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Fargo-Moorhead Area Flood Diversion Task Force: Final Report Appendix A

Fargo Moorhead Metropolitan Area

Flood Risk Management Project

Supplemental Environmental

Assessment Document

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FARGO-MOORHEAD AREA FLOOD DIVERSION TASK FORCE: FINAL REPORT

January 18, 2018

I. Fargo-Moorhead Area Flood Diversion Task Force Summary

North Dakota Governor Doug Burgum and Minnesota Governor Mark Dayton created a joint Task Force to propose the framework for flood risk management for the Fargo-Moorhead region. The Governors served as the Task Force Co-Chairs. Each Governor appointed eight members seeking to represent the range of perspectives in the region. Over a series of five meetings between October 23 and December 11, 2017, the Task Force's role was to discuss flood control options and make recommendations. These recommendations are available for consideration by the Diversion Authority for a future permit application for flood control.

Purpose

The purpose of the Task Force was to develop design principles and concept-level engineering solutions to achieve balanced flood risk management for the Fargo-Moorhead region, including upstream- and downstream communities and properties.

Key Parameters

At the meeting held on October 4th between Governor Burgum and Governor Dayton, two key parameters for the Task Force's work were identified and agreed to:

1. Find solutions within the parameters established by applicable Minnesota, North Dakota and local law.
2. Maintain federal authorization and associated funding for permanent flood protection, unless more expedient and low-cost options are presented that provide protection for a one percent chance flood (i.e., 100-year flood as defined by the Task Force) accreditation by FEMA under the National Flood Insurance Program.

Task Force Members

Minnesota Task Force Members:

- Del Rae Williams, Mayor, Moorhead.
- Heidi Durand, City Council Member, Moorhead.
- Joel Paulsen, City Council Member, Moorhead.
- Jenny Mongeau, Clay County Commissioner.
- Tim Fox, Former Wilkin County Attorney.
- Mark Anderson, Treasurer, Buffalo-Red River Watershed District.
- Curt Johannsen, Mayor, Hendrum.
- Steve Jacobson, Norman County Commissioner.

North Dakota Task Force Members:

- Jason Benson, Cass County Engineer.
- Rob Bergan, Fargo Business Leader and Entrepreneur.
- Nathan Berseth, Richland County Commissioner.
- Bernie Dardis, Board Chair, Greater North Dakota Chamber of Commerce.
- Craig Hertsgaard, Farmer, Richland County.
- Tami Norgard, Vogel Law Firm.
- John Strand, Fargo City Commissioner.
- Ken Vein, City Council Member, Grand Forks

Technical Advisory Committee

The Task Force created a Technical Advisory Committee that included engineers and staff from the Diversion Authority and the Minnesota Department of Natural Resources. This Technical Advisory Committee presented the Task Force with engineering options to address concerns about project impacts in each state and county, maintaining the flood plain, and cost considerations.

Technical Advisory Committee Members

- Bob Zimmerman, City Engineer, Moorhead.
- Nathan Boerboom, City Engineer, Fargo.
- Greg Thielman, Principal/Senior Project Manager, Houston Moore Engineering Group.
- Suzanne Jiwani, Floodplain Engineer, MN Department of Natural Resources.
- Jill Townley, Principal Planner, Environmental Review.
- Kent Lokkesmoe, Administrator of the Management Resources Bureau, DNR.

Task Force Findings

The Task Force focused on variables related to conceptual engineering designs. Early on, the Task Force came to consensus on the level of protection the project should provide, with consideration for the need to be able to fight bigger floods. While formal consensus was not reached on other variables, the Technical Advisory Committee made recommendations on a number of variables that the Task Force discussed. There were more controversial variables that the Technical Committee did not come to agreement on, and the Task Force asked for further technical review. The key variables discussed include:

1. **What is the level of protection?**
   Task Force consensus: 100 year protection at 33,000 cfs

2. **Should there be a western tie-back?**
   Technical Committee Recommendation: The Tech Committee recommends this, as it reduces upstream impacts. No Task Force members expressed opposition to the western tie-back.

3. **Should there be an eastern tie-back?**

Technical Committee Recommendation: The Tech Committee recommends this, as it reduces upstream impacts. No Task Force members expressed opposition to the eastern tie-back, though at least one member expressly reserved judgment regarding the correct alignment.

4. **How much water runs through town?**
   Technical Committee Recommendation: Design for a river stage of 37 feet through town. Note: The Army Corps said they would be able to certify 100-year protection for a system that runs 37 feet through town and also said this approach would likely work for the current authorization. Over the past 100 years, a river stage of 37 feet through Fargo and Moorhead was exceeded for 28 days.

5. **Is there northern storage in the downstream area?**
   Technical Committee Recommendation: The Tech Committee was neutral. It would store water in the northwest part of the project area; however, it reduces the staging area elevations 0.03 feet. It does maintain natural floodplain acres, which is important overall for Minnesota permittability.

6. **Is there a change in the embankment structure?**
   For the purpose of identifying a potential alignment recommendation, the Technical Committee considered different options for the dam alignment--- 7A, B and C were presented to the Task Force. It was discussed how 7A would likely not be permittable by the Minnesota DNR. The Army Corps of Engineers had concerns with 7B and maintaining federal authorization. Option 7C maintained more floodplain than 7A and less than 7B, DNR said that 7C would likely need some additional storage added to be permittable. The combining of the options to maximize storage was suggested by some Task Force members and DNR. Combinations of 7A, 7B, and 7C as well as 7C alone were discussed by the Task Force.

7. **Is there an increase in downstream water levels?**
   This is an issue related to dam operation, rather than constructed project features. The Technical Committee considered an operational approach that would allow up to six inches of stage increase downstream. This would occur at Climax, MN because of a narrowing of the river. A six-inch stage rise at Climax would translate to less than 0.5 inches at the Canadian border. The Task Force Charter called for more balanced impacts upstream and downstream, which implies more flow to the downstream area. However, the impact on water levels at the Canadian border and other downstream communities were significant concerns for several Task Force members. Further determination of this issue can be considered in the operating plan for the dam.

II. Technical Advisory Group Final Report

Background:

The Technical Advisory Group (TAG) was created as an advisory group to the Fargo-Moorhead Area Flood Diversion Task Force to assess components and alternatives and provide technical guidance to the Task Force. Members of the TAG include:

Kent Lokkesmoe - DNR Manager;
Suzanne Jiwani – DNR Floodplain Engineer
Jill Townley – DNR EIS Manager
Bob Zimmerman - Moorhead City Engineer
Nathan Boerboom - Fargo Division Engineer
Gregg Thielman - Diversion Authority Engineer

The TAG held public meetings on November 14, 2017 and November 28, 2017. As part of these meetings the TAG:

- Defined criteria to evaluate alternatives and components. This includes the following key criteria (not in particular order):
    - Satisfy Task Force Charter
    - Meet Laws and Ordinances
    - Minimize Residual Risk
    - Reduce Floodplain Impacts
    - Reduce Environmental Effects
    - Limit Impacts to Structures
    - Resilience/Robustness of Design
    - Cost and Engineering Feasibility
    - Upstream and Downstream Impacts
    - Impacts at the U.S./Canadian Border

- Screened components and alternatives for further evaluation. Components that were considered include:
    - Distributed Storage Alternative
    - Western Tie-back Levee
    - Additional Flows Through Town (River Stage (RS) 35', 37', 38', and 39')
    - Levee-only Alternative
    - Change Location of Dam/Southern Embankment
    - Northern Storage Option
    - Allowing Increased Downstream Impacts (up to 6 inches maximum)
    - Wild Rice River-only Diversion
    - Eastern Tie-back change
- Reviewed technical data and developed information for presentation to the Task Force at their November 29, 2017 and December 11, 2017 meetings.

The Task Force did not discuss funding sources or other financing opportunities for any consensual or majority recommendations.
Meeting notes, and guidance documents developed by the TAG are included in ***Appendix A***.

The Task Force directed the TAG to use full period of record hydrology for its analysis. Based on this direction, the analysis uses a 1-percent annual chance (100-year) discharge of 33,000 cubic feet per second (cfs) at the USGS Fargo stream gage.

November 29, 2017 Task Force Meeting:

The TAG presentation, titled "Component Analysis" as well as technical data presented at the November 29, 2017 Task Force meeting are included in ***Appendix B***. Following is a summary of project components that were developed and presented by the TAG:

- Western Tie-back Levee – This component shifts the Limited Service Spillway for the dam/southern embankment to the west along an existing natural ridge. This reduces the staging elevation and utilizes more storage in North Dakota. It was included in components 1, 3, 4, and 5 that were presented.

- Consideration of Distributed Storage – It is recognized that Distributed Storage provides overall basin-wide benefit, but due to the implementation schedule and need for in-place storage for potentially reducing the 100-year discharge for accreditation purposes, this alternative was not analyzed as part of any components or alternatives by the TAG. To the extent that distributed storage (owned by a public body) is constructed and operational prior to completion of the Fargo-Moorhead project, the resulting changes in hydrology could be incorporated into the Letter of Map Revision (LOMR) for the Fargo-Moorhead project. Distributed storage completed after approval of the LOMR for the Fargo-Moorhead project would serve to increase the level of risk reduction (beyond a 100-year event).

- Components #1a-1d - Additional Flows Through Town – The TAG presented information on the impacts of increasing the flow through town from RS35' to RS37', RS38', and RS39'. Results were presented using the proposed project alignment.

- Component #2 – Levees Only – The TAG presented a conceptual ring levee plan that could potentially achieve FEMA Accreditation and protect the communities of Fargo and Moorhead.

- Components #3a-3c – Dam/Southern Embankment Alignments – The TAG presented 3 conceptual revised alignments for the southern embankment/dam. These include the North of the Wild Rice River (3a), Northern Alignment Alternative (3b) and Modified Storage Area 1 (3c) alignments.

- Component #4 – Northern Storage Option – The TAG presented a component that would increase flows into the flood damage reduction area through the Sheyenne and Maple River

Aqueducts. This would reduce the amount of lost floodplain storage in the northwest project area.

- Component #5 – Change Operation Plan to allow up to 6 inches of Downstream Impacts – The TAG presented a component that would change the project operation to allow up to a maximum of 6 inches of impact downstream from the project.

- Component #6 – Wild Rice River Diversion with Levees (no dam) – The TAG evaluated a component that would divert the Wild Rice River through the proposed project diversion channel and not divert water from the Red River or include a dam/southern embankment to mitigate impacts. This component would result in downstream impacts in excess of 1.5 feet in some areas along the Red River.

During the November 29, 2017 Task Force meeting, the Task Force directed the TAG to further evaluate components and bring information back to the December 11, 2017 Task Force meeting as follows:

- Include the Western Tie-back levee in all options
- Distributed Storage is part of a long-term strategy and will not be included in the current analysis
- Develop 3 alignment options for consideration
- Include results for RS37', RS38', and RS39'
- Include option that allows up to 6 inches of downstream impacts

Additional criteria the TAG was asked to consider in developing alternatives include:

- Strive for equity in impacts – ND/MN
- Minimize acres removed from the floodplain
- Minimize newly impacted acreage and structures
- Consider economics – cost increases and reductions

December 11, 2017 Task Force Meeting:

The TAG presentation, titled "Option Analysis" as well as technical data presented at the December 11, 2017 Task Force meeting are included in ***Appendix C***. Following is a summary of project components that were developed by the TAG and presented:

- Western Tie-back Levee – As noted above, this component shifts the Limited Service Spillway for the dam/southern embankment to the west along an existing natural ridge.
    - *This component was recommended by TAG and included in all of the options that were presented.*

- Eastern Tie-back – The proposed project eastern tie-back for the dam/southern embankment extends to existing high ground near Clay County Highway 11 between Sections 7 and 8 of Alliance Township in Clay County, MN. This component turns the eastern tie-back south in Section 2 of Holy Cross Township, Clay County and extends south

for approximately 5.5 miles and ties into existing high ground in Section 36 of Holy Cross Township near Clay County Highway 50.

- *This component reduces the acreage of newly impacted floodplain in Minnesota and was recommended by TAG. It was included in all of the options that were presented.*

- Northern Storage/Diversion Channel Alignment – In an attempt to lower the staging area elevation and have more balanced impacts, the Task Force recommended storing more water in the northwest portion of the flood damage reduction area. Instead of increasing the size of the aqueducts to pass more water into the lower Sheyenne and Maple Rivers (which would be very costly), changing the diversion alignment was evaluated. This change would have the potential to preserve more existing floodplain. An alignment change that shifts the project east between the BNSF Prosper Subdivision rail line and Interstate 29 was considered and presented. This shift preserves approximately 1800 acres of existing floodplain, but only reduces the 100-year elevation in the staging area by 0.03 feet. Other options to shift the alignment further east were considered, but were not analyzed further due to existing residential developments and structures and the multiple river and roadway crossings in this area.
  - *The TAG was neutral on this component due to the limited reduction in the staging elevation it provided and it was not included in any of the options that were presented.*

- Additional Flows Through Town – The TAG presented information on the impacts of increasing the flow through town from RS35' to RS37', RS38', and RS39'. Results were presented using the proposed project alignment.
  - *The TAG recommended that a flow through town that results in a RS37' during the 100-year flood event be carried forward and RS37' was used for all of the options that were presented. The communities will have to construct additional protection to manage the additional flows through town associated with RS37'.*

- Allow Downstream Impacts up to 6 inches – The TAG evaluated and presented options for changing the project operation to allow up to a maximum of 6 inches of downstream impact to achieve a balance between upstream and downstream interests. The 6-inch maximum impact would occur on the Red River in the vicinity of the city of Climax, MN, where the floodplain is relatively narrow. Analysis was performed for Options 7A, 7B, and 7C and the change results in a maximum staging area reduction at the dam of 0.3' to 0.4', depending on the option. Concerns with this component include potential impacts extending beyond the U.S./Canadian border and potential downstream mitigation costs associated impacted residential structures and existing community flood protection systems. It may be possible to allow downstream impacts less than 6 inches without causing an impact across the U.S./Canadian border. This was not an analysis that TAG completed.
  - *The TAG identified this is a policy/permit decision that will be evaluated more going forward. This is an operational issue and does not directly impact design considerations.*

- Change Location of Dam/Southern Embankment – The TAG developed and evaluated 3 alignment options for the dam/southern embankment. These alignments all shift the dam north (from the proposed project alignment) and added storage in North Dakota. Option 7A is very similar to Component 3c that was presented at the November 29, 2017 Task Force meeting and shifts the alignment north to the west of Interstate 29 and adds

approximately 3,000 acres of storage. Option 7B (which includes the area that is part of Option 7A) shifts the alignment further north to the west of Interstate 29 and adds approximately 5,200 acres. Option 7C shifts the alignment further north both west and east of Interstate 29 and adds approximately 4,800 acres of storage. All three options reduce the staging area elevation; shift more floodplain into North Dakota; and reduce the area removed from the floodplain within the protected area. They also reduce the newly impacted floodplain acreages in Richland County, North Dakota and Wilkin County, Minnesota. Preliminary cost estimates associated with these options were also developed.

- *The TAG did not recommend an Option for changing the dam/southern embankment alignment.*

Issues Yet to be Resolved:

- Dam/Southern Embankment Location
  - Due to time constraints, the TAG was not able to evaluate other potential alignments other than 7A, 7B, and 7C.
  - Shifting the alignment north of the proposed project alignment, similar to the options presented by TAG, seemed to be acceptable to most Task Force members. The exact alignment of the dam would still need to be determined.
- Amount of storage in North Dakota
  - Increasing storage in North Dakota reduces the staging area elevations and reduces new inundation impacts in Minnesota. The exact proportion of new and/or total inundation impacts between North Dakota and Minnesota that would result in a permittable project was not specified. It seemed that most Task Force members were favorable to the reduced newly inundated acres in Richland and Wilkin Counties as shown by TAG in the presented options, as well as the improved equity of impacts between Minnesota and North Dakota.
- Project Permittability
  - The TAG's primary objective was to serve as a technical advisory group to the Task Force, and therefore, TAG did not provide any recommendations on alignment.
  - The TAG advised that 7A would likely not receive a Minnesota permit, but that 7B and 7C, or a combination thereof, might be more permittable.
  - Future permittability questions will be a discussion between the Diversion Authority and both the Minnesota DNR and North Dakota SWC.

III. Statements from Governors

Governor Dayton:

I want to thank our Task Force's Co-Chair, Governor Doug Burgum, for his excellent leadership throughout this process. We have forged a good working partnership, which will be important for this and other collaborative projects, involving our two states.

I also thank the Task Force Members for their tremendous work. Their dedication was the key to our successful completion. And I greatly appreciate the enormously important contributions made by Members of the Technical Advisory Committee, by North Dakota and Minnesota agency experts, and by our two staffs. This was a team effort all the way.

The many important considerations that were presented from a wide range of stakeholders and experts provide a framework for moving forward on flood risk management for the Fargo-Moorhead region. Just as important was the model we established for a truly inclusive, collaborative process, rather than its one-sided, adversarial predecessor.

Reliable and effective flood protection for the cities of Moorhead and Fargo and their surrounding regions is essential. It is a prerequisite for successful future economic growth, business expansion, job creation, and social vitality. Yet it cannot come at the excessive sacrifice of other people's lands, lives, and livelihoods. For a project of this magnitude and complexity, those considerations are also essential.

It would be naive to believe that such a re-routing of massive amounts of water throughout widely divergent climate conditions over the next one hundred years and beyond could avoid any negative impacts on someone. That is why it is so critical to have the different stakeholders represented in this public process. For Minnesota, that would mean representation on the Diversion Authority from the areas both north and south of Fargo-Moorhead, in addition to the Members from those two cities. For the sake of continuity, it would be most desirable to add to the Authority Board individuals, who have served on this Task Force.

The project that was previously submitted to the Minnesota Department of Natural Resources did not meet our state's laws and regulations. Minnesota is committed to helping identify a solution, but major changes must be made to the proposed project.

I am hopeful that the Task Force's work has provided guidelines for the Authority's re-fashioning of its previous proposal to meet those laws and regulations. I emphasize that the necessary approvals will be decided by the Minnesota DNR, in accordance with those requirements and without interference by myself or anyone else. The active participation on the Task Force by the DNR's Commissioner and technical experts should not be construed as predetermining their permitting decisions.

There are other critical components of the project, which were not made known to the Task Force. Most important is the just compensation for any losses, temporary or permanent, suffered by any landowner, business, or other entity, resulting from the project. Committing publicly that fair compensation will be provided without delays or difficulties, is, in my view, absolutely necessary

before the project proceeds. Also needed to be made public is a detailed budget, for both the capital investments and the annual operating expenditures, the anticipated sources and amounts of funds, and the intended fiscal and operating authorities.

The Diversion Authority now has the responsibility to take all of these views and recommendations and combine them into a permittable application to the Minnesota DNR. I stand ready to work with my colleague, Governor Burgum, on other matters regarding this important project.

Governor Burgum:

Reviving the stalled effort to provide permanent flood protection for the greater Fargo-Moorhead area has been an exercise in the art of the possible. I extend my gratitude to Governor Dayton, task force members, the technical advisory group, Minnesota and North Dakota regulatory agencies, and the engaged citizens who made this public process so productive.

We put collaboration ahead of litigation and gathered informed and passionate perspectives from all sides around the same table. We explored a variety of concepts to provide regional protection and, through the process of elimination, made notable strides in identifying approaches that could ensure permanent protection in a cost-effective manner.

Still, much work remains with needed additional collaboration between the Diversion Authority, Minnesota DNR, Army Corps of Engineers and Richland-Wilkin JPA. As stated at the convening meeting, we must develop a project that is permittable under North Dakota and Minnesota law.

It remains clear that a diversion channel with control structures is the only economically viable solution that will provide certifiable protection for citizens, relieving thousands of ND and MN homeowners of the need to purchase flood insurance and allow the region to fight floods beyond a 100-year event.

The need for permanent flood protection is well understood. A solution has been nearly a decade in the making; and now, protection can and must be completed in an expedited fashion. We cannot afford to risk another event like the devastating 1997 Grand Forks-East Grand Forks flood. The Fargo-Moorhead-West Fargo greater metro is the region's largest economic engine – and must be protected from a catastrophic flood event.

We are deeply grateful for the dedicated engagement from all parties involved to move the conversation closer to resolution. My office will continue to work in partnership with Governor Dayton toward finalizing a permittable project, and I commend him for his commitment and engagement throughout this process and his dedication to finding a solution.

IV. Task Force Member Statements

Each Task Force member was afforded the opportunity to submit a statement after the final meeting of the Task Force on December 11, 2017. The following statements have been submitted directly from Task Force members. These statements are published "as is" and have not been reviewed for factual accuracy, spelling or grammar. They represent the opinions of the individual Task Force members and do not represent the views of the governors' offices, the Task Force as a whole, or the entities referenced therein.

Minnesota Representatives:

Mark Anderson- Treasurer, Buffalo-Red River Watershed District

I think that the Task Force should be looked at as a good starting point. Fargo and the Diversion Authority need to embrace a process to achieve permanent flood protection for Fargo-Moorhead. This process has to involve the people and agencies that will be affected by any project. The agencies, government entities, and people that should be at the table during the development process, are: the Minnesota DNR, the Minnesota DOT, Burlington Northern Santé Fe Railroad, Buffalo-Red River Watershed District, Holy Cross Township, Village of Comstock, and the downstream and upstream concerns of the homeowners and landowners affected by the project. This process will help identify problems at the beginning, not at the end. Some problems that have not been adequately addressed are flowage easements, land values, the raising of Trunk Highway No. 75 and County Road No. 2, and raising of the Burlington Northern Santé Fe Railroad tracks. The proposed eastern tieback levy also has some problems regarding local drainage. If a project of this magnitude is to succeed, it must follow all current laws and procedures. I am confident that the State of Minnesota and the Minnesota DNR will have the Diversion Authority comply with all the applicable laws and rules that the citizens of Minnesota must comply with. Thank you.

Heidi Durand- City Council Member, Moorhead

The intent of this report is to express the continued concerns upon the conclusion of the work done by the taskforce. The group of people who will be responsible for creating a flood protection project will need to assure the impacted communities by proving it is the least impactful, the most fair, follows moral and ethical principles; meets the basic needs of the community; and follows state and local laws.

There is no question the Fargo-Moorhead and surrounding communities are in need of permanent flood protection. Without a doubt, floodwaters have affected everyone in this community in some way. Everyone has a flood story to share. The need for protection is not in question. It is the manner in which protection is achieved that continues to be in question. Who pays and how much? Who is inundated and who is protected? What level of protection is wanted and what is needed? What is fair mitigation? What is a balance of impacts?

It is my strong belief that you cannot displace your water problem upon someone who has never had the problem; and those who benefit the most from a project must assume the most impacts associated with the project. Elected officials have an obligation to everyone impacted by a project in which their municipality is involved. If the city of Moorhead is involved in a project that has negative impacts for people outside the city's boundaries, the councilmembers are still obligated to think about those people and their well-being in decision-making. The notion that Moorhead should not "care" about the concerns of people in Clay or Wilkin, Cass or Richland counties is wrong.

The following is a list of remaining concerns and questions I have regarding the purpose and parameters of the taskforce and the key variables identified in the taskforce summary.

1. The purpose of the taskforce was to develop design principles and concept-level engineering solutions to achieve balanced flood risk management for the Fargo Moorhead region.
    a. My continuing question is if Cass County is expected to receive 80-90 percent of the benefit of the project should they not assume 80-90 percent of the impacts? Those involved with the project are quick to point out that North Dakota and Cass County are assuming 90 percent of the financial costs but "impacts" include more things than just dollars. Impacts should include inundation and dedicated flood plain preservation as well.
2. Two key parameters for the taskforce's work include solutions that were within the parameters of Minnesota, North Dakota, and local law; and that maintained federal authorization.
    a. Maintaining federal authorization restricted the taskforce's ability to develop alternatives. Every option that may have resulted in lower costs or less impacts was shot down before it even had a chance to be discussed. Critics were always quick to assert, "It could result in a change that would jeopardize federal authorization." This parameter held back discussions and was detrimental to the work.
3. Key variables of concern:
    a. The eastern tieback was presented and many agreed it was worth more studying. However, there are consequences that were not thoroughly discussed or presented. Perhaps a better solution would be to use an existing feature, such as highway 75, which could also function as a tieback.

b. Northern storage was briefly discussed and many people favored studying it further. The only option presented appeared to be a sliver of what could be pulled in for additional storage. We heard repeatedly that floodplain preservation was the best way to fight floods. This is an opportunity to do just that and must be a part of any future project.
c. More drastic changes in the embankment (high hazard dam) need to be explored. This is where the operational variable and the high hazard dam are connected. We were often told the dam was necessary to reduce the downstream impacts. If the State of North Dakota will follow the State of Minnesota's statutes regarding downstream impacts like they said they would, the height of the high dam could be reduced or perhaps even eliminated. The taskforce received information on mitigation work done in Manitoba. We were told that people "learn to live with the water" and rural homesteads are all ring-diked. If it works for Manitoba, perhaps it could work in the Red River Valley as well and mitigate any downstream impacts.

4. The use of the phrase "newly impacted structures." I repeatedly expressed my concern with this notion of identifying areas as "newly impacted." It is my belief this phrase was misleading and used inaccurately. For example, if a structure never had protection to begin with it, but changes to the plan would no longer benefit from the project, it should not be considered "newly impacted." This catchphrase was used to steer conversations away from several flood plain preservation options.

At the end of the last taskforce meeting, I left doubting there were enough changes or modifications made that would result in a permitable project. Many members tried to reiterate this point and make it clear that the current plan violates Minnesota law and cannot be permitted. However, it did not seem to matter to the handful who continued to resist any major changes.

The lack of changes in the dam structure/alignment and the Minnesota impacts left largely untouched leave us where we started. Despite the DNR's willingness to assist well-intended individuals who came to the table ready to work toward a project that could gain wider support, meet the needs of the communities, and be permitable, the refusal by some to look at major changes has done nothing but solidify the demise of the project. The DNR cannot "change their mind" and permit this project without jeopardizing their credibility. After all, who will bother to wait for a permit after witnessing the Diversion Authority do as they wish without obtaining necessary permits?

Tim Fox- Former Wilkin County Attorney

The Task Force received several presentations of varying relevance. Presentations by the Diversion Authority and Army Corps were intended to persuade the Task Force that the current project should proceed without change. It was not until the final meeting that a realistic effort was made to begin the process of addressing Federal and State laws intended to preserve existing floodplains. The

crux of the dispute is the transfer of floodplain impacts either down stream or upstream. The current plan, as confirmed by Governor Burgum when referencing the development of another subdivision near Davis High School, is to continue development in both south and northwest Fargo in areas that are currently in the floodplain and unfit for development.

There were several points of persuasion used throughout the presentation and discussion by project proponents that were misleading or made with faulty assumptions.

1) Base Line Comparisons: Using the current project, a project that has been denied a DNR permit, as a base line for comparisons or modifications was misleading and could only lead to false assumptions. One of the most obvious misleading assumptions was the designation of the unlawfully constructed inlet structure as a starting or ending point for the alignment of the diversion channel. The vast sums of money spent on Oxbow have clouded the clear benefit of maintaining the south Fargo floodplain while removing or greatly diminishing the impacts of Oxbow, Hickson and Bakke being in the staging area, and incidentally resulted in a $150 million savings. But for unlawful action of the DA, these saving should be a legitimate consideration. Numerous land acquisitions Northwest of Fargo have let to speculative land development in a floodplain area. The slate does need to be wiped clean in order to develop flood protection conforming with Federal and State legal and regulatory criteria. Floodplain Development or previous errors in judgment cannot be the guiding force in pursuing a permittable flood protection project for Fargo.

2) Army Corps Legal/Regulatory Comments: On several occasions the Corps was asked to provide legal or regulatory comments. The Corps refused, when asked, to acknowledge the regulatory authority of the State of Minnesota. By commencing construction of the project, not only once but twice, only to be stopped by the Federal Court, asking the Corps to provide comments about regulations or rules seemed strange at best. The Corps made responses in the nature of what made them comfortable or uncomfortable. If defying Minnesota law and proceeding into construction of a project while legal action was pending, did not make them uncomfortable, little deference should be given to any Corps opinion.

3) Newly Impacted Structures: The entire process of having data provided that tallied newly impacted or not impacted structures was clearly questionable. During the three most recent major floods, the entire area between Oxbow and South Fargo was nothing but a lake. How are there newly impacted structures in an area that is and has been a floodplain and regularly under water? When were these homes/schools built? Why does construction continue today in an area that should be preserved for floodplain to protect Fargo? On the opposite spectrum, there will be numerous farm sites and structures in South Clay and Cass Counties and North Richland and Wilkin Counties impacted by the dam and staging area. Many of the uncounted structures in these areas are considered already impacted though they have never flooded and are not in a floodplain. The distortions created by not recognizing truly impacted structures', to skew the support of the current project, will lead to years of

litigation when impacted property owners, flooded by a dam on the Red River, have never having been compensated or consented to a flowage easement. Again, this data as presented during the Task Force meetings seemed to be readily accepted by diversion proponents but carefully questioned by others. Conclusions of this nature should be closely scrutinized for accuracy.

4) Levee Only Option: At my suggestion this option was again reviewed. However, the conclusion as presented was in a single line of a report. The conclusion stated that it was rejected because of cost, suggesting the cost was $1.9 Billion. There were not any details as to how that cost was determined. Interestingly, that would be a savings over the current proposal and have far less negative impacts. It is another proposal with less negative impacts and reduced costs.

5) Minnesota Diversion: Little attention was given to the option, though it was the preferred option costing less with fewer negative impacts. Governor Dayton originally excluded it from consideration but later stepped back from that position. It should remain an option and be used as the baseline for comparisons of project configurations rather than the currently proposed project.

6) Final Day Options: The only real progress, though limited, occurred on the last day of the task force meeting. Three individual options were presented. It was immediately evident, that at a minimum, a combination of all options would be an excellent starting point. That suggestion was met with decisive opposition from Governor Burgum.

7) My Option: Following up on the presentation by Charlie Anderson, a rough draft of an alignment was put together prior the last task force meeting. That draft/map was distributed towards the end of the Task Force meeting. At one-point Governor Dayton inquired as to what my alternative would be. My initial response was reciting floodplain policy, indicating that preserving the floodplain was the top priority. Governor Dayton than discovered the draft map that was handed out. Keeping in mind that neither I, Richland/Wilkin JPA or the Upstream Coalition have engineering firms at our "beck and call" there were joint discussions on obtaining an independent engineering analysis. As a follow up to the comments of Governor Dayton, Charlie Anderson has been retained to provide a more detailed analysis of a design the would preserve floodplain while providing flood protection to Fargo.

Steve Jacobson- Norman County Commissioner

It is generally accepted that Fargo-Moorhead needs flood protection. What level of protection and at what cost is the issue of debate. Minimizing the cost, both in dollars, and adverse impacts, is of most importance in developing flood protection for FM.

All should be done to minimize upstream and downstream impacts of the project that will give adequate flood protection to developed areas of the Fargo-Moorhead community.

I came into this task force thinking that, there is no way on earth that the DNR will permit a control structure in the channel of the Red River. I'm not so sure of that anymore. The diversion plan will not work without the control structure. Federal funding will not be available without it.

So something is going to have to give on this. If the DNR does not issue a permit for a southern embankment control structure, Fargo-Moorhead flood protection is going to have to take a different approach.

Curt Johannsen- Mayor, Hendrum

There is no doubt that the people of the Fargo-Moorhead area need and deserve flood protection, just like anyone else in the Red River Valley; however, the debate occurs on what is the proper and best way to achieve it. I believe flood protection is obtainable if people listen to one another and collaborate on a solution as much as they do when they are helping to protect their neighbors from a flood. Unfortunately, this spirit of collaboration has been missing from the discussion for quite some time. However, Governor Mark Dayton and Governor Doug Burgum were able to create a cooperative dialogue through the establishment of the Fargo-Moorhead Area Flood Diversion Task Force which was able to offer some recommendations to the Diversion Authority. The following is my comments on the task force's recommendations.

As much as I support basin wide retention efforts, I believe that distributed storage alone cannot achieve the certifiable level of protection that is necessary to protect Fargo-Moorhead; however, retention efforts should be pursued simultaneously in order to increase the Fargo-Moorhead area's level of protection as well as assist in providing basin wide protection. I also do not believe that a levee only alternative is an acceptable solution since the cost would be comparable to that of a diversion and provide less protection with considerable impacts. Therefore, I support the diversion concept as long as impacts both upstream and downstream are minimized and mitigated to the best of the ability.

I strongly support the task force's consensus of using the full period of record hydrology to determine that the one percent annual chance (100 year) flood level would be at 33,000 cubic feet per second. Furthermore, I agree with the Technical Advisory Group's recommendation for the Western Tie-back Levee as well as the modifications to the Eastern Tie-back Levee in order to reduce upstream impacts, increase floodplain in North Dakota and reduce newly inundated floodplain in Minnesota. In addition, I am in favor of pursuing a design that would allow up to 37 feet passing through town on the Red River during a one percent chance event.

I do not support the Northern Storage Option and adjusted diversion alignment resulting from it. Even though this option preserves more of the natural floodplain, it results in minimal staging area reduction therefore doing very little to reduce upstream impacts. The outcome is less area being

protected with a diversion channel that will have sharp bends resulting in an increase in maintenance costs due to erosion in the channel.

Probably the most significant change to the diversion design would be the Southern embankment alignment. Unfortunately, the Task Force could not come to an agreement on where the alignment should be. Even though each option (7A, B, and C) had their own pros and cons, I strongly believe that a combination of these three alignments could offer the most benefits in reducing upstream impacts. I don't think it is worthwhile to further investigate option 7A since the Minnesota Department of Natural Resources will likely not permit it, and 7B since the Army Corps of Engineers had concerns with it maintaining authorization. Instead, I believe that a combination of both options 7A and 7C warrants further investigation. Whatever the result is, shifting the Southern embankment alignment further North is necessary in order to utilize more of the natural flood plain which will considerably reduce negative impacts.

Despite the fact that allowing more water downstream would result in a modification to the operation plan rather than a change in the diversion design, it still warrants discussion here. The reason that the original design of the diversion had upstream storage built into it was to mitigate downstream impacts. Although the staging area influences the upstream, those effects are considerably less then what the negative impacts would be to the downstream without it. Not only would more structures be affected downstream, which would require costly mitigation, but the potential exists to also cause an increase in water levels at the United States/Canadian border which would require approval from International Joint Commission under the Boundary Waters Treaty. The six inches of additional water that the Technical Advisory Group evaluated sending downstream would cause an impact at the International Border thus violating the treaty unless approval was obtained. Even if approval could be obtained, the process would definitely add several years to the diversion timeline. Not to mention, is it worth upsetting our great neighbors to the North for something that may not even be possible? Furthermore, any additional water sent downstream has the potential to negatively impact existing community flood protection measures and their ability to maintain certification which would require costly mitigation. Any additional water sent downstream that has the potential to negatively affect the agricultural industry must also be taken into consideration.

In closing, I would like to express my gratitude to Governor Dayton and Governor Burgum for the great leadership they showed by establishing the Fargo-Moorhead Area Flood Diversion Task Force. Furthermore, I would like to show my appreciation to the task force members for their valuable, professional input and their collaborative effort to help the Fargo-Moorhead area achieve certifiable flood protection with minimal impacts to their neighbors. I would also like to thank the Technical Advisory Group for all their hard work and expertise. I hope the Diversion Authority continues with this spirit of cooperation by allowing all affected parties, including those both upstream and downstream, to have a voting seat on the Diversion Authority as well as on a future operation plan committee. I wish the Diversion Authority the best of luck in their endeavor of achieving flood protection for the Fargo-Moorhead area.

Jenny Mongeau- Clay County Commissioner

The commitment by Governor Dayton and Governor Burgum to help us work collectively to achieve flood protection is significant. The task force had good dialog and is recommending a solid set of parameters.

The first consensus item that task force agreed to recommend was the full period of record, 33,000 cfs 100 year. We also agreed to recommend allowing additional flows through town of 37-foot. I believe this level is appropriate, having the ability to allow an increased flow through town of up to one foot during extreme flood events should be an option outlined in an operational plan.

Given the previous facts of findings from the Minnesota DNR, I still have significant concerns over the ability for DNR to permit a dam on the Red River. During task force discussion we did not discuss modifying the proposed size of a dam, this is something that may need to be looked at to make it more permittable. Location was discussed and the current alignment incorporates some natural drainage into the river. An issue that I have struggled with is how the percentage of physical impacts and benefits will be divided among the two states. Land that has historically seen flooding during flood events are better suited areas to stage water in comparison to areas that are out of the floodplain. Any plan should focus on allowing water to naturally reside in lower areas.

In terms of how the southern embankment could be aligned in North Dakota we discussed options 7A, 7B, and 7C. My recommendation is to implement a combination of options 7A and 7C. Designing an embankment with limited 90-degree turns will increase structural resilience and decrease overall cost. Surrounding land is within existing floodplain and keeping it as such would offer reduced new impacts. The inclusion of a Western tieback was also an addition that was proposed and the majority of the task force felt it would beneficial to add to the project to keep water within the natural floodplain.

With the designed tieback levy in Minnesota a large amount of staged water will be shifted onto higher ground. I have considerable concern with the amount of newly impacted properties with the project. Doing so would conflict with local water ordinances in Holy Cross township and

Wilkin County. Those issues would need to be addressed to follow Minnesota law. An Eastern tieback levy in Minnesota would run north and south. This would dissect Clay County Ditch #59 and JD #1 running east and west. Significant engineering and reroute would need to be done to those systems to ensure drainage is not hindered.

Within the Minnesota staging area there are approximately 15 sections of land that would be placed into the flood plain. There are concerns in regards to the city of Comstock's infrastructure and access during flood events. I question if ring dike protection will be certifiable because of railroad access points. US Highway 75 and the BNSF railroad, both run north and south and are heavily used corridors. Each system would experience deep inundation of floodwater with a proposed project and a significant road and rail raise must take place. My proposal is to engineer US Highway 75 to the standards of what the Eastern tieback would be, make it the tieback levy. The Army Corps had stated that levies could be used in this capacity. By doing this the land between the road and the Red River could be used as staging, the vast majority of that land is currently susceptible to flooding due to its proximity to the river. Doing this would preserve valuable farmland, eliminate the need to ring dike the city, prevent disruption to Hoff and Comstock cemeteries, and offer huge cost savings by eliminating the need for a rail raise.

In looking at other possible changes The Northern Storage-Channel Alignment did not prove to offer any change to impacts, I'm not sure a change is necessary, but if keeping existing floodplain is important to getting a permit it may be an option.

Keeping impacts at the Canadian border neutral is an important factor. A small threshold exists to allow for minor downstream impacts that could help ease the burden upstream. By allowing up to 4 or 5 inches downstream impact we could see a measurable decrease in the staging area.

Ultimately reducing flow into the mainstem of the Red River south of the metro will continue to serve as an integral part of reducing flood levels. Managing flow of the Wild Rice specifically has been identified as something that could drastically decrease mainstem levels.

A comment has been made in reference to the amount of money the task force recommended alternatives add to the final product. While there is truth in the statement, the reality is that these are proposed elements that could potentially allow a project to be permitted. Without

altering the previously denied project we are stifling our ability to achieve flood protection for the region.

One crucial element of this project is what a final operational plan will look like. We are dealing with an unpredictable mother nature and without having an operational structure in place there is an enormous level of unpredictability that exists. Key questions need to be answered and without knowing how these issues will be addressed, it makes it hard to endorse components of a project. Knowing with certainty how the project will be run will allow for better development of mitigation and evolution of proper easement plans.

The opportunity to have region wide dialog on the components of the Diversion has been important. We've had inclusive, intense conversations to find the best possible alternative. I continue to believe that any project moving forward will be stronger if we continue to include perspectives from all involved. I appreciate the opportunity to have had a seat at this table and I look forward to having further dialog and collaboration.

Joel Paulsen- City Council Member, Moorhead

"Information is the resolution of uncertainty"

-Claude Shannon, American Mathematician

1916-2001

The preceding quote by Mr. Shannon clarifies the mission of the Fargo-Moorhead Area Flood Diversion Task Force. Flood events and the natural weather conditions that create them are by nature uncertain events. At best, our scientific advancements and knowledge have allowed us to somewhat accurately predict the weather only a few days in advance. The purpose of the Task Force was to develop design principles and concept-level engineering solutions to achieve balanced flood risk management for the Fargo-Moorhead region, including up and downstream communities and properties. These concept level engineering solutions were based on an intensive review of information that has been compiled about flooding and flood control in the Red River Valley, with the intent of defining our risk and determining the proper project to deal with that uncertainty.

Governor Dayton and Governor Burgum appointed a group of diverse members with an intent to explore all perspectives related to finding a project that will provide the greatest protection, minimize negative impacts, and is economically feasible. This summary contains a list of Task Force Findings that I believe, when implemented, will meet the objectives of the Task Force, meet the

legal requirements of the States of Minnesota and North Dakota, and fulfill the federal legal requirements as defined in Executive Order 11988 – Floodplain Management. I am encouraged by the work that was done by the Task Force and I look forward to implementing the findings and recommendations of the Task Force and the continued work of the Technical Advisory Group in my role as one of the City of Moorhead's representatives on the Flood Diversion Board of Authority. This is a defining moment for the Metro Area, one that will minimize our flood risk significantly and ensure our metro community remains vibrant, safe, and secure. Nevertheless, I remain concerned about the individuals impacted by the construction and operation of a proposed flood control project. Every effort needs to be done to mitigate potential negative consequences of the project and treat affected citizens fairly throughout project development and implementation.

The Task Force process allowed the discussion of major policy decisions with input from all points of view. It allowed a robust discussion on the science and engineering behind the implementation of physical elements of the project. Finally, it allowed a deep and straightforward conversation with Federal and State regulators. Only when science, engineering, policy, and regulations align will a feasible project present itself.

In closing, we will never be able to fully know what Mother Nature has in store for us, however, we can make prudent decisions to manage the uncertainty and risk through sound engineering judgement and scientific analysis while recognizing and minimizing the sacrifices people have to make to implement a sound, just, and reasonable flood risk management plan.

Del Rae Williams- Mayor, Moorhead

Need for Flood Protection

The City of Moorhead needs additional flood protection and has been a local sponsor of the FM Metro Flood Diversion Project since its inception in 2008. Even with the work that has been done in Moorhead, including the construction of over 12 miles of levees and floodwalls and almost 250 acquisitions, our work is not done. We came to realize that we can no longer complete the work alone as a city, nor should we. The problem of flooding in the Red River Valley is bigger than Moorhead and we need to work together with surrounding communities, in Minnesota and North Dakota, to provide the level of protection we need in a way that makes sense.

Working with Fargo and other members of the Diversion Authority, we developed a good project which was able to get federal authorization and federal appropriations. This was not an easy task. The Diversion Project is big, complex, and comes with a hefty price, both financially and due to impacts. Unfortunately, the project was unable to obtain a permit from the DNR in the form it was in. This left Moorhead without a path to provide the level of flood protection it needs, and it left over 1,000 homes in the city with the risk of being placed in the FEMA 100-year floodplain, therefore stuck with expensive mandatory flood insurance policies.

The people of Moorhead are grateful to Governor Mark Dayton for stepping in and helping usher a solution and a way forward. It was clear that his strong leadership and considerable empathy was needed to bring all parties to the table, resolve what could be resolved, and to help everyone better understand the needs and challenges associated with keeping the public safe from flooding. Together, the Governors were able to do

what we have not been able to locally. They created a forum for healthy dialogue and a renewed sense of commitment amongst the region that we have not had in many years. It is my sincerest hope that these talks will continue and lead to not just flood protection for Moorhead, but additional joint efforts that can have a lasting positive impact on our region of the country.

Task Force Efforts

I am so proud of the work we have been able to accomplish in Moorhead. With the support from those in St. Paul, we have made real strides and our citizens know it. The downside of doing such great work is that people have assumed we are done. This was apparent at the start of the Task Force meeting when much of the discussion was dedicated to what level of protection we are at, and a number of false assumptions were expressed. I want this report to make that issue clear. Not only did the Task Force identify and agree with the significant work that needs to be done to make sure the entire city is safe, the Task Force actually made recommendations that will require an additional $50 million worth of work that should be done within city limits.

I think it is important to address the financial implications to Moorhead and Minnesota. The DNR previously identified a figure of 2 percent as the benefit to Minnesota. The 2 percent benefit figure has been used to calculate the anticipate funding level from the state, which amounts to approximately $43 million. With the changes from the Task Force, this $43 million is likely to go up using the same math. In addition, the $50 million of additional work in town will also have to be funding through the State.

What this tells me is that the project previously developed was a good deal for Minnesota. With the changes from the Task Force to allow for a permittable project, I think the project is still a good deal, but it means our local legislators will have to do a lot of work to obtain that additional funding and continued support from those working in St. Paul is needed.

I also wonder if we would be better off taking this opportunity to truly gain environmental benefits, rather than so narrowly focus on temporary impacts to farmland that will remain farmland. Rather than having the state spend $50 million to buyout more homes and displace families, we could create real environmental benefits such as retention for flood control and water quality improvements, buffer strips, wildlife habitat, etc. Instead, there remains an intense focused on preserving floodplain that is in the flood fringe and could be developed anyway over time.

DNR Dam Safety Permit

The Task Force brought more voices to the table. It was a good venue to discuss a project with a regional level of protection. It was also important for the discussion on where the impacts should be. It's a strange concept that isn't totally unique to water projects, but is certainly more prevalent. In order to protect the urban areas from being under water during a flood, you need to find a more appropriate place to store it. In essence, you have the unfortunate task of deciding where that water goes, and who ends up impacted. The changes suggested impact more people, more homes, and more farmsteads. This is unfortunate, but it also allows us to create less new floodplain land, which is important to obtaining a Minnesota permit.

It is now up to regulators at the DNR to be fair and give direction to our technical team as it submits a new permit. I urge them to work quickly so permitting can be completed early this year to allow the use of the construction season before we lose out to another long winter. Governor Dayton laid out a path forward for us so that failure is not an option, and I expect all parties to move along that same path to obtain a permit, end litigation, and protect Minnesotans.

North Dakota Representatives:

Jason Benson- Cass County Engineer

The Governors' Diversion Task Force was a much needed process to bring all parties to the table. While there are many challenges ahead, I am in concurrence on the following items: 33,000 cfs for the 100-year flood, changes to the eastern and western tieback levee, 37-feet of flow through town, no change to the channel alignment from the inlet north to the outlet, and moving forward with option 7c for the southern embankment. While I concur with the items above, I feel the Task Force process never fully addressed the requirements of the Dam Safety Permit. In the end, the recommendations brought forward increase the cost of the project while decreasing the "dam safety" by making the project less robust, less resilient, and less reliable.

The Task Force was an excellent opportunity to learn about the current project. Over eight years we have studied, analyzed, and developed plans in order to reduce impacts and ensure a robust project was developed to protect the Fargo-Moorhead area both now and into the future. I think the Task Force meetings showed the current project design is the most cost-effective design for providing 100-year FEMA certifiable flood protection with the ability to fight up to a 500-year flood event. The Task Force meetings also made it clear that changes to the current design would need to be made for the MDNR to permit the project.

The changes brought forward were viable, but many of these options fell short when looking at the other criteria.

- **Costs:** Prior to meeting, there were several media interviews given by members of the Task Force in which the public was told there was a cheaper, better option available. It is clear now that every option evaluated increased the cost of the project by hundreds of millions of dollars. Adding substantial cost increases are not viable without a significant influx of new money from Minnesota and North Dakota. Citizens in Fargo and Cass County have already voted to tax themselves until 2084. Our local residents have shouldered their share of the financial burden. I ask both Governors to provide additional state funding to address these new costs.
- **Reduce Environmental Impacts:** The suggested changes reduce the newly impacted acres in Minnesota and better balance the impacts between the states.
- **Minimize Residual Risk:** The suggested changes increased residual risk to the project.
- **Limit Impacts to Structures:** Every significant option presented impacted a significantly higher number of rural farmsteads and residences. In addition, the 37-feet of flow dramatically impacts city and rural properties and cuts off a number of additional access roads.

- **Resilience and Robustness of Design:** Increasing to 37-feet of flow, along with changes to the southern embankment only add to the length and complexity of the embankment and reduce the project's resiliency and robustness.

Several Task Force principles were not resolved.

1. I encourage future operational plan discussions to include both upstream and downstream involvement once a final alignment is known.
2. Compensation program for the inundated lands should remain a top priority to be finalized in the near future.

A reoccurring challenge was the moving target in what the MDNR deemed would be a permitable project. Given the goal was to obtain a Dam Safety Permit, it is frustrating that every option considered increased the cost while decreasing the safety of the dam. No alternative was presented that actually made the dam safer. I was also frustrated in the downplaying of the permanent impacts due to construction. Over 7,900 acres of permanent impacts under the diversion channel and embankment are in ND and 433 acres in MN. These permanent impacts should be treated with a greater weight than a temporary impact. For comparison, there are 6,900 acres of newly impacted acres in MN, but these temporary impacts were a primary point of discussion. Also, these temporary impacts would have only occurred less than 30 days over the last 115 years and allowing the land to be farmed every year. However, the 7,900 acres in ND will never be farmed again and forever changed. These permanent impacts are likely the reason Gov. Dayton declared the Minnesota alignment was not possible and so they should be thoroughly addressed by the MDNR in its analysis.

It is critical the permitting requirements are clear. The discussion of a conditional permitting process is encouraging. In hopes of continuing the successful communications of the Task Force, I want to request that the DNR attend our Diversion Authority meetings and provide routine updates.

In the end, our efforts all serve the same taxpayers. With this in mind, it is essential that we move quickly to address the soon to expire contract between the Corps and Ames Construction for the completion of the inlet control structure. A March 2018 deadline is approaching and failure to address this issue would result in costing tax payers millions of dollars.

As Gov. Dayton expressed at the Task Force Meeting, acquiring the lands necessary needs to be a top priority and should start up again as soon as possible. Given past communications which led to halting these activities, the MDNR needs to expressly respond to, and support this position.

Fargo and Moorhead, along with Cass and Clay Counties formed the Diversion Authority to work jointly across two great states to provide permanent flood protection. With the additional leadership displayed by the leaders of Minnesota and North Dakota, I believe we reviewed the more than one hundred alternatives previously studied and identified the substantial changes needed to obtain a Minnesota permit. These changes will result in hundreds of millions of dollars of additional taxpayer dollars, including nearly $100 million from Minnesota alone. These changes will not be easy to implement, or easy to explain to the owners of the additional homes and farmsteads impacted. It

is my hope that the state of Minnesota will act swiftly on conditional permitting and then help us as we communicate the changes to the public.

Ron Bergan- Fargo Business Leader and Entrepreneur

I appreciated being part of the Task Force and all the work the MN DNR put forth working with the Task Force. Also, thanks to Governor Dayton for attending every meeting. We learned a lot about floods and flood protection for the F/M area. The 100 year protection consensus of the Task Force is low compared to the 250, 500, 700, 1,000 and even larger floods that could occur. It was reported that the Minot flood was about 10 times the 100 year protection they had in place. It was reported that the storage dams also in place were full at the start of this flood. They probably caused the flood to be much larger with the entire flood flow going over the dam. At some point concerns of dam failure cause you to open the control gates and the flood becomes larger than without the dam. See attached report showing the effect of dams on flooding. The 'mean annual flood' is reduced by ½ while the size of the flood likely to recur every 50 years barely changed. The risk of dam failure in 100 year and larger floods makes dams "dangerously deceptive". Grand Fork, Minot and Bismarck all have had floods greater than the 100 year level in recent years.

The Diversion will allow us to have a chance to win a 500 year flood fight. Looking at the 500 year flood map, the flood extends west of Mapleton and looks more like a large lake.

The Diversion is designed to give us protection for 100's of years. I am concerned that changes we are considering will cause the risk of failure to increase significantly especially in the very long term. Failures was one of the concerns of the DNR. We need to consider the Red River Basin Commission recommendation that the population should grow in cities protected from flooding, therefore we need adequate area for expansion in F/M.

The Task Force found that all reasonable alternatives were or had been studied and a Diversion is the only alternative to give us the desired protection. I believe the Corps and the local engineers did a very good job also of selecting the route for the diversion balancing the environmental concerns, costs, etc. The western and eastern tie-back levies and allowing 37' through town are acceptable compromises to the Minnesota DNR. It should be noted that the 37' flow affects 82 additional homes in Fargo and adds significant costs.

The northern storage area is not acceptable to me.

The alternatives for additional storage – 7A, 7B and 7C were presented to the Task Force at the last meeting but we were not given adequate time to study the data. After looking at the data I feel the impacts on additional homes and structures that would need to be removed is very significant. There is only a small change in looking at the upstream impacted acres or the protected floodplain acres. These alternatives greatly impact many people for the sake of a few acres of land. The upstream floodplain acres are only affected 38 days in the full period of record. The approximately 8,000 acres permanently removed from production for the Diversion Channel in ND are not shown in the spreadsheet. The cost estimate for 7C alone is $180M (26 more homes in Cass County and about seven more miles of the Dam).

The operating plans for the Diversion should be modified to consider reducing the peak flow at downstream cities for their floods which may not be the same as the peak at the Diversion outlet. More flow may be ok earlier versus later when considering the effects of the other rivers downstream.

Excerpted from *Silenced Rivers*: **The Ecology and Politics of Large Dams**

Patrick McCully. October 10, 2007

Even if flood control is not an intended consequence of a project, a storage dam will almost always delay floods downstream and reduce the size of average flood peaks, commonly by more than a quarter (even a flood control dam, however, may have little effect upon extremely large and infrequent floods — making the 'flood control' offered by dams often dangerously deceptive for people who move onto the downstream floodplain). The Warragamba Dam in Australia, for example, reduced the 'mean annual flood' (a flood likely to recur on average every 2.3 years) by more than half, while the size of the flood likely to recur every 50 years barely changed.

Nathan Berseth- Richland County Commissioner

1. **Apply Least Impact Principles:** The Minnesota Environmental Policy Act prohibits DNR from permitting a project when there are feasible alternatives which significantly reduce the environmental impacts. The least impact principle permeates all of the regulations governing dam permitting and public waters permitting.

2. **Address Permit Conditions:** During the task force deliberations, very little effort was made expressly to apply the permit requirement. The focus of the deliberations was to find a project that reduced impacts and which Diversion Authority could accept. On occasion, a Minnesota official would point out that the configuration being discussed was likely not permittable. That should have led to a discussion of what, then, must be done in order to meet permit conditions. We cannot arrive at an acceptable project unless the Commissioner's permit conditions are itemized and the parties then work through each condition and find ways to meet those

conditions.

3. **Minnesota Project Sets Ceiling on Permissible Impacts.** The North Dakota alignment has significantly greater downstream Impacts than Minnesota alignment of the same capacity and results in nearly twice the stage increase. This doubling of impact results because the LPP eliminates floodplain storage south and northwest of Fargo. Engineer Anderson put it this way:

> *"The North Dakota diversion flows through a low floodplain area thus draining floodplain and also isolating existing floodplain areas, by levees along its alignment, resulting in excessive loss of floodplain storage. The MN Diversion flows through higher ground generally not within the floodplain thereby having minimal effect on floodplain storage along the alignment."*

To avoid these impacts, the project must abandon its attempt to flood protect the undeveloped floodplain, whether the diversion flows through Minnesota or North Dakota.

4. **Minnesota Alternative Meets National Objectives.** The USACE selected the Minnesota diversion as the least impact project which best meets national objectives. The LPP costs $1 billion more than the least impact project, eliminates 50 square miles of floodplain storage more than the Minnesota diversion, and consequently develops more downstream impacts. The billion dollars saved could then be used for distributed storage or other needed improvements.

5. **Change the operative underlying principles—maximize floodplain retention.** If a North Dakota alternative is deemed desirable, the Technical Panel should have been asked-- to design a North Dakota project that maximizes floodplain retention. None of the options studied by the Technical panels were based on that concept. Rather, the task force was continually pressured to foster as much flood plain development as possible. As a result, the task force never considered, options that fully minimize floodplain loss. The Technical Panel inappropriately eliminated options which preserved the floodplain northwest of Fargo. Developing that floodplain is bad for Fargo's sound development: In separate articles, Governor Burgum is quoted in the Fargo Forum as follows: "

> *The reverse of smart growth, in Burgum's view, is sparse development on the city's edge, where it costs the city more to deliver services than developed property contributes in property tax revenues….*
>
> *Our city has an ability to grow and grow smarter than other cities by growing more densely as opposed to growing horizontally," he told the Planning Commission. "The 52 square miles is enough to hold us for a long time."*

Over half of the flood storage eliminated in the LPP is found on the Northwest floodplain. Instead of eliminating that storage, it should be enhanced.

6. **Federal and State Law Prohibits Avoidable Floodplain Development. T**he current project

violates section 1962-3. Under that law, the projectmust avoid the unwise use of floodplains and flood-prone areas and minimize adverse impacts and vulnerabilities.

7. **Apply Sound Engineering Concepts Designed to Minimize Impacts.** DNR should be applying the concepts described by engineer Anderson:

    a. Implement a major system of coordinated distributed storage throughout the basin. (achieves approximately 2 feet reduction in peak flow)

    b. Move the North Dakota Alignment East

    c. Reduce tributary crossings

    d. Redesign the dikework and structures along the channel to restrict inflows from the tributaries and allow water to enter the floodplain area on the west side

    e. Alter the configuration so flood protection follows the edge of the developed area as close as practical.

    f. Provide an understandable operating plan that can be modelled.

8. **Use Distributed Storage:** During deliberations, some have advocated that distributed storage should exclusively be used to mitigate floodwaters not caused by the project instead of mitigating excess flood water from the Fargo area. This is a false dichotomy. Distributed storage properly placed in watersheds tributary to the Red River will accomplish both objectives and reduce peak flows by two feet. Given any project design, the peak flows on the Red below Fargo will be two feet lower with distributed storage than without.

9. **Use Federal Funding Available under WRRDA to leverage state funding for distributed storage.** The reluctance to consider distributed storage stems from the misperception by Diversion Authority that project opponents have advanced distributed storage as a standalone solution. JPA sees distributed storage as a project enhancer that will significantly reduce project impacts and benefit the entire basin in Minnesota. If distributed storage accompanies this project, it becomes eligible for WRRDA funding that will benefit the entire basin and could trigger a major commitment of state bonding dollars to support the basin wide improvements that would then flow from the project. As modified, the project could offer significant benefits to Minnesota.

10. **Involve all parties in Examination of the Operating Plan.** The operating plan is a critical component of any flood control project. Stakeholders cannot understand the impact of the project without understanding the operating plan.

11. **Develop Dialog on the Takings and Compensation Implications of the Project.** A major flaw in the project as submitted to the DNR is that it failed to provide a defensible realistic approach to takings.

Bernie Dardis- Board Chair, Greater North Dakota Chamber of Commerce

Being chosen as one of the members of the Governors' Task Force was a true honor. After seeing the toil flooding has taken on the region, being a part of providing a permanent solution is something I hope I will always be able to look proudly back on. I say I hope, because the work is not done. Several large changes to the project were recommended, but we left unknowing how the DNR would consider these through the permitting process or how we would pay the additional costs, which are considerable.

When Governor Burgum asked me to serve, it gave me pause because I wasn't sure what I had to offer. I have paid attention to the Diversion Project closely, but I was not familiar with all the details. The more I thought about it, the more I realized I might be in a unique situation to provide perspective. I was identified as Chairman of the Greater North Dakota Chamber, but I didn't feel that meant I was looking out for only North Dakota. As CEO of Indigo Signs, we had significant business interests across North Dakota and Minnesota. I often thought about the economic prosperity of both states as I made my way between locations on trips back and forth on I-94. It is with this mindset that I set out to do my job as a member of the Task Force.

