# SUMMER LOW FLOWS
# FOR THE
# LOWER MISSOURI RIVER

## Missouri River Technical Committee
## Of The
## Siouxland Chamber of Commerce

# Summer Low Flows for the Lower Missouri River

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Cover Photos:

Upper photo of Gavins Point Dam, South Dakota and Nebraska. Courtesy of USACE.

Lower photo of Lisbon Chute, Missouri. Courtesy HDR Consutling Company.

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EXECUTIVE SUMMARY

# SUMMER LOW FLOWS FOR THE LOWER MISSOURI RIVER

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The USFWS (U.S. Fish and Wildlife Service) in the Amendment to the Biological Opinion for the Missouri River has asked for a summer low-flow release of 25,000cfs from Gavins Point Dam, South Dakota and Nebraska for the purpose of increasing shallow-water habitat for the pallid sturgeon. An investigation of the effects of such a release was made to evaluate the effect of that release on the amount of shallow-water habitat for the pallid sturgeon and other fishes of the Missouri as well as the affect on congressionally authorized purposes for the Missouri River and its reservoirs.

Analysis of existing information indicates that summer flows of 40,000 cfs at Boonville during the summer would be beneficial in maximizing shallow-water acres of habitat for fishes including the pallid sturgeon. During dry years, it is likely that releases from Gavins Point Dam would have to exceed 25,000 cfs to maintain a flow of 40,000 cfs at Boonville. As an example, in 2002 the release of 25,500 cfs during July and August resulted in flows of only about 32,000 cfs at Boonville, far short of the 40,000 cfs required to maximize shallow-water acres. Similarly in 2003, a release of 26,000 cfs from Gavins Point Dam resulted in flows of about 30,000 cfs in late August at Boonville, or about 10,000 cfs less than flow required to maximize shallow-water acres. Low summer flow would be detrimental to many water-use purposes, such as recreation, water supply, cooling water, and navigation.

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## INTRODUCTION

The USFWS (U.S. Fish and Wildlife Service) (2003, p. 6) asks for a summer release of 25,000cfs from Gavins Point Dam, South Dakota and Nebraska for the purpose of increasing shallow-water habitat for the pallid sturgeon (see **Fig. 1**). This document will investigate if such a release would decrease the benefits to the congressionally authorized purposes, such as water quality including temperature, water supply, recreation, wildlife, and navigation, especially during years of drought in the Lower Missouri River Basin. A release of 25,000 cfs is also suspected to decrease the shallow-water habitat for native fish in the reach from Boonville to St. Louis, Missouri. This reach is potentially a very important reach for the pallid sturgeon because it is known to contain an important pallid sturgeon population and also includes tributary streams that historically were likely sites of sturgeon spawning.

Numerous historical observations indicate that tributary streams are sites of spawning for sturgeons including the pallid sturgeon, shovelnose sturgeon, and lake sturgeon (Jorgensen, 2003). Tributary streams and the mouths of tributary streams are typically important habitat for sturgeon spawning. Shovelnose sturgeons have been documented in the Osage, Gasconade, and the Grand Rivers (Pflieger, 1997, p.51). Lake sturgeons have been documented in the Osage and Gasconade Rivers (Pflieger, 1997, p. 49). The Boonville to St. Louis reach is found in USFWS' segments 14 and 15, both of which are listed as high priority areas in reference to the pallid sturgeon (USFWS, 2000, p. 240).

## FLOW VERSUS SHALLOW-WATER ACRES

Flow versus shallow–water acres was determined by the USACE at five locations in the Lower Missouri River. In general, these locations were in between USGS gaging stations and were selected because it was believed that the locations were representative of shallow-water conditions within selected reaches. The flow versus shallow-water acreage relation at Rocheport, Missouri, for the Boonville to St. Louis reach is shown in **Figure 2**. Shallow water is defined herein as being 5-foot depth or less and having a water velocity of 2-feet per second or less. Shallow-water acres relation at Baker Bend, Missouri, for the Kansas City, Missouri, to Boonville reach is shown in **Figure 3**. The shallow-water acres relation at Doniphan, Missouri, for the St. Joseph, Missouri, to Kansas City reach is shown in **Figure 4**. The shallow-water acres relation at Nebraska City for the Omaha, Nebraska, to St. Joseph reach is shown in **Figure 5.** The shallow–water acres relation at Blair, Nebraska, for the Sioux City, Iowa, to Omaha reach is shown in **Figure 6**. These relations were established from information obtained from the USACE (United States Army Corps of Engineers). The relation at Rocheport is especially interesting because it shows that maximum shallow–water habitat is at 40,000-cfs flow. The acres of shallow water decrease in the 40,000 to 20,000-cfs range. This relation suggests that the total acres of shallow-water habitat for the Lower Missouri River may be decreased if releases at Gavins Point Dam are reduced to less than 40,000-cfs at Boonville.


