Reducing waste in building and civil engineering projects

Guide to cost saving and client cost saving strategies

Guidance for construction clients and their advisers on how to encourage cost savings through waste reduction on their projects and share in these savings
WRAP helps individuals, businesses and local authorities to reduce waste and recycle more, making better use of resources and helping to tackle climate change.
1.0 Reducing the cost of waste in construction: guidance for construction clients

Waste is expensive and often under-estimated as a construction cost. This guidance identifies how projects can cut the costs of waste, and what actions you (as the client) can take to increase and share in these savings.

By taking action on waste, your projects can reduce costs in two ways:
- spending less on materials; and
- spending less on waste disposal.

**Spending less on materials**
Purchase costs can be cut by:
1. taking positive steps to reduce wastage allowances and achieve lower wastage rates on major components; and
2. reusing/reprocessing demolition, excavation and construction materials on site (in place of imported materials); using materials in-situ (e.g. following remediation); and purchasing recovered and/or recycled materials which are less expensive than primary products.

**Spending less on waste disposal**
Disposal costs can be cut by:
1. reducing the total amount of waste produced (e.g. through designing out waste, improving site storage of materials, off site construction, reuse of demolition and excavation materials on site etc); and
2. reducing the unit cost of disposal (e.g. by segregating out the most valuable / high cost waste streams).

Use the table below to access further guidance for building and infrastructure projects.

<table>
<thead>
<tr>
<th>Spending less on materials</th>
<th>Reduce wastage rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incorporate reused / recycled materials (on site reuse and imported materials)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spending less on waste disposal</th>
<th>Reduce total waste (in design and on site)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reduce unit cost of disposal</td>
</tr>
</tbody>
</table>

Use the following links to:
- learn how the client can share in these savings;
- identify where to focus efforts;
- find case study evidence on potential savings; and
- access WRAP’s free tools and resources to help quantify waste and cost savings.
WRAP (Waste & Resources Action Programme) has conducted studies into the potential for cost savings from taking action to reduce waste through design and on site. In addition, WRAP has published case studies on projects (buildings and civils) which demonstrate actual money savings. Clients, design teams and contractors can review these case studies to learn from good practice.

Cost savings from reducing wastage rates and segregating waste streams
WRAP has estimated for a range of building types the savings available if wastage rates on a few key materials are reduced from “typical” industry baseline practice to good practice rates (as identified by major contractors), and if waste is segregated on site rather than going off site in mixed waste skips. The calculations are made using the Net Waste Tool, which applies wastage rates to cost plan information. The analysis identifies which components and specifications offer the greatest opportunities for waste/cost saving, and proposes a least-cost segregation strategy. The results include both the value of materials that are wasted, and the cost of waste disposal. The analysis does not include further savings from more fundamental design changes at an earlier stage, or savings from reuse of demolition and excavation materials.

### 2.0 What are the cost savings?

WRAP has conducted studies into the potential for cost savings from taking action to reduce waste through design and on site. In addition, WRAP has published case studies on projects (buildings and civils) which demonstrate actual money savings. Clients, design teams and contractors can review these case studies to learn from good practice.

<table>
<thead>
<tr>
<th>Project construction value</th>
<th>Reduction in value of materials wasted (A)</th>
<th>Reduction in disposal cost (B)</th>
<th>Cost of implementation (C)</th>
<th>Net Benefit (A+B)−C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Housing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Houses (20, masonry construction)</td>
<td>7,600</td>
<td>9,200</td>
<td>10,700</td>
<td>6,100</td>
</tr>
<tr>
<td>Houses (20, timber-framed)</td>
<td>14,400</td>
<td>7,100</td>
<td>10,800</td>
<td>10,700</td>
</tr>
<tr>
<td>Residential block (concrete-framed)</td>
<td>26,200</td>
<td>6,100</td>
<td>19,700</td>
<td>8,600</td>
</tr>
<tr>
<td>Halls of residence (steel-framed)</td>
<td>57,800</td>
<td>18,600</td>
<td>24,300</td>
<td>52,100</td>
</tr>
<tr>
<td><strong>Commercial</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supermarket (steel-framed)</td>
<td>20,700</td>
<td>5,800</td>
<td>16,200</td>
<td>10,300</td>
</tr>
<tr>
<td>Distribution centre (steel-framed)</td>
<td>44,500</td>
<td>28,600</td>
<td>29,700</td>
<td>56,500</td>
</tr>
<tr>
<td>Office (concrete-framed)</td>
<td>101,700</td>
<td>24,100</td>
<td>29,700</td>
<td>96,100</td>
</tr>
<tr>
<td><strong>Public</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital (in-situ concrete-framed)</td>
<td>446,600</td>
<td>109,100</td>
<td>64,800</td>
<td>490,900</td>
</tr>
<tr>
<td>Secondary school (steel-framed)</td>
<td>125,900</td>
<td>34,700</td>
<td>28,900</td>
<td>131,700</td>
</tr>
<tr>
<td>Primary school (steel-framed)</td>
<td>8,200</td>
<td>2,700</td>
<td>8,400</td>
<td>2,500</td>
</tr>
<tr>
<td>Prison (pre-cast concrete-framed)</td>
<td>8,700</td>
<td>1,200</td>
<td>8,200</td>
<td>1,700</td>
</tr>
<tr>
<td><strong>Refurbishment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social housing refurbishment</td>
<td>3,300</td>
<td>10,300</td>
<td>6,300</td>
<td>7,300</td>
</tr>
<tr>
<td>Small office refurbishment (Cat A)</td>
<td>2,600</td>
<td>1,300</td>
<td>2,300</td>
<td>1,600</td>
</tr>
<tr>
<td>Large office refurbishment (Cat B)</td>
<td>12,700</td>
<td>4,400</td>
<td>5,900</td>
<td>11,200</td>
</tr>
<tr>
<td>Small retail refurbishment</td>
<td>7,300</td>
<td>4,800</td>
<td>8,700</td>
<td>3,400</td>
</tr>
</tbody>
</table>

For example, the quoted savings on the timber-framed house example are from the seven components where lower wastage has the biggest impact in reducing material purchase costs: brickwork, blockwork, plasterboard, insulation, roof tiles, ground slab and chipboard flooring.
The results indicate that projects can save 0.2% to 2% of construction value by reducing wastage and the cost of its disposal. These savings are stated after subtracting the costs of implementing good practice (such as additional planning, monitoring, training, materials storage etc). The case studies also illustrate the associated reductions in landfill and carbon emissions.

The following tables list the cost savings for various building types. For more examples, visit [www.wrap.org.uk/constructioncba](http://www.wrap.org.uk/constructioncba) or the sector-specific pages on WRAP’s web site.

### Cost savings from lower wastage rates and waste segregation in construction averaged across a number of project analyses

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Saving on cost of materials (A)</th>
<th>Reduction in disposal cost (B)</th>
<th>Total saving (A+B)</th>
<th>Cost of implementation (C)</th>
<th>Net Benefit (A+B)-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing</td>
<td>0.55</td>
<td>0.02</td>
<td>0.76</td>
<td>0.34</td>
<td>1.42</td>
</tr>
<tr>
<td>Commercial</td>
<td>0.44</td>
<td>0.16</td>
<td>0.06</td>
<td>0.17</td>
<td>0.43</td>
</tr>
<tr>
<td>Public</td>
<td>0.29</td>
<td>0.07</td>
<td>0.36</td>
<td>0.05</td>
<td>0.30</td>
</tr>
<tr>
<td>Refurbishment</td>
<td>0.24</td>
<td>0.44</td>
<td>0.68</td>
<td>0.34</td>
<td>0.34</td>
</tr>
</tbody>
</table>

### Summary of net cost savings on different trade packages (each £100k value) as a result of reducing wastage rates from baseline to good practice levels on a few major components

<table>
<thead>
<tr>
<th>Trade package</th>
<th>Construction value (£k)</th>
<th>Total saving (A) (£)</th>
<th>Cost of implementation (B) (£)</th>
<th>Net Benefit (A – B) (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick and block wall with insulation</td>
<td>100</td>
<td>8,430</td>
<td>1,060</td>
<td>7,370</td>
</tr>
<tr>
<td>Flooring</td>
<td>100</td>
<td>2,520</td>
<td>1,060</td>
<td>1,460</td>
</tr>
<tr>
<td>Board insulation</td>
<td>100</td>
<td>10,620</td>
<td>1,060</td>
<td>9,560</td>
</tr>
<tr>
<td>Timber stud partitioning</td>
<td>100</td>
<td>2,540</td>
<td>1,060</td>
<td>1,480</td>
</tr>
</tbody>
</table>
Cost savings from designing out waste
WRAP has conducted studies that identified and quantified opportunities to design out waste on several projects (mainly buildings). These opportunities were discussed with the design teams at RIBA stages C/D, and selected actions were approved as real solutions that might be considered on these or future projects.