Flood Insurance

When discussing flood protection with those more technically inclined than myself, the conversation usually turns to river stages, flows per second, and other hydraulic factors. While these are important when designing a project, they are not the first things on the minds of the public. When I'm at meetings around town or talking to neighbors, the topic that comes up most frequently is something much closer to the pocket book, flood insurance.

The technical presentations from city engineers in Fargo and Moorhead showed that more than 1,000 homes in Moorhead and more than 11,000 in Fargo are at risk of being mandated to carry federal flood insurance. Too often, this topic is ignored when we talk about the need for flood protection and the speed at which we need to accomplish it. We know that the flood risk is the highest in early spring, the risk of flood insurance is something that impacts people every day.

According to the information at the Task Force from the DNR's website, a primary $200,000 residential property can expect to pay in excess of $4,000 a year in flood insurance. The kicker here is that this rate is actually subsidized by the federal government. Over the last several years, we have seen Congress slowly chisel away at this subsidy to work towards a more actuarial rate. The DNR's document estimates that a non-subsidized rate for a similar house that sits at an elevation similar to the 2009 flood would face almost double the rate at $8,000 a year. This is 4% of the price of the house every year! I have seen estimates that across Fargo-Moorhead this could mean $30-50 million in annual premiums. This would be money leaving our economy, rather than being reinvested here locally. This is an economic catastrophe that worries me as much or more than the risk of actual flooding.

The long-term results of these flood insurance requirements will mean the detriment of our existing housing stock, the tumbling of property values, the loss of family's retirement nest eggs, and the loss

of considerable tax revenue for government entities in North Dakota and Minnesota. It was clear from FEMA's testimony, the longer we wait, the more we are putting our economies at risk. These requirements aren't going away, they are only getting more fiscally stringent. The time to act is now.

More than Fargo and Moorhead

As a proud resident of West Fargo, I fully understand the frustrations, challenges, and the benefits of living outside of Fargo or Moorhead city limits. The FM Diversion provides protection to much more than just those Fargo and Moorhead. Fargo-Moorhead is a regional center for employment, entertainment, healthcare, and more. Like we've seen during past floods, when it floods in Fargo-Moorhead, every community within 100 miles feels it and pitches in to help solve it. This is how it is, but what was concerning to me was during the Task Force when the focus seemed to only be on the area within city limits. Fargo's and Moorhead's flood problems have never been dealt with solely by city residents, why start now? The changes being recommended mostly come at the expense of protection to the areas around Horace, West Fargo, Harwood and other rural areas that have always headed the call to sandbag when needed. I urge the Minnesota DNR to place a value on those homes in rural areas as those families are just as tough to displace as those in town.

Next Steps

I think it was Governor Dayton at the Task Force who said something like, don't let the perfect get in the way of good. I worry about where we left the implementation of the project. We made a lot of progress on a number of items and it seemed there was a majority consensus around modifying the location of the dam to option C. The DNR said option A would not be permittable and the Corps said option B would lose authorization. Engineers are a godsend, but if left to deliberate, study, and model scenarios, the strive towards perfect could be longer than we can afford. I urge Governor Dayton and Commissioner Landwehr, who I sincerely enjoyed getting to know over the last few months, to stay the course and help drive for a solution. While we have spent months meeting, the public has waited far longer for leaders to decide their fate. We owe to the citizens of Fargo and Moorhead, and to those in surrounding communities of West Fargo, Dilworth, Harwood and across Cass and Clay Counties, a project that protects them.

Craig Hertsgaard- Farmer, Richland County

The Task Force was charged with finding flood control solutions for Fargo-Moorhead that met two Key Parameters. The first was that solutions providing FEMA accredited 100 year flood protection must meet Minnesota and North Dakota statutes, and the second that federal authorization and associated funding tied to the Diversion Authority's project be maintained unless a lower cost method of flood control could be developed. Maintaining federal authorization, if needed, doesn't appear to be a problem. Army Corps representatives stated that the Undersecretary for Civil Works has broad powers to interpret Congressional directives, and communications with unified elected officials from both states would be influential in making their decision. It was also pointed out that

there are fast track remedies to alter previous authorizations that would not significantly delay the project. There was little discussion of the likelihood of full funding for the current or alternate projects.

The Task Force never arrived at a flood solution that met the stated goals and could be permitted by both states. The North Dakota State Engineer appears willing to permit any project the Diversion Authority has proposed. The Task Force would not have been assembled if the same were true of the DNR. The focus of the Task Force then becomes finding a project that meets the requirements of Minnesota law.

DNR Commissioner Tom Landwehr and Administrator Kent Lokkesmoe on several occasions defined Minnesota statutes as requiring the project conform to federal and state floodplain policies and have as little adverse impacts on population and the socioeconomic base as possible. Federal directives say projects should not encourage flood plain development, and Minnesota rules require governmental units to prohibit floodplain development. The task must be to find a flood control project that removes as little of the natural flood plain as possible, and has the least amount of negative impact on the surrounding region.

Identifying area to be protected.

The Task Force identified the area needed to be protected. Presentations from city engineers of Fargo and Moorhead delineated areas that needed flood protection. That area was similarly identified in technical committee modeling labeled Levee Only.

Level of Protection

The Task Force agreed on a level of protection of 33,000 cfs, or approximately 41.3 feet. City engineers described current dikes and levees as being constructed to levels between 42.5 and 44.5 feet. The State of North Dakota appropriated funds for Fargo to complete levees that would provide certifiable flood protection of 39.4 feet.

Protection above a 100 year flood

It was generally agreed that a diversion structure could provide additional protection needed to the 100 year flood level of 33,000 cfs. Representatives of the DNR as well as many Task Force members recommended Distributed Storage be constructed to provide protection beyond the 100 year level.

Diversion Channel Alignment

The Task Force never developed a process for determining diversion channel alignment, and as a result, did not make any recommendations. Several alignment options were reviewed at the Task Force's final meeting, with little time for critical evaluation or tracing the source of the proposals. None of the proposals presented seemed likely to be permitted by the DNR.

Moving Forward

It is clear that a different approach must be taken to meet the original goals of the Task Force. The group was restricted in their deliberations by adhering to features of a project proposal that is in violation of federal and state laws. If federal floodplain guidelines, and Minnesota statues are to be enforced, a successful design must be made on the following basis:

1. **Only the most reasonable contiguous developed area must be protected.** Fargo, and to some extent, Moorhead, are built in a flood plain. While there was good reason for their location 150 years ago, those reasons do not apply to future growth. Moorhead has virtually unlimited area to grow outside the 100, and 500 hundred year flood plains. Transportation arteries and existing infrastructure and development can be protected within state and federal floodplain laws. The natural floodplain and river channels weren't determined by state or federal law. It is a waste of the region's economic resources to design a project with provincial protection instead of regional flood protection.
2. **A diversion alignment must remove as little natural floodplain as possible.** The identified alignment that has the least floodplain impact is the original plan proposed by the Army Corps on the Minnesota side of the river. If that is not adopted, then any North Dakota route must follow the edges of the contiguous developed area as closely possible to avoid draining the natural floodplain. Rural structure counts used to justify large scale destruction of the flood plain are misleading and easily manipulated. Rural flood plain destruction requires a one to one trade with areas upstream and downstream that do not currently flood. The size of the rural 100 year floodplain transfer has huge impacts on communities, school districts, and townships, with no inexpensive compensation plan identified.
3. **Distributed storage should be utilized for protection above the 100 year flood level.** The cost of DSA construction can be shared regionally and nationally. A smaller, and less costly diversion can be constructed if it is sized for a 100 year flood.
4. **State and local officials should consider a plan that is locally sponsored and constructed.** It is clear that the length and complexity of any diversion is going to make the project costly. The Army Corps has constructed two simple diversions of less than five miles in length in the region in the last ten years. Both doubled in cost. Fargo engineers reported to the Task Force that their levee system will double in cost. The Oxbow ring dike and country club enhancement project doubled in cost. There is no reason to expect this project would be any different. The size of the proposed diversion will make an Army Corps directed project financially unsustainable.

Thank you for the opportunity to serve on the Task Force.

Tami Norgard- Managing Partner, Vogel Law Firm'

I appreciate the opportunity to engage in this important and historic process. While another month would bring us closer to a permittable levee alignment, the Task Force succeeded in identifying new key features that significantly reduce impacts of the project for upstream entities and Minnesota while retaining federal authorization.

The MNDNR's involvement provides a permitting advantage moving forward. While the original project was not permitted for a variety of reasons, MNDNR now studied the options and identified features, which should increase its understanding of the social and economic impacts of proposed project modifications that were merely conceptual when suggested as the original permit was denied. MNDNR now has a stronger basis on which to permit a new project, given the lack of or impact of alternatives.

The Technical Team brought forth solutions that optimized numerous important factors; not just minimizing the amount of floodplain removed, but also considering financial and social costs, additional home buyouts and added risk to the communities. MNDNR should find an iteration similar to 7A or 7C to be permittable. The permitability does not rise or fall on whether there is another alternative that removes less floodplain acreage. The entire metro area is within a floodplain, so feature selection is a precarious balancing act, identifying where to draw the lines of protection. The crucial inquiry is how many homes and citizens should be protected, at what cost and at what burden to upstream landowners. Either 7A or 7C represents a significant victory for Richland and Wilkin Counties, and an enormous compromise of the Diversion Authority.

MNDNR should be reasonable in encouraging an affordable embankment alignment. Since 1900, only 5 flood events would have impounded any water upstream with alignment 7C and 37 feet of water through town. Most of that inundation would happen during spring flooding, resulting in little or no impact on planting. This is not constant or regular flooding.

The Tech Team's optimizing of critical factors should be viewed favorably by MNDNR in permitting. Implementing 7C and 37 feet through town, for example, distributes newly impacted upstream acreage more equitably, with the ND/MN impacts split 45/55. In addition, the channel impacts over 8000 acres, 95% of which is in ND. 7C reduces newly impacted acreage in Richland and Wilkin Counties from 1124 and 1391 acres down to 337 and 239, respectively, mostly impacting low areas like creek bottoms. 7C reduces the need to mitigate homes in Richland County from 3 to 2, and in Wilkin County from 5 to 2.

The 7C and 37 feet through town option would be a significant compromise. 8000 less acres will be protected in the metro in order to save 2700 acres upstream from having flood easements. 102 more homes would be removed and metro families displaced in order to save 6 homes in Richland, Wilkin and Clay counties. There will be more risk to thousands of city residents by sending 37' of water through town, causing more pressure on levees and less freeboard in many areas. Further, this is only 100 year protection, which is a huge compromise since the 100 year protection levels have been

surpassed in many communities in recent years all over the country. And importantly for ND entities, this higher risk, less protection project will cost approximately $350-400 million more.

The 7C option example represents a significant compromise by all. If much more is required by MNDNR, it may incentivize the Diversion Authority to spend 18 months continuing litigation rather than spend $500 million or more in additional concessions. While I respect the Court's preliminary injunction and the resulting push to settle this dispute, I believe the chance that a permanent injunction would be issued or be upheld on appeal is uncertain. The Corps of Engineers builds projects across the country using this same arrangement, each of which will be compromised if the Court issues a permanent injunction. When imposing its preliminary injunction, the Court held that the Corps' arrangement was a federal scheme where the sponsor agreed to comply with state permitting, with the Court questioning whether to hold them to it. If upheld, this purported federal scheme provides an inordinate amount of power to local governments since the JPA argued that MNDNR cannot issue a permit if a project violates a city or township's ordinance (i.e., the Holy Cross township ordinance that was passed to stop this project). If taken to its logical extreme, in order for a permanent injunction to be imposed, a Court would have to find that Congress intended that this federal scheme would be vulnerable to wasting millions of dollars of federal investment and time if a local government passed an ordinance during project development that prohibited the project. The very concept of federal sovereign immunity allows the Corps to develop projects without being subjected to a plethora of lawsuits by project opponents or by local governments that deny permits for or spot zone to prohibit an unpopular project. If a permanent injunction were issued, it would mark a significant shift away from federal sovereignty and could compromise thousands of federal projects across the country. My point is not to predict the outcome of the merits of a permanent injunction, but to underscore that there is incentive for the MNDNR to be reasonable, and for the JPA to engage in settlement discussions.

The metro area needs flood protection, like other Red River Valley cities have enjoyed without this level of regulatory intervention or required mitigation. The Diversion Authority suggested numerous concessions in hopes of finding a permittable project. If the Diversion Authority is met with too hard a line, it may understandably continue litigation in order to save $350-400 million, 102 homes and protect 8000 more acres. Continued litigation is expensive and risky for everyone. All parties should instead choose to actively work towards a reasonable solution and find a way to provide this community with affordable, feasible, permittable flood protection.

John Strand- Fargo City Commissioner

Understanding another's perspective is usually the best means to solve a disagreement. I was honored to be asked to serve on the Task Force by Governor Burgum to help bring people with diverse perspectives together to find a common understanding. Together with Governor Dayton, these two great leaders rose to the top -- leading the Task Force with mutual respect and poise. While the Task Force pointed us in the right direction, work remains on a number of topics that will continue to benefit from the leadership and guidance of the Governors and local stakeholders.

Balancing the Costs and Impacts of Providing Public Safety

We already know the costs of comprehensive, adequate flood protection for Fargo-Moorhead will exceed $2 billion. The Task Force discovered there is neither a cheaper nor more affordable alternative. In fact, the Task Force's recommended changes, while balancing the location of impacts along with the impact on the floodplain, have increased the overall cost to the taxpayer an estimated $200 - $400 million. The ability to pay is finite while the need to provide for public protection is not. We must be prudent as we balance funding challenges with public safety needs of our citizens and future generations.

Remember the Land Permanently Sacrificed

Much of the focus of the Task Force was on impacts upstream where water is estimated to be staged once every 21 years, which is a lower frequency as a result of the Task Force recommendation to increase flows through town to 37 feet. Though I support this change, it's not without strong reservations and concerns about increased public safety risks associated with allowing greater water levels pushing against the over 20 miles of levees and floodwalls Fargo has built since 2009.

I felt the Task Force could have been provided a more detailed report during the presentation regarding the goal to balance the impacts between the two states.

In addition to upstream property impacts, we also can't overlook the great sacrifice being asked of many landowners who will permanently lose farmland under the footprint of construction. Over 8,000 acres, almost all tillable, would be lost permanently due to construction and will need to be acquired outright. Over 95% of this land is located within the State of North Dakota. Any further comparison of impacts between the two states must include these impacted acres as well.

Compromise and Continued Communication

The Task Force allowed for an open exchange of ideas that resulted in numerous compromises. Nothing is achieved successfully, for the long-term, unless compromise is sought at the start. These compromises will ensure a viable, responsible and successful project. This communication cannot stop now. I expect that these few meetings, which have already increased dialogue, will lead to further collaboration among the Diversion Authority and the folks upstream and downstream, and of course our neighbors in Minnesota.

An End to Litigation

It is my sincere hope that the effort by so many through this Task Force will result in the end of the litigation that has plagued our communities, counties and states for over four years. Taxing our citizens to pay for our courtroom battles must come to a close. The Governors' report should serve as a beginning to an end and a means to close the door on our legal debate. I urge all parties, who were present at the Task Force, to form a bonding agreement that finds a path forward where compromise and cooperation can be codified and the permanent flood protection we need is realized.

Process Should Drive the Policy of the Southern Embankment

I have heard of no item more contentious than the location of the dam and the southern embankment. The Task Force had a number of positive discussions about this topic, but I accept that it is our failure that we did not provide a clear path forward on this topic.

At the last meeting, three options were presented showing attempts to balance impacts and find compromise among the varied interests. Mr. Lokkesmoe stated clearly that Option A could not be permitted and both his words and the data shown put options B and C as nearly identical toward the goals set forth in the Task Force Charter. After that, Colonel Calkins spoke of the increased public safety risks associated with doubling the length of the embankment so near a dense population that option B would not meet the standards set by federal authorization. While many spoke in support for Option C as the preferred choice, discussion was ended before clear direction was given.

Understanding the need for further study of the exact location, there was only one option that met the goals of the Charter to further balance the impacts between the states, reduce the impacts mostly out of neighboring counties, maintain authorization, and was equal toward getting to a permit. This was Option C, and I urge the technical group to include this option in its final report.

The Task Force was more successful than many could have hoped. The leadership and contributions of the governors was most appreciated. As Governor Dayton stated, "failure is not an option." The legacy we leave future generations is ours to script here and now.

Ken Vein- City Council Member, Grand Forks

Governors and Task Force members agreed to the 'Task Force Charter' which defines **Purpose** and **Key Parameters**. **Purpose** was to develop 'Design Principles' and 'Concept-Level Engineering Solutions' to achieve balanced flood risk management for Fargo-Moorhead region. **Key Parameters** are 'Finding Solutions that 'Meet Applicable Local and State Law' and 'Maintain Federal Authorization and Appropriations' (unless more expedient and low-cost options are presented). I felt it was essential to use this charter as the framework for my recommendations to achieve balanced flood risk management.

The **Key Parameter** of 'finding solutions that meet local and state law' was frustrating as I was never able to understand Minnesota law requirements and why the current project did not receive a permit. On several occasions task force member Tami Norgard asked for clarification of state law, but answers never had clarity I could understand. It appears the intent of MN DNR was to more closely balance new water storage between both states and to send more water downstream.

The second **Key Parameter** of 'maintaining federal authorization and funding' indicated the current project remains the base project, but subject to 'expedient and low-cost options' to meet applicable local and state law.

I commend the Governors for establishing and utilizing the Technical Advisor Group (TAG). TAG was able to quickly analyze Concept Level Engineering Solutions. They, along with their support staff and consultants, should be commended.

Task Force agreed on the 'Design Principles' of setting 100-year flood flow at 33,000 cfs. I felt there was general agreement that Distributed Storage has basin-wide benefits but wouldn't be incorporated into project design.

Task Force assessed six Concept-Level Engineering Solutions studied by TAG. My level of support is as follows:

> I support adding both Western Tie-Back Levee and Eastern Tie-Back Levee. Both solutions were supported by TAG as they reduce upstream impacts and are expedient and low-cost.

I do not support increasing the river stage of water through town to 37 ft. It creates more risk, significantly increases cost to construct and operate, protects fewer properties and negatively impacts life-safety for those within the project limits. This option is neither expedient nor low cost.

I do not support adding Northern Storage. Very minimal benefit (reduction in elevation of up-stream staging area) and TAG was neutral.

I do not support moving the southern embankment further north. Moving a high hazard dam closer to populated areas and adding considerable length to the dam adds risk and cost. It also reduces the geographic area protected and results in impacting more people and structures. This option is neither expedient nor low cost.

At this time, I do not support an increase in downstream water levels because impacts have not been studied and would be felt all the way to the Canadian border. Canada has a history of suing ND on water issues which historically has delayed projects. Mitigation costs in the Grand Forks/East Grand Forks area alone could easily exceed $100 M. This option is neither expedient nor low cost.

The Task Force made progress but did not come to final consensus. A significant benefit to the process was bringing Governor Dayton and Governor Burgum to the table. It was very impressive how both Governors were engaged, dedicating time and effort to the process. With both Governors co-chairing the meetings, they brought a sense of authority and respect that helped the process work. It was very beneficial to have all 16 task force members at the table, allowing us to hear from different perspectives.

Critical Take Away's from Process.

- NED plan is a Minnesota diversion, which Minnesota has refused to allow.
- Minnesota DNR has declined to permit the project, so changes are required for a permit to be issued. We need to understand what changes are required for a permit to be issued.
- Tie-back levees and diversion channel of this magnitude have a significant footprint and forever impact the physical day to day operations of adjacent land owners. The 8,000 acre footprint should be considered in the impact balance between the states.
- Both upstream and downstream impacted property owners are not sure of overall mitigation strategy.

- The Operations plan will have a significant impact on adjacent properties and needs to be developed
- The southern embankment is a high hazard dam that will primarily operate as a dry dam. History has shown there will be a very limited number of days where water will be impounded.
- The primary diversion structure is a mechanical system that will typically operate at sub-freezing temperatures, and will have operational risk.
- Several Concept-Level Engineering solutions had significant cost increases. It was not clear who would pay the increased costs and/or if the funding was available.
- The current project was designed by the Corps of Engineers under a consistent set of national standards with no personal or political bias.
- Credit needs to be given to Diversion Authority for designating funding for future storage projects.

My Recommendations:

1 Leave all major project features intact
2 Add both the Western and Eastern Tie-Back Levee's to the project
3 Continue a strong collaborative process with DNR to achieve permitability
   a. DNR needs to define permit requirements
   b. Keep TAG process engaged
   c. TAG should study additional features such as creating new wetlands, buffer strips, retention sites, etc. that could be incorporated into the project as environmental benefits to the region and to reduce upstream impacts
   d. Corps of Engineers needs to be part of this process as they are essential to maintaining federal authorization and appropriations
   e. Collaborate with downstream entities in a comprehensive study of potential downstream impacts and how to mitigate
4 Diversion Authority consider:
   a. Add up-stream and down-stream representatives to the Authority
   b. Communicate a Comprehensive Mitigation Plan to address mitigation of all negative impacts, upstream and downstream
   c. Create an Operations Committee to establish Operation Plan
5 Governors continue to collaborate with each other, making sure there is a process for all constituencies to be heard
6 Act swiftly as project needs to proceed asap

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Appendices to the Fargo-Moorhead Area Flood Diversion Task Force: Final Report

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Fargo-Moorhead Area Flood Diversion Task Force – Technical Advisory Group

Meeting Minutes

Tuesday, Nov. 14, 2017

Cass County Highway Department, West Fargo ND

GROUP MEMBERS PRESENT

- Kent Lokkesmoe – DNR Manager
- Jill Townley – DNR EIS Manager
- Gregg Theilman – Houston Engineering
- Bob Zimmerman – City of Moorhead Engineer
- Nathan Boerboom – City of Fargo Division Engineering
- Suzanne Jiwani – DNR Floodplain Engineering

INTRODUCTION AND GROUND RULES

- Group members and public present introduced themselves
- Noted that the meeting is a working group and the potential modifications document is meant to be a living document.

REVIEW REVISED PROJECT MODIFICATION DOCUMENT

- Made changes to Design Considerations by adding “the protected area” to “Expand internal storage.” Added new bullets to include “Maintain Federal Authorization” and “Ability to fight floods greater than 100-year.”
- Edited the mitigation section by adding an “s” to permits

FINALIZE KEY CRITERIA

- Group discussed each bullet under Key Criteria and edited to prepare it for use in project evaluation
    - The group added various parameters to each criteria including “Y or N,” or “by state/by county” and “Similar, Better, Worse.”
    - Added “Upstream and downstream impacts for 50, 100 and 500-year flood events to the list of Key Criteria. “Impacts at the U.S./Canadian border (0.04’ at Drayton)” was added.
    - The group also added sub-bullets to Bullet A to include FEMA Accreditation and maintaining federal authorization.
    - Added “cost” to the “engineering feasibility” bullet
    - Added sub bullets to “Meets Laws and Ordinances” to identify states and local requirements.
    - Created sub bullets under Minimize Residual Risk to include “Life and Safety – Evacuation (frequency when evacuation needs to take place),” “Length of levee/dam embankment (feet),” “Height of levee/dam embankment (and depth of water along the face of embankment) (feet),” and “Internal floodplain/drainage (Number of systems needed).” Added additional sub bullet of “Dam Breach No-build zone/hydraulic shadow (acres)”
    - Created sub bullets under “Reduce Floodplain Impacts” to include “New acres added to floodplain,” and “existing floodplain acres protected vs acres flooded –

ND/MN." Further sub bullets were added under each to evaluate by state and county.
  - Created Sub Bullets under "Limit Impacts to structures" by adding "New Structures added to floodplain" and "Existing floodplain structures protected vs. Structures flooded."
  - The group removed the "Limit Impacts to jurisdictions outside of Cass County, ND and Clay County, MN"
  - The group reviewed the Task Force charter to ensure their key criteria are in line with the document.

DISCUSS ALTERNATIVE COMPONENTS

- The group reviewed the tables handed out at the Task Force meeting on Nov. 13.
- Discussion about alternatives listed on the sheet commenced
  - Ms. Jiwani noted that distributed storage should be a part of any alternative. The group discussed this, and the understood direction set by the task force members during the previous days meeting. Types of distributed storage were discussed including dry dams, dropping levels on existing dams prior to flooding to provide additional storage, retention up and down the basin, tiling and internal storage.
  - Additional alternatives including a smaller diversion channel, flowing more water through town, impounding water inside the protection area, diverting the Wild Rice ricer, moving the dam on the Red River north were discussed.
  - Ms. Jiwani noted it would be see what the models show effects from 35 feet, 37 feet, 38 feet and 39 feet of water through town with the current project. Mr. Boerboom noted that 38 feet or 39 feet would require large, potentially costly changes. Mr. Zimmerman noted the technical group should gather all the data and provide all the facts to the Task Force. Mr. Theilman said there may be a point of diminishing returns when running more water through town may not reduce the staging area by much. Ms. Jiwani noted the group should know how many miles of levees would have to be redone with if a levee-only option.
  - Evaluating a levee-only alternative was discussed. Ms. Jiwani said the DNR did evaluate a levee-only option and it was screened out early because it did not meet the stated purpose for the State EIS. Mr. Boerboom agreed the group should include it as data to present to the Task Force. Ms. Townley said they would look at the Corps previous analysis of the option.
  - Discussion about various alignments of a diversion channel and the embankment ensued. Mr. Theilman provided a map with embankment alignments evaluated during the Minnesota EIS process. The group agreed they were focusing on evaluating a 100-year flood event. Moving the alignment north of the Wild Rice was discussed. The group discussed studying a hybrid alignment between "North of Wild Rice River Option" and "MNDNR Northern Alignment."
  - Mr. Boerboom noted there was previous discussion of a no-build zone near the interstate. Mr. Thielman said there are more existing structures near the river as compared to north of Horace. There is a ridge running north of Horace and areas further to the west are less efficient for storage. He noted they would have to study volumes. He also noted there was a previously-studied Storage Area 1 near Horace.
  - Mr. Lokkesmoe asked if storage in the north would be possible. Ms. Jiwani noted she has worked on levees designed to impound water. Mr. Jason Benson noted the area would be fairly shallow due to ground elevation.

- The option of moving the alignment east of the Sheyenne was discussed. Mr. Zimmerman noted that flowing more water through aqueducts could be evaluated. Mr. Theilman said moving the channel alignment in the north may be difficult with concerns like cultural sites and road crossings.
- The group agreed the alternatives that would be evaluated included more flow through town (35 feet, 37 feet, 38 feet and 39 feet), levees only, moving the location of the dam on the Red river (north of the Wild Rice, using the hybrid alignment and adding a Storage Area 1) and northern storage options with the current project and increasing flows in the aqueducts.

SCHEDULE NEXT STEPS

- Mr. Theilman noted dam safety should be discussed with Ms. Jiwani U.S. Army Corps and North Dakota State Water Commission representatives present offered to assist in that discussion.
- The next meeting was set for 11 a.m. to 3 p.m., Tuesday, Nov. 28.

The meeting adjourned at 11:39 a.m.

MEMBERS OF THE PUBLIC PRESENT

- Nathan Berseth, Task Force member
- Tim Fox, Task Force member
- Ken Vein, Task Force member
- Bernie Dardis, Task Force member
- Craig Hertsgaard, Task Force member
- Tami Norgard, Task Force member
- Jason Benson, Cass County and Task Force member
- Ron Bergan, Task Force member
- Randy Gjestvang, ND State Water Commission
- John Paczkowski, Assistant State Engineer - ND State Water Commission
- Aaron Carranza, North Dakota Office of the State Engineer
- Martin Nicholson, CH2M
- Mark Staples, North Dakota Governor's Office
- Tu-Uyen Tran, Fargo Forum
- John T. Shockley, Onstead Twitchell
- April Walker, A. Walker Consulting
- Lisa Gibbens, Rep. Kevin Cramer's office
- Erik Hove, Clay County
- Jeff Ebsch, Cass County
- Terry Williams, U.S. Army Corps of Engineers
- Rocky Schneider, AE2S
- Jessica Lee, Sen. John Hoeven's Office
- Eric Dodds, AE2S
- Greg Thompson, Houston Engineering
- Tammy Jo A. Taft, AE2S

Fargo-Moorhead Area Flood Diversion Task Force – Technical Advisory Group

Meeting Minutes

Tuesday, Nov. 28, 2017

Cass County Highway Department, West Fargo ND

GROUP MEMBERS PRESENT

- Kent Lokkesmoe – DNR Manager
- Jill Townley – DNR EIS Manager
- Gregg Thielman – Houston Engineering
- Bob Zimmerman – City of Moorhead Engineer
- Nathan Boerboom – City of Fargo Division Engineering
- Suzanne Jiwani – DNR Floodplain Engineering

Meeting was called to order by Mr. Kent Lokkesmoe at 11:03 a.m.

The minutes from the November 14, 2017 meeting were reviewed by the group and approved with the inclusion of two edits by Mr. Lokkesmoe.

UPDATE ON ALTERNATIVE/COMPONENT ANALYSIS

The group reviewed a spreadsheet created after the last meeting that included criteria and components. Mr. Lokkesmoe noted the document was in progress and included a lot of data.

- Mr. Thielman noted the components included a western tie back levee that followed an area of higher elevation to the west of the current project's limited service spillway. Mr. Lokkesmoe said during previous discussions, the western tie back levee seemed like a rational adjustment. There was discussion about the height of the tie back, the probable maximum flood (PMF) and inflow design flood (IDF) and elevation in the area. Mr. Thielman noted the IDF and PMF are used during the design of a dam to ensure safety.
- Ms. Jill Townley noted that the components could be used in combination, creating different alternatives. Ms. Suzanne Jiwani said her understanding was to ask the task force if any components stood out that they wanted to include or exclude.
- Mr. Thielman said the bottom of the spreadsheet included a review of downstream stage changes in various locations. He suggested the group review the data in the spreadsheet using an order of magnitude comparison, rather than specifics. He described the various criteria including the numbers outlining impacts with existing conditions. Existing conditions included accredited levees in place but no emergency measures.
- Maps of the various components were distributed for review. Mr. Thielman noted the project boundary was set using a 0.1' depth difference between with-project and existing conditions so there is a consistent boundary for comparison.
- The group was asked if the number of structures included any depth information. Mr. Thielman noted that any structure that would see 0.1' or more of additional flooding was included but no depth information was included in the spreadsheet. There was discussion about the stage impact and depth of water at other locations and FEMA

standards. Ms. Jiwani noted the DNR requires property rights for areas impacted by more than 0.5' of water.

- The group asked for maps to incorporate different colors to call out changes in impacts between different flows amounts through town. A request was also made to fill out the existing conditions information on the spreadsheet. Creating an additional map that shows the impacts from four different flows through town was suggested. Estimated costs for allowing more flows through town were noted by Mr. Bob Zimmerman and Mr. Nathan Boerboom. Moorhead estimated $50 Million, $80 Million and $100 Million in costs for the respective RS37', RS38', and RS39' flows while Fargo estimated $100 Million, $250 Million and $300 Million. The estimated costs of protection were added later to the PowerPoint presentation. Mr. Boerboom noted the map shown at the first task force meeting showed where gaps in protection exist in the city.
- Ms. Jiwani noted she would be interested in reviewing the analysis by the U.S. Army Corps of Engineers about freeboard, risk and uncertainty. Mr. Zimmerman noted working with FEMA regarding the differences between natural ground and disturbed ground has been a bit of a struggle.
- There was discussion about the flow allowed to pass through aqueduct features as part of the previous plan and components that were identified during the last meeting. Modeling studied passing roughly twice the amount of flow through the Sheyenne and Maple River Aqueducts. In the Maple River below the aqueduct this would require cutting through a ridge to allow water to expand into the floodplain, according to Mr. Thielman. Doubling the flow on the Maple River Aqueduct would allow it to pass 5,000 cfs and the cost would rise to $140 Million. Making the Sheyenne Aqueduct feature larger would go up to an estimated $210 Million.

REVIEW OF DRAFT TASK FORCE PRESENTATION

- The group reviewed the slides that will be presented at the next Task Force meeting. They agreed to take out as many acronyms as possible to make it easier to understand.
- There was discussion about distributive storage. Mr. Lokkesmoe noted that distributive storage can add to the factor of safety, but would not be something that could achieve a base level of required protection.
- A graph was included that showed the number of days the Fargo gauge was higher than a certain stage. Mr. Lokkesmoe asked if the graph had a correlation to the number of days a staging area would be operated, for example, if you use a 37-foot through town stage in Fargo, during the last 116 years the staging area would have operated 28 days. Mr. Thielman said there should be a close correlation between the two.
- There was discussion about constraints and mitigation requirements from downstream impacts from the project. Mr. Lokkesmoe questioned the constraint of a stage levels at Drayton. He questioned what level of impact at the Canadian border was acceptable.
- The group noted that there are numerous combinations of components that could be evaluated. Mr. Zimmerman said some options show a clear point of diminishing returns, but it is for the Task Force to decide what an acceptable level is. Ms. Townley asked if there were any items in the PowerPoint tables that were not critical. The group removed some data, but retained much of the information in the tables for the Task Force members to review.
- There was discussion about the levees only component and the various river stages associated with it. It was noted this component could likely get accreditation from FEMA. The logistics of this option were discussed. Ms. Jiwani noted that to build levees at the right locations, more structures in town would need to be purchased and Corps authorization would go away.

- Mr. Thielman noted that they did not run a levees only component with an optimized channel, but it could be done. Ms. Townley suggested task force members could bring various options like this up at their next meeting.
- The group noted the presentation about downstream impacts is more of an operations component.
- The group was asked who would pay for ring levees. Mr. Lokkesmoe said the previous work had been paid for by each community and Fargo and Moorhead have worked together to match elevations. This has avoided a dike war.
- Ms. Jiwani noted that presenters should be able to discuss the component and what is gained, or what issues exist with each. The group discussed the order of the presentation and who would present each slide and what handouts would be given to the task force. Handouts would include a set of the maps discussed at the meeting and a printed version of the PowerPoint slides.
- The group was asked about incorporating development or zoning restrictions as a component. There was also a question about how many combinations of components they could realistically evaluate. The group concluded three was a realistic target. It was also noted that the DNR and the North Dakota State Water Commission should help provide “guiderails” to ensure the combinations being studied would be permittable.

SCHEDULE NEXT STESP AND MEETING

- Mr. Lokkesmoe noted that the next meeting would have to be determined after the Task Force meeting on Nov. 29.

The meeting adjourned at 2:56 p.m.

MEMBERS OF THE PUBLIC PRESENT

- Nathan Berseth, Task Force member
- Tim Fox, Task Force member
- Ken Vein, Task Force member
- Bernie Dardis, Task Force member
- Craig Hertsgaard, Task Force member
- Tami Norgard, Task Force member
- Mark Anderson, Task Force member
- Jason Benson, Cass County Engineer and Task Force member
- Randy Gjestvang, ND State Water Commission
- John Paczkowski, Assistant State Engineer - ND State Water Commission
- Aaron Carranza, North Dakota Office of the State Engineer
- Levi Bachmeier, North Dakota Governor’s Office
- Anna Henderson, Minnesota Governor’s Office
- John T. Shockley, Ohnstad Twitchell
- April Walker, A. Walker Consulting
- Jeff Ebsch, Cass County
- Terry Williams, U.S. Army Corps of Engineers
- Dave Overbo, Clay County
- Cash Aaland, Aaland Law Firm
- Trana Rogne, Richland County landowner
- Sen. Larry Luick, ND Legislature
- Michael Redlinger, Assistant City Administrator - Fargo

- Lyndon Pease, Moore Engineering, Inc
- Rocky Schneider, AE2S
- Eric Dodds, AE2S
- Greg Thompson, Houston Engineering, Inc.
- Tammy Jo A. Taft, AE2S

Fargo- Moorhead Diversion Project 11-14-2017

Potential Project Modifications for F-M Task Force

This is a consensus document created by the Technical Advisory Group: Bob Zimmerman-Moorhead Engineer, Nathan Boerboom-Fargo Engineer, Gregg Thielman-Diversion Authority Engineer; Kent Lokkesmoe-DNR Manager; Suzanne Jiwani—Floodplain Engineer; Jill Townley—EIS Manager

Design Considerations

a. Allow greater downstream flood impacts.
b. Stage increase at Canadian border.
c. Expand internal storage in the protected area.
d. Move the Overflow Embankment further west.
e. Move alignment of the dam further north.
f. Finish appropriate in-town works.
g. Current and future FEMA accreditations
h. Running more water through town (from 35 feet; up to 37 feet or up to 39 feet).
i. Maintain Federal Authorization
j. Ability to fight floods greater than 100-year
k. Wild Rice –only (diversion) + max height levees

Safety

a. Limit risk of a high hazard dam.
b. Magnitude of residual risk as it relates to life and safety

Operation

a. Limit frequency of operation of the staging area
b. Limit number of control structures or closure structures requiring human intervention for flood risk reduction

Land Use Plans and Regulations

a. Meet local ordinances and plans.
b. Other development restrictions (e.g., the area below the dam and between the confluence of the Wild Rice River and Red River; areas requiring significant fill).
c. Limit stage increase at Clay-Cass/Wilkin-Richland County borders.
d. Create a restricted development zone downstream of the dam based on safety concerns (depth x velocity)

Mitigation

a. To be determined

b. Note that acquisition or easements needed to develop the project including the staging area are conditions of the permits.

Key Criteria (in no particular order)

a. Satisfy Task Force Charter
    i. FEMA Accreditation (Y or N).
    ii. Maintain Federal Authorization (Y or N)
b. Meets laws and ordinances
    i. ND Statute and Rules (Y or N)
    ii. MN Statute and Rules (Y or N)
    iii. Local Ordinances (Y or N)
c. Minimize Residual Risk (e.g., Level of Protection (floods greater than the 100-yr flood do occur);
    i. Life and Safety – Evacuation (Frequency when evacuation needs to take place);
    ii. Length of levee/dam embankment (feet);
    iii. Height of levee/dam embankment (and depth of water along the face of embankment) (feet);
    iv. Internal floodplain/drainage (Number of systems needed).
    v. Dam Breach No-build zone/Hydraulic Shadow (acres)
d. Reduce Floodplain Impacts
    i. New Acres Added to floodplain
        1. State (Acres by state)
        2. County (Acres by county)
    ii. Existing Floodplain Acres Protected vs. Acres Flooded
        1. State (Acres by state)
        2. County (Acres by county)
e. Reduce Environmental Effects (Similar, Better, Worse)
f. Limit impacts to Structures (e.g., Residential, Commercial, other)
    i. New Structure Added to floodplain
        1. State (Structures by state)
        2. County (Structures by county)
    ii. Existing Floodplain Structures Protected vs. Structure Flooded
        1. State (Structures by state)
        2. County (Structures by county)
g. Resilience/Robustness of Design
    i. Maintain FEMA Accreditation if Future Hydrology Changes (Similar, Better, Worse)
    ii. Capability to fight floods larger than the 100-year (Similar, Better, Worse)
h. Cost and Engineering Feasibility (Similar, Better, Worse)
i. Upstream and downstream impacts for 50-, 100-, and 500-year flood events (feet at key locations, county borders, and cities).
j. Impacts at the U.S./Canadian border (0.04’ at Drayton).

FM Diversion Task Force Technical Advisory Group Alternative Descriptions for Future Assessment (This is a working document that will change based on input from the Task Force) November 14, 2017	
Alternative ID and Short Name	**Alternative Description (all include DSA + Move Western Tieback)**
1. Flow Through Town; (a) RS35 (b) RS37 (c) RS38 (d) RS39	Current Proposed Project with more flows through town.
2. Levees only	Levees only option.
3. Change Location of Dam; (a) North of Wild Rice River (b) MNDNR Northern Alignment /VE-13C hybrid (c) Current Project + Hybrid Storage Area 1	Change dam location/alignment options; RS35 *Acronyms correspond to alignments in the map titled: PFSAA_Alternatives_Map
4. Northern Storage Option (a) Current Project + Sheyenne/Maple aqueduct flow increase	Northern storage option; RS35

*RS=River Stage

*DSA=Distributed Storage Alternative

This is a list that will be a starting point.

Individual Components that have some merit (discussed on November 14 with input from present Task Force members and public)

- DSA: yes, applies to all as a long-term water management strategy
- Western Tie-back/Limited Service Spillway: yes, apply to all
- Internal Storage (north and south)
- More flows through town
- Change location of dam
- Balance upstream and downstream impacts

For future discussion: Wild Rice –only (diversion) + max height levees

Component Analysis

Presentation by:
Technical Advisory Group

Presentation to:
Fargo-Moorhead Area Flood Diversion Task Force

November 29, 2017

Technical Advisory Group (TAG)

- Held two public meetings on Nov. 14 & Nov. 28
  - Meetings were well attended by Task Force members
- Defined criteria to evaluate alternatives and components
- Screened alternatives and components for further evaluation
- All information shown is for the 1-percent annual chance (100-year flood event)

TAG Key Criteria (not in particular order)

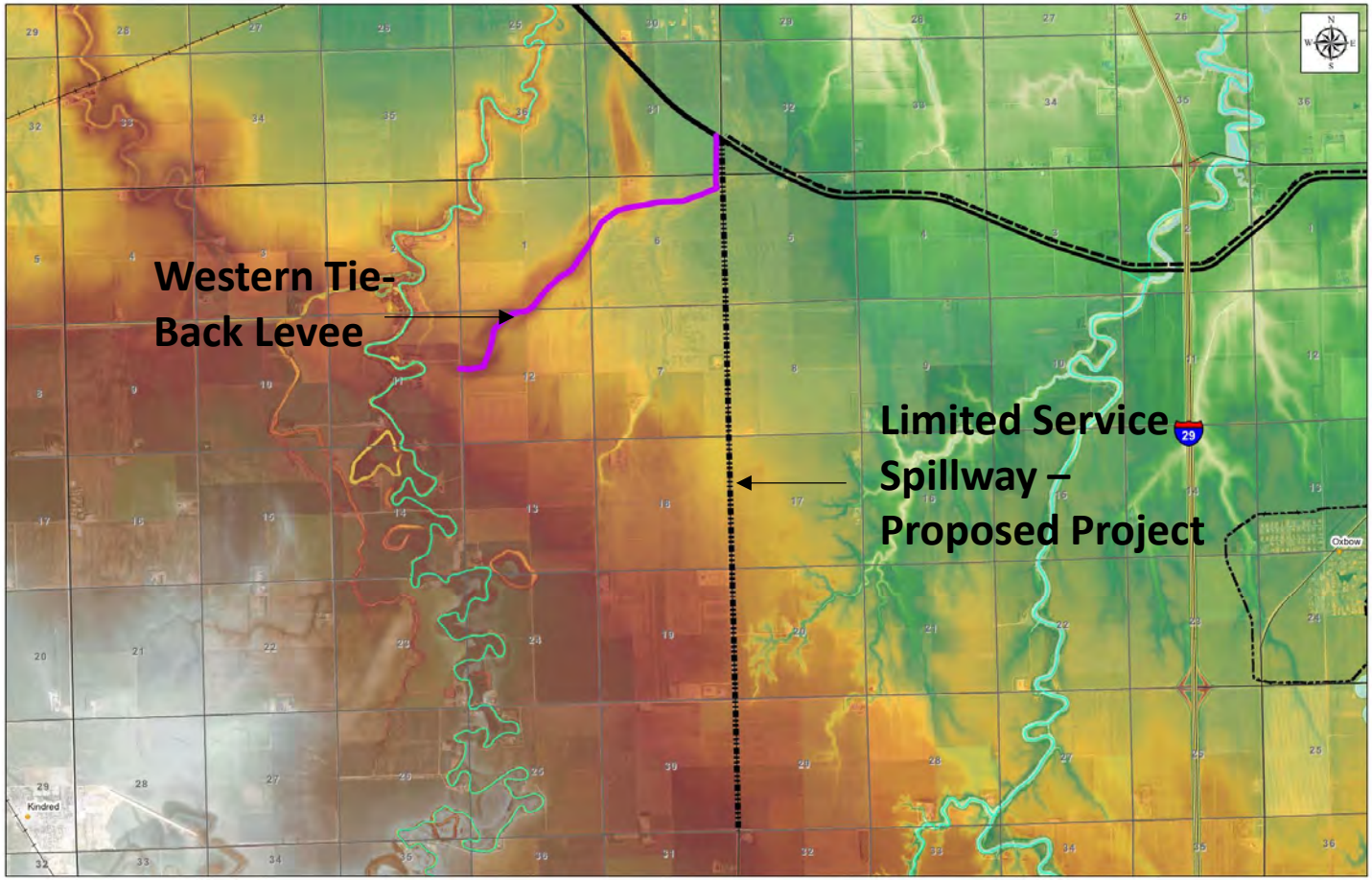
A. Satisfy Task Force Charter
B. Meet Laws and Ordinances
C. Minimize Residual Risk
D. Reduce Floodplain Impacts
E. Reduce Environmental Effects
F. Limit Impacts to Structures
G. Resilience/Robustness of Design
H. Cost and Engineering Feasibility
I. Upstream and Downstream Impacts
J. Impacts at the U.S./Canadian Border

Components

1. Additional Flows Through Town
   a) RS 35 feet
   b) RS 37 feet
   c) RS 38 feet
   d) RS 39 feet
2. Levees Only
3. Change Location of Dam
   a) North of Wild Rice River (NWRR)
   b) Northern Alignment Alternative
   c) Modified Storage Area 1
4. Northern Storage Option
5. Increased Downstream Impacts (6 inches)
6. Wild Rice River Only Diversion

Western Tie Back Levee as a Component

- Included as part of Alternatives 1, 3, 4, and 5
- Alternatives 2 and 6 do not include a WTBL



Consideration of Distributed Storage

- Basin-wide retention efforts can increase the overall level of flood protection for communities
- Distributed storage can be a component for 100-year protection for Fargo-Moorhead only if projects are completed and operational
- Support for retention should continue as a long-term strategy to increase protection above the 100-year

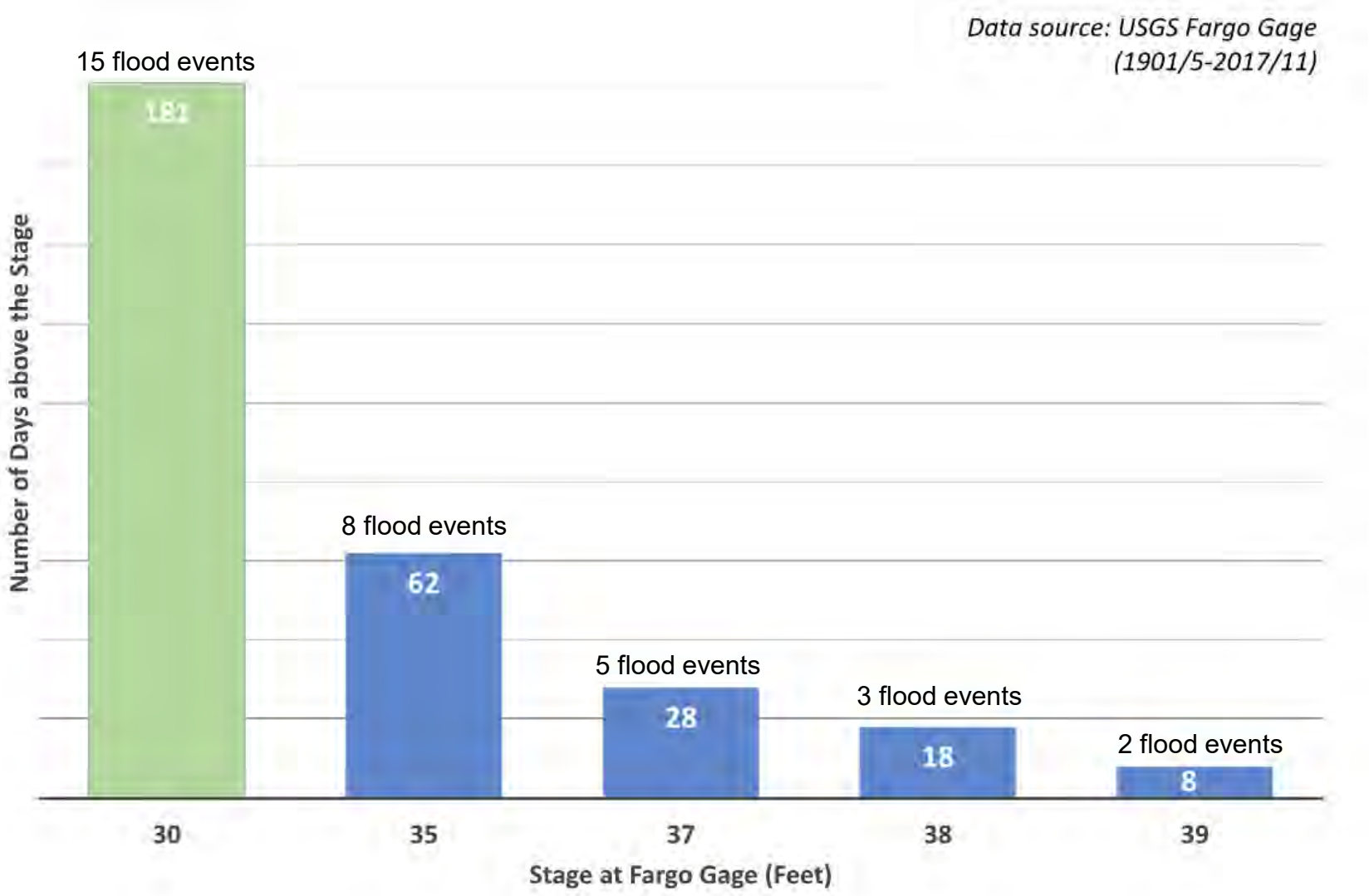
Components

1. Additional Flows Through Town
   a) RS 35 feet
   b) RS 37 feet
   c) RS 38 feet
   d) RS 39 feet
2. Levees Only
3. Change Location of Dam
   a) North of Wild Rice River (NWRR)
   b) Northern Alignment Alternative
   c) Modified Storage Area 1
4. Northern Storage Option
5. Increased Downstream Impacts (6 inches)
6. Wild Rice River Only Diversion

Components #1a-1d: Additional Flows Through Town

- Additional flows through town reduces the frequency of staging area operation and size of the inundation area
- Additional flows through town requires additional In Town measures be implemented
- Original project (2011) had River Stage (RS) 30' through town in a 100-year flood
- Proposed project design (2013) has RS 35' through town in a 100-year flood
- Additional analysis considered up to RS 39'

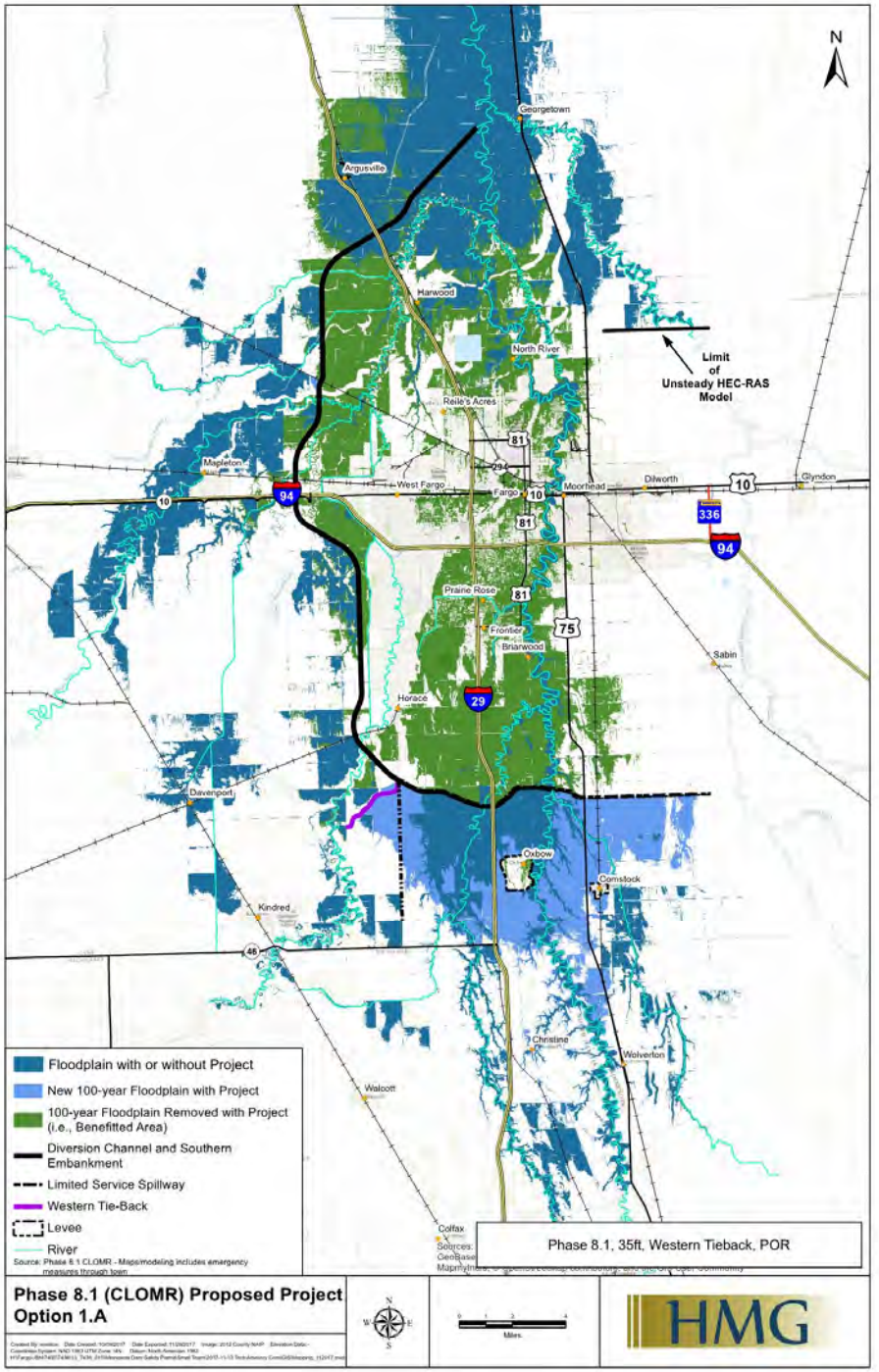
Components #1a-1d: Additional Flows Through Town Histogram and Frequency Curve



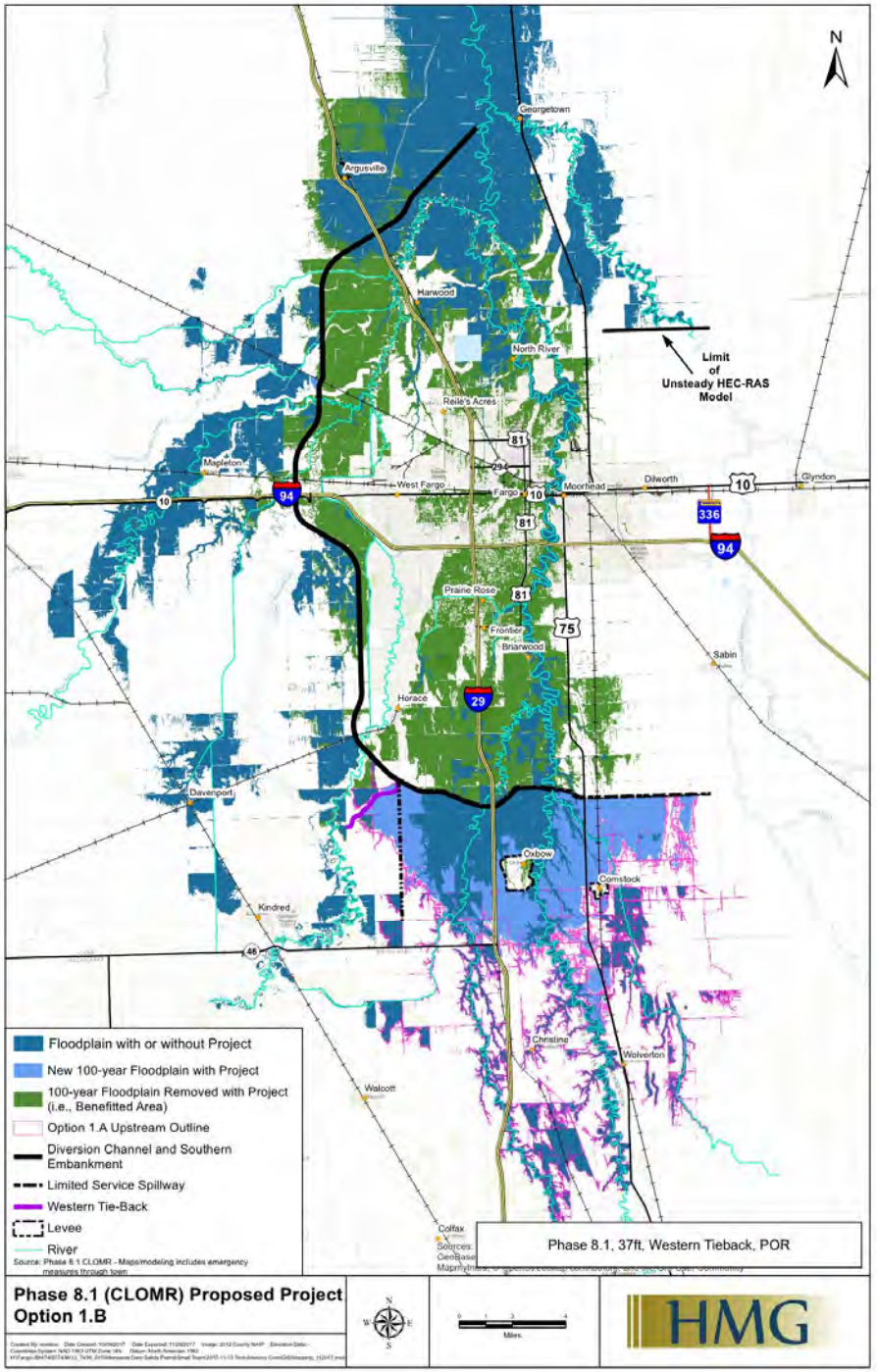
Component #1a-1d: Additional Flows Through Town

	Proposed 35' (baseline)	35' w/WTBL (1a)	36'	37' (1b)	38' (1c)	39' (1d)
Return Frequency /Discharge (cfs)	13 year / 16,400 cfs	13 year / 16,400 cfs	N/A	21 year / 20,200 cfs	28 year / 22,200 cfs	39 year / 24,500 cfs
Staging Area Elevation at Dam	921.66	921.54	N/A	920.87	920.64	920.51
Total Upstream Impacted Area (acres)	35,456	36,364	N/A	33,208	32,136	31,519
Newly Impacted Upstream Area (acres)	18,720	19,463	N/A	16,875	16,015	15,493
Residential/Total Structures Impacted Upstream	69 / 636	70 / 638	N/A	65 / 578	60 / 548	59 / 533
Residential/Total Unprotected Structures within FDRA	29 / 155	29 / 55	N/A	101 / 374	156 / 534	257 / 763
Residual Floodplain Through the Protected Area (acres)	21,051	21,068	N/A	26,736	31,209	35,239
Cost (Construction and Acquisitions – FM Only)	Ongoing	Ongoing	N/A	$150M/130 Homes	$330M/208 Homes	$400M/326 Homes

