



Innovative Technology Transfer Approach for a Background Soil Study in Puerto Rico

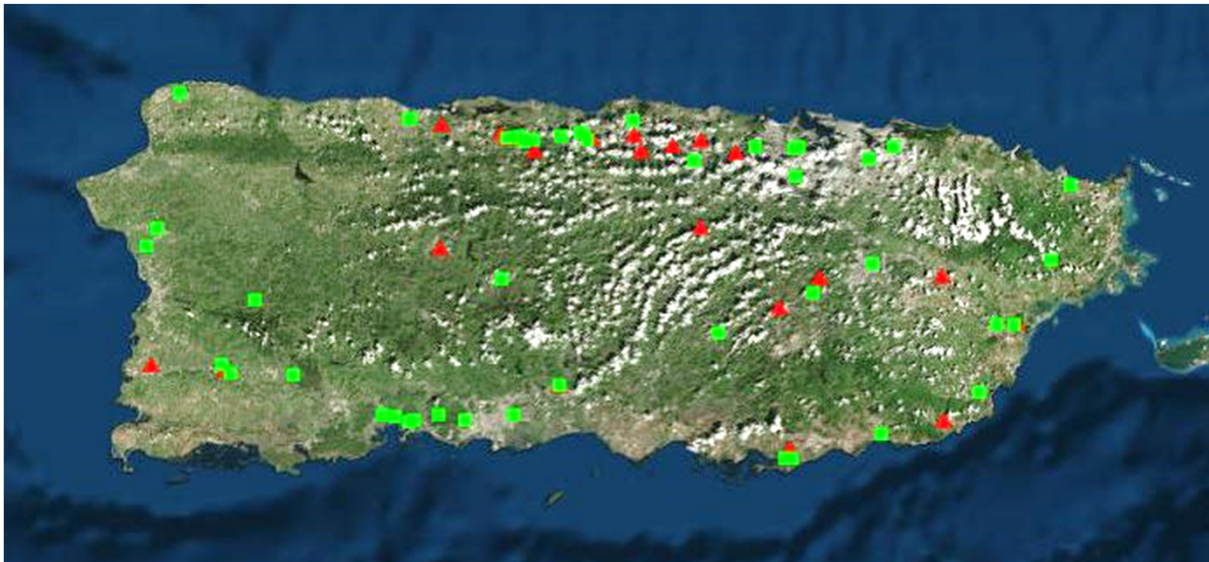


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The Issue



- Puerto Rico is currently home to over 50 contaminated sites
- Data on background soil concentrations of arsenic and other metals are necessary to implement effective cleanups that protect human health and the environment
- Research that improves contaminated site cleanups on the island is a priority for EPA



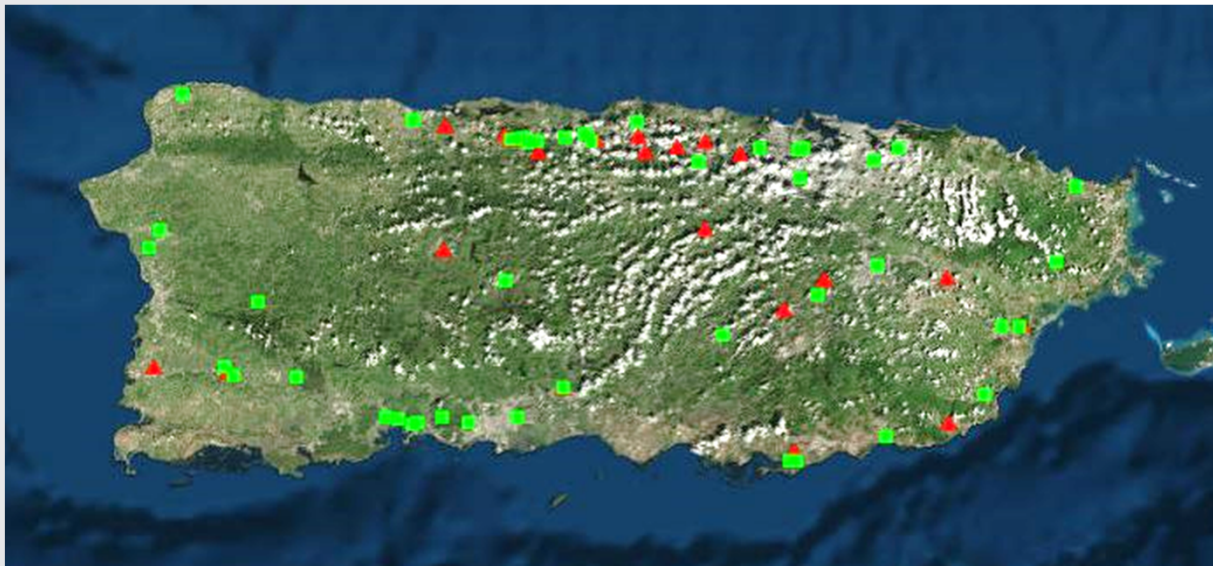
The Issue

Arsenic and other metals can be present in soils due to natural or anthropogenic sources such as local geology, tropical soil chemistry, roadway runoff or past agricultural activities.





