15 Waste Management and Resource Use

15.1 Introduction

15.1.1 This chapter assesses the environmental impacts of solid waste management and resource use associated with the proposed Bank Station Capacity Upgrade (BSCU) and assesses the likely associated impacts during construction and operation.

15.1.2 For the purpose of this assessment, waste is defined as any substance or object…*which the holder discards or intends or is required to discard*, as defined by the *European Directive 2008/98/EC – Waste Directive* (Official Journal of the European Union, 2008).

15.1.3 In the context of this assessment, waste materials are anticipated to comprise:

- waste arising from demolition, excavation, tunnelling and construction activities; and,
- waste produced from the infrastructure once operational.

15.2 Legislative and Policy Context

Legislation and National Policy

15.2.1 The BSCU could be affected by a range of UK waste legislation (now principally originating from European Directives), including, but not limited to:

- *Control of Pollution (Amendment) Act 1989;*
- *Environmental Protection Act 1990;*
- *Environment Act 1995;*
- *Clean Neighbourhoods and Environment Act 2005;*
- *List of Wastes (England) (Amendment) Regulations 2005;*
- *Hazardous Waste (England and Wales) Regulations 2005;*
- *Hazardous Waste (England and Wales) (Amendment) Regulations 2009;*
- *The Environmental Permitting (England and Wales) Regulations 2010;*
- *The Environmental Permitting (England and Wales) (Amendment) Regulations 2012;*
- *The Waste (England and Wales) Regulations 2011;*
- *The Waste (England and Wales) (Amendment) Regulations 2012;*
- *The Controlled Waste (England and Wales) Regulations 2012; and,*

- *Waste Strategy 2000 and 2007.*

National Planning Policy Framework (Department for Communities and Local Government, 2012)

15.2.2 *Paragraph 7 Achieving Sustainable Development* of the *National Planning Policy Framework* (*NPPF*) identifies the need for the planning system to perform mutually dependant economic, social and environmental roles. The environmental role is summarised as *contributing to protecting and enhancing our natural, built and historic environment*; and, as part of this, helping to use natural resources prudently and minimising waste.

Waste Strategy for England (Defra, 2007)

15.2.3 This strategy builds upon the underlying principles set out in *Waste Strategy* 2000 and emphasises the need to put *greater emphasis on waste prevention and reuse.*

Commercial and Industrial Waste in England (Defra, 2009)

15.2.4 Defra's aims for Commercial and Industrial (C&I) Waste are:

- *reducing the amount of waste that arises - by more sustainable design, production, purchasing and use;*
- *increasing the proportion of the waste that does arise which is productively reused, recycled or recovered;*
- *reducing significantly the amount of waste that is sent to landfill or incinerated without recovering energy;*
- *managing any remaining residual waste responsibly; and*
- *maximising the investment opportunities for business from commercial and industrial waste management.*

Regional Policy

The London Plan (Greater London Authority, 2011)

15.2.5 *Policy 5.3 C* requires that major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance. With regard to waste and resources this includes *minimising the generation of waste and maximising reuse or recycling*. In addition to the strategic aims of the plan listed in *Policy 5.3*, additional waste specific requirements are listed in Policies *5.16–5.19*.

15.2.6 *Policy 5.16* states that the Mayor will work with stakeholders and authorities to ensure that as much of London's waste is managed within London as is practicable, working towards managing the equivalent of 100 per cent of

London's waste within London by 2031 (target date brought forward to 2026 in the January 2014 *Draft Further Alterations to the London Plan*) and working towards zero biodegradable or recyclable waste to landfill by 2031 (by 2026 in the *Draft Further Alterations*). These aims will be achieved by:

- *Minimising waste;*
- *Encouraging the reuse of and reduction in the use of materials;*
- *Exceeding recycling / composting levels of Commercial & Industrial (C&I) waste by 70% by 2020;*
- *Exceeding recycling and reuse levels of construction, excavation and demolition (CE&D) waste of 95% by 2020; and*
- *Improving London's net self-sufficiency though reducing the proportion of waste exported from the capital over time.*

15.2.7 *Policy 5.17* states that all new developments should have suitable waste and recycling storage facilities.

