

Within the residential towers the following three main streams: residual waste, mixed recyclables (glass, paper, cardboard and plastics) and organic waste (food) as outlined in Figure 5-4.

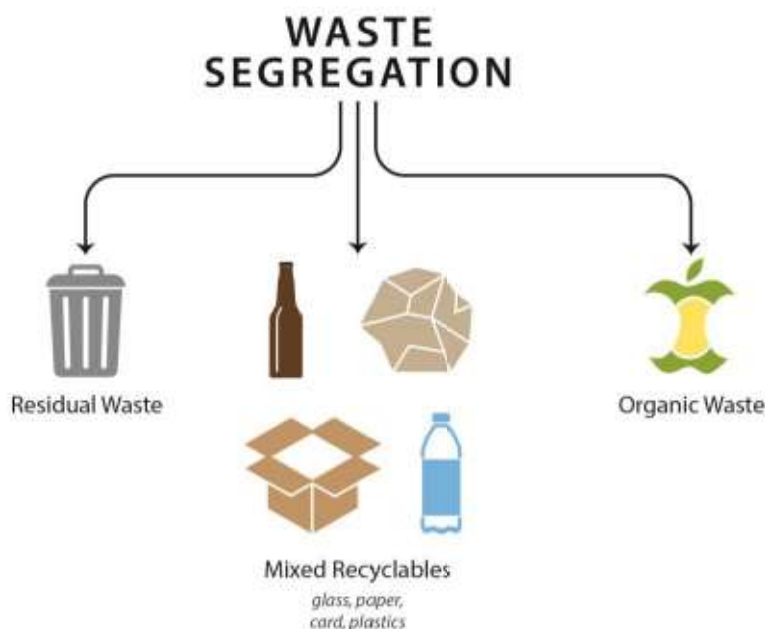


Figure 5-4 Segregation of waste and recyclables in the Southern Residential development

5.5.2 Storage and Collection

Waste management infrastructure within the developments must ensure that waste management operations are hidden and do not interfere with visitors, guests or residents, nor have a detrimental impact on the aesthetics of the buildings. Adequate spatial provision for clean, hygienic and efficient waste management services has been determined in collaboration with the project team.

A summary of how waste will be stored, collected and treated throughout the residential towers is provided below in Table 5-1.

Table 5-1 Summary of storage, treatment and collection strategy

	Storage	Treatment	Collection
Stadium	Bulk at intermediate waste storage rooms, then transfer by FM team to central storage and treatment area	Materials segregation via bins (hazardous, bulky, confidential, WEEE, recyclables) // Mini- MRF // Compactor // Baler	Via service yard in North East
Hotel	FM team bulk in basement, collected by EV and taken to collection point	Materials segregation	Transported by EV from basement to High Road or Park Lane for collection
Residential	Residents move waste to central bin store in basement of towers	Materials segregation	Tower D pick up via Park Lane // Towers A, B and C pick up via Worcester Avenue

5.6 Outline Planning

At present, the waste strategy for the outline planning application concerning the THFC Experience, the North East Building and the Extreme Sports Centre will be finalised and confirmed upon applying for detailed planning approval.

6 Materials

6.1 Introduction

THFC is committed to delivering a scheme that addresses the environmental issues associated with the handling and use of materials. The Materials Strategy has been developed to illustrate and clarify these commitments. To ensure that the proposals will achieve best practice standards, the strategy will be developed further as the development progresses in collaboration with the Waste Resources and Action Programme (WRAP).

The Materials Strategy addresses the selection and management of materials arising from demolition and site excavation, materials used in new construction and waste arising from construction processes.

6.2 Construction Materials

Construction materials have far reaching environmental, economic and social impacts, with irresponsible selection and use having consequences that can lead to further habitat destruction, global warming and economic exploitation.

The development will respond to these concerns through a hierarchical approach to material use which endeavours to minimise material use from the outset through efficient design and construction processes, such as offsite pre-fabrication, before looking to employ low impact and locally sourced materials. Recycled, renewably sourced and robust ecologically inert materials will be employed to help reduce the whole life environmental impacts of the development. A cradle-to-cradle approach will be employed, which will consider the life cycle of the material from its sourcing to its potential reuse.

It is expected that the design team will take a holistic view of material sustainability, selecting materials based on a wide criteria including: sourcing, operational performance, aesthetics and BRE Green Guide rating. This will ensure that the materials selected meet the aspirations of the development and are compliant with BREEAM credits MAT01, MAT02.

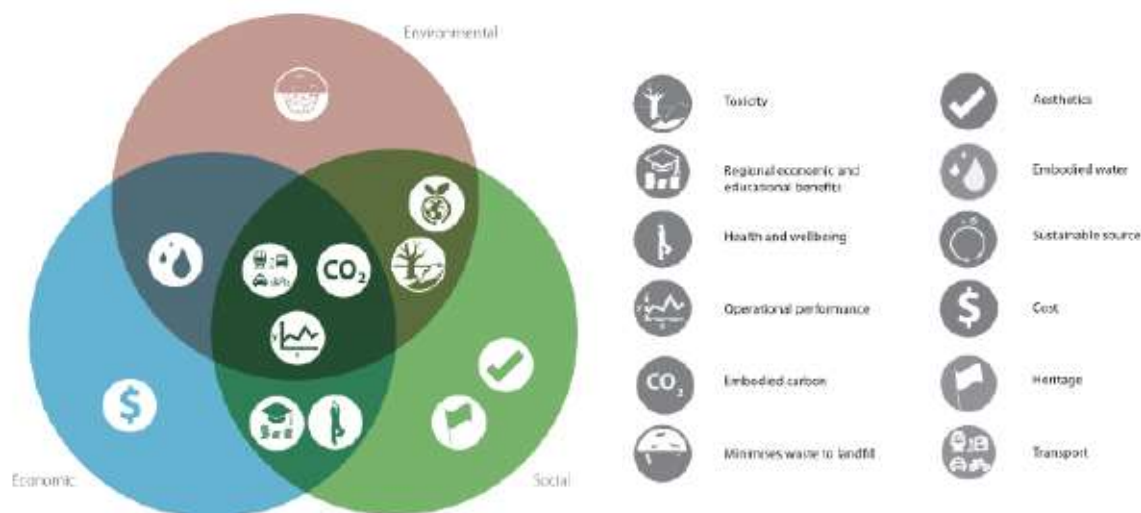


Figure 6-1 Sustainable selection of materials

During the construction of the Project, the management plan will aspire to meet all material targets and policies outlined. Key targets are summarised below.

Source	Target
BREEAM Mat 01/ Sustainable Design and Construction SPG	To recognise and encourage the use of construction materials with a low environmental impact (including embodied carbon) over the full life cycle of the building. At least three of the key elements of the building envelope must achieve a rating of A+-D in the BRE Green Guide and at least 50% of timber and timber products must be sourced from accredited Forest Stewardship Council (FSC) or Programme for the Endorsement of forestry Certification (PEFC). The design of the development will also maximise the potential to use pre-fabricated elements.
BREEAM Mat 03	To recognise and encourage the specification of responsibly sourced materials for key building elements.

6.3 Approach to materials selection

The lifetime maintenance and management costs of buildings are significantly greater than the costs of construction; as such, by optimising the durability, flexibility and lifespan of construction materials and products, this will help both reduce the life cycle costs but also the associated emissions. This can be achieved through *resource efficient construction*, as given by WRAP. This strategy focusses on carbon reduction by:

- Reduction of materials consumption and waste
- Increase reuse and recycled content
- Facilitating reuse and recyclability at end of life
- Using materials and products with lower embodied carbon and embodied water
- Selecting materials that do not have any scarcity or source security issues
- Optimising durability and lifespan
- Designing in flexibility to adapt to changing needs

6.3.1 Responsible Sourcing of Materials

For this development, there is an aspiration that all materials will be responsibly sourced. Where possible, material will be specified from suppliers who participate in responsible sourcing schemes such as BRE BES 6001:2008 or have an ISO 14001 for key supply chain processes.

Further to this, NDP will source materials that are grown or made locally where appropriate; many natural products can be sourced within or close to London. At least 50% of all timber and timber products will be sourced from schemes supported by the Central Point of Expertise for Timber Procurement such as the FSC accreditation, with an aspiration to reach a 90% target.

The use of responsible sourcing will help deliver some credits towards BREEAM accreditation.

6.3.2 Reclaimed and recycled construction materials

The development site will have existing materials which can be reused or recycled. Where possible, NDP will seek reclaim goods and materials and seek options to sensitively reuse existing resources. This will be facilitated by the following means:

- Reuse / recycle materials with significant recycled content
- Where possible, Recycled-Content Building Products are to be used

- Crushed demolition waste is to be used as fill material where appropriate
- 75% of materials from demolition works are to be redirected from landfill for recycling / reclamation
- Construction materials for the hotel, residential towers, visitors attraction and public realm will include at least 10% recycled content

6.3.3 New construction materials

The specification of new construction materials will prioritise those with minimal environmental impact associated with their use and that are economically feasible. Where possible and appropriate, the Project will aspire to meet the following targets:

- Use of environmentally sensitive, non-toxic building materials
- Use of materials and products that have low Volatile Organic Compounds (VOC)
- Use of insulation materials and refrigerants with low Global Warming Potential (GWP)
- Use of insulation materials and refrigerant with zero Ozone Depletion Potential (ODP)
- Minimising use of new aggregates whilst promoting the use of recycled crushed aggregates (RCA)
- Specifying materials that are graded B-upwards in the BRE Green Guide to Specification
- No use of materials proscribed in the Montreal Protocol

6.3.4 Further commitments

In addition to the above, the Project will commit to the following:

- All contractors will develop and implement a Construction Environmental Management Plan for each site
- All contractors will develop and implement a Construction Waste Management Plan for each site
- All sites will be registered under the Considerate Constructors Scheme
- All demolition work will adhere to The ICE Demolition Protocol

7 BREEAM

7.1 Introduction

Haringey Council requires all new major non-domestic developments to achieve a 'Very Good' rating as a minimum under the most up-to-date BREEAM or equivalent scheme. The threshold for major non-residential application in 1000m² or more.

BREEAM 2014 New Construction (NC) will be used to assess the buildings within the development. This covers the wide range of building types within its scheme. Separate assessments are to be required for each of the proposed buildings due to their different uses.

The recommended schemes for the buildings are as follows:

- **Hotel** as BREEAM 2014 NC, Building Type: *Other, Residential Institutions*, sub-group *Hotel, hostel, boarding and guest house*
- **Extreme Sports** as BREEAM 2014 NC, Building Type: *Other, Assembly and Leisure*, sub-group *Indoor or outdoor sports, fitness and recreation centre*
- **North-East Building(Health Centre)** as BREEAM 2014 NC, Building Type: *Public (non-housing), Healthcare*, sub-group *Health centres and clinics or GP surgeries* (dependent on final use)

For the hotel which is a detailed planning application, a full pre-assessment has been carried out using BREEAM New Construction fully fitted requirements. Please refer to Appendix A for the preliminary assessment.

For buildings applying for outline planning application (Extreme sports and the North-East Building), a BREEAM strategy has been outlined with full pre-assessments to be carried out within the future detailed planning application.

7.2 Preliminary Scoring

The figures below summarises the target score and potential score. Note that the target score includes both the Low Risk and Medium Risk scores.

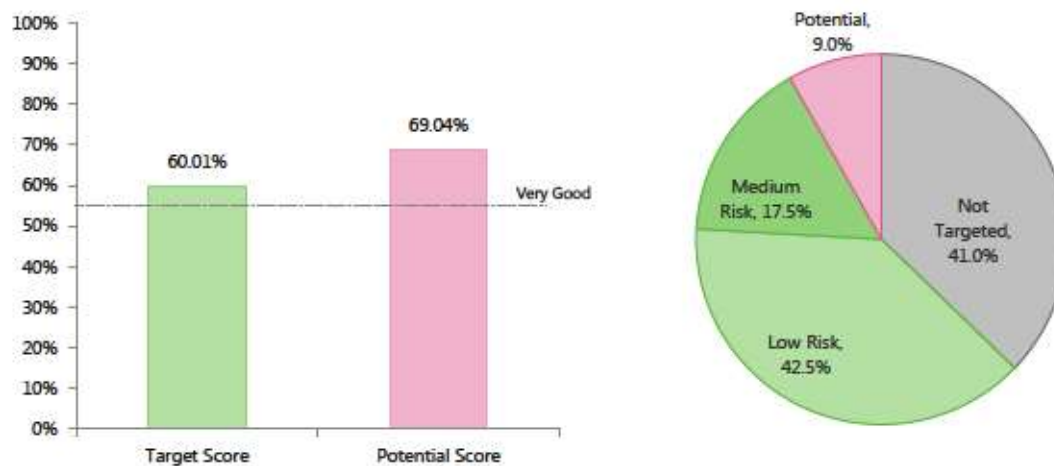


Figure 7-1 Preliminary BREEAM score for the Hotel development

Building Type	Score	Targeted Percentage	BREEAM Level
Hotel <i>Other, Residential Institutions, sub-group Hotel, hostel, boarding and guest house</i>	Total Targeted Score	60%	Very Good
	With Potential Further Score	69%	Very Good

A *Targeted* and *Potential* score has been established for the buildings based on the reports and drawings produced to date. As indicated, the Hotel is scoring above the required 55% to achieve a BREEAM 'Very Good' rating, with an adequate margin of 5%. A number of extra potential credits have been highlighted within the tracking schedule (see Appendix A) It is recommended that these potential credits are assessed at the next stage to investigate their viability.

8 Code for Sustainable Homes

8.1 Introduction

The Code for Sustainable Homes policy was withdrawn in March 2015. Previously, residential buildings were expected by Haringey Council to achieve Code Level 4. Despite its withdrawal, as requested by the Council, the obsolete scheme has been used as a framework to inform the sustainable design of the residential components.

The following sections highlights the key credit areas in which the development would score low risk points.

8.2 Energy

8.2.1 ENE 01: Dwelling Emission Rate

Preliminary SAP calculations have shown that the dwelling would not achieve the three credits required for Code Level 4 without connecting to district heating.

With district heating, it would achieve the equivalent of four credits, exceeding the requirements for Code Level 4, in comparison to the two credits without.

8.2.2 ENE 02: Fabric Energy Efficiency Credits

There are no minimum requirements for this credit for Code Level 4 which has a total of nine credits.

Even without district heating, the tested dwelling scores full credits for the fabric energy efficiency, which is significantly better than the minimum level required of Code Level 6.

8.2.3 ENE 03: Energy Display Devices

Two credits are available for displaying energy consumption data to occupants, which is easily achievable.

8.3 Water

8.3.1 WAT 01: Indoor water use

To achieve Code Level 4, the water consumption must be less than 105l/p/day. This is equal to the water consumption level specified as the maximum by the London Plan and is also achievable for this development.

8.4 Materials

8.4.1 MAT 01: Environmental Impact of Materials

This credit assesses the material rating of the five key building elements (roof, external wall, internal walls, floors and windows) based on the 2008 BRE Green Guide. There are 15 credits in total

As all materials within this development are expected to achieve a minimum B rating, the NDP will score highly in this category.

8.4.2 MAT 02: Responsible Sourcing of Materials

Six credits are available for the responsible sourcing of materials; as this development has the aspiration that all materials will be responsibly sourced and locally source where possible, the Project is expected to score highly in this category.

8.5 Surface Water Run-off

8.5.1 SUR 02: Flood Risk

The development will automatically achieve full credits for being located within Flood Zone 1.

8.6 Health and Wellbeing

8.6.1 HEA 04: Lifetime Homes

Haringey Council SP2 requires that new developments are built to 100% Lifetime Homes Standards, and thus the development will automatically score all four credits.

8.7 Summary

From the preliminary analysis of the residential towers, the development would score highly in many of the key categories that have the highest credits available and highest weighing attached. In many cases, the development would score significantly more than the level required for Code Level 4.

9 Further strategies

9.1 Public Realm

Within the Project, there are a number of public realm spaces; these further contribute towards the overall sustainability strategy by:

- Providing valuable community spaces and amenities that will support the integration of the new development within the existing area
- Ensuring that the development thrives during non-match days by providing adaptable spaces that can be used year-round and potentially for public events
- Improving upon the current ecological value of the site, which will be enhanced in line with Haringey Council's Biodiversity Plan – this includes the strategic planting of trees and indigenous species

9.2 Transport

As it is proposed that the new development remains on the current site, existing relationships with the London Borough of Haringey can be further maintained and developed. The Club has already been working with the Borough for some time on improving the transport options for accessing the site, which included introducing the Controlled Parking Zone to alleviate pressure on the streets surrounding the Stadium.

The public transportation infrastructure is already in place, with four railway stations and up to 144 buses an hour serving the stadium area. There has been significant investment over the years from Transport for London, Network Rail and Haringey Council which will deliver significantly enhanced capacity for increased visitors to the new stadium. In particular, the improvements to the Victoria Line have already enhanced the quality and frequency of public transport serving the area.

These efforts are being recognised through the shift in travel patterns to the stadium. In 2003, over 60% of visitors travelled by car; by 2014, this has now been reduced to 42% for weekend fixtures. THFC has set their own target of reducing this number down to a maximum of 23% in the future. The continued modal shift towards public transport will be achieved through the following, many of which are already underway:

- Actively promoting the new stadium as a 'Public Transport Destination', similar to Wembley Stadium
- White Hart Lane station train service is coming under the control of London Underground in 2015
- White Hart Lane station is also planned for redevelopment
- Improvements at Seven Sisters station interchange is underway
- Network Rail are scheduled to introduce 'three tracking' for the section through Tottenham Hale and Northumberland Park
- THFC will be operating two new shuttle bus services
- Removal of the Tottenham Hale Gyratory is now largely complete which involves the construction of a bus station whilst also alleviating congestion
- An expanded matched-day Controlled Parking Zone will take place
- Construction for the Cycle Superhighway 1 (CS1) which will run between White Hart Lane and Liverpool Street Station has commenced

Appendix A BREEAM Assessment

1.0 Introduction

The Building Research Establishment Environmental Assessment Method (BREEAM) is a leading design and assessment method for sustainable buildings. It sets the standard for best practice within the industry by using recognised measures of environmental performance, which are set against established benchmarks. These measures range from categories such as Energy to Ecology, and seek to evaluate the building across its lifespan – from the design to the construction and subsequent operation of the development.

1.1 Applicability

A BREEAM pre-assessment will identify the building's environmental strengths and weakness, after which the client can specify improvements to the building performance before having the assessment formalised. This flexibility of BREEAM subsequently allows the assessment to exert influence on the building design from an early stage.

For this development, the BREEAM New Construction 2014 Scheme will be used to assess the buildings and determine their score and BREEAM rating. The award of a BREEAM certificate is in two stages:

- **Interim Design Stage**

The BREEAM scheme offers certification of the building as designed. The assessment should be completed and certified at, or shortly after, RIBA Stage 4 and is based on design team drawings, specifications, contract terms and conditions, design studies and reports.

The role of the assessor during this stage is to assess the evidence submitted and determine whether credits can be awarded by comparison to the published BREEAM benchmarks.

- **Post-Construction Stage**

Shortly after project completion and handover, the building is reassessed based on as-built information which will largely be provided by the contractor(s). The purpose is to demonstrate the completed building still meets the requirements of the rating achieved at the design stage.

There is significant risk that a completed building will not achieve the same score and rating as given during the design stage. This is likely to be for two reasons:

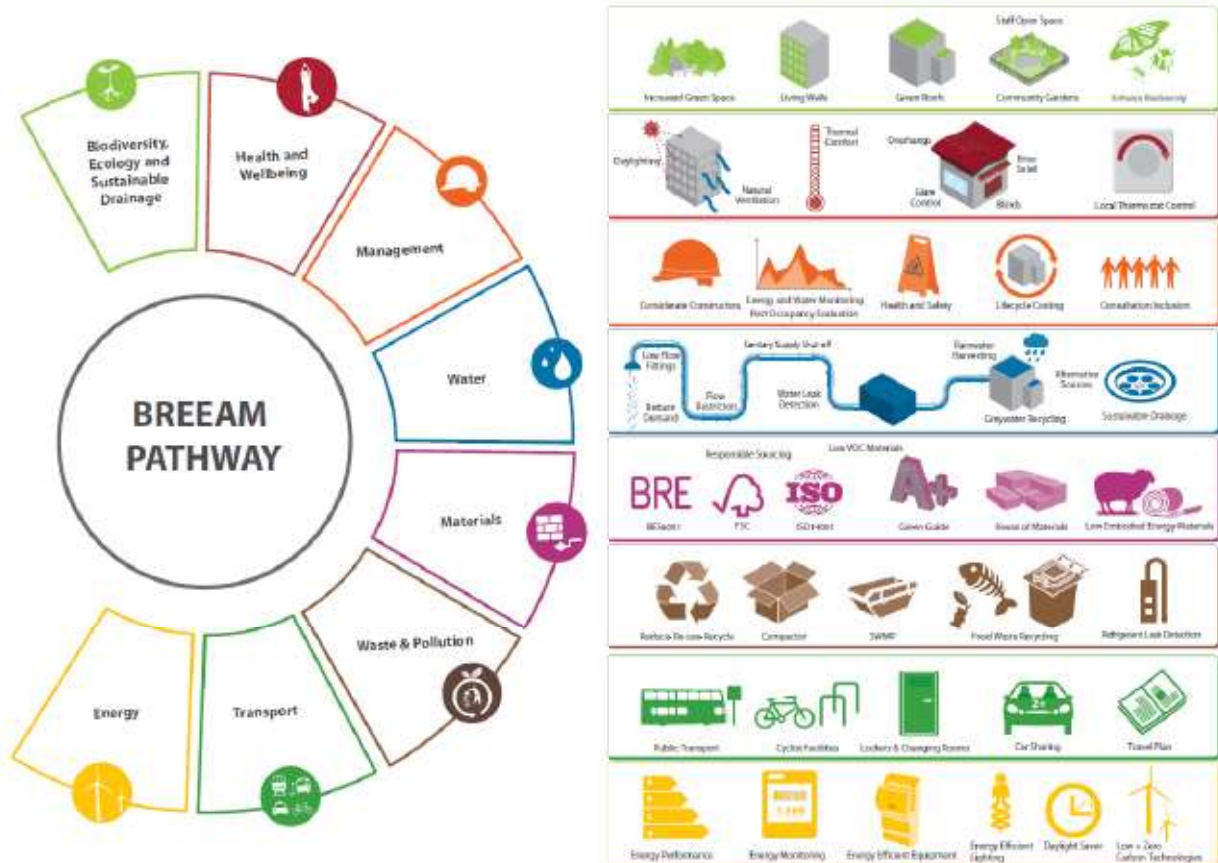
- Documentary evidence derived from the contractor is inadequate, e.g. poor site records
- The design has been changed between Design Stage and completion

1.2 Procurement routes

The timing of the Design Stage Report and the award of the interim certificate is dependent upon the programme and procurement route. Typically, it may occur shortly after RIBA Stage 4. The responsibility for the delivery of the design information must be determined and agreed, particularly if there is a contractor design element. Where this is the case, the Design Stage Report is completed and submitted sometime after the appointment of the contractor. Appropriate terms and conditions must form part of the contract to ensure that the contractor's design information is made available to the BREEAM assessor at the earliest opportunity.

2.0 BREEAM Methodology

The assessment is broken down into nine categories, each of which comprises of a number of credits:



An extra 10% of credits are also available for achieving exemplary performance standards for some credits and for including innovative features or systems.

