Missouri River Recovery Management Plan and Environmental Impact Statement

Recreation
Environmental Consequences Analysis

Technical Report

August 2018

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Acronyms and Abbreviations

AIC	Akaike Information Criteria
BiOp	2003 Amended Biological Opinion
cfs	cubic feet per second
EGM	Economic Guidance Memorandum
EIS	environmental impact statement
EQ	environmental quality
ER	Engineering Regulation
ESA	Endangered Species Act
ESH	emergent sandbar habitat
GDP	gross domestic product
H&H	hydrologic and hydraulic (Model)
HC	human considerations
HEC-RAS	Hydrologic Engineering Center - River Analysis System
HEC-ResSim	Hydrologic Engineering Center - Reservoir System Simulation
MRRMP-EIS	Missouri River Recovery Management Plan and Environmental Impact Statement
MRRP	Missouri River Recovery Program
NED	national economic development
OHV	off-highway vehicle
OMBIL	Operations and Maintenance Business Information Link
OMRR&R	operation, maintenance, repair, replacement, and rehabilitation
OSE	other social effects
P&G	1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
POR	period of record
RECONS	Regional Economic System
RED	regional economic development
RPA	reasonable and prudent alternative
RR&R	repair, replacement, and rehabilitation
TCM	travel cost method
UDV	unit day value
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VERS	Visitation Estimating and Reporting System
VIF	variable inflation factor

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1.0 Introduction

The Kansas City and Omaha Districts of the U.S. Army Corps of Engineers (USACE), in cooperation with the U.S. Fish and Wildlife Service (USFWS), have developed the Missouri River Recovery Management Plan and Environmental Impact Statement (MRRMP-EIS). The purpose of the MRRMP-EIS is to develop a suite of actions that meets Endangered Species Act (ESA) responsibilities for the piping plover, the interior least tern, and the pallid sturgeon.

The purpose of the Recreation Environmental Consequences Analysis Technical Report is to provide supplemental information on the recreation analysis and results to the information presented in the MRRMP-EIS. Additional details on the National Economic Development (NED) and Regional Economic Development (RED) methodology and results are provided in this report. The Other Social Effects (OSE) impacts are presented in the MRRMP-EIS, Chapter 3, Recreation, Environmental Consequences section. No Environmental Quality (EQ) analysis was undertaken for Recreation.

1.1 Summary of Alternatives

The MRRMP-EIS evaluates the following alternatives. A detailed description of the alternatives is provided in Chapter 2 of the MRRMP-EIS.

- **Alternative 1 – No Action.** This is the No Action alternative, in which the Missouri River Recovery Program (MRRP) would continue to be implemented as it is currently, including a number of management actions associated with the MRRP and 2003 Amended Biological Opinion (BiOp) compliance. Management actions under Alternative 1 include creation of early life stage habitat for the pallid sturgeon and emergent sandbar habitat (ESH), as well as a spring pulse for pallid sturgeon. The construction of habitat would be focused in the Garrison and Gavins reaches for ESH (an average rate of 164 acres per year) and between Ponca to the mouth near St. Louis for pallid sturgeon early life stage habitat (3,999 additional acres constructed).
- **Alternative 2 – USFWS 2003 Biological Opinion Projected Actions.** This alternative represents the USFWS interpretation of the management actions that would be implemented as part of the 2003 Amended BiOp Reasonable and Prudent Alternative (RPA) (USFWS 2003). Whereas Alternative 1 only includes the continuation of management actions USACE has implemented to date for BiOp compliance, Alternative 2 includes additional iterative actions and expected actions that the USFWS anticipates would ultimately be implemented through adaptive management and as impediments to implementation were removed. Considerably more early life stage habitat (10,758 additional acres constructed) and ESH (an average rate of 1,331 acres per year) would be constructed under Alternative 2 than under Alternative 1. In addition, a spring pallid sturgeon flow release would be implemented every year if specific conditions were met. Alternative 2 would also modify System operations to allow for summer flows that are sufficiently low to provide for early life stage habitat as rearing, refugia, and foraging areas for larval, juvenile, and adult pallid sturgeon.
- **Alternative 3 – Mechanical Construction.** The USACE would mechanically construct ESH at an average rate of 332 acres per year distributed between the Garrison, Fort Randall, and Gavins Point Reaches. This amount represents the acreage necessary to meet the bird habitat targets after accounting for available ESH resulting from system operations. The average annual construction amount includes replacing ESH lost to

erosion and vegetative growth, as well as constructing new ESH. An estimated 3,380 acres of early life stage habitat for the pallid sturgeon would be constructed under Alternative 3. There would not be any reoccurring flow releases or pulses implemented under this alternative; however, should new information be learned through Level 1 and 2 studies over the next 9 years suggesting that spring discharges result in stronger aggregation of adult pallid sturgeon at spawning locations or increased reproductive success, a one-time spawning cue test could be implemented to provide additional information to support or refute this hypothesis. At the present time, it is assumed the test release would be similar to the timing, magnitude, duration, and pattern of the spawning cue included as a recurring release under Alternative 6.

- **Alternative 4 – Spring ESH Creating Release.** The USACE would mechanically construct ESH annually at an average rate of 195 acres per year distributed between the Garrison, Fort Randall, and Gavins Point Reaches. This amount represents the acreage necessary to meet the bird habitat targets after accounting for available ESH resulting from implementation of an ESH-creating reservoir release in the spring. Alternative 4 would be similar to Alternative 1 (the No Action alternative), with the addition of a spring release designed to create ESH for the least tern and piping plover. An estimated 3,380 acres of early life stage habitat for the pallid sturgeon would be constructed under Alternative 4.
- **Alternative 5 – Fall ESH Creating Release.** The USACE would mechanically construct ESH annually at an average rate of 253 acres per year distributed between the Garrison, Fort Randall, and Gavins Point Reaches. This amount represents the acreage necessary to meet the bird habitat targets after accounting for available ESH resulting from implementation of an ESH-creating reservoir release in the fall. Alternative 5 is similar to Alternative 1 (the No Action alternative), with the addition of a release in the fall designed to create sandbar habitat for the least tern and piping plover. An estimated 3,380 acres of early life stage habitat for the pallid sturgeon would be constructed under Alternative 5.
- **Alternative 6 – Pallid Sturgeon Spawning Cue.** The USACE would mechanically construct ESH annually at an average rate of 245 acres per year distributed between the Garrison, Fort Randall, and Gavins Point Reaches. In addition, the USACE would attempt a spawning cue pulse every three years in March and May. These spawning cue pulses would not be started and/or would be terminated whenever flood targets are exceeded. An estimated 3,380 acres of early life stage habitat for the pallid sturgeon would be constructed under Alternative 6.

1.2 USACE Planning Accounts

Alternative means of achieving species objectives were evaluated including consideration for the effects of each action or alternative on a wide range of human considerations (HC). Human considerations to be evaluated in the MRRMP-EIS alternatives are rooted in the economic, social, and cultural values associated with the natural resources of the Missouri River. The HC effects evaluated in the MRRMP-EIS are required under the National Environmental Policy Act and its implementing regulations (40 CFR Parts 1500–1508). The 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) also served as the central guiding regulation for the economic and environmental analysis included within the MRRMP-EIS. Further guidance that is specific to USACE is described in Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, which provides the overall direction by which USACE Civil Works projects are formulated,

evaluated, and selected for implementation. These guidance documents describe four accounts that were established to facilitate evaluation and display the effects of alternative plans:

- The NED account displays changes in the economic value of the national output of goods and services expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation.
- The RED account registers changes in the distribution of regional economic activity (i.e., jobs and income).
- The EQ account displays non-monetary effect of significant natural and cultural resources.
- The OSE account registers plan effects from perspective that are relevant to the planning process, but are not reflected in the other three accounts. In a general sense, OSE refers to how the constituents of life that influence personal and group definitions of satisfaction, well-being, and happiness are affected by some condition or proposed intervention.

The accounts framework enables consideration of a range of both monetary and non-monetary values and interests that are expressed as important to stakeholders, while ensuring impacts are not double counted. The USACE planning accounts evaluated for recreation include NED, RED, and OSE.

1.3 Approach for Evaluating Environmental Consequences of the MRRMP-EIS

The Missouri River and its surrounding floodplain support a wide range of recreational activities. These include both land and water-based activities, such as camping; swimming; floating; boating; sightseeing; picnicking; hiking; fishing; and hunting. The environmental consequences evaluation to recreational opportunities and experiences as a result of the MRRMP-EIS alternatives requires an understanding of how the physical conditions of the river would change under each of the MRRMP-EIS alternatives. The conceptual flow chart shown in Figure 1 demonstrates, in a stepwise manner, how changes in the physical conditions of the Missouri River and its floodplain can impact recreation along the river.

The recreation analysis assessed how changes in physical river and reservoir conditions under the MRRMP-EIS alternatives would affect visitation over the period of record (POR) between 1931 and 2012. The estimated changes in visitation for the river reaches and the lower three reservoirs were evaluated based on boat ramp operability. For the upper three reservoirs, multiple regressions were undertaken to identify the best explanatory variables and to estimate annual visitation at the reservoirs under the MRRMP-EIS alternatives. The results of this analysis served as inputs in the NED, RED, and OSE evaluations. The NED evaluation also examined how changes in river stages and reservoir elevations under the MRRMP-EIS alternatives would affect operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs of maintaining access to recreation facilities, and how changes in the prevalence of ESH and early life stage habitat for the pallid sturgeon would affect the quality of recreational experiences along the river. Figure 2 shows the overall approach used to evaluate the environmental consequences to recreation from MRRMP-EIS alternatives. The analysis included a series of steps described below, which are further described in Section 2.0.

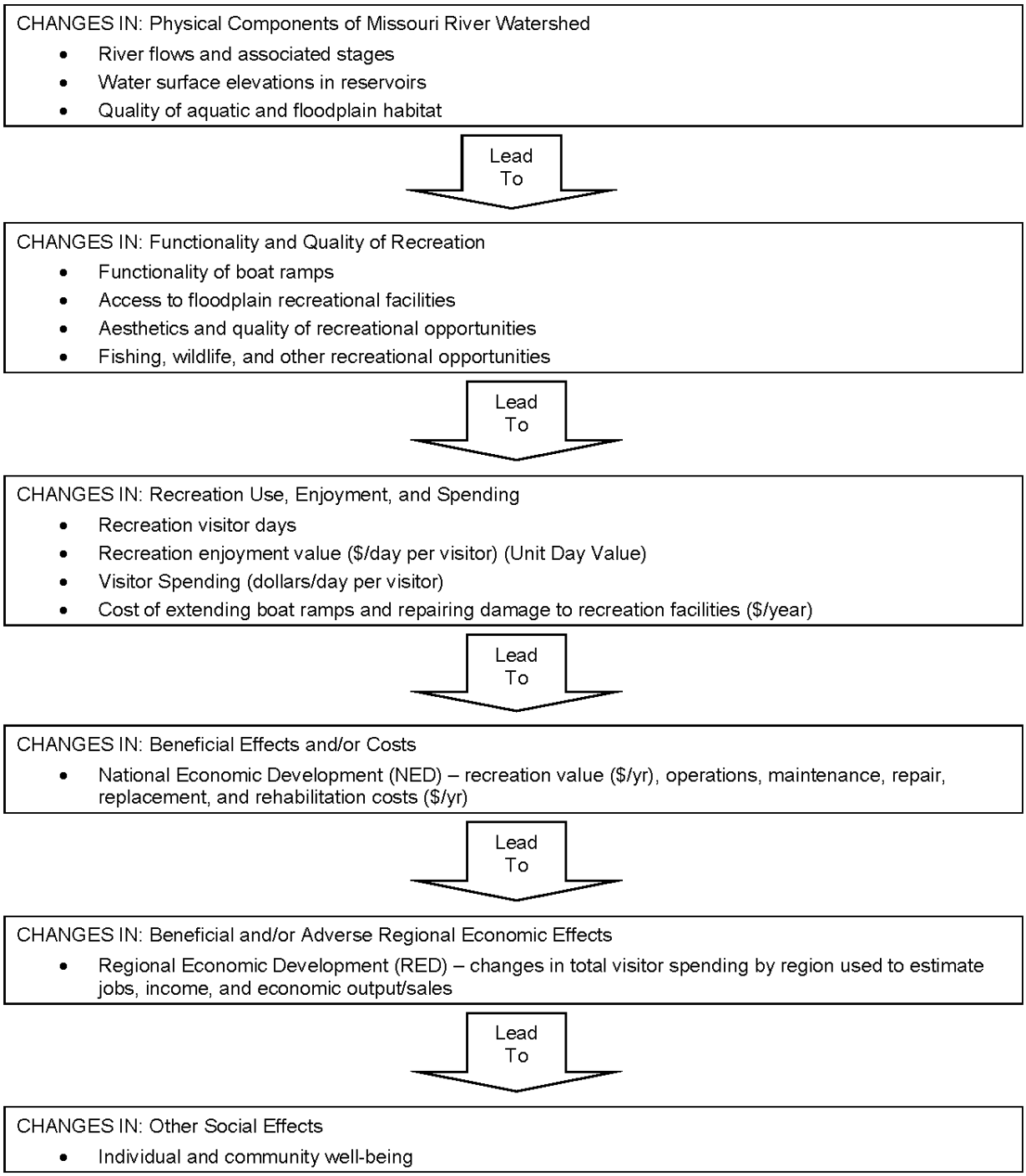

Figure 1. Flow Chart of Inputs Considered in Recreation Evaluation

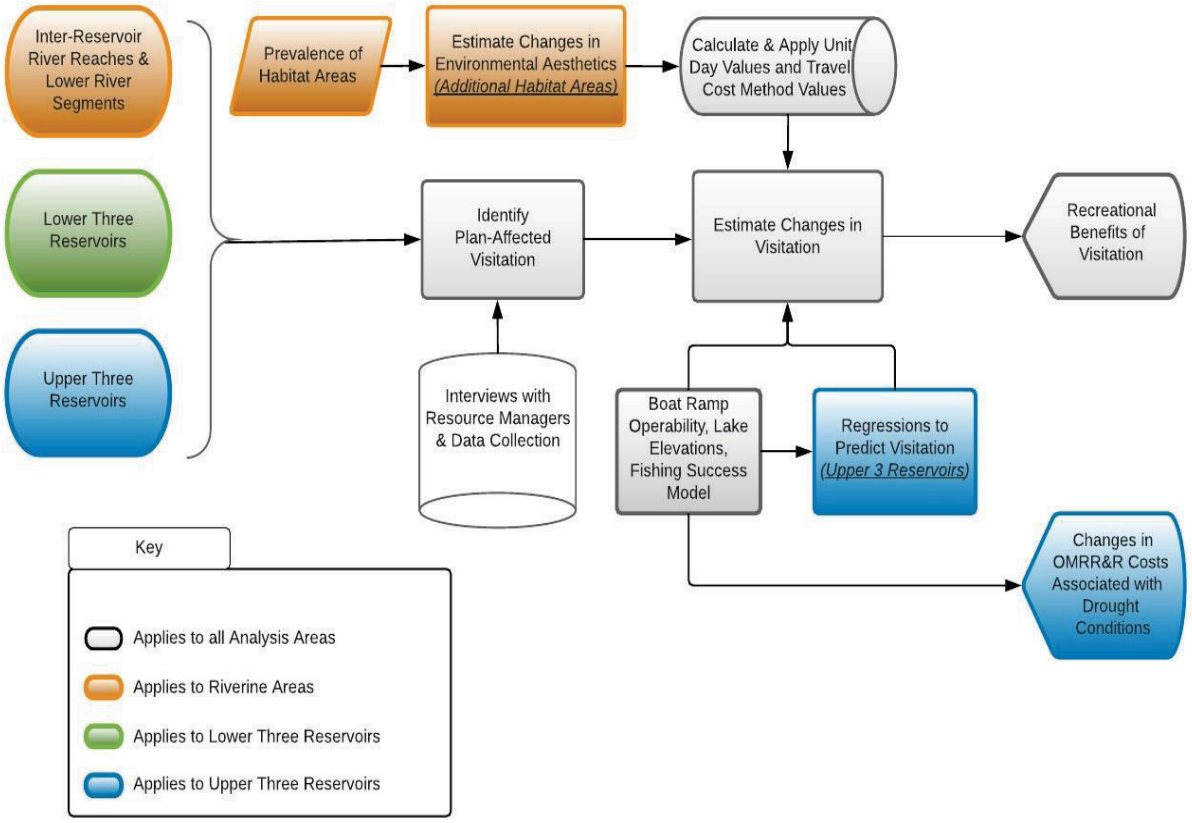

Figure 2. Process to Evaluate the Impacts to Recreation

2.0 Methodology and Assumptions

The methodology includes a summary of assumptions and risk and uncertainty considerations. The initial step in the process, evaluating the relationship between river conditions and recreational opportunities and experiences, is then described, as well as the subsequent steps to assess the NED, RED, and OSE impacts.

2.1 Assumptions

In modeling the environmental consequences to recreation from the MRRMP-EIS alternatives, the project team established a set of assumptions, which are described below.

- The analysis uses data from the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) and Reservoir Simulation (HEC-ResSim) of the river and reservoir system. The analysis assumes that the HEC-RAS models reasonably estimate river flows and reservoir levels over the 82-year POR under each of the MRRMP-EIS alternatives as well as Alternative 1 (the No Action alternative).
- Repair, replacement, and rehabilitation costs would occur at the upper three reservoirs and are estimated based on capital costs to maintain access to the reservoirs during the drought conditions of the 2000s.

- It is assumed that the creation of early life stage habitat would improve the value of the recreational experience but would not induce new visitors to the area, which is based on information provided by recreation area managers.
- Baseline visitation data was used from a number of sources and is assumed to represent accurate visitation to the river and reservoirs.
- It is assumed that the boat ramp operability is an indicator of plan-affected visitation. Visitation is assumed to be proportionally impacted depending on the operability of boat ramps in the river reaches, lower three reservoirs, and winter visitation at all reservoirs.
- Recreation in the Oahe Dam to Lake Sharpe river reach is not evaluated because of stable pool elevations at Lake Sharpe and no HEC-RAS modeling results for the river reach.

2.2 Risk and Uncertainty

Risk and uncertainty are inherent with any model that is developed and used for water resource planning. Much of the risk and uncertainty with the overall MRRMP-EIS is associated with the operation of the Missouri River system and the extent to which flows and reservoir levels will mimic conditions that have occurred over the 82-year POR. Unforeseen events such as climate change and weather patterns may cause river and reservoir conditions to change in the future and would not be captured by the HEC-RAS models or carried through to the recreation model described is this document. The project team has attempted to address risk and uncertainty in the MRRMP-EIS by defining and evaluating a reasonable range of plan alternatives that include an array of management actions within an adaptive management framework for the Missouri River. All of the alternatives were modeled to estimate impacts to recreation along the Missouri River.

A source of uncertainty associated with the recreation analysis is predicting how visitors would react to changes in river and reservoir conditions. The project team has utilized information from interviews with recreation, wildlife, and natural resource management specialists along the river to assess how adverse effects would affect recreation use. It may be possible that prolonged adverse river or reservoir conditions may have long-term impacts to visitation and associated businesses that support visitors, especially in the upper three reservoirs where drought conditions have adverse impacts to recreation.

2.3 Evaluation of River and Reservoir Conditions for Recreation

The purpose of this analysis is to link hydraulic and hydrologic (H&H) modeling efforts, which simulate river operations of the Missouri River under each of the MRRMP-EIS alternatives, with the economic analysis necessary to estimate the consequences to recreation. Specialized software was used to simulate river and reservoir operations for planning studies and decision support developed by the Institute for Water Resources, Hydrologic Engineering Center. HEC-RAS and HEC-ResSim models were used to provide a profile of river conditions at locations that approximately correspond to recreational areas within river reaches and Mainstem reservoirs. The analysis used Microsoft Excel® to evaluate potential effects of changes in river flows, river stages, and reservoir elevations on recreation visitation, as well, as recreation impacts associated with habitat creation under the MRRMP-EIS alternatives.

2.3.1 Boat Ramp Operability

Visitation to the Missouri River is influenced in part on the accessibility of boat ramps at the reservoirs, riverine areas between the reservoirs, and the lower river segments below Gavins Point Dam. Thus, boat ramp operability can be an indicator for river and reservoir access. An Excel®-based model was developed to estimate how often boat ramps would be accessible based on the top and bottom operating elevations of boat ramps relative to the river stages and reservoir pool elevations modeled for different flow regimes under the MRRMP-EIS alternatives. When flows or reservoir elevations are above the boat ramp operating elevations, the water levels may be too high for the boat ramps to be accessible. Similarly, when river stages and reservoir elevations are below the operating elevations, access to the river and reservoirs decreases as launches from boat ramps become more difficult. The “operable” condition is defined as the number of total days when the river stages or reservoir elevations are between the top and bottom operating elevation of the boat ramp. At the upper three reservoirs, there are both “normal water” and “low-water” boat ramps. “Normal water” ramps were used to assess boat ramp operability impacts on the reservoirs, while the elevations of the “low water” boat ramps were used to assess the capital costs to repair or replace ramps during drought conditions (OMRR&R costs).

Boat ramp data, including the river mile for boat ramps, longitude and latitude coordinates, and top and bottom elevations was provided by the USACE Kansas City and Omaha Districts as well as various state and local governments. A list of the sources contacted to obtain boat ramp data is provided at the end of this document (See Appendix: Data Sources for Boat Ramps). The number of boat ramps with useable data for each of the reservoirs and river reaches is provided in Table 1.

Table 1. Number of Total Boat Ramps in the Recreation Analysis

Reservoir or River Reach	Number of Boat Ramps
Fort Peck Lake	21
Fort Peck Dam to Lake Sakakawea	7
Lake Sakakawea	87
Garrison Dam to Lake Oahe	8
Lake Oahe	68
Oahe Dam to Lake Sharpe	0
Lake Sharpe	6
Lake Francis Case	21
Randall Dam to Lewis and Clark Lake	1
Lewis and Clark Lake	7
Total Boat Ramps	226

Source: Please see Appendix A of this Report, Data Sources for Boat Ramps

The bottom elevation of the ramp was assumed to be the lowest engineered elevation of the ramp. Minimum operating boat ramp elevations need to account for the draft of boat, the vertical distance between the waterline and the bottom of the hull of the boat. The approximate draft of a typical boat on the Missouri River was estimated to be 3 feet (Peak pers. comm. 2014). Therefore, the bottom engineered elevation of each boat ramp was increased by 3 feet to

estimate the bottom operating elevation of the boat ramp. There were a few instances (less than one percent), where the top and bottom elevations of the boat ramps were less than 3 feet apart. In these cases, engineered bottom elevation of the ramp was used.

Two seasons were defined for the evaluation as: 1) spring, summer, and fall; and 2) winter. The seasons were defined from information obtained from natural resource managers at the reservoirs and other recreation area managers. For the geographic locations above Gavins Point Dam, the spring, summer, and fall was defined as between April 1st and November 30th, and the winter season occurs between December 1st and March 31st. In the lower portion of the Missouri River below Gavins Point Dam, the spring, summer, and fall season begins on April 1st and ends on December 30th, while the winter season beings on January 1st and ends on March 31st. In addition, because much of the visitation data was only available on an annual basis, the spring, summer, and fall season was defined broadly to include most of the peak season visitors.

Some boat ramps were identified as being used in the winter to access frozen reservoirs, primarily for ice fishing. In the winter, when the lake is frozen, boat ramps can be used when the lake falls to the bottom of the engineered elevation of the ramp. In some cases, visitors in the winter can access the lakes through the shore and without the use the boat ramps; however, when lake elevations fall, there are longer distances to travel to the lakes and other impediments to access (i.e., snow fields, etc.) which can limit access during these conditions. The project team worked with recreation specialists to identify which boat ramps on the reservoirs were used for winter recreation (Longhenry pers. comm. 2015a). The bottom engineered elevations of these normal boat ramps were used to estimate impacts to visitation in the winter season.

The analysis of boat ramp operability used an Excel®-based model to compare the top and bottom operating elevations of 226 boat ramps to the daily stage of the river in the cross section closest to each boat ramp. The model calculated the number of days that river stages at a ramp were within the top and bottom operating elevations or “operable” during each season.

2.3.2 Mid-August Water Elevations

Mid-August reservoir elevations are an important variable used to predict visitation at the upper three reservoirs (Chipps and Fincel 2015) because they are an indicator for lake access as well as the quality of fishing opportunities. Reservoir elevations in the upper three reservoirs can vary depending on the natural hydrologic cycles while the reservoir elevations at the lower three reservoirs remain relatively stable. Generally, with lower lake elevations at the upper three reservoirs, there can be issues with accessing lakes from the boat ramps and fishing opportunities are diminished. Conversely, higher reservoir elevations support greater lake access, increasing fishing and of other visitation at the lakes. Research on fishing pressure (also known as angler effort) in Lake Oahe and Lake Sakakawea has shown that in addition to biological variables (such as the abundance of rainbow smelt and walleye), reservoir elevations are an important variable in predicting angler effort (often measured in angler hours for the summer season). The pool elevations from the H&H data at the upper three reservoirs were used in an Excel®-based model to estimate mid-August water elevations by averaging lake elevations between August 12 and 18 each year over the POR; these dates were based on three days before and three days after August 15.

2.3.3 Fishing Success

A fishing success metric was estimated for the three upper reservoirs with input from the state fisheries biologists. The pool elevations at the upper three reservoirs fluctuate more than those of the lower three reservoirs and reservoir elevations can have a large impact on the health of the fishery as well as fishing success for anglers. A rising pool in the spring is important for habitat for spawning and nutrient productivity, both of which improve sport fishing at the reservoirs. State agencies have fisheries management guidelines on the upper three reservoirs that include recommendations for minimum lake elevation changes and spring reservoir elevation increases to support the fisheries, fish and spawning habitat, and nutrient productivity. Fisheries biologists have indicated that to sustain good to improved fishing in the reservoir in the current summer, the reservoir should rise at least once in the current spring and the past two consecutive springs (Longhenry pers. comm. 2015b; Fincel pers. comm. 2014; Fryda pers. comm. 2015). In addition, fishing success also occurs when the fishery is in a healthy state and the pool drops, often at the onset of a drought, concentrating the fish.

The fishing success analysis was developed with the H&H data for reservoir elevations. The elevation data from the upper three reservoirs was used to identify years during the spring season when the reservoir rose by at least the specified amount (specified in the fisheries management plans: North Dakota Game and Fish 2015; Montana Fish Wildlife and Parks 2011), but also did not fall by more than 0.2 feet per day during the season. These successful spring pool rise years were then analyzed further, to identify whether the spring rising reservoir criteria is met at least one time during the current spring and two previous springs prior to a given recreational season.