15.2.8 *Policy 5.18* estimates that 2011 CE&D recycling rates are around 82 per cent and that through the effective use of existing waste processing sites, recycling facilities at aggregate extraction sites and the use of on-site mobile plant London's future anticipated requirements can be met to achieve more beneficial reuse of this material.

Local Policy

Core Strategy (City of London Corporation, 2011)

15.2.9 *Policy CS17* aims to support City of London businesses in making sustainable choices regarding the minimisation, transport and management of their waste, by requiring on-site facilities for waste segregation, handling and management within new developments; increasing the proportion of municipal solid waste recycled; and promoting waste management choices for businesses.

Unitary Development Plan (City of London Corporation, 2002)

15.2.10 *Policy Util 6* requires adequate provision within all developments for the storage, presentation for collection, and removal of waste, unless exceptional circumstances make it impractical; to encourage provision to allow for the separate storage of recyclable waste where appropriate.

Draft Local Plan (City of London Corporation, 2013a)

15.2.11 *Draft Policy CS17* promotes waste management choices for businesses, by requiring the provision of facilities for waste segregation, handling and

management within new developments and adopting the proximity principle when managing waste.

15.2.12 *Draft Policy DM17.1* requires the provision for waste through the integration of waste facilities in new developments allowing for the separate storage and collection of recyclable and compostable material and onsite waste management wherever possible.

15.2.13 *Draft Policy DM17.2* relates to the designing out of construction waste to minimise the impact of deconstruction and construction waste on the environment and requires:

- [the] *reuse of existing structures;*
- *building design which minimises wastage and makes use of recycled materials;*
- *recycling of deconstruction waste for reuse on site where feasible; and*
- [the] *application of current best practice with regard to… waste handling and waste management.*

The City of London Draft Consultation Waste Strategy 2013-2020 (City of London Corporation, 2013c)

15.2.14 The strategy reinforces the City of London Corporation's intention to review planning applications to ensure that proposed new developments provide adequate waste storage and collection facilities to facilitate waste segregation and recycling.

Other Policy

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

15.2.15 This Supplementary Planning Guidance (SPG) provides additional information to support the implementation of *The London Plan*. The document also sets out the Mayor of London's *priority* and *best practice* guidance for sustainable design and construction, with the guidance split by construction stage.

15.2.16 In relation to the design stage, the Mayor's *Priority guidance* requires that *the design of the development should prioritise* materials that:

- *have a low embodied energy, including those that can be reused intact or recycled;*
- *can be sustainably sourced;*
- *are durable to cater for their level of use and exposure; and,*

- *will not release toxins into the internal and external atmosphere, including those that deplete stratospheric ozone.*

15.2.17 The *Mayor's Best Practice Guidance* for the Design Stage is that *the design of development should maximise the potential to use pre-fabrication element*.

15.2.18 During the construction phase, the Major's priority guidance is that *developers should maximise the use of existing resources and materials and minimise waste generated during the demolition and construction process through the implementation of the waste hierarchy.* The SPG does not provide best practice guidance for construction.

15.2.19 In relation to the occupation of new developments the Mayor's priority guidance is that *developers should provide sufficient internal space for the storage of recyclable and compostable materials and waste in their schemes;* and, *the design of the development should meet borough requirements for the size and location of recycling, composting and refuse storage and its removal*. The SPG does not list best practice guidance for occupation.

15.3 Assessment Methodology

15.3.1 The general environmental impact assessment methodology and criteria described in Chapter 6: Method of Assessment has been applied in order to determine the significance of anticipated effects associated with the BSCU's waste arisings and management.

Determination of Significance

15.3.2 National and local policy and recognised best practice has been used to assess the potential for significant effects. Where specific guidance on assigning significance does not exist, professional judgement has been used to assess the likely impact against the baseline.

15.3.3 The significance of environmental effects has been determined by considering the magnitude of impacts within the context of the sensitivity of receptors likely to be affected, i.e.:

- the magnitude of forecast waste arisings for the BSCU assessed against the current local and regional waste arisings baseline; and the sensitivity of receptors;
- landfill is considered to be a high sensitivity receptor, due to the finite nature of landfill capacity; and,
- local / regional waste recycling / reprocessing is considered to be a low sensitivity receptor, on the basis of the assumption that such activity has a generally beneficial environmental impact and that demand for recycled / recovered materials exceeds supply.

