wrap

Material change for
a better environment

Implementation guidance for civil engineering and infrastructure projects

Civil engineering projects: Waste less and save money

Reducing waste through efficient procurement can help reduce the costs of civil engineering and infrastructure projects; this guidance provides practical advice to individuals on the actions to take and the changes that can be achieved.

Our vision is a world without waste, where resources are used sustainably. We work with businesses and individuals to help them reap the benefits of reducing waste, develop sustainable products and use resources in an efficient way. Find out more at www.wrap.org.uk

Contents

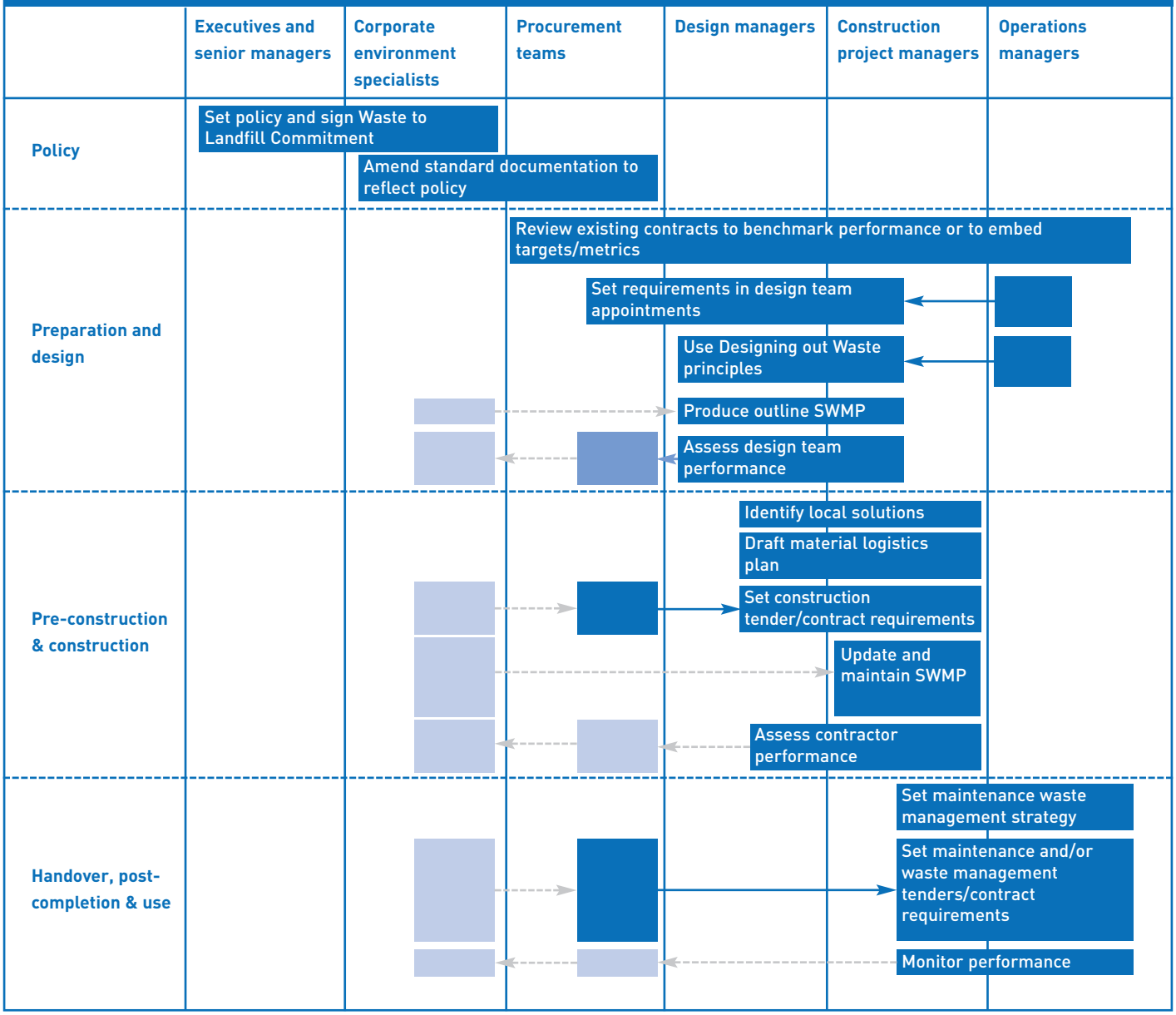
1.0 Introduction

This guide will help managers and specialists in client organisations to ensure that material-efficient practices are adopted by their infrastructure projects. These practices help clients to lower the costs of construction and maintenance projects whilst reducing the amount of waste sent to landfill.

Client organisations include local authorities, government agencies and private companies that are delivering services in the highway, railway, flood defence, water, gas, electricity, airport, ports and other infrastructure sectors.

Figure 1 summarises the influence that individuals within these organisations can have in driving good practice, measuring performance and securing cost savings, with more detail provided in subsequent guidance.

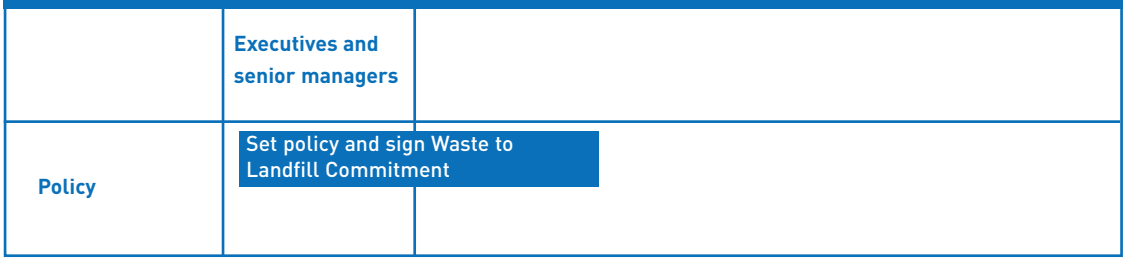
Figure 1: Role of specialists and managers in client organisations in ensuring their supply chain cuts waste on projects



SWMP: Site Waste Management Plan

2.0 Executives and senior managers

Figure 2



Standard practice

It is common for organisations that own or manage civil engineering infrastructure to have an environmental management policy/system or sustainable development policy, or a corporate social responsibility (CSR) policy which addresses environmental issues. Many organisations have accredited environmental management systems and set procurement requirements for sub-consultants and contractors to have similar systems in place. Environmental management procedures may mention waste, although the focus is commonly office waste and not waste generated by construction works.

