

# MERCURY MONITORING: USE OF HANDHELD X-RAY FLUORESCENCE (XRF) FOR FIELD ANALYSIS OF MERCURY IN SOILS



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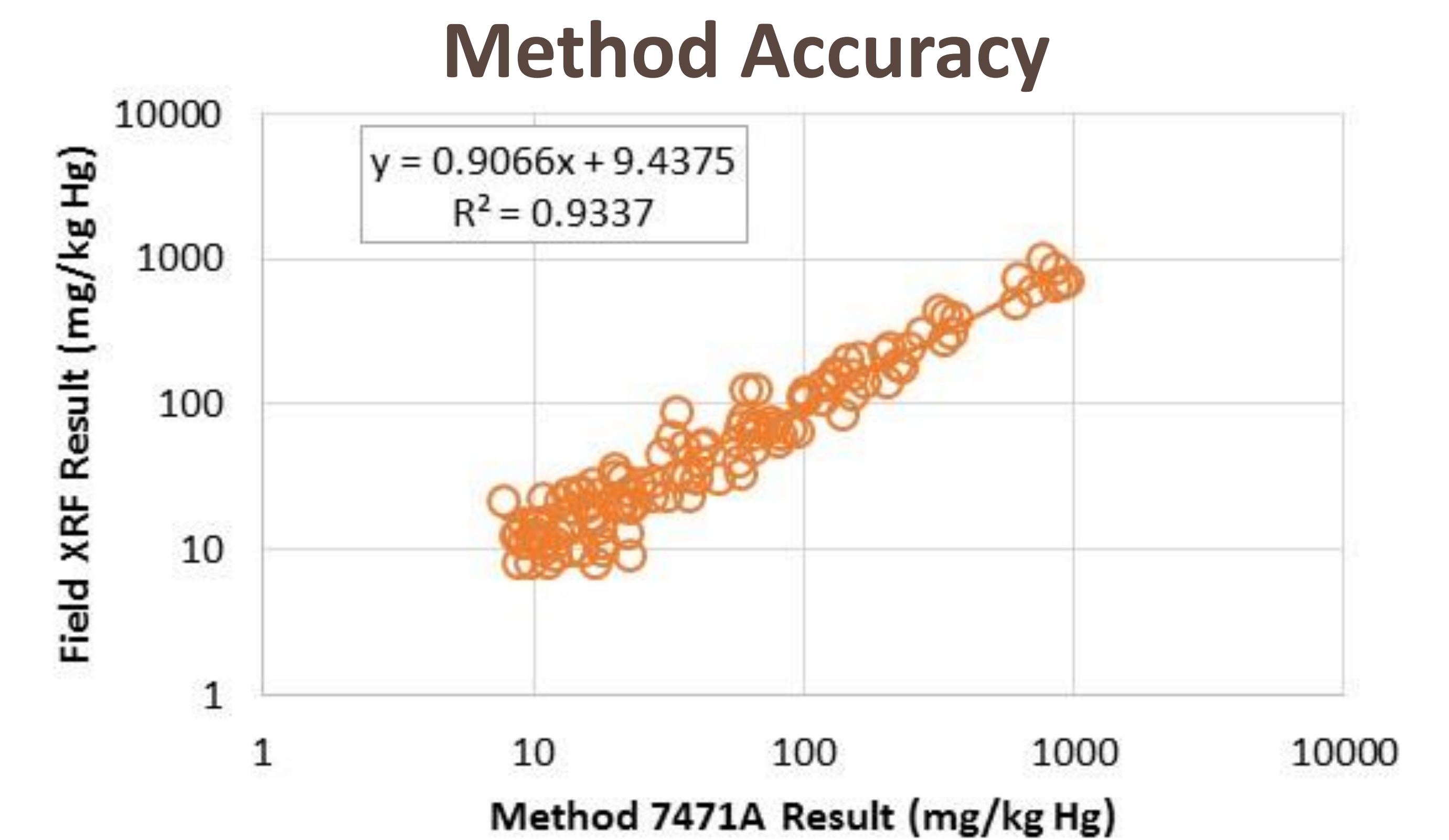
## Abstract

This study demonstrated that handheld X-ray Fluorescence (XRF) can be successfully used in the field to measure Hg in soils with accuracy, precision, and sensitivity. Rather than using manufacturer configurations and calibrations, this study developed a Hg-specific calibration set and used Hg-specific configurations to optimize sensitivity and increase the accuracy of Hg detection. This study measured 239 bank soil samples in the field at the South River remediation site in Waynesboro, Virginia. After field analysis using the handheld XRF, samples were shipped to a laboratory for confirmatory Hg analysis using EPA Method 7471A.

The handheld XRF was able to achieve a method detection limit of 7.4 mg/kg Hg with a 60-second analysis time, sufficient for comparison to most risk-based soil screening levels. Comparison of XRF to lab results showed good accuracy, with an  $R^2$  value of 0.934. Precision of the method was also comparable to the lab method, with a median CV (coefficient of variation) of 18% for XRF field triplicates. These findings demonstrate that the XRF method, if calibrated and optimized properly for Hg, can be used to quickly and reliably analyze the Hg content of soils in the field with sufficient accuracy, precision, and sensitivity.

