REDROW

REDUCE THE RUBBLE
PROJECT REPORT

BUILDING RESPONSIBLY

THE REDUCE RUBBLE
INITIATIVE FROM REDROW

CONTENTS

1.0 | INTRODUCTION

The construction industry is the UK's largest user of natural resources and produces 100 million tonnes of waste per year – more than one-third of the UK's annual waste, according to the Waste and Resources Action Programme (WRAP). The Housebuilding Industry contributes significantly to this, and in 2019 Redrow produced 60,593 tonnes of waste, which equates to an average of 10 tonnes of waste per house built.

Redrow seeks to transition towards a more circular model; where materials and resources are kept in use for as long as possible and waste is avoided. To help with this, a waste project began in 2020, to analyse the waste generated from building a single Redrow home. Information and data was collected on key materials such as bricks, concrete, cardboard and plastic packaging. The main aim of the research project was to explore the key causes of waste, and identify how waste can be reduced during design, procurement and construction stages.

2.0 | RESEARCH AIMS

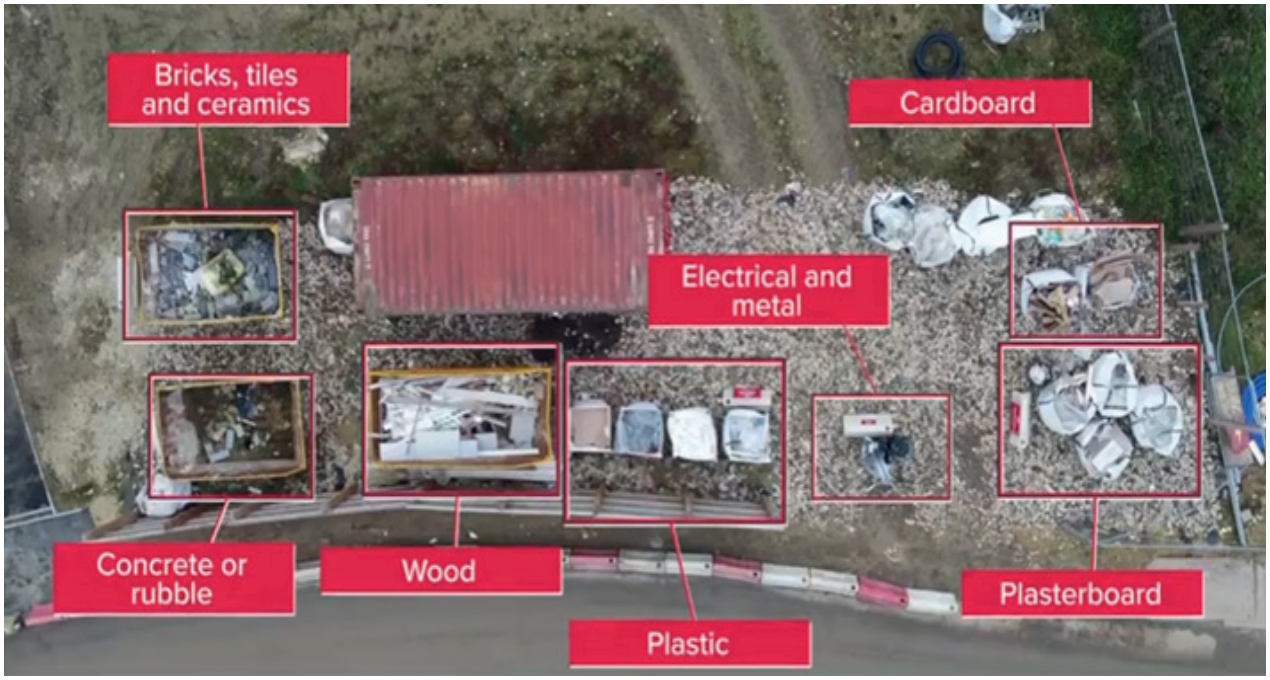
- Determine the amount of waste generated from a single plot, by construction material type.
- Identify key reasons why waste is produced.
- Examine ways to reduce waste during procurement, design and construction.

3.0 | METHODOLOGY

The project was executed in three Redrow Divisions (Yorkshire, Lancashire and the South East). All the waste generated from building a standard 'Oxford' house-type was kept on the respective plot for the duration of the project and weighed at the end when the homes were completed. Two of Redrow's major waste brokers (Reconomy and The Waste.Co) assisted with the weighing process and data was provided in the form of a waste report - including the weight (in tonnes) of each waste stream, the amount diverted from landfill and the cost. This numerical data was collected to evaluate the quantities of materials wasted during construction.

Waste produced during the build of each Oxford House had to be segregated into specific containers (tonne bags or skips), each containing a different waste stream. For the purposes of this project, the waste streams were: Plasterboard, Plaster skim, Inert, Wood, Plastic, Polystyrene & Insulation, Cardboard, Electrical, Metal and Hazardous Waste.

It is not common to segregate materials to this level on construction sites. For example, Plastic and Cardboard Packaging would often be managed in a General Waste/ Mixed Skip with other items, and categorised by the waste broker/skip company as 'Light Mixed Compactable'. However, segregating waste into a larger number of waste streams allowed us to get a more in-depth understanding of the waste materials associated with building a home. Additionally, by segregating and keeping the waste materials on site until the end of the project, we could create a visual image of the waste and environmental impact of a single home.



Aerial shot of the project plot waste area from Langley Grange in Yorkshire

3.0 | METHODOLOGY

The project leaders on each site were asked to identify the key causes of waste. To help capture this information, they were provided with a 'Waste Table' (appendix A) where they could record a number of items including: material type wasted, date, supplier, delivery accuracy/time, build stage and reasons for waste. The waste table also enabled site teams to identify and record potential opportunities for waste elimination, reduction or re-use. The waste tables were regularly sent to the Group Sustainability team, along with photographs of waste produced.

Waste and Resource Efficiency Workshops were also held for all Redrow divisions, in collaboration with the Supply Chain Sustainability School. The workshops were informal to allow for free flowing, open conversations and discussions around waste.

The workshops were a good opportunity for divisions to share best practice. The pertinent findings/discussion points from the workshops are elaborated on within this report.

A total of 83 attendees attended the workshops, two were held face to face (pre-covid19) and the remaining three took place online via Zoom. In attendance were commercial and construction teams, with most managers and/or directors of both departments present.

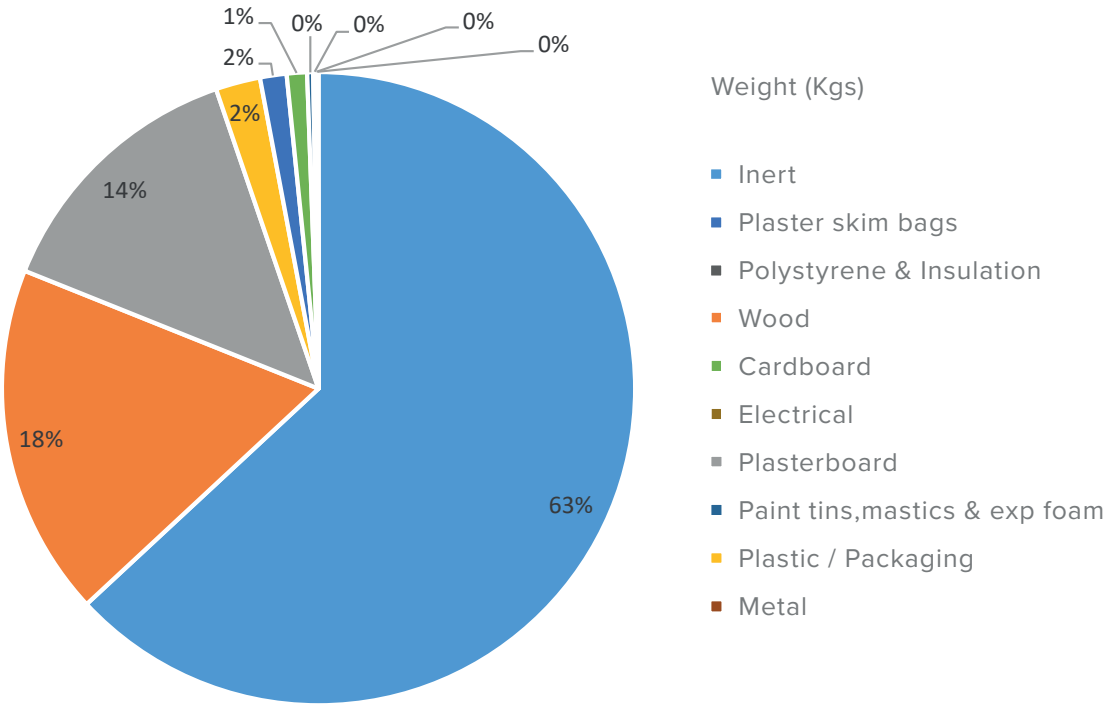
Waste workshop (image taken pre-covid19)

4.0 | THE WEIGHT OF THE WASTE

The waste from plot 136 Langley Grange (Yorkshire) was weighed as follows:

Material	Weight (Kgs)	Weight (tonnes)
Inert	5120	5.12
Wood	1460	1.46
Plasterboard	1110.5	1.1105
Plastic / Packaging	185	0.185
Plaster skim bags	110	0.11
Cardboard	84	0.084
Paint tins, mastics & exp foam	25	0.025
Metal	10	0.01
Polystyrene & Insulation	8	0.008
Electrical	3.75	0.00375
Grand Total	**8116 kg**	**8.116t**

This data is also represented in the Pie Chart below:

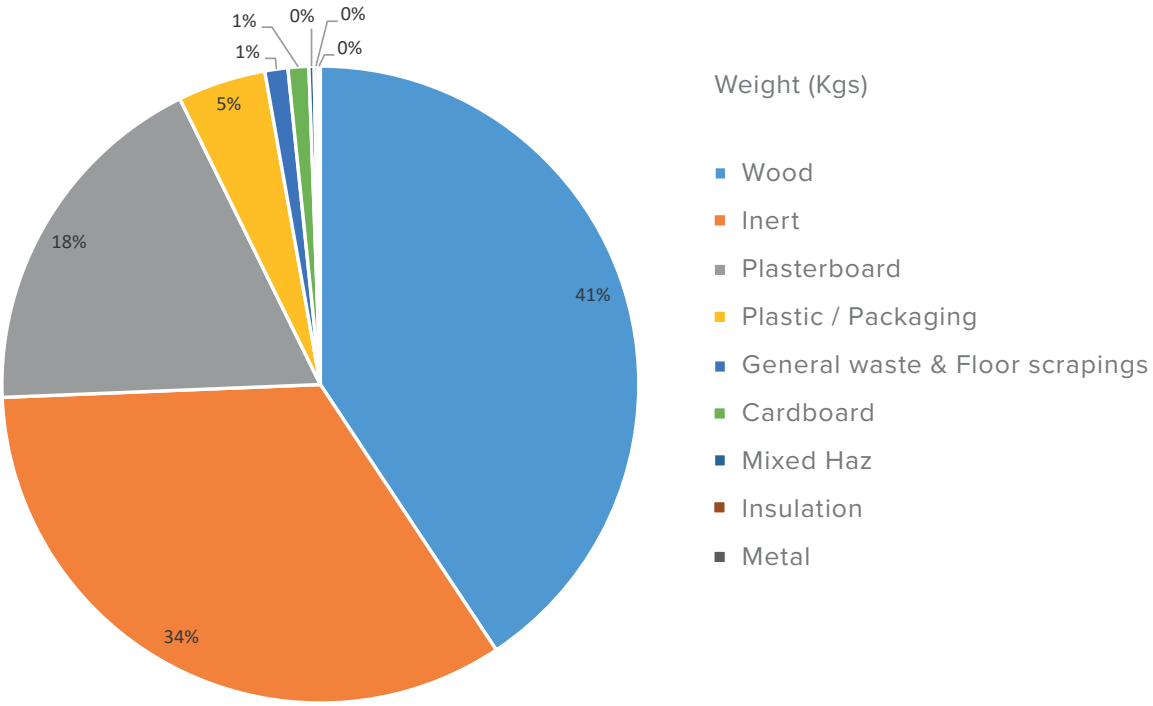


4.0 | THE WEIGHT OF THE WASTE

The waste from plot 121 The Brook, Lancashire was weighed as follows:

Material	Weight (Kgs)	Weight (tonnes)
Wood	3898	3.898
Inert	3227	3.227
Plasterboard	1760	1.76
Plastic / Packaging	429	0.429
General Waste & Floor scrapings	112	0.112
Cardboard	101	0.101
Mixed Haz	25	0.025
Insulation	18	0.018
Metal	12	0.012
Grand Total	**9582kg**	**9.582t**

This data is also represented in the Pie Chart below:



Unfortunately, due to the Ebbsfleet (South East) site being affected by covid19 and illness of the waste project manager, a detailed/accurate set of waste data for plot 472 could not be collected and therefore these figures are not included within the report. Nevertheless, qualitative findings from four site visits which took place during the duration of the project have been incorporated within the report where relevant and the waste tables are listed under appendix 3 at the end of this report.

5.0 | THE COST OF WASTE

The whole-life cost of the waste was calculated by working out the total cost of materials wasted and adding the waste disposal costs (Total Materials Wasted Costs + Total Waste Disposal costs).

Using this calculation, the total whole-life cost of the waste from each plot was between £2,018 - £2,233.

Research undertaken by Zero Waste Scotland suggests that the true cost of waste could be even higher than this value, once labour, equipment (telehandler fuel), skip hire costs and VAT are all factored in.

5.0 | THE COST OF WASTE

Waste disposal costs

The data below was provided by Reconomy who received the Disposal rates per tonne from the waste disposal facility used. These are the costs we paid to remove and dispose of the waste.

Disposal costs from Plot 136, Langley Grange, Yorkshire

Material	Weight (Kgs)	Weight (tonnes)	
Wood	3898	£280.77	£72.03
Inert	3227	£105.65	£32.74
Plasterboard	1760	£172.88	£98.23
Plastic / Packaging	429	£51.71	£110.09
General Waste & Floor scrapings	112	£14.70	£131.25
Cardboard	101	£11.12	£110.09
Mixed Haz	25	£0.62	£24.85
Insulation	18	£1.98	£110.09
Metal	12	-	-
Grand Total		**£639.44**	

Disposal costs from Plot 121, The Brook, Lancashire

Material	Weight (Kgs)	Weight (tonnes)	
Inert	5120	£167.63	£32.74
Plasterboard	1110.5	£109.08	£98.23
Wood	1460	£105.16	£72.03
Plastic / Packaging	185	£20.37	£110.09
Plaster skim	110	£10.81	£98.23
Cardboard	84	£9.25	£110.09
Electrical	3.75	£0.93	£24.85
Polystyrene / Insulation	8	£0.88	£110.09
Hazardous	25	£0.62	£24.85
Metal	10	-	-
Total		**£424.73**	

6.0 | KEY CAUSES OF WASTE: FINDINGS AND RECOMMENDATIONS

Overview

The following sections present the project findings. The key causes of waste are categorised into sources of waste and then analysed separately for clarity, however it is evident that causes are linked and interconnected in many ways.

The aim of this project was to identify some recommendations that will help the business reduce waste. Some of the project findings are relevant to the whole group, however as operational differences exist between divisions and sites, some findings may only be relevant to the particular project plots.

Sources of waste	Causes
Design	Frequent design changes, detailed design specifications
Offcuts	Cutting materials to sizes
Procurement	Supplier's error, over-ordering
Packaging	Excess material product packaging
Material handling	Transportation, off-loading, inappropriate handling
Operations	Tradesperson's error (quality, repairs), material efficiency
Material protection	Bad weather (rain and wind)

7.0 | DESIGN

7.1 Design changes

At the Yorkshire waste project, a batch of products (including joist caps and hangers, restraint straps and framing anchors) were delivered for the previous Oxford house design. Changes had been made to the design of the joist meaning that the batch of products delivered by the supplier were no longer suitable and consequently the products could not be used on the plot. The total cost of this delivery was £181.

Batch of products sent by Robinsons for the previous Oxford housetype

Tension/restraint straps (60 x £1.48 each = £88.80)

Joist hangers (14 x £3.11 each = £43.54)

Framing anchors (62 x £0.30 each = £18.60)

Joist caps (15 x £2 each = £30)

7.0 | DESIGN

The project manager followed up with the supplier (Robinson Manufacturing) to investigate. The supplier said they had not been sent the new drawings for the updated Oxford design, which meant they sent a batch of products intended for the previous drawings.

Yorkshire's Purchasing Manager looked into this issue and said the plot drawings were changed on the 23rd September 2019. The new drawings were sent out on 15th October and Robinsons then returned a requote on 23rd October. The Joists were called off on 28th November. The joists were sent out to the old DCC reference, this was the supplier's error. He added that it has not been uncommon over the years for suppliers to send out the wrong DCC reference where there is more than one of the same Housetype on the same quotation or site. He said sometimes suppliers just go down and find the first Oxford rather than taking note of the DCC variant.

Additional delays were also caused because some items which were required for the new Oxford design did not arrive on time to match the build stage. For example, the steel and lintels delivery did not contain a rear lintel (this was not on order due to the change of design). This was reordered and delivered 4 days later.

Design changes to this particular Oxford were made three times (on three separate occasions) during the course of the project. Design changes are made regularly to all of our house types – both large and small changes. Some of the changes are urgent and necessary for functionality and practicality but some are less urgent, for aesthetic purposes. Redrow has a history of making frequent design changes, due to regulation changes, improving build efficiencies and adapting to design trends. This practice is part of the Redrow business model, enabling the company to have a proactive approach to design - producing attractive homes, on trend with market changes.

Nevertheless, frequent design changes can result in issues and complications for suppliers if the line of communication breaks down. Therefore Redrow could review the process flow for design changes and the frequency of these. Group Technical could consider bulking together design changes, or only making changes every quarter if it is possible. Design changes could be prioritised or categorised to allow for urgent changes within this.

Key recommendations:

- → Examine the process flow for design changes.
- → Review the frequency of design changes and explore whether design changes could be categorised, prioritised, bulked together, only made every quarter etc.

7.0 | DESIGN

7.2 Detailed designs

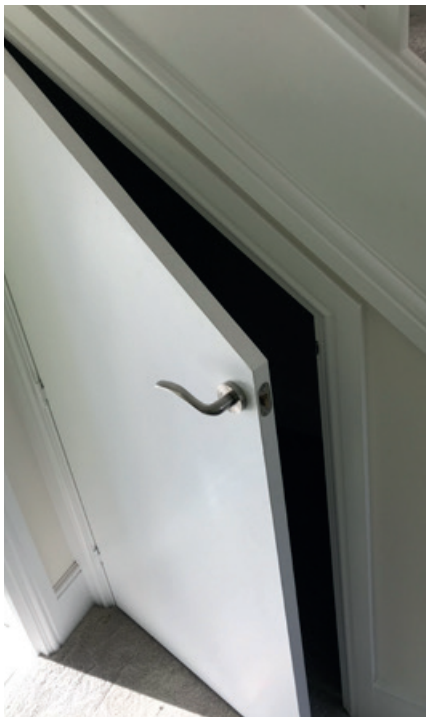
Our homes appear to include a greater number of details and specifications when compared to homes built by other volume house builders. Our attractive, detailed designs are considered to be one of our main USP's – they distinguish our product from others on the market and help to justify premium pricing. However, from discussions with divisions and meetings with trades working on the project, there appears to be downside to having a complex, detailed design as it can increase the likelihood of things going wrong (human error) and also increase material waste.

The Joiner who worked on the project said that the detailed design of the Oxford has "too many nooks and crannies" and that a complex design including lots of small walls and inlets increases the number of cuttings that need to be made. Consequently, this increases the number of offcuts, which collectively account for the large amount of the timber waste skip.

Redrow could consider reviewing the design of houses to ensure they are not overloaded with details generating offcuts, such as small walls and inlets. For example drawings could be reviewed and it may be possible to remove or change some features. Referring to the drawings used to build the Oxford Housetype in this project (DCC 3 Drawing No 202) we could look at removing the nibs in Bedroom 1 (near optional built in wardrobe). Nib walls can also be difficult to plaster, costing time and money for the plasterers. Therefore removing these could save money and materials too.

Another example is the small door under the stairs (Door D06 on DCC 3 Dwg No 202) pictured on the right. This door is specially manufactured for Redrow and needs to be cut to size on site. On the Yorkshire project, this door got damaged and chipped during cutting and installation and had to be repaired by an external repair worker who filled and painted the door, again this process cost time and money. We could consider changing the design of this cupboard to make it larger or more open.

D06 Door under stairs of Oxford was chipped during installation



7.0 | DESIGN

The bay windows design of the Oxford also requires multiple cuttings in order to fit studding and flooring etc. However, the bay windows are a prominent and attractive design feature of the home and so any changes are unlikely to be implemented. Therefore the next best option would be to look at increasing the reuse of offcuts generated during the creation of the bay windows.

Bay windows of the Oxford Housetype

Key recommendations:

- Review design of houses to ensure they are not overloaded with details generating offcuts, such as small walls and inlets.
- Encourage joiners to re-use maximum number of offcuts in the home for example as noggins (excluding the stained roofing timber as it is classed as hazardous due to treatment).

8.0 | OFFCUTS

Materials sometimes need to be cut to size on site which results in offcuts. Offcuts from materials such as plasterboard, chipboard flooring, timber and pipes could be reduced by buying materials of more appropriate sizes or getting them cut off-site.

Example offcuts from materials

Wood offcuts

Plastic guttering

Plasterboard angle bead

Electrical wire offcuts

8.0 | OFFCUTS

8.1 Plasterboard

The amount of plasterboard generated from each of the project plots was 1.1 tonne (14% of total waste) in Yorkshire and 1.76 tonne (16% of total waste) in Lancashire. If these figure are average figure across Redrow, then as a company we are producing between 4,000-6,000t of plasterboard each year (depending on the number of units built).

Early consideration of plasterboard waste prevention, minimisation and management could help to significantly reduce Redrow's plasterboard waste and provide greater levels of efficiency, cost and time savings as well as improved environmental performance.