15.3.4 Assessment of effects assuming standard mitigation as well as specific measures incorporated into the BSCU's design and layout include consideration of:

- management of the waste within the context of the waste hierarchy, i.e. whether generation of the waste can be minimised, the waste can be reused or recycled etc.;
- management of waste in accordance with the proximity principal, i.e. the proximity of the waste management infrastructure used and the mode of transport used where waste is transported out of the region for management;
- the ease of management of the waste generated as determined by its physical and chemical characteristics, i.e. whether the waste can be easily treated, or whether the waste requires specialised treatment with potentially hazardous residual waste; and,
- the potential environmental effects or human health risks associated with the waste e.g. if it is hazardous etc.

Baseline Waste Arisings

15.3.5 Baseline construction, excavation and demolition waste arisings within the City of London and Greater London have been determined from published information.

15.3.6 Baseline annual operational waste arisings have been extrapolated from commercial waste collection figures provided by London Underground Limited (LUL) for the Bank Monument Station Complex for a 13 month period in 2013 - 14.

Forecast Waste Arisings

15.3.7 Demolition waste arisings have been estimated from a desktop assessment of the Whole Block Site by a demolition contractor.

15.3.8 Excavated waste arisings have been estimated using volumes calculated from the BSCU designs. A bulking factor of 1.6 has been applied to the excavated material, assumed to comprise predominantly of London Clay, to account for its expansion once excavated. A density figure of 1.25tonnes/m^3 (WRAP, 2010) has then been used to convert the bulked (surface) volumes to tonnages to enable comparison with the baseline arisings, which are published in tonnes.

15.3.9 Construction waste comprises wastes arising from activities related to the formation of the tunnels and the construction of the operational infrastructure. Construction waste arisings have been estimated from the BSCU plans and

experience from previous projects that have used the same tunnelling method in London.

15.3.10 Future operational waste arisings from the operational infrastructure have been estimated using the 2013 baseline figures extrapolated with the projected increase in passenger numbers. A small retail unit/kiosk is incorporated in the operational infrastructure but, owing to its very small floor area (approximately 96m^2), its contribution to the overall operational waste volume is considered to be negligible and it has therefore not been assessed.

15.4 Baseline Conditions

15.4.1 2013 has been taken as the 'baseline year' as this is when the majority of work to determine baseline conditions was undertaken. 2013 baseline data represent the operational conditions before commencement of on-site project activity. Where publically available forecasts are available e.g. *The Present and Future Waste Arisings – Review for the City of London* (City of London Corporation, 2013b), these are considered in conjunction with the baseline data.

Construction, Excavation and Demolition (CE&D) Waste

15.4.2 It is estimated that 324,119 tonnes of construction waste was generated in the City of London in 2012/13 (City of London Corporation, 2013b). *The Present and Future Waste Arisings – Review for the City of London* projects a stable scenario of approximately 311,000 tonnes of construction waste being generated annually from 2016 onwards. This report recognised that the majority of construction waste is currently processed, or disposed of, outside the City of London.

15.4.3 It is estimated within *The London Plan* that CE&D waste generated by development activity in London is primarily managed by the private sector and amounted to approximately 10.4 million tonnes in 2008 (47 per cent of all waste).

15.4.4 *The London Plan* also states that reuse and recycling rates for CE&D waste in London are already high – estimated at 82 per cent for 2008. Nevertheless, as stated in *Section 5.2*, *Policy 5.16* sets a target of 95 per cent for recycling / reuse of CE&D waste by 2020, and the Mayor supports more sustainable uses of CE&D waste.

Operational Waste

15.4.5 Table 15.1 shows the forecast Commercial and Industrial (C&I) waste arisings for the City of London and London as a whole through to 2031 (Greater London Authority, 2011).

Table 15.1: C&I Waste Records and Projections through to 2031 (Thousand Tonnes per Annum)

	2011	2016	2021	2026	2031
City of London	466	481	496	512	517
London Total	6,485	6,451	6,458	6,504	6,596

15.4.6 Bank Monument Station Complex in 2013 calendar year represents the baseline source of C&I waste. The baseline waste arisings have been derived from figures reported by LUL's cleansing and waste contractor.

15.4.7 148 tonnes of bagged waste was reported to have been collected over a 13-month period in 2013–14. This equates to estimated annual arisings of 137 tonnes for 2013.

