Launders Lane

Technical Response: Proposal

Prepared for: Havering Borough Council

24/10/2022

1	Executive Summary		
2.	Understanding of the project objectives		Benefits Statement
			Provide an independent verification of air quality impacts associated from the Launders Lane land fill site fires.
3.	Methodology		Benefits Statement
			Confidence provided through a clear programme of works to deliver the monitoring requirements.
4.	Experience		Benefits Statement
			Provide confidence in our methodology and assurance in stakeholder reporting.
5.	Stake holder engagement		Benefits Statement
			To facilitate effective decision making, taking into account earlier engagement with stakeholders, consequently reducing the cost of inappropriate mitigation measures.
6.	Risk and Quality Management		Benefits Statement
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7.	Budget		Benefits Statement

EXECUTIVE SUMMARY

1 Executive Summary

The approach laid out in this proposal is designed to provide high quality data in a way to provide confidence to all parties involved.

Using a mixture of standard practices, direct fire monitoring experience, clear processes and risk mitigation, our proposal will deliver a clear understanding of the pollutants arising from the uncontrolled fires, the background levels, how these levels compare to UK air quality standards Limits (and World Health Organisation (WHO) where required), and who would be most likely to be impacted by these pollutants.

This information would be clearly presented in the report to be presented to the wider team of specialists on completion of the monitoring period. To aid with the public and stake holder engagement we will include reporting in both technical and graphical approached to allow for a wider audience.

The methodology includes details around monitoring locations, number of monitoring devices proposed to be used, schedule of work and responsible personnel.

We do understand that this project is likely to change, simply due to the uncontrolled nature of the fires, and to this end the plan can be reviewed and adapted at short notice to accommodate this.

Keys used throughout the document

CQ's	Clarification question
Criteria 1	Response to **Technical Question 1** of Evaluation Criteria for Workstream 2.2
Criteria 2	Response to **Technical Question 2** of Evaluation Criteria for Workstream 2.2
Criteria 3	Response to **Technical Question 3** of Evaluation Criteria for Workstream 2.2
Criteria 4	Response to **Technical Question 4** of Evaluation Criteria for Workstream 2.2

Understanding of the project objectives

2 Project objectives

Summary of Key Evidence Points

Clear understanding of the local situation, pollutants arising from fires and associated health impacts.

From our understanding of the provided documentation, conversations, wider research on the issue and experience, we have determined the following set of goals which our methodology will achieve.

Frequent and numerous fires (70 fire brigade callouts since 2018) at Arnolds Field, Launders Lane in the London Borough of Havering are a nuisance to the nearby residents of the Borough. In addition, the pollutants emitted into the air are causing risks to human health.

In order to identify and quantify the precise products of combustion produced by the fires at Arnolds Field we will monitor persistent organic pollutants (POPs) and metals (mercury) using the approach described in the methodology (Section 3 of the document). The monitoring programme will cover sampling of the air between and during one or more fires at locations close to residential properties, causing a long-term exposure to the airborne pollutants.

In 3.1.1 we propose that several monitoring locations are taken into consideration

- Sources (waste deposition, especially the new ones in the East side of the site),
- Pathway (we anticipate closer review of the local wind rose, therefore there might be some corrections when further information is available) and
- Receptors (residential properties).

2.1 Site Background

Arnolds Field, Launders Lane in the London Borough of Havering was formerly a gravel extraction site excavated between 1965 and 1967. Landfilling operations were undertaken from 1967 to 1971. No proper restoration works are recorded.

In 2000 planning permission for use as a community woodland by importation of further material was granted. Since then, approximately 2,016 significant volumes of waste have been deposited without appropriate authorisation.

No information on waste depth is available, however it can be up to 5 metres in places. There is no clear identification of waste recorded; however, it ranges from household, commercial / industrial (including wood, paper, glass, plastic, mattresses, furniture, cables, and fabric materials) and construction waste deposits.

The eastern boundary of the site appears to be the location of the most recent deposition of waste.

In 2012 a limited site investigation identified elevated levels of lead and benzo(a)pyrene were found in the soil.

Organic waste and combustible types of waste like plastic and overgrown grass led to 70 call outs by the local fire brigade since 2018. The majority of these were recorded when the weather was hot. The fires resulted in complaints from residents about smoke, dust, and odour.

The nearest residential properties are approximately 400 m from the boundaries of the site; however, complaints have been received from the residential properties up to 1km away.

2.2 Background knowledge

There are three established causes of landfill fires[1] and they are summarised below:

1. Spontaneous combustion: a buried heat source such as biological decomposition or chemical oxidation leads to a rise in temperature of the waste mass that cannot dissipate the heat faster than it is being produced; this is a process known as 'thermal runaway'. The life cycle of a landfill includes two periods of significant temperature rise which coincide with elevated oxygen levels and, during the first period, maximum settlement when the landfill mass is prone to collapse and further ingress of oxygen. Examples of this type of combustion would be a short-circuit of a batch of mercury cell batteries and cotton rags soaked in aluminium paint. Moreover, these examples would result in a release of metals, metals oxides and other products to air. Some other heavy metals such as lead, chromium or arsenic may also be released.
2. Piloted Ignition: this is where a source of fire is buried into the waste
3. Arson: this cause of combustion is easy to detect but difficult to prevent and prosecute, especially for uncontrolled sites.

Landfill fires are characterised as confined and unconfined. Confined fires happened between layers of waste, spread horizontally with little presence of oxygen resulting in formation of products of incomplete combustion (a reaction also known as pyrolysis). This causes incomplete reaction of organic compounds forming carbon monoxide, dioxins from PVC, hydrogen sulphide from gypsum drywall board etc.

Unconfined fire happens when pockets of construction and demolition waste are present with sufficient amounts of combustible materials; a vertical direction of fire is created causing a sinkhole at the surface, posing a particular risk for firefighters and to the general public.

