All Assignment EXPERTS

TABLE OF CONTENTS

1. INTRODUCTION

London City Airport was opened in 1987 and is planning for the extension of its terminal building. A site investigation of London City Airport is carried out based on the observations made, attained knowledge from the published information and the same is presented in this report. This site investigation report is assumed to supply inputs to the designing foundations of structure, ground works, and infrastructure.

1.1 OBJECT AND SCOPE OF THE INVESTIGATION

The object of the investigation was to obtain information on the site of London City Airport, investigate its development, ground conditions. The investigation comprises the evaluation of ground conditions, geology, hydrology and hydrogeology from the reports in the published literature. A risk assessment is interpreted based on the investigated and evaluated. The organization of the report is as follows.

A description of the site location, site description and a summary of the proposed developments for LCY are presented in Sections 2. The factual data so obtained are presented in Appendices this report. The findings of desk studies previously carried out for the LCY, with historical developments and ground conditions are summarised and discussed in Section 3. From the interpretation of the data obtained from the investigation, a preliminary risk assessment is concluded and is presented in Section 4. Later a set of recommendations for LCY development is given in Section 5 which includes foundation solutions, excavation solutions, etc.

2. SITE SETTING

This section provides a description of the site location, description and discusses/guides through the proposed developments.

2.1 SITE LOCATION

The site is approximately located at 9.5Kms (6 miles) east of the Central City of London and 4.8kms (3 miles) east of Canary Wharf and 0.5 miles away from the ExCeL Exhibition and Conference Centre. The approximate Ordnance Survey National Grid Reference for the site is TQ 43738045 [National Grid Reference Finder], and an extract from the O.S. Map is included as Appendix 1. A mix of residential, industrial and commercial uses comprise the surroundings of the site. Significant planned development and regeneration is present in the vicinity of the Airport.

2.2 SITE DESCRIPTION

The Surroundings of the Airport, Airport description and access to the airport are presented in this Section.

2.2.1 SURROUNDINGS

In the northern and southern banks of the River Thames at Silvertown and North Greenwich, which surround the airport are with a mixture of diverse zones which include residential and industrial/commercial areas. The most prominent non-residential uses in the surroundings include the large Tate, Lyle factory to the south of the Airport; the University of Eastern London (UEL) on the north-east side of the Royal Albert Dock; the Royals Business Park to the north; the London Regatta Centre on the north-west side of the Royal Albert Dock; the Excel Exhibition Centre and three adjacent high rise hotels to the west on the northern side of Royal Victoria Dock. Further, there are several areas of vacant land like some at Albert Basin to the east with a large expanse of land on the north side of Royal Albert Dock between UEL and Royals Business Park. Some of this land is currently being developed.

2.2.2 AIRPORT

Existing Airport Terminal is a flat-roofed building of approximately 13 m in height with a conning air traffic control (ATC) tower at a maximum height of 15 m, located at the western end of KGV Dock. It contains check-in facilities, ticket desks, security processing, a departure lounge, a departure and arrival pier, departure gate areas, domestic and international baggage reclaim, immigration and customs, shops, a business center and catering outlets. The net floor area occupied up by the existing terminal and piers is 17,991m2. To the south of the Terminal, there are drop-off and pick-up facilities, car rental facilities, as well as the Airport's staff office accommodation within the 4 story City Aviation House (CAH). To the east of CAH is KGV House which is used for offices and as a staff training facility. Further east along the dockside is the LCY Engineering Building and the LCY Fuelling Facility. The remaining land in the Application Site, to the east towards Woolwich Manor Way, is either vacant or used for goods storage and heavy vehicle parking.

