Appendix 1 Assessment of Environmental Objectives

CONTENTS

INTRODUCTION

This Appendix presents the results of the assessment of Environmental Objectives of a number of waste management scenarios for the Municipality identified in the Case Study. Five scenarios were assessed (detailed in Chaper 3), including a base case representing a continuation of the existing situation. The base case serves to provide a reference point against which the performance of the other options can be compared.

The assessment (of some of the environmental objective indicators) has included a life-cycle analysis using the Environment Agency's WISARD model - Waste-Integrated Systems Assessment for Recovery and Disposal (WISARD). The model evaluates the environmental burdens of waste management operations and can compare one option against another. Additionally, for indicators such as 'extent of odour and dust problems' a subjective assessment based on professional judgement has been made. Section 1 of this Appendix details the assessment of indicators using the WISARD tool whilst Section 2 details the assessment of the remaining subjective indicators.

1. WISARD ASSESSMENT OF WASTE MANAGEMENT SCENARIOS

METHODOLOGY

The waste mass flows for each of the scenarios together with the assumed compositional data (both detailed in Chapter 4) have been used to derive the input data for WISARD – essentially the tonnages that describe the various waste streams and their collection, treatment and disposal routes.

WISARD utilises the 'avoided burden' methodology for determining environmental burdens. Credits are allocated to those processes that recycle waste - by calculating the virgin materials and energy that would have been required to produce products if the recycling process had not been undertaken. Credits are also assigned to options producing energy e.g. energy from waste or landfill gas, as they avoid the production of electricity from fossil fuel sources. This difference, in energy and/or material utilisation, is the 'avoided burden'.

ENVIRONMENTAL BURDENS

Waste management functions will give rise to various environmental burdens. For the purposes of this environmental assessment, the WISARD analysis of five key impacts typically found to be significant as a result of waste management processes are reported. These are:

- climate change
- air acidification
- ground level ozone formation
- eutrophication of water
- depletion of non-renewable resources.

In addition, a Human Toxicity assessment is also reported providing a measure of the potential (of net toxic emissions to the environment) to cause harm to human health.

WISARD contains a number of assessment methodologies for aggregating the emissions that contribute to these environmental burdens and expressing the total amount as an equivalent quantity of a particular pollutant. The assessment methodologies used by WISARD are summarised in Table A1.1 and briefly discussed below.

Table A1.1: Environmental Burden Assessment Methodologies

Impact	Assessment methodology	Equivalence unit
Climate change	IPCC (Intergovernmental Panel on Climate Change) greenhouse gas – direct effect 100 year	weight of CO_2 equivalent
Air acidification	CML (Centre of Environmental Science) – atmospheric acidification	weight of hydrogen ions H^+ equivalent
Ground level ozone formation	WMO (World Meteorological Office) Photochemical Oxidant Creation Potential (POCP) (average)	weight of ethylene equivalent
Eutrophication	CML (Centre of Environmental Science) – eutrophication (water)	weight of phosphate (PO_4) equivalent
Depletion of non renewable resources	E_B (yr)	index expressed as 1/year

Climate change

There is now an international consensus that emissions of greenhouse gases are responsible for 'global warming' or 'climate change'. Global warming could lead to substantial changes in global temperatures, weather patterns and sea levels, with subsequent effects in a diverse number of areas, e.g. agriculture, water resources, human health, natural ecosystems.

The main sources of greenhouse gases from a waste management perspective are methane (CH_4) emissions from landfill sites and carbon dioxide (CO_2) from the combustion of fossil fuels. Fossil fuels include; vehicle fuels (e.g. diesel in the operation of refuse vehicles), power station fuel sources to produce electricity used at waste treatment facilities and the combustion of fossil fuel originated material, such as plastics, in EfW plants. CO_2 emissions from the combustion or degradation of 'organic' material such as putrescibles and paper are not considered to contribute to climate change, as they are carbon neutral – they release carbon that was originally sequestered from the air.

Waste management options that produce energy (e.g. EfW plant and/or beneficial use of landfill gas) will assist in reducing greenhouse gas emissions by decreasing the amount of fossil fuels required to produce the equivalent quantity of electricity; in WISARD – the displaced power generation capacity is from coal fired plant. Recycling has a similar effect in that it often saves energy in the production of raw materials.

Atmospheric acidification

Emission of acid gases into the air can have a number of environmental impacts at a local to regional level, including effects on human health, sensitive ecosystems, soiling and deterioration of building facades, forest decline and acidification of lakes. The main acid gases arising from waste management operations are sulphur dioxide (SO_2), nitrogen oxides (NO_X) and hydrogen chloride (HCl). NO_X is emitted whenever fuels are burnt, and the main source of SO_2 is combustion of coal and oil. HCl is mainly emitted from EfW plant. Overall, there are possibilities for reducing emissions wherever energy is recovered from waste treatment facilities (e.g. EfW plant), or saved through recycling.

