# Electrical resistivity profiling of buried valley aquifers in the Edmonton region

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## Introduction

- Groundwater resources are an important consideration for the future of the growing city of Edmonton and it's surrounding communities. Other locations in the province of Alberta have already experienced freshwater scarcity due to demand or contamination (Canadian Press 2011, Faramarzi et al. 2017).
- Edmonton's current freshwater supply is mainly sourced from the North Saskatchewan River (North Saskatchewan Watershed Alliance 2007).
- Valleys incised into Cretaceous bedrock, infilled with coarse sediment, called buried valleys (Cummings et al. 2012), are present throughout the Edmonton area and could provide a significant alternative freshwater source given greater evaluation.
- Electrical resistivity tomography (ERT) methods have been used to characterize buried valley sediments (Baines et al. 2002, Ahmad et al. 2009)

**Question:**
How can we use ERT to constrain and characterize Edmonton's buried valley network?

**Objectives:**
- Determine accuracy of existing mapping of valley fills
- Determine range of resistivity values of valley fills depending on characteristics
- Ground truth ERT results with known geology

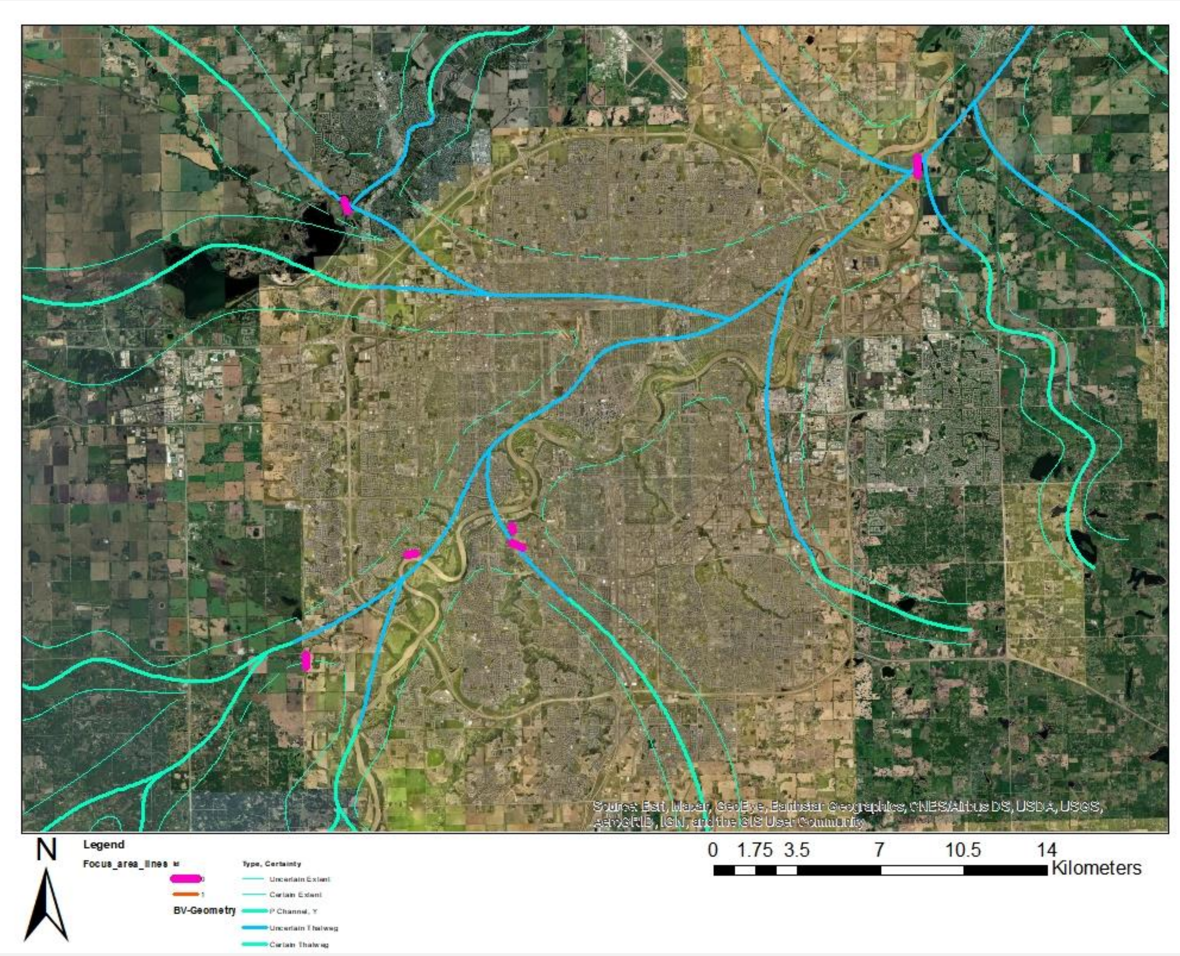


Fig 1. Map of the Edmonton Area. Previously mapped (Rubin 2020) buried valley network is shown along with locations of ERT focus area cross sections.

