Occupational Hygiene Assessments
Occupational Health

GLOSSOP CONSULTANCY

Environmental Health
Chemistry

ANALYSIS OF AIR MONITORING FILTERS FOR ASBESTIFORM MINERALS FROM YATALA, QUEENSLAND BY SCANNING ELECTRON MICROSCOPY

December 2016

Prepared for: COHLABS

Occupational Hygiene Assessments
Occupational Health

GLOSSOP CONSULTANCY

Environmental Health
Chemistry

49 Sch 4

COHLABS
Unit 6A
15 Musgrave St
WEST END QLD 4101

Dear

RE: ANALYSIS OF AIR MONITORING FILTERS FOR ASBESTIFORM MINERALS FROM YATALA BY SCANNING ELECTRON MICROSCOPY AND ENERGY DISPERSIVE SPECTOSCOPY

Please find attached our Report “Analysis of Air Monitoring Filters for Asbestiform Minerals from Properties at Yatala, Queensland, by Scanning Electron Microscopy and Energy Dispersive Spectroscopy”.

Yours sincerely,

Principal Consultant and Director

21st December 2016

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Email: @glossopconsultancy.com.au

EXECUTIVE SUMMARY

Glossop Consultancy was contracted by COHLABS to analyse by Scanning Electron Microscopy (SEM) and Energy Dispersive Spectrometry (EDS), 4 filters plus 1 blank filter from air monitoring from an investigation at the Gold Coast suburb of Yatala.

The SEM/EDS allowed speciation of any respirable fibres observed on the filters.

One filter was identified with actinolite present which appeared to be a cleavage fragment of non-asbestiform actinolite. There were low concentrations of respirable fibres on nearly all the filters and these consisted of a number of inorganic minerals that could be expected in a suburban housing environment.

The concentration of respirable fibres was below the Reporting Limit of Detection of 0.001 f/mL.

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1 INTRODUCTION

Glossop Consultancy was initially contacted by [redacted] of COHLABS in early December 2014 in regards to analysing filters relating to the Department of Science, Information, Technology & Innovation for asbestos fibre using Scanning Electron Microscopy (SEM). Sampling was conducted by a third party and samples were analysed on an as received basis. Filters for the current investigation were received in November 2016.

1.1 Filter Analysis

The filters were initially analysed using the Membrane Filter Method (MFM) which uses an Optical Phase Contrast Microscope (PCM) to determine the size of any fibrous minerals present and whether they meet the criteria for classification as a respirable fibre (fibres with a width less than 3µm, length more than 5µm and an aspect ratio of length to width of more than 3:1). Although able to identify fibres that meet the counting criteria of a respirable fibre on the filter, analysis by PCM cannot determine the composition of. Identified fibre/s.

The MFM for estimating airborne asbestos fibres was developed a long time ago when asbestos was still used in many products (from 2003 all remaining uses of asbestos were banned in Australia). When used for samples taken in industries where asbestos was used, nearly all the fibres identified as meeting the counting criteria for respirable fibres using the MFM would have been asbestos. However, when the MFM is used for industries not using asbestos, the fibres identified as meeting the counting criteria for respirable fibres can be inorganic non-asbestiform fibres as well as organic fibres. The MFM cannot distinguish as to whether the fibres are inorganic or organic.

Scanning Electron Microscopy (SEM) is a much more superior form of analysis compared to PCM and can magnify to higher levels and, using X-ray Energy Dispersive Spectroscopy (known as EDS) on each fibre, allows the determination of the composition/speciation/characterisation of any inorganic fibre. It cannot determine what the composition of any organic fibre, but it can show it is an organic fibre.

SEM analysis was performed on the filters provided by Glossop Consultancy without knowledge the results of the PCM analysis.