Credits are awarded based on the evidence received and totalled to provide a BREEAM score. The score is then converted into a rating as follows:

Rating	Score
Pass	30-45%
Good	45-55%
Very Good	55-70%
Excellent	70-85%
Outstanding	85%+

2.1 BREEAM Scoring

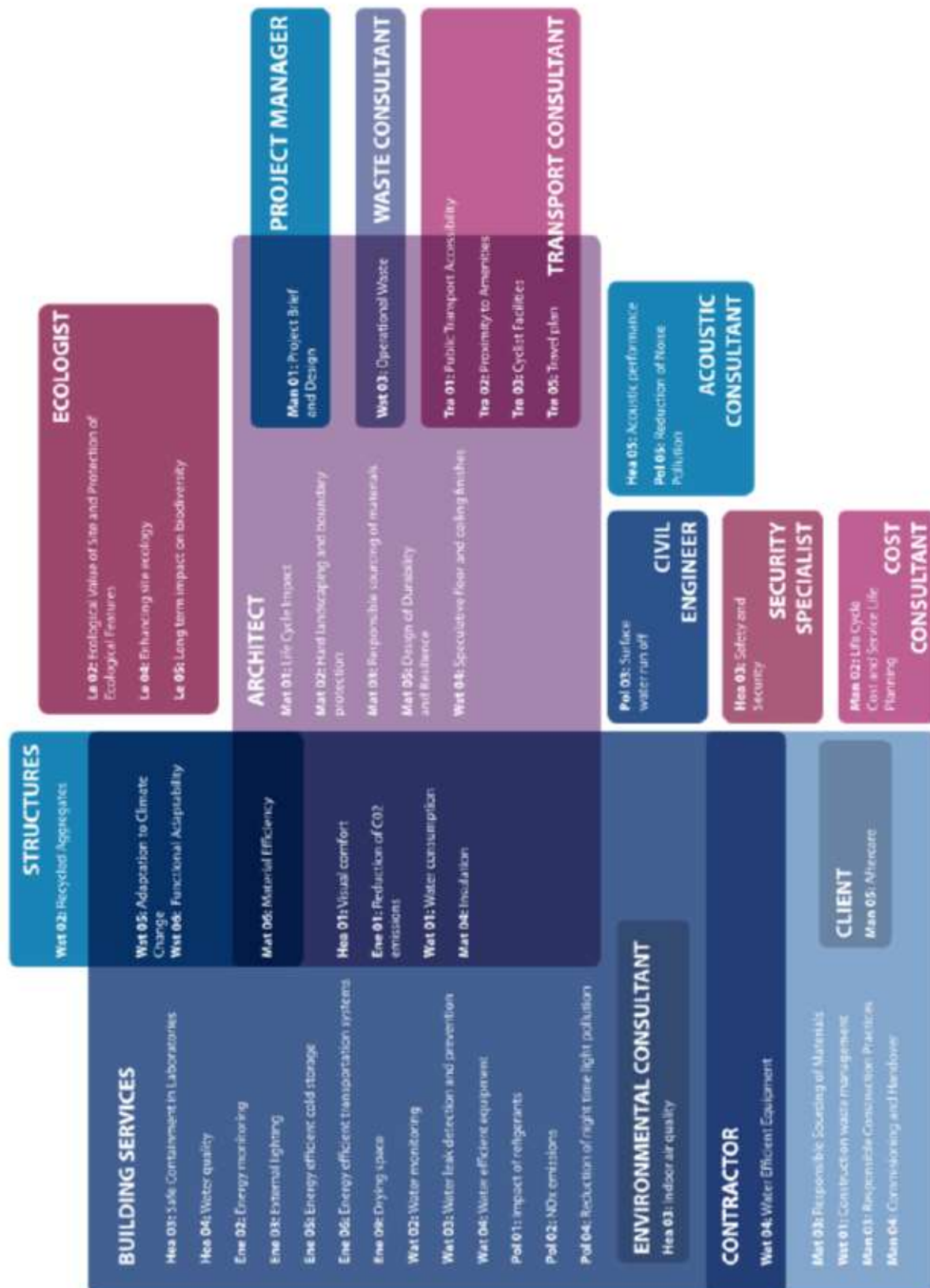
Within each category, there are a number of relevant issues assessed as 'credits'. The number and value of individual credits are not equal. As such, BREEAM puts particular emphasis on measuring energy consumption, carbon emission and health and wellbeing, whilst placing less on waste and water.

To achieve BREEAM 'Very Good' ratings, the building must meet achieved scores in excess of 55%, or in excess of 70% of a BREEAM rating of 'Excellent'. In addition to this, there are a number of mandatory credits to be achieved for these ratings:

BREEAM issue	Mandatory Requirement	
	<i>Very Good</i>	<i>Excellent</i>
Man 03: Responsible construction practices	None	One credit
Man 04: Commissioning and handover	None	Criterion 10
Man 05: Aftercare	None	One credit
Ene 01: Reduction of energy use and carbon emissions	None	Five credits
Ene 02: Energy monitoring	One credit	One credit
Wat 01: Water consumption	One credit	One credit
Wat 02: Water monitoring	Criterion 1	Criterion 1
Mat 03: Responsible sourcing of materials	Criterion 1	Criterion 1
Wst 03: Operational waste	None	One credit
LE 03: Minimising impact on existing site ecology	One credit	One credit

2.2 Roles and Responsibility

The diagram below identifies the design teams credit roles and responsibilities. A number of credits are associated to more than one design team member, as this is the case collaboration between the design team is important to achieving BREEAM.



3.0 Scope of BREEAM Assessment

3.1 Planning Requirements

London Borough of Haringey requires that all non-residential developments are to be designed and built to a minimum BREEAM 'Very Good' with aspirations for BREEAM 'Excellent'. The threshold for major non-residential applications is 1000m² or more.

3.2 Proposed Development

BREEAM 2014 New Construction (NC) will be used to assess the proposed buildings on site. BREEAM 2014 New Construction covers a wide range of building types within the scheme. Separate assessments however will be required for each proposed building.

The recommended schemes for the buildings are as follows:

- **Hotel** as BREEAM 2014 NC, Building Type: *Other, Residential Institutions*, sub-group *Hotel, hostel, boarding and guest house*
- **Extreme Sports** as BREEAM 2014 NC, Building Type: *Other, Assembly and Leisure*, sub-group *Indoor or outdoor sports, fitness and recreation centre*
- **Healthcare** as BREEAM 2014 NC, Building Type: *Public (non-housing), Healthcare*, sub-group *Health centres and clinics or GP surgeries* (dependent on final use)

For detailed planning application, a full pre-assessment will only be carried out for the Hotel using BREEAM New Construction fully fitted requirements.

For outline planning application, a BREEAM strategy will be outlined for both the Extreme Sports building and Healthcare Centre, with full pre-assessments to be carried out a later design stage.

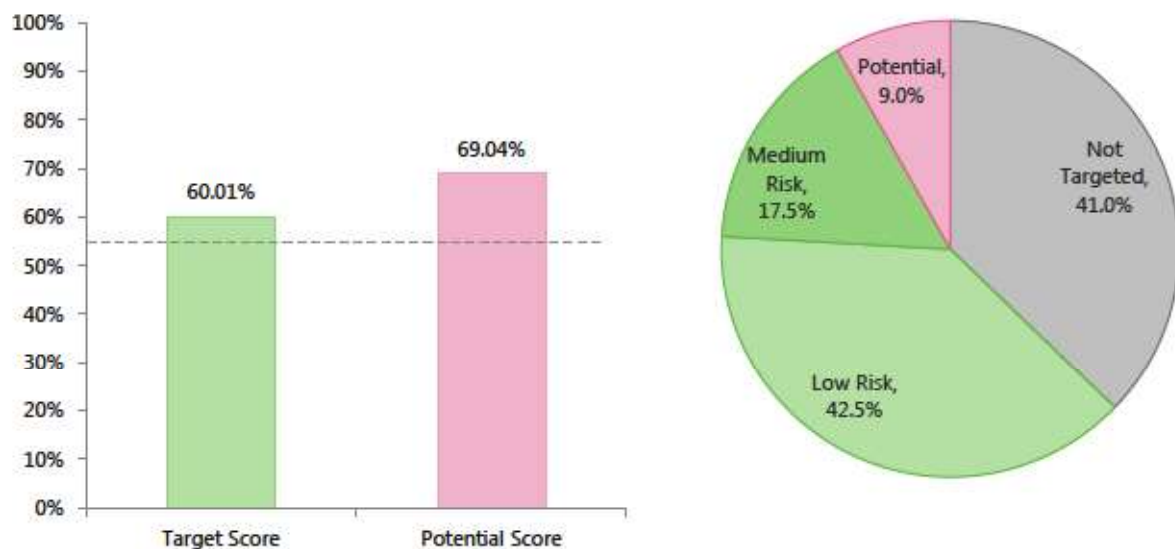
4.0 Preliminary Assessment Scores

4.1 Targeted Rating

After a preliminary review of the development and taking into account the site opportunities and constraints, it has been decided that a target of BREEAM 'Very Good' with a healthy margin will be aimed for.

4.2 Summary of Score

The figures below summarises the target score and potential score. Note that the target score includes both the Low Risk and Medium Risk scores.



Building Type	Score	Targeted Percentage	BREEAM Level
Hotel <i>Other, Residential Institutions, sub-group Hotel, hostel, boarding and guest house</i>	Total Targeted Score	60%	Very Good
	With Potential Further Score	69%	Very Good

A Targeted and Potential score has been established for the buildings based on the reports and drawings produced to date. As indicated, the Hotel is scoring above the required 55% to achieve a BREEAM 'Very Good' rating, but with an adequate margin of 5%. A number of extra potential credits have been highlighted within the tracking schedule (see Section 8.0 of Appendix 1). It is recommended that these potential credits are assessed at the next stage to investigate their viability.

5.0 Credits Summary

Within the targeted score, there are low and medium risk credits; medium risk credits are those that are being targeted but at this stage it is not certain whether they can be achieved.

The table below highlights credits in the medium risk credits. In order to achieve these credits, commitment from the client or design team will be required to ensure they are achievable.

Issue ID	Total Credits Available	Targeted Credits – Medium Risk	Requirements
Man 03 – Monitoring of Construction Site Impacts	2	2	Responsibility to monitor construction site impact includes: - Monitor and record data on principal constructor's and subcontractors' energy and water consumption and total carbon dioxide emissions - Monitor and record data on transport movements and impacts resulting from transport of materials and waste. In addition, report the total fuel consumption and carbon emissions These requirements can be achievable if there is the cost and time commitment from the onset from the client and contractors.
Man 04 – Testing and Inspecting Building Fabric	1	1	The integrity of the building fabric is quality assured through completion of post construction testing and inspection. This can be demonstrated through the completion of a thermographic survey as well as an airtightness test and inspection. The survey and testing must be undertaken by a Suitably Qualified Professional. Any defects identified must be rectified prior to building handover and close out. This is achievable but will incur additional expensive and will therefore need client approval.
Man 04 - Handover	1	1	A Building User Guide (BUG) is developed prior to handover, for distribution to the building occupiers and premises managers. A training schedule is also prepared which includes the following as a minimum: - Building design intent - Available aftercare provisions and contact - Introduction and demonstration of installed systems and key features - Introduction to the BUG and other relevant building documentation - Maintenance requirements This is achievable but will require additional time and cost expense to the client.
Man 05 – Seasonal Commissioning	1	1	The following seasonal commissioning activities will be completed over a 12 month period, once the building becomes substantially occupied: - Testing of all building services under full load conditions - Testing during periods of extreme occupancy - Interviews with building occupants when affected by the building systems - Recommissioning of systems following any worked needed with update to the Operations & Maintenance manual - Review thermal comfort, ventilation and lighting at three, six

			and nine moth intervals by measurement or surveys This is achievable but will require additional time and cost expense to the client.
Man 05 – Post Occupancy Evaluation (POE)	1	1	This requires the client to make a commitment to commission a POE, which must be carried out by an independent third party and one year after initial building occupation. The requirements are: • A review of the design intent and construction process • Feedback on the design and environmental conditions of the building These requirements are readily achievable but require a cost commitment from the client.
Man 05 – Exemplary Level Criteria	1	1	There is or will be operational infrastructure and resources in place to coordinate the following activities at quarterly intervals for the first three years of building occupancy: • Collection of occupant satisfaction, energy consumption and water consumption data • Analysis of data to check that the building is performing as expected and to make any necessary adjustments • Setting targets for reducing energy and water consumption and to monitor progress towards these • Feedback any 'lessons learnt' to the design team and developer • Provision of actual annual building energy, water consumption and occupant satisfaction data to BRE Again, these requirements are achievable but requires a cost and time commitment from the client.
Hea 01 – Glare Control	1	1	A glare control strategy is in place to design out any potential for disabling glare. The strategy avoids increasing lighting energy consumption by ensuring that the system is design to maximise daylight levels under all conditions while avoiding disabling glare in sensitive locations. The system should not inhibit daylight from entering the space and the use of location of shading does not conflict with the operation of the lighting control systems. This is achievable but will need to be considered at an early design stage and will involve input from various disciplines within the design team.
Hea 01 – View Out	1	1	95% of the floor area is within 7m of a wall which has a window or permanent opening that provides a view out; the window must be $\geq 20\%$ of the surrounding wall area. This is an easy credit to achieve but considerations must be given to how this might affect the indoor building environment.
Hea 01 – Internal and External Lighting Levels, Zoning and Control	1	1	All fluorescent lighting is fitted with high frequency ballasts; for areas where computers are regularly used, lighting must comply with the guidance given in the CIBSE Lighting Guide. All internal and external lighting must be designed to provide illuminance levels appropriate to the tasks and use of the space. Internal lighting should be zoned to allow for occupant control. This is an achievable target but will need to be considered early on in the building environment modelling.
Hea 05 – Acoustic Performance	4	3	Requires an acoustician to be hired to set performance criteria and testing regime for sound insulation, indoor ambient noise level and reverberation times. This is achievable, but will be an additional expense so will require

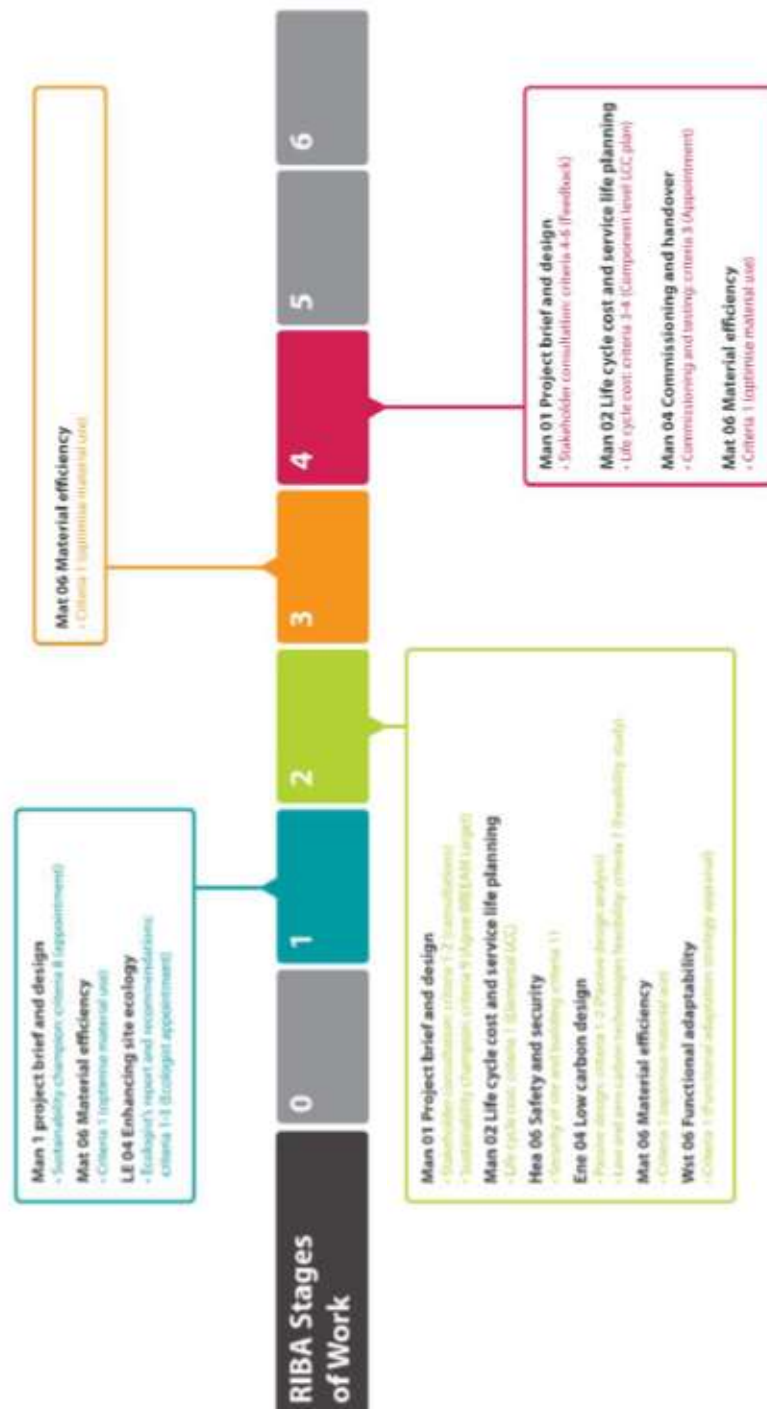
			client approval.
Ene 08 – Energy Efficient Building	2	2	The following is required to demonstrate compliance: - Identify the building's unregulated energy consuming loads and estimate their contribution to the total annual unregulated energy consumption of the building - Identify the systems and/or processes that use a significant proportion of the total annual unregulated energy consumption of the development and its operation - Demonstrate a meaningful reduction in the total annual unregulated energy consumption This is easily achievable through procurement of energy efficient equipment which will ensure optimal performance and deliver energy savings in operation.
Tra 03 – Cyclist Storage	1	1	One space per 10 visitors/beds.
Tra 03 – Cyclist Facilities	1	1	At least two of the following facilities provided: showers, changing facilities, lockers, drying spaces
Tra 04 – Car Parking Capacity	2	2	Maximum parking capacity of 1 space per 6 building users
Tra 05 – Travel Plan	1	1	A travel plan has been developed as part of the feasibility and design stages with a site specific travel assessment. Travel plan should include a package of measures to encourage the use of sustainable modes of transport and movement of people and goods. If the occupier is known, they must be involved in the development of the travel plan and must confirm that it will be implemented post-construction. Achievable but will require integration from early design stages.
Wat 04 – Water Efficient Equipment	1	1	All unregulated water demands are identified that could be realistically mitigated or reduced. Systems or processes are identified to reduce this demand and demonstrate a meaningful reduction in total water demand of the building. Achievable through the specification of water efficient equipment.
Wst 02 – Recycled Aggregates	1	1	Minimise the demand for virgin material through use of recycled and secondary aggregates: % of high grade aggregate that is recycled or secondary must meet the minimum levels as given in the BREEAM guide - Total amount of recycled or secondary aggregate is greater than 25% by weight or volume of the total high grade aggregate specified for the project - Recycled or secondary aggregates are either construction, demolition and excavation waste or secondary aggregates obtained from a non-construction post-consumer industrial by product source. This is in line with the London Plan policy on aggregates and waste.
Pol 05 – Reduction of Noise Pollution	1	1	Noise impact assessment in compliance with BS 7445 has been carried out by a suitably qualified acoustic consultant. The noise levels from the development must be not greater than +5dB during the day and +3dB during the night, or where it is, measures have been installed to attenuate the noise at its source to comply with the levels. Should be achievable as development is on existing THFC site, but will require cost commitment from the client.

The following table highlights the potential additional credits which will need to be confirmed by the design team and/or client if they are feasible. If all credits can be achieved, a 'Very Good' rating with a high margin will be achieved.

Issue ID	Total Credits Available	Targeted Credits – Medium Risk	Requirements
Man 01: Stakeholder Consultation (Third Party)	1	1	Prior to completion of the Concept Design (RIBA Stage 2), the design team must consult all relevant third party stakeholders. Consultation must cover the minimum consultation content. The project must demonstrate how the stakeholder contributions and outcomes have influenced or changed the initial project brief and concept design. Although this is standard practice, it will be an extra expense and will therefore require client approval.
Hea 02 - Ventilation	1	1	Building has been designed to minimise the concentration and recirculation of pollutants in the building. Not currently included in scope but is achievable.
Hea 02 – Exemplary Level Criteria	2	1	Further requirements for the VOC emissions of products, more onerous than those of the first credit. Architect to confirm low VOC products can be specified. Contract preliminaries to ensure that testing is undertaken to show compliance. Client to confirm whether they would be happy for this to be undertaken. This is not seen as difficult however will be at an extra cost to the client.
Ene 01 – Energy Performance	12	3	The Energy Strategy is currently being undertaken. It is uncertain how many credits can be achieved until this has been finalised. The score will be dependent on whether connectivity to district heating is available.
Wat 01 – Water Consumption	5	1	The development must achieve a 12.5% improvement over baseline building water consumption. The Water Strategy is currently being undertaken. With the inclusion of water efficient fittings, there is potential to achieve more than 1 credit but this will not be known until the Water Strategy has been finalised.
Mat 06 – Material Efficiency	1	1	This credit is about identifying material efficiency opportunities and ensuring that appropriate measures investigated and implemented, to optimise the use of materials in building design, procurement, construction, maintenance and end of life. This should have started occurring from Stage 1.
Wst 05 – Adaption to Climate Change	1	1	Conduct a climate change adaptation strategy by end of RIBA Stage 2. This should be occurring now.
Wst 05 – Exemplary Credit	1	1	Must either achieve Hea 04 – Adaptability for a project climate change scenario which requires thermal modelling at an additional cost. This is achievable. OR; Achieve at least 8 credits in Ene 01 which is highly unlikely.
Pol 03 – Surface Water Run Off (Second credit)	1	1	Drainage design measures are specified to ensure that post development run-off volume over the lifetime of the development is no greater than it would be been prior with any addition run-off prevented from leaving site using Sustainable Drainage System techniques. If this is not possible, justification from the Appropriate Consultant and design measures are specified to reduce run off to limiting discharge. This cannot be confirmed until the Water Strategy has been finalised.

6.0 Other Considerations

Certain BREEAM credits require inputs at specific stages of the development, these credits are listed below and action should be taken to consider them immediately as some are relevant to RIBA Stage 1 and 2.



7.0 Next Steps

The following steps should be undertaken at the next stage to ensure the BREEAM Very Good target is achieved.