The United Nations Environment Programme (UNEP) regards non-industrial, uncontrolled combustion, mainly comprised of landfill fires and illegal barrel burning as the most significant source of persistent organic pollutants (POPs) in the form of polychlorinated dibenzo-p-dioxins (PCCDs) and polychlorinated dibenzofurans (PCCFs) in Europe (Thornton, 2002). In addition to particulates of various sizes and nitrogen oxides, other gases include formaldehyde, hydrogen cyanide, hydrogen sulphide, etc.

No matter what the cause of fire, landfill fires fumes consist of a variety of organic compounds which are harmful to human health.

[1] Understanding landfill fires | WMW (waste-management-world.com)

Criteria 1

The WHO[2] and US EPA[3,4] employ Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of dioxin and dioxin-like compounds. Toxicological Prioritization Index (ToxPi) is another tool to calculate the impact of VOCs[5].

Chlorinated organic substances (Dioxins & furans (PCDDs and PCDFs) and Dioxin-Like Polychlorinated Biphenyls (PCB)) require certain conditions to form.

Dioxins and furans are formed from the interaction of hydrocarbons and chlorine-containing compounds at temperatures above 200°C. They are destroyed if heated above 450°C in the presence of excess air (oxygen). They are classified as persistent organic pollutants and have highly toxic potential to be absorbed into human tissue and stored in the body.

The optimum conditions for the formation of dioxins and furans are:

• Temperatures between 200°C and 450°C

• Limited oxygen from fuel or air, preventing oxidation

• The presence of chlorine (in particular chlorinated hydrocarbons), or other hydrocarbons present in plastic, paper and organic waste

• The presence of a catalyst such as:

- Fine particulate matter (smoke). Finer particles are particularly effective as they provide greater catalytic surface area.
- Metals such as copper
- Strong UV radiation (e.g. strong sunshine)

PCBs are aromatic chlorine compounds and are classified as persistent organic pollutants. They consist of a biphenyl structure with two linked benzene rings in which some or all of the hydrogen atoms have been substituted by chlorine atoms. They are synthetic and do not naturally occur in the environment.

PHBs are the most toxic chemicals posing health threat with no safe levels, they are cancerogenic and having an adverse effect to reproductive and immune systems, causing developmental problems and interfere with regulatory hormones[6]. Polychlorinated-p-dioxins (PCDDs) and the related furans (PCDFs) are complex chemicals containing chlorine. Several hundred chemicals referred/classified as PCB known. 2,3,7,8-tetrachloro-dibenzo-p-dioxin (also known as 2,3,7,8-TCDD) considered as the most toxic.

The types of substances described above do not occur naturally but are formed during combustion processes including landfill fires.

[2] There is a 2022 call for experts to update the 2005 WHO TEF for dioxin and dioxin-like compounds https://www.who.int/news-room/articles-detail/call-for-experts-who-initiative-to-update-the-2005-who-tef-for-dioxin-and-dioxin-like-compounds

[3] https://www.epa.gov/sites/default/files/2013-09/documents/hhtef_draft_090109.pdf

[4] Dioxin Toxicity Equivalency Factors (TEFs) for Human Health (epa.gov)

[5] Toxicological Priority Index (ToxPi) - A Framework to Guide Selection of Chemical Alternatives - NCBI Bookshelf (nih.gov)

[6] PII: S1385-8947(01)00228-5 (sciencedirectassets.com)

Chronic exposure of humans to these compounds causes a variety of actions including dermal toxicity (chloracne), immunotoxicity, reproductive effects and teratogenicity, endocrine disrupting effects and carcinogenicity (Van den Berg et al., 1998, WHO, 1998, ATSDR, 2002, Bencko, 2003). The main pathway of ingestion is via food contamination caused by landfills and is of great concern for public health[7].

Many emitted gases listed for monitoring are characterised as persistent organic pollutants with the majority being hydrophobic and lipophilic compounds exhibiting highly resistant to metabolism properties[8]. Their toxicity mediated through the aryl hydrocarbon receptor (AhR), a cytosolic receptor protein present in most vertebrate tissues with high affinity for 2,3,7,8-substituted PCDD/Fs and some non ortho substituted PCBs (Poland et al., 1985; Safe et al., 1985). Food consumption and exposure to the pollutants results in the uptake of many these compounds. As a result, humans retain dozens of PCB congeners in their tissues, blood, and milk (Schecter et al., 1994; Liem et al., 2000). Most PCDD and PCDF congeners with a 2,3,7,8 chlorine substitution pattern is also strongly retained (Van den Berg et al., 1994). Thus, risk assessment of these compounds involves a complex mixture of PCDD, PCDF and PCB compounds that are AhR agonists sharing a common mechanism of action and should not be done for only one specific congener".

The term "PAHs" refers to Polycyclic aromatic Hydrocarbons or Polyaromatic Hydrocarbons. They are a diverse class of organic compounds containing only carbon and hydrogen, comprised of multiple aromatic rings, and lacking further branching substituents on their ring structures. PAHs are also classified as persistent organic pollutants. They are formed during incomplete combustion of organic materials. Air Quality Objectives relating to PAHs are presented in Table 4.

When inhaled the particles are broken down into metabolites and excreted through body waste. There are several hundred PAHs that are known[9] and commonly present as a mixture of compounds. Benzo[a]pyrene (BaP) is the most well-known and described mixture of PAHs.

Long-term exposure to PAHs can have an adverse effect on lung function, exacerbate asthma, and increase rates of obstructive lung diseases, skin irritation, weakened immune system and cardiovascular diseases. In addition, in children it might impact cognitive or behavioural function[10]. Some PAHs exhibit carcinogenic properties.

Another cumulative name for hydrocarbons released because of waste fires is volatile organic compounds (VOC) including benzene and naphthalene. 1,3-butadiene and benzene are the most well-known among them with National objectives set to protect of human health. Some other compounds include aldehydes and ketones, aliphatic hydrocarbons, esters, aromatic hydrocarbons, cyclic terpenes, alcohols, and glycol ethers[11].

