Merrifield Road Red River Bridge Feasibility Study

Prepared For:

Grand Forks / East Grand Forks
Metropolitan Planning Organization

2005

Prepared By:

HDR CPS LTD.

MERRIFIELD ROAD RED RIVER BRIDGE FEASIBILITY STUDY

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January 2005

Prepared by:

6190 Golden Hills Drive
Minneapolis, MN 55416

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Executive Summary

The Merrifield Road Corridor is located approximately six miles south of the urban core of Grand Forks, North Dakota and East Grand Forks, Minnesota. This existing county road is part of a larger bypass route selected through a series of planning studies over the past nine years. This bypass route largely uses existing county roadways, with a new interchange with I-29 and a new crossing of the Red River of the North – with the latter being the subject of this study.

Bridging the Red River of the North requires consideration of many other elements than simply a bridge. First, a new bridge would create a hydraulic impediment into an extremely flood-sensitive river. Secondly, the roadway approaches would require new construction section lines between North Dakota and Minnesota do not directly align, as well as a connection to Polk County Road 58. Since a river crossing would require a large volume of fill material, there is added synergy with constructing a new diversion for Cole Creek and Drain #4, which parallels Merrifield Road. This diversion channel creates flood protection for the Grand Forks Country Club, which is particularly prone to flood damage from Cole Creek, but would require acquisition of new right-of-way, in addition to a bridge over the diversion for the existing north-south township road (8th Street NE).

Merrifield Road Red River Bridge

Two alignments were considered for the potential Red River of the North crossing. Since bridge costs are often a function of size, the most cost effective bridge alignment is a perpendicular crossing of the river. Within the study area, the shortest crossing of the river is approximately 800 feet in length (from bank to bank) and generally aligns with the existing Merrifield Road (extended). Use of prestressed concrete or steel plate beam girders would be the most cost effective measures, with an anticipated construction cost of approximately $7,000,000.

Due to the flood sensitivity of the Red River of the North, any stage increase due to a new bridge is closely regulated. In order to provide sufficient clearance for 100-year flooding events, the low-chord elevation of the bridge must be at least 838.0. This corresponds to a deck elevation of approximately 845.0. With an eight-span perpendicular crossing, the anticipated stage increase for the 100-year event is less than 0.2 feet. This is considerably less than the allowable stage

increase of 0.75 feet for this project type. Therefore, construction of a river crossing at this location should satisfy the regulatory requirements for hydraulics.

Roadway Alignment

A road elevation of 840.0 would be above the 100-year flood event within the study area. At the east and west areas of the study area, the existing roadways are at approximately this elevation. This indicates that a dry crossing during a 100-year event is possible with the replacement of the bridge over Cole Creek and use of fill between Cole Creek and the connection to Polk County Road 58. In addition, a roadway at this elevation would nearly balance with the material excavated from a Cole Creek diversion located 1,100 feet south of Merrifield Road.

A road elevation of 845.0 was also considered, equivalent to the Grand Forks Flood Protection project. Although this is possible to construct, the connection to Polk County 58 is located at approximately 841.0, meaning that either significant improvements to County 58 would be required or the eastern connection would be under water when the west approach was passable. Therefore, a roadway elevation of 840.0 was determined to be the most feasible.

The costs for roadway construction are anticipated to be approximately $2,500,000 for the North Dakota side and between $2,100,000 and $3,000,000 on the Minnesota side – depending on the preferred alternative. The most cost effective alignment is Alternative 1, which is the northern alignment along the section line road (Township 810).

Cole Creek Diversion

The diversion of Cole Creek benefits the Country Club by managing flooding events, as well as reducing road construction costs by providing fill material and eliminating the need for a new bridge over Cole Creek. This channel is anticipated to have approximately 5:1 sideslopes with an 80-ft bottom. Specific features, such as a pilot channel, could be added depending on consideration of other cost benefits. If a road elevation of 840.0 is selected, using the most cost effective alignment, the most feasible alignment is located approximately 1,100 feet south of Merrifield Road. The cost of constructing this diversion channel is estimated to be approximately $2,200,000.

Maintaining connectivity of the existing north-south township road (8th Street NE) could be accomplished by two types of crossings. The first is a crossing at an elevation of 820.5, which is the same elevation as the existing elevation of the Merrifield bridge over Cole Creek. The second alternative is at 840.0, similar to Merrifield Road. Due to the anticipated frequency of high water events over 820.5, in addition to the other connections of township roads, a connection of 840.0 is not considered feasible. The anticipated cost of a crossing of 820.5 is approximately $700,000.

Next Steps

- Due to the size of this project, an Environmental Impact Statement (EIS) will need to be prepared. The most likely impacts anticipated are wetland, riparian area, and fisheries, however, these impacts are anticipated to be independent of roadway or diversion channel alignment. Therefore, a tiered approach could be utilized to first identify the preferred alignment alternative and then quantify environmental impacts. Based on the environmental review performed as part of this study, there do not appear to be any impacts that would prevent this project from moving forward.

- The most feasible combination of project elements is anticipated to cost approximately $14,500,000 in construction costs in 2004, or about $20,000,000 by 2012. This level of funding is more than local agencies typically can budget and preset State programs do not have a bridge crossings budgeted at this time. However, this project is anticipated to have a Benefit : Cost ratio of 3.3, which should allow this project to compete well with others to receive a Federal earmark.

- EIS documents require a lead agency to initiate the process; therefore a project champion needs to be determined. Once decided, this agency should apply for funding to start the EIS process to identify a preferred alternative, which could take between two and five years to complete. This lead local agency also needs to determine how to fund the environmental documentation process. If federal monies are anticipated to be used for this process, the earmark procedure should begin as soon as possible.

Table of Contents

List of Tables

List of Figures

Appendices

1.0 Introduction

The Merrifield Road Corridor (Grand Forks County Road 6) is an east-west county highway generally about six miles south of the urban core of Grand Forks, North Dakota and East Grand Forks, Minnesota. Due to its location outside of the existing urbanized areas of Grand Forks and East Grand Forks, this route became a considered route to establish a "bypass" around the urban core. Using this route as a bypass requires the construction of a bridge over the Red River of the North, which separates Minnesota and North Dakota.

Ongoing studies are considering the improvements necessary to create a continuous "bypass" route along Merrifield Road. These efforts include a new interchange with I-29 and reconstruction of Merrifield Road to accommodate higher traffic volume. In addition, Merrifield Road will be used as the southern levy for the on-going Grand Forks Flood Protection project. This study is part of the larger Merrifield Road "bypass" concept, but focuses near the crossing of the Red River of the North. The purpose of this study includes three main concepts:

1. Identification of the most feasible location and structure type(s) to cross the Red River of the North

2. Identification of option of how to connect Merrifield Road to Polk County Road 58, which runs parallel to the Red River of the North on the eastern bank – this route would be used as a connection to US Highway 2 in order to complete the "bypass" concept

3. Studying possible alternatives to drainage in Cole Creek and Drain #4, which parallels Merrifield Road

1.1 HISTORY OF BYPASS CORRIDOR STUDIES

The communities of Grand Forks, North Dakota and East Grand Forks, Minnesota are connected by three vehicle bridges – all near the urban core. The John F. Kennedy Bridge (U.S. Highway 2), Sorlie Bridge (Business Route 2) and Point Bridge are experiencing increasing levels of congestion - as was identified in the 1970's.

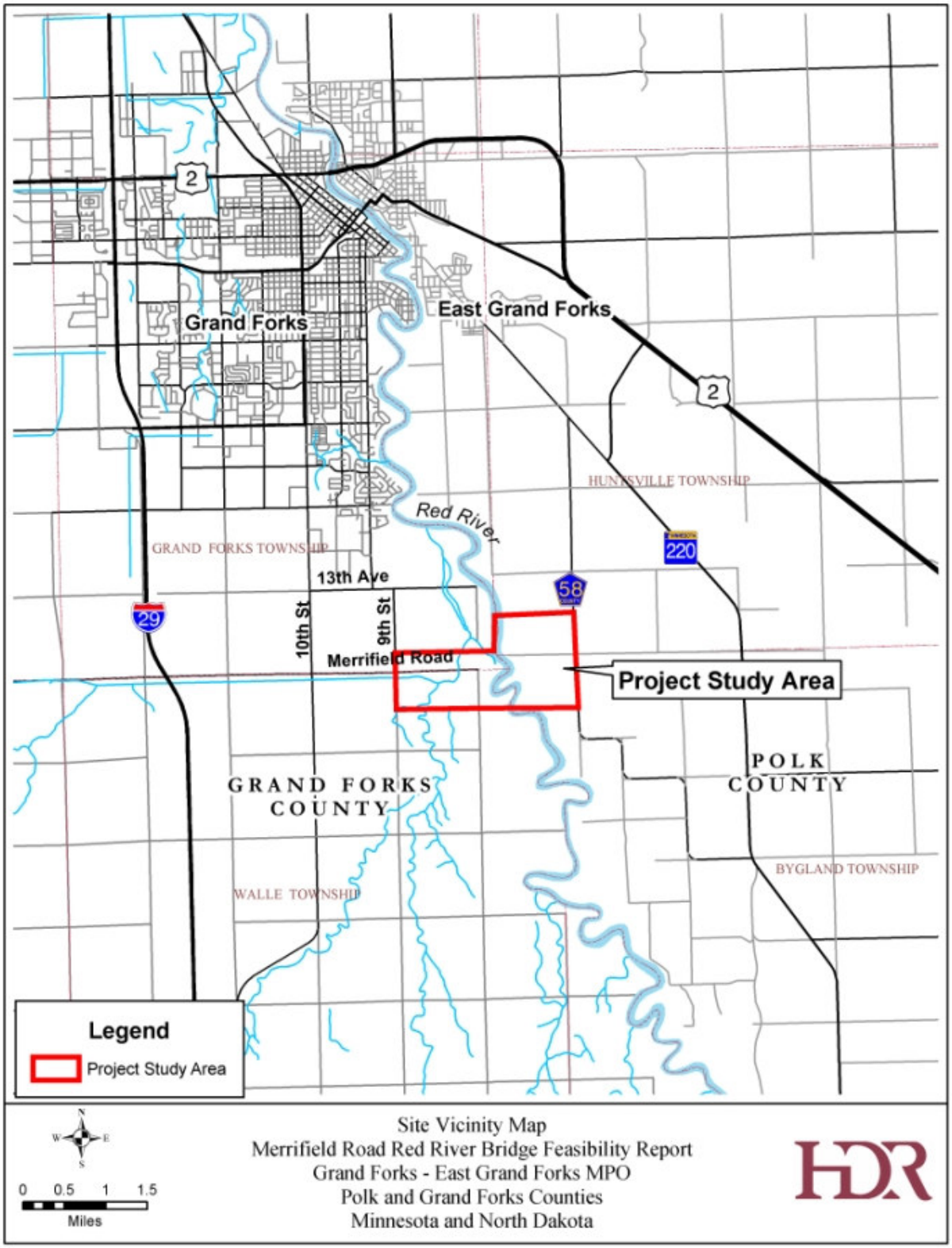
The first known bypass study was conducted in 1979 and focused on creating a new four-lane alignment north of the urban core. This study was never moved forward until 1991 when a second study involving a new Red River crossing was prepared; however, this study only connected to Minnesota Highway 220, which parallels the Red River north of East Grand Forks. In 1996, the Grand Forks – East Grand Forks MPO commissioned the preparation of a study to analyze possible alternatives for a southern bypass. This study resulted in the identification of four possible river crossing locations, as documented in **Table 1-1**.

