

2.0 ROUTE SELECTION AND ALTERNATIVES ANALYSIS

A rational and defensible route selection process for new pipeline facilities involves consideration of environmental, engineering, and economic factors in a multi-disciplinary and iterative fashion. Enbridge currently operates continuous pipeline facilities across North America. This system provides for a relatively direct route to transport petroleum between production areas and markets. The Enbridge pipeline system provides significant opportunities for collocating and using existing right-of-way for the planned capacity expansion projects.

The Applicants studied a variety of alternatives for routing. These alternatives consist of system alternatives, route alternatives, and route variations. The Applicants evaluated and compared several factors, including the ability to meet project objectives, technical and economic feasibility, and potential environmental impacts for each alternative. The following sections describe the Applicants' process for selecting the project route and provide an analysis of alternatives.

2.1 SYSTEM ALTERNATIVES

System alternatives are options to the proposed action that would make use of other existing or proposed pipeline or transportation systems to meet the stated objectives of the project.

Alberta Clipper Project

Enbridge investigated a number of alternatives before determining that the Project was the most economic and feasible expansion available to industry to provide flexible and scaleable incremental capacity out of the WCSB and into the U.S. Midwest markets. In the past, Enbridge expansions have been significantly less substantial capacity increases and traditional pipeline alternatives such as pipeline looping and the addition of horsepower at existing and new intermediate stations were studied in great detail. Due to the substantial increase in the forecasted throughput as proposed by this Project, coupled with the fact that the existing system is at or near capacity, such alternatives were eliminated from detailed analysis as capacity increases from such programs were deemed insufficient. Therefore, Enbridge limited its consideration to alternatives of varying line dimensions (diameter), other projects under development and alternate transportation modes.

The TransCanada Keystone Pipeline, LLC (Keystone) is proposing the construction of a new, 1,833-mile-long pipeline from Alberta, through North Dakota, South Dakota and on to Patoka, Illinois. The Keystone Pipeline is not a viable system alternative because it would not connect to the Minnesota, Wisconsin, and greater Chicago area markets that the Enbridge Mainline System serves.

No other existing pipeline systems provide delivery between Hardisty, Alberta and Superior, Wisconsin. Any other pipeline system would require entirely new right-of-way as well as new pump station sites, power supplies, valve sites and potential access roads, whereas the Enbridge system enables collocation and use of existing infrastructure. Therefore, it is not advantageous to consider a greenfield pipeline to achieve the objectives of the project. Using the existing infrastructure as a basis for comparison, the Applicants evaluated the following possible system alternatives:

- expanding Enbridge's pipeline system by constructing additional pump stations that provide additional horsepower, and constructing additional loops to the existing mainlines along the existing route;
- truck delivery of petroleum supplies from Canada to Superior, Wisconsin.

Southern Lights Diluent Project

The applicant has considered alternatives to the Southern Lights Diluent Project with the objective of providing economical and reliable access to diluent material to meet growing demand in Alberta. Specifically, the applicant is responding to this industry interest within the context of a) responding to the oil sands producers' request to access light hydrocarbon liquids in the Chicago area, b) utilizing existing pipeline assets to the extent feasible to minimize the impact of pipeline construction on the environment, communities and landowners along the right-of-way, c) identifying the available diluent supply in the Chicago region as being sufficient and competitively priced to be utilized in the oil sands projects, and d) meeting shipper requirements and industry need in a timely manner.

The applicant identified and proposed to Canadian producers an opportunity to reverse an existing Enbridge crude oil pipeline that originates in Edmonton, Alberta and now terminates in Clearbrook, Minnesota into diluent delivery service. Thus the optimum pipeline solution for delivery of diluent from Chicago and the wider Midwest to reach this existing pipe segment at Clearbrook became the focus for screening pipeline alternatives. Based on these considerations, the following alternatives for diluent delivery were considered:

- expanding Enbridge's pipeline system by reversing an existing line from Chicago to Clearbrook, constructing additional pump stations that provide additional horsepower, and constructing additional loops to the existing mainlines along the existing route; and
- truck delivery of diluent supplies from Chicago to Clearbrook.

