

## 7.12 NAVIGATION

Navigation on the lower 735 miles of the Missouri River from Sioux City to St. Louis is determined in part by controlled releases from Gavins Point Dam. Changes in several of the criteria making up the alternatives discussed in this chapter affect Gavins Point Dam releases and navigation in differing ways. The drought conservation criteria change how navigation service is affected during droughts in terms of level of service flow support and minimum season lengths. The changes in Gavins Point Dam releases for endangered species affect how navigation is served in the non-drought periods. Two of the alternatives discussed in this chapter eliminate service to navigation for 2 months or longer in the June through August timeframe. This section of Chapter 7 describes the changes in navigation benefits that occur for these changes in the system operation.

Navigation benefits are computed based on the cost reduction the navigation industry provides to the Nation. Alternative modes of transportation can move the commodities that the navigation industry moves on the Missouri River; however, these other modes of transportation would move these commodities at a higher cost. Navigation benefits are computed by taking the difference in cost between the next highest costs and the costs of moving the various commodities by barge on the Missouri River from their various origins to the destinations for the commodities moved in 1994. This analysis derived the value per ton of each commodity moved that year by the barge operators on the Missouri River. The details of how these unit values were determined and the breakdown of the annual tonnage moved among the commodities are detailed in the Economic Studies—Navigation Economics (Revised) technical report (Corps, 1998c). This technical report also discusses how

the operation and maintenance costs were deducted from the cost savings benefits to arrive at the navigation benefits presented in this section.

The navigation benefits for the Chapter 7 alternatives are presented in Table 7.12-1 and shown in Figure 7.12-1. Figure 7.12-1 shows total average annual navigation benefits for each of the alternatives discussed in this chapter (right side of figure) and for the submitted alternatives from Chapter 5 (left side of figure). Table 7.12-1 presents the same average annual navigation benefits data for the Chapter 7 alternatives as well as the navigation benefits by the individual reaches for the full period of analysis from 1898 to 1997.

The CWCP outperforms all of the other alternatives, with average annual navigation benefits of \$6.97 million. The majority (64.7 percent) of these benefits occur in the Kansas City reach which extends from Kansas City to the mouth (\$4.51 million). Moving upstream, 12.6 percent of the benefits are in the Nebraska City reach, 16.1 percent are in the Omaha reach, and 6.6 percent are in the Sioux City reach.

Figure 7.12-1 shows that the alternatives cluster into three basic groupings. The MCP has benefits similar to the CWCP, while the GP options show reduced benefits. The GP1528 and GP2028 options have very similar benefits and average about 24 percent lower in value compared to the CWCP. The GP1521 and GP2021 options have even lower benefits compared to the GP1528 and GP2028 options, with two potential outcomes presented on the figure. The higher benefits outcome assumes that commercial navigation on the Missouri River remains during the months on either side of the summer low-flow period, and provides benefits that are 31.9 percent lower than the CWCP. The lower benefits outcome assumes that Missouri River navigation is limited to local sand and gravel and

**Table 7.12-1.** Average annual Missouri River navigation benefits (\$millions).

| Alternative | Total       | Sioux City | Omaha | Nebraska City | Kansas City |
|-------------|-------------|------------|-------|---------------|-------------|
| CWCP        | <b>6.97</b> | 0.46       | 1.12  | 0.88          | 4.51        |
| MCP         | <b>6.90</b> | 0.49       | 1.11  | 0.93          | 4.36        |
| GP1528      | <b>5.31</b> | 0.28       | 0.90  | 0.55          | 3.58        |
| GP2021*     | <b>4.75</b> | 0.47       | 0.73  | 0.65          | 2.90        |
| GP2021**    | <b>0.99</b> | 0.08       | 0     | 0.14          | 0.78        |
| GP1521*     | <b>4.82</b> | 0.49       | 0.73  | 0.67          | 2.93        |
| GP1521**    | <b>0.99</b> | 0.08       | 0     | 0.14          | 0.78        |
| GP2028      | <b>5.28</b> | 0.28       | 0.89  | 0.54          | 3.56        |

\* Includes benefits if navigation continues before and after the split season.