Table 1-1
Summary of South Bypass Alternatives and Conclusions

Alternative Alignment	Conclusion
Alt A) 32nd Avenue South	Removed from consideration due to development along corridor on North Dakota side
Alt B) 47th Avenue South	Considered to be difficult to construct due to development on North Dakota side and possible connection with I-29
Alt C) 62nd Avenue South	Wetlands impacts considered to make this alternative less attractive when compared to others
Alt D) Merrifield Road	Considered to be best option to serve internal-external trips with relatively low impacts (& has existing overpass at I-29)

Source: Southern Bypass & River Crossing Study Design (Oct. 1996)

When the Grand Forks – East Grand Forks MPO updated the Transportation Plan in 2000, Alternative D (Merrifield Road) was selected as the future southern "bypass" corridor. This concept represented a bypass using largely existing routes of Grand Forks County Road 5 (intersecting U.S. Highway 2 near the Grand Forks Airport), Grand Forks County Road 6 (Merrifield Road – includes interchange with I-29), Polk County Road 58, and Minnesota Highway 220. The new alignment of this corridor was largely in the area of the crossing of the Red River, due to the offset section lines and the lack of an existing bridge crossing. With the latest update to the Long Range Transportation Plan (LRTP), this corridor continues to be identified as the southern bypass; however, a bridge crossing at 32nd Avenue South has been added as an "Intra-city" alternative.


Grand Forks
East Grand Forks
2
2
HUNTSVILLE TOWNSHIP
Red River
GRAND FORKS TOWNSHIP
220
58
29
13th Ave
10th St
9th St
Merrifield Road
Project Study Area
GRAND FORKS COUNTY
POLK COUNTY
BYGLAND TOWNSHIP
WALLE TOWNSHIP
Legend
Project Study Area
N
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S
0 0.5 1 1.5
Miles
Site Vicinity Map
Merrifield Road Red River Bridge Feasibility Report
Grand Forks - East Grand Forks MPO
Polk and Grand Forks Counties
Minnesota and North Dakota
HDR

1.2 STUDY PROCESS

As documented, this study focuses primarily on the crossing and associated approaches of a Red River bridge along the Merrifield Road corridor. However, there are far more complex impacts of a potential river crossing than simply bridge planning and design. This study included other components that are necessary to accompany a new bridge crossing in this location. The general areas covered as part of this study include:

- Environmental Compliance
  - Coordination with proper regulatory agencies
  - Public involvement
  - Prior environmental work in the area (cumulative impacts)
  - Planning & Zoning
  - Environmental documentation required for project advancement

- Hydraulics and Hydrology Impacts
  - Regulatory agency requirements and coordination
  - FEMA floodway mapping
  - Flow impacts of bridge(s)
  - Flow characteristics / benefits / impacts of Cole Creek diversion

- Traffic Characteristics
  - Estimating traffic volume
  - Impacts of I-29 interchange and 32nd Avenue South bridge
  - Roadway capacity requirements

- Roadway Characteristics
  - Development of alignment alternatives
  - Establishment of roadway design criteria and profile

- Earthwork
  - Cole Creek diversion alignment & requirements

- Roadway alignment & requirements

- Bridge Considerations (Elevation, Alignment, Span Length, & Structure Type)
  - Merrifield Road Red River Bridge
  - Merrifield Road over Cole Creek
  - Township Road (8th Street NE) over Cole Creek diversion

- Establishing Project Costs & Benefactors
  - Establishing estimates of probable construction costs
  - Accounting for documentation, design, and inspection costs
  - Separating costs by benefactors (who is responsible)
  - Quantifying project savings
    - Travel time savings
    - Truck savings
    - Flood protection

- Funding
  - Overview of funding source alternatives
  - Recommendations of possible funding sources

2.0 Environmental Impact Assessment

The essence of this task is to equip the Grand Forks – East Grand Forks Metropolitan Planning Organization (MPO) and future jurisdictional agencies with the necessary roadmap to successfully avoid the environmental hang-ups that often plague high visibility projects. This feasibility study focused on the known environmental features that may impact the design decisions or could possibly require significant mitigation. The key to this study was employing a strategy to manage the known features such that all agencies with jurisdiction are identified early and their comments considered as soon as possible.

2.1 AGENCY COORDINATION

HDR prepared letters requesting information on behalf of the MPO in determining the feasibility of constructing a new bridge over the Red River in the Grand Forks – East Grand Forks area. The requested information was specific to identifying sensitive natural resources and potential environmental issues that may be associated with a bridge project in this area. These agencies included:

- Minnesota State Historic Preservation Office (SHPO)
- Minnesota Department of Natural Resources (DNR)
- US Fish and Wildlife Service (USFWS) – Minnesota Threatened and Endangered Species Program
- US Army Corps of Engineers (COE)
- North Dakota Parks and Recreation
- North Dakota State Historic Preservation Office (SHPO)
- US Fish and Wildlife Service (USFWS) – North Dakota Threatened and Endangered Species Program

2.1.1 SHPO

The Minnesota SHPO did not respond. The North Dakota SHPO indicated that two manuscripts, three sites and one lead site are on file for the project area. None of the cultural resources have been evaluated for eligibility for the National Register of Historic Places. The site locations were plotted and all appear to be south of the preliminary alignments.

2.1.2 Mn/DNR

The Minnesota DNR indicated that three are no known occurrences of rare species or natural communities within the area search. They did, however, have a generic concern relative to new bridge construction and the potential impact on mussel resources. This stretch of the Red River has not been surveyed for mussels so it is not clear if a potential impact exists. Therefore, the DNR requested an on-site assessment of the mussel resources at the expense of the proponent, prior to construction.

2.1.3 ND Parks & Recreation

The North Dakota Parks & Recreation is responsible for recreation and biological resources. They indicated that the project would not affect recreational resources they manage and they do not have any information concerning biological resources that may be affected. They did request that any impacted areas be revegetated with species native to the project area.

2.1.4 USFWS

The Minnesota office of the USFWS did not respond but a response was provided by the North Dakota office. The USFWS commented concerning vegetation along the Red River, fish in the Red River, threatened and endangered species and wetland resources. The USFWS noted wetland resources in the project area. The wetland areas were plotted on a map and all appear to be north of the proposed project alignments. The USFWS also noted that the Red River is a popular sport fishery consisting of walleye, northern pike, sauger, and channel catfish. The USFWS requested that the project avoid construction in the channel during April 15 to June 1 to avoid disturbances during the spawning season. This is a common concern for bridge construction and a detailed plan to minimize erosion and sedimentation would be necessary to address agency concerns relative to fish species and what construction activities would need to be limited during the spawning season.

The USFWS also noted that the riparian woodlands associated with the Red River are an important habitat. The project will, similar to wetlands, need to avoid, minimize and mitigate impacts to any riparian woodlands. The USFWS requests to be involved in any mitigation plans and notes that the mitigation fee averages $40,000 per acre. The USFWS, consistent with the Parks and Recreation, requested that all disturbed non-forested upland areas be reseeded with

native grass mixtures. Finally, the USFWS provided a list of threatened and endangered species documented in Grand Forks County but concluded that they are note aware of any species in the project area. A survey for bald eagle nests during the environmental review process would be warranted to confirm this response.

Figure 2-1
Riparian Woods West of the Red River

2.1.5 US Army Corps of Engineers and Coast Guard

The Minnesota office of the COE did not respond but a response was provided by the North Dakota office. The COE indicated that the Red River is a navigable waterway and water of the United States and therefore subject to COE and US Coast Guard jurisdiction. Approvals would be required from both agencies concerning approach and pier fill and construction activities. It does not appear that there is any regular commercial river traffic and so the Coast Guard would not likely dictate any minimum clearances beyond those found with existing bridge structures.

