Appendix A1

Air Hitam Sanitary Landfill
Site Description

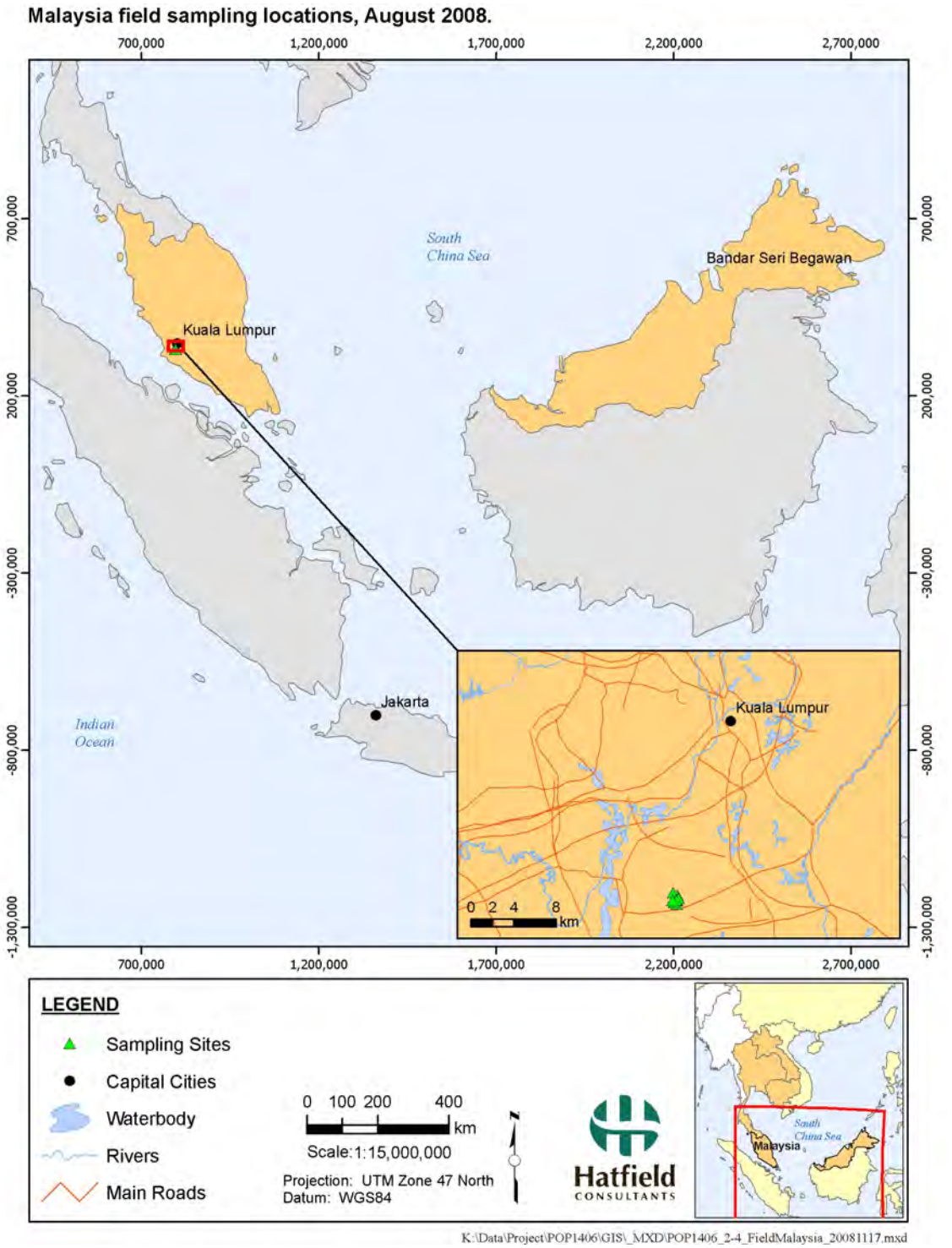
A1.1 MALAYSIA AIR HITAM SANITARY LANDFILL (AHSL) SITE DESCRIPTION

The Ministry of Natural Resources and Environment (NRE) as the National Focal Point for the POPs project in Malaysia in consultation with key stakeholders selected the Air Hitam Sanitary Landfill (AHSL) in the State of Selangor for the POPs HHRA case study for POPs project.

