Material change for a better environment

Assessing the costs and benefits of reducing waste in construction

New build waste infrastructure – composting facility

	Value	Percentage of £3.2m construction cost
Cost saving potential	**£85,830**	**2.7%**
Additional costs to achieve these savings	**£16,100**	**0.5%**
TOTAL POTENTIAL COST SAVING	**£69,730**	**2.2%**

Introduction

Reducing, reusing and recycling waste can help to reduce costs on construction projects. By asking for good practice from an early stage in the design and planning process, clients and contractors can secure these savings and demonstrate corporate responsibility. Such action lies at the heart of corporate commitments in support of the sector target for halving waste to landfill.

This case study identifies, at a post-completion stage, the costs and benefits that might have been achieved through waste reduction and recovery in the construction of a major waste infrastructure project.

The project is a ~£3.2m new build composting facility. The facility has been constructed in part of an existing quarry, and consists of phase 1 and phase 2 composting buildings with a maturation hall attached to each building. All structures had a steel frame with steel roof. This analysis includes a bio-filter and water treatment facility, and the hardstanding, external paving and access roads. Some complex equipment for drainage and aeration has been excluded since it is not commonly wasted during construction.

Design potential

Significant savings can be made by targeting good practice wastage rates for the five components offering the biggest savings in the value of materials wasted.

	Value of materials wasted	Cost of waste disposal	Total cost of waste	Total cost of waste as % of construction value
Baseline practice	£54,814	£115,763	£170,577	5.34%
Good practice (all components)	£25,677	£48,408	£74,085	2.32%
Targeted practice (top opportunities)	£31,179	£53,568	£84,746	2.65%
Improvement over baseline	**£23,635**	**£62,195**	**£85,830**	**2.69%**

These cost savings will be shared across the supply chain. Clients and principal contractors can increase their share through the procurement process.

In addition to financial benefits, actions to be more resource efficient also deliver the following changes in environmental performance:

	Total waste arisings (t)	Waste sent to landfill (t)	Recovery rate	Carbon (t) [1]	Recycled content
Baseline	2,719	1,360	50%	333	24.91%
Good practice	1,438	290	80%	133	36.77%
Targeted practice (top opportunities)	1,640	327	80%	160	36.03%
Improvement over baseline	**1,079 (40%)**	**1,033 (76%)**	**30%**	**173 (52%)**	**11.12%**

Understanding the costs and benefits

WRAP's Net Waste Tool has been used to quantify the extent of the cost savings possible, and to select the top five opportunities. Waste reduction and recovery actions needed to deliver these targeted savings were then identified, and their implementation costs estimated. Costs and benefits are shown in the Tables below.

Achieving cost reductions (BENEFITS)	Baseline	Targeted practice	Improvement
Value of materials wasted Construction materials are a valuable resource, yet it is common to see high levels of waste through damage on site, off-cuts, over-ordering of materials and the need for rework. Reducing this waste saves money. Where a trade contractor supplies materials and labour for a lump sum fee, they are likely to retain savings from waste reduction unless the client or contractor takes specific actions through the procurement process.	**£58,814**	**£31,179**	**£23,635** *(0.7% of construction value)*
Cost of waste disposal Every skip or container of waste carries a cost. Whilst segregated metals are often removed at little or even zero charge, the majority of wastes carry substantial costs – and these are set to rise with the annual increase in Landfill Tax. However, waste disposal costs aren't fixed. Substantial savings are achievable simply by reducing the quantity of waste generated. In addition, the segregation of wastes and finding destinations other than landfill can help further. In this example, the total mass of waste has been reduced by 49%, and a five skip strategy has been chosen instead of a single skip strategy.	**£115,763**	**£53,568**	**£62,195** *(2.0% of construction value)* *(£46,783 saved through reduced waste arisings, and £15,412 saved through increased segregation)*
		Combined savings	**£85,830**

[1] Embodied carbon of wasted materials plus carbon impact of disposal route

These savings will only be achieved by taking specific management actions to change behaviour during design and site practice.

Investing to save (COSTS)[2]	Costs
Develop quality SWMP – Additional time beyond minimum legal compliance (England only) to develop plan with quality forecasts (including using the Net Waste Tool) and robust management actions.	**£1,640**
Develop site logistics strategy – Planning time required to establish how materials are to be delivered, stored and moved around the site	**£1,080**
Site training – Time to provide training, and site operatives' time to receive training (5nr ½hr briefings for 10 operatives per session)	**£1,530**
Materials storage – Nominal allowance for construction of hard standing and temporary shelter for materials (or cabin hire)	**£1,700**
Management time – Additional time required to ensure SWMP is adhered to, including materials handling, re-use of materials on site, efficient installation and waste segregation (2.5hrs per week for ¾ of the programme)	**£3,188**
Updating SWMP – The SWMP needs to be reviewed and updated throughout the project. This cost allows for a 4 hour review every 3 months.	**£1,133**
Site segregation – To ensure good segregation, this cost allows for a single individual to sort and move wastes and monitor the re-use of materials on site. (Included part-time for 50% of the programme as reduced demand during early packages.)	**£5,865**
Combined costs	**£16,136**

Sharing the costs and benefits

On paper there are possible savings of £85,830, but to achieve these savings an estimated £16,136 in costs must be incurred. This Section identifies how to achieve these benefits, who receives the benefits from these savings, and who pays for the improvements.

