LAKE SAKAKAWEA PIPELINE CROSSING REPORT

Construction Methodology Evaluation – Horizontal Directional Drilling

BakkenLink Pipeline Project
Western North Dakota

BakkenLink Pipeline, LLC

This report has been produced as a supplement to *Lake Sakakawea Pipeline Crossing Report* issued by BakkenLink November 2011

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Executive Summary

The crossing of Lake Sakakawea is a key logistical consideration for the routing the of the proposed BakkenLink Pipeline from Beaver Lodge to Fryburg in North Dakota that will provide much-needed transportation capacity for crude oil produced from the Bakken oil play. BakkenLink Pipeline LLC (BakkenLink) has evaluated several options for the proposed lake crossing route and selected a lake crossing north of Keene. This decision was a result of BakkenLink consultation with government agencies, discussions with industry professionals and contractors, and in line with commercial drivers. BakkenLink has provided information describing its preferred lake crossing location and method and its resulting impacts and mitigation techniques in its *Lake Sakakawea Pipeline Crossing Report*, dated November 3, 2011.

As part of the review of the lake crossing, federal agencies have requested additional rationale and background information about the Horizontal Directional Drilling (HDD) technique that was listed as an alternative method of installation to the Company preferred Pipeline-Pull method.

Horizontal Directional Drilling (HDD) is a growing pipeline installation technique that is used where traditional open trench construction is unfavorable. This technique, detailed in Section 3.1, has been growing in popularity and in capability in recent years. The lake geography in this area was concerning for BakkenLink's Engineer with regard to HDD installation. The lake's relatively flat shorelines span 12,000 feet and are surrounded by rolling hills and ravines that yield to high bluffs at the top of the lake valley. The expansive width of the lake would challenge HDD technology and the valley topography is not ideal for HDD operations. BakkenLink consulted with leading drillers to determine the feasibility of an HDD in the area of the lake crossing. The unprecedented 14,000-foot drilled crossing that would be required was considered to be at the outer limits of current equipment capabilities. Drilling contractors discussed with BakkenLink that an HDD of that magnitude would require extensive sub-surface investigations, described in Section 3.6, encounter large risks during construction, described in Section 3.4, and come with no guarantee of success. While a successful HDD would yield no environmental impacts to the lake and minimize pre-construction permitting, a failure of the HDD could put the crossing in jeopardy of large lake impacts, extensive construction and environmental mitigation, and increased costs and schedule delays.

The geotechnical and geophysical investigations required for a drill of this magnitude would likely only provide data suggesting the drill is relatively more or less feasible. Because a drill of this length and potential depth has never been performed, there is no data to support its absolute feasibility. The subsurface investigations may provide information about the most suitable substrata, the type of soils, the equipment that will be required, the potential risks, etc., but it cannot determine success of the operation.

In light of the risks inherent in an HDD of this magnitude, and based on the unique site conditions of the lake at the crossing, BakkenLink proposed a "pipeline-pull" as its preferred installation technique, detailed in Section 4. This method constructs the pipeline one segment at a time from one end of the shoreline, slowly pulling the pipe across the other shoreline using floatation devices. The pipe is sunk to the lake bottom and lowered into the lake sediment using a lowering sled, common in Gulf of Mexico and other international operations. This method is has low intrinsic risk and has been proven to succeed. The main concern involves the impact to the lake caused by operations within the lake itself. BakkenLink's Engineer has extensive experience with this technique and has provided turbidity and re-sedimentation mitigation measures that are commonly used and generally accepted by government agencies and industry standards in the Gulf of Mexico.

BakkenLink has provided additional information evaluating and comparing the risks and benefits of both the HDD and Pipeline-Pull methods, summarized in Section 5. With respect to the risks associated with the installation method, failure BakkenLink supports the preferred Pipeline-Pull method as it is confident that the construction technique will yield no significant impacts to the lake. Bakkenlink concludes that because costly geotechnical and geophysical investigations cannot determine the certainty of installation of this unprecedented drill, then geotechnical studies would not be necessary in the Company's evaluation of the riskier HDD method, particularly with a feasible, low impact, high success pipeline-pull option. This is especially relevant in light of a similar trenched technique being used in the lake within the last 5 years where no significant impacts were experienced in the lake.