[7] Dioxins, Furans and Dioxin-Like Polychlorinated Biphenyls Factsheet | National Biomonitoring Program | CDC

[8] The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds - PMC (nih.gov)

[9] Polycyclic aromatic hydrocarbons (Benzo[a]pyrene): general information - GOV.UK (www.gov.uk)

[10] Human health effects of polycyclic aromatic hydrocarbons as ambient air pollutants (who.int)

[11] Health risk assessment of volatile organic compounds at day care facilities - Bayati - 2021 - Indoor Air - Wiley Online Library

Chronic and acute exposures to VOCs can irritate the eyes, nose and throat, and depending on the concentration in the air can cause difficulty breathing and nausea, as well as damaging the central nervous system and other organs. Some VOCs can cause cancer.

They can react with nitrogen oxides to produce ozone pollution in the presence of the sunlight. However, some are more reactive than others.

Asbestos fibres (due to construction waste) can be released as a result of fire (depending on waste composition such as construction waste) when the cap or capping layer is compromised. Depending on the number of fibres in the air, it can cause immediate difficulties in breathing, eye irritation, coughing and a sore throat. Long term exposure is carcinogenic.

There is no safe limit for asbestos fibres. For example, in the Control of Asbestos Regulations 2012: “The control limit for asbestos is 0.1 asbestos fibres per cubic centimetre of air (0.1 f/cm^3). The control limit is not a 'safe' level and exposure from work activities involving asbestos must be reduced to as far below the control limit as possible”.

The source of Mercury (Hg) in landfills results from the deposition of household batteries, a variety of (usually) electronic Hg-containing devices, fluorescent and other lights, batteries, electrical switches and relays, barometers[12] and lamps[13].

Mercury is an extremely harmful (toxic) pollutant with bio accumulative properties. Mercury and methyl mercury (MeHg) formed in the presence of organic matter, however, is less stable and can be flared away (burned during landfill fire) and is often found in waste and is volatile[14]. Elemental mercury is liquid at normal (room temperature and normal pressure) conditions, it easily forms alloys with noble metals (gold, silver platinum and palladium).

Mercury is a potent neurotoxin that can affect the brain, liver and kidneys, and cause developmental disorders in children. Young children and pregnant women (Hg can cause developing foetuses) are especially at risk.

Mercury can be deposited on the surface of the landfill or brought up to the surface in the form of a landfill gas via vents (if installed) from air voids.

[12] https://www.newmoa.org/prevention/mercury/landfillfactsheet.cfm

[13] https://www.researchgate.net/publication/229785778_Mercury_in_a_municipal_solid_waste_landfill

[14] Example of monitoring using high temporal resolved automated mercury analyser (low Hg blank quartz flux chamber coupled with high temporal resolved automated mercury analyser technique) https://link.springer.com/article/10.1360/04wd0038

Methodology

3 Methodology

Summary of Key Evidence Points

Demonstrating a robust, tried and tested approach to measuring the impact on air quality from the un-controlled burning of landfill sites.

3.1 Monitoring methodology

CQ's

Criteria 2

To measure the required pollutants at an appropriate level we have based our methodology on the use of two fixed location monitoring systems for the PCBs, PAHs and Dixons and Furans and metals measurements. These sites will require mains power and will provide highly accurate measurements to a standard used by the Environment Agency. The risk to this approach is felt to result from the changing wind direction and the possibility for pollutants not to be raised at these locations. To help mitigate this risk we will also recommend the use of a larger number B-tex diffusion tubes to measure VOCs, located at strategic locations around the area; these do not require power and like NO_2 diffusion tubes they simply clip onto lampposts or drainpipes.

3.1.1 Monitoring locations

The exact location of all monitoring systems would be determined at the start of the project and will be based on information from the previous work, meteorological data, the client's information, and findings of a site survey. The type and number of monitoring locations are summarised in Table 1. At this point we have based our assumptions on a prevailing south westerly wind direction and are aware this might change.

PAH/PCB and Metals stations

Site 1) This will act as a background measurement, to the south or west of the site providing a clear indication of ambient the pollution levels

Site 2) Receptor location, located near the housing to the north of the site, designed to demonstrate the levels experienced by the local residents.

B-Tex tubes

For the purposes of costing, we have assumed the use of 10 tubes to measure VOCs. Two of which will be co-located with the PCB/PAH stations (Sites 1 & 2 above) providing a direct comparison. The remaining 8 will be situated geographically around the site and will incorporate receptors, local businesses, and potential background sites.

A key part of this project will be the use of wind speed and direction data to determine the potential source of the measured pollution. To add an additional level of confidence to the readings and maintain independence we would propose installing a met system at Site 1 (background PCB/PAH/Metals site) to monitor wind speed and wind direction. This can also gather additional data such as ambient temperature, pressure and rain fall if required.

Figure 1 Map of proposed monitoring locations

Table 1 Summary table of quantities of monitoring locations

Criteria 2

Monitoring type	QTY
Total number of monitoring location	10
PAH/PCB and Metal	2
Wind speed and direction	2
B-Tex /VOC locations	10

3.1.2 Site duties

To provide the highest level of quality control, all site duties will be undertaken by our in-house team of engineers and technicians. This will start with a site survey to establish the exact monitoring locations. The tested equipment will be delivered and installed at the chosen sites with security cages for the two PAH/PCB/metals stations. PCB/PAH and metals filters will be changed every two weeks and B-Tex tubes every month, with each visit being documented for reporting and quality control. At the end of the project all equipment will be removed and the site cleared.

Filter handling is an important aspect in maintaining the sample integrity; prior to each visit the engineer will be issued a sterilised set of tools, nitrile gloves, pre-labled media for deployment and sterile holders for the collected filters. This site pack is housed in a temperature-controlled case to prevent any ambient effect. Samples are then dispatched within 48 hrs to the laboratory on a next day tracked service. All samples are logged, and details checked prior to dispatch.

