ACCURATE AND RAPID FIELD ANALYSIS OF SOIL SALINITY USING A MULTI-SENSOR DATA FUSION TECHNIQUE

MAAPERA ANALYTICS INC.

OUTLINE

- Reflectance Spectroscopy
- Methods
- Results
- Conclusions

FIELD EC MEASUREMENT

- Bulk EC Measurement – Confounding Variables
  - Clay Content
  - Water Content
- Relationship between bulk EC and these variables are non-linear
- Solution – Multiple sensors and machine learning

http://sis.agr.gc.ca/cansis/taxa/soil/solonetzic/solodized_pr.jpg

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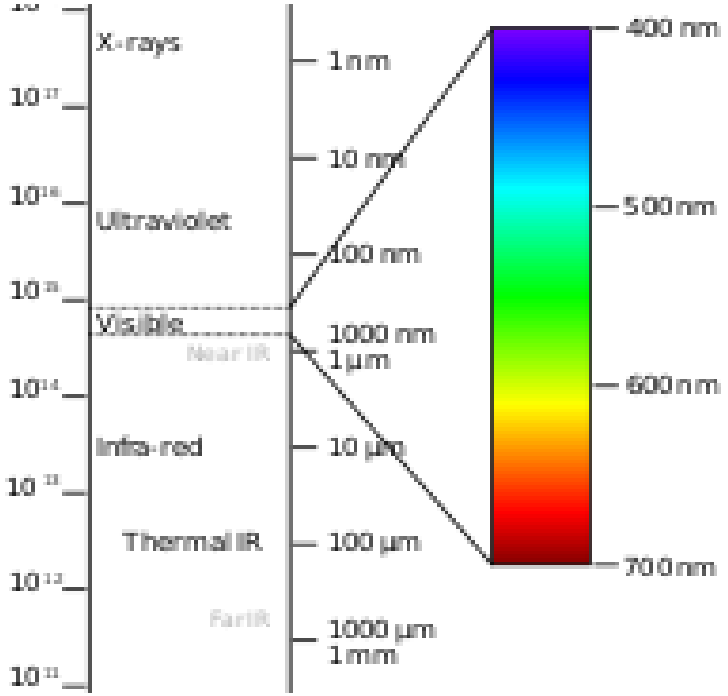
REFLECTANCE SPECTROSCOPY

- Different types of covalent bonds absorb different specific light wavelengths
- Majority of soil properties have spectral features in the short wave infrared portion of the electromagnetic spectrum



