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Eunomia Research & Consulting has taken due care in the preparation of this report to ensure that all facts and analysis presented are as accurate as possible within the scope of the project. However no guarantee is provided in respect of the information presented, and Eunomia Research & Consulting is not responsible for decisions or actions taken on the basis of the content of this report.

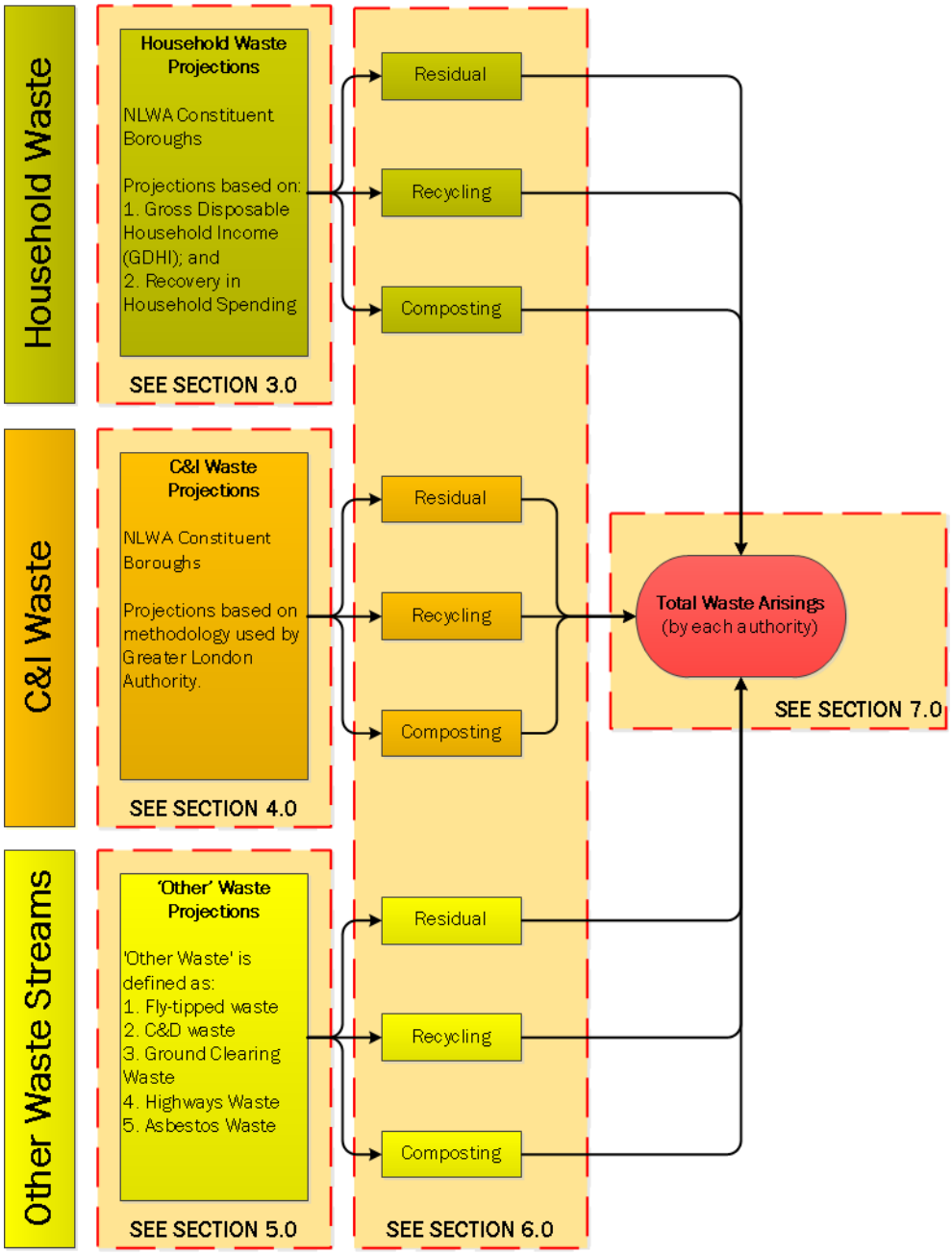
Executive Summary

E.1.0 Introduction

Eunomia Research & Consulting Ltd (Eunomia) is pleased to present this project report to the North London Waste Authority (NLWA); the report summarises the methodology and results of the waste forecasting modelling that has been undertaken to inform the needs case for the development of the Edmonton EcoPark Energy Recovery Facility (ERF) and associated Development Consent Order (DCO) process.

The main objective of the waste forecast model is to forecast the amount (in tonnes) of residual waste collected by the following London Borough Waste Collection Authorities (WCA): Barnet, Camden, Enfield, Islington, Hackney, Haringey, and Waltham Forest over a period beginning in the financial year 2012/13 and ending in 2050/51. An outline of the main model components is shown in Figure E-1 with references to the appropriate sections of the main project report for further information.

Figure E-1: Model Outline



E.2.0 Modelling Assumptions

E.2.1 Limitations

Providing forecasts of waste arisings for over thirty years in the future is extremely difficult given the myriad factors affecting both the generation of waste and how it is subsequently managed; in essence it is unknowable. Recognising that long-term plans for managing the waste generated within the Constituent Boroughs are needed however, we have developed a model based on the best data available, a robust analysis of

historical trends, and a measured set of assumptions about what will happen to these trends in the future.

E.2.2 Household Waste Arisings

As part of earlier work undertaken by Eunomia for the London Environment Directors Network (LEDNET), we completed a detailed statistical analysis of historic household waste arisings in London to ascertain which social and economic factors (or combination thereof) were statistically most strongly correlated with the changing trends in waste arisings.[1]

The best result from the regression analysis was produced using Gross Disposable Household Income (GDHI) as the independent variable, together with a 'time variable' to account for what we would speculate is the cumulative effect of waste prevention and minimisation measures (e.g. product light-weighting) on household waste arisings over time. In addition, we also included an 'indicator variable' to represent the impacts of the recession and the subsequent economic recovery.[2]

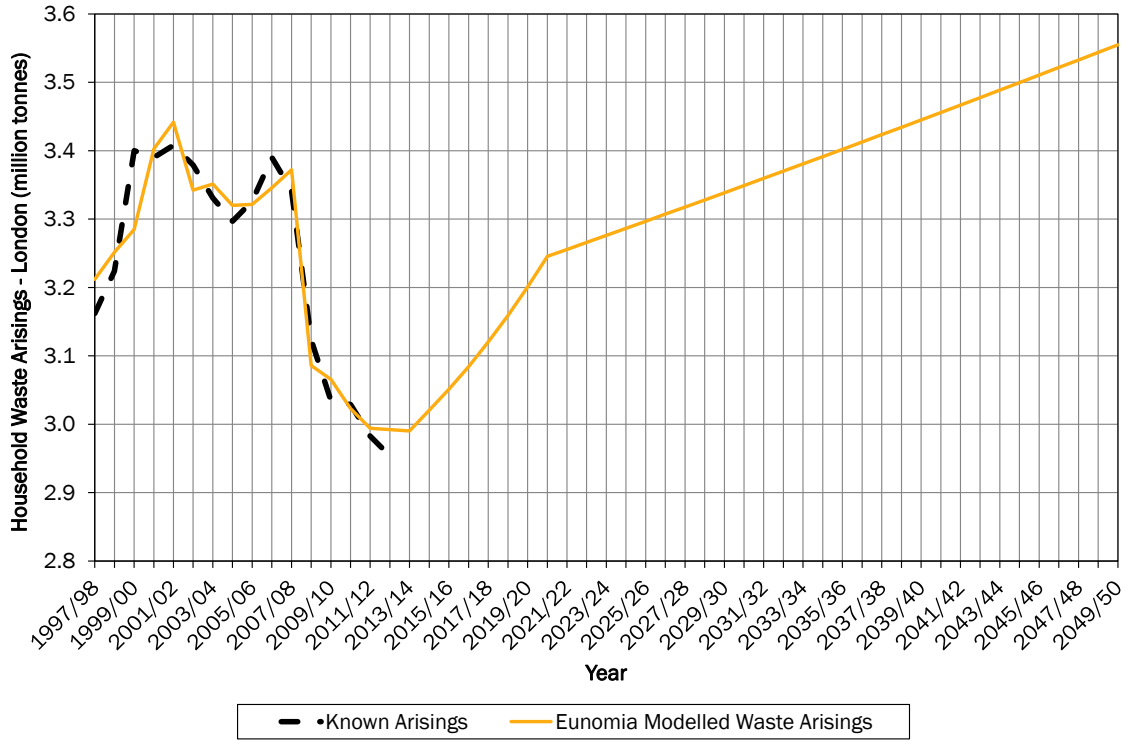
The statistical correlations identified between historic household waste arisings, GDHI, and the two other independent variables yielded a regression equation which has been used to project forward changes in waste arisings based on estimated future changes in the independent variables.

The results of these projections are represented graphically in Figure E-2.

[1] Eunomia Research & Consulting (2012) *Waste Arisings in London*, Report for London Environment Directors Network, October 2012

[2] A 'indicator variable' is a statistical term used in regression analysis for a variable that is used to indicate the presence or absence of an unquantified effect that is assumed to have an impact on the dependent variable (in this case on waste arisings).

Figure E-2: Historic and Forecast Household Waste Arisings in London (1997/98–2050/51, million tonnes)



E.2.3 C&I Arisings

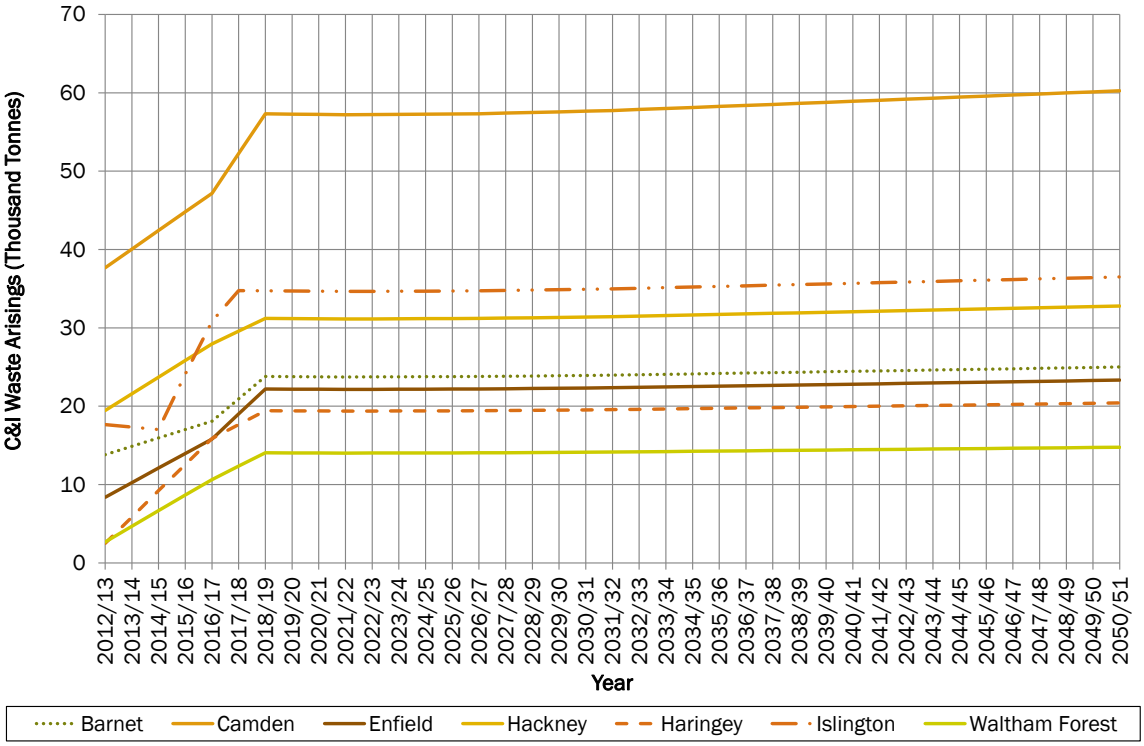
Forecasting C&I waste volumes for future years is notoriously difficult due to the distinct lack of data on historic and current volumes. This lack of data also means that it is not possible to develop projections of C&I waste arisings based on statistical correlations with other independent variables. An alternative method for forecasting C&I waste arisings is therefore required and for this purpose we have drawn on work undertaken by SLR Consulting Ltd on behalf of the GLA for the Draft Further Amendments to the London Plan (FALP). [3]

The draft plan includes a forecast of C&I waste arisings through to 2031 based on a 'waste per employee' figure from GLA employment figures and forecasts and Defra C&I waste data from 2009. We have used the C&I waste arisings forecast growth rate presented in the FALP on which to base our forecast. For the period beyond 2036 (i.e. the end point of the projections in the FALP) it is assumed that the calculated annual growth rate of 0.22% achieved between 2034/35 and 2036/37 would continue until 2050/51.

[3] GLA 2014 Draft Further Alterations to the London Plan. January 2014. http://www.london.gov.uk/priorities/planning/london-plan/draft-further-alterations-to-the-london-plan

Using data on the tonnages of C&I waste collected by each Constituent Borough reported via WasteDataFlow a ‘market share’ was calculated for each borough. Due to the lack of suitable data it is only possible to calculate the market share that each borough had back to 2009. Consequently, in our forecast we assume that each borough's market share recovers to 2009 levels by 2016/17, and then increases a further 2% in both 2017/18 and 2018/19. The results of this apportionment are shown in Figure 4-2 which outlines the forecast tonnages of local authority collected C&I waste for each of the Constituent Boroughs.

Figure 0-1: Local Authority Collected C&I Waste in NLWA’s Constituent Boroughs (2009 – 2036)



E.2.4 Recycling Rates

The model developed for these projections has taken a ‘target-led’ approach, whereby different future recycling rates have been predefined in the model at specific years in the future, completed with a simple linear extrapolation of recycling rate for the intervening and following years.

In each case three scenarios have been agreed with the NLWA for the purposes of developing the model presented in this report. Each of these scenarios represents a different level of achievement for future recycling efforts:

- Low recycling scenario – these scenarios represent limited levels of achievement;
- Central recycling scenario – these scenarios demonstrate moderate to high levels of achievement and allow for the achievement of national recycling targets; and

- High recycling scenario – these scenarios demonstrate very high levels of achievement with respect to recycling and are in line with the London Plan and the Mayor's Waste Strategies.[4,5,6]

The recycling targets selected for household waste are as follows:

- Low recycling scenario – 40% recycling by 2020/21 and remaining static thereafter;
- Central recycling scenario – 50% recycling by 2020/21 and remaining static thereafter; and
- High recycling scenario – 50% recycling by 2020/21, rising to 60% in 2031/32 and remaining static thereafter.

Unlike with household waste, the proportion of local authority collected C&I waste sent for recycling is not defined in the model by set targets. Instead, the modelling assumes that the improvements in the recycling of C&I waste will increase at the same rate as the recycling rate for household waste under the three scenarios. For example, under the Low Recycling Scenario, the recycling of household waste will have to increase by 1.12% per annum in Camden if the 40% target is to be achieved by 2020/21 (see Table 6-1). Under the Low Recycling Scenario for C&I waste it is assumed that recycling of this waste stream will also increase by 1.12% per year, based on a starting point of 2012/13. The same logic has been applied for the Central and High Scenarios.