An additional analysis was undertaken to include the fishing success metric being met when reservoir pool elevations decrease (often at the onset of a drought) when the fishery in the lakes are in good condition, which can concentrate fish in the reservoirs, improving fishing success. When reservoirs are dropping, there are fewer nutrients coming into the reservoirs and lower pool elevations concentrate fish, resulting in higher catch rates for anglers. However, sustained decreases in pool elevations (i.e., drought conditions) for more than two years will result in reduced fishing success. Working with the fisheries biologists, the project team developed criteria to capture both the rising spring pools and the improved fishing success at the initial onset of drought (Longhenry pers. comm. 2015b; Fincel pers. comm. 2015; Fincel pers. comm. 2014).

2.3.4 Habitat Areas

The creation of emergent sandbar habitat and early life stage habitat for the pallid sturgeon, through flows or by mechanical means, has the potential to enhance the aesthetics and quality of recreational opportunities, while providing additional opportunities for low density recreation on or around newly created sandbar habitat areas. Changes in the prevalence of ESH and early life stage habitat for the pallid sturgeon in the lower river and in the inter-reservoir river reaches between Garrison and Fort Randall dams were estimated based on the target number of habitat acres created by the end of the planning period under the MRRMP-EIS alternatives, as described in Chapter 2.

2.4 National Economic Development

National Economic Development (NED) effects are defined as changes in the net value of the national output of goods and services, expressed in monetary units. NED effects are the direct

net benefits (total benefits minus costs) that accrue in the planning area and the rest of the nation. In the case of recreation, the conceptual basis for the NED impacts analysis is society's willingness to pay for recreation, also known as consumer surplus value. These NED effects are measured using the Travel Cost Method (TCM) and Unit Day Value (UDV) approach (U.S. Water Resources Council 1983; ER 1105-2-100 Appendix E (USACE 2000); Economic Guidance Memorandum (EGM) 18-03 (USACE 2017)), and reflect the maximum amount visitors are willing to pay to engage in recreation activities on the Missouri River, rather than forego them (Walsh 1986). The UDV method of estimating willingness to pay relies on expert and informed opinion to assign relative values to recreation days based on the quality of recreational opportunities supported by individual recreation areas. The TCM is a revealed preference method of economic valuation that deduces willingness to pay through observing human behavior (i.e., the number and trips and costs per trip to a recreation area). Additional information is provided in Section 2.4.3.

MRRMP-EIS alternatives could affect the functionality and quality of recreation resources, such as availability and accessibility of boat ramps and other recreational facilities, aesthetic resources, and fishing opportunities. The methodology to evaluate the NED impacts to recreation from the alternatives focuses on how changes in reservoir elevations, river stages, and the prevalence of habitat will affect visitation at lakes and river reaches and the value of the recreational experience. In addition, the methodology includes an assessment of the OMRR&R costs to maintain access to recreation infrastructure further described in this section.

Because data and methods are different for the locations across the Missouri River, the following description is focused on four general locations: the upper three Mainstem reservoirs; the lower three Mainstem reservoirs; the inter-reservoir river reservoirs; and the lower river below Gavins Point Dam. In general, this section includes the following subsections and within each of these subsections the approaches for each of the four locations are described:

- Identify the plan-affected recreation
- Estimate changes in visitation
- Calculate and apply Unit Day Values
- Estimate NED benefits of recreation
- Estimate Operations, Maintenance, Repair, Replacement, and Rehabilitation Costs

2.4.1 Identify Plan-Affected Recreation

This section describes the current visitation for the reservoirs and the river reaches as well as the types of visitors anticipated to be affected by the MRRMP-EIS alternatives.

Reservoirs

There are six Mainstem reservoirs on the Missouri River, located in Montana, North Dakota, and South Dakota. The Mainstem reservoirs include the three upper reservoirs where the storage volumes and lake elevations vary (Lake Oahe, Lake Sakakawea, and Fort Peck Lake), and three lower reservoirs, where the reservoir elevations remain relatively stable (Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake). Because visitation at the upper three reservoirs can be largely affected by changes in reservoir elevations, the approach to estimate changes in visitation at the upper three reservoirs varies from the approach for the lower three reservoirs, both of which are described in this section.

One of the initial steps in the recreation analysis was to interview USACE lake managers to obtain current visitation data, gain an understanding of the relationship between water elevations and recreational use, and identify the types of visitors likely to be affected by changes in lake elevations. USACE resource managers provided monthly visitation counts from the Operations and Maintenance Business Information Link (OMBIL) database and activity distribution reports (i.e., the types of visitation activities) from the Visitation Estimating and Reporting System (VERS). The most recent year in which visitor counts and activity distributions were both available for recreational sites at each of the six reservoirs was 2012. The 2012 visitation data was converted to recreation visitor days by accounting for multiple days for campers with information from USACE Recreation Budget Evaluation SysTem (Rec-BEST) database.[1] Because of the different years of the visitation data (recreation, inter-reservoir reaches, and lower river), the visitation was adjusted to reflect a baseline year of 2015. Population changes were used as a proxy to adjust visitation levels because as more people reside in local areas, they would visit local recreation areas. In addition, as population grows, there is more economic activity, with businesses that can provide services and amenities for tourists. The 2012 recreation visitor days associated with the reservoirs were updated to 2015 based on the average change in population between 2012 and 2015 in the counties bordering the reservoirs (and the river reaches).

Visitation and activity distribution percentages at the six reservoirs (excluding downstream and upstream recreation areas not on the lakes) are shown in Table 2. Since activity participation is not mutually exclusive, annual activity distributions reported by VERS include visitors who participate in more than one activity.

Table 2. Annual Visitation and Distribution of Activities, 2012

Activity	Fort Peck Lake	Lake Sakakawea	Lake Oahe	Lake Sharpe	Lake Francis Case	Lewis & Clark Lake
Camping	12.6%	9.2%	3.5%	3.0%	0.4%	4.3%
Picnicking	9.0%	6.2%	1.6%	13.4%	0.3%	3.0%
Boating	24.8%	23.2%	24.7%	11.5%	28.4%	7.3%
Fishing	21.5%	23.7%	37.1%	15.6%	37.4%	9.1%
Hunting	3.8%	2.6%	2.6%	0.3%	0.2%	0.9%
Skiing	1.2%	1.4%	0.5%	0.6%	3.8%	2.1%
Swimming	3.9%	4.6%	3.4%	4.5%	15.9%	9.5%
Sightseeing	12.0%	15.7%	16.1%	40.3%	5.3%	46.4%
Other	11.3%	13.4%	10.6%	10.7%	8.3%	17.4%
Total 2012 Visits	**209,805**	**1,400,243**	**1,490,215**	**774,642**	**160,716**	**1,009,914**

Source: OMBIL (USACE 2012a) and VERS (USACE 2012c) databases. Note that the percentages do not sum to 100% because visitors can participate in more than one activity.

[1] The U.S. Army Corps of Engineers Recreation Budget Evaluation System (Rec-BEST) is an online tool to assist USACE in achieving Recreation Program objectives, and meeting Administration goals of measuring performance against strategic objectives, and linking performance to budget.

It was then necessary to identify the visitation that is likely to be affected by the lake elevation changes under the alternatives. The natural resource managers at the lakes were interviewed and the following grouping of visitors were identified as plan-affected visitors, or visitors affected by changes in lake elevations (McMurry pers. comm. 2015; Voehler and Sheffield pers. comm. 2015; Bultsma pers. comm. 2015):

- **Winter visitation:** all visits between the months of December and March
- **Spring, summer, and fall lake elevation-affected visitation:** angler, boaters, skiers, campers, and some of the sight-seers

During winter months, reservoir visitors primarily participate in ice fishing as well as other winter activities, including cross-country skiing, sight-seeing, and birding. Although many boat ramps close at the end of November (and re-open or put back in the water in April), several boat ramps continue to provide access to the reservoirs during the winter months (Lepisto and Longhenry pers. comm. 2015; Longhenry pers. comm. 2015a). When lake levels fall below the engineered bottom of the boat ramps open in the winter, access to the lake is difficult because of the relatively longer distance to the lake from the parking area, sometimes as much as a half mile to a mile. In addition, lower lake elevations can cause “river” conditions in the reservoir, which can also affect safety and perceptions of safety on the reservoirs. Boat ramp operability (considering the bottom engineered elevation) was used to evaluate the impacts to winter visitation at all six of the reservoirs.

Popular water-based activities at the reservoirs during the spring, summer, and fall season include fishing, boating, waterskiing, and jet skiing. Typically, these visitors can access the lake directly from boat ramps between April and November, with peak use occurring between the months of June and October. When water elevations drop below the bottom operating elevations of the non-low water boat ramps, anglers, boaters, and skiers have difficulty accessing the water. Low lake elevations during these months can also adversely affect the health of fisheries and lead to reduced fishing opportunities at the upper three reservoirs.

Recreation specialists at the lakes also indicated that low lake elevations could affect shoreline recreation (McMurry pers. comm. 2015; Voehler and Sheffield pers. comm. 2015; Bultsma pers. comm. 2015; Busche pers. comm. 2015). Many visitors during the spring, summer, and fall months are attracted to recreation sites on reservoirs because of their scenic quality and easy access to both facilities and water. Based on discussions with the lake recreation managers, most of the campers and a portion of the sight-seers are typically affected by lake elevations (McMurry pers. comm. 2015; Voehler and Sheffield pers. comm. 2015; Bultsma pers. comm. 2015); therefore, it was assumed that all campers and half of the sight-seers are affected by lake elevations. While some visitors who access the lake by boat may be deterred from visiting when water levels are low; lake visitors who do not require boat access (i.e., some of the sightseers, off-highway vehicle (OHV) users, swimmers, picnickers, etc.) are unlikely to be adversely affected by lower lake levels. In fact, some visitors such as swimmers, OHV users, or hunters might benefit when lower lake elevations expose more beach and shoreline areas for outdoor recreation and waterfowl habitat.

For the upper three reservoirs, the potential changes in visitation associated with fluctuating reservoir elevations was evaluated through regression techniques to best explain the changes in visitation. Because all annual spring, summer, and fall visitation was used in the regressions as the dependent variable, the current plan-affected visitation for the upper three reservoirs was assumed to be all spring, summer, and fall visitation. For the upper three reservoirs, winter

visitation evaluated based on boat ramp operability, as described above. Table 3 summarizes the 2015 visitor days by season for activities affected by lake elevations.

Table 3. Reservoir Recreation Visitor Days by Season, 2015

Reservoir	Winter Recreation Visitor Days (Affected by Lake Elevations)	Spring, Summer, and Fall Recreation Visitor Days		Total Recreation Visitor Days
		Affected by Lake Elevation	All Other Recreation Days	
Fort Peck Lake[a]	58,285	404,148	134,947	597,380
Lake Sakakawea[a]	89,476	1,032,299	394,371	1,516,146
Lake Oahe[a]	214,063	1,076,345	336,694	1,627,102
Lake Sharpe	113,794	368,440	305,593	787,827
Lake Francis Case	8,133	111,757	41,564	161,454
Lewis and Clark Lake	105,273	462,981	431,321	999,575
Total	589,024	3,455,970	1,644,490	5,689,484

Source: Calculated from OMBIL and VERS databases (USACE 2012a, 2012c).

River Reaches

Recreational sites along the riverine segments are administered by private entities and federal, state, and local agencies. To assess how visitation downstream of the dams and along the river reaches may be affected by flow management under the alternatives, the following five riverine reaches were identified:

- Fort Peck Dam to Lake Sakakawea
- Garrison Dam to Lake Oahe
- Randall Dam to Lewis and Clark Lake
- Gavins Point Dam to Rulo, NE
- Rulo, NE to the Mouth

Current visitation data for USACE recreation areas in the river reaches were obtained from OMBIL, data collected from non-USACE recreation areas, and from the Missouri River Public Use Assessment (Sherriff et al. 2011). Although visitation from OMBIL was available monthly between 2000 and 2012, visitation counts at other non-USACE recreation areas were only available annually or one or two years within that period. Since 2009 visitation was the most widely available year across the data sources, 2009 OMBIL data was used and augmented with visitation data collected by the USACE for the inter-reservoir river reaches. Because of the different years of the visitation data (recreation, inter-reservoir reaches, and lower river), the visitation was adjusted to reflect a baseline year of 2015. Similar to the reservoir visitation adjustment, population changes were used as a proxy to reflect changes in visitation. The 2009 baseline data was updated to 2015 levels based on population growth between these two years.

For the lower river, estimates of annual visitation to public and private sites that specifically access the Missouri River were obtained from the Missouri River Public Use Assessment (Sheriff et al. 2011) conducted from January 3, 2004 through January 28, 2005. Estimates of

visitation from the Public Use Assessment for the river segment between Gavins Point Dam and Rulo, Nebraska were increased by 30 percent based on discussions with the author due to reduced sampling in this section of the river during the 2004 survey (Sheriff pers. comm. 2015). Annual visitation for 2004 at public accesses points and private lands from the Public Use Assessment are summarized in Table 4. Similar to the reservoir and inter-reservoir reach visitation estimates, the lower river recreation visitor days were updated to 2015 levels based on the proportional difference in population between 2004 and 2015.

Table 4. Lower River 2004 Visitation by Type

River Reach	River Miles (RM)	Annual River Visits			
		Public Access	Private Access	Yacht Clubs	Cruise Operations
Gavins Point Dam to Rulo[a]	490 to 811	1,052,588	113,946	–	46,360
Rulo, Nebraska, to the Mouth	0 to 490	1,146,940	68,934	12,830	–

a Annual visitation to public access areas between Gavin's Point and Rulo, NE was increased by 30% based on personal communication with Steven Sheriff (2015).

Interviews with the recreation area managers were conducted to gain an understanding of the types and seasons of river use as well as how river stages and the operability of boat ramps can potentially affect various types of visitation. Recreational use of the river slows considerably during the winter months, while the majority of visitation occurred in the spring, summer, and fall seasons. Visitation during the winter months on the inter-reservoir and lower river reaches were assumed to not be affected by boat ramp access and the MRRMP-EIS alternatives.

Because the Public Use Assessment provided annual data, it was necessary to segment the visitation between the spring, summer, and fall season; and the winter season for the river reaches below Gavins Point Dam. To estimate/ the winter visitation, the monthly winter OMBIL visitation data (December through March) for the USACE recreation areas as a percentage of total visitation was applied to all visitation in the reaches below Gavins Point Dam.

Thousands of visitors enjoy recreational activities along the banks of the Missouri River during the spring, summer, and fall months. Pleasure boaters, skiers, and a large portion of hunters and anglers access the river by boat.[2] These visitors launch boats from public and private ramps along the channel and are directly affected by river stages when they fall above or below the operating elevations of the boat ramps. Visitors accessing the river by boat generally use boat ramps from April through November, with peak use occurring between June and October. When river stages rise above or fall below the operating elevations of boat ramps, these facilities become inoperable, access becomes limited, which tends to limit visitation.

Most water-based visitors (those using motorized boats and paddle craft) on the river prefer a quieter, slower, and safer river. In the river below Gavins Point Dam, lower river flows benefit

[2] Approximately half of the hunters and anglers use boats to fish and hunt in the inter-reservoir river reaches (USACE 2011). Between Gavins Point and Rulo, approximately 30 percent of angling is done from shore, while the remaining 70 percent is by boat (USACE 2011). Below Rulo, Nebraska, half of the anglers fish by boat, while half fish by shore (Korman pers. comm. 2015; Niswonger pers. comm. 2016).

boaters, paddlecraft visitors, floaters, anglers, and hunters, who are able to view the structures in the river more easily, and habitat features, sandbars, and/or shorelines become more accessible at relatively lower river flows, benefiting visitors during these river conditions. In a Missouri Department of Natural Resources study over four years, from 1984 to 1988, Fleener (1989) evaluated visitation in the lower river. The second year in the 4-year period had river flows that were more representative of average flows, while the other years had higher than average flows in the spring, summer, and fall. The author states that "an average flow of about 100,000 cubic feet per second (cfs) in year two is ideal for most recreational activities in the busy season, April through September," as measured at the Hermann gage (Fleener 1989, page 43). While, the river flows in all 4 years would have allowed boat ramps to be operable, visitation in the summer of 1985, the second year, was greater than visitation in the other 3 relatively higher-flow years. Since paddlecraft visitors, floaters, and swimmers don't typically rely on boat ramps for their water access, these visitors are likely to also benefit from relatively lower river flows.

Visitation was segmented into the following types of visitors for the river reaches.

- **Spring, summer, and fall boat-accessed visitation:** for the reaches above Gavins Point Dam, boaters, skiers, and half of the anglers and hunters; for the lower river, boating, waterskiing, jetskiing, cruise operations, waterfowl hunting, and a portion of anglers (70 percent in Gavins to Rulo and 50 percent in Rulo to the mouth);
- **Spring, summer, and fall other water-based recreation:** for the reaches above Gavins Point Dam, swimmers; for the lower river, swimmers, floaters, and visitors using paddlecraft[3];
- **Spring, summer, and fall non-water-based recreation:** campers, picnickers, sight-seers, OHVs, sunbathing, hikers, and some anglers and hunters; and
- **Winter visitation:** all visits between the months of December and March (for the reaches above Gavins Point Dam) and January through March for the reaches below Gavins Point Dam.

The first category (boat-accessed visitation) was assumed to be directly affected by changes in boat ramp operability. The second category (other water-based recreation) would also be affected by changing river flows and stages, and was assessed qualitatively in the analysis. Non-water-based recreation were assumed to not be impacted by changes in rivers flows and stages. Winter visitation would not be affected by the plan because boat ramps are typically not operable in the winter and visitation along with river in the winter does not involve water-based recreation.

For the inter-reservoir river reaches, total visitation for spring, summer, and fall was categorized by the type of activity based on VERS 2009 activity distributions. Types of recreational activities for the river reaches below Gavins Point Dam used information from the Public Use Assessment (Sheriff et al. 2011). Activity distributions for the inter-reservoir river reaches and lower river are summarized in Tables 5 and 6.

[3] The types of visitors associated with "other water-based recreation" are limited to those defined by the data sources available. The Public Use Assessment (Sheriff et al. 2011) has more categories of recreation in the lower river compared to the inter-reservoir reaches, where the USACE VERS database was used.

Table 5. Distribution of Activities in the Inter-Reservoir River Reaches, 2009

Activity	Fort Peck Dam to Lake Sakakawea	Garrison Dam to Lake Oahe	Oahe Dam to Lake Sharpe	Randall Dam to Lewis & Clark Lake
Camping	18.5%	11.4%	5.3%	5.1%
Picnicking	15.0%	6.5%	2.9%	4.5%
Boating	19.7%	14.2%	20.9%	14.7%
Fishing	16.7%	19.7%	25.3%	10.3%
Hunting	3.2%	1.6%	0.5%	6.6%
Skiing	0.7%	0.4%	2.8%	0.8%
Swimming	4.1%	3.5%	14.1%	5.0%
Sightseeing	10.7%	24.6%	19.0%	25.9%
Other	11.4%	18.1%	9.1%	27.0%

Source: OMBIL and VERS databases (USACE 2009a, 2009b); USACE data collection efforts.

Table 6. Distribution of Activities in the Lower River, 2004

Activity	Gavins Point Dam to Rulo, Nebraska	Rulo, Nebraska to the mouth near St. Louis
Boating, Jet Skiing, Waterskiing	19%	10%
Fishing	30%	24%
Waterfowl Hunting	3%	3%
Other Water-based Recreation	3%	1%
Non-Water Based Recreation	53%	63%

Source: Sheriff et al. 2011.
Note: percentages may not sum to 100% due to rounding.

The above activity distributions were then applied to all visitation in the respective river reaches. The total recreational visitor days for various types of visitors or activities updated to 2015 levels are provided in Table 7.

Once the baseline plan-affected visitation was specified, the next step in the methodology was to assess how the visitation within the reservoirs and river reaches would be affected by management actions under the MRRMP-EIS alternatives.

Table 7. Visitation on the River Reaches, Annual Recreation Visitor Days, 2015

River Reaches	Total Annual Recreation Visitor Days	Winter Recreation Visitor Days[a]	Spring, Summer, and Fall Recreational Visitor Days		
			Boat-Accessed Recreation Visitor Days[b]	Other Water-Based Recreation Visitor Days[c]	Non-Water-Based Recreation Visitor Days
Fort Peck Dam to Lake Sakakawea	408,439	28,816	100,680	47,294	231,649
Fort Randall Dam to Lewis and Clark Lake	339,060	14,796	40,833	24,180	129,078
Garrison Dam to Lake Oahe	458,378	27,580	56,827	37,036	203,423
Oahe Dam to Lake Sharpe	196,253	24,354	132,728	51,847	231,591
Gavins Point Dam to Rulo, Nebraska	1,319,538	199,116	575,691	146,958	397,773
Rulo, Nebraska, to the Mouth	1,285,292	199,540	338,069	169,500	578,183

a Sheriff et al. 2011 did not specify winter use. Instead, the average percentage of winter use occurring at USACE recreation areas below Gavins Point Dam were applied to total 2004 visitation to estimate winter visitation.

b Boat accessed recreation includes motorized boating, waterskiing, jetskiing, cruise operations, and a portion of hunting and fishing in riverine areas (half of hunting and fishing in inter-reservoir reaches; half of fishing in the Rulo to the mouth reach; 70% of the fishing in the Gavins to Rulo reach; all waterfowl hunting on lower river reaches).

c Other water-based recreational days in the inter-reservoir reaches include swimmers and half of anglers.

2.4.2 Estimate Changes in Visitation

This section describes the approach to estimate changes in visitation under the MRRMP-EIS alternatives for the upper three reservoirs, the lower three reservoirs, and the river reaches.

Upper Three Reservoirs

The project team explored the relationships between visitation, boat ramp operability, lake elevations, fishing success, and gas prices in a number of time series regressions for the upper three reservoirs. The Comprehensive R Archive Network (also known as “CRAN R” or “R”) regression program was used to specify linear relationships to explain visitation at the upper three reservoirs. The team used actual total 8-month (spring, summer, and fall) visitation at the recreation areas located on the lake as the dependent variable from 2001 to 2012. Independent variables that were analyzed included the fishing success metric as a dummy variable, price of gas, mid-August elevations, total 8-month boat-ramp operability for all boat ramps, total boat ramp operability for all non-low water boat ramps (defined by each lake) for the 8-month period, and the average of the monthly mid-point lake elevations for the 8-month period (see Sections 2.3.1 and 2.3.2 for additional details on these estimates).

In addition, economic variables can affect visitation at recreational sites. Generally, more recreation occurs during upswings or booms in the economy and less visitation occurs during times of recession or economic downturns. However, visitation at some sites can benefit from economic downturns if recreation areas have nearby residents that choose to visit proximate sites close to home during economic downturns. Gross domestic product (GDP) and personal income for the nation were also used in the regressions to test their impact on visitation.

Biological and other factors can also heavily influence boating and fishing visitation to the lakes, including biomass of smelt, abundance of sport fish such as walleye, angler effort, catch rates, and others. However, because these variables cannot be estimated for the 82-year POR, the regressions focused on the independent variables associated with lake elevations for the analysis (boat ramp operability, August lake elevations, average annual summer lake elevations).

Based on an approach undertaken by fisheries biologists, regressions were estimated with a number of relevant variables (Chipps and Fincel 2015). To screen through independent variables and choose the best model, the Akaike Information Criteria (AIC) was used. The AIC process uses the statistical information on the goodness of fit and the complexity of the model to estimate the quality of each model in explaining the change in visitation between 2001 and 2012. The AIC process indicated that variables predictive for visitation included the price of gas and mid-August elevations. In addition, the GDP and personal income variables were significant variables in the Lake Oahe and Lake Sakakawea regressions but were not included in the equations to estimate visitation over the POR (1931–2012). The positive correlation between GPD/personal income and visitation between 2001 and 2012 (for the regressions) was not appropriate to apply over the POR because of the large change in GDP/income, which would render the visitation estimates to be negative in most years. For these reasons, the GDP and personal income variables were not chosen to be included in the final regression models. However, the mid-August elevation variables were just as predictive for visitation in the regressions equations and were used in the estimation of visitation. The regressions used to estimate visitation included the following variables: mid-August elevations, the price of gas, and the fishing success dummy variable; the regressions are shown for the three reservoirs in the Table 8.

Table 8. Linear Regression Results for the Upper Three Reservoirs

Reservoir	Independent Variables	Coefficient	T-Statistics	Significance	Goodness of Fit
Fort Peck Lake	Mid-August Elevation	2,419	3.096	0.0128	0.838
	Fishing Success Dummy Variable	104,251	5.459	0.0004	
Lake Sakakawea	1-Year Lag Mid-August Elevation	6,529	6.699	0.0000	0.880
	Price of Gas	−93,920	−4.759	0.0010	
Lake Oahe	Mid-August Elevation	6,529	4.106	0.0034	0.638

The best regressions were tested for multi-collinearity by calculating their Variable Inflation Factor (VIF). This approach quantifies the degree of multi-collinearity in the regression analyses and provides an index value that measures how much the variance of a regression is impacted due to collinearity. For this analysis, a VIF value of 2 or lower was considered to show that a regression lacked multi-collinearity. All regressions estimated here had VIF values below 2.

The relationships identified under these regressions were used with various independent variables to estimate the change in spring, summer, and fall visitation for the upper three reservoirs. Mid-August lake elevations, 1-year lagged mid-August elevations, the fishing success dummy variable, and the price of gas were used to develop a predictive model for each lake, based on the regression equations. Visitation was estimated for 81 years over the POR;

an 82-year POR could not be evaluated because of the lagged variable in the visitation estimates.

Changes in 2015 winter visitation (December through March) on the upper three reservoirs were estimated through boat ramp operability. Because the majority of the winter recreation involves ice fishing, accessing the lakes is an important part of the recreational activity. When the lake elevations in the winter fall below the bottom engineered elevation of the non-low water boat ramps, recreational access to the river is difficult as visitors must travel much farther from the parking lots to access the reservoir. The boat ramp operability (number of boat-ramp days operable) for the 4 winter months when elevations fall above the engineered bottom elevation and below the top operational elevation for the specified winter boat ramps was used to estimate how winter visitation would be affected; the change in visitation was based on a proportional change in winter boat ramp operability.

Lower Three Reservoirs and River Reaches

Since water elevations at the lower three reservoirs remain relatively stable, the correlation between lake elevations and visitation at the lower three reservoirs tends to be much weaker than at the three upper reservoirs. For this reason, regression relationships were not undertaken at the lower three reservoirs. However, lake elevations can still affect boat ramp operability and access to these lakes. Therefore, impacts to spring, summer, and fall lake-affected visitation at Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake were assessed based on changes in the number of days when water elevations fall between the top and bottom operating elevations of the normal water level boat ramps (all boat ramps that are not labeled as “low water”). The change in visitation relative to 2015 conditions was based on the proportional change in boat ramp operability under the MRRMP-EIS alternatives for each of the 81 years.[4] Similar to the upper three reservoirs, the winter visitation was also based on boat ramp operability during these months.

