



Site Waste Reduction Protocol





Site Waste Reduction Protocol

This protocol has been developed for use with the [Construction Waste Indicative Cost \(CWIC\) Calculator](#), developed by Glasgow Caledonian University for Zero Waste Scotland, and should be read in conjunction with the [CWIC User Guide](#) which explains how to input data for the tool in more detail.

The Protocol and CWIC Calculator were created to analyse individual skips on construction sites, to estimate the full cost of materials purchased, labour costs, including indirect costs associated with any rework and replacement of wasted materials, in addition to the more obvious skip-hire costs. The Protocol is not intended to provide a means of discharging the wider Statutory obligations of contractors managing construction sites. There are already tools available to help manage this, such as the BRE SmartWaste tool (BRE 2022).

This protocol and the CWIC Calculator has been developed on a simple Microsoft Excel spreadsheet, aimed at contractors who manage construction sites, focusing on site activities to categorise, quantify and analyse waste materials entering individual skips.

The information generated from individual skips in this way will allow contractors to see, more accurately than generic waste

estimating methods, what materials are in individual skips, how much it has cost to put them there, and why they have become waste. This information will inform contractor Site Waste Management Plans, help reduce future waste arisings (and costs), as well as feed into other tools used by contractors, such as SmartWaste (BRE 2022).

The protocol is labour-intensive, therefore contractors may decide to use it in a targeted way, for sites generating higher than expected waste, or to sample similar sites' waste for benchmarking purposes. Site management teams may prefer to appoint others to undertake sampling on their behalf. Either way, the information generated can both inform management strategies and help motivate employees to reduce materials wastage on site.

Scope

This protocol sets out the principles and methods to categorise and measure construction materials waste, and covers:

- Scope
- Units of measurement
- Method
- Analysis

1.0 Scope

The following points outline the scope of this protocol for categorising and measuring construction waste materials using the CWIC Calculator.

1.1 This protocol is aimed primarily at 'construction' waste materials that have been purchased, then placed in a skip that will leave the site. Whilst demolition and excavation categories of waste can be accommodated within the CWIC Calculator, this is purely so they can be identified separately from the waste materials that have a 'project' cost. Likewise, canteen and office wastes are considered as 'Other' waste and treated separately, with no cost figures.

1.2 The protocol is not intended for skips with only demolition, excavation or canteen waste as these do not have a purchase cost for the project. The recommended cut-off point for including this type of waste is 90% of volume, after which usable waste data becomes negligible.

1.3 A 'project' cost does not necessarily need to be borne by the main contractor managing the site. Some costs associated with skip-hire and materials purchasing may have been borne by others e.g. sub-contractors. However, the CWIC Calculator does not make any distinction between which parties have paid the costs and merely uses indicative cost figures based on industry databases (as at March 2022). Note however, that contractors can replace the indicative costs in the CWIC Calculator with their own purchase costs for greater accuracy (this process is explained later under 'Method').

1.4 Whilst the protocol and CWIC Calculator are intended for use by main contractors with overall site control of waste and skips, they can also be used by sub-contractors, if they purchase their own materials, have control over individual skips and what goes in them.

Scope

- 1.5** What happens to waste once it has left the site, for example off-site segregation to divert from disposal and/or landfill, is not considered separately in the CWIC Calculator. Waste arising from construction work is the focus of the protocol, as the generation of waste in the first place is what is in scope.
- 1.6** The CWIC Calculator has been developed to analyse the contents of a typical 8-yard mixed skip by volume (m³). This is the main unit of measurement for baseline calculations (although the protocol can be applied to any type of skip containing previously purchased materials, e.g. timber, plasterboard, metal). The CWIC Calculator also uses conversion factors to show weight of each material type, in metric tonnes.
- 1.7** A typical 8 yard skip has been assumed to hold 5m³ of waste (allowing for void space), although fully compacted skips can hold up to 6m³. Therefore, for meaningful comparisons, regardless of actual skip size used on site, the volume of waste collected for each piece of analysis should be between 5m³ and 6m³. A running total in the CWIC Calculator changes from red to green once 5m³ of waste has been logged, this returns to red again if the volume logged exceeds 5.9m³. A minimum of 1m³ of waste sample will allow the CWIC Calculator to estimate the full skip contents (the running total will change to amber after the sample amounts to over 1m³), but the closer the sample accumulates to 5m³ the more accurate the estimate will be. **It is strongly recommended that at least 5m³ of waste is used in any one sample.**
- 1.8** The more information that is logged about the waste, the more analysis can be undertaken by the CWIC Calculator. The minimum information required is: type of waste (automatically aligned with European Waste Catalogue (EWC) Codes for typical construction materials), its volume, whether the waste was installed then removed, if replacement materials were needed, and average travel distance from the work area to the skip. Additional information, which allows further analysis, includes: 'source of waste' (why it is in the skip) and the condition of the waste.

