Simtars
Queensland Government
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Screening survey of air and soil at Atherton Fire Station

for Department of Emergency Services

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Client Reference	*P360180*
Investigation Period	*30 April 2008*
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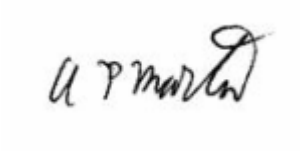
Approved Signatory	 *Andrew Martin, Principal HSE Scientist*
Report Date	*12 Jun 2008*

1 Objectives

Due to concerns about the health of fire station staff at Atherton Fire Station, the Department of Emergency Services requested that Simtars undertake a screening survey of air and soil at the fire station. This screening survey was designed to determine the presence or absence of potential environmental hazards such as volatile organic compounds in air and pesticide residues and metals in the soil. The results of such a survey identify whether or not contaminants are above thresholds requiring further investigation. This screening survey was carried out on 30 April 2008.

2 Scope of Work

The Atherton Fire Station consists of a fenced compound containing an original building to which a new annex has been added, a residential house and a workshop building. Discussions with fire station staff revealed that the residential house in the fire station compound had in the past been treated for extensive termite infestation on at least one occasion. This house was included in the sampling plan.

Locations inside and outside of the fire station were monitored for volatile organic compounds (VOCs) in air, and soil samples were collected outside the perimeters of the fire station and house to be analysed for pesticides and metals including arsenic. Wood samples from the floor and skirting board at locations known to have termite infestation were also collected for pesticide and arsenic analysis. All locations are described in Appendix A.

The volatile organic compounds sampling involved trapping the VOCs on activated charcoal tubes over a four hour period. The tubes were then analysed for 43 organic compounds used commonly in industry, at the Simtars laboratory.

The eight soil samples were collected manually by auger in the depth region of 0-150 mm. Each sample was divided into two portions. One portion was sent to Simtars laboratory for metals screening by Inductively Coupled Plasma techniques (ICP-OES) and the other portion was sent to Queensland Health Forensic and Scientific Services laboratory for analysis of organochlorine and organophosphate pesticides and arsenic.

A sample of flaking paint from the residential house was also collected for analysis for lead.

3 Methodology

Following recommendations in the Australian Standard AS4482.1-2005 the investigation at Atherton Fire Station compound was carried out as a 'screening site investigation'. This involved the gathering of information from Department of Emergency Services and individuals at the Atherton Fire Station, a site inspection and limited sampling, namely for volatile organic compounds in air and pesticides and metals in soil. The fire station compound was assumed to have a land use category of either 'residential with minimal opportunities for soil access' (category D) or 'commercial/industrial: includes premises such as shops and offices' (category F).

The sampling plan for volatile organic compounds (VOCs) included inside-building locations and was aimed at the concentration levels applicable to workplace exposure situations. Using battery operated pumps calibrated in the Simtars laboratory, air was sampled into tubes containing activated charcoal, a universal media for the trapping of volatile organic compounds. The sample tubes were later analysed in the Simtars laboratory for the presence of 43 VOCs using gas chromatography-mass spectrometry procedures. The 43 VOCs selected are those organic compounds commonly used in industry that can be sampled using on activated charcoal.

Soil samples were collected manually using an auger. After removal of any grass a plug of soil to an approximate depth of 150mm was collected. This was immediately divided into two portions. One portion was placed into a solvent washed bottle provided by Queensland Health Forensic and Scientific Services laboratory for the later analysis of organchlorine and organophosphate pesticides. The other portion was placed in a clean plastic bag ready for the further processing and later analysis for metals. These samples were stored in an esky with chiller bricks for transport to the laboratory.

Discussions with fire station staff revealed that the disused residential house had been treated for termite infestation in the past, so samples of wood from inside the house were collected to ascertain the concentrations of pesticides if present. A hole-saw and pinch bar were borrowed from the fire station staff to aid in the collection of these samples. These instruments were washed before use and the samples collected were chilled before transport to the laboratory.

Flaking paint of the west wall of the residential house allowed easy sampling of paint for lead analysis. This sample was analysed at the Simtars laboratory using Inductively Coupled Plasma (ICP-OES) techniques.

4 Results

Detailed results are listed in Appendix B.

Volatile organic compounds were monitored at eight locations. (See Table 2.) Four of these were at the perimeter of the residential house, two were beside the old fire station building and two were inside the fire station building namely the staff office and the tea room. None of the 43 VOCs targeted in the analysis were detected and were less than the minimum reporting limit for that method of analysis, generally less than 0.4 mg/m^3.