For the inter-reservoir river reaches, the change in visitation was based on the proportional change in boat ramp operability under the MRRMP-EIS alternatives for each of the 81 years Baseline visitation in 2015, for the boat-accessed visitation—boaters, skiers, and some of the hunters and anglers—was used to estimate changes in visitation for the spring, summer, and fall season.

The river reach from Oahe Dam to the headwaters of Lake Sharpe is about 9 miles. Lake Sharpe is the first of the lower three reservoirs that is managed as a flow through reservoir. As a result, Lake Sharpe maintains very constant pool levels. Releases from Oahe Dam are coordinated with releases from Big Bend Dam, Randall Dam, and Gavins Point Dam to maintain storage levels at these lower three reservoirs. As a result, the USACE does not have a HEC-RAS model to estimate the changes in river stages and flows in this relatively short river segment. Because of the lack of H&H data in this reach and the relatively constant reservoir elevations at Lake Sharpe, it was assumed that boat ramp operability would remain constant in the river reach and not be affected by MRRMP-EIS alternatives and was not evaluated.

[4] An 81-year period was used for consistency across all locations because the lagged variable in the regression equations prevented an 82-year POR in Lake Sakakawea.

Changes in visitation in the lower river for boat-accessed visitors—boating, skiing, waterfowl hunting, and some of the anglers—were based on boat ramp operability relative to the 2015 baseline condition for the spring, summer, and fall season. The change in visitation relative to the number of operable boat ramp days was based on the proportional change in boat ramp operability for each of the 81 years under each of the MRRMP-EIS alternatives.

As mentioned previously, some water-based visitors on the river reaches prefer relatively lower river flows. However, motorized boat-accessed visitors require river flows and stages that meet the bottom elevation of the boat ramps. Non-motorized boaters, such as those who use paddlecraft, swimmers, floaters, and some of the other non-water-based visitors, may prefer relatively lower river flows. Because no specific threshold could be identified by recreation managers and specialists nor could they specify how visitation changes with lower river flows, the evaluation associated with changes in visitation associated with lower river flows was qualitative in nature, describing the anecdotal evidence. The evaluation was focused on describing how the peak recreation season (May through October) flows would be affected under the MRRMP-EIS alternatives compared to Alternative 1 (the No Action alternative) and a qualitative description of how changes in these conditions would affect these visitors.

Under the MRRMP-EIS alternatives, ESH and early life stage habitat for the pallid sturgeon is anticipated to be created, either through flows or mechanical means, in a number of the river reaches. In addition to supporting native species, these areas are generally viewed as natural features that contribute to topographic diversity and increase scenic values associated with the surrounding viewshed. The prevalence of habitat can benefit visitors, increasing the quality of their recreational experiences. Although there are greater opportunities for low-density dispersed recreation along the river where habitat, especially early life stage habitat, is created, there is not a preponderance of evidence to suggest that the creation of these habitat areas would induce additional visitation to the area (Haller pers. comm. 2016, Kuhlman pers. comm. 2016, Schneider pers. comm. 2016). While these recreational opportunities may or may not translate to a net increase in visitation, the additional features associated with the habitat are likely to be of higher value to visitors. As a result, the recreation analysis associated with habitat areas is focused on how an increase in the acres of habitat could increase the value of the recreational experience (i.e., the TCM and Unit Day Values) through an increase in the quality of recreational experiences. The approach is further described in the subsequent section.

2.4.3 Calculate and Apply the Consumer Surplus Values

Total recreation benefits are defined as the sum of the maximum amount individuals are willing to pay to engage in a recreation activity, rather than forego it (Walsh, 1986). Willingness to pay includes entry and use fees actually paid for site use, plus any unpaid value (surplus) enjoyed by visitors. The procedures described in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council 1983) (Principles and Guidelines) and USACE ER 1105-2-100 Appendix E outline three generally accepted methods for measuring recreational benefits: the unit day value (UDV), the travel cost method TCM, and contingent valuation.

A hybrid method based on both the UDV and the TCM was used for this effort given consideration of the recreation evaluation criteria established in the Principles and Guidelines. The method to estimate the consumer surplus recreation values uses both the UDV, which is based on USACE guidance and site-specific ratings and activities, but also recognizes that the UDV may reflect a relatively lower estimate of the consumer surplus value for a recreation

visitor-day. Therefore, the TCM study conducted as part of the Master Water Control Manual Missouri River Review and Update (USACE 1994) was also considered in the evaluation.

This section describes the approach and steps taken to estimate the consumer surplus values.

Overview of UDV Approach

The UDV method of estimating average willingness to pay relies on expert or informed opinion and judgment. This method of estimating recreational benefits involves the assignment of relative values to individual sites based on the quality of recreation areas. The USACE EGM 18-03 provides guidelines for assigning points on a 100-point scale based on five criteria. The five criteria and total possible points that can be assigned to each criterion are as follows:

1. the quality of the recreation experience as affected by congestion (0–30 points);
2. availability of substitute areas in terms of travel time (0–18 points);
3. carrying capacity determined by level of facility development (0–14 points);
4. accessibility as affected by road and parking conditions (0–18 points); and
5. environmental quality based on aesthetics (0–20 points).

Recreation managers rate the recreation areas based on these 5 criteria and each site is identified as a type of site (general recreation, general hunting and fishing, specialized hunting and fishing, and other specialized activities). The point ratings for each recreation area were obtained from the USACE Rec-BEST database and averaged over a 4-year period for the most recent data available (2009 to 2012). To obtain a value associated with each reservoir or river reach, the UDV points were specified for all of the recreation areas in each geographic location by type of site and then weighted by visitation.

Point ratings were then converted into a monetary value based on values published in EGM 06-03 for each type of recreation (general recreation, general hunting and fishing, specialized hunting and fishing, and other specialized activities). Table 9 provides the points to monetary value conversion from the EGM. The distribution of the visitation to the four different types of values is described in the following section.

Table 9. Unit Day Values for Recreation, Fiscal Year 2018

Point Values	General Recreation Values[a]	General Fishing and Hunting Values[a]	Specialized Fishing and Hunting Values[b]	Specialized Recreation Values other than Fishing and Hunting[b]
0	$4.04	$5.82	$28.35	$16.45
10	$4.81	$6.58	$29.11	$17.47
20	$5.32	$7.09	$29.62	$18.73
30	$6.08	$7.85	$30.38	$20.25
40	$7.59	$8.61	$31.14	$21.52
50	$8.61	$9.37	$34.17	$24.30
60	$9.37	$10.38	$37.21	$26.83

Point Values	General Recreation Values[a]	General Fishing and Hunting Values[a]	Specialized Fishing and Hunting Values[b]	Specialized Recreation Values other than Fishing and Hunting[b]
70	$9.87	$10.89	$39.49	$32.40
80	$10.89	$11.64	$42.53	$37.72
90	$11.64	$11.90	$45.57	$43.04
100	$12.15	$12.15	$48.10	$48.10

Source: USACE EGM 18-03.

a General recreation refers to an area with recreation activities that are attractive to the majority of outdoor users. These activities generally require easy access with facilities and amenities that most individuals take advantage of while utilizing a USACE-administered Recreation Area.

b Specialized recreation refers to an area that supports activities for which opportunities are limited, density of use is low, and a high degree of skill, knowledge, and appreciation of the activity by the user are often involved. In the reservoirs, salmon fishing with downriggers and ice fishing are an example of specialized fishing recreation.

General and Specialized Visitation

Hunting, fishing, and boating visitation from OMBIL and VERS[5] databases for the activity distributions were used for 2009 (inter-reservoir river reaches) and 2012 (reservoirs). The percentages of fishing, hunting, and boating visitation for the lower river were obtained from the Public Use Assessment (Sherriff et al. 2011). The Recreation Economics Volume 6C of the Missouri River Mainstem Reservoir System Master Water Control Manual (USACE 1994) was used to identify the amount of visitation that is allocated to specialized fishing and hunting categories. The OMBIL and VERS databases and the Public Use Assessment were used to identify the proportion of general hunting, general fishing, and boating visitation. Natural resource managers at each reservoir were interviewed to verify whether the proportions of specialized fishing recreation at the reservoirs were still consistent with those reported in the Recreation Appendix of the Master Water Control Manual. Boating visitation was assigned to the specialized recreation category, which is associated with higher-valued activities.[6] The remaining percentage of visitors were allocated to general recreation. Table 10 summarizes the allocation among the general and specialized recreational activities.

[5] The VERS data were obtained by recreation area, and the participation rates were estimated by focusing on the recreation areas at the lakes; visitation at the recreation areas located below the dams were assigned to the appropriate river reach.

[6] The UDV guidance (USACE 2017) indicates that the general category should comprise activities such as swimming, picnicking, and boating. However, based on professional judgment and a review of other studies (Loomis 2005; USACE 2002), boating on the river and reservoirs was allocated to a specialized recreation category with a relatively higher value per day than the general recreation activities.

Table 10. Distribution of Specialized and Generalized Recreation Opportunities in the Reservoirs and River Reaches

Recreation Category/Location	Percent of Visitation
Fort Peck	
General Recreation	41.0%
General Fishing	21.4%
Specialized Fishing	5.0%
Specialized Hunting	4.0%
General Hunting	3.7%
Specialized Recreation	24.8%
Fort Peck Dam to Lake Sakakawea	
General Recreation	52.3%
General Fishing	16.7%
Specialized Fishing	5.0%
Specialized Hunting	3.1%
General Hunting	3.2%
Specialized Recreation	19.7%
Lake Sakakawea	
General Recreation	36.5%
General Fishing	23.7%
Specialized Fishing	12.0%
Specialized Hunting	2.0%
General Hunting	2.6%
Specialized Recreation	23.2%
Garrison Dam to Lake Oahe	
General Recreation	61.4%
General Fishing	19.7%
Specialized Fishing	0.0%
Specialized Hunting	3.1%
General Hunting	1.6%
Specialized Recreation	14.2%
Lake Oahe	
General Recreation	26.4%
General Fishing	37.1%
Specialized Fishing	9.0%
Specialized Hunting	0.2%
General Hunting	2.6%
Specialized Recreation	24.7%

Recreation Category/Location	Percent of Visitation
Lake Sharpe	
General Recreation	59.1%
General Fishing	15.6%
Specialized Fishing	13.0%
Specialized Hunting	0.5%
General Hunting	0.3%
Specialized Recreation	11.5%
Lake Francis Case	
General Recreation	27.9%
General Fishing	37.4%
Specialized Fishing	5.0%
Specialized Hunting	1.1%
General Hunting	0.2%
Specialized Recreation	28.4%
Randall Dam to Lewis and Clark Lake	
General Recreation	80.0%
General Fishing	10.3%
Specialized Fishing	0.0%
Specialized Hunting	3.1%
General Hunting	6.6%
Specialized Recreation	14.7%
Lewis & Clark Lake	
General Recreation	81.2%
General Fishing	9.1%
Specialized Fishing	1.5%
Specialized Hunting	0.0%
General Hunting	0.9%
Specialized Recreation	7.3%
Gavins Point Dam to Rulo, Nebraska	
General Recreation	86.8%
General Fishing	9.1%
Specialized Fishing	0.0%
Specialized Hunting	3.1%
General Hunting	1.0%
Specialized Recreation	7.3%

* Calculated based on activity distribution for VERS (2009 and 2012) Sheriff et al. (2011); the 1991 Angler Survey from the Master Manual (USACE 1994) for the specialized hunting and hunting percentages.

Estimate the Consumer Surplus Values for Non-Habitat-Affected Areas

The UDV point values were obtained from the Rec-BEST database and averaged for 2009 to 2012, weighted based on visitation, and aggregated to provide a single point value for each location. The final step was to weight UDVs based on the allocation of activities among general and specialized recreation for each geographic location. The UDVs are summarized in the second column of Table 11.

Table 11. Estimates of Consumer Surplus Values Per Recreation Visitor Day for Each Reservoir and River Reach

River Reach or Reservoir	UDV (2018$) (a)	Master Manual, Volume 6C: Recreation Economics			Consumer Surplus Value (2018$) (c)
		UDV (1993$)	TCM (1993$)	Difference (TCM/UDV) (b)	
Fort Peck Lake	$15.55	$7.03	$10.66	1.52	$23.58
Fort Peck Dam to Lake Sakakawea	$11.43	$7.07	$8.19	1.16	$13.24
Lake Sakakawea	$14.59	$6.96	$15.06	2.16	$31.56
Garrison Dam to Lake Oahe	$9.35	$6.09	$14.94	2.45	$22.93
Lake Oahe	$14.91	$6.90	$9.21	1.33	$19.89
Lake Sharpe	$15.61	$6.35	$8.35	1.31	$20.52
Lake Francis Case	$16.10	$6.05	$7.69	1.27	$20.47
Randall Dam to Lewis and Clark Lake	$8.45	$6.28	$7.29	1.16	$9.81
Lewis & Clark Lake	$6.17	$5.92	$7.29	1.23	$7.60
Gavins Point Dam to Rulo	$10.01	$6.28	$6.58	1.05	$10.49
Rulo to the Mouth of the Mississippi River	$9.57	$5.73	$5.79	1.01	$9.67

As part of the Master Manual evaluation (USACE 1994), a TCM was implemented to estimate the willingness to pay to recreate along the Missouri River. Travel cost zones of visitor origin were identified around each recreation area for the purpose of estimating travel costs. A travel cost measure was constructed to estimate the round-trip cost of travel per visitor from the origin. The evaluation used regression analysis and other data, including population from zone of origin, various site facility amenities, substitute recreation opportunities, and numerous other demographic variables, to specify visitation rates as a function of travel costs.

The TCM values and UDVs estimated as part of the recreation economics evaluation for the Master Manual (USACE 1994), shown in Table 11, were used to increase the estimated 2018$ UDV to estimate consumer surplus values for this study. Column “a” was then multiplied by column “b” to estimate the consumer surplus values for a recreation visitor day, noted in column “c” which was used in the NED evaluation.

Estimate Consumer Surplus Values for Habitat Areas

Emergent sandbars and shallow waters provide critical nesting and foraging habitat for fish and wildlife and add to the natural aesthetics of the Missouri River floodplain. In addition to supporting native species, these areas are generally viewed as natural features that contribute

topographic diversity and increase scenic values associated with the surrounding viewshed. The prevalence of these habitat types benefit visitors, increasing the quality of their recreational experiences. Thus, increasing their enjoyment and willingness to pay for a variety of recreational experiences along the river.

To better understand the relationship between various types of habitat and outdoor recreation along the lower river, interviews were conducted with natural resource and recreation area managers who administer habitat sites between Fort Randall Dam and the confluence with the Mississippi River. Across the interviews, natural resource managers agreed that the prevalence of habitat and its features contributed to and enhanced the quality of the recreational experience along the Missouri River. Although some recreation managers have implied that previous mitigation projects (e.g., chutes and backwaters expansion/creation) have attracted additional visitors to local recreation areas, they were not able to quantify the relationship between habitat prevalence and changes in visitation given the uncertainties with this relationship. Most resource managers interviewed were hesitant to speculate on this relationship and were unsure whether new habitat features induced visitation. All recreation managers did however, suggest that new habitat areas (ESH and early life stage habitat for the pallid sturgeon) would support greater opportunities for low-density dispersed recreation along the river. While these opportunities may not translate to a net increase in visitation, these additional opportunities are likely to be of higher value to visitors. As a result, the recreation analysis associated with habitat areas is focused on how an increase in prevalence of habitat under the MRRMP-EIS alternatives could increase UDVs through an increase in the quality of recreational experiences.

The areas with both early life stage habitat for the pallid sturgeon and ESH can provide additional access opportunities as well as greater opportunities for solitude. Newly created ESH and early life stage habitat for the pallid sturgeon within the river reaches would provide additional places to stop and participate in shore-based or in-river activities, including hunting, fishing, picnicking, and other activities.

The creation of additional habitat areas would also enhance the aesthetic quality (i.e., geomorphology, topography, water, vegetation) near these mitigation projects, affecting the ratings of affected river reaches under the “environmental aesthetics” criteria within the UDV guidance. The environmental aesthetics criteria ranges from 1 to 20 points, with a value of 1 indicating a site has low esthetic quality with significant limiting factors and a rating of 20 indicating a site has outstanding esthetic quality, with rare or unique elements and no limiting factors. Based on input from recreation managers at habitat sites, the creation of new habitat would improve aesthetic qualities. On average, additional habitat creation could increase the value of recreational experiences near mitigation sites from 5 to 10 points based on the UDV criteria (Haller pers. comm. 2016).

To estimate relatively higher-valued recreational experiences associated with new habitat areas, current point values for the four river reaches (Garrison, Randall, Gavins Point Dam to Rulo and Rulo to the mouth) were adjusted to reflect an increase of 10 points (Haller pers. comm. 2016). New point values for these river reaches were then converted to a monetary UDV based on values published in the 2018 EGM 18-03. The UDVs were weighted based on the four types of recreation (i.e., general and specialized recreation, hunting, and fishing). Similar to the consumer surplus values for non-habitat areas, the relatively higher UDVs for the habitat areas were then increased based on the difference between the Master Manual UDVs and TCM values. The consumer surplus values for habitat areas ranges from $1 to $3 more per recreation visitor day than areas without habitat areas, an increase of between 8 and 13 percent. The consumer surplus values for habitat areas are shown in Table 12.

Table 12. Estimates of Consumer Surplus Values Per Recreation Visitor Day for Sites with New Habitat Areas

River Reach	Consumer Surplus Value (2018$)
Fort Peck Dam to Lake Sakakawea	$14.73
Garrison Dam to Lake Oahe	$25.98
Randall Dam to Lewis and Clark Lake	$10.68
Gavins Point Dam to Rulo	$11.80
Rulo to the Mouth of the Mississippi River	$10.88

The next step in the process was to estimate the proportion of visitors to which the higher UDV would be applied. The approach focused on estimating the prevalence (i.e., proportion) of target habitat acres in the channel compared to all channel acres in each river reach. The proportion of newly created habitat in the channel was then applied to the visitation in the river reaches to provide an estimate of all visitors that would be affected by the creation of new habitat. Information on anticipated acres of ESH and early life stage habitat for the pallid sturgeon from the alternatives descriptions and the bird modeling results was obtained and is summarized in Table 13.

Table 13. The Proportion of the Channel Affected by Habitat Creation

River Reach	Alternatives					
	1	2	3	4	5	6
Garrison to Lake Oahe	3%	14%	3%	3%	3%	2%
Randall Dam to Lewis and Clark Lake	0%	1%	1%	1%	1%	1%
Gavins to Rulo, Nebraska	6%	17%	4%	3%	3%	4%
Rulo, Nebraska to the Mouth	3%	10%	4%	4%	4%	4%

The project team worked with the USACE modeling specialists to estimate the number of acres within the channel in each of the river reaches. The average top width of the channel for each of the river reaches was provided at normal navigation while considering the Alternative 1 2012 geometry with current and additional shallow water habitat below Gavins Point Dam. This information was used to estimate the acres of channel in each river reach (some river reaches had multiple segments if they had considerably different top widths). With the acres of habitat in each river reach (Table 14), the analysis estimated the proportion of the channel that would have newly created habitat under the MRRMP-EIS alternatives. It was assumed that this proportion of habitat in the channel would affect the same proportion of visitors in the river reach being analyzed. Table 13 summarizes the proportion of visitation anticipated to be affected by the habitat. The UDV was then was applied to the annual boat-accessed visitation for each of the river reaches. In addition, the newly created habitat is anticipated to affect other visitors, including winter and other water- and non-water-based visitors. Therefore, the difference between the with-habitat UDVs and the non-habitat UDV for each of the river reaches was applied to the remaining proportion of visitors (non-boat-accessed visitors) affected by habitat to estimate the contribution of the habitat to recreation NED benefits.

Table 14. Target Acres of Habitat Construction by River Reach

River Reach	Alternatives					
	1	2	3	4	5	6
Target Early Life Stage Habitat for the Pallid Sturgeon (Acres)						
Ponca to Rulo, Nebraska	2,008	4,558	861	861	861	861
Rulo, Nebraska, to the Mouth	2,380	6,707	2,519	2,519	2,519	2,519
Median Available Acres of Emergent Sandbar Habitat						
Garrison Dam to Lake Oahe	560	2769	652	569	545	440
Randall Dam to Lewis and Clark Lake	61	129	77	91	78	82
Gavins Point Dam to Rulo, Nebraska	334	2,093	541	484	465	515

Note: Target acres to support early life stage requirements were obtained from the alternatives descriptions (see Chapter 2 for additional details). Target ESH acres of emergent sandbar habitat were obtained from US DOE Pacific Northwest National Laboratory (Buenau pers. comm. 2018); median available acres of ESH at the end of the planning period were used in the analysis.

2.4.4 Recreation Benefits of Visitation (NED Benefits)

The NED benefits of visitation were estimated by applying the appropriate consumer value to the estimated annual spring, summer, and fall; and the winter seasonal visitation under each alternative. The difference in the values between the action alternatives and Alternative 1 represents the change in NED value associated with each alternative. As described in the previous section, the consumer surplus value associated with the prevalence of habitat areas was applied to a proportion of the boat-accessed visitors as well as all other visitors to estimate the NED effects of visitation in proximity to newly created habitat areas. The NED benefits are provided in 2018 dollars.

2.4.5 Estimate Operating, Maintenance, Repair, Replacement and Rehabilitation Costs (NED Losses)

Persistent drought conditions in the mid-2000s resulted in millions of dollars being invested to maintain and improve lake access at the upper three reservoirs. Funding to facilitate access improvements came from Congressional appropriations as well as federal, state, and local governments. These projects included the construction and extension of numerous boat ramps with relatively low engineered bottom elevations in areas most affected by persistent drought conditions. Table 15 summarizes the number of normal and low water boat ramps at the upper three reservoirs.

Table 15. Number of Boat Ramps at each Reservoir

Reservoir	Low Water Boat Ramps	Normal Water Boat Ramps
Fort Peck Lake	11	10
Lake Sakakawea	39	48
Lake Oahe	18	50

Generally low water boat ramps are brought on-line after the “sister” normal-water boat ramp is no longer operable (i.e., reservoir elevations fall below the operating elevation). Once the low water boat ramp is operable, these ramps are maintained for as long as drought conditions persist. During drought conditions, the simulated reservoir elevations under the MRRMP-EIS alternatives at the upper reservoirs show that some of the alternatives would draw down the reservoirs farther than under Alternative 1. As a result, there are possible impacts to capital and operating costs as reservoir elevations fall more frequently and also fall below the bottom elevation of the low water boat ramps. In addition to the costs directly associated with extending or replacing the boat ramp, additional costs may be associated with roads, parking facilities, and toilets to ensure visitors continue to have access to the low water ramps.

Operating and maintenance costs may also be impacted because boat ramps require cleaning and additional maintenance to make them operable after lake elevations have fallen from the previous year. Operations and maintenance activities to ensure access to boat ramps generally include cleaning the silt from the ramp, dredging sand around the ramp, and minor repairs. The approach to evaluate the repair, replacement, and rehabilitation (RR&R) costs is explained in the following subsections.

Repair, Replacement, and Rehabilitation Costs during Drought Conditions at the Upper Three Reservoirs

To evaluate the RR&R costs associated with the MRRMP-EIS alternatives, the simulated reservoir elevations were evaluated at the upper three reservoirs for four drought periods:

- 1931–1942
- 1955–1962
- 1988–1993
- 2001–2009

During these periods, reservoir elevations for most of the alternatives fell below the bottom operating elevation of low water boat ramps. Reservoir elevations during the drought years were compared alongside bottom operating elevations of each low water boat ramp under the alternatives to evaluate whether, and to what extent, the action alternatives would cause lake elevations during drought periods to fall lower than under Alternative 1. Although drought conditions during the 1930s and early 1940s were shown to have the most significant impacts of the four drought periods identified, the differences in lake elevations among the alternatives were minimal.

Lake elevations under the alternatives were shown to adversely affect low water ramp operability during the simulated drought periods that would occur under conditions similar to the late 1950s and early 1960s; late 1980s to early 1990s, and the 2000s. The simulated reservoir elevations during the 2000s drought were used to estimate the RR&R costs to extend and replace low water boat ramps and maintain access to recreation infrastructure during drought conditions because summer impacts were more impacted during the 2000s than the other drought periods, and because reservoir elevations in the 2000s were more impacted compared to Alternative 1 under most of the action alternatives.

To continue to provide lake access during these extreme low water periods, capital investments would have to be made to extend or replace existing low water boat ramps. Costs associated with building and extending boat ramps can vary widely based on individual project needs. Past

projects to construct a new 6 to 9 (vertical) foot boat ramp (including gravel access to the ramp and parking) have cost approximately $50,000, which includes construction materials, labor, associated engineering, project oversight, and permitting (McMurry pers. comm. 2016). Each foot in excess of 9 feet was projected to cost another $2,000 in materials, engineering, oversight, permitting, and road access. In addition to ramp construction, an estimated $10,000 in major road work and additional parking facilities are also needed when a new boat ramp and access point is constructed. When existing infrastructure exists and is in relatively good repair, boat ramps can be extended at lower costs. It was estimated that the average cost to extend an existing ramp 2 to 4 feet is $23,000 (including costs for engineering, oversight, and permitting), with every foot in addition to the 2- to 4-foot extension costing an additional $2,000 (McMurry pers. comm. 2016).

Additional RR&R costs for low water ramps and other infrastructure were estimated at each of the three upper reservoirs based on simulated reservoir elevations between 2001 and 2009. Low water ramps were prioritized for replacement and/or extension based on their location and bottom operating elevations. One boat ramp located in a recreation area was considered a priority ramp for extension and/or replacement. If multiple boat ramps were located in one recreation area, one ramp was considered to be the priority, while the other were not considered for extension and/or replacement. In addition, low water ramps were assumed to be extended and/or replaced if water elevations at the corresponding reservoir fell below the ramp's bottom elevation for the majority of two or more consecutive peak summer seasons.

Based on the elevations of existing boat ramps, it was assumed that some of the ramps most severely affected by drought conditions would not be able to be extended. Instead, these ramps would be replaced. The proportion of ramps extended versus replaced was assumed to be similar across the three upper reservoirs, with one out of every six priority or targeted boat ramps replaced, while the remaining boat ramps would be extended. The lowest point during the drought condition relative to the bottom operating elevation for each low water ramp during the peak summer months (June through September) was used to assess the number of vertical feet needed to extend the boat ramp. The costs obtained from the recreation managers to extend and/or replace the targeted low water boat ramps, along with additional infrastructure, were used to calculate total RR&R costs at the upper three reservoirs.

Operating and Maintenance Costs to Maintain Access to Boat Ramps

Operating and maintenance costs associated with bringing low water ramps online during low water periods can vary based on the maintenance required to restore operability as reservoir elevations fall. Maintenance to enable low water boat ramp operability can include cleaning the silt from the ramp, dredging sand around the ramp to make the ramp accessible for boats, and minor repairs, etc. On average, it costs approximately $800 per ramp to clean and bring a low water ramp online after the reservoir elevation had fallen from the previous year, although these costs can vary considerably (McMurray pers. comm. 2016b). In addition, normal water boat ramps also require maintenance if the boat ramp remains operable when water levels have dropped from the previous year.