- Register schemes with the BRE
- Undertake a workshop with the team to ensure they are on track to achieve the targeted credits
- Identify with the design team which of the potential credits could be achieved.
- Start collation of evidence for early stage credits
- Input BREEAM requirements into contract documents and specifications

8.0 BREEAM Tracking Schedule

[illegible]

MEASURE CREDIT (mandatory credits always valid)	Available credits	N. Score Value	RMA Stage	Targeted credit / (score point)	Targeted credit / (score point)	Available credits	Not Targeted	Approved credits	Overriding	Comments
HEALTH & WELLBEING										
HEAT 01 - Visual comfort										
Glare Control	2	0.40%			1				Not Targeted	Lighting modelling to reduce glare without increasing energy consumption
Daylighting	2	0.40%					3		Approved credits	Min. of floor area within 7m of a wall with a window
Visual Quality	3	0.40%			1				Approved credits	Interior lighting is suitable for the intended use of the building
Interior natural daylight lighting levels, zoning and control	3	0.40%			1				Approved credits	Interior lighting is designed to provide suitable light to enable users to perform outdoor tasks efficiently and accurately during the night
Overhead lighting control	3	0.40%					3		Approved credits	Overhead lighting for daylighting has been met
HEAT 02 - Indoor air quality										
Indoor Air Quality Plan	1	0.40%			1				Approved credits	Indoor Air Quality Plan
Non Tobacco	3	0.40%							Approved credits	Building designed to minimise the concentration and recirculation of pollutants in the building
Volatile Organic Compound (VOC) Emission Levels (products)	2	0.20%			1				Approved credits	
Volatile Organic Compound (VOC) Emission Levels (Paints)	3	0.40%			1				Approved credits	
Provision for Natural Ventilation (heat, temperature, pressure)	3	0.40%					3		Approved credits	Charged spaces are designed to be capable of providing fresh air within an indoor ventilation, the strategy must have been tested at least once
Compliance with CIBSE	3	0.40%					3		Approved credits	Provision credits achieved to comply with CIBSE
HEAT 03 - Safe Environment to Interact										
Indoor environment: broken and contaminated areas	1	0.40%	Stage 3						Approved credits	
Buildings with contaminated level 2 and 3 mandatory facilities	3	0.40%							Approved credits	

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Sustainability Report
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Project Goals (Mandatory Goals - Green cell)	Available credits	N. Score Value	RMS Stage	Targeted credits (not this)	Targeted credits (not this)	Available credits	Not Targeted	Assigned credits	Ownership	Comments
Box 04 - Low Carbon Design										
Passive Design Analysis	0	0.00%	Stage 3	1					Sustainability	
Green Building	0	0.00%					1		MEP Architect	
Low and Zero Carbon Feasibility Study	0	0.00%	Stage 2	2					Physics	UK Technology Feasibility Study
Box 05 - Energy efficient cold storage										
Refrigeration Design Consultation	0	0.00%					0		MEP	If used, refrigeration systems are consistent with the limits of limited low carbon solutions in the refrigeration sector.
Options to reduce heat emissions	0	0.00%					0		MEP	Using to reduce greenhouse gas emissions into operational life.
Box 06 - Energy efficient refrigeration systems										
Refrigeration Systems	0	0.00%							UK Consultants/MEP	
Design Efficient Features	0	1.50%							UK Consultants/MEP	
Box 07 - Energy efficient laboratory systems										
Pre Analysis	0 or negligible	N/A								
Design Specifications	0	0.00%	Stage 1						Client/ Architect	Subsidiary requirements are agreed from the client.
Best Practice Energy Efficiency Measures	0	2.75%							MEP	
Box 08 - Energy efficient equipment										
Energy Efficient Equipment	0	4.00%					1		MEP Architect	From site or equipment energy consuming limits and demonstrate meaningful reduction.
Box 09 Energy Spare										
Energy Spare	0	0.00%							MEP	

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Item/Task/Details	Analysis results	% Save VSAR	MSA Stage	Proposed credit (see 3.1.1)	Proposed credit (see 3.1.1)	Proposed credit (see 3.1.1)	Not Proposed	Not Proposed	Ownership	Comments
TRAFFIC										
Tra B1 - Public Transport Accessibility										
Public Transport Accessibility Index (AI)	5	0.82%		3					Architect / BESAM Architects	Use of BESAM AI software.
Public Transport Service	1	0.82%							Architect / BESAM Architects	
Tra B2 - Priority to Access										
Priority to Access	1	0.82%		3					Architect / BESAM Architects	Analysis of layout & access.
Tra B3 - Cycle Facilities										
Cycle Storage	1	0.82%							Architect / BESAM Architects	
Cycle Facilities	1	0.82%							Architect / BESAM Architects	
Cycle Storage and Cycle Facilities	1	0.82%							Architect / BESAM Architects	
Tra B4 - Maximum Car Parking Capacity										
Car parking Capacity	2	0.82%		3					Architect / BESAM Architects	Car parking capacity dependent on AI.
Tra B5 - Travel plan										
Travel plan (see 3.1.1)	1	0.82%		3					Architect / BESAM Architects	Travel Plan developed with site specific travel assessment. Statement.

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Item/Task/Details	Analysis results	% Save VSAR	MSA Stage	Proposed credit (see 3.1.1)	Proposed credit (see 3.1.1)	Proposed credit (see 3.1.1)	Not Proposed	Not Proposed	Ownership	Comments
WATER										
Wat B1 - Water Consumption										
Water Consumption	5	3.89%		3		2			MPS/Architect BSI, BESAM	BESAM Wat B1 Calculator
Recycling and Collection	1	3.89%				1				Recycled water at every day level.
Wat B2 - Water Recycling										
Water Recycling	1	0.18%		3					MIP	Use of water meters on main supply and any area consuming 10% or more of the total water demand.
Wat B3 - Water Leak Detection										
Leak Detection System	1	0.18%		3					MIP	
Flow Control Device	1	0.18%		3					MIP	
Wat B4 - Water Efficient Equipment										
Water Efficient Equipment	1	0.18%		3					MIP/Computer	

Project Overview		Key Milestones		Timeline		Status		Risk Assessment		Reporting		Approval		Comments	
Project Name		Start Date		End Date		Progress		Risk Level		Report Date		Approved By		Remarks	
Project Alpha		2023-01-01		2023-03-31		85%		Low		2023-02-15		John Doe		On Track	
Project Beta		2023-04-01		2023-06-30		60%		Medium		2023-05-01		Jane Smith		Minor Delay	
Project Gamma		2023-07-01		2023-09-30		30%		High		2023-08-01		Mike Johnson		Significant Risk	
Project Delta		2023-10-01		2023-12-31		10%		Low		2023-11-01		Sarah Lee		On Hold	

Item Code Details <i>(Reference to Codes, phases and</i>	Available units	% Green Value	Risk Stage	Required units (see 10%)	Required units (see 10%)	Required units (see 10%)	Required units (see 10%)	Demolition	Comments
W0001									
W001 - Construction Waste Management									
Construction Resource Planning	3	3.00%						Contractor	Waste has been designed construction waste
Construction Resource Planning	3	3.00%						Contractor	
Construction Resource Planning	3	3.00%						-	
Construction Resource Planning	3	3.00%						Contractor	
Construction Resource Planning	3	3.00%						Contractor	
Construction Resource Planning	3	3.00%						Contractor	
W002 - Recycled Aggregate									
Recycled Aggregate	3	3.00%						Contractor	
Recycled Aggregate	3	3.00%						Contractor	
W003 - Operational waste									
Operational Waste	3	3.00%						W001 Client / Contractor	Provision for waste due to the operation of the building.
Operational Waste	3	3.00%						W001 Client / Contractor	
W004 - Adaptation to Climate Change									
Adaptation to Climate Change	3	3.00%						Check/Design	
Adaptation to Climate Change	3	3.00%						Structures	
Adaptation to Climate Change	3	3.00%						Structures	
W005 - Functional Adaptability									
Functional Adaptability	3	3.00%						Structures	

Available Credits	% Score Value	Risk Score	Targeted Credits (with 10% contingency)	Targeted Credits (with 5% contingency)	Targeted Credits (with 0% contingency)	Not Targeted	Over/Under	Comments
LAND USE & ECOLOGY								
1201 - Site Selection								
Previously Occupied and Contaminated Land	3	1.00%	3	3		3		Client's interest in use of previously developed land
	3	1.00%						BC Guidance - BC
1202 - Biological Value of Site and Protection of Biological Features								
Level of Low Ecological Value	1	1.00%				1		Biological / BFI Ecological Package
Retention of existing ecological features	3	1.00%				3		Level of Ecological report of BIC2 And also this.
1203 - Mitigating Impact on Existing Site Ecology								
Change in Ecological Value 1	2	2.00%				2		Ecological / BFI Ecological Report
Change in Ecological Value 2	1	1.00%				1		Ecological / BFI Ecological Report
1204 - Enhancing Site Ecology								
Ecological Report and Recommendations for the Project and the Site	1	1.00%	Stage 1 Ecological Package	3				Ecological to be appropriate
Ecological Report and Recommendations for the Project and the Site	2	2.00%	Stage 1 Ecological Package					Ecological to be appropriate
Ecological Report and Recommendations for the Project and the Site	3	1.00%	Stage 2 Ecological Package			1		Ecological to be appropriate
Ecological Report and Recommendations for the Project and the Site	3	1.00%	Stage 2 Ecological Package					Ecological to be appropriate
Ecological Report and Recommendations for the Project and the Site	3	1.00%	Stage 2 Ecological Package					Ecological to be appropriate
1205 - Long Term Impact on Biodiversity								
Long Term Impact on Biodiversity	2	2.00%				2		Five Year Landscape & Habitat Management Plan

Available credits	% save value	100% target	Targeted credits (from 100%)	Targeted credits (from 100%)	Targeted credits (from 100%)	Not Targeted	Additional credits	Ownership	Comments
POLLUTION									
Part 01 - Impact of Refrigerants									
No Refrigerant Use	0	2.21%						MDP	
Pre-Regulate	0	N/A						MDP	
Impact of Refrigerant	2	1.54%				2		MDP	
Leak Detection	3	0.77%				3		MDP	
Credit Aim: To encourage the supply of test and/or results from a system that minimises NOx emissions, and therefore reduces pollution of the local environment.									
Part 02 - NOx Emissions									
NOx Emissions	0	2.21%						MDP	
All buildings except individual NOx Emissions	2	1.54%						MDP	
Part 03 - Surface Water Run Off									
Roof Runoff									
Surface Water Run Off - Pre Regulation	0	N/A						Civil Engineer	Visual Risk Assessment
Surface Water Run Off - Credit 1	3	0.77%						Civil Engineer	
Surface Water Run Off - Credit 2	3	0.77%				3		Civil Engineer	
Minimising Maintenance Pollution	3	0.77%						Civil Engineer	
Surface Water Run Off	2	1.54%						Civil Engineer	
Surface Water Run Off	3	0.77%						Civil Engineer	
Part 04 - Reduction of Night Time Light Pollution									
Reduction of Night Time Light Pollution	3	0.77%				3		MDP	
Part 05 - Reduction of Noise Pollution									
Reduction of Noise Pollution	2	0.77%						Acoustician	Visual Impact Assessment
Part 06 - Noise Pollution									
Part 07 - Noise Pollution									
Part 08 - Noise Pollution									
Part 09 - Noise Pollution									
Part 10 - Noise Pollution									
Standard Enclosure credits (Max. 10)	10	10.00%				10	0		
Approved Structures	0	0.00%				0	0		Open structures to be in with research to be discussed with the University.
Total: a maximum of 10 credits on the construction of the building									

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Northumberland Development Project

Energy Strategy for Planning

031627

28 August 2015

Revision 01

Revision	Description	Issued by	Date	Checked
00	Draft for review	JD	14/08/15	SW
01	Final for issue	JD	28/08/15	SW

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author **James Davies**

date **28/08/15**

approved **Simon Wright**

signature 

date **28/08/15**

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1 Introduction

This documents sets out the proposed energy strategy for the Northumberland Development Project located in Haringey, North-East London. This document has been prepared in alignment with GLA guidance "Greater London Authority guidance on preparing energy assessments (April 2015)" and other accompanying documentation from both the GLA and Haringey.

1.1 Description of the scheme

The Northumberland Development Project is a major development located in the Borough of Haringey on and surrounding the existing White Hart lane stadium. The development will be constructed in several phases with the Stadium being completed initially, followed by the other buildings at varying stages. A render of the proposed development is shown in Figure 1—1 and comprises of the following components:

- **Stadium (D)** - 61,000 seat capacity with suitability for 55,000 capacity music concert use
- **Hotel (D)** - 180 bed hotel with 49 serviced apartments
- **Tottenham Experience (D)** - Museum, megastore and other assorted uses
- **Residential Towers (O)** - 585 dwellings and business community uses at plinth level
- **Extreme Sports (O)** - Sports/activity centre
- **North-East building (O)** - Community health centre

The application is a hybrid application seeking part outline and part detailed planning permission (indicated above O=Outline, D= Detailed). The varying levels of detail submitted for approval are referenced throughout the document, as this has an impact on the level of detail and analysis present in this document.



Figure 1—1 Proposed development

1.2 Policy and Drivers

1.2.1 Building Regulations Part L 2013

Part L of the 2013 Building Regulations refers to the Conservation of Fuel and Power in both new construction dwellings (Part L1A) and non-domestic buildings (Part L2A). These documents stipulates a minimum level of efficiency that buildings must be constructed to. The guide to the regulations (Approved Documents) must be read in conjunction with other supporting documents, such as the National Calculation Methodology (NCM) Modelling Guide 2013.

Compliance with these regulations is demonstrated through thermal modelling analysis. For domestic buildings this is demonstrated through SAP (Standard Assessment Procedure calculations) and for non-domestic buildings dynamic simulation energy modelling or SBEM (Simplified Building Energy Model) is required.

1.2.2 London Plan

The London Plan is a policy planning framework for the Greater London Area, within which Haringey is located. This document is intended as an overarching policy to inform all of the London Boroughs and facilitate achievement of the ambitious climate change targets. By definition the document has been incorporated within London Borough of Haringey's policies. For clarity the key energy related requirements are outlined below.

Energy	5.2 Minimising CO2 Emissions	Developments should achieve a carbon emission improvement of 35% on Part L 2013 Building Regulations, or as per Building Regulations requirements after 2016
	5.3 Sustainable Design and Construction	Developments must demonstrate that sustainable design standards are integral to the proposal and is applicable to the design, construction and operation stage of this project. Further guidance in the Mayor's Supplementary Planning Guidance (SPG)
	5.6 Decentralised Energy in Development Proposal	Development should evaluate the feasibility of decentralised energy networks including Combined Heat and Power (CHP) systems
	5.7 Renewable Energy	Seek to reduce emissions in line with Policy 5.2 via use of onsite renewable energy options. There is a presumption that all major development proposals will seek to reduce carbon emissions by at least 20% through renewable energy where feasible
	5.9 Overheating and Cooling	Developments should demonstrate how the proposal will seek to minimise potential overheating and reliance on air conditioning systems

1.2.3 London Borough of Haringey

In addition to the overarching policies of the London Plan, Haringey has several strategic policies included within its Local Plan, and further elaborated upon within the Supplementary Planning Guidance documents. The most relevant energy-related policy is 'SP4: Working towards a low carbon Haringey'.

This sets out requirements for all developments to assess the viability of connecting to existing heating and cooling networks, provision of site wide CHP, and communal heating and cooling systems. This is in line the GLA London Plan expectations and should follow the same energy hierarchy. The Local Plan also specifies a 20% reduction in carbon emissions from onsite renewable energy regeneration, which can include connections to local sources of decentralised renewable energy.

As previously stated, unless local policies are more stringent, the London Plan requirements should take precedence in defining the most onerous targets for the development.

2 Approach

2.1 Strategy

In accordance with planning policy, the energy strategy for the development has been developed in alignment with the energy hierarchy; Lean, Clean, Green.

This approach aims to minimise energy consumption from the outset through the use of efficient massing, passive measures and efficient systems before the deployment of low and zero carbon technologies.

- Lean: Maximise energy efficiency
- Clean: Supply energy efficiently using low carbon heating and cooling systems
- Green: Incorporate renewable energy



2.2 Energy modelling methodology

As stipulated by planning policy guidance, all Carbon Dioxide emissions of the proposed development must be reported on. In order to provide this information, energy modelling has been performed on the entire development and the results are presented throughout this report. Two different methodologies have been utilised to assess the non-domestic and domestic elements of the scheme, in order to produce the required outputs for reporting purposes. These have been used to estimate the baseline CO₂ emissions values as well as the Carbon Dioxide emissions dioxide reductions achieved from application of the Lean, Clean, Green hierarchy.

The Table 2—1 below summarises the utilised methodologies.

Table 2—1 Modelling methodologies

Typology	Methodology (software)	Required for
New build – Domestic	SAP (STROMA)	Building regulations/Planning Policy
New build – Non-domestic	Dynamic simulation model (IES)	Building regulations/BREEAM/Planning Policy

Carbon Dioxide emissions reductions achieved through the design proposals have been detailed for each of the different building typologies within the development, as well as collectively to demonstrate the whole development performance.

2.2.1 Unregulated energy

The energy modelling methods outlined above refer to the regulated energy demands within the development i.e. space heating, domestic hot water, fixed lighting, fans and pumps. Planning policy requires that reporting on unregulated energy demand is also required for the development.

Energy modelling of non-domestic typologies (utilising NCM methodology) provides an estimate of unregulated Carbon Dioxide emissions in the form of 'Equipment' loads. For domestic units the BREDEM (Building Research Establishment Domestic Energy Model) methodology has been adopted.

2.3 Detailed & Outline Planning Permission

The planning application is a hybrid application that seeks part detailed and part outline planning permission. Based on this level of approval sought, the level of detail for each building is very varied and has been reflected through the CO₂ emissions analysis performed. Strategies have been explored for the site as a whole and are explained within the body of the report, but the detailed assessments of each individual building are reflective of this varied level of design.

A summary of the approach used has been presented below:

Permission Sought	Level of Design	CO ₂ emissions assessment
Detailed	Complete architectural plans, sections and elevations Concept MEP strategies	Full Part L modelling analysis
Outline	Basic form (excluding facades details) Basic programme of use typologies	Non-domestic - Estimate of CO ₂ emissions based on industry benchmarks or similar projects Domestic – Estimate of CO ₂ emissions based on indicative apartment layout modelling

Information presented for buildings seeking outline permission will be refined at the subsequent reserved matters application stage through the use of full dynamic thermal modelling. At this stage an estimate has been produced to reflect the potential carbon emissions impacts from the development as a whole.

3 Site-wide systems

In order to deliver the greatest savings in Carbon Dioxide emissions possible, the feasibility of site-wide systems suitable for the development have been explored below.

3.1 Decentralised energy networks

London Borough of Haringey and the Greater London Authority strongly promote the implementation of decentralised energy networks (DENs) across London. In alignment with planning policy, the feasibility of a DEN within the context of the development has been assessed through the following hierarchy:

1. Connection to existing/proposed networks
2. Development of a DEN
3. Site-wide network

3.1.1 Planned Haringey DEN

With any new development, the potential to connect into an existing or proposed DEN can provide significant benefits for the reduction of Carbon Dioxide emissions for the development itself and the wider network. Exploring connection into a planned network can increase the viability of the network itself by creating additional demand and future revenues.

At present there are no existing DENs located in the vicinity of the development. However, the area has been identified as a key development area within the Haringey Sustainable Design and Construction SPG¹. The identified area can be seen as Zone 1 in Figure 3—1 largely driven by the proposals for the regeneration of the Northumberland Park area².

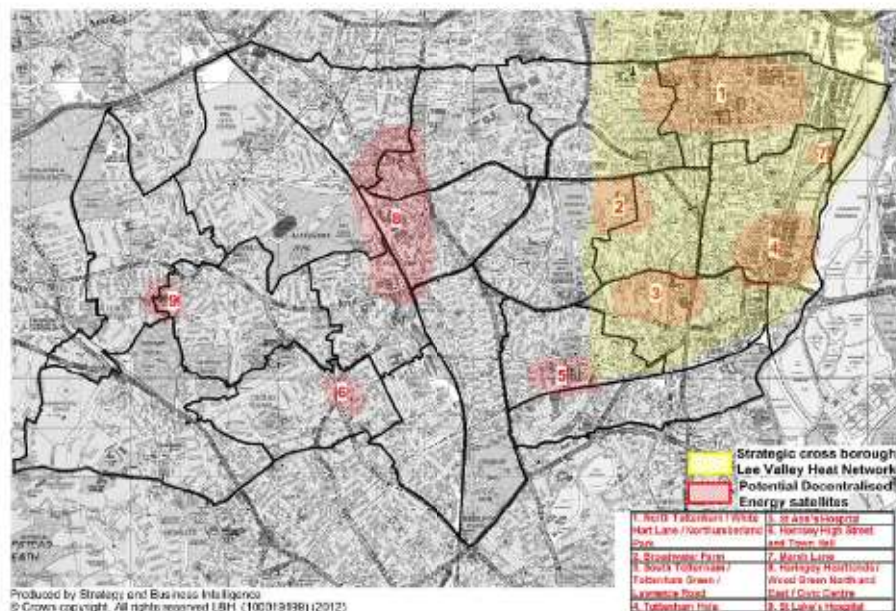


Figure 3—1 Potential for decentralised energy in Haringey (Local Plan: Sustainable Design and Construction SPG Appendices Pg 8)

¹ <http://www.haringey.gov.uk/housing-and-planning/planning/planning-policy/local-development-framework-ldf/supplementary-planning-guidance-documents/sustainable-design-and-construction-spd>

² <http://www.haringey.gov.uk/housing-and-planning/tottenham/tottenham-regeneration/northumberland-park-area-and-regeneration#Next%20steps>

The Council is committed to delivering a district energy solution in this part of Tottenham, most likely a district heating network supplied by gas-fired CHP engines, as part of its wider regeneration plans for the redevelopment of the High Road West and Northumberland Park estates on either side of the NDP site. It is envisaged that these sites will deliver in the order of 7,000 new homes over the next 20 years and that these homes will be served by a DEN. The Council has instructed Parsons Brinkerhoff to prepare a techno-economic viability report for the installation of a DEN in close proximity to the NDP site and a report is expected to be completed by the end of the year.

Plans for development of a DEN within the vicinity of the development are seen as a major opportunity for the Northumberland Development Project, and conversely it is a key part of the district heating feasibility as it is likely to be the first phase of the regeneration proposals. It is proposed that all buildings will be designed to connect into this network when completed. Timelines for the completion of the DEN are still to be confirmed, but there is clear commitment from the Council for a DEN to be delivered at the earliest opportunity.

The Club is committed to working with the Council to advance an energy strategy and assess the feasibility of a DEN and its location within the surrounding regeneration areas, and indeed there is already cooperative working between the parties on this matter.

3.1.2 Proposed strategy

The energy strategy that supports this application is premised on connecting the development in to the DEN once it is delivered. Timeframes for delivery of the network have not yet been confirmed, but it is generally considered that it will come online after completion of the first phase (including the stadium) but hopefully before future phases of the project are complete.

Based on this assumption the proposals for connection and integration with the DEN are as follows:

- Phase 1 complete (Stadium, Tottenham Experience, NE Building)
 - DEN not operational
 - Gas fired boiler plant located in the Stadium's East-Stand will supply all heating demands of the Stadium, Tottenham Experience and NE Building via a site-wide heating network.
 - Systems designed to be district-ready, suitable for future DEN connection.
- Future phases complete (Hotel, Extreme sports, residential towers)
 - DEN operational
 - Connection to the Haringey District Heating network installed to supply heat to all building within the NDP.
 - Connection arrangements (location of entry point, internal routing of pipework, ownership, maintenance requirements etc.) to be agreed. These technical requirements are being developed in consultation with the Haringey DEN team to develop the most appropriate solution for all parties.

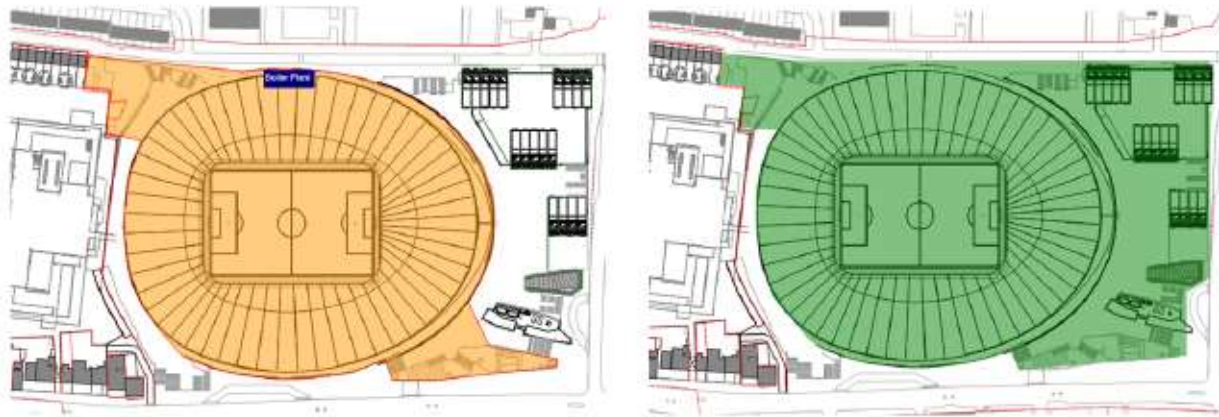


Figure 3—2 Left: Phase 1 site-wide network supplied by gas boilers. Right: Whole-site to be supplied from Haringey District Heating (connection point and internal distribution to be worked up with Haringey).

