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VOC MONITORING ADJACENT TO AN OLD LANDFILL SITE IN NEWCASTLE WEST, CO. LIMERICK

Technical Report Prepared For

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Technical Report Prepared By

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Our Reference

SM/13/6663AR01

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Signature		
Name	Sean McMahon	Dr. Edward Porter
Title	Environmental Consultant	Director
Date	26/07/13	26/07/13

EXECUTIVE SUMMARY

AWN Consulting was commissioned by John Dillon of Tobin Consulting Engineers to carry out volatile organic compounds (VOCs) monitoring at five locations adjacent to an old landfill in Newcastle West, Co. Limerick. Active monitoring over a 2 hour period was carried out at each location and passive monitoring over a 30 day period was carried out at three of the five locations.

Council Directive 2008/50/EC has set a benzene ambient air quality standard of 5 μg/m^3 as an annual mean. Benzene concentrations over the 30 day sampling period were found to exceed this annual mean ambient air quality standard at Location 1 and Location 2. The concentration of benzene at Location 1 was 60 μg/m^3 which is 1200% of the ambient mean air quality standard. The concentration of benzene at Location 2 was 5.9 μg/m^3 which 118% of the ambient mean air quality standard. Extended monitoring over a longer period would be required in order to determine compliance with the annual mean air quality standard for benzene at both Location 1 and Location 2.

With regards to all other VOCs assessed and all other sampling locations, measured levels of VOCs were below the respective Environmental Assessment Levels over both the short-term and long-term sampling periods.

