Network Rail **KING'S CROSS STATION**
REDEVELOPMENT PROGRAMME

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PROGRAMME MANAGEMENT STRATEGY

Air Quality Monitoring Scheme

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Kings Cross Station Enhancement
Air Quality Monitoring Scheme

Network Rail

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1 Introduction

1.1 LOCAL AIR QUALITY MONITORING

1.1.1 WSP Environmental Ltd (WSPE) has been commissioned by Network Rail to prepare an air quality monitoring scheme for the works required for the Kings Cross Station Enhancement project to determine the impact, if any, of the redevelopment. This report presents the proposed air quality monitoring scheme for the redevelopment.

1.1.2 The air quality monitoring scheme is required by Condition 26 of the planning approval (Reference 2006/3387/P) issued by the London Borough of Camden on 16 August 2006 for the Kings Cross Station Enhancement. Condition 26 states:

> *"No works authorised by this consent shall take place until details of an air quality monitoring scheme covering both the construction and occupation including methodology for regular reporting of results has been submitted to and approved by the Council as local planning authority. The methods undertaken shall be carried out in accordance with details which shall have been approved."*

1.1.3 This air quality monitoring scheme has been developed on the basis of the above requirements and consultation with the London Borough of Camden.

2 Relevant Legislation and Guidance

2.1 THE EUROPEAN AIR QUALITY FRAMEWORK DIRECTIVE AND DAUGHTER DIRECTIVES

2.1.2 The European Air Quality Framework Directive (Directive 96/62/EC) establishes a strategic framework for setting Europe-wide limit values for twelve pollutants. The pollutants are sulphur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter smaller than 10 micrometres (µm) in aerodynamic diameter (PM_{10}), lead (Pb), carbon monoxide (CO), benzene (C_6H_6), ozone (O_3), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

2.1.3 Limit values for each pollutant are established by a series of Daughter Directives and based on recommendations made by the World Health Organization (WHO). Legally binding limit values for Member States to achieve have already been set for SO_2, NO_2, nitrogen oxides (NO_x), PM_{10}, Pb, CO and C_6H_6. The European Commission is currently working on proposals for the remaining pollutants identified in the Air Quality Framework Directive.

2.2 NATIONAL LEGISLATION

Air Quality Strategy for England, Scotland, Wales & Northern Ireland

2.2.1 The Government's policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS) published in July 2007[1]. The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK. The AQS is designed to be an evolving process that is monitored and regularly reviewed.

2.2.2 The AQS sets standards and objectives for nine main air pollutants to protect health, vegetation and ecosystems. These are benzene (C_6H_6), 1,3-butadiene (C_4H_6), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM_{10}), sulphur dioxide (SO_2), ozone (O_3), and polycyclic aromatic hydrocarbons (PAHs).

2.2.3 The air quality standards are concentration limits which represent negligible or zero risk to health, based on medical and scientific evidence reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organization (WHO). Above these limits sensitive members of the public (e.g. children, the elderly and the unwell) might experience adverse health effects.

2.2.4 The air quality objectives are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedences of the standard over a given period.

2.2.5 For some pollutants, (e.g. NO_2), there is both a long-term (annual mean) standard and a short-term standard. In the case of NO_2, the short-term standard is for a 1-hour averaging period, whereas for PM_{10} it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants, for example temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road.

[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1 and 2) – July 2007.

Air Quality (England) Regulations

2.2.6 Many of the objectives in the AQS have been made statutory in England with the *Air Quality (England) Regulations 2000*[2] and the *Air Quality (England) (Amendment) Regulations 2002*[3] for the purpose of Local Air Quality Management (LAQM). The standards and objectives for each pollutant in the AQS and the Regulations are given in **Appendix A**.

Local Air Quality Management Technical Guidance Note (LAQM.TG(03))

2.2.7 LAQM.TG(03) provides guidance to local authorities on the set up and management of local air quality monitoring studies. This guidance has been used where appropriate to inform the development of the proposed monitoring scheme

2.3 LOCAL AIR QUALITY MANAGEMENT (LAQM)

2.3.1 Under Part IV of the *Environment Act 1995*, local authorities must review and document local air quality within their area by way of staged appraisals and respond accordingly, with the aim of meeting the air quality objectives by the years defined in the Regulations. Where the objectives of the Air Quality Regulations are not likely to be achieved by the objective year, an authority is required to designate an Air Quality Management Area (AQMA). For each AQMA the local authority is required to draw up an Air Quality Action Plan (AQAP) to secure improvements in air quality and show how it intends to work towards achieving air quality standards in the future.