E.3.0 Summary of Results

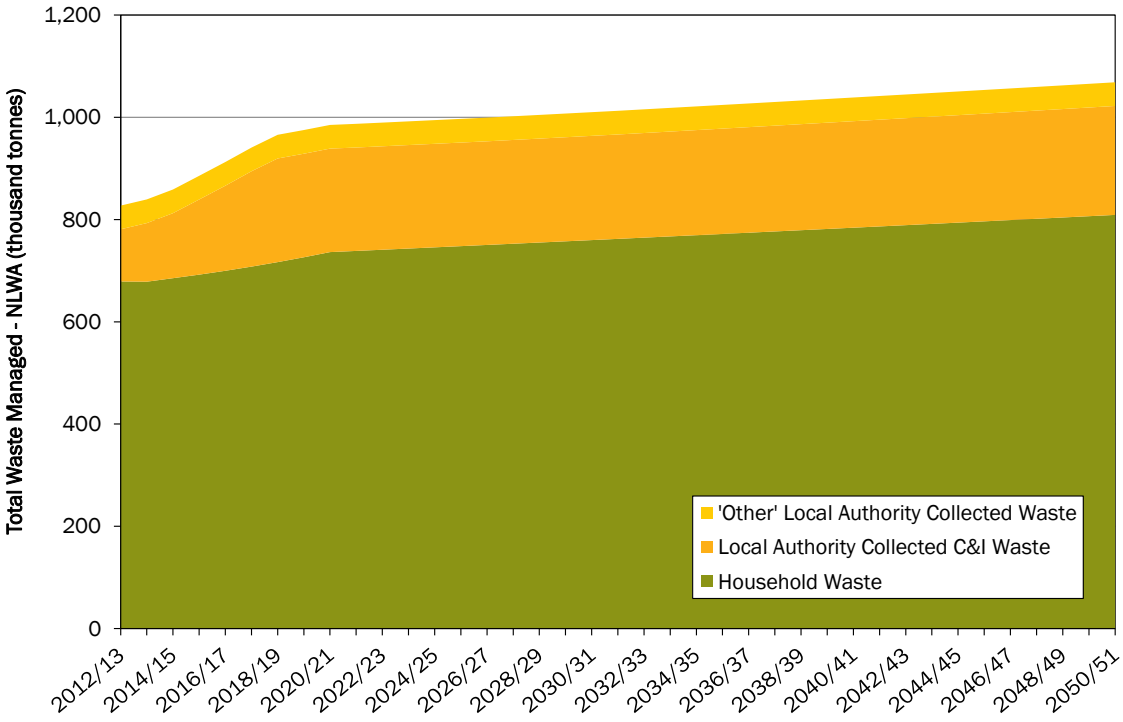
The projected amount of waste to be managed by the NLWA from its Constituent Boroughs is shown in Figure E-2. From this it can be seen that household waste makes up by far the largest proportion, followed by local authority collected C&I waste, and finally a small amount of 'other' waste. The combined total across NLWA rises from 827,000 tonnes in 2012/13 to 985,000 tonnes by 2020/21, and just over a million tonnes by 2050/51.

[4] Greater London Authority (2014) *The London Plan*, Date Accessed: 13th March 2014, Available at: www.london.gov.uk/priorities/planning/london-plan

[5] Mayor of London, Greater London Authority (2011) *London's Wasted Resource: The Mayor's Municipal Waste Management Strategy,* November 2011, www.london.gov.uk/priorities/environment/publications/the-mayors-waste-management-strategies

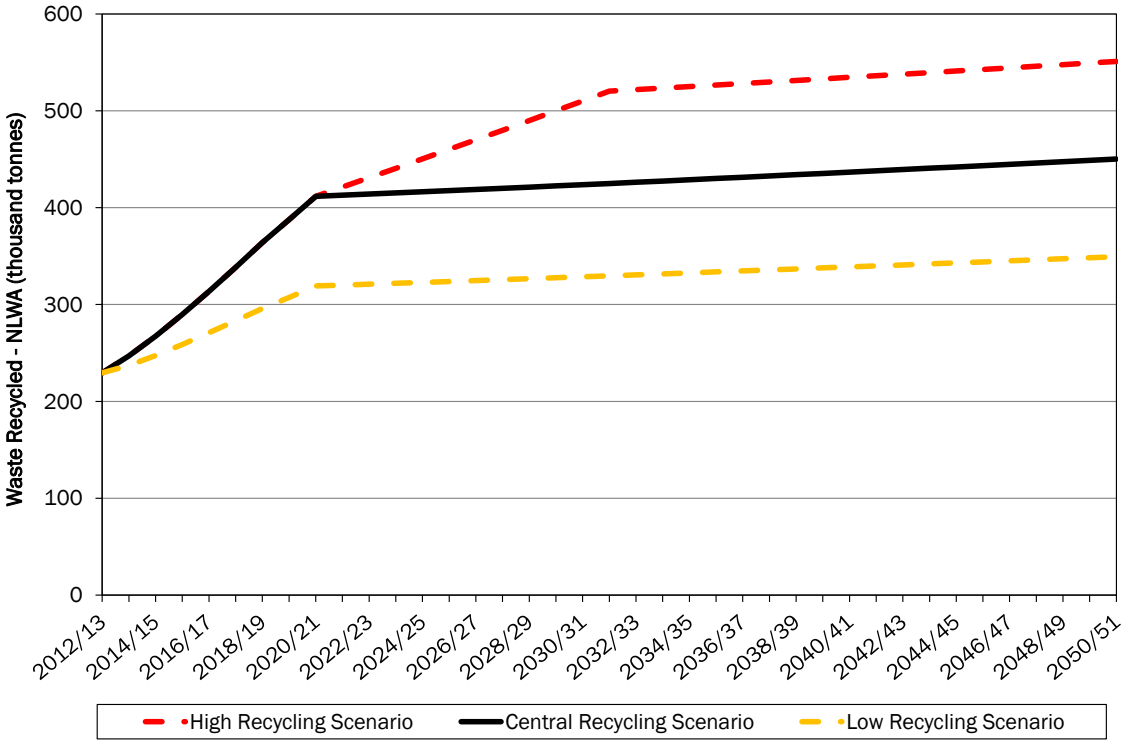
[6] Mayor of London, Greater London Authority (2011) *Making Business Sense of Waste: The Mayor's Business Waste Management Strategy,* November 2011, www.london.gov.uk/priorities/environment/publications/the-mayors-waste-management-strategies

Figure E-2: Projected Waste Arisings for NLWA (2012/13 – 2050/51, thousand tonnes)



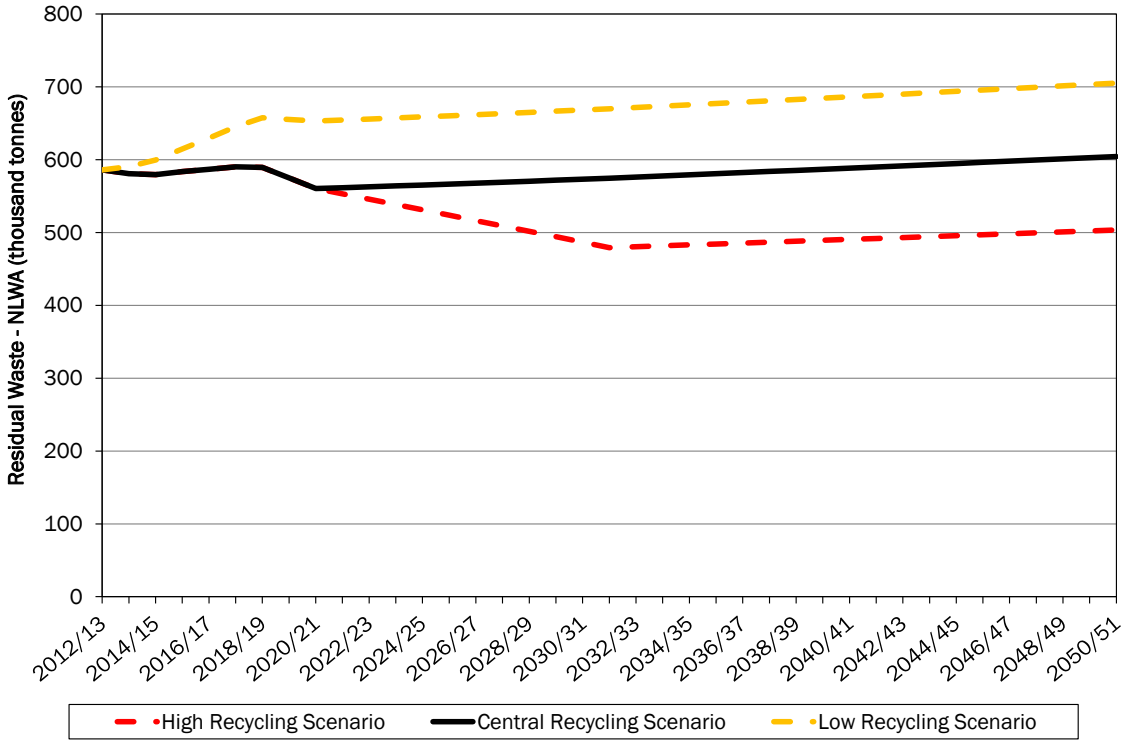
The total quantity of recycling is projected to be between 355,000 tonnes (Low Recycling Scenario) and 559,000 tonnes (High Recycling Scenario) by 2050/51 (Figure E-3). Under the Central Recycling Scenario the quantity of recycling is expected to almost double, from 230,000 tonnes in 2012/13 to over 400,000 tonnes by 2020/21. After this point tonnages will continue to increase due to increases in the total amount of waste arising.

Figure E-3: Projected Quantity of Recycling under Three Recycling Scenarios (2012/13 – 2050/51, thousand tonnes)



The total quantity of residual waste is projected to be between 713,000 tonnes (Low Recycling Scenario) and 509,000 tonnes (High Recycling Scenario) by 2050/51 (Figure E-4). Under the Central Recycling Scenario the quantity of residual waste is only expected to increase very slightly to approximately 611,000 tonnes by 2050/51.

Figure E-4: Projected Quantity of Residual Waste under Three Recycling Scenarios (2012/13 – 2050/51, thousand tonnes)



The results for the three recycling scenarios are summarised in Tables E-1 to E-3 below.

TableE-1: Quantity of Recycling and Residual Waste Arising under the Low Recycling Scenario (thousand tonnes)

Year	2012/13	2020/21	2036/37	2050/51
Recycling	230	324	340	355
Residual	598	661	687	713
Total	827	985	1,027	1,068

Table E-2: Quantity of Recycling and Residual Waste Arising under the Central Recycling Scenario (thousand tonnes)

Year	2012/13	2020/21	2036/37	2050/51
Recycling	230	418	438	457
Residual	598	568	589	611
Total	827	986	1,027	1,068

Table E-3: Quantity of Recycling and Residual Waste Arising under the High Recycling Scenario (thousand tonnes)

Year	2012/13	2020/21	2036/37	2050/51
Recycling	230	418	536	559
Residual	598	567	491	509
Total	827	985	1,027	1,068

Glossary

C&D	Construction and Demolition
C&I	Commercial and Industrial
DCO	Development Consent Order
ERF	Energy Recovery Facility
FALP	Further Amendments to the London Plan
GDHI	Gross Disposable Household Income
GDP	Gross Domestic Product
GLA	Greater London Authority
GVA	Gross Value Added
LAC	Local Authority-Collected
LEDNET	London Environment Directors Network
NLWA	North London Waste Authority
WCA	Waste Collection Authority

Contents

1.0 Introduction

1.1. Eunomia Research & Consulting Ltd (Eunomia) is pleased to present this project report to the North London Waste Authority (NLWA). This report summarises the methodology and results of the waste forecasting modelling that has been undertaken to inform the needs case for the development of the Edmonton EcoPark Energy Recovery Facility (ERF) and associated Development Consent Order (DCO) process.

Project Objectives and Scope

1.2. Eunomia has been commissioned by the NLWA:

> *"To provide advice and support on technical aspects associated with the development of waste forecasts and models for the development of waste treatment and disposal solutions".*[7]

1.3. As part of this advice and support, this report outlines our approach to the development of an initial waste forecasting model including an explanation of the assumptions which underpin the modelling.

1.4. The waste forecast model produced includes all Local Authority-Collected (LAC) Waste that is collected by the following London Borough Waste Collection Authorities (WCA): Barnet, Camden, Enfield, Islington, Hackney, Haringey, and Waltham Forest (Constituent Boroughs).

1.5. The main objective of the model is to forecast the amount (in tonnes) of residual waste collected by the WCAs in scope that will be available for treatment in the proposed ERF.

1.6. The time period covered by the model begins in the financial year 2012/13 and ends in 2050/51.

Modelling Limitations

1.7. Providing forecasts of waste arisings for over thirty years in the future is extremely difficult given the myriad factors affecting both the generation of waste and how it is subsequently managed; in essence it is unknowable.

[7] Extract from Invitation to Tender document.

Recognising that long-term plans for managing the waste generated within the Constituent Boroughs are needed however, we have developed a model based on the data available, a robust analysis of historical trends, and a measured set of assumptions about what will happen to these trends in the future.

Structure of the Report

1.8. This report is broken down into seven sections. This introductory section is followed by **Section 2.0**, which provides an overview of the waste forecasting model. The assumptions and methodology behind Eunomia's projections of household waste arisings is presented in **Section 3.0**, whilst **Section 0** provides an overview of the C&I waste projections, and **Section 5.0** discusses the approach used for modelling 'other' waste streams. **Section 6.0** presents the rationale for modelling different recycling rates across all waste streams as part of a number of different model scenarios, the results of which are summarised in **Section 7.0**.

