	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
1	No action with emergency measures	FMM-Screening Document	No action	This alternative assumes no Federal project is implemented, but the types of emergency measures currently employed in the project area would continue to be implemented as necessary in response to flooding. These emergency measures include such actions as temporarily raising existing levees to protect the cities of Fargo and Moorhead as well as surrounding cities, constructing temporary levees and floodwalls in various areas, and sandbagging.	Analysis of the no-action alternative is required. The no-action alternative includes emergency measures because that is what the community has always done: fought the floods with emergency measures.	
	Non-Structural Alternatives					
2	Buy and relocate flood-prone structures	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	This measure allows for moving structures as part of the project and buying the land upon which the structures are located.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	Incorporated into Federal Project as a mitigation measure.
3	Buyout and demolition of Structures	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	This measure requires buying the structures and the land as part of the project. The structures are either demolished or sold to others and relocated to a location beyond the floodplain, all as part of the project.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project. This measure has already been incorporated as part of the project.	Incorporated into Federal Project as a mitigation measure.
4	Dry flood proofing	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	This measure concerns waterproofing the structures, which can be done to residential structures as well as all other types of structures.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	Incorporated into Federal Project as a mitigation measure.
5	Wet flood proofing	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	This measure is applicable as either a stand alone measure or as a measure combined with other measures such as elevation of structures. As a stand alone measure, all construction materials and finishing materials need to be water resistant. All utilities must be elevated above the design flood elevation.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	Incorporated into Federal Project as a mitigation measure.
6	Elevate structures	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	This measure requires lifting the structure above a particular flood event. In the metropolitan area, the most acceptable elevation measure might be on extended foundation walls. Because most of the structures to be elevated have basements under them, the concept would be to elevate the basement above the floodplain.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	Incorporated into Federal Project as a mitigation measure.

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
7	Flood warning systems	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	All of the nonstructural measures with the exception of buyout and of relocation to a completely flood free site require the development and implementation of flood warning/preparedness planning. The development of such plans and the installation of pertinent equipment such as data gathering devices [rain gages, stream gages], data processing equipment [computer hardware and software], and dial out devices [cellular, land line] can be part of the project. The communities in the area have developed emergency operation plans for floods and those plans are updated during and after flood events.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project. This measure should be incorporated in whatever alternative is selected.	Incorporated into Federal Project
8	Land Acquisition	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	Land acquisition can be in either the form of fee title or permanent easement with preference to fee title. Land use after acquisition is open space use via deed restriction that applies to any property required for the federal project. Individual site conditions may allow flexibility. Prohibits any type of development that can sustain flood damages or restrict flood flows. Land acquired as part of a nonstructural project can be converted to a new use such as ecosystem restoration and/or recreation that is open space based such as trails, canoe access, etc.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	Incorporated into Federal Project as a mitigation measure.
9	Vertical Construction for Residential Occupancy	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	This concept refers to condominium living within floodplains, where the at-grade floor is used for open-space uses and the upper stories (which are all above even the most infrequent floods) are used for residences.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	
10	Flood Management Plan	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	A floodplain management plan (FPMP) is required of the Corps non-Federal project sponsor. The intent of an FPMP is to “protect” the Corps’ partnered project from diminishing the frequency of flood risk reduction provided by the project. Applied after project completion.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	Incorporated into Federal Project
11	Flood insurance	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	The National Flood Insurance Program (NFIP) should be utilized more to reduce the individual risk to flooding.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	
12	Wetlands and Grasslands	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	This alternative includes restoration of drained wetlands, restoration of grasslands, and changes in land use practices in the watersheds upstream of the Fargo-Moorhead Metropolitan Area. These features would reduce peak runoff, change flood frequency, and serve as water storage during flooding. The features would be distributed throughout the upstream portion of the basin and would generally provide low level storage that would be primarily used for wetlands and habitat.	Flood storage and wetland/grassland restoration do not effectively address the problems and opportunities identified in this study. Although there are opportunities to implement these measures on a large scale as an effective basin-wide measure, the implementation would need to take place in increments over a long period of time and in many locations. Based on effectiveness and difficulty of implementation, restoring wetlands and grasslands should no longer be considered as a stand-alone alternative, but may be considered for inclusion to mitigate for other adverse project effects where it can be incrementally justified.	

