Bioaerosol Sampling Report

Severn Trent Water

Derby Sludge Treatment Plant

26th May 2022

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Approval Sheet

Customer:	Severn Trent Water
Site:	Derby STW Derby Treatment Works Megaloughton Lane Derby DE21 7BR
Project title:	Bioaerosols Sampling
Project Manager:	E. Cracknell
Project Staff:	A. Hammersley, A. Lovell
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Issue	Status	Date	Prepared By	Signature	Date
1	Final	07/06/2022	A. Hammersley		07/06/2022
			Approved By	**Signature**	**Date**
			E. Cracknell		07/06/2022

Foreword

Enitial has used its best endeavours, experience and expertise to provide a meaningful, accurate and relevant representation of the works carried out. The works were based on a defined programme and scope of works and terms and conditions agreed with the Client.

enitial cannot accept responsibility to any parties whatsoever, following the issue of this report, for any matters arising which may be considered outside the agreed scope of works.

This report is issued solely to the Client. enitial does not accept any responsibility to any third parties to whom this report may be circulated, in part or in full, and any such parties rely on the contents at their own risk.

Contents

1.0 Scope of Work

Enitial was tasked with providing environmental Bioaerosol monitoring for Severn Trent Water at their Derby Sludge Treatment Plant.

Due to the potential health risks posed by the facility to nearby receptors, the testing was conducted to assess the amount of airborne bioaerosols being generated by the site that is released into the local environment. The monitoring is to ensure that this exposure is below the industry standard threshold set by the Environment Agency.

The work was carried out on 26th May 2022. This document is a presentation of the resulting data.

2.0 Background

The bioaerosol monitoring was specifically undertaken to enumerate the quantity of micro-organisms that can be cultured from representative samples of ambient air, collected at pre-determined monitoring points in the locality of the site.

The monitoring was undertaken in accordance with Environment Agency Technical Guidance Note (Monitoring) M9 – Environmental monitoring of bioaerosols at regulated facilities – July 2018 and Regulatory Position Statement (RPS) 209. Monitoring approach was undertaken after a Best Available Technique (BAT) analysis of the topography, wind direction and other site-specific factors to ensure a suitable site monitoring set up for sampling.

Pre-prepared agar sample plates for *Aspergillus fumigatus,* mesophilic micro-organisms (bacteria) were directly impacted with ambient air using an Andersen sampler at the four selected sampling locations.

In the UK no statutory limits have been set for ambient concentrations of bioaerosols. However, as per the Environment Agency Technical Guidance Note M17, guideline levels have been set for acceptable levels at sensitive receptors as the following:

- Total bacteria: 1000 cfu/m^3
- Aspergillus Fumigatus: 500 cfu/m^3

3.0 Methodology

3.1 Sampling Locations

Sample locations should be determined prior to the commencement of the sampling event where possible. Sampling should be carried out at a minimum of four separate locations as follows:

- Upwind location 001 - at least 25m upwind of the operational area and ideally 50m upwind of the operational of the site.

- Downwind location 002 – in line with the upwind location. This point should be the same distance from the operational area as is the distance from the operational area to the nearest sensitive receptor location.

- Downwind location 003 – 30 degrees to the left from the central point of site and downwind location 2. This point should be the same distance from the operational area as is the distance from the operational area to the nearest sensitive receptor location.

- Downwind location 004 – 30 degrees to the right from the central point of site and downwind location 2. This point should be the same distance from the operational area as is the distance from the operational area to the nearest sensitive receptor location.

The selection of appropriate locations should be made by consulting the site plan and in consultation with enitial's account manager, the Client and/or Site/Facility Manager. Upwind sampling should be performed concurrently with downwind locations or central downwind as a minimum where site topography/distance requires further spread. Locations can be adjusted if necessary if locations are unable to be used due to obstacles or health and safety issues as stated in the M9 document. Should a building, installation or structure intervene between the downwind site and the operational area, then sampling should be carried out upwind of that feature at a distance greater than twice its height.
Sensitive receptors will only be monitored if deemed appropriate by the operator or by requirement through permits and/or public officials.