To evaluate how lower surface elevations under the action alternatives may increase O&M costs, an Excel®-based model was developed to evaluate consecutive years when reservoir elevations fall and normal and low water boat ramps remain operable. Boat ramps were considered operable when surface elevations remained between the top and bottom operating elevation of the boat ramp.

Simulated reservoir elevations at the beginning of the summer season, on average between June 25 and July 5, were obtained and compared to simulated reservoir elevations at the same time in the previous year. If early July surface elevations were three or more feet lower than the average elevation at the beginning of the previous July and the boat ramp was operable, the boat ramps were assumed to require cleaning, de-silting, and other maintenance activities that year to accommodate boat launches. The low water ramps that were to be extended or replaced in the RR&R analysis were assumed to always be operable during the POR. The $800 was applied to every year that these conditions were met (drop of three feet from previous year and operable normal boat ramp) for the MRRMP-EIS alternatives to estimate the operating and maintenance costs at the upper three reservoirs.

2.5 Regional Economic Development

The RED account evaluates how changes under the MRRMP-EIS alternatives would affect regional economic conditions, including labor income, employment, and sales. These effects are typically expressed in monetary values or other numeric units (i.e., number of jobs) and are classified as either a direct or secondary (indirect and induced) effects. Direct effects represent the impacts of non-local visitor spending and resulting sales that are generated to tourism industries near the recreation areas. Indirect effects represent the impacts caused by the iteration of industries purchasing goods and services to support the directly affected industries. Induced effects represent the economic impacts from changes by all affected workers spending their income in the local or regional economy.

The RED effects associated with recreation along the Missouri River stem from non-local visitor spending in communities adjacent to recreation areas. Visitors traveling to the Missouri River spend their income in communities where they eat in restaurants, stock up on gas and supplies at local retailers, and stay in overnight accommodations while at their recreation destination. The visitor spending and resulting sales to local businesses provide a measure of the direct effect of outdoor recreation on the regional economy. An economic impact analysis measures the changes in economic activity associated with an industry, event, or policy in an existing regional economy (Watson et al. 2007). In the case of recreation on the Missouri River, this type of analysis examines how visitors who reside outside of the local region (non-local visitors) inject spending into local economies while visiting the area, and how this spending creates multiplier effects in the local economies stimulating additional economic activity. Although recreation opportunities enjoyed by local residents contribute to personal well-being, spending by residents is generally not included in regional economic analyses because these expenditures would not inject new money or spending into the local economy; spending would occur by local residents regardless of visitation to the recreation area.

The RED recreation analysis uses the results from the NED analysis to assess how changes in visitation under the MRRMP-EIS alternatives would affect regional economic conditions. Since results from the NED analysis showed that visitation to Lake Sharpe would be unaffected by actions under the alternatives, there would be no RED impacts for Lake Sharpe under the MRRMP-EIS alternatives and therefore it was not evaluated in the RED analysis. The inter-reservoir river reaches and lower river were also excluded from the RED analysis since these river reaches primarily wind through private lands where public access is limited, and previous reports have indicated that visitation was mostly by residents who live nearby (USACE 2006; USACE 2011; USACE 2001; Sheriff et al. 2011).

Non-local visitation at five of the Mainstem reservoirs were used as inputs in an economic impact analysis to estimate how changes in visitor spending will affect jobs and income under

the MRRMP-EIS alternatives. The USACE-certified RED model, Regional Economic System (RECONS) was used to estimate the economic impacts. The non-local visitor spending would occur in the communities and counties adjacent to the USACE project area, generally within 50 miles from the USACE project area.

The NED analysis provided estimates of recreation visitor days over the 81-year POR for each reservoir under each of the MRRMP-EIS alternatives. For consistency with RECONS, total visitation by various types of visitors needs to be entered into the model. Total recreational visitor days for upper three reservoirs were estimated by combining the spring, summer, and fall visitation with winter visitation. Since visitation at the lower three reservoirs was segmented in the NED analysis to focus on lake-elevation affected visitors, the non-lake affected visitation needed to be added to estimate total lake visitation. Annual recreation visitor days were then converted back to annual visits by adjusting for multi-day camping visits using an estimate of 3.8 recreation days per camping visit, as reported by the OMBIL database (USACE OMBIL 2012a).

The estimates of annual visitation over the 81-year POR for the plan-affected and non-plan-affected visitation were further analyzed to focus on scenarios for the economic impact analysis so as not to estimate RED impacts for 81 years. Five scenarios were developed on which to estimate the economic impacts under each of the MRRMP-EIS alternatives: lowest annual visitation; highest annual visitation; annual average visitation; average of the eight years with the lowest visitation difference from Alternative 1; and average of the eight years with the highest visitation difference from Alternative 1. The total visitation for each of the five scenarios was further segmented for consistency with RECONS.

The RECONS model, by default, estimates the economic impacts of visitor spending for three study areas: local, state, and the nation. The local study area is specified by default based on USACE project areas. The local study area usually includes the counties within and surrounding the project boundary, including counties generally within 50 miles of the project area. The state study area includes the state or states in which the local study area is located. After reviewing the local study areas for the five reservoirs, the project team felt that there were a number of counties missing from the local study areas. Given this and because the results of the economic impact analysis for the local and state study areas were very similar, the economic impact analysis was based on the state study area results. This state level analysis was also consistent with the RED analysis for other resource topics. Although some of the economic impacts may be experienced over the wider state geographic area, the vast majority of the jobs, income, and sales would be supported and generated in the counties within 50 miles of the reservoirs where the non-local visitor spending occurs. Table 16 summarizes the state study areas for each of the five reservoirs.

Table 16. Study Areas

Reservoir	State Study Area
Fort Peck Lake	Montana
Lake Sakakawea	North Dakota
Lake Oahe	South Dakota
Lake Francis Case	South Dakota
Lewis and Clark Lake	South Dakota

Note: State study areas are defined in the RECONS model.

It should be noted that Lake Oahe extends into North Dakota, but most of the recreation areas at Lake Oahe are located in South Dakota.

As described previously, the focus of the economic impact analysis was on visitor spending from non-local visitors. Information was obtained from state sources, recent angler and visitor surveys, and published reports to estimate the percent of local and non-local visitors. Table 17 summarizes recent data on the residency of visitors to the five reservoirs.

Table 17. Residency of Visitors to the Reservoirs

Reservoir	Visitors from Counties Surrounding or Adjacent to Project Area	Non-local Visitors[a]
Fort Peck Lake	8%	92%
Lake Sakakawea	22%	78%
Lake Oahe	30%	70%
Lake Francis Case	21%	79%
Lewis and Clark Lake	57%	43%

Source: Longhenry pers. comm. 2016; Fryda pers. comm. 2016; USGS 2011; South Dakota Game Fish and Parks 2016.

a Non-local visitors include visitors from counties with population centers greater than 50 miles from the reservoir project area.

Non-local visitation was further segmented into visitor groups consistent with those defined in the RECONS model (Table 18). First, day and overnight visits to each reservoir were estimated by applying the day/overnight proportions for each project area from RECONS to the estimates of non-local visitation at the respective reservoir. Day/Boater visits were then estimated by applying boating activity distributions from VERS to counts of non-local day visits at the corresponding reservoir. The remaining day use visits were then allocated to the Day/Non-Boater category. Camping activity distributions from VERS were then applied to overnight visitation counts to specify camping and non-camping overnight visitation at each of the reservoirs. Boating activity distributions from VERS were then applied to camping and overnight (non-camping) visits to identify Camper/Boater and Overnight/Boater visitation. The remaining Camper and Overnight visitation were then allocated to the Non-Boater category.

Table 18. Non-Local Visitor Activity Distributions

Reservoir	Day/Boater	Day/Non-Boater	Overnight/ Boater	Overnight/ Non-Boater	Camper/Boater	Camper/Non-Boater
Fort Peck Lake	21%	64%	3%	9%	1%	2%
Lake Sakakawea	21%	69%	2%	7%	<1%	1%
Lake Oahe	8%	25%	16%	48%	1%	2%
Lake Francis Case	26%	66%	2%	6%	<1%	<1%
Lewis and Clark Lake	6%	85%	1%	7%	<1%	<1%

Source: Estimated with data and information from VERS (USACE 2012c) and RECONS (USACE 2012b).

Visitor spending profiles for the types of visitors were specified in RECONS; the visitor spending profiles are built into the RECONS database and include spending in ten categories, as shown in Table 19. Total spending is then estimated for each type of visitor by multiplying the number

of visits times the average spending profile. Although the number of visitors (one person for a day or multiple days) is the input into RECONS, RECONS model then converts the visitors to visitor party-days to estimate visitor spending per party per day.[7]

Table 19. RECONS Non-Local Visitor Spending by Type of Visitor ($ per party per day, 2018$)

Spending by Category	Day Boater	Day/Non-Boater	Camper Boater	Camper Non-Boater	Overnight Boater	Overnight Non-Boater
Motel, Hotel Cabin or B&B	0.00	0.00	6.08	2.90	56.55	60.24
Camping Fees	0.00	0.00	18.80	29.60	0.23	0.33
Restaurants & Bars	10.70	10.70	19.66	33.86	44.58	52.39
Groceries, Take-out Food/Drinks	8.40	4.39	29.02	21.67	26.32	14.94
Gas & Oil	21.80	7.27	26.60	21.68	33.38	17.86
Other Auto expenses	0.79	0.09	0.99	5.02	0.33	2.42
Other Boat Expenses	21.03	0.51	10.56	0.96	16.43	0.70
Recreation Fees	0.96	2.46	7.50	28.39	17.35	44.76
Sporting Goods	11.60	2.68	3.66	5.44	6.50	3.29
Souvenirs and Other Expenses	12.03	3.59	6.17	15.29	13.33	29.32
Total	**87.31**	**31.69**	**129.05**	**164.80**	**215.00**	**226.27**

Source: RECONS (2012).

The RECONS recreation module then applies these spending profiles to annual visitation counts for each type of visitor to estimate visitor expenditures. In RECONS, the visitor expenditures are assumed to be spent in the communities within 50 miles from the reservoir. There are ten categories of spending, which are then mapped to industry sectors to quantify the direct and secondary (i.e., indirect and induced) effects of visitor spending on regional sales, employment, and labor income. RECONS uses IMPLAN® multipliers and ratios, which is an industry-standard input-output model to estimate the multiplier impacts. Since RECONS and IMPLAN® are linear models and the distribution of visitors to the various types of visitors is the same across alternatives, results from Alternative 1 can be scaled up or down based on the proportional difference in visitation under the other alternatives and scenarios to quantify the RED effects of visitor spending under MRRMP-EIS alternatives and scenarios.

2.6 Availability of Substitute Recreation Areas

The availability and accessibility of alternative recreation sites may have an impact on the recreation economic evaluation, notably the RED evaluation. When reservoir or river conditions on the Missouri River result in reduced visitation, there may not be a proportional impact on jobs

[7] For further information on the RECONS methods and assumptions, refer to the RECONS User Guide (http://www.iwr.usace.army.mil/Portals/70/docs/missions/RECONS_USER_GUIDE.PDF) and RECONS Methodology Manual (http://www.iwr.usace.army.mil/Portals/70/docs/missions/RECONS_%20MethodologyManual-2.pdf) for additional details on the recreation assumptions and methods.

and income if there are sufficient recreational sites in the region to attract visitors and visitor spending to those substitute recreational areas. Depending on where the visitors decide to recreate during adverse conditions on the Missouri River, there would likely be a transfer in visitors spending and associated economic activity from one region (for example, surrounding a reservoir) to the substitute recreation site.

Because of the prevalence of local visitors (river reaches) and relatively small impacts to visitation (river reaches and the lower three reservoirs), an evaluation of the availability of substitute sites was not conducted for the river reaches and the lower three reservoirs. Therefore, the focus of this section is on the availability of alternative recreational opportunities in proximity to the upper three reservoirs and the potential impacts on the NED and RED values.

Fort Peck Lake, Lake Sakakawea and Lake Oahe are world-famous for their walleye, northern pike, and other boating and fishing opportunities. In general, the upper three reservoirs provide a remote and unique recreational experience. There are limited recreational opportunities located within the local region (defined at 50 miles from the lakes) that provide similar opportunities. A number of reservoirs have been identified as potential recreational areas that provide similar opportunities for sport fishing and boating within 300 miles of the reservoirs (Table 20). The closest lake with similar amenities to those at the upper three reservoirs was identified as Nelson Reservoir in Montana, located approximately 73 miles from Fort Peck Lake.

Table 20. Other Lakes with Similar Amenities to the Missouri River Reservoirs

Reservoir	Closest Missouri River Reservoir	Approximate Distance to Missouri River Reservoir
Nelson Reservoir, Montana	Fort Peck	73 miles
Bighorn Reservoir, Montana	Fort Peck	300 miles
Jamestown Reservoir, North Dakota	Lake Sakakawea	270 miles
Shadehill Reservoir, South Dakota	Lake Oahe	170 miles

Although there are other lakes that provide similar fishing and boating opportunities, they would be relatively far away from the adjacent communities to the upper three reservoirs; that is, visitors would not be staying in the communities surrounding the Missouri River reservoirs while visiting other substitute sites. During adverse recreation conditions on the Missouri River reservoirs, it is possible that visitors would choose to visit these substitute or alternative reservoirs; therefore, the visitor spending and associated regional jobs and income would be reduced in the communities surrounding the Missouri River reservoirs, but could still remain within the state. Changes in visitation, visitor spending, NED, and RED benefits estimated through this evaluation that are associated with the alternatives affecting reservoir conditions at the upper three Missouri River reservoirs would not likely be affected by alternative sites because there are limited proximate recreational opportunities.[8]

[8] It should be noted that as part of regional economic analysis for the recreation evaluation for the Missouri River Master Water Control Manual, Review and Update, Volume 6C: Recreation Economics (USACE 1994), the modeling indicated that there was not a statistically significant association between substitute recreation opportunities and visitation to the upper three reservoirs (see Table 1 in Recreation Economics Technical Report Appendix D within Volume 6C).

3.0 National Economic Development Results

This section presents the results of the NED analysis. The first section provides the NED impacts across all alternatives, and the following section provides a summary of NED impacts specific to each alternative. In this section, results are presented for the upper and lower river locations. The upper river includes all locations above Gavins Point Dam, including the six reservoirs and the inter-reservoir river reaches. The lower river includes the river reaches below Gavins Point Dam.

3.1 Summary Across Alternatives

This section describes the impacts to recreation NED benefits under the MRRMP-EIS alternatives at the upper three reservoirs, lower three reservoirs, the inter-reservoir reaches, and the lower river reaches. The recreation NED tables in this section include total benefits and changes in benefits relative to Alternative 1 over the 81-year period of record (POR), including visitation, recreation NED benefits and OMRR&R costs; average annual NED benefits and changes in average annual benefits. In addition, the recreation NED tables include two statistics that focus on the differences from Alternative 1: the average of the eight best difference years (highest visitation years compared to Alternative 1); and the average eight worst visitation years (lowest visitation years compared to Alternative 1). These statistics allow an understanding of the skewness of impacts and magnitude of impacts in these largest difference years. Additional details on the alternative-specific impacts are provided in Sections 3.3 through 3.7.

3.1.1 Upper Three Reservoirs

The recreation visitor days, recreation NED benefits, and OMRR&R costs for Fort Peck Lake, Lake Sakakawea, and Lake Oahe are each summarized respectively in Tables 21, 22, and 23. Figures 3, 4, and 5 depict the change in annual recreation NED benefits from changes in visitation relative to Alternative 1 at each of the upper three reservoirs, respectively.

Alternatives 4 and 6 would result in adverse impacts on average to recreational NED benefits at Fort Peck Lake, Lake Oahe and Lake Sakakawea. The largest reduction in benefits would occur under Alternative 4, with an average annual reduction of NED benefits of $229,000, $527,000, and $332,000 associated with Fort Peck Lake, Lake Sakakawea, and Lake Oahe, respectively. Alternative 3 and 5 would result in only negligible to small changes in recreation NED benefits, with less than 0.2 percent change from Alternative 1 at each of the reservoirs. Alternative 3 would result in slight increases in recreation NED benefits at each of the upper three reservoirs. Alternative 2 would result in small increases in average annual recreation NED benefits at Fort Peck Lake (0.6%) and small reductions in average annual recreation NED benefits at Lake Sakakawea (-0.2%) and Lake Oahe (-0.9%).

Table 21. Summary of Visitation and Recreation NED Benefits for Fort Peck Lake (Thousands of 2018 Dollars)

Visitation/Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days	385,305	387,450	386,008	375,762	385,198	382,650
Change in Average Annual Recreation Visitor Days	NA	2,146	703	−9,542	−107	−2,654
Percent Change in Average Annual Recreation Visitor Days	NA	0.6%	0.2%	−2.5%	0.0%	−0.7%
Total Visitation Benefits	$738,993	$743,112	$740,353	$720,732	$738,786	$733,954
OMRR&R Costs (total)	$268	$281	$268	$532	$263	$527
Total NED Benefits	$738,725	$742,831	$740,085	$720,200	$738,523	$733,426
Total NED Change from Alternative 1	NA	$4,105	$1,360	−$18,525	−$202	−$5,299
Percent Change from Alternative 1	NA	0.6%	0.2%	−2.5%	0.0%	−0.7%
Average Annual NED Benefits	$9,120	$9,171	$9,137	$8,891	$9,118	$9,055
Change in Average Annual NED Benefits	NA	$51	$17	−$229	−$2	−$65
8 Worst Years Relative to Alternative 1	NA	−$1,073	−$16	−$1,671	−$196	−$586
8 Best Years Relative to Alternative 1	NA	$1,743	$87	$436	$2,138	$2,903

Table 22. Summary of Visitation and Recreation NED Benefits for Lake Sakakawea (Thousands of 2018 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days	1,352,159	1,349,725	1,353,313	1,335,507	1,349,836	1,340,803
Change in Average Annual Recreation Visitor Days	NA	−2,435	1,153	−16,652	−2,323	−11,356
Percent Change in Average Annual Recreation Visitor Days	NA	−0.2%	0.1%	−1.2%	−0.2%	−0.8%
Total Visitation Benefits	$3,456,773	$3,450,549	$3,459,721	$3,414,202	$3,450,833	$3,427,740
OMRR&R Costs (total)	$1,700	$1,673	$1,669	$1,796	$1,667	$1,856
Total NED Benefits	$3,455,072	$3,448,875	$3,458,052	$3,412,406	$3,449,165	$3,425,884
Total NED Change from Alternative 1	NA	−$6,197	$2,980	−$42,667	−$5,907	−$29,189
Percent Change from Alternative 1	NA	−0.2%	0.1%	−1.2%	−0.2%	−0.8%
Annual Average NED Benefits	$42,655	$42,579	$42,692	$42,128	$42,582	$42,294.86

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Change in Annual Average NED Benefits	NA	−$77	$37	−$527	−$73	−$360
8 Worst Years Relative to Alternative 1	NA	−$1,362	−$127	−$2,007	−$736	−$1,092
8 Best Years Relative to Alternative 1	NA	$1,092	$214	$176	$295	$77

Table 23. Summary of Visitation and Recreation NED Benefits for Lake Oahe (Thousands of 2018 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days	993,867	984,987	996,223	977,257	993,451	971,864
Change in Average Annual Recreation Visitor Days	NA	−8,879	2,357	−16,610	−416	−22,003
Percent Change in Average Annual Recreation Visitor Days	NA	−0.9%	0.2%	−1.7%	0.0%	−2.2%
Total Visitation Benefits	$1,601,610	$1,587,302	$1,605,408	$1,574,844	$1,600,940	$1,566,153
OMRR&R Costs (total)	$1,405	$1,316	$1,371	$1,496	$1,398	$1,451
Total NED Benefits	$1,600,206	$1,585,986	$1,604,037	$1,573,347	$1,599,542	$1,564,702
Total NED Change from Alternative 1	NA	−$14,220	$3,832	−$26,858	−$663	−$35,503
Percent Change from Alternative 1	NA	−0.9%	0.2%	−1.7%	0.0%	−2.2%
Annual Average NED Benefits	$19,756	$19,580	$19,803	$19,424	$19,747	$19,317
Change in Annual Average NED Benefits	NA	−$176	$47	−$332	−$8	−$438
Average of 8 Worst Years Relative to Alternative 1	NA	−$873	−$70	−$1,156	−$459	−$1,380
Average of 8 Best Years Relative to Alternative 1	NA	$398	$205	$111	$257	$67

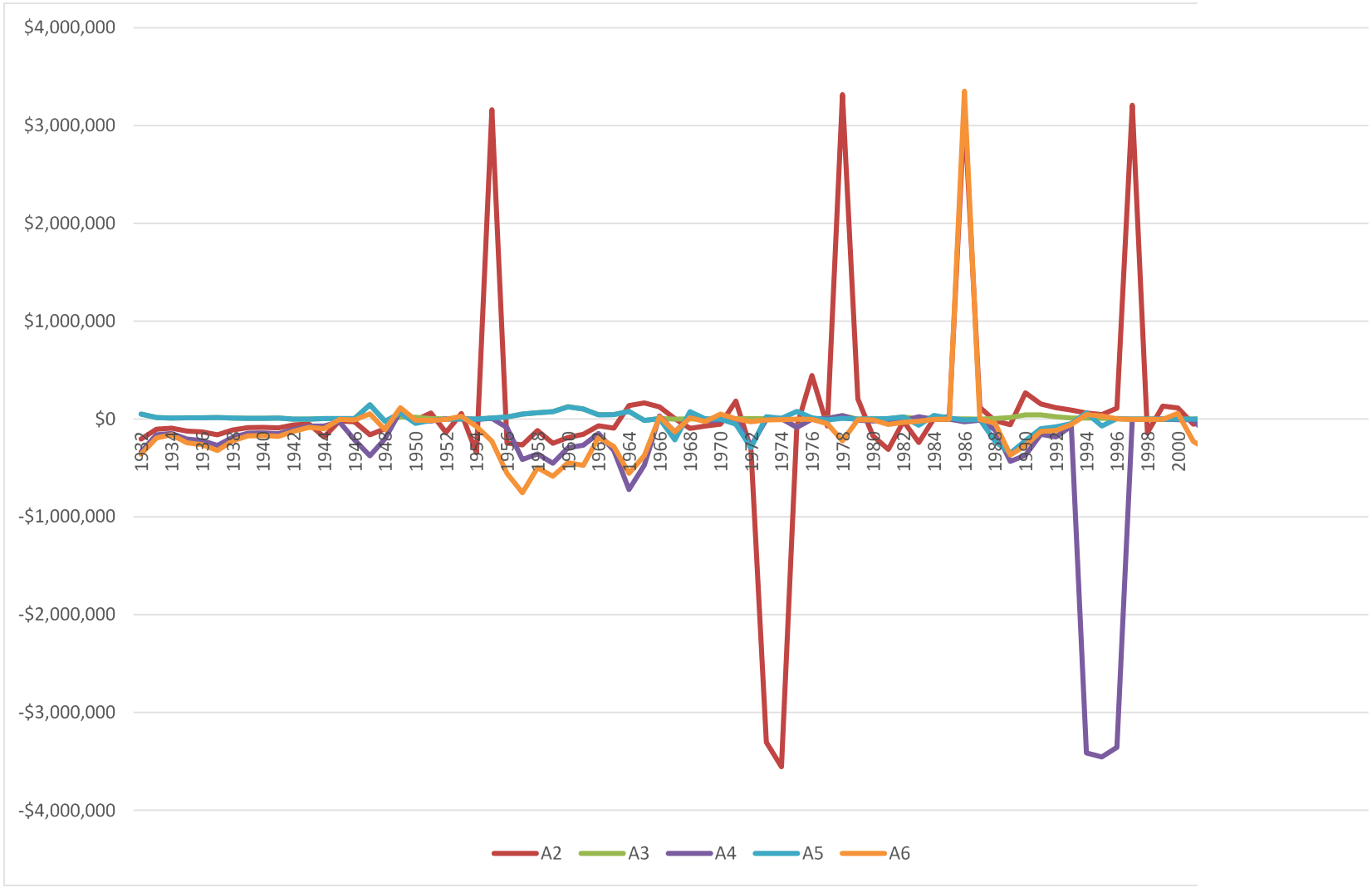

Figure 3. Fort Peck Lake Annual Differences in Recreation NED Benefits under the MRRMP-EIS Alternatives Relative to Alternative 1

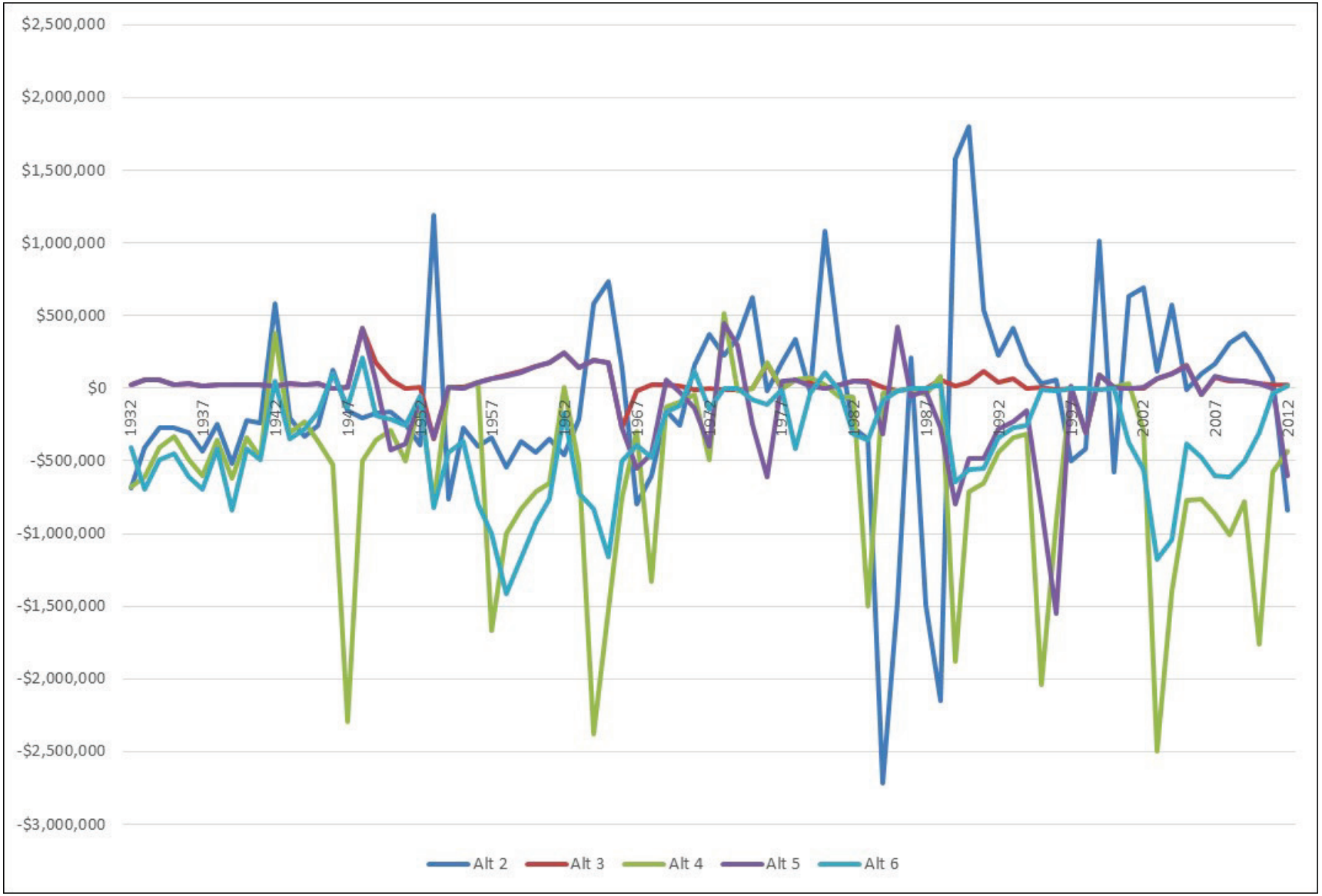

Figure 4. Lake Sakakawea Annual Differences in Recreation NED Benefits under the MRRMP-EIS Alternatives Relative to Alternative 1