15.4.8 Bagged waste collected from the Bank Monument Station Complex comprises waste paper and general/residual waste. The waste is collected and managed by LUL's cleansing and waste contractor and transferred off site to Material Reclamation Facilities (MRFs) managed by private sector waste management firms. The material is sorted for recycling, recovery or disposal at the MRFs prior to bulking and transfer to other recycling/reprocessing or disposal facilities.

15.4.9 Ad-hoc waste from building maintenance is managed independently by the specialist contractors undertaking the work and is not included in the baseline waste figures.

Resource Use

15.4.10 Limited published data is available relating to the reuse of non-virgin resources by similar projects to the BSCU. The baseline assumes that the use of reused or recycled content construction materials on similar projects is very low, owing to the specification constraints for materials used for underground construction.

15.5 Incorporated Mitigation

Design Considerations

15.5.1 The tunnelling method selected for the BSCU, mining with a sprayed concrete lining, ensures that an optimum tunnel profile is achieved without excavating more material than necessary.

15.5.2 An elliptical tunnel cross section has been selected over a circular design. Creating a circular cross section using a tunnel boring machine would result in the removal of more excavated material than is necessary for the intended use

of the tunnel. An elliptical cross section also requires less material to fill the base of the tunnel to support the railway track.

15.5.3 Reused and recycled material will be specified for use within the design wherever possible. Where practicable, recycled and secondary materials will be included in the construction specifications, to reduce the embodied energy within the operational infrastructure, and to reduce the impact of virgin material extraction and processing. Using recycled or secondary materials also helps to create demand for these materials, strengthening the business case for infrastructure to recover or reprocess construction waste. There is the potential to use recycled or secondary aggregates in the operational infrastructure's concrete slabs or for filling void spaces. Recycled steel can be used in the steel reinforcement for the sprayed concrete lining and other concrete reinforcement.

15.5.4 Table 15.2 summarises how design or mitigation features of the BSCU aligns with the materials and waste related principles of the *Sustainable Design and Construction SPG standard* (GLA, 2014).

Table 15.2: BSCU Alignment with the Mayor's Priority Guidance in the Greater London Authority Sustainable Design and Construction SPG Standards

Priority Guidance	**BSCU Adherence**
Design Stage	
The design of the development should prioritise materials that: • can be sustainably sourced; • are durable to cater for their level of use and exposure; and, • will not release toxins into the internal and external atmosphere, including those that deplete stratospheric ozone.	No structural timber is used within the operational infrastructure. 100 per cent of construction timber is targeted to originate from a FSC source. The design team will aim for materials within operational infrastructure to be either 'A' or 'A+' rated under BRE's 'The Green Guide to Specification online', as far as practicable. The use of materials sourced locally, will be encouraged, minimising transport related carbon emissions and supporting local businesses. The target for materials used which are derived from recycled and reused content is 20 per cent by value. Steel and concrete components of the design are likely to contribute to this achievement. Stringent specifications for materials used underground and to achieve the required design life may constrain the use of materials with recycled and/or reused content. The tunnels and operational infrastructure have a design life of over 100 years and materials have been selected on their

Priority Guidance	BSCU Adherence
	ability to achieve this. The materials selected in the design are not expected to release toxins into the internal and external atmosphere under normal in-use conditions.
Construction Phase	
Developers should maximise the use of existing resources and materials and minimise waste generated during the demolition and construction process through the implementation of the waste hierarchy.	A Site Waste Management Plan (SWMP), covering all stages of the construction phase, will be developed and operated by Dragados, as an internal waste management and monitoring tool. This is discussed in more detail in paragraph 15.5.7 below. Demolition waste management on site will, where practical, be consistent with future reuse and recycling. This will be facilitated as far as possible via the Code of Construction Practice (CoCP) and the SWMP. Waste will be sorted on-site where practicable or taken off-site to appropriately licenced facilities. A desktop demolition study has identified opportunities for reuse and recycling of material. The demolition stage includes a 'soft strip' phase where salvageable or difficult to treat waste streams can be removed prior to demolition.
Occupation	
Developers should provide sufficient internal space for the storage of recyclable and compostable materials and waste in their schemes. The design of the development should meet borough requirements for the size and location of recycling, composting and refuse storage and its removal'.	The operational infrastructure includes a dedicated recycling and waste storage area with access from street level to facilitate future collections. The waste storage area designed includes a number of waste receptacles, which can be assigned to recyclable or residual wastes, according to operational requirements.

