

Appendix I - Work Schedule - Disposal of waste and contaminated soil at a paver manufacturer in East Java Alternative **

Notes: Assumes 5 day work weeks, 30 km distance from Pesarean to encapsulation site
Start dates assumes all approvals obtained and funding and contracts in place

Task	Item	No. of work days	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26								
Removal of waste material from central dump area										** Assumes paver manufacturer can take waste as fast as is removed from Pesarean, avoiding storage needs																										
	Secure use of transfer pad	5																																		
	Construct temporary transfer pad	15																																		
	Sign contract with Paver mfg., agree on procedures																																			
	Mobilize equipment	5																																		
	Clear dump area vegetation	8																																		
	Hire and train labor	10																																		
	Excavate waste materials from dump area and send to transfer pad	50																																		
	Send from transfer pad to paver mfg.	50																																		
	Receive clean soil for dump area	20																																		
	Grade dump area & cover with soil	15																																		
	Plant grass over area and pave paths	15																																		
	Clean and decomission transfer pad	15																																		
Excavation of waste piles and contaminated soil in yards and alleys																																				
	Mobilize equipment	5																																		
	Hire and train labor	5																																		
	Waste pile & cont. soil excavation and delivery to transfer pad	25																																		
	Clean soil delivered	25																																		
	Placing, compacting clean soil	25																																		
Paving of alleys & misc areas																																				
	Soil excavation & delivery to transfer pad, preparataion for paving	10																																		
	Installing pavers or concrete	15																																		
	Finishing work	5																																		
Excavating and covering high school yards with clean soil																																				
	Clean soil delivery	4																																		
	Excavate & apply clean soil	5																																		
Covering of cemetary area with clean soil, and then fencing area																																				
	Clean soil and paver delivery	5																																		
	Area clearing and preparation	5																																		
	Clean soil installation	15																																		
	Paver installation on paths	10																																		
House Cleaning																																				
	Purchase supplies and equipment	4																																		
	Hire and train labor	4																																		
	House Cleaning work	30																																		
Qualitry Control and Oversight																																				
	Arrange for storage, laundry, food	10																																		
	Provide laundry and food	90																																		
	XRF/QC team	60																																		
	Management & technical oversight	all days																																		
	Inspection, punch list items																																			
	Reporting	25																																		

Appendix I - Schedule for Preliminary Work before Active Project Work Begins

[illegible]

Appendix J

Environment, Health and Safety (EHS) at the Pesarean PIK Kebasen Smelter Operations

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Prepared by: John Keith, Lead Technical Advisor

May 13, 2015



ANNEXES

Annex A – ILA Visit Report (February 2015)

BLACKSMITH OBSERVATIONS

Summary

Smelting and processing of metals is done at various shops, many of which are informal, at the industrial area, called the PIK Kebasen, in Pesarean. The smelting activities are done as part of scrap metal recycling businesses. Metals recycled include aluminum (probably the greatest quantity), lead (undoubtedly the most hazardous to worker and public health), copper, zinc and perhaps occasionally tin. A thorough description and evaluation of the smelting operations was done by an ILA and Blacksmith team in February 2015. This report is attached and its content will not be repeated here. Note that based on visits to the PIK in March and April, 2016, Blacksmith can affirm that operations there are substantially the same as described in the February 2015 report.

The purpose of this document is to summarize improvements needed at the PIK to reduce worker and public health risks, as well as environmental risks presented by the metal smelting operations at the PIK. These improvement recommendations summarized below include those made by the previous ILA/Blacksmith team, as well as those based on my own observations and experience. In this regard, note that I have over 30 years experience evaluating industrial operations from an environment, health and safety (EHS) perspective; I have evaluated over 200 factories all over the world and at all levels of sophistication, including a dozen or so non-ferrous metal smelting operations, plus I have lead corporate EHS improvement programs at several companies.

There are basically five areas where improvements are needed at the PIK:

1. Worker safety protection from physical injuries such as burns, falls, lacerations, strains, etc.
2. Worker occupational health improvement measures, notably to reduce exposure to metal smelting fumes, fugitive dusts, smoke and acids.

3. Measures to prevent the migration of metal contaminants out of the PIK area on worker clothing, shoes and vehicle wheels.
4. Measures to reduce air pollution from the smelting operations. This includes both control of smelting furnace fumes and fugitive dusts from metal and waste handling.
5. Protection measures to prevent contamination from the PIK polluting the nearby surface water stream as well as surrounding rice paddies.

Each of these areas for improvement will be discussed below. However, there is also need for an overarching EHS program at the PIK that takes a holistic view of EHS needs and presents an organized management approach to assure that the specific improvements made are coordinated and sustainable. A diagram of such a holistic program is shown below:

Coordinated EHS Management Program



While there are some of these elements at some of the PIK metal smelting shops, by and large there is not a coordinated or consistent EHS program. Without the key ingredient of management commitment, engagement and leadership, it is doubtful that any improvements made will be effective or long lasting. Unfortunately, there is no easy way to instill such management commitment. Enforcement by government agencies has only limited effect as it is generally infrequent, very specific to particular issues, and is easily subverted. Financial rewards also are rarely effective, particularly where margins are low the sound EHS management is seen as a cost burden; whatever rewards are made available generally do not compensate for the (perceived) increase cost, and there is a great incentive for the company to misrepresent actual EHS progress in order to both get the reward and save the cost.

The most effective means to promote and assure that business owners implement sound EHS management programs is through public and worker pressure. Basically this means instilling the cultural expectation for responsible EHS behavior in Pesarean. A recommendation for a means to do this was included in the social evaluation of the Feasibility Study. Public education is needed about the hazards related to smelting activities and measures to reduce risks. Then there must be measures taken to get community commitment, such as forming a local environmental organization, developing a community environmental and health vision, and adopting local regulations and doing community planning for EHS management in the PIK and all of Pesarean. Engagement of school children in the issue is also often a key step; if children are taught about sound EHS expectations, the parents usually feel obligated to improve their own behavior.

Unfortunately, instilling such community EHS consciousness is not something easily done through grants or programs set up by organizations external to the community. The drive for a cultural shift in how EHS is perceived – from impediment and cost to business to essential element of business – generally has to come from within a community, or be driven by strong leaders within a company or community.

Specific Measures to Improve EHS at the PIK

1. Worker safety protection from physical injuries

- Purchase and assure consistent use of personal protection equipment (PPE) – some PPE use is observed in use at some shops in the PIK, notably the cement paver and block manufacturing operation. However, in general PPE use is inadequate and inconsistent. PPE needs include:
 - safety glasses or goggles around any dusty or hot work areas
 - sturdy work gloves, especially when handling hot objects, potentially sharp objects and cutting tools
 - sturdy shoes, with toes (no sandals)
 - rubber boots in areas where acids may be present
- Improve floor maintenance – assure floors are kept as clear as possible from debris, tripping hazards, acid spills, fix potholes, etc.
- Assure electrical safety – good condition electrical fixtures, cords. No cords in wet areas.

2. Worker occupational health improvement measures, notably to reduce exposure to metal smelting fumes, fugitive dusts, smoke and acids.

- Provide respiratory protection to all workers, and assure that they are worn and changed. The respirators should be N95 respirators or better; the surgical masks seen worn by some workers provide essentially no protection (their purpose is to catch droplets being exhaled, not prevent dust particles from being inhaled). N95 respirators are intended to be worn for one day only, though in practice they can be effective for several days if cared for (which helps keep down cost).
- Improve ventilation to remove dust, smoke and fumes from the workplace. Ideally this would mean furnaces connected to a smokestack equipped with a fan to provide negative pressure ventilation of the furnace, and hoods, ducts and blowers to capture and remove dust over dusty operations such as used battery breaking. In practice, due

to both the high capital and operating costs of such ventilation systems, they are unlikely to be affordable by the businesses at the PIK. Perhaps the best that could be done is to vent furnace and smelting fires better through construction of or connection to an existing tall, large diameter smokestack (perhaps 40 m tall or more). Such stacks provide significant natural draft.

- Many of the jobs at PIK smelters involve heavy lifting and repetitive motion for workers – all day, every day. These actions will result in cumulative injury to muscles. This is undoubtedly happening at the PIK, but workers probably just bear the pain and injury, as they need to keep their jobs. Ergonomic evaluation of the work tasks could probably find ways to reduce excessive lifting and repetitive motions, such as through lifting aids or job rotation, that would involve little cost and could significantly reduce these cumulative muscle injuries.

3. Measures to prevent the migration of metal contaminants out of the PIK area on worker clothing, shoes and vehicle wheels

- Metal dusts being carried out of the PIK on worker clothing and shoes and to the worker's homes is a significant risk to the families of workers. The obvious way to prevent this is to have workers wear work uniforms and (sturdy) work shoes at the PIK,



A changing facility, seen here, was constructed at a similar site in Vietnam for under USD 60,000.

and then shower and change into street clothes and shoes at the end of their work day, leaving the dust at the PIK. Work uniforms are worn at the cement block manufacturing operation, but generally not at the various smelting shops. A common changing facility, with showers, toilets and a laundry area, could be constructed. This was done at a similar sized industrial area used for used lead acid battery recycling and lead smelting in Vietnam at a cost of

about USD 60,000. Of course, there is a maintenance and operating cost (water, electricity, laundry and uniform costs) that must be born, but this should not be so great,

if shared by all the shops, as to be unsupportable. As discussed before, there also needs to be commitment by the shop owners and workers to used uniforms and shower and change every day for the benefit to be obtained.

- Carrying of contamination out of the PIK area on the wheels of trucks, carts, motorbikes and bicycles is a concern, though likely presenting less risk than the clothing. A simple, maintained, shallow water trough (say 3 m long and 15 cm deep, with ramps at each end) that vehicles have to pass through going into or out of the PIK could greatly reduce this risk. Of course, there needs to be arrangements to dispose of the water, such as having the trough drain to a settling tank to collect contaminated sediments. Again, commitment to use and maintenance of the system is needed for it to be effective.
4. Measures to reduce air pollution from the smelting operations. This includes both control of smelting furnace fumes and fugitive dusts from metal and waste handling
- Ideally, an effective air pollution control system should be installed on each smelting furnace or area, as well as for operations creating a lot of airborne dust. Such systems involve hoods and ducts to capture the fumes and dust, fabric filters (i.e. baghouses) or scrubbers to remove the pollutants entrained in the air, and fans to provide the energy to provide ventilation and overcome the pressure drop of the air pollution control devices. Such systems are expensive to both construct and operate (particularly electricity costs). They also require regular maintenance to remain effective.
 - In practice, the costs of effective air pollution control systems are probably far higher than the margins of the various businesses in the PIK can support. If demanded by the government (which is what would be done in richer countries with established pollution control enforcement programs), the likely result is that the demand will be ignored, the shops would go out of business or the shops would relocate to somewhere where such enforcement is unlikely (not to mention the potential for corruption).
 - There are a number of opportunities for improving smelting operations to reduce smoke and fumes through measures such as: furnace design changes; use of better charging or fluxing methods; or using reducing agents that cause less smoke and fumes than the current use of charcoal to produce a reducing atmosphere. The opportunities for such improvements, their feasibility and cost would require a specific evaluation of each type

of smelting done and each metal processed. But at the least, doing smelting in enclosed furnaces, connected to a stack, would result in better control of the operation, more efficient use of the charcoal, and less smoke and fumes than now produced by the shops doing smelting in open pots.

