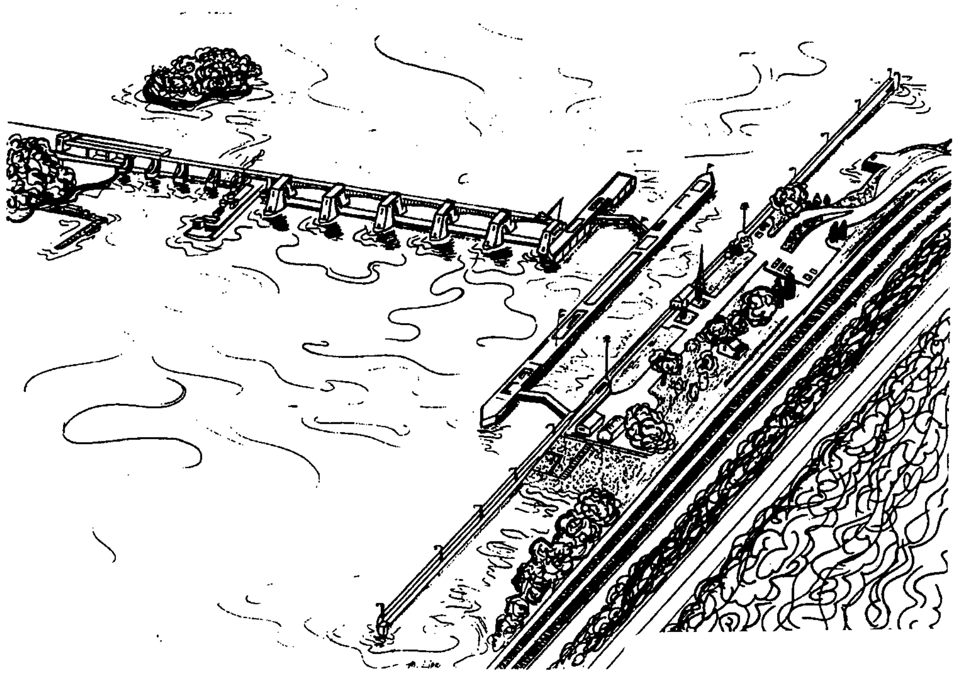
Long Term Resource Monitoring Program

Technical Report

97-T002

Pool 25: Land Ownership Requirements in Moving the Control Point to the Dam



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March 1997

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Preface

The Long Term Resource Monitoring Program (LTRMP) was authorized under the Water Resources Development Act of 1986 (Public Law 99-662) as an element of the U.S. Army Corps of Engineers' Environmental Management Program. The LTRMP is being implemented by the Environmental Management Technical Center, a U.S. Geological Survey science center, in cooperation with the five Upper Mississippi River System (UMRS) States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The U.S. Army Corps of Engineers provides guidance and has overall Program responsibility. The mode of operation and respective roles of the agencies are outlined in a 1988 Memorandum of Agreement.

The UMRS encompasses the commercially navigable reaches of the Upper Mississippi River, as well as the Illinois River and navigable portions of the Kaskaskia, Black, St. Croix, and Minnesota Rivers. Congress has declared the UMRS to be both a nationally significant ecosystem and a nationally significant commercial navigation system. The mission of the LTRMP is to provide decision makers with information for maintaining the UMRS as a sustainable large river ecosystem given its multiple-use character. The long-term goals of the Program are to understand the system, determine resource trends and effects, develop management alternatives, manage information, and develop useful products.

This report was prepared under Strategy 1.2.3, *Determine Effects of Water Levels and Discharges on the Upper Mississippi River Ecosystem*, and Goal 3, *Develop Alternatives to Better Manage the Upper Mississippi River System*, as specified in the Operating Plan of the LTRMP for the Upper Mississippi River System (USFWS 1993). The purpose of this report is to estimate the amount of land directly affected by moving the control point for Pool 25 from its present midpool location to Lock and Dam 25.

This project was developed in part with funding provided by the Long Term Resource Monitoring Program and in part under Military Interdepartmental Purchase Request number EM61 from the U. S. Army Corps of Engineers, St. Louis District.

Pool 25: Land Ownership Requirements in Moving the Control Point to the Dam

by
Joseph H. Wlosinski and James T. Rogala

Abstract

We estimated the amount of land that would have to be acquired if an alternative water-level management plan was used for Pool 25 on the Upper Mississippi River. The work was performed as part of a study to evaluate water regulation alternatives that could minimize negative impacts and increase ecological benefits of dam operation. We used a one-dimensional model (HEC-2) to estimate the ordinary high-water profile and water surfaces at various discharges and management options, by river mile. Maps of these data were then created with a geographic information system, along with maps of land elevations, both above and below the surface of the river, lands controlled by the managing agency, and levees. The ownership and easement, ordinary high water, and levee coverages were combined to represent areas that would not have to come under Government control at a discharge that creates the ordinary high-water profile. As a validation exercise, we estimated the amount of lands that would have to come under Government control if the dam were to be constructed now and no lands were under Government control. The estimated area was 11,276 acres, which can be compared with 11,039 acres owned or controlled by the Government with fee title and flowage easement lands. The difference, 237 acres or 2.1%, is considered to be satisfactory, given the lack of resolution of our elevation coverage, possible sedimentation of backwater areas since the dam was built, and possible differences in the high-water line between the present prediction and the ordinary high-water line estimated before the dam was constructed. The model predicted that no lands would need to be purchased under any scenario for the first 13 miles upriver of the dam. The maximum amount of land needed upriver of this point would be 738 acres. This acreage estimate would be higher if the managing agency elects to purchase or obtain easements on entire parcels of land rather than just the lands the model predicts may be covered by water. The acreage estimate may be lower if some affected lands were already under the control of another Government agency.

Introduction

The Environmental Management Technical Center (EMTC) has been involved with the development of water regulation alternatives at Lock and Dam 25 on the Upper Mississippi River since 1994. The objective of this multiyear study is to evaluate water regulation alternatives that will minimize negative impacts and increase ecological benefits of dam operation. Previous studies summarized historical discharges and water-level management practices in Pool 25 (Wlosinski 1996) and the effects of water-level management alternatives on habitats (Wlosinski and Rogala 1996). Constraints associated with changing water-level management plans, such as the need to purchase additional lands or easements, were not included as part of those studies. Here we estimate the amount of land that would have to be acquired if an alternative plan was used that would increase water levels.