**Figure 1. Missouri River Basin. Lower Missouri River is from Gavins Point Dam to St. Louis.**

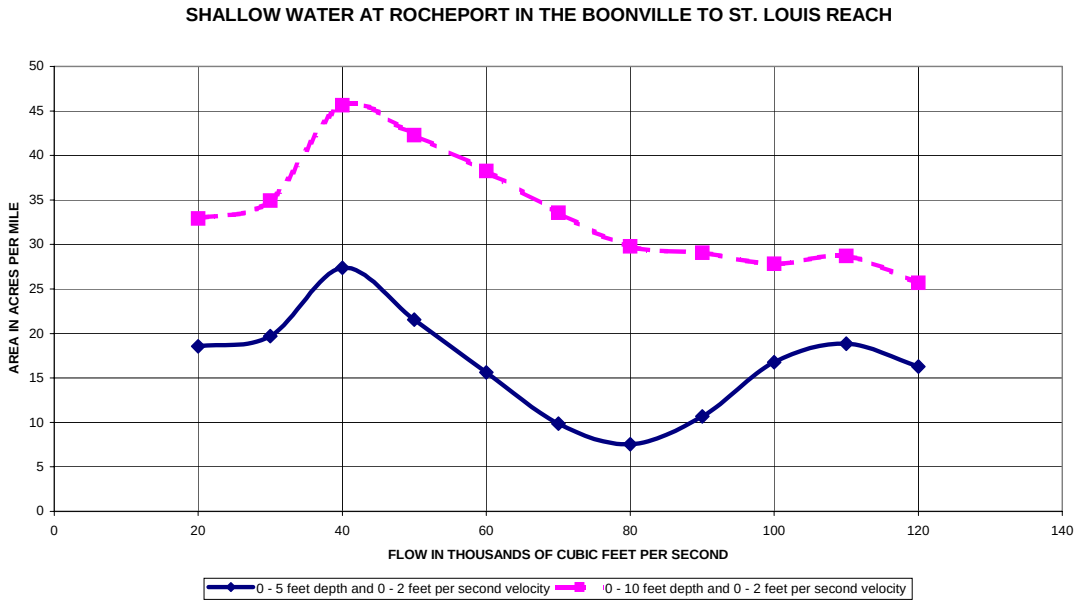


**Figure 2. Shallow-water acres at Rocheport , Missouri, in the Boonville to St. Louis reach. (Data from USACE.)**

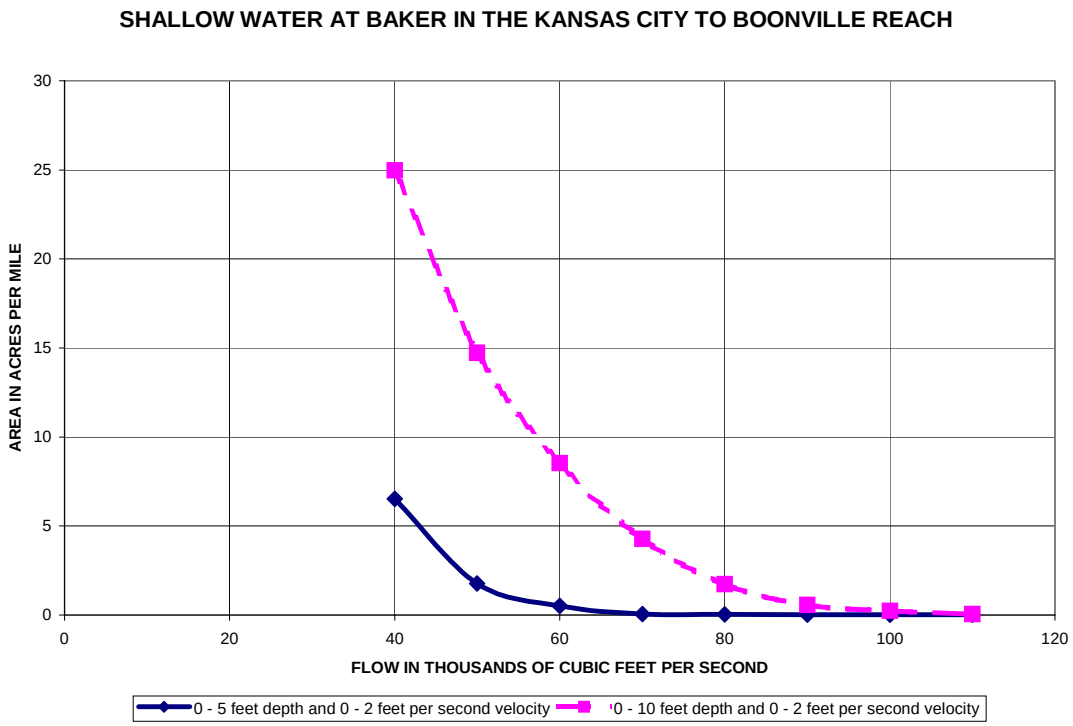


**Figure 3. Shallow-water acres at Baker Bend, Missouri, in the Kansas City to Boonville reach. (Data from USACE.)**

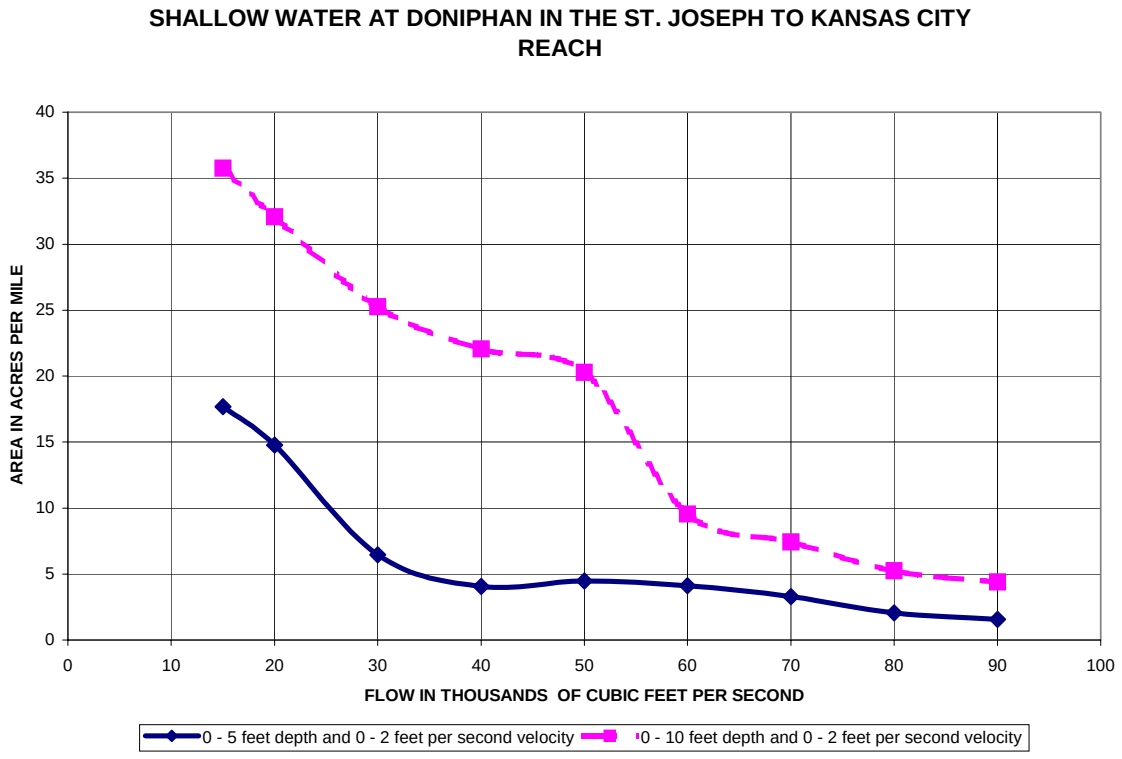


**Figure 4. Shallow-water acres at Doniphan, Missouri, in the St. Joseph to Kansas City reach. (Data from USACE.)**

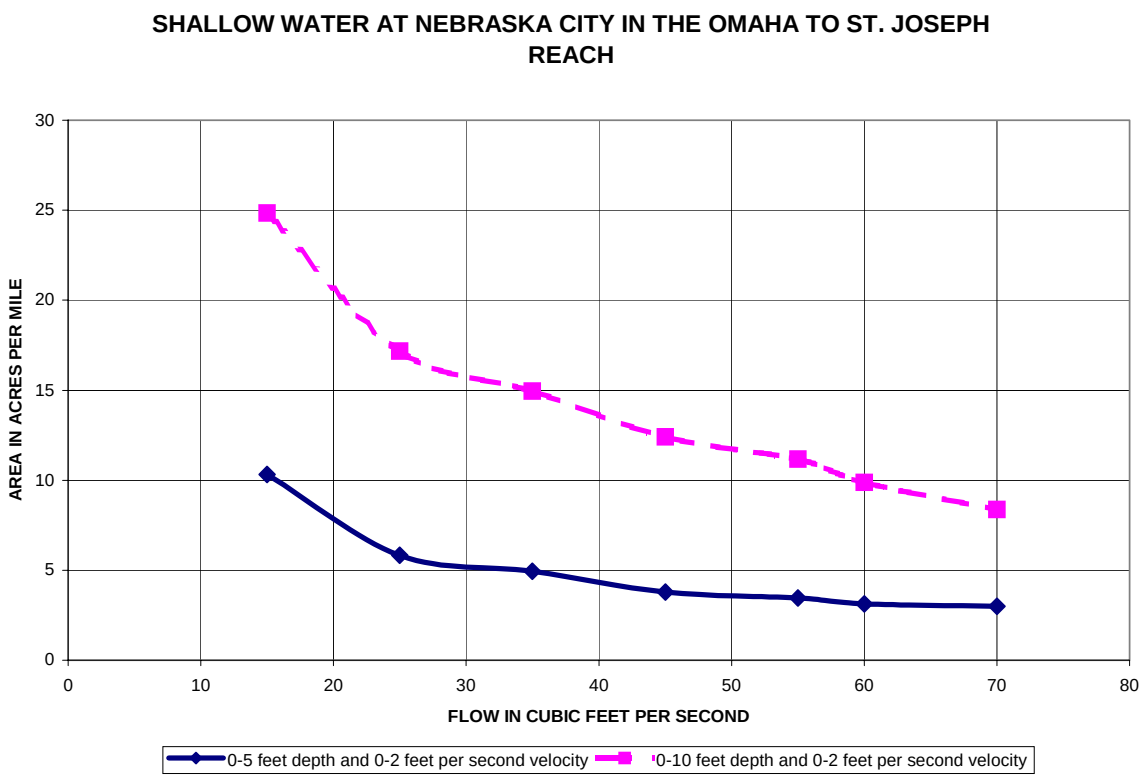


**Figure 5. Shallow-water acres at Nebraska City, Nebraska, in the Omaha to St. Joseph reach. (Data from USACE.)**

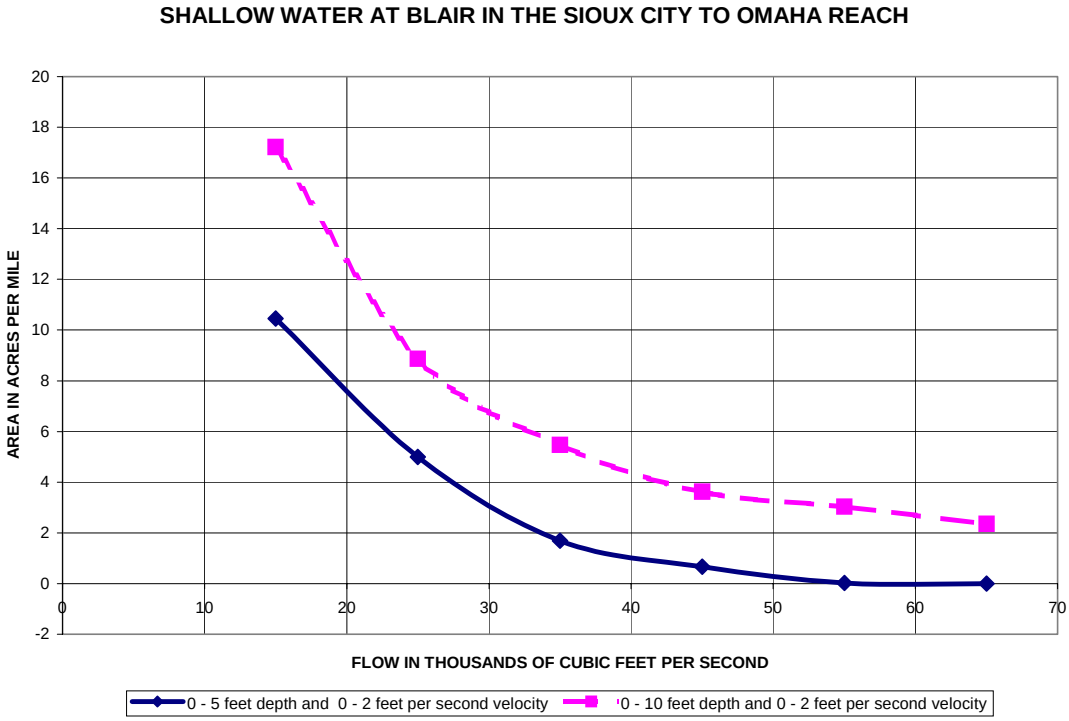


**Figure 6. Shallow-water acres at Blair, Nebraska in the Sioux City to Omaha reach. (Data from USACE.)