5. Protection measures to prevent contamination from the PIK polluting the nearby surface water stream as well as surrounding rice paddies

- Protection of the surrounding water and rice paddies from air pollution requires air pollution controls, as discussed above.
- A particular concern is acids drained from used batteries. The February 2015 ILA report states that batteries sometimes arrive still full with acid, and that this is drained on to the work floor and subsequently out of the building to adjacent rice paddies and irrigation ditches. A special, contained area for draining acid-filled batteries should be constructed, with acids drained to a collection tank where they can be neutralized (by addition of lime or caustic). Neutralized acid, diluted with water, and after settling to remove any suspended solids, could be discharged. The cost for doing this is not great, but it takes conscientious use of the system to be effective.
- Perhaps the greatest risk to surrounding waters and lands is scattering and dumping of trash and waste from the smelting operations. Measures that could be taken to improve this include:
 - Sending smelter ash and slag to the PIK block and paver operation for solidification. This is done with most of the waste now, but still there is some waste from informal shops not sent there but allowed to accumulate around the shops, from which it can contaminate surround areas as a result of wind-carried dust or storm runoff.
 - Having an organized method for depositing of other waste into dumpsters and then having the dumpsters picked up and the waste sent to an appropriate landfill. This notably should be done for the bags used to carry process materials such as charcoal or scrap metals, but also for other bags and containers, potentially contaminated scrap wood, etc.

ILA Visit Report

February 2015

Bogor, West Java, Indonesia

In attendance:

Bret Ericson

Budi Susilorini

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Brian Wilson

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Masnellyarti Hilman

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Aris Wibowo

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Blacksmith Institute

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Komite Penghapusan Bensin Bertimbel (KPBB)

International Lead Association (ILA)

AKRF

AKRF

1. Objective of the visit.

To undertake a qualitative inspection of some of the informal and licensed ULAB recycling activities in Tegal and assess how environmentally sound or unsound, healthy or unhealthy the operations are.

2. Location



Tegal City is located in Central Java and is approximately 316 kilometres east south east of the capital Jakarta.

3. The ULAB Recycling Sites

3.1 Informal Recycling Site

The first informal ULAB site to be visited was located in the heart of a residential area.

The informal operations at this site were recycling battery plates from ULAB and aluminum scrap consisting mainly of drink cans.



Weighing Aluminium Ingots



An informal fire pit for Lead Smelting

There were more aluminium smelters than Lead smelters at this site, but the Lead smelting was carried out in the same manner as the operations in Bogor, although the fire pits were slightly smaller. At the time of the visit there was no Lead smelting on the site and little evidence of any ULAB material. Nevertheless, although all there appeared to be little Lead smelting operations on the day of the visit, when there is Lead smelting, the conditions will be dire. Although the fire pits are inside a building and protected from the rain and winds, there are no filter plants or hygiene extraction units, just open flues and chimneys to atmosphere.





The chimney above the Lead smelting fire pit vents directly to atmosphere

The theory of the chimney stack is that the heat rising from the fire will generate a slight suction effect around the base of the stack and act as a powered vent, but because the fire pits were so small it is difficult to believe that the fires in the small pits are going to generate sufficient heat to create any “suction” effect around the base of the chimney. Hence, the conclusion is that the atmosphere in the Lead smelting unit will be smoky, dusty and very unhealthy.

As you might expect, smelting operations only take place at night to hide the fact that huge amounts of lead contaminated fume and dust are discharged to the atmosphere during smelting.

The method of smelting the battery plates is the same as that outlined in the Bogor visit report.



Unlike Bogor, the furnace residues from this informal operation are disposed of responsibly and sold to a concrete brick and paving plant in Tegal. However, there was evidence at the rear of the premises that in the past the residues had been dumped and rolled into the ground. Significantly, there was no vegetation growing in the dump site area and there were no plans to remove the residues.

The whole site was neglected and in need of attention as well as being dusty and untidy. Where rubbish had been collected, it had been set alight and left to burn out at the rear of the premises.



There was no sign whatsoever that PPE was in use in any operation.

The same toxic gas emission issues and Lead contaminated residue problems highlighted in the Bogor report apply to the informal operations in Tegal.

3.2 The Licensed ULAB Recyclers Located at the Industrial Zone

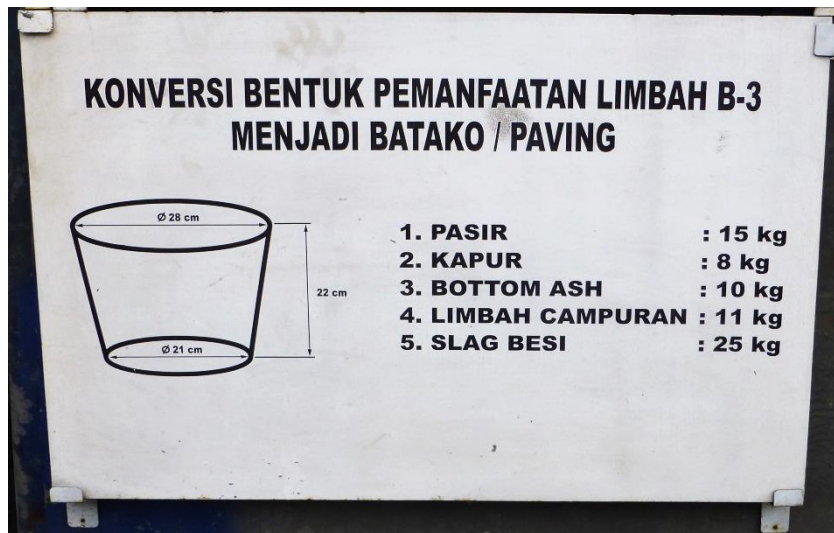
The Tegal Industrial Zone is about 20 minutes or 10 kilometres outside of the city centre and although it is set away from populated areas, it is adjacent to crop growing farmland.



The Site is purpose built with good road access, a security gate at the entry point to the site, concrete roads inside the zone and a proper drainage system to prevent flooding and to contain spillages.

The Zone is divided into a series of individual enterprise lots, some single units and some multiple units. On the site Lead, Aluminium and Copper are recycling and there is a concrete brick making unit that uses the lead furnace residue as a component of the brick mix.

The first Lot visited was the Brick making plant. On exterior wall of the lot was the formula for making the bricks.



Utilization of waste by conversion into a Brick/Paving

1. Sand
2. Lime
3. Furnace Ash
4. Mixed Waste
5. Iron Slag

The furnace residue from the Lead recyclers is number 3 on the list.

The formula included the term “Bottom Ash”, which is normally the term applied to the coal ash from Power Stations, but in this instance is the ash from the Lead furnace that is derived from a mix of wood, from the initial lighting and the coal used as the reducing agent. As far as the brick or paving slab manufacturing was concerned it was process that employed a high compression mould that produced the slab from a dry mix. This is a unique process because the slab will harden as it matures.





The finished Paving Slab is removed from the mould and left to cure and harden



The visit to the paving making plant was unannounced and so it was a welcome surprise to note that ALL the personnel were wearing face masks, overalls, hats and gloves to protect themselves from the risk to exposure to the Lead furnace residues.

There appeared to be three Lead recycling operations at the site, that is, two small operations and one taking up three of the lots on the site. The smaller operations seem to be smelting only battery plates, but the larger operation was breaking ULAB, collecting and selling the battery cases and smelting the battery plates from the ULAB.



The two small ULAB recycling units were using the same basic technology as the plants in Bogor and the informal recyclers in Tegal. One of the units had placed a flue duct over the fire pit to improve the extraction and the other vented straight to the atmosphere in the workplace. One of the operators was wearing a bump hat, gloves and a respirator.



Regretably, although the Tegal municipality has obviously spent a lot of money securing the site for the Industrial Zone, planning and constructing it to a high standard fit for heavy metal industry with good access, power, water and all the amenities expected to be found on a new industrial site, and furthermore, persuaded most of the informal recyclers to transfer to the new purpose built site. As far as could be ascertained the recycling technologies employed by the Lead, Aluminium and Copper recyclers were the same as those they employed before they transferred to the new site. The companies had upgraded their premises, but not their environmental performance.

Typically, as can be seen from the next photograph the modified flue from the fire pit just exhausted into the atmosphere through the stack just above the roof. There is no filter plant to remove the Lead fume or dust and the stack is so low to that the fumes and dust do not dissipate, but, as can be seen in the photograph, just linger around the building as a suffocating mist.



The third Lead Recycler had two furnaces inside the Lot. Both furnaces were enclosed in metal sheeting that helped to create the draft that would expel the dust and fume arising from the smelting operation to the atmosphere.



ULAB were delivered to this recycler whole and many full of battery acid. The tops of the ULAB are manually removed with a clean swipe of a large machete. The battery acid drains onto the floor and presumably leaks out of the building into the soil just outside. The plates are then removed and stacked in preparation for the night shift who will smelt the plates and produce the lead ingots. There are no environmental controls to contain lead emissions or toxic gases and all just vent to the atmosphere.

All the operators working in this unit were wearing respirators, hats, neoprene gloves and boots. Regrettably, they were not wearing glasses or goggles and so were at greater risk of getting acid splashed in their faces as they broke the batteries.

Surprisingly from such a basic operation the purity of the Lead ingots was at least 99.97% and this can be deduced from the purple sheen on the ingots. The purple sheen is only found on Lead that is about 99.97% pure or better. The finish on the ingots was also a high standard and dross free. The Lead ingots produced at this unit will command a premium price.



What is interesting here is that given the poor standard of smelting equipment and the fact that the operators still manage to produce Lead ingots to a very high standard, there is no doubt that given the appropriate environmental control equipment they would manage their operation to comply with the necessary environmental standards.

What is in favour of the population of Tegal is that the Municipal Authorities welcome any assistance from institutions such as the Blacksmith Institute and the KPBB, that can now advise the authorities on the best ways to instigate environmental, safety and occupational health improvements to the recyclers operating at the Industrial Zone.

Conclusion and Recommendations

None of the Lead operations, that is, formal or informal operations visited in Tegal were safe, hygienic or environmentally sound, and neither were the methods of ULAB collection or breaking because the ULAB were either drained of acid, delivered in bags of plates or broken on site with no regard for containing the acid.

The Municipal Authority in Tegal have clearly demonstrated their commitment to improve the environmental performance of the local metal recyclers and now want to take the next step and introduce a program of improvement to the technologies employed. This positive attitude on the part of the authorities in Tegal is most welcome and it is therefore recommended that the relevant personnel in Tegal should have the most appropriate technology options explained to them, so that they can be confident that any further investment will bring a marked improvement in the environmental management of the Lead recyclers.

The agreed outcomes from such a session on the recycling technology options should form the basis of an improvement project for Tegal.

It should be noted that the Paving manufacturer was a most welcome sight in Tegal and this company should be involved in any technology upgrade to ensure that the furnace residues can be reclaimed and used in the manufacture of the paving slabs.

