



**US Army Corps
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St. Paul District

Technical Advisory Group Summary for Policy Group Appendix B

Fargo Moorhead Metropolitan Area
Flood Risk Management Project

Supplemental Environmental
Assessment Document

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TAG Summary for Policy Group

March 8, 2018

A Technical Advisory Group (TAG) was created as an advisory group to the Fargo-Moorhead Area Flood Diversion Task Force to assess components and alternatives as well as to provide technical guidance to the Task Force. After the conclusion of the Task Force, TAG continued to meet to refine, explore and study alternatives, including alignments not studied at the Task Force. TAG utilized the Task Force guidance

Task Force Guidance for TAG

The following is guidance from the Task Force discussions that TAG utilized during all these subsequent alignment studies:

- Full Period of Record (POR) hydrology for 1% annual chance (100yr) discharge flows, which is 33,000 CFS at the Fargo stream gage.
- Change project operation to allow a flow through town that results in a RS37' at the Fargo stream gage during the 100yr flood event.
- New Western Tie-back Levee alignment.
- Add an Eastern Tie-back Levee alignment in Minnesota.
- Allow up to 6-inches of downstream impacts but no increase water elevations at the Canadian border.
- Strive for balanced flood protection.
- Strive for equity in impacts – ND/MN. Current Existing Conditions (POR) floodplain is approximately 77% - ND and 23% - MN within the Project area.
- Minimize acres removed from the floodplain.
- Minimize newly impacted acreage and structures.
- Minimize impacts in Wilkin County, MN and Richland County, ND with a goal of reducing the newly impacted acreage to 640 acres or less.
- Consider economics – cost increases and reductions.

Eastern Tie Back Changes (Option 10D)

In an effort to satisfy these criteria, TAG developed a new alternative for the Eastern Tie-Back that turns the dam/embankment south at the Red River Control structure and follows an alignment between Wolverton Creek and the west side of U.S. Highway 75 and the Red River. This alignment has been referenced as Option 10D. The following are key benefits identified with this new alignment:

- Eliminates the need for a ring levee for the city of Comstock
- Eliminates grade raises for the BNSF Moorhead Subdivision rail line and U.S. Highway 75.
- Significantly reduces the number of organic farms impacted.
- Eliminates impacts to two (2) cemeteries.
 - Further reductions to cemeteries are also achieved with alignment shifts that will be discussed further in this document. This reduces the total cemetery impacts from 11 to 6 (reduction of 5).

- Reduces the newly impacted floodplain and residential structures impacted in Minnesota.
- Minimizes the disruption of local drainage in Minnesota.

TAG has recommended that this Option 10D alternative alignment be included as part of all Options going forward.

Southern Alignments

TAG has developed options for consideration by the Advisory Group as highlighted in the attached Figure. All of the options include RS37' through town; the Western Tie-back Levee; the Option 10D alignment in Minnesota; and were analyzed using the Full POR hydrology. The options are described below:

- Option 7A/10D (Red Line on Figure) – This is the Option 7A alignment as presented in the TAG report to the Task Force.
- Option 7A'/10D (Green Line on Figure) – This is similar to Option 7A, however it extends further north approximately 0.75 mile. This pushes the northern end of the alignment as far north as possible, while still allowing the Staging area to drain south by gravity. This option reduces Task Force Option 7B by approximately 2 square miles.
- Option 7A/7C Hybrid/10D (Blue Line on Figure) – This is a hybrid option of Options 7A and 7C. Option 7C was proposed to match the benefits of Option 7B.
- Option 7A/10D/JPA-NW (Orange Line on Figure) – This is Option 7A combined with the northwest alignment modifications proposed by the JPA.
- JPA Southern Alignment (Orange Line on Figure) – This alignment was proposed by the JPA. It was not modeled in detail, but results have been extrapolated from other alternatives.

The following summary tables include comparisons for Option 7A/10D (Red Line on Figure) to the Pre-Task Force alignment (Black Line on Figure) and for the other options to Option 7A/10D for several criteria. For comparison purposes, preliminary cost estimates were developed by the FM Diversion Authority and USACE. The cost estimates account for changes in land costs as well as construction costs for the dam and diversion channel. This includes increases and reductions, depending on the alternative/features.

Talking Points – Pre-Task Force vs. Option 7A/10D Alignment:

Pre-Task Force Alignment (Black Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	20,676	14,780	58% ND / 42% MN	4,387	2,551
B	Staging Area Additional Acres (newly inundated)	7,088	11,631	38% ND / 62% MN	1,124	1,391
C	Diversion Channel Footprint	6,800	0	100% ND	0	0
D	Southern Embankment Footprint	1,100	430	72% ND / 28% MN	0	0
E	Total Acres & Footprint	28,576*	15,210*	65% ND / 35% MN	4,387*	2,551*
F	Total Impacted Residential Structures in the Staging Area	44	25	64% ND / 36% MN	3	5
G	Newly Impacted Staging Area Residential Structures	35	22	61% ND / 39% MN	3	3
H	Protected Acres	47,145	10,992	81% ND / 19% MN	-	-

*Total acreage is sum of rows A+C+D.

Option 7A/10D (Red Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	22,585	5,420	81% ND / 19% MN	2,783	1,407
B	Staging Area Additional Acres (newly inundated)	7,751	3,286	70% ND / 30% MN	596	385
C	Diversion Channel Footprint	6,800	0	100% ND	0	0
D	Southern Embankment Footprint	1,100	420	72% ND / 28% MN	0	0
E	Total Acres & Footprint	30,485*	5,840*	84% ND / 16% MN	2,783*	1,407*
F	Total Impacted Residential Structures in the Staging Area	60	11	85% ND / 15% MN	2	2
G	Newly Impacted Staging Area Residential Structures	44	8	85% ND / 15% MN	2	0
H	Protected Acres	41,187	9,456	81% ND / 19% MN	-	-

*Total acreage is sum of rows A+C+D.

Difference Between Pre-Task Force (Black Line) and Option 7A/10D (Red Line) Alignment

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	-1,909	-9,360	-	-1,604	-1,144
B	Staging Area Additional Acres (newly inundated)	+663	-8,345	-	-528	-1,006
C	Diversion Channel Footprint	0	0	-	0	0
D	Southern Embankment Footprint	0	-10	-	0	0
E	Total Acres & Footprint	-1,909*	-9,360*	-	-1,604*	-1,144*
F	Total Impacted Residential Structures in the Staging Area	16	-14	-	-1	-3
G	Newly Impacted Staging Area Residential Structures	9	-14	-	-1	-3
H	Protected Acres	-5,958	-1,536	-	-	-

*Total acreage is sum of rows A+C+D.

Other key considerations between the Pre-Task Force & Option 7A/10D alignments:

- Additional cost of \$150M for RS37' and \$45M for Land and Construction Increases (\$195 M total increase).
- Dam length for Option 7A/10D is an additional 3.3 miles.
- Eliminates need for a ring levee around the City of Comstock.
- Eliminates need for grade raises for the BNSF Moorhead Subdivision rail line and U.S. Highway 75.
- Reduces the number of cemeteries impacted to 6 (current alignment is 11).
- Significantly reduces the organic farms impacted.
- Results in the closure of Cass County Highways 16 and 17 during project operation.
- Requires the relocation or raising of Cass County Rural Water wells and associated infrastructure.
- 20 Residential and 125 non-residential structures will be added to the staging area with the Option 7A alignment shift.
- Option 7A/10D removes 1,534 acres of additional floodplain impact from Richland and Wilkin County.

Talking Points – Option 7A/10D vs. Option 7A'/10D Alignment

Option 7A/10D (Red Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	22,585	5,420	81% ND / 19% MN	2,783	1,407
B	Staging Area Additional Acres (newly inundated)	7,751	3,286	70% ND / 30% MN	596	385
C	Diversion Channel Footprint	6,800	0	100% ND	0	0
D	Southern Embankment Footprint	1,100	420	72% ND / 28% MN	0	0
E	Total Acres & Footprint	30,485*	5,840*	84% ND / 16% MN	2,783*	1,407*
F	Total Impacted Residential Structures in the Staging Area	60	11	85% ND / 15% MN	2	2
G	Newly Impacted Staging Area Residential Structures	44	8	85% ND / 15% MN	2	0
H	Protected Acres	41,187	9,456	81% ND / 19% MN	-	-

*Total acreage is sum of rows A+C+D.

Option 7A'/10D (Green Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	22,531	5,112	81% ND / 19% MN	2,499	1,258
B	Staging Area Additional Acres (newly inundated)	7,075	3,013	70% ND / 30% MN	478	270
C	Diversion Channel Footprint	6,800	0	100% ND	0	0
D	Southern Embankment Footprint	1,250	420	75% ND / 25% MN	0	0
E	Total Acres & Footprint	30,581*	5,532*	85% ND / 15% MN	2,499*	1,258*
F	Total Impacted Residential Structures in the Staging Area	61	10	86% ND / 14% MN	2	2
G	Newly Impacted Staging Area Residential Structures	43	7	86% ND / 14% MN	2	0
H	Protected Acres	40,320	9,456	81% ND / 19% MN	-	-

*Total acreage is sum of rows A+C+D.

