5.4 WATER QUALITY

5.4.1 Water Quality in the Lakes of the Mainstem Reservoir System

Water quality impacts to the Mainstem Reservoir System lakes were analyzed for the alternatives submitted for consideration by the Corps. The water quality impacts associated with the CWCP are described in Section 3.5. Table 5.4-1 qualitatively summarizes the effects on lake water quality of the submitted alternatives compared to the effects of the CWCP. No numeric impact values are given for the alternatives. Instead, a general indication is given of no change, a positive change, or a negative change to the mainstem lake water quality relative to the CWCP. The table provides a detailed description of the potential water quality impacts, the qualitative impacts of the alternatives relative to the CWCP, the rationale for the conclusion regarding the potential effects, and non-operational impact reduction activities. Overall, there is little difference between the potential impacts on water quality in the mainstem lakes of the CWCP and the submitted alternatives. Improved water quality conditions might be realized primarily from drought conservation measures that retain more water in the mainstem lakes during droughts than the CWCP.

The CWCP and the MLDDA alternative both include a balanced intrasystem regulation and do not include an additional spring and summer release, but the MLDDA alternative decreases the base of flood control storage by 2 MAF. A reduction in the system's base of flood control storage generally has little effect on water quality for the mainstem lakes. There is little difference in drought conservation between the CWCP and the MLDDA alternative.

Unlike the CWCP, the ARNRC alternative has increased drought conservation, an unbalanced intrasystem regulation, and a split navigation season (releases from Gavins Point Dam are not adequate to support navigation from mid-June through August). In comparison to the CWCP discharge flows, the ARNRC alternative contains a spring release increase of 15 kcfs and a lower summer release of 18 kcfs at Gavins Point Dam. The combination of an additional spring and a lower summer release from Gavins Point Dam mimics the natural flow of the Lower River and retains more water in the lakes through the mid-summer and fall period. The drought conservation measures have the most significant effect on lake water quality. These measures result in improved water quality by increasing the volume of water in the mainstem lakes, thus increasing the dilution of pollutants and reducing rapid fluctuation in lake levels during extended droughts.

The MRBA alternative maintains a flat release from Gavins Point Dam during the summer; however, intrasystem regulation is unbalanced and conservation of water in the upper three lakes during droughts is increased. The latter change, increased conservation during droughts, results in an overall improvement in water quality in the mainstem lakes by increasing lake-surface elevation and volume during droughts compared to the CWCP. The MRBA alternative reduces the drastic fluctuations in lake levels, thereby improving coldwater fish habitat in some of the drought years. It also provides greater protection against developing eutrophic conditions by having more water in storage to dilute nutrient loading from tributaries. The MRBA and ARNRC alternatives have similar levels of water conservation in the lakes during droughts; the major differences between the two alternatives are the higher spring releases and lower summer releases from Gavins Point Dam and the higher spring releases from Fort Peck Dam in many years that are in the ARNRC alternative.

Compared to the CWCP, the MODC alternative improves lake water quality, primarily during droughts. The MODC has the same conservation measures and spring and summer flows as the MRBA alternative but includes a longer, 34.5-kcfs release until mid-September in response to delaying the evacuation of excess water in the flood control zones. It also includes a spring rise out of Fort Peck Lake.

The lower summer releases from Gavins Point Dam that are part of the BIOP and FWS30 alternatives improve water quality in the mainstem lakes. Both the BIOP and FWS30 alternatives have the same drought conservation measures as the MRBA and MODC alternatives; however, they also have a spring rise release from Gavins Point Dam. The lower summer flows slightly reduce the drawdowns of the lakes because the flows are slightly lower during the summer in drought years. Increased water conservation and reduced lake drawdown in the summers during droughts will improve water quality conditions by reducing eutrophic conditions and increasing coldwater fish habitat.

Table 5.4-1. Water quality effects of submitted alternatives on the Missouri River mainstem lakes[1/].