Brian Wilson, ILA

March 2015

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative III. Top and Sides Encapsulation at Central Dump Area

Full Cost

9,198,440

707,572

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Solidfy waste at dump site in situ, then encapsulation on top and sides						2,951,560	227,043	
						SUBTOTAL		
	Clean soil	m3 - delivered	142	5000	1	710,000	54,615	Needed soil from structure excavation
	Clay	m3 - delivered	75	8000	1	600,000	46,154	
	6 mm HDPE liner	m2 - delivered	70	6000	1	420,000	32,308	
	Front end loader w/ operator and fuel	number	4000	2	50	400,000	30,769	
	Excavator w/ operator and fuel	number	5000	1	40	200,000	15,385	
	Roller compactor w/ operator and fuel	number	4000	1	50	200,000	15,385	
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Labor - waste/soil placement	workers	80	10	50	40,000	3,077	
	Labor - mixing cement with soil/waste	workers	80	10	50	40,000	3,077	
	Labor - build concrete mixing pad	workers	80	5	10	4,000	308	
	Supervision	workers	100	2	60	12,000	923	
	Uniforms, gloves, boots	sets	420	44	2	36,960	2,843	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
	Liner installation and sealing	hectare	6000	1.3	1	7,800	600	
	Grass seed	m2	20	6000	1	120,000	9,231	
	Security fencing for area	100 m	8000	4	1	32,000	2,462	
	Pavers for paths	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Labor - paver installation	workers	150	4	30	18,000	1,385	4 m2 per day per worker
* 1 set = 2 wheelbarrows, 3 shovels, 2 picks, 2 rakes								
Excavation of waste piles and highly contaminated soil in yards and alleys						1,302,280	100,175	
	Bobcat w/operator	number	6000	2	35	420,000	32,308	
	Dump trucks (5 m3)	number	3000	5	25	375,000	28,846	1,725 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
	Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
	Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	25	33,000	2,538	
Paving of alleys & misc areas						221,100	17,008	
	Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
	Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative III. Top and Sides Encapsulation at Central Dump Area

Full Cost

9,198,440

707,572

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Dump trucks (5 m3)	number	3000	1	10	30,000	2,308	150 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - soil removal & prep.	workers	80	10	10	8,000	615	
	Labor - installing pavers	workers	150	10	30	45,000	3,462	
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
	Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil						175,820	13,525	4200 m2 to cover
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	400 m2 on sides of roads & misc, 10 cm depth 15 cm depth, 660 m2 at High School 660 m2 in schoolyards haul soil to encapsulation facility excavate, install barrier cloth, soil and gravel
	Gravel	m3	466	40	1	18,640	1,434	
	Clean soil	m3	142	100	1	14,200	1,092	
	Geotextile	m2	28	660	1	18,480	1,422	
	Dump trucks (5 m3)	number	3000	3	5	45,000	3,462	
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor	workers	80	5	10	4,000	308	
	Supervision (per day per supervisor)	workers	100	1	10	1,000	77	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
	Respirators	not needed for this work						
Covering of cemetery area with clean soil						777,180	59,783	
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	400 m of paths, 1 m wide 12,000 m2, 30 cm depth 1,000 m2 for paths 4 m2 per day per worker level, add soil and compact, 12,000 m2
	Pavers	m2	92	400	1	36,800	2,831	
	Clean soil	m3	142	3600	1	511,200	39,323	
	Geotextile	m2	28	3810	1	106,680	8,206	
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - install pavers	workers	150	4	30	18,000	1,385	
	Labor - install soil	workers	80	10	30	24,000	1,846	
	Supervision (per day per supervisor)	workers	100	2	30	6,000	462	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
House Cleaning						154,800	11,908	~ 600 houses
	HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446	2 houses/day, 3 workers/cew
	Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388	
	Labor (per day per laborer)	workers	80	24	40	76,800	5,908	
	Supervision (per day per supervisor)	workers	100	2	40	8,000	615	
	Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative III. Top and Sides Encapsulation at Central Dump Area

Full Cost

9,198,440

707,572

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Respirators	not needed for this work					0	
Community Outreach and Education						218,500	16,808	
	Education sessions for commuinity	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults
	Food for sessions	per attendee	15	2000	1	30,000	2,308	
	Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters
	Video on lead hazrds	total	10000	1	1	10,000	769	Education video about lead and other metals
Project Management, Quality Control and Assessment						1,698,600	130,662	
Project Management and General								
	Project Field Manager (per day)	manager	1400	1	80	112,000	8,615	
	Stockroom manager (per day)	manager	700	1	80	56,000	4,308	
	Stockroom rental (per week)	per week	1400	1	22	30,800	2,369	
	Financial assistant (per day)	manager	700	1	80	56,000	4,308	
	Health, safety and security officer	officer	700	1	80	56,000	4,308	
	Communications officer	officer	700	1	80	56,000	4,308	
	Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day
	Bottled water for workers	per day	30	40	100	120,000	9,231	
	Laundry	worker	4	60	100	24,000	1,846	
	Wash room use	per week	1400	1	20	28,000	2,154	
Assessment and Technical Oversight								
	XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control
	XRF rental	per week	3000	2	24	144,000	11,077	
	Technical Advisers	advisers	2000	2		0	0	For technical oversight
	Poject Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director
	XRF team and TA travel and lodging	total				150000	11,538	
Blood testing and assessment								
	Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work
	Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
	Gifts for children	per child teste	50	100	1	5,000	385	
	Cleaining serviece	number	300	1	2	600	46	
	Meals for Assessment team	number	50	6	2	600	46	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative IIIa. Stabilization and Top and Sides Encapsulation at Central Dump Area Full Cost 21,130,640 1,625,434

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Solidfy waste at dump site in situ, then encapsulaton on top and sides						SUBTOTAL	14,883,760	1,144,905
	Clean soil	m3 - delivered	142	5000	1	710,000	54,615	Needed soil from structure excavation
	Clay	m3 - delivered	75	8000	1	600,000	46,154	
	6 mm HDPE liner	m2 - delivered	70	6000	1	420,000	32,308	
	Concrete pad construction for mixing	m3 concrete	1290	180	1	232,200	17,862	as per Ibu Warma estimate, 20 cm thick
	Stabilization cost - mixing, materials	m3 of waste	585	20000	1	11,700,000	900,000	\$45/m3 cost from MT2 - material, equip. & labor
	Front end loader w/ operator and fuel	number	4000	2	50	400,000	30,769	
	Excavator w/ operator and fuel	number	5000	1	40	200,000	15,385	
	Roller compactor w/ operator and fuel	number	4000	1	50	200,000	15,385	
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Labor - waste/soil placement	workers	80	10	50	40,000	3,077	
	Labor - mixing cement with soil/waste	workers	80	10	50	40,000	3,077	
	Labor - build concrete mixing pad	workers	80	5	10	4,000	308	
	Supervision	workers	100	2	60	12,000	923	
	Uniforms, gloves, boots	sets	420	44	2	36,960	2,843	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
	Liner installation and sealing	hectare	6000	1.3	1	7,800	600	
	Grass seed	m2	20	6000	1	120,000	9,231	
	Security fencing for area	100 m	8000	4	1	32,000	2,462	
	Pavers for paths	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Labor - paver installation	wokers	150	4	30	18,000	1,385	4 m2 per day per worker
* 1 set = 2 wheelbarrows, 3 shovels, 2 picks, 2 rakes								
Excavation of waste piles and highly contaminated soil in yards and alleys						1,302,280	100,175	Stabilization cost in above
	Bobcat w/operator	number	6000	2	35	420,000	32,308	
	Dump trucks (5 m3)	number	3000	5	25	375,000	28,846	1,725 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
	Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
	Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	25	33,000	2,538	
Paving of alleys & misc areas						221,100	17,008	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative IIIa. Stabilization and Top and Sides Encapsulation at Central Dump Area

Full Cost

21,130,640

1,625,434

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
	Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.
	Dump trucks (5 m3)	number	3000	1	10	30,000	2,308	150 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - soil removal & prep.	workers	80	10	10	8,000	615	
	Labor - installing pavers	workers	150	10	30	45,000	3,462	4 m2 day per mason, 1200 m2 to pave
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
	Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil						175,820	13,525	4200 m2 to cover, stabilization cost in above
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Gravel	m3	466	40	1	18,640	1,434	400 m2 on sides of roads & misc, 10 cm depth
	Clean soil	m3	142	100	1	14,200	1,092	15 cm depth, 660 m2 at High School
	Geotextile	m2	28	660	1	18,480	1,422	660 m2 in schoolyards
	Dump trucks (5 m3)	number	3000	3	5	45,000	3,462	haul soil to encapsulation facility
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor	workers	80	5	10	4,000	308	excavate, install barrier cloth, soil and gravel
	Supervision (per day per supervisor)	workers	100	1	10	1,000	77	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
	Respirators	not needed for this work						
Covering of cemetery area with clean soil						777,180	59,783	
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Pavers	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Clean soil	m3	142	3600	1	511,200	39,323	12,000 m2, 30 cm depth
	Geotextile	m2	28	3810	1	106,680	8,206	1,000 m2 for paths
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - install pavers	workers	150	4	30	18,000	1,385	4 m2 per day per worker
	Labor - install soil	workers	80	10	30	24,000	1,846	level, add soil and compact, 12,000 m2
	Supervision (per day per supervisor)	workers	100	2	30	6,000	462	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
House Cleaning						154,800	11,908	~ 600 houses
	HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446	
	Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388	
	Labor (per day per laborer)	workers	80	24	40	76,800	5,908	2 houses/day, 3 workers/crew

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative IIIa. Stabilization and Top and Sides Encapsulation at Central Dump Area **Full Cost** **21,130,640** **1,625,434**

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Supervision (per day per supervisor)	workers	100	2	40	8,000	615	
	Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	2 sets per worker
	Respirators	not needed for this work					0	

Community Outreach and Education **218,500** **16,808**

Education sessions for commuinity	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults
Food for sessions	per attendee	15	2000	1	30,000	2,308	
Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters
Video on lead hazrds	total	10000	1	1	10,000	769	Education video about lead and other metals

Project Management, Quality Control and Assessment **1,698,600** **130,662**

Project Management and General

Project Field Manager (per day)	manager	1400	1	80	112,000	8,615	
Stockroom manager (per day)	manager	700	1	80	56,000	4,308	
Stockroom rental (per week)	per week	1400	1	22	30,800	2,369	
Financial assistant (per day)	manager	700	1	80	56,000	4,308	
Health, safety and security officer	officer	700	1	80	56,000	4,308	
Communications officer	officer	700	1	80	56,000	4,308	
Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day
Bottled water for workers	per day	30	40	100	120,000	9,231	
Laundry	worker	4	60	100	24,000	1,846	
Wash room use	per week	1400	1	20	28,000	2,154	

Assessment and Technical Oversight

XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control
XRF rental	per week	3000	2	24	144,000	11,077	
Technical Advisers	advisers	2000	2		0	0	For technical oversight
Poject Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director
XRF team and TA travel and lodging	total				150000	11,538	

Blood testing and assessment

Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work
Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
Gifts for children	per child teste	50	100	1	5,000	385	
Cleaining servicece	number	300	1	2	600	46	
Meals for Assessment team	number	50	6	2	600	46	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative III - One encapsulation facility in football field for all waste