Redrow could review some design aspects to minimise plasterboard waste and wherever possible, our homes should be designed to use full height boards as this will result in less off-cuts. At the moment, our storey heights (2.5) are too high to use a use a standard size (2.4m) board. It is believed we use 2.5m boards based on feedback form the Yorkshire division however Redrow do not specify what sized boards to use. At present, it is within the remit of the individual Plastering Contractor for each development to decide which length board they use. Some divisions use a combination of 2.7m and 2.5m boards. If 2.7m boards are used then there is risk of large and continuous offcuts which could be contributing a significant amount of waste. Further research should be undertaken to understand exactly what size boards the contractors are buying and using so we can be assured that they are using the correct size boards which best suit the room sizes. In turn this will help to reduce offcuts.

8.0 | OFFCUTS

Other ways to design out plasterboard waste could include removing nibs and inlets from housing designs as this will result in fewer cuttings and subsequent offcuts. Additionally, changing sloping ceilings to flat ones could also design out plasterboard waste as these produce more plasterboard waste. Furthermore they are more difficult to create and are more expensive, as a thermal board is required in this location.

Offcuts were the main source of plasterboard waste generated from the project plot, however errors during installation, damaged boards and over-ordering also contributed to plasterboard waste. Metal angle bead offcuts for plasterboard were also observed as this material is also cut to size.

Redrow could also look at developing methods for efficient material handling (such as undertaking board cutting activity off-site) or getting bespoke sizes of plasterboard manufactured to reduce plasterboard waste. Our supplier (British Gypsum) manufactures bespoke plasterboards to any size, in addition to standard sized boards. Costs for bespoke boards are not yet known but are likely to be higher than the standard size board. Although the initial purchasing price of the bespoke boards may be higher, efficiency savings could be gained further down the supply chain through reducing labour costs (reducing handling time) and reducing waste disposal costs associated. This could also have the potential to improve health and safety on site too.

Similar efficiency gains may also be achieved by having plasterboard cut to size off-site. Off-site cutting of plasterboard could also result in quality improvements and finishes as boards would be cut in a controlled environment.

Sites could also look to create a designated plasterboard storage station on site to store surplus plasterboard and offcuts. Plasterboard needs to be kept dry and stored well in order to be reused. A small designated station made available for excess plasterboard can enable effective collection of offcuts, providing efficiency gains if re-used.

A Construction HSE Advisor confirmed that some sites in London have cutting stations and re-use surplus plasterboard:

> “We try to have a room or a certain place for large offcuts of plasterboard on the level or floor that the plasterboard contractors are working on. It is important to work with the contractor on this to ensure that the operatives are aware of the system and follow it. This reduces the need to cut into a whole sheet for a small piece. We did do this at Saxon Square and will be doing it where we can at Pontoon Reach.”

8.0 | OFFCUTS

However it appears that PB cutting stations like this are not currently achievable on our standard site set ups and usually only work well in high rise buildings (eg London division).

Some Redrow divisions including South East and South West have reduced their plasterboard waste by placing a responsibility on the plasterboard contractor to remove waste from site and paying them for this. Generally, the contractors which have this agreement in place tend to produce less waste, however these divisions must undertake increased due diligence checks and ensure that they have all the relevant waste carriers licence and paperwork for each collection to show the amount collected and where the waste was tipped etc.

Key recommendations:

- → Review options to 'design out' plasterboard waste, eg removing sloping ceilings or nibs.
- → Consider reducing ceiling height to 2.4m, so we could use full length plasterboard.
- → Consider undertaking plasterboard cutting activity off-site to increase efficiency.
- → Enquire about the price of bespoke manufactured length boards if we cannot use standard sizes.
- → Investigate and confirm with plastering subcontractors in all divisions what size boards they are using, so we can be assured that they are using the correct sizes.

8.0 | OFFCUTS

8.2 Chipboard

Redrow order chipboard flooring of 2.4 x 0.6 and offcuts are generated if the chipboard flooring is cut to size on site (in order to match the flooring design). The size of the offcuts is dependent on the room size and small unit areas and inlets. The image shows some offcuts from the Caberdek flooring from the Yorkshire plot.

The amount of chipboard flooring waste from the Lancashire plot appeared to be about 50% less than the Yorkshire plot. When we looked into this, the Lancashire division said that chipboard gets delivered plot packed however the Yorkshire Construction director said that their supplier was sending chipboard in bulk deliveries rather than plot packed. This meant that it was difficult for the Yorkshire site to identify any shortages.

Lancashire previously reported an issue with chipboard flooring shortages as they seemed to be short of sheets for plots. When they investigated, they found out that the correct amount of sheets had in fact been provided, however the contractors who were fitting it were not using the full lengths of the materials. The contractor hadn't looked at the chipboard flooring plan and was cutting/using half a board and throwing the other half away. That other half was needed for another bit of the flooring and should have been saved. This example highlights the importance of contractors being adhering to the designed chipboard flooring plan and understanding how materials work, before starting on the plot. The Lancashire division have resolved this issue already through their investigation, however Redrow should look into this issue elsewhere across the group to check this isn't happening anywhere else.

Key recommendations:

- → Check to ensure we are ordering and using the right size of materials for homes instead of cutting larger sized chipboard.
- → Investigate if we could get Chipboard cut to size off site (plus costs of this).
- → Divisions should ensure that the Chipboard Flooring layouts (circulated by Group Commercial and kept on the Group wide Commercial Drive) are being followed on site and routine checks can be made.

8.0 | OFFCUTS

8.3 Timber

Timber waste from the project plot weighed a total of 1.46t (Yorkshire) and 3.89t (Lancashire).

The Joiner working on the Yorkshire plot said that a large amount of the timber waste generated was timber stud/offcuts from first-fix ground floor. Yorkshire purchase larger standard sized timber (4.8m) because our ground floor storey height (2.540m) is too tall for the smaller standard sized timber (2.4m). This results in continuous offcuts and joiner suggested we could purchase 3.0m timber stud for the ground floor instead. The project highlighted some differences between divisions, for example South East use 3m timber and Lancashire use 2.4m and double up on the sole and header plate, or sometimes use 3m. South Midlands have investigated this and they use 2.7m CLS for both ground floor and second floor as it this means site operatives only have 1 length of timber to use/choose from, rather than multiple different lengths. Redrow could look to develop a standard approach for ground floor timber.

Other timber offcuts were also from oak worktops, cut outs from stairwell flooring openings and doors and kitchen end panels.

Key recommendations:

- → Develop a standard approach and additional guidance or communication for divisions on what size Timber stud to purchase for the Ground floor and also how to fit it.
- → Include a standard detail for ground floor storey height (timber stud).
- → Consider reducing ground floor storey height to 2.475 m so we can use the standard timber stud or 3.0m timber stud.
- → Encourage joiners to be selective of lengths and plan to use any off-cuts eg as noggins (excluding roofing timber).

9.0 | PROCUREMENT

9.1 Supplier error

Some deliveries arrived incorrect and/or short in quantity. For the Yorkshire Project, the items which were missing or short from deliveries for plot 136 include: soffit joint straps, kitchen cupboard doors and a window former for the cloakroom. These items all had to be re-ordered. Roof timbers were short in quantity and the Restraint Straps were the wrong specification, they came as 1mm but needed to be 4mm as requested.

The kitchen delivery (from Moores) was missing grill vents, two cupboard doors, splashback fixing and two taps. The delivery was sent back and the new delivery arrived a week later with the correct items. When the project manager investigated this with the Moores they said they had accidently missed these items off the order.

Some deliveries arrived incorrect and/or short in quantity at the Lancashire project too. The glue delivery for the joists for plot 121 came short of glue and the ASM had to order more. The suppliers do not generally supply enough glue for our sites to meet the spec and NHBC standards on the amount of glue needed, this was a common issue reported across multiple sites.

Additionally, the granite worktop did not fit properly around the kitchen window when it came to be fitted. The ASM investigated the issue and the supplier had manufactured it incorrectly - it was 5mm short on both sides (see below images).

The supplier said it was their error and therefore they picked up the costs of replacement. Nevertheless, time and resources were still wasted as the item had to be re-ordered.

Granite worktop for kitchen of plot 121 was manufactured 5mm too short on either side

9.0 | PROCUREMENT

Furthermore a left-hand hung front door was required for plot 121, but the supplier delivered right-hand hung door by accident. The project manager called the buyer to explain and buyer said there was a site within the division who needs a right-hand one instead, so the doors were arranged to be swapped. This saved the division the cost of ordering a new front door (approx. £700-800) and also avoided the incorrect door being from becoming waste.

For the purpose of this project, all deliveries for the plot were called off and checked thoroughly by the site manager/project managers and any issues were immediately dealt with. This is considered best practice and generally the same should be applied to all deliveries on all sites. However, an ACM commented that deliveries may not always be checked this thoroughly (due to time constraints) particularly on a busy site when managers have multiple deliveries to call off for hundreds of plots.

If deliveries are not thoroughly checked for quality and quantity issues, errors can go unnoticed until contractors come to use the delivered goods (this can be up to 6 weeks if the delivery is stored on site until needed). By this point, it is usually too late to reject an order or re-order items if there are any issues. Incorrect deliveries can cause build delays, wasted labour time and cost. Therefore waste is not only associated with the physical waste of materials in the construction process, but also other activities that do not add value such as repair, re-ordering, waiting time and delays.

Furthermore, in the waste workshops, the divisions raised the issue that our product range is very extensive which complicates things, for example the number of internal doors we offer. They think it is easy for the supplier to send the wrong product due to the large number of options available. If these cannot be used on the plot or get sent back then they may risk becoming waste.

Redrow could consider greater use of a store man or materials controller role on site, to check and call off deliveries and also be responsible for loading out, storing materials and managing the compound. An official job description / list of responsibilities for this role has recently been uploaded to Engage. However, it is understood that not many sites employ someone for this role and the decision to have this role on site is made by the division and comes down to the size of the site and budget/prelims set up.

It was noted from this project that the Ebbsfleet site, which has a full time store man, had an exceptional main compound area and it was noticeably very well organised. The waste management area was tidy and the material segregation in skips was excellent. Additionally, all materials were stored off the ground and kept dry, reducing the risk of damage.

9.0 | PROCUREMENT

The site manager at Ebbsfleet also commented that from his experience, having this role on site can help reduce the chances of materials misplacement and materials going missing on site. In the waste workshops, divisions commented that materials sometimes go missing and materials allocated to a plot get taken from storage areas to be used on other plots if they are short. This causes further delays and issues. Redrow sub-contractors are warned against doing this in their terms and conditions (4.1.2: The Contractor shall not use Materials issued from the store for specific plots for other plots without the prior authority of the Site Manager) however the workshop discussions suggested it is still a common practice on our sites.

Key recommendations:

- → Investigate supplier performance in more detail.
- → Consider streamlining the number of options/products available so suppliers don't get mixed up and send the wrong item.
- → Consider wider use of a store man or material controller to check deliveries etc. This can be beneficial for a number of reasons and on the larger sites it may be more cost effective when you consider the amounts of materials damaged, incorrect/damaged deliveries, materials misplacements, delays etc.
- → Examine how we can be supplied with the right amount of glue to meet spec and NHBC standards as this appears to be causing issues/delays for site managers.

