Toxic Sites Identification Program (TSIP) in Brazil

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Prepared for: UNIDO

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ORGANIZATIONAL BACKGROUND

Pure Earth/ Blacksmith Institute (BI) is an international non-profit organization dedicated to solving pollution problems in low- and middle-income countries. Pure Earth has been implementing the Toxic Sites Identification Program (TSIP), which is an effort to identify and screen contaminated sites in low- and middle-income countries where public health is at risk. TSIP has been supported by The United Nations Industrial Development Organization (UNIDO), European Commission, Asian Development Bank (ADB), World Bank, USAID, and Green Cross Switzerland. The contaminated sites are identified by trained consultants/investigators drawn from universities in respective countries using the Initial Site Screening (ISS) protocol. The ISS helps to understand the risks posed by pollution, types of pollutants, size of the polluted site, population at risk, magnitude of health risk and possible remediation measurers.

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LIST OF ACRONYMS

ADB Asian Development Bank
AMA Accra Metropolitan Assembly
EC European Commission
EEE Electrical and Electronic Equipment
EPA Environmental Protection Agency
GAEC Ghana Atomic Energy Commission
GAHP Global Alliance on Health and Pollution
GASDA Greater Accra Scrap Dealers Association
GreenAd Green Advocacy Ghana
GSA Ghana Standards Authority
ISS Initial Site Screening
MESTI Ministry of Environment, Science, Technology and Innovation
MMDAs Metropolitan, Municipal and Districts Assemblies
NDPC National Development Planning Commission
NGO Non-Governmental Organization
NYA National Youth Authority
PAHs Polycyclic Aromatic Hydrocarbons
PCBs Polychlorinated Biphenyls
PE Pure Earth
SI Site Investigators
TSIP Toxic Sites Identification Program
ULAB Used Lead Acid Batteries
UNIDO United Nations Industrial Development Organization
USAID United States Agency for International Development
VOCs Volatile Organic Compounds
WB World Bank
WEEE Waste Electrical and Electronic Equipment
XRF X-Ray Fluorescence

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EXECUTIVE SUMMARY

To date, Pure Earth has identified a total of 122 sites in Brazil, using the ISS protocol in two different stages: first in the São Paulo state from 2015-2016 and subsequently in the Northeastern Region from 2017-2018. Investigators collected soil samples and measured levels of toxicity using an Alpha XRF instrument. Significant sources of pollution across the two regions included, but were not limited to, agriculture, tannery operations, multi-industry sites, chemical manufacturers, lead smelting, lead mines, ceramics (lead glaze), used lead acid battery (ULAB) recycling, and industrial/municipal dumpsites. Various key pollutants included, but were not limited to, lead, manganese, dioxins, chromium, aldrin, arsenic, asbestos and volatile organic compounds (VOCs).

Pure Earth has utilized data from the ISSs to conduct two different interventions. For the first intervention, Pure Earth conducted a follow-up detailed assessment from January–February 2018 inside a highly contaminated site in Caçapava, São Paulo. Local stakeholders are currently utilizing data obtained from the detailed evaluation to redevelop the property. The second intervention was conducted in May 2018 in the town of Maragogipinho, Bahia, where a significant portion of the community is involved in lead-based pottery. To reduce lead exposure, Pure Earth held a workshop where potters were trained to concoct a lead-free glaze.

Based on data collected and lessons learned, this report provides the following recommendations to the government of Brazil:

- Access the TSIP database to gain further understanding of the pollution issues in Brazil
- Use data gained from the 122 site visits to conduct additional detailed evaluations, which are the first step in pursuing intervention and remediation measures to prevent human health exposure (data collected thus far reveal several possible sites for follow-up assessment)
- Expand the TSIP program in the country to identify additional contaminated sites
- Continue to develop local training centres to encourage viable, pollution-free livelihoods, such as the one established for potters in Maragogipinho, Bahia
- Prohibit burning of e-waste components and other substances in cities and towns to avoid pollution.

INTRODUCTION

Pure Earth/Blacksmith Institute (PE), is an international not-for-profit organization dedicated to solving pollution problems in low and middle-income countries where human health is most affected by pollution. To date, more than 3,000 sites have been identified in 47 countries. These sites alone represent a health risk to more than 80 million poor people. Importantly, however, these sites likely represent a small fraction of the overall total number of contaminated sites in the world. To further this ongoing mapping work, Pure Earth contracts and trains highly qualified professionals, often from the environment or health departments at a national university, to identify and assess contaminated sites using the Initial Site Screening (ISS) protocol.

Pure Earth focuses on locations throughout the developing world where human health is most affected by pollution. To date, more than 3,000 sites have been identified so far, and more than 1,800 screened on site, in 47 countries. These sites alone represent a health risk to more than 80 million people. Crucially, these 3,000 sites likely represent a small fraction of the overall total. To implement this ongoing work, Blacksmith has contracted and trained highly qualified professionals, often from environment or health departments in a reputable national university, to identify and assess contaminated sites using the Initial Site Screening (ISS) protocol.

The ISS protocol provides a rapid quantitative evaluation to help understand the risks posed by pollution, specifically including types of contaminants, size of the site, number of impacted people, magnitude of health risks, and an early projection of remediation methods. The goal is to have a reasonably complete list of the industrial pollution sites most impacting public health in low- and middle-income countries.

Pure Earth also serves as the Secretariat of the Global Alliance on Health and Pollution (GAHP). GAHP is a global consortium comprised of agencies committed to reducing the effects of pollution in LMIC. Current members include national governments (Ministries of Environment) as well as multilateral organizations such as the United Nations, European Commission, World Bank, and Asian Development Bank, among others.

BACKGROUND

Pollution has significant health impacts in Brazil. Over 90,000 deaths a year (or 7% of total deaths in the country) are due to pollution (according to the IHME Global Burden of Disease database 2013). However, the real number is likely higher, as many pollution risk factors

such as those related to soil pollution are not included in these estimates (e.g. exposure to toxic metals from contaminated sites, etc). Children are the most vulnerable– toxic pollution causes physical and neurological developmental delays that can last a lifetime.

While Pure Earth's engagement in Brazil began in 2006 with isolated site screenings, implementation of the comprehensive Toxic Sites Identification Program (TSIP) did not begin until 2015. The program is dedicated to identifying and evaluating contaminated sites in low and middle-income countries (LMICs) with the potential to impact human health. TSIP is not intended to be a comprehensive inventory but it can be used to begin to understand the scope of the problem.

TOXIC SITE IDENTIFICATION PROGRAM (TSIP)

The TSIP identifies active and abandoned hazardous waste sites resulting from both formal and informal industrial activities in Low Middle Income Countries (LMICs). Informal activities include but are not limited to electronic waste or scrap metal recycling, used lead-acid battery recycling, small-scale gold mining, leather tanning, and ceramic pottery making. The TSIP does not include exposure data from non-point sources such as vehicle traffic or sewage contaminated water. As part of a TSIP investigation, a "key pollutant" is identified and analyzed.