Units of measurement

- 2.1** The CWIC Calculator uses the volume (m³) of an 8 yard mixed skip as its baseline. This is based on historical calculations and allows for comparisons with previous data. This means that the most desired volume of waste required per skip to run an accurate analysis is 5m³ (1m³ minimum, 5.9m³ maximum).
- 2.2** If the skip being analysed is an 8 yard skip, then log details of its entire contents. If it is less than 8 yards, continue to log details from additional skip(s) until at least 5m³ of materials is achieved. If the skip is more than 8 yards, stop after 5m³ of materials is achieved (the volume is automatically scaled up from 5m³ to the expected volume of any larger skip sampled).
- 2.3** If the skip being analysed is not a mixed skip, then this affects the skip-hire cost. For such skips, the CWIC Calculator allows the skip hire cost to be altered (exclude VAT as this is added later). This process is explained further under 'Method'.
- 2.4** Volume (m³) is the unit of measurement for data input. This is measured via material dimensions (mm). The dimensions are estimates, based on observation of waste in the skip (or as it is going into the skip) and is recorded as length, width, and thickness. Waste material of the same type and similar dimensions can be logged together using the 'number of similar objects' option (explained further under 'Method').
- 2.5** The CWIC Calculator automatically converts volumes of the same waste type to its corresponding weight using conversion factors (SEPA 2014). This allows for wider comparison with other tools and methods of waste management. However, the majority of analysis is in the volume (m³) unit of measurement.
- 2.6** Costs are in Pounds Sterling (£), excluding VAT which is shown as an optional additional cost (based on 20% as at March 2022) in the 'Dashboard Costs' analysis tab of the CWIC Calculator.
- 2.7** Cost calculations are automated in the CWIC Calculator. This means units of measurement for costing purposes are embedded in the background calculations, i.e. 'Each'; 'Linear meter'; 'Square meter'; 'Cubic meter'; and 'Litre'. However, when there is more than one option e.g. 'Timber: Linear' and 'Timber: Sheet', a second tier of material descriptions allow these separate cost units of measurement to be used. Therefore, it is important to choose e.g. 'Timber: Linear' if logging lengths of timber framing, and not 'Timber: Sheet'.

Method

- 3.1** The person logging waste data from the skip is referred to as 'the user'.
- 3.2** Preparation: ensure the user is trained in construction site health and safety, has received a site induction, been risk assessed, and is wearing appropriate PPE for the site they are on.
- 3.3** Tools: the CWIC Calculator has been created in Microsoft Excel, therefore a hand-held device which can run Excel is the preferred option for data collection. A hard-copy version of the sheet can be printed but this would need to be manually input to a PC or laptop after data is collected and introduces the potential for input errors. It is also advised to have a steel measuring tape to give the user an idea of approximate waste material dimensions; and a digital camera (most phones or hand-held devices will do). Photos become extremely useful if waste arrives at the skip in loads (e.g. bins or by forklift) which can be overwhelming when trying to log information. Photos allow quick placeholders to be noted in the 'Data input' rows (see Section 3.11), which can then be completed during quieter times.
- 3.4** Access to the skip: the location and methods of filling the skip will dictate access to it. Always identify a safe place to stand, where there is no danger

of falling from height or being struck by objects. If waste materials are collected in the skip via a waste chute, then site safety precautions need to be implemented to take the skip out of commission every time access is needed for data collection. It is an express requirement of this protocol that the user NEVER enters a skip to collect data. Likewise, if materials are transported and delivered into the skip via a vehicle, typically a telescopic forklift, then the user should stand in an area where they can see vehicles approaching the skip area. Users should also stand back when a vehicle approaches the skip.

- 3.5** The CWIC Calculator was created on Microsoft Excel 2016 (32-bit), and should be saved as a new file (with a new file name), each time data for a skip (usually 5m³ of material) has been input.



Figure 1: telescopic forklift at skip

Method

- 3.6 CWIC Calculator – Set up page: Note that all cells that require/allow data entry are green. Figure 2 shows the ‘Set up’ page, pre-populated with example data. This requires the user to insert the date(s) when data collection took place; Company name; User name; and Site/location. The Site/location field can also be used to include any site-specific reference.
- 3.7 Figure 2 also shows fields with drop-down lists for: ‘Construction type’; ‘Project type’; ‘Project phase’; ‘Season’ and ‘Weather’.

- 3.8 Set up page – Distances to skip: the average distances to the skip should be input here. There are three modes of travel allowed for and the user should use all that apply, note that the ‘Total average (auto)’ field is automatically calculated on the spreadsheet. However, there is also an option for the ‘Total average (manual)’ to be used.
- 3.9 Estimating average distances to skip: It is advised that a site (or building) layout drawing be used (see Figure 3) to help estimate average distances to the skip.