2.1.1 Expanding Existing Enbridge Facilities

Alberta Clipper Project

In the United States, the Enbridge corridor consists of five pipelines from the United States-Canada border near Neche, North Dakota to the Clearbrook, Minnesota tankage terminal, and four pipelines from Clearbrook, Minnesota to the Superior, Wisconsin tankage facility. This Enbridge system does not contain any discrete pipe segments (loops). Adding new looping was found to be inadequate as a new continuous line for petroleum is needed. However, if looping was feasible to ship product, the operation and maintenance costs associated with additional pump stations and horsepower would not be cost effective. Due to these factors, expansion of existing facilities was not considered in evaluating potential options. The alternatives would not meet the objective of expanding current delivery capacity of Canadian petroleum to customers receiving service from Enbridge's Superior, Wisconsin tankage facility. Additional take-away capacity at the Superior, Wisconsin tankage terminal would not be realized by these alternatives.

Southern Lights Diluent Project

The Enbridge system does not contain any discrete pipe segments (loops). Adding new looping was found to be inadequate as a new continuous line for diluent product is needed. However, if looping was feasible to ship diluent, the operation and maintenance costs associated with additional pump stations and horsepower would not be cost effective. Due to these factors, expansion of existing facilities was not considered in evaluating potential options. The alternatives would not meet the objective of initiating delivery of diluent to Canadian crude oil producers in need of receiving service from United States refineries. Use and recycling of this diluent product would not be realized by these alternatives.

2.1.2 Trucking

Alberta Clipper Project

As an alternative to the Alberta Clipper Project, the Applicants could potentially transport petroleum supplies from its Cromer, Manitoba facility to the Superior, Wisconsin tankage facility by truck. This alternative is, however, characterized by higher public safety and environmental risk, unreasonable logistics, and higher incremental cost. Accident data consistently illustrate that pipelines are the safest form of transportation for bulk liquids, including petroleum. The safety risk is magnified significantly by the impact created by increased truck traffic on Minnesota highway routes. A typical truck transport would carry 150 bbls of petroleum. Truck frequency for 450,000 bpd on a per annum basis would require 3,000 trucks (assuming 1 load per day per truck) between Cromer, Manitoba and Superior, Wisconsin. The trucks would primarily use U.S. Highway 59 in northern Minnesota and U.S. Highway 2 across northern Minnesota which already carries a significant burden of commercial traffic. Collectively, this alternative would add 585,825,000 miles per year of additional truck traffic to Minnesota highways, and the trucks would consume approximately 117,165,000 gallons of fuel per year. Finally, the estimated trucking costs that incorporate operation and maintenance along with average fuels costs is greater than the existing alternative, which is the primary reason trucking currently is not used to move petroleum. The safety and environmental risks, logistical requirements, and high cost eliminate the trucking option as a viable alternative.

Southern Lights Diluent Project

With the trucking alternative applied to the Southern Lights Diluent Project, the Applicants could also potentially transport diluent supplies from its Superior, WI tankage facility to the Clearbrook, tank facility as a receipt point for transport through the Southern Lights Reversal Project. This alternative would also be characterized by the negative aspects discussed above. For this alternative a typical truck transport would carry 150 bbls of diluent product. Truck frequency for 180,000 bpd on a per annum basis would require 600 trucks (assuming 2 loads per day per truck) between Superior and Clearbrook. The trucks would primarily use U.S. Highway 2 across east-central Minnesota which already carries a significant burden of commercial traffic. Collectively, this alternative would add 43,362,000 miles per year of additional truck traffic to Minnesota highways, and the trucks would consume approximately 8,672,400 gallons of fuel per year. As above, the estimated trucking costs that incorporate operation and maintenance along with average fuels costs is greater than the existing alternative, which is the primary reason trucking currently is not used to move petroleum products significant distances. The safety and environmental risks, logistical requirements, and high cost eliminate the trucking option as a viable alternative.