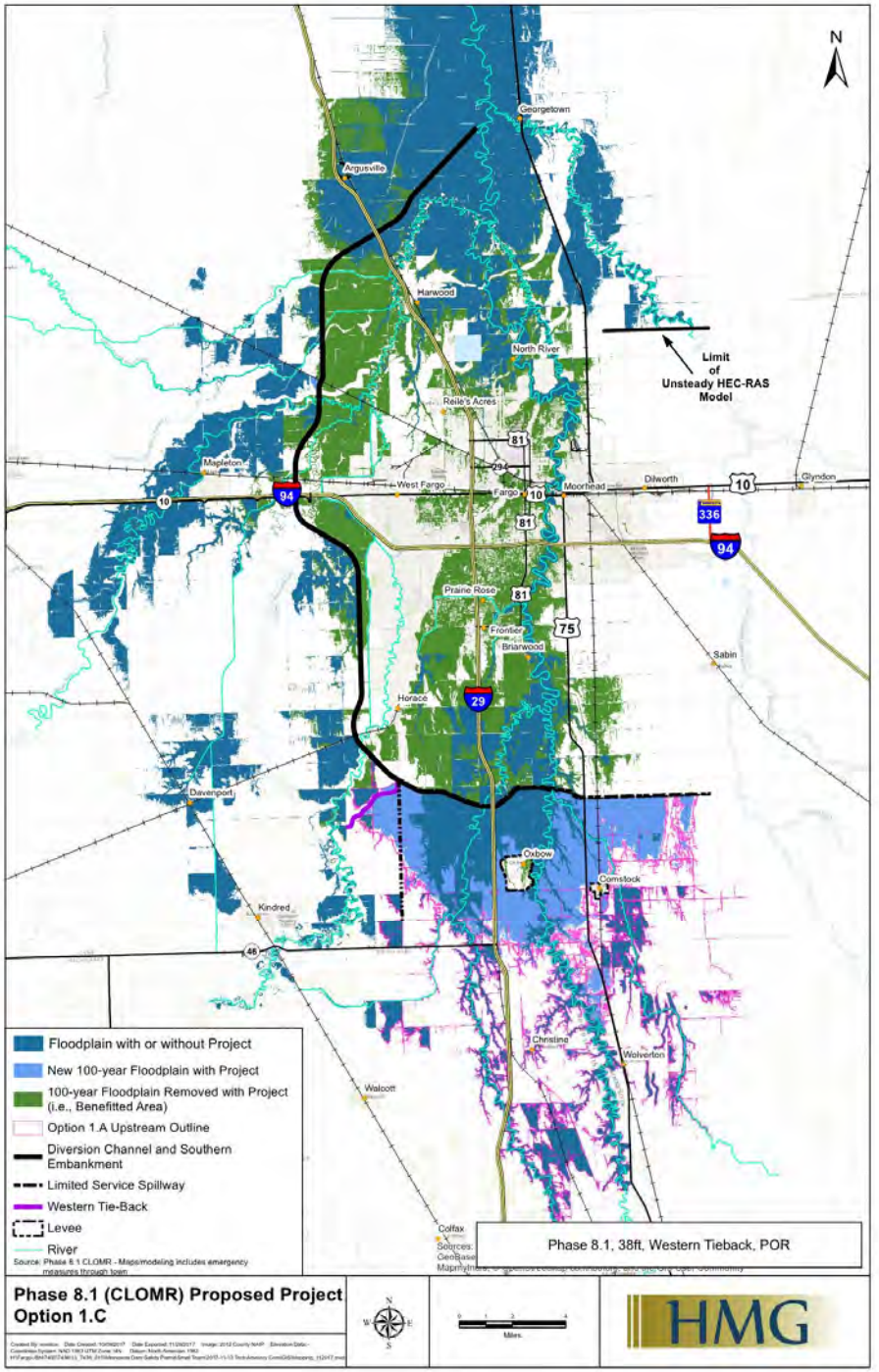
Component #1a (RS 35')



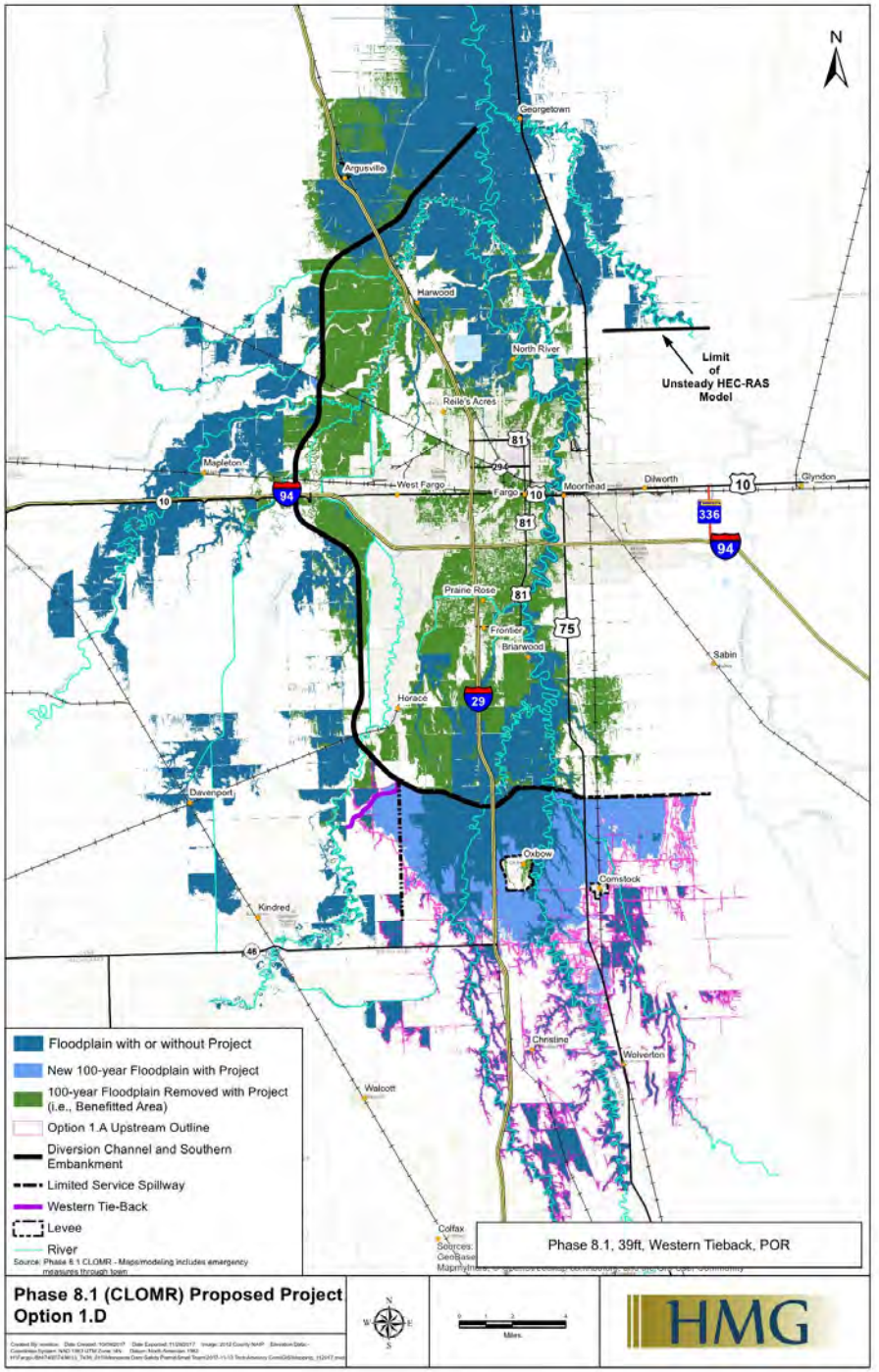
Component #1b (RS 37')



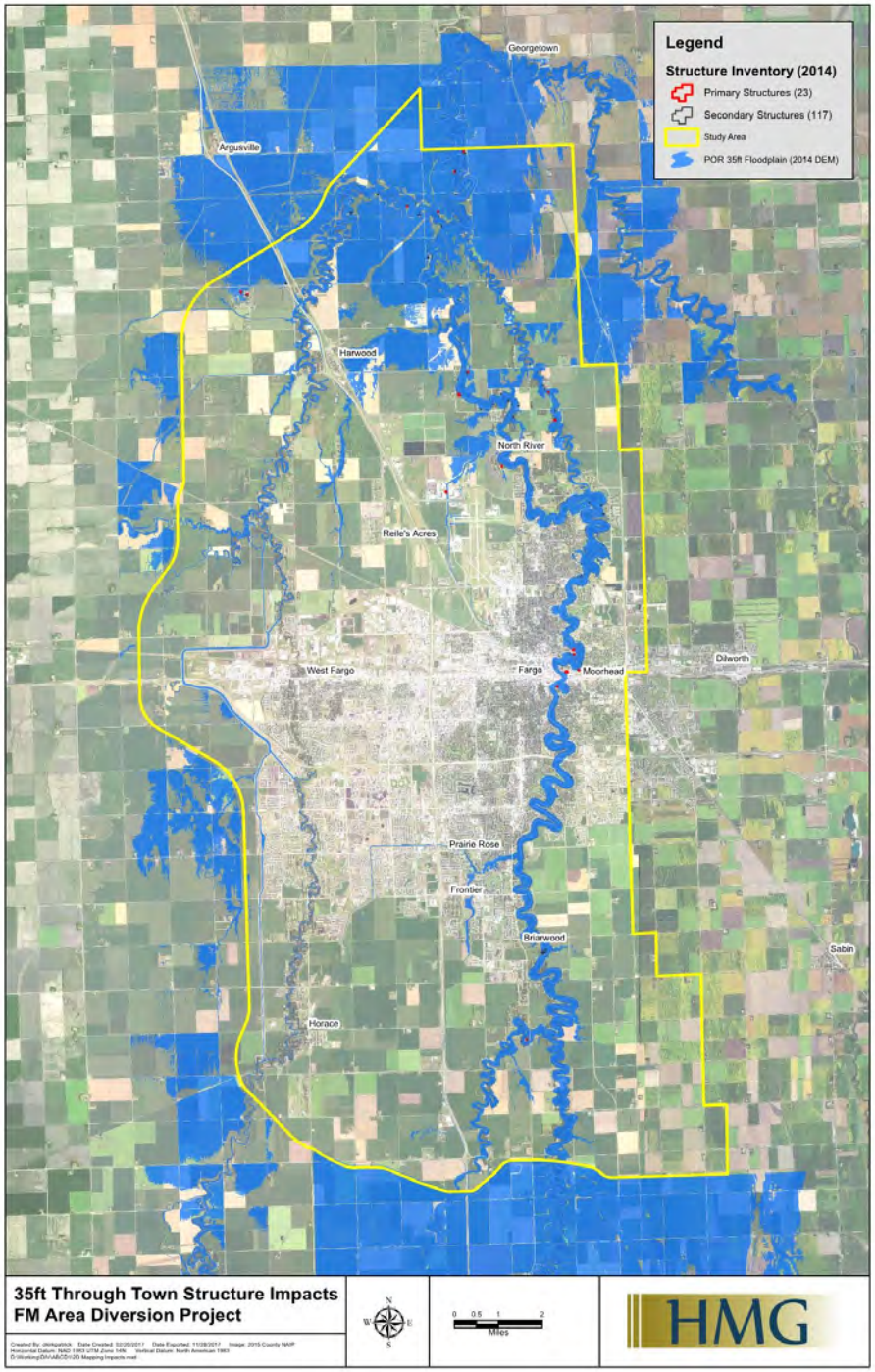
Component #1c (RS 38')



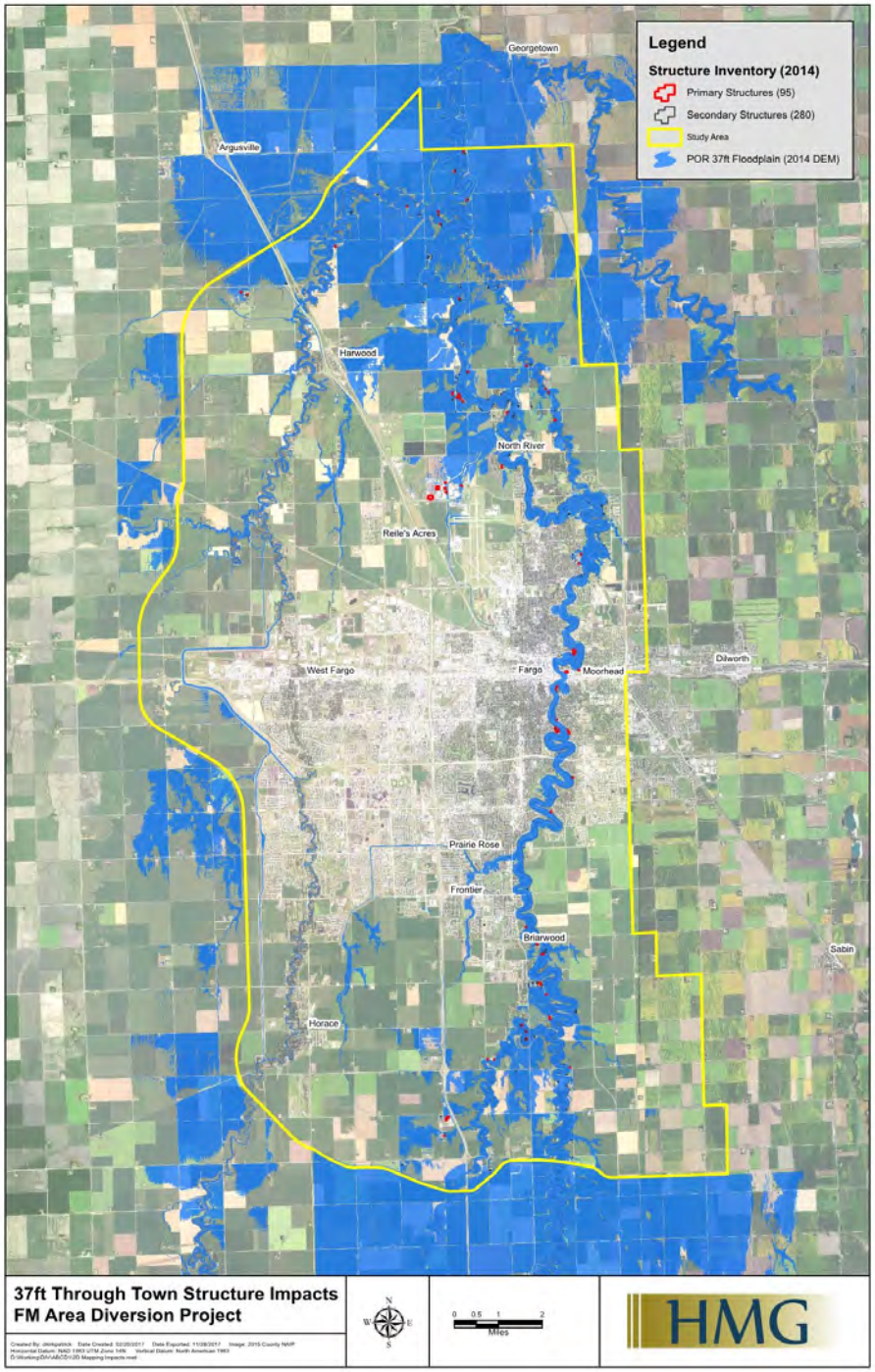
Component #1d (RS 39')



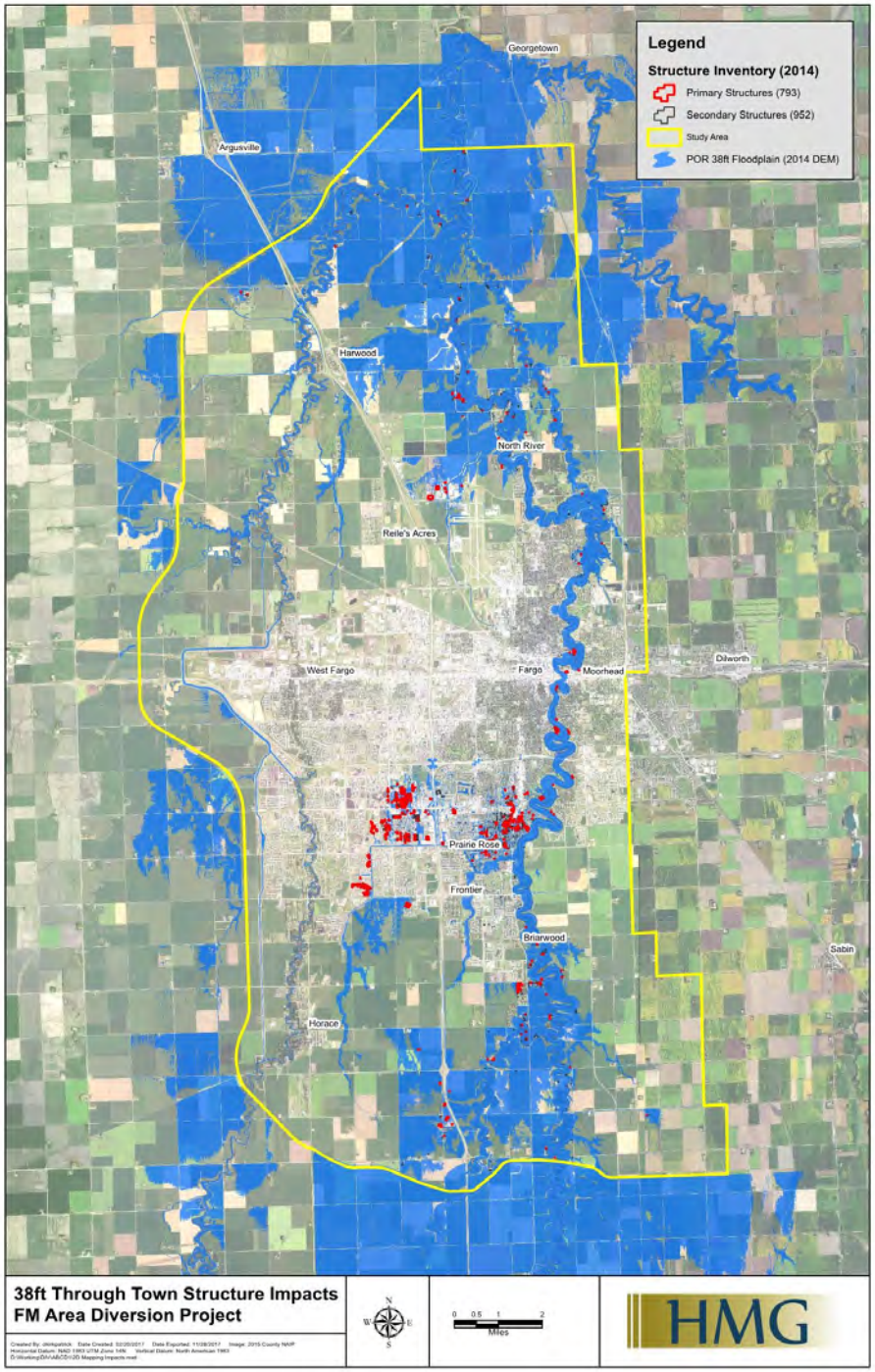
Component #1a (RS 35')



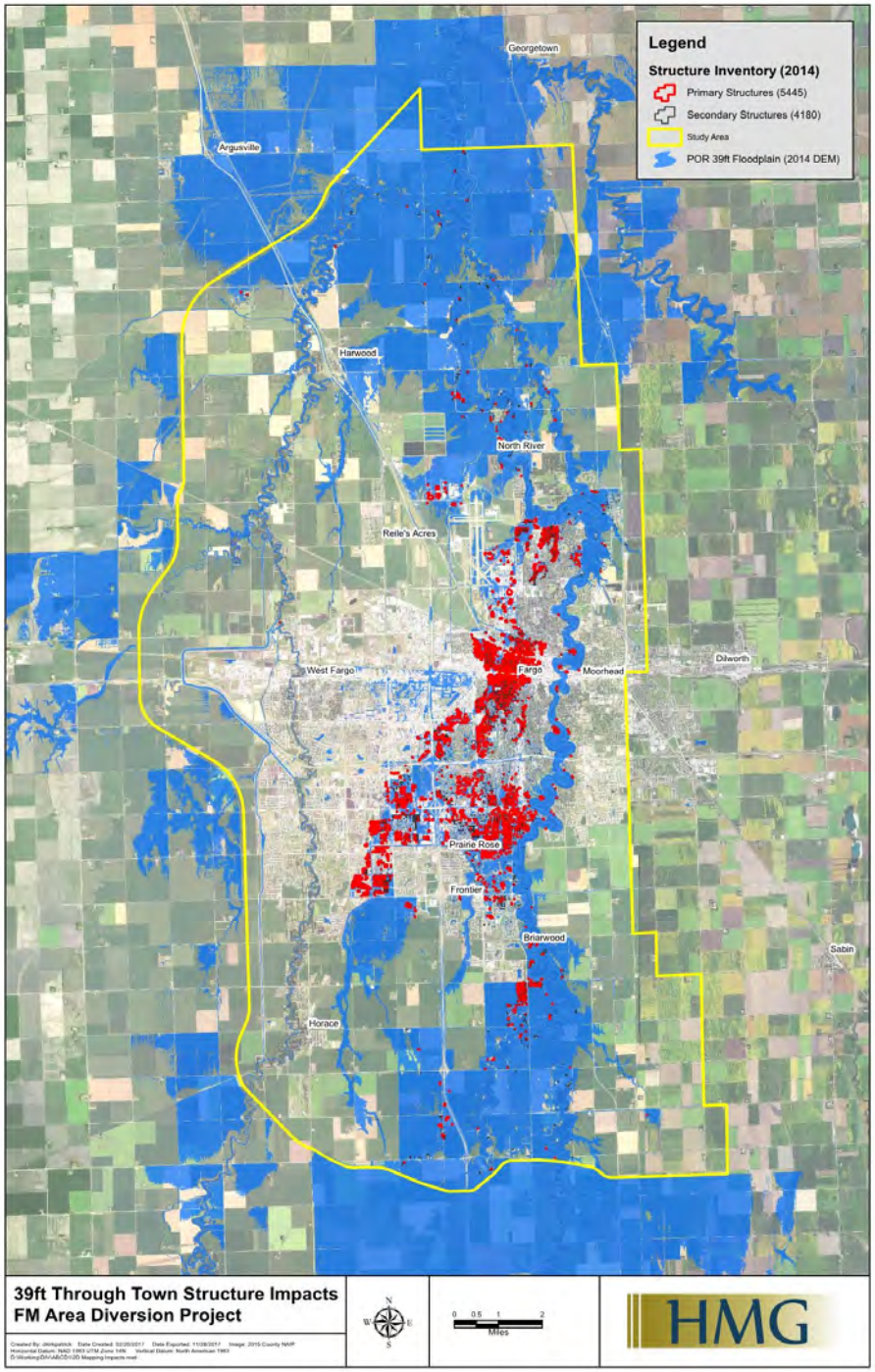
Component #1b (RS 37')



Component #1c (RS 38')



Component #1d (RS 39')



Component #2: Levees Only

- Based on a preliminary analysis, a ring levee could achieve 100-year accredited (FEMA) protection
- Would utilize existing Horace to West Fargo and West Fargo Diversion projects on the west side
- Limited capacity through the Red River induces higher water levels upstream that requires mitigation and property rights
- Causes an induced upstream stage of 1.5 (on Red River) to 4 feet (near Horace) during the 100-year flood and 5.5 to 6.5 feet during the 500-year flood
- Levee/floodwall system would overtop at some point between the 100-year and 500-year flood

Component #2: Levees Only

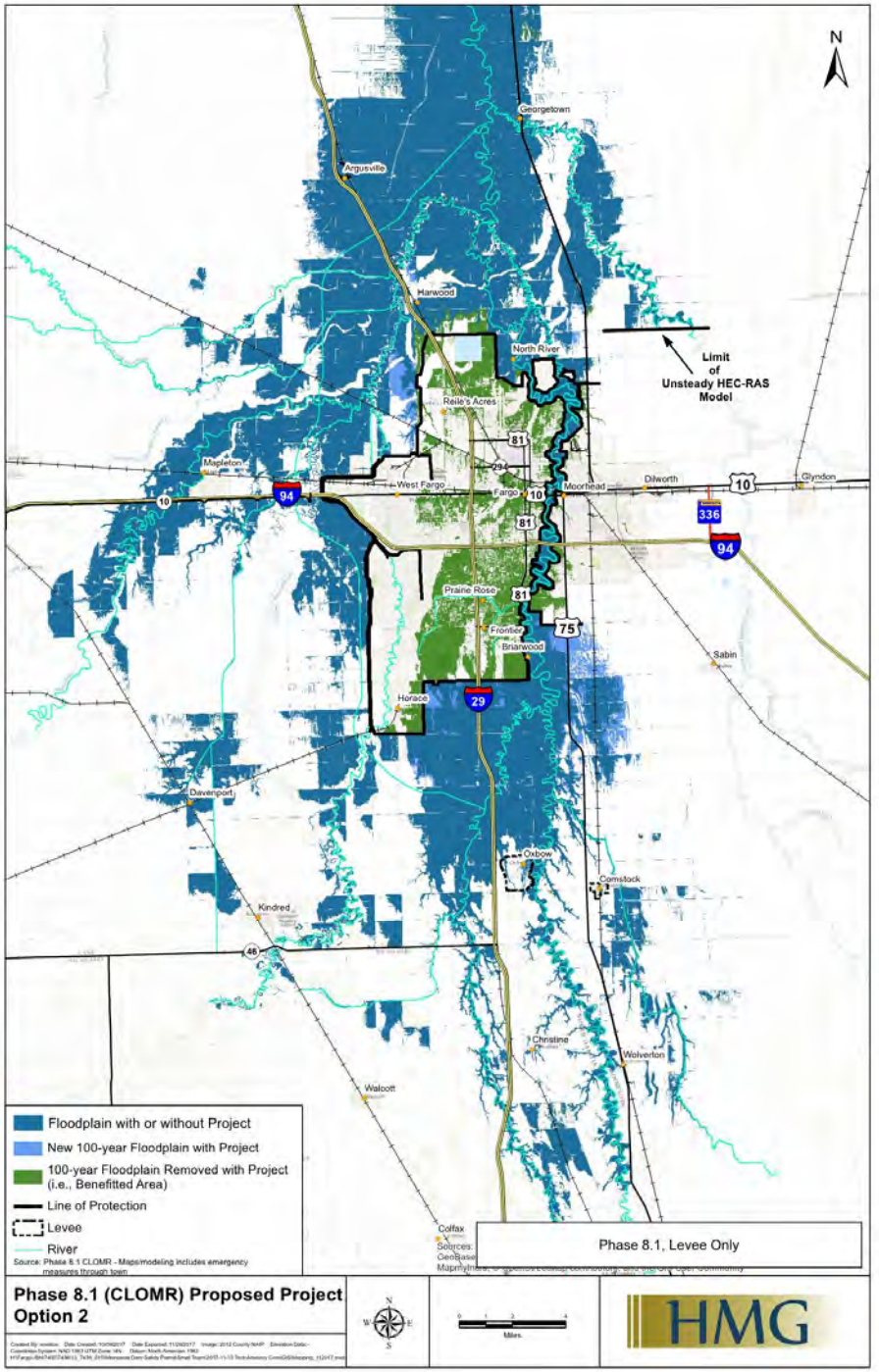
- 66.5 miles of levee/floodwall required (ND = 44 miles; MN = 22.5 miles)
- 64 Stormwater Lift Stations required (ND=38; MN=26)
- Grade raise required for I-29 and potential grade raises for U.S. Highway 75 and BNSF Railway through area with induced stage
- Grade Raises required through F-M for I-94, Main Avenue, and BNSF
- Grade Raise required for I-29 North of FM for levee crossing
- Existing WF and HWF Diversions may need to be modified or may offer a lesser level of protection

Component #2: Levees Only

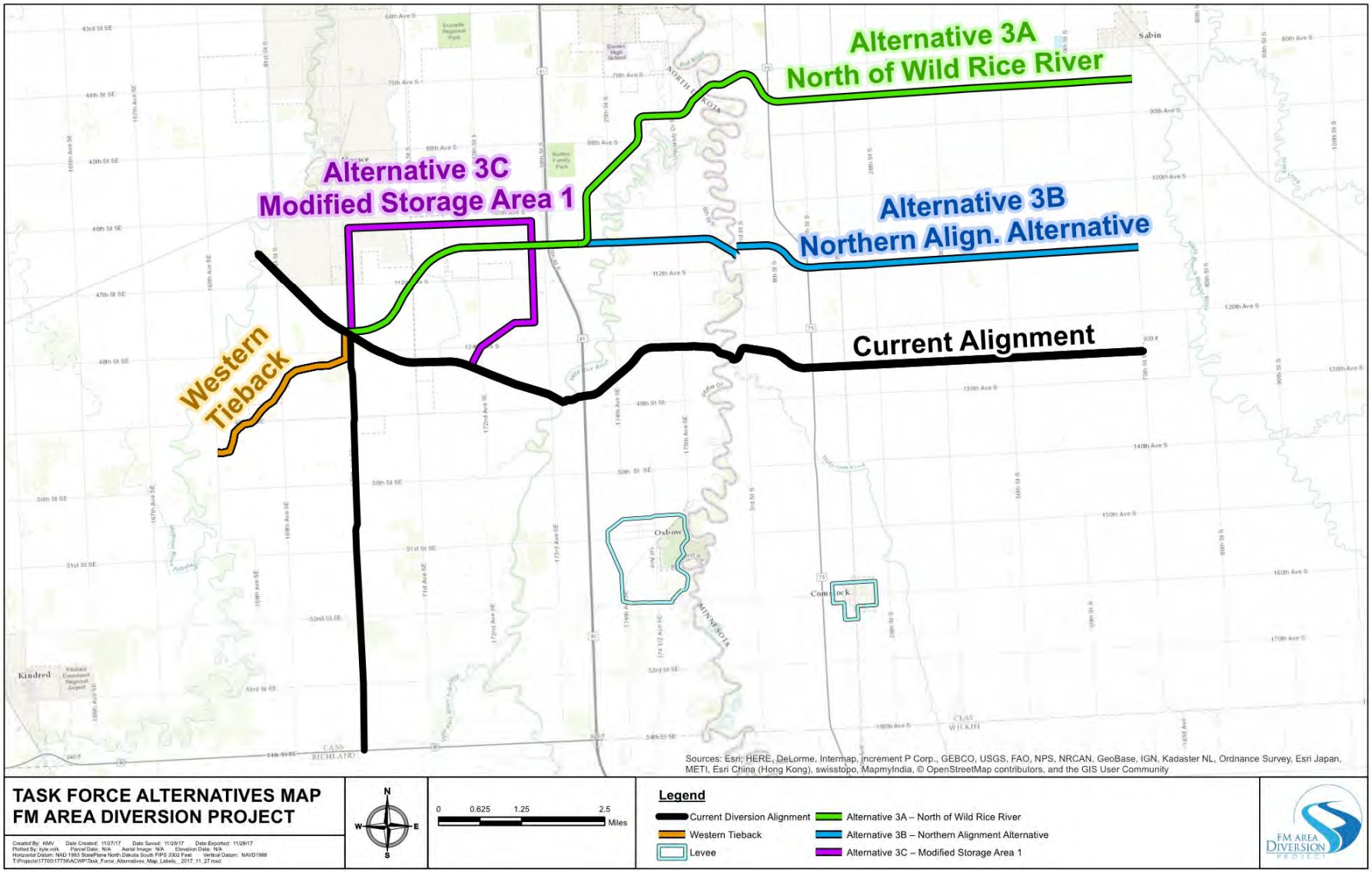
	Proposed 35' (baseline)	Levee Only Alternative (2)
Protected Area Floodplain Removed(acres)	58,137	16,197
Total Upstream Impacted Area (acres)	35,456	22,348
Newly Impacted Upstream Area (acres)	18,720	3,776
Residential/Total Structures Impacted Upstream	69 / 636	259 / 796
Unprotected Structures (Residential/Total) within the FDRA for Proposed Project	23/140	1,071 / 2,686
Residential and Commercial Structure Acquisitions for Construction (ND/MN)	14/3	831 / 673
Cost	$2.2 Billion	*$1.1 Billion (ND) / $800 Million (MN)

$1.9 Billion total excluding upstream mitigation/property rights that may be required.

Component #2 – Levees Only



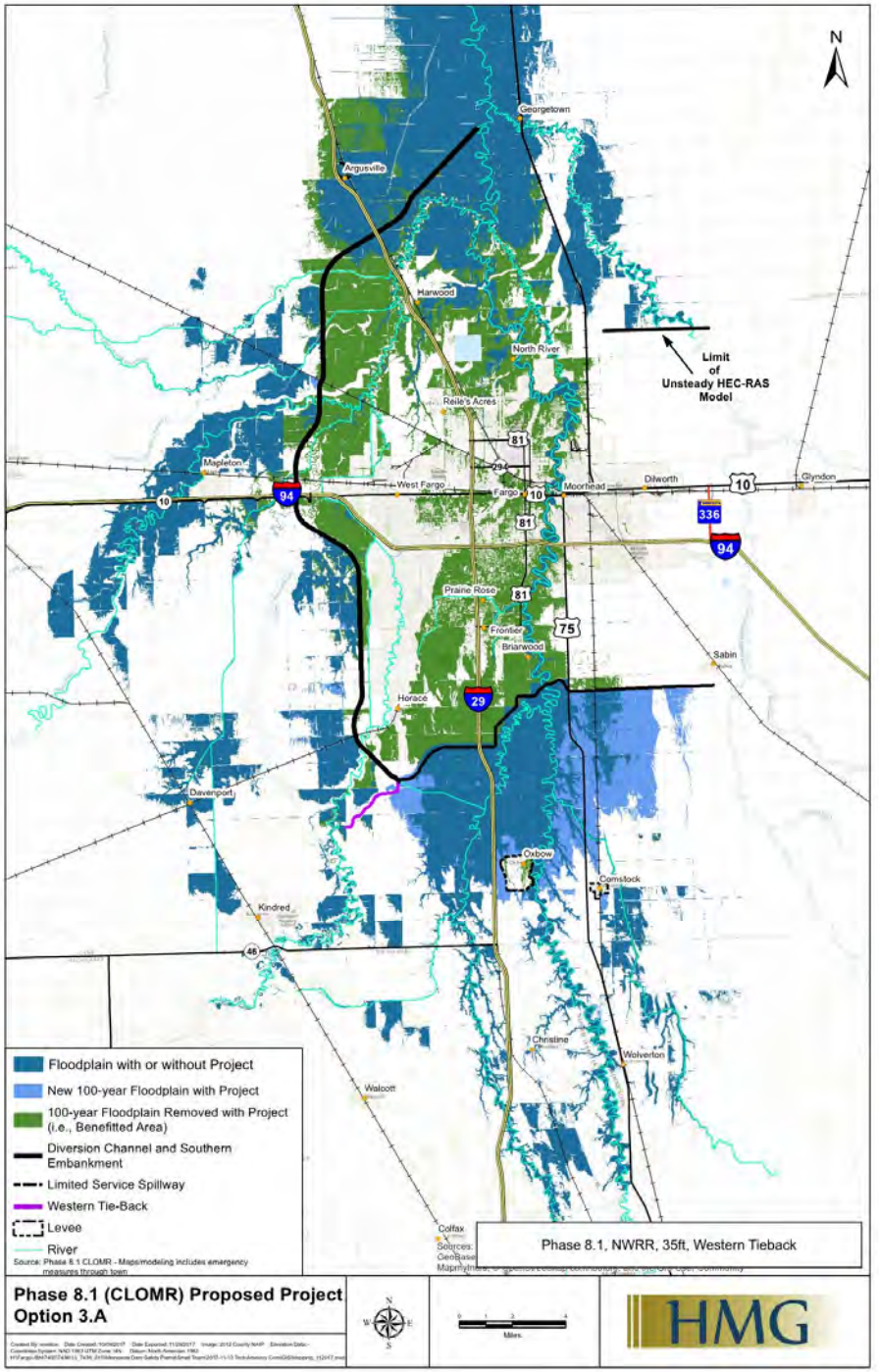
Components #3a-3c: Dam Alignments (RS 35')



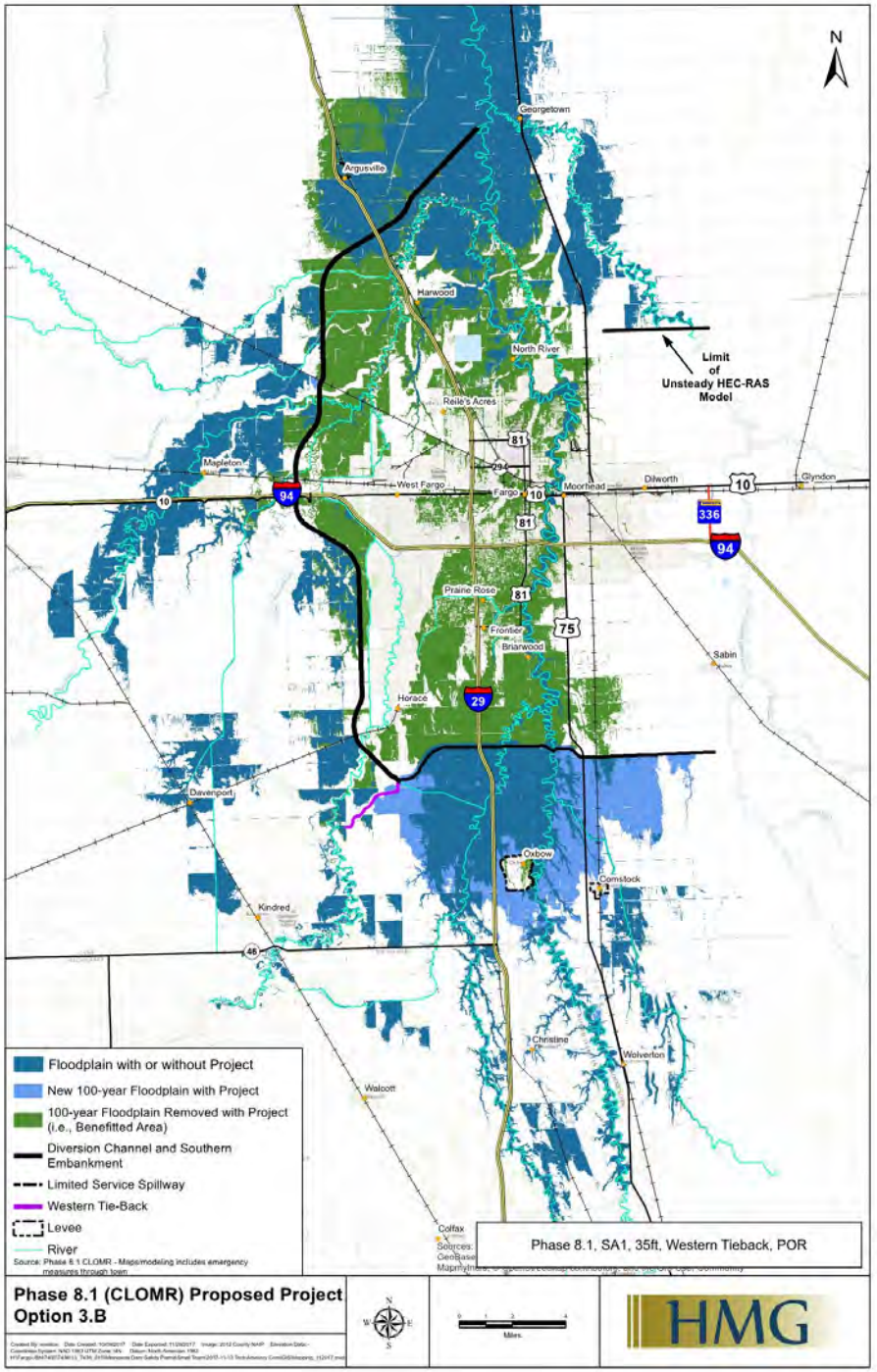
Component #3a-3c: Dam Alignments (RS 35')

	Proposed (baseline)	Proposed WTBL	3a (NWRR)	3b (NAA)	3c (SA1)
Newly Impacted Upstream Area –ND/MN (acres)	7,088 / 11,631	8,194 / 11,270	2,336 / 10,410	4,860 / 9,429	6,956 / 9,001
Newly Impacted Upstream Area –Richland/Wilkin (acres)	1,124 / 1,391	1,053 / 1,283	74 / 29	270 / 118	613 / 640
Area Protected (acres)	58,137	58,119	48,359	52,031	54,972
Residential Structures Impacted - Richland	3	3	0	1	2
Residential Structures Impacted - Wilkin	5	5	0	2	2
Residential Structures Impacted - Cass	41	42	151	90	49
Residential Structures Impacted - Clay	20	20	45	24	17

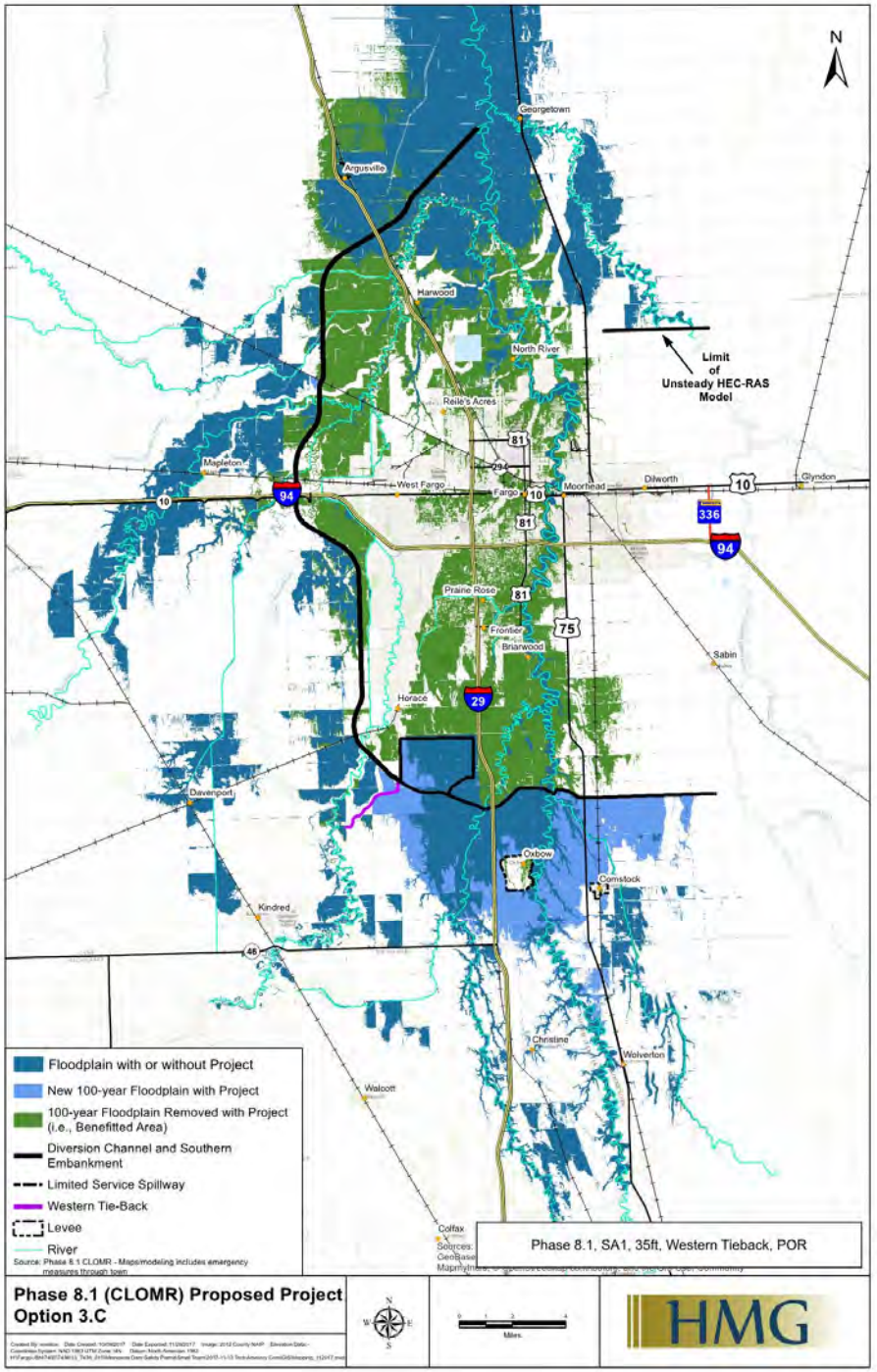
Component #3a – North of Wild Rice River (NWRR)



Component #3b – Northern Alignment Alternative

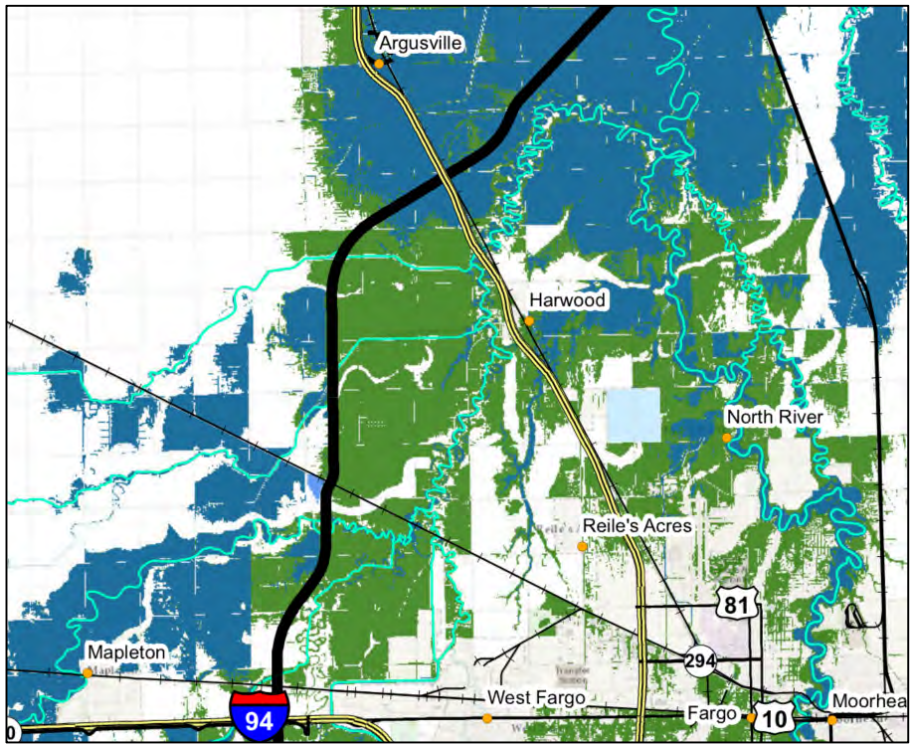


Component #3c – Modified Storage Area 1

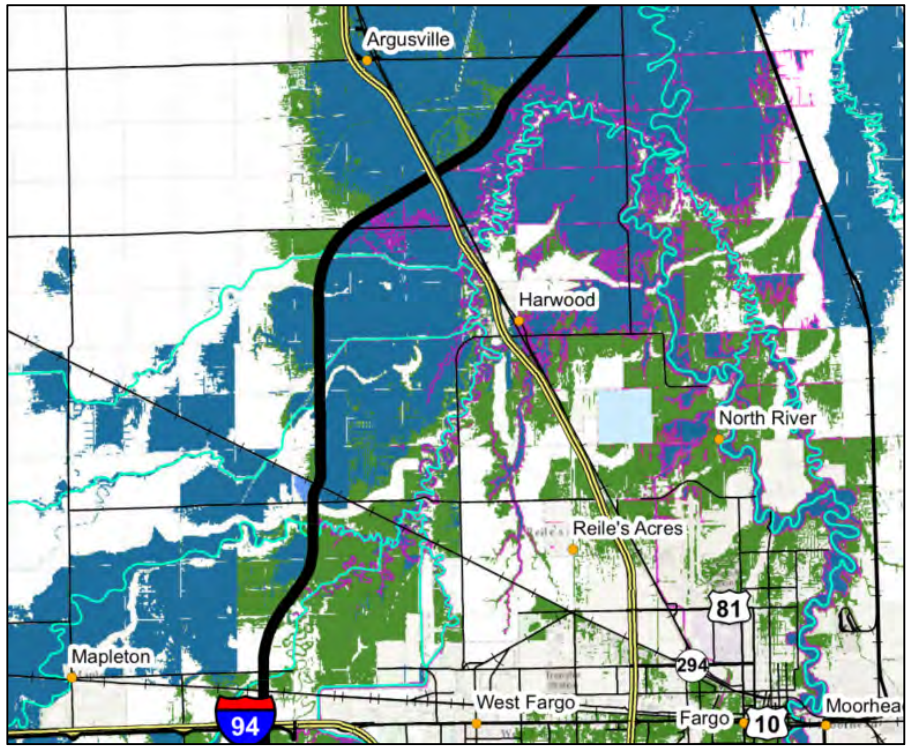


Component #4: Northern Storage Option

- Evaluated passing additional water through the Maple and Sheyenne River Aqueduct to provide storage and retain existing floodplain in the NW area



Component 1a

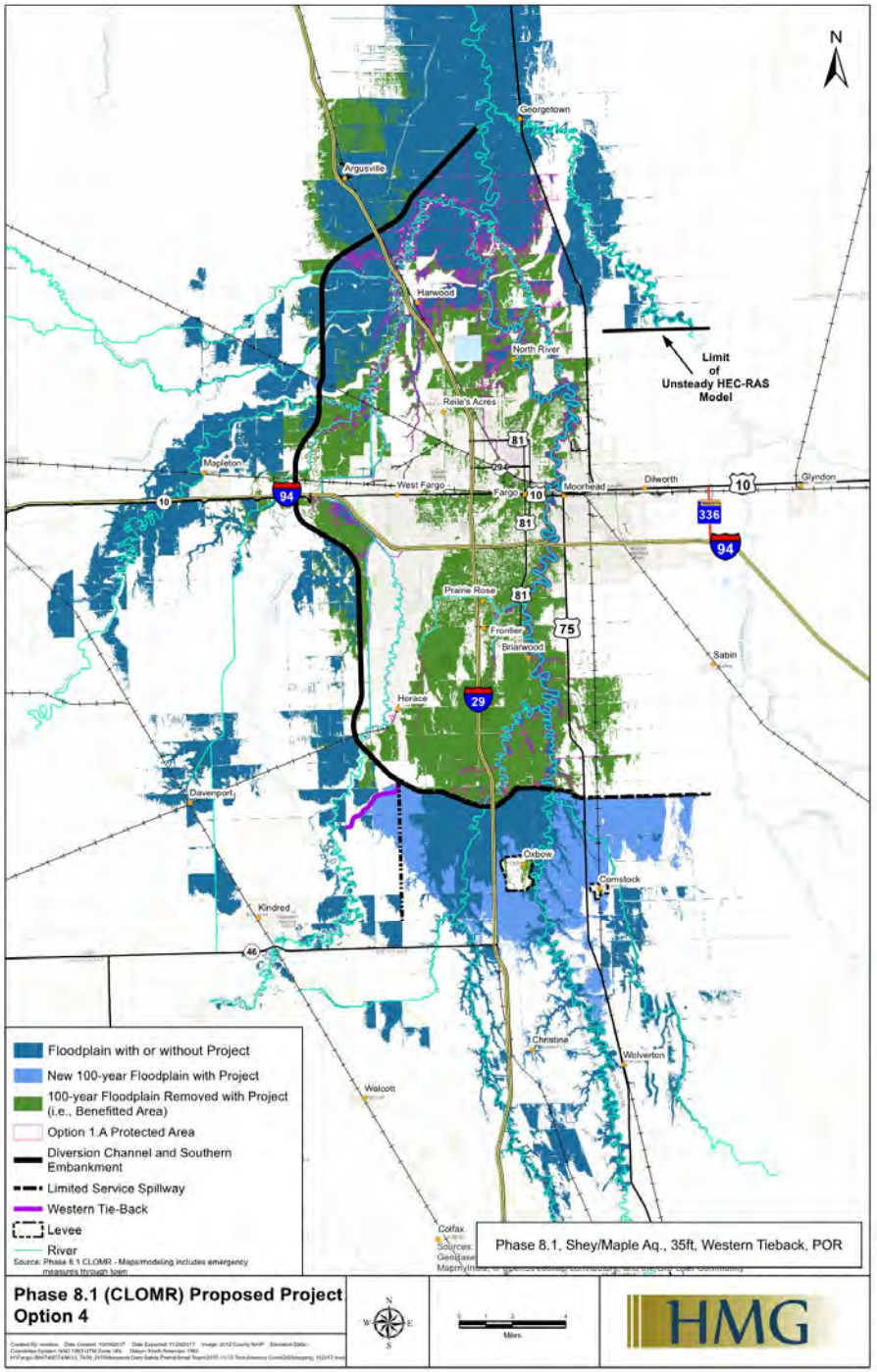


Component 4

Component #4: Northern Storage Option

	Proposed (baseline)	Proposed WTBL	Alt. 4
Staging Area Elevation at Dam	921.66	921.54	921.01
Newly Impacted Upstream Area – ND/MN (total)	7,088 / 11,631	8,194 / 11,270	7,335 / 9,943
Newly Impacted Upstream Area – Richland/Wilkin (total)	1,124 / 1,391	1,053 / 1,283	837 / 957
Unprotected Structures (Residential/Total) within the FDRA for Proposed Project	3 / 14	3 / 14	31 / 140
Acres Protected	58,137	58,119	50,401
Total Residential Structures Impacted—Richland/Wilkin (total)	3 / 5	3 / 5	3 / 5
Total Residential Structures Impacted—Cass/Clay (total)	41 / 20	42 / 20	41 / 19
Cost	N/A	Similar	+$190M

Component #4 – Northern Storage Option



Components #5: Change Operation Plan to Allow up to 6 inches of Downstream Impacts

- Could be applied to Alternatives 1a-1d, 3a-3c, 4
- Some measurable impact will extend beyond the U.S./Canadian border
- Mitigation may be required for existing downstream flood protection projects

Component #5: Change Operation Plan to Allow up to 6 inches of Downstream Impacts

Reference Point	Proposed (baseline)	Proposed WTBL	Alt. 5
Drayton, ND Impact	+0.03’	+0.03’	+0.09’
Grand Forks, ND Gage Impact	+0.05’	+0.06’	+0.25’
Climax, MN Impact	-0.03’	-0.02’	+0.48’
Halstad, MN Impact	-0.05’	-0.04’	+0.17’
Hendrum, MN Impact	-0.12’	-0.11’	+0.22’
Perley, MN Impact	-0.05’	-0.05’	+0.11’
Staging Area Elevation at Dam	921.66	921.54	921.24

Component #6: Wild Rice River Diversion with Levees (no dam)

- Divert the Wild Rice River only
- Includes levees through town
- No staging area or dam included
- Some measurable impact will extend beyond the U.S./Canadian border
- Mitigation may be required for existing downstream flood protection projects

Component #6: Wild Rice River Diversion with Levees (no dam)

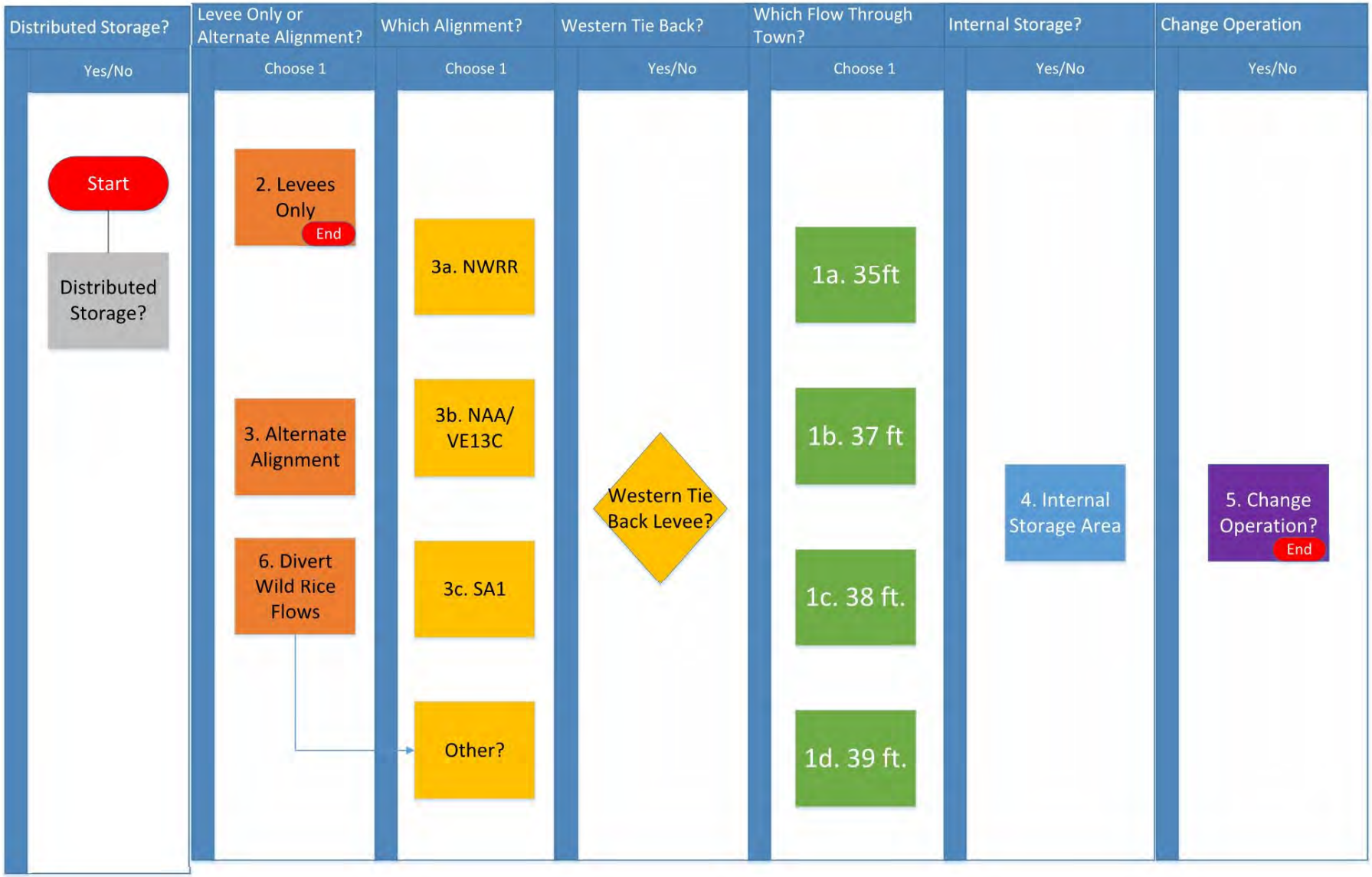
Reference Point	Proposed (baseline)	Proposed WTBL	Alt. 6
Drayton, ND Impact	+0.03’	+0.03’	+0.39’
Grand Forks, ND Gage Impact	+0.05’	+0.06’	+1.07’
Climax, MN Impact	-0.03’	-0.02’	+1.82’
Halstad, MN Impact	-0.05’	-0.04’	+0.63’
Hendrum, MN Impact	-0.12’	-0.11’	+0.73’
Perley, MN Impact	-0.05’	-0.05’	+0.28’
Staging Area Elevation at Dam	921.66	921.54	N/A

Consensus Items?

- Basin-wide Retention
- Zoning (Development) Restrictions within the Protected Area
- Western Tie-Back Levee

1) Additional Flows Through Town
   a) RS 35 feet
   b) RS 37 feet
   c) RS 38 feet
   d) RS 39 feet
2) Levees Only
3) Change Location of Dam
   a) North of Wild Rice River (NWRR)
   b) Northern Alignment Alternative
   c) Modified Storage Area 1
   d) Other
4) Northern Storage Option
5) Increased Downstream Impacts (6 inches)
6) Wild Rice River Only Diversion

Consensus Items?



Questions/Next Steps?

