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Des défis du Nord au Sud

Metadata Template for Ground Temperature Records in the Northwest Territories

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ABSTRACT
In northern Canada, ground temperatures are measured for a number of reasons including permafrost research and infrastructure development. A template for reporting metadata on ground temperature datasets will allow data to be easily shared between various users, and is a necessary step towards a permafrost database. We outline a metadata template for ground temperature measurements developed through collaboration with both users and collectors of ground temperature measurements. Our collaborators are typically involved with: permafrost research and modelling, geotechnical engineering, and infrastructure performance monitoring. Our metadata template is divided into seven sections: (1) Project Details; (2) Location of Ground Temperature Measurements; (3) Installation of Ground Temperature Cable; (4) Ground Temperature Record; (5) Site Conditions; (6) Permafrost Conditions; and (7) Related Publications and Data.

RÉSUMÉ
Dans le Nord canadien, les températures du sol sont mesurées à plusieurs fins, incluant la recherche sur le pergélisol et le développement des infrastructures. Un protocole de communication des métadonnées des mesures de température du sol permettra un partage de données plus efficace entre les intervenants de domaines variés et est nécessaire à l'élaboration d'une base de données sur le pergélisol. Dans cet article, nous présentons un protocole de communication de métadonnées des mesures de température du sol développé à partir d'une collaboration entre les collecteurs et les utilisateurs. Nos collaborateurs sont impliqués dans les domaines de la recherche et la modélisation du pergélisol, de l'ingénierie géotechnique, ainsi que dans le suivi de la performance des infrastructures. Notre protocole est divisé en sept sections: (1) Sommaire du projet; (2) Localisation des sites de mesure; (3) Installation de câbles de mesure de la température du sol; (4) Mesures de température du sol; (5) Description des sites de mesure; (6) Description du pergélisol; et (7) Publications et données connexes. Plusieurs champs sous forme de menu déroulant accompagnent chacune des 7 sections afin d'assurer la cohérence du protocole.

1 INTRODUCTION

In permafrost-affected terrain, knowledge of the ground thermal regime is an essential component to permafrost research, environmental monitoring, resource development projects, and infrastructure design and performance monitoring. In contrast to the broadly distributed data in Yukon and Alaska, publically-available ground temperature information in the Northwest Territories (NWT) is primarily constrained to a linear corridor and the western arctic coastlands (Figure 1). The majority of available data in the NWT was collected by the Geological Survey of Canada (GSC) in the Mackenzie Valley along the Enbridge Pipeline and the proposed pipeline right-of-way for the Mackenzie Gas Project (Smith et al. 2008a, 2008b, 2009, 2010a; Wolfe et al. 2010). Across the NWT, as well as the Western Arctic, ground temperature information is not representative of the terrain types, and so any existing data should be acquired to compliment the currently available records whenever possible. The Government of the Northwest Territories (GNWT) supports the collection of ground temperature data through research projects and infrastructure-related contracts. For example, the territorial government's Aurora Research Institute and Cumulative Impact Monitoring Program support numerous permafrost research projects in the Gwich'in and Inuvialuit Settlement Regions, and the Department of Transportation contracts thermal monitoring of highway infrastructure. Ground temperatures are measured in many NWT communities as part of geotechnical investigations for public infrastructure development. Monitoring of ground temperatures is also required at sites where permafrost is used as a waste containment medium. These research and monitoring programs typically summarize the ground thermal regime in academic publications (i.e. Burn and Kokelj 2009), or reports submitted to the GNWT or regulatory boards. However, the actual temperature data

