Stantec

Interchange Selection and Decision Report

I-29 and 40th Avenue North Interchange in
Fargo, North Dakota

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Prepared for:
North Dakota Department of Transportation

Prepared by:
Stantec Consulting Services

Project Number:
Preliminary Engineering and Feasibility Study
for Project 8-029(213)069 NDDOT PCN 23596

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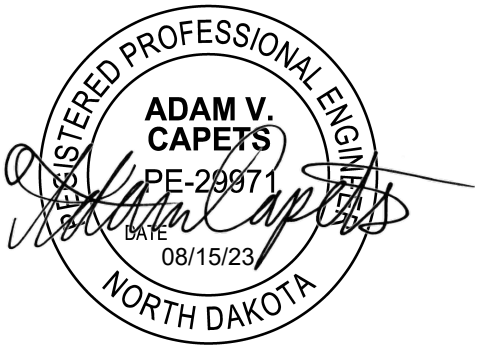

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Executive Summary

The purpose of this study is to determine potential interchange configurations, roadway alignments, and bridge types based on operational, geometric, stakeholder, economic, environmental, safety, and future traffic demands for the Interstate 29 (I-29) and 40th Avenue North interchange and the 40th Avenue North corridor the from 45th Street North to 25th Street North.

A Technical Advisory Committee (TAC) was established to guide the alternatives development process for a potential new interchange configuration. It includes representatives of the Federal Highway Administration (FHWA), North Dakota Department of Transportation (NDDOT), Cass County, Fargo-Moorhead (FM) Metro Council of Governments (COG), and the City of Fargo. This committee guided project development by making informed decisions and providing direction to the consultant team as needed. Also, several outreach opportunities were conducted to inform the public about the project and solicit public input during the alternative development process.

The current I-29 interchange is a two-lane, standard diamond interchange with stop control on the exit ramps and two bridges spanning the interstate and adjacent railroad. The surrounding area is mainly agricultural land with residential developments to the west and commercial/industrial to the east. The Burlington Northern Santa Fe (BNSF) railroad corridor runs parallel to the interstate on the east side.

Existing traffic data was used to develop models that represent the existing and forecasted traffic. The models determined the operational performances of the alternatives. These findings were then presented to the TAC, which ultimately resulted in the development of the following five alternatives:

- Alternative 1 – Standard Diamond Interchange with Signals
- Alternative 2 – Dumbbell Interchange (Standard Diamond w/Roundabouts)
- Alternative 3 – Diverging Diamond Interchange (DDI)
- Alternative 4 – Roundabout Diverging Diamond Interchange
- Alternative 5 – Partial Cloverleaf Interchange (Parclo)

An Alternatives Evaluation Matrix was developed in coordination with the TAC to compare the five alternatives. This matrix consists of 12 evaluation criteria weighted by importance. Each alternative was evaluated and assigned a score from 1 (least positive) to 5 (most positive). The following is a summary of how the alternatives performed against the safety improvements, geometric needs, active transportation facility enhancement, cost, flexibility of future improvements, right-of-way impacts, and structural and geotechnical impacts evaluation criteria. The remaining five evaluation criteria were not included in the executive summary since the impacts of each alternative had similar results.

Safety Improvements

Most of the crashes at the interchange are rear-end crashes at the east ramp terminal intersection. All alternatives provide some reduction in these crashes as evident by selected Crash Modification Factors (CMF). While Alternative 4 has no associated CMF, it is expected to have a similar reduction to either Alternative 2 or 3. Roundabouts have fewer conflict points and lower approach speeds than traditional intersections, resulting in fewer high-severity crashes. DDIs as proposed in Alternative 3 also reduce conflict points and speeds compared to existing conditions, reducing the number of high-severity crashes.

Alternatives 1 and 5 also provide some crash reduction, however it is not expected to be as high as other alternatives. The loop ramp eliminates westbound left turn conflicts but requires an additional auxiliary lane on I-29 southbound. Alternative 1 is expected to have the most angle crashes.

Relating to the initial safety concern of wrong-way westbound left turns, Alternatives 2, 3, and 4 introduce geometry that reduces the potential for this movement while Alternatives 1 and 5 do not address this concern with geometry. Traffic signal control should help discourage wrong-way maneuvers and additional measures can be implemented to communicate “no left turns” to westbound drivers.

Geometric Needs

All alternatives propose a shift of the current 40th Avenue North alignment to the north to facilitate construction staging and allow the roadway to remain open to traffic during construction. Alternatives 2 and 4 require the smallest shift due to the roundabouts included in the design, which reduces median widths and eliminates left turn lanes, resulting in a smaller roadway footprint. In addition to the 40th Avenue North corridor shift, Alternative 5 would need the southbound off-ramp to be shifted westward to make adequate room for the Northwest loop ramp.

Active Transportation Facility Enhancement

In considering possible multimodal accommodations along the 40th Avenue North corridor, each alternative can accommodate pedestrians and bicycles through the interchange. All alternatives propose a separated shared-use path on the north side of 40th Avenue North with grade separation as the path crosses the ramps. Should development and facilities on the south side of 40th Avenue North require crossings at the west ramp terminal intersection, Alternatives 1 and 5 can allow pedestrians/bicycles to cross in a single walk phase at the signal, Alternative 3 allows crossings but in two phases, and Alternatives 2 and 4 allow crossings at the roundabout approaches with the potential for enhanced warning devices.

Cost

Cost estimates for each Alternative were developed using the NDDOT’s average bid price over the past six years. The least costly Alternatives are 2 and 4, which eliminate the traffic signals and require less width for turn lanes and median space on the bridges. The next least costly are Alternatives 1 and 5 since they require traffic signals and more width for the bridge. Finally, the costliest would be Alternative 3 due to the signalization of the intersections and having the widest bridge.

Flexibility of Future Improvements

When looking towards accommodating the future development of the surrounding area, Alternative 3 includes the required space for future widening for eastbound traffic since the widening is on the north side of the structure adjacent to the shared-use path. Alternative 4 also requires widening on the north, but expansion to add a second eastbound lane can be done with median reconfiguration without widening the bridge. Alternatives 1, 2, and 5 can all accommodate additional eastbound capacity with bridge widening to the south.

Right-of-Way Impacts

Preliminary construction limits were used to estimate the potential right-of-way needed to build each Alternative. Estimations resulted from 6 acres to just over 3 acres needed to construct one of these alternatives. Alternative 5 would need the most acreage for right-of-way acquisition, and Alternatives 1,2, and 4 require the least acreage, with Alternative 3 in between them.

Structural and Geotechnical Impacts

The Primary Study Area includes two existing bridges: a four-span steel bridge over I-29 and a three-span steel bridge over the BNSF rail track east of I-29. The existing bridges each accommodate a 30-foot wide roadway. All five interchange alternatives require significantly wider structures ranging in width from approximately 55 to 83 feet for the BNSF bridge and 67 to 89 feet for the I-29 bridge. Widening the existing bridges to achieve these widths is not feasible as it would result in insufficient vertical clearance over I-29 and the railroad.

Replacement bridge options were developed for each alternative. The primary options consist of a two-span prestressed concrete I-girder bridge at I-29 and a three-span prestressed concrete I-girder bridge over the railroad. Prestressed concrete girder superstructures are NDDOT's preferred bridge type due to cost, maintenance, and inspection reasons. The proposed girders are up to 3 feet deeper (taller) than the existing girders requiring a grade raise when compared to the existing profile. Two steel girder bridge options were developed to evaluate whether a shallower, but higher cost superstructure, would provide savings over the cost of the additional embankment. Cost estimates for the range of bridge options showed the prestressed concrete girders were the most economical bridge type for all alternatives and both bridge locations.

The proposed alignment shift of 40th Avenue North would result in the placement of 10 to 20 feet of fill over the existing ground resulting in a potential for 6 to 12 inches of settlement at the proposed bridge abutments. The primary settlement mitigation options consist of surcharge and wick drains or replacing a portion of the new embankment with Geofoam. A detailed geotechnical investigation is outside the scope of this study therefore, Geofoam was assumed for the cost estimates. Expected settlement and mitigation options will be fully developed during the environmental documentation and preliminary design phase.

In conclusion, the alternative that scored the highest in the evaluation matrix was Alternative 2, followed by Alternatives 3, 5, 1, and 4, respectively. The next steps for this interchange project following the conclusions from this report would be selecting the appropriate build alternative(s) and carrying it through the next stages of the project to develop the design and construct the chosen alternative.

1 Introduction

1.1 Project Background

Due to recent and ongoing development along both sides of Interstate 29 (I-29) and anticipated development west of I-29 anticipated upon completion of the Fargo-Moorhead (FM) Area Diversion Project, the interchange of I-29 and 40th Avenue North (County Road 20 (CR 20)) and the 40th Avenue North corridor will experience significant traffic growth. The increased traffic is expected to surpass the capacity of these facilities, and adversely affect the operations and safety of several intersections within the study areas. The North Dakota Department of Transportation (NDDOT) commissioned the completion of a Preliminary Engineering and Feasibility Study to analyze the issues surrounding the interchange and make geometric and traffic related recommendations.

1.2 Project Goals

The Stantec team is working with NDDOT to complete the Preliminary Engineering and Feasibility Study to evaluate and compare retention and reconstruction alternatives for the 40th Avenue North interchange with I-29 in Fargo, ND (Exit 69). The purpose of the study is to determine potential interchange configurations, roadway alignments, bridge type and sizes based on an operational, geometric, stakeholder, and environmental evaluation. This study included the identification of locations and need for potential crash countermeasure treatments and will assess future traffic demand along the corridor. It included the evaluation of the I-29 and 40th Avenue North interchange, the 40th Avenue North corridor, and the Burlington Northern Santa Fe (BNSF) railroad overpass.

The interchange project is being developed under two contracts. Contract I is the Preliminary Engineering and Feasibility Study, which concludes with this document. Contract II consists of three phases: Phase I is the environmental documentation and preliminary design, Phase II is the final design and plan preparation, and Phase III is construction engineering assistance as the engineer of record. Analysis efforts and memos completed throughout Contract I of this project are summarized in this report.

1.3 Study Area

The Primary Study Area, shown on **Figure 1**, included the I-29 and 40th Avenue North interchange and the 40th Avenue North corridor between 45th Street North and County Road 81 (CR 81). A Secondary Study Area extends east from 37th Street North to 25th Street North. The following intersections along 40th Avenue North were included in the study areas:

1. 45th Street North
2. Southbound I-29 Ramp Terminal
3. Northbound I-29 Ramp Terminal
4. CR 81
5. 37th Street North
6. 33rd Street North
7. 32nd Street North
8. 39 ½ Avenue North
9. 25th Street North

Figure 1 – Primary and Secondary Study Areas

1.4 Methods and Assumptions

1.4.1 DATA COLLECTION

The following methods and sources were used to determine the base level traffic data for the study areas and to help develop and calibrate the peak hour traffic simulation models and forecast volumes:

- 2021 FM Urban Area Annual Average Daily Traffic (AADT) counts and truck counts from FM Metro Council of Governments (COG). AADT included mainline I-29, all four interchanges ramps, 40th Avenue North, west and east of I-29, and CR 81 north and south of 40th Avenue North. Truck counts included mainline I-29, all four interchange ramps, and 40th Avenue North between 37th and 33rd Streets.

- 2022 NDDOT seasonal adjustment factors and Average Daily Traffic (ADT) by station for passenger cars, single-unit trucks, and combination trucks. These seasonal factors were not applied to the FM Metro COG AADT data.

- I-29 24-hour lane volumes recorded by NDDOT on July 19, 2022 at stations Reference Point (RP) 68.9 south of interchange and RP 72.1 north of interchange.

- Basic Axle Configuration Report 360 E from FM Metro COG. This report consists of raw data for the FM Metro COG count conducted on 40th Avenue North between 33rd Street and 37th Street. The count was conducted for 48 hours between 9:00 AM on May 17, 2021, to 9:00 AM May 19,

2021. This data provides both speed information and vehicle classification information. FM Metro COG classifies trucks as Class 5 and higher.

- Intersection counts were collected by Quality Counts using video traffic detection equipment at the nine intersections mentioned in Section 1.3 on Tuesday, December 20, 2022. Thirteen (13) hours of traffic count data (6:00 AM – 7:00 PM) were collected at each intersection, including passenger cars and heavy trucks. While buses, bicyclists, and pedestrians were included in the counts, none were recorded traveling through the study areas during the collection period.

More information about data collection and intersection counts can be found in the '– Data Collection Technical Memorandum' and the '– Traffic Count Technical Memorandum' previously submitted to the Technical Advisory Committee (TAC) and found in Appendix A and Appendix B respectively. Volume forecasts for the design year 2045 were developed to estimate future traffic operations and impacts. See Section 4.1.1 for information on the methodology used to develop these forecasts.

1.4.2 NETWORK DEVELOPMENT

The traffic simulation model networks for use in the operational analysis of the existing, no-build, and build conditions were created by importing the corresponding network links of the study areas from FM Metro COG's regional travel demand model into TransModeler (TransModeler is a microsimulation modeling software that facilitates traffic operational analysis based on HCM/HCS methodology). Additional side streets or driveways not included in the regional model were manually added. Other link level attributes, such as functional classification and count data were also added to the link layer. Capacities and speed for each link were managed and coordinated via model parameters established within TransModeler for each functional class. Turning movement counts for the AM and PM peak hours were input into the model based on the collected intersection volumes. TransModeler's Origin-Destination Matrix Estimation (ODME) function was used to estimate the origin and destination of every vehicle trip through the network and develop trip tables. All trip tables were factored by 1.02 to reflect a seasonal adjustment factor across all road functional classes based on the average trip volume for Tuesdays in December, which was derived from NDDOT's seasonal adjustment factors. Vehicle fleet from NDDOT's Basic Axle Configuration Report 360 E was also input.

Traffic control along 40th Avenue North is limited to intersections with side-road stop control and a single, actuated traffic signal at the intersection with CR 81. The signal plans for this intersection were coded for the existing, no-build, and build models based on a detailed review of the signal operations during AM and PM peak hour video recordings.

Traffic operations for the AM and PM peak hours were analyzed using the methodology contained in the Highway Capacity Manual (HCM), published by the Transportation Research Board. Level-of-Service (LOS) for each approach and freeway movement was calculated and the average and 95th percentile queues were determined. These statistics were estimated from the average of five model simulation runs for both the AM peak hour and the PM peak hour.

1.4.3 MODEL CALIBRATION

The traffic simulation models were calibrated to ensure the turning movement and link-based traffic volumes matched real-world conditions. Criteria used to confirm the simulation model calibration were

taken from the Federal Highway Administration's (FHWA) *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, July 2004 (FHWA Publication No. FHWA-HRT-04-040).* The following FHWA calibration criteria were used for this model:

- Visual audits were performed throughout the calibration process. Model observations focused on the operation of each intersection and queue lengths for turning movements at the I-29 interchange ramps and signalized CR 81 intersection.
- Link-based trip volumes for ten simulation runs were averaged and compiled for each direction of each link and compared to the aggregated intersection volumes recorded for each network link associated with the nine intersections where counts were collected. The root-mean-square error (RMSE) method with a target threshold of ten percent or lower was used to ensure calibration.
- Travel speed data was limited to NDDOT's Basic Axle Configuration Report 360 E, which provided a distribution of individual vehicle speeds at a specific location, with average speeds ranging between 44 to 48 mph by direction for each of the two days in May 2021 when counts were collected. This resulted in an adjustment to the speed parameters in the model.

TransModeler's 'error checking' function was also run to identify link connectivity and traffic signal coding issues. Network links flow volumes were reviewed to verify that traffic is consistent with expected volumes. More information about network development and model calibration can be found in the '– Existing Conditions Simulation Model Development Memorandum' previously submitted to the TAC and shown in Appendix C.

2 Public and Agency Engagement

The following section describes the public engagement strategies that were utilized during the project. Strategies included a project website to disseminate relevant project information, utilizing a TAC to guide the Study Team on technical issues, and conducting public outreach opportunities.

2.1 Technical Advisory Committee

A TAC was created to include representatives from NDDOT, FHWA, the City of Fargo, FM Metro COG, and Cass County. The TAC helped guide the study through completion by making informed decisions and providing agency direction to the Study Team as needed. TAC members consisted of the following individuals:

NDDOT

- Aaron Murra (District Engineer – Fargo)
- Bob Walton (District Engineer – Fargo, retiring Spring of 2023)
- Joe Peyerl (Assistant District Engineer – Fargo)
- Jennifer Kern (Design Division)
- Chad Frisinger (Design Division)
- Alexis Wanek (ETS)
- Justin Schlosser (Traffic Operations)
- Michael Johnson (Local Government)
- Dustin Wing (Bridge Division)
- Colter Schwagler (Materials & Research Division)
- Jim Styron (Planning)

FHWA

- Kevin Brodie (Operations Engineer – North Dakota Division)

City of Fargo

- Brenda Derrig (City Engineer)
- Thomas Knakmuhs (Assistant City Engineer)
- Jeremy Gorden (Transportation Division Engineer)
- Eric Hodgson (Traffic Engineer)

Fargo-Moorhead Metro COG

- Cindy Gray (Executive Director, retiring in April 2023)
- Dan Farnsworth (Transportation Planner)

Cass County

- Jason Benson (County Engineer)

Two TAC meetings have been held to date virtually. Meeting summaries were provided for the TAC meetings and will be included in a final summary of all engagement activities which can be found in Appendix D. A third TAC meeting to discuss this report and next steps is anticipated.

2.2 Focus Group Meetings

Focus Group meetings were identified in the Public Engagement Plan (PEP) as a technique that could be utilized to gather or share data with specific groups associated with a particular design component. Examples of focus groups include local businesses, the airport, residential neighborhoods, etc. To date, the project team has engaged these groups through public outreach opportunities and emails or phone calls without the need for standalone focus group meetings. Focus group meetings are anticipated to be utilized in subsequent design phases.

2.3 Public Outreach Opportunities

Three public outreach opportunities will be completed to gain an understanding of the community's issues, needs, and opinions regarding the potential interchange alternatives being evaluated. These outreach opportunities consisted of the following:

- Opportunity 1 – Provide an initial introduction to the project and show the interchange alternatives.
- Opportunity 2 – Show the initial results of the evaluation matrix for each interchange alternative.
- Opportunity 3 – Notification of the draft 'Interchange Selection and Decision Report' for the public's review and comment.

2.3.1 OUTREACH OPPORTUNITY 1

Outreach Opportunity #1 was an in-person community open house held on March 14, 2023 from 5:00 to 7:00 PM CDT at the National Guard Readiness Center in Fargo. The open house was advertised in the Fargo Forum on February 22 and March 8, and a press release was published by NDDOT on March 7. The general public was introduced to the project and given the opportunity to review and comment on the five potential alternatives for the I-29 interchange (described later in Section 4.3).

Approximately 15-20 people attended the open house and were provided comment cards and invited to write comments on roll plots displaying layouts of the five alternatives. Matchbox cars were also available for attendees to better visualize how the Diverging Diamond Interchange (DDI, Alternative 3) and Roundabout DDI (Alternative 4) alternatives would function. Display boards were set up around the room outlining the project background, project logistics, objectives, schedule, and next steps, all interchange alternatives, environmental background, existing 2022 traffic analysis, and future 2045 no-build traffic analysis. A video was also available for attendees to watch at their convenience that explained the five alternatives being considered and their benefits. See Appendix E for a full engagement summary.

2.3.2 OUTREACH OPPORTUNITY 2

Outreach Opportunity #2 was another in-person community open house. The open house was held on May 2, 2023 from 5:00 to 7:00 PM CDT at the Fargo Readiness Center. A presentation was made at 5:15 PM to provide the public with an overview of the project and discuss the preliminary results of the evaluation matrix. Similar to Outreach Opportunity #1, the study team requested input from the public and was on site to answer any questions. The legal advertisement was published in the Fargo Forum on April 12 and April 26. Additionally, a project website was shared with the public that summarizes the purpose,

schedule, and exhibits used in the open house (https://www.dot.nd.gov/exit69). More information on the open house can be found in the 'Public Engagement Plan' shown in Appendix F.

2.3.3 OUTREACH OPPORTUNITY 3

On May 9th, the draft 'Interchange Selection and Decision Report' was available on the project website for comment. Comments were requested May 23, 2023. No comments from the public were received.

3 Existing Conditions

3.1 Demographics

When conducting public engagement efforts, it is important to understand the makeup of the community. In the 2020 Decennial Census, the City of Fargo, ND had a population of 125,990 people. In 2020, the median age was reported to be 31.4. Between 2019 and 2020 the population of Fargo grew from 121,889 to 125,990, a 3.36% increase and its median household income grew from $55,551 to $57,520, a 3.54% increase. The five largest ethnic groups in Fargo are White (Non-Hispanic) (81.3%), Black or African American (Non-Hispanic) (7.83%), Asian (Non-Hispanic) (4.12%), Two or more (Non-Hispanic) (2.31%), and White (Hispanic) (1.87%)[1].

An Environmental Justice Analysis was completed for the 'Environmental Screening Technical Memorandum' previously submitted to the TAC. A summary is provided in Section 3.8. Refer to Section 4.2 in the memo in Appendix G for complete details.

3.2 Existing and Future Land Uses

Most of the existing land use in the vicinity of the interchange is agricultural land, along with some commercial/light industrial and residential uses. Commercial/light industrial uses are located to the east of I-29, while the residential uses are present on the west side of I-29. Additionally, the North Dakota State University (NDSU) Agricultural facility in the southwest and southeast quadrants of the interchange and the Hector International Airport nearby. See **Figure 2** for a map of the existing land uses for the area.

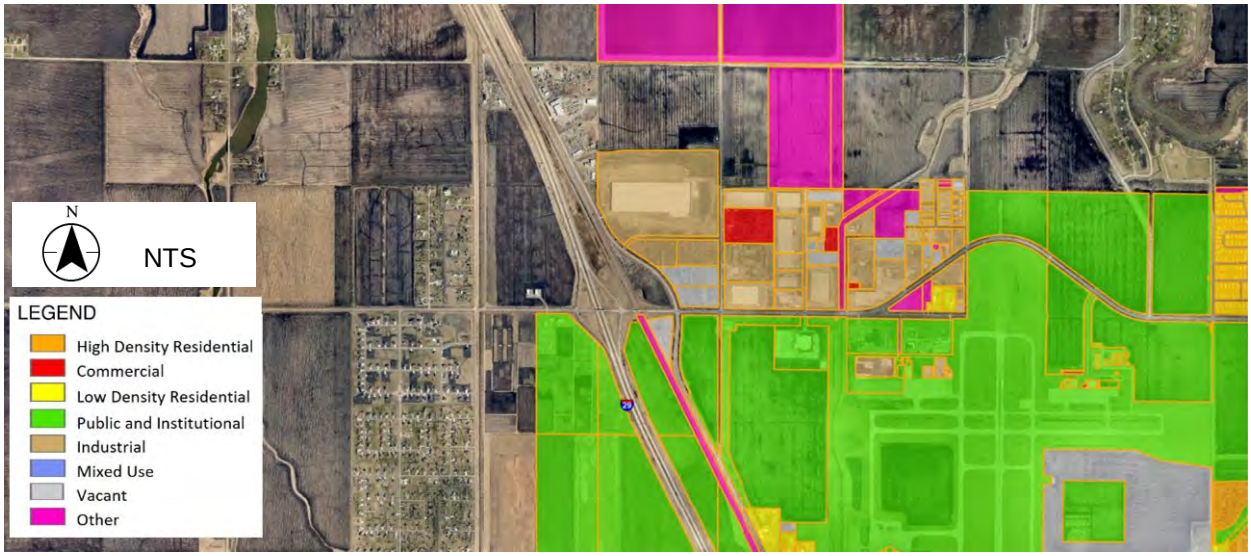

Figure 2 – Existing Land Use[2]

[1] U.S. 2020 Census Data
[2] MetroCOG Northwest Metro Transportation Plan, 2020

Residential development west of 45th Street North is anticipated to grow substantially over the next 20 years, in part due to the FM Area Diversion Project which will create more developable land, although the intensity of the development is expected to be primarily low-density along 40th Avenue North. In February 2023, the City of Fargo City Commission approved the annexation of 231 acres in the northwest quadrant of the I-29/40th Avenue interchange. Additionally, it is anticipated that land immediately surrounding the I-29 and 40th Avenue North interchange and towards the east along 40th Avenue North will be developed for commercial, office/business park, and industrial park uses. Future intersection improvements are anticipated between 45th Street North and I-29, in association with the future land use plans. See **Figure 3** for a map of future land use for the area.

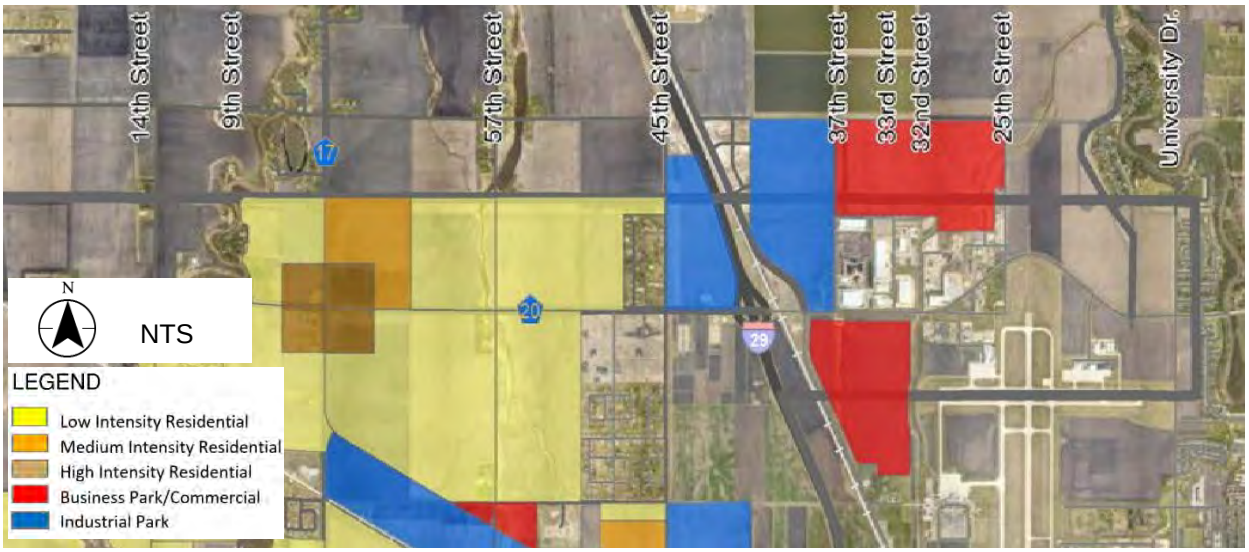

Figure 3 – Future Land Use[3]

3.3 Existing Interchange

The 40th Avenue North interchange with I-29 (Exit 69) is a standard diamond interchange. I-29 at the interchange is a four-lane divided interstate highway with a speed limit of 75 mph running north-south at a skew of approximately 20 degrees to 40th Avenue North. The interchange is bordered on the east by The BNSF Railroad Hillsboro Subdivision track that runs parallel to I-29 and crosses underneath 40th Avenue North.

40th Avenue North at the interchange is a two-lane undivided roadway with a speed limit of 40 mph running east-west. It is classified as a minor arterial east of the southbound ramp terminal and a collector west of the southbound ramp terminal. The I-29 ramps at the ramp terminal intersections are single-lane, stop-controlled approaches with wide radii that can accommodate at least two adjacent vehicles. There are no dedicated turn lanes at either ramp terminal intersection. 40th Avenue North and the interchange ramps were built on substantial fill embankments and the NDDOT Fargo District has noted a history of pavement and embankment maintenance issues due to long term settlement of the embankments.

[3] MetroCOG Northwest Metro Transportation Plan, 2020

3.3.1 BRIDGE CONDITIONS

There are two bridges within the Primary Study Area: Bridge No. 29-069.374 over I-29 (I-29 Bridge) and Bridge No. 29-069.374N over the BNSF railroad (BNSF Bridge). The I-29 Bridge was built in 1966 and is a 295-foot four-span bridge constructed at a 20-degree skew. The deck consists of a 30-foot clear roadway providing for two twelve-foot lanes and three-foot shoulders. The superstructure consists of 42-inch-high steel plate girders supporting a cast-in-place concrete deck and provides 16'-6" of vertical clearance over the southbound lanes of I-29. The substructure consists of concrete piers and abutments supported by steel H-piling. The construction history of the bridge includes deck overlay and rail retrofit projects in 1983 and 2010. The most recent bridge inspection report notes several deficiencies, including concrete cracking in the deck and abutments, rusting of the steel girders, approach settlement, and erosion and undermining at the abutments.

The BNSF bridge is similar to the I-29 bridge. It was built in 1965 as a 210-foot three-span bridge constructed at a 27-degree skew. The deck consists of a 30-foot clear roadway with two twelve-foot lanes and three-foot shoulders. The superstructure consists of 42-inch-high steel plate girders supporting a cast-in-place concrete deck and provides 23'-0" of vertical clearance over the railroad. The substructure consists of concrete piers and abutments supported by steel H-piling. The construction history of the bridge includes deck overlay and rail retrofit projects in 1983 and 2010. The most recent bridge inspection report notes several deficiencies, including concrete cracking in the deck and abutments, rusting of the steel girders, approach settlement, and erosion and undermining at the abutments. The bridge was originally constructed over a single rail track, and BNSF added a siding track on the west side of the mainline track in 2015.

3.3.2 SURROUNDING ROADWAY NETWORK

The 40th Avenue North corridor follows an east-west alignment along a portion of the northern city limits of Fargo and the northern perimeter of the Hector International Airport. It is primarily a two-lane undivided roadway with turn lanes at several intersections, including designated left turn lanes at the CR 81 and 33rd Street North intersections and designated right turn lanes/bypass lanes at the 37th Street North, 33rd Street North, 32nd Street North, and 39 ½ Avenue North intersections. The 40th Avenue North cross section consists of twelve-foot through lanes, four-foot shoulders, and a right-of-way width of that varies between 100 and 175 feet. The speed limit on the 40th Avenue North corridor is 40 mph. Intersection control along the corridor is two-way stop control for almost all side streets within the project limits, except for the intersection with CR 81 which has traffic signal control.

3.4 Alternative Travel Modes

Currently, there are no bicycle or pedestrian facilities along 40th Avenue North. While paved shoulders of at least four feet in width are designated as 'On-road Bike Facility' along 40th Avenue North east of 37th Street North[4], these are intermittent due to the locations of turn lanes. It was noted in Outreach Opportunity #1 that cycling clubs often use this route and there is a desire for wider shoulders that can accommodate bicycles. No designated facilities are present in the immediate area of the I-29 and 40th Avenue North interchange. The *2022 Fargo-Moorhead Metropolitan Bicycle and Pedestrian Plan*

[4] FM Metro Area Bikeways Map, 2017

identifies the 40th Avenue North corridor along with CR 81 and 45th Street North as roadways which are recommended to receive bicycle facility improvements that are suitable for all ages and abilities. Recommended facilities are shown in **Figure 4**.

Figure 4 – Proposed Bicycle and Pedestrian Facilities[5]

Currently, there are no bus routes in the vicinity of the interchange. MATBUS is the transit provider that serves the FM metropolitan area, which operates 24 routes. The nearest route is Route 13, which runs through the NDSU campus and extends to the North University Drive and 32nd Avenue North intersection. MATBUS has completed the *MATBUS 2021-2025 Transit Development Plan*, which determined the need for potential new bus routes to better serve the public. The plan proposes Route 10, which runs through the NDSU campus, stops at Hector International Airport, runs north on CR 81, turns right on 40th Avenue North, and turns left on 37th Street North to terminate at the Amazon Distribution Center.

3.5 Peak Hour Intersection Volumes

Peak hour intersection volumes for the nine study intersections were determined using the intersection counts described in Section 1.4.1. The AM peak hour for the corridor was found to be 7:15 AM – 8:15 AM and the PM peak hour was found to be 4:30 PM – 5:30 PM. The intersections that were counted and their AM and PM peak hour factors (PHF, the hourly volume during the highest peak hour divided by the peak 15-minute flow rate within that hour) are shown below:

	AM PHF	PM PHF
1. 40th Avenue N at 45th Street N:	0.88	0.92
2. 40th Avenue N at I-29 Southbound Ramps:	0.82	0.87
3. 40th Avenue N at I-29 Northbound Ramps:	0.79	0.92

[5] Fargo-Moorhead Metropolitan Bicycle and Pedestrian Plan, 2022

4. 40th Avenue N at CR 81:	0.79	0.88
5. 40th Avenue N at 37th Street N:	0.75	0.91
6. 40th Avenue N at 33rd Street N:	0.76	0.82
7. 40th Avenue N at 32nd Street N:	0.76	0.84
8. 40th Avenue N at 39$^{1/2}$ Avenue N:	0.80	0.91
9. 40th Avenue N at 25th Street N:	0.84	0.94

Figure 5 shows a summary of the rounded AM and PM peak hour turning movement volumes. These volumes have not had the seasonal adjustment factor of 1.02 described in Section 1.4.2 applied to them, which was done before being input into the traffic simulation models.

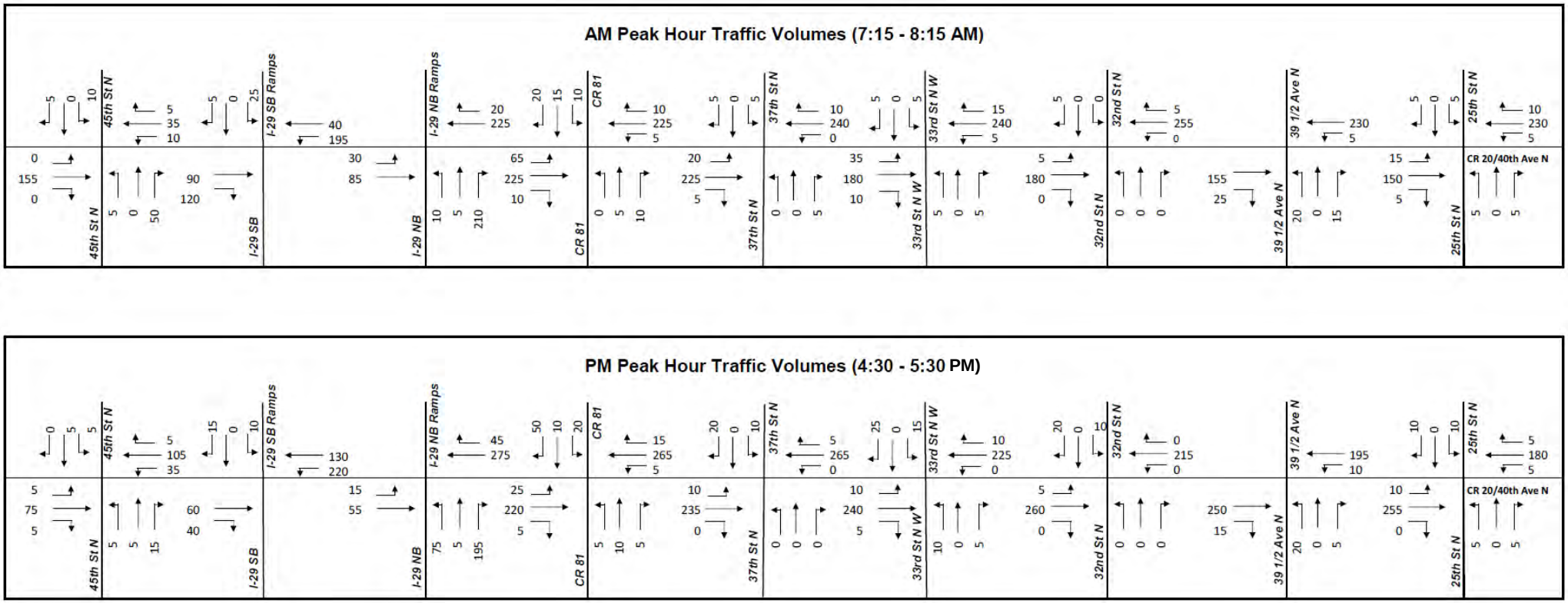

Figure 5 – AM and PM Peak Hour Traffic Volumes

3.6 Operational Analysis

Operational analysis of the existing interchange was performed using TransModeler and the methodology described in Section 1.4.2. Intersection LOS as described in HCM was output from the traffic simulation model. LOS is a qualitative measure describing operational conditions within a traffic system, based on service measures such as speed, delay, freedom to maneuver, traffic interruptions, comfort, and convenience. There are six levels of service, having letter grades A through F. The performance measure for intersection LOS is average delay per vehicle. **Table 1** shows the LOS criteria (in seconds per vehicle) for control delay at unsignalized intersections/roundabouts and at signalized intersections.

Table 1 – Level of Service Criteria

LOS	Unsignalized Intersection/ Roundabout	Signalized Intersection
A	≤ 10 sec	≤ 10 sec
B	10-15 sec	10-20 sec
C	15-25 sec	20-35 sec
D	25-35 sec	35-55 sec
E	35-50 sec	55-80 sec
F	>50 sec	>80 sec

Table 2 shows the base year 2022 intersection delay and LOS for the ramp terminal intersections of the 40th Avenue North interchange under its existing traffic control and geometric configuration. The results demonstrate that the interchange does not warrant any immediate intersection improvements under 2022 volume conditions, as the intersections operate at LOS A with minimal intersection delay. More information about existing corridor operations can be found in the 'Combined No-Build and Primary Corridor Alternatives Models Summary' previously submitted to the TAC and shown in Appendix H.

Table 2 – 2022 Ramp Terminal Intersection Average Delay and LOS

	AM Peak Hour			PM Peak Hour		
Intersection	Vehicles	Avg Delay (sec)	LOS	Vehicles	Avg Delay (sec)	LOS
Southbound I-29 Ramps	488	3.9	A	485	2.4	A
Northbound I-29 Ramps	581	4.8	A	706	4.9	A

3.7 Safety Analysis

The latest five years of available crash data from 2017 to 2021 were collected from the ND County Crash Dashboard[6] and reviewed to determine crash trends and potential safety deficiencies at the interchange. A total of ten crashes occurred in the interchange area during the analysis period. Seven of the ten crashes occurred at the northbound ramp terminal intersection with most of those crashes being rear-end

[6] ND County Crash Dashboard Data

crashes. This is likely due to the higher volume of northbound off-ramp traffic approaching a stop condition but may also be due to abrupt slowdowns in the westbound direction caused by sunlight or vertical curvature obscuring slowing turning vehicles. **Table 3** shows several crash statistics for the ten interchange crashes.

Table 3 – Interchange Crash History (2017-2021)

Crash Severity		Crash Type		Weather		Surface Conditions	
Fatal	0	Rear-End	8	Clear	5	Dry	7
Injury	4	Angle	1	Cloudy	3	Snow	2
Property Damage	6	Sideswipe	1	Snow	2	Ice/Comp-acted Snow	1
Total	**10**	Run-off-Road	0	Rain	0	Wet	0

An initial anecdotal safety concern expressed at the existing interchange is the condition created by the bridge over the railroad tracks combined with the vertical curvature of 40th Avenue North, east of the interchange at the railroad crossing, which creates an illusion for westbound drivers that they have passed over I-29. As a result, after traversing the railroad overpass, some drivers erroneously attempt to make a “wrong way” left turn at the northbound ramp terminal intersection.

3.8 Environmental Screening

An environmental screening was completed for the Primary Study Area encompassing an approximately 500-foot boundary around the existing I-29/40th Avenue North interchange and along 40th Avenue between 45th Street North and CR 81. The screening was documented in the ‘Environmental Screening Technical Memorandum’ previously submitted to the TAC and shown in Appendix G. The memo summarizes the regulatory framework for each environmental and socioeconomic resource, the methodology for considering potential impacts to the resources, and the state and federal compliance requirements.

The following sections provide a brief overview of the environmental screening results, specifically as they pertain to existing conditions surrounding the interchange, potential impacts of the interchange reconstruction, and next steps in advancing the project. Detailed information is provided in the ‘Environmental Screening Technical Memorandum’.

3.8.1 ENVIRONMENTAL RESOURCES

Wetlands and Aquatic Resources

Several aquatic resources are located within the Primary Study Area, including wetlands and waterways. The National Wetlands Inventory (NWI) identifies several wetlands located along the roadways and railroad. County Drain 40 crosses through the Primary Study Area and is a tributary to the Red River. The National Hydrography Dataset (NHD) also identifies a ditch running east along the north side of 40th Avenue North which flows into County Drain 10.

Potential impacts to wetlands could occur if fill is needed to construct the future interchange. A wetland delineation would need to be completed to identify boundaries and determine wetland impacts. Permitting may need to be considered depending on the impacts, such as U.S. Army Corps of Engineers (USACE) permitting, Nationwide Permits (NWP), or Individual Permits. NDDOT also has a wetland mitigation program with wetland banks available for transportation projects. Onsite mitigation may also be pursued.

Water Quality

Under existing conditions, I-29 and 40th Avenue North are rural with no curb and gutter or storm drain. Stormwater runoff is captured in roadside ditches and conveyed through wetlands, open channels, or culverts. No existing stormwater ponds are present within the Primary Study Area.

The future interchange is anticipated to increase impervious surface area, resulting in an increase in the volume and rate of stormwater runoff. The interchange project is required to comply with National Pollutant Discharge Elimination System (NPDES) and other water quality requirements and complete a Stormwater Pollution and Prevention Plan (SWPPP) identifying erosion control Best Management Practices (BMPs).

Regulated Floodplain

The Primary Study Area is located in the Red River Valley approximately 2.8 miles west of the river, and part of the Primary Study Area is located in a Federal Emergency Management Agency (FEMA) flood hazard zone. The majority of the Primary Study Area west of I-29 is protected by a levee and has a reduced flood risk except for lower lying land west of 45th Street North which is in the 500-year (0.2% annual chance) floodplain. East of I-29, the lowest lying areas between the roadways and the railroad are in the regulated 100-year (1% annual chance) floodplain. The eastern end of the roadway and adjacent areas are in the 500-year floodplain.

The future interchange is anticipated to have little impact outside of the existing transportation corridor, thereby the project would avoid contributing to flooding and impacts to the floodplain. Coordination with the local floodplain administrator of the zoning authority (City of Fargo and Reed Township) would be pursued to achieve compliance with Executive Order (EO) 11988 and local regulations, including the Cass County Flood Damage Prevention Ordinance and the City of Fargo Flood Plain Management Ordinance (Article 21-0601).

Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was reviewed to identify species listed by the Endangered Species Act of 1973 (ESA) that may occur in the Primary Study Area and will be re-evaluated when the National Environmental Policy Act (NEPA) environmental review is conducted. Two species were identified from this review: the northern long-eared bat (*Myotis septentrionalis*), reclassified as endangered effective March 31, 2023 and the monarch butterfly (*Danaus plexippus)*, a candidate species. The North Dakota Natural Heritage biological conservation database was searched by the North Dakota Parks and Recreation Department (NDPRD) to determine any current or historical plant/animal species of concern in or near the Primary Study Area. No known records of species of concern or other significant ecological communities were identified.

As interchange project design develops, potential impacts to threatened and endangered species should be reassessed based on anticipated project actions and regulations in compliance with Section 7 of the ESA Guidance for NDDOT Projects, which addresses the federal requirements including USFWS and NEPA requirements.

Farmland

In the approximately 190-acre Primary Study Area, 6.8 acres of prime farmland (if drained) were identified. The southwest portion of the Primary Study Area is owned by NDSU. The land is used for agricultural and natural resources research purposes within the University.

As part of the future NEPA process, a Farmland Conversion Impact Rating Form (Form AD-1006) would need to be completed to determine the relative impact of the project on agricultural land, submitted to the Natural Resources Conservation Service (NRCS) local office for review. Part 523.11.E (1) could apply, which states that an exemption may be allowed for projects resulting in a small-acreage impact (ten acres or less per linear mile or three acres for existing bridge or interchange projects). If it is anticipated that the preferred alternative would qualify for the small-acreage impact exemption, coordination with NRCS would be completed to confirm this understanding.

3.8.2 PHYSICAL AND CONSTRUCTION-RELATED RESOURCE CONSIDERATIONS

Traffic Noise

The 40th Avenue North interchange produces noise typical for this type of transportation facility. Other existing noise sources include adjacent commercial uses, the railroad, and the airport. The nearest sensitive receptors are residential areas beginning approximately 2,300 feet west of the interchange.

The interchange project, being federally funded, will likely trigger the need for a detailed noise analysis due to substantial horizontal/vertical alteration, addition of through lanes, etc., which according to the FHWA would be considered a Type 1 Project pursuant to 23 CFR 772.5 (Code of Federal Regulations). If the noise analysis identifies the potential for noise impacts, abatement would need to be evaluated per state and federal requirements.

Potentially Contaminated Resources

No recorded incidents of contamination were found in the Primary Study Area following screening through the North Dakota Department of Environmental Quality's (NDDEQ) Spill Investigation Program Incidental Reporting database, therefore, it is not anticipated that there would be impacts to contaminated properties with the interchange project.

Utilities

The following utilities have been identified within the Primary Study Area:

- Cass County Electric (overhead 60-85 feet) running from west to east (approximately 45th Street North to 37th Street North)

- Cass Rural Water District waterlines (buried) on the west end of the Primary Study Area along the south side of 40th Avenue North
- CenturyLink (buried) on the north side of 40th Avenue North
- Dakota Carrier Network (overhead 60-85 feet) running from west to east (approximately 45th Street North to 37th Street North)
- Consolidated Communication (buried) running from north to south along the east side of CR 81
- City of Fargo sewer line (buried) running along south side of 40th Avenue North
- City of Fargo traffic signal (above ground) at the intersection of 40th Avenue North and CR 81
- City of Fargo watermain (buried) running southwest to northeast through the 40th Avenue North/CR 81 intersection.
- NDDOT electric cables for lighting on the north side of 40th Avenue North at the I-29 interchange near both the southbound I-29 exit and the northbound I-29 entrance.
- NDDOT fiber optic along the west side of the I-29 corridor.
- Xcel Energy gas line (buried) crossing 40th Avenue North east of CR 81, then crossing CR 81 south of 40th Avenue North.

Further review and consideration of impacts will be a part of the design of the future interchange, including elements of the project through the CR 81 intersection. More information on impacts is shown in Section 4.4.11.

Airport Coordination

The Hector International Airport is located southeast of the I-29/40th Avenue North interchange, approximately 1.0 mile from the center of the interchange to the primary airport property. The Federal Aviation Administration (FAA) Notice Criteria Tool would be used initially to determine whether the project meets the minimum conditions for an FAA Form 7460-1. This form would be submitted to the FAA in coordination with the North Dakota Aeronautics Commission to ensure the project would not present any safety or operation issues for the airport.

Railroad Coordination

BNSF has one mainline track and one two-mile-long additional track west of the mainline in the Primary Study Area. This is the BNSF Hillsboro Subdivision. Based on correspondence with BNSF (February 2023), they have advised that an additional track (total of three tracks) and an access road should be considered as the long-term condition. The additional track would be on the west side of the current tracks and the access road would be on the east side.

The future interchange design would be required to follow the BNSF/UP (Union Pacific) Grade Separation Guidelines for the construction of a new overpass and would be completed per the Construction and Maintenance Agreement (CMA) with BNSF. The vertical clearance standard, previously at 23 feet, was revised to a standard of 23 feet 6 inches. Design factors including road profile, bridge span lengths and beam depth, and overpass pier placement would need to be coordinated to ensure constructability, compatibility, and safety. During preliminary design, it will be determined whether there is a CMA currently in effect between NDDOT and BNSF. Replacement of the 40th Avenue North bridge over the railroad would require a new CMA with BNSF and an updated permanent easement, which will be executed during project design.

3.8.3 SOCIO-ECONOMIC RESOURCES

Community and Public Facilities

One community/public facility is located in the Primary Study Area. The NDSU agricultural research plots are located southwest of the I-29/40th Avenue North interchange. Two public facilities are located just beyond the Primary Study Area, including the National Guard Readiness Center and Hector International Airport. Future construction along the 40th Ave North corridor may result in temporary access impacts for these facilities, however access would not be entirely closed off. Any access impacts would be reviewed, discussed, and coordinated with affected facilities.

Environmental Justice (EJ)

An EJ analysis was completed that included Census block groups within a 0.25-mile buffer of the Primary Study Area. Based on this analysis, minority and low-income populations within these block groups were similar to or less than the percentage of minority and low-income populations at the city and county levels. Consequently, no readily identifiable minority populations or low-income populations were found in the Primary Study Area. Therefore, it is not anticipated that the future interchange would have the potential to cause disproportionately high or adverse effects to EJ populations. No community facilities or businesses that are owned by, employ, and/or serve minority or low-income populations were readily identified based on available desktop information. As part of the NEPA process, outreach with local representatives may be completed to obtain any additional information regarding the presence of EJ populations or businesses that predominantly serve or employ EJ populations within the study area.

Section 4(f)

Section 4(f) of the United States Department of Transportation (USDOT) Act provides protection for publicly owned parks, recreation areas, and publicly or privately owned historic resources. A re-evaluation of the area for Section 4(f) resources would also need to be completed. If potential impacts to Section 4(f) resources are unavoidable, the Section 4(f) process would need to be completed in coordination with NEPA.

Section 6(f)

Section 6(f) properties refer to lands acquired or developed using funds from the Land and Water Conservation Act. No Section 6(f) resources are present in the Primary Study Area. The City of Reile's Acres is located west of the interchange outside of the Primary Study Area. Within the city, there is a city park that has been identified by the North Dakota Parks and Recreation as a Land and Water Conservation (LAWCON) resource. It is unlikely that the interchange project would impact this resource. The inventory of Section 6(f) resources would be reviewed and confirmed as a part of the NEPA process for interchange project.

Section 106

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires consideration of the effects a transportation undertaking may have on historic properties and archaeological resources. The National Park Service (NPS) National Register of Historic Places (NRHP) database was reviewed to identify

potential impacts to historical and cultural resources; however, no listed resources were identified in the Primary Study Area. During development of the interchange project, there would be additional coordination with the State Historic Preservation Office (SHPO) and the NDDOT Cultural Resource Section (CRS), including a Class III Investigation. If it is determined that there are historic properties in the project area, potential impacts would be considered as a part of an adverse effects analysis.

Right-of-Way

The interchange project may require additional permanent right-of-way acquisition. It will also likely require temporary right-of-way during construction. In particular, the project is anticipated to require permanent and construction easements from BNSF for interchange embankments and the railroad overpass. Right-of-way needs should be minimized to the extent possible. However, the process for any confirmed right-of-way needs would be carried out consistent with the NDDOT Right of Way Manual and the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

Economic Impacts

In the Primary Study Area, there are direct accesses/driveways to commercial and industrial land uses. There may be areas were right of way acquisition is not feasible. During construction of the interchange project, there may be temporary access impacts associated with detours. Permanent access impacts would be avoided unless they are required to accommodate the interchange project including the management of traffic conflicts at direct accesses/driveways. Right-of-way impacts to local businesses including commercial and industrial land uses should be avoided. It is not anticipated that future right-of-way needs will result in direct impacts to the local businesses.

Land Use

Land use (existing and future) is summarized in Section 3.2. There is the possibility for right-of-way or access impacts with the interchange project. During construction, it is possible there would be temporary access impacts for a number of the land uses described above. To the extent possible, these impacts would be avoided through the design process or minimized to the extent feasible. Any right-of-way impacts would be analyzed during the NEPA process for the interchange project.

3.9 Previous Studies and Reports

The following studies and reports have been previously conducted for the I-29 and 40th Avenue North interchange area. These studies have been used throughout the project to refer to past information and conclusions and help inform the analysis in this project:

Cass County Road 20 /Clay County State Aid Highway 22 (From I-29 in North Dakota to County State Aid Highway 1 in Minnesota) Corridor Study Report – September 2001, FM Metro COG

This study evaluated the 40th Avenue North (CR 20) corridor from I-29 to the Red River and into Minnesota on County State Aid Highway 22 (CSAH 22) to identify short term and long-term improvements for the corridor. Issues identified included deficiencies that are still relevant today including I-29 ramp site distance and driver confusion at the I-29 east ramp intersection. No long-

term improvements resulted from the study and more recent studies provide more relevant data and information.

Hector International Airport Master Plan Update – 2018, Hector International Airport

This plan provides an inventory of facilities, forecasts of aviation demand and a capital improvement plan. This study helps verify that improvements to 40th Avenue North and the interchange are not in conflict with anticipated airport improvements.

2045 Fargo-Moorhead Metropolitan Transportation Plan – November 2019, FM Metro COG

Metro COG is required to update this document every five years with a minimum planning horizon of 20 years. It is a performance-based planning document focusing on demographics, land use, income, and employment and how those factors impact future transportation needs. This study provides a reference for how this corridor and interchange fit with the larger metro transportation network. While no specific improvements to 40th Avenue North or the interchange were recommended in the study, broader longer-term projects adjacent to the interchange related to regional connectivity and active transportation infrastructure are proposed.

Northwest Metro Transportation Plan – September 2020, FM Metro COG

This planning study focused on a 25-acre study area west of I-29 and north of Main Avenue. The objective of the study was to provide a planning tool for future land use and mobility in the study area under several buildout scenarios. The study provided recommendations for land use, transportation network capacity and traffic control, multimodal facilities, and roadway costs. This study is used for traffic simulation model calibration and roadway and intersection alternatives development.

Bridge 0029-069.374 over I-29 and 0029-069.374N over BNSF Railroad – 2021, NDDOT

The NDDOT Bridge Division provided as-built plans and inspection reports dated July 12, 2021 for the two bridges on the project. This information is utilized in the development of bridge alternatives including the feasibility of retaining the existing bridges for long-term continued use, construction staging, vertical clearance, grade raise requirements, and other bridge related items.

MATBUS 2021-2025 Transit Development Plan – December 2021, FM Metro COG & MATBUS

FM Metro COG and MATBUS created a development plan to evaluate current MATBUS policies and operations, identify transit needs, analyze new services strategies and technologies, ensure coordination with human services to address mobility needs, and provide MATBUS staff/leadership with recommendations for the next five years.

Northwest Fargo Small Area Traffic Study – January 2022, City of Fargo

This study evaluated the traffic impacts associated with the potential buildout of the industrial park area bounded by 40th Avenue North on the south, CR 81 on the west, 25th Street on the east and 64th Avenue on the north. The study estimated traffic volumes for a 2030 full-build scenario and evaluated future intersection capacity, signal warrants, level of service and other factors and provided recommendations for potential near term improvements on the corridor. This study is

used for traffic simulation model calibration and roadway and intersection alternatives development.

Fargo I-29 Exit 69 (Co 20/40th Ave N) Interchange Study – May 2022, NDDOT

This study evaluated the impact of traffic generated by the construction of a new Distribution Center south of the Amazon facility that was completed in 2021. The study evaluated turn lane and traffic signal warrants and other intersection improvements at the ramps and other intersections on the corridor. This study is used for traffic model calibration and roadway and intersection alternatives development.

4 Alternatives Analysis

4.1 No-Build Alternative

4.1.1 FORECAST DEVELOPMENT

Future year 2045 forecasted volumes were developed by comparing growth rates, forecasts, and information presented in various data sources and previous studies. These sources include the following:

NDDOT Historical Counts and Forecasts

Historical count data (2013-2021) from ten NDDOT count stations in proximity to the 40th Avenue North interchange were analyzed to identify traffic growth trends. The counts indicate strong growth of interstate traffic to and from south of the interchange, as well as on 40th Avenue North and CR 81, which is reflective of a rapidly developing exurban area. NDDOT also provided 2042 forecasts for I-29 south of the 40th Avenue North interchange and for the northbound exit and entrance ramps.

FM Metro COG Travel Demand Model

The study team reviewed FM Metro COG's regional travel demand model and corresponding Traffic Analysis Zone (TAZ) data files that include its assumptions for population and employment. The model includes projects from Metro COG's 2045 Long Range Transportation Plan. While the moderately high growth of I-29 traffic reasonably reflects a growing metropolitan area and the model shows relatively robust employment growth on the east side of I-29, growth on the interchange ramps, 40th Avenue North, and CR 81 shows a lack of residential development on the west side of I-29.

U.S. Census Population and Employment Data

Historical population data was obtained from the U.S. Census. State and county population projections for 2040 were obtained from the North Dakota Department of Commerce. Since 2000, Fargo metropolitan area population growth has been among the fastest in the nation. By 2040, Cass County is expected to grow by more than 44,000 people, almost a quarter of its 2020 population. Additionally, employment statistics from U.S. Bureau of Economic Analysis reports were examined. Like population growth, Cass County's 2.0% annual rate of employment growth has been significantly greater than North Dakota statewide and the national average.

Northwest Fargo Small Area Traffic Study

This study analyzed additional traffic growth expected to occur in the industrial zone located in the northeast quadrant of the 40th Avenue North interchange. It accounts for the new Amazon distribution center which opened in 2021 and potential development of up to 4.2 million square feet of new industrial space across six sites.

Northwest Metro Transportation Plan

This plan released in 2020 is one of several plans that directly addresses the anticipated development that will accompany the significant population and employment growth expected through 2045, specifically the undeveloped agricultural land adjacent to 40th Avenue North. The plan presents "25 percent", "50 percent", and "Full" buildout scenarios for the purpose of analyzing expected traffic impacts and mitigation strategies. The "50 percent" scenario equates most closely to the high growth rates in population and employment discussed previously.

The NDDOT historical count data/forecasts and FM Metro COG model both reflect reasonable growth on I-29 south of the interchange for a growing metropolitan area. The COVID-19 pandemic disruption partially accounts for a drop in total volume north of the interchange, however it is likely that this traffic will revert to the rate of growth indicated by Metro COG's model. For the interchange ramps, NDDOT's data best reflects the expected traffic pattern for trips to and from the south, as compared to the model which does not incorporate the full extent of residential expected growth. Similar rates were applied to ramps for traffic to the north. The NDDOT data also aligns well with growth rates estimated from the *Northwest Metro Transportation Plan's* "50 percent" scenario for significant residential development west of the interchange. While an annual growth rate of 7% is extremely high, it is rational if the development expectations of the study occur. Growth patterns east of the interchange in the *Northwest Fargo Small Area Study* also generally align with patterns estimated from NDDOT data and from the *Northwest Metro Transportation Plan*.

Table 4 shows the recommended compound annual growth rates (CAGR) to apply to the 2022 existing year trip tables of the traffic simulation model to use in the 2045 forecast year analysis. Based on a synthesis of the available data sources, these rates will result in future ADTs that reflect historical trends, regional model and population growth assumptions, and development expectations along the corridor. More details on growth rate development are shown in the 'I-29 and 40th Avenue North Interchange Preliminary Engineering and Feasibility Study Traffic Forecast Data Sources and Recommendations' document previously submitted to the TAC and shown in Appendix I.

Table 4 – Source Growth Rates and Recommended CAGR

Source	I-29		I-29 Ramps				40th Ave N		CR 81	
	N of 40th Ave	S of 40th Ave	NB Exit	NB Entrance	SB Exit	SB Entrance	W of I-29	E of CR 81	N of 40th Ave	S of 40th Ave
NDDOT Historical Counts	-0.5%	1.4%	2.9%	-0.8%	0.7%	2.9%	6.2%	3.6%	9.1%	8.4%
NDDOT Forecast (2042)		1.9%	2.4%	4.1%						
Metro COG Model (2045)	1.6%	1.6%	1.3%	0.7%	1.4%	1.4%	1.0%	1.3%	2.3%	4.8%
NW Small Area Study (2030)								6.7%*	14.2%	5.0%
NW Metro Transp. Plan (2045) "50% Buildout"							7.2%	3.0%	2.3%	7.6%
Recommended CAGR	1.9%	1.9%	2.5%	2.5%	2.5%	2.5%	7.0%	3.5%	7.0%	5.0%
Estimated 2045 ADTs	23,000	33,000	6,500	800	750	6,250	15,200	18,300	4,250	5,000

**Between I-29 and CR 81*

4.1.2 OPERATIONAL ANALYSIS

Operational analysis of the no-build interchange alternative for the 2045 forecast AM and PM peak hour scenarios was performed using the methodology described in Section 1.4.2 and the forecasts developed in Section 4.1.1. **Table 5** shows the intersection delay and LOS for the ramp terminal intersections of the 40th Avenue North interchange in 2045 assuming no improvements. As may be expected, the existing interchange fails with the introduction of thousands of additional peak hour vehicles. Significant queues form on both exit ramps and along 40th Avenue North. Backups beyond the limits of the simulation model resulted in a significant number of simulated trips not being loaded onto the network, thus the results only partially reflect the true demand. More information about no-build alternative corridor operations can be found in the 'Combined No-Build and Primary Corridor Alternatives Models Summary' previously submitted to the TAC and shown in Appendix H.

Table 5 – 2045 No-Build Ramp Terminal Intersection Average Delay and LOS

	AM Peak Hour			PM Peak Hour		
Intersection	**Vehicles**	**Avg Delay (sec)**	**LOS**	**Vehicles**	**Avg Delay (sec)**	**LOS**
Southbound I-29 Ramps	1,121	83	F	1,033	155	F
Northbound I-29 Ramps	815	251	F	890	252	F

4.2 Highway Interchange Tool

Stantec's proprietary Highway Interchange Tool (HIT) was used to identify potential interchange configurations for the 40th Avenue North interchange. It identified and prioritized the most feasible alternatives by assigning efficiency, cost, and safety scores to each potential interchange option. Existing AM and PM peak hour intersection volumes described in Section 3.5 and growth rates from the *Northwest Metro Transportation Plan* by FM Metro COG were used to develop preliminary traffic forecasts for the design year (2045) to input into HIT. Existing roadway geometry, free flow speeds, area characteristics, signal timing parameters, right-of-way footprint, and infrastructure unit costs were also input into HIT. More information about HIT can be found in the 'Interchange Alternatives Selection Technical Memorandum' previously submitted to the TAC and shown in Appendix J.

4.2.1 HIT RESULTS

The efficiency, cost, and safety scores were weighted according to weights established with the TAC for use in alternatives comparison throughout the project, which are 5.0 for efficiency, 3.0 for cost, and 4.5 for safety. The cumulative rating calculation for each alternative range from 1 to 10. There were 15 unique interchange designs selected from the aggregate of HIT runs, shown in **Table 6** for the 2045 preliminary forecast interchange volumes.

Table 6 – HIT Preliminary Interchange Designs

Interchange Design	Average Rating from HIT Runs	Requires ROW? Where?
Milwaukee	7.5	No
Ramp Left U-turn Diamond	7.3	Yes, 40th Ave N.
Diverging Diamond (DDI)	7.3	No
Displaced Left Single Point	6.8	No
Displaced Left Diamond	6.7	Yes, 40th Ave N.
Contraflow Ramp Left U-turn Diamond	6.4	Yes, 40th Ave N.
Double-U	6.4	No
Partial Cloverleaf (Parclo)	6.3	Yes, quadrants
Milwaukee and Partial Cloverleaf	6.3	Yes, quadrants
Single Point (SPUI)	6.1	No
Milwaukee and Ramp Left U-Turn	6.1	Yes, 40th Ave N.
Displaced and Ramp Left U-turn Diamond	6.0	Yes, 40th Ave N.
Milwaukee and Contraflow	5.9	No
Standard Diamond	5.5	No
Cloverleaf	4.4	Yes, quadrants

Source: Stantec, 2023

In general, the designs that rank high relocate high-volume left turn movements to reduce conflicts, improving capacity and safety. The Standard Diamond did not score as highly as other designs since HIT assumes the ramp terminal intersections will be controlled by traffic signals in a conventional intersection layout.

4.2.2 DESIGN CHARRETTE

A design charrette meeting was held on January 11, 2023 and was attended by key Stantec-wide staff who have notable interchange design experience nationally. The charrette focused on the results of the HIT and the selected unique interchange designs in **Table 6**. The charrette ultimately resulted in narrowing down the number of interchange alternatives to six interchange alternatives, listed below:

- Alternative 1 – Standard Diamond Interchange with Signals
- Alternative 2 – Dumbbell Interchange (Standard Diamond w/Roundabouts)
- Alternative 3 – Diverging Diamond Interchange (DDI)
- Alternative 4 – Roundabout DDI
- Alternative 5 – Partial Cloverleaf Interchange (Parclo)
- Alternative 6 – Ramp Left U-turn Diamond Interchange

A Preliminary Alternatives Matrix was also developed to summarize the considerations for each alternative discussed in the charrette and was included in the 'Interchange Alternatives Selection Technical Memorandum' shown in Appendix J.

The TAC met on February 9, 2023 to review the alternatives proposed for further consideration as outlined above. The TAC approved the advancement of Alternatives 1 through 5 through the feasibility

study process where Stantec developed detailed traffic microsimulation models for operational analysis. Alternative 6 was discarded primarily over concerns associated with available space for the U-turns and anticipated lack of public acceptance due to increased travel time and distance for some left turn movements.

4.3 Build Alternatives

The five interchange alternatives advanced for further study were analyzed in TransModeler to determine the optimal configuration for each alternative. In combination with the three corridor concepts described in the 'Combined No-Build and Primary Corridor Alternatives Models Summary' found in Appendix H (existing, signalized, and roundabout), the alternatives were fine-tuned through an iterative process. Each alternative was initially developed with single-directional lanes for 40th Avenue North and interchange ramps, then additional lane capacity was incrementally added to maintain LOS D or better for intersection approaches and the corridor. Once an alternative is selected, it will advance to Contract II, where further considerations of the alternative will take place.

4.3.1 ALTERNATIVE 1

Alternative 1, Standard Diamond Interchange, consists of reconstructing and updating the existing interchange layout. The ramp terminal intersections are proposed to have traffic signal control based on the need demonstrated from the forecast scenario no-build analysis in Section 4.1.2. **Figure 6** shows the preliminary geometric layout and lane configurations for Alternative 1.

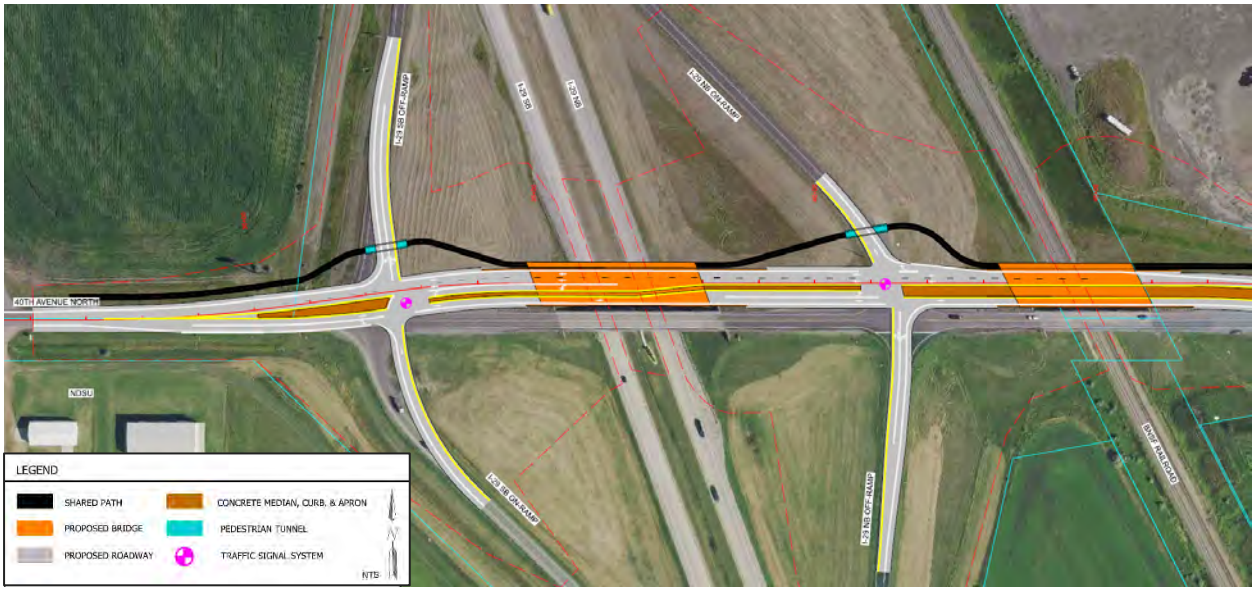

Figure 6 – Standard Diamond Interchange

4.3.2 ALTERNATIVE 2

Alternative 2, Dumbbell Interchange, consists of reconstructing the interchange to maintain a standard diamond layout but with roundabout control at the ramp terminal intersections. The roundabouts can be configured to maintain full circulatory lanes and accommodate U-turns (as shown and modeled in this analysis) or can be configured in a 'tear drop' or 'dog bone' layout without the circulatory lanes closest to the interchange center. **Figure 7** shows the preliminary geometric layout and lane configurations for Alternative 2.

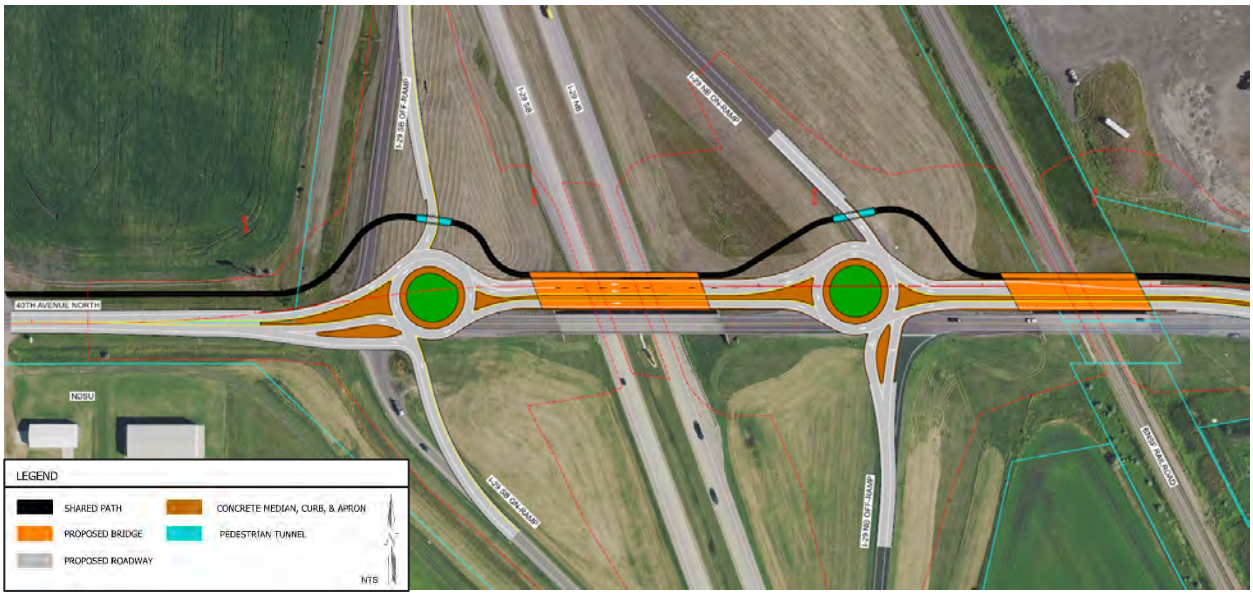

Figure 7 – Dumbbell Interchange

4.3.3 ALTERNATIVE 3

Alternative 3, Diverging Diamond Interchange (DDI), consists of reconstructing the interchange to have traffic along 40th Avenue North cross over to the opposite side and cross back after traversing the bridge, changing the locations of left turning traffic. The crossover intersections would have traffic signal control. **Figure 8** shows the preliminary geometric layout and lane configurations for Alternative 3.

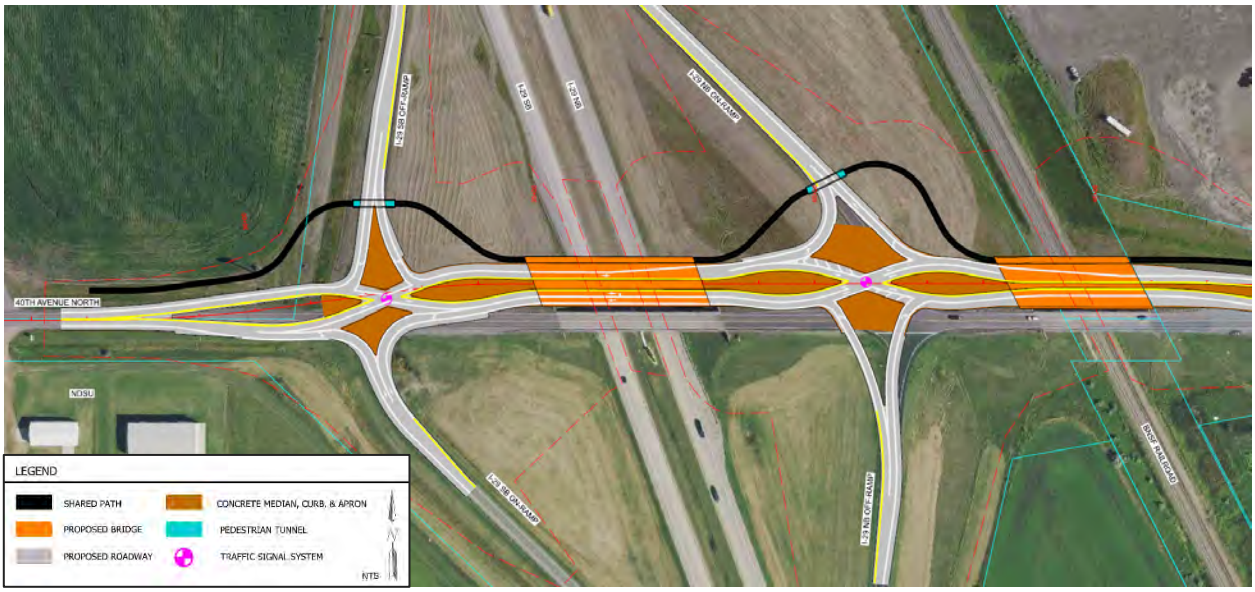

Figure 8 – Diverging Diamond Interchange (DDI)

4.3.4 ALTERNATIVE 4

Alternative 4, Roundabout DDI, consists of reconstructing the interchange to function similar to a DDI with crossing traffic, but with yield control instead of signal control at the crossovers and roundabout-like geometry. Like a DDI, this interchange changes the locations of left turning traffic. **Figure 9** shows the preliminary geometric layout and lane configurations for Alternative 4.

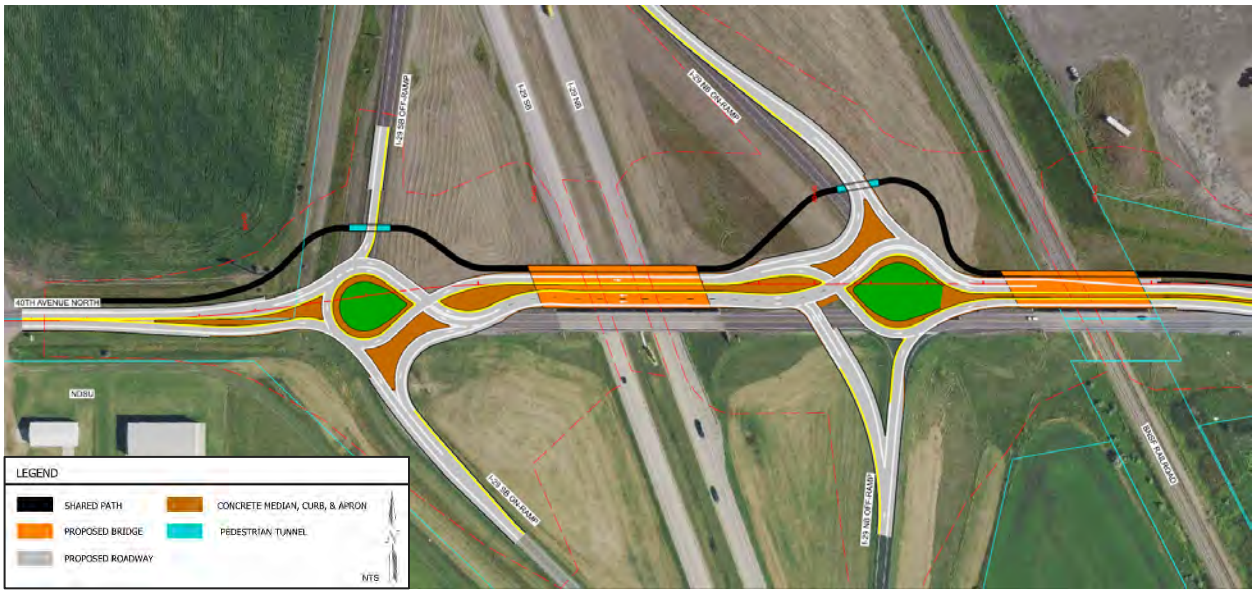

Figure 9 – Roundabout DDI

4.3.5 ALTERNATIVE 5

Alternative 5, Partial Clover Interchange (Parclo), consists of reconstructing the interchange to allow westbound left turning traffic to instead take a free right turn via a loop ramp in the northwest quadrant. The remaining movements would be controlled by a traffic signal at the ramp terminal intersections. **Figure 10** shows the preliminary geometric layout and lane configurations for Alternative 5.