N

Georgetown
Argusville
Harwood
North River
Reile's Acres
Limit of Unsteady HEC-RAS Model
Mapleton
West Fargo
Fargo
Moorhead
Dilworth
Glyndon
Prairie Rose
Frontier
Briarwood
Sabin
Horace
Davenport
Oxbow
Comstock
Kindred
Christine
Wolverton
Walcott
Colfax

94 10 81 294 336 29 75 46

Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Diversion Channel and Southern Embankment
Limited Service Spillway
Western Tie-Back
Levee
River

Source: Phase 8.1 CLOMR - Maps/modeling includes emergency measures through town

Phase 8.1, 35ft, Western Tieback, POR

Sources: GeoBase MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Phase 8.1 (CLOMR) Proposed Project Option 1.A

N W E S

0 1 2 4
Miles

HMG

Created By: enelson Date Created: 10/09/2017 Date Exported: 11/28/2017 Image: 2012 County NAIP Elevation Data: -
Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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N

Georgetown
Argusville
Harwood
North River
Reile's Acres
Mapleton
West Fargo
Fargo
Moorhead
Dilworth
Glyndon
Prairie Rose
Frontier
Briarwood
Sabin
Horace
Davenport
Oxbow
Comstock
Kindred
Christine
Wolverton
Walcott
Colfax

94 10 81 294 336 29 75 46

Limit of Unsteady HEC-RAS Model

- Floodplain with or without Project
- New 100-year Floodplain with Project
- 100-year Floodplain Removed with Project (i.e., Benefitted Area)
- Option 1.A Upstream Outline
- Diversion Channel and Southern Embankment
- Limited Service Spillway
- Western Tie-Back
- Levee
- River

Source: Phase 8.1 CLOMR - Maps/modeling includes emergency measures through town

Phase 8.1, 37ft, Western Tieback, POR

Sources: GeoBase MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Phase 8.1 (CLOMR) Proposed Project Option 1.B

N W E S

0 1 2 4 Miles

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Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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N

Georgetown
Argusville
Harwood
North River
Reile's Acres
Limit of Unsteady HEC-RAS Model
Mapleton
West Fargo
Fargo
Moorhead
Dilworth
Glyndon
Prairie Rose
Frontier
Briarwood
Sabin
Horace
Davenport
Oxbow
Comstock
Kindred
Christine
Wolverton
Walcott
Colfax

94 10 81 294 336 75 29 46

Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Option 1.A Upstream Outline
Diversion Channel and Southern Embankment
Limited Service Spillway
Western Tie-Back
Levee
River

Source: Phase 8.1 CLOMR - Maps/modeling includes emergency measures through town

Sources: GeoBase MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Phase 8.1, 38ft, Western Tieback, POR

Phase 8.1 (CLOMR) Proposed Project Option 1.C

N W E S

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Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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N

Georgetown
Argusville
Harwood
North River
Reile's Acres
Mapleton
West Fargo
Fargo
Moorhead
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Prairie Rose
Frontier
Briarwood
Sabin
Horace
Davenport
Oxbow
Comstock
Kindred
Christine
Wolverton
Walcott
Colfax

94 10 81 294 336 29 75 46

Limit of Unsteady HEC-RAS Model

- Floodplain with or without Project
- New 100-year Floodplain with Project
- 100-year Floodplain Removed with Project (i.e., Benefitted Area)
- Option 1.A Upstream Outline
- Diversion Channel and Southern Embankment
- Limited Service Spillway
- Western Tie-Back
- Levee
- River

Source: Phase 8.1 CLOMR - Maps/modeling includes emergency measures through town

Phase 8.1, 39ft, Western Tieback, POR

Sources: GeoBase MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Phase 8.1 (CLOMR) Proposed Project Option 1.D

N W E S

0 1 2 4
Miles

HMG

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Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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N

Georgetown
Argusville
Harwood
North River
Limit of Unsteady HEC-RAS Model
Reile's Acres
Mapleton
West Fargo
Fargo
Moorhead
Dilworth
Glyndon
Prairie Rose
Frontier
Briarwood
Sabin
Horace
Davenport
Oxbow
Comstock
Kindred
Christine
Wolverton
Walcott
Colfax

94 10 81 294 336 29 75 46

Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Line of Protection
Levee
River

Source: Phase 8.1 CLOMR - Maps/modeling includes emergency measures through town

Sources: GeoBase MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Phase 8.1, Levee Only

Phase 8.1 (CLOMR) Proposed Project Option 2

N W E S

0 1 2 4
Miles

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Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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Georgetown
Argusville
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North River
Reile's Acres
Mapleton
West Fargo
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Moorhead
Dilworth
Glyndon
Prairie Rose
Frontier
Briarwood
Sabin
Horace
Davenport
Oxbow
Comstock
Kindred
Christine
Wolverton
Walcott
Colfax

Limit of Unsteady HEC-RAS Model

Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Diversion Channel and Southern Embankment
Limited Service Spillway
Western Tie-Back
Levee
River

Source: Phase 8.1 CLOMR - Maps/modeling includes emergency measures through town

Sources: GeoBase MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Phase 8.1, NWRR, 35ft, Western Tieback

Phase 8.1 (CLOMR) Proposed Project Option 3.A

N W E S

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Miles

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Georgetown
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Harwood
North River
Reile's Acres
Mapleton
West Fargo
Fargo
Moorhead
Dilworth
Glyndon
Prairie Rose
Frontier
Briarwood
Sabin
Horace
Davenport
Oxbow
Comstock
Kindred
Christine
Wolverton
Walcott
Colfax

94 10 81 294 336 MINNESOTA 29 75 46

Limit of Unsteady HEC-RAS Model

CASS
RICHLAND
NORTH DAKOTA
MINNESOTA

Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Diversion Channel and Southern Embankment
Limited Service Spillway
Western Tie-Back
Levee
River

Source: Phase 8.1 CLOMR - Maps/modeling includes emergency measures through town

Phase 8.1, SA1, 35ft, Western Tieback, POR

Sources:
GeoBase
MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Phase 8.1 (CLOMR) Proposed Project Option 3.B

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Reile's Acres
Mapleton
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Glyndon
Prairie Rose
Frontier
Briarwood
Sabin
Horace
Davenport
Oxbow
Comstock
Kindred
Christine
Wolverton
Walcott
Colfax

Limit of Unsteady HEC-RAS Model

Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Diversion Channel and Southern Embankment
Limited Service Spillway
Western Tie-Back
Levee
River

Source: Phase 8.1 CLOMR - Maps/modeling includes emergency measures through town

Sources: GeoBase MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Phase 8.1, SA1, 35ft, Western Tieback, POR

Phase 8.1 (CLOMR) Proposed Project Option 3.C

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Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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Miles

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Georgetown
Argusville
Harwood
North River
Reile's Acres
Mapleton
West Fargo
Fargo
Moorhead
Dilworth
Glyndon
Prairie Rose
Frontier
Briarwood
Sabin
Horace
Davenport
Oxbow
Comstock
Kindred
Christine
Wolverton
Walcott
Colfax

94 10 81 294 336 29 75 46

Limit of Unsteady HEC-RAS Model

- Floodplain with or without Project
- New 100-year Floodplain with Project
- 100-year Floodplain Removed with Project (i.e., Benefitted Area)
- Option 1.A Protected Area
- Diversion Channel and Southern Embankment
- Limited Service Spillway
- Western Tie-Back
- Levee
- River

Source: Phase 8.1 CLOMR - Maps/modeling includes emergency measures through town

Sources: GeoBase MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Phase 8.1, Shey/Maple Aq., 35ft, Western Tieback, POR

Phase 8.1 (CLOMR) Proposed Project Option 4

N W E S

0 1 2 4
Miles

HMG

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Georgetown
Argusville
Harwood
North River
Reile's Acres
West Fargo
Fargo
Moorhead
Dilworth
Prairie Rose
Frontier
Briarwood
Sabin
Horace

Legend

Structure Inventory (2014)

- Primary Structures (23)
- Secondary Structures (117)
- Study Area
- POR 35ft Floodplain (2014 DEM)

35ft Through Town Structure Impacts FM Area Diversion Project

N
W E
S

0 0.5 1 2
Miles

HMG

Created By: dkirkpatrick Date Created: 02/20/2017 Date Exported: 11/28/2017 Image: 2015 County NAIP
Horizontal Datum: NAD 1983 UTM Zone 14N Vertical Datum: North American 1983
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Legend

Structure Inventory (2014)

- Primary Structures (95)
- Secondary Structures (280)
- Study Area
- POR 37ft Floodplain (2014 DEM)

Georgetown
Argusville
Harwood
North River
Reile's Acres
West Fargo
Fargo
Moorhead
Dilworth
Prairie Rose
Frontier
Briarwood
Sabin
Horace

37ft Through Town Structure Impacts
FM Area Diversion Project

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Horizontal Datum: NAD 1983 UTM Zone 14N Vertical Datum: North American 1983
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N
W E
S

0 0.5 1 2
Miles

HMG

Legend

Structure Inventory (2014)

- Primary Structures (793)
- Secondary Structures (952)
- Study Area
- POR 38ft Floodplain (2014 DEM)

Georgetown
Argusville
Harwood
North River
Reile's Acres
West Fargo
Fargo
Moorhead
Dilworth
Prairie Rose
Frontier
Briarwood
Sabin
Horace

38ft Through Town Structure Impacts
FM Area Diversion Project

N
W E
S

0 0.5 1 2
Miles

HMG

Created By: dkirkpatrick Date Created: 02/20/2017 Date Exported: 11/28/2017 Image: 2015 County NAIP
Horizontal Datum: NAD 1983 UTM Zone 14N Vertical Datum: North American 1983
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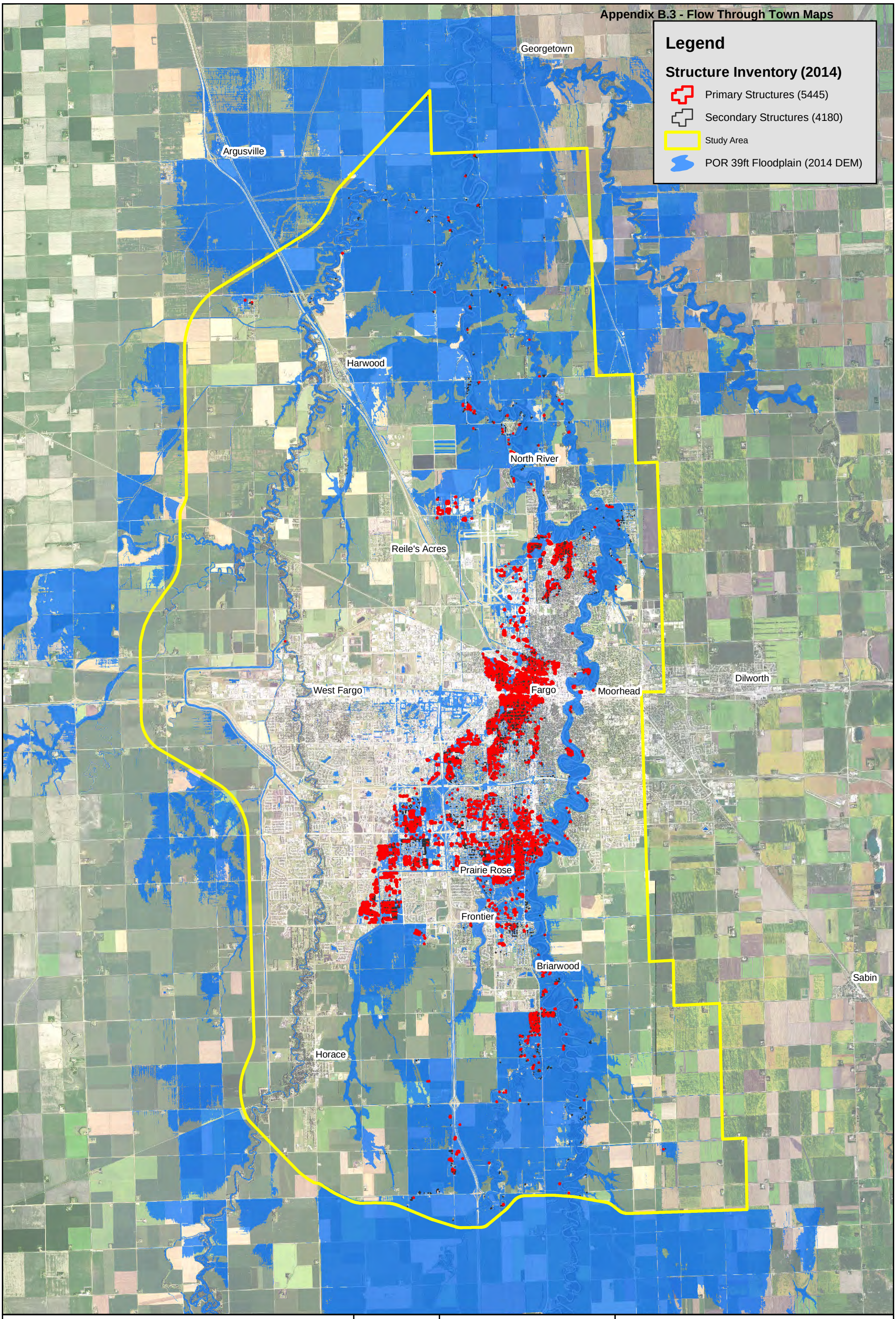

39ft Through Town Structure Impacts
FM Area Diversion Project

Created By: dkirkpatrick Date Created: 02/20/2017 Date Exported: 11/28/2017 Image: 2015 County NAIP
Horizontal Datum: NAD 1983 UTM Zone 14N Vertical Datum: North American 1983
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N W E S

0 0.5 1 2
Miles

HMG

FM Diversion Task Force Technical Advisory Group Alternative Evaluation Key Criteria and Results (November 29, 2017)				Phase 8.1		Alt 1 - Flows Through Town								Alt 2 - Levees Only		Alt 3 - Dam Alignments						Alt 4 - Northern Storage		Alt 5 - 6in. Downstream Impacts	Alt 6 - WRR Diversion + Levees
						1.A		1.B		1.C		1.D		2		3.A		3.B		3.C		4		5	6
Criteria			Existing Conditions	Current Project 35 ft Through Town (baseline)		Current Diversion, Western Tieback, 35 ft Through Town,		Current Diversion, Western Tieback, 37 ft Through Town,		Current Diversion, Western Tieback, 38 ft Through Town,		Current Diversion, Western Tieback, 39 ft Through Town,		Levees Only		North Wild Rice River, Western Tieback, 35 ft Through Town,		NAA/VE13C, Western Tieback, 35 ft Through Town,		Current Diversion, Storage Area 1, Western Tieback, 35 ft Through Town,		Flows through Tributaries, Western Tieback, 35 ft Through Town		Current Diversion, Western Tieback, 35 ft Through Town, Downstream Impacts < 6in.	WRR Diversion Plus Levees, No Staging, No Red Gate, No Diversion Gate
Criteria A - Satisfy Task Force Charter																									
	FEMA Accreditation	Y or N	-																						
	Maintain Federal Authorization	Y or N	-																						
Criteria B - Meets Laws and Ordinances																									
	ND Statute and Rules	Y or N	-																						
	MN Statute and Rules	Y or N	-																						
	Local Ordinances	Y or N	-																						
Criteria C - Minimize Residual Risk																									
	Life and Safety - Evacuation	Frequency	-																						
	Length of Levee/Dam	Length (ft)	-																						
	Height of Levee/Dam	Length (ft)	-																						
	Internal Floodplain/Drainage	# of Systems	-																						
	Dam Breach No Build Zone	Area (ac)	-																						
Criteria D - Upstream Floodplain Impacts [4]				EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP		
	Cass County	Total Area (ac)		10,326	16,290	10,444	17,584	10,331	16,877	10,297	16,629	10,298	16,439	12,883	13,560	16,514	18,776	15,283	19,873	12,659	19,003	10,331	16,829		
		Addn'l Area (ac)			5,964		7,140		6,546		6,332		6,141		677		2,262		4,590		6,344		6,498		
	Richland County	Total Area (ac)		3,263	4,387	3,304	4,357	2,853	3,567	2,719	3,347	2,672	3,245	0	0	1,205	1,279	2,073	2,343	2,692	3,305	3,251	4,088		
		Addn'l Area (ac)			1,124		1,053		714		628		573		0		74		270		613		837		
North Dakota		Total Area (ac)		13,589	20,677	13,748	21,941	13,184	20,444	13,016	19,976	12,970	19,684	12,883	13,560	17,719	20,055	17,356	22,216	15,351	22,308	13,582	20,917		
		Addn'l Area (ac)			7,088		8,193		7,260		6,960		6,714		677		2,336		4,860		6,957		7,335		
	Clay County	Total Area (ac)		1,989	12,229	1,990	11,977	1,988	10,768	1,984	10,351	1,978	10,156	5,689	8,788	5,513	15,894	2,977	12,289	1,949	10,310	1,987	10,974		
		Addn'l Area (ac)			10,240		9,987		8,780		8,367		8,178		3,099		10,381		9,312		8,361		8,987		
	Wilkin County	Total Area (ac)		1,160	2,551	1,163	2,446	1,161	1,996	1,120	1,809	1,078	1,679	0	0	644	673	1,022	1,140	1,123	1,763	1,147	2,104		
		Addn'l Area (ac)			1,391		1,283		835		689		601		0		29		118		640		957		
Minnesota		Total Area (ac)		3,149	14,780	3,153	14,423	3,149	12,764	3,104	12,160	3,056	11,835	5,689	8,788	6,157	16,567	3,999	13,429	3,072	12,073	3,134	13,078		
		Addn'l Area (ac)			11,631		11,270		9,615		9,056		8,779		3,099		10,410		9,430		9,001		9,944		
Total (ND/MN)		Total Area (ac)		16,738	35,457	16,901	36,364	16,333	33,208	16,120	32,136	16,026	31,519	18,572	22,348	23,876	36,622	21,355	35,645	18,423	34,381	16,716	33,995		
		Addn'l Area (ac)			18,719		19,463		16,875		16,016		15,493		3,776		12,746		14,290		15,958		17,279		
Criteria D - Protected Area Floodplain Impacts [5]				EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP		
	Cass County	Total Area (ac)		61,335	14,190	61,335	14,207	61,335	18,368	61,335	21,759	61,335	24,394	61,335	45,138	53,781	13,164	55,956	13,891	58,838	14,878	61,335	21,670		
		Addn'l Area (ac)			0		0		0		0		0		0		0		0		0		0		
	Clay County	Total Area (ac)		17,853	6,861	17,853	6,861	17,853	8,368	17,853	9,450	17,853	10,844	17,853	19,797	14,188	6,447	16,837	6,871	17,853	6,841	17,853	7,116		
		Addn'l Area (ac)			0		0		0		0		0		1,944		0		0		0		0		
Total (ND/MN)		Total Area (ac)		79,188	21,051	79,188	21,068	79,188	26,736	79,188	31,209	79,188	35,239	79,188	64,935	67,969	19,611	72,794	20,762	76,690	21,719	79,187	28,786		
		Addn'l Area (ac)			0		0		0		0		0		1,944		0		0		0		0		
Criteria E - Reduce Environmental Effects																									
		Similar, Better, Worse																							
Criteria F - Upstream Impacted Structures [4]				EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP		
	Cass County	# of Res Structures			41		42		40		39		38		244		151		90		49		41		
		# of Non-Res Structures			258		266		252		241		237		420		499		457		312		248		
		Total # of Structures		139	299	139	308	139	292	139	280	139	275	527	664	430	650	319	547	182	361	139	289		
		# of Additional Stuctures			160		169		153		141		136		137		220		228		179		150		
	Richland County	# of Res Structures			3		3		3		2		2		0		0		1		2		3		
		# of Non-Res Structures			61		58		44		39		36		0		13		20		37		54		
		Total # of Structures		32	64	32	61	28	47	25	41	25	38	0	0	11	13	15	21	25	39	32	57		
		# of Additional Stuctures			32		29		19		16		13		0		2		6		14		25		
North Dakota		# of Res Structures			44		45		43		41		40		244		151		91		51		44		
		# of Non-Res Structures			319		324		296		280		273		420		512		477		349		302		
		Total # of Structures		171	363	171	369	167	339	164	321	164	313	527	664	441	663	334	568	207	400	171	346		
		# of Additional Stuctures			192		198		172		157		149		137		222		234		193		175		
	Clay County	# of Res Structures			20		20		19		17		17		15		45		24		17		19		
		# of Non-Res Structures			211		209		185		178		172		117		306		198		174		189		
		Total # of Structures		30	231	30	229	30	204	30	195	30	189	88	132	90	351	53	222	26	191	30	208		
		# of Additional Stuctures			201		199		174		165		159		44		261		169		165		178		
	Wilkin County	# of Res Structures			5		5		3		2		2		0		0		2		2		5		
		# of Non-Res Structures			37		35		32		30		29		0		16		26		30		32		
		Total # of Structures		23	42	23	40	23	35	23	32	23	31	0	0	15	16	23	28	23	32	23	37		
		# of Additional Stuctures			19		17		12		9		8		0		1		5		9		14		
Minnesota		# of Res Structures			25		25		22		19		19		15		45		26		19		24		
		# of Non-Res Structures			248		244		217		208		201		117		322		224		204		221		
		Total # of Structures		53	273	53	269	53	239	53	227	53	220	88	132	105	367	76	250	49	223	53	245		
		# of Additional Stuctures			220		216		186		174		167		44		262		174		174		192		

FM Diversion Task Force Technical Advisory Group Alternative Evaluation Key Criteria and Results (November 29, 2017)				Phase 8.1		Alt 1 - Flows Through Town								Alt 2 - Levees Only		Alt 3 - Dam Alignments						Alt 4 - Northern Storage		Alt 5 - 6in. Downstream Impacts	Alt 6 - WRR Diversion + Levees
						1.A		1.B		1.C		1.D		2		3.A		3.B		3.C		4		5	6
Criteria			Existing Conditions	Current Project 35 ft Through Town (baseline)		Current Diversion, Western Tieback, 35 ft Through Town,		Current Diversion, Western Tieback, 37 ft Through Town,		Current Diversion, Western Tieback, 38 ft Through Town,		Current Diversion, Western Tieback, 39 ft Through Town,		Levees Only		North Wild Rice River, Western Tieback, 35 ft Through Town,		NAA/VE13C, Western Tieback, 35 ft Through Town,		Current Diversion, Storage Area 1, Western Tieback, 35 ft Through Town,		Flows through Tributaries, Western Tieback, 35 ft Through Town		Current Diversion, Western Tieback, 35 ft Through Town, Downstream Impacts < 6in.	WRR Diversion Plus Levees, No Staging, No Red Gate, No Diversion Gate
Total (ND/MN)		# of Res Structures			69		70		65		60		59		259		196		117		70		68		
		# of Non-Res Structures			567		568		513		488		474		537		834		701		553		523		
		Total # of Structures		224	636	224	638	220	578	217	548	217	533	615	796	546	1,030	410	818	256	623	224	591		
		# of Additional Stuctures			412		414		358		331		316		181		484		408		367		367		
Criteria F - Protected Area Impacted Structures [5]				EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP		
	Cass County	# of Res Structures		15,536	20	15,536	20	15,536	71	15,536	115	15,536	194	15,536	901	15,287	27	15,355	31	15,397	43	15,536	116		
		# of Non-Res Structures		8,854	93	8,854	93	8,854	183	8,854	246	8,854	331	8,854	1,306	8,607	91	8,689	103	8,798	156	8,854	289		
		Total # of Structures		24,390	113	24,390	113	24,390	254	24,390	361	24,390	525	24,390	2,207	23,894	118	24,044	134	24,347	199	24,390	405		
		# of Additional Stuctures			0		0		0		0		0		0		0		0		0		0		
	Clay County	# of Res Structures		637	9	637	9	637	30	637	41	637	63	637	170	618	9	622	10	623	9	637	10		
		# of Non-Res Structures		554	33	554	33	554	90	554	132	554	175	554	309	505	31	534	46	546	32	554	45		
		Total # of Structures		1,191	42	1,191	42	1,191	120	1,191	173	1,191	238	1,191	479	1,123	40	1,156	56	1,169	41	1,191	55		
		# of Additional Stuctures			0		0		0		0		0		0		0		0		0		0		
Total (ND/MN)		# of Res Structures		16,173	29	16,173	29	16,173	101	16,173	156	16,173	257	16,173	1,071	15,905	36	15,977	41	16,020	52	16,173	126		
		# of Non-Res Structures		9,408	126	9,408	126	9,408	273	9,408	378	9,408	506	9,408	1,615	9,112	122	9,223	149	9,344	188	9,408	334		
		Total # of Structures		25,581	155	25,581	155	25,581	374	25,581	534	25,581	763	25,581	2,686	25,017	158	25,200	190	25,516	240	25,581	460		
		# of Additional Stuctures			0		0		0		0		0		0		0		0		0		0		
Criteria G - Resilience/Robustness of Design																									
	Maintain FEMA Accreditation if future hydrology changes	Similar, Better, Worse																							
	Capability to Fight Floods larger than 100-year	Similar, Better, Worse																							
Criteria H - Cost and Engineering Feasibility																									
	Engineering Feasibility	Similar, Better, Worse																							
	Cost	Similar, Better, Worse																							
Criteria I / J - Upstream and Downstream Impacts																									
Downstream	Drayton, ND (30 mi. to Canada)[3]	Elevation, (Impact, ft)	802.03	802.06	(0.03)	802.06	(0.03)	802.07	(0.04)	802.07	(0.04)	802.06	(0.03)	802.01	(-0.02)	802.07	(0.04)	802.06	(0.03)	802.06	(0.03)	802.07	(0.04)	802.12	(0.09)	802.42	(0.39)
Downstream	Oslo, MN	Elevation, (Impact, ft)	813.42	813.44	(0.02)	813.44	(0.02)	813.44	(0.02)	813.44	(0.02)	813.44	(0.02)	813.41	(-0.01)	813.44	(0.02)	813.44	(0.02)	813.44	(0.02)	813.44	(0.02)	813.47	(0.05)	813.62	(0.2)
Downstream	Grand Forks Gage	Elevation, (Impact, ft)	832.38	832.43	(0.05)	832.44	(0.06)	832.45	(0.07)	832.45	(0.07)	832.43	(0.05)	832.34	(-0.04)	832.46	(0.08)	832.43	(0.05)	832.44	(0.06)	832.49	(0.11)	832.63	(0.25)	833.45	(1.07)
Downstream	Thompson, ND (Gage)	Elevation, (Impact, ft)	846.85	846.84	(-0.01)	846.84	(-0.01)	846.86	(0.01)	846.83	(-0.02)	846.79	(-0.06)	846.75	(-0.1)	846.88	(0.03)	846.84	(-0.01)	846.87	(0.02)	846.99	(0.14)	847.16	(0.31)	847.99	(1.14)
Downstream	Climax, MN	Elevation, (Impact, ft)	857.08	857.05	(-0.03)	857.06	(-0.02)	857.09	(0.01)	857.04	(-0.04)	856.96	(-0.12)	856.93	(-0.15)	857.12	(0.04)	857.06	(-0.02)	857.12	(0.04)	857.31	(0.23)	857.56	(0.48)	858.90	(1.82)
Downstream	Nielsville, MN	Elevation, (Impact, ft)	861.16	861.12	(-0.04)	861.13	(-0.03)	861.15	(-0.01)	861.10	(-0.06)	861.02	(-0.14)	861.00	(-0.16)	861.18	(0.02)	861.13	(-0.03)	861.18	(0.02)	861.38	(0.22)	861.63	(0.47)	862.89	(1.73)
Downstream	Shelly, MN	Elevation, (Impact, ft)	865.16	865.12	(-0.04)	865.13	(-0.03)	865.14	(-0.02)	865.11	(-0.05)	865.06	(-0.1)	865.06	(-0.1)	865.16	(0)	865.13	(-0.03)	865.16	(0)	865.29	(0.13)	865.44	(0.28)	866.17	(1.01)
Downstream	Halstad, MN	Elevation, (Impact, ft)	868.27	868.22	(-0.05)	868.23	(-0.04)	868.23	(-0.04)	868.21	(-0.06)	868.17	(-0.1)	868.21	(-0.06)	868.24	(-0.03)	868.23	(-0.04)	868.26	(-0.01)	868.34	(0.07)	868.44	(0.17)	868.90	(0.63)
Downstream	Hendrum, MN	Elevation, (Impact, ft)	872.61	872.49	(-0.12)	872.50	(-0.11)	872.51	(-0.1)	872.47	(-0.14)	872.41	(-0.2)	872.52	(-0.09)	872.53	(-0.08)	872.50	(-0.11)	872.55	(-0.06)	872.65	(0.04)	872.83	(0.22)	873.34	(0.73)
Downstream	Perley, MN	Elevation, (Impact, ft)	877.31	877.26	(-0.05)	877.26	(-0.05)	877.27	(-0.04)	877.26	(-0.05)	877.24	(-0.07)	877.26	(-0.05)	877.27	(-0.04)	877.26	(-0.05)	877.29	(-0.02)	877.34	(0.03)	877.42	(0.11)	877.59	(0.28)
Downstream	Georgetown, MN	Elevation, (Impact, ft)	881.83	881.93	(0.1)	881.93	(0.1)	881.96	(0.13)	881.95	(0.12)	881.94	(0.11)	881.77	(-0.06)	881.94	(0.11)	881.93	(0.1)	881.96	(0.13)	882.01	(0.18)	882.07	(0.24)	882.20	(0.37)
In-Town	Fargo/Moorhead (Fargo Gage[2])	Elevation, (Impact, ft)	903.22	897.56	(-5.66)	897.56	(-5.66)	899.71	(-3.51)	900.69	(-2.53)	901.71	(-1.51)	904.11	(0.89)	897.43	(-5.79)	897.57	(-5.65)	897.56	(-5.66)	897.60	(-5.62)	897.56	(-5.66)	899.10	(-4.12)
			RS 40.5	RS 34.8		RS 34.8		RS 37		RS 38		RS 39		RS 41.4		RS 34.7		RS 34.8		RS 34.8		RS 34.9		RS 34.8		RS 36.4	
Upstream	Upstream of Dam	Elevation, (Impact, ft)	Varies	921.66	(7.4)	921.54	(7.28)	920.87	(6.61)	920.64	(6.38)	920.51	(6.25)	909.85	(1.36)	916.79	(5.37)	918.83	(6.8)	920.64	(6.38)	921.01	(6.75)	921.24	(6.98)	913.20	(-1.06)
Upstream	County Line @ Wild Rice River (xs 109018)	Elevation, (Impact, ft)	922.04	922.6	(0.56)	922.55	(0.51)	922.35	(0.31)	922.30	(0.26)	922.25	(0.21)	922.04	(0)	922.04	(0)	922.07	(0.03)	922.23	(0.19)	922.36	(0.32)	922.54	(0.5)	922.02	(-0.02)
Upstream	County Line @ Red River (xs 2578502)	Elevation, (Impact, ft)	918.76	922.49	(3.73)	922.40	(3.64)	921.94	(3.18)	921.80	(3.04)	921.71	(2.95)	918.77	(0.01)	919.61	(0.85)	920.70	(1.94)	921.76	(3)	922.02	(3.26)	922.25	(3.49)	918.32	(-0.44)
Criteria J - Included in Criteria I.																									

[1] POR = All Models Utilize Full Period of Record Hydrology (1882 and 1902-2009); 100-year discharge = 33,000 cfs

[2] USGS Gage 05054000 - Red River of the North at Fargo, ND (Gage Zero= 862.74 ft, NAVD88)

[3] Impacts of 0.04 ft or less at Drayton indicate zero impacts at US/Canadian Border.

[4] The Impacted Acreages and Structure totals are based on a takings analysis boundary that is defined based on an area where the depth difference between with-project and existing conditions is 0.1 foot or greater.

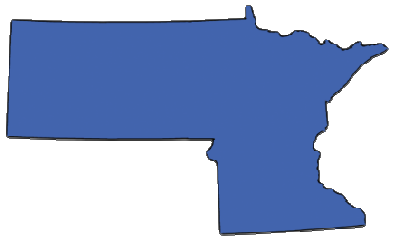
[5] The Protected Area Acreages and Structure totals are based on a boundary that is defined based on an area between the line of protection on the south and any project features on the north, east and west sides.

Option Analysis

Presentation by:
Technical Advisory Group

Presentation to:
Fargo-Moorhead Area Flood Diversion Task Force

December 11, 2017



Task Force Charter

- "Develop design principles and concept-level engineering to achieve balanced flood risk management"
- Find solutions that satisfy state and local laws, rules, and ordinances
- Provide 100-year FEMA certifiable flood protection
- Maintain federal authorization

TAG Direction from Task Force

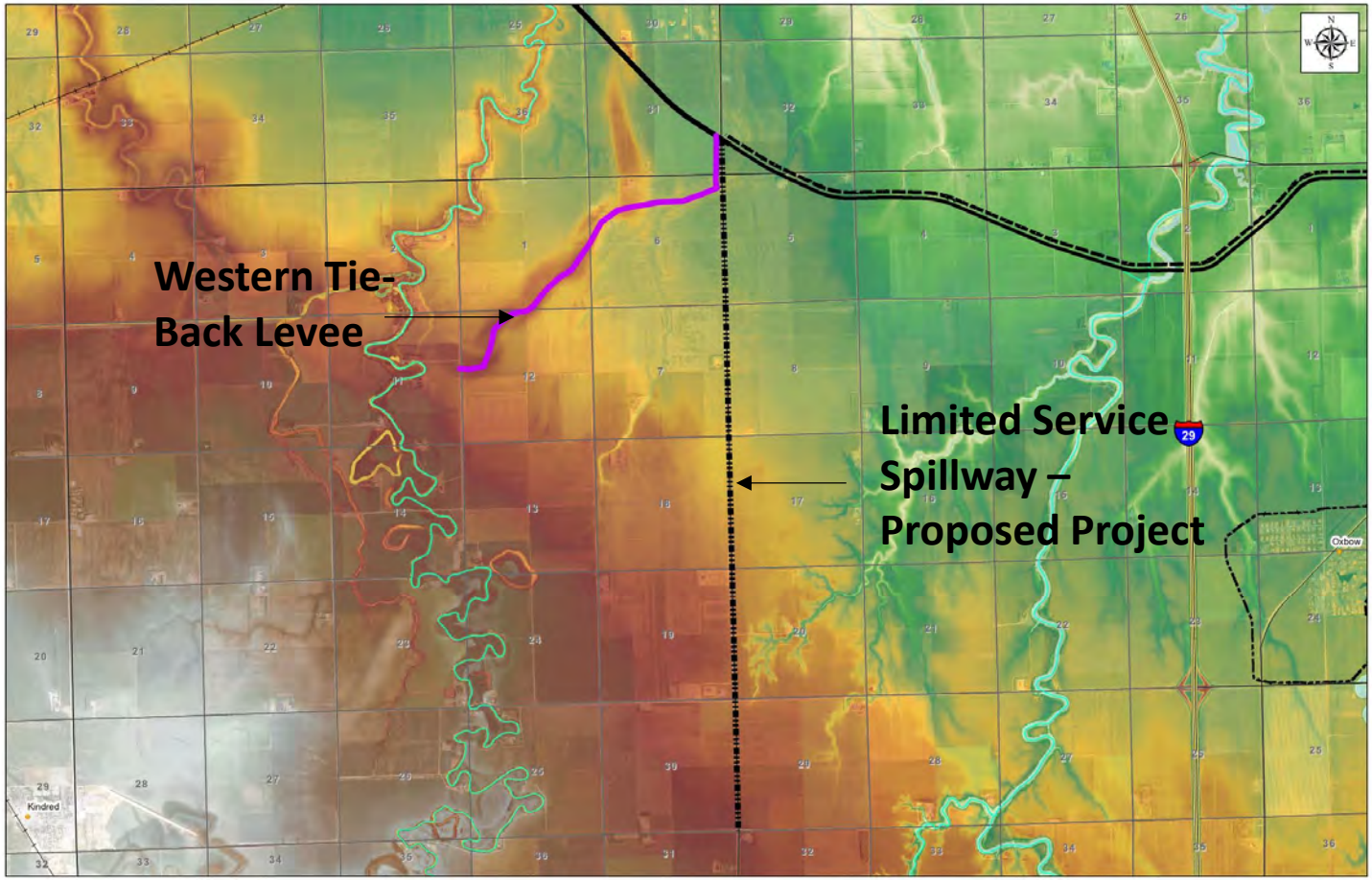
- Use full period of record hydrology (33,000 cfs – 100-year)
- Include Western Tie-back levee in all options
- Distributed Storage is part of a long-term strategy and doesn't impact current analysis
- Develop 3 options for consideration
  - Include results for RS37, RS38, and RS39
  - Include option that allows up to 6 inches of downstream impacts
- Strive for equity in impacts – ND/MN
- Minimize acres removed from the floodplain
- Minimize newly impacted acreage and structures
- Consider economics – cost increases and reductions

Components/Options

- Western Tie Back Levee
- Eastern Tie Back
- Northern Storage/Diversion Channel Alignment
- Additional Flows Through Town
  - RS 35 feet
  - RS 37 feet
  - RS 38 feet
  - RS 39 feet
- Change Location of Dam/Southern Embankment
  - Option 7A
  - Option 7B
  - Option 7C
- Allow Downstream Impacts up to 6 inches

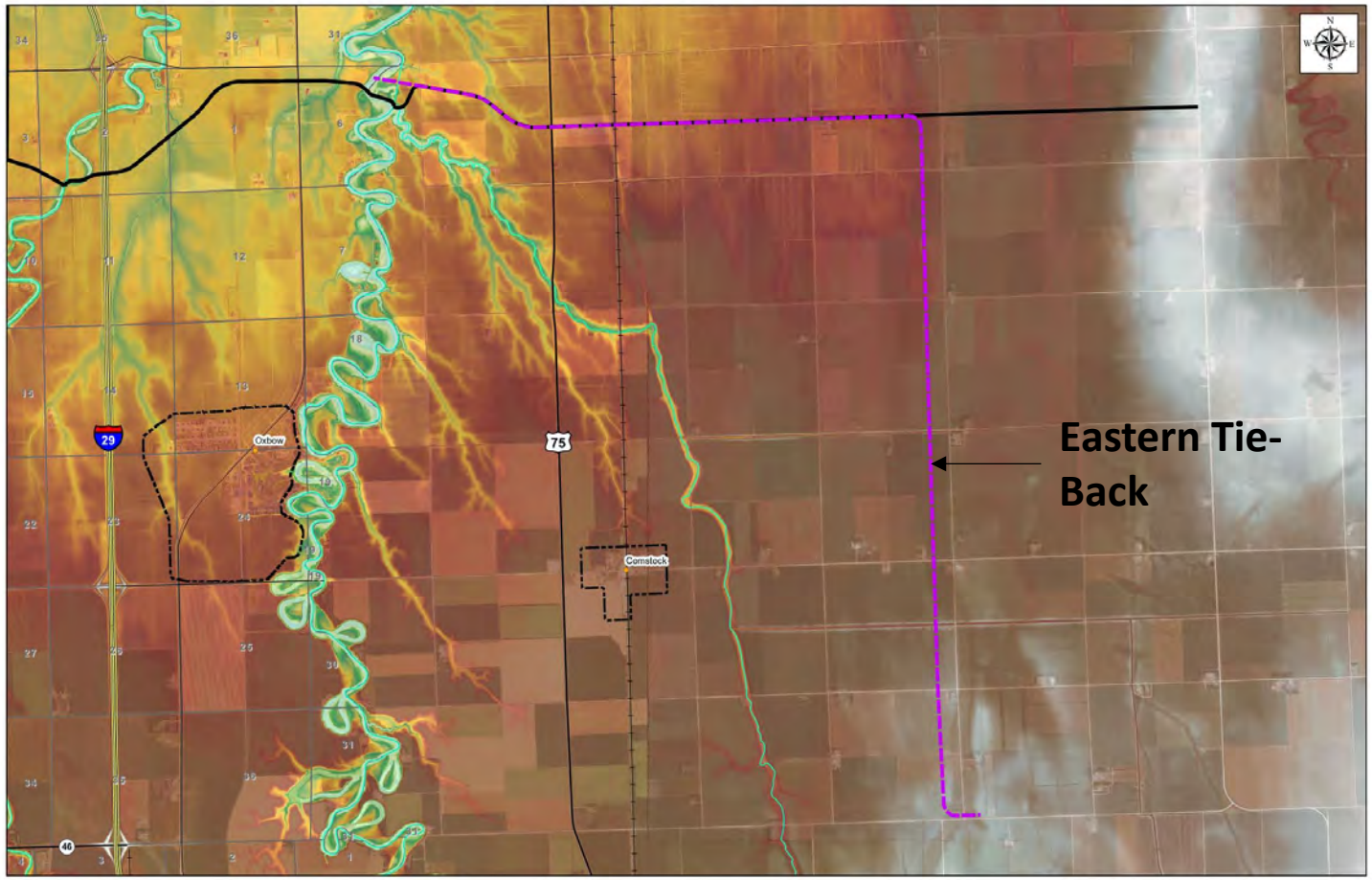
Western Tie Back Levee as a Component

- Included for Options 7A, 7B, and 7C
- Increases floodplain in ND



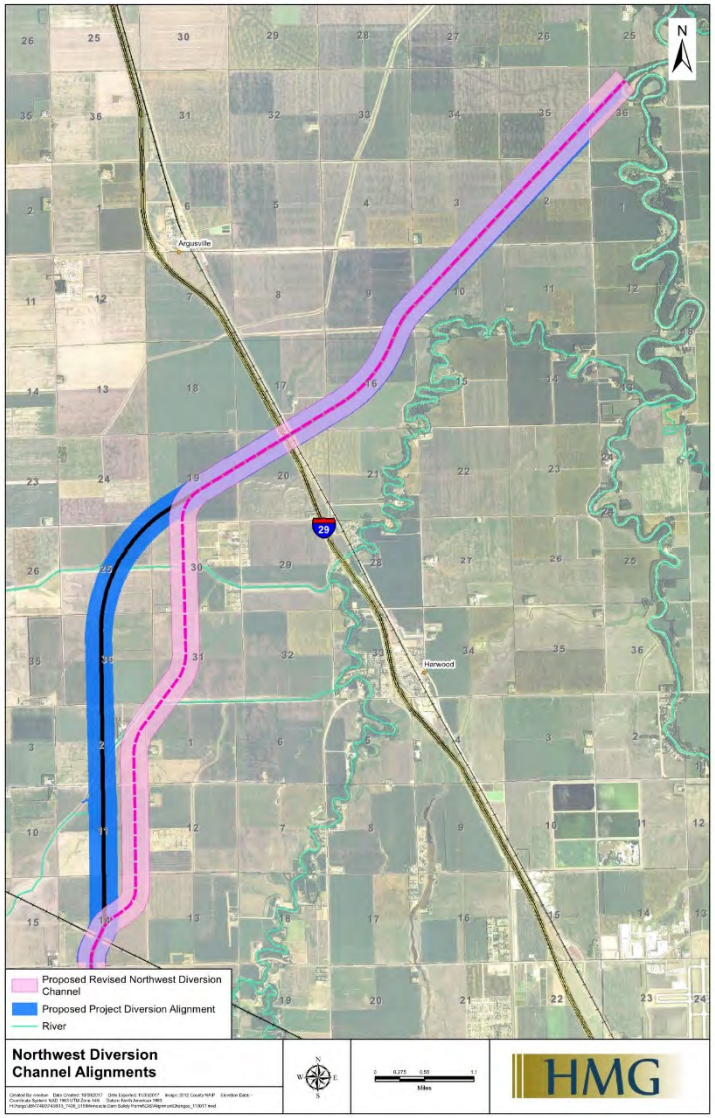
Eastern Tie Back as a Component (new)

- Included for Options 7A, 7B, and 7C
- Reduces newly inundated floodplain in MN



Northern Storage/Diversion Channel Alignment Option

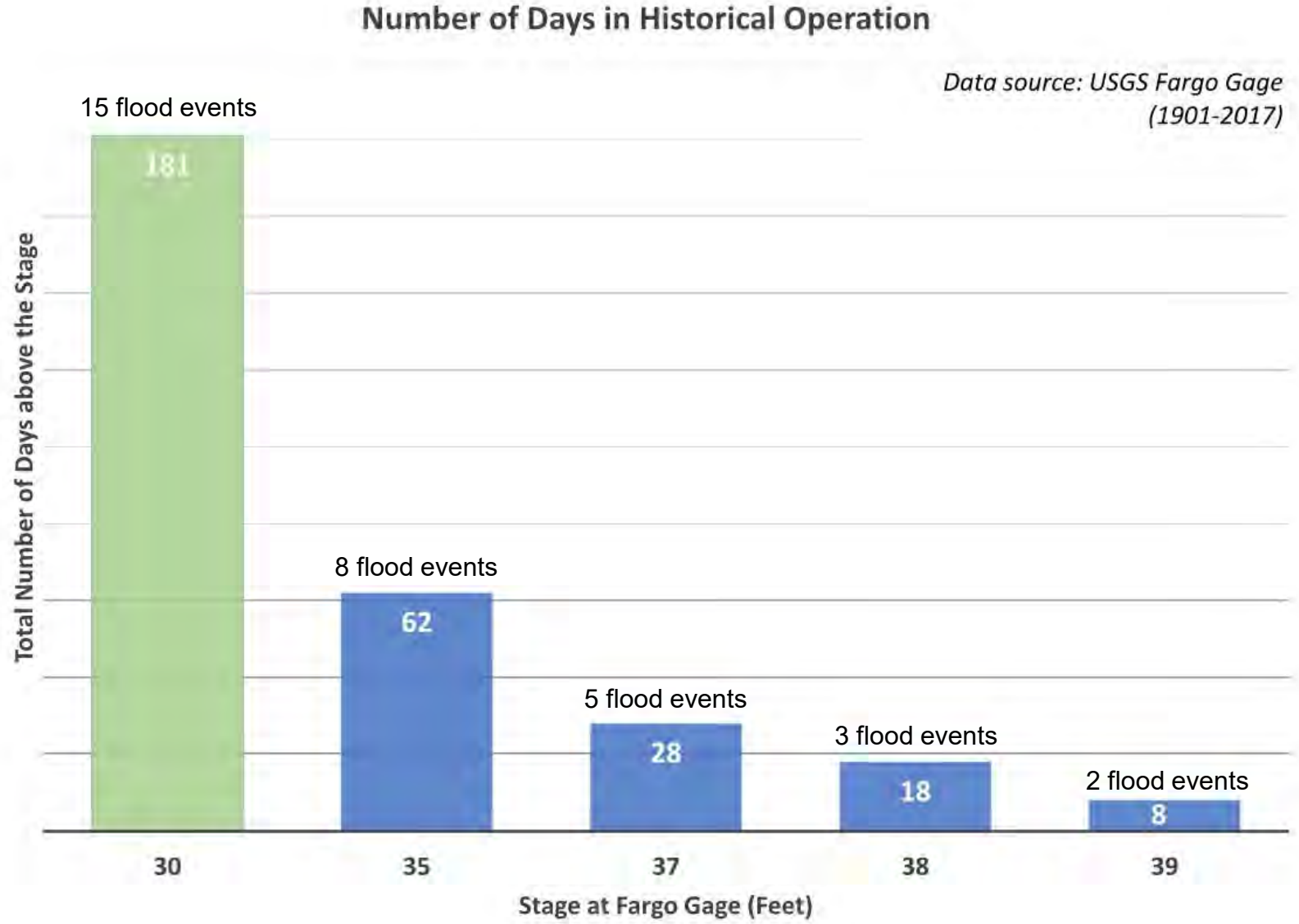
- Evaluated diversion channel alignment change in northwest project area
- Preserves more existing floodplain (potentially 1800 acres)
- Not included in current analysis due to minimal staging area reduction



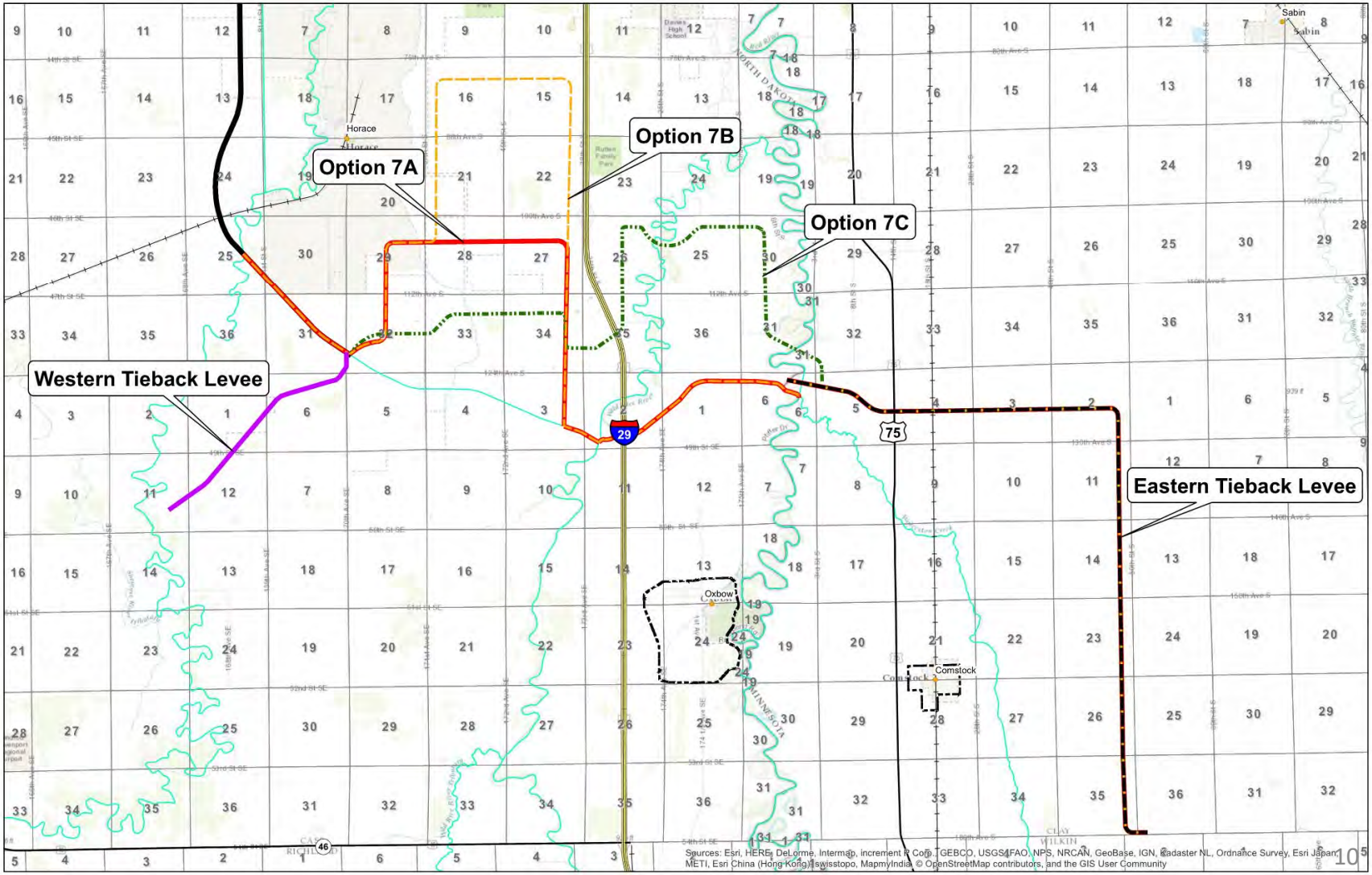
Additional Flows Through Town

- Additional flows through town reduces the frequency of staging area operation and size of the inundation area
- Additional flows through town requires additional In Town measures be implemented
- Proposed project design (2013) has RS 35' through town in a 100-year flood
- Additional analysis includes RS37', RS38', and RS39'

Additional Flows Through Town Histogram and Frequency Curve

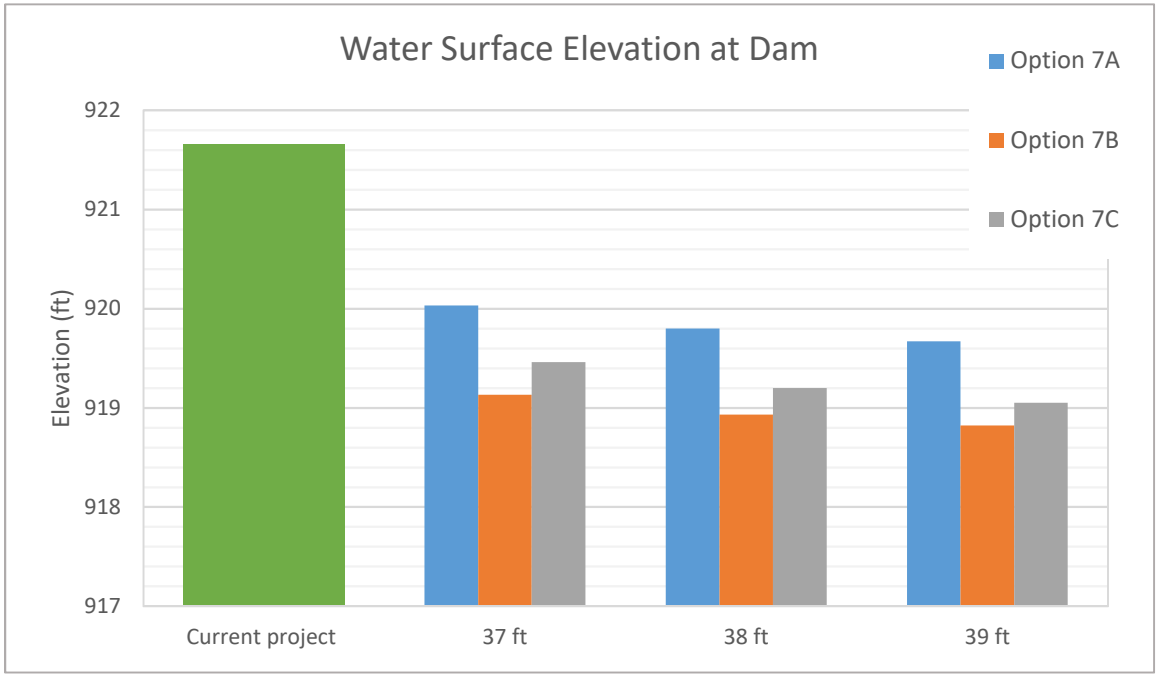


Options 7A, 7B, 7C: Dam Alignments will be discussed in detail later in presentation

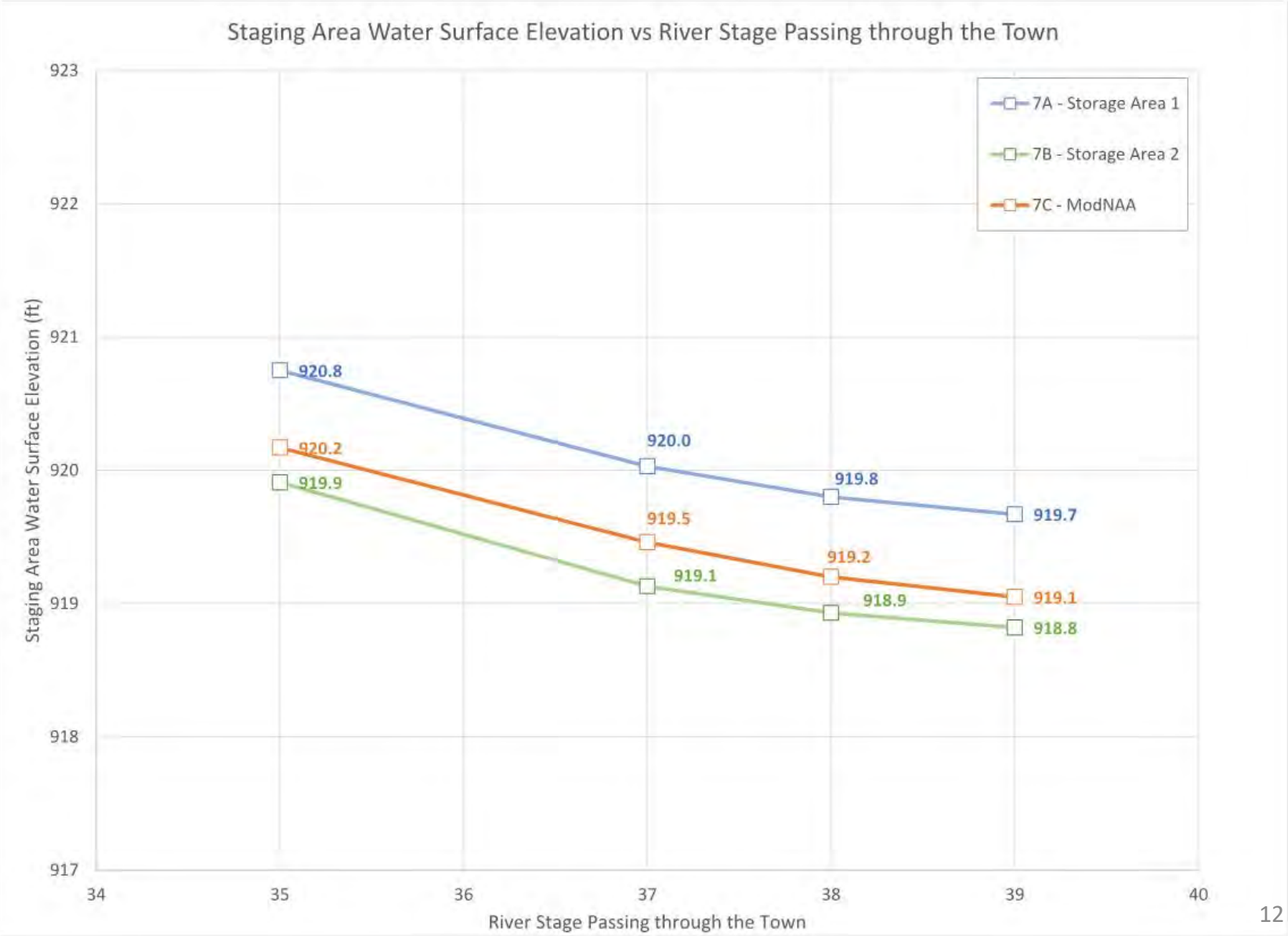


Additional Flows Through Town Summary

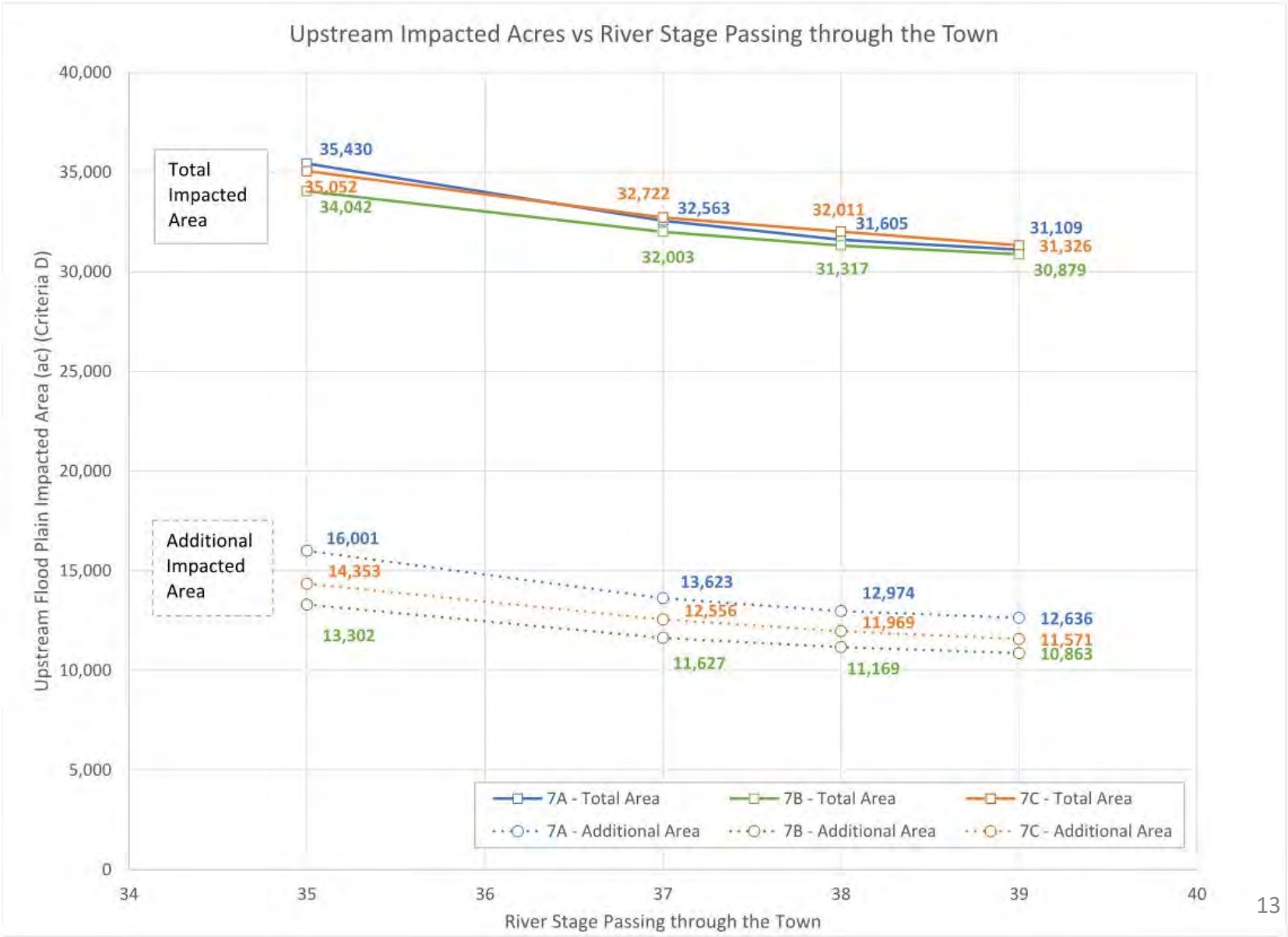
	Proposed 35’ (baseline)	37’	38’	39’
Return Frequency /Discharge (cfs)	13 year / 16,400 cfs	21 year / 20,200 cfs	28 year / 22,200 cfs	39 year / 24,500 cfs
Cost (Construction and Acquisitions – FM Only)	Ongoing	$150M / 82 Additional Homes	$330M / 168 Additional Homes	$420M / 314 Additional Homes



