



AURORA COLLEGE
Aurora Research Institute

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November 27, 2009

RE: 2009 Sump Monitoring Report for Water Licence N7L1-I817

Dear Mr. Harlow,

Please find enclosed the 2009 Sump Monitoring Report for the Mallik site under the Water Licence issued to Aurora College on December 1, 2006, in their capacity as the operator of the 2007/08 Aurora/JOGMEC/NRCan Production Research Well program.

This year's monitoring activities include thermistor readings from the four instrumented locations and visual observations of the well heads 2L/3L/4L/5L/6L – 38 at the Mallik site. Unfortunately, Aurora was unable to obtain Japex Canada Ltd.'s consent to access the sumps at the Mallik site and this limited our ability to conduct a complete monitoring program.

Aurora is working with JOGMEC in an effort to ensure that in future it will have the required access to the sumps to complete all required monitoring activities in a timely fashion.

Please do not hesitate to contact me if you have any questions or concerns regarding this report.

Sincerely,

Pippa Seccombe-Hett
Director, Aurora Research Institute

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Mallik Gas Hydrate Production Research Project:

**Aurora Research Institute Mallik 2L-38 and 3L/4L/5L- 38
Sump Monitoring and Retrofit Program**

**Prepared by
Aurora Research Institute**

November 25, 2009

OVERVIEW

The purpose of this letter report is to document 2009 monitoring activities undertaken as part of NWT Water Board Water License N7L1-1817 issued to Aurora College on December 1, 2006, in their capacity as the operator of the 2007/08 Aurora/JOGMEC/NRCan Production Research Well program.

The report documents monitoring related to separate activities, each conducted with different project histories and operator responsibilities. These include

1. surface activities related to re-entry and production operations conducted as part of the 2007 and 2008 Aurora/JOGMEC/NRCan Mallik 2L-38, 3L-38 and 6 L-38 field programs (Aurora College as operator), and
2. monitoring activities related to the Japex/JNOC/GSC Mallik 2L-38 drill sump constructed in 1998 (Japex Canada Limited as operator) and the Japex/JNOC/GSC et al. Mallik 3L/ 4L/ 5L-38 drill sump constructed in 2002 (Japex Canada Limited as operator).

MONITORING PROGRAM 2009

1) Site History and Status

The history of well site activities conducted at the Mallik site has been complex (see report by K. Martin submitted by Aurora College to the NWT Water Board as part of the 2008 monitoring report). Site features, as we understand them are summarized in Figure 1 and Figure 2.