London Borough of Camden Air Quality Review and Assessment

2.3.2 The London Borough of Camden (LBC) has completed the first and second rounds of the review and assessment process. As a result of the findings of the first round, the Council declared the entire Borough an AQMA due to measured and predicted exceedences of the objectives for both NO_2 and PM_{10}.

2.3.3 Since this time the council has regularly (generally annually) published air quality progress reports detailing monitoring results and any improvements in air quality. The results of the progress reports indicate that exceedences of the air quality objectives for NO_2 and PM_{10} are continuing to occur at some locations and it is appropriate to maintain the designation of the whole Borough as an AQMA.

London Borough of Islington Air Quality Review and Assessment

2.3.4 The London Borough of Islington (LBC) also declared the entire Borough as an AQMA as a result of the findings of its first round of air quality review and assessment, which was done in conjunction with seven other London Boroughs, including Camden.

2.3.5 Similar to LBC, the results of the Council's further review and assessment work have shown that the continued designation of the entire Borough as an AQMA is appropriate.

[2] The Air Quality (England) Regulations 2000 - Statutory Instrument 2000 No.928

[3] The Air Quality (England) (Amendment) Regulations 2002 - Statutory Instrument 2002 No.3043

3 Monitoring Techniques

3.1 AVAILABLE MONITORING TECHNIQUES

3.1.1 There are a number of methods that can be used to monitor fine particulate matter concentrations, primarily PM_{10}, as only air quality standards exist for this fraction. The most common of these are Low Volume Gravimetric Samples, Tapered Element Oscillating Microbalance (TEOM), Beta-attenuation Analysers (BAM) and Light Scattering Systems.

3.1.2 Gravimetric sampling is the reference method specified for monitoring PM_{10} concentrations in the EU Daughter Directives to allow comparison of monitoring results against the limit values set out in the Directives and objective concentrations contained in the AQS. This method is relatively manually intensive (collection of samples and laboratory analysis required) compared to the TEOM and light scattering methods and does not tend to be widely used in the UK monitoring networks.

3.1.3 TEOM instruments are used extensively in monitoring networks operated by local authorities and in national and regional networks in the UK. They have the advantage on only requiring filter changes every 2 weeks to 1 month (depending on the monitoring location). Extensive comparison studies have been undertaken with the TEOM instruments and gravimetric samplers to determine differences in monitoring results due to the difference in monitoring method. This has resulted in the development of a standard factor of 1.3 to be applied to TEOM monitoring results to provide results equivalent to the gravimetric monitoring results.

3.1.4 The use of BAM instruments tend to be less common, again generally due to the manually intensive nature of the method and inclusion of a low-level radioactive source in the instrument.

3.1.5 Light Scattering instruments have not been as extensively compared against the gravimetric method as TEOM instruments; however, studies have shown reasonable comparability in results with co-location studies. These instruments have an advantage over the other methods due to the lower cost and ability to measure more than one particle fraction concurrently. This has led to their increased use by local authorities for short-term and/or screening studies in areas where elevated particle levels maybe occurring due to location characteristics (e.g. high traffic flows)

3.2 SELECTED CONTINUOUS MONITORING OPTION

3.2.1 Liaison between Network Rail and LBC has determined that use of light scattering instruments (Osiris) would be acceptable for the monitoring required by the Condition 26. This type of instrument is capable of measuring total suspended particles (TSP), PM_{10} (particles with an aerodynamic diameter of less than 10 micrometres), $PM_{2.5}$ and PM_1 concurrently and concentrations for each of these fractions will be measured as part of the monitoring programme. This will allow comparison with the results of the Council's previous monitoring.

3.2.2 Whilst this method is not the reference method for monitoring PM_{10} as specified in the EU Daughter Directives, the method is used extensively for preliminary monitoring by local authorities to determine whether elevated particles levels are occurring in a given area and long term monitoring using the reference or equivalent method (e.g. TEOM) is required.

3.2.3 In agreement with LBC, monitoring of other pollutants (e.g. nitrogen dioxide) or for nuisance impacts is not required as part of the monitoring scheme.