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
13	Removal of basements	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	This measure requires filling the existing basement without elevating the remainder of the structure. This measure could be used if the structure's first floor was above the Base Flood Elevation (BFE) or above the design elevation, whichever is higher.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	
14	Berms, levees, and floodwalls	FMM-Screening Document/Appendix O, FEIS, Further described in Appendix P, FEIS	Nonstructural	As nonstructural measures, berms, levees and walls are generally no higher than 6 feet above grade and are not certifiable for the National Flood Insurance Program (NFIP), meaning that flood insurance and floodplain management requirements of the NFIP are still applicable in the protected area. These nonstructural measures are intended to reduce the frequency of flooding but not eliminate floodplain management and flood insurance. These measures can be used for all types of structures in the metropolitan area. They can be around a single structure or a small group of structures.	Non-structural measures should no longer be considered as stand-alone alternatives, because they were not found to be cost effective. However, the non-structural concept should be retained as a possible measure for smaller areas not otherwise benefited by the project or to mitigate for adverse effects caused by the project.	

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
				Structural Alternatives		
15	Flood Barriers	Appendix O, FEIS	Flood Barriers	For the initial screening, this study analyzed flood barrier systems at two different top profiles to reliably contain the 2-percent chance flood and the 1-percent chance flood. Initial analyses were based on constructing levees in both Fargo and Moorhead to the design levels and assessing the costs and economic benefits of the plans. This alternative includes the use of permanent flood barrier systems including levees, floodwalls, invisible floodwalls, gate closures, and pump stations. These features would be considered alone and in concert with other potential measures as part of a flood risk management system for the study area.	The levee plans would provide a limited level of risk reduction, have large short term social impacts, high costs and are moderately cost effective. Would result in stage increases and induce upstream impacts that would require mitigation. Therefore it is recommended that levee plans be removed from further consideration as a stand alone plan, but could be carried forward to be included with other measures.	
16	In-town levees		Flood Barriers	Smaller levees within the Fargo-Moorhead Metro would be constructed at locations that are more susceptible to flooding, to allow the project to operate less frequently.	Reduces frequency and duration of operation. Start operating at a 10-year event vs. a 3-year event. Pass 17,000 cfs through town vs. 9600 cfs. Significantly reduces chance of summer operation. Reduces environmental impacts (connectivity and geomorphic). Carried forward and implemented.	Incorporated into Federal Project as a mitigation measure.
17	Levees	Appendix O, FEIS	Flood barriers	The unique geology of the Fargo-Moorhead area makes it difficult to construct permanent features near the river banks. Earthen levees would need to be located hundreds of feet landward of the river to remain stable.	The levee-only plans would provide a limited level of risk reduction, have large short term social impacts, high costs and are moderately cost effective. The top elevation of flood barrier alternatives is limited to the highest natural ground available to begin and end the levee; within the study area, flood barriers could not be certified to contain floods larger than about a 30,000 cfs event. Therefore it is recommended that levee plans be removed from further consideration as a stand alone plan, but could be carried forward to be included with other measures.	
18	Floodwalls	Appendix O, FEIS/FMM Screening Document	Flood barriers	Floodwalls are typically concrete and steel structures that provide a barrier to flood water both underground and above ground.	Floodwalls like levees and other flood barriers were screened out as a stand alone alternative but were retained and carried forward to potentially be used in combination with other alternatives.	Incorporated into Federal Project as part of In Town Levees.
19	Invisible floodwalls	Appendix O, FEIS/FMM Screening Document	Flood barriers	Invisible floodwalls are floodwalls with removable portions above ground that can be installed only when needed during floods.	Invisible floodwalls like levees and other flood barriers were screened out as a stand alone alternative but were retained and carried forward to potentially be used in combination with other alternatives.	
20	Gate closures	Appendix O, FEIS/FMM Screening Document	Flood barriers	Gate closures are placed where storm sewers pass through the levee or floodwall. The gates would remain open except during floods, when they would be closed to prevent flood waters from passing through the line of protection.	Gate closures like levees and other flood barriers were screened out as a stand alone alternative but were retained and carried forward to potentially be used in combination with other alternatives.	Incorporated into Federal Project as part of In Town Levees.
21	Pump stations	Appendix O, FEIS/FMM Screening Document	Flood barriers	During floods, storm drainage and snow melt inside the protected area would be redirected to pump stations designed to lift the water over the flood barriers.	Pump stations like levees and other flood barriers were screened out as a stand alone alternative but were retained and carried forward to potentially be used in combination with other alternatives.	Incorporated into Federal Project as part of In Town Levees.
22	Closure Structures	Appendix O, FEIS/FMM Screening Document	Flood Barriers	Closure structures would be built where roads and railroads cross the line of protection. During floods, the roads and railroads would be closed to traffic before flood waters reach the closure elevation, and traffic would resume only after the risk of flooding had passed.	Closure structures like levees and other flood barriers were screened out as a stand alone alternative but were retained and carried forward to potentially be used in combination with other alternatives.	Incorporated into Federal Project as part of In Town Levees.