Ground level ozone formation

Ozone at ground level (tropospheric ozone) is formed by reactions between NO_X and hydrocarbons or volatile organic compounds (VOCs). The chemical reactions involved are complex and depend on climatic conditions and relative concentrations of NO_x and VOCs**.** It is therefore difficult to estimate the magnitude of this impact very accurately from total emissions of VOCs and the results should be interpreted with caution. Landfills are one of the main sources of VOCs that are present as trace elements in landfill gas. Ozone is highly reactive and is known to affect human health, crops, forests and some materials such as natural rubbers.

Eutrophication of water

The release of compounds containing the nutritive elements nitrogen or phosphorus or organic matter, can lead to eutrophication of lakes, and in some cases rivers and coastal marine waters. The accumulation of nutritive elements in the water leads to the growth of particular types of algae, resulting in a subsequent depletion of oxygen in the water, and a change in species living in the water (e.g. disappearance of fish such as trout). Leachate from landfills is the main source of such compounds in waste management.

Depletion of non-renewable resources

The world contains limited resources of both minerals and fossil fuels (i.e. coal, oil and gas), and the depletion of such resources is important when assessing the sustainability of any particular option. Some waste management options produce energy (electricity) that is assumed would otherwise be generated from coal fired power stations, so the consumption of coal is avoided. As a further example, recycling of plastics conserves the most oil because the recycling process uses oil in the plastics and therefore avoids the consumption that would be used in the manufacture of products from virgin materials.

INPUT DATA

Tables A1.2 – A1.5 show, for each scenario, the compositional data for each type of waste stream entered into the WISARD model. The projected tonnage data refer to year 2010, the baseline year chosen for the environmental assessment.

Table A1.2: Scenario A

Fraction	Bring	Kerbside dry	Kerbside Organic	CAS Recycled	Residual
Paper	1085	12205	0	1015.5	31789
Plastic Film	0	0	0	0	8276
Plastic Dense	0	1744	0	0	7449
Textiles	68	0	0	0	6400
Misc. Combustible	0	0	0	2504.9	34718
Misc. n-combustible	0	0	0	0	10394
Glass	2239	1744	0	203.1	4247
Putrescible	0	0	0	12000	34953
Fe	34	1395	0	2708	8956
nFe	0	349	0	338.5	1649
Fines (<10mm)	0	0	0	0	20839
Total	**3426**	**17435**	**0**	**18770**	**169671**
Destination %					
MRF/Market	100	100		36	
Composting				64	
MBT/AD					
EfW					
LF					100

Table A1.3: Scenario B

Fraction	Bring	Kerbside dry	Kerbside Organic	CAS Recycled	Residual
Paper	1497	28446	0	1944	14619
Plastic Film	0	0	0	0	8276
Plastic Dense	0	4064	0	0	5128
Textiles	97	0	0	0	6400
Misc. Combustible	0	0	0	4795.2	32428
Misc. n-combustible	0	0	0	0	10394
Glass	3188	4064	0	388.8	1741
Putrescible	0	0	21928	14460	10565
Fe	48	3251	0	5184	4624
nFe	0	813	0	648	876
Fines (<10mm)	0	0	0	0	20839
Total	**4830**	**40637**	**21928**	**27420**	**115891**
Destination %					
MRF/Market	100	100		47	
Composting			100	53	
MBT/AD					
EfW					90
LF					10

Table A1.4: Scenario C/C1

Fraction	Bring	Kerbside dry	Kerbside Organic	CAS Recycled	Residual
Paper	1497	28446	0	1944	14619
Plastic Film	0	0	0	0	8276
Plastic Dense	0	4064	0	0	5128
Textiles	97	0	0	0	6400
Misc. Combustible	0	0	0	4795.2	32428
Misc. n-combustible	0	0	0	0	10394
Glass	3188	4064	0	388.8	1741
Putrescible	0	0	21928	14460	10565
Fe	48	3251	0	5184	4624
nFe	0	813	0	648	876
Fines (<10mm)	0	0	0	0	20839
Total	**4830**	**40637**	**21928**	**27420**	**115891**
Destination %					
MRF/Market	100	100		47	
Composting			100	53	
MBT/AD					90
EfW					
LF					10

Table A1.5: Scenario D

Fraction	Bring	Kerbside dry	Kerbside Organic	CAS Recycled	Residual
Paper	1355	18885	0	1405.5	24719
Plastic Film	0	0	0	0	8276
Plastic Dense	0	2698	0	0	6494
Textiles	87	0	0	0	6400
Misc. Combustible	0	0	0	3466.9	33756
Misc. n-combustible	0	0	0	0	10394
Glass	2884	2698	0	281.1	3214
Putrescible	0	0	13326	13100	20527
Fe	44	2158	0	3748	7152
nFe	0	540	0	468.5	1329
Fines (<10mm)	0	0	0	0	20839
Total	**4370**	**26979**	**13326**	**22470**	**143101**
Destination %					
MRF/Market	100	100		42	
Composting			100	58	
MBT/AD					
EfW					90
LF					10

RESULTS

The results of the WISARD analysis for each scenario, under each of the five main impacts investigated, are presented below.