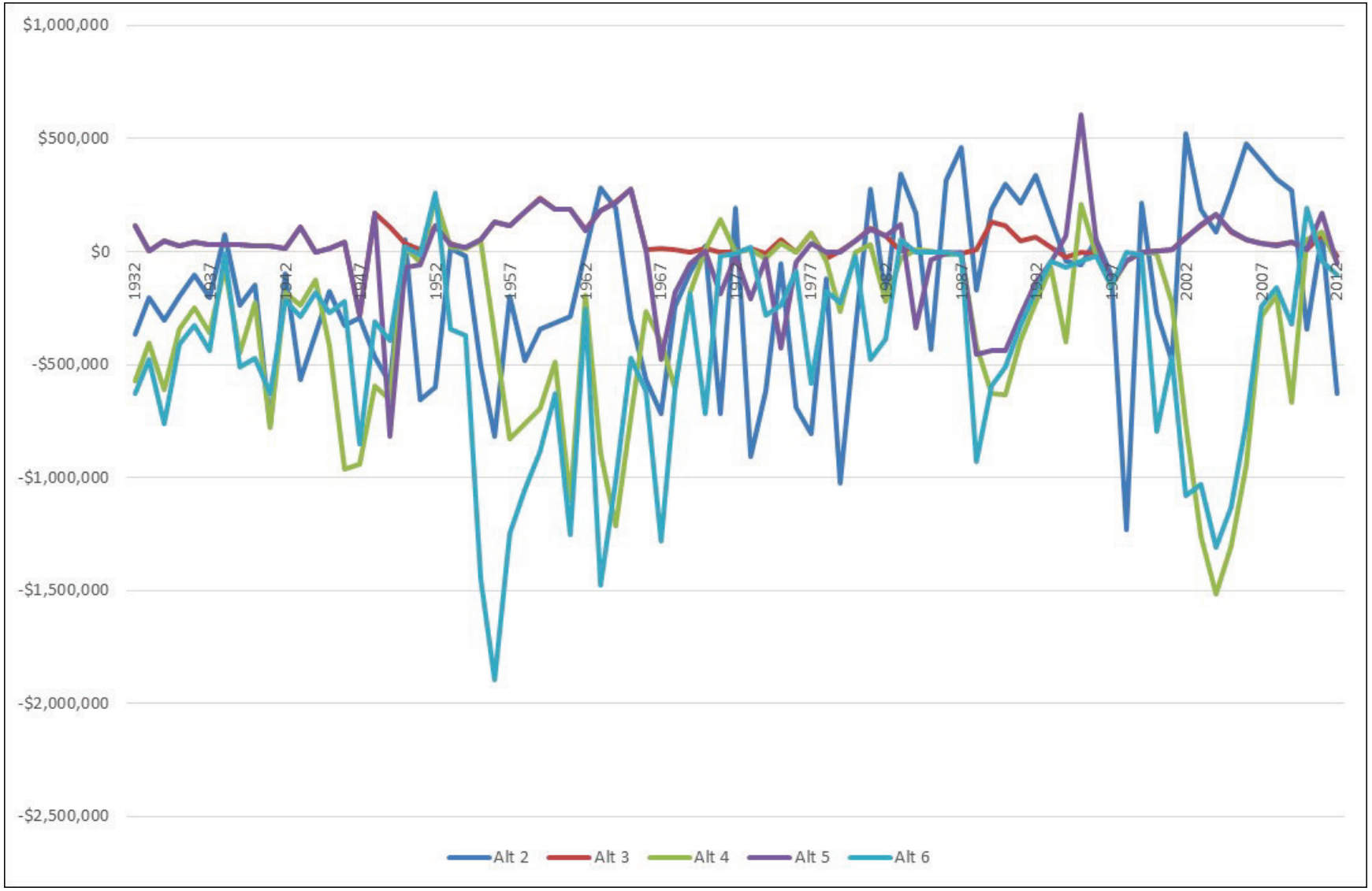

Figure 5. Lake Oahe Annual Differences in Recreation NED Benefits under the MRRMP-EIS Alternatives relative to Alternative 1

3.1.2 Lower Three Reservoirs

Table 24 summarizes the recreation NED benefits in the lower three reservoirs. Relative to Alternative 1, Alternatives 2 through 6 would result in very little change in NED recreation benefits supported by the lower three Mainstem reservoirs. The majority of adverse impacts would occur at Lewis and Clark Lake, while recreation NED benefits associated with Lake Sharpe would be unaffected by management actions under the alternatives. Recreation NED benefits in the eight worst case years relative to Alternative 1 supported by the lower three reservoirs would decrease from $106,000 (Alternative 3) to $253,000 (Alternative 2). In general, adverse impacts affecting visitation in some years at the lower three reservoirs would be offset by increases in benefits in other years, resulting in negligible changes to recreation NED benefits over the POR compared to Alternative 1.

Table 24. Summary of Visitation and Recreation NED Benefits for Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake (Lower Three Reservoirs) (Thousands of 2018 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days[a]	1,193,943	1,200,086	1,194,494	1,192,618	1,194,265	1,198,704
Change in Average Annual Recreation Visitor Days[a]	NA	6,142	551	−1,326	322	4,761
Percent Change in Average Annual Recreation Visitor Days[a]	NA	0.5%	0.0%	−0.1%	0.0%	0.4%
Total Visitation Benefits	$1,358,489	$1,362,718	$1,358,856	$1,357,128	$1,358,006	$1,361,061
Total NED Benefits	$1,358,489	$1,362,718	$1,358,856	$1,357,128	$1,358,006	$1,361,061
Total NED Change from Alternative 1	NA	$4,230	$367	−$1,361	−$483	$2,572
Percent Change from Alternative 1	NA	0.3%	0.0%	−0.1%	−0.0%	0.2%
Annual Average NED Benefits	$16,771	$16,824	$16,776	$16,755	$16,766	$16,803
Change in Annual Average NED Benefits	NA	$52	$5	−$17	−$6	$32
8 Worst Years Relative to Alternative 1	NA	−$253	−$106	−$187	−$202	−$120
8 Best Years Relative to Alternative 1	NA	$334	$158	$171	$171	$319

Note: As described in Section 3.1, the HEC-ResSim modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

a The recreation visitor day estimates include only spring, summer, and fall lake-elevation affected recreation visitor days and do not include all visitation at the reservoirs.

3.1.3 Inter-Reservoir River Reaches

Table 25 summarizes the recreation NED benefits for the inter-reservoir river reaches. Under Alternative 1, the inter-reservoir reaches would support $2.9 million in average annual recreation NED benefits. Alternatives 3 through 6 would result in negligible changes in NED benefits relative to Alternative 1. Alternatives 4, 5, and 6 would result in small decreases in average annual recreation NED benefits would occur compared to Alternative 1. Alternative 2 would have the greatest increases in recreation NED benefits relative to Alternative 1, an average annual increase of 2.1 percent compared to Alternative 1, which would be caused by the considerable amount of habitat created in the Garrison Dam to Lake Oahe and Randall Dam to Lewis and Clark Lake reaches. Average NED benefits in the 8 worst years relative to Alternative 1 would result in a decrease of recreation NED benefits between $17,000 (Alternative 3) and $169,000 (Alternative 2).

Table 25. Summary of Visitation and Recreation NED Benefits for Inter-Reservoir River Reaches (Thousands of 2018 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days[a]	178,908	178,610	178,879	178,071	178,800	178,587
Change in Average Annual Recreation Visitor Days[a]	NA	−298	−28	−837	−107	−321
Percent Change in Average Annual Recreation Visitor Days[a]	NA	−0.2%	0.0%	−0.5%	−0.1%	−0.2%
Total Visitation Benefits	$233,337	$232,200	$233,325	$232,020	$233,194	$232,873
Total Habitat Benefits (total)	$1,631	$7,760	$1,908	$1,703	$1,620	$1,340
Total NED Benefits	$234,968	$239,960	$235,233	$233,723	$234,813	$234,213
Total NED Change from Alternative 1	NA	$4,992	$265	-$1,245	-$155	-$755
Percent Change from Alternative 1	NA	2.1%	0.1%	-0.5%	-0.1%	-0.3%
Annual Average NED Benefits	$2,901	$2,962	$2,904	$2,885	$2,899	$2,892
Change in Annual Average NED Benefits	NA	$62	$3	-$15	-$2	-$9
8 Worst Years Relative to Alternative 1	NA	-$169	-$17	-$132	-$74	-$87
8 Best Years Relative to Alternative 1	NA	$223	$19	$36	$47	$39

a The recreation visitor day estimates include only spring, summer, and fall boat-accessed recreation visitor days and do not include all visitation at the inter-reservoir river reaches.

3.1.4 Lower River

Table 26 summarizes the recreation NED benefits under the MRRMP-EIS alternative for the lower river, the river reaches below Gavins Point Dam. The annual recreation NED benefits are depicted in graphs under each of the alternatives sections below (Sections 4.2 through 4.7). On annual average, recreation NED benefits supported by the lower river under Alternative 2 would be higher than under Alternative 1 because considerably more habitat would increase recreation NED values. There would be negligible changes from Alternative 1 for Alternatives 3 through 6. Spawning cues and flow releases to create habitat under Alternatives 2, 4, 5, and 6 were generally shown to have temporary beneficial effects on boat ramp operability and visitation in the years when these events occurred. However, there would also be lower river flows relative to those under Alternative 1 during other periods which would adversely impact boat ramp access and visitation as the reservoir system rebalances from a pulse or release event. Although Alternative 2 results in higher recreation NED benefits relative to Alternative 1 due to considerably more habitat created under this alternative, there are very small adverse impacts to recreation access (boat ramp operability) in the summer and fall following the spawning cue releases which partially offset the increased habitat benefits.

Table 26. Summary of Visitation and Recreation NED Benefits for the Lower River (Thousands of 2018 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days[a]	1,077,267	1,067,817	1,078,461	1,080,412	1,081,823	1,081,825
Change in Average Annual Recreation Visitor Days[a]	NA	−9,450	1,194	3,145	4,556	4,558
Percent Change in Average Annual Recreation Visitor Days	NA	−0.9%	0.1%	0.3%	0.4%	0.4%
Total Visitation Benefits	$890,060	$882,145	$891,181	$892,897	$893,985	$893,013
Total Habitat Benefits	$13,196	$37,247	$9,957	$9,752	$9,687	$9,870
Total NED Benefits	$903,256	$919,392	$901,138	$902,649	$903,672	$902,883
Total NED Change from Alternative 1	NA	$16,136	-$2,118	-$607	$416	-$373
Percent Change from Alternative 1	NA	1.8%	-0.2%	-0.1%	0.0%	0.0%
Annual Average NED Benefits	$11,151	$11,351	$11,125	$11,144	$11,156	$11,147
Change in Annual Average NED Benefits	NA	$199	-$26	-$7	$5	-$5
8 Worst Years Relative to Alternative 1	NA	-$430	-$120	-$480	-$663	-$462
8 Best Years Relative to Alternative 1	NA	$734	$75	$1,001	$1,048	$832

a The recreation visitor day estimates include only spring, summer, and fall boat-accessed recreation visitor days and do not include all visitation at the inter-reservoir river reaches.

The creation of ESH and habitat to support the early life stage requirements of the pallid sturgeon under the MRRMP−EIS alternatives would contribute to increases in the abundance and diversity of species, and enhance wildlife-related recreation opportunities along the river. Habitat-related recreation benefits are estimated to range between $9.7 million (Alternative 5) and $37.2 million (Alternative 2) under the MRRMP-EIS alternatives over the 81-year POR, with Alternative 2 supporting almost four times more habitat-related benefits than under the other alternatives. Benefits attributable to habitat creation, however, account for a relatively small portion of total NED benefits under all MRRMP-EIS alternatives, with Alternative 2 accounting for the highest proportion of benefits, approximately 4.1 percent.

3.2 Alternative 1 – No Action

Under Alternative 1, average annual recreation NED benefits would be $102 million, with over $70 million would be attributable to the upper three reservoirs (Table 27 and Figure 6). As modeled, the upper three reservoirs would have the largest variation in recreation NED benefits, ranging from $38.5 million in a severe low-water year to $87.0 million in higher water years. Alternative 1 would result in average annual recreation NED benefits of nearly $16.8 million associated with the lower three reservoirs, which have relatively stable pool levels.

Table 27. Summary of NED Analysis for Alternative 1, 1932–2012 (Thousands of 2018 Dollars)

Recreation NED Benefits or Costs	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$5,797,376	$1,358,489	$233,337	$890,060	$8,279,262
Total Habitat Benefits	NA	NA	$1,631	$13,196	$14,827
OMRR&R Costs	$3,373	NA	NA	NA	$3,373
Total NED Benefits[b]	$5,794,003	$1,358,489	$234,968	$903,256	$8,290,716
Annual Average Benefits Less Costs	$71,531	$16,771	$2,901	$11,151	$102,355
Maximum Annual NED Benefits	$87,045	$17,248	$3,177	$18,083	$123,887
Minimum Annual NED Benefits	$38,478	$16,183	$2,349	$4,370	$63,188

a Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not included as plan-affected visitors in the river reaches.

b Total NED Benefits equal the sum of the visitation benefits and habitat benefits less the OMRR&R costs.

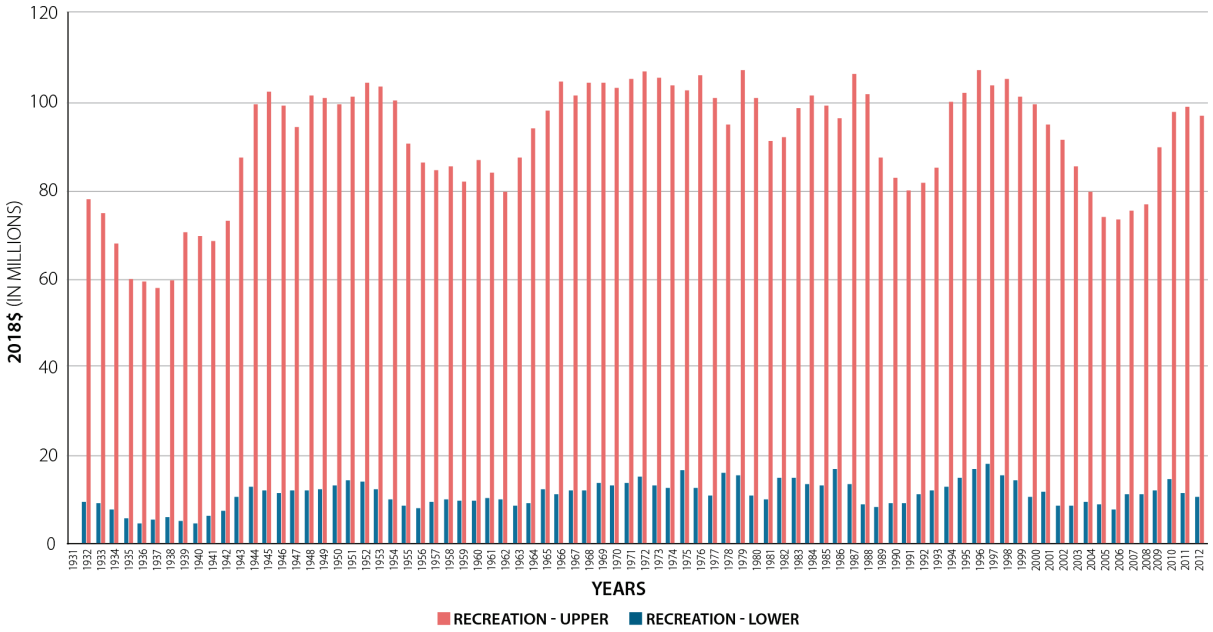

Figure 6. Annual Recreation NED Benefits Under Alternative 1 (2018$)

Average annual recreation NED benefits supported by the inter-reservoir river reaches would be $2.9 million, and habitat-related benefits would account for 0.7 percent of total NED benefit in the inter-reservoir river reaches. Average annual NED benefits in the lower river would be $11.1 million, ranging between $4.4 and $18.1 million in low and high visitation years based on fluctuations in the natural hydrologic cycles that affect accessibility of boat ramps. The prevalence of ESH and shallow water habitat would account for approximately 1.4 percent of recreation NED benefits in the lower river.

In addition, some visitors prefer lower river flows, such as those using paddle craft or swimming, because lower flows offer additional shoreline and sandbars amenities and/or perceptions of safer conditions. During the spawning cue releases in March and May, there could be some adverse impacts to these visitors who may prefer lower river flows. Peak summer visitation would not be affected under the spawning cue releases.

The NED evaluation also assessed costs associated with maintaining accessibility of boat ramps and other recreation facilities when the upper three reservoir elevations experience severe low-water conditions for consecutive years. Results from reservoir simulations showed that these OMRR&R costs associated with extending and/or replacing current ramps, providing infrastructure and road access to low boat ramp locations, and maintaining access to boat ramps when reservoir elevations fall in consecutive summers would be a total of approximately $3.4 million under Alternative 1.

Overall, recreation NED benefits supported by the Missouri River under Alternative 1 would be large and long term, providing local residents and non-local visitors with considerable recreational opportunities. The largest decreases in the recreation NED benefits under Alternative 1 would occur on the upper three reservoirs when access to the lakes and fishing opportunities would be directly affected by lower lake elevations during the natural cycles of drought or relatively drier periods.

3.3 Alternative 2 – USFWS 2003 Biological Opinion Projected Actions

Under Alternative 2, the Missouri River would support on average $102 million in recreation NED benefits per year, an increase of $112,000 (0.1 percent) compared to Alternative 1 (Table 28). The largest variations in recreational benefits would occur at the upper three reservoirs, where management actions under Alternative 2 would cause annual average NED benefits to decrease by 0.3 percent or approximately $201,000 relative to those under Alternative 1. Decreases in average annual NED benefits at the upper three reservoirs are attributable to lower reservoir elevations in modeled years following a spawning cue release during a low precipitation period when it would take longer to replenish system storage. Management actions under Alternative 2 would result in negligible changes to boat ramp operability, visitation, and recreation NED benefits at the lower three reservoirs under this alternative since these reservoirs are managed as flow-through reservoirs with relatively stable elevations.

Extensive habitat creation under Alternative 2 in the Garrison and Randall river reaches would generate long-term recreational benefits and result in higher valued recreational experiences in these river reaches. Under Alternative 2, habitat-related NED benefits in these inter-reservoir river reaches would increase to approximately $7.8 million compared to $1.2 million under Alternative 1 over the total POR. Collectively, management actions under Alternative 2 would increase average annual recreation NED benefits in the inter-reservoir river reaches by approximately $62,000 (2.1 percent) relative to Alternative 1.

Compared to Alternative 1, average annual NED benefits in the lower river would increase by $199,000, or 1.8 percent, as a result of management actions under Alternative 2. This increase in recreation NED benefits would primarily be driven by a greater prevalence of both ESH and early life stage habitat for the pallid sturgeon in the lower river, resulting in beneficial impacts to recreation compared to Alternative 1. In addition, visitors who prefer lower river flows in the lower river may experience adverse impacts during spawning cue releases although this alternative would not affect peak summer visitation.

Table 28: Summary of NED Analysis for Alternative 2, 1932–2012 (Thousands of 2018 Dollars)

Recreation NED Benefits or Costs	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$5,780,962	$1,362,718	$232,258	$882,145	$8,258,084
Total Habitat Benefits	NA	NA	$7,760	$37,247	$45,007
OMRR&R Costs (total)	$3,271	NA	NA	NA	$3,271
Total NED Benefits[b]	$5,777,692	$1,362,718	$239,960	$919,392	$8,299,762
Annual Average NED Benefits	$71,330	$16,824	$2,962	$11,351	$102,466
Change in Average Annual NED Benefits from Alternative 1	−$201	$52	$62	$199	$112
Percent Change in Average Annual NED Benefits from Alternative 1	−0.3%	0.3%	2.1%	1.8%	0.1%
Annual Average 8 Worst Years Relative to Alternative 1	−$2,414	−$253	-$169	-$430	-$2,472
Annual Average of 8 Best Years Relative to Alternative 1	$2,364	$334	$223	$734	$2,708

a Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not included as plan-affected visitors in the river reaches.

b Total NED Benefits equal the sum of the visitation benefits and habitat benefits less the OMRR&R costs.

OMRR&R costs associated with the upper three reservoirs would be lower under Alternative 2, decreasing by a total of $102,000 over the POR compared to OMRR&R costs under Alternative 1 because spawning cue releases under Alternative 2 could reduce lake elevations in the years after release events during periods of relatively low precipitation. As a result, OMRR&R costs associated with low-water recreation infrastructure would increase to maintain reservoir access during these relatively drier periods. OMRR&R costs under Alternative 2 would result in negligible to small adverse impacts relative to Alternative 1 and would depend on the timing and location of capital investments.

When evaluating impacts associated with each MRRMP-EIS alternative, it is useful to analyze annual impacts to better understand under what conditions beneficial or adverse impacts would occur. Figure 7 shows annual NED recreation benefits in the upper (includes Mainstem reservoirs and inter-reservoir river reaches) and lower river. Figures 8 and 9 show the difference in recreation NED benefits between Alternatives 1 and 2, which are plotted and color-coded based on the type of release occurring each year, for the upper river and lower river, respectively.

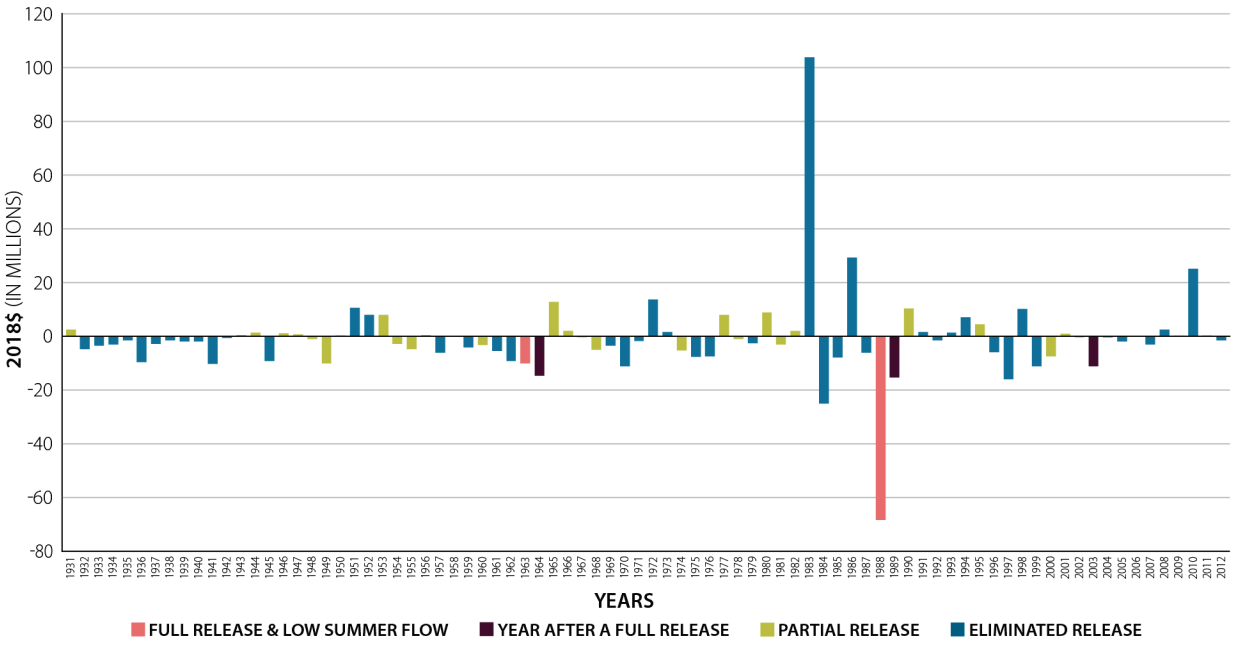

Figure 7. Annual Difference in Recreation NED Benefits Under Alternative 2 Relative to Alternative 1 (2018$)

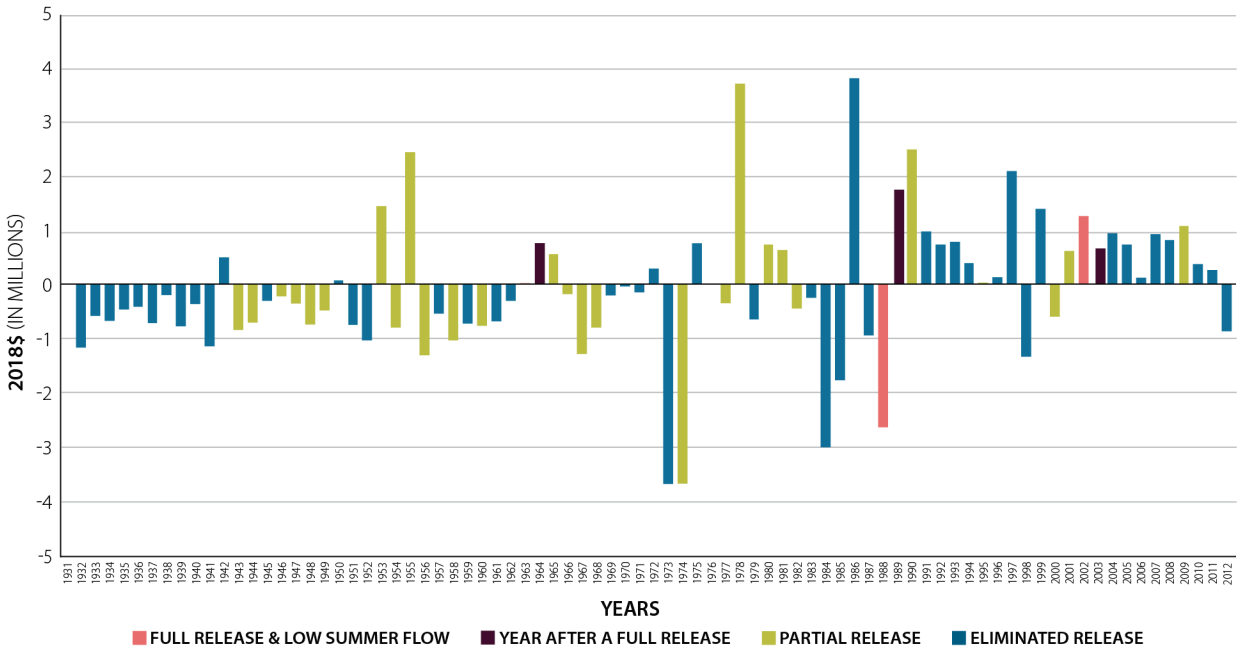

Figure 8. Annual Difference in Recreation NED Benefits under Alternative 2 compared to Alternative 1 in the Upper River (2018$)