Good practice

Key action: Add performance requirements for waste reduction, reuse and recovery existing policies.

Incorporating materials efficiency into policy documents will maximise the likelihood that performance improvements will be delivered. A policy describes the organisation's commitment to minimising the use of materials, reducing waste, and reusing and recovering materials. The policy must be clear, concise and should be fully endorsed by company executives or senior management. The policy provides a mandate for future procurement actions and a clear commitment to measure and improve performance.

In particular, including the intention to cut waste and the costs of waste in corporate procurement policy (as well as the environmental management, sustainable development or CSR policy) provides a means for securing action by project teams. The policy should include a clear signal of intent to supply chain partners, and also define the standard requirements that will be used in tender and contract documents (including metrics and target outcomes for waste reduction, reuse and recovery).

Model wording can be found in Client and Principal Contractor Actions 1B and 1C, at www.wrap.org.uk/procurement_requirements

Best practice

Key action: Sign up to the Waste to Landfill Commitment.

The sector-wide voluntary agreement "Construction Commitments: Halving Waste to Landfill" is a commitment to robust implementation:

"We commit to playing our part in halving the amount of construction, demolition and excavation waste going to landfill by 2012. We will work to adopt and implement standards for good practice in reducing waste, recycling more, and increasing the use of recycled and recovered materials. We will:

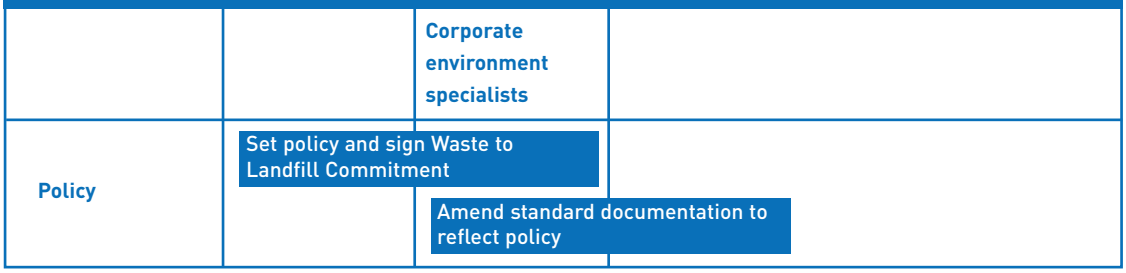
- set a target for reducing waste to landfill;
- embed the target within corporate policy and processes;
- set corresponding requirements in project procurement and engage with our supply chain;
- measure performance at a project level relative to a corporate baseline; and
- report annually on overall corporate performance."

It publicly demonstrates your organisation's support for the sector goal of halving the amount of construction, demolition and excavation waste being sent to landfill by 2012 (compared to 2008). This goal supports targets adopted by the Strategy for Sustainable Construction in England and the zero waste ambitions of governments in Scotland and Wales. It is a voluntary agreement in which each organisation sets its own corporate target for improvement. By signing up, you can formalise a more robust approach to managing and measuring performance – and thereby drive cost and efficiency savings.

For more information on the Commitment, who has signed up and the actions involved, visit www.wrap.org.uk/halvingwastetolandfill and www.wrap.org.uk/modelactionplans

3.0 Corporate environment specialists

Figure 3



Standard practice

Within organisations that own or manage civil engineering infrastructure, it is usually a 'corporate' function to operate environmental management policies and systems. Such organisations will often have a director or senior manager that reports to the Board on environment issues, with support staff allocated depending on the size of the organisation. These 'corporate environment specialists' will implement and disseminate changes in legislation and/or good practice, and ensure that the organisation responds by changing policies and practices – for example providing training when major changes have occurred. They typically collect and report environmental data, prepare outward-facing environment reports, and liaise with auditors that accredit the management systems.

Good practice

Key action: Add performance requirements and targets for waste reduction, reuse and recovery to existing policies, procedures and related documentation.

Section *2.0 Executives and senior managers* explains why and how waste should be included in corporate policies, and signposts model policy wording.

In order to deliver a waste reduction, reuse and recovery policy, it is likely that procedures, work instructions, standard procurement questionnaires and other documentation will need to be amended. The corporate environment function should revise the environmental management system accordingly, and support procurement teams in changing standard documentation. Changes to procurement documentation are discussed in more detail in Section *4.0 Procurement teams*.

Experience suggests that corporate procedures should make explicit reference to reducing construction, demolition and excavation waste through design and construction processes, and reporting on outcomes. Only by including these explicit instructions in internal documentation will the organisation collect the data it needs to assess its performance, make improvements, and quantify and realise cost savings.

A model set of project-level requirements for waste reduction, reuse and recovery can be found in Client and Principal Contractor Action 1C, at www.wrap.org.uk/procurement_requirements

These requirements can be adapted for use in corporate documentation to ensure that targets for waste reduction, reuse and recovery are set on construction and maintenance projects (for example, as part of the Invitation to Tender). For organisations that have signed the Waste to Landfill Commitment (see *2.0 Executives and senior managers*), reference to the WRAP Waste to Landfill Reporting Portal should be included (www.wrap.org.uk/reportingportal). Example requirements for corporate documentation are:

"For all projects/contracts over £300k, design, construction and maintenance teams will be required to:

- implement Site Waste Management Plans throughout the design and construction period that comply with regulatory requirements (where applicable) and include in such Plans project-specific targets for waste recovery and reused and recycled content (see below) and for waste reduction;
- measure and report progress against the corporate KPIs for the quantity of waste produced and the quantity of waste sent to landfill (measured in tonnes per £100k construction value) using the WRAP Waste to Landfill Reporting Portal and guidance (www.wrap.org.uk/reportingportal) – where construction value is the price in the accepted tender or, if there is no tender, the cost of labour, plant and materials, overheads and profit;
- recover at least [70% – state value] of construction materials, and aim to exceed [80% – state value];
- recover at least [80% – state value] of demolition, strip-out and excavation materials (where applicable), and aim to exceed [90% – state value]; and
- ensure that at least [15% – state value] of total material value derives from reused and recycled content in new construction, select the top opportunities to exceed this figure without increasing the cost of materials, and report actual performance.