## Methods

### Previous Mapping Basis

The buried valley network underlying the Edmonton area has been previously mapped with respect to borehole data and sediment exposures (Bayrock & Hughes 1962, Bibby 1974, Carlson 1967, Rubin 2021). The most recent mapping as a part of the current study was conducted by Rubin (2021) by constraining the aquifers via creating cross sections and examining more recent data based on borehole logs. This recent mapping of the buried valleys in the area is the basis on site selection for electrical resistivity tomography (ERT) profiles.

### Site Selection

ERT sites were selected based on availability of borehole data, buried valley junctions, areas of interest for potential water monitoring/extraction, and areas that may help future groundwater modelling.6 sites total were chosen based off of these criteria.

### ERT Methodology

ERT profiles were completed using a ABEM Terrameter LS 2, 2 x 24 electrode cable setup in either 5m or 10m electrode spacing. Spacing choice depended on the predicted depth of buried valley sediment, or available space due to urban conditions. All profiles were completed as Wenner arrays. Data was then edited and inverted using RES2DINV software (Geotomo 2012).

Fig 2. ABEM ERT System and attached cables at the UofA Farm site.

## Results

### Comparison to Well Logs

- Site ERT profiles with well logs or exposures (Big Bend, Whitemud Creek sites) nearby had well-correlated layers
- Figure 3 is a good example of how sediments shown in exposure translate to ERT profile

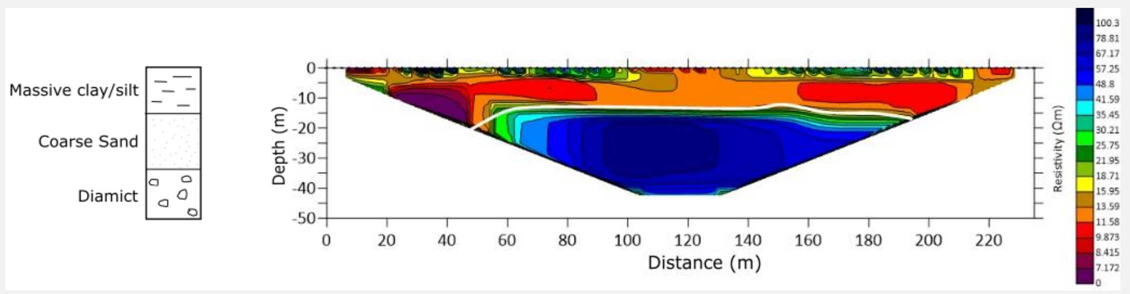


Fig 3. ERT profile with comparison to exposure observations (left). This profile shows buried valley sediment corresponds with blues and greens (>18 Ωm) and a white line is drawn to show the upper sediment boundary.