3.2 Agar Plates

Following the Regulatory Position Statement (RPS) 209, the following sampling media was used. The types of Agar used were:

Mesophilic micro-organisms: (Total Viable Count [TVC]) – Half Strength Nutrient Agar (also known as 93's – white in colour)

Aspergillus Fumigatus / Total Fungi: (colony-forming unit [cfu]) – Malt Extract Agar (also known as 94's – light yellow in colour)

The impacted agar plates were subsequently delivered to a specialist laboratory within 24 hours via a cool box with ice packs where they were cultured and enumerated.

3.3 Equipment

3.31 List of Equipment

The equipment used is as follows:

- Continuous operation mobile weather station (wind speed, direction, temperature, humidity) and tripod
- Digital stopwatch
- GPS device
- 4 x single-stage Andersen samplers
- 4 x tripods
- 4 x hemicylindrical baffles
- 4 x stoppers for Andersen samplers
- 4 x fully charged vacuum pumps (individual capacity of at least 35l per min) and connecting tubing
- Rotameter to fit vacuum pump
- Agar plates – variety dependent on required test
- 2 x sealable airtight sterile plastic containers
- Cool box with ice packs for transport
- 70% v/v aqueous solution / wipes of ethanol or industrial methylated spirits cleaning solution or other suitable disinfectants

3.32 Cleaning of Equipment

All parts of the sampling equipment that were in contact with the samples, work surfaces or storage containers were cleaned with a 70% aqueous solution or wipes of ethanol or methylated spirits, or other suitable disinfectants prior to use. Equipment was completely dried, through air drying before the sampling exercise was commenced.

On completion of cleaning the Andersen single-stage samplers, a stopper was placed in the cone entrance to stop any contamination occurring before the sampling event.

3.33 Setup and Operation

- The pumps were Pre-run for a specified time at the required flow rate of 28.3l/min (±2%). This pump test was undertaken once before the start of the monitoring exercise.
- The Andersen single-stage samplers were mounted on to the tripods securely at a height of 1.5-1.8m above ground and the baffles were fitted on the tripod to form a rear shield when aligned to the desired sampling direction.
- The vacuum pump was connected to the rotameter using an appropriate length and diameter of the tubing. Using the rotameter, the flow rate was adjusted to ensure it is running at a constant flow of 28.3l/min (±2%) for each pump.
- On completion of the pump test, the tubing from the dry gas flow meters was disconnected from the rotameter then connected to the inlet on the corresponding Andersen single-stage sampler.
- Fresh sample plates were installed in turn by removing the lid and being placed within the Andersen single-stage sampler
- The stoppers in the inlet of the Andersen single-stage samplers were removed.
- When the Andersen single-stage samplers were fitted with plates the vacuum pumps were activated and the start time recorded on the stopwatch or pump timer. All pumps were switched on/off at the same time or at a maximum interval of up to 10% of the total run time.
- When the sample duration was completed the pumps were stopped and the finish time recorded.
- The plates were carefully removed ensuring that no contact was made with the exposed agar surface,
- The dish cover was replaced on to the plate and secured with masking tape.
- Each plate was placed into an individual plastic bag and sealed.
- The plates were stored in an upright, protective and cooled container and transported to the laboratory within 24 hours.
- Control blank samples were taken at the site. The steps stated above were adhered to however the sample pump was not switched on. One of each sample media was

inserted within the Andersen single-stage samplers, left in for the same period of sampling time, then packaged.

- Field blank samples were taken. The sample media were placed in re-sealable packaging without being opened.

The impacted agar plates were subsequently delivered to a specialist laboratory via a cool box with an ice pack. The analysis took place within 24 hours from sample collection

4.0 Presentation of Data

The following pages consist of meteorological conditions found on site, a presentation of the estimated concentrations of airborne micro-organisms, a plan displaying sample locations and the laboratory data.