SITE SET UP		Onsite Waste Reduction Calculator
Dates of sampling: from/to	23/03/2022	24/03/22
Company name	GCU	
Your name	B Hare	
Site/location	Glasgow Campus	
Distances to skip		
Average distance (walking)	20	meters
Average distance (hoist/lift - vertical)	50	meters
Average distance (fork-lift/vehicle)	100	meters
Total average (auto)	170	
(or) Total average (manual)		meters
Size of skip sampled	8	yards
<div style="border: 1px solid #ccc; padding: 5px; margin-top: 5px;"> Set up Data input Dashboard Costs Dash Volume Dash Weight Dash Source Dash Condition Lists Costs Calcs + </div>		

Tabs

Figure 2: Drop Down

Method

Table 1: Project types

Mode of transport (if used to transport waste)	Estimation method(s) in meters (m)
Walking	Estimated from the centre of the work area (or floor-slab) to either the skip or where another mode of transport is used.
Hoist/lift (vertical)	Either the full height to a single work area or half the total height for work areas on multiple floors.
Vehicle	Either the distance from a single work area to the skip by vehicle, or the average distance from multiple work areas to the skip.
Cumulative total	Total distance calculated automatically
Or: Total (manual)	Estimate travel distance from the mid-point of the site to the skip.

3.9.1 Average distance on foot should be estimated from the centre of the work area (or floor-slab) to either the skip or to where another mode of transport begins.

3.9.2 There is an option to include further travel via hoist or lift, the average distance should either be the full height to a single work area or half the total height if work areas are on multiple floors.

3.9.3 There is also an option to include travel to the skip via vehicle. Average vehicle distance is either the distance from a single work area to

the skip, or the average distance from multiple work areas. Different speeds and plant costs are included in the automatic calculations depending on which combination of travel modes are used.

3.9.4 Alternatively, use the ‘Total average (manual)’ option to estimate travel from the mid-point of the site to the skip. This is less accurate but can be used if the more detailed breakdown cannot be easily obtained. Table 1 summarises these options.

Method



Figure 3: Example site layout

3.10 Set up page – Size of skip sampled:
The default skip size is an 8 yard skip. But the user has the option to increase the size (there is no smaller option because ‘8 yard’ is the minimum for calculating the figures). Alternative sizes go up to 40 yards and are used to alter the cost and volume parameters for analysis. Note that the skip options appear as a drop-down list and, like every drop-down list in the CWIC Calculator, it has a darker shade of green than the others.

3.11 CWIC Calculator – Data input page (left side): The ‘Data input’ tab (which appears along the bottom of the spreadsheet – see Figure 2) is where most of the waste information

is input. This sheet takes the form of a table with headings describing what information is needed, and rows for inputting information relating to each waste item (or collection of similar items) in the skip. Data is input from left to right along each row, as shown in Table 2. There are some useful tips regarding data input as follows:

3.11.1 Try to be specific; there are some waste categories that include multiple materials in their description. But there is a two-tier system for specific categorising of waste in the second tier. Using the second tier will help avoid combining multiple wastes in one data entry. Doing this will lead to more accurate cost analysis.

Method

- 3.11.2** Take time to learn the drop-down lists; the two-tier system means some materials are not obvious until the Tier 1 option is chosen. For example, 'mixed construction and demolition wastes' is a Tier 1 option that allows materials such as bricks, plasterboard, timber etc. to be logged in Tier 2. But if demolished bricks, timber, plasterboard etc. are logged in Tier 1, the CWIC Calculator will assume this is material that was purchased for the project and add purchase costs, which is incorrect. As a general rule, only use 'mixed construction and demolition wastes' for existing in-situ material that has been demolished, deconstructed or stripped out.
- 3.11.3** Some options on the Data input tab have been developed to be complementary, for example, there are several types of packaging waste in the Tier 1 drop-down list. The most common reason packaging ends up in the skip is because it cannot be returned to the supplier, therefore 'not recovered by supplier' is an option for the waste 'Source' (see Section 3.13).
- 3.11.4** Under the 'Other Each' Tier 1 categories, there is a Tier 2 option for 'Other [Zero Cost]'. This category has been included to identify other waste (not identified elsewhere) with zero cost to the project e.g. office and canteen waste (explained further in the CWIC User Guide).

Method

Table 2: Data input headings (left side)

Seq. No.	Type of waste	Waste code (auto fill)	Description of waste	Notes on waste	Source of waste
	↓Drop-Down List		↓Drop-Down List		↓Drop-Down List
1	Insulation	17-06-04	Insulation: general		Cutting waste
2	Treated wood/glass/plastic, including wood/plastic window frames	17-02-04	Treated wood/glass/plastic: timber (lengths) wall or partition members		Fixing waste: built in wrong place
3	Concrete bricks/tiles and ceramics in mixtures	17-01-07	Concrete bricks/blocks, tiles and ceramics in mixtures: bricks, common bricks including mortar		Fixing waste: poor workmanship/quality
4	Other	0	Other Each (insert cost figure)	Broom	Damaged: Site storage and internal site transit waste
5	Mixed construction and demolition wastes	17-09-04	Mixed construction and demolition wastes		Demolition and stripping out
6	Concrete	17-01-01	Concrete: plain in situ ready mixed - C10		Application and residue waste (spillage)
7	Gypsum materials	17-08-02	Gypsum materials: plasterboard		Client/designer change of mind
8	Other	0	Other Square meter (insert cost figure)	Carpet	Cutting waste

3.12 Table 2 shows the following information:

3.12.1 Sequence number – automatically generated, from 1 to 200.

3.12.2 Type of waste – choose from the drop-down list, there are ‘Other’ options for anything not on the list (Each; Linear metre; Metre squared; Metre cubed, depending on the unit of measurement that the material is usually purchased).

