867	$1,716	$700.00	$770,000.00	50%	$1,155,000
05.0.4.B	REMOVAL OF DEBRIS FROM 56 FT CHAMBER	80	CY	$430	$695	$22	$18.00	$1,440.00	50%	$2,160
05.0.4.B	REMOVAL OF DEBRIS FROM 110 FT CHAMBER	320	CY	$1,719	$2,782	$90	$18.00	$5,760.00	50%	$8,640
05.0.4.B	DRILL HOLES AND GROUT DOWELS, LOCK WALLS	90,550	LF	$243,243	$1,287,640	$123,148	$23.00	$2,082,650.00	50%	$3,123,975
05.0.4.C	CONCRETE REPAIR, FACE OF LOCK WALLS, 12"	7,350	SY	$212,499	$1,107,188	$247,059	$270.00	$1,984,500.00	50%	$2,976,750
05.0.4.C	CONCRETE RESURFACE, TOP OF LOCK WALLS, 12"	1,920	CY	$195,064	$526,983	$168,251	$600.00	$1,152,000.00	50%	$1,728,000
05.0.4.C	CONCRETE REPAIR , RECESS & OTHER MISC. CONCRETE	1,100	CY	$142,544	$455,994	$94,126	$800.00	$880,000.00	50%	$1,320,000
05.0.4.C	DEFORMED STEEL BARS FOR REINFORCEMENT, LOCK WALLS	228,000	LBS	$26,796	$121,101	$63,840	$1.00	$228,000.00	50%	$342,000
05.0.4.C	STEEL WWF REINFORCEMENT,CONCRETE,LOCK WALLS	20,150	LBS	$2,234	$17,494	$8,745	$2.00	$40,300.00	50%	$60,450
05.0.4.C	DOWELS, LOCK WALLS	56,125	LBS	$8,121	$29,370	$15,715	$1.00	$56,125.00	50%	$84,188
05.0.4.C	GROUTING CRACKS IN LOCK WALLS	20	CF	$136	$845	$189	$75.00	$1,500.00	50%	$2,250
05.0.4.C	SHOTCRETE-MONOLITH JOINT REPAIR	500	LF	$2,242	$6,088	$5,321	$35.00	$17,500.00	50%	$26,250
05.0.4.C	SHOTCRETE-REPAIR FACE OF LOCK WALLS	2,600	SY	$67,696	$181,714	$187,878	$215.00	$559,000.00	50%	$838,500
05.0.4.E	WALL ARMOR, STRIAGHT RUN, RUN LOCK WALLS	464,000	LBS	$239,224	$558,192	$372,259	$3.00	$1,392,000.00	50%	$2,088,000
05.0.4.E	WALL ARMOR, CORNER PROTECTION, LOCK WALLS	115,000	LBS	$51,820	$123,509	$123,309	$3.00	$345,000.00	50%	$517,500
05.0.4.E	PLATE ARMOR	30,000	LBS	$8,949	$14,936	$22,936	$2.00	$60,000.00	50%	$90,000
05.0.4.E	CHECK POSTS, LOCK WALLS	120	EA	$6,748	$35,030	$96,349	$1,500.00	$180,000.00	50%	$270,000
05.0.4.E	LINE HOOKS & GUARDS, LOCK WALLS	71	EA	$1,818	$22,225	$110,354	$2,400.00	$170,400.00	50%	$255,600
05.0.4.E	MISCELLANEOUS METAL, LOCK WALLS	59,350	LBS	$23,507	$50,386	$53,415	$3.00	$178,050.00	50%	$267,075
05.0.5.-	LOCK GATES & OPERATING MACHINERY, UPPER & LOWER									
05.0.5.E	REMOVE & RELACE UPPER LOCK GATES, 56 FT CHAMBER	1	SET	$22,247	$51,298	$390,600	$590,000.00	$590,000.00	25%	$737,500
05.0.5.E	REMOVE & REPLACE LOWER LOCK GATES, 56 CHAMBER	1	SET	$22,247	$51,298	$458,000	$675,000.00	$675,000.00	25%	$843,750
05.0.5.E	REMOVE & RELACE UPPER LOCK GATES, 110 FT CHAMBER	1	SET	$50,000	$200,000	$721,540	$1,200,000.00	$1,200,000.00	25%	$1,500,000
05.0.5.E	REMOVE & REPLACE LOWER LOCK GATES, 110 CHAMBER	1	SET	$50,000	$200,000	$867,200	$1,400,000.00	$1,400,000.00	25%	$1,750,000
05.0.5.Q	REMOVE & REPLACE GATE OPERATING MACHINERY, 56 FT CHAMBER	4	EA	$49,324	$374,240	$132,138	$160,000.00	$640,000.00	25%	$800,000
05.0.5.Q	REMOVE & REPLACE GATE OPERATING MACHINERY, 110 FT CHAMBER	4	EA	$50,281	$460,921	$337,838	$245,000.00	$980,000.00	25%	$1,225,000
05.0.5.E	REMOVE & REPLACE GATE ANCHORAGES, 56 FT CHAMBER	4	EA	$2,242	$30,106	$24,368	$18,000.00	$72,000.00	25%	$90,000
05.0.5.E	REMOVE & REPLACE GATE ANCHORAGES, 110 FT CHAMBER	4	EA	$1,984	$33,094	$34,660	$22,000.00	$88,000.00	25%	$110,000
05.0.5.E	MITER SILL, PINTLE & QUION REPAIRS, 56 FT CHAMBER	1	JOB	$12,493	$110,865	$71,899	$250,000.00	$250,000.00	25%	$312,500
05.0.5.E	MITER SILL, PINTLE & QUION REPAIRS, 110 FT CHAMBER	1	JOB	$9,378	$84,208	$61,382	$200,000.00	$200,000.00	25%	$250,000
05.0.5.R	CATHODIC PROTECTION, GATE LEAVES	8	EA	$27,328	$395,104	$162,560	$85,000.00	$680,000.00	25%	$850,000

05.0.6.-	CULVERT VALVES & OPERATING MACHINERY									
05.0.6.E	REMOVE & REPLACE BUTTERFLY VALVES	6	EA	$72,393	$422,709	$600,000	$210,000.00	$1,260,000.00	25%	$1,575,000
05.0.6.Q	REMOVE & REPLACE VALVE OPERATING MACHINERY	6	EA	$66,524	$318,688	$287,500	$130,000.00	$780,000.00	25%	$975,000
05.0.7.-	PIPING SYSTEM									
05.0.7.Q	HYDRAULIC SYSTEM	1	JOB	$72,601	$653,071	$734,250	$1,700,000.00	$1,700,000.00	35%	$2,295,000
05.0.7.Q	COMPRESSED AIR PIPING SYSTEM	1	JOB	$26,285	$199,760	$124,988	$400,000.00	$400,000.00	35%	$540,000
05.0.7.Q	PIPE SUPORTS	1	JOB	$31,234	$96,338	$30,420	$180,000.00	$180,000.00	35%	$243,000
05.0.7.Q	SERVICE WATER PIPING SYSTEM	1	JOB	$6,188	$49,613	$19,313	$85,000.00	$85,000.00	35%	$114,750
05.0.7.Q	SEWAGE COLLECTION SYSTEM	1	JOB	$24,576	$104,220	$50,594	$205,000.00	$205,000.00	35%	$276,750
05.0.7.Q	WATER DISTRIBUTION SYSTEM	1	JOB	$9,878	$47,919	$21,388	$90,000.00	$90,000.00	35%	$121,500
05.0.8.-	POWER & LIGHTING SYSTEMS									
05.0.8.R	REPLACE LOCK ELECTRICAL SYSTEM	1	JOB	$36,024	$553,179	$317,975	$1,000,000.00	$1,000,000.00	25%	$1,250,000
05.0.R.-	ASSOCIATED GENERAL ITEMS									
05.0.R.A	GOVERNMENT FIELD OFFICE	1	JOB	$6,779	$55,861	$58,800	$155,000.00	$155,000.00	25%	$193,750
05.0.R.A	TEMPORARY UTILITIES AND OPERATING FACILITIES	1	JOB	$2,510	$7,105	$1,780	$15,000.00	$15,000.00	25%	$18,750
05.0.R.B	CHAIN LINK FENCE	1,200	LF	$2,765	$11,585	$13,400	$30.00	$36,000.00	25%	$45,000
05.0.R.B	CONCRETE REMOVAL, ESPLANDE PAVEMENT, 12"	7,100	SY	$23,042	$94,040	$682	$20.00	$142,000.00	25%	$177,500
05.0.R.B	UNCLASSIFIED EXCAVATION FOR ESPLANDE	15,775	CY	$66,361	$71,589	$5,079	$12.00	$189,300.00	25%	$236,625
05.0.R.B	COMMON EXCAVATION FOR CONCRETE SLOPE PROTECTION	390	CY	$1,066	$1,492	$126	$9.00	$3,510.00	25%	$4,388
05.0.R.B	#57 AGGREGATE SUBBASE FOR ESPLANDE, 8"	1,950	CY	$43,056	$6,278	$27,126	$50.00	$97,500.00	25%	$121,875
05.0.R.B	#57 AGG BASE CRSE FOR CONCRETE SLOPE PROTECTION	60	CY	$0	$0	$835	$18.00	$1,080.00	25%	$1,350
05.0.R.B	SEEDING AND MULCHING	1	AC	$234	$311	$1,076	$2,000.00	$2,000.00	25%	$2,500
05.0.R.C	DEFORMED STEEL BARS FOR CONCR REINF, ESPLANADE MISC.	380,000	LBS	$4,653	$119,523	$91,314	$1.00	$380,000.00	25%	$475,000
05.0.R.C	DEFORMED STEEL BARS FOR CONCRETE SLOPE PROTECTION	28,200	LBS	$367	$9,436	$6,867	$1.00	$28,200.00	25%	$35,250
05.0.R.C	CONCRETE, ESPLANDE PAVING, 8"	8,900	SY	$4,226	$116,071	$108,000	$35.00	$311,500.00	25%	$389,375
05.0.R.C	CONCRETE, SLOPE PROTECTION, 6"	1,106	CY	$2,348	$64,484	$60,940	$145.00	$160,370.00	25%	$200,463
05.0.R.E	REMOVAL OF EQUIMENT, MISCELLANEOUS METAL & GUARD FENCE	1	JOB	$9,782	$35,162	$0	$57,000.00	$57,000.00	25%	$71,250
05.0.R.E	ALUMINUM PLANKING	5,070	SF	$3,285	$122,618	$88,111	$55.00	$278,850.00	25%	$348,563
05.0.R.E	ALUMINUM COVER PLATES	210	SF	$90	$3,359	$9,700	$80.00	$16,800.00	25%	$21,000
05.0.R.E	ALUMINUM RABBET ANGLES	2,610	LF	$444	$13,685	$16,772	$15.00	$39,150.00	25%	$48,938
05.0.R.E	GUARD FENCE	6,850	LF	$958	$44,539	$223,128	$50.00	$342,500.00	25%	$428,125
05.0.R.E	ALUMINUM PIPE HANDRAIL - 1-1/2" DIA	75	LF	$261	$3,823	$4,150	$140.00	$10,500.00	25%	$13,125
05.0.R.E	ALUMINUM HANDRAIL - 2" DIA	395	LF	$784	$11,468	$13,509	$80.00	$31,600.00	25%	$39,500
05.0.R.E	DISTANCE MARKERS	50	EA	$53	$1,944	$2,700	$120.00	$6,000.00	25%	$7,500
05.0.R.P	TOW HAULAGE & RETRIEVER SYSTEM	1	JOB	$2,608	$25,301	$311,070	$430,000.00	$430,000.00	25%	$537,500
05.0.R.P	PAINT EXISTING MISCELLANEOUS METAL ON LOCKS	1.00	JOB	$29,505	$178,113	$133,736	$280,000.00	$280,000.00	25%	$350,000
05.0.N.-	BUILDING, PROJECT OPERATIONS									
05.0.N.-	LANDWALL SERVICE BUILDING	1	JOB	$40,336	$351,359	$273,102	$760,000.00	$760,000.00	25%	$950,000
05.0.N.-	CONTROL STATION SHELTERS	4	EA	$6,810	$54,716	$27,763	$25,000.00	$100,000.00	25%	$125,000
05.0.N.-	MIDDLE WALL OPERATIONS BUILDING	1	JOB	$9,302	$77,398	$51,126	$160,000.00	$160,000.00	25%	$200,000
	TOTAL, CONSTRUCTION COSTS:							$39,713,910	39%	$55,081,581
05.0.0.-	MAIN AND AUXILIARY LOCKS TOTAL (ROUNDED):									$55,000,000

PRIME CONTRACTOR'S DISTRIBUTED COST ON PRIME'S WORK	$3,704,000	OR	16.5%
PRIME CONTRACTOR'S PROFIT ON PRIMES WORK			9.05%
PRIME CONTRACTOR'S DISTRIBUTED COST ON SUBCONTRACTOR'S WORK	$777,000	OR	7.7%
PRIME CONTRACTOR'S PROFIT ON SUBCONTRACTOR'S WORK			6.07%

LOWER MONONGAHELA NAVIGATION STUDY
FLOODWAY BULKHEAD AT L/D #2 - October 1991 Cost Level
Plans 1,2,3,4,6,7 & Without Project

DESCRIPTION	QUANTITY	UNIT	WITHOUT OVERHEAD AND PROFIT PLANT	LABOR	MATERIALS	UNIT PRICE INCLUDING OVERHEAD &PROFIT	TOTAL AMOUNT	CONTIN GENCY	TOTAL AMOUNT INCL CONTINGENCY
*** FLOODWAY BULKHEAD L/D 2 ***									
05.-.-.- LOCKS									
05.0.A.- Mobilization & Prep. Work	1	JB	$28,973	$54,307	$5,000	$120,000.00	$120,000.00	25%	$150,000.00
05.0.B.B Cofferdam	1	JB	$124,967	$132,674	$141,051	$500,000.00	$500,000.00	25%	$625,000.00
05.0.B.B Cofferdam Overtopping	2	EA	$0	$0	$60,000	$35,000.00	$70,000.00	25%	$87,500.00
05.0.4.B Remove Existing Structure	1	JB	$35,285	$69,261	$5,967	$150,000.00	$150,000.00	50%	$225,000.00
05.0.4.C Remove & Replace 12" Top Concrete (Em Bkd Sill)	1	JB	$61,262	$83,495	$12,000	$210,000.00	$210,000.00	300%	$840,000.00
05.0.4.N Emergency Bulkhead Hoist Structure	1	JB	$35,694	$197,868	$391,384	$830,000.00	$830,000.00	25%	$1,037,500.00
05.0.5.E Emergency Bulkhead & Appurtenances	1	JB	$103,151	$131,679	$240,699	$630,000.00	$630,000.00	25%	$787,500.00
05.0.R.P Emergency Bulkhead	1	JB	$0	$0	$813,000	$1,100,000.00	$1,100,000.00	25%	$1,375,000.00
TOTAL COST							$3,610,000.00		$5,127,500.00
DISTRIBUTED COSTS	$766,800	OR	21.2%						
PRIMES PROFIT	9.1%							42%	
							ROUNDED		$5,100,000.00

R.M. 22.2 - REPLACE L/D 3 @ A NEW LOCATION
CONSTRUCT TWO NEW LOCK CHAMBERS AND A FIXED CREST DAM @ A SITE DOWNSTREAM OF EXISTING L/D 3.
PLAN 2
(October 1991 Cost Level)

FILE:PLAN2LKD

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL CONTINGENCIES
	REPLACEMENT OF LOCKS (BOTH CHAMBERS)						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
05.0.A.A	Mobilization & Prep. Work	JOB	1	$5,000,000.00	$5,000,000	100%	$10,000,000
	PERMANENT ACCESS ROADS AND PARKING						
05.0.C.B	Access Road	JOB	1	$155,000.00	$155,000	40%	$217,000
	CARE AND DIVERSION OF WATER						
05.0.B.B	Cofferdam	JOB	1	$10,200,000.00	$10,200,000	100%	$20,400,000
05.0.B.N	Cofferdam Instrumentation	JOB	1	$50,000.00	$50,000	100%	$100,000
	EARTHWORK FOR STRUCTURES						
05.0.D.B	Clearing and Grubbing	JOB	1	$50,000.00	$50,000	40%	$70,000
05.0.D.B	Excavation, Common	C.Y.	676,100	$7.00	$4,732,700	40%	$6,625,780
05.0.D.B	Excavation, Rock	C.Y.	25,600	$15.00	$384,000	100%	$768,000
05.0.D.B	Pre-splitting	S.Y.	4,000	$20.00	$80,000	100%	$160,000
05.0.D.B	Seeding	ACRE	5	$2,000.00	$10,000	40%	$14,000
	FOUNDATION WORK						
05.0.E.B	Steel Sheet Piling, PS27.5	S.F.	205,700	$17.00	$3,496,900	40%	$4,895,660
05.0.E.B	Steel Bearing Piles, HP10x42	L.F.	90,400	$20.00	$1,808,000	40%	$2,531,200
05.0.E.B	Temp. Retaining Wall, Steel Sheetpiling w/ Anchors	JOB	1	SUM	$4,000,000	40%	$5,600,000
05.0.E.B	Foundation Drilling, 4 in. Core	L.F.	4,000	$90.00	$360,000	70%	$612,000
05.0.E.B	Foundation Drilling, Drilling Without Sampling	L.F.	2,500	$30.00	$75,000	70%	$127,500
	DRAINAGE						
05.0.G.B	Drainage	JOB	1	$225,000.00	$225,000	40%	$315,000
	APPROACH CHANNELS						
05.0.1.B	Filter Material	C.Y.	16,000	$25.00	$400,000	40%	$560,000
05.1.E.B	Stone Protection	C.Y.	32,000	$35.00	$1,120,000	40%	$1,568,000
05.1.E.B	Mooring Piers	EACH	4	$150,000.00	$600,000	40%	$840,000
	GUIDE AND GUARD WALLS, UPPER AND LOWER						
05.0.2.B	Fill, Guide Wall Cells	C.Y.	19,300	$20.00	$386,000	40%	$540,400
05.0.2.E 05.0.4.E	Guard Fence	L.F.	8,000	$35.00	$280,000	40%	$392,000
	LOCK STRUCTURE						
05.0.4.B	Backfill, Pervious	C.Y.	77,600	$17.00	$1,319,200	40%	$1,846,880
05.0.4.C	Concrete, Lock Walls & Sills	C.Y.	317,300	$110.00	$34,903,000	40%	$48,864,200
05.0.4.C	Steel Reinforcement	LBS	2,351,500	$0.50	$1,175,750	40%	$1,646,050
05.0.4.C	Waterstops, Non-metallic	L.F.	3,300	$20.00	$66,000	40%	$92,400
05.0.4.C	Cement	CWT	1,206,100	$3.75	$4,522,875	40%	$6,332,025
05.0.4.E	Wall Armor	LBS	2,001,900	$1.50	$3,002,850	40%	$4,203,990

05.0.4.E	Floating Mooring Bitts	EACH	14	$35,000.00	$490,000	40%	$686,000
05.0.4.N	Permanent Instrumentation	JOB	1	$40,000.00	$40,000	40%	$56,000
	LOCK GATES AND OPERATING MACHINERY, UPPER AND LOWER						
05.0.5.E	Upper Lock Gates	SET	2	$450,000.00	$900,000	40%	$1,260,000
05.0.5.E	Lower Lock Gates	SET	2	$480,000.00	$960,000	40%	$1,344,000
05.0.5.E	Emergency Bulkhead	JOB	1	$1,300,000.00	$1,300,000	40%	$1,820,000
05.0.5.E	Emergency Bulkhead Embedded Metal Recess Fillers & Hoist	JOB	1	$500,000.00	$500,000	40%	$700,000
05.0.5.E	Planking, Aluminum	S.F.	8,500	$30.00	$255,000	40%	$357,000
05.0.5.E	Rabbet Angles, Aluminum	L.F.	3,200	$14.00	$44,800	40%	$62,720
05.0.5.E	Pipe Handrail, Aluminum	L.F.	900	$75.00	$67,500	40%	$94,500
05.0.5.Q	Emergency Bulkhead Hoist & Lifting Beam	JOB	1	$370,000.00	$370,000	40%	$518,000
05.0.5.Q	Bulkhead Dogging Assemblies	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.5.Q	Lock Gate Operating Machinery	SET	8	$110,000.00	$880,000	40%	$1,232,000
05.0.5.R	Cathodic Protection, Gate Leaves	EACH	8	$11,000.00	$88,000	40%	$123,200
	CULVERT VALVES AND OPERATING MACHINERY						
05.0.6.B	Bulkhead Storage Area	JOB	1	$285,000.00	$285,000	40%	$399,000
05.0.6.E	Culvert Valves and Embedded Metal	EACH	6	$110,000.00	$660,000	40%	$924,000
05.0.6.E	Culvert Valve Bulkheads	EACH	6	$35,000.00	$210,000	40%	$294,000
05.0.6.E	Culvert Valve Bulkhead Embedded Metal	JOB	1	$75,000.00	$75,000	40%	$105,000
05.0.6.Q	Culvert Valve Operating Machinery	SET	6	$110,000.00	$660,000	40%	$924,000
	PIPING SYSTEM						
05.0.7.Q	Fuel System	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.7.Q	Compressed Air System	JOB	1	$270,000.00	$270,000	40%	$378,000
05.0.7.Q	Hydraulic System	JOB	1	$1,000,000.00	$1,000,000	40%	$1,400,000
05.0.7.Q	Service Water System	JOB	1	$120,000.00	$120,000	40%	$168,000
05.0.7.Q	Domestic Water System	JOB	1	$200,000.00	$200,000	40%	$280,000
	POWER AND LIGHTING SYSTEMS						
05.0.8.R	Power, Lighting and Signal System	JOB	1	$1,250,000.00	$1,250,000	40%	$1,750,000
05.0.8.R	Stand-by Unit	JOB	1	$40,000.00	$40,000	40%	$56,000
	ASSOCIATED GENERAL ITEMS						
05.0.R.B	Esplanade Subbase	C.Y.	1,890	$25.00	$47,250	40%	$66,150
05.0.R.B	Chain Link Fence	L.F.	3,400	$10.00	$34,000	40%	$47,600
05.0.R.B	Flag Pole	JOB	1	$3,000.00	$3,000	40%	$4,200
05.0.R.C	Concrete, Esplanade	C.Y.	11,340	$60.00	$680,400	40%	$952,560
05.0.R.E	Miscellaneous Metal	LBS	927,100	$2.75	$2,549,525	40%	$3,569,335
05.0.R.K	Life Boats and Lowering Facilities	JOB	1	$45,000.00	$45,000	40%	$63,000
05.0.R.P	Elevator	JOB	1	$55,000.00	$55,000	40%	$77,000
	BRIDGES, ABUTMENTS AND PIERS						
05.0.K.C	Concrete, Lock Wall Bridge Piers	C.Y.	1,100	$175.00	$192,500	40%	$269,500
05.0.K.E	Miscellaneous Items for Lock Wall Piers	JOB	1	$110,000.00	$110,000	40%	$154,000
	BRIDGES, SUPERSTRUCTURE AND DECK						
05.0.L.E	Service Bridge	JOB	1	$600,000.00	$600,000	40%	$840,000

	BUILDINGS, PROJECT OPERATIONS						
05.0.N.-	Operation Building	JOB	1	$350,000.00	$350,000	40%	$490,000
05.0.N.-	Service Building	JOB	1	$150,000.00	$150,000	40%	$210,000
05.0.N.-	Control Shelters	EACH	4	$15,000.00	$60,000	40%	$84,000
05.0.N.-	Gage House & Equipment	JOB	1	$200,000.00	$200,000	40%	$280,000
	DREDGING						
	MECHANICAL DREDGING						
12.0.4.B	Modify Approach Channel, Dredging	C.Y.	120,000	$15.00	$1,800,000	300%	$7,200,000
	TOTAL CONSTRUCTION COSTS, LOCKS				$96,024,250		$148,672,850
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, LOCKS					55%	
30.-.-.-	Planning, Engineering and Design				$10,000,000	25%	$12,500,000
31.-.-.-	Construction Management				$7,500,000	25%	$9,375,000
	TOTAL FIRST COSTS, LOCKS				$113,524,250		$170,547,850
	AVERAGE OVERALL CONTINGENCY, LOCKS					50%	

R.M. 22.2 - REPLACE L/D 3 @ A NEW LOCATION
CONSTRUCT TWO NEW LOCK CHAMBERS AND A FIXED CREST DAM @ A SITE DOWNSTREAM OF EXISTING L/D 3.
PLAN 2
(October 1991 Cost Level)

FILE:PLAN2LKD

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REPLACEMENT OF FIXED CREST DAM						
	SPILLWAY						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
04.2.A.A	Mobilization and Prep. Work	JOB	1	$1,500,000.00	$1,500,000	100%	$3,000,000
	CARE AND DIVERSION OF WATER						
04.2.B.B	Cofferdams	JOB	1	$11,000,000.00	$11,000,000	100%	$22,000,000
04.2.B.N	Cofferdam Instrumentation	JOB	1	$110,000.00	$110,000	100%	$220,000
	EARTHWORK FOR STRUCTURES						
04.2.D.B	Clearing & Grubbing	JOB	1	$10,000.00	$10,000	40%	$14,000
04.2.D.B	Excavation, Common	C.Y.	401,600	$7.00	$2,811,200	100%	$5,622,400
04.2.D.B	Excavation, Rock	C.Y.	7,000	$20.00	$140,000	100%	$280,000
04.2.D.B	Pre-splitting	S.Y.	1,800	$20.00	$36,000	100%	$72,000
04.2.D.B	Compacted Earth Fill	C.Y.	26,200	$5.00	$131,000	40%	$183,400
04.2.D.B	Rock Fill	C.Y.	15,800	$25.00	$395,000	40%	$553,000
	CONCRETE OVERFLOW SECTION						
04.2.2.C	Concrete, Dam & Abutment	C.Y.	54,100	$150.00	$8,115,000	40%	$11,361,000
04.2.2.C	Cement	CWT	203,300	$4.00	$813,200	40%	$1,138,480
04.2.2.C	Steel Reinforcement	LBS	703,300	$0.50	$351,650	40%	$492,310
04.2.2.C	Waterstops, Non-metallic	L.F.	800	$20.00	$16,000	40%	$22,400
	OUTLET WORKS						
	APPROACH AND OUTLET CHANNELS						
04.3.1.B	Filter Material	C.Y.	600	$40.00	$24,000	40%	$33,600
04.3.1.B	Stone Protection	C.Y.	1,200	$35.00	$42,000	40%	$58,800
04.3.1.B	Derrick Stone	C.Y.	15,100	$35.00	$528,500	40%	$739,900
	TOTAL CONSTRUCTION COSTS, DAM				$26,023,550		$45,791,290
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					76%	
30.-.-.-	Planning, Engineering and Design				$2,800,000	25%	$3,500,000
31.-.-.-	Construction Management				$2,100,000	25%	$2,625,000
	TOTAL FIRST COSTS, DAM				$30,923,550		$51,916,290
	AVERAGE OVERALL CONTINGENCY, DAM					68%	