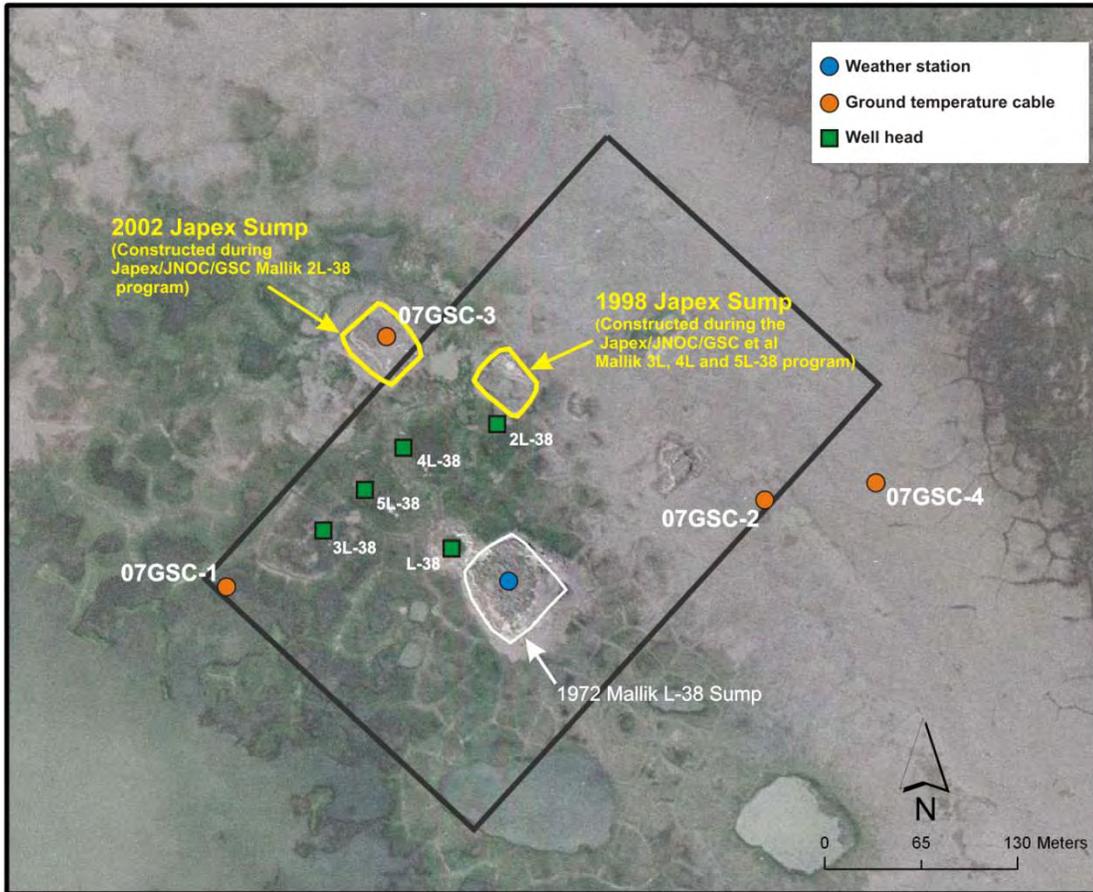


Figure 1: Vertical aerial photo from August 2004 showing location of surface features at Mallik site. Monitoring activities reported here refer to temperature observations at the GSC wells shown in orange and observed site conditions the vicinity of Aurora/JNOC/NRCan Mallik 2L, 3L 5L.



Figure 2: Oblique aerial photograph taken in summer 2008 showing features at Mallik site. No new site photos were taken in 2009.

2) Review of Surface Conditions at Aurora/JOGMEC/NRCan Mallik 2L-38, 3L-38 and 6 L-38

Pippa Seccombe-Hett and Scott Dallimore visited the Mallik site on August 16, 2009 to assess surface conditions in the vicinity of the 2007/08 surface operations. Their observations and notes are summarized on the attached photographs.



Figure 3: Aurora/JOGMEC/NRCan Mallik 2L-38, August 16, 2009 (photo credit S.R. Dallimore). As detailed by K. Martin in the Aurora College 2008 monitoring report, fill was placed at the surface of this well head in the summer of 2008. Site conditions on August 16th were found to be stable with no evidence of settlement or contamination. Grasses and sedges are beginning to colonize in the disturbed area.



Figure 4: Aurora/JOGMEC/NRCan Mallik 3L-38, August 16, 2009 (photo credit S.R. Dallimore). As detailed by K. Martin in the Aurora 2008 monitoring report, fill was placed at the surface of this well head in the summer of 2008. Site conditions on August 16th were found to be stable with no evidence of settlement or contamination. Site conditions on August 16th were quite wet however, with standing water and encroachment of a small pond. Grasses and sedges are beginning to colonize in the disturbed area and it is expected that the standing water only occurs after storm surges or after heavy rain.



Figure 5: Japex/JNOC/GSC et al Mallik4L-38, August 16, 2009 (photo credit S.R. Dallimore). Site conditions on August 16th were found to be stable with no evidence of settlement or contamination.

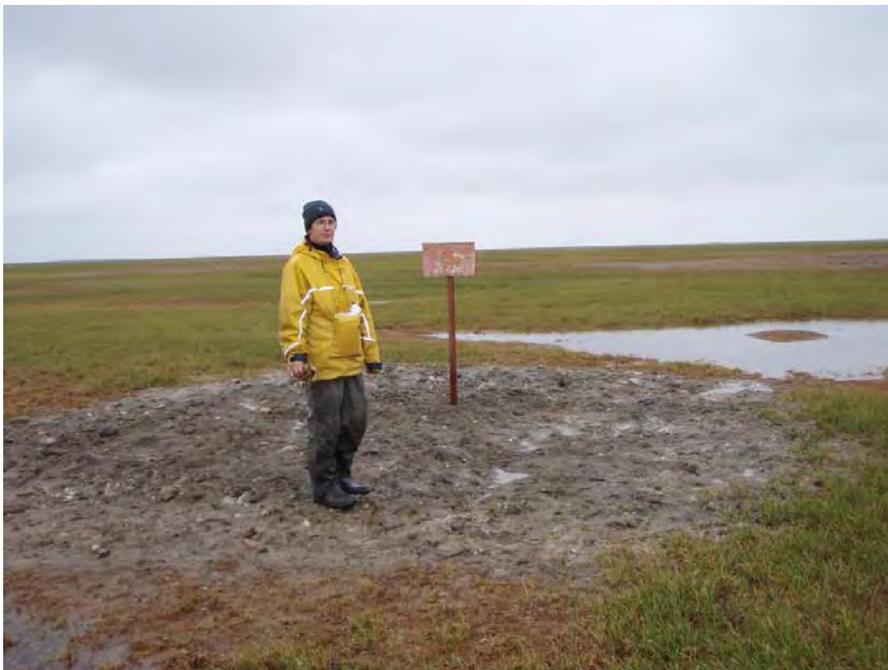


Figure 6: Japex/JNOC/GSC et al Mallik 5L-38, August 16, 2009 (photo credit S.R. Dallimore). Site conditions on August 16th were found to be stable with no evidence of settlement or contamination.



Figure 7: Aurora/JOGMEC/NRCan Mallik 6L-38, August 16, 2009 (photo credit S.R. Dallimore). As detailed by K. Martin in the Aurora College 2008 monitoring report, fill was placed at the surface of this well head in the summer of 2008. Site conditions on August 16th were found to be stable with no evidence of settlement or contamination. Grasses and sedges are beginning to colonize in the disturbed area.