The St. Louis District of the U.S. Army Corps of Engineers (COE) began experimenting with water-level alternatives during summer 1994 in Pools 24, 25, and 26. By managing water levels intensively within current laws and constraints, the COE was able to maintain the Congressionally authorized 9-ft navigation channel while providing for an experimental drawdown. The results of the experiment were considered outstanding by the Pool 25 Natural Resources Committee, an interagency group working to better manage the Upper Mississippi River. The dewatered area allowed for increased growth of vegetation (Figure 1) that provided food for waterfowl and refuge for invertebrates and small fish when the area was later reflooded. An experimental drawdown in 1995 again provided these same benefits.

One of the management options previously investigated by the EMTC (Wlosinski and Rogala 1996) involved moving the control point for Pool 25, during relatively low to moderate discharges, from midpool to the dam while maintaining the old project pool elevation of 434.0 ft (all elevations in this report use the 1929

National Geodetic Vertical Datum). This option would maintain the 9-ft channel while allowing for more flexibility in managing water levels for ecosystem benefits. The COE is further investigating this option as part of a Section 1135 study (St. Louis District 1995). Here we estimate, as part of a preliminary investigation, the amount of additional lands that would have to come under COE control using various water-level management plans. Discharges investigated for estimating lands that would have to be under COE control were 19,000, 56,000, 95,000, and 118,000 cfs. The first three discharges were the same as those used in a previous report (Wlosinski and Rogala 1996); the reason for the fourth discharge will be explained in the Methods section. Modeled water elevations at the dam were held at 434 ft, which is the current project pool elevation, and 430, 431, 432, and 433 ft, which are above the maximum drawdown elevation.

Some terminology in this report may not be common but is used routinely for water-level management or analysis by geographic information systems (GIS) specialists. These terms are defined in Table 1.

Methods

We used a GIS to obtain flooded acreage estimates for various management scenarios. To obtain estimates, we needed (1) land elevation estimates, both above and below the surface of the river; (2) Pool 25 ownership maps; (3) levee information; (4) the ordinary high-water profile; and (5) GIS coverages of water surfaces at various discharges and management options.

We obtained data for a GIS coverage of floodplain elevations from four sources (Wlosinski and Rogala 1996): (1) upland areas from U. S. Geological Survey 1:24,000 quadrangle maps; (2) bathymetric data from COE St. Louis District for main and secondary channels; (3) bathymetric data from the LTRMP Alton, Illinois, Field Station surveys for backwater areas; and (4) shoreline elevations derived from land cover data and SPOT satellite data. All elevation data were then combined into one coverage. Interpolation methods were then used with these data to generate a continuous elevation surface. Please note that the original data for these coverages included data that were as coarse as 5-ft intervals. These low resolution data could significantly affect model predictions.

Ownership or easement areas of Pool 25 were provided by the St. Louis District on three maps. These maps were then digitized to create a GIS coverage. We assumed that all lands between boundaries on the Illinois and Missouri sides of the river were under Government control. The final digital map had to be edited because the three individual maps did not join properly, causing an unknown amount of error in this coverage. In many locations, ownership or easement was difficult to establish because of the proximity of other map symbols. Where Government ownership appeared to stop at a levee, we used a levee coverage provided by the Scientific Assessment and Strategy Team (Wlosinski and Rogala 1996) as the boundary. We assumed that levees would not be overtopped for the discharges of interest, and therefore areas protected by levees are not included in any estimates. This includes a levee system for the entire length of Pool 25 in Missouri, and areas in Illinois near river miles 246 to 248 and 266 north to Lock and Dam 24. Flooding can occur behind the Illinois levee from river miles 264 to 266 because the area is not entirely closed from the south.

The Federal Government can also use riparian lands up to the ordinary high-water mark through the right of navigational servitude (Wilcox and Willis 1993). According to the Master Water Control Manual for Lock and Dam 25, the ordinary high-water mark was 438.0 ft at about river mile 264.4 (COE 1980). This was the only information that we found concerning the ordinary high-water mark. An HEC-2 model (Hydrologic Engineering Center 1990), that was previously developed (Wlosinski and Rogala 1996), was used to estimate the rest of the ordinary high-water profile by river mile. An elevation-discharge relationship for the tailwater of Lock and Dam 25 (Figure 2) was used to obtain the water surface at the location where the dam in now located, assuming a swellhead of 0.5 ft (COE 1980). We ran the model until elevation and discharge values were found that predicted an elevation of 438.0 ft at river mile 264.4. An elevation at the dam of 426.5 ft and a discharge of 118,000 cfs predicted those conditions at river mile 264.4, and this discharge value was then used to represent the ordinary high-water profile. This profile was used to estimate lands that can be flooded through the right of navigational servitude. All lands with elevations below this profile, whether contiguous with the main channel or not, were included.

We used the same HEC model to predict water surface elevations at 1-mi intervals for each scenario. These elevations were then applied to a river mile template (Figure 3) to create a GIS water surface coverage for each scenario. This coverage was then overlaid in the GIS with the elevation and ownership and easement coverages to predict acreages flooded but not owned by the Federal Government.

Results and Discussion

Predictions from the HEC-2 model are presented in Table 2. The predicted estimates of water-level elevations at ordinary high water without the effects of Dam 25 are listed under a discharge of 118,000 cfs and an elevation of 426.5 ft. However, it must be remembered that the model was developed with bathymetric data measured in 1993 and 1994, and the discharge elevation relationship was developed with the next dam down river, Dam 26, in place. Therefore, the resulting predictions of the ordinary high-water line may be different than the line used before Locks and Dams 25 and 26 were constructed.

The ownership and easement, ordinary high-water, and levee coverages were combined to represent areas that would not have to come under Government control at 118,000 cfs and a water level at the dam of 434.0 ft. This map is presented for the northern portion of the pool in Figure 4 and for the southern portion of the pool in Figure 5. As a validation exercise, we estimated the amount of lands that would have to come under Government control if the project were to be constructed now and no lands were under Government control. The estimated area was 11,276 acres, which can be compared with 11,039 acres owned or controlled by the Government with fee title and flowage easement lands (St. Louis District 1995). The difference, 237 acres or 2.1%, is considered to be satisfactory, given the lack of resolution of our elevation coverage, possible sedimentation of backwater areas since the dam was built, and possible differences in the high-water line between the present prediction and the ordinary high-water line estimated in the 1930s.