Potential Impact	Description	Lake	Effects of Alternatives Compared to the CWCP						Rationale for Effect	Impact Reduction
			MLDDA	ARNRC	MRBA	MODC	BIOP	FWS30		
Arsenic concentrations may increase in water column, exceeding Tribal and State water quality standard for domestic drinking water and aquatic life.	Arsenic from the Missouri River basin (natural background and nonpoint sources) becomes adsorbed onto solids entering and being deposited in the lakes. The wave action erodes and agitates the lake sediments during low lake levels, potentially causing elevated dissolved arsenic concentrations in the water column. Elevated arsenic concentrations during low lake elevations and drought conditions may affect domestic water use (requiring additional treatment prior to domestic use) and cause chronic effects to aquatic life in lakes.	FPL, SAK, OAHE	NC	NC	NC	NC	NC	NC	Adverse effects are greatest during droughts when lakes are drawn down and bottom sediments are exposed to erosive effects of waves on the lakes. The alternatives generally have lower or higher lake levels than the CWCP during droughts and, no matter what the alternative is, the lake levels will expose sediments containing adsorbed arsenic.	Sediments with arsenic are already deposited in the lakes from background, point, and nonpoint sources. Accumulation of additional arsenic in the top layers of deposited sediments can be reduced if the arsenic can be stopped at the source. Domestic water systems should test for arsenic, metals, and other pollutants to ensure water supplies are protective of human health.
There may be an increase in exposure of fish to sediment containing mercury, pesticides, and other toxic pollutants that will accumulate in fish tissue.	Advisories have been issued for fish caught in the mainstem lakes in the States of Montana, North Dakota, South Dakota, and Nebraska. Montana suggests limiting the consumption of walleye, northern pike, lake trout, and Chinook salmon due to elevated levels of mercury. In North Dakota, all species and size of fish tested were found to contain mercury. Elevated levels of PCBs and dieldrin in channel catfish taken from the river were found in Nebraska.	All	NC	NC	NC	NC	NC	NC	The alternatives presented will not affect the loading and ultimate fate of metals, pesticides, and other toxic pollutants. Increased methylation of mercury in the lake sediments is not expected to change under these alternatives compared to the CWCP.	The EPA should work with Tribes, States, and other entities to establish an integrated monitoring program to assess increased bioaccumulation of toxic pollutants in lakes. As part of the Missouri River adaptive management process, bioaccumulation of metals and pesticides should be addressed based upon reliable water quality and fish monitoring data. Action needs to be taken in the watershed to reduce point and nonpoint sources of pollutants that bioaccumulate in fish tissue.

Table 5.4-1. Water quality effects of submitted alternatives on the Missouri River mainstem lakes[1/].

Potential Impact	Description	Lake	Effects of Alternatives Compared to the CWCP						Rationale for Effect	Impact Reduction
			MLDDA	ARNRC	MRBA	MODC	BIOP	FWS30		
Severe fluctuations in lake elevations in Fort Peck Lake, Lake Sakakawea, and Lake Oahe may affect the size and quality of coldwater fish habitat.	Reduction in coldwater habitat in lower levels of lakes occurs in Fort Peck Lake, Lake Oahe, and Lake Sakakawea. The low lake volume in combination with warmwater temperatures can decrease the dissolved oxygen concentrations below State water quality standards. The hypolimnion during summer stratification conditions can offer limited habitat area for coldwater fish species that require dissolved oxygen greater than 5 mg/L and a water temperature of less than 10°C.	FPL, SAK, OAHE	NC	+	+	+	+	+	The alternative with NC means that no change relative to the CWCP is expected since the summer flows are the same and there is no water conservation. The ARNRC, MRBA, BIOP, FWS30, and MODC alternatives all have more drought water conservation than the CWCP. These alternatives get a + because the increase in conservation will cause less severe fluctuations in lake levels during drought conditions. The ARNRC, BIOP, and FWS30 alternatives have summer releases from Gavins Point Dam that limit drawdown of lakes in summer relative to the CWCP.	States should make a lake management decision about maintaining a coldwater fishery in lakes during droughts. Drought conditions, by decreasing suitable coldwater habitat, affects coldwater species. States need to consider management options such as re-stocking after droughts or introducing more temperature-tolerant species.
Low lake levels contribute to the development of eutrophic conditions (nutrient enrichment) in the lakes.	Nutrient concentrations in lakes may increase due to reduced lake volumes during extended droughts that provide less dilution to nutrient loads under normal conditions. Nutrient and metal releases from anoxic conditions may occur. The decomposition of organic matter may decrease available dissolved oxygen concentrations in the hypolimnetic region of the lake. Blue green algae blooms can also cause aesthetic and water quality problems.	FPL, SAK, OAHE	NC	+	+	+	+	+	The alternative with NC means that no change relative to the CWCP is expected since the summer flows are the same and there is no change in water conservation. The ARNRC, BIOP and FW30 alternatives all have lower summer flows and more water conservation than the CWCP. These alternatives plus MODC have greater drought conservation measures than the CWCP. These alternatives get a + because of the increase in conservation and lower summer releases that will result in more water volume to dilute nutrient loading during drought in summer months, when eutrophic responses are most noticeable. The MODC has the same flow and conservation conditions as the CWCP and therefore no change is expected.	Reduce nutrient loading from point and nonpoint sources within the watersheds. Under the Missouri River adaptive management strategy, the Corps, Tribes, and States should review potential water quality concerns, referencing water quality monitoring data specific to eutrophic conditions.