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
23	Flood Storage in General	Appendix O, Feis, and FMM Screening Document	Flood Storage	Flood storage involves both preserving natural floodplain areas and also building dams and other water retention facilities to hold water during flood events. Flood storage concepts include large dams, distributed smaller storage sites, controlled field runoff, use or modification of the constructed road network to store water (the "waffle plan"), storage ponds used for water conservation, and payment to landowners for water retention. These facilities would be located in any watershed upstream of the Fargo-Moorhead Metropolitan area and distribution would be throughout that area.	Flood storage should no longer be considered as a stand-alone alternative for the Fargo-Moorhead area because it isn't effective, implementability is low, and costs will be high. Impacts will occur in areas upstream of the FMM area. A model of a system of impoundments with 400,000 acre feet of storage could reduce the 1% chance flood stage event in Fargo-Moorhead by less than 1.6 feet. Storage alone is unlikely to adequately reduce flood risk to the study area in the next 50 years. This option also isn't cost effective. It is unlikely to be economically justifiable for large systems. The flood storage concept should be retained for possible implementation to mitigate for any adverse impacts of other plans or where it can be otherwise incrementally justified. The local communities should continue to seek opportunities for storage in the basin.	The Diversion Authority supports retention projects by others in the region and has committed $25 million to encourage retention initiatives.
24	Large dams upstream	Appendix O, Feis, and FMM Screening Document	Flood storage	Three Corps-owned flood storage projects in the Red River basin benefit the study area: Lake Traverse, Orwell Lake, and Lake Ashtabula. Constructing additional Large Dams were also considered.	Opportunities exist to build additional flood storage, but previous Corps studies have found insufficient national economic interest to support Federal involvement in such projects.	
25	Distributed flood storage versus Upstream Staging and Storage	Appendix O, Feis, and FMM Screening Document	Flood storage	Distributed Storage consists of many options to store water at multiple locations that combined can store large quantities of water. Upstream staging and storage is looking at staging of water and storing of water immediately adjacent to the Southern embankment.	The 150,000 acre feet of staging and storage as part of the LPP is effective and reliable storage. The further away storage is located from Fargo-Moorhead, the less effective and reliable it becomes and the smaller the benefits are. 2 to 5 times more storage is required to have an equal amount of effective storage depending on how much further away you go from Fargo Moorhead meaning more structures and land needed from upstream counties. Flood storage has been studied in the Red River watershed and found to be effective at mitigating for localized smaller events. Distributed storage is screened from further consideration as an alternative to upstream staging and storage because upstream staging and storage is more implementable from a logistical perspective, more effective, will have greater reliability, and will have less overall impacts than distributed storage. Distributive storage would also be difficult to include in FEMA certification due to uncertainty in the origination of flood events.	Incorporated upstream staging into Federal Project as a mitigation measure.
26	Waffle Plan	Appendix O, Feis, and FMM Screening Document	Flood storage	Use or modification of roadways to store water on the landscape.	An economic analysis presented in the Waffle plan report indicated that the Waffle concept may be economically justified, but there are several outstanding technical, social and political issues and institutional arrangements that need additional development before the concept could be implemented. The Waffle concept, as described in the report, does not fit any existing Corps of Engineers implementation authorities. Dismissed due to being ineffective, inefficient and costly. Cannot substantially reduce flood risk to the FM area.	

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
27	Controlled field runoff	Appendix O, Feis, and FMM Screening Document	Flood storage	Install drain tile to store water.	The Red River Retention Authority, via the International Water Institute and the Basin and Technical Advisory Committee (BTSAC), has studied the use of tile drainage systems to store water in the soil. Their reports are posted on the Internet at: http://www.rrbdin.org/archives/649 and http://www.rrbdin.org/archives/4039. BTSAC Briefing Paper #1 includes the following statement: "Any general statement implying that subsurface drainage decreases (or increases) flood peaks is strongly discouraged because it oversimplifies the complex processes involved." BTSAC Briefing Paper #3 states: "Since subsurface drainage systems increase total annual water volume from fields and have the potential to increase downstream flood peaks, the BTSAC reaffirms the subsurface management recommendations to mitigate flood impacts from subsurface drainage systems including the installation and operation of controls to increase temporary storage during flood events whenever possible (BTSAC 2012)." According to these reports, it will be important for existing and future tile systems to be designed and managed carefully to avoid increasing flood peaks; there is no evidence that tile systems can significantly reduce flood peaks. Dismissed from further consideration due to ineffectiveness and unreliability with respect to flood reduction.	