With support from the Alcoa Foundation, Porticus Foundation and the European Commission and UNIDO, Pure Earth implemented the Toxic Sites Identification Program (TSIP) in Brazil in two stages: first in the São Paulo state from 2015-2016 and subsequently in the Northeastern Region from 2017-2018. The project supported the Brazilian government in efforts to identify toxic sites and establish priorities for further evaluation and interventions. In total, Pure Earth performed 122 initial site screenings (ISSs): 22 in the São Paulo State and 100 in the four states in the Northeast Region.

In addition to the trainings and site screenings performed in both regions, the project team and stakeholders produced a video and guidance document in Portuguese on Toxic Site Identification, based on legal review and experience conducting the program. These materials were presented to state secretaries of health and were made available to government and non-government stakeholders interested in addressing pollution problems with an impact on human health.

TSIP TRAINING

TSIP training, conducted over two days, consists of both theoretical and practical components. The theoretical training on day one, introduces participants to the work of Pure Earth, the health impacts of pollution, and the model of Pollution-Migration-Pathway-People.

Participants are also taught how to use a hand-held Alpha Xray Fluorescence (XRF) spectrometer (a precise instrument that permits collection of real-time field data and is key to building in-country capacity to monitor and assess heavy metal contamination). During day two, the practical, field-based component of ISS training, participants visit a site for hands-on experience in using the ISS protocol. Participants then return to the classroom to learn how to enter data into the TSIP database. Each participant practices using the data collected during the morning field visit.

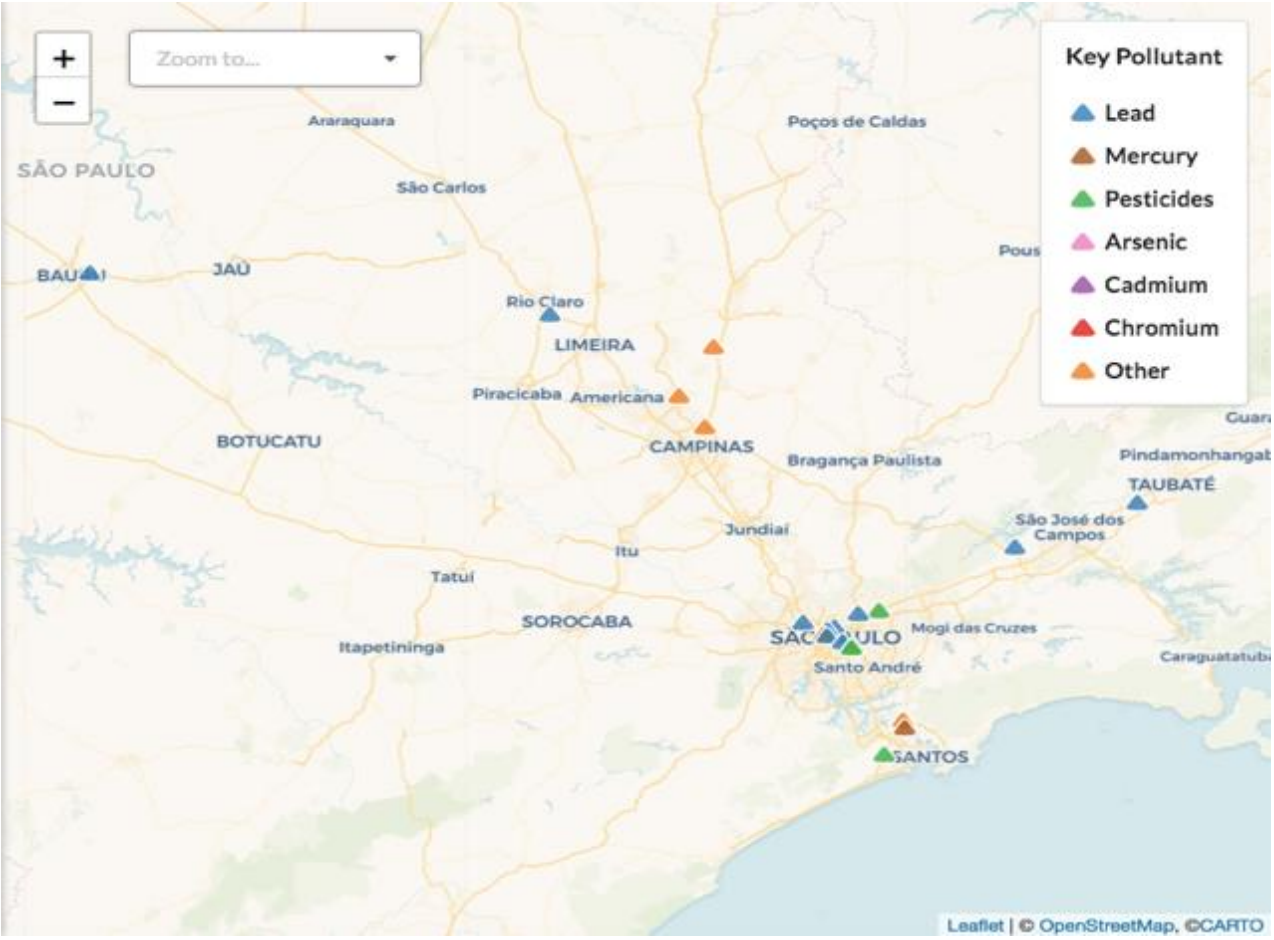
Stage 1: São Paulo

Before TSIP trainings and investigations were conducted, an initial meeting was held on August 26, 2015 in São Paulo to discuss and map future project activities. Participants included representatives from the Ministry of Environment MoE, the Environmental Company of the state of São Paulo (CETESB) and the Centre of the Stockholm Convention on POPs. Because of its status as an economic hub, participants concluded that the project would begin in the state of São Paulo, as this state could serve as model and encourage participation from other Brazilian states in the future. Following the meeting, an official partnership between Pure Earth and the Environmental Company of the State of São Paulo (CETESB) was established via a memorandum of understanding.

In January and February 2016, Pure Earth's Brazil Country Coordinator Joya Correia-Deur met with personnel from the state (SMA) and municipal (SVMA) secretaries of environment, as well as the state (SS) and municipal (SMS) secretaries of health, to present the project and invite them to participate in the TSIP training.

The training took place in March 2016 with the selection and training of five site investigators and twelve government representatives. Following the training, 22 sites were identified, assessed, and uploaded into the TSIP Database (Appendix 1) in 2016. Each site entry includes a description of the contaminated area (coordinates, estimated population at risk, pollutant pathway, pollutant concentration, etc.); pollutant release risks; site stakeholders (government agencies, local authority, opinion leaders, NGOs, etc.); and relevant linked reports and images.

Figure 1. *Map of the state of São Paulo with markers indicating evaluated sites, taken from Pure Earth's TSIP Database*



Of the 22 total sites, five were identified as high-priority and eight were identified as medium priority according to the numerical Black Smith Index (see Annex 2 Blacksmith Index Overview and Population at Risk Calculation). Substantial contamination (BI value 9) was found in Paulínia, São Paulo in two different industrial dumpsites, both of which were associated with facilities of the company Shell. Key pollutants corresponded to the POP 2,3,7,8-TCDD (Dioxins) with concentrations of 200 ppm in soil and pesticides with concentrations of 17,000 ug/l in drinking water.