While there were no existing data or known waste management practices suggesting the presence of POPs at the AHSL site, the site selection was based on speculative concern for (i) potential POPs wastes which inadvertently may have been deposited at the landfill, and (ii) the proximity of residential developments adjacent to the closed landfill.

The AHSL site is located near the Air Hitam Forest Reserve in Mukim Petaling, Daerah Petaling, Puchong, Selangor and is located at longitude 101° 39′ 55″ E and latitude 03° 0′ 10″ N.

Figure A1.1 Location Map of AHSL Site, Puchong, Malaysia.



The predominant land use classes within 3 km^2 are residential and bare ground – 26% and 29% respectively. The proportion of bare ground is expected to decrease quickly if the high development rates seen during the last eight years continue. Some of this land is within the minimum 500 meters buffer zone required by the Guidelines for the Sitting and Zoning of Industries, 1994.

Table A1.1 and Figure A1.2 below show major classes of land use in the vicinity of the AHSL site:

Table A1.1 Major land use classes within 1 km radius from the AHSL site[1].

Land Use	Area (Ha)	Area (Percentage)
Bare Ground	92.43	29%
Forest	24.59	7.8%
Industry/Commercial	2.34	0.74%
Roads	44.47	14%
Infrastructure (Buildings)	0.23	0.07%
Residential Area	81.85	26%
Pond	1.35	0.43%
Trees/Shrub/Bush	65.74	21%
River/Canals	1.11	0.35%
TOTAL	**314.12**	**100%**

[1] Quickbird high resolution satellite imageries (0.6 meter resolution) covering an area of 25 km^2 were used as data input for land-cover delineation over the selected study site. Projection: UTM 47N WGS1984. Imaging Dates- 07 May 2007. The project team applied 'heads-up' digitizing approach (manual on-screen classification) for extracting land cover classes from satellite imagery, based on the general land cover types observed over the study sites.

Figure A1.2 Land-use Map of AHSL Site (LESTARI, 2008).

Abbr	Land use types	Abbr	Land use types
SM	Secondary School (under construction)	KT	Reservoir
PLR	Sewage treatment plant	M	Mosque
S	Muslim place of worship	PPU	Main Electrical Supply Centre
TDK	Kindergarten	TA	Water Tank
SB	Integrated School (under construction)	DS	Multipurpose hall
KYS	Selangor Foundation Club (under construction)		

