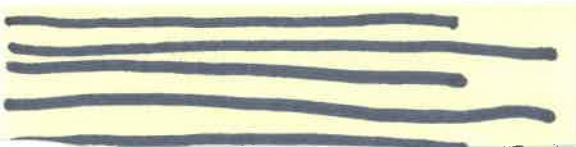


PROCEDURES FOR COMMUNITIES ARRANGING GPR SURVEYS FOR UNMARKED GRAVES

Suggestions from Geophysics for Truth members



Some considerations prior to starting a Residential School search

GPR surveys are a small component in the search for unmarked graves and many steps should take place before a GPR survey is conducted, e.g. archival search, oral history, community consultations, legal assessment, emplacement of health and well-being supports, and consideration of archaeological and forensic search methods. We focus on only GPR surveys in the following document.

- Will oral information from elders and archival information be used to establish initial priority areas for the survey?
- Will supplementary information such as visual or multispectral drone photography and/or LIDAR be useful?
- How will the information from the GPR be integrated with other information for the purposes of interpretation?
- How will the GPR survey results be communicated to the community?
- How will the GPR results be shared with the other impacted communities who had children taken to the school?

Questions for planning a GPR survey

1. What size area to be covered? GPR data acquisition must be carried out in a very carefully and detailed way. Depending on the conditions, a reasonable GPR acquisition rate is 1250 square metres for 1 day of GPR ground survey. This rate corresponds to a 50 metres by 25 metres area covered with lines spaced 0.25 metres in both directions (East-West and North-South). Data processing, interpretation and report writing may take up to three or four times longer than the field data acquisition. Note that the area covered can vary between sites.
2. Normal financial and contracting aspects. What is the cost breakdown of the work for mobilization/demobilization, field acquisition, data analysis and reporting, data interpretation and reporting. What are the sources of funding? An important source is CIRNAC Community Support Funding (<https://rcaanc-cirmac.gc.ca/eng/1622742779529/1628608766235>).
3. Is the GPR survey intended to be a reconnaissance survey of a larger area or is it intended to produce a final definitive mapping of a selected area? Do prior surveys exist?
4. Is the area to be surveyed on community land or is additional permitting required?
5. What is the physical state of the area to be surveyed: vegetation cover, clearing/mowing needed, scrap metal present, fences present, livestock or wildlife, and tree and tree roots? Will the community be responsible for clearing and mowing the site?
6. Is the history of the area to be surveyed well documented? Has there been previous infrastructure there (building foundations, pipes, use of the site for dumping)?
7. Is the area adjacent to known burials? Could the presence of historical features (e.g., dikes, retaining walls, fence post holes) be used to demarcate a boundary?
8. Would there be approval to access a nearby community cemetery (if one is available) that could be used establish the GPR response of graves of different types/ages in the geological setting on-site?

Suggested procedure for selection of a contracting company

Communities may wish to consider a multi-stage process to select a company that meets their expectations and is able to conduct an appropriate/professional survey. A two-tiered procedure, e.g. 1. Bid for Qualification, 2. Bid for Contract, will hopefully discourage predatory companies. This process could include:

- An initial call for submission of a written expression of interest
- Companies that are considered acceptable are then asked to meet with the community and to inspect the potential survey site. At the meeting(s) there is a two-way flow of information regarding the community's objectives and

requirements and the company's procedures, expertise, and capabilities. Companies are advised that the submitted contract and collected data and report may be evaluated by a third party such as a representative from Geophysics for Truth.

- Those companies considered acceptable (in terms of professionalism, experience, expertise, and respect) are then asked to submit a proposal with additional letters of reference from communities they have been previously employed by.

Communities should be wary of predatory companies focussed on the company's financial gain rather than providing accurate and quality GPR surveys with detailed reporting. In particular, communities should follow up on any unsolicited approaches by companies with appropriate evaluation of the company's record, credentials, and capabilities.