Table 5.4-1. Water quality effects of submitted alternatives on the Missouri River mainstem lakes[1/].

			Effects of Alternatives Compared to the CWCP							
Potential Impact	**Description**	**Lake**	**MLDDA**	**ARNRC**	**MRBA**	**MODC**	**BIOP**	**FWS30**	**Rationale for Effect**	**Impact Reduction**
Missouri River flows will transport and deposit large amounts of sediment, causing more problems in achieving narrative sediment standards.	Narrative water quality standards for sediment (siltation) are being exceeded in four lakes (Sharpe, Oahe, Francis Case, and Lewis and Clark Lakes). Siltation and sediment accumulation are the primary reasons for lake impairment and habitat changes.	SRP, LFC, LC, OAHE	NC	NC	NC	NC	NC	NC	Sediment erosion, transport, and deposition are a normal process when operating dam systems. The dam system developed on the Missouri River has resulted in less total suspended solid loading throughout the river system. The total amount of sediment loading will not be affected by the alternatives' flow regimes in the river during the spring and summer. High sediment loading into lakes comes from tributaries within the watershed with highly erodible soils. Tributaries with high sediment loading into the mainstem lakes include the Bad River (Lake Sharpe), the White River (Lake Francis Case), the Niobrara River (Lewis and Clark Lake), and Cheyenne River Arm (Lake Oahe).	Control sediment loading through source control in the watersheds. Implement nonpoint and stormwater control practices such as the Section 319 Project on the Bad River. Erosion control studies that involve both structural controls and best management practices are needed to reduce high sediment loading.

1/ legend for abbreviations used in table:
(+) means positive change or improvement to environment
NC means no change
(-) means negative impact to environment
All – All lakes in Mainstem Reservoir System
FPL – Fort Peck Lake
SAK – Lake Sakakawea
OAHE – Lake Oahe
SRP – Lake Sharpe
LFC – Lake Francis Case
LC – Lewis and Clark Lake

5.4.2 Water Quality in the River Reaches of the Missouri River

This section compares the impacts of the submitted alternatives on water quality in the Upper and Lower River reaches with the impacts of the CWCP. Water quality impacts on river reaches associated with the CWCP are discussed in Section 3.5. Table 5.4-2 qualitatively summarizes the effects on water quality in the river reaches of the submitted alternatives compared to the CWCP. No numeric impact values are given for the alternatives. Rather, a general indication is given of no change, a positive change, or a negative change to the water quality in the river reaches relative to the CWCP. The table provides a detailed description of the potential water quality impacts to the Missouri River reaches, the qualitative impacts of the alternatives relative to the CWCP, the rationale for the conclusion regarding the potential effects, and non-operational impact reduction activities. The negative impacts are primarily related to alternatives that have lower summer releases at Gavins Point Dam than the CWCP.

The CWCP and the MLDDA alternative both include a balanced intrasystem regulation and do not include an additional spring and summer release, but the MLDDA alternative decreases the base of flood control storage by 2 MAF. There is little difference in water conservation between the CWCP and the MLDDA alternative. A reduction in the system's base of flood control storage generally has little effect on the water quality of the Missouri River reaches.

