

Final Report

Prepared for: Stephan Robinson, Green Cross Switzerland

Prepared by: Bret Ericson, Project Manager

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“Mitigation of acute lead exposures in Dong Mai Village, Vietnam”



PROJECT SUMMARY

Site Description

Dong Mai Village, Chi Dao Commune, Van Lam District Vietnam is the site of a severe epidemic of lead poisoning. Blood tests carried out by the University of Washington in 2012 found 15 children with dangerous blood lead levels (BLLs) (≥ 65 ug/dl), 17 children at urgent levels (45 – 65 ug/dl), 70 children at overexposed levels (25 – 44 ug/dl) and 7 children at concerning levels (10 – 19ug/dl). The CDC maintains a level of concern of 5 ug/dl. Lead is an acute neurotoxin with serious implications for brain development and cardiovascular issues.

The cause of the elevated BLLs was decades of informal car battery processing in the village. In this process, lead plates are removed from battery casings by hand and cleaned of lead oxide and sulfide dusts that have accumulated on their exteriors. These dusts are very fine and easily inhaled. Because they contain no inherent commercial value they are regularly discarded in area soils, where they come into contact with children.

In 2008, an industrial area was constructed by the Vietnam Environment Administration (VEA) 1 km south of Dong Mai, and most industrial activity was relocated. However, because lead is very immobile in the environment, surface lead levels in Dong Mai remained dangerously elevated.

Summary of Results

Within six months of the completion of project, Blood Lead Levels (BLLs) had decreased by an average of at least 35% across all groups. The decrease is likely more severe, however the detection limit of the equipment (65 ug/dl) limited the team's ability to assess this. The downward trend is likely to continue.

Summary of Activities

The project contains five key components, enumerated below:

1. Community education
 2. Cleaning contaminated home interiors
 3. Covering of contaminated soils with compacted clean soil or cement to prevent exposure (encapsulation).
 4. Construction of a clothes changing facility for the workers to mitigate migration of lead back into the village
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5. Final village inspection and BLL monitoring

All five components were carried out during the time period and within the proposed budget. Summaries of these activities are provided in the sections below.

Project Partners



Community education workshops were held with more than 90% of households attending. Topics covered included the scope of the project and mitigation measures to protect children.

The project was directed by Blacksmith Institute and implemented by the Center for Environment and Community Development (CECoD), the Center for Environmental Consultancy and Technology of VEA (CECT), the International Lead Management Center (ILMC), the University

of Washington (UW) and Blacksmith Institute. Funding for the project was

provided by the Marilyn S. Broad Foundation, the Global Alliance on Health and Pollution (GAHP), ILMC, UW, and Green Cross Switzerland.

PROJECT COMPONENTS

Community Education

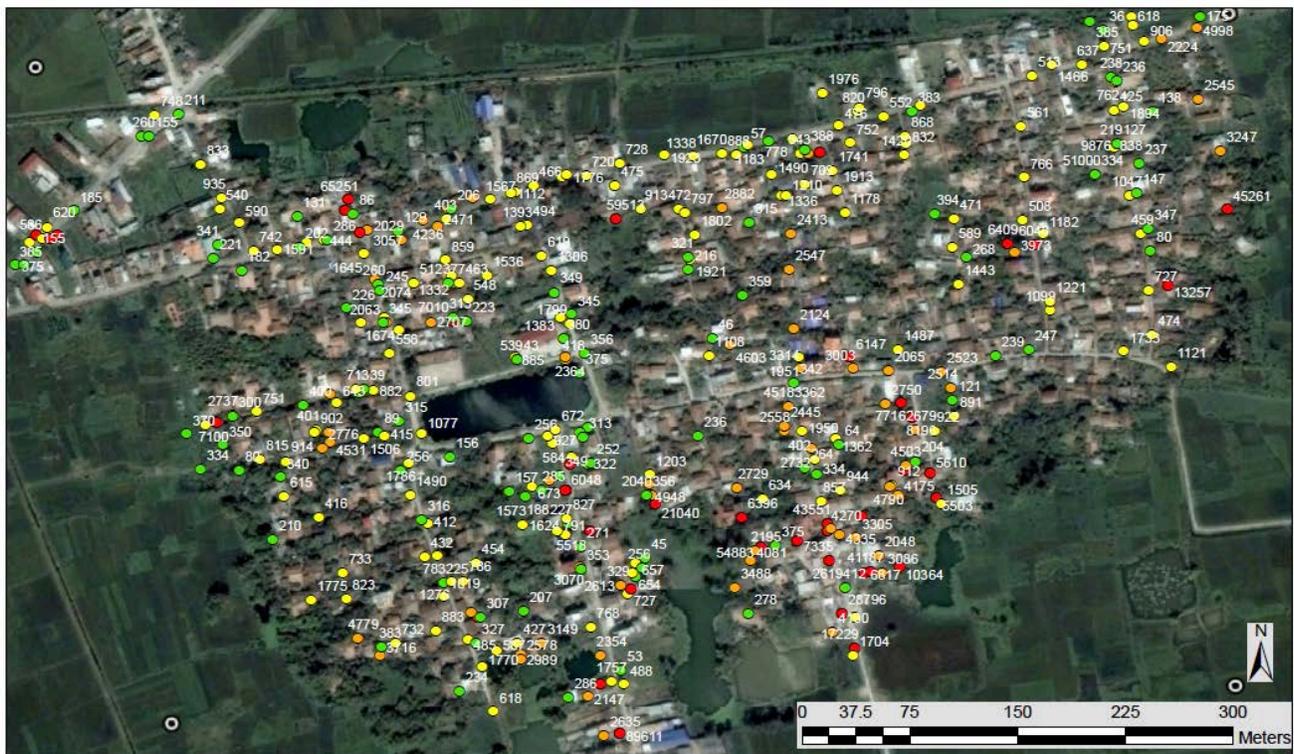
The community education campaign was comprised of four separate activities: three-day community education workshops (n=3); literature distribution; cleaning demonstrations; and loud speaker announcements. The community education workshops were attended by 100% of households – well above anticipated attendance levels or any experience elsewhere. The workshop provided background information on sources of lead exposure and methods of mitigation. It also provided a detailed description of the overall project and expected outcomes. Finally, home cleaning methods were described in detail and demonstrated.