Source: MPSJ 2008

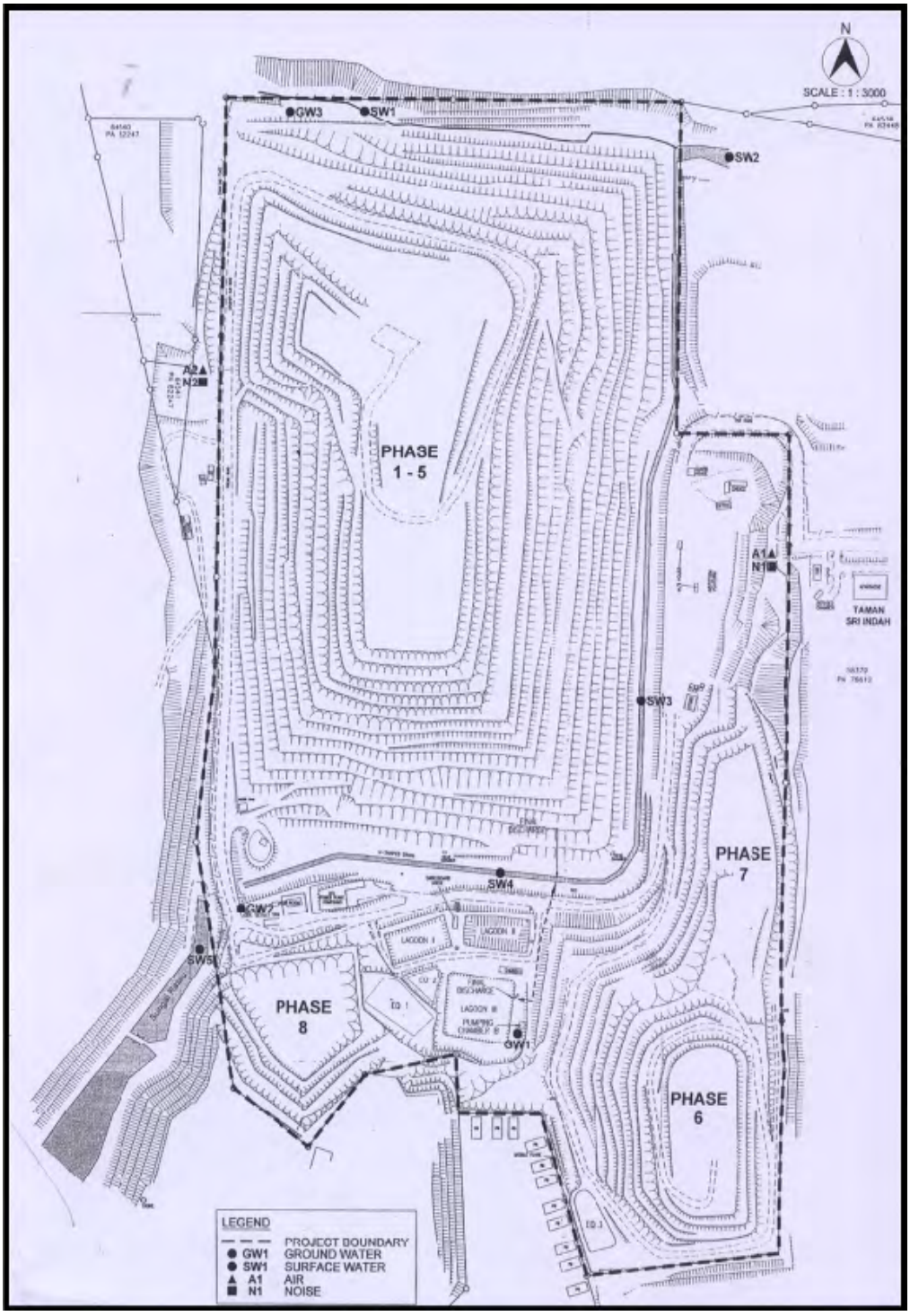
A1.2 SITE OPERATIONS AND SETTINGS

The Selangor State Government Council Meeting on 22 March 1995 approved Worldwide Sita Environmental Management to develop a sanitary landfill in Selangor. Worldwide Landfills obtained a concession contract for 20 years which included a 5 year landfill closure maintenance plan (for the AHSL). However, after the first residential area was built in year 2000, residents started to complain about the operation of AHSL, particularly odors emitted or released from AHSL. The AHSL was officially closed on 31 December 2006 (premature to contracted date, i.e. 2015) and the 5-year Landfill Closure and Post Closure Maintenance Plan (LCPCMP) is in place (2007-2011).

AHSL was built in 1995 and closed in December 2006. It is the first engineered sanitary landfill site in Malaysia. AHSL covers a total area of 42 hectares. The site consists of 7 landfill phases with a base at 35 m above mean sea level (msl) and

its highest point 81 m above msl after capping. It is equipped with a heavy duty geotextile liner, a ground water drainage system, and a leachate collection system and treatment plant.

Figure A2.1 AHSL Landfill Lay-out and phases, Selangor, Malaysia (LESTARI, 2008).