Estimated acres that would have to come under Government control under various discharge and water-level options at Lock and Dam 25 are provided in Table 3. The model predicted that no lands between river miles 242 to 255 would need to be purchased under any scenario. While maintaining the present project pool elevation at a discharge of 95,000 cfs, 142 acres would have to come under Government control. The maximum amount of land needed would be 738 acres (Figures 4 and 5), when water levels are maintained at 434.0 ft at the dam and discharge is 118,000 cfs. This acreage estimate would be higher if the COE elects to purchase or obtain easements on entire parcels of land rather than just the lands the model predicts may be covered by water. The acreage estimate may be lower if some affected lands were already under the control of another Government agency. This may be the case near river mile 263 where part of the lands are within the Clarence Cannon National Wildlife Refuge or near river mile 265 which is within Rip Rap Landing State Fish and Waterfowl Management Area.

An overlay of the ownership or easement and elevation coverages also predicted the minimum elevation of land not now under control of the Government, and the maximum elevation of land purchased or for which easements were obtained in areas not protected by levees. Estimates of these elevations, by river mile, are provided in Table 4. Land was purchased for the 9-ft navigation channel project by the COE from river miles 242 to 263. Observations that are missing for minimum elevations signifies that the model found no land between the levees, or between a levee and the bluff, that was not under control by the Government.

Flexibility in managing water levels would substantially increase most of the time if lands are purchased to allow water levels of 434.0 ft at 118,000 cfs. Under the present management plan, water levels must be between elevations of 429.7 and 434 ft while at the same time holding elevations between 434 and 435.75 ft at the control point near Mozier Landing (Figure 6). These criteria can only be met for discharges up to 110,000 cfs. Estimated flexibility near the dam under the present plan is depicted as Figure 7 (A) and as Figure 7 (A and B) for the alternate plan. Water-level flexibility, in vertical ft, is provided for various discharges at Dam 25, at Mozier Landing, and in the tailwater of Dam 24 (Figure 8).

Acknowledgments

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Table 1. Definitions of terms used in this report

Term	Definition
Control point	A specific location in a pool where the U.S. Army Corps of Engineers maintains a target water level over a range of discharges.
Coverage	A geographical dataset containing attributes for discrete point, line, or polygon features in a vector dataset or cell values for raster datasets.
Geographic Information System (GIS)	An organized collection of computer hardware, software, geographic data, and personnel adapted to efficiently capture, store, update, analyze, and display all forms of geographic information.
Headwater	That part of a pool located immediately upriver of the dam.
Maximum drawdown	The maximum drop in water levels at the headwater, below the project pool elevation, that would still allow a 9-ft navigation channel
Open river	The condition when all of the movable gates at a dam are raised out of the water and the headwater and tailwater elevations are nearly equal.
Overlay	A GIS process that operates on two or more datasets based on their geographic location. Types of operations include combining attributes of different coverages and performing mathematical functions based on attributes of multiple coverages.
Polygon	Discrete areas within closed arcs that represent areas on maps. Within a polygon is an identification label used to link the geographical location of the polygon to data tables containing information about the area.
Pool	The body of water created upriver of a dam.
Project pool elevation	The water-level elevation needed to maintain a 9-ft channel at zero discharge, and for which each dam was designed.
Raster	A type of database that stores information as regularly spaced square cells
Tailwater	That part of a pool located immediately downriver of the dam.
Vector	A GIS data structure that represents map features as a list of ordered *x,y* coordinates.

Table 2. Predicted water surface elevations (feet) by discharge and water surface maintained at the dam site.