9.0 | PROCUREMENT

9.2 Over-ordering on schedules

This project highlighted that some materials and items get over-ordered during scheduling and not all items are used during the build, which can result in surplus materials and products. Leftover materials and products from the Yorkshire Oxford include: 4 skirting boards, 2 soffit boards, 3 fascia boards, 5 lengths of 2.4 timber stud, 1 newel cap, 12 full length plasterboards, 6 full bags of British Gypsum Thistle Board Finish (25kg). These materials were all unused as a result of over ordering. There was also surplus bricks, blocks, tiles and plastic guttering. The leftover materials from the Lancashire plot were similar to this, with 5 skirting boards and 3 architraves left over too.

Redrow over-order materials to accommodate for any shortages, delivery delays, material misplacements or material damages (as these can cause delays to build). However leftover materials are an unnecessary cost to the business because materials have been purchased but not required. In addition to the purchasing cost, there are costs associated with transporting, offloading, storing and disposing of the surplus items. Given the current landfill taxes (£94.15 per tonne,) disposing of materials can be costly. Some materials such as mastic tubes and plasterboard also have additional hazardous waste disposal fees.

Determining the materials that are to be supplied to site is a critical activity. Because materials are considered inexpensive when compared to labour, a ‘waste allowance’ (between 3-5%) is generally included within the order to account for design waste and construction process waste. These waste allowances are generic and not project specific therefore may run a risk of being inaccurate or subject to complacency. This can lead to either the order of surplus of materials (usually entering the waste stream) or a materials shortfall (resulting in additional costs to purchase more materials). We do not track practices of reconciliation between materials ordered and materials used, therefore limiting the information available on efficiency levels.

Materials left over from plot 136.

Surplus timber stud (total cost £9.20) and skirting (£34.34)

Newel cap (£5.50)

Fascia boards (£26.10)

9.0 | PROCUREMENT

This project identified that some of the leftover materials (especially products which had not been opened or cut) are taken to be used on other plots, especially if the contractors are purchasing the materials. However, the joiner said that surplus materials aren't always taken to be reused on other plots because each plot already has allocated timber and materials (plot packs). Therefore, the joiner was of the opinion that if they were to keep carrying over leftover materials then they would have a recurring issue of too many materials. He also said he didn't think it was worth his time to keep carrying bits of timber and materials to next plots so consequently materials end up in skips.

Furthermore, scheduling arrangements and plot pack allocations which contain more materials than needed, can mean that large amounts of materials are often left at the end of a project. There is concern about what happens to the surplus materials when a site nears completion and materials risk becoming waste if not reused on another site. The images below shows leftover fascia and soffit from a site in Yorkshire (The Poplars, Garforth) which is coming to an end.

For this reason, particular time and attention should be paid when ordering materials nearing the completion of a development or phase and it is sensible to carefully plan deliveries, ensuring there is only a minimal amount of unused material left on site when the phase or development is complete.

At the moment, the site team and the ACM work out what materials are left and formulate a plan on how to remove these. During the final stages of a project, it is important to plan for most cost effective and environmentally friendly way to remove surplus materials. However, ideally, there should be no surplus materials to remove in the first place.

Leftover fascia and soffit from a site in Yorkshire (The Poplars, Garforth) coming to an end.

9.0 | PROCUREMENT

This project identified that Redrow site managers and ACM's were already making efforts to reuse surplus materials and some materials exchanges were taking place. For example leftover materials were offered around to other sites. The Yorkshire division have set up a WhatsApp Group which site managers and ACM's use for any spare materials or products. A more structured approach or process flow towards managing these exchanges or possibility of a Group Material Exchange Portal covering all divisions could be considered by Redrow. This could be particularly useful for times of an urgent requirement or swapping items.

If Redrow did not wish to develop an internal MEP then an external one could be used to donate surplus materials to local charities or groups. This could also help with Considerate Constructors Scheme assessments as demonstrated good practice. The Supply Chain School have developed a materials exchange platform https://maps.supplychainschool.co.uk/mep/index.html set up to provide a searchable 'directory' of information on the location and characteristics of a variety of organisations across the UK which are looking for second hand stock

Key recommendations:

- → Review process for set plot material allocation packs and see how these are working/ being implemented on site. Would it be possible to have less allocated contingency within the plot packs?
- → Ensure site teams are identifying and flagging products that are being significantly over-ordered and contact the relevant commercial team to find out if this can be managed more efficiently.
- → Unexpected materials shortfalls and late deliveries should be investigated before new additional materials are ordered - to avoid duplicated deliveries resulting in excess material.
- → Consider reviewing the ordering process for when sites near completion to ensure sites aren't left with lots of excess materials. Encourage sites to only call off what is needed.
- → Explore options to donate surplus stock.

9.0 | PROCUREMENT

9.3 Delivery timings

Some deliveries arrived up to three weeks later than the date requested. For the Yorkshire project (plot 136) this included decorative stone, chipboard flooring and internal doors. The Ironmongery delivery was also late and the Yorkshire division said this was a recurring issue as the supplier rarely hit the requested dates. Issues with delivery timings for internal doors were also raised by both the Yorkshire, Lancashire and South East divisions and upon further discussion it appears their supply chain is being affected by the Covid19 pandemic.

The lead time for roof tiles was also raised as an issue by the Yorkshire division (approx. 12 weeks). This is double lead time of the South East division (approx. 6 weeks) who use Gemini roof tiles from a different supplier, Forticrete. Yorkshire's long lead time could also be adversely affected by its geographical location as it has some sites in a very rural location (further away from manufacturers and transport hubs).

The Yorkshire Construction Director added that some suppliers change lead times without notice and said that lead times across the industry for most products has got gradually worse over the past 10/20 years rather than better. He added that we could look to do a thorough assessment of our suppliers with a specific focus on the level of service provided. A greater focus on service level could help to ensure we are working with suppliers who are meeting the requested dates for deliveries and improve levels of trust in the suppliers which could mean we could operate a Just In Time (JIT) delivery system and not have to stockpile materials.

Whilst delivery timings may not always have a direct link to the physical waste materials in the skips, they can result in build delays and wasted time. Long lead times also make it harder for sites to reject inadequate deliveries, as demonstrated at both Yorkshire and Lancashire sites – when deliveries of Roof Tiles arrived to site broken and damaged. This delivery could have been rejected – however it was not, because the site did not want to wait another 6-12 weeks for new tiles to arrive and at least some were usable.

As part of Redrow's Supplier Service Agreement for Group Deals, suppliers are required to contact each Redrow Division on a quarterly basis to discuss any supply or service issues that have arisen since the last discussion/meeting took place; including delivery issues. These discussions are important so the suppliers know what to expect – for example what sites a division is working on, where we are building, what items/materials we will need and when. Suppliers are also expected to submit a written report on all notable supply issues in the review meetings held with representatives from Redrow's Group Commercial Department. Group commercial also carry out 6 monthly performance reviews but struggle to get detailed feedback at times from site/regions that can be fed back to suppliers.

9.0 | PROCUREMENT

It is not just late deliveries that are an issue but also sometimes early deliveries, some deliveries also arrived earlier than requested and did not match the build stage. This can also cause issues as materials are at a greater risk of being damaged during transportation and storage and the longer they are stored - the greater the risk.

Key recommendations:

- → Divisions should ensure that discussions take place with suppliers/ manufacturers on a quarterly basis to help improve deliveries and also input to supplier performance reviews.
- → All divisions should give detailed feedback during performance reviews so that Group Commercial can feed back to suppliers.

10 | SUPPLY CHAIN

10.1 Subcontractors

There were some examples where subcontractors were not using materials in an efficient manner during construction such as the half used bags of plaster in the image, as well as offcuts which could have been reused. At the Yorkshire project, excess plaster skim bags weighed a total of 110kg, representing 2% of the total waste generated. Similarly, at Lancashire the ASM said there was 3 open bags of plaster dab and 5 bags of plaster finish which had been half used/opened and then disposed of at the end of the plot 121.

We could look to get more of a commitment from subcontractors with regard to efficient material usage, including reusing offcuts and improving storage and reuse. Subcontractors have an important role to play in eliminating or reducing wastage generated by their activities.

As part of the Subcontractor Performance Assessment undertaken by commercial, the subcontractors are ranked according to a number of items – including the 'avoidance of excessive waste' (1 being very poor and 7 being excellent). This is a good opportunity for construction teams to flag any issues to commercial and follow up with the supplier to investigate. If they are ranked 1) very poor this suggests large amounts of waste are produced –we could implement a follow up procedure for this (eg report to Group Commercial or Sustainability then follow up with contractor).

Plot 136 plaster skim bags, total weight = 110kg

10 | SUPPLY CHAIN

We could also encourage site management to make checks on the waste left on plots when subcontractors have finished. Redrow could aim to develop a new approach towards reducing waste, whereby waste is questioned and checked regularly by site operatives and management to check what waste is being generated and questioning sub-contractors on it. For example, small skips outside plots should be checked with a curious attitude – Why is this here? What caused this? Who has generated this waste and speak to subcontractors.

Key recommendations:

- → Develop a waste policy for subcontractors/suppliers and update the Subcontract Conditions and Acceptance of Offer to include reference to Redrow waste policy.
- → Consider including more details on waste or a specific waste section in Subcontractor Conditions and Acceptance of Offer.
- → Develop procedure to prompt further investigation if supplier is ranked 1 in the performance assessment for avoidance of excessive waste.
- → Evaluate the current methods used to monitor sub-contractor waste and recycling levels and encourage site management to undertake checks.

11 | PLASTIC AND PACKAGING

The below images illustrate the types of packaging which were identified from the waste project.

Hazardous material product packaging waste (3 paint tins, approx. 60 mastic tubes and expander foam containers). 1 bag, total weight = 25kg.

Plastic and plastic packaging waste. 6 bags, total weight = 185kg.

Cardboard waste. 2 bags, total weight = 84kg.

11.1 Plastic packaging

We use plastic in various forms during the build, the main uses include for tubing, piping, ducting and guttering; thermal and acoustic insulation; door and window frames and other external profiling such as soffits and fascia boards, flooring and cabling. Plastic is also used in other areas such as temporary protection.

This main source of plastic waste from all project plots was single-use product packaging such as shrink wrap and plastic banding. It was observed that most of the packaging waste was generated from the second fix, in particular from kitchen and bathroom appliances, radiators and towel radiators, shower screens, door casing wrapping, staircase balustrade wrapping and straps.

At the moment, we are not directly in control of the amount of packaging that arrives on our site however further work could be done with our supply chain to help identify packaging reduction opportunities. This could also help with our Considerate Constructors scheme assessments as the scheme has a heavy emphasis on this at the moment.

Redrow could also investigate putting additional measures in place for suppliers and asking some key procurement questions before tender or in supply documents (in a similar format to the way that FSC Timber is managed) as increased due diligence.

11 | PLASTIC AND PACKAGING

Key purchasing questions could include questions about reducing and reusing packaging such as ‘Does your packaging have >30% Recycled content ?’, ‘Is your packaging fully recyclable?’ What plans do you have to move your packaging up the waste hierarchy: to more recycled content, greater levels of reuse and ultimately to no packaging?’

