Table 17 – Efficiency of plans – Net Benefits (all dollar values are in thousands)

		Minnesota Short Alignment				ND East Alignment
	NO Action	20K	25K	30K	35K	35K
Net Benefits of Plan (NED)	$0	$86,964	$98,790	$101,693	$104,897	$95,353
Residual Damages	$195,900	$55,881	$39,490	$32,808	$24,874	$24,752

3.7.3.4 Acceptability

Acceptability is defined in the P&G as the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies. All of the plans in the final array are in accordance with Federal law and policy. All of the alternatives are considered acceptable for implementation, however there are slight differences in the level of acceptability. This information is summarized in the sections below.

3.7.3.4.1 Alignment

There is a strong desire from the non-federal sponsors and the public to have the diversion plan constructed in North Dakota. The North Dakota alignment would be considered highly acceptable to the non-federal sponsors. The Minnesota alignments are also acceptable, as the non-federal sponsors and the public have indicated that doing nothing is not an option; however they generally prefer the North Dakota alignment and officially requested the ND35k plan as a locally preferred plan.

3.7.3.4.2 Downstream Effects

Note for the May 2010 Draft Report: Additional analysis will be completed on the downstream impacts. The information presented in this draft report was presented at public meetings in February 2010. Updated downstream impact information will be fully quantified in the final feasibility report and environmental impact statement.

The diversion plans would all have potential downstream effects, and public concerns have been raised regarding those effects. All of the diversions in the final array could cause increased flood stages downstream of the project. Analysis was conducted only for the MN35k and ND35k alternatives to determine the maximum extent of downstream impacts. The assumption was that the smaller diversions would have smaller downstream impacts for events at which their capacity was exceeded.

Downstream of the MN35k plan, the increase to the peak stage during a 1-percent chance event, with no emergency protection in place, is estimated to be 6.8 inches or less, depending upon location. The 1-percent chance event peak would arrive and recede about one day earlier than under existing conditions. The increase to the peak stage during a 10-percent chance event, with no emergency protection in place, is estimated to be 4.3 inches or less, depending upon location. The timing of the 10-percent chance event peak would be nearly unchanged.

Table 2 - Phase 3 estimated flood stages assuming various diversion capacities

	Stage at Fargo Gage (ft)	
	1% Chance (100- year)	0.2% Chance (500- year)
Existing Condition (Stage)	42.4	46.7
Existing Condition (CFS)	34,700	61,700
Work Group Goal	30	36
20K Diversion Channels	36.9	43.7
25K Diversion Channels	34.8	42.4
30K Diversion Channels	33.6	41.9
35K ND Diversion Channel	30.6	40.0
35K MN Diversion Channel	31.9	39.6
40K Diversion Channels	31.9	37.6
45K Diversion Channels	31.9	35.3

The study identified three plans of significance to decision makers:

- The National Economic Development plan (NED)
- The Locally Preferred Plan (LPP)
- The Federally Comparable Plan (FCP)

The NED plan was the MN40k diversion. The NED plan provides the greatest net economic benefit consistent with protecting the Nation's environment.

The LPP was the ND35k diversion. The LPP is the tentatively selected plan. The LPP is the plan that, in the opinion of the non-federal sponsors, best meets the needs of the local community. The Cities of Fargo and Moorhead, Cass County, North Dakota and Clay County Minnesota jointly requested that the ND35k plan be pursued as the LPP on March 29, 2010. The request to designate the LPP as the tentatively selected plan was approved by the Assistant Secretary of the Army for Civil Works on April 28, 2010.