**

Long term USGS (U.S. Geological Survey) streamflow records at Sioux City, Omaha, Nebraska City, St. Joseph, Kansas City, and Boonville were collected. Records for the period of 1930 to 2003 were examined because they formed a set of pertinent concurent data. To evaluate the gain in flow from Sioux City, which is 79 river miles below Gavin's Point Dam, to Boonville, the difference between August flows at Boonville and Sioux City were plotted as shown in **Figure 7,** which shows a modest correlation. A stronger correlation was not expected because there are many hydrological factors that affect flow, not the least of which are the vagaries of summer rain over a very large drainage basin. Of more significance, is what are the typical gains in each upstream reach for flows of 40,000 cfs or less at Boonville? Accordingly, August gains for the Sioux City to Omaha reach were plotted in **Figure 8**. The relation at this low range was very weak or nearly non-existent. At this low range of gains, consideration of the average of the gains in conjunction with the standard deviation probably better describes the gains than the equation. The average gain for the Sioux City to Omaha reach was 1047 cfs with a standard deviation of 1,062 cfs. The reason that the standard deviation is larger than the average is because three of the gains were negative (losses). The average gain for the Omaha to Nebraska City reach was 2,138 cfs with a standard deviation of 1,281 cfs. The Average gain for the Nebraska City to St. Joseph reach was 1,350 cfs with a 1,226 cfs standard deviation. The average gain in the St. Joseph to Kansas City reach was 2,838 cfs with a 2,300 cfs standard deviation. The average gain in the Kansas City to Boonville reach was 2,264 cfs with a 1,777 cfs standard deviation. These incremental differences in flow were used to calculate the flow at Sioux City for a flow of 40,000 cfs at Boonville for the Sioux City to Boonville reach and was found to be approximately 9,600 cfs.