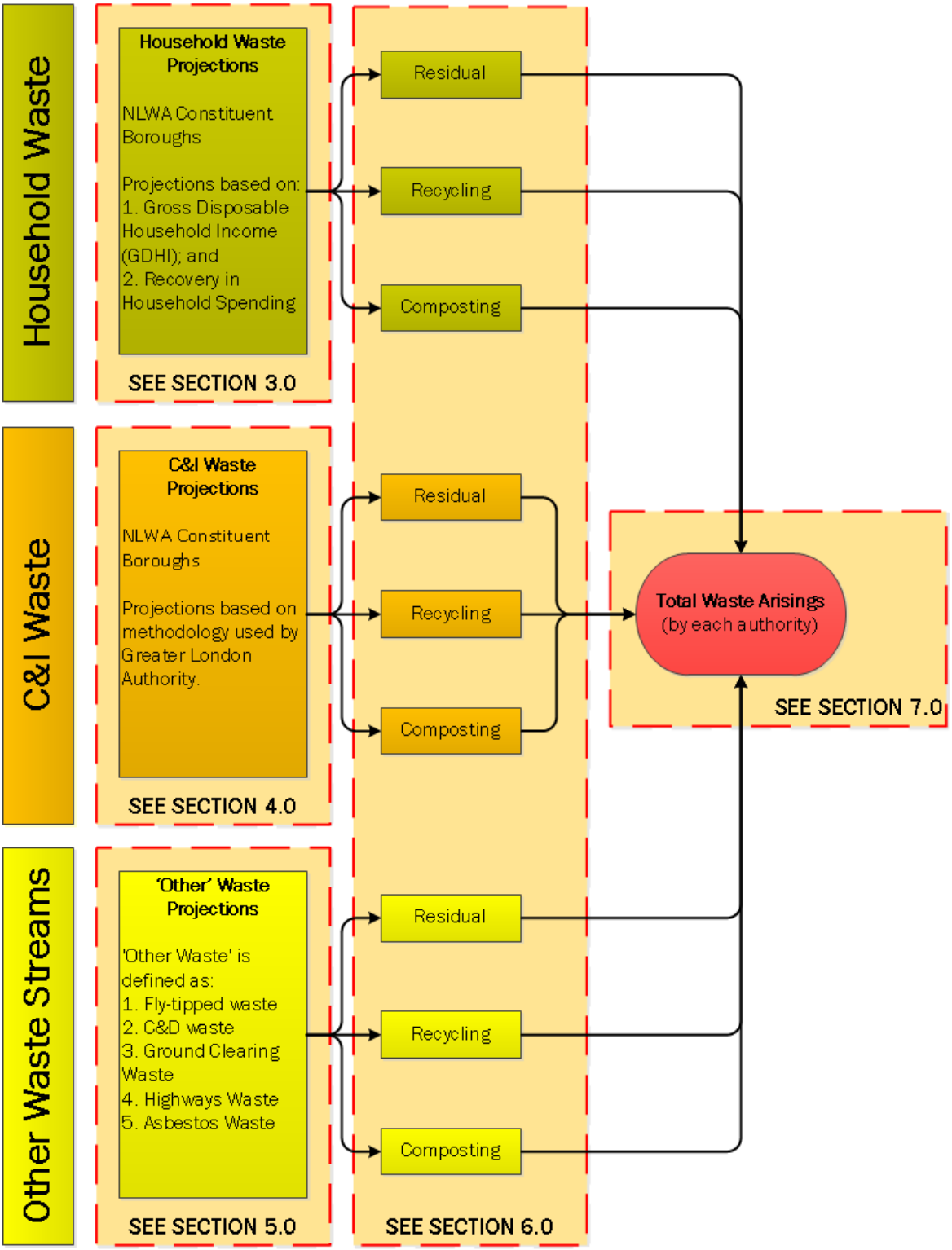
2.0 Model Overview

2.1. Before considering the detailed approach taken to modelling future waste arisings, it is helpful to consider the overall model structure in order to understand how the various component parts fit together. A high level outline of the model is presented in Figure 2-1. From this it can be seen that the model consists of three discreet parts:

- An element dealing with LAC household waste;
- An element dealing with C&I waste; and
- An element dealing with a number of 'other' waste streams.

2.2. Separate projections of these three sections are then provided, based on a range of modelled changes in dry recycling and composting rates in each of the Constituent Boroughs. Changes in recycling rates are critical for determining the quantity of residual waste remaining for treatment at the proposed ERF. The sections of the report under which each of the above elements are discussed is highlighted in Figure 2-1.

Figure 2-1: Model Outline



3.0 Forecasting Household Waste Arisings

Overview

3.1. In 2012/13, residents of the Constituent Boroughs produced, on average, 345 kg of waste per person,[8] as a consequence of household consumption of both essential and non-essential goods.[9] The amount of household waste that arises in a year depends on a number of economic, social and policy drivers which all act together to determine household behaviour when it comes to consumption, recycling and disposal. This section sets out how it is possible, using regression analysis, to identify statistically significant correlations between household waste arisings and a number of social and economic variables.

Limitations

3.2. One limitation of this type of analysis is the number of historical data points which are available on which to carry out the regression analysis described below. This restricts the opportunity for specifying multiple independent variables whilst still achieving the desired level of statistical significance. Although the quality of data has been steadily improving since 2000 (although vagaries remain), the time series for the datasets used are relatively short and the quality of data in the early years is questionable.

3.3. The difficulty with any exercise of this kind, therefore, is that on the one hand, there is a demand for data covering a reasonable number of observations, but on the other, at present, the longer the dataset, the lower the average quality of the data becomes. Furthermore, one has to appreciate that some of the interest in this type of work stems from an interest in whether any 'decoupling' of waste arisings and economic output

[8] Defra (2013) *ENV18 - Local Authority Collected Waste: Annual Results Tables*, www.gov.uk/government/statistical-data-sets/env18-local-authority-collected-waste-annual-results-tables

[9] Although slightly fluid terms, an essential good is a physical item required by a consumer in order to sustain health or life. Non-essential goods include luxury items, or luxury versions of essential items, that are deemed to be non-essential for sustaining health and life.

has and is occurring. Ideally, one would have a lengthy time series in advance of this period, enabling some break with pre-established trends to be observed.

3.4. In addition, since we have at most 15 years' worth of observations on which to base our projections, we would not normally advise forecasting for more than a very small number of years into the future on this basis. The use of this type of analysis for long-term projections remains questionable and open to challenge; an important consideration that needs to be acknowledged is that the projections developed here are looking through to 2050/51 – that is, 36 years into the future and more than double the length of time for which we have reliable historical data on household waste arisings in London.

3.5. However difficult or uncertain future projections may be, projections are required for future planning. The method taken here is in our view the most reasonable possible.

Historic Waste Arisings

3.6. As part of earlier work undertaken by Eunomia for the London Environment Directors Network (LEDNET), we completed a detailed statistical analysis of household waste arisings in London to ascertain which social and economic factors were statistically most strongly correlated with the changing trends in waste arisings.[10] As part of this work we examined London's historic waste arisings data for the period 1997/98 to 2010/11 (arisings being the dependent variable), and used MS Excel's regression analysis tool to ascertain whether there were statistical correlations between household waste arisings and the following independent variables:

- Population;
- Number of households;

[10] Eunomia Research & Consulting (2012) *Waste Arisings in London*, Report for London Environment Directors Network, October 2012

- Household size;
- Gross Value Added (GVA);
- Gross Disposable Household Income (GDHI);
- Unemployment rate; and
- Household expenditure.

3.7. The regression analysis was also applied to a number of combinations of the above variables to identify which combination had the best statistical relationship with the historic total household waste arisings for London.

3.8. The best result from the regression analysis, in terms of statistical correlation, was produced using Gross Disposable Household Income (GDHI) as the independent variable (see Box 1 for a definition of GDHI). Despite the prevailing economic conditions GDHI has continued to increase since 2008, albeit at a reduced rate (Table 3-1). This shows a negative correlation as household waste arisings have been falling over time, suggesting a degree of 'decoupling' from the increase in GDHI.

Box 1: What is Gross Disposable Household Income (GDHI)?

The Office for National Statistics (ONS) describes Gross Disposable Household Income as *"the amount of money that individuals (i.e. the household sector) have available for spending or saving. This is money left after expenditure associated with income, e.g. taxes and social contributions, property ownership and provision for future pension income. It is calculated gross of any deductions for capital consumption".*[11]

In this context the term 'households' includes all individuals living in an economy, whether they be in traditional households, or in institutions such as retirement homes or prisons. The method of calculation has been set out by the European System of Accounts 1995 (ESA 95) and further details can be found via the reference cited above or from the UK National Accounts Blue Book.[12]

[11] Office for National Statistics (undated) *Regional Accounts Methodology Guide*, www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/regional-accounts/regional-accounts-methodology-guide.pdf

[12] Office for National Statistics (2012) *United Kingdom National Accounts Blue Book*, www.ons.gov.uk/ons/rel/naa1-rd/united-kingdom-national-accounts/the-blue-book--2012-edition/index.html

Table 3-1: Gross Disposable Household Income (GDHI) for London 1997–2011 (2013 Real Term Prices)

Year	GDHI (£ million in 2013 prices)	Annual Growth Rate (%)
1997	£115,129	-
1998	£119,989	4.22%
1999	£124,703	3.93%
2000	£133,855	7.34%
2001	£139,324	4.09%
2002	£137,659	-1.19%
2003	£141,712	2.94%
2004	£143,647	1.37%
2005	£147,440	2.64%
2006	£152,656	3.54%
2007	£158,202	3.63%
2008	£159,473	0.80%
2009	£162,219	1.72%
2010	£163,444	0.75%
2011	£165,632	1.34%

Source: Office for National Statistics (2013) Regional Household Income, Spring 2013, Accessed: 8th May 2014, www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-298694

3.9. The analysis revealed additional underlying factors influencing arisings that could not be satisfactorily accounted for using GDHI alone. In order to address this, a 'time variable' was included in the analysis to account for what we would speculate is the cumulative effect of waste prevention and minimisation measures (e.g. product light-weighting) on household waste arisings over time.

3.10. In addition, scrutiny of the waste arisings data reveals a recessionary impact due to the protracted economic downturn which began in 2007/8. In order to allow for this impact in our analysis we also carried out the regression analysis including an 'indicator variable' – referred to here as

the recessionary impact variable – to represent the impacts of the recession and the subsequent recovery.[13] The recessionary impact variable complements GDHI as it more closely accounts for consumer spending and confidence in the economy. As described in Box 1, GDHI includes savings and therefore does not accurately account for household spending on consumer goods. Increased spending on consumer goods is generally associated with greater rates of disposal and therefore increases in waste arisings.

3.11. The fact that waste arisings decrease during the recessionary period even though the GHDI continued to increase can be explained in a number of ways. For example:

- A greater share of income was being saved (as opposed to spent) during the recession;[14,15] and
- The tendency to spend disposable income on discretionary items was lower during the recession.[16]

These behaviours are not captured by the GDHI variable itself, and therefore an indicator variable is used to indicate the magnitude of these recessionary effects on people's behaviour over time.

3.12. For the purpose of developing the model that is the subject of this report, we have used up-to-date data for both the dependent and independent variables and repeated the regression analysis to confirm the

[13] A 'indicator variable' is a statistical term used in regression analysis for a variable that is used to indicate the presence or absence of an unquantified effect that is assumed to have an impact on the dependent variable (in this case on waste arisings).

[14] Office for National Statistics (2013) *Chapter 4: Trends in Household Expenditure Over Time*, December 2013, www.ons.gov.uk/ons/dcp171776_341526.pdf

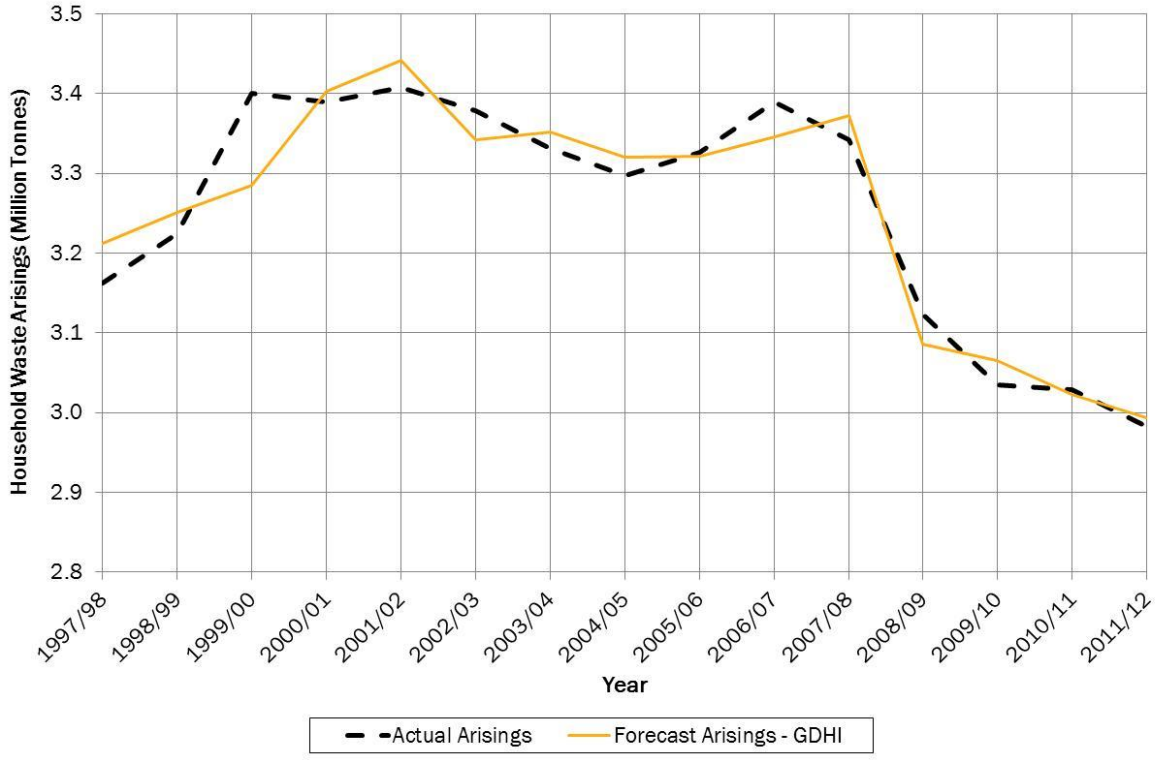
[15] This is borne out by the data; for example, see: Office for National Statistics (2013) *Household Saving Ratio and Gross Disposable Income - 2013 Quarter One*, www.ons.gov.uk/ons/about-ons/business-transparency/freedom-of-information/what-can-i-request/published-ad-hoc-data/econ/july-2013/saving-ratio-brief.doc

[16] See for example: Deloitte (2011) *Consumer 2020: Reading the Signs*, www.deloitte.com/assets/Dcom-CostaRica/Local%20Assets/Documents/Industrias/Consumo/110131-cr%28en%29_consumer-2020.pdf; and McKinsey Global Institute (2009) *Beating the Recession: Buying into New European Consumer Strategies*, April 2009

statistical correlation between the various parameters. It is important to note, that in the context of this work household waste includes kerbside collected waste, waste from bring banks, HWRCs and Schedule 2 waste. The most recent data that could be used was limited by the fact that at the time of writing the regional GDHI data only extended up to 2011. The methodology and results of this analysis are outlined in detail in Appendix A.1.0.

3.13. Using the coefficients calculated from the regression analysis, Eunomia has predicted the total household waste arisings over the period from 1997/98 to 2011/12. The model output is compared with the actual data in Figure 3-1. The regression analysis produces a 'best fit' to the data. The model is, however, not perfect and there are some years (e.g. 1999/2000) where the error between the modelled arisings and the actual arisings is visibly larger than in other years. This difference may be due to other underlying factors that influence waste arisings that are not being captured by the three independent variables included in our model.

Figure 3-1: Comparison of Modelled and Actual Total Household Waste Arisings for London (Million Tonnes)



Looking Forward

3.14. The statistical correlations identified between historic household waste arisings, GDHI, and the two other independent variables yielded a regression equation which has been used to project forward changes in waste arisings based on future changes in the independent variables (see Appendix A.1.0 for more details). However, this requires that one has a relatively good understanding of the likely changes that are going to occur with respect to the independent variables.

3.15. Historical data for GDHI in London suggests that it grew at an average rate of 3.25% per annum during the 10 years prior to 2007, and at slightly reduced rate of 2.8% per annum if only the period 2003 to 2007 is considered. The Office for Budget Responsibility has projected that nationally GDHI fell in 2013 by 0.1% in real terms, and it forecasts suggest that it will start to increase again in 2014 and continue to increase through to 2018 (Figure 3-2).[17] Reliable and independent long term projections of GDHI for London are not available and given that the economic outlook in London is typically better than for the UK as a whole it has been assumed that GDHI will grow annually at 2.5% between 2012/13 and 2014/16, and thereafter rise steadily to reach 3% in 2020/21 (see Table 3-3). For the period beyond 2020/21 it has been assumed that GDHI will continue to grow at 3.0% per annum (in line with average growth rates prior to the onset of the recession).