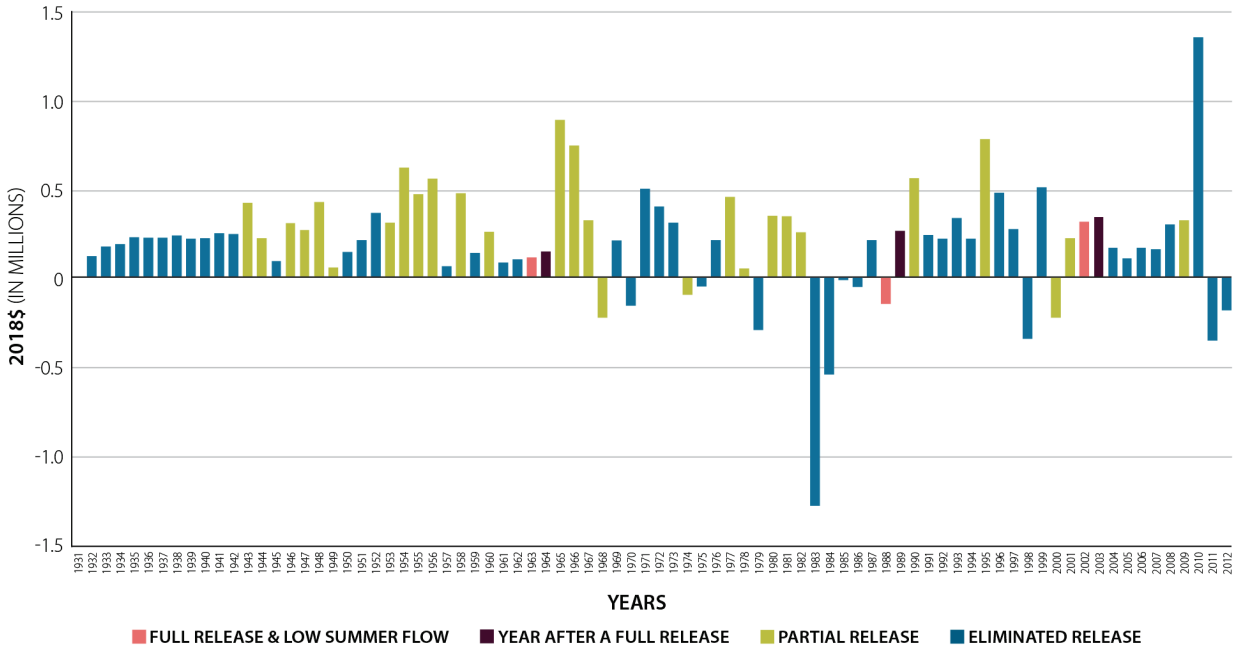

Figure 9. Annual Difference in Recreation NED Benefits under Alternative 2 Compared to Alternative 1 in the Lower River (2018$)

Annual recreation benefits supported by the upper river were between $1 million and $3.7 million lower than those under Alternative 1 in 13 of the 81 simulated years. In some of these simulated years, full or partial spawning cue releases would cause lower reservoir elevations impacting recreational opportunities. When spawning cues coincide with the onset of drier environmental conditions, reservoir elevations tend to be lower under Alternative 2 compared to Alternative 1 in the years following the spawning cue release (or partial release). As simulated under the alternatives, in the worst difference years (for each lake), recreation NED benefits would decrease by $3.6 million at Fort Peck Lake (1974), $2.7 million at Lake Sakakawea (1984), and $1.2 million at Lake Oahe (1998). As simulated in 1983, Lake Sakakawea would be 9 feet lower than Alternative 1, decreasing the recreation visitor days by 86,000 lower relative to Alternative 1 in 1984. In 1998 at Lake Oahe, the pool elevations would be approximately 7 feet lower than Alternative 1, decreasing recreational fishing opportunities and recreation visitor days by 62,000 in this year. These low water elevations would adversely affect recreational access and fishing opportunities at the upper three reservoirs, which could take a number of years to recover depending on the precipitation and inflows.

The low summer flows that occur in the 1988 and 2002 would increase lake elevations, fishing opportunities and visitation in the late 1980s early 1990s, and the 2000s. These conditions result in an increase in recreation NED benefits in the upper river during these periods, especially in Lake Sakakawea and Lake Oahe. As simulated in 1989 at Lake Sakakawea, the pool elevation is up to 7 feet higher than under Alternative 1, with increases in visitation and recreation NED benefits in 1990.

In the upper river, Alternative 2 would result in two additional years when the fishing success criteria would be met at Fort Peck Lake, which has an impact on visitation and recreation NED benefits in Fort Peck Lake (and is captured in the upper river). There are changes in the timing and frequency of the years when the fishing success is met under Alternative 2 and

Alternative 1 at Fort Peck Lake. The changes in the fishing success metric occur in 1955, 1973, 1974, 1978, 1986, and 1997. In all other years, the fishing success metric was the same under both Alternative 2 and Alternative 1. Table 29 summaries the results of the fishing success metrics when they differ between Alternative 1 and Alternative 2.

Table 29: Summary of Fishing Success Metric at Fort Peck Lake

Year	Alternative 1	Alternative 2
1955	Fishing success criteria not met	Fishing success criteria met
1973	Fishing success criteria met	Fishing success criteria not met
1974	Fishing success criteria met	Fishing success criteria not met
1978	Fishing success criteria not met	Fishing success criteria met
1986	Fishing success criteria not met	Fishing success criteria met
1997	Fishing success criteria not met	Fishing success criteria met

Note: Fishing success criteria is met if: 1) the spring pool rise occurs in the current or previous two years and there has been no drop in the mid-August pool in the previous two summers (drought conditions); or 2) if the mid-August reservoir elevation has dropped in the past year (since the previous August), but has not dropped consecutively for the 2 prior years.

There are four years in the model simulation with notably higher recreation NED benefits under Alternative 2 relative to Alternative 1, 1955, 1978, 1986, and 1997, which would occur because fishing success criteria is met at Fort Peck Lake under Alternative 2 and not under Alternative 1. In 1996 and 1997, there was a falling pool even though the fishing success was determined to be good because prior to 1996, the pool had been increasing for the previous two years. These conditions in 1997 concentrate the fish and reduce nutrients coming into the reservoir, improving fishing success. Therefore, 1997 was identified as a good fish success year. Under Alternative 1, the pool increased between 1996 and 1997 but did not meet the spring pool rise criteria in the current or previous two springs so 1997 under Alternative 1 was not identified as meeting the fishing success criteria. The pool likely decreased in 1997 under Alternative 2 because of the partial spawning cue release in the spring of 1997.

Another example where the fishing criteria was met for Alternative 2 but not the Alternative 1 was in 1986. In 1986, the fishing success criteria was met under Alternative 2 and not under Alternative 1 because the pool elevation increased between 1983 and 1984 under Alternative 2 and decreased under Alternative 1. Because the pool elevation fell each year in mid-August between 1983 and 1986 under Alternative 1, this year was identified as a drought year and removed from meeting the fishing success criteria. The rising pool in Fort Peck Lake between 1983 and 1984 is likely due to a relatively lower pool under Alternative 2 from the partial and full spawning cue releases in 1980 and 1982 drawing the lake down about 4 feet lower than under Alternative 1 in 1983, resulting in a rising pool between the summers in 1983 and 1984 under Alternative 2.

Simulations of Alternatives 1 and 2 show that annual average NED impacts supported by the lower river under Alternative 2 would be consistently higher than those under Alternative 1. These increases in recreation NED benefits are largely attributable to the early life stage habitat below Gavins Point Dam under Alternative 2. Recreation benefits associated with the habitat creation in the lower river under Alternative 2 would be $37.2 million over the POR. Although habitat benefits would still only account for approximately 4.1 percent of the lower river recreation NED benefits under Alternative 2, habitat-related benefits under this alternative would

be almost three times higher than those under Alternative 1, resulting in consistently higher NED benefits under Alternative 2 compared to Alternative 1.

Over the simulated 81-year POR, there was one year in which recreation NED benefits in the lower river would be approximately $1.3 million lower under Alternative 2 than under Alternative 1. These adverse impacts to recreation NED benefits as modeled would occur under conditions similar to those in 1983. Partial releases from Gavins Point Dam as simulated under Alternative 2 would occur in the 1982, which reduced reservoir elevations during this year and in 1983. Due to lower system storage and lower reservoir elevations in 1983, simulated river flows and stages in the lower river below Gavins Point Dam in the summer and fall months under conditions similar to those in 1983 would be up to 3 feet lower under Alternative 2 than those under Alternative 1, reducing boat ramp operability and adversely affecting plan-affected visitation during these months.

3.4 Alternative 3 – Mechanical Construction Only

Under Alternative 3, average annual NED benefits would be $102 million, an increase of $83,000 on average annually compared to Alternative 1 (Table 30). At the upper three reservoirs, there would be slightly higher recreation benefits as a result of small increases in reservoir access and visitation in the absence of the spring plenary pulse under Alternative 1. On average, changes in annual recreation NED benefits in the upper three reservoirs would be negligible, increasing by approximately $101,000 (0.1 percent) relative to Alternative 1. Management actions under Alternative 3 would result in negligible changes to boat ramp operability, visitation, and recreation NED benefits at the lower three reservoirs because these reservoirs have relatively stable elevations.

Table 30. Summary of NED Analysis for Alternative 3, 1932–2012 (Thousands of 2018 Dollars)

Recreation NED Benefits	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$5,805,483	$1,358,856	$233,325	$891,181	$8,288,844
Total Habitat Benefits	NA	NA	$1,908	$9,957	$11,865
OMRR&R Costs (total)	$3,308	NA	NA	NA	$3,308
Total NED Benefits[b]	$5,802,175	$1,358,856	$235,233	$901,138	$8,297,401
Annual Average NED Benefits	$71,632	$16,776	$2,904	$11,125	$102,437
Change in Annual Average NED Benefits from Alternative 1	$101	$5	$3	−$26	$83
Percent Change Average Annual NED Benefits from Alternative 1	0.1%	0.0%	0.1%	−0.2%	0.1%
Average 8 Worst Years Relative to Alternative 1	−$158	−$106	−$17	−$120	−$215
Average of 8 Best Years Relative to Alternative 1	$450	$158	$19	$75	$505

a Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not included as plan-affected visitors in the river reaches.

b Total NED Benefits equal the sum of the visitation benefits and habitat benefits less the OMRR&R costs.

Relative to Alternative 1, average annual recreation NED benefits in inter-reservoir reaches would increase slightly, driven by the greater prevalence of ESH under Alternative 3. Average annual recreation NED benefits in the lower river would be approximately $11.1 million, a decrease of $26,000 on average from Alternative 1. Recreation NED benefits over the POR associated with habitat creation in the lower river would be negligible compared to Alternative 1, with fewer acres of early life stage habitat and a greater number of acres of ESH. Visitors in the river reaches that prefer lower river flows, such as those using paddle craft or swimming, would experience no impacts under Alternative 3 compared to Alternative 1 due to negligible changes in river flows.

The OMRR&R costs at the upper three reservoirs would be negligibly lower under Alternative 3, $3.31 million compared to $3.37 million under Alternative 1, because of slightly higher reservoir elevations during drought conditions as the spring plenary pulse would not occur.

Figure 10 shows annual NED recreation benefits in the upper (includes Mainstem reservoirs and inter-reservoir river reaches) and lower (below Gavins Point Dam) river. The difference in recreation NED benefits between Alternatives 1 and 3 are shown in Figures 11 and 12 for the upper river and lower river, respectively. The annual changes in recreation NED benefits show that there would be generally more years with small increases in recreational benefits in the upper river as a result of eliminating the spring plenary pulse under Alternative 3. The elimination of the pulses under Alternative 3 would result in slightly higher lake elevations than under Alternative 1. During the eight best years relative to Alternative 1, average annual recreation NED benefits in the upper three reservoirs would be $450,000 higher under Alternative 3, while the eight worst years relative to Alternative 1 would result in a reduction in average recreation NED benefits of $158,000. Many of the annual increases in recreation NED benefits would occur under conditions similar to those in simulated in the late 1950s and early 1960s as well as in the drought of the 2000s, when the upper three reservoir elevations would be slightly higher under Alternative 3 compared to Alternative 1.

Modeled results under Alternative 3 show that annual changes in recreation NED benefits vary in the lower river compared to Alternative 1. In two of the 81 simulated years, recreational NED benefits in the lower river would be more than $88,000 (1949) and $285,000 (1965) higher than under Alternative 1. As modeled in 1949 and 1965, river flows would be slightly higher than under Alternative 1, with increased boat ramp operability and visitation. There would also be five years over the period of record in the lower river when recreation NED benefits under Alternative 3 would be more than $100,000 lower than under Alternative 1, as simulated in 1956, 1958, 1977, 1989, and 2002. In these years, the spring plenary pulse would not be implemented under Alternative 3 and would be implemented under Alternative 1 at the end of April and early May; the elimination of this pulse reduced boat ramp operability and recreational access with some small reductions in recreation NED benefits under Alternative 3 relative to Alternative 1. Across all years, there is very little change in visitation and recreation NED benefits in the lower river under Alternative 3 relative to Alternative 1.

3.5 Alternative 4 – Spring ESH Creating Release

Under Alternative 4, average annual NED benefits would be $101 million, a decrease of $1.1 million (-1.1%) compared to Alternative 1 (Table 31). The upper three reservoirs would account for most of the decrease in recreation NED benefits, with average annual NED benefits decreasing by almost $1.1 million, approximately -1.5 percent, relative to those under Alternative 1. Decreases in annual NED recreation benefits supported by the upper three reservoirs would occur in most years, with the largest decreases occurring in the years following

the spring releases with relatively low precipitation or snowmelt conditions (for example, as simulated in the 1930s, the 1950s and early 1960s, late 1980s and early 1990s, and mid-2000s). In five simulated years over the POR under Alternative 4, the upper river would experience more than $4 million reduction in recreation NED benefits relative to Alternative 1 (Figure 13).

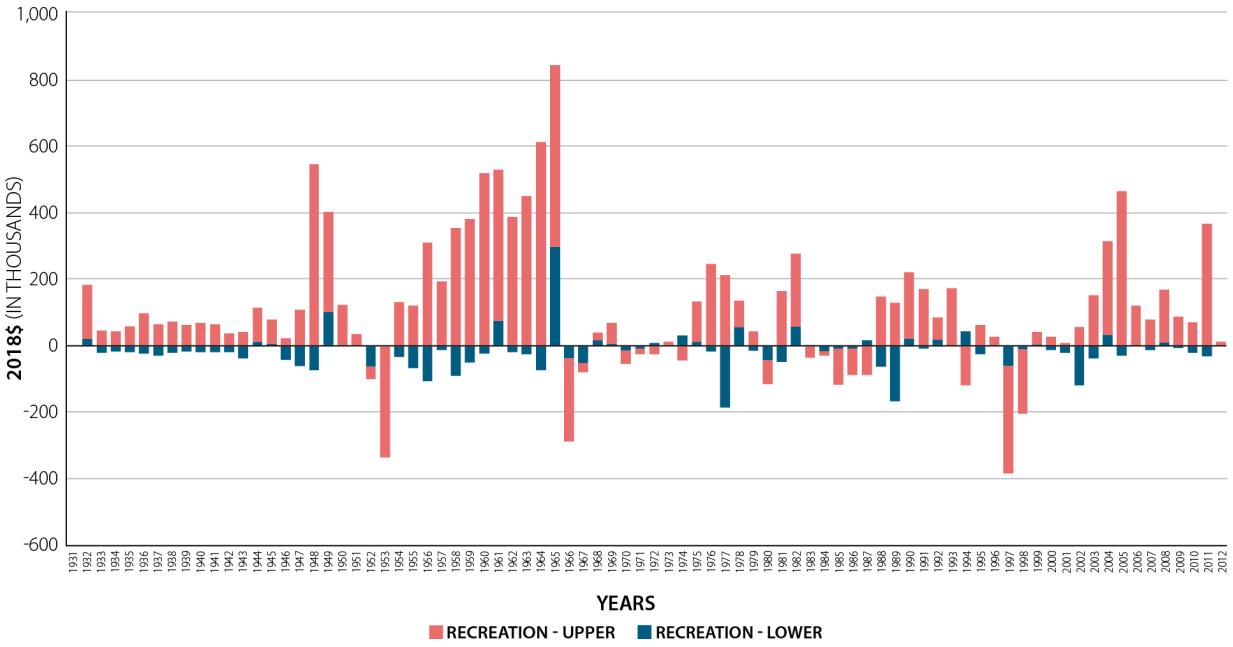

Figure 10. Annual Difference in Recreation NED Benefits under Alternative 3 Relative to Alternative 1 in the Upper and Lower River (2018$)

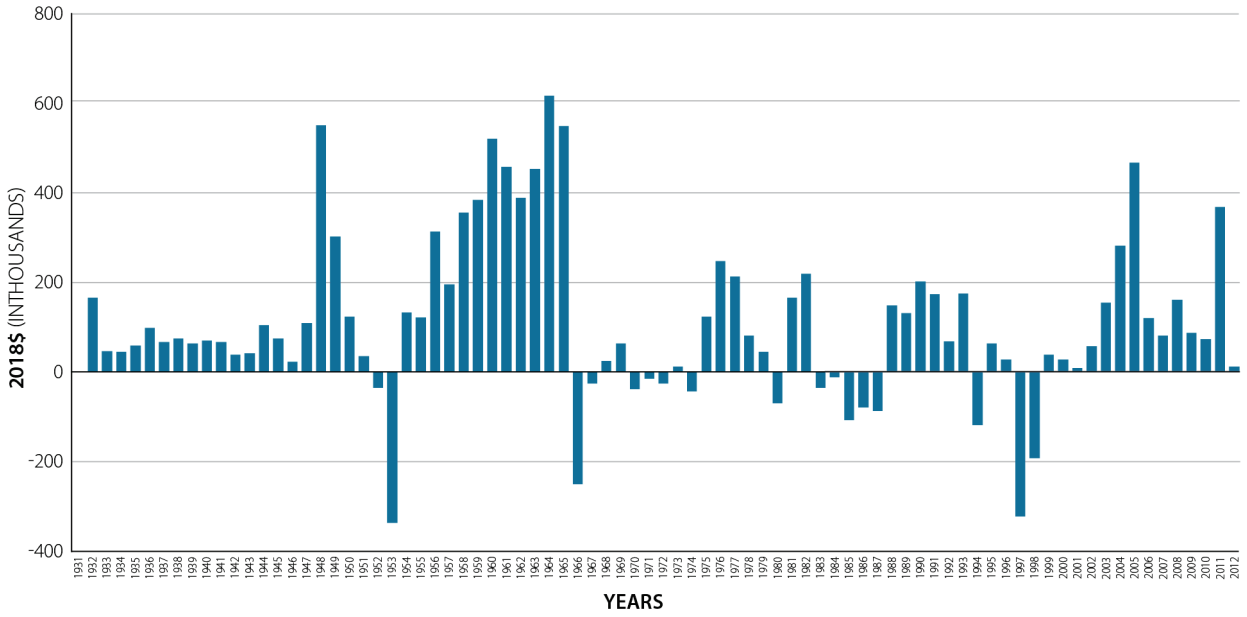

Figure 11. Annual Difference in Recreation NED Benefits under Alternative 3 Compared to Alternative 1 in the Upper River (2018$)

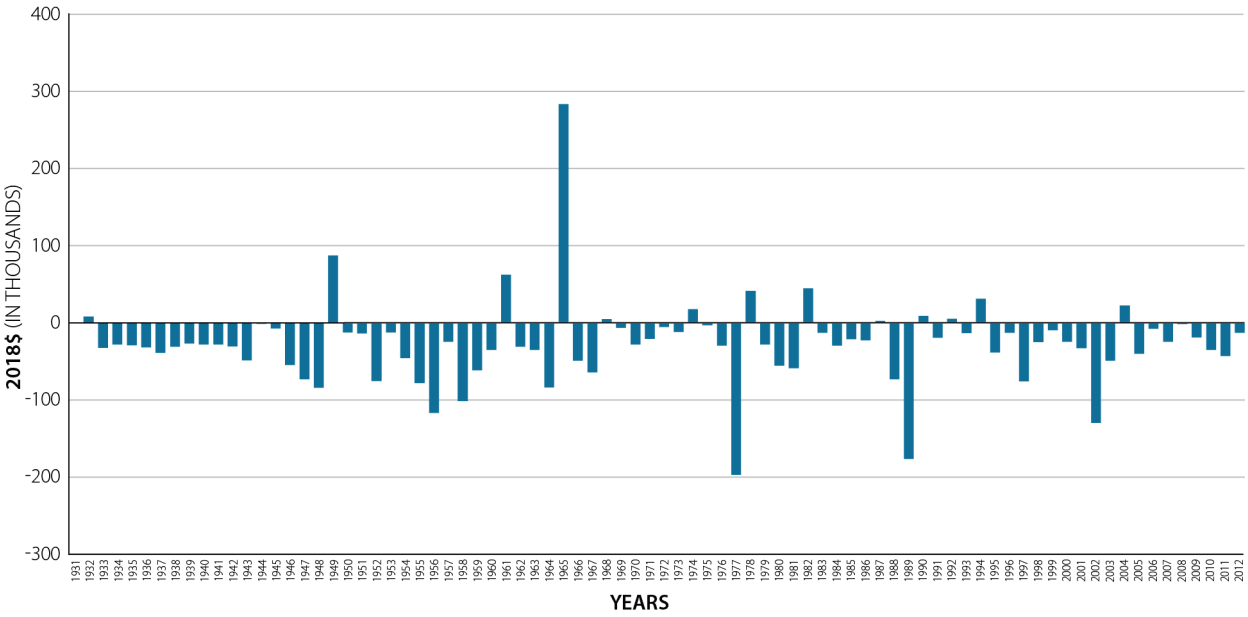

Figure 12. Annual Difference in Recreation NED Benefits under Alternative 3 Compared to Alternative 1 in the Lower River (2018$)

Table 31. Summary of NED Analysis for Alternative 4, 1932–2012 (Thousands of 2018 Dollars)

Recreation NED Benefits	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$5,709,778	$1,357,128	$232,020	$892,897	$8,191,823
Total Habitat Benefits	NA	NA	$1,703	$9,752	$11,455
OMRR&R Costs	$3,825	NA	NA	NA	$3,825
Total NED Benefits[b]	$5,705,953	$1,357,128	$233,723	$902,649	$8,199,453
Annual Average NED Benefits	$70,444	$16,755	$2,885	$11,144	$101,228
Change in Annual Average NED Benefits from Alternative 1	−$1,087	−$17	−$15	$7	−$1,127
Percent Change Average Annual NED Benefits from Alternative 1	−1.5%	−0.1%	-0.5%	-0.1%	-1.1%
Average 8 Worst Years Relative to Alternative 1	−$4,089	−$187	-$132	-$480	-$4,298
Average of 8 Best Years Relative to Alternative 1	$321	$171	$36	$1,001	$527

a Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not included as plan-affected visitors in the river reaches.

b Total NED Benefits equal the sum of the visitation benefits and habitat benefits less the OMRR&R costs.

Management actions under Alternative 4 would result in negligible changes to boat ramp operability, visitation, and recreation NED benefits in the lower three reservoirs because these reservoirs maintain relatively stable elevations under Alternative 4, providing consistent recreational access and opportunities. Relative to Alternative 1, average annual recreational NED benefits in inter-reservoir reaches would decrease slightly. There would be a negligible change in visitation and recreation NED benefits because river stages and boat ramp operability would not noticeably change. Although total habitat benefits in the inter-reservoir reaches over the POR would increase by $72,000 relative to Alternative 1 ($1.7 million compared to $1.6 million), the total habitat benefits across all locations ($11.5 million) under Alternative 4 would decrease by approximately $3.4 million relative to Alternative 1 ($14.8 million) due to fewer target acres of early life stage habitat under Alternative 4.

OMRR&R costs at the upper three reservoirs would be approximately $452,000 higher under Alternative 4 than under Alternative 1 because the spring release would draw down reservoir elevations further than under Alternative 1. Impacts occur when the spring release coincides with the onset of relatively drier periods. As a result, there would be additional capital investments and operating costs needed to extend or replace low water boat ramps, with relatively small to large adverse impacts depending on the timing and location of investments.