Full Cost

15,836,500

1,218,192

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Construct encapsulation structure at football field for all waste						5,743,960	441,843	
						SUBTOTAL		
	Clean soil	m3 - delivered	142	14400	1	2,044,800	157,292	
	Clay (1.5 m below, 0.75 m on top)	m3 - delivered	75	18000	1	1,350,000	103,846	
	6 mm HDPE liner	m2 - delivered	70	15000	1	1,050,000	80,769	
	Leachate collection piping	m of 10 cm PVC pipe	50	600	1	30,000	2,308	
	Leachate sump and pump	number	10000	2	1	20,000	1,538	
	Front end loader w/ operator and fuel	number	4000	1	90	360,000	27,692	
	Excavator w/ operator and fuel	number	5000	1	40	200,000	15,385	
	Roller compactor w/ operator and fuel	number	4000	1	90	360,000	27,692	
	Labor	workers	80	10	50	40,000	3,077	
	Supervision	workers	100	2	90	18,000	1,385	
	Uniforms, gloves, boots	sets	420	24	2	20,160	1,551	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
	Liner installation and sealing	hectare	6000	1.5	1	9,000	692	
	Electrical connection for pump	number	10000	2	1	20,000	1,538	
	Grass seed	m2	20	6000	1	120,000	9,231	
	Security fencing for area	100 m	8000	4.5	1	36,000	2,769	
Transport dump waste to football field						3,046,580	234,352	
	Front end loader w/ operator	number	7500	1	20	150,000	11,538	
	Excavator w/ operator	number	10000	1	50	500,000	38,462	
	Dump trucks (5 m3)	number	3000	15	50	2,250,000	173,077	18,000 m3 of waste to move
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Shovels, wheelbarrows, rakes, picks*	per set	1250	2	1	2,500	192	
	Labor	workers	80	10	60	48,000	3,692	
	Supervision	workers	100	2	60	12,000	923	
	Uniforms, gloves, boots	sets (two per worker)	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
* 1 set = 2 wheelbarrows, 3 shovels, 2 picks, 2 rakes								
Grading and finishing dump waste area after waste removal, paving pathways						799,080	61,468	
	Front end loader w/ operator	number	7500	1	15	112,500	8,654	
	Clean soil	m3 - delivered	142	2600	1	369,200	28,400	13,000 m2 to cover, 20 cm depth
	Shovels, wheelbarrows, rakes, picks*	sets	1250	2	1	2,500	192	
	Labor	workers	80	10	10	8,000	615	

Supervision	workers	100	2	10	2,000	154	
Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
Respirators	not needed for this work					0	
Pavers for paths	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
Labor - paver installation	wokers	150	4	30	18,000	1,385	4 m2 per day per worker
Grass	m2	20	12000	1	240,000	18,462	12,000 m2
Excavation of waste piles and highly contaminated soil in yards and alleys					1,302,280	100,175	
Bobcat w/operator	number	6000	2	35	420,000	32,308	
Dump trucks (5 m3)	number	3000	5	25	375,000	28,846	1,725 m3 to move to encapsulation structure
Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	
Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew
Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
Respirators	number	110	12	25	33,000	2,538	
Paving of alleys & misc areas					221,100	17,008	
Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.
Dump trucks (5 m3)	number	3000	1	10	30,000	2,308	150 m3 to move to encapsulation structure
Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
Labor - soil removal & prep.	workers	80	10	10	8,000	615	
Labor - installing pavers	workers	150	10	30	45,000	3,462	4 m2 day per mason, 1200 m2 to pave
Supervision	workers	100	2	10	2,000	154	
Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil					175,820	13,525	4200 m2 to cover
Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
Gravel	m3	466	40	1	18,640	1,434	400 m2 on sides of roads & misc, 10 cm depth
Clean soil	m3	142	100	1	14,200	1,092	15 cm depth, 660 m2 at High School
Geotextile	m2	28	660	1	18,480	1,422	660 m2 in schoolyards
Dump trucks (5 m3)	number	3000	3	5	45,000	3,462	haul soil to encapsulation facility
Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
Labor	workers	80	5	10	4,000	308	excavate, install barrier cloth, soil and gravel
Supervision (per day per supervisor)	workers	100	1	10	1,000	77	
Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
Respirators	not needed for this work						

Covering of cemetery area with clean soil						777,180	59,783	
Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538		
Pavers	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide	
Clean soil	m3	142	3600	1	511,200	39,323	12,000 m2, 30 cm depth	
Geotextile	m2	28	3810	1	106,680	8,206	1,000 m2 for paths	
Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192		
Labor - install pavers	workers	150	4	30	18,000	1,385	4 m2 per day per worker	
Labor - install soil	workers	80	10	30	24,000	1,846	level, add soil and compact, 12,000 m2	
Supervision (per day per supervisor)	workers	100	2	30	6,000	462		
Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0		
House Cleaning						154,800	11,908	~ 600 houses
HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446		
Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388		
Labor (per day per laborer)	workers	80	24	40	76,800	5,908	2 houses/day, 3 workers/crew	
Supervision (per day per supervisor)	workers	100	2	40	8,000	615		
Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	2 sets per worker	
Respirators	not needed for this work					0		
Community Outreach and Education						218,500	16,808	
Education sessions for community	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults	
Food for sessions	per attendee	15	2000	1	30,000	2,308		
Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters	
Video on lead hazards	total	10000	1	1	10,000	769	Education video about lead and other metals	
Project Management, Quality Control and Assessment						1,698,600	130,662	
Project Management and General								
Project Field Manager (per day)	manager	1400	1	80	112,000	8,615		
Stockroom manager (per day)	manager	700	1	80	56,000	4,308		
Stockroom rental (per week)	per week	1400	1	22	30,800	2,369		
Financial assistant (per day)	manager	700	1	80	56,000	4,308		
Health, safety and security officer	officer	700	1	80	56,000	4,308		
Communications officer	officer	700	1	80	56,000	4,308		
Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day	
Bottled water for workers	per day	30	40	100	120,000	9,231		
Laundry	worker	4	60	100	24,000	1,846		4
Wash room use	per week	1400	1	20	28,000	2,154		
Assessment and Technical Oversight								
XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control	
XRF rental	per week	3000	2	24	144,000	11,077		
Technical Advisers	advisers	2000	2		0	0	For technical oversight	
Project Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director	

XRF team and TA travel and lodging	total				150000	11,538	
Blood testing and assessment							
Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work
Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
Gifts for children	per child teste	50	100	1	5,000	385	
Cleaining serviece	number	300	1	2	600	46	
Meals for Assessment team	number	50	6	2	600	46	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative III - One encapsulation facility at remote site (30 km away) for all waste

Full Cost

22,216,500

1,708,962

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Construct encapsulaton structure at remote site for all waste						5,893,960	453,382	
				SUBTOTAL				
	Clean soil	m3 - delivered	142	14400	1	2,044,800	157,292	
	Clay (1.5 m below, 0.75 m above)	m3 - delivered	75	20000	1	1,500,000	115,385	
	6 mm HDPE liner	m2 - delivered	70	15000	1	1,050,000	80,769	
	Leachate collection piping	m of 10 cm PVC pipe	50	600	1	30,000	2,308	
	Leachate sump and pump	number	10000	2	1	20,000	1,538	
	Front end loader w/ operator and fuel	number	4000	1	90	360,000	27,692	
	Excavator w/ operator and fuel	number	5000	1	40	200,000	15,385	
	Roller compactor w/ operator and fuel	number	4000	1	90	360,000	27,692	
	Labor	workers	80	10	50	40,000	3,077	
	Supervision	workers	100	2	90	18,000	1,385	
	Uniforms, gloves, boots	sets	420	24	2	20,160	1,551	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
	Liner installation and sealing	hectare	6000	1.5	1	9,000	692	
	Electrical connection for pump	number	10000	2	1	20,000	1,538	
	Grass seed	m2	20	6000	1	120,000	9,231	
	Security fencing for area	100 m	8000	4.5	1	36,000	2,769	
Transport dump waste to encapsulation facility						8,296,580	638,198	
	Front end loader w/ operator	number	7500	1	20	150,000	11,538	
	Excavator w/ operator	number	10000	1	50	500,000	38,462	
	Dump trucks (5 m3) (haz waste permitted)	number	5000	30	50	7,500,000	576,923	18,000 m3 of waste to move
	Shovels, wheelbarrows, rakes, picks*	per set	1250	2	1	2,500	192	
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Labor	workers	80	10	60	48,000	3,692	
	Supervision	workers	100	2	60	12,000	923	
	Uniforms, gloves, boots	sets (two per worker)	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
	* 1 set = 2 wheelbarrows, 3 shovels, 2 picks, 2 rakes							
Grading and finishing dump waste area after waste removal, paving pathways						799,080	61,468	
	Front end loader w/ operator	number	7500	1	15	112,500	8,654	
	Clean soil	m3 - delivered	142	2600	1	369,200	28,400	13,000 m2 to cover, 20 cm depth
	Shovels, wheelbarrows, rakes, picks*	sets	1250	2	1	2,500	192	
	Labor	workers	80	10	10	8,000	615	
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative III - One encapsulation facility at remote site (30 km away) for all waste

Full Cost

22,216,500

1,708,962

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Respirators	not needed for this work					0	
	Pavers for paths	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Labor - paver installation	wokers	150	4	30	18,000	1,385	4 m2 per day per worker
	Grass	m2	20	12000	1	240,000	18,462	12,000 m2
Excavation of waste piles and highly contaminated soil in yards and alleys						2,177,280	167,483	
	Bobcat w/operator	number	6000	2	35	420,000	32,308	
	Dump trucks (5 m3)	number	5000	10	25	1,250,000	96,154	1,725 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
	Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
	Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	25	33,000	2,538	
Paving of alleys & misc areas						221,100	17,008	
	Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
	Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.
	Dump trucks (5 m3)	number	3000	1	10	30,000	2,308	150 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - soil removal & prep.	workers	80	10	10	8,000	615	
	Labor - installing pavers	workers	150	10	30	45,000	3,462	4 m2 day per mason, 1200 m2 to pave
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
	Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil						280,820	21,602	4200 m2 to cover
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Gravel	m3	466	40	1	18,640	1,434	400 m2 on sides of roads & misc, 10 cm depth
	Clean soil	m3	142	100	1	14,200	1,092	15 cm depth, 660 m2 at High School
	Geotextile	m2	28	660	1	18,480	1,422	660 m2 in schoolyards
	Dump trucks (5 m3)	number	5000	6	5	150,000	11,538	haul soil to encapsulation facility
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor	workers	80	5	10	4,000	308	excavate, install barrier cloth, soil and gravel
	Supervision (per day per supervisor)	workers	100	1	10	1,000	77	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative III - One encapsulation facility at remote site (30 km away) for all waste