## Split Sample Design

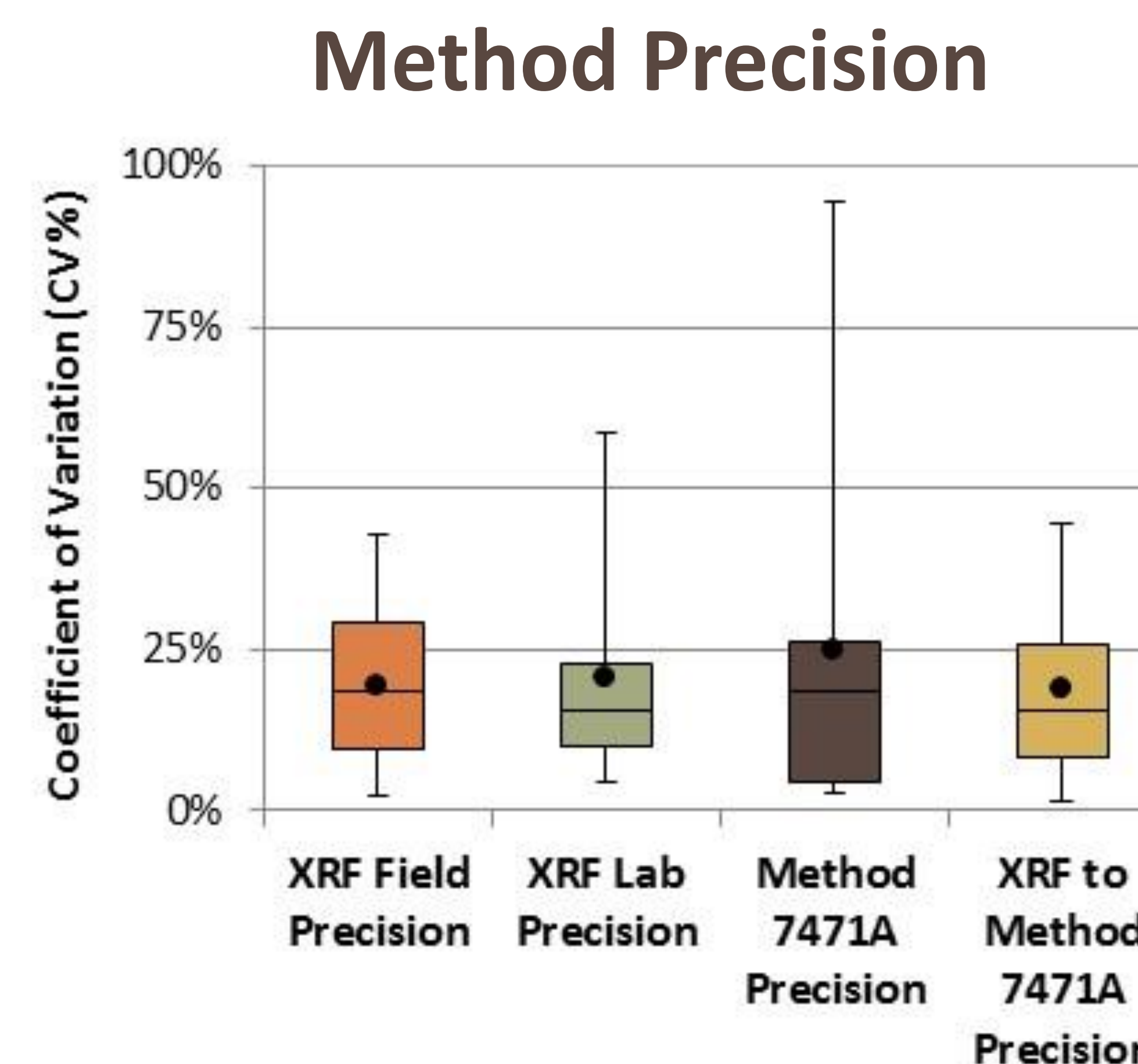
239 surficial soil and bank core samples were collected from the South River in Waynesboro, VA. Samples were homogenized and analyzed for mercury on site using the XRF. Homogenized samples were then shipped to a commercial laboratory for mercury analysis using method 7471A.



## Conclusions

## Results

- Method detection limit = 7.4 mg/kg Hg
- Of 71 blank samples, 100% had reported results of <7.4 mg/kg Hg
- Of 90 field samples measured as <7.4 ppm by Method 7471A, 93% agreed with XRF results
- Average recovery of spike samples = 102%
- Very good agreement with Method 7471A:  $R^2 = 0.9337$
- Median CV for field triplicates was 18%, compared to 19% for Method 7471A
- Precision was limited by sample heterogeneity rather than XRF method



### Field Suitability

- Handheld design and portability allows for in situ field measurements
- Real-time results save time and money

### Sensitivity

- Mercury detection limit of 7.4 mg/kg is much lower than previous studies and is sufficient for comparison to most risk-based soil screening levels

### Accuracy

- Within the range of 10-1000 mg/kg Hg, XRF produces accurate results when compared to spiked samples or field split samples measured by lab method 7471A

### Precision

- XRF precision is comparable to lab method 7471A (18% CV) and constrained by sample heterogeneity and not method performance

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