Demolition

15.5.5 A pre-demolition audit of the buildings on the application site will be conducted by a specialist demolition contractor prior to demolition. The audit will identify opportunities to minimise waste production, informing the Site Waste Management Plan (SWMP), which is discussed in section 15.5.7 below.

15.5.6 Demolition works include a soft strip phase which allows for the segregation of waste streams prior to the main demolition activity. Material will be reused on site as fill material where possible.

Excavation and Construction

15.5.7 The *Site Waste Management Plan Regulations 2008* were repealed on the 1st December 2013. However, it is recognised that a Site Waste Management Plan, incorporating Key Performance Indicators (KPIs), will support the identification of actions to minimise construction waste from being sent to landfill and the associated adverse environmental impacts. Dragados will develop and operate a Site Waste Management Plan as an internal waste management and monitoring tool. This assessment assumes the use of a SWMP as a means of implementing best practice and going beyond current minimum statutory requirements.

15.5.8 The SWMP will be updated throughout the design and procurement phases and maintained by the contractor throughout the demolition and construction works.

15.5.9 A significant proportion of the waste arisings from BSCU construction will originate from tunnel excavation in previously undisturbed sub-soils. It is anticipated that these arisings will essentially comprise of clean, inert material. Whilst there are limited opportunities to use this material on site, it is proposed that it will be transported from the work sites by lorry to licenced (or exempt) sites where it will be used for beneficial purposes such as clean fill, contaminated land remediation or capping material. 95 per cent recovery for reuse of this material is targeted.

15.5.10 The waste arisings from the construction of the tunnels and operational infrastructure is expected to predominantly consist of unset concrete (‘rebound material’) and set concrete (‘breakout material’ and ‘other structural concrete’). These materials will be segregated from other materials on site (if space allows) and transported by lorry to off-site processing facilities in Greater London where they can be reprocessed into recycled aggregate or structural fill for use in other construction projects. 95 per cent recovery is targeted for this material.

15.5.11 The fit out phase will generate mixed CE&D waste which is likely to be either segregated on-site where space allows or at off-site construction waste MRFs. It is not uncommon for construction projects of this type to achieve 80 to 90 per cent recycling rates. The generation, segregation, storage and disposal/recycling of this waste will be controlled and monitored through a SWMP, with 95 per cent recovery targeted.

15.5.12 Sub-contractors and specialist licensed construction waste management firms, with the necessary expertise and capacity will be appointed to sustainably

manage waste arisings from the BSCU and achieve the targeted recovery rates. Delivery of the targets and KPIs for the recovery of materials will form contractual conditions of engagement.

15.5.13 A CoCP has been drafted, (included at draft status in Appendix A4.1) which also specifically addresses waste and resource management and establishes how the construction of the BSCU shall be managed to minimise adverse environmental impacts.

Operational Infrastructure Waste

15.5.14 The design of the new Station Entrance Hall includes a designated waste/bin store of 5.1m^2, configured to accommodate the waste associated with projected future passenger numbers. The design also includes external access to facilitate servicing by the waste management contractor.

15.5.15 It is considered likely that waste arisings from the operational infrastructure will be similar in composition to municipal solid waste predominantly consisting of newsprint in addition to other mixed dry recyclables such as card, plastic, glass etc. The residual fraction would comprise non-recyclable material suitable for waste management with energy recovery.

15.5.16 The proposed bin storage area provides for four 240 litre wheeled bins. The use of multiple bins within the waste storage area allows for on-site segregation of waste according to collection requirements and the potential achievement of high recycling rates.

15.6 Assessment of Effects

Utilities Works

15.6.1 The anticipated volumes and associated tonnages of CE&D waste from utilities works are accounted for within the demolition, excavation and construction waste arising estimates associated with the BSCU construction works assessed below.

Demolition of the Whole Block Site

15.6.2 It is estimated that 18,584 tonnes of material are likely to be generated by the demolition of buildings on the site. Anticipated demolition waste arisings are broken down by material type as shown in Table 15.3.