Full Cost

22,216,500

1,708,962

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
	Respirators	not needed for this work						
Covering of cemetery area with clean soil						777,180	59,783	
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Pavers	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Clean soil	m3	142	3600	1	511,200	39,323	12,000 m2, 30 cm depth
	Geotextile	m2	28	3810	1	106,680	8,206	1,000 m2 for paths
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - install pavers	workers	150	4	30	18,000	1,385	4 m2 per day per worker
	Labor - install soil	workers	80	10	30	24,000	1,846	level, add soil and compact, 12,000 m2
	Supervision (per day per supervisor)	workers	100	2	30	6,000	462	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						0
House Cleaning						154,800	11,908	~ 600 houses
	HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446	
	Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388	
	Labor (per day per laborer)	workers	80	24	40	76,800	5,908	2 houses/day, 3 workers/crew
	Supervision (per day per supervisor)	workers	100	2	40	8,000	615	
	Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	2 sets per worker
	Respirators	not needed for this work						0
Community Outreach and Education						218,500	16,808	
	Education sessions for community	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults
	Food for sessions	per attendee	15	2000	1	30,000	2,308	
	Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters
	Video on lead hazards	total	10000	1	1	10,000	769	Education video about lead and other metals
Project Management, Quality Control and Assessment						1,698,600	130,662	
Project Management and General								
	Project Field Manager (per day)	manager	1400	1	80	112,000	8,615	
	Stockroom manager (per day)	manager	700	1	80	56,000	4,308	
	Stockroom rental (per week)	per week	1400	1	22	30,800	2,369	
	Financial assistant (per day)	manager	700	1	80	56,000	4,308	
	Health, safety and security officer	officer	700	1	80	56,000	4,308	
	Communications officer	officer	700	1	80	56,000	4,308	
	Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative III - One encapsulation facility at remote site (30 km away) for all waste

Full Cost

22,216,500

1,708,962

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Bottled water for workers	per day	30	40	100	120,000	9,231	
	Laundry	worker	4	60	100	24,000	1,846	4
	Wash room use	per week	1400	1	20	28,000	2,154	
	Assessment and Technical Oversight							
	XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control
	XRF rental	per week	3000	2	24	144,000	11,077	
	Technical Advisers	advisers	2000	2		0	0	For technical oversight
	Project Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director
	XRF team and TA travel and lodging	total				150000	11,538	
	Blood testing and assessment							
	Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work
	Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
	Gifts for children	per child teste	50	100	1	5,000	385	
	Cleaining service	number	300	1	2	600	46	
	Meals for Assessment team	number	50	6	2	600	46	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate IVc. - Stabilization and then Encapsulation at Football Field

Full Cost

31,233,420

2,402,571

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Construct encapsulaton structure at football field for all waste						21,140,880	1,626,222	
						SUBTOTAL	21,140,880	1,626,222
	Clean soil	m3 - delivered	142	14400	1	2,044,800	157,292	Needed soil from structure excavation
	Clay	m3 - delivered	75	11000	1	825,000	63,462	
	6 mm HDPE liner	m2 - delivered	70	15000	1	1,050,000	80,769	
	Concrete pad construction for mixing	m3 concrete	1290	180	1	232,200	17,862	as per Ibu Warma estimate, 20 cm thick
	Stabilization cost - mixing, materials	m3 of waste	585	20000	1	11,700,000	900,000	\$45/m3 cost from MT2 - material, equip. & labor
	Leachate collection piping	m of 10 cm PVC pipe	50	600	1	30,000	2,308	
	Leachate sump and pump	number	10000	2	1	20,000	1,538	
	Front end loader w/ operator and fuel	number	4000	2	80	640,000	49,231	
	Excavator w/ operator and fuel	number	5000	1	60	300,000	23,077	
	Roller compactor w/ operator and fuel	number	4000	1	80	320,000	24,615	
	Labor - waste/soil placement	workers	80	10	50	40,000	3,077	
	Labor - mixing cement with soil/waste	workers	80	10	80	64,000	4,923	local labor
	Labor - build concrete mixing pad	workers	80	5	10	4,000	308	local labor
	Supervision	workers	100	2	90	18,000	1,385	
	Uniforms, gloves, boots	sets	420	24	2	75,600	5,815	2 sets per worker and supervisor
	Respirators	number	110	12	50	5,280	406	
	Liner installation and sealing	hectare	6000	1.5	1	3,600,000	276,923	
	Electrical connection for pump	number	10000	2	1	20,000	1,538	
	Grass seed	m2	20	6000	1	120,000	9,231	
	Security fencing for area	100 m	8000	4	1	32,000	2,462	
Transport dump waste to football field						3,046,580	234,352	
	Front end loader w/ operator	number	7500	1	20	150,000	11,538	
	Excavator w/ operator	number	10000	1	50	500,000	38,462	
	Dump trucks (5 m3)	number	3000	15	50	2,250,000	173,077	18,000 m3 of waste to move
	Shovels, wheelbarrows, rakes, picks*	per set	1250	2	1	2,500	192	
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Labor	workers	80	10	60	48,000	3,692	
	Supervision	workers	100	2	60	12,000	923	
	Uniforms, gloves, boots	sets (two per worker)	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
* 1 set = 2 wheelbarrows, 3 shovels, 2 picks, 2 rakes								
Grading and finishing dump waste area after waste removal, paving pathways						799,080	61,468	
	Front end loader w/ operator	number	7500	1	15	112,500	8,654	
	Clean soil	m3 - delivered	142	2600	1	369,200	28,400	13,000 m2 to cover, 20 cm depth
	Shovels, wheelbarrows, rakes, picks*	sets	1250	2	1	2,500	192	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate IVc. - Stabilization and then Encapsulation at Football Field

Full Cost

31,233,420

2,402,571

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Labor	workers	80	10	10	8,000	615	
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	not needed for this work					0	
	Pavers for paths	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Labor - paver installation	wokers	150	4	30	18,000	1,385	4 m2 per day per worker
	Grass	m2	20	12000	1	240,000	18,462	12,000 m2
Excavation of waste piles and highly contaminated soil in yards and alleys						1,302,280	100,175	Stabilization & disposal in above
	Bobcat w/operator	number	6000	2	35	420,000	32,308	
	Dump trucks (5 m3)	number	3000	5	25	375,000	28,846	1,725 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
	Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
	Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	25	33,000	2,538	
Paving of alleys & misc areas						221,100	17,008	
	Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
	Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.
	Dump trucks (5 m3)	number	3000	1	10	30,000	2,308	150 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - soil removal & prep.	workers	80	10	10	8,000	615	
	Labor - installing pavers	workers	150	10	30	45,000	3,462	4 m2 day per mason, 1200 m2 to pave
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
	Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil						175,820	13,525	4200 m2 to cover
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Gravel	m3	466	40	1	18,640	1,434	400 m2 on sides of roads & misc, 10 cm depth
	Clean soil	m3	142	100	1	14,200	1,092	15 cm depth, 660 m2 at High School
	Geotextile	m2	28	660	1	18,480	1,422	660 m2 in schoolyards
	Dump trucks (5 m3)	number	3000	3	5	45,000	3,462	haul soil to encapsulation facility

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate IVc. - Stabilization and then Encapsulation at Football Field

Full Cost

31,233,420

2,402,571

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor	workers	80	5	10	4,000	308	excavate, install barrier cloth, soil and gravel
	Supervision (per day per supervisor)	workers	100	1	10	1,000	77	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
	Respirators	not needed for this work						
Covering of cemetery area with clean soil						777,180	59,783	
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Pavers	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Clean soil	m3	142	3600	1	511,200	39,323	12,000 m2, 30 cm depth
	Geotextile	m2	28	3810	1	106,680	8,206	1,000 m2 for paths
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - install pavers	workers	150	4	30	18,000	1,385	4 m2 per day per worker
	Labor - install soil	workers	80	10	30	24,000	1,846	level, add soil and compact, 12,000 m2
	Supervision (per day per supervisor)	workers	100	2	30	6,000	462	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
House Cleaning						154,800	11,908	~ 600 houses
	HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446	
	Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388	
	Labor (per day per laborer)	workers	80	24	40	76,800	5,908	2 houses/day, 3 workers/crew
	Supervision (per day per supervisor)	workers	100	2	40	8,000	615	
	Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	2 sets per worker
	Respirators	not needed for this work					0	
Community Outreach and Education						218,500	16,808	
	Education sessions for community	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults
	Food for sessions	per attendee	15	2000	1	30,000	2,308	
	Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters
	Video on lead hazards	total	10000	1	1	10,000	769	Education video about lead and other metals
Project Management, Quality Control and Assessment						1,698,600	130,662	
Project Management and General								
	Project Field Manager (per day)	manager	1400	1	80	112,000	8,615	
	Stockroom manager (per day)	manager	700	1	80	56,000	4,308	
	Stockroom rental (per week)	per week	1400	1	22	30,800	2,369	
	Financial assistant (per day)	manager	700	1	80	56,000	4,308	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate IVc. - Stabilization and then Encapsulation at Football Field

Full Cost

31,233,420

2,402,571

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Health, safety and security officer	officer	700	1	80	56,000	4,308	
	Communications officer	officer	700	1	80	56,000	4,308	
	Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day
	Bottled water for workers	per day	30	40	100	120,000	9,231	
	Laundry	worker	4	60	100	24,000	1,846	
	Wash room use	per week	1400	1	20	28,000	2,154	
	Assessment and Technical Oversight							
	XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control
	XRF rental	per week	3000	2	24	144,000	11,077	
	Technical Advisers	advisers	2000	2		0	0	For technical oversight
	Project Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director
	XRF team and TA travel and lodging	total				150000	11,538	
	Blood testing and assessment							
	Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work
	Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
	Gifts for children	per child teste	50	100	1	5,000	385	
	Cleaining servicee	number	300	1	2	600	46	
	Meals for Assessment team	number	50	6	2	600	46	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate IVd. - Stabilization and then Encapsulation at Remote Location

Full Cost

38,033,420

2,925,648

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Construct encapsulaton structure at remote site for all waste						21,815,880	1,678,145	
SUBTOTAL						21,815,880	1,678,145	
	Clean soil	m3 - delivered	142	14400	1	2,044,800	157,292	Needed soil from structure excavation
	Clay - 1.5 m below, 0.75 m above	m3 - delivered	75	20000	1	1,500,000	115,385	
	6 mm HDPE liner	m2 - delivered	70	15000	1	1,050,000	80,769	
	Concrete pad construction for mixing	m3 concrete	1290	180	1	232,200	17,862	as per Ibu Warma estimate, 20 cm thick
	Stabilization cost - mixing, materials	m3 of waste	585	20000	1	11,700,000	900,000	\$45/m3 cost from MT2 - material, equip. & labor
	Leachate collection piping	m of 10 cm PVC pipe	50	600	1	30,000	2,308	
	Leachate sump and pump	number	10000	2	1	20,000	1,538	
	Front end loader w/ operator and fuel	number	4000	2	80	640,000	49,231	
	Excavator w/ operator and fuel	number	5000	1	60	300,000	23,077	
	Roller compactor w/ operator and fuel	number	4000	1	80	320,000	24,615	
	Labor - waste/soil placement	workers	80	10	50	40,000	3,077	
	Labor - mixing cement with soil/waste	workers	80	10	80	64,000	4,923	local labor
	Labor - build concrete mixing pad	workers	80	5	10	4,000	308	local labor
	Supervision	workers	100	2	90	18,000	1,385	
	Uniforms, gloves, boots	sets	420	24	2	75,600	5,815	2 sets per worker and supervisor
	Respirators	number	110	12	50	5,280	406	
	Liner installation and sealing	hectare	6000	1.5	1	3,600,000	276,923	
	Electrical connection for pump	number	10000	2	1	20,000	1,538	
	Grass seed	m2	20	6000	1	120,000	9,231	
	Security fencing for area	100 m	8000	4	1	32,000	2,462	
Transport dump waste to encapsulation facility						8,296,580	638,198	
	Front end loader w/ operator	number	7500	1	20	150,000	11,538	
	Excavator w/ operator	number	10000	1	50	500,000	38,462	
	Dump trucks (5 m3) (haz waste permitte	number	5000	30	50	7,500,000	576,923	18,000 m3 of waste to move
	Shovels, wheelbarrows, rakes, picks*	per set	1250	2	1	2,500	192	
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Labor	workers	80	10	60	48,000	3,692	
	Supervision	workers	100	2	60	12,000	923	
	Uniforms, gloves, boots	sets (two per worker)	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
* 1 set = 2 wheelbarrows, 3 shovels, 2 picks, 2 rakes								
Grading and finishing dump waste area after waste removal, paving pathways						799,080	61,468	
	Front end loader w/ operator	number	7500	1	15	112,500	8,654	
	Clean soil	m3 - delivered	142	2600	1	369,200	28,400	13,000 m2 to cover, 20 cm depth
	Shovels, wheelbarrows, rakes, picks*	sets	1250	2	1	2,500	192	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate IVd. - Stabilization and then Encapsulation at Remote Location