4 Background Air Quality

4.1 LONDON BOROUGH OF CAMDEN AIR QUALITY MONITORING

4.1.1 LBC undertakes air quality monitoring at several locations in the Borough. The closest air quality monitoring station to the site where PM_{10} is monitored is located in Russell Square. The monitoring data for 2006 (most recent full year for which ratified data is available) from this and other monitoring sites in the Borough are shown in Table 1 below.

Table 1 Air Quality Monitoring Data for London Borough of Camden

Monitoring Location	**2006**
Russell Square (Urban Background)	
Annual Mean PM_{10}	30
No. of exceedences of 24-hr PM_{10} objective	21
Shaftsbury Avenue (Roadside)	
Annual Mean PM_{10}	37
No. of exceedences of 24-hr PM_{10} objective	39
Swiss Cottage (Roadside)	
Annual Mean PM_{10}	37
No. of exceedences of 24-hr PM_{10} objective	53

4.1.2 It can be seen from the data in Table 1 that exceedences of the objective for 24-hour mean PM_{10} concentrations occur in roadside locations, but not at the urban background location. No exceedence of the objective for annual mean PM_{10} concentrations was recorded at any of the locations in 2006; however, concentrations are close to the objective at roadside locations.

4.2 LONDON BOROUGH OF ISLINGTON AIR QUALITY MONITORING

4.2.1 LBI also undertakes air quality monitoring at a number of locations in the Borough. The closest air quality monitoring station where PM_{10} is monitored is located in Duncan Terrace. The monitoring data for 2006 from this and other monitoring sites in the Borough are shown in Table 2 below.

Table 2 Air Quality Monitoring Data for London Borough of Islington

Monitoring Location	**2006**
Duncan Terrace (Roadside)	
Annual Mean PM_{10}	37
No. of exceedences of 24-hr PM_{10} objective	17
Upper Street (Urban Background)	
Annual Mean PM_{10}	24
No. of exceedences of 24-hr PM_{10} objective	6
Holloway Road ***(Roadside)***	
Annual Mean PM_{10}	35
No. of exceedences of 24-hr PM_{10} objective	28

4.2.2 The monitoring data in Table 2 shows that the objectives for both annual and 24-hour mean PM_{10} concentrations were not exceeded at any of the Islington monitoring locations in 2006.

4.2.3 Monitoring of fine particle concentrations has been undertaken by LBC at a number of locations around Kings Cross Station using light scattering instruments (Osiris instruments). The results of the monitoring undertaken in Coopers Lane and Camlet Street Reserve have been provided by the Council and are presented in Table 3 below.

Table 3 Fine particle monitoring results for Kings Cross Station area

Location	Monitoring period (2007)		
	September[(a)]	October	November
Coopers Lane			
Monthly Mean Concentration ($\mu g/m^3$)	25.1	38.0	29.9
No. of 24-hr means >50 $\mu g/m^3$	0	5	1
Camlet Street Reserve			
Monthly Mean Concentration ($\mu g/m^3$)	To Be Supplied	To Be Supplied	To Be Supplied
No. of 24-hr means >50 $\mu g/m^3$	To Be Supplied	To Be Supplied	To Be Supplied
(a) Monitoring in this month covered the period 17/09/07 to 30/09/07.			

4.2.4 This monitoring data provides an indication of the baseline concentrations that would be expected at the Kings Cross Station site; however, caution must be exercised when using the data as it only covers a two and a half month period. Nevertheless, the data have been considered as part of the determination of trigger levels for the particle monitoring (see Section 5.3)

4.3 ESTIMATED BACKGROUND CONCENTRATIONS

4.3.1 Estimated background concentrations in the vicinity of the site for 2001, 2004 and 2010 were provided in the Air Quality Chapter of the Environmental Statement submitted in support of the planning application for the enhancement works.

4.3.2 The estimated background concentrations were obtained from the National Air Quality Information Archive (NAQIA). This data is produced through a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automatic and non-automatic sites. The data showed the estimated annual mean PM_{10} concentrations at the site in 2004 and 2010 are 26.2 $\mu g/m^3$ and 23.4 $\mu g/m^3$ respectively.

4.3.3 The NAQIA also provides factors (updated 2006) for adjusting the estimated concentrations to years other than those for which estimates are provided. The adjusted estimated concentrations for 2007 are shown in Table 4 below.