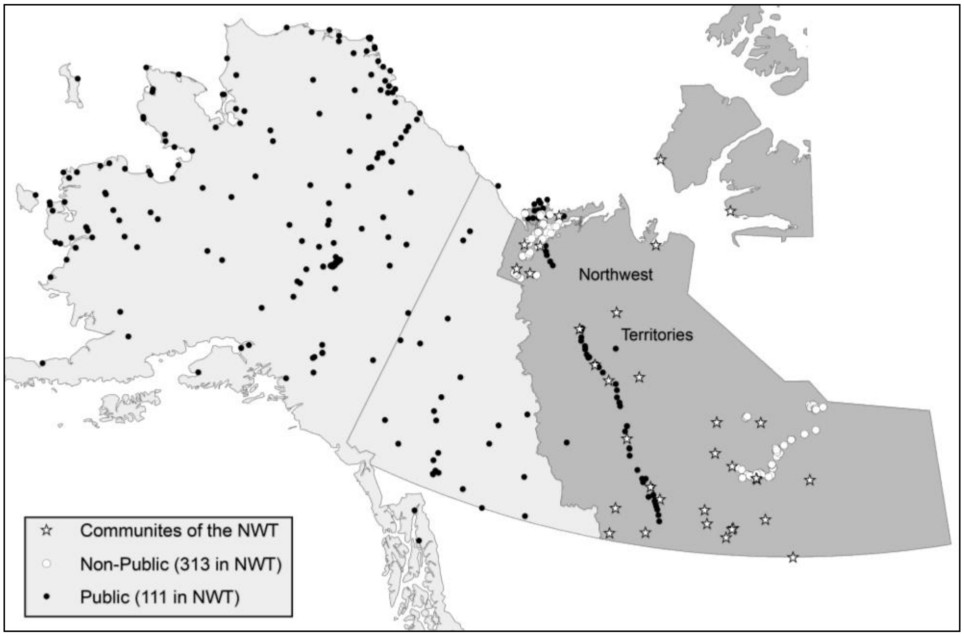

Figure 1. Ground temperature data locations in Alaska, Yukon, and the Northwest Territories (International Permafrost Association 2010; Smith et al. 2010b). In the Northwest Territories, publically-available data (black dots) are constrained to the Mackenzie Valley and western coastline. The NTGS is aware of over 300 ground temperature records that are not presently accessible to the public (white dots). Ground temperatures are probably available for many NWT communities (stars) but this information is not readily accessible either.

used to compile the report typically reside with the research institute or consultant, and are often not retained by the GNWT. As ground temperature data are expensive to collect, especially in remote areas, it is beneficial for the GNWT to house these data and make it accessible for use in future projects for the GNWT, the wider research community, industry and other users. The availability of large homogeneous datasets is a prerequisite for comprehensive statistical analyses (e.g., Boeckli et al. 2012) and process-based simulation (e.g., Fiddes et al. 2015) of permafrost and its changes.

The Northwest Territories Geological Survey (NTGS) and its collaborators are developing a publicly-accessible ground temperature database for the territory. The development of this database is timely because a substantial amount of ground temperature data are being collected for the Inuvik to Tuktoyaktuk Highway (ITH) construction (1110 measurements annually), and will be collected for the NTGS's Slave Province Surficial Material and Permafrost Study (approximately 1.3 million measurements annually). The NTGS also recognizes that a tremendous legacy of ground temperature data have been collected for research and monitoring purposes from across the NWT. Northern agencies that fund, license or regulate ground temperature measurements can leverage data contributions by requiring the submission of ground temperature information as part of funding agreements, research licenses, or land use permits.

The first step towards housing this information in a database is to establish a metadata reporting template so that ground temperature information is described in a common and standardized way. The purpose of this paper is to present a template for ground temperature metadata so that: (1) common attribute information about the installation location, instrumentation and site conditions are recorded; and (2) information on ground temperature data collection in the NWT can be accessed by researchers and decision-makers in the territory and shared with the international scientific community.

2 GROUND TEMPERATURE DATA AND METADATA

Metadata refers to information describing data (Grant, 2003). For ground temperature records, metadata include instrument specifications, borehole drilling procedures, and the details of measurement-site location and conditions. Metadata are needed to assess the nature of the data collection so that users can determine the usefulness of a dataset to an application. Metadata also provide a summary of the dataset, which improves the accessibility of the archive and offers a common language for stakeholders to share their data. Although the majority of ground temperature records are accompanied by some form of metadata, the nature of the documented metadata varies widely depending on the purpose of the data collection. Engineers, environmental researchers, permafrost modellers, and geomorphologists may be interested in different metadata, and may document this information using different terminology.