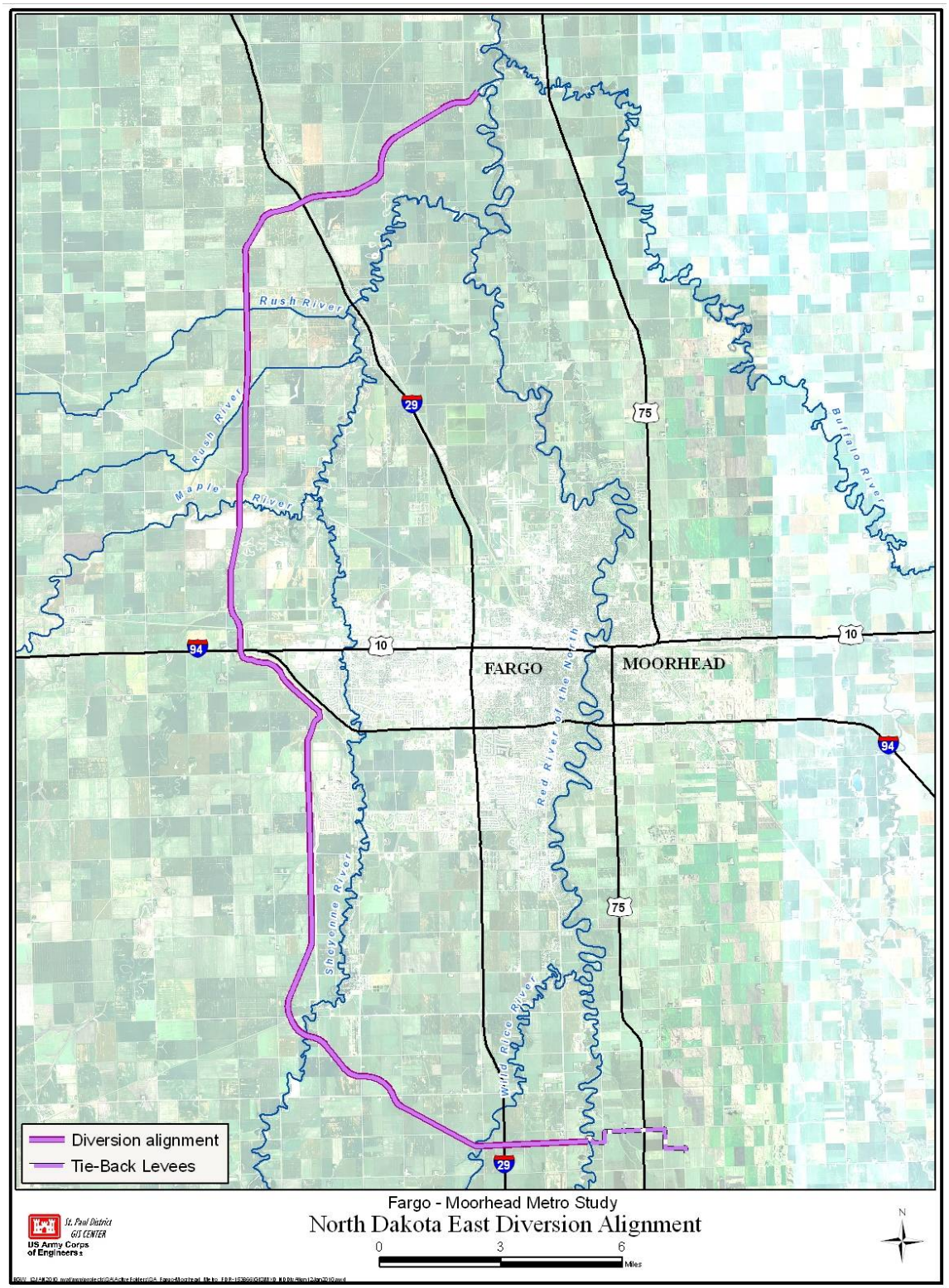
The FCP was the MN35k diversion. The FCP is a plan that provides comparable total annual economic benefits to the LPP and is smaller and less expensive than the NED plan. Normally the NED plan establishes the basis for federal cost sharing of a LPP, but in this case the LPP provides fewer total annual economic benefits than the NED plan does. Therefore, the FCP will be used as the basis for federal cost sharing instead of the NED plan.

DESCRIPTION OF THE TENTATIVELY SELECTED AND LOCALLY PREFERRED PLAN (LPP)

The ND35k diversion channel is the tentatively selected and locally preferred plan (LPP). The LPP would be a 36 mile long diversion channel that would start approximately four miles south of the confluence of the Red and Wild Rice Rivers and would re-enter the Red River north of the confluence of the Red and Sheyenne Rivers. The LPP would incorporate the existing Horace to West Fargo Sheyenne River diversion channel. The channel bottom width varies on the channel from 100 to 300 feet and has a maximum depth of 29 feet. The plan includes 18 highway bridges, four railroad bridges, and would have a construction footprint of approximately 6,560 acres.