Alternative materials to plastic packaging could also be considered with suppliers although at present there are a lack of suitable alternatives on the market that offer the same protection and are cost competitive. ‘Non-plastic’ solutions for packaging are being developed, however these are not used widely in the construction sector yet. These include hessian, wood cellulose, organic waste, seaweed, and mycelium. More traditional packaging types such as paper, cardboard, timber and metal could also be explored, though it is important to consider any alternatives in the context of their overall environmental impact throughout their whole life-cycle.

Plastic waste including packaging is not currently segregated in separate skips on Redrow sites, it goes into mixed skips and becomes contaminated through coming into contact with other waste materials. Contaminated waste can be difficult to recycle therefore waste companies sometimes charge a higher price to take it away. If we were to start segregating plastic waste, and keeping this uncontaminated, it would put Redrow in a better position to negotiate waste disposal costs with waste contractors. Therefore, the company should consider segregating plastic waste at source (on site) for environmental and financial benefits.

Further down the line, Redrow could also undertake a lab analysis of plastic packaging waste to identify polymers used in supplier packaging. This would involve segregating the plastic packaging for a plot and having someone come to site with a polymer reader and analysing the data. Valpak (a Reconomy Group Company) offer this service for £850 a day and estimate this would take 2 days to complete for one plot.

Certain types of plastic can be recycled more easily than others and in the future, Redrow could consider standardising and specifying the types of plastic packaging allowed on to our sites. Furthermore, having detailed polymer data and a thorough analysis of our packaging, could help to inform a future waste/packaging reduction strategy.

The March 2020 budget announced a new tax on plastic packaging containing less than 30% recycled content which will come into force in April 2022 and will be set at £200/tonne. This is set to increase the use of recycled plastic in packaging by 40% – equal to carbon savings of nearly 200,000 tonnes.

11 | PLASTIC AND PACKAGING

Key recommendations:

- Continue with the packaging survey and work with suppliers to identify packaging reduction opportunities.
- Investigate whether additional procurement questions relating to packaging reduction and re-use could be asked in tender or supply documents, as increased due diligence.
- Consider segregating plastic waste in skips at source (on site) for environmental and financial benefits.
- Undertake additional analysis of plastic packaging waste on site to identify polymers and specific plastics used for supplier packaging.

11.2 Plastic temporary protection

Temporary protection sheets used to protect kitchen in plot 121 Lancashire.

Temporary protection sheet disposed of in waste from plot 136 Yorkshire.

Proplex temporary protection sheets were used on all three of the project plots. Two sheets were disposed of from the waste project in Yorkshire. Temporary protection is used widely across the group to prevent damage to flooring within homes. The sheets are made of very durable, fire retardant plastic. Used sheets are currently disposed of in our mixed waste skips. They are often burnt in energy-recovery incinerators once they are disposed of and this process carries a heavy carbon footprint.

11 | PLASTIC AND PACKAGING

The supplier of this temporary protection, Protec, offers a Closed Loop recycling scheme for Proplex sheets. Protec supplied 29,887 Proplex sheets into Redrow in the year 2019-2020, this quantity represents 21.5 tonnes of Polypropylene.

At the moment, Protec only provide Temporary protection in 7 Redrow regions (including Yorkshire) and we use other suppliers too eg Ockwell's. However, if Protec were to have greater engagement with all Redrow regions then the number of sheets recycled could be significant, along with the recycling scheme's impact.

Protec's scheme was discussed with Yorkshire's construction director who said the scheme would involve time and effort on behalf of site operatives, as sheets need to be segregated into bags and stored on site until they can be collected. However, Redrow could consider other ways to implement the recycling system requiring the least amount of effort, for example it might be possible to get the cleaners to separate these when they empty/clean the house after second fix.

Group Commercial and Construction are currently writing a "protection policy" guide where all divisions are recommended to use Ockwells or Protec. Protec's closed loop recycling scheme will be included in the policy document.

Redrow could also further explore other take-back schemes for product packaging and used products. In the packaging survey undertaken by Group Commercial, some of our suppliers declared they offer such schemes. Using supplier recycling/ remanufacturing schemes is an environmentally responsible way to deal with product packaging and/or end of life products and improves the traceability of our waste. Furthermore, packaging return schemes such as the paint can scheme usually support a 'closed-loop' system, whereby the used materials are reprocessed into new products.

11 | PLASTIC AND PACKAGING

Redrow are already using the packaging take-back schemes mentioned in the table below:

Scheme	Utilisation	Details
Paint Can Recycling Scheme	Widely used (all Redrow regions)	All paint cans must be removed from site and, when empty, cans must be recycled through the Dulux Decorator Centre scheme. Last year, we recycled over 17,000 paint cans from our developments.
Community Wood Recycling Scheme	Widely used (half Redrow divisions)	A network providing an efficient collection service for waste wood, with the aim of saving resources by reusing and recycling waste timber. Last year we recycled more than 600 tonnes of waste wood.
British Gypsum Plasterboard Recycling	Partially used (some divisions)	A take back scheme to recycle plasterboard waste. BG provides sites with bags or skips for housing the waste and collects these when they are full.
Scott Pallets. Pallet repatriation	Widely used (most divisions)	Offers returnable pallets in bespoke sizes, made only from responsibly sourced timber. Last year we recycled around 35,000 pallets.

Key recommendations:

- → Continue with Packaging waste survey and explore the packaging return schemes which were identified. Redrow could also further investigate the use of other supplier packaging takeback schemes which were identified in the packaging survey.
- → Trial Protec's closed loop remanufacturing scheme for temporary protection and share feedback with divisions.

12 | MATERIAL HANDLING

Deliveries of roof tiles arrived to both the Brook and Langley Grange containing some damaged tiles and these could not be used, resulting in immediate inert waste. The tiles had been cracked and broken during transportation / offloading. According to an ACM, a common mistake occurs when the grabber picks up pallets via the forklift and if weight is not evenly distributed then items can get damaged. They can also get broken during the transportation process. Additional roof tiles were also cracked and broken during installation and therefore had to be discarded.

At Yorkshire, the inert waste weighed a total of 5.12t, representing the heaviest waste stream and 63% of the total waste. At Lancashire, The inert waste weighed a total of 3.2 tonnes, representing the second heaviest waste stream and 34% of the total waste Other types of inert waste included blocks and ceramics. Redrow sites usually stockpile, crush and reuse inert waste, however following the waste hierarchy we should aim to eliminate the waste in the first instance to improve environmental performance.

Damaged roof tile delivery to the Brook, Lancashire.

Damaged tiles/inert waste from plot 136, Yorkshire.

Some timber waste from the plot was also damaged and had large chips and cracks and could not be used on the plot. The joiner said that some of the timber was damaged during offloading or in storage, outside the plot whilst waiting to be used.

12 | MATERIAL HANDLING

Damage to material also occurred during the bathroom installation. The bath panel pictured below needed to be replaced as it had a large chip in due to workman error and handling.

Damaged bath panel from Yorkshire plot 136 (cost £37.10)

Key recommendations:

- Check if forklift training covers material handling and damage prevention (plus refresher training) and also include a section on this in the forklift guidance.
- Discuss with roof tile supplier how tiles could be better protected to prevent damage during delivery/transport cracked.
- Consider toolbox talk for material handling and how to address this issue with contractors.

13 | MATERIAL PROTECTION

There was a large number of wet blocks on the Yorkshire and Lancashire plots which became damaged and therefore could not be used by the contractor, so had to be disposed of in the inert waste skip. Similarly, some timber was wet and could not be used by the contractor so was disposed of in the wood skip. The materials left in the rain became wet and unusable as they were not covered and became damaged as a consequence.

Yorkshire is prone to bad weather and has a higher amount of rainfall and wind compared to the UK average and other counties. Climate data from the UK Met Office data suggests that the area near Langley Grange in Yorkshire has almost twice as much rainfall compared to the area near Ebbsfleet in the South East. This means that material protection and storage is vitally important here, to keep them dry and prevent damage.

The materials at the main compound/storage area were stored well at Langley Grange, with designated storage containers and materials stored off the ground. Materials were usually only removed from storage when they were needed. However in a couple of instances, materials were removed from storage and placed outside the plot and left there until they were used and this is when they became damaged by weather (timber and blocks). Nevertheless the joiner said that our material call offs are mostly arranged to match work stages (not too early, not too late) and he said it is important to have materials on the plot ready to be used to avoid build delays.

To protect bricks from weather damage, some Redrow divisions are using ‘Brick Jackets’ which are manufactured from woven polypropylene to protect bricks and blocks from harsh weather conditions (including wind, rainfall and frost) and other damage that could occur on site.

Key recommendations:

- → Incorporate material protection requirements for bricks into the bricklaying trade specification.
- → Consider wider usage of ‘brick jackets’, also look into getting these designed for a crate of bricks or packs of blocks. Explore other materials protection techniques to protect materials left outside plots waiting to be used.

14 | DISCUSSION

There are other factors which could help to reduce waste, for example education and training, incentives and quality improvements. These factors are less tangible and more difficult to measure, therefore these could not be directly attributed to the waste generated from the waste project. Nevertheless, the factors discussed below can have an influence on waste generation and could be further investigated.

14.1 Quality

The amount of waste resulting from quality/repair related issues is unknown, so we could further investigate this. Our customers have certain expectations when it comes to quality and we often replace things to satisfy our customers. Developing a company culture which focusses on waste reduction behaviour such as reusing and repairing (rather than replacing), whilst maintaining customer satisfaction is an important issue.

14.2 Designing out waste

Redrow HS&E waste management standard (HSEMS0129-V1- Management of Hazardous and Non-Hazardous Waste, 2020) recognises that **the best opportunity for improving materials resource efficiency in construction projects occurs during the design stage**. Implementing waste reduction opportunities early on in a project can provide significant reductions in cost, waste and our carbon footprint. Designers have an important role in reducing waste, particularly when applying the 'Waste Hierarchy' whereby the preferred option for waste is to eliminate it in the first place.

Designers have a key role in improving the materials resource efficiency (optimising materials use and / or reducing waste) from our projects as their design decisions influence what is constructed and how. Doing this is 'Designing out Waste' and there are five key principles that the Designers can use to reduce waste:

1) Design for Reuse and Recovery
2) Design for Off Site Construction
3) Design for Materials Optimisation
4) Design for Waste Efficient Procurement; and
5) Design for Deconstruction and Flexibility.

14 | DISCUSSION

During the waste workshops, divisions said they weren't sure how to communicate changes and ideas which they had to design out waste. Group should actively encourage ideas and opportunities to design out waste and explore how this could be done. Divisions could use the 'Design Recommendation Report' (DRR) available on Engage to suggest design changes, with a designing out waste guidance note to support this.

Key recommendations:

- → Encourage divisions to use and submit the 'Design Recommendation Report Sheet' (DRR) if they identify opportunities to design out waste. Consider developing a designing out waste guidance note for technical/ design teams.
- → Group Technical could review the Designing out Waste principals and Designing out Waste Guides (for example by WRAP) and explore how they could incorporate these into their work.
- → Expand the waste e-learning module to cover the Technical Team or develop a unique waste module specific to Technical (and/or Technical and Commercial) and make it mandatory during the induction process.

14.3 Supply chain documents

Group commercial have some useful Supply Chain documents which could be used by divisions to help reduce the issues relating to supplier issues and deliveries.