Full Cost

38,033,420

2,925,648

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Labor	workers	80	10	10	8,000	615	
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	not needed for this work					0	
	Pavers for paths	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Labor - paver installation	wokers	150	4	30	18,000	1,385	4 m2 per day per worker
	Grass	m2	20	12000	1	240,000	18,462	12,000 m2
Excavation of waste piles and highly contaminated soil in yards and alleys						2,177,280	167,483	Stabilization & disposal in above
	Bobcat w/operator	number	6000	2	35	420,000	32,308	
	Dump trucks (5 m3)	number	5000	10	25	1,250,000	96,154	1,725 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
	Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
	Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	25	33,000	2,538	
Paving of alleys & misc areas						221,100	17,008	
	Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
	Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.
	Dump trucks (5 m3)	number	3000	1	10	30,000	2,308	150 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - soil removal & prep.	workers	80	10	10	8,000	615	
	Labor - installing pavers	workers	150	10	30	45,000	3,462	4 m2 day per mason, 1200 m2 to pave
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
	Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil						175,820	13,525	4200 m2 to cover
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Gravel	m3	466	40	1	18,640	1,434	400 m2 on sides of roads & misc, 10 cm depth
	Clean soil	m3	142	100	1	14,200	1,092	15 cm depth, 660 m2 at High School
	Geotextile	m2	28	660	1	18,480	1,422	660 m2 in schoolyards
	Dump trucks (5 m3)	number	5000	6	5	45,000	3,462	haul soil to encapsulation facility

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate IVd. - Stabilization and then Encapsulation at Remote Location

Full Cost

38,033,420

2,925,648

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor	workers	80	5	10	4,000	308	excavate, install barrier cloth, soil and gravel
	Supervision (per day per supervisor)	workers	100	1	10	1,000	77	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
	Respirators	not needed for this work						
Covering of cemetery area with clean soil						777,180	59,783	
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Pavers	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Clean soil	m3	142	3600	1	511,200	39,323	12,000 m2, 30 cm depth
	Geotextile	m2	28	3810	1	106,680	8,206	1,000 m2 for paths
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - install pavers	workers	150	4	30	18,000	1,385	4 m2 per day per worker
	Labor - install soil	workers	80	10	30	24,000	1,846	level, add soil and compact, 12,000 m2
	Supervision (per day per supervisor)	workers	100	2	30	6,000	462	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
House Cleaning						154,800	11,908	~ 600 houses
	HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446	
	Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388	
	Labor (per day per laborer)	workers	80	24	40	76,800	5,908	2 houses/day, 3 workers/cew
	Supervision (per day per supervisor)	workers	100	2	40	8,000	615	
	Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	2 sets per worker
	Respirators	not needed for this work					0	
Community Outreach and Education						218,500	16,808	
	Education sessions for commuinity	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults
	Food for sessions	per attendee	15	2000	1	30,000	2,308	
	Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters
	Video on lead hazrds	total	10000	1	1	10,000	769	Education video about lead and other metals
Project Management, Quality Control and Assessment						1,698,600	130,662	
Project Management and General								
	Project Field Manager (per day)	manager	1400	1	80	112,000	8,615	
	Stockroom manager (per day)	manager	700	1	80	56,000	4,308	
	Stockroom rental (per week)	per week	1400	1	22	30,800	2,369	
	Financial assistant (per day)	manager	700	1	80	56,000	4,308	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate IVd. - Stabilization and then Encapsulation at Remote Location

Full Cost

38,033,420

2,925,648

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Health, safety and security officer	officer	700	1	80	56,000	4,308	
	Communications officer	officer	700	1	80	56,000	4,308	
	Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day
	Bottled water for workers	per day	30	40	100	120,000	9,231	
	Laundry	worker	4	60	100	24,000	1,846	
	Wash room use	per week	1400	1	20	28,000	2,154	
	Assessment and Technical Oversight							
	XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control
	XRF rental	per week	3000	2	24	144,000	11,077	
	Technical Advisers	advisers	2000	2		0	0	For technical oversight
	Poject Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director
	XRF team and TA travel and lodging	total				150000	11,538	
	Blood testing and assessment							
	Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work
	Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
	Gifts for children	per child teste	50	100	1	5,000	385	
	Cleaining servicee	number	300	1	2	600	46	
	Meals for Assessment team	number	50	6	2	600	46	

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Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate V. - Stabilize Waste and Cont. Soil then Use Treated Material in Road Construction

Full Cost

28,582,100

2,198,623

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Construct mixing pad at football field and conduct stabilization there						13,344,360	1,026,489	
					SUBTOTAL			
	Concrete pad construction for mixing	m3 concrete	1290	180	1	232,200	17,862	as per Ibu Warma estimate, 20 cm thick
	Stabilization mixing equip., materials	m3 of waste	585	20000	1	11,700,000	900,000	\$45/m3 cost from MT2 - material, equip. & labor
	Front end loader w/ operator and fuel	number	4000	2	80	640,000	49,231	
	Labor - mixing stabilizer with soil/waste	workers	80	5	80	32,000	2,462	local labor
	Labor - build concrete mixing pad	workers	80	5	10	4,000	308	local labor
	Supervision	workers	100	2	90	18,000	1,385	
	Uniforms, gloves, boots	sets	420	24	2	20,160	1,551	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
	Runoff collection and treatment tank	number	300000	1	1	300,000	23,077	
	Electrical connection for pumps, mixer	number	100000	2	1	200,000	15,385	
	Clean up of site after work	number	100000	1	1	100,000	7,692	
	Security fencing for area	100 m	8000	4	1	32,000	2,462	
Transport dump waste to stabilization pad						3,231,180	248,552	
	Front end loader w/ operator	number	7500	1	20	150,000	11,538	
	Excavator w/ operator	number	10000	1	50	500,000	38,462	
	Dump trucks (5 m3)	number	3000	15	50	2,250,000	173,077	18,000 m3 of waste to move
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Clean soil cover after waste removed	m3	142	1300	1	184,600	14,200	13,000 m2, 10 cm avg depth, spread by loader
	Shovels, wheelbarrows, rakes, picks*	per set	1250	2	1	2,500	192	
	Labor	workers	80	10	60	48,000	3,692	
	Supervision	workers	100	2	60	12,000	923	
	Uniforms, gloves, boots	sets (two per worker)	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
	* 1 set = 2 wheelbarrows, 3 shovels, 2 picks, 2 rakes							
Transport of stabilized (non-hazardous) material to road construction site						4,884,680	375,745	assume 30 km away, no cost for use at road site
	Front end loader w/ operator	number	7500	1	50	375,000	28,846	
	Dump trucks (8 m3, 2 trips/day)	number	3000	30	50	4,500,000	346,154	24,000 m3 of waste to move (with bulk increase)
	Labor for loading	workers	80	2	50	8,000	615	Supervision in above
	Uniforms, gloves, boots	sets	420	4	1	1,680	129	2 sets per worker and supervisor
	Respirators	not needed for this work					0	
Excavation of waste piles and highly contaminated soil in yards and alleys						2,177,280	167,483	Stabilization & disposal in above
	Bobcat w/operator	number	6000	2	35	420,000	32,308	
	Dump trucks (5 m3)	number	5000	10	25	1,250,000	96,154	1,800 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate V. - Stabilize Waste and Cont. Soil then Use Treated Material in Road Construction

Full Cost

28,582,100

2,198,623

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
	Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
	Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	25	33,000	2,538	
Paving of alleys & misc areas						221,100	17,008	
	Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
	Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.
	Dump trucks (5 m3)	number	3000	1	10	30,000	2,308	150 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - soil removal & prep.	workers	80	10	10	8,000	615	
	Labor - installing pavers	workers	150	10	30	45,000	3,462	4 m2 day per mason, 1200 m2 to pave
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
	Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil						175,820	13,525	4200 m2 to cover, stabilization in above
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Gravel	m3	466	40	1	18,640	1,434	400 m2 on sides of roads & misc, 10 cm depth
	Clean soil	m3	142	100	1	14,200	1,092	15 cm depth, 660 m2 at High School
	Geotextile	m2	28	660	1	18,480	1,422	660 m2 in schoolyards
	Dump trucks (5 m3)	number	5000	6	5	45,000	3,462	haul soil to encapsulation facility
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor	workers	80	5	10	4,000	308	excavate, install barrier cloth, soil and gravel
	Supervision (per day per supervisor)	workers	100	1	10	1,000	77	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
	Respirators	not needed for this work						
Covering of cemetery area with clean soil						777,180	59,783	
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Pavers	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Clean soil	m3	142	3600	1	511,200	39,323	12,000 m2, 30 cm depth
	Geotextile	m2	28	3810	1	106,680	8,206	1,000 m2 for paths
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate V. - Stabilize Waste and Cont. Soil then Use Treated Material in Road Construction