1. Lake Sakakawea Crossing

1.1. Pipeline Routing

BakkenLink Pipeline LLC (BakkenLink) is planning to build a new crude oil pipeline to provide much needed capacity to transport the increasing supplies of crude oil produced from the Bakken oil play to multiple export outlets. The pipeline will consist of approximately 144 miles of 8-inch and 12-inch steel crude oil pipeline extending from Beaver Lodge, North Dakota to a proposed crude oil rail loading facility located near Fryburg, North Dakota (Rail Facility). .

The Lake Sakakawea crossing between Beaver lodge and Keene is a key logistical consideration for the routing of the pipeline. A crude oil pipeline across Lake Sakakawea will provide increased connectivity between oil production and shipping opportunities, allowing producers access to multiple export outlets on both north and south sides of the Lake Sakakawea. The crossing will significantly reduce the number of trucks required to move crude oil through Williston and New Town, North Dakota to get around this transportation barrier. BakkenLink's proposed pipeline would offers bi-directional flow depending on the commercial demands of the regional markets.

BakkenLink evaluated several options for the proposed lake crossing route. Each option was considered with respect to regional access to markets, economics, engineering design, construction feasibility, schedule and environmental impacts. As part of the project planning, regional US Army Corps of Engineers (USACE), Bureau of Land Management (BLM), US Forest Service (USFS), and US Fish & Wildlife Service (USFWS) agencies were consulted to obtain guidance with regard to the Lake crossing location and methodology in 2010 and 2011. These consultations were integral to selecting the proposed location for the crossing. A location north of Keene was selected and will have minimal effects on resources and residents in the proximity of the lake while meeting the necessary commercial commitments and construction requirements.

1.2. Lake Characteristics at the Proposed Crossing

The selected crossing location north of Keene is favored due to its optimized path between receipt points of the proposed BakkenLink system and the proximity to an existing pipeline corridor. However, this area entails a crossing along the relatively wide central section of the lake. The current crossing from shoreline to shoreline is approximately 12,150 feet. The width of the crossing and the lake water depth are key considerations for the construction method evaluation. At the time of the hydrographic survey performed in the early summer of 2011, the maximum water depth was approximately 50 feet and the bottom substrate is characterized by a 1-2-foot layer of fine silt and mud.

The immediate shorelines in the proposed corridor are characterized by relatively flat plains. However, within 2,000 feet from the water's edge, rolling hills and ravines yield to the high bluffs above the lake, constituting an approximately 450-foot elevation change within one mile from the shoreline. The bluffs rise to approximate elevations of 2,300 feet overlooking the shoreline with elevation about 1,860 feet above sea level.

1.3. Alternate Locations

During initial consultation in 2010, BakkenLink presented the different crossing location options for discussion at meetings with federal agencies. BakkenLink identified three potential alternate locations with various advantages and disadvantages as compared to the current location.

Between the area near Williston, where the Missouri River begins to widen into the lake, and a substantial narrowing of the lake near New Town, only one location along the central part of the lake provides a width that could reduce the 12,000-foot crossing length of the proposed location. Approximately 7-8 miles west

of the proposed location, a narrowing point in the lake reduces the shoreline width to approximately 8,000 feet. This area provides a reduction in lake width and more favorable terrain for construction, but also presents a higher concentration of endangered species.

Another crossing locale considered was near the village of Four Bears and New Town. This area is approximately 20 miles southeast of the proposed location and is along the same corridor as the Four Bears Bridge (ND HWY 23) crossing. After desktop studies, favorable locations for a potential drilled crossing were identified both north and south of the Four Bears Bridge. These crossings would be approximately 7,000 feet and 5,000 feet for the crossings north and south of the lake, respectively. These lengths are significantly more favorable for the success of a potential Horizontal Directional Drill (HDD), however, both locations increase the pipeline reroute length considerably (estimated to be an additional 30 miles of pipeline) between the proposed receipt points at Keene and Beaver Lodge in the BakkenLink system.