Important questions that can be asked of potential companies

Most of these points should also be covered in the contract

1. ***Will the survey be configured for unmarked grave detection in that specific place?*** (Usually 400 to 500 MHz GPR system with 25 cm line spacing and data collection in crossing directions.). Do they have the capability to adjust their instruments (mainly antenna frequency) should conditions arise? Does the company intend to use UAV ('drone') or cart GPR acquisition? For surveys looking for both near-surface and deeper signatures of graves, cart-based acquisition is strongly recommended. **UAV/drone GPR surveys have not been proven to work in the search for unmarked graves.**
2. ***Will the survey be conducted with multiple antennas or multiple GPR systems?*** This may lead to time savings during the data collection (but not in the lab during processing and report writing).
3. ***Will the GPR survey be designed to detect near-surface soil disruptions plus deeper signatures of graves?*** GPR responses from buried bodies are usually subtle signatures that may be difficult to discern from anomalies of other features such as rocks. The most reliable GPR surveys for unmarked graves are based on identifying multiple features of the graves including: evidence of near-surface soil disruptions, evidence of deeper soil disruptions caused by the digging of the grave, soil disruptions with an appropriate size and depth to be burials, GPR signals created by the grave shaft, and/or (very rarely) evidence of signals from the actual body. Deeper signals are usually very weak and require appropriate GPR acquisition and processing procedures as well as experienced interpreters to be identified. Except in the case of coffin burials, there will generally be no signature seen from the body itself (dependent on the age of the burial). The GPR signatures may vary significantly between different sites and soil types and may even vary at one site as the soil moisture changes after rainfall or with ground freezing.
4. ***Will the company classify and describe anomalies (beyond providing a number)?*** Can those anomalies more suggestive of human burials be indicated? Communities should have the final say in designating burials but need additional resources to do this.
5. ***Will the company support Indigenous data sovereignty, for instance by adhering to OCAP principles (<https://fnigc.ca/ocap-training/>) for data collection, storage, and archiving?*** The complete GPR survey dataset (and accompanying metadata) should be provided to the contracting community who will become the sole owners of it. Will the data be provided in a proprietary format requiring specialized software to access or in an open-source format?
6. ***Did the company look into historical maps, airborne or satellite imagery? Did the company display knowledge about the geological setting on-site? Did the company consider survivor knowledge?***
7. ***Will the company arrange the survey permitting required by the Manitoba Historical Resources Branch. Will the survey be supervised within the company by a registered professional geoscientist/geophysicist, engineer or a professional archaeologist?***
8. ***Will the company employ positioning methodologies (differential or RTK GPS or Precise Point Positioning) so that detected anomalies are positioned to better than 5 cm accuracy (both in absolute coordinates and relative to permanent features at the site).*** The positioning accuracy and methods shall be listed in the contract.
9. ***Will the survey include provision of a detailed written report?*** The report should fully document the names of the supervising geoscientist/archaeologist/engineer and the operators, as well as the data interpreters and report writers.

Additionally, the survey location (absolute positions and reference system), instrument configurations, survey configuration, details of data acquisition (personnel, time, issues arising, relevant field notes) information on methods of data processing applied, information on methods of interpretation applied, a general assessment of the collected data, results including radargrams and depth slices showing identified targets, and ranking of the targets in terms of how well they conform to the expected form of unmarked graves. The survey report should be sufficiently detailed so that the collected GPR data can be used in future analyses by the community or a third party.