Cost savings from reducing waste in design

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Construction Value (£m)</th>
<th>Saving in the cost of construction (A) (£)</th>
<th>Saving in the cost of waste disposal (B) (£)</th>
<th>Total savings (A+B) (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colchester &amp; Chelmsford Courts Pre-fabricated concrete stairwells</td>
<td>30</td>
<td>17,800</td>
<td>900</td>
<td>18,700</td>
</tr>
<tr>
<td>Queenshill Court Savings from use of prefabricated bathroom pods</td>
<td>6.8</td>
<td>78,800</td>
<td>3,000</td>
<td>81,800</td>
</tr>
<tr>
<td>Southgate College Modular classroom construction</td>
<td>20</td>
<td>52,300</td>
<td>9,100</td>
<td>61,400</td>
</tr>
<tr>
<td>Pre-cast concrete columns</td>
<td></td>
<td>40,700</td>
<td>600</td>
<td>41,300</td>
</tr>
<tr>
<td>Tate Modern 2 Material re-use for landscaping</td>
<td>118</td>
<td>78,000</td>
<td>11,200</td>
<td>89,200</td>
</tr>
<tr>
<td>Fair-faced finish internal walls</td>
<td></td>
<td>49,400</td>
<td>400</td>
<td>49,800</td>
</tr>
</tbody>
</table>
Cost savings from material re-use

Opportunities for material re-use are more common in civil engineering projects and building projects with significant ground/site works. This is due to the fact that materials reuse is most commonly in the form of recycled aggregates and reprocessed materials that have applications in infrastructure and civil works, and building substructure, rather than building superstructures. Savings from material re-use can be very significant. On average, 50% of the cost of certain packages can be saved by incorporated recycled materials, whether from site arisings or from offsite sources.

WRAP has documented tens of case studies on actual projects demonstrating savings through material re-use. Most of these can be found on the Aggregain website [www.aggregain.org.uk]. Examples of savings achieved include the following:

<table>
<thead>
<tr>
<th>Project</th>
<th>Application</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunk road, South Devon</td>
<td>Off site recycled material for bitumen bound base for a pavement reconstruction</td>
<td>Through off site recycling, 4% of total contract value, compared to a conventional reconstruction.</td>
</tr>
<tr>
<td>Rehabilitation of the A6116 Rockingham Road</td>
<td>Use of recycled materials for the base and binder and surface layers</td>
<td>25% saving in total cost of materials through use of recycled materials, compared to using conventional raw materials.</td>
</tr>
<tr>
<td>New Mill flood control dam construction</td>
<td>Hydraulically-bound mixture utilising pulverized fuel ash (a recycled material)</td>
<td>On average, 35% of materials cost compared to a conventional materials package. Savings were due to less quantity of material required and speedier construction.</td>
</tr>
<tr>
<td>Church Road, Mitcham, London Borough of Merton</td>
<td>Onsite recycling (aggregates) for the reconstruction of a carriageway and footpaths</td>
<td>On site recycling of aggregates led to a saving of 57% in material costs compared to a similar package using conventional raw aggregates.</td>
</tr>
</tbody>
</table>
Overview

When construction materials are ordered, it is the norm for ‘wastage allowances’ to be added. Whilst rarely made explicit in a tender, they are included in the (sub)contractor’s price and therefore paid for by the client. Therefore, higher wastage allowances equate to higher tender prices. They also permit inefficient site practices (higher levels of damage/offcuts, and more unused materials going to waste), leading to higher costs for waste disposal.

All too often, hefty wastage allowances are used ‘just in case’. (Sub)contractors have to strike a balance between low wastage allowances, introducing the potential for material shortfalls and resultant standing time, and high wastage allowances resulting in high costs. To reduce their wastage allowances with confidence, they need to know before tendering what actions the design team and principal contractor will take to reduce the likely wastage rate, and be aware of the savings their own team could achieve through better site practice.

To achieve this reduction in waste, the client needs to instruct their design team and contractor (within tender and appointment documents) to plan the key actions and targeted outcomes, starting from an early design stage. This information should be included in the Site Waste Management Plan (SWMP) and pre-construction tender documents. This then creates the conditions in which specialist/trade contractors are able to reduce their waste allowances prior to tendering. (The nature of the negotiation with trade contractors will depend on whether they are pricing for labour+materials or labour-only; and also whether they have the motivation to share savings in order to sustain a long-term working relationship with the principal contractor.)

What can be done to reduce wastage rates and permit lower wastage allowances?

The following are the most common solutions:

1. **Dimensional coordination:** This is primarily of importance to building construction but does have some applications in civil engineering projects. Developing the design to match standard material dimensions helps reduce off-cuts. If materials don’t need cutting, then wastage allowances can be substantially reduced. Specialist/trade contractors will have to ensure that what is bought fits what has been designed. Such solutions can include having large elements (such as concrete or steel) made to order.
2. **Simplification and standardisation:** This involves rationalising the specification such that there is a narrower palette of materials and the complexity and number of junctions within the building is reduced. The fewer materials required, the less the wastage allowance needs to be. Simplification and standardisation applies equally to building and civil engineering projects.

3. **Improved site management and logistics:** This is where contractors and specialist/trade contractors should be encouraged to apply their expertise. As client, you should check the SWMP at pre-construction stage, and ensure it includes actions to avoid material damage resulting from poor handling and storage during delivery and on site. Improved delivery logistics, and specifically implementing a “Material Logistics Plan”, would allow the contractor to adopt lower wastage allowances and minimise the generation of packaging waste. Materials used in civil engineering projects may be fewer than in building projects, but the implications of poor logistics can be significant since much larger quantities are generally involved than in building construction.

4. **Design team and contractor coordination:** Close cooperation between designers and contractors can reduce wastage rates by identifying and eliminating build-ability issues at the design stage. Such coordination is reasonably common in civil engineering projects where value engineering processes are used.

To maximise these opportunities, your procurement documents should require designers and contractors to focus their attention on the largest sources of waste and unnecessary cost. Success depends on good coordination and communication of the planned savings up and down the supply chain. Check that the SWMP is being used to capture the details of each opportunity, the level of savings, and the allocation of responsibilities throughout the design and construction processes to achieve these savings, whilst ensuring adequate materials are available on site. (In England, according to Regulation, the client is legally responsible with their main contractor for preparing the SWMP “before construction work begins” on projects over £300k in value.)

**Small projects**

Small projects can limit some of the above opportunities. However clients are still able to achieve cost savings by being proactive and setting specific requirements [e.g. on their design team, facilities manager or maintenance contractor], including but not limited to:

- identify the top 2-5 main product types contributing to waste (e.g. by looking at major cost plan items, especially on a programme of minor works such as refurbishment);
- ask contractors what wastage rates they anticipate on major materials, and discuss the potential to improve performance (especially where similar projects are repeated);
- identify actions to reduce waste and include them in a simple waste management plan; and
- on a sampling basis (e.g. across a minor works programme), check actual wastage rates by inspecting skips or skip data.

Further guidance on good practice in small projects can be found in WRAP’s guide to “Reducing waste in smaller construction and refurbishment projects and programmes of minor works”.
# Reduce wastage rates

<table>
<thead>
<tr>
<th>Policy</th>
<th>Preparation &amp; Design</th>
<th>Pre-construction &amp; Construction</th>
<th>Handover, Post-completion &amp; Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost savings from reduced quantities of materials ordered to site through:</strong></td>
<td>■ dimensional coordination</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ simplification and standardisation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ improved site management and logistics</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ design team and contractor coordination</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## The process

1. **Actions**
   - Client sets requirements in Project Brief for design team to reduce wastage and to include corresponding targets and actions in the SWMP and contractor procurement documents.

