NOTICE OF MOTION

A Notice of Motion is the method used by members of Council that wish to introduce a new piece of business, propose an action of Administration, or propose amendments to current work plans for policies to better support the needs of their ratepayers.

Date Submitted: **2023-01-27**
Council Meeting Date: **2023-02-01**

Respectfully Submitted by:
Councillor Lyckman - Division 4

Councillor Northcott - Division 6

Vulcan County Contribution Toward Locating Missing Graves Project – MITACS – University of Lethbridge

Proposal
MOVE THAT Vulcan County contribute a total of $7,500.00 toward the MITACS Vulcan County Locating Missing Graves Project.

AND THAT Council authorise Administration to coordinate the receipt of municipal and community group contributions toward this project on behalf of the region, paying all invoices to the University of Lethbridge to satisfy the fifty percent cost-share requirement.

Background

The Carmangay, Travers, Lomond and Marquis Municipal (East Milo) cemeteries each have significant areas that cannot be utilized because of unmarked graves. Marking these burial sites and updating the cemetery surveys will allow for these cemeteries to be uploaded into the Geographic Information System (GIS) that ORRSC provides for the villages of Carmangay, Lomond and Milo. This will allow for all burial sites to be recognized, some of which might prove historically significant, as well as ensure that historical graves are less likely to be discovered during excavation. This will also enable better long-term record keeping and plot planning for families wishing to have future burials at these cemeteries. Unmarked graves have been a significant issue for the management of cemeteries in the communities of Carmangay, Lomond and Milo for many years and this project hopes to rectify this problem.

If approved by the MITACS Program, Dr. Craig Coburn of the University of Lethbridge will undertake all necessary investigation, producing a report, as well as providing Vulcan County with survey data for each community. Should the project allow time for it, additional investigation and reporting for select cemetery locations remains a possibility, be it the Arrowwood, Anastasia, Hope Lutheran, or Champion cemeteries.

Financial/Policy Consideration

The MITACS Program will provide $15,000 worth of funding toward this program for 8 months of work, allowing partnering organizations to also utilize University of Lethbridge professorial expertise student intern labour, as well as equipment and acquired assets that are deemed necessary. This contribution amounts to fifty percent of the funding requirement while the partnering organizations will need to provide the other fifty percent of the funds to a total of $30,000. Each four month unit costs $15,000 or $7,500 from the partnering organization.

Three communities in Vulcan County require most of the work required to locate unmarked graves in Vulcan County. We are told that the Villages of Carmangay, Lomond and Milo are able to commit $500 each toward the project. Payment will be made to Vulcan County upon approval of MITACS funding and program support. Councillors Lyckman and Northcott propose that Vulcan County contribute $2,500 per community toward this project, to a total of $7,500. The remaining funds required ($6,000) will be raised from community groups serving Carmangay, Lomond and Milo, being $2,000 from each community. Councillors Lyckman and Northcott believe this to be a realistic fundraising target.

Strategic Plan Alignment

Foster a Collaborative Environment

Responsible & Transparent Leadership and Governance

Safe Communities

Implementation/Communication

Should Vulcan County Council approve participation in this project, Councillors Lyckman and Northcott will make immediate application to the MITACS program for this project as outlined above. We are hoping to take advantage of more optimal project weather and temperatures come May of 2023, and we recognise that there is a MITACS review and approval process that needs to be completed before this can occur.

Furthermore, Councillors Lyckman and Northcott will issue the attached template letter to the Villages of Carmangay, Lomond and Milo, as well as the second template letter to the following community groups:

- The Carmangay & District Historical Society
- The Carmangay Agricultural Society
- The Lions Club of Carmangay
- The Lomond Cemeteries Committee
- The Lions Club of Lomond
- The Milo & District Agricultural Society
- The Lions Club of Milo

Attachments

Coburn, Craig. Proposal: Locating Missing Grave Sites using Remote Piloted Aircraft Systems

2023-02-01 Letter to Mayor and Council, Village of TEMPLATE

2023-02-01 Letter to Community Group TEMPLATE

Proposal: Locating Missing Grave Sites using Remote Piloted Aircraft Systems.

