Abstract No 13

Abandoned Coal Mines Make for Challenging HDD Design and Installation

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As part of their Urban Pipeline Replacement Program, ATCO Pipelines is working to replace and relocate its vintage high pressure natural gas pipelines in Calgary and Edmonton primarily into the Transportation Utility Corridors (TUCs) surrounding both cities. One of the projects as a part of this program, the Southwest Edmonton Connector (SWEC), includes the installation of 21 km of 508 mm diameter pipeline through southwest Edmonton. Due to the natural topography, unstable slopes and high level of existing infrastructure, Horizontal Directional Drilling (HDD) was utilized to complete 40% of the pipeline installations. The Whitemud Creek crosses the TUC near the eastern termination point of the project, and is at the bottom of a nearly 30 m deep ravine. Along this ravine, as well as others within the City of Edmonton, are exposed seams of coal. Beginning in the early 1900's, extensive mining was conducted which created hundreds of meters of room and pillar mine works which extend in all directions centralized at the Whitemud Creek. These workings were found in conflict with two of the HDD installations, the Whitemud Creek Crossing as well as a crossing of Anthony Henday Drive. An extensive borehole drilling program, as a well as seismic tomography survey, were used to map the mine works and to assess the level of potential collapse.

To facilitate the installation of the Whitemud Crossing, Thurber Engineering (Thurber) planned and executed an extensive geotechnical investigation. This included 24 boreholes up to 80 m deep and collecting seismic tomography data to determine the potential for voids and presence of existing mine works. Based on the information collected, a ground improvement plan was developed to grout a section of the mine that was determined to be non-collapsed. A grouted perimeter, or outer wall, was constructed first, followed by the grouting of the open void in the center. To maximize the ground improvement plan's effectiveness, it was broken into two parts, a pilot grouting (proof of concept) section, and the full grouting section. Upon completion of the pilot grouting section a reassessment using seismic tomography and additional test hole drilling was conducted. This confirmed the successful grouting of the test pilot area, and the remaining area was then grouted. A total of 105 grout holes were used for the ground improvement program.

Associated Engineering (AE) was retained to complete the design of the crossing by horizontal directional drilling methods. This included borepath design, hydrofracture, and pipe stress analysis. AE and Thurber carried out a parametric study using the finite element method (FEM) to optimize the pipe wall thickness within the limits of the ground improvement zone. As material stress aspects of the crossings were critical, aspects of the borepath design were refined further to maximize the opportunity for successful installations. This paper will outline the design and construction methodology utilized to successfully complete 700 m long crossing of the Whitemud Creek.