[17] HM Treasury (2014) *Budget 2014*, March 2014, www.gov.uk/government/publications/budget-2014-documents

Table 3-2: Office for Budget Responsibility's Projected Real Household Disposable Income (2012/13 – 2018/19)

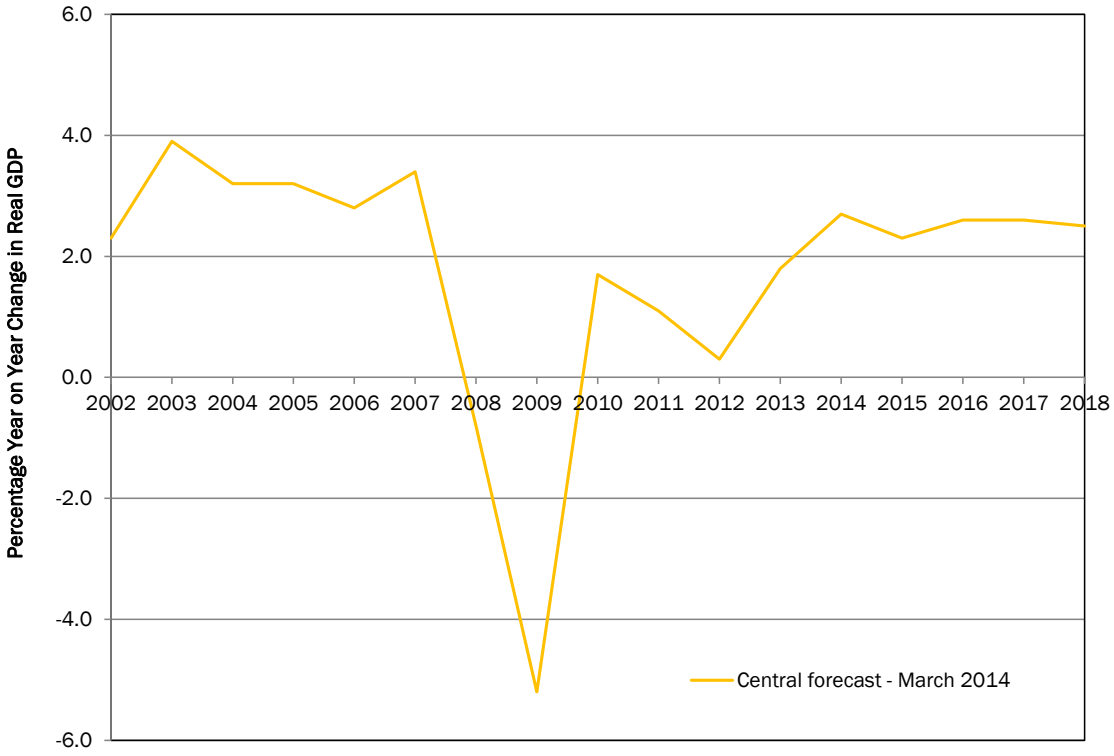
Year	Change in GDHI (%)
2012/13	2.3%
2013/14	-0.1%
2014/15	1.2%
2015/16	1.8%
2016/17	1.5%
2017/18	2.3%
2018/19	2.2%

Source: GDHI figures for the period 2012/13 to 2018/19 comes from OBR central projections of national GDHI provided in the Budget 2014 – see: HM Treasury (2014) Budget 2014, March 2014, www.gov.uk/government/publications/budget-2014-documents.

3.16. Turning to the other independent variables; the time variable is assumed to also continue as further efforts are made locally and in the wider economy to prevent and minimise waste generation. Drivers include the North London Waste Prevention Plan 2014 – 2016, Defra's National Waste Prevention Plan, as well as other national and European regulations. In addition, continued light weighting of materials in response both to consumer and regulatory pressure and to reduce costs in the face of rising input commodity prices as well as changing patterns of consumer behaviour driven partly by rising commodity prices but also by changing technology are also expected to continue to have an effect. However, it is important to note that a future waste prevention / minimisation effect may well exceed that which has taken place historically. It is therefore possible that this time variable may underestimate waste prevention effects going forward as it is given greater priority at both an operational and policy level.

3.17. As for the recessionary impact variable, there is a consensus amongst the majority of economic forecasters that the UK economy is strengthening, with the Office for Budget Responsibility forecasting in March of this year that annual GDP growth will likely exceed 2% for the period 2014 to 2018 (based on the central UK forecast – see Figure 3-2).

Figure 3-2: Office for Budget Responsibility Real GDP Forecast (%Year on Year Change)



Source: Office for Budget Responsibility (2014) Economic and Fiscal Outlook, March 2014, Accessed 12th May 2014, http://budgetresponsibility.org.uk/economic-fiscal-outlook-march-2014/

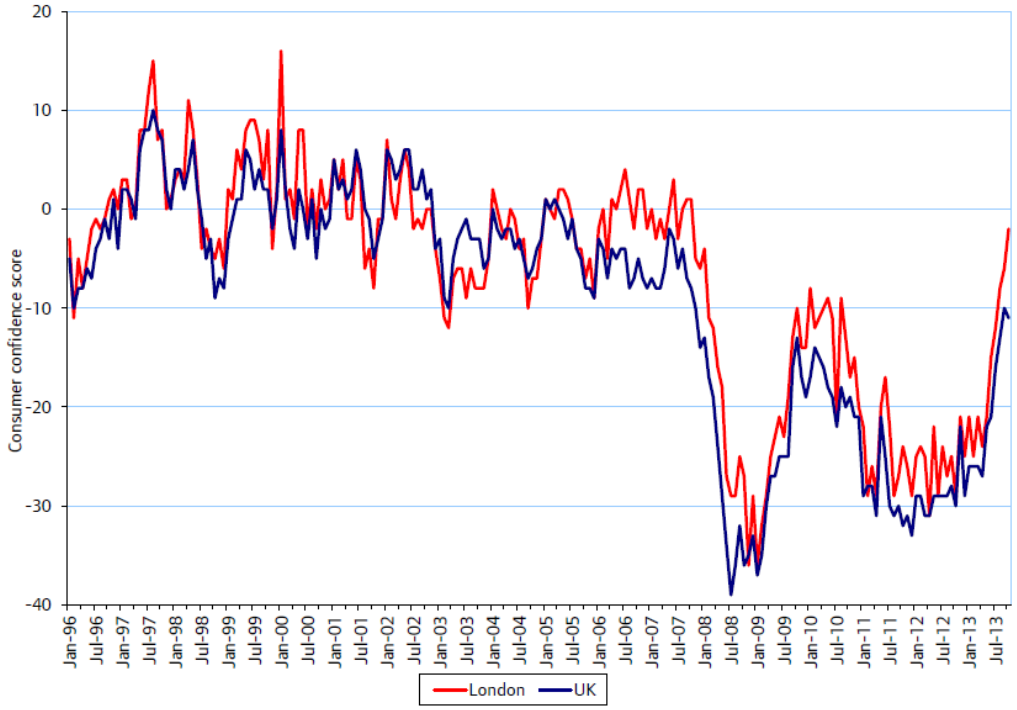
3.18. According to the GLA the economic outlook for London is also looking positive, but not without its challenges:

> *"Most recent economic data indicates that London's economy continues to outperform the UK as a whole as both economies continue to recover from the recession. The majority of economic indicators show a continuing improvement in the London economy, especially when compared to the beginning of 2013. However, uncertainty in a number of key trading areas, for example the on-going Eurozone problems […] may still dampen the economic recovery".*[18]

[18] GLA Economics (2013) *London's Economic Outlook: Autumn 2013 – The GLA's Medium-Term Planning Projections*, November 2013, www.london.gov.uk/priorities/business-economy/publications/gla-economics/london-s-economic-outlook-autumn-2013

3.19. Consumer confidence is also reported to be improving *"…but remains vulnerable to shocks and household incomes remain under pressure but are likely to gradually improve over the next few years although at a subdued rate"*.[19] Historical changes in the confidence of London's consumers are shown in Figure 3-3, where it is contrasted against consumer confidence in the UK as a whole. From this it can be seen that consumer confidence in the capital is typically higher than the UK average, but there have been significant fluctuations in recent years, with signs that confidence is improving again.

Figure 3-3: Changes in Consumer Confidence: UK Average vs London

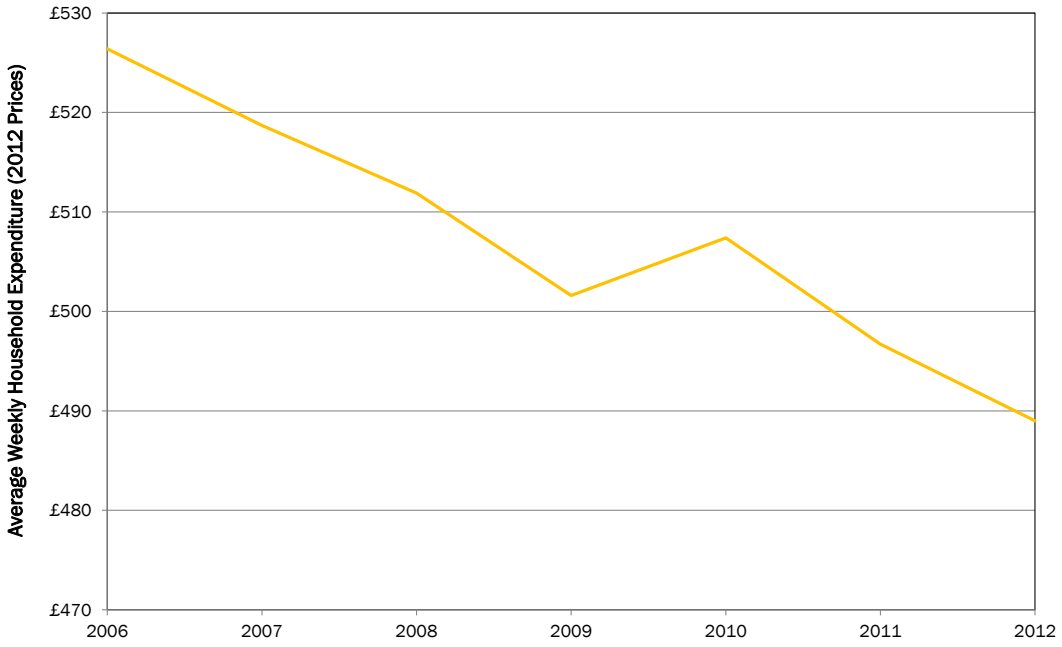


Source: GLA Economics (2013) London's Economic Outlook: Autumn 2013 – The GLA's Medium-Term Planning Projections, November 2013, www.london.gov.uk/priorities/business-economy/publications/gla-economics/london-s-economic-outlook-autumn-2013

[19] GLA Economics (2013) *London's Economic Outlook: Autumn 2013 – The GLA's Medium-Term Planning Projections*, November 2013, www.london.gov.uk/priorities/business-economy/publications/gla-economics/london-s-economic-outlook-autumn-2013

3.20. Average weekly household expenditure in the UK fell by 7% between 2006 and 2012, reflecting the tough economic times faced by households during this period (Figure 3-4).[20] Household expenditure in London has fallen significantly since 2001, but showed signs of growth in 2012 and GLA economists predicts that this will continue over the period 2013 to 2015.[21]

Figure 3-4: UK Average Weekly Household Expenditure (2006 – 2012, in 2012 Prices)



Source: Office for National Statistics (2013) *Chapter 4: Trends in Household Expenditure Over Time*, December 2013, www.ons.gov.uk/ons/dcp171776_341526.pdf

3.21. The independent variables used to project forward household waste arisings are presented in Table 3-3. The slow reduction in the recessionary impact/indicator variable is intended to reflect the above discussion which suggests that the economic recovery may remain sluggish for a number of years, with consumer spending and confidence returning gradually as the

[20] Office for National Statistics (2013) *Chapter 4: Trends in Household Expenditure Over Time*, December 2013, www.ons.gov.uk/ons/dcp171776_341526.pdf

[21] GLA Economics (2013) *London's Economic Outlook: Autumn 2013 – The GLA's Medium-Term Planning Projections*, November 2013, www.london.gov.uk/priorities/business-economy/publications/gla-economics/london-s-economic-outlook-autumn-2013

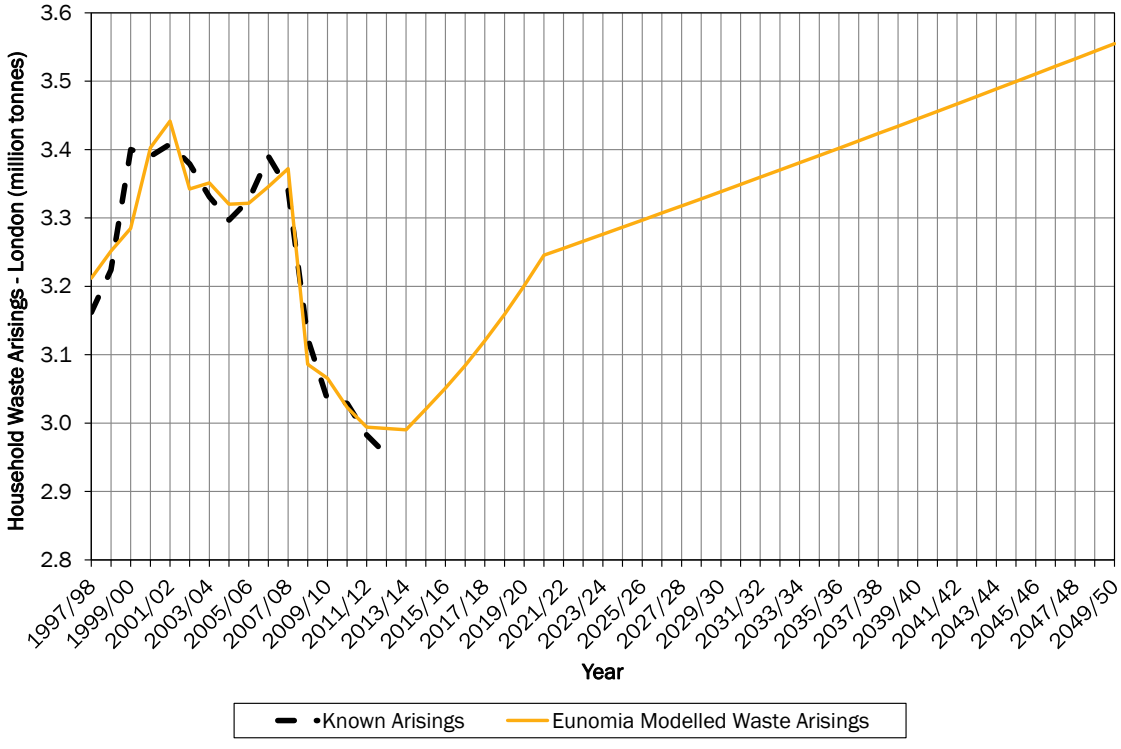
economic outlook improves. We have assumed that the full impacts of the recession on consumer spending/confidence have fully disappeared by 2020/21. The results of these projections are represented graphically in Figure 3-5.

