PRELIMINARY ESTIMATES OF WATER IMPORTATION REQUIREMENTS FOR THE SUNFLOWER RIVER BASIN

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INTRODUCTION

Water level declines in the Mississippi River Alluvial Aquifer (alluvial aquifer) have resulted from heavy use of that aquifer by agriculture for row crop irrigation, flooding of rice fields, and maintaining levels in catfish ponds. If aquifer water levels are allowed to continue to decline, the aquifer may eventually be destroyed and an incredibly valuable natural resource of the region would be lost. To prevent this loss, the YMD Joint Water Management District (YMD) and Area 4 Soil and Water Conservation Districts have undertaken a project with the technical assistance of the Natural Resources Conservation Service to evaluate the feasibility of developing alternative water supplies for the Delta region.

Importing water from the Mississippi or Yazoo River into the Sunflower River system is one option being evaluated. This option will place flows into the Bogue Phalia, the main channel Sunflower River, and the Quiver River during summer irrigation months. These channels already provide drainage and flood stage control for the region. Placing additional flows into these channels will impact channel needs to maintain a given level of flood protection. The Corps of Engineers (Corps) are currently evaluating flood channel needs in the Sunflower Basin. Their analysis of flood protection must now include the impact of using those channels for the dual purposes of flood control and water supply. An estimate of potential flows that will be introduced into the channels by possible agricultural water supplies is needed for the Corps to complete that analysis. This work reports the preliminary estimates of those flows.

METHODS

Imported flows required for irrigation were based on annual crop water requirements and acres of crops watered. Guidance for annual water requirements were taken from Hendricks (1996). A logical and practical land unit used for calculating Sunflower River Basin water requirements is the watershed. To complete the needed analysis, several information sets were combined using relational databases and geographical information systems (GIS). They include the following:

1. The Sunflower River was divided into 4 smaller water sheds based on Natural Resources Conservation Service and US Army Corps of Engineers watershed delineations. The boundaries of the watersheds were digitized into the YMD GIS. The locations of the watersheds are given in Figure 1 and are named: (a) Upper Sunflower River, (b) Lower Sunflower River, (c) Quiver River, and (d) Bogue Phalia.

2. Information contained in the Water Use Permit Database was used to calculate total watered acres in each watershed. GIS was used to summarize the watershed watered acres.

3. A table summary was provided by the Vicksburg District Office of the Corps of Engineers that included the total farmed acres within each of the 4 watersheds. The Corps data originated from satellite imagery. A summary of currently watered and farmed acres in each watershed is given in Table 1.

4. Daily summer water requirements were calculated for each irrigated field or fish pond based on the procedure of Stiles and Pennington (1996). Their procedure was modified by:

a) Using crop water requirements estimated for extreme dry conditions. Substituted crop water requirements are given in Table 2.

b) Calculations were made for daily crop water requirements instead of monthly. The daily calculations were based on the method discussed in Pennington (1996).

Analysis of the data to calculate surface water import flows was performed in 3 major steps. These were:

1. Current daily water use for individual wells was calculated and the total daily water requirement for each of the 4 watersheds was summarized using GIS.

Different scenarios assumed that 0%, 25%, or 50% of current groundwater use would be converted to using imported surface water. Current crop mix ratios were assumed to remain unchanged from current conditions.

2. The potential for expansion of watered acres in each of the 4 major watersheds was calculated as the difference between currently watered acres and currently farmed but non-watered acres. For different scenarios, it was assumed that each watershed achieved a significant increase in watered acres. The increase in watered acres was different for each watershed. Table 1 shows the percent of each watershed that is currently watered and the percent of each watershed assumed to be watered with an expansion scenario. A 100% watering of all farmed acres in each watershed was also evaluated. For both expansion scenarios, the current crop mix ratios were assumed to apply to all new watered acres. It was also assumed that water for all future watered acres will come from imported surface water. Table 3 shows the scenario combinations with a seventh scenario based simply on importation of 100,000 acre feet of water each year that was evenly distributed between the three major channels.

3. Total annual water requirements are converted to flows in cubic feet per second (cfs) at several locations throughout the main channel systems for each of the scenarios.

RESULTS

Figure 2 shows the daily flows required for the Lower Sunflower River watershed for conditions of 25% of current water use converted to imported surface water and watered expansion to include 50% of the entire farmable land. Flows at the top of the watershed and a one location down the watershed channel are depicted. Table 4 shows the maximum flows required for each watershed for each scenario. Results for all scenarios were placed in spreadsheets and made available to the Vicksburg District Office of the US Army Corps of Engineers.