28	Storage ponds	Appendix O, Feis, and FMM Screening Document	Flood storage	Natural storage in the floodplain occurs as the water rises and fills up low-lying areas adjacent to the rivers. Constructed flood storage projects (impoundments) would be located on the main channel of a river or "off-channel" on a ditch or other manmade connection to a river. Impoundments could be designed to remain dry until a flood event, or to retain a pool during non-flood times for conservation or water supply purposes.	The study team has found that storage alternatives, either as stand-alone measures or in combination with others, do not effectively or efficiently address catastrophic flood risk in the Fargo-Moorhead Metro area. Storage alternatives have the potential to reduce flood stages in the local area downstream of a storage site while they significantly increase flood stages upstream within the storage area. The stage reductions produced by flood storage are largest immediately downstream of the storage area and diminish with distance downstream of the storage area.	
29	Pay landowners for water retention	Appendix O, Feis, and FMM Screening Document	Flood storage	Provide payment to individual land owners for them to store water on their property. This could be either an easement or in fee depending on specifics.	The study team has found that storage alternatives, either as stand-alone measures or in combination with others, do not effectively or efficiently address catastrophic flood risk in the Fargo-Moorhead Metro area. Storage alternatives have the potential to reduce flood stages in the local area downstream of a storage site while they significantly increase flood stages upstream within the storage area. The stage reductions produced by flood storage are largest immediately downstream of the storage area and diminish with distance downstream of the storage area.	Incorporated into Federal Project as a mitigation measure.
30	Water Redistribution	Appendix U, FEIS		Redistributing water and snow from the Red River Basin to other areas of the country impacted by drought or water shortages. Public comments proposed a variety of measures including sending snow from North Dakota west via trains or trucks, installing a series of pumps and hoses along trucks, bagging snow and shipping or storing locally for summer melt, and installing permanent pipelines from locations along the Red River.	Water redistribution was considered in the form of storage alternatives and upstream impoundments; water redistribution to western states was not evaluated in great detail because the costs (efficiency) of transporting snow and water are greater than the benefits that could be provided by this reduction in snowpack. The study team has found that other alternatives, such as diversion channels, are more efficient (provide more benefits at less cost) and more effective (reduce flood risk to a greater degree) than water redistribution alternatives.	

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
31	A Passive Diversion channel without an operable river control structure	Appendix O, FEIS	Increase conveyance	This includes diversion channels as described above without operable river control structure(s).	This was screened out because by not having a control structure we could not achieve adequate stage reduction at the Fargo Gauge. For example, a MN45K diversion without a control structure would reduce the 100-yr flood stage by about 4.5 feet; the same diversion with a control structure would reduce the 100-yr flood stage by about 11 feet. This alternative was also not economically justified.	
32	MN Short Diversion Channel and associated features.	Appendix O, FEIS	Increase conveyance	The Minnesota short alignment is approximately 25 miles long, starting near the confluence of the Wild Rice and Red Rivers and ending near the confluence of Sheyenne and Red Rivers. Five separate diversion capacities were analyzed for the Minnesota alignments including 20,000, 25,000, 30,000, 35,000, and 45,000 cubic feet per second (cfs).	The MN Short plans were carried forward for consideration, and it was later determined that the MN40K plan was the NED plan.	
33	MN Long	Appendix O, FEIS	Increase conveyance	The Minnesota long alignment started approximately 3 miles south of the confluence of the Red and Wild Rice Rivers and would end at the Red River near the confluence of the Red and Sheyenne Rivers. The alignment would be approximately 29 miles long. Because this alignment begins south of the confluence of the Red and Wild Rice Rivers, an extension of the diversion channel would be required between the Red and Wild Rice Rivers. The tie-back levee would be required to extend west from the Wild Rice control structure to higher ground.	This alternative was eliminated because the MN Short alignments outperformed the Minnesota Long, and there were no significant unique benefits or avoidance of any environmental effects associated with the Minnesota Long alignment.	
34	MN Diversion option with a shorter diversion in North Dakota	Appendix O, FEIS	Increase conveyance	This option included a MN diversion channel and a diversion channel in North Dakota that only diverted flow from the Maple, Rush and Lower Rush Rivers, this would provide flood risk reduction from not only the Red and Wild Rice Rivers but also from the Maple, Rush and Lower Rush Rivers.	It was determined that this would not be cost effective as an incremental measure so it was eliminated from consideration.	