The ND35k diversion would begin approximately four miles south of the confluence of the Red and Wild Rice Rivers. A connecting channel between the Red and Wild Rice Rivers would convey flow from the Red River to the diversion channel inlet on the west side of the Wild Rice River. A combination of control structures on the Red and Wild Rice Rivers at the south end of the project, along with weirs at the west end of the connecting channel and at the entrance to the diversion channel near the Wild Rice River, control the flow split between the Red and Wild Rice River channels and the diversion channel. The diversion would also cross the Sheyenne, Maple, Lower Rush, and Rush rivers. At the Sheyenne and Maple rivers, structures would be necessary to allow base flows to follow the natural river channel. Flows in excess of a 50-percent chance event would be diverted into the diversion channel. The Lower Rush and Rush rivers would have drop structures that would drop the entire flow of those rivers into the diversion channel. Figure 3 shows the alignment of the LPP.

Figure 3 – LPP Diversion Alignment



3.4.7.3 The preliminary analyses produced information that supported further screening of the diversion alternatives at this screening step. The following paragraphs discuss conclusions drawn from the preliminary analyses that reduced the number of diversion plans retained for further analysis.

3.4.7.3.1 The initial diversion concept presented in May 2009 was a passive diversion channel without an operable river control structure; this concept was not economically justified with a benefit to cost ratio of approximately 0.65. All of the subsequent diversion concepts included a river control structure that dramatically improved performance with a modest increase in cost. Therefore, no diversions lacking a control structure were carried forward.

3.4.7.3.2 The Minnesota Short alignment outperformed the Minnesota Long alignment, and there were no significant unique benefits or avoidance of any adverse environmental effects associated with the Minnesota Long alignment, so that alignment was dropped from consideration.

3.4.7.3.3 The North Dakota East alignment outperformed the North Dakota West alignment, and there were no significant unique benefits or avoidance of any adverse environmental effects associated with the North Dakota West alignment, so the west alignment was dropped from consideration.

3.5 PHASE 2, SCREENING #2

3.5.1 Refined Array of Alternatives

An array of remaining alternatives was formulated using those management measures or plans that remained following the screening described above. Between October 2009 and February 2010 these plans were refined in order to determine the NED plan and to develop a locally preferred plan to more fully address the planning objectives. The second screening in Phase 2 incorporated a traditional hydrologic analysis based on the full period of record, including the 2009 event. The hydraulic modeling was calibrated to the 2006 flood event. The alternatives were differentiated by 1) their location in either Minnesota or North Dakota, and 2) their capacity. Non-structural measures were considered as additional features in the areas immediately upstream of the diversions and in the areas near the downstream end of the diversions, where the diversions provided little or no benefit. The array of alternatives developed to greater detail was as follows:

- MN20k: Minnesota Short Diversion, 20,000 cubic feet per second (cfs) capacity
- MN25k: Minnesota Short Diversion, 25,000 cfs capacity
- MN30k: Minnesota Short Diversion, 30,000 cfs capacity
- MN35k: Minnesota Short Diversion, 35,000 cfs capacity
- ND30k: North Dakota East Diversion, 30,000 cfs capacity
- ND35k: North Dakota East Diversion, 35,000 cfs capacity
- The preceding plans with the addition of non-structural measures

3.6.3.2 The Phase 3 analyses determined that the NED plan was the MN40k plan, with maximum average annual net benefits of $105.6 million. The results of the Phase 3 cost-effectiveness analysis are presented in Table 9.