R.M. 22.2 - REPLACE L/D 2 & L/D 3 @ A NEW LOCATION BETWEEN THE TWO EXISTING SITES.
CONSTRUCT TWO NEW LOCK CHAMBERS AND A FIXED CREST DAM.
PLAN 5
(October 1991 Cost Level)

FILE:PLAN5LKD

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REPLACEMENT OF LOCKS (BOTH CHAMBERS)						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
05.0.A.A	Mobilization & Prep. Work	JOB	1	$5,000,000.00	$5,000,000	100%	$10,000,000
	PERMANENT ACCESS ROADS AND PARKING						
05.0.C.B	Access Road	JOB	1	$155,000.00	$155,000	40%	$217,000
	CARE AND DIVERSION OF WATER						
05.0.B.B	Cofferdam	JOB	1	$10,200,000.00	$10,200,000	100%	$20,400,000
05.0.B.N	Cofferdam Instrumentation	JOB	1	$50,000.00	$50,000	100%	$100,000
	EARTHWORK FOR STRUCTURES						
05.0.D.B	Clearing and Grubbing	JOB	1	$50,000.00	$50,000	40%	$70,000
05.0.D.B	Excavation, Common	C.Y.	677,400	$7.00	$4,741,800	40%	$6,638,520
05.0.D.B	Excavation, Rock	C.Y.	25,600	$10.00	$256,000	100%	$512,000
05.0.D.B	Pre-splitting	S.Y.	4,000	$18.00	$72,000	100%	$144,000
05.0.D.B	Seeding	ACRE	5	$2,000.00	$10,000	40%	$14,000
	FOUNDATION WORK						
05.0.E.B	Steel Sheet Piling, PS27.5	S.F.	165,100	$17.00	$2,806,700	40%	$3,929,380
05.0.E.B	Steel Bearing Piles, HP10x42	L.F.	75,700	$20.00	$1,514,000	40%	$2,119,600
05.0.E.B	Temp. Retaining Wall, Steel Sheetpiling w/ Anchors	JOB	1	SUM	$4,000,000	40%	$5,600,000
05.0.E.B	Foundation Drilling, 4 in. Core	L.F.	4,000	$90.00	$360,000	70%	$612,000
05.0.E.B	Foundation Drilling, Drilling Without Sampling	L.F.	2,500	$30.00	$75,000	70%	$127,500
	DRAINAGE						
05.0.G.B	Drainage	JOB	1	$225,000.00	$225,000	40%	$315,000
	APPROACH CHANNELS						
05.0.1.B	Filter Material	C.Y.	16,000	$25.00	$400,000	40%	$560,000
05.1.E.B	Stone Protection	C.Y.	32,000	$35.00	$1,120,000	40%	$1,568,000
05.1.E.B	Mooring Piers	EACH	4	$150,000.00	$600,000	40%	$840,000
	GUIDE AND GUARD WALLS, UPPER AND LOWER						
05.0.2.B	Fill, Guide Wall Cells	C.Y.	8,200	$20.00	$164,000	40%	$229,600
05.0.2.E	Guard Fence	L.F.	8,000	$35.00	$280,000	40%	$392,000
	LOCK STRUCTURE						
05.0.4.B	Backfill, Pervious	C.Y.	76,400	$17.00	$1,298,800	40%	$1,818,320
05.0.4.C	Concrete, Lock Walls & Sills	C.Y.	310,800	$110.00	$34,188,000	40%	$47,863,200
05.0.4.C	Steel Reinforcement	LBS	2,351,500	$0.50	$1,175,750	40%	$1,646,050
05.0.4.C	Waterstops, Non-metallic	L.F.	3,300	$20.00	$66,000	40%	$92,400
05.0.4.C	Cement	CWT	1,181,700	$3.75	$4,431,375	40%	$6,203,925
05.0.4.E	Wall Armor	LBS	2,418,100	$1.50	$3,627,150	40%	$5,078,010

05.0.4.E	Floating Mooring Bitts	EACH	14	$35,000.00	$490,000	40%	$686,000
05.0.4.N	Permanent Instrumentation	JOB	1	$40,000.00	$40,000	40%	$56,000
	LOCK GATES AND OPERATING MACHINERY, UPPER AND LOWER						
05.0.5.E	Upper Lock Gates	SET	2	$445,000.00	$890,000	40%	$1,246,000
05.0.5.E	Lower Lock Gates	SET	2	$560,000.00	$1,120,000	40%	$1,568,000
05.0.5.E	Emergency Bulkhead	JOB	1	$1,300,000.00	$1,300,000	40%	$1,820,000
05.0.5.E	Emergency Bulkhead Embedded Metal Recess Fillers & Hoist	JOB	1	$490,000.00	$490,000	40%	$686,000
05.0.5.E	Planking, Aluminum	S.F.	8,500	$30.00	$255,000	40%	$357,000
05.0.5.E	Rabbet Angles, Aluminum	L.F.	3,200	$14.00	$44,800	40%	$62,720
05.0.5.E	Pipe Handrail, Aluminum	L.F.	900	$75.00	$67,500	40%	$94,500
05.0.5.Q	Emergency Bulkhead Hoist & Lifting Beam	JOB	1	$370,000.00	$370,000	40%	$518,000
05.0.5.Q	Bulkhead Dogging Assemblies	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.5.Q	Lock Gate Operating Machinery	SET	8	$110,000.00	$880,000	40%	$1,232,000
05.0.5.R	Cathodic Protection, Gate Leaves	EACH	8	$11,000.00	$88,000	40%	$123,200
	CULVERT VALVES AND OPERATING MACHINERY						
05.0.6.B	Bulkhead Storage Area	JOB	1	$285,000.00	$285,000	40%	$399,000
05.0.6.E	Culvert Valves and Embedded Metal	EACH	6	$110,000.00	$660,000	40%	$924,000
05.0.6.E	Culvert Valve Bulkheads	EACH	6	$35,000.00	$210,000	40%	$294,000
05.0.6.E	Culvert Valve Bulkhead Embedded Metal	JOB	1	$75,000.00	$75,000	40%	$105,000
05.0.6.Q	Culvert Valve Operating Machinery	SET	6	$110,000.00	$660,000	40%	$924,000
	PIPING SYSTEM						
05.0.7.Q	Fuel System	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.7.Q	Compressed Air System	JOB	1	$270,000.00	$270,000	40%	$378,000
05.0.7.Q	Hydraulic System	JOB	1	$1,000,000.00	$1,000,000	40%	$1,400,000
05.0.7.Q	Service Water System	JOB	1	$120,000.00	$120,000	40%	$168,000
05.0.7.Q	Domestic Water System	JOB	1	$200,000.00	$200,000	40%	$280,000
	POWER AND LIGHTING SYSTEMS						
05.0.8.R	Power, Lighting and Signal System	JOB	1	$1,250,000.00	$1,250,000	40%	$1,750,000
05.0.8.R	Stand-by Unit	JOB	1	$40,000.00	$40,000	40%	$56,000
	ASSOCIATED GENERAL ITEMS						
05.0.R.B	Esplanade Subbase	C.Y.	1,890	$25.00	$47,250	40%	$66,150
05.0.R.B	Chain Link Fence	L.F.	3,400	$10.00	$34,000	40%	$47,600
05.0.R.B	Flag Pole	JOB	1	$3,000.00	$3,000	40%	$4,200
05.0.R.C	Concrete, Esplanade	C.Y.	11,340	$60.00	$680,400	40%	$952,560
05.0.R.E	Miscellaneous Metal	LBS	927,100	$2.75	$2,549,525	40%	$3,569,335
05.0.R.K	Life Boats and Lowering Facilities	JOB	1	$45,000.00	$45,000	40%	$63,000
05.0.R.P	Elevator	JOB	1	$55,000.00	$55,000	40%	$77,000
	BRIDGES, ABUTMENTS AND PIERS						
05.0.K.C	Concrete, Lock Wall Bridge Piers	C.Y.	1,100	$175.00	$192,500	40%	$269,500
05.0.K.E	Miscellaneous Items for Lock Wall Piers	JOB	1	$110,000.00	$110,000	40%	$154,000

	BRIDGES, SUPERSTRUCTURE AND DECK						
05.0.L.E	Service Bridge	JOB	1	$600,000.00	$600,000	40%	$840,000
	BUILDINGS, PROJECT OPERATIONS						
05.0.N.-	Operation Building	JOB	1	$350,000.00	$350,000	40%	$490,000
05.0.N.-	Service Building	JOB	1	$150,000.00	$150,000	40%	$210,000
05.0.N.-	Control Shelters	EACH	4	$15,000.00	$60,000	40%	$84,000
05.0.N.-	Gage House & Equipment	JOB	1	$200,000.00	$200,000	40%	$280,000
	DREDGING						
	MECHANICAL DREDGING						
12.0.4.B	Modify Approach Channel, Dredging	C.Y.	120,000	$15.00	$1,800,000	300%	$7,200,000
	TOTAL CONSTRUCTION COSTS, LOCKS				$94,628,550		$146,637,270
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, LOCKS					55%	
30.-.-.-	Planning, Engineering and Design				$9,900,000	25%	$12,375,000
31.-.-.-	Construction Management				$7,400,000	25%	$9,250,000
	TOTAL FIRST COSTS, LOCKS				$111,928,550		$168,262,270
	AVERAGE OVERALL CONTINGENCY, LOCKS					50%	

R.M. 22.2 - REPLACE L/D 2 & L/D 3 @ A NEW LOCATION BETWEEN THE TWO EXISTING SITES.
CONSTRUCT TWO NEW LOCK CHAMBERS AND A FIXED CREST DAM.
PLAN 5
(October 1991 Cost Level)

FILE:PLAN5LKD

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	SPILLWAY	REPLACEMENT OF FIXED CREST DAM					
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
04.2.A.A	Mobilization and Prep. Work	JOB	1	$1,500,000.00	$1,500,000	100%	$3,000,000
	CARE AND DIVERSION OF WATER						
04.2.B.B	Cofferdams	JOB	1	$11,000,000.00	$11,000,000	100%	$22,000,000
04.2.B.N	Cofferdam Instrumentation	JOB	1	$110,000.00	$110,000	100%	$220,000
	EARTHWORK FOR STRUCTURES						
04.2.D.B	Clearing & Grubbing	JOB	1	$10,000.00	$10,000	40%	$14,000
04.2.D.B	Excavation, Common	C.Y.	401,606	$7.00	$2,811,242	100%	$5,622,484
04.2.D.B	Excavation, Rock	C.Y.	7,008	$20.00	$140,160	100%	$280,320
04.2.D.B	Pre-splitting	S.Y.	1,817	$20.00	$36,340	100%	$72,680
04.2.D.B	Compacted Earth Fill	C.Y.	26,200	$5.00	$131,000	40%	$183,400
04.2.D.B	Rock Fill	C.Y.	15,818	$25.00	$395,450	40%	$553,630
	FOUNDATION WORK						
04.2.E.B	Steel Sheet Piling, PS27.5	S.F.	23,300	$20.00	$466,000	40%	$652,400
	CONCRETE OVERFLOW SECTION						
04.2.2.C	Concrete, Dam & Abutment	C.Y.	52,899	$150.00	$7,934,850	40%	$11,108,790
04.2.2.C	Cement	CWT	198,900	$4.00	$795,600	40%	$1,113,840
04.2.2.C	Steel Reinforcement	LBS	872,336	$0.50	$436,168	40%	$610,635
04.2.2.C	Waterstops, Non-metallic	L.F.	844	$20.00	$16,880	40%	$23,632
	OUTLET WORKS						
	APPROACH AND OUTLET CHANNELS						
04.3.1.B	Filter Material	C.Y.	600	$40.00	$24,000	40%	$33,600
04.3.1.B	Stone Protection	C.Y.	1,200	$35.00	$42,000	40%	$58,800
04.3.1.B	Derrick Stone	C.Y.	7,403	$40.00	$296,120	40%	$414,568
	TOTAL CONSTRUCTION COSTS, DAM				$26,145,810		$45,962,779
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, DAM					76%	
30.-.-.-	Planning, Engineering and Design				$2,800,000	25%	$3,500,000
31.-.-.-	Construction Management				$2,100,000	25%	$2,625,000
	TOTAL FIRST COSTS, DAM				$31,045,810		$52,087,779
	AVERAGE OVERALL CONTINGENCY, DAM					68%	

R.M. 23.8 - REPLACE EXISTING TWO CHAMBER LOCK "IN KIND" @ EXISTING LOCATION FILE:MNRIK3.WK1
REPLACE BOTH CHAMBERS "IN KIND" (56'x360' LAND CHAMBER & 56'x720' RIVER CHAMBER) & FIXED CREST DAM
Without Project
(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REPLACEMENT OF LOCKS (BOTH CHAMBERS)						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
05.0.A.A	Mobilization & prep. work	JOB	1	$6,500,000.00	$6,500,000.00	100%	$13,000,000
	PERMANENT ACCESS ROADS AND PARKING						
05.0.C.B	Access Road	JOB	1	$250,000.00	$250,000.00	40%	$350,000
	CARE AND DIVERSION OF WATER						
05.0.B.B	Cofferdam	JOB	1	$10,200,000.00	$10,200,000.00	100%	$20,400,000
05.0.B.N	Cofferdam instrumentation	JOB	1	$50,000.00	$50,000.00	100%	$100,000
	EARTHWORK FOR STRUCTURES						
05.0.D.B	Clearing and Grubbing	JOB			$0.00		$0
05.0.D.B	Excavation, common	C.Y.	775,000	$7.00	$5,425,000.00	40%	$7,595,000
05.0.D.B	Excavation, rock	C.Y.	69,500	$15.00	$1,042,500.00	40%	$1,459,500
05.0.D.B	Pre-splitting	S.Y.	8,000	$20.00	$160,000.00	40%	$224,000
05.0.D.B	Seeding	ACRE	5	$2,000.00	$10,000.00	40%	$14,000
	FOUNDATION WORK						
05.0.E.B	Steel sheet piling PS27.5	S.F.	158,500	$17.00	$2,694,500.00	40%	$3,772,300
05.0.E.B	Steel bearing piles, HP10x42	L.F.	28,800	$25.00	$720,000.00	40%	$1,008,000
05.0.E.B	Strut Existing River Chamber	JOB	1	$500,000.00	$500,000.00	100%	$1,000,000
05.0.E.B	Foundation Drilling, 4 in. Core	L.F.	4,000	$90.00	$360,000.00	40%	$504,000
05.0.E.B	Foundation Drilling, Drilling Without Sampling	L.F.	2,500	$30.00	$75,000.00	40%	$105,000
	DRAINAGE						
05.0.G.B	Drainage	JOB	1	$225,000.00	$225,000.00	40%	$315,000
	APPROACH CHANNELS						
05.0.1.B	Modify Approach Channel, Rock/Gravel Fill	C.Y.	50,000	$30.00	$1,500,000.00	50%	$2,250,000
05.0.1.B	Filter Material	C.Y.	16,000	$25.00	$400,000.00	40%	$560,000
05.1.E.B	Stone Protection	C.Y.	32,000	$35.00	$1,120,000.00	40%	$1,568,000
05.1.E.B	Mooring piers	EACH	4	$150,000.00	$600,000.00	40%	$840,000
	GUIDE AND GUARD WALLS, UPPER AND LOWER						
05.0.2.B	Fill, Guide and Guard Wall Cells	C.Y.	24,400	$25.00	$610,000.00	40%	$854,000
05.0.2.E 05.0.4.E	Guard fence	L.F.	8,000	$35.00	$280,000.00	40%	$392,000
	LOCK STRUCTURE						
05.0.4.B	Backfill, pervious	C.Y.	473,810	$17.00	$8,054,770.00	40%	$11,276,678
05.0.4.C	Concrete, Lock walls & sills	C.Y.	305,000	$110.00	$33,550,000.00	40%	$46,970,000
05.0.4.C	Steel reinforcement	LBS	2,351,500	$0.50	$1,175,750.00	40%	$1,646,050
05.0.4.C	Waterstops, non-metallic	L.F.	3,300	$20.00	$66,000.00	40%	$92,400
05.0.4.C	Cement	CWT	1,225,000	$3.75	$4,593,750.00	40%	$6,431,250

05.0.4.E	Wall armor	LBS	2,098,500	$1.50	$3,147,750.00	40%	$4,406,850
05.0.4.E	Floating mooring bitts	EACH	14	$35,000.00	$490,000.00	40%	$686,000
05.0.4.N	Permanent Instrumentation	JOB	1	$40,000.00	$40,000.00	40%	$56,000
	LOCK GATES AND OPERATING MACHINERY, UPPER AND LOWER						
05.0.5.E	Upper lock gates	SET	2	$350,000.00	$700,000.00	40%	$980,000
05.0.5.E	Lower lock gates	SET	2	$450,000.00	$900,000.00	40%	$1,260,000
05.0.5.E	Emergency bulkhead	JOB	1	$800,000.00	$800,000.00	40%	$1,120,000
05.0.5.E	Emergency Bulkhead Embedded Metal Recess Fillers & Hoist	JOB	1	$500,000.00	$500,000.00	40%	$700,000
05.0.5.E	Planking, aluminum	S.F.	8,500	$30.00	$255,000.00	40%	$357,000
05.0.5.E	Rabbet angles, aluminum	LBS	3,200	$14.00	$44,800.00	40%	$62,720
05.0.5.E	Pipe handrail, aluminum	L.F.	900	$75.00	$67,500.00	40%	$94,500
05.0.5.Q	Emergency Bulkhead Hoist & Lifting Beam	JOB	1	$350,000.00	$350,000.00	40%	$490,000
05.0.5.Q	Bulkhead dogging assembl's	JOB	1	$40,000.00	$40,000.00	40%	$56,000
05.0.5.Q	Lock Gate Operating Machinery	SET	8	$85,000.00	$680,000.00	40%	$952,000
05.0.5.R	Cathodic protection, gates	EACH	8	$11,000.00	$88,000.00	40%	$123,200
	CULVERT VALVES AND OPERATING MACHINERY						
05.0.6.B	Bulkhead storage area	JOB	1	$250,000.00	$250,000.00	40%	$350,000
05.0.6.E	Culvert Valves and Embedded Metal	EACH	4	$175,000.00	$700,000.00	40%	$980,000
05.0.6.E	Culvert Valve Bulkheads	EACH	4	$32,000.00	$128,000.00	40%	$179,200
05.0.6.E	Culvert Valve Bulkhead Embedded Metal	JOB	1	$75,000.00	$75,000.00	40%	$105,000
05.0.6.Q	Culvert Valve Operating Machinery	SET	4	$55,000.00	$220,000.00	40%	$308,000
	PIPING SYSTEM						
05.0.7.Q	Fuel system	JOB	1	$40,000.00	$40,000.00	50%	$60,000
05.0.7.Q	Compressed Air System	JOB	1	$250,000.00	$250,000.00	50%	$375,000
05.0.7.Q	Hydraulic System	JOB	1	$750,000.00	$750,000.00	50%	$1,125,000
05.0.7.Q	Service water system	JOB	1	$100,000.00	$100,000.00	50%	$150,000
05.0.7.Q	Domestic water system	JOB	1	$180,000.00	$180,000.00	50%	$270,000
	POWER AND LIGHTING SYSTEMS						
05.0.8.R	Power, Lighting and Signal System	JOB	1	$850,000.00	$850,000.00	50%	$1,275,000
05.0.8.R	Stand-by unit	JOB	1	$40,000.00	$40,000.00	50%	$60,000
	ASSOCIATED GENERAL ITEMS						
05.0.R.B	Esplanade Subbase	C.Y.	1,890	$25.00	$47,250.00	40%	$66,150
05.0.R.B	Chain Link Fence	L.F.	3,400	$10.00	$34,000.00	40%	$47,600
05.0.R.B	Flag pole	JOB	1	$3,000.00	$3,000.00	40%	$4,200
05.0.R.C	Concrete, Esplanade	S.Y.	11,340	$60.00	$680,400.00	40%	$952,560
05.0.R.E	Miscellaneous metal	LBS	927,100	$2.75	$2,549,525.00	40%	$3,569,335
05.0.R.K	Life Boats and Lowering Facilities	JOB	1	$45,000.00	$45,000.00	40%	$63,000
05.0.R.P	Elevator	JOB	1	$55,000.00	$55,000.00	40%	$77,000
	BRIDGES, ABUTMENTS AND PIERS						
05.0.K.C	Concrete, Lock wall bridge piers	C.Y.	1,100	$175.00	$192,500.00	40%	$269,500
05.0.K.E	Miscellaneous Items for Lock Wall Piers	JOB	1	$110,000.00	$110,000.00	40%	$154,000
	BRIDGES, SUPERSTRUCTURE AND DECK						
05.0.L.E	Service bridge	JOB	1	$500,000.00	$500,000.00	40%	$700,000

	BUILDINGS, PROJECT OPERATIONS						
05.0.N.-	Operation building	JOB	1	$500,000.00	$500,000.00	40%	$700,000
05.0.N.-	Service building	JOB	1	$150,000.00	$150,000.00	40%	$210,000
05.0.N.-	Control shelters	EACH	4	$15,000.00	$60,000.00	40%	$84,000
05.0.N.-	Gage House & equipment	JOB	1	$200,000.00	$200,000.00	40%	$280,000
	CHANNELS AND CANALS						
09.0.2.B	Remove Existing Lock Structure, Concrete Removal	C.Y.	87,000	$150.00	$13,050,000.00	40%	$18,270,000
09.0.2.B	Remove Existing Dam Section	C.Y.	650	$150.00	$97,500.00	40%	$136,500
	DREDGING						
	MECHANICAL DREDGING						
12.0.4.B	Modify Approach Channel, Dredging	C.Y.	657,200	$15.00	$9,858,000.00	300%	$39,432,000
	TOTAL CONSTRUCTION COSTS, LOCKS				$119,980,495		$204,324,493
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, LOCKS					70%	
30.-.-.-	Planning, Engineering and Design				$12,150,000.00	25%	$15,187,500
31.-.-.-	Construction Management				$9,100,000.00	25%	$11,375,000
	TOTAL FIRST COSTS, LOCKS				$141,230,495		$230,886,993
	AVERAGE OVERALL CONTINGENCY, LOCKS					63%	

R.M. 23.8 - REPLACE EXISTING TWO CHAMBER LOCK "IN KIND" @ EXISTING LOCATION, REPLACE BOTH CHAMBERS "IN KIND" (56'x360' LAND CHAMBER & 56'x720' RIVER CHAMBER) & FIXED CREST DAM
Without Project
(October 1991 Cost Level)

FILE:MNRIK3.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	SPILLWAY	REPLACEMENT OF FIXED CREST DAM					
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
04.2.A.A	Mobilization and prep work	JOB	1	$2,500,000.00	$2,500,000.00	100%	$5,000,000
	CARE AND DIVERSION OF WATER						
04.2.B.B	Cofferdams	JOB	1	$13,700,000.00	$13,700,000.00	100%	$27,400,000
04.2.B.N	Cofferdam Instrumentation	JOB	1	$140,000.00	$140,000.00	100%	$280,000
	EARTHWORK FOR STRUCTURES						
04.2.D.B	Clearing & grubbing	JOB	1	$3,500.00	$3,500.00	40%	$4,900
04.2.D.B	Excavation, common	C.Y.	222,700	$15.00	$3,340,500.00	100%	$6,681,000
04.2.D.B	Excavation, rock	C.Y.	7,450	$20.00	$149,000.00	40%	$208,600
04.2.D.B	Pre-splitting	S.Y.	1,750	$20.00	$35,000.00	40%	$49,000
04.2.D.B	Compacted earth fill	C.Y.	64,340	$3.00	$193,020.00	40%	$270,228
04.2.D.B	Rock fill	C.Y.	50,315	$25.00	$1,257,875.00	40%	$1,761,025
	CONCRETE OVERFLOW SECTION						
04.2.2.C	Concrete, dam & abutment	C.Y.	70,950	$150.00	$10,642,500.00	40%	$14,899,500
04.2.2.C	Cement	CWT	267,000	$4.00	$1,068,000.00	40%	$1,495,200
04.2.2.C	Steel reinforcement	LBS	634,000	$0.50	$317,000.00	40%	$443,800
04.2.2.C	Waterstops, non-metallic	L.F.	950	$20.00	$19,000.00	40%	$26,600
	OUTLET WORKS						
	APPROACH AND OUTLET CHANNELS						
04.3.1.B	Filter material	C.Y.	1,420	$40.00	$56,800.00	40%	$79,520
04.3.1.B	Stone protection	C.Y.	3,590	$35.00	$125,650.00	40%	$175,910
04.3.1.B	Derrick stone	C.Y.	15,724	$35.00	$550,340.00	40%	$770,476
	CHANNELS AND CANALS						
	CHANNELS, SITE WORK						
09.0.2.B	Removal of Existing Structure, Concrete Removal	C.Y.	16,350	$150.00	$2,452,500.00	40%	$3,433,500
09.0.2.B	Removal of Existing Structure, Wood, Stone and Fill Removal	C.Y.	13,000	$25.00	$325,000.00	40%	$455,000
	TOTAL CONSTRUCTION COSTS, DAM				$36,875,685		$63,434,259
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, DAM					72%	
30.-.-.-	Planning, Engineering, and Design				$4,400,000	25%	$5,500,000
31.-.-.-	Construction Management				$3,275,000	25%	$4,093,750
	TOTAL, FIRST COSTS, DAM				$44,550,685		$73,028,009
	AVERAGE OVERALL CONTINGENCY, DAM					64%	