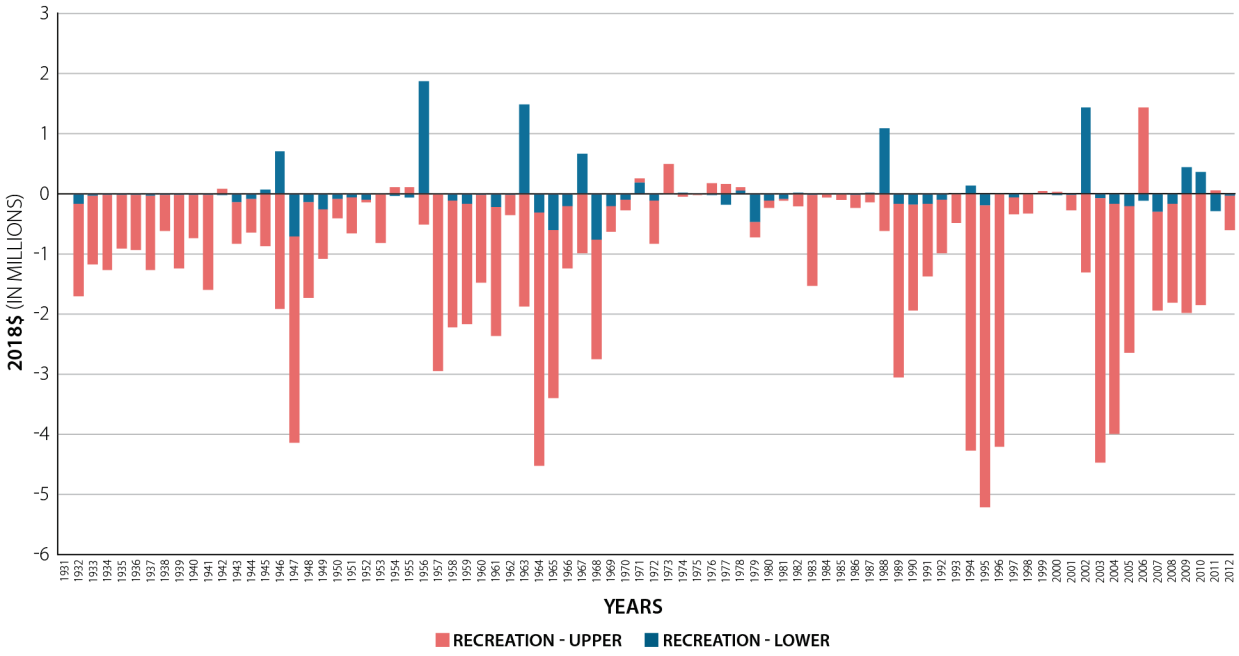

Figure 13. Annual Difference in Recreation NED Benefits under Alternative 4 Relative to Alternative 1 in the Upper and Lower River (2018$)

When evaluating impacts associated with each MRRMP-EIS alternative, it is useful to analyze annual impacts to better understand under what conditions beneficial or adverse impacts would occur. Figure 13 shows annual NED recreation benefits in the upper (includes Mainstem reservoirs and inter-reservoir river reaches) and lower river (below Gavins Point Dam). Figures 14 and 15 show the annual difference in recreation NED benefits between Alternatives 1 and 4, which are plotted and color-coded based on the type of release occurring each year, for the upper river and lower river, respectively.

Average annual recreation NED benefits in the lower river would be $11.1 million under Alternative 4, a negligible decrease (-0.1 percent) relative to Alternative 1. There would be small increases and decreases in annual recreation NED benefits in the lower river compared to Alternative 1 from increases in boat ramp operability during the flow releases (beneficial) and the creation of less habitat on average in the lower river (adverse impact), with negligible changes on average compared to Alternative 1. Habitat-related recreation benefits would account for approximately 1 percent of total recreation NED benefits in the lower river and would be slightly lower than those under Alternative 1. In addition, visitors in the lower river that prefer lower river flows, such as those using paddle craft or swimming, would experience some adverse impacts during the spring releases and negligible changes at other times under Alternative 4.

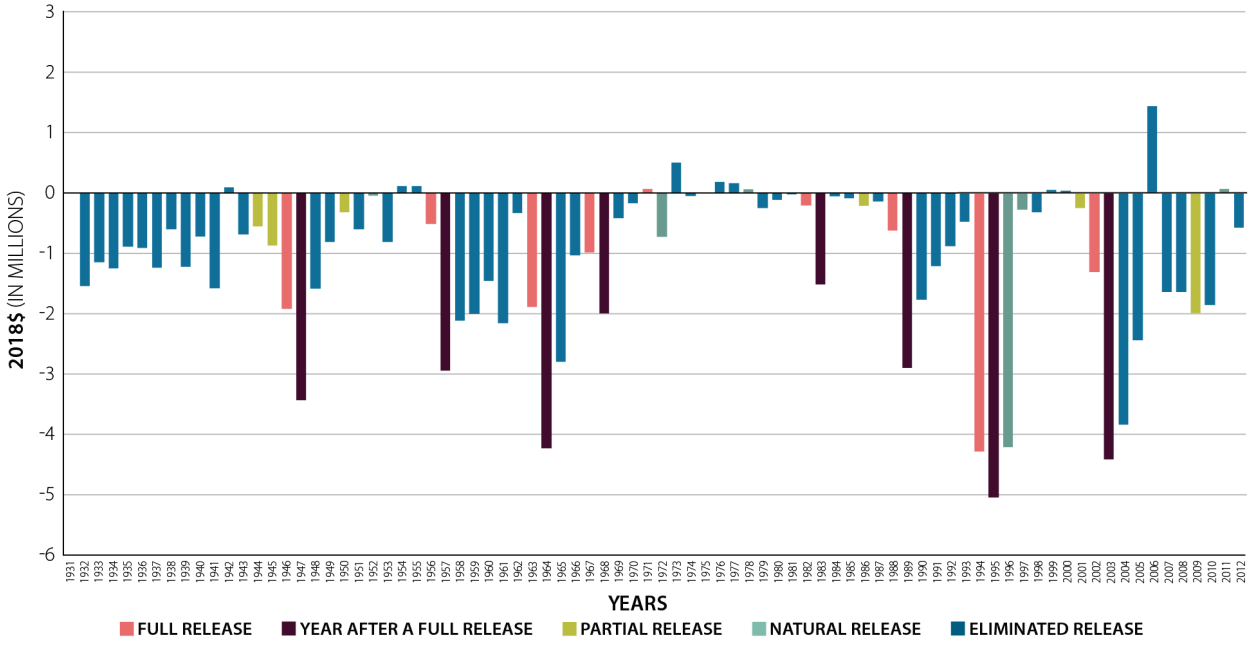

Figure 14. Annual Difference in Recreation NED Benefits under Alternative 4 Compared to Alternative 1 in the Upper River (2018$)

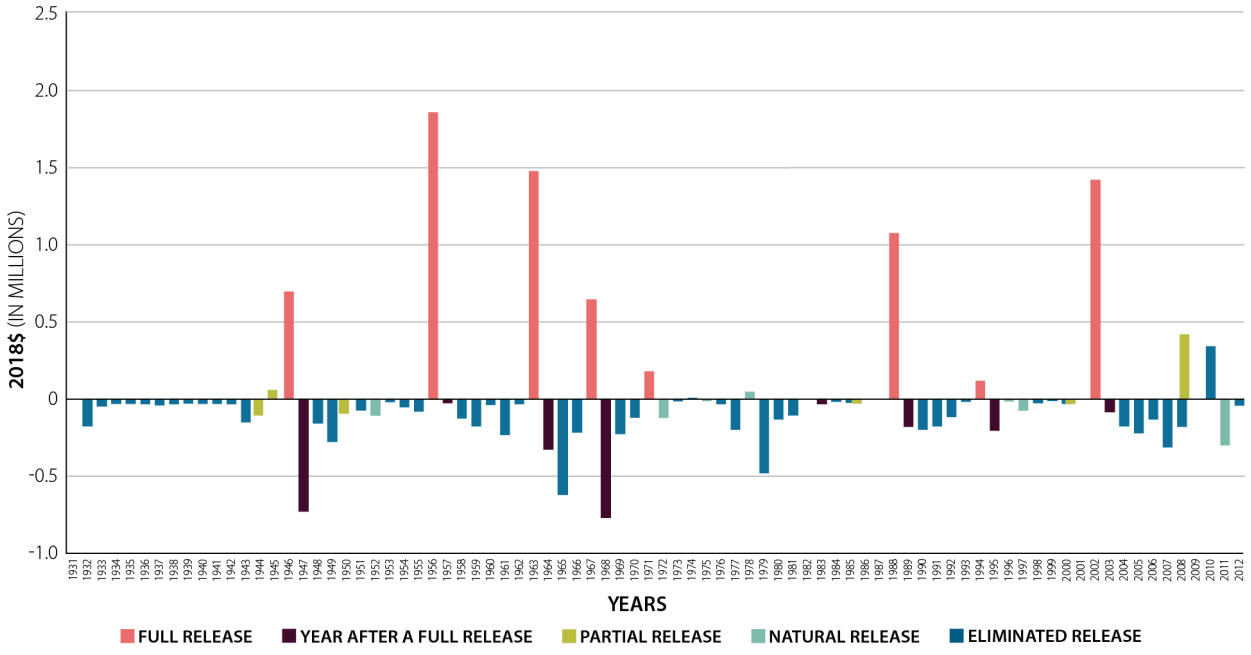

Figure 15. Annual Difference in Recreation NED Benefits under Alternative 4 Compared to Alternative 1 in the Lower River (2018$)

Alternative 4 would result in over $4 million in decreased annual recreation NED benefits in 7 of the 81 simulated years in the upper river. In the 8 worst years relative to Alternative 1, recreational benefits supported by the upper three reservoirs would decline by an average of $4.1 million per year. Simulated spring releases under Alternative 4 would have large adverse impacts in the years following the spring release under drier environmental conditions, like those experienced in the late 1930s and 1940s, the late 1950s to mid-1960s, the late 1980s and early 1990s, and the 2000s would occur. Full and partial releases as simulated in 1930, 1946, 1956, 1963, 1988, 1994, and 2002 would reduce reservoir elevations during the release year and/or subsequent years. This is especially prevalent during relatively drier or drought conditions when system storage is slow to replenish and reservoir elevations would remain relatively lower than under Alternative 1 for a number of years following the releases. Persistently lower lake elevations cause visitation at the reservoirs to decrease relative to Alternative 1 as boat access to the lakes becomes more limited and fishing opportunities decrease.

Fort Peck Lake would experience additional years when fishing success criteria are not met over the POR relative to Alternative 1, adversely impacting fishing opportunities and visitation as simulated in the years 1994, 1995, and 1996. In these years, annual visitation would decrease by approximately 145,000 recreation visitor days, and recreation NED benefits would be reduced by over $3 million at Fort Peck Lake relative to Alternative 1.

Lake Sakakawea would experience the biggest one-year reduction in recreation NED benefits, as simulated in 2003, the year after full spring release, which would draw down the reservoir up to 8 feet lower than under Alternative 1, with a reduction in recreation NED benefits compared to Alternative 1 of $2.5 million. Lake Oahe would also be adversely affected by the spring release in 2002, with its greatest reduction in recreation NED benefits, 2004, occurring two years after the release when the reservoir pool is drawn down up to 8 feet lower than under Alternative 1. In 2004, reductions in annual recreation NED benefits at Lake Oahe were just over $1.5 million lower than under Alternative 1.

In the lower river, recreation NED benefits relative to Alternative 1 would be higher in most years when a simulated full spring release occurs. These benefits result from higher river stages and improved boat ramp operability compared to under Alternative 1. Under simulated conditions in 1956, recreation benefits in the lower river would be nearly $1.9 million higher than under Alternative 1 from the spring release increase boat ramp operability and recreation access. In general, in the years following the spring releases, recreation NED benefits in the lower river decrease compared to those under Alternative 1 from relatively lower river flows in the fall as the system rebalances. On average, there are negligible changes to recreation NED benefits relative to Alternative 1.

3.6 Alternative 5 – Fall ESH Creating Release

Under Alternative 5, average annual recreation NED benefits would decrease by $70,000, a decrease of approximately 0.1 percent compared to Alternative 1 (Table 32). In the upper three reservoirs, average annual recreation NED benefits would decrease by approximately $84,000 relative Alternative 1 or 0.1 percent. The upper three reservoirs would be lower than under Alternative 1 in the year following a fall release, with adverse impacts to recreation NED benefits under these conditions. In the eight worst years compared to Alternative 1, there would be a decrease of annual recreation NED benefits of $1.1 million at the upper three reservoirs. Impacts of fall releases under Alternative 5 would result in negligible changes to boat ramp operability, visitation, and recreation NED benefits at the lower three reservoirs because

reservoir elevations in these flow-through reservoirs are not impacted by management actions and would remain relatively stable.

Table 32. Summary of NED Analysis for Alternative 5, 1932–2012 (Thousands of 2018 Dollars)

Recreation NED Benefits	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$5,790,559	$1,358,006	$233,194	$893,985	$8,275,743
Total Habitat Benefits	NA	NA	$1,620	$9,687	$11,306
OMRR&R Costs	$3,328	NA	NA	NA	$3,328
Total NED Benefits[b]	$5,787,231	$1,358,006	$234,813	$903,672	$8,283,721
Annual Average NED Benefits	$71,447	$16,766	$2,899	$11,156	$102,268
Change in Annual Average NED Benefits from Alternative 1	−$84	−$6	-$2	$5	−$86
Percent Change Average Annual NED Benefits from Alternative 1	−0.1%	0.0%	-0.1%	0.0%	−0.1%
Average 8 Worst Years Relative to Alternative 1	−$1,091	−$202	-$74	-$663	-$1,553
Average of 8 Best Years Relative to Alternative 1	$449	$171	$47	$1,048	$1,059

a Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not included as plan-affected visitors in the river reaches.

b Total NED Benefits equal the sum of the visitation benefits and habitat benefits less the OMRR&R costs.

In the inter-reservoir river reaches, Alternative 5 would result in a negligible decrease in average annual recreation NED benefits of 0.1 percent. Even in the biggest difference years relative to Alternative 1, changes in recreation NED benefits would be very small. Although the creation of ESH in the Garrison and Randall river reaches would be greater under Alternative 5 compared to Alternative 1, the habitat benefits would be a very small part of recreation NED benefits in the inter-reservoir river reaches.

Alternative 5 would result in an increase of $5,000 in average annual recreation NED benefits in the lower river, a negligible increase relative to Alternative 1. Recreation NED benefits under Alternative 5 would occur from increases in boat ramp operability and recreational access, when the fall releases increase river stages. In addition, visitors in the lower river that prefer lower river flows, such as those using paddle craft or swimming, would experience some adverse impacts during the fall releases and negligible changes at other times under Alternative 5.

The OMRR&R costs at the upper three reservoirs would be very similar to those under Alternative 1, with a total cost of $3.3 million to maintain access to the upper three reservoirs during drought conditions. The OMRR&R costs were estimated based on reservoir elevations at the upper three reservoirs during the 2000s drought, which would have very little change from Alternative 1.

When evaluating impacts associated with each MRRMP-EIS alternative, it is useful to analyze annual impacts to better understand under what conditions beneficial or adverse impacts would occur. Figure 16 shows annual NED recreation benefits in the upper (includes Mainstem reservoirs and inter-reservoir river reaches) and lower river. Figures 17 and 18 show the difference in recreation NED benefits between Alternatives 1 and 5, which are plotted and color-coded based on the type of release occurring each year, for the upper river and lower river, respectively.

In general, the year or years after a fall release under Alternative 5 is shown to adversely affect lake elevations and recreation NED benefits in the upper river. Compared to Alternative 1, the worst difference years as simulated under Alternative 5 would occur under conditions similar to those experienced in 1967, 1989, and 1996 when annual recreation NED benefits in the upper river would be up to $1.6 million lower than under Alternative 1. In 1989, as simulated under Alternative 5, the reservoir elevations would be up to 3 feet lower than under Alternative 1 during the summer months. There would be no change in the number of years when the fishing success metric is met under Alternative compared to Alternative 1.

Annual recreation NED benefits in the lower river show that the recreation benefits are generally higher during the full fall release when boat ramp operability is improved and visitation is higher under Alternative 5 relative to Alternative 1. These conditions would benefit visitors who use boats to recreate in the fall months during the years when the simulated releases would occur, such as anglers and waterfowl hunters. However, as simulated under Alternative 1 and Alternative 5, some of the years following the fall release would reduce recreation NED benefits compared to Alternative 1 from the relatively lower river flows in the fall months as reservoirs rebalance. In general, the higher recreation benefits under the Alternative 5 release years offset the adverse impacts in the years following the releases in the lower river, resulting in a negligible change in recreation NED benefits compared to Alternative 1.

3.7 Alternative 6 – Pallid Sturgeon Spawning Cue

Under Alternative 6, the Missouri River would support on average $102 million in recreation NED benefits, decreasing by $846,000 or 0.8 percent on average compared to Alternative 1 (Table 33). Similar to Alternatives 2 and 4, the adverse impacts under Alternative 6 would be driven by adverse impacts in the upper three reservoirs in the years following a spawning cue release when lake elevations are lower than those under Alternative 1. Average annual decreases in recreation NED benefits in the upper three reservoirs would be $864,000 (-1.2%).

Management actions under Alternative 6 would result in small increases in recreation access and associated visitation at the lower three reservoirs and lower river, with negligible changes to boat ramp operability, visitation, and recreation NED benefits at these locations because reservoir elevations and river stages would remain relatively stable. The inter-reservoir reaches under Alternative 6 would experience an average annual decrease in recreation NED benefits of $9,000 (-0.3%). In the lower river, recreational NED benefits would decrease on average by $5,000, a negligible change compared to Alternative 1. Some visitors that prefer lower river flows, such as those using paddle craft or swimmers, may be adversely impacted during the spawning cue releases, but would have negligible impacts at other times under Alternative 6.

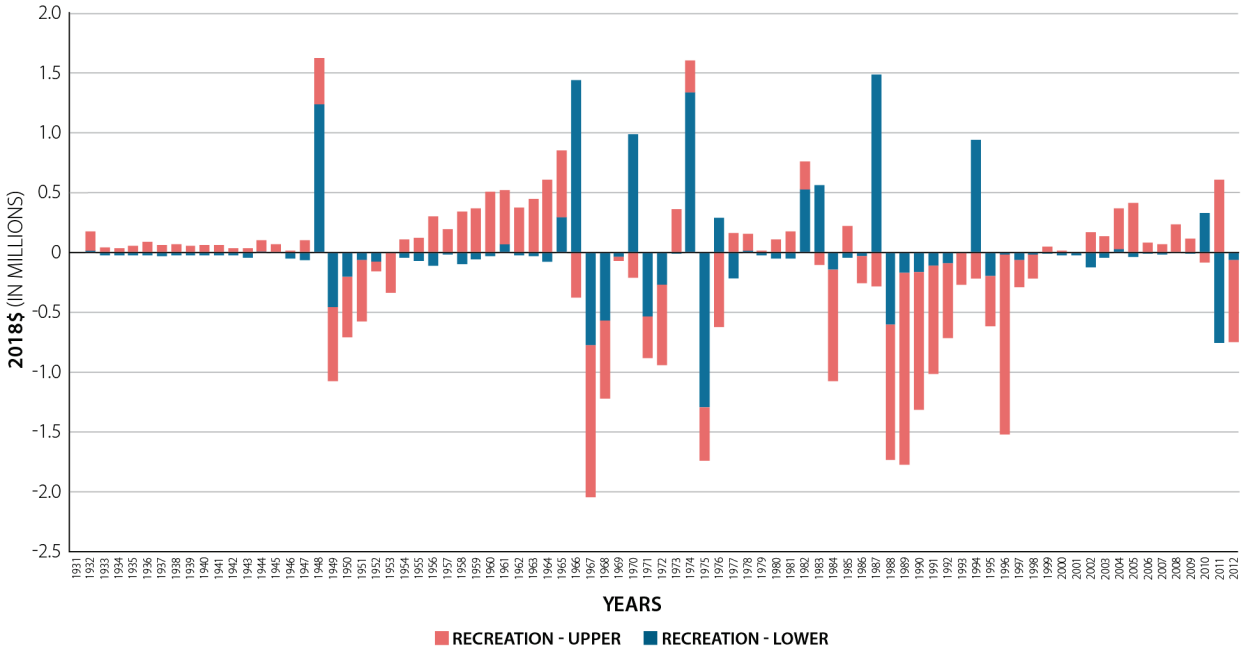

Figure 16 Annual Difference in Recreation NED Benefits under Alternative 5 Relative to Alternative 1 in the Upper and Lower River (2018$)

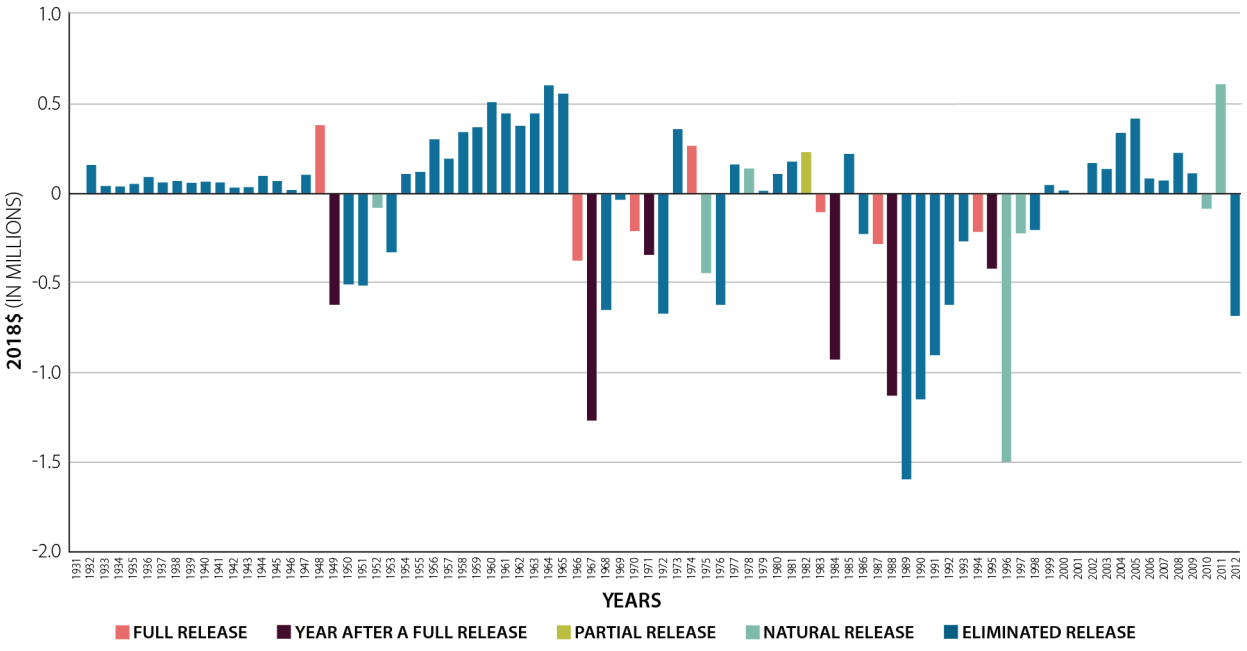

Figure 17. Annual Difference in Recreation NED Benefits Under Alternative 5 compared to Alternative 1 in the Upper River (2018$)

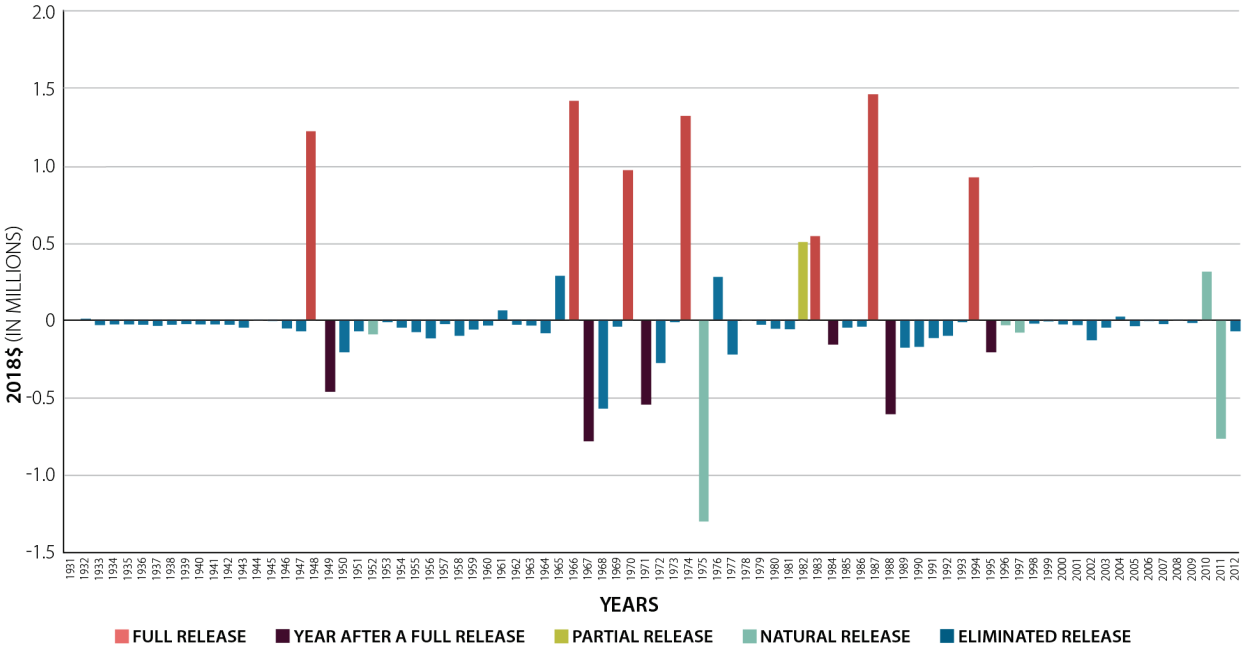

Figure 18. Annual Difference in Recreation NED Benefits Under Alternative 5 compared to Alternative 1 in the Lower River (2018$)

Table 33. Summary of NED Analysis for Alternative 6, 1932–2012 (Thousands of 2018 Dollars)

Recreation NED Benefits	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$5,727,847	$1,361,061	$232,873	$893,013	$8,214,794
Total Habitat Benefits	NA	NA	$1,340	$9,870	$11,210
OMRR&R Costs (total)	$3,835	NA	NA	NA	$3,835
Total NED Benefits[b]	$5,724,012	$1,361,061	$234,213	$902,883	$8,222,169
Annual Average NED Benefits	$70,667	$16,803	$2,892	$11,147	$101,508
Change in Annual Average Benefits from Alternative 1	−$864	$32	−$9	-$5	−$846
Percent Change Average Annual NED Benefits from Alternative 1	−1.2%	0.2%	−0.3%	0.0%	−0.8%
Average 8 Worst Years Relative to Alternative 1	−$2,827	−$120	−$87	−$462	−$2,954
Average of 8 Best Years Relative to Alternative 1	$710	$319	$39	$832	$876

a Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not included as plan-affected visitors in the river reaches.

b Total NED Benefits equal the sum of the visitation benefits and habitat benefits less the OMRR&R costs.

OMRR&R costs would be higher under Alternatives 6, $3.8 million, compared to $3.3 million under Alternative 1. The upper three reservoir elevations would be relatively lower during conditions similar to those simulated in the 2000s drought under Alternative 6, resulting in small to large adverse impacts to OMRR&R costs depending on the timing and location of needed investments.

When evaluating impacts associated with each MRRMP-EIS alternative, it is useful to analyze annual impacts to better understand under what conditions beneficial or adverse impacts would occur. Figure 19 shows annual NED recreation benefits in the upper (includes Mainstem reservoirs and inter-reservoir river reaches) and lower river. Figures 20 and 21 show the difference in recreation NED benefits between Alternatives 1 and 6, which are plotted and color-coded based on the type of release occurring each year, for the upper river and lower river, respectively.