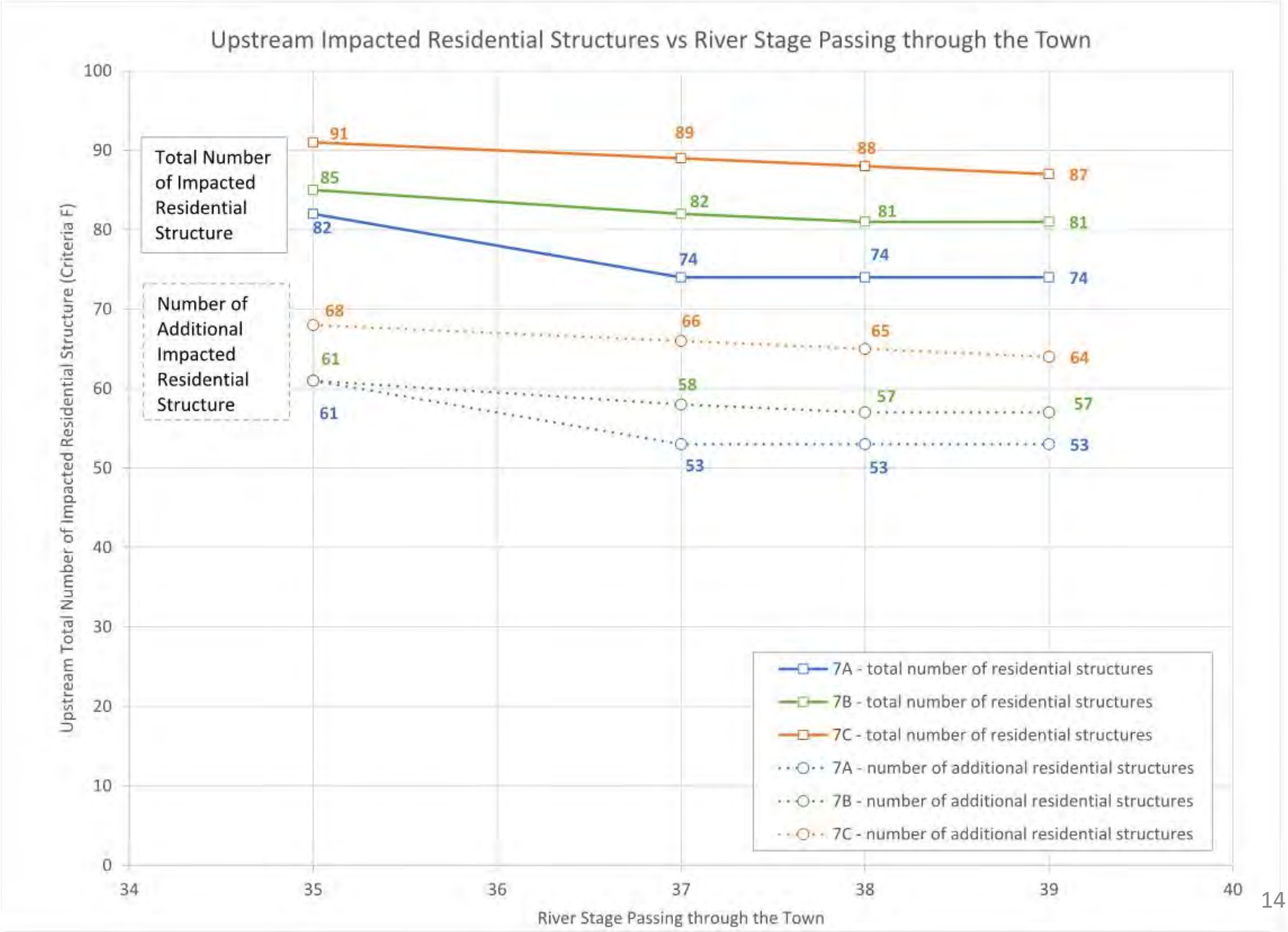
Additional Flows Through Town Summary



Additional Flows Through Town Summary

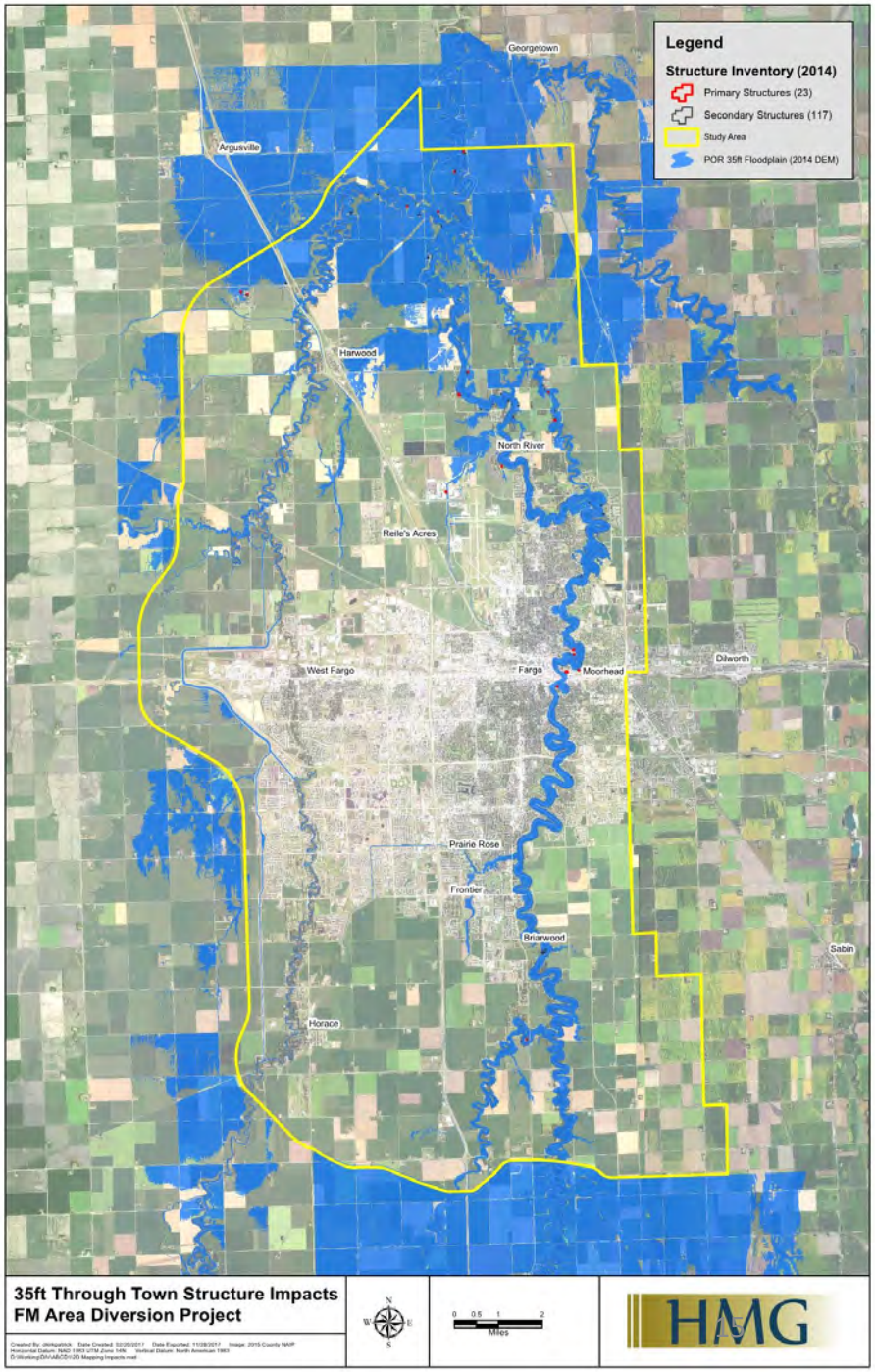


Additional Flows Through Town Summary



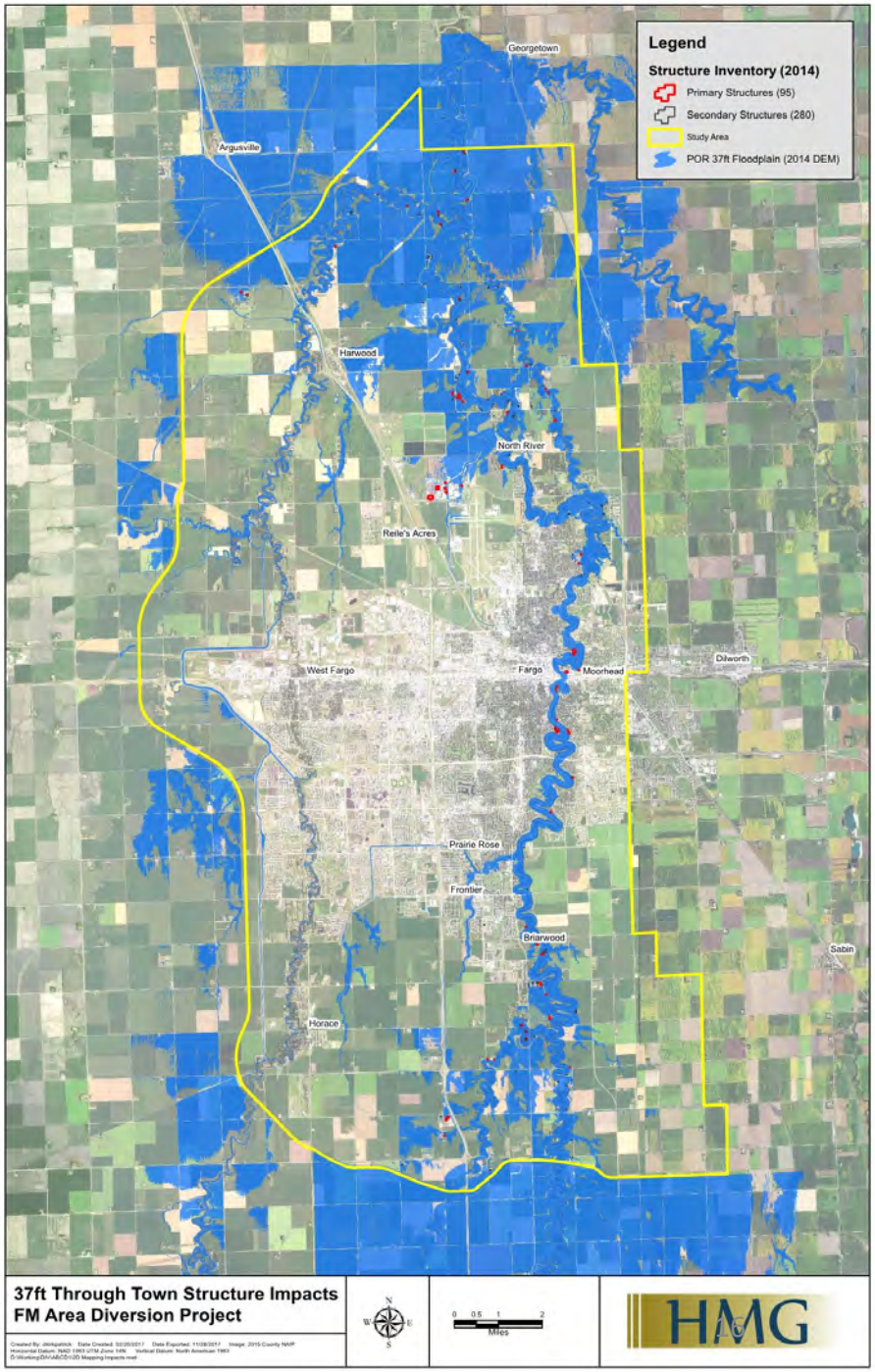
Additional Flows Through Town (RS 35')

23 Unprotected Primary Structures



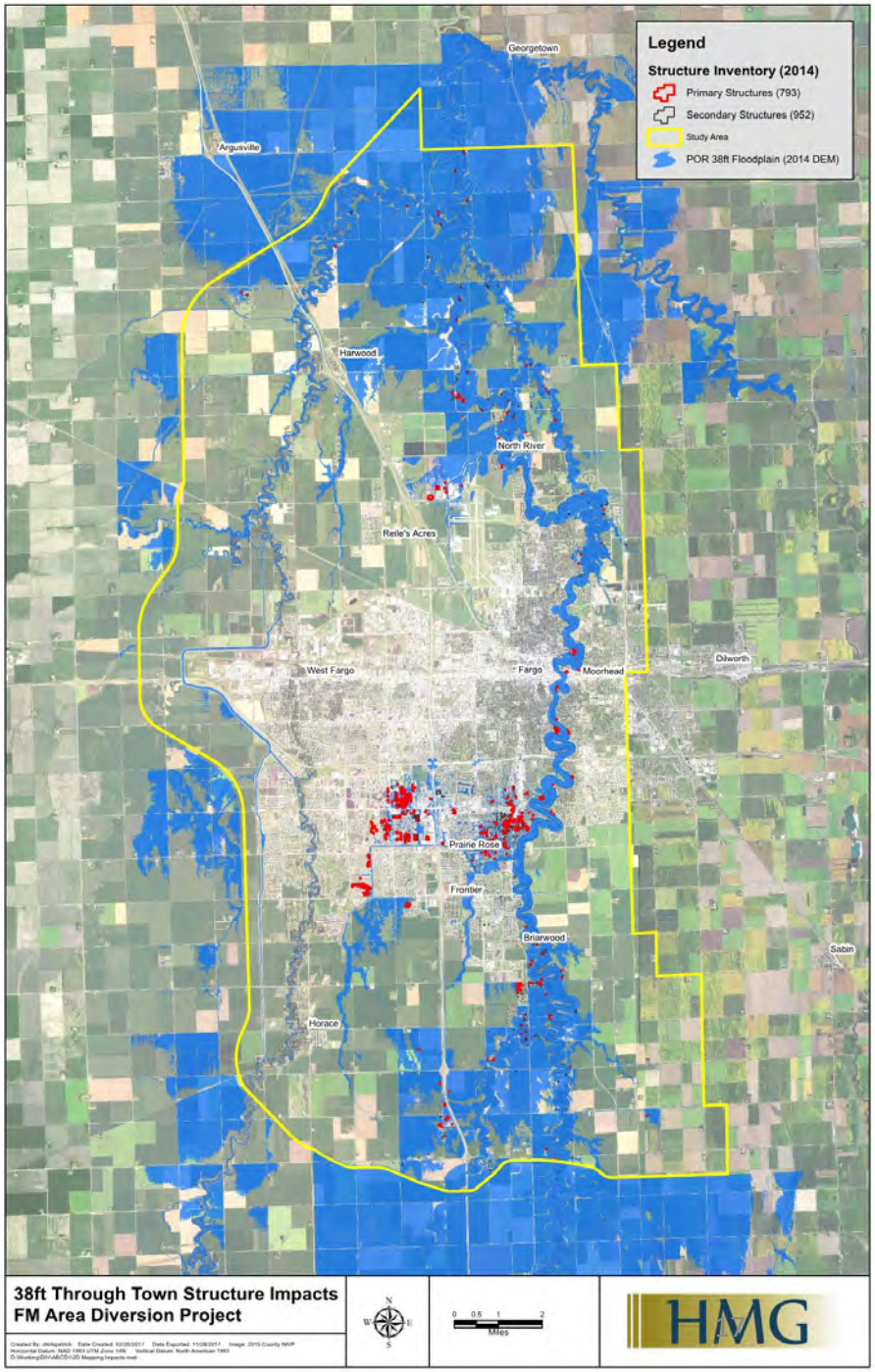
Additional Flows Through Town (RS 37')

95 Unprotected Primary Structures



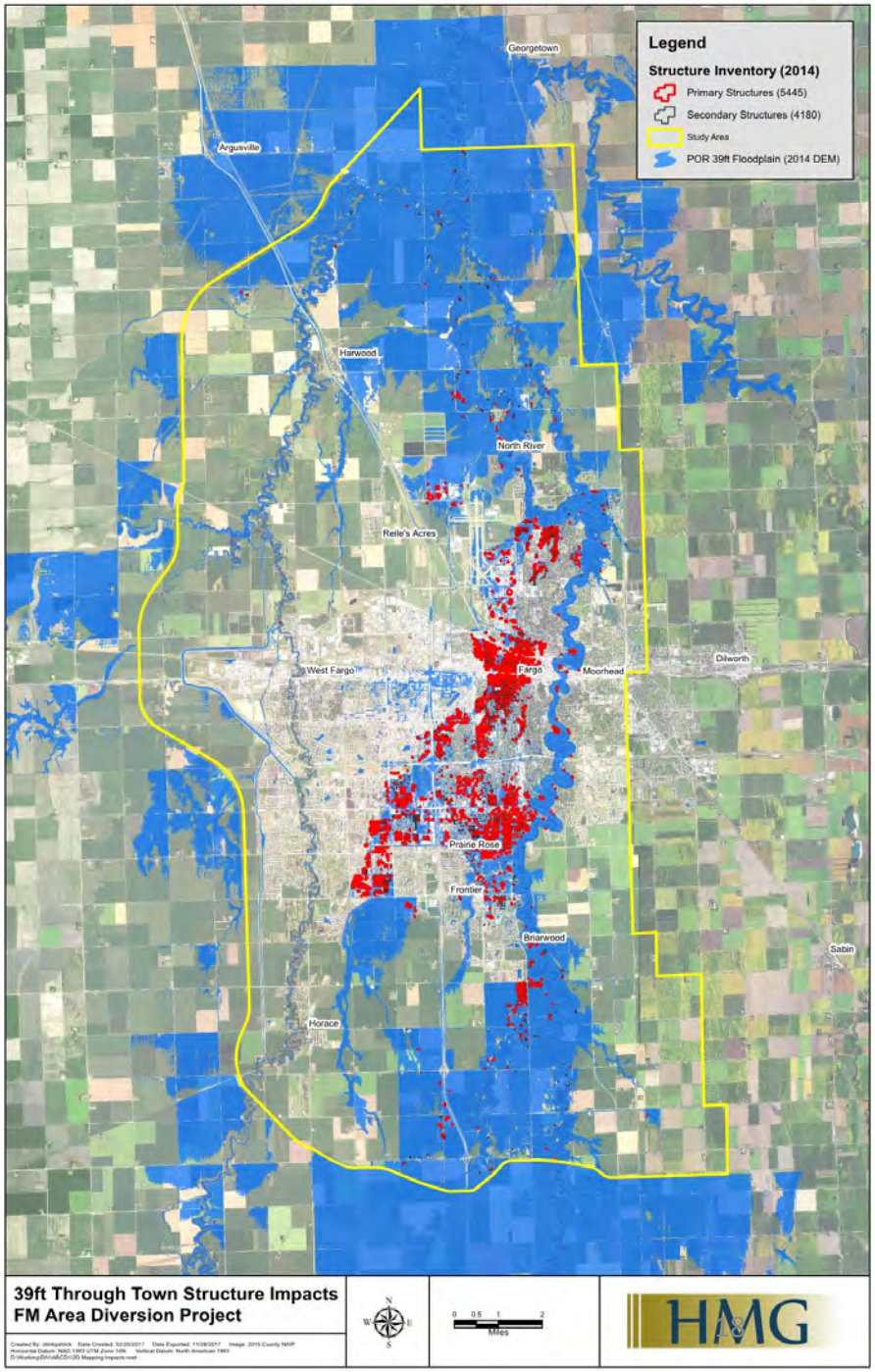
Additional Flows Through Town (RS 38')

793 Unprotected Primary Structures



Additional Flows Through Town (RS 39’)

5,445 Unprotected Primary Structures



Summary

- Western Tie Back Levee – Yes
- Eastern Tie Back – Yes
- Northern Storage/Diversion Channel Alignment – Neutral
- Additional Flows Through Town
  - RS 35 feet
  - RS 37 feet - Yes
  - RS 38 feet
  - RS 39 feet

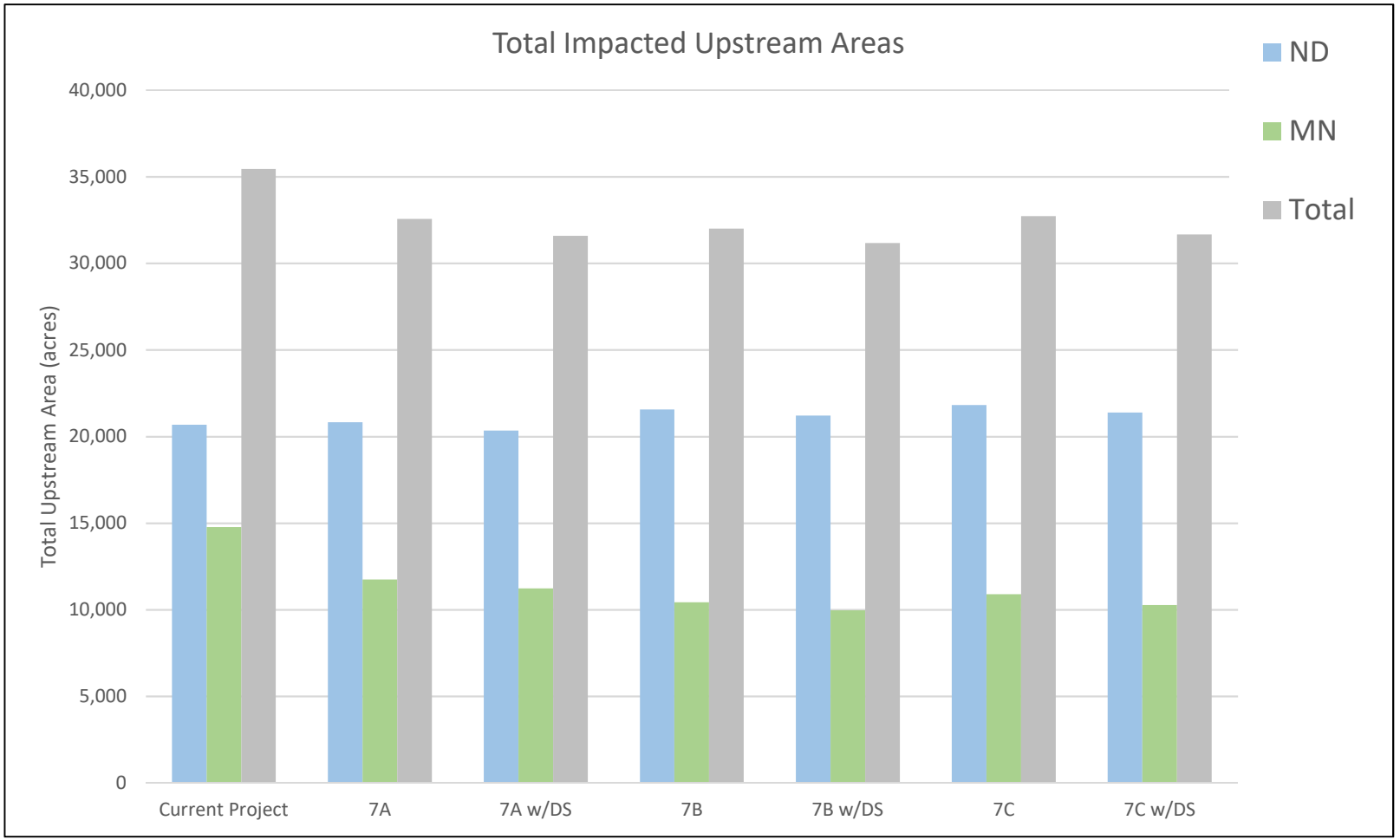
Change Operation Plan to Allow up to 6 inches of Downstream Impacts (RS 37)

Reference Point	7A	7A w/ DS	7B	7B w/DS	7C	7C w/DS
Drayton, ND Impact	+0.03’	**+0.10’**	+0.03’	**+0.10’**	+0.03’	**+0.10’**
Grand Forks, ND Gage Impact	+0.05’	**+0.23’**	+0.05’	**+0.23’**	+0.03’	**+0.22’**
Climax, MN Impact	-0.05’	**+0.49’**	-0.05’	**+0.49’**	-0.10’	**+0.47’**
Halstad, MN Impact	-0.06’	**+0.18’**	-0.06’	**+0.18’**	-0.08’	**+0.17’**
Hendrum, MN Impact	-0.14’	**+0.21’**	-0.14’	**+0.21’**	-0.16’	**+0.20’**
Perley, MN Impact	-0.06’	**+0.11’**	-0.06’	**+0.11’**	-0.07’	**+0.11’**
Staging Area Elevation at Dam (Base/Change)	920.03 / N/A	**919.65 / -0.38’**	919.13 / N/A	**918.80 / -0.33’**	919.46 / N/A	**919.02 / -0.44’**

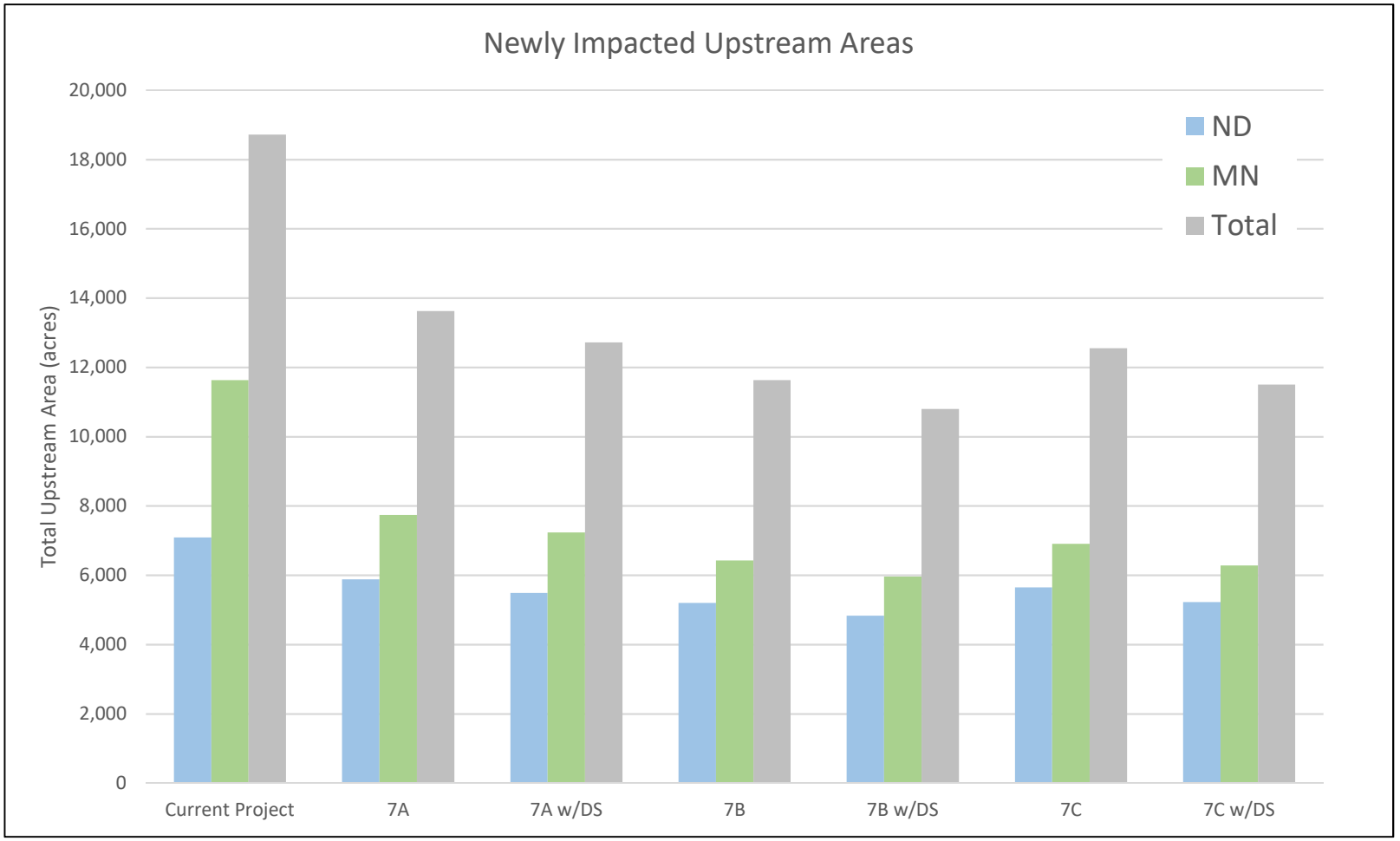
Change Operation Plan to Allow up to 6 inches of Downstream Impacts (RS 37)

	7A	7A w/ DS	7B	7B w/ DS	7C	7C w/ DS
Total Impacted Upstream Area (acres)	32,563	**31,590**	32,003	**31,173**	32,722	**31,671**
Total Impacted Upstream Area – ND/MN (acres)	20,821 (64%) / 11,742 (36%)	**20,354 (64%) / 11,236 (36%)**	21,572 (67%) / 10,430 (33%)	**21,206 (68%) / 9,968 (32%)**	21,816 (67%) / 10,905 (33%)	**21,392 (68%) / 10,278 (32%)**
Total Newly Impacted Upstream Area (acres)	13,623	**12,720**	11,627	**10,798**	12,556	**11,505**
Newly Impacted Upstream Area – ND/MN (acres)	5,885 (43%) / 7,739 (57%)	**5,487 (43%) / 7,233 (57%)**	5,200 (45%) / 6,427 (55%)	**4,834 (45%) / 5,964 (55%)**	5,651 (45%) / 6,904 (55%)	**5,227 (45%) / 6,278 (55%)**
Newly Impacted Upstream Area – Richland/Wilkin (acres)	442 / 418	**416 / 357**	299 / 200	**283 / 191**	337 / 239	**310 / 216**
Total Area Protected (acres)	50,491	**50,401**	48,562	**48,471**	50,810	**50,715**
Protected Area (acres - ND/MN)	41,005 (81%) / 9,486 (19%)	**40,921 (81%) / 9,480 (19%)**	39,074 (80%) / 9,488 (20%)	**38,990 (80%) / 9,481 (20%)**	41,313 (81%) / 9,498 (19%)	**41,222 (81%) / 9,493 (19%)**

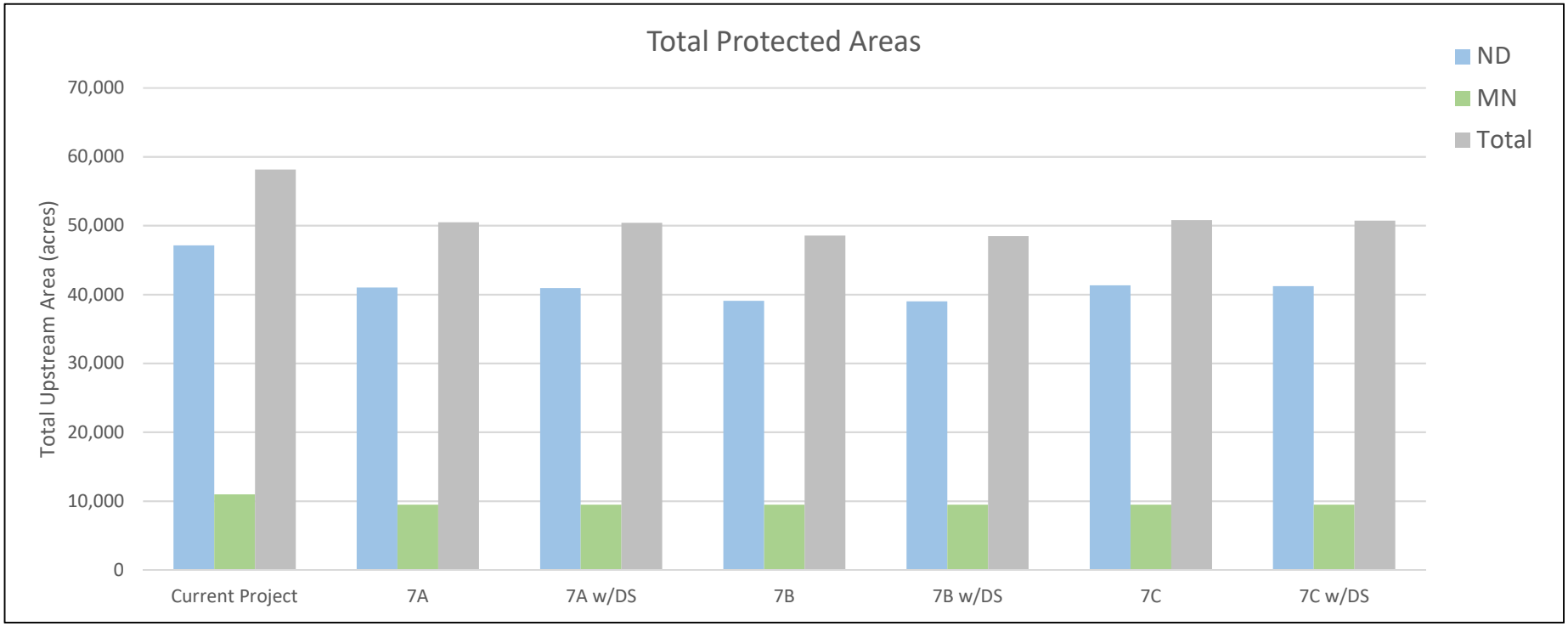
Change Operation Plan to Allow up to 6 inches of Downstream Impacts (RS 37)



Change Operation Plan to Allow up to 6 inches of Downstream Impacts (RS 37)



Change Operation Plan to Allow up to 6 inches of Downstream Impacts (RS 37)



Change Operation Plan to Allow up to 6 inches of Downstream Impacts (RS 37)

	7A	7A w/ DS	7B	7B w/ DS	7C	7C w/ DS
Total Upstream Residential Structures Impacted (Existing/with-Project	21 / 74	21 / 74	24 / 82	24 / 80	23 / 89	23 / 87
Upstream Residential Structures Impacted – Richland (Existing/with-Project)	0 / 2	0 / 2	0 / 1	0 / 1	0 / 2	0 / 1
Upstream Residential Structures Impacted – Wilkin (Existing/with-Project)	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2
Upstream Residential Structures Impacted - Cass (Existing/with-Project)	17 / 53	17 / 53	20 / 63	20 / 62	19 / 67	19 / 66
Upstream Residential Structures Impacted – Clay (Existing/with-Project)	2 / 17	2 / 17	2 / 16	2 / 15	2 / 18	2 / 18

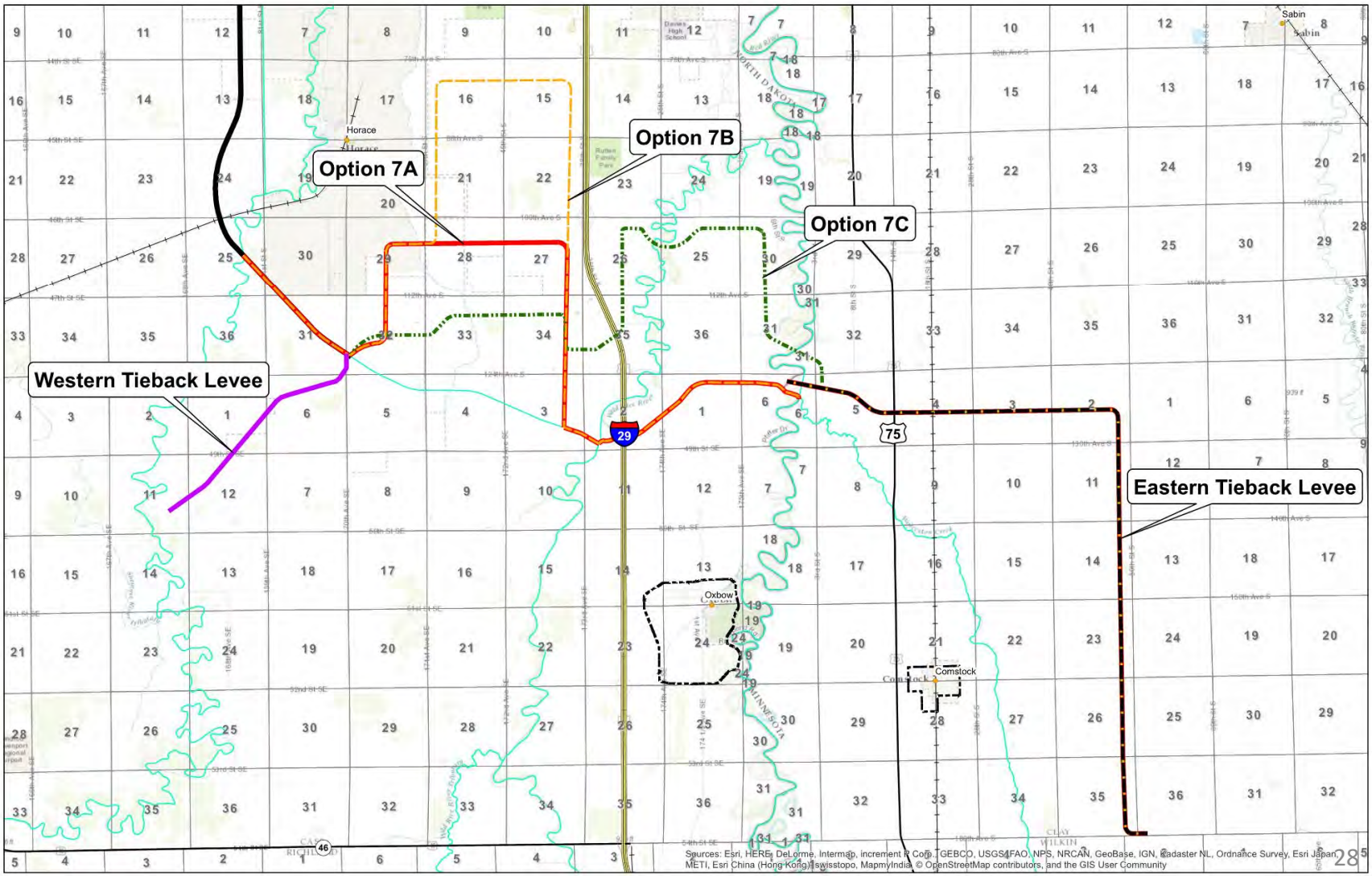
Change Operation Plan to Allow up to 6 inches of Downstream Impacts

- Operational Component that could be applied to Alternatives 7A, 7B, and 7C
- Some impact may extend beyond the U.S./Canadian border
- Generally reduces maximum staging elevation by 0.3 to 0.4 feet
- Cost depends on level of downstream mitigation required

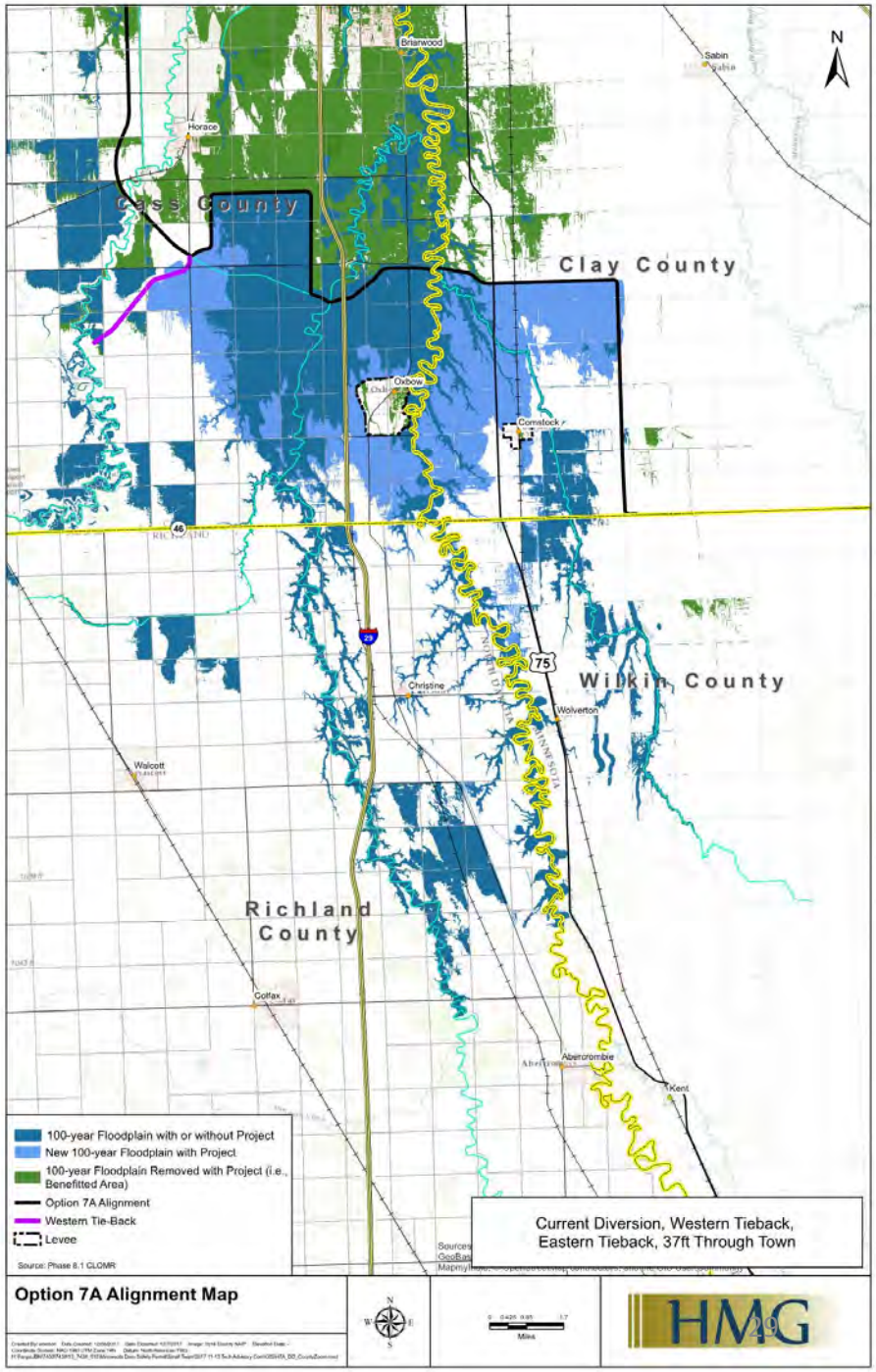
Summary

- **Western Tie Back Levee – Yes**
- **Eastern Tie Back – Yes**
- **Northern Storage/Diversion Channel Alignment – Neutral**
- **Additional Flows Through Town**
  - **RS 35 feet**
  - **RS 37 feet - Yes**
  - **RS 38 feet**
  - **RS 39 feet**
- **Allow Downstream Impacts up to 6 inches – Policy/Permit Decision**
- Change Location of Dam/Southern Embankment
  - Option 7A
  - Option 7B
  - Option 7C

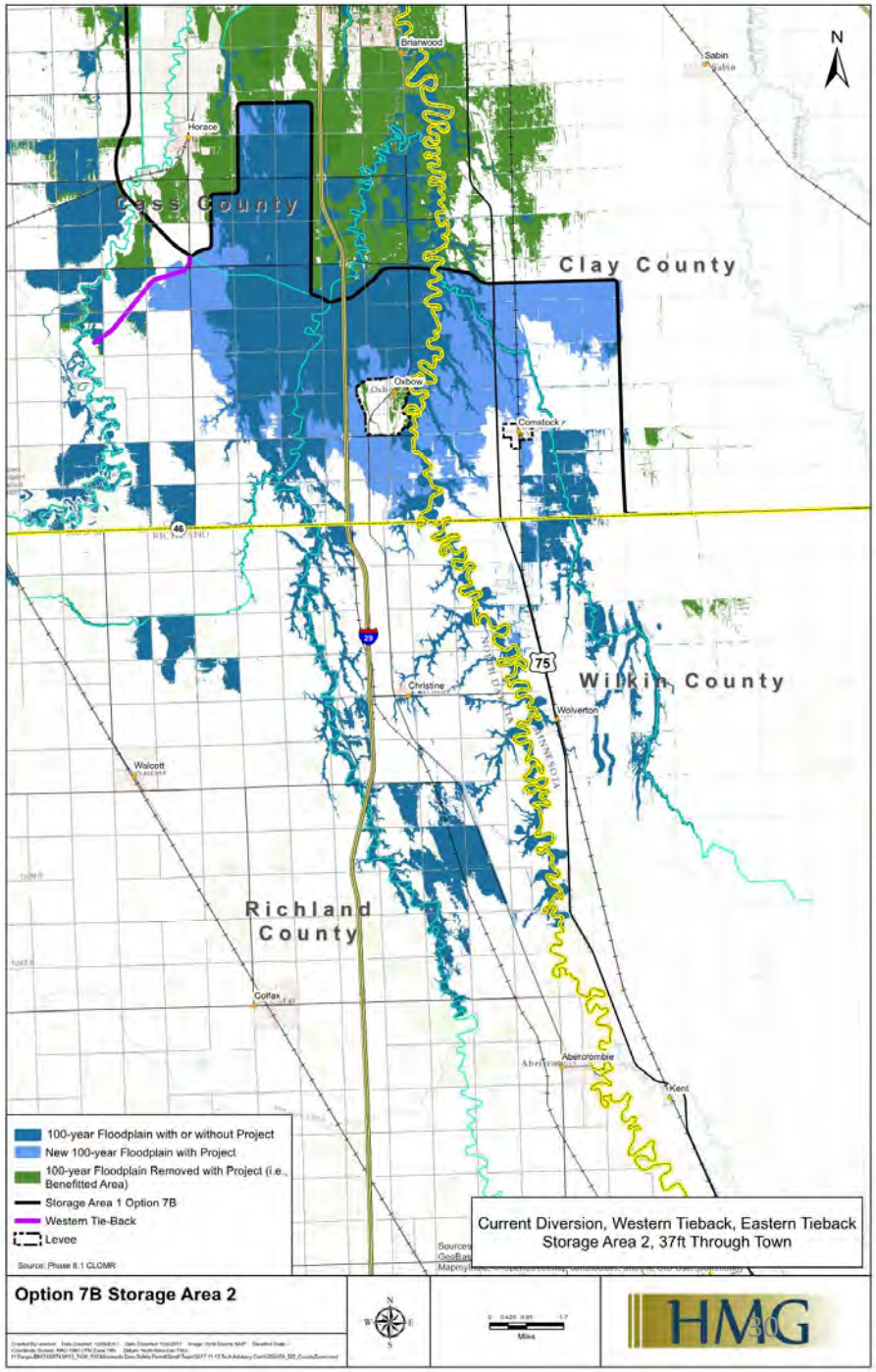
Options 7A, 7B, 7C: Dam Alignments



Option 7A


Cass County
Clay County
Wilkin County
Richland County
Briarwood
Sabin
Horace
Oxbow
Comstock
Christine
Wolverton
Walcott
Colfax
Abercrombie
Kent
N
100-year Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Option 7A Alignment
Western Tie-Back
Levee
Source: Phase 8.1 CLOMR
Current Diversion, Western Tieback, Eastern Tieback, 37ft Through Town
Option 7A Alignment Map
HMG

Option 7B


N
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Cass County
Clay County
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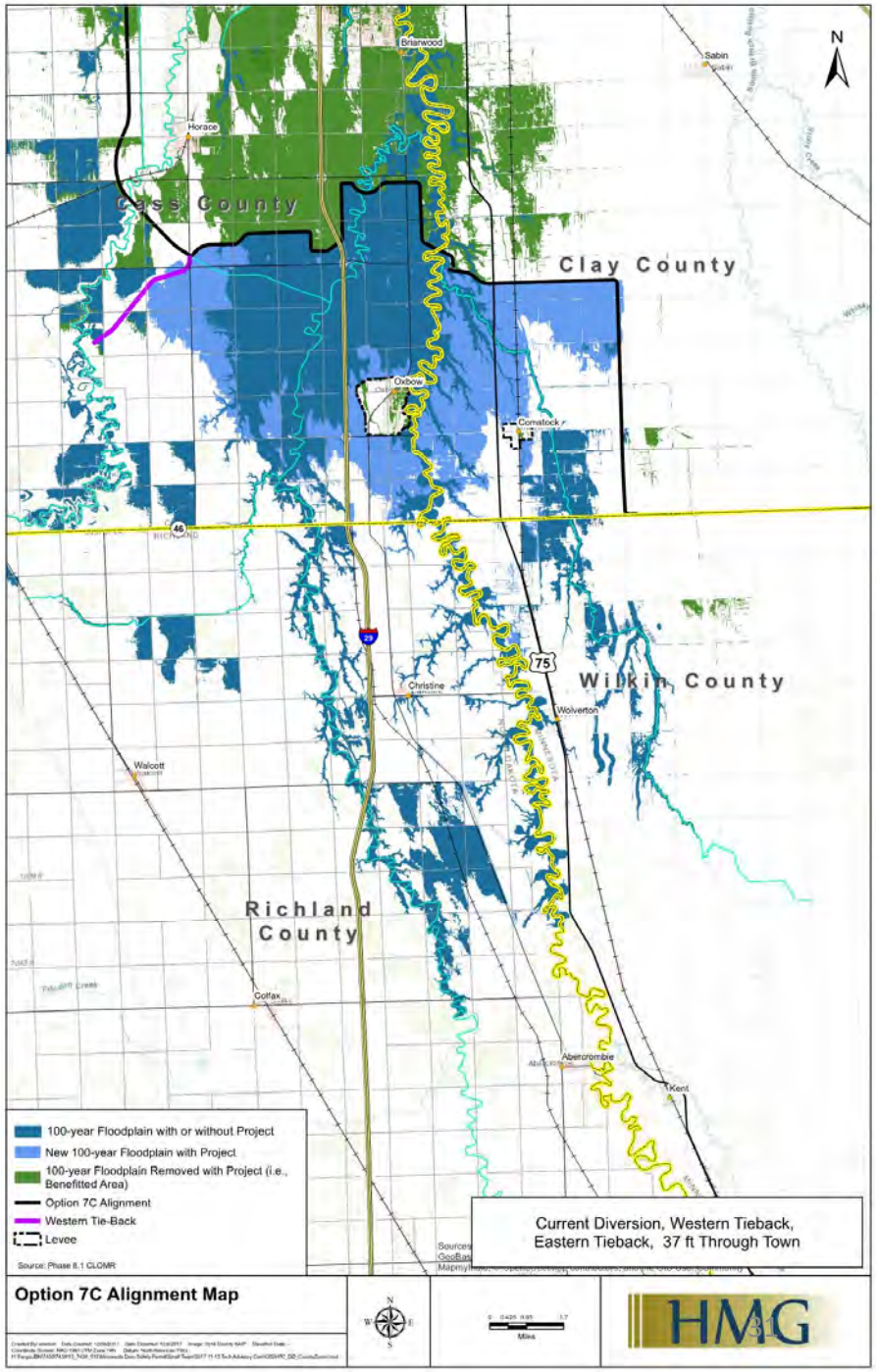
Wilkin County
Wolverton
Walcott
Richland County
Colfax
Abercrombie
Kent
100-year Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Storage Area 1 Option 7B
Western Tie-Back
Levee
Source: Phase 8.1 CLOMR
Current Diversion, Western Tieback, Eastern Tieback
Storage Area 2, 37ft Through Town
Option 7B Storage Area 2
HMG

Option 7C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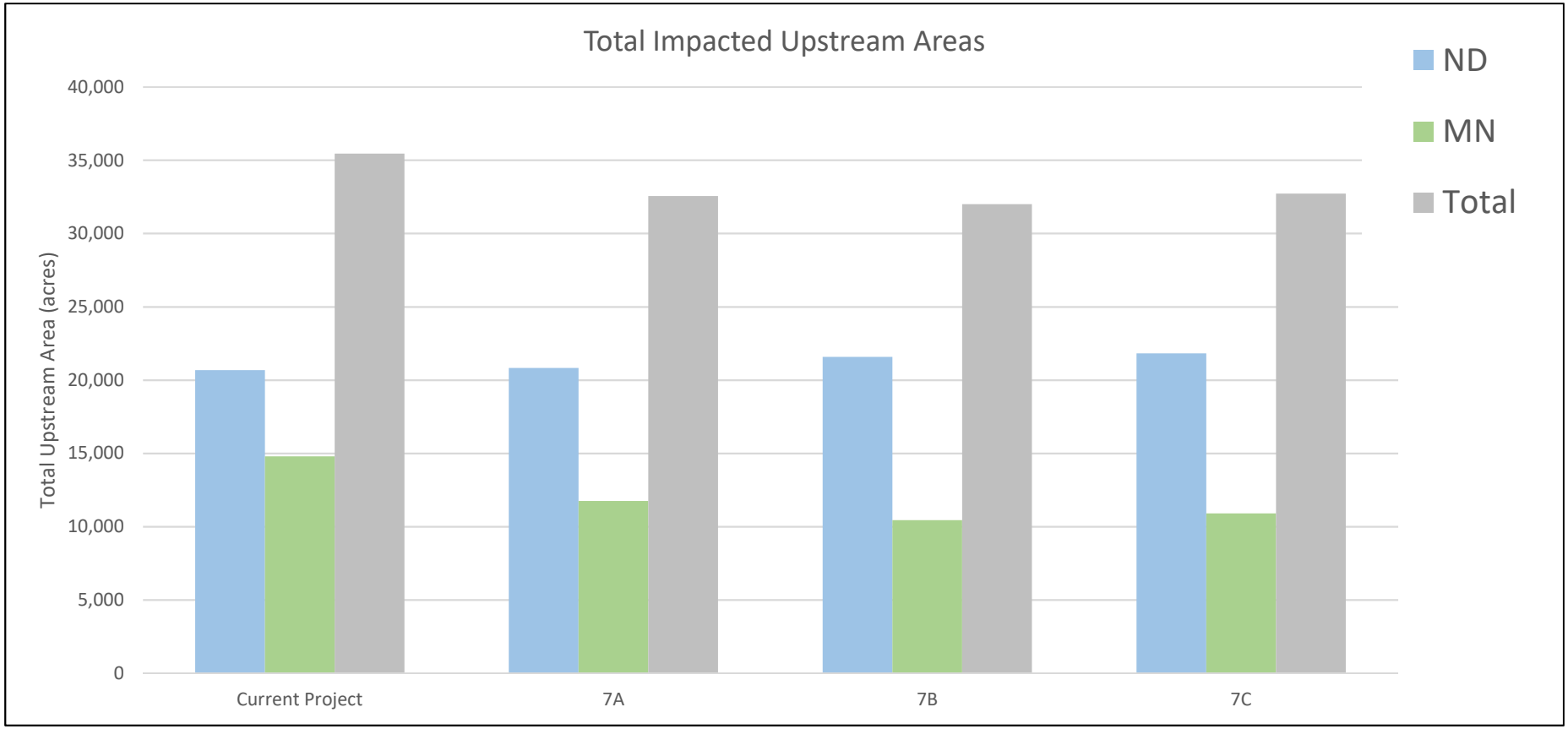
Wilkin County
Walcott
Richland County
Colfax
Abercrombie
Kent
100-year Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Option 7C Alignment
Western Tie-Back
Levee
Source: Phase 8.1 CLOMR
Current Diversion, Western Tieback, Eastern Tieback, 37 ft Through Town
Option 7C Alignment Map
HMG

Options 7A, 7B, 7C (RS37)

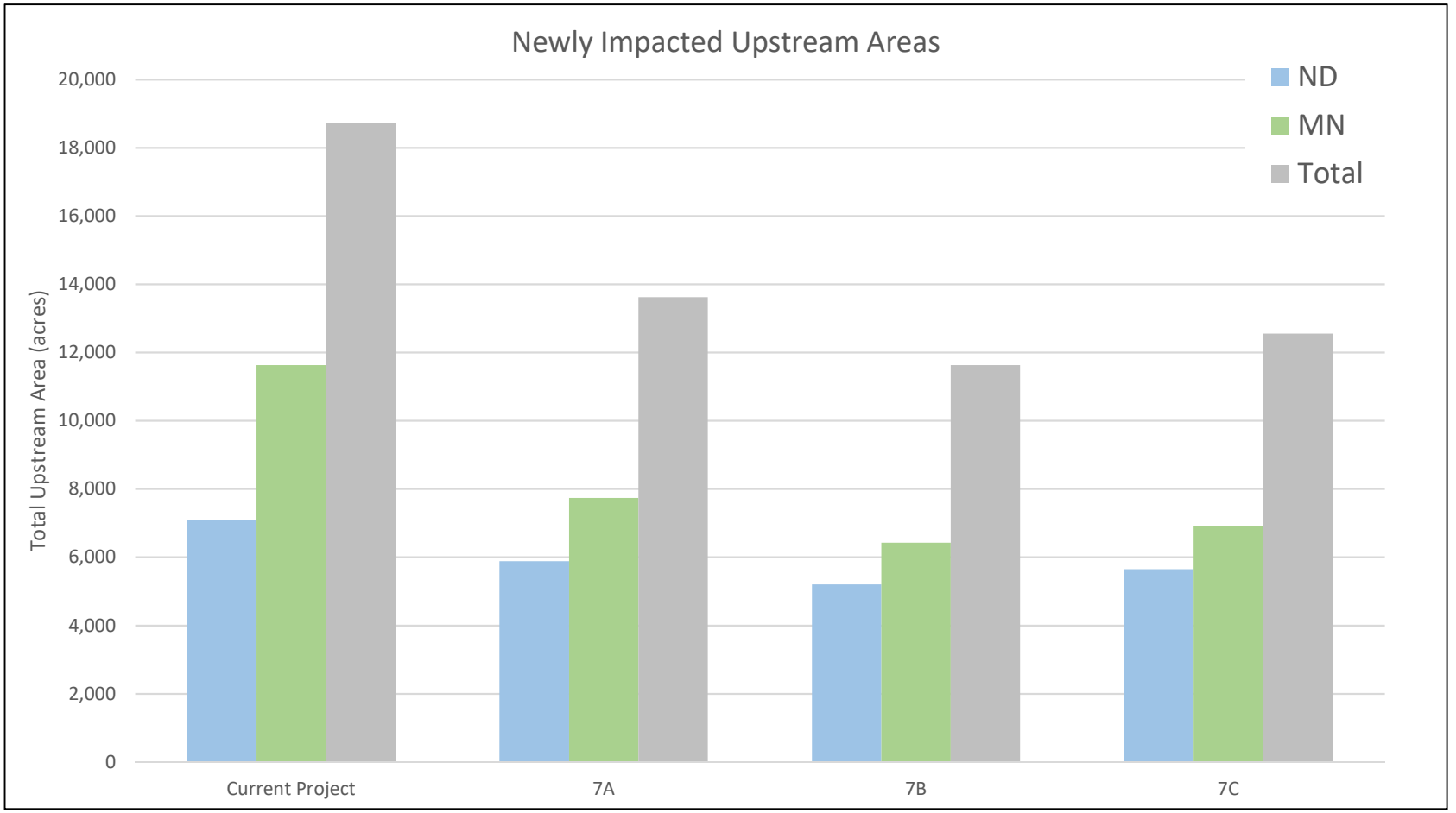
	Proposed (Baseline)	7A	7B	7C
Total Impacted Upstream Area (acres)	35,456	32,563	32,003	32,722
Total Impacted Upstream Area – ND/MN (acres)	20,676 (58%) / 14,780 (42%)	20,821 (64%) / 11,742 (36%)	21,572 (67%) / 10,430 (33%)	21,816 (67%) / 10,905 (33%)
Total Newly Impacted Upstream Area (acres)	18,720	13,623	11,627	12,556
Newly Impacted Upstream Area – ND/MN (acres)	7,088 (37%) / 11,631 (63%)	5,885 (43%) / 7,739 (57%)	5,200 (45%) / 6,427 (55%)	5,651 (45%) / 6,904 (55%)
Newly Impacted Upstream Area – Richland/Wilkin (acres)	1,124 / 1,391	442 / 418	299 / 200	337 / 239
Total Area Protected (acres)	58,137	50,491	48,562	50,810
Protected Area (acres - ND/MN)	47,145 (81%) / 10,992 (19%)	41,005 (81%) / 9,486 (19%)	39,074 (80%) / 9,488 (20%)	41,313 (81%) / 9,498 (19%)

Options 7A, 7B, 7C (RS37)

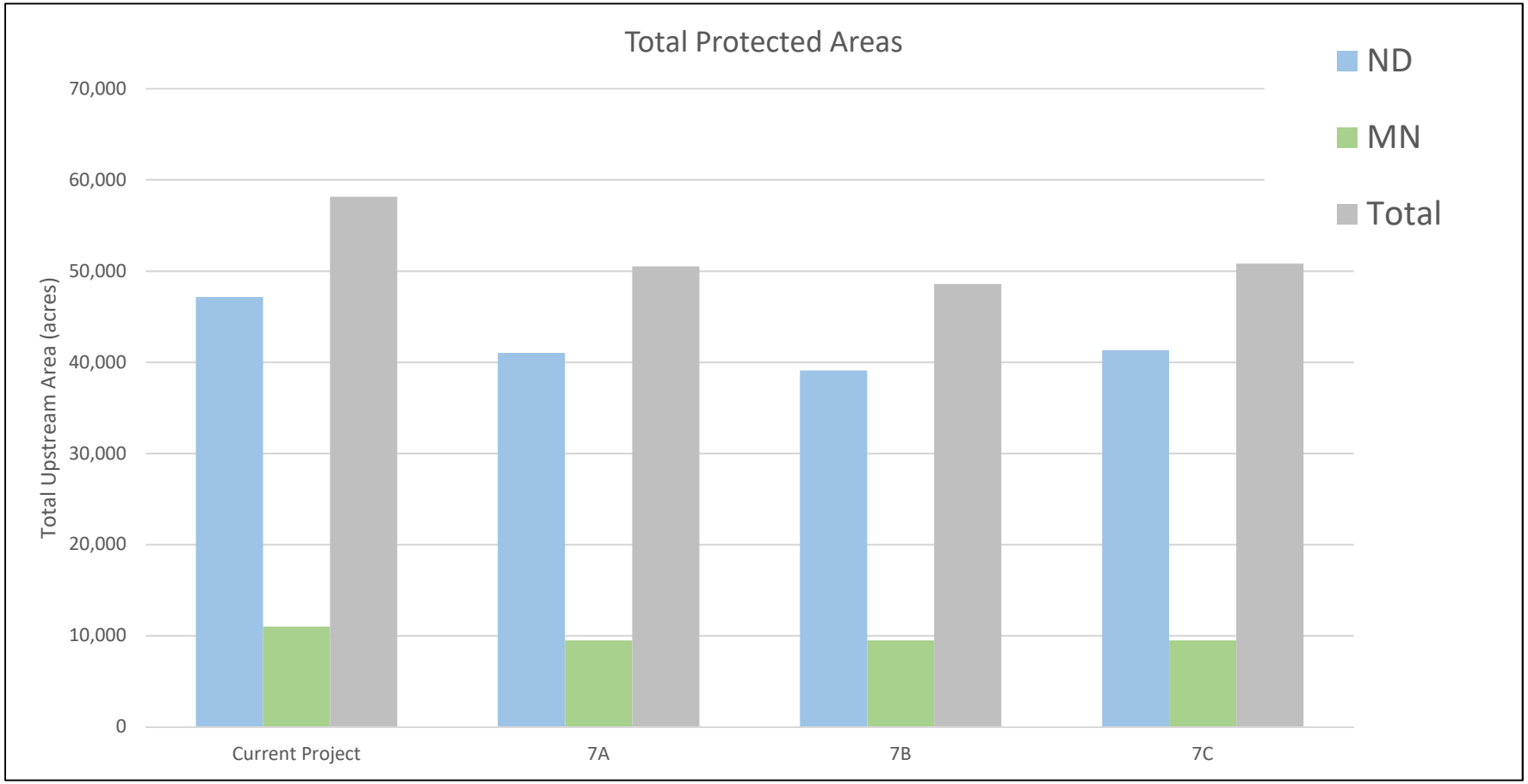


* In addition to acreages shown, there are approximately 8,000 acres in North Dakota and 500 acres in Minnesota that are located under the footprint of the diversion channel and dam and would be impacted by the Project.

