Ownership of waste
Ownership of Waste

Executive Summary

This project forms part of the Construction Resources Waste Platform (CRWP) programme of work undertaken in 2009 and whether the different procurement approaches commonly used by the industry offer adequate incentives to minimise waste in the supply chain.

The study evaluates the three main procurement methods, traditional design led, design and build and PFI, used by the construction industry with the aim of highlighting the stages whereby the ownership for waste could be clearly assigned within the supply chain to help minimise construction waste. The study provides a brief description of each procurement route and the contractual relationships of the key players – client, design team (including the CDM Supervisor), the main contractor and sub-contractors.

Three live Kier Construction projects were visited each operating under a different procurement route and each included the requirement for a BREEAM Very Good certificate. The key players on each project were interviewed using structured questionnaires. The research analysed brick and block and dry lining work packages to evaluate and highlight how the client and main contractor set requirements on resource efficiency and how this is embedded into trade contractors work packages. UK dry lining and brick and block contractors were contacted via their trade organisations representing them. The following trade associations were contacted: Association of Brickwork Contractors, Federation of Plastering and Drywall Contractors and Association of Interior Specialists. A list of questions was prepared on resource efficiency measures that might be included in the tender documentations of the two trade packages. The information for this project was collected during the site visits, telephone interviews and exchanges via e-mails.

For all three projects, there was no requirement set by the client for waste management and as such there was no particular mention of waste within the briefing documents. This may be because clients believe that waste is being addressed as part of BREEAM. The client has no ownership of waste at this stage and therefore little incentive to reduce it, even though they are responsible for the Site Waste Management Plan (SWMP) before construction begins.

In terms of the tender process, under the traditional procured project, the contractors had little incentive to minimise waste. On the PFI and design and build, examples were asked how waste minimisation had been addressed by the teams in the past, although there was no direct incentive to minimise waste or to meet any targets.

Once construction commenced on all projects, the ownership of waste clearly sat with the principal contractor; although some of this may be passed to sub-contractors and most are contracted to supply both labour and materials with an agreed wastage allowance. In terms of the close out meeting waste is not featured for any of the projects. In terms of overall recommendations it is suggested that waste management costs should be arrived an early during the tender stage and clients should be clear in their objectives and requirements for waste. Targets should be set on waste reduction and monitored appropriately. Evaluation of how resources have been used should be undertaken during the close out meeting.

1. The Construction Resources and Waste Platform was funded by Defra to provide support to businesses in the construction sector. It ended in 2010. For more information, go to: www.constructionwaste.info
Ownership of Waste

Ownership of Waste
The project forms part of the Construction Resources Waste Platform (CRWP) programme of work undertaken in 2009\(^2\). This task examines the waste generated during a construction project and whether the different procurement approaches commonly used by the industry offer adequate incentives to minimise waste in the supply chain.

The reduction of waste is one of the main areas where the construction industry can save money, by being more resource efficient with the materials used on the project and paying less for waste removal as a result. The industry uses large quantities of materials and produces large quantities of waste.

Previous research undertaken by CRWP found that the wastage rates of certain construction products can vary between 2% to 40\(^3\). For example the wastage rate added onto the Bills of Quantity (BoQ) for ceramic bricks was 5%. The measured brick waste was 24%, which meant that instead of paying approximately £2,200 for the material waste, the site had to pay £10,200. This price only included the price paid for the wasted material. If the cost of waste removal and labour costs of filling the skip are added then the true cost of waste would be much higher. Therefore the construction industry has real opportunities to reduce the material use. To demonstrate the true cost of waste, CRWP have developed ‘the true cost of waste calculator’, available at www.wastecalculator.co.uk

The Site Waste Management Plan (SWMP) Regulations were introduced in England, with the primary aim of requiring construction companies to account for the different quantities and types of waste they produce and to ensure that they make efforts to divert as much waste as possible from landfill. Construction projects use many sub-contractors, or work package contractors to complete a given job. All the work packages carried out on the site produce waste, which needs to be paid for from a project’s overall budget.

This project seeks to evaluate three construction projects using three procurement methods:

- Traditional design led procurement
- Design and Build
- Private Finance Initiative (PFI)

---

1. Introduction

2. The Construction Resources and Waste Platform was funded by Defra to provide support to businesses in the construction sector. It ended in 2010. For more information, go to: www.constructionwaste.info

3. Wastage Rate Report, 2008 CRWP; available on www.constructionwaste.info
A brief description of these procurement types is provided below.

1.1 Traditional design led procurement

Figure 1. Traditional design led procurement - contractual links

The client (or employer) obtains tenders from and then contracts with a design team – architect, engineers, surveyors etc - to carry out the design based on the client brief. A project manager may also be appointed to represent the client’s interests. The client obtains tenders and enters into a contract with a building contractor to build that design. The project manager or one of the members of the design team (architect or engineer), acting as the client’s agent, supervises the construction of that design.

Under the traditional or competitive tender route the client is involved in separate tendering for the design stage and the construction stage of the project. As a result, there are two distinct phases of appointment into which the requirement for waste management should be incorporated – first with the designer and then with the main contractor tendering for the job. Traditional building contracts are usually architect led and the procedures followed are modelled on the RIBA Outline Plan of Work (2009).
1.2 Design and Build

The development of Design and Build procurement has increased and grown in popularity since the 1970’s. The contractor tenders against a client brief, and will often follow an initial concept design prepared by consultants appointed to advise the client. The design role will be taken and developed by the appointed contractor and the works will be completed, usually for a fixed price.

Tendering is more expensive and carries more risk for the contractor than the traditional approach. This is because the contractor has to develop an outline design and a detailed price during the tender process. Tender lists will probably be shorter than for traditional contracts.

The Design and Build contract could also include a partnering agreement that is created between clients and their preferred contractors they have worked with previously. The ethos behind partnering is that the client and the Design and Build contractor work as a team from the outset, resolving disputes in a non-adversarial manner sharing both risks and rewards and aiming for continuous improvement.

If a project uses a partnering framework a further document, the partnering agreement, is produced clearly setting out the high-level objectives (eg reducing waste on site) and performance measures of the framework and defining the roles and responsibilities of the different partners. There should also be an expectation that the partners demonstrate continuous improvement in performance.
1.3 The Private Finance Initiative (PFI)

The PFI was set up to facilitate closer co-operation between the public and private sectors and introduce private sector skills, finance and disciplines into the delivery and management of projects and services traditionally undertaken by the public sector. Under the most common form of PFI, the private sector designs, builds finances and maintains (DBFM) facilities based on ‘output’ specifications decided by public sector managers and their departments.

Long tendering and negotiating (clarification) periods proceed the awarding the contract to suppliers. Framework contracts are used in most PFI contracts whereby approved suppliers are chosen and preferred. PFI contractors will have their own framework contractors and suppliers. These framework suppliers include contractors, specialist contractors, supplier of goods, and suppliers of professional services (such as architects and surveyors).
PFI is a system where private companies build and sometimes manage large projects such as hospitals or roads, and then the government pays to use them. PFI is used to deliver services only after rigorous assessment has shown that it will provide better value for money compared to traditional public sector investment. Investments through PFI contracts currently represent circa 10-15% of total investment in public services in any one year.

PFI allows the public sector to contract with the private sector to provide services on a long-term basis, typically 25-30 years, so as to take advantage of private sector infrastructure delivery and service management skills, incentivised by having private finance at risk. The private sector takes on the responsibility for providing a service against an agreed specification of required outputs prepared by the public sector.

The private sector carries the responsibility and risks for designing (as with Design and Build), but also financing, enhancing or constructing, maintaining and operating the asset to deliver the service in accordance with the client’s output specification. The public sector typically pays for the project through a series of performance or throughput related payments, which cover service delivery and return on investment. Central Government may provide payment support to the public sector through grants and other financial mechanisms.

Because the PFI Special Purpose Company or Vehicle funds the construction of the asset, it has a vested interest in keeping these costs minimised and under control and should be interested in the potential of reducing the costs of waste during construction and during occupation.

These three procurement types were analysed with the aim of finding out who ultimately pays for the cost of waste within the supply chain engaged on construction.

Once the responsibility for the ownership of waste was been established a detailed assessment of two trade work packages were evaluated to highlight how the client and main contractor requirements on resource efficiency and waste minimisation is embedded into trade contractors work packages. The two trade contractor work packages selected for analysis were:

> Brick & Blockwork and
> Dry lining

These two work packages were chosen for analysis on the basis that on most construction sites both plasterboard and brick and block building materials are used. The use of plasterboard is widespread within all construction sectors. In many cases the internal wall and ceiling areas in the building are constructed using plasterboard.

The Federation of Plastering and Drywalling Contractors (FPDC) has set commitments to reduce and manage plasterboard waste effectively. There have been many initiatives applied to the plasterboard sector, in terms of waste and sustainability and as such the Plasterboard Sustainability Partnership (PSP) has been set up. The PSP is made up of the broad range of stakeholders involved in the production, installation and disposal of plasterboard as well as the relevant government departments and regulatory agencies. The brick and block trade contractors are represented by the Association of Brickwork Contractors (ABC). As part of this project, the members of both trade associations were contacted to establish how and when the work packages are typically procured on projects, payment and other information and how this affects plasterboard and brick and block waste management practiced on construction sites. Additionally, the Association of Interior Specialists (AIS) was also consulted as they had undertaken a simple survey of their members on plasterboard waste.