3.1.3 Sample handling

Criteria 4

The filters and tubes will be supplied, returned to, and analysed by established UKAS accredited laboratories, both of which regularly undertake this type of analysis. At all times the site details will be anonymised to maintain impartiality and independence. The results of the analysis will be supplied in an electronic format for interpretation and reporting.

The B-tex tubes will be analysed for VOC's; we have priced this based on the reporting of the top 5 identified species and their concentrations. Options are available for total VOC and top 10 etc, but we feel that the top 5 analysis provides a good balance between detail and price. The number of compounds being identified can be assessed and changed as the project progresses.

PCB/ PAH - The filters will be analysed for the following compounds (Table 2), and reported by the lab as a total mass, we then use the flow and exposure data to calculate the µg/m^3 figure.

Table 2 Summary of pollutants to be monitored

Analysis	Limit of Detection	Accreditation
Dioxin/Furan PCB WHO 12 suites PCB BZ# 81 PCB BZ# 77 PCB BZ# 123 PCB BZ# 118 PCB BZ# 114 PCB BZ# 105 PCB BZ# 126 PCB BZ# 167 PCB BZ# 156 PCB BZ# 157 PCB BZ# 169 PCB BZ# 189	ng	UKAS
USEPA 16 PAH suites Acenaphthene Acenaphthylene Anthracene Benz[a]anthracene Benzo[a]pyrene Benzo[b]fluoranthene Benzo[ghi]perylene Benzo[k]fluoranthene Chrysene Dibenz[a,h]anthracene Fluoranthene Fluorene	5ng	Not accredited

Analysis	Limit of Detection	Accreditation
Indeno[1,2,3-cd]pyrene		
Naphthalene		
Phenanthrene		

Table 3 below provides details of which metals can be analysed to UKAS standards. It should be noted that the limit of detection (LOD) can depend on exposure time and measurement methodology.

CQ's

Table 3 Metals which can be analysed to UKAS standard

Element	LOD µg
As (Arsenic)	<0.5
Cd (Cadmium)	<0.2
Co (Cobalt)	<0.2
Cr (Chromium)	<0.2
Cu (Copper)	<0.2
Hg (Mercury)	<0.2
Mn (Manganese)	<0.2
Ni (Nickel)	<0.2
Pb (Lead)	<0.2
Sb (Antimony)	<0.2
Tl (Thallium)	<0.2
V (Vanadium)	<0.2
Zn (Zinc)	<0.2

3.1.4 Equipment

Criteria 4

Partisol 2000 (based on US EPA Method IO-2.3 (EPA, 1999)): pump sampler system, which draws ambient air through filters held inside the instrument.

CQ's

PAHs are measured on a paper filter, which is changed every two weeks and batched to give a month's worth of measurements prior to analysis.

Dioxins, Furans and PCBs are measured on Polyurethane Foam (PUF) filters, which will be changed monthly, and on paper filters, which are also changed every two weeks and batched to provide a month's worth of measurements.

CQ's

A second instrument at each site will be used to collect airborne metals, again using a filter collection method.

Following each collection period, filters will be analysed at an UKAS accredited laboratory (except for PAH).

The monitoring results will be compared against National objectives and WHO guidance limits to identify any exceedances and sources of pollution.

3.2 Reporting

Criteria 1

The data collected by methods described above will be validated and averaged for the period, uncertainties discussed and concentrations below detection limits of the equipment outlined. Where possible, the data will be annualised in accordance with Defra procedures[15].

Following the result of the monitoring we will produce a report comparing the results of the monitoring programme with Air Quality Objectives and Standards (Table 4).

Table 4 UK National Objectives

Pollutant	Objective	
	National	
PAH (Benzo(a) pyrene)	0.25 ng/m^3 B[a]P as annual mean	
Benzene	16.25 µg/m^3 as running annual mean	
1,3-butadiene	2.25 µg/m^3 as running annual mean	
Carbon monoxide	10 mg/m^3	
Lead	0.25 µg/m^3 as annual mean	
Sulphur dioxide	266 µg/m^3 not to be exceeded more than 35 times a year	15 minute mean
	350 µg/m^3 not to be exceeded more than 24 times a year	1 hour mean
	125 µg/m^3 not to be exceeded more than 3 times a year	24 maximum daily running 8 hour mean
	20 µg/m^3 annual average	
Mercury (EPA)	2.5 lb/TBtu (0.030 lb/GWh) [Existing IGCC] and 0.003 lb/GWh [New IGCC]	

The 2005 WHO TEF for dioxin and dioxin-like compounds are under review but are still being employed by EPA TEFs. Therefore, concentrations of Polychlorinated Dibenzo-p-Dioxins, Dibenzofurans and Dioxin-Like Polychlorinated Biphenyls will be compared with those currently published on EPA website[16].

Upon agreement with the client and discussion with the expert technical group we will establish the most appropriate format of data representation, so that further health impacts analysis can be performed using the monitoring results.

15 Annualisation of Diffusion Tubes | LAQM (defra.gov.uk)

16 Dioxin Toxicity Equivalency Factors (TEFs) for Human Health (epa.gov)

Criteria 1

The data collected in this part of the study can be combined with NO2 and PM data collected in Work stream 2.1, by proving outputs in the same format and averaging periods we will be able to avoid duplication or re-working of data. We will also include a comparison with local AURN measurements where available.

We suggest that the data is reported in Excel format on a frequency established at the kick-off meeting and can be on a monthly/quarterly basis or at the end of monitoring period.

Following discussion with the client we can compare PAH data with data collected by Defra PAH Network[18] (Figure 1) in London.