Table 4 Estimated Annual Mean Background Concentrations at the site for 2007

Pollutant	2007
PM_{10}	24.9

4.3.4 The estimated concentrations in Table 3 show that annual mean background PM_{10} concentrations are estimated to be well below the objective for this averaging period. Pollutant emissions from traffic using the adjacent road network are superimposed on this background concentration to give a baseline PM_{10} concentration that is likely to be measured at the site. When this data is compared to the Councils particle monitoring results for the area, it can be see that the component of the ambient concentration due to traffic emissions is likely to range between around 5 and 13 $\mu g/m^3$ at the monitoring sites. (TO BE REVIEWED WHEN CAMLET DATA RECEIVED)

4.4 THE LOCAL CLIMATE

4.4.1 The most important climatological parameters governing the atmospheric dispersion of pollutants are as follows:

- **Wind direction** determines the broad transport of the emission and the sector of the compass into which the emission is dispersed;
- **Wind speed** will affect ground level emissions by increasing the initial dilution of pollutants in the emission; and
- **Atmospheric stability** is a measure of the turbulence, particularly of the vertical motions present. It has been classified by Pasquill Stability categories, A to F. Stability A is the unstable extreme, representing very convective conditions with large vertical motions, while F is a very stable category where vertical motion, and consequently mixing, is suppressed. Stability category D refers to neutral conditions, where mechanically generated turbulence is caused by strong surface winds.

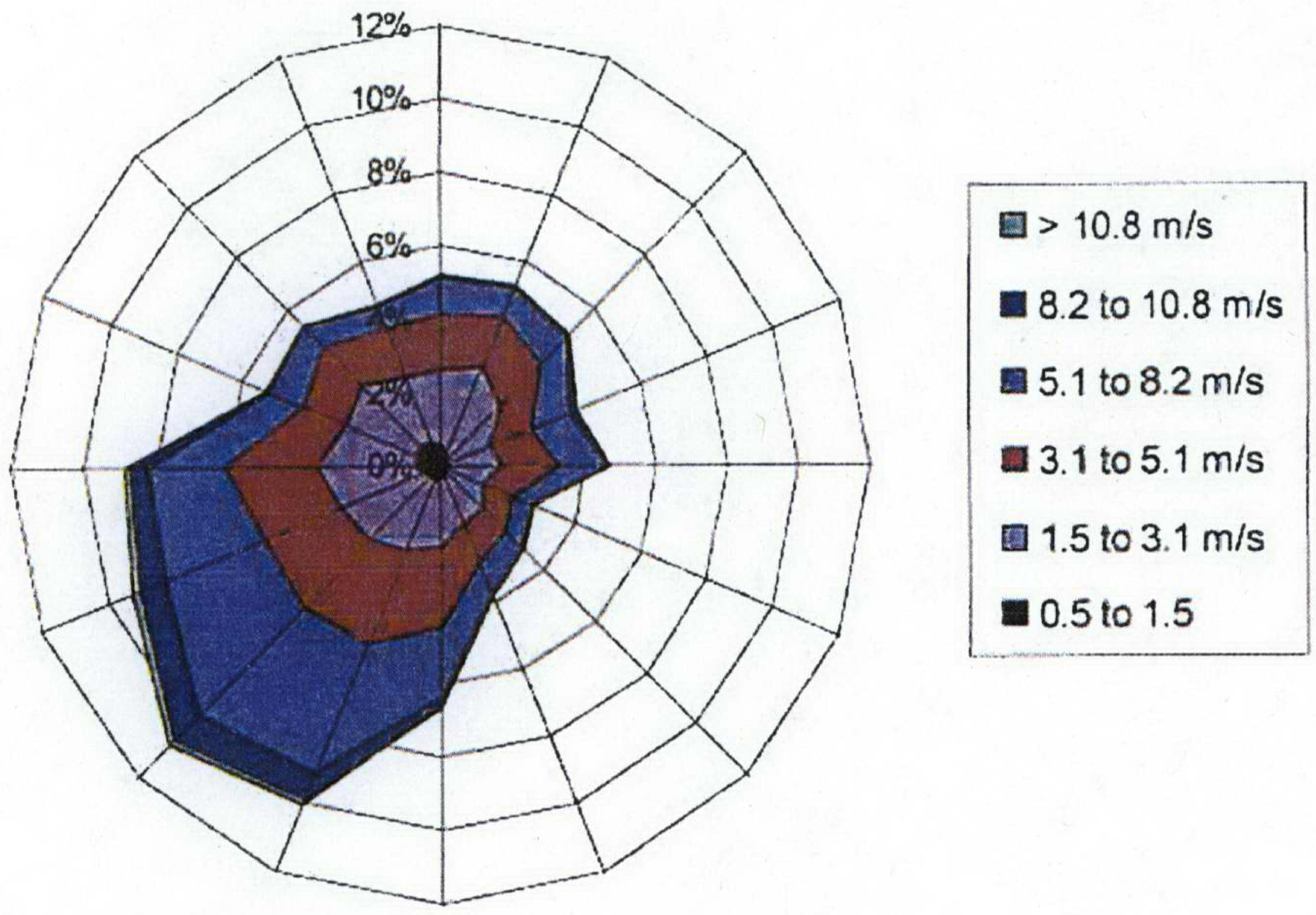
4.4.2 The frequency of each stability class varies significantly. For the meteorological data (Heathrow) reviewed for the development of the monitoring scheme, Stability D is the most commonly occurring stability condition (around 58% of the time); Stability A is the most infrequent (0.02%) and Stabilities B, C, E, and F occur for approximately 3%, 10%, 13% and 16% of the time, respectively. In general, atmospheric stability has more influence on the dispersion of gaseous pollutant releases, where very stable conditions can lead to poor dispersion conditions and elevated ground level concentrations.