Climate Change

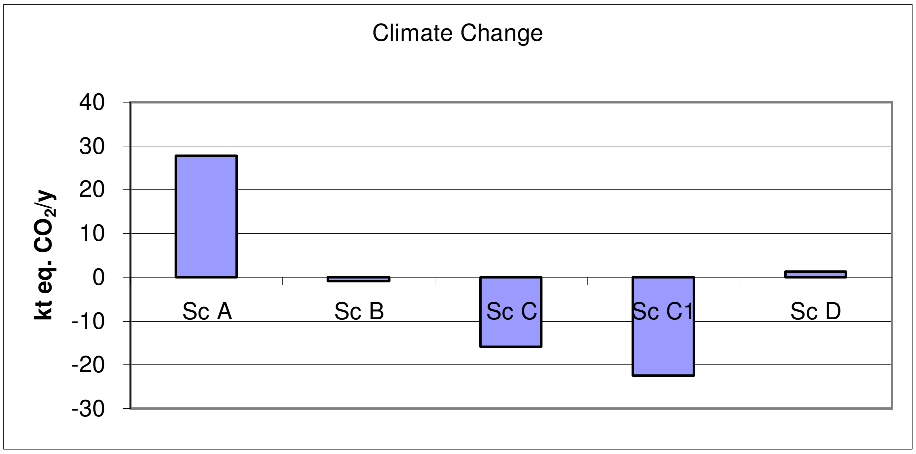

Figure A1.1: Climate Change

Main trend

Compared to the basecase (Scenario A) there is a decrease in greenhouse gas emissions as various combinations of recycling and treatment facilities are introduced – diverting waste away from landfill.

Explanation

CH_4 and CO_2 are the two major contributors to climate change, although N_2O also has an impact. Landfill is by far the biggest influence on CH_4 emissions and for all scenarios the climate change effect is related to the amount and type of waste diverted from landfill.

For Scenarios B and D, the savings from recycling are offset by emissions from energy from waste. This is because after removal of paper for recycling and putrescibles for composting, the residual waste is enriched in fossil carbon (plastics, textiles). Plastics and textiles have a high carbon density relative to their energy content, and when burnt in a municipal waste incinerator (which has relatively low electricity generation efficiency compared to a power station) the emissions of CO_2 exceed savings of CO_2 from displacement of fossil fuels due to energy recovery. Scenario D has less contribution from energy from waste although there is a higher volume of material to burn, because the material is enriched in paper and putrescibles compared to B. If more plastic and textiles were recycled, the large disbenefit from energy from waste would reduce substantially.

For Scenario C, savings from recycling are offset by large emissions from landfill of residue. The emissions from landfill are significant because a large amount of biodegradable material is rejected from the pre-treatment process.

For C1, there are much smaller emissions from energy from waste than for scenario B, as the residual waste is enriched in miscellaneous combustible material (largely biological or inert). Also there is less material going to EfW in total.

Air Acidification

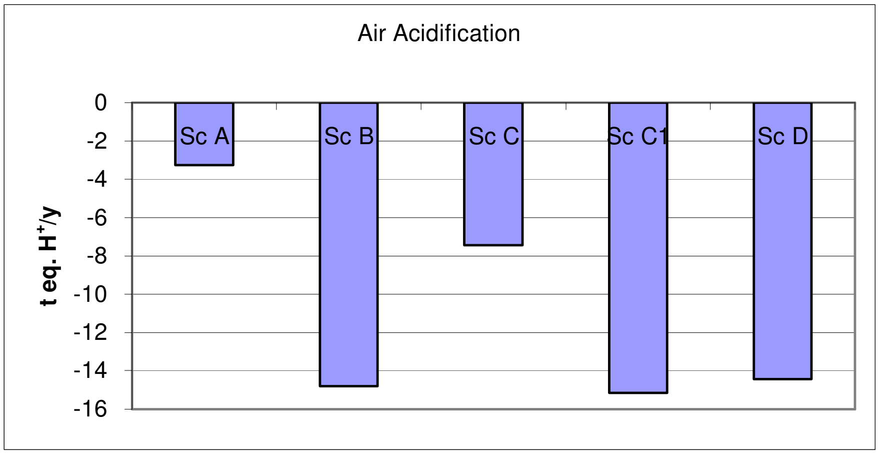

Figure A1.2: Air Acidification

Main trend

All of the scenarios show a positive benefit i.e. a net reduction in emissions of acid gases related to the magnitude of energy generation.

Explanation

Air acidification potential is largely dependent on the emissions of SO_X. SO_X is produced during the combustion of fossil fuels and waste. Burning of sulphur rich fuel to generate electricity is the major contributor to acid gas production. With the application of EfW treatment systems (AD, EfWI, and RDF combustion) there is a consequent reduction in electricity generated from fossil fuel sources, and hence emissions. Energy savings through recycling also make a contribution to reducing air acidification. In Scenarios B, C1 and D the emissions benefits come roughly equally from recycling and energy recovery. In scenario C the benefit from energy recovery is relatively small.