2.2 ENVIRONMENTAL IMPACT REPRESENTATION WITH THE PUBLIC

Staff responsible for consideration of Impact Assessment issues participated in two public meetings. The first public meeting was used to communicate the purpose and need for the project, potential impacts that may be of concern for the public and most importantly identify any unaddressed concerns of the public. The first meeting was held in an open house format which allowed the Impact Assessment staff to interact freely with the public and explain issues typically associated with a bridge crossing. From the first meeting it did not appear that any new issues were raised by the public concerning potential environmental impacts outside of those already identified by the Impact Assessment staff.

The second public meeting was held in a presentation format. At this meeting the Impact Assessment staff summarized identified environmental issues. It was also communicated that while there are environmental features that should be avoided, or mitigated as necessary, there did not appear to be features at this stage in the analysis that would pose a significant barrier to development of the proposed project. No comments from the public were received specific to environmental issues.

2.2.1 Environmental Justice and Local Zoning

The demographics of the public in attendance and for those that reside in the project area would indicate that Environmental Justice considerations should not pose a barrier to this project. The project also appears to be consistent with local plan requirements. Zoning in the project corridor is primarily agricultural with a golf course to the north of the project study area and a residential zone to the south both on the west side of the river. The agricultural zoning allows for the transportation corridor. Indeed, it was noted that at the time of the second public meeting that the City of Grand Forks had placed signs along Merrifield Road informing the public that the road is slated, as found in the MPO plan, as a primary arterial and bridge crossing.

2.3 REVIEW OF PRIOR ENVIRONMENTAL WORK IN THE PROJECT AREA

HDR considered other recent environmental documentation including the General Re-Evaluation Report/EIS issued in November 1998 and the Split Flow Diversion Evaluation issued in January 1998 both prepared by the COE. The documents were reviewed to determine if there was any environmental analysis relevant to this proposed project as both documents discussed flood control projects in the same area as this proposed project. The most relevant statement was found on page C-42 of the Split Flow Diversion Evaluation report which stated that,

> *"Principle natural resources in the area of the proposed diversion channel are fish habitat of the Red River and riparian wildlife corridors of tributary channels."*

This statement was in line with the comments received from state and federal agencies as discussed above.

2.3.1 Cumulative Impacts

Cumulative impacts area also a consideration under the federal National Environmental Policy Act (NEPA) process. Cumulative impacts are defined as…The combined loss of wetlands and riparian resources within the Red River watershed would be good examples of previously impacted resources. Indeed, it is for this reason that the USFWS, COE and DNR identified wetlands, riparian woodlands and fishery resources. Therefore, cumulative impacts can be properly addressed by virtue of a thorough consideration of impacts on each of these resources from this project and any other existing or reasonably foreseeable activity in close proximity.

All of the environmental resources discussed above also took into consideration Cole Creek in addition to the Red River. Cole Creek has experienced a much greater loss of valued habitat than the Red River as agricultural activities are active close to the creek banks upstream of Merrifield Road. Also, urban grassed areas are maintained close to the creek banks downstream of Merrifield Road in the golf course. This is reflected in the fact that none of the agencies contacted identified any valued features in relation to the creek. It is also for this reason that impoundment and diversion of the creek at Merrifield Road is viewed as a viable alternative as part of a formal environmental review.

2.4 SUMMARY OF IMPACT CONSIDERATIONS FOR PROJECT ADVANCEMENT

In summary, the agency responses provide a good list of environmental features that should be avoided or otherwise minimize and mitigate the potential impacts. These features included cultural resource sites, aquatic resources (fish and mussel), wetlands, and riparian woodlands. It appears that the preliminary alignments would avoid wetland and cultural resources. A perpendicular crossing alignment could minimize riparian impacts at the proposed crossing point as compared to other points in the study area (Alignments 1 and 2 appear similar when compared

to Alignment 3). Therefore, the project proponent would need to coordinate with the USFWS to developed an agreed upon method of analysis concerning potential impacts, involve the USFWS in the selection process for proposed alignments, and work with the USFWS to develop an agreeable mitigation plan. A similar process would be needed for consideration of fish and mussel resources with the USFWS and DNR.

The key here is involvement up front and concurrence from the respective agencies on the review approach to ensure an acceptable environmental review process once the project reaches the preliminary design stage. The project will likely require an environmental impact statement due to the involvement of federal funds and the need for federal permits. The lead agency would likely be a state Department of Transportation (DOT) on behalf of the Federal Highway Administration. However, an effective strategy would be to include the COE and the USFWS as cooperating agencies so they are included up front in the development of an agreed upon scope, outline and format. The risk of not securing agency involvement up front is lengthy document rewrites at the end of the process to address these same issues.

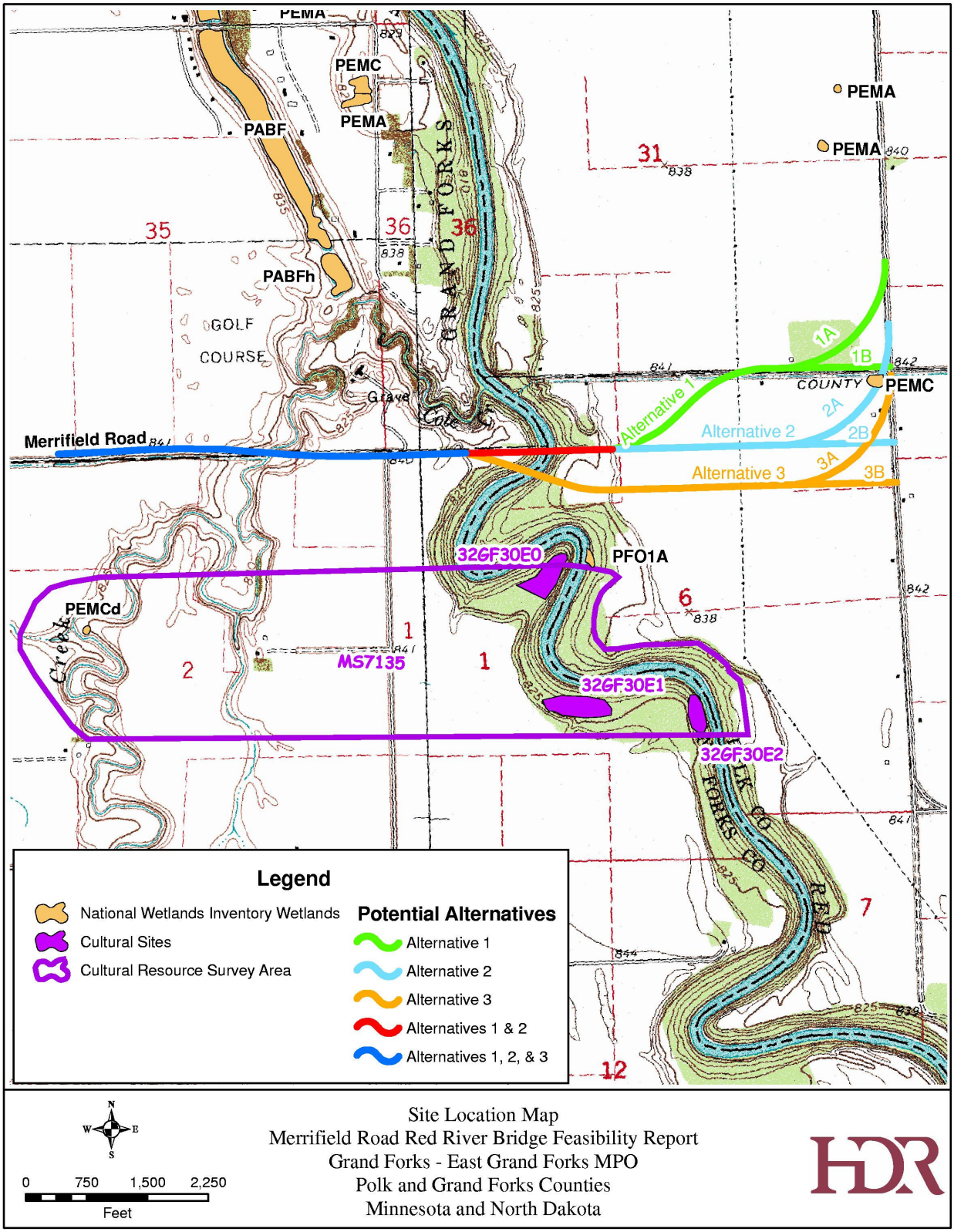
The various alignment alternatives appear to have a definitive impact on right-of-way acquisition needs and construction costs; however, each roadway alignment alterative, as well as the alignment for the potential diversion channel, appears to have similar environmental impacts. The EIS documentation process is lengthy and requires high levels of investment of staff resources. Therefore, it is suggested to consider a tiered EIS approach measuring impacts and costs of alignment options that would be expected to have similar environmental impacts. Once a preferred alignment is selected by the first tier, a second tier of quantifying environmental impacts can be performed at a lower cost than a similar effort for all possible alignment options.

Another important component would be to develop an annotated EIS outline with a clear purpose and need statement that could be used in kick-off meetings for the project with reviewing agencies. Unclear or unsupportable purpose and need statements are often the greatest source of difficulty for environmental reviews that stall out for infrastructure projects. Therefore, ensuring a close review and refinement of the purpose and need up front is time well spent.