Research Abstract:

The proposed research will investigate a variety of methods including multispectral and thermal imaging as well as terrain analysis using topography rendered from Structure from Motion (SfM) to locate potential grave sites at a variety of locations in Southern Alberta. Emerging technological innovation in remote sensing is opening up new applications. The ability of Remote Piloted Aircraft Systems (RPAS) to gather detailed site data using cameras designed to capture light outside of the visible spectrum including thermal infrared emissions. Previous research has found a variety of remote sensing techniques useful for finding grave sites in forensic contexts. This research is seeking to make use of these advances to investigate their utility for finding grave site locations when records are incomplete in the historical context. Some of these sites feature individual grave sites while others may have larger assemblages containing multiple bodies related to the Spanish Flu outbreak in 1918. Using these advances to locate missing grave sites provides an opportunity to recover lost records of graves in a non-destructive and cost-effective manner. By locating these lost graves, municipal records can be updated and detailed maps will prevent potential future disturbance of these sites.

Background and review of relevant prior work:

Introduction:

There has been a lot of interest in the past 20 years on using remote sensing to uncover hidden or lost graves. These unmarked graves are frequently the interest of forensic remote sensing and is focused on finding human remains in hidden locations. The interest is usually in finding murdered victims that are hidden in remote areas often using animal analogues to simulate the common methods used by criminals to hide murder victims. This area of research has investigated a wide range of methods from geophysical methods, hyperspectral remote sensing and thermal emission of the grave site.

Scientists from a variety of research specializations from Archaeology to Geography that are investigating historical grave sites use a variety of techniques to locate these unseen spatial areas. Many Archaeologists have found unmarked graves from the distant past or historical contexts using geospatial technologies. Studies have ranged from ground penetrating RADAR (GPR) and satellite remote sensing approaches with more recent use of Remote Piloted Aircraft Systems (RPAS or Drones) as a method of gathering high spatial and temporal resolution images. For example, the recent uncovering of the graves of Indigenous children located at residential schools in Canada have been located using GPR and other geospatial technologies (TRCC, 2016). Images gathered using RPAS have much higher spatial resolution that from other imaging modalities (like GPR) and these systems can now deploy a range of remote sensing systems including hyperspectral, multispectral, thermal and LiDAR. These systems can produce detailed images (including infrared and thermal) that can be used to find anomalous areas that indicate the grave site or can sense thermal differences that are not seen by eye. Graves can be found through high spatial resolution digital elevation models (DEM) by looking for depressions left after the disturbed area has settled (Kalacska et al., 2009). The advantage of these RPAS methods is being able to collect very detailed geospatial data over small areas as often as needed (Fernández-Hernandez, et al., 2015).

It is not uncommon for cemeteries to have unmarked grave sites. These occur for a wide range of reasons from financial (either poor or wealthy) to theft of the marker. Unmarked graves are also common during pandemics or war when large numbers of people have died and require burial. Unmarked graves may indicate that the person had financial limitations, removal, or theft of the marker or the records of the burial location can be lost or otherwise damaged. Until relatively recently, the loss of grave records meant that the grave site would remain unknown – remote sensing and geophysical methods have been employed to reveal these important locations. Most of the past North American Archaeology research has focused on using the geophysical tools of GPR and ground resistivity surveys for finding unmarked grave sites. While these geophysical methods are reasonably robust, they require expensive specialized equipment and areas must be traversed on foot to collect data.

The ability of geospatial technologies to rapidly record and map the physical properties of Earth surface materials without direct contact enables most of the geospatial informatics we use to map and monitor our planet. Remote sensing is, by definition, a non-destructive method of recording the physical properties of the Earth's surface and the ability of remote sensing technologies to provide broad spatial coverage using a wide variety of reflected and emitted light is the key to the utility of these geospatial technologies.