During the operational period of AHSL (11 years), AHSL received a total of approximately 6.2 million tonnes of domestic wastes (Worldwide Landfills, 2007). Between 1,200 and 3,000 tones/day of domestic waste was deposited in the site between 1995 and 2006 with waste collected from four Selangor municipalities (Ampang Jaya, Subang, Petaling Jaya and Shah Alam), Kuala Lumpur and Putrajaya. A significant increase in the amount of waste deposited at the site occurred in 2002, as a waste from Kuala Lumpur was added to the landfill.

The site topography is complex, with surface water runoff from North to the south east mainly through stream running through the landfills (based on site observations). The compound is equipped with rudimentary drainage of storm water run-off from the site from the site into downstream through a stream.

Table A2.1 provides an estimate of the size of these various components.

Table A2.1 Size of the key building/area of the AHSL site.

Building / area	Size (sqm)
Total Landfill area	420,000
Office Area	300
Parking and loading area	900
Access road	8,000

A1.3 KEY FINDINGS OF THE RISK ASSESSMENT

A1.3.1 CONTAMINATION LEVELS

Due to the lack of POPs data from the site, it is a challenge to specify if and what POPs may be present in the AHSL. The sanitary landfill was designated for disposing non-scheduled waste, including: domestic/household waste, commercial and light industrial waste, market waste, street cleaning waste, construction waste and food waste.

POPs pesticides might be present in AHSL, since several POPs pesticides were historically registered in Malaysia (e.g. DDT was registered for 19 years in the country). Some domestic wastes might also contain PCBs and other POPs-like contaminants. Because the site is a landfill, a wide variety of POPs contaminants may be associated with the site. PCBs, PCDD/Fs (i.e., dioxins/furans) and chlorinated pesticides were targeted for screening.

Through problem formulation, all three elements of risks below are present at the sites were found to be present at the study site: i) Chemical Hazard – one or more chemical contaminants at concentrations capable of causing human health or ecological impacts; ii) Receptors – humans, animals or plants at the site; and, iii) Pathway – a way for chemical contaminants to reach the receptors.

For both soils and sediment the maximum CALUX TEQ concentrations were 13 pg-TEQ/g for PCDD/Fs, and 2.8 pg-TEQ/g for dioxin-like PCBs. Maximum concentrations were derived from material collected from the treatment pond.

Figure A3.1 Photographs of Treatment Pond, and sediment sample collection, AHSL site, Malaysia (note partially exposed sludge at pond edge).

Screening the maximum CALUX TEQ concentrations for PCDD/F + dioxin-like PCBs based on sediment guidelines (AEA Technology 1999) resulted in exceedance factors of 3.3 and 0.7 respectively. Because the maximum exceedance factor for PCDD/Fs were greater than one, they were considered contaminants of potential concern and retained for risk further assessment. PCBs were also included as contaminants of potential concern because the highest Total PCB concentration, 372 µg/kg, resulted in an exceedance factor of 1.55. It might be argued that such a marginal exceedance may at times not justify further risk assessment.

Figure A3.2 PCB/Dioxin Concentrations in Soil and Sediment Samples (TEQ; pg/g) collected in August 2008 at AHSL Site, Malaysia.