3) Monitoring activities related to the 1998 Japex/JNOC/GSC Mallik 2L-38 drill sump and 2002 Japex/JNOC/GSC et al. Mallik 3L/ 4L/ 5L-38 drill sump

The NWT Protocol for the Monitoring of Drilling Waste Disposal Sumps calls for annual monitoring to include measurements of active layer depth, ground temperatures and electromagnetic profiling. In addition, surface observations are required and if any evidence of contamination is observed samples of sediment or water should be taken. Unfortunately, because Japex Canada Ltd., the owner of the sumps, limited Aurora College's access to them, the monitoring activities during 2009 were limited to ground temperature observations in GSC boreholes installed to measure the subsurface temperatures of the 2002 sump and three background locations in areas unaffected by surface operations.

A summary of the 2009 ground temperature conditions is given in Figures 8-15. The estimated mean annual ground surface temperature at the Mallik 2002 sump was -7°C which is colder than the estimated mean annual temperature at the undisturbed sites that varied from -4 to -6°C . This is consistent with the design goals of a sump which are to raise the ground elevation and lower the mean annual ground surface temperature regime. A comparison of the 2008/2009 air and ground temperature at the index site is shown in Figure 16.

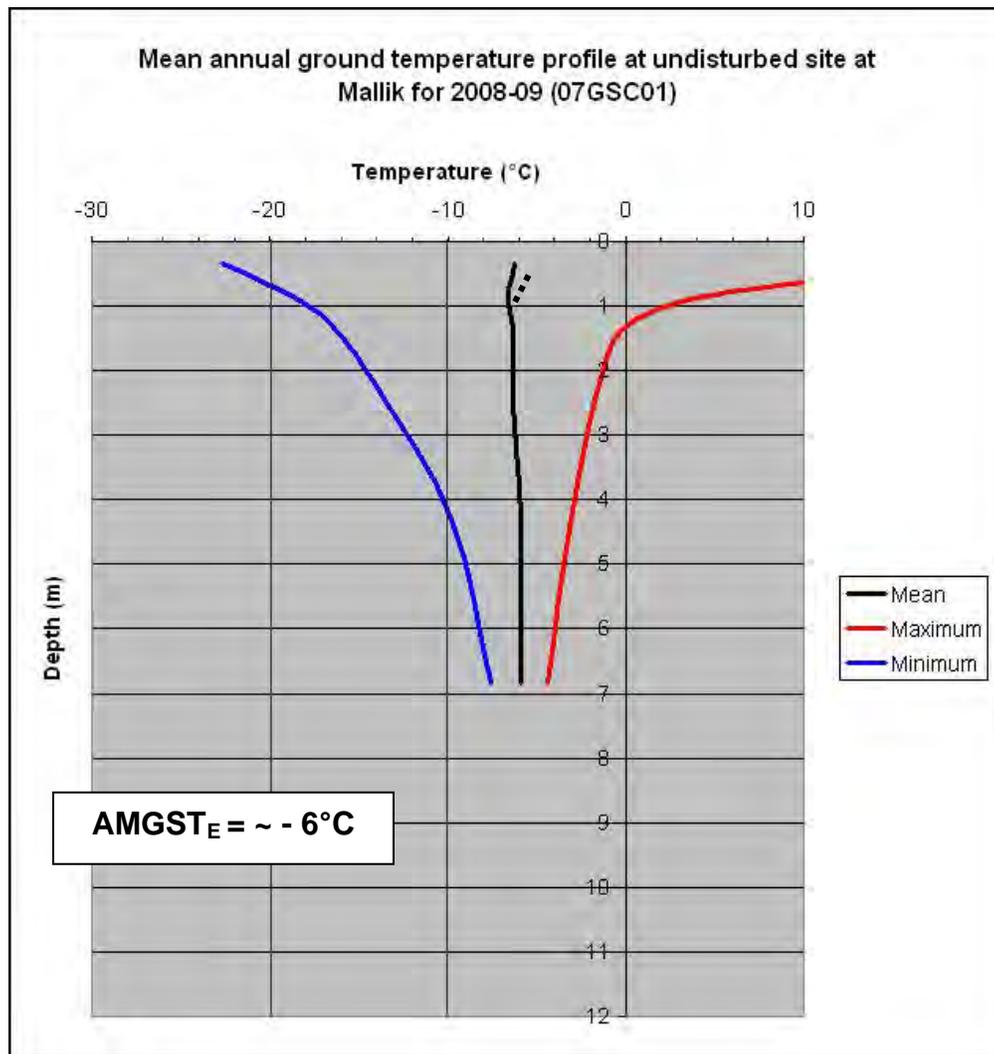


Figure 8: Trumpet curve of permafrost temperatures for 07GSC01 site. Mean annual ground surface temperature at this undisturbed site at the edge of a pond with approximately 10cm of standing water is approximately -6°C.