3.12.3 Waste code – automatically filled with EWC code, depending on type of waste chosen. Note: only ‘construction and demolition’ waste codes are explicitly used (those beginning with a ‘17’) any other waste (e.g. tools, equipment, furniture, carpets) are treated as ‘Other’.

3.12.4 Description of waste – secondary lists of materials for greater cost accuracy. Most include a ‘general’ option if specific materials are not on the list.

3.12.5 Notes on waste – user defined notes (these can only be seen in the ‘Data input’ screen), and can be used to record e.g. corresponding photos of the waste taken on site.

3.12.6 Source of waste – reason why the waste is in the skip. This is a pre-populated drop-down list.

3.13 The options in Table 2 should be self-explanatory, with the exception of the final column. The ‘Source’ of the waste is included as a way of understanding why the waste is in the skip. In many cases this may be due to e.g. off-cuts. However, there may be other reasons why the waste is in the skip, which are explained further in Table 3.

Method

Table 3: Source of waste

Source	Description
Application and residue waste (spillage)	Site error, liquids or liquid at the time that have spilled (should not be in a mixed waste skip if hazardous).
Canteen and office waste	Welfare waste, paper waste etc.
Client/designer change of mind	Result of third party (not contractor) change e.g. design/specification change after materials have been purchased/installed.
Conversion waste (dimensions)	When materials can only be ordered in a pack or dimensions which results in more than is needed (uncut materials).
Criminal waste (vandalism)	Intentional criminal damage or vandalism.
Cutting waste	Common cause of waste, cutting materials to size (cut materials).
Damaged: Site storage and internal site transit waste	Site error, damaged whilst stored or being moved around the site.
Damaged: Transport and delivery	Already damaged on arrival at site (assuming quality control procedures must have failed).
Damaged: Weather	Damaged on site, specifically due to weather conditions.
Demolition and stripping out	Not previously purchased materials that are removed from existing, in-situ.
Design error	Potentially multiple reasons such as inappropriate specification, dimensional error, planning breach or anything else under a designer's control.
Excavated waste	Not previously purchased materials but removed from existing in-situ.
Excess materials (too much in a batch)	Site error, when too much material (e.g. cementitious) is batched on site (not over-ordering)

Method

Table 3: Source of waste

Fixing waste: built in wrong place	Only if a 'site' error i.e. contractor or sub-contractor error. Material installed then removed. 'Design error' if built to the design, which turns out to be wrong.
Fixing waste: poor workmanship/quality	Site error, contractor/sub-contractor workmanship.
Learning waste	Site error, new operative or new material being wasted until optimum working method is reached.
Manufacturing defect	Defects prior to arriving on site, not always obvious, could appear after installation.
Not recovered by supplier (packaging)	All types of packaging, including wooden pallets, are not recovered by supplier.
Over ordering	Ordering more than is needed. If unopened full packs/bags.
Temporary Works	Required to create the permanent works e.g. single-use formwork/falsework, installed then removed.
Waste caused by other trades (if unprotected)	Site error, due to lack of protection after material is installed.
Wrongly specified (by contractor)	If the contractor has responsibility for specifying materials (and not designer).

3.14 Source of waste: Small off-cuts can be considered as 'off-cuts' but anything more than 50% left uncut may point to another source e.g. 'Learning waste' or 'Design error'. There is scope to confuse different sources e.g. 'Over ordering' should only be chosen if full packs/bags are in the skip; whereas 'Excess materials' means there was too much from a site batch (as opposed

to over ordering); and 'Conversion waste' should only be used when materials can only be ordered in a pack or dimensions which results in more than is needed for the job, i.e. the pack or bag has been opened but not all contents have been used.

3.15 CWIC Calculator – Data input page (right side): Table 4 shows the right side of the Data input sheet. The headings on this side of the sheet continue from left to right, following on from those shown in Table 2.