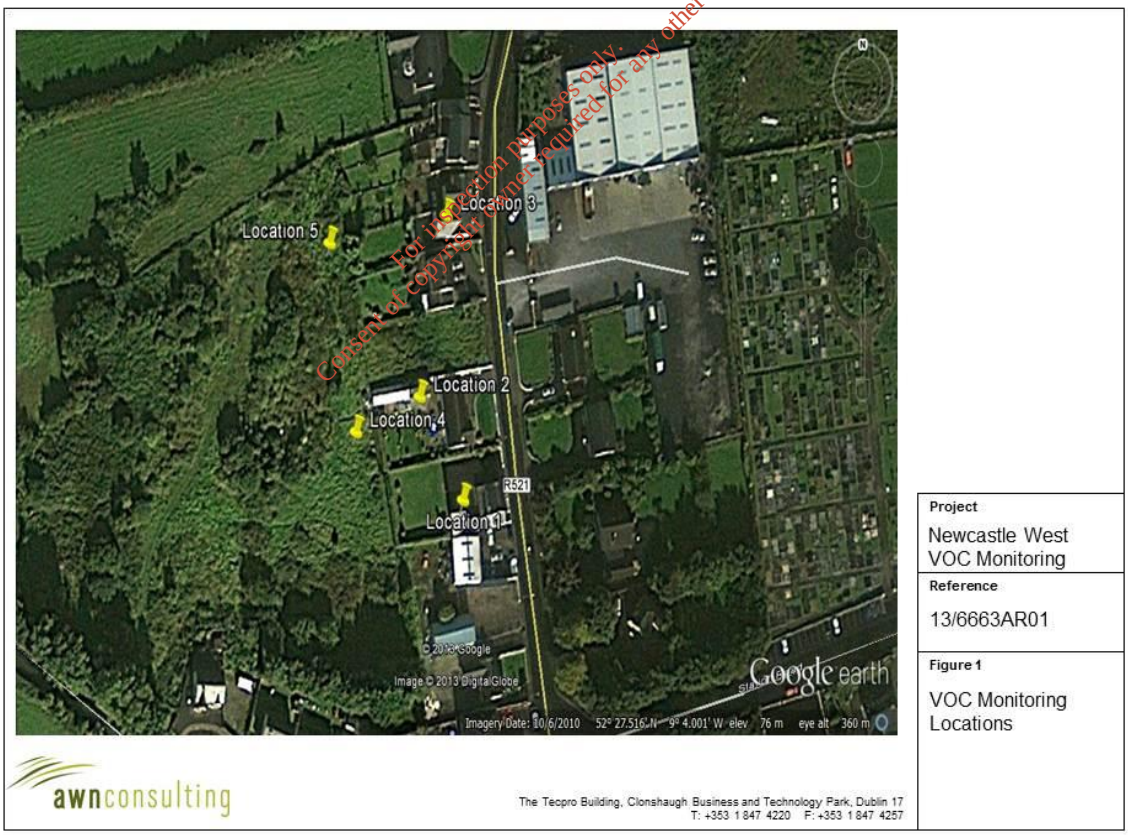
CONTENTS

1.0 INTRODUCTION

AWN Consulting were commissioned by John Dillon of Tobin Consulting Engineers to carry out VOC monitoring at five locations adjacent to an old landfill site in Newcastle West, Co. Limerick. Active monitoring over a 2 hour period was carried out at each location and passive monitoring over a 30 day period was carried out at three of the locations. Active monitoring was carried out on the 04/06/13 and passive monitoring was conducted between 04/06/13 – 04/07/13.

2.0 SAMPLING DETAILS

A survey for VOCs was carried out over a 30-day period at three locations adjacent to the old landfill site (locations 1-3), each of these locations were on residential property. Active monitoring was conducted over a two-hour period from approximately 1pm to 3pm at locations 1 -3. Passive monitoring was also undertaken at locations 1 – 3 and at two additional locations (locations 4 - 5) which were adjacent to two gas wells on the old landfill site. A map of the monitoring locations is shown in Figure 1. Details of the monitoring locations is outlined in Table 1.



Sampling Location	Details
Location 1	Garage on property of Paddy McCoy
Location 2	Garage on property of Gerry Sheehan
Location 3	Foinavon House
Location 4	Gas Well 1 (GW01)
Location 5	Gas Well 2 (GW02)

Table 1 Details of Monitoring Locations

3.0 MONITORING METHODOLOGY

3.1 VOCs

Monitoring for VOCs was carried out based on NIOSH Method 2549. Active sampling was carried out over a 2-hour period on 04/06/13 using SKC universal sampling pumps onto anasorb CSC coconut charcoal tubes at five static locations (locations 1 - 5). Sampling was undertaken at approximately 50 ml/min for 120 minutes giving a total volume sampled of 6 litrers which is the maximum volume outlined in NIOSH method 2549 in order to avoid overload of the adsorbent. These charcoal tubes were analysed at a UKAS accredited laboratory (ESG Laboratories, Staffordshire) using gas chromatography / mass spectrometry (GCMS). Passive Sampling was carried out over a 30-day period between 04/06/13 – 04/07/13 using ATD tubes at three static locations (locations 1-3).

Council Directive 2008/50/EC has set a benzene ambient air quality standard of 5 $\mu g/m^3$ as an annual mean to be complied with in the ambient environment.

However, no statutory air quality standards for the individual organic compounds exist in Irish legislation (except benzene). In the absence of statutory standards, it is common practice to reference other suitable authorities such as the World Health Organisation (WHO) or derive an ambient air quality guideline from occupational exposure limits (OEL).

Although the WHO has ambient air quality guidelines for a small range of volatile organic compounds, guidance has been issued by the UK Environment Agency entitled “IPPC Environmental Assessment and Appraisal of BAT” (Environment Agency, 2003) for an extensive range of organic compounds. The guidance outlines the approach for deriving both short-term and long-term environmental assessment levels (EAL). In relation to the long-term (annual) EAL, this can be derived by applying a factor of 100 to the 8-hour OEL. The factor of 100 allows for both the greater period of exposure and the greater sensitivity of the general population. For short-term (1-hour) exposure, the EAL is derived by applying a factor of 10 to the short term exposure limit (STEL). In this case, only the sensitivity of the general population needs be taken into account as there is no need for additional safety factors in terms of the period of exposure. Where STELs are not listed then a value of 3 times the 8-hour time weighted average occupational exposure limit may be used. No occupational exposure standards can be identified for certain compounds.

4.0 RESULTS

4.1 VOCs – Passive Monitoring.

Concentrations of a suite of VOCs measured over a 30-day sampling period at three locations between 04/06/13 – 04/07/13 are shown in Table 2 - 4.

The ESG analytical method used to determine ambient VOC levels in air considered a suite of 62 compounds comprising numerous VOCs, halogenated VOCs, alkanes and alkenes. Appendix 2 contains the ESG Laboratory report presenting the laboratory results for the full suite of VOCs considered during the analytical determination.