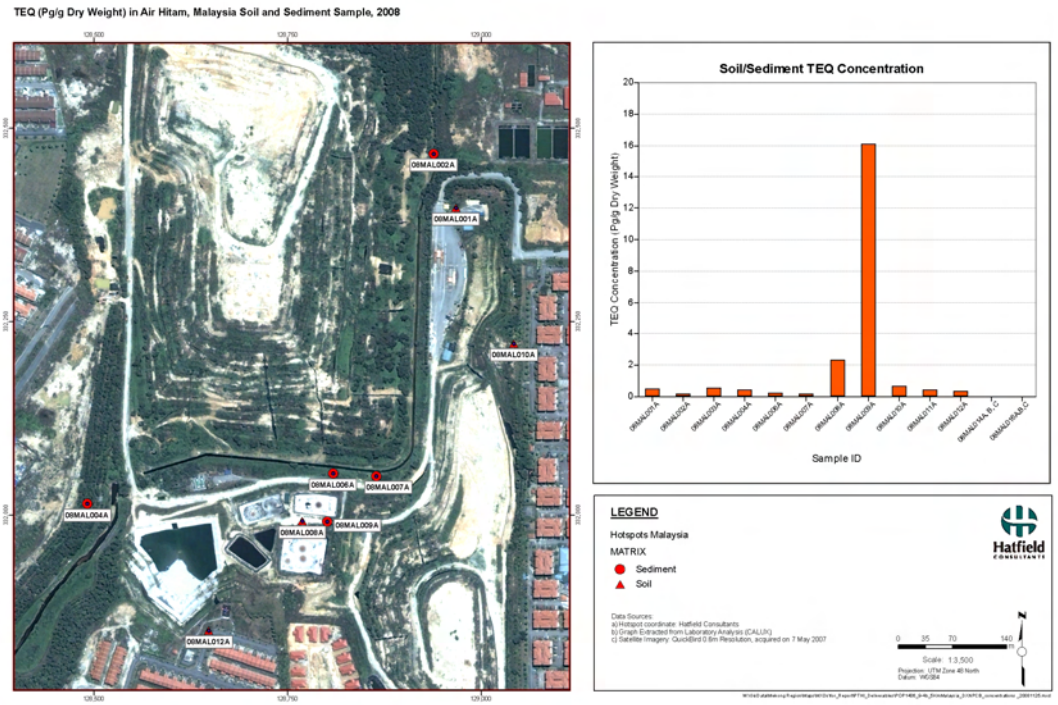


Table A3.1 Potential Human Receptors related to the AHSL site, Malaysia (within 1 km radius).

Air Hitam Sanitary Landfill, Selangor, Malaysia	Estimated numbers
Potentially exposed:	
▪ Residents of housing area (1km radius)	6,095
▪ Full time staff of the site	9
▪ Full time security	3
▪ Students & staff of nearby secondary school (pending)	1,000
▪ Shift workers and visitors	45
Total	7,253

Site workers and security persons working permanently at the site are primary potential receptors. A public health and socio-economic survey conducted by the National Consultant (Mazrura 2009) revealed that some of the nearby residents (2.7% of the total respondance) may be involved directly in activities that could increase their exposure to contaminants present at the site.

Near to the site there are approximately 1,500 housing units in 3 main residential areas covering an area of over 800 hectares. An estimated 6,253 people live within 1 km radius of the site (Figure A3.3).

A1.3.2 IDENTIFICATION OF PATHWAYS

Potential exposure pathways at the AHSL site were identified using the results of the human exposure survey (October 2008, Mazrura 2009) and the site reconnaissance and sampling program (August 2008).

There are several potential exposure pathways at the site related to the treatment pond sediments:

- On-site: inhalation, accidental ingestion and dermal contact of treatment pond sediments;
- Off-Site: wind erosion/transportation to off-site water bodies with treated leachate waters, followed by inhalation, accidental ingestion and dermal contact; and
- Ingestion of potentially contaminated fish and wildlife.

A1.3.3 RISK MANAGEMENT OPTIONS FOR THE SITE

At the National Training Workshop which took place in Putrajaya, Malaysia from 22-23 January 2009, the national participants classified the AHSL site as a Class 3 site - action might be required. The national participants also agreed that the potential risk management measures must be considered within the context of the existing Landfill Closure and Post Closure Maintenance Plan (LCPCMP) (January 2007 – December 2011). They decided that before risk management options are considered, additional risk assessment is recommended to determine if there are any human health risks at the site from potential POPs and other hazardous chemical contaminants.

The LCPCMP reflects a variety of good closure practices, although additional scrutiny of possible human health exposure scenarios may be warranted to reduce potential future liabilities:

- Potential risks to human health arising once the site opens to the general public after decommissioning;
- Potential risks to human and ecological health from contaminants not addressed in this risk assessment (i.e., non-POPs substances such as metals, solvents, petroleum hydrocarbons etc.); and
- Responsibility/liability that the closed landfill may pose to the owners (e.g. cost of remediation, reputation and relations with the local community, and affected parties such as workers at the site, nearby property owners).