NO_X emissions also play some part in air acidification and are generally increased with the inclusion of EfW plant. Transport, landfill and composting also contribute to the NO_X emissions, although these impacts tend to be much smaller. However, in all the scenarios, the negative impacts of NO_X emissions are offset by the overall avoided SO_2 emissions.

Ground Level Ozone Formation

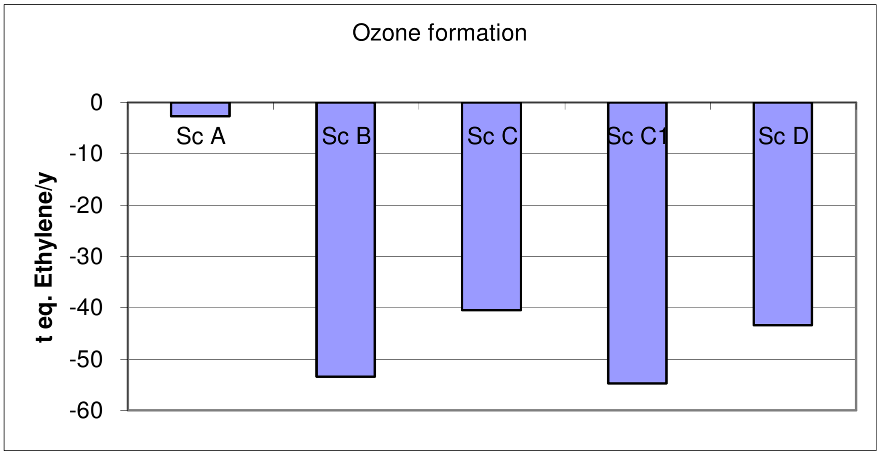

Figure A1.3: Ground Level Ozone Formation

Main Trend

Diversion of waste from landfill together with overall energy recovery has a beneficial effect and scenarios that deliver significant diversion from landfill show the most significant gains.

Explanation

Emissions of volatile organic compounds and hydrocarbons (methane) are the main contributors to ozone formation. Scenarios that divert waste from landfill avoid these releases. Energy recovery is also an important contributory factor and its influence is seen by comparing Scenarios C and C1 – whilst both include the same level of recycling Scenario C1 gains more due to its increased energy recovery element.

Water Eutrophication

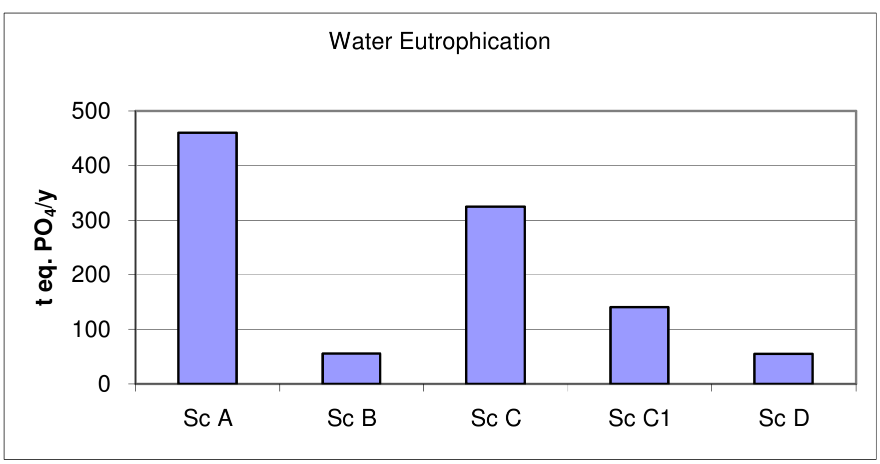

Figure A1.4: Water Eutrophication

Main Trend

All scenarios show an improvement for water eutrophication over the base case.

Explanation

The impact mainly arises from nutrients in the landfill leachate hence the improvements are directly related to the amount of biodegradable waste diverted from landfill – the greater the diversion the greater the gain.

Depletion of Non-renewable Resources

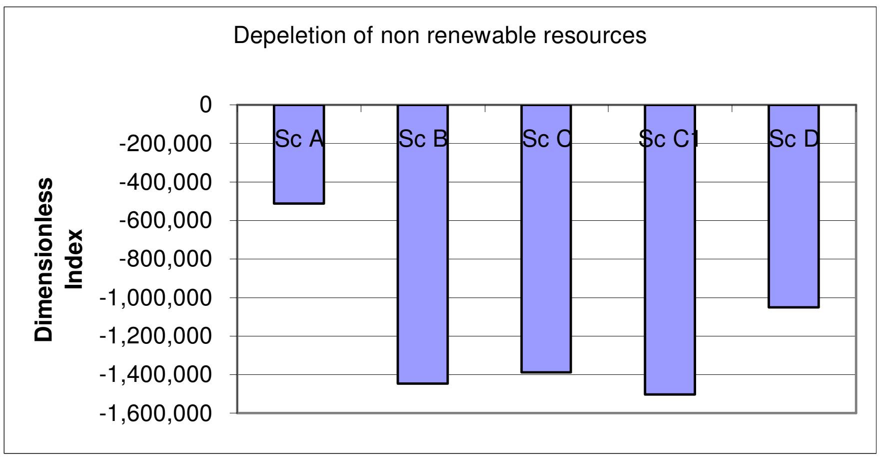

Figure A1.5: Depletion of Non-renewable Resources

Main Trend

Scenarios recovering energy and/or minimising use of fossil derived energy show a net gain or improved performance.