The long term environment assessment levels (EALs) for air (for the protection of human health) for each compound detected in the VOC suite, as set by the IPPC Horizontal Guidance Note for Environmental Assessment and Appraisal of BAT, are presented in Tables 2 - 4. The majority of the 62 compounds in the suite were not detected (see Appendix 2). A small number of the detected compounds do not have a corresponding long term EAL and thus have been excluded from the results.

21 of the 62 compounds in the VOC suite were detected at Location 1. 16 of the 21 detected VOCs are presented here as there are no established long term EALs for 5 of the VOCs detected at this location. Excluding benzene, the measured concentrations for these compounds were lower than their associated EALs (as shown in Table 2). Of those compounds detected, individual concentrations reached at most 37% of their limit values (for toulene). However, with regards to benzene, the measured concentration for this compound exceeded the ambient air quality standard for benzene, reaching 1200% of the annual limit value.

16 of the 62 compounds in the VOC suite were detected at Location 2. 13 of the 16 detected VOCs are presented here as there are no established long term EALs for 3 of the VOCs detected at this location. Excluding benzene, the measured concentrations for these compounds were lower than their associated EALs (as shown in Table 3). Of those compounds detected, individual concentrations reached at most 5% of their limit values (for toulene). However, with regards to benzene, the measured concentration for this compound exceeded the ambient air quality standard for benzene, reaching 118% of the annual limit value.

17 of the 62 compounds in the VOC suite were detected at Location 3. 13 of the 17 detected VOCs are presented here as there are no established long term EALs for 4 of the VOCs detected at this location. The measured concentrations for these compounds were lower than their associated EALs (as shown in Table 4). Of those compounds detected, individual concentrations reached at most 1% of their limit values (for toulene).

In summary, the results show that at two locations benzene was measured over a 30 day period at an ambient concentration in excess of the annual mean ambient air quality standard for benzene. This occurred at Location 1 and Location 2 where the levels of benzene reached 1200% and 118% respectively of the ambient air quality standard for benzene. Extended monitoring over a longer period would be required in order to determine compliance with the annual mean air quality standard for benzene at both Location 1 and Location 2.

Parameter	Concentration (µg/m^3)	Long Term EAL (µg/m^3)	Percentage of EAL (%)
Propan-2-ol	3.4	9,990	0.03%
n-Pentane	23.9	30,000	0.08%
n-Hexane	24.5	720	3.4%
n-Heptane	24.9	20,850	0.12%
n-Octane	11.2	14,500	0.08%
n-Nonane	38.5	10,500	0.37%
Dichloromethane	11.4	700	1.6%
Benzene	60.0	5	**1200%**
Toulene	703.6	1,910	36.8%
Ethylbenzene	82.4	4,410	1.9%
m and p-Xylene	406.4	4,410	9.2%
Styrene	4.5	800	0.57%
o-Xylene	150.5	4,410	3.4%
1,3,5-Trimethylbenzene	19.1	1,250	1.5%
1,2,4-Trimethylbenzene	65.2	1,250	5.2%
Naphthalene	4.4	530	0.84%

Table 2 Results of VOC Monitoring at Location 1 (Compounds above detection threshold only).

Parameter	Concentration (µg/m^3)	Long Term EAL (µg/m^3)	Percentage of EAL (%)
Propan-2-ol	2.4	9,990	0.02%
n-Hexane	7.1	720	0.99%
n-Heptane	3.8	20,850	0.02%
n-Octane	2.4	14,500	0.02%
n-Nonane	2.8	10,500	0.03%
Dichloromethane	7.5	700	1.07%
Benzene	5.9	5	**118%**
Toulene	86.9	1,910	4.6%
Ethylbenzene	5.2	4,410	0.12%
m and p-Xylene	27.1	4,410	0.61%
o-Xylene	9.0	4,410	0.2%
1,3,5-Trimethylbenzene	0.8	1,250	0.06%
1,2,4-Trimethylbenzene	2.2	1,250	0.18%

Table 3 Results of VOC Monitoring at Location 2 (Compounds above detection threshold only).