5. For more information on the Plasterboard Sustainability Partnership go to: http://www.plasterboardpartnership.org/
2. Methodology

The structure and content of the procurement documents used to set up contracts within the construction of commercial developments were investigated by this project.

Current construction projects using traditional, design and build and PFI procurement methods were found. BRE located the three projects with the help of the Kier Group which is a leading construction, development and service group specialising in building and civil engineering, support services, public and private house building, property development and the Private Finance Initiative (PFI).

Kier participated in the project because they continually try to drive the efficient use of resources within their business units and construction sites located throughout the UK. Once the projects were located, questions that focused on waste related issues that could be incorporated within the different procurement documentation were collated. Literature on procurement documentations used by the construction industry was reviewed such as WRAP’s guidance on “Procurement requirements for reducing waste and using resources efficiently.” The waste related procurement questions were formulated based on this information. These questionnaires formed the basis of the site visit interviews that BRE set up with the relevant personnel representing the main contractor, the client, architects and consultants employed by the three different projects.

The following sites were visited in March 2010:

- Project A – D&B, Kier North West, Wirral - education
- Project B – PFI, Kier Eastern, Ipswich – detention centre
- Project C – Traditional, Kier Eastern, Southend - education

The second part of the research analysed brick and block and dry lining work packages to evaluate and highlight how the client and main contractor set requirements on resource efficiency and how this is embedded into trade contractors work packages. UK dry lining and brick and block contractors were contacted via their trade organisations representing them.

The following trade associations were contacted in April 2010:
- Association of Brickwork Contractors (ABC)
- Federation of Plastering and Drywall Contractors (FPDC)
- Association of Interior Specialists (AIS)

A list of questions was prepared on resource efficiency measures that might be included in the tender documentations of the two trade packages.

The information for this project was collected during the site visits, telephone interviews and exchanges via e-mails.

3. Findings

The findings presented in this section are based on the information gathered from the construction site teams during the site visits. The questions presented to the different construction teams, their clients, and designers grouped into three sections within the report.

These are:

> Pre-construction – this section groups together the information that the project teams need to fulfil before the actual contract is awarded.
> Construction – information in this section relates to how waste management is implemented on the site using different procurement methods.
> Post-construction – this section relates to information collected by the project team on evaluating how resource efficiency measures and best practice have been implemented on projects using different procurement methods.

3.1 Pre-construction

The pre-construction waste related questions that were collated for D&B, PFI and traditional procurement types are presented in a table listing the feedback from the site teams in separate columns. Table 1 presents the findings on the type of information and controls the client requires from the construction project teams which are invited to bid for a particular contract.

<table>
<thead>
<tr>
<th>Client policy Questions</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management and ownership of the waste policy and its target.</td>
<td>No management of this on the part of the client.</td>
<td>No management of this on the part of the client.</td>
<td>No management of this on the part of the client.</td>
</tr>
</tbody>
</table>

On all three procurement types overall requirement of the client from the project teams tendering for the contract is to achieve BREEAM ‘very good’ certification. Reaching BREEAM certification is a pre-requisite on all Government funded construction projects. All the projects that participated in this study were Government funded projects. There is no specific reference to the clients’ policy on waste minimisation and diversion from landfill commitment and how waste will be managed on site at this stage.
3.1.1 Building Research Establishments
Environmental Assessment Method (BREEAM)

BREEAM (Building Research Establishment’s Environmental Assessment Method)\(^7\) is the world’s leading and most widely used environmental assessment method for buildings, with over 115,000 buildings certified and nearly 700,000 registered. It sets the standard for best practice in sustainable design and has become the de facto measure used to describe a building’s environmental performance. Credits are awarded in nine categories according to performance. These credits are then added together to produce a single overall score on a scale of Pass, Good, Very Good, Excellent and Outstanding.

The nine sections that are assessed and the available credits are shown in Table 2. This is for BREEAM 2008.

Table 2. BREEAM sections

<table>
<thead>
<tr>
<th>BREEAM section</th>
<th>Credits available</th>
<th>Section weighting (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Health and wellbeing</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Energy</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>Transport</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Water</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Materials</td>
<td>12</td>
<td>12.5</td>
</tr>
<tr>
<td>Waste</td>
<td>7</td>
<td>7.5</td>
</tr>
<tr>
<td>Land use and ecology</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Pollution</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

The process of determining a BREEAM rating is:

For each BREEAM section the number of credits awarded must be determined by a BREEAM assessor in accordance with the BREEAM requirements (detailed in the technical sections of the scheme manual).

- The percentage of the credits achieved is calculated for each BREEAM section.
- The percentage of credits achieved is then multiplied by the corresponding BREEAM section weighting (see note below). This gives the section score.
- The section scores are then added together to give the overall BREEAM score. The BREEAM score is compared to benchmarks and, provided all minimum standards have been met, the relevant BREEAM rating is achieved.
- An additional 1% can be added to the final BREEAM score for each Innovation credit achieved (up to a maximum of 10%).

The credits for waste are made up as follows in Table 3:

Table 3. BREEAM credits for waste

<table>
<thead>
<tr>
<th>Waste 1 Construction site waste management plan</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to three credits are available where evidence provided demonstrates that the amount of non-hazardous construction waste (m(^3)/100m(^2) or tonnes 100m(^2)) generated on site by the development is the same as or better than good or best practice levels.</td>
<td>3</td>
</tr>
<tr>
<td>Where evidence provided demonstrates that a significant majority of non hazardous construction waste generated by the development will be diverted from landfill and reused or recycled.</td>
<td>1</td>
</tr>
</tbody>
</table>

\(^7\) For more information on BREEAM, go to www.breeam.org
Table 3. BREEAM credits for waste (continued)

<table>
<thead>
<tr>
<th>Waste 2 Recycled aggregates</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where evidence provided demonstrates the significant use of recycled or secondary aggregates in ‘high-grade’ building aggregate uses.</td>
<td>3</td>
</tr>
<tr>
<td>Where evidence provided demonstrates that a significant majority of non-hazardous construction waste generated by the development will be diverted from landfill and reused or recycled.</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Waste 3 Recyclable waste storage</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where a central, dedicated space is provided for the storage of the building’s recyclable waste streams.</td>
<td>1</td>
</tr>
<tr>
<td>Where, in addition to the above, policies/procedures have been established which:</td>
<td>1</td>
</tr>
<tr>
<td>a. Include procedures for collection and recycling of consumables</td>
<td></td>
</tr>
<tr>
<td>a. Are endorsed at the school governor level</td>
<td></td>
</tr>
<tr>
<td>a. Will be operational at a local level</td>
<td></td>
</tr>
</tbody>
</table>

Although few BREEAM credits can be obtained under waste and the percentage weighting further reduces the impact, it is nevertheless worth noting that the project team may find that some other sections are difficult for some sites – such as transport over which the team may have little influence. In which case the importance of high scores elsewhere become more vital, particularly when aiming for BREEAM Excellent.

Government clients are now asking for at least Very Good and often Excellent and this is an easy win in the client brief aiming at reducing waste generated on site.

Ideally the clients should state their policies on environmental issues and the commitments their organisation has towards the reduction of waste.
Writing the project brief is one of the most important aspects of the procurement process as the requirement of the clients and the users of the building are communicated to the project teams tendering for the contract at this stage. Table 4 lists information on waste that might be included within the clients’ project brief.

Table 4. Possible content of project brief prepared by the client relating to waste.

<table>
<thead>
<tr>
<th>Client preparation project brief</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference to site waste management at the project’s preparation/briefing stage?</td>
<td>The design drawing and the specification of the materials for the building have been designed on the basis of client’s requirement. The architect and the client were involved at the project briefing stage. The main contractor only received the outcome of the project brief. It is unlikely that SWMP was specifically discussed at this stage. However it was specified that BREEAM ‘very good’ certification needs to be met by the designer and the contractor needs to participate in achieving this certification on the project.</td>
<td>There is no reference to waste at the project’s preparation / briefing stage.</td>
<td>Information in the project brief relates to room sizes, sound insulation and issues relating to the design of the building. Waste issues are not discussed but energy use is as it has a significant effect on achieving BREEAM ‘very good’ certification.</td>
</tr>
<tr>
<td>Is the preparation of the SWMP at the project’s briefing stage a client requirement?</td>
<td>Initially the client should start the SWMP. This does not happen.</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Within traditional procurement, the client appoints an architect and a design team to prepare the design and drawings for the project based on the client’s requirement. The client discussed the project specific design requirements such as achieving BREEAM ‘very good’ certification with the architect on project C. However the implementation of the Site Waste Management Plan (SWMP) was not specifically discussed. The Construction Design Manager (CDM) co-ordinator who is the client representative on the construction project prepared and started the SWMP.
Within PFI and Partnership for Schools (PfS) National Framework, D&B procurement type projects, less prescriptive statements of requirements are listed at the project briefing stage than is the case with projects using traditional procurement methods. Requirements are related to capacity of the building, space issues and quality of the design. Environmental issues are incorporated within the design by requiring the project teams to prepare the design drawings and materials specifications for the buildings to achieve BREEAM ‘very good’ certification. The PFI project B required BREEAM ‘very good’ certification and the D&B project A needs to achieve BREEAM for schools ‘very good’ certification.