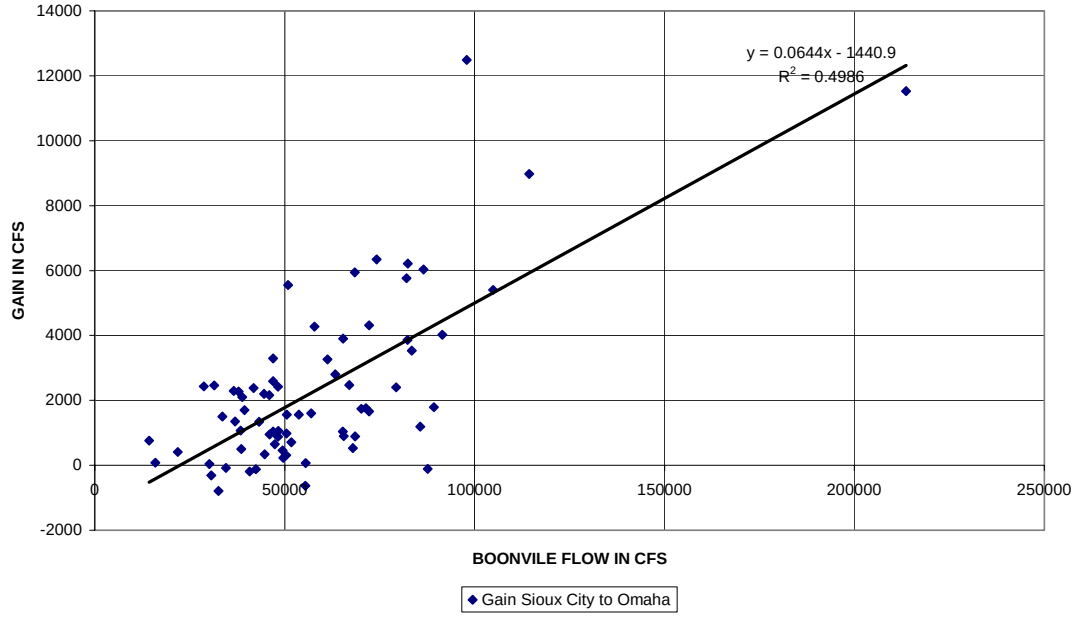


**Figure 7. Flows at Boonville versus gain of flows in the Sioux City to Omaha reach using 1930-1936**

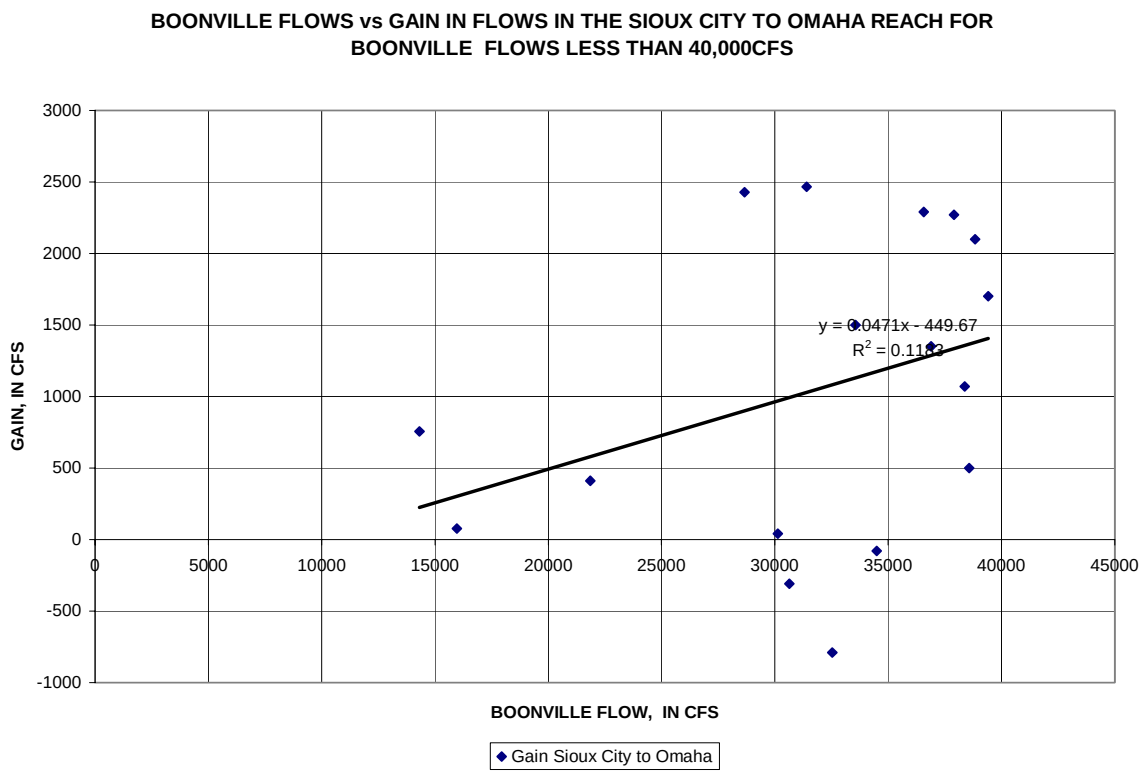


**Figure 8. Boonville flows versus gain of flows in the Sioux City to Omaha reach for August Boonville flows of less than 40,000 cfs. (Data 1930-2003 from USGS.)**

The average gain in acres per mile of shallow-water habitat at a specific flow for a specific reach, along with the length in miles of the specific reach were used to calculate the flow at Sioux City for a discharge of 40,000 cfs at Boonville. The acres of shallow water were also calculated. (See **Table**1.) The total shallow-water habitat from Sioux City to St. Louis was calculated as 8,446 acres at 40,000 cfs at Boonville. For comparison purposes, the shallow-water acres and the flow at Sioux City corresponding to a flow of 35,000-cfs at Boonville was 7,353-acres and 25,400-cfs respectively. (See **Table 2**.)

| REACH | SECTION | FLOW (cfs) | SHAL.WAT. (acres/mile) | LENGTH (river miles) | AREA (acres) |
|---|---|---|---|---|---|
| Sioux City to Omaha | Blair | 30400 | 3 | 116 | 348 |
| Omaha to St. Joseph | Nebraska City | 31400 | 5 | 168 | 840 |
| St. Joseph to Kansas City | Doniphan | 34900 | 5 | 80 | 400 |
| Kansas City to Booneville | Baker Bend | 37800 | 9 | 171 | 1539 |
| Boonville to Saint Louis | Rocheport | 40000 | 27 | 197 | 5319 |
| | | | | TOTAL = | 8446 |

Table 1. Shallow-water acres in the Sioux City to St. Louis reach for a flow of 40,000 cfs at Boonville.

| REACH | SECTION | FLOW (cfs) | SHAL.WAT. (acres/mile) | LENGTH (river miles) | AREA (acres) |
|---|---|---|---|---|---|
| Sioux City to Omaha | Blair | 25400 | 5 | 116 | 580 |
| Omaha to St. Joseph | Nebraska City | 26400 | 5 | 168 | 840 |
| St. Joseph to Kansas City | Doniphan | 29900 | 6 | 80 | 480 |
| Kansas City to Boonville | Baker Bend | 32700 | 10 | 171 | 1710 |
| Boonville to Saint Louis | Rocheport | 35000 | 19 | 197 | 3743 |
| | | | | TOTAL = | 7353 |

Table 2. Shallow-water acres in the Sioux City to St. Louis reach for a flow of 35,000 cfs at Boonville.