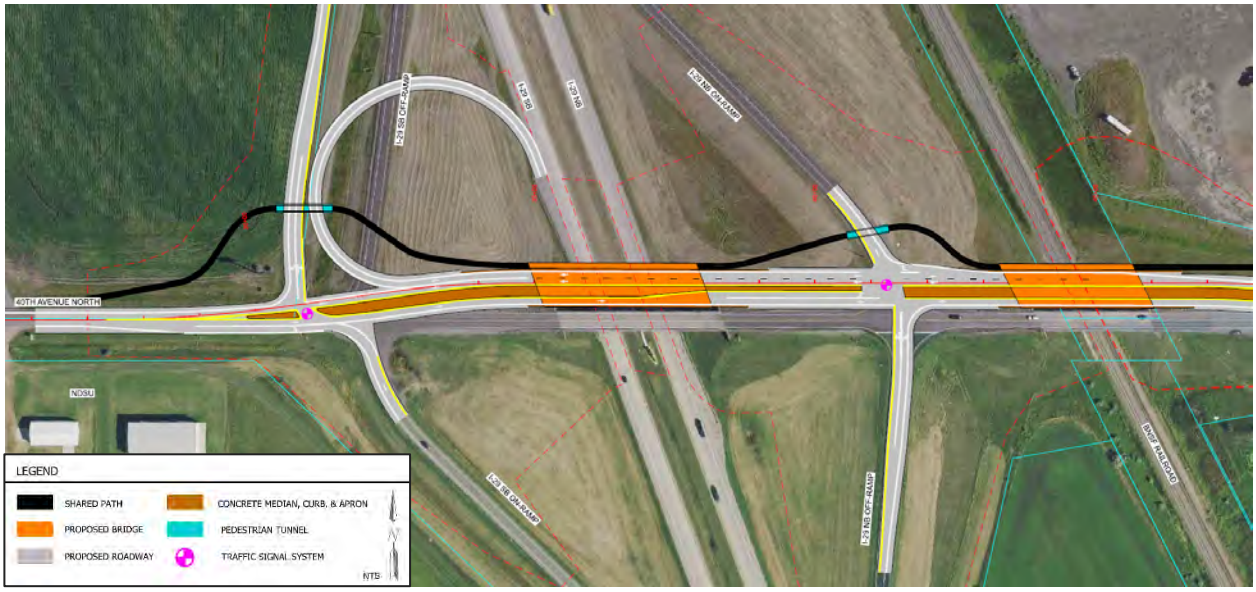

Figure 10 – Partial Cloverleaf Interchange (Parclo)

All five alternatives propose modifications to the CR 81 intersection with 40th Avenue North due to its proximity to the interchange. The signalized alternatives (Alternatives 1, 3, and 5) will maintain signal control at CR 81, while Alternatives 2 and 4 propose roundabout control.

4.4 Evaluation Of Alternatives

4.4.1 OPERATIONAL ANALYSIS

Operational analysis of each interchange alternative for the 2045 forecast AM and PM peak hour scenarios was performed using the methodology described in Section 1.4.2 and the forecasts developed in Section 4.1.1. The interchange alternatives were paired with the existing, signalized, and roundabout corridor concepts in TransModeler to determine multiple sets of results for each alternative.

First, freeway LOS was examined to ensure the interchange alternatives do not negatively impact operations on I-29. If necessary, the conceptual alternatives were adjusted to avoid that outcome by limiting ramp queues at 40th Avenue North from extending to the mainline. The service measure freeway LOS is density as measured by the number of vehicles (passenger car equivalents) per mile, per lane. **Table 7** shows the LOS density thresholds for the three types of freeway facilities present at this interchange. The diverge area occurs before an exit ramp and the merge area occurs past the entrance ramp merge point. The basic segment in this scenario is between the ramps.

Table 7 – Freeway LOS Density Thresholds

LOS	Diverge	Basic	Merge
A	< 10	< 11	< 10
B	< 20	< 18	< 20
C	< 28	< 26	< 28
D	< 35	< 35	< 35
E	< 43	< 45	< 43
Demand Exceeds Capacity			
F	> 43	> 45	> 43

Density: (pc/mi/hr)

Table 8 shows that all alternatives provide the same LOS for each of the adjacent freeway segments, within the desired threshold for peak hour performance of an urban interstate facility.

Table 8 – 2045 Freeway LOS by Interchange Alternative

	AM Peak Hour						PM Peak Hour					
	Southbound			Northbound			Southbound			Northbound		
Alternative	Diverge (N of exit)	Basic (b/t ramps)	Merge (S of exit)	Diverge S of exit)	Basic (b/t ramps)	Merge (N of exit)	Diverge (N of exit)	Basic (b/t ramps)	Merge (S of exit)	Diverge S of exit)	Basic (b/t ramps)	Merge (N of exit)
Alt. 1	A	A	B	B	A	A	A	A	B	C	B	B
Alt. 2	A	A	B	B	A	A	A	A	B	C	B	B
Alt. 3	A	A	B	B	A	A	A	A	B	C	B	B
Alt. 4	A	A	B	B	A	A	A	A	B	C	B	B
Alt. 5	A	A	B	B	A	A	A	A	B	C	B	B

Table 9 shows the LOS and average ramp terminal intersection delay for each alternative interchange and corridor combination. TransModeler was unable to provide metrics for the exit ramp approaches for Alternatives 3 and 4 in its output statistics, presumably because TransModeler sees these approaches as separate and downstream from the primary intersection points, and thus were not included in the intersection delay. It was observed that these approaches have reasonably short queues, averaging below four vehicles with a maximum average queue length of no more than eight vehicles. All intersections for each interchange alternative-corridor concept combination operate acceptably, however in Alternative 4, functionality of the crossover area is highly sensitive to gap availability at the intersections and there is a high potential for the interchange to “lock” if longer queues happen to form. More information about corridor intersection operations under the build alternatives can be found in the ‘I-29 & 40th Ave N Interchange: Interchange Alternatives Models Summary’ previously submitted to the TAC and shown in Appendix K.

Table 9 – 2045 Ramp Terminal Intersection Average Delay and LOS

			AM Peak Hour			PM Peak Hour		
Alternative	**Corridor**	**Intersection**	**Vehicles**	**Avg Delay (sec)**	**LOS**	**Vehicles**	**Avg Delay (sec)**	**LOS**
Alt. 1	Existing	SB Ramps	1,695	14.1	B	2,068	10.1	B
		NB Ramps	1,720	13.2	B	2,348	20.8	C
	Signalized	SB Ramps	1,785	23.1	C	2,127	11.1	B
		NB Ramps	1,257	13.0	B	1,915	24.0	C
	Roundabout	SB Ramps	1,799	14.8	B	2,133	11.6	B
		NB Ramps	1,767	13.3	B	2,391	11.6	B
Alt. 2	Existing	SB Ramps	1,647	6.5	A	1,983	6.2	A
		NB Ramps	1,712	4.1	A	2,307	16.8	C
	Signalized	SB Ramps	1,805	8.2	A	2,129	6.8	A
		NB Ramps	1,778	4.4	A	2,383	18.5	C
	Roundabout	SB Ramps	1,805	1.9	A	2,130	3.4	A
		NB Ramps	1,053	4.4	A	1,213	5.5	A
Alt. 3	Existing	SB Ramps	658	16.9	B	1,082	16.2	B
		NB Ramps	888	19.0	B	1,073	20.7	C
	Signalized	SB Ramps	720	18.6	B	1,157	17.9	B
		NB Ramps	929	20.6	C	1,132	22.9	C
	Roundabout	SB Ramps	722	15.6	B	1,155	11.2	B
		NB Ramps	932	11.7	B	1,133	12.1	B
Alt. 4	Existing	SB Ramps	1,290	9.4	A	1,431	9.6	A
		NB Ramps	1,457	8.7	A	1,655	6.3	C
	Signalized	SB Ramps	1,434	12.7	B	1,563	12.1	B
		NB Ramps	1,496	10.9	B	1,722	9.1	B
	Roundabout	SB Ramps	1,452	6.2	A	1,577	7.6	A
		NB Ramps	1,511	7.5	A	1,736	5.7	A
Alt. 5	Existing	SB Ramps	1,296	3.9	A	1,420	4.4	A
		NB Ramps	1,706	8.7	A	2,308	18.4	B
	Signalized	SB Ramps	1,430	4.3	A	1,557	4.0	A
		NB Ramps	1,767	9.5	A	2,384	19.1	B
	Roundabout	SB Ramps	1,435	4.0	A	1,559	4.2	A
		NB Ramps	1,770	10.2	B	2,389	17.4	B

4.4.2 SAFETY ANALYSIS

To assess the safety improvements of the interchange alternatives, Crash Modification Factors (CMF) from the FHWA CMF Clearinghouse were selected that best represent the anticipated crash reduction. A

CMF represents the anticipated safety countermeasure's ability to reduce crash occurrences or crash severity. The corresponding Crash Reduction represents the percentage reduction estimated for that crash countermeasure. **Table 10** shows the relevant CMFs and their respective descriptions, IDs, and crash reduction potential.

Table 10 – Relevant CMFs for the Interchange Alternatives

		All Crashes			Fatal/Injury Crashes		
Alternative	**CMF Description**	**CMF ID**	**CMF**	**Crash Reduction (%)**	**CMF ID**	**CMF**	**Crash Reduction (%)**
Alt. 1	Install traffic signals (at ramp terminals); urban and suburban	9144	0.840	16.0%	9146	0.782	21.8%
Alt. 2	Convert to Roundabout Interchange	9445	0.756	24.4%	9449	0.672	32.8%
Alt. 3	Convert Diamond Interchange to DDI	8258	0.670	33.0%	8278	0.590	41.0%
Alt. 4	Not available	--	--	--	--	--	--
Alt. 5	Provide cloverleaf ramp instead of long ramp	479*	0.770	23.0%	--	--	--

**Low rating CMF, only applies to portion of interchange*

As described in Section 3.7, the most common vehicle safety concern is the incidence of rear-end crashes at the I-29 northbound interchange ramp terminal intersection. All the alternatives are anticipated to have some reduction on rear-end crashes. While Alternative 4 has no associated CMF, it is expected to have a similar reduction to either Alternative 2 or 3. In addition to ramp terminal intersection control changes, the design of the selected build alternative should incorporate geometry to slow off-ramp traffic, further reducing the risk of rear-end crashes.

Roundabouts and roundabout style approaches as found in Alternatives 2 and 4 have fewer vehicle conflict points than traditional intersections and the conflict points that remain are low-angle low-speed conflicts. Speeds through a roundabout are reduced to 25 mph or less. The slow speeds and the elimination of high-angle crash types reduces the severity of crashes at the ramp terminal intersections. However, the yield-controlled crossover intersections of Alternative 4 will have higher angles of incidence than typical roundabout approaches. DDIs as shown in Alternative 3 also reduce the number of conflict points and approach speeds. Speeds through a DDI are reduced to 35 mph or less through the crossovers. This reduces the incidence of certain angle crash types, thus reducing the number and severity of crashes.

While not as much as other alternatives, the signalization of ramp terminal intersections in Alternatives 1 and 5 will also reduce total crashes and crash severity. Additionally, the loop ramp in Alternative 5, eliminates conflict points for westbound left turning traffic, reducing the potential for crashes, however, an additional auxiliary lane is required on southbound I-29 to accommodate merging traffic from the loop

ramp in Alternative 5. The largest number of crashes, particularly high-angle, high-speed crashes, is expected to happen under Alternative 1.

Relating to the initial safety concern of westbound left turning vehicles making wrong-way movements onto the northbound off-ramp, Alternatives 2, 3, and 4 introduce geometry that significantly reduces the potential for this movement. Alternatives 1 and 5 do not address this concern with geometry, but the introduction of traffic signal control should discourage wrong-way maneuvers. Through-arrow signal heads may be shown to westbound drivers, and additional overhead signage can be implemented as part of the signal configuration to communicate “no left turns” to westbound drivers.

4.4.3 ACTIVE TRANSPORTATION CONSIDERATIONS

While there is little bicycle and pedestrian (active transportation) demand around the existing 40th Avenue North interchange, as surrounding land uses continue to evolve, the potential for increased future demand for active transportation is likely. As mentioned in Section 3.2, a large amount of residential development is expected to the west of I-29 and the area surrounding the interchange is expected to continue growing. This development, along with a new softball complex north of the interchange and the use of the corridor by local bicycle clubs, means that future bicycle and pedestrian demand is probable and should be considered with any future interchange improvements.

As mentioned in Section 3.4, only intermittent paved shoulders exist on 40th Avenue North, east of 37th Street North. Since active transportation proximity to vehicle traffic is a concern, particularly with the increased number of heavy vehicles associated with the commercial area, facility improvements that are safe and suitable for all ages and abilities should be implemented. All the interchange alternatives proposed will have an active transportation path running adjacent to 40th Avenue North on the north side. The path will have adequate buffer/separation from the roadway, and on the bridge segments over the railroad and I-29, the path will be immediately adjacent to the roadway with suitable barrier protection between vehicles and the path to increase safety. Additionally, each alternative assumes a grade-separated path crossing under the north ramps.

Depending on future development adjacent to the west side of interchange and additional active transportation facilities like paths or sidewalks constructed on the south side of 40th Avenue North, the demand for pedestrians/bicycles to cross 40th Avenue North may need to be considered. The signalized west ramp terminal intersection proposed in Alternatives 1 and 5 can allow bicycles and pedestrians to cross in a single pedestrian walk phase. The traffic signal proposed in Alternative 3 is timed to accommodate Diverging Diamond traffic flow, which means bicycles and pedestrians must cross in two phases instead of one, increasing crossing time. The roundabouts in Alternatives 2 and 4 can accommodate bicycle/pedestrian crossings at the roundabout approaches. Further, the crossings at the roundabouts may be enhanced by rectangular rapid flashing beacons (RRFB) or similar warning devices.

4.4.4 GEOMETRIC CONSIDERATIONS

The vertical alignment of 40th Avenue North as it crosses the railroad bridge creates sight distance challenges for westbound vehicles and vehicles on the northbound off-ramp. The new interchange, regardless of the alternative, will improve the vertical alignment to ensure there is adequate sight distance. Additionally, the new interchange will be designed to satisfy current NDDOT geometric standards.

All alternatives propose a shift in the horizontal alignment to the north to accommodate the new bridge north of the existing bridge, which will remain open during construction. Once an alternative is selected, more detailed analysis of traffic operations during construction will be required. Alternative 5 requires the southbound off ramp to be shifted west to accommodate the loop ramp in the northwest quadrant.

The medians in Alternative 3 between the ramp terminal intersections must be wider than other alternatives to provide adequate separation in order to properly set up the angles of the crossover intersections. DDI crossovers are typically designed for 20-30 mph depending on the interchange characteristics. The preliminary geometry in Alternative 3 is designed for 30 mph since the rural characteristics of this interchange call for a higher speed design. If Alternative 3 is carried forward, tradeoffs between design speed and bridge costs can be evaluated further.

Permitted oversize-overweight (OSOW) vehicles on I-29 that are unable to clear the 40th Avenue North bridges will have to use the ramps to traverse the interchange. Alternatives 1, 2, and 5 can accommodate this movement in both directions by allowing OSOW through movements at the ramp terminal intersections. Alternative 3 does not allow these through movements in either direction and Alternative 4 does not allow them in the northbound direction. Designated routes for OSOW vehicles must be established for Alternatives 3 and 4 if either is selected.

4.4.5 COST ESTIMATES

Preliminary cost estimates were developed for each alternative using the NDDOT average bid prices from the previous six years for comparative analysis. Final estimates with current bid prices that represent increased costs in recent years will be developed in Contract II. **Table 11** shows the total estimated costs for the alternatives. The least costly alternatives are Alternatives 2 and 4, which have roundabouts for intersection control. They do not required traffic signals and, since they are narrower, have lower bridge costs. The embankment and settlement mitigation costs are similar since the roundabout alternatives are wider through the intersections. The next least costly are Alternatives 1 and 5. These require signals and more width across the two bridge structures. The most expensive alternative is Alternative 3, which requires signalized intersections and the widest bridge.

All Alternatives include significant costs for embankment and settlement mitigation. Maintaining traffic on 40th Avenue North during construction is a primary goal of the project. It does add costs to the project in the form of added settlement mitigation. Settlement mitigation will include some combination of surcharging the embankment and lightweight fill (i.e. geofoam). Each Alternative is assumed to be built on an alignment shifted to the north to allow traffic to run on the existing bridge during construction.

Table 11 – Cost Estimate Summary

Alternatives	Estimated Cost (Million)
Alternative 1 – Standard Diamond Interchange with Signals	$31.7
Alternative 2 – Dumbbell Interchange (Std Diamond w/ Rdbts)	$28.1
Alternative 3 – Diverging Diamond Interchange	$34.1
Alternative 4 – Roundabout DDI	$27.8
Alternative 5 – Partial Clover Interchange (Parclo)	$31.9

4.4.6 CONSTRUCTABILITY

The interchange and 40th Avenue North are anticipated to remain open to traffic during construction of the selected interchange alternative. To accommodate this, all alternatives were based on shifting the center alignment of 40th Avenue North to the north a sufficient distance to allow the new roadway and bridges to be constructed while the existing facilities carry traffic. In general, the proposed roadway profile will be approximately three feet higher than existing due to the structure type selection and vertical clearance requirements for the bridges, further described in Section 4.4.12. All alternatives have the new east interchange ramps in the same location as the existing ramps. Staged construction of the ramps and intersections will be required and the difference in grades may require temporary shoring and/or temporary road and ramp alignments to facilitate construction.

The proposed profiles of 40th Avenue North west of I-29 and the west interchange ramps are significantly higher than the current grades. The existing grades across the I-29 Bridge and through the west ramps are steeper than current requirements. Current standards for grades through intersections coupled with grade raise required for the proposed structure results in proposed grades 10 to 14 feet higher than existing ground at the west ramp intersection. Since this is common to all alternatives, it is not a differentiator. The construction staging necessary to accommodate this grade change will be further developed in the next phase of project development.

4.4.7 ACCOMMODATES FUTURE IMPROVEMENT

The Alternatives provide sufficient capacity for projected 2045 traffic volumes. Beyond that there is a potential that the 40th Avenue North corridor will require capacity improvements such as additions to through lanes and turn lanes. Because of this, it is important that the interchange with I-29 is compatible with future corridor capacity enhancements. All build alternatives involve constructing new bridges directly north of the existing bridges. Once the existing bridges are demolished, space is created to allow for widening of the bridges to the south for any potential lane additions. Roadway work on the bridge approaches can also be accommodated with all build alternatives.

Some alternatives can be adapted more easily for capacity improvements. Alternatives 1, 2, and 5 require the bridge to be widened to add an eastbound through lane, but this widening is simpler than other alternatives since the widening will be towards the south. Alternative 3 is proposed to be built up front with the space required for extra through lane additions, thus significantly reducing future work required to implement capacity improvements. The extra capacity of a second eastbound through lane would require widening to the north since the bridge is in the crossed over segment of the interchange. Alternative 4 can

reconfigured for a second eastbound lane by adding it toward the center of the bridge since roadway geometry near the roundabouts allows for greater flexibility/curvature that a typical DDI.

Capacity improvements beyond the 2045 future volumes for the roundabouts in Alternative 2 may require modification for additional lanes. Capacity can be added to Alternative 4. A critical movement is northbound to westbound. This movement would initially be built as a single lane for the off ramp yielding left and a single lane through the west roundabout. As additional capacity is needed (near or beyond 2045), the crossover can be signalized and/or the movement can be converted to two lanes (as is shown in **Figure 9**).

4.4.8 WORK ZONE TRAFFIC CONTROL

All I-29 and 40th Avenue North traffic will be maintained through the duration of construction to the extent possible, and traffic will be shifted accordingly as construction progresses through each stage. For all build alternatives, a second bridge will be constructed just north of the existing bridge to maintain 40th Avenue North traffic. Once a recommended interchange alternative is selected, construction staging and traffic control will be further explored. Traffic control plans will be developed in accordance with the 2021 *Traffic Control Requirements for NDDOT Operations on Highways and Streets*.

4.4.9 AIRPORT APPROACH PATH IMPACTS

Due to construction of a new bridge and the interchange being in proximity to nearby Hector International Airport, care must be taken during construction to ensure runway approach paths are not impacted. Construction cranes and other vertical impediments are of particular concern near airports. The approach/takeoff path for Runway 13/31 are directly in line with the interchange, and the approaches for Runway 9/27 run parallel to 40th Avenue North just south of the interchange. Future coordination with the airport and FAA is necessary during the design and construction of the chosen alternative. More information on airport coordination is described in Section 3.8.2.

4.4.10 ENVIRONMENTAL

A comprehensive list of potential impacts to environmental and social-economic resources was addressed in the 'Environmental Screening Technical Memorandum' shown in Appendix G. Additionally, the 'Environmental Evaluation of the I-29/40th Avenue Interchange Alternatives in Support of the I-29/40th Avenue Interchange Transportation Selection and Decisions Report' shown in Appendix L summarizes the environmental conditions and potential impacts associated with each alternative. Several resource types covered in the screening memo were not carried forward to the evaluation report because there was no anticipated difference in impacts amongst the alternatives. The following sections provide a summary of the potential impacts associated with the interchange alternatives:

Environmental Justice

Based on the results of the EJ analysis, no low-income or minority populations were identified within the Primary Study Area. Therefore, it is not anticipated that any of the build alternatives would have the potential to cause disproportionately high and adverse human health or environmental effects to EJ populations. However, the EJ analysis should be reassessed during the NEPA process. Outreach to local representatives should be completed during the NEPA

process to confirm if any businesses are present within a 0.25-mile buffer of the Primary Study Area that are owned by, employ, or serve low-income or minority populations.

Noise

It is anticipated that all build alternatives would require a Type 1 Noise Analysis. Based on the level of planning and study at this stage, a difference in noise impacts cannot be ascertained. The majority of land uses within and in close proximity to the Primary Study Area are industrial, commercial, or agricultural uses, which would not be considered sensitive receptors. The nearest sensitive receptors are residential areas located approximately 2,300 feet west of I-29. The Primary Study Area extends into the residential areas near the intersection of 40th Avenue North and 45th Street North. It is conservatively assumed that a Type 1 Noise Analysis would be required. Coordination with NDDOT Environmental and Transportation Services (ETS) to confirm this assumption should be completed as part of the NEPA process based on the recommended alternative.

Wetlands and Aquatic Resources

All build alternatives are anticipated to result in less than 0.4 acres of wetland and aquatic resource impacts.

Protected Species (Threatened and Endangered Species)

Based on available data and current conditions, it is possible there may be Monarch Butterfly habitat near the Primary Study Area. Suitable habitat for the Northern Long-eared Bat (NLEB) was not identified near the Primary Study Area. Additional review would be needed during completion of the NEPA process. At this time, no other species or habitat are anticipated to be impacted by any of the build alternatives.

Farmland

Alternative 5 may result in impacts to Prime Farmland (less than two acres). Based on the level of planning and study at this stage, the other four build alternatives are not anticipated to result in farmland impacts.

Right-of-Way

Construction limits available at the time of this study were used to estimate potential right-of-way needs. Alternative 5 may result in approximately six acres of right-of-way acquisition, Alternative 3 may result in approximately four acres, and Alternatives 1, 2 and 4 are estimated to require approximately three acres. All alternatives are anticipated to require permanent and construction easements from BNSF for interchange embankments and the railroad overpass.

Floodplain

All build alternatives are estimated to coincide with over three acres of 100-year floodplain.

Section 4(f)/6(f)

Based on current conditions, there are no Section 4(f) or Section 6(f) resources associated with any of the build alternatives.

Cultural Resources (Section 106)

Based on current conditions, there are no cultural resources associated with any of the build alternatives.

4.4.11 UTILITY IMPACTS

Utilities within the Primary Study Area were identified through a study level 811 call and are listed in Section 3.8.2. Of the 14 utilities present in the area, three utilities were identified that may conflict with the design and construction of all the proposed interchange alternatives. These utilities are Cass County Electric, CenturyLink, and Dakota Carrier Network. The following are the general locations for these utilities:

- Cass County Electric – Possible conflict with lines running parallel to 40th Avenue North from east to west from 37th Street North to 45th Street North.
- CenturyLink – Possible conflict with line crossing road at 40th Avenue North on the west side of CR 81 and in the northeast quadrant of the 40th Avenue North/CR 81 intersection.
- Dakota Carrier Network – Possible conflict with lines running parallel to 40th Avenue North from east to west from 37th Street North to 45th Street North.

As the selected interchange alternative design is refined and grading limits are finalized, additional coordination is anticipated and will occur to avoid, minimize, and relocate any impacted utilities.

4.4.12 STRUCTURAL AND GEOTECHNICAL CONSIDERATIONS

Primary Bridge Concepts

Bridge concepts were developed for the I-29 and BNSF bridges for each of the five interchange alternatives. The primary bridge concepts were based on utilizing prestressed I-girders for the superstructures due to economic, maintenance, and inspection advantages and preferences. For the I-29 bridge, the primary concept was based on a two-span configuration to avoid constructing piers adjacent to the interstate shoulders, which would require guardrail that is not preferred by NDDOT. The BNSF bridge concept is a three-span configuration similar to the existing bridge.

Geometric criteria used to develop the bridge concepts includes:

- Lane width: 12 feet
- Shoulder width: 4 feet (minimum)
- Traffic Barriers: Single slope barrier (1'-3" wide)
- Pedestrian facility: 10-foot-wide path on north side
- Vertical clearance
    - 17'-0" minimum over I-29 (per direction from NDDOT Bridge Division)
    - 23'-6" minimum over BNSF track (measured from top of rail elevation, 9 feet from center of track, per BNSF Grade Separation Guidelines).
- Horizontal clearance under BNSF Bridge
    - Accommodate future third track on west side of existing tracks and future access road on east side of existing tracks. (Per correspondence with BNSF Public Projects Manager)
    - Locate piers a minimum of 27 feet from track centerlines to avoid incorporating a crash wall into the pier design. (Per NDDOT Bridge Division)

Secondary Bridge Concepts

For the I-29 bridge, the geometric criteria above result in the use of 72" prestressed I-girders for the superstructure. The additional girder depth over existing, the increase in vertical clearance required over I-29, and the wider typical section of 40th Avenue North results in a total grade raise of approximately three feet. Due to the costs and potential settlement impacts associated with the higher grade, two secondary bridge concepts and associated vertical profiles were developed to determine if a shallower steel superstructure, with a lower profile and less embankment fill, would be less costly. The following bridge concept scenarios were developed:

- Profile 1: Prestressed Concrete I-Girders (Highest Profile, Primary Bridge Concept)
  - Two-span, 72" girders for I-29, three-span 54" girders for BNSF
- Profile 2: Steel Plate Girders (Middle Profile – 1.5 feet lower than primary concept)
  - Two-span, 54" girders for I-29, three-span, 42" girders for BNSF
- Profile 3: Steel Plate Girders (Low Profile – 3 feet lower than primary concept)
  - Four-span, 36" girders for I-29, three-span 42" girders for BNSF

Appendix M includes drawings for the range of options identified above. In general, the bridge lengths for the proposed bridges are the same regardless of interchange alternative, except for the I-29 Bridge for Profile 3. This is a four-span configuration, and the end span lengths were increased to compensate for uplift at the abutments. The bridge widths vary by alternative. To efficiently estimate the structure costs for the large range of bridge options, quantity-based cost estimates were prepared for each superstructure type above for the bridge length and width associated with Alternative 1. Those costs were then used to develop a unit cost per square foot of deck area for each bridge type. The unit costs per square foot were applied to the matrix of bridge options presented in **Table 12**.

Table 12 – Bridge Options Summary

Profile 1 & 2			**Profile 3**		
	Length	Width		Length	Width
Alt 1 - Standard Diamond			**Alt 1 - Standard Diamond**		
I-29	300	79.5	I-29	316	79.5
BNSF	237	79.5	BNSF	237	79.5
Alt 2 - Dumbbell			**Alt 2 - Dumbbell**		
I-29	300	67.5	I-29	316	67.5
BNSF	237	67.5	BNSF	237	60.0
Alt 3 - Diverging Diamond			**Alt 3 - Diverging Diamond**		
I-29	300	89.5	I-29	316	89.5
BNSF	237	83.5	BNSF	237	70.0
Alt 4 - Roundabout DDI			**Alt 4 - Roundabout DDI**		
I-29	300	72.0	I-29	316	72.0
BNSF	237	55.5	BNSF	237	70.0
Alt 5 - Partial Cloverleaf			**Alt 5 - Partial Cloverleaf**		
I-29	300	79.5	I-29	316	79.5
BNSF	237	79.5	BNSF	237	80.0

The calculated areas, unit costs, and the total bridge costs are included in Structure Cost Summary tables for each of the three profiles in Appendix N. The cost analysis showed that the Profile 1 bridge type (prestressed concrete I-girders) resulted in the lowest bridge cost for both the I-29 Bridge and the BNSF Bridge for all alternatives as shown in **Table 13** below.

Table 13 – Bridge Cost Summary

Alt 1 - Std Diamond	**Profile 1 Costs**	**Profile 2 Costs**	**Profile 3 Costs**
I-29 Bridge	$ 7,240,000	$ 9,930,000	$ 9,430,000
BNSF Bridge	$ 5,610,000	$ 6,610,000	$ 6,610,000
Total	**$ 12,850,000**	**$ 16,540,000**	**$ 16,040,000**
Alt 2 - Dumbbell			
I-29 Bridge	$ 6,330,000	$ 8,610,000	$ 8,180,000
BNSF Bridge	$ 4,780,000	$ 5,630,000	$ 5,020,000
Total	**$ 11,110,000**	**$ 14,240,000**	**$ 13,200,000**
Alt 3 - DDI			
I-29 Bridge	$ 8,000,000	$ 11,030,000	$ 10,460,000
BNSF Bridge	$ 5,880,000	$ 6,940,000	$ 5,840,000
Total	**$ 13,890,000**	**$ 17,970,000**	**$ 16,300,000**
Alt 4 - Roundabout DDI			
I-29 Bridge	$ 6,670,000	$ 9,100,000	$ 8,650,000
BNSF Bridge	$ 3,960,000	$ 4,660,000	$ 5,840,000
Total	**$ 10,630,000**	**$ 13,760,000**	**$ 14,490,000**
Alt 5 - Parclo			
I-29 Bridge	$ 7,240,000	$ 9,930,000	$ 9,430,000
BNSF Bridge	$ 5,610,000	$ 6,610,000	$ 6,650,000
Total	**$ 12,850,000**	**$ 16,540,000**	**$ 16,080,000**

For the quantity-based cost estimates used to determine the costs per square foot, the only significant variable among bridge elements and the associated costs is the girder type; prestressed concrete girders used for Profile 1 and steel plate girders used for Profiles 2 and 3. Since steel bridges are rarely built in North Dakota, and given the cost fluctuations prevalent in the current marketplace, a sensitivity analysis was performed to determine how much influence the respective girder unit costs had on the overall bridge cost. The unit prices used for prestressed concrete girders in Profile 1 was $500 per linear foot and $350 per linear foot for the I-29 and BNSF Bridges respectively. The unit cost for all steel plate girder options was $3.50 per pound. The sensitivity analysis consisted of recalculating the bridge costs with girder unit prices of 50%, 75%, 150% and 200% of the costs used for the estimates. The sensitivity analysis showed that the steel unit prices would need to be half of the price used for the base estimate and the concrete price 50% greater than the base estimate for the steel superstructure options in Profiles 2 and 3 to have a lower overall cost than the prestressed girder options used for Profile 1. A summary of the costs computed for the sensitivity analysis is included in Appendix O.

Geotechnical Considerations

The interchange reconstruction alternatives are based on constructing 40th Avenue North on a new alignment north of the existing to facilitate traffic accommodation during construction. This will result in significant embankment construction over previously undisturbed soils. Preliminary calculations by Braun Intertec indicate the potential for six inches of settlement for ten feet of fill, and twelve inches of settlement for twenty feet of fill. Settlement of this magnitude will induce downdrag loads on the abutment piling and result in prolonged maintenance of the new embankments and pavement over the life of the structures.

This settlement can be mitigated by temporary soil surcharge with wick drains to accelerate the settlement prior to final embankment construction, by replacing a portion of the embankment with Geofoam blocks, or a combination of the two. Settlement mitigation alternatives will be fully developed during the next stage of project development with a full geotechnical investigation and settlement analysis.

To simplify the analysis for this report, the Geofoam method was used to estimate the cost associated with settlement mitigation for the three profiles described above to determine if the mitigation cost influences the outcome of the profile cost analysis.

The Geofoam quantity for each profile and alternative was based on replacing the embankment soil from the existing ground up to an elevation four feet below the profile grade, with lateral extents from the back of each abutment to the point at which the fill height was reduced to eight feet over existing. The cost used for installation of the Geofoam blocks was $100 per cubic yard. The Geofoam costs were combined with the bridge costs and the approximate embankment savings for the lower profiles associated with the shallower structure types used for Profiles 2 and 3. The cost comparison showed that the difference in cost for embankment construction and settlement mitigation for the lower profiles is does not outweigh the structure cost savings shown for the use of prestressed concrete I-girders over steel plate girders. In summary, Profile 1 was shown to provide the most economical combination of embankment, bridge, and settlement mitigation costs. The mitigation cost comparison is shown in **Table 14** below.

Table 14 – Mitigation Cost Summary

ALTERNATIVE	PROFILE 1	PROFILE 2	PROFILE 3
Alt 1 - Std Diamond			
Bridge Costs	$ 12,850,000	$ 16,540,000	$ 16,040,000
Settlement Mitgation	$ 7,820,000	$ 7,610,000	$ 7,400,000
Embankment Savings	$ -	$ (400,000)	$ (800,000)
Total	**$ 20,670,000**	$ 23,750,000	$ 22,640,000
Alt 2 - Dumbbell			
Bridge Costs	$ 11,110,000	$ 14,240,000	$ 13,200,000
Settlement Mitgation	$ 7,110,000	$ 6,900,000	$ 6,690,000
Embankment Savings	$ -	$ (400,000)	$ (800,000)
Total	**$ 18,220,000**	$ 20,740,000	$ 19,090,000
Alt 3 - DDI			
Bridge Costs	$ 13,890,000	$ 17,970,000	$ 16,300,000
Settlement Mitgation	$ 8,350,000	$ 8,140,000	$ 7,930,000
Embankment Savings	$ -	$ (400,000)	$ (800,000)
Total	**$ 22,240,000**	$ 25,710,000	$ 23,430,000
Alt 4 - Roundabout DDI			
Bridge Costs	$ 10,630,000	$ 13,760,000	$ 14,490,000
Settlement Mitgation	$ 6,970,000	$ 6,760,000	$ 6,550,000
Embankment Savings	$ -	$ (400,000)	$ (800,000)
Total	**$ 17,600,000**	$ 20,120,000	$ 20,240,000
Alt 5 - Parclo			
Bridge Costs	$ 12,850,000	$ 16,540,000	$ 16,080,000
Settlement Mitgation	$ 7,870,000	$ 7,660,000	$ 7,450,000
Embankment Savings	$ -	$ (400,000)	$ (800,000)
Total	**$ 20,720,000**	$ 23,800,000	$ 22,730,000

5 Conclusions

Through the Preliminary Engineering and Feasibility Study process for the I-29 / 40th Avenue North interchange, twelve categories related to roadway projects were examined. These categories include the following:

- Safety Improvements
- Geometric Needs
- Environmental Impacts
- Structural and Geotechnical Impacts
- Cost
- Traffic and Level of Service
- Constructability Issues
- Impact to Existing Land Use or New Development Including Access
- Right-of-Way Impacts
- Flexibility to Accommodate Future Improvements or Land Use Changes
- Active Transportation Facility Enhancement
- Utility Impacts

The five interchange design alternatives described in Section 4.3 have unique advantages and disadvantages for each category. An Alternatives Evaluation Matrix was developed to compare the alternatives and assign scores for each category based on their positivity or negativity towards evaluation criteria for the categories. The category scores are multiplied by weights established and agreed upon by the TAC and totaled to show the overall scores of each alternative. **Figure 11** shows the Alternatives Evaluation Matrix with the category and total scores. The detailed matrix with the advantages and disadvantages is shown in Appendix P.

Alternative 2 scored the highest of the five build alternatives with a score of 166, followed by Alternative 3 with a score of 140, Alternative 5 with a score of 137, Alternative 1 with a score of 131, and Alternative 4 with a score of 127. The next steps of the interchange project are to select the most appropriate build alternative(s) to carry through to Contract II. A draft work plan for Contract II was developed and is shown in Section 6.

5.1 Final Recommendation

To document a final decision from NDDOT leadership, a Decision Document summarizing each alternative was prepared. This document provides a project description, project schedule, advantages/disadvantages of each alternative, alternatives considered but not carried forward, and comments from local agencies, planning organizations, and NDDOT divisions on the interchange alternatives. Comments/recommendations on a preferred interchange option were received from the following groups.

- NDDOT Design Division
- NDDOT Fargo District
- NDDOT Environmental and Transportation Services Division

- NDDOT Local Government Division
- NDDOT Maintenance Division
- NDDOT Programming Division
- NDDOT Traffic Operations
- City of Fargo
- FHWA
- Cass County Highway Department
- Metro COG

The final decision is to move forward with Alternative 2, Dumbbell Interchange. This decision was in agreement with a majority of the entities listed above who responded with a clear preference. The final Decisions Document is included in Appendix Q.

	Evaluation Criteria												Overall Score of Alternative (Highest Value = Best Score)
	Safety Improvements	Geometric Needs	Environmental Impacts	Structural and Geotechnical Impacts	Cost	Traffic and Level of Service	Constructability Issues	Impact to existing land use or new development including access	Right of Way Impacts	Flexibility to accommodate future improvements or land use changes	Active Transportation Facility Enhancement	Utility Impacts	
Weight	**4.5**	**4.8**	**2.3**	**2.3**	**3.0**	**5.0**	**2.3**	**2.8**	**2.8**	**2.0**	**3.3**	**2.5**	
Alternatives													
1	2	5	3	1	4	4	4	4	4	3	4	3	**131**
2	5	5	3	1	5	5	5	5	5	4	5	3	**166**
3	5	4	3	1	3	5	4	4	3	5	3	3	**140**
4	3	4	3	1	5	3	4	4	4	2	4	3	**127**
5	4	5	2	1	4	5	4	3	2	4	4	3	**137**

Figure 11 – Alternatives Evaluation Matrix

6 Contract II Work Plan

As part of Contract I of the I-29 and 40th Avenue North interchange study, a Work Plan for Contract II will be developed to inform the TAC of the next steps to advance the project following Contract I. Contract II consists of three phases: Phase I is the environmental documentation and preliminary design, Phase II is the final design and plan preparation, and Phase III is construction engineering assistance as the engineer of record. Using an NDDOT Decision Form, NDDOT leadership will make the final determination of which interchange alternative to advance to Contract II. **Figure 12** shows the anticipated schedule for Contract II of the project.

Project Schedule																															
		2023								2024												2025									
Milestone Task and Name	**Completed**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**
Phase I - Environmental Document and Preliminary Design																														
Kickoff Meeting	06-01-23		*																											
Pre-survey Meeting	06-01-23		*																											
Aerial Survey	07-30-23																													
Ground Survey for Aerial Tie-in	07-30-23																													
Wetland Delineation and Report	07-15-23																													
Biological Assessment	07-15-23																													
Class III Cultural Resources Inventory	08-15-23																													
Geotechnical Field Investigation and Report	10-30-23																													
Pre-Bridge Design Meeting	09-15-23					*																								
BNSF Coordination Meeting	09-30-23					*																								
Preliminary Utility Coordination	09-30-23																													
Bridge Type, Size and Location	10-30-23																													
Preliminary Road Design/Interchange Layout	11-30-23																													
Public Input Meeting	12-15-23								*																					
Noise Analysis	01-15-24																													
Section 106 Compliance	01-15-24																													
Environmental Justice Evaluation	11-30-23																													
Preliminary Section 4(f) Evaluation	12-31-23																													
Preliminary Environmental Assessment	02-15-24																													
Preliminary Utility Engineering	02-15-24																													
Draft Environmental Assessment	03-15-24																													
Draft Section 4(f) Evaluation	02-15-24																													
Value Engineering	04-15-24																													
Environmental Assessment	05-15-24																													
Final Section 4(f) Evaluation	05-15-24																													
Public Hearing	06-15-24														*															
Final Environmental Document	08-30-24																													
Interchange Justification Report	08-30-24																													
Phase II - Final Design																														
Bridge Design	12-15-24																													
Bridge Preliminary Plan Prepation	01-15-25																													
Road Preliminary Plan Preparation	01-15-25																													
50% Plan Submittal and Review	01-15-25																					*								
Utility Conflict Plans	01-30-25																													
Design Right of Way Limits	01-30-25																													
Road and Bridge Hydraulics	03-01-25																													
Borrow Investigation	04-01-25																													
Preliminary Right of Way Plats	04-30-25																													
Appraisal	05-30-25																													
Final Bridge Plan Preparation	07-15-25																													
Final Road Plan Preparation	07-15-25																													
Permit Applications and Agreement	06-30-25																													
Cost Estimates and Participation Agreement	07-15-25																													
Plan in Hand Field Inspection	08-15-25																													*
Plan Completion Date	09-30-25																													*
Right of Way Plats Final	09-30-25																													*
Acquistion	09-30-25																													*
Project Completion	09-30-25																													*

Figure 12 – Anticipated Contract II Project Schedule

APPENDICES

Appendix A – Data Collection Technical Memorandum

Stantec

Memo

To:	Jennifer Kern, PE	From:	Wade Frank, PE Pat McGraw, PE
	North Dakota Department of Transportation		Stantec Consulting Services
File:	Preliminary Engineering and Feasibility Study Services for Project 8-029(213)069 NDDOT PCN 23596	Date:	February 9, 2023

Reference: Data Collection Technical Memorandum

PROJECT DESCRIPTION

The Stantec team is working with the North Dakota Department of Transportation (NDDOT) to complete a preliminary engineering and feasibility study to evaluate and compare retention and reconstruction alternatives for the 40th Avenue North (Cass County Road 20) interchange with Interstate 29 (I-29) in Fargo, ND (Exit 69). The purpose of the study is to determine potential interchange configurations, roadway alignments, and bridge type and sizes based on an operational, geometric, stakeholder, and environmental evaluation. This study will focus on identifying locations of crash incidents, the need for crash countermeasure treatments, and future traffic demand along the corridor. The overall project completion date through Phase III (Final Design) is September 30, 2025.

This memorandum documents the data and materials collected by the Stantec team and the intended use of these resources.

STUDY AREA

The study area, shown on **Figure 1**, includes I-29, 40th Avenue North, and the connecting streets between 45th Street North and 25th Street North. Improvement concepts will be considered along the 40th Avenue North corridor and at the I-29 interchange.

TRAFFIC DATA

A. 2021 FM Urban Area AADT Counts and Truck Counts – FM Metro COG

Relevant Average Annual Daily Traffic (AADT) data consists of mainline I-29 south of the interchange, all four interchange ramps, 40th Avenue North (west and east of I-29), and County Road 81 north and south of 40th Avenue North. Relevant truck count data consists of mainline I-29 south of the interchange, all four interchange ramps, and 40th Avenue North between 37th and 33rd Streets.

This information will be utilized in traffic model calibration.

Reference: **Data Collection Technical Memorandum**

Figure 1: Study Area

B. 2022 NDDOT Seasonal Factors and ADT by Station for:

- All vehicles
- Cars
- Single Unit Trucks
- Combination Trucks

This information will be used for traffic simulation model development and calibration. Seasonal factors were not applied to the FM Metro COG counts in Section A above.

C. I-29 raw 24-hour lane volumes recorded by NDDOT on 7/19/22 at the following stations:

- RP 68.9 (south of interchange)
- RP 72.1 (north of interchange)

This information will be used for traffic simulation model development and calibration.

D. Basic Axle Configuration Report 360 E – FM Metro COG

This report consists of raw data for the Metro COG count conducted on 40th Avenue North between 33rd Street and 37th Street. The count was conducted for 48 hours between 9:00 am

5/17/21 and 9:00 am 5/19/21. This data provides both speed information and vehicle classification information. Metro COG classifies trucks as Class 5 and higher.

This information will be used for traffic simulation model development and calibration.

E. Intersection Counts

Quality Counts LLC, under subcontract with Stantec, employed video traffic detection equipment at the following nine intersections along the 40th Avenue North corridor on Tuesday, December 20, 2022.

1. 40th Avenue North at 45th Street North
2. 40th Avenue North at I-29 southbound ramps
3. 40th Avenue North at I-29 northbound ramps
4. 40th Avenue North at CR 81
5. 40th Avenue North at 37th Street North
6. 40th Avenue North at 33rd Street North
7. 40th Avenue North at 32nd Street North
8. 40th Avenue North at 39 1/2 Avenue North
9. 40th Avenue North at 25th Street North

This data was used to develop peak hour traffic simulation models and forecasted turning movements as part of the overall traffic modeling process.

STUDIES AND REPORTS

A. Corridor Study Report – Cass County Road 20/Clay County State Aid Highway 22 (From I-29 in North Dakota to County State Aid Highway 1 in Minnesota) – September 2001, FM Metro COG.

This study evaluated the CR 20 corridor from I-29 to the Red River and into Minnesota on CSAH 22 to identify short term and long-term improvements for the corridor. Issues identified included deficiencies that are still relevant today including I-29 ramp site distance and driver confusion at the I-29 east ramp intersection. No long-term improvements were made as a result of the study and more recent studies provide more relevant data and information; therefore, this study will not be used going forward.

B. Hector International Airport Master Plan Update – 2018

This plan provides an inventory of facilities, forecasts of aviation demand, and a capital improvement plan. This study will be reviewed to verify that improvements to 40th Avenue North and the interchange are not in conflict with anticipated airport improvements.

C. 2045 Fargo-Moorhead Metropolitan Transportation Plan – November 2019, FM Metro COG

This plan is a document that Metro COG is required to update every five years with a minimum planning horizon of 20 years. It is a performance-based planning document

focusing on demographics, land use, income and employment and how those factors impact future transportation needs. This study will provide a reference for how this corridor and interchange fit with the larger metro transportation network.

D. Northwest Metro Transportation Plan – September 2020, FM Metro COG

This planning study focused on a 25-acre study area west of I-29 and north of Main Avenue. The objective of the study was to provide a planning tool for future land use and mobility in the study area under several buildout scenarios. The study provided recommendations for land use, transportation network capacity and traffic control, multimodal facilities, and roadway costs. This study will be used for traffic simulation model calibration and roadway and intersection alternatives development.

E. Northwest Fargo Small Area Traffic Study – January 2022, City of Fargo

This study evaluated the traffic impacts associated with the potential buildout of the industrial park area bounded by 40th Avenue North on the south, County Road 81 on the west, 25th Street on the east and 64 Avenue on the north. The study estimated traffic volumes for a 2030 full build scenario and evaluated future intersection capacity, signal warrants, level of service and other factors and provided recommendations for potential near term improvements on the corridor. This study will be used for traffic simulation model calibration and roadway and intersection alternatives development.

F. Fargo I-29 Exit 69 (Co 20/40th Ave N) Interchange Study – May 2022, NDDOT Traffic Operations Section

This study evaluated the impact of traffic generated by the construction of a new Distribution Center south of the Amazon facility that was completed in 2021. The study evaluated turn lane and traffic signal warrants and other intersection improvements at the ramps and other intersections on the corridor. This study will be used for traffic model calibration and roadway and intersection alternatives development.

Reference: **Data Collection Technical Memorandum**

AS-BUILT PLANS AND INSPECTION REPORTS

A. Bridge 0029-069.374 over I-29 and 0029-069.374N over BNRR
Bridge division provided as-built plans and inspection reports dated July 12, 2021, for the two bridges on the project. This information will be utilized in the development of bridge alternatives including the feasibility of retaining the existing bridges for long-term continued use, construction staging, vertical clearance and grade raise requirements and other bridge related items.

Additional information obtained as the project develops will be added to this memorandum.

STANTEC CONSULTING SERVICES INC.

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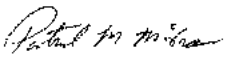

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Appendix B – Traffic Count Technical Memorandum

Stantec

Memo

To:	Pat McGraw, PE Stantec Consulting Services	From:	Brian Aldridge, PE Stantec Consulting Services
File:	Preliminary Engineering and Feasibility Study Services for Project 8-029(213)069 NDDOT PCN 23596	Date:	January 20, 2023

Reference: Traffic Count Technical Memorandum

PROJECT DESCRIPTION

The Stantec team is working with the North Dakota Department of Transportation (NDDOT) to complete a preliminary engineering and feasibility study to evaluate and compare retention and reconstruction alternatives for the 40th Avenue North (40th Ave N / Cass County Route 20) interchange with I-29 in Fargo, ND (Exit 69). The purpose of the study is to determine potential interchange configurations, roadway alignments, and bridge type and sizes based on an operational, geometric, stakeholder, and environmental evaluation. This study will focus on identifying locations of and need for potential crash countermeasure treatments and will assess future traffic demand along the corridor. The overall project completion date through Phase III (Final Design) is September 30, 2025.

This memorandum presents the methodology and resulting data related to the collection of traffic turning movement counts to support subsequent project tasks.

STUDY AREA

The study area includes I-29 and the connecting streets between 45th Street North and 25th Street North. Improvement concepts will be considered along the 40th Ave N corridor and at the I-29 interchange.

TRAFFIC COUNTS

Quality Counts LLC, under subcontract with Stantec, employed video traffic detection equipment at the following nine intersections along the 40th Ave N corridor on Tuesday, December 20, 2022.

1. 40th Ave N at 45th Street N
2. 40th Ave N at I-29 southbound ramps
3. 40th Ave N at I-29 northbound ramps
4. 40th Ave N at CR 81
5. 40th Ave N at 37th Street N
6. 40th Ave N at 33rd Street N
7. 40th Ave N at 32nd Street N
8. 40th Ave N at 39 1/2 Avenue N
9. 40th Ave N at 25th Street N

The nine intersections are shown graphically on **Figure 1**.

Reference: **Traffic Count Technical Memorandum**

Figure 1. Study Area

Thirteen (13) hours of traffic count data (6:00 AM – 7:00 PM) were collected at each intersection, including autos and heavy trucks. While buses, bicyclists, or pedestrians were included in the counts, none traveled through the study area while counts were being collected. The complete traffic count data are included in Attachment A. **Figure 2** presents a summary of the rounded AM peak hour and PM peak hour turning movements. The AM peak hour is from 7:15 – 8:15 AM, and the PM peak hour is from 4:30 – 5:30 PM.

The peak hour factors (PHF), the hourly volume during the highest peak hour divided by the peak 15-minute flow rate within that hour, for each intersection are summarized as follows:

1. 40th Ave N at 45th Street N 0.88
2. 40th Ave N at I-29 southbound ramps 0.82
3. 40th Ave N at I-29 northbound ramps 0.89
4. 40th Ave N at CR 81 0.88
5. 40th Ave N at 37th Street N 0.91
6. 40th Ave N at 33rd Street N 0.82
7. 40th Ave N at 32nd Street N 0.84
8. 40th Ave N at 39 1/2 Avenue N 0.91
9. 40th Ave N at 25th Street N 0.94

Reference: **Traffic Count Technical Memorandum**

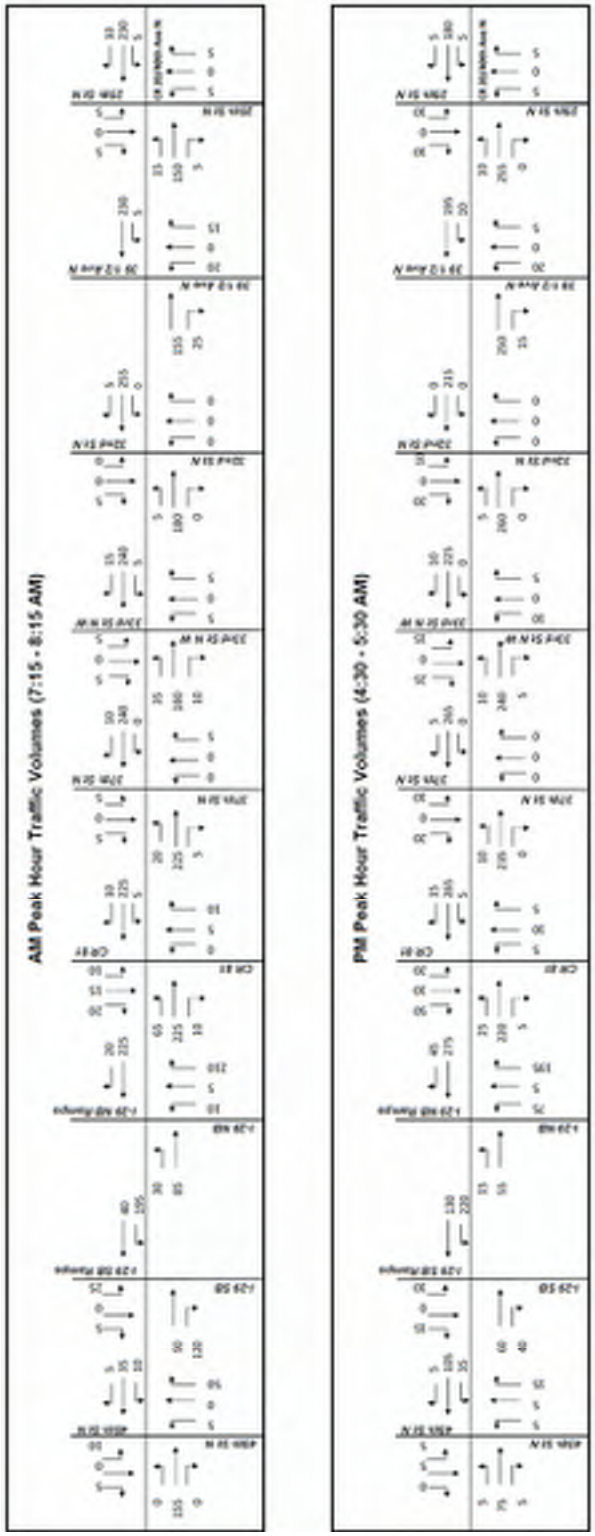


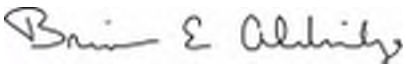
Figure 2. 40th Ave N – AM and PM Peak Hour Traffic Volumes

Reference: **Traffic Count Technical Memorandum**

NEXT STEPS

The peak hour turning movement counts summarized in Figure 2 balance well and provide sufficient data for the development of peak hour traffic simulation models and forecasted turning movements, the next steps related to traffic in the study process.

STANTEC CONSULTING SERVICES INC.



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Appendix C – Existing Conditions Simulation Model Development Memorandum

Stantec

Memo

To:	Jennifer Kern, PE Chad Frisinger, PE	From:	Mark Butler, AICP Pat McGraw, PE
	North Dakota Department of Transportation		Stantec Consulting Services Inc.
File:	Preliminary Engineering and Feasibility Study Services for Project 8-029(213)069 NDDOT PCN 23596	Date:	January 26, 2023

Reference: Existing Conditions Simulation Model Development Memorandum

PROJECT DESCRIPTION

The Stantec team is working with the North Dakota Department of Transportation (NDDOT) to complete a preliminary engineering and feasibility study to evaluate and compare retention and reconstruction alternatives for the 40th Avenue North (Cass County Route 20) interchange with I-29 in Fargo, ND (Exit 69). The purpose of the study is to determine potential interchange configurations, roadway alignments, and bridge type and sizes based on an operational, geometric, stakeholder, and environmental evaluation. This study will focus on identifying locations of and need for potential crash countermeasure treatments and will assess future traffic demand along the corridor.

As part of this study, Stantec has developed a traffic simulation model depicting existing peak hour conditions using Caliper's TransModeler (Version 6) simulation package. This memorandum presents the methodology and associated data related to the development and calibration of the model.

STUDY AREA

The 40th Avenue North corridor follows an east-west alignment along a portion of the northern city limits of Fargo and the northern perimeter of the Hector International Airport. It is primarily a two-lane undivided highway with turn lanes at several intersections. The corridor's speed limit is 40 miles per hour (MPH) with stop control for all side streets within the project limits, except for the intersection with CR 81 which has a traffic signal. The 40th Avenue North interchange with I-29 is a standard diamond and is bordered on the east by a grade separated crossing of a rail line that runs parallel to I-29. East of the CR 81, 40th Avenue North is classified as a minor arterial highway serving light commercial industrial developments. It is classified as a collector west of CR 81. Residential development west of 45th Street North is anticipated to grow substantially over the next 20 years. **Figure 1** presents the model network and study area**.**

Reference: **Existing Conditions Simulation Model Development Memorandum**

Figure 1. Simulation Model Network Study Area

Reference: **Existing Conditions Simulation Model Development Memorandum**

NETWORK DEVELOPMENT

The simulation model network was created by importing the corresponding network links of the study area from Fargo-Moorhead Metro COG's regional travel demand model into TransModeler. Additional side street or driveways not included in the Metro COG regional model were manually added in TransModeler. The network was refined to reflect the specific roadway configuration for all lanes, intersections, and traffic control, using an underlying aerial from Google Earth as reference. Other link level attributes, such as road names, functional classification, and count data were also added to the link layer for reference. Capacities and speeds for each network link are managed and coordinated via model parameters established for each functional class.

Turning movement files for the AM and PM peak hours were input into the model based on the turning movement counts (TMCs) presented in the *Traffic Count Technical Memorandum*. Based on these counts, the AM peak hour was determined to be 7:15 AM to 8:15 AM and the PM peak was determined to be 4:30 PM – 5:30 PM.

Traffic control for traffic traveling on 40th Avenue North is limited to a single, actuated traffic signal at the intersection with CR 81. The AM and PM signal plans for this intersection were coded for the existing conditions model based on a detailed review of the signal operations during AM and PM peak hour video recorded on December 20, 2022. All other intersections are two-way stop-controlled.

MODEL TRIP TABLES

Trip tables for the AM and PM peak hours were developed with rows and columns representing eighteen individual entry and exit points for traffic onto the network. These eighteen points reflect each traffic movement captured by the nine intersection TMCs collected in December 2022. The TMCs for both the AM and PM peak hours were used as input for TransModeler's Origin-Destination Matrix Estimation (ODME) function to estimate the origin and destination of every vehicle trip through the network, with separate tables for autos, single-unit trucks, and multi-unit trucks. All trip tables were factored by 1.02 to reflect a generalized seasonal adjustment factor applied across all road functional classes, based on the average trip volume for Tuesdays in December as compared to the Annual Average Daily Traffic (AADT). This factor was derived from count station data reported in NDDOT's *Seasonal Adjustment Factors & ADT by Station, All Vehicles – 2022.*[1]

Table 1 presents a summary of the trips included in the model trip tables. Most trips in the model are through trips on I-29 with no interaction with the 40th Avenue North corridor. They have been distinguished from the remaining model trips that directly use the model corridor.

[1] North Dakota Department of Transportation, *Seasonal Adjustment Factors & ADT by Station, All Vehicles – 2022.* Printed: 1/10/2023.

Table 1. Model Trips by Peak Hour and Vehicle Class

	AM Peak Hour		PM Peak Hour	
	I-29 (Through)	40th Ave N (Local)	I-29 (Through)	40th Ave N (Local)
Auto/Lt.Trk	1,007	830	1,223	835
SU Truck	102	19	128	28
MU Truck	154	28	193	38
Total Trips	1,263	877	1,544	901

The TMCs, which were collected in 15-minute intervals, were also used to develop the time distribution curve of the traffic in the trip tables. **Table 2** presents the time distribution of traffic for the AM and PM peak hours.

Table 2. Peak Hour Time Distributions

AM Peak Hour		PM Peak Hour	
Time	**% of Total**	**Time**	**% of Total**
7:15	19.9%	4:30	28.1%
7:30	25.1%	4:45	22.9%
7:45	31.5%	5:00	24.4%
8:00	23.5%	5:15	24.6%

VEHICLE FLEET

The distribution of vehicle types reflects count data from NDDOT's *Basic Axle Classification Report:360 E*[2], which reported classification counts on 40th Avenue North taken May 17-19, 2021. TransModeler's default distribution of car performance reflecting three distinct acceleration and speed profiles was applied to autos single- and multi-unit trucks are represented in separate trip tables. **Table 3** presents the vehicle fleet distribution used in the model.

Table 3. Model Vehicles Fleet Distribution

Vehicle Type	FHWA Class	Distribution
Motorcycle	1	0.8%
Car, Low Performance	2	4.1%
Car, Medium Performance	2	19.4%
Car, High Performance	2	23.8%
Pickup/SUV	3	36.7%
Bus	4	0.1%
Single-unit Truck	5-7	6.0%
Multi-unit trucks	8-13	9.0%

[2]North Dakota Department of Transportation, *Basic Axle Classification Report:360 E.* Printed: 5/20/2021.

Reference: **Existing Conditions Simulation Model Development Memorandum**

CALIBRATION

Intersections were checked to ensure that the turning movement and link-based counts were accurate. TransModeler's 'error checking' function was run to identify link connectivity and traffic signal coding issues Network links flow volumes were reviewed to identify areas where the traffic might be inconsistent with expected volumes, but no significant inconsistencies were found.

The criteria used to confirm that the simulation model has been sufficiently calibrated were taken from the Federal Highway Administration's (FHWA) *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, July 2004 (FHWA Publication No. FHWA-HRT-04-040).* The criteria, originally developed by the Wisconsin Department of Transportation, are in Table 4 on page 64 of that document. The criteria consist of three general metrics: 1) visual audits, 2) traffic flow, and 3) travel speeds. Traffic flow and travel speeds are quantifiable based on observed data and the model output while the guidance says that visual audits are to be conducted to the "analyst's satisfaction."

Visual audits were performed throughout the calibration process. Given the relatively low volume on the corridor and side streets, as well as the minimal traffic control at intersections, model observation focused on the operation of each intersection and queue lengths for turning movements at the I-29 interchange ramps and at the signalized CR 81 intersection. All other intersections had minimal cross street traffic, with a single vehicle queuing on rare occasion during the peak hour periods of observation.

A video review of the ramp terminals during both the AM and PM peak hours on December 20, 2022 demonstrated that most turning movements were single vehicles turning unimpeded, resulting in no queuing. The AM northbound exit right turning movement and the PM northbound left turning movement generated relatively minimal queues, with most queues being one or two vehicles, although two AM outlier queues involving heavy vehicles did create longer queues of four and nine vehicles. In comparison, model output reports 95th percentile average queue lengths of one vehicle or less for all ramp related turning movements. A visual audit indicates that in most cases, turns can be made without opposing traffic and queues that do form are typically one to three vehicles that dissipate quickly.

At the signal at CR 81, queue lengths observed for 40th Avenue North ranged from one to seven vehicles, with a mode of one and an average 2.2 vehicles for both AM and PM. This corresponded well with the 95th percentile average queue lengths reported for 40th Avenue North by the model, which was 2 vehicles in both directions for AM and PM. Observed queues on CR 81 southbound averaged 1.5 vehicles in the AM peak and 1.9 vehicles in the PM peak, compared to a 95th percentile average queue length of one vehicle as reported by the model. While slightly higher than the model average queue length, the observed sample of queues was very small.

Overall, the visual audit of traffic operation in the simulation model compared to the observed videos concluded that no movements were notably misrepresented in the model.

To compare traffic flows, link-based trip volumes for ten simulation runs were averaged and compiled for each direction of each link and compared to the aggregated TMC volumes recorded for each network link associated with the nine intersections where TMCs were collected. Several statistical measures can measure model assignment volumes against observed counts. The most relevant of these measures is percent root-mean-square error (RMSE) with a target threshold of 10 percent or lower to confirm the model was sufficiently calibrated for assigned volumes. **Table 4** presents the calibration statistics for both the AM and PM models. As shown, both the AM and PM simulation models have volumes with RMSE less than 10 percent, indicating

Reference: **Existing Conditions Simulation Model Development Memorandum**

a good match to the existing counts, which have also been factored by the 1.02 seasonal adjustment factor to ensure an accurate comparison.

Table 4. Volume Calibration Statistics

Total Volume to Count:	AM Peak	PM Peak
Target: within 5% of count	102.6%	101.1%
Sum of flow	6,956	7,332
Sum of counts	6,781	7,250
Percent Root Mean Square Error	**AM Peak**	**PM Peak**
Target: < 10.0%	6.7%	7.5%

Travel speed data was limited to NDDOT's *Basic Axle Classification Report:360 E*, which provided a distribution of individual vehicle speeds at a single location, with average speeds ranging between 44 to 48 mph by direction for each of the two days in May 2021 when counts were collected. The *Northwest Fargo Small Area Study*[3] from January 2022 noted that the speed limit on 40th Avenue North had recently changed to 40 mph. The free flow speed for the "Minor Arterial" and "Major Collector" road classes within TransModeler's road parameters were revised to 50 mph, which resulted in consistent corridor travel speeds in the mid to upper 40's mph for all links not approaching the traffic signal at CR 81.

Stantec Consulting Services Inc.

Mark Butler AICP
Senior Associate

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[3] Transportation Collaborative and Consultants, LLC (2022) *Northwest Fargo Small Area Study.* Report to the City of Fargo.

Appendix D – TAC Meeting Minutes

Stantec

Meeting Summary

Kickoff & Field Review Meeting

Project/File:	I-29 & CR 20 Interchange Feasibility Project/193805997
NDDOT Project No.	8-029(213)069 NDDOT, PCN 23596
Date/Time:	December 22, 2022 / 1:00 – 3:00 PM (CST)
Location:	Microsoft Teams Virtual Meeting
Attendees:	**Stantec:**

Pat McGraw (pat.mcgraw@stantec.com)
Angie Bolstad (angela.bolstad@stantec.com)
Wade Frank (wade.frank@stantec.com)
Tom Fidler (tom.fidler@stantec.com)
Brian Aldridge (brian.aldridge@stantec.com)
Kate Nelson (kate.nelson@stantec.com)

NDDOT:
Chad Frisinger (cfrising@nd.gov)
Jennifer Kern (jennifer.kern@nd.gov)
Aaron Murra (amurra@nd.gov)
Bob Walton (bwalton@nd.gov)
Joe Peyerl (jpeyerl@nd.gov)
Alexis Wanek (aawanek@nd.gov)
Justin Schlosser (jjschlosser@nd.gov)
James Rath (jrath@nd.gov)
Michael Johnson (mijohnson@nd.gov)
Duane Carlstrom (dcarlstr@nd.gov)
Mumtahin Hasnat (mhasnat@nd.gov)
Stacy Wilz (swilz@nd.gov)
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Matt Gangness (mgangness@nd.gov)
Jason Thorenson (jthorens@nd.gov)
Wyatt Mack (wyatt.mack@nd.gov)
Dustin Wing (dwing@nd.gov)

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Jeremy Gorden (jgorden@fargond.com)

Eric Hodgson (ehodgson@fargond.com)

FHWA:
Kevin Brodie (kevin.brodie@dot.gov)

Cass County:
Jason Benson (bensonj@casscountynd.gov)
Tom Soucy (soucyt@casscountynd.gov)

FM MetroCOG:
Cindy Gray (gray@fmmetrocog.org)

Absentees: **NDDOT:**
Andy Ayash (aayash@nd.gov)
Michael Kisse (mkisse@nd.gov)
Valerie Barbie (vbarbie@nd.gov)

City of Fargo:
Brenda Derrig (bderrig@fargond.gov)

Distribution: Attendees/Absentees

Item	Action

Project Kickoff
Introductions:
• Jennifer Kern provided a general overview of the project and noted that it is a feasibility study only
• Pat McGraw introduced the Stantec staff in attendance
• Chad Frisinger introduced the NDDOT staff
• Additional attendees presented themselves
 	
Project Scope (Work Tasks and Physical):
• Using Google Maps, Pat showed and reviewed the following:
  ○ Project site, including primary intersections for study
  ○ Trail/Path connecting Red River to I-29 to be accommodated. Not necessarily built with interchange project but space allocated to accommodate later	

Item	Action
○ Beginning/Ending Points of project corridor – 45th St N intersection on west end and 25th St N intersection on east end • Public Engagement ○ Pat shared that the external public engagement efforts will be primarily informative. Not engaging in intensive alternatives development or evaluation. Internal evaluations will be completed by TAC members • Primary Deliverables: Pat reviewed the primary project work tasks and deliverables. ○ Project Specific Quality Management Plan (PSQMP): Professional of Record QC reviews and independent peer reviews will be primary tools employed. Pat encouraged attendees to share any special requirements or lessons learned that would strengthen the PSQMP. No immediate responses. Pat encouraged attendees to reach out later as items come to mind. ○ Pat reminded attendees that the Public Engagement Plan (PEP) was attached to the KO meeting invitation and asked that comments be sent to him no later than 12/28 ○ Wade Frank noted that the NDDOT Bridge Division was not included on the TAC list shared on screen by Pat ▪ Dustin Wing was identified as the representative for the Bridge Division ○ Up to three outreach events: In-person intro of project (~March), availability of draft report (virtual), availability of final report (virtual) ○ NDDOT will host a project website ○ Up to ten TAC Meetings as-needed ▪ TAC comprised of: • NDDOT Fargo District ○ Aaron Murra (District Engineer) ○ Bob Walton (District Engineer/retiring spring of 2023) ○ Joe Peyerl (Assistant District Engineer - Fargo) • NDDOT Design Division ○ Jennifer Kern (Tech Rep) ○ Chad Frisinger • NDDOT ETS ○ Alexis Wanek	Attendees to provide specific requirements and/or lessons learned for inclusion in the PSQMP to Pat on or before 12/28/2022 Attendees to provide comments on the draft PEP to Pat on or before 12/28/2022

Item	Action

• NDDOT Traffic Operations
  ○ Justin Schlosser
• NDDOT Bridge
  ○ Dustin Wing
• FHWA
  ○ Kevin Brodie
• City of Fargo
  ○ Brenda Derrig (City Engineer)
  ○ Thomas Knakmuhs
  ○ Jeremy Gorden
  ○ Eric Hodgson
• FMCOG
  ○ Cindy Gray
• Cass County
  ○ Jason Benson (County Engineer)
○ Up to ten Focus Group Meetings
○ Engagement Summary
○ Detailed Work Plan/Schedule: Pat noted that TAC activities have been highlighted in orange in the provided schedule
○ Consultant PM/NDDOT Tech Rep bi-weekly check-ins
○ Bi-weekly consultant team check-ins
○ Design Decision Document
○ Management Presentation: After data collection
○ Field Review Meeting: Combined with this meeting
○ Data Collection Tech Memo
○ Traffic Data: 13-hr turning movement counts collected on 12/20/2022 by Quality Counts. Collected data will be compared to data from previous studies (Northwest Metro Transportation Plan completed by FM Metro COG in September of 2020; and Northwest Fargo Small Area Traffic Study commissioned by the City of Fargo). Attendees asked to share any additional data sources.
○ Interchange Screening
  ▪ Evaluation Criteria: Draft will be sent out following meeting. Main things to look at are the evaluation categories and ranking of categories
  ▪ Highway Interchange Tool (HIT): Will provide quick initial set of interchange alternatives
	Attendees to provide additional studies, reports or data sets which may be pertinent to project to Pat on or before 1/6/2023
	
	Pat to distribute draft Alternatives Evaluation Criteria for TAC feedback following meeting
	
	Attendees to provide feedback on alternatives evaluation criteria to Pat on or before 1/6/2023

Item	Action
▪ Internal Charrette: High-level Stantec practitioners from across North America to review HIT results and brainstorm additional alternatives. ▪ Alternatives Identification TAC Meeting (up to five alternatives to advance for further study): Stantec will present approach to alternatives identification, alternatives identified and recommendations on which alternatives to carry forward. ▪ Traffic Operations Analysis: • Existing Conditions Model & Tech Memo - calibrated to industry standards and observable on-site realities • Future Traffic Forecasts and Tech Memo: o Primary intersections: ▪ CR 20 at 45th Street N ▪ CR 20 at I-29 Southbound Ramp Terminal ▪ CR 20 at I-29 Northbound Ramp Terminal ▪ CR 20 at Highway 81 ▪ CR 20 at 37th Street N ▪ CR 20 at 33rd Street N ▪ CR 20 at 32nd Street N ▪ CR 20 at 39 ½ Avenue N ▪ CR 20 at 25th Street N • No-Build Models (2027 & 2045): Attendees determined that a design year of 2045 would better align with area plans and the traffic demand model than the originally assumed 2042. The base year, 2027 traffic data will be factored using growth rates and in alignment with the MPO Model. • Primary Corridor Alternatives Models: To align with recommendations to consider a uniformly traffic signal or roundabout controlled corridor from previous studies, base models of the existing corridor using roundabouts and signals will be developed for comparison. • Interchange Alternatives Models:	Attendees to provide feedback on project scope of work to Pat on or before 12/29/2022

Item	Action
○ Up to five primary alternatives will be evaluated ○ Three variations of each primary alternative ▪ Existing, Signals, roundabouts • Traffic Operations Report • Interchange Alternatives TAC Meeting: Discuss analysis results to date and possibly eliminate non-performing alternatives ▪ Preliminary Engineering • Roadway: Conceptual. Just enough detail and/or precision to allow for screening. • Bridge: Alternatives to be developed and analyzed include ○ Use of existing structure ○ I-29 Crossing ▪ Two-span prestressed concrete I-girder bridge ▪ Two-span steel plate girder bridge ▪ Four-span steel plate girder bridge ○ BNSF Crossing ▪ Three-span prestressed I-girder bridge ▪ Three-span steel plate girder bridge ○ Consolidated Crossing: will consist of developing one long bridge spanning from the west end of the I-29 crossing to the east end of the BNSF ○ Crossings will include horizontal alignment (bridge construction staging), vertical alignment (grade raise impacts), preliminary settlement calculations/mitigation strategies, and cost estimates.	

Item	Action
• Geotechnical: Preliminary observations and recommendations. Based on existing information. o Utilities: Potential for impacts. ▪ Environmental Screening: Documented CATEX anticipated. Just an early evaluation for early screening of alternatives at this stage. CATEX will be completed through subsequent project phases. • Solicitation of Views • Environmental Justice • Noise (Early) • Wetlands • Protected Species • Farmland • Section 4(f)/6(f) • Cultural Resources • Utility Impacts • Tech Memo ▪ Interchange Selection & Decision Document Schedule: • Pat shared that the schedule will move quickly and encouraged attendees to pay attention to the proposed presentation and/or review times. Pat invited attendees to discuss any schedule concerns ASAP • Pat reiterated that the schedule dates are tentative. Outlined the draft schedule as follows: o Interchange Screening – 3/1/2023 o Traffic Operations Analysis – 3/1/2023 o Preliminary Engineering – 4/5/2023 o Environmental Screening – 4/19/2023 o Draft Interchange Selection & Decision Document - 04/26/2023 o Final Interchange Selection & Decision Document – 5/17/2023 Available Existing Materials: • What pertinent resources do you recommend – CADD files, pavement or bridge info, plans, traffic data, studies, reports, agencies, etc. do you recommend?	Attendees to carefully review schedule and voice any concerns to Pat by 1/6

Item	Action
○ The Cass County Road 20/Clay County Road 22 Corridor Study was noted and later provided to Stantec. ○ The Fargo I-29 Exit 69 (Co 20/ 40th Ave N Interchange Study was noted and later provided to Stantec. ○ The faa OE_Letter_Notification HM #1 thru HM #10 - 347 thru 356 - DETERMINATION OF NO HAZARD TO AIR NAVIGATION Study was noted and later provided to Stantec. Evaluates potential expansion of western runway. Communications Protocol: • Pat McGraw and Jennifer Kern are to be copied on all communications. Jennifer and Pat will determine decision making processes, but will keep the group informed Closures: The attendees were asked to provide any firm restrictions on closing of the interchange or particular movements or time restrictions. It was noted that the in-person open house will provide an opportunity to identify concerns from the public in this regard.	Attendees will share any restrictions they would place on closure of the interchange or specific project components to Pat on or before 1/6/2023
Field Review (FDRVW) Verification of Information Received and Identification of Additional Needs: • Bob Walton made a general comment about east of the interchange being owned/managed by the City and west of interchange being owned/managed by the County • Current conditions of infrastructure based on information received to-date: Pat asked attendees to share any additional information they may have. ○ Roadway: ▪ I-29: Condition Good ▪ CR 20: Problematic sightlines (resulting in wrong way entry to I-29) ▪ No additional information shared ○ Structures: ▪ Bridges over the BNSF railroad tracks and I-29 are nearing the end of their useful life and have limited ability to be widened while maintaining the required vertical clearances over the facilities they cross ▪ Both bridges and the embankment between them have experienced settlement over the years resulting in repeated maintenance work for the Fargo District ▪ Wade Frank has received condition ratings for the bridges.	