Full Cost

28,582,100

2,198,623

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Labor - install pavers	workers	150	4	30	18,000	1,385	4 m2 per day per worker
	Labor - install soil	workers	80	10	30	24,000	1,846	level, add soil and compact, 12,000 m2
	Supervision (per day per supervisor)	workers	100	2	30	6,000	462	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
House Cleaning						154,800	11,908	~ 600 houses
	HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446	
	Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388	
	Labor (per day per laborer)	workers	80	24	40	76,800	5,908	2 houses/day, 3 workers/cew
	Supervision (per day per supervisor)	workers	100	2	40	8,000	615	
	Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	2 sets per worker
	Respirators	not needed for this work					0	
Community Outreach and Education						218,500	16,808	
	Education sessions for commuinity	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults
	Food for sessions	per attendee	15	2000	1	30,000	2,308	
	Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters
	Video on lead hazrds	total	10000	1	1	10,000	769	Education video about lead and other metals
Project Management, Quality Control and Assessment						1,698,600	130,662	
Project Management and General								
	Project Field Manager (per day)	manager	1400	1	80	112,000	8,615	
	Stockroom manager (per day)	manager	700	1	80	56,000	4,308	
	Stockroom rental (per week)	per week	1400	1	22	30,800	2,369	
	Financial assistant (per day)	manager	700	1	80	56,000	4,308	
	Health, safety and security officer	officer	700	1	80	56,000	4,308	
	Communications officer	officer	700	1	80	56,000	4,308	
	Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day
	Bottled water for workers	per day	30	40	100	120,000	9,231	
	Laundry	worker	4	60	100	24,000	1,846	
	Wash room use	per week	1400	1	20	28,000	2,154	
Assessment and Technical Oversight								
	XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control
	XRF rental	per week	3000	2	24	144,000	11,077	
	Technical Advisers	advisers	2000	2		0	0	For technical oversight
	Poject Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director
	XRF team and TA travel and lodging	total				150000	11,538	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 2-05-2016

Alternate V. - Stabilize Waste and Cont. Soil then Use Treated Material in Road Construction

Full Cost

28,582,100

2,198,623

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Blood testing and assessment							
	Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work
	Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
	Gifts for children	per child teste	50	100	1	5,000	385	
	Cleaining servicece	number	300	1	2	600	46	
	Meals for Assessment team	number	50	6	2	600	46	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 21-03-2016

Alternative VI - Solidify Waste and Contaminated Soil into pavers or other concrete items at PIK Full Cost 48,849,540 3,757,657

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Transport dump waste to PIK and disposal there						42,253,580	3,250,275	
	Front end loader w/ operator	number	7500	1	20	150,000	11,538	
	Excavator w/ operator	number	10000	1	50	500,000	38,462	
	Transport to PIK and use in pavers	tons	1500	26000	1	39,000,000	3,000,000	26,000 tons of total waste to move
	Shovels, wheelbarrows, rakes, picks*	per set	1250	2	1	2,500	192	
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Labor	workers	80	10	60	48,000	3,692	
	Supervision	workers	100	2	60	12,000	923	
	Uniforms, gloves, boots	sets (two per worker)	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
	Construct temporary storage pad at PIK	m3 of concrete	1000	1280	1	1,280,000	98,462	6400 m2 concrete, 20 cm thick
	Construct drainage control, wall, etc	total	520000	1	1	520,000	40,000	Appurtenances for temp. storage facility
	Storage pad construction labor	number	100	10	5	5,000	385	
	Security fencing for area	100 m	8000	4	1	32,000	2,462	
	Front end loader for storage pad	number	7500	1	60	450,000	34,615	
	Labor for storage pad	worker	80	5	80	32,000	2,462	
	Storage pad supervisor	workers	100	1	80	8,000	615	
	Storage pad cleaning and closure	total	130000	1	1	130,000	10,000	
* 1 set = 2 wheelbarrows, 3 shovels, 2 picks, 2 rakes								
Grading and finishing dump waste area after waste removal, paving pathways						799,080	61,468	
	Front end loader w/ operator	number	7500	1	15	112,500	8,654	
	Clean soil	m3 - delivered	142	2600	1	369,200	28,400	13,000 m2 to cover, 20 cm depth
	Shovels, wheelbarrows, rakes, picks*	sets	1250	2	1	2,500	192	
	Labor	workers	80	10	10	8,000	615	
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	not needed for this work					0	
	Pavers for paths	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Labor - paver installation	wokers	150	4	30	18,000	1,385	4 m2 per day per worker
	Grass	m2	20	12000	1	240,000	18,462	12,000 m2
Excavation of waste piles and highly contaminated soil in yards and alleys						927,280	71,329	
	Bobcat w/operator	number	6000	2	35	420,000	32,308	
	Dump trucks (5 m3)	number	included in waste area		25			1,725 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 21-03-2016

Alternative VI - Solidify Waste and Contaminated Soil into pavers or other concrete items at PIK Full Cost 48,849,540 3,757,657

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
	Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
	Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	25	33,000	2,538	
Paving of alleys & misc areas						191,100	14,700	
	Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
	Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.
	Dump trucks (5 m3)	number	included in was		1	10		150 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - soil removal & prep.	workers	80	10	10	8,000	615	
	Labor - installing pavers	workers	150	10	30	45,000	3,462	4 m2 day per mason, 1200 m2 to pave
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
	Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil						130,820	10,063	4200 m2 to cover
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Gravel	m3	466	40	1	18,640	1,434	400 m2 on sides of roads & misc, 10 cm depth
	Clean soil	m3	142	100	1	14,200	1,092	15 cm depth, 660 m2 at High School
	Geotextile	m2	28	660	1	18,480	1,422	660 m2 in schoolyards
	Dump trucks (5 m3)	number	included in waste area					haul soil to encapsulation facility
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor	workers	80	5	10	4,000	308	excavate, install barrier cloth, soil and gravel
	Supervision (per day per supervisor)	workers	100	1	10	1,000	77	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
	Respirators	not needed for this work						
Covering of cemetery area with clean soil						777,180	59,783	
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Pavers	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Clean soil	m3	142	3600	1	511,200	39,323	12,000 m2, 30 cm depth
	Geotextile	m2	28	3810	1	106,680	8,206	1,000 m2 for paths
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - install pavers	workers	150	4	30	18,000	1,385	4 m2 per day per worker
	Labor - install soil	workers	80	10	30	24,000	1,846	level, add soil and compact, 12,000 m2
	Supervision (per day per supervisor)	workers	100	2	30	6,000	462	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 21-03-2016

Alternative VI - Solidify Waste and Contaminated Soil into pavers or other concrete items at PIK Full Cost 48,849,540 3,757,657

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
House Cleaning						154,800	11,908	~ 600 houses
	HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446	
	Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388	
	Labor (per day per laborer)	workers	80	24	40	76,800	5,908	2 houses/day, 3 workers/crew
	Supervision (per day per supervisor)	workers	100	2	40	8,000	615	
	Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	2 sets per worker
	Respirators	not needed for this work					0	
Community Outreach and Education						218,500	16,808	
	Education sessions for community	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults
	Food for sessions	per attendee	15	2000	1	30,000	2,308	
	Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters
	Video on lead hazards	total	10000	1	1	10,000	769	Education video about lead and other metals
Project Management, Quality Control and Assessment						1,698,600	130,662	
	Project Management and General							
	Project Field Manager (per day)	manager	1400	1	80	112,000	8,615	
	Stockroom manager (per day)	manager	700	1	80	56,000	4,308	
	Stockroom rental (per week)	per week	1400	1	22	30,800	2,369	
	Financial assistant (per day)	manager	700	1	80	56,000	4,308	
	Health, safety and security officer	officer	700	1	80	56,000	4,308	
	Communications officer	officer	700	1	80	56,000	4,308	
	Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day
	Bottled water for workers	per day	30	40	100	120,000	9,231	
	Laundry	worker	4	60	100	24,000	1,846	
	Wash room use	per week	1400	1	20	28,000	2,154	
	Assessment and Technical Oversight							
	XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control
	XRF rental	per week	3000	2	24	144,000	11,077	
	Technical Advisers	advisers	2000	2		0	0	For technical oversight
	Project Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director
	XRF team and TA travel and lodging	total				150000	11,538	
	Blood testing and assessment							
	Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work
	Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
	Gifts for children	per child tested	50	100	1	5,000	385	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 21-03-2016

Alternative VI - Solidify Waste and Contaminated Soil into pavers or other concrete items at PIK Full Cost 48,849,540 3,757,657

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Cleaining service	number	300	1	2	600	46	
	Meals for Assessment team	number	50	6	2	600	46	

Paver production Cost per 100 tons of waste			units/day	tons	111,794	8,600	100 tons of waste used per day
labor	workers	80	9	1	720	55	
supervisor	wokers	150	1	1	150	12	
Electricity	total/day	600	1	1	600	46	
Water	liters	0	100	334	0	0	
			units/ton	tons/day			
cement	50 kg bags	60	4.82	334	96,593	7,430	
sand	ton	90	0.434	334	13,046	1,004	
lime	ton	70	0.019	334	444	34	
smelter ash		0	0.193	334	0	0	ash, smelter waste
waste		0	0.106	334	0	0	soil with lead
molasses	kg	100	0.0072	334	240	18	
Total cost for 26,000 tons					29,066,320	2,235,871	less sale of pavers
ash + waste = 29.9 %, so total tons/day = Based on use of 100 tons/day of waste			334		24,880,632	1.913,395	at 50,000 Rp per 50 kg bag of cement
Transport from dump site to PIK					3,046,580	234,352	
					32,112,900	2,470,223	
cost per ton at 60,000 Rp/bag of cement					1118	86	
cost per ton at 50,000 Rp/bag of cement					957	74	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative X - Phased Project** – Remediate Yards and Alleys, Temporary Cover for Dump Site

Full Cost

10,761,060

827,774 Phase I only

** Includes only cost of Phase I; Remediation of Dump site would be Phase II

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Smooth, Grade and Cover dump area with clean soil						1,034,180	79,552	
	Front end loader w/ operator	number	7500	1	20	150,000	11,538	
	Bulldozer	number	7500	1	10	75,000	5,769	
	Clean soil	m3 - delivered	142	2600	1	369,200	28,400	13,000 m2 to cover, 20 cm depth
	Shovels, wheelbarrows, rakes, picks*	sets	1250	2	1	2,500	192	
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Labor - place cont. soil from yards, etc.	workers	80	10	25	20,000	1,538	
	Labor - soil cover and grass	workers	80	10	20	16,000	1,231	
	Supervision	workers	100	2	45	9,000	692	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	30	39,600	3,046	
	Pavers for paths	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Labor - paver installation	wokers	150	4	30	18,000	1,385	4 m2 per day per worker
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Grass	m2	20	12000	1	240,000	18,462	12,000 m2
	Security fencing for area	100 m	8000	4	1	32,000	2,462	
Excavation of waste piles and highly contaminated soil in yards and alleys						4,827,280	371,329	
	Bobcat w/operator	number	6000	2	35	420,000	32,308	
	Transport to PIK and use in pavers	tons	1500	2600	1	3,900,000	300,000	2,600 tons of contaminated soil to move
	Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
	Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
	Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	25	33,000	2,538	
Paving of alleys & misc areas						221,100	17,008	
	Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
	Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.
	Dump trucks (5 m3)	number	3000	1	10	30,000	2,308	150 m3 to move to encapsulation structure
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - soil removal & prep.	workers	80	10	10	8,000	615	
	Labor - installing pavers	workers	150	10	30	45,000	3,462	4 m2 day per mason, 1200 m2 to pave
	Supervision	workers	100	2	10	2,000	154	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative X - Phased Project** – Remediate Yards and Alleys, Temporary Cover for Dump Site

