

# Demolition Protocol

## 2008



## About ICE

The Institution of Civil Engineers (ICE) is a global membership organisation that promotes and advances civil engineering around the world.

ICE is a leading source of professional expertise in transport, water supply and treatment, flood management, waste and energy. Established in 1818, it has over 80,000 members throughout the world, including over 60,000 in the UK.

ICE's vision is to place civil engineers at the heart of society, delivering sustainable development through knowledge, skills and professional expertise.

## About the Demolition Protocol 2008

The ICE Demolition Protocol was first launched in 2003 and has been subsequently incorporated in planning guidance, as well as being implemented through the support of a range of organisations including WRAP (the Waste and Resource Action Programme).

The 2008 Demolition Protocol has been developed to provide an overarching framework which enables the waste hierarchy to inform approaches for managing buildings and structures at the end of their lives. There is more emphasis on the need to assess the reuse of buildings, structures, elements and products prior to demolition and recycling activities, recognising the carbon benefits of doing so. The 2008 Protocol also provides an integrated approach to the development of Site Waste Management Plans, with indicative targets described and approaches which deliver major benefits to clients.

For more information on the background to the Protocol please contact ICE communications at:

**t** +44(0)20 7222 7722

**e** [communications@ice.org.uk](mailto:communications@ice.org.uk)

## Acknowledgements

### Steering Group

Nigel Mattravers (Chair), Director, Grant Thornton and ICE Waste Board  
Lawrance Hurst, Consultant, Hurst Peirce & Malcolm and ICE Archives Panel  
Jonathan Essex, Reclaimed Materials Manager, Bioregional Development Group

### Research Team

Brian Menzies  
David Hay, EnviroCentre Ltd  
Nicola Gribble, EnviroCentre Ltd

### ICE Staff Team

Andrew Crudgington  
Faith Opio  
Ed Horton  
Vernon Hunte  
Lisa Stopik

The steering group would also like to thank the organisations and individuals from across the UK who provided input during the consultation phase of this project.

# Table of contents

|  |           |
|--|-----------|
| <b>Overview</b>  | <b>4</b>  |
| Introduction   | 4         |
| The target audience for the Protocol   | 5         |
| What the Protocol does   | 6         |
| How the target audience should use this document   | 7         |
| <b>Implementation</b>  | <b>8</b>  |
| 1. New build, demolition and early planning  | 8         |
| 2. Waste hierarchy approach  | 10        |
| 3. Building reuse/refurbishment audits and recovery targets  | 12        |
| 4. Design: specifying reclaimed materials and value engineering  | 13        |
| 5. Deconstruction and design audit   | 14        |
| 6. Reducing the carbon footprint   | 15        |
| 7. Material recovery planning: linking pre-demolition audits with design assessments to incorporate recycled content | 16        |
| 8. Site Waste Management Planning – regulatory compliance and the code for sustainable homes                         | 19        |
| 9. Indicative targets for recycling  | 20        |
| 10. The cost benefits  | 22        |
| 11. Implementation through tender and contract clauses   | 23        |
| 12. Implementation as a planning requirement   | 24        |
| 13. Verification   | 25        |
| 14. The definition of waste  | 25        |
| <b>Appendices</b>  | <b>26</b> |
| <b>ICE Demolition Protocol Checklist</b>   | <b>27</b> |
| <b>Definitions</b>   | <b>30</b> |

# Overview

## Introduction

The Demolition Protocol was launched by the Institution of Civil Engineers (ICE) in November 2003 and has been adopted and implemented across a range of public and private sector projects. Its use has been either required or recommended by a range of mechanisms, including planning policy/conditions, tenders/contracts and voluntary agreements.

This 2008 version puts greater emphasis on how the aims of the waste hierarchy can be achieved. It describes the overarching implementation approaches for Materials Resource Efficiency (MRE) associated with demolition and construction activities, with a decision-making framework which emphasises the need to reuse, then recycle, with landfill as a last resort.

The Demolition Protocol 2008 does not supersede the 2003 version, which continues to be relevant for the detailed approaches it provides, plus the industry and policy activity it examines in the UK and other parts of Europe at that time. The 2003 version can be downloaded, along with this version, from the ICE website.

The proposal to develop a Demolition Protocol originally came from ICE's Resource Sustainability Initiative, with funding provided from landfill tax credits and ICE's Research and Development fund. The Protocol is effectively guidance made available through ICE, with no Intellectual Property Rights (IPR) associated with its use and adoption.

Since its launch it has been incorporated into many national and local planning guidance documents, and been supported by WRAP (the Waste and Resources Action Programme) in a number of ways, including the production of targeted audience guides in 2004 and incorporation within the publication *The Efficient Use of Materials in Regeneration Projects, A Step by Step Guide*. WRAP has also published a number of case studies implementing the Protocol which are available on the website ([www.aggregain.org.uk/demolition/the\\_ice\\_demolition\\_protocol](http://www.aggregain.org.uk/demolition/the_ice_demolition_protocol)).

The appendix provides a checklist which should be followed to ensure compliance with the Protocol. The checklist also sets out the steps for preparing a Site Waste Management Plan, as well as those which will provide a delivery mechanism to implement the waste hierarchy and minimise carbon footprints.



Figure 1. The first edition of the ICE Demolition Protocol was produced in 2003.

## The target audience for the Protocol

The Protocol is principally aimed at policy-makers and client teams (the principal contractor in a Site Waste Management Plan context). It sets out policy and overall development approaches for sites where building/infrastructure reuse, demolition, stripping out and new build activities are planned. It provides a tool which helps the client and management team (including cost advisers) to make early considerations of potential resources available from buildings and infrastructure. Its potential is most effectively achieved when used as a tool for cost and environmental management.

The Protocol enables connections to be made with new build activities on the same site (or in neighbouring sites) by providing a framework for the reuse of buildings, infrastructure, products etc. It also helps to deliver more sustainable processes by establishing quantities and targets for recovering materials, as well as identifying the potential for procuring recovered materials in the new build.

Managing resources in this way delivers both environmental and cost benefits, as well as providing a Site Waste Management Plan. In England this can demonstrate compliance with regulations or the requirements of the Code for Sustainable Homes. In the other UK nations the Protocol can assist in the delivery of good practice and planning guidance, as described in section 12 of this document.

The fact that the Protocol is pro-active and not retrospective forms an important part of its methodology. It requires fundamental project management issues to be considered from the project outset, with a target setting process which follows the careful consideration of options and costs. The checklist shown in the appendix assists the user in identifying how implementation of the Protocol demonstrates compliance with good practice, regulations or other schemes.

## Ownership of demolition material and MRE

Opportunities to maximise MRE on demolition and regeneration projects are heavily influenced by the way tenders and contracts are arranged to give ownership of bulk materials produced. The demolition industry is an innovative one and already demonstrates high levels of recovery. Demolition contractors, when given this ownership, without conditions, will rightly seek the best available price in the market place and manage/recover materials accordingly.

However, this approach may not necessarily serve the overall best interests of the client, or maximise the environmental benefits in terms of avoiding haulage movements or encouraging the use of what could be higher value reclaimed materials. These are lost opportunities, from the client's perspective; particularly when materials and products can be either recovered for use on the same site, or on another nearby site.

In such circumstances significant additional cost savings and environmental benefits can be made by planning ahead and coordinating the movement of material and products to meet potential demand. Environmental benefits can therefore be realised through reductions in vehicle movements and the distances that materials are transported. Additionally, the reuse of products leads to lower carbon footprints than disposal, recycling and the use of new products (even products with significant recycled content).