In the unfortunate scenario that a Haringey district heating network is not constructed, the energy strategy proposals above will be revisited. A similar strategy to the Phase 1 proposals will be pursued, installing building level heating plant which is futureproofed for any future developments in the district heating network proposals. The feasibility for low-carbon heating systems (e.g. CHP) for each building will also be explored as a strategy to provide further Carbon Dioxide emissions savings which would otherwise have been achieved through the DEN connection.

3.1.3 Modelling approach

Due to the level of technical information available at this time, Carbon Dioxide emissions reductions available through connection to a district heating network cannot be quantified in detail. For the purposes of this report, an estimate of the reductions available have been made using assumptions aligned with the Notional Building, (carbon factor 0.15 kgCO₂/kWh heat) but will be refined once technical information is available regarding the proposed network.

3.2 Low and zero carbon (LZC) technology

LZC technology can help to deliver significant Carbon Dioxide emissions reductions arising from developments. The table below summarises the potential of various LZC technologies considering the context of the proposed development.

Technology	Comments	Viability
Wind turbine	- Generates electricity - Development is located in a high density urban environment. Wind flows in such locations are often turbulent which significantly reduce the available energy output - No land area for installation of a turbine. Roof mounted vertical axis systems do not offer an efficient method of generation.	 LOW
Biomass	- Generates heat/hot water - Development's location in central London creates difficulties for frequent fuel deliveries and air quality - Poor compatibility with proposed District Heating connection from wider network	 LOW
Air source heat pump	- Generates heat/hot water (pre-heat) - Typically used as an alternative to gas-fired boilers to meet space heating requirements. Very low resultant CO2 savings. - Potential noise issues and visual impact - Poor compatibility with proposed District Heating connection from wider network	 LOW
Ground source heat pump	- Generates heat/hot water (pre-heat) - Requires close coupling to building piles, a significant number of expensive and deep boreholes or a large shallow area in which a 'slinky' can be laid - Very constrained development site – coupling with building piles is only possible solution (very high cost). - Poor compatibility with proposed District Heating connection from wider network	 LOW
Solar thermal	- Generates heat/hot water - Low maintenance, efficient technology - Moderate Carbon Dioxide emissions savings due to displacement of natural gas instead of Carbon Dioxide emissions intensive grid electricity - Most suitable for hotel and residential application, with very limited roof area however. - Poor compatibility with proposed District Heating connection from wider network	 MEDIUM

Solar Photovoltaics (PV)	• Generates electricity • Some very small roof areas across the development potentially available • Simple installation, low maintenance • Good delivered Carbon Dioxide emissions savings for the development compared to Carbon Dioxide emissions intensive national grid supply	 MEDIUM
---------------------------------	---	--

As demonstrated above, LZC options for the development are limited to Solar Technologies. Due to the proposed district heating connection, it is considered that the limited roof area available would be more beneficial for Solar Photovoltaics from a Carbon Dioxide emissions reduction perspective as heat-based savings will be delivered from the network connection.

3.2.1 Solar PV

Although Solar Photovoltaics have been identified as the most suitable LZC technology for the site, their application is highly limited due to the form and context of the development. A summary of the proposals across the development is shown below.

Building	Details	Proposal
Stadium	Lightweight structural solution proposed for the stadium roof design. Roof loading is not designed to accommodate Solar PV loading (20kg/m ²). Additional capital cost for a structural solution which could accommodate Solar PV, is not considered viable in addition to the cost of the panels.	No Solar PV proposed
Hotel	Unobstructed roof area due to high-rise form Significant amount of roof top MEP plant – Ventilation plant, lift plant, chillers, water storage. External restaurant/bar areas also proposed.	No Solar PV proposed
Tottenham Experience	Low level building where all Westerly sun is blocked by Hotel tower significantly reducing Solar PV output. Large proportion of roof accessible for roof garden area, with green roof planned for other areas.	No Solar PV proposed
Extreme Sports	Roof area at low-level, overshadowed by surrounding buildings. Potential for a very small array on the highest roof area	No Solar PV currently proposed – to be confirmed at detailed planning
Residential Towers	Unobstructed roof areas suitable for Solar PV. Limited roof area in relation to GFA due to high-rise form. Provisional array proposed, based on estimate of 60% of roof area suitable for PV accounting for roof level plant and spacing between panels for access/maintenance/shading.	250m² of Solar PV proposed – to be confirmed at detailed planning
North-East Building	Low level building located due north of the stadium, therefore roof area significantly shaded.	No Solar PV proposed

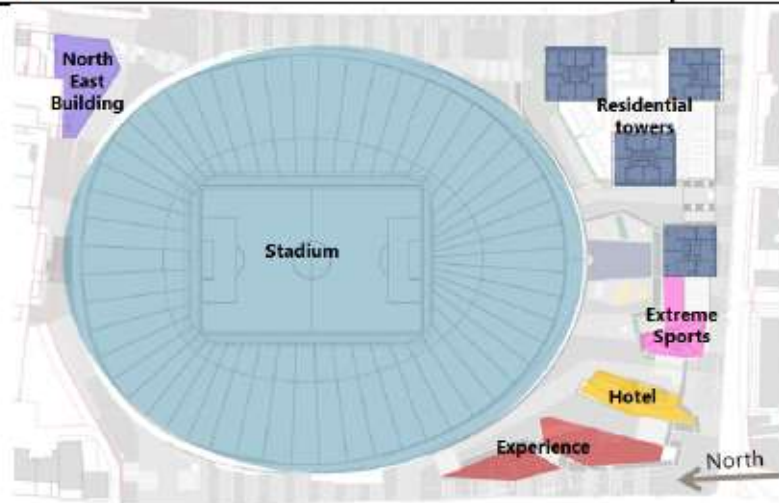


Figure 3—3 Site plan

4 Detailed application

The following section presents the Carbon Dioxide Emissions results following thermal modelling assessment of the development components seeking detailed planning approval.

4.1 Stadium

The stadium represents the major component of the proposed development. The 61,000 seat capacity stadium includes hospitality areas, changing rooms, match-day support facilities, office space and catering facilities. There is additionally a large proportion of un-conditioned spaces such as concourses, car parking and the stadium bowl itself which fall outside of the remit for the Part L modelling.

It should be noted, that from a construction point of view the Tottenham Experience is considered to be the same building as the stadium and shares some common MEP systems (Gas boilers, Chillers, power supply etc.). Due to differing design challenges between the two buildings however, they have been modelled and reported on individually.

4.1.1 Lean

A highly efficient approach to building fabric and MEP systems has been utilised to reduce Carbon Dioxide emissions from the outset. Highly insulated and air-tight fabric has been utilised to reduce heat losses in winter, and minimise solar gains during the summer months.

Fabric element	Unit	Proposed - Stadium	Notional building Part L 2013
External walls	W/m ² .K	0.15	0.26
Glazing (incl. frame)	W/m ² .K	1.4	1.6
Glazing G-value	-	0.3	0.4
Roof	W/m ² .K	0.11	0.18
Floor	W/m ² .K	0.11	0.22
Airtightness	m ³ /m ² @50Pa	3	3

The stadium uses a wide range of MEP systems suited to the proposed use of the different areas. All heating is provided by high efficiency gas-fired boilers, with cooling provided through high efficiency air-cooled chillers, or VRF units. Chillers are prioritised for match day operation to maximise their efficiency, therefore self-contained VRF systems are utilised for more frequent daily use facilities (e.g., office areas). All domestic hot water (DHW) is provided centrally with highly insulated pipework to prevent un-necessary heat loss within the building. LED lighting will be used throughout the development to minimise energy consumption of artificial lighting and cooling systems by reducing internal heat gains.

A summary of the MEP proposals is shown below:

System	Specification
Heating plant	Gas boilers – 95% seasonal efficiency
Cooling plant	Air-cooled chillers – SEER 4.72 VRF – SEER 5-5.2
Ventilation systems	AHU SFP – 0.8-1.55 W/l/s
Lighting efficiency (luminaire)	80 Lumens/Watt
Lighting controls	PIRs and daylight controls where appropriate

Following application of these measures the Stadium achieves a 4% reduction below the Part L 2013 Notional Building. Results for the stadium broken down by energy use are shown below.

kgCO ₂ /m ² .yr	Actual	Notional
Heating	4.0	5.0
DHW	9.8	8.8
Cooling	6.4	5.6
Aux	8.8	10.2
Lighting	8.3	9.3
Total	37.2	38.9
	4% Reduction	

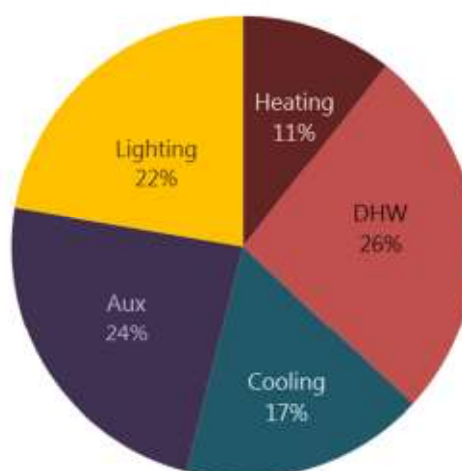


Figure 4—1 Actual building breakdown

4.1.2 Clean

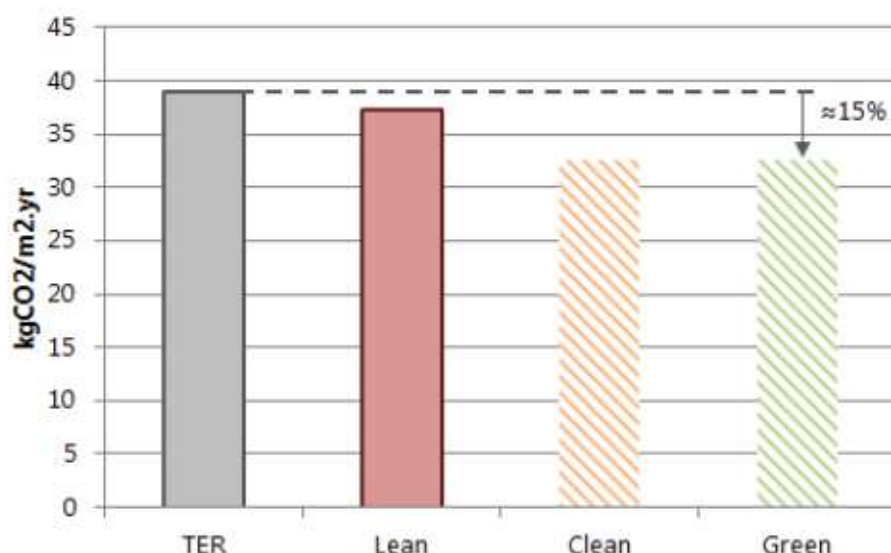
As discussed previously, it is proposed that the Stadium will connect into the proposed Haringey District Heating network. Although technical information regarding the network performance is not yet available based on a network performance aligned with the Notional Building it is estimated that a Carbon Dioxide emissions reduction of 15% could be achieved compared to a Part L 2013 gas-fired boiler TER.

4.1.3 Green

No renewables are proposed for the Stadium development as outlined in Section 4.

4.1.4 Results

Following the application of the energy hierarchy, it is estimated that the Stadium can achieve Carbon Dioxide emissions reduction of 4% without a connection to the district heating network, and potentially 15% with a connection. The impact of a district heating connection will be confirmed when technical details of the network performance are available.



Unit	TER	Lean	Clean	Green
kgCO ₂ /m ² .yr	38.9	37.2	32.5	32.5
tonnes CO ₂ /yr	2,088	1,997	1,746	1,746
%age reduction		4%	15%	15%

4.1.5 Unregulated

The unregulated Carbon Dioxide emissions as reported by the 'Equipment' load within the Part L BRUKL documentation are indicated below. Measures to reduce unregulated energy consumption from the building will include high efficiency office/IT equipment, low-energy floodlighting, efficient F&B equipment etc.

Building	kgCO ₂ /m ² .yr	tonnes CO ₂ /yr
Stadium	37.3	1,999

4.2 Hotel

The hotel building provides a combination of traditional hotel rooms and serviced apartments. It also includes additional facilities such as restaurants, bars, swimming pool and a health club.

4.2.1 Lean

A highly efficient approach to building fabric and MEP systems has been utilised to reduce Carbon Dioxide emissions from the outset. Highly insulated and air-tight fabric has been utilised to reduce heat losses in winter, and minimise solar gains during the summer months. A curtain walling façade system is proposed across the whole building, with an external shading structure providing solar gain mitigation to the majority of spaces within the building.

Fabric element	Unit	Proposed – Hotel	Notional building Part L 2013
Opaque module (curtain walling)	W/m ² .K	0.8	0.26
Glazing (incl. frame)	W/m ² .K	1.4	1.6
Glazing G-value*	-	0.2-0.3	0.4
Roof	W/m ² .K	0.15	0.18
Floor	W/m ² .K	0.11	0.22
Airtightness	m ³ /m ² @50Pa	3	3

* Effective g-value created by the external shading structure has been accounted for as an effective g-value.

The hotel is predominantly serviced by fan coil units located in all bedrooms/apartments, with communal areas utilising a similar strategy a simple back ground heating and ventilation provided in the BOH areas. All heating is provided by high efficiency gas-fired boilers, with cooling provided through high efficiency air-cooled chillers.

All domestic hot water (DHW) is provided centrally with highly insulated pipework to prevent un-necessary heat loss within the building. LED lighting will be used throughout the development to minimise energy consumption of artificial lighting and cooling systems by reducing internal heat gains. Intelligent control of lighting and ventilation is proposed within the hotel rooms and apartments via use of the guest room cards.

A summary of the MEP proposals is shown below:

System	Specification
Heating plant	Gas boilers – 95% seasonal efficiency
Cooling plant	Air-cooled chillers – SEER 4.1
Ventilation systems	AHU SFP – 1.5-1.9 W/l/s
Lighting efficiency (luminaire)	75 Lumens/Watt
Lighting controls	PIRs and daylight controls where appropriate

Following application of these measures the Hotel achieves a 2% reduction below the Part L 2013 Notional Building. Results for the hotel broken down by energy use are shown below. Majority of savings are achieved through highly efficiency lighting systems (including display lighting), and an efficient DHW distribution system due to a single loop configuration to prevent un-necessary pipe lengths. The building energy demand is hot water dominated due to the large number of showers, bathroom, pool facilities, catering laundry, etc.

kgCO2/m2.yr	Actual	Notional
Heating	7.3	5.0
DHW	45.3	45.7
Cooling	2.9	2.9
Aux	13.8	14.2
Lighting	3.9	6.7
Total	73.2	74.4
2% Reduction		

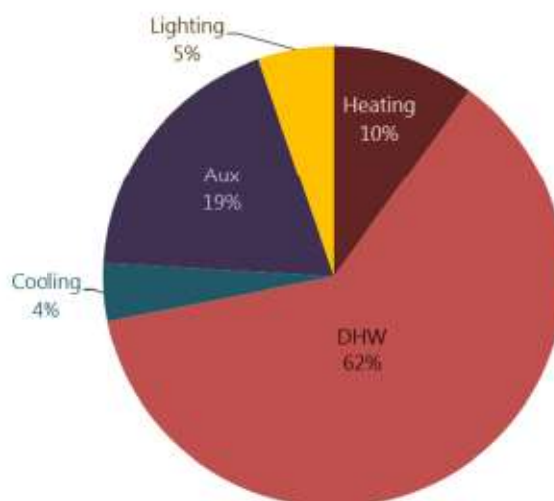


Figure 4—2 Actual building breakdown

4.2.2 Clean

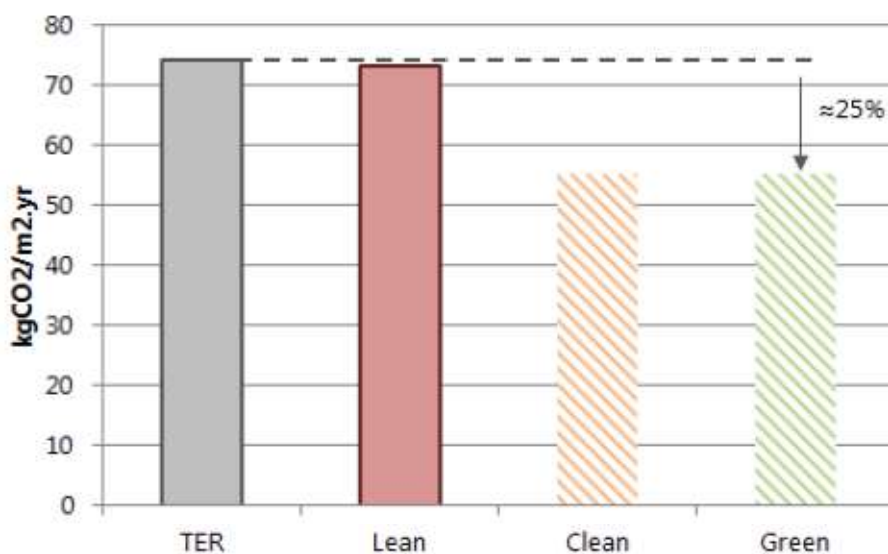
As discussed previously, it is proposed that the Hotel will connect into the proposed Haringey District Heating network. Although technical information regarding the network performance is not yet available based on a network performance aligned with the Notional Building it is estimated that a Carbon Dioxide emissions reduction of 25% could be achieved compared to a Part L 2013 gas-fired boiler TER. The significant potential reduction is due to the major heat-demands associated to the hotel which the district heating would help to minimise.

4.2.3 Green

No renewables are proposed for the Hotel development as outlined in Section 4.

4.2.4 Results

Following the application of the energy hierarchy, it is estimated that the Hotel can achieve Carbon Dioxide emissions reduction of 2% without a connection to the district heating network, and potentially 25% with a connection. The impact of a district heating connection will be confirmed when technical details of the network performance are available.



Unit	TER	Lean	Clean	Green
kgCO ₂ /m ² .yr	74.4	73.2	55.3	55.3
tonnes CO ₂ /yr	1,171	1,151	870	870
%age reduction		2%	25%	25%

4.2.5 Unregulated

The unregulated Carbon Dioxide emissions as reported by the 'Equipment' load within the Part L BRUKL documentation are indicated below. Measures to reduce unregulated energy consumption from the building will include high efficiency office/IT equipment, low-energy vertical transport systems, efficient catering equipment, pool covers etc.

Building	kgCO ₂ /m ² .yr	tonnes CO ₂ /yr
Hotel	29.1	456

4.3 Tottenham Experience

The Tottenham Experience building comprises mainly of the club's megastore, ticket sales facilities, museum/exhibition facilities and a café. It has an accessible roof area for public access and is integrated around Warmington House, a Grade 1 listed building.

4.3.1 Lean

A highly efficient approach to building fabric and MEP systems has been utilised to reduce Carbon Dioxide emissions from the outset. Highly insulated and air-tight fabric has been utilised to reduce heat losses in winter, and minimise solar gains during the summer months. The architectural concept uses glazed façade at the ground level for the retail spaces, with a more opaque construction on the upper level where the museum exhibits are located. The glazed entrance is an un-conditioned space and therefore not within the remit of the Part L model.

It is understood that no fabric refurbishment is possible for the Warmington house building (except loft insulation), therefore assumptions have been made regarding its existing fabric performance. It is important to note, that the results are negatively affected by the inclusion of the Warmington house areas as it is comparing an existing listed building to new construction standards. The specific details of how to consider Warmington House from a Building Regulations Part L perspective will need to be discussed with Building Control.

Fabric element	Unit	Proposed – Tottenham Experience	Notional building Part L 2013
External Wall	W/m ² .K	0.2	0.26
Glazing (incl. frame)	W/m ² .K	1.4	1.6
Glazing G-value	-	0.2-0.3	0.4
Roof	W/m ² .K	0.15	0.18
Floor	W/m ² .K	0.11	0.22
Warmington House – External Wall	W/m ² .K	2.5	0.26 (new construction)
Warmington House - Glazing	W/m ² .K	5.6	1.6 (new construction)
Airtightness	m ³ /m ² @50Pa	3	3

The Experience is predominantly serviced by fan coil units supporting a flexible internal layout for retail and exhibition space. All heating is provided by high efficiency gas-fired boilers, with cooling provided through high efficiency air-cooled chillers which are located within the stadium.

All domestic hot water (DHW) is provided centrally with highly insulated pipework to prevent unnecessary heat loss within the building, although hot water demand will be limited. LED lighting will be used throughout the development to minimise energy consumption of artificial lighting and cooling systems by reducing internal heat gains. LED systems will also be used for all display lighting, which comprise a large proportion of energy demand within retail and museum spaces.

A summary of the MEP proposals is shown below:

System	Specification
Heating plant	Gas boilers – 95% seasonal efficiency
Cooling plant	Air-cooled chillers – SEER 4.72
Ventilation systems	AHU SFP – 1.6 W/l/s
Lighting efficiency (luminaire)	75 Lumens/Watt
Display lighting efficiency (luminaire)	65 Lumens/Watt
Lighting controls	PIRs and daylight controls where appropriate

Following application of these measures the Tottenham Experience achieves a 10% reduction below the Part L 2013 Notional Building. Results for the Tottenham Experience broken down by energy use are shown below. Majority of savings are achieved through high efficiency lighting systems, importantly including display lighting..

kgCO2/m2.yr	Actual	Notional
Heating	5.1	4.1
DHW	10.0	7.9
Cooling	2.6	3.0
Aux	10.7	9.6
Lighting	13.7	22.0
Total	42.1	46.5
	10% Reduction	

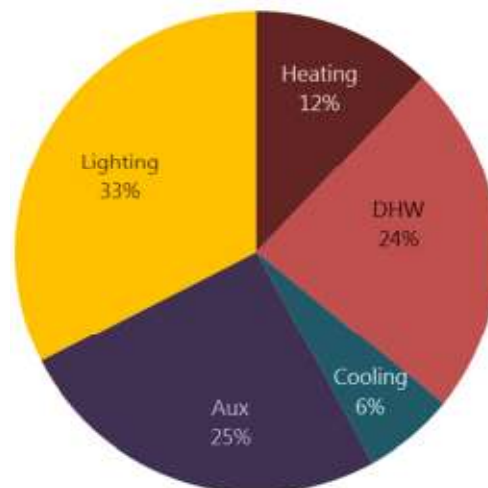


Figure 4—3 Actual building breakdown

4.3.2 Clean

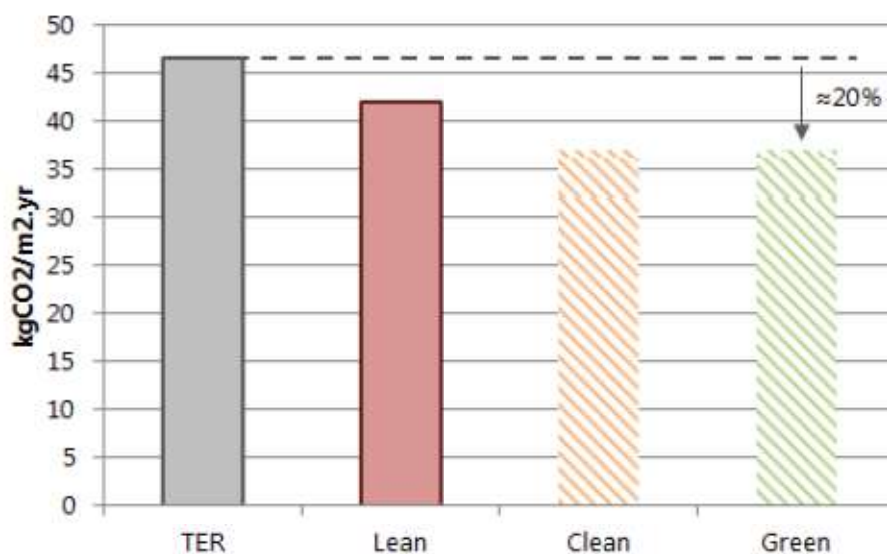
As discussed previously, it is proposed that the Stadium will connect into the proposed Haringey District Heating network, whose heating and cooling distribution will therefore serve the Tottenham Experience building. Although technical information regarding the network performance is not yet available based on a network performance aligned with the Notional Building it is estimated that a Carbon Dioxide emissions reduction of 20% could be achieved compared to a Part L 2013 gas-fired boiler TER.