River mile	Discharge(cfs) and elevation (ft) at dam																
	118,000 426.5	118,000 430.0	118,000 431.0	118,000 432.0	118,000 433.0	118,000 434.0	95,000 430.0	95,000 431.0	95,000 432.0	95,000 433.0	95,000 434.0	56,000 430.0	56,000 431.0	56,000 432.0	56,000 433.0	56,000 434.0	19,000 434.0
242	426.6	430.1	431.1	432.1	433.0	434.0	430.1	431.0	432.0	433.0	434.0	430.0	431.0	432.0	433.0	434.0	434.0
243	427.7	430.5	431.4	432.3	433.2	434.2	430.4	431.3	432.2	433.2	434.1	430.1	431.1	432.1	434.0	434.0	432.0
244	428.2	430.8	431.6	432.5	433.4	434.3	430.5	431.4	432.3	433.3	434.2	430.2	431.1	433.1	433.1	434.1	434.0
245	428.6	431.1	431.9	432.8	433.6	434.5	430.7	431.6	432.5	433.4	434.3	430.3	431.2	432.2	433.1	434.1	434.0
246	428.7	431.2	432.0	432.9	433.7	434.6	430.8	431.7	432.6	433.5	434.4	430.3	431.2	432.2	433.2	434.1	434.0
247	429.6	431.7	432.4	433.2	434.0	434.8	431.1	431.9	432.8	433.6	434.5	430.4	431.3	432.3	433.2	434.2	434.0
248	430.3	432.1	432.8	433.5	434.2	435.0	431.5	432.2	433.0	433.8	434.7	430.6	431.5	432.4	433.3	434.3	434.0
249	430.8	432.5	433.1	433.7	434.5	435.2	431.7	432.4	433.2	434.0	434.8	430.7	431.6	432.5	433.4	434.3	434.0
250	431.4	432.8	433.4	434.0	434.7	435.5	432.1	432.7	433.4	434.1	435.0	430.8	431.7	432.5	433.4	434.4	434.0
251	431.8	433.2	433.7	434.3	434.9	435.6	432.3	432.9	433.6	434.3	435.1	430.9	431.8	432.6	433.5	434.4	434.1
252	432.1	433.4	433.9	434.4	435.1	435.8	432.5	433.0	433.7	434.4	435.2	431.0	431.8	432.7	433.5	434.5	434.1
253	432.5	433.7	434.1	434.7	435.3	436.0	432.7	433.3	433.9	434.6	435.4	431.2	431.9	432.8	433.6	434.5	434.1
254	433.1	434.1	434.5	435.1	435.7	436.3	433.1	433.6	434.2	434.8	435.6	431.3	432.1	432.9	433.7	434.6	434.1
255	433.6	434.5	435.0	435.6	436.1	436.6	433.4	433.8	434.4	435.2	435.9	431.5	432.2	433.0	433.8	434.7	434.1
256	434.1	434.9	435.3	436.0	436.5	436.9	433.7	434.1	434.7	435.5	436.1	431.7	432.4	433.1	433.9	434.8	434.1
257	434.6	435.3	436.0	436.7	437.0	437.4	434.1	434.5	435.0	436.0	436.6	432.0	432.6	433.3	434.0	434.9	434.1
258	435.2	436.0	436.7	437.2	437.5	437.8	434.6	434.9	435.3	436.4	436.9	432.3	432.9	433.5	434.2	435.0	434.1
259	435.4	436.1	436.8	437.3	437.6	437.9	434.7	435.0	435.5	436.5	437.0	432.4	432.9	433.6	434.3	435.1	434.1
260	435.9	436.5	437.2	437.7	437.9	438.2	435.0	435.3	435.8	436.8	437.3	432.5	433.0	433.7	434.4	435.2	434.1
261	436.3	437.0	437.6	438.0	438.2	438.5	435.3	435.6	436.0	437.0	437.5	432.7	433.2	433.8	434.5	435.3	434.2
262	436.6	437.2	437.9	438.2	438.4	438.7	435.5	435.8	436.2	437.2	437.7	432.9	433.4	434.0	434.6	435.3	434.2
263	437.1	437.6	438.2	438.5	438.7	438.9	435.9	436.1	436.5	437.5	437.9	433.2	433.7	434.2	434.8	435.5	434.2
264	437.7	438.2	438.6	438.9	439.1	439.3	436.3	436.5	437.0	437.8	438.2	433.6	434.0	434.5	435.0	435.7	434.2
265	438.6	438.9	439.2	439.5	439.6	439.8	436.7	436.9	437.5	438.4	438.7	433.9	434.2	434.7	435.2	435.8	434.3
266	439.0	439.2	439.5	439.7	439.8	440.0	437.0	437.1	437.9	438.7	438.9	434.1	434.4	434.8	435.3	435.9	434.3
267	439.6	439.8	440.0	440.2	440.3	440.4	437.5	437.9	438.5	439.1	439.3	434.5	434.8	435.1	435.6	436.1	434.3
268	439.8	440.0	440.2	440.3	440.4	440.6	437.8	438.1	438.7	439.3	439.5	434.6	434.9	435.3	435.7	436.3	434.3
269	440.0	440.2	440.4	440.6	440.7	440.8	438.0	438.3	438.8	439.5	439.7	434.8	435.1	435.4	435.8	436.4	434.4
270	440.6	440.7	440.9	441.0	441.1	441.2	438.4	438.7	439.3	439.9	440.0	435.2	435.4	435.7	436.1	436.6	434.4
271	441.0	441.1	441.3	441.4	441.5	441.6	438.9	439.2	439.7	440.2	440.4	435.5	435.7	436.0	436.4	436.8	434.5
272	441.4	441.5	441.6	441.7	441.8	441.9	439.4	439.6	440.1	440.5	440.7	435.7	435.9	436.2	436.5	436.9	434.5
273	441.7	441.8	441.9	442.0	442.1	442.2	439.9	440.1	440.5	440.9	441.0	435.8	436.0	436.3	436.6	437.1	434.5

Table 3. Estimated acres not owned or with easement rights that would be flooded under various discharge and water-level options at Lock and Dam 25.

		River mile																		
Discharge	Elevation at dam	242-255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	Total
19,000	430.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19,000	431.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19,000	432.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19,000	433.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19,000	434.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56,000	430.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56,000	431.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56,000	432.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56,000	433.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56,000	434.0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
95,000	430.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95,000	431.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95,000	432.0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
95,000	433.0	0	13	7	5	1	4	3	4	12	0	0	0	0	0	0	0	0	0	49
95,000	434.0	0	23	11	8	1	6	6	7	22	44	14	0	0	0	0	0	0	0	142
118,000	430.0	0	3	3	3	0	3	3	4	16	44	28	7	0	11	3	1	2	8	139
118,000	431.0	0	8	7	7	1	6	6	8	49	103	96	20	5	14	4	2	5	13	354
118,000	432.0	0	21	11	10	2	9	9	11	74	132	149	27	10	14	10	4	7	17	517
118,000	433.0	0	30	13	12	2	10	11	12	89	179	166	27	10	15	11	5	12	17	621
118,000	434.0	0	36	14	13	3	17	15	14	98	196	186	60	13	19	11	7	15	21	738

Table 4. Minimum elevations of land not now under control of the Government, and the maximum elevations of purchased or easement obtained lands in Pool 25 not protected by levees.

	Elevations	
River mile	Minimum	Maximum
242		433.7
243		436.9
244		436.9
245	436.3	438.3
246	441.9	436.9
247		436.9
248	435.5	442.0
249	436.6	440.7
250	434.6	440.0
251	434.6	437.0
252	434.3	441.9
253	433.8	441.9
254	435.6	441.9
255	435.0	442.3
256	434.2	441.9
257	434.7	441.9
258	435.3	441.9
259	435.4	441.9
260	435.9	442.0
261	436.3	441.9
262	436.7	442.0
263	437.2	437.1
264	437.8	
265	438.7	
266	439.1	
267	439.7	
268	439.8	
269	440.1	
270	440.7	
271	441.1	
272	441.4	
273	441.8	

Figure 1. Before and after photographs of the same area showing the effects of a water-level experiment in Pool 25. The top picture was taken on July 8, 1994, and the bottom on August 5, 1994. (Photos by Ken Dalrymple)