1.2 Limit of Detection

The MFM normally only allows a Limit of Detection (LoD) of 0.01 fibres per millilitre (f/mL). The LoD is restricted due to the amount of air which can filtered and the number of fields counted on the filter. If too much air is filtered, the dust loading on the filter does not allow counting due to the inability to see fibres amongst the other dust on the filter. This is especially true if there is a high background dust level that may be found in industrial/mining situations. Normally to achieve a LoD of 0.01 f/mL, the MFM requires a volume of about 300 to 500L of air to be sampled for a 25mm diameter filter. The other requirement in regards to the LoD is the concentration of fibres on the filter. If the number of fibres is less than 10 per 100 fields, the level of uncertainty in the concentration increases significantly. The loading on fibres of filters

is assumed to be a Poisson distribution. The MFM requires about 300 to 500L of air and the counting of 100 fields to achieve a LoD of 0.01 f/mL.

The LoD can improved by increasing the amount of air filtered and/or increasing the number of fields counted, but in attempting this, the background dust loading needs to be low to medium dust concentrations. It has been our experience that with low background dust, the LoD can be lowered successfully. By increasing the volume of air collected to about 500L and counting 500 fields the LoD can be improved to 0.001 f/mL. Counting 500 fields can cause counting fatigue and only a small number of filters could be counted per day. Automated counting has not proved totally successful, especially for thin fibres. If less than 10 fibres are counted with the 500 fields then the uncertainty is high. Too much significance should not be placed on even a 50% variation or more between counting filters. The result is essentially the same statistically.

1.3 Background Concentration

The background concentration of asbestos fibres in cities according to the World Health Organisation (Air Quality Guidelines, 2nd Edition, Chapter 6.2 Asbestos, 2000) is found to be about 0.0001 to 0.001 f/mL, roughly 1/100th of the Occupational Exposure Standard at the higher concentration.

2 ANALYSIS OF FILTERS BY SEM EDS

Glossop Consultancy predominantly uses the Centre for Microscopy, Characterisation and Analysis at the University of Western Australia because it has High Resolution (High Magnification) SEMs which can provide good images of particles down to about 10 nanometres or smaller in size. In regards to asbestiform minerals, the individual fibres/fibrils range from about 20 nanometres up to about 400 nanometres in width and are readily analysed by these SEMs and comparable to Transmission Electron Microscopes (TEM). SEMs have the added advantage of 3 dimensional images compared to 2 dimensional images on TEM. Any particle can be analysed by EDS to determine the composition and most likely mineral.

Excluding the field blank, the 4 filters sent for analysis had only a very light loading of dust and counting, as well as measuring dimensions of particles, was straight forward. The concentration of fibres was low as expected for these filters.

The one blank filter analysed had no fibres detected even though 500 fields were counted. This indicates that the blank filter was very clean confirming that the lower LoD is valid.

2.1 Loading of Dust on Filters

The loading of dust on the filters was low and typical of non-industrial suburban areas. There was no difficulty measuring the filters for fibre and any fibre on the filters is well separated from other fibres making counting straightforward and identification of mineralogy by EDS of high certainty.

2.2 Measurement of Fibres

The counting of fibres was made at a magnification of 2,000. The MFM using PCM uses a typical magnification of 600. This measurement of fibres using SEM at this magnification is referred to as Phase Contrast Microscopy Equivalent (PCME). This method of counting by SEM is an International Standards Organisation Method: ISO:14966 - *Ambient air — Determination of numerical concentration of inorganic fibrous particles — Scanning electron microscopy*.

Fibres conforming to the counting criteria for respirable fibres (width less than 3µm, length more than 5µm and an aspect ratio of length to width more than 3:1) were counted.

2.3 Concentration and Speciation of Fibres

The number of respirable fibres in 500 fields was counted using a magnification of 2,000 for the SEM.

Each fibre identified on the filter was analysed by EDS. Table 1 below provides the speciation of each respirable fibre and the resulting fibre concentration of each of the samples.

The highest concentration of respirable fibres was at the LoD of 0.001 f/mL for some of the filters. The uncertainty in regards to the concentration would be high because

of the low number of fibres. The MFM says that if less than 10 fibres are counted the concentration is so low statistically that no concentration should be reported. In this case we have reported a concentration when there have been more than 4 fibres, but the uncertainty would be high.