Table 9 – Phase 3 cost-effectiveness analysis results

Screened Alternatives Ranked by Net Benefits with Cost and Schedule Risk Assessment

Alternative	Cost [1]	Avg Annual Net Benefits [1]	Avg Annual Benefits [1]	Residual Damages [1]	B/C Ratio
MN Short Diversion 20K	$1,032	$87.0	$140.0	$55.9	2.64
MN Short Diversion 25K	$1,121	$98.8	$156.4	$39.5	2.71
MN Short Diversion 30K	$1,194	$101.7	$163.1	$32.8	2.66
MN Short Diversion 35K	$1,286	$104.9	$171.0	$24.9	2.59
MN Short Diversion 40K [2]	$1,367	$105.6	$175.9	$20.0	2.50
MN Short Diversion 45K [2]	$1,450	$104.9	$179.5	$16.4	2.41
ND East Diversion 35K	$1,462	$95.4	$171.1	$24.8	2.26

1. In millions of dollars with interest during construction and discounting included
2. Estimate based on linear extrapolation
Expected average annual damages without a project are $195.9 million.

3.6.3.3 It is interesting to note that the NED plan does not produce the highest benefit-cost ratio. The definition of the NED plan is based upon maximizing net benefits rather than maximizing benefit-cost ratio.

3.6.4 Reconsideration of the Locally Preferred Plan (LPP)

On April 28, 2010, the Assistant Secretary of the Army for Civil Works authorized the Corps to recommend the non-federal sponsors' LPP, as described section 3.8.2 of this report. After considering the Phase 3 results, the non-federal sponsors reaffirmed their preference for the ND35k plan as the LPP. It was noted that the revised hydrology and hydraulics affected the nominal performance of the LPP, and the ND35k plan would no longer produce the locally desired stage of 36.0 on the Fargo gage for a 0.2-percent chance event.

3.6.5 Dismissal of the MN40k (NED) plan and the MN45k plan

Selection of the ND35k plan as the LPP made further consideration of the NED plan (MN40k) unnecessary. Federal cost sharing for the LPP could not be based on the NED plan, because the LPP produced fewer total average annual benefits than the NED plan, at $171.1 million and $175.9 million, respectively. Instead, federal cost sharing would be based upon a smaller Minnesota alternative that produced a comparable level of benefits to the LPP. Table 9 shows that the MN35k plan and the LPP produced comparable benefits, at $171.0 million and $171.1 million respectively. Since the MN35k plan would serve as the basis for federal cost sharing, there was no need to fully develop the MN40k (NED) plan. For purposes of the feasibility study,

both effectiveness and acceptability. Higher cost improves effectiveness, but at some point cost becomes unacceptable. Determination of the NED plan is tied directly to costs and economic benefits, but the determination of a locally preferred plan may take other tradeoffs into consideration. Tradeoffs related to cost are primarily non-federal political considerations that cannot be resolved with a technical analysis.

3.8 PLAN SELECTION

The following designations are made in the selection process:

3.8.1 NED Plan

The Corps of Engineers Planning Guidance Notebook, ER 1105-2-100 states "A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the NED plan." Based on the current economic analysis and information contained in Table 9, the MN40k plan is the plan that reasonably maximizes the net national economic development benefits and is therefore the NED plan.

3.8.2 Locally Preferred Plan (LPP) and Tentatively Selected Plan

The ND35K Plan is the plan that, in the opinion of the non-federal sponsors, best meets the needs of the local community. As described in section 3.5.10, the Cities of Fargo and Moorhead, Cass County, North Dakota and Clay County Minnesota jointly requested that the ND35k plan be pursued as a locally preferred plan (LPP) on March 29, 2010. The request to designate the LPP as the tentatively selected plan was approved by the Assistant Secretary of the Army for Civil Works [ASA(CW)] on April 28, 2010. The approval letter can be found in Appendix O, Plan Formulation. The request to approve the LPP as the tentatively selected plan was based on the following considerations:

1. The non-federal sponsors requested in writing that a LPP be pursued, and approval was obtained from the ASA(CW) to tentatively recommend the LPP.
2. The plan has net flood risk management benefits of $95,400,000 annually.
3. The plan provides average annual benefits of $171,100,000 annually.
4. The plan provides additional benefits from multiple river systems including the Red, Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers.
5. The plan provides benefits to a larger area and protects a larger number of people than the NED plan.
6. It significantly reduces the expected loss of life from flooding and provides the communities with the ability to react in times of emergencies.
7. It is a more robust solution than smaller plans considering the potential for future flood flows and frequencies to be larger than reflected in the historic record.
8. It significantly reduces the risk of catastrophic damage for very large events.
9. The non-federal sponsors are prepared to pay the additional costs associated with the LPP.