Literature on house cleaning was distributed door to door. Pamphlets were designed with clear and easy to follow instructions.

Literature was developed in the Vietnamese language with assistance from UW staff and distributed door-to-door. The village literacy rate is near 100% allowing for an eased flow of information. The items distributed included a 20 page booklet describing the whole of the

project, a laminated pamphlet offering tips for mitigating exposure, and a laminated pamphlet detailing the proper method for cleaning a contaminated home. In all, literature was distributed to all but 7 of the more than 800 homes in the village. This work was supplemented by cleaning demonstrations in 39 homes and regular announcements over a community loud speaker system. These types of systems are common in Vietnam. The loud speaker system in Dong Mai (common in Vietnam) was not functional in the beginning of the project and was repaired with project funds.



Lead in Soil (ppm)

- 12 - 400
- 401 - 2000
- 2001 - 5000
- 5001 - 89611

Soil Lead Monitoring - October 2013
Dong Mai Village, Chi Dao Commune, Van Lam District, Vietnam
Local Project Manager: Center for Environment and Community Development
Implementation: Center for Environmental Consultancy and Technology
Blacksmith Project Manager/ Cartographer: Bret Ericson
Blacksmith Lead Technical Advisor: John Keith



Map of soil lead levels in Dong Mai. Lead contamination in Dong Mai was extensive, presenting a challenge in remediation design. The elected approach was one of triage; targeting acutely dangerous areas and catalyzing community action through education.

Cleaning Contaminated Home Interiors

39 home interiors were cleaned by Blacksmith staff as part of the project. A protocol used by Blacksmith elsewhere was modified for Dong Mai. Correct Personal Protective Equipment (PPE) was used in all cases as were High Efficiency Particulate Air (HEPA) vacuums. These cleanings were used as demonstrations for community members who then cleaned their own homes. Testing carried out with the use a hand held X-ray Florescence (XRF) instrument in all 39 homes indicated significant declines in surface lead levels. Declines were also noted during spot checks of homes cleaned by residents.

