



Fargo-Moorhead Flood Risk Management Project Supplemental Draft EIS (SDEIS) Alternative Screening Exercise Report

Date: 08/17/2018

SUMMARY

- Many alternatives were submitted as part of the comment period during the SEIS Scoping Process, as well as during the 2016 EIS process. These submitted alternatives included a range of individual actions, as well as combinations of these individual actions. Some of these individual and combined actions were received during the 2016 EIS process and were subject to an Alternative Screening Process. Additional alternative actions and combinations of actions were submitted during the Scoping Process of the SEIS.
- The Minnesota Department of Natural Resources (DNR) conducted an Alternative Screening Exercise to determine if previously-screened alternatives or new commenter-submitted alternatives should be fully evaluated in the Supplemental Draft EIS (SDEIS).
- The Alternative Screening Exercise approach was developed considering the updated period of record (POR) hydrology and followed a screening process similar to the one conducted for the 2016 Final EIS.
- Initial screening of alternatives in the SDEIS Alternative Screening Exercise determined that none of the previously-screened alternatives and three of the four commenter-submitted alternatives “passed”, so were excluded from further evaluation.
- One commenter-submitted alternative (Alternative 31) was unable to be screened based on available information. The DNR collected information about this alternative as part of SDEIS preparation and subsequently determined that although the alternative would have similar environmental benefits as Plan B, it would have greater socioeconomic impacts and was, therefore, excluded from further consideration.

PURPOSE

- The DNR received many public comments on the scope of the SDEIS that requested the review of alternatives previously screened during the EIS process, new alternatives or additional combinations of components of previously-screened alternatives.

- In response to these public comments, DNR conducted an “Alternative Screening Exercise” between June and August 2018 to determine if any of these alternatives should be fully evaluated in the SDEIS.

APPROACH

The alternatives screening analysis used by DNR in 2012 for the EIS scoping process, and conducted in 2015 for the alternatives received by commenters on the Draft EIS, is outlined in Appendix M: The Purpose & Need and Alternatives Rescreen Report of the 2016 Final EIS. At that time, DNR considered fully analyzing 29 alternatives in all. However, none of these were analyzed in the EIS because they either didn’t demonstrate an ability to adequately meet the Proposer’s Purpose and Need statement, or they did not provide socioeconomic benefits while reducing environmental impacts of the proposed Project. Both alternative screening analyses used as a basis () hydrologic models using the Expert Opinion Elicitation Panel (EOEP) methodology.

Following the 2018 Governor’s Task Force, it was determined that the Plan B should be based upon the hydrologic modeling using the updated Period of Record (POR) hydrology instead of the EOEP. This change means that results from previous alternative screening reports could possibly have been different if they had been based upon the POR hydrology. Therefore, the DNR decided to include the 29 previously-screened alternatives in the 2018 SDEIS Alternative Screening Exercise to ensure consistency of analysis.

In addition to the previously-screened 29 alternatives, during the SDEIS scoping period, DNR received three new alternatives. One of the three new alternatives was described in various ways by many commenters, and therefore was subsequently divided into two alternatives to ensure clarity of the analysis. In all, DNR considered for full analysis in the SDEIS the 29 previously-screened alternatives and 4 new alternatives for a total of 33 alternatives (see Table B-1, below).

Table B- 1. All Alternatives: Previously-Screened and New Commenter-Submitted

ID	Alternative Name
1 & 13	Previously-Proposed Project
2a & 2b	No Action Alternatives
3	MN 35K
4	Diversion in MN/ND
5	Nonstructural Measures
6	Tunneling
7	Flood Barriers
8	I-29 Viaduct
9	Flood Storage
10	Flood Storage + Control Structure + Staging (no diversion, 100-year flows)
11	ND Diversion, no dam

ID	Alternative Name
12	Distributed Storage Alternative (DSA)
14	Project + Reduced staging
15	Distributed Storage Alternative + More
16	Project + Distributed Storage Alternative
17	ND/SD Retention
18	MN 35K + More
19	North of the Wild Rice River
20	Restoration
21	Fargo Flood Damage Reduction
22	Dredge the River/Dynamite
23	Internal Storage
24	Increase Northern Flows, no Project
25	Outlet into MN River
26	Shared Upstream/Downstream Burden
27	Divert Wild Rice into Sheyenne
28	Change Wild Rice Peak
29	North of the Wild Rice River + Distributed Storage Alternative + Existing floodplain storage
30	JPA Alignment with NW Diversion Shift
31	JPA Alignment with Plan B Diversion Alignment (i.e., Alternative C)
32	MN35K plus Staging
33	Wild Rice River with ND-only embankment

Minnesota Rules indicates that an alternative may be excluded from analysis in the SDEIS if it would not meet the underlying need for or purpose of the project, it would likely not have any significant environmental benefit compared to the project as proposed, or if another alternative that will be analyzed in the EIS would likely have similar environmental benefits but substantially less adverse economic, employment, or sociological impacts.

The Purpose and Need statement (P&N) was developed by the Diversion Authority in 2013 to meet the needs of the state environmental review process. The following P&N has not changed from the 2016 Final EIS. Note that it is not the same as the P&N used in the U.S. Army Corps of Engineers (USACE) Final Feasibility Report Environmental Impact Statement (FFREIS).

- The purpose of the Project is to reduce flood risk, flood damages, and flood protection costs related to flooding in the F-M Metropolitan area. To the extent technically and fiscally feasible, the Project will:
 1. Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River, Sheyenne, Wild Rice (North Dakota), Maple, Rush and Lower Rush Rivers passing through or into the F-M metropolitan area,

2. Qualify substantial portions of the F-M metropolitan area for 1-percent chance flood (i.e., 100-year flood) accreditation (i.e., meets the standard to be shown on Flood Insurance Rate Maps as providing protection) by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program; and
3. Reduce flood risk for floods exceeding the 100-year flood or greater, given the importance of the F-M metropolitan area to the region and recent frequencies of potentially catastrophic flood events.

