Magnetic Gradiometry
There are three basic methods for the use of magnetic fields in geophysics to detect patterns underground: gradiometery (which detects the ambient magnetic signals of subsurface patterns), conductivity (which detects in magnetization of underground patterns), and susceptibility (which detects patterns of attraction or repulsion to a magnetic field).
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What is a Gradiometer Survey?
Magnetic gradiometer survey (gradiometry) is one of a group of technologies that can map the contents of the ground remotely and without digging. Gradiometers measure differences in the earth's magnetic field that are caused by buried features and objects that have slightly different magnetic properties from the surrounding natural soil. For example, when a grave is dug and refilled, the topsoil, which is generally more magnetic than the subsoil, gets redistributed within the fill of the grave. This leads to tiny but detectable differences in the earth's magnetic field directly over the grave compared to the ground around it. Pieces of iron in the grave, such as coffin nails or hardware, might also be detectable in relatively shallow graves (less than 3 feet/1 metre deep), but is difficult as it is impossible to distinguish these from other pieces of buried metal that commonly litter the ground.

What Role Can It Play in Identifying Missing Children?
Identifying graves through gradiometer survey, like any remote sensing approach, is challenging. Like all geophysics techniques, the ability to identify a buried feature, such as grave, depends on how different the grave fill is from the surrounding soil. This will vary from site to site.

Generally speaking, gradiometry surveys are not as effective at identifying graves as ground-penetrating radar (GPR). It is therefore likely to remain a supplemental technique to complement the results from GPR investigations and to help improve confidence. However, as one of the fastest geophysics techniques available it can cover large areas very quickly. This type of survey, often referred to as reconnaissance or prospection survey, is not used to identify the location of individual graves but rather to identify larger features such as buried building foundations or define areas of interest for further study. This can help improve the efficiency of GPR investigations.

There may also be some situations where gradiometry may be more suitable than GPR survey. This might include areas of high soil conductivity (e.g. clay soils or salty soils near coastlines) or in areas where low lying vegetation prevents the efficient operation of the GPR. Gradiometer instruments are not adversely affected by conductive soils and as they are usually carried above the ground, they can clear low lying vegetation. However, as gradiometers are adversely affected by the presence of metal and bricks, identifying graves will likely only be possible in areas at some distance from buildings.

What Are the Challenges of Gradiometry Survey?
Gradiometry surveys need to be collected carefully and require special training. Courses for Indigenous communities to build this capacity are being developed. Gradiometers work best in relatively rural locations away from built environments where metal such as nails, fences, buried services and other magnetic materials such as fired brick, create too much noise for effective identification of graves. They also do not work well in areas with igneous geology. It cannot locate children who do not have a burial. Our understanding of this tool improves if we share information between communities, but this can be difficult.