On both PFI and PfS projects the main contractors applying to tender for the contract appoint their own designers and as a result have greater input into the design process. The PFI and PfS project teams were interviewed to find out if there was reference made to the site waste management at the project’s preparation/briefing stage. They stated that the client’s project briefs did not specifically refer site waste management and the preparation of a SWMP at this stage. Under the Regulations it is a requirement of the client to initiate the SWMP for the proposed site and project. This document is passed down to the relevant parties once the contract had been awarded.

Although the clients expressed the overall sustainability standards that they required from the project teams by requiring BREEAM certification of the buildings, references to waste minimisation and SWMP were not specifically made at this stage. This would suggest that the ownership of waste is not considered by the clients at the briefing stage of the procurement process.

**Recommendations at preconstruction:**

- Clients should include the commitment that their own organisation has towards resource efficiency, within the briefing stage of the procurement process.
- Clients should set measurable resource efficiency targets that construction teams need to meet if they are to win the contracts. Resource efficiency targets should be formulated that stand alone from the requirement to achieve BREEAM certification on the project. However they can inter-relate to the waste credits under BREEAM.
- In line with the SWMP Regulations the clients should start the SWMP of the proposed site and than pass this onto the relevant parties.

**3.1.2 Pre-Qualification Questionnaire (PQQ)**

Pre-qualification is a part of the pre-contract supplier appraisal. It is an essential step in deciding whether a supplier is sufficiently capable of timely and quality supply at an acceptable price. If the supplier meets the pre-qualification criteria, the supplier may be invited to tender or negotiate for the purchasing organisation’s business.

The Pre-Qualification Questionnaire (PQQ) sets out the information which a bidder is required to provide to the client and funding body. This is the first stage of the identification of the preferred private sector partner (PSP). The aim of the pre-qualification selection process is to enable the client and funding body to draw up a list of pre-qualified bidders. Whilst it tends to concentrate on issues such as turnover, general experience and bank details, questions are often asked about environmental policies, which open up the opportunity to explore the bidder’s policy on site waste minimisation and management. Table 3 lists waste related questions that could be incorporated within the PQQ by the client.
Table 5. Content of PQQ prepared by the client relating to waste.

<table>
<thead>
<tr>
<th>PQQ stage</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is meeting waste minimisation/landfill diversion targets included in the</td>
<td>There is no specific waste minimisation target but</td>
<td>Yes. There is a section on environment and waste management that the main</td>
<td>Yes. Contractors and designers applying for the contract are asked</td>
</tr>
<tr>
<td>PQQ when contractors and consultants apply to be short-listed for the</td>
<td>BREEAM certification needs to be achieved. The onus</td>
<td>contractor and consultants need to complete.</td>
<td>about waste minimisation.</td>
</tr>
<tr>
<td>contract?</td>
<td>is on the project’s designer to achieve the</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>certification. The main contractor needs to</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>implement the client’s requirement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How are the consultants assessed by the main contractor to see if the</td>
<td>The main contractors do not assess the designers.</td>
<td>Once the client has released the PQQ documents questions, the main contract</td>
<td>The whole design team is asked about it.</td>
</tr>
<tr>
<td>waste minimisation requirements are being met?</td>
<td>The CDM co-ordinator monitors the performance of the</td>
<td>or will ask the designer to design out waste.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>contractors in respect to waste on site.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the designer is appointed by the main contractor, how is waste</td>
<td>The contractor does not appoint the designer.</td>
<td>Try to look to standardised units and buildings on site through the design</td>
<td>The contractor has a design meeting with the design team, during which</td>
</tr>
<tr>
<td>minimisation incorporated into the design process?</td>
<td></td>
<td>process.</td>
<td>inclusion of recycled aggregates into the development is discussed.</td>
</tr>
<tr>
<td>Does the main contractor place a requirement on the designer to design</td>
<td>The main contractor does not have the authority to</td>
<td>There is no requirement contractually.</td>
<td></td>
</tr>
<tr>
<td>out waste?</td>
<td>place this requirement onto the designer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does a SWMP have to be prepared by the main contractor when tendering for</td>
<td>No. The designer has a dual role acting as both</td>
<td>In some cases. The general tendency is to prepare this when starting on the</td>
<td>When the contractor tenders for the job they do not have all the</td>
</tr>
<tr>
<td>the PQQ contract (and when?)</td>
<td>designer and CDM co-ordinator on the project.</td>
<td>however there are some instances that the SWMP is done.</td>
<td>information relating to the project. Waste issues and the SWMP are</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>not evaluated at that stage.</td>
</tr>
</tbody>
</table>
Table 5. Content of PQQ prepared by the client relating to waste. (continued)

<table>
<thead>
<tr>
<th>PQQ stage</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>How the waste quantities are forecasted on the project; are these in the</td>
<td>The designer uses forecast waste figures from WRAP guidelines on forecasting</td>
<td>Three different ways:</td>
<td>The sub-contractors who work on the project will give forecast figures based on their experience. Estimates are also used from the SMARTWaste Plan.⁸</td>
</tr>
<tr>
<td>SWMP?</td>
<td>waste generation.</td>
<td>1. The quantity surveyors will estimate the waste quantities using the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BoQ documentation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. The quantity surveyor will ask the different sub-contractors who</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>supply materials and labour to site to give estimates of the waste</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>that they will produce.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Using SMARTWaste quantity benchmark tool.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. The best way to get the quantity information is from the sub-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>contractors. This is the most correct information.</td>
<td></td>
</tr>
</tbody>
</table>

Within **PFI** and **D&B** PQQ documents evidence needs to be provided by the main contractors bidding on information regarding the quality assurance, health and safety, environmental protection, employees and equality in the workplace. The bidders need to provide information to a range of standard questions. These requirements apply to all projects and all contractors completing the PQQ. They are required to supply evidence on how their organisation treats their employees, the environment and that the work that is required from the employees are done in a safe manner.

Examples are:

> Please confirm whether the Bidder, LEP Investors, PFI Investors and/or any of its named supply chain members are currently, or are in the process of becoming, accredited to International Standards Organisation BS EN ISO9000 and BS EN ISO14001, Investors in People (UK only) or other recognised or equivalent quality standard. Please state appropriate assessment level and enclose a copy of the certificate.

---

⁸ SMARTWaste Plan is BRE’s tool to prepare and implement Site Waste Management Plans. For more information go to: [www.smartwaste.co.uk](http://www.smartwaste.co.uk)
Ownership of Waste

> Please enclose details of any prosecutions, enforcement notices or other statutory notices served on the Bidder, LEP Investors, PFI Investors and/or any of its named supply chain members by the Health and Safety Executive, Environment Agency (equivalent organisations if not a UK based bidder) or under any other relevant or equivalent legislation (e.g. planning, control of pollution, noise pollution, etc).

These questions are there to ensure that the bidders have a suitable management system in place to manage the environmental impacts that may arise on the projects’ construction phase.

The traditional PQQ document had one question - whether the bidder had previous experience on working on projects that needed to achieve BREEAM certification.

> Give details of your experience working on projects where BREEAM was applicable or a requirement.

Questions relating to how the designers are going to design out waste were referred to within the approach to sustainability part of the D&B PQQ. This section asked the bidders to state the following:

> Approach to Sustainability

• Bidders should describe the ways in which they will reduce construction waste; specifically identifying:
  • How they will review each scheme to identify, prioritise and select options to design out waste;
  • How they will communicate and embed information into their Site Waste Management Plan;
  • Issues which they consider to be the main barriers to achieving low levels of waste and high levels of waste recovery.

In the PfS D&B PQQ documentation that applies to Project A there is also a specific section on waste:

PfS is committed to reducing waste to landfill and increasing reuse and recycling rates. Therefore, bidders are required to respond to the following questions:

> What experience, if any, does your company have in forecasting waste arising and identifying and implementing options to reduce waste and increase waste recovery and how accurate were those forecasts.

> What experience, if any, does your company have in preparing a Site Waste Management Plan at the design stage which results in quantified reductions in waste to landfill?

> What experience, if any, does your company have in evaluating recycled content and specifying building materials containing higher recycled content as well as reused materials? (Recycled content is the proportion, by mass, of recycled material in a product. In various product categories, cost competitive mainstream products are available with higher levels of recycled content than others in the same category.)

In the PFI PQQ document, relevant to Project B, the bidders were asked to provide evidence for the following statement:

> Please outline the processes that you implement to reduce, reuse and recycle waste on projects. Provide up to 3 examples where this has been used and the amounts of waste reduced, reused or recycled on your projects.