2. **Quantification of cost savings**
   - Design team identifies the largest sources of waste, focuses upon these and identifies actions that should enable lower wastage allowances to be specified. Design team records decisions in the SWMP.

3. **Guidance & Tools**
   - Main contractor briefs trade contractor on waste reduction actions in SWMP, and negotiates reduced wastage allowances.

4. **Sharing the savings**
   - Trade contractor buys agreed quantity of materials and implements SWMP actions.

   - Savings from reduced materials costs should be reflected in the trade contractor’s reduced tender price for trade package, provided wastage allowances are discussed/negotiated before tender price is submitted.

   - Cost savings shared with client in a reduced tender price from the main contractor (subject to negotiation with subcontractors on trade packages before price for main contract is agreed).
## Actions

**Policy**

The client should include a requirement for a waste reduction target in the Project Brief and in the appointment of the design team or contractor.

Specifically, the client should require their design team and advisers to:

- forecast waste;
- identify the top actions to reduce waste and wastage rates;
- set a target for waste reduction (e.g. waste should not exceed X tonnes per £100k of construction spend);
- include the selected actions in the design stage SWMP – including proposed wastage allowances for the key materials; and
- include corresponding waste requirements in tender and contract documents when procuring the principal contractor.

The client should brief their design team at project kick-off and check progress at design review meetings.

**Preparation & Design**

The design team should identify which materials offer the biggest potential waste and cost savings by reducing wastage allowances/rates from standard industry practice to good practice levels – and define actions to achieve the lower rates, such as:

- dimensional coordination;
- standardisation/simplification;
- improved site management and logistics; and
- design team and contractor coordination.

Take advantage of early contractor involvement and specialist advice from trade contractors where possible.

Record decisions taken in a design stage SWMP, and include this in the tender information for main contractors and specialist/trade contractors.

Forecast the waste arisings, and where possible quantify the intended impact of decisions taken to reduce waste. WRAP’s Net Waste Tool enables this calculation.

**Pre-construction & Construction**

Before agreeing tender prices with trade contractors and with the client, the main contractor should discuss wastage allowances for key trade packages (for the major materials identified at the design stage). The main contractor should agree how materials are to be stored and handled on site, and explain other waste-reducing actions defined in the design stage SWMP.

As a result, tender prices should reflect an appropriate and informed allowance for waste:

- for individual trade packages; and
- in the tender submitted to the client by the main contractor.

The main contractor should update waste forecasts and actions in the SWMP – for the client to review before construction starts on site.

If appropriate, specialist/trade contractor appointments should include performance requirements for wastage.

**Handover, Post-completion & Use**

The main contractor should monitor performance as the project develops. This could include monitoring of specific waste streams (e.g. plasterboard, blocks) to compare actual wastage rates with agreed allowances – enabling on-the-job improvement and lessons for future projects.

At the end of the project, the client should also review the completed SWMP to see what performance can be achieved in the future.
Quantification of cost savings

The client should instruct the design team to quantify the savings achieved by moving to good practice wastage rates on major components (top 10 or so).

WRAP provides guidance on the process of Designing out Waste and the calculation method, as well as freely accessible web-based tools (such as the Net Waste Tool) for quantifying potential savings at outline and detailed design stages.

<table>
<thead>
<tr>
<th>Policy</th>
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<th>Pre-construction &amp; Construction</th>
<th>Handover, Post-completion &amp; Use</th>
</tr>
</thead>
</table>
| The client should instruct the design team to quantify the savings achieved by moving to good practice wastage rates on major components (top 10 or so). | The cost saving can be calculated by finding the difference between the value of the materials wasted at standard and at reduced wastage rates. \[ A = \text{quantity of material required} \]
\[ B = \text{unit cost of material} \]
\[ W_1 = \text{wastage rate at standard (say 20%)} \]
\[ W_2 = \text{reduced wastage rate (say 10%)} \]
\[ C \text{ reduction} = (A \times B \times W_1) - (A \times B \times W_2) \]
This saving should be offset against any additional design or construction costs (e.g. provision of better storage). | Using the designer’s estimate of the potential savings, the contractor can discuss alternative solutions with trade contractors to identify actual cost savings achievable by coordinating materials purchasing with the design specification and by reducing damage during construction. The aim is to reach agreement on lower wastage allowances which are consistent with the achievable wastage rates on key materials. | At the end of construction, subcontractors should be able to measure the quantity of material they actually purchased, compared to the design quantity plus wastage allowance. The main contractor and/or trade contractors can also compare the waste forecast for the key materials with data recorded in the SWMP. This can be a useful exercise for both trade contractors and main contractors, identifying the scope for further improvement on future projects. |
| | WRAP’s Net Waste Tool has data on different wastage rates for common construction materials. | | |

Total cost savings = \((\text{cost reduction in package tender prices}) - \text{implementation costs for design solutions and improved site management})\)

\(^1\)Implementation costs are those costs incurred through extra design, preparation and labour to achieve a certain solution
4.0 Incorporating reused and/or recycled materials (on site reuse and imported materials)

There are two sources of potential cost saving in this category:

- on site reuse and reprocessing of construction, demolition and excavation materials, and maximising the value from in-situ materials – which is often less expensive than importing materials to site, especially where the alternative is to transport bulk materials from distant sources; and
- bringing recovered and recycled materials to site – which can be cheaper than purchasing equivalent primary materials.

The most common applications and savings in both building and civil projects are in:

1. **reuse of excavation materials on site** – for example, by ensuring a cut and fill balance, stabilising soils using hydraulic binders, manufacturing quality soils by adding ‘green’ compost, and remediating brownfield land in-situ;

2. **processing demolition arisings on site** (e.g. using mobile crushing plant) to provide recycled aggregates for applications such as fill, capping, subbase, and other granular applications, and hard landscaping during the construction phase;

3. **importing recycled aggregates** that meet the same quality standards as the primary aggregates they replace (e.g. produced in accordance with the Aggregates Quality Protocol) – which is particularly cost-beneficial where recycled aggregates are available closer to the site than primary ones;

4. **improving the engineering properties of on site materials** to maximise their value: for example, enhancing the engineering properties of the formation layer through producing hydraulically-bound mixtures to reduce the thicknesses of capping and/or subbase layers, or overlying asphalt materials; using geosynthetics to stabilise existing materials, or bonded composites to rehabilitate existing structures;

5. **in situ remediation of contaminated soils** in preference to excavation and disposal; and

6. **using products containing recycled materials** (with above-average recycled content), such as recycled asphalt in asphalt, cement replacement in concrete products, recovered and refurbished units like stone kerbs and setts, bus shelters, fencing and gates.
The client should require their design team to investigate these opportunities at an early design stage. This allows questions to be addressed such as:

- Is space available for materials storage and processing, either on site or off site, and what will happen to volumes of waste materials which cannot be reused – can they be recycled through other local projects?
- Can time be found within the construction programme to source the materials needed and will they be available in sufficient quantities?
- Can demolition, excavation and in situ materials be reused/enhanced in the works through effective processing and scheduling?

**Small projects**

Space, time and equipment costs can constrain the opportunity to reuse materials in-situ on smaller projects (e.g. through on site reprocessing of hard demolition materials). However, opportunities still exist to import reprocessed material from other sites. The potential to use locally sourced reclaimed products can be significant on small projects (which may only be available in limited quantities, and therefore are better suited to small projects). The design team should identify reclaimed products that are available in the required quantities from local stockists, and should also check on the local supply of materials left over from previous projects (e.g. via materials exchanges and reclamation centres).

Further guidance on good practice in small projects can be found in WRAP’s guide to “Reducing waste in smaller construction and refurbishment projects and programmes of minor works”.