Difference Between Option 7A/10D (Red Line) and 7A'/10D (Green Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	-54	-308	-	-284	-149
B	Staging Area Additional Acres (newly inundated)	-676	-273	-	-118	-115
C	Diversion Channel Footprint	0	0	-	0	0
D	Southern Embankment Footprint	+150	0	-	0	0
E	Total Acres & Footprint	+96*	-308*	-	-284*	-149*
F	Total Impacted Residential Structures in the Staging Area	+1	-1	-	0	0
G	Newly Impacted Staging Area Residential Structures	-1	-1	-	0	0
H	Protected Acres	-867	-0	-	-	-

*Total acreage is sum of rows A+C+D.

Other key considerations between Option 7A/10D and Option 7A'/10D Alignments:

- Additional cost of \$71M for Land and Construction.
- Dam length for Option 7A' is an additional 2.1 miles.
- Option 7A' results in 212 fewer acres being impacted (The sum of ND and MN Total Acres and Footprint (Line E) on the Difference Table above).
- 4 Residential and 22 non-residential structures will be added to the staging area with the Option 7A' alignment shift.
- Option 7A' requires closure of Cass County Highway 14 during project operation.
- Option 7A/10D removes 233 acres of additional floodplain impact from Richland and Wilkin County.

Talking Points – Option 7A/10D vs. Option 7A/C Hybrid/10D Alignment

Option 7A/10D (Red Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	22,585	5,420	81% ND / 19% MN	2,783	1,407
B	Staging Area Additional Acres (newly inundated)	7,751	3,286	70% ND / 30% MN	596	385
C	Diversion Channel Footprint	6,800	0	100% ND	0	0
D	Southern Embankment Footprint	1,100	420	72% ND / 28% MN	0	0
E	Total Acres & Footprint	30,485*	5,840*	84% ND / 16% MN	2,783*	1,407*
F	Total Impacted Residential Structures in the Staging Area	60	11	85% ND / 15% MN	2	2
G	Newly Impacted Staging Area Residential Structures	44	8	85% ND / 15% MN	2	0
H	Protected Acres	41,187	9,456	81% ND / 19% MN	-	-

*Total acreage is sum of rows A+C+D.

Option 7A/C Hybrid/10D (Blue Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	23,083	4,755	83% ND / 17% MN	2,239	1,061
B	Staging Area Additional Acres (newly inundated)	6,250	2,753	69% ND / 31% MN	356	170
C	Diversion Channel Footprint	6,800	0	100% ND	0	0
D	Southern Embankment Footprint	900	420	68% ND / 32% MN	0	0
E	Total Acres & Footprint	30,783*	5,175*	86% ND / 14% MN	2,239*	1,061*
F	Total Impacted Residential Structures in the Staging Area	82	10	89% ND / 11% MN	2	2
G	Newly Impacted Staging Area Residential Structures	59	7	89% ND / 11% MN	2	0
H	Protected Acres	39,671	9,467	81% ND / 19% MN	-	-

*Total acreage is sum of rows A+C+D.

Difference Between Option 7A/10D (Red Line) and 7A/C Hybrid/10D (Blue Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	-498	-665	-	-544	-346
B	Staging Area Additional Acres (newly inundated)	-1,501	-533	-	-240	-215
C	Diversion Channel Footprint	0	0	-	0	0
D	Southern Embankment Footprint	-200	0	-	0	0
E	Total Acres & Footprint	-698*	-665*	-	-544*	-346*
F	Total Impacted Residential Structures in the Staging Area	+22	-1	-	0	0
G	Newly Impacted Staging Area Residential Structures	+15	-1	-	0	0
H	Protected Acres	-1516	-1	-	-	-

*Total acreage is sum of rows A+C+D.

Other key considerations between Option 7A/10D and Option 7A/C Hybrid/10D Alignments:

- Additional cost of \$188M for Land and Construction.
- Dam length for 7A/C Hybrid is 1.9 miles shorter.
- Option 7A/C Hybrid results in 1,363 fewer acres being impacted (The sum of ND and MN Total Acres and Footprint (Line E) on the Difference Table above).
- 31 Residential and 120 non-residential structures will be added to the staging area with the Option 7A/C Hybrid alignment shift.
- Option 7A/C Hybrid requires the reconstruction of the I-29/CH16 Interchange.
- More cultural resource impacts, including 3 farmsteads that are eligible for listing on the National Register of Historic Places.
- Adversely impacts the Historic St. Benedict Catholic Church and Cemetery (600 graves).
- Option 7A/10D removes 455 acres of additional floodplain impact from Richland and Wilkin County.

Talking Points – Option 7A/10D vs. Option 7A/10D/JPA-NW Alignment

Option 7A/10D (Red Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	22,585	5,420	81% ND / 19% MN	2,783	1,407
B	Staging Area Additional Acres (newly inundated)	7,751	3,286	70% ND / 30% MN	596	385
C	Diversion Channel Footprint	6,800	0	100% ND	0	0
D	Southern Embankment Footprint	1,100	420	72% ND / 28% MN	0	0
E	Total Acres & Footprint	30,485*	5,840*	84% ND / 16% MN	2,783*	1,407*
F	Total Impacted Residential Structures in the Staging Area	60	11	85% ND / 15% MN	2	2
G	Newly Impacted Staging Area Residential Structures	44	8	85% ND / 15% MN	2	0
H	Protected Acres	41,187	9,456	81% ND / 19% MN	-	-

*Total acreage is sum of rows A+C+D.

Option 7A/10D/JPA-NW (Orange Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	18,509	4,265	81% ND / 19% MN	1,224	728
B	Staging Area Additional Acres (newly inundated)	5,146	2,644	66% ND / 34% MN	228	218
C	Diversion Channel Footprint	8,500	0	100% ND	0	0
D	Southern Embankment Footprint	1,100	420	72% ND / 28% MN	0	0
E	Total Acres & Footprint	28,109*	4,685*	86% ND / 14% MN	1,224*	728*
F	Total Impacted Residential Structures in the Staging Area	51	7	88% ND / 12% MN	1	0
G	Newly Impacted Staging Area Residential Structures	35	6	85% ND / 15% MN	1	0
H	Protected Acres	39,263	9,069	81% ND / 19% MN	-	-

*Total acreage is sum of rows A+C+D.

Difference Between Option 7A/10D (Red Line) and 7A/10D/JPA-NW (Orange Line)

	Impacted Lands	ND	MN	Splits	Richland	Wilkin
A	Staging Area Total Acres	-4,076	-1,155	-	-1,559	-679
B	Staging Area Additional Acres (newly inundated)	-2,605	-642	-	-368	-167
C	Diversion Channel Footprint	+1,700	0	-	0	0
D	Southern Embankment Footprint	0	0	-	0	0
E	Total Acres & Footprint	-2,376*	-1,155*	-	-1,559*	-679*
F	Total Impacted Residential Structures in the Staging Area	-9	-4	-	-1	-2
G	Newly Impacted Staging Area Residential Structures	-1	-1	-	-1	0
H	Protected Acres	-867	-0	-	-	-

*Total acreage is sum of rows A+C+D.

Other key considerations between Option 7A/10D and Option 7A/10D/JPA-NW Alignments:

- Additional cost of \$112M for Land and Construction.
- There are 1381 structures (579 primary and 802 non-primary) located between the current diversion channel alignment and the JPA-NW alignment that will be unprotected. This includes approximately 1,500 people.
- The JPA-NW Diversion Alignment is 1.5 miles shorter which will decrease cost.
- Option 7A/10D/JPA-NW results in 3,531 fewer acres being impacted (The sum of ND and MN Total Acres and Footprint (Line E) on the Difference Table above).
- 52 Residential structures, 10 farmsteads, and 3 businesses will be added to the diversion channel footprint with the JPA-NW alignment shift.
- Stream stability concerns due to the at-grade crossing of the Sheyenne River and backup of water into the Diversion Channel from the Sheyenne River.
- Eliminates the need for the Maple River Aqueduct structure.
- Eliminates the Rush and Lower Rush River channel abandonments.
- Overbank excavation is included along the Red River downstream from the Diversion outlet to reduce tailwater effects in the protected area due to the Diversion Channel outlet being located further south.
- The flatter grade of the diversion channel as part of the JPA-NW alignment will result in a shallower but wider diversion channel, which will likely increase cost, including the need for longer bridges.
- Requires the reconstruction of Cass County Drain 40/45.
- May adversely impact overland flooding south of Harwood, ND. The potential for impact has not been determined.
- May impact local drainage from the west and the height of the embedded levee along the Diversion Channel due to a higher water surface profile along the Diversion Channel in some areas.
- Option 7A/10D removes 535 acres of additional floodplain impact from Richland and Wilkin County.