4.3.3 Green

No renewables are proposed for the Experience development as outlined in Section 4.

4.3.4 Results

Following the application of the energy hierarchy, it is estimated that the THFX Experience can achieve Carbon Dioxide emissions reduction of 10% without a connection to the district heating network, and potentially 20% with a connection. The impact of a district heating connection will be confirmed when technical details of the network performance are available.



Unit	TER	Lean	Clean	Green
kgCO ₂ /m ² .yr	46.5	42.1	36.9	36.9
tonnes CO ₂ /yr	203	183	161	161
%age reduction		10%	20%	20%

4.3.5 Unregulated

The unregulated Carbon Dioxide emissions as reported by the 'Equipment' load within the Part L BRUKL documentation are indicated below. Measures to reduce unregulated energy consumption from the building will include high efficiency office equipment, low energy IT equipment, etc.

Building	kgCO ₂ /m ² .yr	tonnes CO ₂ /yr
THFX Experience	29.1	456

5 Outline application

The following section presents the Carbon Dioxide Emissions results following thermal modelling assessment of the development components seeking outline planning approval. As explained, limited information is available regarding the precise internal layouts and construction details of these buildings therefore a high-level energy modelling assessment has been carried out. The results presented below will be confirmed within the relevant applications for detailed planning approval.

5.1 Residential

The residential component of the development (585 dwellings) is spread across 4 high-rise towers of varying heights, with 5 town houses located at ground level and some community use also at ground level beneath the podium.

Due to the outline nature of this element of the application, floor plans for the dwellings have not yet been fixed, however an indicative apartment layout has been proposed by the architects (Allies and Morrison). This apartment layout has been used as the basis for this energy assessment, and SAP modelling has been performed using Stroma software.

All information presented below is what will be aspired towards during the detailed development of these buildings. At the moment the information represents a best practice approach for a development of this type, but all information is subject to confirmation and will be communicated in detail within the detailed planning application.

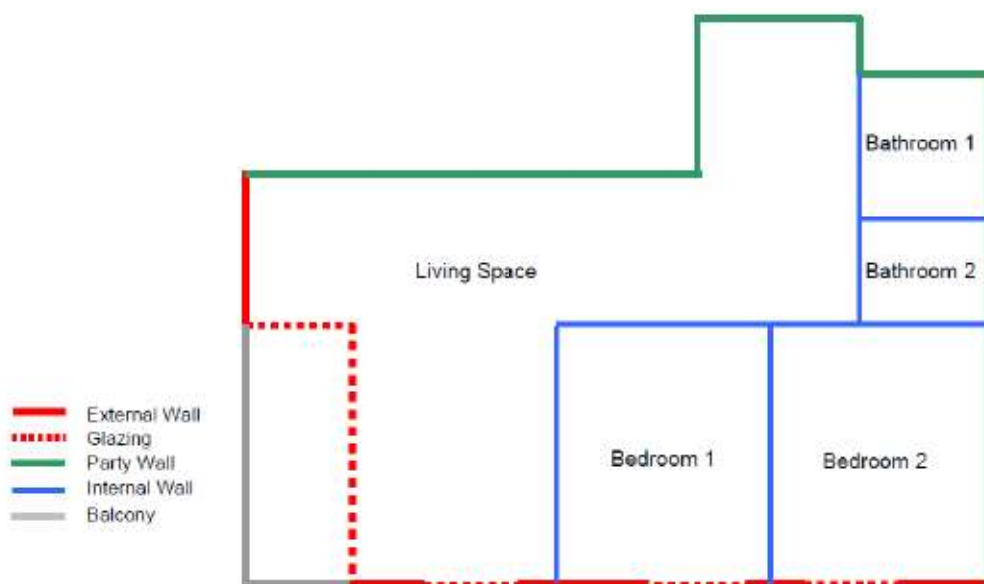


Figure 5—1 Indicative apartment layout

5.1.1 Lean

In order to minimise energy demand from the outset, a highly efficient building form and fabric performance will be adopted. Fabric performance will include low u-value constructions, and construction details which will minimise the heat loss through thermal bridging.

It is proposed that all dwellings would be ventilated via an MVHR (mechanical ventilation heat recovery) system due to the airtight construction, and overheating risk will be managed through passive measures instead of active cooling systems.

The table below summarises the system parameters used within the modelling of this indicative apartment.

Table 5-1 Building envelope and system parameters

Building Parameter	Value
Roof U-value (W/m ² K)	0.10
Wall U-value (W/m ² K)	0.15
Glazing U-value (W/m ² K) inc. frame	1.40
Glazing g-value	0.68
Opaque door U-value	1.00
Air permeability (m ³ /m ² /hour)	3
Ventilation system	MVHR
Heating system	100% gas boiler (community), 89% efficiency
Hot water use	<125 l/p/d
Low energy light fittings	100%

Based on the indicative apartment layout assessed and the inputs proposed above, a lean reduction of 12% could be achieved.

5.1.2 Clean

As discussed previously, it is proposed that the Residential towers will connect into the proposed Haringey District Heating network. Although technical information regarding the network performance is not yet available based on a network performance aligned with best practice (60% CHP supply, 40% gas boiler supply) it is estimated that a Carbon Dioxide emissions reduction of 33% could be achieved compared to a Part L 2013 gas-fired boiler TER.

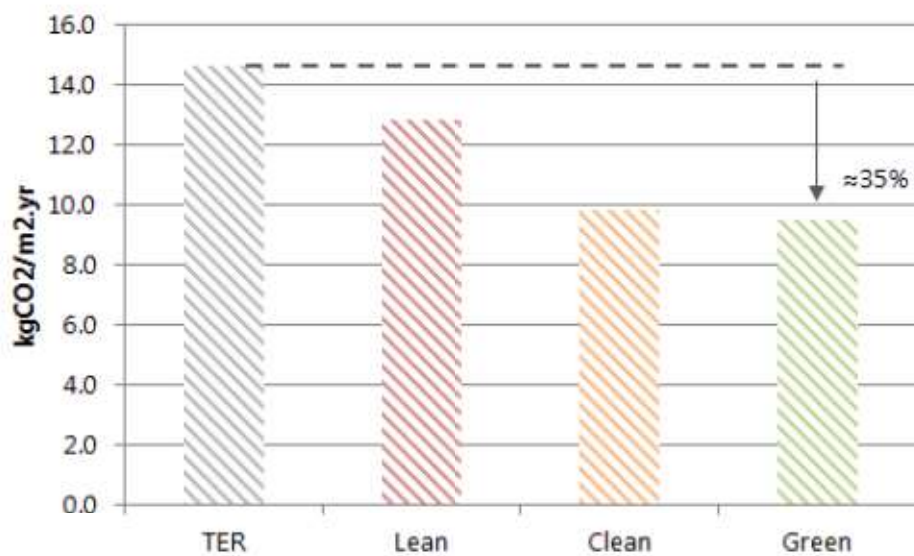
5.1.3 Green

As indicated in Section 4, it is proposed to explore the potential for a 250m² Solar PV array across the tower roofs. In order to maximise the benefit from this small roof area it is proposed to use high-performance panels which can achieve efficiencies of 20%.

Apportioning this array across the proposed residential component relative to the GFA of this indicative layout, it is estimated that a Carbon Dioxide emissions reduction of 35% could be achieved compared to a Part L 2013 gas-fired boiler TER.

5.1.4 Results

Following the application of the energy hierarchy outlined above, it is estimated that the residential component could achieve a Carbon Dioxide emissions reduction of 15% without a connection to the district heating network (including Solar PV), and potentially 35% with a connection. These results are estimates at this stage, and indicate an order of magnitude for the potential Carbon Dioxide reductions which could be achieved within the development. All details will be explored further and confirmed when the buildings apply for detailed planning approval. Per m² values have been summed across the complete residential component floor area below.



Unit	TER	Lean	Clean	Green
kgCO ₂ /m ² .yr	14.6	12.8	9.9	9.5
tonnes CO ₂ /yr	773	678	521	502
%age reduction		12%	33%	35%

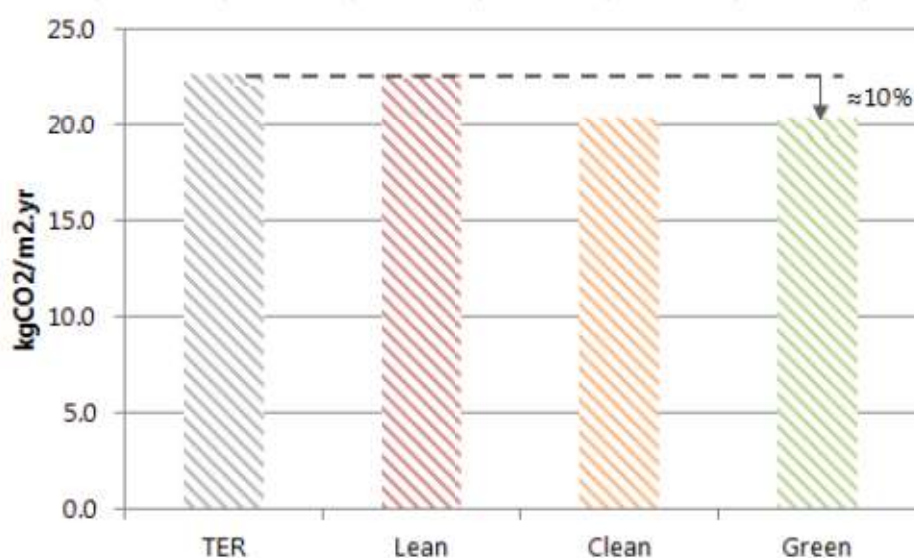
5.2 Extreme Sports Building

The Extreme Sports building is envisaged to include a diving tank, climbing wall among other high-performance sports facilities. At this outline stage façade constructions and detailed floor plans have yet to be developed and so detailed Part L modelling has not been carried out.

In order to provide an indication of the Carbon Dioxide emissions which will arise from the development, a benchmark value has been utilised from a comparable sports centre project designed to equal sustainable new-construction standards.

High performance fabric and MEP systems will be proposed of an equivalent standard to all other buildings across the site. Equally, the building will connect into the Haringey District Heating network when available, to deliver further Carbon Dioxide emissions reductions. There will be no provision of renewable technology within this building.

At this outline stage, for the purposes of assessing the site wide Carbon Dioxide emissions results have been presented below. At this stage no improvements on the Lean stage of the hierarchy have been assumed, and a 10% improvement from the district heating connection has been assumed. All details will be explored further and confirmed when the building applies for detailed planning approval.



Unit	TER	Lean	Clean	Green
kgCO ₂ /m ² .yr	22.7	22.7	20.4	20.4
tonnes CO ₂ /yr	40	40	36	36
%age reduction		0%	10%	10%

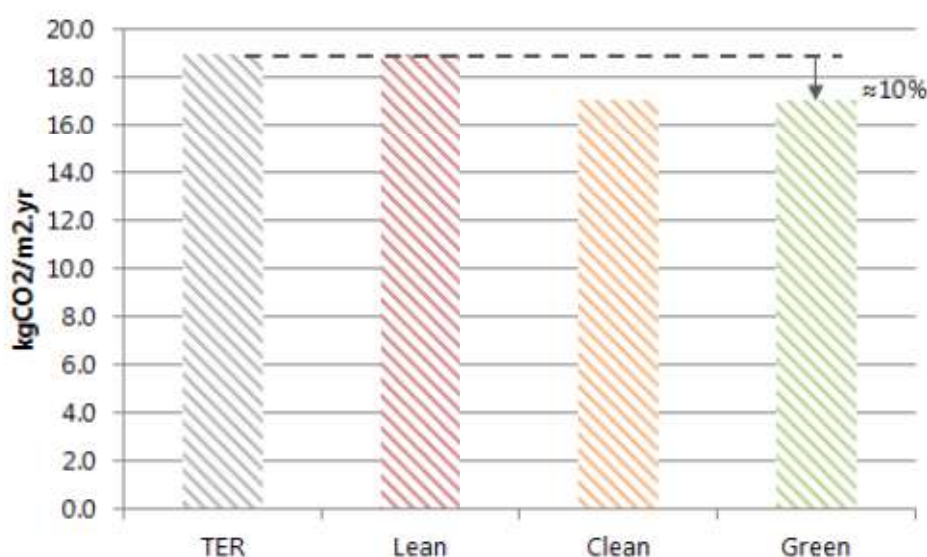
5.3 North-East building

The North-East building is envisaged to be a health centre serving the local community around the Northumberland Development project. At this outline stage façade constructions and detailed floor plans have yet to be developed and so detailed Part L modelling has not been carried out.

In order to provide an indication of the Carbon Dioxide emissions which will arise from the development, a benchmark value has been utilised from a comparable health centre development designed to equal sustainable new-construction standards.

High performance fabric and MEP systems will be proposed of an equivalent standard to all other buildings across the site. Equally, the building will connect into the Haringey District Heating network when available, to deliver further Carbon Dioxide emissions reductions. There will be no provision of renewable technology within this building.

At this outline stage, for the purposes of assessing the site wide Carbon Dioxide emissions results have been presented below. At this stage no improvements on the Lean stage of the hierarchy have been assumed, and a 10% improvement from the district heating connection has been assumed. All details will be explored further and confirmed when the building applies for detailed planning approval.



Unit	TER	Lean	Clean	Green
kgCO ₂ /m ² .yr	19.0	19.0	17.1	17.1
tonnes CO ₂ /yr	42	42	38	38
%age reduction		0%	10%	10%

6 Overheating

As stated within policy, all developments must make reasonable endeavours to mitigate overheating risks and ensure cooling demands are managed to prevent excessive energy consumption from air-conditioning systems.

Across the development this has been achieved through provision of passive solar control measures such as solar control glazing (low g-value), self-shading from building form and minimising the air-conditioned areas to essential spaces.

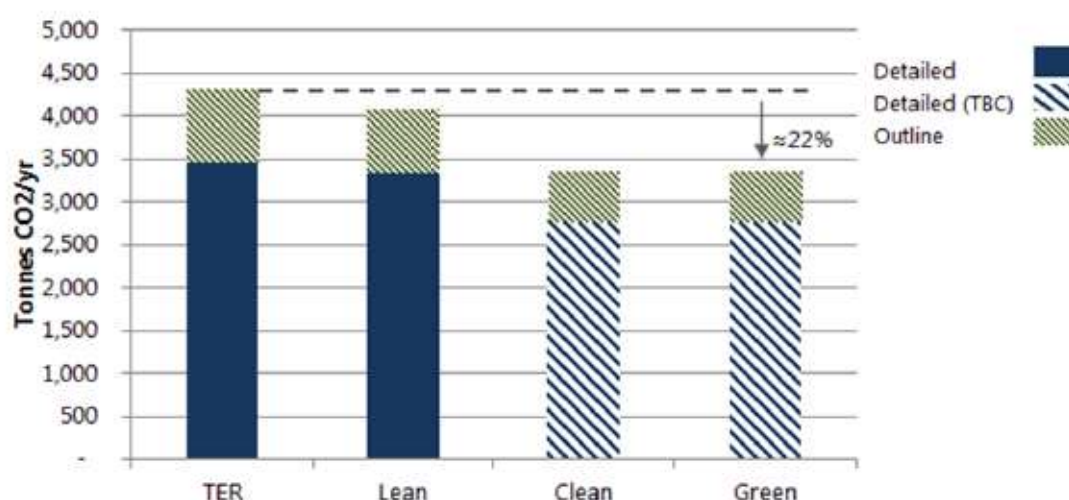
Part L Criterion 3 is an effective measure of overheating risk and excessive solar exposure. All spaces within buildings across the development which are occupied for large periods of the day are compliant with Criterion 3 as can be seen within the BRUKL documentation provided in the appendix. Spaces which do not comply, primarily include circulation areas such as concourses, which are not occupied for large portions of the day and are therefore exempt from the assessment as per Approved Documents Part L2A methodology.

The residential towers are not envisaged to be comfort cooled, and overheating risk will be effectively managed when the design progresses to a greater level of detail. The indicative apartment performed well from an overheating perspective due to the large openable windows area and self-shading provided by the balcony structure.

7 Summary

7.1 Overall results

The graph below summarises the results from all components of the Northumberland Development project. Differentiation has been provided between the detailed and outline elements of the application, in addition to the savings achieved through connection to the DEN to be delivered by the council.



tonnes CO ₂ /yr	TER	Lean	Clean	Green
Detailed	3,460	3,330	2,780	2,780
Outline	860	760	600	575
TOTAL	4,320	4,100	3,380	3,355
%age reduction		5%	22%	22%

As shown in the results above; based on proposals for the detailed elements of the application and the assumptions included within this report regarding the district heating and the outline elements of the application it is estimated that the Northumberland Development project could achieve a total site-wide Carbon Dioxide emissions reduction of 22% compared to a Part L 2013 gas-boiler TER baseline.

At this stage, the carbon efficiency of the Haringey District Heating network will have the largest impact on the results but this cannot be explored in greater detail until this technical information is available. Until this district heating connection becomes available the development has employed all viable sustainable design measures and can achieve a 5% Carbon Dioxide emissions reduction from those alone.

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Northumberland Development Project

Water Strategy

031627

7 September 2015

Revision 03

Revision	Description	Issued by	Date	Checked
00	For comment	SC	31/07/2015	SM
01	For planning	SC	17/08/2015	SM
02	Revised for planning	SC	28/08/2015	SM
03	Updated image	EH	07/09/2015	SW

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author **Steve Clarke**

date **07 September 2015**

approved **Stephen Macey**

signature



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date **07 September 2015**

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Glossary

Term	Definition
BRE	Building Research Establishment Ltd.
BREEAM	BRE Environmental Assessment Method
CAMS	Catchment Area Management Plans
CIRIA	Construction Industry Research and Information Association
DEFRA	Department for Environment Food and Rural Affairs
DMR	Demand Reduction Measures
EA	Environment Agency
ECA	Enhanced Capital Allowances
FIFA	Fédération Internationale de Football Association (<i>International Federation of Association Football</i>)
FRA	Flood Risk Assessment
GLA	Greater London Authority
OFWAT	The Water Services Regulation Authority.
PPS25	Planning Policy Statement 25: Development and Flood Risk
SUDS	Sustainable Drainage Systems
GA	General Admission
TWUL	Thames Water Utilities Limited

1 Executive Summary

The proposed Northumberland Development Project is centred on the redevelopment of Tottenham Hotspur Football Club stadium. In addition to the new 61,000 capacity stadium a 2000 m² Health/Office use building is proposed, along with a 4900m² Tottenham Experience, 2100m² Extreme Sports Building, a 180 bedroom hotel with 49 Serviced Apartments and 579 residential properties with 4 towers of varying heights.

This Water Strategy describes the approach to all aspects of water use and management across the proposed Northumberland Development Project. The strategies described are the water supply and demand strategy and the foul and surface water drainage strategies.

1.1 Water Resources

The demand strategy is focused around the implementation of efficient water use practices across the development, including both social and engineered demand reduction measures. There are currently no defined water use targets for commercial properties but the demand reduction measures identified would provide significant reductions in water demand. Residential properties were assessed in accordance with the updated London Plan. A reduction in water demand from residential properties of 150 l/person/day to 105 l/person/day target has been demonstrated to be achievable. It is proposed to achieve the target rate within the residential area and significantly reduce the demand throughout the rest of the development by installing a combination of water efficient fittings such as:

- Low Flush, 4/2.6 l/flush, WCs throughout
- Water Efficient, 3.2 l/min, aerating taps throughout
- Water efficient, 9 l/min, showers within the residential and hotel developments.
- Water efficient, 80 l/use (150 l sized), baths where fitted
- Waterless urinals where fitted in Stadium, General Admission Concourse areas.
- Water efficient, 39 l/use, washing machine where fitted
- Water efficient, 10 l/use, dishwasher where fitted

1.2 Drainage

The site currently drains to separate surface water and foul sewers. The development will maintain the separation and connect into these networks. Local network upgrades will be made on Worcester Avenue with the addition of a new sewer. This is important in terms of managing the impact of the increase in discharge as a result of the increase in stadium capacity. The installation of water efficient fittings will further minimise the increase in discharge volume.

The surface water drainage of the site will aim to improve the existing situation through the introduction of SUDS across the site. This will provide attenuation of storm water to reduce the flood risk to the downstream catchments as well as to the development itself.

As a result of this approach the site-wide surface water discharge will be reduced from the current rate of 284l/ha/s to 150 l/ha/s. The surface water drainage strategy has been approved in principle by the EA, TWUL and Haringey Council.

The foul drainage of the development will connect into the existing network and upgrades will be provided to ensure that the systems do not back up and avoid exceeding existing network capacity. The Stadium will drain into the High Road sewer to the west, the hotel and residential development to the south to Park Lane. The foul water drainage strategy will require a pumped system and has been approved in principle by TWUL.

1.3 Flood Risk

The site is located in EA Flood Zone 1, which means that the probability of fluvial and tidal flooding in any one year is less than or equal to 0.1%. Planning Policy Statement 25 (PPS25) requires that developments in Flood Zone 1 do not increase flood risk to the development or elsewhere through the addition of hard surfaces and increase in surface water run-off.

The provision of surface water attenuation will significantly reduce the risk of surface water flooding for the site. A controlled discharge rate from the underground storage tanks will also reduce the risk of the development surcharging the surface water drainage network and impacting on third parties.

A revised Flood Risk Assessment (FRA) has been written by Aecom and is provided as a separate document.

1.4 Consultation

Extensive consultation, has taken place between the design team and the Environment Agency (EA). The EA are aware of the development proposals and have confirmed informally their approval of the proposals. They acknowledge that the reduction of the surface water run-off rate from 284l/s/ha to 150l/s/ha represents a significant improvement and welcome the reductions in water usage that have been demonstrated against the baseline demands.

Agreement has also been reached with Thames Water Utilities Limited with regard to the site-wide surface water runoff and foul discharge rates.

2 Introduction

2.1 Development Description

The Northumberland Development Project is an 11 hectare site centred on the redevelopment of the Tottenham Hotspur Football Club (THFC) stadium, White Hart Lane, in Haringey in North East London. The existing site contains the stadium, a number of residential properties, shops and the Wingate Trading Estate to the north, as shown in **Error! Reference source not found..**



Figure 2-1 Site location plan

The proposed development is for the relocation of the stadium to the north, to the centre of the site, with a large supermarket proposed for the north of the site and residential units and hotel in the south. The current Masterplan is shown in **Error! Reference source not found.** and Figure 2-2. This Masterplan, and an outline area schedule, forms the basis for the numbers generated in this Water Strategy. The type and use of the developments are outlined below and the assumed built areas are contained in Table 2—1.