These flows at specific dates can now be used to estimate the impact of large water importations into the Sunflower River system of flood stages and drainage.

REFERENCES

Hendricks, Michael W. 1996. Crop water use in the Mississippi Delta. In Proceedings of the 26th Mississippi Water Resources Conference, April 2-3, 1996, edited by B. Jean Daniel, 10-13. Water Resources Research Institute: Mississippi State University.

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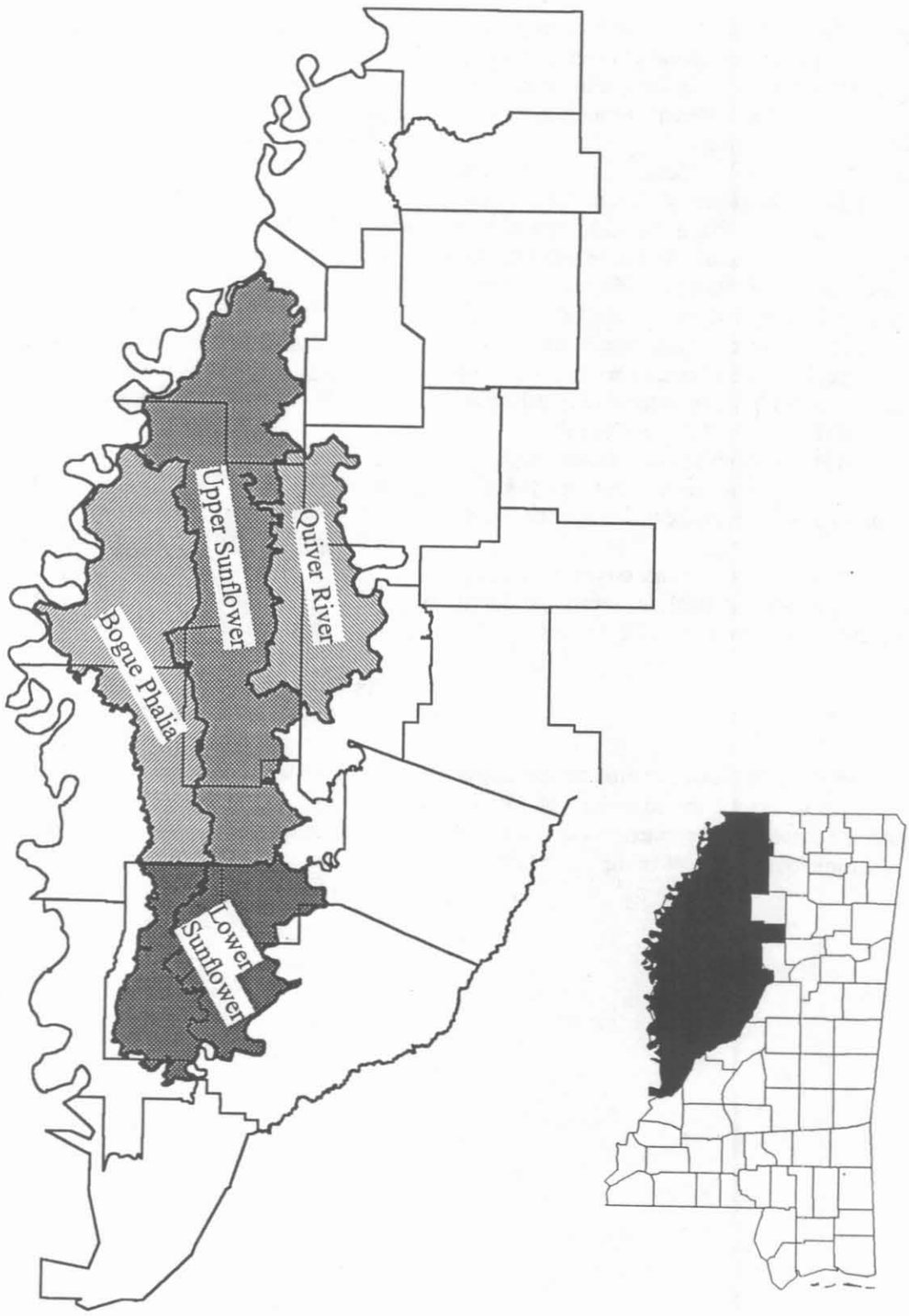
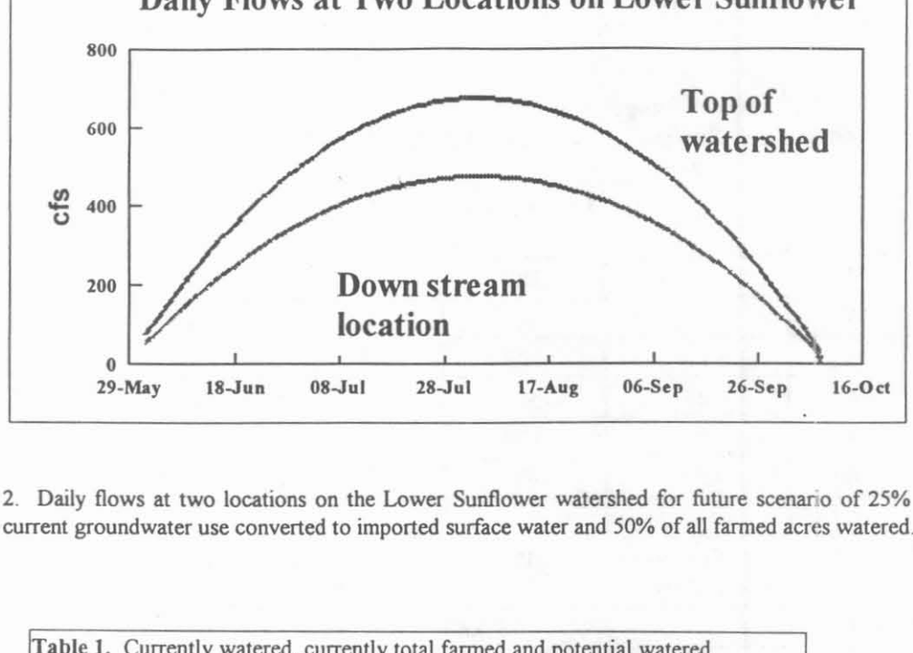