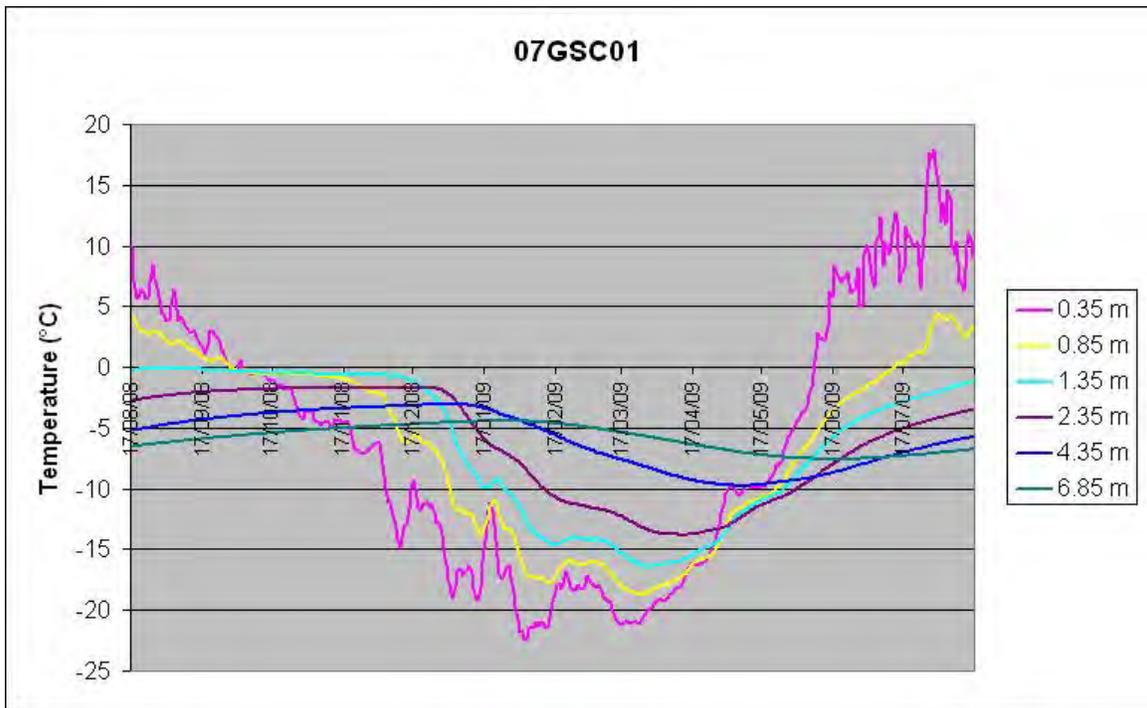


Figure 9: Record of annual temperatures at each measured depth below ground surface in 07GSC01 showing that surface thawing at this site was less than 1.35m.