Table 3-3: Parameters Used for Projecting Household Waste Arisings (2012/13 – 2050/51)

Year	Change in GDHI[1]	Time Variable	Recessionary Impact / Dummy Variable
2012/13	2.5%	2012	1.00
2013/14	2.5%	2013	1.00
2014/15	2.5%	2014	0.86
2015/16	2.5%	2015	0.71
2016/17	2.6%	2016	0.57
2017/18	2.7%	2017	0.43
2018/19	2.8%	2018	0.29
2019/20	2.9%	2019	0.14
2020/21	3.0%	2020	0.00
2021/22 to 2050/51	3.0%	+1 for each year	0.00

Note: 1. GDHI figures for the period 2012/13 to 2018/19 comes from OBR central projections of national GDHI provided in the Budget 2014 – see: HM Treasury (2014) Budget 2014*, March 2014, www.gov.uk/government/publications/budget-2014-documents.*

Figure 3-5: Historic and Forecast Household Waste Arisings in London (1997/98– 2050/51, million tonnes)

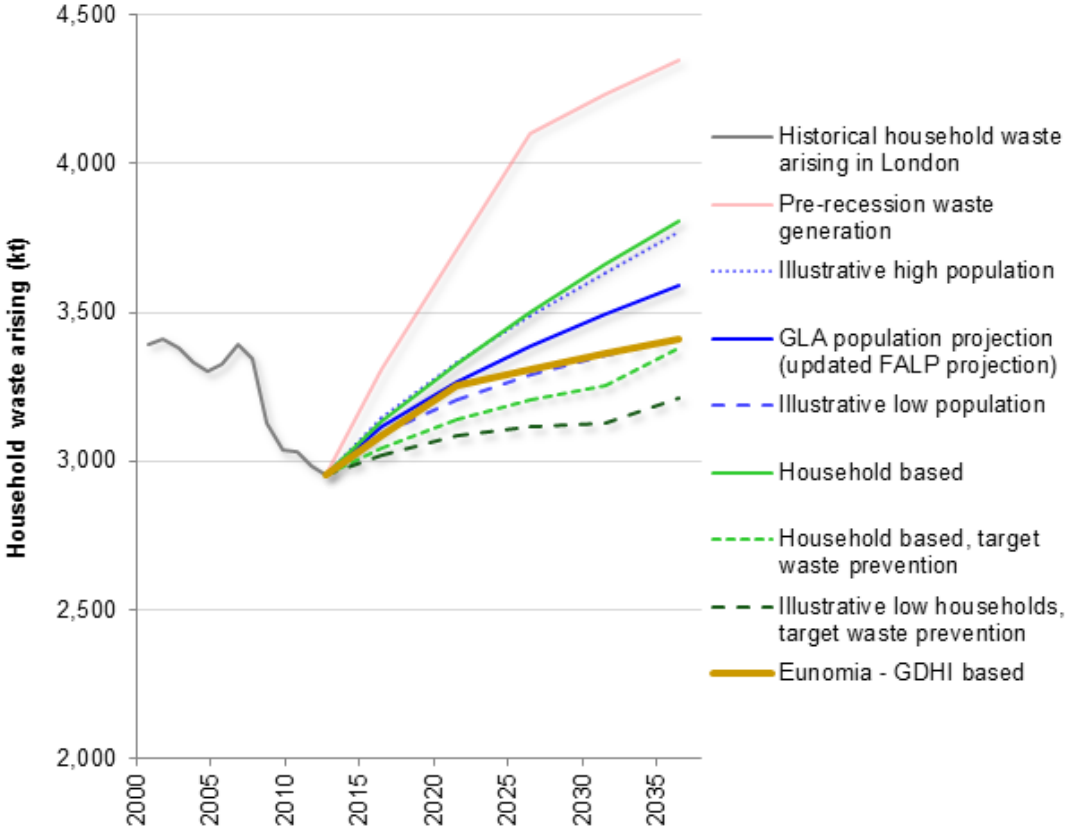


3.22. Figure 3-6 compares Eunomia's projections (solid brown line) to those developed as part of the Draft Further Alterations to the London Plan (FALP) published by the Mayor of London on 15 January 2014 (solid blue line) and projections of waste arisings based on other forecasting methodologies as compared by SLR in their review of the plan for the GLA.[22] [23] The forecast of household waste arisings in the FALP are based on a waste per household basis with population forecasts used to predict future arisings. It can be seen from this that the two projections are similar in the years leading up to 2020/21, after which point Eunomia's projections start to flatten off relative to those presented in the FALP. Both projections see London's household waste arisings increasing to just over 3.2 million tonnes by 2020/21 and then continuing to grow, albeit at different rates. Eunomia's projections estimate that total household waste arisings will be 3.4 million tonnes in 2036 compared to the FALP projection of 3.6 million tonnes in the same year (the final year in the FALP). Our model projects arisings of just less than 3.6 million by 2050/51, whilst the FALP (if extrapolated forward from 2036) predicts more consistent growth leading to waste arisings in excess of 3.8 million tonnes by the same point.

[22] GLA 2014 Draft Further Alterations to the London Plan. January 2014. http://www.london.gov.uk/priorities/planning/london-plan/draft-further-alterations-to-the-london-plan

[23] SLR 2014 Revised London Plan Waste Arisings Study Review for the Greater London Authority – Model Guide and task 4 Findings https://www.london.gov.uk/sites/default/files/Model%20Guide%20and%20Findings%20.pdf

Figure 3-6: Eunomia Forecast Household Waste Arisings compared with that presented in the Draft Further Alterations to the London Plan and other Comparator Forecasts



4.0 Forecasting C&I Waste Arisings

Overview

4.1. Forecasting C&I waste volumes for future years is notoriously difficult due to the distinct lack of data on historic and current volumes. This lack of data also means that it is not possible to develop projections of C&I waste arisings based on statistical correlations with other independent variables. This section outlines the data and projections that have been used to forecast Local Authority Collected C&I arisings for the NLWA.

Historic Waste Arisings

4.2. There have recently been some attempts to demonstrate a decoupling between economic output and C&I waste arisings.[24] However, given the paucity of robust, regular time-series data on arisings and the recent economic recession, it seems premature to make any definitive conclusions in this respect. Indeed, the lack of historical data makes it impossible to undertake the regression analysis carried out on household waste as described in Section 3.0 (estimates of C&I waste arisings are only available for 1999, 2003, and 2009). An alternative method for forecasting C&I waste arisings is therefore required and for this purpose we have drawn on work published in the FALP.

Looking Forward

4.3. Research undertaken by SLR Consulting Ltd in 2010 on behalf of the GLA for the London Plan included a forecast of C&I waste arisings through to 2031. This forecast was based on what was at the time the most recent (2003) figures on C&I waste arisings, and based on this calculated a 'waste per employee' figure from GLA employment figures. This baseline was then extrapolated through to 2031 by applying economic growth assumptions in the form of GLA employment forecasts to predict a total

[24] For example, see: Defra (2011) *Commercial and Industrial Waste Arisings 2010 – Revised Final Results*, June 2011, www.gov.uk/government/publications/commercial-and-industrial-waste-generation-and-management

C&I tonnage for each London authority. The overall picture was one of an increase in total jobs overall in London, but less waste being produced (as 'heavy waste' jobs in industry are replaced by 'lighter waste' jobs in the service sector) resulting in a relatively constant amount of C&I waste through the period.[25]

4.4. This work was updated by SLR in late 2013 as part of the draft revisions to the London Plan published in January 2014.[26] This analysis uses updated employment data and forecasts as well as the C&I waste data from 2009. In addition, the projections were extended from 2031 to 2036. At present these projections are the most up-to-date projections of likely future C&I waste arising available at a borough by borough level.

4.5. There are alternative methods of analysing and forecasting C&I waste arisings using C&I business classification (SIC) code data; however, in our view there is also an issue regarding the reliability of this data when used for forecasting purposes. There is also a danger in over-complicating matters with spurious levels of detail; detail which in and of itself is based on relatively high-level sampling and assumptions.

4.6. Therefore whilst there are options for a number of more complex modelling methods to be used for projecting future C&I waste arisings, given the absence of reliable trend data we have used the C&I waste arisings forecast growth rate presented in the FALP on which to base our forecast. These projections are shown for the Constituent Boroughs in Figure 4-1. As with the original projections in the London Plan, these projections show very little change in C&I waste arisings over time. For the period beyond 2036 (i.e. the end point of the projections in the FALP) it is assumed that the calculated annual growth rate of 0.22% achieved between 2034/35 and 2036/37 would continue until 2050/51.

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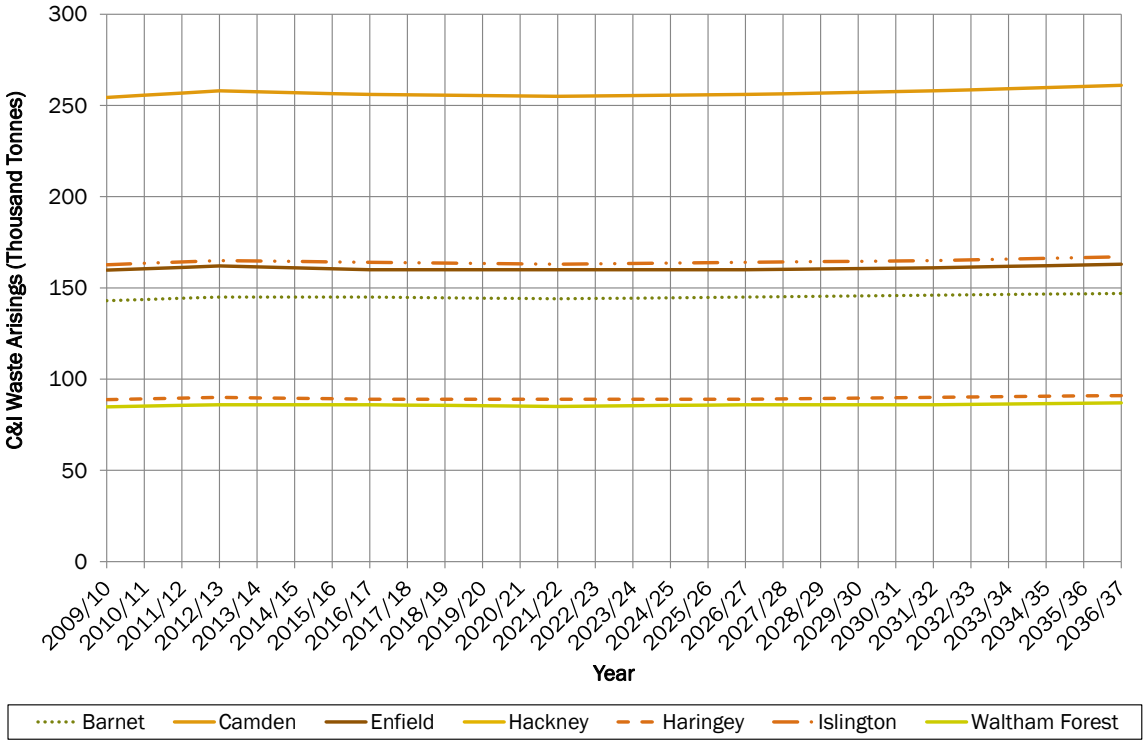
[25] GLA (2010) *Future Waste Arisings in London 2010-2031 – Summary Note*, March 2010, www.london.gov.uk/shaping-london/london-plan/docs/waste-arisings-note.pdf

[26] SLR (2014) *Revised London Plan Waste Arisings Study Review for the Greater London Authority – Model Guide and Task 4 Findings*, January 2014, www.london.gov.uk/sites/default/files/Model%20Guide%20and%20Findings%20.pdf

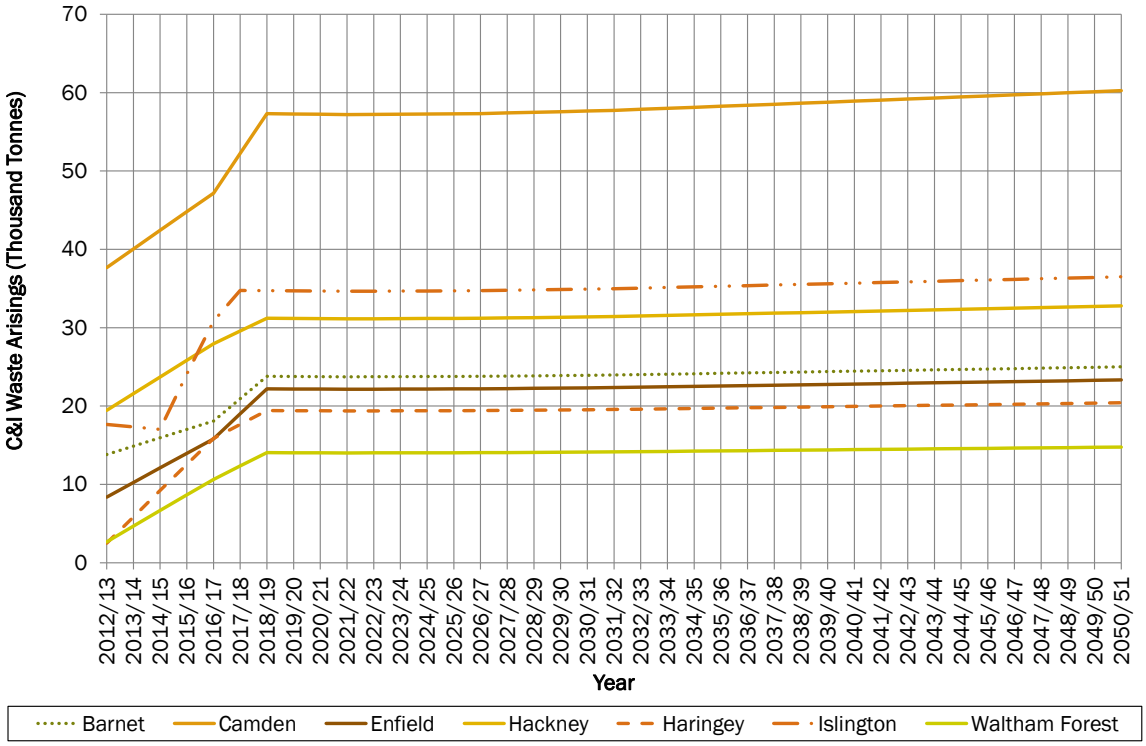
Figure 4-1: Total C&I Arisings in NLWA's Constituent Boroughs (2009 – 2036)



Source: Mayor of London, Greater London Authority (2014) Draft Further Alterations to the London Plan, January 2014, www.london.gov.uk/priorities/planning/london-plan/draft-further-alterations-to-the-london-plan

4.7. Using data on the tonnages of C&I waste collected by each Constituent Borough reported via WasteDataFlow a 'market share' was calculated for each borough. Due to the lack of suitable data it is only possible to calculate the market share that each borough had back to 2009. Consequently, in our forecast we assume that each borough's market share recovers to 2009 levels by 2016/17, and then increases a further 2% in both 2017/18 and 2018/19. The results of this apportionment are shown in Figure 4-2 which outlines the amount of local authority collected C&I waste for each of the Constituent Boroughs.