Item	Action
○ Drainage: ▪ Asked attendees if there are any problem areas. None noted. ▪ Asked attendees if there are any condition ratings for existing culverts. None noted. ▪ Bob Walton noted that they most likely will not need to design with flood concerns in mind due to diversion project. ○ Traffic Control Devices: N/A ○ Pat noted that the following resources have been received: ▪ CADD files and PDF plans for 2009/2010 NB/SB I-29: Area from CR 20 to next interchange to the north ▪ 2006_NB__AC-IM-8-029(065)065_part_1.pdf: Grading, surfacing, drainage NB, North of CR 20 ▪ 2006_NB__AC-IM-8-029(065)065_part_2.pdf: Includes construction signing ▪ 2007_SB___AC-IM-8-029(008)065_part_1.pdf: As-Built Copy ▪ 2007_SB___AC-IM-8-029(008)065_part_2.pdf: As-Built Copy ▪ Rudimentary DTM created by NDDOT 12/12/2022. Will fly and or ground survey later as-needed and as weather allows. Doesn't appear to extent to eastern project limit. Probably okay for now (work off aerials) ▪ 9/23/2022: Hwy_Components_Report_I-29_NB.pdf: I-29 pavement section info.pdf: • PRPI = Good; Avg Rut N/A; ADT 7317; ESALS = 2233 ▪ 9/23/2022: Hwy_Components_Report_I-29_SB.pdf: • PRPI = Good; Avg Rut N/A; ADT 7196; ESALS = 2005 ▪ Traffic_Est_NB%20(1).pdf: • I-29 NB • Passenger Expansion Factor = 1.49 • Truck Expansion Factor 1.35 • Traffic's Annual % of Growth = 2.0 • ESAL's Annual % of Growth = 1.5	

Item	Action
• Based on 2021 counts • Prepared 5/11/2022 ▪ Traffic_Est_NB-On_and_SB-Off-Ramps.pdf: • Passenger Expansion Factor == 2.21 • Truck Expansion Factor 2.21 • Traffic's Annual % of Growth = 4.0 • ESAL's Annual % of Growth = 4.0 • Based on 2021 counts • Prepared 9/27/2022 ▪ Traffic_Est_SB.pdf: • Passenger Expansion Factor = 1.49 • Truck Expansion Factor 1.35 • Traffic's Annual % of Growth = 2.0 • ESAL's Annual % of Growth = 1.5 • Based on 2021 counts • Prepared 5/11/2022 ▪ Traffic_Est_Structure.pdf: Both directions on structure • Passenger Expansion Factor = 1.64 • Truck Expansion Factor 1.35 • Traffic's Annual % of Growth = 2.5 • ESAL's Annual % of Growth = 1.5 • Based on 2021 counts • Prepared 9/27/2022 ▪ Traffic_Est_SB-On_and_NB-Off-Ramps.pdf: • Passenger Expansion Factor = 1.64 • Truck Expansion Factor 1.35 • Traffic's Annual % of Growth = 2.5 • ESAL's Annual % of Growth = 1.5 • Based on 2021 counts • Prepared 9/27/2022 ▪ Aaron Murra and Michael Johnson mentioned a DTM surfaces source related to recent Lidar data (2020) that might be useful for study. Stated Jeremy Gorden with the City of Fargo may be able to share this latest data. Suggested to keep	

Item	Action
working with Steve Martinez to see if he can see any gaps in the data ▪ Northwest Metro Transportation Plan completed by FM Metro COG in September of 2020: Pat asked if there is anything to be especially aware of. Nothing noted. o Cindy mentioned a possible study of CR 20 regarding alternatives from 20 years ago – felt it might be worth reviewing. This study was later provided to Stantec. o City of Reile's Acres: ▪ Pat reviewed the following items related to the City of Reile's Acres: • Developing a new residential subdivision north of CR 20 and west of 45th Street North • Proposed replat of the land between 45th and I-29 also north of CR 20 that will result in the development of approximately 130 acres • Northwest Fargo Small Area Traffic Study commissioned by the City of Fargo to evaluate traffic impacts of industrial growth between 40th Avenue and 64th Avenue to the north and I-29 and 25th Street to the east. • Cindy Gray with FM Metro COG said she is not aware of anything else out of the City of Reile's Acres at this time Purpose and Need for Project: • Pat shared the project need: Poor sightlines; traffic growth expected to increase • Pat shared the project purpose: Provide interchange to serve area to 2045 and beyond Additional Questions and Components to Consider: • Operational Concerns? None in addition to those discussed above noted. • Maintenance Concerns? None in addition to those discussed above noted. • Problem Areas? None in addition to those discussed above noted. • Opportunities? None in addition to those discussed above noted. • Additional Materials Testing Needs? None noted.	

Item	Action

• Additional Traffic Analysis Needed? None in addition to those discussed above noted.
• Additional Survey Needs? None in addition to those discussed above noted.
• Existing and Potential R/W Needs? None noted.
• Review potential environmental and social issues - How will the number and severity of environmental issues affect how the project is advanced? Note any potential 4(f) issues (parks, grasslands, easement wetlands, historic sites, etc.). None noted.
• Utilities:
  o Note existing utilities that might be impacted by the project
  o Ask District Utility Coordinator about recent and proposed utility permits within the project limits
• Extent of city/county involvement and participation: Engagement plan and TAC membership discussed under TAC Kickoff Meeting as documented above.
• Assumed to be a Documented CATEX
	Jennifer to request pertinent utility permits (recent or proposed) from the District Utility Coordinator and provide to Pat by 1/6/2023

Closing Comments and Questions
• Pat began the Q/A portion of the meeting asking for any questions or comments that have not been addressed
  o Justin Schlosser noted a potential project related to wrong way drivers. It is a grant opportunity that they are waiting to hear back about.
  o Bob Walton shared that there is dirt piled up in the NE quadrant of the project site – providing extra fill if needed
  o Additional comments made about the following:
  ▪ Teardrop roundabout memo
  ▪ Airport/stadium affect concerns: East to west runway extensions that have previously made an impact on the project site. Associated documents have been provided to Stantec.
  ▪ Railroad coordination
  • Pat commented that coordination with the railroad is anticipated
  • Jason Thorenson noted that we would need to figure out what accommodations the railroad would need
  ▪ What is the likelihood of needing new right of way?
  • Pat noted that it is too early to say
	Jennifer to provide “Teardrop Roundabout Memo” to Pat by 1/6/2023
	
	Wade Frank to schedule focus group meeting with railroad. Scheduling to be set by 1/6/2023. Meeting to be held by the end of January 2023

Item	Action
• Kevin Brodie shared that a constraint/criterion on the evaluation matrix could be trying to keep the existing right of way • DOT right of way goes to CR 81 on the east with access control on west side of the interchange per Bob Walton o Noted City operated CR 81 east of I-29 ▪ Hazard identification between the ramp and the railroad. This is the westbound profile issue discussed above. ▪ Fiberoptics on the west side of interchange per Aaron Murra ▪ Pipelines along CR 20 • Believes water is transferred from Castleton, ND and then returned to the Red River, but not certain. More located at 25th Street or further east. ▪ Utilities • Clear from 45th Street to 37th Street • 37th Street to Hwy 81 has a few ▪ Roadway • Tom Knakmuhs mentioned the County oversees the roadway west of the interchange and that annexation might occur within the next year ▪ City of Reile's Acres correction noted – the 130 acres referenced earlier in the meeting/agenda is the number of acres for the City of Fargo annexation ▪ Kevin Brodie shared that I-29 is identified as an electric vehicle corridor ▪ Bridges • Vertical clearance of 23 feet for the existing bridge over the railroad • Mentioned the possibility having a 17-foot clearance for any new interstate bridge options • Would an underpass be an option or is that a non-starter?	

Item	Action
○ Agreed that it is most likely more complicated than desired • Pat re-reviewed Action Items and made final closing remarks	

The meeting adjourned at 2:54 PM CST.

The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

Thank you,

STANTEC CONSULTING SERVICES INC.

Pat McGraw
Associate, Senior Project Manager
pat.mcgraw@stantec.com

Stantec

Meeting Summary

Interchange Alternatives Recommendations Meeting

Project/File:	I-29 & 40th Ave N Interchange Feasibility Project/193805997
NDDOT Project No.	8-029(213)069 NDDOT, PCN 23596
Date/Time:	February 9, 2023 / 3:00 – 5:00 PM (CST)
Location:	Microsoft Teams Virtual Meeting
Attendees:	**Stantec:**

Pat McGraw (pat.mcgraw@stantec.com)
Wade Frank (wade.frank@stantec.com)
Tom Fidler (tom.fidler@stantec.com)
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Brenda Derrig (bderrig@fargond.gov)

FHWA:
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Cass County:
Jason Benson (bensonj@casscountynd.gov)

FM MetroCOG:
Cindy Gray (gray@fmmetrocog.org)
Dan Farnsworth (farnsworth@fmmetrocog.org)

Absentees: **City of Fargo:**
Brenda Derrig (bderrig@fargond.gov)

Distribution: Attendees/Absentees

Item	Action

Project Update: Pat McGraw provided the following project update to the attendees.
• Work Completed
  ○ Traffic Data Collection
  ○ Data Collection
  ○ Interchange Alternatives Evaluation Criteria
  ○ Existing Conditions Models
  ○ Future Traffic Forecasts
• Work Underway:
  ○ No-Build & Preliminary Corridor Alternatives Models
  ○ Prep for Public Outreach Event #1
• Next Steps
  ○ Confirm Alternatives for feasibility analysis (Anticipated outcome of this meeting)
  ○ Interchange Alternatives Models
  ○ Traffic Operations Report
  ○ Preliminary Engineering
  ▪ Roadway	

Item	Action
▪ Bridge ▪ Geotech ▪ Utility (Pat noted that utilities will be mapped along the whole corridor (45th St N to 25th St N) but impacts will only be evaluated within the interchange footprint) o Environmental Screening (Pat noted that environmental screening will only be completed for the area within the interchange footprint) o Draft Interchange Selection & Decision Document o Management Presentation o 2nd Open House: will be in-person. Primary objective will be to share alternatives evaluation findings and to seek feedback. o 3rd Outreach Event – Virtual only: Primary purpose will be to present the Design Decision Document for review and comment. • Public Outreach Event 1: Will be an open house format without a formal presentation. All TAC members are welcome to attend. Representation from the City is especially desired since residents often pose questions which may be best answered by their City representatives. The event will be held from 5pm to 7pm CST on March 14th at the US Army National Guard Readiness Center. • Next Phase of Project: The more typical Phase 1 Preliminary Design contract will follow this feasibility project. It is anticipated that one primary interchange alternative will come from this current phase. The full NEPA, FHWA IJR, engagement and preliminary design requirements will be met through this next phase of the project. Standing/Reoccurring TAC meetings are anticipated during this next phase. Interchange Alternatives Development Tech Memo (Stantec, January 25, 2023): Pat McGraw provided a brief overview of the memo and highlighted a few key considerations. The Attendees reviewed and discussed the proposed alternatives. • Overview of Memo: o Highway Interchange Tool (HIT)(a Stantec Proprietary Tool): The tool draws from approximately 200 interchange types and allows for hundreds of site specific variables. The primary selection drivers are efficiency, costs and safety. The weighting of these factors were aligned with the Alternatives Evaluation Criteria developed previously. The traffic counts collected for the project in 2022 were utilized.	

Item	Action
▪ Since project-specific growth rates had not yet been approved by the TAC the rates from the FM MetroCOG NW Metro Transportation Plan were applied. • 6.6% west and 2.6% per year east of interchange • Mainline 2.0% for passenger vehicles and 1.5% for heavy vehicles • These rates were used solely for HIT but reasonably aligned with ultimate forecasts o Stantec Internal Design Charrette: Leading interchange designers from Stantec from across North America assembled to review the HIT results, project parameters and to develop the final list of proposed alternatives. o HIT Alts Ruled Out: ▪ The cloverleaf interchange was eliminated since loops on all quadrants are not anticipated to be necessary and right-of-way challenges, including the NDSU agricultural facility in the southwest quadrant and railroad to the east, make it less feasible ▪ Contraflow, displaced left turn, and single point interchange options were eliminated due to the necessity for a divided roadway or additional traffic signals, increased width of the overpass structure, increased snow clearing difficulty, difficulty accommodating active transportation facilities, and ability of other more cost-efficient design alternatives to accommodate traffic adequately. ▪ The Milwaukee and Double-U interchanges were eliminated due to the necessity of additional overpass structures and ability of other more cost-efficient design alternatives to accommodate traffic adequately. • Review and Discussion of the Six Primary Alternatives Recommended for Further Analysis: Tom Fidler shared draft conceptual sketches and Google images of the interchange concepts and described key attributes of their functioning. o Standard Diamond: Justin Schlosser noted that signal warrants may not be met in the build year so determination of when warrants are anticipated to be met may be of value. Include as a primary interchange alternative for further evaluation.	

Item	Action
○ Dumbbell: This is a standard diamond interchange with roundabout control at the ramp terminals. It was noted that the HIT does not differentiate ramp terminal control possibilities for concepts such as the standard diamond. Include as a primary interchange alternative for further evaluation. ○ Diverging Diamond (DDI): Include as a primary interchange alternative for further evaluation. ○ Roundabout DDI: Include as a primary interchange alternative for further evaluation. ○ Partial Cloverleaf (Parclo): A single loop ramp would be built in the NW quadrant to accommodate the WB to SB movement. It is not anticipated to be necessary at this time but there appears to be room in the NE quadrant if desired in the future. Include as a primary interchange alternative for further evaluation. ○ Ramp Left U-Turn Diamond: The TAC decided to eliminate this alternative. There are intersection spacing and public acceptance concerns. The alternative did not provide any unique benefits compared to the other alternatives that would warrant continued consideration in light of these concerns. • General Notes Regarding All Alternatives: ○ Refine off-ramps to approach the ramp terminal intersection perpendicularly ○ When conceptual layouts are refined and ready for the alternatives provide them to the TAC for review prior to public release. ○ The TAC agreed that grade separated active transportation facilities (underpasses) should be the initial goal in all cases. ○ When showing the conceptual layouts at the Open House include pros and cons on each ○ When showing the conceptual layouts at the Open House include photos of the concept in use elsewhere on each ○ Keep in mind that I-29 may be increased to an 80mph interstate. This will impact clear zone requirements and other parameters. ○ Should the bridge length be similar to that at 64th Ave to accommodate future expansion? No. ○ Minimum clearance for the I-29 bridge will be 17'. ○ For bridge length determination for the PARCLO alternative, assume a loop ramp may be added to the east side in the future.	

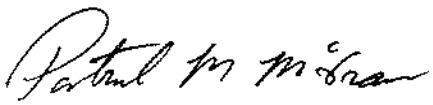
Item	Action
○ Use 180’ diameter for all roundabouts initially. ○ Alternatives analysis will include offset/new alignments at the bridge crossings only. Use/widening of the existing bridges will be evaluated in the preliminary engineering and environmental documentation contract.	

The meeting adjourned at 4:40 PM CST.

The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

Thank you,

STANTEC CONSULTING SERVICES INC.



Pat McGraw
Associate, Senior Project Manager
pat.mcgraw@stantec.com

Appendix E – Engagement Summary

Public Engagement Summary

April 5, 2023

Public Input Meeting #1 – Summary

IM-8-029(213)069, PCN 23596 | I-29 & 40th Ave N Interchange Feasibility Study

Stantec PN: 193805997

Date/Time:	March 14, 2023 / 5:00PM to 7:00PM
Place:	Fargo Readiness Center – 3270 40th Avenue North, Fargo, ND 58102
Attendees:	See Sign-In Sheet

Overview

NDDOT and Stantec hosted the first public input meeting to discuss the I-29/40th Avenue North Interchange Feasibility Study on March 14, 2023. The meeting was held from 5-7PM at the Fargo Readiness Center. Approximately 15-20 people attended to learn about the project purpose and objectives, and to provide input regarding the five potential interchange alternatives being considered.

All meeting materials will be posted to NDDOT's project website.

Meeting materials included:

- A pre-recorded video was played on continuous loop for participants to view and/or listen to at their convenience. The video explained the five alternatives being considered and discussed the benefits of each.
- Informative boards displaying the following: Welcome with how to stay involved information, project background, project logistics (including objectives, schedule, and next steps), interchange alternatives 1 through 5, environmental background, existing 2022 traffic analysis, and future 2045 traffic analysis – no build.
- Handout describing the project, study purpose, primary and secondary study area, schedule, contact information, and how to stay involved.
- After the Storm brochures provided by NDDOT describing the effects of pollution, the problems with stormwater runoff, and stormwater pollution solutions.
- Stormwater and the Construction Industry poster provided by NDDOT that covered the following: Maintaining your BMPs and planning and implementing erosion and sediment control practices.
- Large roll plots:
  - One large roll plot showing the Alternative 1 – Standard Diamond Interchange layout
  - One large roll plot showing the Alternative 2 – Dumbbell Interchange layout
  - One large roll plot showing the Alternative 3 – Diverging Diamond Interchange (DDI) layout
  - One large roll plot showing the Alternative 4 – Roundabout DDI layout
  - One large roll plot showing the Alternative 5 – Partial Cloverleaf Interchange layout
- Large roll plots with Matchbox cars:
  - Two large roll plots showing zoomed in version of Alternative 3 – Diverging Diamond Interchange (DDI) with matchbox cars for hands-on visualization
  - Two large roll plots showing zoomed in version of Alternative 4 – Roundabout DDI with matchbox cars for hands-on visualization
- Comment forms for individuals to express comments and/or ideas. Comment cards could be left at the meeting, scanned and emailed, or tri-folded and mailed.

- NDDOT Title VI Public Participation survey provided by NDDOT for demographic information.
- PowerPoint presentation was looped at the check-in table showing photos of the interchange and bridges existing conditions.
- Sign-in Sheet for attendees to fill out upon arrival.

Advertising

The meeting was advertised through the following channels:

- Fargo Forum Legal Display Advertisement on February 22 and March 8
- NDDOT press release on March 7

Summary of Comments Received

At the meeting, people were able to leave a general comment on the provided comment cards and post-it notes for each of the five interchange alternatives. They were also given the option to send their comments to Pat McGraw via email or mail. The comment period closed on Wednesday, March 29. One formal comment was received in-person at the meeting. The remaining comments were received via email.

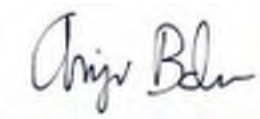
The formal comment received in-person was voting for alternative 5, the partial cloverleaf interchange, and mentioning not needing to go to “such extremes”. The post-it note comments also indicated that alternative 5 was the best option and should be Option #1. The emailed comments note issues the participating public feel are currently at the interchange, including but not limited to lack of stop lights (traffic signals), unclear or minimal signage, steep slopes, and not ideal configuration for large trucks and traffic. Wrong-way movements down the I-29 North exit ramp were noted with the suggestion to have two lanes northbound (and presumably southbound) with the addition of more visible or noticeable signage to reduce potential accidents. The comments also mention that the roads are frequently used for long-distance cycling and recommend that the shoulders be widened with improved grading to accommodate safer bicycle travel. All comments have been included in the attachments of this document.

PIM #1 Supporting Documentation

The following documents have been included as supporting documentation for this public input meeting:

- Video presentation slides
- Informative Boards Displayed at Meeting
- Meeting Handout
- NDDOT After the Storm Brochure
- NDDOT Stormwater and the Construction Industry Poster
- Alternative Layouts 1-5
- Matchbox Car Plot Roll for Alternative 3
- Matchbox Car Plot Roll for Alternative 4
- Legal Display Ad and Press Release
- Written and Emailed Comments
- NDDOT Title VI Public Participation Surveys
- Meeting Photos
- Public Input Meeting #1 Sign-in Sheet

Stantec Consulting Services Inc.



Angie Bolstad, PE
Transportation Engineer

Phone: (612) 712-2019

Angela.Bolstad@stantec.com

Attachment: PIM#1 Supporting Documentation

cc. Chad Frisinger, NDDOT Section Leader – Design Division
Jennifer Kern, NDDOT Transportation Engineer
Pat McGraw, Stantec Project Manager

Appendix F – Public Engagement Plan

Public Engagement Plan (PEP)

Preliminary Engineering Services

Interstate 29 and 40th Ave N Interchange

Project 8-029(213)069, PCN 23596

NORTH Dakota | Transportation

Be Legendary.

Stantec

TABLE OF CONTENTS

INTRODUCTION

PUBLIC ENGAGEMENT PLAN PURPOSE

This Public Engagement Plan (PEP) outlines the outreach, education, and input processes that are intended for various stages of a project. Engagement details, goals, audiences, activities, and schedules are laid out as a roadmap for the project. This process will coincide with the NDDOT public engagement process identified in the NDDOT Design Manual, Chapter 2: Environmental and Public Involvement.

PROJECT BACKGROUND

Due to recent and proposed development along both sides of I-29, the interchange of I-29 and 40th Avenue North has been and will continue to experience significant traffic growth. The increase in traffic is expected to surpass the capacity of the interchange and County Road 20/40th Avenue, and adversely affect the operations and safety of several intersections within the study area. The NDDOT commissioned the completion of a Preliminary Engineering and Feasibility Study to analyze the issues surrounding the study area and make geometric and traffic related recommendations.

This project consists of three phases. Phase 1 is the preliminary engineering and feasibility study, phase 2 is the environmental document and final design, and phase 3 is to provide construction engineering assistance as the engineer of record. This PEP will outline engagement pertaining to phase 1, until phase 2 is initiated, at which time this document will be updated to account for Phase 2 activities. The NDDOT is anticipated to lead engagement activities during construction (phase 3).

More specifically during phase 1, this project will complete a preliminary engineering and feasibility study to determine the retention and reconstruction alternatives for the interchange, including the BNSF overpass. The study will determine potential interchange configurations, roadway alignments, and bridge types and sizes. It will include the operational and geometric evaluation of the I-29 & 40th Avenue North interchange and the 40th Avenue North corridor from 45th Street North to 25th Street N, and the following intersections along 40th Avenue North:

- 40th Ave N at 45th Street N
- 40th Ave N at I-29 Southbound Ramp Terminal
- 40th Ave N at I-29 Northbound Ramp Terminal
- 40th Ave N at Highway 81
- 40th Ave N at 37th Street N
- 40th Ave N at 33rd Street N
- 40th Ave N at 32nd Street N
- 40th Ave N at 39 ½ Avenue N
- 40th Ave N at 25th Street N

See below for a project location map.

Project Location Map: I-29 and 40th Avenue North Interchange from 45th Street N to 25th Street N

COMMUNITY PROFILE

When completing public engagement efforts, it is important to understand the community you are trying to reach. In 2020 Fargo, ND had a population of 124k people with a median age of 31.4 and a median household income of $57,520. Between 2019 and 2020 the population of Fargo, ND grew from 121,889 to 123,550, a 1.36% increase and its median household income grew from $55,551 to $57,520, a 3.54% increase. The 5 largest ethnic groups in Fargo, ND are White (Non-Hispanic) (81.3%), Black or African American (Non-Hispanic) (7.83%), Asian (Non-Hispanic) (4.12%), Two+ (Non-Hispanic) (2.31%), and White (Hispanic) (1.87%).

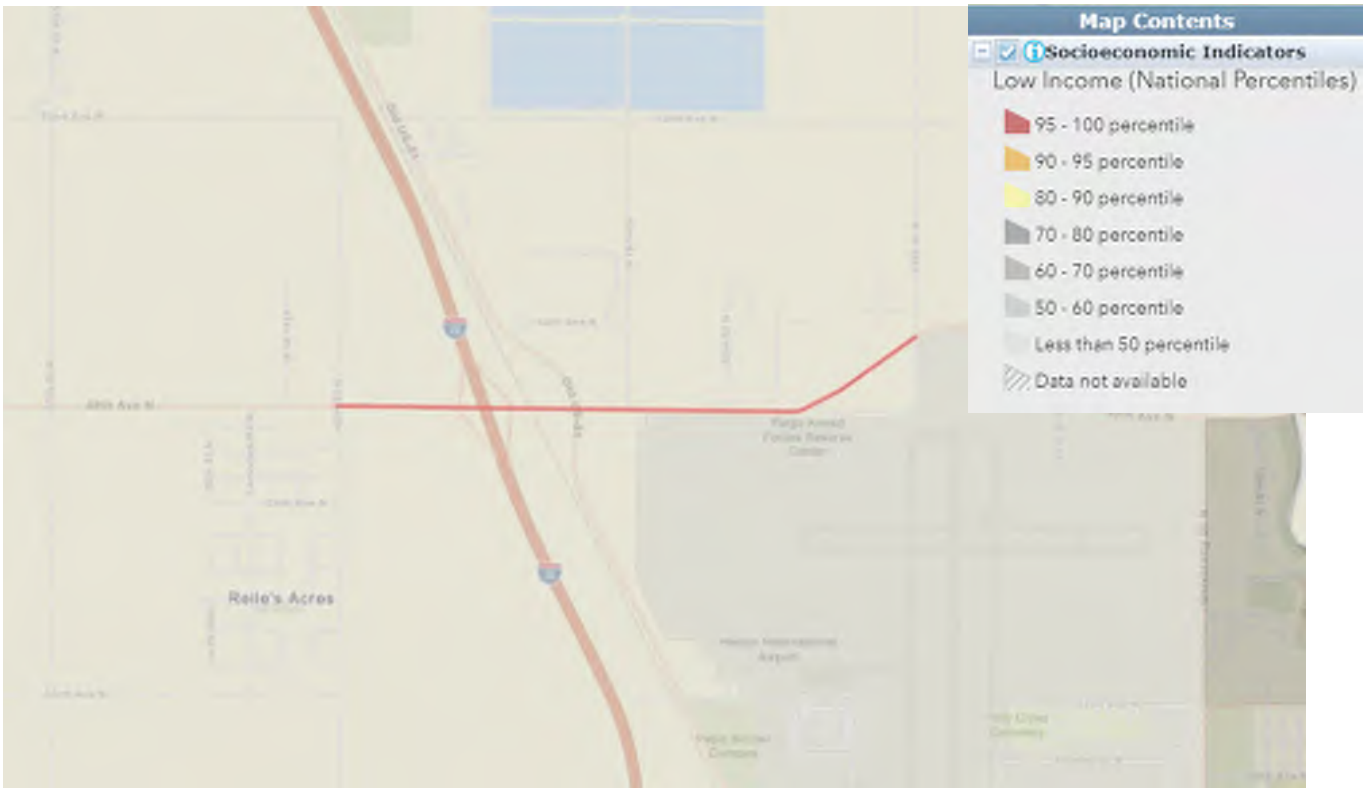
A demographic summary using the Environmental Justice Screening and Mapping Tool (EJ Screen) was completed for a 1-mile buffer around the project. EJ Screen uses data from the US Census Bureau's American Community Survey (ACS). The summary showed a population of 828 with a population density of 140 people per square mile. There are 235 households within the area. 87% of people within this area are white, 67% are above the age of 18, and 79% of people have a household income above $75,000. The full summary is included in Appendix A.

ENVIRONMENTAL JUSTICE POPULATIONS

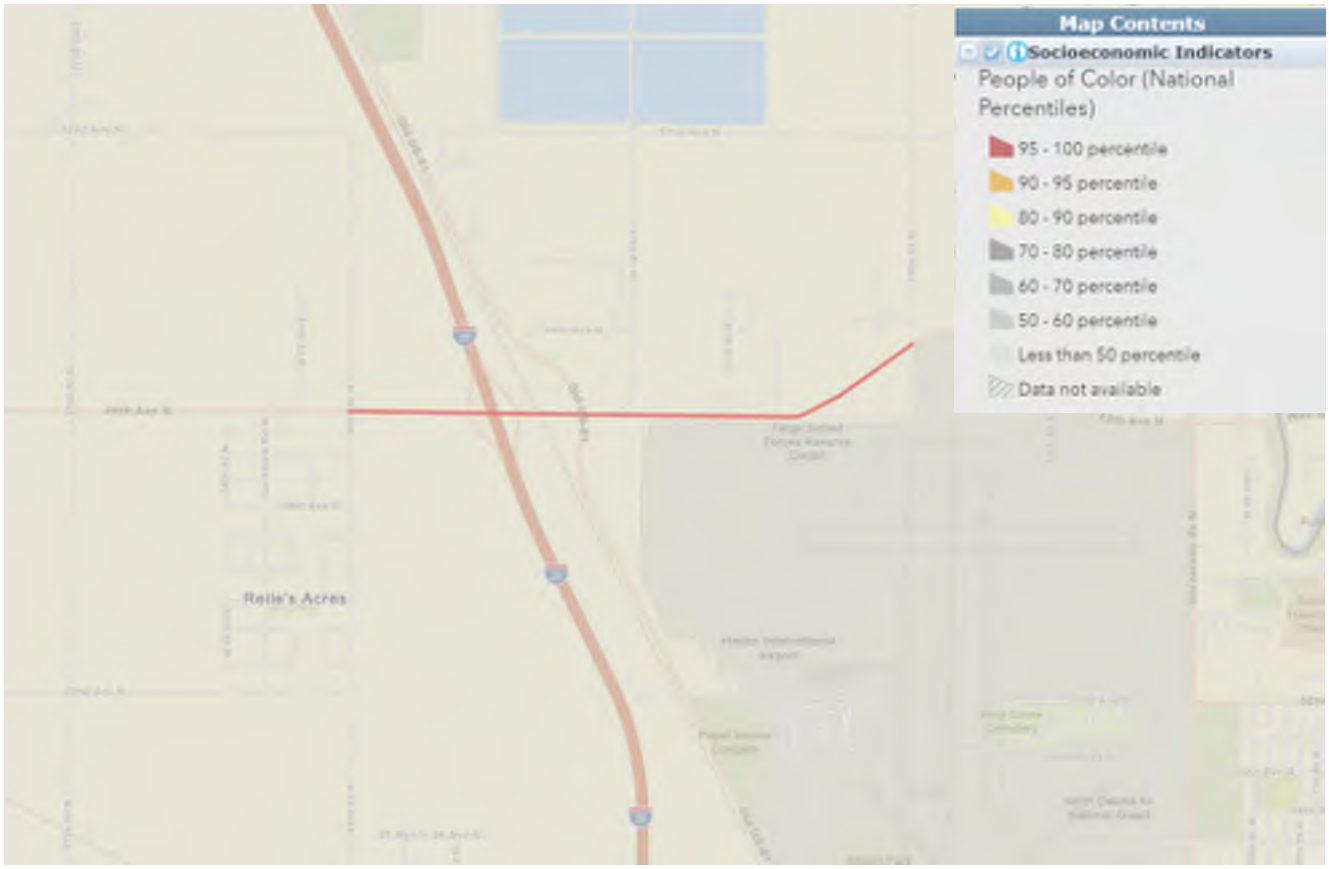
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations, dated February 11, 1994, directed "each federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States…"

EJ Screen was used to review the percentages of low-income and minority populations within a 1-mile radius of the study area. Low-income populations are in the 13th percentile and minority populations are in the 17th percentile meaning there is not a high probability of disproportionally affecting either of these groups.

Maps showing these percentages are shown below. The EJ Screen report is included in Appendix B.



EJ Screen: Percentages of low income population within 1 mile of the project area.



EJ Screen: Percentages of minorities population within 1 mile of the project area.

PUBLIC ENGAGEMENT ACTIVITIES

PUBLIC/STAKEHOLDER INVOLVEMENT

The following section describes the core public engagement techniques that will be utilized during the project. They are a project website, Technical Advisory Committee (TAC), Focus Group Meetings, and Public Outreach Opportunities.

Technical Advisory Committee

A Technical Advisory Committee (TAC) will be created to include representation from NDDOT, FHWA, City of Fargo, Fargo-Moorhead Metro COG, Cass County, and others as needed. The TAC will help guide the project through project completion by making informed decisions and providing agency direction to the consultant team as needed. TAC members are anticipated to consist of the following individuals:

NDDOT Fargo District
- Aaron Murra (District Engineer)
- Bob Walton (District Engineer/retiring spring of 2023)
- Joe Peyerl (Assistant District Engineer - Fargo)

NDDOT Design Division
- Jennifer Kern
- Chad Frisinger

NDDOT ETS
- Alexis Wanek

NDDOT Traffic Operations
- Justin Schlosser

NDDOT Local Government
- Michael Johnson

NDDOT Bridge Division
- Dustin Wing

NDDOT Materials & Research
- Colter Schwagler

NDDOT Planning
- Jim Styron

FHWA
- Kevin Brodie

City of Fargo
- Brenda Derrig (City Engineer)
- Thomas Knakmuhs

- Jeremy Gorden
- Eric Hodgson

Fargo-Moorhead Metro COG

- Cindy Gray (retiring in April 2023)
- Dan Farnsworth

Cass County

- Jason Benson (County Engineer)

Up to ten TAC meetings will be conducted virtually for this project. Each TAC meeting will be approximately one hour long. A meeting summary will be provided for all TAC meetings and will be included in a final summary of all engagement activities.

Focus Group Meetings

A focus group is utilized to gather data from or share data with groups associated with a particular design component. Each session will include people with similar interests. Up to four focus group meetings are anticipated to be held virtually. Potential focus groups include but are not limited to:

- Local businesses
- Hector International Airport
- Reile's Acres representatives
- NDSU representatives
- BNSF Railroad
- Truck drivers
- Nearby warehouse or manufacturing operations
- Bicycle advocacy groups

Public Outreach Opportunities

Three public outreach opportunities will be held during phase 1 of this project. These outreach events consist of the following:

1. Initial project notification
2. Draft interchange selection & decision document review
3. Notification of final document

The first and second outreach events will be held in-person with a virtual component and the third will done virtually only. Following each outreach event, a brief graphical summary of findings and recommendations will be completed and shared with the public. All materials for public consumption will be ADA compliant.

Outreach events will be enhanced by the State’s project website, virtual and published advertisements, providing multiple avenues for the public to express comments, online survey opportunities, graphics, and GIS based story maps as needed.

Additional tools can be added if it becomes apparent that a group or organization needs supplementary interaction with the project team. The addition or subtraction of engagement techniques will be fluid as public engagement needs and project development progress.

Information to be Presented for Public Outreach Opportunities

The following information will be presented at all public outreach opportunities in accordance with the NDDOT Design Manual. This includes both in-person and virtual meetings.

- SFN 59531 NDDOT Sign-In Sheet and SFN 60149 NDDOT Title VI Public Participation Survey
- The project's purpose, need, and consistency with the goals and objectives of any local planning.
- The project alternatives under consideration and major design features.
- The social, economic, environmental, and other impacts of the project, including any floodplain and/or wetland impacts.
- The storm water poster will be on display, and the brochure “After the Storm” should be made available for attendees.
- The right of way acquisition process, to include the relocation assistance program if needed. Also a tentative schedule of acquisition will be presented, and a brochure describing the land acquisition process and the owner’s rights, privileges, and obligation will be distributed.
- A description of the procedures for receiving both oral and written statements from the public. The participants should be informed that statements or exhibits may be presented for 15 calendar days following the Public Input Meeting and will be made part of the record.
- Provide a tentative schedule of construction.
- The source of project funding and reasonable expectation of cost sharing responsibilities.
- The agency responsible for developing the project.
- The back of the comment cards will have space for land owners to write down if they have wetlands or borrow on their property that they would be willing to mitigate or sell.

SCHEDULE

The kickoff meeting for this project is December 22, 2022. Dates below are based off the NDDOT Design Manual, Chapter 2: Environmental and Public Involvement. A more detailed schedule and responsibly table are included under the detailed work plan section.

Outreach Opportunity 1

Outreach Opportunity #1 – In-person Community Open House. This meeting will notify the general public of the project. The anticipated open house date is **March 14, 2023**. Below are the subsequent milestone dates for activities leading up to the open house.

- Legal display ad to the Technical Support Contact for review (7 to 10 days prior to the publication deadline): **February 6, 2023**
- Legal display ad in the official county newspaper. The Cass County official paper is the Fargo Forum and publishes weekly on Wednesdays (15 to 21 calendar days prior to the meeting): **February 22, 2023**
- Press release and social media picture to the Technical Support Contact (21 calendar days prior to the meeting): **February 21, 2023**
- Press release and social media picture (5 to 7 calendar days prior to the meeting): **March 7, 2023**
- Anticipated open house date: **March 14, 2023**

- Comment period (15 calendar days following the meeting): **March 29, 2023**

Outreach Opportunity 2

Outreach Opportunity #2 – In-person Community Open House. This meeting will provide the public a chance to review interchange alternatives and comment on the Draft Interchange Selection and Decision Document. The anticipated open house date is **April 18, 2023**. Below are the subsequent milestone dates for activities leading up to the open house.

- Legal display ad to the Technical Support Contact for review (7 to 10 days prior to the publication deadline): **March 19, 2023**
- Legal display ad in the official county newspaper. The Cass County official paper is the Fargo Forum and publishes weekly on Wednesdays (15 to 21 calendar days prior to the meeting): **March 29, 2023**
- Press release and social media picture to the Technical Support Contact (21 calendar days prior to the meeting): **March 28, 2023**
- Press release and social media picture (5 to 7 calendar days prior to the meeting): **April 11, 2023**
- Anticipated opportunity date: **April 18, 2023**
- Comment period (15 calendar days following the meeting): **May 5, 2023**

Outreach Opportunity 3

Outreach Opportunity #3 – Virtual engagement opportunity. This meeting will notify the public of the final Interchange Selection and Decision Document. The anticipated date this opportunity will be available is **May 8, 2023**. Below are the subsequent milestone dates for activities leading up to the open house.

- Legal display ad to the Technical Support Contact for review (7 to 10 days prior to the publication deadline): **April 9, 2023**
- Legal display ad in the official county newspaper. The Cass County official paper is the Fargo Forum and publishes weekly on Wednesdays (15 to 21 calendar days prior to the meeting): **April 19, 2023**
- Press release and social media picture to the Technical Support Contact (21 calendar days prior to the meeting): **April 19, 2023**
- Press release and social media picture (5 to 7 calendar days prior to the meeting): **May 1, 2023**
- Anticipated opportunity date: **May 8, 2023**
- Comment period (15 calendar days following the meeting): **May 23, 2023**

TAC and Focus Group Meetings

TAC and Focus Group meetings will take place throughout the entire project. TAC meeting dates can be seen in the detailed project schedule which has been included in Appendix C.

Focus group meetings will be completed during existing conditions modeling and alternatives development evaluation phases. This will give the opportunity for the project team to address any concerns prior to completing the Interchange Selection and Design Document. Focus group meeting attendees may be the same groups or different groups depending on the needs of the project.

RESPONSIBLITIES

Stantec is responsible for attending, scheduling, and presenting at all TAC, Focus Group, and outreach activities. They will develop engagement and advertising materials and coordinate online engagement opportunities. Stantec will create meeting summaries to document the engagement process.

The State is responsible for posting to the State's project website, oversight of engagement activities, and reviewing material developed for engagement opportunities. The table below shows responsibilities at the major public outreach milestones.

DETAILED WORK PLAN

The detailed work plan below will be updated as needed throughout the project. It contains milestone dates and responsibilities for all engagement activities including submittals and reviews.

Task	Engagement Activity	Due Date	Status	Responsible Party
Legal display ad to NDDOT for review	Public Outreach #1	2/6/23		Stantec
Review legal display	Public Outreach #1	2/9/23		NDDOT
Publish legal display ad	Public Outreach #1	2/22/23		Stantec
Press release and social media picture to NDDOT for review	Public Outreach #1	2/21/23		Stantec
Developed public outreach materials to NDDOT for review	Public Outreach #1	2/25/23		Stantec
Review press release and social media picture	Public Outreach #1	3/4/23		NDDOT
Review public outreach materials	Public Outreach #1	3/7/23		NDDOT
Press release submitted to media	Public Outreach #1	3/6/23		Stantec
Social media picture posted to website	Public Outreach #1	3/7/23		NDDOT
Make changes to public outreach materials	Public Outreach #1	3/10/23		Stantec
Post public outreach materials to website	Public Outreach #1	3/14/23		NDDOT

Task	Engagement Activity	Due Date	Status	Responsible Party
In-person open house	Public Outreach #1	3/14/23		Stantec
Legal display ad to NDDOT for review	Public Outreach #2	3/19/23		Stantec
Review legal display ad	Public Outreach #2	3/23/23		NDDOT
Comment period closes	Public Outreach #1	3/29/23		Stantec
Press release and social media picture to NDDOT for review	Public Outreach #2	3/28/23		Stantec
Publish legal display ad	Public Outreach #2	3/29/23		Stantec
Develop engagement summary graphic and submit to NDDOT for review	Public Outreach #1	4/3/23		Stantec
Developed public outreach materials to NDDOT for review	Public Outreach #2	4/3/23		Stantec
Review public outreach materials	Public Outreach #2	4/7/23		NDDOT
Legal display ad to NDDOT for review	Public Outreach #3	4/7/23		Stantec
Review engagement summary	Public Outreach #1	4/8/23		NDDOT
Review press release and social media picture	Public Outreach #2	4/9/23		NDDOT
Make changes to public outreach materials	Public Outreach #2	4/10/23		Stantec
Press release submitted to media	Public Outreach #2	4/11/23		Stantec
Social media picture posted to website	Public Outreach #2	4/11/23		NDDOT
Review legal display ad	Public Outreach #3	4/14/23		NDDOT
Make changes to the engagement summary	Public Outreach #1	4/18/23		Stantec
Post engagement summary online	Public Outreach #1	4/18/23		NDDOT

Task	Engagement Activity	Due Date	Status	Responsible Party
Post public outreach materials to website	Public Outreach #2	4/18/23		NDDOT
In-person open house	Public Outreach #2	4/18/23		Stantec
Press release and social media picture to NDDOT for review	Public Outreach #3	4/19/23		Stantec
Publish legal display ad	Public Outreach #3	4/19/23		Stantec
Developed public outreach material to NDDOT for review	Public Outreach #3	4/21/23		Stantec
Review press release and social media picture	Public Outreach #3	4/28/23		NDDOT
Review public outreach materials	Public Outreach #3	4/28/23		NDDOT
Press release submitted to media	Public Outreach #3	5/1/23		Stantec
Social media picture posted to website	Public Outreach #3	5/1/23		NDDOT
Comment period closes	Public Outreach #2	5/3/23		Stantec
Make changes to public outreach materials	Public Outreach #3	5/4/23		Stantec
Post public outreach materials to website	Public Outreach #3	5/8/23		NDDOT
Virtual Engagement Opportunity	Public Outreach #3	5/8/23		Stantec
Develop engagement summary graphic and submit to NDDOT for review	Public Outreach #2	5/9/23		Stantec
Review engagement summary	Public Outreach #2	5/16/23		NDDOT
Make changes to the engagement summary	Public Outreach #2	5/21/23		Stantec
Post engagement summary online	Public Outreach #2	5/21/23		NDDOT
Comment period closes	Public Outreach #3	5/23/23		Stantec

Task	Engagement Activity	Due Date	Status	Responsible Party
Develop engagement summary graphic and submit to NDDOT for review	Public Outreach #3	5/30/23		Stantec
Review engagement summary	Public Outreach #3	6/2/23		NDDOT
Make changes to the engagement summary	Public Outreach #3	6/6/23		Stantec
Post engagement summary online	Public Outreach #3	6/6/23		NDDOT

APPENDICIES

APPENDIX A – EJ Screen Demographic Summary

EJSCREEN ACS Summary Report

Location: User-specified linear location
Ring (buffer): 1-miles radius
Description:

Summary of ACS Estimates	2016 - 2020
Population	828
Population Density (per sq. mile)	140
People of Color Population	145
% People of Color Population	17%
Households	235
Housing Units	246
Housing Units Built Before 1950	2
Per Capita Income	47,772
Land Area (sq. miles) (Source: SF1)	5.90
% Land Area	100%
Water Area (sq. miles) (Source: SF1)	0.03
% Water Area	0%

	2016 - 2020 ACS Estimates	Percent	MOE (±)
Population by Race			
Total	828	100%	359
Population Reporting One Race	808	98%	638
White	723	87%	292
Black	80	10%	302
American Indian	1	0%	10
Asian	3	0%	14
Pacific Islander	0	0%	10
Some Other Race	0	0%	10
Population Reporting Two or More Races	21	2%	53
Total Hispanic Population	56	7%	159
Total Non-Hispanic Population	772		
White Alone	684	83%	276
Black Alone	64	8%	252
American Indian Alone	1	0%	10
Non-Hispanic Asian Alone	3	0%	14
Pacific Islander Alone	0	0%	10
Other Race Alone	0	0%	10
Two or More Races Alone	20	2%	53
Population by Sex			
Male	404	49%	188
Female	424	51%	212
Population by Age			
Age 0-4	61	7%	88
Age 0-17	271	33%	166
Age 18+	558	67%	202
Age 65+	52	6%	41

Data Note: Detail may not sum to totals due to rounding. Hispanic population can be of any race.
N/A means not available. **Source:** U.S. Census Bureau, American Community Survey (ACS) 2016 - 2020 .

EJSCREEN ACS Summary Report

Location: User-specified linear location
Ring (buffer): 1-miles radius
Description:

	2016 - 2020 ACS Estimates	Percent	MOE (±)
Population 25+ by Educational Attainment			
Total	499	100%	200
Less than 9th Grade	3	1%	15
9th - 12th Grade, No Diploma	13	3%	31
High School Graduate	78	16%	64
Some College, No Degree	82	16%	76
Associate Degree	90	18%	69
Bachelor's Degree or more	233	47%	134
Population Age 5+ Years by Ability to Speak English			
Total	767	100%	327
Speak only English	756	99%	281
Non-English at Home[1+2+3+4]	11	1%	24
[1]Speak English "very well"	5	1%	16
[2]Speak English "well"	5	1%	17
[3]Speak English "not well"	1	0%	12
[4]Speak English "not at all"	0	0%	10
[3+4]Speak English "less than well"	1	0%	12
[2+3+4]Speak English "less than very well"	6	1%	18
Linguistically Isolated Households*			
Total	0	0%	10
Speak Spanish	0	0%	10
Speak Other Indo-European Languages	0	0%	10
Speak Asian-Pacific Island Languages	0	0%	10
Speak Other Languages	0	0%	10
Households by Household Income			
Household Income Base	235	100%	96
< $15,000	0	0%	10
$15,000 - $25,000	0	0%	10
$25,000 - $50,000	36	15%	65
$50,000 - $75,000	14	6%	25
$75,000 +	185	79%	101
Occupied Housing Units by Tenure			
Total	235	100%	96
Owner Occupied	228	97%	97
Renter Occupied	7	3%	21
Employed Population Age 16+ Years			
Total	571	100%	222
In Labor Force	486	85%	214
Civilian Unemployed in Labor Force	19	3%	54
Not In Labor Force	84	15%	74

Data Note: Datail may not sum to totals due to rounding. Hispanic population can be of anyrace.
N/A means not available. **Source:** U.S. Census Bureau, American Community Survey (ACS)
*Households in which no one 14 and over speaks English "very well" or speaks English only.

EJSCREEN ACS Summary Report

Location: User-specified linear location
Ring (buffer): 1-miles radius
Description:

	2016 - 2020 ACS Estimates	Percent	MOE (±)
Population by Language Spoken at Home*			
Total (persons age 5 and above)	928	100%	403
English	831	90%	350
Spanish	18	2%	51
French, Haitian, or Cajun	2	0%	56
German or other West Germanic	2	0%	13
Russian, Polish, or Other Slavic	1	0%	8
Other Indo-European	25	3%	83
Korean	1	0%	11
Chinese (including Mandarin, Cantonese)	26	3%	95
Vietnamese	1	0%	10
Tagalog (including Filipino)	0	0%	10
Other Asian and Pacific Island	8	1%	42
Arabic	3	0%	23
Other and Unspecified	9	1%	38
Total Non-English	96	10%	534

Data Note: Detail may not sum to totals due to rounding. Hispanic popultion can be of any race.
N/A meansnot available. **Source:** U.S. Census Bureau, American Community Survey (ACS) 2016 - 2020.
*Population by Language Spoken at Home is available at the census tract summary level and up.

APPENDICIES

APPENDIX B – EJ Screen Environmental Justice Summary

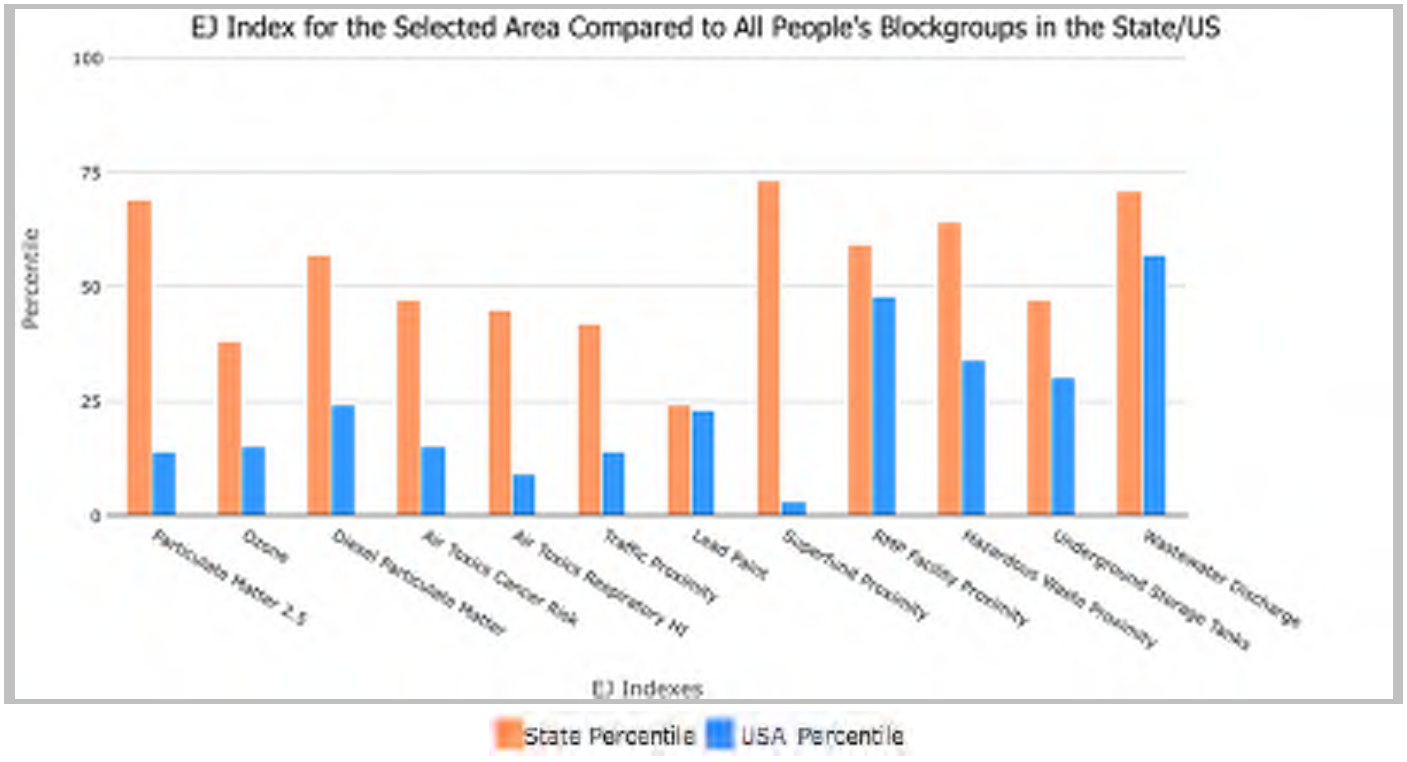
EJScreen Report (Version 2.1)

1 mile Ring around the Corridor, NORTH DAKOTA, EPA Region 8

Approximate Population: 828

Input Area (sq. miles): 7.31

Selected Variables	State Percentile	USA Percentile
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	69	14
EJ Index for Ozone	38	15
EJ Index for Diesel Particulate Matter*	57	24
EJ Index for Air Toxics Cancer Risk*	47	15
EJ Index for Air Toxics Respiratory HI*	45	9
EJ Index for Traffic Proximity	42	14
EJ Index for Lead Paint	24	23
EJ Index for Superfund Proximity	73	3
EJ Index for RMP Facility Proximity	59	48
EJ Index for Hazardous Waste Proximity	64	34
EJ Index for Underground Storage Tanks	47	30
EJ Index for Wastewater Discharge	71	57



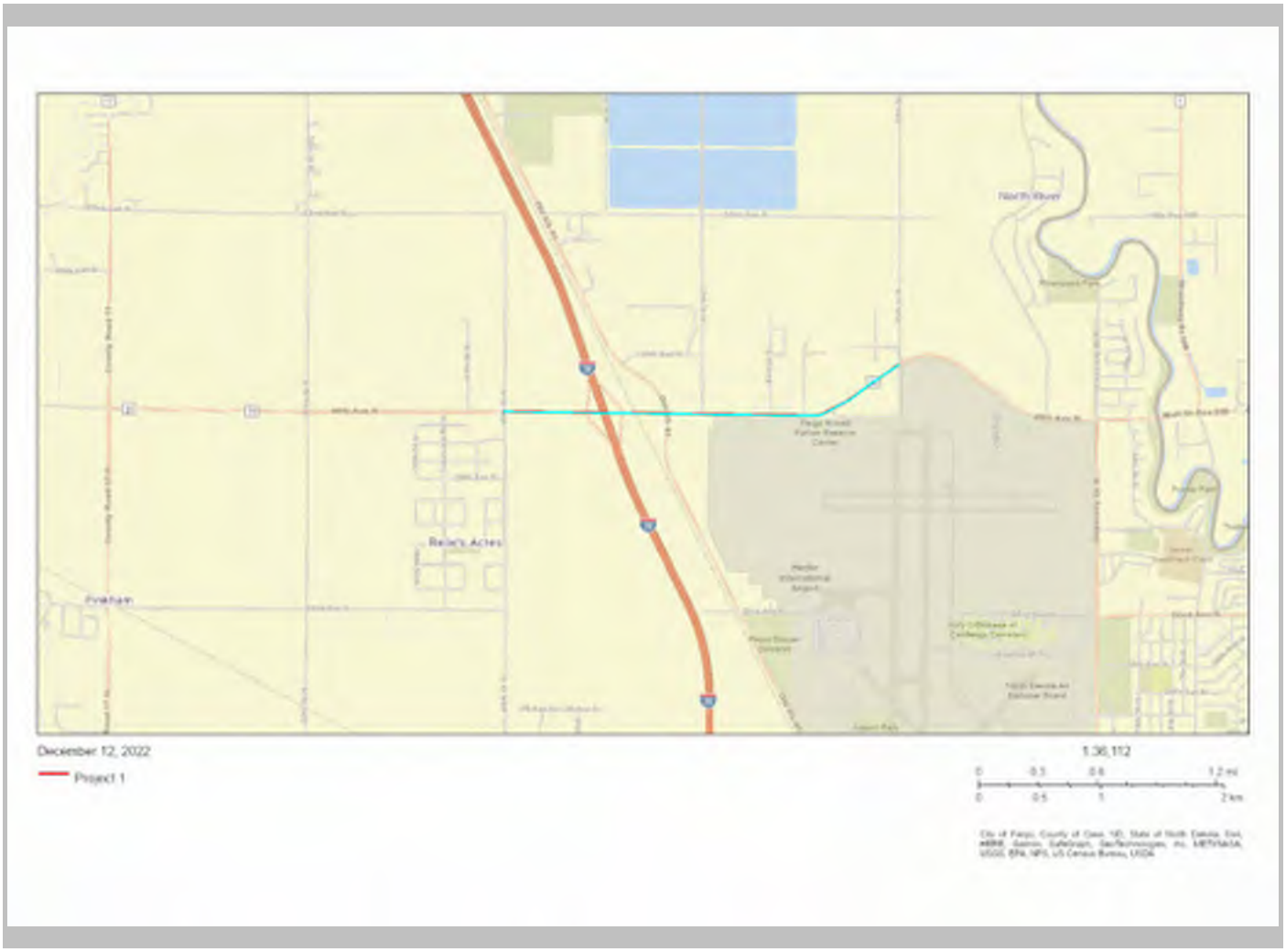
This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

EJScreen Report (Version 2.1)

1 mile Ring around the Corridor, NORTH DAKOTA, EPA Region 8

Approximate Population: 828

Input Area (sq. miles): 7.31



Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

EJScreen Report (Version 2.1)

1 mile Ring around the Corridor, NORTH DAKOTA, EPA Region 8

Approximate Population: 828

Input Area (sq. miles): 7.31

Selected Variables	Value	State Avg.	%ile in State	USA Avg.	%ile in USA
Pollution and Sources					
Particulate Matter 2.5 (µg/m^3)	7.18	6.54	73	8.67	16
Ozone (ppb)	37.6	38.7	35	42.5	19
Diesel Particulate Matter* (µg/m^3)	0.151	0.17	57	0.294	<50th
Air Toxics Cancer Risk* (lifetime risk per million)	21	20	90	28	<50th
Air Toxics Respiratory HI*	0.21	0.22	79	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	26	220	34	760	16
Lead Paint (% Pre-1960 Housing)	0.05	0.25	23	0.27	26
Superfund Proximity (site count/km distance)	0.0094	0.0049	79	0.13	4
RMP Facility Proximity (facility count/km distance)	1	1.1	60	0.77	75
Hazardous Waste Proximity (facility count/km distance)	0.46	0.52	65	2.2	43
Underground Storage Tanks (count/km^2)	0.13	2.1	42	3.9	29
Wastewater Discharge (toxicity-weighted concentration/m distance)	8.3	6.3	95	12	97
Socioeconomic Indicators					
Demographic Index	15%	21%	44	35%	21
People of Color	17%	16%	70	40%	36
Low Income	13%	25%	20	30%	23
Unemployment Rate	4%	3%	72	5%	50
Limited English Speaking Households	0%	1%	0	5%	0
Less Than High School Education	3%	7%	31	12%	25
Under Age 5	7%	7%	64	6%	71
Over Age 64	6%	15%	17	16%	13

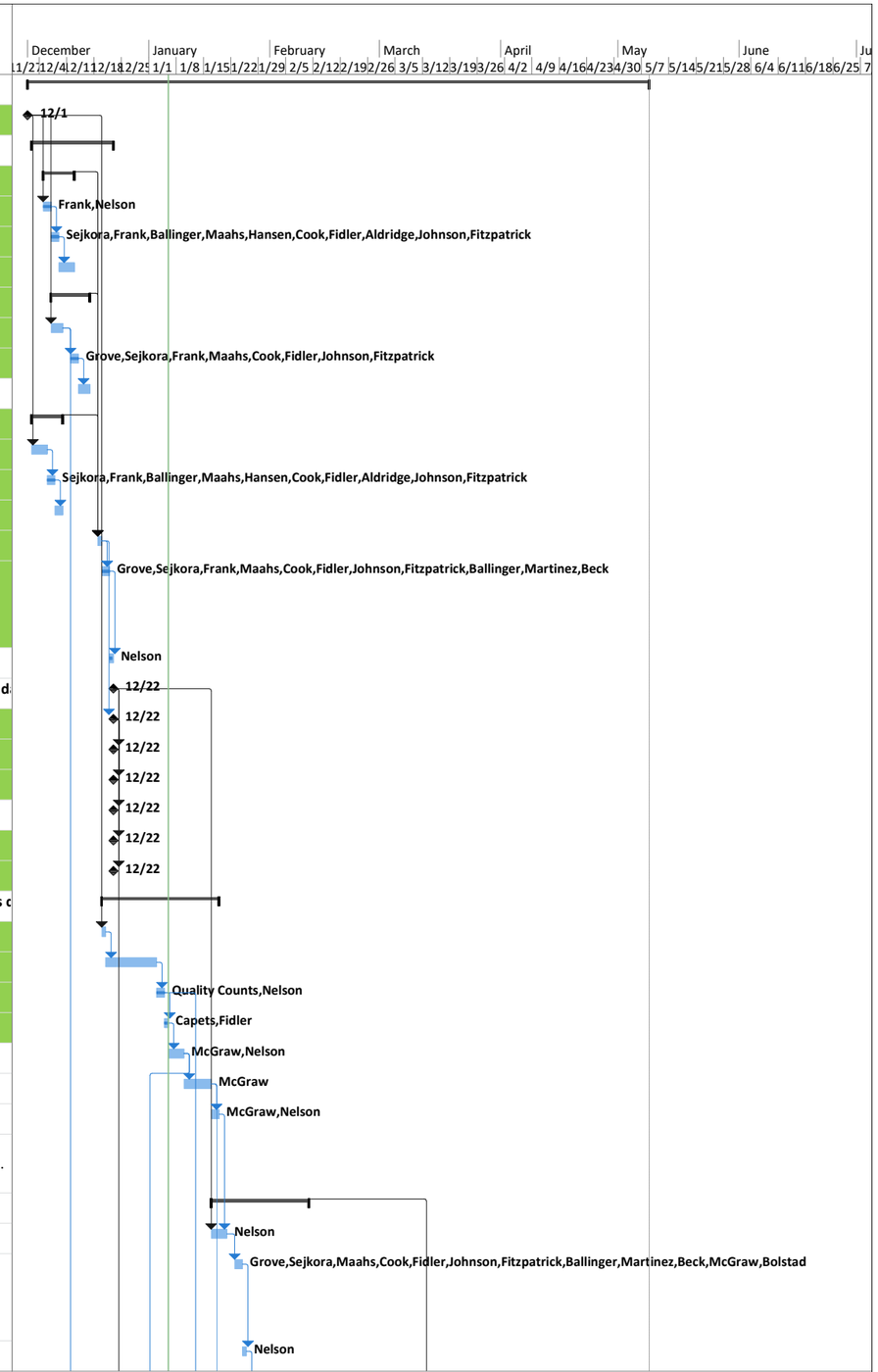
*Diesel particular matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update.

For additional information, see: www.epa.gov/environmentaljustice

APPENDICIES

APPENDIX C – Detailed Project Schedule

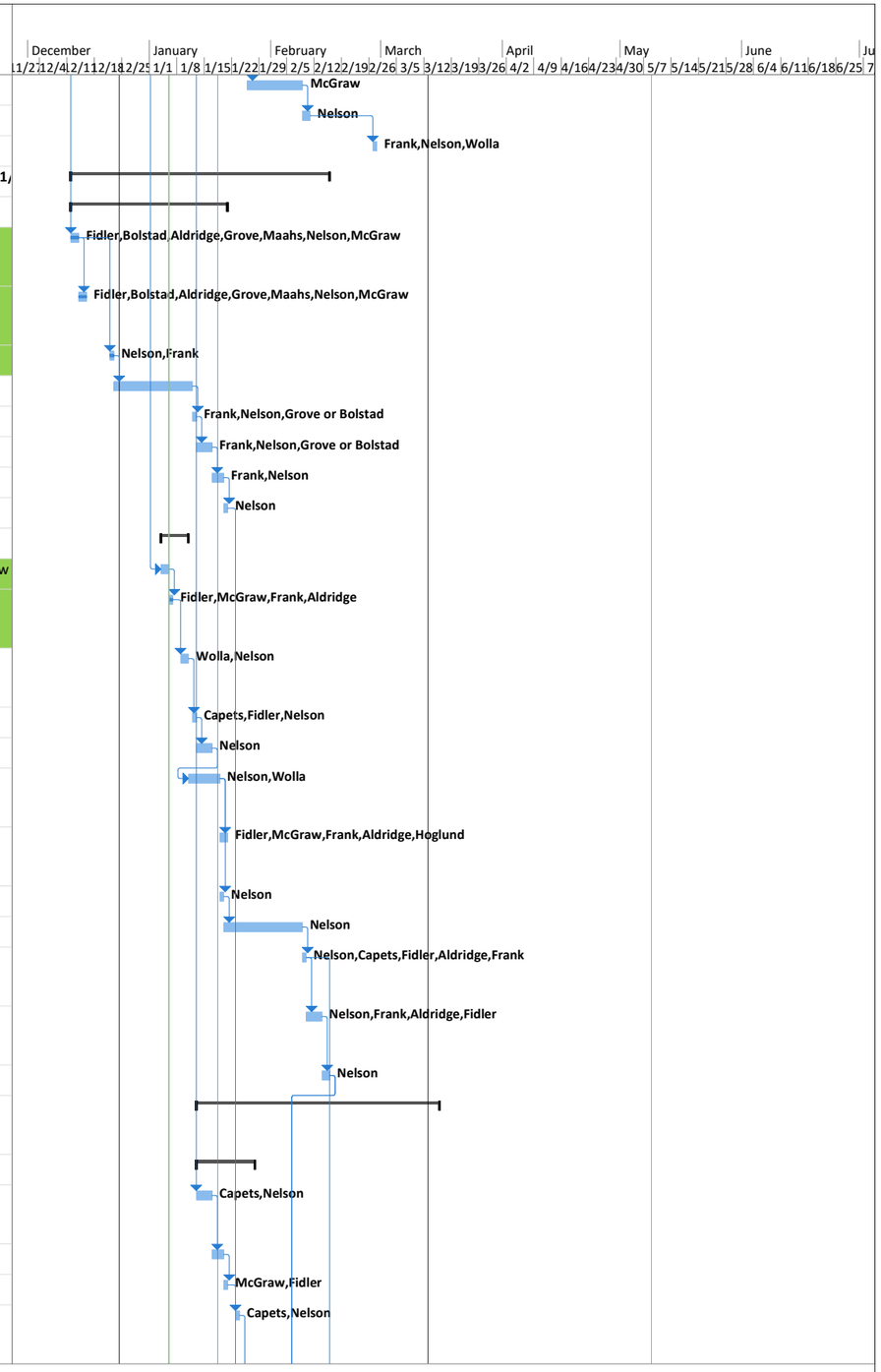
ID	Task Mode	Task Name	Duration	% Work Compl	Start	Finish	Predecessors	Task Owner	Resource Names	Notes
1		**Feasibility Phase**	**113 days**	**10%**	**Thu 12/1/22**	**Mon 5/8/23**				
2		NTP	0 days	10...	Thu 12/1/22	Thu 12/1/22				
3		**Draft Project Work Plan**	**15 days**	**99%**	**Fri 12/2/22**	**Thu 12/22/22**				
4		**PSQMP**	**6 days**	**10...**	**Mon 12/5/22**	**Mon 12/12/22**		**McGraw**		
5		Draft PSQMP	2 days	10...	Mon 12/5/22	Tue 12/6/22	2FS+2 days	McGraw	Frank,Nelson	Sent to Team for review 12/05/2022
6		Team Leads Review	2 days	10...	Wed 12/7/22	Thu 12/8/22	5	McGraw	Sejkora,Frank,Ballinger,Maahs,	
7		Final PSQMP	2 days	10...	Fri 12/9/22	Mon 12/12/22	6	McGraw		
8		**Public Engagement Plan**	**8 days**	**10...**	**Wed 12/7/22**	**Fri 12/16/22**		**Bolstad**		
9		Draft PEP	3 days	10...	Wed 12/7/22	Fri 12/9/22	2FS+4 days	Bolstad		
10		Team Leads Review	2 days	10...	Mon 12/12/22	Tue 12/13/22	9	Bolstad	Grove,Sejkora,Frank,Maahs,Co	
11		Final PEP	3 days	95%	Wed 12/14/22	Fri 12/16/22	10	Bolstad		
12		**Detailed Schedule**	**6 days**	**10...**	**Fri 12/2/22**	**Fri 12/9/22**		**McGraw**		
13		Draft Schedule	2 days	10...	Fri 12/2/22	Mon 12/5/22	2FS+1 day	McGraw		Sent to Team for review 12/05/2022
14		Team Leads Review	2 days	10...	Tue 12/6/22	Wed 12/7/22	13	McGraw	Sejkora,Frank,Ballinger,Maahs,	
15		Final Schedule	2 days	10...	Thu 12/8/22	Fri 12/9/22	14	McGraw		
16		Draft Work Plan to Team Leads	1 day	10...	Mon 12/19/22	Mon 12/19/22	4,8,12	McGraw		
17		Receive Team Lead's Input	2 days	10...	Tue 12/20/22	Wed 12/21/22	16		Grove,Sejkora,Frank,Maahs,Co	
18		Revised Draft Work Plan	1 day	85%	Thu 12/22/22	Thu 12/22/22	17	McGraw	Nelson	
19		**KO Meeting**	**0 days**	**0%**	**Thu 12/22/22**	**Thu 12/22/22**		**McGraw**	**Nelson**	**Have Kate attend to draft minutes; 12/20/2022 d**
20		Establish Communications Protocol	0 days	10...	Thu 12/22/22	Thu 12/22/22	16FS+3 days	McGraw		
21		Confirm TAC Membership	0 days	10...	Thu 12/22/22	Thu 12/22/22	20	McGraw		
22		Review Project Work Plan Components	0 days	10...	Thu 12/22/22	Thu 12/22/22	20	McGraw		
23		Approved Project Work Plan	0 days	95%	Thu 12/22/22	Thu 12/22/22	20	McGraw		
24		Receive Available Existing Information from State	0 days	10...	Thu 12/22/22	Thu 12/22/22	20	McGraw		
25		**Field Review**	**0 days**	**10...**	**Thu 12/22/22**	**Thu 12/22/22**	**19**	**McGraw**	**Frank,Sejkora,Cook,Fidler**	**12/28/2022 is date in Milestone Schedule**
26		**Traffic Data Collection**	**22 days**	**22%**	**Tue 12/20/22**	**Wed 1/18/23**		**Aldridge**	**McGraw**	**Pat can assist with sub agreement; 2/01/2023 is d**
27		Data Collection - Field	1 day	10...	Tue 12/20/22	Tue 12/20/22	2FS+13 days	Quality Counts		
28		Data Processing	9 days	10...	Wed 12/21/22	Mon 1/2/23	27	Quality Counts		
29		Draft Traffic Data Tech Memo	2 days	10...	Tue 1/3/23	Wed 1/4/23	28	Aldridge	Quality Counts,Nelson	
30		Quality Review	1 day	10...	Thu 1/5/23	Thu 1/5/23	29	Aldridge	Capets,Fidler	
31		Distribute Draft for TAC Review	2 days	0%	Fri 1/6/23	Mon 1/9/23	30	Aldridge	McGraw,Nelson	
32		TAC Comments Received	5 days	0%	Tue 1/10/23	Mon 1/16/23	31	Aldridge	McGraw	
33		Distribute Final Tech Memo	2 days	0%	Tue 1/17/23	Wed 1/18/23	32	Aldridge	McGraw,Nelson	Need to verify all comment resolutions
34		Preliminary Control/Targets & Digital Level Loop For Aerial LiDAR		0%						NDDOT may fly in December and then return to fly again with ground control as weather permits. Treating as a non-critical path item for now.
35		**Data Collection Tech Memo:**	**19 days**	**0%**	**Tue 1/17/23**	**Fri 2/10/23**				
36		Draft Memo for Internal Review	4 days	0%	Tue 1/17/23	Fri 1/20/23	19,33FS-2 day:	Frank	Nelson	
37		Internal Review	2 days	0%	Mon 1/23/23	Tue 1/24/23	36	Frank	Grove,Sejkora,Maahs,Cook,Fid	
38		Draft Memo to TAC for Review	1 day	0%	Wed 1/25/23	Wed 1/25/23	37	Frank	Nelson	



Project: msproj11
Date: Fri 1/6/23

Task	Summary	External Milestone	Inactive Summary	Manual Summary Rollup	Finish-only	Manual Progress
Split	Project Summary	Inactive Task	Manual Task	Manual Summary	Deadline	
Milestone	External Tasks	Inactive Milestone	Duration-only	Start-only	Progress	

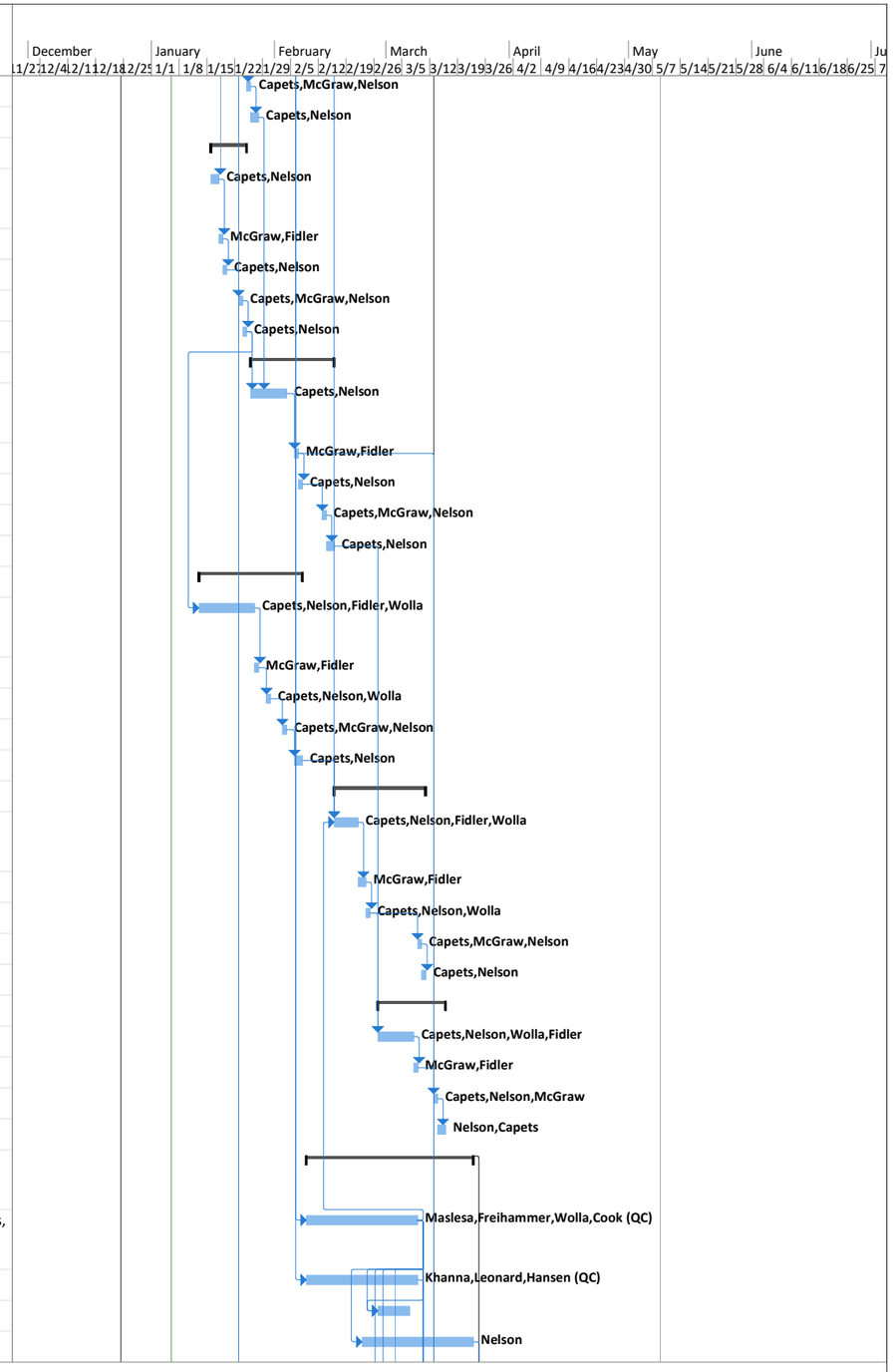
ID	Task Mode	Task Name	Duration	% Work Compl	Start	Finish	Predecessors	Task Owner	Resource Names	Notes
39		TAC Comments Returned	10 days	0%	Thu 1/26/23	Wed 2/8/23	38	Frank	McGraw	
40		Final Tech Memo Distributed	2 days	0%	Thu 2/9/23	Fri 2/10/23	39	Frank	Nelson	
41		Management Presentation (MGTPR)	1 day	0%	Mon 2/27/23	Mon 2/27/23	40FS+2 wks	McGraw	Frank,Nelson,Wolla	
42		**Interchange Screening Process**	**48 days**	**31%**	**Mon 12/12/22**	**Wed 2/15/23**				**Milestone Schedule calls for this to be done 3/01/**
43		**Evaluation Criteria**	**30 days**	**65%**	**Mon 12/12/22**	**Fri 1/20/23**				
44		Draft Evaluation Criteria for Internal Review	2 days	10...	Mon 12/12/22	Tue 12/13/22	9	Frank	Fidler,Bolstad,Aldridge,Grove,M	
45		Internal Review	2 days	10...	Wed 12/14/22	Thu 12/15/22	44	Frank	Fidler,Bolstad,Aldridge,Grove,M	
46		Draft Evaluation Criteria to TAC	1 day	10...	Thu 12/22/22	Thu 12/22/22	44FS+6 days	McGraw	Nelson,Frank	
47		TAC Comments Returned	14 days	95%	Fri 12/23/22	Wed 1/11/23	46	McGraw		Comments to be returned by 1/6/2023
48		Meet with TAC to Discuss Proposed Comment Resolu	1 day	0%	Thu 1/12/23	Thu 1/12/23	47	McGraw	Frank,Nelson,Grove or Bolstad	
49		Revised Evaluation Criteria & Draft Tech Memo to TA	2 days	0%	Fri 1/13/23	Mon 1/16/23	48	McGraw	Frank,Nelson,Grove or Bolstad	Need to verify all comment resolutions
50		TAC Approval and/or comments Received	3 days	0%	Tue 1/17/23	Thu 1/19/23	49	McGraw	Frank,Nelson	
51		Final Evaluation Criteria and Tech Memo Distributed	1 day	0%	Fri 1/20/23	Fri 1/20/23	50	McGraw	Nelson	
52		**Highway Interchange Tool (HIT)**	**5 days**	**50%**	**Wed 1/4/23**	**Tue 1/10/23**				
53		Initial Run	2 days	10...	Wed 1/4/23	Thu 1/5/23	31FS-4 days	Capets		Initial run planned for 1/5 with review by McGraw
54		Review Results/Outputs with Sr Transp Designer and Project Manager	1 day	10...	Fri 1/6/23	Fri 1/6/23	53	Capets	Fidler,McGraw,Frank,Aldridge	
55		Complete Revised Run and Draft HIT Portion of Alternatives Tech Memo	2 days	0%	Mon 1/9/23	Tue 1/10/23	54	Capets	Wolla,Nelson	
56		Internal Charrette	1 day	0%	Thu 1/12/23	Thu 1/12/23	55FS+1 day	McGraw	Capets,Fidler,Nelson	
57		Internal Charrette Summary	2 days	0%	Fri 1/13/23	Mon 1/16/23	56	McGraw	Nelson	
58		Draft Alternatives Development Tech Memo for Internal Review	6 days	0%	Wed 1/11/23	Wed 1/18/23	57FS-4 days	McGraw	Nelson,Wolla	
59		Internal Review	2 days	0%	Thu 1/19/23	Fri 1/20/23	58	McGraw	Fidler,McGraw,Frank,Aldridge,I	
60		Draft Tech Memo to TAC for Review	1 day	0%	Thu 1/19/23	Thu 1/19/23	58	McGraw	Nelson	
61		TAC Comments Received	14 days	0%	Fri 1/20/23	Wed 2/8/23	60	McGraw	Nelson	
62		TAC Meeting	1 day	0%	Thu 2/9/23	Thu 2/9/23	61	McGraw	Nelson,Capets,Fidler,Aldridge,F	
63		Revised Draft Tech Memo for TAC Approval	2 days	0%	Fri 2/10/23	Mon 2/13/23	62	McGraw	Nelson,Frank,Aldridge,Fidler	Need to verify all comment resolutions
64		Alternatives Identification Tech Memo Approved	2 days	0%	Tue 2/14/23	Wed 2/15/23	63	McGraw	Nelson	File
65		**Traffic Operations Analysis**	**44 days**	**0%**	**Fri 1/13/23**	**Wed 3/15/23**		**Aldridge**	**Capets**	**Milestone Schedule calls for 3/01/2023 completion**
66		**Existing Conditions Models**	**11 days**	**0%**	**Fri 1/13/23**	**Fri 1/27/23**		**Aldridge**	**Capets,Nelson**	
67		Develop Models and Base Year / Existing Modelling Tech Memo for Internal Review	2 days	0%	Fri 1/13/23	Mon 1/16/23	29FS+6 days	Aldridge	Capets,Nelson	
68		Draft Memo	3 days	0%	Tue 1/17/23	Thu 1/19/23	67			
69		Internal Review	1 day	0%	Fri 1/20/23	Fri 1/20/23	68	Aldridge	McGraw,Fidler	
70		Revised Models and Base Year / Existing Modelling Tech Memo	1 day	0%	Mon 1/23/23	Mon 1/23/23	69	Aldridge	Capets,Nelson	