3.8.3 Federally Comparable Plan (FCP)

5.2.3.1.7 Community Growth and Development
All of the diversion channel alternatives are expected to have a beneficial effect on the growth and development of the Fargo-Moorhead Metropolitan Area. Provision of this level of flood risk management will likely foster investment in homes, businesses, and community infrastructure. This would be greater for the North Dakota alignments as they remove a much larger area from the existing floodplain.

5.2.3.1.8 Business and Home Relocations
All of the diversion channel alternatives would have no substantial effect on business and home relocations in the project area as the number of impacted structures is extremely small compared to the number of structures in the area. There are an estimated six residential or farmstead relocations in the proposed project right-of-way for the North Dakota East diversion alignment, or five residential or farmstead relocations in the proposed project right-of-way for the Minnesota Short diversion alignment. The structures will be purchased, and the affected landowners will be compensated for their relocation.

The subject of relocations can be controversial, especially because some of the homes and farmsteads slated for relocation received either no damage or only minor damage from the recent flood events. Some of those affected by planned relocations have expressed feelings that plan formulation has been hasty, some alternatives under consideration have been screened out too quickly, and that diversion should be constructed on the other side of the river.

Because the affected owners will be covered by P.L. 91-646 (Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970), they should not experience direct financial loss from the relocations. However, there is no way to quantify any stress and anguish that some may experience over these relocations.

5.2.3.1.9 Existing and Potential Land Use
All of the diversion channel alternatives would have no significant effect on land use. Along with the aforementioned relocations, land use changes could occur along and near the proposed diversion alignments with the purchase of project right-of-way, although farming will be allowed on the landward side slopes of the diversion channel spoil banks.

An estimated 5,400 acres of prime farmland would be directly or indirectly impacted with the construction of the North Dakota alternatives, while an estimated 5,500 – 5,700 acres of prime farmland would be directly or indirectly impacted with the construction of the Minnesota alternatives. This includes less than ½-percent of the total cropland in Cass and Clay counties. Owners of agricultural lands that are purchased for the project would be compensated at fair market value.

The proposed alignments are expected to split or divide farms into separate parcels. In some cases, farmers would have to detour around the proposed diversion channel using established roadways or specially constructed access roads to access their property and conduct farming operations. The number of farms under active use that would be divided by the proposed right-

diversions and in the areas near the downstream end of the diversions, where the diversions provided little or no benefit. The array of alternatives developed to greater detail was as follows:

- MN20K: Minnesota Short Diversion, 20,000 cubic feet per second (cfs) capacity
- MN25K: Minnesota Short Diversion, 25,000 cfs capacity
- MN30K: Minnesota Short Diversion, 30,000 cfs capacity
- MN35K: Minnesota Short Diversion, 35,000 cfs capacity
- ND30K: North Dakota East Diversion, 30,000 cfs capacity
- ND35K: North Dakota East Diversion, 35,000 cfs capacity
- The preceding plans with the addition of non-structural measures

3.5.1.1 Minnesota versus North Dakota location: There were several issues related to the location of the diversion that were pertinent to plan formulation:

- Phase 2, Screening #1 showed that the Minnesota alignment appeared to provide optimal net benefits (noting that additional analysis was needed to capture known but omitted benefits of the North Dakota plans).
- The Minnesota alignment was constrained on the east by the Buffalo Aquifer and on the west by the city of Dilworth, Minnesota.
- The Minnesota alignment crosses a railyard east of Dilworth, Minnesota
- Significantly more economic benefits accrue to properties in North Dakota regardless of channel location. That led to a public perception that Minnesota would suffer disproportionate harm if the diversion were located in Minnesota.
- North Dakota alignments cross five tributaries (Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers); Minnesota alignments cross none.
    - Tributary crossings introduce additional environmental impacts.
    - Tributary crossings provide flood risk reduction for flood events on the tributaries as well as the Red River.
- The North Dakota alignment benefits a greater geographic area and removes 50 more square miles from the 1-percent chance event floodplain than the Minnesota alignment.
- The sponsors and a majority of stakeholders preferred a North Dakota alignment.