Project teams shall forecast waste quantities and reused and recycled content and set targets for waste reduction from an early design stage (for instance by using WRAP's Outline Designing out Waste Tools and Net Waste Tool, freely accessible at www.wrap.org.uk/nwtool).

Before starting on site, the project team shall submit a copy of the Site Waste Management Plan, identifying the actions to be taken to reduce waste, increase the level of recovery and increase reused and recycled content, and quantifying the resulting changes.

On completion of the Works, the project team shall submit a copy of the completed Site Waste Management Plan, reporting the forecast and actual performance for waste quantities, disposal routes, and reused and recycled content used in construction.

The procurement team will ensure that all relevant tender and contract documentation includes these requirements. It will be the responsibility of project/contract managers to ensure that targets are set which are appropriate to the project, and performance is recorded and reported.

Project/contract managers will be required to report back on project performance to the environment team, and quarterly reports will be prepared for the Board."

The performance levels quoted above are widely applicable to all construction project types, including infrastructure, but may be adjusted to suit an organisation's portfolio of construction and maintenance works, for example based on evidence of performance to date.

Best practice

Key action: Sign up to the Waste to Landfill Commitment, set a corporate target, and report annually on performance.

Section *2.0 Executives and senior managers* provides information on signing up to the Waste to Landfill Commitment.

Organisations signing the Waste to Landfill Commitment agree to:

- set a target for reducing waste to landfill;
- embed the target within corporate policy and processes;
- set corresponding requirements in project procurement and engage with our supply chain;
- measure performance at a project level relative to a corporate baseline; and
- report annually on overall corporate performance.

It will usually be the corporate environment specialists that need to set the corporate target embed corresponding requirements in processes (working with procurement, design, construction and operations teams as appropriate) and then collate data for annual reports.

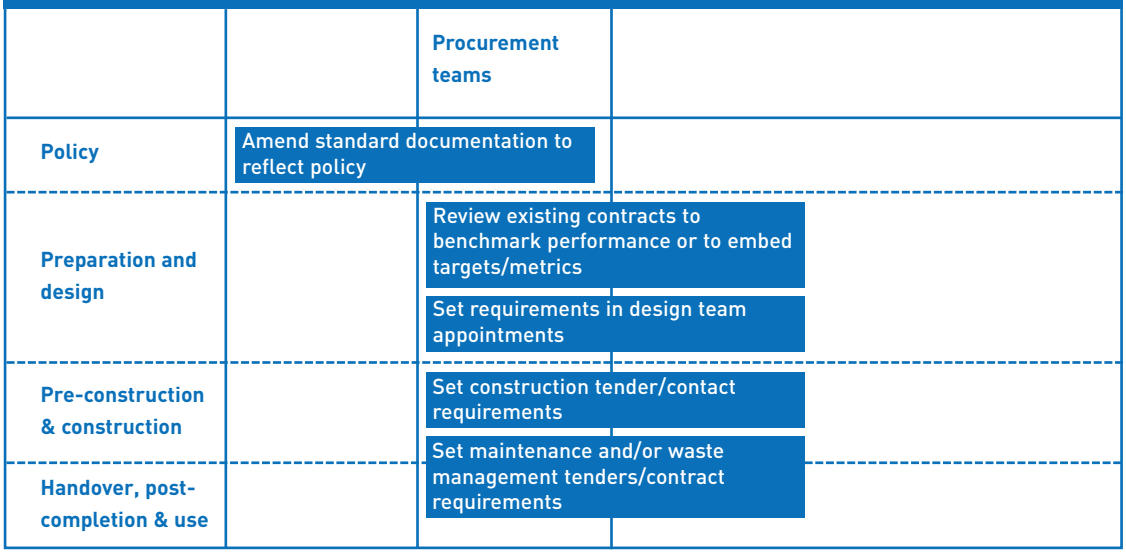
Information and ideas on how to set a target are given in the model action plan for clients at www.wrap.org.uk/modelactionplans

This is supported by benchmarks for target setting at www.wrap.org.uk/reportingportal

Annual reporting can be completed using WRAP's Waste to Landfill Reporting Portal, which allows you to set and record your baseline and target for corporate performance, and then record annual outcomes for the KPI of waste to landfill (measured in tonnes per £100k of construction spend). Project managers can also register and access the Portal; so project waste totals can be directly uploaded for the environment team to collate and review as required. For more information on the Reporting Portal, go to www.wrap.org.uk/reportingportal

4.0 Procurement teams

Figure 4



Standard practice

Procurement is the key mechanism to ensure that services meet value, cost and technical demands. Procurement can also provide assurance that consultants and contractors understand the objectives of their client organisation and equip themselves to deliver.

Many organisations have recognised the power of procurement; for example, organisations in London signing up to the Mayor of London's Green Procurement Code (www.greenprocurementcode.co.uk). However, in many instances, the actions taken may not extend to systematic requirements for waste reduction, reuse and recovery within tenders and contracts; in which case the potential for cost saving may not be maximised (for example, if the design team is not asked to quantify and prioritise the opportunities) and the client is unlikely to share in those savings.

Good practice

Key action: Add performance requirements and targets for waste reduction, reuse and recovery to standard procurement documentation; include requirements in new tenders and contracts.

WRAP has produced procurement guidance to help organisations that own and/or manage civil engineering infrastructure when setting requirements for waste reduction, reuse and recovery in design, construction and maintenance contracts. This guidance includes model wording for pre-qualification questions, invitation to tender clauses and contractual obligations. This information can be accessed at www.wrap.org.uk/procurement_requirements

Procurement of design, construction and maintenance services should draw in the experience of design managers, construction managers and operations managers as appropriate. For example, it can be useful to include all of these stakeholders in design team procurement since design issues will influence construction and operation. Construction contractor procurement may also cover design and should include the design team manager, but might also include the operations manager to ensure that maintenance issues are adequately understood and addressed.