All the PQQ documents requested information on waste reduction, apart from the traditional procurement project, to ensure that those bidding for the contracts can demonstrate with past examples how they managed to reduce waste on site. None of the PQQ documents asked the bidders to achieve a set KPI target on waste. It
appears that standard questions are asked by the clients as there were no specific and measurable targets for waste reduction included within the contract documentation.

The site team were interviewed and asked the level to which the main contractor places a requirement on the designers, selected to undertake the work on D&B contract. The site team stated that once the client passed onto the PQQ stage there were no questions asked by the client of the designer to design out waste. Moreover it appears that the designers were not contractually bound to reduce waste in their designs. However the main contractor did have a discussion with the designer on how the units and buildings could be standardised to design out waste. Since the D&B contractor employs the designer partly in order to reduce the overall costs of the project, the main contractor wanted to ensure that the design of the buildings aids the speed of construction. The designers were encouraged to use pre-manufactured elements to cut waste production on site and also to reduce the construction programme.

Within the PFI PQQ documentation, waste minimisation questions are asked of the consultants and contractors applying for the contract. Similarly, as in the D&B procurement documentation, the designers are not contractually bound to design out waste. The main contractor has a design meeting with the design team, during which inclusion of recycled aggregates into the development is discussed.

In the traditional contract documentation, no specific waste minimisation targets were included but BREEAM certification has to be achieved. The onus is on the project’s designer to achieve the certification and the main contractor needs to co-operate with the designer to implement the client’s requirement. Within the traditional contract, the main contractor short listed to undertake the contract does not have the authority to place waste minimisation requirements onto the designer as the contractor does not appoint the designer.

The SWMP is prepared by the designer who also acts as a CDM co-ordinator within Project C’s traditional procurement type contract. Waste issues and the SWMP are not stated and evaluated at the PQQ stage. The SWMP will only be prepared when the contract is won.

Within the SWMP, waste is forecasted using three methods:

- Quantity surveyors will estimate the waste quantities using the Bill of Quantities (BoQ) documentation.
- The quantity surveyor will ask the different sub-contractors who supply materials and labour to site to give estimates of the waste that they will produce.
- Using BRE’s SMARTWaste Plan waste forecast tool.

Within D&B and PFI PQQ contracts, the site manager will implement the SWMP. On the traditional procurement contract, the implementation of the SWMP is the responsibility of the CDM co-ordinator.

Recommendation PQQ

- Designers have a significant impact on designing out waste within a building. Questions should be addressed to the designers to identify areas where waste can be minimised via the design of a building / structure. These questions should demonstrate compliance with the standards expected from the main contractor bidding for the work.
- Where feasible and relevant, designers should be encouraged to use any in-situ materials in any new development.
- Set requirements for the waste credits under BREEAM.
- Waste KPIs and targets should be included in the PQQ documentation to enable easier comparison between tenderers.
### 3.1.3 Invitation to tender

The PQQ documents are assessed by the clients and the relevant authority who invited tenderers to bid for the contract. By the preliminary invitation to tender stage, the number of bids has been reduced. Only the shortlisted contractors are invited to partake in this stage of the bidding process.

Table 6. Main tender preferred bidder stage questions on waste asked by Clients

<table>
<thead>
<tr>
<th>ITT stage</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the main contractor applying to be short listed for the contract need to meet waste KPI set by the client?</td>
<td>The main contractor needs to participate in achieving BREEAM certification. The contractor follows the guidance of the CDM co-ordinator.</td>
<td>No KPIs on waste. BREEAM certification needs to be achieved.</td>
<td>The requirement is to meet BREEAM Very Good. The preferred bidder stage may take to 6-9 months. There is nothing specific on waste.</td>
</tr>
<tr>
<td>Are there any incentives offered to the selected main contractor if the waste minimisation and landfill diversion target set by the client is being met?</td>
<td>The main contractor needs to co-operate with the requirements of BREEAM. There are no incentives for the main contractor other than winning the contract in the first place.</td>
<td>No.</td>
<td>No. If you minimise waste you provide incentive to yourself to save on waste disposal and material costs. No inducement to meet target.</td>
</tr>
<tr>
<td>How is waste costed for in the tender?</td>
<td>A waste allowance is made in the tender price based on historical records. This is not an exact science. The sub-contractors will make a monetary allowance for the expected quantities of material waste that will be produced on the site. They will also make an allowance on waste management costs that relates to removing waste materials and packaging from the site.</td>
<td>Sub-contractors need to make allowance for waste produced. Internal estimators when there is a labour only packages i.e. when the main contractor buys the materials the internal estimators set waste cost allowance. The waste allowance will be arrived at by the construction project team looking back at past projects to see how much was spent on waste removal and management on other sites. Waste figures will be used form those projects that are most similar to the project that they are bidding for.</td>
<td>The sub-contractors will give one price for the work package which will also include the waste removal costs. This is not detailed in the contract - the waste cost will be built into the sub-contractor’s price. The main contractor will pay for the removal of waste from site. The waste management and disposal costs that the main contractor will put into the tender documentation will be based on information collected on waste management and removal costs from past projects.</td>
</tr>
<tr>
<td>Who pays for the management and removal of waste on the project?</td>
<td>The main contractor.</td>
<td>The main D&amp;B contactor.</td>
<td>Main PFI contractor.</td>
</tr>
</tbody>
</table>
During this stage of the bidding process, the main contractors are not required to meet waste KPI set by the clients. The requirement stated is to achieve BREEAM Very Good certification by the PFI and D&B contracts. Within traditional procurement, the main contractor needs to participate in achieving BREEAM certification and the contractor follows the guidance provided by the CDM co-ordinator.

The client does not provide financial incentive to the contractors bidding for the job in cases where they demonstrate waste reduction. The onus to reduce waste during the construction phase of the project falls onto the main contractors.

Waste is costed via the main contractors making allowance for the waste produced on the site. Within the D&B contact the main contractor’s internal estimators will make an allowance for waste for labour only work packages. Using labour only work packages means that the main contractor buys the materials and the sub-contractors employed on the project will supply the labour. If the main contractor buys the materials, the site project team has to check and ensure that the sub-contractors do not use more materials than it was costed for within the package documentation.

If the sub-contractors were to buy their own materials, they would have more incentive not to waste it as they would have to pay for the material cost. Main contractors buying the materials for the sub-contractors to use on the site requires careful daily monitoring of waste generated by the sub-contractors. It appears that if the sub-contractors buy their own materials it is more likely that the waste will be reduced on the site. However, the minimisation of material waste will ultimately depend on each individual sub-contractor.

Within PFI procurement projects, the trade contractor will give one price for the work package, which will include the waste removal costs. This is not detailed in the contract. The trade contractors will give a price for the work, which will also include the estimated wastage rate of materials and the cost of labour to take the waste materials from the work areas to the skips. These costs will be built into the sub-contractor’s price. In all cases the main contractor will pay for the removal of waste from site.

On projects using traditional procurement methods, a waste allowance is made in the tender price based on historical records. The trade contractor will make an allowance on the quantity of expected material waste likely to be generated on site. They will also make an allowance on waste management costs that relate to removing waste materials and packaging from the site.

The tender documents submitted to the client will be evaluated by scoring the different elements in the documents. The highest score is given to economic consideration i.e. the client wants to ensure that the main contractor will be able to complete the project financially and that the company is credit worthy. While visiting sites, all the project teams stated that the waste is not scored separately by the client within the tender documentation but is evaluated as part of the environment section which may account for 10% of the overall scores.

Recommendations

- In the ITT documentation the client should request detailed particulars from the short listed contractors regarding how they will meet waste targets set on the project.
- The ITT documentation should include questions on how waste KPI’s were achieved on previous projects.
- Compare wastage on similar projects for contracts that are labour only or labour and materials.
- Incentivise sub-contractors to reduce waste by lowering their wastage allowances and discuss opportunities for reduction.
- Consider scoring the ITT for waste reduction and management.
3.2 Construction stage
This section of the report summarises the waste management practices that have to be implemented by the main contractors on site to fulfil waste requirements as specified by the clients via the different contractual documentations. Table 7 lists the findings on the type of information and controls the main contractors require from the trade contractors bidding for work on a particular contract.

When the winning bidder is selected to undertake construction works on the site within D&B and PFI contracts the work packages of the selected sub-contractors need to be formalised and written up as a contract requiring the sub-contractors to work in accordance to their contracts.

In D&B procurement type projects, the sub-contractor clauses on reducing waste on site are included within labour only work packages. A waste target is set by the main contractor cost estimators, anticipating that a certain percentage of waste will be produced by a given work package. If sub-contractors go over this waste allowance, they will have to pay for the extra material that they wasted above the agreed wastage rate of materials that they have given to the main contractor. They will also need to pay the main contractor for the waste removal costs incurred by the main contractor to remove the material waste produced which is above the agreed wastage rate that was given by the trade contractor to the main contractor. Ownership of waste is passed onto the sub-contractors if the level of waste they produce is more than they have predicted when they have initially priced for the job.

In PFI contracts, the sub-contractor clauses refer to the use of segregated skips by the sub-contractors working on the site.