Project Approach



- Review EPA records for all Superfund (red triangles) and RCRA Corrective Action sites (green squares) to identify existing data for arsenic, barium, cadmium, chromium, lead, silver, mercury, and selenium
- Map the data using ArcGIS and compare it to land use, known contaminated sites and geology
- Analyze the data and identify data gaps



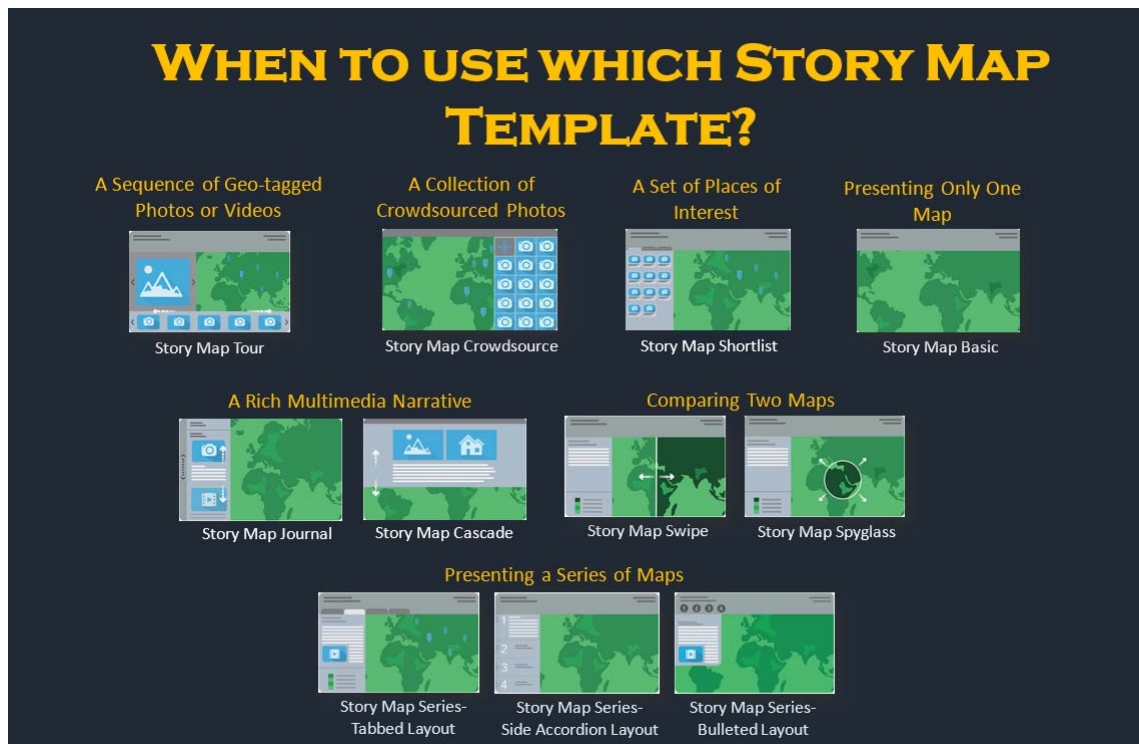
Project Approach



- Share the results in a user friendly format - **Story Map**
- Stakeholders include the community and site assessment/remediation practitioners



Communication Tool – ESRI Story Map



- Powerful tool for telling a story about data using interactive maps and images
- Combines maps with narrative text, images, and multimedia content
- You can choose from many different story map templates depending on your goals and needs.
- Learn more:
<http://storymaps.arcgis.com/en/>



Story Map Journal Format

A story map



Metals from Natural & Anthropogenic Sources in Puerto Rico Soils

No issues detected ✕

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The Issue

A number of diverse issues impact the health of communities in Region 2's Caribbean territories, such as the lack of sufficiently treated source waters in small, remote communities; inadequately closed landfills; and, compared to the U.S. mainland, greater risks of asthma and a greater likelihood of preterm births. Puerto Rico is currently home to over 50 contaminated sites under the Superfund and Resource Conservation and Recovery Act (RCRA) Corrective Action Cleanup programs. Research that improves contaminated site cleanups on the island is a priority for EPA.



Photo credit: EPA Flickr Site

When determining cleanup levels at a contaminated site, it is important to establish the contribution of background concentrations to concentrations associated with





Story Map Journal Format

A story map

Metals from Natural & Anthropogenic Sources in Puerto Rico Soils

No issues detected × Story not shared ×

Research Objectives

The objectives of this project were to:

- identify existing soil background data through a literature and database review,
- compile and analyze the data, and
- identify data gaps.

It was anticipated that data gaps would likely exist and an additional phase of soil sampling would be required at a later time before island-wide background concentrations could be determined.

This project addresses an EPA Region 2 priority science and research need: identification of background concentrations of arsenic and other metals in the soils of Puerto Rico to aid in decision making at RCRA Corrective Action sites and Superfund cleanups on the island. The project also aligns with the goals of **EPA's Office of Research and Development (ORD)**, Sustainable and Healthy Communities (SHC) Research Program in helping the public become better informed about the sources and levels of pollutants, the nature of cumulative exposures, and the locations of disproportionate impacts.