Talking Points – Option 7A/10D (Red Line) vs. JPA Southern Alignment (Orange Line)

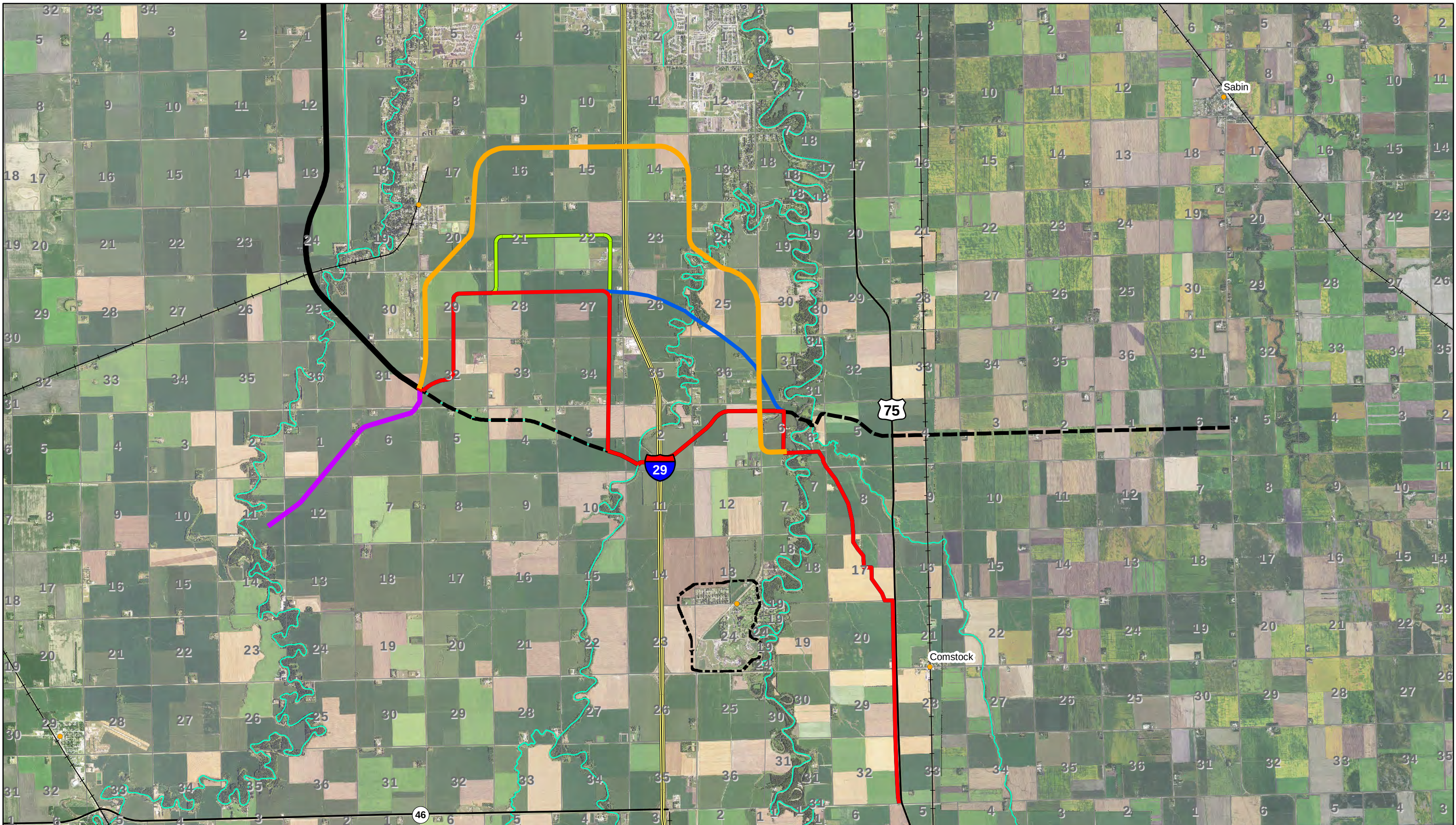
The JPA southern alignment was presented, but has not been modeled in detail. The staging area elevation for an option that includes the JPA Southern Alignment was estimated to be 917.6 for the 100-year flood event, which is 4 feet lower than the pre-task force project and approximately 3.4 feet lower than Option 7A/10D.

Other key considerations between Option 7A/10D and Option 7A/10D/JPA Southern Alignments:

- JPA Southern Alignment is 3 miles longer than the Option 7A/10D Alignment.
- Additional cost of \$280M for Land and Construction for JPA Southern Alignment.
- 67 Residential and 204 non-residential structures will be added to the staging area with the JPA southern alignment shift.
- Utilizes more existing floodplain area.
- Requires the reconstruction of the I-29 interchanges at CH14 and CH16.
- Adversely impacts the Historic St. Benedict Catholic Church and Cemetery (600 graves).
- Will require reconstruction of a portion of Cass County Drain 27.
- Will require considerably more drainage improvements to accommodate local drainage within the staging area.
- The maximum pool elevation during the Probably Maximum Flood (PMF) event may still drive the top of dam elevation and the mitigation pool.
- North-South section of embankment/dam to the west of the Red River may increase the tailwater on the Red River Control Structure. This may result in higher peak WSEL in the staging area during project operation during the PMF event, or may require additional gates be added to the RRN or WRR control structures.
- Potential dam breach concerns by bringing the dam closer to existing developed areas, especially near the WRR control structure. Potential zoning restrictions downstream from the dam are being evaluated for all alignments as part of ongoing dam safety discussions with MN and ND.

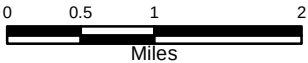
Talking Points – Option 7A/10D (Red Line) vs. JPA Southern Alignment + JPA-NW Diversion Alignment (Orange Lines)

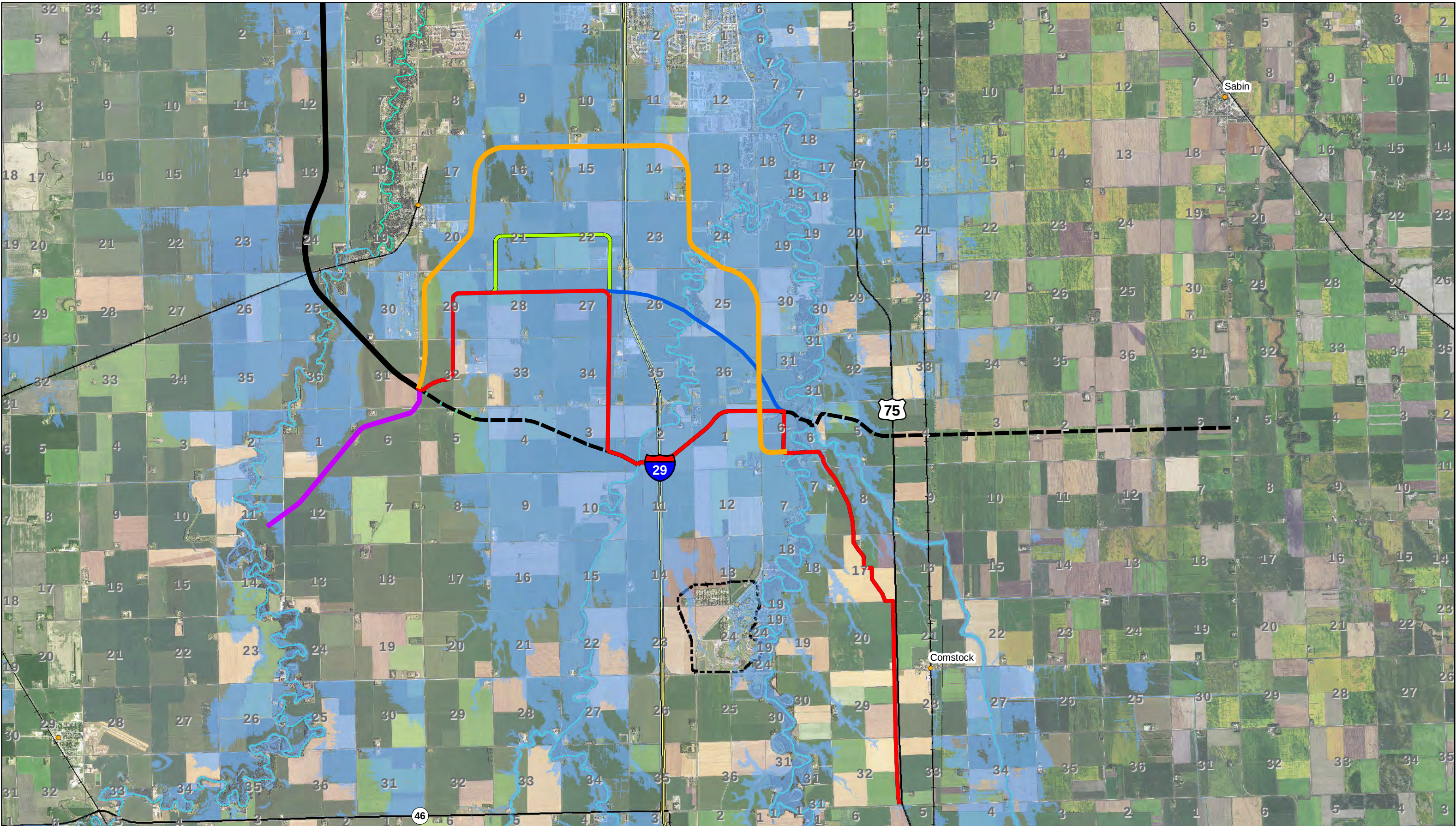
The JPA Southern Alignment + JPA NW Diversion was presented but not modeled in detail. The staging area elevation for an option that includes both the JPA Southern Alignment and the JPA-NW Diversion Alignment was estimated to be 916.2 for the 100-year flood event, which is approximately 5.4 feet lower than the pre-task force project and approximately 4.7 feet lower than Option 7A/10D.