- Stadium – New 61000 seat stadium
- Retail – THFC Experience/Museum. 4900m²
- Extreme Sports Building-2100m²
- Residential – 579 residential units, a mixture of, 2, 3 and 4 bed apartments.
- Hotel - 180 bedroom Hotel and 49 Serviced Apartments

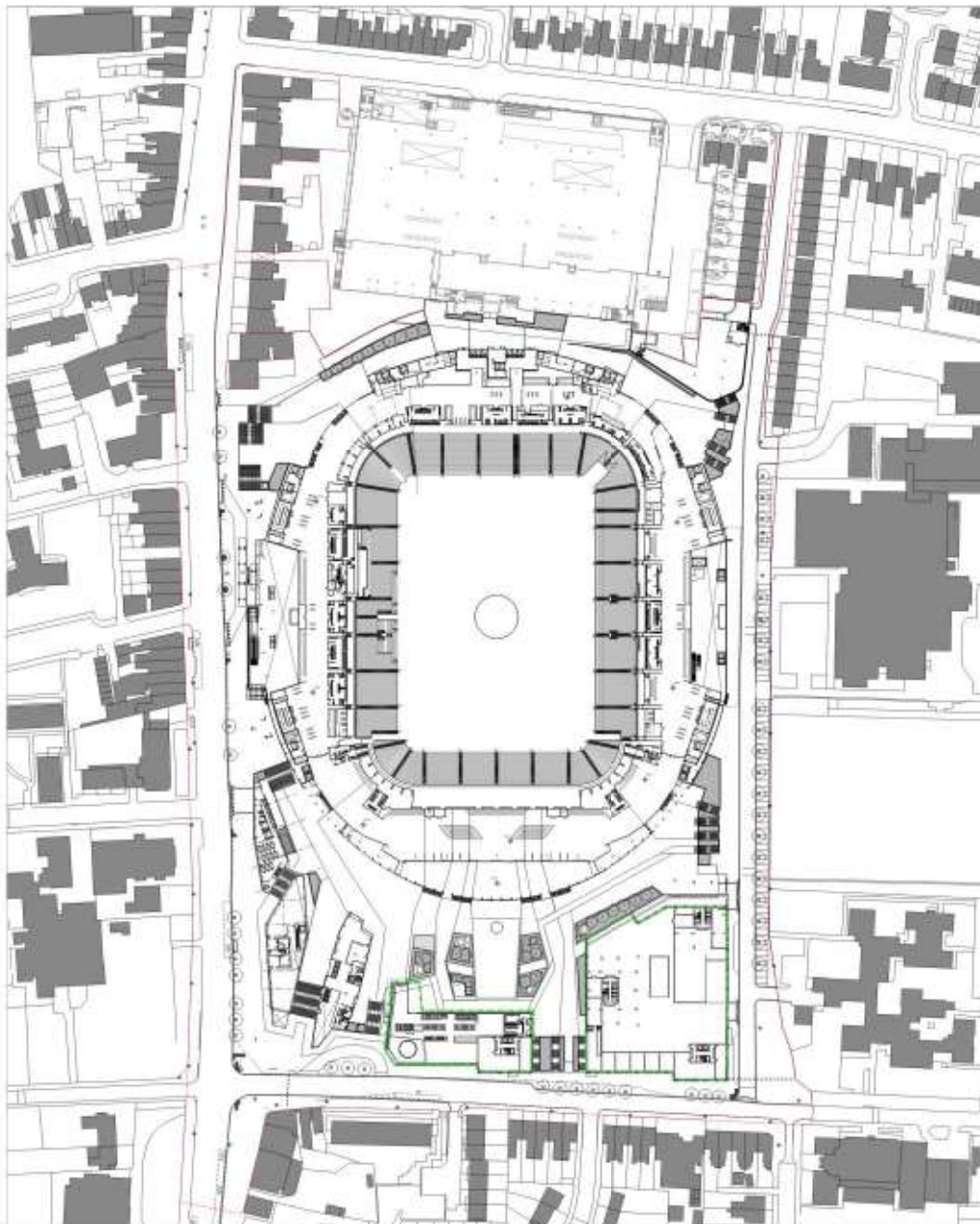


Figure 2-2 Northumberland Development Masterplan

Table 2—1 Assumed development size

Development	Assumed built area / occupancy
Stadium	61,000 capacity
Tottenham Experience	4,165m ²
NE Building	2000 m ²
Hotel	180 bedrooms plus 49 Serviced Apartments
Extreme Sports	2100 m ²
Residential	579 units



Figure 2-3 NDP Masterplan

2.2 Purpose of this Water Strategy

The proposals for the redeveloped White Hart Lane stadium and accompanying development will impact the water infrastructure in and around the local area. As well as the potential for increasing water demand from constructing a larger capacity stadium, the development will have new requirements for foul drainage and surface water flow management.

The purpose of a water strategy is to provide guidance to aid design development and to outline to the client how much investment needs to, and should be made in water based technologies. In recent years water strategies have also become important documents to accompany planning applications to demonstrate that consideration to protect and conserve water supplies and resources has been made from the first stages of a development. To this end this strategy will also ensure that sufficient information is given about water resource management and use to satisfy all stakeholders and will outline targets, where applicable, and strategies for each of the different aspects of water across the site.

An overview of the Water Strategy processes is provided in the form of the flow diagram in Figure 2-4. This is an expanded water cycle diagram that charts the sources and movement of water through the water cycle and a development. All the processes shown need to be understood to ensure that the appropriate infrastructure is in place and that water is managed effectively ensuring efficient water use.

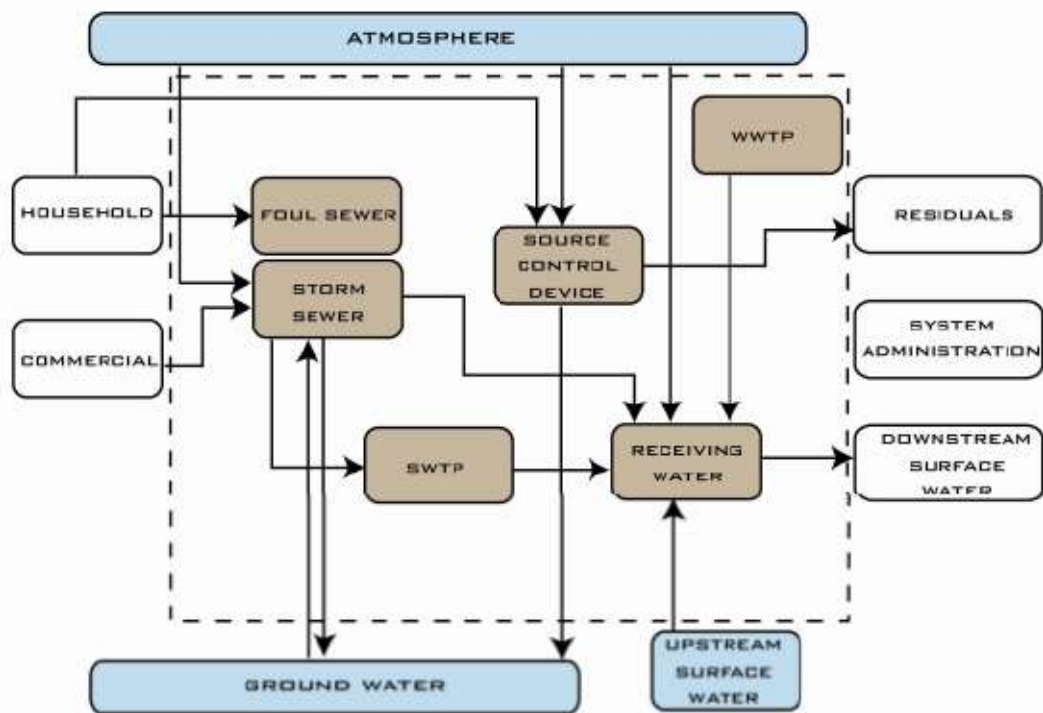


Figure 2-4 Flow diagram

This Water Strategy will take into account guidelines, standards and policy documents that affect the use of water. Where appropriate the objectives and targets defined within these documents are described together with how these targets will be met within the development. The documents referred to in this way are;

- The London Plan
- Local planning policies
- The Mayor's Water Strategy
- The European Water Framework Directive
- DEFRA –Future Water
- National Planning Policy Framework
- BREEAM
- Water Matters, Greater London Authority
- Key design standards

- Part L Building Regulations
- CIRIA - Interim Code of Practice for Sustainable Drainage Systems

This Water Strategy is divided into the following sections.

Section 3 - Policy	A description of the key policies that affect the Water Strategy
Section 4 – Water Demand	An explanation of the baseline requirements in terms of water demand
Section 5 – Meeting Demand	An assessment of how this demand can be met and a description of the demand reduction measures and water sources that could be employed in line with the policies outlined in Section 3
Section 6 – Demand Strategy	Assessment of the which of the measures identified in Section 4 need to be used for this development and identification of the supply and demand strategy
Section 7 – Drainage	Description of surface water and foul drainage strategies
Section 8 - Summary & Conclusions	Summary of this Water Strategy.

This strategy defines the high level concepts for dealing with water. It does not aim to provide detailed information as to how exactly the identified quantities of water will be delivered and removed from the site. These details will be provided over the course of the detailed design process in consultation with the key stakeholders, which will include Thames Water Utilities Limited (TWUL), the Environment Agency (EA), the London Borough of Haringey and others. As such it is the intention that this strategy provides sufficient detail to inform the stakeholders during the planning application process and acts as a basis for further discussions during the process of detailed design development post planning application.

2.3 Assumptions

This Water Strategy has been undertaken based on several key assumptions. Many of the assumptions relating to the individual aspects of the Strategy are discussed in the relevant sections. The key wider reaching assumptions are listed below;

Water Demands	- The demands are based on the latest area schedule, see Table 2—1. - Baseline demands for the Stadium were calculated from usage information obtained from the Arsenal Emirates Stadium
---------------	---

- | | |
|----------------|---|
| Meeting Demand | <ul style="list-style-type: none"> - The Megastore/Museum has been treated as if it were purely retail space - The areas of roofs for estimating rainwater harvesting have been assumed based on the latest Masterplan. - This strategy does not assess the possible connection points to the potable main or the network; it identifies the total development demand. |
| Drainage | <ul style="list-style-type: none"> - The existing surface and foul networks are based on the plans provided by TWUL - The strategy identifies possible connections to the existing networks but does not specify the development network or specific connection locations. |

3 Policies Affecting Water

3.1 Water Demand and Usage

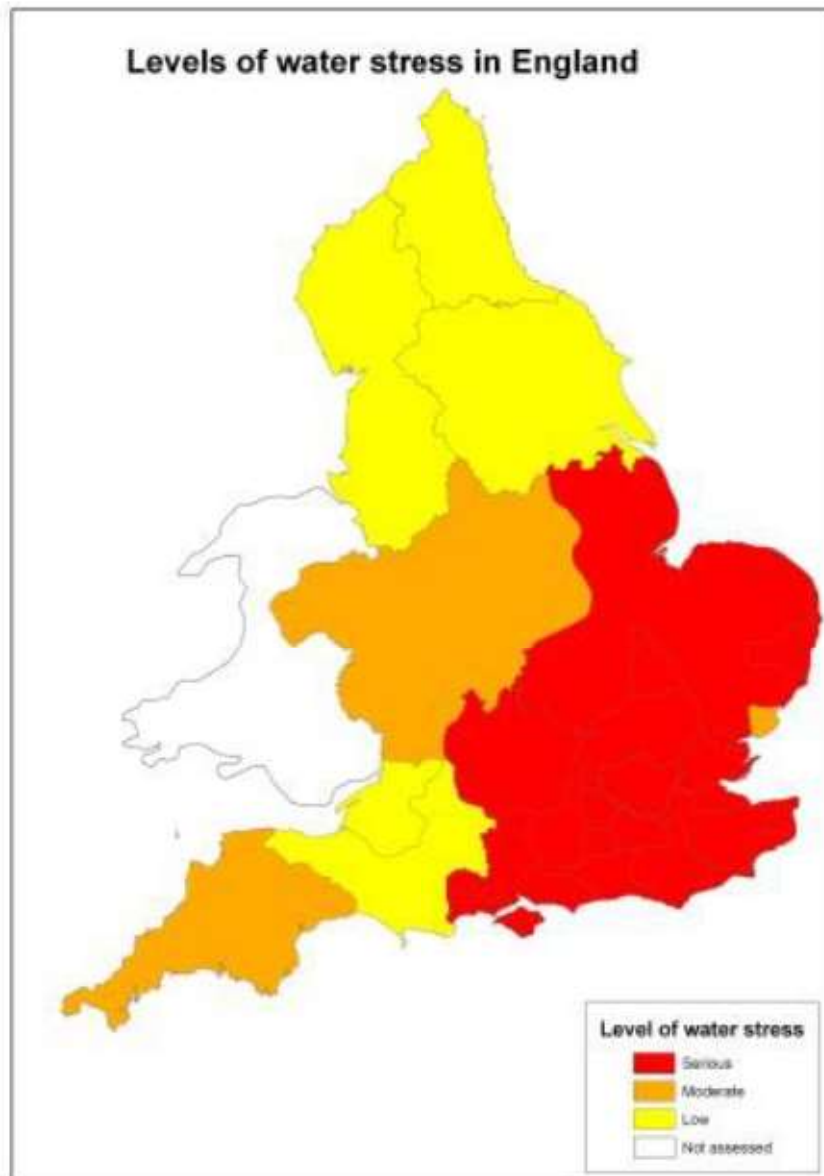


Figure 3-1 Water stress in England and Wales (DEFRA image at ECA presentation, 12th March 2008)

Demand for potable water is an issue that continues to gain momentum in the political and public arena. Areas of England are increasingly considered to be water stretched and hosepipe bans imposed by water authorities are becoming more frequent and longer in duration. The south-east and London experience relatively low rainfall, this combined with the rate of development and the burgeoning population continue to place significant strain on the water infrastructure. The current level of stress on water supplies in England and Wales is illustrated in Figure 3-1.

The approach to water demand is introduced in Section 4. The approach supports various EU, UK and London strategies including:

The European Water Framework Directive

- Directive 2000/60/EC of the European Parliament (October 2000)
- <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF>

The Water Act, UK Parliament (May 2014)

- <http://www.legislation.gov.uk/ukpga/2014/21/contents/enacted>

Water Matters, Efficient Water Management in London, Greater London Authority (September 2012)

- <http://www.london.gov.uk/sites/default/files/Water%20management%20report%20pdf.pdf>

Securing London's Water Future – The Mayor's Water Strategy (October 2011)

- <https://www.london.gov.uk/sites/default/files/water-strategy-oct11.pdf>

Supplementary Planning Guidance on Sustainable Design and Construction Greater London Authority (April 2014)

- <https://www.london.gov.uk/sites/default/files/Sustainable%20Design%20%26%20Construction%20SPG.pdf>

The London Plan, Spatial Development Strategy for Greater London, Consolidated with Alterations since 2011 Greater London Authority (March 2015)

- [http://www.london.gov.uk/sites/default/files/London%20Plan%20March%202015%20\(FALP\).pdf](http://www.london.gov.uk/sites/default/files/London%20Plan%20March%202015%20(FALP).pdf)

DEFRA Future Water: The Government's water strategy for England (June 2011)

- <https://www.gov.uk/government/publications/future-water-the-government-s-water-strategy-for-england>

Policies and commitments relating to water usage are detailed below. The policies relate to all water resources with particular focus on the demands for potable water.

3.1.2 The European Union Water Framework Directive

On the 23rd October 2000 the European Parliament and Council established a Community framework for water protection and management. The Framework Directive provides, amongst other things, for the identification of European waters and their characteristics, on the basis of individual river basin districts, and the adoption of management plans and programmes of measures appropriate for each body of water. Within the directive it sets clear deadlines by which Member States should meet certain goals regarding protecting, enhancing and restoring the European water bodies. One of the innovations of the Directive is that it provides a framework for integrated management of groundwater and surface water for the first time at European level.

3.1.3 The Water Act 2014

The Water Act 2014 places increased focus on water conservation with the majority of emphasis placed on water companies and premises of public bodies rather than private developers.

3.1.4 The Mayor's Water Strategy, October 2011

The Mayor's Water Strategy sets out a 'six-point plan' of integrated actions to help reduce water demand and cost. The key strategy of relevance is '*to ensure all new development is super-water efficient*' with reference to the London Plan's standard of 105l/p/d. The Mayor also recommends using rainwater for non-potable uses to reduce demand for treated mains water and encourages greater use of water metering.

3.1.5 Supplementary Planning Guidance on Sustainable Design and Construction

The Supplementary Planning Guidance on Sustainable Design and Construction identifies key priority and best practice targets on water demand and consumption:

The Mayor's Priority standards are:

- Developers should maximise the opportunities for water saving measures and appliances in all developments, including the reuse and using alternative sources of water
- Developers should design residential schemes to meet a water consumption of 105 litres or less /person/day
- New non-residential developments should aim to achieve the maximum number of water credits in a BREEAM assessment or the 'best practice' level of the AECB water standards
- All developments should be designed to incorporate rainwater harvesting

The Mayor's Best Practice standard is:

- All residential units should be metered

DEFRA Future Water 2011

In the Future Water the Government's water strategy for England published in June 2011 the paper proposes that the average domestic water use in England should be reduced to 130l/person/day by 2030, with an aim of 120l/person/day, without impacting quality of life.

The London Plan, March 2015

The London Plan was originally produced in February 2004 and was most recently revised in March 2015.. One of the major changes relates to lower water demand targets.

Development should minimise the use of mains water by:

1. Incorporating water saving measures and equipment
2. Designing residential development so that mains water consumption would meet a target of 105 litres or less per head per day

3.1.6 Targets and Standards

The targets outlined above will be monitored and reviewed as the design progresses and are summarised in Table 3—1.

Table 3—1 Potable water consumption targets for residential properties by 2013

Body	Lowest standard (L/person/day)	Medium standard (L/person/day)	Optimum standard (L/person/day)
Mayor's Water Strategy	-	105	
London Plan (Mar 2015)	105	-	-
Mayor's SPG	105		
DEFRA Water Strategy 2008	-	130	120

It is important to note that there are clear targets for residential developments but no current targets for commercial properties. This doesn't mean that demand reduction isn't important here but that the water use targets for these developments are based on an individual assessment of what reductions can reasonably be achieved. Within this report the rate of 105 l/person/day as sought by the London Plan is the target for the residential areas and a similar percentage reduction is sought for the rest of the development where possible.

Section 4 outlines the baseline demand of the development and Section 5 discusses levels of compliance with these policies in terms of demand reduction and matching quality of supply to quality of use, in other words using non potable water with in the development.

3.2 Water Supply

Specific policy relating to the approach to water supply are contained within the Mayor's Draft Water Strategy (March 2007) and The London Plan (March 2015).

The London Plan, March 2015

Policy 5.15 of the London Plan relates to water supply and resources and states:

"The Mayor will work in partnership with appropriate agencies within London and adjoining local planning authorities to protect and conserve water supplies in order to secure London's needs in a sustainable manner by supporting the Water Strategy and by:

- Minimising the use of treated water
- Reaching cost effective minimum leakage levels
- Maximising rainwater harvesting opportunities
- Introducing targets for water recycling in major developments
- Promoting the use of dual potable and grey water recycling systems
- In conjunction with demand side measures, promoting the provision of additional sustainable water resources in a timely and efficient manner, to reduce the water supply deficit and achieve a security of supply in London
- Maintaining and upgrading the infrastructure

In determining planning applications, the Mayor will and boroughs should have proper regard to the impact of those proposals on water demand and existing capacity"

The Mayor's Water Strategy, October 2011

Chapter 2 and 3 of the Mayor's Water Strategy discusses water supply in London and proposes several Actions for water companies to manage their water supplies in London:

- Monitor water usage in new homes
- Raise awareness of water metering
- Increase use of rainwater for potable uses

3.3 Drainage & Flooding

The guidelines for surface water drainage and flooding are given by the National Planning Policy Framework document produced by the Department for Communities and Local Government.

National Planning Policy Framework (NPPF), March 2012

The NPPF provides guidance for safeguarding developments for current and future flood risk. The NPPF highlights the need for incorporating the issues of flood risk into all stages of the planning process to avoid inappropriate development in areas at risk of flooding. It also promotes using opportunities offered by new developments to reduce the causes and impact of flooding.

The London Plan, March 2015

Policy 5.12 of the London Plan relates to Flood risk management and states:

Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated technical Guidance on flood risk over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 and Catchment Flood Management Plans.

In line with the NPPF and the Technical Guidance, boroughs should, when preparing LDFs, utilise Strategic Flood Risk Assessments to identify areas where particular flood risk issues exist and develop actions and policy approaches aimed at reducing these risks, particularly through redevelopment of sites at risk of flooding and identifying specific opportunities for flood risk management measures.

Policy 5.13 of the London Plan relates to sustainable drainage and states:

Development should utilise SUDS unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

- Store rainwater for later use
- Use infiltration techniques, such as porous surfaces in non-clay areas
- Attenuate rainwater in ponds or open water features for gradual release to a watercourse
- Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse

- Discharge rainwater direct to a watercourse
- Discharge rainwater to a surface water drain
- Discharge rainwater to the combined sewer.

Drainage should be designed and implemented in ways that deliver other policy objectives of the London Plan, including water use efficiency, quality, biodiversity, amenity and recreation.

The Mayor's Water Strategy, October 2011

Chapter 5 of the Mayor's Draft Water Strategy discusses water supply in London and proposes the following hierarchy (3) for rainwater drainage in London:

- Store rainwater for use later,
- Use infiltration techniques, such as porous surfaces in non-clay areas,
- Attenuate rainwater in ponds or open water features for gradual release to a watercourse,
- Attenuate rainwater in tanks or sealed water features for gradual release to a watercourse,
- Discharge rainwater direct to a watercourse,
- Discharge rainwater to a surface water drain,
- Discharge rainwater to the combined sewer, as a last resort.

Also included is a hierarchy (4) for the disposal of wastewater in London:

- Discharge wastewater to a foul sewer
- Discharge wastewater to the combined sewer, as a last resort.

The Supplementary Planning Guidance on Sustainable Design and Construction, April 2014

The Supplementary Planning Guidance on Sustainable Design and Construction identifies key priority targets on surface water flooding and sustainable drainage:

The Mayor's Priorities are:

- Developers should maximise all opportunities to achieve greenfield runoff rates in their developments
- When designing their schemes, developers should follow the drainage hierarchy set out in the London Plan policy 5.13
- Developers should design Sustainable Drainage Systems (SUDS) into their schemes that incorporate attenuation for surface water runoff as well as habitat, water quality and amenity benefits
- Development in areas at risk of any form of flooding should include flood resistance and resilience measures in line with industry best practice
- Developments are designed to be flexible and capable of being adapted to and mitigating the potential increase in flood risk as a result of climate change

- Where development is permitted in a flood risk zone, appropriate residual risk management measures are to be incorporated into the design to ensure resilience and the safety of occupiers
- All sources of flooding need to be considered when designing and constructing developments

4 Water Demand

4.1 Baseline Demand

4.1.1 Introduction

The baseline is the assessment of the total requirement for water, for all purposes potable and non-potable, of the proposed development. It represents the performance level against which the demand reduction measures and strategy to further minimise the use of potable water can be compared to. It is usually established based on industry standards but can also be based on historic data. This strategy will use a combination of the two and will use previous experience of work on large scale stadiums to provide the benchmarks and targets for water demands.

It is important to note that the targets listed in Section 3 are not to be taken as the baseline demand. These are the targets that need to be met once reduction measures and other non-potable water sources have been identified. There are two baselines that can be explored.