Project: msproj11
Date: Fri 1/6/23

Task	Summary	External Milestone	Inactive Summary	Manual Summary Rollup	Finish-only	Manual Progress
Split	Project Summary	Inactive Task	Manual Task	Manual Summary	Deadline	
Milestone	External Tasks	Inactive Milestone	Duration-only	Start-only	Progress	

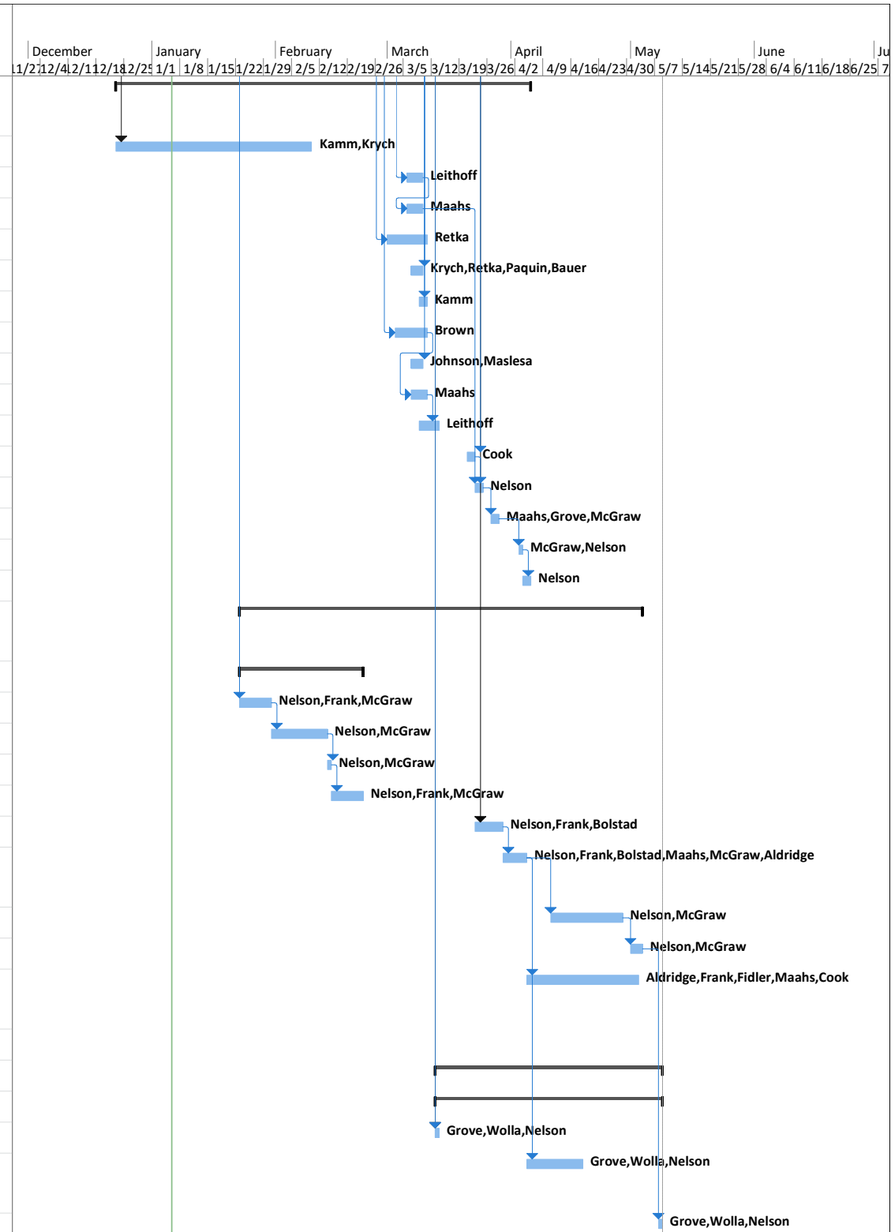
ID	Task Mode	Task Name	Duration	% Work Compl	Start	Finish	Predecessors	Task Owner	Resource Names	Notes
71		Present to TAC	1 day	0%	Wed 1/25/23	Wed 1/25/23	70FS+1 day	Aldridge	Capets,McGraw,Nelson	
72		Final Tech Memo	2 days	0%	Thu 1/26/23	Fri 1/27/23	71	Aldridge	Capets,Nelson	Need to verify all comment resolutions
73		**Future Traffic Forecasts**	**7 days**	**0%**	**Mon 1/16/23**	**Tue 1/24/23**		**Aldridge**	**Capets,Nelson**	
74		Develop Forecasts and Forecast Methodology Tech Memo for Internal Review	2 days	0%	Mon 1/16/23	Tue 1/17/23	32FS-1 day	Aldridge	Capets,Nelson	Just growth rates
75		Internal Review	1 day	0%	Wed 1/18/23	Wed 1/18/23	74	Aldridge	McGraw,Fidler	
76		Revised Forecasts and Forecast Methodology Tech M	1 day	0%	Thu 1/19/23	Thu 1/19/23	75	Aldridge	Capets,Nelson	
77		Present to TAC	1 day	0%	Mon 1/23/23	Mon 1/23/23	76FS+1 day	Aldridge	Capets,McGraw,Nelson	
78		Final Tech Memo	1 day	0%	Tue 1/24/23	Tue 1/24/23	77	Aldridge	Capets,Nelson	Need to verify all comment resolutions
79		**No-Build Models**	**15 days**	**0%**	**Thu 1/26/23**	**Wed 2/15/23**		**Aldridge**	**Capets,Nelson**	
80		Develop No-Build Models and Tech Memo for Internal Review	7 days	0%	Thu 1/26/23	Fri 2/3/23	78FS-2 days,72FS-2 days	Aldridge	Capets,Nelson	
81		Internal Review	1 day	0%	Mon 2/6/23	Mon 2/6/23	80	Aldridge	McGraw,Fidler	
82		Revised No-Build Models and Tech Memo	1 day	0%	Tue 2/7/23	Tue 2/7/23	81	Aldridge	Capets,Nelson	
83		Present to TAC	1 day	0%	Mon 2/13/23	Mon 2/13/23	82FS+3 days	Aldridge	Capets,McGraw,Nelson	
84		Final Tech Memo	2 days	0%	Tue 2/14/23	Wed 2/15/23	83	Aldridge	Capets,Nelson	Need to verify all comment resolutions
85		**Primary Corridor Alternatives Models**	**18 days**	**0%**	**Fri 1/13/23**	**Tue 2/7/23**		**Aldridge**	**Capets,Nelson**	
86		Develop Primary Corridor Alternatives and Tech Memo for Internal Review	10 days	0%	Fri 1/13/23	Thu 1/26/23	78FS-8 days	Aldridge	Capets,Nelson,Fidler,Wolla	
87		Internal Review	1 day	0%	Fri 1/27/23	Fri 1/27/23	86	Aldridge	McGraw,Fidler	
88		Revised Primary Corridor Alternatives and Tech Mem	1 day	0%	Mon 1/30/23	Mon 1/30/23	87	Aldridge	Capets,Nelson,Wolla	
89		Present to TAC	1 day	0%	Fri 2/3/23	Fri 2/3/23	88FS+3 days	Aldridge	Capets,McGraw,Nelson	
90		Final Tech Memo	2 days	0%	Mon 2/6/23	Tue 2/7/23	89	Aldridge	Capets,Nelson	Need to verify all comment resolutions
91		**Interchange Alternatives Models**	**17 days**	**0%**	**Thu 2/16/23**	**Fri 3/10/23**		**Aldridge**	**Capets,Nelson**	
92		Develop Interchange Alternatives and Tech Memo for Internal Review	4 days	0%	Thu 2/16/23	Tue 2/21/23	90FS-3 days,62FS-3 days,103FS-15	Aldridge	Capets,Nelson,Fidler,Wolla	
93		Internal Review	2 days	0%	Wed 2/22/23	Thu 2/23/23	92	Aldridge	McGraw,Fidler	
94		Revised Interchange Alternatives and Tech Memo to	1 day	0%	Fri 2/24/23	Fri 2/24/23	93	Aldridge	Capets,Nelson,Wolla	
95		Interchange Alternatives TAC Meeting	1 day	0%	Thu 3/9/23	Thu 3/9/23	94FS+8 days	Aldridge	Capets,McGraw,Nelson	
96		Final Tech Memo	1 day	0%	Fri 3/10/23	Fri 3/10/23	95	Aldridge	Capets,Nelson	Need to verify all comment resolutions
97		**Traffic Operations Report**	**13 days**	**0%**	**Mon 2/27/23**	**Wed 3/15/23**		**Aldridge**	**Capets,Nelson**	
98		Develop Draft Report	7 days	0%	Mon 2/27/23	Tue 3/7/23	84FS-6 days,94	Aldridge	Capets,Nelson,Wolla,Fidler	
99		Internal Review	1 day	0%	Wed 3/8/23	Wed 3/8/23	98	Aldridge	McGraw,Fidler	
100		Present to TAC	1 day	0%	Mon 3/13/23	Mon 3/13/23	99FS+2 days	Aldridge	Capets,Nelson,McGraw	
101		Final Report	2 days	0%	Tue 3/14/23	Wed 3/15/23	100	Aldridge	Nelson,Capets	Need to verify all comment resolutions
102		**Preliminary Engineering**	**30 days**	**0%**	**Thu 2/9/23**	**Wed 3/22/23**				**Milestone Schedule Calls for 4/05/2023 completion**
103		Roadway Layouts	20 days	0%	Thu 2/9/23	Wed 3/8/23	64FS-5 days	Fidler	Maslesa,Freihammer,Wolla,Co (QC)	5 Primary with 3 variations each (existing, signals, roundabouts)
104		Bridge Layouts	20 days	0%	Thu 2/9/23	Wed 3/8/23	64FS-5 days	Frank	Khanna,Leonard,Hansen (QC)	3 Primary with total of five variations
105		Geotech Recommendations	6 days	0%	Mon 2/27/23	Mon 3/6/23	103FS-8 days,1	Ballinger (Brau		
106		Utility Coordination	4 wks	0%	Thu 2/23/23	Wed 3/22/23	103FS-10 days	Cook	Nelson	



Project: msproj11
Date: Fri 1/6/23

Task | Summary | External Milestone | Inactive Summary | Manual Summary Rollup | Finish-only | Manual Progress
Split | Project Summary | Inactive Task | Manual Task | Manual Summary | Deadline
Milestone | External Tasks | Inactive Milestone | Duration-only | Start-only | Progress

ID	Task Mode	Task Name	Duration	% Work Compl	Start	Finish	Predecessors	Task Owner	Resource Names	Notes
107		**Environmental Screening**	**74 days**	**0%**	**Fri 12/23/22**	**Wed 4/5/23**		**Sejkora**		**Milestone Schedule Calls for 4/19/2023 completion**
108		Solicitation of Views	35 days	0%	Fri 12/23/22	Thu 2/9/23	19	Sejkora	Kamm,Krych	
109		Environmental Justice	4 days	0%	Mon 3/6/23	Thu 3/9/23	103FS-3 days	Sejkora	Leithoff	
110		Noise	4 days	0%	Mon 3/6/23	Thu 3/9/23	109FS-4 days	Sejkora	Maahs	
111		Wetlands	8 days	0%	Wed 3/1/23	Fri 3/10/23	103FS-6 days	Sejkora	Retka	
112		Protected Species	3 days	0%	Tue 3/7/23	Thu 3/9/23	103FS-2 days	Sejkora	Krych,Retka,Paquin,Bauer	
113		Farmland	2 days	0%	Thu 3/9/23	Fri 3/10/23	103	Sejkora	Kamm	
114		R/W	6 days	0%	Fri 3/3/23	Fri 3/10/23	103FS-4 days	Sejkora	Brown	
115		Floodplain	3 days	0%	Tue 3/7/23	Thu 3/9/23	103FS-2 days	Sejkora	Johnson,Maslesa	
116		Section 4(f)/6(f)	4 days	0%	Tue 3/7/23	Fri 3/10/23	114FS-4 days	Sejkora	Maahs	
117		Cultural Resources	3 days	0%	Thu 3/9/23	Mon 3/13/23	116FS-2 days	Sejkora	Leithoff	
118		Utility Impacts	2 days	0%	Tue 3/21/23	Wed 3/22/23	106FS-2 days	Sejkora	Cook	
119		Draft Tech Memo	2 days	0%	Thu 3/23/23	Fri 3/24/23	118,110	Sejkora	Nelson	
120		Internal Review	2 days	0%	Mon 3/27/23	Tue 3/28/23	119	Sejkora	Maahs,Grove,McGraw	
121		Present to TAC	1 day	0%	Mon 4/3/23	Mon 4/3/23	120FS+3 days	Sejkora	McGraw,Nelson	
122		Final Memo	2 days	0%	Tue 4/4/23	Wed 4/5/23	121	Sejkora	Nelson	Need to verify all comment resolutions
123		**Draft Interchange Selection & Decision Document**	**73 days**	**0%**	**Mon 1/23/23**	**Wed 5/3/23**				**Milestone schedule calls for draft submittal 4/26/2023 and Final SUBMITTAL 5/17/2023**
124		**Confirm Outline**	**23 days**	**0%**	**Mon 1/23/23**	**Wed 2/22/23**				
125		Draft outline for Internal Review	6 days	0%	Mon 1/23/23	Mon 1/30/23	51	Bolstad	Nelson,Frank,McGraw	
126		TAC Review of Outline	10 days	0%	Tue 1/31/23	Mon 2/13/23	125	Bolstad	Nelson,McGraw	
127		TAC Comments Received	1 day	0%	Tue 2/14/23	Tue 2/14/23	126	Bolstad	Nelson,McGraw	
128		Outline Confirmed	6 days	0%	Wed 2/15/23	Wed 2/22/23	127	Bolstad	Nelson,Frank,McGraw	Need to verify all comment resolutions
129		Draft Doc	5 days	0%	Thu 3/23/23	Wed 3/29/23	102	Bolstad	Nelson,Frank,Bolstad	
130		Internal Review	4 days	0%	Thu 3/30/23	Tue 4/4/23	129	Bolstad	Nelson,Frank,Bolstad,Maahs,M	
131		TAC Review	14 days	0%	Tue 4/11/23	Fri 4/28/23	130FS+4 days	Bolstad	Nelson,McGraw	
132		Distribute Final Draft for Approval	3 days	0%	Mon 5/1/23	Wed 5/3/23	131	Bolstad	Nelson,McGraw	Need to verify all comment resolutions
133		Proposed Contract II Work Plan and Schedule	4 wks	0%	Wed 4/5/23	Tue 5/2/23	130	McGraw	Aldridge,Frank,Fidler,Maahs,Cc	Milestone schedule calls for submittal by 5/24/2023
134				0%						
135		**Engagement**	**41 days**	**0%**	**Mon 3/13/23**	**Mon 5/8/23**				
136		**Outreach Events**	**41 days**	**0%**	**Mon 3/13/23**	**Mon 5/8/23**				
137		Open House	1 day	0%	Mon 3/13/23	Mon 3/13/23	35FS+4 wks,81	Bolstad	Grove,Wolla,Nelson	
138		Public Review of Draft Interchange Selection & Decision Document	2 wks	0%	Wed 4/5/23	Tue 4/18/23	130	Bolstad	Grove,Wolla,Nelson	
139		Post Final Draft Interchange Selection & Decision Doc	1 day	0%	Mon 5/8/23	Mon 5/8/23	132FS+2 days	Bolstad	Grove,Wolla,Nelson	
140				0%						



Project: msproj11
Date: Fri 1/6/23

Task	Summary	External Milestone	Inactive Summary	Manual Summary Rollup	Finish-only	Manual Progress
Split	Project Summary	Inactive Task	Manual Task	Manual Summary	Deadline	
Milestone	External Tasks	Inactive Milestone	Duration-only	Start-only	Progress	

Appendix G – Environmental Screening Technical Memorandum

Stantec

Memo

To:	Chad Frisinger, PE Jennifer Kern, PE	From:	Courtnay Bot Erin Sejkora, AICP Pat McGraw, PE
Project/File:	Environmental Screening Technical Memo for Project 8-029(213)069 NDDOT PCN 23596	Date:	March 31, 2023

Reference: Environmental Screening Technical Memorandum

1 Introduction

The I-29/40th Avenue North interchange Study Area ("Primary Study Area") was screened for potential impacts to environmental and social-economic resources, and compliance with federal and state requirements. Appendix A, Figure 1 - Study Area shows the Primary Study Area which includes an approximate 500-foot boundary around the existing interchange and along 40th Avenue North, from just west of 45th Street to just east of US 81. This memo summarizes the regulatory framework for each resource, the methodology for considering potential impacts, the resources identified in the Primary Study Area, and the potential impacts that may occur as a result of future transportation improvements in the Primary Study Area.

Note: The Secondary Study Area, shown in Appendix A, Figure 1 - Study Area, is associated with potential future projects that may be completed by others. The Secondary Study Area and potential future projects were considered in reviewing the compatibility of the interchange geometrics and 40th Avenue North roadway geometrics. Limited discussions below refer to the Secondary Study Area (e.g., gardens with nectar resources in the Secondary Study Area that may introduce the potential for the monarch butterfly in the Primary Study Area).

2 Environmental

2.1 Wetlands and other Aquatic Resources

2.1.1 REGULATORY BACKGROUND/METHODOLOGY

Wetlands are federally regulated by the U.S. Army Corps of Engineers (USACE). Waters of the United States (WOTUS) are protected under Sections 401 and 404 of the Clean Water Act (CWA). Any activity that involves any discharge of dredged or fill material into WOTUS, including wetlands and waterbodies, is subject to regulation by USACE. WOTUS are defined as:

"Traditional navigable waters, interstate waters, and the territorial seas, and their adjacent wetlands; most impoundments of WOTUS; tributaries to traditional navigable waters, interstate waters, the territorial seas, and impoundments that meet either the relatively permanent standard or the significant nexus standard; wetlands adjacent to impoundments and tributaries, that meet either the relatively permanent standard or the significant nexus standard; and ''other waters'' that meet either the relatively permanent standard or the significant nexus standard."

Additionally, projects with a federal nexus must comply with Executive Order (EO) 11990, which requires that projects resulting in wetland impacts demonstrate that (1) there is no practicable alternative to such construction and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use.

The Primary Study Area falls under the jurisdiction of the Omaha District. The Omaha District has several permit options available for North Dakota including Nationwide Permits (NWP), and Individual Permits. Some examples of NWPs that may be applicable to the Project are: NWP 14 – Linear Transportation Projects; NWP 33 – Temporary Construction, Access, and Dewatering; NWP 43 – Stormwater Management Facilities; and NWP 46 – Discharges in Ditches, so long as impacts to WOTUS do not exceed one-half acre for NWP 14 and NWP 43, or one acre for NWP 46 (USACE 2021). There are no acreage limits for NWP 33. Many NWPs require a Pre-Construction Notification (PCN) to be submitted prior to starting work. Projects with impacts which exceed the amounts allowed under the NWPs will need to apply for Individual Permits.

North Dakota has very few state-specific wetland regulations. Permitting is required for the drainage of any water resource, including a wetland, pond, slough, or lake with a watershed of 80 acres or more; however, this threshold is not often reached so this regulation is rarely applied.

2.1.2 EXISTING CONDITIONS

Several aquatic resources are located within the Primary Study Area, including wetlands identified by the National Wetlands Inventory (NWI) and waterways identified by the United States Geological Survey (USGS) National Hydrography Dataset (NHD), which can be seen in Appendix A, Figure 2 - Water Resources. The NWI identifies several linear freshwater emergent wetlands (PEM1Cx) and riverine/ditch (R4SBCx) wetlands located alongside the roadways and railroad in the Primary Study Area. One county drainage ditch, Drain No. 40, crosses through the Primary Study Area and is a tributary of the Red River. The NHD also identifies a ditch running east along the north side of 40th Avenue North which flows into County Drain 10.

In the Secondary Study Area, one freshwater pond (PABFx) and one riverine/ditch (R4SBCx) wetland are located on the north side of 40th Avenue North. The NHD shows one county drainage ditch, County Drain No. 10, crosses through the Secondary Study Area and is a tributary of the Red River, along with a lateral ditch that runs along the north side of 40th Avenue North and flows into County Drain 10.

2.1.3 POTENTIAL IMPACTS & NEXT STEPS

Potential impacts to wetlands could occur if fill is needed to construct the future potential interchange project. A wetland delineation would need to be completed to identify the wetland boundaries and determine if any wetlands would be impacted. The wetland delineation should be sent to USACE to

determine if the wetlands fall under USACE jurisdiction. If wetlands under USACE jurisdiction would be impacted, then the potential future project must follow the USACE permitting process. It is possible that the future potential project may qualify for one of the NWPs described in Section 2.1.1 if the impacts are under the threshold for the NWP. Many NWPs require a Pre-Construction Notification (PCN) to be submitted prior to initiating any project work. Projects with impacts which exceed the amounts allowed under the NWPs would need to apply for Individual Permits. In the case of wetland impacts and need for wetland mitigation, the North Dakota Department of Transportation (NDDOT) has a wetland mitigation program with wetland banks available for NDDOT transportation projects. Alternatively, if mitigation is needed and site conditions permit, onsite mitigation could be pursued.

2.2 Water Quality

2.2.1 REGULATORY BACKGROUND/METHODOLOGY

A future potential interchange project would be required to comply with National Pollutant Discharge Elimination System (NPDES) and any other water quality requirements (e.g., local). The NPDES permit program is administered by the North Dakota Department of Environmental Quality (NDDEQ). Construction activities that result in a disturbance of one or more acres of land area, including clearing, grading and excavation would require a Stormwater Pollution and Prevention Plan (SWPPP) to identify stormwater Best Management Practices (BMPs) that are required to mitigate stormwater runoff impacts and protect surface waters, including erosion control BMPs. Pollutants typically associated with roadway stormwater runoff include total suspended solids, hydrocarbons, fertilizers, pesticides, bacteria, heavy metals, and chlorides from winter deicing activities. During rainfall events, pollutants collected on the roadway surface are conveyed into the roadway drainage system.

2.2.2 EXISTING CONDITIONS

Under existing conditions, I-29 and 40th Avenue North are rural roadways, with no curb and gutter or storm sewer. Stormwater runoff from the roadway is captured in roadside ditches and conveyed through wetlands, open channels, or culverts. No existing stormwater ponds are present within the Primary Study Area.

2.2.3 POTENTIAL IMPACTS & NEXT STEPS

The future potential interchange project is anticipated to increase impervious surface area, resulting in an increase in the volume and rate of stormwater runoff from the roadway. The future potential interchange project would be required to comply with NPDES and any other water quality requirements (e.g., local). A SWPPP would be prepared, identifying erosion control BMPs.

2.3 Regulated Floodplain/Floodway

2.3.1 REGULATORY BACKGROUND/METHODOLOGY

Congress established the National Flood Insurance Program (NFIP) with the passage of the National Flood Insurance Act of 1968. The NFIP and the Flood Disaster Protection Act of 1973 were Congress' response

to increasing costs of disaster relief. These acts serve to reduce the need for large publicly funded flood control structures and disaster relief by providing flood insurance and restricting development on floodplains. The Federal Emergency Management Agency (FEMA) administers the National NFIP, providing subsidized flood insurance for those communities that comply with FEMA regulations. FEMA issues flood insurance rate maps (FIRMs) that delineate flood hazard zones in a community and demonstrate which areas are prone to flooding. FEMA established the design standard for flood protection, with the minimum level of flood protection for new development determined to be the 1-in-100 annual exceedance probability (AEP) event (i.e., the 100-year flood event).

In accordance with EO 11988, future improvements within the regulated floodplain must avoid, minimize, or mitigate potential harm within the floodplain. Unavoidable temporary or permanent fill within the regulated floodplain would need to be minimized and mitigated, if impacts to the regulated floodplain would result, compensatory flood storage may be required.

2.3.2 EXISTING CONDITIONS

The Primary Study Area is located in the Red River Valley with the river located 2.8 miles east of I-29. Consequently, part of the Primary Study Area and nearly all of the Secondary Study Area are located in a FEMA flood hazard zone as seen in Appendix A, Figure 2 - Water Resources. Most of the existing roadway system is raised and in the 500-year floodplain (i.e., the 0.2 percent annual chance of flood hazard zone) or areas with reduced flood risk due to a levee.

In the Primary Study Area, the higher elevation portions of the northbound I-29 exit and entrance ramps that are located east of the freeway are located in an area of minimal flood hazard. The majority of the Primary Study Area located west of I-29 is protected by a levee and has a reduced flood risk with the exception of the lower lying land west of 45th Street that is in the 500-year floodplain. In the portion of the Primary Study Area east of I-29, the lowest lying areas between the roadways and the railroad are in the regulated 100-year floodplain (1 percent annual chance flood zone); the eastern end of the roadway and adjacent areas are within the 500-year floodplain.

In the Secondary Study Area, the roadway is within the 500-year floodplain. Areas adjacent to 40th Avenue North are in the regulated 100-year floodplain and 500-year floodplain.

2.3.3 POTENTIAL IMPACTS & NEXT STEPS

A future potential interchange project is anticipated to have little impact outside of the existing transportation corridor. The future potential interchange project would be designed to avoid contributing to flooding and minimize any potential impacts to the floodplain. Once a preferred interchange project concept is selected, coordination with the local floodplain administrator of the zoning authority (City of Fargo and Reed Township) would be pursued to achieve compliance with EO 11988 and local regulations, including the Cass County Flood Damage Prevention Ordinance and the City of Fargo Flood Plain Management Ordinance (Article 21-0601).

2.4 Threatened and Endangered Species

2.4.1 REGULATORY BACKGROUND/METHODOLOGY

2.4.1.1 Federal

Projects receiving federal funds are required to complete a review of potential impacts to federally listed threatened and endangered species pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) of 1973. For NDDOT Projects, the Section 7 of the ESA Guidance for NDDOT Projects is available to guide consultation.[1]

2.4.1.2 State

According to the North Dakota Game and Fish (NDGF), North Dakota does not have their own list of threatened and endangered species. Only those species listed by the U.S. Fish and Wildlife Service (USFWS) under the ESA are considered threatened or endangered in the state of North Dakota. Therefore, the USFWS oversees these species.[2]

2.4.2 EXISTING CONDITIONS

2.4.2.1 Federally Threatened and Endangered Species

The USFWS Information for Planning and Consultation (IPaC) tool[3] was reviewed in March 2023 to identify federally listed species that have the potential to occur within the broader Study Area (Primary and Secondary). This review was based on current federally listed species and will need to be re-evaluated at the time that a future National Environmental Policy Act (NEPA) environmental review process is conducted. Two species were identified from this review: the northern long-eared bat (*Myotis septentrionalis*; threatened – scheduled for reclassification to endangered on March 31, 2023) and the monarch butterfly (*Danaus plexippus*; candidate). The IPaC results are included in Appendix B.

Northern long-eared bat

Suitable roosting, forage, and travel habitat for northern long-eared bat (NLEB) in the summer consists of a wide variety of contiguous forested and wooded habitats with varying tree density and amounts of canopy closure. While roosting, NLEB is generally found in deep crevices in areas such as forests and woodlots (i.e., live trees and/or snags greater than or equal to three inches in diameter at breast height that have

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[1] North Dakota Department of Transportation. 2017. Section 7 of the Endangered Species Act Guidance for NDDOT Projects. Available at: https://www.dot.nd.gov/manuals/design/designmanual/wordfiles_design/Section%207%20ESA%20Guidance.pdf. Accessed March 2023.
[2] North Dakota Game and Fish Department. 2021. Threatened and Endangered Species. Available at: https://gf.nd.gov/wildlife/endangered. Accessed March 2023.
[3] U.S. Fish and Wildlife Service. 2023a. Information for Planning and Consultation. Available at: https://ipac.ecosphere.fws.gov/. Accessed March 2023.

exfoliating bark, cracks, crevices, and/or cavities) as well as linear features such as fence rows, riparian forests, and other wooded corridors. NLEB roosts in both live trees and snags.[4,5,6] Additional summer habitat for the NLEB consists of areas adjacent to wooded areas, namely emergent wetlands and edges of agricultural fields, old fields, and pastures. The NLEB has also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses.[7] During winter months, NLEB hibernate in caves or abandoned mines.[5]

According to Section 7 of the ESA Guidance for NDDOT Projects, the potential future project falls within the scope of the NDDOT/Federal Highway Administration (FHWA) Programmatic Biological Assessment (PBA).[5]

According to the North Dakota State Wildlife Action Plan (SWAP), Cass County falls within the possible range of the NLEB, but not the primary range. The primary range includes areas where NLEB has been identified in the state of North Dakota, including the forested habitats of the Turtle Mountains and the riparian corridors of the Missouri River and the Little Missouri River. As of this 2015 report, no NLEB hibernacula have been identified in the state.[8]

Appendix A, Figure 4 - Land Use shows that the broader Study Area (Primary and Secondary) is composed of road and rail rights of way, industrial areas, and public and institutional areas (including Hector International Airport). Minimal agriculture, pasture, wetland, park area, and windbreak trees are also present within the Study Area. Suitable habitat for the NLEB (contiguous forest and/or hibernacula) is not present within the Study Area. Additionally, NLEB hibernacula have not been identified within the state of North Dakota, and NLEB individuals have not been identified within this county as of the 2015 SWAP report. As such, it is not anticipated that a future potential interchange project would result in incidental take based on the current regulations.

It is recommended that any tree clearing be conducted during the inactive season (November 1 to March 31). Tree clearing amounts, distances from the roadway, and timing will be determined as the Project progresses, as needed.

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[4] Sasse, D.B., and P.J. Pekins. 1996. Summer roosting ecology of northern long-eared bats (*Myotis septentrionalis*) in the White Mountain National Forest. Bats and forests symposium. British Columbia Ministry of Forests Working Paper 23:91-101.
[5] Foster, R.W. and A. Kurta. 1999. Roosting ecology of the northern bat. (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (Myotis sodalis). Journal of Mammalogy 80:659-672.
[6] Owen et al. 2003. Homerange size and habitat use by the northern Myotis (*Myotis septentrionalis*). American Midland Naturalist 150: 352-359.
[7] U.S. Fish and Wildlife Service. 2022. Rangewide-Wide Indiana Bat & Northern Long-Eared Bat Survey Guidelines. Available at: https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines. Accessed March 2023.
[8] Dyke, Steve R., Sandra K. Johnson, and Patrick T. Isakson. 2015. North Dakota State Wildlife Action Plan. North Dakota Game and Fish Department, Bismarck, ND.

The reclassification of the NLEB from threatened to endangered is scheduled to take effect on March 31, 2023.[9] Therefore, it is recommended that potential effects be reassessed once the endangered status is in effect.

Monarch butterfly

The monarch butterfly is a migratory butterfly that exists in two main populations within the United States divided by the Rocky Mountains: the eastern population that overwinters in the mountains of Mexico, and the western population that overwinters along the southern pacific coast of California.[10] Monarch butterflies are a widespread species found in fields, prairies, savannahs, and most places where their host plant, milkweeds (*Asclepias* spp.), occur throughout the United States and southern Canada. This species generally occurs in areas with high densities of nectar sources. During late summer and migration adults use nectar species such as goldenrods (*Solidago* spp.), wild bergamot (*Monarda fistulosa*), asters (*Aster* spp.), coneflowers (*Echinacea* spp.), and blazing stars (*Liatris* spp.)[11]; however, the presence of milkweeds is required for breeding habitat as it is the only plant on which the larvae can feed.[12]

Given the level of disturbance from active agriculture and industry, suitable habitat (nectar sources and milkweed) for the monarch butterfly is likely highly limited within the broader Study Area; however, nectar resources may be present within the park located east of the Primary Study Area, specifically on the south side of 40th Avenue North, and in gardens associated within residential areas further east and west of the Primary Study Area shown on Appendix A, Figure 1 - Study Area. Therefore, this species may be present within the Primary Study Area. Potential future project impacts to this species would need to be evaluated based on current regulations and when a final listing status for the species is determined.

2.4.2.2 State Threatened and Endangered Species

The NLEB and monarch butterfly falls under the of North Dakota ESA listed species and candidate species designations, respectively. See the Federally Threatened and Endangered Species Screening above for information on these species.

The North Dakota Natural Heritage biological conservation database was searched in March 2023 by the North Dakota Parks and Recreation Department (NDPRD) to determine if any current or historical plant or animal species of concern or other significant ecological communities are known to occur within the broader Study Area or within an approximate one-mile radius of this broader Study Area. No known records of plant or animal species of concern or other significant ecological communities were identified within the Study

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[9] U.S. Fish and Wildlife Service. 2023b. Effective date to reclassify northern long-eared bat as endangered extended. Available at: https://www.fws.gov/press-release/2023-01/effective-date-reclassify-northern-long-eared-bat-endangered-extended. Accessed January 2023.
[10] U.S. Department of Agriculture [USDA] Forest Service. undated. Migration and Overwintering. Available at: https://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/migration/. Accessed November 2021.
[11] North Dakota Game and Fish Department et al. 2018. North Dakota Monarch Butterfly and Native Pollinator Strategy. Available at: https://gf.nd.gov/pollinators/conservation. Accessed March 2023.
[12] National Wildlife Federation. undated. Monarch Butterfly. Available at: https://www.nwf.org/Educational-Resources/Wildlife-Guide/Invertebrates/Monarch-Butterfly. Accessed December 2021.

Area (Primary or Secondary) or within a one-mile radius of the broader Study Area. Please see Appendix B for the NDPRD response letter.

2.4.3 POTENTIAL IMPACTS & NEXT STEPS

As the potential future interchange project plans progress, potential impacts to threatened and endangered species should be reassessed based on anticipated project actions and regulations in place at that time. This would be carried out consistent with Section 7 of the ESA Guidance for NDDOT Projects, which addresses the federal requirements, including USFWS and NEPA requirements.

2.5 Farmland Protection Policy Act

2.5.1 REGULATORY BACKGROUND/METHODOLOGY

Prime Farmland is protected under the Farmland Protection Policy Act (FPPA), which was instituted to minimize the impact of federal programs on the unnecessary and irreversible conversion of farmland to non-agricultural uses. Highway projects with a federal nexus are subject to FPPA requirements if they may irreversibly directly or indirectly convert farmland to a nonagricultural use. The FPPA only pertains to federally owned and public lands and does not regulate the use of private or non-federal land for non-agricultural purposes.[13]

Soils are typically classified as Prime Farmland, Farmland of Statewide Importance, Farmland of Local Importance, or Not Prime Farmland. In general, Prime Farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. Farmland of Statewide Importance includes soils that are nearly Prime Farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Farmland of Local Importance are areas not identified as having national or statewide importance, but otherwise is considered important for the production of food, feed, fiber, forage, and oilseed crops. Locally important farmland is identified by local agencies and may include tracts of land that have been designated for agriculture by local ordinance.

2.5.2 EXISTING CONDITIONS

The acreage of farmland in the Primary Study Area are listed in Table 1 and mapped on Figure 3 – Farmland Classification as part of Appendix A. A total of 6.8 acres within the Primary Study Area are classified as prime farmland if drained.

[13] USDA NRCS 2023. Farmland Protection Policy Act. Accessed: March 2023 Available: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/fppa/

Table 1 Farmland Soil Classifications in the Primary Study Area

Soil Type	Acres	% Of Study Area
Prime farmland if drained	6.8	3.6
Not prime farmland	182.6	96.4
Total	**189.4**	**100.0**

Appendix A, Figure 4 - Land Use shows that the southwest portion of the Primary Study Area is owned by the North Dakota State University (NDSU). The land is used for agricultural and natural resources research purposes within the University.

2.5.3 POTENTIAL IMPACTS & NEXT STEPS

A Farmland Conversion Impact Rating Form (Form AD-1006) would need to be completed for all feasible alternatives to rate the relative impact of the project on agricultural land. This would be submitted to the Natural Resources Conservation Service (NRCS) local office for review. There is the potential that Part 523.11.E (1) could apply, which states that an exemption may be allowed for projects resulting in a small-acreage impact, defined as ten acres or less per linear mile or three acres where there is a project for an existing bridge or interchange. As part of the future NEPA process, Form AD-1006 would be completed and submitted to the NRCS local office for the preferred alternative. If it is anticipated that the preferred alternative would qualify for the small-acreage impact exemption, coordination with NRCS would be completed to confirm this understanding.

3 Physical/Construction

3.1 Traffic Noise

3.1.1 REGULATORY BACKGROUND/METHODOLOGY

3.1.1.1 Federal

Projects receiving federal funds or requiring Federal Highway Administration (FHWA) approval require adherence with federal noise standards (23 CFR 772), including approach to noise analysis, for transportation-related noise sources closely linked to interstate commerce.

3.1.1.2 State

NDDOT has a noise policy for highway traffic noise and construction noise. The NDDOT policy follows the FHWA Noise Standard 23 CFR 772. The FHWA Noise Standard gives NDDOT flexibility that reflects state-specific attitudes and objectives in approaching the problem of highway traffic and construction noise.

NDDOT's policy addresses definition of highway traffic noise impacts, abatement evaluation, and abatement decision making.

3.1.2 EXISTING CONDITIONS

The I-29/40th Avenue North interchange exists today along with noise typical for this type of transportation system. Other existing noise sources include adjacent commercial uses and transportation uses including the railroad and airport. The nearest sensitive receptors are residential areas located 2,300 feet west of the interchange.

3.1.3 POTENTIAL IMPACTS & NEXT STEPS

Alternatives considered for a future potential interchange project are likely to trigger the need for a detailed noise analysis (i.e., due to substantial horizontal or vertical alteration). Type 1 Projects, triggering detailed noise analysis, include those that result in physical alteration of an existing highway where there is either: substantial horizontal or vertical alteration; bridge replacement that results in horizontal or vertical alteration, addition of through lanes, addition of auxiliary lanes (unless a turn lane), restriping of existing pavement for purpose of adding a through lane or auxiliary lane. If the noise analysis identifies the potential for noise impacts, abatement would need to be evaluated per state and federal requirements.

3.2 Potentially Contaminated Properties

3.2.1 REGULATORY BACKGROUND/METHODOLOGY

Identifying areas of contamination within or adjacent to the Study Area early allows time to assess and manage the risk and liability related to acquisition of right of way, make changes to design if necessary, and prevent delays during construction.

3.2.2 EXISTING CONDITIONS

A Hazardous Material Incident Map was prepared for the Study Area through review of the North Dakota Department of Environmental Quality's (NDDEQ) Spill Investigation Program Incidental Reporting database (accessed March 22, 2023). Please see Appendix A, Figure 5 for the Hazardous Material Incident Map. No recorded incidents were found within the Primary Study Area.

3.2.3 POTENTIAL IMPACTS & NEXT STEPS

Based on the information reviewed through NDDEQ's database, it is not anticipated that there would be any impacts to contaminated properties with a future potential interchange project.

3.3 Utilities

3.3.1 REGULATORY BACKGROUND/METHODOLOGY

Above and below ground utilities must be considered when reviewing a potential project area. Both temporary and permanent impacts must be evaluated, including opportunities to avoid impacts.

3.3.2 EXISTING CONDITIONS

The following utilities have been identified within the Primary Study Area:

- Cass County Electric (overhead 60-85 feet) running from west side of interchange to east side (approximately 45th Street to 37th Street).
- Cass Rural Water District waterlines (buried) on the west end of the Primary Study Area along the south side of 40th Avenue North.
- CenturyLink (buried) on the north side of 40th Avenue North (north side US 81 intersection).
- Dakota Carrier Net (overhead 60-85 feet) running from west side of interchange to east side (approximately 45th Street to 37th Street).
- Consolidated Communication (buried) running north/south along the east side of US 81.
- City of Fargo sewer line (buried) running along south side of 40th Avenue North in the Primary Study Area.
- City of Fargo traffic signal (aboveground) at the intersection of 40th Avenue North and US 81.
- City of Fargo watermain (buried) running southwest to northeast through the 40th Avenue North/US 81 intersection.
- NDDOT electric cables for lighting on the north side of 40th Avenue North at the current I-29 interchange in the vicinity of both the southbound I-29 exit and the northbound I-29 entrance.
- Xcel Energy gas line (buried) crossing at 40th Avenue North east of CR 81 and then crossing CR 81 south of 40th Avenue North.

3.3.3 POTENTIAL IMPACTS & NEXT STEPS

Based on the level of study completed to date (i.e., data request from the utility providers), it is anticipated that with the exception of the Cass Rural Water District waterline, further review and consideration of potential impacts will need to be considered as a part of the design of a future potential interchange project including elements of the project extending through the US 81/40th Avenue North intersection. As project planning proceeds, coordination would occur with each of the utilities potentially affected by a future interchange project.

3.4 Airport Coordination

3.4.1 REGULATORY BACKGROUND/METHODOLOGY

It is necessary to coordinate roadway and right of way when considering projects within the influence area of an airport to prevent height hazards in the path of approaching and departing aircraft. Additionally, airports have a variety of visual and instrument approach and departure procedures that are dependent on runway and aircraft type. The flight approaches and departures require that airspace around the airport be free of any height hazards such as roadway signage, lighting, and landscaping, which includes trees, living fencing, and other natural barriers.

If a project is located within five miles of an airport, coordination must occur with the North Dakota Aeronautics Commission and the Federal Aviation Administration (FAA). In administering Title 14 of the Code of Federal Regulations (14 CFR Part 77), the prime objective of the FAA is to promote air safety and the efficient use of the navigable airspace. The project proponent would provide the FAA with FAA Form 7460-1, Notice of Proposed Construction or Alteration and with this information, the FAA would complete review of the project.

3.4.2 EXISTING CONDITIONS

The Hector International Airport is located southeast of the I-29/40th Avenue North interchange, approximately 4,600 feet (0.8 mile) from the Primary Study Area on Figure 4 - Land Use, Appendix A.

3.4.3 POTENTIAL IMPACTS & NEXT STEPS

The FAA Notice Criteria Tool would be used initially to determine whether the potential future project meets the minimum conditions for an FAA Form 7460-1, Notice of Proposed Construction or Alteration. It is presumed that the Notice of Criteria Tool would confirm need for the FAA Form 7460-1, for temporary condition/construction and permanent structures. This form would be submitted to the FAA in coordination with the North Dakota Aeronautics Commission to ensure the project would not present any safety or operation issues for the Hector International Airport.

3.5 Railroad Coordination

3.5.1 REGULATORY BACKGROUND/METHODOLOGY

Coordination with railroads regarding their facilities ensures public safety and efficient project planning, including attention to rail operation and project constructability. For future transportation improvements in the study area, NDDOT will be required to adhere to the Burlington Northern Santa Fe railway (BNSF) Grade Separation Guidelines and Construction and Maintenance agreement with BNSF (to be acquired during project design).

3.5.2 EXISTING CONDITIONS

Currently the BNSF has one mainline track and one two-mile-long additional track (to the west of the mainline) in the Primary Study Area seen in Figure 4 - Land Use, Appendix A. This is the BNSF Hillsboro Subdivision. BNSF has advised that an additional track (total of three tracks) and an access road should be considered as the long-term condition. The additional track would be on the west side of the current tracks and the access road would be on the east side of the current tracks.

3.5.3 POTENTIAL IMPACTS & NEXT STEPS

The design of the potential future I-29/40th Avenue North interchange project would be required to follow the BNSF/UP (United Pacific) Grade Separation Guidelines for the construction of a new overpass and would be completed per the Construction and Maintenance Agreement with BNSF. One updated standard that has already been identified is that for vertical clearance. Previously the vertical standard was 26 feet. New improvements must meet the updated/revised standard of 26 feet 3 inches. A number of design factors including road profile, bridge span lengths (and corresponding beam depth), overpass pier placement, would need to be coordinated to ensure constructability, compatibility and safety.

4 Social-Economic

4.1 Community and Public Facilities

4.1.1 REGULATORY BACKGROUND/METHODOLOGY

As part of accounting for the environmental setting in the study area, community and public facilities are identified. Physical impacts to the properties, access changes, noise and visual impacts, and other potential impacts are considered for each of the identified facilities.

4.1.2 EXISTING CONDITIONS

One community and public facility is located within the Primary Study Area. The North Dakota State University (NDSU) agricultural research plots and associated equipment storage are located southwest of the current I-29/40th Avenue North interchange.

Two public facilities are located just beyond the Primary Study Area which include:

- North Dakota National Guard Armory (Armory): located south of 40th Avenue North, just east of 35th Street.
- The Hector International Airport: located east/southeast of the I-29/40th Avenue North interchange with most northwestern portion of the Hector International Airport, located approximately 4,600 feet (0.8 mile) from the Primary Study Area.

4.1.3 POTENTIAL IMPACTS & NEXT STEPS

Future construction may result in temporary access impacts for these facilities during construction of a potential future project; however, it is not anticipated access would be entirely closed off to either facility. Any access impacts would be reviewed, discussed, and coordinated with affected facilities. Refer to Item 3.4 for Airport Coordination requirements.

4.2 Environmental Justice

4.2.1 REGULATORY BACKGROUND/METHODOLOGY

Executive Order 12898, Federal Actions to Address Environmental Justice (EJ) in Minority Populations and Low-income Populations, dated February 11, 1994, directed " each federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States." Additionally, FHWA Order 6640.23A (FHWA Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), issued June 14, 2012, establishes policies and procedures for the FHWA to use in complying with Executive Order 12898. FHWA issued Order 6640.23A on June 14, 2012. If the project receives federal funding, it would be considered a federal project for purposes of compliance with Executive Order 12898.

The EJ Study Area included the area within a 0.25-mile buffer of the broader Study Area (Primary and Secondary). To determine if an EJ community is present, the percentage of the total minority and low-income populations for each block group with the Study Area was compared to a larger geographical area. Block groups within the Study Area included Census Tract 3, Block Group 5 and Census Tract 408, Block Group 2. For this study, comparison data was collected for Cass County and the City of Fargo. It is generally assumed that an EJ population is present if the minority and/or low-income population at the block group-level is ten percent or greater than that of the larger geographical area. Additionally, if the total percentage of the minority and/or low-income population at the block group-level is 50 percent or greater, it is assumed that an EJ population is present. Figure 6 - Environmental Justice, Appendix A, identifies the block groups included in the Study Area.

4.2.2 EXISTING CONDITIONS

4.2.2.1 Minority Populations

Minority populations were identified using Census data on race and ethnicity from the 2020 U.S. Census. "Minority" is defined by the U.S. Department of Transportation (DOT) Order 5610.2(a) as a person who is Black or African American, Hispanic, Asian American, American Indian/Alaskan Native and Native Hawai'ian or Pacific Islander. Census data on race and ethnicity for the study area is tabulated in Table 2. The minority populations within Cass County and the City of Fargo are approximately 18.0 percent and 21.1 percent of the total population, respectively. The minority populations within the Census Tract 3, Block Group 5 and Census Tract 408, Block Group 2 are 6.4 percent and 7.2 percent of the total population, respectively. Given that the minority population at the Block Group-level is less than the proportion of

minority populations at the County and City level, no readily identifiable minority populations were identified within the Study Area.

Table 2 Race and Ethnicity Demographics of the Study Area

	Cass County	City of Fargo	Census Tract 3, Block Group 5	Census Tract 408, Block Group 2
Total Population	184,525	125,990	1,070	2,262
White	151,307 (82.0%)	99,439 (78.9%)	1,002 (93.6%)	2,099 (92.8%)
Black	12,963 (7.0%)	11,033 (8.8%)	4 (0.4%)	26 (1.1%)
American Indian or Alaska Native	2,614 (1.4%)	2,012 (1.6%)	5 (0.5%)	17 (0.8%)
Asian	6,068 (3.3%)	5,173 (4.1%)	13 (1.2%)	13 (0.6%)
Native Hawai'ian and other Pacific Islander	101 (0.1%)	93 (0.1%)	1 (0.1%)	0 (0%)
Other	1,994 (1.1%)	1,511 (1.2%)	1 (0.1%)	13 (0.6%)
Pop. Of Two or More Races	9,478 (5.1%)	6,729 (5.3%)	44 (4.1%)	94 (4.2%)
Hispanic*	6,182 (3.4%)	4,670 (3.7%)	21 (2.0%)	40 (1.8%)
Total Minority	33,218 (18.0%)	26,551 (21.1%)	68 (6.4%)	163 (7.2%)

Source: 2020 Decennial Census, Table IDs P1 and P2
Notes: CT = Census Tract, BG = Block Group
** Hispanic or Latino refers to ethnicity and is derived from the total population; 'Hispanic or Latino' is not classified as a separate race.*

4.2.2.2 Low-Income Populations

Low-income populations were identified based on poverty status and household income from the 2016-2020 American Community Survey (ACS) at the Block Group level. FHWA defines a "low income" individual as a person whose median household income is at or below the Department of Health and Human Services (HHS) poverty guidelines.[14] Poverty thresholds are updated each year by the Census Bureau and vary based on family size and composition. The year 2020 HHS poverty threshold for a four-person family was set at $26,200.[15] Income and poverty data is tabulated in Table 3. The percent of households below the

[14] U.S. Department of Transportation. Federal Highway Administration. Federal Highway Administration Environmental Justice Reference Guide. April 1, 2015. https://www.environment.fhwa.dot.gov/env_topics/ej/guidance_ejustice-nepa.aspx
[15] Office of the Assistant Secretary for Planning and Evaluation (ASPE). 2020 Poverty Guidelines. Accessed March 10, 2023 online at: https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines/prior-hhs-poverty-guidelines-federal-register-references/2020-poverty-guidelines

poverty thresholds in Cass County and the City of Fargo is approximately 11.4 percent and 13.7 percent, respectively. The percent of households below poverty thresholds within Census Tract 3, Glock Group 5 and Census Tract 408, Block Group 2 are 0 percent and 4.8 percent, respectively. Given that proportion of households below poverty for Block Groups within the Study is less than the County and City levels, no readily identifiable low-income populations were identified within the Study Area.

Table 3 Low-Income Demographics of the Study Area

	Cass County	City of Fargo	Census Tract 3, Block Group 5	Census Tract 408, Block Group 2
Total Households	77,027	55,478	327	668
Total Families	43,034	27,647	310	559
Median Household Income	$65,976	$57,520	$132,159	$112,083
Households Below Poverty Thresholds	11.4%	13.7%	0%	4.8%
Families Below Poverty Thresholds	6.0%	7.9%	0%	5.7%

Source: 2016-2020 ACS Five-Year Estimates, Table IDs B17010, B17017, B19001, B19013
Notes: CT = Census Tract, BG = Block Group

The Fargo-Moorhead Metropolitan Council of Governments (Metro COG) prepared a Title VI Non-Discrimination Plan[16] in 2020 which included in an environmental justice analysis. As part of this environmental screening evaluation, this plan was reviewed to inform the EJ analysis. The findings of the Metro COG Title VI Plan indicate that EJ communities are not present within the Study Area, consistent with the EJ analysis completed as part of this document.

4.2.3 POTENTIAL IMPACTS & NEXT STEPS

Based on the results of the EJ analysis, no low-income or minority populations were identified within the broader Study Area. Therefore, it is not anticipated that the potential future interchange project would have the potential to cause disproportionately high and adverse human health or environmental effects to EJ populations. As part of the future NEPA process, a revaluation of the EJ analysis may be needed based on the most recent Census data available to confirm that the findings of EJ analysis completed as part of this environmental screening document have not changed. Additionally, future outreach with local representatives, such as the City of Fargo and Cass County, may be completed to include any additional information local communities may have regarding the presence of EJ populations or businesses in the Study Area that may predominantly serve or employ EJ populations.

[16] Fargo-Moorhead Metropolitan Council of Governments. Title VI Non-Discrimination Plan. Adopted January 16, 2020. Accessed March 29, 2023 at: https://www.fmmetrocog.org/application/files/7916/4979/8100/Title_VI_and_Non-Discrimination_Plan_2022.pdf

4.3 Section 4(f)

4.3.1 REGULATORY BACKGROUND/METHODOLOGY

Section 4(f) of the Department of Transportation Act of 1966 provides protections for publicly-owned parks, recreational areas, wildlife and waterfowl refuges and historic sites. Section 4(f) requires avoidance of the publicly-owned resource unless there is no feasible and prudent alternative to its use. A Section 4(f) "use" occurs when land from a Section 4(f) resource is permanently incorporated into a transportation facility (i.e., purchased as highway right of way or permanent easement). If avoidance is not feasible and prudent, then all possible planning to minimize harm to the Section 4(f) resource is required.

4.3.2 EXISTING CONDITIONS

Within the Primary Study Area, there is an existing "on street" bikeway along 40th Avenue North. Within the Secondary Study Area, located approximately a mile east of the interchange on the south side of 40th Avenue North, there is a piece of property owned by the City of Fargo that is identified as parkland but appears to currently be in passive parkland use. This can be seen on Figure 7 - Parks, Trails, and Other Recreational Areas, Appendix A. The City of Fargo Comprehensive Plan does not have a name or any amenities defined for the property.

4.3.3 POTENTIAL IMPACTS & NEXT STEPS

During the NEPA process/preparation of the NEPA documentation for the potential future interchange project, it would need to be determined whether the on street bikeway qualifies as a Section 4(f) resource and if so, whether there is the potential for impacts. Additionally, at the point, reevaluation of the area for Section 4(f) resources would need to be completed. If potential impacts to Section 4(f) resources were unavoidable with a future project, the Section 4(f) process would need to be completed in coordination with NEPA.

4.4 Section 6(f)

4.4.1 REGULATORY BACKGROUND/METHODOLOGY

The Land and Water Conservation (LAWCON) Fund Act of 1965, as amended, provides a nationwide program to help preserve, develop and provide accessibility to outdoor recreation resources. Section 6(f) of the LAWCON Act provides protections to land acquired, developed, or improved using LAWCON funding. Similar to Section 4(f) described above, Section 6(f) requires consideration of all practical alternatives to avoid a LAWCON conversion (i.e., converting LAWCON-funded property to nonpublic outdoor recreation uses). A parkland conversion that cannot be avoided requires the acquisition of replacement parkland of at least equal fair market value and reasonably equivalent usefulness.

4.4.2 EXISTING CONDITIONS

No Section 6(f) resources are present within the Primary Study Area. The City of Reile's Acres is located west of the interchange (southwest of the 40th Avenue North/45th Street intersection), outside of the Primary Study Area. Within the city, there is a city park that has been identified by the North Dakota Parks and Recreation as a LAWCON resource. The city park, located south of 35th Avenue, provides playground equipment, picnic areas, tennis courts, an ice skating rink, a baseball diamond and other typical park amenities.

4.4.3 POTENTIAL IMPACTS & NEXT STEPS

Due to the Section 6(f) resources distance from the Primary Study Area, it is unlikely that a future potential interchange project would impact this resource. This same conclusion was provided by the North Dakota Parks and Recreation Department and as Appendix C, NDPRD - RE: I-29 ND: LAWCON/Section 6(f). The inventory of Section 6(f) resources would be reviewed and confirmed as a part of the NEPA process associated with a future potential interchange project.

4.5 Section 106

4.5.1 REGULATORY BACKGROUND/METHODOLOGY

The NDDOT Cultural Resource Section (CRS) is responsible for reviewing FHWA projects for potential impacts to historic properties pursuant to Section 106 of the National Historic Preservation Act of 1966. To advance a project in the Study Area, consultation with the North Dakota State Historic Preservation Office (SHPO) would be required and coordination with the NDDOT CRS. NDDOT CRS would provide formal determination of the potential effects of a project on historical properties.

4.5.2 EXISTING CONDITIONS

For the purposes of this review, the National Park Service National Register of Historic Places database was accessed (March 6, 2023), to identify potential impacts to historical and cultural resources. Based on this review, no historical or cultural resources were identified in the broader Study Area.

4.5.3 POTENTIAL IMPACTS & NEXT STEPS

During development of a future potential interchange project, there would be additional coordination with the SHPO and the NDDOT CRS, including a Class III Investigation. If it is determined that there are historic properties in the future potential interchange project area, a variety of potential impacts would be considered as a part of an adverse effects analysis.

4.6 Right of Way

4.6.1 REGULATORY BACKGROUND/METHODOLOGY

Right of way must be considered anytime a project would require property that is not already owned or under the control of the party proposing the project. This includes both the temporary use of right of way for construction of the project and the permanent right of way required for the transportation improvement.

The NDDOT Right of Way Manual (reviewed by FHWA) outlines the right of way use and acquisition activities and is designed to guide and assist in performing these activities. Any acquisitions would also need to be completed consistent with the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

4.6.2 EXISTING CONDITIONS

I-29 and 40th Avenue North are currently situated within the roadway/transportation corridor right of way.

4.6.3 POTENTIAL IMPACTS & NEXT STEPS

A future potential interchange project may require additional permanent right of way acquisition/use. It is also likely that there would be temporary right of way needs during construction. The objective would be to minimize right of way needs to the extent possible; however, the process for any confirmed right of way needs would be carried out consistent with the NDDOT Right of Way Manual. Additionally, if there were any structures impacted or relocations required, this would need to be completed consistent with the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

4.7 Economic Impacts

4.7.1 REGULATORY BACKGROUND/METHODOLOGY

The Study Area was reviewed to identify potential economic impacts that may occur as a result of access changes or right of way acquisition in the Primary Study Area.

4.7.2 EXISTING CONDITIONS

Within the Primary Study Area, there are direct access/driveways to commercial/industrial land uses. There may also be areas where current right of way for the transportation system is more limited.

4.7.3 POTENTIAL IMPACTS & NEXT STEPS

During construction of the potential future interchange project, there may be temporary access impacts associated with detours. Permanent access impacts would be avoided unless they are required to accommodate the interchange project including the management of traffic conflicts at direct access points/driveways. Right of way impacts to local businesses including commercial and industrial land uses

would be avoided. It is not anticipated that any additional right of way needs would result in impacts to the local businesses.

4.8 Land Use

4.8.1 REGULATORY BACKGROUND/METHODOLOGY

As part of accounting for the environmental setting in the Study Area, the existing land uses were identified. Physical impacts to these land uses, access changes, noise and visual impacts, and other potential impacts are considered for the land uses. Additionally, compatibility of the transportation system and land uses is considered.

4.8.2 EXISTING CONDITIONS

The I-29/40th Avenue North interchange is situated in an existing transportation corridor. The land uses within or the near the broader Study Area are seen in Figure 4 – Land, Appendix A, and described below:

- West of the I-29/40th Avenue North interchange: north of 40th Avenue North, there is a combination of commercial, rural residential, and agricultural land uses. To the south of 40th Avenue North, is the NDSU Agricultural Research plots and the City of Reile's Acres (comprised of residential land uses and three parks).
- East of I-29/40th Avenue North interchange: north of 40th Avenue North, there is a number of light industrial/commercial land uses including an Amazon Fulfillment Center. To the south of 40th Avenue North, the land uses are generally identified as Public/Institutional and are represented by a number of freight and aviation related land uses including Federal Express and the United Postal Service and the North Dakota National Guard Armory. The Hector International Airport is slightly beyond the Study Area. Just beyond the Study Area (east of North University Drive), there are residential land uses north and south of 40th Avenue North.

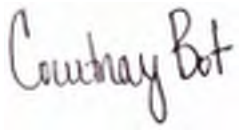
4.8.3 POTENTIAL IMPACTS & NEXT STEPS

At this stage of study, right of way impacts and associated land use impacts have not been identified or quantified including potential access changes. There is the possibility for right of way or access impacts with a future potential interchange project. During construction, it is likely there would be temporary access impacts for a number of the land uses described above. To the extent possible these impacts would be avoided or minimized. Any right of way impacts would be analyzed during the NEPA process for a future potential interchange and any acquisitions would be completed consistent with requirements set out under Section 4.6 Right of Way (including NDDOT Right of Way Manual and the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970).

Reference: Environmental Screening Technical Study for Project 8-029(213)069 NDDOT PCN 23596

Regards,

STANTEC CONSULTING SERVICES INC.



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Project Manager
Phone: (763) 479-4232
courtnay.bot@stantec.com

Attachments: Appendix A: Figures; Appendix B: Threatened and Endangered Species Review Materials (IPAC results & NDPRD response letter); Appendix C: NDPRD - RE: I-29 ND: LAWCON/Section 6(f)

APPENDIX A

Figures

Figure No.
1

Title
Study Area Map

Client/Project
NDDOT
I-29 and CR-20 Interchange
Project Location Map

193805997

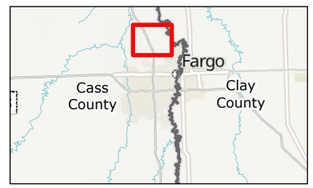
Project Location
T140N, R49W, S14, 15, 22 & 23
Cass Co., ND

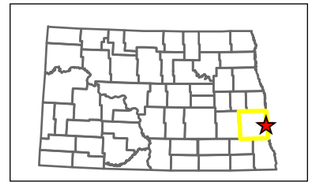
Prepared by KJM on 2023-03-02

N

0 1,000 2,000 Feet
(At original document size of 11x17)
1:24,000

Legend
- Hector Airport
- Railroad
- Primary Study Area
- Secondary Study Area
- Municipal Boundary
- State Boundary





Notes
Drawn by: KJM (Stantec)
Date: 1/25/2023
Project ID: 8-029(213)069
PCN: 23596
Coordinate System: NAD 1983 UTM Zone 14N
Background Imagery: City of Fargo 2021

NDDOT
North Dakota Department of Transportation

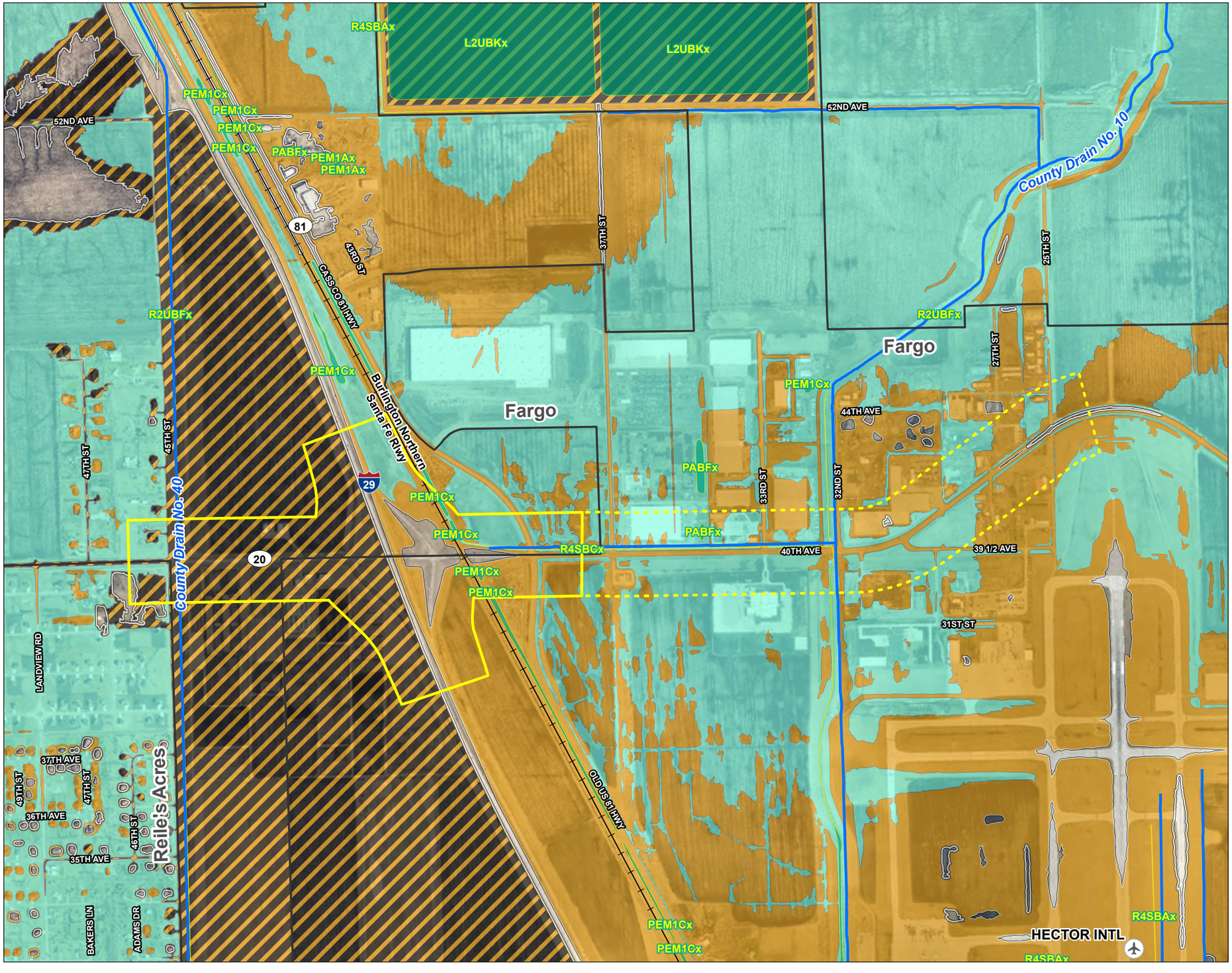


Figure No.