Figure 2. Recycled aggregates

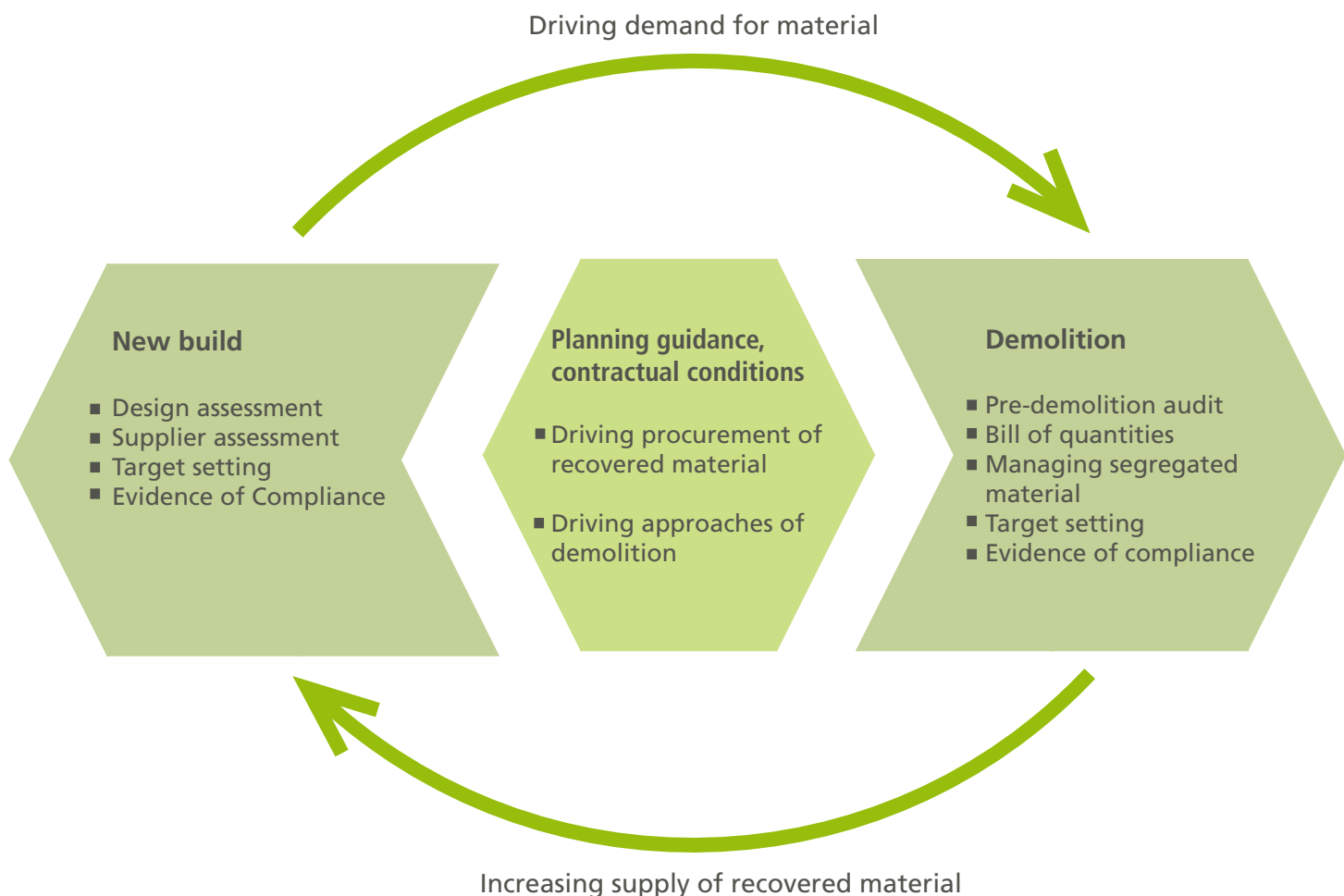
## What the Protocol does

This 2008 version of the Protocol provides overarching methodologies which:

- Explain the role of policy-makers and the client team in delivering cost benefits, by adopting the Protocol
- Ensure that the principles of the waste hierarchy are adopted in the decision-making process for evaluating buildings, the fit out materials and structures
- Offer a process-driven approach to setting targets for deconstruction, reclamation and reuse
- Provide a Deconstruction/Demolition Recovery Index (DRI) – this is the percentage of building elements, products or materials to be reused or recycled
- Estimate bulk quantities through a pre-demolition audit, summarised in a Demolition Bill of Quantities (D-BOQ)
- Provides a new build recovery index (NBRI) – describing the percentage of building elements, products or materials recovered for use in the new build
- Demonstrate compliance with Site Waste Management Plan requirements
- Describe how carbon benefits, through avoided haulage movements, can be realised and estimated easily
- Provide data for in-house and local authority monitoring of annual construction and demolition waste arisings.

The 2003 version of the Demolition Protocol referenced a mechanism for driving the supply and demand of recovered materials (reused and recycled). This mechanism is shown in Figure 3.

Figure 3. Supply–demand mechanism from the 2003 protocol



It summarises the approach of the Protocol in terms of its influence on the supply and demand side of demolition and construction projects. This indicates that policy-makers and client teams are at the heart of the process, with contractors then working to deliver overarching objectives.

This 2008 version of the Protocol goes further by describing an approach which entails policy-makers and client teams adopting practices to ensure that building/infrastructure reuse, deconstruction and the use of reclaimed materials are at the heart of decision-making processes. Only once these have been given full consideration should recycling opportunities be taken forward. These processes/practices are reflected in the diagram shown in Figure 4.

Figure 4 therefore describes a set of overarching methodologies which allow the objectives of the waste hierarchy to be delivered and, as in the 2003 version the Protocol, requires monitoring and verification of performance. These approaches are described in the implementation sections of this document. A checklist is provided in the appendix to summarise the data and steps required.

### How the target audience should use this document

The target audience (policy-makers, clients and construction supply chain) may find benefit in reading the full document to ensure a detailed understanding of the approach. Each of the following implementation sections of this document begin by identifying the target audience (policy-makers and the construction supply chain) which may find the information and approaches most relevant.

Figure 4. The 2008 ICE Demolition Protocol – requiring the adoption of practices which ensure that building reuse, deconstruction and material reclamation have been considered

Driving the potential to incorporate reused products and recycled materials



Providing reuse and recycling options for existing buildings/infrastructure, products and materials

# Implementation

## 1. New build, demolition and early planning

Key Target Audience: Policymakers, clients and project managers

The most effective point for considering the opportunities represented by existing buildings and infrastructure in a regeneration project is at the initial feasibility and outline design stages. At this point, cost and environmental benefits can be realised most effectively by undertaking appraisals to understand the potential for reusing existing infrastructure/buildings, followed by the reuse of products/components and then recycling.

The responsibility for ensuring that the above opportunities are fully maximised lie with the client and project management team. The starting point in a project feasibility assessment has to include consideration of building/infrastructure reuse, deconstruction and reclamation delivered through the client setting this as a requirement for the project management team. An important consideration in this respect, though not within the scope of the Protocol at this point, is consideration of how design approaches can extend the life of buildings in the future, to support their reuse.

The timescales associated with most construction and demolition projects are such that there will be sufficient time to plan MRE approaches. When larger projects are involved their timescales will, more often than not, allow even more opportunities to undertake the required forward planning.

Unless these early project planning considerations take place there can be little certainty that the most cost and resource efficient approach is being taken forward. Deconstruction may often be a limited opportunity if, as is currently often the case, the building/infrastructure being considered was not designed for deconstruction. However, there may often be opportunities which an audit will bring to light, that may have otherwise been unclear.

For example, the recovery of bricks may be possible because lime-based mortar makes separation and reclamation much simpler than predominantly cement-based mixes. In addition, reclamation of fit out items, plant and equipment may provide an income or cost neutral opportunity, for example where functioning air conditioning plant, architectural features, steel framing, floorboards and timber joists etc can be recovered.

However, if audits to assess this potential are instigated late in the development process then other pressures associated with the project will dominate and these opportunities, which require more time than traditional demolition approaches, will be lost.

The recycling of demolition arisings, such as concrete and brick, to produce recycled aggregates is now a mainstream activity usually driven by the cost benefits to be made. However, client teams still do not often consider establishing the quantity of bulk materials which could arise and linking this to an overall site materials management plan – one which identifies where recycled aggregates can be re-processed on-site (or nearby) and used for a variety of applications.