The recognition of permafrost as a key cryospheric variable has resulted in a substantial increase in the collection of ground temperature information and in the number of permafrost databases developed over the last decade. Examples of online permafrost databases include: the Norwegian Permafrost Database – NORPERM (Juliussen et al. 2010); Alpine Permafrost

Data (Cremonese et al. 2011); and the Global Terrestrial Network of Permafrost – GTN-P (Burgess et al. 2000). GTN-P is an international and publically-accessible database that provides long term field observations of permafrost (IPA 2012). The ground temperature metadata form described here was designed to be compatible with GTN-P standards (Smith and Brown 2009) so that NWT data can be integrated in this database.

3 DEVELOPMENT OF THE METADATA TEMPLATE

The development of this proposed metadata template was guided by three objectives. First, compilation of the metadata should be relatively straightforward for scientists (and their students) and engineers (both professionals and Engineers-In-Training). Second, the metadata should be comprehensive so that the captured information is relevant to a variety of stakeholders including territorial residents and decision-makers. Finally, the captured information should use consistent language and units, and be reported with the same level of detail. A ground temperature metadata template was designed to accomplish these objectives.

The NWT Ground Temperature Metadata template was initially designed to include variables that control the climate-permafrost relation, such as snow, vegetation and geology (Lachenbruch et al. 1988), as well as instrumentation details. The template was further developed by reviewing the information presented in academic and government publications and industry reports such as Smith et al. 2010b, Wolfe et al. 2010, and ITH reports submitted to the GNWT, and by examining existing permafrost databases. The metadata template was revised based on feedback received from: permafrost researchers and thermal modellers; geotechnical engineers; public and private sector geologists; and civil servants (federal, territorial, and municipal) involved with infrastructure performance monitoring.

The challenge of developing this metadata template is to capture sufficient and relevant information about site characteristics, instrumentation and measurement procedures, without overwhelming the tasks of data entry and data management. To address this issue, selected information fields of the template were designated as Mandatory – marked with an asterisk (*). All other fields provide valuable information using common terminology. The mandatory fields are the minimum required information needed for using the ground temperatures at regional investigations.

4 THE METADATA TEMPLATE

The metadata template describes one location of ground temperature measurements, and data contributors will be able to complete the template online, or as a fillable-pdf, which will be submitted to the NTGS. The ability to compile the metadata in a spreadsheet will also be available for those with multiple ground temperature measurement sites.

The metadata template is divided into seven sections: (1) Project Details; (2) Location of Ground Temperature Measurements; (3) Installation of Ground Temperature Cable; (4) Ground Temperature Record; (5) Site Conditions; (6) Permafrost Conditions; and (7) Related Publications and Data. Within each section there are several metadata fields, some of which are mandatory. To ensure consistent compilation of the metadata, the template uses selectable lists whenever possible. Open numerical fields with assigned units are used for quantitative metadata, such as site elevation, and open text fields are used for qualitative metadata that require more flexibility than is practical for a predetermined list. In the online template, all the open fields have a limited number of characters and have examples of appropriate metadata responses provided as 'ghost text'. Explanations of the metadata fields and references to background literature, such as NWT vegetation classification, are provided below the response fields. Finally, a free-form text box is provided at the end of each section to include important information not captured in the fields above. The metadata template is summarised in Table 1. Explanations of, and justifications for, the metadata fields that were included in the template are presented below.

4.1 Project Details

This section identifies the source and purpose of the ground temperature data collection. The majority of the metadata fields in this section are self-explanatory – *Data Submission Date*, *Project Manager* and their *Organization* and various contact information. The project name and/or number assigned by the project manager, as well as any GNWT-assigned identification (research license or contract number) will allow the data submitted to be cross-referenced with submitted proposals and deliverables.