2.2 ROUTE ALTERNATIVES

The Applicants conducted extensive surveys and research to identify the optimal route for the project. Typically, the safest and least environmentally damaging route is within an existing right-of-way. Enbridge's Lakehead pipeline system provides some opportunities to use existing right-of-way and significant opportunities for collocation with the project. Maximizing use of this Enbridge right-of-way for the project will decrease both environmental and land acquisition costs. However, in some cases, it may be advantageous to deviate from an existing right-of-way in congested or environmentally sensitive areas. These locations represent approximately 5.3 miles of deviations from the Enbridge right-of-way. Of these, approximately 1.7 miles occur in locations directly adjacent to the Applicants' Southern Lights 20-inch Crude Line, or "LSr Project" (MN PUC Docket No. PL9/PPL-07-360) between the Minnesota/North Dakota border in Kittson County and Clearbrook, Minnesota. None of the alternatives were adopted as the preferred route.

The Applicants identified and evaluated several options for routing its projects. These studies were designed to define a pipeline route that achieves respective project objectives, is technologically and economically feasible to construct, and minimizes impacts on landowners and the environment. The following sections provide a general discussion of the route selection process, an analysis of the various route alternatives evaluated for the projects, and a detailed comparison of minor route alternatives.

2.2.1 Initial Route Selection Process

During initial route studies, the Applicants determined that the projects should parallel its existing system from Neche, North Dakota to Superior, Wisconsin. However, this Enbridge right-of-way already contains multiple pipelines and in some instances, crossings, workspace, or right-of-way is constrained by the presence and proximity of these multiple existing pipelines. The Applicants assessed the route from Neche, North Dakota to Superior, Wisconsin with the intent of maximizing the Enbridge right-of-way to the extent feasible while identifying specific areas where collocation may not be feasible. The locations where it may not be feasible to use or place the pipelines adjacent to Enbridge right-of-way due to corridor congestion are discussed below. For environmental review purposes in support of this environmental assessment the Applicants analyzed environmental data and the proposed route based on the assumption that the previously proposed LSr Project would be present from the North Dakota/Minnesota border to Clearbrook, Minnesota. Descriptions of each alternative where applicable are noted below with comparisons of an alternative route option that would be placed adjacent to the northernmost existing Enbridge pipeline (see section 2.2.3).