Understanding the likely demand and supply of materials for a site, particularly a complex scheme with a number of phases, will allow the client team to decide if ownership of demolition arisings is their preferred approach, with tenders and contracts then set out to reflect this. The subsequent plans developed will identify if there are locations for the storage and reprocessing of materials on-site.

Early planning is fundamental to any organisation that aims to demonstrate it is behaving in an environmentally friendly manner, and which wants to create measurable reductions in its carbon footprint by implementing improved practices. A clear example of this is the reduction in vehicle movements achieved by eliminating or reducing the quantities of materials hauled to and from the site.



Figure 5. Aerial view of the Glasgow Harbour regeneration, where Demolition Protocol approaches have led to hundreds of thousands of tonnes of material remaining on-site and being recycled.

## 2. Waste hierarchy approach

Key Target Audience: Policymakers, clients and project managers

The Egan Review in 2004 (Skills for Sustainable Communities) described how government should incentivise progress that enables the construction of: "...developments that achieve carbon emissions and waste minimisation standards consistent with a sustainable one planet level within, say eight years."

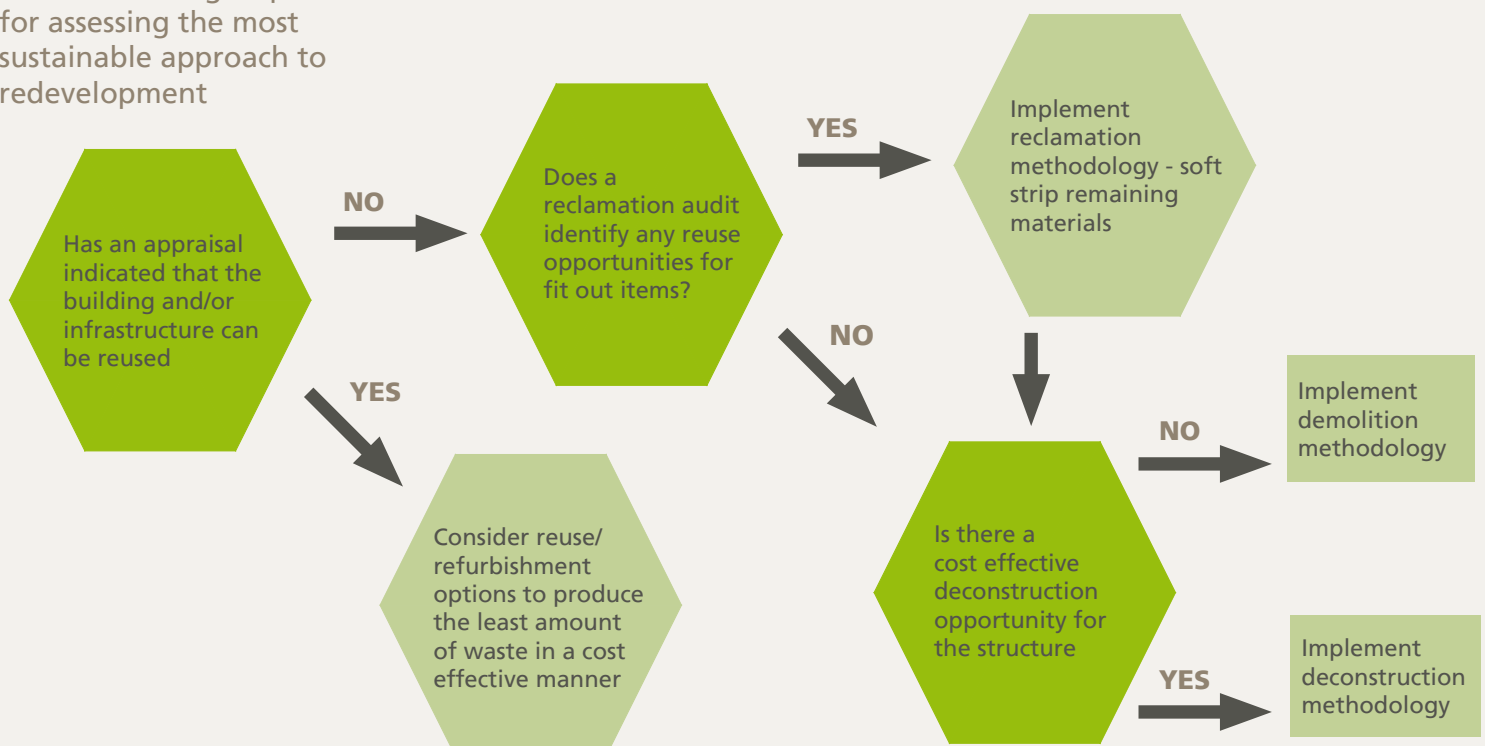
The earlier 1998 review Rethinking Construction described how whole life costing and value engineering required a new approach. The Waste Strategy for England 2007 identifies the benefits associated with reuse in terms of carbon. The Strategy gives the example of how the:

"...substitution of locally-sourced reclaimed materials for new in construction work can radically reduce the lifecycle environmental impact of that particular item, with use of reclaimed timber estimated as having a 79% lower impact compared to new."

As such the Protocol requires the partnering, innovation and one planet thinking of the 2004 Egan report, responding to the call to increase the reuse of products as mentioned in the England Waste Strategy. Actions which deliver the waste hierarchy are called for in strategy and policy documents from all of the devolved governments of the UK.

A building/infrastructure considered to have reached the end of its useful life can be assessed following the method shown in the flowchart in Figure 6. This takes a client and project management team through a process which ensures that the priorities advocated by the waste hierarchy have been considered and form a part of the decision-making process. The viability of approaches advocated by the waste hierarchy (waste minimisation being the first priority) will be considered when following this process -- in terms of cost impacts/benefits, health and safety, logistics (eg is there the space required) and the potential to deliver wider environmental benefits.

Figure 6. Flowchart of decision-making steps for assessing the most sustainable approach to redevelopment



A key consideration in terms of the above is that although a building or infrastructure may have reached the end of its life, many of its elements, products/components have not.

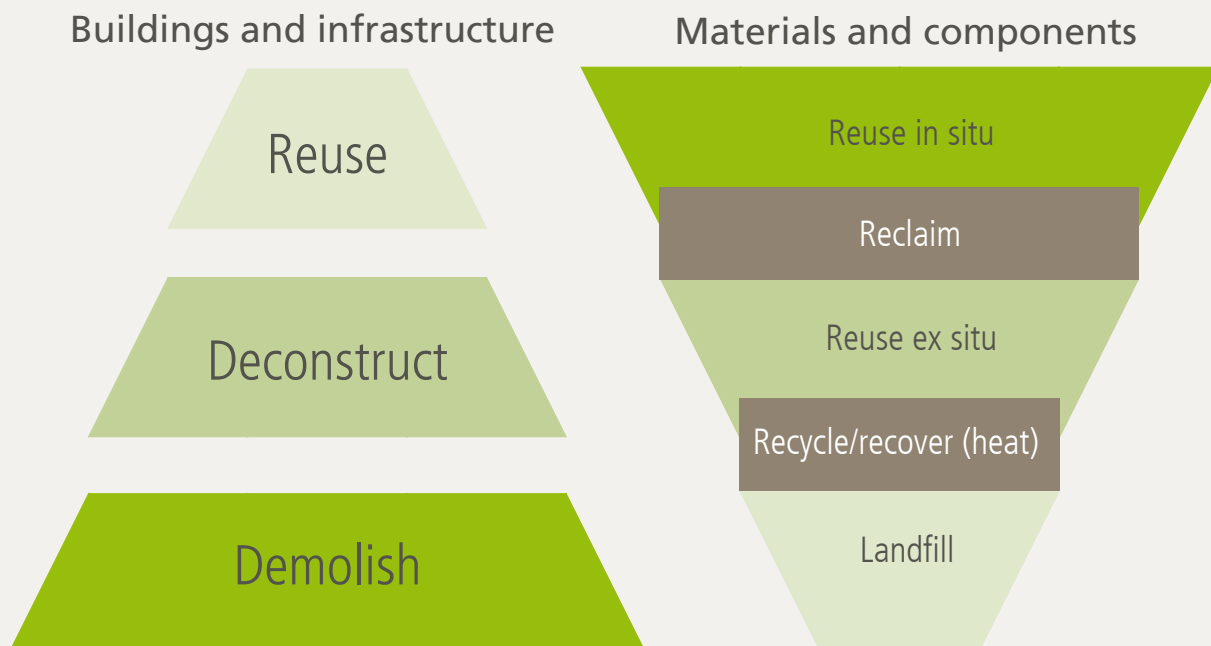
This decision-making process therefore reflects the aspirations of the waste hierarchy as shown in Figure 7, where the most sustainable approach involves building/infrastructure reuse followed by deconstruction, then demolition. This hierarchy will drive (i) waste minimisation activities through in situ building element/product reuse (ii) reclamation and the reuse of products ex situ, and (iii) recycling or heat recovery.