A pre-qualification questionnaire (PQQ) enables an organisation to rapidly assess the capability of bidders to deliver against specified performance requirements, whether through design services, construction execution, maintenance contracts, or material supply. The PQQ can be supplemented by more detailed discussion at subsequent interviews, or can be used as an initial filter to rapidly eliminate unsuitable organisations. A PQQ should assess the consultants' and/or contractors' ability to reduce waste (for example, by design improvements), to manage waste efficiently (such as segregation on site) and to maximise waste reuse and recovery (for example, by using recycled materials or reusing in-situ materials).

Requirements for data collection and reporting should be embedded in the invitation to tender and in the contract, so that the organisation's design, construction and operations managers are readily able to report internally and externally. Performance targets (for example, for % recovery of materials or recycled content by value) should be specified in tender invitations for design and construction services and in the project briefs issued to partner or framework organisations, so that only companies able to address these expectations will be contracted to deliver the work.

Although the core actions for procurement teams will include setting requirements in appointments for design teams and contractors, it is possible that other procurement processes will require amendments. For example, the role of site investigations and potential changes to reporting requirements are discussed in *5.0 Design managers*.

Best practice

Key action: Review existing contracts to introduce waste reduction, reuse and recovery performance targets and reporting requirements.

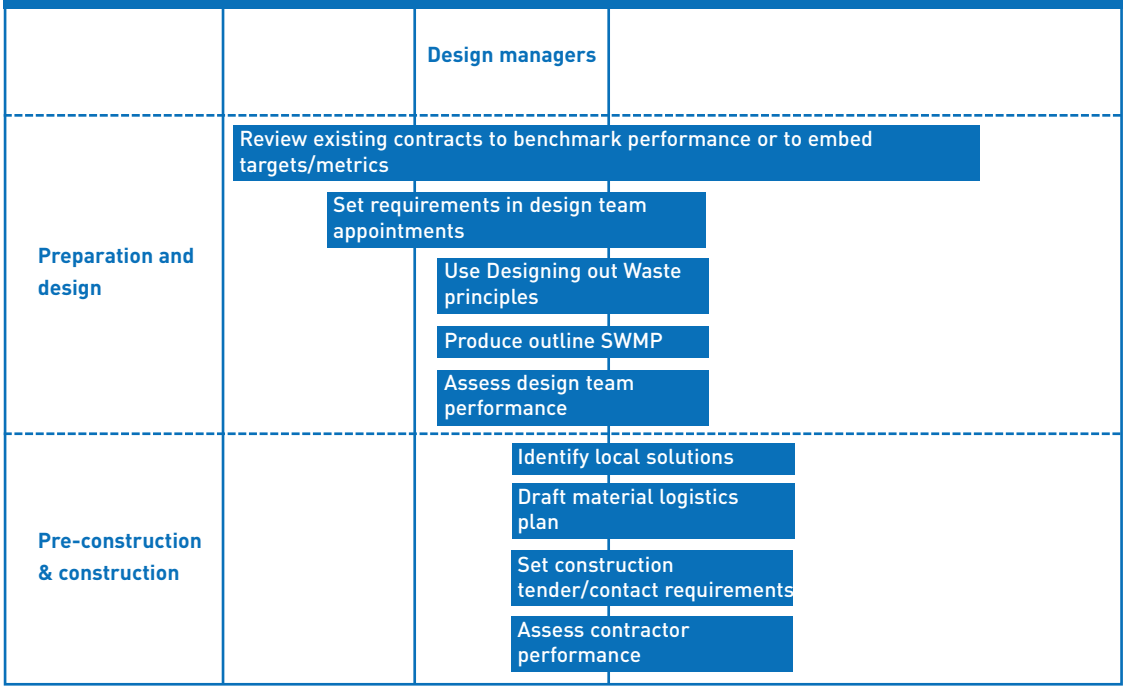
It is always easier to implement changes in practice through new contracts, but where relationships with existing contractors are very good, and where there is a long time yet to run on a contract, it is worth discussing win-win changes. These can include more robust measurement and reporting to help the client organisation and supply chain partners to demonstrate progress against their Waste to Landfill Commitments, and quantifying and sharing the savings from waste reduction, reuse and recovery.

It is possible that design, construction and operations managers have already identified key projects where waste and cost savings would be worth targeting. They may also be able to quickly identify projects where contractual changes should be possible; for example, on a maintenance contract that has recently been let and the maintenance contractor is still establishing working practices, or in framework contracts with design consultancies where good working relationships exist. Close liaison with the design, construction and operations managers will be needed to implement these contract amendments, which will help them to meet their internal reporting requirements.

Amendments to existing contracts can draw on the same clauses used for new contracts, accessible at www.wrap.org.uk/procurement_requirements

5.0 Design managers

Figure 5



Standard practice

The design phase presents some of the greatest opportunities to influence waste. As the scale of materials used in an infrastructure project is so large, designing to achieve a 'cut and fill' balance is considered by most engineers to be an integral part of the design process, to minimise material movements and associated costs. However, design teams do not often think systematically about all the major opportunities to reduce waste, reuse and recover materials and cut costs. Moreover, unless the design team quantifies the potential to save money through design actions and factors this into tender invitations or partnering agreements, the client organisation is unlikely to share in savings achieved by the contractor on site.

The design process sets the size, shape and materials required by the works. It is crucial to 'design out waste' – to reduce the quantity of waste before it arises on site. Failure to think about waste at the design stage means that the contractor is often unable to reduce some of the wasteful elements which have been locked in by the designer. Therefore, empowering design teams to identify and act upon the top opportunities to eliminate waste and recover materials is important.

The use of recycled materials is generally considered to be a routine part of infrastructure works, but may be constrained by:

- volume availability – for example, because the demand for materials in infrastructure projects is so large, quantities of recycled aggregates needed may not be available locally within the specified time schedule; early identification of the potential 'quick wins' to increase the use of recycled materials will help to identify suppliers (and supply constraints) and set realistic targets for recycled content of components; and
- engineering need – for example, slower-setting concrete made using high levels of cement replacement materials may not be acceptable if very early trafficking of a surface is required.

WRAP's Designing out Waste Tool for Civil Engineering can be used at an early design stage to quickly estimate and select the top opportunities and actions to reduce waste and reuse and recover materials. WRAP's more detailed Net Waste Tool helps further in identifying the 'quick win' opportunities to increase reused and recycled content at no extra cost. Both tools are freely accessible via www.wrap.org.uk/nwtool

Good practice

Key action: Embed design for waste reduction, reuse and recovery in design practice, including early site investigation.