The potential to use locally sourced reclaimed products can be significant on small projects.
Incorporate reused and/or recycled material

<table>
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<tbody>
<tr>
<td>Cost savings from:</td>
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<tr>
<td>- on site reuse and reprocessing of materials rather than buying in materials</td>
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<tr>
<td>- importing lower cost recycled/reprocessed materials and reclaimed products</td>
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<tr>
<td>- avoiding the costs of disposal of ‘waste’ materials reused on site</td>
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</table>

The process

1. Actions
2. Quantification of cost savings
3. Guidance & Tools
4. Sharing the savings
## Actions

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<thead>
<tr>
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<tbody>
<tr>
<td>The client should include a <strong>requirement</strong> to identify the top cost saving opportunities for materials reuse in the Project Brief and in the appointment of the design team – since reuse needs to be addressed at an early design stage.</td>
<td>Where excavation or demolition is required, the design team should investigate possible site re-use. The design team should also consider the potential to use recycled or reclaimed materials. Both the savings and costs need to be calculated. For example, site re-use of aggregates avoids the cost of importing new material, but this saving must exceed the cost of hiring processing equipment.</td>
<td>The contractor should review the design specification and SWMP, and identify how to implement reuse options. The contractor should evaluate the cost saving potential before submitting a tender price. Where possible, early contractor involvement with the design team will help to identify the most financially attractive solution.</td>
<td>The contractor provides data on final performance back to the client team in the SWMP. (Reviewing the SWMP is a regulatory requirement in England.) Optional: Contractor reports any learning about quality, handling, supply, etc.</td>
</tr>
<tr>
<td>Specifically, the client should require their design team and advisers to:</td>
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<tr>
<td>■ forecast waste;</td>
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<tr>
<td>■ identify the top actions to reuse materials on site and import recovered materials;</td>
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<tr>
<td>■ if appropriate (e.g. on civil engineering projects with a high reuse potential), set targets for waste reuse (e.g. use at least 25% recycled aggregate, recover / reuse at least 90% of D&amp;E waste);</td>
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<tr>
<td>■ include the selected actions in the design stage SWMP – including site investigation; and</td>
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<tr>
<td>■ include corresponding waste requirements in tender and contract documents when procuring the principal contractor.</td>
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<td>The client should brief their design team at project kick-off and check progress at design review meetings.</td>
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<td>Where excavation or demolition is required, the design team should investigate possible site re-use. The design team should also consider the potential to use recycled or reclaimed materials.</td>
<td>The contractor should review the design specification and SWMP, and identify how to implement reuse options. The contractor should evaluate the cost saving potential before submitting a tender price. Where possible, early contractor involvement with the design team will help to identify the most financially attractive solution.</td>
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<tr>
<td>Record the plans for reuse in the design stage SWMP, and include requirements in the ITT and contractor’s appointment. Note that some decisions over aggregate/material re-use may rest with the contractor. Discuss options with potential contractors, demolition contractors, groundworks contractors, site investigation specialists etc as appropriate.</td>
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<td>The contractor provides data on final performance back to the client team in the SWMP. (Reviewing the SWMP is a regulatory requirement in England.) Optional: Contractor reports any learning about quality, handling, supply, etc.</td>
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Quantification of cost savings

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</table>
| In the design team appointment, the client (or contractor, depending on the procurement route) should instruct the design team to estimate the cost saving potential in the reuse of material in lieu of new products or primary aggregates – looking for the top opportunities. | Each opportunity should be tested for both commercial and technical impacts. Commercial considerations should include:  
- the saving achieved through the reduction in disposal;  
- the saving achieved through the reduction in the purchase of new material; and  
- additional costs for material pre-demolition audits, site investigations, technical trials, processing, cleaning, preparation and material testing (as required). | The contractor can help substantiate the design team’s assessment through market testing of alternative solutions. | Contractor supplies the data on material reuse required by the client, and includes them within the final SWMP. The client’s advisers can use these data to check that cost savings were achieved as planned. |

Where demolition/excavation arisings can be used in the new build:

**Total cost savings =** \( \text{avoided disposal costs} + \text{avoided cost for new materials} \) - \( \text{demolition/excavation material processing costs} + \text{testing/quality costs} \)

Where recycled and reclaimed materials are imported:

**Total cost savings =** \( \text{cost of recycled materials and products, including transport to site} \) - \( \text{cost of alternative virgin materials and products, including transport to site} \)

Where on site remediation is possible:

**Total cost savings =** \( \text{avoided disposal costs} + \text{avoided cost for new materials required for remediation} \) - \( \text{remediation and testing/quality costs} \)
5.0 Reduce total waste (in design and on site)

Overview
Reducing waste (through design, off site construction, reuse etc) will reduce the total cost of disposal, as will finding alternative end-markets to which wasted or unwanted materials can be sold or donated. (The latter includes donations of furniture to social enterprises, selling reclaimed products to a salvage yard, and operating an in-house “resale” of unused materials to the next project.)

If the design team has adopted solutions such as off site construction and in-situ reuse, there will be a significant cut in waste volumes, so it is important to communicate this within the SWMP and project specification at the ITT stage to avoid contractors over-pricing for the “risk” of typical waste arisings.

The client can encourage cost saving on waste disposal by:
- adopting minimum and stretch recovery rates as requirements in the Project Brief and procurement documents;
- agreeing waste disposal as a separate cost item rather than accepting a fixed price that is bundled into the preliminaries; and
- asking their design team to forecast waste quantities (after allowing for waste reduction actions), so that contractors can price their waste management more keenly.

Cost savings exist in design and in construction:

In design
WRAP recommends focusing efforts on five main areas as outlined and explained in the “Designing out Waste” guidance (these are described below):
- at an early design stage – select alternative design solutions with lower materials use, greater reuse and lower waste (including off site construction); and
- at a later design stage – identify ways of reducing wastage rates within the chosen design, e.g. standardising specifications and/or simplifying the design to minimise the amount of off-cut waste.
Guide to cost saving and client cost saving strategies

Design for reuse and recovery
This centres upon the reuse of materials such as reclaimed products, excavation arisings or crushed demolition materials. This route has particular reference to building projects with significant ground/site works and civil engineering projects, which typically use large quantities of materials in earthworks, pavements and structures and can generate larger quantities of waste. Refer to the Section on ‘Incorporating reused and/or recycled materials’ for more detailed guidance.

Design for off site construction
Off site construction has been shown to achieve a dramatic reduction in the waste generated on site. Off site construction is reasonably common in building construction but is less often used in civil engineering. For civil engineering projects, off site construction can include use of pre-cast concrete components or preassembled steel structures.

Off site construction can result in changes to on site practice and may require different teams of specialist contractors; for example, compare operational needs on site to place large precast concrete components (handling areas, cranes and operators) with the demands of cast in-situ concrete (erection and striking of shuttering, temperature monitoring/ control of large pours). To gain the waste benefits of off site construction, and to facilitate the resulting construction process, consideration at the design stage is essential.

Equally possible for large civil infrastructure projects is the use of on site technology to essentially provide ‘off site manufacturing on site’. For example, anecdotal evidence suggests that site batching of concrete can reduce wastage rates by providing improved responsiveness and flexibility to construction demands; on site precasting reduces lead times and ensures on-time delivery; and on site (in-plant) production of hydraulically-bound materials ensures a high quality and consistent product for large-scale applications. However, to take advantage of such on site technology, early consideration and planning is essential. The use of such technology must be integrated at the design stage, and the potential cost benefits quantified, to inform construction planning.

Design for materials optimisation
The materials optimisation route focuses on solutions that lead to less material used for the design, hence less cost for a certain package, without compromising the design concept and quality. The main solutions that lead to significant reduction in new material use are minimisation of excavation, simplification and standardisation of materials/components, and dimensional coordination. Such solutions lead to lower wastages rates, by which the client can capitalise on the potential savings (refer to the Section on “reducing wastage allowances”).

Within civil engineering, the opportunities for dimensional coordination may be limited. However, simplification and standardisation of materials and component choices can be very important. Standard details for most forms of construction are available, e.g. standard drawings for
highway construction details are available in Volume 3 of the Manual of Contract Documents for Highway Works. Standardisation of joints, bearings and other structural details can reduce the need for rework as ‘standard practice’ develops over time on site. In such instances, material optimisation should involve contractors in considering build-ability of works.