The Supplier Service Agreement is an external document for suppliers, which outlines some requirements they are expected to meet for group agreements. This includes some items on relating to deliveries and waste as outlined below:

3.3 Designed components to minimise waste during installation from cutting, fitting, managing packaging, and damage etc.

5.2 The Supplier must give adequate written notice of any change in the call off period. The minimum notice period for change in should be 15 working days.

5.3 Deliveries, where applicable, must be made in Plot Sets

5.5 Deliveries must be fully complete in accordance with the order/call off provided by Redrow or their Subcontractor

14 | DISCUSSION

5.6 The Supplier is to ensure that replacement components due to an incorrect delivery are supplied to the designated address within 3 working days.

5.7 Damaged or defective parts/products are to be supplied, without exception, within 5 working days of receipt of notification from Redrow or via carrier.

5.8 Suppliers must ensure that comprehensive stock levels are maintained and monitored at all times.

14.1 The Supplier is to contact/meet each Redrow Division on a quarterly basis to discuss any supply/service issues that have arisen since the last discussion meeting took place.

14.2 The Supplier is to submit a written report on all notable supply issues in the review meetings held with representatives from Redrow's Group Commercial Department.

14.3 Redrow reserves the right to recover any costs incurred associated with a product quality or service issue.

14.4 The Supplier is to work in accordance with Redrow's Waste Management Policy. A copy of the policy will be forwarded to the Supplier for implementation, with the agreement acknowledgement form contained within the document signed and returned back to the relevant Company.

14.5 Redrow are committed to promoting processes and working practices that minimise the environmental impact our developments have on the natural environment with particular respect to timber product usage. As such you are required to confirm the source of all Timber products used on their sites. Suppliers of timber or timber products will therefore be required to confirm the volume, country of origin, species, source of the timbers used and there status i.e. FSC etc.

Signed service agreements could be used by divisions as a tool to push suppliers for delivery and service improvements and hold them to account. For Group agreements, suppliers are expected to adhere to the Supplier Service Agreement and non-compliance may result in a review of the supply agreement.

The Supplier agreements are signed off by National Suppliers and held by Group. Copies of the pro-forma document are held on Engage and held on the Group discipline drive for all Commercial Teams to access. All Commercial and Construction Heads can have access to signed versions of the Supplier Service Agreements and other relevant documents

14 | DISCUSSION

The Supply Chain Management Overview is a different, internal document mainly used by divisional commercial teams and this includes some information on waste - a 2015 version of Redrow's Waste Policy. This policy will be reviewed and updated. It will require reissuing to divisions and suppliers and subcontractors to educated and ensure all parties are aware of our commitments to reduction of waste and what our standard procedures are.

Key recommendations:

- → Review the Redrow waste policy (2015) and circulate new Waste Policy to all Redrow Suppliers and Subcontractors to sign and return.
- → Update the Supply Chain Management Overview Document to include the new Waste Policy.
- → Send out a reminder to ensure that Commercial and Construction Heads know how to access signed versions of the Supplier Service Agreements or relevant signed docs, so these can be used as a tool to push suppliers for delivery improvements and improve their service.

14.4 Trade Specifications

According to Redrow Trade Specifications, the only contractors allowed to remove waste from site are carpet fitters, appliances and painters (paint cans). However, it appears that not all divisions are adhering to this and there are variations between divisions with regard to which contractors are taking waste off site (eg plasterboard removal from South East). This means that each division's monthly and annual waste data represents different practices, meaning Group Sustainability are not able to draw true comparisons between the waste (tonnage) data. Consequently, it is difficult to monitor performance and track which divisions are producing more/less waste in comparison to the group average.

During the waste workshops, the London division said they think that if a subcontractor is bringing waste on site eg pallets, that they should also be responsible for taking these away. The NW division also said that if the groundworkers took their waste away (and it was incorporated into their trade specs/agreements) then they would likely see a reduction in the amount of waste produced. At the moment, NW dispose of all groundworkers waste and said it is a significant amount. The divisions were in favour of getting certain trades eg drylingings and groundworkers to remove waste from site as they said this has a huge impact on reducing waste.

However, as a responsible business, we have a duty of care for our waste and need to ensure it is being managed responsibly. Due diligence checks must be undertaken before any waste is removed from site and contractors need to have the correct waste carriers licenses.

Redrow could review trade specifications and consider which, if any, trades should be allowed to remove waste from site. Once decided, a communication should be sent to all divisions to remind them which contractors are allowed to be removing waste from site so all divisions are doing the same across the group. Additionally, we could look at working closely with two/three trades who are identified as being major contributors to the company's waste.

Key recommendations:

- → Review trade specifications for dry linings and ground workers and decide if they should be allowed to take away their waste.
- → Investigate what other major housebuilders are doing with regard to waste going off site.
- → Develop group wide approach with regard to which contractors are allowed to remove waste from site and consult the divisions.
- → Make sure all divisions are implementing the standard trade specs.

14.5 Lack of incentives

In the workshops, the groups suggested that we should consider incentivising waste reduction, good waste management or waste cost savings. This could be done in the form of a bonus or other incentive (for example a voucher). There was a consensus that industry participants generally understand what is required to reduce waste, but are not incentivised to implement responses in practice.

15 | FURTHER AREAS OF RESEARCH

An area for further research for Redrow could be an investigation into how other homebuilders manage their supply chain. For example, Taylor Wimpey have their own supply chain logistics business called ‘Taylor Wimpey Logistics’ which acts as a central distribution network and is a vital component of their supply chain. Currently operating out of 65,000 sq.ft warehousing on a 5.5 acre site, Taylor Wimpey Logistics (TWL) deliver to some 120 sites across England, Scotland and Wales.

TWL produce quantified schedules reflecting the product specification. In addition to calculating quantities required, products are placed into plot specific schedules consolidating materials to facilitate delivery of those products required to arrive on site together at the relevant stage of build. Integrated supply chain management puts TW in a position to improve value and quality from suppliers, which in turn can deliver to better value and quality.

TWL source bulk materials directly from manufacturers to prepare ‘just in time’ delivery of build packs for each stage of the building process. This reduces the amount of stock on site at any one time and together with consolidated ordering, delivery and billing can potentially reduce costs.

Additionally, Redrow could also undertake some more research into offsite manufacturing. This has been covered briefly in this report (for example getting plasterboard and chipboard cut to size off site) however this has not been covered in detail.

16 | CONCLUSION

The Reduce the Rubble project involved stringent segregation of 10 different waste streams, allowing us to collect a detailed set of data on the amount of waste generated from building an Oxford housetype, by construction material type. The largest contributor to waste was inert material and in particular, blocks and roof tiles. Timber and plasterboard were the second and third largest waste streams respectively. The amount of plasterboard waste produced from a single plot (1.1-1.76t) was startling, and this could be a 'quick-win' focus point for Redrow moving forward, as the company attempts to further drive down waste.

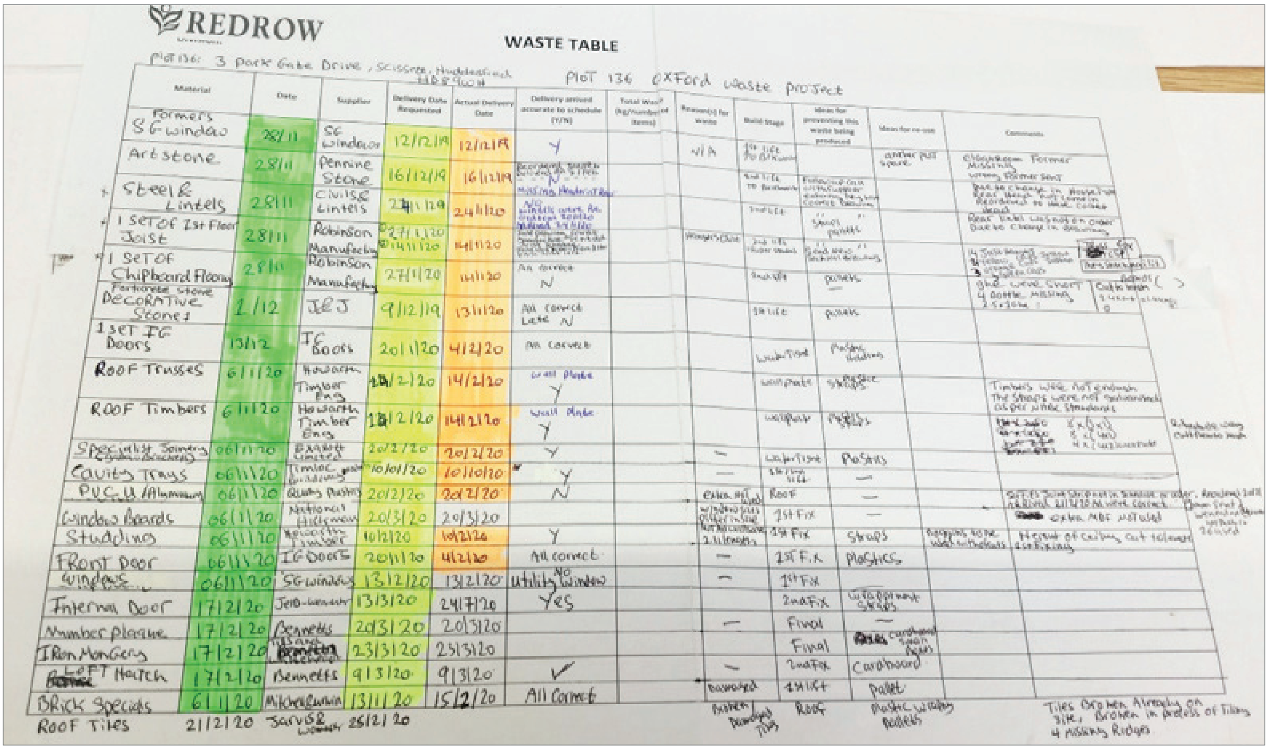
This project has improved our knowledge and understanding of key reasons why waste is produced. There appears to be no single, major cause of our construction waste, instead there are many interconnected reasons why we generate waste. Those identified during this research related to design changes, detailed specifications, supplier error, over-ordering, offcuts, product packaging, tradesperson error, material handling and protection and material usage efficiency. The causes of waste relate to various activities undertaken by multiple different business departments in the company, therefore reducing waste will require a collaborative effort from people across the business.

Finally, this project has identified some recommendations and examined ways we could reduce waste during procurement, design and construction. By implementing some of the recommendations suggested within this report, Redrow has the potential to significantly reduce its waste. In turn, this will help save money in terms of purchasing materials, as well as reducing waste disposal costs. Furthermore, by reducing waste, Redrow will also will also be able to help save natural resources and reduce CO2 emissions, helping to tackle climate change.

16 | CONCLUSION

Appendix A

Waste tables completed by Freddy Rahal, project manager at Langley Grange.