Method

Table 4: Data input headings (right side)

No. of similar objects (enter 1 if only one)	Length (mm)	Width (mm)	Thickness (mm)	Total volume (auto fill). Aim for 5m3:	Condition	Waste material was installed then removed	New material needed to replace material wasted
				1.193	↓ Drop-Down List	↓ List Yes/No	↓ List Yes/No
5	1200	400	200	0.480	Potentially reusable	No	No
10	2400	100	50	0.120	Potentially reusable	No	No
1	200	1200	120	0.029	Suitable for recycling	Yes	Yes
1	1200	20	20	0.000	Suitable for recycling	No	Yes
5	100	100	50	0.003	Landfill		
1	1000	600	400	0.240	Landfill		
50	50	300	10	0.008	Landfill		
7	600	300	150	0.189	Landfill		
1	500	500	500	0.125	Landfill		

3.16 The first heading in Table 4 shows the next option for data entry, following on from entering the ‘Source’ of the material. This option is for entering how many objects of the same material and of similar size there are e.g. the number of single bricks. This is particularly useful when a load of e.g. cut plasterboard sheets are placed in the skip at the same time. Even if they are of differing sizes, observing the smallest and largest sheet will allow an estimate to be made of the average dimensions per sheet (for sheeted materials the thickness can be assumed to be the same) to input the load on one row. It is essential to input a number ‘1’ for single objects so the ‘volume’ calculator works properly.

Method



Figure 4: multiple similar objects can be entered in one row

3.17 The dimension columns should be self-explanatory. However, note that the 'Total volume' column is auto-filled (this column is not green, indicating it is not for data input) and should not be used to estimate the volume of objects – the three dimensional planes need to be used for this data input. This is where a measuring tape is useful to help record dimensions. There should be no need to retrieve materials out of the skip or go into the skip. But rather, use the tape on a sample of materials as they are going into the skip (which then makes for a useful dimensional reference point), or hold the measuring tape up to the skip to note typical distances in relation to the side of the skip. Note that the 'Total volume' heading in Table 4 incorporates a running total of

waste volume as it is being logged. In the example in Table 4, there is currently only 1.193m³ of waste logged, therefore the figure is amber (as it is over the minimum 1m³) and will remain amber until 5m³ is logged.



Figure 5: estimating dimensions with a measuring tape

3.18 When volumes of waste material are being estimated there are some tips to follow. Discarded containers, such as buckets are usually filled with air rather than the material they are made of. Therefore, simply estimating the dimensions of the bucket's base multiplied by its height will calculate more material than there actually is (which will inflate cost calculations). To avoid this error, estimate the dimensions of the sides (height and circumference) and add the approximate radius of the base to the height. This provides an approximate 'length' (circumference) and 'width' (height +

Method



Figure 6: estimating volume of containers

radius) dimension for data input, which leaves 'thickness', measured as the thickness of the material the container is made of.

3.19 Bulk materials are regularly brought to the skip in various containers, e.g. wheel barrows, wheeled bins, boxes etc. When containers of this type are presented at the skip, a quick estimate needs to be made of its contents before they are emptied into the skip. It may be easier to note the contents after this point (i.e. when they are visible in the skip). However, they can be estimated together if the contents of each container are of the same material. In this scenario, there are a few options: (1) if there is more void space than materials it will be easier to estimate the approximate number and dimensions of the materials (a photo with the measuring tape beside the container helps if time is a factor); if there

is little or no void space then use the volume of the container as the measure (a visual estimation of any void space can be used to subtract from the total volume).



Figure 7: container for transporting waste to the skip

3.20 Bulk materials in bags present a challenge for estimating their contents and dimensions. A conversation with the operative(s) using the skip helps to establish if there are several bags of similar material and what the waste material is likely to be. If possible, open a single bag, or samples from multiple bags, to inspect the contents. Use the same method recommended for containers, when estimating either the bulk volume of bags or the individual contents.

Method



Figure 8: bags of waste

3.21 The next column, after ‘Volume’, is the ‘Condition’ of the waste. This field allows an estimation of the suitability

of the waste materials regarding the potential for reuse or recycling (i.e. circular economy). The options come from a drop-down list as follows:

- 3.21.1** As good as new
- 3.21.2** Potentially reusable
- 3.21.3** Slight damage/Repairable
- 3.21.4** Suitable for recycling
- 3.21.5** Mostly recyclable (applicable to multiple or bulk materials)
- 3.21.6** Disposal/Landfill

Table 5: Condition of waste

Category	Description and comments
As good as new	Undamaged; in original packaging, or protected against damage.
Potentially reusable*	Undamaged; can be used for its original purpose*.
Slight damage/Repairable	Damaged; superficial surface damage; scuffs, scratches, chips under 10mm.
Suitable for recycling	Damaged, cut, missing parts; can be recycled without cleaning/preparation; free from contamination.
Mostly recyclable	Bulk materials in various conditions and levels of contamination; requiring preparation (e.g. cleaning, repair, etc.).
Disposal/Landfill	Damaged/contaminated, as described in Appendix 1, or not on the list of materials suitable for recycling in Appendix 1. Disposal in the majority of cases will be landfill or low value reuse of material.

* Additional SEPA rules apply; if waste material leaves site or there is a change of ownership it cannot be legally classified as ‘Reusable’. Definition in the CWIC Calculator means it ‘could’ be reused (Potentially reusable), rather than legally classified as ‘Reusable’ (ZWS 2020).