A key aspect of materials optimisation is the use of various ground improvement techniques to avoid having to excavate soft foundation soils, which may be unable to support the proposed loading from embankments, buildings or structures without excessive settlement or even failure. Techniques include geosystems, dynamic consolidation, foundation drains and lightweight fill.

| Design for waste efficient procurement | Considering design for waste efficient procurement directs the design team to reduce the waste inherent in their designs. This should include discussions with principal contractors and specialist/trade contractors and a review of any specifications which may restrict waste reduction options. If departures from standard specifications are required to enable waste reduction, these are more readily implemented if identified by the design team and discussed with the client and contractor.

Designing for waste efficient procurement considers the most significant wastes produced by the design, and identifies if these can be reduced by alternative design solutions or build-ability solutions, and suggests mechanisms to deal with the waste which cannot be eliminated. WRAP’s Net Waste Tool and the Designing out Waste Tools for Buildings and Civil Engineering can help designers to identify the most significant wastes associated with the project, and the residual wastes which will remain once avoidable wastes have been eliminated. By targeting the major waste streams, contractors and design teams can help in achieving highest possible cost savings, especially when the biggest waste streams are amongst the most expensive in terms of materials price.

| Design for deconstruction and flexibility | This is less relevant for cost savings during construction, but is an important consideration when addressing the whole life impact of a building or a structure. Most buildings and civil engineering structures are constructed to meet demanding service lives and to fulfil specific functions, so design for deconstruction and flexibility may not be a significant waste reduction option. However, design for maintenance should be considered wherever possible. These longer-term savings may or may not benefit the client, depending on the asset ownership and operation arrangements. |
In construction
Some of the largest opportunities to reduce waste on site include:

- ensuring there is an effective strategy for delivery, handling and storage of materials (e.g. a “materials logistics plan”);
- providing site training on the appropriate use of materials (to avoid unnecessary off cuts and encourage their reuse as appropriate); and
- targeting packaging either through reduction at source or through take back agreements.

All of these actions should be recorded in the SWMP, starting from the early design stage. In England, the SWMP Regulations [2008] require the contractor and client to include in the final SWMP an estimate of the cost savings that have been achieved by completing and implementing the Plan.

Small projects
While reducing total waste can be more effective on large projects, the design team and contractor should still investigate the following on small projects:

- choosing to refurbish instead of replacing structures or components;
- avoiding unnecessary excavation and strip-out;
- reusing construction, demolition and excavation materials available on site;
- selecting pre-fabricated components;
- reducing wastage allowances on major materials (e.g. by improving materials storage, agreeing just-in-time delivery and adjusting floor-to-ceiling heights to reduce the expected wastage rate of plasterboard from say 20% to 10%); and
- select materials and components with low maintenance requirements, long in-service life and easy refurbishment.

Further guidance on good practice in small projects can be found in WRAP’s guide to “Reducing waste in smaller construction and refurbishment projects and programmes of minor works”.
# Reduce total waste

## Policy
- Reduced materials purchase
- Lower total waste disposal costs

## Preparation & Design & Construction

<table>
<thead>
<tr>
<th>The process</th>
<th>Implementation</th>
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</thead>
<tbody>
<tr>
<td>Client sets requirements in project brief for waste reduction in design and construction.</td>
<td>Main contractor develops SWMP further and agrees waste mitigation actions. Contractor uses SWMP forecasts to price for disposal of reduced quantity of waste.</td>
</tr>
<tr>
<td>Design team identifies the top opportunities to reduce, reuse and recover more waste material, starting from the early design stage, and records decisions in SWMP.</td>
<td>Cost savings shared with client in a reduced tender from the main contractor.</td>
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</tbody>
</table>

## Pre-construction & Construction

Cost savings shared with client in a reduced tender from the main contractor.

## Handover, Post-completion & Use

Cost of waste disposal is decreased through less waste generated on site.

## The process

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## Actions

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</table>
| The client should include a requirement for a waste reduction target in the Project Brief and in the appointment of the design team. Specifically, the client should require their design team and advisers to:  
- forecast waste;  
- identify the top actions to reduce waste;  
- set a target for waste reduction (e.g. waste should not exceed X tonnes per £100k of construction spend);  
- include the selected actions in the design stage SWMP; and  
- include corresponding waste requirements in tender and contract documents when procuring the principal contractor.  

The client should brief their design team at project kick-off and check progress at design review meetings.  

From the start, the design team should forecast waste and the associated cost impacts. For example, decisions to adopt an offsite solution, change design specifications and reuse materials need to be taken early in the design, although other decisions (such as dimensional coordination) may wait until the detailed design stage.  

WRAP’s Designing Out Waste Guides for Buildings and Civil Engineering provide a structured approach to identifying opportunities in the following areas:  
- Design for reuse and recovery;  
- Design for offsite construction;  
- Design for materials optimisation;  
- Design for waste efficient procurement; and  
- Design for deconstruction and flexibility.  

All decisions to reduce waste should be included within the design stage SWMP.  

The contractor should review the design stage SWMP and, if appropriate, identify additional opportunities to reduce waste.  

Then, in developing the SWMP further, the contractor should identify specific actions that will help reduce the waste generated on site. These should centre on:  
- tackling packaging waste  
- planning for material delivery, handling and storage; and  
- ensuring site staff are well trained.  

The contractor should compare the forecast quantity of waste with the actual quantities generated. This should be linked to a review of why there are differences (e.g. to comply with the SWMP Regulations in England).  

Design teams should seek contractor feedback on the effectiveness of the design decisions to reduce waste.
## Quantification of cost savings

The client should instruct the design team to quantify the potential for waste reduction, focusing on the most significant changes.

WRAP provides guidance on the process of Designing out Waste (DoW) and the calculation method, as well as freely accessible web-based tools (such as the Net Waste Tool) for quantifying potential savings at outline and detailed design stages.

The DoW process involves comparing the base option versus the lower-waste alternative for each of the top design changes, and quantifying the impact on waste, materials costs, waste disposal costs and carbon.

### Total cost savings

\[
\text{Total cost savings} = \left( \text{reduction in disposal costs as a result of decreased total volume of waste} \right) - \left( \text{cost of considering waste systematically within the design development process, and implementation cost of improved site management} \right)
\]

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<tr>
<td>The client should instruct the design team to quantify the potential for waste reduction, focusing on the most significant changes.</td>
<td>As part of WRAP’s Net Waste Tool, the Designing out Waste Tools for Buildings and for Civil Engineering are freely accessible to help designers focus on the largest opportunities to reduce waste. In addition, WRAP has guidance which details how a design team can quantify the savings achieved through designing out waste.</td>
<td>Having reviewed and refined the SWMP forecasts and actions to reduce waste, the contractor should be able to calculate the reduction in waste disposal costs. Working with good practice waste management companies in the pre-construction phase will help identify ways to reduce waste generated on site and costs of disposal.</td>
<td>On completion, the contractor provides data on total waste in the final SWMP. In England, the SWMP Regulations require the contractor and client to include an estimate of the cost savings that have been achieved by completing and implementing the Plan.</td>
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6.0 Reduce unit cost of disposal

Overview
There are two main sources of potential cost saving in this category:
- segregating waste on site – which can lead to an increase in the quality/recyclability of the materials and hence their value, resulting in lower charges for disposal per unit of waste; and
- finding a waste contractor who achieves a high recovery rate off site and therefore can offer competitive disposal rates by extracting maximum value from mixed waste.

Site segregation is likely to yield the highest quality materials, but may not be practical in some situations (depending on space and quantities). Before starting on site, the contractor should identify the most cost-effective solutions for waste disposal. This involves:
- forecasting the major waste streams (in the SWMP);
- speaking to waste management contractors (and reprocessors where appropriate) to understand the local market for waste materials;
- investigating space on site for skips and handling;
- establishing a site management system which ensures health, safety and quality; and
- identifying take-back mechanisms available within the materials supply chain which can be used on the project.

Compactors or shredders can help to substantially reduce the volume of waste, thereby reducing the disposal costs (although the cost of hiring the plant must be taken into account).

The client can encourage cost saving on waste disposal by:
- adopting minimum and stretch recovery rates as requirements in the Project Brief and procurement documents;
- agreeing waste disposal as a separate cost item rather than accepting a fixed price that is bundled into the preliminaries; and
- asking their design team to forecast waste quantities (after allowing for waste reduction actions), so that contractors can price their waste management more keenly.

