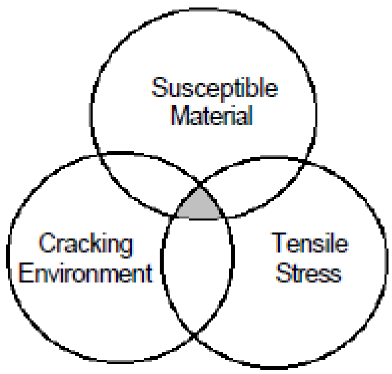
Direct Assessment Dig Program – November 2011 Plan

For SCC to occur, three conditions must be present:

- Material susceptible to cracking;
- Tensile stress; and
- A cracking environment.



Since steel material is always susceptible, we can focus on the stress and environment to assist in determining which areas of the pipeline may have an increased susceptibility to C-SCC. Industry experience indicates the C-SCC has similar growth factors to as axial transgranular SCC, aside from the source of principle stress. Therefore, as in the case of axial SCC, a combination of known parameters related to susceptibility can be used to develop a process to assess and prioritize pipeline segments or discrete sites. In the case of C-SCC, the parameters related to SCC susceptibility are augmented by parameters that give rise to axial loading or bending of the pipe. The first step was to compile and review available operational, environmental and geotechnical data for the pipeline. The existing data was reviewed, and then additional data considered useful for the selection of discrete areas or segments of pipeline with an increased susceptibility to SCC was acquired.

A review of susceptible environment related to SCC was conducted along the right-of-way. An SCC coil model based on CEPA/Marr susceptible environments for low pH SCC and tape coated pipe was developed. This consisted of classifying surficial soil conditions by the interpretation of aerial photos, and then completing ground truthing in the field along the entire right-of-way. The basis of the model included classifying soil, drainage, and topographical conditions.

A review of axial tensile stresses was completed along the right-of-way. This consisted of reviewing existing geotechnical data from the Pembina geotechnical database, as known areas of slope movement were already known and being monitored. Inclinometer data from existing monitoring locations was reviewed. A field geotechnical study was then completed along the entire right-of-way to classify all the areas and slopes. The study utilized the Unified Soil Classification System (USCS), which includes grain size, texture, soil plasticity, etc. During the field survey, visual observations were also made, consisting of examining areas for cracking of soil indicating recent movement, and observation of vegetation adjacent to the right-of-way indicating past soil movement. Utilizing these techniques, the entire right-of-way was risk ranked, broken out into segments, and categorized in terms of slope instability. The categories consisted of very low risk of slope movement, low risk, moderate risk, and high risk.

Operational and maintenance data was then reviewed for relevance to C-SCC. This consisted primarily of reviewing in-line inspection (ILI) data. The ILI data was used to delineate areas where a corrosive environment is known to be in contact with the pipe at corrosion features, and hence an environment present for the potential development of SCC in contact with the pipe. The ILI data was also used to delineate areas of coating disbondment at and in proximity to corrosion features, which is a prerequisite for development of SCC. Other pipeline data such as bend locations was also compiled.

A data overlay was then developed for the final selection of discrete dig sites. The SCC soil model data, the geotechnical slope data (axial stress), and the ILI data was aligned to engineering stationing and plotted on a graphical data overlay. Larger areas of increased C-SCC susceptibility were determined, and individual dig sites selected. All of the dig sites (with the exception of potential control digs) were to be located in high and moderate slope instability ranked areas where tensile axial stresses are at the highest, generally in the presence of coating disbondment and traditionally susceptible SCC soils.