Concerning the public, the key will be to develop a consensus with the local stakeholders on key issues that would need to be addressed in an environmental review and standards that lead to

majority support of the project. Many of these issues have been identified during this feasibility study and so the environmental review process could effectively build on the groundwork that has been laid. The environmental process would likely utilize a process similar to that used during the feasibility study but attempt greater level of involvement through the use of newsletters, a web site (required by the DOTs), and possibly a community advisory group.

A summary of the environmental elements that will require further consideration is located in **Figure 2-1** on the following page.



Site Location Map
Merrifield Road Red River Bridge Feasibility Report
Grand Forks - East Grand Forks MPO
Polk and Grand Forks Counties
Minnesota and North Dakota

3.0 Hydraulics and Hydrology

Due to the complexity and importance of hydraulics and hydrology on this study, an independent effort was commissioned to prepare a stand along report documenting the hydraulic elements of this study area. The full report is included in the appendices of this document with an abbreviated version in this section.

The Red River of the North (RRN) has a drainage area of approximately 21,500 square miles at the confluence of the Red Lake River and RRN (approximately 5 miles north of project site). After the 1997 flood, the US Army Corps of Engineers (Corps) prepared extensive detailed hydraulic/hydrologic studies for the design of the GF/EGF Flood Protection Project. The Corps, as part of their GF/EGF studies and the entire RRN basin reevaluation, developed flows and Water Surface Elevations (WSE) for the 10 – 500 year flood events, which have been used in this study. Cole Creek currently drains into the RRN approximately 800 feet north of Merrifield Road and is an intermittent stream with a 226 square mile drainage area, including 36 square miles from Drain No. 4. **Tables 3-1** and **3-2** provide the flow rates for the respective river and creek.

Table 3-1
Red River of the North Flow Rates @ Red Lake River Confluence

Event	Flows
10-year	32,000 cfs
50-year	69,300 cfs
100-year	71,410 cfs
500-year	108,400 cfs

Source: US Army Corps of Engineers

Table 3-2
Cole Creek Flows Near Merrifield Road

Event	Flows
10-year	2,245 cfs
50-year	4,514 cfs
100-year	5,624 cfs
500-year	8,472 cfs

Source: US Army Corps of Engineers

2.5 HYDRAULIC MODELING

Using the HEC-RAS computer modeling program developed by the Hydrological Engineering Center, the Corps has developed a HEC-RAS model for the RRN from Wahpeton, ND to the Canadian Border. As part of the GF/EGF Flood Protection project, the Corp has developed a pre 1997 GF/EGF project conditions and a post GF/EGF flood control completed project HEC-RAS model for the RRN. The Corps HEC-RAS model has two cross-sections near the project site, one approximately 670' (channel distance) north of Merrifield Road (cross section 201) and one 8200' (channel distance) south of Merrifield Road (cross section 202). **Table 3-3** summarizes various WSE's at cross sections 201 and 202 for pre- and post- flood control project.

Table 3-3
Pre- and Post-Flood Protection Project Water Surface Elevations

Event Years	Cross Section 201 North of Merrifield Road		Cross Section 202 South of Merrifield Road	
	Pre Project	Post Project	Pre Project	Post Project
10	826.12	826.08	826.54	826.49
50	834.63	834.46	835.20	835.04
100	837.39	837.08	837.93	837.64
500	842.43	842.85	843.19	843.57

Source: COE GF/EGF Flood Protection HEC-RAS Model

In order to evaluate the hydraulic impacts of a new Red River bridge crossing at Merrifield Road, additional cross sections were added to Corps of Engineers model at proposed alternative crossing locations. For each crossing alternative, WSE's were computed with and without a bridge to determine corresponding stage increases with added cross sections. Added cross sections were based on City of Grand Forks GIS data, supplemental surveys by CPS, Ltd., and Corps of Engineers upstream and downstream river soundings were interpolated to determine channel bottom configurations at new cross sections. **Figure 3-1** graphically illustrates the location of the proposed bridge and RRN cross sections, and **Figure 3-2** depicts an example of a HEC-RAS cross-section showing the proposed bridge.

Figure 3-1
HEC-RAS Model: Confluence of Cole Creek and RRN

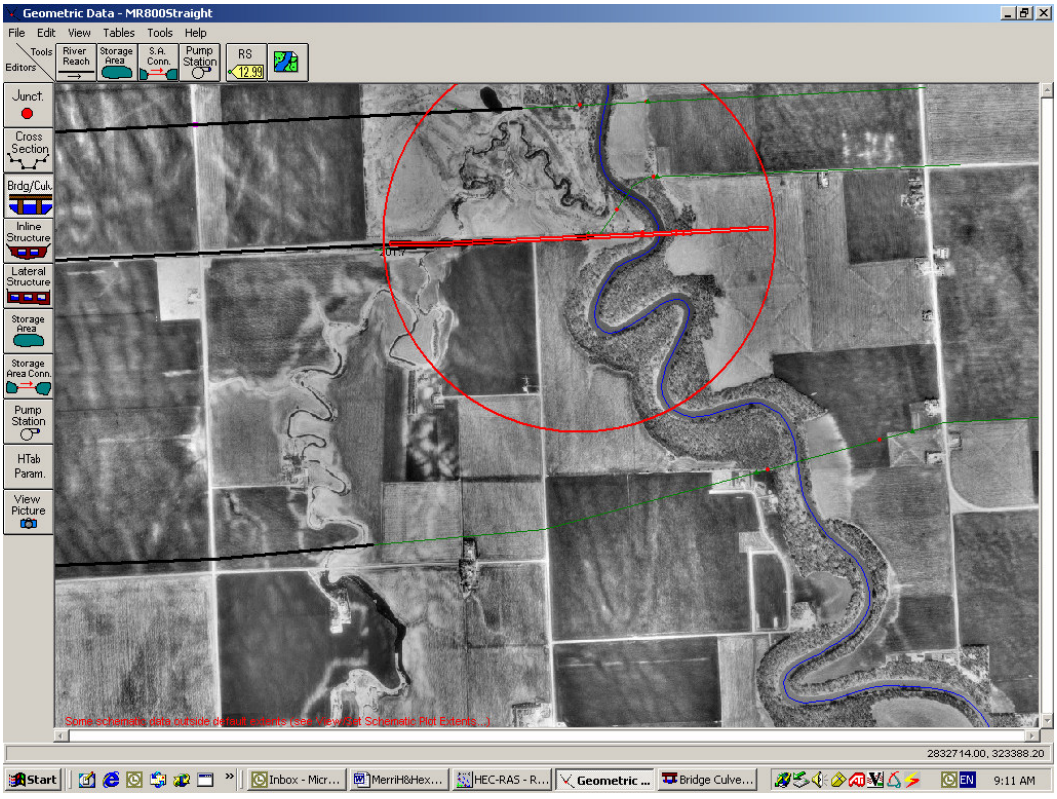
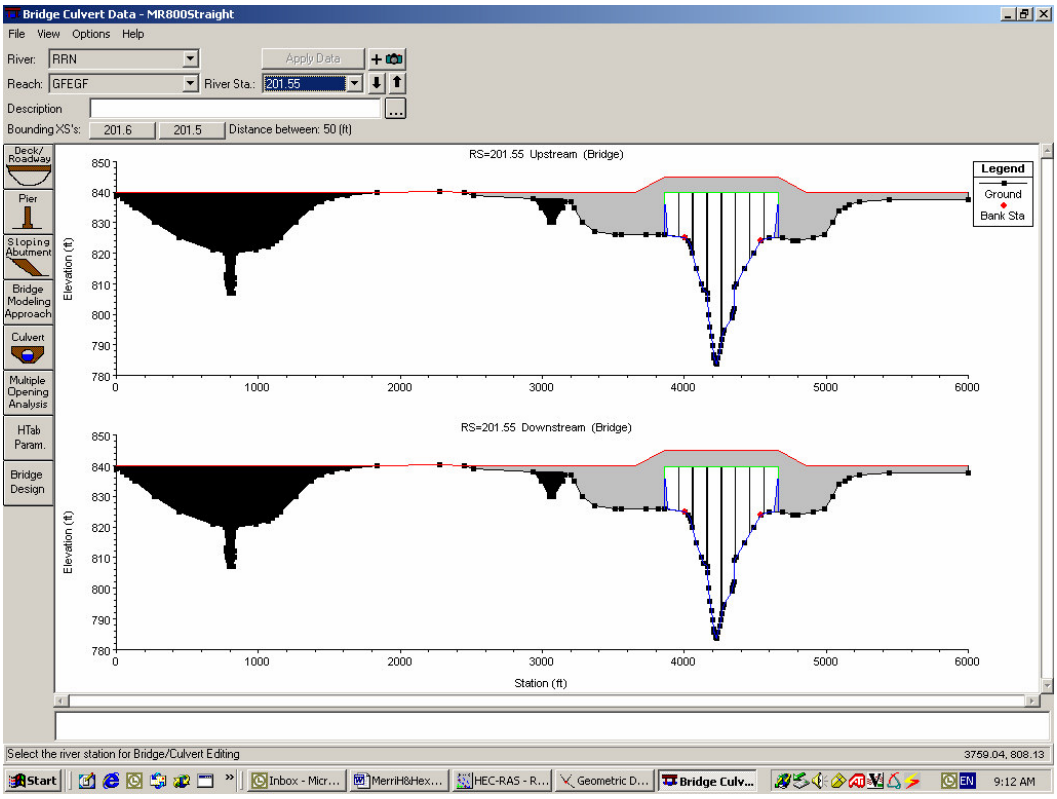


Figure 3-2
HEC-RAS Cross Sections Along Merrifield Road (RRN at Right)



A HEC-RAS model was also developed for the analysis of Cole Creek Diversion alternatives with results shown in **Table 3-4**.