The ARNRC alternative has an unbalanced intrasystem regulation and a split navigation season, unlike the CWCP. Compared to the releases under the CWCP, the ARNRC alternative includes a spring release increase of 15 kcfs in many years and a lower summer release of 18 kcfs at Gavins Point Dam. The combination of an additional spring and a lower summer release from Gavins Point Dam that mimics the natural flow of the Lower River can affect water quality conditions. Improved water quality conditions will result in the Upper River, where the Fort Peck Dam spillway will be used to reduce coldwater thermal discharge impacts downstream; however, some contend that the spillway discharges could adversely affect downstream water quality by increasing streambank erosion and sediment loading in the river. At this time, the Corps believes additional erosion on an annual basis will be limited to the bankline directly across the river from the spillway. Other negative changes to water quality in the Upper River involve the use of the spillway, which may increase total dissolved gas concentrations above the National standard of no more than 110 percent of saturation. The negative changes to water quality in the Lower River result from the ARNRC alternative's reduced summer releases out of Gavins Point Dam, which provide less dilution of pollutants (including thermal waste discharges) entering the river from point and nonpoint sources.

The MRBA alternative maintains a flat release from Gavins Point Dam during the summer; however, intrasystem regulation is unbalanced and drought conservation in the upper three lakes is increased above the CWCP level. This alternative results in no water quality changes to the Upper and Lower River relative to the CWCP.

Compared to the CWCP, the MODC alternative has both positive and negative effects on water quality. Improved water quality conditions will result in the reach downstream from Fort Peck Dam. The Fort Peck Dam spillway will be used in many springs to reduce the thermal impacts of coldwater releases downstream. During these spring rises, the spillway discharges may adversely affect downstream water quality by temporarily increasing streambank erosion and sediment loading in the river. The spillway discharges also have the potential to increase total dissolved gas concentrations above the National standard. The MODC alternative has the same spring- and summertime flows as the CWCP, but has a longer, 34.5-kcfs release to mid-September. The MODC alternative also has the same water conservation conditions and unbalancing of the storage among the upper three lakes as the MRBA alternative, which results in no water quality changes in the river reaches.

The lower summer flows associated with the BIOP and FWS30 alternatives may have a negative effect on water quality in the Missouri River reaches. Both the BIOP and FWS30 alternatives include the low summer releases from Gavins Point Dam, ranging from 21 to 25 kcfs, thereby creating lower flow conditions downstream of Gavins Point Dam (and also Fort Randall Dam) than the CWCP. Most of the negative impacts in the Lower River result from reduced summer flow that provides less

Table 5.4-2. Effects of submitted alternatives on the river reaches of the Missouri River[1/].

Potential Impact	Description	River Reach	Effects of Alternatives Compared to the CWCP						Rationale for Effect	Impact Reduction
			MLDDA	ARNRC	MRBA	MODC	BIOP	FWS30		
Water discharged from dams causes channel alterations via bank and channel cuts that affect aquatic life habitat.	Dam discharges are considered to be aggressive since they are not in equilibrium with the receiving water sediment conditions, causing sediment erosion downstream. Erosion of river banks and channels near the dam discharge location can also be influenced by discharge velocity, channel morphology, and soil erosion potential. Erosion scours the river bed, which affects benthic aquatic life and lowers the elevation of the riverbed. The lowering of the riverbed elevation in turn lowers the local groundwater table, which affects vegetation and side channels.	Downstream of Fort Peck Dam	NC	-	NC	-	-	-	Four of the alternatives have a negative (-) impact relative to the CWCP. They have a spring water release from Fort Peck Dam. The spillway on the Fort Peck Dam will be used to draw warm water from the lake. The spillway will discharge water into the downstream reach at a high velocity, causing streambank erosion on the opposite side of the discharge. Increased bank erosion and sediment loading may occur.	Pilot testing will be performed by the Corps to assess potential erosion problems from using the spillway for thermal mixing downstream. Portions of the streambank areas being eroded by the high-velocity spillway discharges may be stabilized using best management practices for erosion control.
Coldwater releases at Fort Peck, Garrison, and Oahe Dams may affect downstream habitat by not meeting thermal water quality standards.	Discharge water from dams comes from releases of cold hypolimnetic water. Coldwater releases into designated warmwater habitats can affect aquatic life downstream until temperature equilibrium conditions are achieved. Montana is the only State on the Missouri River to list thermal modifications as a problem (Fort Peck only).	Downstream of Fort Peck Dam	NC	+	NC	+	+	+	Under the alternatives with a +, Fort Peck spillway will be used to discharge warmer water from the lake. Mixing with water released from the powerhouse will increase water temperatures downstream.	Construction of a selective withdrawal structure through which releases could be taken from optimum lake depths would improve thermal problems downstream. The TMDL study being performed by the State of Montana, EPA, and Fort Peck Tribe will review and assess alternatives to achieve water quality standards below Fort Peck Dam.
	North and South Dakota have not recognized that coldwater releases from Garrison and Oahe Dams contribute to water quality problems.	Downstream of Garrison and Oahe Dams	NC	NC	NC	NC	NC	NC	Garrison and Oahe Dam releases are not significantly affected by the alternatives.	N/A