2.2.3 ACCESS TO THE SITE

The Airport is well connected to London's public transport rail system via its on-site Docklands Light Railway (DLR) station, which links directly into the Airport terminal building. As a result, it has the highest public transport mode share of any UK airport, with 70.5% of passengers using public transport (DLR, Bus, and Black Taxi) in the Baseline Year of 2014. This includes 61% of passengers using the DLR. The main strategic road connections to the Airport are the east-west A13 and the A406 North Circular that connects with the M11 and M25 motorways. The Airport is approximately 1 mile from the A13, 3 miles from the A406 and 15 miles from the M25. The Airport can also be easily accessed via walking, cycling, taxi/mini cabs or buses. There are two main car parking areas within the Airport, shared between passengers and staff. There is also a small stay car park located near to the terminal building, and the mainstay car park adjacent to the east of this. The short-stay car park has 148 spaces whilst the main stay car park has 644 spaces. Fifty-two spaces are provided the western staff car park, whilst 10 spaces are provided in the triangle staff car park. In addition, 120 parking spaces are allocated to car hire companies. These are located within the Forecourt and in an area adjacent to Hartmann Road.

2.3 PROPOSED DEVELOPMENT

The development as mentioned by the LCY reports [1], will comprise seven aircraft parking stands, an extended terminal building, a new eastern passenger pier and associated works on a platform over the King George V Dock. It is proposed to provide a new passenger forecourt in front of the terminal building together with a new office building (to replace City Aviation House) and a hotel. Passenger and staff car parking will be re-organized. The new aircraft parking stands are proposed to the east of existing aircraft parking stands 21-24. As part of the upgrade works there will be an extension of the aircraft taxiway running along the eastern length of the runway. A landside access pontoon for use by emergency services will also be provided at the eastern end of the seven new stands. It is proposed to construct a new airfield infrastructure, new passenger (terminal building) facilities, seven new aircraft stands, and associated infrastructure together with a Hotel as elements of extending the London City Airport. In particular, it is proposed to construct two extensions to the existing terminal building (west and east of the building) to match the terminal capacity to future demands.

Hence, it is necessary to undertake a Site Investigation to design the foundations of the structure. To do this, it is first necessary to prepare a desk study report.

3. SITE INVESTIGATION

In this Section, a brief introduction of the source of information for the site investigation considered is presented initially, followed by a summary of historical developments and ground conditions of the site.

3.1 INTRODUCTION

A brief site investigation report for the LCY was published in [1]. This report contains findings from that report and some other resources [2] [3] [4].

3.2 SUMMARY OF HISTORICAL DEVELOPMENTS

The construction of the LCD site began on 2 May 1986 with Charle, Prince of Wales laying the foundation stone for the terminal building in the site. On 31 May 1987, LCY has its first aircraft landing.However, commercial services have begun on 26 October 1987. LCY was officially opened by Queen Elizabeth in the same year.

The airport handled an amount of almost 230000 passengers by 1990. However, the figures got reduced drastically because of the Gulf War, and the effect of the same was seen for almost 3 years till 1993. Within this 3 years duration, the LCY got the permission for the extended runway and was opened on 5 March 1992. The glide path was also reduced to 5.5, where the normal airport glide path is 3.0. This is still steep for the airport but is sufficient enough to allow larger range aircraft, including BAE 146, Airbus A318 for service of the airport.

LCY DLR station opened a new branch of the Docklands Light Railway, providing rail access to the airport for the first time on 2 December 2005. It provides fast railway link to Canary Wharf, the City of London. Almost a 2.3 million passengers used the LCY by the end of 2006.

LCY was purchased by a consortium comprising insurer AIG Financial Products Corp. and Global Infrastructure Partners (GIP) from the Dermot Desmond in October 2006. GIP has increased its stake in the airport to 75% in the final quarter of 2008, leaving the remaining 25% to Highstar Capital.

LCY got permission for constructing an extended apron with four new aircraft parking stands. There are also four new gates to the east side of the terminal in the approved plan. The approval came in 2001, and the operations have begun on 30 May 2008. They are carried on piles above the water of the King George V Dock.

The work is done with an investment of around £15m in early 2013 to refurbish the western pier with new departure gates, improved lounges, develop international arrivals hall, and baggage handling areas.