R.M. 23.8 - REPLACE L/D 3 @ EXISTING LOCATION.
CONSTRUCT TWO NEW LOCK CHAMBERS AND A NEW FIXED CREST DAM @ EXISTING L/D 3.
PLAN 3
(October 1991 Cost Level)

FILE:PLAN3LKDM

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REPLACEMENT OF LOCKS (TWO CHAMBERS)						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
05.0.A.A	Mobilization & Prep. Work	JOB	1	$8,500,000.00	$8,500,000	100%	$17,000,000
	CARE AND DIVERSION OF WATER						
05.0.B.B	Cofferdam	JOB	1	$21,500,000.00	$21,500,000	100%	$43,000,000
05.0.B.N	Cofferdam Instrumentation	JOB	1	$110,000.00	$110,000	100%	$220,000
	EARTHWORK FOR STRUCTURES						
05.0.D.B	Excavation, Common	C.Y.	1,700,000	$8.00	$13,600,000	40%	$19,040,000
05.0.D.B	Excavation, Rock	C.Y.	26,400	$15.00	$396,000	100%	$792,000
05.0.D.B	Pre-splitting	S.Y.	3,900	$20.00	$78,000	100%	$156,000
05.0.D.B	Seeding	ACRE	5	$2,000.00	$10,000	40%	$14,000
	FOUNDATION WORK						
05.0.E.B	Steel Sheet Piling, PS27.5	S.F.	258,158	$20.00	$5,163,160	40%	$7,228,424
05.0.E.B	Steel Bearing Piles, HP10x42	L.F.	124,905	$25.00	$3,122,625	40%	$4,371,675
05.0.E.B	Temp. Retaining Wall, Steel Sheetpiling w/ Anchors	JOB	1	SUM	$10,000,000	40%	$14,000,000
05.0.E.B	Stabilize Existing Lock Structure	JOB	1	$2,000,000.00	$2,000,000	100%	$4,000,000
05.0.E.B	Foundation Drilling, 4 in. Core	L.F.	4,000	$90.00	$360,000	70%	$612,000
05.0.E.B	Foundation Drilling, Drilling Without Sampling	L.F.	2,500	$30.00	$75,000	70%	$127,500
	DRAINAGE						
05.0.G.B	Drainage	JOB	1	$225,000.00	$225,000	40%	$315,000
	APPROACH CHANNELS						
05.0.1.B	Derrick Stone	C.Y.	23,956	$35.00	$838,460	40%	$1,173,844
05.0.1.B	Filter Material	C.Y.	16,000	$25.00	$400,000	40%	$560,000
05.1.E.B	Stone Protection	C.Y.	32,000	$35.00	$1,120,000	40%	$1,568,000
05.1.E.B	Mooring Piers	EACH	4	$150,000.00	$600,000	40%	$840,000
	GUIDE AND GUARD WALLS, UPPER AND LOWER						
05.0.2.B	Fill, Guide Wall Cells	C.Y.	69,116	$20.00	$1,382,320	40%	$1,935,248
05.0.2.E	Guard Fence	L.F.	8,000	$35.00	$280,000	40%	$392,000
	LOCK STRUCTURE						
05.0.4.B	Backfill, Pervious	C.Y.	473,810	$17.00	$8,054,770	40%	$11,276,678
05.0.4.C	Concrete, Lock Walls & Sills	C.Y.	361,190	$110.00	$39,730,900	40%	$55,623,260
05.0.4.C	Steel Reinforcement	LBS	2,351,500	$0.50	$1,175,750	40%	$1,646,050
05.0.4.C	Waterstops, Non-metallic	L.F.	3,300	$20.00	$66,000	40%	$92,400
05.0.4.C	Cement	CWT	1,371,000	$3.75	$5,141,250	40%	$7,197,750
05.0.4.E	Wall Armor	LBS	2,001,900	$1.50	$3,002,850	40%	$4,203,990
05.0.4.E	Floating Mooring Bitts	EACH	14	$35,000.00	$490,000	40%	$686,000
05.0.4.N	Permanent Instrumentation	JOB	1	$40,000.00	$40,000	40%	$56,000

	LOCK GATES AND OPERATING MACHINERY, UPPER AND LOWER						
05.0.5.E	Upper Lock Gates	SET	2	$405,000.00	$810,000	40%	$1,134,000
05.0.5.E	Lower Lock Gates	SET	2	$485,000.00	$970,000	40%	$1,358,000
05.0.5.E	Emergency Bulkhead	JOB	1	$1,300,000.00	$1,300,000	40%	$1,820,000
05.0.5.E	Emergency Bulkhead Embedded Metal Recess Fillers & Hoist	JOB	1	$440,000.00	$440,000	40%	$616,000
05.0.5.E	Planking, Aluminum	S.F.	8,500	$30.00	$255,000	40%	$357,000
05.0.5.E	Rabbet Angles, Aluminum	L.F.	3,200	$14.00	$44,800	40%	$62,720
05.0.5.E	Pipe Handrail, Aluminum	L.F.	900	$75.00	$67,500	40%	$94,500
05.0.5.Q	Emergency Bulkhead Hoist & Lifting Beam	JOB	1	$370,000.00	$370,000	40%	$518,000
05.0.5.Q	Bulkhead Dogging Assemblies	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.5.Q	Lock Gate Operating Machinery	SET	8	$110,000.00	$880,000	40%	$1,232,000
05.0.5.R	Cathodic Protection, Gate Leaves	EACH	8	$11,000.00	$88,000	40%	$123,200
	CULVERT VALVES AND OPERATING MACHINERY						
05.0.6.B	Bulkhead Storage Area	JOB	1	$285,000.00	$285,000	40%	$399,000
05.0.6.E	Culvert Valves and Embedded Metal	EACH	6	$110,000.00	$660,000	40%	$924,000
05.0.6.E	Culvert Valve Bulkheads	EACH	6	$32,000.00	$192,000	40%	$268,800
05.0.6.E	Culvert Valve Bulkhead Embedded Metal	JOB	1	$75,000.00	$75,000	40%	$105,000
05.0.6.Q	Culvert Valve Operating Machinery	SET	6	$110,000.00	$660,000	40%	$924,000
	PIPING SYSTEM						
05.0.7.Q	Fuel System	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.7.Q	Compressed Air System	JOB	1	$270,000.00	$270,000	40%	$378,000
05.0.7.Q	Hydraulic System	JOB	1	$1,000,000.00	$1,000,000	40%	$1,400,000
05.0.7.Q	Service Water System	JOB	1	$120,000.00	$120,000	40%	$168,000
05.0.7.Q	Domestic Water System	JOB	1	$200,000.00	$200,000	40%	$280,000
	POWER AND LIGHTING SYSTEMS						
05.0.8.R	Power, Lighting and Signal System	JOB	1	$1,250,000.00	$1,250,000	40%	$1,750,000
05.0.8.R	Stand-by Unit	JOB	1	$40,000.00	$40,000	40%	$56,000
	ASSOCIATED GENERAL ITEMS						
05.0.R.B	Esplanade Subbase	C.Y.	1,890	$25.00	$47,250	40%	$66,150
05.0.R.B	Chain Link Fence	L.F.	3,400	$10.00	$34,000	40%	$47,600
05.0.R.B	Flag Pole	JOB	1	$3,000.00	$3,000	40%	$4,200
05.0.R.C	Concrete, Esplanade	S.Y.	11,340	$60.00	$680,400	40%	$952,560
05.0.R.E	Miscellaneous Metal	LBS	927,100	$2.75	$2,549,525	40%	$3,569,335
05.0.R.K	Life Boats and Lowering Facilities	JOB	1	$45,000.00	$45,000	40%	$63,000
05.0.R.P	Elevator	JOB	1	$55,000.00	$55,000	40%	$77,000
	BRIDGES, ABUTMENTS AND PIERS						
05.0.K.C	Concrete, Lock Wall Bridge Piers	C.Y.	1,095	$175.00	$191,625	40%	$268,275
05.0.K.E	Miscellaneous Items for Lock Wall Piers	JOB	1	$110,000.00	$110,000	40%	$154,000
	BRIDGES, SUPERSTRUCTURE AND DECK						
05.0.L.E	Service Bridge	JOB	1	$600,000.00	$600,000	40%	$840,000

	BUILDINGS, PROJECT OPERATIONS						
05.0.N.-	Operation Building	JOB	1	$350,000.00	$350,000	40%	$490,000
05.0.N.-	Service Building	JOB	1	$150,000.00	$150,000	40%	$210,000
05.0.N.-	Control Shelters	EACH	4	$15,000.00	$60,000	40%	$84,000
05.0.N.-	Gage House & Equipment	JOB	1	$200,000.00	$200,000	40%	$280,000
	DREDGING						
	MECHANICAL DREDGING						
12.0.4.B	Modify Approach Channel, Dredging	C.Y.	770,190	$15.00	$11,552,850	300%	$46,211,400
	CHANNELS AND CANALS						
09.0.2.B	Remove Existing Lock Structure, Concrete Removal	C.Y.	88,000	$150.00	$13,200,000	40%	$18,480,000
09.0.2.B	Remove Existing Lock Structure, Cell Removal	EACH	18	$30,000.00	$540,000	40%	$756,000
09.0.2.B	Remove Existing Lock Structure, Arc Removal	EACH	14	$10,000.00	$140,000	40%	$196,000
	TOTAL CONSTRUCTION COSTS, LOCKS				$168,028,035		$284,957,559
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, LOCKS					70%	
30.-.-.-	Planning, Engineering and Design				$16,800,000	25%	$21,000,000
31.-.-.-	Construction Management				$12,600,000	25%	$15,750,000
	TOTAL FIRST COSTS, LOCKS				$197,428,035		$321,707,559
	AVERAGE OVERALL CONTINGENCY, LOCKS					63%	

R.M. 23.8 - REPLACE L/D 3 @ EXISTING LOCATION.
CONSTRUCT TWO NEW LOCK CHAMBERS AND A NEW FIXED CREST DAM @ EXISTING L/D 3. FILE:PLAN3LKDM
PLAN 3
(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	SPILLWAY	REPLACEMENT OF FIXED CREST DAM					
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
04.2.A.A	Mobilization and Prep. Work	JOB	1	$1,900,000.00	$1,900,000	100%	$3,800,000
	CARE AND DIVERSION OF WATER						
04.2.B.B	Cofferdams	JOB	1	$13,700,000.00	$13,700,000	100%	$27,400,000
04.2.B.N	Cofferdam Instrumentation	JOB	1	$140,000.00	$140,000	100%	$280,000
	EARTHWORK FOR STRUCTURES						
04.2.D.B	Clearing & Grubbing	JOB	1	$3,500.00	$3,500	40%	$4,900
04.2.D.B	Excavation, Common	C.Y.	211,368	$8.00	$1,690,944	100%	$3,381,888
04.2.D.B	Excavation, Rock	C.Y.	7,070	$20.00	$141,400	100%	$282,800
04.2.D.B	Pre-splitting	S.Y.	1,665	$20.00	$33,300	100%	$66,600
04.2.D.B	Compacted Earth Fill	C.Y.	61,065	$3.00	$183,195	40%	$256,473
04.2.D.B	Rock Fill	C.Y.	47,760	$30.00	$1,432,800	40%	$2,005,920
	CONCRETE OVERFLOW SECTION						
04.2.2.C	Concrete, Dam & Abutment	C.Y.	67,335	$150.00	$10,100,250	40%	$14,140,350
04.2.2.C	Cement	CWT	253,325	$4.00	$1,013,300	40%	$1,418,620
04.2.2.C	Steel Reinforcement	LBS	601,600	$0.50	$300,800	40%	$421,120
04.2.2.C	Waterstops, Non-metallic	L.F.	900	$20.00	$18,000	40%	$25,200
	OUTLET WORKS						
	APPROACH AND OUTLET CHANNELS						
04.3.1.B	Filter Material	C.Y.	1,350	$45.00	$60,750	40%	$85,050
04.3.1.B	Stone Protection	C.Y.	3,407	$35.00	$119,245	40%	$166,943
04.3.1.B	Derrick Stone	C.Y.	14,922	$35.00	$522,270	40%	$731,178
	CHANNELS AND CANALS						
	CHANNELS, SITE WORK						
09.0.2.B	Removal of Existing Structure, Concrete Removal	C.Y.	17,000	$150.00	$2,550,000	40%	$3,570,000
	TOTAL CONSTRUCTION COSTS, DAM				$33,909,754		$58,037,042
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					71%	
30.-.-.-	Planning, Engineering and Design				$3,500,000	25%	$4,375,000
31.-.-.-	Construction Management				$2,600,000	25%	$3,250,000
	TOTAL FIRST COSTS, DAM				$40,009,754		$65,662,042
	AVERAGE OVERALL CONTINGENCY, DAM					64%	

R.M. 24.6 - REPLACE L/D 3 @ A NEW LOCATION
CONSTRUCT TWO NEW 84 FT LOCK CHAMBERS AND FIXED CREST DAM
PLAN 4
(October 1991 Cost Level)

FILE:PLAN4LKDM

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REPLACEMENT OF LOCKS (BOTH CHAMBERS)						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
05.0.A.A	Mobilization & Prep. Work	JOB	1	$6,500,000.00	$6,500,000	100%	$13,000,000
	PERMANENT ACCESS ROADS AND PARKING						
05.0.C.B	Access Road	JOB	1	$80,000.00	$80,000	40%	$112,000
	CARE AND DIVERSION OF WATER						
05.0.B.B	Cofferdam	JOB	1	$20,000,000.00	$20,000,000	100%	$40,000,000
05.0.B.N	Cofferdam Instrumentation	JOB	1	$100,000.00	$100,000	100%	$200,000
	EARTHWORK FOR STRUCTURES						
05.0.D.B	Clearing and Grubbing	JOB	1	$75,000.00	$75,000	40%	$105,000
05.0.D.B	Excavation, Common	C.Y.	2,343,700	$6.00	$14,062,200	40%	$19,687,080
05.0.D.B	Excavation, Rock	C.Y.	66,830	$15.00	$1,002,450	100%	$2,004,900
05.0.D.B	Pre-splitting	S.Y.	9,350	$20.00	$187,000	100%	$374,000
05.0.D.B	Seeding	ACRE	5	$2,000.00	$10,000	40%	$14,000
	FOUNDATION WORK						
05.0.E.B	Steel Sheet Piling, PS27.5	S.F.	184,670	$17.00	$3,139,390	40%	$4,395,146
05.0.E.B	Steel Bearing Piles, HP10x42	L.F.	70,300	$20.00	$1,406,000	40%	$1,968,400
05.0.E.B	Temp. Retaining Wall, Steel Sheetpiling w/ Anchors	JOB	1	SUM	$3,000,000	40%	$4,200,000
05.0.E.B	Foundation Drilling, 4 in. Core	L.F.	4,000	$90.00	$360,000	40%	$504,000
05.0.E.B	Foundation Drilling, Drilling Without Sampling	L.F.	2,500	$30.00	$75,000	40%	$105,000
	DRAINAGE						
05.0.G.B	Drainage	JOB	1	$225,000.00	$225,000	40%	$315,000
	APPROACH CHANNELS						
05.0.1.B	Modify Approach Channel, Rock/Gravel Fill	C.Y.	35,800	$30.00	$1,074,000	40%	$1,503,600
05.0.1.B	Filter Material	C.Y.	21,300	$25.00	$532,500	40%	$745,500
05.1.E.B	Stone Protection	C.Y.	43,000	$35.00	$1,505,000	40%	$2,107,000
05.1.E.B	Graded Stone, Dikes	C.Y.	15,500	$40.00	$620,000	40%	$868,000
05.1.E.B	Rock Fill, Random, Dikes	C.Y.	56,800	$30.00	$1,704,000	40%	$2,385,600
05.1.E.B	Mooring Piers	EACH	4	$150,000.00	$600,000	40%	$840,000
	GUIDE AND GUARD WALLS, UPPER AND LOWER						
05.0.2.B	Fill, Guide Wall Cells	C.Y.	50,180	$20.00	$1,003,600	40%	$1,405,040
05.0.2.E 05.0.4.E	Guard Fence	L.F.	8,000	$35.00	$280,000	40%	$392,000
	LOCK STRUCTURE						
05.0.4.B	Backfill, Pervious	C.Y.	207,250	$17.00	$3,523,250	40%	$4,932,550
05.0.4.C	Concrete, Lock Walls & Sills	C.Y.	350,100	$110.00	$38,511,000	40%	$53,915,400
05.0.4.C	Steel Reinforcement	LBS	2,737,370	$0.50	$1,368,685	40%	$1,916,159

05.0.4.C	Waterstops, Non-metallic	L.F.	8,230	$20.00	$164,600	40%	$230,440
05.0.4.C	Cement	CWT	1,343,520	$3.75	$5,038,200	40%	$7,053,480
05.0.4.E	Wall Armor	LBS	2,170,440	$1.50	$3,255,660	40%	$4,557,924
05.0.4.E	Floating Mooring Bitts	EACH	14	$35,000.00	$490,000	40%	$686,000
05.0.4.N	Permanent Instrumentation	JOB	1	$40,000.00	$40,000	40%	$56,000
	LOCK GATES AND OPERATING MACHINERY, UPPER AND LOWER						
05.0.5.E	Upper Lock Gates	SET	2	$400,000.00	$800,000	40%	$1,120,000
05.0.5.E	Lower Lock Gates	SET	2	$480,000.00	$960,000	40%	$1,344,000
05.0.5.E	Emergency Bulkhead	JOB	1	$1,300,000.00	$1,300,000	40%	$1,820,000
05.0.5.E	Emergency Bulkhead Embedded Metal Recess Fillers & Hoist	JOB	1	$430,000.00	$430,000	40%	$602,000
05.0.5.E	Planking, Aluminum	S.F.	8,500	$30.00	$255,000	40%	$357,000
05.0.5.E	Rabbet Angles, Aluminum	L.F.	3,200	$14.00	$44,800	40%	$62,720
05.0.5.E	Pipe Handrail, Aluminum	L.F.	900	$75.00	$67,500	40%	$94,500
05.0.5.Q	Emergency Bulkhead Hoist & Lifting Beam	JOB	1	$370,000.00	$370,000	40%	$518,000
05.0.5.Q	Bulkhead Dogging Assemblies	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.5.Q	Lock Gate Operating Machinery	SET	8	$110,000.00	$880,000	40%	$1,232,000
05.0.5.R	Cathodic Protection, Gate Leaves	EACH	8	$11,000.00	$88,000	40%	$123,200
	CULVERT VALVES AND OPERATING MACHINERY						
05.0.6.B	Bulkhead Storage Area	JOB	1	$285,000.00	$285,000	40%	$399,000
05.0.6.E	Culvert Valves and Embedded Metal	EACH	6	$110,000.00	$660,000	40%	$924,000
05.0.6.E	Culvert Valve Bulkheads	EACH	6	$35,000.00	$210,000	40%	$294,000
05.0.6.E	Culvert Valve Bulkhead Embedded Metal	JOB	1	$75,000.00	$75,000	40%	$105,000
05.0.6.Q	Culvert Valve Operating Machinery	SET	6	$110,000.00	$660,000	40%	$924,000
	PIPING SYSTEM						
05.0.7.Q	Fuel System	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.7.Q	Compressed Air System	JOB	1	$270,000.00	$270,000	40%	$378,000
05.0.7.Q	Hydraulic System	JOB	1	$1,000,000.00	$1,000,000	40%	$1,400,000
05.0.7.Q	Service Water System	JOB	1	$120,000.00	$120,000	40%	$168,000
05.0.7.Q	Domestic Water System	JOB	1	$200,000.00	$200,000	40%	$280,000
	POWER AND LIGHTING SYSTEMS						
05.0.8.R	Power, Lighting and Signal System	JOB	1	$1,250,000.00	$1,250,000	40%	$1,750,000
05.0.8.R	Stand-by Unit	JOB	1	$40,000.00	$40,000	40%	$56,000
	ASSOCIATED GENERAL ITEMS						
05.0.R.B	Esplanade Subbase	C.Y.	1,275	$25.00	$31,875	40%	$44,625
05.0.R.B	Chain Link Fence	L.F.	3,400	$10.00	$34,000	40%	$47,600
05.0.R.B	Flag Pole	JOB	1	$3,000.00	$3,000	40%	$4,200
05.0.R.C	Concrete, Esplanade	S.Y.	5,700	$60.00	$342,000	40%	$478,800
05.0.R.E	Miscellaneous Metal	LBS	927,100	$2.75	$2,549,525	40%	$3,569,335
05.0.R.K	Life Boats and Lowering Facilities	JOB	1	$45,000.00	$45,000	40%	$63,000
05.0.R.P	Elevator	JOB	1	$55,000.00	$55,000	40%	$77,000

	BRIDGES, ABUTMENTS AND PIERS						
05.0.K.C	Concrete, Lock Wall Bridge Piers	C.Y.	3,860	$175.00	$675,500	40%	$945,700
05.0.K.E	Miscellaneous Items for Lock Wall Piers	JOB	1	$110,000.00	$110,000	40%	$154,000
	BRIDGES, SUPERSTRUCTURE AND DECK						
05.0.L.E	Service Bridge	JOB	1	$600,000.00	$600,000	40%	$840,000
	BUILDINGS, PROJECT OPERATIONS						
05.0.N.-	Operation Building	JOB	1	$350,000.00	$350,000	40%	$490,000
05.0.N.-	Service Building	JOB	1	$150,000.00	$150,000	40%	$210,000
05.0.N.-	Control Shelters	EACH	4	$15,000.00	$60,000	40%	$84,000
05.0.N.-	Gage House & Equipment	JOB	1	$200,000.00	$200,000	40%	$280,000
	DREDGING						
	MECHANICAL DREDGING						
12.0.4.B	Modify Approach Channel, Dredging	C.Y.	72,200	$15.00	$1,083,000	300%	$4,332,000
	TOTAL CONSTRUCTION COSTS, LOCKS				$126,266,735		$196,262,899
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, LOCKS					55%	
30.-.-.-	Planning, Engineering and Design				$13,000,000	25%	$16,250,000
31.-.-.-	Construction Management				$9,750,000	25%	$12,187,500
	TOTAL FIRST COSTS, LOCKS				$149,016,735		$224,700,399
	AVERAGE OVERALL CONTINGENCY, LOCKS					51%	

R.M. 24.6 - REPLACE L/D 3 @ A NEW LOCATION
CONSTRUCT TWO NEW 84 FT LOCK CHAMBERS AND FIXED CREST DAM
PLAN 4
(October 1991 Cost Level)

FILE:PLAN4LKDM

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REPLACEMENT OF FIXED CREST DAM						
	SPILLWAY						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
04.2.A.A	Mobilization and Prep. Work	JOB	1	$2,517,521.58	$2,517,522	100%	$5,035,043
	CARE AND DIVERSION OF WATER						
04.2.B.B	Cofferdams	JOB	1	$25,000,000.00	$25,000,000	100%	$50,000,000
04.2.B.N	Cofferdam Instrumentation	JOB	1	$250,000.00	$250,000	100%	$500,000
	EARTHWORK FOR STRUCTURES						
04.2.D.B	Clearing & Grubbing	JOB	1	$6,000.00	$6,000	40%	$8,400
04.2.D.B	Excavation, Common	C.Y.	402,570	$6.00	$2,415,420	40%	$3,381,588
04.2.D.B	Excavation, Rock	C.Y.	24,280	$15.00	$364,200	100%	$728,400
04.2.D.B	Pre-splitting	S.Y.	2,290	$30.00	$68,700	100%	$137,400
04.2.D.B	Rock Fill	C.Y.	5,100	$30.00	$153,000	40%	$214,200
	FOUNDATION WORK						
04.2.E.B	Steel Sheet Piling, PS27.5	S.F.	7,200	$20.00	$144,000	40%	$201,600
04.2.E.B	Steel Sheet Piling with Anchors, PS27.5	S.F.	10,200	$45.00	$459,000	40%	$642,600
	CONCRETE OVERFLOW SECTION						
04.2.2.B	Backfill, Pervious	C.Y.	12,790	$20.00	$255,800	40%	$358,120
04.2.2.C	Concrete, Dam & Abutment	C.Y.	79,000	$150.00	$11,850,000	40%	$16,590,000
04.2.2.C	Cement	CWT	309,300	$4.00	$1,237,200	40%	$1,732,080
04.2.2.C	Steel Reinforcement	LBS	780,000	$0.50	$390,000	40%	$546,000
04.2.2.C	Waterstops, Non-metallic	L.F.	2,550	$20.00	$51,000	40%	$71,400
	OUTLET WORKS						
	APPROACH AND OUTLET CHANNELS						
04.3.1.B	Filter Material	C.Y.	22,300	$45.00	$1,003,500	40%	$1,404,900
04.3.1.B	Stone Protection	C.Y.	54,700	$35.00	$1,914,500	40%	$2,680,300
04.3.1.B	Derrick Stone	C.Y.	15,300	$40.00	$612,000	40%	$856,800
	CAISSONS, 30 IN. DIA.						
04.1.E	Drill & Concrete thru Rock	L.F.	1,220	$300.00	$366,000	40%	$512,400
04.1.E	Structural Steel	LBS	160,900	$0.50	$80,450	40%	$112,630
	TOTAL CONSTRUCTION COSTS, DAM				$49,138,292		$85,713,861
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, DAM					74%	
30.-.-.-	Planning, Engineering and Design				$5,100,000	25%	$6,375,000
31.-.-.-	Construction Management				$3,800,000	25%	$4,750,000
	TOTAL FIRST COSTS, DAM				$58,038,292		$96,838,861
	AVERAGE OVERALL CONTINGENCY, DAM					67%	