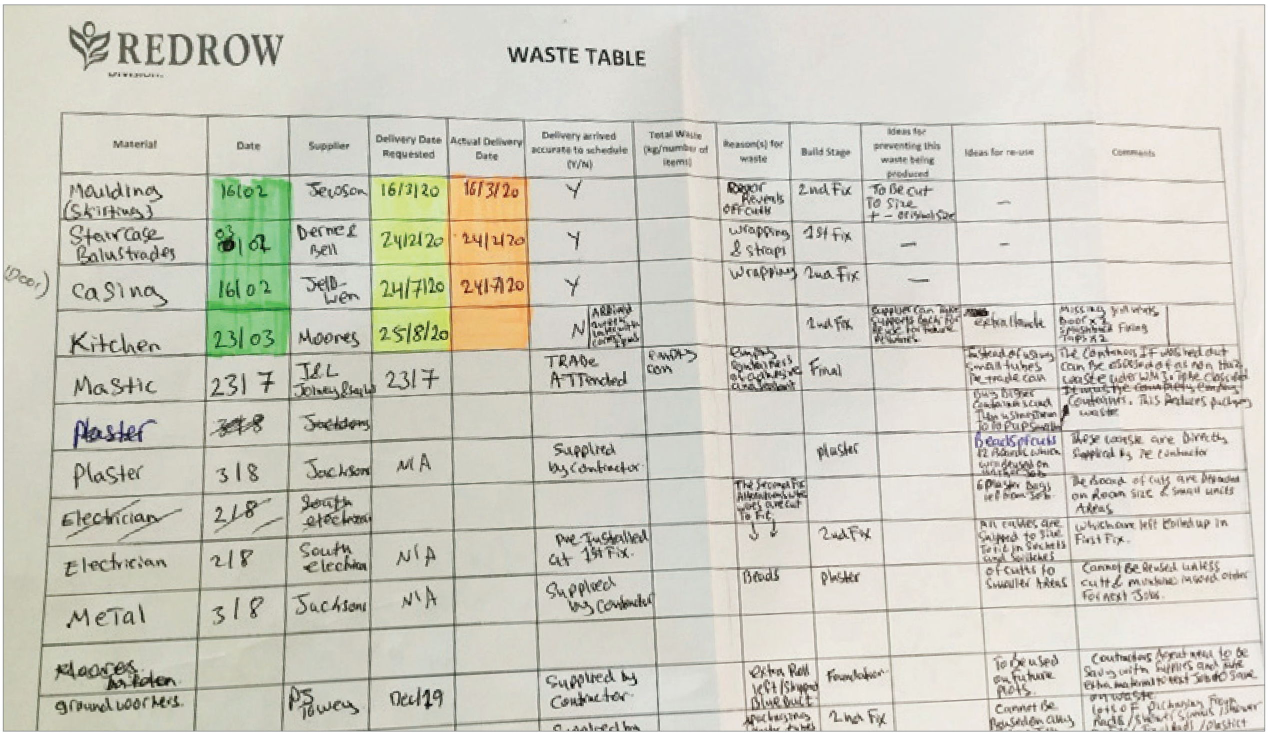
REDROW

WASTE TABLE

Plot 136: 3 Park Gate Drive, Scissett, Huddersfield HD8 9QH — Plot 136 Oxford waste project

Material	Date	Supplier	Delivery Date Requested	Actual Delivery Date	Delivery arrived accurate to schedule (Y/N)
Formers SG window	28/11	SG Window	12/12/19	12/12/19	Y
Art stone	28/11	Pennine Stone	16/12/19	16/12/19	N
Steel & Lintels	28/11	Civils & Lintels	24/1/20	24/1/20	
1 Set of 1st Floor Joist	28/11	Robinson Manufacturing	27/1/20	14/1/20	
1 Set of Chipboard Flooring	28/11	Robinson Manufacturing	27/1/20	14/1/20	All correct N
Fortune stone Decorative Stones	1/12	J&J	9/12/19	13/1/20	All correct Late N
1 set IG Doors	13/12	IG Doors	20/1/20	4/2/20	All correct
Roof Trusses	6/1/20	Howarth Timber Eng	18/2/20	14/2/20	Wall plate Y
Roof Timbers	6/1/20	Howarth Timber Eng	18/2/20	14/2/20	Wall plate Y
Specialist Joinery	06/1/20		20/2/20	20/2/20	Y
Cavity Trays	06/1/20	Timloc	10/01/20	10/10/20	Y
PVC-U/Aluminium	06/1/20		20/2/20	20/2/20	N
Window Boards	06/1/20	National Hickman	20/3/20	20/3/20	
Studding	06/1/20	Howarth Timber	10/2/20	10/2/20	Y
Front Door	06/1/20	IG Doors	20/1/20	4/2/20	All correct
Windows	06/1/20	SG windows	13/2/20	13/2/20	utility window No
Internal Door	17/2/20	Jeld-Wen	13/3/20	24/7/20	Yes
Number plaque	17/2/20	Bennetts	20/3/20	20/3/20	
Ironmongery	17/2/20	Bennetts	23/3/20	23/3/20	
Loft Hatch	17/2/20	Bennetts	9/3/20	9/3/20	✓
Brick Specials	6/1/20		13/1/20	15/2/20	All Correct
Roof Tiles	21/2/20		26/2/20		

Tiles Broken Already on site, Broken in process of Tiling, 4 missing Ridges



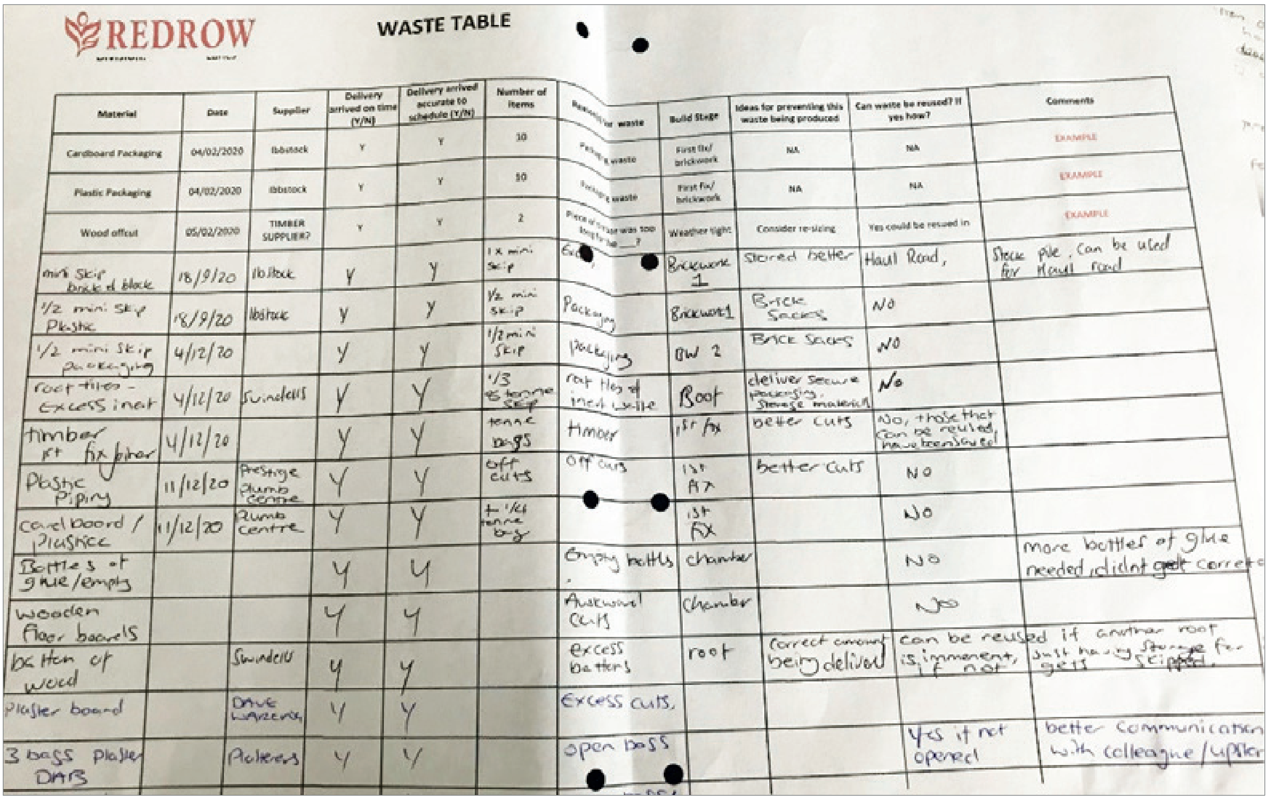
REDROW

WASTE TABLE

Material	Date	Supplier	Delivery Date Requested	Actual Delivery Date	Delivery arrived accurate to schedule (Y/N)	Total Waste (kg/number of items)	Reason(s) for waste	Build Stage	Ideas for preventing this waste being produced	Ideas for re-use	Comments
Moulding (Skirting)	16/02	Jeroson	16/3/20	16/3/20	Y		Offcuts	2nd Fix	To Be cut To Size	—	
Staircase Balustrades	03/02	Derne & Bell	24/2/20	24/2/20	Y		Wrapping & straps	1st Fix	—	—	
Casing	16/02	Jeld-Wen	24/7/20	24/7/20	Y		Wrapping	2nd Fix	—		
Kitchen	23/03	Moores	25/8/20		N			2nd Fix		extra Handle	Missing Door x 3, Tops x 2
Mastic	23/7	J&L	23/7		TRADE ATTended			Final			
Plaster	3/8	Jackson	N/A		Supplied by Contractor			plaster			These Waste are Directly Supplied by the Contractor
Electrician	2/8	South electrics									
Electrician	2/8	South electrics	N/A		Pre-Installed at 1st Fix.			2nd Fix			First Fix.
Metal	3/8	Jacksons	N/A		Supplied by Contractor		Beads	plaster			Cannot Be Reused unless
Groundworkers		PS Towey	Dec/19		Supplied by Contractor		Extra Roll	Foundation		To be used on future plots	

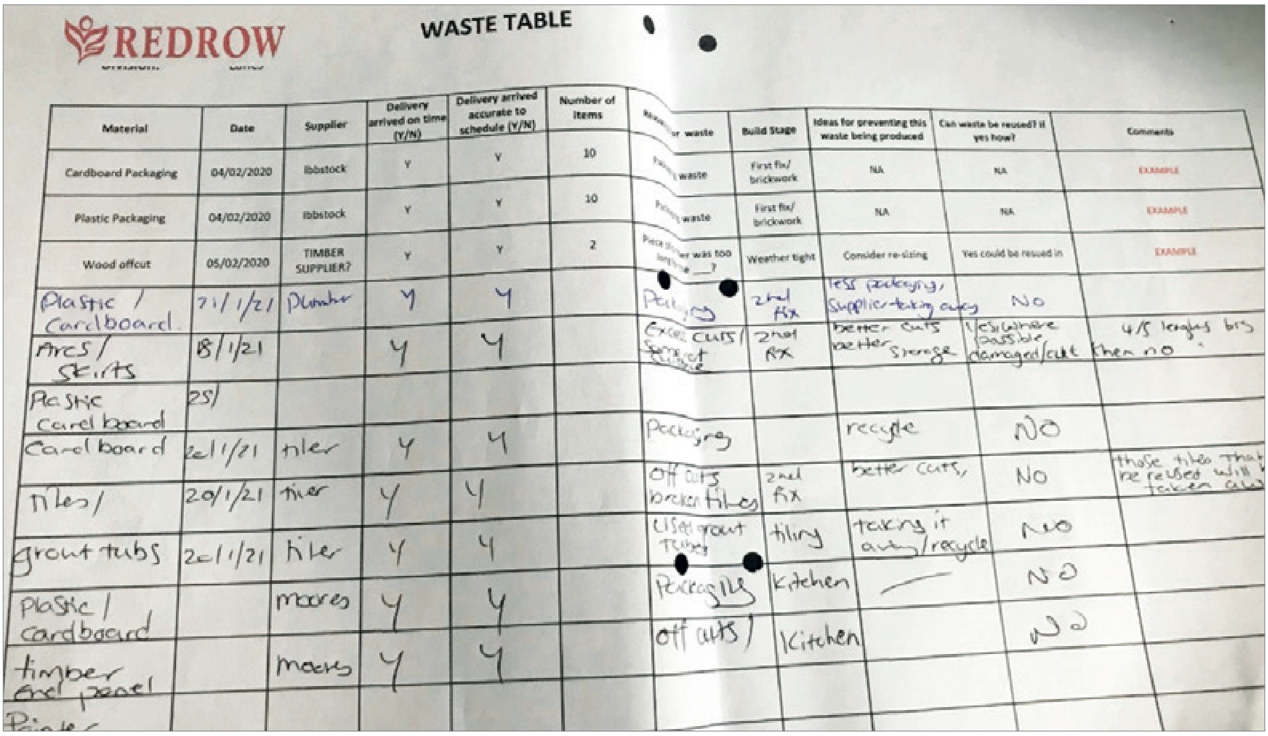
Appendix B

Waste tables completed by Kurt Trotman, project manager at The Brook.