4.1 Field Sampling Report

Site: Derby Sludge Treatment Plant

Site Operator: Severn Trent Water

Date: 26th May 2022

Start Time: 09:00
Finish Time: 12:00

Monitoring Technician ID: A. Hammersley, A Lovell

4.11 Meteorological Conditions

Table 1: Weather Conditions

Parameter	Wind Direction	Wind Speed (m/s)	Pressure (mb)	Temperature (°C)	Cloud Cover (0-8)
Start	WSW	6.2	1018	15	8
Finish	WSW	6.6	1018	15	8

4.12 Site Description

Derby Sludge Treatment Plant is located as part of a sewage treatment works approximately one mile south of Spondon in the county of Derbyshire.

The Sludge Treatment Plant was under normal operations during the sampling period.

4.2 Field Sampling Comments

Samples were taken at an upwind and three downwind locations (photographs of locations are presented in *Appendix C*) using Andersen samplers. Ambient air samples were collected by the technique of direct impaction, where a known quantity of air was directed onto an agar plate. The agar samples were then cultured and counted by a specialist laboratory. The count result provides a quantification of the potential health risks posed by the facility to nearby receptors.

An aerial plan of sampling locations is presented in *Appendix A*

Upwind Location:

- Upwind sample location 001 was located on a gravel area by the gas plant at the rear of the AD plant. Thick vegetation was noted nearby.

Downwind Locations:

- Downwind location 002 was located on a grass area east of the sludge plant between a river and storm tanks.
- Downwind location 003 was located on a grass area east of the sludge plant near a river and vegetation.
- Downwind location 004 was located on a grass area east of the sludge plant between a river and storm tanks.

A distinct sewage odour was detected at the downwind locations. The three downwind samples were set up as far apart as possible to achieve a 30° (+-3°) angle from the upwind/downwind axis.

4.3 Deviations from Methods

The locations were assessed to take into account the effect of features and obstructions which may impact the effectiveness of the monitoring. The sampling locations were restricted to where safe physical access was possible along with being legally accessible. (See the enclosed annotated image presented in *Appendix A*)

- Upwind location restricted by site infrastructure and thick vegetation.
- Downwind locations slightly restricted by a river and thick vegetation.

Downwind locations were placed in areas where restrictions of infrastructure and boundary fences allowed enough space for the monitoring equipment to be deployed. Deviation of monitoring time was made to achieve suitable sample location points; Upwind 001 and downwind 002 ran simultaneously and Downwind 003 and 004 ran simultaneously. This was to achieve the required distance and spread of the downwind samples while overcoming access restrictions as per stated in the M9 documentation.

4.4 Field Sampling Record

Table 2: Field Sampling Results

Ambient Sampling: Estimated concentration of bioaerosols								
Site: Deeby Sampling Date: 26/05/2022 Estimated Mass of Materials: Unknown Activities affecting the concentration of Bioaerosols: Exposed sludge cake, sewage/ sludge treatment processes				Site Operator: Severn Trent Water Monitoring Contractor: Enitial Type of Materials Processed on Site: Sewage and Sludge Site Activity: Normal Operations				
Location and grid reference	Sample reference number	Distance from centre of active area (m)	Difference in bearing between location of samplers and mean direction wind blows to (°)	Sampling start/end times (HH:MM)	Concentration of bioaerosols (CFU/m³) **Total Count (TVC)**	Concentration of bioaerosols (CFU/m³) **Aspergillus Fumigatus (YM)**	Median of samples (CFU/m³)	
							TVC	**YM**
Upwind (1) SK 38658 34821	DE001BIOAEM. Upwind location on a gravel area by the gas plant at the rear of the AD plant on	192m	226°	10:34-10:49	112	-	168	<7
				10:34-10:49	-	<7		
				10:41-10:46	168	-		
				10:41-10:46	-	<7		
				10:48-10:53	168	-		
				10:48-10:53	-	<7		