Lead (Pb) was the most frequently occurring primary contaminant, found at eleven sites. Other contaminants identified included additional toxic heavy metals and persistent organic pollutants (POPs) such as pesticides and dioxins. Significant pollution source industries in the region included industrial/municipal dump sites, lead battery recycling initiatives and chemical manufacturing centers. The total population affected at these sites was estimated at 58,753.

Table 1: *Key pollutants identified in the state of São Paulo during TSIP site visits*

Key Pollutant	Number of Sites Identified
2,3,7,8-TCDD (Dioxins)	2
Benzene	1
Dichloroethane	1
HCH (Hexachlorocyclohexane)	2
Hexachlorobenzene (Benzene Hexachloride)	1
Mercury - elemental	1
Lead	11
Volatile Organic Compounds (VOCs)	1
Pesticides (Total)	1
Other	1
Total	**22**

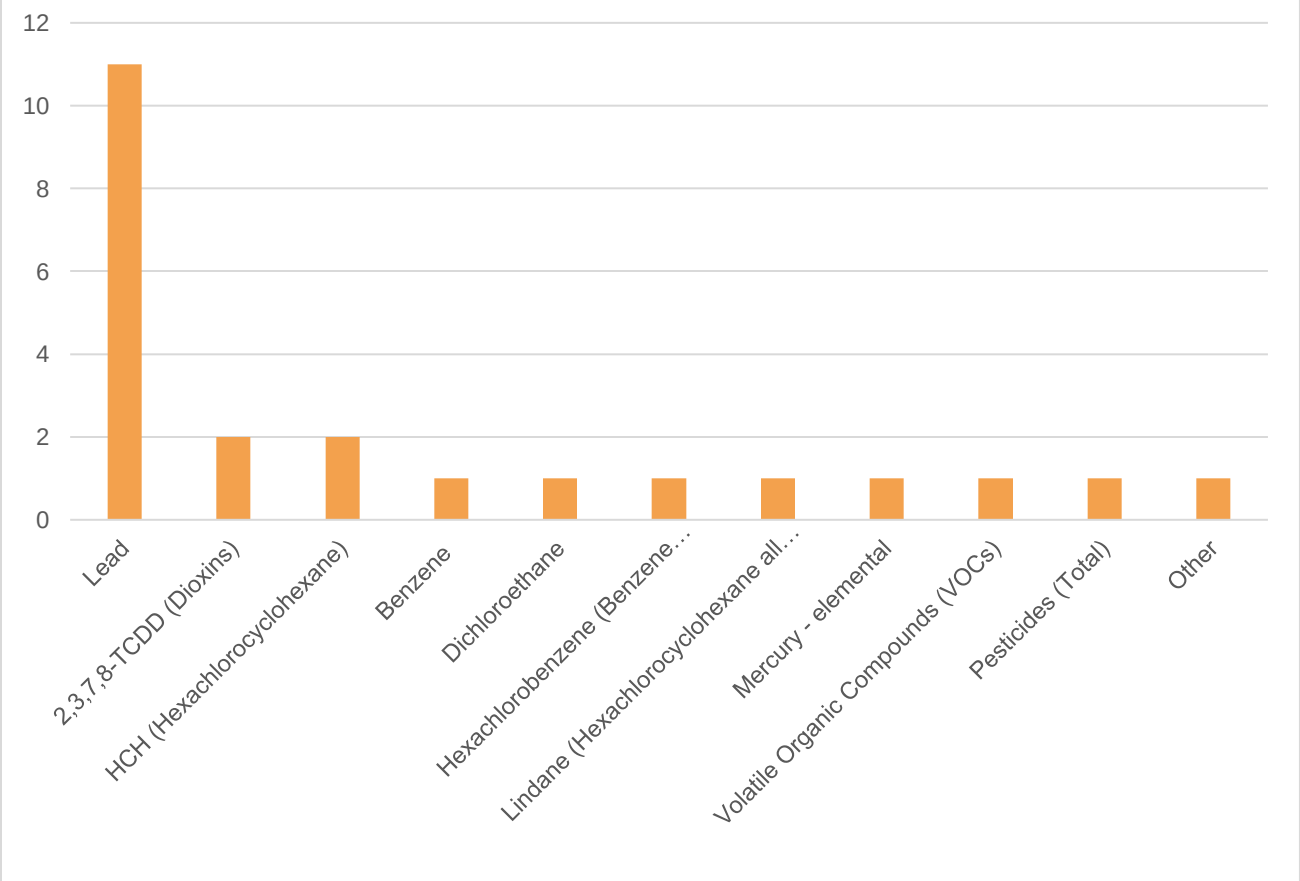
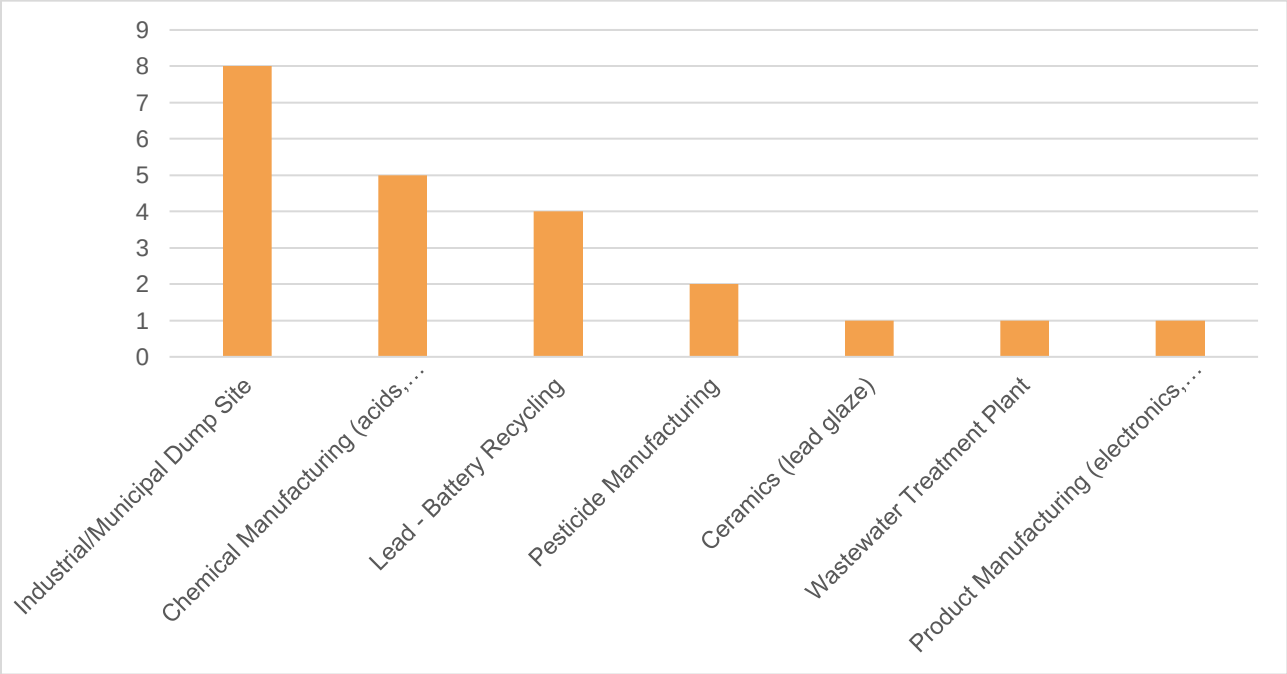