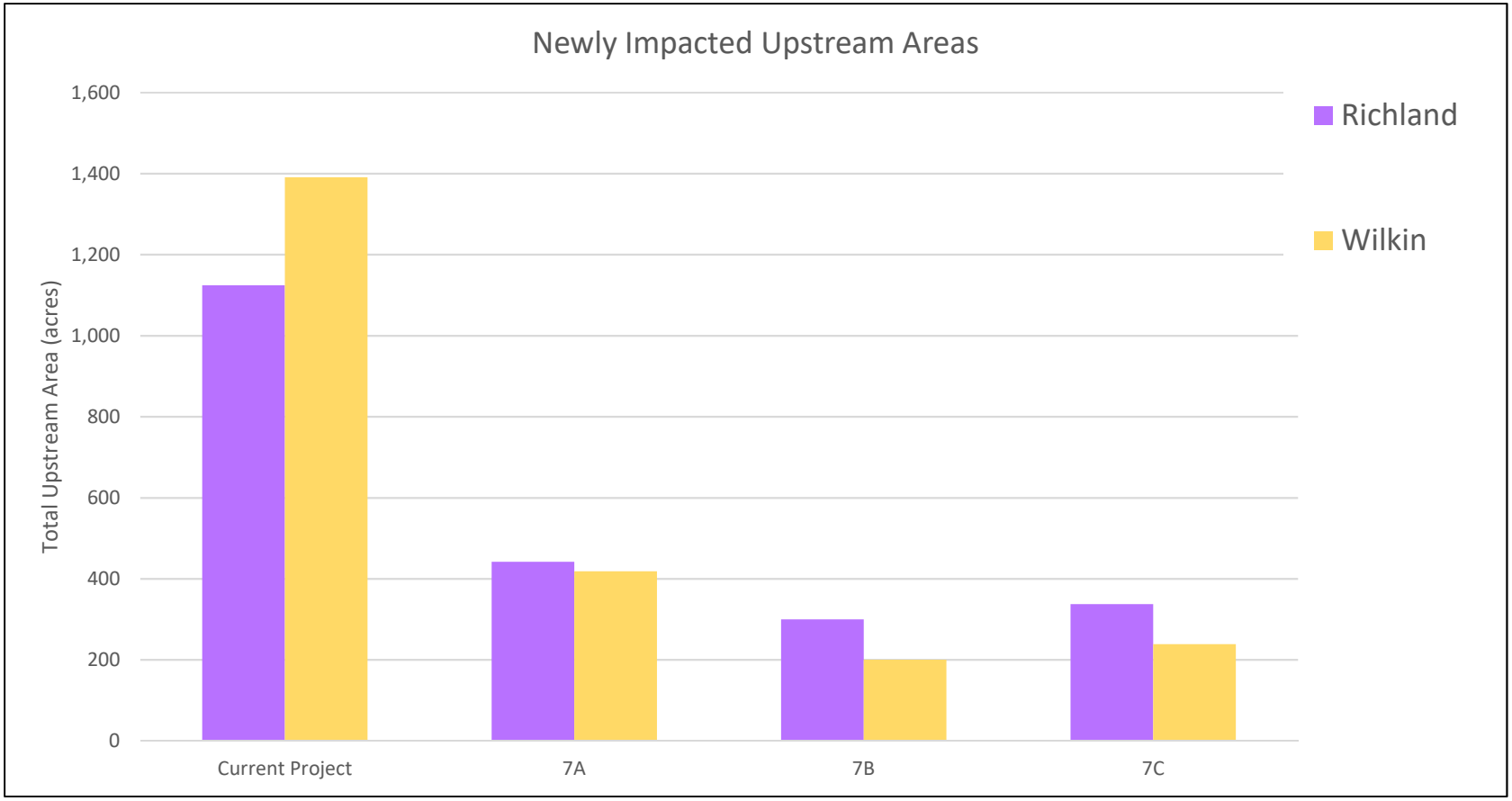
Options 7A, 7B, 7C (RS37)



Options 7A, 7B, 7C (RS37)



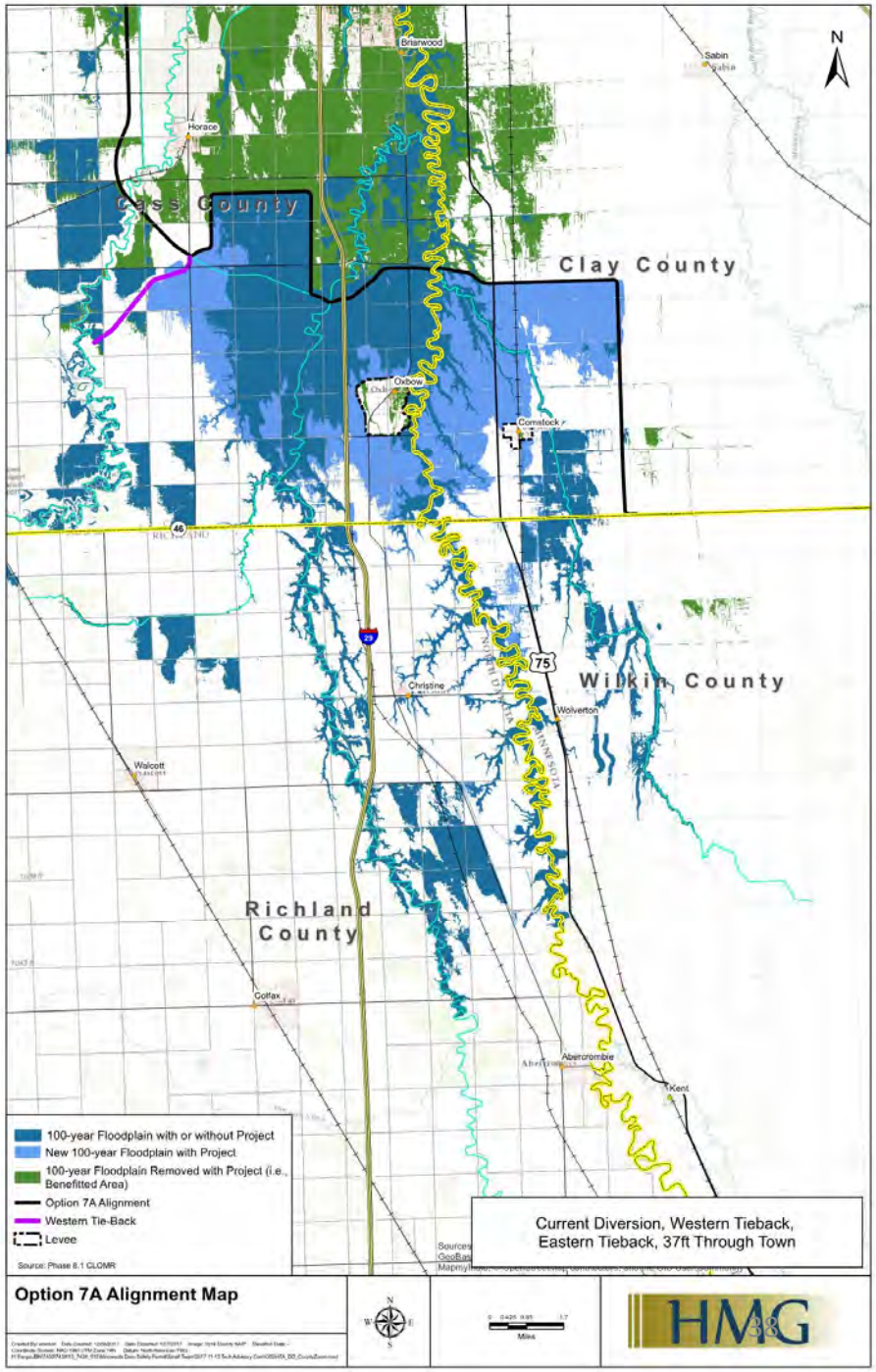
Options 7A, 7B, 7C (RS37)



Options 7A, 7B, 7C (RS37)

	Proposed (Baseline)	7A	7B	7C
Total Upstream Residential Structures Impacted (Existing/with-Project	12 / 69	21 / 74	24 / 82	23 / 89
Upstream Residential Structures Impacted – Richland (Existing/with-Project)	0 / 3	0 / 2	0 / 1	0 / 2
Upstream Residential Structures Impacted – Wilkin (Existing/with-Project)	2 / 5	2 / 2	2 / 2	2 / 2
Upstream Residential Structures Impacted - Cass (Existing/with-Project)	9 / 41	17 / 53	20 / 63	19 / 67
Upstream Residential Structures Impacted – Clay (Existing/with-Project)	1 / 20	2 / 17	2 / 16	2 / 18
Length of Dam (miles)	12.8	19.6	23.7	19.6

Option 7A


N
Briarwood
Sabin
Horace
Cass County
Clay County
Oxbow
Comstock
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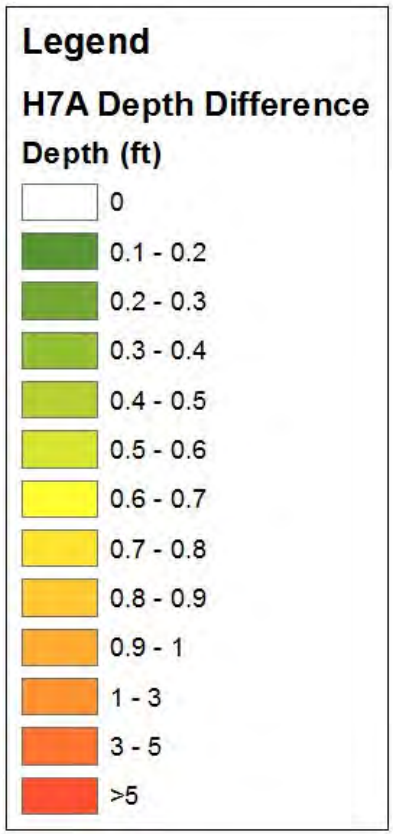
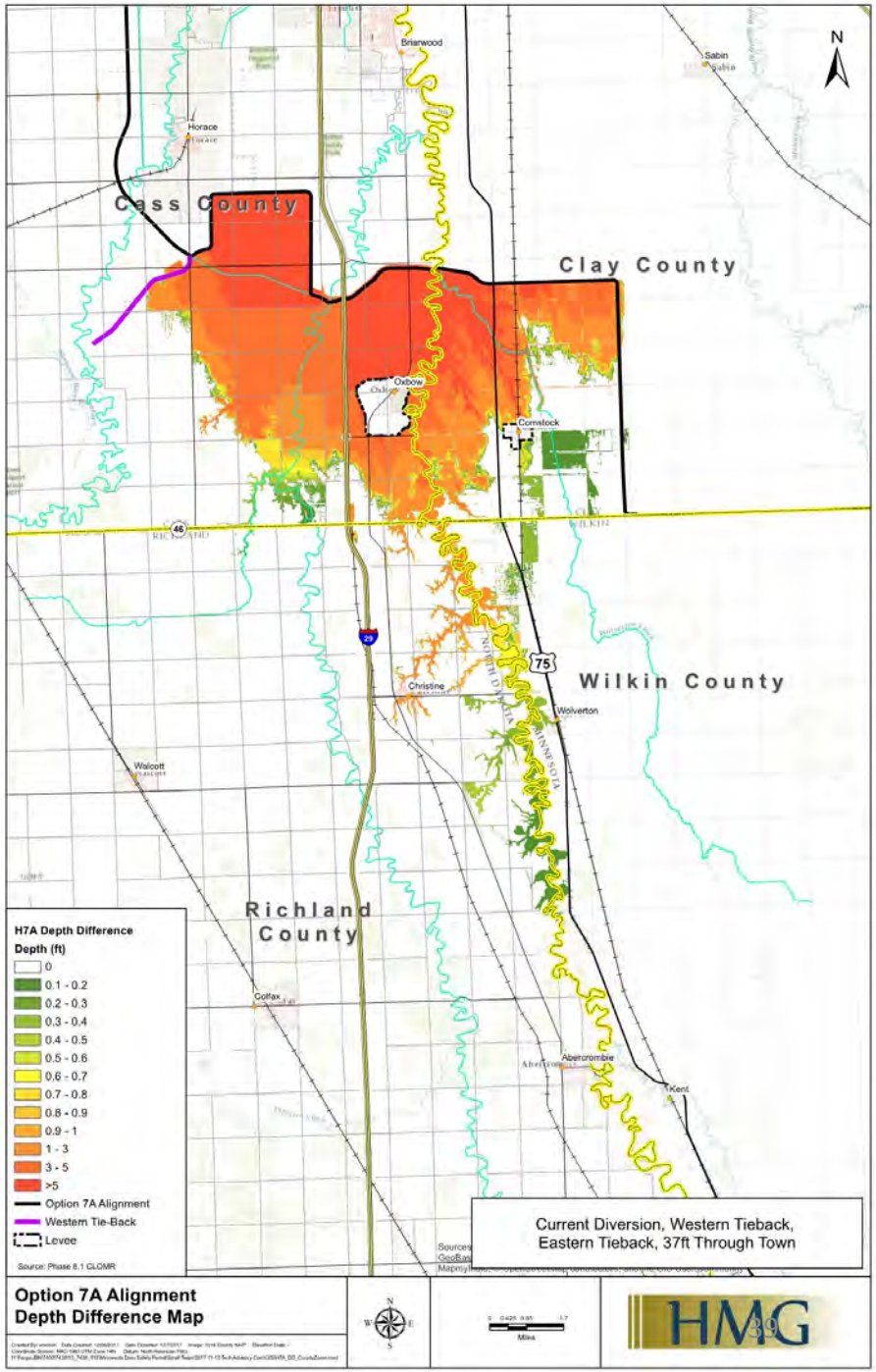
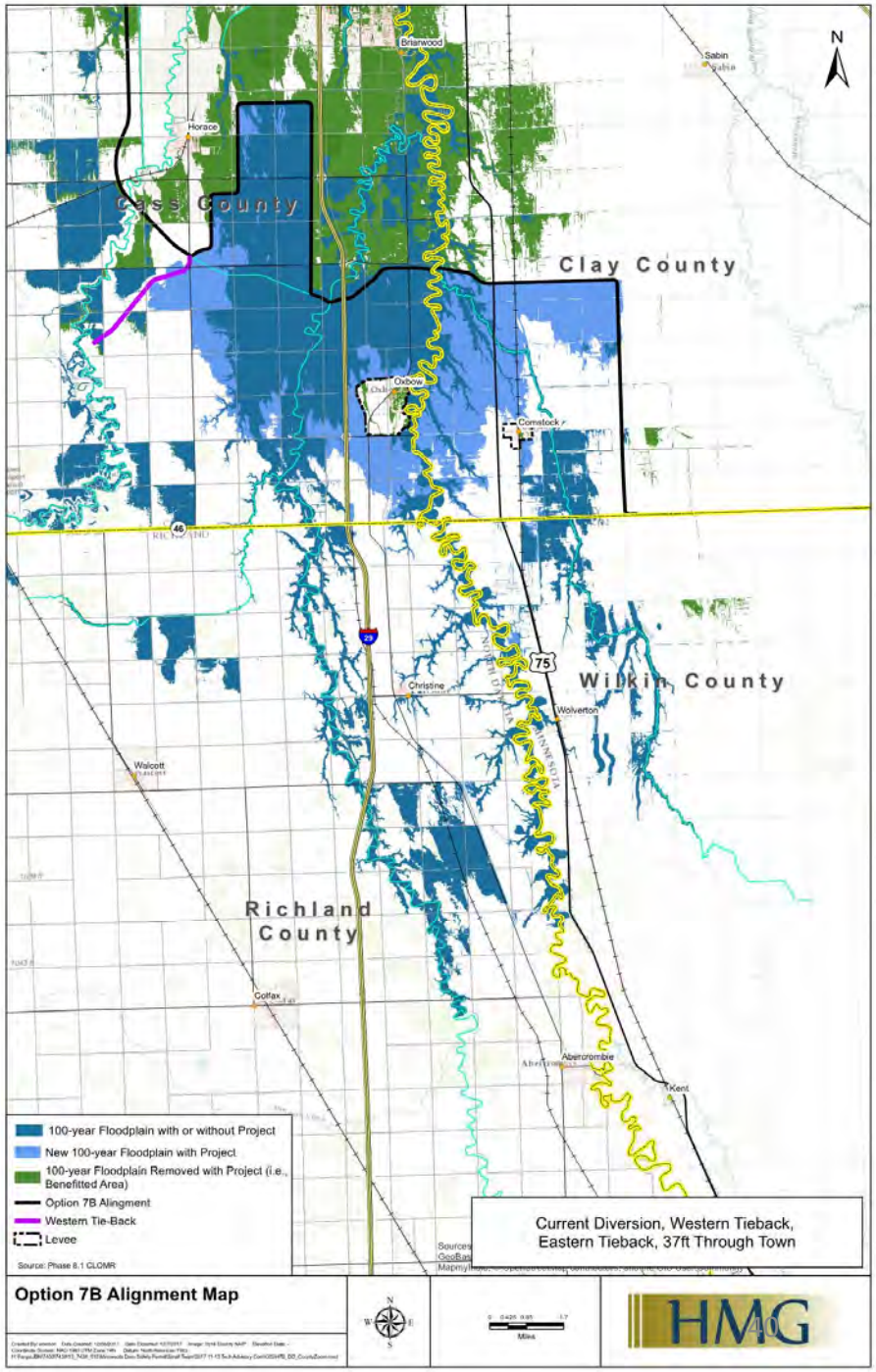
Christine
Wolverton
Wilkin County
Walcott
Richland County
Colfax
Abercrombie
Kent
100-year Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Option 7A Alignment
Western Tie-Back
Levee
Source: Phase 8.1 CLOMR
Current Diversion, Western Tieback, Eastern Tieback, 37ft Through Town
Option 7A Alignment Map
Miles
HMG

Option 7A – Additional Depth





Option 7B


Cass County
Clay County
Wilkin County
Richland County
Briarwood
Sabin
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Wolverton
Walcott
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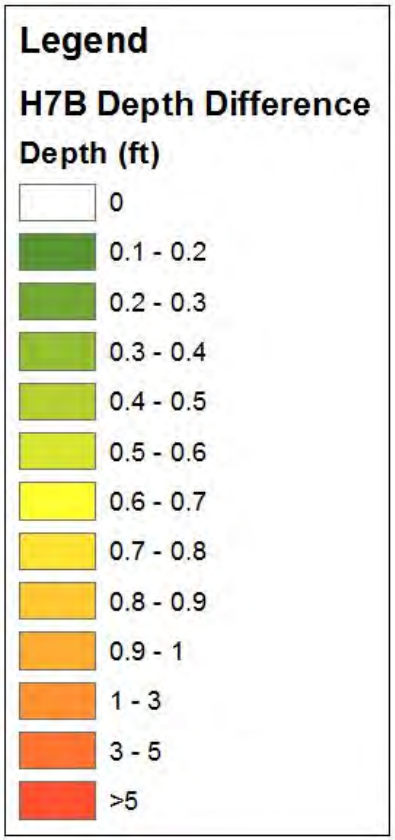
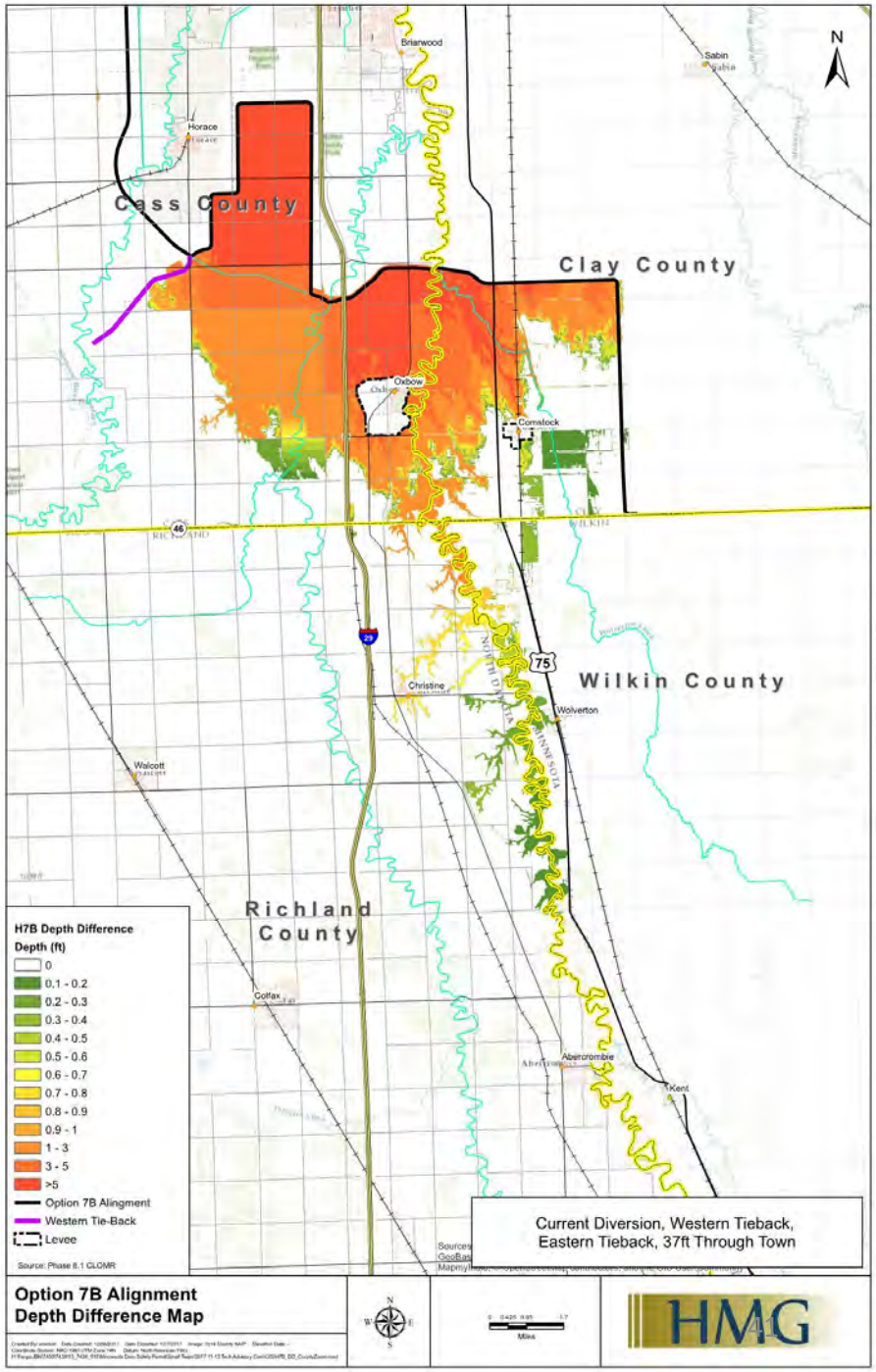
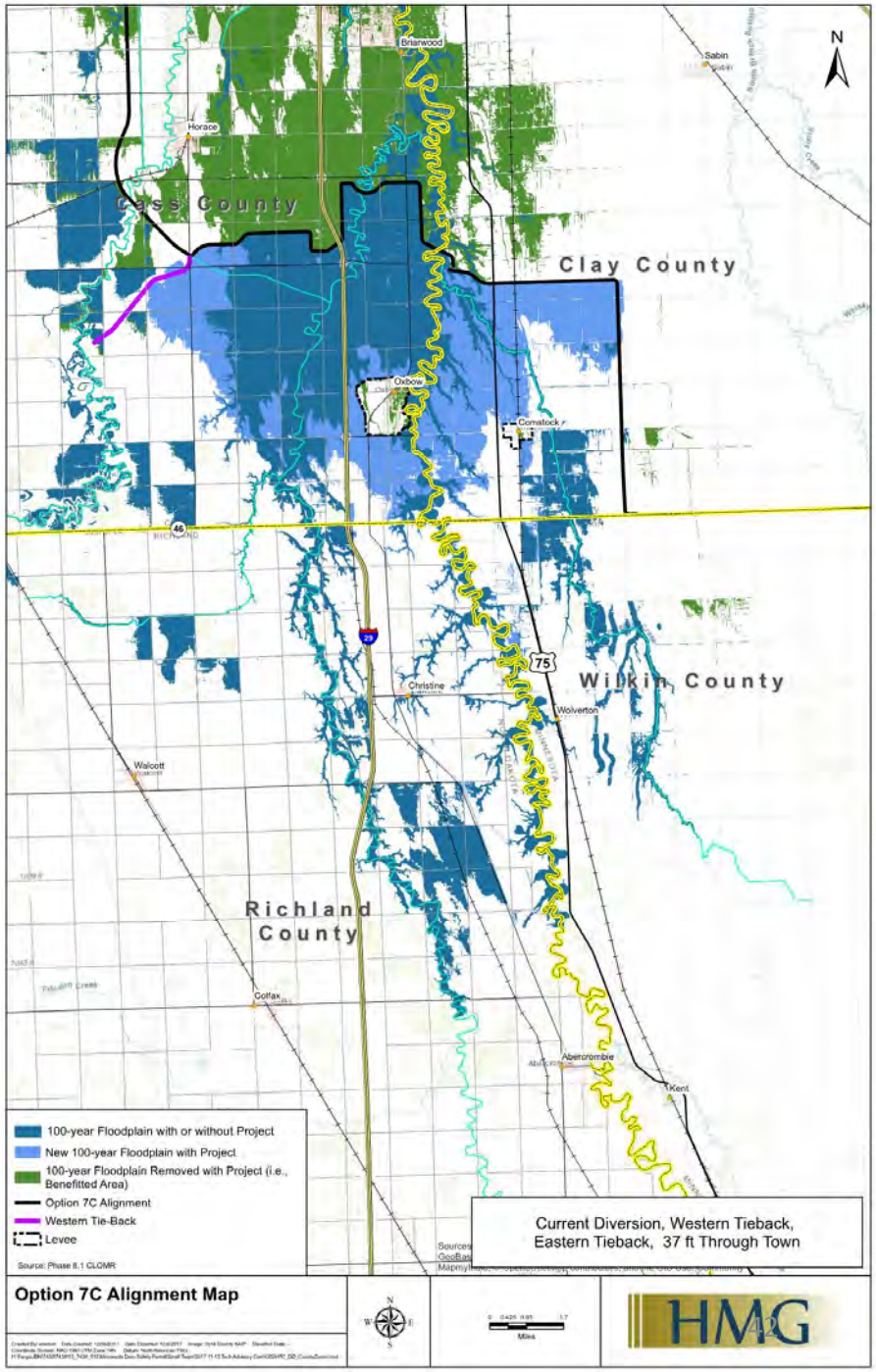
Abercrombie
Kent
N
100-year Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Option 7B Alingment
Western Tie-Back
Levee
Source: Phase 8.1 CLOMR
Current Diversion, Western Tieback, Eastern Tieback, 37ft Through Town
Option 7B Alignment Map
HMG

Option 7B – Additional Depth





Option 7C


Briarwood
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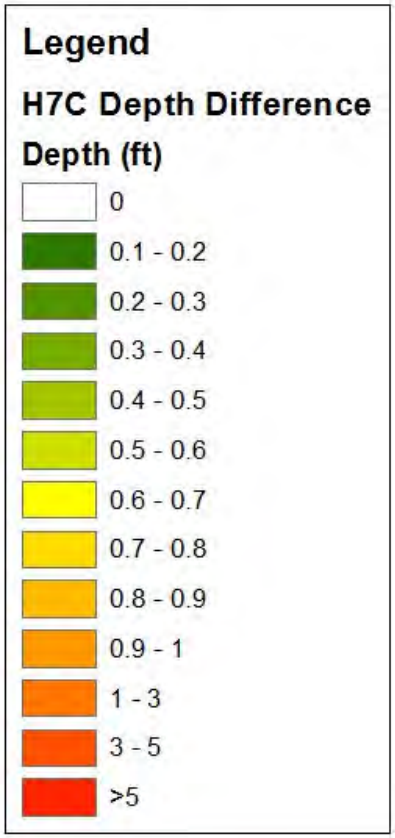
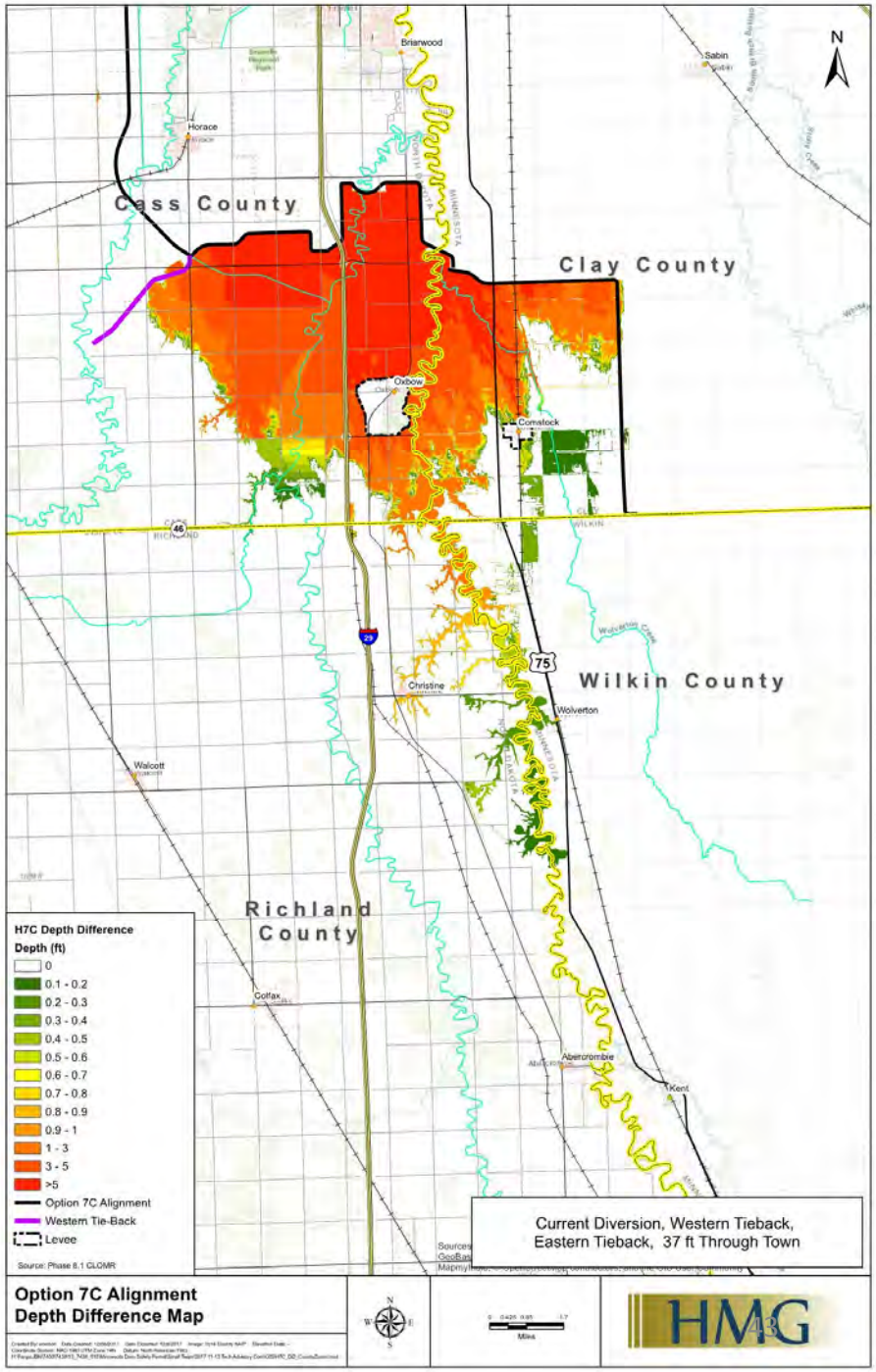
Richland County
Colfax
Abercrombie
Kent
100-year Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Option 7C Alignment
Western Tie-Back
Levee
Source: Phase 8.1 CLOMR
Current Diversion, Western Tieback, Eastern Tieback, 37 ft Through Town
Option 7C Alignment Map
N
HMG

Option 7C – Additional Depth





Options 7A, 7B, 7C (RS37) – Estimated Additional Cost Summary ($ millions)

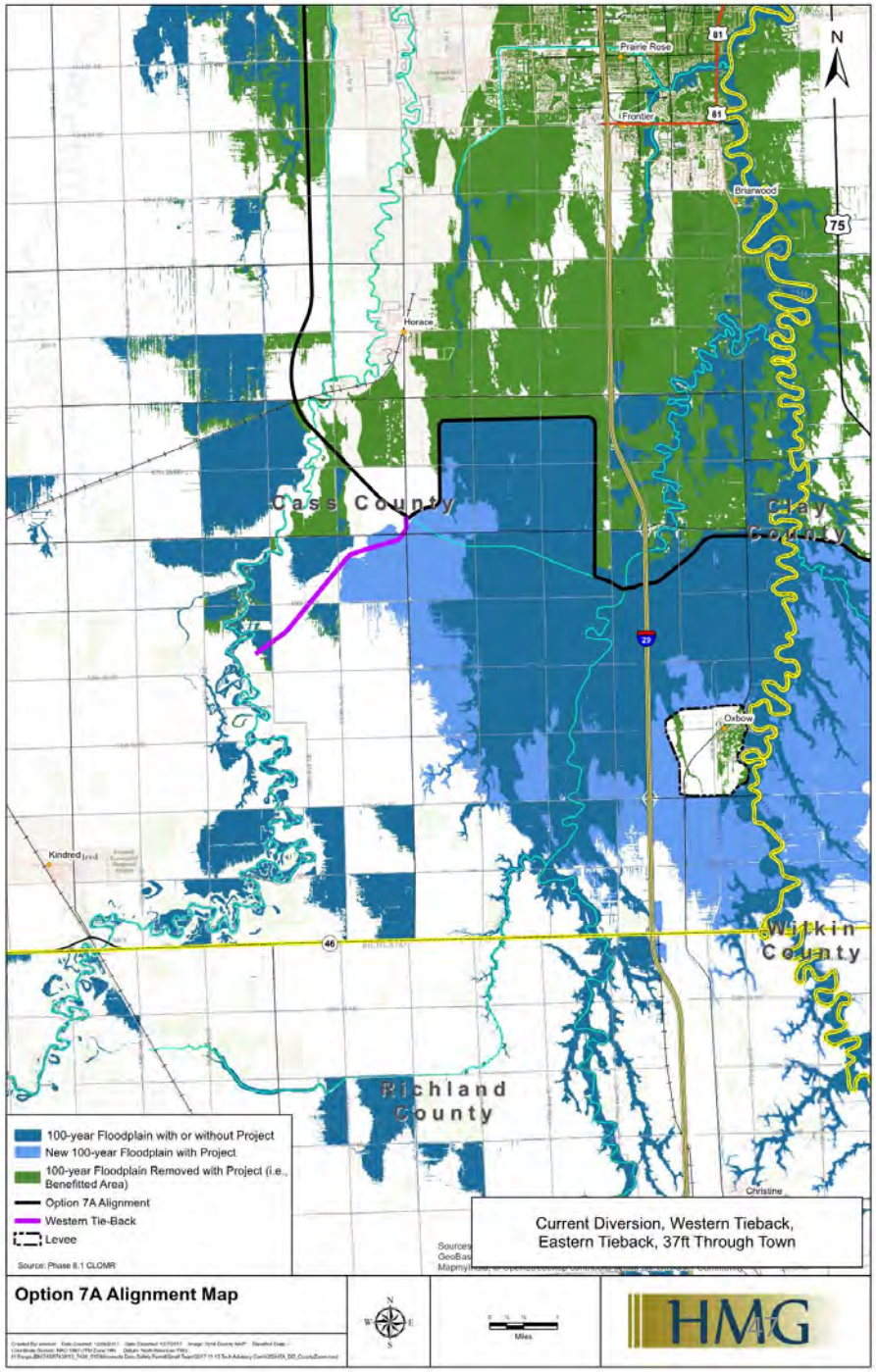
	7A	7B	7C
Western Tie-Back Levee	4	4	4
Eastern Tie-Back	15	15	15
Additional Flows Through Town (RS37')	150	150	150
Change Location of Dam	135	270	180
Total	304	439	349
Potential Cost Reductions (Lower grade raises, Comstock Ring Levee, etc.)	TBD	TBD	TBD

Summary

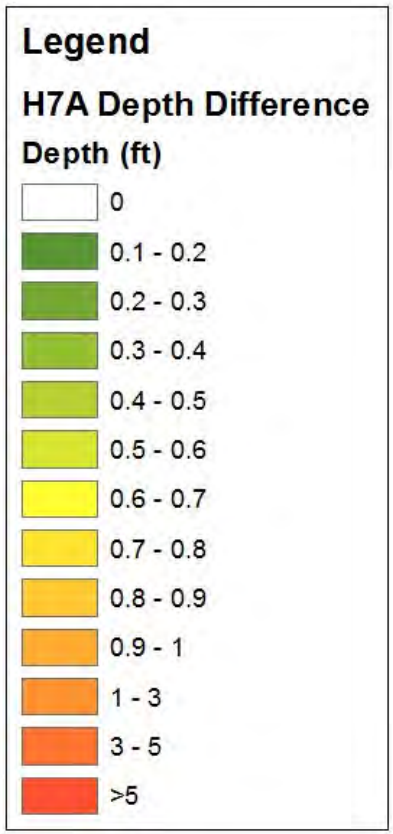
- Western Tie Back Levee – Yes
- Eastern Tie Back – Yes
- Northern Storage/Diversion Channel Alignment – Neutral
- Additional Flows Through Town
  - RS 35 feet
  - RS 37 feet - Yes
  - RS 38 feet
  - RS 39 feet
- Allow Downstream Impacts up to 6 inches – Policy/Permit Decision
- **Change Location of Dam/Southern Embankment**
  - **Option 7A**
  - **Option 7B**
  - **Option 7C**