Location and grid reference	Sample reference number	Distance from centre of active area (m)	Difference in bearing between location of samplers and mean direction wind blows to (°)	Sampling start/end times (HH:MM)	Concentration of bioaerosols (CFU/m³) **Total Count (TVC)**	Concentration of bioaerosols (CFU/m³) **Aspergillus Fumigatus (YM)**	Median of samples (CFU/m³)	
							TVC	**YM**
Downwind (2) SK 39041 34780	DE002BIOAEM. Centre downwind location on grass area east of the sludge plant between a river and storm tanks.	228m	13°	10:34-10:49	63	-	63	<7
				10:34-10:49	-	<7		
				10:41-10:46	49	-		
				10:41-10:46	-	<7		
				10:48-10:53	112	-		
				10:48-10:53	-	<7		
Downwind (3) SK 39043 34846	DE003BIOAEM Left downwind location on grass area east of the sludge plant near a river.	258m	11°	11:18-11:23	2352	-	952	<7
				11:18-11:23	-	<7		
				11:25-11:30	952	-		
				11:25-11:30	-	<7		
				11:32-11:37	210	-		
				11:32-11:37	-	<7		

	Sample reference number	Distance from centre of active area (m)	Difference in bearing between location of samplers and mean direction wind blows to (°)	Sampling start/end times (HH:MM)	Concentration of bioaerosols (CFU/m³) **Total Count (TVC)**	Concentration of bioaerosols (CFU/m³) **Aspergillus Fumigatus (YM)**	Median of samples (CFU/m³)	
							TVC	**YM**
Downwind (4) SK 39075 34682	DE004BIOAEM Right downwind location on grass area east of the sludge plant between a river and storm tanks.	259m	38°	11:18-11:23	98	-	98	<7
				11:18-11:23	-	<7		
				11:25-11:30	133	-		
				11:25-11:30	-	<7		
				11:32-11:37	91	-		
				11:32-11:37	-	<7		
Control	DEControlBIOAEM At same location as Upwind	N/A	N/A	N/A	<1	-	N/A	
					-	<1		
Field	DEFieldBIOAEM Not removed from package. For QA/QC	N/A	N/A	N/A	<1	-	N/A	
					-	<1		

4.5 Process Contribution Results

The median is routinely used for statistics and probability theory as the results are less likely to be skewed by extremely high or low values that are not representative of the data set. The median is located by finding the middle value by evenly separating the data set. The median for each location has been calculated and then the highest result for the downwind locations identified. The process contribution has then been calculated by subtracting the upwind median value from the highest downwind median value. The process contribution shows the input the activity of the site has on the ambient bioaerosols concentrations. In the table below the process contribution is shown.

Table 3: Process Contribution Results

Process Contribution Results			
Sample Type	**Upwind Median Results**	**Downwind Median Highest Results**	**Process Contribution**
Total Bacteria viable Count (TVC)	168	952	**784**
Aspergillus fumigatus (YM)	<7	<7	**0**

5.0 Summary of Analytical Results

The above report indicates that at the time of sampling:

1. Mesophilic micro-organisms - Total Viable Count (TVC) shows higher readings at the downwind locations compared to the upwind location.

2. Aspergillus Fumigatus readings were not detected at either upwind or downwind locations.

3. Upwind location median results remained below the industry standard threshold values of 1000cfu/m^3 for Total Bacteria.

4. The downwind location median process contribution results of **784cfu/m^3** were 21.6% below the industry standard threshold values of 1000cfu/m^3 for Total Bacteria.

5. Upwind location median results remained below the industry standard threshold values of 500cfu/m^3 for Aspergillus Fumigatus.

6. Downwind location median process contribution results of **0cfu/m^3** remained 100% below the industry standard threshold values of 500cfu/m^3 for Aspergillus Fumigatus.