R.M. 34.0 - REPLACE L/D 3 AND L/D 4 @ A NEW LOCATION. FILE:PLAN67LKD
CONSTRUCT TWO NEW 84 x 720 LOCK CHAMBERS AND A NEW GATED DAM BETWEEN THE TWO EXISTING SITES
PLAN 6 & 7
(October 1990 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REPLACEMENT OF LOCKS (BOTH CHAMBERS)						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
05.0.A.A	Mobilization & Prep. Work	JOB	1	$6,000,000.00	$6,000,000	100%	$12,000,000
	PERMANENT ACCESS ROADS AND PARKING						
05.0.C.B	Access Road	JOB	1	$73,500.00	$73,500	40%	$102,900
	CARE AND DIVERSION OF WATER						
05.0.B.B	Cofferdam	JOB	1	$8,100,000.00	$8,100,000	100%	$16,200,000
05.0.B.N	Cofferdam Instrumentation	JOB	1	$40,000.00	$40,000	100%	$80,000
	EARTHWORK FOR STRUCTURES						
05.0.D.B	Clearing and Grubbing	JOB	1	$80,000.00	$80,000	40%	$112,000
05.0.D.B	Excavation, Common	C.Y.	1,340,200	$6.00	$8,041,200	40%	$11,257,680
05.0.D.B	Excavation, Rock	C.Y.	63,200	$10.00	$632,000	100%	$1,264,000
05.0.D.B	Pre-splitting	S.Y.	10,700	$18.00	$192,600	100%	$385,200
05.0.D.B	Seeding	ACRE	5	$2,000.00	$10,000	40%	$14,000
	FOUNDATION WORK						
05.0.E.B	Steel Sheet Piling, PS27.5	S.F.	210,000	$17.00	$3,570,000	40%	$4,998,000
05.0.E.B	Steel Bearing Piles, HP10x42	L.F.	58,600	$20.00	$1,172,000	40%	$1,640,800
05.0.E.B	Temp. Retaining Wall, Steel Sheetpiling w/ Anchors	S.F.	48,500	$50.00	$2,425,000	40%	$3,395,000
05.0.E.B	Foundation Drilling, 4 in. Core	L.F.	4,000	$90.00	$360,000	40%	$504,000
05.0.E.B	Foundation Drilling, Drilling Without Sampling	L.F.	2,500	$30.00	$75,000	40%	$105,000
	DRAINAGE						
05.0.G.B	Drainage	JOB	1	$225,000.00	$225,000	40%	$315,000
	APPROACH CHANNELS						
05.0.1.B	Filter Material	C.Y.	16,200	$25.00	$405,000	40%	$567,000
05.1.E.B	Stone Protection	C.Y.	32,400	$35.00	$1,134,000	40%	$1,587,600
05.1.E.B	Mooring Piers	EACH	4	$150,000.00	$600,000	40%	$840,000
	GUIDE AND GUARD WALLS, UPPER AND LOWER						
05.0.2.B	Fill, Guide Wall Cells	C.Y.	17,900	$20.00	$358,000	40%	$501,200
05.0.2.E	Guard Fence	L.F.	8,000	$35.00	$280,000	40%	$392,000
	LOCK STRUCTURE						
05.0.4.B	Backfill, Pervious	C.Y.	92,800	$17.00	$1,577,600	40%	$2,208,640
05.0.4.C	Concrete, Lock Walls & Sills	C.Y.	350,750	$110.00	$38,582,500	40%	$54,015,500
05.0.4.C	Steel Reinforcement	LBS	2,440,500	$0.50	$1,220,250	40%	$1,708,350
05.0.4.C	Waterstops, Non-metallic	L.F.	3,300	$20.00	$66,000	40%	$92,400
05.0.4.C	Cement	CWT	1,344,400	$3.75	$5,041,500	40%	$7,058,100
05.0.4.E	Wall Armor	LBS	2,170,500	$1.50	$3,255,750	40%	$4,558,050
05.0.4.E	Floating Mooring Bitts	EACH	14	$35,000.00	$490,000	40%	$686,000
05.0.4.N	Permanent Instrumentation	JOB	1	$40,000.00	$40,000	40%	$56,000

	LOCK GATES AND OPERATING MACHINERY, UPPER AND LOWER					
05.0.5.E	Upper Lock Gates	SET	2	$430,000.00	$860,000	40%	$1,204,000
05.0.5.E	Lower Lock Gates	SET	2	$536,000.00	$1,072,000	40%	$1,500,800
05.0.5.E	Emergency Bulkhead	JOB	1	$1,300,000.00	$1,300,000	40%	$1,820,000
05.0.5.E	Emergency Bulkhead Embedded Metal Recess Fillers & Hoist	JOB	1	$420,000.00	$420,000	40%	$588,000
05.0.5.E	Planking, Aluminum	S.F.	8,500	$30.00	$255,000	40%	$357,000
05.0.5.E	Rabbet Angles, Aluminum	LBS	3,200	$14.00	$44,800	40%	$62,720
05.0.5.E	Pipe Handrail, Aluminum	L.F.	900	$75.00	$67,500	40%	$94,500
05.0.5.Q	Emergency Bulkhead Hoist & Lifting Beam	JOB	1	$370,000.00	$370,000	40%	$518,000
05.0.5.Q	Bulkhead Dogging Assemblies	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.5.Q	Lock Gate Operating Machinery	SET	8	$110,000.00	$880,000	40%	$1,232,000
05.0.5.R	Cathodic Protection, Gates	EACH	8	$11,000.00	$88,000	40%	$123,200
	CULVERT VALVES AND OPERATING MACHINERY					
05.0.6.B	Bulkhead Storage Area	JOB	1	$285,000.00	$285,000	40%	$399,000
05.0.6.E	Culvert Valves and Embedded Metal	EACH	6	$110,000.00	$660,000	40%	$924,000
05.0.6.E	Culvert Valve Bulkheads	EACH	6	$35,000.00	$210,000	40%	$294,000
05.0.6.E	Culvert Valve Bulkhead Embedded Metal	JOB	1	$75,000.00	$75,000	40%	$105,000
05.0.6.Q	Culvert Valve Operating Machinery	SET	6	$110,000.00	$660,000	40%	$924,000
	PIPING SYSTEM					
05.0.7.Q	Fuel System	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.7.Q	Compressed Air System	JOB	1	$270,000.00	$270,000	40%	$378,000
05.0.7.Q	Hydraulic System	JOB	1	$1,000,000.00	$1,000,000	40%	$1,400,000
05.0.7.Q	Service Water System	JOB	1	$120,000.00	$120,000	40%	$168,000
05.0.7.Q	Domestic Water System	JOB	1	$200,000.00	$200,000	40%	$280,000
	POWER AND LIGHTING SYSTEMS					
05.0.8.R	Power, Lighting and Signal System	JOB	1	$1,250,000.00	$1,250,000	40%	$1,750,000
05.0.8.R	Stand-by Unit	JOB	1	$40,000.00	$40,000	40%	$56,000
	ASSOCIATED GENERAL ITEMS					
05.0.R.B	Esplanade Subbase	C.Y.	1,890	$25.00	$47,250	40%	$66,150
05.0.R.B	Chain Link Fence	L.F.	3,400	$10.00	$34,000	40%	$47,600
05.0.R.B	Flag Pole	JOB	1	$3,000.00	$3,000	40%	$4,200
05.0.R.C	Concrete, Esplanade	S.Y.	11,340	$60.00	$680,400	40%	$952,560
05.0.R.E	Miscellaneous Metal	LBS	927,100	$2.75	$2,549,525	40%	$3,569,335
05.0.R.K	Life Boats and Lowering Facilities	JOB	1	$45,000.00	$45,000	40%	$63,000
05.0.R.P	Elevator	JOB	1	$55,000.00	$55,000	40%	$77,000
	BRIDGES, ABUTMENTS AND PIERS					
05.0.K.C	Concrete, Lock Wall Bridge Piers	C.Y.	1,095	$175.00	$191,625	40%	$268,275
05.0.K.E	Miscellaneous Items for Lock Wall Piers	JOB	1	$110,000.00	$110,000	40%	$154,000
	BRIDGES, SUPERSTRUCTURE AND DECK					
05.0.L.E	Service Bridge	JOB	1	$600,000.00	$600,000	40%	$840,000

	BUILDINGS, PROJECT OPERATIONS						
05.0.N.-	Operation Building	JOB	1	$350,000.00	$350,000	40%	$490,000
05.0.N.-	Service Building	JOB	1	$150,000.00	$150,000	40%	$210,000
05.0.N.-	Control Shelters	EACH	4	$15,000.00	$60,000	40%	$84,000
05.0.N.-	Gage House & Equipment	JOB	1	$200,000.00	$200,000	40%	$280,000
	DREDGING						
	MECHANICAL DREDGING						
12.0.4.B	Modify Approach Channel, Dredging	C.Y.	240,000	$15.00	$3,600,000	300%	$14,400,000
	TOTAL CONSTRUCTION COSTS, LOCKS				$102,930,000		$162,440,760
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, LOCKS					58%	
30.-.-.-	Planning, Engineering and Design				$11,150,000	25%	$13,937,500
31.-.-.-	Construction Management				$8,350,000	25%	$10,437,500
	TOTAL FIRST COSTS, LOCKS				$122,430,000		$186,815,760
	AVERAGE OVERALL CONTINGENCY, LOCKS					53%	

R.M. 34.0 - REPLACE L/D 3 AND L/D 4 @ A NEW LOCATION. FILE:PLAN67LKD
CONSTRUCT TWO NEW 84 x 720 LOCK CHAMBERS AND A NEW GATED DAM BETWEEN THE TWO EXISTING SITES
PLAN 6 & 7
(October 1990 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
		CONSTRUCTION OF GATED DAM					
	SPILLWAY						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
04.2.A.A	Mobilization and prep. work	JOB	1	$3,000,000.00	$3,000,000	100%	$6,000,000
	CARE AND DIVERSION OF WATER						
04.2.B.B	Cofferdams	JOB	1	$11,700,000.00	$11,700,000	100%	$23,400,000
04.2.B.N	Cofferdam Instrumentation	JOB	1	$120,000.00	$120,000	100%	$240,000
	EARTHWORK FOR STRUCTURES						
04.2.D.B	Clearing & grubbing	JOB	1	$10,000.00	$10,000	40%	$14,000
04.2.D.B	Excavation, Common	C.Y.	88,340	$7.00	$618,380	100%	$1,236,760
04.2.D.B	Excavation, Rock	C.Y.	17,580	$20.00	$351,600	100%	$703,200
04.2.D.B	Pre-splitting	S.Y.	3,150	$25.00	$78,750	100%	$157,500
04.2.D.B	Rock Fill	C.Y.	10,700	$30.00	$321,000	40%	$449,400
	FOUNDATION WORK						
04.2.E.B	H-piles, HP10x42	L.F.	22,400	$25.00	$560,000	40%	$784,000
	CONCRETE OVERFLOW SECTION						
04.2.2.B	Backfill, Pervious	C.Y.	10,700	$20.00	$214,000	40%	$299,600
04.2.2.C	Concrete, Dam Apron and Abutment	C.Y.	96,900	$165.00	$15,988,500	40%	$22,383,900
04.2.2.C	Cement	CWT	437,900	$4.00	$1,751,600	40%	$2,452,240
04.2.2.C	Steel Reinforcement, Rebar	LBS	1,160,000	$0.50	$580,000	40%	$812,000
04.2.2.C	Waterstops, Non-metallic	L.F.	800	$20.00	$16,000	40%	$22,400
04.2.2.C	Tainter Gate Anchorage	JOB	1	$1,100,000.00	$1,100,000	40%	$1,540,000
04.2.2.N	Permanent Instrumentation	JOB	1	$10,000.00	$10,000	40%	$14,000
	EMBEDDED METAL WORK						
04.2.4.E	Emergency Bulkhead Embedded Metal	JOB	1	$675,000.00	$675,000	40%	$945,000
04.2.4.E	Tainter Gate Embedded Metal	JOB	1	$120,000.00	$120,000	40%	$168,000
04.2.4.E	Downstream Bulkhead Embedded Metal	JOB	1	$245,000.00	$245,000	40%	$343,000
04.2.4.Q	Common Water & Air Piping	JOB	1	$12,000.00	$12,000	40%	$16,800
	GATES, STOPLOGS AND EQUIPMENT						
04.2.5.E	Non-overflow Tainter Gates	EACH	6	$840,000.00	$5,040,000	40%	$7,056,000
04.2.5.Q	Tainter Gate Operating Machinery	JOB	1	$3,375,000.00	$3,375,000	40%	$4,725,000
04.2.5.Q	Bulkhead Dogging Assemblies	JOB	1	$70,000.00	$70,000	40%	$98,000
04.2.5.R	Side Seal Heater Units	JOB	1	$80,000.00	$80,000	40%	$112,000
	ASSOCIATED GENERAL ITEMS						
04.2.R.E	Miscellaneous Metal	LBS	87,000	$3.00	$261,000	40%	$365,400
04.2.R.R	Power & Lighting Systems	JOB	1	$865,000.00	$865,000	40%	$1,211,000

	BRIDGES, ABUTMENTS AND PIERS						
04.2.K.C	Concrete, Dam Piers	C.Y.	14,250	$175.00	$2,493,750	40%	$3,491,250
04.2.K.H	Doors & Windows in Piers	JOB	1	$14,000.00	$14,000	40%	$19,600
	BRIDGES, SUPERSTRUCTURE AND DECK						
04.2.L.E	Service Bridge	JOB	1	$2,300,000.00	$2,300,000	40%	$3,220,000
04.2.L.E	Bridge & Pier Handrail	JOB	1	$215,000.00	$215,000	40%	$301,000
04.2.L.E	Fixed & Swinging Walkways	JOB	1	$20,000.00	$20,000	40%	$28,000
	OUTLET WORKS						
	APPROACH AND OUTLET CHANNELS						
04.3.1.B	Filter Material	C.Y.	1,050	$45.00	$47,250	40%	$66,150
04.3.1.B	Stone Protection	C.Y.	1,600	$45.00	$72,000	40%	$100,800
04.3.1.B	Derrick Stone	C.Y.	5,400	$40.00	$216,000	40%	$302,400
	TOTAL CONSTRUCTION COSTS, DAM				$52,540,830		$83,078,400
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, DAM					58%	
30.-.-.-	Planning, Engineering and Design				$5,320,000	25%	$6,650,000
31.-.-.-	Construction Management				$4,000,000	25%	$5,000,000
	TOTAL FIRST COSTS, DAM				$61,860,830		$94,728,400
	AVERAGE OVERALL CONTINGENCY, DAM					53%	

R.M. 41.5 - MAJOR REHABILITATION OF LOCKS @ EXISTING L/D 4.
REHABILITATION OF BOTH LOCK CHAMBERS ONLY.
Without Project
(October 1991 Cost Level)

FILE:REHAB4FI.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REHABILITATION OF LOCKS						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
05.0.A.A	Mobilization and Preparatory Work	JOB	1	$2,000,000.00	$2,000,000.00	100%	$4,000,000
	CARE AND DIVERSION OF WATER						
05.0.B.B	Cofferdam, Internally braced, u.s. & d.s., LC & RC	JOB	1	$2,000,000.00	$2,000,000.00	100%	$4,000,000
05.0.B.B	Lower Guide Wall Stabilization	JOB	1	$650,000.00	$650,000.00	40%	$910,000
05.0.D.B	Unclassified Excavation, Behind LW monoliths	C.Y.	1,700	$15.00	$25,500.00	40%	$35,700
	GUIDE AND GUARD WALLS, UPPER AND LOWER						
05.0.2.B	PS31 Sheetpiling	S.F	34,200	$20.00	$684,000.00	40%	$957,600
05.0.2.B	HP12x53 Bearing Piles	L.F	7,700	$30.00	$231,000.00	40%	$323,400
05.0.2.B	Unclassified Excavation	C.Y.	9,275	$15.00	$139,125.00	40%	$194,775
05.0.2.B	Cell Fill	C.Y.	6,875	$25.00	$171,875.00	40%	$240,625
05.0.2.C	Concrete Removal	C.Y.	2,750	$100.00	$275,000.00	40%	$385,000
05.0.2.C	Concrete	C.Y.	3,325	$250.00	$831,250.00	40%	$1,163,750
05.0.2.C	Tremie Concrete	C.Y.	1,235	$150.00	$185,250.00	40%	$259,350
05.0.2.E	Wall Armor, Straight Run	Lbs	76,700	$2.50	$191,750.00	40%	$268,450
05.0.2.E	Wall Armor,.Corner Protection	Lbs	13,400	$3.00	$40,200.00	40%	$56,280
	LOCK STRUCTURE						
05.0.4.B	Remove Concrete, Face of Walls	C.Y.	4,850	$250.00	$1,212,500.00	40%	$1,697,500
05.0.4.B	Remove Concrete, Top of Monoliths	C.Y.	4,350	$250.00	$1,087,500.00	40%	$1,522,500
05.0.4.B	Remove Concrete, Pipe Galleries	C.Y.	2,375	$500.00	$1,187,500.00	50%	$1,781,250
05.0.4.C	Concrete, Reface Walls	C.Y.	4,850	$600.00	$2,910,000.00	40%	$4,074,000
05.0.4.C	Concrete, Resurface Top of Monoliths	C.Y.	4,350	$450.00	$1,957,500.00	40%	$2,740,500
05.0.4.C	Concrete, Pipe Galleries	C.Y.	2,375	$500.00	$1,187,500.00	50%	$1,781,250
05.0.4.C	Reinforcing Steel, Bars	LBS	370,000	$0.75	$277,500.00	40%	$388,500
05.0.4.C	Welded Wire Fabric	LBS	5,000	$1.00	$5,000.00	40%	$7,000
05.0.4.C	Dowels	LBS	78,900	$1.00	$78,900.00	40%	$110,460
05.0.4.C	Drill Holes and Grout Dowels	L.F.	45,400	$20.00	$908,000.00	40%	$1,271,200
05.0.4.C	Remove & Replace 12" Top Concrete, all sills LC & RC	JOB	1	$625,000.00	$625,000.00	50%	$937,500
05.0.4.E	Aluminum Grating	S.F.	4,000	$35.00	$140,000.00	40%	$196,000
05.0.4.E	Aluminum Rabbet Angles	LBS	3,000	$10.00	$30,000.00	40%	$42,000
05.0.4.E	Guard Fence	L.F	4,000	$25.00	$100,000.00	40%	$140,000
05.0.4.E	Aluminum Pipe Handrail	L.F.	250	$100.00	$25,000.00	40%	$35,000
05.0.4.E	Install Floating Mooring Bitts on existing MW & RW	EACH	6	$80,000.00	$480,000.00	40%	$672,000
05.0.4.E	Wall Armor, Straight Run	LBS	1,017,000	$2.50	$2,542,500.00	40%	$3,559,500
05.0.4.E	Wall Armor, Corner Protection	LBS	53,000	$3.00	$159,000.00	40%	$222,600

	LOCK GATES AND OPERATING MACHINERY, UPPER AND LOWER						
05.0.5.E	Remove & Replace Upper Lock Gates, 56 ft. Chamber	SET	2	$425,000.00	$850,000.00	40%	$1,190,000
05.0.5.E	Remove & Replace Lower Lock Gates, 56 ft. Chamber	SET	2	$500,000.00	$1,000,000.00	40%	$1,400,000
05.0.5.E	Remove & Replace Gate Operating Machinery, 56 ft. Chamber	EACH	8	$100,000.00	$800,000.00	40%	$1,120,000
05.0.5.E	Remove & Replace Gate Anchorages, 56 ft. Chamber	EACH	8	$30,000.00	$240,000.00	40%	$336,000
05.0.5.R	Cathodic Protection, Gate Leaves	EACH	8	$10,000.00	$80,000.00	40%	$112,000
	CULVERT VALVES AND OPERATING MACHINERY						
05.0.6.E	Remove and Replace Butterfly Valves	EACH	6	$135,000	$810,000.00	40%	$1,134,000
05.0.6.Q	Remove and Replace Valve Operating Machinery	EACH	6	$110,000	$660,000.00	40%	$924,000
	PIPING SYSTEM						
05.0.7.Q	Fuel System	JOB	1	$40,000.00	$40,000.00	40%	$56,000
05.0.7.Q	Hydraulic System	JOB	1	$850,000.00	$850,000.00	40%	$1,190,000
05.0.7.Q	Compressed Air Piping System	JOB	1	$300,000.00	$300,000.00	40%	$420,000
05.0.7.Q	Service Water Piping System	JOB	1	$150,000.00	$150,000.00	40%	$210,000
05.0.7.Q	Domestic Water Piping System	JOB	1	$180,000.00	$180,000.00	40%	$252,000
05.0.7.Q	Temporary Diversion of Piping LW, MW, RW, & Esplanade	JOB	1	$25,000.00	$25,000.00	100%	$50,000
	POWER AND LIGHTING SYSTEM						
05.0.8.R	Replace Lock Electrical System	JOB	1	$900,000.00	$900,000.00	40%	$1,260,000
	ASSOCIATED GENERAL ITEMS						
05.0.R.B	Esplanade Removal	C.Y.	110	$100.00	$11,000.00	40%	$15,400
05.0.R.C	Esplanade Replacement	C.Y.	110	$150.00	$16,500.00	40%	$23,100
05.0.R.E	Miscellaneous Metal	LBS	60,000	$6.00	$360,000.00	40%	$504,000
05.0.R.E	Tow Haulage and Retriever System	JOB	1	$300,000.00	$300,000.00	40%	$420,000
	BUILDINGS, PROJECT OPERATIONS						
05.0.N.-	Remove & Replace Control Station Shelters	EACH	4	$25,000.00	$100,000.00	40%	$140,000
05.0.N.-	Removal of Existing Landwall Building	JOB	1	$50,000.00	$50,000.00	40%	$70,000
05.0.N.-	New Landwall Building	JOB	1	$500,000.00	$500,000.00	40%	$700,000
05.0.N.-	Removal of Existing Middlewall Building	JOB	1	$25,000.00	$25,000.00	40%	$35,000
05.0.N.-	New Middlewall Operations Building	JOB	1	$150,000.00	$150,000.00	40%	$210,000
	TOTAL CONSTRUCTION COSTS, LOCKS				$30,735,850		$45,745,190
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, LOCKS					49%	
30.-.-.-	Planning, Engineering and Design				$3,150,000	25%	$3,937,500
31.-.-.-	Construction Management				$2,335,000	25%	$2,918,750
	TOTAL FIRST COSTS, LOCKS				$36,220,850		$52,601,440
	AVERAGE OVERALL CONTINGENCY, LOCKS					45%	

R.M. 41.5 - REPLACE EXISTING TWO CHAMBER LOCK "IN-KIND" @ EXISTING L/D 4.
REPLACE BOTH LOCK CHAMBERS "IN KIND" (56'x360' and 56'x720')
Without Project
(October 1991 Cost Level)

FILE:MNRIK4.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REPLACEMENT OF LOCKS (BOTH CHAMBERS)						
	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK						
05.0.A.A	Mobilization & Preparatory Work	JOB	1	$7,000,000.00	$7,000,000	100%	$14,000,000
	CARE AND DIVERSION OF WATER						
05.0.B.B	Cofferdam	JOB	1	$15,500,000.00	$15,500,000	100%	$31,000,000
05.0.B.N	Cofferdam Instrumentation	JOB	1	$80,000.00	$80,000	100%	$160,000
	EARTHWORK FOR STRUCTURES						
05.0.D.B	Excavation, Common	C.Y.	400,000	$9.00	$3,600,000	40%	$5,040,000
05.0.D.B	Excavation, Rock	C.Y.	18,000	$15.00	$270,000	40%	$378,000
05.0.D.B	Pre-splitting	S.Y.	2,800	$20.00	$56,000	40%	$78,400
05.0.D.B	Seeding	ACRE	1	$2,000.00	$2,000	40%	$2,800
	FOUNDATION WORK						
05.0.E.B	Steel Sheet Piling, PS27.5	S.F.	60,000	$20.00	$1,200,000	40%	$1,680,000
05.0.E.B	Steel Bearing Piles, HP10x42	L.F.	118,000	$20.00	$2,360,000	40%	$3,304,000
05.0.E.B	Temp. Retaining Wall, Steel Sheetpiling w/anchors	S.F.	86,000	$45.00	$3,870,000	40%	$5,418,000
05.0.E.B	Strut Existing River Chamber	JOB	1	$500,000.00	$500,000	100%	$1,000,000
05.0.E.B	Predrilled Concrete Caissons, 4 ft. Diam., thru Overburden	L.F.	2,750	$250.00	$687,500	70%	$1,168,750
05.0.E.B	Predrilled Concrete Caissons, 4 ft. Diam., thru Rock	L.F.	8,780	$475.00	$4,170,500	70%	$7,089,850
05.0.E.B	Foundation Drilling, 4 in. Core	L.F.	4,000	$90.00	$360,000	70%	$612,000
05.0.E.B	Foundation Drilling, Drilling Without Sampling	L.F.	2,500	$30.00	$75,000	70%	$127,500
	DRAINAGE						
05.0.G.B	Drainage	JOB	1	$225,000.00	$225,000	40%	$315,000
	APPROACH CHANNELS						
05.0.1.B	Modify Approach Channel, Rock/Gravel Fill	C.Y.	235,000	$30.00	$7,050,000	50%	$10,575,000
05.0.1.B	Filter Material	C.Y.	16,500	$25.00	$412,500	40%	$577,500
05.1.E.B	Stone Protection	C.Y.	33,000	$35.00	$1,155,000	40%	$1,617,000
05.1.E.B	Mooring Piers	EACH	4	$150,000.00	$600,000	40%	$840,000
	GUIDE AND GUARD WALLS, UPPER AND LOWER						
05.0.2.B	Fill, Guide Wall Cells	C.Y.	32,000	$20.00	$640,000	40%	$896,000
05.0.2.E	Guard Fence	L.F.	8,000	$35.00	$280,000	40%	$392,000
	LOCK STRUCTURE						
05.0.4.B	Backfill, Pervious	C.Y.	300,000	$17.00	$5,100,000	40%	$7,140,000
05.0.4.C	Concrete, Lock Walls & Sills	C.Y.	300,000	$110.00	$33,000,000	40%	$46,200,000
05.0.4.C	Steel Reinforcement	LBS	1,850,000	$0.50	$925,000	40%	$1,295,000
05.0.4.C	Waterstops, Non-metallic	L.F.	3,300	$20.00	$66,000	40%	$92,400
05.0.4.C	Cement	CWT	800,000	$3.75	$3,000,000	40%	$4,200,000