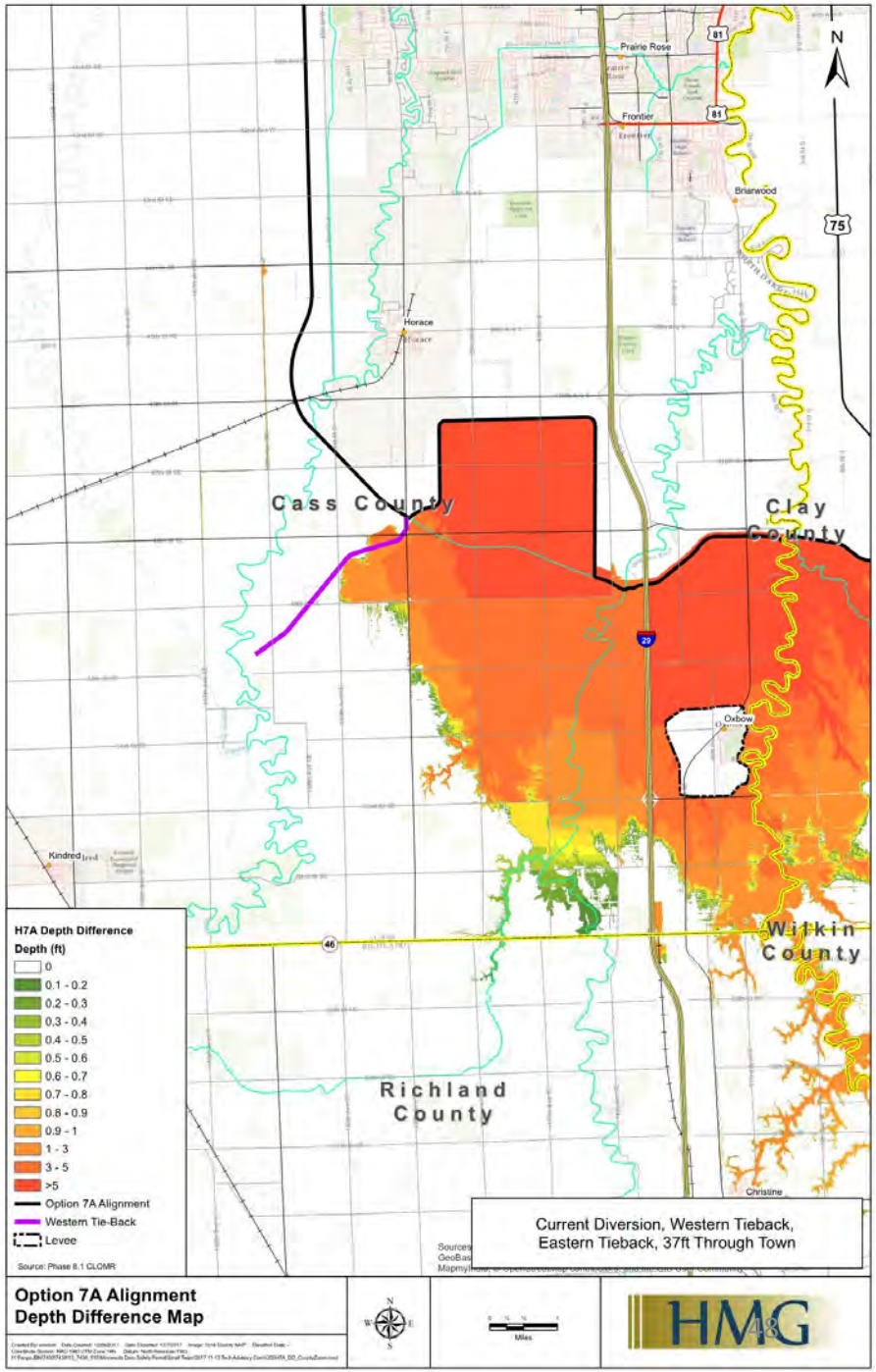
Discussion

Option 7A – Cass County

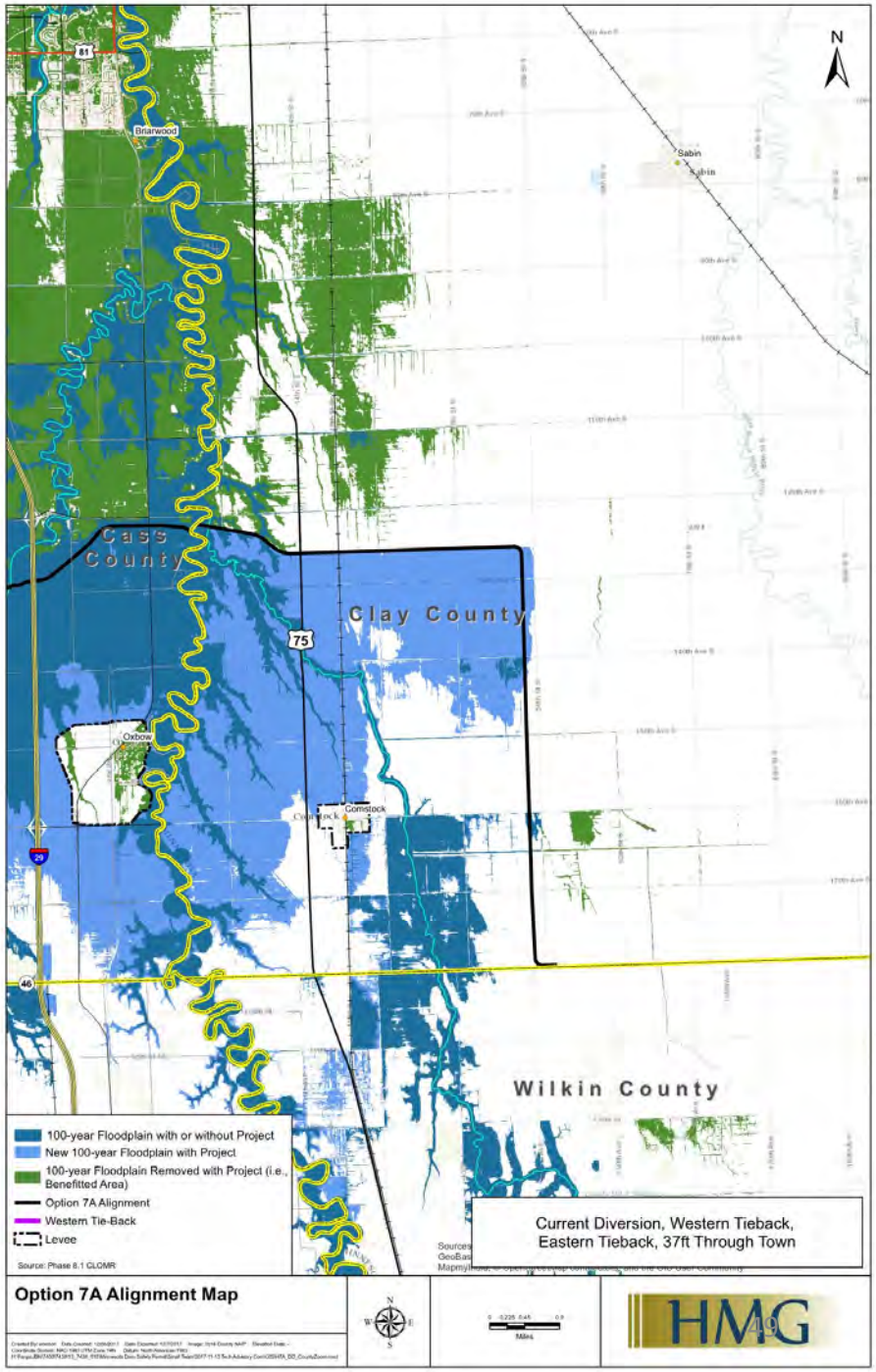


Option 7A – Cass County Additional Depth

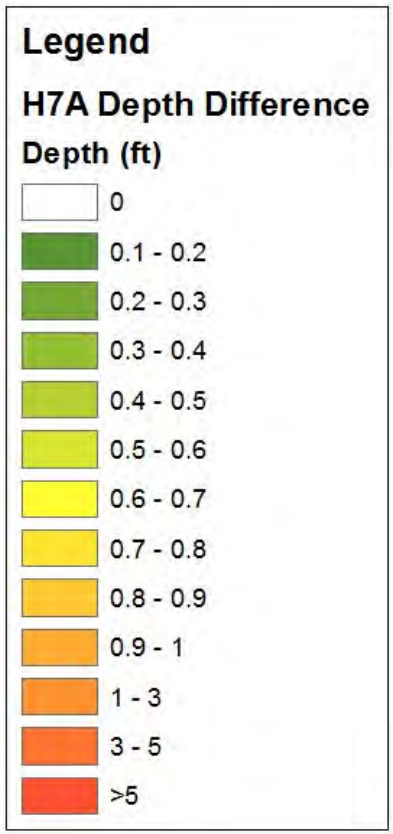


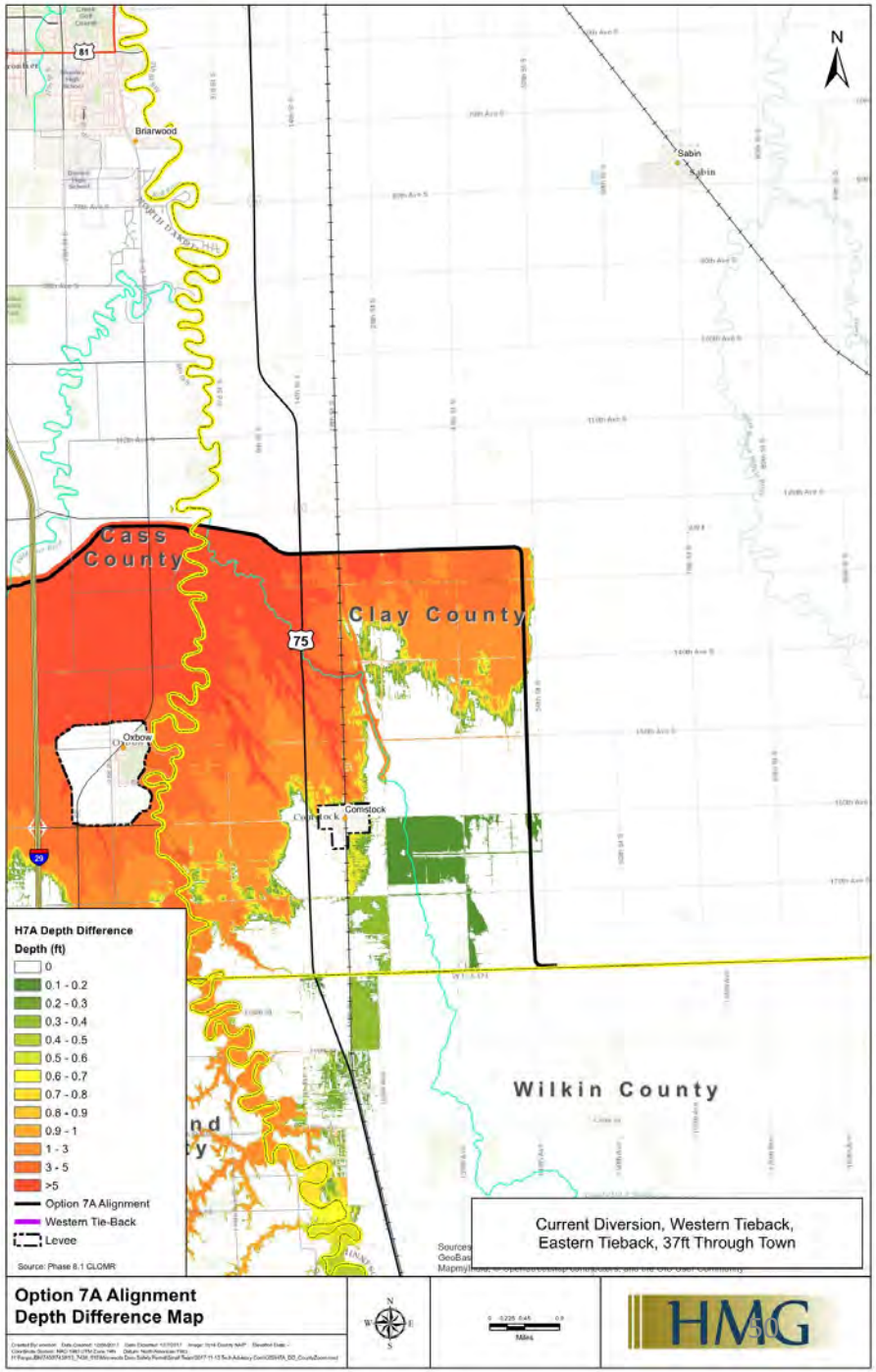


Option 7A – Clay County

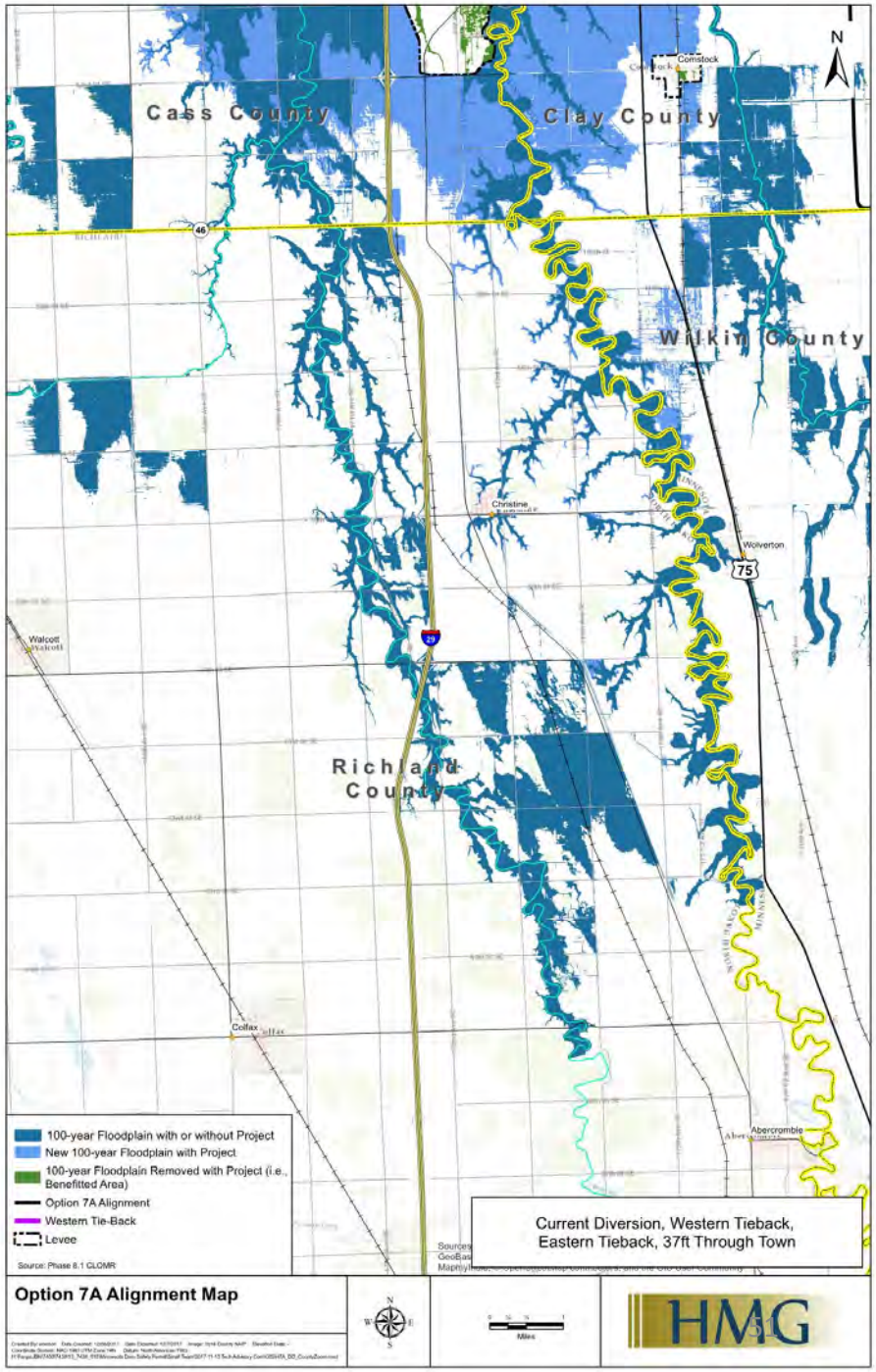


Option 7A – Clay County Additional Depth

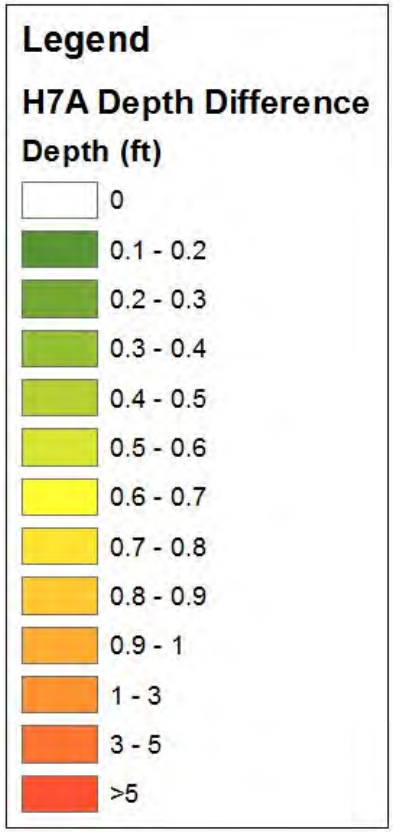


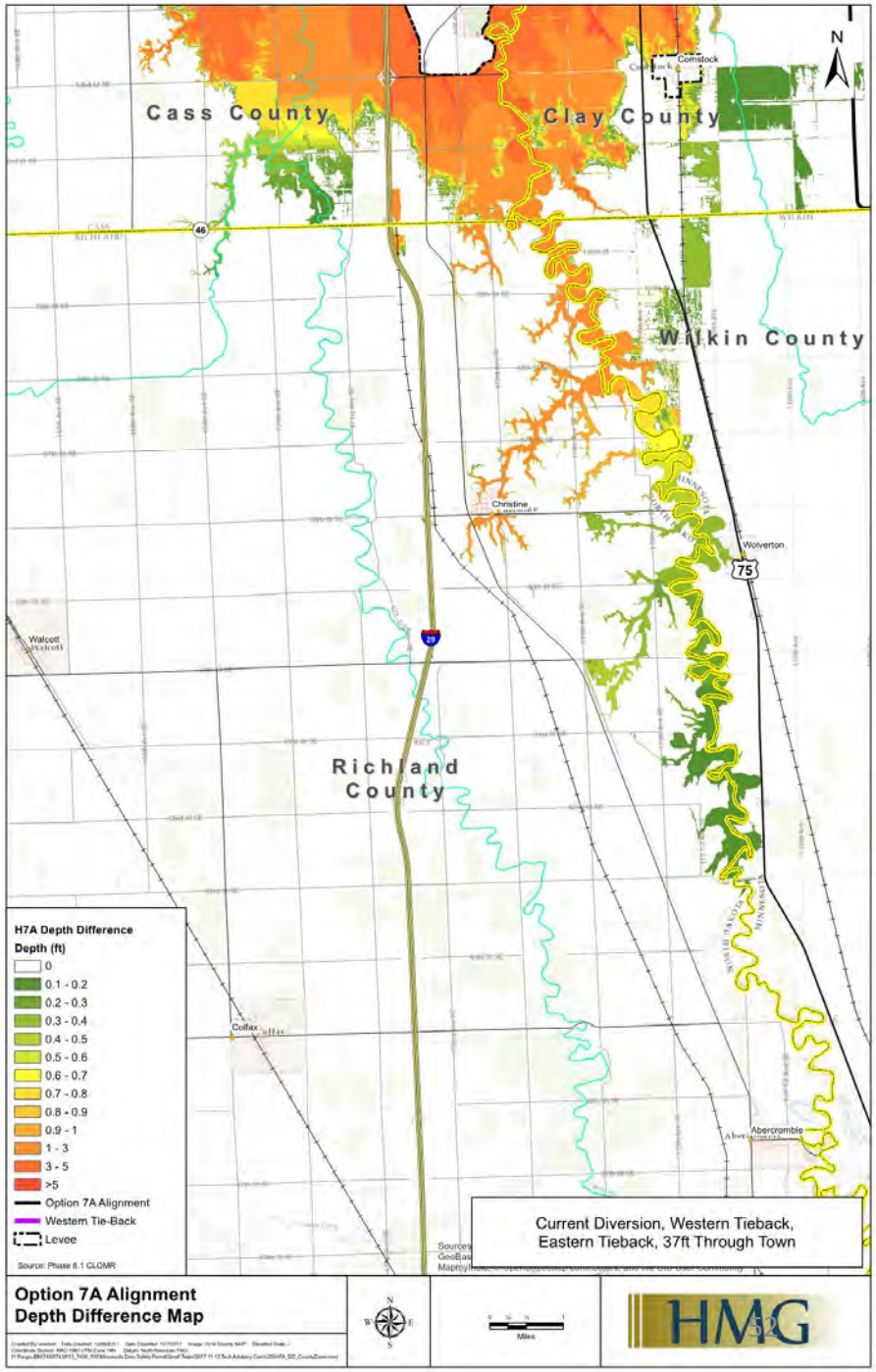


Option 7A – Richland County

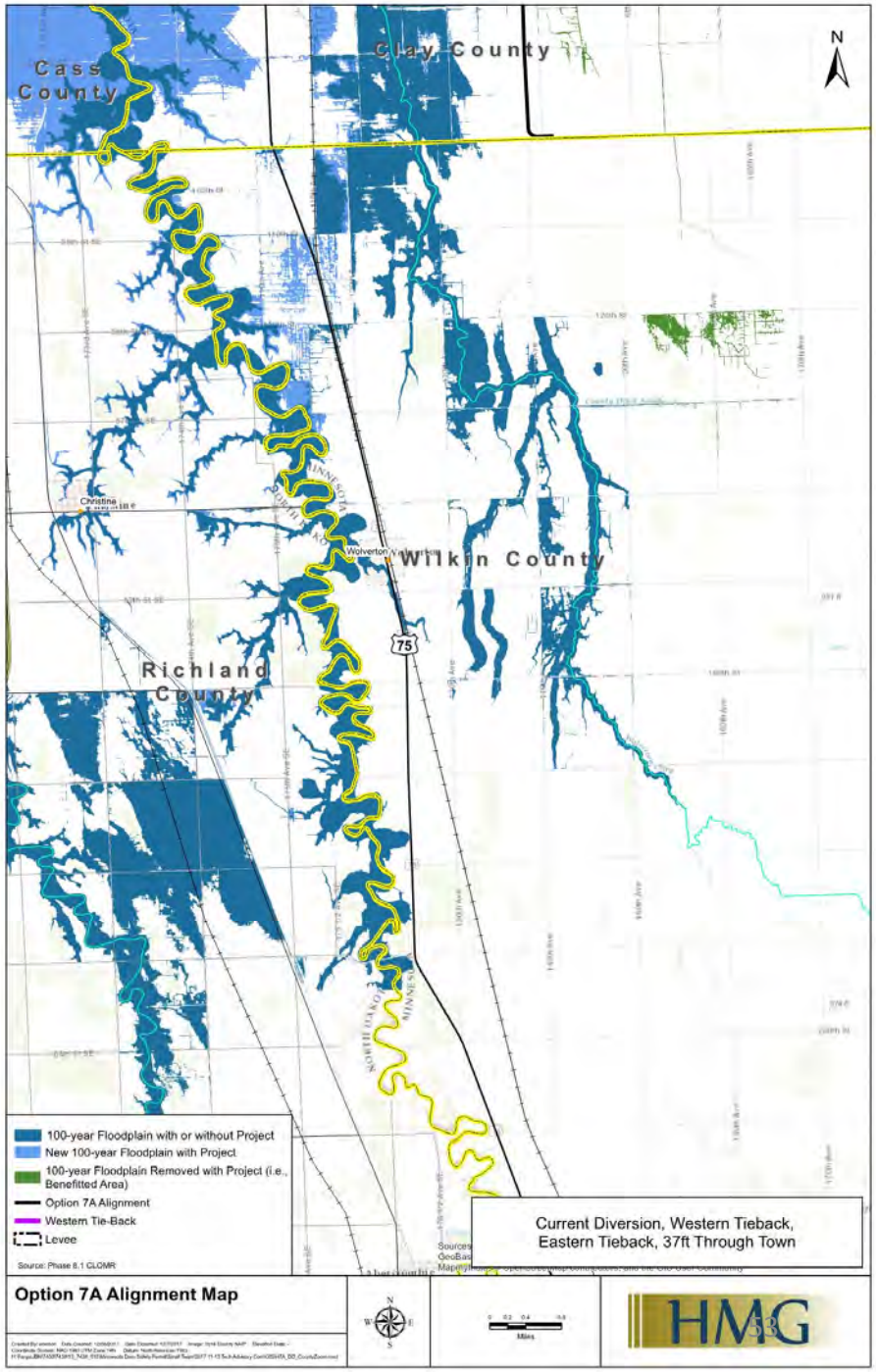


Option 7A – Richland County Additional Depth

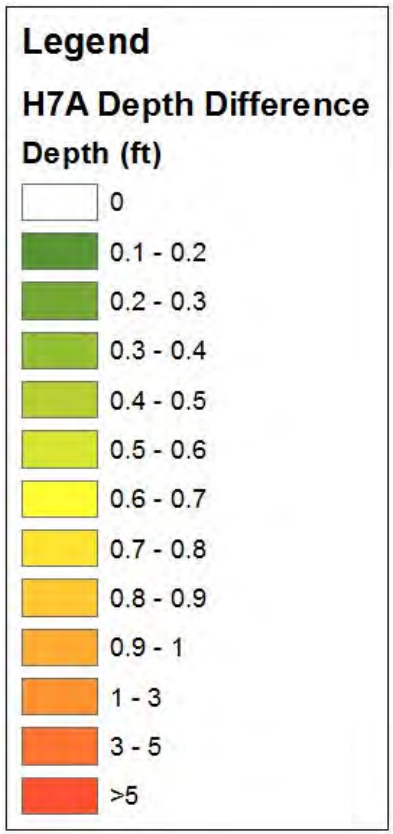


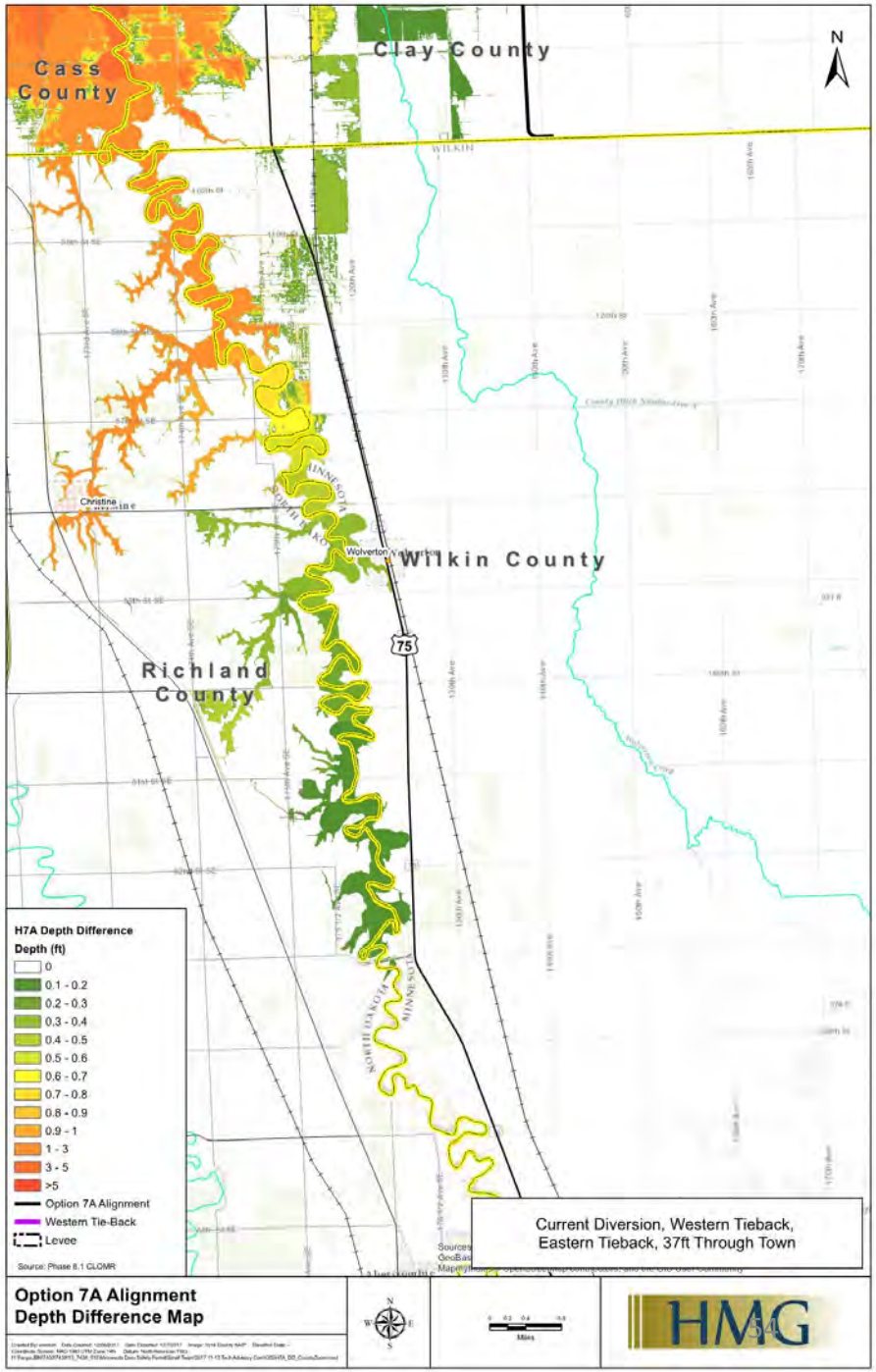


Option 7A – Wilkin County

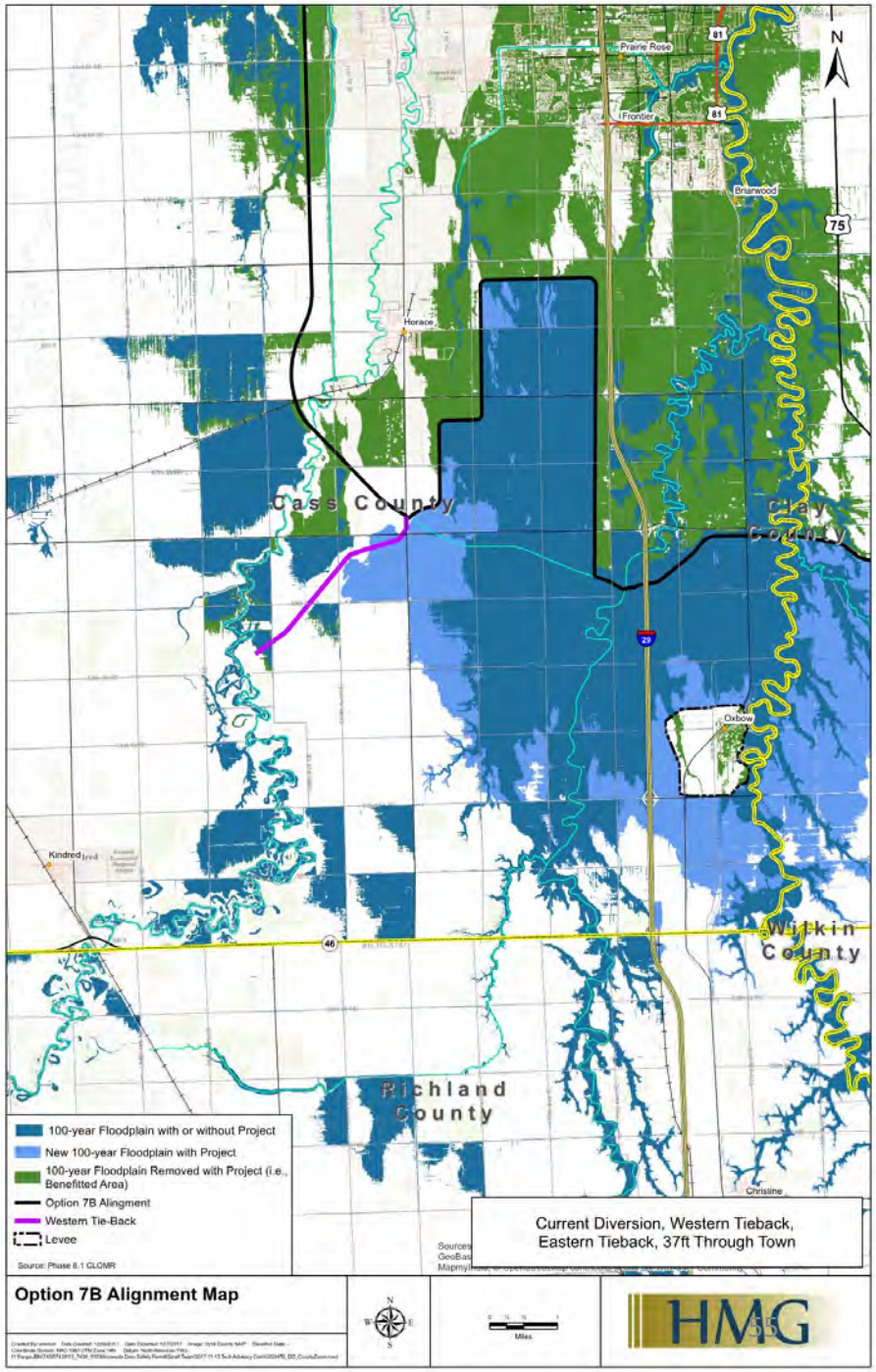


Option 7A – Wilkin County Additional Depth

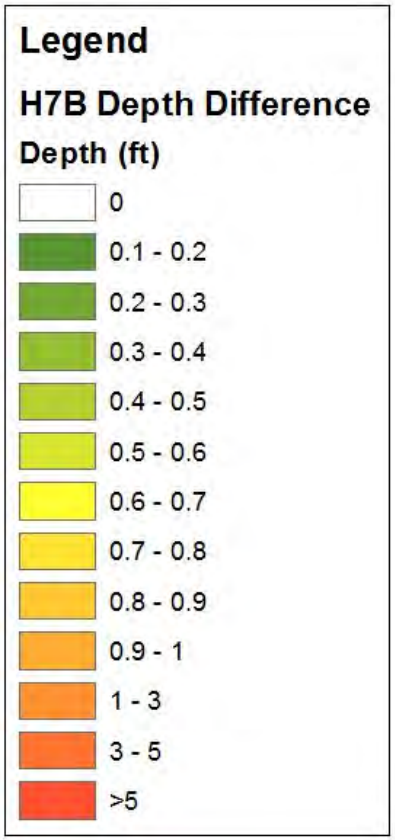


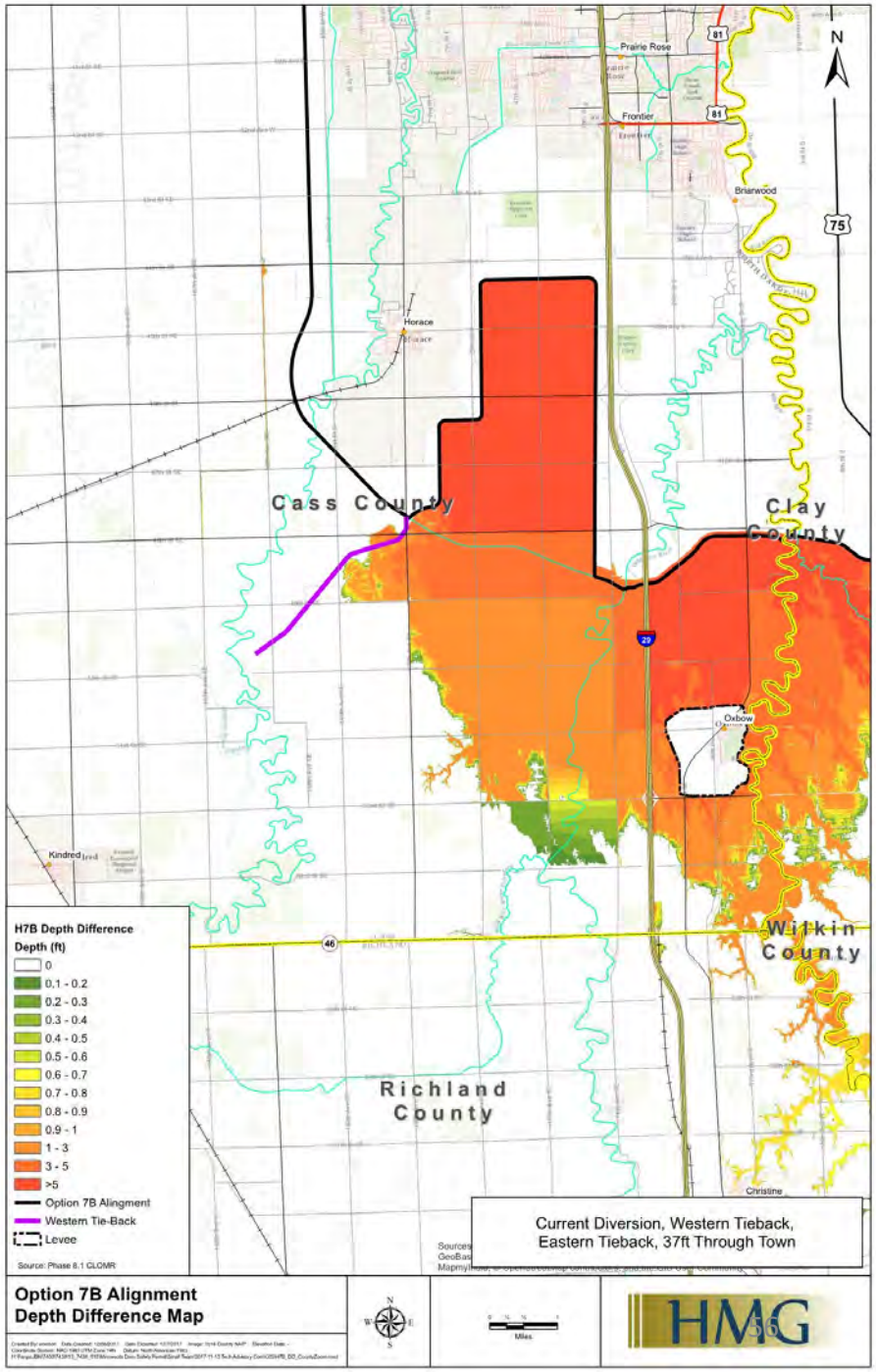


Option 7B – Cass County

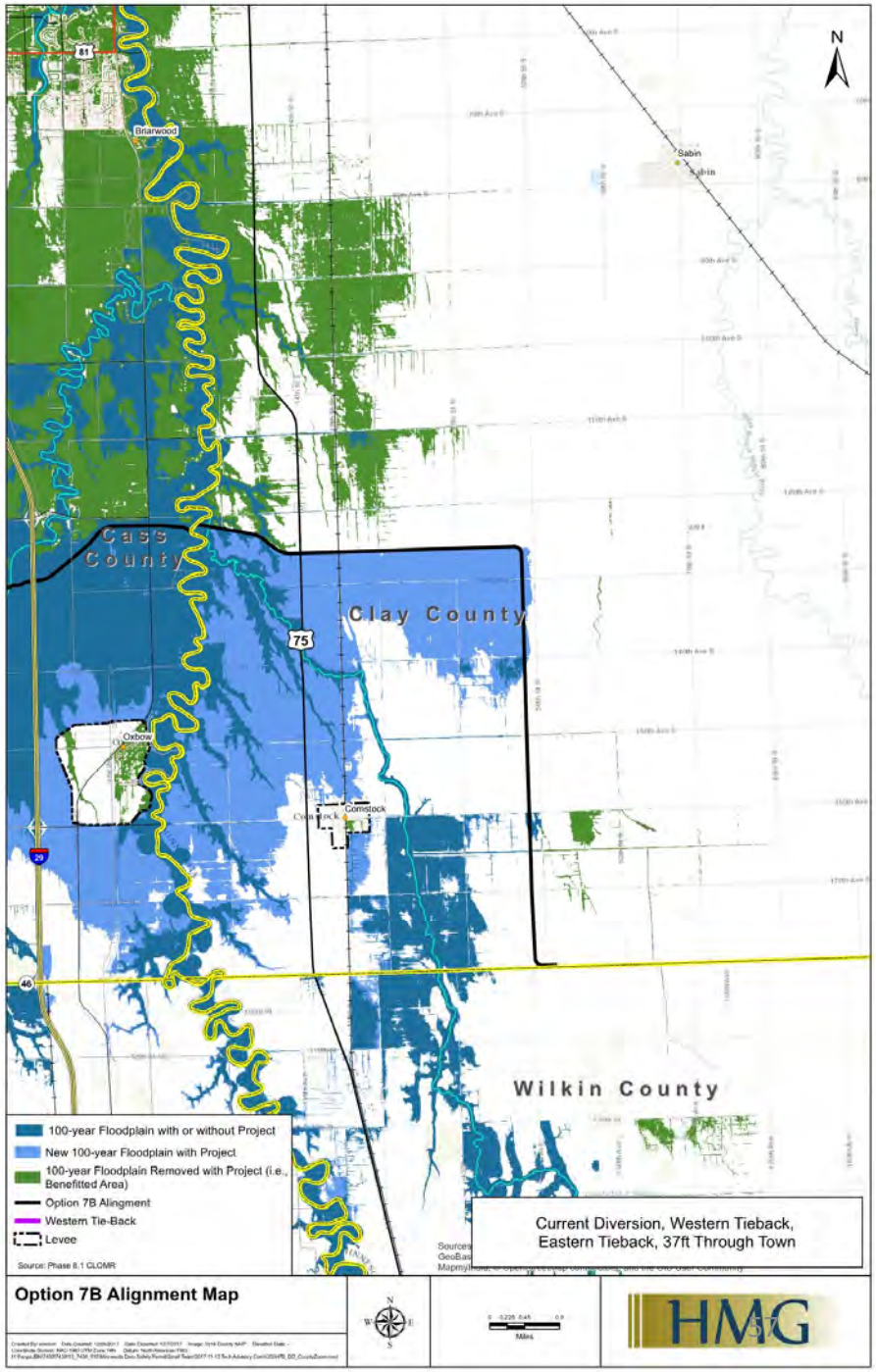


Option 7B – Cass County Additional Depth

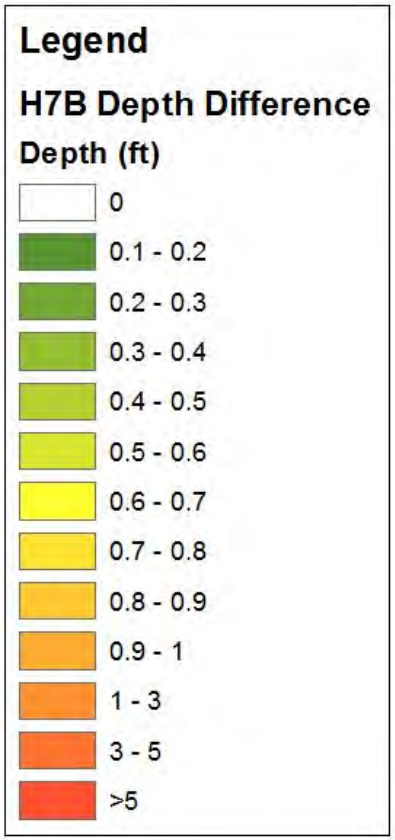


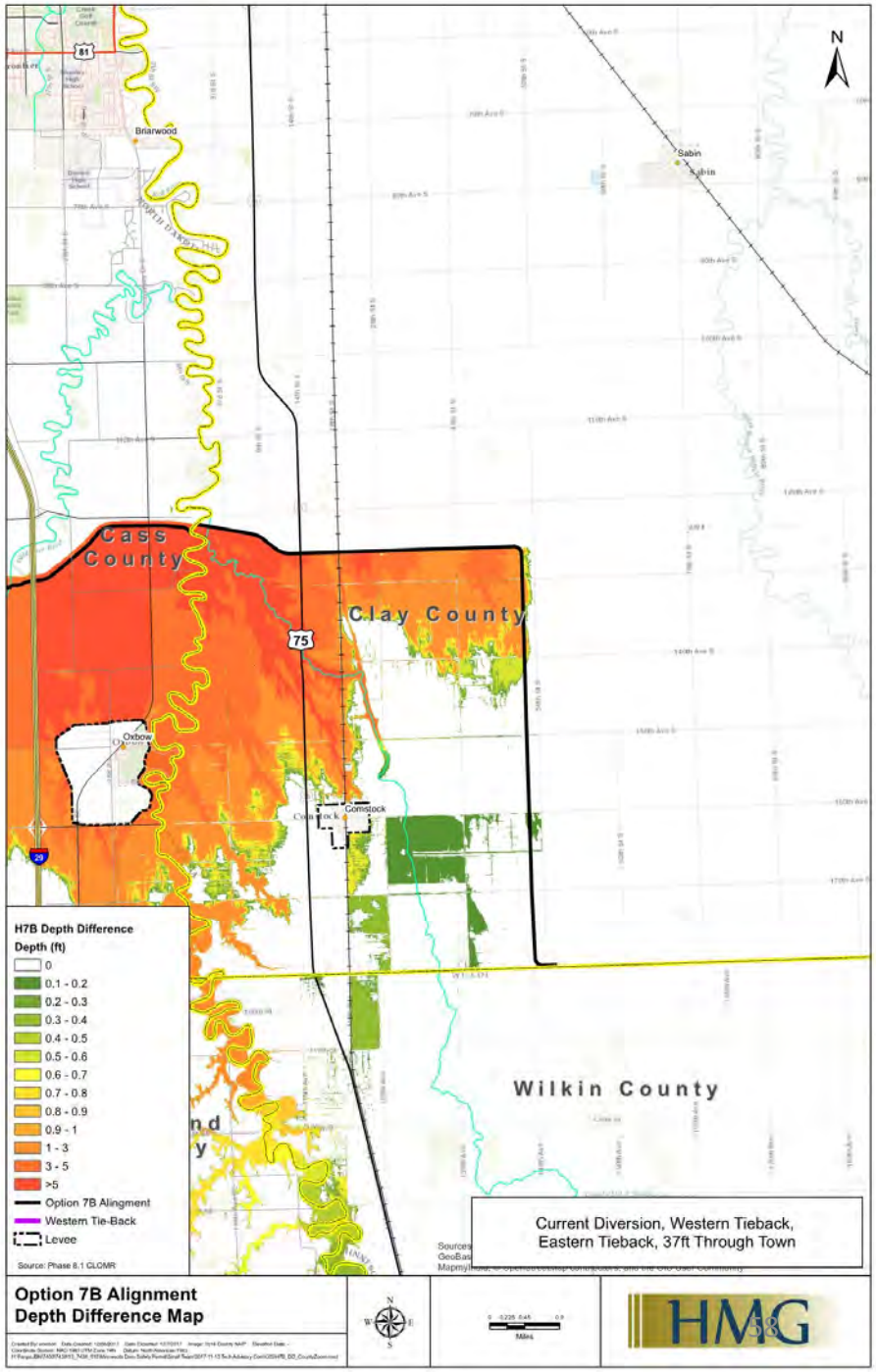


Option 7B – Clay County

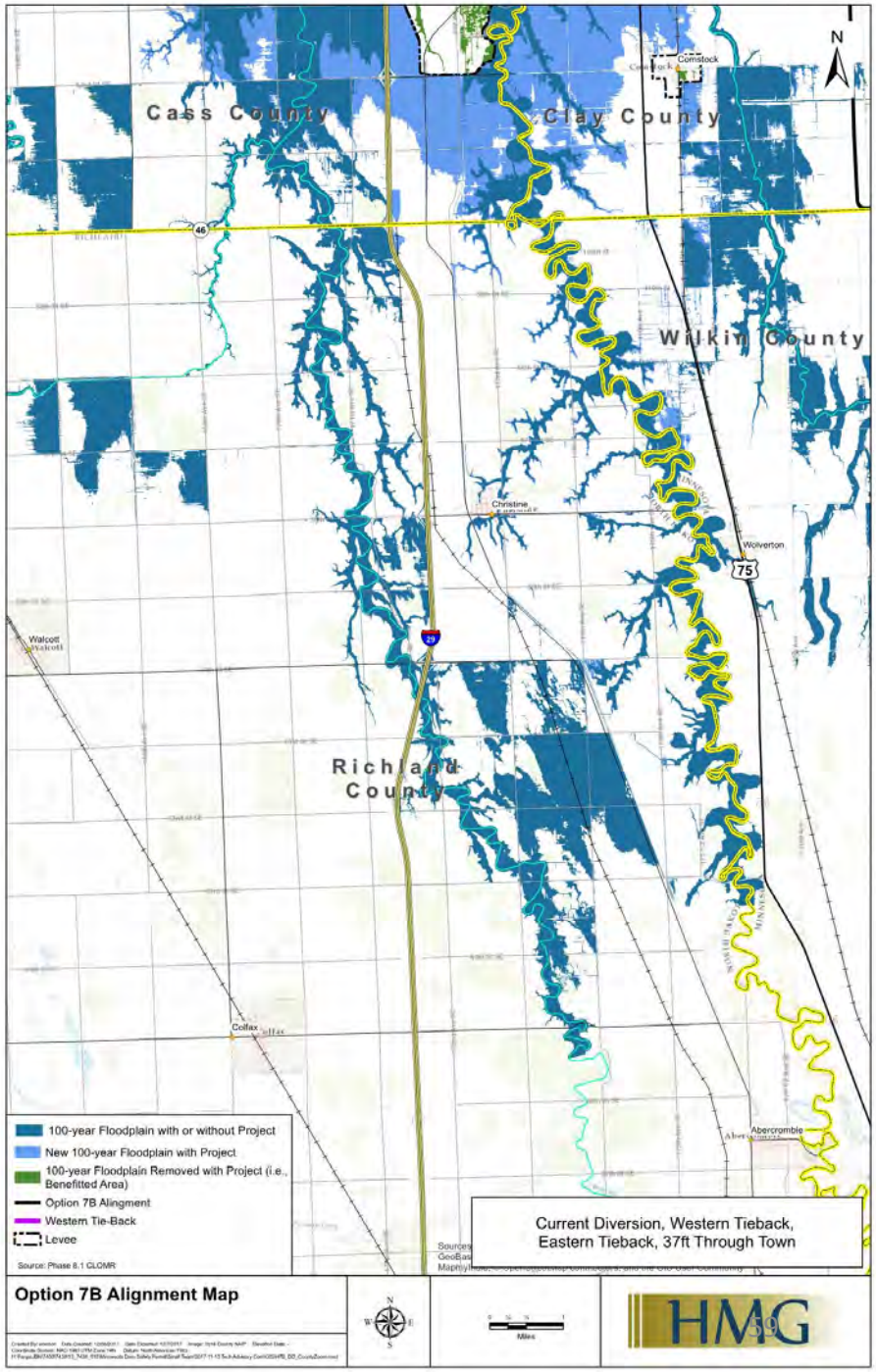


Option 7B – Clay County Additional Depth

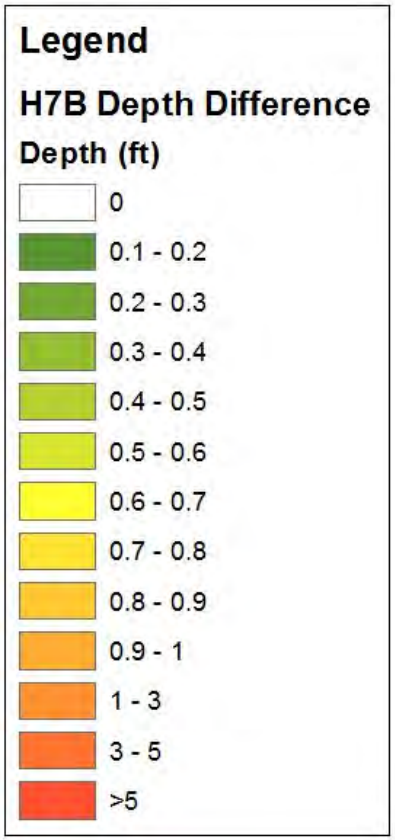


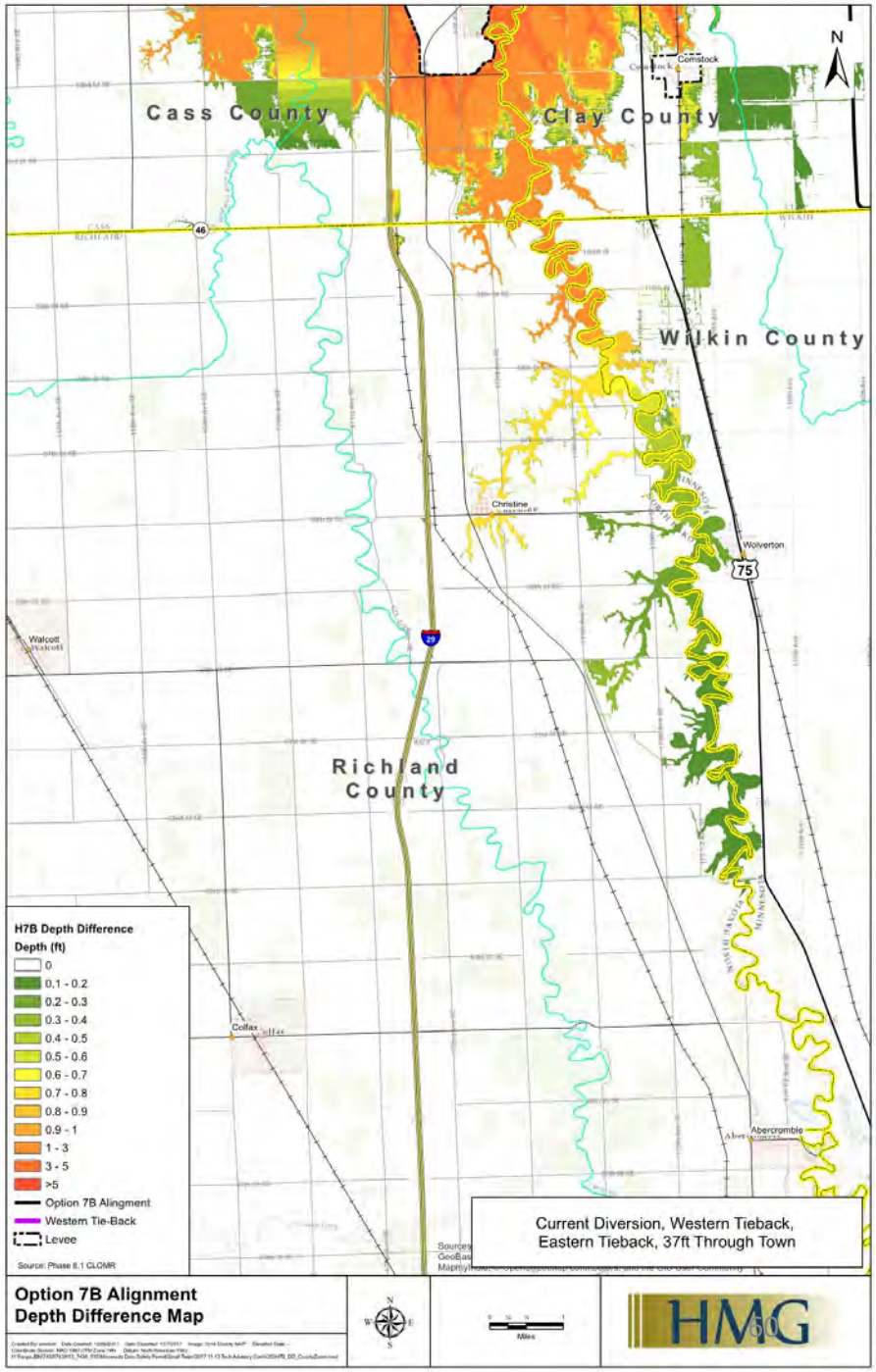


Option 7B – Richland County

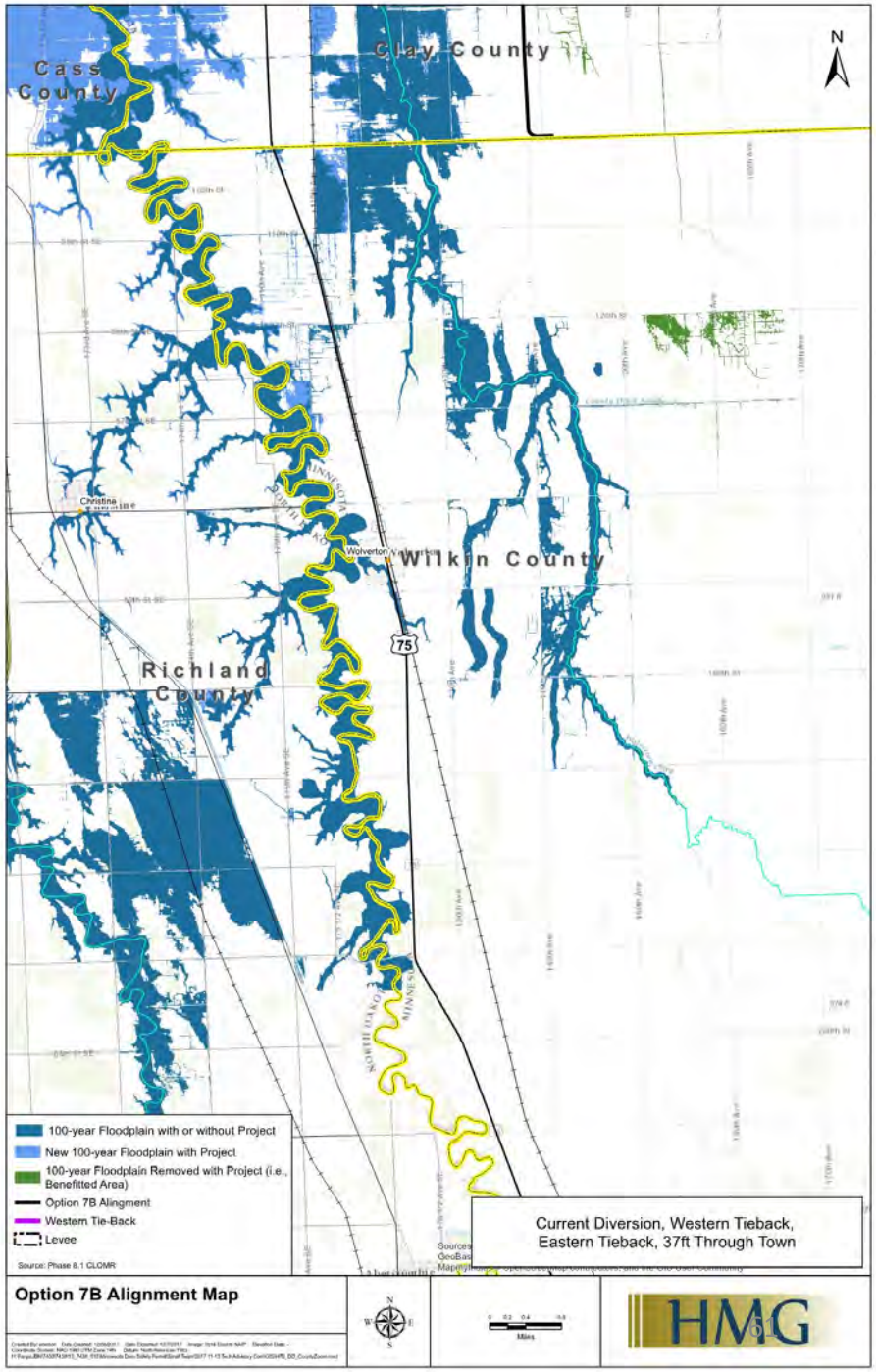


Option 7B – Richland County Additional Depth

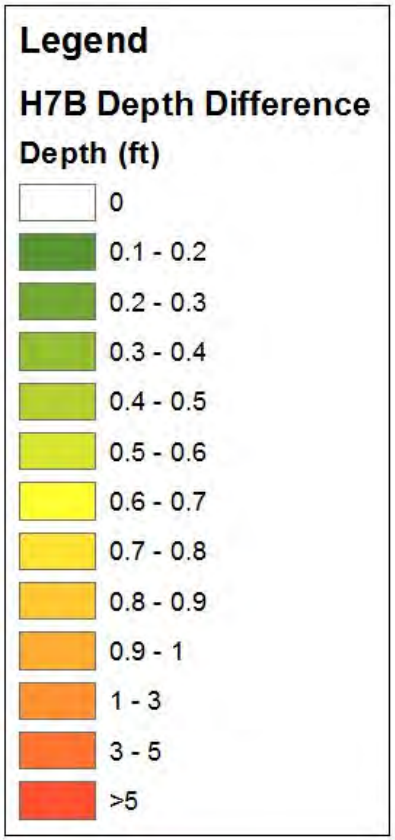


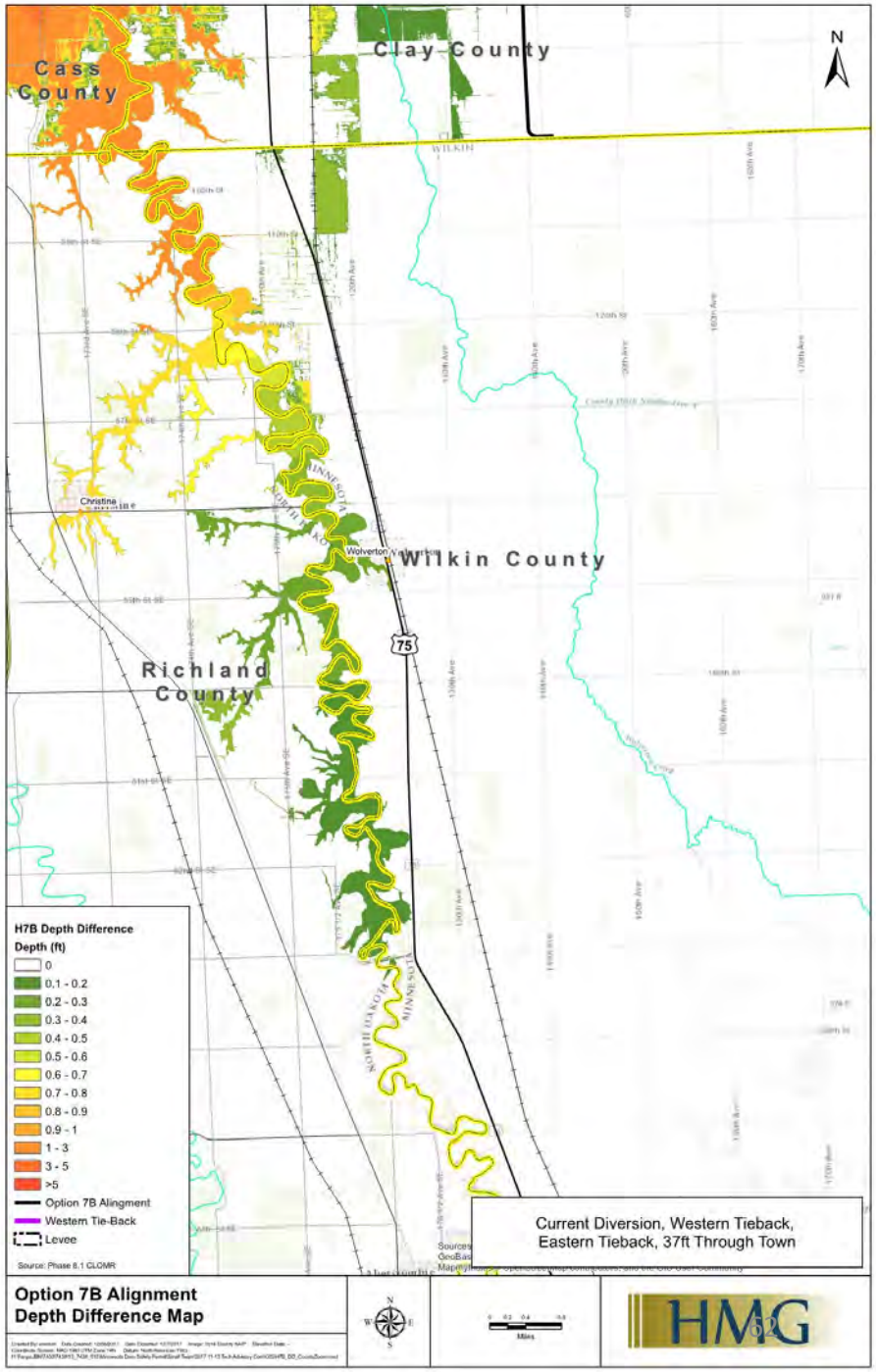


Option 7B – Wilkin County

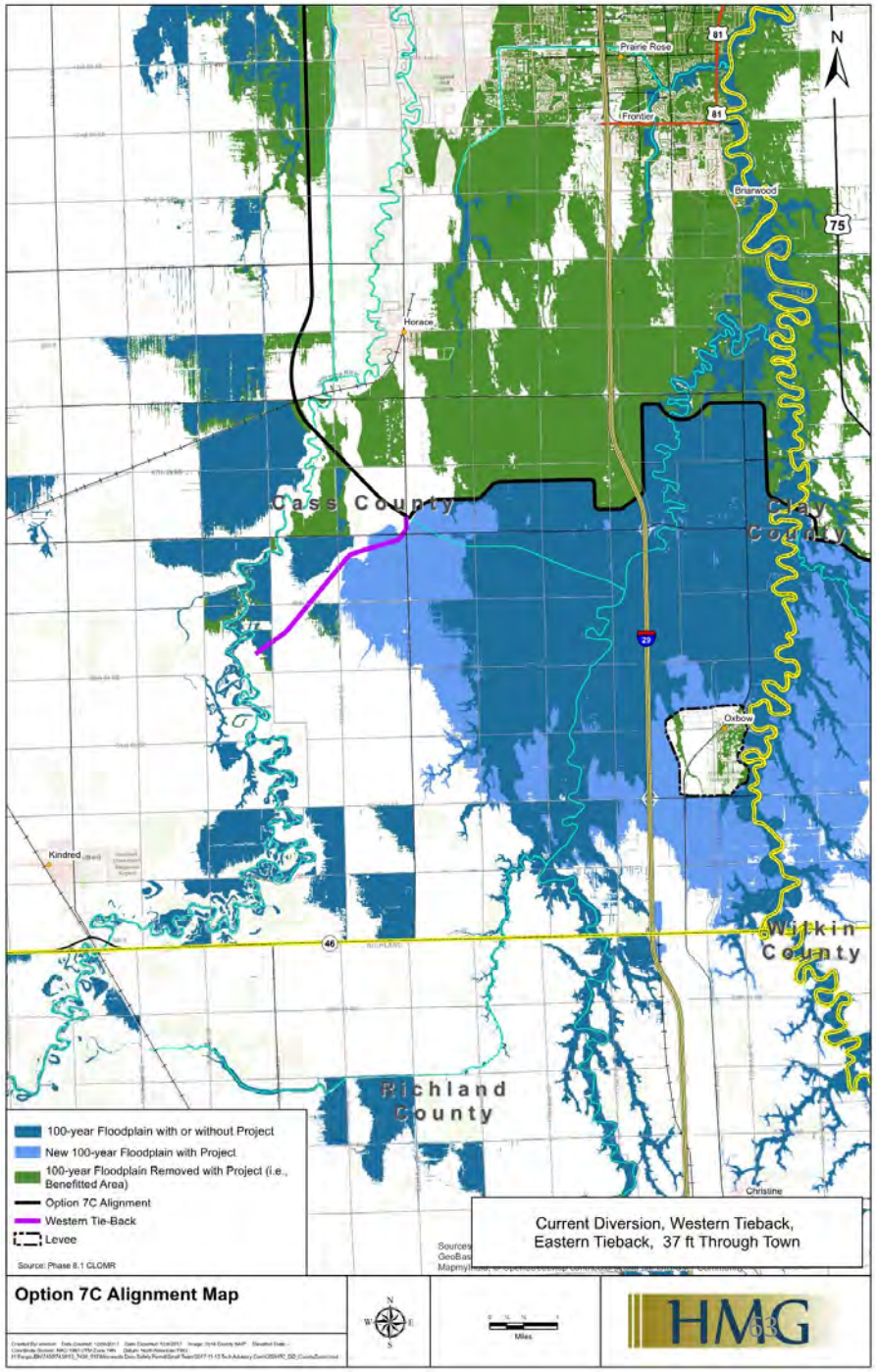


Option 7B – Wilkin County Additional Depth

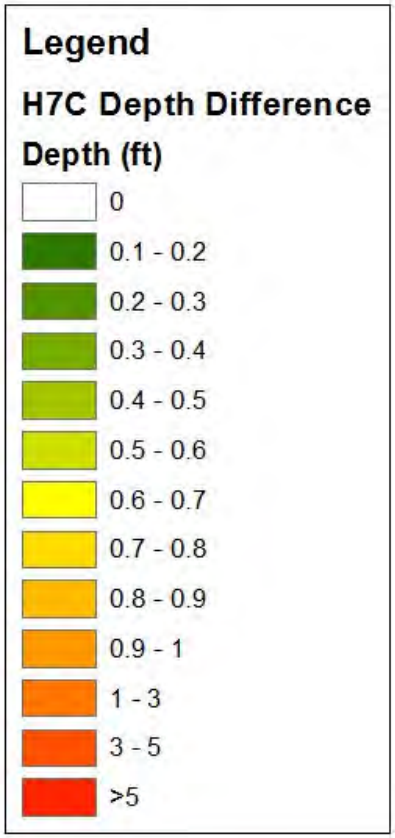


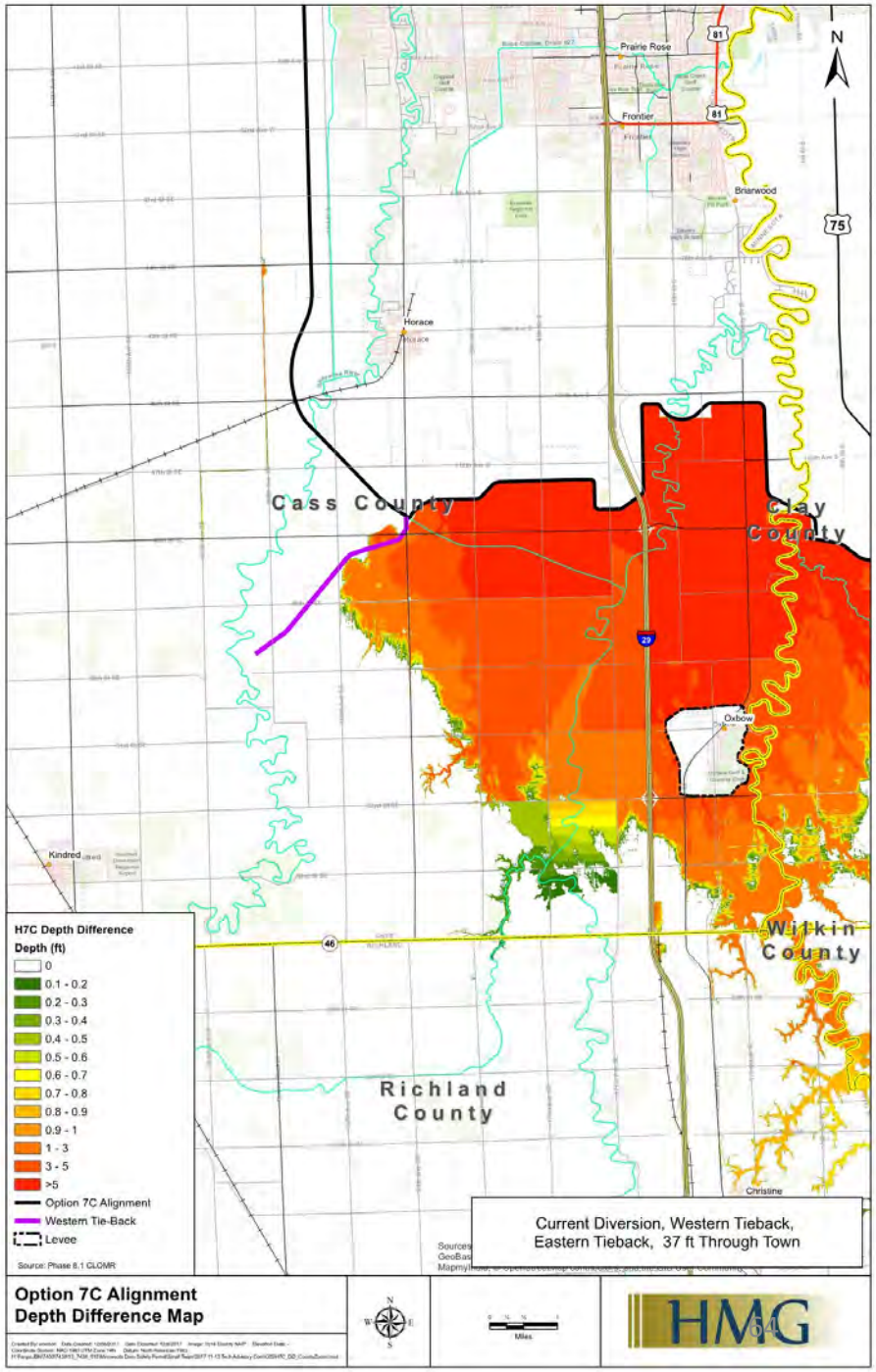


Option 7C – Cass County

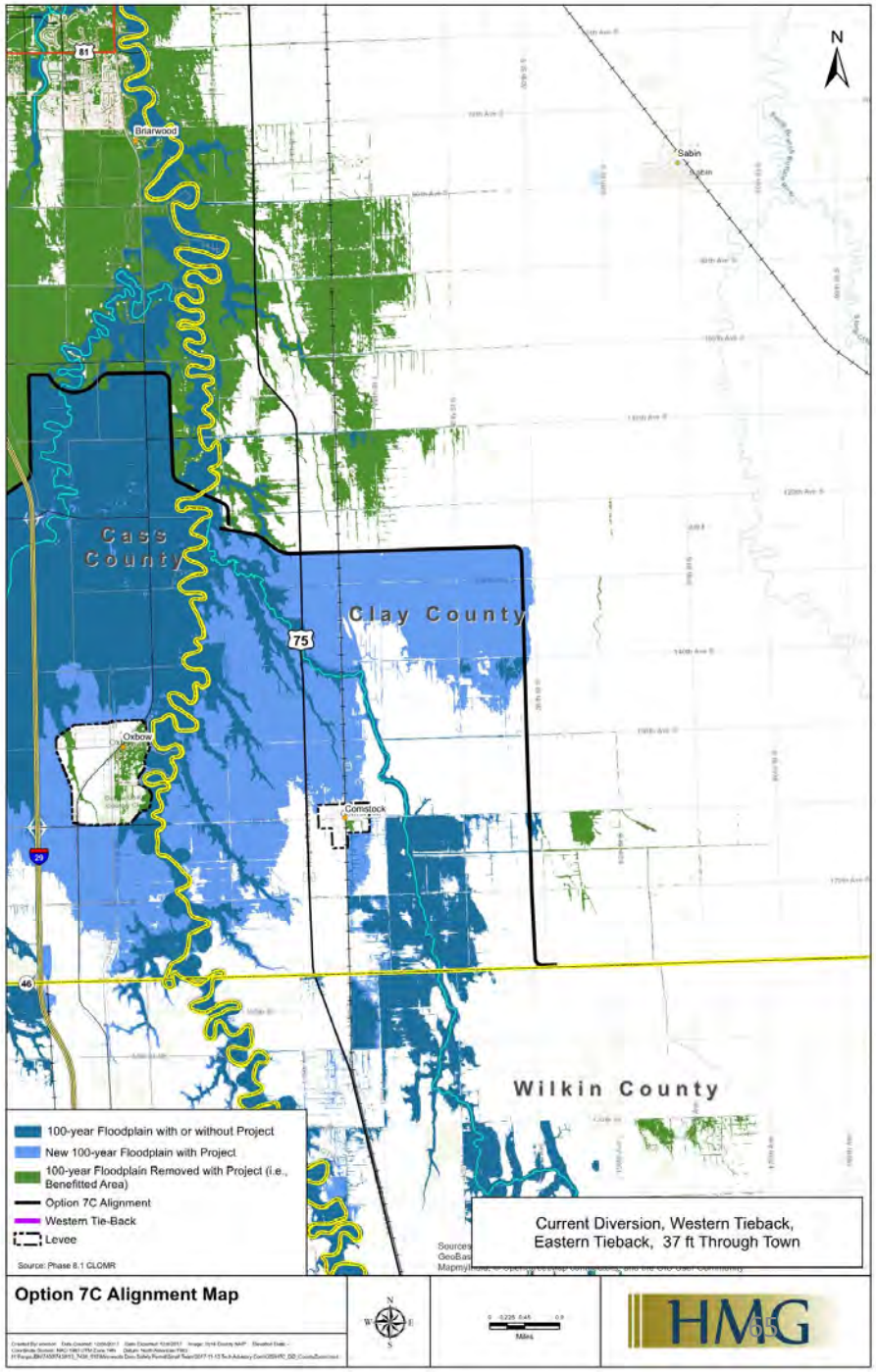


Option 7C – Cass County Additional Depth

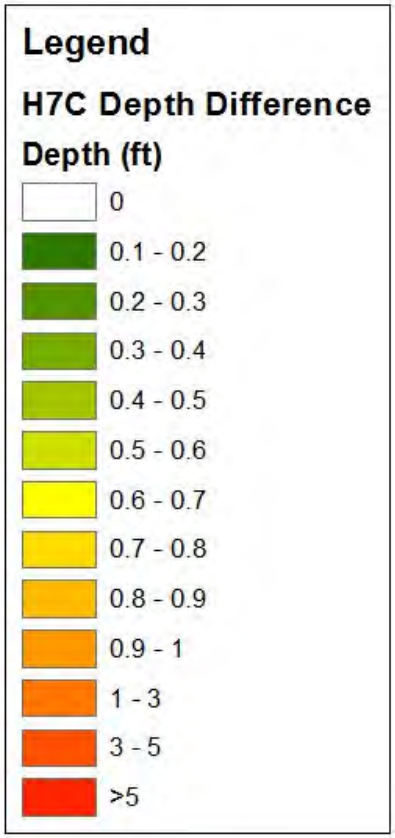


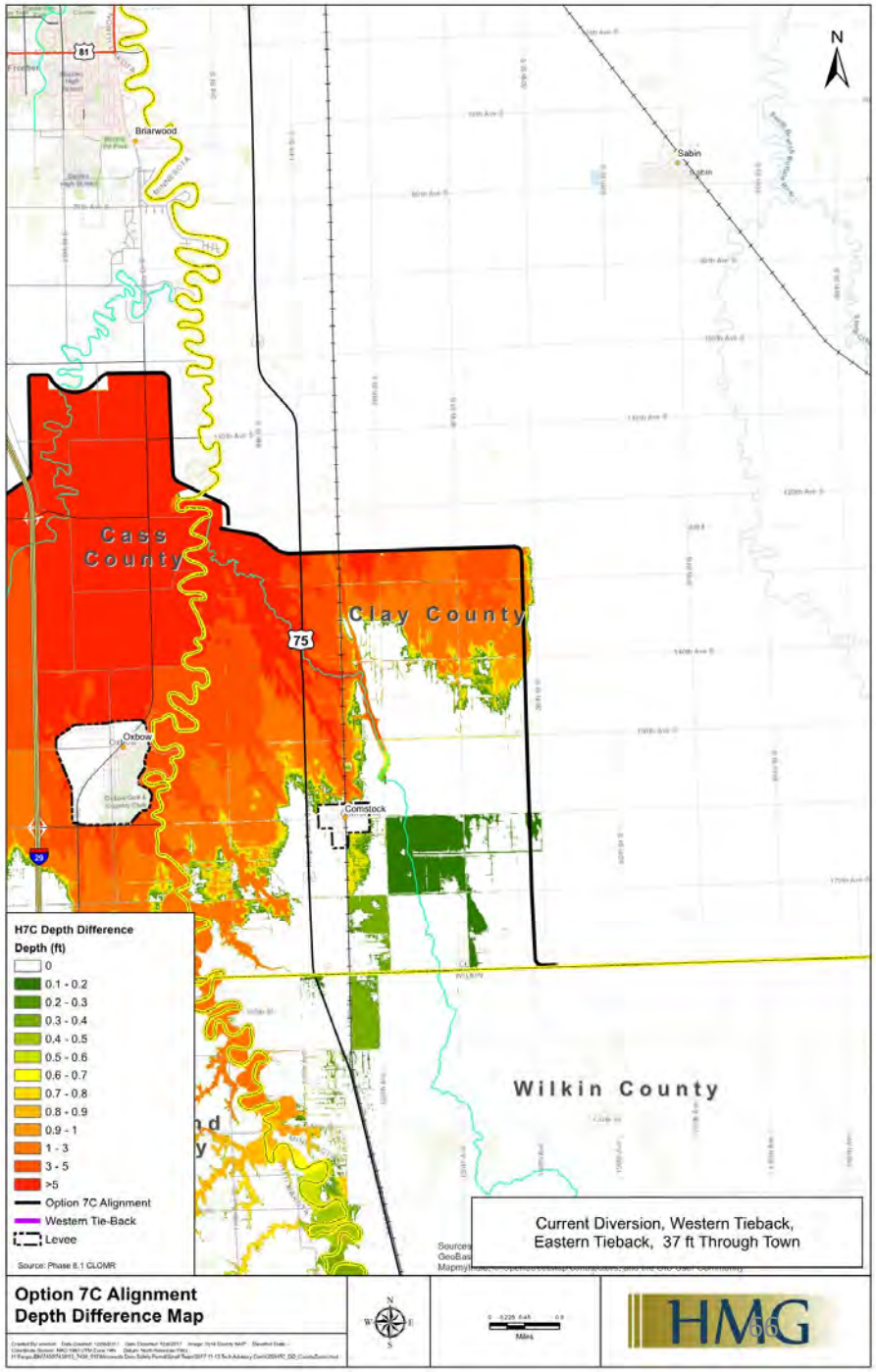


Option 7C – Clay County

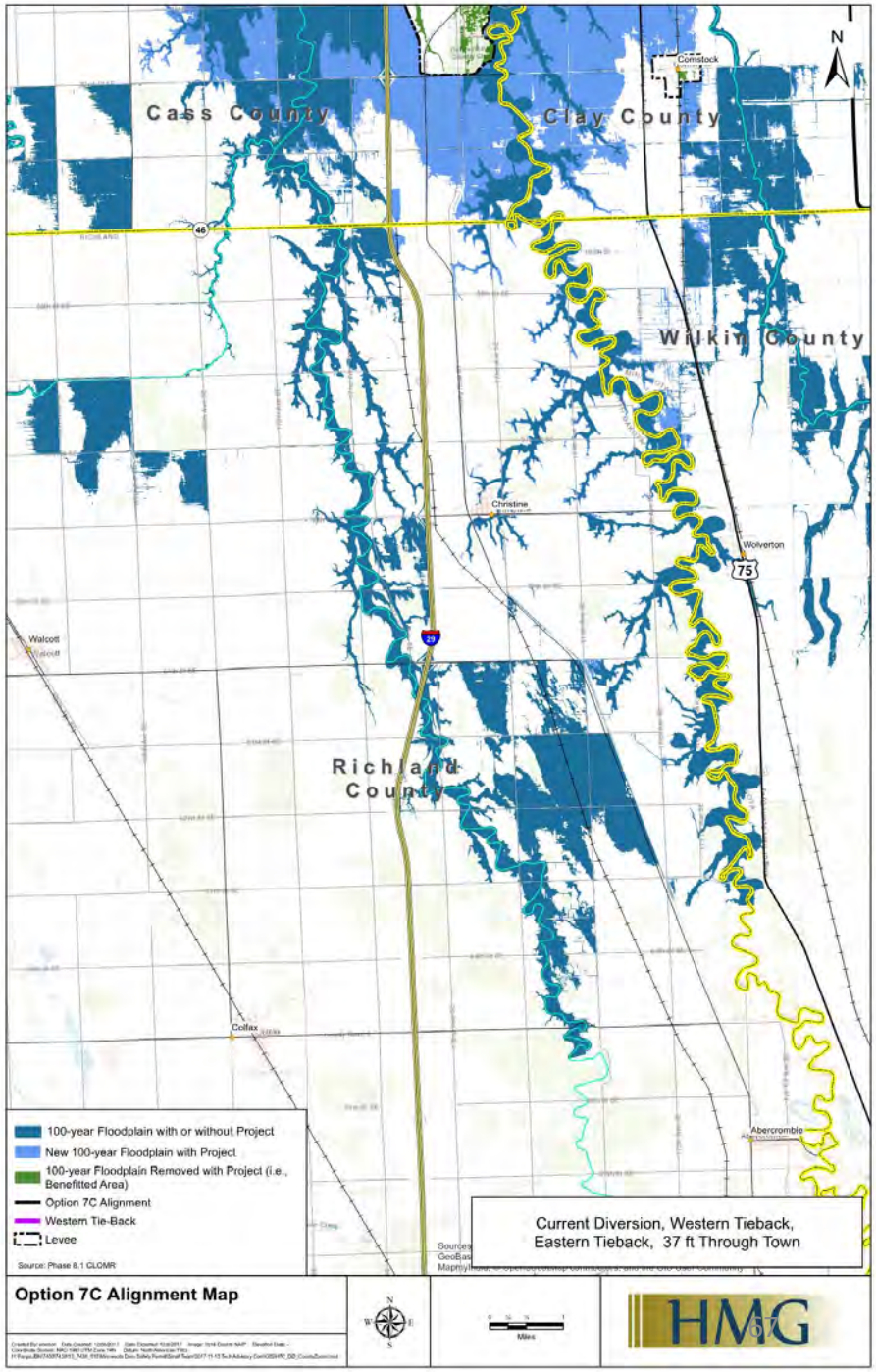


Option 7C – Clay County Additional Depth

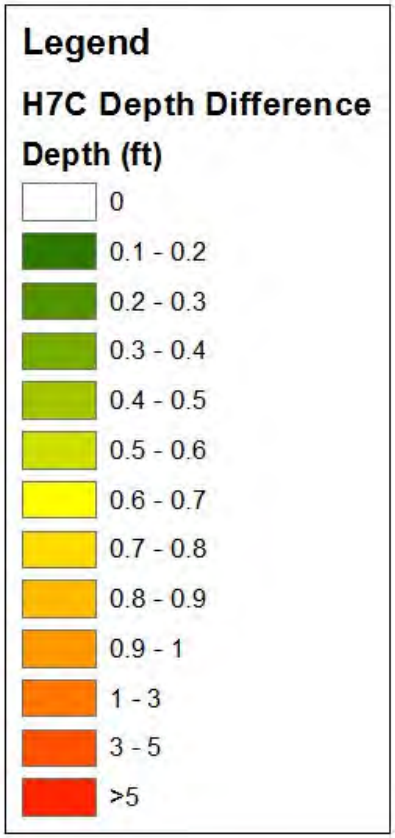


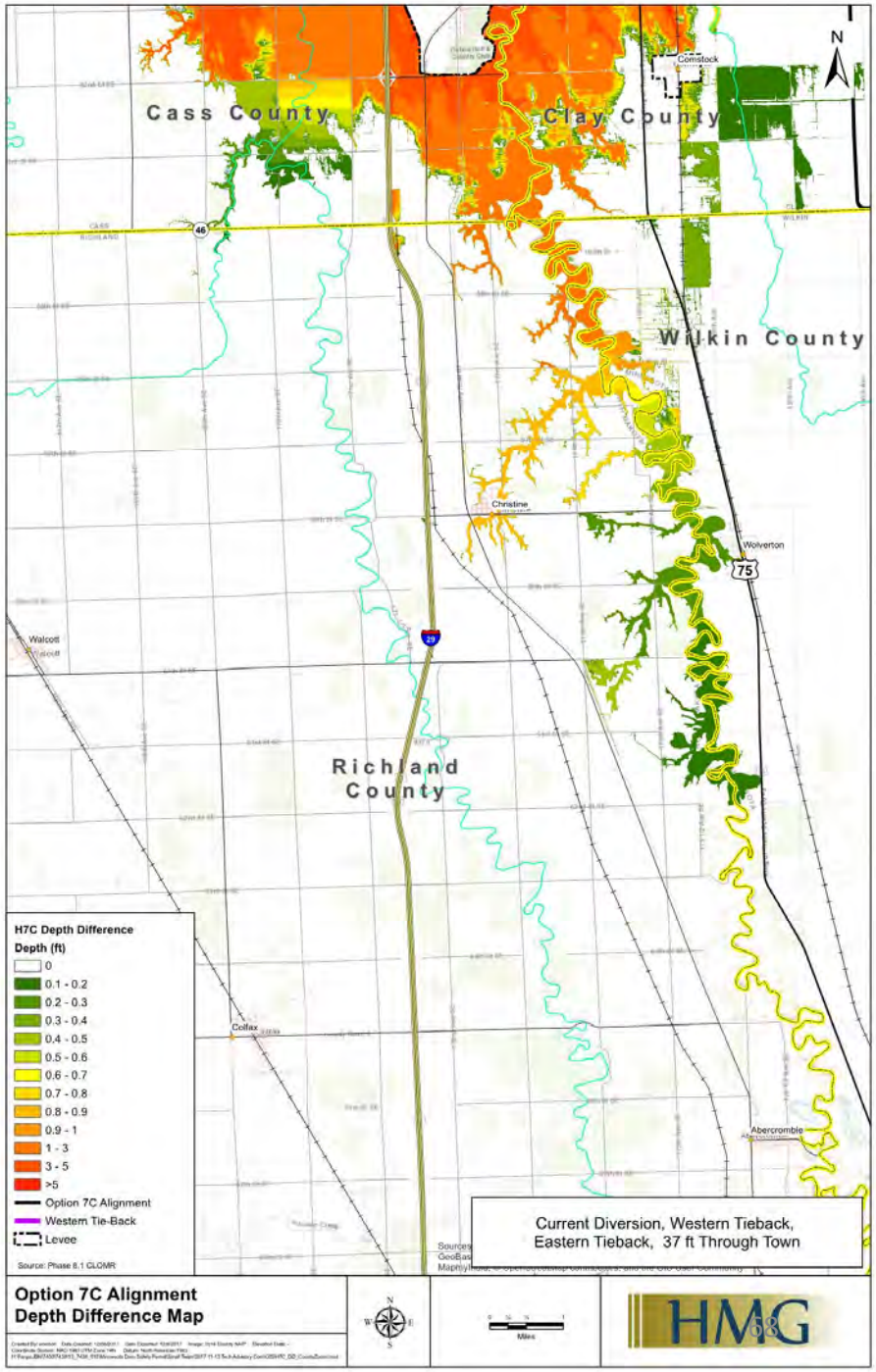


Option 7C – Richland County

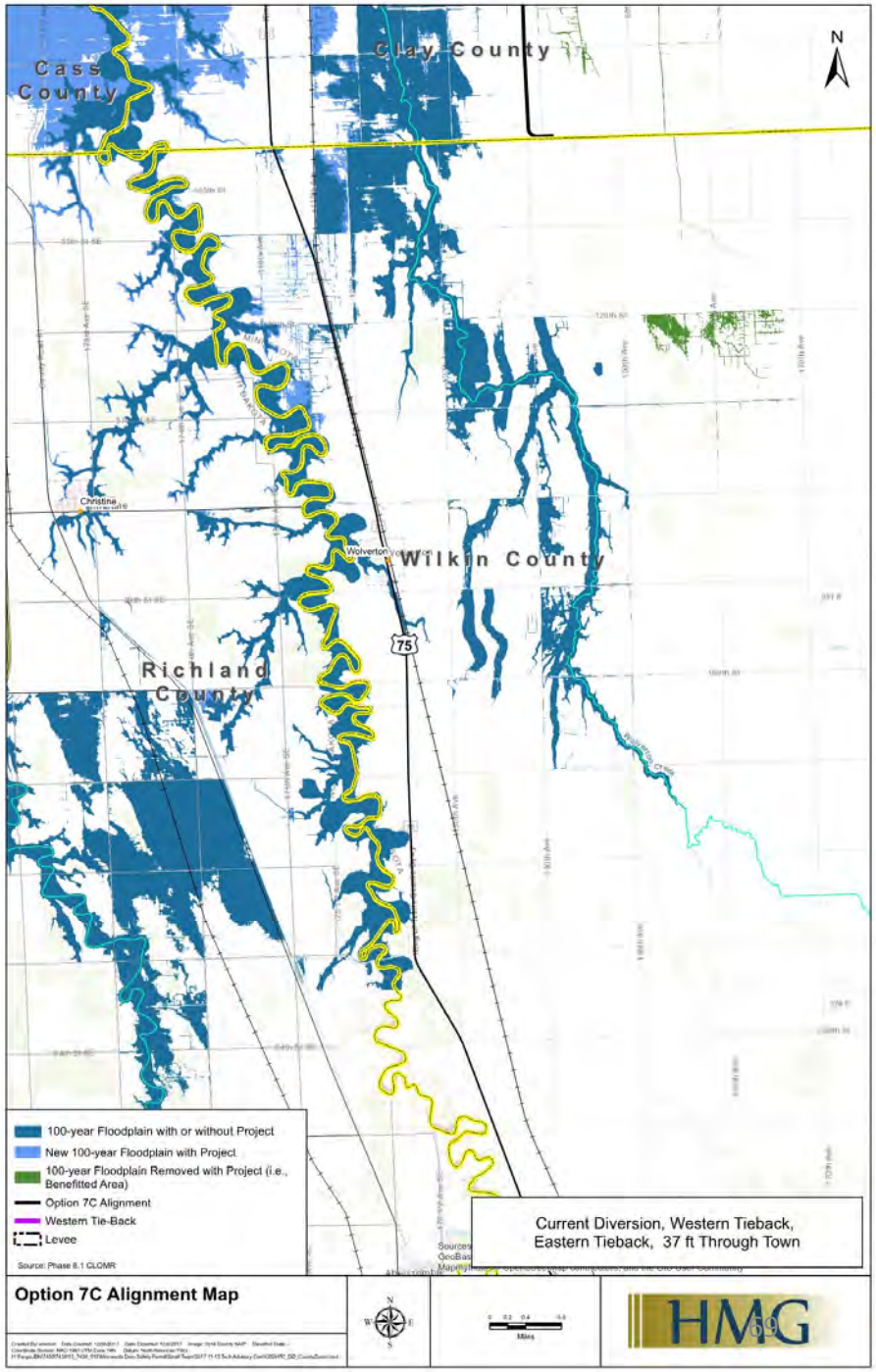


Option 7C – Richland County Additional Depth

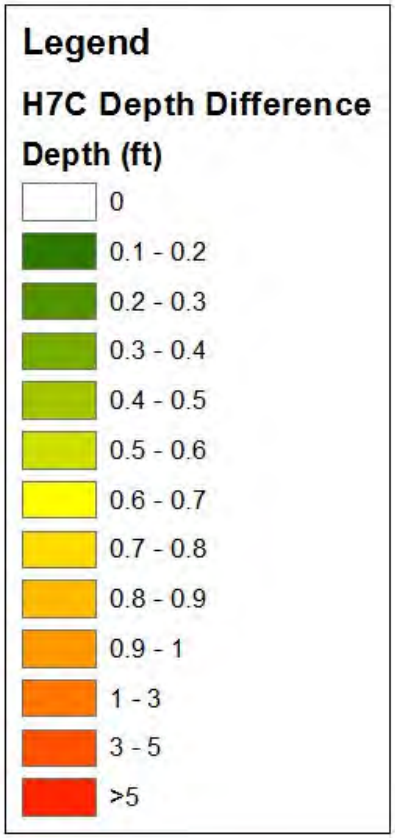


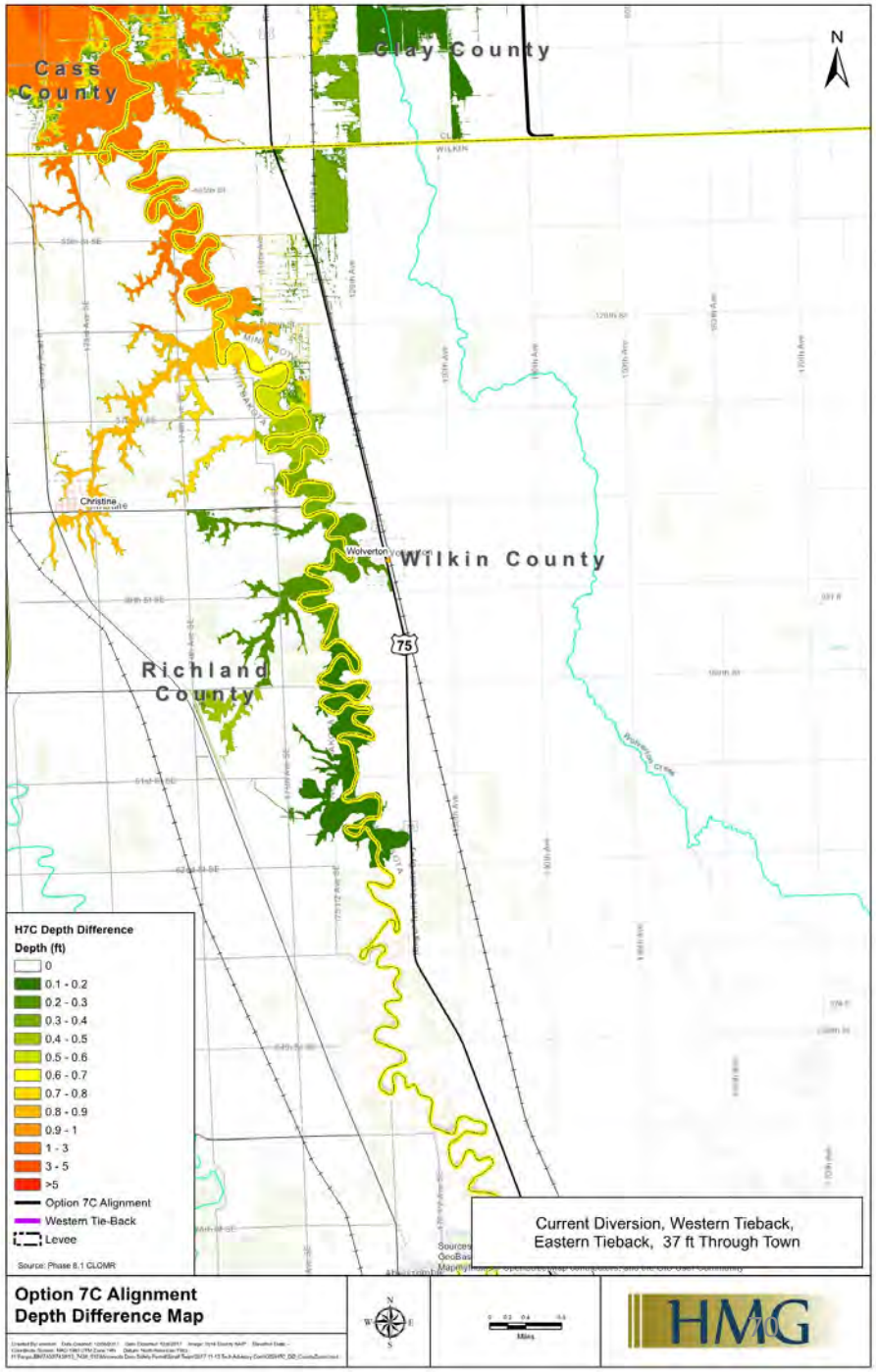


Option 7C – Wilkin County



Option 7C – Wilkin County Additional Depth





Horace
Briarwood
Sabin
Oxbow
Comstock
Kindred
29
75

TAG Optional Alignments

- Option 7A Alignment
- Option 7B Alignment
- Option 7C Alignment
- Diversion Channel
- Original Western Tieback Hwy17
- Western Tie-Back
- Existing Conditions POR 100-Year Floodplain

N W E S

0 0.5 1 2
Miles

HMG

Created By: enelson Date Created: 12/04/2017 Date Exported: 12/8/2017 Image: 2016 County NAIP Elevation Data: NA
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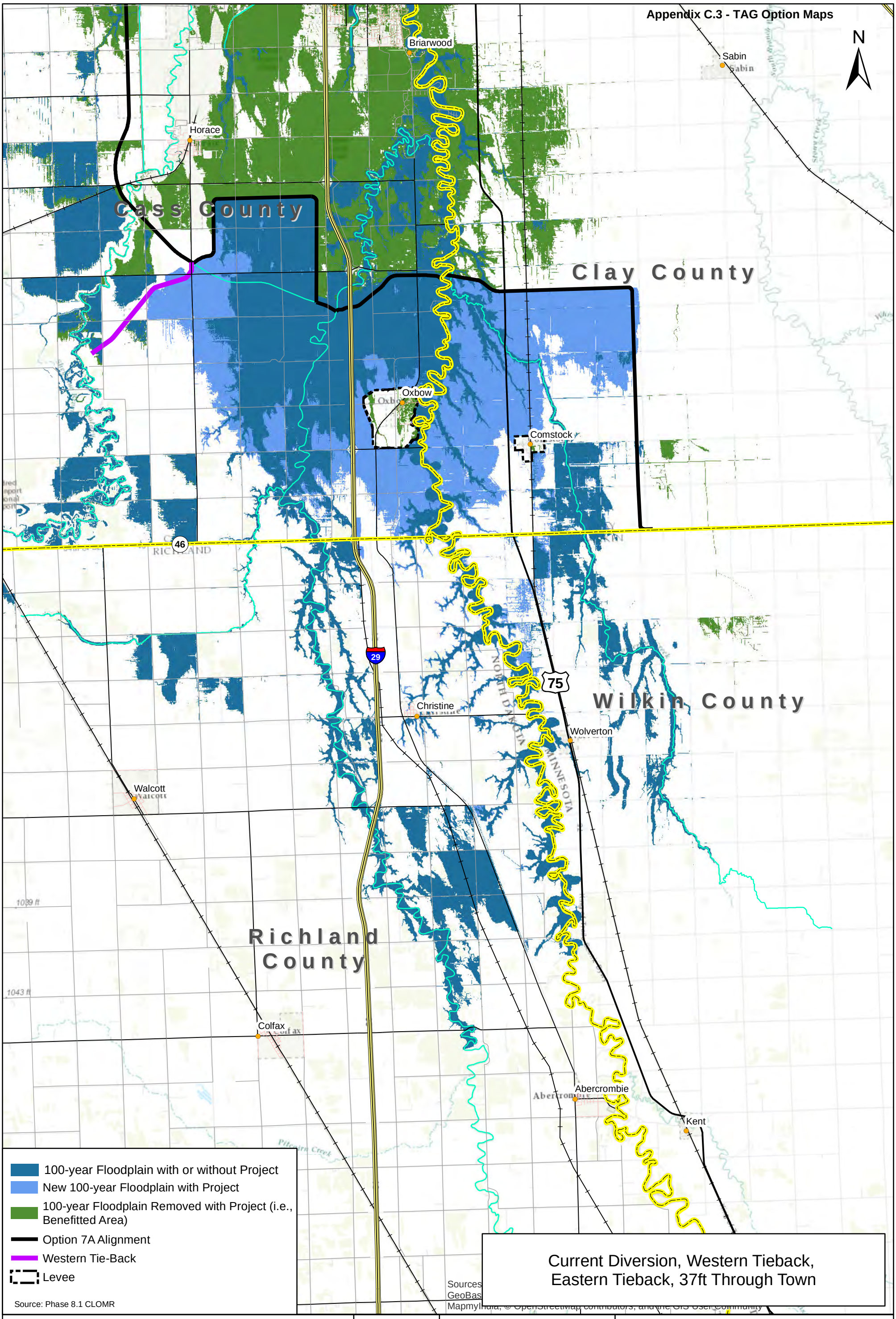

Option 7A Alignment Map

N
W E
S

0 0.425 0.85 1.7
Miles

HMG

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Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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N

Briarwood
Sabin
Horace
Cass County
Clay County
Oxbow
Comstock
46
RICHLAND
WILKIN
29
75
Christine
Wolverton
Wilkin County
Walcott
Richland County
Colfax
Abercrombie
Kent

H7A Depth Difference

Depth (ft)

- 0
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1
- 1 - 3
- 3 - 5
- >5
- Option 7A Alignment
- Western Tie-Back
- Levee

Source: Phase 8.1 CLOMR

Current Diversion, Western Tieback, Eastern Tieback, 37ft Through Town

Option 7A Alignment Depth Difference Map

N W E S

0 0.425 0.85 1.7
Miles

HMG

Created By: enelson Date Created: 12/06/2017 Date Exported: 12/7/2017 Image: 2016 County NAIP Elevation Data: -
Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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N

Briarwood
Sabin
Horace
Cass County
Clay County
Oxbow
Comstock
46
29
75
Christine
Wolverton
Wilkin County
Walcott
Richland County
Colfax
Abercrombie
Kent

100-year Floodplain with or without Project
New 100-year Floodplain with Project
100-year Floodplain Removed with Project (i.e., Benefitted Area)
Option 7B Alingment
Western Tie-Back
Levee

Source: Phase 8.1 CLOMR

Current Diversion, Western Tieback, Eastern Tieback, 37ft Through Town

Option 7B Alignment Map

N
W E
S

0 0.425 0.85 1.7
Miles

HMG

Created By: enelson Date Created: 12/06/2017 Date Exported: 12/7/2017 Image: 2016 County NAIP Elevation Data: -
Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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N

Briarwood
Sabin
Horace
Cass County
Clay County
Oxbow
Comstock
Wilkin County
Christine
Wolverton
Walcott
Richland County
Colfax
Abercrombie
Kent

46
29
75

H7B Depth Difference

Depth (ft)

- 0
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1
- 1 - 3
- 3 - 5
- >5
- Option 7B Alingment
- Western Tie-Back
- Levee

Source: Phase 8.1 CLOMR

Current Diversion, Western Tieback, Eastern Tieback, 37ft Through Town

Option 7B Alignment Depth Difference Map

N W E S

0 0.425 0.85 1.7
Miles

HMG

Created By: enelson Date Created: 12/06/2017 Date Exported: 12/7/2017 Image: 2016 County NAIP Elevation Data: -
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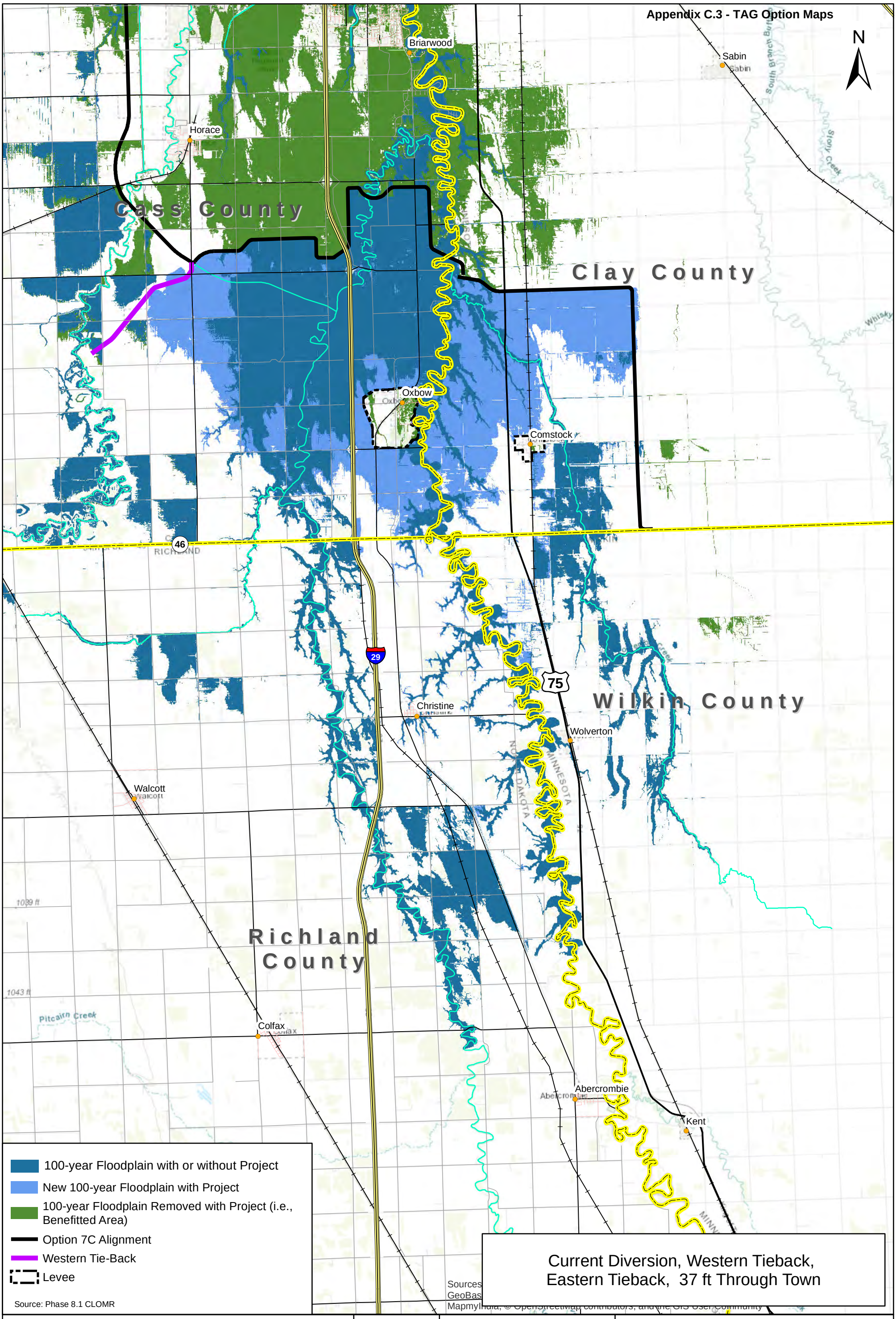

Option 7C Alignment Map

N
W E
S

0 0.425 0.85 1.7
Miles

HMG

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N

Briarwood
Brunelle Regional Park
Horace
Sabin
Cass County
Clay County
Oxbow
Comstock
Wilkin County
Christine
Wolverton
Walcott
Richland County
Colfax
Abercrombie
Kent

46
29
75

Frontier
South Branch Buffalo
Stony Creek
Whisky
Wolverton Creek
NORTH DAKOTA
MINNESOTA
RICHLAND
WILKIN
1039 ft

H7C Depth Difference

Depth (ft)

- 0
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1
- 1 - 3
- 3 - 5
- >5
- Option 7C Alignment
- Western Tie-Back
- Levee

Source: Phase 8.1 CLOMR

Current Diversion, Western Tieback, Eastern Tieback, 37 ft Through Town

Sources: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Option 7C Alignment Depth Difference Map

N W E S

0 0.425 0.85 1.7
Miles

HMG

Created By: enelson Date Created: 12/06/2017 Date Exported: 12/8/2017 Image: 2016 County NAIP Elevation Data: -
Coordinate System: NAD 1983 UTM Zone 14N Datum: North American 1983
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Appendix C.4 - TAG Key Criteria and Results Table

FM Diversion Task Force Technical Advisory Group Alternative Evaluation Key Criteria and Results (December 11, 2017)				Phase 8.1		Alternative H7A - Storage Area 1										Alternative H7B - Storage Area 2										Alternative 7C - ModNAA									
						7A_35		7A_37		7A_38		7A_39		7A_37DS		7B_35		7B_37		7B_38		7B_39		7B_37DS		7C_35		7C_37		7C_38		7C_39		7C_37DS	
Criteria			Existing Conditions	Current Project 35 ft Through Town (baseline)		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 35 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 37 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 38 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 39 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 37 ft Through Town, Max 6 inch downstream impact		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 35 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 37 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 38 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 39 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 37 ft Through Town, Max 6 inch downstream impact		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 35 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 37 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 38 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 39 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 37 ft Through Town, Max 6 inch downstream impact	
Criteria A - Satisfy Task Force Charter																																	
	FEMA Accreditation	Y or N	-																														
	Maintain Federal Authorization	Y or N	-																														
Criteria B - Meets Laws and Ordinances																																	
	ND Statute and Rules	Y or N	-																														
	MN Statute and Rules	Y or N	-																														
	Local Ordinances	Y or N	-																														
Criteria C - Minimize Residual Risk																																	
	Life and Safety - Evacuation	Frequency	-																														
	Length of Levee/Dam	Length (ft)	-																														
	Height of Levee/Dam	Length (ft)	-																														
	Internal Floodplain/Drainage	# of Systems	-																														
	Dam Breach No Build Zone	Area (ac)	-																														
Criteria D - Upstream Floodplain Impacts [4]				EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP
	Cass County	Total Area (ac)		10,326	16,290	12,680	19,375	12,677	18,120	12,596	17,781	12,595	17,682	12,607	17,678	14,477	19,881	14,156	19,057	14,156	18,913	14,155	18,787	14,156	18,706	14,255	20,238	14,172	19,486	14,172	19,303	14,105	19,107	14,172	19,089
		Addn'l Area (ac)			5,964		6,695		5,443		5,185		5,087		5,071		5,404		4,901		4,757		4,632		4,550		5,983		5,314		5,131		5,002		4,917
	Richland County	Total Area (ac)		3,263	4,387	2,746	3,368	2,260	2,702	2,116	2,512	1,993	2,360	2,260	2,676	2,260	2,671	2,217	2,516	2,073	2,343	1,975	2,225	2,217	2,500	2,324	2,783	1,994	2,331	1,946	2,244	1,745	2,008	1,993	2,303
		Addn'l Area (ac)			1,124		622		442		396		367		416		411		299		270		250		283		459		337		298		263		310
North Dakota		Total Area (ac)		13,589	20,676	15,426	22,743	14,937	20,821	14,712	20,293	14,588	20,043	14,867	20,354	16,737	22,552	16,373	21,572	16,229	21,256	16,130	21,013	16,373	21,206	16,579	23,021	16,166	21,816	16,118	21,548	15,850	21,115	16,165	21,392
		Addn'l Area (ac)			7,088		7,317		5,885		5,581		5,454		5,487		5,815		5,200		5,027		4,882		4,834		6,442		5,651		5,430		5,265		5,227
	Clay County	Total Area (ac)		1,989	12,229	2,728	10,710	2,728	10,048	2,728	9,779	2,728	9,622	2,728	9,605	2,728	9,895	2,728	8,955	2,728	8,689	2,728	8,537	2,728	8,502	2,845	10,321	2,844	9,510	2,844	9,175	2,844	8,965	2,844	8,906
		Addn'l Area (ac)			10,240		7,982		7,320		7,051		6,894		6,877		7,167		6,227		5,961		5,809		5,774		7,476		6,666		6,331		6,121		6,062
	Wilkin County	Total Area (ac)		1,160	2,551	1,275	1,977	1,276	1,694	1,191	1,533	1,157	1,444	1,275	1,632	1,276	1,596	1,275	1,475	1,191	1,372	1,157	1,329	1,275	1,466	1,275	1,710	1,156	1,395	1,080	1,288	1,060	1,245	1,156	1,372
		Addn'l Area (ac)			1,391		702		418		342		287		357		320		200		181		172		191		435		239		208		185		216
Minnesota		Total Area (ac)		3,149	14,780	4,003	12,687	4,004	11,742	3,919	11,312	3,885	11,066	4,003	11,236	4,004	11,491	4,003	10,430	3,919	10,061	3,885	9,866	4,003	9,968	4,120	12,031	4,000	10,905	3,924	10,463	3,904	10,210	4,000	10,278
		Addn'l Area (ac)			11,631		8,684		7,739		7,393		7,182		7,233		7,487		6,427		6,142		5,981		5,964		7,911		6,904		6,539		6,306		6,278
Total (ND/MN)		Total Area (ac)		16,738	35,456	19,429	35,430	18,941	32,563	18,631	31,605	18,473	31,109	18,870	31,590	20,741	34,042	20,376	32,003	20,148	31,317	20,015	30,879	20,376	31,173	20,699	35,052	20,166	32,722	20,042	32,011	19,754	31,326	20,165	31,671
		Addn'l Area (ac)			18,720		16,001		13,623		12,974		12,636		12,720		13,302		11,627		11,169		10,863		10,798		14,353		12,556		11,969		11,571		11,505
Criteria D - Protected Area Floodplain Impacts [5]				EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP
	Cass County	Total Area (ac)		61,335	14,190	58,844	13,966	58,844	17,839	58,844	20,212	58,844	22,229	58,844	17,923	56,897	13,963	56,897	17,823	56,897	20,180	56,897	22,129	56,897	17,907	57,306	13,463	57,306	15,993	57,306	17,579	57,306	19,126	57,306	16,083
		Floodplain reduction (ac)			47,145		44,878		41,005		38,632		36,615		40,921		42,934		39,074		36,717		34,768		38,990		43,842		41,313		39,727		38,180		41,222
	Clay County	Total Area (ac)		17,853	6,861	17,853	6,858	17,853	8,367	17,853	9,507	17,853	10,973	17,853	8,373	17,853	6,857	17,853	8,365	17,853	9,502	17,853	10,972	17,853	8,372	17,773	6,808	17,773	8,275	17,773	9,457	17,773	10,989	17,773	8,280
		Floodplain reduction (ac)			10,992		10,995		9,486		8,346		6,880		9,480		10,996		9,488		8,351		6,881		9,481		10,965		9,498		8,316		6,784		9,493
Total (ND/MN)		Total Area (ac)		79,188	21,051	76,697	20,824	76,697	26,206	76,697	29,719	76,697	33,202	76,697	26,296	74,750	20,820	74,750	26,188	74,750	29,682	74,750	33,101	74,750	26,279	75,079	20,271	75,079	24,268	75,079	27,036	75,079	30,115	75,079	24,364
		Floodplain reduction (ac)			58,137		55,873		50,491		46,978		43,495		50,401		53,930		48,562		45,068		41,649		48,471		54,808		50,810		48,042		44,964		50,715
Criteria E - Reduce Environmental Effects																																	
		Similar, Better, Worse																															
Criteria F - Upstream Impacted Structures [4]				EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP
	Cass County	# of Res Structures		9	41	17	59	17	53	17	53	17	53	17	53	20	64	20	63	20	62	20	62	20	62	19	67	19	67	19	67	19	66	19	66