Figure A3.3 Vulnerability Map, AHSL, Puchong, Selangor, Malaysia.

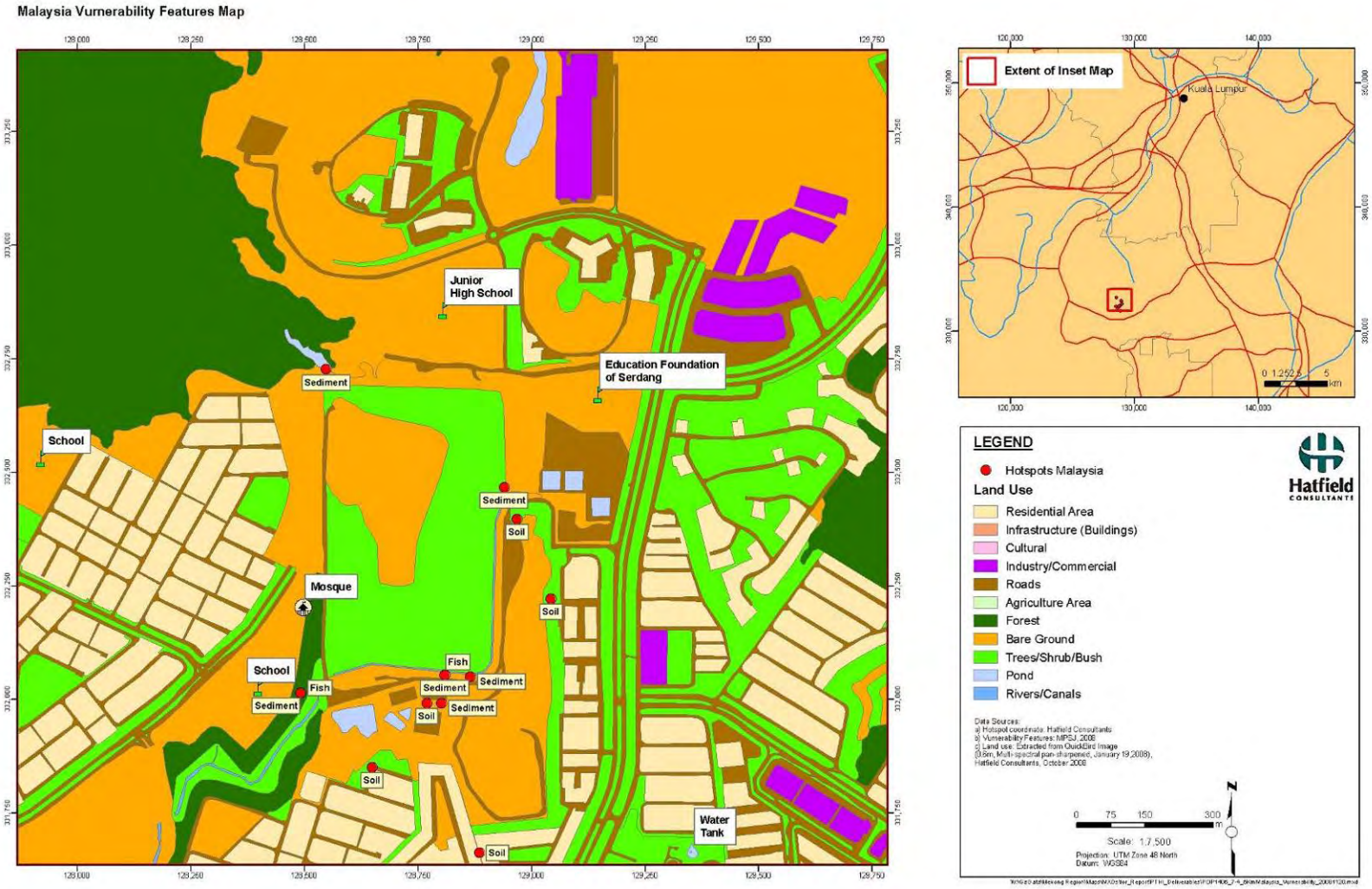


Figure A3.4 Potential receptors associated with the AHSL site, Malaysia.