Table 15.3: Breakdown of Anticipated Waste Arisings from Demolition

Material	Demolition (2016) (Tonnes)
Hardcore (Mixed)	8,416
Concrete	5,260
Masonry	3,945
Mixed Waste	438
Mixed Metals	292
Wood	146
Plasterboard	58
Hazardous Materials	29
Excavated Material	0
Total	**18,584**

BSCU Construction Works

15.6.3 BSCU construction waste arises from three principal activities: excavation of the tunnels through unmade ground; construction (lining) of the associated tunnels and waste associated with the creation of the new operational infrastructure. Anticipated arisings from each individual activity is presented below, with the total arisings from all activities assessed against the baseline.

15.6.4 The anticipated volumes and associated tonnages of excavated materials arising from excavation activities are summarised in Table 15.4. The data presented in Table 15.4 is intended to provide a worst case estimate to include bulking. It is assumed that all of the material is uncontaminated London clay.

Table 15.4: Estimated Excavation Waste Arisings by Tonnage and Volume from the BSCU Work Sites

	2016 Tonnes (m^3)	**2017** Tonnes (m^3)	**2018** Tonnes (m^3)	**2019** Tonnes (m^3)	**2020** Tonnes (m^3)	**Total** Tonnes (m^3)
Arthur Street Work Site	12,616 (10,093)	52,374 (41,899)	24,904 (19,923)	2,972 (2,378)	4,988 (3,990)	**97,854 (78,283)**
Whole Block Work Site	0 (0)	17,920 (14,336)	19,776 (15,821)	5,704 (4,563)	0 (0)	**43,400 (34,720)**
Total Arisings from both Work Sites	**12,616 (10,093)**	**70,294 (56,235)**	**44,680 (35,744)**	**8,676 (6,941)**	**4,988 (3,990)**	**141,254 (113,003)**

Notes: Data presented is based on anticipated bulked volume of spoil arisings at the surface. The figures presented in the table assume the density of excavated material is 1.25t/m^3 from *Guidelines for measuring and reporting construction, demolition and excavation waste* (WRAP, 2010).

15.6.5 The sprayed concrete lining (SCL) process used in the construction of the tunnels generates unset (rebounded concrete) and set (breakout) concrete waste. The anticipated volumes and associated tonnages of each of these material streams are presented in Table 15.5.

Table 15.5: Concrete Waste Arisings from the SCL Tunnelling

	2016 Tonnes (m^3)	**2017** Tonnes (m^3)	**2018** Tonnes (m^3)	**2019** Tonnes (m^3)	**2020** Tonnes (m^3)	**Total** Tonnes (m^3)
'Rebound' concrete waste	2,910 (1,212)	10,592 (4,414)	7,898 (3,291)	1,636 (682)	840 (350)	**23,876 (9,948)**
'Breakout' concrete waste	831 (346)	3,026 (1,261)	1,888 (787)	287 (120)	240 (100)	**6,273 (2,614)**
Total SCL tunnel construction waste arisings	**3,741 (1,559)**	**13,618 (5,675)**	**9,786 (4,077)**	**1,923 (801)**	**1,080 (450)**	**30,149 (12,562)**

Note: The figures presented in the table assume the worst case scenario using a concrete density of 2.4t/m^3.

15.6.6 Waste arisings from the construction of the operational infrastructure comprises structural concrete waste and mixed construction waste. Estimated arisings are shown in Table 15.6.

Table 15.6: Construction Waste Arisings from Construction of the Operational Infrastructure

	2016 Tonnes (m^3)	**2017** Tonnes (m^3)	**2018** Tonnes (m^3)	**2019** Tonnes (m^3)	**2020** Tonnes (m^3)	**Total** Tonnes (m^3)
Structural concrete waste	0 (0)	772 (322)	1,811 (755)	0 (0)-	74 (31)	**2,657 (1,107)**
Mixed construction waste	861 (990)	1,148 (1,320)	1,148 (1,320)	1,148 (1,320)	1,148 (1,320)	**5,455 (6,270)**
Total operational infrastructure construction waste	**861 (990)**	**1,921 (1,642)**	**2,959 (2,075)**	**1,148 (1,320)**	**1,222 (1,351)**	**8,112 (7,377)**

Note: The figures presented in the table assume the density of structural concrete waste is 2.4t/m^3 and the density of mixed construction waste is 0.87t/m^3 from *Guidelines for measuring and reporting construction, demolition and excavation waste* (WRAP, 2010).