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REFLECTANCE SPECTROSCOPY

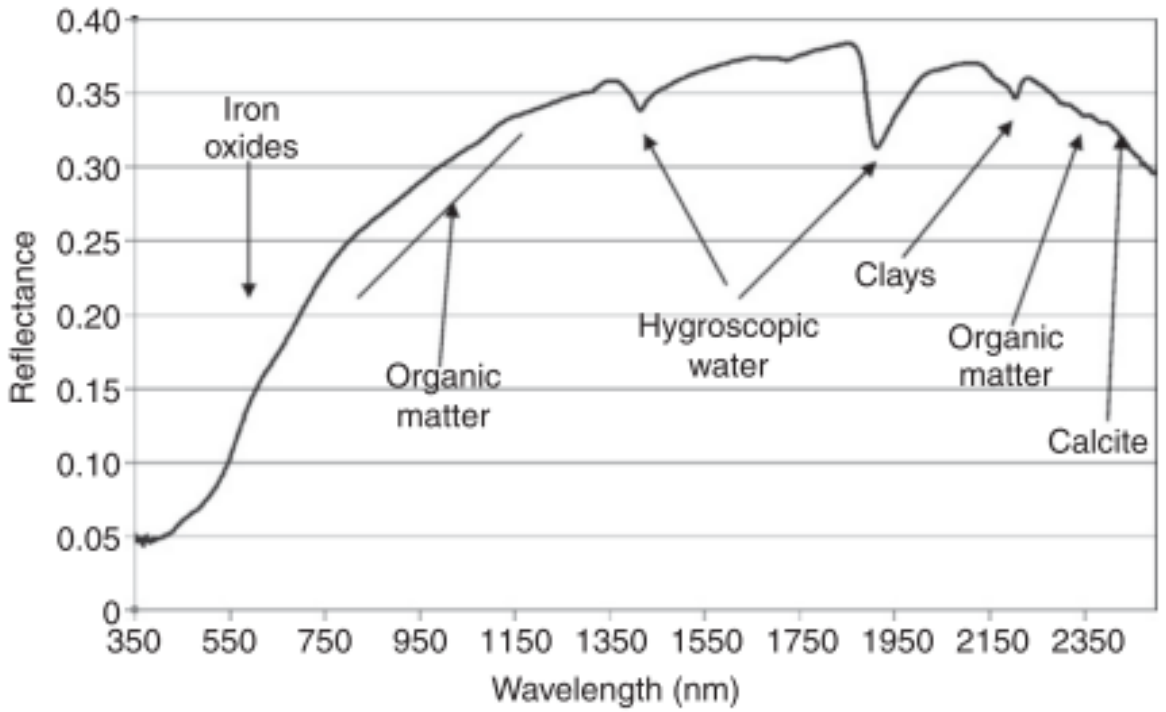

Figure 3 A soil spectra (Haploxeralf) that represents the major chromophors in soils (see text for more details).

Ben-Dor, E., R.G. Taylor, J. Hill, J. a M. Demattê, M.L. Whiting, S. Chabrillat, and S. Sommer. 2008. Imaging Spectrometry for Soil Applications. Adv. Agron. 97(07): 321–392.

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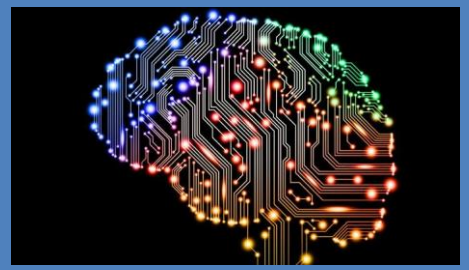
METHODS

- Samples prepared in the laboratory with spiking and collected from the field
- Samples analyzed using Maapera's multi-sensor fusion approach
- Samples analyzed with saturated paste for comparison
- Field trial conducted at site in SE Saskatchewan

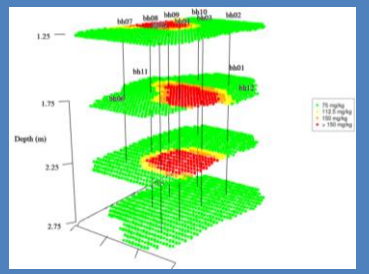
Methods

Sensor Data

Machine Learning and Advanced Data Analysis



Automated Visualization Data Products – delivered as HTML



Process in the Field

Set up scanner and allow for 30 min start up cycle and Calibrate by optimizing system to background signal and scanning Spectralon ® reference panel

Scan calibration soil samples – supplied by Maapera – to confirm set up is correct

Collect Sample in typical industry practice and take sample to scanning set up (skinning is recommended)

Place contact probe with attached spacer that leaves 1 cm gap up to the sample

Entering location tag, comments and then press button on laptop to scan (2sec)

Analyze spectral data using machine learning algorithms

Process in the Field

Insert salinity probe into soil sample

Enter salinity data in salinity fields on spectrometer software

Analyze spectral data using machine learning algorithms

Process in the Field

Field Trial

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Field Trial

- Salt impacted site in SE Saskatchewan
- Historic produced water spill
- Trial objectives were to evaluate how field data compared to laboratory data