05.0.4.E	Wall Armor	LBS	1,900,000	$1.75	$3,325,000	40%	$4,655,000
05.0.4.E	Floating Mooring Bitts	EACH	6	$35,000.00	$300,000	40%	$420,000
05.0.4.N	Permanent Instrumentation	JOB	1	$40,000.00	$40,000	40%	$56,000
	LOCK GATES AND OPERATING MACHINERY, UPPER AND LOWER						
05.0.5.E	Upper Lock Gates	SET	2	$350,000.00	$700,000	40%	$980,000
05.0.5.E	Lower Lock Gates	SET	2	$425,000.00	$850,000	40%	$1,190,000
05.0.5.E	Emergency Bulkhead	EACH	2	$400,000.00	$800,000	40%	$1,120,000
05.0.5.E	Emergency Bulkhead Embedded Metal Recess Fillers & Hoist	JOB	1	$450,000.00	$450,000	40%	$630,000
05.0.5.E	Planking, Aluminum	S.F.	8,500	$30.00	$255,000	40%	$357,000
05.0.5.E	Rabbet Angles, Aluminum	LBS	3,200	$14.00	$44,800	40%	$62,720
05.0.5.E	Pipe Handrail, Aluminum	L.F.	750	$75.00	$56,250	40%	$78,750
05.0.5.Q	Emergency Bulkhead Hoist & Lifting Beam	JOB	1	$350,000.00	$350,000	40%	$490,000
05.0.5.Q	Bulkhead Dogging Assemblies	JOB	1	$40,000.00	$40,000	40%	$56,000
05.0.5.Q	Lock Gate Operating Machinery	SET	8	$85,000.00	$680,000	40%	$952,000
05.0.5.R	Cathodic Protection, Gate Leaves	EACH	8	$10,000.00	$80,000	40%	$112,000
	CULVERT VALVES AND OPERATING MACHINERY						
05.0.6.B	Bulkhead Storage Area	JOB	1	$250,000.00	$250,000	40%	$350,000
05.0.6.E	Culvert Valves and Embedded Metal	EACH	6	$110,000.00	$660,000	40%	$924,000
05.0.6.E	Culvert Valve Bulkheads	EACH	6	$35,000.00	$210,000	40%	$294,000
05.0.6.E	Culvert Valve Bulkhead Embedded Metal	JOB	1	$75,000.00	$75,000	40%	$105,000
05.0.6.Q	Culvert Valve Operating Machinery	SET	6	$100,000.00	$600,000	40%	$840,000
	PIPING SYSTEM						
05.0.7.Q	Fuel system	JOB	1	$40,000.00	$40,000	50%	$60,000
05.0.7.Q	Compressed Air System	JOB	1	$250,000.00	$250,000	50%	$375,000
05.0.7.Q	Hydraulic System	JOB	1	$750,000.00	$750,000	50%	$1,125,000
05.0.7.Q	Service Water System	JOB	1	$100,000.00	$100,000	50%	$150,000
05.0.7.Q	Domestic Water System	JOB	1	$180,000.00	$180,000	50%	$270,000
	POWER AND LIGHTING SYSTEMS						
05.0.8.R	Power, Lighting and Signal System	JOB	1	$850,000.00	$850,000	50%	$1,275,000
05.0.8.R	Stand-by Unit	JOB	1	$40,000.00	$40,000	50%	$60,000
	ASSOCIATED GENERAL ITEMS						
05.0.R.B	Esplanade Subbase	C.Y.	1,890	$25.00	$47,250	40%	$66,150
05.0.R.B	Chain Link Fence	L.F.	3,400	$10.00	$34,000	40%	$47,600
05.0.R.B	Flag Pole	JOB	1	$3,000.00	$3,000	40%	$4,200
05.0.R.C	Concrete, Esplanade	S.Y.	11,340	$60.00	$680,400	40%	$952,560
05.0.R.E	Miscellaneous Metal	LBS	800,000	$2.75	$2,200,000	40%	$3,080,000
05.0.R.E	Tow Haulage & Retreiver System	JOB	1	$300,000.00	$300,000	40%	$420,000
05.0.R.K	Life Boats and Lowering Facilities	JOB	1	$45,000.00	$45,000	40%	$63,000
05.0.R.P	Elevator	JOB	1	$55,000.00	$55,000	40%	$77,000
	BRIDGES, ABUTMENTS AND PIERS						
05.0.K.C	Concrete, Lock Wall Bridge Piers	C.Y.	1,100	$175.00	$192,500	40%	$269,500
05.0.K.E	Miscellaneous Items for Lock Wall Piers	JOB	1	$110,000.00	$110,000	40%	$154,000

	BRIDGES, SUPERSTRUCTURE AND DECK						
05.0.L.E	Service Bridge	JOB	1	$500,000.00	$500,000	40%	$700,000
	BUILDINGS, PROJECT OPERATIONS						
05.0.N.-	Operation Building	JOB	1	$500,000.00	$500,000	40%	$700,000
05.0.N.-	Service Building	JOB	1	$150,000.00	$150,000	40%	$210,000
05.0.N.-	Control Shelters	EACH	4	$15,000.00	$60,000	40%	$84,000
05.0.N.-	Gage House & Equipment	JOB	1	$200,000.00	$200,000	40%	$280,000
	DAM						
04.1.3.B	Dam Scour Protection	JOB	1	$1,250,000.00	$1,250,000	100%	$2,500,000
	CHANNELS AND CANALS						
09.0.2.B	Remove Existing Lock Structure, Concrete Removal	C.Y.	134,000	$150.00	$20,100,000	40%	$28,140,000
	DREDGING						
	MECHANICAL DREDGING						
12.0.4.B	Modify Approach Channel, Dredging	C.Y.	260,000	$15.00	$3,900,000	300%	$15,600,000
	TOTAL CONSTRUCTION COSTS, LOCKS				$134,487,700		$215,534,680
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY, LOCKS					60%	
30.-.-.-	Planning, Engineering and Design				$15,100,000	25%	$18,875,000
31.-.-.-	Construction Management				$11,350,000	25%	$14,187,500
	TOTAL FIRST COSTS, LOCKS				$160,937,700		$248,597,180
	AVERAGE OVERALL CONSTRUCTION, LOCKS					54%	

LOWER MON NAVIGATION STUDY
LOWER MON, RM 41.5, TWIN 84' x 720' LOCK CHAMBERS
(OCTOBER 1991 COST LEVEL)
Plans 1,2,3,4 & 5

ACCOUNT NO.	DESCRIPTION	QUANTITY	UNIT	WITHOUT OVERHEAD & PROFIT PLANT	LABOR	MATERIAL	UNIT PRICE INCLUDING OH&P (ROUNDED)	TOTAL AMOUNT	CONT.	TOTAL AMOUNT INCLUDING CONTINGENCY
05.-.-.-	LOCKS									
05.0.A.-	MOBILIZATION, DEMOBILITATION & PREPARATORY WORK									
05.0.A.A	MOBILIZATION & PREPARATORY WORK	1	JOB	$167,099	$513,598	$1,375,035	$2,400,000.00	$2,400,000.00	25%	$3,000,000.00
05.0.C.-	PERMANENT ACCESS ROADS & PARKING									
05.0.C.B	EXCAVATION FOR ACCESS ROAD & PARKING AREA	1,310	CY	$6,185	$6,673	$0	$12.00	$15,720.00	25%	$19,650.00
05.0.C.B	RANDOM FILL, ACCESS ROAD & PARKING AREA	7,500	CY	$25,263	$36,211	$0	$10.00	$75,000.00	25%	$93,750.00
05.0.C.B	SUBBASE, ACCESS ROAD & PARKING AREA	350	CY	$289	$902	$5,362	$30.00	$10,500.00	25%	$13,125.00
05.0.C.B	CRUSHED AGGR BASE COURSE, ACCESS ROAD & PARKING AREA	250	CY	$207	$644	$4,500	$35.00	$8,750.00	25%	$10,937.50
05.0.C.B	# 57 AGGR BASE COURSE, ACCESS ROAD & PARKING AREA	250	CY	$207	$644	$3,815	$30.00	$7,500.00	25%	$9,375.00
05.0.C.B	BINDER COURSE	2,650	SY	$1,715	$2,205	$7,595	$7.00	$18,550.00	25%	$23,187.50
05.0.C.B	BITUMINOUS PRIME COAT	2,650	SY	$200	$200	$935	$1.00	$2,650.00	25%	$3,312.50
05.0.C.B	BITUMINOUS WEARING COURSE	2,650	SY	$1,320	$1,815	$5,940	$5.00	$13,250.00	25%	$16,562.50
05.0.C.B	MILL SURFACE, ACCESS ROAD	550	SY	$0	$0	$55	$0.50	$275.00	25%	$343.75
05.0.C.B	PRECAST UNDERDRAINS, 4" PERFORATED PVC	1,000	LF	$552	$7,319	$3,520	$16.00	$16,000.00	25%	$20,000.00
05.0.C.B	PIPE UNDERDRAIN OUTLETS	1	JOB	$331	$4,392	$1,065	$8,000.00	$8,000.00	25%	$10,000.00
05.0.C.B	PRECAST CONCRETE PARKING BUMPERS	18	EA	$19	$26	$406	$35.00	$630.00	25%	$787.50
05.0.C.B	GUIDE RAIL, TYPE 2-W	900	LF	$337	$597	$9,099	$15.00	$13,500.00	25%	$16,875.00
05.0.C.J	PARKING LINES	700	LF	$26	$228	$22	$0.50	$350.00	25%	$437.50
05.0.C.K	TRAFFIC SIGNS	1	JOB	$81	$684	$756	$2,000.00	$2,000.00	15%	$2,300.00
05.0.B.-	CARE & DIVERSION of WATER									
05.0.B.B	SHEETPILE RETAINING WALL	1	JOB	$323,847	$407,531	$7,711,536	$10,000,000.00	$10,000,000.00	25%	$12,500,000.00
05.0.B.B	COFFERDAMS	1	JOB	$8,165,875	$7,224,614	$14,001,915	$35,000,000.00	$35,000,000.00	15%	$40,250,000.00
05.0.B.B	COFFERDAM OVERTOPPING	1	JOB	$0	$0	$172,600	$180,000.00	$180,000.00	15%	$207,000.00
05.0.B.B	DEWATERING	1	JOB	$927,200	$668,439	$5,000	$1,900,000.00	$1,900,000.00	25%	$2,375,000.00
05.0.B.B	SEALING EXISTING MONOLITH JOINTS	1,000	LF	$9,412	$50,691	$1,250	$90.00	$90,000.00	15%	$103,500.00
05.0.B.B	DRILLED FOUNDATION CAISSONS, MIDDLE WALL	11,520	LF	$527,760	$514,579	$11,520	$130.00	$1,497,600.00	25%	$1,872,000.00
05.0.B.B	STABILIZATION OF EXISTING MIDDLEWALL	1	JOB	$626,719	$673,026	$109,012	$1,500,000.00	$1,500,000.00	50%	$2,250,000.00
05.0.B.C	DEFORMED STEEL BARS FOR CAISSONS, MIDDLE WALL	1,832,650	LBS	$6,647	$67,997	$458,000	$0.50	$916,325.00	25%	$1,145,406.25
05.0.B.C	CONCRETE IN-PLACE CAISSONS, MIDDLE WALL	5,400	CY	$129,670	$237,519	$325,520	$180.00	$972,000.00	25%	$1,215,000.00
05.0.B.N	COFFERDAM INSTRUMENTATION	1	JOB	$52,032	$538,664	$1,189,053	$2,500,000.00	$2,500,000.00	25%	$3,125,000.00
05.0.B.N	PERMANENT INSTRUMENTATION	1	JOB	$662	$15,158	$10,514	$38,000.00	$38,000.00	25%	$47,500.00
05.0.D.-	EARTHWORK FOR STRUCTURES									
05.0.D.B	CLEARING & STRIPPING	1	JOB	$1,013	$1,610	$0	$3,000.00	$3,000.00	25%	$3,750.00
05.0.D.B	HANDLING VEGETATION	1	JOB	$471	$855	$0	$1,500.00	$1,500.00	25%	$1,875.00
05.0.D.B	EROSION & SEDIMENTATION CONTROL	1	JOB	$57,158	$171,650	$260,156	$580,000.00	$580,000.00	25%	$725,000.00
05.0.D.B	REMOVAL OF ADMINISTRATION BUILDING	1	JOB	$2,269	$7,783	$0	$12,000.00	$12,000.00	15%	$13,800.00
05.0.D.B	REMOVAL OF POWER HOUSE	1	JOB	$1,561	$5,053	$0	$8,000.00	$8,000.00	15%	$9,200.00
05.0.D.B	RIVERBANK PROTECTION, LEFT BANK, GRADED STONE	44,460	CY	$198,293	$147,181	$756,330	$30.00	$1,333,800.00	25%	$1,667,250.00

05.0.D.B	RIVERBANK PROTECTION, LEFT BANK, GRANULAR FILL	14,130	CY	$42,905	$33,118	$197,820	$25.00	$353,250.00	25%	$441,562.50
05.0.D.B	EXPL DRILLING, MOBILIZATION & DEMOBILIZATION	1	JOB	$1,824	$1,422	$0	$4,700.00	$4,700.00	25%	$5,875.00
05.0.D.B	EXPL DRILLING, DRILLING WITHOUT CORING	5,000	LF	$56,987	$44,423	$0	$30.00	$150,000.00	25%	$187,500.00
05.0.D.B	EXPL DRILLING, CORE DRILLING, 4" DIA. CORES	4,500	LF	$102,578	$79,962	$0	$58.00	$261,000.00	25%	$326,250.00
05.0.D.B	EXPL DRILLING, SEALED EXPLORATION HOLES WITH CEMENT	1,700	CWT	$1,916	$16,933	$11,900	$25.00	$42,500.00	25%	$53,125.00
05.0.D.B	COMMON EXCAVATION, LOCK & APPURTENANCES	612,000	CY	$3,774,919	$2,772,414	$0	$12.00	$7,344,000.00	35%	$9,914,400.00
05.0.D.B	ROCK EXCAVATION, LOCK & APPURTENANCES	50,200	CY	$349,590	$411,921	$48,320	$20.00	$1,004,000.00	35%	$1,355,400.00
05.0.D.B	PRESPLITTING, LOCK & APPURTENANCES	7,025	SY	$33,780	$98,449	$40,665	$35.00	$245,875.00	50%	$368,812.50
05.0.D.B	GRANULAR BACKFILL, LOCK & APPURTENANCES	103,000	CY	$70,342	$150,875	$1,442,000	$20.00	$2,060,000.00	25%	$2,575,000.00
05.0.D.B	RANDOM BACKFILL, LOCK & APPURTENANCES	132,250	CY	$241,063	$305,917	$66,125	$6.00	$793,500.00	25%	$991,875.00
05.0.D.B	ADDITIONAL ROLLING FOR COMPACTION	100	HR	$3,497	$2,736	$0	$75.00	$7,500.00	25%	$9,375.00
05.0.E.-	FOUNDATION WORK									
05.0.E.B	FOUNDATION PREP, PRELIMINARY CLEANUP	18,900	SY	$27,416	$239,300	$0	$17.00	$321,300.00	25%	$401,625.00
05.0.E.B	FOUNDATION PREP, FINAL CLEANUP	17,200	SY	$41,056	$386,123	$0	$30.00	$516,000.00	25%	$645,000.00
05.0.E.B	FOUNDATION PREP, PROTECTIVE COATING FOR ROCK SURFACES	112,200	SF	$6,661	$34,627	$17,952	$0.70	$78,540.00	25%	$98,175.00
05.0.E.B	FOUNDATION PREP, TEMPORARY EARTH COVER	17,200	SY	$19,404	$67,055	$0	$6.00	$103,200.00	25%	$129,000.00
05.0.E.B	FOUNDATION PREP, GROUT, MOBILIZATION & DEMOBILIZATION	1	JOB	$1,539	$3,997	$0	$6,600.00	$6,600.00	25%	$8,250.00
05.0.E.B	FOUNDATION PREP, GROUT,DRILLING GROUT HOLES, 1-1/2" DIA	1,300	LF	$3,335	$8,660	$325	$11.00	$14,300.00	25%	$17,875.00
05.0.E.B	FOUNDATION PREP, GROUT, PLACING CEMENTITIOUS GROUT	100	HR	$1,664	$12,325	$11	$168.00	$16,800.00	25%	$21,000.00
05.0.E.B	FOUNDATION PREP, GROUT, CEMENT IN GROUT	300	CF	$0	$0	$972	$4.00	$1,200.00	25%	$1,500.00
05.0.E.B	FOUNDATION PREP, DENTAL TREATMENT, CONCRETE	50	CY	$2,987	$16,570	$2,150	$520.00	$26,000.00	25%	$32,500.00
05.0.E.B	FOUNDATION PREP, DENTAL TREATMENT, MOTAR	20	CY	$418	$2,320	$1,080	$230.00	$4,600.00	25%	$5,750.00
05.0.G-	DRAINAGE									
05.0.G.B	ESPLANADE TRENCH & PIPE DRAINAGE SYSTEM	1	JOB	$6,666	$49,266	$37,047	$130,000.00	$130,000.00	25%	$162,500.00
05.0.G.B	CORRUGATED METAL PIPE, 12" DIA.	200	LF	$261	$2,393	$1,960	$30.00	$6,000.00	25%	$7,500.00
05.0.G.B	CORRUGATED METAL PIPE, 15" DIA.	500	LF	$599	$5,484	$5,526	$33.00	$16,500.00	25%	$20,625.00
05.0.G.B	CORRUGATED METAL PIPE, 36" DIA.	100	LF	$223	$2,044	$2,450	$68.00	$6,800.00	25%	$8,500.00
05.0.G.B	END SECTION FOR 15" DIA. CMP	2	EA	$208	$1,127	$250	$1,100.00	$2,200.00	25%	$2,750.00
05.0.G.B	ENDWALL FOR 36" DIA. CMP	2	EA	$185	$1,563	$400	$1,500.00	$3,000.00	25%	$3,750.00
05.0.G.B	INLET BOX, MODIFIED TYPE I	2	EA	$185	$1,563	$970	$1,900.00	$3,800.00	25%	$4,750.00
05.0.G.B	AREA INLETS	3	EA	$248	$2,760	$897	$1,900.00	$5,700.00	25%	$7,125.00
05.0.G.B	60" DIA. HALF-CIRCLE BITUMINOUS CMP	200	LF	$1,395	$9,777	$45,252	$400.00	$80,000.00	25%	$100,000.00
05.0.1.-	APPROACH CHANNELS									
05.0.1.B	UNCLASSIFIED EXCAVATION, APPROACHES	28,210	CY	$156,924	$126,312	$0	$11.00	$310,310.00	100%	$620,620.00
05.0.1.B	COMPACTED GRANULAR FILL, APPROACHES	45,530	CY	$112,809	$96,859	$637,420	$22.00	$1,001,660.00	25%	$1,252,075.00
05.0.1.B	GRADED STONE RIPRAP, APPROACHES	70,540	CY	$257,873	$199,002	$1,200,098	$30.00	$2,116,200.00	25%	$2,645,250.00
05.0.1.B	GRANULAR FILTER, APPROACHES	24,400	CY	$70,487	$55,755	$366,000	$24.00	$585,600.00	25%	$732,000.00
05.0.1.B	ROCK & GRAVEL FILL	204,000	CY	$494,903	$375,352	$3,062,414	$23.00	$4,692,000.00	25%	$5,865,000.00
05.0.1.B	STONE PROTECTION, RIGHT BANK	15,400	CY	$68,771	$51,947	$262,446	$30.00	$462,000.00	25%	$577,500.00
05.0.1.B	GRANULAR FILL, RIGHT BANK RIPRAP	6,900	CY	$24,793	$21,752	$103,500	$26.00	$179,400.00	25%	$224,250.00
05.0.1.B	DREDGING	272,250	CY	$1,513,952	$1,204,936	$0	$12.00	$3,267,000.00	100%	$6,534,000.00
05.0.1.B	MOORING PIERS	1	JOB	$32,915	$49,880	$104,718	$220,000.00	$220,000.00	25%	$275,000.00
05.0.1.B	REMOVAL OF SPUR DIKE	1	JOB	$35,770	$38,148	$0	$85,000.00	$85,000.00	15%	$97,750.00
05.0.2.-	GUARD & GUIDE WALLS, UPPER & LOWER									
05.0.2.B	CONC RMVL, GUIDE & GUARD WALLS, UPPER & LOWER	29,000	CY	$488,030	$714,715	$80,920	$55.00	$1,595,000.00	15%	$1,834,250.00
05.0.2.B	GUARD WALLS CELLS, UPPER & LOWER	1	JOB	$480,346	$576,517	$1,721,639	$3,300,000.00	$3,300,000.00	25%	$4,125,000.00
05.0.2.B	LOWER GUIDE WALL CELLS	1	JOB	$213,495	$345,411	$1,173,729	$2,000,000.00	$2,000,000.00	25%	$2,500,000.00

05.0.2.B	SHEETPILE BULKHEAD, GUARD WALLS	30,670	SF	$92,981	$126,122	$247,127	$18.00	$552,060.00	25%	$690,075.00
05.0.2.C	DEFORMED STEEL, GUIDE & GUARD WALLS	552,000	LBS	$6,658	$53,255	$138,000	$0.50	$276,000.00	25%	$345,000.00
05.0.2.C	CONCRETE CAP WALL, GUARD WALLS	32,200	CY	$887,780	$2,720,001	$1,492,609	$190.00	$6,118,000.00	25%	$7,647,500.00
05.0.2.C	CONCRETE UPPER GUIDE WALL	13,520	CY	$294,032	$757,319	$558,295	$140.00	$1,892,800.00	25%	$2,366,000.00
05.0.2.C	CONCRETE, TREMIE, GUARD WALLS, LOWER GUIDE WALL	2,480	CY	$41,657	$39,340	$136,400	$110.00	$272,800.00	25%	$341,000.00
05.0.2.C	WATER REDUCING ADMIXTURE	3,500	CY	$0	$0	$20,000	$7.00	$24,500.00	25%	$30,625.00
05.0.2.C	PORTLAND CEMENT	181,240	CWT	$0	$0	$724,960	$5.00	$906,200.00	25%	$1,132,750.00
05.0.2.C	POZZOLAN	56,100	CF	$0	$0	$31,416	$1.00	$56,100.00	25%	$70,125.00
05.0.2.C	CORE HOLES, UPPER GUARD WALL END CELL	175	LF	$2,128	$1,658	$0	$25.00	$4,375.00	25%	$5,468.75
05.0.2.E	WALL ARMOR	968,350	LBS	$183,225	$387,140	$786,373	$2.00	$1,936,700.00	25%	$2,420,875.00
05.0.2.E	MISC. METAL, STEEL	17,400	LBS	$7,558	$14,996	$15,646	$3.00	$52,200.00	25%	$65,250.00
05.0.2.E	CORNER PROTECTION	146,700	LBS	$607	$4,002	$151,551	$1.50	$220,050.00	25%	$275,062.50
05.0.2.E	CHECK POSTS	40	EA	$2,570	$7,234	$33,336	$1,300.00	$52,000.00	25%	$65,000.00
05.0.2.E	LINE HOOKS AND GUARDS	48	EA	$1,315	$10,131	$73,312	$2,100.00	$100,800.00	25%	$126,000.00
05.0.2.E	STEEL SHEET PILING, TYPE PS-27.5 CUTOFF WALL	1,110	LF	$9,364	$13,022	$19,351	$45.00	$49,950.00	25%	$62,437.50
05.0.4.-	LOCK STRUCTURE									
05.0.4.B	REMOVAL OF NEEDLE DAM	1	JOB	$12,736	$13,667	$0	$30,000.00	$30,000.00	15%	$34,500.00
05.0.4.B	CONCRETE REMOVAL, LOCK WALLS & APPURTENANCES	67,000	CY	$1,111,839	$1,616,866	$199,048	$55.00	$3,685,000.00	15%	$4,237,750.00
05.0.4.B	CHAMBER FLOOR WEEP HOLES	31,240	LF	$83,970	$224,465	$9,060	$12.00	$374,880.00	25%	$468,600.00
05.0.4.B	DRILL & GROUT ANCHORS FOR CHAMBER FLOOR STRUTS	15,400	LF	$35,050	$121,398	$5,698	$13.00	$200,200.00	25%	$250,250.00
05.0.4.C	WATERSTOPS, LOCK WALLS & APPURTENANCES	13,500	LF	$2,617	$129,330	$153,900	$25.00	$337,500.00	25%	$421,875.00
05.0.4.C	DEFORMED STEEL BARS, LOCK WALLS & APPURTENANCES	4,057,000	LBS	$48,930	$391,406	$1,014,250	$0.50	$2,028,500.00	25%	$2,535,625.00
05.0.4.C	CONCRETE IN-PLACE, GRAVITY MONOLITHS	216,540	CY	$5,177,747	$13,894,554	$9,154,465	$155.00	$33,563,700.00	25%	$41,954,625.00
05.0.4.C	CONCRETE IN-PLACE, SILLS & PIPE & CABLE CROSSOVERS	22,100	CY	$721,257	$1,438,541	$922,083	$165.00	$3,646,500.00	25%	$4,558,125.00
05.0.4.C	CONCRETE IN-PLACE, DEFLECTORS	110	CY	$3,973	$34,832	$5,593	$480.00	$52,800.00	25%	$66,000.00
05.0.4.C	CONCRETE IN-PLACE, RECESSED & OTHER 2ND POUR WORK	340	CY	$44,434	$76,482	$18,491	$490.00	$166,600.00	25%	$208,250.00
05.0.4.C	CONCRETE IN-PLACE, LOCK CHAMBER FLOOR STRUTS & SLAB	23,540	CY	$574,919	$1,542,473	$959,840	$155.00	$3,648,700.00	25%	$4,560,875.00
05.0.4.C	PORTLAND CEMENT, LOCK WALLS & APPURTENANCES	986,030	CWT	$0	$0	$3,944,120	$5.00	$4,930,150.00	25%	$6,162,687.50
05.0.4.C	EXPANSIVE HYDRAULIC CEMENT	420	TN	$1,965	$19,994	$646,380	$1,900.00	$798,000.00	25%	$997,500.00
05.0.4.C	POZZOLAN	227,110	CF	$0	$0	$126,375	$1.00	$227,110.00	25%	$283,887.50
05.0.4.C	MONOLITH JOINT GROUTING	80	CF	$902	$7,969	$2,000	$160.00	$12,800.00	25%	$16,000.00
05.0.4.E	WALL ARMOR, LOCK WALLS	840,960	LBS	$3,625	$24,067	$750,200	$1.00	$840,960.00	25%	$1,051,200.00
05.0.4.E	CORNER PROTECTION LOCK WALLS	535,000	LBS	$3,206	$21,361	$552,856	$1.50	$802,500.00	25%	$1,003,125.00
05.0.4.E	MISCELLANEOUS METAL, STEEL	316,000	LBS	$4,651	$31,034	$476,800	$2.00	$632,000.00	25%	$790,000.00
05.0.4.E	MISC METAL, STAINLESS STEEL	226,760	LBS	$736	$4,789	$1,133,800	$6.00	$1,360,560.00	25%	$1,700,700.00
05.0.4.E	MISC METAL, STAINLESS STL CLAD PLATE	46,200	LBS	$150	$976	$231,000	$6.00	$277,200.00	25%	$346,500.00
05.0.4.E	CHECK POSTS, LOCK WALLS	42	EA	$653	$5,011	$34,932	$1,100.00	$46,200.00	15%	$53,130.00
05.0.4.E	LINE HOOKS & GUARDS, LOCK WALLS	128	EA	$3,663	$28,032	$195,384	$2,100.00	$268,800.00	15%	$309,120.00
05.0.4.E	BULKHEAD RECESS FILLERS	1	JOB	$2,579	$19,659	$97,936	$140,000.00	$140,000.00	15%	$161,000.00
05.0.4.E	FLOATING MOORING BITTS	14	EA	$9,401	$78,583	$368,942	$40,000.00	$560,000.00	15%	$644,000.00
05.0.4.E	MAINTENANCE BULKHEAD EMBEDDED METALS	1	JOB	$428	$2,834	$88,689	$100,000.00	$100,000.00	15%	$115,000.00
05.0.4.N	EMERGENCY BULKHEAD HOIST STRUCTURE	1	JOB	$38,552	$214,265	$469,200	$850,000.00	$850,000.00	25%	$1,062,500.00
05.0.5.-	LOCK GATES & OPERATING MACHINERY, UPPER & LOWER									
05.0.5.B	REMOVAL OF 56' CHAMBER LOCK GATES, UPPER AND LOWER	1	JOB	$52,810	$63,366	$0	$140,000.00	$140,000.00	15%	$161,000.00
05.0.5.E	UPPER LOCK GATES	1	JOB	$53,351	$165,293	$1,091,800	$1,500,000.00	$1,500,000.00	25%	$1,875,000.00
05.0.5.E	LOWER LOCK GATES	1	JOB	$60,266	$247,253	$1,678,600	$2,400,000.00	$2,400,000.00	25%	$3,000,000.00
05.0.5.E	EMERGENCY BULKHEAD & APPURTENANCES	1	JOB	$24,389	$131,598	$717,267	$1,100,000.00	$1,100,000.00	25%	$1,375,000.00
05.0.5.E	LOCK GATE OPERATING MACHINERY	8	EA	$52,917	$515,296	$620,335	$175,000.00	$1,400,000.00	25%	$1,750,000.00