Table 5.4-2. Effects of submitted alternatives on the river reaches of the Missouri River[1/].

Potential Impact	Description	River Reach	Effects of Alternatives Compared to the CWCP						Rationale for Effect	Impact Reduction
			MLDDA	ARNRC	MRBA	MODC	BIOP	FWS30		
Flow regime changes from Gavins Point Dam will affect downstream NPDES permits for thermal discharges.	Lower flow conditions, especially during summer split and drought conditions, may affect critical low-flow assumptions (7Q10) in permits. Change in flow regimes may cause temperature violations by industries using water for once-through cooling water. Reduced flows in the Missouri River could cause some river segments to not meet thermal water quality standards.	Downstream of Gavins Point Dam to the Mississippi River	NC	-	NC	NC	-	-	Relative to the CWCP, alternatives MLDDA, MRBA, and MODC have no change. The downstream discharges of these alternatives from Gavins Point Dam are similar to the CWCP. Alternatives ARNRC, BIOP, and FWS30 have lower summer flows, with the lowest discharge at Gavins Point Dam at 21 kcfs. The alternatives that have summer flows lower than 25 kcfs at Gavins Point Dam may cause thermal problems downstream.	States will enforce NPDES permit conditions for thermal discharges. Renewed NPDES permits may need to be changed due to the change in flow regimes from Gavins Point Dam. Powerplants may need to consider using cooling ponds or towers to reduce thermal discharges into the river. Powerplants may have to reduce power generation capabilities when discharges at Gavins Point Dam are less than 25 kcfs. EPA is studying thermal discharges and verifying mixing zone calculation assumptions on the Missouri River.
Flow regime changes from Gavins Point Dam will affect downstream NPDES permits for industrial and Publicly Owned Treatment Works (POTW) dischargers.	Lower flow conditions during summer split and drought conditions may affect low-flow assumptions in permits. Flows used to determine chronic effluent discharge limits (7Q10) and acute discharge limits (1Q10) may change. With less dilution available, water quality-based NPDES permit limits may have to be reduced.	Downstream of Gavins Point Dam to the Mississippi River	NC	NC	NC	NC	NC	NC	NC means that there will be no change relative to the CWCP. Studies have indicated that above 9 kcfs, adequate flows exist for NPDES 7Q10 flows. Historically, releases from Gavins Point Dam occurred during the drought years. No water quality problems associated with NPDES permits or water quality impacts from these releases were reported to the Corps.	N/A

Table 5.4-2. Effects of submitted alternatives on the river reaches of the Missouri River[1/].