7. Control and Field blanks for QA/QC did not show any evidence of contamination.

APPENDIX A
Aerial Plan

Key

1 – Upwind

2 – Downwind Centre

3 – Downwind Left

4 – Downwind Right

Blue area – Emission source

Red Box – Site area

STW –Derby Sludge Treatment Plant 26/05/2022
Aerial Plan Showing Bioaerosol Sample Locations

Enitial part of Cawood

APPENDIX B
Meteorological Conditions

METEOROLOGICAL CONDITIONS

SITE:	Derby	SITE OPERATOR:	Severn Trent Water
SAMPLING DATE:	26/05/2022	COMMISSIONING LABORATORY:	Southern Microbiological Services
ESTIMATED MASS OF MATERIALS:	Unknown	TYPE OF MATERIALS PROCESSED ON SITE:	Sludge and Sewage

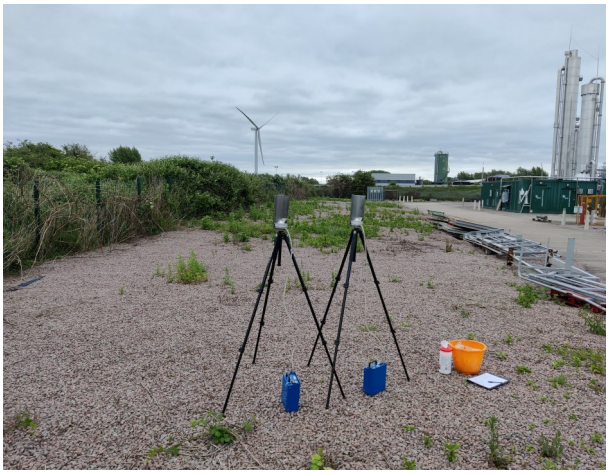
Location	Sample Reference Number	Bearing of samplers from boundary of operational area or turning/ screening operation (° from true north) - GPS	Mean direction the wind blows to during the sampling period (° from true north)	Difference in bearing between location of samples from boundary/ source and mean direction wind blows to (°)	Mean wind speed during sampling (m/s)	Arithmetic mean of air temperature (°C)	Arithmetic mean of relative humidity (%)
Upwind	DE001BIOAEM	293 SK 38658 34821	67	226	6.4	15	76.5
Downwind	DE002BIOAEM	80 SK 39041 34780	67	13	6.4	15	76.5
Downwind	DE003BIOAEM	56 SK 39043 34846	67	11	6.4	15	76.5
Downwind	DE004BIOAEM	105 SK 39075 34682	67	38	6.4	15	76.5