05.0.6.- CULVERT VALVES & OPERATING MACHINERY										
05.0.6.B	REMOVAL OF EXISTING CULVERT VALVES	1	JOB	$9,676	$9,747	$0	$23,000.00	$23,000.00	15%	$26,450.00
05.0.6.E	TAINTER VALVES & EMBEDDED METALS	6	EA	$60,158	$325,193	$494,957	$175,000.00	$1,050,000.00	25%	$1,312,500.00
05.0.6.E	TAINTER VALVE BULKHEADS & EMBEDDED METALS	1	JOB	$12,234	$89,167	$156,618	$310,000.00	$310,000.00	25%	$387,500.00
05.0.6.Q	TAINTER VALVE, OPERATING MACHINERY	6	EA	$41,576	$357,711	$370,559	$150,000.00	$900,000.00	25%	$1,125,000.00
05.0.7.- PIPING SYSTEM										
05.0.7.Q	WATER DISTRIBUTION SYSTEM	1	JOB	$7,902	$38,335	$17,110	$90,000.00	$90,000.00	25%	$112,500.00
05.0.7.Q	GAS DISTRIBUTION SYSTEM	1	JOB	$999	$6,602	$2,410	$15,000.00	$15,000.00	25%	$18,750.00
05.0.7.Q	SANITARY SEWAGE SYSTEM	1	JOB	$16,347	$74,676	$39,315	$185,000.00	$185,000.00	25%	$231,250.00
05.0.7.Q	PIPE SUPPORTS	1	JOB	$4,758	$31,688	$16,310	$75,000.00	$75,000.00	25%	$93,750.00
05.0.7.Q	PACKAGED TYPE HYDRAULIC SYSTEM	8	EA	$16,067	$133,483	$210,296	$65,000.00	$520,000.00	25%	$650,000.00
05.0.7.Q	COMPRESSED AIR SYSTEM	1	JOB	$21,032	$130,969	$153,976	$440,000.00	$440,000.00	25%	$550,000.00
05.0.7.Q	SERVICE WATER SYSTEM	1	JOB	$5,725	$46,374	$30,897	$120,000.00	$120,000.00	25%	$150,000.00
05.0.7.Q	AIR COMPRESSOR & DRYER	1	JOB	$3,219	$19,365	$45,404	$95,000.00	$95,000.00	25%	$118,750.00
05.0.8.- POWER & LIGHTING SYSTEMS										
05.0.8.R	POWER LIGHTING & SIGNAL SYSTEM	1	JOB	$51,923	$916,580	$764,750	$2,500,000.00	$2,500,000.00	25%	$3,125,000.00
05.0.8.R	STANDBY GENERATOR UNIT	1	JOB	$0	$0	$77,250	$110,000.00	$110,000.00	25%	$137,500.00
05.0.R.- ASSOCIATED GENERAL ITEMS										
05.0.R.A	GOVERNMENT FIELD OFFICE	1	JOB	7,328.00	83,798.00	188,383.00	$330,000.00	$330,000.00	15%	$379,500.00
05.0.R.A	JANITORAL SERVICES	1	JOB	17,304.00	63,600.00	0.00	$95,000.00	$95,000.00	25%	$118,750.00
05.0.R.A	TEMPORARY UTILITIES AND OPERATING FACILITIES	1	JOB	77,484.00	390,175.00	245,811.00	$800,000.00	$800,000.00	25%	$1,000,000.00
05.0.R.B	CHAIN LINK FENCE, 4-FT.	200	LF	397.00	1,930.00	2,083.00	$27.00	$5,400.00	25%	$6,750.00
05.0.R.B	CHAIN LINK FENCE, 8-FT.	2,300	LF	$3,672	$15,254	$20,560	$20.00	$46,000.00	25%	$57,500.00
05.0.R.B	SLIDE GATE, 12-FT, ELECTRIC OPERATED	1	JOB	$171	$2,469	$10,400	$16,000.00	$16,000.00	25%	$20,000.00
05.0.R.B	DOUBLE SWING GATE 15-FT., MANUALLY OPERATED	1	JOB	$43	$445	$850	$1,600.00	$1,600.00	25%	$2,000.00
05.0.R.B	SLIDE GATE, 12 FT., MANUALLY OPERATED	1	JOB	$43	$445	$1,200	$2,000.00	$2,000.00	25%	$2,500.00
05.0.R.B	SEEDING AND MULCHING	3	AC	$701	$934	$3,228	$2,000.00	$6,000.00	25%	$7,500.00
05.0.R.B	PROJECT SIGNS	1	JOB	$69	$1,025	$2,977	$5,000.00	$5,000.00	15%	$5,750.00
05.0.R.B	FLAG POLE & BASE	1	JOB	$234	$2,125	$6,875	$11,000.00	$11,000.00	15%	$12,650.00
05.0.R.B	NO. 57 AGGREGATE BASE COURSE FOR ESPLANADE	1,700	CY	$35,880	$5,232	$23,648	$45.00	$76,500.00	25%	$95,625.00
05.0.R.B	RAILROAD FLAGMEN	30	DAY	$399	$15,900	$0	$650.00	$19,500.00	25%	$24,375.00
05.0.R.C	DEFORMED STEEL BARS, ESPLANADE MISCELLANEOUS	42,000	LBS	$23,220	$13,684	$10,180	$0.05	$2,100.00	25%	$2,625.00
05.0.R.C	STEEL WELDED WIRE REINFORCEMENT, ESPLANADE PAVING	53,000	LBS	$27,863	$16,421	$19,332	$1.50	$79,500.00	25%	$99,375.00
05.0.R.C	CONCRETE, ESPLANADE PAVING, 6-INCHES THICK	9,035	SY	$4,226	$116,071	$84,564	$28.00	$252,980.00	25%	$316,225.00
05.0.R.C	CONCRETE, SIDEWALK PAVING, 4-INCHES THICK	1,020	SY	$720	$17,921	$7,620	$30.00	$30,600.00	25%	$38,250.00
05.0.R.C	CONCRETE CURBING	1,020	LF	$612	$15,233	$1,853	$20.00	$20,400.00	25%	$25,500.00
05.0.R.C	CONCRETE, ESPLANADE MISCELLANEOUS	650	CY	$3,240	$80,645	$36,765	$220.00	$143,000.00	25%	$178,750.00
05.0.R.E	STEEL IRON CASTINGS	25,000	LBS	$3,322	$22,381	$137,479	$8.00	$200,000.00	25%	$250,000.00
05.0.R.E	ALUMINIUM PLANKING	6,100	SF	$4,005	$149,493	$106,177	$50.00	$305,000.00	15%	$350,750.00
05.0.R.E	ALUMINUM COVER PLATES	265	SF	$90	$3,359	$12,376	$70.00	$18,550.00	15%	$21,332.50
05.0.R.E	ALUMINUM RABBET ANGLES	2,610	LF	$444	$13,685	$16,772	$15.00	$39,150.00	15%	$45,022.50
05.0.R.E	GUARD FENCE	9,365	LF	$28,335	$69,940	$304,650	$50.00	$468,250.00	25%	$585,312.50
05.0.R.E	HANDRAIL - 2" DIA., TOP SURFACE MOUNTED	405	LF	$850	$12,423	$19,188	$95.00	$38,475.00	25%	$48,093.75
05.0.R.E	PIPE HANDRAIL - 2" DIA., ESPLANADE	75	LF	$196	$2,867	$2,637	$90.00	$6,750.00	25%	$8,437.50
05.0.R.E	DISTANCE MARKERS	1	JOB	$53	$1,944	$2,170	$5,000.00	$5,000.00	25%	$6,250.00

05.0.R.E	LIFEBOAT LOWERING FACILITIES	1	JOB	$6,857	$10,189	$31,200	$58,000.00	$58,000.00	25%	$72,500.00
05.0.R.E	WORK FLAT ROLLING BITT ASSEMBLY	1	JOB	$367	$3,719	$3,966	$10,000.00	$10,000.00	25%	$12,500.00
05.0.R.E	REMOVE & REINSTALL TOW HAULAGE & RETRIEVER SYSTEM	1	JOB	$2,700	$25,469	$0	$35,000.00	$35,000.00	25%	$43,750.00
05.0.R.P	EMERGENCY BULKHEAD HOIST	1	JOB	$0	$0	$1,626,000	$2,000,000.00	$2,000,000.00	25%	$2,500,000.00
05.0.N.-	BUILDING, PROJECT OPERATIONS									
05.0.N._	LANDWALL BUILDING	1	JOB	$45,121	$419,770	$333,352	$1,100,000.00	$1,100,000.00	35%	$1,485,000.00
05.0.N._	MIDDLEWALL BUILDING	1	JOB	$11,456	$99,967	$85,939	$280,000.00	$280,000.00	35%	$378,000.00
05.0.N._	CONTROL SHELTERS	4	EA	$7,184	$59,724	$27,760	$34,000.00	$136,000.00	25%	$170,000.00
05.0.N._	PUMP SHELTERS	2	EA	2,517.00	$18,620	$9,388	$22,000.00	$44,000.00	25%	$55,000.00
05.0.N._	UPPER GAGING STATION	1	JOB	$133	$7,232	$3,260	$15,000.00	$15,000.00	25%	$18,750.00
04.-.-.-	DAMS									
04.1.-.-	MAIN DAM									
04.1.1.-	CONCRETE DAM, NON OVERFLOW SECTION									
04.1.1.C	DEFORMED STEEL BARS, FOOTBRIDGE ACCESS TOWER	68,000	LBS	$3,530	$10,499	$18,156	$0.50	$34,000.00	25%	$42,500.00
04.1.1.C	CONCRETE IN-PLACE, FOOTBRIDGE ACCESS TOWER	500	CY	$45,774	$122,709	$19,490	$450.00	$225,000.00	25%	$281,250.00
04.1.1.C	PORTLAND CEMEMT, FOOTBRIDGE ACCESS TOWER	2,600	CWT	$0	$0	$7,859	$4.00	$10,400.00	25%	$13,000.00
04.1.1.E	FOOTBRIDGE	1	JOB	$7,991	$36,820	$96,635	$170,000.00	$170,000.00	25%	$212,500.00
04.1.1.E	TEMPORARY FOOTBRIDGE	1	JOB	$2,010	$4,191	$194,000	$240,000.00	$240,000.00	25%	$300,000.00
04.1.1.N	MISC. ITEMS FOR FOOTBRIDGE ACCESS TOWER	1	JOB	$2,254	$31,501	$66,053	$120,000.00	$120,000.00	25%	$150,000.00
04.1.3.-	APRON, STILLING BASIN AND DEFLECTORS									
04.1.3.B	DAM SCOUR PROTECTION, GRADED STONE	2,200	CY	$7,678	$15,559	$58,630	$45.00	$99,000.00	25%	$123,750.00
04.1.3.B	DAM SCOUR PROTECTION, GROUT FILLED BAGS	3,040	CY	$188,480	$279,680	$468,160	$370.00	$1,124,800.00	25%	$1,406,000.00
04.0.R.-	ASSOCIATED GENERAL ITEMS									
04.0.R.P	ELEVATOR	1	JOB	$68	$4,311	$87,600	$130,000.00	$130,000.00	15%	$149,500.00
	TOTAL CONSTRUCTION COSTS :							$186,471,085.00	25%	$232,900,737.50

PRIME CONTRACTOR'S DISTRIBUTED COST ON PRIME'S WORK	$15,273,209	OR	10.7%
PRIME CONTRACTOR'S PROFIT ON PRIME'S WORK			8.8%
PRIME CONTRACTOR'S DISTRIBUTED COST ON SUBCONTRACTOR'S WORK	$857,200	OR	7.3%
PRIME CONTRACTOR'S PROFIT ON SUBCONTRACTOR'S WORK			7.5%
SUBCONTRACTOR'S OVERHEAD AND PROFIT ON HIS WORK			25.0%

CODE OF ACCOUNTS TOTALS (ROUNDED)

05	LOCK	$184,000,000.00	25%	$230,000,000.00
04	DAM	$2,200,000.00	23%	$2,700,000.00

LOWER MONONGAHELA RIVER NAVIGATION STUDY
REMOVAL OF L/D #3 - October 1991 Cost Level
Plans 1,2,4,5,6 & 7

	DESCRIPTION	QUANTITY	UNIT	WITHOUT OVERHEAD AND PROFIT PLANT	LABOR	MATERIALS	UNIT PRICE INCLUDING OVERHEAD &PROFIT	TOTAL AMOUNT	CONTIN-GENCY	TOTAL AMOUNT INCL CONTINGENCY
	*** RESERVOIRS ***									
03.0.-.-	RESERVOIRS									
03.0.1.B	REMOVAL OF L/D #3	1	JB	$1,620,847	$2,451,521	$304,067	$6,000,000.00	$6,000,000.00	30%	$7,800,000.00
03.0.1.B	SHEET PILING REMOVAL	55,890	SF	$111,016	$133,987	$0	$6.00	$335,340.00	30%	$435,942.00
03.0.1.B	EXCAVATION (CELLS)	14,060	CY	$37,310	$21,988	$0	$6.00	$84,360.00	30%	$109,668.00
03.0.1.B	CONCRETE (CELLS)	770	CY	$7,273	$35,572	$0	$70.00	$53,900.00	25%	$67,375.00
03.0.1.B	REMOVAL OF TIMBER FENDERS	1	JB	$12,165	$26,040	$0	$50,000.00	$50,000.00	25%	$62,500.00
03.0.1.B	EQUIPMENT REMOVAL	1	JB	$6,036	$15,965	$0	$30,000.00	$30,000.00	25%	$37,500.00
	TOTAL COST							$6,553,600.00		$8,512,985.00
	DISTRIBUTED COSTS	$922,900	OR	14.1%						
	PRIMES PROFIT	9.3%							30%	
								ROUNDED		$9,000,000.00

SCREENING LEVEL STRUCTURE REMOVAL ESTIMATES
PLANS 5,6,& 7

FILE:LKREMV.WK1

(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	REMOVAL OF EXISTING LOCKS AND DAM 2						
09.-.-.-	Remove Existing Locks and Dam Concrete	C.Y.	158,000	$60.00	$9,480,000	40%	$13,272,000
	Remove Existing Cells	EACH	6	$30,000.00	$180,000	40%	$252,000
09.-.-.-	TOTAL CONSTRUCTION COSTS				$9,660,000		$13,524,000
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$970,000	25%	$1,212,500
31.-.-.-	Construction Management				$725,000	25%	$906,250
	TOTAL FIRST COSTS				$11,355,000		$15,642,750
	AVERAGE OVERALL CONTINGENCY					38%	
	REMOVAL OF EXISTING LOCKS AND DAM 4						
09.-.-.-	Remove Existing Locks and Dam Concrete	C.Y.	172,000	$60.00	$10,320,000	40%	$14,448,000
	Structural Steel Removal	L.F.	750	$150.00	$112,500	40%	$157,500
	Machinery Housing & Machinery Removal	EACH	6	$10,000.00	$60,000	40%	$84,000
	Tainter Gate Removal	EACH	5	$10,000.00	$50,000	40%	$70,000
09.-.-.-	TOTAL CONSTRUCTION COSTS				$10,432,500		$14,605,500
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$1,050,000	25%	$1,312,500
31.-.-.-	Construction Management				$785,000	25%	$981,250
	TOTAL FIRST COSTS				$12,267,500		$16,899,250
	AVERAGE OVERALL CONTINGENCY					38%	

SCREENING LEVEL DREDGING ESTIMATES
PLANS 5,6, & 7

FILE:DREDGE.WK1

(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	PLAN 5, Pool 2 (R.M. 11.2 to R.M. 23.8)						
09.-.-.-	TOTAL CONSTRUCTION COSTS, DREDGING	C.Y.	4,900,000	$8.00	$39,200,000	150%	$98,000,000
30.-.-.-	Planning, Engineering and Design				$4,700,000	25%	$5,875,000
31.-.-.-	Construction Management				$3,530,000	25%	$4,412,500
	TOTAL FIRST COSTS, DREDGING				$47,430,000		$108,287,500
	PLAN 6, Pool 3 (R.M. 23.8 to R.M. 41.5)						
09.-.-.-	TOTAL CONSTRUCTION COSTS, DREDGING	C.Y.	5,700,000	$8.00	$45,600,000	150%	$114,000,000
30.-.-.-	Planning, Engineering and Design				$5,500,000	25%	$6,875,000
31.-.-.-	Construction Management				$4,100,000	25%	$5,125,000
	TOTAL FIRST COSTS, DREDGING				$55,200,000		$126,000,000
	PLAN 7, Pool 3 (R.M. 23.8 to R.M. 41.5)						
09.-.-.-	TOTAL CONSTRUCTION COSTS, DREDGING	C.Y.	190,000	$15.00	$2,850,000	150%	$7,125,000
30.-.-.-	Planning, Engineering and Design				$345,000	25%	$431,250
31.-.-.-	Construction Management				$260,000	25%	$325,000
	TOTAL FIRST COSTS, DREDGING				$3,455,000		$7,881,250

R.M. 22.2 - PLANS 2 & 5
SCREENING LEVEL ROAD RELOCATIONS
(October 1991 Cost Level)

FILE:ROAD25.WK1

ITEM	TOTAL CONSTRUCT COSTS	TOTAL CONTINGENCIES	TOTAL P, E & D	TOTAL S & A
SUMMARY				
RAISE 0.09 MILE OF ROADWAY (MILL ALLEY) ALONG MONONGAHELA RIVER @ R.M. 22.5	$175,975	$78,140	$17,500	$13,500
RAISE 0.02 MILE OF ROADWAY (HILL AVE CONN.), AND 0.04 MILE (ROAD B CONN.) ALONG MONONGAHELA RIVER @ R.M. 22.5	$27,625	$12,275	$2,800	$2,100
RAISE 0.02 MILE OF ROADWAYS (FERRY-MARKET-WATER AND FIRST STREETS) ALONG MONONGAHELA RIVER @ R.M. 23.0	$196,000	$86,975	$19,600	$14,700
SUMMARY OF ROAD RELOCATIONS	$399,600	$177,390	$39,900	$30,300

R.M. 22.2 - PLANS 2 & 5
SCREENING LEVEL ROAD RELOCATIONS
(October 1991 Cost Level)

FILE:ROAD25.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	RAISE 0.09 MILE OF ROADWAY (MILL ALLEY) ALONG MONONGAHELA RIVER @ R.M. 22.5						
02.1.-.-	Excavation, Common	C.Y.	940	$15.00	$14,100	40%	$19,740
02.1.-.-	Compacted Fill (Borrow)	C.Y.	4,700	$20.00	$94,000	40%	$131,600
02.1.-.-	Crushed Aggregate Base Course	C.Y.	410	$35.00	$14,350	40%	$20,090
02.1.-.-	Stone Slope Protection	C.Y.	950	$40.00	$38,000	40%	$53,200
02.1.-.-	Filter Material	C.Y.	285	$45.00	$12,825	40%	$17,955
02.1.-.-	Guard Rail	L.F.	270	$10.00	$2,700	40%	$3,780
	TOTAL CONSTRUCTION COSTS				$175,975		$246,365
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$17,500	25%	$21,875
31.-.-.-	Construction Management				$13,500	25%	$16,875
	TOTAL FIRST COSTS				$206,975		$285,115
	AVERAGE OVERALL CONTINGENCY					38%	
	RAISE 0.02 MILE OF ROADWAY (HILL AVE CONN.), AND 0.04 MILE (ROAD B CONN.) ALONG MONONGAHELA RIVER @ R.M. 22.5						
02.1.-.-	Excavation, Common	C.Y.	265	$25.00	$6,625	40%	$9,275
02.1.-.-	Compacted Fill (Borrow)	C.Y.	525	$20.00	$10,500	40%	$14,700
02.1.-.-	Crushed Aggregate Base Course	C.Y.	300	$35.00	$10,500	40%	$14,700
	TOTAL CONSTRUCTION COSTS				$27,625		$38,675
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$2,800	25%	$3,500
31.-.-.-	Construction Management				$2,100	25%	$2,625
	TOTAL FIRST COSTS				$32,525		$44,800
	AVERAGE OVERALL CONTINGENCY					38%	

R.M. 22.2 - PLANS 2 & 5
SCREENING LEVEL ROAD RELOCATIONS
(October 1991 Cost Level)

FILE:ROAD25.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	RAISE 0.02 MILE OF ROADWAYS (FERRY-MARKET-WATER AND FIRST STREETS) ALONG MONONGAHELA RIVER @ R.M. 23.0						
02.1.-.-	Excavation, Common	C.Y.	2,100	$15.00	$31,500	40%	$44,100
02.1.-.-	Compacted Fill (Borrow)	C.Y.	4,300	$20.00	$86,000	40%	$120,400
02.1.-.-	Crushed Aggregate Base Course	C.Y.	1,315	$35.00	$46,025	40%	$64,435
02.1.-.-	Bituminous Surface Course	S.Y.	3,205	$5.00	$16,025	40%	$22,435
02.1.-.-	Stone Slope Protection	C.Y.	80	$40.00	$3,200	40%	$4,480
02.1.-.-	Filter Material	C.Y.	190	$45.00	$8,550	40%	$11,970
02.1.-.-	Guard Rail	L.F.	220	$10.00	$2,200	40%	$3,080
02.1.-.-	Seeding & Mulching	ACRE	1	$2,500.00	$2,500	40%	$3,500
	TOTAL CONSTRUCTION COSTS				$196,000		$274,400
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$19,600	25%	$24,500
31.-.-.-	Construction Management				$14,700	25%	$18,375
	TOTAL FIRST COSTS				$230,300		$317,275
	AVERAGE OVERALL CONTINGENCY					38%	

PLANS 6 & 7
SCREENING LEVEL ROAD RELOCATIONS
(October 1991 Cost Level)