Because previous public comments received during the 2014-2016 EIS process have alleged that the EIS P&N was too narrow, DNR broadened the statement by using only the Federal Emergency Management Agency (FEMA) 100-year flood accreditation (accreditation) component for the Project P&N. DNR's reasoning was that FEMA accreditation is likely the most essential part of the need for the Project because it is the level of flood risk reduction that is typically sought by communities. To be consistent with the 2016 DNR alternatives screening process, this Alternatives Screening Exercise utilized the same methodology as outlined in the 2016 Final EIS Appendix M: The Purpose & Need and Alternatives Rescreen Report.

DATA/RESOURCES

To inform the Alternatives Screening Exercise, DNR used the following sources:

- 2016 Final EIS (FEIS) Alternatives Rescreen Exercise (FEIS Appendix M).
- Phase 9 POR hydrology for Alternatives 30 and 31.
- Additional dam breach analysis.
- Information submitted and discussed during the 2018 Governor's Task Force.
- Data and information from the Diversion Authority and USACE.
- Professional judgement.

The following DNR staff participated in the Alternatives Screening Exercise:

- Randall Doneen; Environmental Review Unit Supervisor
- Jill Townley; EIS Project Manager
- Cynthia Novak-Krebs; EIS Planner Intermediate
- Suzanne Jiwani; Floodplain Hydrologist/Engineer
- Rita Weaver; Floodplain Action Hydrologist/Engineer
- Kelsey Forward; Floodplain Hydrologist
- Jason Boyle; Dam Safety Unit Supervisor/Engineer
- Jamison Wendel; Red River Fisheries Biologist
- Neil Haugerud; River Ecologist
- Jaime Thibodeaux; Environmental Assessment Ecologist

PROCESS/METHODOLOGY

Each alternative was assessed against each of the following questions in the order below.

1. Does the alternative fulfill the Purpose and Need? Do we believe the new alternative could receive FEMA accreditation (the critical component as explained above)? OR, if the alternative was previously-screened out, would the updated POR allow it to get FEMA accreditation?
2. Is the proposal a reasonable alternative to the proposed Project (i.e., it is not challenged by physical limitations, factors of time, cost, land acquisition, or political or regulatory issues?) (Minn. Rules 4410.2300, item G)?
3. Does the alternative have significant environmental benefit compared to the Project as proposed? b) If no, is it similar? (Minn. Rules 4410.2300, item G)?
4. Does the alternative have substantially less adverse socioeconomic impact over the Project? (Minn. Rules 4410.2300, item G)?

In order for an alternative to be included for potential further analysis, it must receive a “yes” to all five of the above questions.

- Questions 1-2 and 4: If the answer to a question was ‘no’, the alternative was determined not subject to further questions.
- For question 3, an alternative must receive a “yes” for either parts a) or b) of the question in order to advance to the question four.
- “N/A” is used in select instances (question 1) when the alternative has previously been included or is required by rule to be included and therefore does not need to pass the screening exercise (e.g., No Action Alternative).
- “Unavailable Info” was documented if the proposed new or suggested combination alternative described components for which DNR had no reliable data, and could not easily acquire this data within a reasonable amount of time, upon which to evaluate this proposed alternative.

ASSUMPTIONS

Feasibility Assumptions

- **The Distributed Storage Alternative** (DSA, and other similarly-described upstream storage and/or retention options). As analyzed in the Draft EIS Appendix C and D, the DSA remains infeasible because it is challenged by time, cost, and regulatory issues. This applies to Alternatives 12, 15, 16, and 29.
- **Incremental Alternatives.** Alternative 18 recommended multiple actions that cumulatively could potentially meet flood risk goals. While it is theoretically possible to combine enough measures to achieve FEMA accreditation, at some point, because each measure contributes only incrementally to the overall accreditation, it becomes impractical and infeasible to assume the completion of the number and scope of projects and measures that would be needed to achieve the necessary flood risk reductions.
- **Feasibility of Mitigating Downstream Impacts.** In Alternative 3, while the alternative meets the 100-year accreditation and would have environmental benefits over the Project, it would also

result in downstream impacts, potentially into Canada, that would require mitigation. Given the broad geographic distribution of downstream impacts and the significant amount of water that would require storage elsewhere on the landscape, it was determined that mitigating these potentially large impacts downstream was infeasible and would not be allowed by Minnesota floodplain regulations.

- **Minnesota Permitting Feasibility.** Any alternative that would not offer benefits to the state that are commensurate with the impacts to the state would be unable to be permitted in Minnesota. This is because such an alternative wouldn't represent the least impactful solution in Minnesota (as required by Minnesota Law), and thus it would be infeasible.