The *Project Purpose* field communicates the intention of the data collection and thus suggests to users the nature of the record and other important metadata within the template to reference. For instance, if ground temperature measurements are for reclamation purposes, then disturbance-related metadata are expected. The *Project Purpose* list includes: *Permafrost Research*; *Reclamation*; *Long-term* (*environmental*) *Monitoring*; *Infrastructure Performance Monitoring*; *Regulatory Compliance Monitoring*; and *Geotechnical Investigation*. An opportunity to document an alternate purpose is provided.

4.2 Location of Ground Temperature Measurements

The metadata in this section describes the location of the borehole where ground temperatures were measured, and also includes geographical references. The *Site Identification* name and/or number allow the data to be linked to results presented in reports and publications. The geographic coordinates of the borehole informs the stakeholders where ground temperatures were measured, allows the geological and ecological site conditions to be determined, and enables spatial analyses to correlate ground temperatures with various environmental factors and infrastructure designs. The location of the borehole is reported in decimal-degrees with four decimal places (e.g. 62.45452; -114.37174). A precision of 110 m, 11 m, and

Table 1. A summary of the metadata fields included in the template. Proposed mandatory fields are identified with an asterisk (*).

Northwest Territories Ground Temperature Metadata Template			
Project Details			
*Data Submission Date:	*Project Manager:	*Organization:	*Phone Number:
*Email:	Project Name/Number:		
Project Purpose:	Permafrost Research [ ] Reclamation [ ] Long-term Monitoring [ ] Infrastructure Performance Monitoring [ ] Regulatory Compliance Monitoring [ ] Geotechnical Investigation [ ]		
Additional Comments:			
Location of Ground Temperature Measurements			
Site Identification:	*Latitude:	*Longitude:	Coordinate Accuracy:
*Geodetic Datum:	Geographic Reference:		
NWT Region:	North Slave [ ] South Slave [ ] Dehcho [ ] Sahtu Settlement Area [ ] Gwich'in Settlement Area [ ] Inuvialuit Settlement Region [ ] Outside NWT [ ]		
Additional Comments:			
Installation of Ground Temperature Data			
*Date of Drilling:	Drilling Method:	Borehole Diameter (cm):	Borehole Depth (m):
Casing Type:	Casing-Fill:	Borehole Backfill:	*GTC Installation Date:
*Sensor Type:	Sensor Resolution (°C):	Sensor Accuracy (°C):	*GTC Permanent [ ] Temporary [ ]
Calibration Values:	Missing [ ] Provided [ ] Adjusted [ ] *Sensor Depths (m):		
Sensor Status:	Functional Thermistors [ ] Not Functional Thermistors [ ] Partially Functional Thermistors [ ]		
Additional Comments:			
Ground Temperature Record			
*Record Start Date:	Data Collection:	Ongoing [ ] Complete [ ] Occasional [ ]	
Record End Date:	Data Recorded:	*Data Logger [ ] Manually [ ]	
Logger Resolution (°C):	Logger Accuracy (°C):	*Measure Interval (days):	
Additional Comments:			
Site Conditions			
Elevation (m):	Slope Aspect:	Slope Angle:	Local Relief (m):
*Ecoregion:	Tundra-Northern Arctic [ ] Tundra-Plains [ ] Tundra-Cordillera [ ] Tundra-Shield [ ] Taiga-Plains [ ] Taiga-Cordillera [ ] Taiga-Shield [ ] Boreal-Cordillera [ ] Other [ ]		
*Vegetation:	Exposed Bedrock [ ] Exposed Mineral Soil [ ] Moss and Lichen [ ] Shrub-Tall [ ] Shrub-Low [ ] Wetland-Treed [ ] Wetland-Shrub [ ] Wetland-Low Plants [ ] Coniferous-Dense [ ] Coniferous-Open [ ] Coniferous-Sparse [ ] Broadleaf-Dense [ ] Broadleaf-Open [ ] Broadleaf-Sparse [ ] Mixed Forest-Dense [ ] Mixed Forest-Open [ ] Mixed Forest-Sparse [ ]		
Organic Layer:	Thin (0-10 cm) [ ] Moderate (11-40 cm) [ ] Thick (41-100 cm) [ ] Very Thick (>100 cm) [ ]		
Snow Cover:	Thin (0-10 cm) [ ] Moderate (11-40 cm) [ ] Thick (41-100 cm) [ ] Very Thick (>100 cm) [ ]		
Surface Moisture:	Standing Water [ ] Flowing Water [ ] Wet [ ] Damp [ ] Dry [ ]		
Drill Logs:	Provided with Data [ ] Available from Project Manager [ ] Unavailable [ ]		
Overburden Thickness:			
*Surficial Geology:	Bedrock [ ] Till [ ] Organic [ ] Lacustrine [ ] Alluvial [ ] Colluvial [ ] Glaciofluvial [ ] Marine [ ]		
*Disturbance:	Natural Undisturbed [ ] Natural Disturbance [ ] Anthropogenic w/o Infrastructure [ ] Anthropogenic w/ Infrastructure [ ]		
Disturbance Type:	Disturbance Proximity (m):	Disturbance Date:	
Confidence of Disturbance Date:	Known [ ] Informed Estimate [ ] Uninformed Estimate [ ]		
Additional Comments:			
Permafrost Conditions			
MAGT (°C):	MAGT Sensor Depth(m):	MAGT Date/Interval:	
MAGT Calculation Method:	Measurement below the depth of seasonal temperature influence [ ] Mean of monthly/daily measurements taken below the active layer [ ] Extrapolation of the temperature envelope [ ]		
Ground Ice:	Observed [ ] Suspected but Unconfirmed [ ] Not Observed [ ]		
Additional Comments:			
Related Publications and Data			
Please list			