Photo to the right: View looking north-northwest from El Yunque Rainforest (photo credit: Jesse Aviles)

Approach





Contaminated Sites in Puerto Rico

A story map



Metals from Natural & Anthropogenic Sources in Puerto Rico Soils

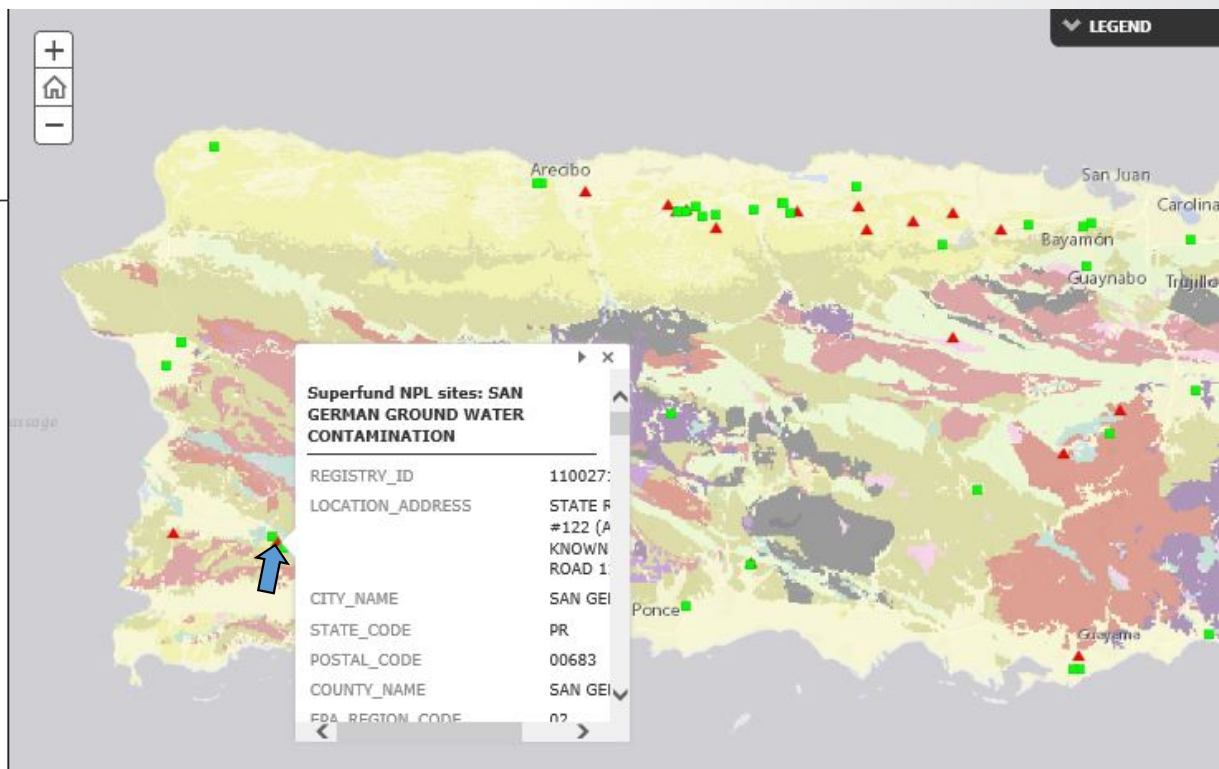
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Approach

The project was conducted in collaboration with the University of Puerto Rico Medical Sciences Campus (UPRMSC), EPA ORD and the EPA Region 2 RCRA and Superfund Programs.

- A literature and database search was conducted to identify existing data. EPA records for all Superfund (red triangles) and RCRA Corrective Action sites (green squares) in Puerto Rico shown on the interactive map to the right were reviewed. Records from initial site investigations that were conducted to determine CERCLA National Priorities Listing candidates were also reviewed for background data.
- EQIS and GIS were used to create maps and other products to graphically depict the data and compare it to land use, known contaminated sites and geology.
- The data were analyzed and data gaps were identified.





Geology of Puerto Rico

A story map



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Metals from Natural & Anthropogenic Sources in Puerto Rico Soils