35	North Dakota Alignments	Appendix O, FEIS	Increase conveyance	The North Dakota alignments would require an extension of the diversion channel between the Red and Wild Rice Rivers which would begin south of the confluence of the Red and Wild Rice Rivers, like the Minnesota long alignment. The tie-back levee associated with these alternatives would extend east from the Red River control structure to high ground. The North Dakota west alignment was analyzed for 35,000 and 45,000 cfs, and the North Dakota east alignment was analyzed for 35,000 cfs. A combination of control structures on the Red and Wild Rice Rivers at the south end of the project, along with a weir at the entrance to the diversion channel, would control the flow split between the Red and Wild Rice River channels and the diversion channel. This alignment would cross several rivers, including the Sheyenne, Maple, Lower Rush, and Upper Rush. Hydraulic structures would be necessary at the point where the diversion channel crosses these rivers.	A North Dakota Diversion was carried forward because the diversion channel concept was the only concept that could achieve a high level of flood risk reduction in the study area. This concept was recommended by the 6 local entities: City of Moorhead, Clay County, Buffalo-Red Watershed District (Minnesota) and City of Fargo, Cass County and Cass County Joint Water Resource District (North Dakota).	
36	North Dakota West Alignment	Appendix O, FEIS	Increase conveyance	The North Dakota west alignment would start approximately 4 miles south of the confluence of the Red and Wild Rice Rivers and extended west and north around the cities of Horace, Fargo, West Fargo, and Harwood and would end at the Red River north of the confluence of the Red and Sheyenne Rivers near the city of Georgetown, Minnesota. The alignment would be approximately 35 miles long.	This alternative was eliminated because the North Dakota East alignments outperformed the North Dakota West Alignment, and there were no significant unique benefits or avoidance of any environmental effects associated with the North Dakota West alignment.	

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
37	North Dakota East Alignment	Appendix O, FEIS	Increase conveyance	The North Dakota east alignment generally followed the North Dakota west alignment except that, after crossing the Sheyenne River, it would use the existing Horace to West Fargo Sheyenne River Diversion corridor between Horace and I-94. The North Dakota east alignment would be approximately 36 miles long.	This plan was carried forward and later modified to become the ND35K plan which, with the addition of other measures developed into the LPP. The North Dakota diversions are more complete solutions to the regional flood problem, because they would reduce the risk of flooding from the major tributaries in the North Dakota portion of the study area that are not addressed by the Minnesota Diversions.	This is the Federal Project.
38	Final Array of combinations	Appendix O, FEIS		The final array of combinations consisted of 25 combinations (starting from 384 combinations that were considered) that can be broken down into three alternatives; a MN diversion with no staging, a North Dakota diversion with no staging, and a North Dakota diversion with staging. There are 8 combinations with a North Dakota diversion and staging, 16 with a North Dakota diversion without staging, and one Minnesota diversion without staging. These combinations include four measures that may or may not be included in those plans; Non-structural measures, Flood Storage, Wetland/Grassland Restoration, and smaller levees.	From these 25 combinations it was determined that only three would be carried forward which include the following the Federally Comparable Plan (FCP), the ND35K plan and the Locally Preferred Plan (LPP) which is the North Dakota diversion ND35K with upstream storage and staging. The other 22 combination alternatives were dropped from consideration.	
39	North Dakota West Alignment Gets Reconsidered	Appendix O, FEIS		This alternative alignment was re-considered based on information from local entities. A comparison of the ND East and West were revisited based on the following; Western Area power Administration sub station, impacts to natural Resources including wetlands and floodplains, benefits to additional homes and emergency access, benefit of a straighter channel and interaction with existing diversions, level of protection for the existing community of West Fargo, and benefits to local communities of developing in former floodplain areas.	The North Dakota Western Alignment was screened out again because the east alignment will have less impact to floodplain, less overall impact to wetlands, and will provide no appreciable benefits to the WAPA substation. The East Alignment minimizes floodplain impacts, provides a reasonable balance between protecting existing development and preserving the floodplain, and is a practicable alternative to the West alignment.	

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
	The following six scenarios were considered to assist with local decsion making. *Appendix O, FEIS/Attachment 7*					
40	Locally Preferred Plan LPP, Scenario 1 (Appendix O, pg O-72)	Appendix O, FEIS	Combination	Enlarge Storage Area 1 and reduce upstream Staging	This scenario was looked at to determine if the addition of storage areas could be a cost effective way to reduce the upstream staging. This would just transfer where the storage is located and does not impact quantity of storage which is necessary for the project. Would have increased the length of the high-hazard dam. This would not be cost effective, nor would it have any appreciable environmental benefit therefore it was eliminated from further consideration.	