On Project C, traditional procurement type project, no formal clauses are included within the sub-contractors document on reducing the quantity of waste. Generic requirements that are included relate to placing the correct materials into the correct skip, clearing up work areas, storing materials appropriately and using just in time delivery of materials to the site to eliminate the possibility of damage due to inadequate storage.

Table 7. Main contractor requirements from the site’s project team and sub-contractors on achieving resource efficiency

<table>
<thead>
<tr>
<th>Construction Type</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the contractor use contractural clauses in the sub-contractor tender documentation to encourage them to reduce their waste quantities produced?</td>
<td>No specific clauses on reducing the quantity of waste. Generic statements included placing the correct materials into the correct skip, clearing up work areas, storing materials appropriately and arranging just in time delivery. The main contractor encourages the sub-contractors to cut waste on site.</td>
<td>This is only applicable to labour only work packages. Targets are set by cost estimators on anticipating for example 5% waste produced by this work package. If the sub-contractors go over this waste allowance they will have to pay for the wasted materials that are above the wastage rate and the waste removal costs incurred on the project.</td>
<td>The contractual clauses refer to the use of segregated skips on site.</td>
</tr>
</tbody>
</table>
Table 7. Main contractor requirements from the site's project team and sub-contractors on achieving resource efficiency (continued)

<table>
<thead>
<tr>
<th>Construction</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation and monitoring of SWMP on site.</td>
<td>By main contractor. CDM co-ordinator checks this throughout the project.</td>
<td>By main contractor.</td>
<td>By main contractor.</td>
</tr>
<tr>
<td>Who pays for the management and removal of waste on the project?</td>
<td>Main contractor.</td>
<td>With labour only work packages if greater than the forecasted wastage rate the sub-contractors will have to pay. If they do not clear the site the contractor will charge them. Also they will be charged if excess material is left on site. For example if the trade contractor, on a supply and fix contract, over orders materials and leaves these materials on site the main contractor will charge the trade contractor for the removal of this waste from the site.</td>
<td>If the sub-contractors working on site buy excess materials by over ordering there is a requirement to remove the waste materials themselves. Muck away during site preparation will be removed by the sub-contractors who undertake that job. The sub-contractors will be contra charged if they put the wrong waste in the wrong skip</td>
</tr>
<tr>
<td>Who pays for the removal of hazardous waste?</td>
<td>Main contractor.</td>
<td>Main contractor. Painters are required to remove their own waste.</td>
<td>Main contractor.</td>
</tr>
<tr>
<td>Is there a material take back scheme on site?</td>
<td>Plasterboard. The manufacturer will take plasterboard back in case of over ordering.</td>
<td>Some suppliers. Plasterboard, drainage, general builders' merchants. Returning materials in case over ordering attracts costs for pick up, restocking, put it back on shelf. Have to be in mint condition. The supplier will give credit note to contractor. Limited schemes.</td>
<td>Plasterboard. The manufacturer will take plasterboard back in case of over ordering. Sub-contractor will take some materials back to their yard and will utilise it later. No financial benefit.</td>
</tr>
</tbody>
</table>
Are there any financial incentives for sub-contractors to reduce waste on site?

Traditional: Encourage it. But no financial incentive. They will save money by saving materials.

Design & Build: No

PFI: Encourage it. But no financial incentive. They will save money by saving materials.

Is there a requirement for material segregation on site?

Traditional: There is a requirement to segregate canteen, general construction waste and hazardous waste. The waste management company employed by the main contractor will further segregate the general builders waste at the waste transfer station.

Design & Build: The following materials need to be separated on the site: gypsum wood, metal, cardboard, hazardous waste. The furniture packaging has to be taken back by the furniture supplier. In some cases the furniture covers are reusable.

PFI: Yes. Inert, timber, metal and plasterboard, hazardous waste and cardboard.

How is waste monitoring on site undertaken?

Traditional: Site manager. The waste management company also contributes by sending in monthly reports on number and type of skips removed from the site.

Design & Build: Main contractor site manager or environmental champion.

PFI: Waste management company that supplies the site with skips will issue Waste Transfer Notes (WTNs) when skips are taken to Waste Transfer Station. Percentage of materials recycled sent back to the main contractor. The waste management company gives material specific recycling rates.

Is there a feedback loop to let the client know how the project team progresses on meeting the waste minimisation / landfill diversion target?

Traditional: CDM co-ordinator monitors the SWMP. Client has monthly regular meeting with CDM co-ordinator.

Design & Build: Notice board information on waste is displayed. The client never asks. When the client comes to site for a visit waste is not on the agenda. The cost is the main contractor’s therefore client does not worry about it.

PFI: The client will look into the H&S file. Probably will not look at waste. CDM co-ordinator will compile these documents. The CDM contractor is separate / independent party to the main contractor.
Ownership of Waste

Table 7. Main contractor requirements from the site’s project team and sub-contractors on achieving resource efficiency (continued)

<table>
<thead>
<tr>
<th>Construction</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are there penalties or rewards offered by the client to the main contractor and sub-contractors if they miss or reach the set target?</td>
<td>No.</td>
<td>Not on waste. The only requirement is to fulfil legal obligations.</td>
<td>Not on waste</td>
</tr>
<tr>
<td>Who is responsible for the purchasing of materials?</td>
<td>All the materials are purchased by the sub-contractors.</td>
<td>Sub-contractor with exception of brick and block, joinery, and ground works, external works, paving flagging, hard landscaping.</td>
<td>Site procurement personnel and the site project manager. The material order will be sent to the procurement team at head office. The majority of sub-contractors working on site will buy their own materials.</td>
</tr>
</tbody>
</table>

The waste contract is set up with local waste management companies to provide the waste removal from the sites. Project A is located at a large site. As a result the site can accommodate several skips for material segregation. Ground work on project B just started and so far not much waste has been generated on the site. Project C is the smallest site and there is only room for one general skip. The waste management companies used by all three sites have Waste Transfer Stations (WTS). The skips are taken there and the mixed skips will go through segregation. The waste management companies send monthly reports to the site teams on the quantities of waste removed from the sites and the materials sent for recycling and landfill diversion.

The SWMP is set up and implemented by the main contractors on the D&B and PFI procurement projects. The SWMP is started and the waste minimisation statements are written by the CDM co-ordinator and passed onto the main contractor to implement for the duration of the project. The CDM contractor periodically checks the progression of the SWMP.

On all three projects, the main contractor pays for the removal of waste. On D&B contracts, using labour only work packages if the sub-contractors produce more waste the waste allowance forecasted by the main contractor the sub-contractors will have to pay for the removal of excess waste. Moreover, if the sub-contractors do not clear their work areas or if they leave excess materials on site the main contractor will charge them for site clearance. Labour and fix work packages are also required to clear their work areas otherwise the main contractor will charge them for site clearance.

On the PFI procurement project, if the sub-contractors working on site buy excess materials there is a requirement to pay for the removal of the excess materials themselves.
On the traditional procurement project, the responsibility of waste removal and payment for it falls within the remit of the main contractor.

The hazardous waste removal on all three contract types is paid by the main contractor. However on the D&B project the painters are required to remove and pay for their own waste. The site manager on the PFI project stated that those sub-contactors who are responsible for the removal of their hazardous waste will charge the main contractor for it and include it in the tender. Their responsibility is written into the preliminary tender document. On the PFI Project B the hazardous and non-hazardous waste removal is paid by the main contractor. There are no financial incentives given to sub-contactors if they reduce the volume of waste they produce on site. On all three projects, the main contractors encourage the sub-contactors to reduce the volume of waste on site. The main contractor felt that the sub-contactors who buy their own materials will save money by using their own materials more efficiently.

In order to reduce the volume of waste on site, material take back schemes are set up with some of the suppliers on all three procurement type projects. On the D&B project plasterboard, drainage and general builder's merchant products can be returned to the supplier in case of over ordering. This service attracts pick up cost, restocking cost and the products have to be in mint condition. If these conditions are met the supplier will give a credit note to the contractor. These product return schemes offered to the industry are limited.

On all three projects, the sub-contactors need to participate in material segregation that is requested by the main contractors. As to what materials are segregated on the sites will depend on the size of the sites and the appointed waste management contractor's WTS facility. For example on the D&B contract the following materials have to be segregated onsite; gypsum, timber, metals, cardboard, general waste and hazardous waste. The packaging arriving to site from the furniture supplier has to be taken back by the supplier when furniture is delivered to the site. On the PFI contract, the same types of waste materials are segregated without returning the furniture packaging to the supplier. On the traditional contract, there is a requirement to segregate canteen, general construction and hazardous waste. The waste management company employed by the main contractor will further segregate the general builders waste at the waste transfer station.

The purchasing practices of the construction materials on the three Kier projects differ. On the D&B contract with the exception of brick and block, joinery, ground works, external works, paving flagging, hard landscaping the sub-contactors will buy their own material. On the PFI contract the majority of sub-contactors working on site will buy their own materials. For the project using traditional procurement methods all the materials are purchased by the sub-contactors.