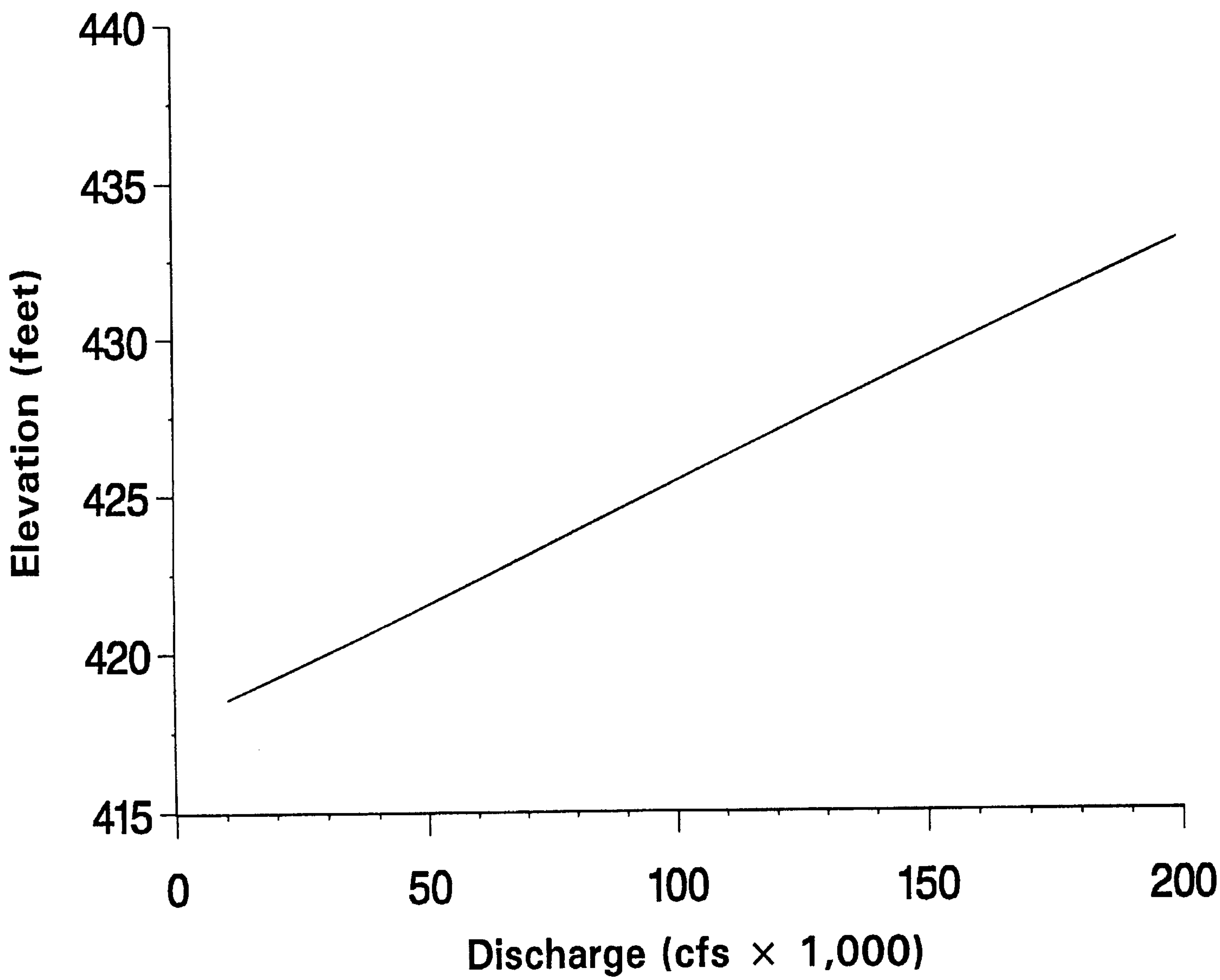

Figure 2. The discharge-elevation relationship developed for the tailwater of Lock and Dam 25.

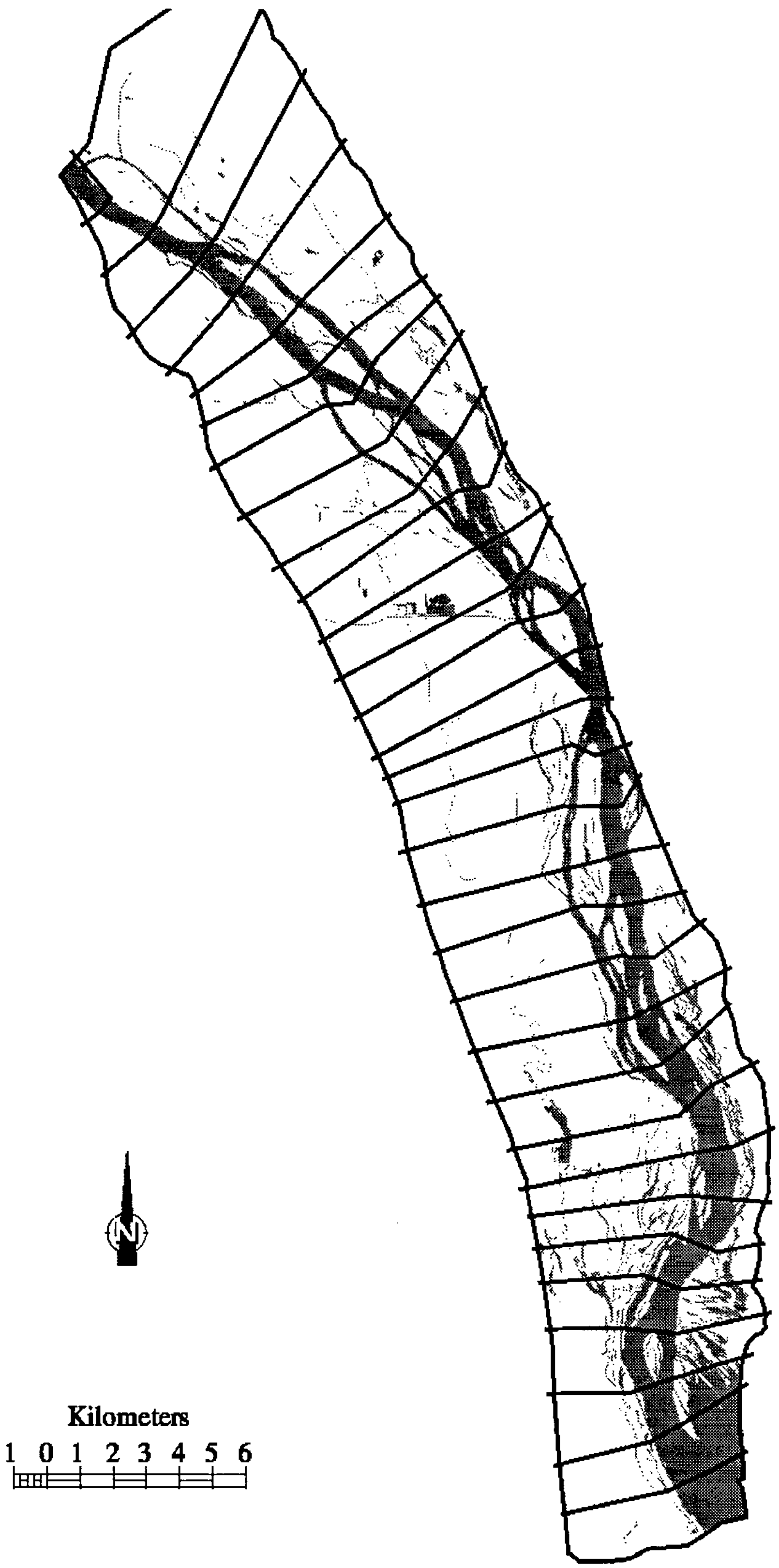

Figure 3. The river mile template for Pool 25.