The benefits

A. Reduction in value of wasted materials

Potential saving £23,635

The following materials provide the largest cost reduction potential. The values below show the potential saving if wastage rates are improved from a Baseline to a Good practice[3] level.

	Baseline wastage rate (%)	Good practice wastage rate (%)	Potential saving
Flexible sheet DPM in substructure	**15**	**5**	**£8,832**
200mm thick sub-base gravel	**10**	**5.5**	**£4,918**
Steel reinforcement in foundations	**10**	**5**	**£3,474**
Perforated uPVC pipes	**10**	**5**	**£3,446**
Concrete in foundations, strength C30 or higher	**2**	**1**	**£2,965**

[2] These costs are based upon estimated durations, and have been reviewed with selected contractors.

[3] These wastage rates are based upon primary research carried out by Arup (on behalf of WRAP) with main contractors and sub contractors. Data were gathered on the likely level of waste at Baseline practice (the waste one would expect in normal working conditions) and at Good practice (the reduced level of waste if additional measures are put in place to prevent damage and install efficiently).

This list is dominated by low value, high quantity items (damp proof membrane, sub-base gravel and pipework). Steel reinforcement in foundations also provides a significant cost reduction potential as a high value and high quantity item. Focusing efforts on the high quantity materials listed above will ensure the cost of waste is reduced as low as possible.

Who saves?
Whoever takes the risk for the supply of materials will see these cost savings. This is normally the trade contractor, or the main contractor for bulk products such as aggregates. The extent of waste is rarely reconciled with the original order, meaning that trade contractors often do not know how much waste is costing. To convert this reduction in waste into a reduction in price (for the contractor or client), the trade contractor will need to:

- include a reduced wastage rate in their tender (for more competitive pricing on a lump sum tender); or
- procure fewer materials, therefore save money, and share this up the supply chain (open book tender).

B. Reduction in cost of waste disposal

Potential saving £62,195

A reduction in waste cuts the cost of waste disposal (by £46,783). In addition, several of the largest waste streams can be segregated. By segregating wastes, the value of these waste streams is increased, and therefore the cost of disposal is reduced (£15,412 saving).

On this project the following waste streams would ideally be segregated, and the breakdown of the wastes in each (by volume) is as follows. (In practice, the contractor would look for opportunities to reuse the inert materials on site, further reducing the cost of disposal.)

Inert	Metal	Timber	Mixed
1890m^3	14m^3	21m^3	8m^3

Who saves?
The main contractor would normally pay for waste disposal on the basis of volume (and type) of waste removed, therefore these savings would normally accrue to the main contractor. The client's ability to share in these savings is determined by the procurement route. Where a form of renegotiated or open book payment structure is used, there should be an opportunity to share in these cost savings.

The costs

Most of the costs required to reduce waste or increase recovery are borne by the contractor. These costs are divided into two parts: planning costs and management costs.

Planning for waste is a low cost / high impact activity, highlighting the big opportunities such that effort can be focused on these. For example, by planning you might identify that you need better material storage, hence the allowance of £1,700 for this.

During construction the **management** of wastes is important to ensure that the plan is delivered. This analysis includes an additional amount of management time to oversee the waste management process (including material deliveries, material storage, installation and waste disposal), plus an allowance for a dedicated operative to manage and monitor materials storage and waste segregation (£9,053).

Conclusion

By adopting good practice on the top five components, the main contractor will typically benefit from the reduction in the cost of waste disposal (£62.2k), and will also incur some costs (£16.1k for waste reduction and segregation) – providing a net saving.

To ensure that maximum benefit from good waste practices is realised (and shared), it is important for the client, the contractor and the trade contractor to work together to ensure that *the potential for waste reduction is built into wastage allowances for materials purchasing at the tender stage*, i.e. greater recycling is not enough in itself. For this project the potential reduction in value of materials wasted is £23.6k, which enhances the net savings. Therefore:

- clients need to instruct designers to look for waste reduction opportunities, plus set threshold waste reduction and recovery targets;
- designers need to look for opportunities to design out waste (such as simplification of the specification);
- contractors need to develop a quality SWMP and a materials logistics plan;
- trade contractors need to ensure that materials are not over ordered, and that the materials brought to site are used as efficiently as possible; and
- the waste management contractor must ensure that all wastes received are recycled wherever possible.

Methodology

This cost benefit analysis has been conducted using data taken from WRAP's Net Waste Tool. The Tool is freely accessible on the web at www.wrap.org.uk/nwtool, and helps project teams to forecast the waste that would be expected on different projects. The Tool works by setting up basic cost plan information to which baseline and good practice industry wastage rates are applied. The analysis identifies which components and specifications offer the greatest opportunities for waste reduction, and proposes a least cost segregation strategy. The Tool forecasts the overall quantities and costs of waste at baseline, good and user-targeted levels of performance, including the value of wasted materials and the cost of waste disposal.