Explanation

Energy production is a large consumer of non-renewable resources (oil, coal and gas). Savings gained through recycling of materials and energy recovery from waste have a positive influence on reducing this impact. Scenarios B, C and C1 perform better than D largely due to the higher recycling rates achieved by these Scenarios.

Human Toxicity

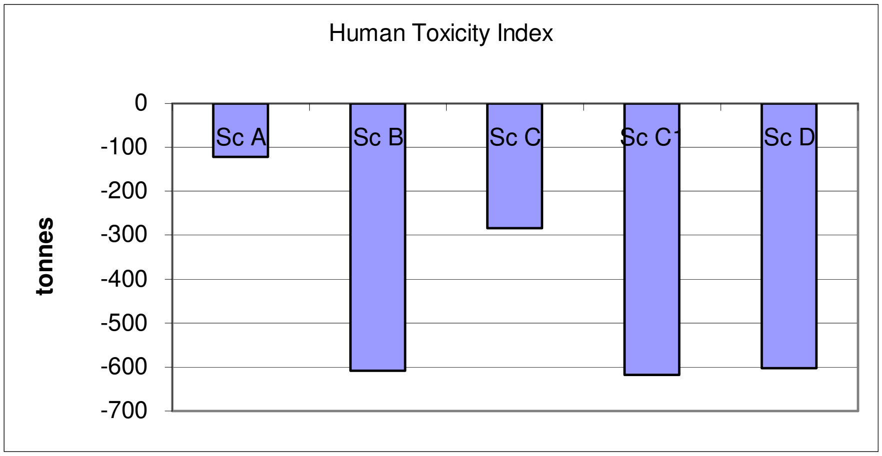

Figure A.1.6: Human Toxicity Index

WISARD reports a Human Toxicity Index (HTI) which is a product of two factors – an exposure factor (emission of toxic substance) and an effects factor (toxicological classification – assuming uniform distribution and exposure of the general population). The product of these two factors, for each emission determined, is summed up for all media and reported as the index.

Figure A1.6 shows the HTI for all scenarios. High diversion from landfill and positive energy impacts contributes to a lowering of the HTI i.e. improved performance. The higher diversion from landfill of Scenarios B, C1 and D lead to improved performance compared to Scenarios A and C.

SUMMARY OF WISARD ASSESSMENT

Table A1.6 collates the output of the WISARD assessment for the relevant environmental objective indicators.

Table A1.6: Output of WISARD Assessment

Objectives	Indicators	Scenario				
		A	B	C	C1	D
1. To ensure prudent use of land and other resources	Resource depletion (avoided burden in million years)	-0.51	-1.45	-1.39	-1.50	-1.05
2. To reduce greenhouse gas emissions	Emissions of greenhouse gases (ktonnes equivalents of CO_2)	27.81	-0.83	-15.80	-22.40	1.37
3. To minimise air quality impacts	Emissions which are injurious to human health (Human Toxicity Index - tonnes)	-121.10	-608.20	-284.80	-618.40	-603.00
	Air acidification (tonnes equivalents of H^+)	-3.26	-14.80	-7.46	-15.20	-14.40
	Ozone depletion (tonnes equivalents of CFC-11)	-2.72	-53.40	-40.50	-54.70	-43.30
6. To minimise adverse effects on water quality	Eutrophication (million grams equivalents of PO4)	460.22	56.57	324.40	141.40	55.24

2. ASSESSMENT OF ENVIRONMENTAL INDICATORS (NON WISARD)

This section provides an assessment of the performance of the options against environmental objectives that require the use of generic data or professional judgement, as opposed to a quantitative assessment tool such as WISARD.

For each objective and associated indicators, we outline:

- Why the issue is important for waste management, together with any relevant targets and contextual information.
- How performance was assessed.
- The performance of the options against the indicators.

TO ENSURE PRUDENT USE OF LAND AND OTHER RESOURCES

Landtake

A key sustainable development objective is to use finite natural resources (such as fossil fuels and land) more efficiently. The emphasis of government policy is to 'recycle' the use of land and buildings through brownfield site development and re-use of buildings. Some waste management options are more 'land hungry' than others. Long-term regional trends indicate the continuing loss of greenfield sites to built development.

Table A1.7 sets out the generic data used in assessing the five waste management options regarding landtake. These are based on examples within the UK and adapted according to the capacity of the facilities.