### Resistivity Controls

- Out of the 6 selected sites, channel resistivity varied largely
- Sites predicted unsaturated and/or coarse grained resistivity values at 55-300 Ωm
- Sites predicted saturated and/or fine grained resistivity values at 15-45 Ωm

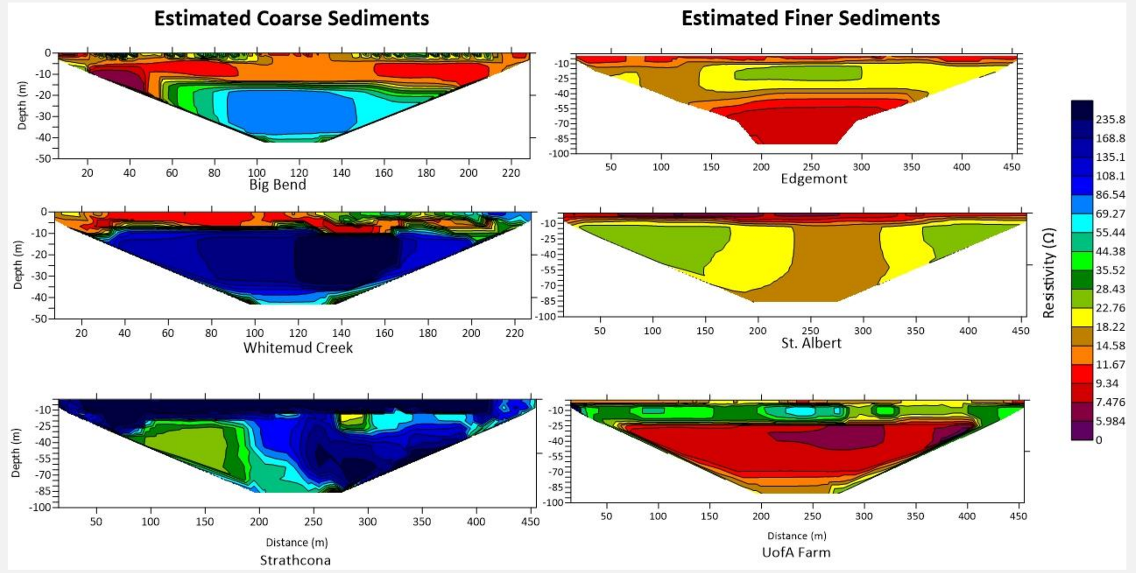


Fig 4. ERT profiles overlying buried valley sediment fills. Profiles are organised into estimated coarse or fine diamicts to sands based on resistivity values.

### Constraining Previous Mapping

- ERT profiles were completed in some uncertain areas
- In uncertain areas, ERT profiles provided information on whether previous mapping is accurate
- Inaccurate areas such as the UofA Farm site (fig. 6) were identified
- Confirmed accuracy in other areas such as the Edgemont site (fig. 5)
- 4 out of 6 sites were deemed accurate
- UofA Farm and St.Albert sites had inaccurate thalweg locations on previous mapping
- Depths of buried valley sediments are also shown to reach 80m + depth

## Results

Fig 5. Superimposed Edgemont ERT cross section over a buried valley boundary that can be identified in profile.

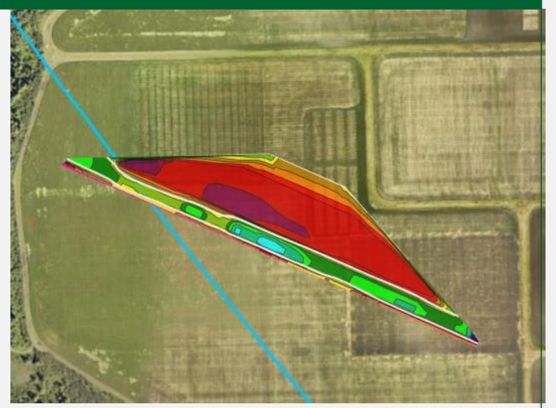

Fig 6. Superimposed UofA Farm ERT cross section over a predicted thalweg. Sediments were found as not at thalweg thickness.

## Conclusion

### Conclusions & Future Work

- Sediment saturation and grain size were identified as the defining factors for resistance values of buried valley sediments
- Buried valley sediments varied from finer grained sands to coarser diamicts
- ERT data was truthed via comparisons to well logs and exposures
- Previous mapping of the buried valley aquifer network underlying the Edmonton area was constrained in focus areas
- Future lines should be run to truth saturated vs. unsaturated values in known locations

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