Airport also got a master plan which outlines their vision for growth till 2030. There is an expansion mentioned in the plan to the airport for achieving maximum capacity of around 8 million passengers per annum. This is further meant to be achieved without any addition of the second runway or significant expansion of the LCY boundaries.

3.3 GROUND CONDITIONS

Numerous former industrial land uses were present approximately 100m to the south of the Application Site. A former gas works were located approximately 100m to the south of the site from at least 1873 and to the east of this a sewage works and chemical factory, from 1896.

The Application Site is predominantly comprised of hard surfaces. Some limited soft-standing exists to the north-west of the site, in the vicinity of the fire training ground. A tank farm, operated by BP, is located within a fenced enclosure behind the western end of the West Pier. Four above-ground storage tanks (AST) totaling 710,000L capacity are understood to store aviation fuel. Approximately 152,000L of aviation fuel is pumped into the ASTs each day via delivery tankers. There is some general hazardous waste storage, including waste oils and ‘jet slops’ associated with the tanks. Potential sources of contamination related to bulk fuel storage and aircraft maintenance, including refueling and de-icing. The areas of fuel storage, aircraft maintenance, and fire training ground were well maintained and managed with surface run-off draining to dedicated interceptors.

Next, a preliminary risk assessment is presented based on the information and investigation carried out earlier.

4. PRELIMINARY RISK ASSESSMENT

In this Section, initially, risk assessment is carried out based on the published work from various sources [1], followed by some conclusions from personal understanding.

4.1 BASED ON PUBLISHED GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

4.1.1 GEOLOGY

Based on the British Geological Survey (BGS) mapping (1:50,000 scale) and previous intrusive site investigation reports carried out between 2001 and 2013, the stratigraphic sequence beneath the Application Site comprises [1]:

Strata	Location	Age	Thickness (m)
Made Ground	Whole Application Site	Recent	Several metres
Alluvium	Whole Application Site	Pleistocene	Several metres
River Terrace Deposits	Whole Application Site	Quaternary	Several metres
Lambeth Group	Western area of Application Site	Palaeogene	Up to 30m, thinning towards the east
Thanet Sand Formation	Western and central areas of Application Site.	Palaeogene	Up to 15m, thinning towards the east
Upper Chalk	Whole site	Cretaceous	> 80m

Table 1 Geology of the LCY Site

There are no recommended or potential Regionally Important Geological Sites (RIGS) or Locally Important Geological Sites (LGS) within the London Borough of Newham, as set out by the London Plan (2011) and supplementary guidance presented in the London Plan [1].

4.1.2 HYDROGEOLOGY

Environment Agency Groundwater Vulnerability Digital Mapping indicates that Application Site overlies a Secondary Undifferentiated Aquifer relating to the Alluvium. Secondary Undifferentiated Aquifers are formations which have low permeability and have negligible significance for water supply or base flow. The River Terrace Deposits are classified as a Secondary A Aquifer, which is considered to be a moderately sensitive receptor to any contamination. Secondary A Aquifers are formed of permeable layers capable of supporting water supplies at a local scale. Further, they are in some scenarios form an important source of base flow to the rivers as well. Shallow groundwater within this deposit beneath the Site may be in hydraulic continuity with the River Thames, located approximately 460m to the south of the site.

The Lambeth Group and the Thanet Sand Formation are also classified as Secondary A Aquifers. The Upper Chalk is classified as a Principal Aquifer; these formations provide a high level of water storage and may support water supply and / or river base flow on a strategic scale. Notably, the overlying, variably permeable Alluvium will likely afford a degree of protection to these more sensitive groundwater bodies from contamination sourced within shallow soils and perched groundwater (if present). The Lambeth Group, Thanet Sand, and Upper Chalk strata are designated as Water Framework Directive groundwater bodies. Under the Water Framework Directive, measures will be put in place to improve the quality of groundwater within these bodies.