1. The first is the average peak day demand baseline; which is the average water demand on a day when the various parts of the development are at maximum capacity, this helps to inform the supply and distribution infrastructure requirements. The biggest, single influence on this will be that of the stadium demand, due to the infrequent but intense use.
2. The second is the annual baseline demand; this is used to demonstrate the overall water use of the development and provides an alternative indication of where water savings can be made.

4.1.2 Average Peak Day Demand Baseline

In order to calculate the average match day demand, water usage measurements were taken at the Arsenal Emirates Stadium, a similar size to the proposed NDP stadium, by the project team. This reading, along with the known fittings in the stadium, has been used to calibrate the usage data and a baseline demand using standard UK fittings is then calculated. The sample stadium data is not used as the baseline as this stadium already had various water efficient fittings installed.

Thames Water have undertaken a network analysis of their infrastructure and confirmed the 10l/s required for the Stadium and Tottenham Experience can be serviced from a new connection off the High Road.

The stadium has been separated down into three categories of users; Spectators, Staff and Players, due to their varying usage types. Assumptions have been made on the number of staff and Players based on prior knowledge of stadia.

The residential properties were broken down into apartment types from which the occupancy was then determined.

The development Masterplan and approximate gross floor areas produced by the architects Populous and A&M have been used to generate the average demand for each type of building within the development based on a water use per person. The demands are based on either the number of users or staff numbers.

The assumptions for occupancy and water demand for each building use is given in Table 4—1.

Table 4—1 Occupancy and baseline demand assumptions

Development		Occupancy	Potable water demand (L/person/day)
Stadium (matchday)	Spectators	61,000 capacity	4.5
	Competitors	40 people	60
	Staff	1000 people	25
Stadium Non Matchday		500	25
Tottenham Experience		(4900 m ²) 19 m ² /member of staff	120 ¹
NE Podium Building (Office)		(2000 m ²) 10 m ² /member of staff	25
Hotel		180 bedrooms plus 49 Serviced apartments	150 (/bedroom)
Extreme Sports		(2900 m ²) 19 m ² /member of staff	25
Residential (4 towers)		579 apts.	150 ²

The accepted Annual Average Daily Demand for domestic use is 150l/person/day, this is agreed by DEFRA, the Mayor's Office, Thames Water and others.

The Tottenham experience/Museum, Hotel and Office demands are taken from industry standards. Within the stadium there is also a certain amount of water demand from the hospitality and staffing on match days which has been accounted for within the calculations. However, the spectators make up the majority of the demand.

There is a row dedicated to the stadium in non matchday scenario as that is the case more than 90% of the year. The potable water demand takes account of the mix of Club and General admission spectators and is based on POE figures from WHL and Emirates.

These assumptions together with the area schedule have been used to calculate the baseline annual average daily potable water demand for the development as outlined in Table 4—3. The additional water demand from the development that is not covered by Table 4—2 will be for the irrigation of the football pitch. Based on FIFA guidelines for the layout of irrigation of football pitches the demand will be based on a 4 hour irrigation cycle with two sprinklers on at one time. Assuming that 1 cycle will be required during the summer the peak daily demand has been estimated as 50m³/day.

The EA retains the power under Section 57 of the Water Resources Act 1991 to temporarily restrict licences for spray irrigation at times of drought and during periods when restrictions on public water supply are in force. Therefore the irrigation supply could be at risk during periods of drought.

¹ This water demand takes into consideration both the staff and customer water demand

² OFWAT Security of Supply Report 2006/7

Table 4—2 Average peak day potable water demand

Development		Built area (m ²)	Occupancy (m ² /person)	Number of people	Potable water demand (L/person/d)	Total demand (L/day)
Stadium	Spectators	-	-	61,000	4.5	274,500
	Competitors	-	-	40	60	2,400
	Staff	-	-	1000	25	25,000
Pitch		-	50,000ltr for 200 days from HST.	-	-	50,000
Tottenham Experience/Museum		4900	19 m ² /member of staff	258	25	6,450
NE Podium Building		2000	10 m ² /member of staff	200	25	5,000
Hotel		-	180 bedrooms plus 49 Serviced apartments	458	105	*48,090
Extreme Sports		2900	19 m ² /member of staff. Plus public.	*500	25	*12,500
Residential		-	579 apartments	1158	105	*121,590
					Total	545,530

Table 4—2 represents the baseline for demand reduction to be measured against. It is important to note that this is a daily average based on full occupancy (peak) and does not represent the annual water consumption.

4.1.3 Annual Baseline

The annual average daily potable water demand for full occupancy is skewed by the stadium, which will only be in use 30 – 40 days a year. It is therefore the annual baseline that provides the benchmark for the overall water demand. It is also a better indicator of the applicability of non-potable water sources to meet some of the demand, as for example the stadium will produce large quantities of grey water but it may not be able to be used due to storage requirements. It should be noted, however, that in terms of annual demands the residential demand may be the largest factor of influence. Non-potable sources are discussed in more detail in Section 5. Table 4—3 shows the assumptions made to generate this annual demand.

The annual average daily potable water demands are taken from Table 4—2 and an estimate of the days of occupancy is made. It is assumed that when in use the separate developments will be at full occupancy and at average peak day demand. The assumptions for the irrigation demand of the pitch are different and these and the other assumptions for the frequency of occupancy are detailed below:

- The stadium will be in use for an average of 40 days every year, split as below
 - 19 league games
 - 6 domestic cup games
 - 5 European games
 - 5 friendlies; and
 - concerts
- The residential properties and hotel will be occupied every day of the year.
- The Tottenham Experience/Museum, NE Podium Building and Extreme Sports will be occupied every day of the year.
- The football pitch will have an average of 1 full irrigation cycle 200 days of the year.

Other uses of the stadium, such as for conferences, have not been included in this initial assessment; and the irrigation of other areas of the development has also not been included.

Table 4—3 Baseline annual water demand

Development	Average Daily Demand	Occupancy (days/year)	Total demand (L/year)
Stadium	301900	40	12,076,000
Stadium non matchday	12500	325	4,062,5000
Pitch	50000	200	10,000,000
Tottenham Experience/Museum	6,450	350	2,257,500
NE Podium Building	5,000	365	1,825,000

Hotel	*48,090	365	17,552,850
Extreme Sports	*12,500	350	312,500
Residential	*121,590	365	44,380,350
		Total	92.4 MI/year

Table 4—3 demonstrates that, despite the large peak daily demand of the stadium, it is the residential development and irrigation demands that represent the greatest demands over the course of a year.

5 Meeting demand

5.1 Introduction

This section describes how the water demands of the development may be met.

Many uses of water, such as toilet flushing, clothes washing, etc, do not require a potable standard of water quality, yet these demands are often met from high quality mains water. Treating water to a potable standard and then disposing of waste water are energy-intensive and expensive processes. In addition, the distribution infrastructure is largely dependent on mechanised pumping, thereby adding to the overall energy consumption of the water supply system. Reducing water consumption and utilising local non-potable sources where they are deemed fit for purpose can significantly reduce strain on natural water resources as well as reducing energy consumption.

The easiest and most efficient to implement is demand reduction through social initiatives, then engineering reductions and using non potable sources where appropriate is the final option to achieve the potable demand reduction targets. This section assesses the options available to the development in relation to the reducing of potable water demand.

The strategy will be two fold;

1. Minimise demand by Demand Reduction Measures (DRM); and then
2. Match quality of supply with quality of demand

5.2 Demand Reduction Measures

5.2.1 Introduction

Demand reduction is a very important aspect of any development. As outlined in Section 4 water resources are under stress and any new development must demonstrate that it uses water efficiently. There are two broad types of demand reduction measures;

1. Social
2. Engineered

The social and the engineered measures are discussed below. Engineered demand reduction takes two forms, efficient fittings and efficient infrastructure. The former can be quantified, as the water consumption of different fittings is known, but it is not possible to quantify efficient delivery systems or social reductions.

5.2.2 Demand Reduction - Social

Social measures are the simplest to implement and are very important to change the attitudes to general water use of both individuals and companies. In order to achieve the demand reductions associated with any engineered solutions to reducing water use, education is required to ensure people fully utilise, operate and maintain the engineered solutions adequately.

Tottenham Hotspur will align itself with the GLA and Thames Water "Save It" water awareness campaign thereby ensuring additional educational messages such as only flushing when necessary, taking shorter showers and turning the tap off while brushing teeth are promoted across the site and will further contribute to reducing overall water demand.

5.2.3 Demand Reduction - Engineered

Engineered demand reduction takes two forms;

1. Efficient fittings; and
2. Efficient infrastructure

Efficient Fittings

To reduce the baseline potable demand a range of water efficient fittings have been explored for the development and include:

- Water efficient dual flush toilets (4/2.6 l/flush)
- Waterless urinals
- Low flow showers (9l/min)
- Very low flow showers (6l/min)
- Low flow taps (5l/min)
- Very low flow taps (3.2l/min)
- low water usage appliances
- low volume baths

It is assumed that low/very low flow fittings will be installed throughout the development and if standard use fittings are required for different applications, such as the stadium showers, they can be done so on an individual basis.

Efficient Infrastructure

The key to efficient use of water is good management. Monitoring of the water networks will enable any leaks to be quickly detected and shut off, minimising wastage of treated water. Metering of properties will clearly illustrate the water use identifying where better water use practices need to be implemented.

In addition to the low flow systems listed above the irrigation of the pitch and other landscaped areas would need to be managed to ensure efficient use. This could be done manually or by using automated systems to irrigate only when required. The pitch will have a very efficient drainage system to avoid waterlogged pitches and with recovery of the irrigation water and rainfall, water could be reused rather than discharged to the foul sewers.

These proposed efficiency measures demonstrate a commitment to the Mayor's Draft Water Strategy, hierarchy 2, by promoting water efficiency fixture and fittings throughout the park. To further reduce the volume of potable water used these measures could be supplemented by non-potable source(s) of water such as rainwater harvesting and other alternatives described below.

5.3 Matching Quality of Supply to Quality of Need

The use of non-potable water depends on the quality of water that is required. This varies for the different uses with differing chemical and biological standards. Where expected end-use results in a high potential for contact with humans the quality of water should be high. Where there is low risk of human contact the non-potable water can be of a lower quality. Additionally commercial uses where water contamination can lead to fouling of appliances will require a high quality potable or non-potable water supply. Further information on water quality standards is given in Appendix A.

Currently there are no published parameters for non-potable water quality but guidelines are listed in Table A1 in Appendix A.

The options for supplementing the potable water supply with non-potable sources, appropriate to that need, include the following options;

- Potable water
- Rain water
- Ground water
- Greywater
- Black water

Recommendations for the supply strategy to be adopted for the development are then discussed in Section 6.

5.3.1 Potable water

Potable water is the mains water that is treated to drinking water, Class A standard new connections will be run off the new/existing main as appropriate to serve the developments.

To maximise the efficiency of the potable network the new pipework should avoid losses of water through leakage within the development. Choice of materials for pipework will give due consideration to ground conditions including potential contamination to ensure the pipe network continues to operate efficiently in the long term. Monitoring within buildings is recommended as part of the demand reduction strategy and it is also recommended that meters are placed at strategic points within the main distribution network.

The mains supply strategy provides a robust and reliable source of potable water to the site. It is consistent with the Mayor's water supply hierarchy as the strategy aims to reduce leakage losses and relies on a primary potable water source with existing capacity. Alternative water sources and water recycling opportunities will be fully exploited where cost effective and sustainable to do so.

5.3.2 Rain water

Rainwater collected from roofs or permeably paved road surfaces can be used for flushing toilets and landscape irrigation with little additional treatment. Indeed rainwater is often preferable to potable water for irrigation purposes and permeable paving provides hydrocarbon and heavy metal filtration prior to collection in the rainwater harvesting tank. Basic filtering of rainwater prior to entering the tank and a tank volume that allows for regular over-flowing is generally sufficient to maintain water quality in the system. All rainwater tanks will however require a mains water back-up supply to accommodate periods of low rainfall.

The quantities of rainwater available for use depends on the collection area, the collection area surface, filter efficiency and the average rainfall. Any rainwater tanks would however require a mains water back-up supply to accommodate periods of low rainfall, which will need to comply with TWUL Water Regulations to prevent cross-contamination.

The Pitch Specialists were not prepared to use harvested rainwater for pitch irrigation and the use of waterless urinals on all General Admission areas reduced the application of harvested rainwater and it is not included in the Stadium Scheme.

5.3.3 Ground water

The desk study carried out by Envirocheck reveals that half the site is located above a minor aquifer and one likely historic well was discovered. The London Catchment Area Management Strategy (CAMS), April 2006, states that new abstraction licenses in the area will be restricted to 0.5ML/day as an annual average, subject to the local assessment being favourable.

The River Lea valley area is however known to be over abstracted and at this stage of planning ground water abstraction is not a favoured option. It is also not recognised as a non-potable source of water by BRE and so therefore would not be considered as such for water requirements.

5.3.4 Greywater recycling

Another viable source of non-potable water that could be harnessed is greywater. Greywater is water that does not include any faecal or food matter and is collected from bathroom sinks, showers, baths and washing machines via a dedicated pipe network. The water is treated and can be stored for up to 5 days prior to use, after this time the water must either be re-circulated or discharged to foul sewer. The end-product, sometimes termed "green water", is delivered via more dedicated pipework and is suitable for toilet flushing, clothes washing and outdoor uses (not irrigation).

Greywater recycling within properties reduces the potable demand of the development reduces the discharge to the foul networks.

However it does require a considerable amount of additional pipework, which can be expensive and also the installation of treatment facilities, which will require space within the development. Given the lack of available space on the site this is not an option that will be considered within this development.

5.3.5 Black water

Black water recycling is similar to greywater recycling with the exception that all used water discharges are collected and treated. The advantage of this system is that it requires no additional collection pipework; black water would be collected via the proposed sewerage network and treated centrally.

Nonetheless black water recycling is a new technology and as such there are risks associated with its use. As well as the risks associated with any system that does not have a proven track record a black water recycling plant from the foul water service provider would require third party approval and there is always a risk that this may not be granted. The land take required for such a plant would also represent a problem in an already congested development therefore black water recycling will not be considered in this development.

5.3.6 Water Supply Summary

The approach throughout the Scheme is to utilise water reducing fittings to manage the water consumption.

6 Water demand strategy

6.1 Demand reduction targets

Reducing the potable demand across the development is an important aspect of any planning process and this section demonstrates how this can be achieved. There are only clear guidelines for the potable demand targets of residential properties, due to the range of type of commercial properties clearly defined targets do not exist. However it is important to show that demand reduction in any development has been considered and any measures are at least reasonable.

With the updated London Plan requesting that demand from residential properties should not exceed 105l/p/d, as outlined in Section 3, this assessment will use this target as the minimum required for the development. The potential reductions from efficiencies and non-potable water sources are outlined in this section and a demand reduction strategy will be proposed.

To identify the most appropriate reduction measures to be applied and to where all the options below have been considered. Each type of development will have rainwater systems considered individually for viability but social measures, water efficient fittings, metering and infrastructure will be assumed to be done across the whole development.

6.2 Incentives

In March 2004 the Government created Water Technology List to provide an incentive for companies to utilise water conservation appliances and practices within their developments. This means that businesses can now offset 100% of the cost and installation of the products on the Water Technology List against their profits. All companies that pay corporation tax and income tax in the UK are eligible for this 100% capital allowance relief. A full list of the products on the Water Technology List can be found at www.eca-water.gov.uk and it is important to note that only these are eligible for relief and that there is no allowance for domestic systems.

This list includes rainwater harvesting technology, water efficient fittings and leakage detection and monitoring equipment.

Reducing the potable water demand of a development will also go some way to improving its BREEAM rating. Whilst there are currently no statutory requirements to meet certain BREEAM ratings, it is likely that in the future the Government will be introducing Council charges based upon the BREEAM ratings a development has achieved. Meaning that the more developments have been designed to reduce the impacts on the environmental, and therefore achieved a higher BREEAM rating, the lower the Council Charges they will be subjected to. This system will be much like the one already in place within the UK for road tax, with the higher polluting vehicles being charged higher rates.

Significant savings could be made by reducing demand with appliances/efficiency measures rather than potentially having to pay high off-site infrastructure reinforcement costs and incur possible delays if demand exceeds the existing network capacity.

6.3 Efficiency Demand Reduction

The following assumptions have been made in order to calculate the savings available:

- Occupancy and breakdowns for the various parts of the development were primarily based upon information within Employment Densities: A Full Guide. English partnerships & the Regional Development Agencies. Arup, 2001.
- Water demand breakdown for residential properties comes from using the BRE Water Use Calculator
- Water demand breakdown for offices comes from BRE IP15/98. Water Conservation. Shoulder et al. BRE, 1998. The retail breakdown is assumed to be similar to that of the offices.
- Water efficient fittings volumes are taken from various industry standards (Market Transformation Programme).

The breakdown of water demand for the Stadium was an Engineering estimate based upon prior knowledge of working on the Emirates Stadium.

Table 6—1 Water efficient fittings data

Fitting	Baseline	Water Efficient	Highly Water Efficient
WCs	6l/flush	6l/4l	4l/2.6l All
Urinals	7.5 l/hr/bowl	3.5 l/hr/bowl	0 l/hr/bowl All (not Residential)
Taps	5 l/min	3.2 l/min All	1.7 l/min
Showers	14 l/min	9 l/min Residential, Stadium and Hotel	6 l/min Offices
Baths	110 l/use	100 l/use	80 l/use Residential and Hotel
Washing Machine	49 l/use	39 l/use Residential, Stadium and Hotel	-
Dishwasher	13 l/use	10 l/use All	-

Table 6—1 identifies the type of water efficient fittings that are and will potentially be more readily available in the future. It also identifies where it is proposed to utilise these fittings within the development in order to reduce the water demand of the development.

6.4 Non Potable Sources

Calculations and engineering experience has shown that the use of rainwater can help reduce the potable water demand, therefore improving the environmental impacts of the development, whilst also being potentially financially viable options. The adoption of this technology will not be appropriate in every part of the development and the appropriateness for each section is discussed here.

6.4.1 Stadium including Tottenham Experience.

There are no defined water use targets for commercial properties but the installation of efficient fittings across the development does provide significant savings in potable water use.

6.4.2 Residential

With the installation of water efficient fittings within the residential properties it is possible to achieve the target 105 l/p/d rate. Given the complex roof structure of the residential buildings rainwater harvesting is not seen as a viable or necessary addition here.

6.4.3 Extreme Sports

The exact nature of this facility is yet to be finalised so appropriate water saving measure will be implemented when the design is further developed.

6.4.4 NE Podium Building

There are no defined water use targets for commercial properties but the installation of efficient fittings across the development does provide significant savings in potable water use.

6.5 Demand Reduction Conclusions

The use of water efficient fittings and efficient management of the water systems across the Northumberland Development Project will ensure significant water savings. Currently there are no legal targets for water use but planning permission will take into account how the development fits within the targets of the London Plan, therefore it is important to meet the 105 l/person/day rate specified for the residential properties to aid in the planning process.

With the essential water efficient fittings for the residential development it is calculated that a saving of 30% is achieved, thus reducing the potable water demand within the residential development to less than 105 l/person/day. The installation of water efficient fittings throughout the rest of the development will also provide a benefit by reducing the overall water demand. In addition to the annual financial savings in water, which are likely to increase due to the rise in costs of water supply, this will have the following additional benefits;

1. The target water demand as stated within the London Plan is achieved within the residential development;
2. The BREEAM rating for the development would be increased meaning that some more onerous environmentally friendly items would not be required elsewhere in the development;
3. It represents an opportunity for Tottenham Hotspur to be the leaders in green technology in the football world and set a precedent for other stadiums to follow;
4. Negates the need to upgrade the existing potable network; and perhaps most importantly
5. It would show the planning authority how serious Tottenham Hotspur is about reducing its impacts to the environment and could favourably impact the planning approvals.

7 Drainage strategy

7.1 Objectives

This drainage strategy aims to provide an overarching appraisal of surface and foul water management procedures to provide a range of design principles and a statement of intent, of considered practices that are appropriate in the confines of the site and surrounding area, and current government and non-government policies and legislations. This drainage strategy will act as a precursor to detailed development drainage design. An assessment of the existing management strategy will also be provided.

7.1.1 Methodology

The guidelines for surface water drainage and flooding are given by the following documents, as reviewed earlier within Section 3:

- National Planning Policy Framework, March 2012
- London Plan, March 2015
- Mayor's Water Strategy, October 2011
- Supplementary Planning Guidance on Sustainable Design and Construction, April 2014

These identify similar key requirements on developments such as the need to provide separate surface water and foul drainage networks and the overall promotion of SUDS on site.

Table 7—1 The London Plan specifically identifies the following standards:

Essential Standards Mayor's Preferred Standards	Mayor's Preferred Standards
Use sustainable drainage systems (SDS) measures, wherever practical.	Achieve 100% attenuation of the undeveloped site's surface water run off at peak times
Achieve 50% attenuation of the undeveloped site's surface water run off at peak times	

7.2 Background

7.2.1 Existing Surface Water Runoff Drainage Summary

TWUL have been consulted regarding the sewerage infrastructure located in the vicinity of the development site and asset location plans provided by TWUL show the location of sewerage surrounding the site. Plans indicate the presence of separate surface and foul water drainage networks (Foul drainage is covered later in 7.3.2). The following points provide a summary of the surface water network in close proximity to the site:

- To the northeast of the site a 229mm sewer runs south to north along Worcester Avenue before outfalling to Northumberland Park. The sewer services the properties to the east and west of Worcester Avenue.
- To the north of the site a 335mm sewer directs flows westward along Northumberland Park.

- To the west of the site a 610mm sewer flows south along High Road conveying flows from upstream catchments (north and east), before discharging to a culverted watercourse.
- The culverted watercourse, the Moselle Culvert, formally the Moselle River or Brook, once tributary of the River Lea, continues south along High Road before turning east at Scotland Green and ultimately discharging to Pymmes Brook, adjacent to the River Lea in the east (OS 534904, 189932).
- To the south of the site, along Park Lane, a 914mm x 914mm sewer directs surface water collected from the site and the south flowing surface water sewer in Worcester Avenue, to the east and again to the an outfall at Pymmes Brook (OS 535011, 190336).

7.2.1.1 Existing Surface Water Runoff

Based on the area of impermeable surfaces within the development site (8.46ha) the volume of surface water runoff for a 1 year return period storm is estimated as 1030 litres/second. This volume of runoff is based on a 90% runoff coefficient of surfaces in the development site (allowing for some degree of infiltration to the ground and loss through evapotranspiration) and a rainfall intensity of 50mm/hr.

7.2.2 Existing Foul Drainage Summary

The site is surrounded by an extensive foul water drainage network. A summary of the foul network is as follows:

- To the north of the site a 305mm foul sewer runs eastward along Northumberland Park.
- To the east of the northern half of the site a 229mm foul sewer runs north along Worcester Avenue, beside Wingate Trading Estate, before joining the sewer running east along Northumberland Park.
- To the east of the existing White Hart Lane Stadium a 229mm foul water sewer runs south towards Park Lane along Worcester Avenue.
- To the South of the existing stadium (Park Lane) a 229mm foul water sewer runs east where it meets the sewer running south down Worcester Avenue. From here the pipe size increases to a 305mm and flows east.
- To the west of the site a 686mm foul water sewer runs south down High Road.
- There is also an existing 305mm foul water sewer which runs westward along Paxton Road, which with the relocation of the stadium is likely to be removed.