TAG Optional Alignments

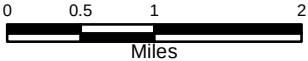
- Option 7A/10D
- Option 7A/C Hybrid/10D
- Option 7A'/10D
- JPA Southern Alignment Revised
- Diversion Channel
- Western Tie-Back
- Pre-Task Force Alignment





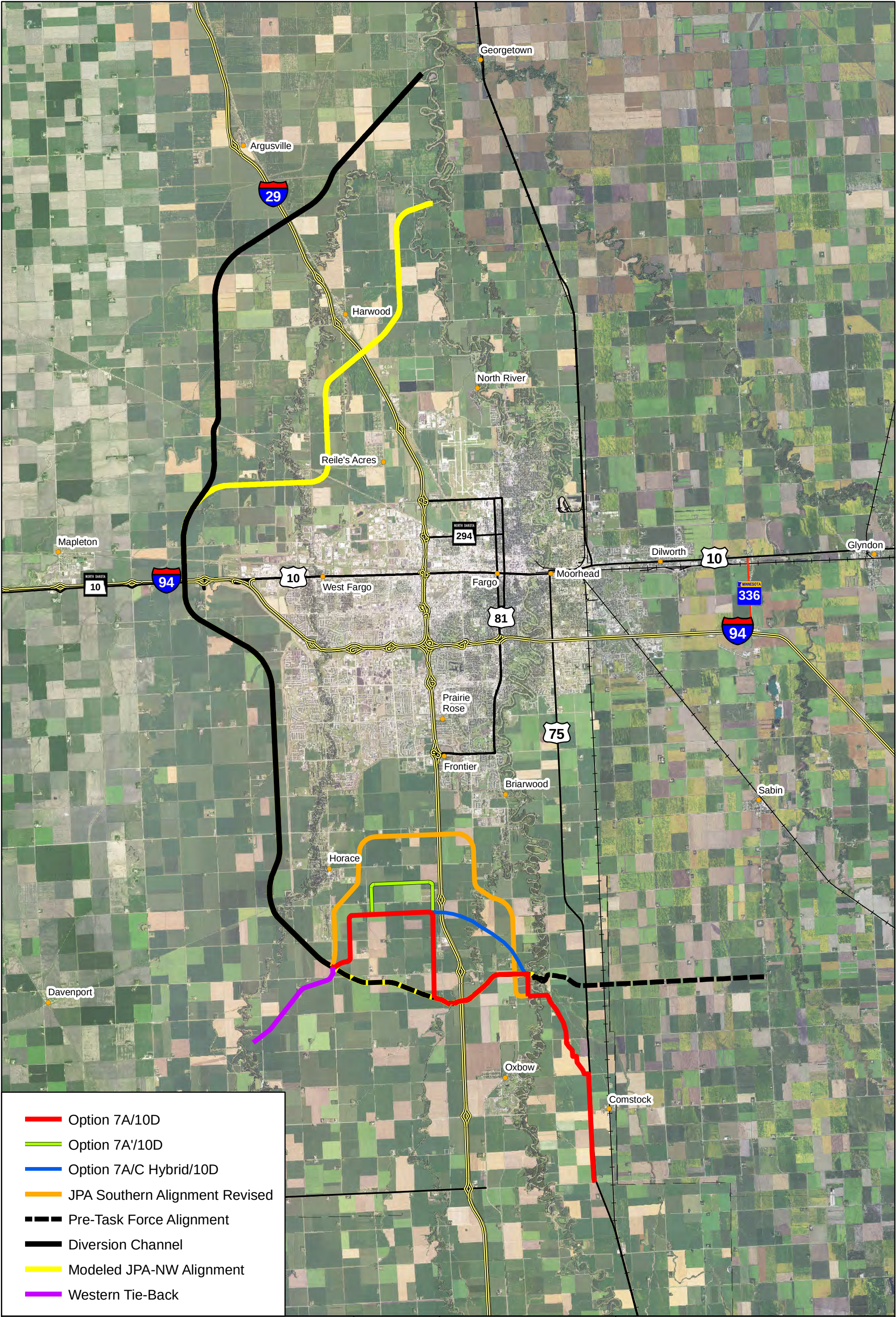
TAG Optional Alignments

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|  Option 7A/10D |  Diversion Channel |
|  Option 7A/C Hybrid/10D |  Western Tie-Back |
|  Option 7A/10D |  Pre-Task Force Alignment |
|  JPA Southern Alignment Revised |  100yr Floodplain (Existing Conditions POR Hydrology) |

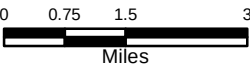


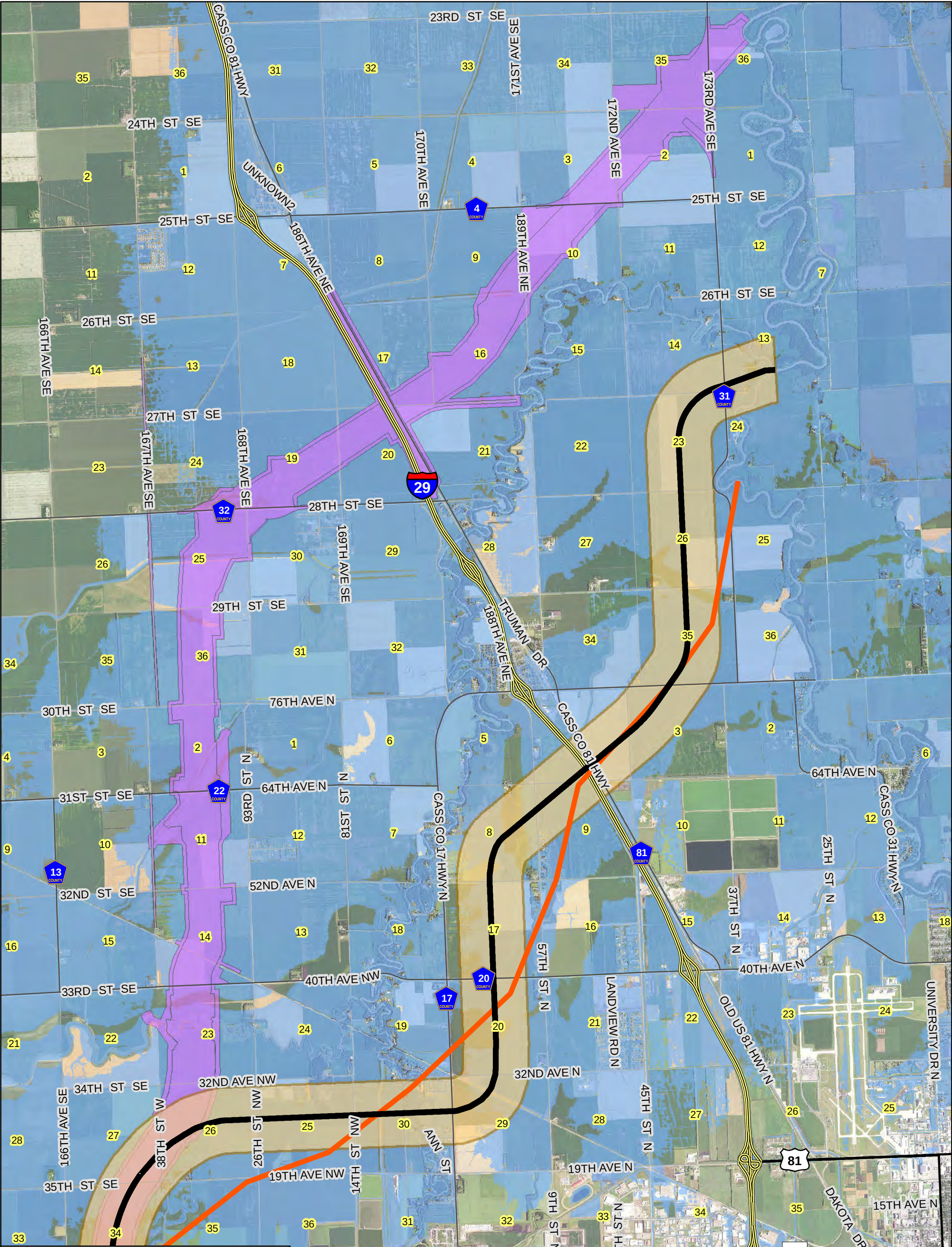
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 Option 7A/10D



TAG Optional Alignments

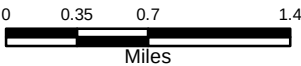




- JPA Alignment
- Modeled JPA Alignment
- Project Work Limits
- 100yr Floodplain (Existing Conditions POR Hydrology)

JPA Alignment with Work Limit Boundaries

Created By: enelson Date Created: 02/09/2018 Date Exported: 3/7/2018 Image: 2016 County NAIP Elevation Data: NA
Horizontal Datum: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet Vertical Datum: North American 1983
H:\Fargo\UBN\7400\7438\13_7438_015\Minnesota Dam Safety Permit\Small Team\2017-11-13 Tech Advisory Com\GIS\JPA_AlignmentMap.mxd