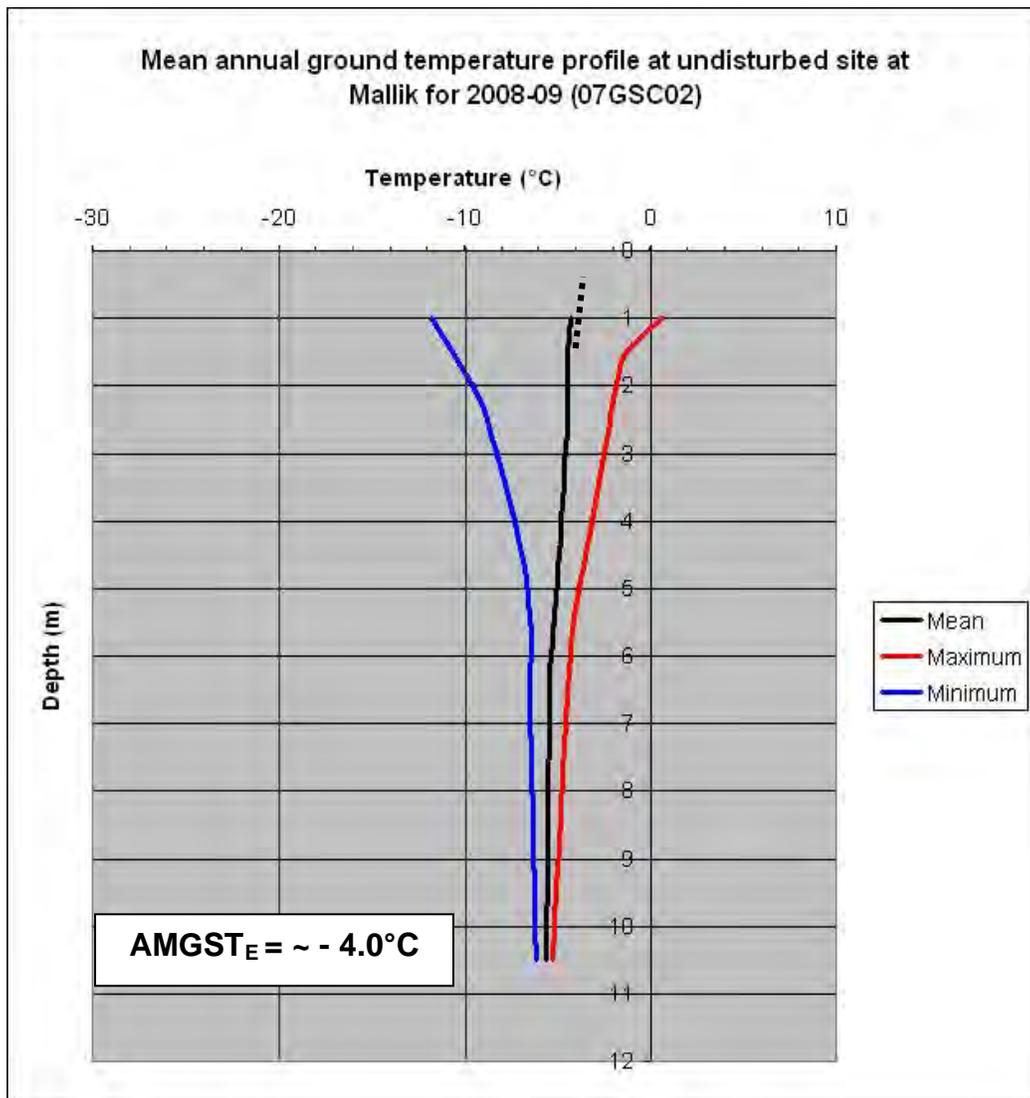


Figure 10: Trumpet curve of permafrost temperatures for 07GSC02 site located in an undisturbed site with low sedge and grass ground cover. Mean annual ground surface temperature at this site is approximately -4°C.

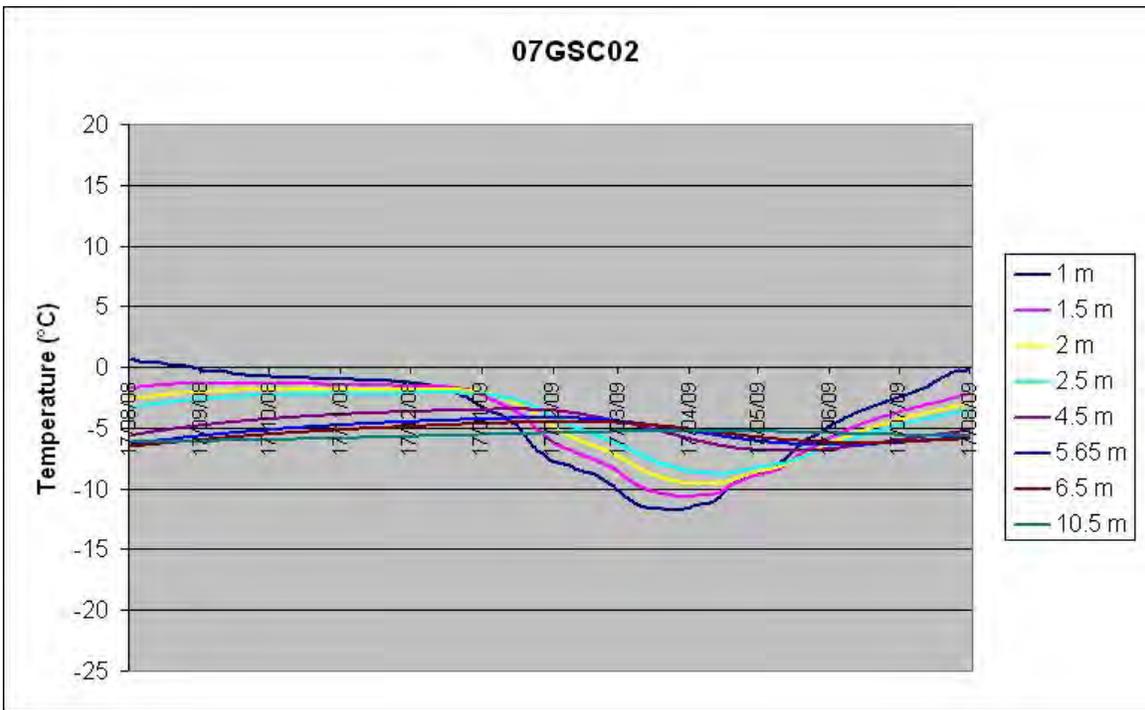


Figure 11: Record of annual temperatures at each measured depth below ground surface in 07GSC02 showing that surface thawing at this site was less than 1.5m.