Information Assumptions and Limitations

- When evaluating the environmental benefits of an alternative in Alternative Screening Exercise Question 3, a common criteria for consideration was impact acreage. However, the exact number of impacted acres in each screened and rescreened alternative was imprecise. Therefore, alternatives reaching this step in the process were screened based on existing information, including H&H modeling, and based on estimations of magnitude of potentially flooded areas using professional judgement.
 - For example, Alternatives 10, 14, 19 and 26 involve the transfer of flooding impacts between upstream and downstream locations. DNR used existing flood maps and existing flood modeling information associated with the Project to estimate acreages of flood reductions upstream and flood increases downstream.
- When evaluating socioeconomic benefits or impacts (SDEIS Alternative Screening Exercise Question 4), a common criteria was number of impacted structures. However, the numbers of structures impacted for each alternative was estimated and compared. Therefore, the alternative evaluation in Question 4 was based on professional judgement in assessing the potentially flooded areas. Where professional judgment was uncertain (i.e., could not definitively say that there would be lesser socioeconomic impacts) the alternative was screened in with the expectation that more information would be generated in the SDEIS.
- Similar to the above example, while specific information related to flood increases and reductions was unavailable, DNR estimated that the net socioeconomic impacts downstream and upstream would be approximately equivalent or greater than the socioeconomic impacts of the Project for Alternatives 10, 14, and 19.
- When determining the basic description of the alternative provided by commenters (i.e., what components it included), some submissions were not descriptive enough to paint a clear picture of the specific actions and measures that the commenter intended to include. In those cases, DNR attempted to fill in the gaps, but in some cases, was unable to.
- During the SDEIS scoping comment period, many commenters requested inclusion of the commonly-referred-to "JPA alignment" or "Charlie Anderson's alignment," originally called "Alternative 30" for the Alternative Screening Exercise. This alternative has been discussed generally in the time before, during and after the Governor's Task Force. In this time, there have been many renditions and variations of diversion channel and embankment alignments, making it unclear in SEIS scoping exactly which components were being requested for inclusion. The alternative generally included a dam/southern embankment alignment much closer to the existing Fargo-Moorhead urban area, and the components. Others discussed a change to the

northwest portion of the diversion channel. Because of the lack of clarity, DNR decided organize this commenter-submitted alternative into two alternatives:

- Alternative 30 includes a change to the northwest diversion channel alignment, as well as a change to the dam/Southern Embankment alignment.
- Alternative 31 does not include the northwest diversion channel alignment, but retains the dam/Southern Embankment alignment described in Alternative 30.

RESULTS

Table B- 8, at the end of this Appendix, provides a summary of the 33 alternatives screened as part of the SDEIS. The table includes DNR's response to the question(s) posed at each step in this Alternative Screening Exercise.

DISCUSSION AND DETERMINATION

Based on the available data, and the above-discussed limitations and process, DNR made the following determinations for SDEIS alternatives:

Previously-Proposed Project (Alternatives 1 and 13)

The 2016 permit application for this alternative was denied; therefore, it was not included in the Alternative Screening Exercise.

No Action Alternatives (Alternatives 2a and 2b)

The No Action Alternative is required per Minnesota Rules 4410.2300 Subpart G to be included in the EIS and was, therefore, not included in the Alternative Screening Exercise.

Previously-Screened Alternatives (Alternatives 3-29)

None of the previously-screened alternatives newly "passed" the Alternative Screening Exercise in consideration of the POR hydrological modeling; therefore, DNR has determined that none of the previously-screened alternatives require further analysis in the SEIS.

New Alternative 30

Although this alternative would remove the Maple River Aqueduct, preserve existing floodplain and retain approximately five miles of the Rush and Lower Rush Rivers, there are other environmental impacts associated with this alternative that would outweigh these benefits. The realignment of the northwest portion of the diversion channel (see Appendix B, Attachment 1) would require an at-grade crossing where the diversion channel crosses the Sheyenne River. The at-grade crossing would cause water to backup in the diversion channel all the way to the Sheyenne River Aqueduct. To account for the backup, the width of the diversion channel would have to increase from 210 feet to almost 600 feet, thus requiring the Sheyenne River Aqueduct to also increase almost three times in width. Additionally, an at-grade river crossing would cause a larger, slower-moving pool in the diversion channel which

would be expected to quickly fill with sediment. The increased sedimentation would create an aquatic dead-zone near and around that location which would increase impacts to aquatic resources and habitat. Increased potential for invasive species colonization is also a concern during operation because the diversion channel would have a slower-moving pool, which is more attractive to invasive species. It would also render the proposed mitigation, which includes wetlands in the Diversion Channel, obsolete because the increased inundation and sedimentation would cover the wetlands up and they would not function as intended. Finally, there was concern about excessive channel scour because the diversion outlet would be in such close proximity to the confluence of the Red River and the Sheyenne. These factors led the DNR to determine that this alternative did not have significant environmental benefits over Plan B, so it was therefore excluded from further evaluation in the SEIS.

New Alternative 31

Alternative 31 would retain the Plan B alignments for the Diversion Channel, Eastern and Western Tieback Levees, but would modify the dam/southern embankment alignment (see Appendix B, Attachment 2). Unlike other alternatives, there was not an apparent or clear response to Alternative Screening Questions 3 and 4 for Alternative 31. Without more information, DNR was unable to determine the outcome of Question 3. Therefore, DNR decided to continue to analyze the alternative with the purpose of gaining further information. The analysis of Alternative 31 continued, and during this evaluation it became known as “Alternative C,” referred to hereafter as such. DNR directed the Diversion Authority to complete a Phase 9 POR hydrologic model run for Alternative C, which provided information on impacts to floodplains, structures, watersheds, transportation, and cemeteries, among others. DNR also directed the USACE to complete a dam breach analysis for Alternative C to inform dam safety permitting considerations. Those two data sets provided the bulk of the information and were instrumental in determining environmental and socioeconomic impacts. They also informed the comparison of alternatives, which was required to answer Questions 3 and 4. After a robust, interdisciplinary deliberation and evaluation, DNR determined it had sufficient information to adequately answer Screening Questions 3 and 4. Factors and data that were considered are outlined below by topic area. Following is a table that summarizes the considerations and DNR’s response to Alternative Screening Questions 3 and 4.

Floodplain

Commenters and DNR were concerned about the acres of existing floodplain that as a result of the proposed Plan B Project would no longer act as floodplain on the landscape. There was also concern about floodplain that would involve new acres of land not previously included in the floodplain. The Phase 9 POR hydrologic model shows that Plan B would remove about 56,882 acres of floodplain and Alternative C would remove 53,087. Therefore, Alternative C’s impact to existing floodplain would be smaller than that of Plan B by 3,800 acres. Attachment 2 shows the 100-year floodplain under Plan B and Alternative C. Alternative C does a better job of maintaining existing floodplain than does Plan B.