41	Scenario 2	Appendix O, FEIS	Combination	Eliminate storage area 1 and reduce staging and increase downstream impacts	This scenario included stage impacts that would likely continue into Canada, and would require removing additional land from the floodplain. This scenario was eliminated from consideration.	
42	Scenario 3	Appendix O, FEIS	Combination	Add large storage cell on downstream end of diversion and reduce upstream staging.	This scenario was looked at to determine if the addition of storage areas could be a cost effective way to reduce the upstream staging. This would just transfer where the storage is located and does not impact quantity of storage which is necessary for the project. This would not be cost effective, nor would it have any appreciable environmental benefit, therefore it was eliminated from further consideration.	
43	Scenario 4	Appendix O, FEIS	Combination	Eliminate storage area 1 and eliminate staging, basically the ND35K plan	This is basically the ND35K plan which was eliminated due to downstream impacts that would have extended to Canada.	
44	Scenario 5	Appendix O, FEIS	Combination	Eliminate storage area 1 and increase upstream staging	This scenario would result in the additional staging of approximately 1.2 feet to offset the loss of additional storage, which would require larger structures, increase in levee length and height, and the acquisition of additional land for staging. This scenario was eliminated because it would require more land to be removed from the floodplain and issues with fish passage because the project would have to operate for a longer period of time.	
45	Scenario 6	Appendix O, FEIS	Combination	Diversion alignment south of Oxbow, Hickson, and Bakke	The scenario looked at moving the diversion channel alignment south of the town of Oxbow. By doing this more land would be taken out of the floodplain, would require larger structures, increase in levee length and height, and impact an additional 5,900 acres of land. The current diversion channel alignment would have fewer impacts to the floodplain while still providing flood risk management for the Red River and five tributaries. Therefore this scenario is no longer being considered.	
46	20% flow reduction	Appendix O, FEIS		A 20-percent flow reduction plan was recommended to reduce flood damages to the Red River Basin.	This was screened from further consideration due to the number of sites required and the availability of sites required to achieve the amount of storage necessary for this. In addition to this the large number of acres required to implement this would have greater impacts on property owners, agriculture, and the environment.	
47	Cutoff channels	Appendix O, FEIS	Increase conveyance	Building cut-off channels across meanders that would provide the water a straighter path through the city and potentially reduce peak stages. The channels would be designed with a bottom elevation above a certain design stage to allow the river to flow naturally up until a design event at which time the excess water would flow into the cut-off channel.	Cut-off channels should not be considered as a stand-alone alternative because they would not be effective in substantially reducing flood risk in the study area, but should be retained for possible inclusion in an overall plan where they could be incrementally justified.	

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
48	Flatting the slopes on riverbank	Appendix O, FEIS	Increase conveyance	Similar to dredging the river this would create more capacity for flow in the existing river channels.	This was screened out because it wasn't implementable. Extensive excavation would be required to achieve the desired conveyance which would impact many structures and infrastructure, have significant environmental impacts and stability issues, etc.	
49	Replacing bridges	Appendix O, FEIS	Increase conveyance	Bridges can restrict the flow during flood events. Raising or modifying bridges can increase conveyance in the channel and reduce flood stages.	This alternative should not be considered further as a stand-alone plan, because it would not be effective in substantially reducing flood risk in the study area, but should be retained for possible inclusion in an overall plan if it can be incrementally justified.	
50	Underground tunnels	Appendix O, FEIS	Increase conveyance	Large tunnels would be used to divert flows under the communities; this would function similar to a diversion channel, just underground. It was estimated that at least three 30-foot diameter tunnels approximately 25 miles long would be needed to provide approximately 25,000 cubic feet per second capacity.	There would be a number of positive aspects to a tunnel alternative, however due to the cost of this alternative being substantially greater than any of the diversion channels while providing similar benefits, and other uncertainties with long term maintenance and repair, it is recommended that no additional study of tunnels be conducted. Downstream impacts would have to be mitigated.	
51	Interstate 29 viaduct	Appendix O, FEIS	Increase conveyance	Reconstructing the Interstate 29 (I-29) corridor to serve as an open viaduct during floods. The reconstructed corridor would function as an interstate highway during non-flood times. It would essentially be a diversion channel with an interstate highway either on the bottom or elevated.	Was screened from consideration because of cost, access to evacuation routes, and technical issues, among other reasons.	
52	Dredge river deeper and wider	Appendix O, FEIS	Increase conveyance	Digging the Red River channel deeper and wider to allow for more flow to pass through the Fargo-Moorhead Metropolitan Area. This alternative could also be looked at underneath existing bridges to prevent the damming effect the bridges can create.	This alternative was eliminated for several reasons, including environmental impacts and cost effectiveness. If this alternative was implemented on a hydraulically effective scale, it would be highly detrimental to the riverine and riparian ecosystems and would likely not be permitable.	