Table A1.7: Landtake

Facility type	Hectares
Materials Recovery Facility (MRF) – small (17.3)	0.5
Materials Recovery Facility (MRF) – medium (27)	0.8
Materials Recovery Facility (MRF) – large (40.6)	1.2
Open windrow composting plant (11.9 – 14.5)	1
In-Vessel composting plant – small (13.3)	0.5
In-Vessel composting plant – medium (21.9)	0.8
MBT (AD) option C (106.6)	5
MBT (AD/EfW) option C1 (106.6)	5.25
Energy From Waste Plant (EfW) – large (131.2)	2.5
Energy From Waste Plant (EfW) – medium (106.6)	2
Very high landfill (183) (majority non-inert)	7
Low landfill (41) (majority inert)	5
Very low landfill (26) (majority inert)	5
Medium landfill (65) (majority non-inert)	4
Medium landfill (57) (majority inert)	3
Civic amenity site (30)	0.06
Refuse transfer station (175.6)	1.25

NB. Figure in parenthesis denote annual throughput (ktonnes)

Applying these figures to each of the facility requirements within each Scenario allows determination of the total landtake – Table A1.8.

Table A1.8: Environmental Objectives - Landtake

Objectives	Indicators	Scenario				
		A	B	C	C1	D
1. To ensure prudent use of land and other resources	Landtake (hectares)	9.93	9.18	13.18	11.43	9.98

Performance is influenced by the requirement for high levels of landfill, as this method of treatment requires the most land (accepting that restoration can lead to beneficial afteruses); MBT plants also have relatively large footprints compared to other facility types. Scenario C performs least well (it requires approximately 13 hectares of land) because it includes an MBT plant and a medium level of landfill. Scenario C1 performs second worst (requiring approximately 11.5 hectares) due to the MBT facility and also the fact that it still has some reliance on landfill, albeit a low level. Scenario B performs best (requiring just over 9 hectares), followed by Scenario A (requiring nearly 10 hectares), and then D (similarly requiring nearly 10 ha).

TO MINIMISE AIR QUALITY IMPACTS

Extent of odour problems

Odour is a common cause of public concern in relation to waste management. Like dust, odours can be particularly acute where mechanical operations and storage of waste take place in the open. Odours are difficult and expensive to abate.

There are currently no UK statutory standards or limits appropriate for the assessment of deposited dust and odour and their propensity for causing a nuisance.

The following performance factors were assessed in determining the performance rating:

- type of waste
- throughput (000s tonnes per annum)
- whether operations are open or enclosed
- whether stored material is covered or uncovered, and
- vehicle movements on site.

A simple scoring system based on a scale of 1 to 5 was used to assess the impact – with 1 representing no impact (i.e. best) and 5 a significant impact (worst). Table A1.9 shows the score for each facility type.

Table A1.9: Odour impacts

Facility	Performance score
Materials Recovery Facility (MRF), In-Vessel composting – small scale	1
Materials Recovery Facility (MRF), In-Vessel composting – medium scale	2
Open windrow composting plant	3
MBT (AD)	1
MBT (AD/EfW)	1
Energy From Waste Energy from waste (EfWI)	1
Very high landfill (majority non-inert)	4
Low landfill (majority inert)	1
Very low landfill (majority inert)	1
Medium landfill (majority non-inert)	3
Medium landfill (majority inert)	2
Civic amenity site	2
Refuse transfer station	2

Applying these scores to each facility type within each scenario allows determination of the total score for odour impacts – Table A1.10.

Table A1.10: Environmental Objectives – Odour impacts

Objectives	Indicators	Scenario				
		A	B	C	C1	D
3. To minimise air quality impacts	Extent of odour problems	16.00	15.00	17.00	15.00	15.00

EfWI is typically a less odorous operation, whereas landfill and composting in particular are more odorous. All the options have open windrow composting and CA sites, so the odour impacts from these facilities is constant across the options. Scenarios B, D and C1 perform best (equally well). The odour impacts of Scenarios B, D and C1 are less, due to the fact that landfill in these options is primarily for inert waste which is far less odorous than active waste, and because they contain significant elements of EfW. Scenario A performs less well and Scenario C performs worst (although the actual degree of difference between these scenarios and the best performing is not very great). Scenario C performs poorly because it has a large MRF, a medium in-vessel composting plant and medium landfill taking active wastes, all of which cause odour to some degree. Scenario A performs poorly due to the high level of landfill of active waste.

Extent of dust problems

Dust is defined as small particles in the range 1-75 microns in diameter. Small particles of dust (PM10) are injurious to human health. However, it is the soiling of property that is the most common cause of complaint. A range of waste management processes potentially give rise to dust, particularly where mechanical operations and storage of waste take place in the open. Vehicle movements can also be a significant dust generator, both on and off site.

There are currently no UK statutory standards or limits appropriate for the assessment of deposited dust and its propensity for causing a nuisance.

The performance factors assessed in determining the dust impacts were the same as reported above for odours. The performance scores (scale of 1(best) to 5 (worst)) for each type of facility are given in Table A1.11.

Table A1.11: Dust impacts

Facility	Performance Score
Materials Recovery Facility	1
Open windrow composting plant	2
In-Vessel composting plant	1
MBT (AD)	1
MBT (AD/EfW)	1
Energy From Waste Plant	1
Very high landfill (majority non-inert)	4
Low landfill (majority inert)	3
Very low landfill (majority inert)	2
Medium landfill (majority non-inert)	3
Medium landfill (majority inert)	3
Civic amenity site	1
Refuse transfer station	1

Applying these scores to each facility type within each scenario allows determination of the total score for dust impacts – Table A1.12.