Depth and Duration of Inundation

Under Alternative C, the Wild Rice River Control Structure (WRRS) would be located approximately 3 straight miles downstream of its current Plan B location. The area of land

between the Plan B and Alternative C Dam/Southern Embankment is lower in elevation than the current staging area. During operation of Alternative C, this area would experience greater inundation depths and duration than during operation of Plan B. This additional inundation area was a concern raised by commenters and DNR, so information was collected to determine the degree of additional impact this may cause under Alternative C.

During operation of Alternative C, the storage area immediately upstream of the Alternative C Dam/Southern Embankment would fill quickly with Wild Rice River peak flood waters. The total inundation area for Alternative C is slightly greater than Plan B, even though the depth is also greater. This is due to three factors: 1) the lower land elevation of the area at the dam/Southern Embankment proposed as part of Alternative C, as compared to the location of the dam/Southern Embankment proposed as part of Plan B; 2) the location of the Alternative C WRRS, and 3) the early peak flow on the Wild Rice River. As a result, a large portion of Alternative C's storage area would be filled and unable to hold flow from the Red River. This would cause the total inundation area under Alternative C to be greater than Plan B. Table B- 2, below, outlines the 100-year flood event depths by acreage and total inundation acreage for Plan B and Alternative C.

Table B- 2. Depths by Acreage and Total Inundation for Plan B and Alternative C, 100-year Event

Depths by Acreage	Plan B	Alternative C
Acres with Depths Greater than five feet	20,800	22,800
Acres with depths between two to five feet	13,200	12,700
Acres with depths Less than two feet	25,800	25,100
Total Acreage	59,800	60,600

Under Alternative C, the inundation area would take longer to drain than under Plan B, due to the additional inundations depths and the locations of the WRRS and Diversion Inlet Structure (DIS). During drawdown, less flow would be able to pass through the DIS under Alternative C. Instead, much of the water in the staging area would need to be directed through the WRRS during drawdown. Alternative C has an approximate additional drawdown duration of 6.5 days for a 50-year flood and 6 days for the 100-year flood as compared to Plan B.

Table B- 3. Drawdown Duration for Plan B and Alternative C by Flood Event

Drawdown Duration	Plan B	Alternative C
50-year Flood	15.5 days	22 days
100-year Flood	17-18 days	23-24 days

An area with greater inundation depth and duration extends the time that land is impacted. . Inundation depths greater than five feet also have greater impacts to the land and resources than lower inundation depths. Plan B would have less depth and duration impact than Alternative C.

Skewed Operation

As explained above, the WRRS would be located approximately 3 miles downstream from the current Plan B location. During the Alternatives Screening Exercise, DNR staff considered that one potential benefit of the Alternative C WRRS location would be the opportunity to operate the WRRS and Red River Control Structure (RRS) independently of each other (i.e., allowing the WRRS gates to close and start inundation prior to the RRS gate closure). Skewed operation could allow the RRS gates to remain open up to approximately the 50-year event. If this could be accomplished, one potential benefit would be reduced impacts to fish and aquatic organism passage on Red River. Skewed operation of Alternative C has the potential to further limit flooding along the Red River riparian corridor, which is an environmental benefit over Plan B.

Skewed operation was identified as a possible option that could be applied to Plan B. However, Alternative C would provide greater benefits with skewed operation by reducing velocities through the RRS (3.3 feet/second (fps) with Plan B, 2.7 fps with Alternative C at the 35-year event) and returning Red River flows to normal levels faster. Skewed operation under Alternative C would also reduce the extent, depth, and duration of Red River riparian inundation.

Wild Rice River Watershed

A notable concern of Plan B is the impact that operation and inundation would have on stream stability, floodplain forest, forested wetlands, fish passage and aquatic habitat. As explained above under the *Floodplain* and *Depth and Duration of Inundation* topics, Alternative C would cause greater inundation depths and duration in the area immediately upstream of the Dam/Southern Embankment. This area of increased depth and duration would occur along 3 miles of the Wild Rice River. When considering the sinuosity and aquatic habitat of the entire Wild Rice River, those 3 miles of the Wild Rice River have excellent natural patterns, which indicates the potential for quality aquatic habitat and stream stability. Additional inundation depths and durations that occur along this section of the Wild Rice River would increase overall impacts to the Wild Rice River watershed. The increased depths and include durations could cause additional floodplain forest impacts due to increased sedimentation and increased forested wetland impacts due to the Alternative C Wild Rice River crossing location. A higher percentage of water within the inundation area would also be released through the WRRS following project operation. This increase in water flows through the WRRS for drainage would increase impacts to aquatic habitat due to additional river scour. These impacts would not be offset by a shift in the inundation area because the Wild Rice River reach further upstream is of lower sinuosity, which indicates that it has less potential for quality habitat and stream stability.

During operation of either Plan B or Alternative C, velocities of the Red and Wild Rice Rivers would increase. Increased velocities challenge a fish's ability to pass through the water. As described above in the *Depth and Duration of Inundation* topic, Alternative C would result in increased duration of inundation during project operation, and thus, a greater number of days that the project would operate. A greater number of days of project operation also means that aquatic organisms and fish would be in danger of experiencing higher velocities for longer periods of time. Therefore, aquatic organism and fish passage concerns would be greater under Alternative C as compared to Plan B for the Wild Rice River watershed.

During drawdown, more water would need to be directed through the WRRS under Alternative C. Prolonged high flows may destabilize banks in the segment of the Wild Rice River downstream of the WRRS and increase sedimentation and erosion.