Landfill is shown as the least preferred option, one which will become increasingly unwelcome as environmental and cost pressures grow. The flowchart above and summary table below should be used to demonstrate that the waste hierarchy has been considered when developing regeneration approaches to buildings and infrastructure. The mechanisms and considerations required when following the flowchart and hierarchy are described in the sections following this one.

Table 1. Summary table for the waste hierarchy decision-making process.

| Consideration                              | Stage          | Mechanism  | Outcome which demonstrates viability  |
|--|----------------|--|---|
| Building / infrastructure reuse            | Feasibility    | Design and cost appraisal.   | Space, integrity, aesthetics, and refurbishment costs satisfactory.                                   |
| Reclamation of internal – fit out products | Outline design | Reclamation and design audit to assess potential for recovering internal/fit out products for reuse. | Opportunities for reuse in situ and ex situ identified, ie market potential is good.                  |
| Deconstruction                             | Outline design | Audit to assess the potential of the structure for reuse.  | Elements of structure identified which can be reused in situ or ex situ, ie market potential is good. |
| Demolition                                 | Outline design | Pre-demolition audit to assess recycling options.  | Recovery targets for recycling, in situ and ex situ set.  |

Figure 7. Waste hierarchy and delivering MRE



### 3. Building reuse/refurbishment audits and recovery targets

Key target audience: Policymakers, clients and project managers

The reuse of buildings and structures (or part of them) not only provides environmental benefits, but an opportunity to take advantage of the legacy that such reuse offers – maintaining heritage and connections between past, present and future generations. This social and aesthetic opportunity sits well with the environmental benefits to be realised from reuse. There are a number of initiatives, papers and research documents published on the pros and cons of reusing buildings in preference to demolition.

In the UK, the Code for Sustainable Homes, BREEAM, and EcoHomes (Scotland only) refer to Site Waste Management Plans as a way of demonstrating responsible behaviour. Credits are given for the reuse of elements and products.

In the US the LEED (Leadership in Energy and Environmental Design) Green Building Rating System provides credits on the basis of a percentage of the existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing) being maintained (excludes window assemblies and non-structural roofing material). Credits are awarded for different scales of retention, for example at 75%, with more credits for 95% reuse.

These percentages refer to area (m<sup>2</sup>) being considered. The approach also extends to interior non-structural elements where 50% of existing materials (interior walls, doors, floor coverings and ceiling systems) should be reused. These levels of retention can be described within the Protocol terminology as the New Build Recovery Index (NBRI), describing the percentage of the building (by area) which is reused.

Where such an approach (a building reuse/refurbishment audit) can be demonstrated as having been employed for a project, the ICE Demolition Protocol can be considered to have been implemented. Above 75% reuse of the building structure and envelope will demonstrate compliance with the Protocol and for interior elements reuse of 50% or more will demonstrate compliance. In terms of the Protocol, the remaining features described in this document can therefore be considered and implemented to continue adding value.

## 4. Design: specifying reclaimed materials and value engineering

Key target audience: Policymakers, clients, project managers and construction supply chain

The UK construction industry has in recent years seen enormous investment in both awareness-raising and capital equipment to increase recycling knowledge and infrastructure for processing construction wastes. The reclamation industry has not witnessed a comparable level of investment, with the result that the ambitions of the waste hierarchy are not being supported, and opportunities to minimise CO<sub>2</sub> emissions are being lost. This Protocol provides an overarching framework that requires innovative partnering methods to deliver more sustainable approaches to regeneration projects.

Where the refurbishment or deconstruction/demolition of a building is being considered the principal contractor should be required to demonstrate that the potential for reusing structures, components etc has been explored effectively, as described in section 3. Where there is no opportunity to follow this approach, or where the project will result in a new build, the contractor should be asked to demonstrate that more than 5% reclaimed materials, by value, have been procured for the new development. These could come from (i) the building demolished on the site (ii) a building earmarked for refurbishment/demolition at another site or (iii) from reclamation yards/traders. This would be described in terms of a NBRI of more than 5%, using the Protocol's terminology, and identified separately as a reclamation/reuse performance indicator.

The use of reclaimed products from a building/structure demolished on the same site could potentially make for an attractive option in terms of the cost benefits and environmental sustainability. To enable this to happen, the principal contractor would need to consider the following:

- The type, quality, measurability and quantity of items with reclamation potential
- Identify removal methods, with associated recovery rates (ie accounting for damage)
- Additional staff time required
- Identify a storage area for the materials.

In terms of the last point, support for establishing storage space (reclamation yards) could be considered by local authorities, to assist with temporary requirements across the duration of a regeneration project. Although on a large scale, the success of a site such as the Heathrow Consolidation Centre may be worth considering in this context. This centre, providing an area for the stockpiling of construction materials and packaging waste, has been described as providing an opportunity to manage stock more effectively, with environmental benefits realised through reduced numbers of vehicle movements.

## 5. Deconstruction and design audit

Key target audience: Project managers and construction supply chain

Deconstruction of buildings is viable if their construction lends itself to being taken apart, which will apply particularly if this option was included as part of the original design approach. Buildings should be assessed to establish if this is the case, or if there are aspects of the design which would suit this. A deconstruction audit should provide a Deconstruction Recovery Index (DRI) -- a percentage which describes, in terms of area (m<sup>2</sup>), how much of the structure, cladding, flooring/ceiling elements etc is capable of being dismantled without significant risk of damage. This DRI can then be used to develop a deconstruction target.

The Scottish Ecological Design Association (SEDA), with Scottish Government support, has produced guidance on Design and Detailing for Deconstruction ([www.seda2.org](http://www.seda2.org)) which can be freely accessed online or in pdf format. CIRIA has also produced the publication Design for Deconstruction -- Principles of Design to Facilitate Reuse and Recycling, which can be purchased from the CIRIA bookshop. Designers should use the principles described as a core part of their design approach.

The New Build Recovery Index (NBRI) can then be used as a way of future proofing the potential for recovering components once the building comes to the end of its life. The NBRI can be expressed as a percentage of structural, cladding, flooring/ceiling elements which are able to be deconstructed.

Figure 8. A steel-framed structure being deconstructed



## 6. Reducing the carbon footprint

Key target audience: Policymakers and clients

From a waste minimisation and management perspective, activities which lead to reductions in the carbon footprint of developments will often be those which implement the waste hierarchy. Carbon footprinting in the context of the ICE Demolition Protocol therefore focuses on this in terms of encouraging the reuse of materials, as well as emphasising the importance of minimising associated haulage movements ie there are significant CO<sub>2</sub> savings to be made by managing resources in a joined up way, planning ahead in terms of using the resources which arise on site and avoiding unnecessary material and product movements.

Using DEFRA's Guidelines for Company Reporting on Greenhouse Gas Emissions, or WRAP's CO<sub>2</sub> Estimator Tool, it is possible to determine the avoided impacts of minimising vehicle movements and CO<sub>2</sub> emissions for different management options related to demolition arisings. To demonstrate this, take the example of a 20-tonne payload (articulated) vehicle, which could be expected to deliver a performance of around eight miles per gallon of diesel, or 1.7 miles per litre. With 2.63 kg of CO<sub>2</sub> produced per litre of diesel, this translates to 1.55 kg of CO<sub>2</sub> emissions per mile.