53	Increase conveyance at Oakport Coulee	Appendix O, FEIS	Increase conveyance	This alternative was considered with widening and deepening the Red River.	The was screened out with the "Dredge River Wider and Deeper" Alternative.	
54	Staging Water with diversion channel	Appendix O, FEIS	Increase conveyance	Staging is a measure intended to change the timing and volume of total flows passing around communities with the result of reducing downstream impacts. Requires gate operations at control structures. Results in a temporary pool upstream of the diversion.	This alternative was carried forward into the final alternative. This measure is needed to offset downstream impacts.	Incorporated into Federal Project.
55	Control Structures/Hydraulic Structures	Appendix O, FEIS	Increase conveyance	Control structures are concrete structures that can be located on the rivers or at the inlet of the diversion channel. A control structure has the advantage of creating hydraulic head at the diversion inlet and forcing flows down the diversion channel while restricting flows down the main stem channel. They can be gated or un-gated.	Control structures carried forward include a gated Diversion Inlet Structure, gated control structures on the Red River and the Wild Rice River.	Incorporated into Federal Project.
56	Aqueducts	Appendix O, FEIS	Increase conveyance	Aqueducts are needed at locations where diversions cross tributary streams. Any of the North Dakota diversions would require crossing structures at the Sheyenne River and the Maple River.	Aqueducts at the Sheyenne River and Maple River Crossing were carried forward into the final alternative.	Incorporated into Federal Project.
57	LPP	Appendix O, FEIS	Combination	The LPP is a modification of the ND35K plan which incorporates features that allow upstream storage and staging designed to minimize the downstream impacts and the extent of those impacts.	This is the selected plan that came out of the FEIS.This concept was recommended by the 6 local entities: City of Moorhead, Clay County, Buffalo-Red Watershed District (Minnesota) and City of Fargo, Cass County and Cass County Joint Water Resource District (North Dakota).	Incorporated into Federal Project.
58	ND35K plan	Appendix O, FEIS	Combination	Similar to the LPP, but doesn't incorporate storage or staging as part of the plan.	This plan was eliminated because downstream impacts reach as far as into Canada.	

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
59	FCP (MN 35K Plan)	Appendix O, FEIS	Combination	The MN35K plan was kept for comparison to the LPP for cost-sharing purposes, it was not the NED, but it was determined that it was not necessary to fully describe the NED plan once it was demonstrated that the LPP was a smaller capacity plan and the NED (MN40K) was dropped from consideration.	For federal cost share purposes a Federally Comparable Plan (FCP) had to be identified that would have a comparable level of benefits to the LPP. This plan was identified as the MN35K plan. This plan had downstream impacts that would have required upstream staging to mitigate in order to be implementable.	
60	NED (MN40K Plan)	Appendix O, FEIS	Combination	This was the plan with the most Net Economic Development (NED) benefits.	The MN35K plan was kept for comparison to the LPP for cost-sharing purposes. It was not the NED, but it was determined that it was not necessary to fully describe the NED plan once it was demonstrated that the LPP was a smaller capacity plan and the NED (MN40K) was dropped from consideration. Minnesota officials supported moving diversion channel to ND. MN diversion footprint impacted 6500 acres in MN. This plan had downstream impacts.	
61	MN and North Dakota Alignments Without Staging	Appendix O, FEIS	Increase conveyance	These alternatives are the same MN and ND diversion plans but with downstream impacts versus upstream impacts.	These options were eliminated in favor of the plans that would have lower, mitigatible upstream impacts when compared to greater downstream impacts to Canada.	
62	Basin-wide versus Metro Area focus	Appendix S, FEIS		Flood risk management solutions should be developed from a basin-wide perspective, so as to find a full range of alternatives (including upstream storage), and impacts to areas outside the metro would be fully considered.	The problems and opportunities in the EIS pertain to the metro area. Planning efforts consider a full array of possible solutions and evaluate effects of reasonable alternatives. The significant amount of existing flood risk in the metro warrants evaluating measures that chiefly benefit the metro. Planning objectives are to reduce flood risk in the metro, improve environmental quality, wetland habitat, and recreation in conjunction with reducing flood risk, with the constraint of avoiding increasing peak flood stages upstream or downstream of the metro area.	