The analysis sheet for each of the filters can be found in the Appendix.

Table 1: Concentration of respirable fibres on filters

Sample Number	Location of Sample	Fibres	Fields	Volume mL	Conc. f/mL Calculated	Conc. f/mL Reportable
C000258081 08-1410	49 Sch 4 Kingsholme	**4** Mica (x2) Quartz Halite	500	473280	<0.001	<0.001
C0048334 08-1398	Yatala	**8** Mica (x5) Halite Quartz (x2)	500	471410	<0.001	<0.001
C000258092 08-1410	Yatala	**4** Mica (x3) Actinolite	500	473280	<0.001	<0.001
C0048294 827571	49 Sch 4 Ormeau Hills	**3** Organic Chlorite Mica	500	482580	<0.001	<0.001
C0048299 08-1410	Field Blank	**0** No Fibres Detected	500	4930	N/A	N/A

Appendix: SEM's of Filters

Centre for Microscopy Characterisation and Analysis, The University of Western Australia
Air Filter / Bulk Sample SEM Analysis Report

Sample No. C000258081 08-1410 -Kingsholme Date 1/12/2016 Analyst Dr 49 Sch 4

Fields examined (0.01mm^2) / field @ x 2000

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

fibre	field	length (um)	width (um)	aspect ratio	major elements			minor elements			Mineral Name	spectrum ID
1	22	5	1		Si	Al		K	Mg	Fe	Mica	
2	324	6	1.2		Si	Al		K	Mg	Fe	Mica	
3	324	5	1.3		Si						Quartz	
4	464	5	1		Na	Cl					Halite	
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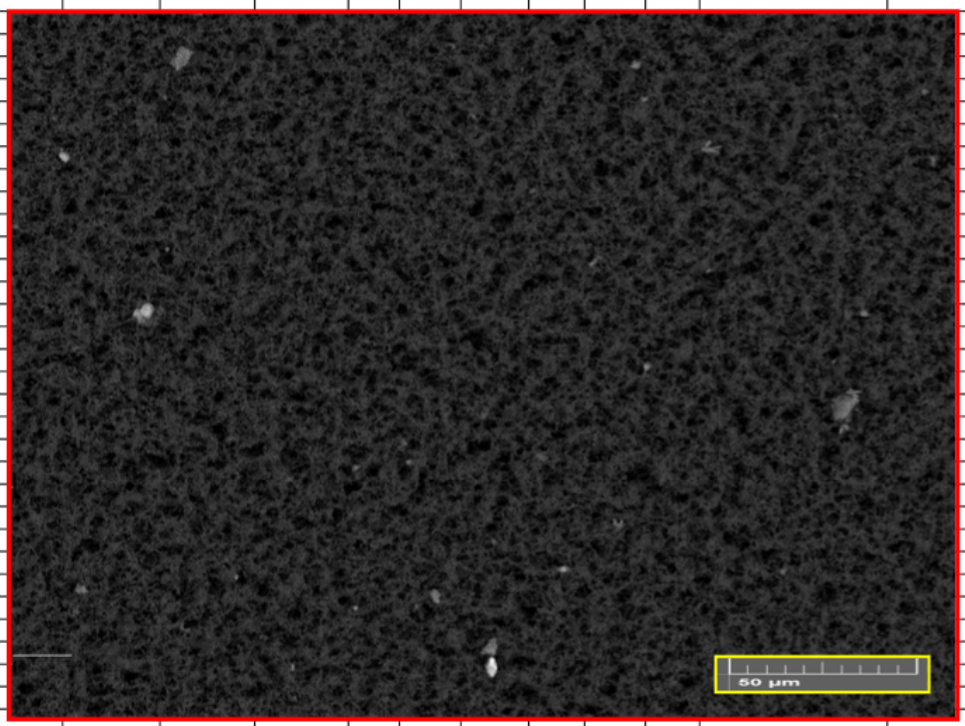