There are almost no records of licensed groundwater abstractions within 1km of the Application Site. The Site is not located within an Environment Agency defined groundwater Source Protection Zone (SPZ) [1].

4.1.3 HYDROLOGY

King George V (KGV) Dock is situated to the east of the terminal, and the Royal Albert Dock is situated adjacent to the north of the runway. The Royal Victoria Dock is located approximately 70m to the west of the Application Site. The River Thames is located approximately 460m to the south and flows in an easterly direction.

According to Environment Agency data, there are two watercourses recorded within 1km of the Application Site classified within a River Basin Management Plan published by the Environment Agency under the European Water Framework Directive (2000).

Watercourse / body	Current Chemical Quality Classification	Approx. Distance and Direction from Site
Thames, Creekhead, Trinity, Wylees Sewers	Does not require assessment	50m North
River Thames	Fail	460m South

Table 2 Classification of the water sources within 1Km range of LCY site

There are records of two licensed surface water abstractions within 1km of the site. These both relate to abstractions from the River Thames by Tate and Lyle Sugars Ltd and the abstractions are recorded as being located approximately 375m and 480m south of the Application Site [1].

4.2 BASED ON THE PERSONAL UNDERSTANDINGS

The one-off volume of demolition, earthworks, piling and foundation spoil and other construction waste will exceed the current baseline waste volume. However, this is unlikely to impact the existing and proposed waste management infrastructure significantly. Where possible construction waste will be re-used on-site; over 90% of the waste material is to be targeted to be recycled, reused or otherwise diverted away from landfill [1].

During the construction phase, waste will be segregated and stored on-site within a dedicated compound pending its onward transfer. Within Greater London, from [1], there is a significant commitment to improving the existing waste management infrastructure in order to deal with increasing waste generation across the capital and achieve the targets set by the London Plan.

Waste production at the Airport will increase under the proposed CADP due to the increase in the number of arriving and departing passengers, and the associated enlargement of passenger facilities within the terminal buildings. Volumes of waste generated as a result of the proposed CADP are relatively small. Additional waste is therefore not likely to adversely impact existing and proposed infrastructure.

Within the Airport's Sustainability Strategy, the Airport proposes to minimise operational waste production and promote sustainability by monitoring waste leaving the Airport more closely, raise awareness to staff on recycling and develop ways to monitor how and where waste is generated at the Airport.

5. RECOMMENDATIONS FOR THE PLAN

5.1 GENERAL

In this section, some of the recommendations are provided based on the site investigation presented out earlier. Initially, water management and related constructional recommendations are provided. This is followed by some foundations solutions and excavation related recommendations.

5.2 WATER MANAGEMENT AND CONSTRUCTIONAL RECOMMENDATIONS

During construction works there is potential for a tidal flood to occur and, uncontrolled surface water runoff from the Application Site. There is potential for construction materials, fuels, lubricants, debris and sediment entering the water as a result of construction activities, or by accident. There is also the potential for sediments to be washed off-site within runoff, and cause silting within KGV Dock. Piling may pose the risk of the release of contaminated sediment. As well as contaminates entering KGV Dock from washed away stockpiling and cause silting within the dock, which could consequently threaten the aquatic habitat.

The existing surface water drainage gullies will be maintained and used as long as possible during construction. The majority of the development is either over KGV Dock or not positively drained at present. However, an effective CEMP will help to ensure that sediment, oils, lubricants and other contaminants will not be released. A water quality monitoring regime will be established during the piling works to inform the process and any action necessary to ensure that no adverse effects arise, this will involve: The prevention of silt-laden run-off and mud entering the site surface water drains, and KGV Dock and, good housekeeping (i.e., appropriate storage of construction materials, fuels/lubricants, and waste).