Potential Impact	Description	River Reach	Effects of Alternatives Compared to the CWCP						Rationale for Effect	Impact Reduction
			MLDDA	ARNRC	MRBA	MODC	BIOP	FWS30		
Changing flow regimes will affect waters designated as outstanding water resources (Tier III Anti-degradation)	Low-flow conditions may affect Missouri River's designation as "outstanding waters" in Nebraska and Iowa due to sediment erosion, deposition, and elevated pollutant concentrations. According to the Clean Water Act, the water quality of outstanding waters must be maintained and protected. No water quality degradation can occur.	Iowa-Missouri state line to Big Sioux confluence and Nebraska from Nebraska-South Dakota state line to Niobrara River and from Niobrara River to Big Sioux River	NC	NC	NC	NC	NC	NC	The alternatives have a spring flow range of 34.5 to 50 kcfs and a summer low-flow range of 21 to 34.5 kcfs. These flows are well within the range of flows that have occurred under the CWCP. No water quality degradation has occurred in these outstanding water resources under the CWCP. No change in the condition of outstanding water resources is expected.	No water quality impacts expected. The Missouri River adaptive management process should be used to ensure that designated high quality water resources will not be negatively affected.
Low-flow conditions may cause portions of the river unsuitable for domestic drinking water uses.	Low-flow conditions in the Missouri River may provide less dilution of tributary loading of pollutants. Higher concentrations of pollutants may be realized in isolated stream reaches, exceeding domestic drinking water standards.	Below Gavins Point Dam	NC	NC	NC	NC	NC	NC	Low-flow studies performed by the Corps conclude that the critical flow from Gavins Point Dam that will affect drinking water quality is 9 kcfs. Alternative flows are well above this critical flow value. No change in water quality is expected.	No water quality concerns expected. The Missouri River adaptive management process should be used to assess the river water quality and operational changes necessary to ensure that impairment to drinking water resources will not occur in the Missouri River.
Low-flow conditions may cause portions of the river exceed water quality standards for recreation and aquatic life uses.	During low-flow conditions, less dilution may be available to reduce pollutant concentrations in the Missouri River. Pollutant loading may be from tributaries, overland runoff, stormwater drainage from urban areas, combined sewer overflows, and wastewater bypassing. Water quality standards criteria for aquatic life (chronic) and recreation may be exceeded, especially near tributaries and urban areas. Metal, nutrient, pathogen, and basic water quality criteria may be exceeded periodically.	Downstream of Gavins Point Dam to the Mississippi River	NC	-	NC	NC	-	-	Alternatives with a - have low summer flows below 25 kcfs. There is a lack of available information to determine the critical summer flow at Gavins Point Dam that could cause aquatic life criteria to be exceeded below flows of 25 kcfs. It seems possible that Lower River flows in combination with lower tributary flows could create conditions that cause aquatic life criteria to be temporarily exceeded. During drought conditions, there is the possibility that some water quality criteria with low values may be exceeded in the Missouri River. Chronic water quality standards may be exceeded in localized river segments. During the last drought, no water quality problems were reported to the Corps.	The Missouri River adaptive management process should review monitoring data collected on the Missouri River to determine if water quality problems occur during low summer flow and drought conditions. Water quality studies to address this critical flow issue should be designed and executed by the Tribes, States, EPA, and the Corps. Modeling studies can be performed to estimate critical flow to maintain water quality standards. Modeling studies need to be verified by water quality monitoring and analysis.

Table 5.4-2. Effects of submitted alternatives on the river reaches of the Missouri River[1/].