Table 2: *The number of sites as categorized by pollution source assessed by Pure Earth's TSIP investigators in the state of São Paulo*

Industry	Number of Sites Identified
Ceramics (lead glaze)	1
Wastewater Treatment Plant	1
Industrial/Municipal Dump Site	8
Lead - Battery Recycling	4
Chemical Manufacturing (acids, organics, base chemicals)	5
Pesticide Manufacturing	2
Product Manufacturing (electronics, equipment, clothing)	1
Total	**22**



Detailed Evaluation Project in Caçapava, São Paulo

In March 2017, Pure Earth's project team in Brazil conducted an initial soil assessment in Caçapava, a municipality located in the São Paulo State, in a former used lead-acid battery (ULAB) recycling facility. The initial soil measurements, obtained from an x-ray fluorescence (XRF) hand-held device, revealed lead levels as high as 7% (71,089 ppm) inside the former processing building and 24.4% (243,610 ppm) outside the building. Local experts

determined that the property represented a possible economic opportunity for metal recovery as well as property redevelopment.

Due to local receptivity and the severity of contamination, Pure Earth conducted a follow-up detailed assessment from January–February 2018 inside the contaminated building. This project was supported by the organization *Project Management Institute* (PMI) and the Caçapava government's desire to remediate the property. Of the 132 XRF soil readings collected during the follow-up assessment, lead concentrations ranged from 889 ppm to 240,998 ppm (24.10%), with an average concentration of 34,303 ppm (3.43%).
Currently, two companies have proposed cleanup projects for Caçapava: *Antares*, which would recycle the contaminated soil for cement production, and a second company, which would dispose of the soil and redevelop the property for beneficial reuse. Regardless of which approach is ultimately selected, the contaminated ULAB site is slated for cleanup and eventual redevelopment (see Annex 3 for an executive summary of the detailed soil assessment and redevelopment in Caçapava).

Stage 2: The Northeast Region

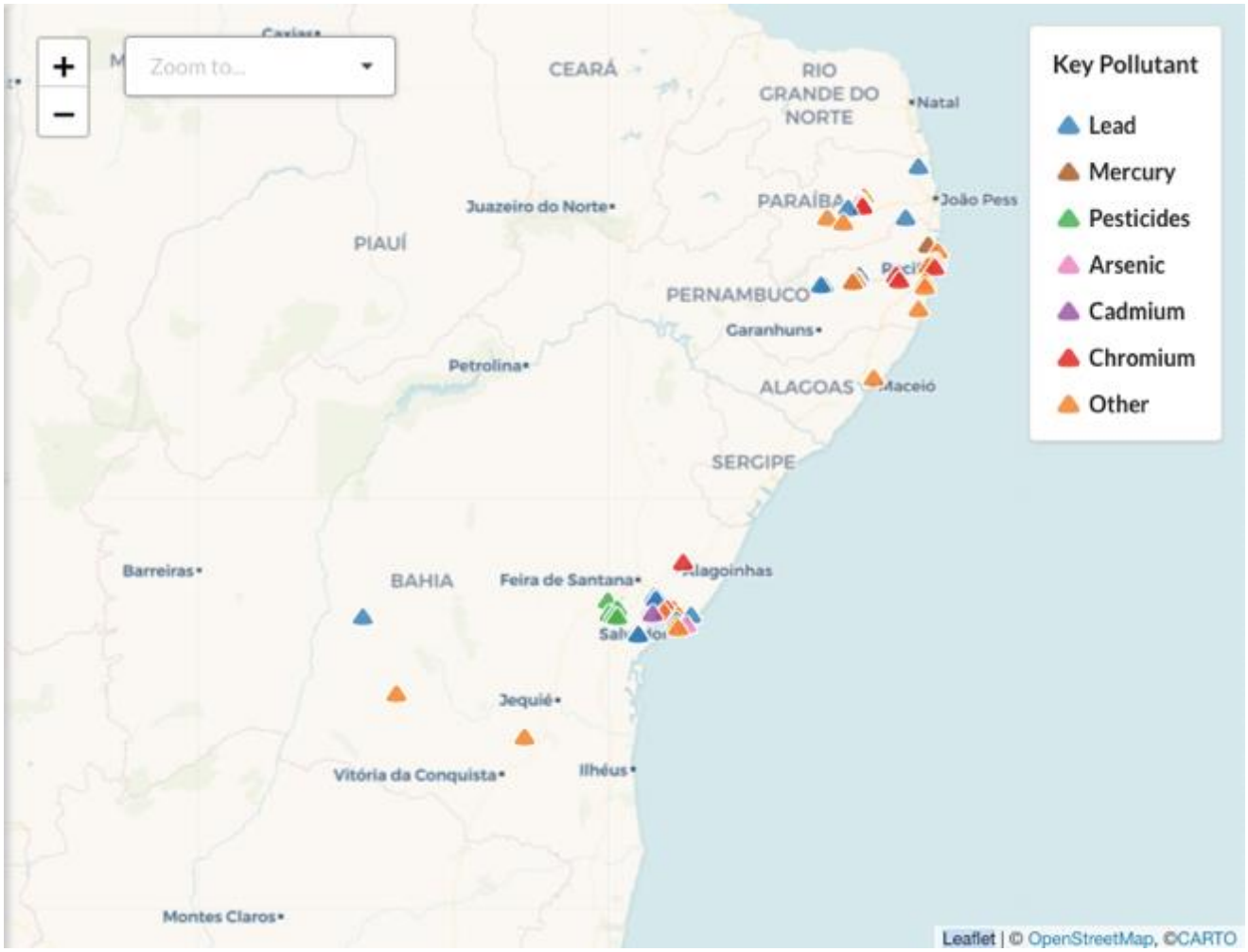
At the request of state officials and with financial support from the Alcoa Foundation, Pure Earth expanded the program into the Northeast Region of Brazil from 2017-2018. To initiate the project, Pure Earth trained ten local site investigators and seven stakeholders on March 20-22, 2017 in Salvador, Bahia. Along with government officials, representatives from UNIFACS (Universidade Salvador), the National University of Bahia and RUI Barbosa College participated in the event.

Following meetings with faculty from the Federal University of Bahia, investigators visited and assessed 19 contaminated sites in Bahia, which was chosen as a pilot state due to its wide range of pesticide use, mining activities, and lead contamination hotspots. Notable contamination was identified with lead-based pottery in Maragogipinho, lead in Santo Amaro City, pesticides in Castro Alves, manganese in Simões Filho, and Titanium in Areias.