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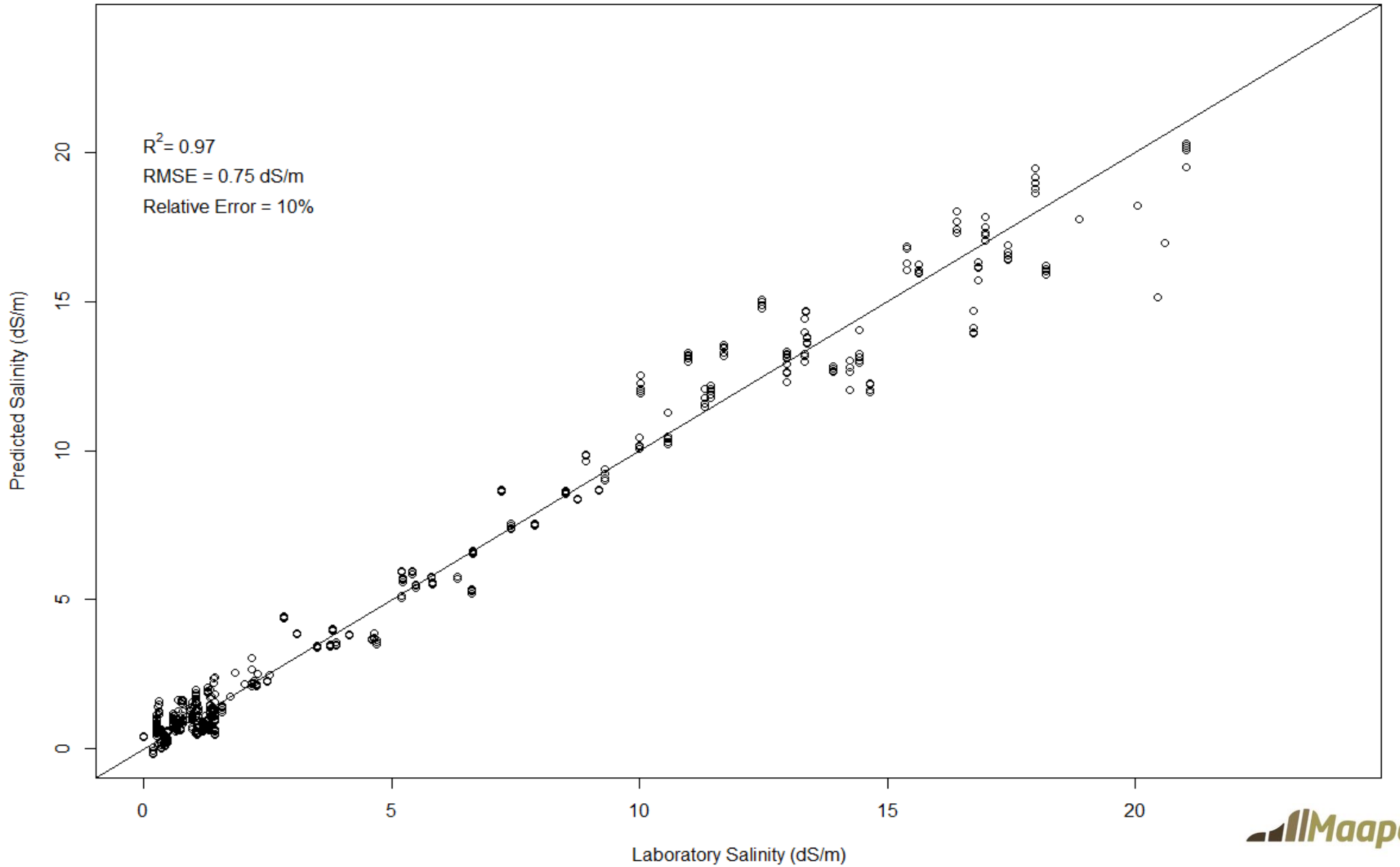
Salinity Measurement System Results