The sub-contactors charge the main contractor for a certain percentage of waste allowance produced by their work package, within all procurement type projects. During the site interviews the site project teams have stated that the sub-contactors look at the design of the building and if there is any non-standard design features, more waste allowance would be assumed. For example if the design of the walls are curved instead of straight, the brick and block sub-contractor would count a bigger waste allowance as more bricks would have to be cut to construct a curved wall.

Feedback mechanisms for communicating to the client on the progress to meeting waste minimisation and resource efficiency requirements are not always followed up.

On the D&B project, information on waste is displayed on the site’s notice board. The site manager stated that when the client visits the site issues relating to waste are not on the agenda. The cost of waste removal stays with
the construction company therefore the client does not worry about it. Ultimately however the client pays for the waste removal as the budget for the project comes from the client.

On the PFI project, the client will look into the site’s health and safety file; however it is very unlikely that the client will specifically look at the SWMP. The CDM co-ordinator, who is independent of the construction company, will compile these documents and present them to the client. On the traditional procurement project, the CDM co-ordinator monitors the SWMP. The client has monthly regular meetings with CDM co-ordinator who updates the client on the site’s progress towards meeting the requirements of BREEAM. The site project manager noted that it is very unlikely that the site’s waste issues will be discussed during these meetings.

On the D&B and PFI projects the main contractor has much more involvement on shaping how the project progresses.

On the D&B contract, the main contractor works in partnership with the client and the designer. It is the D&B contractor who appoints the designer for the project and as a result the contractor will have the responsibility to ensure that the waste is minimised on the project via the design stages. The waste management costs are paid by the main contractor who includes a price for waste removal and waste management when the company initially tenders for the job to the client. On the D&B contract the painting work packages are required to remove the paint tins themselves from the site.

On the PFI project, the main contractor who is the 1st tier supplier on the project will have responsibility for the waste management, monitoring and achieving the waste reduction targets and KPI’s on the site. Under the most common form of PFI, the private sector designs, builds finances and maintains (DBFM) facilities based on ‘output’ specifications decided by public sector managers and their departments. If at the end of the construction phase, the PFI contractor also undertakes the facilities management of the buildings, this will provide an incentive for the main contractor to construct the buildings in such a way that uses less energy and waste. Similarly to the D&B contract, on the PFI contract the main contractor will put in a cost for the waste removal and management at the bidding stage. It is in the interest of the main contractor to reduce the cost of waste management and disposal on the site to ensure that the costs are minimised on the project.

Under traditional type contracts, the main contractor has the responsibility of the ownership of the waste. The traditional procurement contract differs from the D&B and PFI contract. Using traditional procurement methods removes the responsibility from the main contractor to implement the requirements set by the client. Within this contract the main contractor has to follow the instructions of the CDM co-ordinator who was chosen by the client. Within traditional contract, the CDM coordinator sets up the SWMP and monitors its implementation during the construction phase. The main contractor puts in a price for the waste management and its removal from site at the bidding stage. The onus is on the main contractor to stay within this waste budget. The main contractor procures the sub-contractor work packages who put in waste removal costs for the waste that their work package is expected to produce on the site. It is in the interest of the sub-contractors to reduce the volume of waste hence saving on their overall waste management costs. This practice is common to all projects using traditional procurement methods.

It appears that on all three procurement projects the main contractor has ownership for the waste.
**Recommendations**

- The main contractor on each procurement type should take on the responsibility for completing and managing the SWMP, to reduce the chain of management.
- Sub contractors should, wherever practicable, be responsible for the procurement of their own materials which should incentivise them to reduce over ordering and encourage them to reduce waste on site.
- Sub contractors should be envisaged to use suppliers that take back surplus materials and/or packaging.
- Waste management and avoidance should be included on the agenda for site meetings with sub contractors.
- Establish contractual clauses for meeting waste targets.
- Engage regularly with the client on waste management issues.

### 3.3 Post-construction

This section of the report looks at how waste minimisation and resource efficiency can be evaluated and the lessons learnt taken forward to implement on other construction projects. Table 8 summarises the requirement that main contractors place on the project’s site teams and sub-contractors to achieve resource efficiency during the post-construction phase of the project.

Table 8. Main contractor requirements from the site’s project team and sub-contractors on achieving resource efficiency.

<table>
<thead>
<tr>
<th>Post-construction</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a close out meeting between the client and contractor to evaluate waste management on the project?</td>
<td>Yes. During the close out meeting the BREEAM documentation and the completed SWMP will be evaluated and signed off by the client.</td>
<td>No. Internal feedback meeting talk about procurement, waste internal meeting</td>
<td>Not waste. BREEAM is reviewed to ensure that the certification required is met. The project also has to meet all the requirements laid down by planning condition and any requirement that the client might have.</td>
</tr>
<tr>
<td>How is good practice/lessons learnt taken forward?</td>
<td>Knowledge about waste minimisation learnt on this project is taken forward. Every project is a learning curve.</td>
<td>Suggestions and best practice scheme run by the main contractor.</td>
<td>Suggestions and best practice scheme run by the main contractor.</td>
</tr>
</tbody>
</table>
When a construction project comes to a close and the buildings are handed over to the client there is an opportunity to evaluate how effective the waste minimisation efforts were on the project. The client, the main contractor and the designers should all participate in the close out meeting. One of the requirements of the SWMP Regulations is to review the SWMP within the three month period after completing the project.

The site project teams were asked if waste management on the site is evaluated during the close out meeting.

On the D&B contract the waste management is not evaluated at the close out meeting. Waste management issues are only discussed during the internal meetings the main contractor has with its sub-contractors and suppliers.

On the PFI project, issues relating to site waste management are not evaluated during the close out meeting. BREEAM is reviewed to ensure that the certification that was specified by the client at the bidding stage of the project was met. During the close out meeting requirements laid down by the planning conditions are evaluated. The project team stated that it is very unlikely that the reduction of waste will be brought up as a separate issue from achieving the BREEAM certification.

On the traditional procurement project the CDM co-ordinator stated that the BREEAM documentation and the completed SWMP will be evaluated and signed off by the client.

Recommendations

> In order to take forward resource efficiency best practice onto new project the lessons learnt should be publicised within the business units of the main contractor.

> On the D&B and the PFI projects, resource efficiency best practice suggestions are distributed via the main contractors’ schemes. Innovations relating to the environment are written up and posted onto the company’s website. To communicate the different innovations implemented on the different projects to the company’s employees the innovations are branded. Innovations relating to the environment receive a green badge, health and safety receive a red badge, and construction innovations receive a blue badge. All the innovations implemented on the site are passed onto the company directors and employees.

> On the traditional project, waste minimisation issues learnt on the project is taken forward. The CDM co-ordinator counts each project as a learning curve.

> There should be a formal review meeting on the effectiveness of the SWMP between the client, contractor and where appropriate the designer. Subcontractors should also be invited to give feedback.
4. Trade contractor work packages

The assessment of two trade work packages are evaluated to highlight how the client and main contractor requirements on resource efficiency and waste minimisation might be embedded into trade contractor work packages. The trade contractor work packages selected for analysis on all three contracts were:

> Dry lining
> Brick and block

The two main contract types used for trade contractors working under main contractors are:

> ‘Supply and fix’ – Within this type of contract the trade contractor supplies the labour and buys the materials needed to complete the work package on the site. The trade contractor buys the materials from their own supply chain.

> ‘Labour only’ – Within this type of contract the trade contractor supplies the labour only. The materials needed to complete a work package on site are purchased by the main contractor through the main contractors’ supply chain.

Table 9. Summarises the waste management requirements placed on brick & block and drylining trade contractors on projects using different procurement methods.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: Removing waste from site and payment for waste removal.</td>
<td>Main contractor pays and organises the removal of</td>
<td>Main contractor pays and organises the removal of</td>
<td>Both B&amp;B and dry lining sub-</td>
</tr>
<tr>
<td>Brick &amp; Block</td>
<td>waste from the site.</td>
<td>waste from the site.</td>
<td>contractors are required to take the</td>
</tr>
<tr>
<td></td>
<td>If the sub-contractors over order materials they</td>
<td></td>
<td>off cuts and waste from work their</td>
</tr>
<tr>
<td></td>
<td>would have to take the surplus materials from the</td>
<td></td>
<td>work area to the designated skip.</td>
</tr>
<tr>
<td></td>
<td>site. The production of waste on site has to be</td>
<td></td>
<td>Waste is then removed via the main</td>
</tr>
<tr>
<td></td>
<td>reasonable.</td>
<td></td>
<td>contractor.</td>
</tr>
<tr>
<td>Drylining</td>
<td>Same as above.</td>
<td>Same as above.</td>
<td>Same as above.</td>
</tr>
</tbody>
</table>

Table 9. Summarises the waste management requirements placed on brick & block and drylining trade contractors on projects using different procurement methods.
Q: Calculation of material wastage rates