\*\* Includes remaining sand/rock benefits if navigation is essentially extinguished; excludes operation and maintenance (O&M) cost adjustments.

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the movement of waterway improvement materials (rock) throughout the normal 8-month navigation season, and these benefits are minimal at \$0.99 million per year.

Figure 7.12-1 also presents the navigation benefits for the submitted alternatives discussed in Chapter 5 on the left side of the bar plot. The BIOP alternative has benefits very similar to the GP2021 and GP1521 options. This is appropriate because all three of the alternatives have the same basic summer flows and drought conservation measures, which result in similar benefits. More specifically, the navigation benefits for the BIOP alternative fall in between the benefits of the two GP options, and the only difference among the three alternatives is the amount of the spring rise. The BIOP spring rise amount is 17.5 kcfs, midway between the spring rise values for the two GP options. The MCP and the CWCP have benefits similar to the MRBA alternative, and this again is appropriate because there is essentially no difference between the MRBA alternative and the MCP in terms of releases from Gavins Point Dam. The MCP has a Fort Peck spring rise and the MRBA alternative does not, which should not affect Gavins Point Dam releases.

The MCP differs from the CWCP in that it has greater conservation during droughts. This difference has very little net impact on the average annual navigation benefits. The total navigation benefits of the MCP are very close to the CWCP at \$6.90 million per year, a decrease of \$0.07 million per year (a 1.0 percent decrease). The MCP values include slight declines for Kansas City (3.3 percent, or \$0.15 million) and Omaha reaches (0.9 percent, or \$0.01 million), and gains in benefits at Sioux City (6.5 percent, or \$0.03 million) and Nebraska City (5.7 percent, or \$0.05 million) reaches compared to the CWCP.

Also considered in this chapter are the four GP options (GP1528, GP2021, GP1521, and GP2028). The GP1528 option serves as the potential starting point for comparison against the MCP because its spring and summer releases are closest to the release during the same timeframe for the CWCP. The other GP options represent the range in changes from GP1528 that could be made under adaptive management without going through the NEPA process again.

The GP1528 option has the conservation features of the MCP and includes a Gavins Point Dam spring rise of 15 kcfs over full service navigation levels during non-drought periods and during the first year

of a drought unless downstream flooding is imminent or occurring. It also provides for a flat release from Gavins Point Dam of 28.5 kcfs from June 21 to August 31, which is 6 kcfs less than the full service release included in the CWCP. The GP1528 option's benefits are \$5.31 million per year, which are \$1.59 million (23.0 percent) lower per year than the benefits for the MCP. This reduction in benefits is due primarily to the reduced summer flows. Benefits decrease in all reaches of between 17.9 and 42.9 percent compared to the MCP benefits.

The GP2021 and GP1521 options have a 25/21-kcfs split season option for summer flows. This includes a 25-kcfs flow from June 21 to July 15, then 21 kcfs from July 16 to August 15, and 25 kcfs again from August 16 to September 1. For these GP options, the impacts are presented for two potential outcomes. The Corps believes these outcomes represent the full range of potential impacts to Missouri River navigation. The first possible outcome to these GP options assumes that commercial navigation on the Missouri River remains intact during the months on either side of the summer low-flow period. The second possible outcome assumes that other modes of transportation would be used to move the commodities and Missouri River navigation is limited to local sand and gravel mining and the movement of waterway improvement materials throughout the normal 8-month navigation season. The GP2021 option's potential navigation benefits range from a low of \$0.99 million to a high of \$4.75 million per year. If the GP1528 option were selected sometime in the future, these benefits represent a reduction in total benefits of between 10.5 and 81.4 percent compared to the benefits for the GP1528 option. The benefits increase in the Sioux City and Nebraska City reaches by 67.9 and 18.2 percent, respectively; however, they decrease in the Omaha and Kansas City reaches by 18.9 and 19.0 percent, respectively. Similar responses occur for the GP1521 option with the total percentage changes from the benefits of the GP1528 option being a decrease of 9.2 percent and the individual reach changes being within a few percent of those changes for the GP2021 option.

The GP2028 option is the same as the GP1528 option except that it has an increased Gavins Point Dam spring rise of 20 kcfs. The benefits of this option are \$5.28 million per year, virtually the same as for the GP1528 option (only a 1.0 percent difference). The changes in the individual reaches from the values for the GP1528 option range from no change to a decrease of 1.8 percent.