Eight of the soil samples were analysed for the presence of metals with the emphasis being on the more toxic heavy metals arsenic, cadmium, chromium, and lead. These results have been compared to the environmental investigation levels indicated in the National Environmental Protection (Assessment of Site Contamination) Measure 1999. The lead levels in soil samples 4, 5 and 7 collected from near the residential house may have been the result of contamination by lead paint from the house exterior. Levels of metals at sample location 11, the historic school yard, were within the thresholds for park and recreation areas. Levels at other locations were within the thresholds for both residential and commercial land uses. (See Tables 5 and 6)

Eleven samples of soil, wood and dust were analysed for organochlorine and organophosphate pesticides using gas chromatography techniques. (See Table 4.) The soil samples collected from near the fire station and the residential house showed less than the limits of detection for pesticides. However the samples of wood and dust from the residential house showed the presence of some pesticides at residue levels. These pesticides were the types commonly used in termite treatment. A sample of ant nest soil collected from the oil storage facility showed the presence of dieldrin.

Flaking paint from the western side of the residential house was tested for the presence of lead and found to contain 6% lead. (See Table 7.) Houses painted prior to 1970s commonly made use of paint containing lead and levels above 1% lead are considered elevated enough to require precautions during cleaning or removal.

5 Conclusions

Air

The air monitoring at the fire station site showed the absence of the 43 volatile organic compounds monitored both outside and inside the occupied buildings.

Soil

Testing of soil samples collected around the perimeter of the residential house and the fire station building showed the general absence of pesticides with the exception of a trace of Bifenthrin found near the front steps of the residential house.

The workshop area at the back of the fire station compound was co-located with an ant nest. The soil residue from this nest was regularly cleaned away from the oil storage area by fire station staff. This soil was found to contain residues of dieldrin pesticide possibly from previous ant treatment..

The soil samples collected around the fire station compound and the adjacent historic school yard showed the presence of some metals above the normal background levels. While these metals were detected they are considered to be safe levels for the current land use category of the site.

Wood

According to anecdotal information, inside the residential house had been treated for termite infestation and this was confirmed by the presence of pesticides found on or under the floor boards in the front room and on a skirting board in the living room.

Although pesticide residues were found, it is the nature of this type of insect treatment to be present and act over long periods. Detected pesticides were within those levels considered environmentally safe for residential areas in category D or commercial/industrial offices in category F.

Paint

The fact that the residential house external paint contains lead necessitates the need for caution if the house were to be cleaned or paint removed.

The investigated 17 pesticides and 19 metals in soils and wood and 43 volatile organic compounds in ambient air listed in the tables in the appendices were determined to be within acceptable concentrations for the land use category of the fire station. Therefore in our view this result does not warrant further expansion of the sampling program past this screening survey. Overall, we consider that no further investigations are necessary of pesticides or metals in soils, or volatile organic compounds in air.

References / Bibliography

Australian Standard AS4482.1-2005 “Guide to the investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds.

Australian Standard AS 4361.2-1998 “Guide to lead paint management” Part 2: Residential and commercial buildings.

National Environment Protection (Assessment of Site Contamination) Measure 1999 Schedule B (7a) Guideline on Health-Based Investigation Levels

NIOSH Manual of Analytical Methods. Method 1003: “Hydrocarbons, Halogenated”.

NIOSH Manual of Analytical Methods. Method 1005: “Methylene Chloride”.

NIOSH Manual of Analytical Methods. Method 1300: “Ketones I”.

NIOSH Manual of Analytical Methods. Method 1450: “Esters I”.

NIOSH Manual of Analytical Methods. Method 1457: “Ethyl Acetate”.

NIOSH Manual of Analytical Methods. Method 1500: “Hydrocarbons 36 - 126 oC BP”.

NIOSH Manual of Analytical Methods. Method 1501: “Hydrocarbons, Aromatic”.

NIOSH Manual of Analytical Methods. Method 1609: “Tetrahydrofuran”.

NIOSH Manual of Analytical Methods. Method 1610: “Ethyl Ether”.

NOHSC:3000 (1995) Exposure Standards for Atmospheric Contaminants in the Occupational Environment

Queensland Government Department of Environment. Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland May 1998

Queensland Health Scientific Services Laboratory Procedures. Organochlorine and organophosphate pesticides analysis.

Simtars Laboratory Procedure LP0057 “ Procedure for Determination of Acid Extractable Metals in Soils or Paints."