During the design process there are numerous opportunities to reduce waste; WRAP has developed a systematic approach to 'Designing out Waste in Civil Engineering' and a supporting tool, which are freely available at www.wrap.org.uk/designingoutwaste

By focusing on waste minimisation in the earliest stages of a project as an explicit part of the design development process, the greatest opportunities for waste elimination, reuse and recycling can be prioritised, and corresponding actions included in the design stage Site Waste Management Plan (SWMP).

The five principles which are recommended by WRAP to guide the attention of design teams are:

- Design for Reuse and Recovery;
- Design for Off Site Construction;
- Design for Materials Optimisation;
- Design for Waste Efficient Procurement; and
- Design for Deconstruction and Flexibility.

WRAP's Designing out Waste methodology provides a practical means of identifying and prioritising design actions, and quantifying their waste, cost and carbon savings. In civil engineering projects, the most significant opportunities to reduce waste are by improving reuse and recovery; and by design for waste-efficient procurement.

Generally, **Design for Reuse and Recovery** means using:

- materials on site to better effect;
- materials reclaimed from other construction sites; and/or
- new products with higher than average recycled content.

A site investigation early in the project/design phase ensures that any materials already on the site are taken into account during the design. In civil engineering projects, there may often be an option of material retention and/or improvement of on site materials; but this must be confirmed by a site investigation and may require mixture/material development and testing. Case study evidence suggests that it is the retention and recycling of on site materials that offer the most significant cost savings to infrastructure projects. Some organisations require that all site investigation reports include a section on the potential to reuse and recover on site materials – such a requirement should be embedded in the procurement process.

Understanding the quality of the formation layer can be an important first step in ensuring that designs maximise the value of in-situ materials. It should not be assumed that the formation layer is inadequate without site investigation, and options for maximising the value of this existing material should be considered. Use of on site materials can include processing marginal excavated materials for use as fill; but higher value applications include enhancing the value/engineering properties of on site materials, for example, by manufacturing hydraulically bound mixtures or by using geosynthetic materials. Such higher value uses may require development and testing and so consideration during the design phase is essential to ensure there is adequate time for this work.

Priority should be given to retaining materials in their current condition, avoiding unnecessary excavation and treatment where possible. This might include retaining layers of capping and subbase which provide adequate bases for new works. Good practice site clearance and demolition should account for the retention of these materials, and their processing as appropriate; which is also facilitated by identification within the design phase to ensure appropriate scheduling.

Design for Waste Efficient Procurement directs design teams to specify low-waste designs and work sequences, and set targets on contractors to reduce waste. Procurement guidance is available at www.wrap.org.uk/procurement_requirements and is referenced in *4.0 Procurement teams*. In delivering waste efficient design, designers should assess the most significant wastes produced by the design and identify if these can be reduced by alternative design solutions or build-ability solutions.

WRAP's Designing out Waste Tool for Civil Engineering (early design stage) and the Net Waste Tool (later design stage) can help designers to identify the main sources and types of waste associated with their project. Reviewing designs using these tools helps designers and clients to set realistic targets in construction procurement processes, and assists contractors in defining their own procurement of subcontractors, specialist contractors, waste management contractors and materials suppliers. Both tools are freely accessible via www.wrap.org.uk/nwtool

Design teams should discuss the designing out waste actions and SWMP with principal contractors and specialist subcontractors, see *6.0 Construction project managers*, especially where there is the opportunity for early contractor involvement. In addition, designers should identify any specifications which may restrict the scope for waste reduction. If departures from standard specifications are required to reduce waste, these are more readily implemented if identified by the design team and discussed with the client and contractor.

Design actions to reduce waste, and forecasts for the most significant wastes along with potential recovery routes, should be recorded in an outline/design phase SWMP. This Plan can record estimates of the waste eliminated through the design process, to help design managers with internal reporting processes. WRAP have produced a SWMP template which includes a section to record Designing out Waste decisions. The template can be accessed via www.wrap.org.uk/swmp

The outputs of the SWMP, or reports produced from the Designing out Waste Tool for Civil Engineering or Net Waste Tool can all be used to demonstrate the reductions in waste and associated potential cost savings.

Best practice

Key action: Implement all Designing out Waste principles and, where appropriate, benchmark performance on current designs and assess design team performance in reducing waste.

To implement best practice waste reduction through design, all five Designing out Waste principles should be considered.

Work with building projects clearly indicates that **Design for Off Site Construction**, where there is factory production, has the potential to significantly reduce waste. However, it can also result in changes to on site practice and may require different teams of specialist contractors: for example, compare operational needs on site to place large precast concrete components (handling areas, cranes and operators) with the demands of cast in-situ concrete (erection and striking of shuttering, temperature monitoring/control of large pours). To gain the waste benefits of off site construction, and to facilitate the resulting construction process, consideration at the design stage is important.

There are fewer immediate opportunities for off site construction within civil engineering projects, although precast component use is increasing. In addition to this, increasing numbers of innovative off site products are becoming available, and it is important that designers take note of these and remember to include them as options: for example, asphalt surfacings on a 'carpet roll', geosynthetics as structural materials in trackbeds, and pre-assembled traffic islands. Identifying innovative solutions using off site/on site construction early in the project enables research into previous performance and location-specific developments/trials to be completed in a timely manner.

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

Design for Materials Optimisation demands that explicit consideration is given to material consumption and waste inherent in the design so that the design uses less material and results in less waste in the construction process – all without compromising the design.

Key elements in materials optimisation are:

- simplification and standardisation of materials and component choices – to ensure that learning developed for certain aspects of the project is transferable; and
- dimensional coordination – designing to include components in readily available sizes.

Standardisation of materials and component choices can be important where innovative solutions are used or where unfamiliar (although not unusual) materials are specified. For example, if cement replacement materials are being used, this can affect the colour of the concrete without affecting quality (and potentially enhancing durability). Hence, using a consistent concrete mixture with consistent cement replacement levels will ensure that loads are not rejected simply because of a colour difference; it will also ensure that all mixtures are given adequate curing times before striking. Standardisation of joints, bearings and other structural details can reduce the need for rework as 'standard practice' develops over time on site. In such instances, material optimisation should acknowledge the role of contractors in considering build-ability of works.