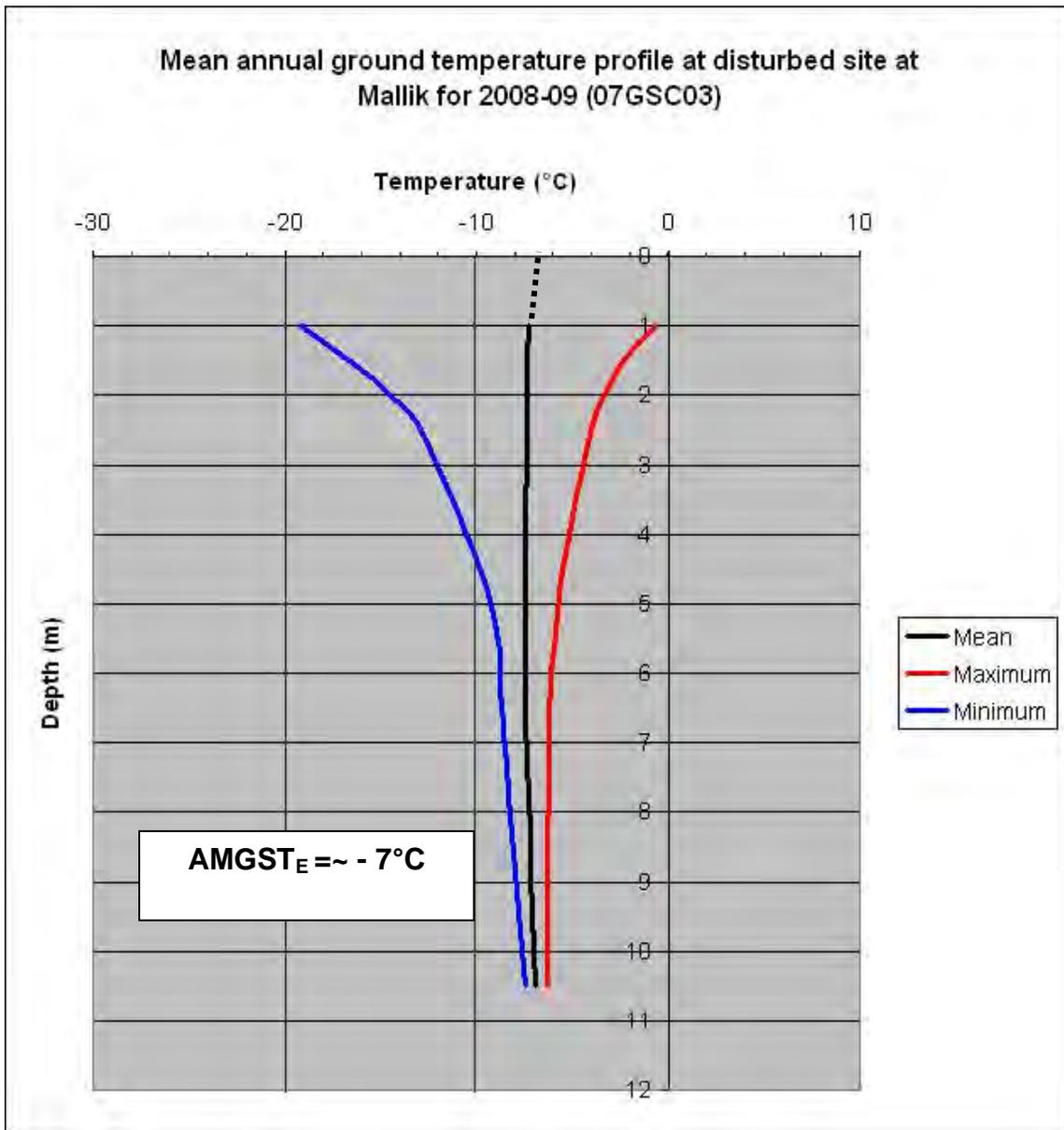


Figure 12: Trumpet curve of permafrost temperatures for 07GSC03 site located in Mallik 2002 sump. Mean annual ground surface temperature at this site is approximately -7°C.