Encapsulation of Outdoor Areas



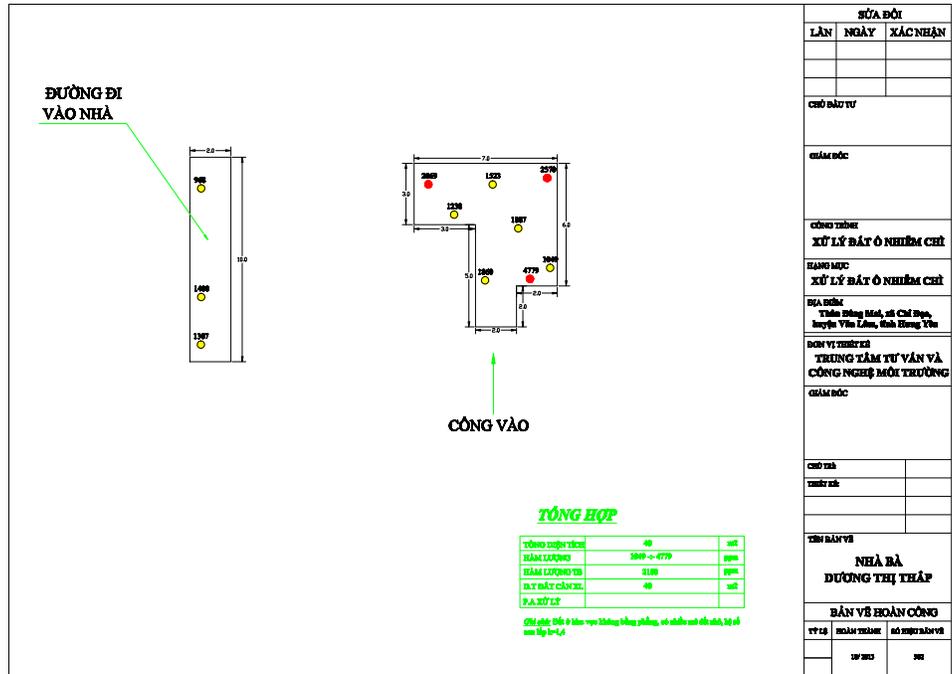
Yards with lead levels above the threshold of 800 ppm were capped with a geotextile layer and compacted clean soil.

Most of the homes in Dong Mai are surrounded by concrete patios. These pose little risk as they are regularly washed and do not retain much lead. 261 homes have soil gardens. All of these were assessed with a handheld XRF. Sampling found that 42 gardens of the 261 gardens in the village exceeded 800 ppm at the beginning of the project. While the USEPA standard for lead in residential soil is 400 ppm, a decision was made to limit remediation activity to only those above 800 ppm. Mitigating exposures in the yards between 400 ppm

and 800 ppm would have been cost prohibitive. Additional funds will be sought to carry out this task.

Of the 42 homes, 23 exceeded 1200 ppm, with the average for this group around 4,000 ppm and the high above 20,000 ppm. 39 of these houses were remediated during the project. The remaining 3 were large enough that including them would have been to the exclusion of all of the others. They were therefore not included. At least one of these home owners elected to carry out remediation with his own funds.

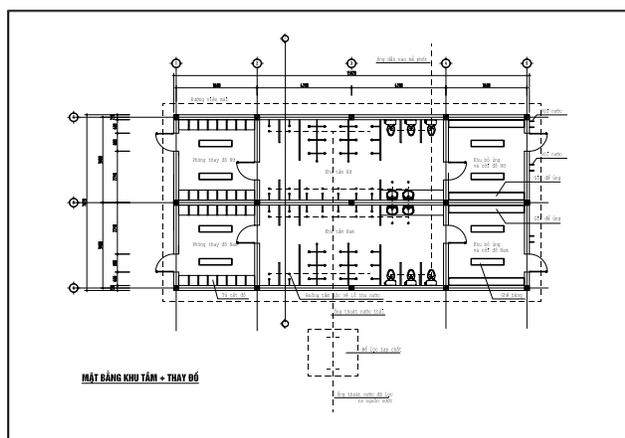
To mitigate the risk posed by residential soil, the team elected to cover contaminated soil first with 5 cm of sand and second with a geotextile layer. This was then covered by either 20 cm of sand, 20 cm of compacted clean soil, pavers (bricks), or concrete. The alternative would have been to remove and landfill the contaminated soil at USD 400 per m³. Given the scope of the soil contamination, this would have been prohibitively expensive and incurred additional risks in transit. Soil capping (in-situ encapsulation) is a well excepted methodology recommended by USEPA among others and was appropriate in this case. Soil in Vietnam is comparatively expensive, as it is typically excavated alluvial. As a result, it only maintains a marginal cost advantage to concrete or pavers, thus the decision to use concrete or soil was made based more on intended use than other parameters. All soil levels are now ~50ppm in yards.



Each soil yard was characterized with a handheld XRF. Detailed diagrams were generated to inform design and planning.

Changing Room Construction

Although not identified as an activity in the original proposal, a changing room for workers in the industrial area was constructed as part of the project. The changing room was designed by ILMC and will help mitigate the migration of lead dust from the industrial zone to residential areas. It has showers, lockers and toilets and will be sufficient in size to for all workers to use. The facility was constructed in a joint effort with the major private smelter; Blacksmith co-financed 60% of the construction and the private facility covered the balance. This was made possible through costs savings during the project and through a concerted effort to engage the facility owner in the project.