2

Title

Water Resources Map

Client/Project 193805997

NDDOT
I-29 and CR-20 Interchange
Project Location Map

Project Location
T140N, R49W, S14, 15, 22 & 23
Cass Co., ND

Prepared by KJM on 2023-03-28

N

0 600 1,200 Feet

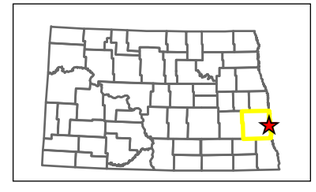
(At original document size of 11x17)
1:14,400

Legend

- Hector Airport
- Railroad
- Streams (USGS NHD)
- National Wetlands Inventory
- Primary Study Area
- Secondary Study Area
- Municipal Boundary

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Area of Minimal Flood Hazard
- Area with Reduced Flood Risk Due to Levee



Notes

Drawn by: KJM (Stantec)
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PCN: 23596
Coordinate System: NAD 1983 UTM Zone 14N
Background Imagery: City of Fargo 2021

NDDOT
North Dakota Department of Transportation

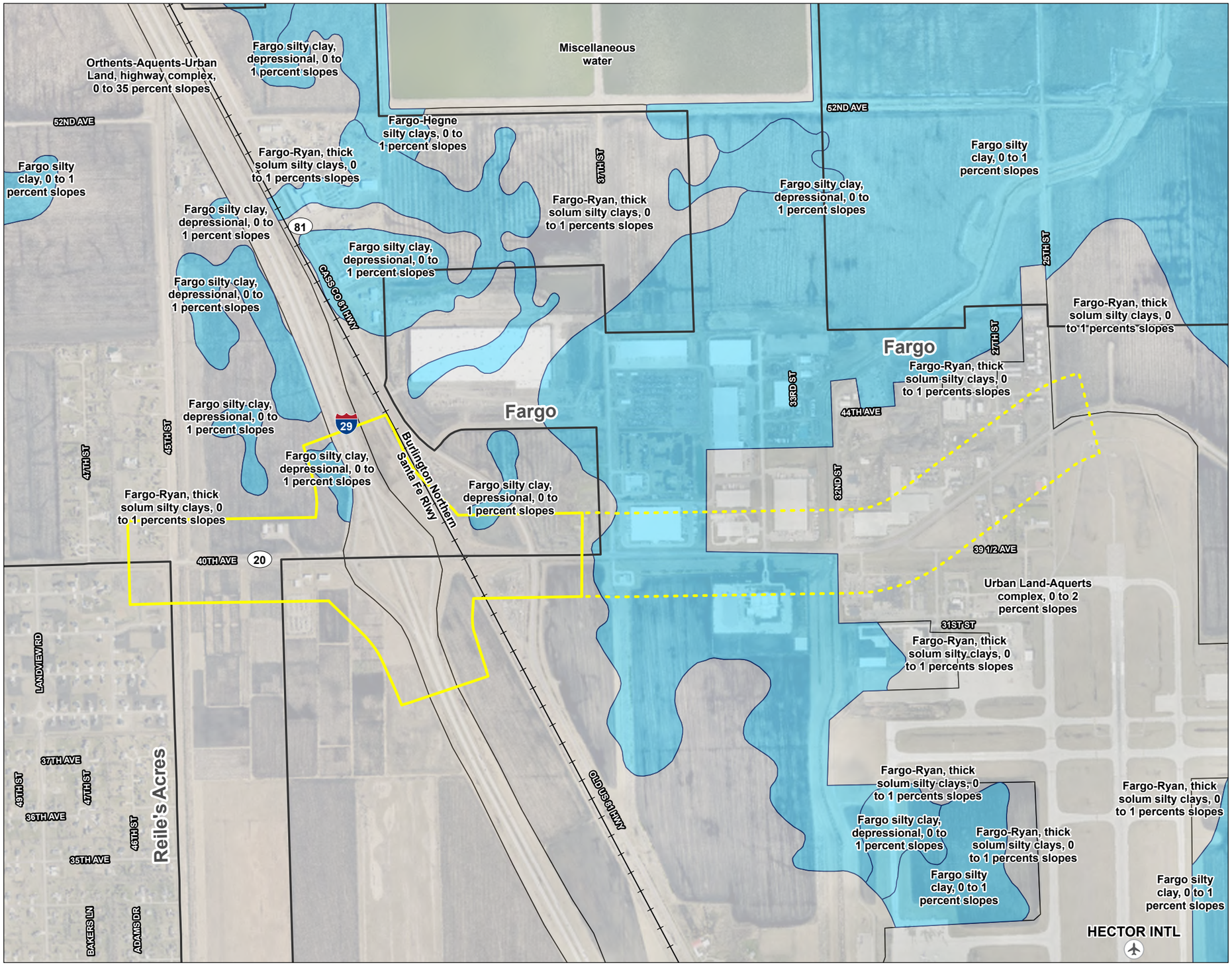


Figure No.
3

Title
Farmland Classification Map

Client/Project 193805997
NDDOT
I-29 and CR-20 Interchange
Project Location Map

Project Location
T140N, R49W, S14, 15, 22 & 23
Cass Co., ND

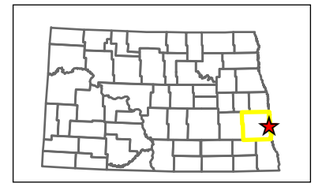
Prepared by KJM on 2023-03-21

N

0 600 1,200 Feet
(At original document size of 11x17)
1:14,400

Legend
- Hector Airport
- Railroad
- Primary Study Area
- Secondary Study Area
- Municipal Boundary

Farmland Classification
- Not Prime Farmland
- Prime Farmland if Drained



Notes
Drawn by: KJM (Stantec)
Date: 1/25/2023
Project ID: 8-029(213)069
PCN: 23596
Coordinate System: NAD 1983 UTM Zone 14N
Background Imagery: City of Fargo 2021

NDDOT
North Dakota Department of Transportation

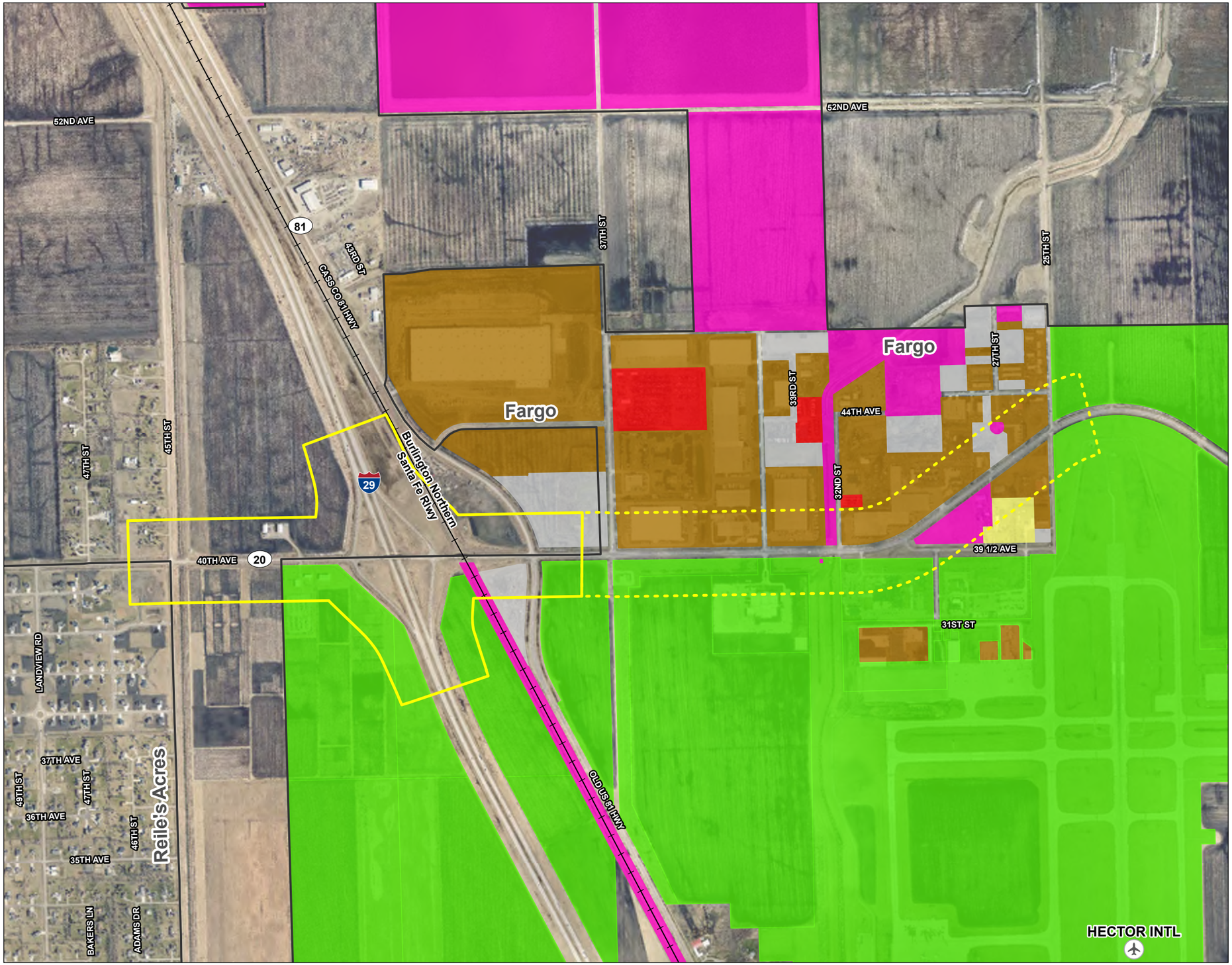


Figure No.
4

Title
Land Use Map

Client/Project 193805997
NDDOT
I-29 and CR-20 Interchange
Project Location Map

Project Location
T140N, R49W, S14, 15, 22 & 23
Cass Co., ND

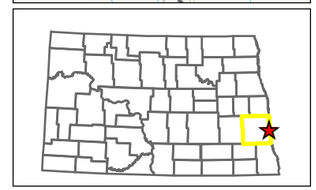
Prepared by KJM on 2023-03-21

N

0 600 1,200 Feet
(At original document size of 11x17)
1:14,400

Legend
- Hector Airport
- Railroad
- Primary Study Area
- Secondary Study Area
- Municipal Boundary

City of Fargo Land Use
- Commercial
- Industrial
- Low Density Residential
- Other
- Public and Institutional
- Vacant



Notes
Drawn by: KJM (Stantec)
Date: 1/25/2023
Project ID: 8-029(213)069
PCN: 23596
Coordinate System: NAD 1983 UTM Zone 14N
Background Imagery: City of Fargo 2021

NDDOT
North Dakota Department of Transportation

Figure No.
5

Title
Hazardous Material Incident Map

Client/Project 193805997
NDDOT
I-29 and CR-20 Interchange
Project Location Map

Project Location
T140N, R49W, S14, 15, 22 & 23
Cass Co., ND

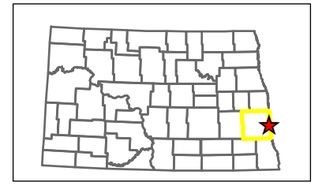
Prepared by KJM on 2023-03-23

N

0 600 1,200 Feet
(At original document size of 11x17)
1:14,400

Legend

Hazardous Material Incidents
- E Environmental Incident
- OG Oil/Gas Spill Incident
- Railroad
- Primary Study Area
- Secondary Study Area
- Municipal Boundary



Notes
Drawn by: KJM (Stantec)
Date: 1/25/2023
Project ID: 8-029(213)069
PCN: 23596
Coordinate System: NAD 1983 UTM Zone 14N
Background Imagery: City of Fargo 2021

NDDOT
North Dakota Department of Transportation

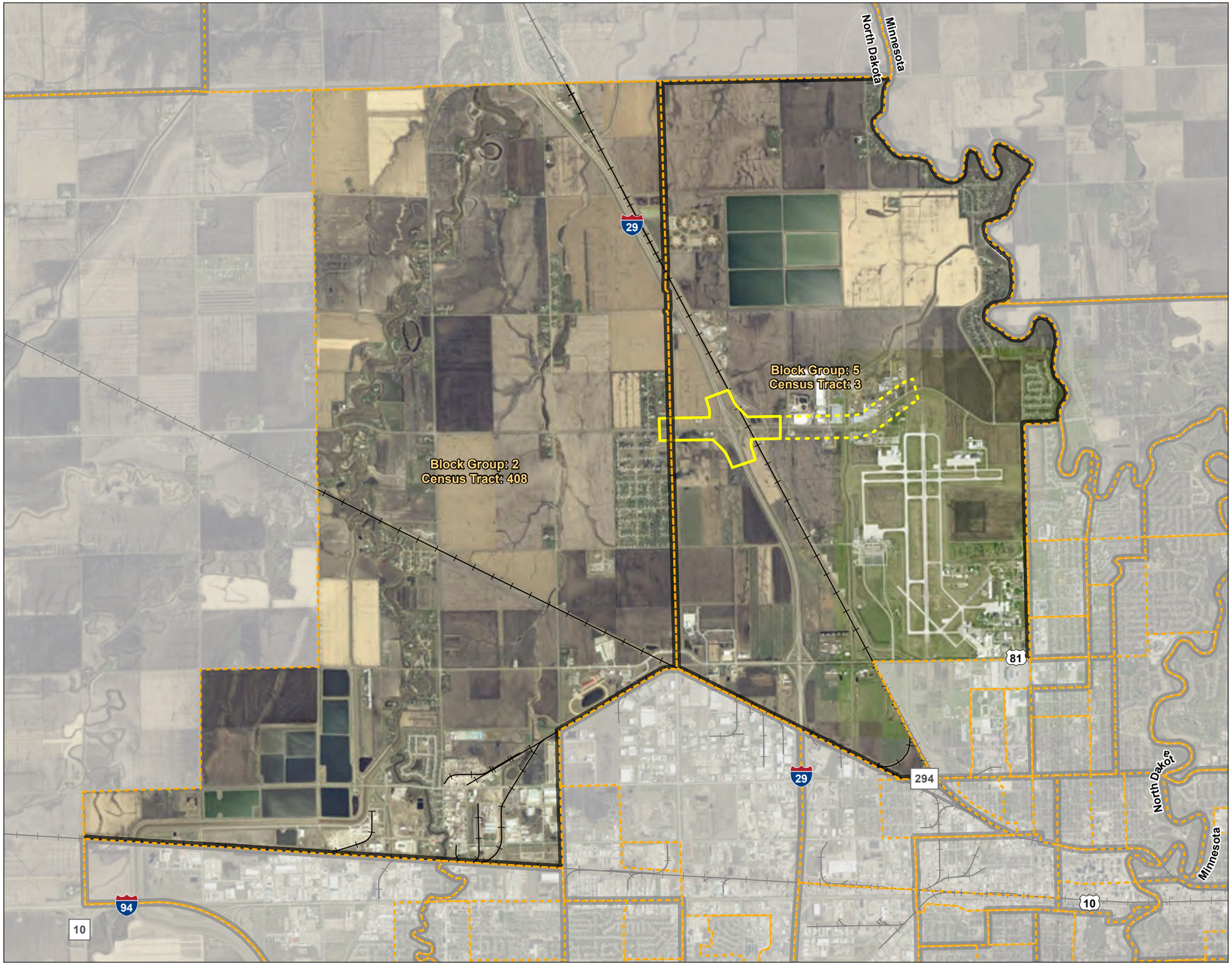


Figure No.
6

Title
Environmental Justice

Client/Project 193805997
NDDOT
I-29 and CR-20 Interchange
Project Location Map

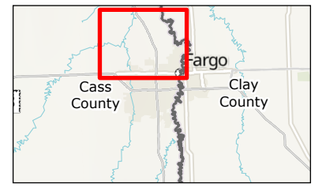
Project Location
T140N, R49W, S14, 15, 22 & 23
Cass Co., ND

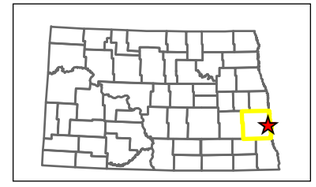
Prepared by KJM on 2023-03-23

N

0 2,250 4,500 Feet
(At original document size of 11x17)
1:54,000

Legend
- Hector Airport
- Railroad
- Census Block Group
- Census Tract
- Primary Study Area
- Secondary Study Area





Notes
Drawn by: KJM (Stantec)
Date: 1/25/2023
Project ID: 8-029(213)069
PCN: 23596
Coordinate System: NAD 1983 UTM Zone 14N
Background Imagery: City of Fargo 2021

NDDOT
North Dakota Department of Transportation

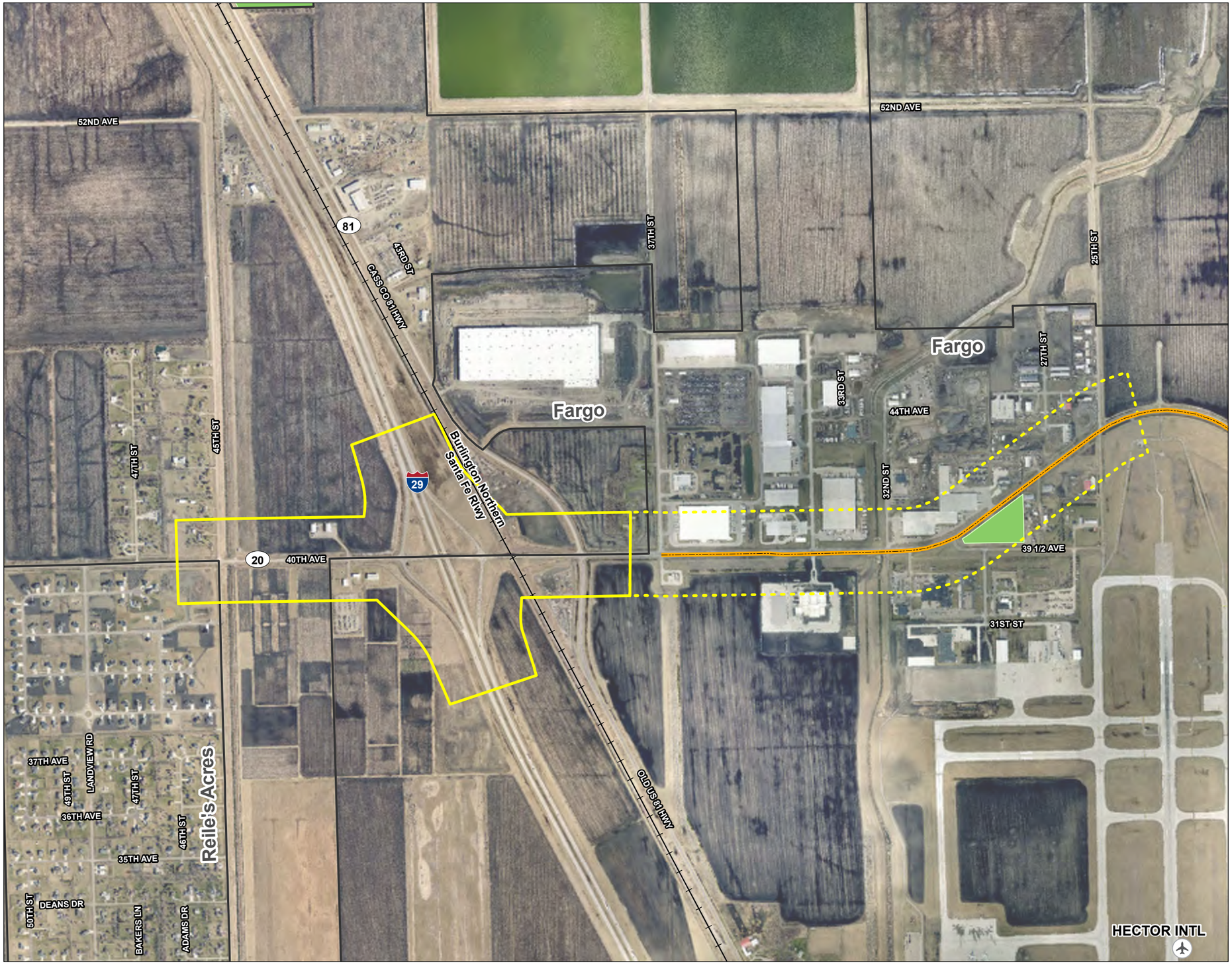


Figure No.
7

Title
Parks Trails and Other Recreational Areas

Client/Project 193805997
NDDOT
I-29 and CR-20 Interchange
Project Location Map

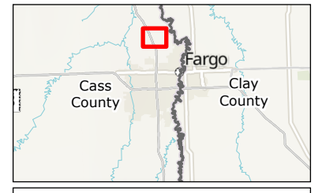
Project Location
T140N, R49W, S14, 15, 22 & 23
Cass Co., ND

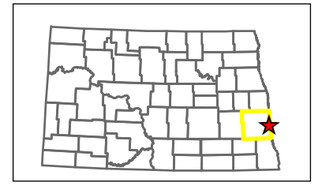
Prepared by KJM on 2023-03-28

N

0 600 1,200
Feet
(At original document size of 11x17)
1:14,400

Legend
- Hector Airport
- Railroad
- Existing On-Street Bikeways
- City of Fargo Parks
- Primary Study Area
- Secondary Study Area
- Municipal Boundary





Notes
Drawn by: KJM (Stantec)
Date: 1/25/2023
Project ID: 8-029(213)069
PCN: 23596
Coordinate System: NAD 1983 UTM Zone 14N
Background Imagery: City of Fargo 2021

NDDOT
North Dakota Department of Transportation

APPENDIX B

Threatened and Endangered Species Review Materials

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Cass County, North Dakota

Local office

North Dakota Ecological Services Field Office

(701) 250-4481
(701) 355-8513

3425 Miriam Avenue

Bismarck, ND 58501-7926

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).

2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Northern Long-eared Bat Myotis septentrionalis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9045	Threatened

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern https://www.fws.gov/program/migratory-birds/species
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
American Golden-plover Pluvialis dominica This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Dec 1 to Aug 31
Black Tern Chlidonias niger This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3093	Breeds May 15 to Aug 20

Black-billed Cuckoo Coccyzus erythropthalmus — Breeds May 15 to Oct 10

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9399

Bobolink Dolichonyx oryzivorus — Breeds May 20 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

California Gull Larus californicus — Breeds Mar 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Chimney Swift Chaetura pelagica — Breeds Mar 15 to Aug 25

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Clark's Grebe Aechmophorus clarkii — Breeds Jun 1 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Eastern Whip-poor-will Antrostomus vociferus — Breeds May 1 to Aug 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Franklin's Gull Leucophaeus pipixcan — Breeds May 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Golden-winged Warbler Vermivora chrysoptera — Breeds May 1 to Jul 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8745

Hudsonian Godwit *Limosa haemastica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Long-eared Owl *asio otus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
Marbled Godwit *Limosa fedoa* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9481	Breeds May 1 to Jul 31
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10
Ruddy Turnstone *Arenaria interpres morinella* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Short-billed Dowitcher *Limnodromus griseus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Western Grebe *aechmophorus occidentalis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/6743	Breeds Jun 1 to Aug 31
Willet *Tringa semipalmata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 20 to Aug 5

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

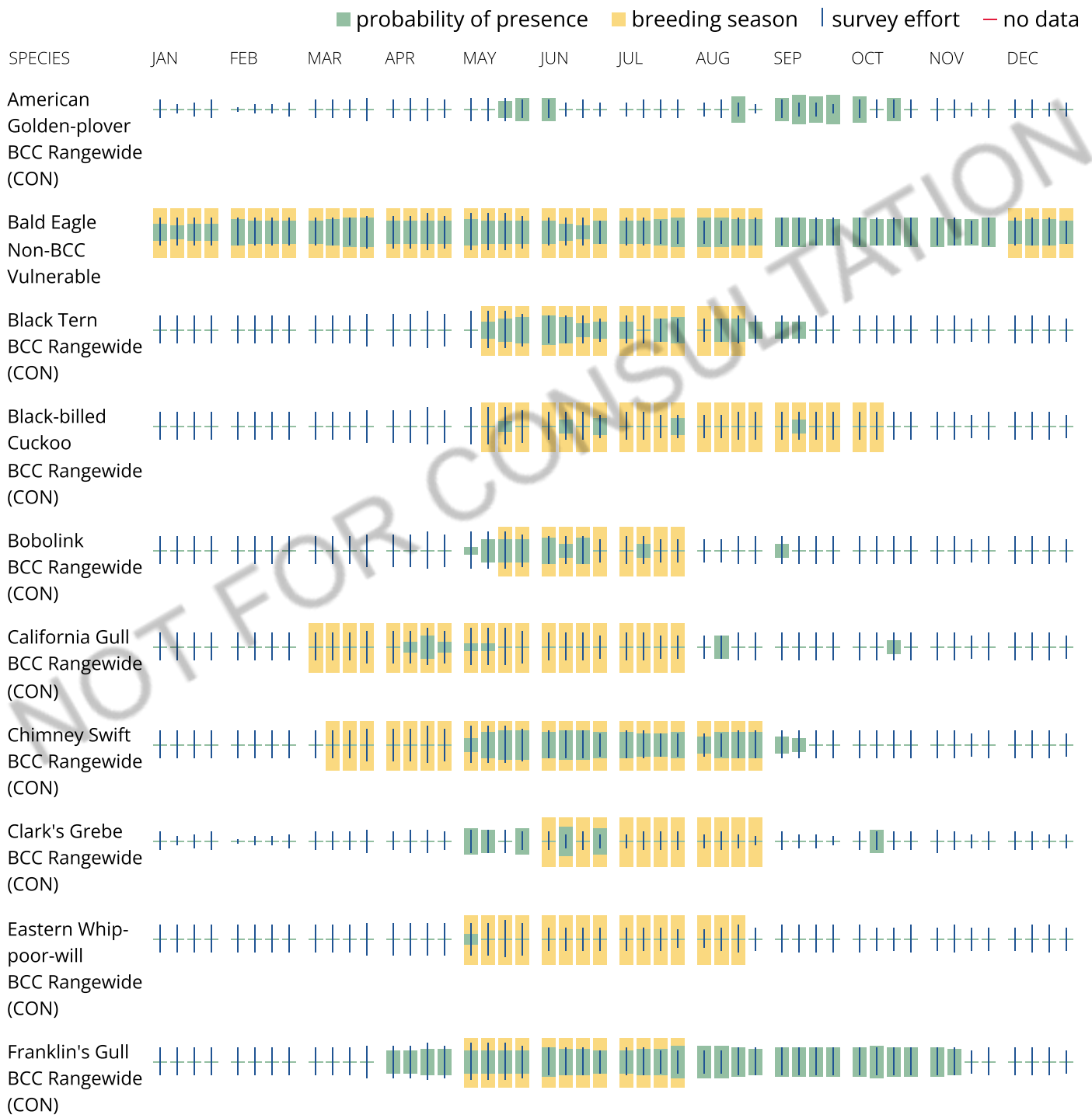
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

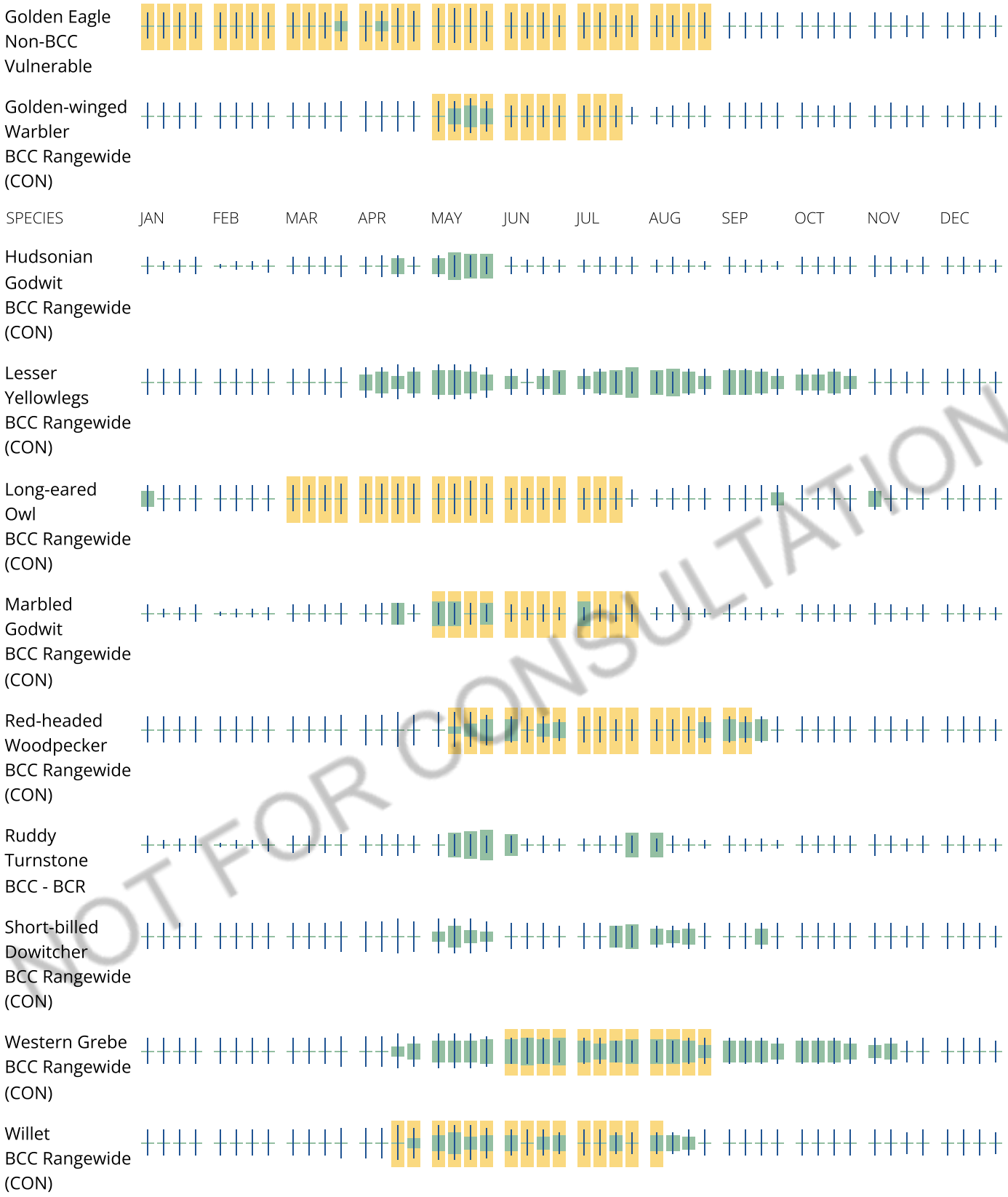
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the

locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and

3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

This location did not intersect any wetlands mapped by NWI.

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

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March 7, 2023

Courtnay Bot
Stantec
One Carlson Parkway, Suite 100
Plymouth, MN 55447

Re: Interstate 2940th Ave. N Interchange Project, Fargo, ND

Dear Courtnay,

The North Dakota Parks and Recreation Department (NDPRD) has reviewed the above-referenced Interstate 2940th Ave. N Interchange Project in Fargo, North Dakota.

NDPRD's scope of authority and expertise covers properties that NDPRD owns, leases, or manages; properties protected under Section 6(f) of the Land and Water Conservation Fund (LWCF); rare plants; and ecological communities established through the Natural Heritage Program.

The project does not appear to affect properties NDPRD owns, leases, or manages.

The project does not appear to affect any properties protected under Section 6(f) of the LWCF.

A North Dakota Natural Heritage biological conservation database query determines if any current or historical plant or animal species of concern or other significant ecological communities are known to occur within an approximate one-mile radius of the project area. Based on this review, no known plant and animal species of concern or significant ecological communities were documented within or immediately adjacent to the project site.

We appreciate your commitment to rare plant, animal, and ecological community conservation, management, and inter-agency cooperation. For additional information, please contact me at 701-328-5370, 701-220-3377 (cell), or kgduttenhefner@nd.gov.

Thank you for the opportunity to comment on the proposed project.

Sincerely,

Kathy Duttenhefner

Kathy Duttenhefner, Chief
Natural Resources Division

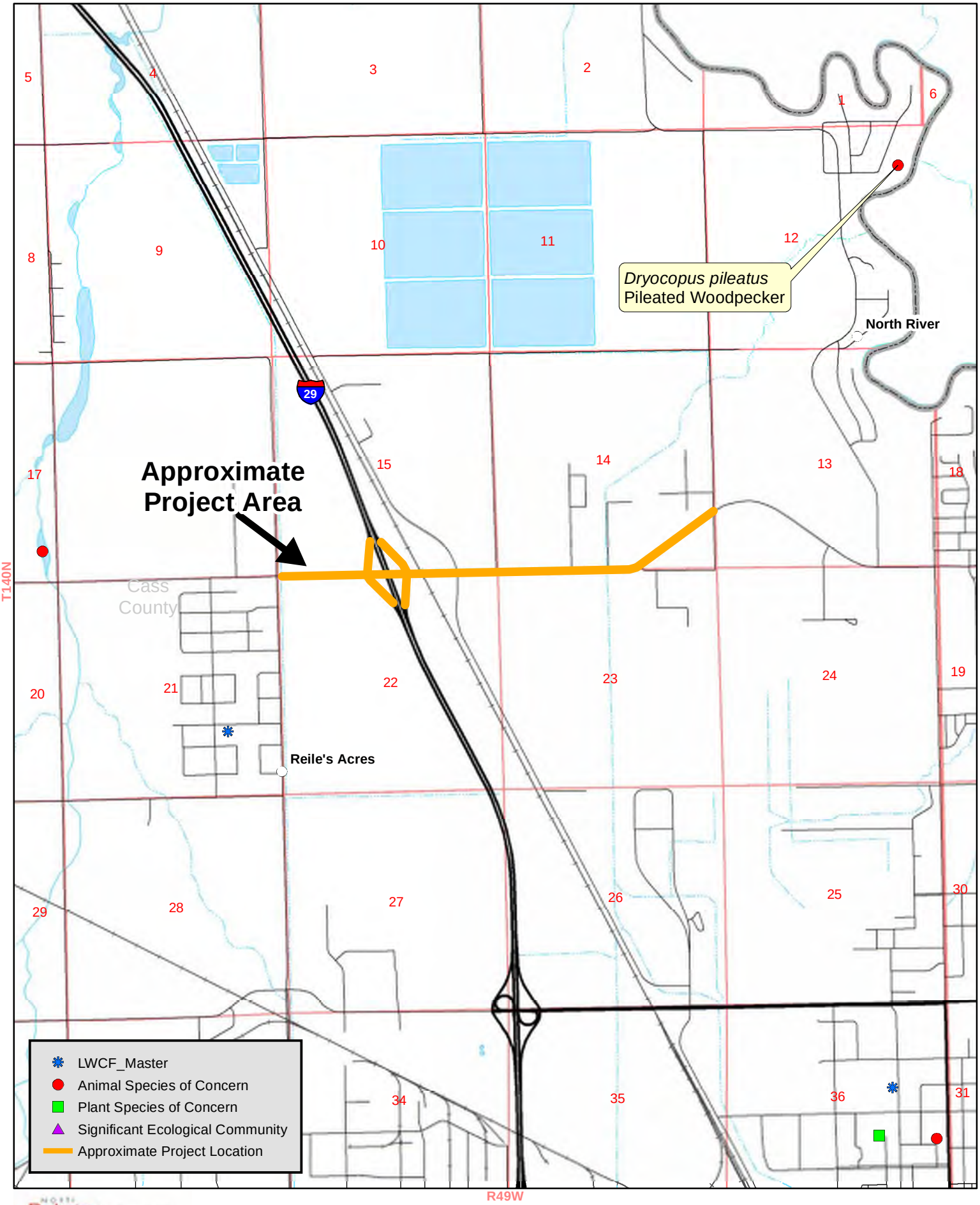
604 E Boulevard Ave Dept. 750 | Bismarck, ND 58505
PHONE: 701-328-5357 | FAX: 701-328-5363 | EMAIL: parkrec@nd.gov | WEBSITE: www.parkrec.nd.gov

North Dakota Natural Heritage Inventory

Rare Animal and Plant Species and Significant Ecological Communities

State Scientific Name	State Common Name	State Rank	Global Rank	Federal Status	Township Range Section	County	Last Observation	Estimated Representation Accuracy	Precision
Dryocopus pileatus	Pileated Woodpecker	S3	G5		140N049W - 12; 140N049W - 10; 141N049W - 21; 140N049W - 16; 141N049W - 35; 140N049W - 02; 140N049W - 35; 141N049W - 22; 140N049W - 28; 141N049W - 14; 141N049W - 34; 140N049W - 26; 141N049W - 13; 140N049W - 06; 139N049W - 01; 140N049W - 23; 140N049W - 20	Cass	1972		G

North Dakota Parks and Recreation Department
North Dakota Natural Heritage Inventory



February 2023

APPENDIX C

NDPRD - RE: I-29 ND: LAWCON/Section 6(f)

From: Bjergaard, Gabriel J. <gbjergaard@nd.gov>
Sent: Friday, February 24, 2023 6:17 PM
To: Bot, Courtnay
Subject: RE: I-29 ND: LAWCON/Section 6(f)

Hello Courtney,

There is a Land and Water Conservation Fund (LWCF) Project at Reale's Acres. that is 1.26 miles away from your project. Char and I both agree that this will not interfere with your project. if you have any other GIS questions, I am always happy to help you out.

Gabriel Bjergaard
Geographic Information Systems Specialist
gbjergaard@nd.gov • (O) **701-328-5339** • (C) **701-319-8621**
604 E Boulevard Ave, Dept. 750 • Bismarck, ND 58505
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Appendix H – Combined No-Build and Primary Corridor Alternatives Models Summary

Stantec

Memo

To:	Jennifer Kern, PE, Chad Frisinger, PE North Dakota Department of Transportation	From:	Mark Butler, AICP Pat McGraw, PE Stantec Consulting Services
File:	Preliminary Engineering and Feasibility Study Services for Project 8-029(213)069 NDDOT PCN 23596	Date:	February 17, 2023

Reference: I-29 & 40th Ave N Interchange: Combined No-Build and Primary Corridor Alternatives Models Summary

PROJECT DESCRIPTION

The Stantec team is working with the North Dakota Department of Transportation (NDDOT) to complete a preliminary engineering and feasibility study to evaluate improvement alternatives for the 40th Avenue North (Cass County Route 20) interchange with I-29 in Fargo, ND (Exit 69). Previous studies have recommended implementing traffic signals or roundabouts at the primary intersections throughout the project corridor. To further develop a basis for comparison of interchange alternatives, Stantec developed a corridor alternative with traffic signals and a corridor alternative with roundabouts at seven intersections along the corridor. As an initial comparison, base year (2022) and future year (2045) AM and PM peak hour simulation models were created for the **existing** corridor configuration, the **signalized** corridor alternative, and the **roundabout** corridor alternative. The existing interchange and roadway geometry was otherwise maintained as a single directional lane corridor.

STUDY AREA

The study area includes the 40th Avenue North interchange with I-29 and 40th Avenue North between the connecting streets from 45th Street North to 25th Street North. The 40th Avenue North corridor is classified as a two-lane major collector highway west of CR 81 and as a two-lane minor arterial highway east of CR 81. The corridor's speed limit is 40 miles per hour (MPH) with stop control for all side streets within the project limits, except for the intersection with CR 81, which has a traffic signal. **Figure 1** presents the study area.

Figure 1: Corridor Study Area

CORRIDOR CONCEPTS

Three corridor concepts have been developed to pair with each interchange design alternative. The first of these three corridor concepts is the existing corridor configuration. The existing corridor configuration contains a single traffic signal at CR 81and stop control for all other side streets and driveways. In the existing corridor, There are currently no turns lanes at the intersections at 45th Street North and the I-29 ramp terminals, and various lane configurations for the intersections east of I-29, as depicted in **Table 1**. A "1" indicates one lane provides the movements as listed in the table heading and an "X" reflects when a movement is not allowed.

Table 1. Existing Corridor Intersection Turn Lane Configurations

	Westbound Appr.			Eastbound Appr.			Southbound Appr.			Northbound Appr.		
40th Avenue North at:	**LT**	**TH**	**RT**	**LT**	**TH**	**RT**	**LT**	**TH**	**RT**	**LT**	**TH**	**RT**
45th Street North	1			1			1			1		
I-29 Southbound Ramps	1			1			1			X		
I-29 Northbound Ramps	1			1			X			1		
CR 81	1	1	1	1	1		1		1	1		
37th Street North	1		1	1		1	1		1	1		
33rd Street North	1	1	1	1	1	1	1			1		
32nd Street North	1		1	1		1	1			X		
39 1/2 Avenue North	1			X	1	1	X			1		
25th Street North	1			1			1			1		

In addition to the existing corridor concept, traffic signal and roundabout intersection control improvement concepts were developed for seven intersections along the 40th Avenue North corridor. These two corridor concepts were developed with improved intersection control based on "No Build" corridor geometry (i.e. traffic signals were added to the existing roadway configuration). These intersections include:

1. 45th Street North
2. Southbound I-29 Ramps
3. Northbound I-29 Ramps
4. County Route 81 (CR 81)
5. 37th Street North
6. 33rd Street North
7. 25th Street North

As directed by the project scope, for this analysis the traffic signal and roundabout concepts generally maintain the existing roadway geometry of the corridor where possible. Existing turn lanes were maintained in the signalized corridor, although all roundabout approaches are single lane. Additional lane capacity improvements on the corridor may be added as deemed necessary in the proceeding alternative interchange models.

EXISTING 2022 NETWORK INTERSECTION DELAY AND LEVEL OF SERVICE

Each of the three corridor concepts was simulated with existing 2022 traffic for AM and PM peak hour traffic. **Attachment A** presents the turning movement counts that were the basis for the existing year trips. Traffic analyses were performed using the TransModeler traffic simulation program which replicates analysis procedures included within the Highway Capacity Manual (HCM). TransModeler provides a number of performance measures as output, including level of service (LOS). LOS is a qualitative measure describing operational conditions within a traffic system, based on service measures such as speed, delay, freedom to maneuver, traffic interruptions, comfort, and convenience. There are six levels of service, having letter grades A through F. In regard to intersections, the performance measure for LOS is average delay per vehicle. **Table 2** presents the LOS criteria (in seconds per vehicle) for control delay at unsignalized intersections / roundabouts and at signalized intersections.

Table 2. Intersection LOS Scale

LOS	Unsignalized Intersection / Roundabout	Signalized Intersection
A	≤10 sec	≤10 sec
B	10–15 sec	10–20 sec
C	15–25 sec	20–35 sec
D	25–35 sec	35–55 sec
E	35–50 sec	55–80 sec
F	>50 sec	>80 sec

Table 3 presents the base year 2022 intersection delay and LOS for the seven identified intersections on the corridor for the existing configuration of traffic control on the corridor, with a single signal at the intersection at CR 81. These statistics were estimated from the average of five model simulation runs for both the AM peak hour and the PM peak hour, using TransModeler's standard output report function, which incorporates the basic methodological principles of the Highway Capacity Manual (HCM). **Table 3** illustrates that the low volume on the corridor in 2022 does not warrant any intersection improvements, as all intersections operate at LOS A with minimal intersection delay.

Table 3. Existing Intersection 2022 Average Delay and LOS

Intersection	AM Peak Hour			PM Peak Hour		
	Vehicles	Avg Delay (sec.)	LOS	Vehicles	Avg Delay	LOS
45th Street North	273	1.0	A	234	0.5	A
Southbound I-29 Ramps	488	3.9	A	485	2.4	A
Northbound I-29 Ramps	581	4.8	A	706	4.9	A
County Route 81 (CR 81)*	622	6.9	A	694	8.3	A
37th Street North	527	0.2	A	584	0.5	A
33rd Street North	524	0.3	A	560	1.1	A
25th Street North	459	0.9	A	486	0.6	A

*Intersection with Traffic Signal

SIGNALIZED INTERSECTIONS

As **Table 3** illustrates, no capacity improvements are necessary for the seven identified intersections to operate with acceptable LOS for existing 2022 traffic volumes. While these intersections do not warrant signals under existing traffic conditions, the signalized intersections were analyzed with the base year 2022 trip tables as a test to ensure all movements and functionality work correctly. All signal timings plans were optimized to minimize average delay using TransModeler's optimization function and existing turning movement counts. As is typical of diamond interchanges, the traffic signal timing plans at the northbound and southbound ramp terminal intersections are coordinated with each other. The remaining five intersections operate independently. These intersections are shown in **Figure 2**.

Figure 2: Conceptual Signalized Intersection Locations

Table 4 presents a summary of average intersection delay and LOS for existing 2022 traffic conditions for the signalized corridor concept. As expected, all intersections operate at LOS A, although delay increases slightly due to the introduction of signals at intersections where free flow on 40th Avenue North currently exists.

Table 4. 2022 Average Intersection Delay and LOS with Traffic Signals

Intersection	AM Peak Hour			PM Peak Hour		
	Vehicles	Avg Delay (sec.)	LOS	Vehicles	Avg Delay	LOS
45th Street North	271	2.7	A	231	1.5	A
Southbound I-29 Ramps	485	7.8	A	483	6.7	A
Northbound I-29 Ramps	579	6.3	A	705	8.3	A
County Route 81 (CR 81)	622	6.6	A	693	8.1	A
37th Street North	524	0.6	A	585	1.3	A
33rd Street North	517	1.8	A	559	4.7	A
25th Street North	456	2.2	A	482	1.9	A

ROUNDABOUTS

The roundabout corridor alternative converts each of the seven intersections into roundabouts. Conceptual single-lane roundabouts were coded into the model network and analyzed with the base year 2022 trip tables as a test to ensure all movements and functionality work correctly. Based on existing traffic volumes, single-lane roundabouts, shown in **Figure 3**, sufficiently serve base year traffic.

Figure 3: Conceptual Roundabout Locations

Table 5 presents a summary of average intersection delay and LOS for existing conditions for this concept.

Table 5. 2022 Average Delay and LOS with Roundabouts

	AM Peak Hour			PM Peak Hour		
Roundabout	Vehicles	Avg Delay (sec.)	LOS	Vehicles	Avg Delay	LOS
45th Street North	277	3.2	A	236	2.3	A
Southbound I-29 Ramps	493	4.2	A	486	4.1	A
Northbound I-29 Ramps	585	3.8	A	710	3.7	A
County Route 81 (CR 81)	631	4.2	A	698	4.0	A
37th Street North	531	3.8	A	594	3.7	A
33rd Street North	527	3.6	A	569	3.3	A
25th Street North	461	2.1	A	496	1.5	A

CORRIDOR LEVEL OF SERVICE

TransModeler also reports LOS at the corridor level, generally based on operational speed compared to free flow speed. This metric reflects the overall LOS from 45th Street North to 25th Street North. The free flow speed established for this corridor is 50 MPH. **Table 6** presents the corridor LOS for each corridor type for the 2022 base year. With low traffic volumes, the LOS of the corridor in the 2022 base year reflect optimal conditions.

Table 6. Base year 2022 Corridor LOS

AM Peak Hour			
Direction	Network	Average Speed (MPH)	LOS
Westbound	Existing	39	B
	Signalized	37	B
	Roundabouts	33	B
Eastbound	Existing	41	A
	Signalized	41	A
	Roundabouts	33	B
PM Peak Hour			
Direction	Network	Average Speed (MPH)	LOS
Westbound	Existing	40	A
	Signalized	37	B
	Roundabouts	33	B
Eastbound	Existing	41	A
	Signalized	40	B
	Roundabouts	32	B

2045 FUTURE TRAFFIC

Future year 2045 AM and PM peak hour trip tables were developed for the simulation models based on growth assumptions developed from an analysis of count data and FM Metro COG travel demand model assignments, and from the **Northwest Fargo Small Area Study**[1] and Metro COG's **Northwest Metro Transportation Plan Final Report**.[2] These assumptions were synthesized in a previous memorandum[3] to identify growth rates that reflected the general average daily traffic (ADT) expected in 2045, given the local development anticipated to occur. **Table 7** presents the summary of compound annual growth rates (CAGRs) from that technical memorandum.

Table 7. CAGRs by Data Source and Recommended CAGRs

Source	I-29		I-29 Ramps				40th Ave. N.		CR 81	
	north of 40th Ave.	south of 40th Ave.	NB Exit	NB Entrance	SB Exit	SB Entrance	west of I-29	east of CR 81	north of 40th Ave.	south of 40th Ave.
NDDOT Historical Counts	-0.5%	1.4%	2.9%	-0.8%	0.7%	2.9%	6.2%	3.6%	9.1%	8.4%
NDDOT Forecast (2042)		1.9%	2.4%	4.1%						
Metro COG Model (2045)	1.6%	1.6%	1.3%	0.7%	1.4%	1.4%	1.0%	1.3%	2.3%	4.8%
NW Small Area Study (2030)								6.7%*	14.2%	5.0%
NW Metro Trans. Plan. (2045) "50% Buildout"							7.2%	3.0%	2.3%	7.6%
Recommended CAGR	1.9%	1.9%	2.5%	2.5%	2.5%	2.5%	7.0%	3.5%	7.0%	7.0%
Estimated 2045 ADTs	23,000	33,000	6,500	800	750	6,250	15,200	18,300	4,250	7,750

* Between I-29 and CR 81

The AM and PM 2045 trip tables were developed to reflect and reconcile the target growth rates with an emphasis and deference to fully assigning anticipated traffic to the 40th Avenue North corridor. **Table 8** compares the total number of trips in the model trip tables for 2022 and 2045 and demonstrates that total traffic on the 40th Avenue North corridor almost quadruples in both the AM and PM peak hours, in line with the AADT expectations for the corridor, as presented in the **Northwest Metro Transportation Plan Final Report** for its *50% Buildout* development scenario for the area.

Table 8. Model Trips Summary by Vehicle Class and Scenario Year

	AM Peak Hour				PM Peak Hour			
	I-29 (Through)		40th Ave N (Local)		I-29 (Through)		40th Ave N (Local)	
	2022	**2045**	**2022**	**2045**	**2022**	**2045**	**2022**	**2045**
Auto/Lt.Trk	1,007	1,462	830	2,887	1,223	1,694	835	3,221
SU Truck	102	138	19	98	128	179	28	118
MU Truck	154	208	28	137	193	269	38	171
Total Trips	1,263	1,808	877	3,122	1,544	2,142	901	3,510

Attachment B presents the unrounded output 2045 demand turning movements derived from the 2045 trip tables.

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[1] Transportation Collaborative and Consultants, LLC (2022) *Northwest Fargo Small Area Study.* Report to the City of Fargo.
[2] https://www.fmmetrocog.org/projects-rfps/completed-projects/nwmetro-transportation-plan
[3] Mark Butler, Pat McGraw. Stantec (January 23, 2023) *I-29 and 40th Avenue North Interchange Preliminary Engineering and Feasibility Study Traffic Forecast Data Sources and Recommendations,* Technical memorandum to NDDOT.

FUTURE TRAFFIC COMPARISON

Model simulations of the three corridor models were run with the future 2045 trip tables. These test simulations are intended to assess the anticipated corridor function should no other improvements be made to the interchange. As may be expected, the **existing network configuration** fails immediately with the introduction of thousands of additional peak hour vehicles. Traffic queues form on both exit ramps, along 40th Avenue North, and on the side streets. Backups beyond the limits of the model network result in a significant number of scheduled trips that cannot be loaded onto the network before the simulation period ends. The independent performance of the other intersections away from the interchange are impossible to determine given the bottleneck created at the interchange.

Similar failed results occur with the **signalized corridor**. Without left turn lanes to store left turning vehicles at the interchange ramp intersections, the single through lanes on the bridge quickly congest and create queues that ultimately spread to include the entire 40th Avenue North corridor. As with the existing configuration, the performance of the signalized intersections away from the interchange cannot be accurately assessed.

The results for the **roundabout corridor** concept appear more promising overall, but still fail to adequately serve all movements. The ramp terminal roundabouts process significantly more vehicles than the other intersection alternatives and overall delay is much lower. However, in the AM peak hour, eastbound traffic on 40th Avenue North between 45th Street North and the southbound ramp terminal roundabout queues almost to 45th Street due to westbound-to-southbound traffic consistently flowing through the roundabout. Similar examples exist in the PM peak hour in the opposite direction as westbound traffic on 40th Avenue North must yield to northbound-to-westbound interstate exit ramp traffic inside the northbound I-29 ramp terminal roundabout. Similar queues exist for southbound CR 81 and 37th Street North traffic. These delays are reflected in the overall system delay, but not specifically in the delay recorded at the corresponding roundabouts.

Tables 9, 10, and **11** present the recorded delay and LOS for each of the corridor alternatives applying the future year 2045 trip tables. **Table 12** presents the corridor LOS for the 2045 future year for each network type.

Table 9. Existing Intersection Configuration 2045 Average Delay and LOS

	AM Peak Hour			PM Peak Hour		
Intersection	Vehicles	Avg Delay (sec.)	LOS	Vehicles	Avg Delay	LOS
45th Street North	1,081	57	F	998	10	F
Southbound I-29 Ramps	1,121	83	F	1,033	155	F
Northbound I-29 Ramps	815	251	F	890	252	F
County Route 81 (CR 81)*	904	169	F	925	223	F
37th Street North	696	163	F	655	331	F
33rd Street North	662	79	F	653	183	F
25th Street North	648	63	F	665	53	F

*Intersection with Traffic Signal

Table 10. 2045 Average Intersection Delay and LOS for Signalized Corridor

	AM Peak Hour			PM Peak Hour		
Intersection	Vehicles	Avg Delay (sec.)	LOS	Vehicles	Avg Delay	LOS
45th Street North	1,241	15	B	1,056	85	F
Southbound I-29 Ramps	1,335	88	F	1,073	189	F
Northbound I-29 Ramps	987	196	F	1,099	278	F
County Route 81 (CR 81)	1,061	154	F	1,000	232	F
37th Street North	786	122	F	703	308	F
33rd Street North	718	63	E	725	165	F
25th Street North	689	35	D	719	59	E

Table 11. 2045 Average Delay and LOS for Roundabout Corridor

	AM Peak Hour			PM Peak Hour		
Roundabout	Vehicles	Avg Delay (sec.)	LOS	Vehicles	Avg Delay	LOS
45th Street North	1,330	37	E	1,643	5	A
Southbound I-29 Ramps	1,661	50	E	1,797	13	B
Northbound I-29 Ramps	1,692	10	A	2,019	86	F
County Route 81 (CR 81)	1,792	9	A	1,545	81	F
37th Street North	1,333	5	A	1,359	62	F
33rd Street North	1,192	5	A	1,303	4	A
25th Street North	1,025	3	A	1,111	2	A

Table 12. 2045 Future Year Corridor LOS

AM Peak Hour			
Direction	Network	Average Speed (MPH)	LOS
Westbound	Existing	9	F
	Signalized	10	F
	Roundabouts	31	B
Eastbound	Existing	38	B
	Signalized	25	C
	Roundabouts	24	C
PM Peak Hour			
Direction	Network	Average Speed (MPH)	LOS
Westbound	Existing	6	F
	Signalized	6	F
	Roundabouts	16	E
Eastbound	Existing	38	B
	Signalized	9	F
	Roundabouts	31	B

MODEL TRIP STATISTICS

Table 13 presents the total trip statistics for each of the 2045 model simulations. As the table illustrates, both the existing network and signalized network produce severe delay and leave a significant number of trips either stuck on the network by the end of the simulation period (en route trips), redirected from their destination due to congestion (missed trips) or unable to enter the network entirely (unserved trips). By comparison, the roundabout corridor served significantly more trips, but still produced significant total delay.

Table 13. 2045 Model Trip Statistics

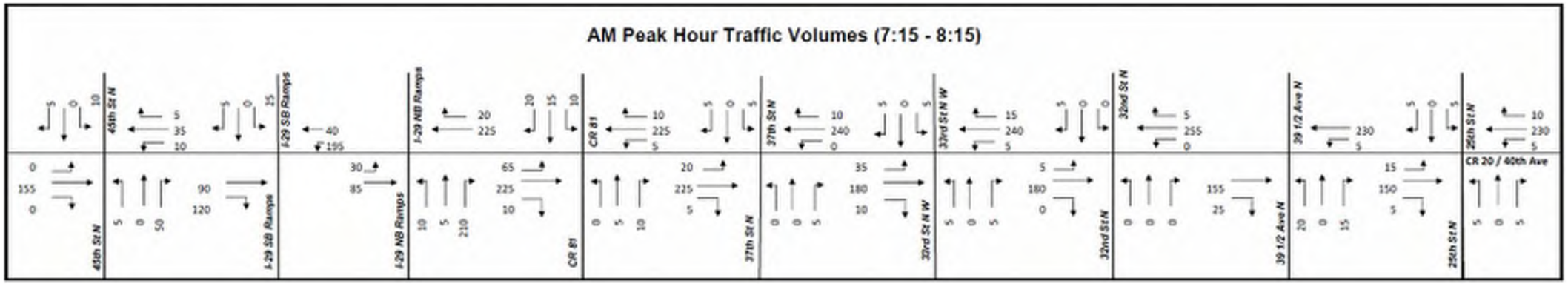
AM Peak Hour									
Metric	Trips			Total Delay (Hours)			Vehicle Hours Traveled (VHT)		
Corridor Type	Existing	Signalized	Roundabout	Existing	Signalized	Roundabout	Existing	Signalized	Roundabout
Completed	3,058	3,391	4,616	255	191	89	382	332	291
En Route	1,149	1,062	332	419	315	18	438	330	25
Missed / Unserved	829	577	72	130	79	10	133	80	10
Total	5,036	5,030	5,020	804	585	118	953	743	326
PM Peak Hour									
Metric	Trips			Total Delay (Hours)			Vehicle Hours Traveled (VHT)		
Corridor Type	Existing	Signalized	Roundabouts	Existing	Signalized	Roundabouts	Existing	Signalized	Roundabouts
Completed	2,667	3,111	4,853	361	561	161	466	690	380
En Route	1,215	1,215	441	634	475	80	654	493	89
Missed / Unserved	1,860	1,440	467	493	280	175	499	281	175
Total	5,742	5,766	5,762	1,488	1,316	416	1,619	1,465	645

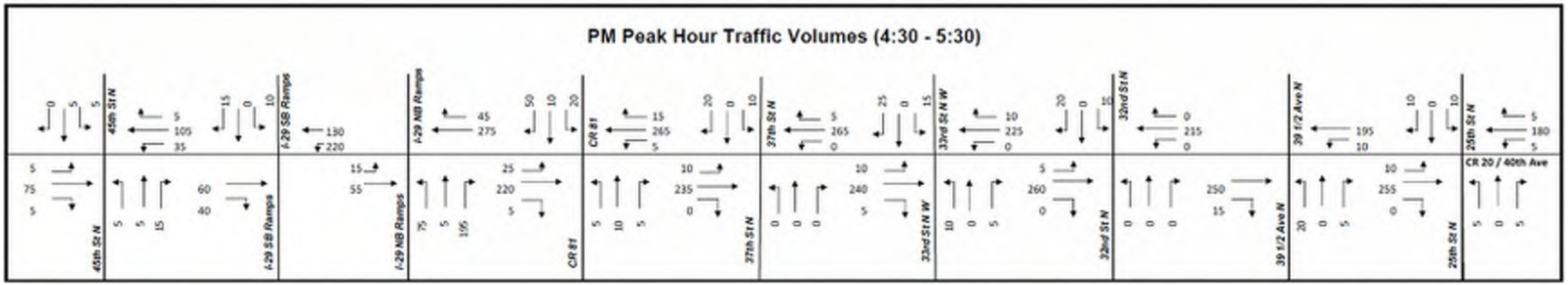
NEXT STEPS

The next step is to prepare simulation model networks for each of the approved alternative interchange concepts described in the *Interchange Alternatives Development Technical Memorandum* dated January 25, 2023. These alternatives will be paired with each of the three corridor concepts and will be refined as necessary to determine appropriate lane and capacity requirements for each alternative to effectively serve the 2045 future year traffic tested on the corridors presented in this memorandum. All geometric considerations will be coordinated with the interchange design team to develop the optimal designs for each alternative. Once final alternative designs are established, traffic operation metrics will be prepared for each alternative. This work will be documented in the future *Interchange Alternatives Models Analysis and Technical Memorandum.*

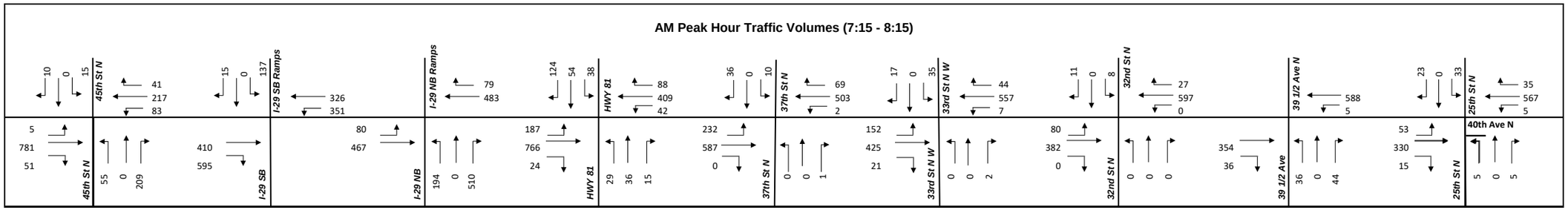
STANTEC CONSULTING SERVICES INC.

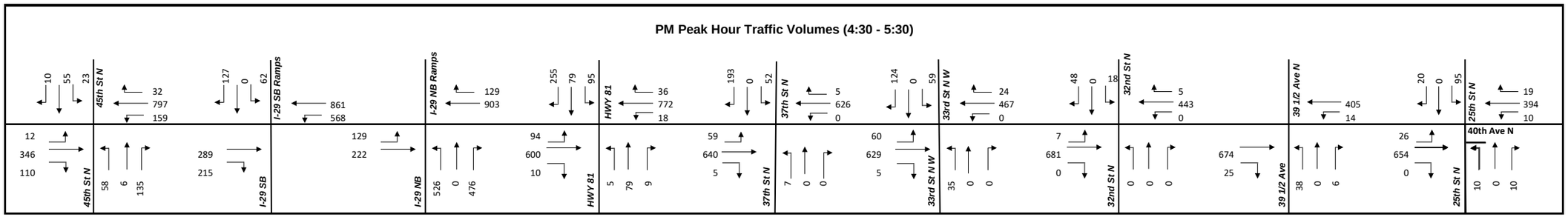
Mark Butler, AICP
Senior Associate
Phone: (859) 212-5033
Mark.Butler@stantec.com





Attachment A: 2022 Existing Peak Hour Turning Movement Counts





Attachment B: 2045 Forecast Peak Hour Demand Turning Movement Counts

Appendix I – I-29 and 40th Avenue North Interchange Preliminary Engineering and Feasibility Study Traffic Forecast Data Sources and Recommendations

Stantec

Memo

To:	Jennifer Kern, PE North Dakota Department of Transportation	From:	Mark Butler, AICP Stantec Consulting Services
File:	193805997	Date:	January 23, 2023

Reference: I-29 and 40th Avenue North Interchange Preliminary Engineering and Feasibility Study
Traffic Forecast Data Sources and Recommendations

INTRODUCTION

The North Dakota Department of Transportation (NDDOT) has contracted with Stantec Consulting Services Inc. to perform a Preliminary Engineering and Feasibility Study for the I-29 interchange with 40th Avenue North and the adjacent 40th Avenue North corridor in the City of Fargo and Cass County. As part of this study, Stantec will prepare a traffic operations analysis for the interchange and the approximately 2.1-mile corridor, which is located between the intersection with 45th Street North on the west and the intersection with 25th Street North on the east. This memorandum reviews data sources and presents forecast recommendations to be used in the development of traffic estimates for 2045 forecast year traffic analyses.

STUDY AREA

The 40th Avenue North corridor (County Road 20) follows an east-west alignment along a portion of the northern city limits of Fargo and the northern perimeter of the Hector International Airport. It is primarily a two-lane undivided highway with turn lanes and/or bypass lanes at several intersections. The corridor's speed limit is 40 miles per hour (MPH) with stop control for all side streets within the project limits, except for the intersection with CR 81, which has a traffic signal. 40th Avenue North's standard diamond interchange with I-29, which runs in a 20° skewed northwest-southeast alignment, is bordered on the east by a grade separated crossing of a rail line that runs parallel to I-29. On the east side of the I-29 interchange, 40th Avenue North is classified as a minor arterial highway serving light commercial industrial developments. It is classified as a major collector west of the interchange and is currently bordered by agricultural land. Residential development west of 45th Street North is anticipated to grow substantially over the next 20 years. **Figure 1** presents the study area, along with the nine intersections where turning movement counts were collected in December 2022[1]:

1. 40th Avenue N at 45th Street N
2. 40th Avenue N at I-29 southbound ramps
3. 40th Avenue N at I-29 northbound ramps
4. 40th Avenue N at CR 81
5. 40th Avenue N at 37th Street N
6. 40th Avenue N at 33rd Street N
7. 40th Avenue N at 32nd Street N
8. 40th Avenue N at 391/2 Avenue N
9. 40th Avenue N at 25th Street N

[1] A January 4, 2023 **Traffic Count Technical Memorandum** presents the peak hour counts and count statistics for these intersections.

Figure 1. Project Corridor and Turn Movement Count Locations

HISTORICAL TRAFFIC VOLUMES AND GROWTH

Historical count data from ten NDDOT count stations[2] in proximity to the I-29 interchange with 40th Avenue North were analyzed to identify historical traffic growth trends. The stations include total mainline volumes on I-29 north and south of the interchange, all four interchange ramps, and count stations on 40th Avenue North and CR 81. **Figure 2** presents the location of each count station. The average daily traffic (ADT) volumes and compound annual growth rates (CAGR) for the ten stations are summarized in **Table 1**.

The counts included in **Table 1** range from 2013 to 2021. While counts can fluctuate significantly from year to year for many reasons, they provide an opportunity to identify general growth trends and patterns. It is important to recognize that the most recent counts include the period between 2020 and 2021 when COVID-19 disruptions were at their peak. The counts indicate strong growth of interstate traffic to and from the south of the interchange. Further, traffic growth on 40th Avenue North and CR 81 illustrate the strong growth associated with a rapidly developing exurban area.

NDDOT also provided traffic estimates and 2042 forecasts for I-29 south of the 40th Avenue North interchange and for the northbound exit and entrance ramps. **Table 1** presents these forecasts along with the estimated annual growth rate these forecast volumes imply.

[2] https://gis.dot.nd.gov/external/ge_html/?viewer=ext_transinfo

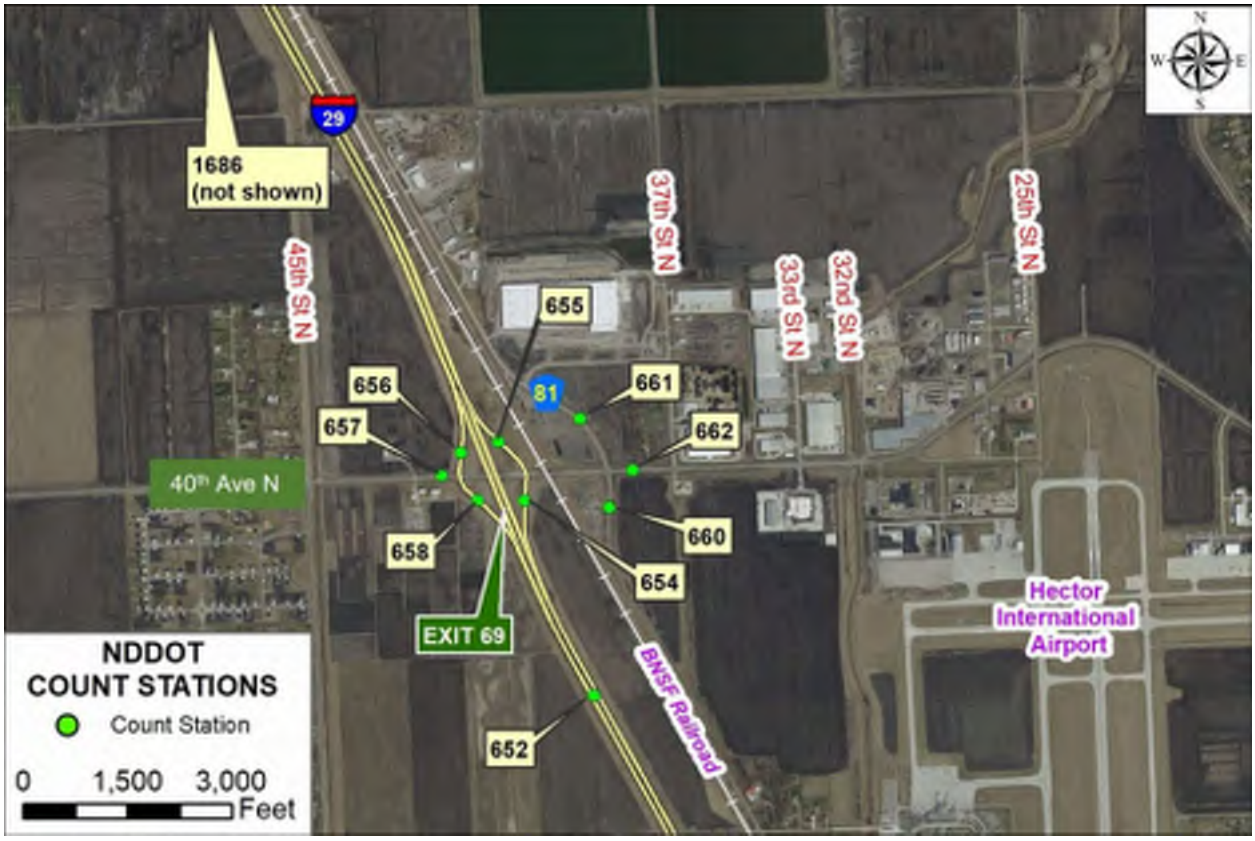


Figure 2. NDDOT Count Station Locations

Table 1. NDDOT Count Station Traffic Volumes and Growth

Year	I-29		I-29 Ramps				40th Ave. N.		CR 81	
	Sta. 1686	Sta. 652	Sta. 654	Sta. 655	Sta. 656	Sta. 658	Sta. 657	Sta. 662	Sta. 661	Sta. 660
	north of 40th Ave.	south of 40th Ave.	NB Exit	NB Entrance	SB Exit	SB Entrance	west of I-29	east of CR 81	north of 40th Ave.	south of 40th Ave.
2013		18,975	2,830	455	388	2,691	1,984	6,239	819	468
2014										
2015	15,385		3,653	387	435	3,367	2,372	5,986	1,234	563
2016										
2017										
2018			2,977	459	583	2,796	3,228	7,896	746	528
2019	16,344	21,698								
2020	13,711	20,178								
2021	14,083	21,068	3,554	428	409	3,387	3,208	8,290	1,642	892
2022	14,859	21,582								
% CAGR*	**-0.5%**	**1.4%**	**2.9%**	**-0.8%**	**0.7%**	**2.9%**	**6.2%**	**3.6%**	**9.1%**	**8.4%**
NDDOT 2042		30,850	5,685	955						
% CAGR*		**1.9%**	**2.4%**	**4.1%**						

Source: NDDOT Planning Division - Traffic Information Section

* CAGR reflects annualized growth estimated from the first and last year of available data.

TRAVEL DEMAND MODEL ANALYSIS

Stantec reviewed traffic assignments from the Fargo-Moorhead Metropolitan Council of Governments (Metro COG) regional travel demand model and the corresponding Traffic Analysis Zone (TAZ) data files that include its assumptions for population and employment. The model assignments represent the 2015 base year and the 2045 future year with the "LRTP" network, which includes projects from Metro COG's 2045 Long Range Transportation Plan. There were no notable network attribute differences between the 2015 and 2045 networks for the links on I-29 or 40th Avenue North relevant to this study. The only notable network distinction found was on 45th Street North between 40th Avenue North and 19th Avenue North, where the free flow speed was lowered from 45 MPH in the 2015 network to 30 MPH in the 2045 LRTP network.

The primary distinction between the 2015 base year and 2045 LRTP model assignments for the study corridor is the growth of the household and employment values between assignment years in the model's TAZs. However, while total regional households grow from 92,007 households in 2015 to 128,757 households in 2045, the number of households in the twelve (12) TAZs directly adjacent to the 40th Avenue North corridor does not change from its total of 254 in 2015. In contrast, total employment grows in these zones from 605 employees in 2015 to 1,614 employees in 2045. However, this growth occurs exclusively in three TAZs east of I-29, in the existing industrial zones. **Figure 3** presents the location of the twelve adjacent TAZs.

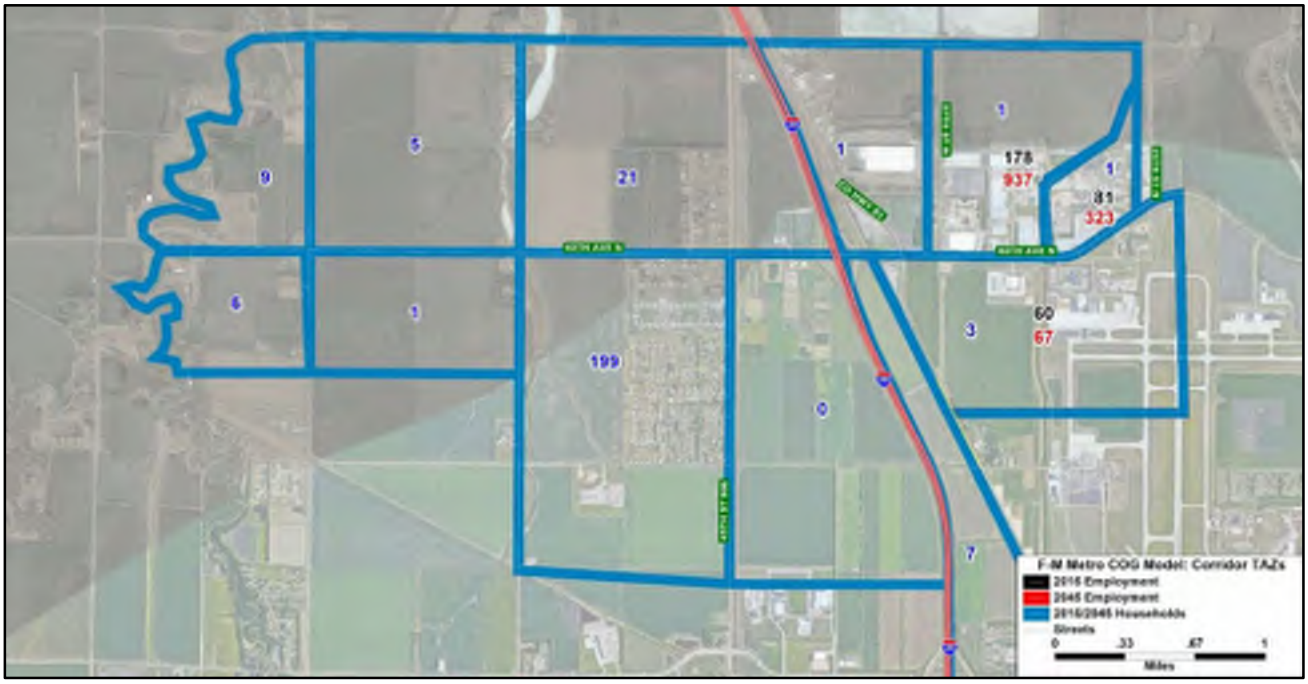


Figure 3. F-M Metro COG Corridor TAZs

Table 2 presents the demand model assignments for 2015 and 2045, and the estimated CAGR between assignment years, at the same ten locations used to report historical counts. While the moderately high growth of interstate traffic reasonably reflects the general expectations of a growing metropolitan area, the growth for the interchange ramps and on 40th Avenue North and CR 81 illustrate the lack of residential growth on the west side of the interstate and relatively robust employment growth on the east side of the interstate.

Table 2. FM Metro COG Travel Demand Model Traffic Assignments

Year	I-29		I-29 Ramps				40th Ave. N.		CR 81	
	north of 40th Ave.	south of 40th Ave.	NB Exit	NB Entrance	SB Exit	SB Entrance	west of I-29	east of CR 81	north of 40th Ave.	south of 40th Ave.
2015 ADT	11,935	18,088	3,927	849	700	3,775	4,473	11,532	662	599
2045 ADT	19,169	28,724	5,802	1,053	1,053	5,802	6,113	17,178	1,303	2,475
% CAGR	**1.6%**	**1.6%**	**1.3%**	**0.7%**	**1.4%**	**1.4%**	**1.0%**	**1.3%**	**2.3%**	**4.8%**

Source: F-M Metro COG Regional Travel Demand Model

POPULATION AND EMPLOYMENT TRENDS

Historical population data were obtained from the U.S. Census. State and county population projections for 2040 were obtained from the North Dakota Department of Commerce. These estimates and projections are summarized in **Table 3**. Population projections for the year 2040 are used to estimate a CAGR for the years between 2020 and 2040. Since 2000, Fargo metropolitan area population growth has been among the fastest in the nation. By 2040, Cass County is expected to grow by more than 44,000 people, almost a quarter of its 2020 population.

Table 3. Population Projections

Area	U.S. Census Population			CAGR	2040* Projection	CAGR
	2000	2010	2020	2000 - 2020		2020 - 2040
Cass County, ND	123,138	149,778	184,525	2.0%	228,895	1.1%
Clay County, MN	51,229	58,999	65,318	1.2%	--	--
North Dakota	642,200	672,591	779,094	1.0%	991,522	1.2%

*Source: North Dakota Census Office Population Projections of the State, Regions and Counties, 2016

The U.S. Bureau of Economic Analysis (BEA) reports employment statistics for individual states and counties. **Table 4** presents the total employment for North Dakota, Cass County, and Clay County in Minnesota, from 2000 to 2020. Similar to population growth, Cass County's 2.0% annual rate of employment growth has been significantly greater than the rate growth seen in North Dakota and the national average. Assuming job growth continues at this rate, Cass County may have almost 72,000 more jobs by 2040, a 48% increase.

Table 4. Total Employment

Area	Total Employment			CAGR	2040* Projection
	2000	2010	2020	2000 - 2020	
Cass County, ND	101,452	124,472	149,984	2.0%	221,732
Clay County, MN	24,988	27,827	28,546	0.7%	--
North Dakota	440,643	503,813	560,682	1.2%	

*Source: U.S. BEA; 2040 employment estimated.

NORTHWEST FARGO SMALL AREA TRAFFIC STUDY

The Northwest Fargo Small Area Study[3] (January 2022) analyzed additional traffic growth expected to occur in the industrial zone located in the northeast quadrant of 40th Avenue North and I-29. In addition to a new Amazon distribution center which opened in 2021, this study contemplates the potential development of up to 4.2 million square feet of new industrial space over 585 acres across six sites adjacent to 40th Avenue North and CR 81. At full buildout, the report estimated the new development would create up to 760 additional PM peak hour and 7,200 daily trips. While the phasing and final year of full build out was not explicitly established, the report used 2030 as the full buildout year for analysis. **Table 5** presents the 2021 existing year and 2030 forecast year ADTs, and the associated growth rates, for several locations along the 40th Avenue North corridor.

Table 5. Northwest Small Area Traffic Study Daily Traffic Forecasts

Year	40th Ave. N. between I-29 & CR 81	CR 81 north of 40th Ave.	CR 81 south of 40th Ave.	37th St. north of 40th Ave.	33rd St. north of 40th Ave.	32nd St. north of 40th Ave.	25th St. north of 40th Ave.	40th Ave. N. east of 25th St.
Existing 2021 ADT	7,800	1,000	550	800	750	550	1,000	6,000
Buildout 2030 ADT	14,000	3,300	850	3,200	2,100	650	2,800	9,400
% CAGR	**6.7%**	**14.2%**	**5.0%**	**16.7%**	**12.1%**	**1.9%**	**12.1%**	**5.1%**

Source: Northwest Fargo Small Area Study, 2022

The Fargo I-29 Exit 69 (Co 20 / 40th Ave N) Interchange Study (May 2022) prepared by NDDOT analyzed the traffic impact of the new Amazon development and an industrial distribution center under construction on one of the six sites included in the Small Area Study. This analysis focused on the I-29 interchange ramp terminals but limited its analysis to 2022 volumes.

NORTHWEST METRO TRANSPORTATION PLAN

In September 2020, Metro COG released the Northwest Metro Transportation Plan Final Report[4]. This plan is one of several plans that directly address the anticipated development that will accompany the significant population and employment growth expected through 2045. The plan specifically includes areas of currently undeveloped agricultural land adjacent to 40th Avenue North. **Figure 4** presents the boundaries of the study area, which includes 40th Avenue North labeled as CR 20. While the study area covers an area significantly larger than the land directly served by 40th Avenue North, with its direct connection to I-29, 40th Avenue is expected to be a primary corridor serving the anticipated development.

[3] Transportation Collaborative and Consultants, LLC (2022) *Northwest Fargo Small Area Study.* Report to the City of Fargo.
[4] https://www.fmmetrocog.org/projects-rfps/completed-projects/nwmetro-transportation-plan

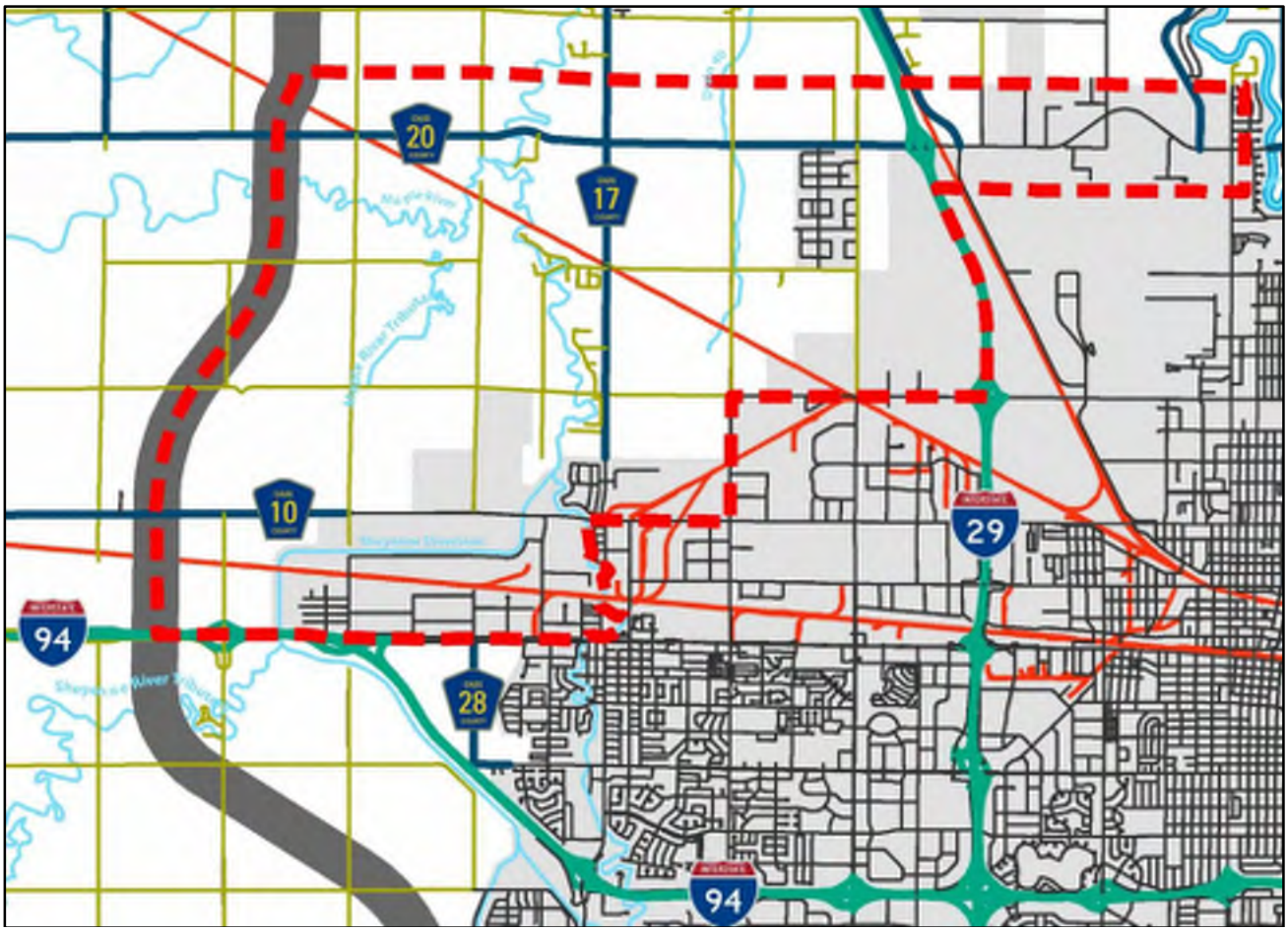


Figure 4. Northwest Metro Transportation Plan Study Area

Source: https://www.fmmetrocog.org/application/files/1115/5983/5057/Thumbnail_Image_Northwest_Metro_Transportation_Plan_1.jpg

The Northwest Metro Transportation Plan presents "*25 percent*", "*50 percent*", and "*Full*" buildout scenarios for the purpose of analyzing expected traffic impacts and required mitigation strategies. The report uses 2045 as the forecast year for these scenarios, although it states that full buildout is not expected to occur within that time period. **Table 6** presents the study's household, population, and job allocations for the study area, for each of these scenarios.