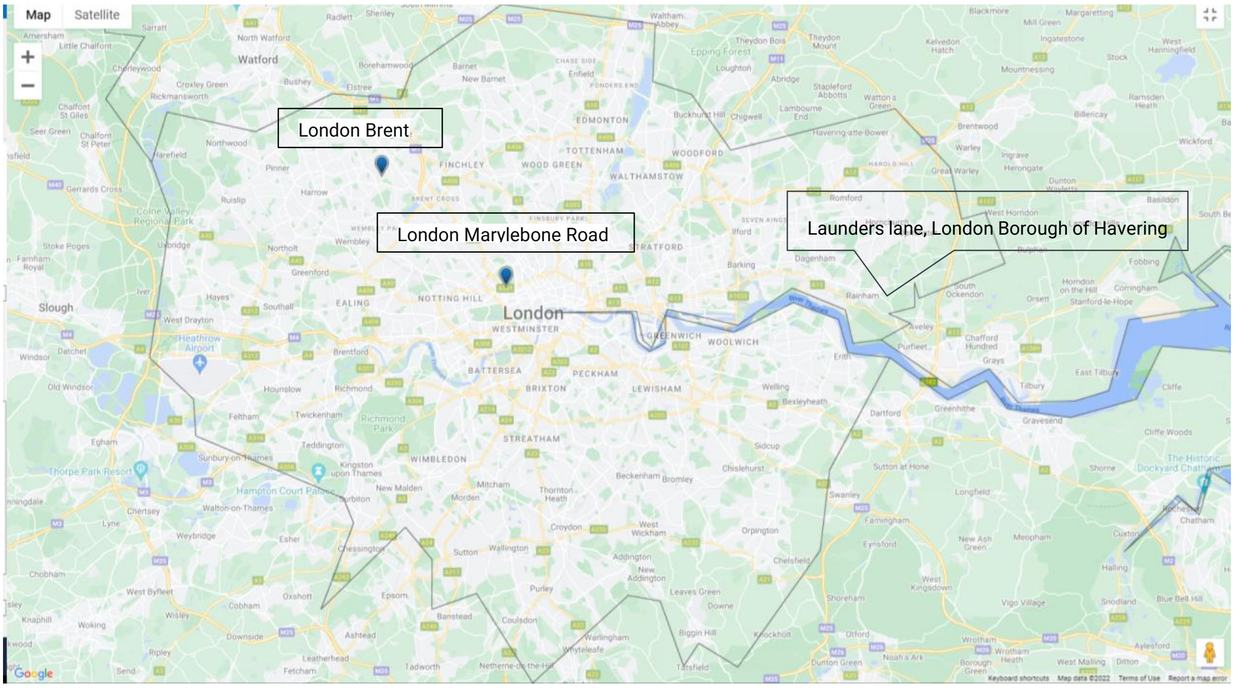


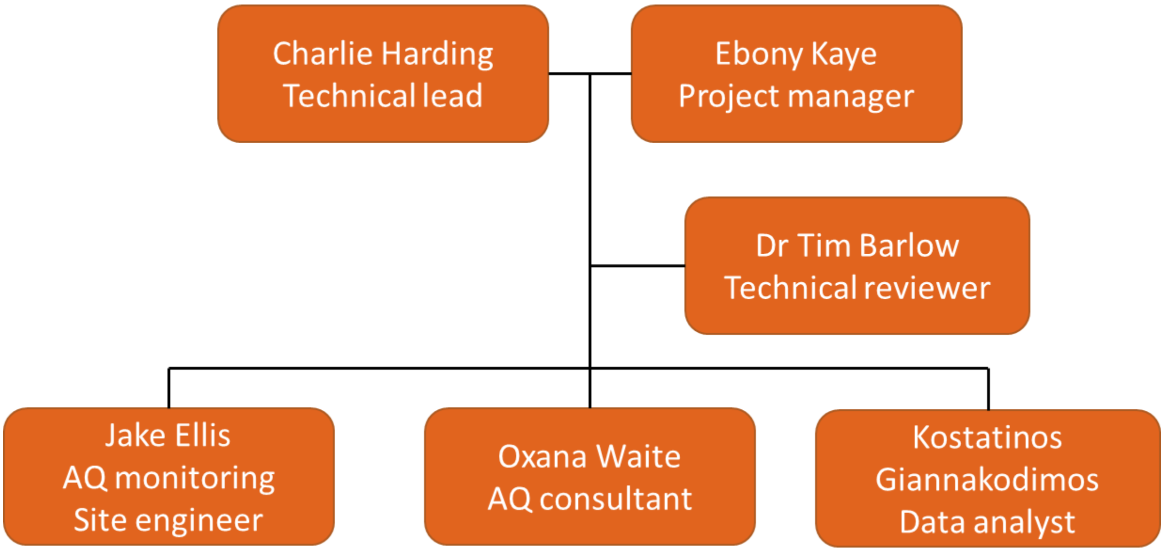
Figure 1 Defra PAH Network & site location

A final non-technical summary in a public-facing format will also be produced within a month of the completion of the monitoring programme.

Every effort will be made to present the insights of this study to the expert technical group and to assist the group with reaching a consensus as to the likely health impacts of any identified exposures including the significance of any exceedances detected of statutory and / or health related short and long term limits.

[18] Interactive monitoring networks map - Defra, UK

3.3 Project Team



3.3.1 Key project personnel

Charlie Harding will be the Technical Lead. Charlie joined TRL in 2010 and is the Decarbonisation Services lead. Charlie brings a wealth of knowledge of monitoring systems and air quality, along with his strong customer relation and leadership skills to lead TRL's air quality monitoring team. He offers solutions and guidance to clients and has been involved in and has led a long list of successful air quality projects. Charlie is responsible for ensuring clients' time frames and requirements are met in line with contracted work and that all work is carried out to a high standard. Charlie also has many qualifications including electrical qualification and the NEBOSH health and safety certificate.