As a result of the meetings with the federal agencies and the commercial drivers for the project, the other crossing locations were eliminated in favor of the proposed route north of Keene. A summary of the meeting minutes concerning lake crossing locations and methods are available in BakkenLink's *Lake Sakakawea Pipeline Crossing Report* dated November 14, 2011.

1.4. Pipelines and Facilities in the Vicinity

As mentioned previously, the proposed crossing location is adjacent to an existing pipeline corridor. The following pipelines have been identified in the vicinity of the proposed lake crossing at the site north of Keene:

Pipeline Owner	Outer Diameter of Pipe	Number of Pipelines	Construction Method	Product
Amerada Hess	8"	3	Open cut – 1950s	Gas
Amerada Hess	16"	1	Open cut – 1950s	Gas
Amoco Pipeline (Tesoro)	12"	1	Open cut? – 1954	Crude Oil
Dakota Gasification Company (exposed and replaced 2007)	14"	1	Open cut -1999	CO_2
Dakota Gasification Company (Replaced 1999 line)	14"	1	Open cut with lay barge & controlled depth tow – (2007)	CO_2

The Hess gas and Tesoro oil pipelines predate the flooding of the lake in the mid-1950s and were installed utilizing open cut trenching methods. The Dakota Gasification Company (DGC) pipeline, also installed using open cut techniques, was constructed when the lake water level was only 10 feet deep in the center of the Missouri River Thalweg (old river channel). The alignment of the proposed pipeline is approximately 200 feet west of the existing DGC pipeline.

2. Construction Methodology Evaluation

2.1. Construction Methods

During the project planning stages, several crossing construction methodologies were evaluated. The evaluated options include:

1. Conventional offshore pipelay from a marine barge accompanied by trenching to lower the pipeline and tie-in operations at the north and south shores of the lake;

2. Horizontal Directional Drill (HDD) Options:
    a) a single HDD across the entire lake crossing from a single onshore location;
    b) a dual HDD from both shores toward the center of the lake, also referred to as a "intersect method" with drills intersecting under the lake;
    c) a dual HDD from the shores of the lake to the center of the lake with an intermediate underwater tie-in operation utilizing a dredge and barge;
3. Pipeline-Pull Methods:
    a) perform a pipeline-pull operation with a buoyant pipeline constructed on a stationary offshore barge positioned midstream and then pull the line toward each shore line in sequence. When the pipe is within the trenched corridor, remove floats and lower pipeline. Conduct the intermediate tie-in operation from the vessel;
    b) perform a pipeline-pull operation with the pipeline made entirely from one shoreline and then pull the line across the water. When the pipe is within the trenched corridor, remove floats and lower pipeline. Conduct the tie-in operations from each shoreline.

2.2. Method Evaluations

The conventional marine pipelay, dual HDD with marine vessels, and the pipeline-pull from a stationary marine barge are not favored options due to the necessity of offshore equipment. Although the lay barges, stationary jack-up barges and other support vessels and equipment are plentiful in the Gulf of Mexico and other coastal areas, mobilization of such large and specialized equipment to this region is not feasible and is cost prohibitive . Additionally, the water depth conditions of the lake increase vessel susceptibility to weather.

The plausible HDD options, the single HDD and dual HDD intersect methods, both involve drilling beneath the lake to depths ranging from 50 to 300 below the lake bottom to install the pipe. The length and depth of the crossing introduce engineering and construction risks and a drill of this magnitude is unprecedented exceeding the current world and US domestic HDD records in length (12,000 and 10,000 feet, respectively) and depth. Although HDD is a proven and effective solution to pipeline installation, it is not without limitations.