Figure 1. Locations of Sunflower River watersheds.



2. Daily flows at two locations on the Lower Sunflower watershed for future scenario of 25% of current groundwater use converted to imported surface water and 50% of all farmed acres watered.

Table 1. Currently watered, currently total farmed and potential watered expansion (farmed, non-watered) acres for the 4 major Sunflower River Basin watersheds.

Watershed	Currently Watered	Currently Farmed	Expansion	Percent Farmed Acres Watered Current	Percent Farmed Acres Watered Projected
	Acres				
Bogue Phalia	303,878	373,845	69,967	81	95
Quiver River	164,933	273,410	108,477	60	85
Upper Sunflower	434,595	831,663	397,068	52	80
Lower Sunflower	56,464	205,911	149,447	27	50
Total	959,870	1,684,829	724,959	57	

Table 2. Annual crop water requirement used in analysis.

Crop	Acre feet per Acre annually
Row Crops	1.5
Rice	3
Aquaculture	3

Table 3. Combinations of changes of current groundwater use to imported surface water with different combinations of expansion scenarios. Scenario 7 is based on preliminary US Geological Survey preliminary estimates of alluvial aquifer annual overdrafts of about 100,000 acre feet per year.

Scenario	% Current Groundwater Use to Change to Surface Water	Percent of Farmable Land in Major Watersheds to be Watered			
		Bogue Phalia	Quiver River	Upper Sunflower	Lower Sunflower
1	0	100	100	100	100
2	0	95	85	80	50
3	25	100	100	100	100
4	25	95	85	80	50
5	50	100	100	100	100
6	50	95	85	80	50
	Acre Feet to be Annually introduced into Each of the 3 major Upper Watersheds				
7		33,000	33,000	33,000	

Table 4. Maximum flow, in cfs, introduced into the top of each major watershed for the different scenarios.

Watershed	Expansion Scenario	Percent of Current Use Changed to Surface Water Imports		
		0	25	50
		Maximum Flow in cfs		
Bogue Phalia	100	781	1,628	2,476
Quiver River	100	1,203	1,660	2,117
Upper Sunflower	100	4,408	5,615	6,821
Lower Sunflower	100	1,668	1,826	1,983
Bogue Phalia	95	572	1,420	2,267
Quiver River	85	748	1,205	1,663
Upper Sunflower	80	2,562	3,768	4,974
Lower Sunflower	50	519	677	834
	Flow to be Introduced into the top of Bogue Phalia, Upper Sunflower, and Quiver River to meet 100,000 af annual water import requirement.			
		187		