7.2.3 Existing Ground Conditions

The findings of a Phase 1 Geotechnical assessment, included as part of the BuroHappold Engineering Infrastructure Review report, indicate that the upper layers of the site generally comprise of Made Ground, with Silt formations and Gravels beneath. This is underlined by London clay (approximately 14 – 20m thickness) and borehole logs indicate a sub base of Chalk. Groundwater can be expected in the gravels layers, with a level between 1.5m bgl and 4.2m bgl.

7.2.4 Existing Sustainable Drainage Systems

There are very few existing SUDS features across the development site. On visual inspection, the area is primarily surfaced with impermeable surfaces and the use of surface water flow attenuation, quality control and amenity is limited.

7.2.5 Exceedance

The development has been designed so that the capacity of the drainage network is not exceeded more often than it is currently and introduced improvement on the current situation. Any necessary upgrades to the existing networks have been suggested to provide conveyance for storm water up to the 1 in 30 year annual storm event. Measures have been put in place to reduce the probability of the foul network from surcharging, such as identification of areas for possible ponding of water in events exceeding this size of storm for which the network is designed.

7.3 Post Development Drainage Strategy

7.3.1 Surface Water Drainage Strategy

7.3.1.1 Introduction

Surface water generated onsite as a result of pluvial (rainfall) sources has the potential to cause surface water flooding to not only the site but the surrounding land if an effective management strategy is not incorporated into the design and implemented. The effective disposal of surface water from the development is a material planning consideration in determining proposals for the development and use of land. It is much more effective to manage flooding at and from new development early in the land acquisition and design process (PPS25, Annex F). The following will outline the methods adopted for accommodating surface water onsite and its subsequent discharge from the site.

7.3.1.2 Construction Phase Strategy

During the construction phase the existing site surface water infrastructure will be used to convey surface water flows. Where construction works are proposed, directly or indirectly influencing drainage infrastructure, the management of surface water flows will be subject to Contactor review and should be included as part of the intended construction works method statement.

7.3.1.3 Completed Development SUDS

SUDS are an approach to managing surface water run-off which seeks to mimic natural drainage systems.

Through a sequence of management practices and control structures, SUDS are designed to drain surface water in a more sustainable fashion than some conventional techniques, by controlling rainfall as near to its source as possible, protecting or enhancing the quality of discharge and providing amenity to previously urbanised areas.

Pollution Prevention (Good Housekeeping)

In accordance with the EA SUDs treatment train (Figure 7-1) and the approved Document Part H of the Building Regulations (2015) a hierarchy for surface water disposal exists. Under this hierarchy measures are proposed for use in the development of the stadium and surrounding area. The commitment to provide SUDS will improve the quality of the water discharging from the site with an emphasis on source treatment techniques.

The hierarchy (Figure 7-1) was developed to give a rationale for the development of SUDS drainage systems at a variety of scales. It is a hierarchy which may be tailored to suit the size and the complexity of the area being drained. The full hierarchy (with good housekeeping as an essential addition) has principally been adopted for larger developments.

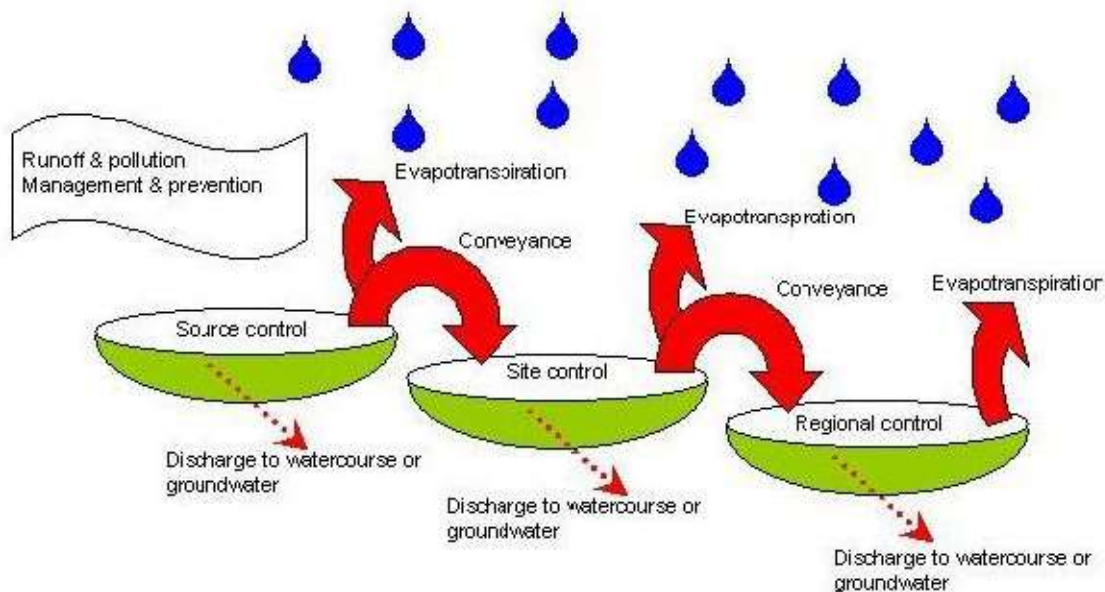


Figure 7-1 The Treatment Train (http://www.ciria.org.uk/suds/suds_management_train.htm)

Design - Areas considered as potential high risk pollution areas that are integral to the development site have been separated from other drainage areas with treatment appropriate to the potential contaminant or discharge to the foul sewer, where required. Areas include; but are not limited to, car/coach parking areas, service areas (chiefly commercial and stadium delivery areas) and transfer areas.

Management – Management and maintenance policies will be developed to ensure that identified surface water pollutants are minimised. This includes programmes for the cleaning and maintenance of roads and gullies and the sweeping of impermeable areas.

Education - A programme of educating the public will be undertaken to ensure that the SUDS elements proposed remain sustainable in the long term. This will include informing the public of what chemicals are inappropriate for the surface water drainage system. As an example, the creation of a dedicated surface water drainage network for residential areas will require residents to be informed that it is inappropriate to wash cars with detergents on roads.

7.3.1.4 Source Control

Current EA best practise guidance notes that surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management. Traditional drainage approaches have involved piping surface water off site as quickly as possible, which has, historically, lead to flooding of downstream catchments. Current sustainable drainage systems look to retain water on site and release it at a controlled rate through a combination of:

- Infiltration into the ground;
- Holding water in storage areas; and
- Slowing down the movement of water.

The current design for a sustainable surface water drainage scheme limits the peak discharge from the site to 1269 l/s, or 150 l/ha/s, which meets the limit agreed with the Environment Agency and TWUL for the development.

7.3.1.5 Site Zoning

For the purposes of surface water drainage design, the site has been split into a number of main areas as described below. Each catchment can be seen in Figure 7-2.

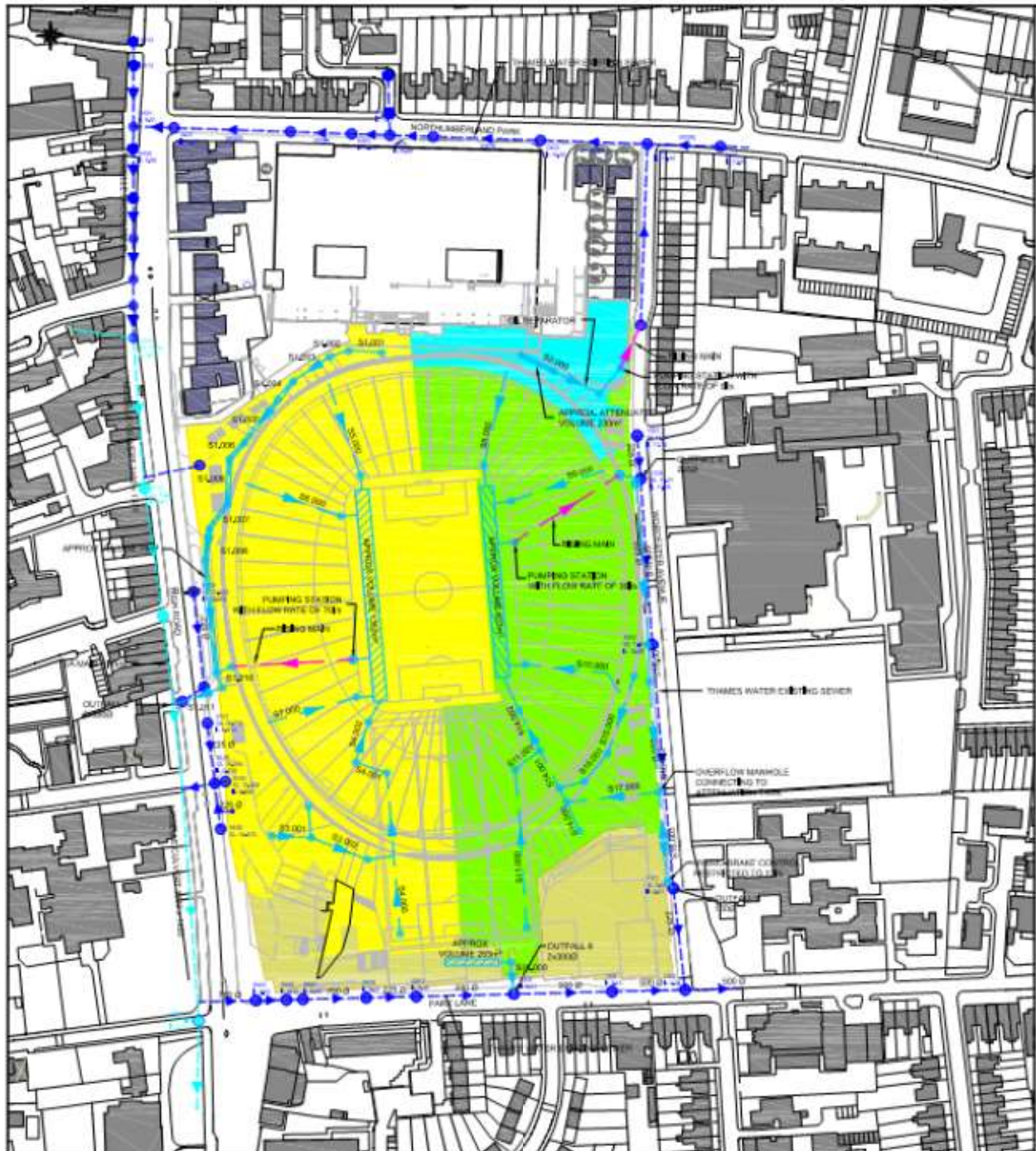


Figure 7-2 SWD catchment areas

Stadium Zone – The Stadium site including the public realm and hotel (6.4ha total) will have a surface water network that provides attenuation totalling 1640m³. 1 in 30 year attenuation (980m³) will be provided by below ground tanks. It is anticipated that only a portion of the 1 in 100 attenuation requirement (660m³) will be provided by controlled surface level flooding due to site constraints and the remainder will have to be provided below ground. The Stadium will utilise multiple outfalls due to the size of the catchment, the requirement to use existing connections and the complex phasing sequence. The outfalls will be split between the Moselle Culvert in the High Road (east) and the new sewer to be laid in Worcester Avenue (west). Existing connections will be re-used wherever possible and flow control devices will ensure the total discharge from the catchment is limited to 960l/s. The public realm area will be drained by slot drains which will be connected to the main system. Rainwater harvesting is proposed for part of the stadium roof to reduce the mains demand for non-potable water. The pitch drainage will be designed by the specialist pitch contractor Hewitt's but will link into the wider system.

South Development – The South (Residential) development (0.6ha) will have a surface water network that provides attenuation totalling 180m³. At present it is assumed that 100% of the 1 in 100 year attenuation will have to be provided below ground and some pumping will be required due to the basement car park. The system will outfall south to Park Lane re-using existing connections where possible with flow control devices installed to limit discharge to 90l/s.

Hydrocarbon Interception – Permanent parking areas will have pollution control measures including hydrocarbon removal through oil separators.

7.3.1.6 Surface Water Flooding

The surface water drainage system is to be designed to allow for exceedance. In accordance with good practice and to meet adoptable standards the surface water drainage is to be designed to ensure no flooding in a critical duration 30 year storm event. This design criterion used to define the size of surface water storage requirements has been based on 1:100 year storm event plus 20% for Climate Change.

The recommendations of PPS25 for increases in intensity due to climate change have not been accommodated in this assessment as there is no guarantee that the current sewer network would have sufficient capacity to accommodate the increase in flows.

7.3.1.7 Other forms of Flooding

Other forms of flooding identified in Appendix C of PPS25 include reservoir flooding, sewer overflow flooding and ground water flooding. The flood risk assessment has been carried out by Aecom.

7.3.2 Foul Water Drainage Strategy

7.3.2.1 Construction Phase

During the construction phase the discharge profile will change as the existing stadium's capacity is temporarily reduced. The existing site infrastructure will be used to convey the foul flows from the site. The sewer running along Paxton Road has been diverted and the surface water and foul water have been pumped further downstream foul network to the High Road.

Initial TWUL assessment show there to be enough capacity to cope with the proposed development and the resulting increase in discharge, however it is important that when designing the foul water drainage strategy for this development that it will not jeopardise the potential for future development within the immediate area by using up all the available capacity within the system. Therefore the view has been taken that it is important that all new/upgraded drainage infrastructure developed for this proposal will have an allowance for additional capacity to cope with the demands/discharges from any potential developments. TWUL are currently undertaking a capacity study of the local foul network.

7.3.2.2 Completed Development

The development will have a dedicated foul sewer system that is separate from the surface water drainage system, in the same vein as the site currently. The site has been broken down for the three discrete elements of the development as they outfall to different systems. It is important to note that this particular development has an unusual usage pattern, due to it being a football stadium, which leads to a high peak discharge but proportionately low average discharge. Discharge will only reach this peak on match day and even then only for 20 minute periods corresponding to just prior to kick off, half-time and after the final whistle.

The new foul drainage infrastructure will require connection into the existing TWUL network surrounding the site. The Stadium and South Development will outfall to a 686mm diameter sewer on the High Road. Outline approval from Thames Water has been granted on the basis of their being sufficient capacity. The sewers within the site will discharge via pumping stations and rising mains.

7.3.3 Pumping Stations

TWUL plans show no pumping stations or rising mains in the immediate vicinity of the site, therefore it is safe to assume that the surrounding network is currently gravity fed.

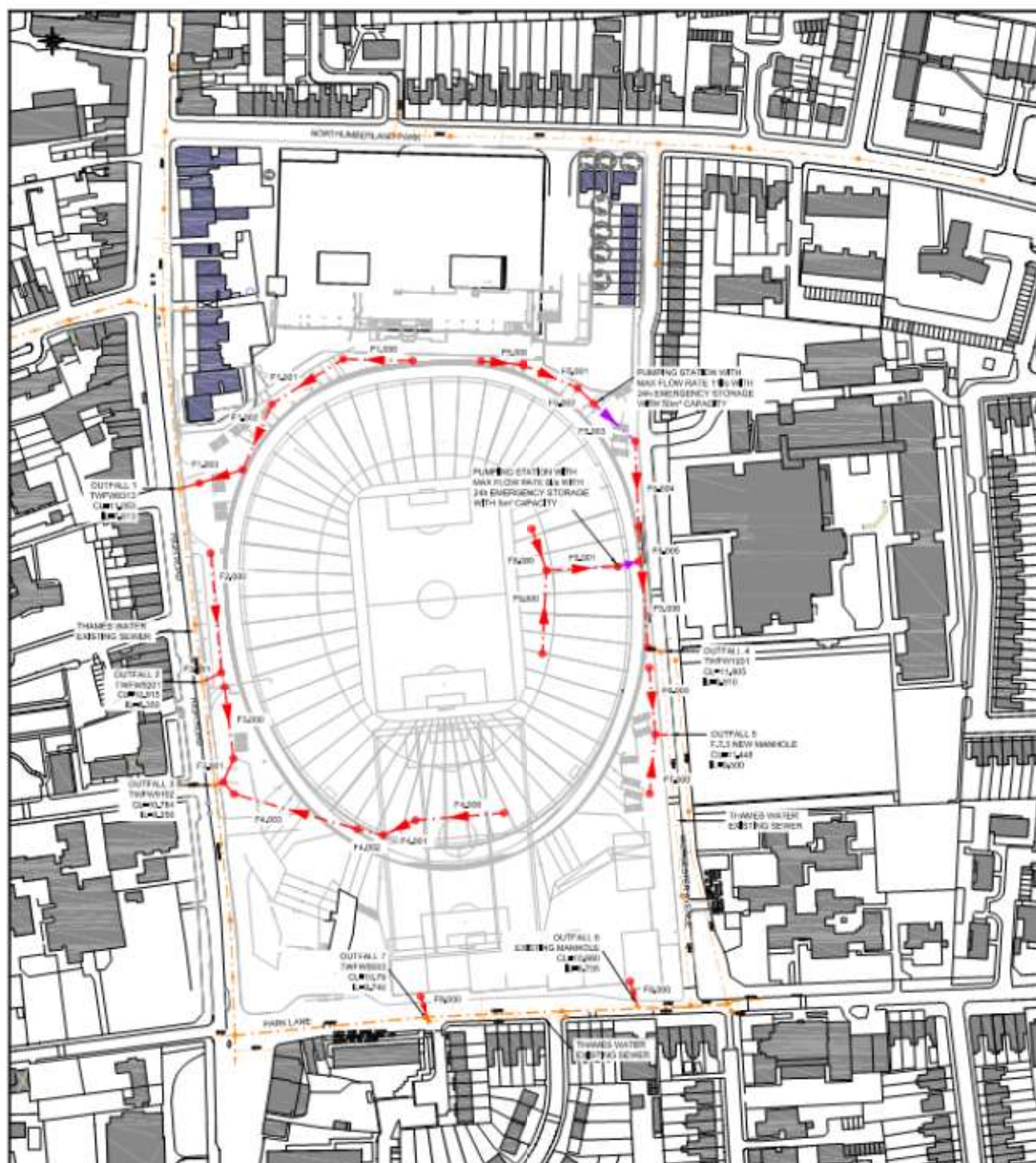


Figure 7-3 Foul Water Drainage Strategy

8 Summary & Conclusions

8.1 Summary

The Water Strategy identifies the broad strategies in relation to water supply, surface water drainage and foul water. It also introduces the flood risk assessment findings and relates them to the surface water strategy. The central part of this water strategy is however the assessment of demand reduction for the development.

In line with local, national and European guidelines the Northumberland Development Project must be shown to consider and manage all uses and movements of water with the intention of employing efficient systems and practices across the development.

Potable Water Supply

It is proposed to connect into the existing water mains to provide the potable water requirements for the development. To minimise any potential upgrade requirements a suite of demand reduction measures are proposed, these will reduce the volume of potable water required for the development and could therefore save money from not undertaking off-site reinforcement works as well as using less mains water. The proposed measures are discussed below.

Demand Reduction

The Northumberland Development Project must demonstrate that savings in potable water use have been made in relation to the baseline demand.

It is recommended that water efficient practices and fittings are incorporated across the development. These include monitoring of the water networks and metering of all properties to detect leaks quickly and better inform users of their water use.

Efficient fittings include:

- Low Flush, 4/2.6 l/flush, WCs throughout
- Water Efficient, 3.2 l/min, aerating taps throughout
- Water efficient, 9 l/min, showers within the residential, hotel and stadium developments
- Highly water efficient, 6 l/min, showers within the office, supermarket and megastore/museum developments
- Water efficient, 80 l/use (150 l sized), baths where fitted
- Waterless urinals where fitted
- Water efficient, 39 l/use, washing machine where fitted
- Water efficient, 10 l/use, dishwasher where fitted

With these efficiencies user education will be a key part of water demand reduction as the end users must understand the impacts of their habits as well as knowing how to get the best use from low flow fittings.

Drainage

The site currently drains to separate surface water and foul sewers. The development will maintain the separation and connect into these networks. Local network upgrades will be made on Worcester Avenue with the addition of a new sewer. This is especially relevant to the increased capacity stadium which will have larger peaks in its discharge flows, although the installation of water efficient fittings will minimise this potential increase in discharge volume.

The surface water drainage of the site will aim to improve the existing situation through the introduction of SUDS across the site. This will treat the first flush of a storm event to improve the water quality of the discharge and provide attenuation of storm water to reduce the flood risk to the downstream catchments as well as to the development itself. The site is divided into zones, with underground surface water storage tanks provided for each zone. For the area surrounding the Stadium, permeable paving will be provided so surface water can infiltrate into the underground tanks. The discharge from these tanks will be limited to comply with the 150 l/s/ha limit on drainage rate as agreed with the EA and TWUL. The surface water drainage strategy will be achieved with no pumping throughout the system.

The foul drainage of the development will connect into the existing network and upgrades will be provided to ensure that the systems do not back up and avoid exceeding existing network capacity. The stadium and the Southern Development will drain into the High Road sewer to the west, with the Northern Development draining to the Northumberland Park sewer to the north. The foul water drainage strategy will be achieved with no pumping throughout the system and has been agreed with TWUL.

The potential use of local rainwater harvesting will help to reduce the volumes of discharge as well as reduce the potable demands of the development, potentially avoiding network upgrades. The adoption of green roofs on the residential development will further reduce the run-off and discharge rates.

Flood Risk

A separate FRA Document has been prepared by Aecom.

The site is located in EA Flood Zone 1, which means that the probability of fluvial and tidal flooding in any one year is less than or equal to 0.1%. PPS25 requires that developments in Flood Zone 1 do not increase flood risk to the development or elsewhere through the addition of hard surfaces and increase in surface water run-off.

The provision of underground surface water storage will reduce the risk of surface water flooding for the site. A controlled discharge rate from the underground storage tanks will also reduce the risk of the development surcharging the surface water drainage network and impacting on third parties. The controlled discharge is via pumps.

8.2 Conclusion

This water strategy shows that the Northumberland Development Project will not adversely impact the surrounding area but will actually improve the current situation in relation to the water infrastructure and the flood risk.

Potable and foul mains will be upgraded if required to serve not only the development itself but the needs of any future developments surrounding the site. Surface water drainage and flood risk will be improved through the use of SUDS, which will retain water and discharge it gradually to the surrounding drainage network reducing the 'first flush' impacts downstream.

The water demands of the development will be reduced when compared to the baseline demand for a development of its size. Efficiency measures will be incorporated across the entire development to reduce the potable water demand in line with the London Plan and wider water saving initiatives. The development will be a leading light in sporting stadia in terms of water efficiency.

Appendix A Water quality

Guidelines are presented in CIRIA Guidance C539, Rainwater and greywater use in buildings: Best Practice Guidance, BSRIA Water Reclamation Standard TN 7/2002 and WRAS Guidance, Reclaimed Water Systems.

Parameters contained in the above guidance are given in Table A1;

Table A1 Guidance for parameters of non-potable water

Quality Parameter	Classification from BSRIA Guidance			Source
	Class A (pressure applications; not to exceed drinking water quality)	Class B (gravity fed applications; may exceed drinking water quality but must take toxicity to plants in to consideration)	Class C (wc flushing: may exceed drinking water quality but must consider the effect on materials water is in contact with)	
Total coliforms cfu/100ml	10	1,000	1,000	BSRIA Guidance
Faecal coliforms cfu/100ml	-	10,000	10,000	WRAS Guidance
Faecal enterococci cfu/100ml	-	100	100	WRAS Guidance
Total Chlorine ppm	0.5	0.5	2.0	BSRIA Guidance

Table Notes:

1. The WRAS Guidance sets the faecal coliform level at 10,000cfu/100ml as reclaimed water is not considered to add to the burden of exposure in the toilet environment at lesser levels.
2. The parameters given are in all cases equal to, or more stringent than those identified in the Mayor's Draft Water Strategy.

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Utilities Planning Report

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Revision 01

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date **17 August 2015**

approved **Steve Clarke**

signature 

date **17 August 2015**

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