Table 6. Northwest Metro Transportation Plan Development Scenarios

Sub Area Totals	2045 Base Model	25% Buildout	50% Buildout	Full Buildout
Households	1,952	+6,606	+18,097	+27,772
Population	4,898	+13,664	+37,342	+56,816
Jobs	9,519	+28,658	+56,959	+90,015

Source: Table 10, Northwest Metro Transportation Plan, page. 46

While high, of the three scenarios, the allocations presented for the "*50 percent*" scenario compares most closely to the historically high growth rates in population and employment discussed in this memorandum. In fact, the "*50 percent*" scenario implies that 85 percent of all population growth and 80 percent of all

employment growth expected in Cass County by 2040 will occur in this northwest quadrant of the city. This allocated growth will occur across the study area beyond the area directly served by 40th Avenue North.

The Northwest plan used the Metro COG travel demand model to estimate 2045 ADTs based on the scenario allocations of households and employment. **Table 7** presents the assignments along 40th Avenue North for the 2045 "*50 percent"* scenario presented in Figure 39 (page 53) of the report. **Table 7** also presents the comparable 2021 ADTs from Metro COG's rural and urban count maps[5] and the associated growth rates between counts and forecast assignments.

Table 7. Northwest Metro Transportation Plan 2045 "50% Buildout" ADT Forecast

Year	40th Ave. N.				45th St. N.	CR 81	
	west of 45th St. N	east of 45th St. N	east of CR 81	east of 37th St.	south of 40th Ave N.	north of 40th Ave.	south of 40th Ave.
Existing 2021 ADT	1,410	3,210	8,290	7,640	400	1,640	890
50% Buildout 2045 ADT	15,000	16,900	16,800	15,500	4,000	2,800	5,200
% CAGR	**10.4%**	**7.2%**	**3.0%**	**3.0%**	**10.1%**	**2.3%**	**7.6%**

Source: 2021 Metro COG AADT Maps; Northwest Metro Transportation Plan, 2020

GROWTH RATE RECOMMENDATION

This memorandum has summarized the various data sources informing traffic growth on 40th Avenue North corridor. Historical growth demonstrated through counts can be difficult to assess for an exurban area at the beginning phase of rapid development as historically low volume counts can grow exponentially with relatively little additional traffic. For travel model assignments to be valid along specific corridors, they must reflect the new development expected. In this case, the model recognizes significant employment growth on the corridor east of the I-29 interchange but does not include any new residential development west of the interchange. Fortunately, the two recent studies referenced in this memorandum, the Northwest Small Area Study and the Northwest Metro Transportation Plan provides specific details and associated forecasts for new future development on both sides of the corridor.

Table 8 summarizes the annual growth rates estimated and presented in the previous tables in this memorandum. The historical count data, Metro COG model and NDDOT's forecast for the mainline volumes on I-29 south of the 40th Avenue interchange all reflect reasonable rates of growth for a high-volume facility serving a growing metropolitan area. Given the immediate drop in traffic volume north of the interchange leaving the metro area, it is reasonable to conclude that the COVID pandemic disruption at least partially accounts for the recent drop in total volume for interstate traffic north of the interchange. Therefore, it is likely that this traffic will revert to the rate of growth indicated by Metro COG's model assignments. Regarding growth on the interchange ramps, both historical growth and NDDOT's forecast growth appear to best reflect the expected traffic pattern for trips to and from the south, as compared to the model, which does not incorporate the full extent of expected growth, particularly residential growth. From a practical perspective, the volumes of ramp traffic serving interstate traffic to the north are low enough that it is safe to apply similar rates, as the resulting forecast volumes will still be relatively low.

The historical count data aligns well with the projected growth rates estimated from the Northwest Metro Transportation Plan's *50% Buildout* scenario for significant residential development to be served by the corridor to the west of the interchange. An annual growth rate of 7% is extremely high. However, it is rational if the development expectations of the study occur. East of the interchange, the Northwest Small Area Study

[5] https://www.fmmetrocog.org/resources/traffic-counts

provides the most detail for industrial development growth in this area of the corridor. The Study's 2030 full build out forecast ADTs align with 2045 ADTs that grow at rates estimated from historical counts. They also generally align with Northwest Metro Transportation Plan's forecast ADTs for 40th Avenue North in 2045.

Table 8 presents the recommended CAGRs to apply to the 2022 existing year trip tables of the traffic simulation model to use in the 2045 forecast year traffic simulation analysis. Based on a synthesis of the available data sources, these recommended rates will result in future ADTs that reflect historical trends, regional model and population growth assumptions, and specific development expectations along the corridor.

Table 8. CAGRs by Data Source and Recommended CAGRs

Source	I-29		I-29 Ramps				40th Ave. N.		CR 81	
	north of 40th Ave.	south of 40th Ave.	NB Exit	NB Entrance	SB Exit	SB Entrance	west of I-29	east of CR 81	north of 40th Ave.	south of 40th Ave.
NDDOT Historical Counts	-0.5%	1.4%	2.9%	-0.8%	0.7%	2.9%	6.2%	3.6%	9.1%	8.4%
NDDOT Forecast (2042)		1.9%	2.4%	4.1%						
Metro COG Model (2045)	1.6%	1.6%	1.3%	0.7%	1.4%	1.4%	1.0%	1.3%	2.3%	4.8%
NW Small Area Study (2030)								6.7%*	14.2%	5.0%
NW Metro Trans. Plan. (2045) "50% Buildout"							7.2%	3.0%	2.3%	7.6%
Recommended CAGR	1.9%	1.9%	2.5%	2.5%	2.5%	2.5%	7.0%	3.5%	7.0%	5.0%
Estimated 2045 ADTs	23,000	33,000	6,500	800	750	6,250	15,200	18,300	4,250	5,000

* Between I-29 and CR 81

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Appendix J – Interchange Alternatives Selection Technical Memorandum

Stantec

Memo

To:	Jennifer Kern, PE North Dakota Department of Transportation	From:	Adam Capets, PE Pat McGraw, PE Stantec Consulting Services
Project/File:	Preliminary Engineering and Feasibility Study Services for Project 8-029(213)069 NDDOT PCN 23596	Date:	February 23, 2023

Reference: Interchange Alternatives Selection Technical Memorandum

PROJECT DESCRIPTION

The Stantec team is working with the North Dakota Department of Transportation (NDDOT) to complete a preliminary engineering and feasibility study to evaluate and compare retention and reconstruction alternatives for the 40th Avenue N. interchange with I-29 in Fargo, ND (Exit 69). The purpose of the study is to determine potential interchange configurations, roadway alignments, and bridge type and sizes based on an operational, geometric, stakeholder, and environmental evaluation. This study will focus on identifying locations of crash incidents and the need for potential crash countermeasure treatments and will address future traffic demand along the corridor. The overall project completion date through Phase III (Final Design) is September 30, 2025.

This memorandum presents the methodology and resulting data related to the Highway Interchange Tool (HIT) developed by Stantec. The HIT results and comments received during a subsequent Stantec design charrette are documented in this technical memorandum and support the interchange alternatives recommended to receive further analysis in subsequent project tasks.

HIGHWAY INTERCHANGE TOOL (HIT)

Stantec's proprietary Highway Interchange Tool (HIT) aides in the planning level review of interchange alternatives by identifying potential interchange configurations for a specific location using site-specific data. The tool is meant to be used as a starting point by scoring approximately 200 interchange design concepts and variations based on site specific data. Its main function is to identify and prioritize the best alternatives for a location by assigning efficiency, cost, and safety scores to each potential interchange option. The tool does not consider the existing interchange configuration, assuming it is to be fully reconstructed, nor does it consider the ramp terminal intersection control which is assumed to be signalized if applicable. This allows all interchange designs to be given an equal and fair assessment. This, however, does not preclude unsignalized control types at ramp terminals from being considered feasible. The scores are totaled to identify the top interchange designs. The following are descriptions of the three scoring categories:

Efficiency

The tool calculates the average travel for each route through the interchange, as determined by speed on individual segments and delay at signals. The overall score is weighted by the volume of traffic using each route.

Cost

The tool combines the cost of right-of-way, pavement (not including mainline through and bike lanes), bridge concrete, and traffic signals to identify planning-level costs for the interchange. This is not intended to be a true estimate of project cost, but rather a way to compare interchange alternatives.

Safety

The tool calculates the number of crossing, merging, and diverging conflicts for vehicles and active transportation users. Using site-specific data entered into the program, these conflicts are weighted. The conflicts are then adjusted to account for each individual moving through the interchange, including the number of bicyclists, pedestrians, and vehicle occupants (using a vehicle occupancy rate) to determine the weighted average number of conflicts that each user experiences.

Existing AM and PM peak hour turning movement counts (2022) and growth rates were used to develop preliminary traffic forecasts for the design year (2045) to input into HIT. Turning movement counts for the ramp terminal intersections were collected by the Stantec team (see 'Traffic Count Technical Memorandum') and growth rates for 40th Avenue N. were obtained from the 'Northwest Metro Transportation Plan' by MetroCOG. Growth west of the interchange was assumed to be 6.6% per year and east of the interchange was 2.6% per year. I-29 mainline hourly volumes and growth rates were supplied by NDDOT using data from counting station numbers 1686 and 652 north and south of the interchange, respectively. Mainline growth was assumed to be 2.0% per year for passenger vehicles and 1.5% per year for heavy vehicles. It should be noted that these preliminary forecasts were used solely for the purpose of HIT. For subsequent stages of the project, more precise traffic forecasts will be developed and presented at a later date.

HIT also requires input related to existing roadway geometry, free flow speeds, area characteristics, signal timing parameters, right-of-way footprint, and infrastructure unit costs. Most of these inputs were obtained from historical plans and existing conditions. Default signal timing parameters were used since there are no existing traffic signals at the study interchange. Default pedestrian and bicycle hourly volumes of 10 pedestrians and 10 bicycles per hour per direction were used since none were observed during the traffic counts and future active transportation facilities are to be considered in the design. Infrastructure unit costs were estimated using 2022 average bid prices from NDDOT[1]. A summary of input parameters is provided in Attachment A.

[1] https://www.dot.nd.gov/pacer/AABP2022E.pdf

HIT RESULTS

The efficiency, cost, and safety scores were weighted according to weights established with the TAC for use in alternatives comparison throughout the project, which are 5.0 for efficiency, 3.0 for cost, and 4.5 for safety. The cumulative rating calculation for each alternative ranges from 1 to 10. AM and PM peak hours were modeled and additional HIT runs were conducted to obtain designs that fit within existing right-of-way. There were 15 unique interchange designs selected from the aggregate of HIT runs, shown in Table 1, for the 2045 preliminary forecast interchange volumes. Attachment A shows the summary of results from the HIT runs and schematic designs for each alternative.

Table 1 – HIT Interchange Designs

Interchange Design	Average Rating from HIT Runs	Requires ROW? Where?
Milwaukee	7.5	No
Ramp Left U-turn Diamond	7.3	Yes, 40th Ave N.
Diverging Diamond (DDI)	7.3	No
Displaced Left Single Point	6.8	No
Displaced Left Diamond	6.7	Yes, 40th Ave N.
Contraflow Ramp Left U-turn Diamond	6.4	Yes, 40th Ave N.
Double-U	6.4	No
Partial Cloverleaf (Parclo)	6.3	Yes, quadrants
Milwaukee and Partial Cloverleaf	6.3	Yes, quadrants
Single Point (SPUI)	6.1	No
Milwaukee and Ramp Left U-Turn	6.1	Yes, 40th Ave N.
Displaced and Ramp Left U-turn Diamond	6.0	Yes, 40th Ave N.
Milwaukee and Contraflow	5.9	No
Standard Diamond	5.5	No
Cloverleaf	4.4	Yes, quadrants

Source: Stantec, 2023

In general, the designs that rank highly relocate high-volume left turn movements to reduce conflicts, improving capacity and safety. The Standard Diamond did not score as highly as other designs since HIT assumes the ramp terminal intersections will be controlled by traffic signals in a conventional intersection layout. Other ramp terminal control types such as roundabouts, known as a Dumbbell Interchange, may create a safer and more efficient Standard Diamond interchange.

STANTEC DESIGN CHARRETTE

A Stantec design charrette meeting was held on January 11, 2023 and was attended by key Stantec-wide staff who have notable interchange design experience nationally. The charrette focused on the results of the Highway Interchange Tool (HIT) and the selected unique interchange designs in Table 1. The charrette ultimately resulted in narrowing down the number of interchange designs and developing alternatives that will advance to subsequent project tasks including detailed modeling, capacity analysis, and safety analysis.

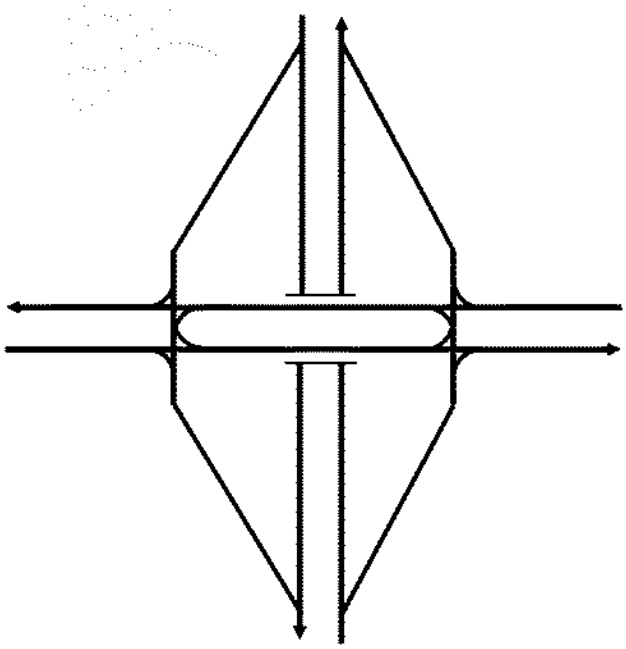
CHARRETTE FINDINGS AND SELECTED ALTERNATIVES

From the design charrette, the 15 interchange designs from the HIT results were reduced and modified to create 6 interchange alternatives that are proposed to advance to subsequent project tasks. Specific considerations were examined during the charrette to ensure the most appropriate interchange alternatives were selected.

Constructability and future expansion were high priorities during the alternative development process. All the interchange alternatives recommended to advance can be constructed with a new overpass structure just north of the existing bridge to maintain traffic during construction. This also allows for future capacity improvements on 40th Avenue N. that require a 4-lane divided section, as the second overpass can be built in the location of the existing bridge.

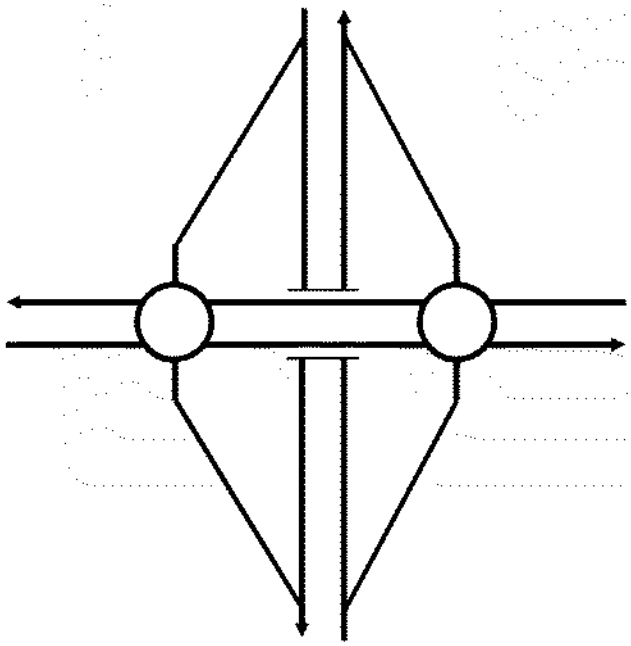
An initial safety concern at the existing interchange is that the railroad bridge crossing combined with the vertical curvature of 40th Avenue N. east of the interchange create an illusion for westbound drivers. As a result, after traversing the railroad bridge, some drivers erroneously assume the next intersection is the I-29 southbound on-ramp and make a left turn at the I-29 northbound off-ramp to go the wrong way south. These vehicles then travel the wrong way down the northbound off-ramp. All interchange layouts except the standard diamond and partial clover use modified geometry to eliminate the possibility of making this wrong-way westbound left. Below are the schematic designs and additional considerations for each of the 6 proposed interchange alternatives to be advanced in the project.

Alternative 1 – Standard Diamond Interchange



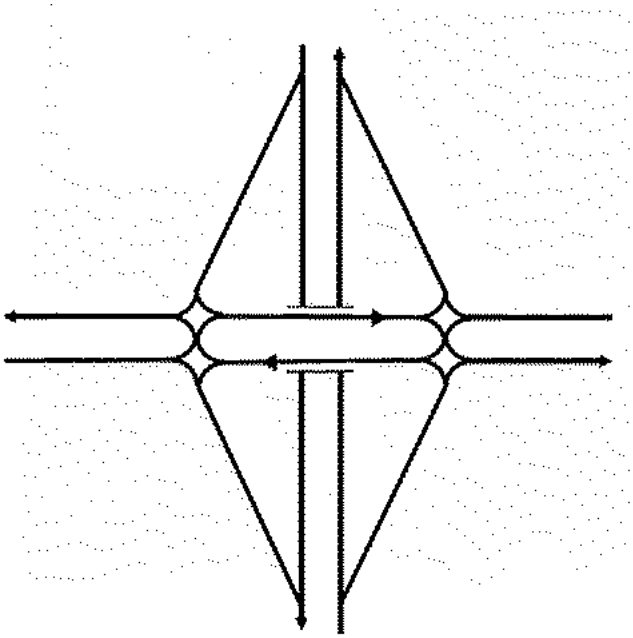
- Two versions of this alternative will be analyzed in this project:
    - Stop-controlled ramp terminal intersections (existing conditions)
    - Signalized ramp terminal intersections

Alternative 2 – Dumbbell Interchange



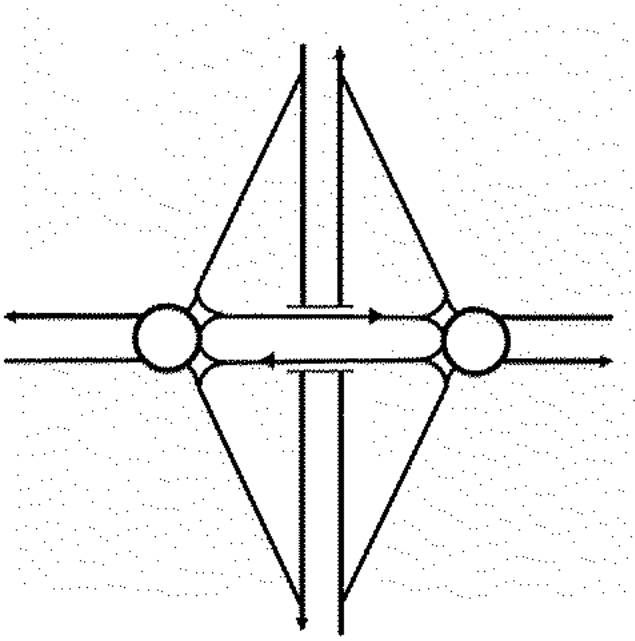
- A variation of the standard diamond interchange with roundabouts at the ramp terminal intersections
- Anticipated to accommodate the high left turn volumes relative to the 40th Avenue N. through volumes
- Allows U-turns at each ramp terminal intersection

Alternative 3 – Diverging Diamond Interchange (DDI)



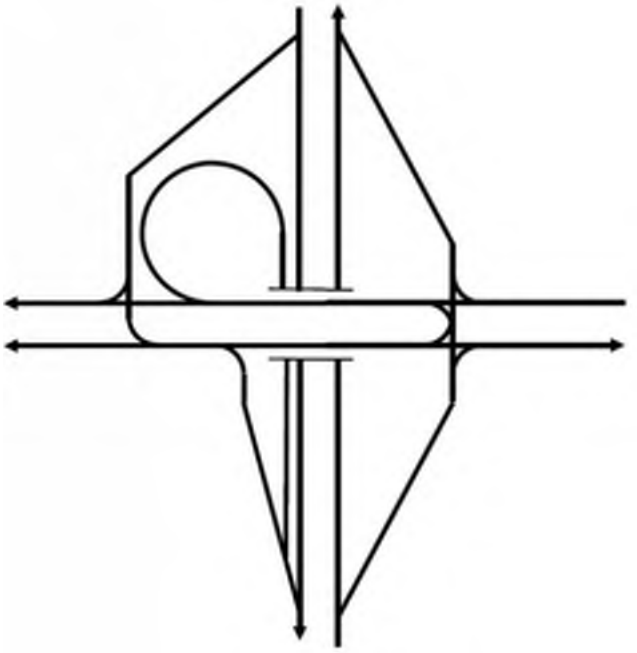
- Anticipated to accommodate the high left turn volumes relative to the 40th Avenue N. through volumes
- Requires greater overall road width to achieve the required crossover angle
- Requires signal control at the ramp terminal intersections
- Increased number of crossings for active transportation users. Grade separated ramp crossings for a shared-use path should be considered to mitigate crossing times for east-west travel

Alternative 4 – Roundabout DDI



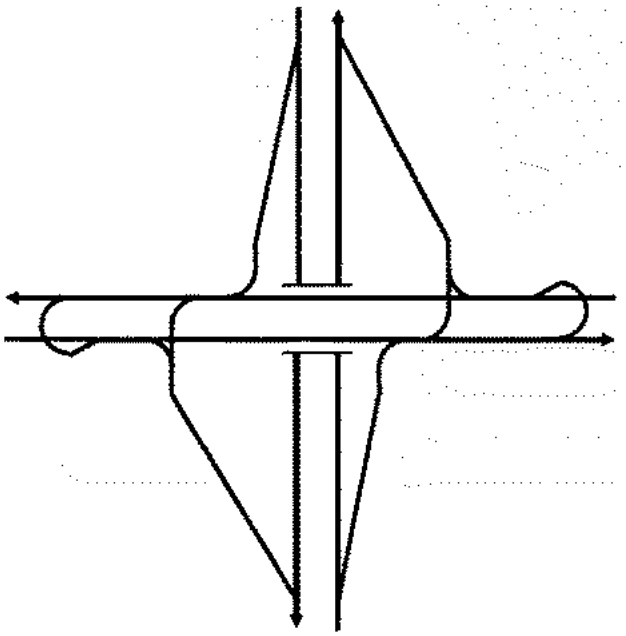
- An unsignalized variation of the DDI with roundabouts at the ramp terminal intersections may be achievable
- Allows left-turning trucks to bypass a roundabout
- Increased number of crossings for active transportation users. Grade separated ramp crossings for a shared-use path should be considered to mitigate crossing times for east-west travel

Alternative 5 – Partial Cloverleaf (Parclo)



- As shown, only one loop in the northwest quadrant included to accommodate high westbound left turn volumes. Additional loop in north-east quadrant may be feasible if traffic volumes warrant it. Control should be modified to avoid weaving section between loops
- The loop creates a free-right condition for vehicles. Consider placing the shared-use path on the south side of 40th Avenue N. or using a grade-separated ramp crossing to prevent active transportation users from crossing at-grade at the loop.
- While travel delay is added due to the increased travel distance of the loop, it may be offset by the stop delay savings

Alternative 6 – Ramp Left U-turn Diamond Interchange



- This U-turn layout allows left turns from 40th Avenue N. and diverts off-ramp left turns to U-turn locations
- Dedicated U-turn locations require medians and possibly bulb-outs to accommodate U-turn movements, particularly for trucks. U-turns may instead be achieved at adjacent roundabouts at County Highway 81 and the North Dakota State University (NDSU) agricultural facility access
- While travel delay is added due to the increased travel distance of the U-turn movement, it may be offset by the stop delay savings

A Preliminary Alternatives Matrix was developed to summarize the considerations for each alternative discussed in the charrette. The matrix is shown in Attachment B.

The remaining designs from the HIT results were ruled out for the following reasons:

- The cloverleaf interchange was eliminated since loops on all quadrants are not anticipated to be necessary and right-of-way challenges, including the NDSU agricultural facility in the southwest quadrant and railroad to the east, make it less feasible
- Contraflow, displaced left turn, and single point interchange options were eliminated due to the necessity for a divided roadway or additional traffic signals, increased width of the overpass structure, increased snow clearing difficulty, difficulty accommodating active transportation facilities, and ability of other more cost-efficient design alternatives to accommodate traffic adequately.

  The Milwaukee and Double-U interchanges were eliminated due to the necessity of additional overpass structures and ability of other more cost-efficient design alternatives to accommodate traffic adequately.

The Project TAC met on February 9, 2023 to review the alternatives proposed for further consideration as outlined above. The TAC approved the advancement of Alternatives 1 through 5 through the feasibility study process where Stantec will develop detailed traffic microsimulation models for operational analysis. Alternative 6 was discarded primarily over concerns associated with available space for the U-turns and anticipated lack of public acceptance due to the increase in travel time and distance for some left turn movements.

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Attachments: HIT Summary and Inputs, Preliminary Alternatives Matrix

Attachment A - HIT Summary and Inputs

2042 AM

Sheet	Left from Arterial	Left from Freeway	Name	Avoid ROW?	Graph Label	Base Efficiency	Base Cost	Base Safety	Weighted Efficiency	Weighted Cost	Weighted Safety	Overall Score
9C.2	9	C	Parclo A (Spread)		9C.2 - Parclo	6.4	8.8	8.3	2.6	2.1	3.0	7.7
3G.2	3	G	Standard Diamond Ramp U-Turn (Spread Standard)		3G.2 - Standa	10.0	7.6	5.1	4.0	1.8	1.8	7.6
8B.2	8	B	Displaced Tight Diamond (Spread Tight)		8B.2 - Displac	9.8	4.8	6.7	3.9	1.2	2.4	7.5
12C	12	C	Milwaukee A (Standard)	YES	12C - Milwau	7.6	5.4	8.6	3.0	1.3	3.1	7.4
8E	8	E	DDI (Standard)	YES	8E - DDI (Sta	8.5	9.9	4.5	3.4	2.4	1.6	7.4
12C.2	12	C	Milwaukee A (Standard Tight)	YES	12C.2 - Milw	7.6	5.5	8.5	3.0	1.3	3.0	7.4
12C.1	12	C	Milwaukee A (Standard Spread)		12C.1 - Milw	7.7	5.0	8.6	3.1	1.2	3.1	7.4
8E.2	8	E	DDI (Spread)		8E.2 - DDI (S	8.0	9.5	4.5	3.2	2.3	1.6	7.1
2G	2	G	Tight Diamond Ramp U-Turn (Standard Tight)	YES	2G - Tight Dia	10.0	5.0	5.1	4.0	1.2	1.8	7.0
2G.2	2	G	Tight Diamond Ramp U-Turn (Spread Tight)		2G.2 - Tight D	10.0	4.8	5.1	4.0	1.2	1.8	7.0
1E.1	1	E	Displaced Single Point (Spread)		1E.1 - Displac	9.1	1.7	7.7	3.6	0.4	2.8	6.8
8E.1	8	E	DDI (Tight)	YES	8E.1 - DDI (T	8.7	7.2	4.5	3.5	1.7	1.6	6.8
1E.2	1	E	Displaced Single Point (Spread Standard)		1E.2 - Displac	8.9	1.8	7.7	3.6	0.4	2.8	6.8
12F	12	F	I-41 (Standard Spread)		12F - I-41 (St	6.6	2.9	9.4	2.6	0.7	3.4	6.7
1E.4	1	E	Displaced Single Point (Tight Spread)		1E.4 - Displac	8.8	2.2	7.4	3.5	0.5	2.6	6.7
1E.5	1	E	Displaced Single Point (Tight Standard)	YES	1E.5 - Displac	8.6	2.3	7.4	3.5	0.6	2.6	6.7
12B	12	B	U Turn over Freeway with Slips Tight Diamond (Tight)	YES	12B - U Turn	7.5	2.2	8.6	3.0	0.5	3.1	6.6
12F.1	12	F	I-41 (Spread)		12F.1 - I-41 (	6.4	2.7	9.4	2.6	0.6	3.4	6.6
12B.1	12	B	U Turn over Freeway with Slips Tight Diamond (Standard)	YES	12B.1 - U Tur	7.5	2.0	8.6	3.0	0.5	3.1	6.6
9C	9	C	Parclo A (Spread Standard)		9C - Parclo A	4.5	8.7	7.5	1.8	2.1	2.7	6.6
5G.2	5	G	Tight Contraflow U on Arterial (Spread Tight)		5G.2 - Tight C	7.9	4.8	6.3	3.2	1.1	2.3	6.6
5G.1	5	G	Tight Contraflow U on Arterial (Standard Tight)	YES	5G.1 - Tight C	7.8	4.9	6.3	3.1	1.2	2.3	6.6
12B.2	12	B	U Turn over Freeway with Slips Tight Diamond (Spread)		12B.2 - U Tur	7.6	1.7	8.6	3.0	0.4	3.1	6.5
11H.3	11	H	Elevated Double U from Dunlop South of Arterial (Standard)	YES	11H.3 - Eleva	6.1	5.5	7.6	2.5	1.3	2.8	6.5
9C.1	9	C	Parclo A (Spread Tight)		9C.1 - Parclo	4.2	8.8	7.5	1.7	2.1	2.7	6.5
5G	5	G	Tight Contraflow U on Arterial (Tight)	YES	5G - Tight Co	7.6	5.0	6.3	3.0	1.2	2.3	6.5
6G.2	6	G	Standard Contraflow U Turn on Arterial (Spread Standard)		6G.2 - Standa	7.7	4.5	6.3	3.1	1.1	2.3	6.4
9D.2	9	D	ParClo A (Spread)		9D.2 - ParClo	6.0	9.3	5.0	2.4	2.2	1.8	6.4
6G	6	G	Canton I 275 at US 12 Synchronized Interchange (Standard)	YES	6G - Canton I	7.5	4.7	6.3	3.0	1.1	2.3	6.4
6G.1	6	G	Standard Contraflow U Turn on Arterial (Tight Standard)	YES	6G.1 - Standa	7.3	4.8	6.3	2.9	1.1	2.3	6.3
8G.1	8	G	Displaced U Turn on Arterial (Tight)	YES	8G.1 - Displa	7.6	5.0	5.7	3.0	1.2	2.0	6.3
11H.4	11	H	Elevated Double U from Dunlop South of Arterial (Spread)		11H.4 - Eleva	5.6	5.1	7.6	2.3	1.2	2.8	6.2
9F.1	9	F	Clover-leaf (Without Signals)		9F.1 - Clover-	7.6	9.6	2.4	3.1	2.3	0.9	6.2
8B.5	8	B	Displaced Tight Diamond (Spread)		8B.5 - Displac	7.0	4.2	6.7	2.8	1.0	2.4	6.2
9D.3	9	D	Parclo A (Spread)		9D.3 - Parclo	4.5	9.1	6.2	1.8	2.2	2.2	6.2
12G.3	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Tight)		12G.3 - U Tur	6.0	4.2	7.7	2.4	1.0	2.8	6.2
12G.4	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Standard)		12G.4 - U Tur	6.1	4.1	7.7	2.4	1.0	2.8	6.2
12G.4	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Standard)		12G.4 - U Tur	6.1	4.1	7.7	2.4	1.0	2.8	6.2
12G.1	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard Tight)	YES	12G.1 - U Tur	5.8	4.4	7.7	2.3	1.1	2.8	6.2
12G	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard)	YES	12G - U Turn	5.9	4.3	7.7	2.4	1.0	2.8	6.1
1D.2	1	D	Single Point Spread Diamond (Spread)		1D.2 - Single	5.6	6.4	6.5	2.3	1.5	2.3	6.1
8B	8	B	Displaced Tight Diamond (Standard Tight)	YES	8B - Displace	6.4	4.8	6.7	2.6	1.1	2.4	6.1
12G.2	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard Spread)		12G.2 - U Tur	5.9	3.9	7.7	2.4	0.9	2.8	6.1
8B.1	8	B	Displaced Tight Diamond (Tight)	YES	8B.1 - Displac	6.3	4.9	6.7	2.5	1.2	2.4	6.1
8C	8	C	Displaced Left (Spread Standard)		8C - Displace	6.5	4.4	6.7	2.6	1.1	2.4	6.1
8C.4	8	C	Displaced Left (Standard Tight)	YES	8C.4 - Displac	6.4	4.6	6.7	2.5	1.1	2.4	6.1
8C.5	8	C	Displaced Left (Spread Tight)		8C.5 - Displac	6.6	4.2	6.7	2.6	1.0	2.4	6.0
8B.3	8	B	Displaced Tight Diamond (Standard)	YES	8B.3 - Displac	6.2	4.6	6.7	2.5	1.1	2.4	6.0
8B.4	8	B	Displaced Tight Diamond (Spread Standard)		8B.4 - Displac	6.3	4.3	6.7	2.5	1.0	2.4	6.0
1E	1	E	Displaced Single Point (Standard)	YES	1E - Displace	6.0	3.3	7.7	2.4	0.8	2.8	6.0
8C.1	8	C	Displaced Left (Standard)	YES	8C.1 - Displac	6.1	4.6	6.7	2.4	1.1	2.4	6.0
8B.6	8	B	Displaced Tight Diamond (Tight Standard)	YES	8B.6 - Displac	6.0	4.8	6.7	2.4	1.1	2.4	5.9
2A.1	2	A	Tight Diamond Single Point (Spread Tight)		2A.1 - Tight D	7.5	5.0	4.7	3.0	1.2	1.7	5.9
3G	3	G	Standard Diamond Ramp U-Turn (Standard)	YES	3G - Standard	5.4	7.8	5.1	2.2	1.9	1.8	5.9
2A.2	2	A	Tight Diamond Single Point (Standard Tight)	YES	2A.2 - Tight D	7.3	5.2	4.7	2.9	1.2	1.7	5.9
7A.2	7	A	Spread Contraflow Single Point (Spread)		7A.2 - Spread	7.8	2.8	5.6	3.1	0.7	2.0	5.8
10G.8	10	G	Ramp Arterial U-Turn (Spread)		10G.8 - Ramp	3.4	8.6	6.7	1.4	2.1	2.4	5.8
6I.2	6	I	Standard Contraflow U with Slips (Spread Standard)		6I.2 - Standa	7.9	0.0	7.3	3.2	0.0	2.6	5.8
1E.3	1	E	Displaced Single Point (Standard Spread)		1E.3 - Displac	6.2	3.1	7.2	2.5	0.7	2.6	5.8
2A	2	A	Tight Diamond Single Point (Tight)	YES	2A - Tight Dia	7.2	5.2	4.7	2.9	1.3	1.7	5.8
4A	4	A	Three Point (Spread)		4A - Three Po	6.8	5.9	4.7	2.7	1.4	1.7	5.8
6I.1	6	I	Standard Contraflow U with Slips (Tight Standard)	YES	6I.1 - Standa	7.7	0.3	7.3	3.1	0.1	2.6	5.8
10G.5	10	G	Ramp Arterial U-Turn (Standard Spread)		10G.5 - Ramp	3.2	8.7	6.7	1.3	2.1	2.4	5.8
8A.1	8	A	Displaced Single Point (Tight)	YES	8A.1 - Displac	7.2	3.8	5.6	2.9	0.9	2.0	5.8
7A.1	7	A	Spread Contraflow Single Point (Tight Spread)		7A.1 - Spread	7.5	3.0	5.6	3.0	0.7	2.0	5.8
7A	7	A	Spread Contraflow Single Point (Standard Spread)		7A - Spread C	7.7	2.8	5.6	3.1	0.7	2.0	5.7
6I	6	I	Standard Contraflow U with Slips (Standard)	YES	6I - Standard	7.7	0.1	7.3	3.1	0.0	2.6	5.7
8B.8	8	B	Displaced Tight Diamond (Standard Spread)		8B.8 - Displac	5.7	4.3	6.7	2.3	1.0	2.4	5.7
10G.3	10	G	Ramp Arterial U-Turn (Tight Spread)		10G.3 - Ramp	3.0	8.8	6.7	1.2	2.1	2.4	5.7
10G.7	10	G	Ramp Arterial U-Turn (Spread Standard)		10G.7 - Ramp	3.0	8.7	6.7	1.2	2.1	2.4	5.7
10G	10	G	Ramp Arterial U-Turn (Standard)	YES	10G - Ramp A	2.8	8.9	6.7	1.1	2.1	2.4	5.7
8C.3	8	C	Displaced Left (Spread)		8C.3 - Displac	5.8	4.0	6.7	2.3	1.0	2.4	5.7
8C.2	8	C	Displaced Left (Standard Spread)		8C.2 - Displac	5.5	4.3	6.7	2.2	1.0	2.4	5.7
4G.2	4	G	Spread Diamond Ramp U-Turn (Spread)		4G.2 - Spread	5.1	7.4	5.1	2.1	1.8	1.8	5.7
8B.7	8	B	Displaced Tight Diamond (Tight Spread)		8B.7 - Displac	5.4	4.5	6.7	2.2	1.1	2.4	5.6
7B	7	B	Spread Contraflow Tight Diamond		7B - Spread C	6.0	5.4	5.4	2.4	1.3	1.9	5.6
8A	8	A	Displaced Single Point (Standard)	YES	8A - Displace	7.0	3.5	5.6	2.8	0.8	2.0	5.6
10G.2	10	G	Ramp Arterial U-Turn (Tight Standard)	YES	10G.2 - Ramp	2.6	9.0	6.7	1.1	2.2	2.4	5.6
4F.3	4	F	Parclo B (Spread)		4F.3 - Parclo	5.2	8.3	4.2	2.1	2.0	1.5	5.6
9D.4	9	D	Parclo A (Spread Standard)		9D.4 - Parclo	3.5	9.2	5.4	1.4	2.2	2.0	5.6
8A.7	8	A	Displaced Single Point (Spread Tight)		8A.7 - Displac	6.9	3.4	5.6	2.8	0.8	2.0	5.6
10G.6	10	G	Ramp Arterial U-Turn (Spread Tight)		10G.6 - Ramp	2.6	8.8	6.7	1.0	2.1	2.4	5.6
8F.2	8	F	CFI (Standard Spread)		8F.2 - CFI (St	5.4	1.3	8.6	2.1	0.3	3.1	5.5
3F.2	3	F	Parclo B (Spread)		3F.2 - Parclo	4.5	7.5	5.4	1.8	1.8	1.9	5.5
10G.4	10	G	Ramp Arterial U-Turn (Standard Tight)	YES	10G.4 - Ramp	2.4	9.0	6.7	1.0	2.2	2.4	5.5
8A.6	8	A	Displaced Single Point (Standard Tight)	YES	8A.6 - Displac	6.6	3.6	5.6	2.6	0.9	2.0	5.5
8F.1	8	F	CFI (Tight Spread)		8F.1 - CFI (Ti	5.2	1.5	8.6	2.1	0.4	3.1	5.5
9D.5	9	D	Parclo A (Spread Tight)		9D.5 - Parclo	3.3	9.3	5.4	1.3	2.2	2.0	5.5
1D.1	1	D	Single Point Spread Diamond (Spread Standard)		1D.1 - Single	4.7	6.6	5.7	1.9	1.6	2.1	5.5
3F	3	F	Parclo B (Standard Spread)		3F - Parclo B	4.3	7.7	5.4	1.7	1.8	1.9	5.5
1D	1	D	Single Point Spread Diamond (Spread Tight)		1D - Single Po	4.4	6.9	5.7	1.8	1.7	2.1	5.5
10G.1	10	G	Ramp Arterial U-Turn (Tight)	YES	10G.1 - Ramp	2.2	9.0	6.7	0.9	2.2	2.4	5.5
3F.1	3	F	Parclo B (Tight Spread)		3F.1 - Parclo	4.1	7.7	5.4	1.7	1.9	1.9	5.5
3C	3	C	Standard Diamond	YES	3C - Standard	3.3	10.0	4.7	1.3	2.4	1.7	5.4
9F	9	F	Clover-leaf		9F - Clover-le	5.8	7.4	3.7	2.3	1.8	1.3	5.4
1A.4	1	A	Single Point Single Point (Spread)		1A.4 - Single	6.3	4.6	4.9	2.5	1.1	1.8	5.4
8A.8	8	A	Displaced Single Point (Spread Standard)		8A.8 - Displac	6.5	3.2	5.6	2.6	0.8	2.0	5.4
1A.8	1	A	Single Point Single Point (Standard Spread)		1A.8 - Single	6.2	4.8	4.9	2.5	1.1	1.8	5.4
8A.4	8	A	Displaced Single Point (Tight Standard)	YES	8A.4 - Displac	6.2	3.6	5.6	2.5	0.9	2.0	5.4
9D	9	D	ParClo A (Spread Standard)		9D - ParClo A	4.0	9.2	4.3	1.6	2.2	1.5	5.4

Southbound Freeway

	Right	Through	Left
Truck %	12%	16%	9%
PHF	0.80	0.80	0.80
Volume	17	1,038	44

Eastbound Through

	Volume	PHF
Bikes	10	0.80
Peds	10	0.80

Eastbound Arterial

Truck %	PHF	Volume	
3%	0.80	125	Left
6%	0.80	111	Through
2%	0.80	527	Right

Westbound Arterial

	Volume	PHF	Truck %
Right	35	0.80	26%
Through	53	0.80	14%
Left	356	0.80	6%

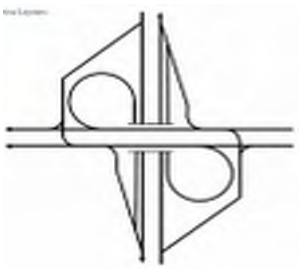
Westbound Through

PHF	Volume	
0.80	10	Bikes
0.80	10	Peds

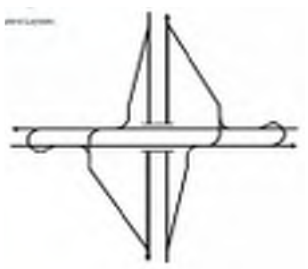
	Left	Through	Right
Volume	52	899	380
PHF	0.80	0.80	0.80
Truck %	2%	18%	10%

Northbound Freeway

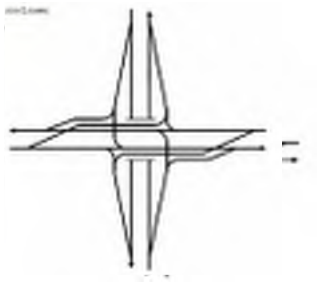
1. Parclo A (Spread)
7.7
ROW
9C



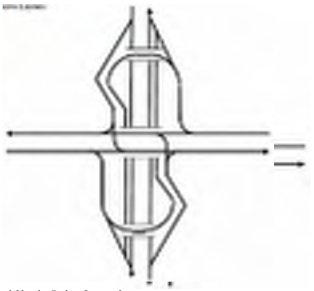
2. Standard Diamond Ramp U-Turn (Spread Standard)
7.6
ROW
3G



3. Displaced Tight Diamond (Spread Tight)
7.5
ROW
8B

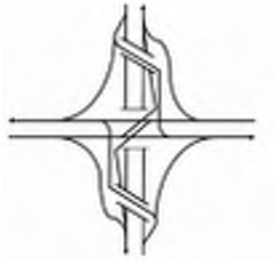


4. Milwaukee A (Standard)
7.4
FITS
12C

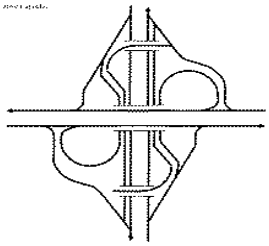


5. DDI (Standard)
7.4
FITS
8E

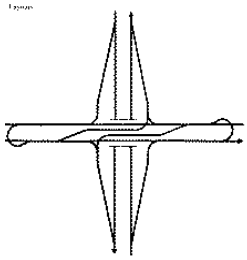
6. Displaced Single Point Spread
6.8
ROW
1E



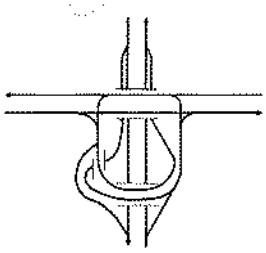
7. I-41 (Standard Spread)
6.7
ROW
12F



8. Tight Contraflow U on Arterial (Spread Tight)
6.6
ROW
5G



9. Elevated Double U from Dunlop South of Arterial (Standard)
6.5
FITS
11H



Elevated Double U from Dunlop South of Arterial (Spread)
6.2
ROW
9F

Sheet	Left from Arterial	Left from Freeway	Name	Avoid ROW?	Graph Label	Base Efficiency	Base Cost	Base Safety	Weighted Efficiency	Weighted Cost	Weighted Safety	Overall Score
3G.2	3	G	Standard Diamond Ramp U-Turn (Spread Standard)		3G.2 - Standa	10.0	7.7	5.0	4.0	1.8	1.8	7.6
12C	12	C	Milwaukee A (Standard)	YES	12C - Milwau	8.3	5.5	8.3	3.3	1.3	3.0	7.6
12C.2	12	C	Milwaukee A (Standard Tight)	YES	12C.2 - Milwa	8.3	5.6	7.9	3.3	1.3	2.8	7.5
12C.1	12	C	Milwaukee A (Standard Spread)		12C.1 - Milwa	8.2	5.2	8.3	3.3	1.2	3.0	7.5
9C.2	9	C	Parclo A (Spread)		9C.2 - Parclo	5.8	8.8	7.4	2.3	2.1	2.7	7.1
8E	8	E	DDI (Standard)	YES	8E - DDI (Sta	7.9	9.9	4.2	3.2	2.4	1.5	7.1
2G	2	G	Tight Diamond Ramp U-Turn (Standard Tight)	YES	2G - Tight Dia	10.0	5.2	5.0	4.0	1.2	1.8	7.0
2G.2	2	G	Tight Diamond Ramp U-Turn (Spread Tight)		2G.2 - Tight D	10.0	4.9	5.0	4.0	1.2	1.8	7.0
8B.2	8	B	Displaced Tight Diamond (Spread Tight)		8B.2 - Displac	9.8	4.9	5.1	3.9	1.2	1.9	7.0
1E.5	1	E	Displaced Single Point (Tight Standard)	YES	1E.5 - Displac	9.0	2.5	7.6	3.6	0.6	2.7	6.9
1E.4	1	E	Displaced Single Point (Tight Spread)		1E.4 - Displac	9.1	2.3	7.6	3.7	0.6	2.7	6.9
12B	12	B	U Turn over Freeway with Slips Tight Diamond (Tight)	YES	12B - U Turn	8.5	2.4	8.3	3.4	0.6	3.0	6.9
12B.1	12	B	U Turn over Freeway with Slips Tight Diamond (Standard)	YES	12B.1 - U Tur	8.4	2.2	8.3	3.4	0.5	3.0	6.9
12B.2	12	B	U Turn over Freeway with Slips Tight Diamond (Spread)		12B.2 - U Tur	8.4	1.9	8.3	3.4	0.5	3.0	6.8
1E.2	1	E	Displaced Single Point (Spread Standard)		1E.2 - Displac	8.8	2.1	7.7	3.5	0.5	2.8	6.8
1E.1	1	E	Displaced Single Point (Spread)		1E.1 - Displac	8.9	1.9	7.7	3.5	0.5	2.8	6.8
12F	12	F	I-41 (Standard Spread)		12F - I-41 (St	5.7	3.1	10.0	2.3	0.7	3.6	6.6
8E.2	8	E	DDI (Spread)		8E.2 - DDI (S	7.0	9.5	4.2	2.8	2.3	1.5	6.6
8E.1	8	E	DDI (Tight)	YES	8E.1 - DDI (T	8.4	7.3	4.2	3.3	1.7	1.5	6.6
12F.1	12	F	I-41 (Spread)		12F.1 - I-41 (	5.6	2.9	10.0	2.2	0.7	3.6	6.5
9C	9	C	Parclo A (Spread Standard)		9C - Parclo A	4.4	8.8	6.8	1.7	2.1	2.4	6.3
2A.1	2	A	Tight Diamond Single Point (Spread Tight)		2A.1 - Tight D	8.3	4.6	5.1	3.3	1.1	1.8	6.3
2A.2	2	A	Tight Diamond Single Point (Standard Tight)	YES	2A.2 - Tight D	8.2	4.8	5.1	3.3	1.2	1.8	6.3
9C.1	9	C	Parclo A (Spread Tight)		9C.1 - Parclo	4.2	8.8	6.8	1.7	2.1	2.4	6.3
11H.3	11	H	Elevated Double U from Dunlop South of Arterial (Standard)	YES	11H.3 - Eleva	5.6	5.6	7.4	2.2	1.3	2.7	6.2
2A	2	A	Tight Diamond Single Point (Tight)	YES	2A - Tight Dia	8.0	4.9	5.1	3.2	1.2	1.8	6.2
5G.2	5	G	Tight Contraflow U on Arterial (Spread Tight)		5G.2 - Tight C	6.7	4.9	6.4	2.7	1.2	2.3	6.2
4A	4	A	Three Point (Spread)		4A - Three Po	7.5	5.5	5.1	3.0	1.3	1.8	6.2
9D.2	9	D	ParClo A (Spread)		9D.2 - ParClo	6.0	9.3	4.2	2.4	2.2	1.5	6.1
8B.5	8	B	Displaced Tight Diamond (Spread)		8B.5 - Displac	8.1	4.3	5.1	3.2	1.0	1.9	6.1
1D.2	1	D	Single Point Spread Diamond (Spread)		1D.2 - Single	6.4	6.5	5.6	2.5	1.6	2.0	6.1
5G.1	5	G	Tight Contraflow U on Arterial (Standard Tight)	YES	5G.1 - Tight C	6.4	5.1	6.4	2.6	1.2	2.3	6.1
6I.2	6	I	Standard Contraflow U with Slips (Spread Standard)		6I.2 - Standa	7.4	0.1	8.5	3.0	0.0	3.1	6.0
12G.3	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Tight)		12G.3 - U Tur	5.2	4.4	8.1	2.1	1.1	2.9	6.0
9F.1	9	F	Clover-leaf (Without Signals)		9F.1 - Clover	7.4	9.7	2.0	2.9	2.3	0.7	6.0
12G.4	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Standard)		12G.4 - U Tur	5.1	4.2	8.1	2.1	1.0	2.9	6.0
12G.4	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Standard)		12G.4 - U Tur	5.1	4.2	8.1	2.1	1.0	2.9	6.0
5G	5	G	Tight Contraflow U on Arterial (Tight)	YES	5G - Tight Co	6.1	5.1	6.4	2.4	1.2	2.3	6.0
6G.2	6	G	Standard Contraflow U Turn on Arterial (Spread Standard)		6G.2 - Standa	6.4	4.7	6.4	2.6	1.1	2.3	6.0
6I.1	6	I	Standard Contraflow U with Slips (Tight Standard)	YES	6I.1 - Standa	7.3	0.0	8.5	2.9	0.0	3.1	6.0
12G.1	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard Tight)	YES	12G.1 - U Tur	4.9	4.6	8.1	2.0	1.1	2.9	6.0
7B	7	B	Spread Contraflow Tight Diamond		7B - Spread C	6.9	5.5	5.2	2.8	1.3	1.9	6.0
7A.2	7	A	Spread Contraflow Single Point (Spread)		7A.2 - Spread	8.1	2.5	5.9	3.2	0.6	2.1	6.0
6I	6	I	Standard Contraflow U with Slips (Standard)	YES	6I - Standard	7.1	0.3	8.5	2.8	0.1	3.1	6.0
8B	8	B	Displaced Tight Diamond (Standard Tight)	YES	8B - Displace	7.3	4.9	5.1	2.9	1.2	1.9	5.9
12G	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard)	YES	12G - U Turn	4.9	4.4	8.1	1.9	1.1	2.9	5.9
9D.3	9	D	Parclo A (Spread)		9D.3 - Parclo	4.6	9.1	5.2	1.9	2.2	1.9	5.9
6G	6	G	Canton I 275 at US 12 Synchronized Interchange (Standard)	YES	6G - Canton I	6.1	4.8	6.4	2.4	1.2	2.3	5.9
8B.1	8	B	Displaced Tight Diamond (Tight)	YES	8B.1 - Displac	7.1	5.0	5.1	2.8	1.2	1.9	5.9
7A.1	7	A	Spread Contraflow Single Point (Tight Spread)		7A.1 - Spread	7.8	2.7	5.9	3.1	0.7	2.1	5.9
7A	7	A	Spread Contraflow Single Point (Standard Spread)		7A - Spread C	7.9	2.4	5.9	3.2	0.6	2.1	5.9
2E.5	2	E	Tight Diamond Displaced (Tight Spread)		2E.5 - Tight D	7.1	3.7	5.9	2.8	0.9	2.1	5.9
1E	1	E	Displaced Single Point (Standard)	YES	1E - Displace	5.6	3.5	7.7	2.2	0.8	2.8	5.8
12G.2	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard Spread)		12G.2 - U Tur	4.8	4.1	8.1	1.9	1.0	2.9	5.8
6G.1	6	G	Standard Contraflow U Turn on Arterial (Tight Standard)	YES	6G.1 - Standa	5.8	4.9	6.4	2.3	1.2	2.3	5.8
8B.6	8	B	Displaced Tight Diamond (Tight Standard)	YES	8B.6 - Displac	6.9	4.9	5.1	2.8	1.2	1.9	5.8
8C.4	8	C	Displaced Left (Standard Tight)	YES	8C.4 - Displac	7.0	4.8	5.1	2.8	1.1	1.9	5.8
8B.3	8	B	Displaced Tight Diamond (Standard)	YES	8B.3 - Displac	7.0	4.8	5.1	2.8	1.1	1.9	5.8
1D	1	D	Single Point Spread Diamond (Spread Tight)		1D - Single Po	5.8	7.0	5.0	2.3	1.7	1.8	5.8
8C	8	C	Displaced Left (Spread Standard)		8C - Displace	7.1	4.5	5.1	2.8	1.1	1.9	5.8
8B.4	8	B	Displaced Tight Diamond (Spread Standard)		8B.4 - Displac	7.1	4.5	5.1	2.8	1.1	1.9	5.8
8C.5	8	C	Displaced Left (Spread Tight)		8C.5 - Displac	7.2	4.3	5.1	2.9	1.0	1.9	5.8
1D.1	1	D	Single Point Spread Diamond (Spread Standard)		1D.1 - Single	5.9	6.7	5.0	2.3	1.6	1.8	5.8
4B	4	B	Spread/Tight Diamond		4B - Spread/T	5.9	8.8	3.5	2.4	2.1	1.3	5.7
8A.1	8	A	Displaced Single Point (Tight)	YES	8A.1 - Displac	8.4	3.5	4.2	3.4	0.8	1.5	5.7
10G.8	10	G	Ramp Arterial U-Turn (Spread)		10G.8 - Ramp	2.9	8.6	6.9	1.1	2.1	2.5	5.7
11H.4	11	H	Elevated Double U from Dunlop South of Arterial (Spread)		11H.4 - Eleva	4.3	5.3	7.4	1.7	1.3	2.7	5.7
8G.1	8	G	Displaced U Turn on Arterial (Tight)	YES	8G.1 - Displac	6.9	5.1	4.6	2.8	1.2	1.7	5.7
8C.1	8	C	Displaced Left (Standard)	YES	8C.1 - Displac	6.7	4.7	5.1	2.7	1.1	1.9	5.7
1E.3	1	E	Displaced Single Point (Standard Spread)		1E.3 - Displac	5.7	3.3	7.2	2.3	0.8	2.6	5.6
10G.7	10	G	Ramp Arterial U-Turn (Spread Standard)		10G.7 - Ramp	2.6	8.8	6.9	1.0	2.1	2.5	5.6
10G.5	10	G	Ramp Arterial U-Turn (Standard Spread)		10G.5 - Ramp	2.6	8.8	6.9	1.0	2.1	2.5	5.6
4A.2	4	A	Spread Diamond Single Point (Standard Spread)		4A.2 - Spread	6.7	5.9	4.2	2.7	1.4	1.5	5.6
8B.7	8	B	Displaced Tight Diamond (Tight Spread)		8B.7 - Displac	6.5	4.6	5.1	2.6	1.1	1.9	5.6
10G	10	G	Ramp Arterial U-Turn (Standard)	YES	10G - Ramp A	2.3	9.0	6.9	0.9	2.1	2.5	5.6
3E	3	E	Standard Diamond Displaced (Standard Standard/Tight)	YES	3E - Standard	6.9	3.9	5.1	2.8	0.9	1.8	5.5
10G.6	10	G	Ramp Arterial U-Turn (Spread Tight)		10G.6 - Ramp	2.3	8.8	6.9	0.9	2.1	2.5	5.5
9D.4	9	D	Parclo A (Spread Standard)		9D.4 - Parclo	4.2	9.3	4.6	1.7	2.2	1.6	5.5
10G.3	10	G	Ramp Arterial U-Turn (Tight Spread)		10G.3 - Ramp	2.3	8.8	6.9	0.9	2.1	2.5	5.5
9D.5	9	D	Parclo A (Spread Tight)		9D.5 - Parclo	4.0	9.3	4.6	1.6	2.2	1.6	5.5
8A	8	A	Displaced Single Point (Standard)	YES	8A - Displace	8.1	3.2	4.2	3.2	0.8	1.5	5.5
8B.8	8	B	Displaced Tight Diamond (Standard Spread)		8B.8 - Displac	6.4	4.5	5.1	2.6	1.1	1.9	5.5
4A.1	4	A	Spread Diamond Single Point (Tight Spread)		4A.1 - Spread	6.4	6.0	4.2	2.5	1.4	1.5	5.5
10G.4	10	G	Ramp Arterial U-Turn (Standard Tight)	YES	10G.4 - Ramp	2.0	9.0	6.9	0.8	2.2	2.5	5.5
3G	3	G	Standard Diamond Ramp U-Turn (Standard)	YES	3G - Standard	4.5	7.8	5.0	1.8	1.9	1.8	5.5
10G.2	10	G	Ramp Arterial U-Turn (Tight Standard)	YES	10G.2 - Ramp	2.0	9.0	6.9	0.8	2.2	2.5	5.5
8F.2	8	F	CFI (Standard Spread)		8F.2 - CFI (St	5.0	0.5	9.2	2.0	0.1	3.3	5.5
8A.7	8	A	Displaced Single Point (Spread Tight)		8A.7 - Displac	8.0	3.1	4.2	3.2	0.7	1.5	5.5
8F.1	8	F	CFI (Tight Spread)		8F.1 - CFI (Ti	4.9	0.7	9.2	1.9	0.2	3.3	5.4
8C.2	8	C	Displaced Left (Standard Spread)		8C.2 - Displac	6.3	4.5	5.1	2.5	1.1	1.9	5.4
3C	3	C	Standard Diamond	YES	3C - Standard	4.1	10.0	3.8	1.6	2.4	1.4	5.4
8A.6	8	A	Displaced Single Point (Standard Tight)	YES	8A.6 - Displac	7.8	3.3	4.2	3.1	0.8	1.5	5.4
2E.2	2	E	Tight Diamond Displaced (Tight Standard)	YES	2E.2 - Tight D	7.4	1.2	5.9	3.0	0.3	2.1	5.4
1A.7	1	A	Single Point Single Point (Spread Standard)		1A.7 - Single	6.7	4.5	4.5	2.7	1.1	1.6	5.4
1A.4	1	A	Single Point Single Point (Spread)		1A.4 - Single	6.8	4.3	4.5	2.7	1.0	1.6	5.4
1A.9	1	A	Single Point Single Point (Spread Tight)		1A.9 - Single	6.6	4.6	4.5	2.6	1.1	1.6	5.4
10G.1	10	G	Ramp Arterial U-Turn (Tight)	YES	10G.1 - Ramp	1.7	9.0	6.9	0.7	2.2	2.5	5.4
8C.3	8	C	Displaced Left (Spread)		8C.3 - Displac	6.3	4.2	5.1	2.5	1.0	1.9	5.4
1A	1	A	Single Point Single Point (Standard)	YES	1A - Single Po	6.5	4.6	4.5	2.6	1.1	1.6	5.3
1A.8	1	A	Single Point Single Point (Standard Spread)		1A.8 - Single	6.6	4.4	4.5	2.6	1.1	1.6	5.3

Southbound Freeway

	Right	Through	Left
Truck %	2%	16%	18%
PHF	0.90	0.90	0.90
Volume	73	897	20

Eastbound Through

	Volume	PHF
Bikes	10	0.90
Peds	10	0.90

Eastbound Arterial

Truck %	PHF	Volume	
5%	0.90	61	Left
2%	0.90	80	Through
2%	0.90	182	Right

Westbound Arterial

	Volume	PHF	Truck %
Right	80	0.90	11%
Through	102	0.90	2%
Left	398	0.90	9%

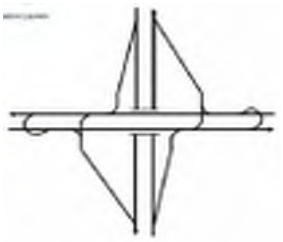
Westbound Through

PHF	Volume	
0.90	10	Bikes
0.90	10	Peds

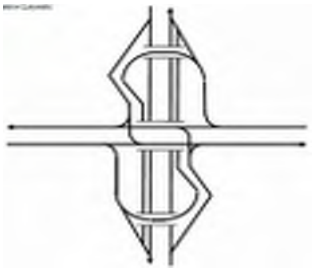
	Left	Through	Right
Volume	320	1,307	352
PHF	0.90	0.90	0.90
Truck %	2%	18%	12%

Northbound Freeway

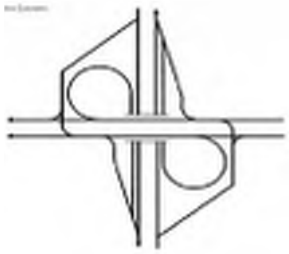
1. Standard Diamond Ramp U-Turn (Spread Standard)
7.6
ROW
3G



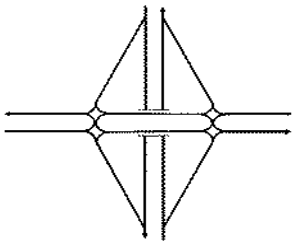
2. Milwaukee A (Standard)
7.6
FITS
12C



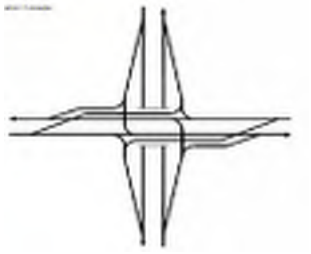
3. Parclo A (Spread)
7.1
ROW
9C



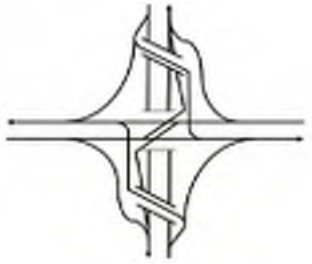
4. DDI (Standard)
7.1
FITS
8E



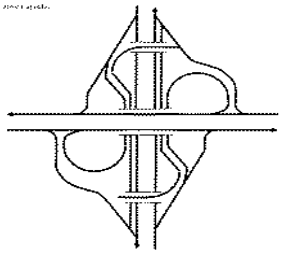
5. Displaced Tight Diamond (Spread Tight)
7
ROW
8B



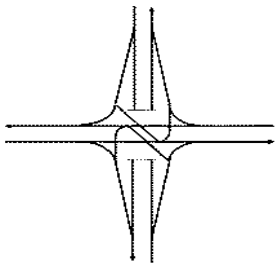
6. Displaced Single Point (Tight Standard)
6.9
FITS
1E



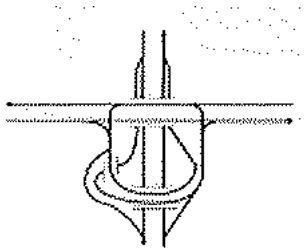
7. I-41 (Standard Spread)
6.6
ROW
12F



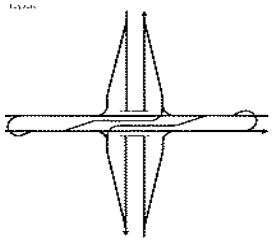
8. Tight Diamond Single Point (Spread Tight)
6.3
FITS
2A



9. Elevated Double U from Dunlop South of Arterial (Standard)
6.2
FITS
11H



10. Tight Contraflow U on Arterial (Spread Tight)
6.2
ROW
5G



2042 AM - Prohibitive ROW

Sheet	Left from Arterial	Left from Freeway	Name	Avoid ROW?	Graph Label	Base Efficiency	Base Cost	Base Safety	Weighted Efficiency	Weighted Cost	Weighted Safety	Overall Score
12C	12	C	Milwaukee A (Standard)	YES	12C - Milwau	7.6	5.5	8.6	3.0	1.3	3.1	7.4
8E	8	E	DDI (Standard)	YES	8E - DDI (Sta	8.5	10.0	4.5	3.4	2.4	1.6	7.4
12C.2	12	C	Milwaukee A (Standard Tight)	YES	12C.2 - Milw	7.6	5.6	8.5	3.0	1.4	3.0	7.4
2G	2	G	Tight Diamond Ramp U-Turn (Standard Tight)	YES	2G - Tight Dia	10.0	5.1	5.1	4.0	1.2	1.8	7.0
8E.1	8	E	DDI (Tight)	YES	8E.1 - DDI (T	8.7	7.5	4.5	3.5	1.8	1.6	6.9
1E.5	1	E	Displaced Single Point (Tight Standard)	YES	1E.5 - Displac	8.6	2.0	7.4	3.5	0.5	2.6	6.6
5G.1	5	G	Tight Contraflow U on Arterial (Standard Tight)	YES	5G.1 - Tight C	7.8	5.0	6.3	3.1	1.2	2.3	6.6
11H.3	11	H	Elevated Double U from Dunlop South of Arterial (Standard)	YES	11H.3 - Eleva	6.1	5.6	7.6	2.5	1.3	2.8	6.5
12B	12	B	U Turn over Freeway with Slips Tight Diamond (Tight)	YES	12B - U Turn	7.5	1.9	8.6	3.0	0.4	3.1	6.5
12B.1	12	B	U Turn over Freeway with Slips Tight Diamond (Standard)	YES	12B.1 - U Tur	7.5	1.7	8.6	3.0	0.4	3.1	6.5
5G	5	G	Tight Contraflow U on Arterial (Tight)	YES	5G - Tight Co	7.6	5.0	6.3	3.0	1.2	2.3	6.5
1E.1	1	E	Displaced Single Point (Spread)		1E.1 - Displac	9.1	0.0	7.7	3.6	0.0	2.8	6.4
6G	6	G	Canton I 275 at US 12 Synchronized Interchange (Standard)	YES	6G - Canton I	7.5	4.7	6.3	3.0	1.1	2.3	6.4
6G.1	6	G	Standard Contraflow U Turn on Arterial (Tight Standard)	YES	6G.1 - Standa	7.3	4.8	6.3	2.9	1.1	2.3	6.3
1E.2	1	E	Displaced Single Point (Spread Standard)		1E.2 - Displac	8.9	0.0	7.7	3.6	0.0	2.8	6.3
8B.2	8	B	Displaced Tight Diamond (Spread Tight)		8B.2 - Displac	9.8	0.0	6.7	3.9	0.0	2.4	6.3
8G.1	8	G	Displaced U Turn on Arterial (Tight)	YES	8G.1 - Displa	7.6	5.0	5.7	3.0	1.2	2.0	6.3
1E.4	1	E	Displaced Single Point (Tight Spread)		1E.4 - Displac	8.8	0.0	7.4	3.5	0.0	2.6	6.2
12G.1	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard Tight)	YES	12G.1 - U Tur	5.8	4.4	7.7	2.3	1.1	2.8	6.2
12C.1	12	C	Milwaukee A (Standard Spread)		12C.1 - Milwa	7.7	0.0	8.6	3.1	0.0	3.1	6.2
12G	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard)	YES	12G - U Turn	5.9	4.2	7.7	2.4	1.0	2.8	6.1
12B.2	12	B	U Turn over Freeway with Slips Tight Diamond (Spread)		12B.2 - U Tur	7.6	0.0	8.6	3.0	0.0	3.1	6.1
8B	8	B	Displaced Tight Diamond (Standard Tight)	YES	8B - Displace	6.4	4.8	6.7	2.6	1.2	2.4	6.1
8B.1	8	B	Displaced Tight Diamond (Tight)	YES	8B.1 - Displa	6.3	5.0	6.7	2.5	1.2	2.4	6.1
8C.4	8	C	Displaced Left (Standard Tight)	YES	8C.4 - Displa	6.4	4.6	6.7	2.5	1.1	2.4	6.1
12F	12	F	I-41 (Standard Spread)		12F - I-41 (St	6.6	0.0	9.4	2.6	0.0	3.4	6.0
8B.3	8	B	Displaced Tight Diamond (Standard)	YES	8B.3 - Displa	6.2	4.6	6.7	2.5	1.1	2.4	6.0
3G	3	G	Standard Diamond Ramp U-Turn (Standard)	YES	3G - Standar	5.4	8.2	5.1	2.2	2.0	1.8	6.0
8C.1	8	C	Displaced Left (Standard)	YES	8C.1 - Displa	6.1	4.6	6.7	2.4	1.1	2.4	6.0
8B.6	8	B	Displaced Tight Diamond (Tight Standard)	YES	8B.6 - Displa	6.0	4.8	6.7	2.4	1.2	2.4	5.9
12F.1	12	F	I-41 (Spread)		12F.1 - I-41 (	6.4	0.0	9.4	2.6	0.0	3.4	5.9
1E	1	E	Displaced Single Point (Standard)	YES	1E - Displace	6.0	3.2	7.7	2.4	0.8	2.8	5.9
2A.2	2	A	Tight Diamond Single Point (Standard Tight)	YES	2A.2 - Tight D	7.3	5.2	4.7	2.9	1.3	1.7	5.9
2A	2	A	Tight Diamond Single Point (Tight)	YES	2A - Tight Dia	7.2	5.3	4.7	2.9	1.3	1.7	5.8
3G.2	3	G	Standard Diamond Ramp U-Turn (Spread Standard)		3G.2 - Standa	10.0	0.0	5.1	4.0	0.0	1.8	5.8
2G.2	2	G	Tight Diamond Ramp U-Turn (Spread Tight)		2G.2 - Tight D	10.0	0.0	5.1	4.0	0.0	1.8	5.8
10G	10	G	Ramp Arterial U-Turn (Standard)	YES	10G - Ramp A	2.8	9.5	6.7	1.1	2.3	2.4	5.8
6I.2	6	I	Standard Contraflow U with Slips (Spread Standard)		6I.2 - Standa	7.9	0.0	7.3	3.2	0.0	2.6	5.8
8A.1	8	A	Displaced Single Point (Tight)	YES	8A.1 - Displa	7.2	3.7	5.6	2.9	0.9	2.0	5.8
10G.2	10	G	Ramp Arterial U-Turn (Tight Standard)	YES	10G.2 - Ramp	2.6	9.5	6.7	1.1	2.3	2.4	5.8
6I	6	I	Standard Contraflow U with Slips (Standard)	YES	6I - Standard	7.7	0.0	7.3	3.1	0.0	2.6	5.7
6I.1	6	I	Standard Contraflow U with Slips (Tight Standard)	YES	6I.1 - Standa	7.7	0.0	7.3	3.1	0.0	2.6	5.7
10G.4	10	G	Ramp Arterial U-Turn (Standard Tight)	YES	10G.4 - Ramp	2.4	9.5	6.7	1.0	2.3	2.4	5.7
8A	8	A	Displaced Single Point (Standard)	YES	8A - Displace	7.0	3.3	5.6	2.8	0.8	2.0	5.6
10G.1	10	G	Ramp Arterial U-Turn (Tight)	YES	10G.1 - Ramp	2.2	9.6	6.7	0.9	2.3	2.4	5.6
9C.2	9	C	Parclo A (Spread)		9C.2 - Parclo	6.4	0.0	8.3	2.6	0.0	3.0	5.5
8A.6	8	A	Displaced Single Point (Standard Tight)	YES	8A.6 - Displa	6.6	3.5	5.6	2.6	0.8	2.0	5.5
5G.2	5	G	Tight Contraflow U on Arterial (Spread Tight)		5G.2 - Tight C	7.9	0.0	6.3	3.2	0.0	2.3	5.4
3C	3	C	Standard Diamond	YES	3C - Standard	3.3	10.0	4.7	1.3	2.4	1.7	5.4
1A	1	A	Single Point Single Point (Standard)	YES	1A - Single Po	6.0	5.0	4.9	2.4	1.2	1.8	5.4
6G.2	6	G	Standard Contraflow U Turn on Arterial (Spread Standard)		6G.2 - Standa	7.7	0.0	6.3	3.1	0.0	2.3	5.4
8A.4	8	A	Displaced Single Point (Tight Standard)	YES	8A.4 - Displa	6.2	3.5	5.6	2.5	0.8	2.0	5.3
1A.6	1	A	Single Point Single Point (Tight Standard)	YES	1A.6 - Single	5.8	5.1	4.9	2.3	1.2	1.8	5.3
1A.5	1	A	Single Point Single Point (Standard Tight)	YES	1A.5 - Single	5.7	5.1	4.9	2.3	1.2	1.8	5.3
8G.4	8	G	Displaced U Turn on Arterial (Standard Tight)	YES	8G.4 - Displa	5.2	4.9	5.7	2.1	1.2	2.0	5.3
2G.1	2	G	Tight Diamond Ramp U-Turn (Tight)	YES	2G.1 - Tight D	5.5	5.2	5.1	2.2	1.2	1.8	5.2
1A.3	1	A	Single Point Single Point (Tight)	YES	1A.3 - Single	5.6	5.2	4.9	2.2	1.2	1.8	5.2
8B.5	8	B	Displaced Tight Diamond (Spread)		8B.5 - Displac	7.0	0.0	6.7	2.8	0.0	2.4	5.2
8F.2	8	F	CFI (Standard Spread)		8F.2 - CFI (St	5.4	0.0	8.6	2.1	0.0	3.1	5.2
12G.4	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Standard)		12G.4 - U Tur	6.1	0.0	7.7	2.4	0.0	2.8	5.2
12G.4	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Standard)		12G.4 - U Tur	6.1	0.0	7.7	2.4	0.0	2.8	5.2
3G.1	3	G	Standard Diamond Ramp U-Turn (Tight Standard)	YES	3G.1 - Standa	4.5	8.2	3.9	1.8	2.0	1.4	5.2
12G.3	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Tight)		12G.3 - U Tur	6.0	0.0	7.7	2.4	0.0	2.8	5.2
3E	3	E	Standard Diamond Displaced (Standard Standard/Tight)	YES	3E - Standard	6.5	3.7	4.7	2.6	0.9	1.7	5.2
8F.1	8	F	CFI (Tight Spread)		8F.1 - CFI (Ti	5.2	0.0	8.6	2.1	0.0	3.1	5.2
8G	8	G	Synchronized (Standard)	YES	8G - Synchro	4.9	4.7	5.7	2.0	1.1	2.0	5.2
12G.2	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard Spread)		12G.2 - U Tur	5.9	0.0	7.7	2.4	0.0	2.8	5.1
7A.2	7	A	Spread Contraflow Single Point (Spread)		7A.2 - Spread	7.8	0.0	5.6	3.1	0.0	2.0	5.1
8G.2	8	G	Displaced U Turn on Arterial (Tight Standard)	YES	8G.2 - Displa	4.7	4.9	5.7	1.9	1.2	2.0	5.1
7A	7	A	Spread Contraflow Single Point (Standard Spread)		7A - Spread C	7.7	0.0	5.6	3.1	0.0	2.0	5.1
1E.3	1	E	Displaced Single Point (Standard Spread)		1E.3 - Displac	6.2	0.0	7.2	2.5	0.0	2.6	5.1
8C.5	8	C	Displaced Left (Spread Tight)		8C.5 - Displac	6.6	0.0	6.7	2.6	0.0	2.4	5.0
7A.1	7	A	Spread Contraflow Single Point (Tight Spread)		7A.1 - Spread	7.5	0.0	5.6	3.0	0.0	2.0	5.0
8C	8	C	Displaced Left (Spread Standard)		8C - Displace	6.5	0.0	6.7	2.6	0.0	2.4	5.0
11H.4	11	H	Elevated Double U from Dunlop South of Arterial (Spread)		11H.4 - Eleva	5.6	0.0	7.6	2.3	0.0	2.8	5.0
8B.4	8	B	Displaced Tight Diamond (Spread Standard)		8B.4 - Displac	6.3	0.0	6.7	2.5	0.0	2.4	4.9
10B.1	10	B	U Turn on Arterial Tight Diamond (Tight Standard)	YES	10B.1 - U Tur	3.3	9.5	3.7	1.3	2.3	1.3	4.9
8E.2	8	E	DDI (Spread)		8E.2 - DDI (S	8.0	0.0	4.5	3.2	0.0	1.6	4.8
8F	8	F	CFI (Spread)		8F - CFI (Spre	5.5	0.0	7.3	2.2	0.0	2.6	4.8
8A.7	8	A	Displaced Single Point (Spread Tight)		8A.7 - Displa	6.9	0.0	5.6	2.8	0.0	2.0	4.8
6C	6	C	Standard Contraflow Diamond	YES	6C - Standard	3.3	10.0	2.8	1.3	2.4	1.0	4.8
2B	2	B	Tight Diamond	YES	2B - Tight Dia	3.5	7.6	4.2	1.4	1.8	1.5	4.8
8C.3	8	C	Displaced Left (Spread)		8C.3 - Displac	5.8	0.0	6.7	2.3	0.0	2.4	4.7
8B.8	8	B	Displaced Tight Diamond (Standard Spread)		8B.8 - Displac	5.7	0.0	6.7	2.3	0.0	2.4	4.7
2A.1	2	A	Tight Diamond Single Point (Spread Tight)		2A.1 - Tight D	7.5	0.0	4.7	3.0	0.0	1.7	4.7
8C.2	8	C	Displaced Left (Standard Spread)		8C.2 - Displac	5.5	0.0	6.7	2.2	0.0	2.4	4.6
8A.2	8	A	Displaced Single Point (Spread)		8A.2 - Displa	6.6	0.0	5.6	2.6	0.0	2.0	4.6
10B	10	B	U Turn on Arterial Tight Diamond (Tight)	YES	10B - U Turn	2.5	9.5	3.7	1.0	2.3	1.3	4.6
8A.8	8	A	Displaced Single Point (Spread Standard)		8A.8 - Displa	6.5	0.0	5.6	2.6	0.0	2.0	4.6
1D.2	1	D	Single Point Spread Diamond (Spread)		1D.2 - Single	5.6	0.0	6.5	2.3	0.0	2.3	4.6
8B.7	8	B	Displaced Tight Diamond (Tight Spread)		8B.7 - Displac	5.4	0.0	6.7	2.2	0.0	2.4	4.6
11B	11	B	Median U-Turn	YES	11B - Median	8.0	5.6	0.0	3.2	1.3	0.0	4.6
9C	9	C	Parclo A (Spread Standard)		9C - Parclo A	4.5	0.0	7.5	1.8	0.0	2.7	4.5
9C.1	9	C	Parclo A (Spread Tight)		9C.1 - Parclo	4.2	0.0	7.5	1.7	0.0	2.7	4.4
4A	4	A	Three Point (Spread)		4A - Three Po	6.8	0.0	4.7	2.7	0.0	1.7	4.4
8A.3	8	A	Displaced Single Point (Standard Spread)		8A.3 - Displa	5.9	0.0	5.6	2.4	0.0	2.0	4.4
7B	7	B	Spread Contraflow Tight Diamond		7B - Spread C	6.0	0.0	5.4	2.4	0.0	1.9	4.3
12H	12	H	U Turn Over Freeway with Slips U Turn Over Freeway (Standard)	YES	12H - U Turn	4.9	4.0	3.9	2.0	0.9	1.4	4.3
10A.6	10	A	U Turn on Arterial Single Point (Standard)	YES	10A.6 - U Tur	3.3	6.7	3.9	1.3	1.6	1.4	4.3
8A.5	8	A	Displaced Single Point (Tight Spread)		8A.5 - Displa	5.8	0.0	5.6	2.3	0.0	2.0	4.3