Table 7.12-2 summarizes navigation service level and season length expressed in years for the

**Table 7.12-2.** Summary of navigation service level and season length data (years).

| 1898 to 1997         | CWCP | MCP | GP1528 | GP2021 | GP1521 | GP2028 |
|----------------------|------|-----|--------|--------|--------|--------|
| <b>Service Level</b> |      |     |        |        |        |        |
| <b>March Check</b>   |      |     |        |        |        |        |
| Full                 | 56   | 63  | 68     | 68     | 69     | 67     |
| Partial              | 24   | 25  | 18     | 19     | 19     | 19     |
| Minimum              | 19   | 7   | 8      | 8      | 7      | 8      |
| No Service           | 1    | 5   | 6      | 5      | 5      | 6      |
| <b>July Check</b>    |      |     |        |        |        |        |
| Full                 | 59   | 60  | 0      | 63     | 65     | 0      |
| Partial              | 16   | 27  | 0      | 23     | 22     | 0      |
| Minimum              | 24   | 8   | 94*    | 9      | 8      | 94*    |
| No Service           | 1    | 5   | 6      | 5      | 5      | 6      |
| <b>Season Length</b> |      |     |        |        |        |        |
| 5.5 to < 6 Months    | 5    | 0   | 0      | 95     | 95     | 0      |
| 6.0 to < 6.5 Months  | 2    | 0   | 0      | 0      | 0      | 0      |
| 6.5 to < 7.0 Months  | 1    | 0   | 0      | 0      | 0      | 0      |
| 7.0 to < 7.5 Months  | 0    | 35  | 30     | 0      | 0      | 30     |
| 7.5 to < 8 Months    | 0    | 0   | 0      | 0      | 0      | 0      |
| 8 Months             | 45   | 10  | 11     | 0      | 0      | 11     |
| 8.33 Months          | 46   | 50  | 53     | 0      | 0      | 53     |

\* Does not reflect that the service level will go back up to partial or full service on 1 September in all but six of those years. The service level increased in 88 of those years.

alternatives discussed in this chapter. Operation of the Missouri River Mainstem Reservoir System for navigation includes two check points for determining navigation service level and season length: the March 15 check and the July 1 check. Navigation service levels can range from full service to minimum service (6 kcfs less than full service). Navigation season length can range from 5.5 to 8.33 months. In addition, navigation support is suspended in years where the system storage falls below the navigation preclude level (31 MAF).

The CWCP provides full or partial service for 80 and 75 years for the March 15 and July 1 checks, respectively, and only one no service year (1937) for the 100-year period of analysis. Note that navigation service levels of full service to minimum service represent a difference of 1 foot of draft (8.5 versus 7.5 feet). Under the CWCP, navigation season length can range from 5.5 to 8.33 months. The CWCP has 91 years where the season length is 8 months or longer out of the 99 years that navigation was possible. This is markedly greater than the other alternatives.

The MCP differs from the CWCP in that it has greater conservation during droughts. The navigation service levels remain higher throughout the droughts compared to the CWCP by limiting

the reduction in service by only 3 kcfs in many years. A cutback to minimum service occurs in a relatively few years (generally about 6) when there is no gain in the amount of water in system storage between the two checks. To offset the extra water used for the higher service levels, the navigation season length was cut at the same storage level as the cutback was made to service level, the top of the CWCP navigation guide curves for both checks. The resulting conservation is also reflected in more 7.0- to 7.5-month navigation seasons compared to the CWCP (Table 7.12.2), but fewer navigation seasons of 8-months or greater. The minimum season length for the MCP is 7.1 months instead of declining like the CWCP to as little as 5.5 months during the 1930 to 1941 drought.