In order to better understand the scope of pollution in the Northeast Region and gain more cooperation from local governments, Pure Earth decided to expand TSIP to three additional states in the region: Pernambuco, Alagoas and Paraiba. Representatives from the Secretaries of Health of each state were receptive and collaborative. Although officials from Pairaba and Alagoas could not participate directly, state representatives from the Secretary of Health accompanied site investigators for the majority of site visits in Pernambuco (see Annex 2: List of Government Contacts).
In total, Pure Earth conducted 100 initial site screenings (ISS) in the Northeast states: 3 in Alagoas, 45 in Pernambuco, 17 in Paraiba, and 35 in Bahia. Each site entry includes a description of the contaminated area (coordinates, estimated population at risk, pollutant pathway, pollutant concentration, etc.); pollutant release risks; site stakeholders

(government agencies, local authority, opinion leaders, NGOs, etc.); and relevant linked reports and images.

Figure 2. *Map of the Northeast Region with markers indicating evaluated sites, taken from Pure Earth's TSIP Database*



The results were presented to officials and inputted into the TSIP digital database. Lead (Pb) was the most frequently occurring primary contaminant, found in 35 sites, followed by "other," chromium and aldrin/pesticides. The high incidence of non-specified pollutants ("other") primarily corresponded to the presence of the heavy metal manganese, which is not currently specified in Pure Earth's pollutant index. The most significant pollution source industries in the region found from the visits included agriculture, tannery operations, multiple/diverse industries and lead-related operations (lead smelting, lead mines and

ceramics). The high incidence of agriculture as a pollution source and its corresponding contaminants—pesticides, aldrin, chromium—are likely due to the region's reliance on agricultural crops as the chief economic output. The total population in proximity to the contaminated sites was estimated at 95,889.

32 of these sites were identified as medium-to-high priority (BI value > 3) and 3 of these contained a BI value greater than six, indicating that they pose significant risks to human health and should be prioritized for cleanup. Results from a 2015 study showed that a site in Caitité, Bahia contained substantial uranium contamination (BI value 8), found in an open-cast mine. Concentrations in drinking water were found as high as 566,850 ug/L (EPA recommended level is 30 ug/L) and highf incidents of cancer were reported in the nearby community.

It is also important to mention that 33% of sites contained a Blacksmith Index value of 0, suggesting that Pure Earth investigators discovered little or no significant traces of contamination in these areas. In the majority of these cases, the Pure Earth team was referred to the site by government officials or other stakeholders, based on local anecdotal evidence or previous scientific papers.

Table 3: *The number of sites as categorized by pollution source assessed by Pure Earth's TSIP investigators*

Industry	Number of Sites Identified
Agriculture	24
Multiple Diverse Industries	16
Tannery Operations	14
Lead Smelting (with ingot production)	10
Lead Mines	6
Ceramics (lead glaze)	5
Product Manufacturing (electronics, equipment, clothing)	4
Mining and Ore Processing	3
Industrial/Municipal Dump Site	3
Industrial Estate (mixed industries)	3
Lead - Battery Recycling	3
Chemical Manufacturing (acids, organics, base chemicals)	2
Recycling / Recyclers (including salvage yards)	2
Heavy Industry (casting, rolling, stamping)	2
Medical (hospitals, clinics)	1
Petrochemical Industries (refineries)	1
Dye Industry	1

Industry	Number of Sites Identified
Total	100

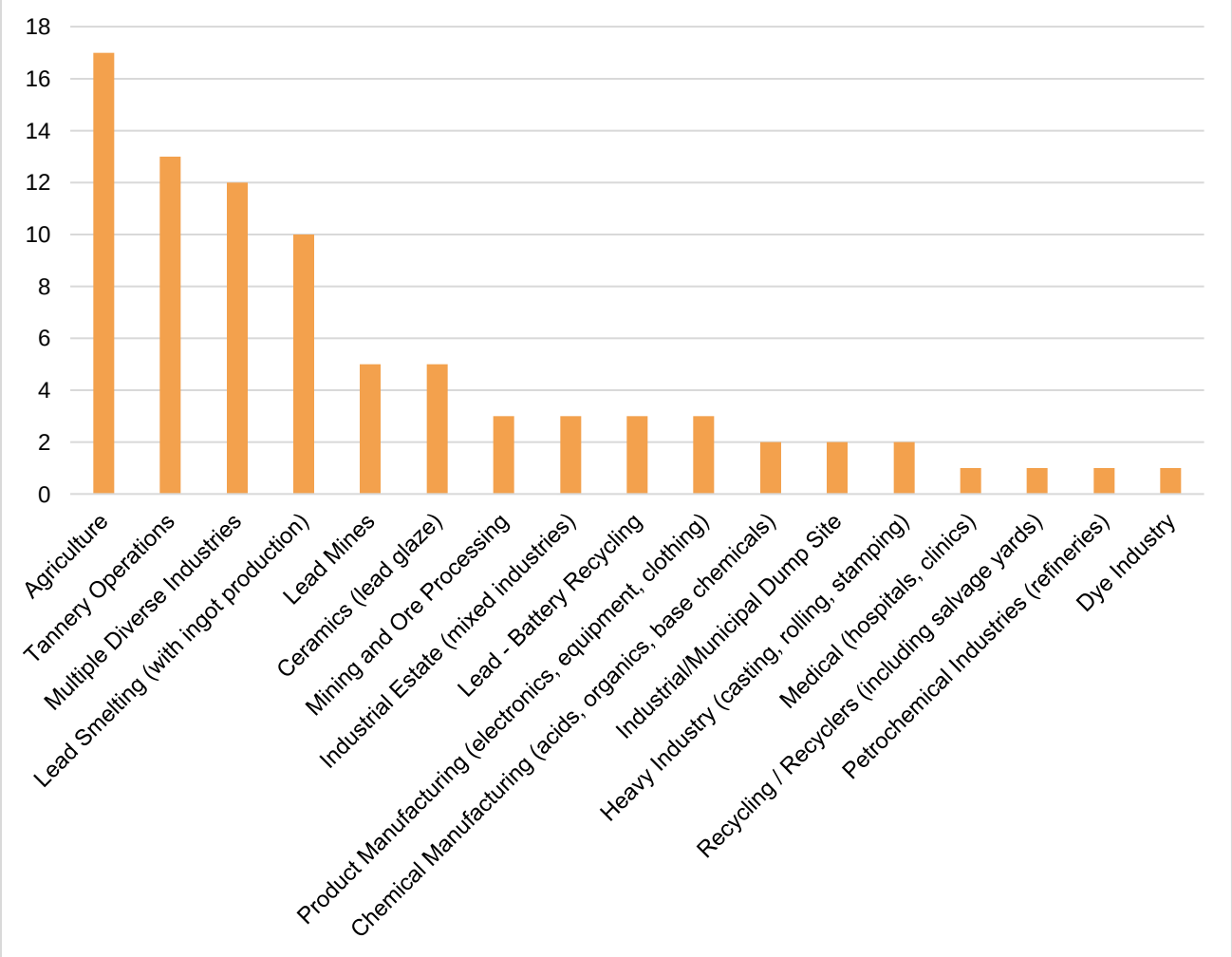
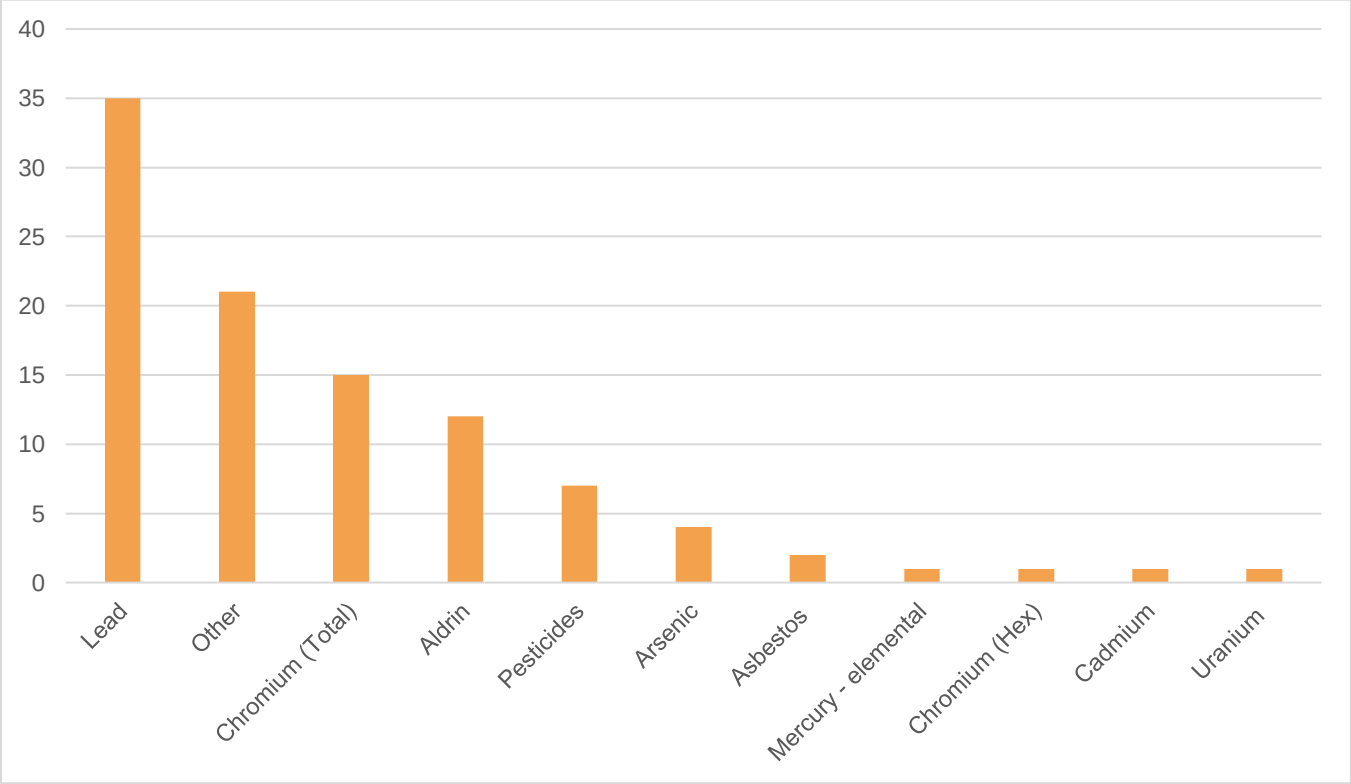