<table>
<thead>
<tr>
<th>Questions</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick &amp; Block</td>
<td>Based on historical data and on the assessment of site plans / drawing. The wastage rate will also depend on the design e.g. position of window opening. If there is no BoQ information the material quantities will be calculated using site drawings / plans.</td>
<td>Using the sub-contractors experience over the years. Information is given by main contractor on the design of the building. If projects have an uneconomical size the sub-contractor will put more allowance in for waste. The waste allowance will depend on room size, how modular the building is, and corners for bricks. The sub-contractors have a standard base wastage rate but would change this if the building for example has an unusual shape. Drawing is sent to sub-contractor to use in his estimation. This applies to both B&amp;B and drywall sub-contractors.</td>
<td>The calculation of wastage rates based on experience built up over a 20 year period. The sub-contractors will add a percentage onto the quantities of actual materials needed to do the job. Wastage rate data have been collated on the last 100 jobs the sub-contractor worked on. Historical data lists the measurement of quantities of materials brought and thrown away. The difference between the two quantities is called the wastage rate. Not always the same wastage rates are used. It will depend on the type of construction. The wastage rates for both of the work packages will depend on the height of the ceilings. In case the ceiling heights are standardised and the elements within the buildings are modular and standard it is likely that the wastage rate will be less. In case the construction of the walls is not standard (e.g. curved) it is likely that the wastage rate will be higher.</td>
</tr>
</tbody>
</table>

Table 9. Summarises the waste management requirements placed on brick & block and drylining trade contractors on projects using different procurement methods. (continued)
Table 9. Summarises the waste management requirements placed on brick & block and drylining trade contractors on projects using different procurement methods. (continued)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drylining</td>
<td>Same as above. Often the dry lining sub-contractor will ask the material supplier to estimate the quantities needed.</td>
<td>The wastage rate given would depend on factors such as how high the wall is. If the height is a standard measurement that correlates to sizes of plasterboard. If the design specification states that the plasterboard height is the same height as the wall's height than a standard wastage rate would be applied. This wastage rate would change if the building has an unusual shape e.g. curved walls which would produce more plasterboard off cuts. Drawing is sent to sub-contractor to use in his estimation.</td>
<td>The wastage rates for both of the work packages will depend on the height of the ceilings. In case the ceiling heights are standardised and the elements within the buildings are modular and standard it is likely that the wastage rate will be less. In case the construction of the walls is not standard (e.g. curved) it is likely that the wastage rate will be higher.</td>
</tr>
<tr>
<td>Q: Materials purchasing</td>
<td>Labour and material is purchased by brick and block trade contractors. This provides cost certainty on the project.</td>
<td>Brick and block work-package on site the sub-contractor supplies labour only and the main contractor supplies the materials. Usually the contractor places the order for slightly more than it is required on the BoQ. The material is then called off on requirement basis. Not all materials are delivered to site straight away. When the work package is coming towards the end the sub-contractor will take a final take of and assess if the work would require more materials. If there is any variation, damage, quality issues or the materials does not meet the specification more may need to be ordered.</td>
<td>Brick and block work package on site main contractor pays for both labour and materials. The wastage rate is added onto the quantities needed specified in the BoQ. The sub-contractors will check towards the end of the job to make sure they are not going to run out of materials. The main contractor pays for both the labour and materials. Same as above.</td>
</tr>
</tbody>
</table>
Questions

Trade Contractors

<table>
<thead>
<tr>
<th>Questions</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drylining</td>
<td>Same as above</td>
<td>On the dry lining work package the sub-contractor pays for both labour and materials. Usually the contractor places the order for slightly more than is required on the BoQ. The material is then called off on the requirement basis. Not all materials are delivered to site straight away. Coming towards the end of the work package they will take a final take of and assess if the work would require more materials. If there is any variation, damage, quality issues or the materials does not meet specs then more will be ordered if necessary.</td>
<td>Both the brick and block and the plasterboard materials are bought by main contractor.</td>
</tr>
</tbody>
</table>

Q: Main contractor monitoring waste arising

<table>
<thead>
<tr>
<th>Questions</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick &amp; Block</td>
<td>The main contractor provides the day to day waste management on site. No monitoring of brick and block quantities. There is 5% waste allowance for bricks. If the sub-contractor produces visibly more the sub-contractor would be charged for it the extra waste produced.</td>
<td>The main contractor will check how much brick and block waste is produced. No more wasted than set in contract</td>
<td>The main contractor will have a casual eye on it during site inspections. For example if there are lots of bricks damaged main contractor would notify the sub-contractors.</td>
</tr>
</tbody>
</table>

Table 9. Summarises the waste management requirements placed on brick & block and drylining trade contractors on projects using different procurement methods. (continued)
Table 9. Summarises the waste management requirements placed on brick & block and drylining trade contractors on projects using different procurement methods. (continued)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Trade Contractors</th>
<th>Traditional</th>
<th>Design &amp; Build</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drylining</td>
<td>Same as above</td>
<td>The main contractor does not monitor the quantities of plasterboard waste produced as the sub-contractor pays for the material. Feedback on waste quantities via the waste management company's monthly reporting system.</td>
<td>Same as above</td>
<td></td>
</tr>
<tr>
<td>Brick &amp; Block</td>
<td>No</td>
<td>Minimum on using materials where main contractor supplies them. Percentage wastage on black bricks was agreed at 3% on red bricks at 3% on blocks at 3% and on tiles was agreed at 5%.</td>
<td>No. If main contractor provides material the sub-contractors would have a target not to produce more waste.</td>
<td></td>
</tr>
<tr>
<td>Drylining</td>
<td>No</td>
<td>This is written into sub-contractors’ documentation. If the sub-contractors produce more than the agreed wastage rate charges will be made by the main contractor for removing the excessive waste.</td>
<td>Same as above</td>
<td></td>
</tr>
<tr>
<td>Q: Incentives from the client / main contractor if the quantity of waste produced by work package is reduced/ minimised</td>
<td>No financial incentive.</td>
<td>No financial incentive.</td>
<td>No financial incentive.</td>
<td></td>
</tr>
<tr>
<td>Q: Close out meeting between the main contractor and trade contractors at the end of the job.</td>
<td>Same as above.</td>
<td>Same as above.</td>
<td>Same as above.</td>
<td></td>
</tr>
<tr>
<td>Brick &amp; Block</td>
<td>Yes. Not always a sit down meeting. The H&amp;S performance is regarded as the most important.</td>
<td>No. The main contractor does score the trade contractors’ performance on H&amp;S, quality, commercial and environmental issues and on how the team worked on site.</td>
<td>Yes. The work packages are being evaluated at the end of the job at the close out meeting. How the job went, H&amp;S, commercial and environmental performance.</td>
<td></td>
</tr>
<tr>
<td>Drylining</td>
<td>Same as above.</td>
<td>Same as above.</td>
<td>Same as above.</td>
<td></td>
</tr>
</tbody>
</table>
4.1 Waste removal from site
The waste produced by the B&B and drylining trade packages is removed and paid for by the main contractors on the three procurement type projects. The sub-contractor work package documents require the main contractor to take the waste materials from their work areas to the designated skips.

4.2 Material take back
The dry lining trade contractor has to segregate the plasterboard off cuts on all three sites. The gypsum waste will be removed by the waste management contractor. The gypsum materials than will be bulked up in a 40 yard container and taken back to one of the plasterboard manufacturers for reprocessing. There is no take back of bricks to the manufacturers. Bricks are segregated either at the construction sites or if the sites do not have space to store more than one skip than at the WTSs.

4.3 Purchase of materials and the calculation of wastage rates.
On the D&B contract, the B&B sub-contractor supplies labour only and the main contractor supplies the materials. The dry lining sub-contractor supplies both the labour and the materials. Waste is then removed via the main contractor. On the PFI contract the material and labour supplied by the main contractor for both work packages. On the traditional contract however the sub-contractors supply both the labour and the materials. The site manager of the traditional site stated that this provides the site team with more cost certainty.

Although the waste removal and waste management is paid by the main contractors on all the sites the sub-contractors have to forecast the volume of waste that their work package will produce on the site.

The method of forecasting the wastage rates on the different projects are listed below:

> A certain wastage rate is added onto the BoQ of materials calculated by the main contractor.
> In case there is no BoQ the site drawings / plans will be used by the sub-contractor to calculate the materials needed to complete the work package on site.
> Material requirements have been collated on the jobs the sub-contractor worked on. Historical data lists the measurement of quantities of materials brought and thrown away. This is a standard wastage rate for a particular work package.

The standard wastage rate would be changed if the design of the building is unusual. Information is given by main contractor on the design of the building. If a project has an uneconomical size the sub-contractor will put more allowance in for waste. The waste allowance will depend on room size, how modular the building is, corners for bricks etc.

Building in the wastage rates for the material within the sub-contractors’ tender documentation is one instrument used by the main contractors to get the sub-contractors to take ownership for the waste that they produce on the site. When the sub-contractors are tendering for a particular contract the main contractor requests from them to price for the following in the preambles relating to waste:

> Onsite distribution of materials/plant
> Special storage of materials and equipment
> Removal of waste to designated area / skip
> Removal of protection clean down

The overall waste management and the removal of waste is organised and paid for by the main contractors on all the different procurement projects. The main contractors however require the sub-contractors to have ownership for the waste that they produce. Requirements relating to clearing up their work areas, transporting the waste
materials that they produce into the designated skips stored on site, not producing more waste than was set out within wastage rates allowed for certain materials are written into the sub-contractor work packages.