The GP1528 option has the conservation attributes of the MCP and includes a Gavins Point Dam spring rise of 15 kcfs over full service navigation levels during many non-drought years and during the first year of the three extended droughts, unless downstream flooding is imminent or occurring. It also provides for a flat release from Gavins Point Dam of 28.5 kcfs from June 21 to August 31, which is 6 kcfs less than the full service release included in the CWCP and 3 kcfs less than allowed in the remainder of the navigation season in many drought years. At the

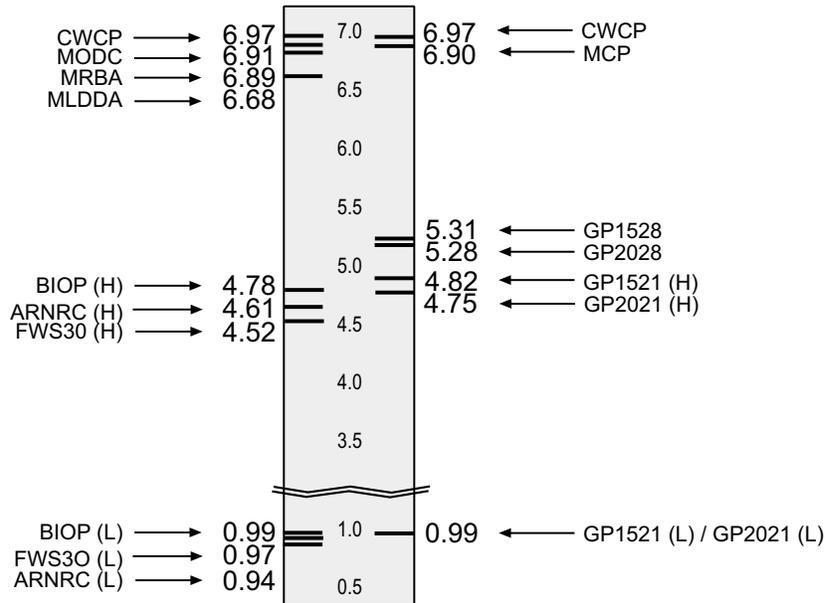
March 15 check, there are 5 more years with full service than with the MCP, bringing the years of full service at the March check to 68 of the 100 years studied. Compared to the MCP, the GP1528 option provides for 86 full service or partial service years, while the MCP provides for 88 years. The summer low flow in the GP1528 option results in having no years with full or partial service at the July 1 check compared to 87 years for the MCP. This does not reflect the fact that flows will bump back up 3 kcfs to partial service or 6 kcfs to the full service level on September 1 in 88 of those 94 years listed as minimum service in the table. This alternative has 4 more years with navigation season length that is greater than 8 months long for GP1528 (64 years compared to 60 years for the MCP). The minimum navigation season is 7.1 months, the same as the MCP.

For the GP2021 option, the navigation service levels at the March check are virtually the same as GP1528, but the July 1 check shows 86 years with full or partial service compared to none for the GP1528 option. As discussed above, this is misleading because the service level increases on September 1 in 88 of the 94 years. There are 5 years with no service, which is similar to the GP1528 option. The split season results in shorter navigation season lengths. The GP2021 option has a season length of only 5.5 to 6 months in all 95 years with service, compared to 64 years with at

least 8 months of service in the GP1528 option. Similar results occur for the GP1521 option as occurred in GP2021. The navigation season ends November 23 in drought years.

The navigation service levels and season length are virtually the same for the GP2028 option as they are for the GP1528 option. The additional release of 5 kcfs in the spring rise does not have a significant effect on service level and season length.

Annual benefits for the 100-year simulation period for the CWCP and the submitted alternatives are shown in Figures 7.12-2 to 7.12-6. These figures show that the most noticeable difference among the alternatives occurs in the non-drought periods. This indicates that the service that is provided during the mid-June through August timeframe is the factor that causes the differences among the alternatives. The change to the 25/21-kcfs summer split has a more noticeable effect than the reduction to minimum navigation service in the same timeframe. There are less dramatic differences during the three major droughts, with the differences in the 1930 to 1941 drought being the greatest of the three. Annual benefits are essentially the same in every year for the GP2021 and GP1521 options for the lower benefits assumption.



(H) Includes benefits if navigation continues before and after the split season.  
 (L) Includes remaining sand/rock benefits if navigation is essentially extinguished.