The pipeline-pull method from the shoreline is a common installation technique used in similar shallow water conditions in the Gulf of Mexico and internationally; however, the disadvantage to this method is that lowering of the pipe requires a lowering method that fluidizes lake sediments where lake turbidity could be experienced. With proven equipment and mitigation measures, turbidity and re-sedimentation issues can be mitigated during construction activities.

BakkenLink engaged the expertise of qualified industry consultants to evaluate methodologies. With the construction and environmental risks and costs considered, BakkenLink selected the pipeline-pull method from a single shoreline (Option 3b) as the most favorable option, consistent with the company's risk tolerances and environmental strategies. More information about the HDD and pipeline-pull methods, supplemental to BakkenLink's *Lake Sakakawea Pipeline Crossing Report* is presented in the following sections.

3. Horizontal Directional Drilling (HDD) Methodology

3.1. Typical HDD Construction

In general, horizontal directional drilling is a trenchless technique for installing pipelines or other linear utilities to minimize surface or sensitive area disruptions and install pipe where conventional installation techniques are not favorable. The first phase consists of drilling a directionally controlled pilot hole along a predetermined path extending from grade at one end to grade at the opposite end. The entry and exit holes for the HDD are typically designed to be set-back from the area of avoidance to allow for the geometry of the drill to reach a desired target depth. For example, entry and exit holes for a river crossing may be set-back an additional 50 feet from the river banks to allow for the geometry of the drill to reach the designed depth. In the case of the Lake Sakakawea crossing, the set-back from the shoreline for drill entry and exit could range between 200 and 1700 feet depending on the required drill depth beneath the lake bed.

The second phase consists of enlarging the pilot hole to a size that will accommodate pulling the pipeline through the enlarged hole. Generally, the hole should be 1.5 to 2 times the outer diameter of the pipe. Preliminary analysis of the HDD of the Lake Sakakawea crossing indicates a 24 inch hole would be recommended for the 12-inch pipeline. The enlargement of the pilot hole, or reaming, is accomplished by pulling reaming heads of specific diameters through the hole, in stages if necessary, to create a wider hole. All stages of HDD involve circulating drilling fluid from equipment on the surface through the drill pipe to a downhole bit or reamer, and back to the surface through the annular space between the pipe and the wall of the hole. The drill mud serves several purposes: to control the frictional heating of the drilling components, remove large cuttings, and keep the drilling equipment lubricated. In a separate operation, while the hole is being drilled, the pipe is being welded to the length of the HDD and tested in one piece along the construction easement. Once the drilled hole is prepared and stable, the welded pipeline, or drill string, is pulled. Generally the pipe string is laid out and welded on the exit side of the drill. The drill string can be assembled in segments instead of a continuous length; however pipe pulling operations will cease while the segments are being welded together. This cessation of pull back activities can lead to the drilled hole seizing up or even collapsing depending on subsurface conditions. To minimize the risk of the drilled hole failing, a continuous drill string fabrication is preferred, provided enough workspace/acreage exists.

The major advantage of the HDD technique is the minimal effects on sensitive surface areas and temporary surface impacts during construction activities. Additional workspace is required at the drill entry and exit locations, generally 300 feet by 300 feet as well an area to string, weld and leak test the pipe prior to pull back. This drill stringing area is essential for proper alignment of the pipeline as it is pulled through the hole.

The HDD technique does have limitations and significant risks that could outweigh the benefits. Extensive subsurface evaluations and explorations must first be performed to determine if suitable conditions exist to support the drilling operations. Should the geotechnical investigations shows unfavorable subsurface conditions, drill failure could result in the inability to properly steer the drill head, inability to maintain the hole integrity, excessive drill stresses on the pipe, and/or inability for drill equipment to deliver the torque capacity necessary for extensive drilling operations. Additionally, drilling fluid will be under great pressures during drilling operations and when expended down-hole, it will flow in the path of least resistance. In the drilled annulus, this path may be an existing fracture or fissure in the substrata, a high porosity streak, and/or a pocket of incompetent substrate material being penetrated. These paths could lead to the surface and unplanned releases of drilling fluid (“frac out”) can occur. Although the fluid is not considered hazardous, may result in environmental impacts to the lake if drilling fluid returns to the surface... Thus, the feasibility of successful HDDs are highly dependent on the geotechnical characteristics of the area being drilled.

