EXECUTIVE SUMMARY

Petroleum Technology Alliance Canada (PTAC) has engaged InnoTech Alberta Inc. (InnoTech) to determine what an acceptable sweet gas leak rate may be on abandoned wells.

In 2008 the Alberta regulator stipulated that abandoned wells cannot have a welded sealed cap and the casing strings must be vented when the casing strings are cut and capped below ground level. The AER has observed that wells abandoned since 2008 have a much higher frequency of leaking to the surface than wells abandoned before 2008.

The primary question was to determine if more atmospheric greenhouse gases (GHGs in CO_2 equivalent) are generated in repairing a well with a very low rate methane leak than would have occurred from the actual leak. Since well remediation to repair a leak is complex and many different methods may be deployed, the objective was to provide a proof of concept (POC) Excel workbook, that can be utilized for a wide variety of field circumstances. This concept would only be applied to low rate sweet natural gas leaks without any liquids.

A POC workbook was designed with a user guide and the user may select the necessary equipment for well remediation, the length of time each piece of equipment is utilized and some field conditions. The fuel consumption for the field work is automatically calculated along with the associated GHGs that are generated. A methane leak from a well to atmosphere is entered and the resulting GHGs are calculated. The workbook also contains information on methane oxidation in soil and in the atmosphere. In the workbook, the sheets are linked with macros, formulas, and data tables.

The methane leak rate from the well is also entered into the POC workbook and the GHGs are calculated from the cumulative volume that would accumulate in the atmosphere. A comparison is then made for each source of GHG.

This project used existing research and studies to populate the subject workbook so that it can be used as a POC and as a working tool in industry. Gaps are identified where further research is recommended to address the majority of conditions in Alberta.

Since this project was structured as a proof of concept, the assessments were not down to every possible minutia of detail. For example, if trees or vegetation must be removed to gain access to a site in order to conduct the well remediation, the loss of CO_2 sequestration from the vegetation was not considered.

It is critical that any leak from an abandoned well does not adversely affect vegetation. Some guidelines are provided in the workbook and in this report to help minimize this risk. This issue has many variables and is a key area where more research is required. A proposed field practice in the POC workbook provides some information to help minimize the risk of an adverse effect on plant health resulting from a sweet gas leak from an abandoned well that is cut and capped below ground.

Methane is known to be oxidized in soil by methanotrophic bacteria, an aerobic bacterium. As part of the POC, this project examined criterion for determining how much methane from a leaking well with a vented subsurface cap, could be oxidized in soil under field conditions.

A study conducted at the University of Calgary (by V.B. Stien and J.P.A. Hettiaratchi[1]) provided enough details for InnoTech to develop a proposed field practice for the natural consumption of methane leaking from an abandoned well. The concept is to oxidize methane in soil in a cost-effective and environmentally acceptable manner.

The proposed field practice, utilizing loam containing methanotrophic bacteria, is expected to result in oxidation of about 40% of a methane leak rate from an abandoned well when under good climate and soil conditions. In the proposed field practice, the volume of methanotrophic loam that is required is proportional to the methane leak rate. The workbook is designed to allow user flexibility and has a provision to make an adjustment for Alberta climate conditions.

This report and the POC workbook demonstrate that there are conditions in which more GHGs are released to the atmosphere during remediationthan a leaking abandoned well would produce.

The primary technology gaps that are recommended for further research are:

1. Additional studies of vegetation tolerance to methane in soil for the most common Alberta soils and the most common types of vegetation cover in Alberta.
2. Construct a laboratory or field pilot to validate the results of the proposed field practice that was developed in this project.
3. Acquire additional data on fuel consumption of well remediation equipment and trucking equipment from private sources.
4. Additional studies of bacterial methane consumption, or oxidation, in the most common Alberta soils and under Alberta climate conditions from a source below the soils.

This study did not examine the cost benefit of allowing very low leak rate wells to be abandoned without remediation and then utilizing the unspent funds where a higher reduction of GHGs could be achieved. This is an important consideration for optimizing the use of limited funds especially considering that multiple attempts are usually required to remediate a low leak rate on a well. It is understood that the most effective strategy in mitigating GHGs is to deploy scarce funds to the most impactful methods of reducing GHGs.

All recommendations and proposals in this report are subject to local regulatory acceptance before any field trials are implemented.

A separate report on Cost Effective Wellsite Monitoring has also been provided for this project. This report covers various site monitoring and leak measurement technologies that are in use and some that are emerging. It also identifies some gaps where technology development is recommended.