**Figure 7.12-1.** Average annual navigation benefits for submitted alternatives and the alternatives (\$millions).

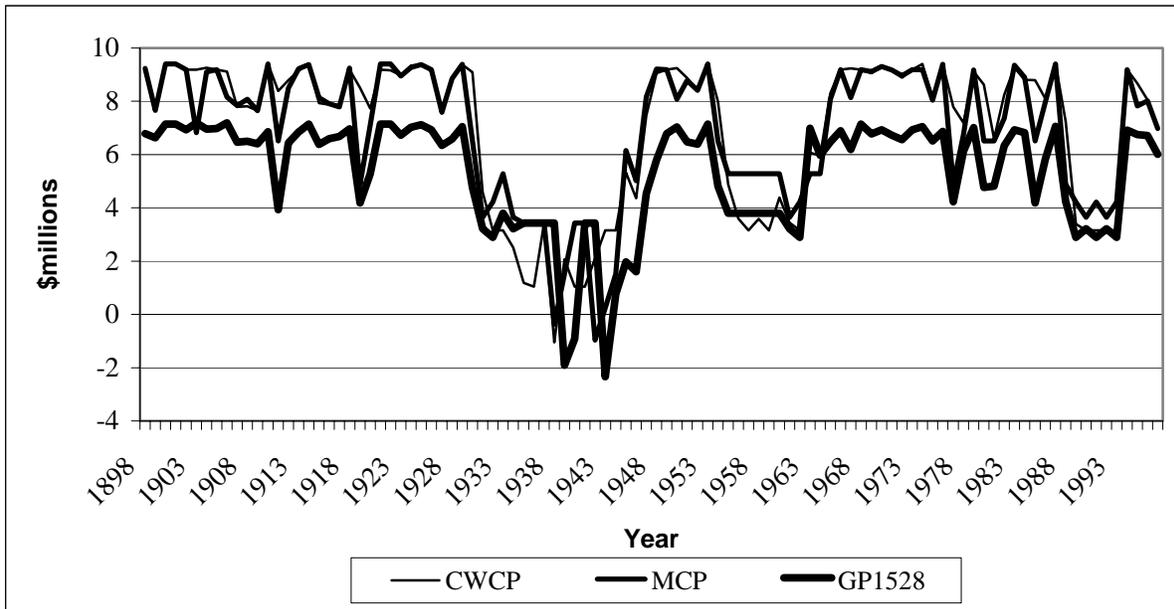
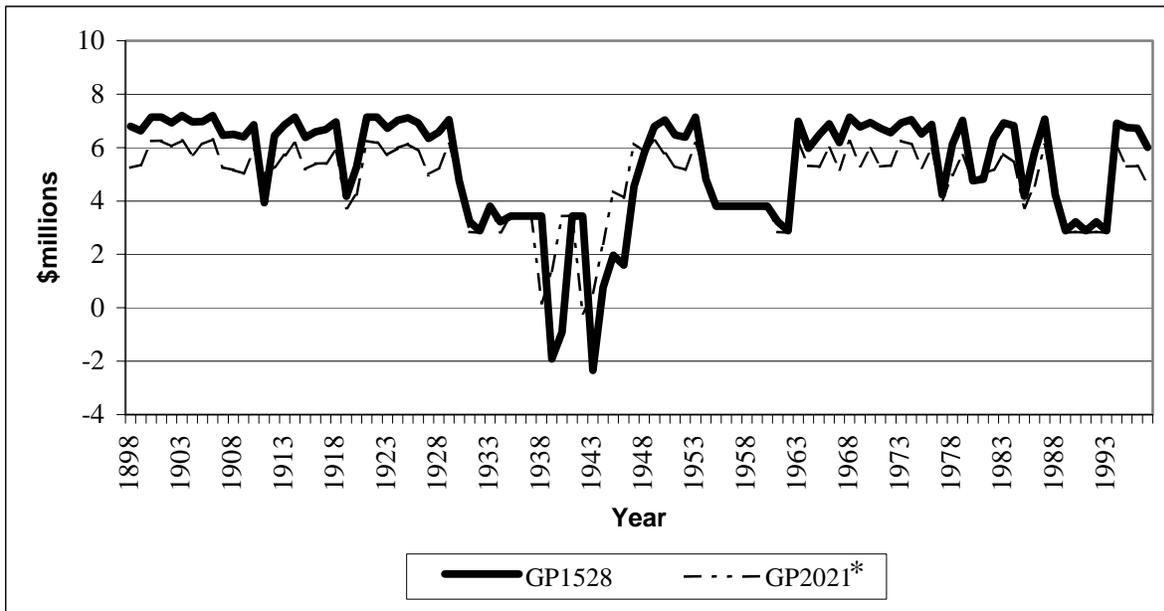
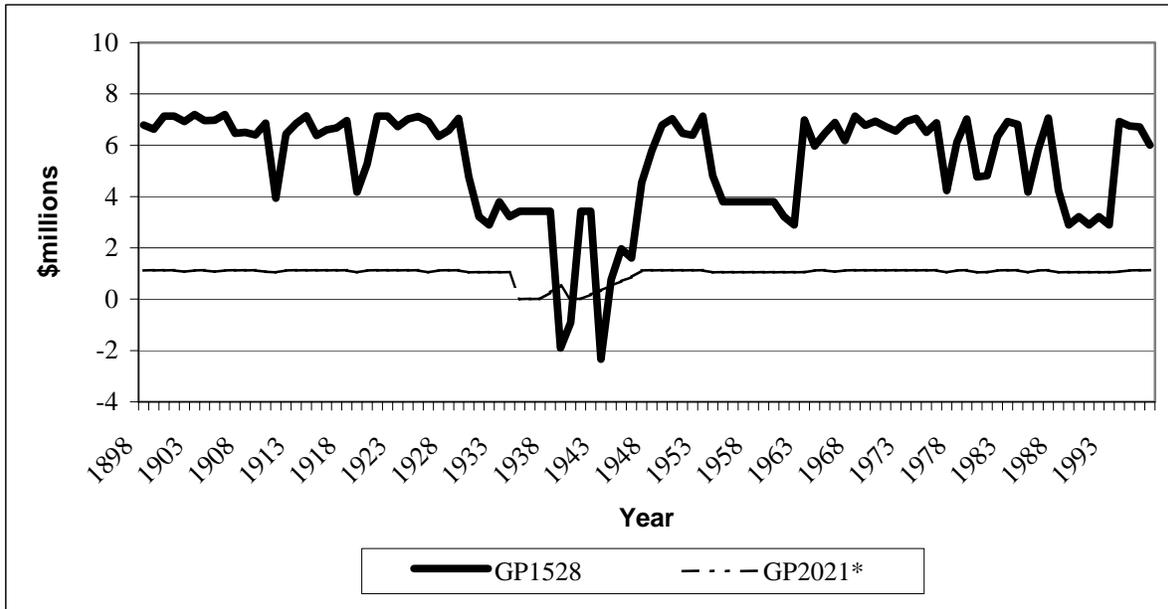