		# of Non-Res Structures		130	258	209	365	209	341	209	338	209	335	209	336	244	383	238	369	238	369	238	367	238	364	233	384	233	375	233	373	233	370	233	369
		Total # of Structures		139	299	226	424	226	394	226	391	226	388	226	389	264	447	258	432	258	431	258	429	258	426	252	451	252	442	252	440	252	436	252	435
		# of Additional Stuctures			160		198		168		165		162		163		183		174		173		171		168		199		190		188		184		183
	Richland County	# of Res Structures		0	3	0	2	0	2	0	2	0	2	0	2	0	2	0	1	0	1	0	1	0	1	0	2	0	2	0	1	0	1	0	1
		# of Non-Res Structures		32	61	26	38	16	25	15	24	15	23	16	25	17	26	16	22	15	20	15	20	16	21	22	31	15	23	15	22	12	17	15	22
		Total # of Structures		32	64	26	40	16	27	15	26	15	25	16	27	17	28	16	23	15	21	15	21	16	22	22	33	15	25	15	23	12	18	15	23
		# of Additional Stuctures			32		14		11		11		10		11		11		7		6		6		6		11		10		8		6		8
North Dakota		# of Res Structures		9	44	17	61	17	55	17	55	17	55	17	55	20	66	20	64	20	63	20	63	20	63	19	69	19	69	19	68	19	67	19	67
		# of Non-Res Structures		162	319	235	403	225	366	224	362	224	358	225	361	261	409	254	391	253	389	253	387	254	385	255	415	248	398	248	395	245	387	248	391
		Total # of Structures		171	363	252	464	242	421	241	417	241	413	242	416	281	475	274	455	273	452	273	450	274	448	274	484	267	467	267	463	264	454	267	458
		# of Additional Stuctures			192		212		179		176		172		174		194		181		179		177		174		210		200		196		190		191
	Clay County	# of Res Structures		1	20	2	19	2	17	2	17	2	17	2	17	2	17	2	16	2	16	2	16	2	15	2	20	2	18	2	18	2	18	2	18
		# of Non-Res Structures		29	211	33	187	33	171	33	153	33	148	33	147	33	159	33	142	33	140	33	139	33	140	40	180	40	153	40	150	40	149	40	147
		Total # of Structures		30	231	35	206	35	188	35	170	35	165	35	164	35	176	35	158	35	156	35	155	35	155	42	200	42	171	42	168	42	167	42	165
		# of Additional Stuctures			201		171		153		135		130		129		141		123		121		120		120		158		129		126		125		123
	Wilkin County	# of Res Structures		2	5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		# of Non-Res Structures		21	37	21	30	21	28	21	27	21	26	21	28	21	27	21	26	21	26	21	26	21	26	21	28	21	26	21	26	21	26	21	26
		Total # of Structures		23	42	23	32	23	30	23	29	23	28	23	30	23	29	23	28	23	28	23	28	23	28	23	30	23	28	23	28	23	28	23	28
		# of Additional Stuctures			19		9		7		6		5		7		6		5		5		5		5		7		5		5		5		5
Minnesota		# of Res Structures		3	25	4	21	4	19	4	19	4	19	4	19	4	19	4	18	4	18	4	18	4	17	4	22	4	20	4	20	4	20	4	20
		# of Non-Res Structures		50	248	54	217	54	199	54	180	54	174	54	175	54	186	54	168	54	166	54	165	54	166	61	208	61	179	61	176	61	175	61	173
		Total # of Structures		53	273	58	238	58	218	58	199	58	193	58	194	58	205	58	186	58	184	58	183	58	183	65	230	65	199	65	196	65	195	65	193
		# of Additional Stuctures			220		180		160		141		135		136		147		128		126		125		125		165		134		131		130		128
Total (ND/MN)		# of Res Structures		12	69	21	82	21	74	21	74	21	74	21	74	24	85	24	82	24	81	24	81	24	80	23	91	23	89	23	88	23	87	23	87
		# of Non-Res Structures		212	567	289	620	279	565	278	542	278	532	279	536	315	595	308	559	307	555	307	552	308	551	316	623	309	577	309	571	306	562	309	564
		Total # of Structures		224	636	310	702	300	639	299	616	299	606	300	610	339	680	332	641	331	636	331	633	332	631	339	714	332	666	332	659	329	649	332	651
		# of Additional Stuctures			412		392		339		317		307		310		341		309		305		302		299		375		334		327		320		319

FM Diversion Task Force Technical Advisory Group Alternative Evaluation Key Criteria and Results (December 11, 2017)				Phase 8.1		Alternative H7A - Storage Area 1										Alternative H7B - Storage Area 2										Alternative 7C - ModNAA									
						7A_35		7A_37		7A_38		7A_39		7A_37DS		7B_35		7B_37		7B_38		7B_39		7B_37DS		7C_35		7C_37		7C_38		7C_39		7C_37DS	
Criteria			Existing Conditions	Current Project 35 ft Through Town (baseline)		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 35 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 37 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 38 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 39 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 1, 37 ft Through Town, Max 6 inch downstream impact		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 35 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 37 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 38 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 39 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Storage Area 2, 37 ft Through Town, Max 6 inch downstream impact		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 35 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 37 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 38 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 39 ft Through Town		Current Diversion, Western Tieback, Eastern Tieback, Modified Northern Alignment, 37 ft Through Town, Max 6 inch downstream impact	
Criteria F - Protected Area Impacted Structures [5]				EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP	EX	WP
	Cass County	# of Res Structures		15,536	20	15,393	22	15,393	72	15,393	112	15,393	190	15,393	72	15,386	22	15,386	72	15,386	112	15,386	190	15,386	72	15,389	22	15,389	64	15,389	101	15,389	180	15,389	64
		# of Non-Res Structures		8,854	93	8,766	92	8,766	176	8,766	233	8,766	291	8,766	177	8,750	92	8,750	176	8,750	233	8,750	291	8,750	177	8,754	93	8,754	171	8,754	219	8,754	262	8,754	175
		Total # of Structures		24,390	113	24,159	114	24,159	248	24,159	345	24,159	481	24,159	249	24,136	114	24,136	248	24,136	345	24,136	481	24,136	249	24,143	115	24,143	235	24,143	320	24,143	442	24,143	239
		# of Protected Stuctures			24,277		24,045		23,911		23,814		23,678		23,910		24,022		23,888		23,791		23,655		23,887		24,028		23,908		23,823		23,701		23,904
	Clay County	# of Res Structures		637	9	623	9	623	30	623	42	623	64	623	30	623	9	623	30	623	42	623	64	623	30	623	9	623	30	623	42	623	65	623	30
		# of Non-Res Structures		554	33	546	33	546	90	546	134	546	180	546	90	546	33	546	90	546	134	546	180	546	90	545	33	545	86	545	137	545	181	545	87
		Total # of Structures		1,191	42	1,169	42	1,169	120	1,169	176	1,169	244	1,169	120	1,169	42	1,169	120	1,169	176	1,169	244	1,169	120	1,168	42	1,168	116	1,168	179	1,168	246	1,168	117
		# of Protected Stuctures			1,149		1,127		1,049		993		925		1,049		1,127		1,049		993		925		1,049		1,126		1,052		989		922		1,051
	Total (ND/MN)	# of Res Structures		16,173	29	16,016	31	16,016	102	16,016	154	16,016	254	16,016	102	16,173	31	16,009	102	16,009	154	16,009	254	16,009	102	16,012	31	16,012	94	16,012	143	16,012	245	16,012	94
		# of Non-Res Structures		9,408	126	9,312	125	9,312	266	9,312	367	9,312	471	9,312	267	9,408	125	9,296	266	9,296	367	9,296	471	9,296	267	9,299	126	9,299	257	9,299	356	9,299	443	9,299	262
		Total # of Structures		25,581	155	25,328	156	25,328	368	25,328	521	25,328	725	25,328	369	25,581	156	25,305	368	25,305	521	25,305	725	25,305	369	25,311	157	25,311	351	25,311	499	25,311	688	25,311	356
		# of Protected Stuctures			25,426		25,172		24,960		24,807		24,603		24,959		25,149		24,937		24,784		24,580		24,936		25,154		24,960		24,812		24,623		24,955
Criteria G - Resilience/Robustness of Design																																			
	Maintain FEMA Accreditation if future hydrology changes	Similar, Better, Worse																																	
	Capability to Fight Floods larger than 100-year	Similar, Better, Worse																																	
Criteria H - Cost and Engineering Feasibility																																			
	Engineering Feasibility	Similar, Better, Worse																																	
	Cost	Similar, Better, Worse																																	
Criteria I / J - Upstream and Downstream Impacts																																			
Downstream	Drayton, ND (30 mi. to Canada)[3]	Elevation, (Impact, ft)	802.03	802.06	(0.03)	802.05	(0.02)	802.06	(0.03)	802.06	(0.03)	802.05	(0.02)	802.13	(0.1)	802.05	(0.02)	802.06	(0.03)	802.06	(0.03)	802.05	(0.02)	802.13	(0.1)	802.04	(0.01)	802.06	(0.03)	802.05	(0.02)	802.05	(0.02)	802.13	(0.1)
Downstream	Oslo, MN	Elevation, (Impact, ft)	813.42	813.44	(0.02)	813.43	(0.01)	813.44	(0.02)	813.43	(0.01)	813.43	(0.01)	813.47	(0.05)	813.43	(0.01)	813.44	(0.02)	813.43	(0.01)	813.43	(0.01)	813.47	(0.05)	813.43	(0.01)	813.43	(0.01)	813.43	(0.01)	813.43	(0.01)	813.47	(0.05)
Downstream	Grand Forks Gage	Elevation, (Impact, ft)	832.38	832.43	(0.05)	832.41	(0.03)	832.43	(0.05)	832.42	(0.04)	832.41	(0.03)	832.61	(0.23)	832.41	(0.03)	832.43	(0.05)	832.42	(0.04)	832.40	(0.02)	832.61	(0.23)	832.39	(0.01)	832.41	(0.03)	832.41	(0.03)	832.40	(0.02)	832.60	(0.22)
Downstream	Thompson, ND (Gage)	Elevation, (Impact, ft)	846.85	846.84	(-0.01)	846.80	(-0.05)	846.82	(-0.03)	846.79	(-0.06)	846.75	(-0.1)	847.16	(0.31)	846.80	(-0.05)	846.82	(-0.03)	846.79	(-0.06)	846.74	(-0.11)	847.16	(0.31)	846.76	(-0.09)	846.79	(-0.06)	846.78	(-0.07)	846.75	(-0.1)	847.15	(0.3)
Downstream	Climax, MN	Elevation, (Impact, ft)	857.08	857.05	(-0.03)	856.99	(-0.09)	857.03	(-0.05)	856.97	(-0.11)	856.90	(-0.18)	857.57	(0.49)	856.99	(-0.09)	857.03	(-0.05)	856.97	(-0.11)	856.89	(-0.19)	857.57	(0.49)	856.94	(-0.14)	856.98	(-0.1)	856.95	(-0.13)	856.91	(-0.17)	857.55	(0.47)
Downstream	Nielsville, MN	Elevation, (Impact, ft)	861.16	861.12	(-0.04)	861.05	(-0.11)	861.09	(-0.07)	861.04	(-0.12)	860.96	(-0.2)	861.64	(0.48)	861.05	(-0.11)	861.09	(-0.07)	861.03	(-0.13)	860.95	(-0.21)	861.64	(0.48)	861.00	(-0.16)	861.04	(-0.12)	861.01	(-0.15)	860.97	(-0.19)	861.62	(0.46)
Downstream	Shelly, MN	Elevation, (Impact, ft)	865.16	865.12	(-0.04)	865.08	(-0.08)	865.10	(-0.06)	865.07	(-0.09)	865.02	(-0.14)	865.45	(0.29)	865.08	(-0.08)	865.10	(-0.06)	865.06	(-0.1)	865.01	(-0.15)	865.45	(0.29)	865.05	(-0.11)	865.07	(-0.09)	865.05	(-0.11)	865.02	(-0.14)	865.44	(0.28)
Downstream	Halstad, MN	Elevation, (Impact, ft)	868.27	868.22	(-0.05)	868.19	(-0.08)	868.21	(-0.06)	868.18	(-0.09)	868.15	(-0.12)	868.45	(0.18)	868.19	(-0.08)	868.21	(-0.06)	868.18	(-0.09)	868.15	(-0.12)	868.45	(0.18)	868.18	(-0.09)	868.19	(-0.08)	868.18	(-0.09)	868.16	(-0.11)	868.44	(0.17)
Downstream	Hendrum, MN	Elevation, (Impact, ft)	872.61	872.49	(-0.12)	872.46	(-0.15)	872.47	(-0.14)	872.44	(-0.17)	872.38	(-0.23)	872.82	(0.21)	872.46	(-0.15)	872.47	(-0.14)	872.43	(-0.18)	872.38	(-0.23)	872.82	(0.21)	872.43	(-0.18)	872.45	(-0.16)	872.43	(-0.18)	872.39	(-0.22)	872.81	(0.2)
Downstream	Perley, MN	Elevation, (Impact, ft)	877.31	877.26	(-0.05)	877.24	(-0.07)	877.25	(-0.06)	877.24	(-0.07)	877.23	(-0.08)	877.42	(0.11)	877.24	(-0.07)	877.25	(-0.06)	877.24	(-0.07)	877.23	(-0.08)	877.42	(0.11)	877.23	(-0.08)	877.24	(-0.07)	877.24	(-0.07)	877.24	(-0.07)	877.42	(0.11)
Downstream	Georgetown, MN	Elevation, (Impact, ft)	881.83	881.93	(0.1)	881.92	(0.09)	881.94	(0.11)	881.94	(0.11)	881.94	(0.11)	882.08	(0.25)	881.92	(0.09)	881.94	(0.11)	881.94	(0.11)	881.94	(0.11)	882.08	(0.25)	881.91	(0.08)	881.93	(0.1)	881.94	(0.11)	881.95	(0.12)	882.07	(0.24)
In-Town	Fargo/Moorhead (Fargo Gage[2])	Elevation, (Impact, ft)	903.22	897.56	(-5.66)	897.56	(-5.66)	899.71	(-3.51)	900.73	(-2.49)	901.77	(-1.45)	899.71	(-3.51)	897.56	(-5.66)	899.71	(-3.51)	900.73	(-2.49)	901.77	(-1.45)	899.71	(-3.51)	897.55	(-5.67)	899.68	(-3.54)	900.73	(-2.49)	901.80	(-1.42)	899.68	(-3.54)
			RS 40.5	RS 34.8		RS 34.8		RS 37		RS 38		RS 39		RS 37		RS 34.8		RS 37		RS 38		RS 39		RS 37		RS 34.8		RS 36.9		RS 38		RS 39.1		RS 36.9	
Upstream	Upstream of Dam	Elevation, (Impact, ft)	Varies	921.66	(7.4)	920.75	(6.49)	920.03	(5.77)	919.80	(5.54)	919.67	(5.41)	919.65	(5.39)	919.91	(5.65)	919.13	(4.87)	918.93	(4.67)	918.82	(4.56)	918.80	(4.54)	920.17	(5.91)	919.46	(5.2)	919.20	(4.94)	919.05	(4.79)	919.02	(4.76)
Upstream	County Line @ Wild Rice River (xs 109018)	Elevation, (Impact, ft)	922.04	922.6	(0.56)	922.23	(0.19)	922.13	(0.09)	922.11	(0.07)	922.09	(0.05)	922.13	(0.09)	922.08	(0.04)	922.05	(0.01)	922.05	(0.01)	922.04	(0)	922.05	(0.01)	922.15	(0.11)	922.08	(0.04)	922.07	(0.03)	922.06	(0.02)	922.08	(0.04)
Upstream	County Line @ Red River (xs 2578502)	Elevation, (Impact, ft)	918.76	922.49	(3.73)	921.80	(3.04)	921.38	(2.62)	921.26	(2.5)	921.17	(2.41)	921.24	(2.48)	921.26	(2.5)	920.83	(2.07)	920.73	(1.97)	920.65	(1.89)	920.72	(1.96)	921.43	(2.67)	921.04	(2.28)	920.90	(2.14)	920.79	(2.03)	920.84	(2.08)
Criteria J - Included in Criteria I.																																			

[1] *POR = All Models Utilize Full Period of Record Hydrology (1882 and 1902-2009); 100-year discharge = 33,000 cfs*

[2] *USGS Gage 05054000 - Red River of the North at Fargo, ND (Gage Zero= 862.74 ft, NAVD88)*

[3] *Impacts of 0.04 ft or less at Drayton indicate zero impacts at US/Canadian Border.*

[4] *The Impacted Acreages and Structure totals are based on a takings analysis boundary that is defined based on an area where the depth difference between with-project and existing conditions is 0.1 foot or greater.*

[5] *The Protected Area Acreages and Structure totals are based on a boundary that is defined based on an area between the line of protection on the south and any project features on the north, east and west sides.*