Comment:

Centre for Microscopy Characterisation and Analysis, The University of Western Australia
Air Filter / Bulk Sample SEM Analysis Report

Sample No. C0048334 08-1398 -Yatala Date 1/12/2016 Analyst Dr 49 Sch 4

Fields examined (0.01mm^2) / field @ x 2000

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

fibre	field	length (um)	width (um)	aspect ratio	major elements			minor elements			Mineral Name	spectrum ID
1	12	6	2		Si	Al		K	Mg	Fe	Mica	
2	87	5	1.5		Na	Cl					Halite	
3	130	5	0.7		Si						Quartz	
4	188	6	1.5		Si	Al		K	Mg	Fe	Mica	
5	246	5	1		Si	Al		K	Mg	Fe	Mica	
6	273	6	2		Si	Al		K	Mg	Fe	Mica	
7	484	5	1		Si	Al		K	Mg	Fe	Mica	
8	493	9	3		Si						Quartz	
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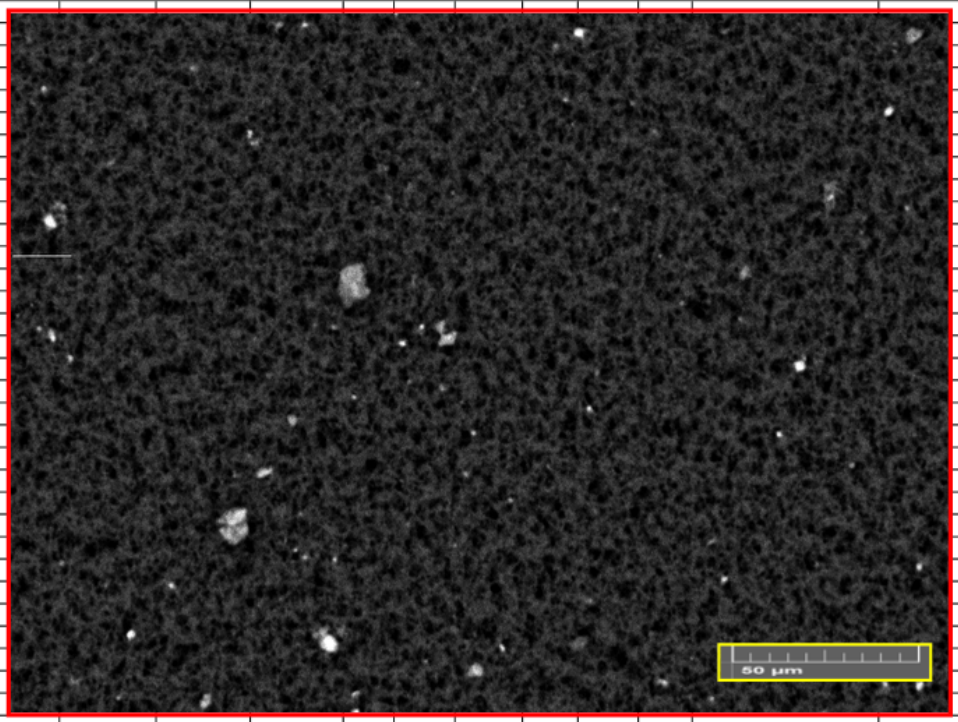

Comment:

Centre for Microscopy Characterisation and Analysis, The University of Western Australia
Air Filter / Bulk Sample SEM Analysis Report