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3.22 The final two columns of data input allow further cost calculations to be made, depending on whether materials were installed then removed, and/or replaced with new materials. These options are closely linked to the ‘Source’ options for the materials, however, their application is left to the discretion of the user as they need to be considered on a case by case basis. For example, the first of these columns should be checked if, e.g. a wall was built in the wrong place, then pulled back down. Further, if a new wall had to be built in the correct location as a result of this, then the second column should also be checked. However, another scenario applicable to these columns may be materials with a manufacturing defect, which may be discovered before (don’t check the columns) or after (do check the columns) being installed on site. Note that if these last two columns are left blank the CWIC Calculator assumes them to be ‘No’ (see Table 4).

3.23 This concludes the main data input options. Further descriptions and examples to aid data input are provided in the CWIC Calculator User Guide [link].

3.24 There are a few more additional options available to the user which allows for a more tailored analysis when using the CWIC Calculator. There are five ‘Dashboard’ tabs and a ‘Report’ tab (blue in colour) to the right of the two green ‘Set up’ and ‘Data input’ tabs in the spreadsheet (see Figure 2). These are prepopulated with tables and pie charts which will automatically generate analysis of the data inputted for any given skip. Interpretation of these tabs is covered later, but for the purposes of additional data input, click on the ‘Dashboard Costs’ tab, and note there is a green field to allow the ‘skip hire cost’ to be changed. This is useful for two reasons: (1) if the skip that was sampled is NOT a mixed skip (e.g. a skip for specifically segregated waste which is usually less expensive), then the user can input the skip hire cost (excluding VAT); (2) if the default cost estimate for the skip hire is different from what was actually paid, this field can be used to record a more accurate figure. Table 6 illustrates this feature, simply input the cost (excluding VAT) for the skip in the green box.

Table 6: Alternative skip hire cost

	Volume (m3) of sample: 1.167	Per m3	For skip (Yards): 8	Alt. Skip
Total Materials Costs	£ 1,119.73	£ 959.59	£ 1,119.73	£1,119.73
Total Labour Costs	£ 595.23	£ 510.10	£ 595.23	£ 595.23
Skip Hire Cost (mixed)	£ 178.33	£ 35.67	£ 178.33	£ -

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3.25 To the right of the blue 'Dashboard' tabs, there are further (grey) tabs which contain all of the lists and formulas for the various calculations the CWIC Calculator performs. On the 'Costs' tab, there are green fields beside the 'materials' 'labour' and 'plant' columns for various 'Other' material options. These are default to zero. However, if there are unusual materials, not found in the default list, then costs can be manually inserted here for any of the 'Other' cost options: i.e. Each; Linear metre; Square metre; Cubic metre.

3.26 Table 7 illustrates how 'Other' names and costs can be input, note in the example £10 per item has been inserted to demonstrate the cost of a 'Broom' (in the 'Other_Each' option under the 'Material' column)

which is not a standard default option from the CWIC lists. Likewise, Table 7 shows a barrow and carpet tiles (per square metre) as textiles are not specifically labelled construction and demolition waste (17-XX-XX) under the EWC (textiles are coded 20-01-11). Up to 9 different one-off items can be added to the 'Others' lists for each unit of measurement (i.e. Each; Linear metre; Square metre; Cubic metre). The user has the option to include the materials ('Materials Rate'), labour, and associated plant costs (per unit of measure) if they have this information and wish to include it as a project cost, which will automatically be added to the cost calculations. However, these can also be left blank if, for example, the wheelbarrow was owned by a third party or was already on the site and therefore not a project cost.