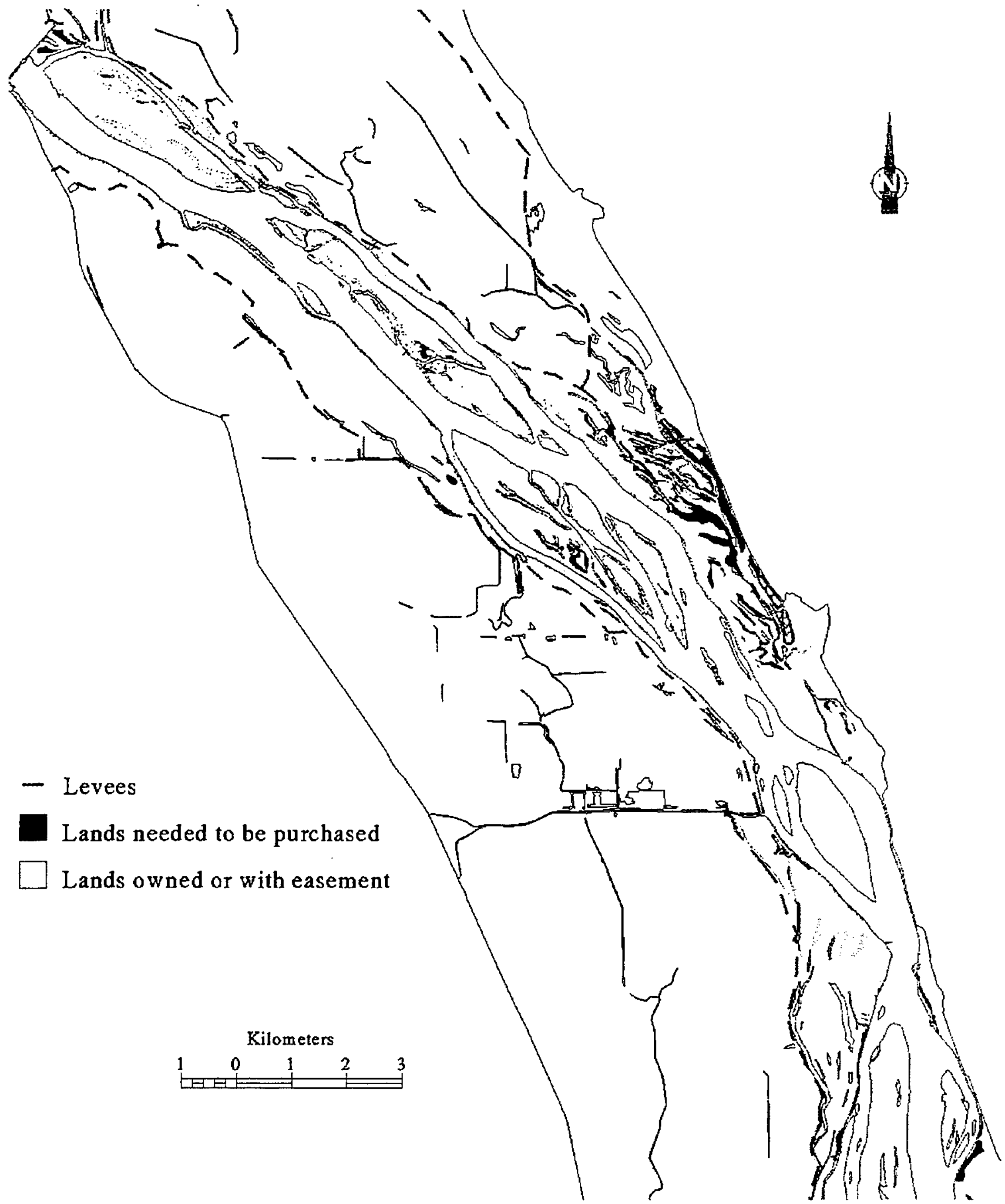

Figure 4. Map for the northern portion of Pool 25 depicting levees, lands presently under Government control, and lands needed to be purchased when water levels are always managed at the dam with a maximum water elevation of 434.0 ft.