As with Plan B, Alternative C would need to be designed to hold the Probable Maximum Flood (PMF). Alternative C's North-South section of the Dam/Southern Embankment to the west of the Red River would increase the tailwater on the RRS. This would result in higher peak water surface elevations (WSEs) in the inundation area during Alternative C operation during the PMF event. It might also require additional gates be added to the RRS and/or WRRS. If additional gates need to be added to account for the higher peak WSEs, Alternative C would have greater direct footprint impacts from one or two additional 50-foot gates, which in turn would cause greater difficulties for fish passage and loss of aquatic habitat. These impacts would be realized at all times--even when the Project was not operating.

Alternative C would have a greater environmental impact on the Wild Rice watershed than Plan B.

Footprint

Initially, DNR had thought that the inundation area for Alternative C would be shifted downstream far enough that it would eliminate the need for the Eastern Tieback and the Wolverton Creek box culverts. Removal of those two components would greatly reduce impacts to Wolverton Creek aquatic habitat and stream stability. However, since the PMF inundation areas for Plan B and Alternative C are almost the same, the Eastern Tieback and Wolverton Creek box culverts would still be required with Alternative C, so the benefit would not be realized. Table B- 4, below, summarizes the 100-year, 500-year and PMF flood event modeling performed for Alternative C.

Table B- 4. Elevations by Flood Event for Existing Conditions, Plan B and Alternative C

Phase 9 HEC-RAS Model Location	100-year Existing	100-year Plan B	100-year Alt. C	500-year Existing	500-year Plan B	500-year Alt. C	PMF Existing	PMF Plan B	PMF Alt. C
Red River Upstream from Dam (XS 2531315)	914.1	921.0	917.9	915.7	922.7	919.8	917.8	923.7	923.5
Red River at Cass/Richland County Line (XS 2578502)	918.3	921.9	919.8	922.3	923.8	922.7	924.9	926.3	926.2

Since the Western and Eastern Tieback locations and length would essentially stay the same with Alternative C, the greatest footprint difference between Plan B and Alternative C would be the dam/Southern Embankment and any required levees. The length of Plan B's dam/Southern Embankment would be approximately 20.2 miles. The length of Alternative C's dam/Southern Embankment would be approximately 23.1 miles. Under either proposal, the OHB Levee would be required.

Under Alternative C, the area around St. Benedict's Church and Cemetery would see increased inundation depths. Given the church's cultural resource significance, the area around it would require a ring levee which would include the cemetery and many businesses. This type of ring levee would require extensive modifications to Interstate-29 (I-29) as the highway would be situated very closely to the ring levee. These modifications would be needed to either travel along the top edge of the ring levee or be rerouted to curve around it while still providing ingress. The additional direct footprint acreage for the additional Dam/Southern Embankment, St. Benedict's ring levee, and transportation modifications would add about 800 acres of direct impact for this alternative.

Based on 800 acres of direct impact, it can be assumed that additional acres of wetland could be potentially impacted. Although Alternative C has a larger footprint than Plan B, the magnitude of increase compared with the overall footprint of Plan B is insufficient to determine a meaningful difference to the environment.

New Inundation

Many commenters were concerned about newly experiencing flood conditions under Plan B on their lands that currently do not experience floods. One way to consider this is to analyze the amount of newly-inundated acres that would result from operation of Plan B and Alternative C. Operation of Alternative C would result in more of the staged water on land that currently floods, meaning that it requires less land to be newly-inundated. For a 100-year flood event, the amount of newly-inundated acres with operation of Alternative C is about 50% less than with Plan B (see Table B- 5, below). Alternative C would create less new inundation than Plan B.

Table B- 5. Newly-Inundated Acres by State and Total for Plan B and Alternative C

Consideration	Plan B	Alternative C
Newly-Inundated Acres in MN	3,676 Acres	1,993 Acres
Newly-Inundated Acres in ND	8,374 Acres	4,997 Acres
Total Newly-Inundated Acres	12,050 Acres	6,990 Acres

Cost

Minnesota Rules 4410.2300, part G, require that a Responsible Government Unit (RGU) consider economic, employment and social effects of an alternative. The 2016 Final EIS completed a thorough economic analysis for the previously-proposed Project. The DNR believes that changes proposed between the previously-proposed Project, Plan B and Alternative C are not substantial

enough to change the regional economic impact analysis. Additionally, the regional economic impact analysis was not conducted in such a way that individual city impacts can be separated out. However, there are economic considerations that can be analyzed qualitatively.

The alignment for Alternative C would require an additional 2.9 miles of dam/southern embankment and the construction of a ring levee around St. Benedict's Church, Cemetery and surrounding businesses. The St. Benedict's ring levee would be situated too close to I-29 for that segment of the highway it to remain in its current location, and would thus need to be realigned and/or reconstructed. This would include reconstruction of the interchanges at Cass County Highway (CH) 14 and CH16, and/or a potential interstate grade raise over the St. Benedict ring levee. Alternatively, I-29 could be reconstructed to swing wide around the ring levee, although this would still require reconstruction of CH14 and CH16. The footprint required for the St. Benedict's ring levee could also require that some surrounding businesses close to the footprint of the ring levee be removed and relocated. These would likely incur significant costs.

Another economic consideration is the number of required easements and acquisitions. The PMF elevation is used to determine the Property Rights Mitigation Area and subsequently, the number of easements and structures that would need to be removed and acquired. As described above, Alternative C and Plan B would have essentially the same PMF elevation, and therefore would not dramatically change the southern edge of the Property Rights Mitigation Area; easements would still be required in this area under Alternative C. However, in addition to a similar southern property rights mitigation area, the alignment of Alternative C adds an approximate 8,000 acres to the north that would need to be obtained. Given that the value of an easement will, in part, be based on amount of anticipated impact (e.g., inundation depth and duration) the increased depth and duration in this northern area would increase the total cost of easements. The entire property rights mitigation area also contains a greater number of businesses under Alternative C, which would have a greater economic impact than Plan B.

