

**Smokey Mountain Remediation Project:
Summary of the Technical Report on Leachate Analysis, 1993 and 2006 ¹**

Smokey Mountain is a 2 million ton garbage heap, which has served as a waste disposal facility for Metro Manila for over 40 years. The garbage dumpsite was home to a huge squatter community, who scavenged through the garbage to survive. It is estimated that 30,000 people live around the dumpsite. The dump has been closed in 1990 but has continued to leak pollutive and toxic substances putting the health of nearby residents at risk.

Sustainable Project Management (SPM) conducted leachate sampling, testing, and analysis at selected sites in Smokey Mountain to assess the soil composition and waste's metal and organic pollutants in the area. This is part of SPM's efforts to implement remediation strategies at the Smokey Mountain in Manila under the Smokey Remediation and Development Project, which is funded by the Asian Development Bank's Poverty and Environment Program.

The main finding of the study is that the Smokey Mountain landfill still contains and discharge heavy metals and other pollutants to the environment and possibly into food chain. An education and awareness campaign will be launched in order to inform the surrounding community of the health hazards associated with on going activities in the landfill including the planting and consumption of vegetables grown on the landfill and allowing children to play and come into contact with the landfill runoff.



The children at Smokey Mountain atop a garbage heap

By Rita Festin

¹ Sustainable Project Management (SPM) conducted this study in collaboration with the University of the Philippines and the Swiss Federal Institute of Technology (EPFL). This study is a component of the Smokey Mountain Remediation and Development Project, which is funded by the Asian Development Bank's Poverty and Environment Program.

Leachate samples were collected at locations where leachate was observed to be dripping in sites where children play and where the community grows vegetables. Results of the analysis were compared to the DENR's marine water concentration guidelines, the US-Environmental Protection Agency (EPA) leachate concentration guidelines, the records of 58 landfills in the United Kingdom, and marine ecotoxicology indexes. Soils samples were also collected at 2 sites to determine the degree of contamination of other pollutants.



Sampling locations for leachate

The analysis of the leachate collected demonstrates significant levels of heavy metal in all samples. Although no single value exceeded the national guidelines for industrial effluents, some heavy metals which are not yet subjected to these guidelines were found at high concentration. No heavy metal concentrations were extremely high, except for copper at one sample point which was above the highest concentration found in the UK's landfills. Most of the heavy metals are above the UK's median concentrations. Zinc is the only heavy metal above the US-EPA heavy metals' emissions guidelines. No heavy metal concentration was found to be above the DENR's guidelines.

High amounts of dissolved and suspended solids were also found in samples collected in two of the four sites revealing a high organic content. The leachate data also indicate that Smokey Mountain is likely to have some methanogenic activity. Allowing remediation activities or the extraction of plastics in the decommissioned Smokey Mountain dumpsite as proposed by some private sector groups could result in the release of methane and particle emissions and have a negative impact on the environment and the surrounding population, if appropriate measures are not taken.

The analysis of organic pollutants in the soil reveals the presence of persistent organic pollutants (POPs) such as pesticides and poly-chlorinated biphenyls (PCBs). These pollutants were not found at extreme values but are still far above non-polluted soil mean concentrations. Methanogenic activity was deduced from our measurements, although no quantification was possible. A more in-depth study would be necessary to evaluate the risk of methane emission during the remediation process.

Comparison of Heavy Metal Concentration

Heavy metals	Results from sampling conducted in 2007				DENR effluent guidelines, class SC ^a	DENR effluent guidelines, class SD ^b	1993 mean concentration	UK median concentration	UK maximum concentration
	Point 1	Point 2	Point 3	Point 4					
	mg/l								
Chromium	0.1360	0.0930	0.0180	0.2670	0.5000	1	ND	0.0500	1.2400
Lead	0.0000	0.0860	0.0020	0.0580	1.0000	NG	1.2000	0.0600	0.4000
Arsenic	0.0040	0.0650	0.0040	0.0270	0.2000	0.5	0.3740	0.0080	0.1600
Zinc	0.2870	1.1230	0.2800	0.6950	NG	NG	ND	0.1350	56.0000
Cadmium	0.0271	0.0101	0.0000	0.0000	0.2000	0.5000	0.1500	ND	ND
Cobalt	0.0300	0.0410	0.0090	0.0800	NG	NG	ND	ND	ND
Copper	0.0010	0.7610	0.0490	0.0720	NG	NG	ND	0.0110	0.3540
Nickel	0.1220	0.1970	0.0500	0.2710	NG	NG	ND	0.0600	1.5300
Barium	0.4710	0.0470	0.1250	0.1000	NG	NG	ND	ND	ND

^aClass SC -1) Recreational Water Class II (e.g. boating, etc.); 2) Fishery Water Class II (Commercial and sustenance fishing); and 3) Marshy and/or mangrove areas declared as fish and wildlife sanctuaries.

^bClass SD -1) Industrial Water Supply Class II (e.g. cooling, etc.); and 2) Other coastal and marine waters, by their quality, belong to this classification.

NG- no guideline for the parameter; ND- not determined or data not available

A historical review and interpretation of the 1993 Environmental Impact Statement (EIS) of the Smokey Mountain Reclamation and Development Project, was also done. Based on this EIS, the analyses of the 37 boreholes show that heavy metals were present throughout Smokey Mountain and there is high organic carbon to nitrogen ratio, which translates to a high probability of methane formation. The EIS also provides a good estimation of the landfill's general content, showing a predominance of organic material with a low proportion of plastics and metals.

The 2007 study reveals that the Smokey Mountain landfill contains heavy metals and other pollutants and that it is very unlikely that heavy metals have been washed out of Smokey Mountain since 1993, as confirmed by more recent leachate measurements. In addition, it is unlikely that we will be able to definitively quantify the emissions and pollutant concentrations without extensive additional work. Many more locations would need to be investigated and a more comprehensive analysis undertaken.

Based on the findings of this study, it is recommended that an awareness campaign be launched in order to inform the community living around the landfill of the health hazards associated with on-going activities in the mountain, for example, the planting and consumption of vegetables grown on the landfill and children playing and coming into contact with the landfill runoff. The vegetables growing in the gardens should be further studied in order to assess the heavy metal uptake. According to some sources, it is said that people continue to plant vegetables on the mountain because they do not become sick after eating these food. An awareness campaign is needed to explain that while the health consequences are not immediately apparent, in the long-term this can lead to the occurrence of disease including cancer. Pregnant and breastfeeding women can particularly be vulnerable.

Many questions remain to be answered concerning the landfill's current environmental status and the hazards that could be generated during and after the implementation of a remediation strategy. This report provides new findings related to the current heavy metal content. It provides a historical perspective on the tests conducted to date and a compelling argument for the need to undertake a proper environmental assessment before any remediation program is implemented.