Whilst the Airport is located within an area at risk of flooding, the risk is 'residual' based on the presence of the River Thames defenses. There will be no loss of floodplain storage and no alteration of flood flow routes as a result of the proposed CADP. Modelling mentioned in [1], indicates the potential for an increase in surface flooding of the airfield and some landside areas during extreme storm events. However, the increase was not considered as an excessive to the Airport operation and will only occur for a short time period after an extreme flood event. A number of options for drainage of the CADP site have been explored, and the drainage strategy consists of a range of suitable Sustainable Drainage Systems (SUDS), which will aim to limit flows to the existing sewers as far as possible. The strategy centers on the use of attenuation tanks with oil separators across the site appropriately sized to reduce the existing flow to greenfield runoff rates. The new East Passenger Pier and the Arrivals Building roof drainage is intended to discharge directly to the dock due to the clean nature of this discharge. A rainwater harvesting system is also proposed, which stores rainwater collected from the new Terminal roof and provides water to irrigate the landscaping in the forecourt area. The Proposed Surface Water Drainage Strategy identifies that discharge flow rate to the existing sewer network will be reduced in the magnitude of 60% to 65% for the 1 in 30 years plus 20% allowance for climate change event and up to 86% for the 1 in 100 years plus 20% allowance for climate change event.

The proposed CADP will incorporate flood mitigation measures, and a Flood Management Plan as detailed within the Flood Risk Assessment. This ensures there is sufficient time to evacuate in the unlikely occurrence of an extreme flood event. The Proposed Surface Water Drainage Strategy will reduce discharge flow rates and utilize SUDS techniques [1]. The Airport is in advanced discussions with the EA and Thames Water regarding acceptance of the environmental strategy for the existing airfield drainage; it is likely that this will be dealt with under the Airports Environmental Permit.

5.3 FOUNDATIONS SOLUTIONS

In formulating proposals for foundation solutions, the two primary controlling factors are soil strength and foundation settlement. In general, it is the latter which is the primary determinant of what is perceived to be satisfactory performance. For clay soils, allowable bearing capacity is based on undrained shear strength, although a Factor of Safety of 3 is commonly adopted in order to ensure that the loading is on the sensibly linear component of the stress/strain curve for the soil. With time, the clays will strengthen under the higher loadings as any excess pore water pressures dissipate. Hence, the worst case is at the time of initial loading and, for gradually applied or static loading, bearing capacity should progressively increase.