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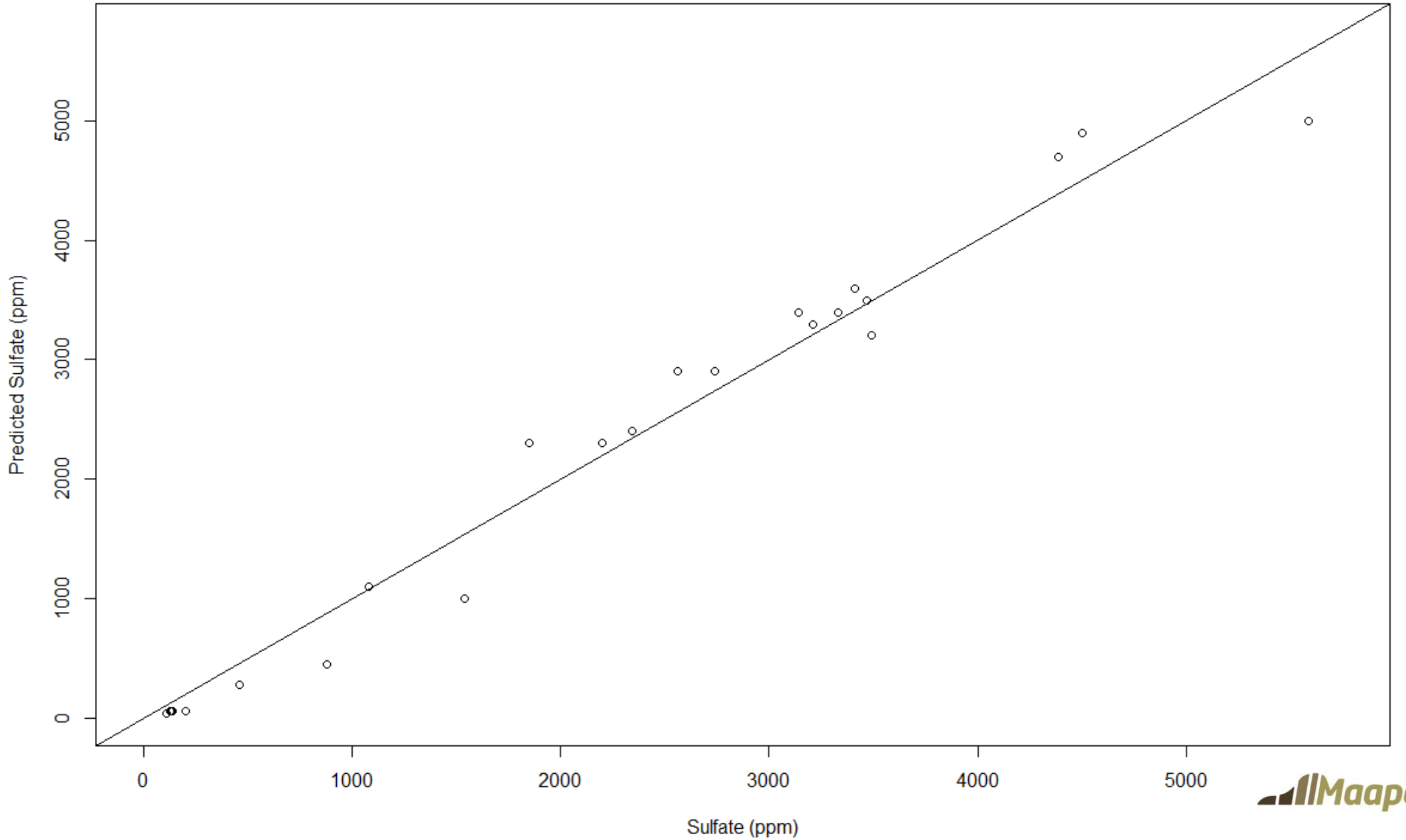
Sulfate Measurement System Results