APPENDIX C
Photograph Sheet

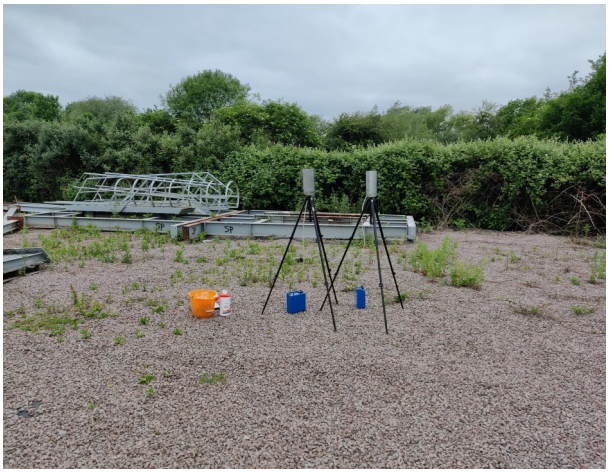
MONITORING PHOTOGRAPH RECORD

Site: STW Derby Sludge Treatment Plant **Date:** 26/05/2022

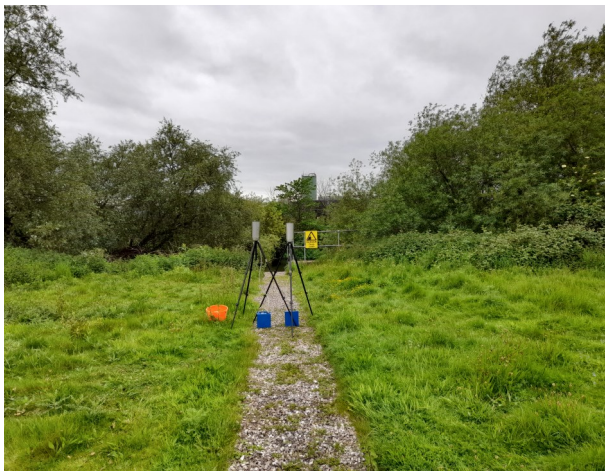
Title: Bioaerosol Sampling **Ref:** DE2605



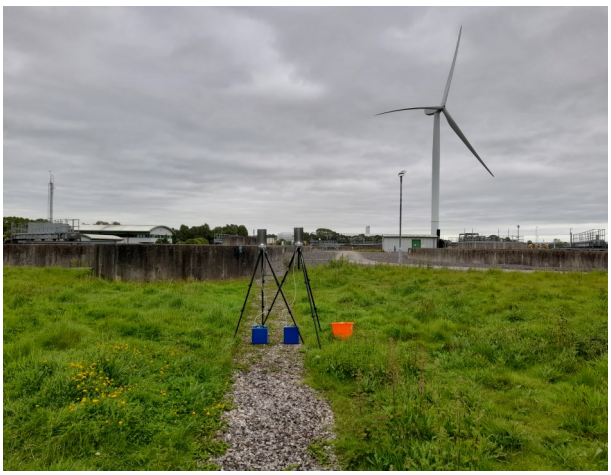
Upwind 001 location looking towards site



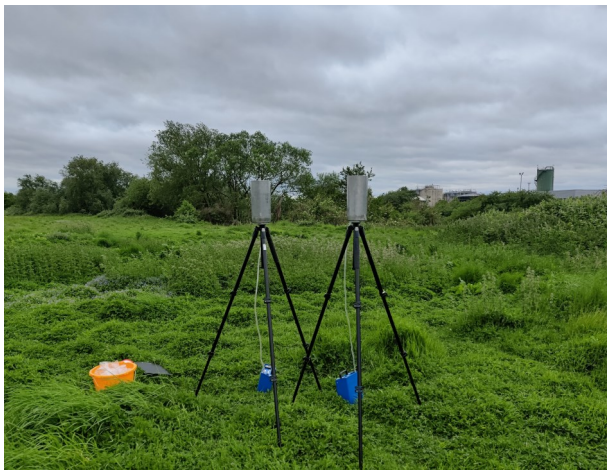
Upwind 001 location looking away from site



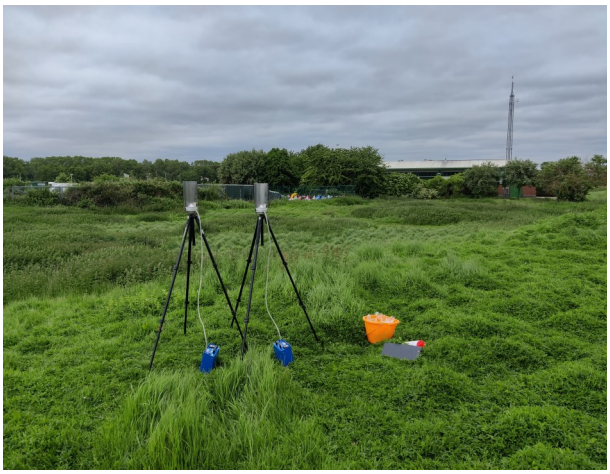
Downwind 002 location looking towards site