10. ***What data processing will be done?*** As a minimum, the processing should include zero-timing, velocity analysis and depth conversion, and adjustment of gains to optimize the visibility of possible graves. Other processing methods such as trace averaging, background removal, and spectral filtering, should be applied as needed. The order of processing is important as well.
11. ***What methods will be used to assess the GPR anomalies and identify possible unmarked graves?*** What level of experience will the data interpreter have in the identification of graves and in the identification of other responses that may be observed including geological features and buried infrastructure? Does the data interpreter have experience in identifying aspects of GPR responses such as near-surface reverberations and multiple reflections, lateral changes in signal coupling, and reflections from above the surface that may be mistaken for sub-surface targets? For instance, powerlines create anomalies that look like subsurface targets in the radargram, and approaching a building or a wall creates anomalies that look like they are underneath the GPR cart, but are actually ahead.
12. ***Can the company provide samples of previous reports on surveys for unmarked graves and references from Indigenous communities for whom they have conducted similar surveys in the past?*** Those experience reports or data can be anonymized, and locations can be removed.
13. ***Is there an opportunity for community members to be trained in, and participate, in the survey design and GPR acquisition?***
14. ***Will the company personnel participate in ceremonial aspects requested by the community?***
15. ***Normal financial and contracting aspects.*** What is the cost breakdown of the work for mobilization/demobilization, field acquisition, data analysis and reporting, data interpretation and reporting. How will contingencies be handled (lost acquisition time due to instrument malfunction, lost time due to weather, parts of the survey area that are unexpectedly unsuitable for GPR surveying, delays in report finalization, community requests for surveying of additional areas). What are the on-site insurance conditions? Who are the on-site contacts/liaison for the company and the community? What level of daily reporting is expected/required? Who are the contacts for the processing and interpretation phases? Is a final in-person report by the company to community representatives expected/required?

Additional Resources

Indigenous Services Canada - Interactive Indian Residential Schools Mapping Application

ISC's Geomatics Services developed an Indian Residential Schools Mapping Application using site location data provided by the NCTR (Orlandini, 2018) and layered it with Government of Canada Open data (First Nation and Inuit Communities, reserve boundaries, and historical air photos provided by Natural Resources Canada). In addition to the collection of geospatial data to situate and provide historical context to the Indian Residential School sites, the application has search, filtering, measurement, and print tools to assist users with analysis or the creation of their own maps.

To access the interactive map:

<https://sac-isc.maps.arcgis.com/apps/webappviewer/index.html?id=115dfbe0b5824a74ac88131cef759b55>

Questions about this map? Contact: IRS-ISC.PI-SAC@sac-isc.gc.ca

Energy and Natural Resources Canada - National Air Photo Library

The National Air Photo Library (NAPL) of Natural Resources Canada archives over 6 million aerial photographs covering all of Canada, some of which date back to the 1920s. The NAPL indexes and stores federal aerial photography for Canada, and maintains a comprehensive historical archive and public reference centre.

Access the NAPL through the Earth Observation Data Management System (EODMS):

https://www.eodms-sgdot.nrcan-rncan.gc.ca/index.en.html?_gl=1*_ygv0rz*_ga*NDc0MDc1MzA4LjE2NjA3NTI2NDI.*_ga_C2N57Y7DX5*MTY5Mzc3NDQ5NS40NC4wLjE2OTM3NzQ0OTUuMC4wLjA.

Also:

Communities seeking free access to historic air photos associated with former residential schools, contact:

Steve Westley

Manager, Geographical Names Board of Canada Secretariat

Steve.Westley@NRCan-RNCan.gc.ca

Manitoba Historical Maps

Free historical Maps of Manitoba.

Accessed through Flickr at: <https://www.flickr.com/people/manitobamaps/>

Geophysics for Truth

Geophysics For Truth is a volunteer initiative of geophysicists providing pro bono geophysical surveys, training and expertise for Indigenous Community's projects across Canada. We are offering Ground Penetrating Radar and other geophysical survey techniques to help with the detection and identification of burials related to former residential school sites.

Email: <mailto:info@geophysicsfortruth.org>

Phone: +1 (613) 533 6621 - Please use email to arrange a phone call

Alliance to Support Indian Residential School Missing Children Investigations

<https://canadianarchaeology.com/caa/news-announcements/new-alliance-supports-indigenous-communities-indian-residential-school-missing>

Canadian Archeological Association documents

Searching For Missing Children: A Guide to Unmarked Graves Investigations

https://canadianarchaeology.com/caa/sites/default/files/page/non_technical_guide_final_april_11_sh.pdf

Searching For Missing Children: A Guide to Ground Search Techniques

https://canadianarchaeology.com/caa/sites/default/files/page/technical_guide_final_april_11_sh.pdf

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