4.4.3 Unlike gaseous atmospheric pollutants, the generation of fugitive dust is particularly dependent upon weather conditions. The prevailing meteorological conditions at any site would be dependent upon many factors including its location in relation to macroclimatic conditions as well as more site specific, micro-climatic conditions. Clearly the most significant meteorological factor, in addition to rainfall, is the predominant wind direction and wind speeds, and consequently data has been collected regarding this for the site.

Local Wind Speed and Direction Data

4.4.4 Wind speed and direction data have been obtained for Heathrow Airport for the five-year period 2001 to 2005. Heathrow Airport is located approximately 21km to the west south west of the site and this observing station has wind speed and direction data appropriate for characterising the wind climate at the site. Wind speed and direction data for Heathrow are presented as a wind rose in **Figure 1**.

Figure 1 Meteorological Data for Heathrow 2001 to 2005



4.4.5 The predominant wind direction is from the southwest and south southwest at 10.8% and 10.0% of the time, respectively; with winds from the west southwest and west also occurring frequently at 9.2% and 8.8% of the time, respectively. These are followed by southerly winds, at a frequency of 6.6%. Wind directions from the northeast and southeast sectors occur relatively infrequently. Calm conditions (<0.5 m s^{-1}) occur for approximately 4.9% of the time.

Other Climate Data

4.4.6 A climatic observing station is located at Greenwich. This observing station is located at a height of 16m above mean sea level (AMSL), approximately 9km east southeast of Kings Cross Station. This is the nearest observing station to the proposed development site where long-term summary data are provided by the Meteorological Office. Summaries of temperature, sunshine hours and rainfall for Greenwich observing station are presented in **Table 5**.

Table 5 Summary of Meteorological Observations for Greenwich (1971 to 2000)

Month	Maximum Temperature (°C)	Minimum Temperature (°C)	Sunshine (hours)	Rainfall (mm)	Rain days (>=1mm)
January	7.9	2.6	61.7	81.0	12.8
February	7.9	2.3	81.1	58.7	10.3
March	10.1	3.6	121.8	60.3	10.6
April	12.4	4.7	181.5	48.4	8.8
May	15.9	7.7	223.2	45.9	8.4
June	18.4	10.4	212.4	51.9	7.8
July	20.8	12.5	231.6	37.7	6.5
August	20.8	12.6	223.2	49.5	7.1
September	18.3	10.7	160.2	67.1	9.5
October	14.9	8.2	120.0	88.0	10.9
November	11.1	5.0	80.7	84.2	11.0
December	9.0	3.6	53.3	91.2	12.1
Year	**14.0**	**7.0**	**1750.7**	**763.7**	**115.8**

4.4.7 As may be expected, temperature and sunshine hours show a strong seasonal variation with maxima during the summer months. Although there is not a large seasonal variation in rainfall, the highest rainfall occurs during the months of September through to January. The total annual average rainfall for the thirty-year period was 764 mm and rainfall greater than 1 mm occurred on 32% of days of the year. Dust generation and emission will be suppressed during these periods.