Based on the information presently available, the gain of streamflow downstream from Gavins Point Dam to Boonville for dry years is expected to be on the average about 10,000-cfs. To maximize the shallow-water acres, the flow at Boonville should be 40,000 cfs. At this flow rate, the average August release at Gavin Point Dam would be about 30,000 cfs. However, greater release rates may be required as is shown in Figures 9 and 10. A release of 25,000 cfs from Gavins Point Dam would result in an expected flow of 35,000 cfs at Boonville with a reduction of total shallow-water acres for the Sioux City to St. Louis reach of 1,100 acres. (Note: If the equation shown in Figure 7 was used to calculate expected gains, the gains in each reach would have been typically reduced, and accordingly the reduction of the calculated shallow-water habitat would have been more than the 1, 100 acres, which was obtained by using the average gain of 9,600 cfs.) The decrease of habitat would almost be entirely in the Boonville to St. Louis reach, which is believed to be one of the most important reaches for the pallid sturgeon.

**Figure 9** and **Figure 10** are hydrographs of the actual releases from Gavins Point Dam for 2002 and 2003. Figure 9 shows that a release of 25,500 cfs from Gavins Point Dam during July and early August of 2002 was inadequate to sustain a flow of 40,000-cfs at Boonville. During early August 2002, the Gavins Point Dam release deficit was up to 8,000 cfs. Figure 10 indicates that a Gavins Point Dam release of about 26,000 cfs in late August resulted in a maximum deficit of about 10,000 cfs in late August 2003 at Boonville.