Downwind 002 location looking away from site



Downwind 003 location looking towards site

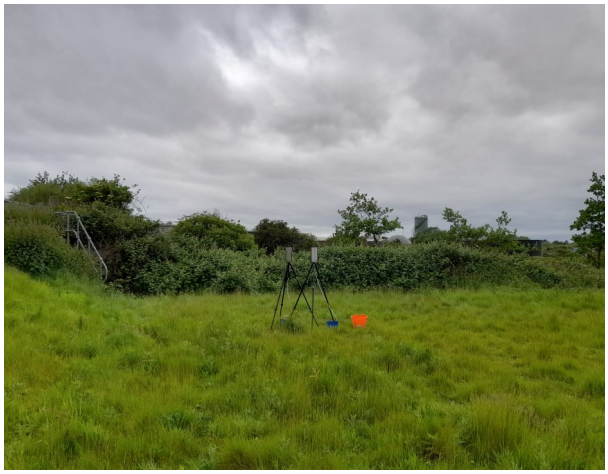


Downwind 003 location looking away from site

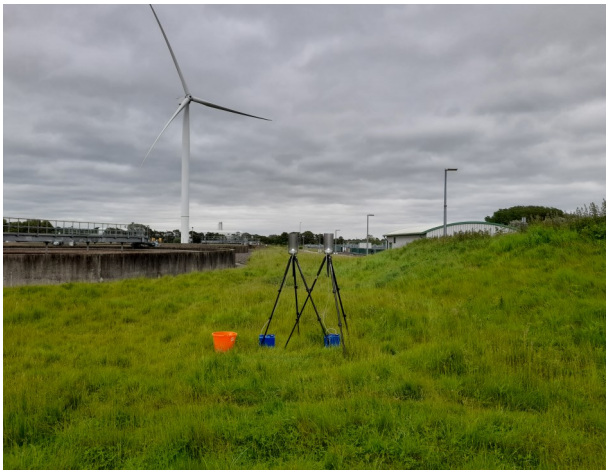
MONITORING PHOTOGRAPH RECORD

Site: STW Derby Sludge Treatment Plant **Date:** 26/05/2022

Title: Bioaerosol Sampling **Ref:** DE2605



Downwind 004 location looking towards site



Downwind 004 location looking away from site

APPENDIX D
Laboratory Certificate

SOUTHERN MICROBIOLOGICAL SERVICES LTD

Unit3, Georges Farm, West Buckland, Wellington, Somerset, TA21 9LE
Telephone: 01823 662062 Fax: 01823 660505
Email: laboratory@smslab.co.uk Website: www.smslab.co.uk

Enitial
Enterprise Drive
Four Ashes,
Wolverhampton
WV10 7DE

TEST REPORT

Report Reference: 1220504153
Date Reported: 30 May 2022

Enitial Anderson Plates Site: Derby Date: 26/05/22 PO: emailed

						*	*
SMS Reference	Date Tested	Sample Code	Sample Details	Ltrs of Air filtered	Further Details 2	*TVC cfu/m3 (2 day pr*	*Asp fumigatus cfu/m3*
1220525923	27/05/22	DE 001BIOAEM (93.)	---	140	---	112 cfu/m3	
1220525924	27/05/22	DE 001BIOAEM (94.)	---	140	---		< 7 cfu/m3
1220525925	27/05/22	DE 001BIOAEM (93.A)	---	140	---	168 cfu/m3	
1220525926	27/05/22	DE 001BIOAEM (94.A)	---	140	---		< 7 cfu/m3
1220525927	27/05/22	DE 001BIOAEM (93.B)	---	140	---	168 cfu/m3	
1220525928	27/05/22	DE 001BIOAEM (94.B)	---	140	---		< 7 cfu/m3