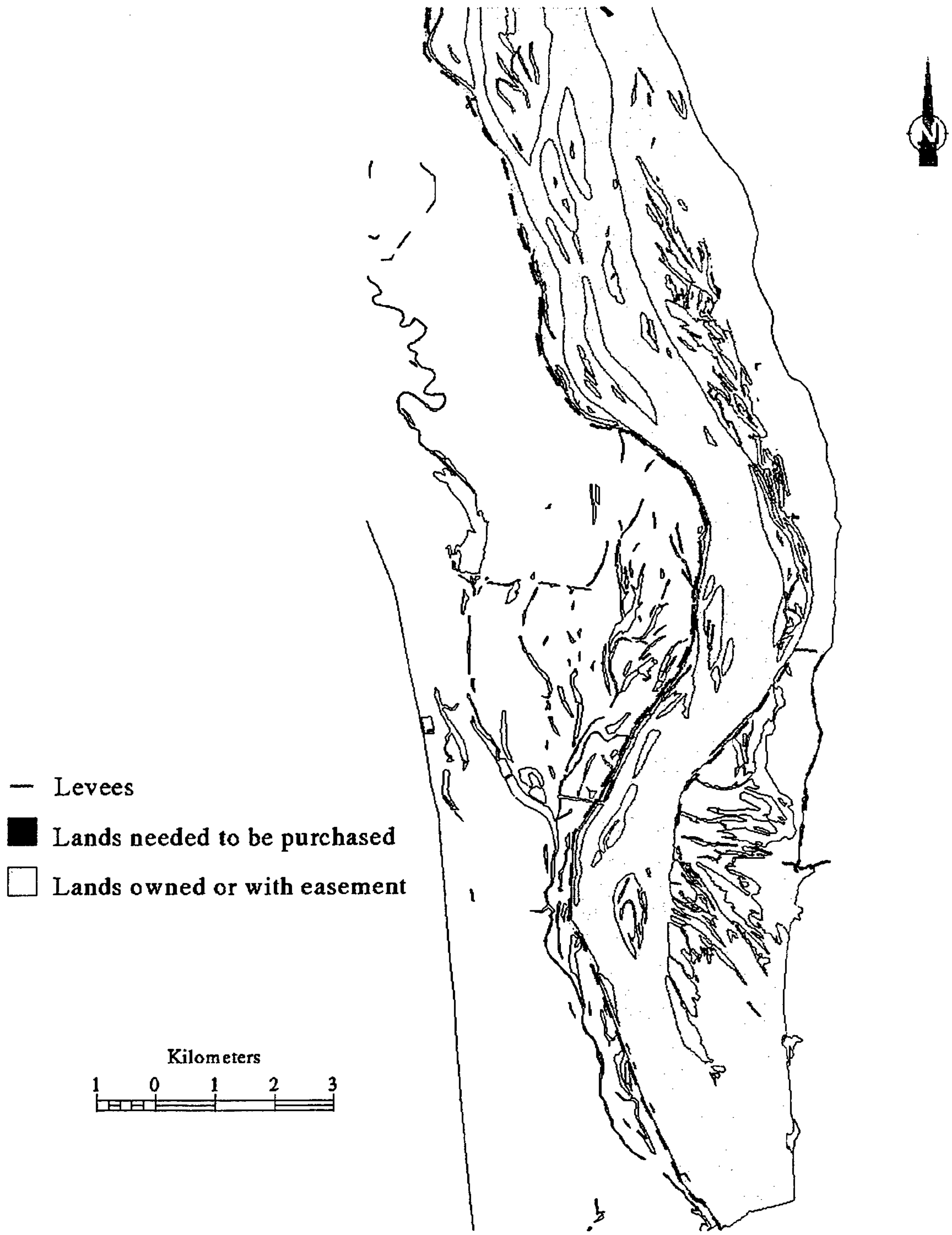

Figure 5. Map for the southern portion of Pool 25 depicting levees, lands presently under Government control, and lands needed to be purchased when water levels are always managed at the dam with a maximum water elevation of 434.0 ft.

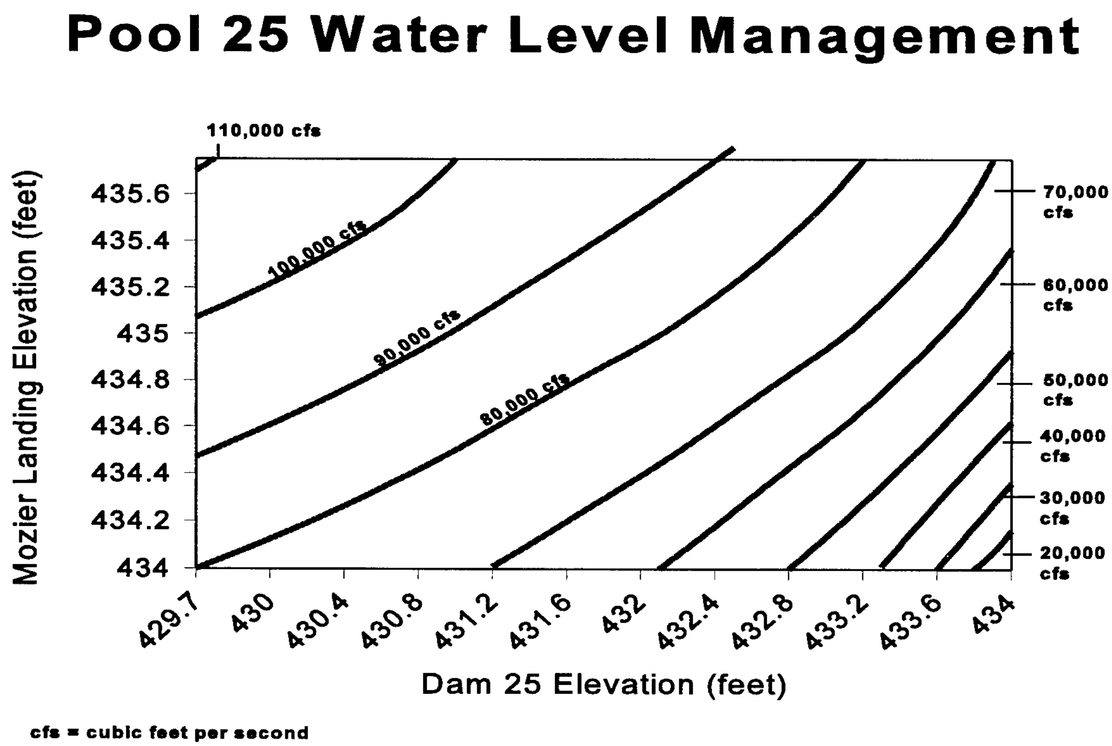

Figure 6. The relationship between water elevations at Dam 25 and Mozier Landing for various discharges.

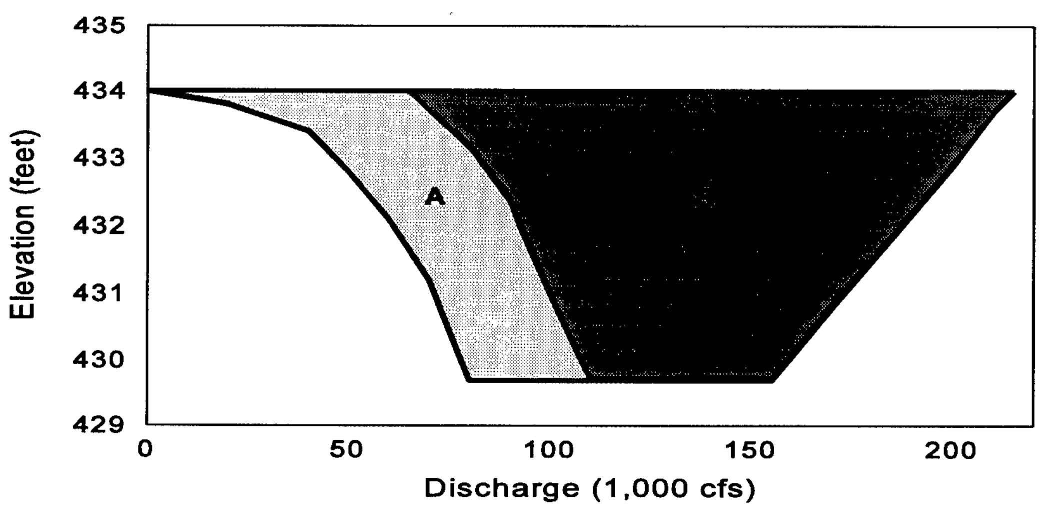

Figure 7. The band representing water-level flexibility for Pool 25 using the present plan (A) and the alternative where water levels are always managed at the dam with a maximum water elevation of 434.0 ft (A and B combined).