FM Diversion Project - Southern Embankment/Dam Option Comparison

March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
Dam Length (measured from Diversion Inlet to eastern end of dam; excludes Western Tie-Back – longer dam means greater dam safety risk)	12.8 miles	16.1 miles (+3.3 miles)	18.2 miles (+5.4 miles)	14.2 miles (+1.4 miles)	16.1 miles (+3.3 miles)
Staging Elevation Upstream from Dam	921.66	920.98 (-0.68')	920.55 (-1.11')	919.97 (-1.69')	919.61 (-2.05')
Total Staging Area Floodplain Impacts (Total Acres/Additional Acres)	35,456 / 18,720	28,005 / 11,037 - Reduces Newly Impacted Acreage by 7,683 acres	27,643 / 10,088 - Reduces Newly Impacted Acreage by 8,632 acres	27,839 / 9,003 - Reduces Newly Impacted Acreage by 9,717 acres	22,774 / 7,790 - Reduces Newly Impacted Acreage by 10,930 acres
Minnesota Staging Area Floodplain Impacts (Total Acres/Additional Acres)	14,780 / 11,631	5,420 / 3,286 - Reduces Newly Impacted Acreage by 8,345 acres	5,112 / 3,013 - Reduces Newly Impacted Acreage by 8,618 acres	4,755 / 2,753 - Reduces Newly Impacted Acreage by acres 8,878	4,265 / 2,644 - Reduces Newly Impacted Acreage by acres 8,987
Wilkin County Staging Area Floodplain Impacts (Total Acres/Additional Acres)	2,551 / 1,391	1,407 / 385 - Reduces Newly Impacted Acreage by 1,006 acres	1,258 / 270 - Reduces Newly Impacted Acreage by 1,121 acres	1,061 / 170 - Reduces Newly Impacted Acreage by 1,221 acres	728 / 218 - Reduces Newly Impacted Acreage by 1,173 acres

FM Diversion Project - Southern Embankment/Dam Option Comparison

March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
Clay County Staging Area Floodplain Impacts (Total Acres/Additional Acres)	12,229 / 10,240	4,013 / 2,902 - Reduces Newly Impacted Acreage by 7,338 acres	3,854 / 2,743 - Reduces Newly Impacted Acreage by 7,497 acres	3,694 / 2,583 - Reduces Newly Impacted Acreage by 7,657 acres	3,537 / 2,426 - Reduces Newly Impacted Acreage by 7,814 acres
North Dakota Staging Area Floodplain Impacts (Total Acres/Additional Acres)	20,676 / 7,088	22,585 / 7,751 - Increases Newly Impacted Acreage by 663 acres	22,531 / 7,075 - Reduces Newly Impacted Acreage by 13 acres	23,083 / 6,250 - Reduces Newly Impacted Acreage by 838 acres	18,509 / 5,146 - Reduces Newly Impacted Acreage by 1,942 acres
Richland County Staging Area Floodplain Impacts (Total Acres/Additional Acres)	4,387 / 1,124	2,783 / 596 - Reduces Newly Impacted Acreage by 528 acres	2,499 / 478 - Reduces Newly Impacted Acreage by 646 acres	2,239 / 356 - Reduces Newly Impacted Acreage by 768 acres	1,224 / 228 - Reduces Newly Impacted Acreage by 896 acres
Cass County Staging Area Floodplain Impacts (Total Acres/Additional Acres)	16,290 / 5,964	19,802 / 7,155 - Increases Newly Impacted Acreage by 1,191 acres	20,032 / 6,597 - Increases Newly Impacted Acreage by 633 acres	20,845 / 5,895 - Reduces Newly Impacted Acreage by 69 acres	17,285 / 4,918 - Reduces Newly Impacted Acreage by 1,046 acres
Total Protected Area Floodplain Impacts – Acres (Existing Conditions /With-Project /Reduction)	79,188 / 21,051 / 58,137	76,812 / 26,169 / 50,643 - Reduces Protected Area Floodplain by 7,494 acres	75,959 / 26,183 / 49,776 - Reduces Protected Area Floodplain by 8,361 acres	74,334 / 25,196 / 49,138 - Reduces Protected Area Floodplain by 8,999 acres	76,697 / 28,365 / 48,332 - Reduces Protected Area Floodplain by 9,805 acres

FM Diversion Project - Southern Embankment/Dam Option Comparison

March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
Minnesota Protected Area Floodplain Impacts – Acres (Existing Conditions /With-Project /Reduction)	17,853 / 6,861 / 10,992	17,854 / 8,398 / 9,456 - Reduces Protected Area Floodplain by 1,536 acres	17,854 / 8,398 / 9,456 - Reduces Protected Area Floodplain by 1,536 acres	17,854 / 8,387 / 9,467 - Reduces Protected Area Floodplain by 1,525 acres	17,853 / 8,784 / 9,069 - Reduces Protected Area Floodplain by 1,923 acres
North Dakota Protected Area Floodplain Impacts – Acres (Existing Conditions /With-Project /Reduction)	61,335 / 14,190 / 47,145	58,958 / 17,771 / 41,187 - Reduces Protected Area Floodplain by 5,958 acres	58,105 / 17,785 / 40,320 - Reduces Protected Area Floodplain by 6,825 acres	56,480 / 16,809 / 39,671 - Reduces Protected Area Floodplain by 7,474 acres	58,844 / 19,581 / 39,263 - Reduces Protected Area Floodplain by 7,882 acres
Minnesota Staging Area Residential Structure Impacts (Existing/with-Project)	3 / 25	3 / 11 - Reduces Newly Impacted Residential Structures by 14	3 / 10 - Reduces Newly Impacted Residential Structures by 15	3 / 10 - Reduces Newly Impacted Residential Structures by 15	1 / 7 - Reduces Newly Impacted Residential Structures by 18
Wilkin County Staging Area Residential Structure Impacts (Existing /with-Project)	2 / 5	2 / 2 - Reduces Newly Impacted Residential Structures by 3	2 / 2 - Reduces Newly Impacted Residential Structures by 3	2 / 2 - Reduces Newly Impacted Residential Structures by 3	0 / 0 - Reduces Newly Impacted Residential Structures by 5
Clay County Staging Area Residential Structure Impacts (Existing/with-Project)	1 / 20	1 / 9 - Reduces Newly Impacted Residential Structures by 11	1 / 8 - Reduces Newly Impacted Residential Structures by 12	1 / 8 - Reduces Newly Impacted Residential Structures by 12	1 / 7 - Reduces Newly Impacted Residential Structures by 13

FM Diversion Project - Southern Embankment/Dam Option Comparison

March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
North Dakota Staging Area Residential Structure Impacts (Existing/with-Project)	9 / 44	16 / 60 - Increases Newly Impacted Residential Structures by 16	18 / 61 - Increases Newly Impacted Residential Structures by 17	23 / 82 - Increases Newly Impacted Residential Structures by 38	16 / 51 - Increases Newly Impacted Residential Structures by 7
Richland County Staging Area Residential Structure Impacts (Existing/with-Project)	0 / 3	0 / 2 - Reduces Newly Impacted Residential Structures by 1	0 / 2 - Reduces Newly Impacted Residential Structures by 1	0 / 2 - Reduces Newly Impacted Residential Structures by 1	0 / 1 - Reduces Newly Impacted Residential Structures by 2
Cass County Staging Area Residential Structure Impacts (Existing/with-Project)	9 / 41	16 / 58 - Increases Newly Impacted Residential Structures by 17	18 / 59 - Increases Newly Impacted Residential Structures by 18	23 / 80 - Increases Newly Impacted Residential Structures by 39	16 / 50 - Increases Newly Impacted Residential Structures by 9

March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
Hydrology and Hydraulics	• Uses EOE (Wet Cycle) Hydrology (34,700 cfs for 100-year) • Targets RS35' through protected area = 16,400 cfs (10-year flood event)	• Uses full POR Hydrology (33,000 cfs for 100-year) • Targets RS37' through protected area = 20,200 cfs (21-year flood event), which reduces the frequency of gate and staging area operation.	• Uses full POR Hydrology (33,000 cfs for 100-year) • Targets RS37' through protected area = 20,200 cfs (21-year flood event), which reduces the frequency of gate and staging area operation.	• Uses full POR Hydrology (33,000 cfs for 100-year) • Targets RS37' through protected area = 20,200 cfs (21-year flood event), which reduces the frequency of gate and staging area operation.	• Uses full POR Hydrology (33,000 cfs for 100-year) • Targets RS37' through protected area = 20,200 cfs (21-year flood event), which reduces the frequency of gate and staging area operation.
FEMA Regulations and the CLOMR Process	• CLOMR has been issued	• May require a CLOMR update	• May require a CLOMR update	• May require a CLOMR update	• May require a CLOMR update

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Stream Stability	Impacts have been quantified	No identified changes	No identified changes	No identified changes	- At-Grade crossing for the Sheyenne River with JPA-NW alignment has potential for stream stability impacts along the Sheyenne River due to the flow interaction of the Diversion Channel and the Sheyenne River. - The At-Grade crossing for the Sheyenne River with the JPA-NW alignment will result in water backing up in the Diversion Channel, all the way to the Sheyenne River Aqueduct. This will increase the potential for bank sloughing and sedimentation in the Diversion Channel. - The JPA-NW alignment will likely have a wider and shallower channel which may result in
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FM Diversion Project - Southern Embankment/Dam Option Comparison

March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
					a more stable channel. • Overbank Excavation downstream from the diversion channel outlet associated with the JPA-NW alignment may have negative effects on the stability of the riverbanks along the Red River that would need to be designed to avoid impacts.

