

Near surface geophysics for geohazard risk identification for pipelines

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Summary

Geologically active areas such as river crossings, can present significant risk to pipelines. A geophysical investigation was completed in a broader geotechnical investigation to support the design and construction of a proposed horizontal directional drilled (HDD) trenchless crossing of the North Saskatchewan River was completed between 2019 – 2020. The investigation included a desktop study, a borehole program, laboratory testing, geotechnical analysis, and a geophysical program using seismic refraction and electrical resistivity imaging (ERI).

Theory/Method/Workflow

Consideration for potential geohazards, future potential environmental releases, and river hazards must all be considered in the design of a HDD crossing. The desktop study was used to identify surficial geology, bedrock geology, groundwater geology, topography, and thalweg locations in the area. The borehole program was completed to visually assess the soil, bedrock, and groundwater conditions, and to collect representative samples for further classification and laboratory testing. The geophysical program was designed to identify bedrock depth and differentiate between coarse and fine grained sediment along the planned HDD path.

Results, Observations, Conclusions

Two survey lines of seismic and ERI were acquired; one south of the river and one north of the river. The borehole results agreed with the results of the geophysical investigation. Line 1 presented a high resistivity layer overlying less resistive material. The high resistivity material was been interpreted as sand and coarse-grained soils, and the lower resistivity material was interpreted as clay, clay till, and clay shale.

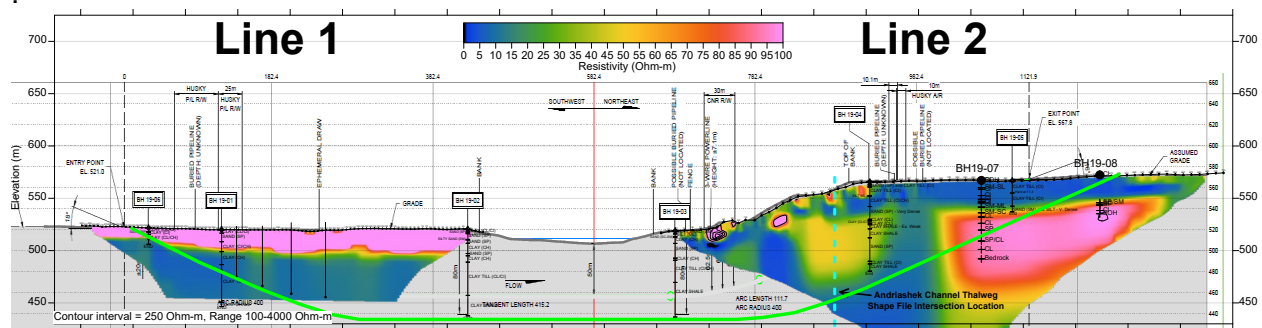
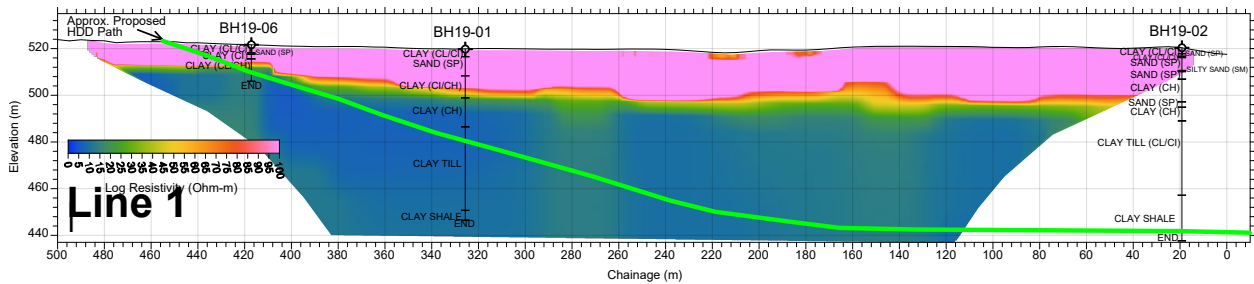


Figure 1: ERI survey results with borehole results and planned HDD path.



Line 2 appeared to be more geologically complicated as indicated by various seismic and resistivity anomalies. The desktop study indicated the presence of a thalweg along the proposed HDD path (Andriashek, 2018). The location of the thalweg corresponded with the location of a resistivity high indicating coarse grained sediment at that location and defining the lateral and vertical extents of the thalweg. Along with the thalweg, several other resistive anomalies were identified (Figure 2).

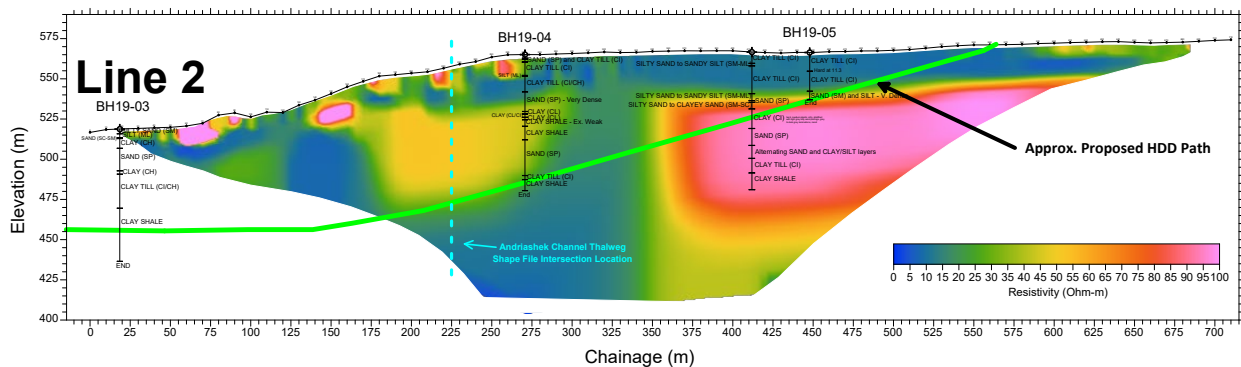


Figure 2: ERI survey results along Line 2 with borehole results and proposed HDD path overlain.

Furthermore, the desktop study found evidence of landslide geomorphology near the location of the planned HDD crossing.

The geophysical survey results, desktop study, and borehole program identified potential surficial and subsurface features and provided considerations for the effective design of a HDD path across the North Saskatchewan River. By establishing “no-drill” zones and setback distances for the HDD path, the risk potential geohazards, river hazards, and future environmental release were minimized.

Novel/Additive Information

Acknowledgements

References

Reference Style (use Arial 9pt normal)