Table A1.12: Environmental Objectives – Dust impacts

Objectives	Indicators	Scenario				
		A	B	C	C1	D
3. To minimise air quality impacts	Extent of dust problems	11.00	11.00	11.00	10.00	11.00

However well-managed, all facilities have the potential to generate dust; although landfill and open windrow composting are the facilities that perform least well in terms of this objective. Scenarios A, B, C and D perform equally poorly on this objective, and Scenario C1 performs best (although again the difference is not very great). As noted above windrow composting is a treatment method common to all the options (as it is an existing facility). Therefore Scenario C1 performs best because it has a very low level of landfill.

TO CONSERVE LANDSCAPES AND TOWNSCAPES

Visual and landscape impacts

Landscapes and townscapes result from the interactions between the physical, biological and social components of our environment and have strong economic, social and community value. In recognition of their importance at local, regional and national scales, there are a number of protective designations, including National Parks, Areas of Outstanding Natural Beauty and local designations such as Areas of Great Landscape Value. To complement the protection that designations offer, the Government is keen to improve the quality of the whole countryside and of urban environments. Increased attention is also being placed on the importance of perceptual characteristics such as tranquillity, wildness and dark night skies.

All waste management options involve development components such as buildings, processing plant, access roads, lighting/signage, storage mounds and perimeter bunds. These can have landscape impacts (effects on the general landscape character and quality of the surrounding area) and visual impacts (including changes in available views, the effect of those changes on people and the overall impact on visual amenity). Whilst the extent of landscape and visual impacts is strongly influenced by the nature of the receiving environment, concern is likely to be greatest where options involve emissions stacks, large enclosed facilities or significant storage/ disposal of waste above ground level.

Although gradual change in landscapes and townscapes is inevitable, there has been a recorded decline in some highly valued landscapes over the last 30 years. Whilst there are no specific targets in the UK, there is a national policy commitment to ensuring that changes are well managed and do not cause unacceptable impacts on urban or countryside character.

The Municipality reported here is a fairly compact city contained by and integrating closely with its rural surroundings – from many parts of the city there are views to the adjacent rural areas. For example, woods or agricultural fields and hedgerows are skyline features containing many urban areas.

The following performance factors were assessed in determining the performance rating:

- Scale of built development
- High structures
- Impact on landscape/townscape character

The performance scores (scale of 1(best) to 5 (worst)) for each type of facility are given in Table A1.13.

Table A1.13: Landscape and townscape impacts

Facility	Performance Score
Materials Recovery Facility	2
Open windrow composting plant	1
In-Vessel composting plant	2
MBT (AD)	3
MBT (AD/EfW)	4
Energy From Waste Plant (EfWI)	5
Very high landfill (majority non-inert)	3
Low landfill (majority inert)	2
Very low landfill (majority inert)	2
Medium landfill (majority non-inert)	2
Medium landfill (majority inert)	2
Civic amenity site	2
Refuse transfer station	2

Applying these scores to each facility type within each scenario allows determination of the total score for landscape and townscape impacts – Table A1.14.

Table A1.14: Environmental Objectives – Landscape and Townscape

Objectives	Indicators	Scenario				
		A	B	C	C1	D
4. To conserve landscapes and townscapes	Visual and landscape impacts	14.00	18.00	16.00	17.00	18.00

All facilities have some impact on landscape/townscape character; EfWI plants have the most potential to affect landscape/townscape character (they involve larger structures and an emissions stack), followed by MBT plants and also large landfill sites. The scale of landscape/townscape impact will, of course, depend on the nature of the receiving environment as well as the facility type. These latter effects can be addressed through a specific siting study.

Scenario A performs best (quite significantly better than the other options) against this objective because overall it has the lowest number of facilities (7 compared to 8 in the other options) and it has few built facilities, and none that perform less well such as MBT or EfWI plants; the main potential for landscape/townscape impact for this option is from the very high landfill. Scenarios B and D perform the worst (equally poorly) due to the EfWI plants within these options. Scenario C performs second best, followed by Scenario C1. These Scenarios perform better due to the fact that MBT will have a slightly lesser impact on landscape/townscape character than EfWI.

To Protect Local Amenity

Living and working environments make an important contribution to 'quality of life'. In addition to attractive streets and buildings, access to green spaces, and community safety, low levels of noise and litter are important considerations. Very high levels of noise can cause physical damage to hearing and property, whilst lower levels of noise, and the existence of litter, can cause annoyance and stress. Although there is evidence to suggest that population exposure to different noise levels has not changed significantly in the last twenty to thirty years, noise complaints are increasing. This may be because people are becoming less tolerant to noise.

All waste management options generate noise and litter, as they involve the storage, treatment and transport of waste. However, litter is most likely to be of concern where the waste is stored or processed/deposited in the open. Noise is most likely to be of concern in relation to sites that operate outside standard working hours, or use particularly noisy unenclosed plant (e.g. screening/crushing machinery).