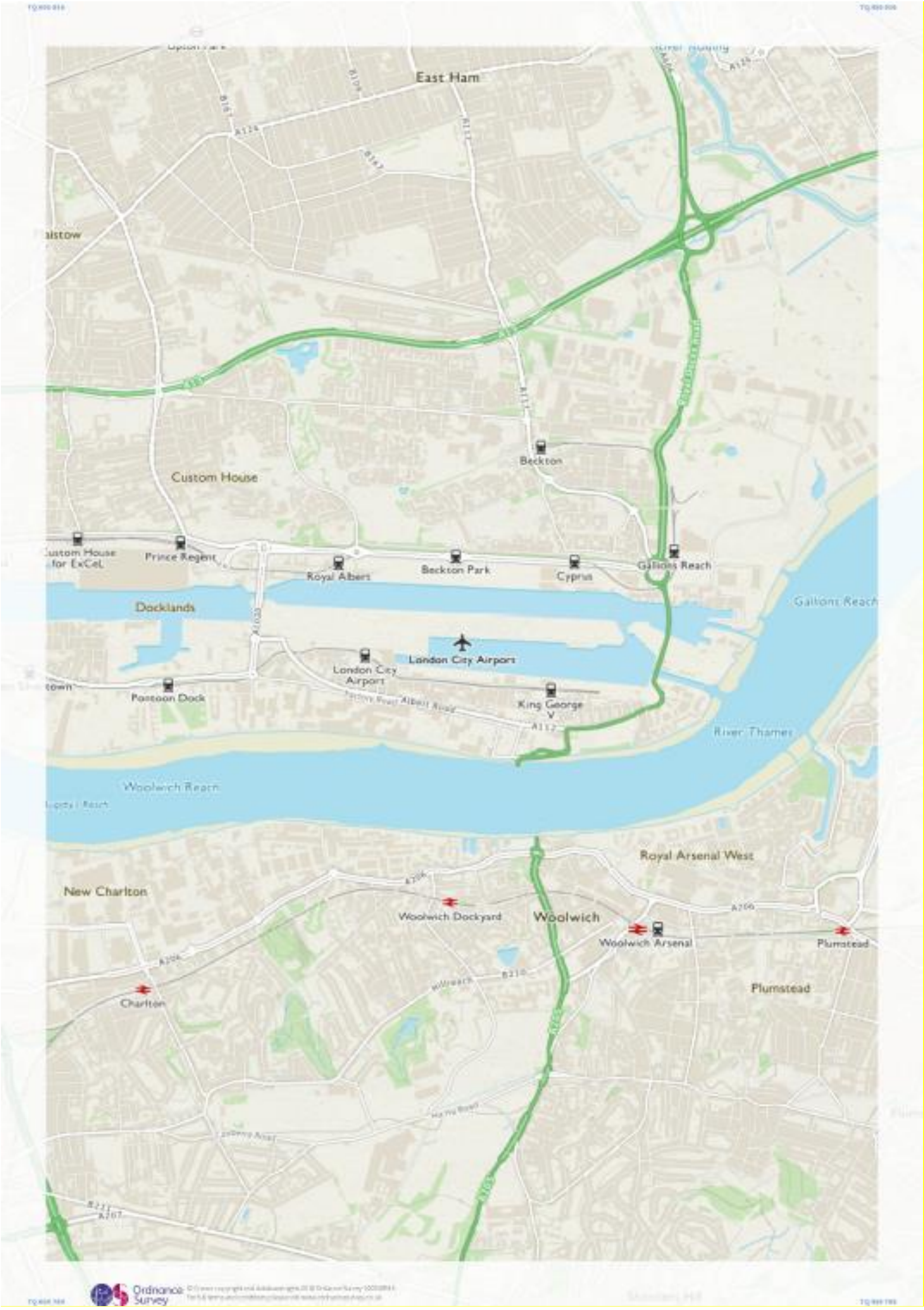
For eccentric loading, where peak load is at an extremity of the foundation, this can be higher than the allowable load, provided that the mean equivalent stress is within the allowable value. For granular or essentially free draining soils the frictional characteristics and density will dominate bearing capacity, and this is generally much higher than for clay soils. For normal spread foundations, conventional design is typically based on the stress which would give rise to 25mm settlement. Actual settlements will depend upon the type, period, load intensity and width of the loaded area and the thickness and compressibility of the soils below. A further issue for foundations is the degree of variability in the foundation soils. The adoption of a lower bearing pressure than strength criteria would indicate implicitly results in a larger foundation which is likely to behave more in line with average conditions and hence, for a given load, to result in less differential settlement. Shallow strip/pad foundations are likely to be suitable for the proposed buildings. To avoid unpredictable total and differential settlements, the foundations should be taken beneath any Made Ground and bear into the strata of the Superficial Deposits, Great Oolite Limestone or the Upper Estuarine Series. Ideally, foundations for the terminal building should be founded within the same material in order to provide more uniform foundation behavior and minimise any differential settlement and where this is not possible the design should take into account possible differential behavior. The settlements of any footings bearing into the granular soils are likely to be small and occur soon after the application of the load. The depth of the foundations should be checked in relation to any trees or shrubs present or proposed on the site or to any that will be removed as part of the construction following the guidelines are given in the NHBC Standards. A medium volume change potential should be used for this assessment.