Table 4: *Key pollutants identified in the Northeastern Region during TSIP site visits*

Key Pollutant	Number of Sites Identified
Lead	35
Other	21
Chromium (Total)	15
Aldrin	12

Pesticides	7
Arsenic	4
Asbestos	2
Mercury - elemental	1
Chromium (Hex)	1
Cadmium	1
Uranium	1
Total	**100**



Lead-Free Pottery Workshop in Maragogipinho, Bahia

When investigators visited the town of Maragogipinho, Bahia, during one of the 2017 TSIP assessments, the team found lead concentrations in soil as high as 44,500 ppm (the EPA maximum standard level is 400 ppm). The town contains about 3,000 inhabitants and 800 people directly exposed. Unfortunately, the source of contamination is also a significant source of the community's economic and cultural production: artisanal pottery. Artisans use a lead-based glaze, meaning that anyone who handles the pottery, including their families

and customers, may be exposed. About 80% of the community is employed in these workshops.

In May 2018, Pure Earth in collaboration with the Federal University of Bahia hosted a lead-free workshop for potters in Maragogipinho, led by Daniel Estrada, director of the *Barro Aprobado* project in Mexico, as well as Víctor Águila, Mexican potter, director of the NGO *Barro Sin Plomo*. Participants included local potters, government officials, members of the Federal University of Bahia (UFBA) and the Pure Earth team. The workshop trained potters to concoct a lead-free glaze with the so-called “triaxial method” (see Annex 4 for an executive summary of the project).

Furthermore, Pure Earth recently obtained additional support for the project from the Alcoa Foundation. With this funding, Pure Earth will conduct follow-up activities in June 2019, which include further education initiatives, livelihood resources and remediation of contaminated workshops.

LESSONS LEARNED

Among all site visits conducted between 2016 and 2018 in Brazil, Lead (Pb) was the most frequently occurring primary contaminant, found in 35 sites in the Northeast Region and 11 in the state of São Paulo. The pollution industry responsible for the contamination varied widely, including ULAB operations, lead-based ceramics, industrial/municipal dump sites, lead smelters, etc.

Pure Earth’s lead-free pottery initiative in Maragogipinho is designed to establish and spread livelihoods which reduce lead pollution. Instituting similar alternative livelihood initiatives throughout the country could be an effective means of reducing the substantial degree of pollution caused by artisanal practices. Another important step in reducing the threats to human health by lead contamination is to develop legal frameworks which regulate and manage waste, such as the prohibition of burning e-waste components and other substances in cities and towns.

Furthermore, while the 122 ISSs conducted are not intended to provide a comprehensive picture of pollution in Brazil, they do reveal important differences about contamination trends in the Northeast Region versus in the Southeastern state of São Paulo. Likely reflective of respective dominant economic activities, the Northeastern Region’s primary polluting industries included agriculture, multiple diverse industries and tanneries while the state of São Paulo’s primary polluting industries included industrial/municipal dump sites, lead - battery recycling and chemical manufacturing. The differing pollution profiles in each region

require accordingly varied response and cleanup strategies from the respective states to address unique local conditions.

8 sites (5 in the state of São Paulo and 3 in the Northeast Region) contained a Blacksmith Index value of 7 or higher (see Annex 2 Blacksmith Index Overview and Population at Risk Calculation), indicating that they pose significant risks to human health and should be prioritized for detailed evaluation and possible remediation. While this number likely represents only a fraction of the total high-priority sites throughout the country, these sites provide the state and national government with a foundation on which to begin reducing the pollution scope in Brazil. If the project is expanded into other states, Minas Gerais and Rio de Janeiro should be considered, given that recent studies estimate 642 and 328 possible toxic sites in these states respectively.