Recent advances in remote sensing systems integrated into RPAS methods has sparked the interest in remote sensing applications well beyond the traditional realm of mapping and monitoring that have been the focus of remote sensing science for the past 80 years. For example, Archaeologists were early adopters of remote sensing because it can provide a "birds-eye" view that helps them understand the landscape by providing images of the spatial context. They employed aerial photography using planes, balloons and kites to gather this important vantage point. With the advent of satellite remote sensing in the 1970's, Archaeology found new sites based on spectral differences outside of what could be seen using photography. Most recently, new technologies like RPAS, GPR and Light Detection and Ranging (LiDAR) are continuing to revolutionize Archaeology.

RPAS technologies allow Archaeologists to record spectral and topographic data themselves in a cost-effective way. They then integrating these tools into their methods, they are uncovering many hidden areas that are important to understanding our past.

This research proposes to employ remote sensing techniques using RPAS data to collect multispectral and thermal images as well as terrain models using Structure from Motion (SfM) to attempt to locate potential grave locations in a variety of cemeteries in Southern Alberta. These cemeteries have incomplete records of their grave site locations and require detailed maps in order to locate known and probable grave locations. The results of this study will provide the municipal governments responsible for these cemeteries to update their records and provide the detailed maps required to avoid future disturbance of the sites.

Background:

Remote sensing has been making significant scientific contributions in the areas of mapping and monitoring the Earth since the first balloon flights in the 1860's. Prior to the deployment of photographic cameras on these precarious platforms, maps were made using laborious manual techniques and were often only completed for areas during times of conflict or conquest. The use of remote sensing in the field of Archaeology starts in these early years and has continued until the present day. The ability to see the spatial context of any geographical pursuit is paramount. Lately, the development of reasonably inexpensive remote sensing technologies in the form of RPAS has expanded the opportunities to use current advanced imaging systems coupled with inexpensive "drone" platforms. The available sensors now include hyperspectral, multispectral, LiDAR and even RADAR systems. These advanced technologies have enabled scientists beyond remote sensing to further explore research opportunities that only a few years ago were unknown to their science.

Remote sensing is often conducted when searching for geographical evidence of past civilization. By providing the spatial data needed to understand human occupation of a landscape, the archaeologist has a much enhanced view of resource extraction, trade, migration and culturally significant areas (Campana, 2017; Emaus & Goossens, 2015; Renfrew & Bahn, 2019; G. Verhoeven & Sevara, 2016; G. J. J. Verhoeven, 2009).

The use of RPAS systems enhances our ability to collect high spatial resolution images with sufficient spatial overlap to compute three-dimensional Digital Elevation Models (DEM) from the images in a photogrammetric process known as Structure from Motion (SfM). These dense point clouds are used to compute the precise 3D position of all features visible in the image as well as correct the original image which is distorted due to topography, camera position and optical characteristics. These images are transformed into accurate maps called orthophotos. These DEMs have been used in many studies from identifying previously unseen geoglyphs at the Nazca Lines in Peru (Pavelka, Šedina, and Matoušková, 2018) to the identification of building outlines (Mancera-Taboada, 2015) to name but a few examples of the use of this analytical tool.

More recently, Laser Detection and Ranging (LiDAR) has been extensively used to assess landscapes. LiDAR uses a rapidly pulsed laser to accurately measure distances to objects and develop 3D point clouds. The primary advantage of this technology is the ability to record pulses that have traversed through vegetation canopies and are collected from the ground. This gives a true 3D view of landscapes as it allows for the vegetation to be digitally removed from the landscape (Bundzel et al., 2020; Chase, Chase, Fisher, Leisz, & Weishampel, 2012). LiDAR is typically acquired via fixed-wing aircraft, making it costly, but there is now a trend to utilize LiDAR sensors mounted to UAVs, reducing the expense by restricting the area being observed (Murtha et al., 2019; Risbøl & Gustavsen, 2018; VanValkenburgh et al., 2020).