Sample No. C000258092 08-1410 Yatala | Date 1/12/2016 | Analyst Dr 49 Sch 4

Fields examined (0.01mm^2) / field @ x 2000

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

fibre	field	length (um)	width (um)	aspect ratio	major elements			minor elements			Mineral Name	spectrum ID
1	181	7	1.2		Si	Al		K	Mg	Fe	Mica	
2	303	5	0.7		Si	Al		K	Mg	Fe	Mica	
3	339	5	1		Si	Al		K	Mg	Fe	Mica	
4	433	10	1.7		Si	Mg	Ca	Fe	Al	Fe	Actinolite	
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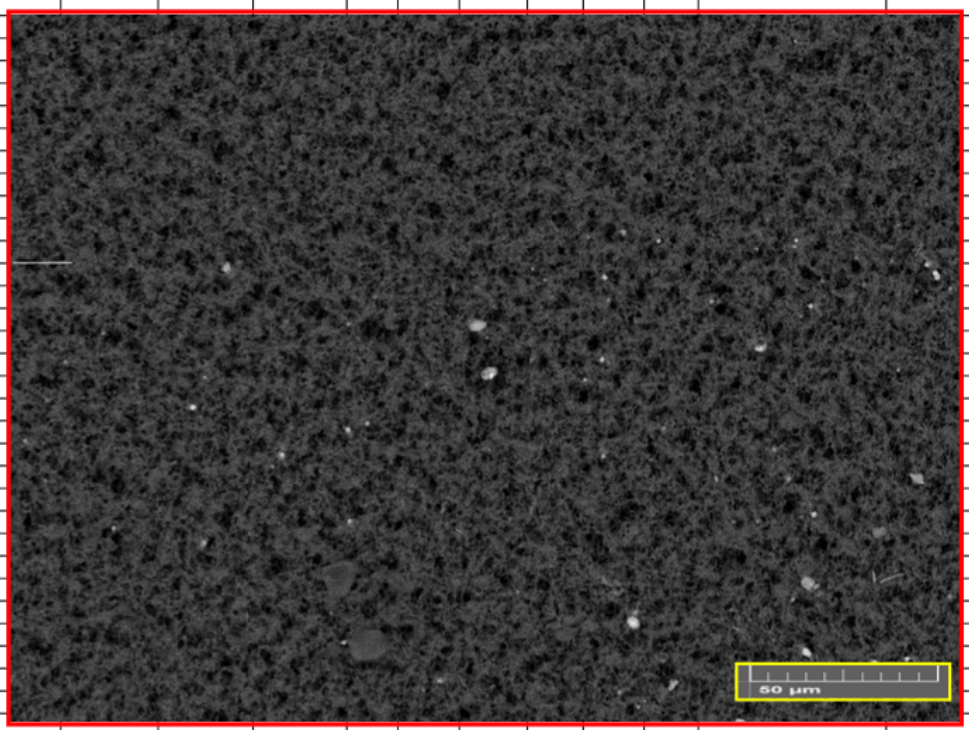

Comment:

Centre for Microscopy Characterisation and Analysis, The University of Western Australia
Air Filter / Bulk Sample SEM Analysis Report