Security was one recurring obstacle throughout the project. A 2017 study conducted by the NGO Global Witness stated that more environmentalists are killed in Brazil than anywhere else in the world, a condition especially prevalent in the North, Midwest and Northeast Regions. Even when the Pure Earth team was accompanied by government representatives, some sites remained unreachable due to unsafe conditions.

Regarding government participation, many local governmental officials found that the ISS protocol is an effective tool that can be easily adopted by the Secretary of Health. They informed Pure Earth that the protocol is simple yet comprehensive and would thus like to replicate it in other regions of the country. However, the political climate in Brazil has a strong effect on the government's capacity to commit to new projects and can be an obstacle to sustained commitment. Furthermore, due to the large size of the country and the difficulty of sustained long-distance travel, Pure Earth found that it is imperative to find a project coordinator in Brazil who is based in the state or region where the program is being implemented.

Annex 1: List of Government Contacts from the Northeast Region

Pernambuco
Gerência de Vigilância em Saúde Ambiental- VIGISOLO
Endereço: R. Doná Maria Augusta Nogueira, 519 - Bonji, Recife – PE
Gabriela Murakami (Psicóloga/Sanitarista), pe.vigipeq@gmail.com
Phone: 55-81-3184-0190 Cell phone: 55-11-991926971
Encontro com o departamento VIGIPEQ / VIGISOLO da Secretaria Estadual de Saúde de Pernambuco em 4 de dezembro de 2017. Ela nos deu as informações que tinha sobre os locais contaminados e visitou alguns deles para entender como é feito o ISS.

Gerência de Vigilância em Saúde Ambiental/ Caruaru
Departamento de Vigilância Sanitária-IV GERES (Regional Health Management)
Endereço: R. Gen. Estilac Leal - Salgado, Caruaru - PE, 55018-610
Telefone: 55-81- 3719-9287 / 55-81 97008884
Responsável: José Ricardo Borba Alves
Cargo: Técnico
e-mail: kadoborba@gmail.com
Encontro com o departamento VIGISOLO de Caruaru em 05 de dezembro de 2017. Ele nos deu as informações que tinha sobre os locais contaminados e solicitou o motorista Marcos para visitar algumas áreas.
Gerência de Vigilância em Saúde Ambiental/ Belo Jardim
Coordenação de Vigilância de Populações Expostas a Contaminantes Químicos - VIGIPEQ/VIGISOLO Belo Jardim
Contato: Fábio Vieira
Cargo: Farmaceútico
Endereço:Av. Deputado José Mendonça Bezerra, 220 - Centro, Belo Jardim – PE. CEP: 55150-005.
Telefone: 55 81 96550404
e-mail: fabio.jsvieira34@hotmail.com
O Fábio Vieira teve um imprevisto e cancelou a reunião, no dia 19/01/2018 ele solicitou o técnico Jorge da Vigilância Ambiental em Belo Jardim para acompanhar a equipe e relatar as informações que tinha sobre os locais contaminados e visitou alguns deles para entender como é feito o ISS.

Gerência de Vigilância em Saúde Ambiental/ Afogados
Niely
Fone: 81 97515214

Alagoas
Secretaria de Saúde do Estado de Alagoas
Gerência de Vigilância em Saúde Ambiental- Programa VIGISOLO

Maria Elisabeth Vieira da Rocha
Engenheira Ambiental- Gerente da Vigilância Ambiental
Fone: 55 82 3315 2539
Isabel
Coordenadora da Vigilância Ambiental
Fone: 82 91133457
Reunião com Isabel- Coordenadora de Vigilância Ambiental / VIGISOLO em 12 de dezembro de 2017. Ela nos deu informações sobre os locais a visitar.
E-mail: saudeambiental.al@gmail.com

Paraíba

Secretaria da Saúde do Estado da Paraíba
Gerência de Vigilância em Saúde Ambiental
Endereço: Av. Dom Pedro II, 1826 - Torre, João Pessoa
Liliane Pedreira
Assessora de comunicação da saúde
Liliane.ufpb@hotmail.com
Fone:55 83 88871543

Geraldo Menezes Medeiros
Gerente de Vigilância Ambiental
Tel: 55 083 3218 7480
e-mail: geraldommedeiros@yahoo.com.br

Emanuel
Contato: (083) 3218 7329 ou 3218 7330 (FAX)
Encontro com o departamento VIGIPEQ / VIGISOLO da Secretaria Estadual de Saúde da Paraíba em 23 de Janeiro de 2018. Eles nos deram as informações que tinha sobre os locais contaminados e para entender como é feito o ISS.

Secretaria do Meio Ambiente
Superintendência de Administração do Meio Ambiente - SUDEMA
Av. Monsenhor Walfredo Leal, 181 - Tambiá - João Pessoa-PB
Samara Galvão
Engenheira Ambiental e coordenadora de medições ambientais
samara.sudema@gmail.com
Tel:55 083 32185620
emails: sudema@sudema.pb.gov.br / sudema.paraiba@gmail.com

SUDEMA - Núcleo Regional de Campina Grande
Av. Rio Branco, 89 - Centro - Campina Grande-PB - CEP 58.400-058
Wladimir Lucio- Agente Ambiental
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ANNEX 2: BLACKSMITH INDEX OVERVIEW AND POPULATION AT RISK CALCULATION

BLACKSMITH INDEX OVERVIEW

The Blacksmith Index (BI) provides a basic numerical value for the estimated risk associated with any site where an Initial Site Screening (ISS) has been carried out. The values provided are relative rather than absolute and are intended to provide a basis for setting priorities between sites. It calculates an Index value (an integer from 0 to 10) using standard information collected in the ISS.

The Index is based on the widely used Source-Pathway-Receptor model of risk assessment. The Blacksmith Index has been refined over the years in light of the increasing number of sites in the database and the wide range of information that has become available. During 2012, a new sector sampling protocol was implemented, providing more nuanced information on population and concentration of the pollutant. Previously, a small number of target samples were taken as representative of the site as a whole. With sector sampling, the site is divided into separate areas based in part on use, and aggregated samples are taken for each area. Distinct population numbers are then given for each 'sector' and added together to determine the population of the site as a whole. In addition, a handful of targeted samples are taken from areas with particularly sensitive receptor (e.g. school yards, hospitals). In 2017, with input from the Food and Agriculture Organization of the United Nations and the World Bank, multiple contaminants were integrated into the index rather than reliance on a single Key Pollutant. To account for these changes, a revised version of the formulation is being proposed.

FORMULATION

Similar to the previous formulation, the new one is a function of:

BI = f [(Potential population at risk); (Severity of pollution); (Allowance for persistent toxins)]

The Blacksmith Index for the site is the highest among the different sector's Indexes, including the Index calculated for the "*Additional Possibly Exposed Population*".