Enitial Anderson Plates Site: Derby Date: 26/05/22 PO: emailed

						*	*
SMS Reference	Date Tested	Sample Code	Sample Details	Ltrs of Air filtered	Further Details 2	*TVC cfu/m3 (2 day pr*	*Asp fumigatus cfu/m3*
1220525929	27/05/22	DE 002BIOAEM (93.)	---	140	---	63 cfu/m3	
1220525930	27/05/22	DE 002BIOAEM (94.)	---	140	---		< 7 cfu/m3
1220525931	27/05/22	DE 002BIOAEM (93.A)	---	140	---	49 cfu/m3	
1220525932	27/05/22	DE 002BIOAEM (94.A)	---	140	---		< 7 cfu/m3
1220525933	27/05/22	DE 002BIOAEM (93.B)	---	140	---	112 cfu/m3	
1220525934	27/05/22	DE 002BIOAEM (94.B)	---	140	---		< 7 cfu/m3
1220525935	27/05/22	DE 003BIOAEM (93.)	---	140	---	2352 cfu/m3	
1220525936	27/05/22	DE 003BIOAEM (94.)	---	140	---		< 7 cfu/m3
1220525937	27/05/22	DE 003BIOAEM (93.A)	---	140	---	952 cfu/m3	
1220525938	27/05/22	DE 003BIOAEM (94.A)	---	140	---		< 7 cfu/m3
1220525939	27/05/22	DE 003BIOAEM (93.B)	---	140	---	210 cfu/m3	
1220525940	27/05/22	DE 003BIOAEM (94.B)	---	140	---		< 7 cfu/m3

Enitial Anderson Plates Site: Derby Date: 26/05/22 PO: emailed

						*	*
SMS Reference	Date Tested	Sample Code	Sample Details	Ltrs of Air filtered	Further Details 2	*TVC cfu/m3 (2 day pr*	*Asp fumigatus cfu/m3*
1220525941	27/05/22	DE 004BIOAEM (93.)	---	140	---	98 cfu/m3	
1220525942	27/05/22	DE 004BIOAEM (94.)	---	140	---		< 7 cfu/m3
1220525943	27/05/22	DE 004BIOAEM (93.A)	---	140	---	133 cfu/m3	
1220525944	27/05/22	DE 004BIOAEM (94.A)	---	140	---		< 7 cfu/m3
1220525945	27/05/22	DE 004BIOAEM (93.B)	---	140	---	91 cfu/m3	
1220525946	27/05/22	DE 004BIOAEM (94.B)	---	140	---		< 7 cfu/m3

Unless otherwise indicated, all samples were received in good condition, tests were performed at the above address and results apply to the sample as received. Date tested equals date received.

Carol Macready
Technical Administration Manager

* Tests marked with a * in this report are not included in the UKAS Accreditation Schedule for our laboratory

SOUTHERN MICROBIOLOGICAL SERVICES LTD

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Telephone: 01823 662062 Fax: 01823 660505
Email: laboratory@smslab.co.uk Website: www.smslab.co.uk

Enitial
Enterprise Drive
Four Ashes,
Wolverhampton
WV10 7DE

TEST REPORT

Report Reference: 1220504154
Date Reported: 30 May 2022

Enitial Anderson Plates Controls Site: Derby Date: 26/05/22 PO: emailed

SMS Reference	Date Tested	Sample Code	Sample Details	Ltrs of Air filtered	Further Details 2	*TVC/plate*	*Asp. Fumigatus Plate*
1220525947	27/05/22	DE CONTROLBIO AEM (93-C)	---	---	---	< 1 cfu / plate	
1220525948	27/05/22	DE CONTROLBIO AEM (94-C)	---	---	---		< 1 cfu / plate
1220525949	27/05/22	DE FIELDBIOAEM (93-F)	---	---	---	< 1 cfu / plate	
1220525950	27/05/22	DE FIELDBIOAEM (94-F)	---	---	---		< 1 cfu / plate

Enitial Anderson Plates Controls Site: Derby Date: 26/05/22 PO: emailed

SMS Reference	Date Tested	Sample Code	Sample Details	Ltrs of Air filtered	Further Details 2	*TVC/plate*	*Asp. Fumigatus Plate*

Unless otherwise indicated, all samples were received in good condition, tests were performed at the above address and results apply to the sample as received. Date tested equals date received.

Carol Macready
Technical Administration Manager