FILE:RD67B.WK1

	TOTAL CONSTRUCT COSTS	TOTAL CONTINGENCIES	TOTAL P, E & D	TOTAL S & A
SUMMARY				
RAISE 0.04 MILE OF ROADWAY (GILMORE ST.) AND 0.06 MILE OF ALLEY CONN. ALONG MONONGAHELA RIVER @ R.M. 36.0	$76,700	$34,055	$7,750	$5,750
RAISE 0.07 MILE OF ROADWAY (ALONG TURKEY RUN) ON MONONGAHELA RIVER @ R.M. 36.8	$91,300	$40,520	$9,000	$7,000
RAISE 0.40 MILE OF ROADWAY ALONG MONONGAHELA RIVER (SPEARS, PA) @ R.M. 42.9	$354,825	$157,430	$35,500	$26,500
RAISE 0.11 MILE OF WATER STREET AND 0.03 MILE OF 2ND STREET ALONG MONONGAHELA RIVER @ R.M. 43.7, RIGHT BANK	$115,575	$51,355	$11,500	$9,000
ADJUSTMENT OF ALLEY ALONG RR. & RIVER, ROAD #1 CONN. TO ALLEY, MARKET ST CONN. TO ALLEY, 1ST ST CONN. TO FORDING ST. AND FORDING ST. (RIGHT BANK) @ R.M. 46.0	$137,925	$61,220	$13,800	$10,400
ADJUSTMENT OF ROADWAY (COAL ROAD) LEFT BANK, @ R.M. 48.8	$47,375	$21,025	$4,750	$3,550
RAISE 0.27 MILE OF ROADWAY (2ND ST - PART A), 0.12 MILE OF ROADWAY (MECH ST.), 0.08 MILE OF ROADWAY (2ND ST - PART B), 0.06 MILE OF ROADWAY (ALLEY #1), 0.05 MILE OF ROADWAY (ASH ST CONN TO 2ND ST) AND 0.03 MILE OF ROADWAY (ALLEY #2) ALONG MONONGAHELA RIVER @ R.M. 51.4	$961,925	$427,270	$95,000	$75,000
RAISE 0.07 MILE OF ROADWAY (ALLEY), 0.04 MILE OF ROADWAY (ALLEY "A"), 0.03 MILE OF ROADWAY (UNION ST.), 0.03 MILE OF ROADWAY (FIRST STREET-WEST) AND 0.05 MILE OF ROADWAY (FIRST STREET-EAST) ALONG MONONGAHELA R. @ R.M. 51.5	$88,575	$39,343	$9,000	$6,650
SUMMARY OF ROAD RELOCATIONS	$1,874,200	$832,218	$186,300	$143,850

PLANS 6 & 7
SCREENING LEVEL ROAD RELOCATIONS
(October 1991 Cost Level)

FILE:RD678.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	RAISE 0.04 MILE OF ROADWAY (GILMORE ST.) AND 0.06 MILE OF ALLEY CONN. ALONG MONONGAHELA RIVER @ R.M. 36.0						
02.1.-.-	Excavation, Common	C.Y.	715	$20.00	$14,300	40%	$20,020
02.1.-.-	Compacted Fill (Borrow)	C.Y.	2,460	$15.00	$36,900	40%	$51,660
02.1.-.-	Crushed Aggregate Base Course	C.Y.	325	$35.00	$11,375	40%	$15,925
02.1.-.-	Bituminous Surface Course	S.Y.	1160	$5.00	$5,800	40%	$8,120
02.1.-.-	Stone Slope Protection	C.Y.	125	$45.00	$5,625	40%	$7,875
02.1.-.-	Filter Material	C.Y.	45	$60.00	$2,700	40%	$3,780
	TOTAL CONSTRUCTION COSTS				$76,700		$107,380
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$7,750	25%	$9,688
31.-.-.-	Construction Management				$5,750	25%	$7,188
	TOTAL FIRST COSTS				$90,200		$124,255
	AVERAGE OVERALL CONTINGENCY					38%	
	RAISE 0.07 MILE OF ROADWAY (ALONG TURKEY RUN) ON MONONGAHELA RIVER @ R.M. 36.8						
02.1.-.-	Excavation, Common	C.Y.	1,465	$15.00	$21,975	40%	$30,765
02.1.-.-	Compacted Fill (Borrow)	C.Y.	105	$20.00	$2,100	40%	$2,940
02.1.-.-	Crushed Aggregate Base Course	C.Y.	185	$40.00	$7,400	40%	$10,360
02.1.-.-	Stone Slope Protection	C.Y.	275	$45.00	$12,375	40%	$17,325
02.1.-.-	Filter Material	C.Y.	95	$50.00	$4,750	40%	$6,650
02.1.-.-	Guard Rail	L.F.	270	$10.00	$2,700	40%	$3,780
02.1.-.-	Corrugated Metal Pipe, 5 ft. dia.	L.F.	250	$150.00	$37,500	40%	$52,500
02.1.-.-	Seeding & Mulching	ACRE	1	$2,500.00	$2,500	40%	$3,500
	TOTAL CONSTRUCTION COSTS				$91,300		$127,820
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$9,000	25%	$11,250
31.-.-.-	Construction Management				$7,000	25%	$8,750
	TOTAL FIRST COSTS				$107,300		$147,820
	AVERAGE OVERALL CONTINGENCY					38%	

PLANS 6 & 7
SCREENING LEVEL ROAD RELOCATIONS
(October 1991 Cost Level)

FILE:RD67B.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	RAISE 0.40 MILE OF ROADWAY ALONG MONONGAHELA RIVER (SPEARS, PA) @ R.M. 42.9						
02.1.-.-	Excavation, Common	C.Y.	3,525	$15.00	$52,875	40%	$74,025
02.1.-.-	Compacted Fill (Borrow)	C.Y.	14,310	$10.00	$143,100	40%	$200,340
02.1.-.-	Crushed Aggregate Base Course	C.Y.	1,000	$35.00	$35,000	40%	$49,000
02.1.-.-	Stone Slope Protection	C.Y.	2,040	$40.00	$81,600	40%	$114,240
02.1.-.-	Filter Material	C.Y.	550	$45.00	$24,750	40%	$34,650
02.1.-.-	Guard Rail	L.F.	750	$10.00	$7,500	40%	$10,500
02.A.-.-	Right-of-way	SUM	1	$10,000.00	$10,000	40%	$14,000
	TOTAL CONSTRUCTION COSTS				$354,825		$496,755
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$35,500	25%	$44,375
31.-.-.-	Construction Management				$26,500	25%	$33,125
	TOTAL FIRST COSTS				$416,825		$574,255
	AVERAGE OVERALL CONTINGENCY					38%	
	RAISE 0.11 MILE OF WATER STREET AND 0.03 MILE OF 2ND STREET ALONG MONONGAHELA RIVER @ R.M. 43.7, RIGHT BANK						
02.1.-.-	Compacted Fill (Borrow)	C.Y.	7,075	$10.00	$70,750	40%	$99,050
02.1.-.-	Crushed Aggregate Base Course	C.Y.	600	$35.00	$21,000	40%	$29,400
02.1.-.-	Bituminous Surface Course	S.Y.	2,135	$5.00	$10,675	40%	$14,945
02.1.-.-	Stone Slope Protection	C.Y.	45	$50.00	$2,250	40%	$3,150
02.1.-.-	Filter Material	C.Y.	15	$60.00	$900	40%	$1,260
02.A.-.-	Right-of-way	SUM	1	$10,000.00	$10,000	40%	$14,000
	TOTAL CONSTRUCTION COSTS				$115,575		$161,805
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$11,500	25%	$14,375
31.-.-.-	Construction Management				$9,000	25%	$11,250
	TOTAL FIRST COSTS				$136,075		$187,430
	AVERAGE OVERALL CONTINGENCY					38%	

PLANS 6 & 7
SCREENING LEVEL ROAD RELOCATIONS
(October 1991 Cost Level)

FILE:RD67B.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	ADJUSTMENT OF ALLEY ALONG RR. & RIVER, ROAD #1 CONN. TO ALLEY, MARKET ST CONN. TO ALLEY, 1ST ST CONN. TO FORDING ST. AND FORDING ST. (RIGHT BANK) @ R.M. 46.0						
	ALLEY						
02.1.-.-	Excavation, Common	C.Y.	865	$20.00	$17,300	40%	$24,220
02.1.-.-	Compacted Fill (Borrow)	C.Y.	1,400	$15.00	$21,000	40%	$29,400
02.1.-.-	Crushed Aggregate Base Course	C.Y.	650	$35.00	$22,750	40%	$31,850
02.1.-.-	Bituminous Surface Course	S.Y.	2,320	$5.00	$11,600	40%	$16,240
02.1.-.-	Stone Slope Protection	C.Y.	15	$60.00	$900	40%	$1,260
02.1.-.-	Filter Material	C.Y.	5	$60.00	$300	40%	$420
	ROAD #1						
02.1.-.-	Excavation, Common	C.Y.	75	$25.00	$1,875	40%	$2,625
02.1.-.-	Crushed Aggregate Base Course	C.Y.	90	$50.00	$4,500	40%	$6,300
02.1.-.-	Bituminous Surface Course	S.Y.	320	$10.00	$3,200	40%	$4,480
	MARKET STREET						
02.1.-.-	Excavation, Common	C.Y.	30	$25.00	$750	40%	$1,050
02.1.-.-	Compacted Fill (Borrow)	C.Y.	5	$20.00	$100	40%	$140
02.1.-.-	Crushed Aggregate Base Course	C.Y.	70	$50.00	$3,500	40%	$4,900
02.1.-.-	Bituminous Surface Course	S.Y.	255	$10.00	$2,550	40%	$3,570
	1ST STREET						
02.1.-.-	Excavation, Common	C.Y.	55	$25.00	$1,375	40%	$1,925
02.1.-.-	Compacted Fill (Borrow)	C.Y.	95	$20.00	$1,900	40%	$2,660
02.1.-.-	Crushed Aggregate Base Course	C.Y.	35	$35.00	$1,225	40%	$1,715
02.1.-.-	Bituminous Surface Course	S.Y.	120	$10.00	$1,200	40%	$1,680
	FORDING STREET						
02.1.-.-	Excavation, Common	C.Y.	310	$25.00	$7,750	40%	$10,850
02.1.-.-	Compacted Fill (Borrow)	C.Y.	630	$20.00	$12,600	40%	$17,640
02.1.-.-	Crushed Aggregate Base Course	C.Y.	215	$40.00	$8,600	40%	$12,040
02.1.-.-	Bituminous Surface Course	S.Y.	770	$10.00	$7,700	40%	$10,780
02.1.-.-	Stone Slope Protection	C.Y.	75	$50.00	$3,750	40%	$5,250
02.1.-.-	Filter Material	C.Y.	25	$60.00	$1,500	40%	$2,100
	TOTAL CONSTRUCTION COSTS				$137,925		$193,095
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$13,800	25%	$17,250
31.-.-.-	Construction Management				$10,400	25%	$13,000
	TOTAL FIRST COSTS				$162,125		$223,345
	AVERAGE OVERALL CONTINGENCY					38%	

PLANS 6 & 7
SCREENING LEVEL ROAD RELOCATIONS
(October 1991 Cost Level)

FILE:RD67B.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	ADJUSTMENT OF ROADWAY (COAL ROAD) LEFT BANK, @ R.M. 48.8						
02.1.-.-	Excavation, Common	C.Y.	290	$25.00	$7,250	40%	$10,150
02.1.-.-	Compacted Fill (Borrow)	C.Y.	1,250	$15.00	$18,750	40%	$26,250
02.1.-.-	Crushed Aggregate Base Course	C.Y.	140	$50.00	$7,000	40%	$9,800
02.1.-.-	Bituminous Surface Course	S.Y.	500	$10.00	$5,000	40%	$7,000
02.1.-.-	Stone Slope Protection	C.Y.	115	$45.00	$5,175	40%	$7,245
02.1.-.-	Filter Material	C.Y.	45	$60.00	$2,700	40%	$3,780
02.1.-.-	Guard Rail	L.F.	150	$10.00	$1,500	40%	$2,100
	TOTAL CONSTRUCTION COSTS				$47,375		$66,325
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$4,750	25%	$5,938
31.-.-.-	Construction Management				$3,550	25%	$4,438
	TOTAL FIRST COSTS				$55,675		$76,700
	AVERAGE OVERALL CONTINGENCY					38%	
	RAISE 0.27 MILE OF ROADWAY (2ND ST - PART A), 0.12 MILE OF ROADWAY (MECH ST.), 0.08 MILE OF ROADWAY (2ND ST - PART B), 0.06 MILE OF ROADWAY (ALLEY #1), 0.05 MILE OF ROADWAY (ASH ST CONN TO 2ND ST) AND 0.03 MILE OF ROADWAY (ALLEY #2) ALONG MONONGAHELA RIVER @ R.M. 51.4						
02.1.-.-	Excavation, Common	C.Y.	5,400	10.00	54,000	40%	75,600
02.1.-.-	Compacted Fill (Borrow)	C.Y.	26,170	10.00	261,700	40%	366,380
02.1.-.-	Crushed Aggregate Base Course	C.Y.	1,810	35.00	63,350	40%	88,690
02.1.-.-	Bituminous Surface Course	S.Y.	8,265	5.00	41,325	40%	57,855
02.1.-.-	Stone Slope Protection	C.Y.	2,535	40.00	101,400	40%	141,960
02.1.-.-	Filter Material	C.Y.	650	45.00	29,250	40%	40,950
02.1.-.-	Guard Rail	L.F.	1,090	10.00	10,900	40%	15,260
02.A.-.-	Right-of-way	SUM	1	400,000.00	400,000	40%	560,000
	TOTAL CONSTRUCTION COSTS				$961,925		$1,346,695
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$95,000	25%	$118,750
31.-.-.-	Construction Management				$75,000	25%	$93,750
	TOTAL FIRST COSTS				$1,131,925		$1,559,195
	AVERAGE OVERALL CONTINGENCY					38%	

PLANS 6 & 7
SCREENING LEVEL ROAD RELOCATIONS
(October 1991 Cost Level)

FILE:RD67B.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	RAISE 0.07 MILE OF ROADWAY (ALLEY), 0.04 MILE OF ROADWAY (ALLEY "A"), 0.03 MILE OF ROADWAY (UNION ST.), 0.03 MILE OF ROADWAY (FIRST STREET-WEST) AND 0.05 MILE OF ROADWAY (FIRST STREET-EAST) ALONG MONONGAHELA R. @ R.M. 51.5						
02.1.-.-	Excavation, Common	C.Y.	2,900	15.00	43,500	40%	60,900
02.1.-.-	Crushed Aggregate Base Course	C.Y.	915	35.00	32,025	40%	44,835
02.1.-.-	Bituminous Surface Course	S.Y.	1,055	10.00	10,550	40%	14,770
02.1.-.-	Seeding & Mulching	ACRE	1	2,500.00	2,500	40%	3,500
	TOTAL CONSTRUCTION COSTS				$88,575		$124,005
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$9,000	25%	$11,250
31.-.-.-	Construction Management				$6,650	25%	$8,313
	TOTAL FIRST COSTS				$104,225		$143,568
	AVERAGE OVERALL CONTINGENCY					38%	

R.M. 34.0 - PLANS 6, & 7
SCREENING LEVEL RAILROAD RELOCATIONS
(October 1991 Cost Level)

FILE:RRTRK67.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	RAISE 0.058 MILE SINGLE TRACK RAILROAD FROM R.M. 35.2 TO R.M. 35.7						
02.2.-.-	Excavation, Common	C.Y.	125	$25.00	$3,125	40%	$4,375
02.2.-.-	Compacted Fill (Borrow)	C.Y.	5,720	$10.00	$57,200	40%	$80,080
02.2.-.-	Remove & Replace Trackage (Ties, Rails, etc.)	L.F.	3,050	$200.00	$610,000	40%	$854,000
	TOTAL CONSTRUCTION COSTS				$670,325		$938,455
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$70,000	25%	$87,500
31.-.-.-	Construction Management				$50,000	25%	$62,500
	TOTAL FIRST COSTS				$790,325		$1,088,455
	AVERAGE OVERALL CONTINGENCY					38%	

LOWER MONONGAHELA RIVER NAVIGATION STUDY
RAILROAD BRIDGE RELOCATION - October 1991 Cost Level
Plans 1 & 7

	DESCRIPTION	QUANTITY	UNIT	PLANT	LABOR	MATERIALS	UNIT PRICE INCLUDING OH & PROFIT	TOTAL AMOUNT	CONT.	TOTAL AMOUNT INCLUDING CONTINGENCY
	*** RAILROAD RELOCATION ***									
02.-.-.-	RELOCATIONS									
02.2.1.B	Railroad Traffic Detour	1	JOB	$23,228	$136,691	$405,000	$565,000.00	$565,000.00	30%	$734,500.00
02.2.3.B	Track Relocation	1	JOB	$0	$0	$80,000	$80,000.00	$80,000.00	30%	$104,000.00
02.2.3.B	Track Reprofile	1	JOB	$5,605	$18,869	$15,000	$40,000.00	$40,000.00	30%	$52,000.00
02.2.K.C	Concrete, Pier Encasement	1,200	CY	$778,932	$1,251,908	$455,000	$2,070.00	$2,484,000.00	30%	$3,229,200.00
02.2.K.C	Concrete, Pier Rehabilitation	200	CY	$111,276	$178,844	$25,200	$1,575.00	$315,000.00	30%	$409,500.00
02.2.L.E	Remove & Replace Main Span (Steel)	4,000,000	LBS	$2,199,780	$2,436,750	$4,275,000	$2.25	$9,000,000.00	30%	$11,700,000.00
02.2.L.E	Remove & Replace North Approach Span (Steel)	2,400,000	LBS	$1,466,520	$1,624,500	$2,280,000	$2.25	$5,400,000.00	30%	$7,020,000.00
02.2.L.E	Rehabilitation South Approach Span (Steel)	640,000	LBS	$488,840	$541,500	$550,000	$2.50	$1,600,000.00	30%	$2,080,000.00
02.2.L.E	Raise South Approach Spans	1	JOB	$0	$0	$1,050,000	$1,050,000.00	$1,050,000.00	30%	$1,365,000.00
02.2.L.F	Timber Deck	1,665	EA	$42,968	$302,853	$405,000	$450.00	$749,250.00	30%	$974,025.00
02.2.R.-	Communication & Signal Work	1	JOB	$0	$0	$50,630	$50,000.00	$50,000.00	30%	$65,000.00
02.2.R.-	Utility Work	1	JOB	$0	$0	$65,000	$65,000.00	$65,000.00	30%	$84,500.00
	TOTAL COST							$21,398,250.00		$27,817,725.00
									30%	
								ROUNDED		$27,800,000.00

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TOTAL RAILROAD BRIDGE RELOCATION (ROUNDED):

FEDERAL RELOCATION COST, 90%	$19,260,000	30%	$25,000,000
NON-FEDERAL RELOCATION COST, 10%	$2,140,000		

PLAN 5
SCREENING LEVEL RAILROAD BRIDGE MODIFICATION ESTIMATES
(October 1991 Cost Level)

FILE:RRMOD5.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	CONRAIL RAILROAD BRIDGE						
	PIER NO. 7 - CONCRETE ENCASEMENT AROUND THE PIER						
02.2.-.-	Concrete	C.Y.	250	$350.00	$87,500	100%	$175,000
02.2.-.-	Steel Sheetpiling	S.Y.	640	$50.00	$32,000	100%	$64,000
	SUBTOTAL, PIER NO.7				$119,500		$239,000
	PIER NO. 8 - CONCRETE BUTTRESS WALL						
02.2.-.-	Concrete	C.Y.	790	$350.00	$276,500	100%	$553,000
02.2.-.-	Reinforcement Bars	LBS.	55,500	$0.50	$27,750	100%	$55,500
02.2.-.-	Piles	L.F.	960	$30.00	$28,800	100%	$57,600
02.2.-.-	Pile Tips	EACH	24	$200.00	$4,800	100%	$9,600
02.2.-.-	Demolition	JOB	1	$50,000.00	$50,000	100%	$100,000
	SUBTOTAL, PIER NO.8				$387,850		$775,700
	TOTAL CONSTRUCTION COSTS, PIER NOS. 7 & 8				$507,350		$1,014,700
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					100%	
30.-.-.-	Planning, Engineering and Design				$50,000	25%	$62,500
31.-.-.-	Construction Management				$40,000	25%	$50,000
	TOTAL FIRST COSTS				$597,350		$1,127,200
	AVERAGE OVERALL CONTINGENCY					89%	

SCREENING LEVEL HIGHWAY BRIDGE ESTIMATES
PLAN 6 & 7

(October 1991 Cost Level)

FILE:HIGBR7.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	DONORA-WEBSTER BRIDGE						
02.1.-.-	TOTAL CONSTRUCTION COSTS	JOB	1	$30,000,000	$30,000,000	75%	$52,500,000
30.-.-.-	Planning, Engineering and Design				$3,250,000	25%	$4,062,500
31.-.-.-	Construction Management				$2,450,000	25%	$3,062,500
	TOTAL FEDERAL FIRST COSTS				$35,700,000		$59,625,000
	AVERAGE OVERALL CONTINGENCY					67%	
	TOTAL NON-FEDERAL CONSTRUCTION COSTS (10%)				$3,000,000		
	TOTAL FEDERAL CONSTRUCTION COSTS (90%)				$27,000,000	75%	$47,250,000

SCREENING LEVEL BANK PROTECTION ESTIMATES
PLANS 2,5, & 6

(October 1991 Cost Level)

FILE:BANKPRO2.WK1

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	PLANS 2 & 5, POOL 2						
16.-.-.-	R.M. 23, Left Bank	JOB	1	$293,475	$293,475	40%	$411,000
	R.M. 23.45, Right Bank	JOB	1	$159,525	$159,525	40%	$225,000
16.-.-.-	TOTAL CONSTRUCTION COSTS				$453,000		$636,000
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$50,000	25%	$62,500
31.-.-.-	Construction Management				$35,000	25%	$43,750
	TOTAL FIRST COSTS				$538,000		$742,250
	AVERAGE OVERALL CONTINGENCY					38%	
	PLANS 6, POOL 3						
16.-.-.-	R.M. 35.4, Left Bank	JOB	1	$234,045	$234,045	40%	$330,000
	R.M. 35.5, Right Bank	JOB	1	$164,250	$164,250	40%	$230,000
	R.M. 36.78, Right Bank	JOB	1	$12,195	$12,195	40%	$20,000
	R.M. 38, Right Bank	JOB	1	$236,050	$236,050	40%	$331,000
16.-.-.-	TOTAL CONSTRUCTION COSTS				$646,540		$911,000
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					41%	
30.-.-.-	Planning, Engineering and Design				$65,000	25%	$81,250
31.-.-.-	Construction Management				$50,000	25%	$62,500
	TOTAL FIRST COSTS				$761,540		$1,054,750
	AVERAGE OVERALL CONTINGENCY					39%	

SCREENING LEVEL BANK PROTECTION ESTIMATES
PLANS 7

FILE:BANKPRO7.WK1

(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	PLANS 7, POOL 2						
16.-.-.-	R.M. 23, Left Bank	JOB	1	$293,475	$293,475	40%	$410,865
	R.M. 23.45, Right Bank	JOB	1	$159,525	$159,525	40%	$223,335
	R.M. 14.6, Left Bank	JOB	1	$856,050	$856,050	40%	$1,198,470
	R.M. 17.5, Left Bank	JOB	1	$198,000	$198,000	40%	$277,200
	R.M. 20.7, Left Bank	JOB	1	$37,075	$37,075	40%	$51,905
	R.M. 21.9, Left Bank	JOB	1	$52,325	$52,325	40%	$73,255
	Yough & Mon River	JOB	1	$55,250	$55,250	40%	$77,350
	R.M. 12.5, Right Bank	JOB	1	$863,140	$863,140	40%	$1,208,396
	R.M. 17.4, Right Bank	JOB	1	$267,425	$267,425	40%	$374,395
	R.M. 20.8, Right Bank	JOB	1	$970,400	$970,400	40%	$1,358,560
	End of 8th Avenue, Youghiogheny River	JOB	1	$36,875	$36,875	40%	$51,625
16.-.-.-	TOTAL CONSTRUCTION COSTS				$3,789,540		$5,305,356
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					40%	
30.-.-.-	Planning, Engineering and Design				$380,000	25%	$475,000
31.-.-.-	Construction Management				$285,000	25%	$356,250
	TOTAL FIRST COSTS FOR POOL 2				$4,454,540		$6,136,606
	PLANS 7, POOL 3						
16.-.-.-	R.M. 35.4, Left Bank	JOB	1	$234,045	$234,045	40%	$327,663
	R.M. 35.5, Right Bank	JOB	1	$164,250	$164,250	40%	$229,950
	R.M. 36.78, Right Bank	JOB	1	$12,195	$12,195	40%	$17,073
	R.M. 38, Right Bank	JOB	1	$236,050	$236,050	40%	$330,470
16.-.-.-	TOTAL CONSTRUCTION COSTS				$646,540		$905,156
30.-.-.-	Planning, Engineering and Design				$65,000	25%	$81,250
31.-.-.-	Construction Management				$50,000	25%	$62,500
	TOTAL FIRST COSTS FOR POOL 3				$761,540		$1,048,906
	AVERAGE OVERALL CONTINGENCY					38%	
	TOTAL FIRST COSTS FOR BANK PROTECTION				$4,436,080	40%	$6,210,512
30.-.-.-	TOTAL, Planning, Engineering and Design				$445,000	25%	$556,250
31.-.-.-	TOTAL, Construction Management				$335,000	25%	$418,750

SCREENING LEVEL PERMANENT OPERATING EQUIPMENT
PLANS 2, 3, 4 & Without Project

FILE:POE.WK1

(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	Permanent Operating Equipment						
20.-.-.-	Equipment at L/D #2	JOB	1	$162,000.00	$162,000	25%	$202,500
20.-.-.-	Equipment at L/D #3	JOB	1	$162,000.00	$162,000	25%	$202,500
20.-.-.-	Equipment at L/D #4	JOB	1	$162,000.00	$162,000	25%	$202,500
	TOTAL FIRST COSTS				$486,000		$607,500
	AVERAGE OVERALL CONTINGENCY					25%	

PLAN 5

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	Permanent Operating Equipment						
20.-.-.-	Equipment at Alt. Site	JOB	1	$162,000.00	$162,000	25%	$202,500
20.-.-.-	Equipment at L/D #4	JOB	1	$162,000.00	$162,000	25%	$202,500
	TOTAL FIRST COSTS				$324,000		$405,000
	AVERAGE OVERALL CONTINGENCY					25%	