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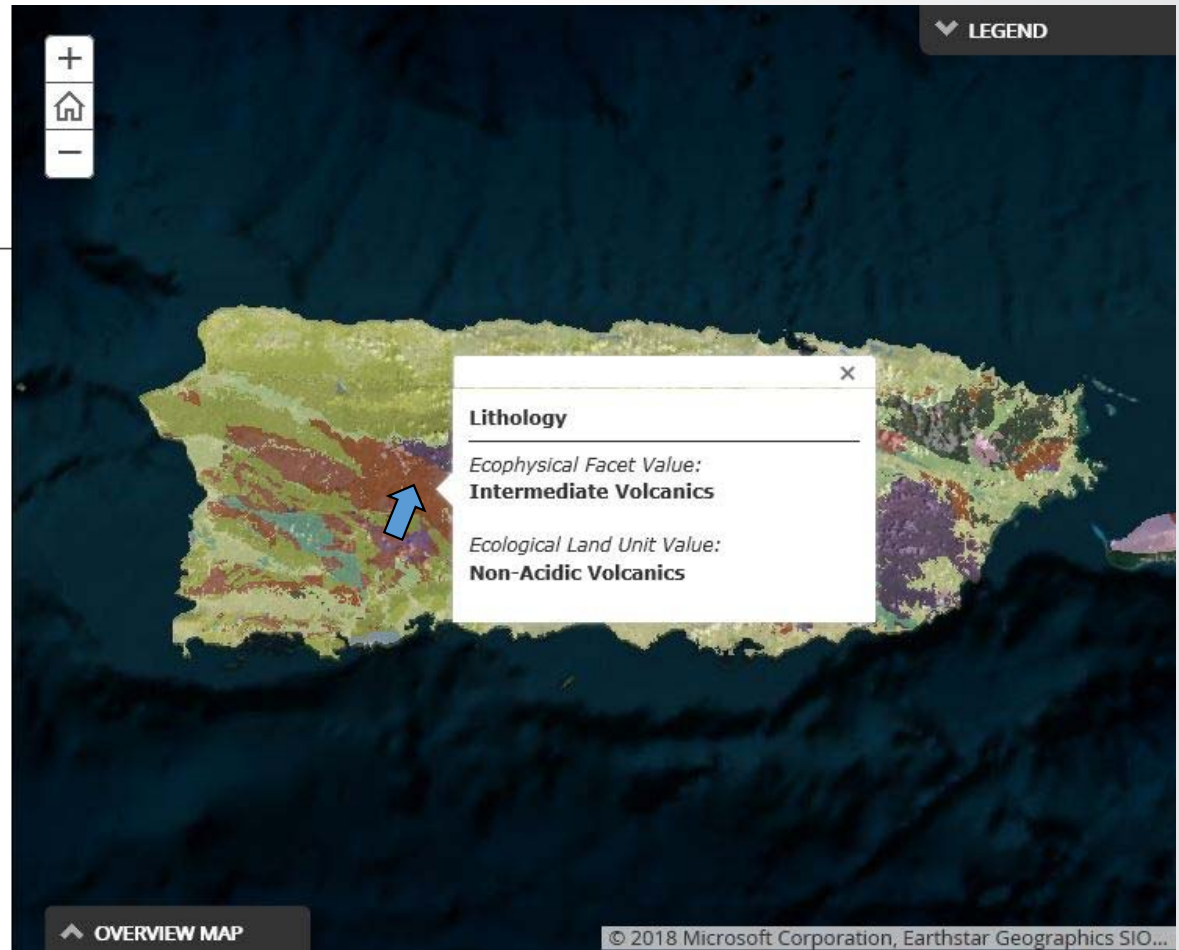
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Geology of Puerto Rico

Soil contains minerals from the erosion of the earth's crust. In order to assess background concentrations of inorganics in soil, it is therefore important to understand the geology of the area.

As illustrated in the interactive map to the right, Puerto Rico is dominated by a central cordillera, or mountain axis, of faulted, folded volcanoclastic and sedimentary rocks intruded by igneous rocks that are overlain by limestones on the north and the south. Alluvial coastal plain and valley-fill deposits are present in a discontinuous belt around the periphery of the island.