3.2. Single HDD Method

Because of the lake width at the crossing of 2.3 miles (12,150 feet), a single HDD operation across the entire lake would require an unprecedented drill and pipe string of an estimated 14,000 feet to include the set-back distances. This length would exceed both world and domestic HDD record lengths as mentioned in Section 2.2. Although such a lengthy HDD operation could be theoretically feasible under optimal circumstances, many unfavorable risks are involved. As drill lengths increase, so will drilling fluid pressures which will increase the likelihood of an inadvertent return, even in considerably competent substrates. As pipe lengths increase, the tensile and axial forces acting on the drill pipe and pipe string can become uncontrollable and cause bending or buckling of the pipeline, adding considerable difficulty and potential failure of the HDD operation. Additionally, as the pressures and lengths increase, additional pumping and support equipment are required, increasing the construction footprint and complexity of the project and pushing drilling equipment beyond its upper limits.

3.3. Dual HDD Intersect Method ("Intersect Method")

A dual HDD intersect method would utilize two drilling rigs operating on both the north and south shores of the lake that drill toward each other and intersect forming a continuous drill hole. Advances in drill head controlling and positioning systems have allowed drillers to intersect pilot passes from opposite ends of a proposed HDD. Once the intersected pilot hole has been drilled, reaming operations begin and the process reverts to traditional single HDD operations, where reaming and pulling occurs from one end of the drill. This method is more feasible than the single HDD method because the initial pilot hole drills are more manageable in length. Additionally, longer successful drills have been completed using the dual method over the single drill method. Again, even while this option may be technically achievable, the method's success greatly depends on the subsurface conditions. Like the single HDD method, this option would still involve very high drilling fluid pressures, the potential for frac out, and difficulties when trying to pull the pipe back through the pilot hole.

3.4. HDD Construction Risk

At the initial stages of the Lake crossing construction method evaluation, the BakkenLink team consulted with prominent drilling contractors in the pipeline industry regarding the feasibility of the HDD method for crossing the lake. Although the dual HDD intersect method is more feasible, the consulting contractor advised that a 14,000-foot drill is still on the outer limits of the equipment capabilities. This length has not yet been proven under these conditions and introduces extensive risk to the project. The current world record for such a drill is 12,000 feet performed in the United Kingdom and the current United States domestic record is approximately 10,000 feet, both performed in recent years. Despite the evidence that the industry is moving toward longer successful drills, this 14,000-foot drill, under the site-specific circumstances, would be unprecedented. The high level of risk for a failed drill in these soils, the loss of pipe due to sticking or buckling, and the increased potential for inadvertent returns make the odds of completing this specific HDD very risky.

In addition to the limitations of the HDD technology, the surface conditions for this operation are not ideal. As previously discussed, a pipe is typically strung and welded along the construction easement to the full length of the drill and properly aligned prior to pull-back. The pull-back string for this project would be the entire estimated 14,000 feet of drill length. Yet, the surface topography along the shoreline of the lake does not allow for a full length pipe string. The rolling nature of the lake valley and large elevation changes caused by the lake bluffs prohibit the continuous stringing of pipe. Consequently, multiple shorter strings must be laid out as the topography allows. This allows the pipe to be aligned properly during pull-back but requires that the pull be stopped incrementally to allow for welding of each pipe string that is welded to the tail of the pipe in the hole. This start and stop technique will greatly increase the chances of hole collapse and pipe sticking or buckling.