Small projects
The scope to reduce the unit cost of disposal may be limited on small projects, for example where segregation is not economically practical due to the relatively small volume of waste produced. However, competitive disposal rates might be negotiated with waste management contractors who use effective waste segregation systems at their off site facilities. Also, contractors who run several small projects within a reasonable transport distance may be able to achieve economies of scale by appointing a single waste management contractor.

Further guidance on good practice in small projects can be found in WRAP’s guide to "Reducing waste in smaller construction and refurbishment projects and programmes of minor works".
Reduce unit cost of disposal

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<tr>
<td><strong>Cost savings from:</strong></td>
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<td></td>
<td></td>
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<tr>
<td>■ paying less for segregated skips compared to mixed skips</td>
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<tr>
<td>■ using a waste contractor with a highly efficient recovery facility</td>
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The process

**Client sets requirements in Project Brief for good practice waste recovery rates.**

**The design team** forecasts the major waste streams to inform the initial segregation strategy proposed in the design stage SWMP.

**Main contractor** develops a detailed SWMP, detailing the waste segregation strategy and opportunities for take back or resale.

**Main contractor** measures performance and reports back to client (recovery rate).

**Cost savings shared in contractor’s reduced tender price (depending upon procurement route).**

**Cost savings achieved by the contractor by paying less for waste disposal (total cost and cost per skip).**

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<td>The client should include a <strong>requirement</strong> for waste recovery rates in the Project Brief and in the appointment of the design team.</td>
<td>The design team should quantify the likely quantities and costs of waste disposal, and estimate the potential savings from on site segregation. WRAP’s Net Waste Tool helps with this calculation. If appropriate, the design team should identify possible locations for waste segregation / management on site. If this involved securing additional space (e.g. on adjacent land), a financial appraisal would be needed. The project team should ensure that the tender process makes specific provision to examine the cost of waste disposal in relation to forecasts of waste reduction and proposals for site segregation / lower skip rates (included in the design stage SWMP).</td>
<td>The contractor should identify the least-cost waste disposal strategy that meets/exceeds the client’s requirement for a minimum overall recovery rate and is consistent with the forecast of waste arisings. Waste disposal costs for this strategy should be reflected in prices/tenders. The contractor should negotiate costs and refine details of the preferred strategy with waste management contractors and/or other end-destinations. The contractor should agree contractual responsibilities for waste data measurement and reporting. Before starting on site, the contractor should develop a detailed segregation strategy and provide training to key site operatives/trade contract managers. The main contractor should monitor costs and quantities throughout the project to ensure cost objectives are met. Note that poorly managed segregation can result in rejected loads, incurring additional costs. WRAP’s Site-Specific Waste Analysis Tool can be used by waste contractors to provide more accurate data on the composition of waste arisings and their destinations and recovery rates. Contractor reports to the client (in the SWMP) on the types and quantities of the various waste materials reused (on/off site), recycled (on/off site), recovered (on/off site), sent to landfill and otherwise disposed of (e.g. to comply with the SWMP regulations in England). Optional: Contractor reports to client any learning about site conditions, barriers, cost of disposal etc.</td>
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<tr>
<td>■ forecast waste quantities and the split between waste streams;</td>
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<tr>
<td>■ propose actions to increase the recovery rate and reduce disposal costs;</td>
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<tr>
<td>■ include these actions in the design stage SWMP – including suggested segregation where appropriate; and</td>
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<td>■ include corresponding waste requirements in tender and contract documents when procuring the principal contractor.</td>
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<td>The client should brief their design team at project kick-off, and review the contractor’s SWMP before work starts on site.</td>
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<td>The contractor should identify the least-cost waste disposal strategy that meets/exceeds the client’s requirement for a minimum overall recovery rate and is consistent with the forecast of waste arisings. Waste disposal costs for this strategy should be reflected in prices/tenders. The contractor should negotiate costs and refine details of the preferred strategy with waste management contractors and/or other end-destinations. The contractor should agree contractual responsibilities for waste data measurement and reporting. Before starting on site, the contractor should develop a detailed segregation strategy and provide training to key site operatives/trade contract managers. The main contractor should monitor costs and quantities throughout the project to ensure cost objectives are met. Note that poorly managed segregation can result in rejected loads, incurring additional costs. WRAP’s Site-Specific Waste Analysis Tool can be used by waste contractors to provide more accurate data on the composition of waste arisings and their destinations and recovery rates. Contractor reports to the client (in the SWMP) on the types and quantities of the various waste materials reused (on/off site), recycled (on/off site), recovered (on/off site), sent to landfill and otherwise disposed of (e.g. to comply with the SWMP regulations in England). Optional: Contractor reports to client any learning about site conditions, barriers, cost of disposal etc.</td>
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<tr>
<td>For medium to large projects, the client should ask the design team to estimate waste disposal costs at the design stage and cost saving actions. This will allow a more informed discussion with the main contractor, before agreeing to a price. Otherwise, the cost of waste disposal is often buried within the allowance for preliminaries and typically does not take account of waste reduction and segregation actions.</td>
<td>To decide on the most cost-effective solution, the design team should include a forecast of the waste (quantities and type) in the design stage SWMP. WRAP’s Net Waste Tool provides this information and an estimate of the cost of disposal using different segregation strategies. The Designing out Waste Tools for Building and for Civil Engineering will also provide a quick estimate of waste arisings and potential savings at an earlier design stage. The calculation of potential savings is based on the unit cost of disposal of mixed waste compared to segregated waste, where mixed wastes are generally the most expensive.</td>
<td>The contractor should review the waste forecasts in the SWMP and the suggested segregation strategy. By negotiating with waste contractors over container sizes and unit rates, the contractor can find the most cost-effective solution to achieving the client’s required % recovery. Any cost appraisal should take account of the cost of supervising site segregation/compaction activity, and the SWMP management time.</td>
<td>Contractor supplies SWMP data on breakdown of waste materials segregated and their destinations. This should include any materials that are part of a take-back scheme or resold for further use. The client’s advisers can use these data to check that cost savings were achieved as planned.</td>
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</table>

**Total cost savings** = \( \text{[reduction in cost of disposal using segregated skips in place of mixed waste skips]} - \text{[additional costs of supervising segregation and providing additional space]} \)
7.0 Sharing the savings

In the first instance, savings accrue to whoever takes the risk for the cost item. This means that if a trade contractor is providing materials at a fixed price, then any saving they achieve through waste reduction will be kept by them.

Similarly, if it is the main contractor who is offering a fixed price for the preliminaries (which would normally include waste disposal costs), then reduced costs would be kept by the main contractor.

Therefore, once a fixed-price contract has been agreed, savings on materials purchasing and costs of waste disposal achieved subsequently during the course of a project would not be shared by the client.

Therefore, to share in the cost savings, the client and their advisers should take action by:

- setting requirements on the design team to quantify the potential to improve performance and provide a design stage SWMP as part of the tender invitation (so that tender prices reflect the cost saving potential); and/or
- setting up a contractual arrangement and pricing structure (such as an open book partnering framework) which enable savings to be shared on a win-win basis.

**Being proactive**

The client should require the design team to identify and quantify the top opportunities to reduce, reuse and recover waste materials, and to estimate the potential cost savings. By highlighting cost reduction opportunities through design and prior to agreement of the contract sum, there is greater potential to convert these into actions on site and a lower tender price. These savings may need to be negotiated with the main contractor (who in turn will need to negotiate with trade and waste contractors), but to do this the client’s team must have sufficient evidence and specific plans for how the savings can be achieved.

For example, if a decision was taken to use an off site construction system, resulting in a 50% reduction in site waste, then one would expect to achieve a 50% reduction in the cost of waste disposal. If, as is most common, waste disposal was priced as a lump sum within the preliminaries, then explicit action might be required to ensure an appropriate drop in price for disposal. Therefore, the client should encourage the project team to identify savings, and negotiate a share in these wherever possible.
Procurement routes
The procurement method and associated pricing structure have the single largest impact on the client’s ability to realise savings. Generally, the largest savings are achieved when the design team collaborates with the contracting team. For example, a reduction in wastage rates relies upon coordination between designers, the main contractor and specialist/trade contractors.