As an example of the benefits to be realised, 1,000 tonnes of demolition material retained on-site rather than hauled to a recycling facility (or to landfill), would avoid approximately 50 vehicle movements. For a haulage distance of 10 miles (return journey of 20 miles) this avoids 1,550 kg (1.55 tonnes) of CO<sub>2</sub> emissions. However, the overall benefit is greater than this because these site-won recycled materials substitute for the need to import materials to site. If the haulage distance for imported materials were also to be 10 miles then the overall saving is 3,100 kg of CO<sub>2</sub>. This approach to measuring CO<sub>2</sub> savings should be reported with the Demolition Protocol outputs.

Section 2 of this document refers to the Waste Strategy for England, with benefits quoted in terms of avoiding CO<sub>2</sub> emissions by reusing materials. This can be elaborated on by considering the example of a concrete framed building. The CO<sub>2</sub> emissions associated with the manufacture of new cement, the production of aggregates and steel, and the haulage emissions involved in delivering materials to site can all be avoided through reuse of the structure. The same scenario applies for cladding, flooring, fit out items etc. Haulage apart, it is also reasonable to consider that construction products which are recycled, or have a high recycled content, will normally be produced using less energy than that required for primary materials (which include extraction processes) again providing CO<sub>2</sub> savings.

However, there are often differences in the outputs of various carbon footprinting tools used to quantify the extent of CO<sub>2</sub> savings associated with reclamation and recycling. For example, wide-ranging carbon footprinting approaches are not considered in this version of the Protocol. The assumption is that, generally speaking, the adoption of approaches which maximise reuse, followed by recycling, will ensure that CO<sub>2</sub> emissions are minimised.

Figure 9. Reclaimed steel section



## 7. Material recovery planning: Linking pre-demolition audits with design assessments to incorporate recycled content

Key target audience: Clients, project managers and construction supply chain

### 7.1 Pre-demolition audit

A pre-demolition audit can take place either in parallel to a reclamation audit or separately. Its aim is to identify the key building and infrastructure materials which will arise from demolition and excavation works. This typically provides most value by establishing the bulk quantities available on site, as well as the potential for recovering value from timber, steel, etc for recycling. It also provides information on contaminated materials, if present, which it will not be possible to recover.

Information can be provided in a format which suits the requirements of Site Waste Management Plans, as described later in this section. Volumes/tonnages are estimated for materials and recovery targets set as a percentage and quantity of materials. This target is the DRI (Demolition Recovery Index) and can be set on the basis of standard, good and best practice (see section 9: Indicative targets for recycling).

This description of different standards for target setting is a new addition to the Protocol, informed by case studies and experience implementing the Protocol. Information is then summarised in a Demolition Bill of Quantities (D-BOQ), an example of which is shown in the table below. This demonstrates that a good practice recycling target of 95% for concrete items has been set.



Table 2. Demolition Bill of Quantities (D-BOQ) example

\*The recovery potential identified here is recycled concrete aggregates (RCA)

|                            | Recovery Potential | Units  | Total Material Weight (Tonnage) | Demolition Recovery Index (DRI) Good Practice | Demolition Recovered Material Potential (Tonnage) |
|----------------------------|--------------------|--------|---------------------------------|---|---|
| <b>Concrete Components</b> |                    |        |                                 |   |   |
| Blocks                     | RCA*               | 20,000 | 100                             | 95%   | 95  |
| Ceiling soffits            | RCA                | 20     | 10                              | 95%   | 9.5   |
| Floor slabs                | RCA                | 1,000  | 1,000                           | 95%   | 950   |
| Foundations                | RCA                | n/a    | 200                             | 95%   | 190   |
| <b>Totals</b>              |                    |        | <b>1,310</b>                    | <b>95%</b>                                    | <b>1,244</b>                                      |

This is an important step in the design and costing process because it establishes the potential for recycling demolition materials either on site, or for recovery at a recycling facility. A statement should be made describing the use for recycled materials, on or off site, with the details of any waste management or haulage contractors involved. In the WRAP Regeneration Guide the percentage of material recovered for use on the same site has been classified as the Retained Material (RM) Index. This approach could also be followed here.

Taking the kind of example shown above, demolition arisings may be assessed in terms of their potential for use as a recycled aggregate, with a site layout plan showing where reprocessing equipment and storage areas should be located. To assist the process of estimating the quantity of waste, guidance and tools have been established by organisations such as WRAP and BRE (SMARTWaste).

## 7.2 Design assessment

Linked to the demolition planning, the Demolition Protocol provides a framework for describing the quantities of materials to be procured in the new build and the potential for recycled materials to substitute for primary materials. Data is summarised in the New Build Bill of Quantities (NB-BOQ), with the percentage of materials which could be procured from recycled sources identified as the New Build Recovery Index (NBRI).

The NBRI does not form the target, which is instead developed by the design team carrying out an appraisal of recovered materials, following the three key considerations: (i) are they cost neutral or lower cost? (ii) can they meet the quality requirements? (iii) what quantity can be supplied? The Protocol NB-BOQ was originally established to include quantities of recycled/reused materials for internal/fit out applications. To date, the NB-BOQ has been most commonly used to describe the potential for using recycled bulk materials such as aggregates, concrete, soils etc.

Figure 10. Planning ahead and producing a Demolition Bill of Quantities will deliver cost and environmental benefits



Figure 11. The Wembley Link project, through implementation of the Protocol resulted in 75% of unbound aggregates coming from recycled sources



For users who wish to look at the full range of recycled content in a new build (eg including internal, fit out components etc) reference should be made to WRAP's publication A Step by Step Guide – The Efficient Use of Materials in Regeneration Projects ([www.wrap.org.uk/construction/](http://www.wrap.org.uk/construction/)). This allows the user to integrate the Demolition Protocol with WRAP's Recycled Content Toolkit, which describes recycled content potential by construction value for all materials.

The NB-BOQ example below summarises bulk material quantities for two applications to demonstrate the approach. A much wider range of applications and materials would normally be recorded in this format.

The table identifies that specifications allow a total of 46% (the NBRI) of materials to be procured from recovered sources. However, for the target setting process to be realistic it has to be set following the three key considerations outlined earlier. In the example shown, the target set means that all of the sub-base (1,500 tonnes) will come from recycled sources, and half of the allowable recycled aggregates or in situ concrete (118 tonnes) will be specified.

Linking this with the earlier demolition example, 1,244 tonnes of the 1,735 tonnes of new build recovered material potential could potentially be supplied from reprocessed demolition arisings. This would avoid hauling 1,244 tonnes from site, as well as the need to import the same amount. This provides carbon savings as well as avoiding a significant number of vehicle movements.

Table 3. Example of New Build Bill of Quantities (NB-BOQ)

\* Target is determined from consultation with reprocessors and construction product suppliers

| Materials  | Vol (m <sup>3</sup> ) | Total Material Weight (tonnes) | Coarse Aggregate Weight (tonnes) | Recycled Material Allowed % | New Build Recovered Material Potential (tonnes) | New Build Recovered Material Index (NBRI) | New Build Recovered Material Target (tonnes) |
|--|-----------------------|--------------------------------|----------------------------------|-----------------------------|---|---|--|
| Aggregates for In situ Concrete  | 958                   | 2,299                          | 1,173                            | 20                          | 235   | 10%                                       | 118  |
| Type 1 road sub-base   | 1,000                 | 1,500                          | 1,500                            | 100                         | 1,500   | 100%                                      | 1,500  |
| TOTALS   |                       | 3,799                          |                                  |                             | 1,735   | 46%                                       | 1,618  |
| New Build Recovery Index (NBRI) % = Recovered material potential/Total tonnage = 46% |                       |                                |                                  |                             |   |   |  |

## 8. Site Waste Management Planning – regulatory compliance and the Code for Sustainable Homes

Key target audience: Policymakers, clients, project managers and construction supply chain

Site Waste Management Plans (SWMPs), at the time of writing, are only a regulatory requirement in England (for projects above £300,000), with different approaches adopted in the other UK nations. For example in Scotland SWMPs are promoted through Scottish Planning Policy 10 (SPP10) – Planning for Waste Management.