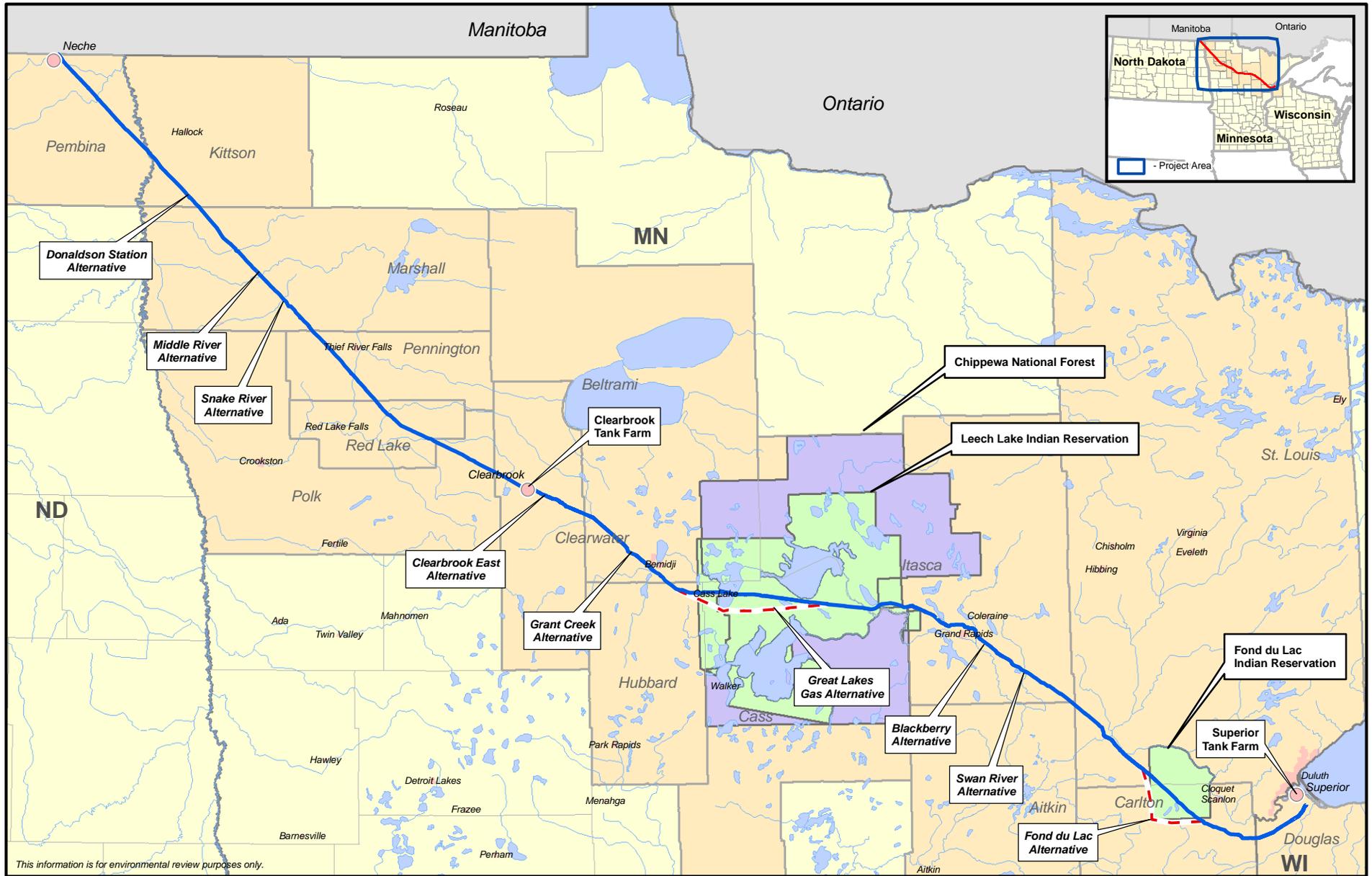
The first step in the route selection process consisted of collecting publicly available environmental data to identify routing constraints. The sources of data consisted primarily of Geographic Information Systems (GIS) digital information layers including U.S. Geological Survey (USGS) topographic maps; USGS land use database; U.S. Department of Agriculture (USDA) Farm Services Agency 2003 and 2005 aerial photography; National Wetlands Inventory (NWI) maps; Minnesota Department of Natural Resources (MNDNR) county biological survey maps; MNDNR Natural Heritage information System database; Minnesota Department of Transportation (MDOT) highway maps; USDA state soil geographic (STATSCO and SSURGO) databases; and other natural feature databases obtained from the "data deli" on the MNDNR website. The Applicants also consulted with the MNDNR to identify other environmental routing constraints that may not be included in these publicly available data.

The next step involved mapping selected layers of the collected GIS data on 1:24,000-scale USGS topographic maps to identify the locations of environmental constraints within the study area. Existing major utility rights-of-way also were identified for potential use in collocation.

Collocating the projects with the Enbridge right-of-way, generally on the southern/western edge of the right-of-way, between Neche and Superior was determined to be the initial proposed route.

2.2.2 Refined Route Selection Process

The Applicants conducted a number of route reconnaissance efforts to further examine specific areas of concern identified during the desktop review. During the field review, the route was examined and adjustments were made to avoid or minimize potential impacts on sensitive environmental features, adjust for preferred construction alignment, or to accommodate landowner concerns. Further refinement of the route was completed as detailed engineering design efforts led to the identification of specific facility modifications or additions. Enbridge's existing pipeline right-of-way provides for collocation and, in some cases, the opportunity to use existing right-of-way. However, in some locations it may not be feasible to use existing right-of-way because of congestion, poor crossing conditions, or other constraints on the existing right-of-way. The Applicants completed the route refinement process after engineering, environmental, and landowner issues were identified and addressed. The following sections describe the major and minor route alternatives identified as a result of these efforts (see figure 2.2.2-1). For environmental review purposes in support of this environmental assessment the analysis of environmental data includes both projects as they will be co-constructed south of Clearbrook. As stated in section 2.2.1, environmental review north of Clearbrook was performed based on the assumption that the previously proposed LSr Project would be present between the North Dakota/Minnesota border and Clearbrook, Minnesota.



This information is for environmental review purposes only.