63	Upstream Dams Operating Plans Alternatives	Appendix S, FEIS		Alter operating plans for existing upstream dams to reduce flood risk.	Many dams in the basin are operated for flood damage reduction, but dams are not always located in an area where all snowmelt or rainfall can be captured. Dams in the basin are operated according to specific operating plans to optimize the performance of the individual dam. Many dams in the basin do provide flood water storage and reduce the flows downstream and provide risk reduction benefits.	
64	Level of Risk Reduction	Appendix S, FEIS		Consider changing the level of flood risk reduction to a lesser event.	The level of risk reduction targeted in this project guided by a goal set by the non-federal sponsors' Work Group. The Metro Flood Study Work Group (MFSWG) established the goal of a stage of 36 feet at the Fargo gage during a 0.2-percent chance event, or the 500-year event. The assurance of a stage of 36 feet is not achieved at the 0.2 percent event with the Locally Preferred Plan, or the Federally Comparable Plan; the MFSWG has approved of the diversion channel alternatives providing a level of protection (approx. 1-percent event) lower than the original goal.	
65	Locks on the Diversion	Appendix U, FEIS		Include a series of locks on the diversion that control the flow.	Adding locks or other structures to impede flow in the diversion channel would make it more expensive and less hydraulically efficient.	

	Alternative/Measures	Source	Type	Description	Evaluation/Determination	Additional
These Alternatives were looked at during the Supplemental EA dated September 2013						
66	VE13A Southern Embankment Alignment	Supplemental EA/PFSAA	Increase conveyance	This alternative recommends that a portion of the SE alignment east of the Sheyenne River be moved 1 mile north from the Federally Recommend Plan (FRP) alignment.	This option was adopted because it impacted fewer structures, provided the greatest cost reduction and retained more project benefits when compared to the other alternatives. Reduced upstream impacts. Preserved benefits. Eliminated Storage Area 1, reducing length of high-hazard dam.	Incorporated into Federal Project.
67	VE13C Southern Embankment Alignment	Supplemental EA/PFSAA	Increase conveyance	This alternative recommends that a portion of the alignment east of the Sheyenne River be moved 2.5 miles north of the FRP alignment.	Was screened out because it cost more, more direct impacts to structures and businesses than the selected alternative (VE13A).	
68	South of Oxbow Southern Embankment Alignment	Supplemental EA/PFSAA	Increase conveyance	Follows the same SE alignment as the FRP except for the portion east of the Wild Rice River Control Structure, where it turns straight south and then East where Oxbow/Hickson/Bakke would be on the protected side.	This alternative was screened out because it would take far more land out of the floodplain which would require additional staging or storage, would impact more communities and landowners further upstream, and would raise additional technical challenges associated with the higher structures and levees that would be required. Would cost millions more than the selected alternative.	
69	North of Wild Rice River (NWRR) Southern Embankment Alignment	Supplemental EA/PFSAA	Increase conveyance	This alternative is the same as the VE13C alignment West of I-29, unlike the VE13C alignment, which crosses the Wild Rice River and Red River of the North along an alignment south of CH16, the NWRR alignment follows a path roughly parallel to the Wild Rice River between I-29 and the Red River of the North. The alignment crosses the RRN south of 76th ave south and the tie-back embankment extends eastward from that point to existing high ground.	This alternative was eliminated from consideration twice - the first time in the FEIS because this alignment was not sufficient to eliminate the need for the Upstream staging area to adequately reduce downstream impacts, plus many additional structures would be impacted. The 2nd time this alternative was eliminated because had direct impacts to many more structures and businesses and cost $millions more than the remaining alternatives.	
70	Add gates to the Diversion Inlet Structure	Supplemental EA/PFSAA		Replace 90 ft fixed weir with adjustable gates	Reduces upstream staging elevations. Adds flexibility in operations. Affects timing of flows in diversion. Provides more control of flow to better match existing downstream conditions. Increased the cost of the structure.	Incorporated into Federal Project.
71	More Flow through Town/ In Town Levees	Supplemental EA/PFSAA	Flood Barriers	The use of levees/floodwalls in town to 35 feet (at Fargo gage) allows additional water to pass through control structures. Mitigates impacts due to project operation	Reduces frequency and duration of operation. Start operating at a 10-year event vs. a 3-year event. Pass 17,000 cfs through town vs. 9600 cfs. Significantly reduces chance of summer operation. Reduces environmental impacts (connectivity and geomorphic). Increased project cost.	Incorporated into Federal Project as a mitigation measure.
72	Oxbow/Hickson/Bakke Ring Levee	Supplemental EA/PFSAA	Flood Barriers	Ring levee the communities in lieu of the buyout proposed in the FEIS	Preserves the communities and school district tax base	Incorporated into Federal Project as a mitigation measure.