In England, the original guidance produced by the DTI on SWMPs, as a voluntary requirement, identified the ICE Demolition Protocol as a way of delivering the required data. Subsequent legislative requirements (Site Waste Management Plan Regulations 2008) require a number of additional features to be incorporated. Following the checklist shown in the appendix will assist with compliance of the SWMP regulations, as well as adding value by considering the waste hierarchy, target setting and reducing carbon footprints, as described elsewhere in this document.

SWMPs, from a regulatory perspective, do not require a target to be set for recovering demolition arisings. However, target setting, as required by the Protocol adds an extra dimension which can deliver cost savings and more integrated project management. These aspects of the Protocol will be of value across the UK, in terms of delivering more sustainable outcomes and transparency.

The Code for Sustainable Homes (CSH) applies to England, Wales and Northern Ireland, but at time of writing not to Scotland. It requires that SWMPs state a target for recovering wastes. However, the Code is not prescriptive in terms of the level of target to be set. This 2008 version of the Demolition Protocol provides standard, good and best practice targets, as summarised in the following section, which can be used by project teams when producing a CSH SWMP.

Following the checklist, as mentioned above, enables compliance with the CSH requirements. The checklist also summarises the monitoring approach required and therefore allows the user to demonstrate how performance compares with the targets set.

The CSH has a number of non-mandatory elements for SWMPs, with the minimisation of construction waste resulting in two credits being awarded as part of the overall scoring scheme. The requirements involve confirmation that an obligation will be made to (i) reduce construction waste and (ii) divert waste from landfill. Two checklists in the CSH technical guide must be completed (checklists 2b and 2c) to demonstrate compliance.

The Demolition Protocol can provide sufficient evidence that construction waste is being reduced on site and that waste is being diverted from landfill eg by recycling and reusing demolition material on the same site.

## 9. Indicative targets for recycling

Key target audience: Project managers and construction supply chain

The indicative targets provided here are for materials recovered from demolition for recycling, rather than for materials/components to be reused. Target setting for the reuse of buildings, deconstruction and reclamation follows a different approach as set out in previous sections (by identifying the area (m<sup>2</sup>) of a building/structure to be reused/deconstructed etc).

Case study results from implementing the Demolition Protocol indicate that close to 100% recycling performance can be achieved for concrete and masonry where a soft strip process has removed materials/wastes that would be considered contamination. In addition, work carried out by WRAP (Waste Recovery Quick Wins, 2007) has resulted in standard (baseline), Quick Wins (good practice) and best practice recovery rates being established for different wastes from construction and demolition projects.

This information complements data gained from Demolition Protocol case studies, with the results summarised in the table 11, opposite. These DRIs can be specified by client teams, principal contractors etc, as a way of requiring minimum levels of performance.

Other wastes are referenced in the WRAP publication, but apply to a construction site context rather than to demolition (see Table 12). With careful consideration and detailed soft strip approaches these targets could also be set for a demolition project, but it is recommended that this would follow detailed consultation with a demolition contractor.

The WRAP report also provides recovery rates for insulation, hazardous materials and electrical equipment. However, no targets can be provided in a demolition context until more data is secured from case studies.

More information on good practice in waste minimisation and management is provided on the WRAP website at: [www.wrap.org.uk/construction/construction\\_waste\\_minimisation\\_and\\_management/good\\_practice\\_wmm.html](http://www.wrap.org.uk/construction/construction_waste_minimisation_and_management/good_practice_wmm.html)

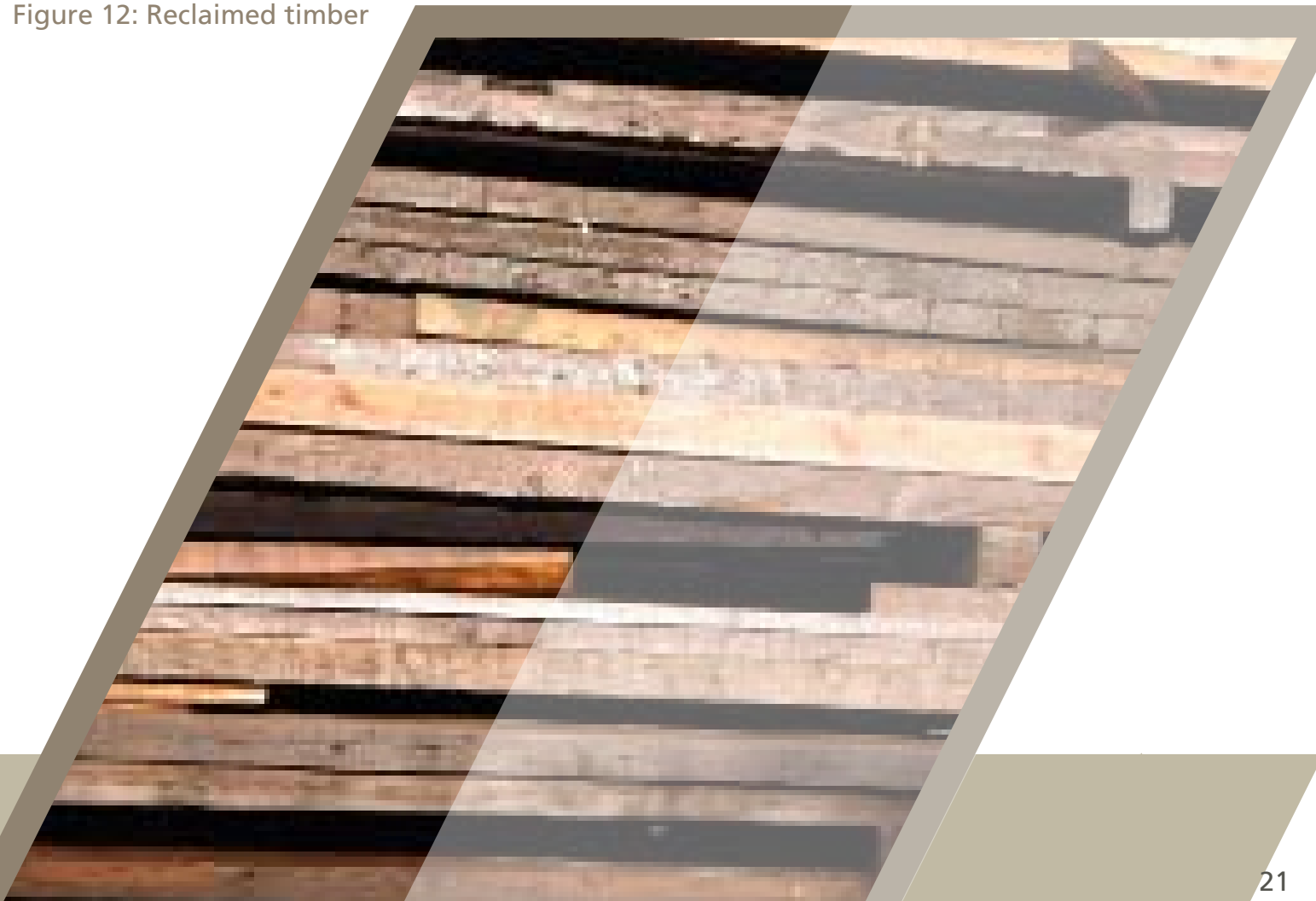
Table 11. Potential demolition recovery indices/targets

| Material                             | Standard DRI % | Good practice DRI % | Best practice DRI % |
|--------------------------------------|----------------|---------------------|---------------------|
| Concrete                             | 75             | 95                  | 100                 |
| Ceramics (eg masonry such as bricks) | 75             | 85                  | 100                 |
| Metals                               | 95             | 100                 | 100                 |
| Timber                               | 57             | 90                  | 95                  |
| Inert (eg subsoils)                  | 75             | 95                  | 100                 |

Table 12. Summary of recovery rates from construction (not demolition) sites

| Material     | Standard DRI % | Good practice DRI % | Best practice DRI % |
|--------------|----------------|---------------------|---------------------|
| Plasterboard | 30             | 90                  | 95                  |
| Plastics     | 60             | 80                  | 95                  |
| Furniture    | 0-15           | 25                  | 50                  |

Figure 12: Reclaimed timber



## 10. The cost benefits

Key target audience: Clients and project managers

Demolition Protocol case studies consistently demonstrate the cost savings to be realised by adopting this approach. Cost savings in case studies have been achieved through:

- Avoiding haulage costs associated with exporting material from site for reprocessing and/or landfill
- Avoiding haulage costs associated with the reuse of site-won material instead of importing material
- The lower costs associated with using recycled instead of primary aggregates (primary aggregates incur a £1.95/tonne levy)
- The reuse of reclaimed items with significant value such as mechanical plant, carpets, flooring, tiles, bricks etc.

