

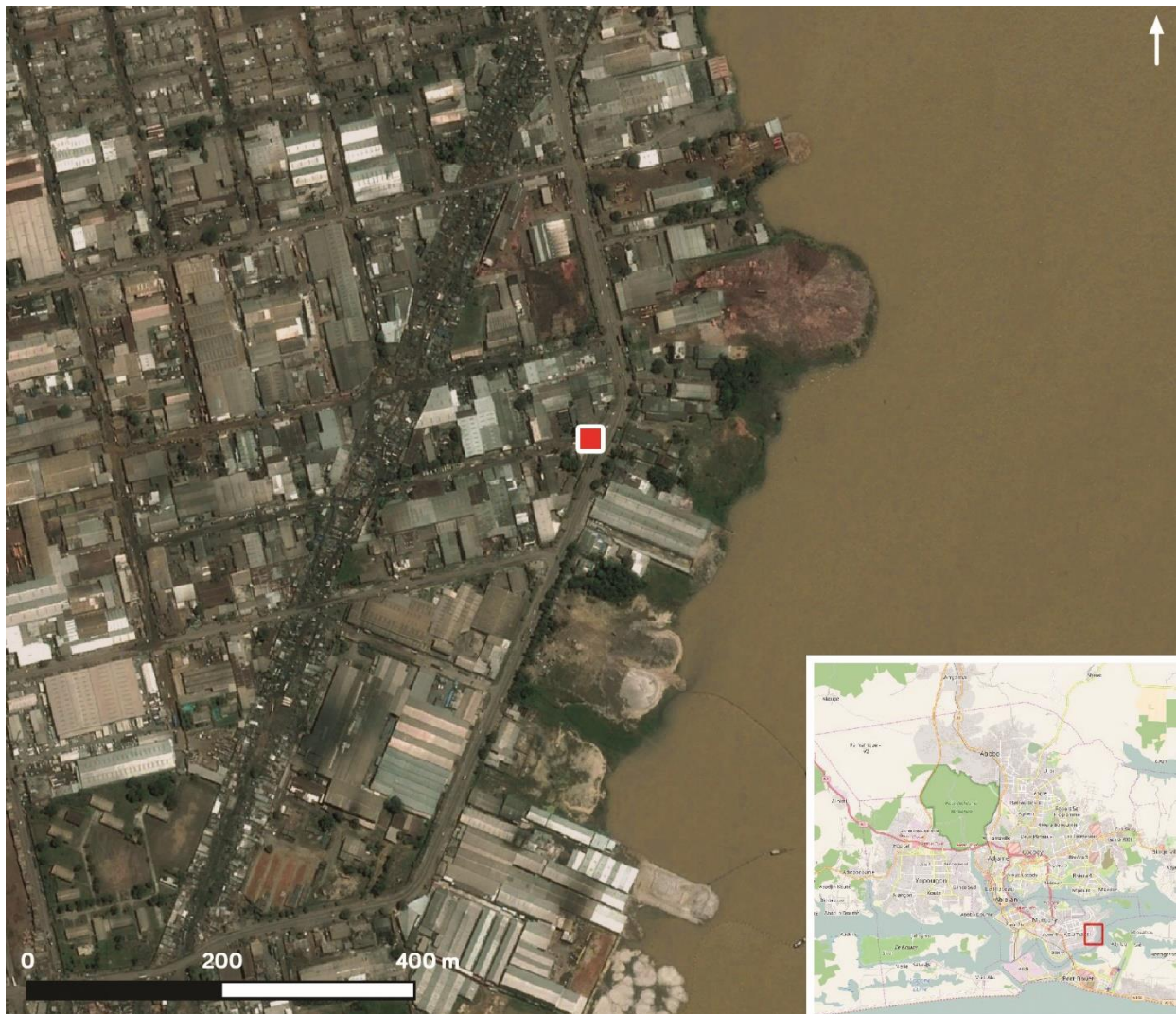
ENVIRONMENTAL AUDIT OF THE SITES IMPACTED BY THE “PROBO KOALA” TOXIC WASTE DUMPING IN ABIDJAN, CÔTE D’IVOIRE



This series of fact sheets was prepared as part of UN Environment's environmental audit of the sites impacted by the “Probo Koala” toxic waste dumping in Abidjan, Côte d'Ivoire. The fact sheets provide complete analysis results, observations and the recommendations for each of the sampling sites. They should be read in conjunction with the full assessment report, available at: www.unep.org/CotedIvoire

Site Description

Site name: Koumassi (Industrial zone)
UN Environment site reference no: 4



Spill History

This site is located in the industrial zone of Koumassi, an area in the south of Abidjan. It is reported that wastes from the Probo Koala were dumped into an open roadside drain running alongside buildings used for commercial purposes. The original concrete drain and surrounding soil were removed and remediated by Trédi in 2006-2007, and the resulting void backfilled with material excavated from elsewhere. The original drain was replaced by a buried drainage pipe. Finally, the site was re-surfaced in conjunction with the removal of an obsolete weighbridge that had operated at that location for several years. At the time of sampling, the location had become an informal dumping site for household and municipal waste.