Table 3-4
Cole Creek Existing Conditions at Section 504

Event	Flows	WSE
2 Year	570 cfs	812.90
10 Year	2,245 cfs	817.79
50 Year	4,514 cfs	821.34
100 Year	5,624 cfs	822.15
500 Year	8,472 cfs	823.60

Source: US Army Corps of Engineers

2.6 AGENCY REQUIREMENTS

2.6.1 Minnesota Department of Natural Resources (Mn/DNR)

Mn/DNR allows a maximum stage increase of 0.5 feet for a 100 year event in areas that are not within a FEMA 100 year floodway. No filling that would cause any stage increase are allowed in FEMA floodways.

2.6.2 North Dakota State Water Commission (ND-SWC)

ND-SWC allows a maximum stage increase of 1.0 feet for waterways outside of a FEMA 100 year floodway. No stage increase is allowed within FEMA floodway areas.

2.6.3 Minnesota – North Dakota Boundary Waters

For streams located on the Minnesota / North Dakota border, these two states have generally agreed upon a 0.75 foot maximum allowable stage increase for streams located outside of a FEMA floodway.

2.6.4 FEMA Floodway

The project area is not currently in a designated FEMA floodway. Under the current proposed FEMA Flood Insurance Study (FIS) updates for the RRN floodplain and floodway, FEMA and the Corps of Engineers are proposing to extend the new floodway south of Merrifield Road and possibly all the way to the Thompson Bridge. This study is in progress and may effect the bridge site.

2.7 HYDRAULIC ALTERNATIVES

2.7.1 Red River Crossing Alternatives

Two bridge alternatives were considered in the hydraulic analysis. The first alternative is a perpendicular crossing of the Red River with an 800 foot long - 8 span bridge on a straight east-west Merrifield Road alignment (see Section 8). Whereas, the second alternative is a 20 degree skewed crossing of the Red River with a 920 foot long - 9 span bridge (See Section 8). Both crossing alternatives have a deck elevation of 845.00, a maximum span length of approximately

100 feet and a box girder depth of 45". Computed stage increases at for each of these alternatives has been tabulated in **Table 3-5**:

Table 3-5
Merrifield Road / Red River Crossing: Computed Stage Increases

Flood Frequency (Years)	Stage Increase (Feet)	
	800' Long - 8 Span Bridge Perpendicular Alignment	920' Long - 9 Span Bridge Skewed Alignment
10	0.05 ft	0.02 ft
50	0.13 ft	0.05 ft
100	0.14 ft	0.04 ft
500	0.19 ft	0.11 ft

Source: CPS, Ltd. and HDR Engineering, Inc.

2.7.2 Cole Creek Drainage Alternatives

Cole Creek drainage alternatives have three primary components; 1) location of diversion channel, 2) diversion channel bridge crossing on township road between Cole Creek and the Red River and 3) Merrifield Road crossing of Cole Creek. Two diversion channel locations were considered:

- The first diversion channel alternative is located approximately 1100 feet south of Merrifield Road. This location was selected because it is the shortest distance between Cole Creek and the Red River (2,185 feet) and therefore would require the least amount of excavation (381,000 cubic yards).

- The second diversion channel alternative is located directly south of Merrifield Road. This alternative is being considered because it would require the shortest haul distance for Merrifield Road embankment material and would require less right-of-way than the first alternative. However, it would require more channel excavation (473,000 cubic yards) than the first alternative due to its greater length (2,950 feet).

Based on the HEC-RAS model for Cole Creek and RRN, **Table 3-6** summarizes 10 – 500 WSE for independent flooding events.

Table 3-6
Cole Creek and Red River of the North Water Surface Elevations

Event	Cole Creek – North of Merrifield Road (Section 500)	RRN – North of Merrifield Road (Section 201)
10	816.05	826.08
50	818.74	834.46
100	819.75	837.08
500	821.77	842.85

Source: CPS, Ltd. and HDR Engineering, Inc.

Since the WSE for a 10 year event on the RRN is higher than the 100 year event on Cole Creek, Cole Creek is essentially controlled by backup from the RRN during RRN flooding events. For the diversion channel design at Cole Creek, the design was based on normal flows in the RRN. As a point of reference, the WSE of the RRN was approximately 800.0 feet within the study area.

2.8 HYDRAULICS OBSERVATIONS AND SUMMARY

2.8.1 Red River of the North

Two alternate bridges locations and configurations were modeled crossing the RRN at Merrifield Road. Both alternatives meet the Mn/DNR and ND-SWC maximum allowable stage increase criteria. In general, the length and design of the bridges is more controlled by the physical features of the RRN channel crossing versus the allowable stage increases (hydraulic impact).

The ongoing FEMA/Corps 100 year flood plain study update may place the project area in a FEMA designated floodway. Any new FEMA floodway ordinance adopted by GF/EGF for the RRN should consider a bridge on Merrifield Road and any bridge proposed between the Point Bridge and Merrifield Road (i.e. an Intra-City crossing at 32nd Avenue South).

2.8.2 Cole Creek / Cole Creek Diversion

A review of the four options presented in the full hydraulic report (see appendix) indicate that the WSE's for all 2 year through 500 year events will be less than the WSE's under the Cole baseline condition with the existing Merrifield Road Bridge in place. The Grand Forks County Club has indicated their preferred option includes the smaller 72" RCP under Merrifield Road with the lower flows. Since there are an unlimited number of options for the channel diversion (varying depth, width, flows, bridge height, and slope), the full report includes a summary of the design items common of all options.

2.8.3 Project Summary

Based on the HEC-RAS modeling for the RRN, Cole Creek and the Cole Creek diversion, it appears that either RRN bridge alternate could be constructed within the MN/ND allowable stage increase criteria and that a Cole Creek diversion channel can be designed which will provide the same or lower flooding WSE's on the existing Cole Creek.

3.0 Traffic and Travel Demand

The transportation portion of this study is principally based on estimating how many vehicles would utilize the Merrifield Road Red River crossing on a daily basis. To calculate this value, an established travel demand model for the Grand Forks – East Grand Forks metro area was used and accounted for other projects, including the Merrifield Road interchange with I-29 and the Intra-City crossing at 32nd Avenue South. The outcome of this analysis leads to recommendations for the proper roadway design, access control, and right-of-way preservation.

3.1 PROCEDURE FOR ESTIMATING FUTURE TRAFFIC VOLUME

This corridor falls within the metropolitan limits of Grand Forks – East Grand Forks and is therefore within the modeled limits of the MPO's Travel Demand Model (TDM). This TDM is the basis for determining 20-year (current horizon year is 2027) forecasts within the metro area on routes that are either existing or proposed. In addition, several scenarios can be studied using this model in order to make reasonable estimates and recommendations for future improvements. The model uses socio-economic data to estimate trip generation and assigns trips by route depending on the input parameters. Due to calibration of existing year models, the forecast model is considered to be the most reasonable estimate of future traffic volume. However, as the model is data-intensive, changes made by cities, counties, townships, etc.. from future land use plans can alter the actual traffic generation if the model is not updated to reflect these changes.

The MPO recently updated the entire TDM including verification and calibration of data. Therefore, the use of data from this model is considered to be the best practice for anticipating traffic volume along this corridor.

3.2 FORECAST ADT IN CORRIDOR

Many roadway parameters and design decisions are based on Average Daily Traffic (ADT). This value represents the total number of vehicles that are expected to pass by a certain point along a roadway during a typical 24-hour period. On nearly every roadway, traffic volumes vary based on days of the week and seasonal variations throughout the year. In this report, the term

ADT is used to reflect what is truly the Average Annual Daily Traffic (AADT). No variation has been established to determine seasonal variation, as it is not necessary at this level of planning.

3.2.1 Impact of I-29 Interchange

In 2002, the MPO approved an Interchange Justification Report (IJR) at the crossing of Merrifield Road of I-29. The IJR process is an element required by the Federal Highway Administration to allow access to full-access controlled routes such as Interstate Highways. The process documents the purpose and need, similar to this study, and is focused primarily on preserving the integrity of mainline and ramp operations.

The forecast 2027 no-build (in reference to the I-29 interchange at Merrifield Road) ADT on Merrifield Road east of I-29 is 1,200 (vehicles per day). In contrast, the ADT with an interchange is expected to be near 9,000 at the same location. To the east, this value drops to about 7,000 east of Columbia Road and 2,200 east of Washington Street.

As documented, the interchange at I-29 has a high impact on the ADT within the corridor. In particular, this route as a by-pass of the City relies on it's connectivity with I-29. Since the IJR was approved for this interchange, it was considered a committed project for this study. Therefore, estimates of ADT and other study parameters assumed an interchange at I-29 would be constructed.

3.2.2 Impact of a New Intra-City Red River Crossing

The location of the proposed Merrifield Red River crossing is located south of the current urban fringe, and therefore functions differently than a river crossing would within the current urban area. The desire to provide a new Intra-City crossing has been debated in the metro area for several years, with multiple corridors studied. At the time of the preparation of this report, a new Intra-City bridge is being planned by the Grand Forks – East Grand Forks MPO generally to align with 32nd Avenue South in Grand Forks (approximately three miles north of the Merrifield corridor).

Similar to the I-29 interchange with Merrifield Road, this project was considered to be a possible project and therefore included in the analysis. However, not including the proposed 32nd Avenue

South crossing would only further the documented purpose and need for this river crossing. For example, the anticipated 2027 ADT crossing the Red River on Merrifield Road is approximately 2,000 (vehicles per day). If the 32nd Avenue South bridge were not constructed, this value doubles to 4,000.