Definitions

Gas Chromatography Mass Spectrometry – Laboratory analytical technique used for the analysis of organic compounds

ICP-OES – Laboratory instrumentation used for the analysis of metals using the analytical principle of Inductively Coupled Plasma Optical Emission Spectrometry

LOR – Limit of Reporting below which the laboratory cannot distinguish

NIOSH – The National Institute for Occupational Safety and Health (USA)

NOHSC – National Occupational Health and Safety Commission

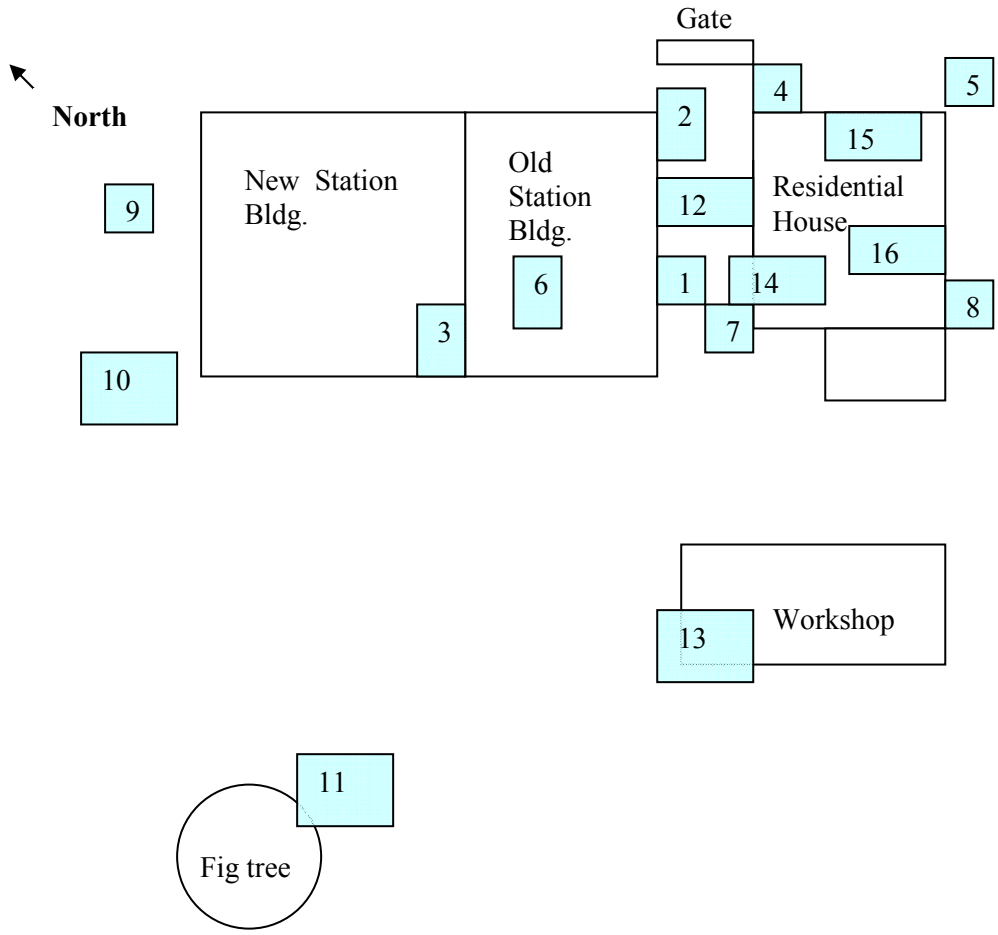
VOC - Volatile organic compounds are those organic compounds which readily evaporate and may be found in a vapour phase in ambient air

Appendix A: Sampling Locations

Table 1: Sampling Locations at Atherton Fire Station on 30 April 2008

Location No	Location	Sample	Test	Presence of VOCs at exposure standard levels	Presence of pesticides at investigation levels	Presence of metals at investigation levels
1	South-east of old fire station building	Air/soil	VOC/ Pesticide/Metals	no	no	no
2	North-east of old fire station building	Air/soil	VOC/ Pesticides/Metals	no	no	no
3	Tea room bench in fire station	Air	VOC	no	-	-
4	North of residential house	Air/soil	VOC/ Pesticides/Metals	no	no	no
5	North-east of residential house	Air/soil	VOC/ Pesticides/Metals	no	no	no
6	Staff office in fire station	Air	VOC	no	-	-
7	South-west of residential house	Air/soil	VOC/ Pesticides/Metals	no	no	no
8	South-east of residential house	Air/soil	VOC/ Pesticides/Metals	no	no	no
9	North of new fire station building	Soil	Pesticides/Metals	-	no	no
10	West side of new fire station building	Soil	Pesticides/Metals	-	no	no
11	Historic school yard under fig tree	Soil	Pesticides/Metals	-	no	no
12	East side of old fire station building	Soil	Pesticides/Metals	-	no	no
13	Oil store in workshop area	Soil	Pesticides/Metals	-	no	no
14	West wall of residential house	Paint	Lead	-	-	yes
15	Plug from wood floor in front room of residential house	Wood	Pesticides	-	no	-
16	Rebuilt wall in lounge room of residential house	Wood/dust	Pesticides	-	no	-