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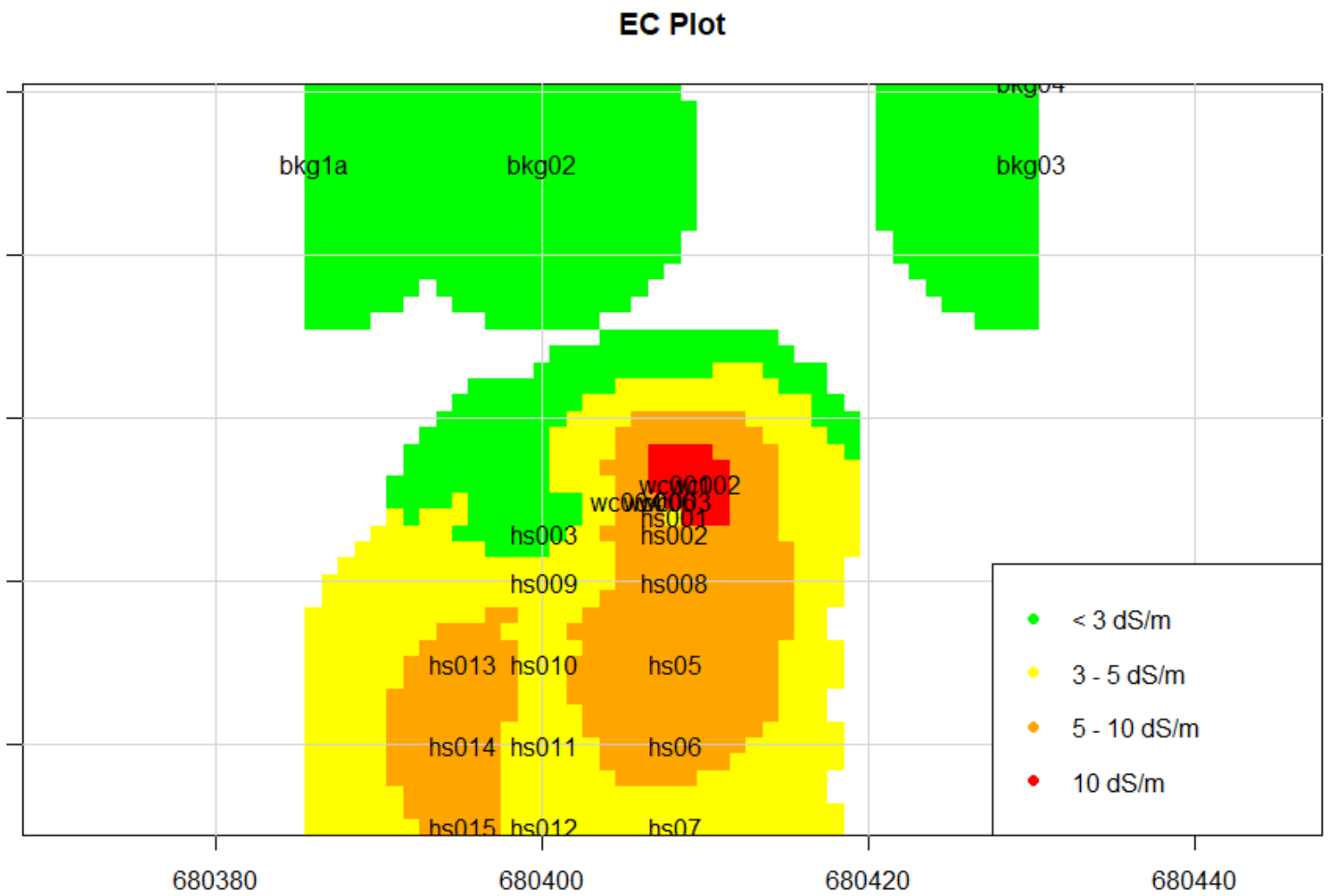
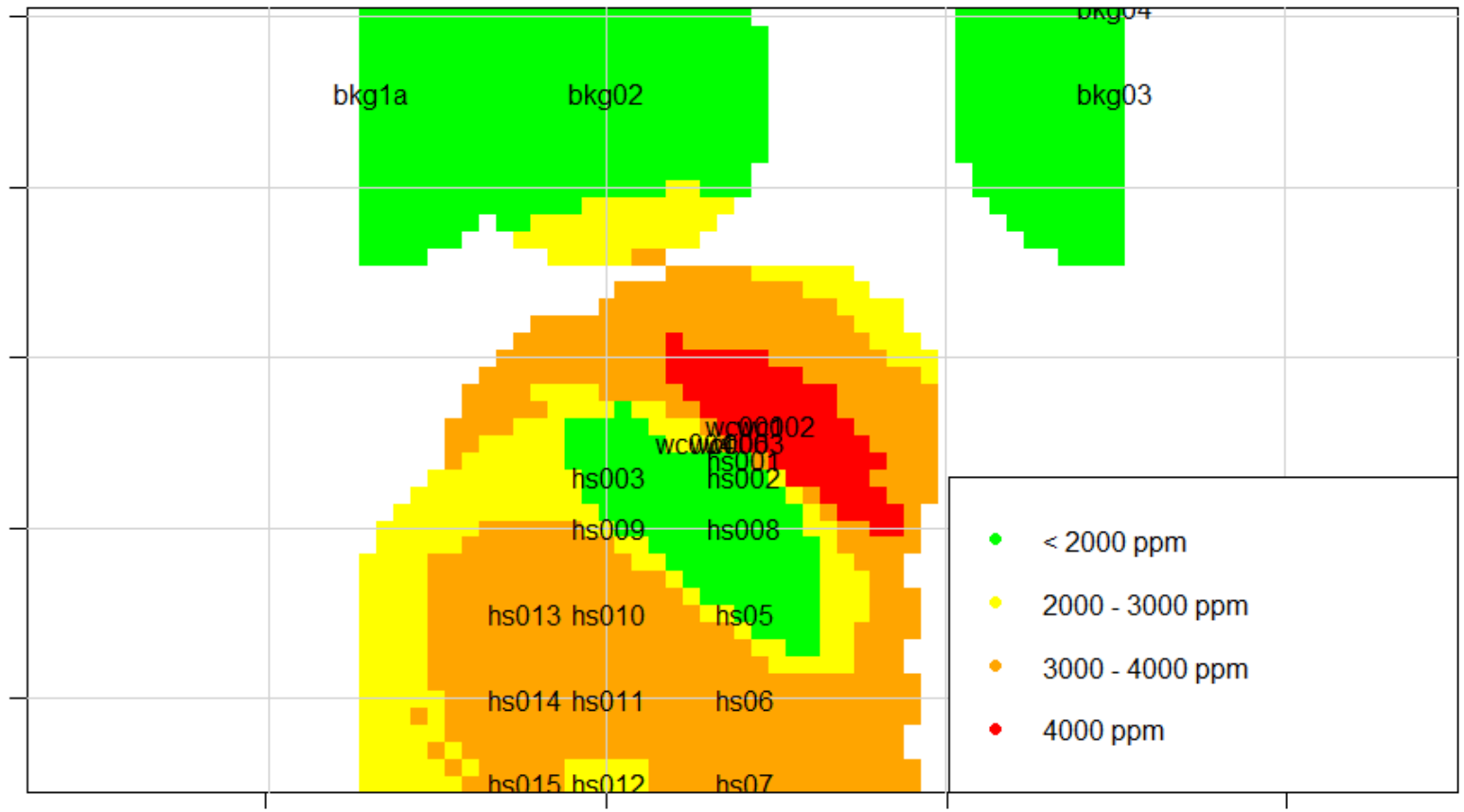