In general, dimensional coordination has a more limited role in civil engineering than in buildings, and can be more readily applied to precast concrete components (such as kerbs, pavers, blocks) and drainage (such as pipes, chambers, gullies) than to other types of construction (for example, earthworks).

Most civil engineering structures are constructed to meet demanding service lives and to fulfil specific functions, so **Design for Deconstruction and Flexibility** may not be a significant waste reduction option. However, design for maintenance should be considered wherever possible, particularly for such long-life structures. Examples of design for maintenance include installing access chambers/points that facilitate inspections or routine testing (for example, assessment of reinforcement corrosion) without needing to close or divert network users, and coordinating access to components with similar life cycles so that they can be replaced in a single closure. To maximise the waste reduction benefits of design for maintenance, discussions with operations managers and maintenance contractors are highly recommended.

Design managers should consider benchmarking design team performance on current projects, using the tools available from WRAP. This will help to quantify what is already being achieved as routine practice, and where more effort to reduce waste should be focussed.

Such reviews will also help in setting targets that respond to the Halving Waste to Landfill Commitment. A selection of designs where design alternatives have been selected can be used for these benchmarking processes.

It should be made clear that the design team (whether in-house or contracted) will be assessed against their performance in reducing waste and reporting on this reduction. Without such performance assessment, changes in practice that embed all five Designing out Waste principles may not be made. Where this requires a change in contract, amendments should be discussed with the procurement team (see *4.0 Procurement teams*).

5.1 Design managers checklist of design options

This checklist aims to help design managers ensure that waste reduction is central to the design team's approach and that options for waste reduction are being considered and implemented by the team. It also prompts design managers to collect evidence of the process, so that learning is transferable between projects.

More information on many of these design actions can be found in WRAP's 'Designing out Waste in Civil Engineering' guidance at www.wrap.org.uk/designingoutwaste

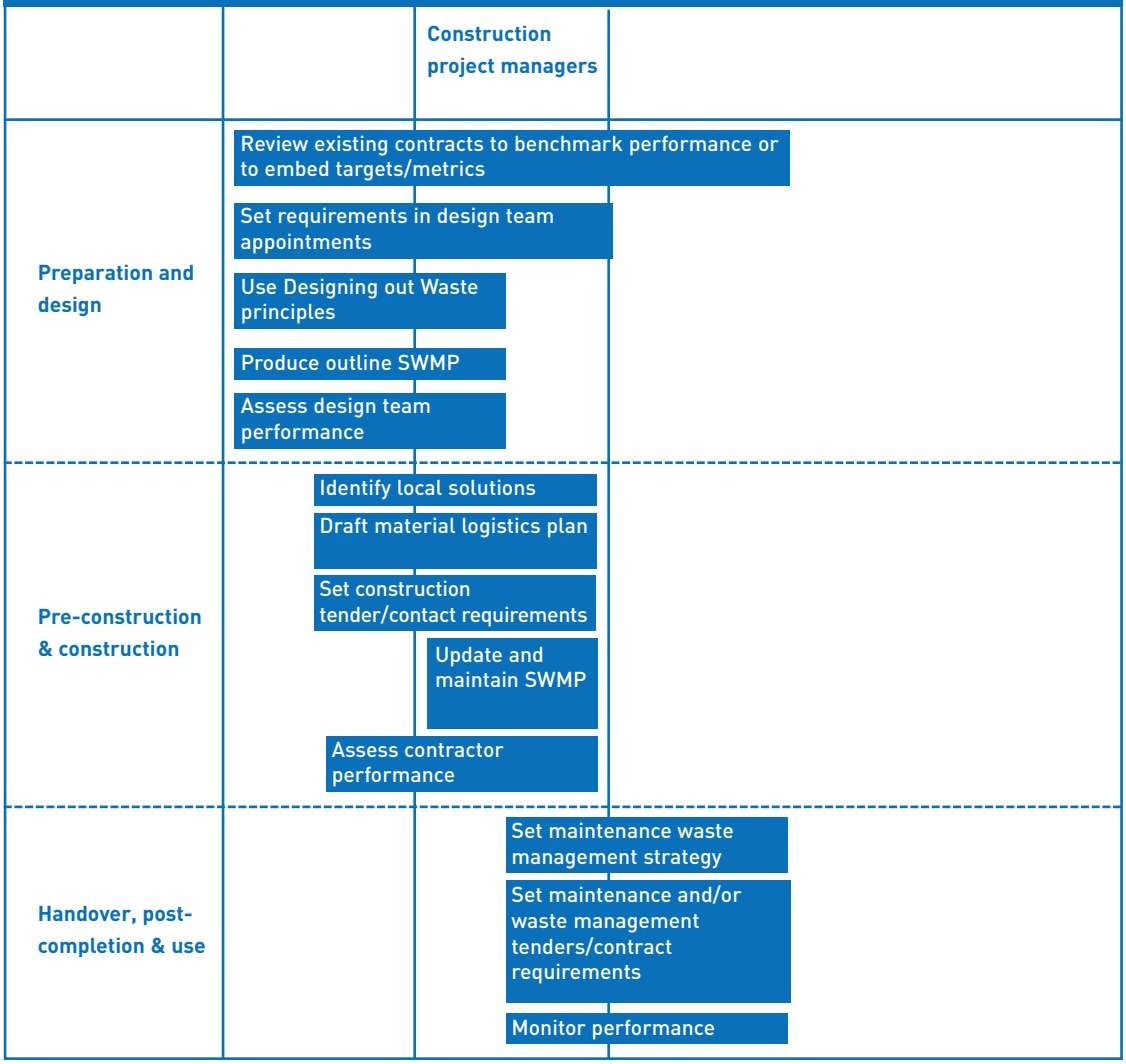
Design actions	Relevant to the project	Design team implemented	Evidence acceptable
Standard practice			
Determine if the design is likely to require import/export of materials and if a cut/fill balance can be achieved on site.			
Confirm if contaminated land is present, the appropriate options to remediate it (preferably on site) and agree the preferred option with the regulatory authorities.			
Confirm whether ground improvement techniques are likely to be required (when weak foundation soils are present).			
Review availability of recycled aggregates and other materials on site and in the local area and compare to project demands.			
Identify the probable significant wastes and input this information into the Site Waste Management Plan (SWMP).			
Identify any special contract conditions requiring review by client's legal advisors.			
Highlight design options which address planning or environmental impact assessment requirements.			
Ensure that any relevant information related to the construction and maintenance of the infrastructure works is recorded in the Health and Safety file. Identify any constraints on using recycled materials (such as, need for very early trafficking of concrete surfaces).			
Good practice			
Develop the requirements for the preliminary site investigation to enable decisions to be made on the options for ground improvement (including in-situ reuse) and provide adequate time for designs, testing and trials.			
Investigate opportunities to avoid or minimise excavation on site.			
Identify existing foundations, structures, pavements, floor slabs or services that can be reused as they exist on site.			
Identify existing materials and quantities that can be recycled for use in the new construction – choose between on site and off site recycling.			
Determine if treatment of unsuitable soils is possible and what options might be used (such as in-situ stabilisation, producing hydraulically bound mixtures ex-situ, or using geosystems).			