Southbound Freeway

	Right	Through	Left
Truck %	12%	16%	9%
PHF	0.80	0.80	0.80
Volume	17	1,038	44

Eastbound Through

	Volume	PHF
Bikes	10	0.80
Peds	10	0.80

Eastbound Arterial

Truck %	PHF	Volume	
3%	0.80	125	Left
6%	0.80	111	Through
2%	0.80	527	Right

Westbound Arterial

	Volume	PHF	Truck %
Right	35	0.80	26%
Through	53	0.80	14%
Left	356	0.80	6%

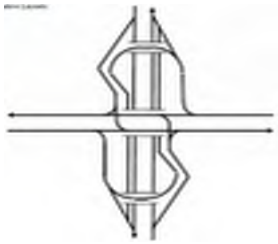
Westbound Through

PHF	Volume	
0.80	10	Bikes
0.80	10	Peds

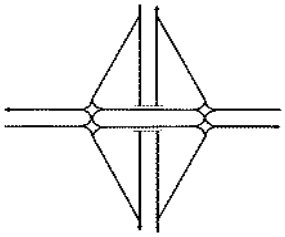
	Left	Through	Right
Volume	52	899	380
PHF	0.80	0.80	0.80
Truck %	2%	18%	10%

Northbound Freeway

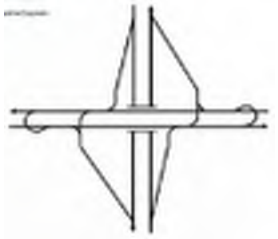
1. Milwaukee A (Standard)
7.4
FITS
12C



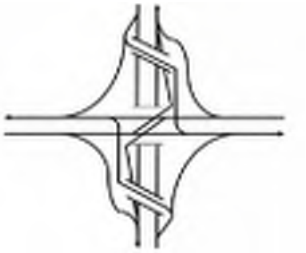
2. DDI (Standard)
7.4
FITS
8E



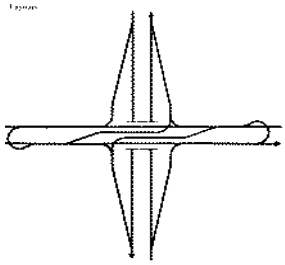
3. Tight Diamond Ramp U-Turn (Standard Tight)
7
FITS
2G



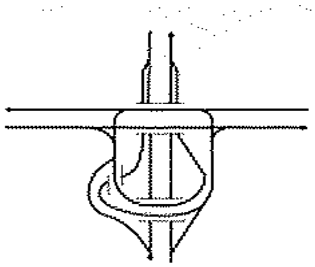
4. Displaced Single Point (Tight Standard)
6.6
FITS
1E



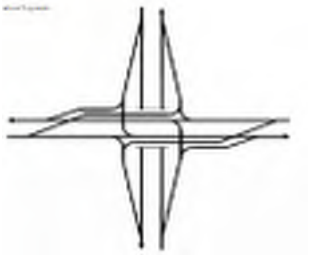
5. Tight Contraflow U on Arterial (Standard Tight)
6.6
FITS
5G



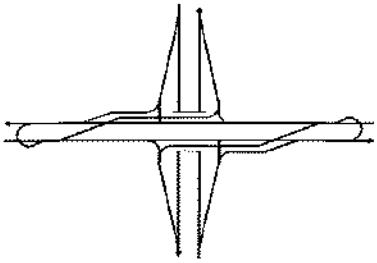
6. Elevated Double U from Dunlop South of Arterial (Standard)
6.5
FITS
11H



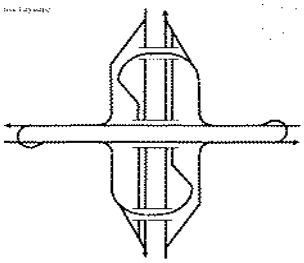
7. Displaced Tight Diamond (Spread Tight)
6.3
ROW
8B



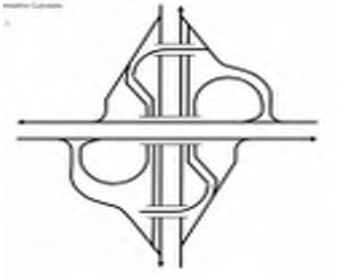
8. Displaced U Turn on Arterial (Tight)
6.3
ROW
8G



9. U Turn Over Freeway with Slips U Turn on Arterial (Standard Tight)
6.2
ROW
12G



10. I-41 (Standard Spread)
6.0
ROW
12F



2042 PM - Prohibitive ROW

Sheet	Left from Arterial	Left from Freeway	Name	Avoid ROW?	Graph Label	Base Efficiency	Base Cost	Base Safety	Weighted Efficiency	Weighted Cost	Weighted Safety	Overall Score
12C	12	C	Milwaukee A (Standard)	YES	12C - Milwau	8.3	5.6	8.3	3.3	1.3	3.0	7.6
12C.2	12	C	Milwaukee A (Standard Tight)	YES	12C.2 - Milw	8.3	5.8	7.9	3.3	1.4	2.8	7.6
8E	8	E	DDI (Standard)	YES	8E - DDI (Sta	7.9	10.0	4.2	3.2	2.4	1.5	7.1
2G	2	G	Tight Diamond Ramp U-Turn (Standard Tight)	YES	2G - Tight Dia	10.0	5.3	5.0	4.0	1.3	1.8	7.0
1E.5	1	E	Displaced Single Point (Tight Standard)	YES	1E.5 - Displac	9.0	2.3	7.6	3.6	0.5	2.7	6.9
12B	12	B	U Turn over Freeway with Slips Tight Diamond (Tight)	YES	12B - U Turn	8.5	2.1	8.3	3.4	0.5	3.0	6.9
12B.1	12	B	U Turn over Freeway with Slips Tight Diamond (Standard)	YES	12B.1 - U Tur	8.4	1.9	8.3	3.4	0.5	3.0	6.8
8E.1	8	E	DDI (Tight)	YES	8E.1 - DDI (T	8.4	7.6	4.2	3.3	1.8	1.5	6.7
1E.4	1	E	Displaced Single Point (Tight Spread)		1E.4 - Displac	9.1	0.0	7.6	3.7	0.0	2.7	6.4
12B.2	12	B	U Turn over Freeway with Slips Tight Diamond (Spread)		12B.2 - U Tur	8.4	0.0	8.3	3.4	0.0	3.0	6.3
1E.1	1	E	Displaced Single Point (Spread)		1E.1 - Displac	8.9	0.0	7.7	3.5	0.0	2.8	6.3
2A.2	2	A	Tight Diamond Single Point (Standard Tight)	YES	2A.2 - Tight D	8.2	4.8	5.1	3.3	1.2	1.8	6.3
11H.3	11	H	Elevated Double U from Dunlop South of Arterial (Standard)	YES	11H.3 - Eleva	5.6	5.7	7.4	2.2	1.4	2.7	6.3
12C.1	12	C	Milwaukee A (Standard Spread)		12C.1 - Milw	8.2	0.0	8.3	3.3	0.0	3.0	6.3
1E.2	1	E	Displaced Single Point (Spread Standard)		1E.2 - Displac	8.8	0.0	7.7	3.5	0.0	2.8	6.3
2A	2	A	Tight Diamond Single Point (Tight)	YES	2A - Tight Dia	8.0	4.9	5.1	3.2	1.2	1.8	6.2
5G.1	5	G	Tight Contraflow U on Arterial (Standard Tight)	YES	5G.1 - Tight C	6.4	5.1	6.4	2.6	1.2	2.3	6.1
6I.2	6	I	Standard Contraflow U with Slips (Spread Standard)		6I.2 - Standa	7.4	0.0	8.5	3.0	0.0	3.1	6.0
5G	5	G	Tight Contraflow U on Arterial (Tight)	YES	5G - Tight Co	6.1	5.2	6.4	2.4	1.2	2.3	6.0
12G.1	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard Tight)	YES	12G.1 - U Tur	4.9	4.6	8.1	2.0	1.1	2.9	6.0
6I.1	6	I	Standard Contraflow U with Slips (Tight Standard)	YES	6I.1 - Standa	7.3	0.0	8.5	2.9	0.0	3.1	6.0
8B	8	B	Displaced Tight Diamond (Standard Tight)	YES	8B - Displace	7.3	5.0	5.1	2.9	1.2	1.9	6.0
6G	6	G	Canton I 275 at US 12 Synchronized Interchange (Standard)	YES	6G - Canton I	6.1	4.9	6.4	2.4	1.2	2.3	5.9
8B.1	8	B	Displaced Tight Diamond (Tight)	YES	8B.1 - Displac	7.1	5.1	5.1	2.8	1.2	1.9	5.9
12G	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard)	YES	12G - U Turn	4.9	4.4	8.1	1.9	1.1	2.9	5.9
12F	12	F	I-41 (Standard Spread)		12F - I-41 (St	5.7	0.0	10.0	2.3	0.0	3.6	5.9
6I	6	I	Standard Contraflow U with Slips (Standard)	YES	6I - Standard	7.1	0.0	8.5	2.8	0.0	3.1	5.9
12F.1	12	F	I-41 (Spread)		12F.1 - I-41 (	5.6	0.0	10.0	2.2	0.0	3.6	5.8
6G.1	6	G	Standard Contraflow U Turn on Arterial (Tight Standard)	YES	6G.1 - Standa	5.8	4.9	6.4	2.3	1.2	2.3	5.8
8B.6	8	B	Displaced Tight Diamond (Tight Standard)	YES	8B.6 - Displac	6.9	5.0	5.1	2.8	1.2	1.9	5.8
1E	1	E	Displaced Single Point (Standard)	YES	1E - Displace	5.6	3.4	7.7	2.2	0.8	2.8	5.8
8C.4	8	C	Displaced Left (Standard Tight)	YES	8C.4 - Displac	7.0	4.8	5.1	2.8	1.2	1.9	5.8
8B.3	8	B	Displaced Tight Diamond (Standard)	YES	8B.3 - Displac	7.0	4.8	5.1	2.8	1.2	1.9	5.8
3G.2	3	G	Standard Diamond Ramp U-Turn (Spread Standard)		3G.2 - Standa	10.0	0.0	5.0	4.0	0.0	1.8	5.8
2G.2	2	G	Tight Diamond Ramp U-Turn (Spread Tight)		2G.2 - Tight D	10.0	0.0	5.0	4.0	0.0	1.8	5.8
8B.2	8	B	Displaced Tight Diamond (Spread Tight)		8B.2 - Displac	9.8	0.0	5.1	3.9	0.0	1.9	5.8
10G	10	G	Ramp Arterial U-Turn (Standard)	YES	10G - Ramp A	2.3	9.5	6.9	0.9	2.3	2.5	5.7
8G.1	8	G	Displaced U Turn on Arterial (Tight)	YES	8G.1 - Displa	6.9	5.2	4.6	2.8	1.2	1.7	5.7
8A.1	8	A	Displaced Single Point (Tight)	YES	8A.1 - Displac	8.4	3.3	4.2	3.4	0.8	1.5	5.7
8C.1	8	C	Displaced Left (Standard)	YES	8C.1 - Displac	6.7	4.8	5.1	2.7	1.1	1.9	5.7
10G.4	10	G	Ramp Arterial U-Turn (Standard Tight)	YES	10G.4 - Ramp	2.0	9.6	6.9	0.8	2.3	2.5	5.6
10G.2	10	G	Ramp Arterial U-Turn (Tight Standard)	YES	10G.2 - Ramp	2.0	9.6	6.9	0.8	2.3	2.5	5.6
3G	3	G	Standard Diamond Ramp U-Turn (Standard)	YES	3G - Standard	4.5	8.3	5.0	1.8	2.0	1.8	5.6
3E	3	E	Standard Diamond Displaced (Standard Standard/Tight)	YES	3E - Standard	6.9	3.9	5.1	2.8	0.9	1.8	5.5
10G.1	10	G	Ramp Arterial U-Turn (Tight)	YES	10G.1 - Ramp	1.7	9.6	6.9	0.7	2.3	2.5	5.5
8A	8	A	Displaced Single Point (Standard)	YES	8A - Displace	8.1	3.0	4.2	3.2	0.7	1.5	5.5
3C	3	C	Standard Diamond	YES	3C - Standard	4.1	10.0	3.8	1.6	2.4	1.4	5.4
10B.1	10	B	U Turn on Arterial Tight Diamond (Tight Standard)	YES	10B.1 - U Tur	4.5	9.5	3.7	1.8	2.3	1.3	5.4
8A.6	8	A	Displaced Single Point (Standard Tight)	YES	8A.6 - Displa	7.8	3.2	4.2	3.1	0.8	1.5	5.4
7A.2	7	A	Spread Contraflow Single Point (Spread)		7A.2 - Spread	8.1	0.0	5.9	3.2	0.0	2.1	5.4
1A	1	A	Single Point Single Point (Standard)	YES	1A - Single Po	6.5	4.6	4.5	2.6	1.1	1.6	5.4
1A.5	1	A	Single Point Single Point (Standard Tight)	YES	1A.5 - Single	6.4	4.8	4.5	2.6	1.1	1.6	5.3
8F.2	8	F	CFI (Standard Spread)		8F.2 - CFI (St	5.0	0.0	9.2	2.0	0.0	3.3	5.3
7A	7	A	Spread Contraflow Single Point (Standard Spread)		7A - Spread C	7.9	0.0	5.9	3.2	0.0	2.1	5.3
1A.6	1	A	Single Point Single Point (Tight Standard)	YES	1A.6 - Single	6.4	4.7	4.5	2.5	1.1	1.6	5.3
1A.3	1	A	Single Point Single Point (Tight)	YES	1A.3 - Single	6.2	4.8	4.5	2.5	1.2	1.6	5.3
2E.2	2	E	Tight Diamond Displaced (Tight Standard)	YES	2E.2 - Tight D	7.4	0.8	5.9	3.0	0.2	2.1	5.3
8F.1	8	F	CFI (Tight Spread)		8F.1 - CFI (Ti	4.9	0.0	9.2	1.9	0.0	3.3	5.3
10B	10	B	U Turn on Arterial Tight Diamond (Tight)	YES	10B - U Turn	4.1	9.6	3.7	1.6	2.3	1.3	5.3
7A.1	7	A	Spread Contraflow Single Point (Tight Spread)		7A.1 - Spread	7.8	0.0	5.9	3.1	0.0	2.1	5.2
8A.4	8	A	Displaced Single Point (Tight Standard)	YES	8A.4 - Displa	7.3	3.2	4.2	2.9	0.8	1.5	5.2
2A.1	2	A	Tight Diamond Single Point (Spread Tight)		2A.1 - Tight D	8.3	0.0	5.1	3.3	0.0	1.8	5.2
11H.5	11	H	Elevated Double U from Dunlop North of Arterial (Standard)	YES	11H.5 - Eleva	3.5	4.7	7.3	1.4	1.1	2.6	5.1
8F	8	F	CFI (Spread)		8F - CFI (Spre	5.2	0.0	8.5	2.1	0.0	3.1	5.1
8B.5	8	B	Displaced Tight Diamond (Spread)		8B.5 - Displac	8.1	0.0	5.1	3.2	0.0	1.9	5.1
6C	6	C	Standard Contraflow Diamond	YES	6C - Standard	4.1	10.0	2.7	1.6	2.4	1.0	5.0
2B	2	B	Tight Diamond	YES	2B - Tight Dia	4.6	7.7	3.7	1.8	1.9	1.3	5.0
9C.2	9	C	Parclo A (Spread)		9C.2 - Parclo	5.8	0.0	7.4	2.3	0.0	2.7	5.0
12G.3	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Tight)		12G.3 - U Tur	5.2	0.0	8.1	2.1	0.0	2.9	5.0
5G.2	5	G	Tight Contraflow U on Arterial (Spread Tight)		5G.2 - Tight C	6.7	0.0	6.4	2.7	0.0	2.3	5.0
2E.1	2	E	Tight Diamond Displaced (Spread Standard)		2E.1 - Tight D	7.0	0.0	6.0	2.8	0.0	2.2	5.0
2E.5	2	E	Tight Diamond Displaced (Tight Spread)		2E.5 - Tight D	7.1	0.0	5.9	2.8	0.0	2.1	5.0
12G.4	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Standard)		12G.4 - U Tur	5.1	0.0	8.1	2.1	0.0	2.9	5.0
12G.4	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Spread Standard)		12G.4 - U Tur	5.1	0.0	8.1	2.1	0.0	2.9	5.0
2E.3	2	E	Tight Diamond Displaced (Standard Spread)		2E.3 - Tight D	7.0	0.0	5.9	2.8	0.0	2.1	5.0
10A.6	10	A	U Turn on Arterial Single Point (Standard)	YES	10A.6 - U Tur	4.5	6.3	4.4	1.8	1.5	1.6	4.9
1E.3	1	E	Displaced Single Point (Standard Spread)		1E.3 - Displac	5.7	0.0	7.2	2.3	0.0	2.6	4.9
6G.2	6	G	Standard Contraflow U Turn on Arterial (Spread Standard)		6G.2 - Standa	6.4	0.0	6.4	2.6	0.0	2.3	4.9
2G.1	2	G	Tight Diamond Ramp U-Turn (Tight)	YES	2G.1 - Tight D	4.5	5.3	5.0	1.8	1.3	1.8	4.9
12G.2	12	G	U Turn Over Freeway with Slips U Turn on Arterial (Standard Spread)		12G.2 - U Tur	4.8	0.0	8.1	1.9	0.0	2.9	4.8
10A.4	10	A	U Turn on Arterial Single Point (Tight Standard)	YES	10A.4 - U Tur	4.3	6.3	4.4	1.7	1.5	1.6	4.8
4A	4	A	Three Point (Spread)		4A - Three Po	7.5	0.0	5.1	3.0	0.0	1.8	4.8
8G.4	8	G	Displaced U Turn on Arterial (Standard Tight)	YES	8G.4 - Displa	4.9	5.0	4.6	1.9	1.2	1.7	4.8
10A.2	10	A	U Turn on Arterial Single Point (Standard Tight)	YES	10A.2 - U Tur	4.2	6.3	4.4	1.7	1.5	1.6	4.8
10A.1	10	A	U Turn on Arterial Single Point (Tight)	YES	10A.1 - U Tur	4.0	6.4	4.4	1.6	1.5	1.6	4.7
8C.5	8	C	Displaced Left (Spread Tight)		8C.5 - Displac	7.2	0.0	5.1	2.9	0.0	1.9	4.7
8A.7	8	A	Displaced Single Point (Spread Tight)		8A.7 - Displa	8.0	0.0	4.2	3.2	0.0	1.5	4.7
8B.4	8	B	Displaced Tight Diamond (Spread Standard)		8B.4 - Displac	7.1	0.0	5.1	2.8	0.0	1.9	4.7
8C	8	C	Displaced Left (Spread Standard)		8C - Displace	7.1	0.0	5.1	2.8	0.0	1.9	4.7
3G.1	3	G	Standard Diamond Ramp U-Turn (Tight Standard)	YES	3G.1 - Standa	3.4	8.3	3.7	1.4	2.0	1.3	4.7
8G	8	G	Synchronized (Standard)	YES	8G - Synchro	4.5	4.9	4.6	1.8	1.2	1.7	4.6
7B	7	B	Spread Contraflow Tight Diamond		7B - Spread C	6.9	0.0	5.2	2.8	0.0	1.9	4.6
1D.2	1	D	Single Point Spread Diamond (Spread)		1D.2 - Single	6.4	0.0	5.6	2.5	0.0	2.0	4.6
8G.2	8	G	Displaced U Turn on Arterial (Tight Standard)	YES	8G.2 - Displa	4.2	5.0	4.6	1.7	1.2	1.7	4.6
8A.8	8	A	Displaced Single Point (Spread Standard)		8A.8 - Displa	7.6	0.0	4.2	3.0	0.0	1.5	4.5
11B	11	B	Median U-Turn	YES	11B - Median	7.9	5.7	0.0	3.2	1.4	0.0	4.5
8A.2	8	A	Displaced Single Point (Spread)		8A.2 - Displa	7.6	0.0	4.2	3.0	0.0	1.5	4.5
3E.1	3	E	Standard Diamond Displaced (Spread Standard/Tight)		3E.1 - Standa	6.6	0.0	5.1	2.7	0.0	1.8	4.5
8B.7	8	B	Displaced Tight Diamond (Tight Spread)		8B.7 - Displac	6.5	0.0	5.1	2.6	0.0	1.9	4.5
8B.8	8	B	Displaced Tight Diamond (Standard Spread)		8B.8 - Displac	6.4	0.0	5.1	2.6	0.0	1.9	4.4

Southbound Freeway

	Right	Through	Left
Truck %	2%	16%	18%
PHF	0.90	0.90	0.90
Volume	73	897	20

Eastbound Through

	Volume	PHF
Bikes	10	0.90
Peds	10	0.90

Eastbound Arterial

Truck %	PHF	Volume	
5%	0.90	61	Left
2%	0.90	80	Through
2%	0.90	182	Right

Westbound Arterial

	Volume	PHF	Truck %
Right	80	0.90	11%
Through	102	0.90	2%
Left	398	0.90	9%

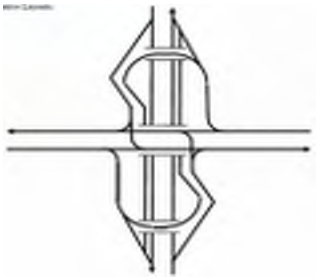
Westbound Through

PHF	Volume	
0.90	10	Bikes
0.90	10	Peds

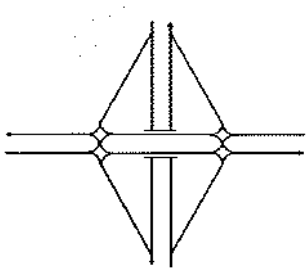
	Left	Through	Right
Volume	320	1,307	352
PHF	0.90	0.90	0.90
Truck %	2%	18%	12%

Northbound Freeway

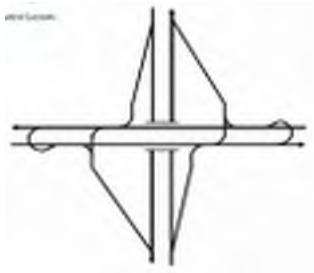
1. Milwaukee A (Standard)
7.6
FITS
12C



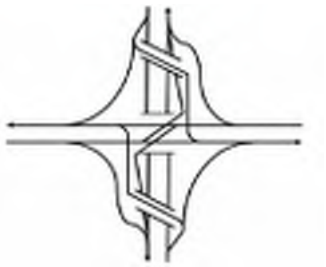
2. DDI (Standard)
7.1
FITS
8E



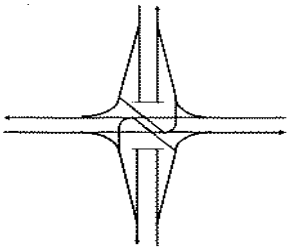
3. Tight Diamond Ramp U-Turn (Standard Tight)
7
ROW
2G



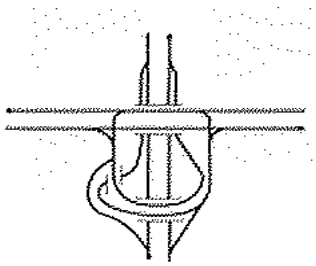
4. Displaced Single Point (Tight Standard)
6.9
FITS
1E



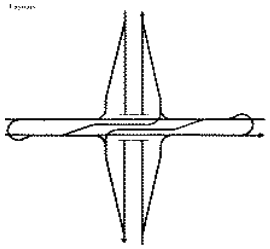
5. Tight Diamond Single Point (Standard Tight)
6.3
FITS
2A



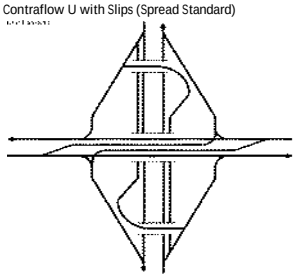
6. Elevated Double U from Dunlop South of Arterial (Standard)
6.3
FITS
11H



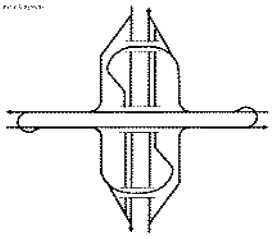
7. Tight Contraflow U on Arterial (Standard Tight)
6.1
ROW
5G



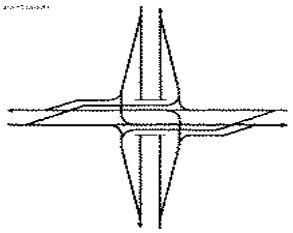
8. Standard Contraflow U with Slips (Spread Standard)
6
FITS
6I



9. U Turn Over Freeway with Slips U Turn on Arterial (Standard Tight)
6.0
ROW
12G



10. Displaced Tight Diamond (Standard Tight)
6
ROW
8B



Global (Default) Variables

Required Inputs

Roadway Geometry

Freeway # of Lanes (NB):	2	
Freeway # of Lanes (SB):	2	
Freeway Lane Width (ft):	12	
Freeway Inside Paved Shoulder Width (ft):	4	
Freeway Outside Paved Shoulder Width (ft):	10	
Acceleration Lane Length (ft):	600	Larger of 2
Second Acc. Lane Additional Length (ft):	600	
Deceleration Lane Length (ft):	250	Larger of 2
Ramp Left Paved Shoulder Width (ft):	4	
Ramp Right Paved Shoulder Width (ft):	6	
C-D Left Paved Shoulder Width (ft):	4	
C-D Right Paved Shoulder Width (ft):	6	
Arterial # of Lanes (EB):	1	
Arterial # of Lanes (WB):	1	
Arterial Lane Width (ft):	12	
Arterial Median Type:	Undivided	
Arterial Inside Paved Shoulder Width (ft):	0	
Arterial Outside Paved Shoulder Width (ft):	5	

Facility Free Flow Speeds

Freeway Speed (mph):	75
Arterial Speed (mph):	40
Left Over Speed (mph):	40
Ramp Speed (mph):	45
Loop Speed (mph):	25
Flyover Speed (mph):	45
Freeway Flyover U-Turn Speed (mph):	30
C-D Speed (mph):	55

Driver Population Adjustments

Freeway Capacity Adjustment Factor:	1.00	
Freeway Speed Adjustment Factor:	1.00	
Average Vehicle Occupancy:	1.1	

Area Characteristics

Terrain:	Level	
Metropolitan Area with Population ≥ 250k:	TRUE	252k, 2021
Location in Central Business District:	FALSE	
Interchange Density (interchange/mile):	0.725	

Signal Timing Settings

Critical Intersection Volume-to-Capacity Ratio:	0.85
Platoon Ratio:	1.00
Minimum Cycle Length - 2 phase (s):	60
Minimum Cycle Length - 3 phase (s):	90
Minimum Cycle Length - 4+ phase (s):	120
Maximum Cycle Length (s):	180
Minimum Green Time - Major Movement (s):	15
Minimum Green Time - Minor Movement (s):	10
Yellow Time (s):	3.5
Red Time (s):	2.0
Start-Up Lost Time (s):	0.0
Extension of Effective Green (s):	2.0
Volume Requiring Dual Left Turn Lanes (vph):	300
Maximum Delay Override (s):	300

Measure of Effectiveness Weights

Efficiency Weight:	5.00
Cost Weight:	3.00
Safety Weight:	4.50

Measure of Effectiveness Range

Minimum MOE Score:	0
Maximum MOE Score:	10

Right-of-Way Availability

Available NE Quadrant ROW (sqft):	Standard		
Available NW Quadrant ROW (sqft):	Standard		
Available SW Quadrant ROW (sqft):	Standard		
Available SE Quadrant ROW (sqft):	Standard		
			and
Cost of NE Quadrant ROW ($/sqft):	$ 0.115	Conservative	Prohibitive
Cost of NW Quadrant ROW ($/sqft):	$ 0.115	Estimate for	Prohibitive
Cost of SW Quadrant ROW ($/sqft):	$ 0.115	Cass Co. ND	Prohibitive
Cost of SE Quadrant ROW ($/sqft):	$ 0.115	($5000/ac)	Prohibitive

Infrastructure Costs

Cost for Sq. Yard of Pavement ($):	$ 42
Cost for Sq. Yard of Bridge ($):	$ 1,500
Cost for Signalization ($):	$ 230,000

Weights for Safety Conflict Opportunities

Vehicle Merge:	1.00
Vehicle Diverge:	1.00
Vehicle Crossing:	2.00
Bike Merge:	0.00
Bike Diverge:	0.00
Bike Crossing:	1.00
Pedestrian Signal Crossing:	1.00
Pedestrian Stop Crossing:	0.00
Pedestrian Uncontrolled Crossing:	3.00

Optional Inputs

Area Characteristics

Upstream Ramp Type:	
Distance to Adjacent Upstream Ramp (ft):	
Flow Rate on Adjacent Upstream Ramp (pc/hr):	
Downstream Ramp Type:	
Distance to Adjacent Downstream Ramp (ft):	
Flow Rate on Adjacent Downstream Ramp (pc/hr):	

Acceptable MOE Ranges

Minimum Cost ($):	
Maximum Cost ($):	
Minimum Average Delay (sec):	
Maximum Average Delay (sec):	
Minimum Conflict Rate Per User:	
Maximum Conflict Rate Per User:	

Additional Inputs (Change Not Recommended)

Right-of-Way Area Required

Tight Diamond (sqft):	65,000
Standard Diamond (sqft):	165,000
Spread Diamond (sqft):	315,000

Structure Geometry

Bridge Length (ft):	200

Attachment B - Preliminary Alternatives Matrix

I-29 & 40th Avenue Interchange Feasibility Study

Preliminary Alternatives Matrix

Alternatives		Safety Considerations	Bicycle/Pedestrian Considerations	Right-of-way Impacts	Construction and Maintenance Costs	Constructability	Left Turn Capacity	Accomodates Future 40th Ave. Capacity Improvements
1	Standard Diamond Interchange	- Higher number of conflict points - Does not eliminate wrong-way movements	+ Requires fewer crossings	+ Minimal to no right-of-way needed	- May include signalization	+ New structure can be built while maintaining traffic	+ Dual-left turn lanes can be constructed - Left turn phase competes for signal time	+ Second structure can be built in place of existing structure for 4-lane divided section
2	Dumbbell Interchange	+ Reduces number of conflict points + Eliminates wrong-way movements	+ Requires fewer crossings	- Minimal right-of-way required for roundabouts	+ Unsignalized	+ New structure can be built while maintaining traffic	+ Roundabouts accomodate high left turn movements	+ Second structure can be built in place of existing structure for 4-lane divided section - Multi-lane roundabout required
3	Diverging Diamond Interchange (DDI)	+ Reduces number of conflict points + Eliminates wrong-way movements	- Requires twice as many crossings in all directions - Creates free-left condition, mitigated by grade separated ramp crossing	+ Minimal to no right-of-way needed	- Requires signalization - Requires second structure to be built initially	+ New structure can be built while maintaining traffic - Requires median on structure	+ Accomodates high left turn movements	+ Second structure will be built initially and can be widened for 4-lane divided section
4	Roundabout DDI	+ Reduces number of conflict points + Eliminates wrong-way movements	- Requires twice as many crossings in east-west directions - Creates free-left condition, mitigated by grade separated ramp crossing	- Minimal right-of-way required for roundabouts	+ Unsignalized - Requires second structure to be built initially	+ New structure can be built while maintaining traffic - Requires median on structure	+ Accomodates high left turn movements	+ Second structure will be built initially and can be widened for 4-lane divided section - Multi-lane roundabout required
5	Partial Cloverleaf (Parclo)	+ Reduces number of conflict points - Does not eliminate wrong-way movements	- Loop creates free-right condition, mitigated by grade separated ramp crossing or running path south of 40th Ave.	- Requires right-of-way in quadrants	- Requires additional pavement and right-of-way	+ New structure can be built while maintaining traffic - Requires loop construction, additional traffic control considerations	+ Loop removes left turn movements from intersections	+ Second structure can be built in place of existing structure for 4-lane divided section
6	Ramp Left U-Turn Diamond Interchange	+ Eliminates wrong-way movements - Reduces conflict points at ramp terminals, but creates conflicts at U-turns	- U-turn creates additional obstacles for bicycles/pedestrians	- Requires right-of-way at U-turn locations on 40th Ave.	- Requires additional work at U-turns and right-of-way	+ New structure can be built while maintaining traffic - Requires additional work at U-turn locations	+ Allows eastbound and westbound left turns at interchange - Diverts northbound and southbound left turns to U-turn locations which requires out of direction travel	+ Second structure can be built in place of existing structure for 4-lane divided section

Appendix K – I-29 & 40th Ave N Interchange: Interchange Alternatives Models Summary

Stantec

Memo

To:	Jennifer Kern, PE, Chad Frisinger, PE North Dakota Department of Transportation	From:	Mark Butler, AICP Pat McGraw, PE Stantec Consulting Services
File:	Preliminary Engineering and Feasibility Study Services for Project 8-029(213)069 NDDOT PCN 23596	Date:	March 2, 2023

Reference: I-29 & 40th Ave N Interchange: Interchange Alternatives Models Summary

INTRODUCTION

The Stantec team is working with the North Dakota Department of Transportation (NDDOT) to complete a preliminary engineering and feasibility study to evaluate improvement alternatives for the 40th Avenue North (Cass County Route 20) interchange with I-29 in Fargo, ND (Exit 69). As part of this study, Stantec has developed AM and PM peak hour traffic simulation models of alternative interchange and corridor configurations. Previous memoranda have described the development of the existing network models and results of analyses of alternative corridor concepts for both the base year (2022) and future year (2045) traffic, with no improvements made to the existing interchange aside from traffic signals or roundabouts at the ramp terminals. Without left turn storage, neither the existing stop-controlled corridor concept or signalized corridor concept could acceptably serve the significantly higher traffic forecast for 2045, rating Level of Service (LOS) F for each intersection and intersection approaches. The one lane roundabout concept fared slightly better, but still failed to serve the PM peak hour westbound traffic, with backup queues ultimately affecting multiple upstream intersections.

This memorandum presents a summary of traffic metrics for these corridor concepts in combination with five alternative interchange designs to provide additional capacity to serve 2045 future year traffic. Each of the five interchanges was paired with the existing, signalized, and roundabout corridor concepts, for a total of 15 model networks analyzed with 2045 AM and PM peak hour traffic.

STUDY AREA

The study area includes the 40th Avenue North interchange with I-29 and 40th Avenue North between the connecting streets from 45th Street North to 25th Street North. The 40th Avenue North corridor is classified as a two-lane major collector highway west of CR 81 and as a two-lane minor arterial highway east of CR 81. The corridor's speed limit is 40 miles per hour (MPH) with stop control for all side streets within the project limits, except for the intersection with CR 81, which has a traffic signal. **Figure 1** presents the study area.

Figure 1. Corridor Study Area

CORRIDOR INTERSECTIONS

The three corridor design concepts that accompany the alternative interchanges are **Existing**, **Signalized**, and **Roundabout**. Aside from optimizing the traffic signal timing plans for the intersection at CR 81, the existing corridor configuration assumes no changes on 40th Avenue North or the approaches of side streets. The signalized and roundabout corridor concepts add either signals or single-lane roundabouts at 45th Street North, 37th Street North, 33rd Street North, and 25th Street North. In the signalized corridor, a westbound left turn lane and a northbound right turn lane are added at 45th Street intersection. Given the low traffic demand, the intersections at 32nd Street North and 39 1/2 Avenue North remain two-way stop-controlled in all corridor concepts. Two lanes are needed for the southbound and eastbound approaches to accommodate heavier turning movements at CR 81 for the roundabout corridor concept. **Figures 2** through **15** present the assumed layouts of each of the intersections for each concept.

Figure 2: Existing 45th Street North Intersection

Figure 3: Signalized 45th Street North Intersection

Figure 4: 45th Street North with Roundabout

Figure 5: Existing / Signalized CR 81 Intersection

Figure 6: Intersection at CR 81 with Roundabout

Figure 7: Existing 37th Street North Intersection

Figure 8: Signalized 37th Street North Intersection

Figure 9: Intersection at 37th Street North with Roundabout

Figure 10: Existing 33rd Street North Intersection

Figure 11: Signalized 33rd Street North Intersection

Figure 12: 33rd Street North Roundabout

Figure 13: Existing 25th Street North Intersection

Figure 14: Signalized 25th Street North Intersection

Figure 15: 25th Street North Roundabout

ALTERNATIVE INTERCHANGE DESIGNS

Five alternative interchange designs were combined with the three corridor concepts and analyzed. Each of the design concepts was originally developed with single directional lanes for both 40th Avenue North and the interstate ramps. However, additional lane capacity was incrementally added as required to maintain LOS D or better for intersection approaches and the

corridor. In general, this resulted in two westbound travel lanes on 40th Avenue North through the interchange and two or three lanes of storage capacity for the interstate exit ramps. Eastbound traffic on 40th Avenue North across the interstate can be served with a single lane. For several alternatives, two directional lanes are required for the 40th Avenue North approaches to the ramp terminals, either for storage or as receiving lanes.

Figures 16 through **20** present the five alternative interchange concepts.

Figure 16. Alternative 1: Standard Diamond Interchange

Figure 17. Alternative 2: Dumbbell Interchange

Figure 18. Alternative 3: Diverging Diamond Interchange (DDI)

Figure 19. Alternative 4: Roundabout DDI Interchange

Figure 20. Alternative 5: Partial Cloverleaf (Parclo) Interchange

For the Diamond interchange paired with the existing and signalized corridors, the four-lane eastern approach connecting to the CR 81 intersection tapers to single directional lanes. However, for its pairing with the Roundabout corridor and for all the corridors for the Partial Cloverleaf, Roundabout, and DDI interchanges, the segment of 40th Avenue North between the northbound ramps and CR 81 is four lanes. This configuration was necessary to achieve appropriate performance for both the interchange and CR 81 intersections.

The DDI Roundabout concept required special consideration to obtain acceptable traffic performance. To avoid the need for traffic signals with this concept, the northbound I-29 exit ramp left-turn needed to be relocated such that left-turning traffic would not travel around the eastern roundabout. Instead, the exit ramp is split south of the roundabout such that the right-turning traffic continues to the roundabout and the left-turning traffic merges (under yield control) with westbound 40th Avenue to the west of the roundabout. This left-turn operates well as a single lane near to the design year, however, at full design year traffic, it will need to be two lanes. When this left turn is two lanes, then two lanes are required all the way westbound through the west roundabouts. This relocation of the left turns sufficiently reduces the demand at the eastern roundabout for it to operate at an acceptable level.

2045 TRIP STATISTICS

Table 1 presents trip statistics from the average of five traffic simulation runs for each combination of interchanges and corridors in the 2045 AM and PM peak hours. The model incorporates a seed generator to create random various between runs, as evidenced by the variation in the total number of trips recorded by the model in each peak hour. **Table 1** presents the number of trips that were still enroute at the end of the simulation period, as well as trips that missed or unserved due to congestion. High numbers of such trips reflect congested conditions. Vehicle Hours Traveled (VHT) represents the total time that all trips recorded on the network or waiting to enter the network.

Table 1. 2045 Peak Hour Model Trip Statistics

		AM Peak Hour (7:15 - 8:15 AM)					PM Peak Hour (4:30-5:30)				
		Trips			VHT	Total Delay (hrs.)	Trips			VHT	Total Delay (hrs.)
Interchange	Corridor	Total	En Route	Missed/ Unserved			Total	En Route	Missed/ Unserved		
Alternative 1: Standard Diamond	Existing	5,021	299	93	321	119	5,767	403	57	398	162
	Signalized	5,026	273	2	293	87	5,768	358	3	346	107
	Roundabouts	5,074	297	11	289	79	5,764	353	15	342	101
Alternative 2: Dumbbell	Existing	5,076	301	175	352	150	5,770	403	211	465	231
	Signalized	5,082	297	2	285	76	5,764	349	5	342	102
	Roundabouts	5,079	288	10	279	67	5,768	340	18	332	89
Alternative 3: Diverging Diamond	Existing	5,069	314	169	355	154	5,759	396	183	453	221
	Signalized	5,071	297	1	290	84	5,757	346	2	339	102
	Roundabouts	5,074	292	10	282	73	5,769	341	17	332	91
Alternative 4: Roundabout DDI	Existing	5,082	304	182	347	145	5,768	386	209	446	213
	Signalized	5,070	291	16	286	79	5,773	349	17	338	99
	Roundabouts	5,079	296	23	281	70	5,768	335	34	326	83
Alternative 5: Partial Cloverleaf	Existing	5,078	308	158	345	142	5,764	404	192	467	233
	Signalized	5,077	309	1	292	84	5,758	354	2	349	109
	Roundabouts	5,068	291	8	282	72	5,771	346	16	338	96

Table 1 demonstrates interchange conceptual alternatives paired with the existing corridor produce significantly more delay and unserved trips than the corridors with signalized intersections or roundabouts, primarily due to delays from side street traffic at two-way stop-controlled intersections, particularly at 45th Street North and 37th Street North.

CORRIDOR TRAVEL TIME AND URBAN STREETS LEVEL OF SERVICE

TransModeler estimates an Urban Street LOS according to corridor attributes and conditions described in the Highway Capacity Manual, including average operational speed on the corridor compared to the corridor's free flow speed. While the relationship between speed and LOS is indirect and varies according to the free flow speed, **Table 2** presents the general thresholds TransModeler uses for corridors with a free flow speed of 50 mph. **Table 3** presents the average travel time, travel speed, and LOS for the 40th Avenue North corridor from 45th Street North to 25th Street North, for each interchange alternative and corridor combination.

Table 2. TransModeler Threshold Speeds for Urban Streets LOS

Level of Service	Travel Speed Threshold (mph)
Free Flow	50
A	40
B	30
C	25
D	20
E	15
F	0

Table 3. 40th Avenue North Corridor Travel Times and LOS

		AM Peak Hour						PM Peak Hour					
		Eastbound			Westbound			Eastbound			Westbound		
Interchange	Corridor	Travel Time (min.)	Travel Speed (mph)	LOS	Travel Time (min.)	Travel Speed (mph)	LOS	Travel Time (min.)	Travel Speed (mph)	LOS	Travel Time (min.)	Travel Speed (mph)	LOS
Alternative 1: Standard Diamond	Existing	4.6	32	C	4.2	35	B	4.7	31	C	4.4	33	C
	Signalized	5.3	28	C	4.6	32	C	5.3	28	C	5.0	29	C
	Roundabouts	5.1	29	C	4.8	31	B	5.2	28	C	4.8	30	B
Alternative 2: Dumbbell	Existing	4.6	32	B	4.7	32	B	4.8	31	B	5.1	29	C
	Signalized	5.0	29	C	4.7	31	B	5.0	29	C	5.4	27	C
	Roundabouts	4.9	30	B	4.8	31	B	4.9	30	B	5.1	29	C
Alternative 3: Diverging Diamond	Existing	4.7	31	C	5.0	30	C	5.2	28	C	4.9	30	C
	Signalized	5.2	28	C	5.1	29	C	5.7	26	C	5.1	28	C
	Roundabouts	5.2	29	C	5.0	29	C	5.5	29	C	5.0	29	C
Alternative 4: Roundabout DDI	Existing	4.6	32	B	4.6	32	B	4.8	31	B	4.6	32	B
	Signalized	5.1	29	C	4.8	30	B	5.5	27	C	5.1	29	C
	Roundabouts	5.0	29	C	4.9	30	B	5.3	28	C	4.9	30	B
Alternative 5: Partial Cloverleaf	Existing	4.2	34	B	4.5	33	C	4.3	34	B	4.7	31	C
	Signalized	4.8	30	C	4.7	31	C	4.7	31	C	5.1	28	C
	Roundabouts	4.7	31	B	4.7	31	B	4.6	32	B	4.9	30	C

FREEWAY LEVEL OF SERVICE

Freeway LOS is relevant to this project in that any change to the interchange must not affect the operation of the main interstate facility. Each alternative interchange design was adjusted to avoid that outcome, if possible, by limiting ramp queues at 40th Avenue North from extending to the interstate mainline. A default metric for measuring freeway LOS is density as measured by the number of vehicles (passenger car equivalents) per mile, per lane. **Table 4** presents the LOS density thresholds for the three types of freeway facilities present at this interchange. The diverge area occurs before an exit ramp and the merge area occurs past the entrance ramp merge point. The basic segment is in this scenario between the ramps.

Table 4. Freeway LOS Density Thresholds

Level of Service	Diverge	Basic	Merge
A	< 10	< 11	< 10
B	< 20	< 18	< 20
C	< 28	< 26	< 28
D	< 35	< 35	< 35
E	< 43	< 45	< 43
Demand Exceeds Capacity			
F	> 43	> 45	> 43

Density: (pc/mi/hr)

Table 5 illustrates that all alternatives provide the same LOS for each of the adjacent freeway segments, within the desired threshold for peak hour performance of an urban interstate facility.

Table 5. Freeway LOS by Interchange Alternative

	AM Peak Hour						PM Peak Hour					
	Southbound			Northbound			Southbound			Northbound		
Interchange	Diverge (North of Exit)	Basic (Between Ramps)	Merge (South of Exit)	Diverge (South of Exit)	Basic (Between Ramps)	Merge (North of Exit)	Diverge (North of Exit)	Basic (Between Ramps)	Merge (South of Exit)	Diverge (South of Exit)	Basic (Between Ramps)	Merge (North of Exit)
1. Diamond	A	A	B	B	A	A	A	A	B	C	B	B
2. Dumbell	A	A	B	B	A	A	A	A	B	C	B	B
3. Diverging Diamond	A	A	B	B	A	A	A	A	B	C	B	B
4. Roundabout DDI	A	A	B	B	A	A	A	A	B	C	B	B
5. Partial Cloverleaf	A	A	B	B	A	A	A	A	B	C	B	B

INTERSECTION LEVEL OF SERVICE

Tables 6 and **7** present the AM peak hour and PM peak hour LOS and average vehicular delay for each alternative interchange and corridor combination. LOS and delay are provided for each intersection approach, although the TransModeler was unable to include the exit ramp approaches for the DDI alternatives in its output statistics, presumably because TransModeler sees these approaches as separate and downstream from the primary intersections. These approaches have reasonably short queues, averaging below four vehicles with a maximum average queue length of no more than eight vehicles.

Tables 6 and **7** indicate that all intersections and intersection approaches for each interchange-corridor concept operate acceptably.

Table 6. Interchange and Approach Level of Service: 40th Avenue North and I-29 Southbound Ramps

Interchange	Corridor	Approach	AM Peak			PM Peak		
			Vehicles	LOS	Delay	Vehicles	LOS	Delay
Alternative 1: Standard Diamond	Existing	SB Ramp	111	D	39.9	191	C	21.3
		EB 40th Ave.	910	B	14.0	449	C	26.9
		WB 40th Ave.	674	B	10.0	1,429	A	3.3
		Total	1,695	**B**	14.1	2,068	**B**	10.1
	Signalized	SB Ramp	189	C	21.7	189	C	21.7
		EB 40th Ave.	501	C	28.8	501	C	28.8
		WB 40th Ave.	1,437	A	3.5	1,437	A	3.5
		Total	1,785	**C**	23.1	2,127	**B**	11.1
	Roundabouts	SB Ramp	113	D	42.3	192	C	20.5
		EB 40th Ave.	1,012	B	15.3	508	C	27.1
		WB 40th Ave.	674	A	9.6	1,434	A	4.9
		Total	1,799	**B**	14.8	2,133	**B**	11.6
Alternative 2: Dumbbell	Existing	SB Ramp	115	A	6.3	191	C	22.1
		EB 40th Ave.	856	B	10.2	359	B	14.2
		WB 40th Ave.	675	A	2.4	1,433	A	2.7
		Total	1,647	**A**	6.5	1,983	**A**	6.2
	Signalized	SB Ramp	117	A	6.6	190	C	22.3
		EB 40th Ave.	1,009	B	12.6	506	B	14.1
		WB 40th Ave.	679	A	2.2	1,433	A	2.7
		Total	1,805	**A**	8.2	2,129	**A**	6.8
	Roundabouts	SB Ramp	113	A	5.8	190	C	23.1
		EB 40th Ave.	1,010	A	2.6	504	A	4.7
		WB 40th Ave.	682	A	0.6	1,436	A	0.7
		Total	1,805	**A**	1.9	2,130	**A**	3.4
Alternative 3: Diverging Diamond	Existing	EB 40th Ave.	344	B	16.2	217	C	25.4
		WB 40th Ave.	314	B	17.7	865	B	13.9
		Total	658	**B**	16.9	1,082	**B**	16.2
	Signalized	EB 40th Ave.	407	B	19.1	288	C	27.1
		WB 40th Ave.	313	B	17.9	870	B	14.9
		Total	720	**B**	18.6	1,157	**B**	17.9
	Roundabouts	EB 40th Ave.	407	B	17.1	290	C	24.7
		WB 40th Ave.	315	B	13.7	866	A	6.7
		Total	722	**B**	15.6	1,155	**B**	11.2
Alternative 4: Roundabout DDI	Existing	SB Ramp	114	A	3.6	191	A	6.0
		EB 40th Ave.	863	A	9.0	379	B	12.2
		WB 40th Ave.	313	B	12.6	862	A	9.3
		Total	1,290	**A**	9.4	1,431	**A**	9.6
	Signalized	SB Ramp	112	A	3.5	190	A	6.6
		EB 40th Ave.	1,008	B	13.1	506	B	14.5
		WB 40th Ave.	313	B	14.8	867	B	11.9
		Total	1,434	**B**	12.7	1,563	**B**	12.1
	Roundabouts	SB Ramp	112	A	3.8	191	A	5.9
		EB 40th Ave.	1,027	A	4.6	523	A	3.1
		WB 40th Ave.	314	B	12.4	864	B	10.8
		Total	1,452	**A**	6.2	1,577	**A**	7.6
Alternative 5: Partial Cloverleaf	Existing	SB Ramp	112	C	26.6	189	B	13.1
		EB 40th Ave.	872	A	2.1	373	A	2.0
		WB 40th Ave.	313	A	0.7	858	A	3.5
		Total	1,296	**A**	3.9	1,420	**A**	4.4
	Signalized	SB Ramp	114	C	25.8	189	B	12.4
		EB 40th Ave.	1,001	A	3.0	507	A	1.7
		WB 40th Ave.	315	A	0.4	861	A	3.6
		Total	1,430	**A**	4.3	1,557	**A**	4.0
	Roundabouts	SB Ramp	111	C	24.6	188	B	12.9
		EB 40th Ave.	1,012	A	2.7	505	A	2.1
		WB 40th Ave.	312	A	0.8	866	A	3.5
		Total	1,435	**A**	4.0	1,559	**A**	4.2

Table 7. Interchange and Approach Level of Service: 40th Avenue North and I-29 Northbound Ramps

Interchange	Corridor	Approach	AM Peak			PM Peak		
			Vehicles	LOS	Delay	Vehicles	LOS	Delay
Alternative 1: Standard Diamond	Existing	SB Ramp	681	B	14.4	997	B	16.1
		EB 40th Ave.	468	A	6.6	323	C	32.6
		WB 40th Ave.	570	B	17.2	1,029	C	21.5
		Total	1,695	**B**	14.1	2,068	**B**	10.1
	Signalized	SB Ramp	526	C	21.5	526	C	21.5
		EB 40th Ave.	351	D	35.7	351	D	35.7
		WB 40th Ave.	1,039	C	21.3	1,039	C	21.3
		Total	1,785	**C**	23.1	2,127	**B**	11.1
	Roundabouts	SB Ramp	683	B	14.0	999	B	13.1
		EB 40th Ave.	514	A	7.2	355	C	32.4
		WB 40th Ave.	570	B	17.8	1,037	B	18.3
		Total	1,799	**B**	14.8	2,133	**B**	11.6
Alternative 2: Dumbbell	Existing	SB Ramp	685	A	4.1	998	A	4.3
		EB 40th Ave.	447	A	4.3	270	A	3.7
		WB 40th Ave.	580	A	6.0	1,039	D	32.6
		Total	1,647	**A**	6.5	1,983	**A**	6.2
	Signalized	SB Ramp	688	A	4.7	996	A	4.8
		EB 40th Ave.	513	A	3.9	350	A	3.9
		WB 40th Ave.	289	A	6.6	1,038	D	32.6
		Total	1,805	**A**	8.2	2,129	**A**	6.8
	Roundabouts	SB Ramp	686	A	3.6	999	A	3.4
		EB 40th Ave.	510	A	0.7	348	A	0.7
		WB 40th Ave.	578	A	2.7	1,037	B	10.2
		Total	1,805	**A**	1.9	2,130	**A**	3.4
Alternative 3: Diverging Diamond	Existing	EB 40th Ave.	384	B	16.8	164	C	29.9
		WB 40th Ave.	504	C	20.7	909	B	19.0
		Total	658	**B**	16.9	1,082	**B**	16.2
	Signalized	EB 40th Ave.	431	B	18.5	217	C	33.7
		WB 40th Ave.	498	C	22.3	915	C	20.4
		Total	720	**B**	18.6	1,157	**B**	17.9
	Roundabouts	EB 40th Ave.	426	B	13.4	221	C	30.0
		WB 40th Ave.	505	B	10.3	912	A	7.8
		Total	722	**B**	15.6	1,155	**B**	11.2
Alternative 4: Roundabout DDI	Existing	SB Ramp	505	B	11.0	477	A	4.4
		EB 40th Ave.	368	B	12.7	146	C	20.7
		WB 40th Ave.	584	A	4.1	1,032	A	5.1
		Total	1,457	**A**	8.7	1,655	**C**	6.3
	Signalized	SB Ramp	505	B	11.5	472	A	4.8
		EB 40th Ave.	413	C	19.6	205	E	38.0
		WB 40th Ave.	578	A	4.3	1,045	A	5.3
		Total	1,496	**B**	10.9	1,722	**B**	9.1
	Roundabouts	SB Ramp	505	B	13.7	475	A	5.2
		EB 40th Ave.	429	A	8.6	222	D	26.6
		WB 40th Ave.	577	A	1.3	1,039	A	1.4
		Total	1,511	**A**	7.5	1,736	**A**	5.7
Alternative 5: Partial Cloverleaf	Existing	SB Ramp	682	A	5.9	991	B	12.3
		EB 40th Ave.	457	A	9.8	281	B	19.7
		WB 40th Ave.	568	B	11.1	1,036	C	24.0
		Total	1,296	**A**	3.9	1,420	**A**	4.4
	Signalized	SB Ramp	683	A	6.4	993	B	12.3
		EB 40th Ave.	511	A	9.5	355	B	19.5
		WB 40th Ave.	574	B	13.2	1,037	C	25.5
		Total	1,430	**A**	4.3	1,557	**A**	4.0
	Roundabouts	SB Ramp	686	A	9.2	996	B	10.2
		EB 40th Ave.	512	B	10.6	353	C	20.4
		WB 40th Ave.	572	B	11.0	1,040	C	23.2
		Total	1,435	**A**	4.0	1,559	**A**	4.2

Tables 8 through **12** present the intersection LOS for each of the other corridor intersections that were either signalized or converted to roundabouts in those respective corridor concepts. Unless otherwise noted, the signalized concept added traffic signals only and otherwise maintain the current roadway geometry. The roundabout concept includes single lane roundabouts.

For the intersection at 45th Street North, a left turn lane from westbound 40th Avenue to southbound 45th Street, and a right turn lane from northbound 45th Street North to eastbound 40th Avenue North were added to the signalized intersection. As **Table 8** indicates, the increased traffic expected in 2045 from west and south of this intersection will cause the existing stop-controlled intersection to fail.

Table 8. Intersection Level of Service: 40th Avenue North and 45th Street North

Intersection	Interchange Type	Corridor	AM Peak			PM Peak		
			Vehicles	LOS	Delay	Vehicles	LOS	Delay
40th Ave. N at 45th St. North	Alternative 1: Standard Diamond	Existing	1,310	E	45.6	1,642	F	69.1
		Signalized	1,428	B	8.7	1,743	A	9.3
		Roundabouts	1,436	A	4.1	1,436	A	4.1
	Alternative 2: Dumbbell	Existing	1,246	E	46.4	1,484	F	55.4
		Signalized	1,441	B	9.8	1,739	A	8.3
		Roundabouts	1,441	A	4.1	1,739	A	4.0
	Alternative 3: Diverging Diamond	Existing	1,250	F	52.2	1,508	F	75.9
		Signalized	1,438	B	11.2	1,734	B	10.6
		Roundabouts	1,439	A	4.2	1,439	A	4.2
	Alternative 4: Roundabout DDI	Existing	1,257	F	53.6	1,517	F	65.0
		Signalized	1,438	A	9.7	1,746	A	9.5
		Roundabouts	1,455	A	4.2	1,754	A	4.5
	Alternative 5: Partial Cloverleaf	Existing	1,267	E	52.4	1,497	F	67.1
		Signalized	1,432	C	27.3	1,731	A	10.1
		Roundabouts	1,442	A	4.4	1,442	A	4.4

For the intersection at CR 81 with roundabout, dual lanes are required for the eastbound to northbound, and southbound to westbound movements. With that modification, acceptable operations can be achieved as shown in **Table 9**.

Table 9. Intersection Level of Service: 40th Avenue North and CR 81

Intersection	Interchange Type	Corridor	AM Peak			PM Peak		
			Vehicles	LOS	Delay	Vehicles	LOS	Delay
40th Ave. N at CR 81	Alternative 1: Standard Diamond	Existing	1,811	B	14.4	2,015	C	20.4
		Signalized	1,834	B	22.2	2,050	C	22.2
		Roundabouts	1,851	A	7.4	1,851	A	7.4
	Alternative 2: Dumbbell	Existing	1,816	B	16.2	1,988	C	20.3
		Signalized	1,865	B	15.7	2,049	C	21.2
		Roundabouts	1,856	A	6.0	2,050	A	9.0
	Alternative 3: Diverging Diamond	Existing	1,805	C	20.7	1,992	C	23.2
		Signalized	1,438	C	21.2	2,047	C	23.3
		Roundabouts	1,858	A	5.9	1,858	A	5.9
	Alternative 4: Roundabout DDI	Existing	1,794	C	15.6	1,981	B	19.8
		Signalized	1,830	C	15.6	2,039	C	21.1
		Roundabouts	1,853	A	5.7	2,055	A	8.3
	Alternative 5: Partial Cloverleaf	Existing	1,814	B	15.1	1,989	C	20.2
		Signalized	1,856	B	15.0	2,045	C	20.8
		Roundabouts	1,853	A	7.7	1,853	A	7.7

Tables 10 through **12** illustrate that each of the three most eastern intersections operate optimally regardless of the interchange or corridor concept employed.

Table 10. Intersection Level of Service: 40th Avenue North and 37th Street

Intersection	Interchange Type	Corridor	AM Peak			PM Peak		
			Vehicles	LOS	Delay	Vehicles	LOS	Delay
40th Ave. N at 37th St. North	Alternative 1: Standard Diamond	Existing	1,353	A	2.5	1,557	A	2.5
		Signalized	1,370	A	8.7	1,587	A	5.9
		Roundabouts	1,377	A	5.9	1,377	A	5.9
	Alternative 2: Dumbbell	Existing	1,350	A	3.0	1,539	A	2.7
		Signalized	1,387	A	5.9	1,590	A	5.9
		Roundabouts	1,386	A	5.7	1,587	A	5.4
	Alternative 3: Diverging Diamond	Existing	1,347	A	2.5	1,537	A	2.4
		Signalized	1,384	A	6.2	1,586	A	6.0
		Roundabouts	1,385	A	5.6	1,385	A	5.6
	Alternative 4: Roundabout DDI	Existing	1,343	A	2.6	1,526	A	2.4
		Signalized	1,363	A	5.8	1,577	A	6.0
		Roundabouts	1,382	A	5.6	1,593	A	5.4
	Alternative 5: Partial Cloverleaf	Existing	1,353	A	2.9	1,538	A	2.5
		Signalized	1,384	A	6.4	1,592	A	7.1
		Roundabouts	1,379	A	6.0	1,379	A	6.0

Table 11. Intersection Level of Service: 40th Avenue North and 33rd Street

Intersection	Interchange Type	Corridor	AM Peak			PM Peak		
			Vehicles	LOS	Delay	Vehicles	LOS	Delay
40th Ave. N at 33rd St. North	Alternative 1: Standard Diamond	Existing	1,206	A	3.5	1,370	D	29.8
		Signalized	1,218	A	8.7	1,402	A	9.0
		Roundabouts	1,232	A	5.5	1,232	A	5.5
	Alternative 2: Dumbbell	Existing	1,210	A	3.7	1,355	D	25.7
		Signalized	1,237	A	8.9	1,402	A	8.7
		Roundabouts	1,231	A	5.7	1,402	A	5.2
	Alternative 3: Diverging Diamond	Existing	1,205	A	4.1	1,350	D	26.1
		Signalized	1,235	A	8.6	1,397	A	8.9
		Roundabouts	1,238	A	5.4	1,238	A	5.4
	Alternative 4: Roundabout DDI	Existing	1,203	A	4.2	1,339	C	17.7
		Signalized	1,217	A	8.4	1,389	A	8.6
		Roundabouts	1,233	A	5.6	1,404	A	5.1
	Alternative 5: Partial Cloverleaf	Existing	1,211	A	3.3	1,352	D	32.4
		Signalized	1,236	A	9.1	1,404	A	9.1
		Roundabouts	1,228	A	5.7	1,228	A	5.7

Table 12. Intersection Level of Service: 40th Avenue North and 25th Street

Intersection	Interchange Type	Corridor	AM Peak			PM Peak		
			Vehicles	LOS	Delay	Vehicles	LOS	Delay
40th Ave. N at 25th St. North	Alternative 1: Standard Diamond	Existing	1,033	A	5.1	1,191	A	4.4
		Signalized	1,042	B	8.7	1,212	A	8.7
		Roundabouts	1,436	A	4.1	1,436	A	4.1
	Alternative 2: Dumbbell	Existing	1,035	A	7.0	1,168	A	5.6
		Signalized	1,049	A	9.3	1,215	A	8.8
		Roundabouts	1,053	A	4.4	1,213	A	5.5
	Alternative 3: Diverging Diamond	Existing	1,037	A	5.0	1,167	A	5.4
		Signalized	1,046	A	8.5	1,209	A	9.8
		Roundabouts	1,439	A	4.2	1,439	A	4.2
	Alternative 4: Roundabout DDI	Existing	1,037	A	5.6	1,158	A	4.5
		Signalized	1,043	A	8.1	1,198	A	8.2
		Roundabouts	1,053	A	4.3	1,214	A	5.5
	Alternative 5: Partial Cloverleaf	Existing	1,040	A	6.1	1,164	A	4.2
		Signalized	1,054	A	10.0	1,211	A	9.6
		Roundabouts	1,442	A	4.4	1,442	A	4.4

STANTEC CONSULTING SERVICES INC.

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Appendix L – Environmental Evaluation of the I-29/40th Avenue Interchange Alternatives

Stantec

Memo

To:	Chad Frisinger, PE Jennifer Kern, PE	From:	Courtnay Bot Erin Sejkora, AICP Pat McGraw, PE
Project/File:	Technical Memo: Environmental Evaluation of I-29/40th Avenue Interchange Alternatives for Project 8-029(213)069 NDDOT PCN 23596	Date:	March 29, 2023

Reference: Environmental Evaluation of the I-29/40th Avenue Interchange Alternatives in Support of the I-29/40th Avenue Interchange Transportation Selection and Decisions Report

1 Introduction

A comprehensive list of potential impacts to environmental and social-economic resources was addressed in the I-29/40th Avenue Environmental Screening Memo ("Environmental Screening Memo"). This Environmental Evaluation of the I-29/40th Avenue Interchange Alternatives Memo ("Environmental Evaluation of Interchange Alternatives Memo") summarizes the environmental conditions and potential impacts associated with each alternative. A number of the resource types covered in the Environmental Screening Memo have not been included in this memo because there was no difference in impacts amongst the alternatives. Refer to the Conclusion for more information.

The five interchanges alternatives are described as:

- Design Alternative 1 - Standard Diamond with Traffic Signal Control
- Design Alternative 2 - Standard Diamond with Roundabout Control
- Design Alternative 3 - Diverging Diamond
- Design Alternative 4 - Roundabout Diverging Diamond
- Design Alternative 5 - Parclo (partial clover leaf) with Traffic Signals

2 Environmental

2.1 Wetlands and other Aquatic Resources

Table 1 summarizes the potential wetland impacts for each interchange alternative. The difference in potential wetland impacts is minor. None of the alternatives result in an impact greater than 0.4 acre. Refer to the Figure 1 map set for Wetlands in Appendix A.

Table 1 Wetland Impacts by Alternative

Alternative	Wetland Type	Total Est. Acres of Impact
Design Alternative 1 - Standard Diamond with Traffic Signal Control	Freshwater Emergent Wetland	0.13
	Riverine	0.24
	Design Alternative 1 Total	**0.37**
Design Alternative 2 - Standard Diamond with Roundabout Control	Freshwater Emergent Wetland	0.11
	Riverine	0.24
	Design 2 Alternative Total	**0.35**
Design Alternative 3 - Diverging Diamond	Freshwater Emergent Wetland	0.13
	Riverine	0.24
	Design 3 Alternative Total	**0.37**

Design Alternative 4 - Roundabout Diverging Diamond	Freshwater Emergent Wetland	0.11
	Riverine	0.24
	Design 4 Alternative Total	**0.35**
Design Alternative 5 - Parclo with Traffic Signals	Freshwater Emergent Wetland	0.13
	Riverine	0.24
	Design 5 Alternative Total	**0.37**

2.2 Regulated Floodplain/Floodway

Table 2 summarizes the type of floodplain/way acreages associated with each alternative. Refer to the Figure 2 map set for FEMA Floodplain in Appendix A. All five alternatives would encompass approximately 3.4 acres of land within the 100-year floodplain.

Table 2 Flooplain/Floodway Acreage by Alternative

Alternative	**Floodplain/way by Type**	**Est. Acreage of Floodplain/way**
Design Alternative 1 - Standard Diamond with Traffic Signal Control	500-year floodplain	8.7
	100-year floodplain	3.4
	Area of Minimal Flood Hazard	12
	Area of Reduced Flood Risk Due to Levee	9.3

Reference: Environmental Screening Technical Study for Project 8-029(213)069 NDDOT PCN 23596

Design Alternative 2 - Standard Diamond with Roundabout Control	500-year floodplain	7.6
	100-year floodplain	3.4
	Area of Minimal Flood Hazard	11
	Area of Reduced Flood Risk Due to Levee	9.7
Design Alternative 3 - Diverging Diamond	500-year floodplain	8.8
	100-year floodplain	3.4
	Area of Minimal Flood Hazard	12
	Area of Reduced Flood Risk Due to Levee	9.8
Design Alternative 4 - Roundabout Diverging Diamond	500-year floodplain	7.8
	100-year floodplain	3.4
	Area of Minimal Flood Hazard	11
	Area of Reduced Flood Risk Due to Levee	8.4

Design Alternative 5 - Parclo with Traffic Signals	500-year floodplain	8.8
	100-year floodplain	3.4
	Area of Minimal Flood Hazard	13
	Area of Reduced Flood Risk Due to Levee	6

2.3 Farmland Protection Policy Act

Table 3 outlines the acreage of Prime Farmland versus non-farmland, associated with each alternative. Alternative 5 is the only alternative anticipated to result in impacts to Prime Farmland. Refer to the Figure 3 map set for Farmland Classification in Appendix A.

Table 3 Acreage of Prime Farmland by Alternative

Alternative	**Farmland vs. Non-Farmland**	**Est. Acreage** (less than 0.05 reported as 0)
Design Alternative 1 - Standard Diamond with Traffic Signal Control	Not prime farmland	33
	Prime farmland if drained	0
	Design 1 Alternative Farmland Acreage Total	0

Reference: Environmental Screening Technical Study for Project 8-029(213)069 NDDOT PCN 23596

Design Alternative 2 - Standard Diamond with Roundabout Control	Not prime farmland	31
	Prime farmland if drained	0
Design 2 Alternative Farmland Acreage Total		0
Design Alternative 3 - Diverging Diamond	Not prime farmland	34
	Prime farmland if drained	0
Design 3 Alternative Farmland Acreage Total		0
Design Alternative 4 - Roundabout Diverging Diamond	Not prime farmland	31
	Prime farmland if drained	0
Design 4 Alternative Farmland Acreage Total		0
Design Alternative 5 - Parclo with Traffic Signals	Not prime farmland	39
	Prime farmland if drained	1.7
Design 5 Alternative Farmland Acreage Total		1.7

3 Physical/Construction

3.1 Right of Way

I-29 and 40th Avenue are currently situated within the roadway/transportation corridor right of way (ROW). Each of the I-29/40th Avenue interchange alternatives are anticipated to require minimal additional right of way.

Table 4 summarizes the potential right of way needs by alternative, based on the currently anticipated construction limits (i.e., temporary right of way impacts). The actual right of way needs are anticipated to be less than the estimated temporary right of way impacts. Alternative 5 would require the addition of approximately 6 acres of right of way. Alternatives 1-4 are anticipated to require approximately 4 or less acres of right of way impact. Refer to the Figure 4 map set for Right of Way in Appendix A.

Table 4 Potential Right of Way Impacts by Alternative

Alternative	**Existing vs. Potential Right of Way (ROW) Needs**	**Est. Right of Way Impact Acreage**
Design Alternative 1 - Standard Diamond with Traffic Signal Control	Existing ROW	30
	Outside of ROW	3.8
Design 1 Alternative Total Right of Way Impacts		3.8
Design Alternative 2 - Standard Diamond with Roundabout Control	Existing ROW	28
	Outside of ROW	3.1
Design 2 Alternative Total Right of Way Impacts		3.1

Reference: Environmental Screening Technical Study for Project 8-029(213)069 NDDOT PCN 23596

Design Alternative 3 - Diverging Diamond	Existing ROW	30
	Outside of ROW	4.0
Design 3 Alternative Total Right of Way Impacts		4
Design Alternative 4 - Roundabout Diverging Diamond	Existing ROW	27
	Outside of ROW	3.5
Design 4 Alternative Total Right of Way Impacts		3.5
Design Alternative 5 - Parclo with Traffic Signals	Existing ROW	34
	Outside of ROW	6.2
Design 5 Alternative Total Right of Way Impacts		6.2

Conclusion

With the exception of Alternative 5 Parclo with Traffic Signals, there is minimal difference amongst the five alternatives being considered for the future potential I-29/40th Avenue interchange project. Preliminary right of way impacts (based on construction limits) were used to calculate the estimated right of way impacts and Alternative 5 may require approximately two more acres of right of way than the other alternatives being considered. Additionally, Alternative 5 is the only alternative currently anticipated to result in impacts to Prime Farmland (approximately 1.7 acres).

As noted in the introduction to this memo, a number of resources were not quantified in this report because at this stage of review and planning, it is anticipated that there may be no difference in impacts amongst the alternatives. This includes water quality, threatened and endangered species, traffic noise, potentially contaminated properties, utilities, airport coordination, railroad coordination, community and public facilities, environmental justice, Section 4(f) and Section 6(f), Section 106, economic impacts, and land use.

Regards,

STANTEC CONSULTING SERVICES INC.

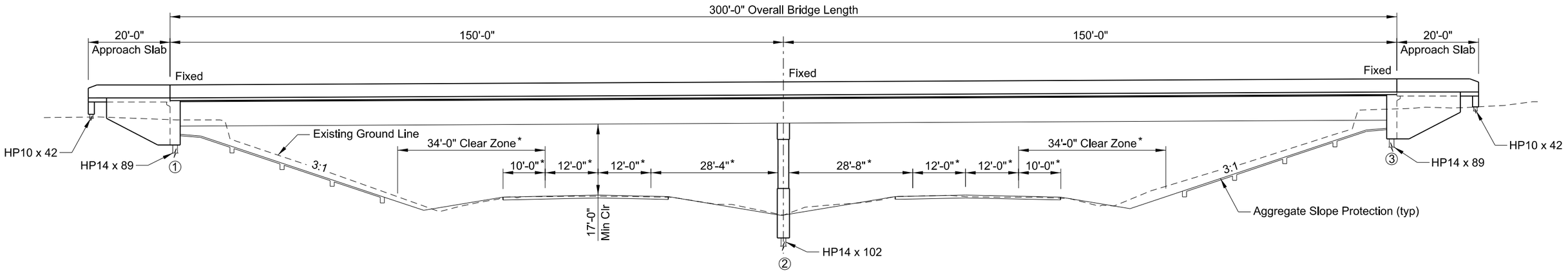
Courtnay Bot
Project Manager
Phone: (763) 479-4232
courtnay.bot@stantec.com

Attachment: Appendix A: Figures

Appendix M – Bridge Drawings

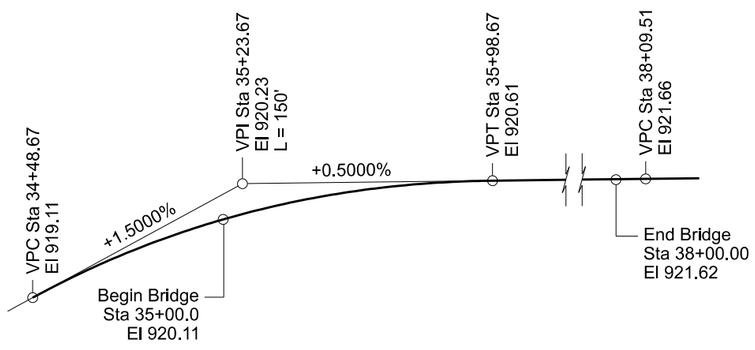
BRIDGE ELEVATION: PROFILE 1 - I-29 BRIDGE

	STATE	PROJECT NUMBER	SECTION NO.	SHEET NO.
	ND	IM-8-029(213)069	170	1



ELEVATION

*Dimensions are perpendicular to the I-29 alignment



VERTICAL CURVE DATA

DESIGN STRENGTHS:

f'c = 3,000 psi ~ Class AE-3 Concrete
f'c = 4,000 psi ~ Class AAE-3 Concrete
f'c = 7,000 psi ~ Prestressed Beam Concrete
fy = 60,000 psi ~ Reinforcing Steel

Load & Resistance Factor Design

This drawing is preliminary and not for construction or implementation purposes.