Potential Impact	Description	River Reach	Effects of Alternatives Compared to the CWCP						Rationale for Effect	Impact Reduction
			MLDDA	ARNRC	MRBA	MODC	BIOP	FWS30		
Pollutant loading from the Missouri River basin into the Mississippi River contributes to the Gulf of Mexico's poor water quality conditions.	Nonpoint sources such as nutrients, pesticides, metals, and sediment from the Missouri River basin are discharged into the Missouri River. The combination of the nutrient and organic chemical loading from both the Mississippi River and Missouri River basins causes poor water quality conditions in the Gulf of Mexico (low dissolved oxygen, eutrophic conditions).	Confluence with the Mississippi River to the Gulf of Mexico	NC	NC	NC	NC	NC	NC	The alternatives will have no effect on the hypoxic conditions in the Gulf of Mexico. Essentially, the same amount of water and mass loading of chemical constituents will be released at Gavins Point Dam on an annual basis relative to the CWCP.	Nonpoint source pollution needs to be controlled at the source within watersheds. Best management practices need to be implemented to control pollutant runoff into surface waters.
Releases from dams may exceed the National standard of 110% saturation for total dissolved gases.	Waters being discharged from dams can become aerated to the extent that supersaturation of gases, especially nitrogen, can occur. States have not listed total dissolved gases as a cause of water quality impairment.	Tailwaters of dams located on the Missouri River mainstem.	NC	-	NC	-	-	-	It is possible that aeration will occur during spring rise discharges over spillways, which can lead to high total dissolved gases. The CWCP has fewer historic operational spillway discharges. Alternatives ARNRC, BIOP and FWS30 have spillway discharges that will occur more frequently at Fort Peck Dam and Gavins Point Dam. MODC has Fort Peck Dam discharges only. High concentrations of dissolved gases are harmful to fish; therefore, a negative (-) impact is shown. The alternatives showing an NC mean no spillway discharges that differ from the CWCP.	As part of the Missouri River Adaptive Management process, the Corps should monitor dissolved gas concentrations during spillway discharge conditions. No water quality problems have been observed by the Corps from spillway discharges at Gavins Point Dam.

1/ legend for abbreviations used in this table:
NC means no change relative to the CWCP
(+) means a positive change or improved impact to environment
(-) means negative impact to environment
N/A – Not applicable

dilution of pollutants entering the river. Under extended drought conditions, these alternatives have more years during which navigation would not be served than the CWCP (5 years versus 1 year), which is also the case for the MRBA and MODC alternatives. The summer flow would drop to 18 kcfs in these years. Flows could be as low as 9 kcfs in the non-summer months in many of the drought years; however, these low flows would also occur under the CWCP. In those years during which the summer release from Gavins Point Dam would be 18 kcfs, even less dilution of pollutants would occur. Low-flow conditions during droughts may negatively affect aquatic life and recreational uses due to a loss of pollutant dilution. All of the low-flow conditions may negatively affect powerplant thermal discharge permits and thermal conditions within the river. Under the BIOP and FWS30 alternatives, improved water quality conditions will result in the Upper River, where the Fort Peck Dam spillway will be used to reduce the thermal impacts of coldwater releases downstream relative to the CWCP. The spillway discharges may negatively affect downstream water quality by increasing streambank erosion and sediment loading in the river during the spring rise from Fort Peck Dam.

5.4.3 Water Quality for Tribal Reservations

There are numerous uses for the Missouri River designated by the Tribes, EPA, and the States. These designated uses include coldwater and warmwater aquatic life, domestic drinking water, recreation, agriculture, and industrial uses. Tribes have water rights to the Missouri River and are actively involved with managing their water resources.

Overall, there is no change in water quality associated with the MLDDA alternative compared to the CWCP in water segments associated with Tribal Reservations. Both alternatives have a balanced intrasystem regulation and do not have an additional spring and summer release, but the MLDDA alternative decreases the base of flood control storage by 2 MAF. A reduction in the system's base of flood control storage generally has little effect on water quality for Tribes located near the mainstem lakes. There is little difference in water conservation between the CWCP and the MLDDA alternatives.

The MRBA has flow characteristics similar to those of the CWCP but it has an unbalanced intrasystem regulation and greater drought conservation measures. The ARNRC, BIOP, and FWS30 alternatives have increased drought conservation, an unbalanced intrasystem regulation, and a split navigation season, unlike the CWCP. The combination of an additional spring and a lower summer release from Gavins Point Dam that mimics the natural flow of the Lower River retains more water in the lakes during the mid-summer through fall period. The drought conservation measures are most beneficial for Reservations that are adjacent to the lakes in the upper portion of the basin. These alternatives result in improved water quality conditions for the Tribes by increasing the volume of water in the mainstem lakes, thus increasing the dilution of pollutants and reducing the fluctuation of the lake levels during drought conditions.