Ebony Kaye will be the Project Manager. Ebony is an experienced project manager with 3 years designated to air quality monitoring. She conducts stage reviews to ensure project plans are up to date by reviewing resource allocation, staff and non-staff costs are forecast accurately, financial reviews and client deliverables met. She will be responsible for identifying where process can be improved, implementing change, providing governance.

Tim Barlow will take on the role of Technical Reviewer. Tim is Technical Lead of the TRL Sustainability Team, managing and conducting research regarding exhaust emissions and air quality. This has included running instrumented vehicles, derivation of representative driving cycles and dynamometer, vehicle-based emission tests and emissions modelling and evaluating the impact of new road schemes & policy on local air quality – for example Low Emission Zones. Tim has extensive experience of undertaking the Technical Reviewer role on a wide range of air quality and vehicle emissions projects.

Oxana Waite is an Environmental Consultant at TRL and as part of the Air Quality team, she oversees the monitoring, analysis, and reporting of data to Local Authorities (LA) to fulfil their statutory duty under the Environment Act 1995, Part IV in provision of an Air Quality Annual Status Report. Previously she has worked for local and Governmental authorities (Defra, AQ target team). Oxana has experience in data aggregation and summarization from referenced and small sensors monitoring equipment and producing environmental reports.

Jake Ellis is an Air Quality monitoring site engineer. Jake undertakes his tasks related to installation, maintenance, service and calibration of reference method instruments and small sensors. His site experience, knowledge, and desire for continuous improvement through collaboration with senior members of the service team will ensure that issues within the constraints of the project will be appropriately dealt with.

Konstantinos Giannakodimos is a Statistician and Data Analyst. As part of the Air Quality team, he conducts AQ data analysis and reviews of analysis employing such skills as derivation and development of factors using co-location data, use of Python programming language, advanced Excel and data calibration and ratification.

Additional staff can be drawn in from across the Air Quality and wider TRL teams as required.

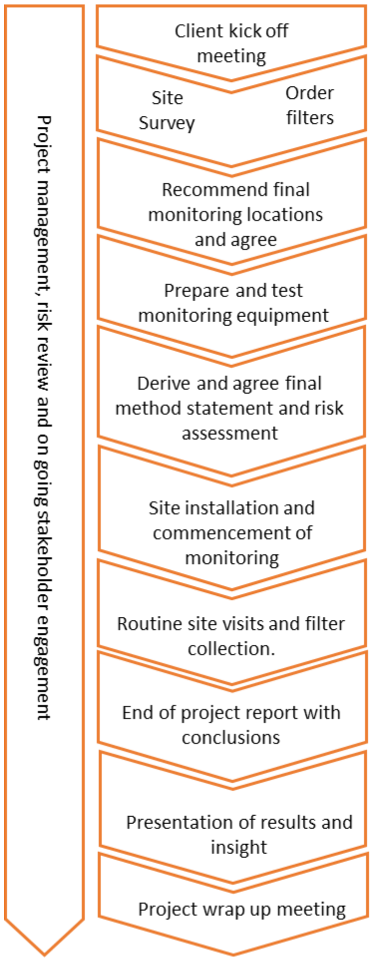
3.4 Project timeline / Scope

The flow chart outlines the programme of work required to successfully achieve the required outcome. This is based on our current understanding and is subject to change as the project progresses.

Criteria 3

We have budgeted on an initial three-month monitoring programme to allow for monthly averages to be derived and weather / traffic variations to be considered. The start of the project will be based on historical information and local knowledge around when the fires are more likely to occur. The preparation work can be completed well in advance, for instance, if fires are more likely in the summer month (July onwards) we would look to start work in May with the kick off meeting and site surveys, ensuring that by July everything is in place and operational. Monitoring can be undertaken through the hottest three month when fires are more likely and increasing the chances of directly measuring one or more occurrences.

Ideally, we would like to measure the impact from three or more fires to provide a better evidence base, but this is not within anyone's control and as such we do not believe this can be defined.



Experience

4 Experience

Summary of Key Evidence Points

Demonstrating experience of high-profile air quality monitoring projects for a range of clients.

TRL's air quality monitoring team has been monitoring air quality at the Grenfell Tower site since 2017 on behalf of UKHSA (formerly PHE). Having completed over 300 projects over the last 20 years, ranging from diffusion tube deployment and emissions testing through to multi-site, reference monitoring of EfW facilities and the feasibility study into the Abu Dhabi low emission zone. TRL's team of in-house consultants, engineers, and project managers work with a range of clients including local authorities, consultancies and public bodies including UKHSA, the Environment Agency and National Highways. The case studies below outline recent projects which are delivering similar requirements to that outlined in this tender. In addition to these case studies, our team are currently undertaking 6 sensor-based projects, 10 reference monitoring programmes and various other research projects based on the decarbonisation of transport, details of which can be provided upon request.

4.1 Project specific experience

Criteria 4

Through our links with the Environment Agency, UKHSA and local authorities we have monitored uncontrolled commercial and residential fires around the country. We utilise a range of technology and measurement methods to ensure the desired pollutants are quantified in a way that provides confidence to all stakeholders. We hold a stock of equipment and media to allow for fast deployment where required and use agile working practices to provide a fast and reliable service. While there is no direct guidance for monitoring this type of fire, we use a mix of Defra's TG16(2021) guidance, client led local knowledge and experience to provide a robust approach which has led to at least one conviction.

Alongside the examples below the team have monitored fires at several locations including Kidderminster, Brentwood, Kirklees. We have also included a recent example of stakeholder engagement which we understand to be an important part of the requirement.

4.1.1 Example projects

Sunderland fire

Following a fire at the commercial premises at Alex smiles Ltd. Waste management depot, the Environment Agency's fast response unit undertook initial on-site air quality monitoring until TRL were commissioned by Sunderland City Council to monitor the particulate concentrations, dioxin and furans, PCBs, PAH's and metals at sites surrounding the fire.