Results





Soil Data Plotted on Geology Map

A story map



Metals from Natural & Anthropogenic Sources in Puerto Rico Soils

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Results

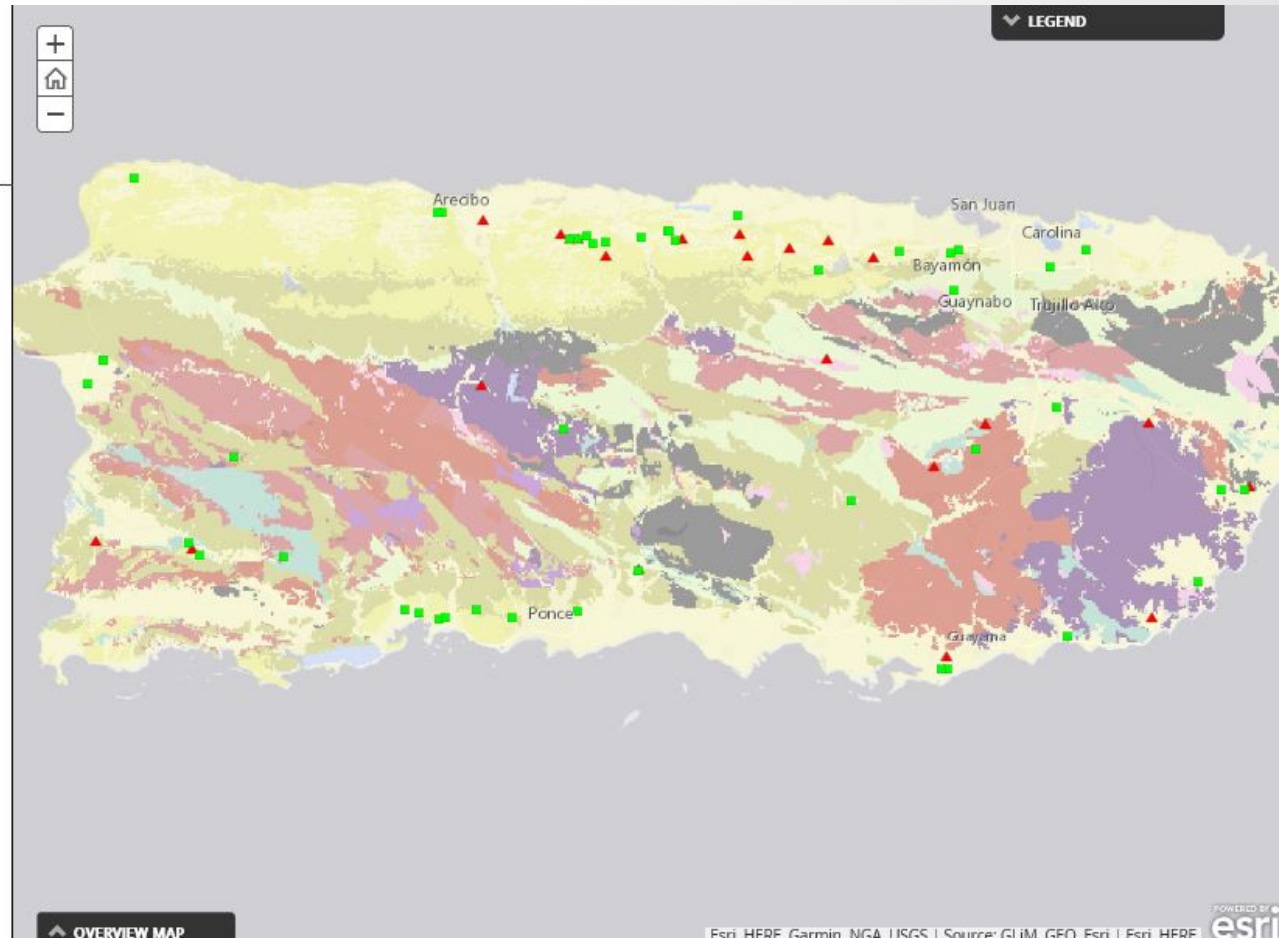
Background concentrations of metals in soil were found for 18 Superfund and RCRA Corrective Action sites. The metals data included arsenic, barium, cadmium, chromium, lead, silver, mercury, and selenium. Samples from 301 locations were evaluated and 2,058 results were deemed acceptable and used for this study. These interactive data points are plotted on the following figures. In some cases background samples from multiple depths at one location were plotted.

The data were limited since background samples were not found for each site. The distribution of available data was limited to roughly five geographical areas.

1. the San Juan metropolitan area,
2. the northern coast extending to the west of San Juan,
3. southwest Puerto Rico extending west to east from Cabo Rojo to Guayanilla,
4. the east coast of Puerto Rico in the Humacao municipality, and
5. northeast Puerto Rico in the municipality of Fajardo

Insets of the regions of Puerto Rico can be found [here](#)

The soil samples collected from the eastern regions of Puerto Rico (Fajardo and Humacao) were mostly located in geological provinces of interlayered sedimentary and volcanic rocks. The soil samples collected from the San Juan area and the northern coast were located in geological provinces of sedimentary rock. For those in the southwest, the Cabo Rojo and San German samples were collected in volcanic geologic origins while those in Guayanilla are predominantly from sedimentary