Figure 4-2: Local Authority Collected C&I Waste in NLWA's Constituent Boroughs (2009 – 2036)



Limitations

4.8. The projections of C&I waste in the FALP are based on assumptions about the amount of waste produced per employee in different business sectors. The arisings per employee were calculated based on Defra's 2009 survey data and this yielded much lower results than SLR's earlier work that used data from 2003. Explanatory notes for the FALP explain that:

> *"The reduction in projected C&I waste arisings is largely due to the use of Defra's 2009 survey to characterise baseline waste production. Previous C&I waste forecasts presented in the Alterations to the London Plan used the Environment Agency's 2002/3 C&I waste survey as a basis. The EA 2002/3 survey estimated a London's total C&IW*

arising of 7.5 Mt, while the more recent Defra survey found a substantially reduced arising 4.6 Mt (39% lower)".[27]

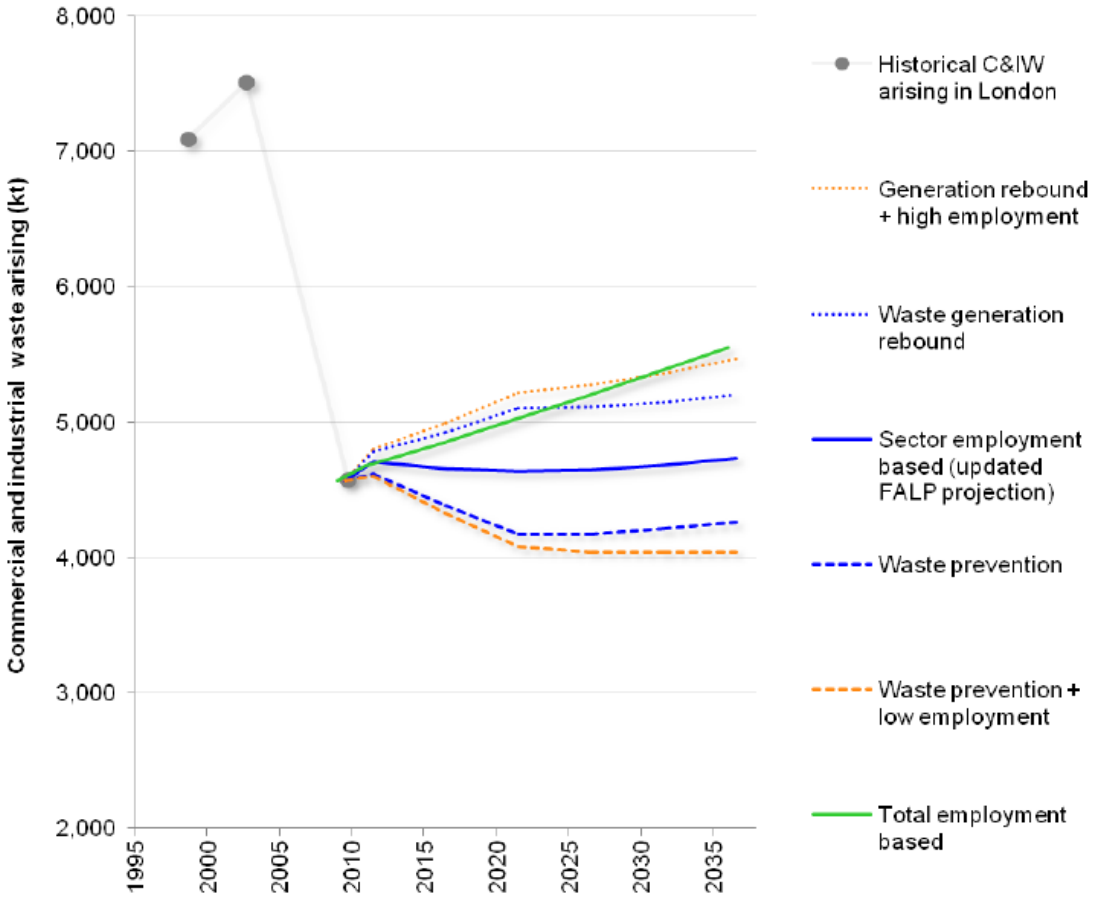
4.9. Given that the last C&I waste survey was only a year after the onset of the financial downturn in 2008 – the recovery from which we are only slowly beginning to see – it would seem reasonable that C&I waste arisings have fallen further since this point. This would, using SLR's methodology, act to further reduce the projections made in the FALP as waste per employee would be a lot lower.

4.10. It is also assumed that waste generation per employee remains constant over time, which may not necessarily prove to be true given significant financial pressures to make efficiency savings and the growing focus on waste prevention. SLR's analyses also apportions the London-wide C&I waste arising by borough based on Defra's 2009 survey. It was therefore assumed that the proportion of waste produced by each borough would remain constant for the period 2009 to 2036. Given the lack of data there is little that can be done about this crude assumption; however, it needs to be born in mind that changes within individual boroughs' approach to C&I waste and recycling collection service provision may lead to fairly significant shifts in these proportions.

4.11. Further details on the methodology used for the FALP projections can be found in the documents cited above. It is worth re-emphasising, however, that given the paucity of historical data there is limited scope for making accurate predictions, particularly at the borough level. The projections provided by SLR should be seen as indicative only and are based on a number of key assumptions. Indeed, the analysis of a number of alternative scenarios show that waste arisings could vary significantly depending on the assumption made (Figure 4-3).

[27] SLR (2014) *Revised London Plan Waste Arisings Study Review for the Greater London Authority – Model Guide and Task 4 Findings*, January 2014, www.london.gov.uk/sites/default/files/Model%20Guide%20and%20Findings%20.pdf

Figure 4-3: SLR's Modelled C&I Waste Arising Scenarios for the London Plan



Source: SLR 2014 Revised London Plan Waste Arisings Study Review for the Greater London Authority – Model Guide and task 4 Findings
https://www.london.gov.uk/sites/default/files/Model%20Guide%20and%20Findings%20.pdf

5.0 Forecasting Waste Arisings from Other Waste Streams

Overview

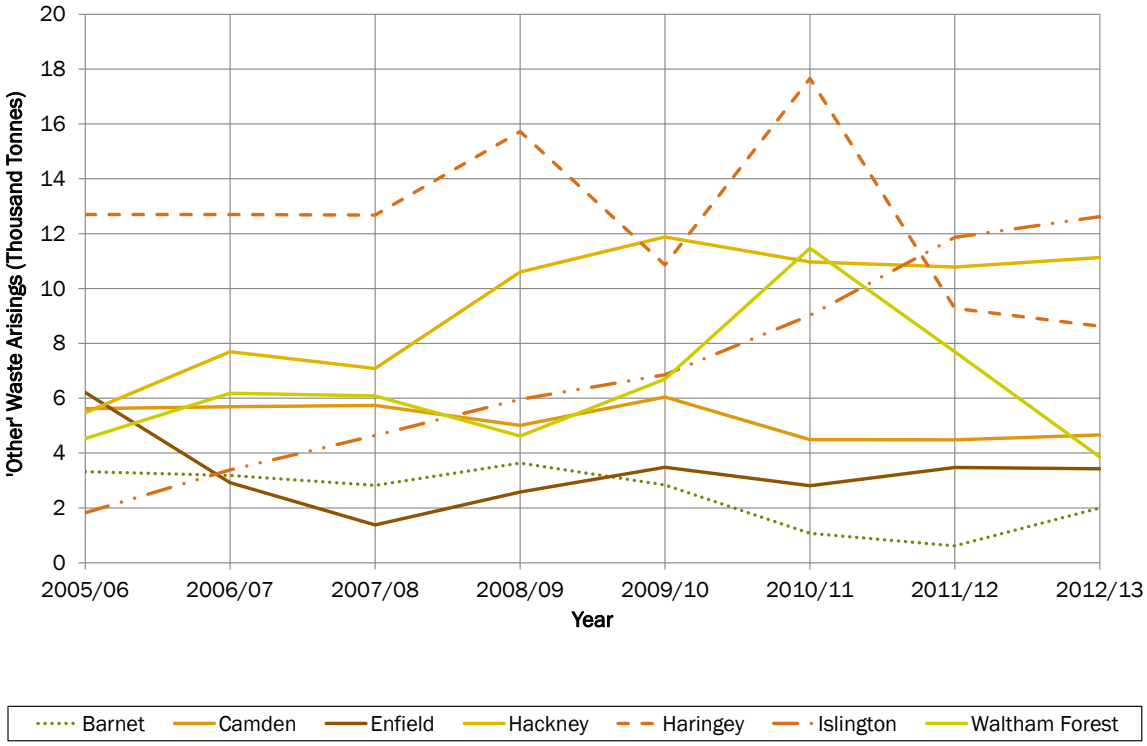
5.1. In addition to household and C&I waste, the model also includes a number of other local authority collected waste streams, namely:

- Fly-tipped waste;
- C&D waste;
- Ground clearing waste;
- Highways waste; and
- Asbestos waste.

Historic Waste Arisings

5.2. The model sums the arisings for the waste streams listed above as an 'other' category. The historic trends in these arisings are shown for each of the Constituent Boroughs in Figure 5-1. It can be seen from this figure that there are no obvious trends between the Constituent Boroughs and that as mentioned above, relative to the local authority collected household and C&I waste arisings these wastes make up only a very small proportion of total arisings.

Figure 5-1: Historic Arisings of 'Other' Waste Streams in NLWA (2005/06 – 2012/13, thousand tonnes)



Looking Forward

Given the uncertainty regarding changes in these waste streams in the future, and the relatively low proportion of the overall waste arisings represented, we have assumed that these 'other' waste arisings will remain static at 2012/13 levels for the duration of the modelling period (i.e. out to 2050/51).

6.0 Forecasting Future Recycling Rates

6.1. Anticipating likely future trends in dry recycling and composting is no easy task and is strongly linked to a number of factors, not least of all economic drivers such as landfill tax and the cost of recycling, alongside obligatory recycling targets. The model developed for these projections has taken a 'target-led' approach, whereby different future recycling rates have been predefined in the model at specific years in the future, completed with a simple linear extrapolation of recycling rate for the intervening and following years.

6.2. It is acknowledged that the drivers for household and C&I waste, while not dissimilar, are still worth separating out and we therefore discuss each in turn below. In each case three scenarios have been agreed with the NLWA for the purposes of developing the model presented in this report. Each of these scenarios represents a different level of achievement for future recycling efforts:

- Low recycling scenario – these scenarios represent limited levels of achievement;
- Central recycling scenario – these scenarios demonstrate moderate to high levels of achievement and allow for the achievement of national recycling targets; and
- High recycling scenario – these scenarios demonstrate very high levels of achievement with respect to recycling and are in line with the London Plan and the Mayor's Waste Strategies.[28,29,30]

The chosen recycling rates used in each scenario are outlined below.

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[28] Greater London Authority (2014) *The London Plan*, Date Accessed: 13th March 2014, Available at: www.london.gov.uk/priorities/planning/london-plan

[29] Mayor of London, Greater London Authority (2011) *London's Wasted Resource: The Mayor's Municipal Waste Management Strategy,* November 2011, www.london.gov.uk/priorities/environment/publications/the-mayors-waste-management-strategies

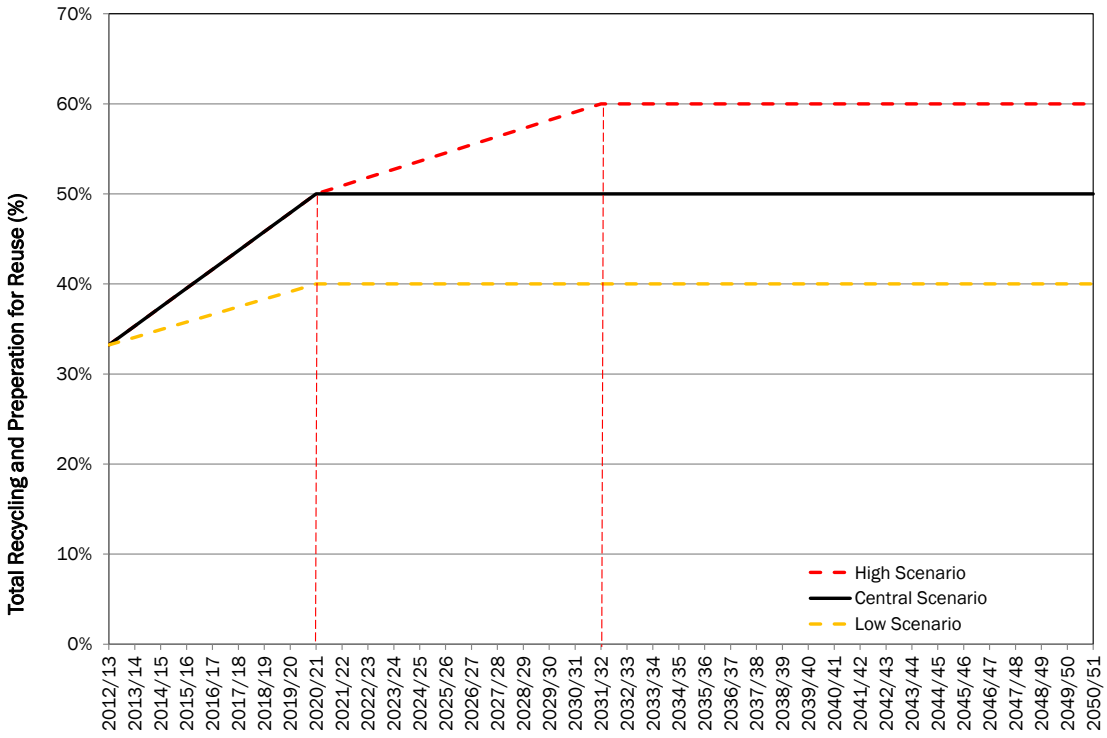
[30] Mayor of London, Greater London Authority (2011) *Making Business Sense of Waste: The Mayor's Business Waste Management Strategy,* November 2011, www.london.gov.uk/priorities/environment/publications/the-mayors-waste-management-strategies

Household Waste

6.3. The recycling targets selected for household waste are as follows (see Figure 6-1):

- Low recycling scenario – 40% recycling by 2020/21 and remaining static thereafter;
- Central recycling scenario – 50% recycling by 2020/21 and remaining static thereafter; and
- High recycling scenario – 50% recycling by 2020/21, rising to 60% in 2031/32 and remaining static thereafter.

Figure 6-1: Graphical Representation of Recycling Scenarios for Household Waste



Note: the recycling rate in 2012/13 is the NLWA average for household waste.

Low Recycling Scenario

6.4. The average recycling rate for household waste across the seven Constituent Boroughs was 32.8% in 2012/13, ranging from 23.7% in Hackney to 40.5% in Enfield. Table 6-1 shows the required year on year increase in recycling rates required for each borough to reach a 40% recycling rate in 2020/21.

Table 6-1: Percentage Year on Year Increase in Household Recycling Rates Required in Order to Achieve 40% Recycling by 2020/21

Borough	Annual Change in Recycling Rate - 2006/7 to 2012/13	Actual Household Recycling Rate in 2012/13	Low Recycling Scenario Target for 2020/21	Required Year on Year Change in Recycling Rate
Barnet	0.70%	34.4%	40%	0.70%
Camden	0.83%	31.4%	40%	1.08%
Enfield	2.82%	40.5%	40%	0.00%
Hackney	0.93%	23.7%	40%	2.04%
Haringey	1.94%	33.3%	40%	0.83%
Islington	1.54%	34.0%	40%	0.75%
Waltham Forest	0.97%	32.2%	40%	0.97%
Average	1.39%	32.8%	40%	0.90%

Central Recycling Scenario

6.5. Article 11(2)a of the Waste Framework Directive (2008/98/EC) requires that Member States achieve 50% recycling of *"household and similar waste"* by 2020. This target was transposed into English law through the Waste (England and Wales) Regulations 2011 (amended 2012). England as a whole is therefore obliged to recycle 50% of its household waste by 2020.[31] This is a national target and individual authorities are not legally bound by it; however, if it is to be achieved underperformance in one area will have to be matched by above target performance elsewhere in the country. The Central Recycling Scenario assumes that the Constituent Boroughs achieve this rate of recycling by the target year; this is also in

[31] Under the Waste Framework Directive Member States are allowed to meet the 50% recycling target by using one of four calculation methods. These methods are set out in a 2011 Commission Decision and each varies quite significantly. At present the UK has chosen to meet the target by using Method 3, which calculates the recycling rate (%) of all household as being equal to: recycled amount of household waste divided by the total amount of household waste excluding certain waste categories. See: Commission Decision of 18 November 2011 Establishing Rules and Calculation Methods for Verifying Compliance with the Targets Set in Article 11(2) of Directive 2008/98/EC of the European Parliament and of the Council (notified under document C(2011) 8165) (2011/753/EU).

line with the target included within the North London Joint Waste Strategy published in early 2009.[32]

6.6. Table 6-2 shows the required year on year increase in recycling rates required for each borough to reach a 50% recycling rate in 2020/21.