Cost alone is insufficient to remove an alternative from consideration, unless the cost increase is at such a level that the project would become infeasible. The increased cost of Alternative C does not render the alternative infeasible, but is a factor for consideration of socioeconomic impacts.

Dam Safety

Of primary concern for the DNR Dam Safety permit is the safety of upstream and downstream residents and businesses. Factors that influence dam safety include, among others, the time needed to respond and/or evacuate affected areas in the event of a breach, the number of structures in the dam shadow, and the design of the dam. The lengthier a dam, the greater risk it poses based on increased areas of potential breach. To inform this consideration, the USACE completed a Dam Breach Analysis for Alternative C.

As described above in the Footprint topic, the Dam/Southern Embankment is 2.9 miles longer under Alternative C. This is an increase of 14%, which represents a slightly higher potential risk than the dam for Plan B.

The location of Alternative C is closer to Fargo, so there would be less time to evacuate or respond if the Alternative C Dam/Southern Embankment were to breach. A breach at the northern-most section of the Dam/Southern Embankment could cause the Fargo levee to be overtopped in as little as 15 hours, compared to 71 hours for Plan B.

Upon receiving the Alternative C Dam Breach Analysis, DNR analyzed the number of structures that would be within the area of dangerous flood depths and velocities from a breach of the dam (dam shadow). The dam shadow for both Plan B and Alternative C extends 0.25 miles, or about 1,300 feet, on average from the downstream toe of the dam. Plan B has 123 structures within the dam shadow, and Alternative C has 199 structures (an increase of 76 structures, or approximately 61%). Therefore, Alternative C poses a greater risk to safety than Plan B.

Structures

Of major concern to both DNR and commenters is the number of homes and businesses that would need to be removed due to their location under the Project footprint or within portions of the staging area that would receive greater than two feet of inundation. This represents households and businesses that would be displaced and require relocation. It also represents farmsteads that would be impacted through new or increased inundation. One way to consider the socioeconomic impact of a project is to complete an impacted structure analysis. Table B- 6, below, summarizes the net change in structure impacts between Plan B and Alternative C for the 100-year flood event. Although Alternative C would impact more structures than Plan B, the magnitude of increase compared to overall structure impacts was insufficient to determine a meaningful difference to socioeconomic impacts.

Table B- 6. Net Change in Structure Impacts Between Plan B and Alternative C; 100-year

Structure Type	Change with Alternative C
Farmsteads Removed	-12
Farmsteads Added	9
Net Farmstead Change	-3
Businesses Removed	-1
Businesses Added	10
Net Business Change	9
Residential Removed	-17
Residential Added	54
Net Residential Change	37
Non-Residential Removed	-146
Non-Residential Added	160
Net Non-Residential Change	14

Consideration of Factors

The above factors were consolidated into two categories: environmental or socioeconomic considerations. According to the Alternative Screening methodology prescribed by Minnesota Rules, environmental factors are considered first (Question #3a and 3b), followed by socioeconomic (Question #4).

Scoring was based on whole values between -2 and 2, where:

-2 = Significantly worse

-1 = Worse

0 = About the same

1 = Better

2 = Significantly better

In order to “pass” Question 3a, the score must be a 1 or 2. To “pass” Questions 3b, the score must be 0, 1 or 2. To “pass” Question 4, the score should be above zero.

EISs are informational documents intended to provide sufficient information on a proposed project and reasonable alternatives so that any RGU, including DNR and others, can determine permissibility and/or appropriate mitigation for impacts. Since DNR cannot determine for another RGU the level of importance, or weight, which should be assigned to each factor of a project, DNR considered equal weight for each factor when determining benefits. In the end, each permitting authority will have to make their own determination about the proposed Project. The below tables outlines the consolidated factors considered by DNR and how they influenced a comparison of impact between the alternative and the proposed Project (i.e., Plan B).

Screening Question 3. a) Does the alternative have significant environmental benefit compared to the Project as proposed? b) If no, is it similar? (Minn. Rules 4410.2300, item G)?

Table B- 7. Environmental Considerations; Screening Score by Factor

	Environmental Consideration	Score
1	Floodplain	1
2	Depth/Duration of Inundation	-1
3	Skewed Operation	1
4	WRR Watershed	-1
5	Footprint	0
	TOTAL	0

Response:

3a. No (based on a score of zero. A "yes" must be above 1);

3b. Yes (based on a score of zero)

Screening Question 4. Does the alternative have substantially less adverse socioeconomic impact over the Project? (Minn. Rules 4410.2300, item G)?

	Socioeconomic Consideration	Score
6	New Inundation	1
7	Cost	-1
8	Dam Safety	-1
9	Structures	0
	TOTAL	-1

Response: No. (Based on a score of -1. A “yes” must be above 1)

Although Alternative 31 has similar environmental benefits to Plan B, it does not offer substantially less adverse socioeconomic impacts and will not be evaluated further in the SDEIS.

New Alternative 32

Alternative 32 includes the MN35K Plan (also known as the NED Plan) plus a staging area. Although Alternative 32 meets the 100-year accreditation and would have regional environmental benefits compared to Plan B, the acreage required for the Minnesota diversion footprint would result in greater direct impacts to Minnesota. Any alternative that would not offer benefits to the state that are commensurate with the impacts would be unable to be permitted in Minnesota because it wouldn’t represent the least impactful solution in Minnesota (as required by Minnesota Law); thus, would be infeasible. As such, it was excluded from further evaluation.