To calculate the Blacksmith Index for the ""*Additional Possibly Exposed Population*," it is assumed that this population is exposed at the level of the "worst sample test result" multiplied by a "Spatial Attenuation Factor"; this factor depends on the "Pathway" selected for the sector with the "worst sample test result"

The detailed formulas is as follows:

$$BI_{SITE} = \text{Highest among } BI_1, BI_2 \ldots BI_n, BI_{add\_popu}$$

n = number of sectors sampled

$$BI_{1..n} = [\log_{10}(sector\ pop)\ ] + \left[\log_{10}\left(\frac{sector\ test\ result}{screening\ threshold}\right)\right] + Persist.Factor$$

$$BI_{add\_popu} = [\log_{10}(add.est.pop.)] + \left[\log_{10}\left(\frac{worst\ sector\ test\ result}{screening\ threshold} \times Esp.Attenua.factor\right)\right] + Persit.factor$$

In cases where the test result is below the screening threshold, the Blacksmith Index for the sector becomes “zero” (i.e. there is not pollution above the screening threshold level).

In cases where the test result is above but still less than two times the screening threshold, the Blacksmith Index for the sector becomes “One” (i.e. here there is pollution above the screening threshold level, but not more than twice).

SPATIAL ATTENTUATION FACTOR (SAF)

See attached document “Basis for Spatial Attenuation Factors”

PERSISTANCE FACTOR

An allowance is included to account for compounds, such as heavy metals and certain POPs, that persist in the environment over time.

APPLICATION

A Blacksmith Index value is calculated for each site, using standard data fields from the Initial Site Screening. Each site is reviewed for internal consistency, to ensure that the BI value does reflect the overall character of the site and the scale of the reported impacts. It must be emphasized that the Index provides a relative ranking of sites and is intended to help in setting priorities for more detailed investigation. It is not, of itself, a judgment on the health impacts of any one site.

POPULATION AT RISK CALCULATION

The population at risk is calculated understanding how many people could possibly be affected by the pollution. If the impacted area is a residential area, the investigators count or estimate the number of dwellings and estimate the number of people per dwelling, using available maps, information for governments or community leaders and their own observation. If schools are present, the investigators ask about the number of students. If a contaminated water source (wells or surface water) is suspected, the investigators ask about and estimate the number of people using this water source. At the end of the screening the investigators enter the “estimated population at risk” based on the number of people that could possibly be exposed through the pollution migration pathways.

ANNEX 3: Executive Summary: Detailed Soil Assessment and Redevelopment in Caçapava, Brazil

Site Background and Initial Assessment

In March 2017, Pure Earth's project team in Brazil conducted an initial soil assessment in Caçapava, a municipality located in São Paulo State, at a former used lead-acid battery (ULAB) recycling facility. The area is trafficked by both people and livestock and is adjacent to a stream. Rapid urban encroachment and economic development make the contaminated property a potentially lucrative plot of land. The soil measurements, obtained from an x-ray fluorescence (XRF) hand-held device, revealed lead levels as high as 7% (71,089 ppm) inside the former processing building with one reading of 24.4% (243,610 ppm) outside the building. Local experts determined that the property represented a possible economic opportunity for metal recovery as well as property redevelopment.

Follow-Up Evaluation Results

As a result of additional PMI funding and the Caçapava government's desire to remediate the property, Pure Earth performed a follow-up detailed assessment from January–February 2018 focusing on the large soil stockpile inside the partially collapsed building. The assessment was conducted in collaboration with *Antares*, a Brazilian company focused on the beneficial reuse of industrial waste, which was interested in recycling the contaminated soil as source material for cement production.

Of the 132 XRF soil readings collected during the follow-up assessment, lead concentrations ranged from 889 ppm to 240,998 ppm (24.10%), with an average concentration of 34,303 ppm (3.43%). Because the soil samples revealed significant iron concentrations and an average lead concentration below 5%, *Antares* deemed the soil conditions suitable for cement production.

Moving Forward: Site Cleanup and Redevelopment

Since the ULAB facility closed in 1999, the Caçapava government has made repeated attempts to remediate the toxic site, in order to protect the local population and facilitate redevelopment. However, these efforts failed because the city lacked sufficient funds to implement remediation and, thus, make the property economically viable.

Pure Earth's assessment data and engagement have provided relevant stakeholders with the data necessary to incentivize and assist the local government with remediation and, ultimately, redevelop the property. Currently, two companies have proposed cleanup projects: *Antares*, which would recycle the contaminated soil for cement production, and a second company, which would recycle the lead-impacted soil and redevelop the property for beneficial reuse. Regardless of which approach is ultimately selected, the contaminated ULAB site is slated for cleanup and eventual redevelopment.

ANNEX 4: Executive Summary: Changing a Toxic Tradition in Maragogipinho, Brazil

When Pure Earth visited the town of Maragogipinho, Brazil in 2017 as part of the Toxic Sites Identification Program (TSIP), the team found lead concentrations in soil as high as 44,500 ppm (the EPA maximum standard level is 400 ppm). With about 3,000 inhabitants and 800 people directly exposed, such a high concentration meant big health risks for the town, particularly children.

Unfortunately, the source of contamination is also the source of the community's economic and cultural richness: artisanal pottery. There are over 100 ceramic workshops in Maragogipinho and about 80% of the community is employed in these workshops. The trouble is that artisans use a lead-based glaze, meaning that anyone who handles the pottery, including the artisans' families and clients, faces serious health risks.

While unique and devastating, this dilemma is not entirely new. In Mexico, millions of people suffer from lead poisoning due to the use of a lead-based glaze in traditional pottery. To combat this problem, Pure Earth began the *Barro Aprobado* project in 2014, which endeavors to diagnose sources of contamination and raise awareness about a lead-free alternative, which is as healthy, beautiful and affordable as its toxic counterpart.

Since the situations in Mexico and Brazil are so similar, Pure Earth realized that connecting the *Barro Aprobado* project with Maragogipinho would be the perfect way to eliminate contamination, preserve tradition and build solidarity. In May 2018, Pure Earth with the support of the Federal University of Bahia hosted a lead-free workshop for potters in Maragogipinho, led by Daniel Estrada, director of the *Barro Aprobado* project in Mexico, as well as Víctor Águila, Mexican potter, director of the NGO Barro Sin Plomo and champion of the lead-free method.

The training began with a meeting between local potters, government officials, members of the Federal University of Bahia (UFBA) and the Pure Earth team. Participants expressed concerns about lead poisoning and aspirations to promote a lead-free glaze, within Maragogipinho and throughout the state of Bahia.

Over the next days, the Pure Earth team held a workshop in the studio of Nivaldo Dos Santos, a local artisan who wants to see Maragogipinho go lead-free. Potters were initially skeptical that glaze could be made in their low temperature kilns without using lead . However, after Víctor taught them to use a lead free glaze and to concoct a glaze with the so-called "triaxial method", combining calcium carbonate, ground glass and clay, the artisans became more enthusiastic and encouraged. At the end of the workshop, participants created a Whatsapp group to share their experiences and help one another create a better lead-free glaze.

While the workshop was the first step in changing Maragogipinho's toxic tradition, the community needs sustained support. Contaminated workshops must be remediated so artisans and their families do not continue suffering from lead poisoning. More potters need to learn the lead-free method and also be given the resources to experiment with a glaze mixture that suits their own unique conditions. Taking these crucial steps will enable artisans to preserve their livelihood while keeping the Maragogipinho community free from lead poisoning.