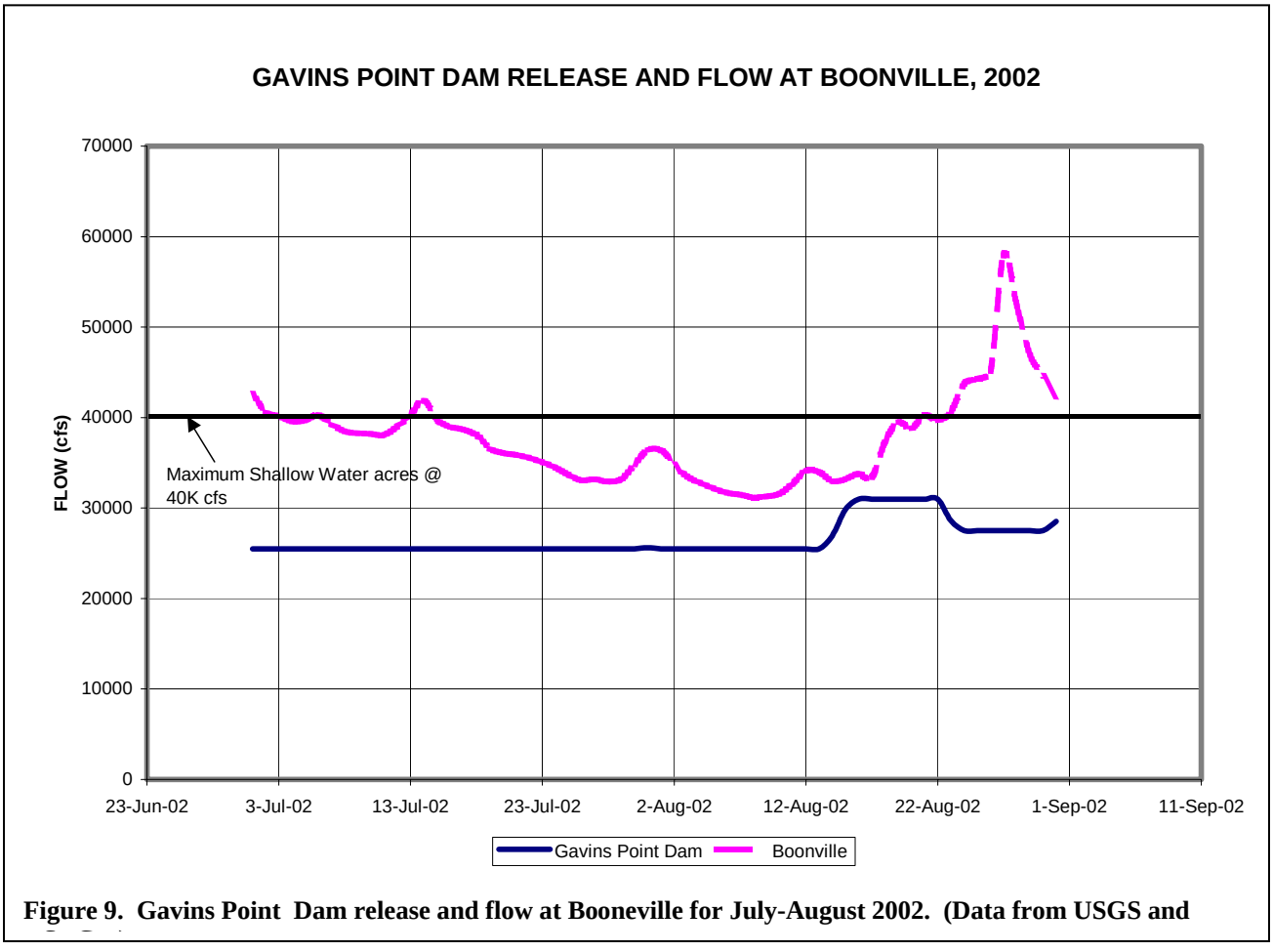


**Figure 9. Gavins Point Dam release and flow at Booneville for July-August 2002. (Data from USGS and**

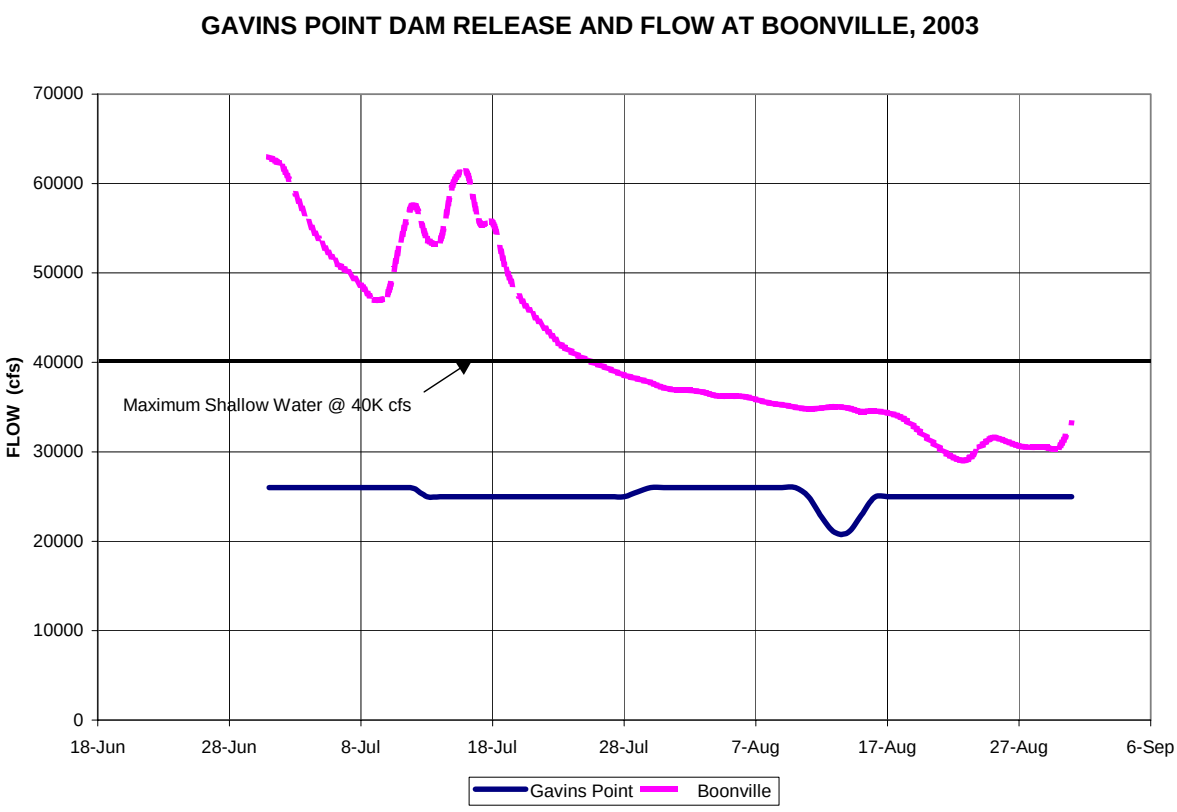


**Figure 10. Gavins Point Dam release and flow at Boonville for July-August 2003. (Data from USGS and USACE.)**

## SUMMARY AND CONCLUSIONS

Flows that sustain a flow of 40,000 cfs at Boonville during the summer would be beneficial in maximizing shallow-water acres. During dry years it is likely that releases from Gavins Point Dam would have to exceed 25,000 cfs to maintain a flow of 40,000 cfs at Boonville. As an example, in 2002 the release of 25,500 cfs during July and August resulted in a flow of only 32,000 cfs at Boonville, far short of the 40,000 cfs required to maximize shallow water acres. Similarly in 2003, a release of 26,000 cfs from Gavins Point Dam resulted in flows as of about 30,000 cfs in late August or about 10,000 cfs less than flow required to maximize shallow-water acres. Additionally low summer flow would be detrimental to many water-use purposes, such as recreation, water supply, cooling water, and navigation.

The data for the analysis presented here is from several sources. The data were originally developed for different objectives. Additional investigation would be beneficial, especially in reference to the accuracy of the results. For example, establishment of the

flow versus shallow-water area relation at additional locations would increase the accuracy of the analysis.

**Acknowledgements**

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