Table 6-2: Percentage Year on Year Increase in Household Recycling Rates Required in Order to Achieve 50% Recycling by 2020/21

Borough	Annual Change in Recycling Rate - 2006/7 to 2012/13	Actual Household Recycling Rate in 2012/13	Central Recycling Scenario Target for 2020/21	Required Year on Year Change in Recycling Rate
Barnet	0.70%	34.4%	50%	1.95%
Camden	0.83%	31.4%	50%	2.33%
Enfield	2.82%	40.5%	50%	1.19%
Hackney	0.93%	23.7%	50%	3.29%
Haringey	1.94%	33.3%	50%	2.08%
Islington	1.54%	34.0%	50%	2.00%
Waltham Forest	0.97%	32.2%	50%	2.22%
Average	1.39%	32.8%	50%	2.15%

High Recycling Scenario

6.7. As stated above, the targets in this scenario are based on those set out in the FALP and the Mayor's Waste Strategies. [33,34,35] This scenario also aims to reflect possible changes in European waste policy which is showing increasing commitment to the resource efficiency agenda.[36] Indeed, the principle has already been enshrined in a number of documents, such as:

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[32] North London Waste Authority (2009) *North London Joint Waste Strategy*, February 2009, www.nlwa.gov.uk/docs/nlwa-general-documents-and-plans/north-london-joint-waste-strategy.pdf, p. 53

[33] Greater London Authority (2014) *The London Plan*, Date Accessed: 13th March 2014, Available at: www.london.gov.uk/priorities/planning/london-plan

[34] Mayor of London, Greater London Authority (2011) *London's Wasted Resource: The Mayor's Municipal Waste Management Strategy,* November 2011, www.london.gov.uk/priorities/environment/publications/the-mayors-waste-management-strategies

[35] Mayor of London, Greater London Authority (2011) *Making Business Sense of Waste: The Mayor's Business Waste Management Strategy,* November 2011, www.london.gov.uk/priorities/environment/publications/the-mayors-waste-management-strategies

[36] See for example: Let's Recycle (2014) *Potočnik: Resource Efficiency Key to EU's Success*, Date Published: 9 May 2014, Date Accessed: 12 May 2014, Available at:

1. The Roadmap to a Resource Efficient Europe including 2020 aspirational targets; [37]
2. The 7th Environmental Action Programme;[38]
3. The Raw Materials Initiative highlighting the importance of recycling to ensure safe access to raw materials;[39] and
4. The Report on the Thematic Strategy on Waste Prevention and Recycling summarising progress thus far, remaining challenges and proposals for the future.[40]

6.8. The above documents include a number of aspirations which the Commission is working to have enshrined in legislation as objective targets against which Member States' performance can be compared. Paragraph 40 of the recently published 7th Environmental Action Programme, for example, includes the following statement:

> *"Additional efforts are needed to reduce per capita waste generation and waste generation* in absolute terms. *Limiting* energy recovery to non-recyclable [41] materials, *phasing* out landfilling *of recyclable or*

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www.letsrecycle.com/news/latest-news/waste-management/environment-and-economy-are-linked-says-commissioner; and Let's Recycle (2014) *Higher Recycling Targets Package 'Out in June'*, Date Published: 9 May 2014, Date Accessed: 12 May 2014, Available at: www.letsrecycle.com/news/latest-news/waste-management/eu-higher-recycling-targets-out-in-june

[37] European Commission (2011) *Roadmap to a Resource Efficient Europe*, COM(2011) 571 final, http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm

[38] Decision of the European Parliament and of the Council (2013) Decision of the European Parliament and of the Council on a General Union Environment Action Programme to 2020 "Living Well, Within the Limits of our Planet", November 2013, http://ec.europa.eu/environment/newprg/

[39] Communication from the Commission to the European Parliament and the Council (2012) *The Raw Materials Initiative — Meeting Our Critical Needs for Growth and Jobs in Europe*, COM(2008) 699 final, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0699:FIN:en:PDF

[40] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (2011) *Report on the Thematic Strategy on the Prevention and Recycling of Waste*, SEC(2011) 70 final, http://ec.europa.eu/environment/waste/strategy.htm

[41] 'recycling' defined in Article 3.17 of Directive 2008/98/EC as *"any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations"*.

recoverable waste [42], *ensuring* high quality recycling *where the use of the recycled material will not lead to overall adverse environmental or human health impacts,* and *developing* markets for secondary raw materials *are also necessary to achieve resource efficiency objectives"*.[43]

Objectives such as this clearly lay out the Commission's intentions with respect to improving resouce efficency and the intention is that future policy will allows for the concrete realisation of these aspirations. However, it is still very uncertain as to what may come of these ambitions and how they may materialise as formal targets.

6.9. In line with the 'aspiration' enshrined within the FALP, this scenario also assumes that authorities continue to invest in their services to the extent that 60% recycling can be achieved by 2031/32 (an annual increase of 0.91% between 2020/21 and 2031/32 - Table 6-3).

[42] 'recovery' defined in Article 3.15 of Directive 2008/98/EC as *"any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy"*.

[43] Decision of the European Parliament and of the Council (2013) *Decision of the European Parliament and of the Council on a General Union Environment Action Programme to 2020 "Living Well, Within the Limits of our Planet",* November 2013, http://ec.europa.eu/environment/newprg/

Table 6-3: Percentage Year on Year Increase in Household Recycling Rates Required in Order to Achieve 50% Recycling by 2020/21

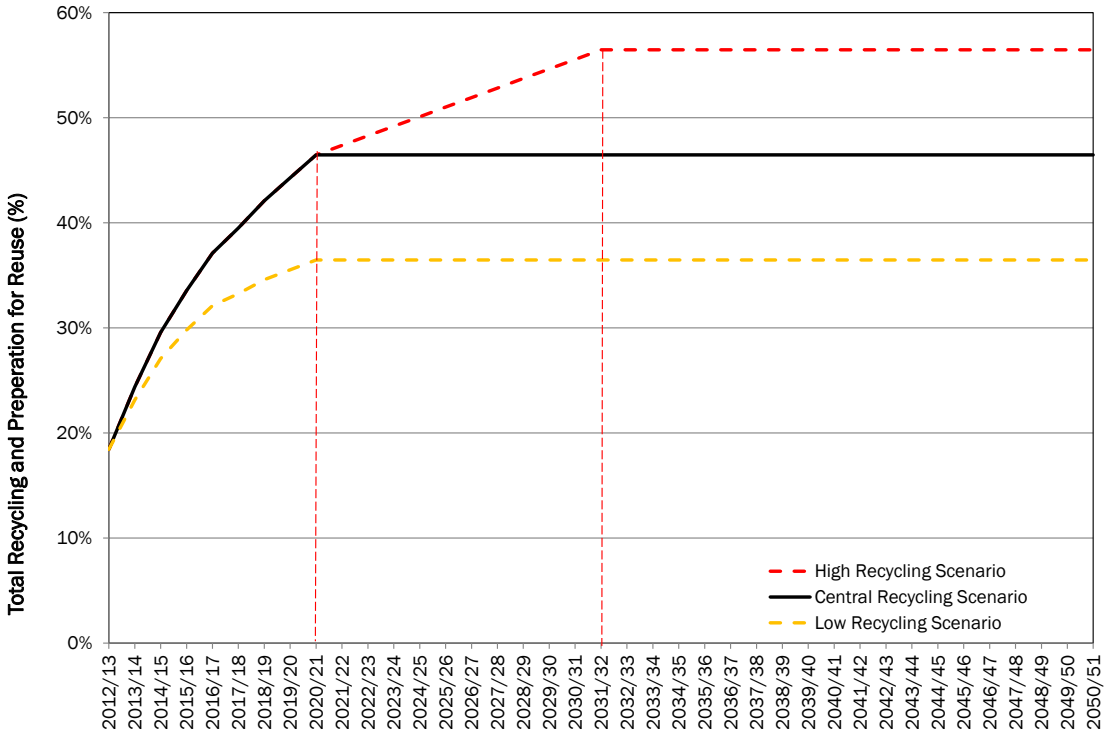
Borough	Annual Change in Recycling Rate - 2006/7 to 2012/13	Actual Household Recycling Rate in 2012/13	High Recycling Scenario Target for 2020/21	Yr on Yr Change in Recycling Rate (12/13-20/21)	High Recycling Scenario Target for 2031/32	Yr on Yr Change in Recycling Rate (20/21-31/32)
Barnet	0.70%	34.4%	50%	1.95%	60%	0.91%
Camden	0.83%	31.4%	50%	2.33%	60%	0.91%
Enfield	2.82%	40.5%	50%	1.19%	60%	0.91%
Hackney	0.93%	23.7%	50%	3.29%	60%	0.91%
Haringey	1.94%	33.3%	50%	2.08%	60%	0.91%
Islington	1.54%	34.0%	50%	2.00%	60%	0.91%
Waltham Forest	0.97%	32.2%	50%	2.22%	60%	0.91%
Average	1.39%	32.8%	50%	2.15%	60%	0.91%

C&I Waste

6.10. Unlike with household waste, the proportion of local authority collected C&I waste sent for recycling is not defined in the model by set targets. Instead, the modelling assumes that the improvements in the recycling of C&I waste will increase at the same rate as the recycling rate for household waste under the three scenarios. For example, under the Low Recycling Scenario, the recycling of household waste will have to increase by 1.12% per annum in Camden if the 40% target is to be achieved by 2020/21 (see Table 6-1). Under the Low Recycling Scenario for C&I waste it is assumed that recycling of this waste stream will also increase by 1.12% per year, based on a starting point of 2012/13. The same logic has been applied for the Central and High Scenarios.

6.11. The forecast recycling rates assumed for all local authority collected C&I waste is shown graphically in Figure 6-2.

Figure 6-2: Graphical Representation of Recycling Scenarios for Local Authority Collected C&I Waste



Note: the recycling rate in 2012/13 is the NLWA average for local authority collected C&I waste.

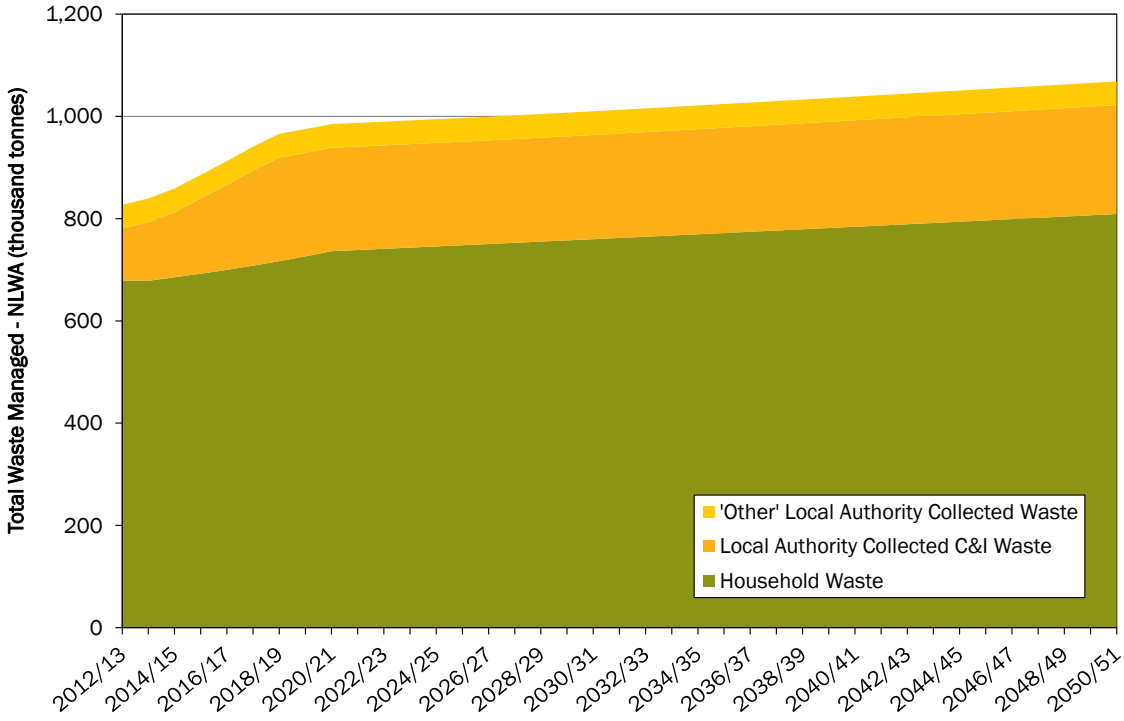
'Other' Waste

6.12. For the purpose of these projections it was assumed that none of the material included under the 'other' waste category would be separated out for recycling. Thus, zero percent recycling was assumed for the entire modelled period.

7.0 Results

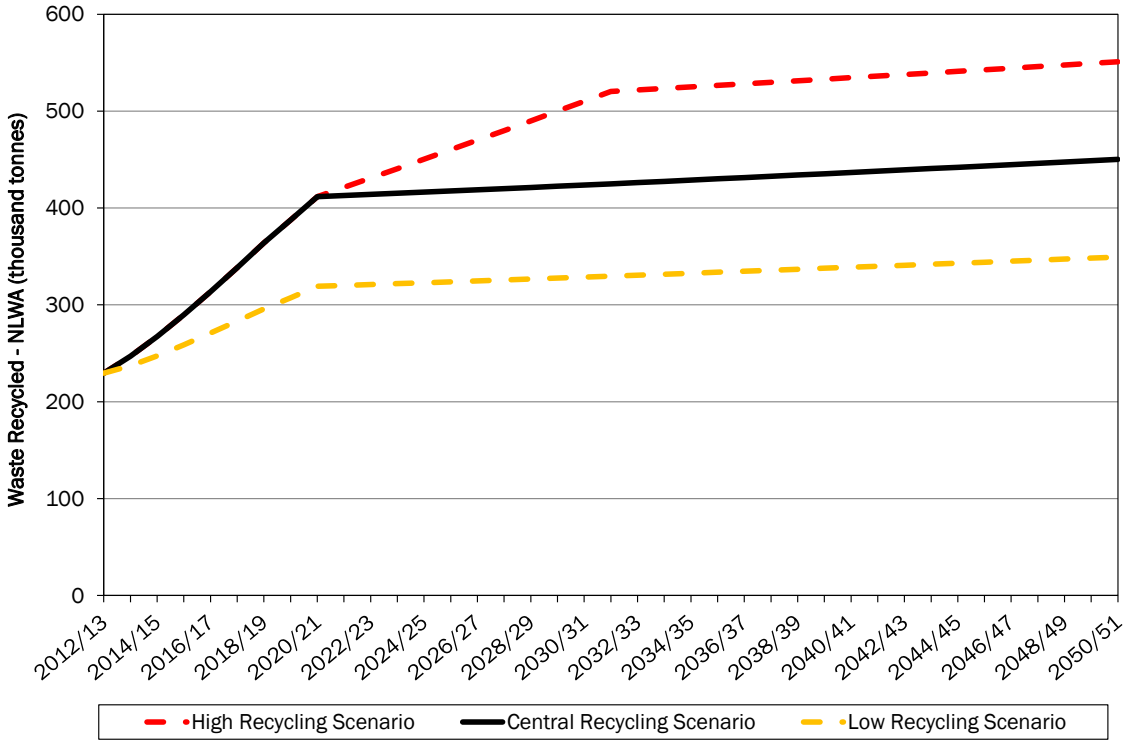
7.1. The projected amount of waste collected by Constituent Boroughs and requiring treatment or disposal by the NLWA is shown in Figure 7-1. From this it can be seen that household waste makes up by far the largest proportion of the total arisings, followed by local authority collected C&I waste, and finally a small quantity of 'other' waste. The combined total across NLWA rises from 827,000 tonnes in 2012/13 to 985,000 tonnes by 2020/21, and just over one million tonnes by 2050/51.