Parameter	Concentration (µg/m^3)	Long Term EAL (µg/m^3)	Percentage of EAL (%)
Propan-2-ol	1.9	9,990	0.02%
n-Hexane	4.3	720	0.6%
n-Heptane	1.0	20,850	0.005%
n-Nonane	2.8	10,500	0.03%
Dichloromethane	5.7	700	0.82%
Toulene	21.3	1,910	1.1%
Ethylbenzene	2.3	4,410	0.05%
m and p-Xylene	11.4	4,410	0.26%
Styrene	0.9	800	0.11%
o-Xylene	4.5	4,410	0.10%
1,3,5-Trimethylbenzene	0.8	1,250	0.06%
1,2,4-Trimethylbenzene	2.6	1,250	0.21%
Naphthalene	1.1	530	0.21%

Table 4 Results of VOC Monitoring at Location 3 (Compounds above detection threshold only).

4.2 VOCs – Active Monitoring

Concentrations of a suite of VOCs measured over a 2-hour sampling period at five locations on the 04/06/13 are shown in Table 5.

The ESG analytical method used to determine ambient VOC and hydrocarbon levels in air aimed to detect the top 20 most abundant analytes present on the tube. Appendix 3 contains the ESG Laboratory report presenting the laboratory results for detection of the top 20 most abundant VOCs present on the charcoal tubes.

The resulting concentrations from each of the sampled locations were all below the limit of detection.

Analytes	Location 1 Front (µg/m^3)	Location 1 Back-up (µg/m^3)
VOCs	<1225	<1225
	Location 2 Front (µg/m^3)	**Location 2 Back-up (µg/m^3)**
VOCs	<758	<758
	Location 3 Front (µg/m^3)	**Location 3 Back-up (µg/m^3)**
VOCs	<801	<801
	Location 4 Front (µg/m^3)	**Location 4 Back-up (µg/m^3)**
VOCs	<833	<833
	Location 5 Front (µg/m^3)	**Location 5 Back-up (µg/m^3)**
VOCs	<817	<817

Table 5 Results of Active VOC Monitoring at 5 locations

5.0 DISCUSSION

Council Directive 2008/50/EC has set a benzene ambient air quality standard of 5 μg/m^3 as an annual mean. Benzene concentrations over the 30 day sampling period were found to exceed this annual mean ambient air quality standard at Location 1 and Location 2. The concentration of benzene at Location 1 was 60 μg/m^3 which is 1200% of the ambient mean air quality standard. The concentration of benzene at Location 2 was 5.9 μg/m^3 which 118% of the ambient mean air quality standard. Extended monitoring over a longer period would be required in order to determine compliance with the annual mean air quality standard for benzene at both Location 1 and Location 2.

Environmental Assessment Levels (EALs) values have been set for a range of VOC compounds in order to provide a basis for ensuring the protection of human health in the ambient environment. With reference to Appendix D of the *IPPC Environmental Assessment and Appraisal of BAT*, the appropriate EAL, where available, has been applied for comparison with measured concentrations.

With regards to all other VOCs assessed and all other sampling locations, measured levels of VOCs were below the respective Environmental Assessment Levels over both the short-term and long-term sampling periods.

6.0 CONCLUSIONS

The concentration of benzene at Locations 1 and 2 was in excess of the annual mean ambient mean air quality standard for benzene. Extended monitoring over a longer period would be required in order to determine compliance with the annual mean air quality standard for benzene at both Location 1 and Location 2.

APPENDIX 1

SAMPLING AND ANALYSIS - METHODS AND DETAILS

A.1.1 Location of Sampling

R521 Churchtown Road,

Newcastle West,

Co. Limerick,

A.1.2 Date of Sampling

4th June 2013 – 4th July 2013

A.1.3 Personnel Present During Sampling

Sean McMahon, AWN Consulting

A.1.4 Personnel Involved in Analysis

Sean McMahon, AWN Consulting

Dr. Edward Porter, AWN Consulting

Environmental Scientifics Group Laboratories, Staffordshire

A.1.5 Instrumentation

SKC Universal Sampling Pumps

Multi-bed Sorbent Tubes

Anasorb CSC Coconut Charcoal Tubes

APPENDIX 2

LABORATORY RESULT SHEET (PASSIVE MONITORING)