Design actions	Relevant to the project	Design team implemented	Evidence acceptable
Good practice (continued)			
Identify suitable materials for soil manufacture with PAS 100 compost (either on site or off site) and use PAS100 compost in soils manufacture and landscaping.			
When working platforms are required, determine if they can be integrated into the permanent works and if they can be constructed using in-situ and/or recycled materials.			
Review piling designs to determine if rotary or displacement piles (rather than replacement) can be considered.			
Use the Designing out Waste Tool and/or Net Waste Tool to identify key ways to reduce waste on the project.			
Record design decisions and outline quantities of waste in the project Site Waste Management Plan from an early design stage, and set preliminary targets for waste reduction, reuse and recovery.			
Identify opportunities for small scale components (such as manholes) to be manufactured using off site construction.			
Embed waste reduction and recovery initiatives in drawings, specifications and contracts.			
Ensure that no materials are used that will be difficult to recycle in the future and record assessment in the project Health and Safety file.			
Consider the sequence of work and how this can reduce waste.			
Include Designing out Waste on the agenda for design team meetings and design reviews.			
Review existing drawings, specifications and contracts to ensure that they do not limit waste reduction, reuse and recovery.			
Identify the potential costs/cost savings made by Designing out Waste and good practice on site waste management and ensure that this is shown transparently in construction tenders/pricing.			
Best practice			
Design site layout to use existing topography and features to minimise earthworks.			
Use geosystems to reduce overall material use in pavements, structures and earthworks.			
Use in-situ remediation or encapsulation of contaminated land in preference to excavation and treatment.			
Use innovative materials to reduce demand for primary resources, for example, tyre bales or plastic piles.			
Standardise similar elements (for example, geosystems) so that repeatability of the process leads to manufacturing and installation efficiencies including waste reduction.			
Identify if future expansion or modification of the construction is likely to be required and if measures need to be included in the design to facilitate this.			

Design actions	Relevant to the project	Design team implemented	Evidence acceptable
Best practice			
Assess the opportunities for off site construction of key components and compare to on site construction methods and the cost of any testing and certification required.			
Consider structural solutions that use less material and simplify the structural solutions as much as possible (for example, the use of post tensioned concrete instead of cast in-situ reinforced concrete).			
Provide wording to embed all of the design options to be pursued into the SWMP, project briefings and procurement.			
Include specific measures to enable future expansion or upgrading if required.			
Identify opportunities for large-scale components (such as panels) to be manufactured using off site construction.			
Identify opportunities to bring manufacturing on site.			
Consider opportunities for dimensional coordination of small-scale elements (such as kerbs, gullies, and chambers).			
Highlight opportunities for the design to enable longer-term maintenance with reduced waste.			
Benchmark design team performance on projects to enable future performance assessment.			

6.0 Construction project managers

Figure 6



Standard practice

Meeting regulatory requirements (in England) for site waste management should be standard practice for all construction projects. To use the Site Waste Management Plan (SWMP) effectively, it should be considered as early in the project as possible and involve all members of the supply chain. WRAP has produced leaflets which summarise the role of each supply chain member, available at www.wrap.org.uk/swmp

Standard practice should include review and update of the SWMP.

Good practice

Key action: Develop and update the SWMP to reduce and reuse wastes as well as managing their recovery, starting at an early stage of design, and use this information to direct and assess contractor performance; require design teams and contractors to identify with their supply chains how to use in-situ and reused materials and higher recycled content products, and recover more waste materials.

Construction project managers have a key role in informing design processes (see *5.0 Design managers*) and working with operation managers to ensure construction projects have waste-efficient maintenance strategies (see *7.0 Operations managers*). The influence of 'contractor thinking' in design is particularly evident in some forms of procurement, such as Design and Build or Early Contractor Involvement, but construction managers within client organisations should be involved in all design processes irrespective of the procurement route. They may also be involved in benchmarking current waste management performance within ongoing projects; this may be facilitated by the WRAP Site Waste Management Plan Template, visit www.wrap.org.uk/swmp

Although it is a mandatory requirement (in England) for the Principal Contractor to update a SWMP every six months at least, organisations can benefit from more regular reviews to ensure that unexpectedly high waste levels are recognised and tackled; and surprisingly low wastage rates are understood and good practice shared across the supply chain. Identifying and capturing good waste management practice will help organisations transfer learning between projects. The SWMP can be used to assess contractor performance on an ongoing basis and at the end of the contract.