Conversely, the associated traffic impacts and design needs of this corridor are very similar between 2,000 and 4,000 vehicles per day. In other words, accounting for a new river crossing at 32nd Avenue South is a conservative assumption, but does not sacrifice the integrity of the roadway design estimates for this corridor. Determination of a river crossing at Merrifield Road being feasible by accounting for the 32nd Avenue South crossing provides assurance that if the 32nd Avenue South crossing were constructed, this crossing would still be justified.

3.3 ROADWAY SECTION

The existing Merrifield Road corridor within North Dakota is typically a paved two-lane (farm to market) roadway, with the exception of the segment between Washington Street and Belmont Road (which remains gravel). The roadway has no shoulders and typically consists of two 12-ft driving lanes. In Minnesota, County Road 58 is typically a paved (concrete) two-lane roadway with two 12-ft driving lanes and limited shoulders. Township Road 810 which is the nearest section line road to the Merrifield Crossing in Minnesota is a typical gravel roadway consisting of one primary lane with adequate room to pass vehicles in opposing directions.

3.3.1 Capacity Analysis

Within the study area, the anticipated 2027 ADT on Merrifield Road is approximately 2,000[1] (vehicles per day). This traffic volume suggests that two through lanes has adequate capacity to allow for LOS C or better operation at peak times. Assuming a typical peak hour fraction of 10% of ADT, and a directional split of 60/40 (i.e. 60% of peak hour traffic is traveling in the peak direction); the functional capacity of the roadway is approximately 6,000 vehicles per day (using the LOS C/D boundary as the index of congestion).

[1] Or 4,000 ADT if a crossing at 32nd Avenue South is not constructed. See previous section for a discussion of the accommodation of an Intra-City crossing.

Balancing the desire for reserve capacity in the roadway with the cost for construction is one of the most often-contested steps in the highway development process. It is not advisable to construct a roadway that has no reserve capacity for several reasons:

- The horizon 20- or 25-year forecasts often are shorter than the actual life cycle of the roadway. Some counties are reporting that the life cycle of some county roads is now up to 75 years due to budget constraints.

- Model estimates are socio-economic / land use based and changes made in zoning or the local economy can dramatically impact travel demand. If the economy is more successful than expected, it is advisable to have some reserve capacity to accommodate the demand.

- Although it is widely accepted by transportation planners that land use creates traffic, and not roads, the construction of new roadways into urbanizing or suburban areas often spurs the reallocation of land use from agricultural to a more dense use (residential or commercial).

Comments received by the public through the series of public meetings had support for constructing this corridor as a four-lane roadway to accommodate growth along the corridor. However, based on the current land use data available, the added construction costs (approximately double) of a four-lane highway do not appear to be justified at this time. Discussion of future expansion is included in the Right-of-Way section.

In addition, the MPO has not identified any potential improvements to Polk County Road 58, which is currently a two-lane highway. Connection of a four-lane facility to a two-lane highway would only be justified if a large traffic demand (generator) existed, or plans were being considered to expand the two-lane facility.

Depending on the development of intersections, it is advisable to consider expansion for left turn lanes where significant volumes of traffic may be turning, or at locations that may become signalized (such as Columbia Road, and Washington Street). The accommodation of left turn lanes at this time is far easier than attempting to fit them in after the major roadway construction

is complete. This recommendation is consistent with the Grand Forks Flood Protection Project, which included provisions for left turn lanes along Merrifield Road.

3.3.2 Access Management

Based on research conducted in the 1980's and 1990's, there is now irrefutable evidence that links the density of access with the safety characteristics of any roadway. Roadways with full access control such as Interstate Highways are the safest in the nation, which have access only every few miles. Conversely, urban arterials with no access control have the highest crash rate (particularly four-lane undivided roadways), as these roads serve the dual function of access and mobility.

Recommendations for access spacing differ depending on the type of facility and location (urban vs. rural). For example, I-29 in rural areas typically has about one access every eight miles. However, through Grand Forks, there are four existing access points (with the addition of Merrifield Road) in about the same area. This reflects the demand and adjacent land use through the urban area. Research conducted in 1998 found that an average value of access density for rural at-grade highways (non-Interstate) is about eight access points per mile[2]. In urban areas, this average value increases to 28 access points per mile. In some cases, well managed urban corridors can keep access to only a few points per mile, whereas unregulated access on routes typically constructed in the 1960's often have more than 100 per mile.

Nearly every agency recommends that the best time to promote access management is prior to the time that any roadway is constructed. Taking of any existing access typically results in a contested process with land owners and public officials disagreeing over what should be done. In Minnesota, the State Supreme Court has ruled[3] that restriction of access is not a compensable damage, as the safety of the public is paramount to accessibility. In North Dakota, similar case law[4] allows the road authority to determine where a landowner may have "free and convenient access to the abutting roadway." In other words, driveway or other access locations can be

[2] Using the Access Inventory Methodology where a full (four-legged) intersection counts as two access points, whereas a "T" (three-legged) intersection counts as one access point.

[3] Dale Properties v. State of Minnesota

[4] Cady v. North Dakota Department of Transportation

regulated by the road authority without compensation to the land owner. In either case, it is in the best interest of the public to purchase the right of access with the roadway construction to (1) set the location of access points and (2) avoid liability claims in the future.

This corridor has been designated a principal arterial route, which has different requirements for access spacing in North Dakota and Minnesota. However, the spacing of access along this route will likely not be a major issue at this time, as the study area is generally comprised of agricultural, recreational, and limited residential land (Polk County only).

Table 4-1
Summary of Access Management Criteria

Minimum Access Spacing	North Dakota: Principal Arterial	Minnesota: Bypass	Minnesota: Urbanizing
Primary Full Movement Intersection	880 feet	1 mile	½ mile
Conditional Secondary Intersection	N/A	½ mile	¼ mile
Signal Spacing	N/A	1 mile	½ mile
Private Access	Permitted	Permitted	By Exception Only

Source: City of Grand Forks Code 18.0907 Section 2(L) and Mn/DOT Category System and Spacing Guidelines

The access spacing criteria used will be a function of how this roadway will be perceived to operate into the future. A true bypass, by Minnesota guidelines, is defined as:

> *…road segments extending through agricultural or forested areas with limited development. It will also be assigned to areas planned as long term low-density exurban areas characterized by scattered large lot residential development and limited commercial and industrial land use. This sub-category is also intended for roadway segments that have been designated (and constructed) as high-speed urban bypasses. Roadways in this sub-category will be expected to operate at higher speeds, typically 50 mph or more.*

The definition of urbanizing area, as defined by Minnesota's guidelines include:

> *…areas outside of urban cores that are either urbanized or planned for urbanization with a full range of urban services, especially with a supporting street network…*

The City of Grand Forks guidelines for access spacing are generally aimed specifically at urbanized areas, as allowing access every 880 feet in rural areas could result in 12 access points per mile (above the existing average of 8). Conversely, the existing land use along this corridor is consistent with the bypass definition rather than the urbanizing area.
It is the opinion of the authors that the City of Grand Forks access code is not applicable in cases such as Merrifield Road that are a rural area with the possibility to maintain access control. Since approximately one-half of the study area is within Minnesota, the use of Mn/DOT's Access Management Guidelines is appropriate for North Dakota.

Since current zoning in Polk County is agricultural, it is not possible to suggest an access spacing scenario different from the bypass guidelines. However, if urbanization occurs along this corridor in Polk County, it is possible to decrease access spacing guidelines. In addition, Polk County is allowed to utilize a separate access spacing guideline, if determined to be applicable. Based on the current and proposed land uses in this corridor, access guidelines suggest:

- Primary (full access) locations should be spaced at ½-mile in North Dakota and 1-mile in Minnesota.

- Secondary (full access) locations may be permitted at ¼-mile spacing in North Dakota and ½-mile in Minnesota, assuming that a risk-analysis is performed based on available gaps. Based on the anticipated ADT in the study area, it is highly likely that access at ¼-mile locations would meet gap acceptance criteria as established by Mn/DOT.

- Private access points are subject to the same criteria as public access points. If possible private access should be limited, but it is understood that most existing access within the study area is private due to the country club and residences east of the river.

3.3.3 Right of Way Preservation

Along Merrifield Road today, the Right of Way (ROW) consists of an owned 66-ft section centered on the section line, with a dedication of 100-ft. Along Township Road 810 east of the river, a 66-ft section centered on the section line exists. This increases to 120-ft along Polk County Road 58, which is also centered on the section line.

The appropriate ROW preservation for this corridor is dictated by MPO guidance, which uses a value of 140 feet for urban and exurban principal arterial routes. A preservation of 140 feet will accommodate the anticipated two-lane section with 10-ft paved shoulders with a rural drainage section (in addition to a shared use trail, if desired). In addition, a 140-ft corridor can accommodate a future four-lane divided or urban five-lane section if demand is present; however, this would likely require an urban cross section.

3.3.4 FEMA Flood Plain Impacts

As outlined in the hydraulic study, the designated FEMA floodway is 300 feet for areas within the City, which are not on the official FEMA floodway map. As discussed with Bev Collings, Grand Forks Building and Zoning Administrator, this designation ends at 62nd Avenue South at the subdivisions that have been annexed into the City limits. This project area is not currently in a designated FEMA floodway. Under the current proposed FEMA Flood Insurance Study (FIS) update for the RRN floodplain and floodway, FEMA and the Corps are proposing to extend a new calculated floodway south of Merrifield Road and possibly all the way to the Thompson bridge. This study is currently in progress and any floodway changes adopted will affect the bridge site and should be considered at the time any floodway ordinance changes are proposed.