Environmental Scientifics Group

ANALYSIS OF ATD TUBES FOR VOCs

Client:	Sean McMahon AWN Consulting The Tecpro Building IDA Business and Technology Park Clonshaugh Dublin 17
Testing Facility:	Environmental Scientifics Group Limited Specialist Chemistry Etwall House Bretby Business Park Ashby Rd Burton-on-Trent DE15 0YZ
Laboratory Reference:	ASC/10885
Customer Reference:	Newcastle West 13/6663
Samples Received:	08 July 2013
Sample Condition:	Good
Analysis Completed:	12 July 2013
Approved by:	M Mullard
Date:	17 JUL 13
Approver's name:	Marya Hubbard
Job Title:	Analyst
Report Date:	17 July 2013

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Test Report ASC/10885: Page 1 of 4

Introduction

Three ATD tubes were received for the analysis of VOCs. The samples were received in good condition and stored in a solvent free environment prior to analysis.

Laboratory Reference	Customer Reference	Tube ID	Analysis
ASC/10885.001	Paddy McCoy	Mi013263	VOC Suite
ASC/10885.002	Foinavon	Mi149808	VOC Suite
ASC/10885.003	Shed	Mi001705	VOC Suite

Experimental

Standard preparation and sample measurement was carried out according to UKAS accredited method ASC/SOP/210 Issue 2.
The samples were analysed by thermal desorption-gas chromatography-mass spectrometry on a Markes ATD and an Agilent GC-MS.
Before the samples were ran a calibration was generated for the compounds listed in Table 1. This allowed for positive identification and quantification of these compounds.
Please be aware that values close to the limit of detection (say within an order of magnitude) carry a high uncertainty. The overall uncertainty on those results significantly above the LOD, have been calculated to be ± 25%.
A Quality Control tube with known analyte loading was run with each sequence of samples.

Results

Table 1 shows the results for the amount of VOCs detected on tube (ng) for the samples.
Please note compounds marked with a ~ are not within the scope of our UKAS accreditation. Results which are over calibration range have been marked with a * and should be considered an estimate only. These results are not within the scope of our UKAS accreditation.
Any opinion and interpretation expressed in the report are outside the scope of UKAS accreditation.

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Table 1 – Amount of VOCs on tube for samples 001-003 (ng)

Compound	ASC/10885.001	ASC/10885.002	ASC/10885.003
	Mi013263	Mi149808	Mi001705
Ethanol	<10	<10	<10
Acetone	<10	<10	<10
Propan-2-ol	110	61	76
n-Propanol	<10	<10	<10
Ethyl Acetate	<10	<10	<10
n-Butanol	45	44	17
n-Pentane	640	<10	<10
n-Hexane	550	97	160
n-Heptane	480	20	74
n-Octane	190	<10	40
n-Nonane	580	42	43
n-Decane	2000*	54	94
~1,1-Dichloroethene~	<10	<10	<10
Dichloromethane	260	130	170
~Cis-1,2-dichloroethene~	<10	<10	<10
~1,1-Dichloroethane~	<10	<10	<10
Trans-1,2-dichloroethene	<10	<10	<10
~Bromochloromethane~	<10	<10	<10
Chloroform	<10	<10	<10
~2,2-Dichloropropane~	<10	<10	<10
1,2-Dichloroethane	<10	<10	<10
1,1,1-Trichloroethane	<10	<10	<10
~1,1-Dichloropropene~	<10	<10	<10
Benzene	520	<10	51
Carbon Tetrachloride	<10	<10	<10
Dibromomethane	<20	<20	<20
1,2-Dichloropropane	<10	<10	<10
Bromodichloromethane	<10	<10	<10
Trichloroethene	<10	<10	<10
Cis-1,3-dichloropropene	<20	<20	<20
~Trans-1,3-dichloropropene~	<10	<10	<10

~ Indicates compound results not included within UKAS accreditation.
***Results are over calibration and should be considered an estimate. These results are not included within UKAS accreditation.**

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Table 1 cont. – Amount of VOCs on tube for samples 001-003 (ng)