Thermal imaging unlike other remote sensing techniques is looking at emission (8 – 15 μm) differences (temperature) between objects for discrimination. The use of thermal sensors in either airborne or RPAS modes has been hampered by the cost and low spatial resolution of the sensors. In the past 10 years, the cost of these sensors has become much more cost effective and consequently research in areas like detection of archaeological sites is beginning to develop as an application (Brooke, 2018; Piga et al., 2014).

For example, James et al. (2020) utilized thermal sensors mounted on UAVs to detect buried archaeological features under cultivated crops in the United Kingdom. A FLIR thermal sensor that is typically used to detect crop stress was used on a known site in Scotland. Vegetation index maps were generated from multispectral images, also mounted on the UAV, and compared to the thermal images. While this study concluded that the multispectral images provided better results in identifying buried archaeological features than the thermal imaging, it demonstrated that for certain targets, thermal images were also effective (Des Marais, 2014).

Many studies exist in the forensic context that demonstrate that decomposing bodies (even when buried) are detectable due to increased temperature of the grave site relative to the undisturbed soil (Butters et al., 2021; Des Marais, 2014; Edelman et al., 2013). Other studies have shown that even after the decomposition period has passed, the difference in the soil temperature of a disturbed site can be detected for very long periods of time post burial due to the presence of voids and differences in soil moisture or soil permeability caused by the disturbance of the soil profile (Silván-Cárdenas, et al., 2021).

Grave sites in the majority of cases involve the disturbance of soil. These disturbances are detectable as an anomalous variation in the elevation of the surface. Often higher than normal initially and then a depression in later years (Silván-Cárdenas, et al., 2021). These topographic anomalies can be found using terrain analysis techniques commonly used in other geographical fields (Kalacska et al., 2009).

This study will focus on the use of RPAS multispectral imaging and analysis techniques, terrain analysis from SfM derived DEMs and thermal imagery for the detection of possible grave locations in southern Alberta rural cemeteries. The combination of these spatial analysis techniques has not been implemented in very many published works and could represent a valuable contribution to detecting unknown graves in municipal cemeteries in rural areas.

General Objectives:

The study areas are in rural cemeteries in Southern Alberta. The specific cemeteries identified at this time include those located at Carmangay, Arrowwood, Champion, Lomond and Vulcan. Each site will present a unique context and history. Through consultation with the partner organisation (Vulcan County – I need input here) we will work to develop a detailed field survey plan. The selection criteria will first involve locating grave sites at for locations where unmarked but known graves exist. RPAS imagery will be deployed several times over the spring/summer and fall seasons to gather the required image and topographical data.

This preliminary site selection and analysis method will assist in identifying remote sensing methods required for the further survey of the other required locations. While it is not possible in the scope of this project to survey all cemeteries in the region, identification of viable methods for extracting this important missing data would enable future work to aid in compiling a complete record of the location of missing graves.

Expected deliverables: Mitacs Final Report and Mitacs survey at the end of the project. The partner organisation will receive a written report and digital archive of all images and ground photographs acquired as part of this project. All digital data including orthophotos, elevation models and thermal imagery for each site will be exported in a GIS accessible format to be determined at the conclusion of the research project.

Benefit to the intern: The development of new geospatial technologies out-strips our ability to adequately train undergraduate students for potential career prospects. One of the areas that we require additional training is in the acquisition and analysis of data from RPAS remote sensing. The intern will learn the latest software and hardware technology as well as continue to develop critical analysis and communication skills. We are expecting that the intern will also spend some time consulting with the various communities and stakeholders and will benefit from the interaction.