4.0 Roadway Design and Earthwork

Construction of a new roadway and potentially a diversion channel would require a high effort of earthwork and associated grading. Due to the magnitude of the quantities of this potential project, it was important to develop an accurate estimate of earthwork quantities and roadway characteristics. This section documents the roadway alignment alternatives that were analyzed as part of this study, the Cole Creek Diversion channel alternatives analyzed as part of this study, and the associated earthwork for each.

4.1 ROADWAY ALIGNMENT ALTERNATIVES

Three river crossing alignment alternatives were developed to connect Merrifield Road in North Dakota to Polk County Road 58 in Minnesota. They are documented in **Figure 5-1** and documented below:

- **Alternative 1:** This Alternative departs existing Merrifield Road near the existing Cole Creek crossing. It parallels Merrifield Road approximately 90 feet to the south as it continues eastward. This alignment crosses the Red River approximately perpendicular near an existing narrow point of the riparian area along the river. Once across the river, two reverse curves align this alternative onto the existing township road on the Minnesota side.

- **Alternative 2:** This Alternative is similar to Alternative 1 except that the alignment continues straight east (on a new alignment) once across the river instead of aligning on the township road.

- **Alternative 3**: This Alternative begins (to the west) similar to Alternatives 1 and 2. As this Alternative approaches the river on the west, it turns 20-degrees to the south and crosses the river at an approximate 20-degree angle. Once across the river, the alignment turns eastward to County Road 58.

4.1.1 Roadway Design Criteria

At the concept level of this study, it is not necessary nor advisable to go to a level of detail that is beyond this feasibility level. However, due to the need to obtain accurate estimates of earthwork quantities, several assumptions were made as to the likely design elements of this potential future roadway. These estimates are similar with current design practices of the North Dakota Department of Transportation and the Minnesota Department of Transportation's guidelines for State-Aid rural highways. These elements are documented in **Table 5-1**.

Table 5-1
Assumed Roadway Design Criteria

Element	Criterion Used	Notes
Lane Width	12 feet	
Shoulder Width	8 feet	
Ped / Bike Trail	10 feet	North of Roadway
Minimum Design Speed	60 MPH	
Superelevation Rate	6%	Plus Transition from Left to Right

Source: HDR Engineering, Inc.

4.1.2 Roadway Profile

A specific profile was developed for each alternative. Since all the alternatives have the same point of origin on Merrifield Road, each has the same begin elevation on the west end. The assumed elevation at the east end of each alternative was 842.0 for all three alternatives even though all three alternatives tie to County Road 58 at different points. The roadway profiles for each alternative are documented in **Figures 5-2** through **5-4**.

The profile high point was set such that the bottom of the proposed bridge would be at least at elevation 840.0. This results in relatively flat grades generally between 0.10 to 0.15 percent range, but this is consistent with the topographical nature of the route. However, the normal cross slopes of the roadway (assumed 2.1 percent) should provide adequate pavement drainage for this roadway as it is anticipated to have a rural cross section.

4.2 COLE CREEK DIVERSION CHANNEL ALTERNATIVES

Two diversion channel alignments were studied to connect Cole Creek to the Red River. The potential alignment, profile, and typical section are documented in **Figures 5-5** through **5-10** and described below.

- **Alternative 1:** This alternative connects the farthest east oxbow of Cole Creek to the farthest west oxbow of the Red River. This creates the shortest possible channel length between Cole Creek and the Red River, or about 2,185 feet. This alignment is approximately 1,100 feet south of existing Merrifield Road.

- **Alternative 2:** This alternative runs along the south edge of the proposed river crossing connection between Cole Creek and the Red River. This alignment is approximately 250 feet south of existing Merrifield Road. This alternative is approximately 2,950 feet in length, or about 750-feet longer than Alternative 1.

Each alternative assumes the west end elevation (inlet) of 813.0 and an east end elevation (outlet) of 810.0 (plus an associated drop structure to the Red River). The grades of each channel are different due to the difference in the length of the channel under each alternative. Each channel assumed an 80-foot wide flat bottom with 1:5 sideslopes.

4.3 EARTHWORK CALCULATIONS

Earthwork estimated quantities were generated for each roadway and diversion channel alternative. An existing (surveyed) ground surface was available on the North Dakota side of the river but not for the Minnesota side, where existing contours were approximated from USGS Contour Maps.

4.3.1 Earthwork Quantities: North Dakota Roadway Alignment

GEOPAK software was used to generate cross sections for both diversion channel alternatives and for the three roadway alternatives on the North Dakota side of the river. From these cross sections, earthwork numbers could be generated using the average end area method.

4.3.2 Earthwork Quantities: Minnesota Roadway Alignment

As a result of using USGS data on the Minnesota side, it was determined that GEOPAK would not be an appropriate tool to measure earthwork quantities east of the Red River. Therefore, stations were determined where the roadway alignments intersected the existing contours to develop an existing ground profile. The elevation difference between the proposed and existing profiles was calculated every 50-feet along the alignment before an average elevation difference was calculated. A typical section was drawn assuming this average elevation difference and that the existing ground is generally flat. The resultant cross sectional area was then multiplied by the length of the alignment to determine the volume of earthwork necessary for the Minnesota side of the river.

4.3.3 Earthwork Quantities: Cole Creek Diversion

GEOPAK software was again used to develop the quantity estimates for the Cole Creek Diversion, as an existing ground surface profile was available for the entire area considered for the diversion channel.

An option that was considered by the hydraulics study was the use of a pilot channel in the diversion channel. The pilot channel was assumed be five feet below the surface of the original channel that was modeled in GEOPAK. It was also assumed to have a 10-ft flat bottom with 1:5 sideslopes back to the bottom of the original channel. This would leave a 10-ft bench on each side of the original channel. Since this cross sectional area is constant, the additional earthwork for the pilot channel option was determined by multiplying by the length of each of the diversion channel alternatives.

4.3.4 Earthwork Summary

The Earthwork for all studied roadway and diversion channel alternatives is summarized in **Table 5-2**. All embankment numbers were multiplied by 20% to account for typical compaction. All excavation numbers represent the excavated volume of the material from its original position. Earthwork volumes do not account for topsoil stripping or placement. Additional information regarding the earthwork volume calculations can be found in the appendix.

Table 5-2
Estimated Earthwork Quantities

Alternative	Length	Embankment (+) Excavation (-)
Roadway #1 (ND Side)	4,500 feet	+ 320,000 CY
Roadway #1 (MN Side)	4,100 feet	+130,000 CY
Roadway #2 (ND Side)	4,500 feet	+320,000 CY
Roadway #2 (MN Side)	3,900 feet	+210,000 CY
Roadway #3 (ND Side)	4,200 feet	+280,000 CY
Roadway #3 (MN Side)	4,100 feet	+230,000 CY
Diversion Channel #1	2,185 feet	-381,000 CY
Diversion #1 w/Pilot Channel	2,185 feet	-395,000 CY
Diversion Channel #2	2,950 feet	-473,000 CY
Diversion #2 w/Pilot Channel	2,950 feet	-492,000 CY

Source: HDR Engineering, Inc.

The GEOPAK generated earthwork volumes can be considered at a design-level of accuracy, as they reflect both the existing and proposed ground lines and are comparable. The estimated volumes on the Minnesota side of the river represent a level of accuracy more consistent with typical feasibility studies, Project Concept Reports, or concept design.