EC Plot
bkg1a
bkg02
bkg03
hs003
hs002
hs009
hs008
hs013
hs010
hs05
hs014
hs011
hs06
hs015
hs012
hs07
< 3 dS/m
3 - 5 dS/m
5 - 10 dS/m
10 dS/m
680380
680400
680420
680440

Sulfate Plot



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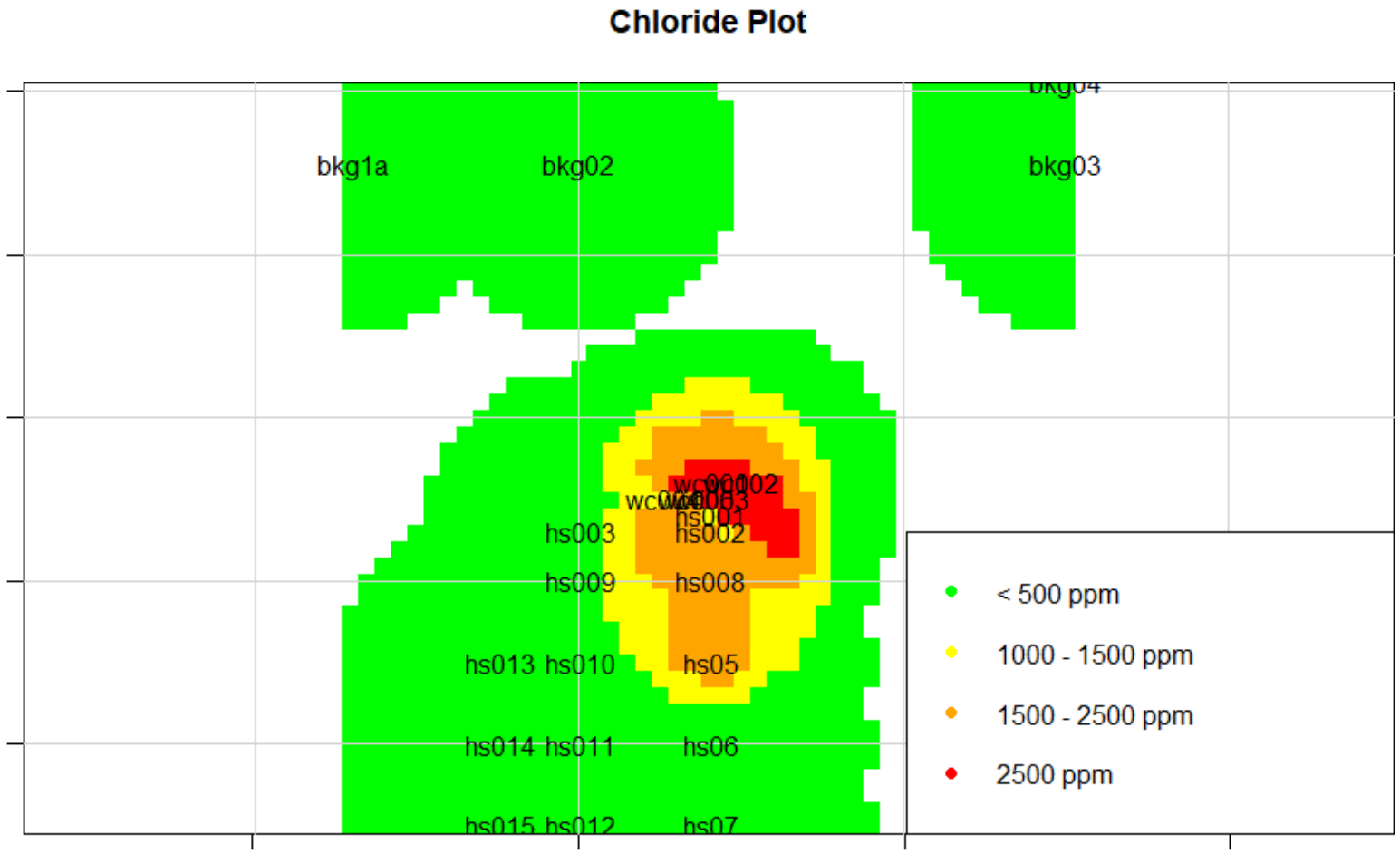

- 190 m^3 over excavation
- ~$19,000 at $100/$m^3$

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CHALLENGES AND FUTURE DEVELOPMENTS

- Samples can be measured directly on large piece of soil.
  - If sample consists of small aggregates or is loose, then it needs to be packed into a container
  - Insufficient packing can cause poor contact with probe and artificially low readings

- Cannot provide chloride specific readings.

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