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Wetlands	Wetland Impacts have been quantified	Assume increased impacts to seasonally flooded wetland impact due to longer project footprint (+3.3 miles)	Assume Increased impacts to Seasonally flooded wetland impact due to longer project footprint (+5.4 miles)	- Assume Increased impacts to Seasonally flooded wetland impact due to longer project footprint (+1.4 miles) - Increased Forested Wetland Impacts due to Wild Rice River crossing location.	- Assume increased impacts to seasonally flooded wetland impact due to longer project footprint for the dam. (+3.3 miles) - JPA-NW alignment reduces the Diversion Channel length by approximately 1.5 miles but requires the diversion channel to be considerably wider for much of the Diversion Channel length. Given this, it is anticipated that wetland impacts will change. - JPA-NW alignment may require additional/changed wetland mitigation because the diversion channel will have more water in it for longer periods of time. - Overbank Excavation feature of the JPA-NW
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March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
					alignment may increase wetland impacts to higher functioning wetlands unless it is designed to avoid impacts.
Cold Weather Impacts on Aqueduct Function and Biotics	Addressed through Project Design	No Change	No Change	No Change	- JPA-NW alignment eliminates the need for the Maple River Aqueduct which reduces potential cold weather impacts. - JPA-NW alignment includes an at-grade crossing at the north Sheyenne River crossing, which could create ice buildup due to the complicated nature of the crossing and mixing of flow from the Diversion Channel and Sheyenne River. Design will need to account for this.

FM Diversion Project - Southern Embankment/Dam Option Comparison

March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
Cover Types	Impacts have been quantified	TBD	TBD	- TBD - Would have more impacts to Floodplain Forest at Wild Rice River crossing.	- TBD - JPA-NW alignment would have more impacts to floodplain forest at the northern Sheyenne River crossing and the overbank excavation feature downstream from the Diversion channel outlet.
Potential Environmental Hazards	Impacts have been quantified	TBD	TBD	TBD	TBD

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Fish Passage and Mortality	Impacts have been quantified	No identified changes	No identified changes	No identified changes	- Elimination of the Maple, Rush, and Lower Rush River crossings with the JPA-NW alignment reduces potential impacts to Fish Passage and Mortality. - At-Grade crossing of the Sheyenne River for the JPA-NW alignment may increase potential impacts to Fish Passage and Mortality. - Fish can follow their natural spawning path up the Sheyenne River more readily with the JPA-NW alignment. - For the JPA-NW alignment, if the channel is wider at the Sheyenne River Aqueduct, it will result in a longer structure that fish
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FM Diversion Project - Southern Embankment/Dam Option Comparison

March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
					will need to traverse.

March 8, 2018

Wildlife and Wildlife Habitat	Impacts have been quantified	TBD	TBD	Would have more impacts to floodplain forest at Wild Rice River crossing.	- The JPA-NW alignment reduces impacts to floodplain forest by eliminating the Maple Aqueduct. - Impacts from Rush and Lower Rush being cut off is removed. - JPA-NW alignment increases impacts to floodplain forest at the Sheyenne River crossing and at the overbank excavation features downstream from the diversion channel outlet. - The potential for wildlife and wildlife habitat may increase through the formation of newly created wetlands and other seasonally flooded areas along the overbank excavation features of the JPA-NW alignment.
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FM Diversion Project - Southern Embankment/Dam Option Comparison

March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
State Listed Species and Special Status Species	Impacts have been quantified	TBD	TBD	TBD	TBD
Invasive Species	Impacts have been quantified	TBD	TBD	TBD	TBD

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Cultural Resources	Impacts have been quantified or are being evaluated	- Increased potential for impacts due to longer dam/embankment. - Impacts a farmstead in Section 33, T138N, R49W that is eligible for listing on the National Register of Historic Places. - Cultural resources survey, assessment, and determination for all additional impacted structures is required; mitigation required for any eligible historic properties. Also applies to additional flows through Town (RS37')	- Increased potential for impacts due to longer dam/embankment. - Impacts a farmstead in Section 33, T138N, R49W that is eligible for listing on the National Register of Historic Places. - Cultural resources survey, assessment, and determination for all additional impacted structures is required; mitigation required for any eligible historic properties. Also applies to additional flows through Town (RS37')	- Increased potential for impacts due to length of the dam/embankment in close proximity to the Red River and Wild Rice River. - Adversely Impacts 3 farmsteads that are eligible for listing on the National Register of Historic Places (Sections 33 and 35, T138N, R49W and Section 2, T137N, R49W. Farm in Section 2 contains 7 controlling/eligible structures. - Adversely impacts the Historic St. Benedict Catholic Church. - Adversely impacts the St. Benedict Cemetery, which includes 600 graves. - Cultural resources survey, assessment, and determination for all additional impacted structures is required; mitigation required	- Increased potential for impacts due to longer dam/embankment. - Reduced potential for impacts due to shorter diversion channel (1.5 miles) associated with JPA-NW alignment, however increased potential due to the required widening of the diversion channel. There is potential for cultural sites near the confluence of the Sheyenne and Red River, which is the proposed outlet for the JPA-NW alignment. The alignment would need to be screened and refined as needed to avoid such sites. - Increased potential for impacts due to overbank excavation feature downstream from the Diversion
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March 8, 2018

Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
				for any eligible historic properties. Also applies to additional flows through Town (RS37')	channel for the JPA-NW alignment. • Impacts a farmstead in Section 33, T138N, R49W that is eligible for listing on the National Register of Historic Places. • Cultural resources survey, assessment, and determination for all additional impacted structures is required; mitigation required for any eligible historic properties. Also applies to additional flows through Town (RS37') • With the JPA-NW alignment it is estimated that 4 cemeteries will no longer be in the benefited area.

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Infrastructure and Public Services	Impacts have been quantified	- Increased impacts due to longer dam/embankment. - Requires the closure of Cass County Highway 16 (Current ADT of 842) during project operation. - Requires more local drainage improvements within the staging area for the additional area that is impacted, which increases agricultural land impacted. - Requires the raising or relocation of Cass Rural Water wells and associated infrastructure.	- Increased impacts due to longer dam/embankment. - Requires the closure of Cass County Highway 14 (Current ADT of 1,175; Projected at 3,700 by 2040) during Project operation. Traffic counts do not include impacts from closure of Cass County Highway 16 (842 ADT), which will also be closed as part of this Option. - May require transportation improvements to the CH14/I-29 interchange due to the close proximity of the dam. - Requires more local drainage improvements within the staging area for the additional area that is impacted, which increases	- Increased impacts due to longer dam/embankment. - Results in the closure of an additional portion of Cass County Highway 16 during project operation, including the I-29 interchange. - Could potentially impact the I-29 interchange at Cass County Highway 14 due to the close proximity of the dam/embankment. - Requires more local drainage improvements within the staging area for the additional area that is impacted, which increases agricultural land impacted. - Impacts the KFGO Radio Tower. - Requires the raising or relocation of Cass Rural Water wells	- Increased impacts due to longer dam/embankment. - JPA-NW alignment may require up to two additional bridge crossings over the Diversion Channel. - JPA-NW alignment may create transportation impacts for both Interstate 29 and the BNSF Hillsboro Subdivision Railroad line due to the close proximity to the city of Harwood, ND. - JPA-NW alignment will require the reconstruction and relocation of the lower portion of Cass County Drain 40/45 due to the Diversion Channel cutting off the drain. - JPA-NW alignment will significantly increase the length of bridge crossings due to the wider
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			agricultural land impacted. Requires the raising or relocation of Cass Rural Water wells and associated infrastructure.	and associated infrastructure.	channel that is required. - The JPA-NW alignment may result in a higher water surface profile along the Diversion Channel. This could increase the required height of the embedded levee line of protection on the interior side of the diversion channel. A higher water surface profile would also adversely impact local drainage to the west, which may require the acquisition of property rights, or larger inlet structures or pumping to mitigate it. - Requires the closure of Cass County Highway 16 (Current ADT of 842) during project operation.
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Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
					- Requires more local drainage improvements within the staging area for the additional area that is impacted, which increases agricultural land impacted. - Requires the raising or relocation of Cass Rural Water wells and associated infrastructure. - JPA-NW Alignment could cut off overland flow breakout corridors near Harwood, ND, which may increase the flood risk for the city of Harwood and rural residents in the area.
Land Use Plans and Regulations	Impacts have been quantified	TBD	TBD	TBD	TBD

FM Diversion Project - Southern Embankment/Dam Option Comparison

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Topic	Pre-Task Force Project	Option 7A/10D compared to Pre-Task Force Project	Option 7A'/10D compared to Pre-Task Force Project	Option 7A/7C Hybrid/10D compared to Pre-Task Force Project	Option 7A/10D/JPA-NW compared to Pre-Task Force Project
Minnesota Dam Safety and Work in Public Waters Regulations and Permitting	Minnesota Dam Safety Permit Required	Minnesota Dam Safety Permit Required	Minnesota Dam Safety Permit Required	Minnesota Dam Safety Permit Required	Minnesota Dam Safety Permit Required