For this reason, the more traditional ‘adversarial’ contract types (such as a single stage lump sum tender) tend to reduce the extent of savings, whilst those built around partnering arrangements (say – an open book contract) provide greater opportunity to maximise cost saving opportunities as the project develops.

Follow the links below for more information on securing cost savings in each of the common procurement routes:

- Traditional procurement – single stage
- Traditional procurement – 2 stage
- Design and build
- Collaborative procurement
- PFI/PPP contracts
- Management Contracting and Construction Management

7.1 Traditional procurement – single stage
Traditional procurement requires the main contractor to develop a ‘lump sum’ tender, issued before the project starts. This tender is the contractor’s best estimate of the outturn costs of the project, combined with the requisite level of profit. If the contractor finds ways during the course of the project to reduce costs (e.g. value of materials wasted, or cost of waste disposal), then there is no incentive to share the savings with the client. Therefore, to benefit financially from waste reduction and good waste management, the client and their advisers/designers need to set performance standards and communicate the cost saving potential and design actions upfront at the tender stage, so that bidders factor the potential savings into competitive tender prices.

So, if waste reduction is considered during design, and actions are defined upfront that will deliver either lower wastage rates, more reuse of materials and/or higher recovery rates, then in a competitive market the tender should reflect lower out-turn costs. But this will not happen by chance, and the client should require the design team (through the appointment process) to explore waste reduction opportunities, and then inform all bidders (during the tender process) about the waste reduction potential, the top opportunities identified, target wastage allowances and the resulting SWMP actions.
Key actions

Client action 1 – instruct design team to pursue waste reduction opportunities

Client action 2 – instruct design team to inform contractor of waste reduction opportunities during the tender

Opportunity for the client to save – provided waste reduction is considered in sufficient detail before prices are agreed.

7.2 Traditional procurement – two stage

If the contractor is appointed on a two-stage basis, the tender for Stage 1 is commonly based upon overheads and profits. This would include the contractor’s allowance for the cost of waste disposal. If the client wishes to pursue waste reduction cost savings, then it may be appropriate to exclude this item from the preliminaries, and wait until the second stage to agree a fixed price for waste disposal. This allows the design and contracting team to develop the SWMP, allowing a more accurate waste forecast to be produced. Whether deferred or not, there is still the opportunity to review and negotiate this allowance.

The second benefit of a two-stage approach is that the main contractor can help to influence the development of the design, and in doing so, help reduce wasteful elements. At the same time, whilst procuring trade packages, the main contractor can help trade contractors reduce their wastage allowances. The second stage is therefore a powerful opportunity to link design development to trade contractor pricing. If successful, real reductions in waste and cost can be achieved.

Both of the above mechanisms could potentially save the client money which might otherwise not be possible in a single stage tender.

Client action 1 – [where appropriate] exclude the cost of waste disposal from the Stage 1 tender, and include within the trade contractor negotiations within Stage 2

Client action 2 – instruct the design team to work with the main contractor to explore and quantify the potential to reduce waste and wastage allowances. At the same time, instruct the main contractor to work with specialist/trade contractors to reduce wastage allowances, and develop a SWMP with the design team which identifies how these reduced allowances are to be achieved.

Opportunity for the client to save – the two-stage process allows prices to be negotiated, but the main contractor and trade contractors must still price the risk of working within waste allowances.
7.3 Design and Build
One of the benefits of design and build is that it automatically links the skills of the contractor into the design process. There is therefore both the ability and the incentive to reduce waste in design. On completion of the second stage works, the design and build contract is usually let on a ‘lump sum’ basis. This naturally excludes the client from additional savings. What this should also do, however, is focus effort on waste reduction during the 2nd stage, for example by:
- working with specialist/trade contractors to identify areas of waste and reduce these; and
- developing a quality SWMP which allows commercial discussions with the waste management contractor (ideally reducing the cost of waste disposal within the main contractor’s ‘lump sum’).

Client action 1 – include requirements within main contractor’s appointment to:
- demonstrate methods taken to reduce waste and the financial impact of these; and
- provide a copy of the SWMP, clearly identifying how the chosen waste management solution is the most commercially advantageous (lowest cost).

Opportunity for the client to save – because the main contractor has the potential to pursue these savings and include them within the lump sum cost.

7.4 Collaborative procurement
Because there are multiple forms of contract and payment structures under the collaborative procurement ‘umbrella’, it is difficult to be prescriptive, but there are some common actions which can be used to maximise the reward for the client.

Whichever mechanism is used, the assumption is that the client and the contractor share risk on cost, including the cost of materials (via trade contractor prices) and waste management. This shared risk therefore encourages collaboration to reduce costs. For this reason, collaborative contracts create ideal scenarios to explore and realise savings from resource efficiency that might otherwise be quite difficult.

Client action 1 – instruct the designer to pursue waste reduction opportunities, and to use the contractor’s knowledge to do this.

Client action 2 – instruct the main contractor to review trade contractor waste allowances, and help them identify ways to reduce these (in turn reducing costs), and investigate opportunities for materials reuse.

Opportunity for the client to save – because the client and contractor share the risk, there is joint interest in pursuing these savings.
7.5 PFI/PPP contracts

PFI/PPP contracts are usually versions of Design & Build, albeit the client is often far removed from the design process. The client can do little more than set explicit requirements for waste reduction and recovery, and require evidence that key opportunities have been considered and performance levels achieved. The client shares in the cost savings provided these are pursued by the contractor from an early design stage and reflected in the unit charge.

**Client action** – include the following requirements within the tender documents:
- minimum and stretch targets for waste reduction and recovery – including specific requirements to consider waste reduction in design; and
- provision of a copy of the SWMP (before starting on site) which clearly shows how waste will be reduced and recovered.

**Opportunity for the client to save** – by setting clear requirements for waste reduction, reuse and recovery at the start of the project.

7.6 Management Contracting and Construction Management

Both of these procurement routes concentrate on the compilation of specialist/trade contractor prices. Because of this, there is the opportunity to interrogate each package, and ensure that an appropriate allowance is included for waste, and that the trade contractor has a plan to keep waste to a minimum.

Waste management services should also be treated in this way, so again there is the potential to have an open dialogue that ensures a waste strategy is developed which both increases quality and reduces costs. For each procurement route, a nominal main contractor must be appointed to develop the SWMP and manage site operations.

**Client action 1** – ensure specialist/trade contractor prices include appropriate allowances for waste and have waste reduction strategies.

**Client action 2** – ensure the waste management contract is fully negotiated to give an optimum cost and recovery solution.

**Opportunity for the client to save** – the focus on trade contractors and waste management contractors is a powerful way to identify and pursue cost reduction opportunities.
8.0 Where should I focus?

Client focus
1. Ensure you include requirements and performance standards for waste outcomes (e.g. minimum waste recovery rate) in the Project Brief and tender/contract documents for your design team as well as your contractor.
2. Consider using a procurement route which facilitates early contractor involvement in designing out waste, quantification of cost savings before tender prices are agreed, and a win-win sharing of savings.
3. Get your design team (and contractor if applicable) to identify the top opportunities to reduce and reuse waste from an early design stage, and to include corresponding outcome requirements in the design stage SWMP and contractor ITT.
4. Review waste forecasts and planned savings at design stage sign-offs (e.g. RIBA Stages C, D and E for buildings), and require to see the contractor’s detailed SWMP before work starts on site.
5. Agree contractual responsibilities for waste data reporting (which your main contractor should then cascade to trade and waste contractors).
6. Review the SWMP on project completion, compare forecast and actual performance (benchmarking against other projects / your peer group), and use the learning to update corporate targets and inform future projects.
7. On programmes of minor works, get your FM or maintenance contractor to focus on the top five products and waste streams, and identify just a few key actions to reduce, reuse and recover more waste and use higher recycled content (especially actions which are common across multiple projects). Agree a simple data reporting template. (See guidance on Reducing waste in smaller construction and refurbishment projects and programmes of minor works.)