Other negative scenarios for HDD installation include drill pipe or pipe string buckling or sticking, inadvertent return of drilling mud, or failure to accomplish a drill. In the event of drill pipe buckling or shearing during drilling operations, the contractor would need to pull back the drill string and replace the damaged pipeline. If the issue is severe enough, the contractor may recommend or require alternate methods to complete the drill that can add substantial costs or schedule delays. In the event of inadvertent returns, drilling operations would halt and drilling mud pressures would be reduced to moderate surface returns. In order to prevent subsequent returns, the area of fracture would need to be grouted or otherwise mitigated in some manner depending on the circumstances of the release prior to recommencing of drilling operations. If the pipe string gets stuck or buckles during pull-back operations, the pipe string would likely be required to be completely removed, inspected and repaired before reattempting installation. In the case of a failure to accomplish the drill path or repeated failures in the pull-back, the contractor may recommend an alternate depth or alternate location to provide a higher likelihood of drill success. If this should result, the costs and delays in construction would be substantial. If the drill is deemed "failed," the pipeline installation method would need to revert to another method, most likely the well proven pipeline-pull method or an open-cut method.

3.5. Key Feasibility Information – Geological Conditions

Characterization of the subsurface conditions across the lake would be required to determine the feasibility on an HDD operation, should that be the selected method, and help to quantify the severity of some of the risks associated with an HDD of 14,000 feet. It should be noted that the performeance subsurface investigations cannot provide conclusive proof for the success of an HDD, only whether more or less favorable conditions exist. For an unprecedented drill of this length, best management practices necessitate a comprehensive campaign employing geotechnical corings up to 50 foot below the intended drill depth and at intervals of 500 to 1000 feet across the lake. Additionally, geophysical soundings would be used to verify the corings. The geotechnical and geophysical data would allow for a continuous horizontal and vertical characterization of the lake crossing substrate to assess whether substrate would support HDD operations at all. Essentially, the more information obtained about the subsurface conditions, the better quantification of feasibility and risk can be determined concerning an HDD of subject length. Additionally, should the drill be determined to be feasible, the subsurface conditions will drive the drilling equipment employed and specific drilling techniques that may affect cost and scheduling.

BakkenLink did not feel that conducting an extensive subsurface investigation would be beneficial when compared to other methods, particularly the favored pipeline-pull method, where less extensive surficial geotechnical surveys could be undertaken with more surety and less cost.

3.6. Non-Construction Related Risk

The preceding sections describe the technical advantages and disadvantages associated with performing an HDD to accomplish the lake crossing from a construction standpoint. In addition to the risks mentioned for construction feasibility, this method can also affect the logistics and scheduling of the project that were considered by BakkenLink.

Cost is a major concern for any project, particularly as it relates to risk. Investors, designers and builders all prefer a level confidence and stability while minimizing risk where possible. BakkenLink, in its due diligence, assessed the risks and benefits of an HDD and deemed them to have high costs and high risks. As compared to alternatives that were considered, the HDD option was found to be much more costly to construct and have a greater chance for schedule creep and cost increases. From the beginning, costly and timely geotechnical and geophysical investigations would be required to properly determine feasibility, design and mitigation techniques. Should the HDD be successful as designed, the Company would have higher initial costs but would have avoided environmental mitigation costs and additional permitting. However, should the HDD frac out during the drill, or fail due to pipe buckling or sticking, the Company would face large expenses in the form of increased contractor costs due to

redrilling or lost equipment retrieval, substantial environmental mitigation costs, the risk of a recurrence of failure and schedule delays. Schedule delays could push construction operations to encroach on nesting seasons, creating a situation where demobilization and remobilization of construction equipment could cause additional ground disturbances.

When assessing the risks, potential mitigation procedures and potential for cost and schedule creep, the HDD option was not the preferred construction methodology. The most favorable method, as described in the BakkenLink *Lake Sakakawea Pipeline Crossing Report*, is the pipeline-pull method, which involves the highest potential for success, fewest unknown risks, insignificant environmental impacts, manageable mitigation factors, and minimal potential for cost and schedule creeping.

4. Preferred Methodology – Pipeline-Pull

BakkenLink has provided additional information about its preferred method in its *Lake Sakakawea Pipeline Crossing Report*, which was provided to the relevant federal agencies for review. The report details the evaluated methodologies and outlined the selection process. The preferred "Pipeline-Pull" method, as described by BakkenLink, is summarized below.