Method

Table 7: ‘Other’ cost options

Type	Material	Unit	Materials R:	Total count	Materials Cost	Labour	Plant
Other_Each	[Broom] Other Each (insert cost figure)	Each	£ 10.00	1.000	£ 10.00	£ -	£ -
Other_Each	[Barrow] Other Each (insert cost figure)	Each	£ 50.00	1.000	£ 50.00	£ -	£ -
Other_Each	[NAME 3] Other Each (insert cost figure)	Each	£ -	0.000	£ -	£ -	£ -
Other_Each	[NAME 4] Other Each (insert cost figure)	Each	£ -	0.000	£ -	£ -	£ -
Other_Each	[NAME 5] Other Each (insert cost figure)	Each	£ -	0.000	£ -	£ -	£ -
Other_Each	[NAME 6] Other Each (insert cost figure)	Each	£ -	0.000	£ -	£ -	£ -
Other_Each	[NAME 7] Other Each (insert cost figure)	Each	£ -	0.000	£ -	£ -	£ -
Other_Each	[NAME 8] Other Each (insert cost figure)	Each	£ -	0.000	£ -	£ -	£ -
Other_Each	[NAME 9] Other Each (insert cost figure)	Each	£ -	0.000	£ -	£ -	£ -
Other_Linear	[NAME 1] Other Linear meter (insert cost figure)	m	£ -	0.000	£ -	£ -	£ -
Other_Linear	[NAME 2] Other Linear meter (insert cost figure)	m	£ -	0.000	£ -	£ -	£ -
Other_Linear	[NAME 3] Other Linear meter (insert cost figure)	m	£ -	0.000	£ -	£ -	£ -
Other_Linear	[NAME 4] Other Linear meter (insert cost figure)	m	£ -	0.000	£ -	£ -	£ -
Other_Linear	[NAME 5] Other Linear meter (insert cost figure)	m	£ -	0.000	£ -	£ -	£ -
Other_Linear	[NAME 6] Other Linear meter (insert cost figure)	m	£ -	0.000	£ -	£ -	£ -
Other_Linear	[NAME 7] Other Linear meter (insert cost figure)	m	£ -	0.000	£ -	£ -	£ -
Other_Linear	[NAME 8] Other Linear meter (insert cost figure)	m	£ -	0.000	£ -	£ -	£ -
Other_Linear	[NAME 9] Other Linear meter (insert cost figure)	m	£ -	0.000	£ -	£ -	£ -
Other_Square	[Carpet tiles] Other Square meter (insert cost figure)	m2	£ 32.73	0.750	£ 24.55	£ 10.13	£ -
Other_Square	[Carpet - roll] Other Square meter (insert cost figure)	m2	£ 47.19	0.000	£ -	£ 5.99	£ -
Other_Square	[NAME 3] Other Square meter (insert cost figure)	m2	£ -	0.000	£ -	£ -	£ -

3.27 The ‘Costs’ tab allows for any of the material, labour and plant costs to be manually altered from the default ‘indicative’ cost, to a specific purchase price decided by the user. This allows for a more accurate cost calculation, based on the actual costs incurred, if the user has these to hand. Simply scroll down the sheet to find the other green columns where the default costs are located to make any desired changes. But be careful to note the unit of measurement that the cost figure is based on so like-with-like replacements can be made e.g. do not replace a ‘square metre’ rate with a ‘cubic metre’ rate.

3.28 Advanced tailoring is possible, to add new options of construction and demolition waste in the ‘Costs’ and ‘Lists’ tabs. However, it is recommended to use the existing pre-populated lists which have two tiers of categories: Tier 1 aligned with EWC Codes, and Tier 2 with specific descriptions (see Table 2 ‘Type of waste’ and ‘Description of waste’). Most Tier 2 categories include a ‘general’ option for any materials that do not match the existing categories, which is preferred to creating new options. The CWIC User Guide [link] describes how to insert new Tier 2 options if users require this (there is no facility to add new Tier 1 options to maintain continuity of data).

Analysis

4.1 There are five ‘Dashboard’ tabs, located at the bottom of the spreadsheet (in blue), which show analysis for the data input via tables and pie charts. There is also a sixth blue ‘Report’ tab, which summarises the contents of the previous five Dashboards in one sheet for ease of extraction to company-specific databases.

4.2 Each tab contains a blue-headed table which can be updated every time new data is added. To refresh the table, click on the filter icon at the top of the last column (see Figure 9), which will show a list of values that can be seen in the table. First, check ‘Select all’, then uncheck any ‘zero’ options (e.g. £0; £-; 0). This will result in the table and the linked pie chart automatically updating to include all new materials from the ‘Data input’ tab, whilst hiding all zero values to create a clean and uncluttered table and pie chart. The same method should be applied to all the other Dashboard tabs: ‘Dash Volume’; ‘Dash Weight’; ‘Dash Source’; ‘Dash Condition’ to see the updated results. More detailed information on the Dashboard tabs is provided in the CWIC User Guide [link].

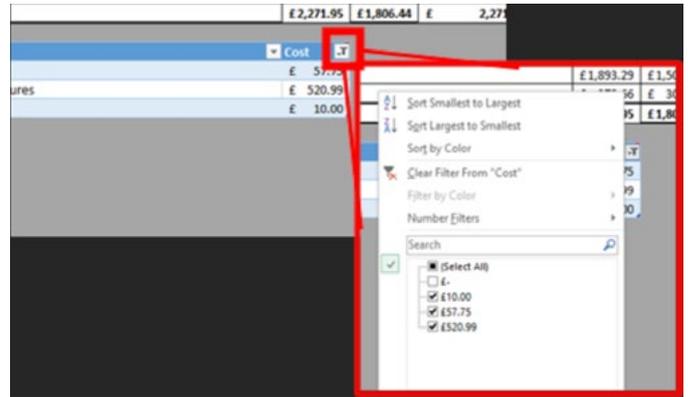


Figure 9: Refresh Dashboard tables, remove zeros

4.3 The Dashboard data for each skip can be saved individually. All data shown can also be copied and saved to an organisation-specific database, which can be used to help input detailed data to other tools, such as BRE SmartWaste. The easiest way to copy and paste output data is to use the ‘Report’ tab, which presents all the data from the individual Dashboard tabs in one spreadsheet. The cost data will allow construction organisations to monitor the full cost of their waste on a skip by skip basis, and with the additional analysis, help to pinpoint where waste is originating from on their construction sites.