Figure 1: Diagram of Atherton Fire Station Sampling Locations



Appendix B: Detailed Results

Table 2: Volatile Organic Compounds in Air at Atherton Fire Station

Location No	Location	Pump No	Volume of air collected (litres)	Concentration of individual VOC tested (mg/m^3)
1	SW of old station building (near drain/grass area)	2516	14.0	Less than 0.29
2	NE of old station building	3585	12.4	Less than 0.32
3	Tea Room of New Station (on bench)	2542	17.0	Less than 0.24
4	North of old house front	3508	12.5	Less than 0.32
5	NE of old house front	3535	14.3	Less than 0.28
6	General staff office (behind door)	3513	11.1	Less than 0.36
7	SW of old house back	3511	14.0	Less than 0.29
8	SE of old house back	3289	12.8	Less than 0.31

Table 3: Volatile Organic Compounds Analysed (ug on sample tube)

Location Number Compound	1	2	3	4	5	6	7	8	Exposure Standard (mg/m^3)
Hexane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	176
Heptane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
Octane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	1400
Nonane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	1050
Decane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
Cyclohexane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	1030
Methyl cyclohexane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	1610
alpha-Pinene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
beta-Pinene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
3-Carene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
D-Limonene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
Benzene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	3.2
Toluene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	191
Ethylbenzene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	434
Xylenes	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	350
Styrene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	213
1,2,3-Trimethylbenzene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	123
1,2,4-Trimethylbenzene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	123
1,3,5-Trimethylbenzene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	123
Cumene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
Acetone	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	1185
Methyl ethyl ketone	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	445
Methyl Isobutyl Ketone	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	205
Ethyl Acetate	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	1440
n-Propyl acetate	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	835
Butyl acetate	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	950
Ethyl ether	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	1210
Tetrahydrofuran	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	295
Dichloromethane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
Chloroform	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	49
Carbon Tetrachloride	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	31
1,2-Dichloroethane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
1,1,1-Trichloroethane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	680
1,1,2-Trichloroethane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	55
Trichloroethylene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	270
Tetrachloroethylene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
1,2,3-Trichloropropane	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	60
Chlorobenzene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	46
1,2-Dichlorobenzene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	ND
1,3-Dichlorobenzene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	301
1,4-Dichlorobenzene	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	451
Bromoform	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	5.2

Limit of Reporting (LOR) = 4µg / tube. Over the exposure period this is less than 0.4 mg/m3

ND no data

Table 4: Pesticides in Samples from Atherton Fire Station (mg/kg on dry weight basis)

Location No	13	15	16	4	16	Investigation levels	
						D	F
Sample Type/Matrix	Soil sample	Wood sample	Dust sample	Soil sample	Wood sample		
%Solids	98	-	-	86	-		
Dieldrin	**0.98**	<0.01	<0.01	<0.01	**0.04**	**40**	**50**
Chlorpyrifos	<0.01	**31**	**0.08**	<0.01	**1.75**	**- [2]**	**- [2]**
DDE-pp	<0.01	<0.01	<0.01	<0.01	**0.01**	**800[1]**	**10001**
DDD-pp	<0.01	<0.01	<0.01	<0.01	<0.01	800[1]	1000[1]
DDT-op	<0.01	<0.01	<0.01	<0.01	**0.04**	**800[1]**	**1000[1]**
DDT-pp	<0.01	<0.01	<0.01	<0.01	**0.12**	**800[1]**	**1000[1]**
Piperonyl butoxide	<0.01	**0.18**	<0.01	<0.01	**0.09**	**-**	**-**
Methoxychlor	<0.01	<0.01	<0.01	<0.01	**0.04**	**-**	**-**
Heptachlor	<0.01	<0.01	<0.01	<0.01	<0.01	40	50
Heptachlor epoxide	<0.01	<0.01	**0.01**	<0.01	<0.01	-	-
Chlordane-trans	<0.01	**0.32**	**0.06**	<0.01	**0.05**	**200[1]**	**250[1]**
Chlordane-cis	<0.01	**0.04**	**0.01**	<0.01	**0.02**	**200[1]**	**250[1]**
Nonachlor-trans	<0.01	<0.01	<0.01	<0.01	**0.01**	**-**	**-**
Bifenthrin	<0.01	<0.01	<0.01	**0.01**	<0.01	-	-
Permethrin	<0.01	**0.80**	<0.01	<0.01	**0.14**	**-**	**-**
Cypermethrin	<0.01	<0.01	**0.21**	<0.01	**0.82**	**-**	**-**
Cyfluthrin	<0.01	<0.01	<0.01	<0.01	**0.35**	**-**	**-**