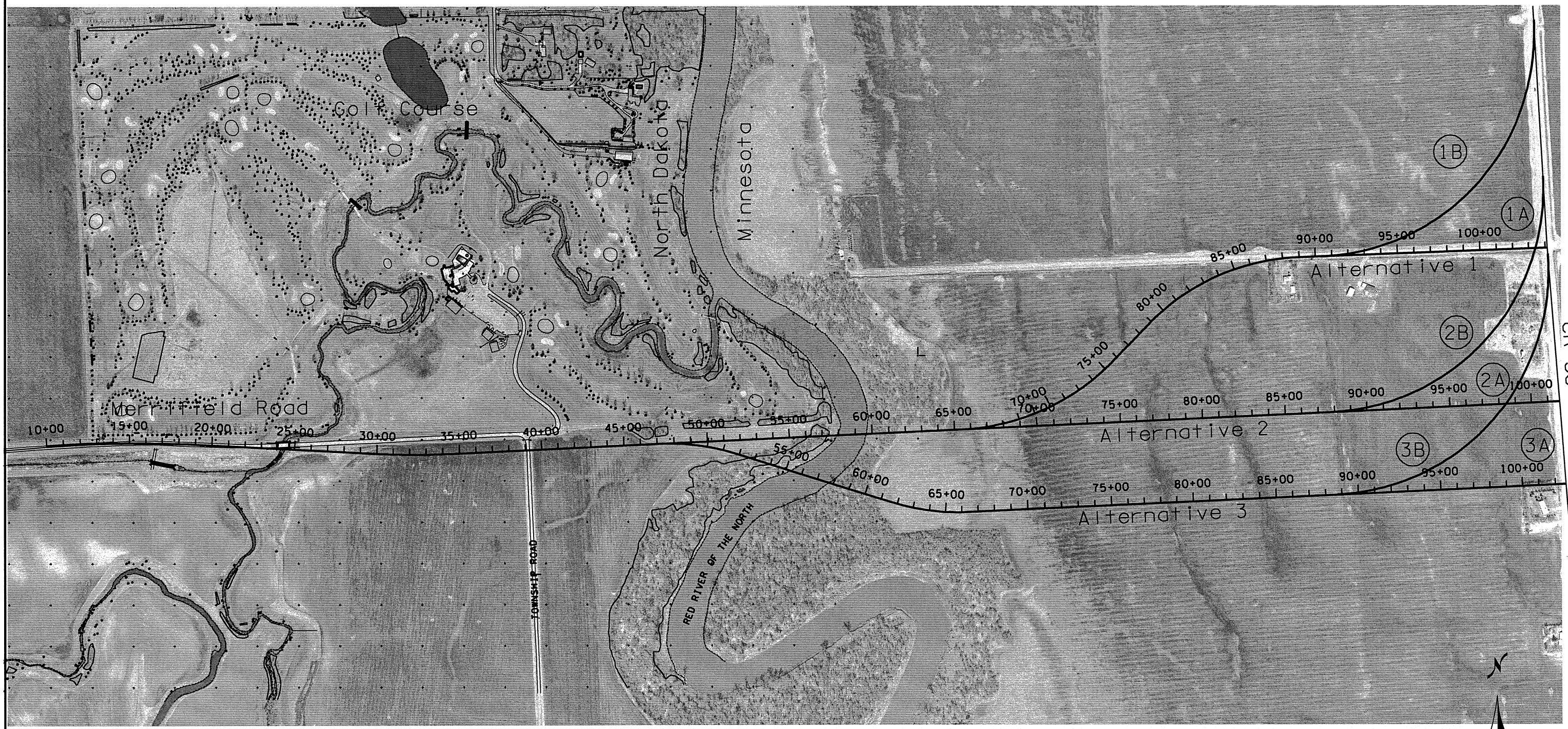
There are other items that should be noted with each alternative. For example, Alternative 1 requires the longest length, however the total earthwork suggests it needs the least amount of roadway embankment. This alignment does use a portion of the existing township road. The profile comparison is from the centerline of both the proposed and existing profiles. Therefore the existing ground for this common part of the township road assumes that the ground is flat from the center of this road (which may not be valid). The cross section of the township road is narrower than the proposed roadway with steep ditches and the fields lower than the roadway elevation. Therefore, additional embankment would be required and the earthwork volume using this methodology is not as accurate.

Some savings should be expected from using an existing alignment but not to the degree as determined by this analysis. Since the alignment lengths are roughly the same, the earthwork

volumes would be roughly the same as well. Therefore, the roadway embankment volume would not be a factor in determining the preferred roadway alignment alternative.

The most important conclusion from these analyses is that any of the diversion channel alternatives will provide an excess of excavation material. The Merrifield Road embankment on the North Dakota side of the river will use most but not all of this material. The Merrifield Road profile could be raised to create a better earthwork balance on the North Dakota side of the river, since it is likely that the excess material would not be used on the Minnesota side of the river. The nearest bridge crossing in Thompson would result in an approximate 18 mile haul route. Depending on the contract bid, this is likely outside the limit of economic haul.[5] The East Grand Forks Hartsville Flood Control project will have a substantial amount of excess excavation. This excess material will likely be stockpiled adjacent to the Hartsville Diversion. This material could potentially be used for road embankment material and would require an average haul of approximately three (3) miles.

[5] In the winter of 2003-04, Zavoral and Sons contractors used a haul route over the then-frozen Red Lake River to minimize the haul route. During this study process, CPS contacted this contractor to determine if a similar approach could be used in this case. It was determined jointly that the Merrifield Corridor would not be as feasible as the Red Lake River in East Grand Forks to use as a winter haul route. This is based on the ice cover & water depth in the Red River as well as steeper slopes to gain access to the river. Therefore, a winter haul route was not considered to be feasible.



DRAWN BY: _____
DESIGNED BY: _____

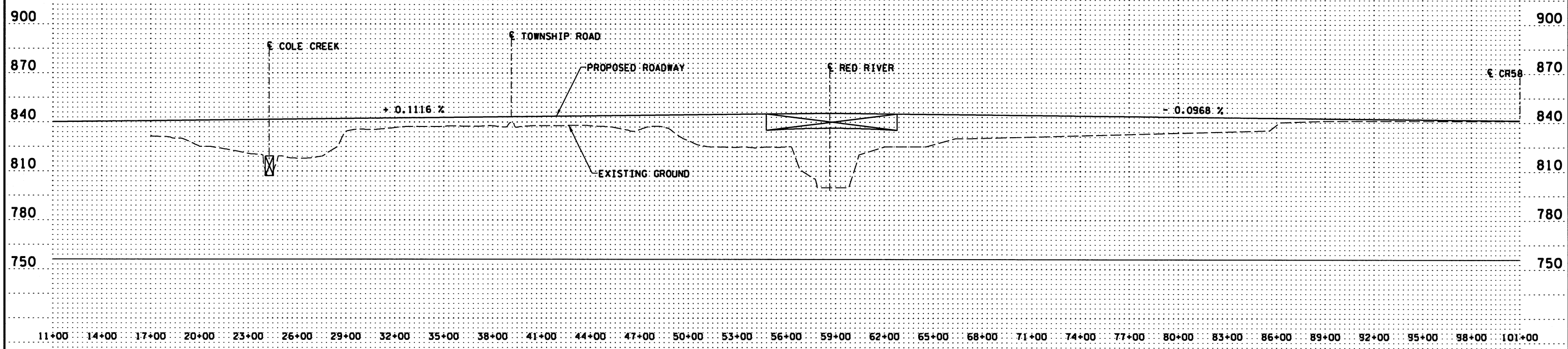
I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota.

Signature: Date:

HDR

ROADWAY ALIGNMENT ALTERNATIVES

MERRIFIELD ROAD FEASIBILITY STUDY — FIGURE 5-1



DRAWN BY: _____

DESIGNED BY: _____

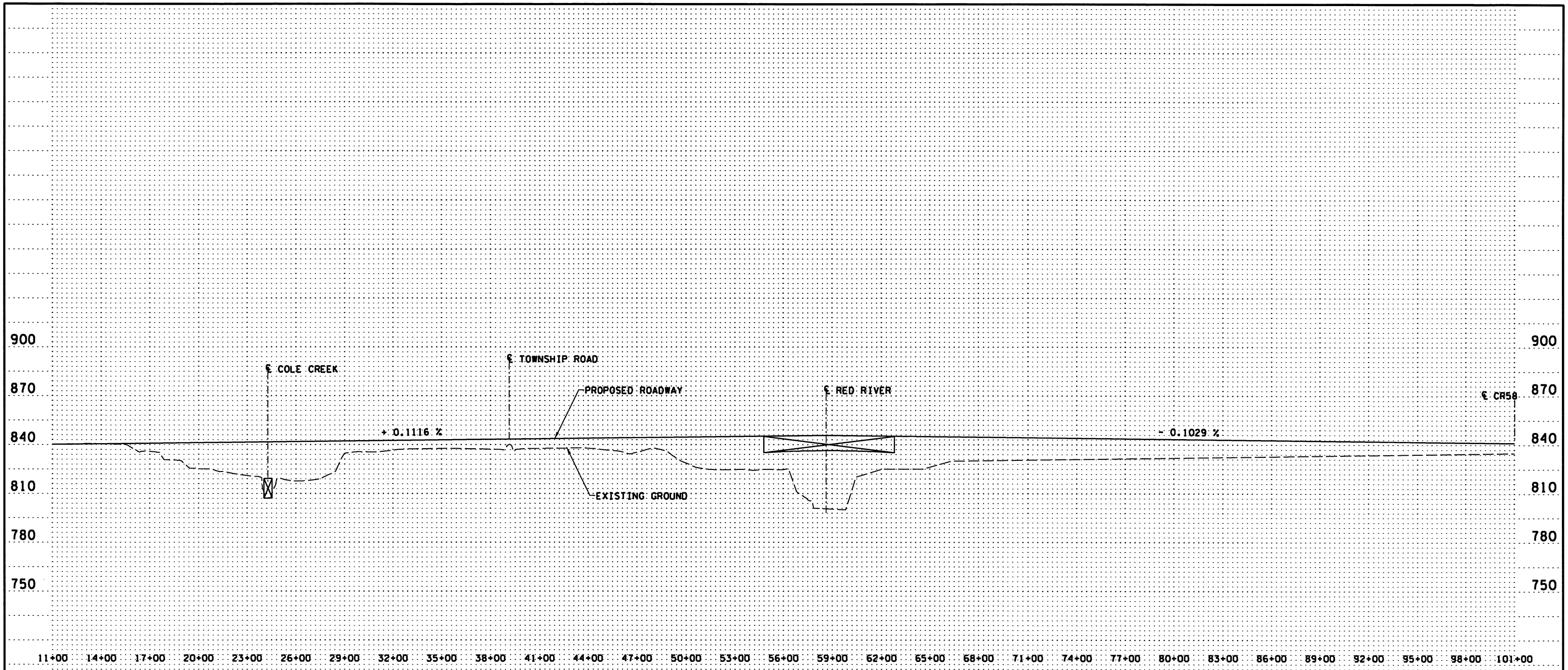
I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota.

Signature: Date:

HDR

ROADWAY ALTERNATIVE 1 PROFILE

MERRIFIELD ROAD FEASIBILITY STUDY — FIGURE 5-2



DRAWN BY: _____

DESIGNED BY: _____

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota.

Signature: _____ Date: _____

HDR

ROADWAY ALTERNATIVE 2 PROFILE

MERRIFIELD ROAD FEASIBILITY STUDY — FIGURE 5-7