Four monitoring sites were initially selected at locations around the site of the fire with an additional two side being installed 2 weeks later.

Monitoring results were compared across all locations and nearest AURN sites for verification purposes and cross referenced with meteorological data to identify the source.

Six of the monitoring sites carried out automatic monitoring for particulate matter via Osiris dust monitors, and two of the sites additionally carried out passive monitoring of dioxins and furans, PCBs, PAHs and metals via pumped sampler Partisols.

Following a fire at the commercial premises at Alex Smiles Ltd. Waste management depot, the Environment Agency's fast response unit undertook initial on-site air quality monitoring until TRL were commissioned by Sunderland City Council to monitor concentration of particulates, dioxin and furans, PCBs, PAHs, and metals at sites surrounding the fire.

Initially TRL's monitoring commenced at four sites on the 24th of May and finished on 27th June. Two further monitoring sites were added on the 31st of May 2018. These six monitoring sites were selected at locations around the site of the fire.

Monitoring results were compared across monitoring locations and nearest AURN sites for verification purposes and cross referenced with meteorological data to identify the source.

Six of the monitoring sites carried out automatic monitoring for particulate matter using Osiris dust monitors, providing near live reading online data, and armed with e-mail alarms, once levels reached specified limit values. Two of the sites additionally carried out passive monitoring of dioxins and furans, PCBs, PAHs and metals via pumped sampler Partisols located upwind from the fire. Two unit was installed to measure metals.

Post-fire Air Quality Monitoring at Grenfell Tower

TRL continues to carry out an air quality monitoring programme at Grenfell Tower in response to the devastating residential fire. Initially this was design to investigate whether harmful pollutants were arising from the Tower after the fire was extinguished.

Period of monitoring: 24th June 2017 – 31st August 2018.

Pollutants monitored: particulate matter (PM), dioxins, furans, Polychlorinated Biphenyls (PCBs) and Polyaromatic Hydrocarbons (PAHs).

Since 2018 the monitoring programme has focused on the ongoing measurement particulate matter as confirmation of site dust levels with both refence and indicative monitors.

TRL carried out an air quality monitoring programme at Grenfell Tower in response to the fire, to investigate whether harmful pollutants were arising from the Tower after the fire was extinguished.

Period of monitoring: 24th June 2017 – 31st August 2018.

Pollutants monitored: particulate matter (PM), dioxins, furans, Polychlorinated Biphenyls (PCBs) and Polyaromatic Hydrocarbons (PAHs).

Equipment/instruments used:

Turnkey Osiris method of monitoring: a non-reference method light scattering technique for SP, PM10, PM2.5 and PM1 as well as wind speed and wind direction.

Partisol 2000 (based on US EPA Method IO-2.3 (EPA, 1999)): pump sampler system, which draws ambient air through filters held inside the instrument.

PAHs were measured on a paper filter, which was changed every two weeks and batched to give a month's worth of measurements prior to analysis.

Dioxins, furans and PCBs were measured on Polyurethane Foam (PUF) filters, which were changed monthly, and on paper filters, which were also changed every two weeks and batched to provide a month's worth of measurements.

Following collection period, filters were analysed at UKAS accredited laboratory (except for PAH).

The monitoring results were compared against National objectives and WHO guidance limits to identify any exceedances and sources of pollution.

Camden/City of London Idling Campaign (public engagement)

TRL reviewed and quantified emissions produced when idling, applicable to the types of vehicles present in London today using data from laboratory, track and RDE (Real Driving Emission) testing of petrol and diesel cars, vans, and HGVs (Heavy Goods Vehicles). Nitrogen oxides (Nox) and carbon dioxide (CO_2) were considered, demonstrating the emissions various types of vehicles would produce over the year. From quantitative analysis some successful visuals were created. The results of the research were used by Camden and Idling Action London (Idling Action) in their information campaigns and accessible via Action (TRL-Executive-Summary.pdf (squarespace.com)).

Stakeholder Engagement

5 Stakeholder Engagement

Summary of Key Evidence Points

Working with the client at every stage to ensure the requirements of each stakeholder are qualified and addressed.

Stakeholder engagement will have a key role to play in this project as there has been considerable concern about the fires at the site from residents. To help the public understand what is going on, we will deploy lamppost plaques with a link and QR code on at locations around the boundary of Arnold's Field and at other locations as agreed with the Council. This will take the user to a website explaining the monitoring work that is being undertaken.

With the agreement of the Council, we can create posts for social media to explain the work that is being undertaken. As part of this, we can attend, or host, a maximum of two 'pop-up shop' type events to engage with the local community about the work that is being undertaken.

Risk and quality

6 Risk and Quality

Summary of Key Evidence Points

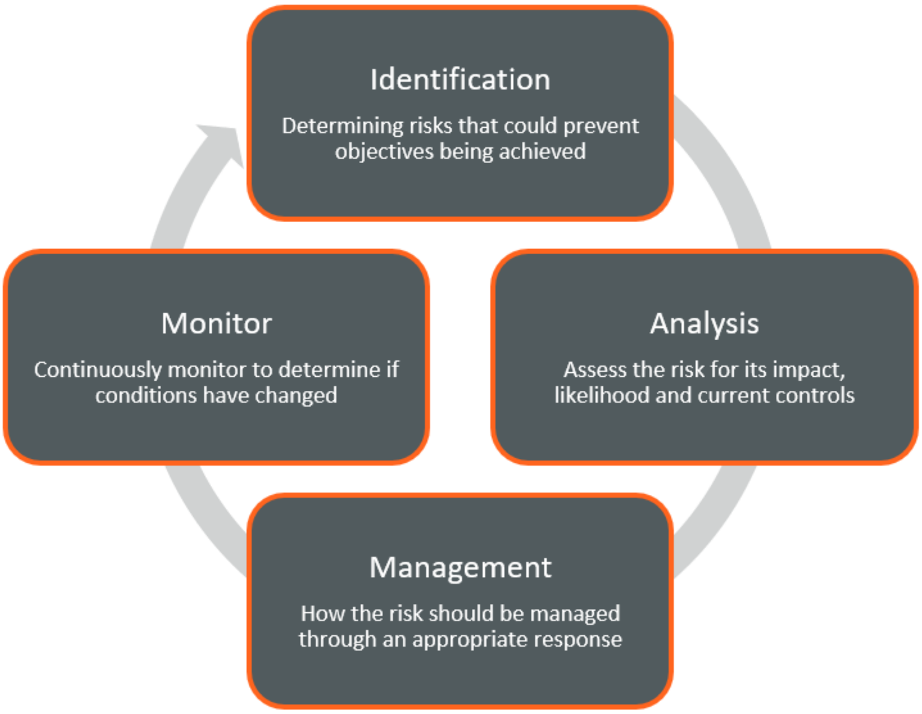
Ensuring a right first-time approach through risk mitigation and quality control.