— Alberta Clipper
 - - - Route Alternative

0 10 20 40
 Miles



Figure 2.2.2-1
Alberta Clipper and Southern Lights Diluent Projects
 Overview of Route Alternatives



2.2.3 Comparison of Major Route Alternatives

The Applicants conducted a detailed quantitative analysis of environmental impacts along each major route alternative. This analysis used the same sources of publicly available environmental data described in section 2.2.1, supplemented by field reviews. The analysis primarily focused on land use issues and wetland and waterbody crossings. In total, the Applicants identified and compared a variety of factors for each route, including: total length, proximity to an existing right-of-way, NWI-mapped wetlands and forested wetlands, highly wind erodible soils, depth to water table, hydric soils, agricultural land, forest and herbaceous lands, intermittent and perennial waterbodies, railroads, roads, and major highways. After review, the Applicants identified two major route alternatives in Minnesota for the project.

Great Lakes Gas Alternative

The Great Lakes Gas Alternative would depart from the Enbridge pipeline corridor at MP D946 west of Steamboat Road and would run parallel along the north side of the Great Lakes Gas Transmission Company right-of-way for approximately 32 miles (see figure 2.2.3-1). The Great Lakes Gas Alternative would present a major system deviation from the Enbridge pipeline corridors for the entire 32 miles along the Enbridge/U.S. Highway 2 corridor. This alternative route would rejoin a combined Enbridge and Great Lakes Gas Transmission right-of-way south of the village of Bena at approximate MP 974. From MP 974 the Great Lakes Alternative would cross under all Enbridge and Great Lakes Gas Transmission pipelines to route on the north side of the corridor and continue east until just east of Six Mile Lake Road at MP 978.2.

The project route would travel directly offset and parallel the south side of an Enbridge pipeline corridor from MP D946 just west of Steamboat Road east to MP 978.2 just east of Six Mile Lake Road for approximately 32.5 miles. The project route and Great Lakes Alternative would each lie entirely adjacent and offset of existing pipeline rights of way except for an approximate 1,000-foot section of greenfield route at the eastern end of the project route.

The project route would cross 1,314 less feet of NWI-mapped wetlands, an additional 10.4 miles of highly wind erodible soils, and 10.3 miles less prime farmland soils when compared to the Great Lakes Gas Alternative. The Great Lakes Gas Alternative would cross 3.8 miles of additional forest land, an additional 2.9 miles of agricultural land, and another 3,697 feet of hydric soils compared to the project route. The Great Lakes Gas Alternative would also cross 687 additional feet of open water and two additional perennial waterbodies than the project route.

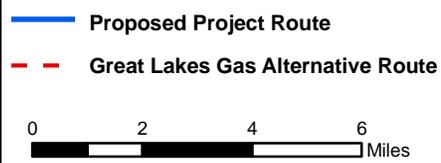


Figure 2.2.3-1
Alberta Clipper and Southern Lights Diluent Projects
Great Lakes Gas Alternative