The submitted alternatives have different impacts to individual Reservations, depending on the location of the Reservation in the Missouri River basin. The Missouri River reach downstream from Fort Peck Dam that is adjacent to Fort Peck Reservation has the following designated uses: domestic drinking water, recreation, agriculture, and industry. There are several water quality problems or concerns for the Missouri River reach serving Fort Peck Reservation, which include coldwater releases and erosion of sediment into the river. No change in water quality is anticipated under the MLDDA and MRBA alternatives because they have Fort Peck releases similar to the CWCP. The other four submitted alternatives have a spring rise out of Fort Peck Dam, with a portion of the release coming over the spillway. The coldwater problem is expected to improve with the warmer spillway release in the spring. Increased erosion is expected across the river from the spillway because these releases are directed at the opposite bank. Local residents are concerned about increased erosion in the spring, but Corps studies indicate that long-term erosion beginning a few miles downstream from the spillway (where the spillway releases have fully merged with the powerhouse releases) should be similar for alternatives with or without the spring rise.

Water quality concerns for Fort Berthold Reservation is dependent on the conditions of Lake Sakakawea. Lake Sakakawea water quality concerns include metals, nutrient loading, loss of coldwater habitat, and accumulation of metals and other toxic elements in fish tissue. The MRBA, MODC, ARNRC, BIOP, and FWS30 are the best

alternatives for increased lake elevations during drought conditions. Limiting the decline of the lake level under these alternatives through increased conservation during droughts will maintain greater amounts of coldwater habitat for species that rely on this habitat and provide greater volumes of water in the lakes to dilute nutrient loads and reduce eutrophication. The MLDDA alternative does not decrease the lake level fluctuations, and it provides no improvement in coldwater fish habitat, nutrient loading, or eutrophication relative to the CWCP. None of the alternatives limit the suspension of metals in the water column and the accumulation of metals and other toxic elements in fish tissue in Lake Sakakawea.

Standing Rock and Cheyenne River Reservations are located on Lake Oahe. This lake has the same water quality issues as Lake Sakakawea. As stated above, the only alternatives that will improve any of the water quality conditions are those with increased water conservation during droughts: the ARNRC, MRBA, MODC, BIOP, and FWS30 alternatives. The severity of eutrophication and coldwater habitat issues will be reduced during droughts under these alternatives relative to the CWCP.

Lower Brule and Crow Creek Reservations are located on Lake Sharpe. Water quality concerns are bioaccumulation of metals and other toxic elements in fish tissue and accumulated sediment. For this Missouri River reach, there is no difference among the alternatives and the CWCP in terms of addressing these two water quality issues.

Yankton Reservation has two water quality concerns: bioaccumulation of metals and other toxics in fish tissue and accumulated sediment. This Reservation is located primarily along Lake Francis Case. Little difference relative to the CWCP is expected to occur among the alternatives in terms of lake levels. Tributaries carrying pollutant loads from highly erodible watersheds heavily influence the water quality of Lake Francis Case. For the part of the Reservation downstream from Fort Randall Dam, there are water quality issues related to the designation of this reach as an outstanding water resource by the State of Nebraska. The lower summer flows of the ARNRC, BIOP, and FWS30 alternatives may have an impact on this designation.

Ponca Tribal Lands and Santee Reservation are located adjacent to the headwaters of Lewis and Clark Lake. Water quality concerns include bioaccumulation of metals and other toxics in fish tissue and accumulated sediment. The alternatives will have no effect on the sediment loading and siltation within the lake relative to the CWCP because the sediment loading and siltation are influenced by tributary inputs. No difference in lake levels are expected among the alternatives relative to those under the CWCP; therefore, no differences in the two water quality issues are expected.

There are several Reservations located on the Missouri River downstream from Sioux City: Winnebago, Omaha, Iowa, and Sac and Fox Reservations. These Reservations are located below the Gavins Point Dam and in the Lower River portion of the basin, which has been influenced by river channelization. The water quality issues in this river reach include nutrient loading, NPDES permit limits, thermal discharges, designation of the reach adjacent to Omaha and Winnebago Reservations by the State of Iowa as an outstanding water resource, drinking water degradation, water quality standards for recreation and aquatic life, and habitat modification. The alternatives with lower summer flows—the ARNRC, BIOP, and FWS30 alternatives—may adversely affect several of these issues. The issues that may be adversely affected include the NPDES permit limits, thermal discharges, and the outstanding water resource designation.

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