Approach

One surface (0-20 cm) soil sample was taken at the exact location of the dumping, adjacent to the commercial building at the junction of the street. Before the soil sample was collected, the overlying waste had to be cleared by hand.

In addition, one air sample and two groundwater samples were collected at this site.

Assessment Criteria

Based on the different analyses of the chemical composition of the samples taken onboard the Probo Koala in 2006, as well as those undertaken on samples collected on the dumping sites, UN Environment considered the following groups as the key contaminants of interest for the audit:

- Petroleum hydrocarbons;
- Sulfur compounds; and
- Heavy metals.

The speciation of contaminants to be analyzed within the above three groups was primarily determined by what was present in the Probo Koala waste as well as the environmental standards set by the Government of Côte d'Ivoire for clean-up. In addition, the impact of high levels of sodium hydroxide was measured through the pH value of the soil.

The results obtained from the analyses of **soil** samples were screened according to the following process:

1. Findings were first compared with relevant national standards. In this case, results for soil from all the sites where Probo Koala wastes were dumped and which had undergone remediation were compared with the environmental standards set by the Government of Côte d'Ivoire for clean-up operations conducted by Biogénie at Alépé. If the values obtained were lower than the standards set by the Government, UN Environment considered that no additional clean-up intervention was necessary on the site.
2. If laboratory results for a given parameter showed values exceeding the clean-up standards set by the Government or contractor, results were then compared with the internationally recognized Dutch soil remediation standards (intervention values) to see if further immediate action was needed from an environmental point of view. Dutch standards have been in existence for over 30 years and are used as a basis for contaminated site assessment and clean-up in many parts of the world, when local standards are not available. For most parameters of analysis, however, the Government's clean-up standard was more stringent than the Dutch values.

- Results were also compared with the control sites to see if the observed pollution was also present in the background.

For **air** quality analysis, for which no national standards exist in Côte d'Ivoire, the approach taken was to compare air quality results from the affected sites with Control Site 21, some 69 km away from Abidjan near Agboville, where the impact of urban pollution was expected not to be felt.

Three key sets of parameters were analyzed for groundwater samples, which together would constitute a theoretical "fingerprint" of the Probo Koala wastes: (i) sulfur; (ii) phenols; and (iii) hydrocarbons. In addition, a number of heavy metals that were included in the Government's contract for soil clean-up were also analyzed. Results for **groundwater** quality were compared against control site values (Site 19 at Anyama) and, in the absence of national standards for water quality, Dutch intervention values.

Laboratory Analysis Findings

Soil Parameters (mg/kg)	Site 4 Koumassi	Government standard (mg/kg)
	0-20 cm	
Total Hy C5-C44	197	1,000
Benzene	< 0.009	1
Ethylbenzene	< 0.003	25
Toluene	0.00319	5
Xylene	< 0.009	5
Total sulfur (%)	0.0642	10
Pb	92	400
Cd	1.7	20
As	1.5	37
Cr	19	130
Ni	8.4	140
Co	1.6	240
Hg	0.022	7
Cu	61	190
Zn	95	9,000
pH	7.61	

Air		Site 4	Control site 21
Parameters/units		Koumassi	Agboville
Dimethyl sulfide	ppm v/v	< 0.1	< 0.1
Ethyl mercaptan	ppm v/v	< 0.1	< 0.1
Methyl ethyl sulfide	ppm v/v	< 0.1	< 0.1
Carbonyl sulfide	ppm v/v	< 0.1	< 0.1
Tertiary butyl mercaptan	ppm v/v	< 0.1	< 0.1
Hydrogen sulfide	ppm v/v	< 0.1	< 0.1
Methyl tert-butyl ether	µg/m3	ND	ND
Benzene	µg/m3	ND	ND
Toluene	µg/m3	2,50	ND
Ethylbenzene	µg/m3	ND	ND
Xylene	µg/m3	ND	ND
Naphthalene	µg/m3	ND	ND
TPH (C4-C6)	µg/m3	76	10
TPH (C6-C8)	µg/m3	3,800	20
TPH (C8-C10)	µg/m3	380	35
TPH (C10-C12)	µg/m3	ND	53
TPH (C4-C12)	µg/m3	4,300	120
Aliphatic (C4-C6)	µg/m3	76	ND
Aliphatic (C6-C8)	µg/m3	1,300	17
Aliphatic (C8-C10)	µg/m3	290	31
Aliphatic (C10-C12)	µg/m3	ND	53
Aromatic (EC5-EC7)	µg/m3	ND	ND
Aromatic (EC7-EC8)	µg/m3	2,500	ND
Aromatic (EC8-EC10)	µg/m3	87	ND
Aromatic (EC10-EC12)	µg/m3	ND	ND