REDROW — WASTE TABLE

Material	Date	Supplier	Delivery arrived on time (Y/N)	Delivery arrived accurate to schedule (Y/N)	Number of items	Reason for waste	Build Stage	Ideas for preventing this waste being produced	Can waste be reused? If yes how?	Comments
Cardboard Packaging	04/02/2020	Ibbstock	Y	Y	10	Packaging waste	First fix/ brickwork	NA	NA	EXAMPLE
Plastic Packaging	04/02/2020	Ibbstock	Y	Y	10	Packaging waste	First fix/ brickwork	NA	NA	EXAMPLE
Wood offcut	05/02/2020	TIMBER SUPPLIER?	Y	Y	2	Piece of timber was too long for the ___?	Weather tight	Consider re-sizing	Yes could be reused in	EXAMPLE
mini skip brick & block	18/9/20	Ibstock	Y	Y	1 x mini skip	[illegible]	Brickwork 1	Stored better	Haul Road,	Stock pile, can be used for Haul road
1/2 mini skip Plastic	18/9/20	Ibstock	Y	Y	1/2 mini skip	Packaging	Brickwork1	Brick Sacks	NO	
1/2 mini skip packaging	4/12/20		Y	Y	1/2 mini skip	Packaging	BW 2	Brick Sacks	NO	
roof tiles - excess [illegible]	4/12/20	Swindells	Y	Y	1/3 8 tonne skip	roof tiles of [illegible]	Roof	deliver secure packaging. Storage material	No	
timber 1st fix [illegible]	4/12/20		Y	Y	tonne bags	timber	1st fix	better cuts	No, those that can be reused, have been saved	
Plastic Piping	11/12/20	Prestige Plumb Centre	Y	Y	off cuts	Off cuts	1st fix	better cuts	NO	
cardboard / plastic	11/12/20	Plumb centre	Y	Y	1/4 tonne bag		1st fix		NO	
Bottles of glue/empty			Y	Y		Empty bottles	chamber		NO	more bottles of glue needed, didnt get correct
wooden floor boards			Y	Y		Awkward cuts	Chamber		No	
batten of wood		Swindells	Y	Y		excess battens	roof	Correct amount being delivered	can be reused if another roof is imminent, if not	just having storage for gets skipped.
plaster board		Dave [illegible]	Y	Y		Excess cuts.				
3 bags plaster bags		[illegible]	Y	Y		open bags			Yes if not opened	better communication with colleague/supplier



REDROW — WASTE TABLE

Material	Date	Supplier	Delivery arrived on time (Y/N)	Delivery arrived accurate to schedule (Y/N)	Number of items	Reason for waste	Build Stage	Ideas for preventing this waste being produced	Can waste be reused? If yes how?	Comments
Cardboard Packaging	04/02/2020	Ibbstock	Y	Y	10	Packaging waste	First fix/ brickwork	NA	NA	EXAMPLE
Plastic Packaging	04/02/2020	Ibbstock	Y	Y	10	Packaging waste	First fix/ brickwork	NA	NA	EXAMPLE
Wood offcut	05/02/2020	TIMBER SUPPLIER?	Y	Y	2	Piece of timber was too long for the ___?	Weather tight	Consider re-sizing	Yes could be reused in	EXAMPLE
Plastic / Cardboard	21/1/21	Plumber	Y	Y		Packaging	2nd fix	less packaging, supplier taking away	NO	
Arcs / skirts	18/1/21		Y	Y		Excess cuts / [illegible]	2nd fix	better cuts better storage	Yes where possible damaged/cut then no	4/5 lengths bits
Plastic cardboard	25/									
Cardboard	21/1/21	tiler	Y	Y		Packaging		recycle	NO	
tiles /	20/1/21	tiler	Y	Y		off cuts broken tiles	2nd fix	better cuts,	No	those tiles that be reused will be taken away
grout tubs	21/1/21	tiler	Y	Y		used grout tubes	tiling	taking it away/recycle	No	
Plastic / cardboard		moores	Y	Y		Packaging	Kitchen	—	NO	
timber end panel		moores	Y	Y		off cuts /	Kitchen		No	
[illegible]										

Appendix C

Waste Tables completed by Jack Leslie, project manager at Ebbsfleet.

REDROW Plot 412

WASTE TABLE

Division: South East, Ebbsfleet

Material	Date	Supplier	Delivery arrived on time (Y/N)	Delivery arrived accurate to schedule (Y/N)	Number of items	Reason(s) for waste	Build Stage	Ideas for preventing this waste being produced	Can waste be reused? If yes how?	Comments
Cardboard Packaging	2020/02/04	Ibbstock	Y	Y	10	Packaging waste	First fix/ brickwork	NA	NA	
Plastic Packaging	2020/02/04	Ibbstock	Y	Y	10	Packaging waste	First fix/ brickwork	NA	NA	
Wood offcut	2020/02/05	TIMBER SUPPLIER?	Y	Y	2	Piece of timber was too long for the ___?	Weather tight	Consider re-sizing	Yes could be resued in	
Ibstock Yellow Multi Yellow stock bricks	17/8/20	Ibstock	Y	Y	5 packs	wet or damaged cuts	1st lift brickwork	Supply with pallets	Yes re use as crush for footpaths	we do this on site already
Celcon blocks	17/8/20	Travis Perkins	Y	Y	4 packs	wet or damaged cuts	1st lift brickwork	N/A	Yes, re-use as crush for footpaths	we do this already on site
Plastic packaging	17/8/20	Ibstock	Y	Y	5 packs worth	Packaging waste	1st lift brickwork	N/A	N/A	Have re-useable brick jackets instead of plastic packaging
Ibstock Yellow Multi Yellow Stock bricks	27/8/20	Ibstock	Y	Y	2 packs	wet / damaged / cuts	2nd lift brickwork	Supply with pallets	Yes. Re-use as crush for footpaths	we do this already on site
Celcon blocks	27/8/20	Travis Perkins	Y	Y	2 packs	wet / damaged / cuts	2nd lift brickwork	N/A	Yes, Re-use as crush for footpaths	"
Joists	3/9/20	Pasquills	Y	Y	1 pack	No waste	Joist	N/A	N/A	
Flooring	3/9/20	Pasquills	Y	Y	1 pack 56 sheets	cuts / damaged	Joist	N/A	re use for bricklayers mark boards	
Plastic packaging	27/8/20	Ibstock	Y	Y	2 packs worth	packaging waste	2nd lift brickwork	N/A	N/A	Have re-useable brick pack jackets
Plastic packaging	3/9/20	Pasquills	Y	Y	1 pack worth	packaging waste	Joist	N/A	N/A	
Ibstock Yellow Multi Yellow stock bricks	7/9/20	Ibstock	Y	Y	4 packs	wet / damaged / cuts	3rd lift brickwork	Supply with pallets	Yes re use as crush for footpaths	we already do this
Celcon blocks	7/9/20	Travis Perkins	Y	Y	4 packs	"	"	N/A	"	"

REDROW

WASTE TABLE

Division: South East, Ebbsfleet

Material	Date	Supplier	Delivery arrived on time (Y/N)	Delivery arrived accurate to schedule (Y/N)	Number of items	Reason(s) for waste	Build Stage	Ideas for preventing this waste being produced	Can waste be reused? If yes how?	Comments
Cardboard Packaging	2/4/2020	Ibbstock	Y	Y	10	Packaging waste	First fix/ brickwork	NA	NA	
Plastic Packaging	2/4/2020	Ibbstock	Y	Y	10	Packaging waste	First fix/ brickwork	NA	NA	
Wood offcut	2/5/2020	TIMBER SUPPLIER?	Y	Y	2	Piece of timber was too long for the ___?	Weather tight	Consider re-sizing	Yes could be resued in	
Plumbers pipes + fittings	28/10/20	Plumbase	Y	Y	numerous	off cuts plastic wrapping	1st Fix plumbing	have set routes on drawings	No	
Shower Tray	28/10/20	City plumbing	Y	Y	3	plastic wrapping	1st Fix plumbing	N/A	N/A	
Cables	2/11/20	A Eyre Ellison	Y	Y	numerous	off cuts plastic wrapping	1st Fix elec	Have set routes on drawing	N/A	
Plasterboard	19/11/20	Minsters	Y	Y	3 packs	off cuts plastic wrapping	Drylining	Have specific setting out drawings	N/A	
MDF Skirting + Architrave	3/12/20	National Hickman	Y	Y	40 lengths Arc 40 lengths Skirting	off cuts plastic wrapping	2nd Fix Carp	N/A	N/A	
Doors + linings	3/12/20	National Hickman	Y	Y	14 doors	off cuts plastic wrapping	2nd Fix Carp	N/A	N/A	
Switches + sockets pendants	7/12/20	BG	Y	Y	numerous	packaging Cable off cuts	2nd Fix elec	N/A	N/A	
Baths, basins pans	9/12/20	City plumbing	Y	Y	numerous	packaging	2nd Fix plumb	N/A	N/A	

16 | CONCLUSION

Additional images

The weighing process involved using a forklift to pick up the segregated dumpy bags and load them on to a truck. From here, they were transported to the waste sorting facility, where they were individually weighed under careful supervision of our Reconomy account manager. This ensured we had a reliable set of data.

17 | NEXT STEPS

We have established a waste working group which will discuss the recommendations in this report and decide which ones are pertinent and practical. This working group includes representatives from Group Design and Technical, Group Commercial, Construction, Sustainability and Sales. We will develop an implementation plan for the workable recommendations and our overall aim will be to reduce waste and associated costs.

As part of this process, we will engage with the supply chain and get their feedback on ideas, as well as identify any future plans or opportunities for minimising waste.

Report written by Olivia Ward, Sustainability Coordinator

REDROW

THE REDUCE RUBBLE

INITIATIVE FROM REDROW

A BETTER WAY TO LIVE