The Pipeline-Pull method is a common pipeline installation technique used in various construction circumstances and is adaptable to meet the site specific construction requirements. In the case of the Lake Sakakawea crossing, this method would require work sites at both shorelines. At one end, a high powered winch will be stationed and aligned to pull the assembled pipeline originating from the opposite shore. On the other side, a construction "assembly line" is constructed that will allow for the systematic assembly of the pipeline. The pipeline is welded and tested along this assembly line until it is ready to begin crossing the lake. As new pipe is added to the end of the pipe string, the winch slowly pulls the pipe across the lake one pipe length at a time. As the completed pipe is pulled across, floatation devices are used to keep the pipe a certain distance above the lake bottom as to not impede surface traffic. After the pipeline has fully crossed the lake, the floatation devices are removed and the pipeline is lowered to the lake bottom.

Once the assembly and positioning of the pipeline is complete, it must be lowered below the lake bottom for additional protection and positioning as required by federal regulations. BakkenLink has proposed using a common jetting technique that has been adapted for the site specific conditions of the lake. A customized lowering sled will use fluid jets and suction pumps to fluidize the lake bottom under the pipeline, causing the pipeline to sink into the fluidized substrate as the sled is pulled along the lake bottom. This proven technique will be adapted from typical Gulf of Mexico practices to minimize the turbidity of the sled. A slurry diffuser and turbidity mats are part of the adapted design of the jetting sled to mitigate turbidity and re-sedimentation in the lake. In addition to the jetting sled modifications to reduce turbidity, other mitigative measures can be employed to ensure minimal and localized effects to the lake, including turbidity monitoring and turbidity curtains.

During the evaluation process, BakkenLink conducted subsurface investigations of the lake sediments to determine the feasibility of lowering operations any effects that turbidity and re-sedimentation may have based on the components of the sediment. After initial concerns with re-sedimentation, the North Dakota Department of Health – Water Quality Division analyzed the sediment findings and during additional discussions with BakkenLink, expressed confidence in this lowering method.

Negative effects toward the pallid sturgeon were also considered by BakkenLink. The proposed crossing location is not within designated critical spawning habitat. The construction schedule BakkenLink is proposing for the lake crossing would avoid the spawning periods for the pallid sturgeon. Additionally, turbidity is not perceived to be an issue affecting the sturgeon, as they prefer turbid flowing water. Any

impacts will be insignificant, short lived and should not exceed the impacts of the DGC installation in 2007.

BakkenLink is confident that, in the unlikely event of pipeline leaks or spills, the pipeline-pull method will allow quick and reliable access to the damaged portion of pipeline for immediate mitigation and repair. Contrastingly for HDD, in the unlikely event of leaks or spills, the depth of the pipeline as a result of HDD installation will not allow access to any localized damaged area.

In addition to the above considerations, installation of the pipeline employing the pipeline-pull method has supplementary advantages to the regional infrastructure. The system in-service date would be sooner than if an HDD method were employed and would remove significant traffic and wear for regional infrastrucure currently used for oil transportation activities. With an initial oil transportation capacity of 65,000 BPD, this translates into removing upwards of 400 truckloads of oil per day from roads and highways transporting Bakken crude between lease and tank batteries around Johnson's Corner and multiple pipeline and rail destinations in Ross/Stanley/Berthold in western North Dakota.

5. Method Comparison –Push-Pull vs. HDD

	Pipeline-Pull Method	**HDD Intersect Method**
Installation Technique	• Method proven in Gulf of Mexico. High percentage success rate with minimum long term impacts. (Examples provided in *Lake Sakakawea Pipeline Crossing Report)*	• Installation success rate undetermined as drill length and application are unprecedented. • Finding suitable subsurface strata to support drilling activities. • Increased pipe stress during installation activities. • Bore hole collapse during drilling operations. • Contingency plan/alternative installation technique recommended in case of failure.
Installation Schedule	• Current schedule estimates construction August thru December 2012. • Approximately 115 day duration • Low risk of schedule creep	• Current schedule estimates construction August 2012 thru January 2013. • Approximately100 day duration. • Winter installation preferred to be able to field verify drill head locations and increase odds of pilot hole intersection on frozen lake. • Potential for schedule creep dependent on success of drilling operations