Specific targets on reaching waste reduction on site are not written into the sub-contractors’ contract documents. The main contractors do not offer any incentives to the sub-contractors if waste reduction was achieved on site. The main contractors noted that it is in the interest of the sub-contractor to reduce the waste volume produced on site, as they would benefit financially by not wasting materials.

4.4 Feedback from the Association of Brickwork Contractors

The Association of Brickwork Contractors (ABC) were contacted to find out how waste reduction requirements are embedded within the members’ contracts issued by the main contractors on contracts using different procurement methods.

“The primary goal of the ABC is to promote the role of the bricklayer and the brickwork contractor. More specifically, it will seek to improve standards by focusing on four key areas:

> Quality of work
> Employment
> Health & Safety
> Training and education.”

The aim and objectives of the association is supported by the Brick Development Association, which represents the UK and Ireland’s clay brick and paver industries; the Construction Industry Training Board and the Better Brick Work Alliance.

Twelve of the largest of brickwork sub-contractors, who are members of the ABC were asked to provide feedback on how main contractors address waste reduction issues within the sub-contractors contract documentation. The wastage rate added onto the quantities of material needed to complete the job is calculated by using previous experience gained on other projects. The site drawings would also be used to check whether or not cutting will be required and would adjust the wastage rates accordingly. If no BoQ is provided by the main contractor they would calculate their own quantities.

The tendency is to generally allow +10%, on top of the BoQ but this figure will depend on the materials. Some materials such as bricks can be calculated precisely others such as bagged materials are not so easy to estimate correctly. The trade contractors also stated that on most contracts they purchase their own material and on ‘supply and fix’ contract they will have ownership of the waste.

The general impression was that the main contractors do not appear to be interested in monitoring the quantity of waste produced on site by the brick and block work package. As a result there is no incentive offered to the trade contractors if the waste is reduced by their work package. There is no mechanism in place to check if waste was minimised on the site. The trade contractors responding to this survey never experienced the meeting of waste reduction target set on the sites that they have worked on.

The on site waste management of the brick and block trade contractors is the responsibility of their own site manager. The trade contractors have to participate in the on site segregation of materials. On most sites brick and inert materials are segregated out from the general waste stream. Training on waste is not provided, although all the trade contractors work to ISO 14001 standards.
When a job is completed on site there is a close out meeting to agree the final account for the package but the contractors’ performance on achieving waste reduction is not on the agenda.

Based on their previous experience working as brick and block sub-contactors on construction projects it appears that the waste generated by their work package is not evaluated by the main contractors. Most of the contracts that they work under are on a ‘supply and fix’ basis i.e. a clearly defined sub-contract to the main contractor, whereby the ownership of waste is their own responsibility. The general consensus of the sub-contactors was that little attention seems to be paid to waste.

4.5 Feedback from the Federation of Plastering and Drywalling Contractors

The Federation of Plastering and Drywalling Contractors (FPDC) were contacted to find out how waste reduction requirements are embedded within the members’ contracts issued by the main contractor.

“The FPDC is a national trade association with both specialist contractor and associate members that are involved in designing and installing internal and external build solutions.”

FPDC also represents the interests of the sector through effective lobbying on a wide range of topics. The members of the FPDC have signed a voluntary commitment to work with plasterboard sector stakeholders – including construction companies – to achieve a reduction in plasterboard waste being disposed of in landfill. The main targets to achieve by 2010 are:

- For contractors and developers to engage with other plasterboard sector stakeholders, to undertake activities which reduce the amount of new plasterboard waste sent to landfill, with the long-term aim of achieving the objective of zero waste sent to landfill by 2025.
- To reduce the amount of plasterboard waste generated from new construction and refurbishment in both residential and commercial projects to 15%.
- To encourage reuse, recycling and recovery of plasterboard waste at all sites, detailing plasterboard waste management in their site waste management plans (SWMPs).

Construction companies acting as main contractors and dry lining trade contractors working as sub-contractors on construction projects are working to implement the targets set out by the voluntary agreement. The voluntary agreement signed by the industry’s supply chain demonstrates that both main contractors and the dry lining sub-contractors take ownership of plasterboard waste generated on site.

Gypsum waste (including plasterboard) can only be landfilled in separately engineered cells in landfills which have an appropriate license. This means that plasterboard has to be segregated either on the construction site or at the waste transfer station. For these projects, the plasterboard had to be segregated by the drylining contractors on site which is standard practice.

The Association of Interior Specialists (AIS) is a trade association that represents companies involved in the manufacture, supply and installation of all aspects of interior fit-outs and refurbishments, with particular emphasis on ceilings and partitions. Their members operate in retail and commercial offices, the public sector, banks and building societies, hotels and leisure, airports and hospitals. They recently undertook a brief online survey which was sent out to sub-contractors and had a 7% response rate. The results were that on average 10% of plasterboard delivered to sites is typically...
wasted with a third of those surveyed believing it was recycled back into new plasterboard and further third of respondents didn’t know what happened to this waste.

**Recommendations**

> Ensure that the trade contractors’ supervisors have adequate training in waste management. This could be provided by the trade associations but this should be tailored for each site by the main contractor.

> Trade contractors should procure their own materials, wherever practicable.

> Trade contractors should review their wastage allowances based on previous experience.

> Trade contractors should be involved in the design process in order to provide suggestions and ideas for minimising waste.

> Waste issues should be included on the agenda for site and close out meetings.
5. Conclusion and recommendations

The procurement methods used on the three construction projects have been reviewed to establish the ownership of waste. Within the three procurement documents waste reduction and resource efficiency were not included in the client’s overall policy. The briefing stage of the procurement process included the requirement to meet BREEAM Very Good certification on all three projects. References to meeting waste minimisation targets were not stated in the briefing documents. This provides evidence that clients do not single out waste as an issue, but may assume that it is being managed within an overall sustainability standard (i.e. BREEAM). The client at this stage shows no ownership of the waste issue and therefore has little incentive to actively encourage its reduction.

On the traditional project, the client employs the designer directly and as a result the tender document was put together by the client and the designer. The construction team will tender for the job based on the tender requirement. On projects that were procured traditionally the construction team has little opportunity to address waste minimisation issues and in effect does not have ownership of the waste at this stage. Within the PFI and D&B projects, the contractors had to demonstrate with past examples gained from other projects how they minimised waste previously. Procurement methods for PFI and D&B projects are similar in so far as both project teams directly employ their own designers and construction teams. On the PFI project, design meetings were scheduled to design out waste.

During the construction stage, the ownership of waste clearly sits with the main contractor; this is largely due to the SWMP Regulations requirements on the main contractor. The main contractors are responsible for the implementation of the SWMP. On the traditional contract, the CDM co-ordinator representing the client, monitors the SWMP but the ownership of the waste stays with the main contractor throughout the project. For all projects, the main contractors transfer some responsibility to the sub-contractors for the ownership of the waste that their work package produces. Most sub-contractors are required to supply the labour and the materials needed to complete a work package on site. The sub-contractor’s preliminaries documentation sets out the main contractor’s requirements in terms of agreeing the waste allowance of materials that the different work packages are expected to produce. The sub-contractor’s contractual documentation also sets out the way in which they need to participate in material segregation and site waste management. However there is little incentive for the sub-contractor to produce less waste than is already agreed.

During the post construction stage, on all three projects it was evident that waste minimisation and resource efficiency issues are not on the agenda. The project team signs off the documentations that are needed for the BREEAM certification but how the project team has performed on waste management is not evaluated during the close out meeting.

In terms of the actual costs of waste the client for all three projects knows the forecasted cost of waste, however, does not see the actual cost as the project progresses and completes.

Evaluating the contractual requirements of the brick and block and the dry lining sub-contractor trade packages correspond with the findings that the ownership of the waste sits within the ownership of the main contractors at construction stage. The main contractors will require the sub-contractors to take responsibility for the waste that their work package produces. Requirements for the responsibility of waste are set out in the sub-contractor’s ‘preliminaries’ documentation.

Members of the Association of Brickwork Contractors noted that in their experience there has been little attention paid to waste. The trade contractors always
work as ‘sub-contractors’ whereby they have their own surveyors to take off quantities and will have a manager on site rather than coming under the wing of the general contractor. They will almost always work on a ‘supply and fix’ basis i.e. a clearly defined sub-contract to the main contractor.

**Recommendations**

- Main contractors to price appropriately for site waste management within the tender documentation. Waste management costs should be arrived at early on during the tender stage of the procurement process. The sooner it is articulated the greater degree of cost certainty will be achieved.
- Clients should include the commitment that their own organisation has towards resource efficiency, within the briefing stage of the procurement process.
- Clients should set measurable resource efficiency targets that construction teams need to meet if they win the contracts. Resource efficiency targets should be formulated that stand alone from the requirement to achieve BREEAM certification on the project.
- Evaluating how resources were minimised on projects should be undertaken during the close out meeting.