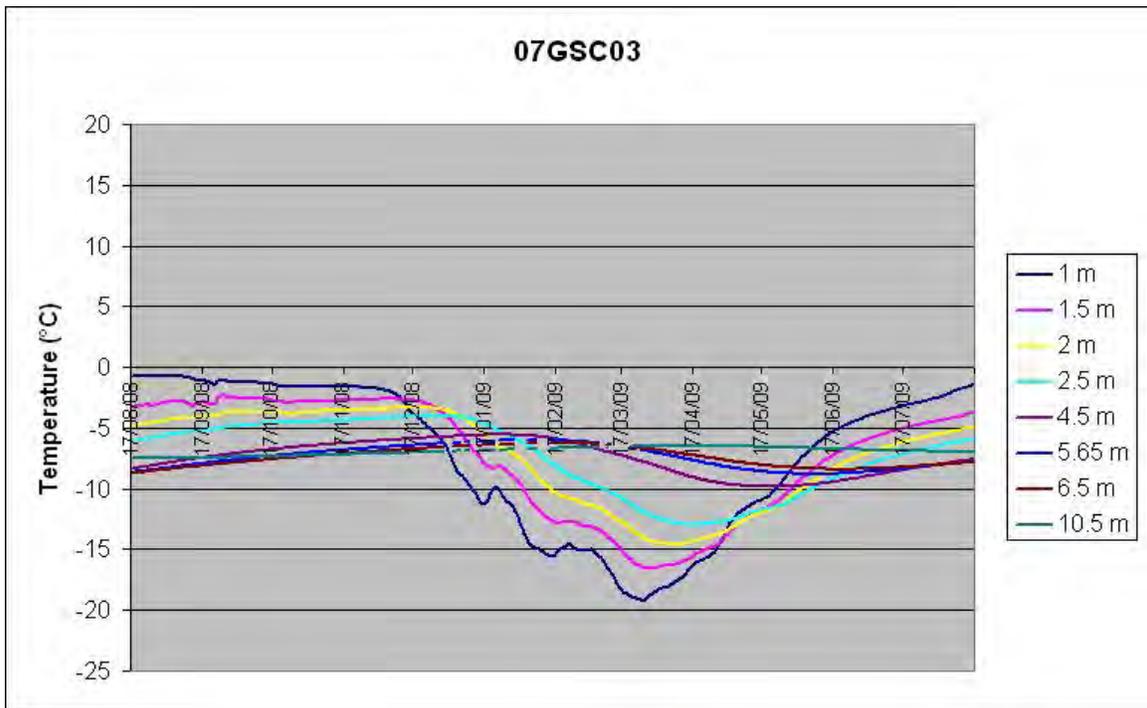


Figure 13: Record of annual temperatures at each measured depth below ground surface in 07GSC03 showing that surface thawing at this site was less than 1.0m.

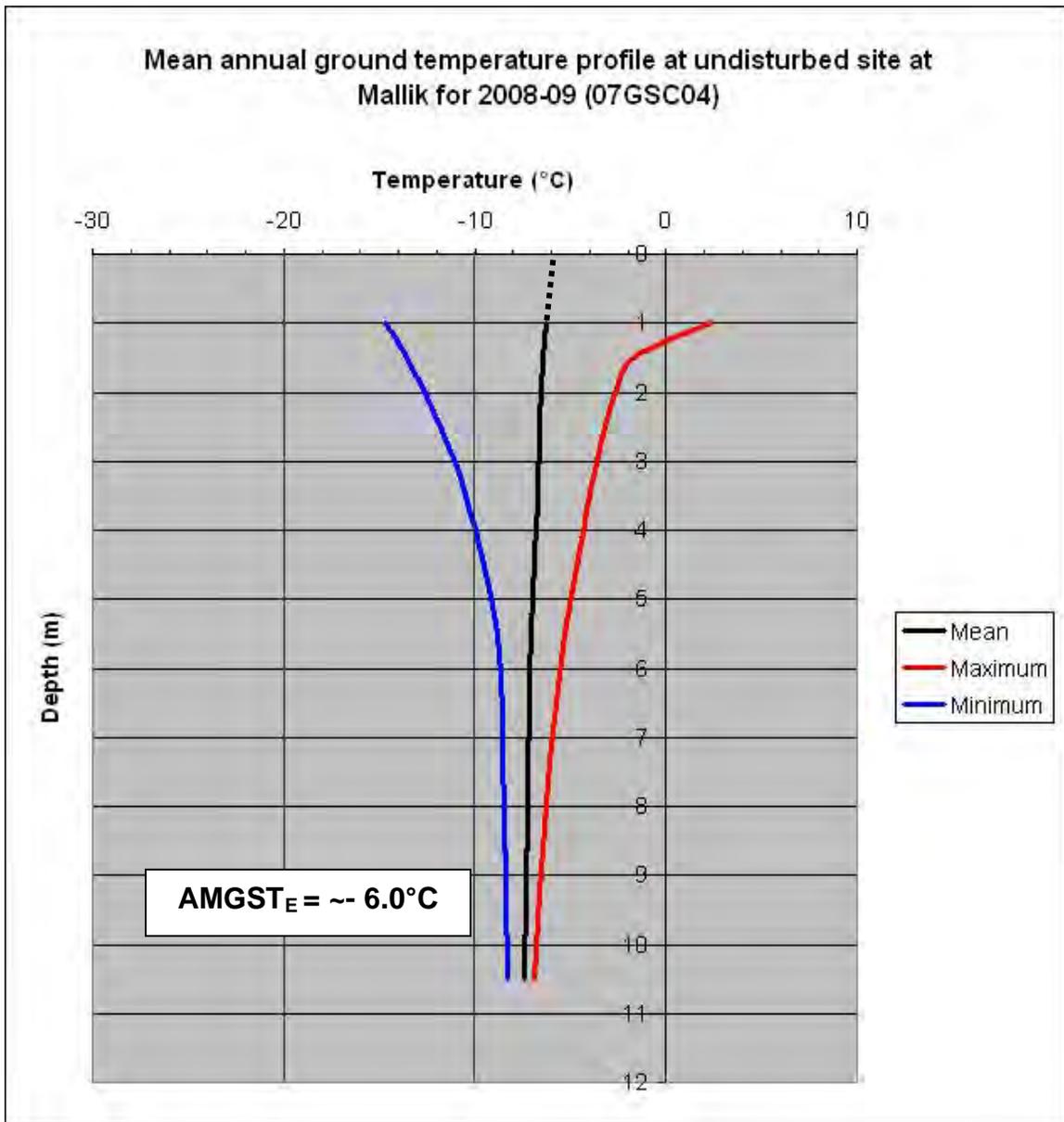


Figure 14: Trumpet curve of permafrost temperatures for 07GSC04 site located in an undisturbed site with sparse to bare ground cover. Mean annual ground surface temperature at this site is approximately -6°C.