System In-Service Schedule *(BakkenLink System – Beaver Lodge to Fryburg)*	• System in-service by December 2012 (pending permit issuance). • In service sooner (than HDD method), resulting in more oil transportation being removed from regional infrastructure.	• Earliest in service date March 2013 (pending permit issuance).
Subsurface Exploration Requirements	• Hydrographic/hazard survey characterizing soils along the route. • Performed July 2011. 6 bore samples taken at roughly 1800-foot intervals to 10 foot depth.	• Extensive subsurface evaluation with core drills up to 300 feet at 500-1000 foot intervals with geophysical data to tie in subsurface geological strata for continuous horizontal characterization for determining drill depth, external pipe stresses during installation and equipment requirements. • Schedule estimates exploration not complete until June 2012 (best-case)
Environmental Impact	• Mild to insignificant turbidity expected during pipeline lowering activities. • Mitigated by turbidity screens (approved and successful mitigation technique used in Gulf of Mexico) • Use of USACE approved hydraulic excavators in operation	• If drill successful, no environmental impacts • Hydraulic fracturing/high permeability streaks/inadvertent returns during drilling process resulting in drilling mud (bentonite) release in Lake
Temporary Workspace Requirements	• 330 by 1150 feet workspace on North and 400 by 680 feet South shores of lake • Approximately 652,000 sq.ft. total	• 300 by 300 feet workspace on North and South Shores of lake plus drill string pull back area of 14,000' X 25' • Approximately 530,000 sq.ft. total
Pipe Stringing	• Ability to install pipe segments ("pipe joint") segments to pipe string during pipeline "assembly line" installation activities with minimal risk to success of installation.	• Recommend to have single 14,000' drill string to minimize potential for pipe getting stuck during pull back operations. • Workspace limited on North and South shores of lake for continuous drill string fabrication. • Topography also prohibits single pipe string. • Drill string segmentation will be required, which increases the chances of pipe seizing during pull-back operations.
Pipe Stresses during Installation	• Minimal axial and tensile stresses experienced during push-pull and lowering	• Length of drill exposes drill pipe and pipe string to high torque and risks buckling and sticking during drilling and/or pull-back

Operations/Maintenance	• Easily access to pipeline following installation for quick identification of failure, mitigation and repair damage	• Inability to locate point of leak and repair. Pipeline would require re-installation resulting in abandonment of installed pipe.
Pipeline Protection/Cover	• Lowering to 3-4 feet below lake bed per Federal regulations • Concrete weight coating for additional protection	• Depth of drill provides protection to pipeline
Cost	• Reduced costs for surveys, installation costs and turbidity mitigation compared to HDD • In unlikely event of damage to pipeline, cost to access and repair pipeline minimal (compared to HDD pipe)	• Expensive subsurface explorations and installation method • Mitigation measures may be substantial based on conditions of surface returns • In unlikely event of damage to pipeline, cost to access and repair pipeline substantial (including redrill and abandonment of pipe)

6. Conclusion

In summation, with all data available under consideration, BakkenLink, in its due diligence, advocates the pipeline-pull installation methodology over HDD installation at the Corps designated crossing location. The advantages of this method include a higher installation success with a proven methodology, reduced installation and subsurface investigation costs, and proven experience in managing and implementing this technique. Its main disadvantage includes the creation of minimal turbidity and re-sedimentation but which can be successfully mitigated during construction activities. Consequently, this technique was considered the best Risk- Reward scenario, with reward being confidence of a successful installation and risk being short term turbidity mitigation and cost contingencies. Contrastingly, the HDD Risk-Reward profile, where the reward of possibility no impact to the lake is not considered to outweigh the risks of HDD uncertainties, frac out impacts to the lake, and drilling or installation failures, does not support this method.