Sample No. C0048294 827571 -Ormeau Hills | Date 2/12/2016 | Analyst Dr 49 Sch 4

Fields examined (0.01mm^2) / field @ x 2000

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

fibre	field	length (um)	width (um)	aspect ratio	major elements			minor elements			Mineral Name	spectrum ID
1	53	21	1								Organic	
2	429	11	2		Si	Al	Mg	Fe			Chlorite	
3	444	9	1.7		Si	Al		K	Mg	Fe	Mica	
4												
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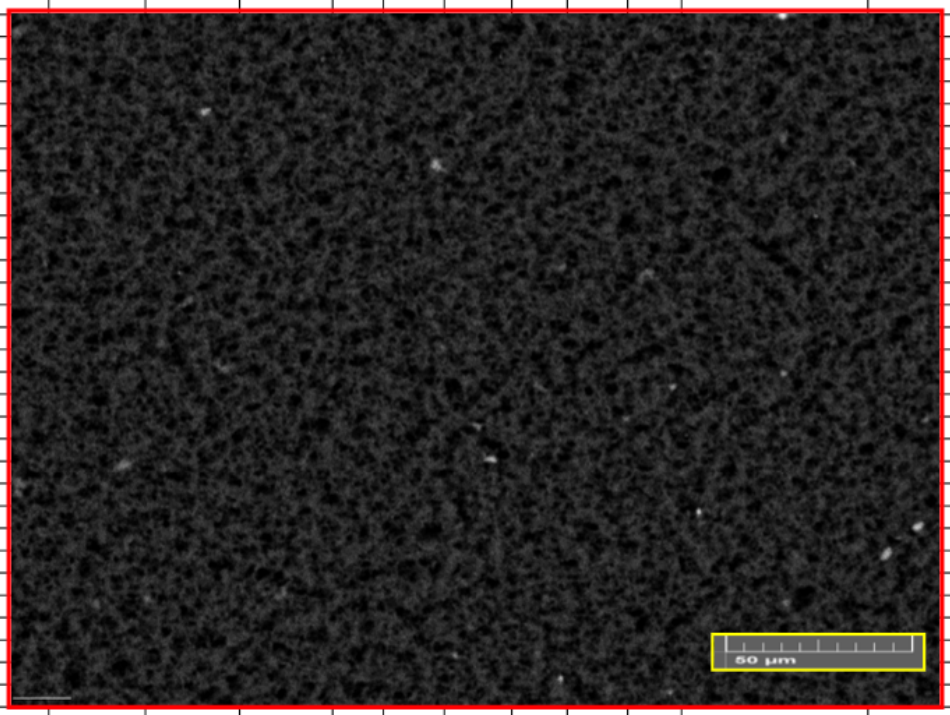

Comment:

Centre for Microscopy Characterisation and Analysis, The University of Western Australia
Air Filter / Bulk Sample SEM Analysis Report

Sample No. C0048299 08-1410 Field Blank | **Date 1/12/2016** | **Analyst Dr** 49 Sch 4

Fields examined (0.01mm^2) / field @ x 2000

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

fibre	field	length (um)	width (um)	aspect ratio	major elements	minor elements	Mineral Name	spectrum ID
1	No	Fibres	Detected					
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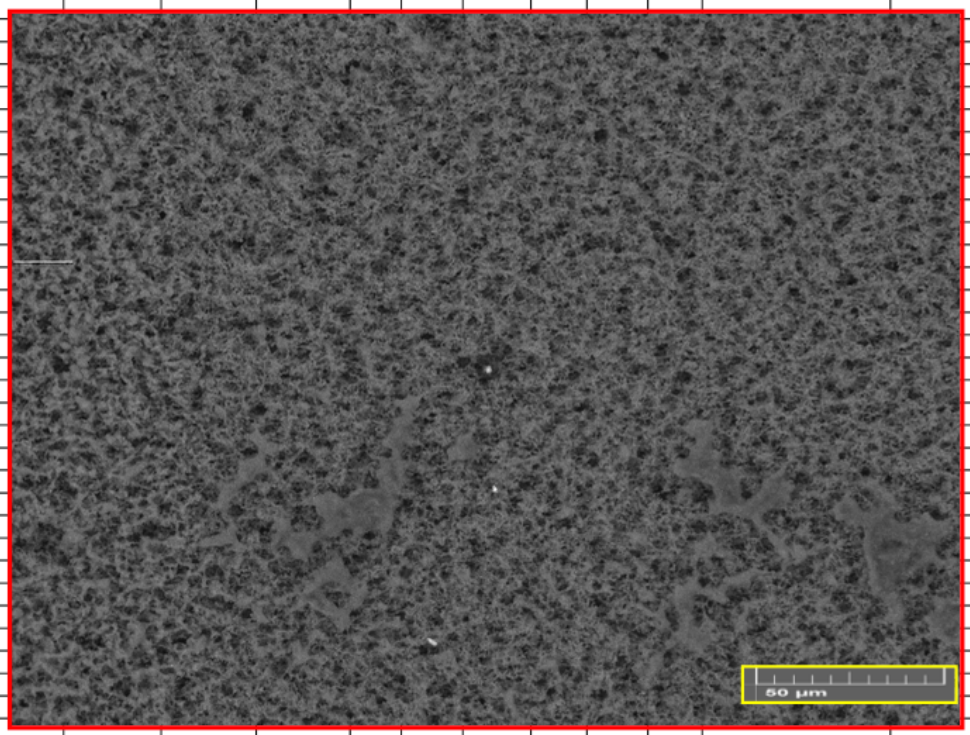