New Alternative 33

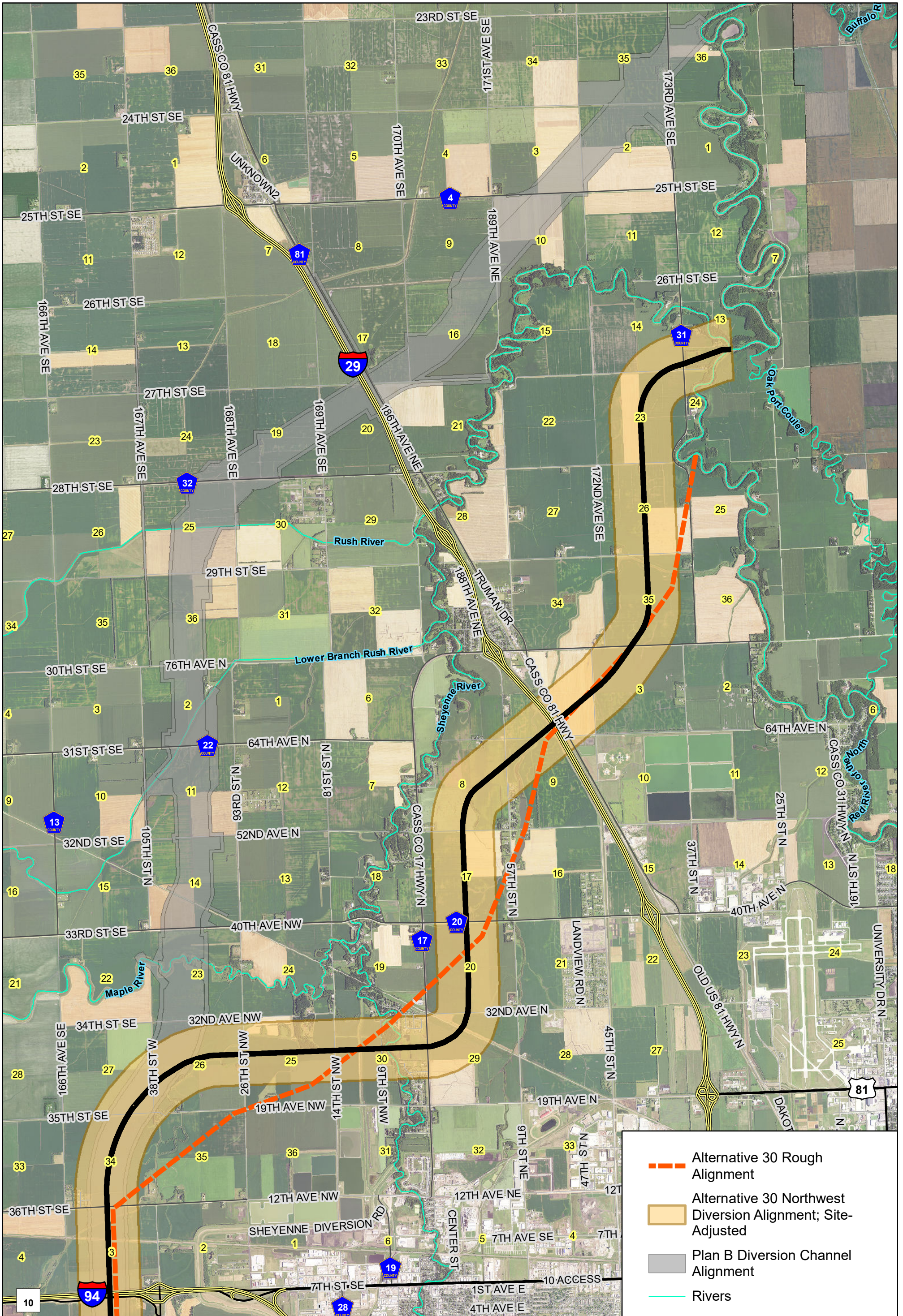
Alternative 33 would include a control structure on the Wild Rice River, a dam/southern embankment located entirely in North Dakota (between the Wild Rice and Red Rivers), a staging area (that would have to extend upstream to about Christine), and no control on the Red River. A project design that does not account for Red River flow would also not account for the years that the Red River floods more than the Wild Rice River, which would make it harder for the project to receive FEMA 100-year accreditation (because it couldn’t be assured). As such, it was excluded from further evaluation.

Determination

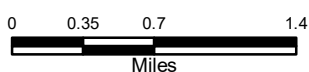
In summary, none of the 29 previously-screened alternatives received a “yes” to all four questions posed. None of the four, new commenter-submitted alternatives received a “yes” to all four questions posed. Thus, DNR has determined that no alternatives require full evaluation in the SDEIS.