Groundwater Parameters (µg/l)	Site 4 Koumassi		Control site 19 Anyama	Dutch intervention values (µg/l)
	Metal works zone	Well	Borehole	
Total Hy C5-35	< 10	< 10	< 10	600,000
Benzene	< 7	< 7	< 7	30
Ethylbenzene	< 5	< 5	< 5	1 000
Toluene	< 4	< 4	< 4	150
Xylene	< 11	< 11	< 11	70
Free sulfur	< 50	< 50	< 50	-
Pb	1.1	35	< 0.25	75
Cd	< 0.25	0.67	< 0.25	6
As	0.46	0.78	< 0.25	60
Cr	0.48	1.8	0.41	30
Ni	< 0.25	< 0.25	1.5	75
Co	0.43	1.1	1.4	100
Hg	< 0.25	2.1	< 0.25	0.3
Cu	3.1	13	1.8	75
Zn	3.8	610	5.4	800

Conclusions and Recommendations

The laboratory results show that the current concentrations of the contaminants of concern in soil are all below the standards set by the Government of Côte d'Ivoire for clean-up. Likewise, hydrocarbon levels in the sample analysed are well below Dutch intervention values. Furthermore, the pH values are not in the caustic range (9 or above), demonstrating that the impact of the disposal of caustic substances can no longer be detected. No further action is therefore needed on this site to remediate the soil impacts of the 2006 toxic waste dumping from the Probo Koala.

The results of the air quality analysis can be summarized as follows:

- Mercaptans, hydrogen sulfide and related components cannot be detected in this site, nor the control site. This is significant considering that the key odorants in the Probo Koala wastes were most likely hydrogen sulfide and mercaptans.
- This site, however, shows significantly elevated levels of hydrocarbon pollutants as compared to the background sites. Given the site's location, elevated levels of hydrocarbons are not unexpected. Indeed, the industrial zone of Koumassi is scattered with small-scale industrial plants operating in the automobile and metal working sectors in particular. During UN Environment's several visits to the site, heavy smoke emissions were observed from numerous chimneys in the immediate area. The chimneys were very old structures and clearly lacked any smoke emission control technology.

While not related to the dumping of wastes from the Probo Koala, the impacts of such poor local air quality could be significant. In particular, the presence of high levels of toluene, as well as other aromatics, is a matter of concern. Daily exposure to this pollution will undoubtedly adversely affect the health of thousands of workers and residents in the area.

Two observations can be made regarding the analysis of groundwater quality for this site:

- The samples taken at Koumassi do not show the combined presence of sulfur and hydrocarbons, which could have been indicative of leachate contamination from sites impacted by the Probo Koala wastes.
- A comparison with the pollutant concentrations in the control well (Site 19) indicates that the sample from the well near Site 4 (Koumassi) contains elevated levels of lead, zinc and mercury. Given the industrial nature of the area, and the fact that the results in question, except for mercury, are still below the Dutch intervention values, no immediate action is needed. In combination, however, the groundwater and air pollution findings expose Koumassi as a developing pollution “hotspot” that requires Government attention.

While the industrial units in Koumassi are not large in size, their collective emissions are sufficient to result in elevated levels of hydrocarbons in the air. Such situations are not unusual, as many countries do not have environmental systems for small and medium-scale industries, or do not subject them to an environmental clearance process. Even when limits are set, they are generally set for individual industries and collective impact is not monitored or controlled.

However, as the findings of UN Environment's audit for this site show elevated levels of hydrocarbons in the air, as well as higher concentrations of some heavy metals in groundwater, the following measures are recommended:

1. First and foremost, it is important to address the risks faced by the workers in these plants and workshops, who are most directly exposed to the pollution. Small and medium-scale industries typically have fewer occupational health controls and employees have less awareness about what health impacts exposure to air pollutants may have. The first priority should therefore be to provide employees with training on occupational health and access to personal protection equipment.
2. Even if small-scale industries are not regulated, creating a simple guideline on emissions controls and waste management, providing guidance on such issues as the minimum height for a chimney, storage and disposal of chemicals and solid wastes, setting up of simple grease traps before effluent disposal and other such measures would be very beneficial. Such a guidance note would need to be provided to all industries in the area.
3. Working together with all industries in the area, a comprehensive assessment should be conducted to gather information on such issues as the different types of industries, chimneys and stack-emissions controls, effluents, effluent disposal arrangements and occupational health. The findings of this assessment should be used as a basis for establishing a combined effluent treatment system, if needed, and specific measures for better environmental management in the area. Such an audit should also provide information about the community living around the area, and suggest zoning restrictions to reduce the exposure of the most vulnerable populations (children, the elderly and those in ill-health).

Site Photos



Source : UN Environment



Source : UN Environment



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