Comment:

COHLABS

Sample Submission Form

(for asbestos sample analysis)

Client:	**Science Delivery - Department of Science, Information Technology & Innovation**		
Contact:	**Steven Torr**	**Phone No.**	**(07) 31705488**
Address:	**Ecosciences Precinct**	**Fax No.**	
	41 Boggo Road	**Email:**	**steven.torr@dsiti.qld.gov.au**
	Dutton Park QLD 4102	**Order No.**	**PP-DSITI- 221015- MS –Rev A**

Site details (Please use separate submission forms for each site):
Yatala Quarry Investigation – Impacts to surrounding properties.

Total No. samples sent:	**7**	CLIENT USE 5 samples submitted	
Total No. samples received:		LAB USE ONLY	
Date samples collected:	**01.09.2016 – 15.11.2016**	**Date results required:**	**01/12/2016**

Sample locations:
49 Sch 4 **The Plateau, Ormeau Hills – C0048294**
Glen Osmond Road, Yatala – C0048334
Upper Ormeau Road, Kingsholme – C000258081
Enkleman Road, Yatala – C000258092
Field Blank – C0048299

Additional comments: ***Please analyse each sample for asbestos as per quote reference PP-DSITI- 221015- MS –Rev A***

PLEASE SEND SAMPLES TO:

COHLABS
PO Box 5324
West End QLD 4101

Or

Unit 6A, 15 Musgrave Street
West End QLD 4101

Tel: (07) 3015 7555
Email: enquiries@cohlabs.com.au

OFFICE USE ONLY
Job No.
Date Samples Received:
Samples Checked by:

Note: It is recommended that you photocopy this form and retain for your records

Department of Science, Information Technology and Innovation

SITE LOG SHEET AND CHAIN OF CUSTODY - PERSONAL SAMPLERS

Company: DSITI
Client Address: 41 BOGGO ROAD, DUTTON PARK
Client Contact:
Client Email:

Project/Site: FIELD BLANK - YATALA INVESTIGATION
Weather:
Sheet: 1

Site/ Location ID	Pump ID	Cowl/ Filter ID	Date On	Time On	Date Off	Time Off	Total Run Time (Min)	Rotameter ID	Initial Flow (L/Min)	Final Flow (L/Min)	Average Flow (L/Min)	Analysis Required	Comment
FIELD BLANK	–	C0048299	16/11/16	1000	16/11/16	1005	5	447	1.00	0.970	0.986	Yes	USED FOR CALIBRATION CHECKS
										= 4.93L	(volume)		

Sampled by:
Relinquished by: 49 Sch 2
Signature:
Date: 16/11/16 Time: 1300

Additional comments
Received by:
Signature:
Date: Time:

RTI page No. 17

Department of Science, Information Technology and Innovation

SITE LOG SHEET AND CHAIN OF CUSTODY - PERSONAL SAMPLERS

Company: 49 Sc
Client Address: [redacted] Glen Osmond road, Yatala
Client Contact:
Client Email:

Project/Site:
Weather:
Sheet: /

Site/ Location ID	Pump ID	Cowl/ Filter ID	Date On	Time On	Date Off	Time Off	Total Run Time (Min)	Rotameter ID	Initial Flow (L/Min)	Final Flow (L/Min)	Average Flow (L/Min)	Analysis Required	Comment
	081398	C0048334	11-10-16	12:54pm	11-10-16	9.00pm	488	140202	1.001	0.930	0.966	Yes	*Flow transfer standard kit 7
											V = 471.41		
Sampled by:	[redacted]						Additional comments		Sample bags kept upright in cool dry place.				
Relinquished by:	[redacted]						Received by:	[redacted]			[redacted]		16/11/16
Signature:	[redacted]						Signature:	[redacted]					
Date:	21/10/2016	Time:	10:19 am				Date:	21/10/2016	Time:	10:19			