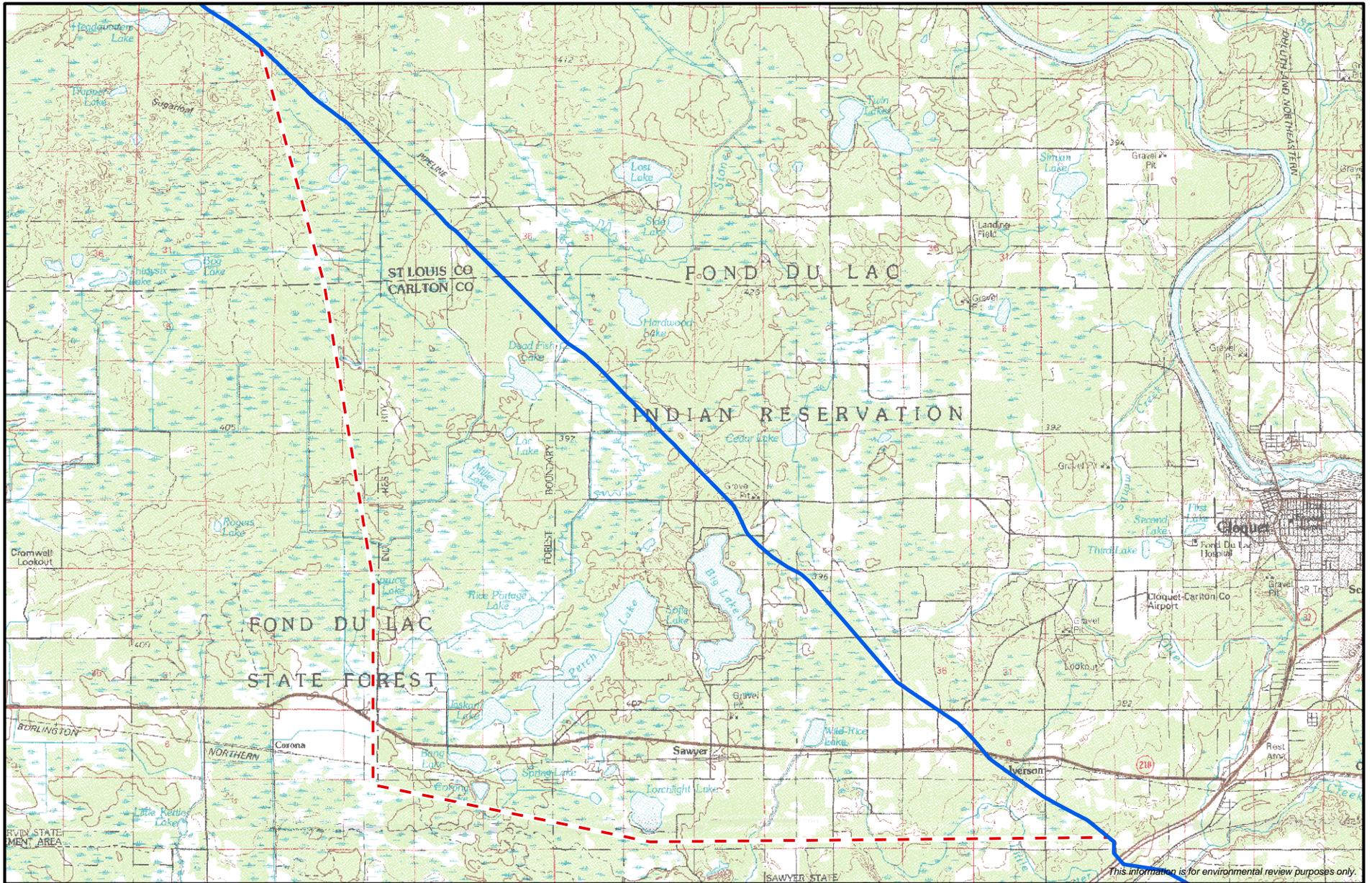
In summary, the project route offers a familiar and consistent route adjacent to the Enbridge pipeline system and a route that traverses less open water, wetlands, prime farmland soils, forest lands and agricultural land than the alternative. Table 2.2.3-1 provides a comparison of environmental features for the two routes.

| Environmental Features | Unit | Proposed Project Route | Great Lakes Gas Alternative |
|---|-------|------------------------|-----------------------------|
| Length | miles | 32.0 | 32.5 |
| Adjacent to Existing Right-of-Way | feet | 167,690 | 171,600 |
| Greenfield Route | feet | 1,000 | 0 |
| NWI-mapped Wetlands Crossed | feet | 32,086 | 33,400 |
| Highly Wind Erodible Soils ^b | feet | 136,224 | 81,312 |
| Shallow Bedrock | feet | 0 | 0 |
| Hydric Soils | feet | 29,568 | 33,264 |
| Prime Farmland Soils | miles | 3.9 | 14.2 |
| Forest Land Affected | miles | 15.3 | 19.1 |
| Agricultural Land Affected | miles | 1.0 | 3.9 |
| Herbaceous Land Affected | miles | 0.1 | 0.2 |
| Open Water Crossed | feet | 211 | 898 |
| Intermittent Waterbodies Crossed | no. | 1 | 1 Artificial path |
| Perennial Waterbodies Crossed | no. | 3 | 5 |
| Railroad Crossings | no. | 4 | 0 |
| Interstate and Highway Crossings | no. | 3 | 5 |

^a Route characteristics that were not significantly different were not included in this comparison.
^b Indicates length of the pipeline route where project would cross soils with a wind erodible index of a potential for a loss of 134 to 310 tons per acre per year.