1.1 m is associated with three, four, and five decimal places respectively, so three decimal places is insufficient, four decimal places is a minimum, and five decimal places is ideal. Universal Transverse Mercator (UTM) coordinates were not selected for the metadata template because the use of decimal-degree coordinates eliminates the need to record the UTM zone, and because UTM coordinates are not recognized by Google Earth™, which is an important and accessible tool. The geodetic datum are reported – WGS84 is preferred – as well as an accuracy estimate for the coordinates.

This section of the template also includes two geographic reference fields: *Geographic Reference* (e.g. Yellowknife is 30 km south of borehole); and *NWT Region* (*North Slave*, *South Slave*, *Dehcho*, *Sahtu Settlement Area*, *Gwich'in Settlement Area*, *Inuvialuit Settlement Region*, or *Outside NWT*). These fields are important to, especially for regional users in the NWT, as they allow the database to be searched for datasets of interest without needing to plot the borehole coordinates. They also indicate accessibility of the site.

4.3 Installation of Ground Temperature Cable

Ground temperatures are typically measured using a permanently installed ground temperature cable (GTC) – an electrical cable with temperature sensors (usually thermistors) fixed along the length of the cable. Ground temperatures are also measured using single-sensor cables and/or non-permanent cables that are lowered down established boreholes. The initial part of this section of the metadata template describes the borehole in which ground temperatures were measured. The majority of the fields in this section are self-explanatory such as: *Date of Drilling*; *Drilling Method*; *Borehole Diameter*; *Borehole Depth*; and *Casing Type* (size and material) if casing was used. The field *Casing-Fill* refers to the material/fluid, such as silicone oil, that was placed in the casing following the installation of the GTC to inhibit convection. *Borehole-Backfill* refers to the material placed between the GTC or outside casing wall and the inside wall of the borehole.

Metadata for the temperature sensors include the *Date of GTC Installation*, and *Sensor Type* along with the *Sensor Resolution* and *Sensor Accuracy* specifications. The *Measurement Depths* are reported as positive values in metres, whereas any sensors along the GTC that lie above the ground surface should be noted using negative values or simply as A.G. (Above Ground). Temperature sensors should be calibrated prior to installation and the availability and application of *Calibration Values* are reported in this section of the metadata template.

4.4 Ground Temperature Record

This section of the metadata template describes the timing, duration and measurement frequency of the ground temperature record. If a data logger was used to record the measurement data, then the specifications are reported here. It is important to describe the quality of the data record in terms of *Record Completeness*, which is the amount of available data over the total expected data given the duration and measurement frequency. Any manipulation of the dataset, such as extrapolation to fill missing measurement values or reporting averages that were calculated from a series of measurements, are reported. These metadata are important to ensure that the use of any ground temperature dataset is done with recognition of data quality and hence limitations.