Locations 5,7,8,9,10 and 12 showed less than detectable levels of the above pesticides

Notes:

1. *Investigation level of the sum of pesticide isomers*
2. *Chlorpyrifos decomposes more rapidly in the environment than other organochlorines, and hence has no investigation threshold.*

Table 5: Mercury in Samples collected at Atherton Fire Station

Location	Sample	Mercury concentration (mg/kg)
Residential house 4	Soil	< 1.0
Residential house 5	Soil	< 1.0
Residential house 7	Soil	< 1.0
Residential house 8	Soil	< 1.0
New fire station 9	Soil	< 1.0
New fire station 10	Soil	< 1.0
Fig tree in school yard 11	Soil	< 1.0
Old fire station 12	Soil	< 1.0
Oil store 13	Soil	< 1.0
Residential house 15	Wood	< 1.0
Residential house 16	Wood	< 1.0
Dust sample 16	Dust	< 1.0

Table 6: Metals in Soils from Atherton Fire Station

Location	Al (mg/kg)	As (mg/kg)	B (mg/kg)	Ba (mg/kg)	Cd (mg/kg)	Co (mg/kg)	Cr# (mg/kg)	Cu (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	Mo (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	S (mg/kg)	Sb (mg/kg)	Sn (mg/kg)	V (mg/kg)	Zn (mg/kg)
Residential house 4	53000	130	<LOR	160	<LOR	48	201	73	93000	3400	<LOR	130	86	450	<LOR	<LOR	170	390
Residential house 5	53000	120	<LOR	140	<LOR	48	210	93	97000	2800	<LOR	130	78	460	<LOR	<LOR	180	230
Residential house 7	50000	110	<LOR	96	<LOR	45	180	73	87000	2300	<LOR	120	130	390	<LOR	<LOR	170	310
Residential house 8	46000	107	<LOR	77	<LOR	41	200	84	87000	2200	<LOR	120	<LOR	390	<LOR	<LOR	170	190
New fire station 9	38000	87	<LOR	76	<LOR	37	150	<LOR	72000	2400	<LOR	101	<LOR	380	<LOR	<LOR	130	110
New fire station 10	30000	76	<LOR	56	<LOR	24	110	<LOR	54000	1300	<LOR	80	<LOR	507	<LOR	<LOR	106	130
Fig tree in historic school yard 11	46000	110	<LOR	120	<LOR	41	180	<LOR	82000	2300	<LOR	120	<LOR	540	<LOR	<LOR	150	102
Old fire station 12	38000	96	<LOR	59	<LOR	37	170	<LOR	78000	1400	<LOR	100	<LOR	220	<LOR	<LOR	140	170
Dust sample 16		30																
Limit of Reporting (LOR)	**1000**	**10**	**200**	**10**	**5**	**5**	**10**	**50**	**1000**	**50**	**5**	**10**	**50**	**100**	**5**	**5**	**5**	**50**
Investigation level D		**400**	**12000**		**80**	**400**	**400**	**4000**		**6000**		**2400**	**1200**					**28000**
Investigation level E		**200**	**6000**		**40**	**200**	**200**	**2000**		**3000**		**600**	**600**					**14000**
Investigation level F		**500**	**15000**		**100**	**500**	**500**	**5000**		**7500**		**3000**	**1500**					**35000**
Background levels^		**0.2-30**	**1-75**		**0.04-2**	**2-170**	**0.5-110**	**1-190**		**4-12600**	**<1-20**	**2-400**	**<2-200**		**4-44**	**1-25**		**2-180**

Investigation level D – Residential with minimum opportunities for soil access

Investigation level E – Parks, recreational open space and playing fields

Investigation level F – Commercial/Industrial including shops and offices

#Analysed as total chromium

^ Queensland EPA Draft Guidelines

Table 7: Lead in Paint from Residential House

Location	**Lead (Pb)** (mg/kg)	**Lead (Pb)** (%)
Residential house 14	62000	6.2
Limit of Reporting (LOR)	1000	0.1