Case studies commissioned by WRAP, involving implementation of the Protocol, identified the following cost savings:

- Glasgow City Council, Schools Regeneration Programme (2006): The Council stated that £150,000 was saved by substituting (for primary aggregates) site-won, reprocessed demolition arisings. This was the result of market price differentials, as well as through avoided haulage movements of materials, either to intermediate sites for reprocessing, or to landfill. 12,500 tonnes of reprocessed demolition arisings were retained on different sites for reuse, with 7,000 tonnes exported following a carefully produced project plan
- London Borough of Brent Council, the Wembley Stadium Access Corridor (2006): A conservative estimate of £23,910 cost savings were identified, for the use of 6,000 tonnes of aggregates. This case study saw 95% recovery of demolition material, with more than 50% of the aggregates used coming from recycled sources.

Cost savings associated with the reuse of buildings, products, deconstructed items etc are likely to be significant, and will become increasingly so in the future. Approaches which involve minimal impacts in terms of embedded CO<sub>2</sub> (the use of fossil fuels) will deliver cost savings. Those processes and materials which require most energy use will increasingly become less attractive in terms of overall costs.

Figure 13. The Protocol was employed on the Wembley Stadium Access Corridor development.

Source: Brent Council



## 11. Implementation through tender and contract clauses

Key target audience: Clients and project managers

Opportunities to maximise MRE on demolition and regeneration projects are heavily influenced by the way in which tenders and contracts are arranged to give ownership of materials. Tenders and contracts should incorporate clauses which clearly articulate the requirements of the Protocol, with the responsibilities of different parties set out.

This is a fundamental requirement to ensure that each link in the supply chain understands its role in the process. This becomes particularly important when there are changes to the project team and where sub-contractors are appointed who may not be party to previous discussions and arrangements.

To support the implementation of the Protocol, a tendering and contractual framework is required. Key considerations for potential tender/contract clauses include the following:

- Reference should be made as early and as clearly as possible in the tender/contract documentation. This is important because the approach may be non-standard and attention therefore needs to be drawn to it as soon as possible
- For aggregates only, refer to the WRAP publication Tender and Contract Clauses To Encourage Greater Use of Recycled and Secondary Aggregates. A pdf version of this document can be found at the WRAP Procurement webpage, which provides various resources to assist sustainable practices: [www.aggregain.org.uk/procurement](http://www.aggregain.org.uk/procurement)
- A checklist summarising the key implementation requirements eg target setting
- Method statement – tenderers to submit a method statement describing their compliance with the ICE Demolition Protocol.

## 12. Implementation as a planning requirement

Key target audience: Policymakers and clients

Demolition protocols are referenced in the Practice Guide (Planning and Minerals) to Minerals Policy Statement 1 (MPS1) for England. The MPS1 Guide states that:

“In recent years, the proportion of construction, demolition and excavation waste productively used has increased to the point where additional recovery depends on improved segregation of waste materials at the demolition site. Demolition protocols have been proposed to address this issue.”

Demolition protocols are also referenced in Scottish Planning Policy 10 (Planning for Waste Management), where it is stated that:

“Waste reduction at demolition and construction sites through protocols and site management should be supported.”

SEPA (the Scottish Environment Protection Agency) has stated that there is an opportunity to promote demolition protocols within development planning policy and the assessment of planning applications. Reflecting this, the Protocol has been incorporated within many local authority supplementary planning documents on sustainable construction, and has been implemented through planning conditions or agreements (Section 106 in England & Wales, Section 75 in Scotland).

Examples of this approach can be found by reading case studies funded by WRAP, involving the London Borough of Brent Council and in particular in the redevelopment of the Wembley area ([www.aggregain.org.uk/demolition/the\\_ice\\_demolition\\_protocol](http://www.aggregain.org.uk/demolition/the_ice_demolition_protocol)).

Although, SWMPs are now a regulatory requirement in England, implementation of the Demolition Protocol and its range of MRE methodologies can deliver a wider range of benefits, while at the same time ensuring that regulatory requirements are met. For projects across all parts of the UK, the 2008 Protocol can provide improved delivery in terms of the waste hierarchy, stimulating practices such as reclamation, refurbishment and target setting. The approach also has the added benefit of providing transparency and measurable performance.

## 13. Verification

Key target audience: Policymakers, clients, project managers and construction supply chain

Site Waste Management Plans require verification that the plan has been followed. The Demolition Protocol, when not implemented as a SWMP, requires the verification procedures described in the following table.

Table 13. Summary of verification requirements

| Protocol element                                  | Verification method   |
|---|---|
| Building reuse/Refurbishment audit                | Statement of viability from the client  |
| Reclamation and design audit                      | Reclamation NBRI provided   |
| Deconstruction audit                              | Statement of the opportunities and a Deconstruction DRI produced                      |
| Design for deconstruction                         | Statement of the guidance followed and key opportunities                              |
| Pre-demolition audit                              | D-BOQ, DRI, stockpile measurements, transfer note summary.                            |
| Design assessment to incorporate recycled content | NB-BOQ, summary of purchases  |
| Report CO <sub>2</sub> emissions                  | Statement based on avoided vehicle movements which corresponds with the D-BOQ and DRI |

## 14. The definition of waste

Key target audience: Policymakers, clients and project managers

Guidance from the UK regulators on the definition of waste means that the ICE Demolition Protocol goes hand in hand with WRAP's Quality Protocol for the Production of Aggregates from Inert Waste. Where there are appropriate planning permissions in place, demolition arisings processed and tested in accordance with the WRAP Protocol may not need to be defined as waste before use. Planning permissions would also need to be in place prior to the stockpiling and movement of material.

Essentially, if there is a guaranteed market the regulator may not need to have further involvement. Planning permissions and use of the Demolition Protocol, by providing quantities of arisings and targets for reuse in defined applications, could be considered as a way of providing certainty of use. However, it should be noted that if further treatment of material is needed then this may need to be controlled by the regulator.

Further guidance on the definition of waste can be obtained from the regulators' websites:

- SEPA, Is it Waste – Understanding the Definition of Waste  
[www.sepa.org.uk/pdf/guidance/waste/is\\_it\\_waste\\_v2.pdf](http://www.sepa.org.uk/pdf/guidance/waste/is_it_waste_v2.pdf)
- Environment Agency, The Definition of Waste: Developing Greenfield and Brownfield Sites  
[www.environment-agency.gov.uk/commondata/acrobat/dowv10506\\_1386151.pdf](http://www.environment-agency.gov.uk/commondata/acrobat/dowv10506_1386151.pdf)

# Appendices

Appendix A - ICE Demolition Protocol Checklist

Appendix B - Definitions

# Appendix A - ICE Demolition Protocol Checklist





















This checklist should be followed to ensure compliance with the ICE Demolition Protocol 2008. The checklist also identifies the compliance areas for producing Site Waste Management Plans (SWMPs), as required by legislation (in England) and as also required by the Code for Sustainable Homes (CSH). The CSH has now replaced EcoHomes as an environmental standard in England, Wales and Northern Ireland.