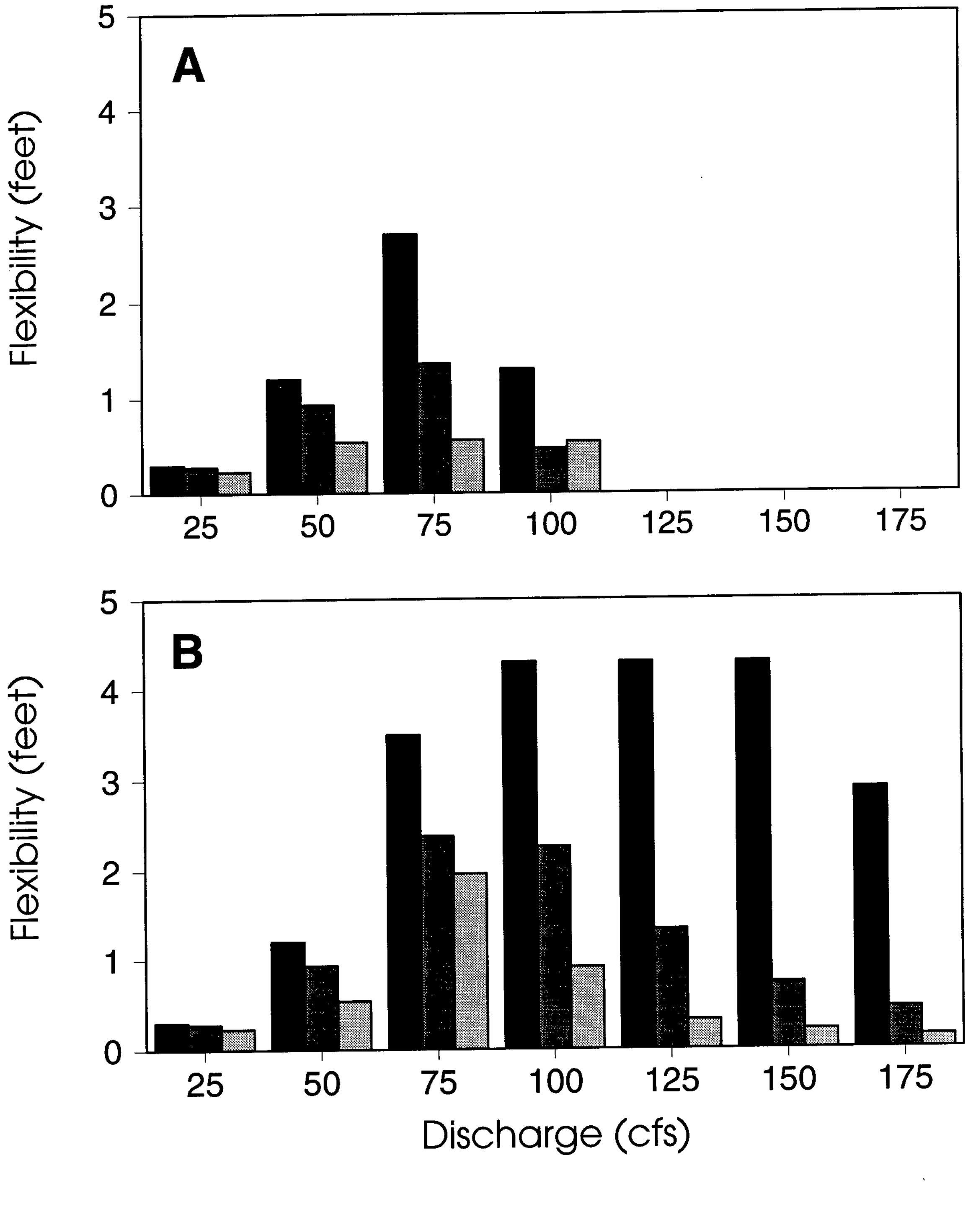

Figure 8. Water-level flexibility (feet) at various discharges using the present plan (A) and the alternative where water levels are always managed at the dam with a maximum water elevation of 434.0 ft (B). The darkest shade represents the area at Dam 25, followed by Mozier Landing and the tailwater at Lock and Dam 24.

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13. ABSTRACT (Maximum 200 words)

We estimated the amount of land that would have to be acquired if an alternative water-level management plan was used for Pool 25 on the Upper Mississippi River. The work was performed as part of a study to evaluate water regulation alternatives that could minimize negative impacts and increase ecological benefits of dam operation. We used a one-dimensional model (HEC-2) to estimate the ordinary high-water profile and water surfaces at various discharges and management options, by river mile. Maps of these data were then created with a geographic information system, along with maps of land elevations, both above and below the surface of the river, lands controlled by the managing agency, and levees. The ownership and easement, ordinary high water, and levee coverages were combined to represent areas that would not have to come under Government control at a discharge that creates the ordinary high-water profile. As a validation exercise, we estimated the amount of lands that would have to come under Government control if the dam were to be constructed now and no lands were under Government control. The estimated area was 11,276 acres, which can be compared with 11,039 acres owned or controlled by the Government with fee title and flowage easement lands. The difference, 237 acres or 2.1%, is considered to be satisfactory, given the lack of resolution of our elevation coverage, possible sedimentation of backwater areas since the dam was built, and possible differences in the high-water line between the present prediction and the ordinary high-water line estimated before the dam was constructed. The model predicted that no lands would need to be purchased under any scenario for the first 13 miles upriver of the dam. The maximum amount of land needed upriver of this point would be 738 acres. This acreage estimate would be higher if the managing agency elects to purchase or obtain easements on entire parcels of land rather than just the lands the model predicts may be covered by water. The acreage estimate may be lower if some affected lands were already under the control of another Government agency.

14. SUBJECT TERMS

Geographic information system, HEC-2, one-dimensional model, Upper Mississippi River, water regulation

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