PLANS 6 & 7

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	Permanent Operating Equipment						
20.-.-.-	Equipment at L/D #2	JOB	1	$162,000.00	$162,000	25%	$202,500
20.-.-.-	Equipment at Alt. Site	JOB	1	$162,000.00	$162,000	25%	$202,500
	TOTAL FIRST COSTS				$324,000		$405,000
	AVERAGE OVERALL CONTINGENCY					25%	

LOWER MONONGAHELA NAVIGATION STUDY
FISH AND WILDLIFE FACILITIES - October 1991 Cost Level
Plans 1,5,6 & 7

DESCRIPTION	QUANTITY	UNIT	WITHOUT OVERHEAD & PROFIT PLANT	LABOR	MATERIALS	UNIT PRICE INCLUDING OVERHEAD &PROT	TOTAL AMOUNT	CONT.	TOTAL AMOUNT INCLUDING CONTINGENCY
*** FISH & WILDLIFE FACILITIES ***									
06.-.-.- FISH & WILDLIFE FACILITIES									
06.1.-.- Low Flow Gate at L/D #2	1	JB	$0	$0	$175,000	$175,000.00	$175,000.00	15%	$201,250.00
06.1.-.- Air Entrainment System at L/D #4	1	JB	$0	$0	$125,000	$125,000.00	$125,000.00	15%	$143,750.00
06.3.-.- Instream Fish Habitat	1	JB	$356,728	$144,720	$0	$500,000.00	$500,000.00	15%	$575,000.00
06.3.-.- Habitat Restoration at Disposal Areas	1	JB	$21,342	$89,412	$90,000	$200,000.00	$200,000.00	15%	$230,000.00
06.3.-.- Wetlands Restoration at Disposal Areas	1	JB	$149,020	$35,570	$15,000	$200,000.00	$200,000.00	15%	$230,000.00
TOTAL COST							$1,200,000.00		$1,380,000.00
								15%	
							ROUNDED		$1,400,000.00

SCREENING LEVEL FISH AND WILDLIFE FACILITIES ESTIMATES
PLANS 3 & Without Project
FILE:FISH.WK1

(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	Fish & Wildlife Facilities						
06.1.-.-	Habitat Restoration at Disposal Areas	JOB	1	$325,000.00	$325,000	15%	$373,750
06.1.-.-	Wetlands Restoration at Disposal Areas	JOB	1	$325,000.00	$325,000	15%	$373,750
06.1.-.-	Replacement of Terrestrial Habitat	JOB	1	$150,000.00	$150,000	15%	$172,500
	TOTAL CONSTRUCTION COSTS				$800,000		$920,000
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					15%	
30.-.-.-	Planning, Engineering and Design				$80,000	25%	$100,000
31.-.-.-	Construction Management				$60,000	25%	$75,000
	TOTAL FIRST COSTS				$940,000		$1,095,000
	AVERAGE OVERALL CONTINGENCY					16%	

SCREENING LEVEL FISH AND WILDLIFE FACILITIES ESTIMATES
PLAN 2

FILE:FISH.WK1

(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	Fish & Wildlife Facilities						
06.1.-.-	Habitat Restoration at Disposal Areas	JOB	1	$325,000.00	$325,000	15%	$373,750
06.1.-.-	Wetlands Restoration at Disposal Areas	JOB	1	$325,000.00	$325,000	15%	$373,750
	TOTAL CONSTRUCTION COSTS				$650,000		$747,500
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					15%	
30.-.-.-	Planning, Engineering and Design				$65,000	25%	$81,250
31.-.-.-	Construction Management				$50,000	25%	$62,500
	TOTAL FIRST COSTS				$765,000		$891,250
	AVERAGE OVERALL CONTINGENCY					17%	

SCREENING LEVEL FISH AND WILDLIFE FACILITIES ESTIMATES
PLAN 4

FILE:FISH.WK1

(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	Fish & Wildlife Facilities						
06.1.-.-	Habitat Restoration at Disposal Areas	JOB	1	$325,000.00	$325,000	15%	$373,750
06.1.-.-	Wetlands Restoration at Disposal Areas	JOB	1	$325,000.00	$325,000	15%	$373,750
06.1.-.-	Replacement of Terrestrial Habitat	JOB	1	$750,000.00	$750,000	25%	$937,500
	TOTAL CONSTRUCTION COSTS				$1,400,000		$1,685,000
	AVERAGE OVERALL CONSTRUCTION CONTINGENCY					20%	
30.-.-.-	Planning, Engineering and Design				$140,000	25%	$175,000
31.-.-.-	Construction Management				$105,000	25%	$131,250
	TOTAL FIRST COSTS				$1,645,000		$1,991,250
	AVERAGE OVERALL CONTINGENCY					21%	

SCREENING LEVEL CULTURAL RESOURCES MANAGEMENT
PLANS 3, 4 & Without Project
FILE:CULT.WK1

(October 1991 Cost Level)

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	Cultural Resources - Hired Labor & Contracts						
18.-.-.-	Disposal Sites - L/D #2, 3 & 4	JOB	1	$780,000.00	$780,000	50%	$1,170,000
18.-.-.-	RM 24.6 - Terrace RB	JOB	1	$500,000.00	$500,000	50%	$750,000
	TOTAL FIRST COSTS				$1,280,000		$1,920,000
	AVERAGE OVERALL CONTINGENCY					50%	

PLANS 2 & 5

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	Cultural Resources - Hired Labor & Contracts						
18.-.-.-	Disposal Sites - L/D #2, 3 & 4	JOB	1	$780,000.00	$780,000	50%	$1,170,000
18.-.-.-	RM 22.2	JOB	1	$150,000.00	$150,000	50%	$225,000
	TOTAL FIRST COSTS				$930,000		$1,395,000
	AVERAGE OVERALL CONTINGENCY					50%	

PLANS 6 & 7

CODE OF ACCOUNTS	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONT. (%)	AMOUNT INCL. CONTINGENCIES
	Cultural Resources - Hired Labor & Contracts						
18.-.-.-	Disposal Sites - L/D #2, 3 & 4	JOB	1	$780,000.00	$780,000	50%	$1,170,000
18.-.-.-	NR Bridges - 1 or 2	JOB	1	$100,000.00	$100,000	50%	$150,000
18.-.-.-	RM 34.0 - Terrace RB	JOB	1	$500,000.00	$500,000	50%	$750,000
	TOTAL FIRST COSTS				$1,380,000		$2,070,000
	AVERAGE OVERALL CONTINGENCY					50%	

FEDERAL RELOCATION COSTS SUMMARY

	PLAN 2 (1000)	PLAN 4 (1000)	PLAN 5 (1000)	PLAN 6 (1000)	PLAN 7 (1000)
STRUCTURES	7931.3	0.0	18418.1	140654.5	153573.7
MAJOR STORM SEWERS	2996.3	0.0	2996.3	496214.3	582488.6
UTILITIES	0.0	0.0	0.0	0.0	0.0
TOTAL, CONSTRUCTION COSTS: (including PED,S&A,& Contingencies)	10927.5	0.0	21414.4	636868.8	736062.3

Refer to Engineering Technical Appendix for detailed estimates concerning Plan 1.

FEDERAL RELOCATION COSTS

STRUCTURES

POOL 2		PLAN 2 (1000)	PLAN 4 (1000)	PLAN 5 (1000)	PLAN 6 (1000)	PLAN 7 (1000)
PARKS:						
ELIZABETH		250.0	0.0	250.0	0.0	250.0
	SUBTOTAL	250.0	0.0	250.0	0.0	250.0
STORM SEWER OUTFALLS:						
RM 22.2 TO 23.8		2000.0	0.0	2000.0	0.0	0.0
	SUBTOTAL	2000.0	0.0	2000.0	0.0	0.0
SANITARY SEWERS:						
DUQUESNE		0.0	0.0	0.0	0.0	440.0
WEST ELIZABETH		0.0	0.0	1825.0	0.0	1825.0
ELIZABETH		0.0	0.0	950.0	0.0	950.0
ELIZABETH TOWNSHIP		0.0	0.0	200.0	0.0	200.0
	SUBTOTAL	0.0	0.0	2975.0	0.0	3415.0
SUBTOTAL, CONSTRUCTION COSTS:		2250.0	0.0	5225.0	0.0	3665.0
SUBTOTAL, PED:		675.0	0.0	1567.5	0.0	1099.5
SUBTOTAL, S&A:		506.3	0.0	1175.6	0.0	824.6
SUBTOTAL, CONTINGENCIES (200%):		4500.0	0.0	10450.0	0.0	7330.0
POOL 3						
LAUNCHING RAMPS:						
BORO OF NEW EAGLE		0.0	0.0	0.0	20.0	20.0
CITY OF MONONGAHELA		0.0	0.0	0.0	20.0	20.0
PA FISH COMMISSION		0.0	0.0	0.0	20.0	20.0
FORWARD TOWNSHIP		0.0	0.0	0.0	20.0	20.0
BORO OF WEBSTER		0.0	0.0	0.0	1.0	1.0
BORO OF WEBSTER		0.0	0.0	0.0	1.0	1.0
CITY OF MONESSEN		0.0	0.0	0.0	1.0	1.0
	SUBTOTAL	0.0	0.0	0.0	83.0	83.0
AQUATORIUM:						
CITY OF MONONGAHELA		0.0	0.0	0.0	125.0	125.0
	SUBTOTAL	0.0	0.0	0.0	125.0	125.0
STORM SEWER OUTFALLS:						
RM 34 TO 41.5		0.0	0.0	0.0	13494.0	13494.0
	SUBTOTAL	0.0	0.0	0.0	13494.0	13494.0

SANITARY SEWERS:

MON VALLEY SEWAGE AUTHORITY	0.0	0.0	0.0	25000.0	25000.0
NORTH CHARLEROI	0.0	0.0	0.0	100.0	100.0
CHARLEROI SEWAGE AUTHORITY	0.0	0.0	0.0	1000.0	1000.0
CITY OF WEBSTER	0.0	0.0	0.0	100.0	100.0
SUBTOTAL	0.0	0.0	0.0	26200.0	26200.0
SUBTOTAL, CONSTRUCTION COSTS:	0.0	0.0	0.0	39902.0	39902.0
SUBTOTAL, PED:	0.0	0.0	0.0	11970.6	11970.6
SUBTOTAL, S&A:	0.0	0.0	0.0	8977.9	8977.9
SUBTOTAL, CONTINGENCIES (200%):	0.0	0.0	0.0	79804.0	79804.0

STRUCTURES

TOTAL, POOLS 2 & 3**

TOTAL, CONSTRUCTION COSTS:	2250.0	0.0	5225.0	39902.0	43567.0
TOTAL, PED:	675.0	0.0	1567.5	11970.6	13070.1
TOTAL, S&A:	506.3	0.0	1175.6	8977.9	9802.6
TOTAL, CONTINGENCIES (200%):	4500.0	0.0	10450.0	79804.0	87134.0

FEDERAL RELOCATION COSTS

MAJOR STORM SEWERS

POOL 2	PLAN 2 (1000)	PLAN 4 (1000)	PLAN 5 (1000)	PLAN 6 (1000)	PLAN 7 (1000)
MAJOR STORM SEWERS:					
RM 11.2 TO 22.2	0.0	0.0	0.0	0.0	23625.0
RM 22.2 TO 23.8	850.0	0.0	850.0	0.0	850.0
SUBTOTAL, CONSTRUCTION COSTS:	850.0	0.0	850.0	0.0	24475.0
SUBTOTAL, PED:	255.0	0.0	255.0	0.0	7342.5
SUBTOTAL, S&A:	191.3	0.0	191.3	0.0	5506.9
SUBTOTAL, CONTINGENCIES(200%):	1700.0	0.0	1700.0	0.0	48950.0
POOL 3					
MAJOR STORM SEWERS:					
RM 34 TO 41.5	0.0	0.0	0.0	140770.0	140770.0
SUBTOTAL, CONSTRUCTION COSTS:	0.0	0.0	0.0	140770.0	140770.0
SUBTOTAL, PED:	0.0	0.0	0.0	42231.0	42231.0
SUBTOTAL, S&A:	0.0	0.0	0.0	31673.3	31673.3
SUBTOTAL, CONTINGENCIES(200%):	0.0	0.0	0.0	281540.0	281540.0

MAJOR STORM SEWERS

TOTAL, POOLS 2 & 3

TOTAL, CONSTUCTION COSTS:	850.0	0.0	850.0	140770.0	165245.0
TOTAL, PED:	255.0	0.0	255.0	42231.0	49573.5
TOTAL, S&A:	191.3	0.0	191.3	31673.3	37180.1
TOTAL, CONTINGENCIES(200%):	1700.0	0.0	1700.0	281540.0	330490.0

FEDERAL RELOCATION COSTS

UTILITIES

	PLAN 2 (1000)	PLAN 4 (1000)	PLAN 5 (1000)	PLAN 6 (1000)	PLAN 7 (1000)
SUBMARINE CROSSINGS:					
MON VALLEY SEWAGE AUTHORITY	0.0	0.0	0.0	0.0	0.0
BORO OF CHARLEROI	0.0	0.0	0.0	0.0	0.0
BORO OF CHARLEROI	0.0	0.0	0.0	0.0	0.0
TOTAL, CONSTRUCTION COSTS:	0.0	0.0	0.0	0.0	0.0
TOTAL, PED:	0.0	0.0	0.0	0.0	0.0
TOTAL, S&A:	0.0	0.0	0.0	0.0	0.0
TOTAL, CONTINGENCIES(200%):	0.0	0.0	0.0	0.0	0.0

NON-FEDERAL RELOCATION COSTS SUMMARY

	PLAN 2 (1000)	PLAN 4 (1000)	PLAN 5 (1000)	PLAN 6 (1000)	PLAN 7 (1000)
UTILITIES	0.0	6800.0	75000.0	36340.4	35550.4
STRUCTURES	1570.0	3474.0	8944.0	60935.0	49207.6
HIGHWAYS	0.0	0.0	0.0	3000.0	3000.0
STORM SEWERS	0.0	0.0	0.0	0.0	24554.0
TOTAL, CONSTRUCTION COSTS:	1570.0	10274.0	83944.0	100275.4	112312.0

NON-FEDERAL RELOCATION COSTS

STRUCTURES

	PLAN 2 (1000)	PLAN 4 (1000)	PLAN 5 (1000)	PLAN 6 (1000)	PLAN 7 (1000)
PRIVATE DOCKS:					
MON-VALLEY SPEED CLUB, 15.9R	0.0	0.0	30.0	0.0	15.0
UNKNOWN, 16.3R	0.0	0.0	1.0	0.0	1.0
SCHIFFMAN, 16.4R	0.0	0.0	2.0	0.0	1.0
SWIFT HOMES, 22.4R	2.0	0.0	2.0	0.0	2.0
ELIZABETH BOAT CLUB, 22.8R	8.0	0.0	8.0	0.0	8.0
PINE RUN OUTBOARD, 26.3R	0.0	0.0	0.0	15.0	15.0
EVAN FORD BOAT SALES, 26.4R	0.0	0.0	0.0	10000.0	1500.0
JOHN N. MOLNER, 29.1R	0.0	0.0	0.0	15.0	15.0
BEACH CLUB MARINA, 30.9L	0.0	0.0	0.0	50.0	50.0
J. SMINKO, 31.4L	0.0	0.0	0.0	50.0	50.0
MONONGAHELA MARINA, 31.8L	0.0	0.0	0.0	40.0	20.0
UNKNOWN, 32.6L	0.0	0.0	0.0	15.0	15.0
MARINA ONE, 32.1L	0.0	0.0	0.0	1000.0	1000.0
UNKNOWN, 33.1R	0.0	0.0	0.0	15.0	15.0
HAMEL, 34.3R	0.0	0.0	0.0	2.0	2.0
FRANK IREY MARINA, 34.5R	0.0	0.0	0.0	50.0	50.0
GIBSON, 34.6R	0.0	0.0	0.0	3.0	3.0
SUBTOTAL	10.0	0.0	43.0	11255.0	2762.0
LAUNCHING RAMPS:					
BLAIR S. EVANS, 33.2R	0.0	0.0	0.0	15.0	15.0
SUBTOTAL	0.0	0.0	0.0	15.0	15.0
BARGE MOORING:					
UNION R.R., 12.1-12.4L	0.0	0.0	400.0	0.0	3000.0
INGRAM BARGE,16.4-17.2L	0.0	0.0	2000.0	0.0	1000.0
CONSOL, 22.9-23.4L	100.0	0.0	100.0	0.0	24.6
CENTOFANTI MARINE, 24.5-24.6L	0.0	300.0	0.0	200.0	200.0
SUBTOTAL	100.0	300.0	2500.0	200.0	4224.6
BARGE LOADING FACILITY:					
U.S. STEEL, 20.3L	0.0	0.0	0.0	0.0	0.0
CLAIRTON SLAG, 23.6-23.7L	100.0	0.0	100.0	0.0	100.0
HERCULES PICCO, 23.8L	1360.0	0.0	1360.0	0.0	1360.0
SUBTOTAL	1460.0	0.0	1460.0	0.0	1460.0
MARINEWAYS:					
CENTOFANTI MARINE, 24.5	0.0	450.0	0.0	450.0	450.0
SUBTOTAL	0.0	450.0	0.0	450.0	450.0
PLANT DISCHARGE:					
R.M. 38.3	0.0	0.0	0.0	125.0	125.0
SUBTOTAL	0.0	0.0	0.0	125.0	125.0

COMMERCIAL DOCKS:

UNION R.R., 11.7-11.9L	0.0	0.0	200.0	0.0	200.0
UNION R.R., 12.1L	0.0	0.0	500.0	0.0	7400.0
REG. IND. DEVEL., 15.0R	0.0	0.0	50.0	0.0	50.0
DAVIDSON S&G, 16.1-16.2L	0.0	0.0	120.0	0.0	60.0
BOSWELL OIL, 16.25L	0.0	0.0	1000.0	0.0	1000.0
ST. CLAIR SUPPLY CO., 17.4R	0.0	0.0	50.0	0.0	50.0
C&C MARINE MAINT., 18.7L	0.0	0.0	50.0	0.0	50.0
U.S. STEEL, 18.9-19.1L	0.0	0.0	1000.0	0.0	0.0
GLASSPORT TRANS. CTR., 19.1R	0.0	0.0	150.0	0.0	200.0
ARISTECH CHEM. CORP., 19.4L	0.0	0.0	86.0	0.0	86.0
U.S. STEEL, 19.8-20.5L	0.0	0.0	1500.0	0.0	0.0
U.S. STEEL, 20.9-21.1L	0.0	0.0	50.0	0.0	0.0
GUTTMAN, 21.8R	0.0	0.0	110.0	0.0	110.0
CROUNSE, 22.0R	0.0	0.0	75.0	0.0	0.0
DILLNER, 24.2-24.3L	0.0	350.0	0.0	350.0	1000.0
ASHLAND, 24.6L	0.0	2374.0	0.0	1225.0	1225.0
LOCK 3 O&G, 24.8-24.9R	0.0	0.0	0.0	1000.0	1000.0
DUQUESNE, 25.0-25.3L	0.0	0.0	0.0	21341.0	8100.0
CHEMPLY, 27.8R	0.0	0.0	0.0	1350.0	250.0
MON. RIVER TERM., 28.6-28.8R	0.0	0.0	0.0	1300.0	1300.0
ALLEGHENY POWER, 29.2-29.4L	0.0	0.0	0.0	12184.0	5100.0
MATHIES COAL, 29.4-29.7L	0.0	0.0	0.0	2450.0	950.0
U.S. STEEL, 30.1-30.6L	0.0	0.0	0.0	3150.0	7500.0
PATTERSON SUPPLY, 31.3L	0.0	0.0	0.0	50.0	50.0
MON. IRON & METALS, 32.7L	0.0	0.0	0.0	125.0	125.0
RIVERSIDE I&S, 33.1L	0.0	0.0	0.0	50.0	50.0
DUQUESNE SLAG PROD CO., 34.3L	0.0	0.0	0.0	1200.0	1200.0
BABCOCK & WILCOX, 37.2-37.3R	0.0	0.0	0.0	5.0	5.0
MCGREW WELDING, 38.2L	0.0	0.0	0.0	10.0	10.0
CANASTRAL CONST., 38.5-38.6R	0.0	0.0	0.0	200.0	200.0
SHARON STEEL, 39.8-40.3R	0.0	0.0	0.0	1000.0	1000.0
RESERVE PET., 40.9L	0.0	0.0	0.0	1900.0	1900.0
SUBTOTAL	0.0	2724.0	4941.0	48890.0	40171.0
TOTAL, CONSTRUCTION COSTS:	1570.0	3474.0	8944.0	60935.0	49207.6

NON-FEDERAL RELOCATION COSTS

UTILITIES

	PLAN 2 (1000)	PLAN 4 (1000)	PLAN 5 (1000)	PLAN 6 (1000)	PLAN 7 (1000)
SUBMARINE CROSSINGS:					
KEYSTONE PIPELING (2), 12.5	0.0	0.0	2000.0	0.0	0.0
PEOPLES NATURAL GAS, 13.1	0.0	0.0	1000.0	0.0	0.0
CARNEGIE NATURAL GAS, 15.3	0.0	0.0	1000.0	0.0	0.0
DUQUESNE LIGHT, 16.4	0.0	0.0	1000.0	0.0	0.0
MAGNOLIA PIPELINE, 17.3	0.0	0.0	1000.0	0.0	0.0
MON. VALLEY WATER CO., 18.4	0.0	0.0	1000.0	0.0	0.0
PEOPLES NATURAL GAS, 18.5	0.0	0.0	1000.0	0.0	0.0
PEOPLES NATURAL GAS (2), 18.6	0.0	0.0	2000.0	0.0	0.0
CARNEGIE NATURAL GAS, 19.3	0.0	0.0	1000.0	0.0	0.0
MFRS HEAT & LIGHT, 19.5	0.0	0.0	1000.0	0.0	0.0
PEOPLES NATURAL GAS, 20.7	0.0	0.0	1000.0	0.0	0.0
SOUTH PITTSBURGH WATER CO., 21.2	0.0	0.0	1000.0	0.0	0.0
UNKNOWN (?), 21.2	0.0	0.0	1000.0	0.0	0.0
ALLEGHENY PIPELINE, 24.6	0.0	1800.0	0.0	1400.0	1400.0
COLUMBIA GAS, 24.6	0.0	5000.0	0.0	3500.0	3500.0
EQUITABLE GAS, 25.4	0.0	0.0	0.0	1325.0	1325.0
CONSOLIDATED GAS (2), 33.0	0.0	0.0	0.0	1200.0	1200.0
PEOPLES NATURAL GAS (6), 33.0	0.0	0.0	0.0	1025.4	1025.4
N.Y. STATE NATURAL GAS (2), 34.0	0.0	0.0	0.0	1800.0	1800.0
WEST PENN POWER, 34.1	0.0	0.0	0.0	900.0	900.0
CONSOLIDATED GAS (2), 34.3	0.0	0.0	0.0	1600.0	1600.0
UNKNOWN OWNER, 35.1	0.0	0.0	0.0	0.0	0.0
MFRS HEAT & LIGHT, 36.8	0.0	0.0	0.0	0.0	0.0
PEOPLES NATURAL GAS, 38.7	0.0	0.0	0.0	0.0	0.0
PEOPLES NATURAL GAS, 40.8	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	0.0	6800.0	15000.0	12750.4	12750.4
WATER INTAKES:					
U.S. STEEL, 11.2R	0.0	0.0	30000.0	0.0	500.0
U.S. STEEL, 17.6L	0.0	0.0	30000.0	0.0	0.0
DUQUESNE, 25.1L	0.0	0.0	0.0	18764.0	6900.0
WEST PA WATER, 25.3L	0.0	0.0	0.0	550.0	5500.0
ALLEGHENY POWER, 29.0L	0.0	0.0	0.0	4276.0	9900.0
SUBTOTAL	0.0	0.0	60000.0	23590.0	22800.0
TOTAL, CONSTRUCTION COSTS:	0.0	6800.0	75000.0	36340.4	35550.4

NON-FEDERAL RELOCATION COSTS

STORM SEWERS

	PLAN 2 (1000)	PLAN 4 (1000)	PLAN 5 (1000)	PLAN 6 (1000)	PLAN 7 (1000)
STORM SEWERS:					
P & LE RAILROAD, 11.6R	0.0	0.0	0.0	0.0	9.5
UNION RAILROAD, 12.1L	0.0	0.0	0.0	0.0	1030.4
USX, 13.1L	0.0	0.0	0.0	0.0	595.4
UNKNOWN, 14.2R	0.0	0.0	0.0	0.0	888.0
NATIONAL TUBE, 14.4R	0.0	0.0	0.0	0.0	275.0
UNKNOWN, 16.2R	0.0	0.0	0.0	0.0	112.6
USX, 19.1L	0.0	0.0	0.0	0.0	915.0
UNKNOWN, 19.7L	0.0	0.0	0.0	0.0	9371.0
USX, 20.7L	0.0	0.0	0.0	0.0	775.0
USX, 21.1L	0.0	0.0	0.0	0.0	2728.0
UNKNOWN, 21.5L	0.0	0.0	0.0	0.0	1245.0
P & LE RAILROAD, 23.4R	0.0	0.0	0.0	0.0	287.1
STEEL MET, 1.2 YOUGH L	0.0	0.0	0.0	0.0	1360.0
STEEL MET, 1.3 YOUGH L	0.0	0.0	0.0	0.0	1025.0
STEEL MET, 1.5 YOUGH L	0.0	0.0	0.0	0.0	771.0
CSX, 2.3 YOUGH R	0.0	0.0	0.0	0.0	2076.0
P & LE RAILROAD, 2.6 YOUGH L	0.0	0.0	0.0	0.0	1090.0
TOTAL, CONSTRUCTION COSTS:	0.0	0.0	0.0	0.0	24554.0

NON-FEDERAL RELOCATION COSTS

HIGHWAYS

	PLAN 2 (1000)	PLAN 4 (1000)	PLAN 5 (1000)	PLAN 6 (1000)	PLAN 7 (1000)
HIGHWAY BRIDGES:					
DONORA-WEBSTER, 36.3	0.0	0.0	0.0	3000.0	3000.0
TOTAL, CONSTRUCTION COSTS:	0.0	0.0	0.0	3000.0	3000.0