6.1 Risk and Mitigation

Risks and mitigations

Criteria 4

TRL's risk assessment and management procedures are externally accredited to ISO 9001:2015. Working with the services management team the technical lead will apply best practice risk management procedures based on industry excellence, standards (ISO31000:2018) and methods from the Institute of Risk Management and the Association for Project Management. This will ensure that we identify, assess, and actively manage risks.



A Risks and Issues Register will b" dev'loped to identify both technical and commercial risks associated with the work. With inputs from the technical team, service management team, client and relevant stakeholders each of the identified risks are then assessed for impact, likelihood of occurrence and potential mitigations developed. The primary focus is on the removal of risk, but where this is not possible, reduction to an acceptable level. This Risk and Issues Register remains a live document which will be updated throughout the project as new risks, issues or mitigations are identified. The register will be reviewed with the client at the progress meetings to update, identify anything new or to further reduce risk.

An initial risk register (Table 5) is included below highlighting some potential issues. This will be updated and agreed with the client at inception phase, then updated as a live document.

Table 5 Risk register

Criteria 1

Criteria 3

Criteria 4

Risk ID	Rick Description	Prob.	Impact	Proposed action to deal with risk	Residual risk	Risk owner
1	Not capturing a fire due to wind direction or monitoring period	Medium	High	Continuous monitoring over the high-risk periods at multiple locations. Weather monitored and locations routinely reviewed.	Low	TRL/ Client
2	Repeating work, conflict, or information gaps in the three work streams	Medium	Medium	Early stake holder engagement to ensure all teams have a clear and defined project scope and expectation.	Low	TRL/ Stakeholder
3	Not capturing a fire due to no fires during the monitoring period	Medium	High	Selecting the monitoring period based on historic data, flexible approach to start and end dates.	Medium	TRL/Client
4	Unable to fire measurements due to equipment failure.	Low	High	Fully tested and serviced equipment. Remote monitoring checked daily. Thorough site checks undertaken on every visit.	Low	TRL
5	Unable to attend site due to Covid19 or similar restrictions and social distancing.	Low	High	All TRL staff have been vaccinated, therefore reducing recovery time.	Low	TRL
6	Delays to the start of the monitoring programme due to equipment availability / delivery times	Low	Medium	Re-confirm delivery times at the point of order and plan around these. Identify possible second sources of equipment and manage delivery.	Low	TRL/supplier
7	Equipment damage/loss at site	Low	Medium	PCB/PAH equipment housed in locked security cages, Tenex tubes sited above normal reach. Spare equipment in stock.	Low	TRL

Risk ID	Rick Description	Prob.	Impact	Proposed action to deal with risk	Residual risk	Risk owner
8	Risk of low stakeholder confidence in the data quality.	Low	High	Provide full transparency with regards to QA/QC procedures, maintain traceability for calibration process.	Low	TRL
9	Staff unavailability due to leave, sickness etc.	Low	Medium	Several staff will be trained to do the survey work to cover any absences, managed through our internal scheduling system.	Low	TRL
10	Risk of injury at site through health and safety issues	Medium	High	Trained and experienced staff, bespoke risk assessment and method statement. Continuous development and review of staff.	Medium	TRL
11	Poor standard of analysis at the laboratory	Low	High	UKAS accredited labs, long working relationships, direct experience of measurement technique.	Low	TRL/supplier
12	Not capturing air quality at all sensitive receptors	Medium	High	Clear identification of sensitive receptors at project inception, multiple monitoring locations, regular review and potential relocation of monitoring sites.	Low	TRL /Client
13	Harassment or heckling of TRL staff undertaking the survey	Low	Medium	Lone working policies in place. Trained and experienced team.	Low	TRL

Criteria 4

Criteria 2

TRL maintain internal policies associated with health, safety and well-being, ranging from lone worker policies, safe travel, battery charging, driving on business, and stress management. These have been developed over several years using best practice, external advice, and internal expertise and are reviewed on at least an annual basis.

Every member of staff has access to and is actively encouraged to use the internal reporting system for accidents, incidents and near misses. Primarily this is a way to investigate and remove the risk completely or if that is not possible, mitigate it to avoid a repetition. It provides an opportunity to share findings with the wider TRL team to raise awareness and thereby further improve Health & Safety in our workplace.

6.2 Quality

Criteria 4

All work will be covered under TRL's externally audited quality control systems, this includes Business Management System (BMS) which covers our Project Management and Risk Management Procedures, GDRP, Site and laboratory work, environmental management, and health and safety.

- ISO 9001:2015 (Quality Management Systems),
- ISO 14001:2015 (Environmental Management Systems),
- ISO 45001:2018 (Occupational Health and Safety Management systems),
- ISO 27001:2013 (Information Security), and
- ISO/IEC 17025:2017 (competence of testing and calibration laboratories).

As a company we are also proud of our Silver Investors In People status, Gold cyber security rating and being living wage employers.