4.5 Site Conditions

The surface and subsurface conditions at the borehole sites control the relation between climate and the ground thermal regime and are described in this section of the metadata template. Different users have different priorities with respect to site characterization. This section of the template received the most feedback from those consulted during the development of the metadata template. Upon consideration of the feedback provided by those consulted, it is proposed that the site conditions should be described using the metadata fields below. Also the effect of site conditions on the ground thermal regime is highly scale-dependent – ground temperature at depth is influenced by a much larger surface area than at the near-surface. It is proposed that site conditions are described within a 15-m radius of the ground temperature measurement, as this is the resolution of most Landsat images.

4.5.1 Terrain

The metadata template includes several fields describing the terrain at a site. *Elevation*, *Slope Aspect*, and Slope *Angle* are included in the metadata template because they are important characteristics that control air temperature and solar radiation, especially in mountainous terrain. These parameters not only affect the ground temperature, but also influence snow, moisture, and vegetation conditions. Where the terrain is flat or undulating, slope and aspects are less important, and *Local Relief* (here defined as the range of elevations with a kilometre of the site) is more useful information.

4.5.2 Vegetation

Vegetation influences permafrost through shading Brown 1963), but also by affecting other variables particularly snow cover (Smith 1975; Sturm et al. 2001). Descriptions of vegetation can vary considerably depending on the project's purpose and the expertise of the person entering the information. It is important that metadata paint a picture of the vegetation assemblages without making the task too onerous. The template uses three fields to describe vegetation. First, the NWT *Ecoregion* is selected from a list of nine options: *Tundra* (*Northern Arctic*, *Plains*, *Cordillera*, or *Shield*); *Taiga* (*Plains*, *Cordillera*, or *Shield*); *Boreal Cordillera*; or '*Other*'. The NWT Ecosystem Classification includes distribution maps and detailed descriptions of each of the ecoregions, which can be referenced to inform this selection (Department of Environment and Natural Resources 2015). The ecoregion is included because it provides a broad climate and geological context for the vegetation conditions.

The second field in this section is *Vegetation Classification*, and employs a list of 17 choices to facilitate the description. *Exposed Bedrock*, *Exposed Mineral Soil*, or *Moss and Lichen* is selected to describe sites with little vegetation. Sites dominated by shrubs are described as having either tall (>0.3 m) or short shrubs, and wetlands are classified as having trees, shrubs, or non-woody plants. Treed sites are classified as coniferous, broadleaf, or mixed forest, and the tree density within each of these three classifications is described as dense, open, or sparse. This classification list has been slightly modified from the EOSD Vegetation Classification in the NWT (ENR-GNWT 2011). In the instance that the vegetation at a site is not easily described by one of these classifications, the best classification is entered along with a note in the free-form text box for this section.

The *Organic Layer Thickness*, including peat, is particularly important to the ground thermal regime (Brown 1963; Nicholas and Hinkel 1996), and so a qualitative description is included. The organic layer is described as: *Thin* (0-10 cm), *Moderate* (11-40 cm), *Thick* (41-100 cm), or *Very Thick* (>100 cm). A field is provided to report this value or range where the organic layer thickness is known or varies considerably (i.e. hummocky terrain).

4.5.3 Snow and Moisture

Snow and surface moisture conditions greatly affect the ground thermal regime (ie. Goodrich, 1982, Palmer et al. 2012) but are challenging to describe unless sites are visited regularly, as these conditions vary interannually and throughout the year. If snow or moisture conditions are known, this information should be reported with the observation date. *Snow Cover Thickness* can be classified as: *Thin* (0-10 cm), *Moderate* (11-40 cm), *Thick* (41-100 cm), or *Very Thick* (>100 cm). *Surface Moisture* conditions are described as: *Standing Water*, *Flowing Water*, *Wet*, *Damp*, or *Dry*. Snow and moisture conditions are not estimated if they were not observed