Design team focus
1. At the options appraisal stage, consider with the client the opportunities to refurbish an existing asset (instead of redeveloping), to use existing space more efficiently, and to design new works to be flexible to future changes in needs.
2. At an early design stage, forecast waste and identify the top opportunities for waste reduction and reuse on which to focus attention. In particular, consider use of in-situ materials (e.g. through remediation and stabilisation), reprocessing of materials for reuse on site (e.g. demolition and excavation arisings; cut and fill balance), alternative design solutions, and off site construction.
3. At a later design stage, focus attention on reducing wastage rates to good practice levels for the top ten products/components in the waste forecast – for example by matching product and design dimensions, and standardising the choice of components across a project. Select materials and components with high durability.
4. Seek early contractor involvement in identifying and vetting low waste solutions (where appropriate).
5. Quantify the forecast waste and costs of waste, estimate the achievable cost savings from specific actions, and capture these in a SWMP, starting from the early design stage (e.g. RIBA Stage C for building projects).

6. Include the waste/cost estimates and actions in the contractor tendering process, so that tender prices take account of design decisions and potential savings.

**Main contractor focus**

1. At the pre-construction stage, develop the SWMP in more detail and refine the waste forecasts. Include plans for materials logistics (delivery and site storage); for waste recovery (site segregation etc); for reducing wastage (lower wastage allowances on trade packages etc); and for reuse on site (mobile processing plant etc).

2. Discuss practical implementation with the design team, specialist/trade contractors and waste contractors to maximise savings before tender prices are agreed.

3. Include responsibilities (e.g. for waste reduction, reuse and segregation, and for data reporting) in specialist/trade contractor appointments.

4. Communicate waste actions to your team and supply chain, providing training where needed.

5. Collect data on waste arisings into the SWMP, following the method for measurement and reporting agreed by members of the **UK Contractors Group and Civil Engineering Contractors Association**.
## 9.0 Guidance and tools

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<tr>
<th>Tool</th>
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<tr>
<td><strong>Policy stage</strong></td>
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<tr>
<td>Model procurement requirements for reducing waste to landfill</td>
<td>Helps the client ensure that their design team quantifies the potential to cut waste and costs from an early design stage (where most of the potential for waste reduction and reuse lies).</td>
<td><a href="http://www.wrap.org.uk/procurement_requirements">www.wrap.org.uk/procurement_requirements</a></td>
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<tr>
<td>Guidance for client project managers</td>
<td>Helps the client’s team plan for key actions to be taken throughout the life of the project</td>
<td><a href="http://www.wrap.org.uk/constructionclient">www.wrap.org.uk/constructionclient</a></td>
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<tr>
<td>Guidance for minor works</td>
<td>Helps the client identify and ask for cost-effective actions on smaller projects and programmes of minor works</td>
<td><a href="http://www.wrap.org.uk/constructionminorworks">www.wrap.org.uk/constructionminorworks</a></td>
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<tr>
<td><strong>Preparation &amp; Design stage</strong></td>
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<tr>
<td>Designing out Waste (DoW) guides for buildings and civil engineering (plus design details)</td>
<td>Helps clients and designers identify approaches and solutions for reducing waste during the design development process.</td>
<td><a href="http://www.wrap.org.uk/designingoutwaste">www.wrap.org.uk/designingoutwaste</a></td>
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<tr>
<td>Designing out Waste (DoW) tools for buildings and civil engineering</td>
<td>Helps the design team to quickly estimate the waste and savings from DoW actions at an early design stage, identify the top options and select specific actions.</td>
<td><a href="http://www.wrap.org.uk/nwtool">www.wrap.org.uk/nwtool</a></td>
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<tr>
<td>Net Waste Tool</td>
<td>Allows the design team to forecast waste and calculate the potential savings by working towards good practice wastage rates on major components. Also identifies which opportunities will yield the biggest savings, and how to optimise materials recovery.</td>
<td><a href="http://www.wrap.org.uk/nwtool">www.wrap.org.uk/nwtool</a></td>
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<td>Wastage rate cost-benefit case studies</td>
<td>Helps the design team understand the likely quantum of cost savings in a certain building types through achieving lower than standard wastage rates.</td>
<td><a href="http://www.wrap.org.uk/constructioncba">www.wrap.org.uk/constructioncba</a></td>
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<tr>
<td>Design review exemplars</td>
<td>Helps the design team understand the likely quantum of cost savings on actual projects and the actions/practice behind them.</td>
<td><a href="http://www.wrap.org.uk/designingoutwaste">www.wrap.org.uk/designingoutwaste</a></td>
</tr>
<tr>
<td>Aggregain case studies on reuse and guidance on reuse options</td>
<td>Demonstrate how reuse and recycling on actual projects led to direct cost savings. Clients and design teams can learn from these practices and the likely relevant savings.</td>
<td><a href="http://www.aggregain.co.uk">www.aggregain.co.uk</a></td>
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<tr>
<td>Regeneration guide</td>
<td>Helps design teams link the materials recovered on site to their use in new construction.</td>
<td><a href="http://www.wrap.org.uk/construction/tools_and_guidance/regeneration.html">www.wrap.org.uk/construction/tools_and_guidance/regeneration.html</a></td>
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<tr>
<td>Off site construction case studies</td>
<td>Helps the design team establish the likely savings by adopting OSC into their project.</td>
<td><a href="http://www.wrap.org.uk/offsiteconstruction">www.wrap.org.uk/offsiteconstruction</a></td>
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<tr>
<td>SWMP Template</td>
<td>Helps the design team prepare a design stage SWMP, setting out the waste forecasts and waste reduction actions, so that the main contractor, trade contractors and waste contractor can price their tenders competitively (with regard to the amounts and types of waste expected and the actions to be taken to enable lower wastage allowances to be adopted).</td>
<td><a href="http://www.wrap.org.uk/swmp">www.wrap.org.uk/swmp</a></td>
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<tr>
<td>Model procurement requirements for reducing waste to landfill</td>
<td>Helps the design team include requirements in the contractor ITT, so that the tender price reflects the cost saving potential.</td>
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<tr>
<td>■ SWMP Template</td>
<td>Enables the client to check that design team actions for waste reduction will be implemented in the works</td>
<td><a href="http://www.wrap.org.uk/swmp">www.wrap.org.uk/swmp</a></td>
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<tr>
<td>■ Model procurement requirements for reducing waste to landfill</td>
<td>Helps the main contractor include requirements in the ITT and appointments for trade and waste contractors, so that their tender prices reflect the cost saving potential and waste data are reported</td>
<td><a href="http://www.wrap.org.uk/procurement_requirements">www.wrap.org.uk/procurement_requirements</a></td>
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<tr>
<td>■ Material Logistics Plan</td>
<td>Helps the contractors achieve lower wastage rates and hence cost savings, through planning for and implementing better material handling and storage on sites</td>
<td><a href="http://www.wrap.org.uk/materiallogistics">www.wrap.org.uk/materiallogistics</a></td>
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<tr>
<td>■ CD&amp;E waste measurement and reporting method</td>
<td>Helps the contractor report back to the client on waste reduction and recovery using industry agreed metrics materials recovery.</td>
<td><a href="http://www.wrap.org.uk/reportingportal">www.wrap.org.uk/reportingportal</a></td>
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<td><strong>Handover, Post-completion &amp; Use stage</strong></td>
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<tr>
<td>■ SWMP Template</td>
<td>Helps the client check the detailed record of waste generation and the extent to which design team forecasts/savings have been achieved.</td>
<td><a href="http://www.wrap.org.uk/swmp">www.wrap.org.uk/swmp</a></td>
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<tr>
<td>■ SWMP Tracker</td>
<td>Helps the client aggregate the data from multiple SWMPs with minimum effort.</td>
<td><a href="http://www.wrap.org.uk/swmptracker">www.wrap.org.uk/swmptracker</a></td>
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</table>
WRAP and Davis Langdon believe the content of this report to be correct as at the date of writing. However, factors such as prices, costs of waste disposal, taxation levels and regulatory requirements are subject to change and users of the report should check with their supply chain to confirm the current situation. The views and recommendations within this report are based upon normal contracting conditions and consideration must be given to the relevance of this guidance to each project type. Particular care should be taken in using any of the cost information provided as it is based upon numerous project-specific assumptions (such as scale, location, tender context, etc.).

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