PRELIMINARY

40TH AVE NW INTERCHANGE

PROFILE 1

TWO-SPAN P/S CONCRETE GIRDER OVER I-29 W/ GRADE RAISE

ND DEPARTMENT OF TRANSPORTATION
BRIDGE DIVISION

BRIDGE SECTIONS: PROFILE 1 - I-29 BRIDGE

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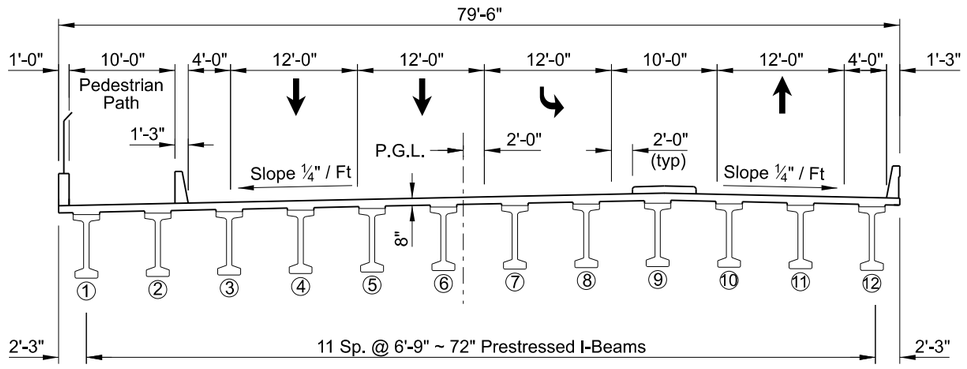
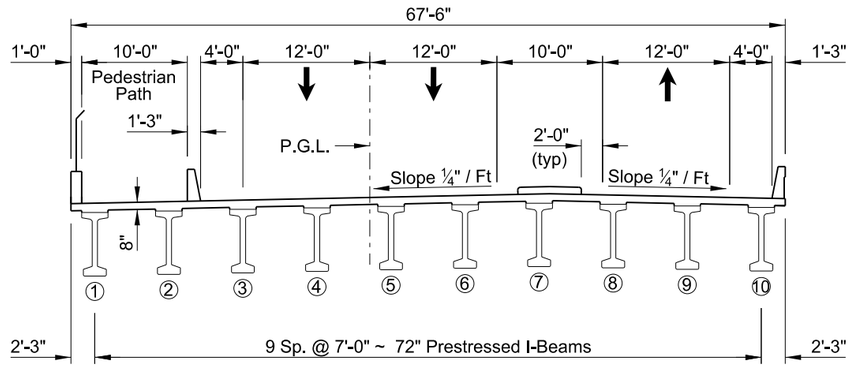
	ND	IM-8-029(213)069	170	2



TYPICAL SECTION
ALTERNATIVE 1 - STANDARD DIAMOND INTERCHANGE



TYPICAL SECTION
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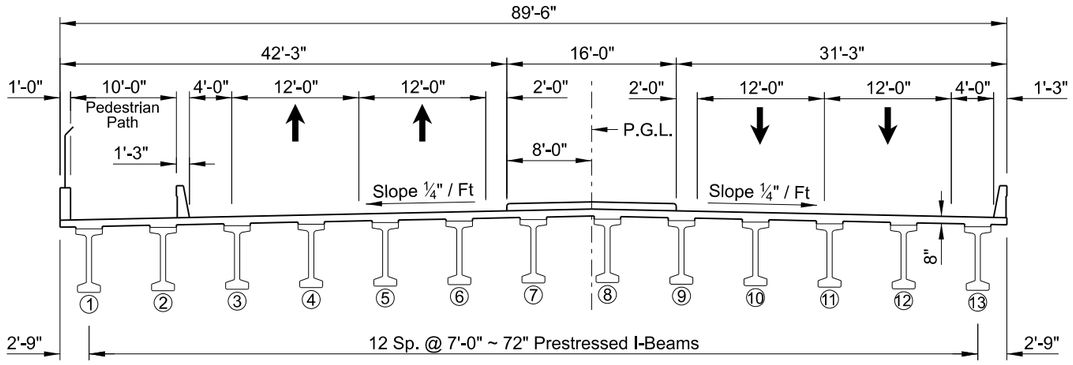
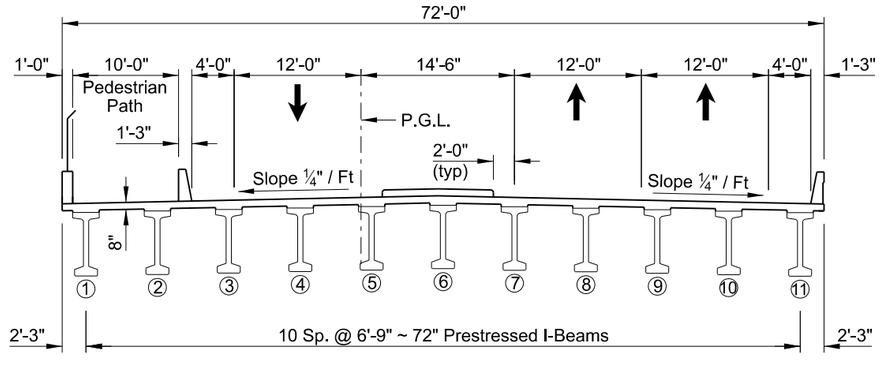
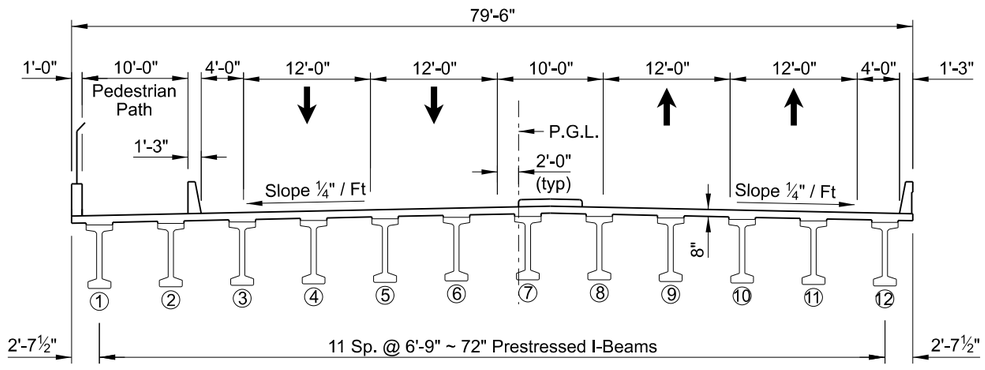


TYPICAL SECTION
ALTERNATIVE 3 - DIVERGING DIAMOND INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 4 - ROUNDABOUT DIVERGING DIAMOND INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 5 - PARTIAL CLOVERLEAF INTERCHANGE

40TH AV NW INTERCHANGE

PROFILE 1

SLAB SECTIONS

BRIDGE ELEVATION: PROFILE 2 - I-29 BRIDGE

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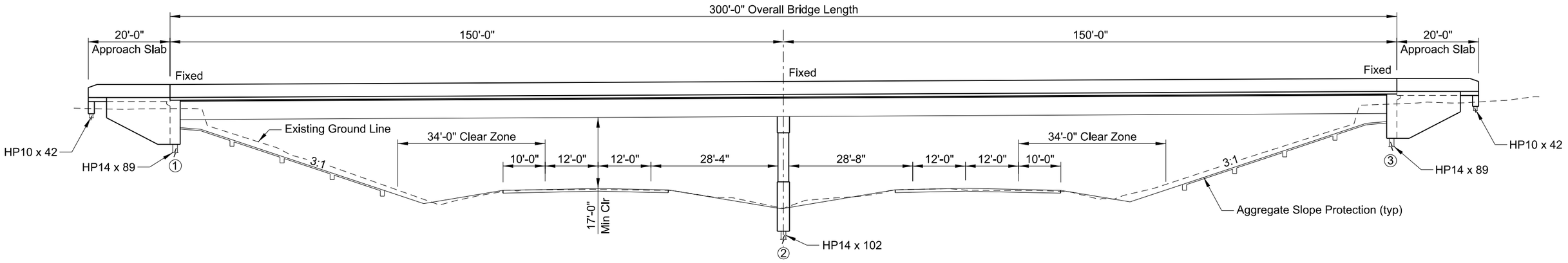
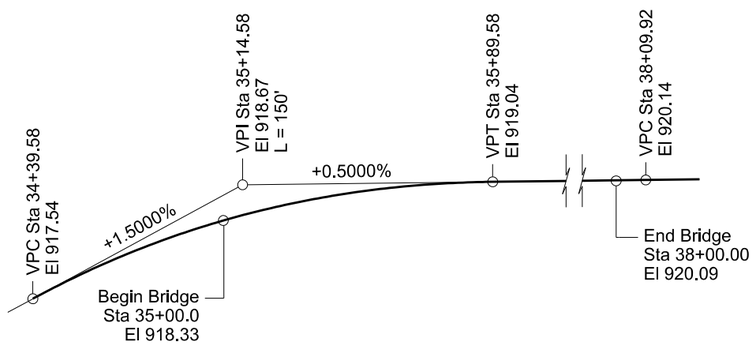
	ND	IM-8-029(213)069	170	3



ELEVATION

*Dimensions are perpendicular to the I-29 alignment



VERTICAL CURVE DATA

DESIGN STRENGTHS:

f'c = 3,000 psi ~ Class AE-3 Concrete
f'c = 4,000 psi ~ Class AAE-3 Concrete
fy = 50,000 psi ~ Structural Steel
fy = 60,000 psi ~ Reinforcing Steel

Load & Resistance Factor Design

This drawing is preliminary and not for construction or implementation purposes.

PRELIMINARY

40TH AVE NW INTERCHANGE

PROFILE 2

TWO-SPAN STEEL GIRDER OVER I-29 W/ GRADE RAISE

ND DEPARTMENT OF TRANSPORTATION
BRIDGE DIVISION

BRIDGE SECTIONS: PROFILE 2 - I-29 BRIDGE

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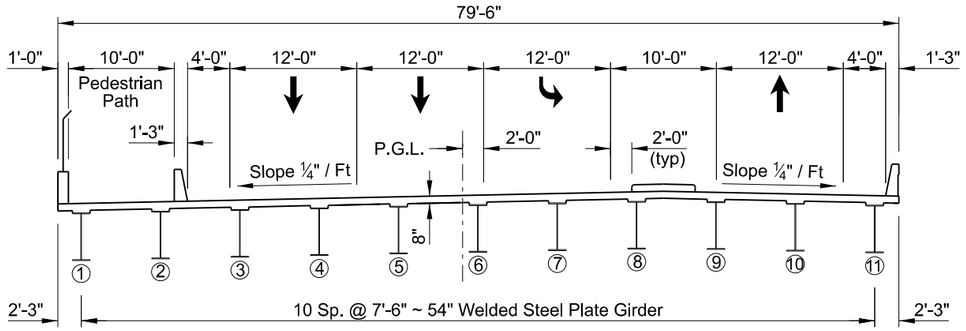

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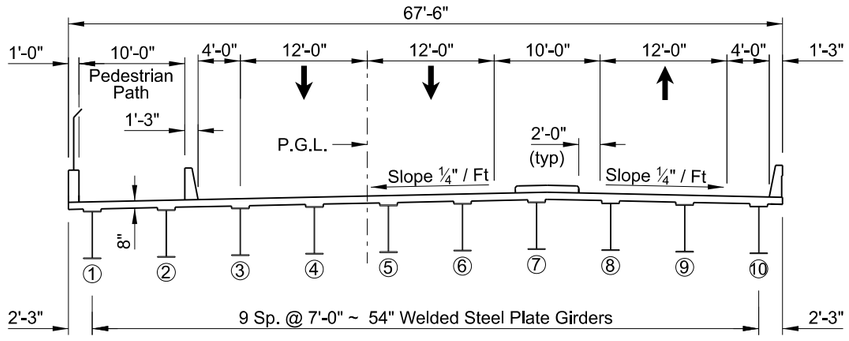
ALTERNATIVE 1 - STANDARD DIAMOND INTERCHANGE



TYPICAL SECTION
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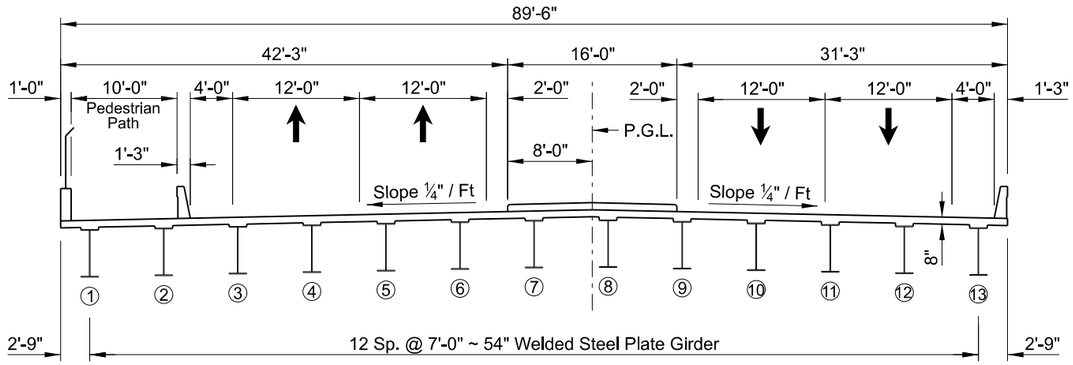
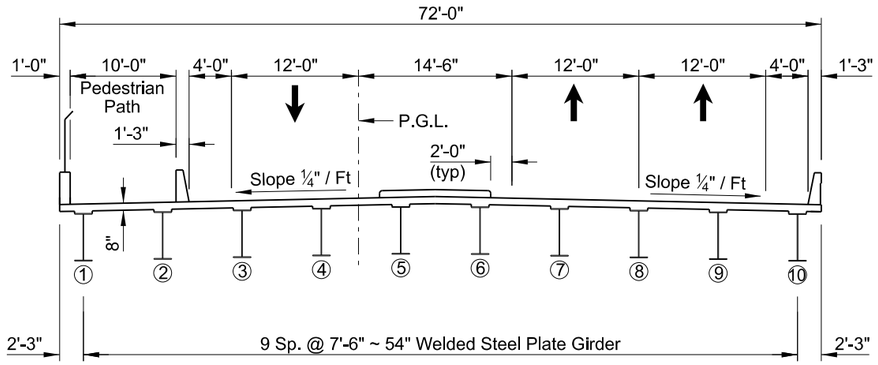


TYPICAL SECTION
ALTERNATIVE 3 - DIVERGING DIAMOND INTERCHANGE



TYPICAL SECTION
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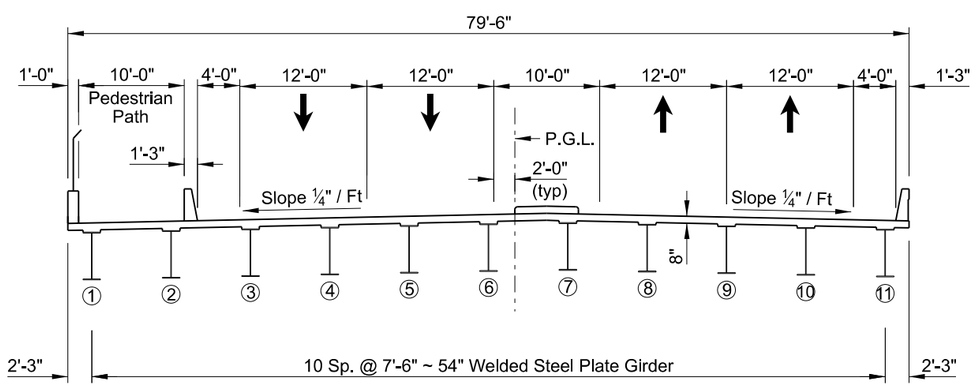


TYPICAL SECTION
ALTERNATIVE 5 - PARTIAL CLOVERLEAF INTERCHANGE

This drawing is preliminary and not for construction or implementation purposes.

PRELIMINARY

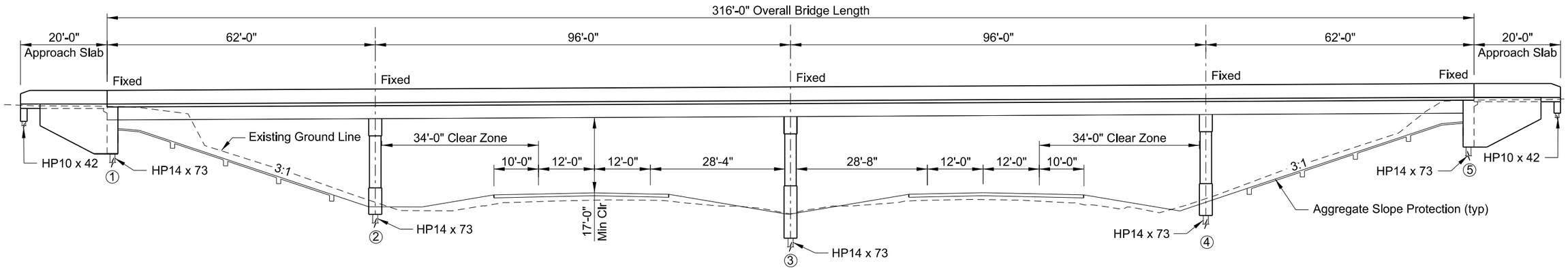
40TH AV NW INTERCHANGE

PROFILE 2

SLAB SECTIONS

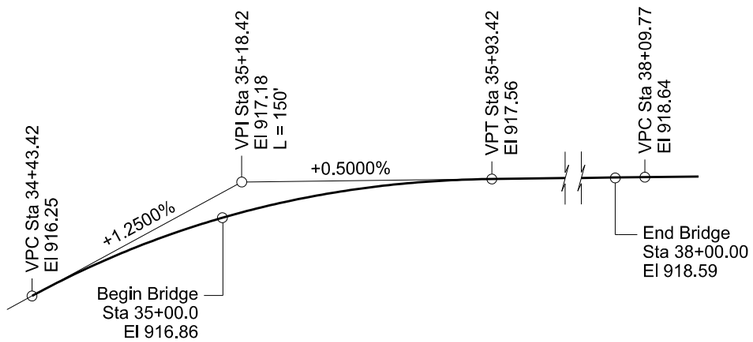
BRIDGE ELEVATION: PROFILE 3 - I-29 BRIDGE

	STATE	PROJECT NUMBER	SECTION NO.	SHEET NO.
	ND	IM-8-029(213)069	170	5



ELEVATION

*Dimensions are perpendicular to the I-29 alignment



VERTICAL CURVE DATA

DESIGN STRENGTHS:

f'c = 3,000 psi ~ Class AE-3 Concrete
f'c = 4,000 psi ~ Class AAE-3 Concrete
fy = 50,000 psi ~ Structural Steel
fy = 60,000 psi ~ Reinforcing Steel

Load & Resistance Factor Design

This drawing is preliminary and not for construction or implementation purposes.

PRELIMINARY

40TH AVE NW INTERCHANGE

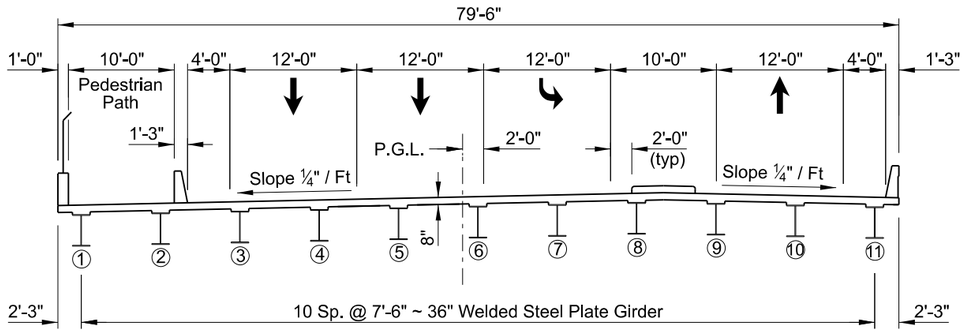
PROFILE 3

FOUR-SPAN STEEL GIRDER OVER I-29 W/ MINIMAL GRADE RAISE

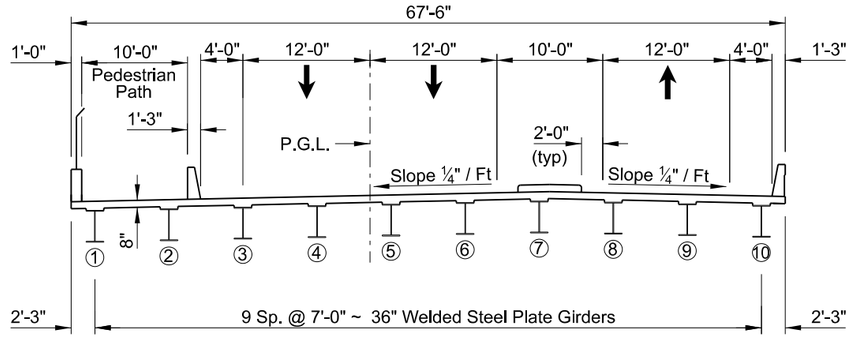
ND DEPARTMENT OF TRANSPORTATION
BRIDGE DIVISION

BRIDGE SECTIONS: PROFILE 3 - I-29 BRIDGE

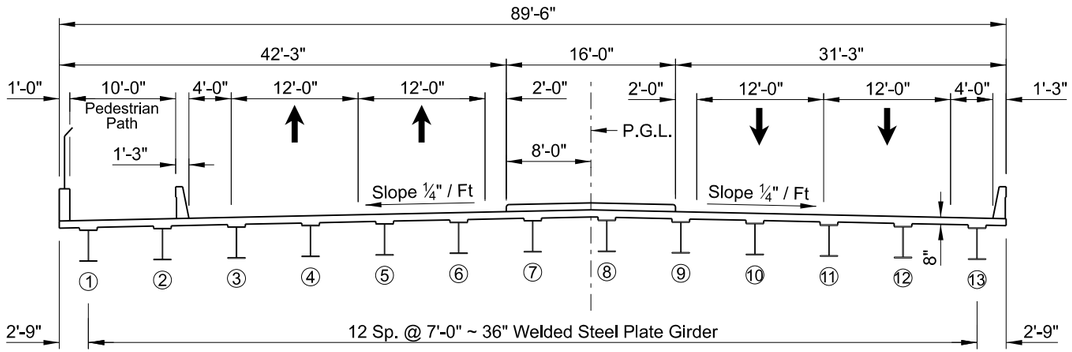
	STATE	PROJECT NUMBER	SECTION NO.	SHEET NO.
	ND	IM-8-029(213)069	170	6



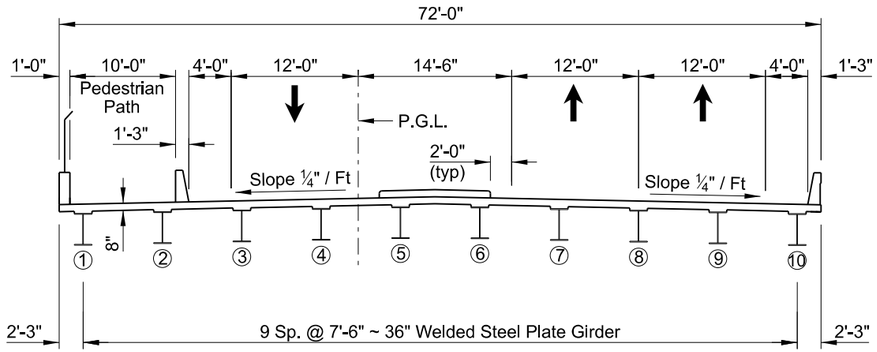
TYPICAL SECTION
ALTERNATIVE 1 - STANDARD DIAMOND INTERCHANGE



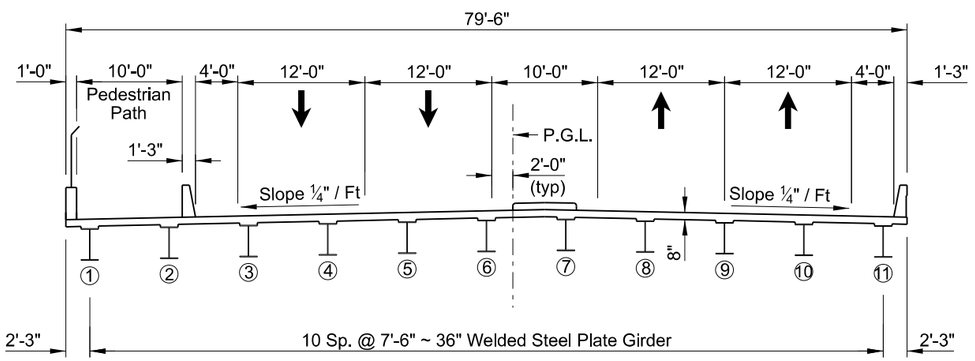
TYPICAL SECTION
ALTERNATIVE 2 - DUMBBELL INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 3 - DIVERGING DIAMOND INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 4 - ROUNDABOUT DIVERGING DIAMOND INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 5 - PARTIAL CLOVERLEAF INTERCHANGE

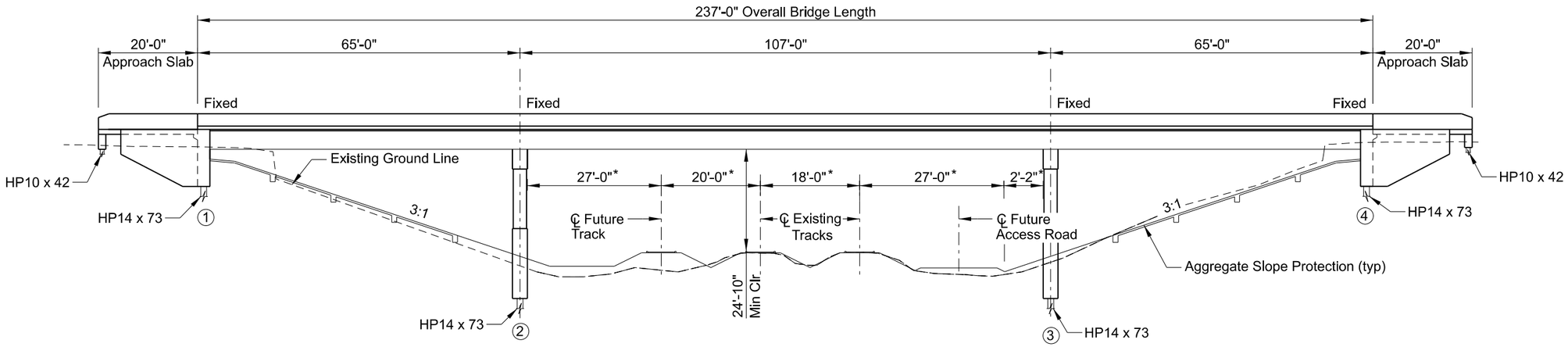
40TH AV NW INTERCHANGE

PROFILE 3

SLAB SECTIONS

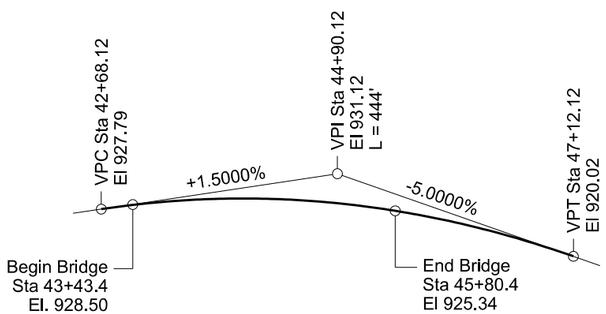
BRIDGE ELEVATION: PROFILE 1 - BNSF BRIDGE

	STATE	PROJECT NUMBER	SECTION NO.	SHEET NO.
	ND	IM-8-029(213)069	170	7



ELEVATION

*Dimensions are perpendicular to the Rail alignment



VERTICAL CURVE DATA

DESIGN STRENGTHS:

f'c = 3,000 psi ~ Class AE-3 Concrete
f'c = 4,000 psi ~ Class AAE-3 Concrete
f'c = 7,000 psi ~ Prestressed Beam Concrete
fy = 60,000 psi ~ Reinforcing Steel

Load & Resistance Factor Design

This drawing is preliminary and not for construction or implementation purposes.

PRELIMINARY

40TH AVE NW INTERCHANGE

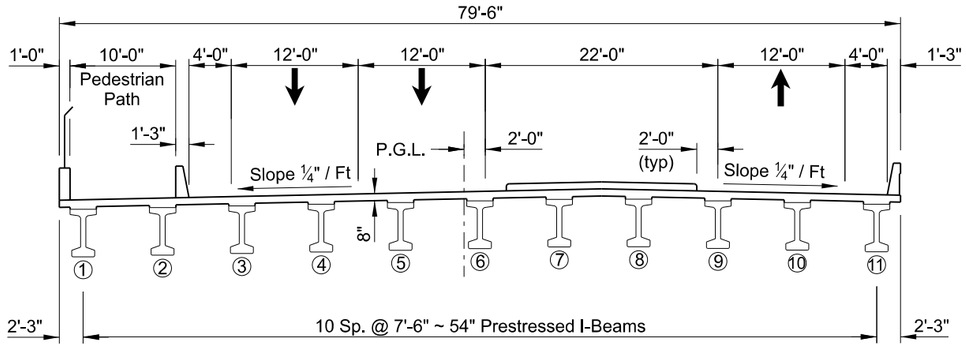
PROFILE 1

THREE-SPAN P/S CONCRETE GIRDER OVER RAIL W/ GRADE RAISE

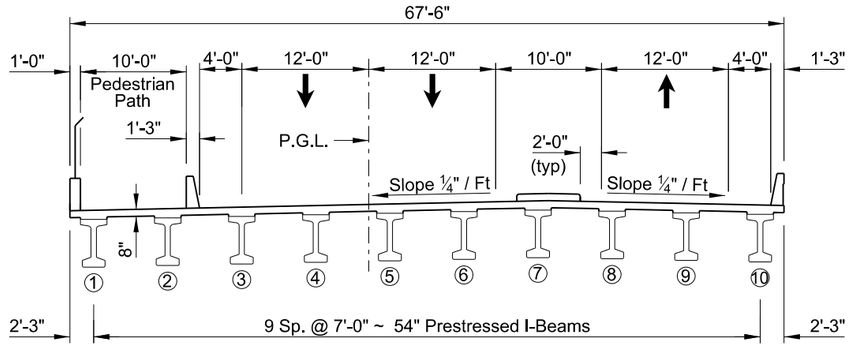
ND DEPARTMENT OF TRANSPORTATION
BRIDGE DIVISION

BRIDGE SECTIONS: PROFILE 1 - BNSF BRIDGE

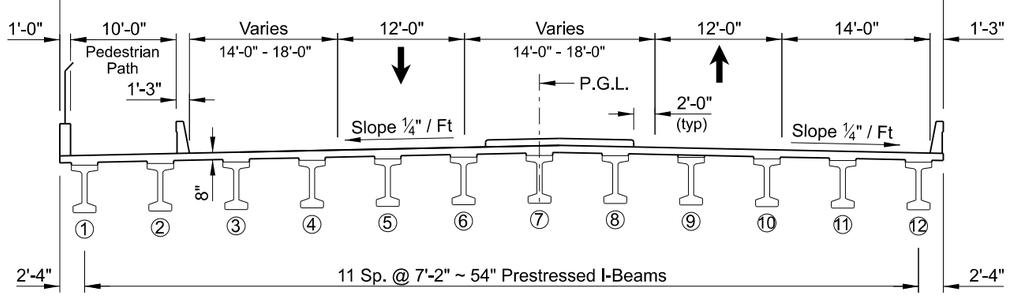
	STATE	PROJECT NUMBER	SECTION NO.	SHEET NO.
	ND	IM-8-029(213)069	170	8



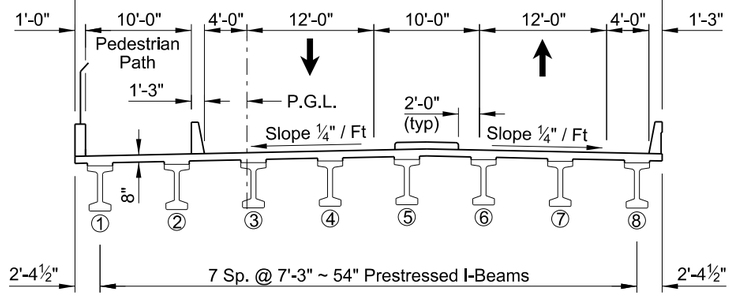
TYPICAL SECTION
ALTERNATIVE 1 - STANDARD DIAMOND INTERCHANGE



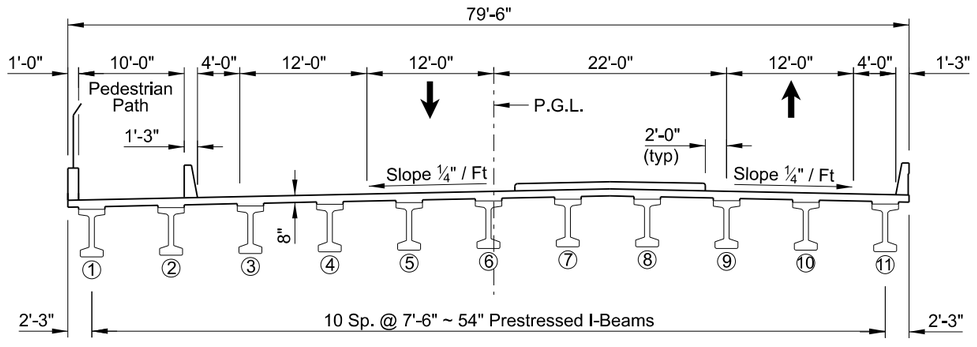
TYPICAL SECTION
ALTERNATIVE 2 - DUMBBELL INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 3 - DIVERGING DIAMOND INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 4 - ROUNDABOUT DIVERGING DIAMOND INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 5 - PARTIAL CLOVERLEAF INTERCHANGE

This drawing is preliminary and not for construction or implementation purposes.

PRELIMINARY

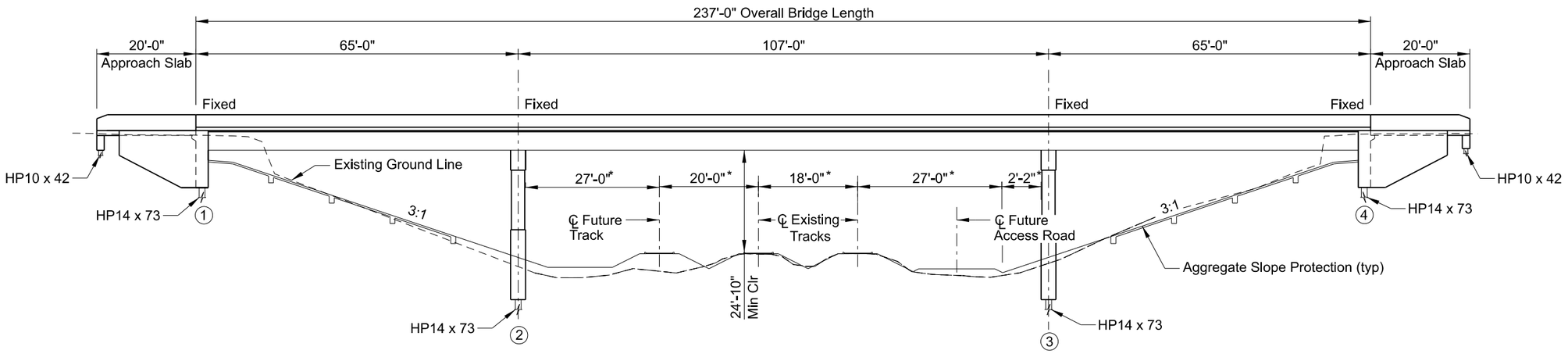
40TH AV NW INTERCHANGE

PROFILE 1

SLAB SECTIONS

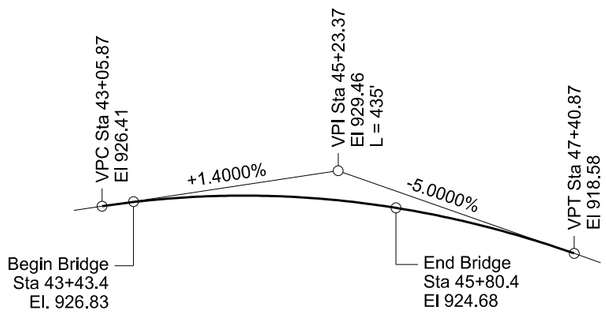
BRIDGE ELEVATION: PROFILE 2/3 - BNSF BRIDGE

	STATE	PROJECT NUMBER	SECTION NO.	SHEET NO.
	ND	IM-8-029(213)069	170	9



ELEVATION

*Dimensions are perpendicular to the Rail alignment



VERTICAL CURVE DATA

DESIGN STRENGTHS:

f'c = 3,000 psi ~ Class AE-3 Concrete
f'c = 4,000 psi ~ Class AAE-3 Concrete
f'c = 7,000 psi ~ Prestressed Beam Concrete
fy = 60,000 psi ~ Reinforcing Steel

Load & Resistance Factor Design

This drawing is preliminary and not for construction or implementation purposes.

PRELIMINARY

40TH AVE NW INTERCHANGE

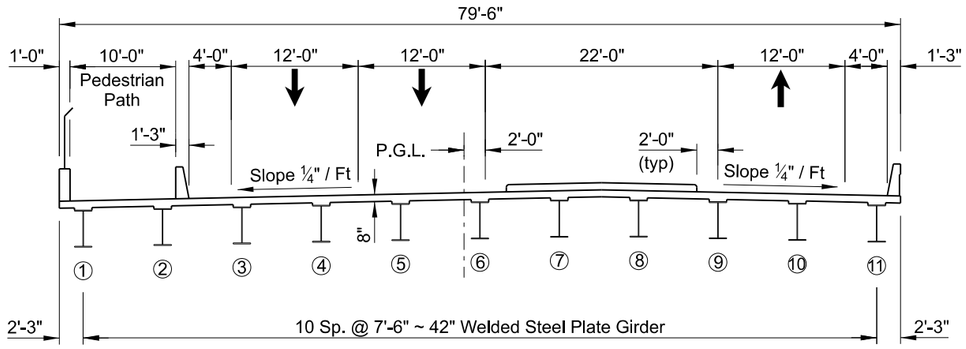
PROFILE 2

THREE-SPAN STEEL GIRDER OVER RAIL W/ GRADE RAISE

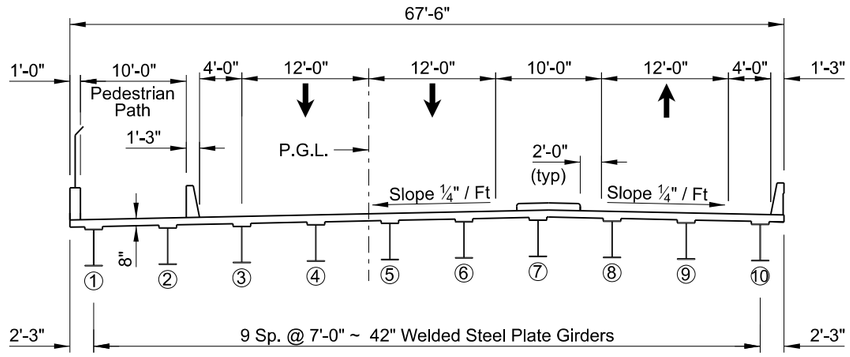
ND DEPARTMENT OF TRANSPORTATION
BRIDGE DIVISION

BRIDGE SECTIONS: PROFILE 2/3 - BNSF BRIDGE

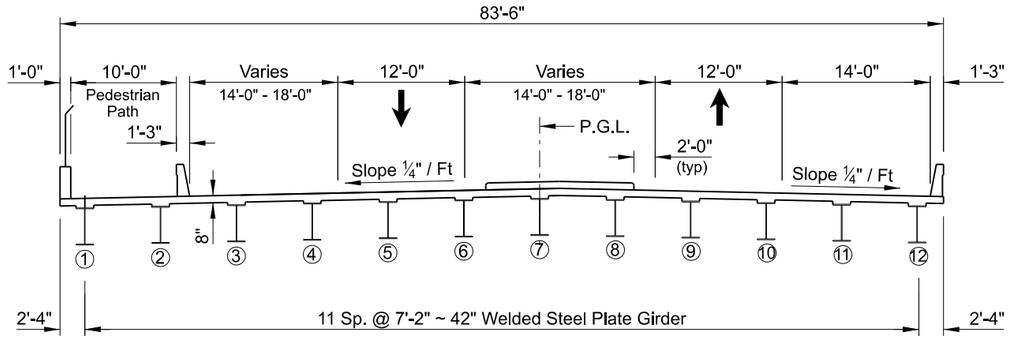
	STATE	PROJECT NUMBER	SECTION NO.	SHEET NO.
	ND	IM-8-029(213)069	170	10



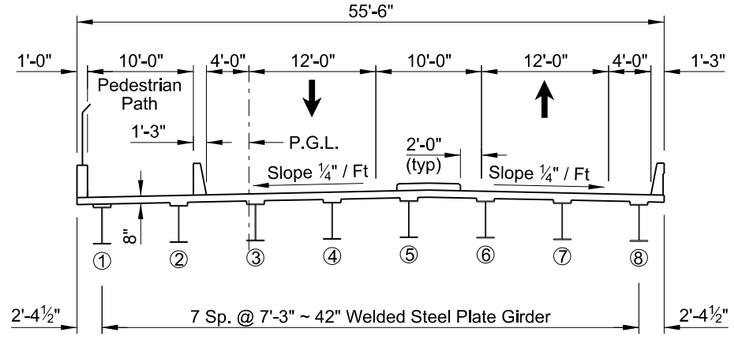
TYPICAL SECTION
ALTERNATIVE 1 - STANDARD DIAMOND INTERCHANGE



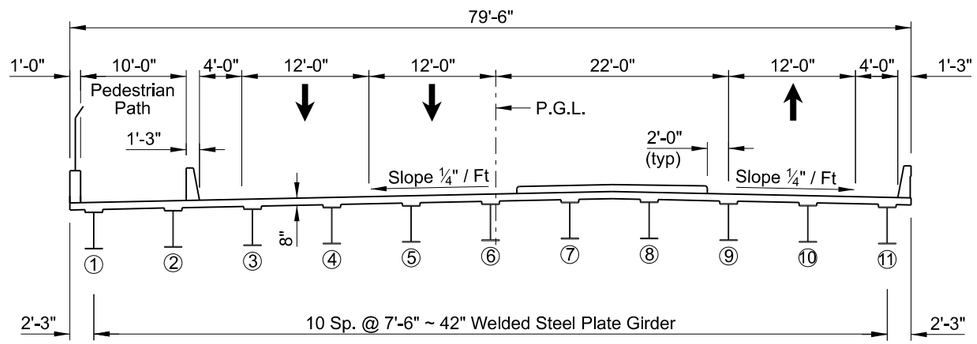
TYPICAL SECTION
ALTERNATIVE 2 - DUMBBELL INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 3 - DIVERGING DIAMOND INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 4 - ROUNDABOUT DIVERGING DIAMOND INTERCHANGE



TYPICAL SECTION
ALTERNATIVE 5 - PARTIAL CLOVERLEAF INTERCHANGE

This drawing is preliminary and not for construction or implementation purposes.

PRELIMINARY

40TH AV NW INTERCHANGE

PROFILE 2

SLAB SECTIONS

Appendix N – Structure Cost Summary

Stantec

Structure Cost Summary: Profile 1 - 3 ft Grade Raise

I-29 and 40th Avenue North Interchange
NDDOT
IM-8-029(213)069, PCN 23596

PREPARED BY:
DATE: 4/3/2023

ALTERNATIVE	BASE COST		VARIABLE COST				ALTERNATIVE TOTAL
	UNIT	COST	UNIT	PRICE	QTY	COST	COST
Alt 1 - Std Diamond							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 254.12	23,850.00	$ 6,060,750	$ 7,241,625
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 290.64	18,841.50	$ 5,476,114	$ 5,608,614
Total		$ 1,313,375.00				$ 11,536,864	**$ 12,850,239**
Alt 2 - Dumbbell							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 254.12	20,250.00	$ 5,145,920	$ 6,326,795
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 290.64	15,997.50	$ 4,649,531	$ 4,782,031
Total		$ 1,313,375.00				$ 9,795,450	**$ 11,108,825**
Alt 3 - DDI							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 254.12	26,850.00	$ 6,823,108	$ 8,003,983
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 290.64	19,789.50	$ 5,751,642	$ 5,884,142
Total		$ 1,313,375.00				$ 12,574,750	**$ 13,888,125**
Alt 4 - Roundabout DDI							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 254.12	21,600.00	$ 5,488,981	$ 6,669,856
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 290.64	13,153.50	$ 3,822,947	$ 3,955,447
Total		$ 1,313,375.00				$ 9,311,929	**$ 10,625,304**
Alt 5 - Parclo							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 254.12	23,850.00	$ 6,060,750	$ 7,241,625
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 290.64	18,841.50	$ 5,476,114	$ 5,608,614
Total		$ 1,313,375.00				$ 11,536,864	**$ 12,850,239**

Notes

1. I-29 Bridge Base Cost includes existing bridge demolition, bridge bench marks and all costs associated with pedestrian box culverts.
2. BNSF Bridge Base Cost inludes existing bridge demolition and bridge bench marks.

3. Variable costs for all bridges are based on a cost per square foot derived from a detaled quantiy based estimate for the Alternative 1 structures. The cost per square foot includes all excavation, foundation preparation, substructure and superstructure elements, roadway canopy, slope protection, and abutment underdrain systems.
4. I-29 Bridge superstructure consists of a two-span configuration with 72" prestressed I-girders.
5. BNSF Bridge superstructure consists of a three-span configuration with 54" prestressed I-girders

Stantec

Structure Cost Summary: Profile 2 -1.5 ft Grade Raise

I-29 and 40th Avenue North Interchange
NDDOT
IM-8-029(213)069, PCN 23596

PREPARED BY:
DATE: 4/3/2023

ALTERNATIVE	BASE COST		VARIABLE COST				ALTERNATIVE TOTAL
	UNIT	COST	UNIT	PRICE	QTY	COST	COST
Alt 1 - Std Diamond							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 366.79	23,850.00	$ 8,747,850	$ 9,928,725
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	18,841.50	$ 6,480,635	$ 6,613,135
Total		$ 1,313,375.00				$ 15,228,485	**$ 16,541,860**
Alt 2 - Dumbbell							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 366.79	20,250.00	$ 7,427,420	$ 8,608,295
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	15,997.50	$ 5,502,426	$ 5,634,926
Total		$ 1,313,375.00				$ 12,929,846	**$ 14,243,221**
Alt 3 - DDI							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 366.79	26,850.00	$ 9,848,208	$ 11,029,083
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	19,789.50	$ 6,806,705	$ 6,939,205
Total		$ 1,313,375.00				$ 16,654,913	**$ 17,968,288**
Alt 4 - Roundabout DDI							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 366.79	21,600.00	$ 7,922,581	$ 9,103,456
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	13,153.50	$ 4,524,217	$ 4,656,717
Total		$ 1,313,375.00				$ 12,446,798	**$ 13,760,173**
Alt 5 - Parclo							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 366.79	23,850.00	$ 8,747,850	$ 9,928,725
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	18,841.50	$ 6,480,635	$ 6,613,135
Total		$ 1,313,375.00				$ 15,228,485	**$ 16,541,860**

Notes

1. I-29 Bridge Base Cost includes existing bridge demolition, bridge bench marks and all costs associated with pedestrian box culverts.
2. BNSF Bridge Base Cost inludes existing bridge demolition and bridge bench marks.

3. Variable costs for all bridges are based on a cost per square foot derived from a detaled quantiy based estimate for the Alterntive 1 structures. The cost per square foot includes all excavation, foundation preparation, substructure and superstructure elements, roadway canopy, slope protection, and abutment underdrain systems.
4. I-29 Bridge superstructure consists of a two-span configuration with 54" steel plate girders.
5. BNSF Bridge superstructure consists of a three-span configuration with 42" steel plate girders

Stantec

Structure Cost Summary: Profile 3 - Match Existing Profile

I-29 and 40th Avenue North Interchange
NDDOT
IM-8-029(213)069, PCN 23596

PREPARED BY:
DATE: 4/3/2023

ALTERNATIVE	BASE COST		VARIABLE COST				ALTERNATIVE TOTAL
	UNIT	COST	UNIT	PRICE	QTY	COST	COST
Alt 1 - Std Diamond							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 328.17	25,122.00	$ 8,244,250	$ 9,425,125
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	18,841.50	$ 6,480,635	$ 6,613,135
Total		$ 1,313,375.00				$ 14,724,885	**$ 16,038,260**
Alt 2 - Dumbbell							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 328.17	21,330.00	$ 6,999,835	$ 8,180,710
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	14,220.00	$ 4,891,045	$ 5,023,545
Total		$ 1,313,375.00				$ 11,890,880	**$ 13,204,255**
Alt 3 - DDI							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 328.17	28,282.00	$ 9,281,263	$ 10,462,138
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	16,590.00	$ 5,706,219	$ 5,838,719
Total		$ 1,313,375.00				$ 14,987,482	**$ 16,300,857**
Alt 4 - Roundabout DDI							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 328.17	22,752.00	$ 7,466,491	$ 8,647,366
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	16,590.00	$ 5,706,219	$ 5,838,719
Total		$ 1,313,375.00				$ 13,172,710	**$ 14,486,085**
Alt 5 - Parclo							
I-29 Bridge	L SUM	$ 1,180,875.00	SF	$ 328.17	25,122.00	$ 8,244,250	$ 9,425,125
BNSF Bridge	L SUM	$ 132,500.00	SF	$ 343.96	18,960.00	$ 6,521,394	$ 6,653,894
Total		$ 1,313,375.00				$ 14,765,644	**$ 16,079,019**

Notes

1. I-29 Bridge Base Cost includes existing bridge demolition, bridge bench marks and all costs associated with pedestrian box culverts.
2. BNSF Bridge Base Cost inludes existing bridge demolition and bridge bench marks.

3. Variable costs for all bridges are based on a cost per square foot derived from a detaled quantiy based estimate for the Alternative 1 structures. The cost per square foot includes all excavation, foundation preparation, substructure and superstructure elements, roadway canopy, slope protection, and abutment underdrain systems.
4. I-29 Bridge superstructure consists of a four-span configuration with 36" steel plate girders.
5. BNSF Bridge superstructure consists of a three-span configuration with 42" steel plate girders (same bridge costs as Profile 2)

Appendix O – Sensitivity Analysis Cost Summary

Stantec

GIRDER COST SENSITIVITY ANALYSIS

I-29 and 40th Avenue North Interchange
NDDOT
IM-8-029(213)069, PCN 23596

Girder Cost Sensitivity Analsyis

I-29 Crossing

	Profile 1 - Two Span		Profile 2 - Two Span		Profile 3 - Four Span	
	Concrete Bridge (72" I girders)		Steel Bridge (54" I girders)		Steel Bridge (36" I girders)	
	Beam Unit Cost $/LF	Bridge Cost $M	Beam Unit Cost $/LB	Bridge Cost ($m) $M	Beam Unit Cost $/LB	Bridge Cost ($m) $M
50%	$250	$6.42	$1.75	$7.56	$1.75	$7.80
75%	$375	$6.83	$2.63	$8.75	$2.63	$8.62
100%	$500	$7.24	$3.50	$9.93	$3.50	$9.43
150%	$750	$8.06	$5.25	$12.30	$5.25	$11.05
200%	$1,000	$8.88	$7.00	$14.63	$7.00	$12.68

BNSF Crossing

	Profile 1 - Three Span		Profile 2/3 - Three Span	
	Concrete Bridge (54" I girders)		Steel Bridge (42" I girders)	
	Beam Unit Cost $/LF	Bridge Cost $M	Beam Unit Cost $/LB	Bridge Cost ($m) $M
50%	$175	$5.01	$1.75	$5.28
75%	$263	$5.24	$2.63	$5.87
100%	$350	$5.47	$3.50	$6.45
150%	$525	$5.93	$5.25	$7.62
200%	$700	$6.39	$7.00	$8.80

Appendix P – Detailed Alternatives Evaluations Matrix

I-29 & CR 20 Interchange Feasibility Study

Detailed Alternatives Evaluation Matrix

	Alternatives	Safety Improvements	Geometric Needs	Environmental Impacts	Geotechnical Impacts	Cost			Traffic and Level of Service	Constructability Issues	Impact to existing land use or new development resulting access	Right of Way Impacts	Flexibility to accommodate future improvements or land use changes	Active Transportation Facility Enhancement	Utility Impacts
						Noise	Construction	Maintenance							
1	STANDARD DIAMOND INTERCHANGE	- Highest number of conflict points - Potential for high-speed angle - Does not eliminate wrong-way movements	+ Brings interchange geometry up to current standards + Eliminates vertical curvature concerns near RR bridge - Alignment shifted to north	+ No EJ, 4(f)/6(f), and cultural impacts - Similar T&E species, noise, wetlands, and floodplain impacts	- Settlement can be addressed, but at great detriment to cost and staging	- Requires three signalized intersections +Existing footprint reduces grading	$31,731,800	- Signals require electricity and extra maintenance for hardware	+ Performs adequately for all corridor concepts	+ New structure can be built while maintaining traffic (I-29 and 40th Ave) - More complex ramp staging on west ramp terminal intersection	+ Maintains businesses and development accesses + Accomodates U-turns at far ramp terminal if access control implemented	+ Minimal permanent right-of-way needed (3.8 ac) - Temporary easements may be needed	+ Bridge can be widened to south - Significant and complex widening required to accommodate thru and left turn lanes	+ Accomodates grade separated shared-use path + Crossing in single ped phase - Greater crossing conflicts with signals	- Potentially moderate impacts to Utilities
2	DUMBBELL INTERCHANGE	+ Reduces number of conflict points + Reduces severity + Eliminates wrong-way movements	+ Brings interchange geometry up to current standards + Eliminates vertical curvature concerns near RR bridge - Minor alignment shift north + Roundabouts accommodate trucks	+ No EJ, 4(f)/6(f), and cultural impacts - Similar T&E species, noise, wetlands, and floodplain impacts	- Settlement can be addressed, but at great detriment to cost and staging	+ Unsignalized - Roundabouts require increased grading	$28,114,700	- Higher snow clearing costs due to roundabout	+ Performs adequately for all corridor concepts, slightly better than others	+ New structure can be built while maintaining traffic (I-29 and 40th Ave) + West ramp terminal intersection and ramps constructed more easily	+ Maintains businesses and development accesses + Accomodates U-turns at near ramp terminal if access control implemented	+ Minimal to no permanent right-of-way needed (3.1 ac) - Temporary easements may be needed	+ Bridge can be widened to south - Expansion of roundabout to multi-lane required	+ Accomodates grade separated shared-use path + Enhanced crossing at roundabout approach	- Potentially moderate impacts to Utilities
3	DIVERGING DIAMOND INTERCHANGE (DDI)	+ Reduces number of conflict points + Eliminates wrong-way movements	+ Brings interchange geometry up to current standards + Eliminates vertical curvature concerns near RR bridge - Alignment shifted to north	+ No EJ, 4(f)/6(f), and cultural impacts - Similar T&E species, noise, wetlands, and floodplain impacts	- Settlement can be addressed, but at great detriment to cost and staging	- Requires three signalized intersections - Requires wider structures over I-29 and RR	$34,141,700	- Signals require electricity and extra maintenance for hardware	+ Performs adequately for all corridor concepts, slightly better than others	+ New structure can be built while maintaining traffic (I-29 and 40th Ave) - More complex ramp staging on west ramp terminal intersection	+ Maintains businesses and development accesses - Doesn't accomodate U-turns at ramp terminal if access control implemented	+ Minimal permanent right-of-way needed, slightly more in NW quadrant (4.0 ac) - Temporary easements may be needed	+ Bridge and approach geometry already designed/built to accommodate expansion	+ Accomodates grade separated shared-use path - Crossing in two ped phases	- Potentially moderate impacts to Utilities
4	ROUNDABOUT DDI	+ Reduces number of conflict points + Reduces severity + Eliminates wrong-way movements - Yield controlled crossings have higher angles of incidence than typical roundabout	+ Brings interchange geometry up to current standards + Eliminates vertical curvature concerns near RR bridge - Minor alignment shift north + Roundabouts accommodate trucks	+ No EJ, 4(f)/6(f), and cultural impacts - Similar T&E species, noise, wetlands, and floodplain impacts	- Settlement can be addressed, but at great detriment to cost and staging	+ Unsignalized - Requires wider structures over I-29 and RR	$27,816,800	- Higher snow clearing costs due to roundabout	+ Performs adequately for all corridor concepts - Has the potential to "lock" if longer queues form	+ New structure can be built while maintaining traffic (I-29 and 40th Ave) - More complex ramp staging on west ramp terminal intersection	+ Maintains businesses and development accesses - Doesn't accomodate U-turns at ramp terminal if access control implemented	+ Minimal permanent right-of-way needed, slightly more in NW quadrant (3.5 ac) - Temporary easements may be needed	+ Bridge can be widened to south - More complex widening required - Expansion of roundabout to multi-lane required - May require signals, negating benefits of unsignalized	+ Accomodates grade separated shared-use path - Enhanced crossing at roundabout approach, but requires double lane exit	- Potentially moderate impacts to Utilities
5	PARTIAL CLOVERLEAF INTERCHANGE (PARCLO)	+ Removes left turn conflicts from one ramp terminal intersection - Does not eliminate wrong-way movements	+ Brings interchange geometry up to current standards + Eliminates vertical curvature concerns near RR bridge - Alignment shifted to north	+ No EJ, 4(f)/6(f), and cultural impacts - Similar T&E species, noise, wetlands, and floodplain impacts - Impacts to farmland (1.7 ac)	- Settlement can be addressed, but at great detriment to cost and staging	- Requires three signalized intersections - Requires additional pavement, grading, and right-of-way	$31,901,200	- Signals require electricity and extra maintenance for hardware	+ Performs adequately for all corridor concepts, slightly better than others	+ New structure can be built while maintaining traffic (I-29 and 40th Ave) - More complex ramp staging on west ramp terminal intersection	+ Maintains businesses and development accesses + Accomodates U-turns at far ramp terminal if access control implemented - Requires portion of property from NW quadrant developable parcel	- Requires significant right-of-way in NW quadrant (6.2 ac) - Temporary easements may be needed	+ Bridge can be widened to south - More complex widening required	+ Accomodates grade separated shared-use path + Crossing in single ped phase - Greater crossing conflicts with signals	- Potentially moderate impacts to Utilities

Appendix Q – Final Decisions Document

DECISION DOCUMENT

RECONSTRUCTION

Project No.	PCN
8-029(213)069	23596

I-29 and 40th Avenue North Interchange (Exit 69)

Prepared by

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
BISMARCK, NORTH DAKOTA

http://www.dot.nd.gov/

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PROJECT DEVELOPMENT DIRECTOR
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August 2023

23 USC § 407
NDDOT Reserves All Objections

A. Project Description

Project Number: 8-029(213)069
Highway: Interstate 29
Study Limits: I-29 & 40th Ave N Interchange (Exit 69)
Project Description: Interchange and adjacent bridge over BNSF Railroad Reconstruction
District: Fargo

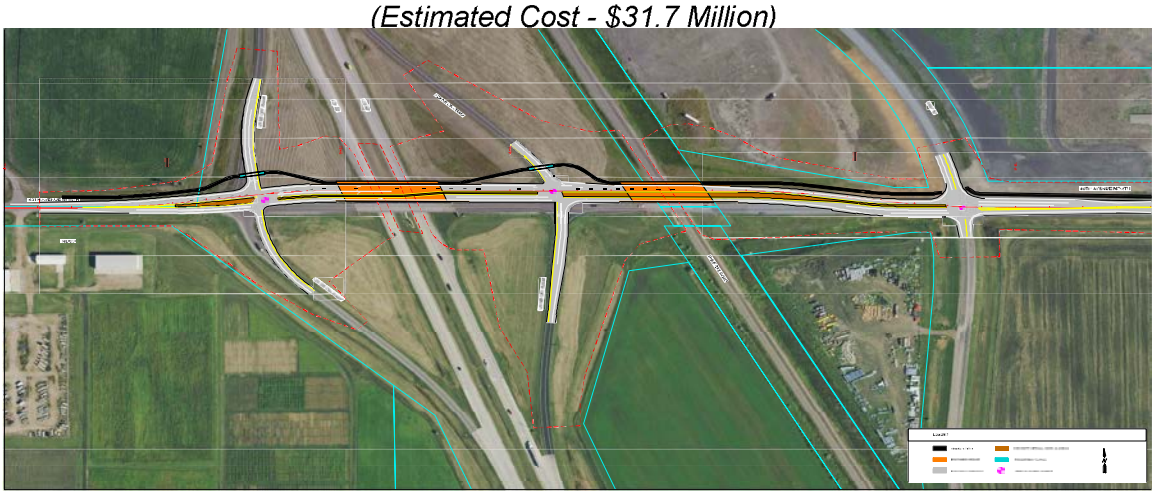
B. Project Schedule

Project	*Plans Complete*	*Bid Ready*
Reconstruction	November 1, 2026	January 1, 2028 (place holder date - actual date TBD)

C. Purpose of Decision Document

The purpose of this decision document is to present the proposed build alternatives for the Exit 69 interchange through Fargo and select which proposed build alternative to move forward into the environmental document (DCE).

Alternative 1: Standard Diamond (Ranked 4th of 5 Alternatives)[1]
(Estimated Cost - $31.7 Million)



Advantages:
- Lesser amount of grading
- High driver familiarity.
- Lower potential for snow drifting compared to other alternatives

Disadvantages:
- Highest number of Conflict Points
- Does not physically eliminate wrong-way movements
- Potential for high-speed/high-angle crashes
- Three signalized intersections

[1] An alternatives evaluation matrix was developed in coordination with and approved by the project Technical Advisory Committee. Cited rankings come from the TAC approved evaluation matrix.

Alternative 2: Dumbbell (Ranked 1st of 5 Alternatives)[1]
(Estimated Cost - $28.1 Million)

Advantages:

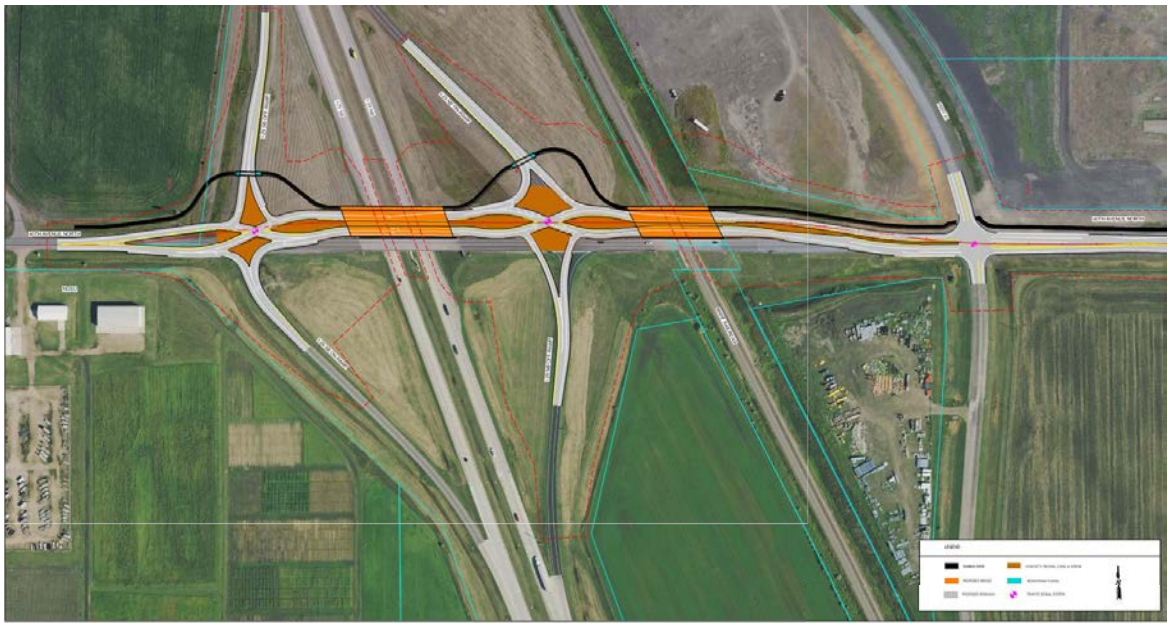
- Reduced number of conflict points
- Reduced crash severity
- Eliminates wrong-way movement
- No signals to power, maintain and operate
- Lowest cost alternative
- Tied for second regarding Flexibility

Disadvantages:

- Snow drifting – can be mitigated
- Somewhat lesser driver familiarity
- Moderate to high amount of grading

[1] An alternatives evaluation matrix was developed in coordination with and approved by the project Technical Advisory Committee. Cited rankings come from the TAC approved evaluation matrix.

Alternative 3: Diverging Diamond (DDI) (Ranked 2nd of 5 Alternatives)[1]
(Estimated Cost - $34.1 Million)



Advantages:

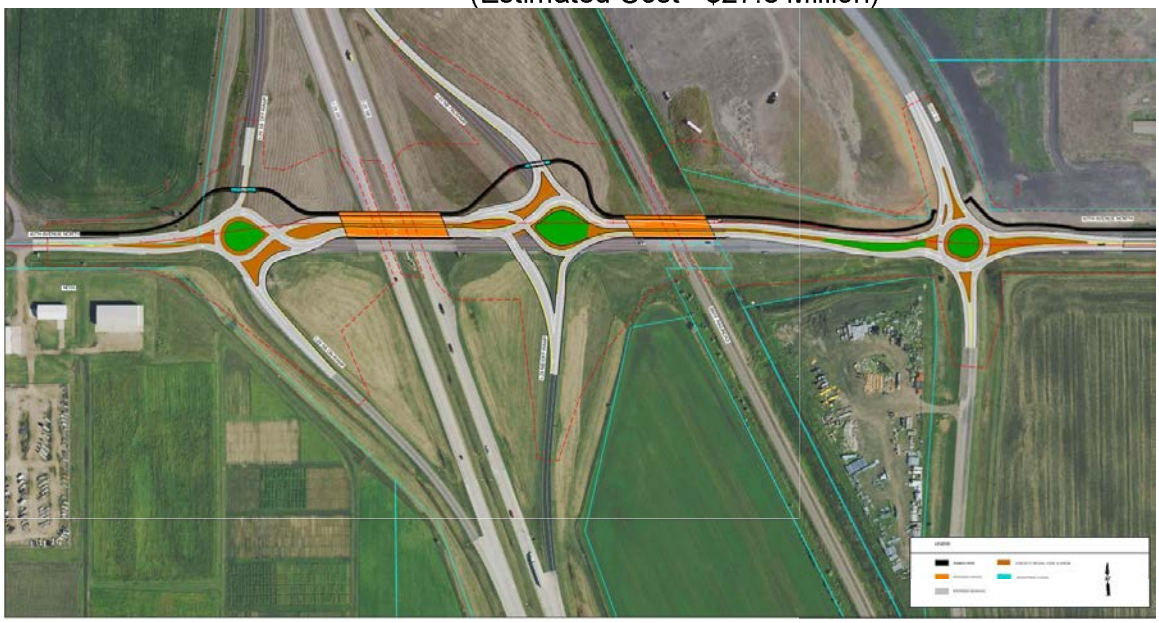
- Reduced conflict points
- Greater capacity
- Eliminates wrong-way movements
- Reduced crash severity
- Rated first in Flexibility

Disadvantages:

- Signal system
- Medians
- Lesser flexibility for expansion
- High amount of grading

[1] An alternatives evaluation matrix was developed in coordination with and approved by the project Technical Advisory Committee. Cited rankings come from the TAC approved evaluation matrix.

Alternative 4: Roundabout DDI (Ranked 5th of 5 Alternatives)[1]
(Estimated Cost - $27.8 Million)



Advantages:

- Reduced conflict points
- Greater capacity
- No signals
- Free lefts
- Eliminates wrong-way movements
- Reduced crash severity

Disadvantages:

- Less empirical data
- Low to no driver familiarity
- Lesser flexibility for expansion
- High amount of grading

[1] An alternatives evaluation matrix was developed in coordination with and approved by the project Technical Advisory Committee. Cited rankings come from the TAC approved evaluation matrix.

Alternative 5: Partial Cloverleaf (Parclo) (Ranked 3rd of 5 Alternatives)[1]
(Estimated Cost - $31.9 Million)

Advantages:
- Reduced conflict points
- Free lefts for WB/SB
- High driver familiarity
- Lower snow drifting concern
- Tied for second regarding Flexibility

Disadvantages:
- Signal system
- Costs
- R/W

D. Alternatives Considered but not carried forward

1. Retention of existing bridges: Rehabilitation and usage of the existing 40th Ave N bridges over I-29 and the Railroad was ruled out for the following primary reasons.

a. The required bridge width for the five alternatives range from 67'-6" to 89'-6" as compared to the existing width of 30 feet for both the I-29 and BNSF crossings.

b. Widening the existing bridges to accommodate the alternatives would have resulted in the vertical clearance falling below the required minimum clearance for both structures (rehab clearances are 16 feet and 23 feet for roadway and railroad respectively).

c. Retaining the existing bridges would have forced the need to retain the existing vertical profile which does not meet current geometric standards.

d. Assuming a bridge's useful life is 75 years, the existing bridges would reach that age in 2039 whereas new structures would "last" until 2100.

[1] An alternatives evaluation matrix was developed in coordination with and approved by the project Technical Advisory Committee. Cited rankings come from the TAC approved evaluation matrix.

E. Comments received regarding the interchange alternatives

1. **Design Division:** Design Division recommends Alt#2 Dumbbell as the preferred alternative to carry forward into the environmental document. Alt#3 Diverging Diamond is favored as the close second to consider and possibly a favored alternate if looking long term during the life of the project. Chad Frisinger, Design Division

2. **District:** The District preference is the dumbbell roundabout interchange first and the DDI as a second preference. As this moves forward we should be watching that outside lane off-tracking amount and trying to minimize it without impacting the function of the roundabout. Aaron Murra, P.E.; Fargo District Engineer

3. **Environmental and Transportation Services Division:** ETS recommends Alternative 3 Diverging Diamond first and Alternative 2 Dumbbell second. It seems the two are fairly equal in advantages. I believe that an Interchange Justification Report is necessary for this project. In the recent past the NDDOT has had to justify way the interchange with the best operations was not selected. It appears the Diverging Diamond has the better operation based on the advantages noted.

In terms of the environmental document, I don't think it should be concluded this is a DCE until it is confirmed with FHWA. Whatever alternatives are eliminated, they should be discussed in the environmental document as alternatives considered and not carried forward. The discussion should be more than referencing a report. It seems there are concerns with the extent of grading and ability to expand in the future.

The management presentation seemed to indicate that the brides would have clearances of 17 feet and 23.5 feet at the railroad. I think the 17 feet should be a minimum. The designs should evaluate the both the vertical and horizontal clearances to minimize obstruction to loads and the improve the ability to limit drifting of snow as well as facilitate the removal of snow drifts under and around the structures.

4. **Local Government:** The Local Government Division recommends Alternative #2 Dumbbell Interchange as the preferred alternative to carry forward into the environmental document. The Local Government Division will also support Alternative #3 Diverging Diamond Interchange as the preferred second alternative to carry forward into the environmental document. Paul M. Benning, P.E.; Local Government Engineer

5. **Maintenance:** Good Morning Chad. Maintenance Division recommends Alternate 2: dumbbell option. We feel this will be the most user friendly for heavy loads needing to ramp this overhead and for snow and ice control operations. Thank You. Mike Kisse, P.E., Assistant Division Director – Maintenance

6. **Programming:** Programming's preferred alternative is Alt 2: Dumbbell interchange. This alternative shows the most benefits. If needed, our second choice would be Alt 3: DDI. Jane E. Berger, PE - Programming Engineer

7. **Traffic Operations:** Traffic operations section preferred alternative would be alternative 2- dumbbell, as this alternative has the highest rating. It also has the most 5's (highest rating) on what we would consider the more important evaluation criteria of: safety improvements, geometric needs, traffic and level of service, and active transportation facility enhancements.

For safety improvements, one of the major advantages of alternative 2 is that it eliminates the possibility/concern of WB traffic mistakenly going the wrong way down the NB off ramp as the roundabout would guide you past that off ramp. With the current configuration we have heard that drivers believe they went over the interstate because of the railroad structure and turn left down the off ramp. Thanks, Justin Schlosser - Traffic Operations Engineer

8. **City:** We put this Interchange Selection Report on our Public Works agenda last Monday and we are like Alternative #2 (Dumbbell with roundabouts) the best. From a pure traffic movement standpoint, we believe these are the most efficient and are the safest intersections for that location. We also think that this part of the city will not see large scale growth like we do on the city's south side because there is so much land either locked up by the airport authority and NDSU, and even in a post FM Diversion world, there will still be residual flood plain issues north of this interchange.
Getting into the details of the dumbbell design, there is some concern from the Public Works Operations Director with regards to the additional median that is shown on the layout for the right turning movement to head south on I-29. The issue is that as it's shown, a plow operator couldn't plow that turn lane and then continue east on the avenue over I-29; they would be forced to make that turn onto I-29. We understand that these are preliminary layouts and not final design material, but we thought we'd mention it. We think this issue could be addressed during the final design process.
As for the other alternatives in the report, we were pretty neutral to trending more negatively on them. The DDI with traffic signals, I believe, is over-engineering for this location, and the DDI with roundabouts seems like a really strange concept for an exurban interchange. We also believe that the old and reliable traditional interchange with basic intersection design and traffic signals is a thing of the past, too much starting and stopping and yielding. The default future interchange concept should be using roundabouts as the intersection control. Jeremy M. Gorden, PE, PTOE; Division Engineer – Transportation. Note: These comments were received prior to the May 10th Management Presentation.

9. **FHWA:** FHWA ND Division concurs with this [Recommended NEPA] decision document. We have no comments to offer. Kevin Brodie, Transportation Engineer

Note: The Recommended NEPA Document Decision is attached to this document for reference.

10. **Cass County Highway Department:** My preference is Alternative 2 – Dumbbell. I'm comfortable with this option being able to reduce conflict points, reduce traffic going down the wrong way, and handle the variabilities of high traffic times of day and low traffic times. Jason Benson, P.E.; County Engineer, Cass County Highway Department

11. **Metro COG:** Metro COG's vote is for Alternative #2. We believe this alternative will accommodate future traffic conditions (including trucks), mitigate the wrong-way issue on the NB off-ramp, and would provide safe and efficient traffic flow through the interchange. Dan Farnsworth, Transportation Planner

Recommendations Table

	Which alternate should proceed into the environmental document (DCE)?
Office of Project Development	Alternative 2: Dumbbell
Office of Operations	
Bridge Division	Alternative 2: Dumbbell
Construction Services Division	
Design Division	Alternative 2: Dumbbell *
District	Alternative 2: Dumbbell *
Environmental and Transportation Services Division	Alternative 3: Diverging Diamond
Local Government Division	Alternative 2: Dumbbell *
Maintenance Division	Alternative 2: Dumbbell
Materials and Research Division	Alternative 2: Dumbbell
Programming Division	Alternative 2: Dumbbell *
Planning/Asset Management Division	
City	Alternative 2: Dumbbell
FHWA	
County	Alternative 2: Dumbbell
Fargo-Moorhead Metropolitan Council of Governments (Metro COG)	Alternative 2: Dumbbell

* Alternative 3: Diverging Diamond (DDI) acceptable as second alternative, if needed.

F. Executive Decisions

1. Which alternate should proceed into the environmental document (DCE)?

_____ Alternative 1 – Standard Diamond (Estimated Cost - $31.7 Million)

__X__ Alternative 2 – Dumbbell (Estimated Cost - $28.1Million)

_____ Alternative 3 – Diverging Diamond (DDI) (Estimated Cost - $34.1 Million)

_____ Alternative 4 – Roundabout DDI (Estimated Cost - $27.8 Million)

_____ Alternative 5 – Partial Cloverleaf (Parclo) (Estimated Cost - $31.9 Million)

Amendments/Comments for Project No. 8-029(213)069:

Move the project forward with Alternative 2 - Dumbbell Interchange Option. A No Build Option will also need to be included in the Environmental Document.

Matt Linneman
Matt Linneman, P.E., Deputy Director for Engineering

08/11/23
Date