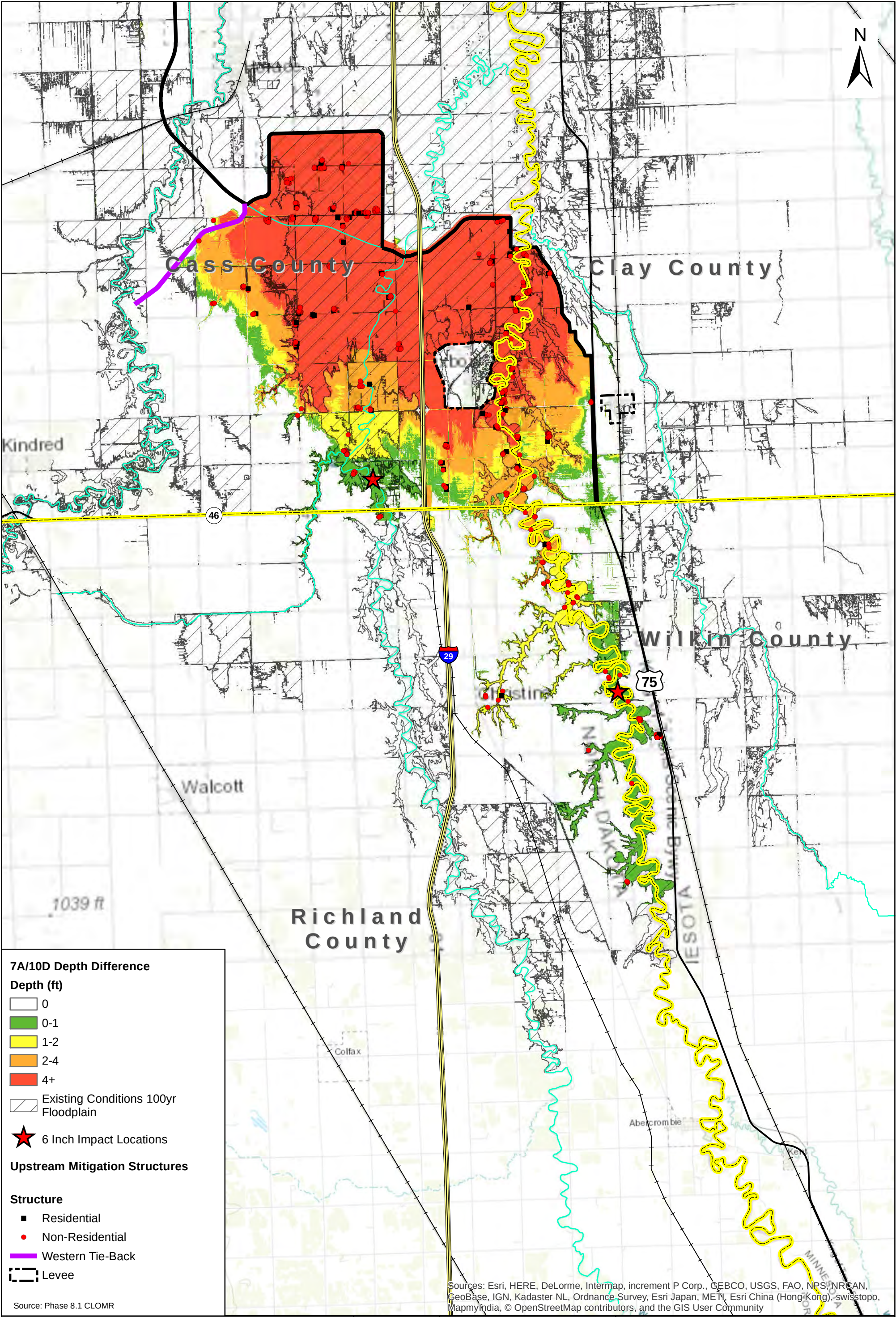
March 8, 2018

Socioeconomics	Impacts have been quantified	- Additional cost of \$45 million for changing the location of the dam (Lands and Construction). - Cost of \$150 M for In-Town Levees to accommodate RS37' through town. - Requires the acquisition of 20 Residential and 125 non-residential structures for the additional upstream area that is impacted.	- Additional cost of \$116 million for changing the location of the dam (Lands and Construction). - Cost of \$150 M for In-Town Levees to accommodate RS37' through town. - Requires the acquisition of 24 Residential and 147 non-residential structures for the additional upstream area that is impacted.	- Additional cost of \$233 million for changing the location of the dam (Lands and Construction). - Cost of \$150 M for In-Town Levees to accommodate RS37' through town. - Requires the acquisition of 51 Residential and 245 non-residential structures for the additional upstream area that is impacted.	- Additional cost of \$157 million for changing the location of the dam and the diversion channel (Lands and Construction). - Cost of \$150 M for In-Town Levees to accommodate RS37' through town. - Requires the acquisition of 20 Residential and 125 non-residential structures for the additional upstream area that is impacted. - JPA-NW alignment footprint impacts 69 more primary and 103 more non-primary structures under the project footprint than the proposed project alignment. - JPA-NW alignment may increase the flood risk for the City of Harwood and rural subdivisions located between
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FM Diversion Project - Southern Embankment/Dam Option Comparison

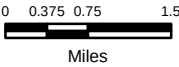
March 8, 2018

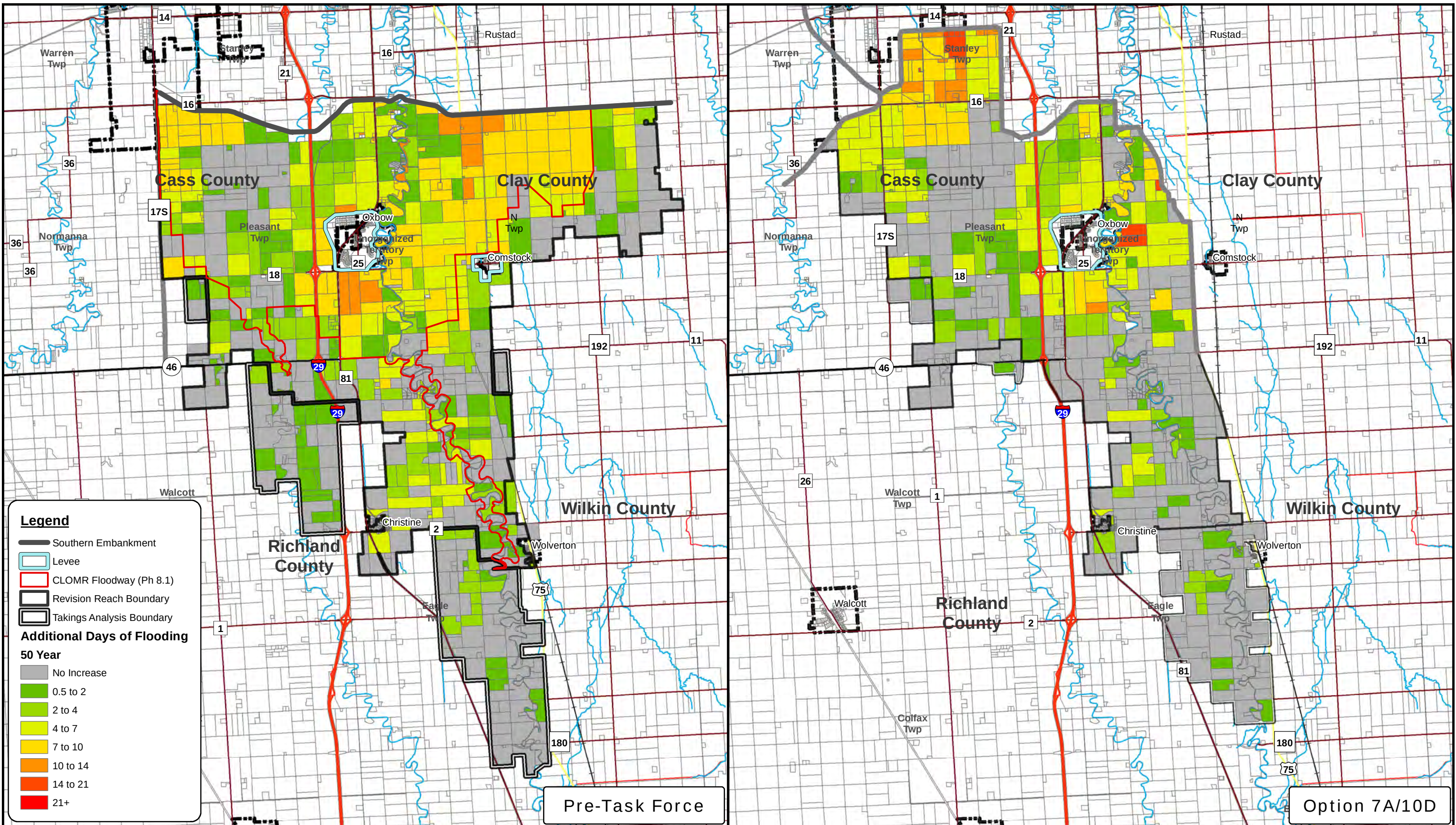
					the current Project alignment and the JPA-NW alignment due to blocking overland flows from the Sheyenne River. • At-grade crossing of the Sheyenne River for the JPA-NW alignment may increase O&M costs for the Diversion Channel due to frequent water back up into the channel from the Sheyenne River. • There are 1381 structures (579 primary and 802 non-primary) located between the proposed Project Diversion Alignment and the JPA-NW alignment that will be unprotected. This includes a population of approximately 1,500 people.
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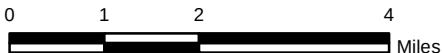
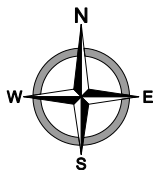
Option 7A/10D Alignment
Depth Difference Map