Arsenic Results on Geology Map

A story map



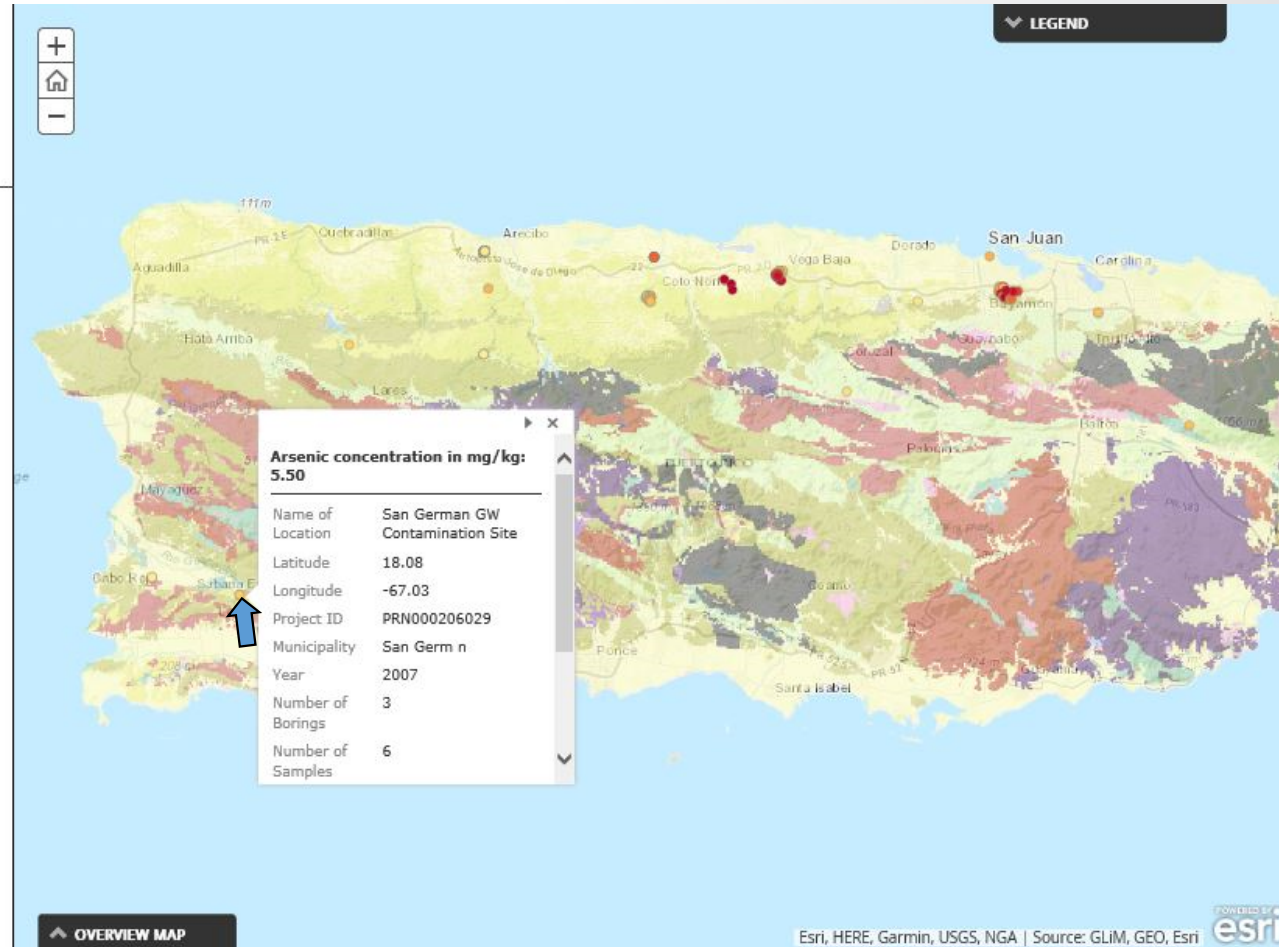
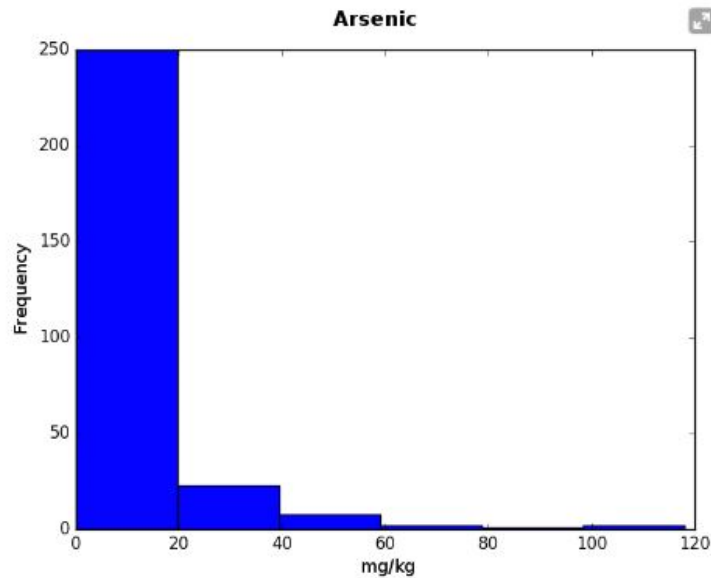
Metals from Natural & Anthropogenic Sources in Puerto Rico Soils

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Background arsenic in soils

A total of 286 samples were available for the evaluation of background concentrations. Arsenic concentrations in soil range from non detect to 118 ppm.