Fond du Lac Alternative

The Fond du Lac Alternative would depart from the Enbridge pipeline corridor at MP 1056.2 and travel cross-country within a new greenfield pipeline right-of-way for approximately 21.4 miles (see figure 2.2.3-2). The Fond du Lac Alternative was considered given the uncertainty of favorable easement negotiations with the Fond du Lac Band within the reservation. This route alternative would depart from the Enbridge pipeline corridor and travel south and then east around the Fond du Lac Reservation’s western and southern boundaries to rejoin the Enbridge pipeline corridor at MP D1073.2 due west of Interstate Highway 35.



This information is for environmental review purposes only.

- Proposed Project Route
- - - Fond du Lac Alternative Route



Figure 2.2.3-2
Alberta Clipper and Southern Lights Diluent Projects
Fond du Lac Alternative



The project route would travel directly offset and parallel to the Enbridge corridor’s south side between MPs 1056.2 to D1073.2 for a total length of approximately 16.8 miles. Table 2.2.3-2 provides a comparison of environmental features for the two routes.

| Environmental Features | Unit | Proposed Project Route | Fond du Lac Alternative |
|---|-------|--|--|
| Length | miles | 16.8 | 21.4 |
| Adjacent to Existing Right-of-Way | feet | 88,704 | 0 |
| Greenfield Route | feet | 0 | 112,992 |
| NWI-mapped Wetlands Crossed | feet | 37,619 | 61,478 |
| Highly Wind Erodible Soils ^b | feet | 17,952 | 20,592 |
| Shallow Bedrock | feet | 0 | 0 |
| Hydic Soils | miles | 5.4 | 8.2 |
| Prime Farmland Soils ^c | miles | 0.3 | 0.9 |
| Forest Land Affected | miles | 5.9 | 7.9 |
| Agricultural Land Affected | miles | 2.0 | 0.8 |
| Herbaceous Land Affected | miles | 0.1 | 0.0 |
| Open Water Crossed | feet | 0.0 | 3,696 |
| Intermittent Waterbodies Crossed | no. | 0.0 | 0.0 |
| Perennial Waterbodies Crossed | no. | (3 defined as Canal/Ditch no perennial or intermittent status given) | (6 defined as Canal/Ditch no perennial or intermittent status given) |
| Railroad Crossings | no. | 1 | 6 |
| Interstate and Highway Crossings | no. | 1 | 1 |

^a Route characteristics that were not significantly different were not included in this comparison.
^b Indicates length of the pipeline route where project would cross soils with a wind erodible index of a potential for a loss of 134 to 310 tons per acre per year.
^c St Louis County soil data was not available and was not factored into soil totals soil for each route.

The project route is 21 percent shorter in total length, traverses 4.5 less miles of NWI-mapped wetlands, and 34 percent less hydric soils in comparison to the Fond du Lac Alternative. The project route would cross 6,864 feet of additional agricultural land and 528 feet of developed land compared to the Fond du Lac Alternative. The Fond du Lac Alternative crosses five additional perennial waterbodies and four fewer roads than the project route.

2.2.4 Comparison of Minor Route Alternatives

The Applicants reviewed areas along the preferred route where construction of the project will pose challenges due to impingements on the construction right-of-way from existing features. As with the analysis of major route alternatives, a detailed quantitative analysis of environmental impacts was conducted along each minor route alternative. The Applicants identified 7 minor route alternatives in Minnesota for the projects as discussed below. None of the alternatives were adopted as the preferred route.

Donaldson Station Alternative

The Donaldson Station Alternative would parallel the south side of the Enbridge pipeline right-of-way into the west side of Donaldson Station at MP 814.0 (see figure 2.2.4-1). The alternative route would turn east along the north side of Minnesota Highway 11 and cross a

county road east of the station before turning south to cross Minnesota Highway 11. The alternative route would then continue along the south side of the Enbridge pipeline right-of-way at MP 814.4. This alternative alignment is approximately 1,900 feet in length and would encounter utility congestion between Minnesota Highway 11 and the pump station's southern boundary.