Children living in housing adjacent to the site

.Fish living in the aquatic receiving environment.

Families living in housing adjacent to the site.

Natural receiving environment (ecological receptors)

Natural receiving environment (ecological receptors)

Until additional risk assessment work is performed risk management activities should be put on hold. Furthermore, it must be noted that some of the risk management alternatives provided below would only be considered if predicted human health risks were high.

Based on the National Training Workshop's outputs, the following 2 risk management scenarios were developed for the AHSL site economic valuation.

Scenario 1: Detailed Assessment of possible human health risk

At this time, additional risk assessment work needs to be conducted to determine if human health risks are present. The followings are the risk management alternatives identified by the participants.

1. Enhanced monitoring program:

    - Human health assessment: to determine the potential health impacts related to exposure to POPs and other chemicals originating from the site.
    - Sampling and Analysis of Environmental Samples: A detailed sampling program to be conducted to determine with greater accuracy the level of contamination (by POPs, dioxin and possibly other chemicals) in this medium.
    - Fish tissue analysis: Fish samples should be collected from streams and ponds near the site and analyzed using HR-GCMS for chemical contaminants.
    - Groundwater analysis: A detailed sampling program of groundwater to be conducted to determine with greater accuracy the level of contamination (by POPs, dioxin and possibly other chemicals) in this medium.

Scenario 2: Implementation, enforcement and monitoring of Health and Safety Plan + Regular Monitoring under Scenario 1

The scenario 2 should be considered if the site is found to pose unacceptable human health risks after a more detailed site investigation in scenario 1 above. The key components of Scenario 2 include:

1. Control potential chemical hazards:

    - Disposal of contaminated sludge: The contaminated sludge needs to be regularly removed from the treatment ponds and disposed of, for example by disposal at an authorized landfill or any other mean, based on technology availability, nature of the sludge contamination, etc.
    - Improvement of drainage system: To prevent sediments from migrating off site during rainfall/flood events. They may include the creation of settling ponds, catch basins, and silt fences.

2. Monitoring of health and environment

   - Human health assessment: Regular human health assessment should be conducted on the AHSL site in accordance with Malaysian regulations (i.e. every 5 years) to determine the potential health impacts related to exposure to POPs and other chemicals originating from the site.
   - Soil and sediment monitoring: a monitoring program of soil and sediment should be implemented at the site to determine with the evolution of level of contamination (by POPs, dioxin and possibly other chemicals) in this medium. Monitoring will be conducted at the same frequency than the health assessment.
   - Fish monitoring: Fish monitoring program should be implemented at the site to determine the evolution of level of contamination (by POPs, dioxin and possibly other chemicals) in fish tissue. Monitoring will be conducted at the same frequency than the health assessment.
   - Groundwater monitoring: A groundwater monitoring program should be implemented at the site to determine the evolution of level of contamination (by POPs, dioxin and possibly other chemicals) in fish tissue. Monitoring will be conducted at the same frequency than the health assessment.
   - Air quality monitoring: Should the landfill be proved to pose a risk to human health and if risks through inhalation of contaminated particles are predicted, an air quality monitoring program should be implemented at the site to determine the evolution of level of contamination (by POPs, dioxin and possibly other chemicals) in fish tissue. Monitoring will be conducted at the same frequency than the health assessment.
   - Other proposed measures: Supplemental selective sampling for POPs and certain non-POPs (i.e., metals, solvents, petroleum hydrocarbons) is needed to determine if contaminants are contained appropriately as the landfill ages.
   - Consider if the site could be converted back into forest reserve (i.e., plant trees). Smaller plants may be planted if compromising the landfill cap is a concern.