5 Proposed Monitoring Scheme

5.1 GENERAL APPROACH

5.1.1 In order to ensure that the monitoring scheme allows determination of any impacts on ambient PM_{10} (and other particle fractions) concentrations and is useful as a tool for managing impacts, the approach to monitoring utilises continuous monitoring instruments in two locations at the site.

5.1.2 The monitoring would be undertaken using Osiris light scattering instruments, which will be provided with a mains power supply at both locations. The instruments have a battery back-up that will last 12-hours in the event of an interruption to the mains power supply. It is expected that any power failure would be rectified within a 12-hour period.

5.1.3 Meteorological data (wind speed and direction) will also be measured at one of the locations. This will provide valuable site specific information for the interpretation of the monitoring results and investigation of any elevated particle concentrations (i.e. above trigger levels) measured at the monitoring locations.

5.1.4 Each of the monitoring instruments will be installed with GSM Modems to allow checking of the instrument status and viewing and downloading of monitoring data remotely.

5.1.5 The data recorded by the continuous monitors will be backed up on a daily basis and also checked daily to ensure that there were no errors in the data or problems with the operation of the instruments. The raw dataset will be reviewed on a monthly basis to ensure any erroneous/abnormal data is identified and removed (data ratification).

5.1.6 The particle monitoring instruments will be maintained and calibrated in accordance with the manufacturer's specifications.

5.2 MONITORING LOCATIONS

5.2.1 Continuous monitoring instruments (light scattering) will be deployed at 2 locations on the site, which have been selected in consultation with LBC.

5.2.2 One instrument will be located at the Signal Box in the northeast corner of the site, adjacent to the corner of York Way and Goodsway. The other instrument would be located on the Suburban Train Shed, which is in approximately the middle of the site. The exact locations will be finalised taking into account on the site uses at and surrounding the locations, accessibility and health and safety issues. The general monitoring locations are shown in **Figure 2**.

5.2.3 The Signal box location is downwind (prevailing) of the location of the proposed Western Concourse and associated structures and the Network Rail Link Plantroom and Central Shared Service Yard. This monitoring site is located in close proximity to the nearest sensitive receptor locations (on York Road and beyond) that are downwind of the site. Monitoring results from this location will provide an indication of particle concentrations at the boundary of the site.

5.2.4 The Suburban Shed location will be immediately adjacent to the area where excavations and piling will be undertaken for the Central Shared Service Yard and Link Plantroom. Monitoring results from this location will provide data on the likely on-site ambient particle concentrations for comparison against the boundary monitoring data.

This will provide information on the significance of particle emissions in this area during the construction works.

5.2.5 Subject to final agreement with LBC, it is proposed to include the wind speed and direction monitoring instruments at the Suburban Shed location.

5.3 TRIGGER LEVELS

5.3.1 A Trigger Level is a concentration at which actions would be initiated if measured concentrations exceed the level. The Trigger Level for the monitoring has been set in terms of PM_{10} concentrations because this is the only fraction of airborne particles measured that has an air quality standard.

5.3.2 The Trigger Level has been set at **38 $\mu g/m^3$** on the basis of the available air quality monitoring data and the locations of the monitoring instruments. The Trigger Level is more relevant to the Signal Box location due to its proximity to the boundary of the site and prevailing wind. Software provided with the instruments allows for a trigger level to be set and will alarm if this level is exceeded.

5.3.3 The Programme Environment Manager (or his delegate) will be responsible for reviewing monitoring data on a daily basis to ensure compliance with the trigger levels and responding to trigger level exceedence alarms.Reporting

5.3.4 Routine reporting of the monitoring results to LBC will be undertaken on a six-monthly basis. This will take the form of a brief factual report of the monitoring data over the previous six-month period, together with a brief discussion of the results relative to the air quality objectives for PM_{10}. The report will also include details of any exceedences of the Trigger Levels, the subsequent investigation of the exceedences and any corrective measures put in place as a result of the investigations.