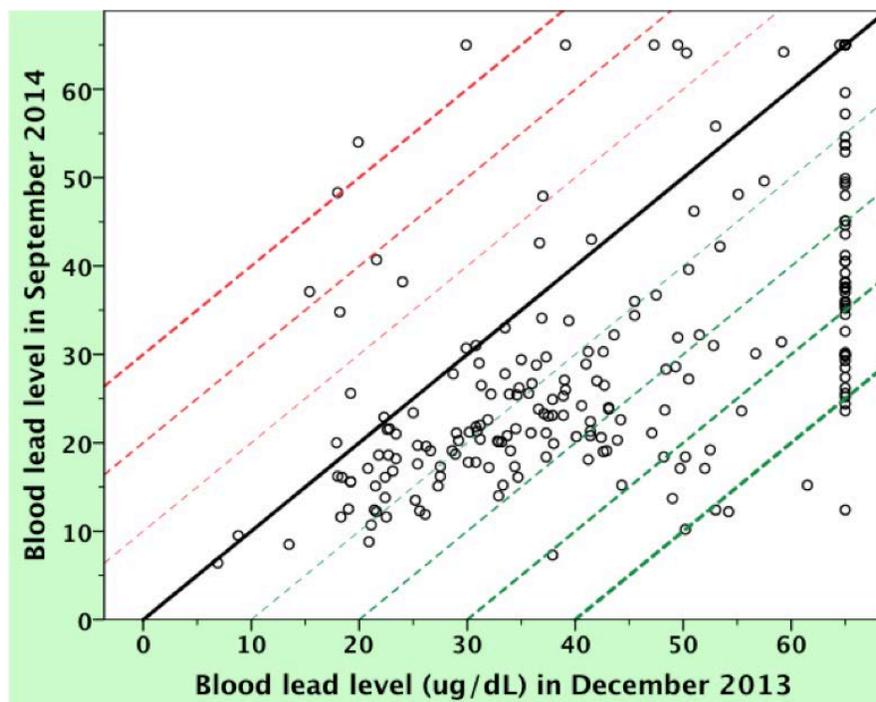


A changing facility was constructed to mitigate the take home risk. The design on the left was first drafted by and American architect than modified to meet local conditions. The foundation was poured August 7th 2014 and completed in November.

Final Inspection and BLL monitoring

Final environmental sampling in all remediated yards was conducted with a handheld XRF and found levels at or below 50ppm in all yards.

In addition to environmental sampling. Blood Lead Levels (BLLs) were taken from a total of 263 children on two separate dates (December 2013 and September 2014), with 209 of the same children participating on both dates. BLLs fell from an average of 39.1 ug/dL to an average of 25.35 ug/dl (35.17%). Declines were seen in all age groups and at all levels of exposure. The table below graphically summarizes the results of the 209 participants.



Blood lead levels before and after cleanup and community education. Green lines represent incremental decreases of 10 ug/dL. Red lines represent increases.

Remediation and education work were completed in March 2013. The graph above therefore represents gains made as a result of these components, though not those made by the construction of the changing room or road construction. This downward trend is expected to continue through 2015 absent further work.

Road Construction

As a result of the intervention, community members and district authorities pooled resources to carry out additional remediation activities. In particular at least three main (collector and distributor) roads within the community were paved in 2014. This will drastically reduce dust creation in the community and therefore exposures. Importantly, residents contributed more than 50% of the construction cost, indicating the success of the community education component of the present project.

This work was done outside of the project and its costs are not reflected in the budget. The likely cost of this construction work was USD 150,000, therefore eclipsing the financial inputs of the project.

Stakeholder Development

The project was implemented with government support at the national, provincial, commune, district and village levels. Regular meetings were held with all relevant stakeholders, including the informal operators in the village and the formal operators in the industrial area.

The key implementer for the construction and mapping aspects of the project was the Center for Environment Consultancy and Technology (CECT) of the Vietnam Environment Administration (VEA).

At the conclusion of the project a workshop was held with National Institute of Environmental Health Sciences (NIEHS-USA) support to identify exposures and risk mitigation measure in craft villages. As a result of the workshop a tripartite proposal is being developed by UNDP, Blacksmith and VEA to replicate this work in 10 other villages.

Funding

Funding for the project came from several key sources. These are listed below.

Donor	USD
Marilyn S. Broad	10,000
Global Alliance on Health and Pollution (European Commission and World Bank resources)	25,000
Green Cross Switzerland	60,000
In-Kind (ILMC, UW, Blacksmith)	23,750
Project Total	118,750