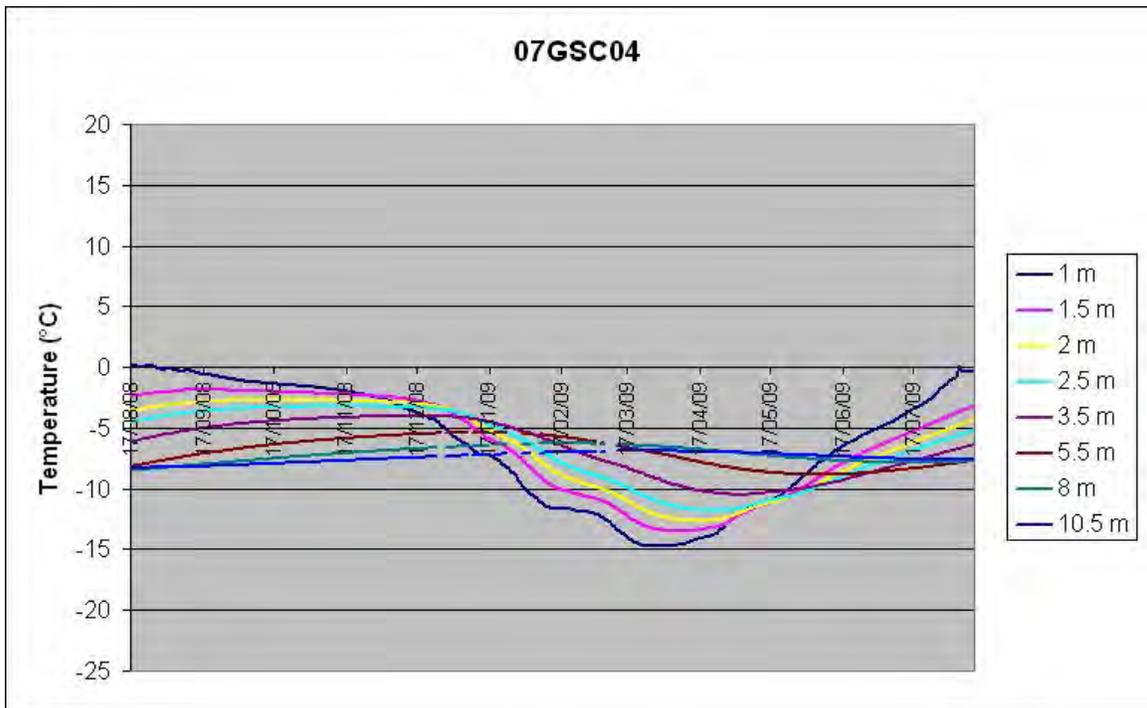


Figure 15: Record of annual temperatures at each measured depth below ground surface in 07GSC04 showing that surface thawing at this site was less than 1.5m.

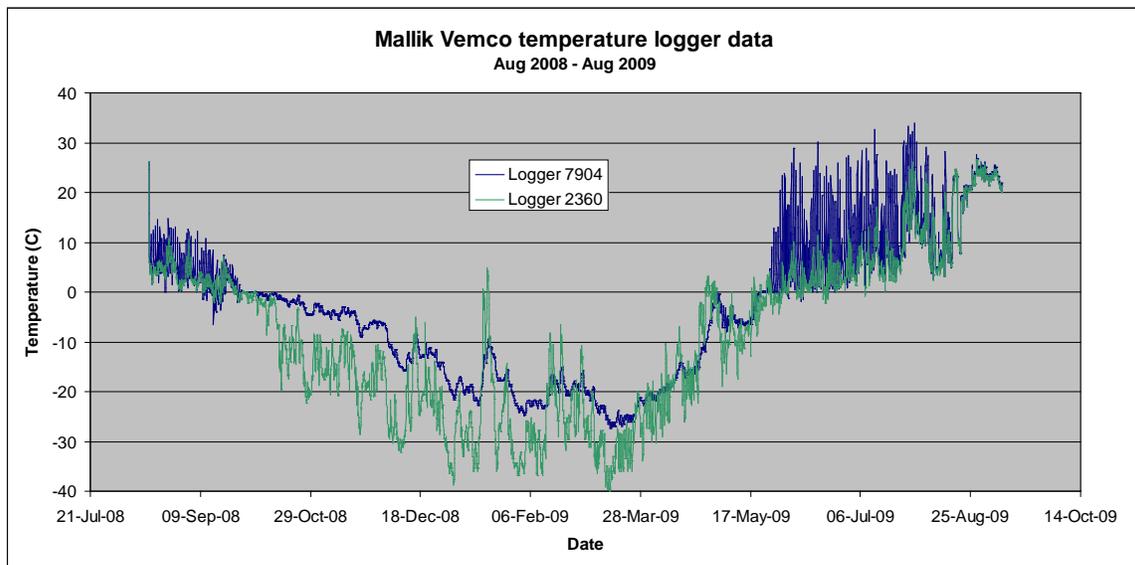


Figure 16: Air temperature record (green) and ground temperature data (blue) for the index site. Note the air temperature station was knocked down during the field season. By the change in the trend of the two records it is likely this occurred near the beginning of April.