Blockade

15.6.7 Waste arisings from the construction of the tunnels and operational infrastructure are anticipated during this phase of the BSCU. These have been considered as part of the overall construction waste arisings and are included within the figures presented in the figures above.

Summary of Total Waste Arisings

15.6.8 The assessment of environmental impacts from CE&D waste requires the collective consideration of the demolition, excavation, tunnel construction and operational infrastructure construction waste. Table 15.7, presents a summary of the total waste arisings discussed above and split by year for the duration of the BSCU construction works from both work sites.

Table 15.7: Total Annual (Bulked) Waste Arisings for the BSCU Split by Demolition, Excavation and Construction Activities

	2016 Tonnes	**2017** Tonnes	**2018** Tonnes	**2019** Tonnes	**2020** Tonnes	**Total** Tonnes
Demolition waste	18,584	0	0	0	0	**18,584**
Bulked excavated materials	12,616	70,294	44,680	8,676	4,988	**141,254**
Concrete waste from tunnel construction	3,741	13,619	9,786	1,923	1,080	**30,149**
Operational infrastructure construction waste	861	1,921	2,959	1,148	1,222	**8,112**
Total BSCU CE&D Waste Arisings	**35,802**	**85,834**	**57,425**	**11,748**	**7,290**	**198,099**

15.6.9 Approximately 200,000 tonnes of CE&D waste is anticipated to be generated from the BSCU construction works over the five year construction period.

Waste arisings are expected to peak in 2017 with 85,834 tonnes per annum (Table 15.7).

15.6.10 If the peak arisings in 2017 are considered against the Greater London baseline, the waste from the BSCU construction works account for less than one per cent of Greater London's annual construction waste.

15.6.11 Based on the estimates described in *The London Plan*, over 80 per cent of CE&D waste in London is reused or recycled. However, through the incorporated mitigation measures identified in section 15.5, a greater proportion (targeted at 95 per cent) of the BSCU waste arisings will be recovered for beneficial reuse or reprocessed/recycled at sites considered to be 'low sensitivity receptors' within the assessment. The magnitude of impact of the BSCU demolition excavation and construction waste is therefore considered to be very low.

15.6.12 The overall effects from waste from the construction, excavation and demolition activities associated with the BSCU are therefore considered to be negligible when considered in isolation.

Operational Waste Arisings

15.6.13 Operational waste arisings are assumed to be directly linked to the predicted increase in passenger numbers in the City of London, with a minimal increase in operational waste directly attributable to the BSCU itself.

15.6.14 Consistent with assessing the worst case scenario, increases in operational waste have been estimated by applying the projected passenger increases forecast by LUL, 3 per cent per annum growth, to the 2013 baseline. From this it is estimated that C&I waste arisings of 178 tonnes per year will be generated from 2022 when the infrastructure is fully operational.

15.6.15 When compared to the baseline C&I waste arisings for the City of London as a whole projected for 2022, the net increase attributable to the operational infrastructure and retail area represents significantly less than one per cent of this total and a significantly lower proportion when C&I waste arisings for Greater London are considered.

15.6.16 The operational waste would likely be processed using local waste management infrastructure / capacity, the sensitivity of which, as a receptor, is considered to be low.

15.6.17 A very low magnitude impact combined with low sensitivity receptors leads to the assessment of operational waste as negligible, which is not significant.

Resource Use

15.6.18 A number of incorporated mitigation measures for resource use have been described in section 15.5 for the BSCU, including the establishment of a reused/recycled content target of 20 per cent. Whilst there is no baseline for sustainable resource use, it is assumed that the BSCU will achieve the stated target.

15.7 Mitigation

Excavation and Construction

15.7.1 With the implementation of measures identified in Section 15.5, Incorporated Mitigation, it is concluded that impacts resulting from excavation and construction waste will be negligible. No further mitigation measures for excavation and construction waste are considered necessary.

Operation

15.7.2 With the implementation of measures identified in Section 15.5, Incorporated Mitigation, it is concluded that impacts resulting from operational waste will be negligible. No further mitigation measures for operational waste are considered necessary.