Full Cost

10,761,060

827,774 Phase I only

** Includes only cost of Phase I; Remediation of Dump site would be Phase II

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
	Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil						130,820	10,063	4200 m2 to cover, transport & disposal in above
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Gravel	m3	466	40	1	18,640	1,434	400 m2 on sides of roads & misc, 10 cm depth
	Clean soil	m3	142	100	1	14,200	1,092	15 cm depth, 660 m2 at High School
	Geotextile	m2	28	660	1	18,480	1,422	660 m2 in schoolyards
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor	workers	80	5	10	4,000	308	excavate, install barrier cloth, soil and gravel
	Supervision (per day per supervisor)	workers	100	1	10	1,000	77	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
	Respirators	not needed for this work						
Covering of cemetery area with clean soil						777,180	59,783	
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Pavers	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Clean soil	m3	142	3600	1	511,200	39,323	12,000 m2, 30 cm depth
	Geotextile	m2	28	3810	1	106,680	8,206	1,000 m2 for paths
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - install pavers	workers	150	4	30	18,000	1,385	4 m2 per day per worker
	Labor - install soil	workers	80	10	30	24,000	1,846	level, add soil and compact, 12,000 m2
	Supervision (per day per supervisor)	workers	100	2	30	6,000	462	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
House Cleaning						154,800	11,908	~ 600 houses
	HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446	
	Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388	
	Labor (per day per laborer)	workers	80	24	40	76,800	5,908	2 houses/day, 3 workers/crew
	Supervision (per day per supervisor)	workers	100	2	40	8,000	615	
	Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	2 sets per worker
	Respirators	not needed for this work					0	
Community Outreach and Education						218,500	16,808	
	Education sessions for community	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults
	Food for sessions	per attendee	15	2000	1	30,000	2,308	
	Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative X - Phased Project** – Remediate Yards and Alleys, Temporary Cover for Dump Site

Full Cost

10,761,060

827,774 Phase I only

** Includes only cost of Phase I; Remediation of Dump site would be Phase II

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Video on lead hazards	total	10000	1	1	10,000	769	Education video about lead and other metals

Project Management, Quality Control and Assessment

1,698,600

130,662

Project Management and General

Project Field Manager (per day)	manager	1400	1	80	112,000	8,615	
Stockroom manager (per day)	manager	700	1	80	56,000	4,308	
Stockroom rental (per week)	per week	1400	1	22	30,800	2,369	
Financial assistant (per day)	manager	700	1	80	56,000	4,308	
Health, safety and security officer	officer	700	1	80	56,000	4,308	
Communications officer	officer	700	1	80	56,000	4,308	
Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day
Bottled water for workers	per day	30	40	100	120,000	9,231	
Laundry	worker	4	60	100	24,000	1,846	
Wash room use	per week	1400	1	20	28,000	2,154	

Assessment and Technical Oversight

XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control
XRF rental	per week	3000	2	24	144,000	11,077	
Technical Advisers	advisers	2000	2		0	0	For technical oversight
Project Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director
XRF team and TA travel and lodging	total				150000	11,538	

Blood testing and assessment

Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work
Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
Gifts for children	per child teste	50	100	1	5,000	385	
Cleaining service	number	300	1	2	600	46	
Meals for Assessment team	number	50	6	2	600	46	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative HWL - Send Waste and Contaminated Soil to a Hazardous Waste Landfill

Full Cost

127,179,660

9,783,051

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Transport and disposal of dump waste to Bogor hazardous waste landfill						120,932,780	9,302,522	
	Front end loader w/ operator	number	7500	1	20	150,000	11,538	
	Excavator w/ operator	number	10000	1	50	500,000	38,462	
	Dump trucks (5 m3)	number	3000	15	50	2,250,000	173,077	18,000 m3 of waste to move
	Shovels, wheelbarrows, rakes, picks*	per set	1250	2	1	2,500	192	
	Clearing of vegetation at dump site	workers	80	10	10	8,000	615	
	Labor	workers	80	10	60	48,000	3,692	
	Supervision	workers	100	2	60	12,000	923	
	Uniforms, gloves, boots	sets (two per worker)	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	50	66,000	5,077	
	Construct transfer pad for waste	m3 of concrete	1000	60	1	60,000	4,615	400 m2 concrete, 15 cm thick
	Transfer pad construction labor	number	100	10	5	5,000	385	
	Front end loader for transfer	number	7500	1	80	600,000	46,154	
	Labor for transfer	worker	80	5	80	32,000	2,462	
	Transfer supervisor	workers	100	1	80	8,000	615	
	Truck transport to Bogor and Disposal							solidification and disposal of 26,000 tons,
	fee at landfill	ton	4500	26000	1	117,000,000	9,000,000	transport in 30 m3/trk
	Security fencing for temp area	100 m	8000	4	1	32,000	2,462	
	security labor	workers	80	3	80	19,200	1,477	
	Final clean up of transfer pad	total	130000	1	1	130,000	10,000	Cleaning, testing, closure
* 1 set = 2 wheelbarrows, 3 shovels, 2 picks, 2 rakes								
Excavation of waste piles and highly contaminated soil in yards and alleys						1,302,280	100,175	
	Bobcat w/operator	number	6000	2	35	420,000	32,308	
	Dump trucks (5 m3)	number	3000	5	25	375,000	28,846	1,725 m3 to move to transfer pad
	Shovels, wheelbarrows, rakes, picks	sets	1250	4	1	5,000	385	
	Hand pushed roller compactor	number	20000	2	1	40,000	3,077	purchase for project, use wherever needed
	Labor - pile & cont. soil excavation	workers	80	10	25	20,000	1,538	1 yd/day/crew aveage, 48 yards, 5 workers/crew
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	1 supervisor for 2 crew
	Clean soil (m3) - delivered	m3	142	2600	1	369,200	28,400	11,500 m2 to cover, 15 cm depth
	Labor - placing, compacting clean soil	workers	80	10	25	20,000	1,538	
	Supervision (per day per supervisor)	workers	100	2	25	5,000	385	
	Uniforms, gloves, boots	sets	420	24	1	10,080	775	2 sets per worker and supervisor
	Respirators	number	110	12	25	33,000	2,538	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative HWL - Send Waste and Contaminated Soil to a Hazardous Waste Landfill

Full Cost

127,179,660

9,783,051

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
Paving of alleys & misc areas						221,100	17,008	
	Pavers	m2	92	1200	1	110,400	8,492	1200 m2 to pave
	Cement	sack	100	100	1	10,000	769	extra cement for repairs, drainage, etc.
	Dump trucks (5 m3)	number	3000	1	10	30,000	2,308	150 m3 to move to transfer pad
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - soil removal & prep.	workers	80	10	10	8,000	615	
	Labor - installing pavers	workers	150	10	30	45,000	3,462	4 m2 day per mason, 1200 m2 to pave
	Supervision	workers	100	2	10	2,000	154	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	
	Respirators	number	110	12	10	13,200	1,015	
Excavation and covering high school yard with clean soil						175,820	13,525	4200 m2 to cover
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Gravel	m3	466	40	1	18,640	1,434	400 m2 on sides of roads & misc, 10 cm depth
	Clean soil	m3	142	100	1	14,200	1,092	15 cm depth, 660 m2 at High School
	Geotextile	m2	28	660	1	18,480	1,422	660 m2 in schoolyards
	Dump trucks (5 m3)	number	3000	3	5	45,000	3,462	haul soil to transfer pad
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor	workers	80	5	10	4,000	308	excavate, install barrier cloth, soil and gravel
	Supervision (per day per supervisor)	workers	100	1	10	1,000	77	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms						
	Respirators	not needed for this work						
Covering of cemetery area with clean soil						777,180	59,783	
	Bobcat w/operator (per day)	number	6000	1	12	72,000	5,538	
	Pavers	m2	92	400	1	36,800	2,831	400 m of paths, 1 m wide
	Clean soil	m3	142	3600	1	511,200	39,323	12,000 m2, 30 cm depth
	Geotextile	m2	28	3810	1	106,680	8,206	1,000 m2 for paths
	Shovels, wheelbarrows, rakes, picks	sets	1250	2	1	2,500	192	
	Labor - install pavers	workers	150	4	30	18,000	1,385	4 m2 per day per worker
	Labor - install soil	workers	80	10	30	24,000	1,846	level, add soil and compact, 12,000 m2
	Supervision (per day per supervisor)	workers	100	2	30	6,000	462	
	Uniforms, gloves, boots	use same workers as for yards, so no additional for uniforms					0	

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative HWL - Send Waste and Contaminated Soil to a Hazardous Waste Landfill

Full Cost

127,179,660

9,783,051

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
House Cleaning						154,800	11,908	~ 600 houses
	HEPA vacuums (per unit)	number	5600	8	1	44,800	3,446	
	Buckets, sponges, etc. (per team)	set	630	8	1	5,040	388	
	Labor (per day per laborer)	workers	80	24	40	76,800	5,908	2 houses/day, 3 workers/crew
	Supervision (per day per supervisor)	workers	100	2	40	8,000	615	
	Uniforms, gloves, boots	sets (two per worker)	420	48	1	20,160	1,551	2 sets per worker
	Respirators	not needed for this work					0	
Community Outreach and Education						218,500	16,808	
	Education sessions for community	per session	28000	6	1	168,000	12,923	Sound system rental, cleaning - schools & adults
	Food for sessions	per attendee	15	2000	1	30,000	2,308	
	Printing of posters, brochures, banners	total	10500	1	1	10,500	808	10000 brochures, 5 banners, 50 posters
	Video on lead hazards	total	10000	1	1	10,000	769	Education video about lead and other metals
Project Management, Quality Control and Assessment						1,698,600	130,662	
Project Management and General								
	Project Field Manager (per day)	manager	1400	1	80	112,000	8,615	
	Stockroom manager (per day)	manager	700	1	80	56,000	4,308	
	Stockroom rental (per week)	per week	1400	1	22	30,800	2,369	
	Financial assistant (per day)	manager	700	1	80	56,000	4,308	
	Health, safety and security officer	officer	700	1	80	56,000	4,308	
	Communications officer	officer	700	1	80	56,000	4,308	
	Food for workers	per day	40	40	100	160,000	12,308	average of about 40 workers/day
	Bottled water for workers	per day	30	40	100	120,000	9,231	
	Laundry	worker	4	60	100	24,000	1,846	
	Wash room use	per week	1400	1	20	28,000	2,154	
Assessment and Technical Oversight								
	XRF Team	teams	3000	2	80	480,000	36,923	2 people per team for QC control
	XRF rental	per week	3000	2	24	144,000	11,077	
	Technical Advisers	advisers	2000	2		0	0	For technical oversight
	Project Technical Director	adviser	6300	1	32	201,600	15,508	Project technical director
	XRF team and TA travel and lodging	total				150000	11,538	
Blood testing and assessment								
	Blood testing children	per blood care kit box	3500	4	1	14,000	1,077	before and after project work

Pesarean Metal Waste Remediation Option Cost Estimate

J. Keith 02-05-2016

Alternative HWL - Send Waste and Contaminated Soil to a Hazardous Waste Landfill

Full Cost 127,179,660 9,783,051

Task	Item	Units	Unit Cost (1000 Rp)	No. of units	No. of days	Total Cost (1000 Rp)	Cost - USD	Comments
	Doctor for conducting blood tests	per doctor	1000	2	2	4,000	308	
	Gifts for children	per child teste	50	100	1	5,000	385	
	Cleaining servicece	number	300	1	2	600	46	
	Meals for Assessment team	number	50	6	2	600	46	