Figure 7.12-2. Average annual Missouri River navigation benefits for CWCP, MCP, and GP1528.



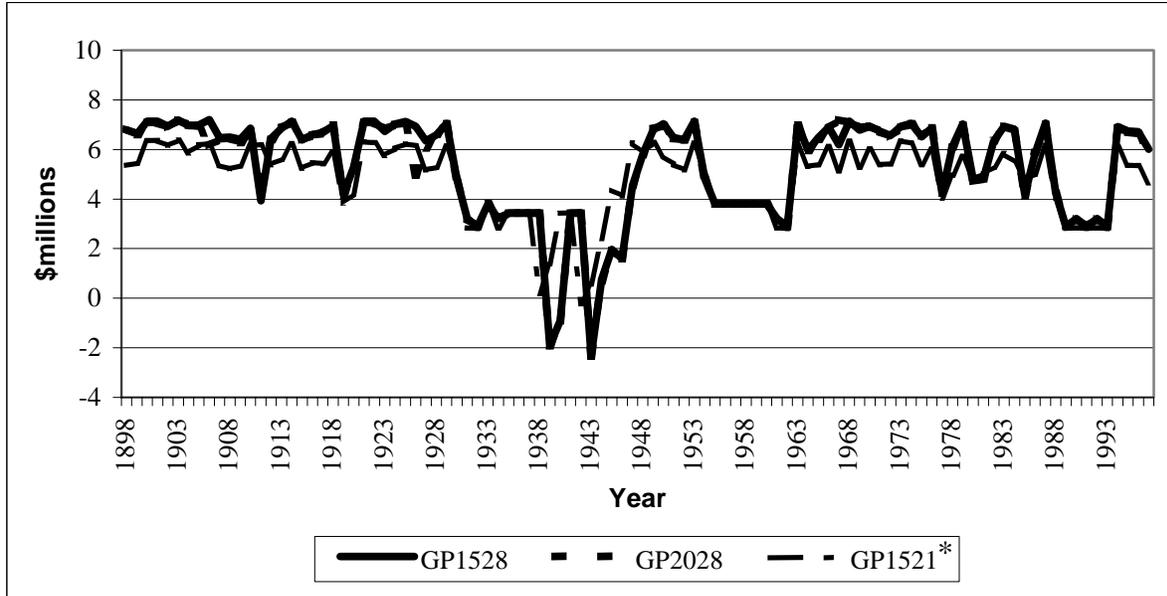
\*Includes benefits if navigation continues before and after the split season.