RTI page No. 18

Department of Science, Information Technology and Innovation

SITE LOG SHEET AND CHAIN OF CUSTODY - PERSONAL SAMPLERS

Company:
Client Address: Enkleman Rd, 4212
Client Contact:
Client Email:

Project/Site:
Weather:
Sheet: /

Site/ Location ID	Pump ID	Cowl/ Filter ID	Date On	Time On	Date Off	Time Off	Total Run Time (Min)	Rotameter ID	Initial Flow (L/Min)	Final Flow (L/Min)	Average Flow (L/Min)	Analysis Required	Comment
Enkleman Rd.	08-1410	C000258092	6/9/2016	9:00am	6/9/2016	5:00pm	480	140202	1.1001	0.970	0.986	Yes	
													Refer below
Refer below													
												V = 473.28	

Sampled by:
Relinquished by:
Signature:
Date: 9/9/2016 Time:

Additional comments: Flow Transfer Standard kit 7 used for final checks 16/11/16 EO.
Received by:
Signature:
Date: 9/9/16 Time: 12.35pm

49 Sch 4

As there is not adequate provision for the full description under the site Location & the Comments columns, please refer to the attached 2 pages titled "Comments attachment to DSITI Log sheet for dust sample taken 6/9/2016".

RTI page No. 19

Department of Science, Information Technology and Innovation

SITE LOG SHEET AND CHAIN OF CUSTODY - PERSONAL SAMPLERS

Company: [redacted]
Client Address: [redacted] Ormeau Hills
Client Contact:
Client Email:

Project/Site: *
Weather:
Sheet: /

Site/ Location ID	Pump ID	Cowl/ Filter ID	Date On *	Time On *	Date Off *	Time Off *	Total Run Time (Min) *	Rotameter ID	Initial Flow (L/Min)	Final Flow (L/Min)	Average Flow (L/Min)	Analysis Required	Comment *
[redacted]	827571	C0048294	9-11-16	0915 AM	9-11-16 E.O. 16/11/16	5.20 PM.	4285 E.O. 16/11/16	140202	1.009	~~1.000~~ 0.980	0.995	Yes	
									~~1.000~~ E.O. 16/11/16				
											V = 482.58		

Sampled by:	[redacted]			Additional comments	Flow transfer Standard kit 7 used for final flow checks. E.O.		
Relinquished by:				Received by:	[redacted]		
Signature:				Signature:	[redacted]		
Date:	15/11/16	Time:	11:50	Date:	15/11/16	Time:	11:30 am

Department of Science, Information Technology and Innovation

SITE LOG SHEET AND CHAIN OF CUSTODY - PERSONAL SAMPLERS

Company:
Client Address: Upper Ormeau Rd, Kingsholme
Client Contact:
Client Email:

Project/Site:
Weather:
Sheet: /

Site/ Location ID	Pump ID	Cowl/ Filter ID	Date On	Time On	Date Off	Time Off	Total Run Time (Min)	~~Rotameter ID~~ (KIT 7)	Initial Flow (L/Min)	Final Flow (L/Min)	Average Flow (L/Min)	Analysis Required	Comment /observations ie wind
	08-1410	~~827302~~	26-10-16	9-30	26-10-16	5-30	480	C000	1.001	0.970	0.986	Flow Transfer Std.	→ Yes
	C000	258081						255051				↳ Yes	
											V = 473.28		

Sampled by:		Additional comments			
Relinquished by:	49 Sch 4	Received by:			
Signature:		Signature:			
Date:	26-10-16 Time:	Date:	26-10-16	Time:	26/11/16

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