Chromium Results on Geology Map

A story map



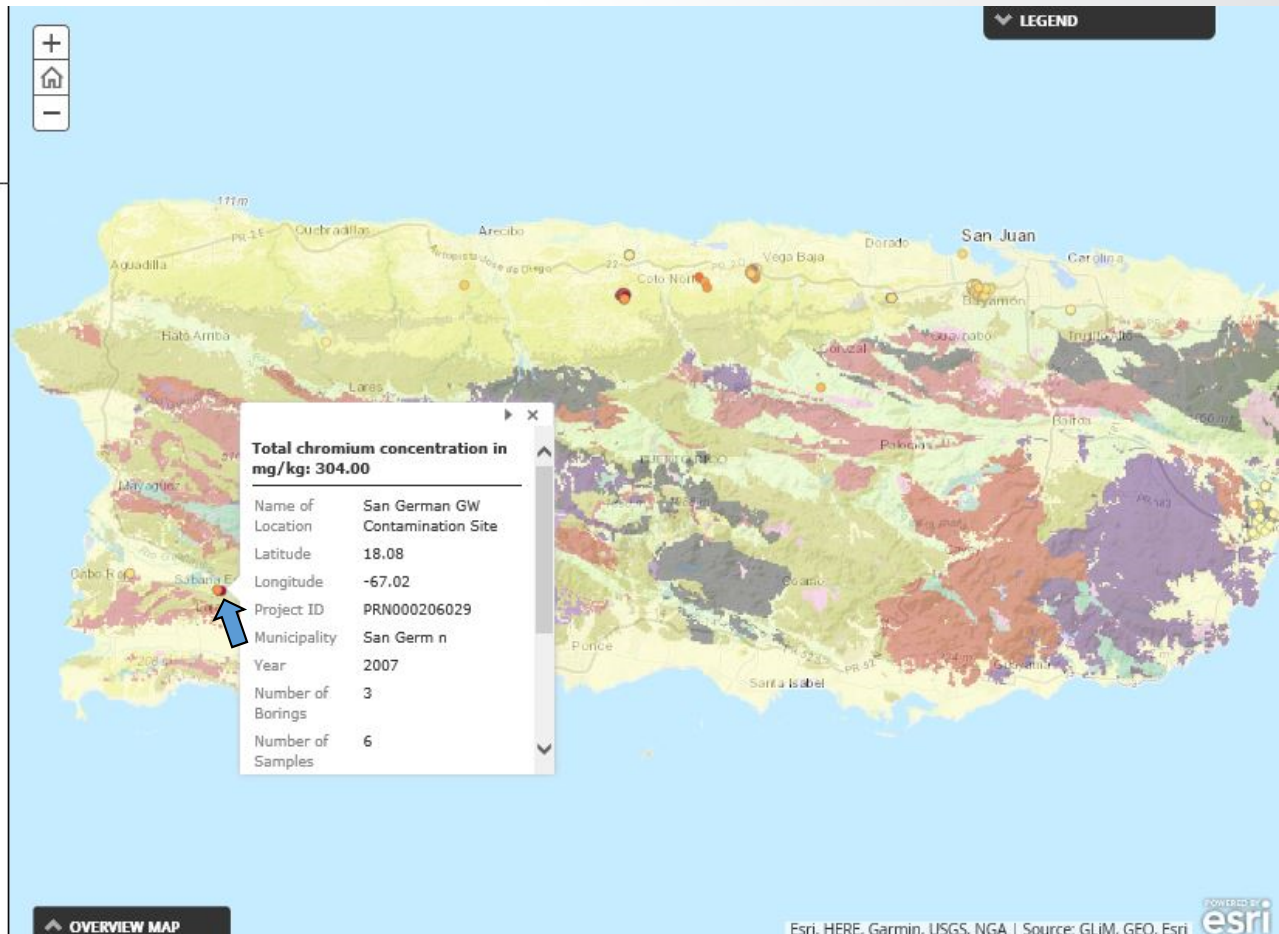
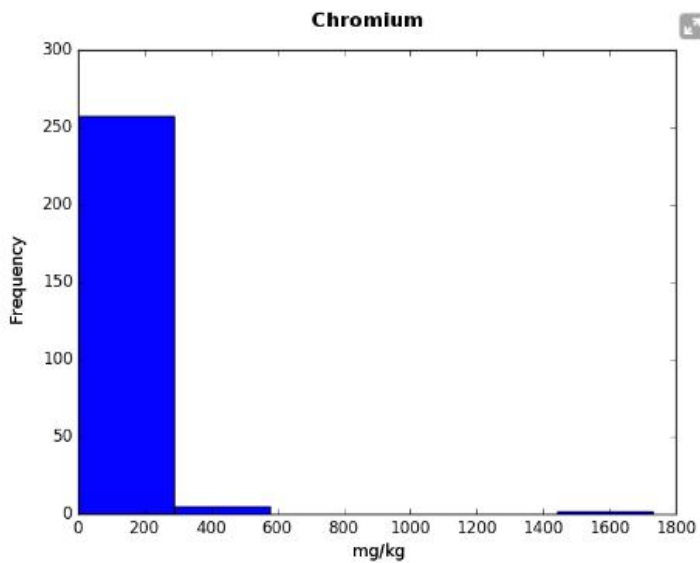
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Background chromium in soil

Total chromium concentrations in soil range from non detect to 1730 ppm.