Partner interaction
Resources that will be provided by the partner organization include cemetery site location and historical or archival data. Acting as a liaison between the intern and private landowners or caretaking organizations as needed, and providing guidance as needed. The partner organization has a wide variety of members and expertise that can be drawn upon should any questions arise during the project.

Interaction % at partner organization location in Canada = 30% (I need input here)
Interaction % at academic institution in Canada = 70%
Rationale for percent breakdown: The academic institution host the computer hardware and specialized equipment required for this project. The training required for the intern can only be delivered by the professor/supervisor.

Relevance to partner organization and to Canada:
The partner organization requires detailed historical data on the location of potential grave sites to preserve these sites, prevent disturbance and enable the continued use of the area for its intended purpose. This information is historically relevant and represents a record of the early settlement of these area in Southern Alberta. [Add as needed]
The early settlement history of Canada as represented in the many cemeteries across this country is subject to the shifting nature of rural populations. During these times, records and locations of graves was not regulated and subject to the upkeep of the area and the maintenance of these records. Consequently, as the population has shifted to more urban areas, these cemeteries have become the responsibility of larger municipal governments who often have limited resources and historical records to adequately manage these areas. This is a phenomena across Canada. The development of advanced geospatial tools to assist in the recording of these grave locations is beneficial for the preservation of Canadian history. The recent discovery of thousands of lost graves on Canadian residential schools draws clear focus on the importance of geospatial technologies to the uncovering and preservation of Canadian history.

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P.O. BOX 180
VULCAN, ALBERTA
T0L 2B0

TELEPHONE: 1-403-485-2241
TOLL FREE: 1-877-485-2299
FAX: 1-403-485-2920
www.vulcancounty.ab.ca

February 1, 2023

Mayor & Council
Village of TEMPLATE
P.O. Box
TEMPLATE, AB
A1B 2C3

Re: MITACS Vulcan County Locating Missing Graves Project

Dear Mayor & Council,

The communities of Carmangay, Lomond and Milo have recognized that unmarked graves present a significant challenge for the planning and maintenance of their cemeteries. Through the SouthGrow Regional Initiative we were made aware of a unique program offered through the University of Lethbridge called MITACS. This program will provide fifty percent of the funding to a partnering organization for an approved project. It will also provide the partnering organization access to university professorial expertise, equipment and the labour of student interns.

At the February 1, 2023, meeting of Vulcan County Council, the following motion was carried:

> MOVED by Councillor _____________ that Vulcan County contribute a total of $7,500.00 toward the MITACS Vulcan County Locating Missing Graves Project.
>
> AND THAT Council authorise Administration to coordinate the receipt of municipal and community group contributions toward this project on behalf of the region, paying all invoices to the University of Lethbridge to satisfy the fifty percent cost-share requirement.

To ensure that this project moves forward, Vulcan County is prepared to sponsor the administration of it. This project will take eight months and the local contribution required to match the MITACS program is $15,000.00. As such, we are looking secure $500.00 from each of the three villages and $2,000.00 from each community, whether it is raised by one organization or multiple interested parties.

The MITACS Vulcan County Locating Missing Graves Project will investigate four primary cemeteries, being the Carmangay, Travers, Lomond and Marquis Municipal (East Milo) cemeteries. This project will result in a report produced by Dr. Craig Coburn of the University of Lethbridge, as well as provide all the necessary survey data that can be uploaded to your respective Geographic Information System (GIS) that is provided to each village through Oldman River Regional Services Commission. We fully intend to keep your administration informed of project status and progress.

Sincerely,

Councillors Laurie Lyckman & Christopher Northcott

P.O. BOX 180
VULCAN, ALBERTA
T0L 2B0

TELEPHONE: 1-403-485-2241
TOLL FREE: 1-877-485-2299
FAX: 1-403-485-2920
www.vulcancounty.ab.ca

February 1, 2023

Community Group TEMPLATE
P.O. Box
TEMPLATE, AB
A1B 2C3

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