Table B- 8. Summary of Screening Responses by Alternative

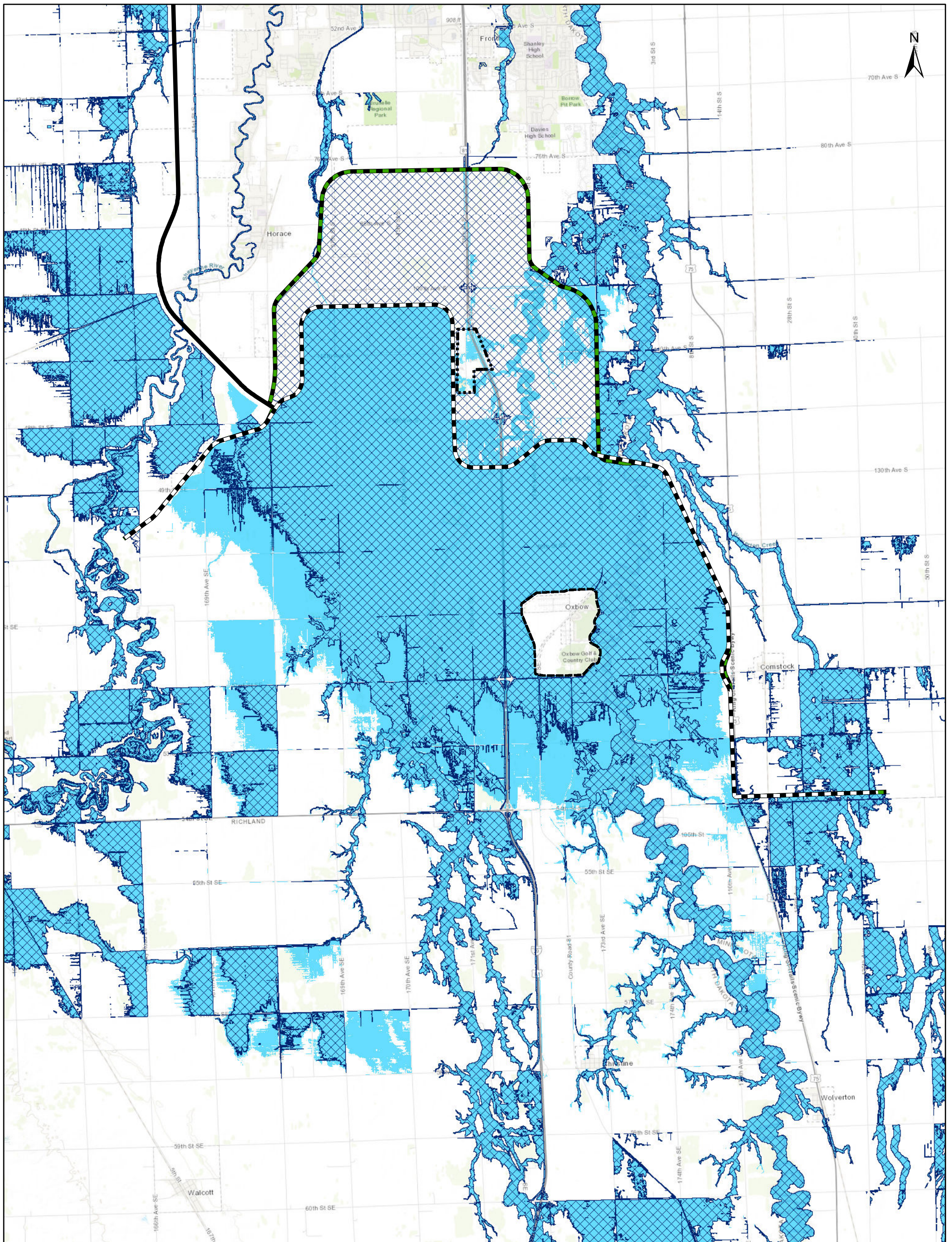
ID	Alternative Name	Step 1. Do we believe the new alternative could receive FEMA accreditation? OR, if previously-screened out, would the updated POR allow it to get FEMA accreditation?	Step 2. Is the proposal a reasonable alternative to the proposed project (i.e., not challenged by physical limitations, factors of time, cost, land acquisition, or political or regulatory issues)?	Step 3. a. Does the alternative have significant environmental benefit compared to the project as proposed? b. If no, is it similar?	Step 4. Does the alternative have substantially less adverse socioeconomic impact over Proposed Project?
1&13	Previously-Proposed Project	n/a			
2a&b	No Action Alternatives	n/a			
3	MN 35K	Y	N		
4	Diversion in MN/ND	Y	Y	a. NO. b. NO.	
5	Nonstructural Measures	N			
6	Tunneling	N			
7	Flood Barriers	N			
8	I-29 Viaduct	N			
9	Flood Storage	N			
10	Flood Storage + Control Structure + Staging (no diversion, 100-year flows)	Y	Y	a. NO. b. YES, similar.	N
11	ND Diversion, no dam	N			
12	Distributed Storage Alternative (DSA)	Y	N		
14	Project + Reduced staging	Y	Y	a. NO. b. YES, similar.	N
15	DSA + More	Y	N		
16	Project + DSA	Y	N		
17	ND/SD Retention	N			
18	MN 35K + More	Y	N		
19	NWRR	Y	Y	a. NO. b. YES, similar.	N
20	Restoration	N			
21	Fargo Flood Damage Reduction	N			
22	Dredge the River/Dynamite	N			
23	Internal Storage	N			
24	Increase Northern Flows, no Project	N			
25	Outlet into MN River	Unavailable info			
26	Shared Upstream/Downstream Burden	Y	Y	a. NO. b. YES, similar.	N
27	Divert Wild Rice into Sheyenne	N			
28	Change Wild Rice Peak	N			
29	NWRR + DSA + Existing floodplain storage	Y	N		
30	JPA Alignment with NW Diversion Shift	Y	Y	a. NO. b. NO.	
31	JPA Alignment with Plan B Diversion Alignment (i.e., Alternative C)	Y	Y	a. NO. b. YES, similar.	N
32	MN35K plus Staging	Y	N		
33	Wild Rice River with ND-only embankment	N			



Alternative 30, Modified Northwest Diversion Channel Alignment

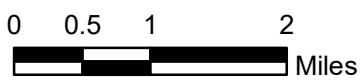


Appendix B, Attachment 1



Legend

- Plan B Alignment
- Alternative C Alignment
- St Benedict's Levee for Alternative C
- OHB Levee
- Diversion Channel
- 100 Year Floodplain with Plan B
- 100 Year Floodplain with Alternative C



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

FARGO-MOORHEAD FLOOD RISK MANAGEMENT PROJECT

100-year Floodplain under Plan B and Alternative C

Created by: Forward K. Date Created: 08/13/2018 Exported Date: 08/13/2018



**Appendix B
Attachment 2**

Source: Phase9_Polygons_Updates.gdb, WP_CombRPTP_FP_100yr, AlternativeC_071918.gdb, AltC_20180719_100yr_Polygon, AltC_Alignment_071918, StBenedictsLevee_AltC
Coordinate System: NAD 1983 UTM Zone 14N