Compound	ASC/10885.001	ASC/10885.002	ASC/10885.003
	Mi013263	Mi149808	Mi001705
1,1,2-Trichloroethane	<10	<10	<10
Toluene	7600*	230	940
1,3-Dichloropropane	<10	<10	<10
Dibromochloromethane	<10	<10	<10
1,2-Dibromoethane	<20	<20	<20
Tetrachloroethene	<10	<10	<10
1,1,1,2-Tetrachloroethane	<10	<10	<10
Chlorobenzene	<10	<10	<10
Ethylbenzene	1500*	42	95
m and p-Xylene	5400*	151	360
Styrene	84	17	<10
o-Xylene	2000*	60	120
~1,2,3-Trichloropropane~	<10	<10	<10
Isopropylbenzene	<10	<10	<10
Bromobenzene	<30	<30	<30
2-Chlorotoluene	<10	<10	<10
n-Propylbenzene	220	13	11
4-Chlorotoluene	<10	<10	<10
1,3,5-Trimethylbenzene	410	17	17
tert-butylbenzene	<30	<10	<10
1,2,4-Trimethylbenzene	1400*	56	48
1,3-Dichlorobenzene	<20	<20	<20
1,4-Dichlorobenzene	<20	<20	<20
~sec-Butylbenzene~	44	<10	<10
p-Isopropyltoluene	44	12	<10
1,2-Dichlorobenzene	<20	<20	<20
n-Butylbenzene	<10	<10	<10
~1,2,4-Trichlorobenzene~	<20	<20	<20
Naphthalene	67	17	<10
~1,2,3-Trichlorobenzene~	<20	<20	<20
~Hexachlorobutadiene~	<20	<20	<20

~ Indicates compound results not included within UKAS accreditation.
*** Results are over calibration and should be considered an estimate. These results are not included within UKAS accreditation.**

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APPENDIX 3

LABORATORY RESULT SHEET (ACTIVE MONITORING)

Analysis of Charcoal Sorbent Tubes for Volatile Organic Compounds

Customer: Sean McMahon
AWN Consulting
The Tecpro Building
Clonshaugh Business and Technology Park
Dublin 17
Ireland

Testing Facility: Environmental Scientifics Group Limited
Specialist Chemistry
Etwall House
Bretby Business Park
Ashby Road
Burton upon Trent
Staffordshire
DE15 0YZ

Laboratory Reference: ASC/10908

Customer Reference: 13/6663 PO 248

Sample Received: 8th July 2013

Analysis Completed: 14th July 2013

Approved by:

Approver's name: Paul Walker

Job Title: Organic Team Leader

Report Date: 17th July 2013

Test Report: ASC/10908: Page 1 of 3

ESG Environmental Scientifics Group

Introduction

Five charcoal sorbent tubes were received requiring analysis for Volatile Organic Compounds (VOCs).

The tubes were received in good condition and were logged into our system upon receipt.

Samples Received

O/R	Y/R	Sample Description
ASC/10908.001	4504616779	Charcoal Sorbent Tube
ASC/10908.002	4504616776	Charcoal Sorbent Tube
ASC/10908.003	4504616780	Charcoal Sorbent Tube
ASC/10908.004	4504616778	Charcoal Sorbent Tube
ASC/10908.005	4504616774	Charcoal Sorbent Tube

Experimental

The samples were desorbed in Carbon Disulphide (CS_2) and analysed using Gas Chromatography Mass Spectrometry (GC/MS). The top twenty most abundant analytes were tentatively identified by mass spectral data and semi-quantified against the response of the internal standard (Tetradecane). Our detection limit for unknown compounds is in the region of 5ug/ml per analyte.

Results

The results for the samples are detailed in the following tables.

Results

Analytes	ASC/10908.001 4504616779 Front (ug)	ASC/10908.001 4504616779 Back-up (ug)
VOCs	<5	<5

Analytes	ASC/10908.002 4504616776 Front (ug)	ASC/10908.002 4504616776 Back-up (ug)
VOCs	<5	<5

Analytes	ASC/10908.003 4504616780 Front (ug)	ASC/10908.003 4504616780 Back-up (ug)
VOCs	<5	<5

Analytes	ASC/10908.004 4504616778 Front (ug)	ASC/10908.004 4504616778 Back-up (ug)
VOCs	<5	<5

Analytes	ASC/10908.005 4504616774 Front (ug)	ASC/10908.005 4504616774 Back-up (ug)
VOCs	<5	<5

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