Lead Results on Geology Map

A story map



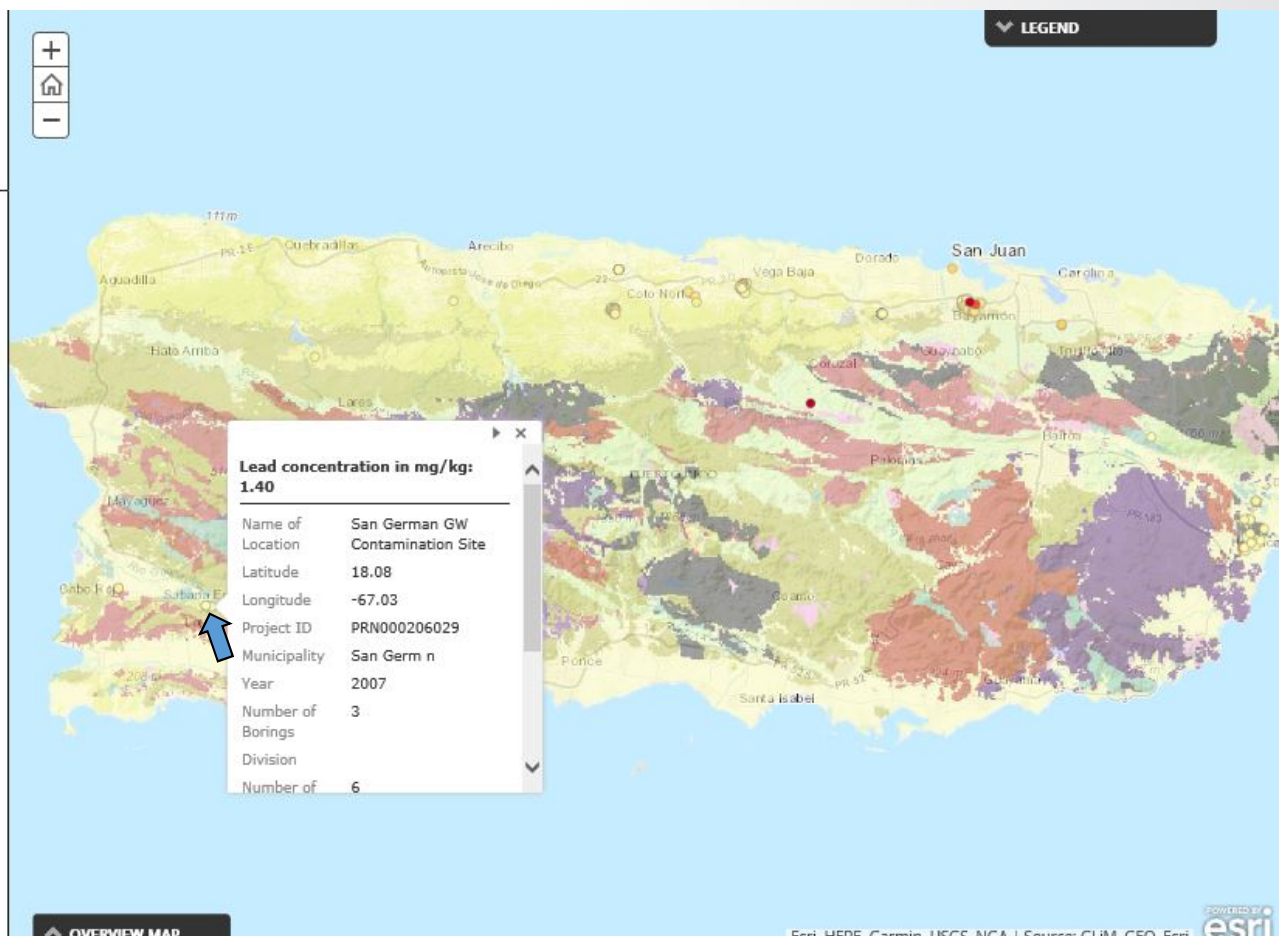
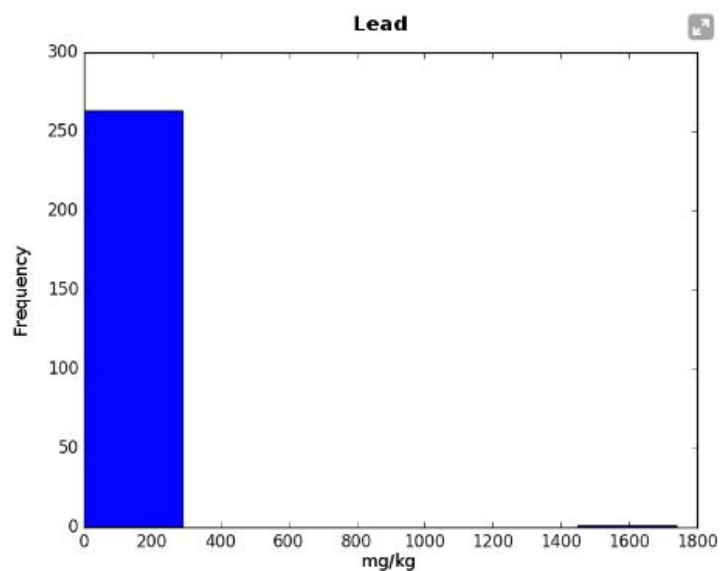
Metals from Natural & Anthropogenic Sources in Puerto Rico Soils

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Background lead in soil

Lead concentrations in soil range from non detect to 1,740 ppm.





Next steps

- This study represents the first compilation of soil background data in Puerto Rico. Background soil data for the island were limited as noted in the discussion of results, and additional work is needed to fill existing data gaps.
- Determine locations for sampling based on soil types/geology, and current and past land use
- Collect and analyze additional samples
- Determine representative island-wide background concentrations
- Add the data to the Story Map and share with stakeholders



Project Team

A story map



Edit



Metals from Natural & Anthropogenic Sources in Puerto Rico Soils

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Project Team

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Acknowledgments

A story map



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Metals from Natural & Anthropogenic Sources in Puerto Rico Soils

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Acknowledgements

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photo: EPA FLICKr