As discussed in *5.0 Design managers*, designers have a key role to play in identifying options for waste reduction, on site reuse and import of recovered or recycled content materials. However, contractors will need to use local (or national) supply chains to deliver against these options. Organisations that procure significant works in particular regions may wish to identify suppliers able to support the range of projects undertaken. WRAP provides information on suppliers of recycled products, recycled aggregates, recycled wood, and reclaimed products (such as pavers) which might be of use in civil engineering projects. The supplier directories for recycled aggregates and for recycled wood also identify organisations that accept these materials for recycling. For more details, go to:

- www.wrap.org.uk/rcproducts
- www.aggregain.org.uk/supplier_directory
- www.recyclewood.org.uk
- www.wrap.org.uk/recycledcontent

WRAP has also recommended good practice standard terms and conditions for waste management companies that will help them identify themselves as good practice providers, as well as tender and contract clauses specifically for clients and contractors to procure waste management services. For more details, visit:

- www.wrap.org.uk/constructionmrf
- www.wrap.org.uk/procurement_requirements

When using recycled materials, it is important that everyone involved is confident in the use of these materials, including inspectors and clerks of works. Without sufficient training and experience, it is possible that some recycled materials may be turned away as they 'look' different. For example, concrete containing cement replacement materials may look different to traditional Portland cement concrete (see *5.0 Design managers*); recycled aggregates may contain wood, plastic or metal contamination without affecting performance.

WRAP provides additional guidance for client project managers at www.wrap.org.uk/constructionclient

Best practice

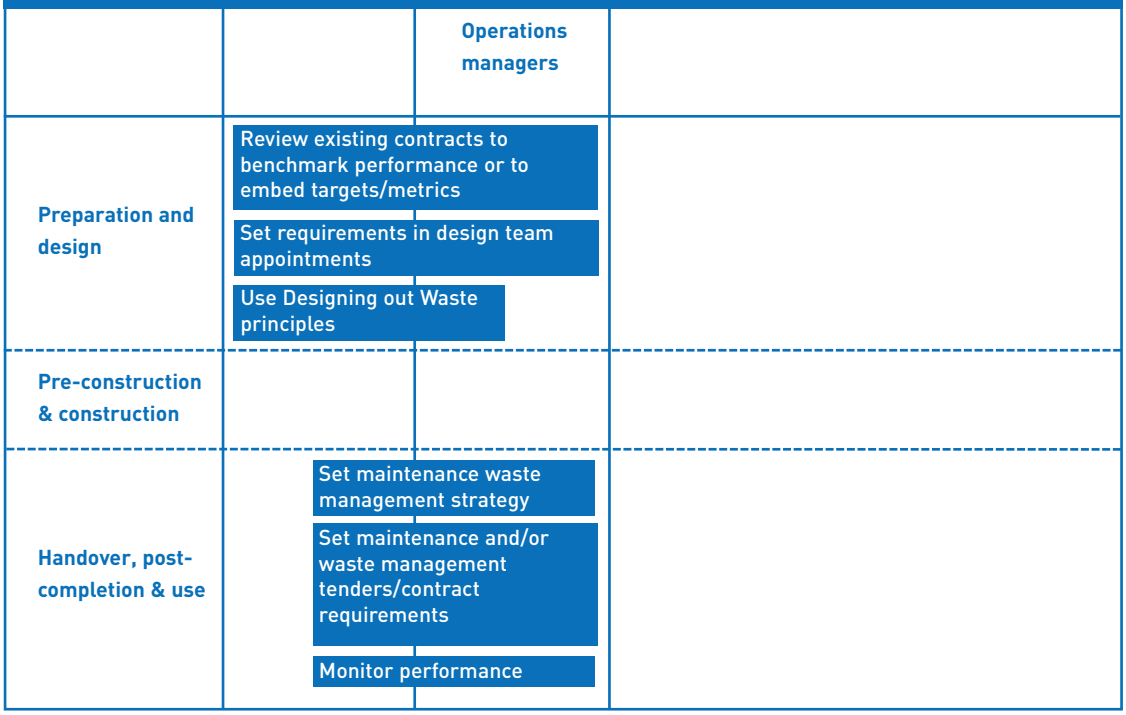
Key action: Develop and implement a Material Logistics Plan.

Multiple handling of materials on site costs money and increases the likelihood of damage and wastage. In addition, construction logistics can reduce the waste generated on site; by, for example, effective delivery scheduling, creating materials handling areas or consolidation centres off site, back-hauling materials following deliveries and effective use of information technology. Considering materials logistics during design will help to facilitate effective site practices (such as on site manufacturing – see *5.0 Design teams*), but the key influence will be when construction supply chains are established.

WRAP has produced extensive guidance on developing Materials Logistics Plans which can be downloaded from www.wrap.org.uk/materiallogistics

7.0 Operations managers

Figure 7



Standard practice

Site Waste Management Planning for major maintenance projects will be commonplace; but such plans may not be applied to small works, even where these are undertaken by a single supplier. However, it will be reasonably common for some form of waste analysis to be in place on all works so that the maintenance contractor can understand and manage their waste arisings to minimise costs. These cost savings may not be visible to the client organisation, and formal procedures for reporting on waste arisings and reductions may not be in place.

Good practice

Key action: Set formal reporting requirements and monitor performance.

For large maintenance projects where Site Waste Management Plans (SWMP) are used, waste management will resemble that of construction projects (see *5.0 Design managers* and *6.0 Construction project managers*). For smaller projects, there may be no formal waste management process in place dictated by the client. At minimum, contract requirements should be set to measure and report waste arisings and their destinations since this will influence cost. The WRAP Site Waste Management Plan Template may be helpful in this recording and reporting process; it can be downloaded from www.wrap.org.uk/swmp Benchmarking current projects will provide data for target setting in future contracts.

WRAP provides guidance for programmes of minor works, including a simple template for reporting key actions and outcomes to the client in the absence of a SWMP – available at www.wrap.org.uk/constructionminorworks

Best practice

Key action: Support design and construction processes to minimise waste in operation and use design and construction information to develop a maintenance waste management strategy.

Operations Managers may be asked to become involved in best practice design and construction processes that consider maintenance implications (see *5.0 Design managers* and *6.0 Construction project managers*).

Accounting for the waste generated by the long-term management of civil engineering works may be facilitated by a formal waste management strategy. The strategy should complement any asset management strategy and, like an asset management strategy, should provide a consistent approach to maintenance wastes over the lifetime of the asset even though the managing personnel will change during that time. The life span of civil engineering assets can be tens, if not hundreds of years. The strategy could begin by identifying the significant wastes expected and their occurrence with time. The disposal and recovery options for such wastes can be identified and should be periodically reviewed and updated as technologies and local markets change. However, it should be recognised that developing such a strategy may only add value if the wastes being generated from existing operations are quantified and understood.

Waste & Resources Action Programme

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recycle