Figure 7-1: Projected Waste Arisings for NLWA (2012/13 – 2050/51, thousand tonnes)



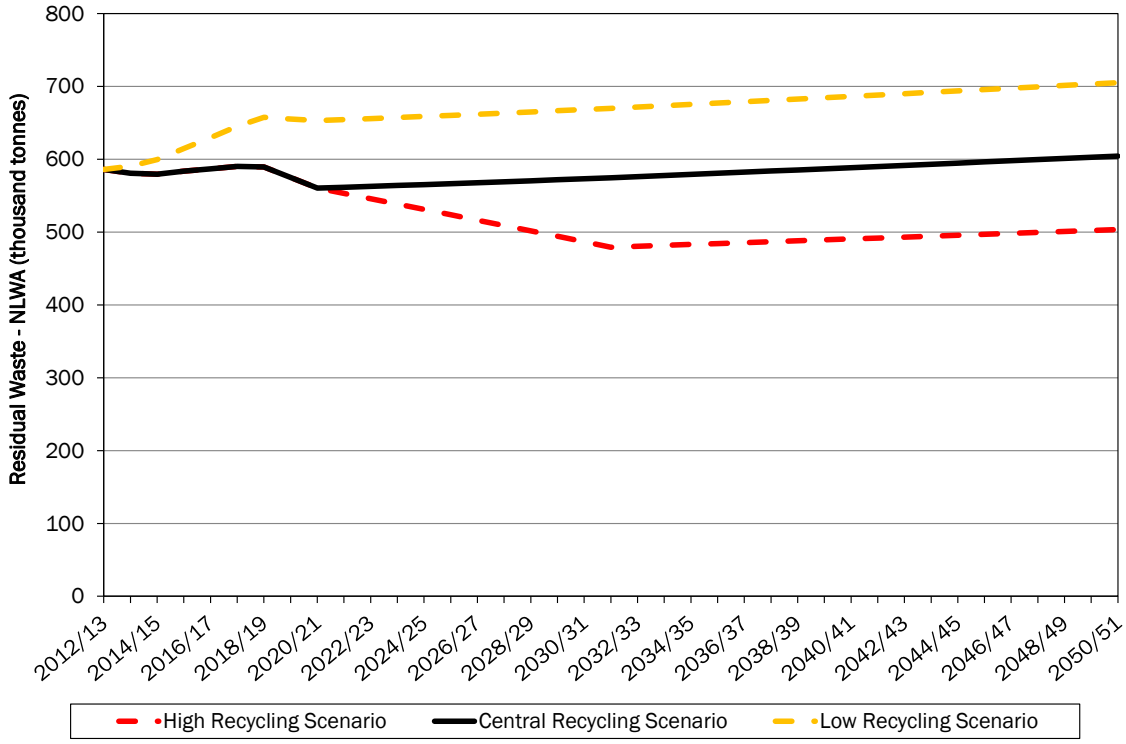
7.2. The total quantity of recycling is projected to be between 355,000 tonnes (Low Recycling Scenario) and 559,000 tonnes (High Recycling Scenario) by 2050/51 (Figure 7-2). Under the Central Recycling Scenario the quantity of recycling is expected to increase, from 230,000 tonnes in 2012/13 to over 400,000 tonnes by 2020/21. After this point tonnages will continue to gradually increase in line with increases in the total amount of waste arising.

Figure 7-2: Projected Quantity of Recycling under Three Recycling Scenarios (2012/13 – 2050/51, thousand tonnes)



7.3. The total quantity of residual waste is projected to be between 713,000 tonnes (Low Recycling Scenario) and 509,000 tonnes (High Recycling Scenario) by 2050/51 (Figure 7-3). Under the Central Recycling Scenario the quantity of residual waste is expected to increase to approximately 611,000 tonnes by 2050/51.

Figure 7-3: Projected Quantity of Residual Waste under Three Recycling Scenarios (2012/13 – 2050/51, thousand tonnes)



7.4. The results for the three recycling scenarios are summarised in Table 7-1 to Table 7-3 below.

Table 7-1: Quantity of Recycling and Residual Waste Arising under the Low Recycling Scenario (thousand tonnes)

Year	2012/13	2020/21	2036/37	2050/51
Recycling	230	324	340	355
Residual	598	661	687	713
Total	827	985	1,027	1,068

Table 7-2: Quantity of Recycling and Residual Waste Arising under the Central Recycling Scenario (thousand tonnes)

Year	2012/13	2020/21	2036/37	2050/51
Recycling	230	418	438	457
Residual	598	568	589	611
Total	827	986	1,027	1,068

Table 7-3: Quantity of Recycling and Residual Waste Arising under the High Recycling Scenario (thousand tonnes)

Year	2012/13	2020/21	2036/37	2050/51
Recycling	230	418	536	559
Residual	598	567	491	509
Total	827	985	1,027	1,068

APPENDICES

A.1.0 Household Waste Regression Analysis Methodology

1.1. As part of earlier work carried out by Eunomia, multi-criteria regression analysis was used to determine the factors analysed that, in combination, have the strongest association to the level of household waste that arise in any given year. This work identified Gross Disposable Household Income (GDHI), a time variable, and an 'indicator' variable as having a statistically significant correlation with household waste arisings in London. This work builds on this earlier work and has rerun the analysis using the most recent data available for both the dependent and independent variables.

1.2. The most basic regression model is simple linear regression, for which we assume that the relationship between our variables *x* and *y* is linear:

$$y = ax + b$$

where a, the slope of the regression line, is calculated given a number of data points. In this case, the correlation coefficient can be used as a 'goodness-of-fit' indicator for regression lines. The hypothesis test is thus essentially the same as the test for the significance of correlations. The starting hypothesis is that there is no trend, i.e. $y = 0$. If the p-value of the result (which indicates the probability that the test result is at least as extreme as the result actually observed) is less than the significance threshold, then we reject this hypothesis and say the slope of the line, or the trend in the data, is statistically significant.

1.3. In the case of multiple independent variables, say x_1 and x_2, we assume that the relationship between our variables is:

$$y = a_1 x_1 + a_2 x_2 + b$$

The relationship between y and each of the independent variables is tested separately, and a p-value is calculated for each slope (in this example for both a_1 and a_2). Statistically significant relationships between pairs of variables will again have a p-value of less than 5%. Combinations of variables where the p-values for all independent variables are all less

than 5% represent a combination that is highly related to the levels of waste produced.

1.4. As part of this work a 'time variable' (1, 2, 3, 4, 5, etc.) was included alongside GDHI in the analysis. The time variable was used to test for a change over time that may be present but would otherwise have no associated data, e.g. the on-going effect of waste prevention measures or public awareness/education over time.

1.5. The linear relationship between the logarithms of each variable was also tested, and eventually used in the forecasting model. In the equation above, instead of testing a linear relationship – in the form of $y = ax + b$ - Eunomia tested:

$$\log y = a \times \log(x) + b$$

This form of a relationship is common in econometric analysis.[44] The difference between this and the standard linear regression discussed above is that the coefficient a represents the percentage change in y that can be expected from a percentage change in x, rather than simply the unit change in y that can be expected from a unit change in x.

1.6. In choosing which variables should be included in a regression analysis, the potential for overlap between variables had to be taken into account to ensure certain areas were not being taken into consideration more than once through indirect paths, as this would result in the impacts being 'double-counted'. The selection of the independent variables used in our analysis here has therefore been careful to ensure that there is no overlap.

1.7. The historic data used for each of the independent variables is summarised in Table A-1. These data were used to run the regression

[44] Annex IV of Copenhagen Resource Institute, umweltbundesamt and Technical University of Denmark (2011) *Projections of Municipal Waste Management and Greenhouse Gases: ETC/SCP Working Paper 4/2011*, Report for European Environment Agency, August 2011

analysis and formed the basis for the forward projections. Although data for household waste arisings is available for the year 2012/13, the current GDHI data provided by the Office for National Statistics only goes up to 2011, and thus this date forms the cut-off point for the analysis.[45]

Table A-1: Comparison of Modelled Total Household Arisings Based on Regression Analysis with Actuals

Year	Dependent Variable	Independent Variables		
	Historic Household Waste Arisings in London (Million Tonnes)	GDHI in London (Log)	Time Variable (Years)	Dummy Variable
1997/98	14.97	11.65	1997	0
1998/99	14.99	11.70	1998	0
1999/00	15.04	11.73	1999	0
2000/01	15.04	11.80	2000	0
2001/02	15.04	11.84	2001	0
2002/03	15.03	11.83	2002	0
2003/04	15.02	11.86	2003	0
2004/05	15.01	11.88	2004	0
2005/06	15.02	11.90	2005	0
2006/07	15.04	11.94	2006	0
2007/08	15.02	11.97	2007	0
2008/09	14.95	11.98	2008	1
2009/10	14.93	12.00	2009	1
2010/11	14.92	12.00	2010	1
2011/12	14.91	12.02	2011	1

Results

1.8. The statistical results of the regression analysis between historic waste arisings, GDHI[46], a time variable and the 'indicator' variable are shown in Figure A-1.

[45] Office for National Statistics (2013) *Regional Household Income*, Spring 2013, Accessed: 8th May 2014, www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-298694

[46] Per calendar year in real terms adjusted with GDP deflator at market prices (ONS)

Figure A-1: Regression Analysis Results

Y Variable: Log of total household waste arisings in London

X Variable 1: Log of London GDHI

X Variable 2: Time variable (years)

X Variable 3: 'Indicator' variable (0 to 1)

Regression Statistics	
Multiple R	0.961378916
R Square	0.92424942
Adjusted R Square	0.903590171
Standard Error	0.014588009
Observations	15

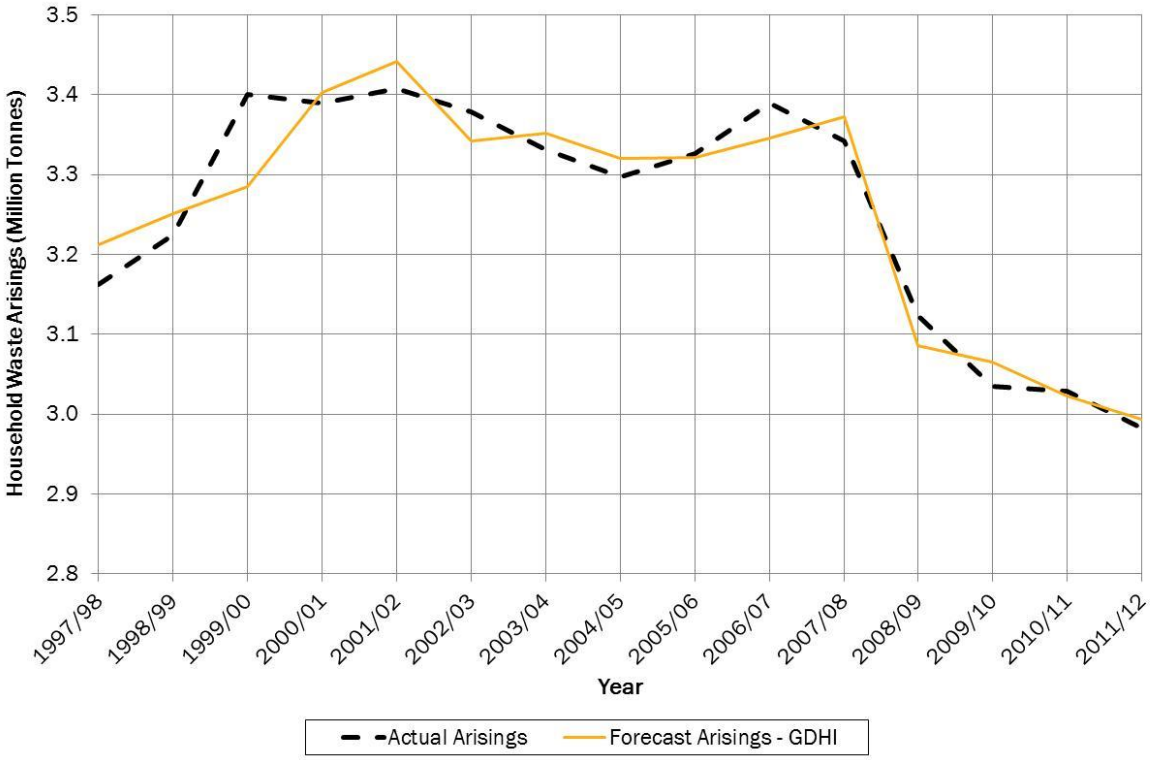
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0.028561955	0.009520652	44.73780309	1.87413E-06
Residual	11	0.00234091	0.00021281		
Total	14	0.030902865			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	45.64746688	8.747795039	5.218168313	0.000286316	26.39369981	64.90123394	26.39369981	64.90123394
GDHI	0.779703285	0.184083283	4.235600726	0.00139918	0.374538712	1.184867859	0.374538712	1.184867859
Time	-0.019905678	0.005413672	-3.676927405	0.003645305	-0.03182109	-0.007990267	-0.03182109	-0.007990267
Dummy	-0.07504434	0.015386993	-4.877128491	0.000489116	-0.108910883	-0.041177798	-0.108910883	-0.041177798

1.9. The historic household waste arisings in London are compared to the modelled arisings using the regression equation in Figure A-2. From this it can be seen that in most years there is a good fit between actual and modelled waste arisings (R2 value is 92% - see Figure A-1).

Figure A-2: Comparison of Modelled and Actual Total Household Waste Arisings for London (Million Tonnes)



1.10. For projecting forward total household waste arisings in London the values in Table 3-3 were used. Figure A-3 shows the projected household waste arisings for London for the period 2012/13 to 2050/51 based on the assumptions set out in this table. The growth rate in London's household waste arisings was assumed to apply equally to each of the Constituent Boroughs. In practice, however, each borough is likely to see household waste arisings grow at slightly different rates. Given that the GDHI data is not available at the borough level it is not possible to go into such detail using the current approach.

Figure A-3: Forecast of London's Total Household Arisings Based on Regression Analysis