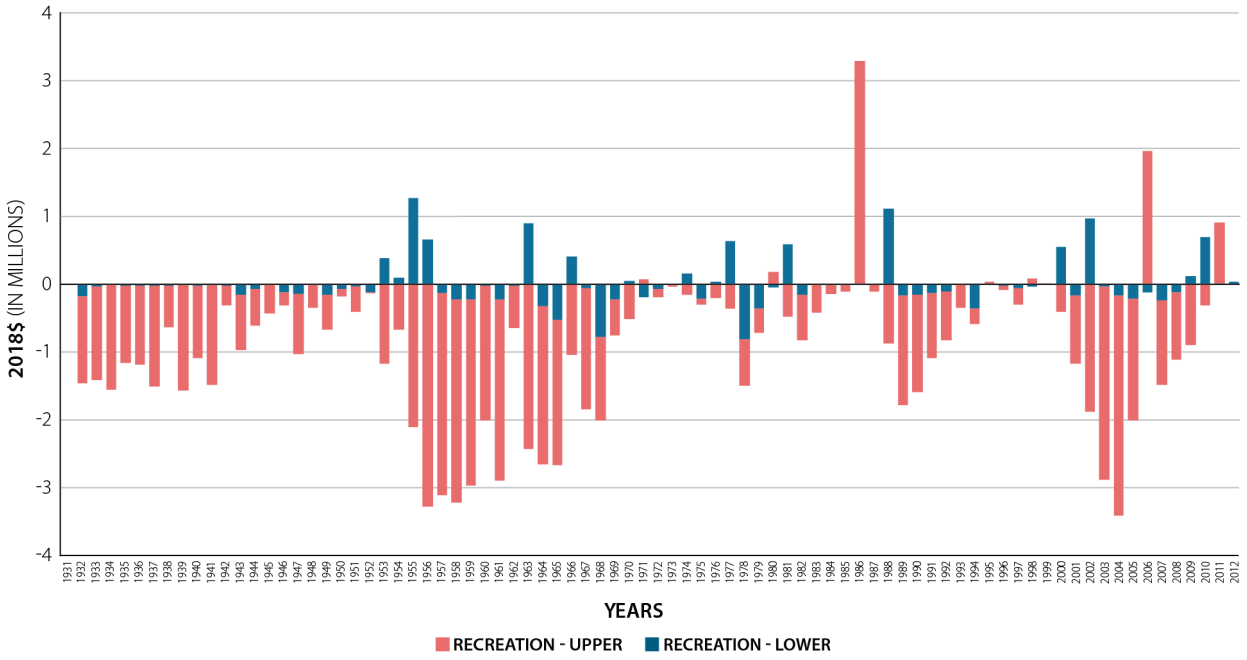

Figure 19. Annual Difference in Recreation NED Benefits under Alternative 6 Relative to Alternative 1 in the Upper and Lower River (2018$)

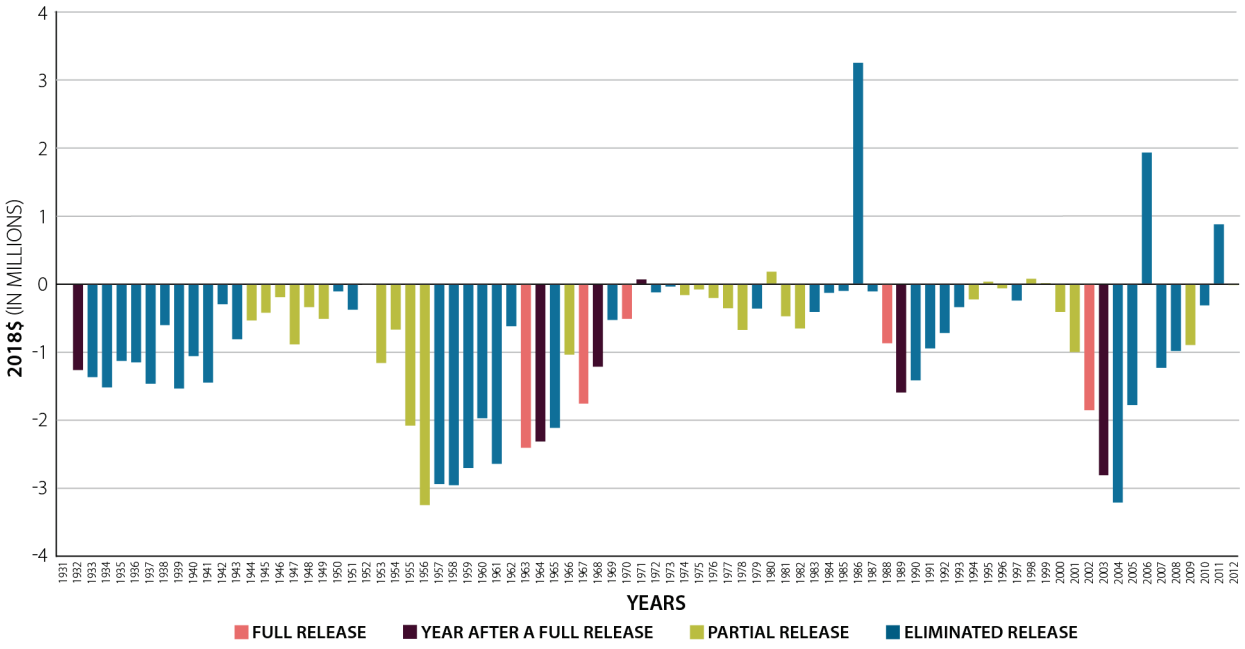

Figure 20. Annual Difference in Recreation NED Benefits under Alternative 6 Relative to Alternative 1 in the Upper River (2018$)

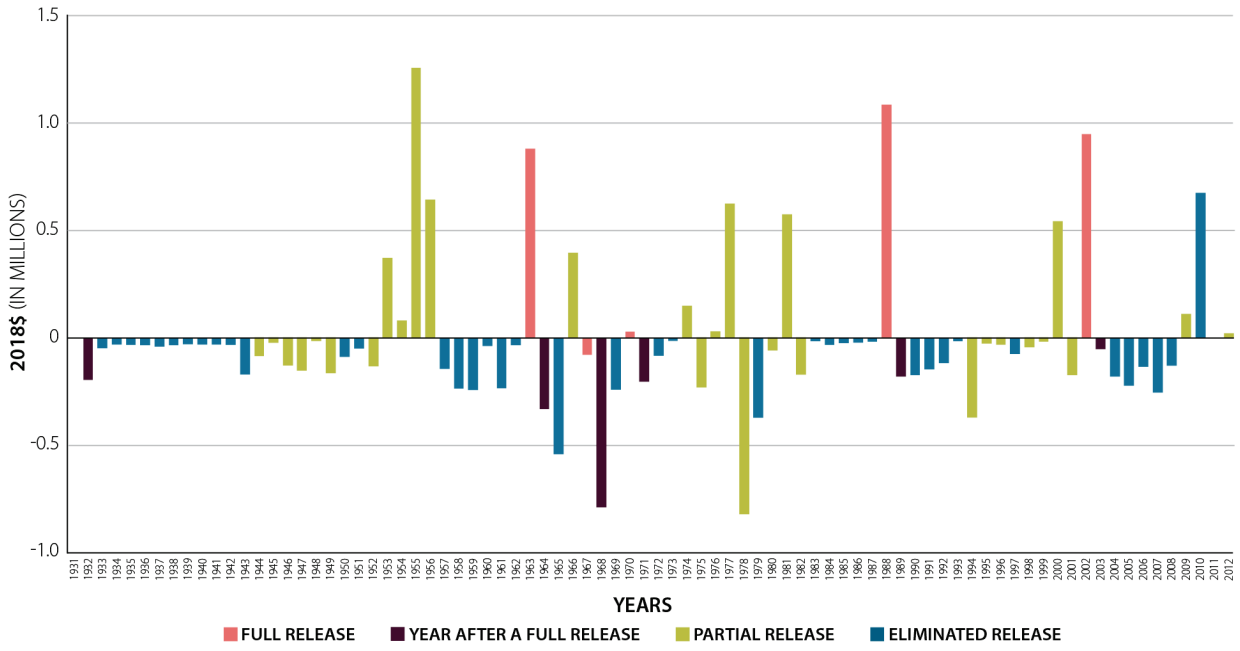

Figure 21. Annual Difference in Recreation NED Benefits under Alternative 6 Relative to Alternative 1 in the Lower River (2018$)

In the upper river, modeled results under Alternative 6 show that there would be reductions in recreation NED benefits compared to Alternative 1 during the relatively drier periods of the 1930s, the 1950s to 1960s, the late 1980s and early 1990s, and the 2000s. The full spawning cue releases in 1931, 1963, 1967, 1988, and 2002 decrease the upper reservoirs elevations in the years that follow the release and the reservoirs remain lower than under Alternative 1 due to the relatively drier conditions, causing adverse impacts to visitation and recreation NED benefits. In 11 of the 81 years, recreation benefits in the upper river (the reservoirs and the inter-reservoir reaches) are over $2 million lower than those under Alternative 1; these 11 years occur in the drought and low water years of the late 1950s to early to mid-1960s and mid-2000s when the upper three reservoirs would be drawn down lower under Alternative 6 than under Alternative 1. In the worst-case visitation year in Lake Oahe, as simulated in 1956, reductions in NED benefits would be approximately $1.9 million lower than under Alternative 1. In the worst-case visitation year in Lake Sakakawea, as simulated in 1958, reductions in NED benefits would be approximately $1.4 million lower than under Alternative 1. And in the worst-case visitation year in Fort Peck Lake, as simulated in 2004, reductions in NED benefits would be approximately $755,000 lower than under Alternative 1.

In the upper river, there are two years in the model simulation with notably higher recreation NED benefits relative to Alternative 1, 1986 and 2006. Alternative 6 would result in two additional years relative to Alternative 1 where the fishing success criteria is met at Fort Peck Lake, 1986 and 2006, which results in $3.3 and $1.9 million higher recreation NED benefits in these years, respectively. One part of the fishing success modeling includes removing years from meeting the fishing success criteria if there are multiple consecutive years of falling pool elevations in mid-August (termed “drought conditions”). From 1983 to 1984, Fort Peck Lake increased under Alternative 6 whereas under Alternative 1, the pool fell during this period, which resulted in this year being considered a good pool year under Alternative 6 because the “drought condition” did not occur. In 1986, the spring pool rise criteria was met in 1986, 1985, and 1984. Since these criteria were met, 1986 was considered to meet the fishing success criteria under Alternative 6. It is likely that as simulated in 1983, Fort Peck Lake was relatively lower than under Alternative 1 due to the full or partial spawning cue releases in 1981 and 1982, which allowed for an increase in the pool between 1983 and 1984. A similar situation occurred between 2004 and 2005 in Fort Peck Lake, with a higher pool in 2005 compared to 2004 levels under Alternative 6. This is likely due to a relatively lower pool in 2004 from partial spawning cue releases in 2000, 2001, and 2002, allowing for an increasing pool from 2004 to 2005 for Alternative 6.

In the lower river, the annual impacts vary, generally with higher benefits relative to Alternative 1 during spawning cue releases and adverse impacts in the years following the releases. The changes in recreation NED benefits under Alternative 6 relative to Alternative 1 are attributable to changes in boat ramp operability with generally higher operability during the spawning cue release and lower operability when river stages fall further than under Alternative 1 in the fall months when the reservoir system must rebalance under Alternative 6. The highest benefit year in the lower river, as simulated in 1955, occurred during a partial release, which compared to Alternative 1 would result in $1.2 million higher recreation NED benefits. The lowest benefit year, as simulated in 1978, would result in a decrease of $816,000 compared to Alternative 1. Across the POR, there would be a negligible change in recreation NED benefits on average in the lower river.

4.0 Regional Economic Development Results

This section provides results from the RED analysis. The economic impact analysis was analyzed at state and local levels (i.e., counties adjacent to and surrounding each of the lakes) for each of the five reservoirs. In general, regional economic impacts tend to be greater in larger geographic areas because larger economies capture additional economic activity. However, local and state economic impact results from the visitor spending under the MRRMP-EIS alternatives for each reservoir project were very similar in magnitude, indicating that changes in economic activity stimulated by visitor spending are mostly concentrated in local communities surrounding each reservoir. This section summarizes the economic impacts at the state level for each of the reservoirs (see Table 17 for the state study areas for each reservoir). The spending is assumed to occur within communities 50 miles from the reservoir, and therefore, most of the economic impacts are likely to be generated from and supported by the communities surrounding the reservoirs.

The employment and income estimates include industries and businesses directly benefitting from non-local visitor spending (i.e., those who provide goods and services to non-local visitors), as well as secondary jobs and income in industries that support recreation and tourism-related businesses (indirect impact) and jobs and income supported by local workers spending their income in the local economy (induced impact). The employment estimates include both full-time and part-time jobs.

Recreation RED effects were presented for the following scenarios so as to limit the number of years for which the RED estimates were calculated: the lowest visitation year; the highest visitation year; annual average visitation over the 81-year POR; the average difference during the 8 worst years (lowest visitation years) relative to Alternative 1; and the average difference during the 8 best years (highest visitation years) relative to Alternative 1.

The degree to which recreation at the reservoirs contributes to regional employment and income at each reservoir is based on the number of non-local visitors and the types of recreational activities in which visitor participate. Under Alternative 1, non-local visitor spending at the five Mainstem reservoirs would support between 44 (Lake Francis Case) and 660 (Lake Oahe) jobs, and between $1.1 million (Lake Francis Case) and $17.3 million (Lake Oahe) in labor income on average annually across the POR. Lake Francis Case has the fewest number of visitors of all of the six reservoirs.

Tables 33, 34, and 35 summarize employment, labor income, and sales, respectively, supported by non-local visitor spending under the MRRMP-EIS alternatives for each lake. Under Alternative 1, reservoir elevations can affect visitation, which in turn can affect the amount of visitor spending in local economies. As a result, there can be substantial variations in employment and income impacts over the POR under Alternative 1. For example, Lake Oahe supports between 229 and 825 jobs and $8.1 million and $21.7 million in labor income depending on lake conditions and visitation at the lake. Lake elevations are the main driver of changes in visitation at the upper three reservoirs, with drought and relatively drier climactic and hydrologic conditions adversely affecting recreation access and fishing opportunities at the lakes.

Table 33. Direct, Indirect, and Induced Employment Impacts from Non-Local Visitor Spending under the MRRMP-EIS Alternatives

Reservoir	Alternative					
	1	2	3	4	5	6
Fort Peck Lake						
Lowest Visitation Year	0	0	0	0	0	0
Highest Visitation Year	227	225	227	224	227	225
Annual Average	157	158	157	153	157	156
Change in Annual Average	–	1	0	−4	0	−1
8 Worst Years Relative to Alt 1	–	−18	0	−29	−3	−10
8 Best Years Relative to Alt 1	–	30	2	8	2	15
Lake Sakakawea						
Lowest Visitation Year	92	278	281	277	281	276
Highest Visitation Year	538	534	535	535	535	538
Annual Average	441	440	441	435	440	437
Change in Annual Average	–	−1	0	−5	−1	−4
8 Worst Years Relative to Alt 1	–	−14	−1	−21	−8	−11
8 Best Years Relative to Alt 1	–	11	2	2	3	1
Lake Oahe						
Lowest Visitation Year	229	297	309	287	309	282
Highest Visitation Year	825	822	820	820	823	820
Annual Average	660	654	662	649	660	646
Change in Annual Average	–	−6	2	−11	0	−15
8 Worst Years Relative to Alt 1	–	−29	−2	−39	−15	−46
8 Best Years Relative to Alt 1	–	13	7	4	9	2
Lake Francis Case						
Lowest Visitation Year	32	32	31	33	31	32
Highest Visitation Year	47	47	47	47	47	47
Annual Average	44	44	44	44	44	44
Change in Annual Average	–	0	0	0	0	0
8 Worst Years Relative to Alt 1	–	−2	0	−1	−2	−1
8 Best Years Relative to Alt 1	–	2	0	1	0	1
Lewis and Clark Lake						
Lowest Visitation Year	185	193	186	180	185	182
Highest Visitation Year	235	235	235	241	248	261
Annual Average	210	212	210	210	211	212
Change in Annual Average	–	2	0	0	0	2
8 Worst Years Relative to Alt 1	–	−10	−5	−7	−8	−6
8 Best Years Relative to Alt 1	–	16	8	9	10	17

Note: Estimated with the USACE RECONS model (USACE 2012b).

Table 34. Direct, Indirect, and Induced Labor Income Impacts from Non-Local Visitor Spending under the MRRMP-EIS Alternatives (Thousands of 2018 Dollars)

Reservoir	Alternative					
	1	2	3	4	5	6
Fort Peck Lake						
Lowest Visitation Year	$0	$0	$0	$0	$0	$0
Highest Visitation Year	$5,030	$4,992	$5,021	$4,955	$5,021	$4,989
Annual Average	$3,483	$3,502	$3,489	$3,396	$3,482	$3,459
Change in Annual Average	–	$19	$6	−$86	−$1	−$24
8 Worst Years Relative to Alt 1	–	−$410	−$6	−$637	−$75	−$222
8 Best Years Relative to Alt 1	–	$665	$33	$168	$40	$330
Lake Sakakawea						
Lowest Visitation Year	$6,162	$6,106	$6,168	$6,080	$6,168	$6,067
Highest Visitation Year	$11,810	$11,716	$11,741	$11,741	$11,741	$11,810
Annual Average	$9,673	$9,656	$9,681	$9,554	$9,657	$9,592
Change in Annual Average	–	−$17	$8	−$119	−$17	−$81
8 Worst Years Relative to Alt 1	–	−$309	−$29	−$455	−$167	−$247
8 Best Years Relative to Alt 1	–	$247	$48	$40	$67	$18
Lake Oahe						
Lowest Visitation Year	$8,060	$7,791	$8,101	$7,524	$8,101	$7,392
Highest Visitation Year	$21,658	$21,569	$21,532	$21,530	$21,600	$36,376
Annual Average	$17,331	$17,176	$17,372	$17,041	$17,323	$16,947
Change in Annual Average	–	−$155	$41	−$290	−$7	−$384
8 Worst Years Relative to Alt 1	–	−$766	−$62	−$1,012	−$402	−$1,209
8 Best Years Relative to Alt 1	–	$348	$179	$99	$225	$59
Lake Francis Case						
Lowest Visitation Year	$772	$771	$753	$787	$734	$773
Highest Visitation Year	$1,123	$1,128	$1,122	$1,123	$1,122	$6,468
Annual Average	$1,063	$1,066	$1,063	$1,059	$1,057	$1,060
Change in Annual Average	–	$3	$0	−$4	−$6	−$3
8 Worst Years Relative to Alt 1	–	−$39	−$10	−$32	−$44	−$25
8 Best Years Relative to Alt 1	–	$54	$6	$15	$5	$23
Lewis and Clark Lake						
Lowest Visitation Year	$4,577	$4,777	$4,592	$4,455	$4,581	$4,514
Highest Visitation Year	$5,819	$5,819	$5,819	$5,952	$6,128	$6,468
Annual Average	$5,200	$5,256	$5,204	$5,192	$5,208	$5,249
Change in Annual Average	–	$56	$5	−$8	$9	$49
8 Worst Years Relative to Alt 1	–	−$249	−$124	−$185	−$186	−$154
8 Best Years Relative to Alt 1	–	$404	$190	$218	$240	$417

Note: Estimated with the USACE RECONS model. It should be noted that labor income per worker is relatively small (approximately $22,000) due to the relatively lower paying jobs associated with the services sectors (retail, accommodations, and restaurants) and because part-time employees are included in the employment estimates. The ratios and multipliers embedded in RECONS are from IMPLAN®.

Table 35. Direct, Indirect, and Induced Sales from Non-Local Visitor Spending under the MRRMP-EIS Alternatives (Thousands of 2016 Dollars)

Reservoir	Alternative					
	1	2	3	4	5	6
Fort Peck Lake						
Lowest Visitation Year	$0	$0	$0	$0	$0	$0
Highest Visitation Year	$15,934	$15,934	$15,906	$15,695	$15,906	$15,804
Annual Average	$11,031	$11,031	$11,052	$10,759	$11,028	$10,956
Change in Annual Average	–	$0	$20	−$273	−$3	−$75
8 Worst Years Relative to Alt 1	–	−$1,297	−$19	−$2,017	−$237	−$705
8 Best Years Relative to Alt 1	–	$2,107	$2,107	$531	$126	$1,046
Lake Sakakawea						
Lowest Visitation Year	$19,319	$19,143	$19,337	$19,063	$19,337	$19,022
Highest Visitation Year	$37,028	$36,734	$36,810	$36,810	$36,812	$37,028
Annual Average	$30,328	$30,273	$30,354	$29,955	$30,276	$30,073
Change in Annual Average	–	−$55	$26	−$373	−$52	−$255
8 Worst Years Relative to Alt 1	–	−$986	−$91	−$1,425	−$524	−$774
8 Best Years Relative to Alt 1	–	$776	$151	$126	$209	$56
Lake Oahe						
Lowest Visitation Year	$26,345	$25,467	$26,480	$24,595	$26,480	$24,164
Highest Visitation Year	$70,795	$70,504	$70,383	$70,377	$70,606	$70,350
Annual Average	$56,650	$56,144	$56,784	$37,346	$56,626	$55,396
Change in Annual Average	–	−$506	$134	−$19,304	−$24	−$1,254
8 Worst Years Relative to Alt 1	–	−$2,504	−$203	−$3,309	−$1,315	−$3,952
8 Best Years Relative to Alt 1	–	$1,138	$585	$322	$736	$192
Lake Francis Case						
Lowest Visitation Year	$2,391	$2,388	$2,332	$2,436	$2,274	$2,394
Highest Visitation Year	$3,476	$3,492	$3,475	$3,476	$3,475	$3,482
Annual Average	$3,291	$3,301	$3,291	$3,279	$3,274	$3,281
Change in Annual Average	–	$10	$0	−$13	−$17	−$11
8 Worst Years Relative to Alt 1	–	−$122	−$31	−$98	−$137	−$78
8 Best Years Relative to Alt 1	–	$167	$18	$45	$15	$72
Lewis and Clark Lake						
Lowest Visitation Year	$14,776	$15,423	$14,825	$14,382	$14,789	$14,572
Highest Visitation Year	$18,787	$18,787	$18,787	$19,215	$19,783	$20,882
Annual Average	$16,787	$16,967	$16,802	$16,762	$16,815	$16,946
Change in Annual Average	–	$181	$15	−$25	$28	$159
8 Worst Years Relative to Alt 1	–	−$805	−$399	−$597	−$600	−$497
8 Best Years Relative to Alt 1	–	$1,305	$614	$705	$774	$1,345

Note: Estimated with the USACE RECONS model (USACE 2012b).

Under the MRRMP-EIS alternatives, Lewis and Clark Lake and Lake Francis Case would result in negligible changes in visitation and regional economic impacts compared to Alternative 1, with Lewis and Clark Lake experiencing more years with slightly higher visitation and economic impacts than years with lower visitation and regional impacts. On average, Lewis and Clark Lake would experience an increase of 2 jobs under Alternatives 2 and 6 compared to Alternative 1, and no change under the other alternatives.

In general, Alternatives 2, 4, and 6 would have the greatest adverse impacts to jobs, income, and sales relative to Alternative 1. Lake Oahe would be most affected with 6 (Alternative 2) to 15 (Alternative 6) fewer average annual jobs on average relative to Alternative 1, while Lake Sakakawea would have from 1 (Alternative 2) to 5 (Alternative 4) fewer jobs. Fort Peck Lake is most adversely impacted by Alternative 4, with an average annual reduction in 4 jobs and $86,000 in labor income relative to Alternative 1.

At Lake Oahe and Lake Sakakawea, Alternatives 2, 4, and 6 would reduce reservoir elevations further than under Alternative 1 in the years following a spring release or spawning cue pulse during relatively drier conditions. Under these simulated conditions, the releases would exacerbate drought or drier conditions and further reduce recreational access and visitation relative to Alternative 1, reducing reservoirs elevations. During the eight worst years relative to Alternative 1, Alternatives 2, 4, and 6 would reduce annual jobs by 29, 39, and 46, respectively, at Lake Oahe. Lake Sakakawea and Fort Peck Lake would experience from 11 to 29 fewer jobs under Alternatives 4 and 6 in the eight worst years relative to Alternative 1.

There are a number of modeled years under Alternatives 2, 4, and 6 when lake elevations would be higher than under Alternative 1, resulting in small increases in RED impacts compared to Alternative 1. However, when comparing the eight worst and eight best years at the Lake Sakakawea and Lake Oahe, the adverse annual impacts under the eight worst years are considerably worse than the small increases in impacts during the eight best years. Fort Peck Lake experiences more years with higher visitation under Alternative 2 relative to Alternative 1, partially due to the fishing success metric being met in two additional years relative to Alternative 1 from rising pool elevations (see Section 3.3. for additional details).

Alternative 3 would result in negligible change in jobs and income at the upper three reservoirs, with Lake Oahe experiencing slight increases in visitation, visitor spending, jobs (2), and income ($41,000) due to small increases in reservoir elevations relative to Alternative 1. During the eight best years under Alternative 3 compared to Alternative 1, Lake Oahe would experience 7 more jobs.

Alternative 5 would result in negligible changes from Alternative 1 at the upper three reservoirs, with an average annual reduction in 1 job at Lake Sakakawea and no change in jobs at Fort Peck Lake and Lake Oahe. During the 8 worst years relative to Alternative 1, usually in the years following simulated fall releases, there would be a reduction in average annual jobs of 8 and 15 at Lake Sakakawea and Lake Oahe, respectively.

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Appendix A: Data Sources for Boat Ramps

Alysen M. Abel, P.E., Public Works Director, City of Parksville, Missouri.

Elizabeth “Betty” Peake, NEPA Coordinator, US Army USACE of Engineers, Omaha District.

Bob Frohlich, Fisheries Development Supervisor, North Dakota Game and Fish.

Cathi Warren, Native American Consultation Specialist, US Army USACE of Engineers, Omaha District.

Christine Cieslik, P.E., Hydraulic Engineer, Omaha District, CENWO-ED-HF.

Darin McMurry, Operations Project Manager, Fort Peck Dam, US Army USACE of Engineers, Omaha District.

Jacki Bultsma, Chief, Natural Resource Section, Big Bend Project, US Army USACE of Engineers, Omaha District.

Jason Taylor, Building Engineer Assistant, South Dakota Game, Fish, and Parks.

Jean Reed, PE., Hydraulic Engineer, US Army USACE of Engineers, Kansas City District.

Jerry Garris, Facility Construction Coordinator, State of Nebraska.

John Voeller, Natural Resource Specialist, Lake Oahe, US Army USACE of Engineers, Omaha District.

Mark Fincel, Senior Biologist, State of South Dakota.

Nathan Busche, Natural Resource Specialist/Park Ranger, Garrison Dam, US Army USACE of Engineers, Omaha District.

Patrick Kline, GISP, Geographer, US Army USACE of Engineers, Kansas City District.

Scott Zessin, Geographer, US Army USACE of Engineers, Omaha District.