5.4 EXCAVATIONS

Excavations & Groundwater Excavations on the site should be readily achievable using the conventional earthmoving plant, although more difficult conditions may be present in the granular deposits of the Great Oolite Limestone. Where foundation excavations extend to depths greater than 1.00m they will need to be fully shored if entry by personnel is required. Even for shallow excavations the need for support will still need to be evaluated under CDM regulations. When exposed, the formation level for the foundations should be kept dry, and steps are taken to avoid disturbance. Blinding with concrete as soon as possible after excavation and inspection would also help minimise disturbance. Prior to construction, the formation should be inspected and any soft spots removed. Where deep excavations are envisaged, they are likely to require battering back to a safe angle or some form of support will be necessary, possibly in the form of trench-shore type boxes or sheet piles. If sheet piling is proposed the presence of the very hard strata of the Great Oolite Limestone should be noted. Temporary works design for such piles will need to ensure that there is sufficient embedment of the piles and/or that sufficient props are provided to maintain the stability of the excavation sites.

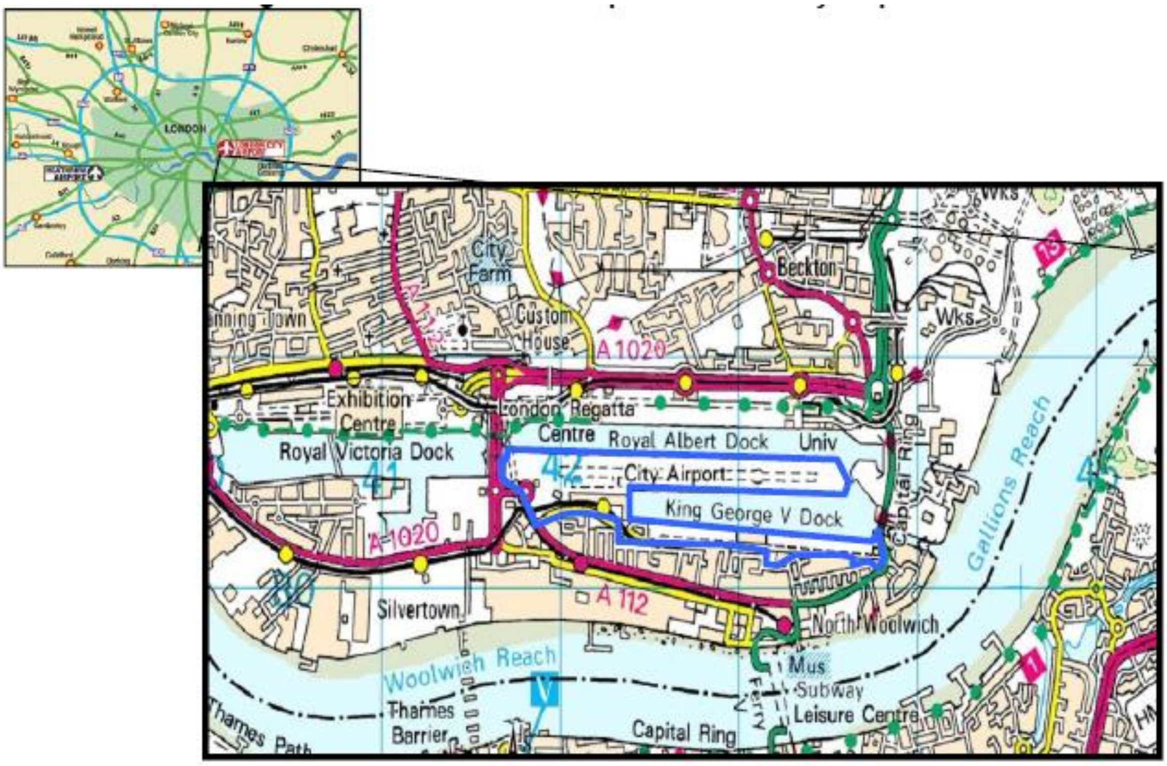
APPENDICES

APPENDIX 1-SITE LOCATION MAP OF LCY [2]



Reference: OSM Maps [2].