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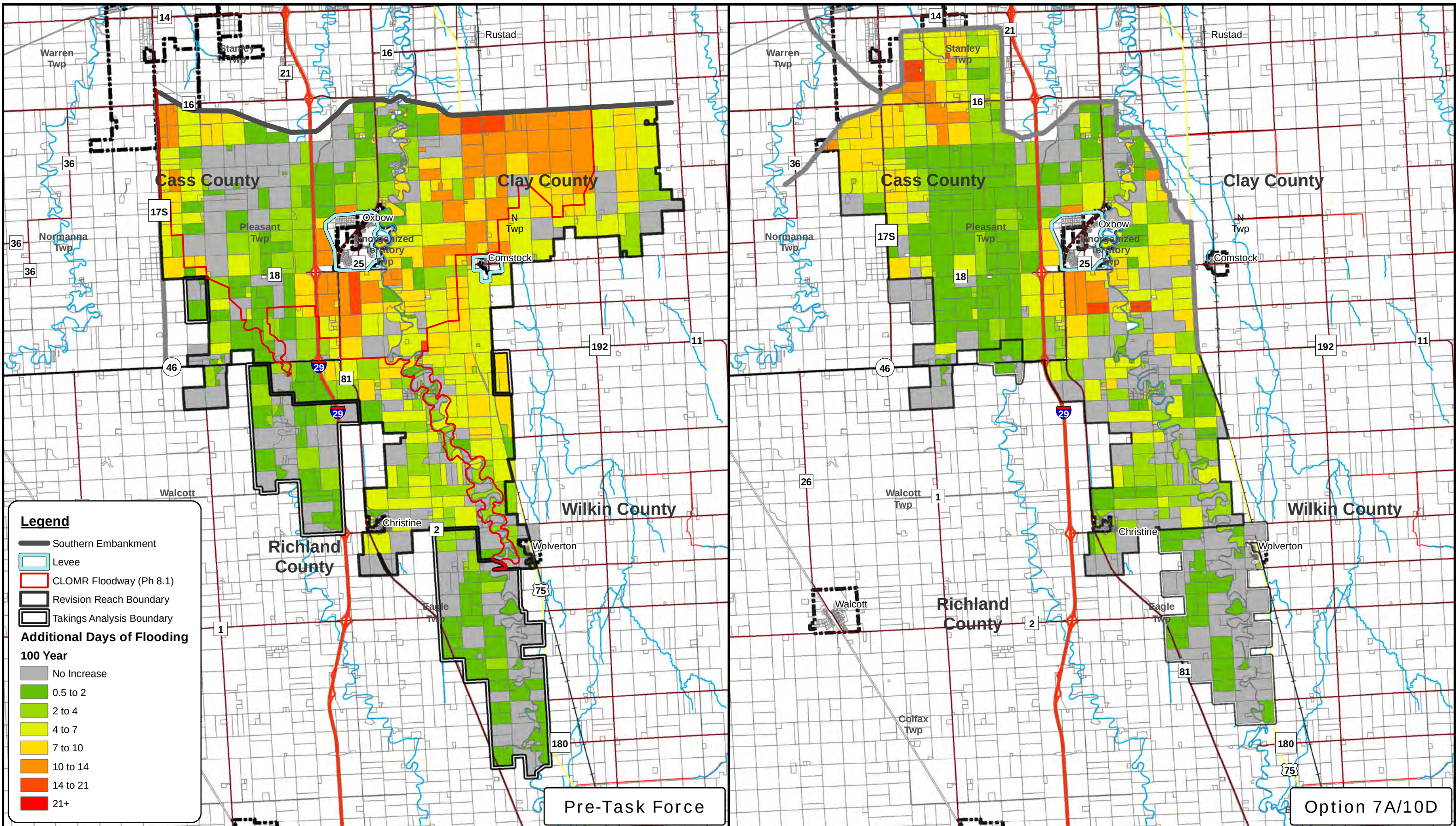




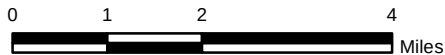
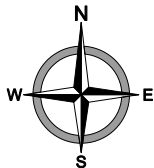
Pre-Task Force vs Option 7A/10D
Additional Days of Flooding Analysis
FM Area Diversion Project

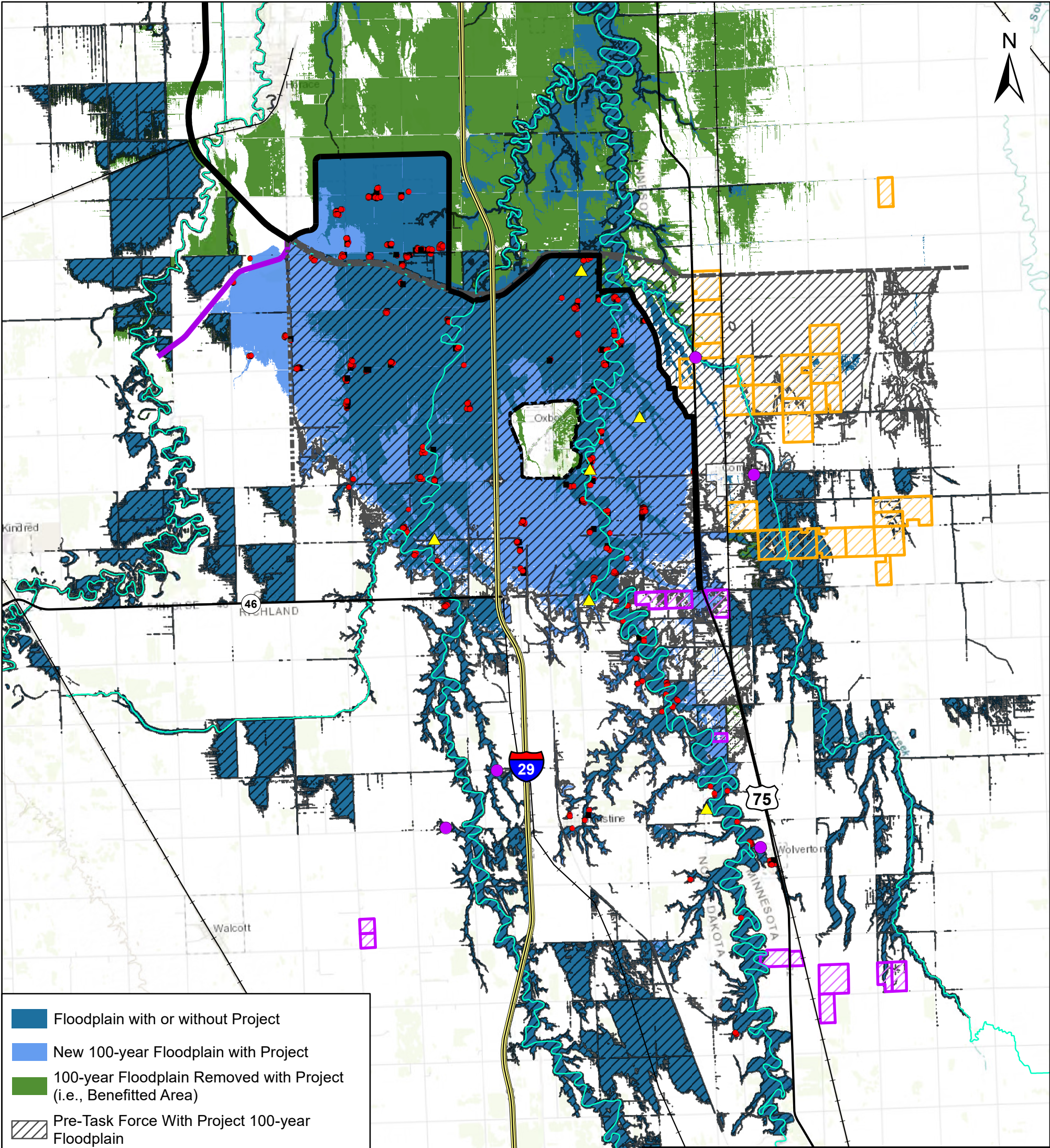


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Pre-Task Force vs Option 7A/10D
Additional Days of Flooding Analysis
FM Area Diversion Project





- Floodplain with or without Project
- New 100-year Floodplain with Project
- 100-year Floodplain Removed with Project (i.e., Benefitted Area)
- Pre-Task Force With Project 100-year Floodplain

Cemetery Impact

- Impacted by Base Project, Not Impacted by Alt. 7A/10D
- Impacted by Base Project and Alt. 7A/10D

Upstream Mitigation Structures

- Residential
- Non-Residential
- Organic Farms (Impacts To Be Determined)
- Organic Farms (No Longer Imacted)
- Diversion Channel and Southern Embankment
- Western Tie-Back
- Pre-Task Force Southern Embankment Alignment
- Levee
- River

	Pre-Task Force Project	Option 7A/10D
Length of Dam (miles)	12.8	16.6
Impacted Cemeteries	11	6

Criteria	Pre-Task Force Project (acres)		Alternative 7A/10D (acres)		Change (acres)	
	Total	Additional	Total	Additional	Total	Additional
Upstream Floodplain Impact						
Total (ND/MN)	35,456	18,720	28,005	11,037	-7,451	-7,683
Minnesota	14,780	11,631	5,420	3,286	-9,360	-8,345
Clay County	12,229	10,240	4,013	2,902	-8,216	-7,338
Wilkin County	2,551	1,391	1,407	385	-1,144	-1,006
North Dakota	20,676	7,088	22,585	7,751	1,909	663
Cass County	16,290	5,964	19,802	7,155	3,512	1,191
Richland County	4,387	1,124	2,783	596	-1,604	-528
Upstream Impacted Residential Structures	Existing	With-Project	Existing	With-Project	Existing	With-Project
Total (ND/MN)	12	69	19	71	7	2
Minnesota	3	25	3	11	0	-14
Clay County	1	20	1	9	0	-11
Wilkin County	2	5	2	2	0	-3
North Dakota	9	44	16	60	7	16
Cass County	9	41	16	58	7	17
Richland County	0	3	0	2	0	-1

Alternative 7A/10D
100yr Floodplain