References

BRE (2022) SmartWaste: Sustainability and environmental monitoring and reporting software for construction, property development, offsite and product manufacturing, Building Research Establishment (BRE): <https://www.bresmartsite.com/products/smartwaste/>

SEPA (2014) Density conversion factors for waste, Scottish Environment Protection Agency (SEPA), <https://www.sepa.org.uk/media/163323/uk-conversion-factors-for-waste.xlsx>

ZWS (2020) Maximising re-use of materials on-site; Zero Waste Scotland https://www.zerowastescotland.org.uk/sites/default/files/Maximising%20Re-use%20of%20materials%20on-site_0.pdf

Appendix 1: Construction materials suitable for recycling*

*Dependent on the condition and level of contamination. Assume the following are not suitable:

1. Contaminated materials;
2. Whole objects (e.g. statues, fireplaces, bathroom fittings) that have been damaged;
3. Materials in damaged containers (e.g. paint).

References

Material	Examples
Excavated material	Top soil, concrete, rubble, clay.
Iron and steel	Rolled steel joint (RSJ), structural steel, water tanks, steel buildings, stainless steel sinks and kitchens, modern pressed steel baths, fire escapes.
Wood off-cuts	Softwood studding, modern staircases, modern mouldings, scrap timber, cheap wood and panel furniture.
Beams	Beams, joists, trusses, rough sawn planks, railway sleepers, baulks, good pine or oak ceiling joists.
Brick, concrete and masonry	Common / building bricks, fire or refractory bricks, ceramic glazed, engineering bricks, paving. Masonry: Marble, granite travertine, limestone, cast stone, concrete block, glass block and cob.
Carpet tiles	Various fibres and yarns: Wool and wool blends nylon, polypropylene, polyester, acrylic.
Ironwork	Wrought iron, cast iron and early steel columns, conservatories, windows, doors trusses, frames, features and staircases.
Ironwork and brassware	Cast iron radiators, fire surrounds, kitchenware, door fittings, window fittings, church fittings, statues, urns, stoves, fire grates, grilles, gates, railings, cast and wrought iron furniture and fountains, made from iron, lead, brass, bronze, copper, spelter and aluminium.
Paving	Concrete products, flagstones, clay floor tiles and brick pavers.
Roofing	Reclaimed clay plain tiles, clay pantiles, clay interlockers, Bridgwater double triple and single romans and others, concrete tiles, stone tiles and slates, reclaimed natural roof slates, ridge and hips.
Scrap wood	Chipboard, plywood, MDF offcuts.

References

Trees and shrubs	Evergreen or deciduous trees / shrubs varying in size.
Wood flooring	Wood floorboards, roof boards, woodblock, wood strip, parquet, re-sawn beams.
Woodwork	Doors, door surrounds, window frames, window surrounds, shutters, staircases, facades, mouldings, skirting, dado, cornice, porches and cladding.
Decorative woodwork	Carved work, fire surrounds, church or pub interiors, shop fittings, institutional woodwork, carved relief panels, statues, bygones, carved ships figureheads, fire surrounds, panelling and panelled rooms.
Bricks	Handmade bricks, wire cut bricks, machine made bricks and pressed bricks.
Electrical equipment	Cables, light fittings, consumer unit, alarm systems. Free standing equipment: kitchen appliances, visual and audio equipment.
Excess insulation from exterior cavities	Foam board or rigid foam (polystyrene, polyisocyanurate, polyurethane), loose-fill and blown-in (cellulose, fibreglass, mineral wool), reflective system (foil-faced kraft paper, plastic film, polythene bubbles or cardboard), structural insulated panels, rigid fibrous or fibre insulation, sprayed foam, blanket insulation (fibreglass, mineral wool, plastic fibres, natural fibres).
Pallets	Timber pallets from transportation of materials (blockwork, bricks, cement, grout, tiles, etc.).
Stone	Walling stone, random, pitch-faced, dressed, ashlar, copings, dressings, calls, lintels and quoins. Door surrounds, window surrounds, steps and stairs, facades, stone features, cornice, mouldings, string course, portico, porches and cladding in natural stone, composition stone and concrete.

References

Bathroom sanitary ware	Baths, basins, toilets, cisterns, towel rails, bathroom cabinets, brass taps, shower heads, flush pipe, stoneware, earthenware, porcelain, vitrolite, brass, lead and copper bathroom fittings.
Ceramic structures	Heavily moulded or bas-relief bricks, columns, cladding and balustrade.
Ceramic objects	Statues, vases, reliefs, moulded detail, fireplaces, garden ware, garden edging, flowerpots in fired clay, earthenware, stoneware, composition stone etc.
Paint	Unused quantities of paint.
Plasterboard	Used for walls, ceilings, partitions and encasements etc.
Stonework	Carved stonework, statues, urns, troughs, pillars, cider presses, cider mills, fire surrounds and capitals.

Source: ZWS (2020)