In 1990, over a quarter of the population in England and Wales were exposed to high noise levels outside their homes (over 60 dB) and five percent of the population were exposed to very high noise (over 70dB).

Extent of noise problems

The following performance factors were assessed in determining the performance rating for noise:

- noisy plant and machinery
- operating hours, and
- vehicle movements.

The performance scores (scale of 1(best) to 5 (worst)) for each type of facility are given in Table A1.15.

Table A1.15: Noise impacts

Facility	Performance Score
Materials Recovery Facility	1
Open windrow composting plant (11.9 – 14.5)	2
In-Vessel composting plant	1
MBT (AD)	2
MBT (AD/EfW)	2
Energy From Waste Plant (EfW) – large (131.2)	3
Energy From Waste Plant (EfW) – medium (106.6)	2
Very high landfill (majority non-inert)	3
Low landfill (majority inert)	2
Very low landfill (majority inert)	2
Medium landfill (majority non-inert)	2
Medium landfill (majority inert)	2
Civic amenity site	1
Refuse transfer station	2

Applying these scores to each facility type within each scenario allows determination of the total score for noise impacts – Table A1.16.

Table A1.16: Environmental Objectives – noise impacts

Objectives	Indicators	Scenario				
		A	B	C	C1	D
5. To protect local amenity	Extent of noise problems	11.00	11.00	11.00	11.00	12.00

All facilities have the potential to generate noise from traffic and machinery. Generally large energy from waste plants and large landfill sites are expected to have the greatest noise impacts (due to the number of vehicle movements and the presence of noisy plant and machinery). Scenarios A, B, C and C1 perform equally well against this indicator, whilst Scenario D performs slightly less well (large EfWI plant). The potentially poor performance of Scenario A, which includes high levels of landfill, is countered by the fact that overall this option has a lesser number of facilities than the other options.

Extent of litter and vermin problems

The following performance factors were assessed in determining the performance rating:

- throughput at each site
- open or enclosed operations
- covered or uncovered storage, and
- vehicle movements.

The performance scores (scale of 1(best) to 5 (worst)) for each type of facility are given in Table A1.17.

TableA1.17: Litter and vermin

Facility	Performance Score
Materials Recovery Facility (MRF) – small	1
Materials Recovery Facility (MRF) – medium	2
Open windrow composting plant	2
In-Vessel composting plant – small	1
MBT (AD)	1
MBT (AD/EfW)	1
Energy From Waste Plant (EFWI)	1
Very high landfill (majority non-inert)	4
Low landfill (majority inert)	2
Very low landfill (majority inert)	2
Medium landfill (majority non-inert)	3
Medium landfill (majority inert)	2
Civic amenity site	2
Refuse transfer station	2

Applying these scores to each facility type within each scenario allows determination of the total score for litter and vermin impacts – Table A1.18.

Table A1.18: Environmental Objectives – litter and vermin impacts

Objectives	Indicators	Scenario				
		A	B	C	C1	D
5. To protect local amenity	Extent of litter and vermin problems	15.00	14.00	15.00	14.00	14.00

It is assumed that however well managed, all waste management facilities have potential to generate problems. Landfill sites typically have greater potential due to the open operations and uncovered storage, and vermin problems are worse where the landfill accepts primarily active wastes. Other facilities, such as MRFs where there is some open storage also have potential to generate litter and vermin.

Overall, Scenarios B, C1 and D perform best (equally well), whilst Scenarios A and C perform worst (equally poorly, although they only perform marginally less well than the best options). Scenario A performs poorly due to the very high level of landfill of primarily active waste. Scenario C also performs poorly due to the high level of landfill of active wastes (although this is not nearly as high as in Scenario A). The large MRF in Scenario C also contributes to its slightly poorer performance.

TO MINIMISE LOCAL TRANSPORT IMPACTS

An efficient transport system is needed to support a strong and prosperous economy and to maintain and improve people's quality of life. However, congestion and unreliability of journeys add to the costs of business, and undermine competitiveness. Major traffic arteries cause 'severance' within a community when people become separated from places and other people and 'fear and intimidation' amongst pedestrians. Heavy levels of traffic also damage towns and cities and harms the countryside. All waste management options have local transport impacts as they involve some degree of off-site movement of waste.

A record of the total transport distance associated with the collection of waste for each scenario is reported as one of the outputs of the WASTEFLOW model – which takes in to account factors such as vehicle size, distance of collection rounds, distance to downstream delivery points and off-loading times. The results are presented in Table A1.19.

Table: A1.19: Environmental Objectives – Collection transport impacts

Objectives	Indicators	Scenario				
		A	B	C	C1	D
7. To minimise local transport impacts	Collection transport distance (thousand kilometres)	1755	2097	2097	2097	1664

Scenarios B, C and C1 record the greatest transport distances as they have the most intensive of kerbside collection systems. The basecase Scenario A includes a widespread two bin collection system – Scenario D builds on and improves on the efficiency of the existing collection system and this is reflected in the slightly lower transport distance recorded for Scenario D.