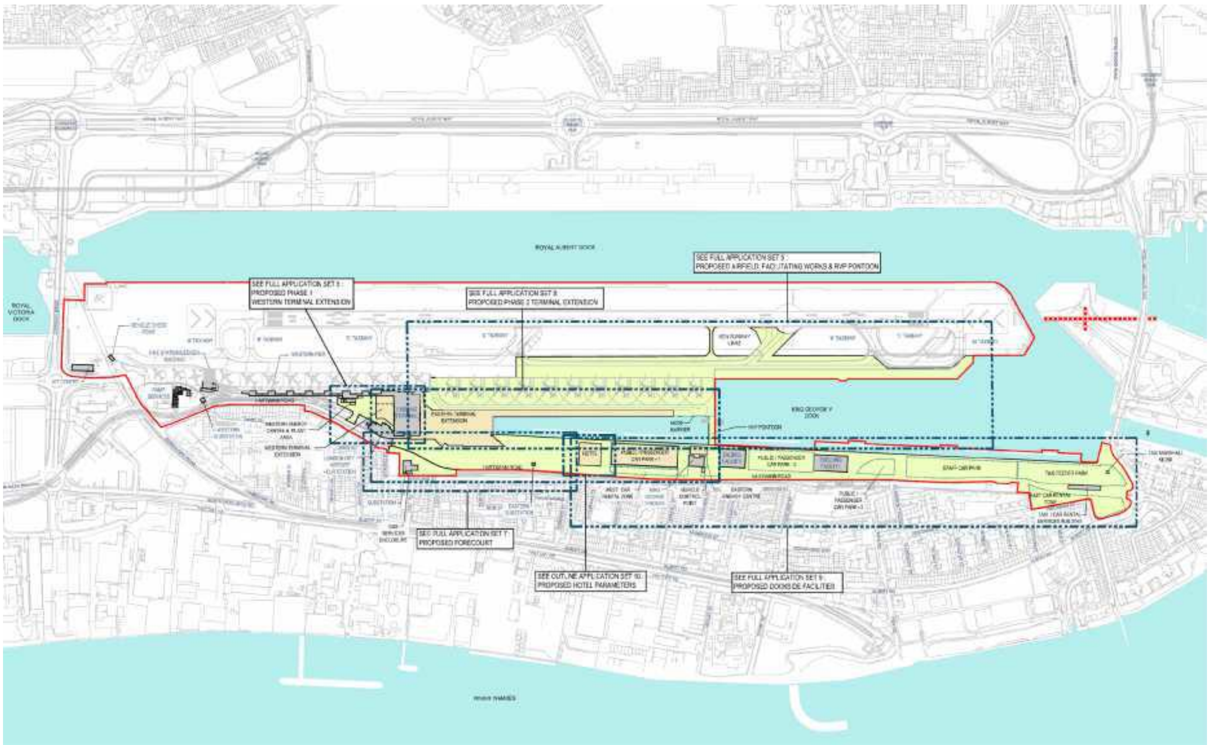
APPENDIX 2-SITE LOCATION MAP OF LCY



Reference for the maps: [1]

APPENDIX 3- AERIAL VIEW OF LCY

APPENDIX 3- DESIGN LAYOUT OF LCY



REFERENCES

[1] CADP, “LCY CADP,” [Online]. Available: https://www.londoncityairport.com/aboutandcorporate/cadpsubmission.

[2] O. Maps, “London City Airport,” [Online]. Available: https://osmaps.ordnancesurvey.co.uk/51.50384,0.05460,14.

[3] Wikipedia, “London City Airport,” [Online]. Available: https://en.wikipedia.org/wiki/London_City_Airport#History.

[4] “Digi History,” [Online]. Available: http://digimap.edina.ac.uk/roam/historic.

[5] [Online]. Available: http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e.

[6] DigiMap. [Online]. Available: http://digimap.edina.ac.uk/roam/os.

[7] G. Finder, “UK Grid Reference Finder,” [Online]. Available: http://www.gridreferencefinder.com/.

[8] [Online]. Available: http://www.britainfromabove.org.uk.

[9] [Online]. Available: http://mapapps2.bgs.ac.uk/ukso/home.html?.