3.5.1.2 The Phase 2, Screening #1 analysis completed in October 2009 indicated that the smallest capacity Minnesota plan considered (25,000 cfs) provided the largest net economic benefits. That suggested that an even smaller plan could optimize the net economic benefits. The final array of plans must include at least one plan smaller than the National Economic Development (NED) plan to show that the benefits cannot be maximized at a lower cost. To address this issue, a 20,000 cfs capacity Minnesota alternative was added to the array. Channel capacity is directly related to the project's effectiveness in reducing flood stages. The initial design data (presented in Table 6, above), indicated that a capacity of approximately 30,000-35,000 cfs would be needed to reduce the 0.2-percent chance event at the Fargo gage to a stage of 36 feet. The non-federal sponsors indicated that a project of that size would be needed to provide a tolerable level of residual risk, and they requested that these capacities be included in the array for both Minnesota and North Dakota alignments as potential locally preferred alternatives.

FMM Feasibility VE Study - Comments

Proposal	Civil	PM	Structures	Geotech	H&H	Environmental
#1						
Realign ND diversion East of the Sheyenne River & protect Harwood, ND with ring levees.	The ND alignment is a locally preferred alignment and therefore they chose the locations to be taken out of the flood plain to include Harwood. By placing a ring levee around Harwood it would defeated the local sponsors goal of eliminating the small town from becoming isolated each flood season. In addition, the Federal Government would not be able to play a role in a ring levee proposal for the town of Harwood because the Benefit to Cost ratio is not above 1.0 and therefore the local sponsors would have to come up with other means on their own to accomplish this proposal in full.					
#2						
Realign MN diversion by shortening channel & re-orienting outlet works.	This proposal is to realign and shorten the MN diversion by shifting the alignment to the West of Kragness. The alignment is to include the town of Kragness to eliminate their flooding from the Buffalo River which is to the East of the town. If the channel were aligned to exclude the town of Kragness it would also make the city of Moorhead feel as though they are being squeezed for future development which was not acceptable for their city's acceptance of the MN diversion alternative.				Figures 2 & 3 regarding the outlet design and location of the MN alignment were agreed and completed during phase 3 of the feasibility study.	
#3						
Begin ND diversion channel further North.	Again, the ND alignment is a locally preferred alignment and therefore they chose the general location for the inlet. Their reasoning for the location of the inlet being further South than the MN alignment was to accommodate the city of Fargo's current future plans of development and to protect the city from the Wild Rice River flooding to the South.	To eliminate and relocate the 10 houses of Horace will not be acceptable to the Locally Preferred Plan sponsors.			With the new location proposed of the inlet structure it is very probable that a control structure of some sort will need to be placed at the intercept of the Wild Rice River and the Red River of the North due to the amount of water build up that will occur. This is a similar concept to the extension channel on the MN alignment that was needed for conveyance, no structure at the proposed ND inlet on the Wild Rice will potentially disrupt the design of the channel.	
#4						
Redesign Wild Rice Diversion for MN alignments.	Agreed…This is a possibility to consider during plans and specifications if the MN alignment is chosen.					
#5						
Replace bridged crossings with at grade crossings.			The level of design that has been done is only feasibility level and for the purpose of feasibility the cost needs to be as close as possible to construction cost and therefore actual bridges were only considered at this stage. This is an option to look into during plans and specifications as each crossing will need to be considered individually. The major issue with this idea is the impedance it will cause with the low flow channel. The purpose of the low flow channel was to continually pass enough flow through the channel so that it did not change the environmental habitat that will be meandering through for example the northern end of the ND alignment. This idea will require the concurrence of the natural resource agencies, the safety council for the required work to patrol the roads during every rain storm as well as the hydraulics department to ensure the overall channel purpose will not be affected. This is a possibility for cost savings and will be considered during plans and specifications.			