4.5.4 Stratigraphy

The *Stratigraphy* of the subsurface is of interest to most ground temperature stakeholders as soil, moisture, and ice conditions control the transfer of heat in the ground (Williams and Smith 1989; Andersland and Ladanyi 2004), and these parameters indicate the vulnerability of the terrain to climate change and surface disturbance. The metadata template provides a table to report the thickness of stratigraphic layers with a succinct description of the subsurface properties (Table 2). The text box for the description is limited to 100 characters to enforce brevity. The metadata template also provides a field to report if stratigraphic logs are available, and the overburden thickness (depth to bedrock) if it is known.

Table 2. An example of a simplified stratigraphic log.

Depth (m)	Succinct Description
0 – 0.5	Organics, saturated
0.5 – 2.3	Sand and Silt in layers, frozen, 10% ice
2.3 – 5.4	Silt, frozen, <10% ice
5.4	End of Borehole

The *Surficial Geology* of a site provides insight to larger scale subsurface conditions, and is therefore reported as: *Bedrock*, *Till*, *Organic*, *Lacustrine*, *Alluvial*, *Colluvial*, *Glaciofluvial*, or *Marine*. This list was modified from (Fulton 1995), and a Google Earth™ compilation of NWT surficial geology maps can be accessed through the NTGS website (www.nwtgeoscience.ca). Important observations of subsurface conditions are recorded in the free-form text box.

4.5.5 Disturbances and Infrastructure

Disturbance to the surface conditions (both natural and anthropogenic), as well as the proximity of a thermal object (i.e. lake or thermosyphon) are recorded on the metadata template as they influence the ground thermal regime (Kanigan et al., 2008). There are several fields in the metadata template to capture the nature of a disturbance. First, the nature of the disturbance is selected from: *Natural Undisturbed*, *Natural Disturbed* (i.e. forest fire), *Anthropogenic Disturbance with no Infrastructure* (i.e. cleared of vegetation), and *Anthropogenic Disturbance with Infrastructure* (i.e. road embankment or building). A brief description of the disturbance or infrastructure is included along with the proximity to the disturbance. If appropriate, the date of the disturbance is estimated and the confidence in the estimate is selected from: *Uninformed Estimate*, *Informed Estimate*, or *Known*.

4.6 Permafrost Conditions

The ground temperature metadata template includes a summary of permafrost conditions. The mean annual ground temperature (*MAGT*) is an effective descriptive statistic and is to be reported when possible and should be accompanied by a description of the method used to calculate MAGT, the depth of the sensor used in the calculations, and the date or timing of the 12 month interval of the temperature measurements. Ideally, the MAGT at the depth of zero annual amplitude is provided. The supporting calculation information allows the MAGT to be applied, or omitted, with confidence. Finally, *Ground Ice* is noted as: *Observed*, *Suspected but Not Confirmed*, or *Not Observed*. These fields are provided in the metadata template. A Ground ice Description text-box is included to describe the type or origin (i.e. ice wedge, segregated) of the ground ice.

4.7 Related Publications and Data

This final section provides the opportunity to include *References and/or Links* to related papers, reports, projects and ancillary information such as climate data. It should be noted here if the data are already hosted on a publically-accessible database such as GTN-P. The contributor must also complete the *Publication Policy* field which includes two options – *Unrestricted Data Usage* or *Permission Required Prior to Publication*.

4.8 Conclusion

Development of the metadata template is the first step towards improving organization and accessibility of ground temperature data collected in the NWT. Additional input on the content and structure of the template will be acquired from partners before the template is finalized. At this time the NTGS will begin populating the database – first by compiling the known records using the metadata template and then harvesting the associated ground temperature data. Ultimately the data will be disseminated through the NTGS online database applications, which are currently being redesigned, and the data management (including acquiring new datasets, validating metadata, and formatting the data) will be accomplished by the NTGS Information Services Team. Eventually, other GNWT agencies will be compelled to include the submission of ground temperature data in their contracting, funding and licencing agreements.

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