Figure 7.12-3. Average annual Missouri River navigation benefits for GP1528 and GP2021.



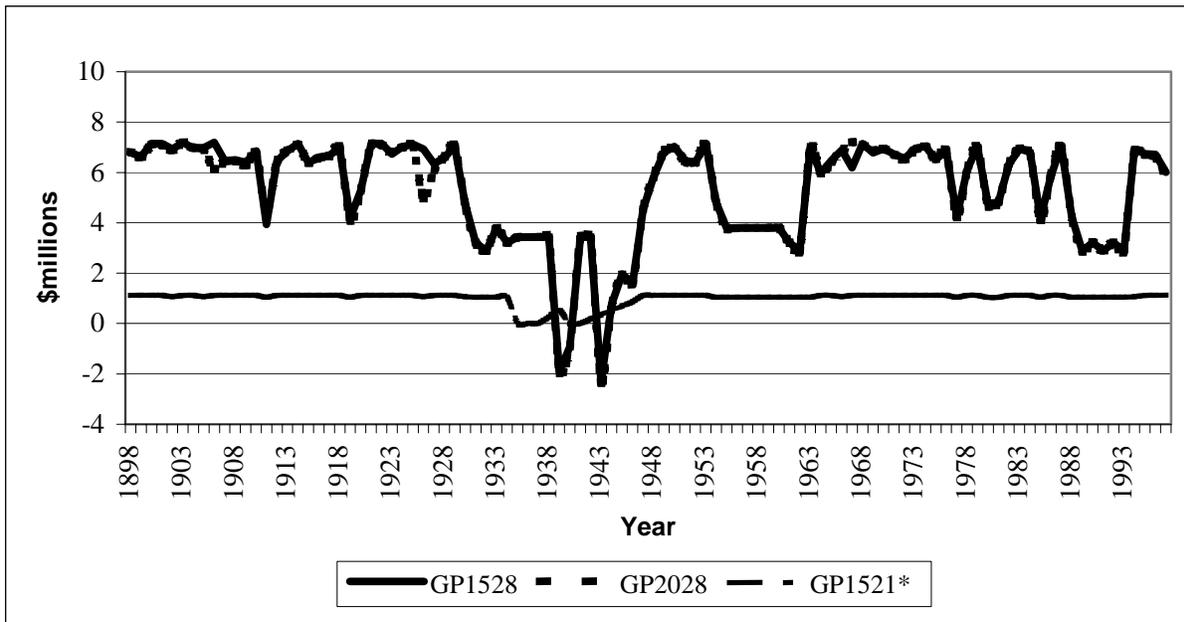
\*Includes remaining sand/rock benefits if navigation is essentially extinguished.

**Figure 7.12-4.** Average annual Missouri River navigation benefits for GP1528 and GP2021.



\* Includes benefits if navigation continues before and after the split season.

**Figure 7.12-5.** Average annual Missouri River navigation benefits for GP1528, GP2028, and GP1521.



\*Includes remaining sand/rock benefits if navigation is essentially extinguished.

**Figure 7.12-6.** Average annual Missouri River navigation benefits for GP1528, GP2028, and GP1521.

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