The project route would be 2,060 feet long. The project route would be parallel and adjacent to the south of the LSr Project, turn southwest of the Donaldson Station property boundary and is located adjacent to the Enbridge pipeline right-of-way between the station and existing high voltage electric transmission lines to the west. Once south of the station, the project route would continue south under Minnesota Highway 11 and then be located between an existing electrical substation and an abandoned residence further to the south. The project route would then turn southeast, continuing to run adjacent to the LSr Project's south side, and then east to cross a county road before rejoining the south side of the northernmost Enbridge pipeline right-of-way. Table 2.2.4-1 provides a comparison of environmental features for the two routes.

Neither route would cross NWI-mapped wetlands, shallow bedrock, or highly wind erodible soils. Both routes would traverse similar flat terrain comprising agricultural and commercial land before reconnecting with the existing northern corridor. Also, both routes would cross road ditches along each road crossing; however, the alternative route would pose construction constraints due to the existing utilities and Minnesota Highway 11. Although longer, the project route would cross 1,056 feet of agricultural land compared to 1,742 feet for the Donaldson Station Alternative. The project route would cross 158 feet additional hydric and prime farmland soils but would cross 581 feet less total agricultural land than the Donaldson Station Alternative. The Donaldson Station Alternative would be confined along Minnesota Highway 11 which would present difficulty during construction.



This information is for environmental review purposes only.

— Proposed Project Route

- - Alternative Route

0 250 500 750 Feet



Figure 2.2.4-1
Alberta Clipper and Southern Lights Diluent Projects
Donaldson Station Alternative



| Environmental Features | Unit | Proposed Project Route | Donaldson Station Alternative |
|---|-------|------------------------|-------------------------------|
| Length | miles | 0.4 | 0.4 |
| Adjacent to Existing Right-of-Way | feet | 2,060 | 1,900 |
| Greenfield Route | feet | 0 | 0 |
| NWI-mapped Wetlands Crossed | feet | 0 | 0 |
| Highly Wind Erodible Soils ^b | feet | 0 | 0 |
| Shallow Bedrock | feet | 0 | 0 |
| Hydric Soils | miles | 0.4 | 0.4 |
| Prime Farmland Soils | miles | 0.4 | 0.4 |
| Forest Land Affected | miles | 0.1 | <0.1 |
| Agricultural Land Affected | miles | 0.2 | 0.3 |
| Herbaceous Land Affected | miles | 0 | <0.1 |
| Open Water Crossed | feet | 0 | 0 |
| Intermittent Waterbodies Crossed | no. | 1 | 1 |
| Perennial Waterbodies Crossed | no. | 0 | 0 |
| Railroad Crossings | no. | 0 | 0 |
| Interstate and Highway Crossings | no. | 1 | 1 |

^a Route characteristics that were not significantly different were not included in this comparison.
^b Indicates length of pipeline that would cross soils with a wind erodible index of a potential for a loss of 134 to 310 tons per acre per year.

Neither route would cross NWI-mapped wetlands, shallow bedrock, or highly wind erodible soils. Both routes would traverse similar flat terrain comprising agricultural and commercial land before reconnecting with the existing route alignment. Also, both routes would cross road ditches along each road crossing; however, the alternative route would pose construction constraints due to the existing utilities and Minnesota Highway 11. Although longer, the project route would cross 1,056 feet of agricultural land compared to 1,742 feet for the Donaldson Station Alternative. The project route would cross 158 feet additional hydric and prime farmland soils but would cross 581 feet less total agricultural land than the Donaldson Station Alternative. The Donaldson Station Alternative would be confined along Minnesota Highway 11 which would present difficulty during construction.

Middle River Alternative

The Middle River Alternative would parallel the south side of Enbridge pipeline right-of-way between MPs 835.6 and 836.1 (see figure 2.2.4-2). The alternative route would be directly offset and parallel to the river channel for about 500 feet presenting construction and restoration issues due to steep banks. The Middle River Alternative route could cause undercutting of the Alberta Clipper Project pipeline in the future during normal river flow. Also, the Middle River Alternative route would present potential constraints to waterbody construction given the river's close proximity and parallel alignment when compared to the project route across the Middle River south of the northern Enbridge pipeline right-of-way.