15.8 Residual Effects

Excavation and Construction Waste

15.8.1 The assessment has concluded that impacts from excavation and construction waste are negligible and not likely to result in significant effects.

Operational Waste

15.8.2 The assessment has concluded that impacts from operational waste are negligible and not likely to result in significant effects.

15.9 Inter-relationships and Cumulative Effects

15.9.1 Chapter 17: Inter-relationships and Cumulative Effects, provides further details regarding proposed commercial properties and one hotel / residential development which have met the criteria for the consideration of cumulative effects. Demolition and construction of these developments is anticipated to commence between 2014 and 2020, although precise dates are currently unavailable.

15.9.2 The assessment of the BSCU suggests that excavation and construction waste arisings will peak in 2017 at 85,834 tonnes per annum.

15.9.3 The largest of the major developments identified, 20 Fenchurch Street, is scheduled to be completed by 2016 (City of London Corporation, 2013b). This building is therefore not considered to have a cumulative effect relating to waste and resource use.

15.9.4 There is potential for the demolition of 20 Abchurch Lane (required for the construction of the 10 King William Street Over Site Development) to overlap with the end of the BSCU construction works in 2020, when the operational infrastructure is undergoing fit out. However, Table 15.7 (above) shows that a low level of CE&D waste arisings are anticipated during this phase of the BSCU and therefore the cumulative effects are unlikely to be significant.

15.9.5 Within the *Present and Future Waste Arisings - Review for the City of London* the City of London Corporation has identified an increase in new build commercial property in the City of London and its waste projections take this into account. The assessment considers the BSCU waste arisings against the post 2016 baseline and has identified the magnitude of impact as very low.

15.9.6 The assessment estimates that the operational waste arisings from the BSCU resulting from the predicted increase in passenger numbers will contribute significantly less than one per cent of the City of London C&I waste arisings. The *Present and Future Waste Arisings - Review for the City of London* report uses projected employment figures, independent of building areas, to develop high and low projections of C&I waste for the whole of the City of London. It is therefore reasonable to assume that in response to these projections, sufficient waste processing capacity will exist in the City of London and Greater London in 2022 and beyond. Should waste arisings increase, a large proportion is likely to constitute recyclable material which can be sustainably managed without resulting in significant adverse effects either alone or in combination with other developments.

15.10 Assumptions and Limitations

15.10.1 The estimations of construction waste arisings (tonnes) are derived from projected volumes of excavated material, which include an allowance of 1.6 for expansion following excavation. In order to convert these volumes to tonnages, as used in the baseline figures, published densities have been used. These densities reflect the types of materials anticipated as being encountered during excavation, demolition or used during construction. The use of such data is considered suitable for application to the type of development proposed and adequate to assess the significance of likely waste arisings in a local context.

15.10.2 The consideration of landfill as a high sensitivity receptor and of waste recycling / reprocessing infrastructure as low sensitivity is to some extent an arbitrary assessment. However, is consistent with the waste hierarchy and

allows consideration of waste management using a familiar environmental assessment methodology to assess impact significance.

15.10.3 The operational infrastructure is also likely to generate other ad-hoc waste arisings related to maintenance. Currently, this is managed by the contractor conducting the works on a project basis and this approach is expected to continue in the future.

15.11 Conclusions

15.11.1 It is estimated that 198,099 tonnes of CE&D will arise during the BSCU construction and demolition between 2016 and 2021. Annual waste arisings are expected to peak at 85,834 tonnes in 2017.

15.11.2 Waste arisings from the operational infrastructure have been estimated as 178 tonnes per year from 2022 – a net increase of 41 tonnes compared to the estimated 2013 baseline. However, operational waste arisings are directly linked to increasing passenger numbers, which are assumed to increase independently of the BSCU.

15.11.3 The potential significance of forecast waste arisings has been assessed in the context of existing local waste arisings, applicable legislation, local waste management infrastructure and the methods by which the waste is likely to be managed.

15.11.4 The assessment identifies a number of incorporated mitigation measures to reduce the impact of CE&D waste. These include design and construction measures, as well as the use of licenced sites for beneficial reuse of excavated materials and sites for reprocessing of construction waste.

15.11.5 The effects of waste and resource management associated with the excavation and construction of the BSCU and the operational infrastructure have been assessed as negligible and not significant.

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