Although SWMPs are not a regulatory requirement in Scotland, they are encouraged through Scottish Planning Policy 10 (SPP10) – Planning for Waste Management. As such this checklist can be used to assist in determining the scope of implementation of the Protocol and SWMPs in Scotland.













It should be noted that the Duty of Care requirements referred to in this checklist apply to all projects, regardless of size, and records must be maintained to reflect this.

|  |  |   |   |
|--|--|---|---|
|  | ICE Demolition Protocol (DP) Requirement                     |   |   |
|  | Site Waste Management Plan (SWMP) Requirement above £300,000 |  | Site Waste Management Plan (SWMP) Requirement above £500,000      |
|  | Mandatory elements to comply with Code for Sustainable Homes |  | Additional elements to score points in Code for Sustainable Homes |


























## Information about the basic details of the project






| Data Required                                 | Compliance   |
|---|--|
| 1. The client name                            |     |
| 2. The principal contractor name              |     |
| 3. The person who drafted the Protocol / SWMP |     |
| 4. The location of the site                   |     |
| 5. The estimated cost of the project          |     |

## Actions required at the beginning of the feasibility and design stages

| Actions Required   | Compliance  |
|--|---|
| 6. Description of any decisions taken on the nature of the project, its design, construction method or materials employed in order to minimise the quantity of waste produced on site. |     |
| 7. Description of how tender and contracts will implement the Demolition Protocol and/or SWMP.   |     |
| 8. Are examples of clauses available / provided?   |     |

## Detailed implementation actions

| Requirement   | Comment and how to achieve compliance  | Compliance areas  |
|---|--|---|
| 9. Building reuse/ refurbishment audit  | <ul style="list-style-type: none"> <li>Requires a statement of the viability for reusing the building, influenced by the required design aesthetic, space, cost and socio-economic factors.</li> <li>If viable, the percentage of external &amp; internal components to be recovered should be stated as a NBRI (New Build Recovery Index) percentage, using area (m<sup>2</sup>) as the metric.</li> </ul>  |    |
| 10. Reclamation and design audit.   | <ul style="list-style-type: none"> <li>NBRI stating the value of reclaimed products incorporated. This should be a minimum of 5%, by value, of the construction.</li> </ul>  |    |
| 11. Deconstruction audit  | <ul style="list-style-type: none"> <li>State deconstruction potential of the building / infrastructure.</li> <li>The percentage of elements to be deconstructed, should be stated as a DRI, using area (m<sup>2</sup>) as the metric.</li> </ul>   |    |
| 12. Design for deconstruction   | <ul style="list-style-type: none"> <li>Demonstration that good practice guidance has been adopted.</li> </ul>  |    |
| 13. Pre-demolition audit, if required.  | <ul style="list-style-type: none"> <li>Produce a D-BOQ (Demolition Bill Of Quantities) to describe the DRI.</li> <li>This delivers SWMP compliance by describing (i) each waste type to be produced in the course of the project and (ii) the quantity of each.</li> </ul>   |                |
| 14. Design assessment to incorporate recycled content   | <ul style="list-style-type: none"> <li>NBRI to be produced for recycled content of bulk items.</li> <li>WRAP Recycled Content Toolkit to be used (in terms of £ value) for internal/fit out items.</li> </ul>  |    |
| 15. Report CO <sub>2</sub> emissions avoided from avoided haulage movements   | <ul style="list-style-type: none"> <li>Calculated from the quantity of material recovered and reused on-site.</li> </ul>   |    |
| 16. Verification of ICE Demolition Protocol elements  | <ul style="list-style-type: none"> <li>Summary of requirements provided in Section 13 of main Protocol document</li> </ul>   |    |
| 17. Identify the waste management action proposed for each different waste type, including re using, recycling, recovery and disposal | <ul style="list-style-type: none"> <li>This is identified in the D-BOQ table as the recovery potential.</li> <li>This should be complemented by a description, stating the use with details of any waste management or haulage contractors involved.</li> </ul>  |      |
| 18. Records to be kept  | <ul style="list-style-type: none"> <li>Identity of the person removing the waste.</li> <li>Types of waste removed.</li> <li>Site that the waste is being taken to.</li> </ul>  |      |
|   | <ul style="list-style-type: none"> <li>Waste carrier registration number of the carrier.</li> <li>Copy of, or reference to, the written description of the waste required by section 34 of the Environmental Protection Act 1990.</li> <li>Whether the operator of that site holds a permit under the Environmental Permitting Regulations 2007 or is registered under those Regulations as a waste operation exempt from the need for such a permit.</li> </ul> |      |

| Requirement  | Comment and How to Achieve Compliance   | Compliance Areas  |
|--|---|---|
| 19. Within three months of the work being completed additions to the plan are required | <ul style="list-style-type: none"> <li>Confirmation that the plan has been monitored on a regular basis to ensure that work is progressing according to the plan and that the plan was updated in accordance with this regulation.</li> <li>An explanation of any deviation from the plan.</li> </ul>   |    |
| 20. Not less than every six months a review and update is required                     | <ul style="list-style-type: none"> <li>A comparison of the estimated quantities of each waste type against the actual quantities of each waste type.</li> <li>An estimate of the cost savings that have been achieved by completing and implementing the plan.</li> </ul>   |    |
| 21. Set targets for the recovery of wastes   | <ul style="list-style-type: none"> <li>Review the plan.</li> <li>Record types and quantities of waste produced.</li> <li>Record the types and quantities of waste that have been re-used (and whether this was on or off site)</li> <li>recycled (and whether this was on or off site)</li> <li>sent for another form of recovery (and whether this was on or off site)</li> <li>sent to landfill or otherwise disposed of</li> <li>Update the plan to reflect the progress of the project</li> </ul> |    |
| 22. Demonstrate that waste reduction is being delivered on-site                        | <ul style="list-style-type: none"> <li>The DRI, D-BOQ and methods used identify the quantity of waste being recovered for reuse on site.</li> </ul>   |  |
| 23. Describe the three key waste groups identified for diversion from landfill         | <ul style="list-style-type: none"> <li>This could refer to wastes shown in the D-BOQ – e.g. such as concrete, masonry, soils, identified because they are the largest wastes by weight.</li> </ul>  |  |

The following declaration is required.

The client and the principal contractor will take all reasonable steps to ensure that:



All waste from the site is dealt with in accordance with the waste duty of care in section 34 of the Environmental Protection Act 1990 and the Environmental Protection (Duty of Care) Regulations 1991.

Materials will be handled efficiently and waste managed appropriately.

|                       |
|-----------------------|
| Signed:               |
| Name:                 |
| Company and position: |
| Date:                 |

# Appendix B - Definitions

To avoid confusion the Demolition Protocol uses the definitions shown below for activities related to the reuse and recycling of building elements, products and materials.

| Activity       | Definition  |
|----------------|---|
| To recover     | A generic term which means that a material, product/component is managed by a defined process so that it either does not become waste, or is taken out of the waste stream.   |
| To reuse       | Buildings/infrastructure, products, components etc recovered for use without reprocessing activities or alterations to their characteristics. In situ reuse could refer to the refurbishment of a building, involving the reuse of the steel frame, without any disassembly. Ex situ reuse is synonymous with reclamation, and involves the disassembly or removal of products/components prior to their reuse.         |
| To reclaim     | Refers to the removal of products/components from a building or structure, with the aim of subsequently reusing them.   |
| To recycle     | To take a product/component (e.g. concrete block) and, because of the nature and characteristics of its constituent material, put it through a reprocessing activity. The output will be a material which can then be used in a range of products and applications, including its previous use.   |
| To deconstruct | Synonymous with 'reclaim' and typically referring to the action of disassembling products/components as part of an overall approach to managing entire elements of a building (e.g. the roof, walls etc). 'Design for deconstruction' is the commonly used term to describe how the end of life of a building/structure is considered at the outset - to ensure the future ease of disassembly for components/elements. |



One Great George Street  
Westminster  
London SW1P 3AA  
t +44 (0)20 7222 7722  
f +44 (0)20 7222 7500  
ice.org.uk

